IEEE STANDARDS ASSOCIATION

IEEE Standard for Information technology—
Telecommunications and information exchange between systems
Local and metropolitan area networks—
Specific requirements

Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

Amendment 2: Sub 1 GHz License Exempt Operation

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std 802.11ah™-2016
(Amendment to IEEE Std 802.11™-2016
as amended by IEEE Std 802.11ai™-2016)

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IEEE-SA Standards Board

Abstract: Modifications to both the IEEE 802.11™ physical layer (PHY) and the medium access control (MAC) sublayer to enable operation of license-exempt IEEE 802.11 wireless networks in frequency bands below 1 GHz, excluding the television (TV) White Space bands, with a transmission range up to 1 km and a minimum data rate of at least 100 Kb/s are defined in this amendment.

Keywords: IEEE 802.11ah™, long transmission range, low power consumption, MAC, medium access control, narrower bandwidth, OFDM, orthogonal frequency division multiplexing, PHY, physical layer, sub 1 GHz, wireless local area network, WLAN

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Introduction

This introduction is not part of IEEE Std 802.11ah-2016, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area network—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications—Amendment 2: Sub 1 GHz License-Exempt Operation.

This amendment defines modifications to both the IEEE 802.11™ physical layer (PHY) and the medium access control (MAC) sublayer to enable operation of license-exempt IEEE 802.11 wireless networks in frequency bands below 1 GHz, excluding the television (TV) White Space bands, with a transmission range up to 1 km and a minimum data rate of at least 100 Kb/s.

Contents

Tables

Figures

IEEE Standard for Information technology—
Telecommunications and information exchange between systems
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Amendment 2: Sub 1 GHz License Exempt Operation

[This amendment is based on IEEE Std 802.11™-2016, as amended by IEEE Std 802.11ai™-2016.]

NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard.

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[1]Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

3. Definitions, acronyms, and abbreviations

3.2 Definitions specific to IEEE 802.11

Change the following definition in 3.2 as shown:

~~very high throughput (VHT)~~ single medium access control (MAC) protocol data unit (~~VHT single~~ S-MPDU): An MPDU that is the only MPDU in an aggregate MPDU (A-MPDU)~~ carried in a VHT physical layer (PHY) protocol data unit (PPDU)~~ and that is carried in an A-MPDU subframe with the EOF subfield of the MPDU delimiter field equal to 1.

Insert the following definitions into 3.2:

1 MHz mask physical layer (PHY) protocol data unit (PPDU): A PPDU that is transmitted using the 1 MHz transmit spectral mask defined in Clause 23 and that is a 1 MHz sub 1 GHz (S1G) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW1).

1 MHz physical layer (PHY) protocol data unit (PPDU): A Clause 23 1 MHz sub 1 GHz (S1G) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW1).

2 MHz mask physical layer (PHY) protocol data unit (PPDU): A PPDU that is transmitted using the 2 MHz transmit spectral mask defined in Clause 23 and that is one of the following:

a) A 1 MHz sub 1 GHz (S1G) non-duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW1)
b) A 2 MHz S1G non-duplicate or S1G 1 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW2)

2 MHz physical layer (PHY) protocol data unit (PPDU): A Clause 23 2 MHz sub 1 GHz (S1G) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW2) or a Clause 23 2 MHz S1G 1 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW2).

4 MHz mask physical layer (PHY) protocol data unit (PPDU): A PPDU that is transmitted using the 4 MHz transmit spectral mask defined in Clause 23 and that is one of the following:

a) A 1 MHz sub 1 GHz (S1G) non-duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW1)
b) A 2 MHz S1G non-duplicate or S1G 1 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW2)
c) A 4 MHz S1G non-duplicate, or S1G 1 MHz duplicate, or S1G 2 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW4)

4 MHz physical layer (PHY) protocol data unit (PPDU): A Clause 23 4 MHz sub 1 GHz (S1G) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW4), a Clause 23 4 MHz S1G 1 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW4), or a Clause 23 4 MHz S1G 2 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW4).

8 MHz mask physical layer (PHY) protocol data unit (PPDU): A PPDU that is transmitted using the 8 MHz transmit spectral mask defined in Clause 23 and that is one of the following:

a) A 1 MHz sub 1 GHz (S1G) non-duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW1)
b) A 2 MHz S1G non-duplicate or S1G 1 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW2)

c) A 4 MHz S1G non-duplicate, or S1G 1 MHz duplicate, or S1G 2 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW4)
d) An 8 MHz S1G non-duplicate, or S1G 1 MHz duplicate, or S1G 2 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW8)

8 MHz physical layer (PHY) protocol data unit (PPDU): A Clause 23 8 MHz sub 1 GHz (S1G) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW8), a Clause 23 8 MHz S1G 1 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW8), or a Clause 23 8 MHz S1G 2 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW8).

16 MHz mask physical layer (PHY) protocol data unit (PPDU): A PPDU that is transmitted using the 16 MHz transmit spectral mask defined in Clause 23 and that is one of the following:
a) A 1 MHz sub 1 GHz (S1G) non-duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW1)
b) A 2 MHz S1G non-duplicate or S1G 1 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW2)
c) A 4 MHz S1G non-duplicate, or S1G 1 MHz duplicate, or S1G 2 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW4)
d) An 8 MHz S1G non-duplicate, or S1G 1 MHz duplicate, or S1G 2 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW8)
e) An 16 MHz S1G non-duplicate, or S1G 1 MHz duplicate, or S1G 2 MHz duplicate (TXVECTOR parameter CH_BANDWIDTH equal to CBW16)

16 MHz physical layer (PHY) protocol data unit (PPDU): A Clause 23 16 MHz sub 1 GHz (S1G) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW16), a Clause 23 16 MHz S1G 1 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW16), or a Clause 23 16 MHz S1G 2 MHz duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW16).

centralized authentication controller (CAC) access point (AP): A sub 1 GHz (S1G) AP with dot11S1GCentralizedAuthenticationControlActivated equal to true. A CAC AP is able to alleviate wireless medium contention when a large number of stations (STAs) are trying to, or are expected to, reconnect to the AP at about the same time.

centralized authentication controlled (CAC) station (STA): A sub 1 GHz (S1G) non-access point (non-AP) STA with dot11S1GCentralizedAuthenticationControlActivated equal to true. A CAC STA supports a CAC access point (AP) to alleviate wireless medium contention when a large number of STAs are trying to, or are expected to, reconnect to the AP at about the same time.

energy limited (EL) station (STA): A sub 1 GHz (S1G) STA whose limited energy supply requires the STA to transmit or receive in certain intervals of time determined by an EL Operation element.

non-sensor station (STA): A sub 1 GHz (S1G) non-access point (non-AP) STA transmitting or receiving data frames not subject to limitation of payload size. A non-sensor STA might not have the power and traffic volume limitation expected for a sensor STA.

non-traffic indication map (non-TIM) mode: A sub 1 GHz (S1G) non-access point (non-AP) station (STA) power save mode in which an S1G non-AP STA need not listen for traffic indication map (TIM) Beacon frames but transmits at least one PS-Poll or trigger frame to the associated AP every listen interval.

non-traffic indication map (non-TIM) station (STA): A sub 1 GHz (S1G) non-access point (non-AP) station (STA) that has entered the non-TIM mode.

null data packet (NDP) 1M (NDP_1M): An NDP carrying medium access control (MAC) information (CMI) frame that is transmitted using the S1G_1M format.

null data packet (NDP) 2M (NDP_2M): An NDP carrying medium access control (MAC) information (CMI) frame that is transmitted using the S1G_SHORT format.

null data packet (NDP) carrying medium access control information (CMAC) frame: A physical layer (PHY) protocol data unit (PPDU) with no Data field used by the PHY to provide to the medium access control (MAC) the service of carrying MAC information in the SIGNAL field of the sub 1 GHz (S1G) PPDU.

paged association identifier (AID): An AID of a sub 1 GHz (S1G) non-access point (non-AP) station (STA) whose corresponding bit value in a transmitted traffic indication map (TIM) encoded in AID with differential encoding (ADE) mode is 1.

primary 1 MHz channel: In a 2 MHz, 4 MHz, 8 MHz, or 16 MHz sub 1 GHz (S1G) basic service set (BSS), the 1 MHz channel that is used to transmit 1 MHz physical layer (PHY) protocol data units (PPDUs).

primary 2 MHz channel: In a 4 MHz, 8 MHz, or 16 MHz sub 1 GHz (S1G) basic service set (BSS), the 2 MHz channel that is used to transmit 2 MHz physical layer (PHY) protocol data units (PPDUs).

primary 4 MHz channel: In an 8 MHz or 16 MHz sub 1 GHz (S1G) basic service set (BSS), the 4 MHz channel that is used to transmit 4 MHz physical layer (PHY) protocol data units (PPDUs).

primary 8 MHz channel: In a 16 MHz sub 1 GHz (S1G) basic service set (BSS), the 8 MHz channel that is used to transmit 8 MHz physical layer (PHY) protocol data units (PPDUs).

protocol version 0 (PV0) medium access control (MAC) protocol data unit (MPDU): An MPDU that has the Protocol Version field of the Frame Control field of the MPDU header equal to 0.

protocol version 1 (PV1) medium access control (MAC) protocol data unit (MPDU): An MPDU that has the Protocol Version field of the Frame Control field of the MPDU header equal to 1.

restricted access window (RAW): A medium access interval for a group of stations (STAs) during which a STA in the RAW group indicated by the RAW parameter set (RPS) element is allowed to contend for access to the medium.

secondary 1 MHz channel: In a 2 MHz sub 1 GHz (S1G) basic service set (BSS), the 1 MHz channel adjacent to the primary 1 MHz channel that with the primary 1 MHz channel forms the 2 MHz channel of the 2 MHz S1G BSS. In a 4 MHz, 8 MHz, and 16 MHz S1G BSS, the 1 MHz channel adjacent to the primary 1 MHz channel that together form the primary 2 MHz channel of the S1G BSS.

secondary 2 MHz channel: In a 4 MHz sub 1 GHz (S1G) basic service set (BSS), the 2 MHz channel adjacent to the primary 2 MHz channel that with the primary 2 MHz channel forms the 4 MHz channel of the 4 MHz S1G BSS. In an 8 MHz and 16 MHz S1G BSS, the 2 MHz channel adjacent to the primary 2 MHz channel that together form the primary 4 MHz channel of the S1G BSS.

secondary 4 MHz channel: In an 8 MHz sub 1 GHz (S1G) basic service set (BSS), the 4 MHz channel adjacent to the primary 4 MHz channel that with the primary 4 MHz channel forms the 8 MHz channel of the 8 MHz S1G BSS. In a 16 MHz S1G BSS, the 4 MHz channel adjacent to the primary 4 MHz channel that together form the primary 8 MHz channel.

secondary 8 MHz channel: In an 16 MHz sub 1 GHz (S1G) basic service set (BSS), the 8 MHz channel adjacent to the primary 8 MHz channel that with the primary 8 MHz channel forms the 16 MHz channel of the 16 MHz S1G BSS.

sensor station (STA): A sub 1 GHz (S1G) non-access point (AP) STA that has certain traffic and device characteristics (e.g., limited payload size, limited traffic volume, battery operated device) and is allowed to associate with an AP that transmits an S1G Beacon, a Probe Response, or a PV1 Probe Response frame containing the S1G Capabilities element with the STA Type Support subfield indicating a sensor basic service set (BSS) or a mixed BSS.

short beacon interval: The interval between the consecutive target short beacon transmission times (TSBTTs) of beacons containing a minimal set of information elements.

sub 1 GHz (S1G) physical layer (PHY) protocol data unit (PPDU): A PPDU transmitted with the TXVECTOR parameter FORMAT equal to S1G, S1G_DUP_1M, or S1G_DUP_2M. The PPDU is transmitted with the S1G_SHORT, S1G_LONG, or S1G_1M preamble.

sub 1 GHz 1M (S1G_1M) physical layer (PHY) protocol data unit (PPDU): A 1 MHz PPDU or 1 MHz duplicate PPDU that is transmitted with S1G_1M preamble.

sub 1 GHz long (S1G_LONG) physical layer (PHY) protocol data unit (PPDU): A 2 MHz, 4 MHz, 8 MHz, or 16 MHz PPDU with long preamble format.

sub 1 GHz modulation and coding scheme (S1G-MCS): A specification of the S1G physical layer (PHY) parameters that consists of modulation order (e.g., BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM) and forward error correction (FEC) coding rate (e.g., 1/2 rep2, 1/2, 2/3, 3/4, 5/6) that is used in an S1G PHY protocol data unit (PPDU).

sub 1 GHz short (S1G_SHORT) physical layer (PHY) protocol data unit (PPDU): A 2 MHz, 4 MHz, 8 MHz, 16 MHz, or 2 MHz duplicate PPDU with short preamble format.

subchannel selective transmission (SST) channel: A channel that is permitted for the subchannel selective transmission indicated by either an SST element or an RPS element.

target wake time (TWT): A specific time or set of times for individual stations (STAs) to wake in order to exchange frames with other STAs.

target wake time (TWT) responder: A station (STA) that has accepted a TWT agreement that was requested by another STA and that assigns TWT service period (SP) start times to the requesting STA.

target wake time (TWT) service period (SP): A period of time during which a TWT station (STA) is awake to transmit and/or receive frames.

target wake time (TWT) service period (SP) start time: The value of the timing synchronization function (TSF) at the beginning of a TWT SP.

target wake time (TWT) requester: A station (STA) that has had a requested TWT agreement accepted by another STA and that receives TWT service period (SP) start times from that STA.

3.4 Abbreviations and acronyms

Insert the following abbreviations into 3.4 in alphabetical order:

ADE	AID with differential encoding
BAT	block acknowledgment TWT
BDT	bidirectional TXOP
BPN	base packet number
CAC	centralized authentication controller (for access points) or controlled (for stations)
EL	energy limited
EOM	end of multi-user
MAD	maximum away duration
OLB	offset length bitmap
PRAW	periodic restricted access window
PV0	protocol version 0
PV1	protocol version 1
RAW	restricted access window
RID	response indication deferral
RPS	RAW parameter set
S1G	sub 1 GHz
SC	sequence counter
SID	short identifier
S-MPDU	single MAC protocol data unit
SST	subchannel selective transmission
STACK	short TWT acknowledgment
TACK	TWT acknowledgment
TSBTT	target short beacon transmission time
TWT	target wake time
USF	unified scaling factor

4. General description

Change the following phrase throughout IEEE Std 802.11:

from "[a] VHT Single MPDU" to "[an] S-MPDU"

4.3 Components of the IEEE 802.11 architecture

Insert the following subclauses (4.3.13a through 4.3.13a.2) after 4.3.13:

4.3.13a Sub 1 GHz (S1G) STA

4.3.13a.1 Overview

The IEEE 802.11 S1G STA operates in frequency bands below 1 GHz excluding the TV White Space bands.

An S1G STA supports S1G features identified in Clause 9, Clause 10, Clause 11, Clause 12, and Clause 23.

The main PHY features in an S1G STA are the following:

— Mandatory support for 1 MHz and 2 MHz channel width
— Mandatory support for S1G_1M, S1G_SHORT PPDU
— Mandatory support for S1G_LONG PPDU if ≥ 4 MHz channel width is supported
— Mandatory support for detection and decode of SIG-A field of the S1G_LONG preamble
— Mandatory support for single spatial stream S1G-MCS 0 to S1G-MCS 2 and S1G-MCS 10 (for 1 MHz PPDU only)
— Mandatory support for single spatial stream S1G-MCS 3 to S1G-MCS 7 for an S1G AP
— Mandatory support for binary convolutional coding
— Mandatory support for normal guard interval
— Mandatory support for fixed pilots
— Optional support for 2, 3 and 4 spatial streams (transmit and receive)
— Optional support for S1G_LONG PPDU if only 2 MHz channel width is supported
— Optional support for beamforming sounding (by sending an S1G NDP frame)
— Optional support for compressed beamforming feedback
— Optional support for STBC, LDPC (transmit and receive)
— Optional support for S1G MU PPDUs (transmit and receive)
— Optional support for 4 MHz, 8 MHz, or 16 MHz channel width
— Optional support for S1G-MCSs 8 and 9 (transmit and receive)
— Optional support for short guard interval
— Optional support for traveling pilots

The main MAC features supported for S1G STA are the following:

— Mandatory support for NDP Ack, NDP BlockAck, and NDP CTS frames; mandatory support for the reception of NDP Probe Request frame for S1G AP; optional support for other NDP CMAC frames
— Mandatory support for the reception of PV1 MPDUs but optional support for the transmission of PV1 MPDUs
— Mandatory support for the second virtual carrier sensing - RID
— Mandatory support for the hierarchical structure of TIM element by an S1G AP

- Mandatory support for extended BSS max idle periods and extended listen intervals with USF
- Optional support for RAW
- Optional support for Relay
- Optional support for grouping of non-AP STAs and group AID
- Optional support for TWT
- Optional support for BDT
- Optional support for sectorization
- Optional support for non-TIM STA operation
- Optional support for asymmetric block ack operation, fragment block ack operation
- Optional support for page slicing, dynamic AID assignment for an S1G AP
- Optional support for authentication control
- Optional support for SST
- Optional support for rescheduling STA's doze/awake cycle
- Optional support for either a sensor STA or a non-sensor STA
- Optional support for an EL STA

NOTE—Some NDP CMAC frames are mandatory under certain conditions as indicated in B.4.4.2.

Most S1G features help either reduce a STA's energy consumption or increase the usable range between an AP and a non-AP STA.

An S1G STA is a non-mesh STA, and a QoS STA that does not support HCCA.

4.3.13a.2 S1G Relay

The S1G relay is a mechanism for expanding the coverage area of an AP. The AP is referred to as the root AP. An S1G relay consists of an S1G relay AP and an S1G relay STA. An S1G relay forwards frames between STAs associated to its S1G relay AP and the AP to which its S1G relay STA is associated.

5. MAC service definition

5.1 Overview of MAC services

5.1.2 Security services

Insert the following paragraph at the end of 5.1.2:

An S1G STA shall not use the pairwise cipher suite selectors WEP-40, WEP-104, TKIP, or “Use group cipher suite”.

5.1.5 MAC data service architecture

Insert the following subclause (5.1.5.6, including Figure 5-7) after 5.1.5.5:

5.1.5.6 S1G Relay

An S1G relay comprises a relay AP, a relay STA and a relay function (see Figure 5-7).

A relay STA is a non-AP STA associated to a root AP or the relay AP of another relay. A relay AP is an AP that offers the relay function to its associated non-AP STAs, and provides access to the DS indirectly through the relay STA’s path to the root AP. The relay function performs local reception or selective forwarding of MSDUs between the relay STA and relay AP, based on the destination address, as described in 10.50.

The MAC data plane architecture of an S1G relay is shown in Figure 5-7.

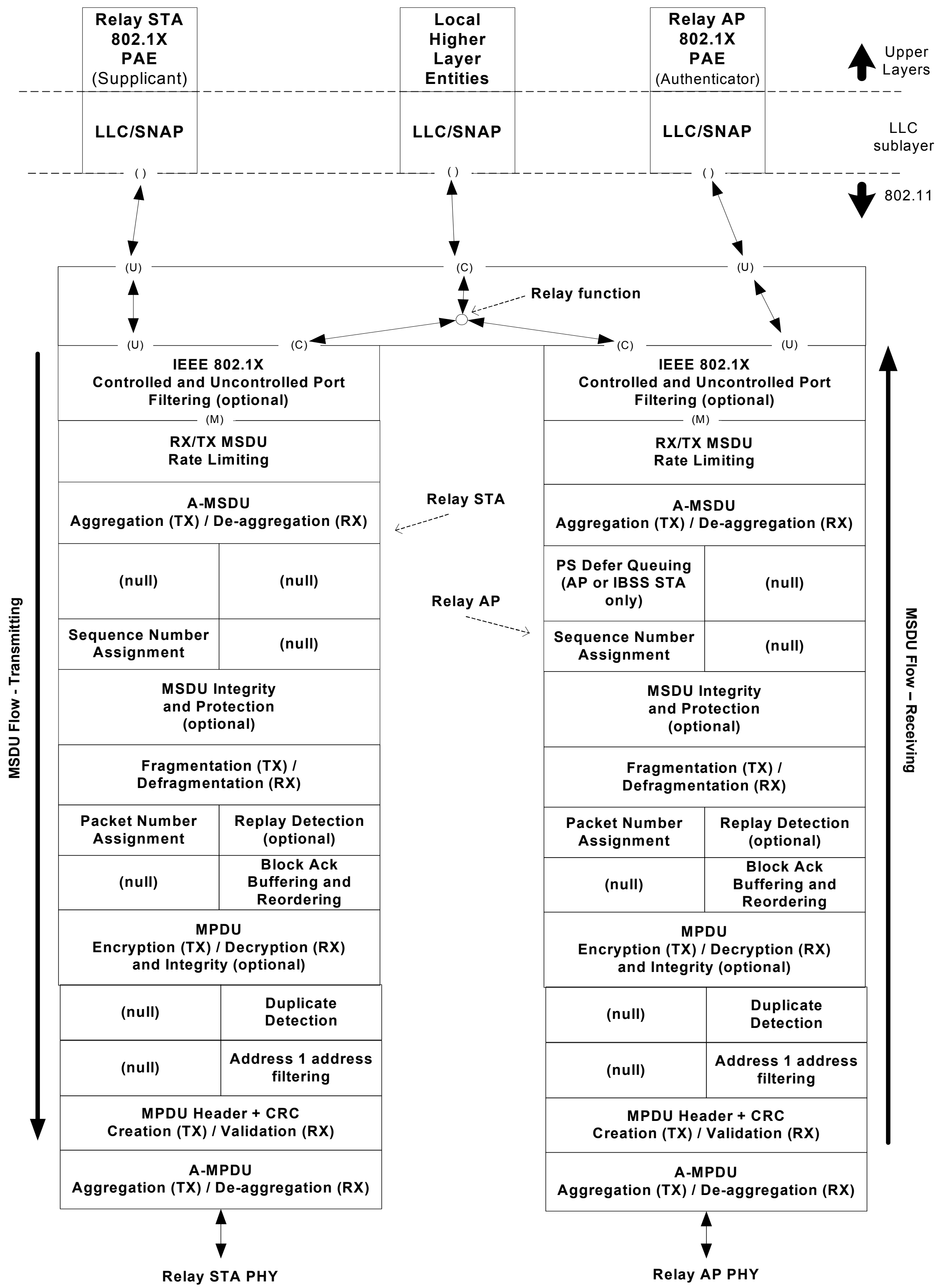


Figure 5-7—S1G relay data plane architecture

6. Layer management

6.3 MLME SAP interface

6.3.2 Power management

6.3.2.2 MLME-POWERMGT.request

6.3.2.2.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.2.2.2 as follows:

The primitive parameters are as follows:

MLME-POWERMGT.request(
PowerManagementMode,
ReceiveDTIMs,
ReceiveTIMs
)

Insert the following row at the end of the parameter table in 6.3.2.2.2:

Name	Type	Valid range	Description
ReceiveTIMs	Boolean	true, false	The parameter is present if dot11S1GOptionImplemented is true; otherwise not present. This parameter is set to the boolean complement of dot11NonTIMModeActivated. When true, this parameter causes the S1G STA to awaken to receive a Beacon frame, as determined by the STA's ListenInterval and the ReceiveDTIMs parameter. When this parameter is false, the S1G STA transmits at least one frame every listen interval without receiving a Beacon frame.

6.3.3 Scan

6.3.3.2 MLME-SCAN.request

6.3.3.2.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.3.2.2 as follows:

The primitive parameters are as follows:

MLME-SCAN.request(
BSSType,
BSSID,
SSID,
ScanType,
ActiveScanType,
ProbeDelay,
ChannelList,
MinChannelTime,
MaxChannelTime,

RequestInformation,
SSID List,
ChannelUsage,
AccessNetworkType,
HESSID,
MeshID,
DiscoveryMode,
FILSRequestParameters,
ReportingOption,
APConfigurationSequenceNumber,
S1GRelayDiscovery,
PV1ProbeResponseOption,
S1GCapabilities,
ChangeSequence,
ELOperation,
MaxAwayDuration,
VendorSpecificInfo
)

Insert the following row into the parameter table in 6.3.3.2.2 after the "ScanType" row:

Name	Type	Valid range	Description
ActiveScanType	Enumeration	FRAME, NDP	Indicates active scanning type by the transmission of either Probe Request frames or NDP Probe Request frames. This parameter is optionally present if dot11S1GOptionImplemented is true and if ScanType is ACTIVE; otherwise not present.

Insert the following rows into the parameter table in 6.3.3.2.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
S1GRelayDiscovery	S1G Relay Discovery element	As defined in 9.4.2.208	Indicates link budget information and QoS requirements for relay discovery. This element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
PV1ProbeResponseOption	PV1 Probe Response Option element	As defined in 9.4.2.210	Indicates which optional information is requested to be included in the PV1 Probe Response frame. This element is optionally present if dot11PV1ProbeResponseOptionImplemented is true; otherwise not present.
S1GCapabilities	S1G Capabilities element	As defined in 9.4.2.201	Indicates S1G capabilities of an S1G STA. The S1G Capabilities element is present if dot11S1GOptionImplemented is true; otherwise not present.
ChangeSequence	Change Sequence element	As defined in 9.4.2.199	Specifies the parameters within the Change Sequence element that are supported by the MAC entity. The parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.

Name	Type	Valid range	Description
ELOperation	EL Operation element	As defined in 9.4.2.211	Specifies the parameters within the EL Operation element that are supported by the MAC entity. The parameter is present if dot11S1GELOperationActivated is true; otherwise not present.
MaxAwayDuration	Integer	0–65 535 inclusive	Indicates the maximum duration, in TUs, that the AP is unavailable for communications with the STA. The parameter is optionally present if dot11MaxAwayDuration is nonzero; otherwise not present.

6.3.3.3 MLME-SCAN.confirm

6.3.3.3.2 Semantics of the service primitive

Change the second paragraph in 6.3.3.3.2 as follows:

Each BSSDescription consists of the parameters shown in the following table, in which the term *peer STA* refers to the STA transmitting the Beacon frame, S1G Beacon frame, ~~or~~ Probe Response frame, or PV1 Probe Response frame from which the BSSDescription was determined and the term *local STA* refers to the STA performing the scan, and in which the "IBSS adoption" column indicates whether

a) This parameter is adopted by a STA that is joining an IBSS.

b) This parameter is adopted by a STA that is a member of an IBSS that receives a beacon or S1G Beacon from a STA that is a member of the same IBSS and that has a timestamp value that is greater than the local TSF value (see 11.1.5).

Change the following row in the BSSDescriptionSet table in 6.3.3.3.2 as shown:

Name	Type	Valid range	Description	IBSS adoption
Timestamp	Integer	N/A	The timestamp of the received frame (Probe Response/ Beacon, or PV1 Probe Response/S1G Beacon) from the found BSS. When a PV1 Probe Response or an S1G Beacon frame is received, the timestamp is reconstructed as described in 11.1.3.10.3.	Adopt

Insert the following rows at the end of the BSSDescriptionSet table in 6.3.3.3.2:

Name	Type	Valid range	Description	IBSS adoption
Compressed SSID	Integer	N/A	The Compressed SSID of the received frame (PV1 Probe Response or S1G Beacon) from the found BSS. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.	Adopt

Name	Type	Valid range	Description	IBSS adoption
Next TBTT	Integer	N/A	Highest 3 octets of the 4 least significant octets of the next TBTT. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.	Adopt
S1G Relay Discovery	As defined in frame format	As defined in 9.4.2.208	The values from the S1G Relay Discovery element if such an element was present in the Probe Response, PV1 Probe Response, or S1G Beacon frame. More description is provided in 10.50.6.	Do not adopt
RPS	RPS element	As defined in 9.4.2.192	The parameter set for group-based restricted medium access, if such element was present in the S1G Beacon, PV1 Probe Response, or Probe Response frame, else null. The support of the feature is described on RAW-based medium access (10.22.5).	Do not adopt
Page Slice	Page Slice element	As defined in 9.4.2.193	The set of page slices present in DTIM interval, if such element was present in the S1G Beacon, or Probe Response, or PV1 Probe Response frame, else null. The support of the feature is described 10.47.	Do not adopt
S1G Capabilities	As defined in frame format	As defined in 9.4.2.201	The values from the S1G Capabilities element. The parameter is present if dot11S1GOptionImplemented is true and an S1G Capabilities element was present in the S1G Beacon, or Probe Response, or PV1 Probe Response, frame from which the BSSDescription was determined; otherwise not present.	Adopt
TSF Timer Accuracy	TSF Timer Accuracy element	As defined in 9.4.2.204	The values from the TSF Timer Accuracy element if such an element was present in the Probe Response, PV1 Probe Response, or S1G Beacon frame, else null. The parameter is optionally present if dot11TSFTimerAccuracyImplemented is true; otherwise not present.	Adopt
Change Sequence	As defined in frame format	As defined in 9.4.2.199	A Change Sequence element indicates the change of system information within a BSS. The support of the feature is described 10.42.2.	Do not adopt

Name	Type	Valid range	Description	IBSS adoption
S1GRelay	As defined in frame format	As defined in 9.4.2.205	The S1G Relay element is present in the S1G Beacon if dot11RelayAPOperationActivated is true or if dot11RelayAPImplemented is true; otherwise not present. The S1G Relay element is optionally present in Probe Response, or PV1 Probe Response, if dot11RelayAPImplemented is true. More description is provided in 10.50.	Do not adopt
S1GOperation	As defined in frame format	As defined in 9.4.2.213	The values from the S1G Operation element if such an element was present in the Probe Response, PV1 Probe Response, or S1G Beacon frame, else null. The parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.	Adopt
ShortBeaconPeriod	As defined in frame format	As defined in 9.4.2.198	The short beacon period, in TUs, of the found BSS if the Short Beacon Interval element was present in the Probe Response, PV1 Probe Response, or S1G Beacon frame, else null. The parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.	Adopt
ShortBeaconDTIMPeriod	As defined in frame format	As defined in 9.4.2.6	The values from the TIM element if such an element was present in the S1G Beacon frame, else null. The parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.	Adopt
MaxAwayDuration	Integer	0–65 535 inclusive	Indicates the maximum duration, in TUs, that the AP is unavailable for communications with the STA. The parameter is optionally present if dot11MaxAwayDuration is nonzero; otherwise not present.	Do not adopt

6.3.4 Synchronization

6.3.4.2 MLME-JOIN.request

6.3.4.2.4 Effect of receipt

Insert the following paragraph at the end of 6.3.4.2.4:

If the MLME of an S1G STA receives an MLME-JOIN.request primitive with a SelectedBSS parameter containing a BSSDescription with a Basic S1G-MCS and NSS Set field in the S1G Operation element that contains any unsupported <S1G-MCS, NSS> tuple, the ResultCode parameter in the MLME's responding invocation of the MLMEJOIN.confirm primitive shall contain a value that is not SUCCESS.

6.3.5 Authenticate

6.3.5.2 MLME-AUTHENTICATE.request

6.3.5.2.3 When generated

Insert the following paragraph at the end of 6.3.5.2.3:

When dot11S1GCentralizedAuthenticationControlActivated is true and a STA's local MAC variable AuthenticationRequestTransmission is false, then the STA shall not invoke this primitive.

6.3.7 Associate

6.3.7.2 MLME-ASSOCIATE.request

6.3.7.2.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.7.2.2 as follows:

The primitive parameters are as follows:

```
MLME-ASSOCIATE.request(
                    PeerSTAAddress,
                    BSSMaxIdlePeriod,
                    ListenInterval,
                    Supported Channels,
                    RSN,
                    QoSCapability,
                    Content of FT Authentication elements,
                    SupportedOperatingClasses,
                    SM Power Save,
                    QoSTrafficCapability,
                    TIMBroadcastRequest,
                    EmergencyServices,
                    DMG Capabilities,
                    Multi-band local,
                    Multi-band peer,
                    MMS,
                    FILSHLPContainer,
                    FILSIPAddressAssignment,
                    AID Request,
                    S1G Capabilities,
```

TWT,
MaxAwayDuration,
S1GRelayActivation,
ReachableAddress,
VendorSpecificInfo
)

Insert the following row into the parameter table in 6.3.7.2.2 before the "ListenInterval" row:

Name	Type	Valid range	Description
BSSMaxIdlePeriod	BSS Max Idle Period element	As defined in 9.4.2.79	Indicates the preferred BSS Max idle period parameters. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.

Insert the following rows into the parameter table in 6.3.7.2.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
AID Request	AID Request element	As defined in 9.4.2.194	Indicates the device characteristic of the non-AP STA requesting AID assignment. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
S1G Capabilities	As defined in frame format	As defined in 9.4.2.201	Specifies the parameters in the S1G Capabilities element that are supported by the STA. The parameter is present if dot11S1GOptionImplemented is true; otherwise not present.
TWT	TWT element	As defined in 9.4.2.200.	Specifies the parameters in the TWT element. This parameter is optionally present if dot11TWTOptionActivated is true; otherwise not present.
MaxAwayDuration	Integer	0–65 535 inclusive	Indicates the maximum duration, in TUs, that the AP is unavailable for communications with the STA. The parameter is optionally present if dot11MaxAwayDuration is nonzero; otherwise not present.

Name	Type	Valid range	Description
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Indicates if the STA with dot11RelaySTAImplemented equal to true requests to operate as a relay (in a request) and the AP with dot11RelayAPImplemented equal to true requests/ confirms operation as a relay. The parameter is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
ReachableAddress	Reachable Address element	As defined in 9.4.2.206	The Reachable Address element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.

6.3.7.3 MLME-ASSOCIATE.confirm

6.3.7.3.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.7.3.2 as follows:

The primitive parameters are as follows:

MLME-ASSOCIATE.confirm(
ResultCode,
CapabilityInformation,
AssociationID,
EDCAParameterSet,
RCPI of Request,
RSNI of Request,
RCPI of Response,
RSNI of Response,
RMEnabledCapabilities,
Content of FT Authentication elements,
SupportedOperatingClasses,
Extended Capabilities,
20/40 BSS Coexistence,
TimeoutInterval,
BSSMaxIdlePeriod,
TIMBroadcastResponse,
QoSMapSet,
QMFPolicy,
DMG Capabilities,
Multi-band local,
Multi-band peer,
MMS,
FILSHLPContainer,
FILSIPAddressAssignment,
KeyDelivery,
<u>S1G Sector Operation,</u>

S1G Capabilities,
AID Response,
TSF Timer Accuracy,
TWT,
Sectorized Group ID List,
MaxAwayDuration,
S1GRelayActivation,
S1GOperation,
SSTOperation,
S1GRelay,
HeaderCompression,
VendorSpecificInfo
)

Change the following row in the parameter table in 6.3.7.3.2 as shown:

Name	Type	Valid range	Description
AssociationID	Integer	Non-DMG: 1-2007 DMG: 1-254	If the association request result was SUCCESS, then AssociationID specifies the association ID value assigned by the AP or PCP. This parameter is not present if dot11S1GOptionImplemented is true.

Insert the following rows into the parameter table in 6.3.7.3.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
S1G Sector Operation	S1G Sector Operation element	As defined in 9.4.2.196	Specifies the sectorization scheme, period, subperiod sector intervals, and sector training.
S1G Capabilities	As defined in frame format	As defined in 9.4.2.201	Specifies the parameters in the S1G Capabilities element that are supported by the AP. The parameter is present if dot11S1GOptionImplemented is true and the S1G Capabilities element is present in the Association Response frame received from the AP; otherwise not present.
AID Response	AID Response element	As defined in 9.4.2.195	Parameters describing an AID assignment. This parameter is present if dot11S1GOptionImplemented is true; otherwise not present.
TSF Timer Accuracy	TSF Timer Accuracy element	As defined in 9.4.2.204	Indicates the information about the TSF Timer Accuracy. The parameter is optionally present if dot11TSFTimerAccuracyImplemented is true; otherwise not present.
TWT	TWT element	As defined in 9.4.2.200	Specifies the parameters in the TWT element. This parameter is optionally present if dot11TWTOptionActivated is true; otherwise not present.

Name	Type	Valid range	Description
Sectorized Group ID List	Sectorized Group ID List element	As defined in 9.4.2.212	Specifies the parameters in the Sectorized Group ID List element. This parameter is optionally present if dot11S1GSectorizationActivated is true; otherwise not present.
MaxAwayDuration	Integer	0–65 535 inclusive	Indicates the maximum duration, in TUs, that the AP is unavailable for communications with the STA. The parameter is optionally present if dot11MaxAwayDuration is nonzero; otherwise not present.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Indicates if the STA with dot11RelaySTAImplemented equal to true requests to operate as a relay (in a request) and the AP with dot11RelayAPImplemented equal to true requests/confirms operation as a relay. The parameter is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
S1GOperation	S1G Operation element	As defined in 9.4.2.213	The S1G Operation element is present if dot11S1GOptionImplemented is true; otherwise not present.
SSTOperation	SST Operation element	As defined in 9.4.2.215	The SST Operation element is optionally present if dot11SelectiveSubchannelTransmissionPermitted is true; otherwise not present.
S1GRelay	S1G Relay element	As defined in 9.4.2.205	Indicates the support of the relay operation by the STA transmitting the element.
HeaderCompression	Header Compression element	As defined in 9.4.2.214	The Header Compression element is present if dot11PV1MACHeaderOptionImplemented is true; otherwise not present.

6.3.7.4 MLME-ASSOCIATE.indication

6.3.7.4.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.7.4.2 as follows:

The primitive parameters are as follows:

MLME-ASSOCIATE.indication(
PeerSTAAddress,
CapabilityInformation,
<u>BSSMaxIdlePeriod,</u>
ListenInterval,
SSID,
OperationalRateSet,
BSSMembershipSelectorSet,
RSN,
QoSCapability,
RCPI,

RSNI,
RMEnabledCapabilities,
Content of FT Authentication elements,
SupportedOperatingClasses,
DSERegisteredLocation,
HT Capabilities,
Extended Capabilities,
20/40 BSS Coexistence,
QoSTrafficCapability,
TIMBroadcastRequest,
EmergencyServices,
DMG Capabilities,
Multi-band local,
Multi-band peer,
MMS,
VHT Capabilities,
FILSHLPContainer,
FILSIPAddressAssignment,
AID Request,
S1G Capabilities,
TWT,
MaxAwayDuration,
S1GRelayActivation,
ReachableAddress,
VendorSpecificInfo
)

Insert the following row into the parameter table in 6.3.7.4.2 before the "ListenInterval" row:

Name	Type	Valid range	Description
BSSMaxIdlePeriod	BSS Max Idle Period element	As defined in 9.4.2.79	Indicates the preferred BSS Max idle period parameters. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.

Insert the following rows into the parameter table in 6.3.7.4.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
AID Request	AID Request element	As defined in 9.4.2.194	Indicates the device characteristic of the non-AP STA requesting AID assignment. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.

Name	Type	Valid range	Description
S1G Capabilities	As defined in frame format	As defined in 9.4.2.201	Specifies the parameters in the S1G Capabilities element that are supported by the STA. The parameter is present if dot11S1GOptionImplemented is true and the S1G Capabilities element is present in the Association Request frame received from the STA; otherwise not present.
TWT	TWT element	As defined in 9.4.2.200	Specifies the parameters in the TWT element. This parameter is optionally present if dot11TWTOptionActivated is true; otherwise not present.
MaxAwayDuration	Integer	0–65 535 inclusive	Indicates the maximum duration, in TUs, that the AP is unavailable for communications with the STA. The parameter is optionally present if dot11MaxAwayDuration is nonzero; otherwise not present.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Indicates if the STA with dot11RelaySTAImplemented equal to true requests to operate as a relay (in a request) and the AP with dot11RelayAPImplemented equal to true requests/confirms operation as a relay. The parameter is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
ReachableAddress	Reachable Address element	As defined in 9.4.2.206	The Reachable Address element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.

6.3.7.5 MLME-ASSOCIATE.response

6.3.7.5.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.7.5.2 as follows:

The primitive parameters are as follows:

MLME-ASSOCIATE.response(
PeerSTAAddress,

ResultCode,
AssociationID,
RCPI,
RSNI,
RMEnabledCapabilities,
Content of FT Authentication elements,
SupportedOperatingClasses,
TimeoutInterval,
BSSMaxIdlePeriod,
TIMBroadcastResponse,
QoSMapSet,
Multi-band peer,
FILSHLPContainer,
FILSIPAddressAssignment,
KeyDelivery,
S1G Sector Operation,
S1G Capabilities,
AID Response,
TSF Timer Accuracy,
TWT,
Sectorized Group ID List,
MaxAwayDuration,
S1GRelay,
S1GRelayActivation,
S1GOperation
HeaderCompression,
SSTOperation,
VendorSpecificInfo
)

Change the following rows in the parameter table in 6.3.7.5.2 as shown:

Name	Type	Valid range	Description
AssociationID	Integer	Non-DMG: 1-2007 DMG: 1-254	If the association request result was SUCCESS, then AssociationID specifies the association ID value assigned by the AP or PCP. This parameter is not present if dot11S1GOptionImplemented is true; otherwise not present.
BSSMaxIdlePeriod	~~As defined in~~ BSS Max Idle Period element	As defined in 9.4.2.79	Indicates the BSS max idle period parameters of the AP or PCP. This parameter is present if dot11WirelessManagementImplemented is true or dot11S1GOptionImplemented is true; otherwise not present~~, and is not present otherwise~~.

Insert the following rows into the parameter table in 6.3.7.5.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
S1G Sector Operation	S1G Sector Operation element	As defined in 9.4.2.196	Specifies the sectorization scheme, period, subperiod sector intervals, and sector training.
S1G Capabilities	As defined in frame format	As defined in 9.4.2.201	Specifies the parameters in the S1G Capabilities element that are supported by the AP. The parameter is present if dot11S1GOptionImplemented is true and the S1G Capabilities element is present in the Association Response frame received from the AP; otherwise not present.
AID Response	AID Response element	As defined in 9.4.2.195	Parameters describing an AID assignment. This parameter is present if dot11S1GOptionImplemented is true; otherwise not present.
TSF Timer Accuracy	TSF Timer Accuracy element	As defined in 9.4.2.204	Indicates the information about the TSF Timer Accuracy. The parameter is optionally present if dot11TSFTimerAccuracyImplemented is true; otherwise not present.
TWT	TWT element	As defined in 9.4.2.200.	Specifies the parameters in the TWT element. This parameter is optionally present if dot11TWTOptionActivated is true; otherwise not present.
Sectorized Group ID List	Sectorized Group ID List element	As defined in 9.4.2.212	Specifies the parameters in the Sectorized Group ID List element. This parameter is optionally present if dot11S1GSectorizationActivated is true; otherwise not present.
MaxAwayDuration	Integer	0–65 535 inclusive	Indicates the maximum duration, in TUs, that the AP is unavailable for communications with the STA. The parameter is optionally present if dot11MaxAwayDuration is nonzero; otherwise not present.

Name	Type	Valid range	Description
S1GRelay	S1G Relay element	As defined in 9.4.2.205	Indicates the support of the relay operation by the STA transmitting the element.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Indicates if the STA with dot11RelaySTAImplemented equal to true requests to operate as a relay (in a request) and the AP with dot11RelayAPImplemented equal to true requests/ confirms operation as a relay. The parameter is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
S1GOperation	S1G Operation element	As defined in 9.4.2.213	The S1G Operation element is present if dot11S1GOptionImplemented is true; otherwise not present.
HeaderCompression	Header Compression element	As defined in 9.4.2.214	The Header Compression element is present if dot11PV1MACHeaderOptionImplemented is true; otherwise not present.
SSTOperation	SST Operation element	As defined in 9.4.2.215	The SST Operation element is optionally present if dot11SelectiveSubchannelTransmissionPermitted is true; otherwise not present.

6.3.8 Reassociate

6.3.8.2 MLME-REASSOCIATE.request

6.3.8.2.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.8.2.2 as follows:

The primitive parameters are as follows:

MLME-REASSOCIATE.request(
NewPCPorAPAddress,
<u>BSSMaxIdlePeriod,</u>
ListenInterval,
Supported Channels
RSN,
QoSCapability,
Content of FT Authentication elements,
SupportedOperatingClasses,
SM Power Save,
QoSTrafficCapability,
TIMBroadcastRequest,

FMSRequest,
DMSRequest,
EmergencyServices,
DMG Capabilities,
Multi-band local,
Multi-band peer,
MMS,
FILSHLPContainer,
FILSIPAddressAssignment,
AID Request,
S1G Capabilities,
TWT,
Sectorized Group ID List,
MaxAwayDuration,
S1GRelayActivation,
ELOperation,
S1GRelay,
HeaderCompression,
ReachableAddress,
S1GOperation,
SSTOperation,
VendorSpecificInfo
)

Insert the following row into the parameter table in 6.3.8.2.2 before the "ListenInterval" row:

Name	Type	Valid range	Description
BSSMaxIdlePeriod	BSS Max Idle Period element	As defined in 9.4.2.79	Indicates the preferred BSS Max idle period parameters. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.

Insert the following rows into the parameter table in 6.3.8.2.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
AID Request	AID Request element	As defined in 9.4.2.194	Indicates the device characteristic of the non-AP STA requesting AID assignment. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
S1G Capabilities	As defined in frame format	As defined in 9.4.2.201	Specifies the parameters in the S1G Capabilities element that are supported by the STA. The parameter is present if dot11S1GOptionImplemented is true; otherwise not present.

Name	Type	Valid range	Description
TWT	TWT element	As defined in 9.4.2.200.	Specifies the parameters in the TWT element. This parameter is optionally present if dot11TWTOptionActivated is true; otherwise not present.
Sectorized Group ID List	Sectorized Group ID List element	As defined in 9.4.2.212	Specifies the parameters in the Sectorized Group ID List element. This parameter is optionally present if dot11S1GSectorizationActivated is true; otherwise not present.
MaxAwayDuration	Integer	0–65 535 inclusive	Indicates the maximum duration, in TUs, that the AP is unavailable for communications with the STA. The parameter is optionally present if dot11MaxAwayDuration is nonzero; otherwise not present.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Indicates if the STA with dot11RelaySTAImplemented equal to true requests to operate as a relay (in a request) and the AP with dot11RelayAPImplemented equal to true requests/confirms operation as a relay. The parameter is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
ELOperation	EL Operation element	As defined in 9.4.2.211	The EL Operation element is optionally present if dot11S1GELOperationActivated is true; otherwise not present.
S1GRelay	S1G Relay element	As defined in 9.4.2.205	Specifies the parameters within the S1G Relay element that are supported by the MAC entity. The parameter is present if dot11RelaySTAImplemented is true; otherwise not present.
HeaderCompression	Header Compression element	As defined in 9.4.2.214	The Header Compression element is present if dot11PV1MACHeaderOptionImplemented is true; otherwise not present.

Name	Type	Valid range	Description
ReachableAddress	Reachable Address element	As defined in 9.4.2.206	The Reachable Address element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
S1GOperation	S1G Operation element	As defined in 9.4.2.213	The S1G Operation element is present if dot11S1GOptionImplemented is true; otherwise not present.
SSTOperation	SST Operation element	As defined in 9.4.2.215	The SST Operation element is optionally present if dot11SelectiveSubchannelTransmissionPermitted is true; otherwise not present.

6.3.8.3 MLME-REASSOCIATE.confirm

6.3.8.3.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.8.3.2 as follows:

The primitive parameters are as follows:

MLME-REASSOCIATE.confirm(
ResultCode,
CapabilityInformation,
AssociationID,
EDCAParameterSet,
RCPI of Request,
RSNI of Request,
RCPI of Response,
RSNI of Response,
RMEnabledCapabilities,
Content of FT Authentication elements,
SupportedOperatingClasses,
Extended Capabilities,
20/40 BSS Coexistence,
TimeoutInterval,
BSSMaxIdlePeriod,
TIMBroadcastResponse,
FMSResponse,
DMSResponse,
QoSMapSet,
QMFPolicy,
DMG Capabilities,
Multi-band local,
Multi-band peer,
MMS,
FILSHLPContainer,
FILSIPAddressAssignment,
KeyDelivery,
S1G Sector Operation

S1G Capabilities,
AID Response,
TSF Timer Accuracy,
TWT,
MaxAwayDuration,
S1GRelayActivation,
ELOperation,
S1GRelay,
HeaderCompression,
S1GOperation,
SectorizedGroupIDList,
SSTOperation,
VendorSpecificInfo
)

Change the following rows in the parameter table in 6.3.8.3.2 as shown:

Name	Type	Valid range	Description
AssociationID	Integer	Non-DMG: 1-2007 DMG: 1-254	If the association request result was SUCCESS, then AssociationID specifies the association ID value assigned by the AP or PCP. This parameter is not present if dot11S1GOptionImplemented is true.
BSSMaxIdlePeriod	~~As defined in~~ BSS Max Idle Period element	As defined in 9.4.2.79	Indicates the BSS max idle period parameters of the AP or PCP. This parameter is present if dot11WirelessManagementImplemented is true or dot11S1GOptionImplemented is true; otherwise, ~~and is~~ not present ~~otherwise~~.

Insert the following rows into the parameter table in 6.3.8.3.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
S1G Sector Operation	S1G Sector Operation element	As defined in 9.4.2.196	Specifies the sectorization scheme, period, subperiod sector intervals, sector training.
S1G Capabilities	As defined in frame format	As defined in 9.4.2.201	Specifies the parameters in the S1G Capabilities element that are supported by the AP. The parameter is present if dot11S1GOptionImplemented is true and the S1G Capabilities element is present in the (Re)Association Response frame received from the AP; otherwise not present.

Name	Type	Valid range	Description
AID Response	AID Response element	As defined in 9.4.2.195	Parameters describing an AID assignment. This parameter is present if dot11S1GOptionImplemented is true; otherwise not present.
TSF Timer Accuracy	TSF Timer Accuracy element	As defined in 9.4.2.204	Indicates the information about the TSF Timer Accuracy. The parameter is optionally present if dot11TSFTimerAccuracyImplemented is true; otherwise not present.
TWT	TWT element	As defined in 9.4.2.200.	Specifies the parameters in the TWT element. This parameter is optionally present if dot11TWTOptionActivated is true; otherwise not present.
MaxAwayDuration	Integer	0–65 535 inclusive	Indicates the maximum duration, in TUs, that the AP is unavailable for communications with the STA. The parameter is optionally present if dot11MaxAwayDuration is nonzero; otherwise not present.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Indicates if the STA with dot11RelaySTAImplemented equal to true requests to operate as a relay (in a request) and the AP with dot11RelayAPImplemented equal to true requests/confirms operation as a relay. The parameter is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
ELOperation	EL Operation element	As defined in 9.4.2.211	The EL Operation element is optionally present if dot11S1GELOperationActivated is true; otherwise not present.
S1GRelay	S1G Relay element	As defined in 9.4.2.205	Specifies the parameters within the S1G Relay element that are supported by the MAC entity. The parameter is present if dot11RelaySTAImplemented is true; otherwise not present.
HeaderCompression	Header Compression element	As defined in 9.4.2.214	The Header Compression element is present if dot11PV1MACHeaderOptionImplemented is true; otherwise not present.

Name	Type	Valid range	Description
S1GOperation	S1G Operation element	As defined in 9.4.2.213	The S1G Operation element is present if dot11S1GOptionImplemented is true; otherwise not present.
SectorizedGroupIDList	Sectorized Group ID List element	As defined in 9.4.2.212	Specifies the parameters in the Sectorized Group ID List element. This parameter is optionally present if dot11S1GSectorizationActivated is true; otherwise not present.
SSTOperation	SST Operation element	As defined in 9.4.2.215	The SST Operation element is optionally present if dot11SelectiveSubchannelTransmissionPermitted is true; otherwise not present.

6.3.8.4 MLME-REASSOCIATE.indication

6.3.8.4.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.8.4.2 as follows:

The primitive parameters are as follows:

MLME-REASSOCIATE.indication(
PeerSTAAddress,
CurrentAPAddress,
CapabilityInformation,
<u>BSSMaxIdlePeriod,</u>
ListenInterval,
SSID,
OperationalRateSet,
BSSMembershipSelectorSet,
RSN,
QoSCapability,
RCPI,
RSNI,
RMEnabledCapabilities,
Content of FT Authentication elements,
SupportedOperatingClasses,
DSERegisteredLocation,
HT Capabilities,
Extended Capabilities,
20/40 BSS Coexistence,
QoSTrafficCapability,
TIMBroadcastRequest,
FMSRequest,
DMSRequest,
EmergencyServices,
DMG Capabilities,
Multi-band local,
Multi-band peer,
MMS,

VHT Capabilities,
FILSHLPContainer,
FILSIPAddressAssignment,
AID Request,
S1G Capabilities,
TWT,
Sectorized Group ID List,
MaxAwayDuration,
S1GRelayActivaton,
ELOperation,
S1GRelay,
HeaderCompression,
ReachableAddress,
S1GOperation,
SSTOperation,
VendorSpecificInfo
)

Insert the following row into the parameter table in 6.3.8.4.2 before the "ListenInterval" row:

Name	Type	Valid range	Description
BSSMaxIdlePeriod	BSS Max Idle Period element	As defined in 9.4.2.79	Indicates the preferred BSS Max idle period parameters. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.

Insert the following rows to the parameter table in 6.3.8.4.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
AID Request	AID Request element	As defined in 9.4.2.194	Indicates the device characteristic of the non-AP STA requesting AID assignment. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
S1G Capabilities	As defined in frame format	As defined in 9.4.2.201	Specifies the parameters in the S1G Capabilities element that are supported by the STA. The parameter is present if dot11S1GOptionImplemented is true and the S1G Capabilities element is present in the Reassociation Request frame received from the STA; otherwise not present.

Name	Type	Valid range	Description
TWT	TWT element	As defined in 9.4.2.200.	Specifies the parameters in the TWT element. This parameter is optionally present if dot11TWTOptionActivated is true; otherwise not present.
Sectorized Group ID List	Sectorized Group ID List element	As defined in 9.4.2.212	Specifies the parameters in the Sectorized Group ID List element. This parameter is optionally present if dot11S1GSectorizationActivated is true; otherwise not present.
MaxAwayDuration	Integer	0–65 535 inclusive	Indicates the maximum duration, in TUs, that the AP is unavailable for communications with the STA. The parameter is optionally present if dot11MaxAwayDuration is nonzero; otherwise not present.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Indicates if the STA with dot11RelaySTAImplemented equal to true requests to operate as a relay (in a request) and the AP with dot11RelayAPImplemented equal to true requests/ confirms operation as a relay. The parameter is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
ELOperation	EL Operation element	As defined in 9.4.2.211	The EL Operation element is optionally present if dot11S1GELOperationActivated is true; otherwise not present.
S1GRelay	S1G Relay element	As defined in 9.4.2.205	Specifies the parameters within the S1G Relay element that are supported by the MAC entity. The parameter is present if dot11RelaySTAImplemented is true; otherwise not present.
HeaderCompression	Header Compression element	As defined in 9.4.2.214	The Header Compression element is present if dot11PV1MACHeaderOptionImplemented is true; otherwise not present.

Name	Type	Valid range	Description
ReachableAddress	Reachable Address element	As defined in 9.4.2.206	The Reachable Address element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
S1GOperation	S1G Operation element	As defined in 9.4.2.213	The S1G Operation element is present if dot11S1GOptionImplemented is true; otherwise not present.
SSTOperation	SST Operation element	As defined in 9.4.2.215	The SST Operation element is optionally present if dot11SelectiveSubchannelTransmissionPermitted is true; otherwise not present.

6.3.8.5 MLME-REASSOCIATE.response

6.3.8.5.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.8.5.2 as follows:

The primitive parameters are as follows:

MLME-REASSOCIATE.response(
PeerSTAAddress,
ResultCode,
AssociationID,
RCPI,
RSNI,
RMEnabledCapabilities,
Content of FT Authentication elements,
SupportedOperatingClasses,
TimeoutInterval,
BSSMaxIdlePeriod,
TIMBroadcastResponse,
FMSResponse,
DMSResponse,
QoSMapSet,
Multi-band peer,
FILSHLPContainer,
FILSIPAddressAssignment,
KeyDelivery,
S1G Sector Operation,
S1G Capabilities,
AID Response,
TSF Timer Accuracy,
TWT,
Sectorized Group ID List,
MaxAwayDuration,
S1GRelay,
S1GRelayActivation,
S1GOperation,

HeaderCompression,
SSTOperation,
VendorSpecificInfo
)

Change the following rows in the parameter table in 6.3.8.5.2 as shown:

Name	Type	Valid range	Description
AssociationID	Integer	Non-DMG: 1–2007 DMG: 1–254	If the association request result was SUCCESS, then AssociationID specifies the association ID value assigned by the AP or PCP. This parameter is not present if dot11S1GOptionImplemented is true.
BSSMaxIdlePeriod	~~As defined in~~ BSS Max Idle Period element	As defined in 9.4.2.79	Indicates the BSS max idle period parameters of the AP or PCP. This parameter is present if dot11WirelessManagementImplemented is true or dot11S1GOptionImplemented is true; otherwise ~~and is~~ not present ~~otherwise~~.

Insert the following rows into the parameter table in 6.3.8.5.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
S1G Sector Operation	S1G Sector Operation element	As defined in 9.4.2.196	Specifies the sectorization scheme, period, subperiod sector intervals, and sector training.
S1G Capabilities	As defined in frame format	As defined in 9.4.2.201	Specifies the parameters in the S1G Capabilities element that are supported by the STA. The parameter is present if dot11S1GOptionImplemented is true; otherwise not present.
AID Response	AID Response element	As defined in 9.4.2.195	Parameters describing an AID assignment. This parameter is present if dot11S1GOptionImplemented is true; otherwise not present.
TSF Timer Accuracy	TSF Timer Accuracy element	As defined in 9.4.2.204	Indicates the information about the TSF Timer Accuracy. The parameter is optionally present if dot11TSFTimerAccuracyImplemented is true; otherwise not present.

Name	Type	Valid range	Description
TWT	TWT element	As defined in 9.4.2.200.	Specifies the parameters in the TWT element. This parameter is optionally present if dot11TWTOptionActivated is true; otherwise not present.
Sectorized Group ID List	Sectorized Group ID List element	As defined in 9.4.2.212	Specifies the parameters in the Sectorized Group ID List element. This parameter is optionally present if dot11S1GSectorizationActivated is true; otherwise not present.
MaxAwayDuration	Integer	0–65 535 inclusive	Indicates the maximum duration, in TUs, that the AP is unavailable for communications with the STA. The parameter is optionally present if dot11MaxAwayDuration is nonzero; otherwise not present.
S1GRelay	S1G Relay element	As defined in 9.4.2.205	Indicates the support of the relay operation by the STA transmitting the element.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Indicates if the STA with dot11RelaySTAImplemented equal to true requests to operate as a relay (in a request) and the AP with dot11RelayAPImplemented equal to true requests/confirms operation as a relay. The parameter is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
S1GOperation	S1G Operation element	As defined in 9.4.2.213	Provides additional information for operating the S1G BSS. The parameter is present if dot11S1GOptionImplemented is true; otherwise not present.

Name	Type	Valid range	Description
HeaderCompression	Header Compression element	As defined in 9.4.2.214	The Header Compression element is present if dot11PV1MACHeaderOptionImplemented is true; otherwise not present.
SSTOperation	SST Operation element	As defined in 9.4.2.215	The SST Operation element is optionally present if dot11SelectiveSubchannelTransmissionPermitted is true; otherwise not present.

6.3.11 Start

6.3.11.2 MLME-START.request

6.3.11.2.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.11.2.2 as follows:

The primitive parameters are as follows:

MLME-START.request(
SSID,
BSSType,
BeaconPeriod,
DTIMPeriod,
CF parameter set,
PHY parameter set,
IBSS parameter set,
NAVSyncDelay,
CapabilityInformation,
BSSBasicRateSet,
OperationalRateSet,
Country,
IBSS DFS Recovery Interval,
EDCAParameterSet,
DSERegisteredLocation,
HT Capabilities,
HT Operation,
BSSMembershipSelectorSet,
Extended Capabilities,
20/40 BSS Coexistence,
Overlapping BSS Scan Parameters,
MultipleBSSID,
InterworkingInfo,
AdvertisementProtocolInfo,
RoamingConsortiumInfo,
Mesh ID,
Mesh Configuration,
QMFPolicy,
DMG Capabilities,
Multi-band,
MMS,

DMG Operation,
Clustering Control,
CBAP Only,
PCP Association Ready,
VHT Capabilities,
VHT Operation,
Known OUIs,
S1G Capabilities,
S1GOperation,
ShortBeaconPeriod,
ShortBeaconDTIMPeriod,
VendorSpecificInfo
)

Insert the following rows into the parameter table in 6.3.11.2.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
S1G Capabilities	As defined in frame format	As defined in 9.4.2.201	Specifies the parameters in the S1G Capabilities element that are supported by the STA. The parameter is present if dot11S1GOptionImplemented is true; otherwise not present.
S1GOperation	As defined in frame format	As defined in 9.4.2.213	Provides additional information for operating the S1G BSS. The parameter is present if dot11S1GOptionImplemented is true; otherwise not present.
ShortBeaconPeriod	As defined in frame format	As defined in 9.4.2.198	Provides the short beacon period of the S1G BSS. The parameter is present if dot11ShortBeaconInterval is true; otherwise not present.
ShortBeaconDTIMPeriod	As defined in frame format	As defined in 9.4.2.6	Provides the DTIM period (in short beacon periods) of the S1G BSS. The parameter is present if dot11ShortBeaconInterval is true; otherwise not present.

6.3.11.2.4 Effect of receipt

Insert the following paragraph at the end of 6.3.11.2.4:

If the MLME of an S1G STA receives an MLME-START.request primitive with a Basic S1G-MCS and NSS Set field in the S1G Operation parameter containing any unsupported <S1G-MCS, NSS> tuple, the MLME response in the resulting MLME-START.confirm primitive shall contain a ResultCode parameter whose value is not SUCCESS.

6.3.29 Block Ack

6.3.29.3 MLME-ADDBA.confirm

6.3.29.3.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.29.3.2 as follows:

The primitive parameters are as follows:

MLME-ADDBA.confirm(
PeerSTAAddress,
DialogToken,
TID,
ResultCode,
BlockAckPolicy,
BufferSize,
BlockAckTimeout,
GCRGroupAddress,
Multi-band,
TCLAS,
ADDBA Extension,
OriginatorPreferredMCS,
VendorSpecificInfo
)

Insert the following row into the parameter table in 6.3.29.3.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
OriginatorPreferredMCS	Integer	0–10, 15	Indicates preferred MCS used for eliciting A-MPDUs. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.

6.3.29.5 MLME-ADDBA.response

6.3.29.5.2 Semantics of the service primitive

Change the primitive parameter list in 6.3.29.5.2 as follows:

The primitive parameters are as follows:

MLME-ADDBA.response(
PeerSTAAddress,
DialogToken,
TID,
ResultCode,
BlockAckPolicy,
BufferSize,
BlockAckTimeout,
GCRGroupAddress,
Multi-band,
TCLAS,

ADDBA Extension,
OriginatorPreferredMCS,
VendorSpecificInfo
)

Insert the following row in the parameter table in 6.3.29.5.2 before the "VendorSpecificInfo" row:

Name	Type	Valid range	Description
OriginatorPreferredMCS	Integer	0–10, 15	Indicates preferred MCS used for eliciting A-MPDUs. This parameter is optionally present if dot11S1GOptionImplemented is true; otherwise not present.

Insert the following subclauses (6.3.106 through 6.3.117.5.4) after 6.3.105.5.4:

6.3.106 Dynamic AID assignment operation

6.3.106.1 General

The following MLME primitives support the signaling of AID switch request/response procedure described in 10.20a.

6.3.106.2 MLME-AIDSWITCH.request

6.3.106.2.1 Function

This primitive requests that an AID Switch Request frame be sent to the AP with which the non-AP STA is associated.

6.3.106.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-AIDSWITCH.request(
PeerSTAAddress,
DialogToken,
AIDRequest
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the AID switch request/response procedure.
DialogToken	Integer	1–255	The dialog token to identify the AID switch request/response transaction.
AIDRequest	AID Request element	As defined in 9.4.2.194	Specifies the proposed service parameters for the AID Request.

6.3.106.2.3 When generated

This primitive is generated by the SME to request that an AID Switch Request frame be sent to the AP with which the non-AP STA is associated.

6.3.106.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs an AID Switch Request frame. The STA then attempts to transmit this frame to the AP with which it is associated.

6.3.106.3 MLME-AIDSWITCH.confirm

6.3.106.3.1 Function

This primitive reports the result of an AID switch request/response procedure.

6.3.106.3.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-AIDSWITCH.confirm(
                    PeerMACAddress,
                    DialogToken,
                    AIDResponse
                    )
```

Name	Type	Valid range	Description
Peer MAC Address	MACAddress	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the AID switch request/response procedure.
DialogToken	Integer	0–255	The dialog token to identify the AID switch request/response transaction.
AIDResponse	AID Response element	As defined in 9.4.2.195	Specifies service parameters for the AID Response.

6.3.106.3.3 When generated

This primitive is generated by the MLME as a result of an MLME-AIDSWITCH.request primitive and indicates the results of the request. This primitive is generated when the STA receives an AID Switch Response frame from the AP.

6.3.106.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.20a.

6.3.106.4 MLME-AIDSWITCH.indication

6.3.106.4.1 Function

This primitive indicates that an AID Switch Request frame was received from a non-AP STA.

6.3.106.4.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-AIDSWITCH.indication(
PeerSTAAddress,
DialogToken,
AIDRequest
)

Name	Type	Valid range	Description
PeerSTAAddress	MACAddress	Any valid individual MAC Address	The address of the non-AP STA MAC entity from which an AID Switch Request frame was received.
DialogToken	Integer	1–255	The dialog token to identify the AID switch request/response transaction.
AIDRequest	AID Request element	As defined in 9.4.2.194	Specifies the proposed service parameters for the AID Request.

6.3.106.4.3 When generated

This primitive is generated by the MLME when a valid AID Switch Request frame is received.

6.3.106.4.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.20a.

6.3.106.5 MLME-AIDSWITCH.response

6.3.106.5.1 Function

This primitive is used to send an AID Switch Response frame, in response to a received AID Switch Request frame or autonomously by the AP.

6.3.106.5.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-AIDSWITCH.response(
PeerSTAAddress,
DialogToken,
AIDResponse
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the non-AP STA MAC entity from which an AID Switch Request frame was received.

Name	Type	Valid range	Description
DialogToken	Integer	0–255	The dialog token to identify the AID switch request/response transaction. Value is 0 for an autonomous AID Switch Response frame.
AIDResponse	AID Response element	As defined in 9.4.2.195	Specifies service parameters for the AID Response.

6.3.106.5.3 When generated

This primitive is generated by the SME to request that an AID Switch Response frame be sent to a peer entity to convey AID assignment information.

6.3.106.5.4 Effect of receipt

On receipt of this primitive, the MLME constructs an AID Switch Response frame. The STA then attempts to transmit this frame to the non-AP STA indicated by the PeerSTAAddress parameter.

6.3.107 Sync Control

6.3.107.1 General

The following MLME primitives support the signaling of a sync control procedure described in 10.45.

6.3.107.2 MLME-SYNCCONTROL.request

6.3.107.2.1 Function

This primitive requests that a Sync Control frame be sent to the AP with which the non-AP STA is associated.

6.3.107.2.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-SYNCCONTROL.request(
                          PeerSTAAddress,
                          SyncControl
                          )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the sync control procedure.
SyncControl	Sequence of octets	As defined in 9.4.1.58	Specifies the proposed service parameters for the Sync Control.

6.3.107.2.3 When generated

This primitive is generated by the SME to request that a Sync Control frame be sent to the AP with which the non-AP STA is associated.

6.3.107.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Sync Control frame. The STA then attempts to transmit this frame to the AP with which it is associated.

6.3.107.3 MLME-SYNCCONTROL.indication

6.3.107.3.1 Function

This primitive indicates that a Sync Control frame was received from a non-AP STA.

6.3.107.3.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-SYNCCONTROL.indication(
                PeerSTAAddress,
                SyncControl
                )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the non-AP STA MAC entity from which a Sync Control frame was received.
SyncControl	Sequence of octets	As defined in 9.4.1.58	Specifies the proposed service parameters for the Sync Control.

6.3.107.3.3 When generated

This primitive is generated by the MLME when a valid Sync Control frame is received.

6.3.107.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.45.

6.3.108 STA Information Announcement

6.3.108.1 General

The following MLME primitives support the signaling of a STA information announcement procedure described in 10.20a.

6.3.108.2 MLME-STAINFORMATION.request

6.3.108.2.1 Function

This primitive requests that a STA Information Announcement frame be sent to the AP with which the non-AP STA is associated.

6.3.108.2.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-STAINFORMATION.request(
```

PeerSTAAddress,
AIDAnnouncement
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the STA information announcement procedure.
AIDAnnouncement	AID Announcement element	As defined in 9.4.2.209	Specifies service parameters for the AID Announcement.

6.3.108.2.3 When generated

This primitive is generated by the SME to request that a STA Information Announcement frame be sent to the AP with which the non-AP STA is associated.

6.3.108.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a STA Information Announcement frame. The STA then attempts to transmit this frame to the AP with which it is associated.

6.3.108.3 MLME-STAINFORMATION.indication

6.3.108.3.1 Function

This primitive indicates that a STA Information Announcement frame was received from a non-AP STA.

6.3.108.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-STAINFORMATION.indication(
PeerSTAAddress,
AIDAnnouncement
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the non-AP STA MAC entity from which a STA Information Announcement frame was received.
AIDAnnouncement	AID Announcement element	As defined in 9.4.2.209	Specifies service parameters for the AID Announcement.

6.3.108.3.3 When generated

This primitive is generated by the MLME when a valid STA Information Announcement frame is received.

6.3.108.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.50.5.3 and 10.20a.

6.3.109 EDCA Parameter Set update

6.3.109.1 General

The following MLME primitives support the signaling of an EDCA Parameter Set update procedure described in 10.2.4.2.

6.3.109.2 MLME-EDCAPARAMETERSET.request

6.3.109.2.1 Function

This primitive requests that an EDCA Parameter Set frame be sent to the non-AP STA.

6.3.109.2.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-EDCAPARAMETERSET.request(
                                PeerSTAAddress,
                                EDCAParameterSet
                                )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the EDCA Parameter Set update.
EDCAParameterSet	EDCA Parameter Set element	As defined in 9.4.2.29	Specifies service parameters for the updated EDCA Parameter Set.

6.3.109.2.3 When generated

This primitive is generated by the SME to request that an EDCA Parameter Set frame be sent to the non-AP STA.

6.3.109.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs an EDCA Parameter Set frame. The AP then attempts to transmit this frame to the non-AP STA that is associated with it.

6.3.109.3 MLME-EDCAPARAMETERSET.indication

6.3.109.3.1 Function

This primitive indicates that an EDCA Parameter Set frame was received from an AP.

6.3.109.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-EDCAPARAMETERSET.indication(
PeerSTAAddress,
EDCAParameterSet
)

Name	Type	Valid range	Description
PeerSTAAddress	MACAddress	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the EDCA Parameter Set update.
EDCAParameterSet	EDCA Parameter Set element	As defined in 9.4.2.29	Specifies service parameters for the updated EDCA Parameter Set.

6.3.109.3.3 When generated

This primitive is generated by the MLME when a valid EDCA Parameter Set frame is received.

6.3.109.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.2.4.2.

6.3.110 EL Operation

6.3.110.1 General

The following MLME primitives support the signaling of an EL operation procedure described in 11.48.

6.3.110.2 MLME-ELOPERATION.request

6.3.110.2.1 Function

This primitive requests that an EL Operation frame be sent to the AP with which the non-AP STA is associated.

6.3.110.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-ELOPERATION.request(
PeerSTAAddress,
ELOperation
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the EL operation procedure.
ELOperation	EL Operation element	As defined in 9.4.2.211	Specifies the proposed service parameters for the EL operation.

6.3.110.2.3 When generated

This primitive is generated by the SME to request that an EL Operation frame be sent to the AP with which the non-AP STA is associated.

6.3.110.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs an EL Operation frame. The STA then attempts to transmit this frame to the AP with which it is associated.

6.3.110.3 MLME-ELOPERATION.indication

6.3.110.3.1 Function

This primitive indicates that an EL Operation frame was received from a non-AP STA.

6.3.110.3.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-ELOPERATION.indication(
                                PeerSTAAddress,
                                ELOperation
                                )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the non-AP STA MAC entity from which a EL Operation frame was received.
ELOperation	EL Operation element	As defined in 9.4.2.211	Specifies the proposed service parameters for the EL Operation.

6.3.110.3.3 When generated

This primitive is generated by the MLME when a valid EL Operation frame is received.

6.3.110.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 11.48.

6.3.111 TWT Setup

6.3.111.1 General

The following MLME primitives support the signaling of TWT Setup procedure described in 10.43.

6.3.111.2 MLME-TWTSETUP.request

6.3.111.2.1 Function

This primitive requests that a TWT Setup frame be sent as specified in 10.43.

6.3.111.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-TWTSETUP.request(
PeerSTAAddress,
DialogToken,
TWT
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the TWT Setup request/ response procedure.
DialogToken	Integer	0–255	The dialog token to identify the TWT Setup request/response transaction.
TWT	TWT element	As defined in 9.4.2.200	Specifies the proposed service parameters for the TWT Setup request.

6.3.111.2.3 When generated

This primitive is generated by the SME to request that a TWT Setup frame be sent.

6.3.111.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a TWT Setup frame. The STA then attempts to transmit this TWT Setup frame.

6.3.111.3 MLME-TWTSETUP.confirm

6.3.111.3.1 Function

This primitive reports the result of a TWT Setup request/response procedure.

6.3.111.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-TWTSETUP.confirm(
PeerMACAddress,
DialogToken,
TWT
)

Name	Type	Valid range	Description
PeerMACAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the TWT Setup request/ response procedure.

Name	Type	Valid range	Description
DialogToken	Integer	0–255	The dialog token to identify the TWT Setup request/response transaction.
TWT	TWT element	As defined in 9.4.2.200	Specifies the proposed service parameters for the TWT Setup response.

6.3.111.3.3 When generated

This primitive is generated by the MLME as a result of an MLME-TWTSETUP.request primitive and indicates the results of the request. This primitive is generated when the STA receives a TWT Setup frame from another STA.

6.3.111.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.43.

6.3.111.4 MLME-TWTSETUP.indication

6.3.111.4.1 Function

This primitive indicates that a TWT Setup frame was received from another STA.

6.3.111.4.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-TWTSETUP.indication(
                              PeerSTAAddress,
                              DialogToken,
                              TWT
                              )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the non-AP STA MAC entity from which a TWT Setup frame was received.
DialogToken	Integer	0–255	The dialog token to identify the TWT Setup request/response transaction.
TWT	TWT element	As defined in 9.4.2.200	Specifies the proposed service parameters for the TWT Setup request.

6.3.111.4.3 When generated

This primitive is generated by the MLME when a valid TWT Setup frame is received.

6.3.111.4.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.43.

6.3.111.5 MLME-TWTSETUP.response

6.3.111.5.1 Function

This primitive is used to send a TWT Setup frame, in response to a received TWT Setup frame.

6.3.111.5.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-TWTSETUP.response(
PeerSTAAddress,
DialogToken,
TWT
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the non-AP STA MAC entity from which a TWT Setup frame was received.
DialogToken	Integer	0–255	The dialog token to identify the TWT Setup request/response transaction.
TWT	TWT element	As defined in 9.4.2.200	Specifies service parameters for the TWT Setup response.

6.3.111.5.3 When generated

This primitive is generated by the SME to request that a TWT Setup frame be sent to a peer entity to convey TWT assignment information.

6.3.111.5.4 Effect of receipt

On receipt of this primitive, the MLME constructs a TWT Setup frame. The STA then attempts to transmit this frame to the non-AP STA indicated by the PeerSTAAddress parameter.

6.3.112 TWT Teardown

6.3.112.1 General

The following MLME primitives support the signaling of a TWT Teardown procedure described in 10.43.8.

6.3.112.2 MLME-TWTTEARDOWN.request

6.3.112.2.1 Function

This primitive requests that a TWT Teardown frame be sent to the AP with which the non-AP STA is associated.

6.3.112.2.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-TWTTEARDOWN.request(
                              PeerSTAAddress,
                              TWTFlow
                              )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the TWT Teardown procedure.
TWTFlow	As defined in frame format	As defined in 9.6.25.9	Specifies the proposed service parameters for the TWT Teardown.

6.3.112.2.3 When generated

This primitive is generated by the SME to request that a TWT Teardown frame be sent to the AP with which the non-AP STA is associated.

6.3.112.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a TWT Teardown frame. The STA then attempts to transmit this frame to the AP with which it is associated.

6.3.112.3 MLME-TWTTEARDOWN.indication

6.3.112.3.1 Function

This primitive indicates that a TWT Teardown frame was received from a non-AP STA.

6.3.112.3.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-TWTTEARDOWN.indication(
                              PeerSTAAddress,
                              TWTFlow
                              )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the TWT Teardown procedure.
TWTFlow	As defined in frame format	As defined in 9.6.25.9	Specifies the proposed service parameters for the TWT Teardown.

6.3.112.3.3 When generated

This primitive is generated by the MLME when a valid TWT Teardown frame is received.

6.3.112.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.43.8.

6.3.113 Sectorized Group ID List management

6.3.113.1 General

The following MLME primitives support the signaling of a Sectorized Group ID List management described in 10.49.

6.3.113.2 MLME-SECTORIZEDGROUPID.request

6.3.113.2.1 Function

This primitive requests that a Sectorized Group ID List frame be sent to the non-AP STA.

6.3.113.2.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-SECTORIZEDGROUPID.request(
                    PeerSTAAddress,
                    SectorizedGroupIDList
                    )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the Sectorized Group ID List management.
SectorizedGroupIDList	Sectorized Group ID List element	As defined in 9.4.2.212	Specifies service parameters for the updated Sectorized Group ID List.

6.3.113.2.3 When generated

This primitive is generated by the SME to request that a Sectorized Group ID List frame be sent to the non-AP STA.

6.3.113.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Sectorized Group ID List frame. The AP then attempts to transmit this frame to the non-AP STA that is associated with it.

6.3.113.3 MLME-SECTORIZEDGROUPID.indication

6.3.113.3.1 Function

This primitive indicates that a Sectorized Group ID List frame was received from an AP.

6.3.113.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-SECTORIZEDGROUPID.indication(
PeerSTAAddress,
SectorizedGroupIDList
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the Sectorized Group ID List management.
SectorizedGroupIDList	Sectorized Group ID List element	As defined in 9.4.2.212	Specifies service parameters for the updated Sectorized Group ID List.

6.3.113.3.3 When generated

This primitive is generated by the MLME when a valid Sectorized Group ID List frame is received.

6.3.113.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.49.

6.3.114 Header Compression procedure

6.3.114.1 General

The following MLME primitives support the signaling of Header Compression procedure described in 10.54.

6.3.114.2 MLME-HEADERCOMPRESSION.request

6.3.114.2.1 Function

This primitive requests that a Header Compression frame be sent to a peer MAC entity.

6.3.114.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-HEADERCOMPRESSION.request(
PeerSTAAddress,
DialogToken,
HeaderCompression
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the Header Compression request/response procedure.

Name	Type	Valid range	Description
DialogToken	Integer	0–255	The dialog token to identify the Header Compression request/ response transaction.
HeaderCompression	Header Compression element	As defined in 9.4.2.214	Specifies the proposed service parameters for the Header Compression request.

6.3.114.2.3 When generated

This primitive is generated by the SME to request that a Header Compression frame be sent to a peer MAC entity.

6.3.114.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Header Compression frame. The STA then attempts to transmit this frame to the peer MAC entity.

6.3.114.3 MLME-HEADERCOMPRESSION.confirm

6.3.114.3.1 Function

This primitive reports the result of a Header Compression request/response procedure.

6.3.114.3.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-HEADERCOMPRESSION.confirm(
                              PeerMACAddress,
                              DialogToken,
                              HeaderCompression
                              )
```

Name	Type	Valid range	Description
PeerMACAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the Header Compression request/response procedure.
DialogToken	Integer	0–255	The dialog token to identify the Header Compression request/ response transaction.
HeaderCompression	Header Compression element	As defined in 9.4.2.214	Specifies the proposed service parameters for the Header Compression response.

6.3.114.3.3 When generated

This primitive is generated by the MLME as a result of an MLME-HEADERCOMPRESSION.request primitive and indicates the results of the request. This primitive is generated when the STA receives a Header Compression frame from the peer MAC entity.

6.3.114.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.54.

6.3.114.4 MLME-HEADERCOMPRESSION.indication

6.3.114.4.1 Function

This primitive indicates that a Header Compression frame was received from a STA.

6.3.114.4.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-HEADERCOMPRESSION.indication(
                                   PeerSTAAddress,
                                   DialogToken,
                                   HeaderCompression
                                   )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the STA MAC entity from which a Header Compression frame was received.
DialogToken	Integer	0–255	The dialog token to identify the Header Compression request/ response transaction.
HeaderCompression	Header Compression element	As defined in 9.4.2.214	Specifies the proposed service parameters for the Header Compression request.

6.3.114.4.3 When generated

This primitive is generated by the MLME when a valid Header Compression frame is received.

6.3.114.4.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.54.

6.3.114.5 MLME-HEADERCOMPRESSION.response

6.3.114.5.1 Function

This primitive is used to send a Header Compression frame, in response to a received Header Compression frame.

6.3.114.5.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-HEADERCOMPRESSION.response(
                                PeerSTAAddress,
                                DialogToken,
                                HeaderCompression
                                )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the STA MAC entity from which a Header Compression frame was received.
DialogToken	Integer	0–255	The dialog token to identify the Header Compression request/ response transaction.
HeaderCompression	Header Compression element	As defined in 9.4.2.214	Specifies service parameters for the Header Compression response.

6.3.114.5.3 When generated

This primitive is generated by the SME to request that a Header Compression frame be sent to a peer entity to convey Header Compression information.

6.3.114.5.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Header Compression frame. The STA then attempts to transmit this frame to the peer MAC entity indicated by the PeerSTAAddress parameter.

6.3.115 Reachable Address Update

6.3.115.1 General

The following MLME primitives support the signaling of a reachable address update procedure described in 10.50.

6.3.115.2 MLME-REACHABLEADDRESSUPDATE.request

6.3.115.2.1 Function

This primitive requests that a Reachable Address Update frame be sent to the AP with which the non-AP STA is associated.

6.3.115.2.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-REACHABLEADDRESSUPDATE.request(
                                PeerSTAAddress,
                                ReachableAddress
                                )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the reachable address update procedure.
ReachableAddress	Reachable Address element	As defined in 9.4.2.206	Specifies the proposed service parameters for the Reachable Address Update.

6.3.115.2.3 When generated

This primitive is generated by the SME to request that a Reachable Address Update frame be sent to the AP with which the non-AP STA is associated.

6.3.115.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Reachable Address Update frame. The STA then attempts to transmit this frame to the AP with which it is associated.

6.3.115.3 MLME-REACHABLEADDRESSUPDATE.indication

6.3.115.3.1 Function

This primitive indicates that a Reachable Address Update frame was received from a non-AP STA.

6.3.115.3.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-REACHABLEADDRESSUPDATE.indication(
                                        PeerSTAAddress,
                                        ReachableAddress
                                        )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the non-AP STA MAC entity from which a Reachable Address Update frame was received.
ReachableAddress	Reachable Address element	As defined in 9.4.2.206	Specifies the proposed service parameters for the Reachable Address Update.

6.3.115.3.3 When generated

This primitive is generated by the MLME when a valid Reachable Address Update frame is received.

6.3.115.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.50.

6.3.116 Control response MCS negotiation operation

6.3.116.1 General

The following MLME primitives support the signaling of control response MCS negotiation procedure described in 10.7.6.5.4b.

6.3.116.2 MLME-CONTROLRESPONSEMCS.request

6.3.116.2.1 Function

This primitive requests that a Control Response MCS Negotiation Request frame be sent to a peer entity.

6.3.116.2.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-CONTROLRESPONSEMCS.request(
                    PeerSTAAddress,
                    MCSDifference
                    )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the control response MCS negotiation procedure.
MCSDifference	As defined in frame format	As defined in 9.6.28.2)	Specifies the proposed service parameters for the Control Response MCS Negotiation Request frame.

6.3.116.2.3 When generated

This primitive is generated by the SME to request that a Control Response MCS Negotiation Request frame be sent to the peer entity.

6.3.116.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Control Response MCS Negotiation Request frame. The STA then attempts to transmit this frame to the peer entity.

6.3.116.3 MLME-CONTROLRESPONSEMCS.confirm

6.3.116.3.1 Function

This primitive reports the result of an control response MCS negotiation request/response procedure.

6.3.116.3.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-CONTROLRESPONSEMCS.confirm(
                    PeerMACAddress,
```

Command
)

Name	Type	Valid range	Description
PeerMACAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the control response MCS negotiation request/ response procedure.
Command	As defined in frame format	As defined in 9.6.28.3	Specifies service parameters for the Control Response MCS Negotiation Response frame.

6.3.116.3.3 When generated

This primitive is generated by the MLME as a result of an MLME-CONTROLRESPONSEMCS.request primitive and indicates the results of the request. This primitive is generated when the STA receives a Control Response MCS Negotiation Response frame from the peer entity.

6.3.116.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.7.6.5.4b.

6.3.116.4 MLME-CONTROLRESPONSEMCS.indication

6.3.116.4.1 Function

This primitive indicates that a Control Response MCS Negotiation Request frame was received from a peer entity.

6.3.116.4.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-CONTROLRESPONSEMCS.indication(
PeerSTAAddress,
MCSDifference
)

Name	Type	Valid range	Description
PeerSTAAddress	MACAddress	Any valid individual MAC Address	The address of the peer MAC entity from which a Control Response MCS Negotiation Request frame was received.
MCSDifference	As defined in frame format	As defined in 9.6.28.2	Specifies the proposed service parameters for the Control Response MCS Negotiation Request frame.

6.3.116.4.3 When generated

This primitive is generated by the MLME when a valid Control Response MCS Negotiation Request frame is received.

6.3.116.4.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.7.6.5.4b.

6.3.116.5 MLME-CONTROLRESPONSEMCS.response

6.3.116.5.1 Function

This primitive is used to send a Control Response MCS Negotiation frame, in response to a received Control Response MCS Negotiation Request frame.

6.3.116.5.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-CONTROLRESPONSEMCS.response(
                        PeerSTAAddress,
                        Command
                        )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the non-AP STA MAC entity from which an Control Response MCS Negotiation Response frame was received.
Command	As defined in frame format	As defined in 9.6.28.3	Specifies service parameters for the Control Response MCS Negotiation Response frame.

6.3.116.5.3 When generated

This primitive is generated by the SME to request that a Control Response MCS Negotiation Response frame be sent to a peer entity to convey control response MCS negotiation information.

6.3.116.5.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Control Response MCS Negotiation Response frame. The STA then attempts to transmit this frame to the peer entity indicated by the PeerSTAAddress parameter.

6.3.117 S1G Relay (de)activation

6.3.117.1 General

The following MLME primitives support the signaling of relay activation and deactivation procedure described in 10.50.

6.3.117.2 MLME-S1GRELAYACTIVATE.request

6.3.117.2.1 Function

This primitive requests that a Relay Activation Request frame be sent to a peer entity.

6.3.117.2.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-S1GRELAYACTIVATE.request(
PeerSTAAddress,
S1GRelayActivation
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the relay (de)activation procedure.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Specifies the proposed service parameters for the Relay Activation Request.

6.3.117.2.3 When generated

This primitive is generated by the SME to request that a Relay Activation Request frame be sent to the peer entity.

6.3.117.2.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Relay Activation Request frame. The STA then attempts to transmit this frame to the peer entity.

6.3.117.3 MLME-S1GRELAYACTIVATE.confirm

6.3.117.3.1 Function

This primitive reports the result of a relay (de)activation request/response procedure.

6.3.117.3.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-S1GRELAYACTIVATE.confirm(
PeerMACAddress,
S1GRelayActivation
)

Name	Type	Valid range	Description
PeerSTAAddress	MACAddress	Any valid individual MAC Address	Specifies the address of the peer MAC entity with which to perform the relay (de)activation procedure.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Specifies service parameters for the Relay Activation Response.

6.3.117.3.3 When generated

This primitive is generated by the MLME as a result of an MLME-S1GRELAYACTIVATE.request primitive and indicates the results of the request. This primitive is generated when the STA receives a Relay Activation Response frame from the peer entity.

6.3.117.3.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.50.

6.3.117.4 MLME-S1GRELAYACTIVATE.indication

6.3.117.4.1 Function

This primitive indicates that a Relay Activation Request frame was received from a peer entity.

6.3.117.4.2 Semantics of the service primitive

The primitive parameters are as follows:

```
MLME-S1GRELAYACTIVATE.indication(
                    PeerSTAAddress,
                    S1GRelayActivation
                    )
```

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the peer MAC entity from which a Relay Activation Request frame was received.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Specifies the proposed service parameters for Relay Activation Request.

6.3.117.4.3 When generated

This primitive is generated by the MLME when a valid Relay Activation Request frame is received.

6.3.117.4.4 Effect of receipt

On receipt of this primitive, the SME should operate according to the procedure in 10.50.

6.3.117.5 MLME-S1GRELAYACTIVATE.response

6.3.117.5.1 Function

This primitive is used to send a Relay Activation Response frame, in response to a received Relay Activation Request frame.

6.3.117.5.2 Semantics of the service primitive

The primitive parameters are as follows:

MLME-S1GRELAYACTIVATE.response(
PeerSTAAddress,
S1GRelayActivation
)

Name	Type	Valid range	Description
PeerSTAAddress	MAC Address	Any valid individual MAC Address	The address of the non-AP STA MAC entity from which a Relay Activation Response frame was received.
S1GRelayActivation	S1G Relay Activation element	As defined in 9.4.2.207	Specifies service parameters for the Relay Activation Response.

6.3.117.5.3 When generated

This primitive is generated by the SME to request that a Relay Activation Response frame be sent to a peer entity to convey relay activation information.

6.3.117.5.4 Effect of receipt

On receipt of this primitive, the MLME constructs a Relay Activation Response frame. The STA then attempts to transmit this frame to the peer entity indicated by the PeerSTAAddress parameter.

6.5 PLME SAP interface

6.5.4 PLME-CHARACTERISTICS.confirm

6.5.4.2 Semantics of the service primitive

Change the primitive parameter list in 6.5.4.2 as follows:

The primitive parameters are as follows:

PLME-CHARACTERISTICS.confirm(
aSlotTime,
aSIFSTime,
aSignalExtension,
aCCATime,
aCCAMidTime,
aRxPHYStartDelay,
aRxTxTurnaroundTime,
aTxPHYDelay,
aRxPHYDelay,

aRxTxSwitchTime,
aTxRampOnTime,
aAirPropagationTime,
aMACProcessingDelay,
aPreambleLength,
aRIFSTime,
aSymbolLength,
aSTFOneLength,
aSTFTwoLength,
aLTFOneLength,
aLTFTwoLength,
aPHYHeaderLength,
aPHYSigTwoLength,
aPHYServiceLength,
aPHYConvolutionalTailLength,
aPSDUMaxLength,
aPSDUMaxLengthWithNoAggregation,
aPPDUMaxTime,
aIUSTime,
aDTT2UTTTime,
aCWmin,
aCWmax,
aMaxCSIMatricesReportDelay
aMaxTODError,
aMaxTOAError,
aTxPHYTxStartRFDelay,
aTxPHYTxStartRMS,
aMaxTODFineError,
aMaxTOAFineError
)

Insert the following row into the parameter table in 6.5.4.2 after the "aPSDUMaxLength" row:

Name	Type	Description
aPSDUMaxLengthWithNoAggregation	integer	The maximum number of octets in a PSDU that can be conveyed by an S1G PPDU when the Aggregation field is 0.

8. PHY service specification

8.3 Detailed PHY service specifications

8.3.4 Basic service and options

8.3.4.4 Vector descriptions

Change the following rows in Table 8-4 as shown:

Table 8-4—Vector descriptions

Parameter	Associated vector	Value
PARTIAL_AID_LIST_GID00	PHYCONFIG_VECTOR	For a non-S1G STA, ~~I~~includes the list of partial AIDs, of which the STA is an intended recipient, associated with group ID 0. The settings of the PARTIAL_AID are specified in 10.20. For an S1G STA, includes the list of partial AIDs, of which the S1G STA is an intended recipient, in which a frame is addressed to an AP. The settings of the PARTIAL_AID are specified in 10.20b.
PARTIAL_AID_LIST_GID63	PHYCONFIG_VECTOR	For a non-S1G STA, ~~I~~includes the list of partial AIDs, of which the STA is an intended recipient, associated with group ID 63. The settings of the PARTIAL_AID are specified in 10.20. For an S1G STA, includes the list of partial AIDs, of which the S1G STA is an intended recipient, in which a frame is addressed to a non-AP STA. The settings of the PARTIAL_AID are specified in 10.20b.

Insert the following row at the end of Table 8-4:

Table 8-4—Vector descriptions

Parameter	Associated vector	Value
CCA_SENSITIVITY_TYPE	PHYCONFIG_VECTOR	Enumerated type: CCA_SENSITIVITY_TYPE_1 indicates that the PHY issues a PHY-CCA.indication primitive based on the CCA conditions listed in Table 23-33 and 23.3.17.5.5. CCA_SENSITIVITY_TYPE_2 indicates that the PHY issues a PHY-CCA.indication primitive based on the CCA conditions listed in Table 23-34 and 23.3.17.5.5. CCA_SENSITIVITY_TYPE_2_WIDEBAND indicates that the PHY issues a PHY-CCA.indication primitive based on the CCA conditions listed in Table 23-35 and 23.3.17.5.5.

8.3.5 PHY SAP detailed service specification

8.3.5.8 PHY-TXEND.confirm

8.3.5.8.2 Semantics of the service primitive

Change 8.3.5.8.2 as follows:

The semantics of the primitive are as follows:

PHY-TXEND.confirm(
    SCRAMBLER_OR_CRC
)

~~This primitive has no parameters.~~

The SCRAMBLER_OR_CRC parameter is present if dot11S1GOptionImplemented is true. The value of SCRAMBLER_OR_CRC parameter depends on the type of the transmitted frame:

- When transmitting a non-NDP frame, the value of the SCRAMBLER_OR_CRC parameter is the Scrambler Initialization value in the Service field after scrambling (i.e., [B0:B6] of the Service field]) (as defined in 23.3.9.2) of the frame.
- When transmitting an NDP CMAC frame, the value of the SCRAMBLER_OR_CRC parameter is the calculated CRC value in the SIG/SIG-A field (as defined in 23.3.8.2.1.5) as follows:
  - When the frame is an NDP_1M CMAC frame, the value of SCRAMBLER_OR_CRC parameter is equal to [B26:B29] of the SIG field.
  - When the frame is an NDP_2M CMAC frame, the value of SCRAMBLER_OR_CRC parameter is equal to [B38:B41] of the ≥2 MHz SIG-A field.

8.3.5.12 PHY-CCA.indication

8.3.5.12.2 Semantics of the service primitive

Change the fourth paragraph of 8.3.5.12.2 and Table 8-5 as follows:

When STATE is IDLE or when, for the type of PHY in operation, CCA is determined by a single channel, the channel-list parameter is absent. Otherwise, it carries a set indicating which channels are busy. The channel-list parameter in a PHY-CCA.indication primitive generated by a VHT or S1G STA contains at most a single element. Table 8-5 defines the members of this set.

Table 8-5—The channel-list parameter elements

Channel-list elements	Meaning
primary	In an HT STA that is not a VHT STA, indicates that the primary 20 MHz channel is busy. In a VHT STA, indicates that the primary 20 MHz channel is busy according to the rules specified in 21.3.18.5.3. For a TVHT STA, indicates that the primary channel is busy according to the rules specified in 22.3.18.6.3.

Table 8-5—The channel-list parameter elements *(continued)*

Channel-list elements	Meaning
secondary	In an HT STA that is not a VHT STA, indicates that the secondary channel is busy. In a VHT STA, indicates that the secondary 20 MHz channel is busy according to the rules specified in 21.3.18.5.4. In a TVHT STA, indicates that the secondary channel is busy according to the rules specified in 22.3.18.6.4.
secondary40	In a VHT STA, ~~I~~indicates that the secondary 40 MHz channel is busy according to the rules specified in 21.3.18.5.4. In a TVHT STA, indicates that the secondary TVHT_2W channel is busy according to the rules specified in 22.3.18.6.4.
secondary80	In a VHT STA, ~~I~~indicates that the secondary 80 MHz channel is busy according to the rules specified in 21.3.18.5.4.
primary1	In an S1G STA, indicates that the primary 1 MHz channel is busy according to the rules specified in 23.3.17.5.4.
primary2	In an S1G STA, indicates that the primary 2 MHz channel is busy according to the rules specified in 23.3.17.5.4.
secondary2	In an S1G STA, indicates that the secondary 2 MHz channel is busy according to the rules specified in 23.3.17.5.5.
secondary4	In an S1G STA, indicates that the secondary 4 MHz channel is busy according to the rules specified in 23.3.17.5.5.
secondary8	In an S1G STA, indicates that the secondary 8 MHz channel is busy according to the rules specified in 23.3.17.5.5.

Insert the following paragraph and Figure 8-5 at the end of 8.3.5.12.2:

For an S1G STA, the relationship of the channel-list parameter elements to the 1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz BSS operating channel is illustrated by example in Figure 8-5.

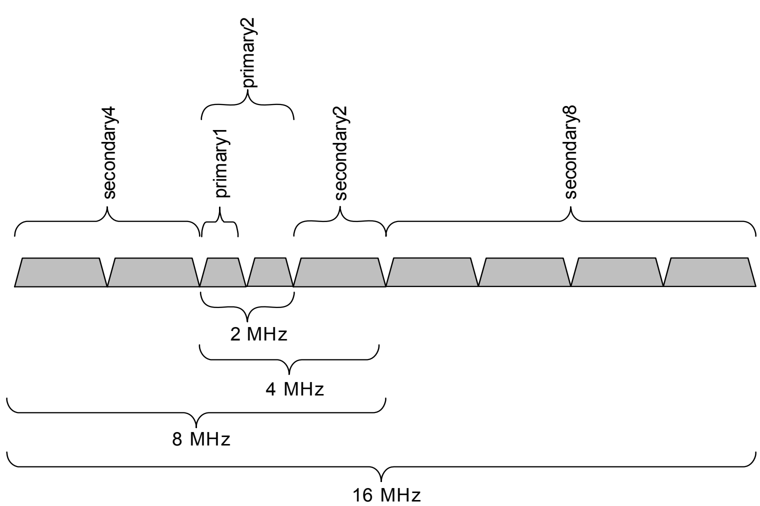


Figure 8-5—The channel-list parameter elements to the 1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz channel width

9. Frame formats

9.2 MAC frame formats

9.2.2 Conventions

Insert the following list items at the end of the dashed list after the 12th paragraph ("Parentheses enclosing portions....") of 9.2.2:

— (NDP) CTS refers to CTS and NDP CTS.
— (NDP) CF-END refers to CF-END and NDP CF-END.
— (NDP) PS-Poll refers to PS-Poll and NDP PS-Poll.
— (NDP) Ack refers to Ack and NDP Ack.
— NDP (PS-Poll-)Ack refers to NDP Ack and NDP PS-Poll-Ack.
— (NDP) Block Ack refers to Block Ack and NDP Block Ack.
— PS-Poll(+BDT) refers to PS-Poll and PS-Poll+BDT.

9.2.3 General frame format

Change the first paragraph of 9.2.3 (including splitting it into two paragraphs) as follows (Figure 9-1 remains unchanged):

The MAC frame format comprises a set of fields that occur in a fixed order in all frames. Figure 9-1 depicts the general MAC frame format for protocol version 0 (PV0) MPDUs, and Figure 9-748 (in 9.8.2) depicts the general MAC frame format for protocol version 1 (PV1) frames. The first 2 bits of the first subfield (Protocol Version) of the Frame Control Field and the last field (FCS) in Figure 9-1 are present in all PV0 MPDUs and PV1 MPDUs, including reserved types and subtypes.

For PV0 MPDUs, t~~T~~he first three fields (Frame Control, Duration/ID, and Address 1) and the last field (FCS) in Figure 9-1 constitute the minimal frame format and are present in all these frames, including reserved types and subtypes. The fields Address 2, Address 3, Sequence Control, Address 4, QoS Control, HT Control, and Frame Body are present only in certain frame types and subtypes. Each field is defined in 9.2.4. For PV1 MPDUs, the fields constituting the minimal frame format are defined in 9.8. The format of each of the individual subtypes of each PV0 frame type is defined in 9.3, the format of each PV1 frame type is defined in 9.8, and the format of NDP CMAC frames is defined in 9.9. The components of management frame bodies are defined in 9.4. The formats of Action frame~~s~~ bodies (PV0 and PV1) are defined in 9.6.

9.2.4 Frame fields

9.2.4.1 Frame Control field

9.2.4.1.1 General

Change 9.2.4.1.1 as follows (including inserting Figure 9-3a and Figure 9-3b):

The first three subfields of the Frame Control field of a PV0 frame are Protocol Version, Type, and Subtype. The remaining subfields of the Frame Control field depend on the setting of the Type and Subtype subfields. The Control frames carried by S1G PPDUs are called *S1G Control frames*.

For a frame carried in an non-S1G PPDU, w~~W~~hen the value of the Type subfield is not equal to 1 or the value of the Subtype subfield is not equal to 6, the remaining subfields within the Frame Control field are:

To DS, From DS, More Fragments, Retry, Power Management, More Data, Protected Frame, and +HTC/Order. In this case, the format of the Frame Control field is illustrated in Figure 9-2.

	B0 B1	B2 B3	B4 B7	B8	B9	B10	B11	B12	B13	B14	B15
	Protocol Version	Type	Subtype	To DS	From DS	More Fragments	Retry	Power Management	More Data	Protected Frame	+HTC/Order
Bits:	2	2	4	1	1	1	1	1	1	1	1

Figure 9-2—Frame Control field in non-S1G PPDUs when Type is not equal to 1 or Subtype is not equal to 6

For a frame carried in an non-S1G PPDU, w~~W~~hen the value of the Type subfield is equal to 1 and the value of the Subtype subfield is equal to 6, the remaining subfields within the Frame Control field are the following: Control Frame Extension, Power Management, More Data, Protected Frame, and +HTC Order. In this case, the format of the Frame Control field is illustrated in Figure 9-3.

	B0 B1	B2 B3	B4 B7	B8 B11	B12	B13	B14	B15
	Protocol Version	Type	Subtype	Control Frame Extension	Power Management	More Data	Protected Frame	+HTC/Order
Bits:	2	2	4	4	1	1	1	1

Figure 9-3—Frame Control field in non-S1G PPDUs when Type is equal to 1 and Subtype is equal to 6

For a frame carried in an S1G PPDU, when the value of the Type subfield is equal to 0 or 2, the remaining subfields within the Frame Control field are: To DS, From DS, More Fragments, Retry, Power Management, More Data, Protected Frame, and +HTC/Order. In this case, the format of the Frame Control field is illustrated in Figure 9-3a.

	B0 B1	B2 B3	B4 B7	B8	B9	B10	B11	B12	B13	B14	B15
	Protocol Version	Type	Subtype	To DS	From DS	More Fragments	Retry	Power Management	More Data	Protected Frame	+HTC/Order
Bits:	2	2	4	1	1	1	1	1	1	1	1

Figure 9-3a—Frame Control field in S1G PPDUs when Type is equal to 0 or 2

The Frame Control field of S1G Control frames is defined in 9.3.1.1.

When the Type subfield is equal to 3 and the Subtype subfield is equal to 1, the format of the Frame Control field is shown in Figure 9-3b.

	B0 B1	B2 B3	B4 B7	B8	B9	B10	B11 13	B14	B15
	Protocol Version	Type	Subtype	Next TBTT Present	Compressed SSID Present	ANO Present	BSS BW	Security	AP PM
Bits:	2	2	4	1	1	1	3	1	1

Figure 9-3b—Frame Control field format when Type subfield is equal to 3 and Subtype subfield is equal to 1

9.2.4.1.2 Protocol Version subfield

Change 9.2.4.1.2 as follows:

The Protocol Version subfield is 2 bits in length and is invariant in size and placement across all revisions of this standard. For this standard, the value of the protocol version is 0 for MAC frames as described in 9.2 and 1 for PV1 MAC frames as described in 9.8. All other values are reserved. The revision level is incremented only when a fundamental incompatibility exists between a new revision and the prior edition of the standard. See 10.27.2.

9.2.4.1.3 Type and Subtype subfields

Change Table 9-1 as follows:

Table 9-1—Valid type and subtype combinations

Type value B3 B2	Type description	Subtype value B7 B6 B5 B4	Subtype description
...			
01	Control	0000–~~0011~~0010	Reserved
01	Control	0011	TACK
...			
11	Extension	0001	S1G Beacon
11	Extension	0010~~0001~~–1111	Reserved

9.2.4.1.4 To DS and From DS subfields

Change the following row of Table 9-3 as shown:

Table 9-3—To/From DS combinations in Data frames

To DS and From DS values	Meaning
To DS = 1 From DS = 1	A Data frame using the four-address MAC header format. This standard defines procedures for using this combination of field values ~~only~~ in ~~a~~ mesh BSSs and by S1G relays, as specified in 10.50. This is the only valid combination for individually addressed Data frames transmitted by a mesh STA.

9.2.4.1.8 More Data subfield

Change 9.2.4.1.8 as follows:

The More Data subfield is 1 bit in length and is used differently by a ~~non-~~DMG, S1G, and other STAs.~~and by a DMG STA.~~

A non-DMG and non-S1G STA uses the More Data subfield to indicate to a STA in PS mode that more BUs are buffered for that STA at the AP. The More Data subfield is valid in individually addressed Data or Management frames transmitted by an AP to a STA in PS mode. A value of 1 indicates that at least one additional buffered BU is present for the same STA.

A non-DMG and non-S1G STA optionally sets the More Data subfield to 1 in individually addressed data type frames transmitted by a CF-Pollable STA to the PC in response to a CF-Poll to indicate that the STA has at least one additional buffered MSDU available for transmission in response to a subsequent CF-Poll.

An AP optionally sets the More Data subfield to 1 in Ack frames to a non-DMG and non-S1G STA from which it has received a frame that contains a QoS Capability element in which the More Data Ack subfield is equal to 1 and that has one or more ACs that are delivery enabled and that is in PS mode to indicate that the AP has a pending transmission for the STA.

A TDLS peer STA optionally sets the More Data subfield to 1 in Ack frames to a STA that has TDLS peer PSM enabled and that has the More Data Ack subfield equal to 1 in the QoS Capability element of its transmitted TDLS Setup Request frame or TDLS Setup Response frame to indicate that it has a pending transmission for the STA.

The More Data subfield is 1 in individually addressed frames transmitted by a mesh STA to a peer mesh STA that is either in light sleep mode or in deep sleep mode for the corresponding mesh peering, when additional BUs remain to be transmitted to this peer mesh STA.

The More Data subfield is set to 1 in individually addressed frames transmitted by a VHT AP to a VHT STA when both support the VHT TXOP power save feature (as determined from their VHT Capabilities elements) to indicate that at least one additional buffered BU is present for the STA. See 11.2.2.19.

A non-DMG and non-S1G STA sets the More Data subfield to 0 in all other individually addressed frames.

A non-DMG and non-S1G STA sets the More Data subfield to 1 in non-GCR-SP group addressed frames transmitted by the AP when additional group addressed bufferable units (BUs) that are not part of an active GCR-SP remain to be transmitted by the AP during this beacon interval. The More Data subfield is set to 0 in non-GCRSP group addressed frames transmitted by the AP when no more group addressed BUs that are not part of an active GCR-SP remain to be transmitted by the AP during this beacon interval and in all group addressed frames transmitted by non-AP STAs.

An S1G STA sets the More Data subfield to 1 in individually addressed frames to indicate that the S1G STA has MSDUs, MMPDU or A-MSDUs buffered for transmission to the frame's recipient during the current SP or TXOP. An S1G STA does not set the More Data subfield to 1 in individually addressed frames if it does not have any MSDUs, MMPDU or A-MSDUs buffered for transmission to the frame's recipient during the current SP or TXOP.

An S1G AP sets the More Data subfield to 1 in group addressed frames when additional group addressed BUs remain to be transmitted by the AP during this beacon interval or short beacon interval (see 11.1.3.10.2). The S1G AP sets the More Data subfield to 0 in group addressed frames transmitted by the AP when no more group addressed BUs remain to be transmitted by the AP during this beacon interval or short beacon interval.

The More Data subfield is set to 1 in GCR-SP group addressed frames transmitted by the AP when additional group addressed BUs that are part of an active GCR-SP remain to be transmitted by the AP during this GCR-SP. The More Data subfield is set to 0 in GCR-SP group addressed frames transmitted by the AP when no more group addressed BUs that are part of an active GCR-SP remain to be transmitted by the AP during this GCR-SP.

The More Data subfield is 1 in group addressed frames transmitted by a mesh STA when additional group addressed BUs remain to be transmitted. The More Data subfield is 0 in group addressed frames transmitted by a mesh STA when no more group addressed BUs remain to be transmitted.

A DMG STA sets the More Data subfield as follows:

— In individually addressed frames, it is set to 1 to indicate that the STA has MSDUs or A-MSDUs buffered for transmission to the frame's recipient during the current SP or TXOP.
— It is set to 1 in group addressed frames transmitted by the AP when additional group addressed BUs remain to be transmitted by the AP during this beacon interval. The More Data subfield is set to 0 in group addressed frames transmitted by the AP when no more group addressed BUs remain to be transmitted by the AP during this beacon interval.

A DMG STA does not set the More Data bit to 1 if it does not have any MSDUs or A-MSDUs buffered for transmission to the frame's recipient during the current SP or TXOP.

9.2.4.1.10 +HTC/Order subfield

Change 9.2.4.1.10 as follows:

The +HTC/Order subfield is 1 bit in length. ~~It is used for two purposes~~ The setting of the Order subfield is as follows:

— It is set to 1 in a non-QoS Data frame transmitted by a non-QoS STA to indicate that the frame contains an MSDU, or fragment thereof, that is being transferred using the StrictlyOrdered service class.
— It is set to 1 in a QoS Data or Management frame transmitted with a value of HT_GF, HT_MF, ~~or~~ VHT, or S1G for the FORMAT parameter of the TXVECTOR to indicate that the frame contains an HT Control field.
— It is set to 1 in an RTS frame transmitted with a value of S1G for the FORMAT parameter of the TXVECTOR to indicate that the intended recipient of the frame has permission to extend the TXOP as described in 10.50.5.4.

Otherwise, the +HTC/Order subfield is set to 0.

NOTE—The +HTC/Order subfield is always set to 0 for frames transmitted by a DMG STA.

Insert the following subclauses (9.2.4.1.11 through 9.2.4.1.20, including Table 9-4a through Table 9-4d) after 9.2.4.1.10:

9.2.4.1.11 Bandwidth Indication and Dynamic Indication subfields

The Bandwidth Indication subfield identifies the bandwidth of the PPDU. The Bandwidth Indication and Dynamic Indication subfields are used to negotiate the bandwidth of PPDUs within a TXOP. Table 9-4a defines the bandwidth used for exchanging PPDUs between a TXOP holder and a TXOP responder.

Table 9-4a—Bandwidth Indication subfield encoding

Bandwidth Indication encoding	Meaning
0	1 MHz
1	2 MHz
2	4 MHz
3	8 MHz
4	16 MHz
5–7	Reserved

Table 9-4b indicates whether the bandwidth used for exchanging PPDUs in a TXOP is static or can change dynamically.

Table 9-4b—Dynamic Indication subfield encoding

Dynamic Indication encoding	Meaning
0	Static
1	Dynamic

9.2.4.1.12 Next TWT Info Present subfield

The Next TWT Info Present subfield is set to 1 if the Next TWT Info/Suspend Duration field is present in the frame. Otherwise, it is set to 0.

9.2.4.1.13 Flow Control subfield

The Flow Control subfield is used for flow suspension signaling as described in 10.57.

9.2.4.1.14 Poll Type subfield

The Poll Type subfield is defined in Table 9-4c if the Power Management subfield is 1 in PS-Poll frame. Otherwise, the Poll Type subfield is reserved.

Table 9-4c—Poll Type subfield encoding

Poll Type subfield	Description
0	Request for a buffered frame without a request to reschedule the awake/doze cycle
1	Request for the information of change sequence of the beacon and partial timestamp
2	Request for a duration to a TBTT or Next TWT to reschedule awake/doze cycle
3	Request for a duration to a service period to reschedule awake/doze cycle

9.2.4.1.15 Next TBTT Present subfield

The Next TBTT Present subfield is set to 1 if the Next TBTT field is present; otherwise, it is set to 0.

9.2.4.1.16 Compressed SSID Present subfield

The Compressed SSID Present subfield is set to 1 if the Compressed SSID field is present; otherwise, it is set to 0.

9.2.4.1.17 ANO Present subfield

The ANO Present subfield is set to 1 if the Access Network Options field is present; otherwise, it is set to 0.

9.2.4.1.18 BSS BW subfield

The BSS BW subfield indicates the minimum and the maximum operating bandwidths of the BSS as defined in Table 9-4d.

Table 9-4d—Frame Control field BSS BW setting

BSS BW	Minimum BSS BW (MHz)	Maximum BSS BW (MHz)
0	1	2
1	Equal to the BW of the PPDU carrying the BSS BW field	Equal to the BW of the PPDU carrying the BSS BW field
2	1	4
3	2	4
4	1	8
5	2	8
6	1	16
7	2	16

9.2.4.1.19 Security subfield

The Security subfield is set to 1 if the AP is an RSNA AP.

9.2.4.1.20 AP-PM subfield

The AP-PM subfield indicates whether the AP can go to Power Save mode until the next TBTT or TSBTT. If the AP-PM subfield is equal to 1, the AP can go to Power Save mode until the next TBTT or TSBTT unless otherwise is indicated by restricted access windows (RAWs) or TWTs. If the AP-PM subfield is equal to 0, the AP does not go to Power Save mode until the next TBTT or TSBTT.

9.2.4.2 Duration/ID field

Change the following list item of 9.2.4.2 as shown:

a) In Control frames of subtype PS-Poll other than PS-Poll+BDT frames, the Duration/ID field carries the association identifier (AID) of the STA that transmitted the frame in the 14 least significant bits (LSB), and the 2 most significant bits (MSB) both set to 1.

Change Table 9-5 as follows:

Table 9-5—Duration/ID field encoding

Bits 0–13	Bit 14	Bit 15	Usage
0–32 767		0	Duration value (in microseconds) within all frames except: — PS-Poll frames that are not PS-Poll+BDT, transmitted during the CP — frames transmitted during the CFP using the HCF
0	0	1	Fixed value under point coordination function (PCF) within frames transmitted during the CFP.
1–16 383	0	1	Reserved
0	1	1	~~Reserved~~ AID 0 is used for broadcast transmission in S1G PPDU, reserved if not in S1G PPDU
1–2007	1	1	AID in PS-Poll frames other than PS-Poll+BDT.
2008–8191	1	1	Additional AIDs in S1G PS-Poll frames other than PS-Poll+BDT. Reserved if not in S1G PS-Poll frames
~~2008~~ 8192–16 383	1	1	Reserved

9.2.4.5 QoS Control field

9.2.4.5.4 Ack Policy subfield

Change the following row in Table 9-9 as shown:

Table 9-9—Ack Policy subfield in QoS Control field of QoS Data frames

Bits in QoS Control field		Meaning
Bit 5	Bit 6	
0	0	Normal Ack or Implicit Block Ack Request. In a frame that is a non-A-MPDU frame or ~~VHT single~~ S-MPDU where either the originator or the addressed recipient does not support fragment BA procedure: The addressed recipient returns an Ack or QoS +CF-Ack frame after a short interframe space (SIFS) period, according to the procedures defined in 10.3.2.9 and 10.22.3.5. A non-DMG STA sets the Ack Policy subfield for individually addressed QoS Null (no data) frames to this value. In a non-A-MPDU frame or S-MPDU containing a fragment where both the originator and the addressed recipient support the fragment BA procedure: The addressed recipient returns an NDP BlockAck frame after a SIFS, according to the procedure defined in 10.3.2.9a. Otherwise: The addressed recipient returns a BlockAck frame, either individually or as part of an A-MPDU starting a SIFS after the PPDU carrying the frame, according to the procedures defined in 10.3.2.9, , 10.24.8.3, 10.28.3, 10.28.4, and 10.32.3.

9.2.4.6 HT Control field

9.2.4.6.3 VHT variant

Change the fourth paragraph of 9.2.4.6.3 as follows (Figure 9-15 remains unchanged):

In a non-S1G STA, t~~T~~he format of the MFB subfield in the VHT variant HT Control field is shown in Figure 9-15.

Insert the following paragraph and Figure 9-15a after the fourth paragraph of 9.2.4.6.3:

In an S1G STA, the format of the MFB subfield in the VHT variant HT Control field is shown in Figure 9-15a.

	B9 B10	B11 B14	B15 B17	B18 B23
	NUM_STS	VHT-MCS	BW	SNR
Bits:	2	4	3	6

Figure 9-15a—MFB subfield in the VHT variant HT Control field when carried in S1G PPDU

Change the following row in Table 9-18 as shown:

Table 9-18—MFB subfield in the VHT variant HT Control field

Subfield	Meaning	Definition
BW	Bandwidth of the recommended VHT-MCS or S1G-MCS	If the Unsolicited MFB subfield is 1, the BW subfield indicates the bandwidth for which the recommended VHT-MCS or S1G-MCS is intended, as defined in 10.31.3: For a VHT STA: Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz. For a TVHT STA: Set to 0 for TVHT_W Set to 1 for TVHT_2W and TVHT_W+W Set to 2 for TVHT_4W and TVHT_2W+2W The value 3 is reserved. In an S1G STA: Set to 0 for 1 MHz Set to 1 for 2 MHz Set to 2 for 4 MHz Set to 3 for 8 MHz. Set to 4 for 16 MHz. The values 5 to 7 are reserved. If the Unsolicited MFB subfield is 0, the BW subfield is reserved.

9.2.4.7 Frame Body field

9.2.4.7.1 General

Change 9.2.4.7.1 as follows:

The Frame Body is a variable-length field that contains information specific to individual frame types and subtypes. The minimum length of the frame body is 0 octets. The maximum length of the frame body is constrained or affected by the following:

- The maximum MMPDU, MSDU, A-MSDU, and MPDU sizes supported by the recipient(s) for the PPDU format in use, as specified in Table 9-19
- The maximum PPDU duration (e.g., HT_MF L-SIG L_LENGTH, HT_GF, VHT, TVHT, S1G or DMG aPPDUMaxTime (see Table 9-19); any nonzero TXOP limit; any regulatory constraints (e.g., CS4-msBehavior)
- The fields present in the MAC header (e.g., QoS Control, Address 4, HT Control)
- The presence of security encapsulation (e.g., TKIP, CCMP or GCMP Header and MIC)
- The presence of Mesh Control fields (see 9.2.4.7.3)

NOTE 1—In an A-MSDU, the Mesh Control field is located in the A-MSDU Subframe Header (see Figure 9-56). In an MMPDU, the Mesh Control field is located within the MMPDU (see 9.6.18). Such Mesh Control fields need to be taken into account if a maximum A-MSDU or MMPDU size constraint applies as well as if a maximum MPDU size constraint applies.

NOTE 2—TKIP is not allowed with A-MSDUs (see 12.2.6) or MMPDUs (see 12.5.4.1) and, therefore, need not be taken into account if a maximum A-MSDU or MMPDU size constraint applies.

Table 9-19—Maximum data unit sizes (in octets) and durations (in microseconds)

	Non-HT non-VHT non-S1G non-DMG PPDU and non-HT duplicate PPDU	HT PPDU	VHT PPDU	S1G PPDU	DMG PPDU
MMPDU size	2304	2304	See NOTE 1	See NOTE 1	2304
MSDU size	2304	2304	2304	2304	7920
A-MSDU size	3839 or 4065 (see NOTE 2) (HT STA, see also Table 9-162) or N/A (non-HT STA, see also 10.12)	3839 or 7935 (see also Table 9-162)	See NOTE 3	See NOTE 3	7935
MPDU size	See NOTE 4	See NOTE 5	3895 or 7991 or 11 454 (see also Table 9-249)	3895 or 7991 (see also Table 9-262n)	See NOTE 5
PSDU size (see NOTE 7)	$2^{12}–1$ (see Table 15-5, Table 16-4, Table 17-21, Table 18-5)	$2^{16}–1$ (see Table 19-25)	4 692 480 ($\sim 2^{22.16}$) (see Table 21-29)	797 160 ($\sim 2^{19.60}$) (see Table 23-37)	$2^{18}–1$ (see Table 20-32)

Table 9-19—Maximum data unit sizes (in octets) and durations (in microseconds) *(continued)*

	Non-HT non-VHT non-S1G non-DMG PPDU and non-HT duplicate PPDU	HT PPDU	VHT PPDU	S1G PPDU	DMG PPDU
PPDU duration (see NOTE 7)	See NOTE 6	5484 (HT_MF; see 10.26.4) or 10 000 (HT_GF; see Table 19-25)	5484 (see Table 21-29)	27 840 (see Table 23-37)	2000 (see Table 20-32)

NOTE 1—No direct constraint on the maximum MMPDU size; indirectly constrained by the maximum MPDU size (see 9.3.3.1).

NOTE 2—Indirect constraint from the maximum PSDU size: $2^{12}-1$ octets minus the minimum QoS Data frame overhead (26 octets for the MAC header and 4 octets for the FCS).

NOTE 3—No direct constraint on the maximum A-MSDU size; indirectly constrained by the maximum MPDU size.

NOTE 4—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum MSDU/MMPDU or (for HT STAs only) A-MSDU size.

NOTE 5—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum A-MSDU size.

NOTE 6—No direct constraint on the maximum duration, but an L_LENGTH value above 2332 might not be supported by some receivers (see last NOTE in 10.26.4).

NOTE 7—The values for maximum PSDU size and maximum PPDU duration are informative only. References to the normative requirements are provided.

9.2.5 Duration/ID field (QoS STA)

9.2.5.1 General

Insert the following paragraphs at the end of 9.2.5.1:

The value in the Duration field of NDP Ack, and NDP CTS frames transmitted by an S1G STA is defined in 9.2.5.7. Setting the value in the Duration field is additionally constrained by the same rules that apply to the value of the Duration/ID field of Ack, and CTS frames as described in 9.2.5.2 and 9.2.5.8.

The value in the Duration field for NDP_1M Ack, NDP_1M CTS and NDP_1M CF-End frames are calculated in multiples of 40 µs. If a calculated duration is not a multiple of 40 µs, the value inserted in the Duration field is rounded up to the next higher integer so that the contained duration is a multiple of 40 µs. If a calculated duration results in a negative value, the Duration field is 0.

The value in the Duration field for NDP_2M Ack, NDP_2M PS-Poll-Ack, NDP_2M CTS, and NDP_2M CF-End frames are calculated in microseconds. If a calculated duration includes a fractional microsecond, the value inserted in the Duration field is rounded up to the next higher integer. If a calculated duration results in a negative value, the Duration field is 0.

9.2.5.2 Setting for single and multiple protection under enhanced distributed channel access (EDCA)

Change the second paragraph of 9.2.5.2 as follows:

The STA selects between single and multiple protection when it transmits the first frame of a TXOP. All subsequent frames transmitted by the STA in the same TXOP use the same class of duration settings. A STA always uses multiple protection in a TXOP that includes:

- Frames that have the RDG/More PPDU subfield equal to 1
- PSMP frames
- VHT NDP Announcement frames or Beamforming Report Poll frames
- S1G Beacon frames
- Frames transmitted by an S1G STA with the TXVECTOR parameter RESPONSE INDICATION equal to Long Response

Insert the following paragraph after the second paragraph of 9.2.5.2:

For S1G STAs, Duration/ID field determination rules are further specified in 10.3.2.14.

Change the following list items of 9.2.5.2 as shown:

a) Single protection settings.
   1) In an RTS frame that is not part of a dual clear-to-send (CTS) exchange and is not part of a BDT exchange, the Duration/ID field is set to the estimated time, in microseconds, required to transmit the pending frame, plus one CTS frame, plus one Ack or BlockAck frame if required, plus any NDPs required, plus explicit feedback if required, plus applicable IFSs.
b) Multiple protection settings. The Duration/ID field is set to a value D as follows:
   4) Else $T_{END-NAV} - T_{PPDU} \le D \le T_{TXOP-REMAINING} - T_{PPDU}$

   where

$T_{SINGLE\text{-}MSDU}$	is the estimated time required for the transmission of the allowed frame exchange sequence defined in 10.22.2.8 (for a TXOP limit of 0), including applicable IFS durations
$T_{PENDING}$	is the estimated time required for the transmission of — Pending MPDUs of the same AC — Any associated immediate response frames — Any HT NDP, VHT NDP, or Beamforming Report Poll frame transmissions and explicit feedback response frames — Applicable IFSs — Any RDG — Any BDT — Any pending QoS Null frame exchanges by paged STAs — Any pending PS-Poll or NDP PS-Poll frame exchanges by paged STAs
T_{TXOP}	is the duration given by dot11EDCATableTXOPLimit (dot11QAPEDCATableTXOPLimit for the AP) for that AC
$T_{TXOP\text{-}REMAINING}$	is T_{TXOP} less the time already used time within the TXOP
$T_{END\text{-}NAV}$	is the remaining duration of any NAV set by the TXOP holder, or 0 if no NAV has been established
T_{PPDU}	is the time required for transmission of the current PPDU

Insert the following paragraphs at the end of 9.2.5.2:

In a PS-Poll+BDT frame or an RTS frame generated by an S1G STA as part of a BDT exchange the Duration/ID field is determined as follows:

— In a PS-Poll+BDT frame, the Duration/ID field is set to the estimated time required for the transmission of one Ack frame, plus the estimated time required for the transmission of its following MPDUs and their responses if required, plus applicable IFS durations.
— In an RTS frame that is sent as a response to the PS-Poll+BDT frame, the Duration/ID field is set to a value D: min ($T_{END\text{-}NAV} + T_{PENDING} - T_{PPDU}$; $T_{TXOP\text{-}REMAINING} - T_{PPDU}$) $<= D <= T_{TXOP\text{-}REMAINING} - T_{PPDU}$.

In any frame that includes a Duration/ID field, transmitted by an S1G STA as a response to PV1 frames that are not part of a BDT exchange, the Duration/ID field of the frame is set to 0. For any frame transmitted by a BDT initiator that is the TXOP holder as a response to PV1 frames, the Duration/ID field of the frame is set to the value of the TXNAV timer minus the estimated time required to transmit the frame. In any frame transmitted by a BDT initiator that is not the TXOP holder as a response to PV1 frames, the Duration/ID field of the frame is set to the remaining duration of the TXOP.

9.2.5.7 Setting for control response frames

Insert the following paragraphs at the end of 9.2.5.7:

In an NDP CTS frame transmitted in response to an RTS frame, the Duration field is set to the value obtained from the Duration/ID field of the RTS frame that elicited the response minus the time, in microseconds, between the end of the PPDU carrying the RTS frame and the end of the NDP CTS frame except as described in 10.50.5.4.

In an NDP Ack frame with the Idle Indication field equal to 0, the Duration field is set to the value obtained from the Duration/ID field of the frame that elicited the response minus the time, in microseconds, between the end of the PPDU carrying the frame that elicited the response and the end of the NDP Ack frame except when the eliciting frame is a PS-Poll frame in which case the Duration field can be set as described in 10.3.2.14.

In an NDP Ack frame with the Idle Indication field equal to 1, the Duration field is set to the value of the duration of time, in milliseconds, during which an idle period is expected from the STA that elicited the response, starting from the end of NDP Ack frame response.

In a TACK frame, the Duration/ID field is set to the value obtained from the Duration/ID field of the frame that elicited the response minus the time, in microseconds, between the end of the PPDU carrying the frame that elicited the response and the end of the PPDU carrying the TACK frame.

9.3 Format of individual frame types

9.3.1 Control frames

9.3.1.1 Format of Control frames

Change the second paragraph of 9.3.1.1 and the title of Table 9-19 as follows:

The subfields within the Frame Control field of Control frames <u>carried in a non-S1G PPDU</u> are set as illustrated in Figure 9-19.

Figure 9-19—Frame Control field subfield values within Control frames <u>carried in a non-S1G PPDU</u>

Insert the following paragraphs and Figure 9-15a through Figure 9-15c at the end of 9.3.1.1:

In an S1G Control frame, when the Subtype subfield is not equal to 3 and not equal to 10, the format of the Frame Control field is illustrated in Figure 9-19a.

	B0 B1	B2 B3	B4 B7	B8 B10	B11	B12	B13	B14	B15
	Protocol Version	Type	Subtype	Bandwidth Indication	Dynamic Indication	Power Manage-ment	More Data	Protected Frame	+HTC/ Order
Bits:	2	2	4	3	1	1	1	1	1

Figure 9-19a—Frame Control field in S1G Control frames when Subtype is not equal to 3 and not equal to 10

In an S1G Control frame, when the Subtype subfield is equal to 3, the format of the Frame Control field is illustrated in Figure 9-19b.

	B0 B1	B2 B3	B4 B7	B8 B10	B11	B12	B13	B14	B15
	Protocol Version	Type	Subtype	Bandwidth Indication	Dynamic Indication	Power Management	More Data	Flow Control	Next TWT Info Present
Bits:	2	2	4	3	1	1	1	1	1

Figure 9-19b—Frame Control field in S1G Control frame when Subtype subfield is equal to 3

In an S1G Control frame, when the Subtype subfield is equal to 10, the format of the Frame Control field is illustrated in Figure 9-19c.

	B0 B1	B2 B3	B4 B7	B8 B10	B11	B12	B13	B14 B15
	Protocol Version	Type	Subtype	Bandwidth Indication	Dynamic Indication	Power Management	More Data	Poll Type
Bits:	2	2	4	3	1	1	1	2

Figure 9-19c—Frame Control field in S1G Control frames when Subtype subfield is equal to 10

9.3.1.5 PS-Poll frame format

Insert the following subclause title after the subclause title for 9.3.1.5:

9.3.1.5.1 General

Change 9.3.1.5.1 as follows:

The frame format for the PS-Poll frame is as defined in Figure 9-23.

Octets:	2	2	6	6	4
	Frame Control	Duration/ID	BSSID (RA)	TA	FCS

MAC header

Figure 9-23—PS-Poll frame

The BSSID (RA) field is set to the address of the STA contained in the AP. The TA field is the address of the STA transmitting the frame or a bandwidth signaling TA. In a PS-Poll frame transmitted by a VHT STA in a non-HT or non-HT duplicate format and where the scrambling sequence carries the TXVECTOR parameter CH_BANDWIDTH_IN_NON_HT, the TA field value is a bandwidth signaling TA.

The Duration/ID field contains the AID value assigned to the STA transmitting the frame by the AP in the (Re)Association Response frame that established that STA's current association, with the two MSBs set to 1.

Insert the following subclause (9.3.1.5.2) after 9.3.1.5.1:

9.3.1.5.2 BDT variant of the PS-Poll frame format

A PS-Poll frame with the Duration/ID field that contains a duration value as described in 9.2.5 is a BDT variant of the PS-Poll frame and is referred to as PS-Poll+BDT frame.

The Poll Type field in the Frame Control field of the PS-Poll+BDT frame is set to 0.

Bit 15 of the Duration/ID field of a PS-Poll+BDT frame is set to 0.

A non-S1G STA does not transmit PS-Poll+BDT frames.

9.3.1.6 CF-End frame format

Change the second paragraph of 9.3.1.6 as follows:

When transmitted by a non-DMG and non-S1G STA, the Duration field is set to 0. When transmitted by a DMG STA, the Duration field is set to the time required to complete the CF-End truncation sequence of which it is part (see 10.36.8): Duration = (i – 1) × (TXTIME(CF-End) + SIFS), where i is in the range 1 to 3 and indicates the order of the CF-End frame in the truncation sequence in the reverse direction (i.e., i=1 corresponds to the last CF-End frame in the sequence). When transmitted by an S1G STA, the Duration field is set to either 0 or a truncated time as described in 10.22.2.9.

9.3.1.20 VHT NDP Announcement frame format

Change the title of Figure 9-51 as follows:

Figure 9-51—STA Info field in a non-S1G STA

Insert the following paragraph and Figure 9-51a at the end of 9.3.1.20:

If the NDP Announcement frame is transmitted by an S1G STA, the format of the STA Info field is shown in Figure 9-51a. The Feedback Type and Nc Index subfields are defined in Table 9-25, wherein the Nc Index field does not indicate a value that is more than 4. The AID13 subfield contains the least significant bits of the AID of the STA that could process the following S1G NDP and prepare sounding feedback. The AID13 subfield is equal to 0 if the STA is an AP or is in an IBSS.

	B0 B12	B13	B14 B15
	AID13	Feedback Type	Nc Index
Bits:	13	1	2

Figure 9-51a—STA Info field in an S1G STA

Insert the following subclause (9.3.1.22, including Figure 9-52a and Figure 9-52b) after 9.3.1.21:

9.3.1.22 TACK frame format

The frame format of the TACK frame is defined in Figure 9-52a.

	Frame Control	Duration	RA	TA	Beacon Sequence	Pentapartial Timestamp	Next TWT Info/ Suspend Duration (optional)	FCS
Octets:	2	2	6	6	1	5	0 or 6	4

Figure 9-52a—TACK frame format

The Frame Control field is defined in 9.2.4.1 and is illustrated in Figure 9-19b.

The Duration field is described in 9.2.5.7.

The RA field contains the address of the intended recipient of the frame.

The TA field contains the address of the transmitter sending the frame.

The Beacon Sequence field contains the value of the Change Sequence field from the most recently transmitted S1G Beacon frame.

The Pentapartial Timestamp field contains the least significant 5 octets of the TSF timer value of the transmitting STA at the time that the data symbol containing the first bit of the Pentapartial Timestamp field is transmitted to the PHY plus the transmitting STA's delays through the local PHY from the MAC-PHY interface to its interface with the WM.

The format for the optional Next TWT Info/Suspend Duration field is defined in Figure 9-52b.

	B0 B44	B45 B47
	Next TWT	TWT Flow Identifier
Bits:	45	3

Figure 9-52b—Next TWT Info/Suspend Duration field format

If the Next TWT Info Present field of the Frame Control field is equal to 1 and the Flow Control field of the Frame Control field is equal to 0, then the Next TWT Info/Suspend Duration field is present and contains the value of the 45 MSBs of the lowest 6 octets of the TSF timer corresponding to the next scheduled TWT SP for the TWT agreement identified by the TWT Flow Identifier subfield for the STA that is the intended recipient of the frame.

If the Next TWT Info Present field of the Frame Control field is equal to 1 and the Flow Control field of the Frame Control field is equal to 0 and the Next TWT Info/Suspend Duration subfield is equal to all 0s, the transmitter does not currently have a Next TWT value available for transmission for the TWT agreement identified by the TWT Flow Identifier subfield for the STA that is the intended recipient of the frame.

If the Next TWT Info Present field of the Frame Control field is equal to 1 and the Flow Control field of the Frame Control field is equal to 1, then the Next TWT Info/Suspend Duration field is present and contains a flow suspension duration in microseconds during which the intended recipient TWT STA is not allowed to transmit data frames to the STA identified by the TA field of the TACK frame.

If the Next TWT Info Present field is equal to 0 in the Frame Control field, the Next TWT Info/Suspend Duration field is not present in the TACK frame.

9.3.2 Data frames

9.3.2.1 Format of Data frames

Change Table 9-26 as follows:

Table 9-26—Address field contents

To DS	From DS	Address 1	Address 2	Address 3: MSDU and Short A-MSDU case	Address 3: Basic A-MSDU and Dynamic A-MSDU case	Address 4: MSDU and Short A-MSDU case	Address 4: Basic A-MSDU and Dynamic A-MSDU case
0	0	RA = DA	TA = SA	BSSID	BSSID	N/A	N/A
0	1	RA ~~= DA~~ (see NOTE 1)	TA = BSSID	SA	BSSID	N/A	N/A
1	0	RA = BSSID	TA ~~= SA~~ (see NOTE 2)	DA	BSSID	N/A	N/A
1	1	RA	TA	DA	BSSID	SA	BSSID

NOTE 1—Address 1 field of a frame with To DS equal to 0 and From DS equal to 1 is equal to the DA, except when an individually addressed A-MSDU frame is used in DMS and S1G relay, in which case, the destination address of the frame is included in the DA field of the A-MSDU subframe (see 11.24.16 and 10.50).

NOTE 2—Address 2 field of a frame with To DS equal to 1 and From DS equal to 0 is equal to the SA, except when an individually addressed A-MSDU frame is used in S1G relay, in which case, the source address of the frame is included in the SA field of the A-MSDU subframe (see 10.50).

9.3.2.2 Aggregate MSDU (A-MSDU) format

9.3.2.2.1 General

Change the text of 9.3.2.2.1 as follows (Figure 9-54 remains unchanged):

An A-MSDU is a sequence of A-MSDU subframes as shown in Figure 9-54. Each A-MSDU subframe consists of an A-MSDU subframe header followed by an MSDU and 0 to 3 octets of padding as shown in Figure 9-55 (in 9.3.2.2.2),~~ and~~ Figure 9-57 (in 9.3.2.2.3), and Figure 9-57a (in 9.3.2.2.4).

Three ~~Two~~ A-MSDU subframe formats are defined: the Basic A-MSDU subframe described in 9.3.2.2.2, ~~and~~ the Short A-MSDU subframe described in 9.3.2.2.3, and the Dynamic A-MSDU subframe described in 9.3.2.2.4. Unless otherwise noted, in this standard, the term *A-MSDU* applies to ~~both~~ any of the Basic A-MSDU,~~ and~~ the Short A-MSDU, and the Dynamic A-MSDU. The Basic A-MSDU uses only the Basic A-MSDU subframe format, ~~while~~ the Short A-MSDU uses only the Short A-MSDU subframe format, and the Dynamic A-MSDU uses only the Dynamic A-MSDU subframe format.

Insert the following subclause (9.3.2.2.4, including Figure 9-57a and Figure 9-57b) after 9.3.2.2.3:

9.3.2.2.4 Dynamic A-MSDU format

The structure of a Dynamic A-MSDU subframe is shown in Figure 9-57a. In the Dynamic A-MSDU subframe, each A-MSDU subframe (except the last) is padded, so that its length is a multiple of 4 octets. The last A-MSDU subframe has no padding.

Octets:	2	0 or 6	0 or 6	0–2034	0–3
	Subframe Control	DA (Optional)	SA (Optional)	MSDU	Padding

A-MSDU subframe header

Figure 9-57a—Dynamic A-MSDU subframe structure

The A-MSDU subframe header contains the Subframe Control field and optionally the DA and SA fields. A Dynamic A-MSDU subframe has 0, 1, or 2 addresses associated with it, as governed by the Subframe Control field.

The Subframe Control field is defined in Figure 9-57b and contains the Length, DA Present, and SA Present subfields.

	B0 B13	B14	B15
	Length	DA Present	SA Present
Bits:	14	1	1

Figure 9-57b—Subframe Control field

The Length subfield contains the length in octets of the MSDU.

The DA Present field is set to 1 when the DA field is present in the Dynamic A-MSDU subframe header and is set to 0 when the DA field is not present.

The SA Present field is set to 1 when the SA field is present in the Dynamic A-MSDU subframe header and is set to 0 when the SA field is not present.

If present, the DA field of the Dynamic A-MSDU subframe header contains the destination address of the MSDU. When the DA field is not present, the DA of the MSDU is defined by the rules in 10.12.

If present, the SA field of the Dynamic A-MSDU subframe header contains the source address of the MSDU. When the SA field is not present in a Dynamic A-MSDU subframe, the SA is defined by the rules in 10.12.

The MSDU field contains the MSDU that is carried in the Dynamic A-MSDU subframe.

The Padding field contains 0 to 3 octets of padding, so that the length of the Dynamic A-MSDU subframe is a multiple of 4 octets, except for the last Dynamic A-MSDU subframe in a Dynamic A-MSDU, which has no padding.

9.3.3 Management frames

9.3.3.1 Format of Management frames

Change the first paragraph and note in 9.3.3.1 as follows:

The format of a Management frame is defined in Figure 9-58. The Frame Control, Duration, Address 1, Address 2, Address 3, and Sequence Control fields are present in all management frame subtypes. In an MMPDU carried in one or more non-VHT PPDUs the maximum MMPDU size is specified in Table 9-19. In an MMPDU carried in one or more PPDU(s), all of which are VHT <u>or S1G</u> PPDU(s), the maximum MMPDU size specified in Table 9-19 is the maximum MPDU size supported by the recipient(s) less the shortest management frame MAC header and FCS.

NOTE—In an MMPDU carried in one or more PPDUs, all of which are VHT <u>or S1G</u> PPDUs, the presence of encryption overhead (i.e., the MMPDU is transmitted in robust Management frames) or an HT Control field might cause an MMPDU to be fragmented that would not otherwise need to be fragmented.

9.3.3.6 Association Request frame format

Insert the following rows into Table 9-29:

Table 9-29—Association Request frame body

Order	Information	Notes
29	TWT	The TWT element is optionally present if dot11TWTOptionActivated is true; otherwise not present.
30	AID Request	The AID Request element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
31	S1G Capabilities	The S1G Capabilities element is present if dot11S1GOptionImplemented is true; otherwise not present.
32	EL Operation	The EL Operation element is optionally present if dot11S1GELOperationActivated is true; otherwise not present.
33	S1G Relay	The S1G Relay element is present if dot11RelaySTAImplemented is true; otherwise not present.

Table 9-29—Association Request frame body *(continued)*

Order	Information	Notes
34	BSS Max Idle Period	The BSS Max Idle Period element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
35	Header Compression	Header Compression element is present if dot11PV1MACHeaderOptionImplemented is true.
36	MAD	The MAD element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
37	Reachable Address	The Reachable Address element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
38	S1G Relay Activation element	The S1G Relay Activation element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.

9.3.3.7 Association Response frame format

Change the following rows of Table 9-30 as shown:

Table 9-30—Association Response frame body

Order	Information	Notes
3	AID	This field is not present when dot11S1GOptionImplemented is true.
13	Timeout Interval (Association Comeback time)	A Timeout Interval element (TIE) containing the Association Comeback time is present when dot11RSNAActivated is true, dot11RSNAProtectedManagementFramesActivated is true, and either the association request is rejected with a status code REFUSED_TEMPORARILY or the association request is accepted with a status code 0 and when dot11S1GOptionImplemented is true.
19	BSS Max Idle Period	The BSS Max Idle Period element is present if dot11WirelessManagementImplemented is true or optionally present if dot11S1GOptionImplemented is true.

Insert the following rows into Table 9-30:

Table 9-30—Association Response frame body

Order	Information	Notes
37	S1G Sector Operation	The S1G Sector Operation element is optionally present if dot11S1GSectorizationActivated is true; otherwise not present.
38	TWT	The TWT element is present if dot11TWTOptionActivated is true and the TWT element is present in the Association Request frame that elicited this Association Response frame.

Table 9-30—Association Response frame body *(continued)*

Order	Information	Notes
39	TSF Timer Accuracy	The TSF Timer Accuracy element is optionally present when dot11TSFTimerAccuracyImplemented is true; otherwise not present.
41	S1G Capabilities	The S1G Capabilities element is present if dot11S1GOptionImplemented is true; otherwise not present.
42	S1G Operation	The S1G Operation element is present if dot11S1GOptionImplemented is true; otherwise not present.
43	AID Response	The AID Response element is present when dot11S1GOptionImplemented is true.
44	Sectorized Group ID List	The Sectorized Group ID List element is optionally present when dot11S1GSectorizationActivated is true; otherwise not present.
45	S1G Relay	The S1G Relay element is optionally present if dot11RelayAPImplemented is true; otherwise not present.
46	Header Compression	Header Compression element is present if dot11PV1MACHeaderOptionImplemented is true.
47	SST Operation element	The SST Operation element is present if dot11SelectiveSubchannelTransmissionPermitted is true.
48	MAD element	The MAD element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
49	S1G Relay Activation element	The S1G Relay Activation element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.

9.3.3.8 Reassociation Request frame format

Insert the following rows into Table 9-31:

Table 9-31—Reassociation Request frame body

Order	Information	Notes
34	TWT	The TWT element is optionally present if dot11TWTOptionActivated is true; otherwise not present.
35	AID Request	The AID Request element is present when dot11S1GOptionImplemented is true.
36	S1G Capabilities	The S1G Capabilities element is present if dot11S1GOptionImplemented is true; otherwise not present.
37	EL Operation	The EL Operation element is present if dot11S1GELOperationActivated is true.
38	BSS Max Idle Period	The BSS Max Idle Period element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
39	S1G Relay	The S1G Relay element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
40	Header Compression	Header Compression element is present if dot11PV1MACHeaderOptionImplemented is true.

Table 9-31—Reassociation Request frame body *(continued)*

Order	Information	Notes
41	MAD element	The MAD element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
42	Reachable Address	The Reachable Address element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.
43	S1G Relay Activation element	The S1G Relay Activation element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.

9.3.3.9 Reassociation Response frame format

Change the following rows of Table 9-32 as shown:

Table 9-32—Reassociation Response frame body

Order	Information	Notes
3	AID	This field is not present when dot11S1GOptionImplemented is true.
15	Timeout Interval (Association Comeback time)	TIE containing the Association Comeback time is present when dot11RSNAActivated is true, dot11RSNAProtectedManagementFramesActivated is true, and either the reassociation is rejected with status code REFUSED_TEMPORARILY or the reassociation request is accepted with a status code 0 and when dot11S1GOptionImplemented is true.
21	BSS Max Idle Period	The BSS Max Idle Period element is present if dot11WirelessManagementImplemented is true or optionally present if dot11S1GOptionImplemented is true.

Insert the following rows into Table 9-32:

Table 9-32—Reassociation Response frame body

Order	Information	Notes
41	S1G Sector Operation	The S1G Sector Operation element is optionally present if dot11S1GSectorizationActivated is true; otherwise not present.
42	TWT	The TWT element is present if dot11TWTOptionActivated is true and the TWT element is present in the Reassociation Request frame that elicited this Reassociation Response frame.
43	TSF Timer Accuracy	The TSF Timer Accuracy element is optionally present when dot11TSFTimerAccuracyImplemented is true; otherwise not present.
44	S1G Capabilities	The S1G Capabilities element is present if dot11S1GOptionImplemented is true; otherwise not present.
45	S1G Operation	The S1G Operation element is present when dot11S1GOptionImplemented is true; otherwise not present.

Table 9-32—Reassociation Response frame body *(continued)*

Order	Information	Notes
46	AID Response	The AID Response element is present when dot11S1GOptionImplemented is true.
47	Sectorized Group ID List	The Sectorized Group ID List element is optionally present when dot11S1GSectorizationActivated is true; otherwise not present.
48	S1G Relay	The S1G Relay element is optionally present if dot11RelayAPImplemented is true; otherwise not present.
49	Header Compression	Header Compression element is present if dot11PV1MACHeaderOptionImplemented is true.
50	SST Operation element	The SST Operation element is present if dot11SelectiveSubchannelTransmissionPermitted is true.
51	MAD element	The MAD element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
52	S1G Relay Activation element	The S1G Relay Activation element is optionally present if dot11RelaySTAImplemented is true; otherwise not present.

9.3.3.10 Probe Request frame format

Insert the following rows into Table 9-33:

Table 9-33—Probe Request frame body

Order	Information	Notes
22	Change Sequence	The Change Sequence element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
23	S1G Relay Discovery	The S1G Relay Discovery element is optionally present if dot11RelayDiscoveryOptionImplemented is true; otherwise not present.
24	PV1 Probe Response Option	The PV1 Probe Response Option element is optionally present if dot11PV1ProbeResponseOptionImplemented is true; otherwise not present.
25	S1G Capabilities	The S1G Capabilities element is present if dot11S1GOptionImplemented is true; otherwise not present.
26	EL Operation	The EL Operation element is present if dot11S1GELOperationActivated is true.
27	MAD element	The MAD element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.

9.3.3.11 Probe Response frame format

Change the following row of Table 9-34 as shown:

Table 9-34—Probe Response frame body

Order	Information	Notes
62	Channel Switch Wrapper element	The Channel Switch Wrapper element is optionally present if dot11VHTOptionImplemented is true or dot11ExtendedSpectrumManagementImplemented and at least one of a Channel Switch Announcement element or an Extended Channel Switch Announcement element is also present in the Probe Response frame and the Channel Switch Wrapper element contains at least one subelement. <u>The Channel Switch Wrapper element is optionally present if dot11S1GOptionImplemented is true and Extended Channel Switch Announcement element is present in the Probe Response.</u>

Insert the following rows into Table 9-34:

Table 9-34—Probe Response frame body

Order	Information	Notes
74	RPS	The RPS element is optionally present if dot11RAWOperationActivated is true; otherwise not present.
75	Page Slice	The Page Slice element is optionally present if dot11PageSlicingActivated is true; otherwise not present.
76	Change Sequence	The Change Sequence element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
77	TSF Timer Accuracy	The TSF Timer Accuracy element is optionally present when dot11TSFTimerAccuracyImplemented is true; otherwise not present.
78	S1G Relay Discovery	The S1G Relay Discovery element is optionally present if dot11RelayDiscoveryOptionImplemented is true; otherwise not present.
79	S1G Capabilities	The S1G Capabilities element is present if dot11S1GOptionImplemented is true; otherwise not present.
80	S1G Operation	The S1G Operation element is present when dot11S1GOptionImplemented is true; otherwise not present.
81	MAD element	The MAD element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
82	Short Beacon Interval	The Short Beacon Interval element is present if dot11ShortBeaconInterval is true.

Table 9-34—Probe Response frame body *(continued)*

Order	Information	Notes
83	S1G Open-Loop Link Margin Index element	The S1G Open-Loop Link Margin Index element is optionally present if dot11S1GOptionImplemented is true; otherwise not present.
84	S1G Relay element	The S1G Relay element is optionally present if dot11RelayAPImplemented is true; otherwise not present.

9.3.4 Extension frames

Insert the following subclause (9.3.4.3, including Figure 9-63a and Table 9-41a) after 9.3.4.2:

9.3.4.3 S1G Beacon frame format

The format of the S1G Beacon is shown in Figure 9-63a.

	Frame Control	Duration	SA	Time stamp	Change Sequence	Next TBTT (optional)	Compressed SSID (optional)	Access Network Options (optional)	Frame Body	FCS
Octets:	2	2	6	4	1	0 or 3	0 or 4	0 or 1	variable	4

Figure 9-63a—S1G Beacon frame format

The Duration field is set to the duration of time, in microseconds, required by the paged STAs to transmit any pending QoS Null, PS-Poll or NDP PS-Poll frames as specified in 9.2.5.2.

The SA field is the address of the STA transmitting the S1G Beacon frame.

The Timestamp field contains the 4 least significant octets of the transmitting STA's TSF timer at the time that the start of the data symbol, containing the first bit of the Timestamp, is transmitted by the PHY plus the transmitting STA's delays through its local PHY from the MAC-PHY interface to its interface with the WM.

The Change Sequence field is defined as an unsigned integer, initialized to 0, that increments when a critical update to the Beacon frame has occurred (see 10.42.2).

The Next TBTT field is present if the Next TBTT Present field in the Frame Control field is 1 and indicates the most significant 3 octets of the 4 least significant octets of the next TBTT. Otherwise, it is not present.

The Compressed SSID field is present if the Compressed SSID Present field in the Frame Control is 1 and indicates a 32-bit CRC calculated over the SSID contained in the S1G Beacon frame (calculation is performed as defined in 9.2.4.8 where the SSID is the *calculation fields*). Otherwise, it is not present.

The Access Network Options field is present if the ANO field in the Frame Control field is 1 and it is defined in 9.4.2.92 (see Figure 9-440). Otherwise, it is not present.

The Frame Body field contains the optional elements listed in Table 9-41a. The minimum set of optional elements is included in an S1G Beacon frame transmitted at a TSBTT that is not a TBTT and the full set of optional elements is included in an S1G Beacon frame that is transmitted at a TBTT (see 11.1.3.10.1). See 10.27.6 on the parsing of the elements.

Table 9-41a—Minimum and full set of optional elements

Order	Information	Notes	Allowed in minimum set	Allowed in full set
1	S1G Beacon Compatibility	The S1G Beacon Compatibility element is present within S1G Beacon frames generated at TBTTs.	NO	YES
2	Traffic indication map (TIM)	The TIM element is present within S1G Beacon frames generated by APs at TBTTs and is optionally present otherwise.	YES	YES
3	FMS Descriptor	The FMS Descriptor element is present if dot11FMSActivated is true.	YES	YES
4	RPS	The RPS element is optionally present if dot11RAWOperationActivated is true.	YES	YES
5	SST Operation element	The SST Operation element is present if dot11SelectiveSubchannelTransmissionPermitted is true.	NO	YES
6	Subchannel Selective Transmission	The Subchannel Selective Transmission element is optionally present if dot11SubchannelSelectiveTransmissionActivated is true.	YES	YES
7	S1G Relay	The S1G Relay element is optionally present if dot11RelayAPImplemented is true.	YES	YES
8	Page Slice	The Page Slice element is optionally present if dot11PageSlicingActivated is true.	NO	YES
9	S1G Sector Operation	The S1G Sector Operation element is optionally present if dot11S1GSectorizationActivated is true.	NO	YES
10	Authentication Control	The Authentication Control element is optionally present when dot11S1GCentralizedAuthenticationControlActivated is true or dot11S1GDistributedAuthenticationControlActivated is true.	NO	YES
11	TSF Timer Accuracy	The TSF Timer Accuracy element is optionally present when dot11TSFTimerAccuracyImplemented is true.	NO	YES
12	S1G Relay Discovery	The S1G Relay Discovery element is optionally present if dot11RelayDiscoveryOptionImplemented is true.	NO	YES
13	S1G Capabilities	The S1G Capabilities element is present if dot11S1GOptionImplemented is true; otherwise not present.	NO	YES
14	S1G Operation	The S1G Operation element is present when dot11S1GOptionImplemented is true; otherwise not present.	NO	YES

Table 9-41a—Minimum and full set of optional elements *(continued)*

Order	Information	Notes	Allowed in minimum set	Allowed in full set
15	Short Beacon Interval	The Short Beacon Interval element is present if dot11ShortBeaconInterval is true.	NO	YES
Last–1	One or more elements can appear in this frame.	These elements are optionally present and follow all other elements that are not vendor-specific elements and precede all other elements that are vendor-specific elements that are part of the Last field in the frame.	NO	YES
Last	Vendor Specific	One or more vendor-specific elements are optionally present. These elements follow all other elements.	NO	YES

9.4 Management and Extension frame body components

9.4.1 Fields that are not elements

9.4.1.6 Listen Interval field

Change 9.4.1.6 as follows (including inserting Figure 9-71a and Table 9-44a):

The Listen Interval field is used to indicate to the AP how often an S1G STA with dot11NonTIMModeActivated equal to false or a non-S1G STA in power save mode wakes to listen to Beacon frames. It is also used to indicate to an AP the duration during which an S1G STA with dot11NonTIMModeActivated equal to true is required to transmit at least one frame that is addressed to the associated AP. The value of this field is derived from the ListenInterval parameter ~~of the MLME-ASSOCIATE.request or MLME-REASSOCIATE.request~~ when present as a parameter of an MLME primitive~~,~~. The value is in units of ~~B~~beacon ~~I~~interval if dot11ShortBeaconInterval is false and in units of short beacon interval if dot11ShortBeaconInterval is true (see 11.1.3.10.2). The length of the Listen Interval field is 2 octets. The Listen Interval field carried in a non-S1G PPDU is illustrated in Figure 9-71.

NOTE—The value 0 might be used by a STA that never enters power save mode.

	Listen Interval
Octets:	2

Figure 9-71—Listen Interval field carried in a non-S1G PPDU

The Listen Interval field carried in an S1G PPDU is illustrated in Figure 9-71a.

	B0 B13	B14 B15
	Unscaled Interval	Unified Scaling Factor
Bits:	14	2

Figure 9-71a—Listen Interval field carried in an S1G PPDU

In an S1G STA, the value of ListenInterval parameter used by the MLME primitives is equal to the Unscaled Interval subfield multiplied by the scaling factor that corresponds to the value indicated in the Unified Scaling Factor subfield. The Unified Scaling Factor subfield encoding is defined in Table 9-44a.

Table 9-44a—Unified Scaling Factor subfield encoding

Unified Scaling Factor	Scaling factor
0	1
1	10
2	1000
3	10 000

An AP uses the listen interval in determining the lifetime of frames that it buffers for a STA.

9.4.1.8 AID field

Change the second paragraph of 9.4.1.8 as follows:

A non-DMG and non-S1G STA assigns the value of the AID in the range of 1 to 2007; the 5 MSBs of the AID field are reserved. An S1G STA assigns the value of the AID in the range of 1 to 8191; the 3 MSBs of the AID field are reserved.

9.4.1.9 Status Code field

Insert the following rows into Table 9-46:

Table 9-46—Status codes

Status Code	Name	Meaning
108	ENERGY_LIMITED_OPERATION_NOT_SUPPORTED	Re(association) refused or disassociated because energy limited operation is not supported at the AP.
109	REJECTED_NDP_BLOCK_ACK_SUGGESTED	BlockAck negotiation refused because, due to buffer constraints and other unspecified reasons, the recipient prefers to generate only NDP BlockAck frames.
110	REJECTED_MAX_AWAY_DURATION_UNACCEPTABLE	Association denied/disassociated because the suggested value for max away duration is unacceptable.
111	FLOW_CONTROL_OPERATION_SUPPORTED	Re(association) refused or disassociated because flow control operation is not supported by the non-AP STA.

9.4.1.11 Action field

Insert the following rows into Table 9-47:

Table 9-47—Category values

Code	Meaning	See subclause	Robust	Group addressed privacy
22	S1G	9.6.25	No	No
23	S1G Relay	9.6.26	Yes	No
24	Flow control	9.6.27	Yes	No
25	Control Response MCS Negotiation	9.6.28	Yes	No

Insert the following subclause (9.4.1.15a, including Figure 9-80a and Table 9-47a) after 9.4.1.15:

9.4.1.15a Originator Preferred MCS field

The Originator Preferred MCS field is used in ADDBA Response frame to signal the preferred MCS used for eliciting A-MPDUs from the data originator. The length of the Originator Preferred MCS field is 2 octets. The Originator Preferred MCS field is illustrated in Figure 9-80a.

	B0 B11	B12 B15
	Reserved	MCS
Bits:	12	4

Figure 9-80a—Originator Preferred MCS field

The MCS subfield of the Originator Preferred MCS field is defined in Table 9-47a.

Table 9-47a—MCS subfield of the Originator Preferred MCS field

MCS subfield value	S1G-MCS Index	Description
0–10	0–10	The value represents the preferred S1G-MCS level
11–14		Reserved
15		The value represents that the asymmetric BlockAck operation is not supported by either the originator or the intended recipient of the ADDBA Response that contains this value in the MCS subfield of the Originator Preferred MCS field. See 10.24.1 for asymmetric BlockAck operation and 11.5.2.3 on how to set the MCS subfield of the Originator Preferred MCS field in the ADDBA Response.

9.4.1.33 Rate Identification field

Change the original third through tenth paragraphs (including restructuring them into six paragraphs) of 9.4.1.33 as follows:

The MCS Selector field value 0 indicates that the MCS Index field is reserved. The MCS Selector field value 1 indicates the MCS Index field specifies an index value that is taken from Table 19-27 to Table 19-30 and Table 19-36 to Table 19-38 in 19.5.

The MCS Selector field value 2 indicates that the MCS Index field specifies

— ~~an index v~~Values that are~~is~~ taken from Table 19-31 to Table 19-35 and Table 19-40 to Table 19-41 in 19.5, when carried in frames transmitted by a non-S1G STA.
— Values that are taken from Table 23-38 to Table 23-41, indicating an S1G MCS for a 1 MHz channel width, when carried in frames transmitted by an S1G STA.

The MCS Selector field value 3 indicates that the MCS Index field specifies

— ~~v~~Values that are taken from Table 21-30 to Table 21-37, indicating a VHT-MCS for a 20 MHz channel width, when carried in frames transmitted by a non-S1G STA.
— Values that are taken from Table 23-42 to Table 23-45, indicating an S1G MCS for a 2 MHz channel width, when carried in frames transmitted by an S1G STA.

The MCS Selector field value 4 indicates that the MCS Index field specifies

— ~~v~~Values that are taken from Table 21-38 to Table 21-45, indicating a VHT-MCS for a 40 MHz channel width, when carried in frames transmitted by a non-TVHT and non-S1G STA.
— ~~In frames transmitted by a TVHT STA, the MCS Selector field value 4 indicates that the MCS Index field specifies v~~Values that are taken from Table 22-26 to Table 22-29, indicating a TVHT MCS for a TVHT_W channel width, when carried in frames transmitted by a TVHT STA.
— Values that are taken from Table 23-46 to Table 23-49, indicating an S1G MCS for a 4 MHz channel width, when carried in frames transmitted by an S1G STA.

The MCS Selector field value 5 indicates that the MCS Index field specifies

— ~~v~~Values that are taken from Table 21-46 to Table 21-53, indicating a VHT-MCS for an 80 MHz channel width, when carried in frames transmitted by a non-TVHT and non-S1G STA.
— ~~In frames transmitted by a TVHT STA, the MCS Selector field value 5 indicates that the MCS Index field specifies v~~Values that are taken from Table 22-30 to Table 22-33, indicating a TVHT MCS for a TVHT_2W or TVHT_W+W channel width, when carried in frames transmitted by a TVHT STA.
— Values that are taken from Table 23-50 to Table 23-53, indicating an S1G MCS for an 8 MHz channel width, when carried in frames transmitted by an S1G STA.

The MCS Selector field value 6 indicates that the MCS Index field specifies

— ~~v~~Values that are taken from Table 21-54 to Table 21-61, indicating a VHT-MCS for a 160 MHz or 80+80 MHz channel width, when carried in frames transmitted by a non-TVHT and non-S1G STA.
— ~~In frames transmitted by a TVHT STA, the MCS Selector field value 6 indicates that the MCS Index field specifies v~~Values that are taken from Table 22-34 to Table 22-37, indicating a TVHT MCS for a TVHT_4W or TVHT_2W+2W channel width, when carried in frames transmitted by a TVHT STA.
— Values that are taken from Table 23-54 to Table 23-57, indicating an S1G MCS for a 16 MHz channel width, when carried in frames transmitted by an S1G STA.

Change the last two paragraphs of 9.4.1.33 as follows (Figure 9-103 remains unchanged):

If MCS Selector field is 3, 4, 5, or 6, the MCS Index field format is as shown in Figure 9-103. In frames transmitted by an S1G STA, the MCS Index field format is also valid when MCS Selector field is 2. The NSS subfield indicates the number of spatial streams, and the VHT-MCS Index Row subfield indicates a value from the "VHT-MCS Index" column of Table 21-30 to Table 21-61 in 21.5 or from the "MCS Index" column of Table 22-26 to Table 22-37 in 22.5 that corresponds to the channel width and N_{SS} values, or from the "MCS Idx" column of Table 23-38 to Table 23-57 that corresponds to the channel width and N_{SS} values.

For non-S1G STAs, t~~T~~he Rate field contains a 2-octet unsigned integer that specifies the PHY rate in 0.5 Mb/s units. For S1G STAs, it is reserved.

9.4.1.48 VHT MIMO Control field

Change the following rows in Table 9-66 as shown:

Table 9-66—Subfields of the VHT MIMO Control field

Subfield	Description
Nc Index	Indicates the number of columns, *Nc*, in the compressed beamforming feedback matrix minus 1: Set to 0 for *Nc* = 1 Set to 1 for *Nc* = 2 … Set to 7 for *Nc* = 8 In an S1G PPDU, the Nc Index field does not indicate a value that is greater than 4.
Nr Index	Indicates the number of rows, *Nr*, in the compressed beamforming feedback matrix minus 1: Set to 0 for *Nr* = 1 Set to 1 for *Nr* = 2 … Set to 7 for *Nr* = 8 In an S1G PPDU, the Nr Index field does not indicate a value that is greater than 4.
Channel Width	Indicates the width of the channel in which the measurement to create the compressed beamforming feedback matrix was made: In a non-S1G PPDU: Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz or 80+80 MHz In an S1G PPDU: Set to 0 for 2MHz Set to 1 for 4 MHz Set to 2 for 8 MHz Set to 3 for 16 MHz

Table 9-66—Subfields of the VHT MIMO Control field *(continued)*

Subfield	Description
Codebook Information	Indicates the size of codebook entries: If Feedback Type is SU in a VHT PPDU: Set to 0 for 2 bits for ψ, 4 bits for ϕ Set to 1 for 4 bits for ψ, 6 bits for ϕ If Feedback Type is SU in an S1G PPDU with Nc Index field equal to 0: Set to 0 for 2 bits for ϕ, and ψ is not fed back Set to 1 for 2 bits for ψ, and 4 bits for ϕ If Feedback Type is MU in a VHT PPDU: Set to 0 for 5 bits for ψ, 7 bits for ϕ Set to 1 for 7 bits for ψ, 9 bits for ϕ If Feedback Type is MU in an S1G PPDU: Set to 0 for 5 bits for ψ, 7 bits for ϕ Set to 1 for 7 bits for ψ, 9 bits for ϕ

9.4.1.49 VHT Compressed Beamforming Report field

Insert the following subclause title after the subclause title for 9.4.1.49:

9.4.1.49.1 VHT Compressed Beamforming Report field in non-S1G Band

Change the third paragraph of 9.4.1.49.1 as follows:

The VHT Compressed Beamforming Report information contains the channel matrix elements indexed, first, by matrix angles in the order shown in Table 9-67 for a VHT PPDU and, second, by data subcarrier index from lowest frequency to highest frequency. For an S1G PPDU, the matrix angles order and the subcarrier indexes are defined in 9.4.1.49.2. The explanation on how these angles are generated from the beamforming feedback matrix V is given in 19.3.12.3.6. In Table 9-66,

Nc is the number of columns in a compressed beamforming feedback matrix determined by the Nc Index field of the VHT MIMO Control field,

Nr is the number of rows in a compressed beamforming feedback matrix determined by the Nr Index field of the VHT MIMO Control field.

Change the title of Table 9-67 as follows:

Table 9-67—Order of angles in the Compressed Beamforming Matrix subfield in a VHT PPDU

Insert the following subclause (9.4.1.49.2, including Table 9-71a and Table 9-71b) after 9.4.1.49.1:

9.4.1.49.2 VHT Compressed Beamforming Report field in S1G Band

For S1G band, the same VHT Compressed Beamforming Report field is applied in the sounding feedback frame except that:

— The matrix angles order is shown in Table 9-71a and in Table 9-71b, where the Feedback Type is indicated in the STA Info field of the NDP Announcement frame with format shown in Figure 9-51a.

The subcarriers indices corresponding to different tone grouping values (Ng) for 2 MHz, 4 MHz, 8 MHz, and 16 MHz are the same as the values defined for 20 MHz, 40 MHz, 80 MHz, and 160 MHz in Table 9-70, respectively.

Table 9-71a—Order of angles in the Compressed Beamforming Feedback Matrix subfield if the Feedback Type field is SU in an S1G PPDU

Size of *V* (*Nr* × *Nc*)	Codebook Information field	Number of angles (*Na*)	The order of angles in the Compressed Beamforming Feedback Matrix subfield
2×1	0	1	ϕ11
2×1	1	2	ϕ11, ψ21
2×2	0 or 1	2	ϕ11, ψ21
3×1	0	2	ϕ11, ϕ21
3×1	1	4	ϕ11, ϕ21, ψ21, ψ31
3×2	0 or 1	6	ϕ11, ϕ21, ψ21, ψ31, ϕ22, ψ32
3×3	0 or 1	6	ϕ11, ϕ21, ψ21, ψ31, ϕ22, ψ32
4×1	0	3	ϕ11, ϕ21, ϕ31
4×1	1	6	ϕ11, ϕ21, ϕ31, ψ21, ψ31, ψ41
4×2	0 or 1	10	ϕ11, ϕ21, ϕ31, ψ21, ψ31, ψ41, ϕ22, ϕ32, ψ32, ψ42
4×3	0 or 1	12	ϕ11, ϕ21, ϕ31, ψ21, ψ31, ψ41, ϕ22, ϕ32, ψ32, ψ42, ϕ33, ψ43
4×4	0 or 1	12	ϕ11, ϕ21, ϕ31, ψ21, ψ31, ψ41, ϕ22, ϕ32, ψ32, ψ42, ϕ33, ψ43

Table 9-71b—Order of angles in the Compressed Beamforming Feedback Matrix subfield if the Feedback Type field is MU in an S1G PPDU

Size of *V* (*Nr* × *Nc*)	Codebook Information field	Number of angles (*Na*)	The order of angles in the Compressed Beamforming Feedback Matrix subfield
2×1	0 or 1	2	ϕ11, ψ21
2×2	0 or 1	2	ϕ11, ψ21
3×1	0 or 1	4	ϕ11, ϕ21, ψ21, ψ31
3×2	0 or 1	6	ϕ11, ϕ21, ψ21, ψ31, ϕ22, ψ32
3×3	0 or 1	6	ϕ11, ϕ21, ψ21, ψ31, ϕ22, ψ32
4×1	0 or 1	6	ϕ11, ϕ21, ϕ31, ψ21, ψ31, ψ41
4×2	0 or 1	10	ϕ11, ϕ21, ϕ31, ψ21, ψ31, ψ41, ϕ22, ϕ32, ψ32, ψ42
4×3	0 or 1	12	ϕ11, ϕ21, ϕ31, ψ21, ψ31, ψ41, ϕ22, ϕ32, ψ32, ψ42, ϕ33, ψ43
4×4	0 or 1	12	ϕ11, ϕ21, ϕ31, ψ21, ψ31, ψ41, ϕ22, ϕ32, ψ32, ψ42, ϕ33, ψ43

9.4.1.53 Operating Mode field

Change the second paragraph of 9.4.1.53 and the title of Figure 9-118 as follows:

The Operating Mode field for a non-S1G STA is shown in Figure 9-118.

Figure 9-118—Operating Mode field when it is carried in a non-S1G PPDU

Insert the following paragraph and Figure 9-118a after the second paragraph of 9.4.1.53:

The Operating Mode field in an S1G PPDU is shown in Figure 9-118a.

	B0 B2	B3 B4	B5 B6	B7
	Channel Width	Reserved	Rx NSS	Rx NSS Type
Bits:	3	2	2	1

Figure 9-118a—Operating Mode field when it is carried in an S1G PPDU

Change the following rows in Table 9-74 as shown:

Table 9-74—Subfield values of the Operating Mode field

Subfield	Description
Channel Width	If the Rx NSS Type subfield is 0, indicates the supported channel width: In a VHT STA, see Table 9-75. In a TVHT STA: Set to 0 for TVHT_W Set to 1 for TVHT_2W and TVHT_W+W Set to 2 for TVHT_4W and TVHT_2W+2W The value of 3 is reserved. In an S1G STA: Set to 0 for 1 MHz Set to 1 for 2 MHz Set to 2 for 4 MHz Set to 3 for 8 MHz Set to 4 for 16 MHz Reserved for values 5-7 Reserved if the Rx NSS Type subfield is 1.

Table 9-74—Subfield values of the Operating Mode field *(continued)*

Subfield	Description
Rx NSS	If the Rx NSS Type subfield is 0, the value of this field, combined with other information described in 9.4.2.158.3, indicates the maximum number of spatial streams that the STA can receive. If the Rx NSS Type subfield is 1, the value of this field indicates the maximum number of spatial streams that the STA can receive as a beamformee in an SU PPDU using a beamforming steering matrix derived from a VHT Compressed Beamforming report with Feedback Type subfield indicating MU in the corresponding VHT Compressed Beamforming frame sent by the STA. In a non-S1G STA: Set to 0 for $NSS = 1$ Set to 1 for $NSS = 2$ … Set to 7 for $NSS = 8$ In an S1G STA: Set to 0 for $NSS = 1$ Set to 1 for $NSS = 2$ Set to 2 for $NSS = 3$ Set to 3 for $NSS = 4$ NOTE—In a STA with dot11VHTExtendedNSSBWCapable equal to true, NSS might be further modified per Table 9-75.

Insert the following subclauses (9.4.1.58 through 9.4.1.60, including Table 9-76a, Table 9-76b, and Figure 9-121a through Figure 9-121c) after 9.4.1.57:

9.4.1.58 Sync Control field

The Sync Control field is present in the Sync Control frame (see 9.6.25.4). The Sync Control field is shown in Figure 9-121a.

	B0	B1	B2 B7
	Uplink Sync Request	Time Slot Protection Request	Reserved
Bits:	1	1	6

Figure 9-121a— Sync Control field format

The non-AP STA transmitting this field indicates its mode of operation for the sync frame transmission. The subfields of the Sync Control field are defined in Table 9-76a.

Table 9-76a—Subfields of the Sync Control field

Subfield	Definition	Encoding
Uplink Sync Request	This subfield indicates request for sync frame transmission for uplink. (see 10.45.1)	Set to 0 if not requested. Set to 1 if requested.
Time Slot Protection Request	This subfield indicates request for a time slot protection during a time slot in a RAW (9.4.2.192) or during a time duration defined in the Nominal Minimum TWT Wake Duration field for a TWT time (9.4.2.200), or for the duration of a TXOP after the expiration of wakeup timer.	Set to 0 if not requested. Set to 1 if requested.

9.4.1.59 Suspend Duration field

The format of the Suspend Duration field is shown in Figure 9-121b.

	Suspend Duration
Octets:	2

Figure 9-121b—Suspend Duration field format

The Suspend Duration field contains a 16-bit unsigned integer. See 10.57 for the use of this field.

9.4.1.60 TWT Information field

The TWT Information field is present in the TWT Information frame (see 9.6.25.12). The TWT Information field format is shown in Figure 9-121c.

	B0 B2	B3	B4	B5 B6	B7	B8 Bn
	TWT Flow Identifier	Response Requested	Next TWT Request	Next TWT Subfield Size	Reserved	Next TWT
Bits:	3	1	1	2	1	0, 32, 48, or 64

Figure 9-121c—TWT Information field format

The TWT Information field size is variable and depends on the value of the Next TWT Size field.

The TWT Flow Identifier subfield contains the TWT flow identifier for which TWT information is requested or being provided.

The Response Requested subfield indicates whether the transmitter of the frame containing the TWT Information field is requesting a TWT Information frame to be transmitted in response to the receipt of this frame. The Response Requested subfield is set to 0 to request the recipient to not transmit a TWT Information frame in response to the receipt of the frame. The Response Requested subfield is set to 1 to request the recipient to transmit a TWT Information frame in response to the receipt of the frame.

The Next TWT Request subfield is set to 1 to indicate that the TWT Information frame is a request for the delivery of a TWT Information frame containing a nonzero length Next TWT field. Otherwise, it is set to 0.

The Next TWT Subfield Size subfield describes the size of the Next TWT subfield according to Table 9-76b.

Table 9-76b—Next TWT Subfield Size subfield encoding

Next TWT Subfield Size subfield value	Size of the Next TWT subfield in bits
0	0
1	32
2	48
3	64

The Next TWT subfield is of a variable size as determined by the Next TWT Subfield Size subfield value according to Table 9-76b. The value contained in the Next TWT subfield is the least significant portion of the TSF at the next TWT for the TWT specified by the TWT Flow Identifier subfield.

9.4.2 Elements

9.4.2.1 General

Insert the following rows into Table 9-77:

Table 9-77—Element IDs

Element	Element ID	Element ID Extension	Extensible	Fragmentable
S1G Open-Loop Link Margin Index	207	N/A	No	No
RPS	208	N/A	No	No
Page Slice	209	N/A	No	No
AID Request	210	N/A	No	No
AID Response	211	N/A	No	No
S1G Sector Operation	212	N/A	Yes	No
S1G Beacon Compatibility	213	N/A	No	No
Short Beacon Interval	214	N/A	No	No
Change Sequence	215	N/A	No	No
TWT	216	N/A	Yes	No
S1G Capabilities	217	N/A	Yes	No
Subchannel Selective Transmission	220	N/A	No	No

Table 9-77—Element IDs *(continued)*

Element	Element ID	Element ID Extension	Extensible	Fragmentable
Authentication Control	222	N/A	Yes	No
TSF Timer Accuracy	223	N/A	No	No
S1G Relay	224	N/A	Yes	No
Reachable Address	225	N/A	Yes	No
S1G Relay Discovery	226	N/A	No	No
AID Announcement	228	N/A	No	No
PV1 Probe Response Option	229	N/A	No	No
EL Operation	230	N/A	No	No
Sectorized Group ID List	231	N/A	Yes	No
S1G Operation	232	N/A	No	No
Header Compression	233	N/A	Yes	No
SST Operation	234	N/A	No	No
MAD	235	N/A	No	No
S1G Relay Activation	236	N/A	Yes	No

9.4.2.6 TIM element

Insert the following subclause title after the subclause title for 9.4.2.6:

9.4.2.6.1 General

Change the fifth paragraph of 9.4.2.6.1 as follows:

The DTIM Period field indicates the number of beacon intervals or short beacon intervals between successive DTIMs. If all TIMs are DTIMs, the DTIM Period field has the value 1. The DTIM Period value 0 is reserved. The DTIM period field is a single octet. If dot11ShortBeaconInterval is equal to true, the DTIM Period field is set to dot11ShortBeaconDTIMPeriod. If dot11ShortBeaconInterval is equal to false, the DTIM Period field is set to dot11DTIMPeriod (see 11.1.3.10.2).

Change the sixth paragraph of 9.4.2.6.1 as follows:

The Bitmap Control field is a single octet. Bit 0 of the field contains the traffic indication virtual bitmap bit associated with AID 0. This bit is set to 1 in TIM elements with a value of 0 in the DTIM Count field when one or more group addressed MSDUs/MMPDUs are buffered at the AP or the mesh STA and they are not to be delivered using group AID as described in 10.51. When the TIM is carried in a non-S1G PPDU, ~~T~~the remaining 7 bits of the field form the Bitmap Offset as shown in Figure 9-127a. When the TIM is carried in an S1G PPDU, bit 1 to bit 5 of the field form the Page Slice Number subfield, and bit 6 and bit 7 of the field form the Page Index subfield as shown in Figure 9-127b.

Insert Figure 9-127a, Figure 9-127b, and the following paragraphs after the sixth paragraph of 9.4.2.6.1:

	B0	B1 B7
	Traffic Indicator	Bitmap Offset
Bits:	1	7

Figure 9-127a—Bitmap Control field (when TIM is carried in a non-S1G PPDU)

	B0	B1 B5	B6 B7
	Traffic Indicator	Page Slice Number	Page Index
Bits:	1	5	2

Figure 9-127b—Bitmap Control field (when TIM is carried in an S1G PPDU)

The Page Slice Number subfield indicates which page slice is encoded in the Partial Virtual Bitmap field (see 10.47) when the value in the subfield is in the range of 0 to 30. If the value of the Page Slice Number subfield is 31, then the entire page indicated by the Page Index subfield value is encoded in the Partial Virtual Bitmap field of the TIM elements with the same page index.

The Page Index subfield indicates the index of the page encoded in the Partial Virtual Bitmap field.

Change the now ninth paragraph of 9.4.2.6.1 as follows (including inserting Figure 9-127c):

When the TIM is carried in a non-S1G PPDU, ~~T~~the traffic indication virtual bitmap, maintained by the AP or the mesh STA that generates a TIM, consists of 2008 bits, and is organized into 251 octets such that bit number N ($0 \le N \le 2007$) in the bitmap corresponds to bit number (N mod 8) in octet number $\lfloor N / 8 \rfloor$ where the low-order bit of each octet is bit number 0, and the high order bit is bit number 7. When the TIM is carried in an S1G PPDU, the traffic-indication virtual bitmap consists of $64N_PN_B$ bits and is organized into N_P pages where each page consists of N_B blocks, each block consists of eight subblocks, and each subblock consists of 8 bits (N_P=4 and N_B=32). Bit number N in the bitmap corresponds to bit number $N[0{:}2]$ of the $N[3{:}5]$-th subblock of the $N[6{:}5+n_1]$-th block of the $N[6+n_1{:}12]$-th page, where n_1 is $\log_2 N_B$ and N_B is power of 2. $N[a{:}b]$ represents bits a to b inclusive of the bit number N. The hierarchical structure of the traffic-indication virtual bitmap is as shown in Figure 9-127c. Each bit in the traffic-indication virtual bitmap corresponds to traffic buffered for a specific neighbor peer mesh STA within the MBSS that the mesh STA is prepared to deliver or STA within the BSS that the AP is prepared to deliver at the time the Beacon frame is transmitted. Bit number N indicates the status of buffered, either individually addressed MSDUs/MMPDUs for the STA whose AID is N, or group addressed MSDUs/MMPDUs for the STAs whose group AID is N. It is determined as follows:

— If the STA is not using APSD, and any individually addressed MSDUs/MMPDUs for that STA are buffered and the AP or the mesh STA is prepared to deliver them, then bit number N in the traffic indication virtual bitmap is 1.

— If the STA is using APSD, and any individually addressed MSDUs/MMPDUs for that STA are buffered in at least one nondelivery-enabled AC (if there exists at least one nondelivery-enabled AC), then bit number N in the traffic-indication virtual bitmap is 1.

— If the STA is using APSD, all ACs are delivery-enabled, and any individually addressed MSDUs/MMPDUs for that STA are buffered in any AC, then bit number N in the traffic-indication virtual bitmap is 1.

— Otherwise, bit number N in the traffic-indication virtual bitmap is 0.

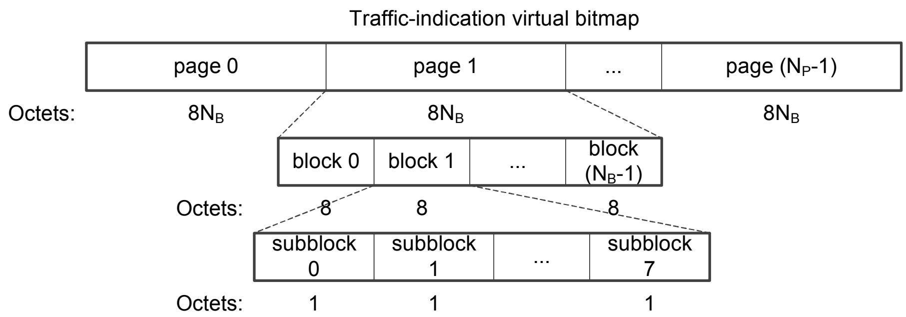


Figure 9-127c—Hierarchical structure of traffic-indication virtual bitmap

Change the now 11th through 15th paragraphs of 9.4.2.6.1 as follows:

When dot11MultiBSSIDActivated is false and the TIM is carried in a non-S1G PPDU, the Partial Virtual Bitmap field consists of octets numbered $N1$ to $N2$ of the traffic indication virtual bitmap, where $N1$ is the largest even number such that bits numbered 1 to $(N1 \times 8) - 1$ in the traffic indication virtual bitmap are all 0 and $N2$ is the smallest number such that bits numbered $(N2 + 1) \times 8$ to 2007 in the traffic indication virtual bitmap are all 0. In this case, the Bitmap Offset subfield value contains the number $N1/2$, and the Length field is set to $(N2 - N1) + 4$.

NOTE—The bit numbered 0 in the traffic indication virtual bitmap need not be included in the Partial Virtual Bitmap field even if that bit is set.

When the TIM is carried in a non-S1G PPDU, ~~I~~in the event that all bits other than bit 0 in the traffic indication virtual bitmap are 0, the Partial Virtual Bitmap field is encoded as a single octet equal to 0, the Bitmap Offset subfield is 0, and the Length field is 4. When the TIM is carried in an S1G PPDU, if all bits in virtual bitmap are 0, the Partial Virtual Bitmap field is not present in the TIM element and the Length field of the TIM element is set to 3. If all bits in the virtual bitmap are 0 and all the bits of the Bitmap Control field are 0, both the Partial Virtual Bitmap field and the Bitmap Control field are not present in the TIM element and the Length field of the TIM element is set to 2.

When dot11MultiBSSIDActivated is true, the Partial Virtual Bitmap field of the TIM element is constructed as follows, where the maximum possible number of BSSIDs is an integer power of 2, n = log2 (maximum possible number of BSSIDs), k is the number of actually supported nontransmitted BSSIDs, and $k \leq (2^n - 1)$.

— The bits 1 to k of the bitmap are used to indicate that one or more group addressed frames are buffered for each AP corresponding to a nontransmitted BSSID and are called *BSS assigned identifiers (BSS AIDs)*. The AIDs from 1 to k are not allocated to a STA (in each page for an S1G STA). The AIDs from $(k + 1)$ to $(2^n - 1)$ are reserved and set to 0 (in each page for an S1G STA). The remaining AIDs are shared by the BSSs corresponding to the transmitted BSSID and all nontransmitted BSSIDs.

— When the DTIM Count field is 0 for a BSS that has a nontransmitted BSSID, and one or more group addressed frames are buffered at the AP for this BSS, the corresponding bits from bit 1 to bit k is set to 1.

— Each bit starting from bit 2^n in the traffic-indication virtual bitmap corresponds to individually addressed traffic buffered for a specific STA within any BSS corresponding to a transmitted or nontransmitted BSSID at the time the Beacon frame is transmitted. The correspondence is based on the AID of the STA.

— Based upon its knowledge of the capability of associated stations to support the multiple BSSID capability, as indicated by the corresponding field in the Extended Capabilities element and the content of the traffic indication virtual bitmap, an AP encodes the Partial Virtual Bitmap and the

Bitmap Control field of the TIM element using one of the ~~two~~ three following methods. Specifically, a~~n~~ non-S1G AP uses Method B when it determines that the bit for each associated non-AP STA in the traffic indication virtual bitmap that is reconstructed by each non-AP STA from the received TIM element encoded using Method B is set correctly. Otherwise, a~~n~~ non-S1G AP uses Method A and an S1G AP uses Method C.

Method A, ~~and~~ Method B, and Method C are described as follows:

a) Method A: The Partial Virtual Bitmap field consists of octets numbered 0 to $N2$ of the traffic indication virtual bitmap, where $N2$ is the smallest number such that bits numbered $(N2 + 1) \times 8$ to 2007 in the traffic indication virtual bitmap are all 0. If such a value $N2$ does not exist, that is, when not all bits in the last octet of the traffic indication virtual bitmap are equal to 0, $N2 = 250$. When using this method, the Bitmap Offset subfield value always contains the number 0, and the Length field is $N2 + 4$.

b) Method B: The Partial Virtual Bitmap field consists of a concatenation of octets numbered 0 to $N0 - 1$ and octets numbered $N1$ to $N2$ of the traffic indication virtual bitmap, where $N0$ is the smallest positive integer such that $N0 \times 8 - 2^n < 8$. If $N0$ is an odd number, then $N1$ is the largest odd number such that $N0 < N1$ and each of the bits $N0 \times 8$ to $(N1 \times 8 - 1)$ is equal to 0. When $N0$ is an even number, $N1$ is the largest even number such that $N0 < N1$ and each of the bits $N0 \times 8$ to $(N1 \times 8 - 1)$ is equal to 0. If such a value $N1 > N0$ does not exist, $N1 = N0$. Additionally, $N2$ is the smallest integer value for which the values for bit $(N2+1) \times 8$ to 2007 in the traffic indication virtual bitmap are all 0. If such a value $N2$ does not exist, that is, when not all bits in the last octet of the traffic indication virtual bitmap are equal to 0, $N2 = 250$. When using this method, the Bitmap Offset subfield contains the value of $(N1 - N0)/2$, and the Length field is $N0 + N2 - N1 + 4$.

c) Method C: The Partial Virtual Bitmap field of the TIM that is carried in an S1G PPDU consists of a concatenation of Encoded Block subfields that contain BSS AIDs and Encoded Block subfields that contain AIDs. When using this method, the Page Slice Number subfield is equal to 31, and the Page Index subfield is equal to the page index of the TIM to which the AIDs belong.

NOTE—When $N1 = N0$, Method B reduces to Method A.

For both Method A and Method B, when there are no frames buffered for any BSS corresponding to a transmitted or nontransmitted BSSID supported, the Partial Virtual Bitmap field is encoded as a single octet equal to 0, the Bitmap Offset subfield is 0, and the Length field is 4. For Method C when the Partial Virtual Bitmap field is not present in the TIM element then the Length field is 3 and when both the Partial Virtual Bitmap field and the Bitmap Control field are not present in the TIM element then the Length field is 2. For both Method A and Method B, w~~W~~hen there are no buffered individually addressed frames for any BSS corresponding to a transmitted or nontransmitted BSSID, but there are buffered group addressed frames for one or more of the BSSs, the Partial Virtual Bitmap field consists of the octets number 0 to $N0 - 1$ where $N0$ is the smallest positive integer such that $(N0 \times 8 - 2^n < 8)$. For Method C, the Partial Virtual Bitmap field consists of Encoded Block subfields that contain the BSS AIDs of the BSSs for which there are buffered group addressed frames. In this case for Method A and Method B, the Bitmap Offset subfield value contains the number 0, and the Length field is $N0+3$, while for Method C, the Length field is equal to 3 plus the size of the encoded blocks that carry the BSS AIDs, which are present in the TIM element.

Insert the following paragraphs, Figure 9-127d through Figure 9-127f, and Table 9-78a at the end of 9.4.2.6.1:

When the TIM with a nonzero Partial Virtual Bitmap field is carried in an S1G PPDU, the Partial Virtual Bitmap field is constructed with one or more Encoded Block subfields as shown in Figure 9-127d. The Encoded Block subfield consists of the Block Control subfield, the Block Offset subfield, and the Encoded Block Information subfield as shown in Figure 9-127e. When dot11MultipleBSSIDActivated is true, the Partial Virtual Bitmap field contains zero or more Encoded Block subfields that contain BSS AIDs.

	Encoded Block 1	Encoded Block 2	…	Encoded Block n
Octets:	variable	variable		variable

Figure 9-127d—Partial Virtual Bitmap field

	B0 B2	B3 B7	
	Block Control	Block Offset	Encoded Block Information
Bits:	3	5	variable (a multiple of 8 bits)

Figure 9-127e—Encoded Block subfield

The Block Control subfield indicates the encoding mode used in the Encoded Block subfield as shown in Table 9-78a. The format of the Block Control subfield is as shown in Figure 9-127f. The Block Control subfield consists of the Encoding Mode subfield and the Inverse Bitmap subfield.

Table 9-78a—Block Control field encoding

Bit 2	Bit 1	Bit 0	Encoding mode
0	0	0	Block Bitmap
0	0	1	Single AID
0	1	0	OLB
0	1	1	ADE
1	0	0	Inverse Bitmap + Block Bitmap
1	0	1	Inverse Bitmap + Single AID
1	1	0	Inverse Bitmap + OLB
1	1	1	Inverse Bitmap + ADE

	B0 B1	B2
	Encoding Mode	Inverse Bitmap
Bits:	2	1

Figure 9-127f—Block Control subfield

The Inverse Bitmap subfield is set to 1, if the Encoded Block Information field is encoded based on the inverted version of the block, which inverts each bit value of the block. The Inverse Bitmap subfield is set to 0, otherwise.

The Encoding Mode subfield indicates one of the four encoding modes: the Block Bitmap mode, the Single AID mode, the offset length bitmap (OLB) mode, and the AID with differential encoding (ADE) mode. The four encoding modes are explained in the following subclauses.

The Block Offset field indicates the index of the block that is encoded in the Encoded Block subfield.

The Encoded Block Information subfield is defined depending on the Encoding Mode subfield and explained within the subclause for each of the encoding modes.

Insert the following subclauses (9.4.2.6.2 through 9.4.2.6.5, including Figure 9-127g through Figure 9-127j) after 9.4.2.6.1:

9.4.2.6.2 Block Bitmap mode

The Encoded Block Information field consists of the Block Bitmap subfield and *n* Subblock subfields, where *n* is the number of bits equal to 1 in the Block Bitmap subfield. The format of the Encoded Block Information subfield is shown in Figure 9-127g.

	Block Bitmap	Subblock 1	Subblock 2	…	Subblock *n*
Octets:	1	1	1		1

Figure 9-127g—Encoded Block Information (Block Bitmap mode)

The Block Bitmap subfield is 1 octet in length. The bit in position *m* of the Block Bitmap subfield, if equal to 1, indicates that the subblock in position *m* of the Block is present in the Encoded Block Information subfield. The bit in position *m* of the Block Bitmap subfield, if equal to 0, indicates that the subblock in position *m* of the block is not present in the Encoded Block Information subfield. When *n* bits in the Block Bitmap subfield are equal to 1, *n* Subblock subfields follow the Block Bitmap field in ascending order of the subblock positions in the block.

Each Subblock subfield is 1 octet in length and contains a subblock of the block, which has at least one bit position equal to 1. The bit in position *q* of the Subblock subfield, which contains the Subblock in position *m* of the block, indicates traffic buffered for the STA whose AID is *N*, where *N* is constructed by concatenating *q* (*N*[0:2]), *m* (*N*[3:5]), the Block Offset field (*N*[6:10]), and the Page Index field (*N*[11:12]) in sequence from LSB to MSB.

9.4.2.6.3 Single AID mode

The Encoded Block Information subfield consists of the Single AID subfield as shown in Figure 9-127h. The Single AID subfield contains the 6 LSBs of the single AID in the block. The rest of the bits of the Encoded Block Information subfield are reserved. The value in the Single AID subfield indicates traffic buffered for the STA whose AID is *N*, where *N* is constructed by concatenating the Single AID subfield(*N*[0:5]), the Block Offset field (*N*[6:10]), and the Page Index field (*N*[11:12]) in sequence from LSB to MSB.

	B0 B5	B6 B7
	Single AID	Reserved
Bits:	6	2

Figure 9-127h—Encoded Block Information (Single AID mode)

9.4.2.6.4 OLB mode

The Encoded Block Information field consists of the Length subfield and *n* Subblock subfields. The format of the Encoded Block Information field is shown in Figure 9-127i.

	Length	Subblock 1	Subblock 2	…	Subblock *n*
Octets:	1	1	1		1

Figure 9-127i—Encoded Block Information (OLB mode)

The Length subfield is 1 octet. A value of the Length subfield equal to *n* indicates that the Encoded Block Information field contains *n* contiguous subblocks in ascending order from multiple blocks starting from the first subblock of the block in position Block Offset.

Each Subblock subfield is 1 octet in length and contains a subblock of the Partial Virtual Map. A subblock *m* of the Encoded Block Information field is located in block *k* where *k* is obtained as Block Offset + $\lfloor m / 8 \rfloor$. The bit in position *q* of the subblock *m*, which is located in block *k*, when set to 1, indicates that there is traffic buffered for the STA whose AID is *N*, where *N* is constructed by concatenating *q* (*N*[0:2]), the subblock offset mod(*m*, 8) (*N*[3: 5]), the block *k* (*N*[6:10]), and the Page Index field (*N*[11:12]), in sequence from LSB to MSB.

9.4.2.6.5 ADE mode

The Encoded Block Information field consists of the Encoding Word Length (EWL) subfield, Length subfield, *n* AID Differential Values (ΔAID) subfields and padding subfield, where *n* is the number of paged AIDs encoded in the ADE block. The format of the Encoded Block Information field is shown in Figure 9-127j.

	EWL	Length	ΔAID1	…	ΔAIDn	Padding
	B0 B2	B3 B7				
Bits:	3	5	1–8		1–8	0–7

Figure 9-127j—Encoded Block Information (ADE Block)

The length of each ΔAID subfields (*WL*) represents the encoded word length (the number of bits of each encoded words) of each AID. All *WL* have the same length. *WL* is indicated by EWL subfield.

The EWL subfield is 3 bits with B0 being LSB. The values of EWL subfield ranging from 0 to 7 represent *WL* being 1 to 8, respectively.

The Length subfield is 5 bits with B3 being LSB and it specifies the total length of the current ADE block in octets, excluding EWL and Length subfields.

The padding subfield contains 0–7 padding bits. The padding bits are set to 0.

To encode a list of paged AIDs, denoted as AID1, AID2 … AIDn, an AP can derive the *offset* value in the Block Offset field (9.4.2.6) for the current ADE Block by $\lfloor (\mathrm{AID}_1 \text{ modulo } 2048) / 64 \rfloor$.

The encoding procedure is as follows:

If all AIDs in the ADE blocks are paged, AP sets the Inverse Bitmap subfield to 1 and ADE block consists only EWL and Length fields, where both EWL and Length Field are set to 0s.

If all but one AIDs in the ADE blocks are paged, AP sets the Inverse Bitmap subfield to 1 and ADE block consists only one ΔAID subfield. The AP sets the EWL to 7 and the Length subfield to one. ΔAID subfield is set to (AID – (*Page Index* × 2048 + *Block Offset* × 64)).

If only one AID is paged in the ADE blocks, AP sets the Inverse Bitmap subfield to 0 and uses the Single AID mode.

For all other cases, AP sorts all AID*i*, *i* = 1, 2…*n* in an ascending order (AID1 < AID2 < … < AID*n*) and then calculates the AID differential values according to

$$\Delta\text{AID1} = \text{AID1} - (\textit{Page Index} \times 2048 + \textit{Block Offset} \times 64)$$

$$\Delta\text{AID}i = \text{AID}i - \text{AID}i{-}1,\ i = 2 \ldots n.$$

Determine *WL* as the minimum bits that can represent the largest ΔAID*i* (or mathematically $\lfloor \log_2(MAX)(\Delta\text{AID}_i) \rfloor + 1$ where $MAX(\Delta\text{AID}_i)$ denotes the largest ΔAID_i), *i*=1,2,…,*n*. The value of EWL subfield is set to *WL*-1. For *n* AID differential values, a total of *WL* × *n* bits are required. The number of bits is less than or equal to 248 since maximum payload in an ADE block is 31 × 8=248 (31 is the maximum value in the 5-bit Length subfield). If the total number of bits *WL* × *n* is not a multiple of an octet, [*WL*×*n*/8]×8-*WL*×*n* zero bits are padded to make the ADE block end at octet boundary.

When decoding, if the Inverse Bitmap subfield is 1, and the EWL and Length subfield are 0s, then all AIDs in the ADE blocks are paged.

If the Inverse Bitmap subfield is 1, the EWL is 7 and the Length subfield is 1, then all AIDs except one in the ADE blocks are paged. The unpaged AID is ΔAID1 + *Block Offset* × 64 + *Page Index* × 2048.

For other cases, a STA can extract *Page Index* (9.4.2.6) and *Block Offset* (9.4.2.6), EWL and Length values from the respective fields. It derives *WL* by adding 1 to the value from EWL field. The paged AIDs are then derived with following formulas:

$$\text{AID1} = \Delta\text{AID1} + (\textit{Page Index} \times 2048 + \textit{Block Offset} \times 64)$$

$$\text{AID}i = \Delta\text{AID}i + \text{AID}i - 1,\ i = 2, \ldots, n.$$

The decoder stops the decoding of the current ADE block when either one of following conditions is satisfied:

— The number of bits left for decoding is less than WL
— ΔAIDi is zero and *i* > 1.

AIDs from the same or different blocks can be encoded into one ADE block. A STA can derive the number of AIDs, including both paged and unpaged AIDs, encoded in one ADE block with following method:

If an ADE block is not the last encoded block in the TIM element, the decoder can derive the number of AIDs encoded by this ADE block based on the *Block offset* values in the current and the immediate next encoded blocks. For example, the offset values in the current ADE block and the next encoded block are *Offset*1 and *Offset*2. Then the AIDs encoded by this ADE block is [*Page Index* × 2048 + *Offset*1 × 64, *Page Index* × 2048 + *Offset*2×64), *Page Index*×2048 + *Offset*1 × 64 is included and *Page Index* × 2048 + *Offset*2 × 64 is excluded.

If an ADE block is the last one in the TIM element, the number of AIDs encoded by the last ADE block can be determined based on the offset value and page length or page slice length if its TIM page is sliced.

9.4.2.29 EDCA Parameter Set element

Change Figure 9-261 as follows:

	Element ID	Length (18)	QoS Info	~~Reserved~~ Update EDCA Info	AC_BE Parameter Record	AC_BK Parameter Record	AC_VI Parameter Record	AC_VO Parameter Record
Octets:	1	1	1	1	4	4	4	4

Figure 9-261—EDCA Parameter Set element

Insert the following paragraphs and Figure 9-261a after the fourth paragraph ("The format of the QoS Info field....") of 9.4.2.29:

The Update EDCA Info field is reserved for non-S1G STAs. For S1G STAs, it is shown in Figure 9-261a.

	B0	B1 B2	B3 B4	B5 B6	B7
	Override	PS-Poll ACI	RAW ACI	STA Type	Reserved
Bits:	1	2	2	2	1

Figure 9-261a—Update EDCA Info field

The Override field is used by S1G APs to indicate to S1G STAs that this element overrides previously stored EDCA parameters as described in 10.2.4.2.

The PS-Poll ACI field is used by S1G APs to inform the S1G STAs of the access category for sending a PS-Poll frame. The mapping between the PS-Poll ACI field and AC is identical to the one defined in Table 9-135.

The RAW ACI field is used by S1G APs to inform the S1G STAs of the access category for accessing the WM in the RAW as described in 10.22.5.5. The mapping between the RAW ACI field and AC is identical to the one defined in Table 9-135.

The STA Type field indicates the type of STA for which the information in the element is provided. The S1G AP sets the STA Type field to

— 0 to indicate that the information provided by this element is valid for STAs (i.e., both sensor STAs and non-sensor STAs)
— 1 to indicate that the information is valid for sensor STAs
— 2 to indicate that the information provided by this element is valid for non-sensor STAs
— 3 to indicate a reserved value

NOTE—An S1G STA that transmits a (NDP) PS-Poll frame within a RAW uses the access category indicated by PS-Poll ACI subfield rather than the access category indicated by the RAW ACI subfield.

Change Table 9-137 as follows:

Table 9-137—Default EDCA Parameter Set element parameter values if dot11OCBActivated is false or the STA is a non-sensor STA

AC	CWmin	CWmax	AIFSN	TXOP limit			
				For PHYs defined in Clause 15 and Clause 16	For PHYs defined in Clause 17, Clause 18, Clause 19~~, and~~ Clause 21, and Clause 23	For PHY defined in Clause 22	Other PHYs
AC_BK	aCWmin	aCWmax	7	3.264 ms	2.528 ms	0	0
AC_BE	aCWmin	aCWmax	3	3.264 ms	2.528 ms	0	0
AC_VI	(aCWmin+1)/2 – 1	aCWmin	2	6.016 ms	4.096 ms	22.56 ms (BCU: 6 or 7 MHz), 16.92 ms (BCU: 8 MHz)	0
AC_VO	(aCWmin+1)/4 – 1	(aCWmin+1)/2 – 1	2	3.264 ms	2.080 ms	11.28 ms (BCU: 6 or 7 MHz), 8.46 ms (BCU: 8 MHz)	0

Insert the following paragraph and Table 9-137a at the end of 9.4.2.29:

The default EDCA parameter set used by sensor STAs is given in Table 9-137a.

Table 9-137a—Default EDCA Parameter Set element parameter values if the STA is a sensor STA

AC	CWmin	CWmax	AIFSN	TXOP limit
AC_BK	aCWmin	aCWmax	7	0
AC_BE	(aCWmin+1)/4 – 1	aCWmin	2	0
AC_VI	(aCWmin+1)/2 – 1	aCWmin	5	0
AC_VO	(aCWmin+1)/2 – 1	aCWmin	4	0

9.4.2.31 TCLAS element

Change Table 9-145 as follows:

Table 9-145—Frame classifier type

Classifier type	Classifier parameters
0	Ethernet parameters
1	TCP/UDP IP parameters
2	IEEE Std 802.1Q parameters
3	Filter Offset parameters
4	IP and higher layer parameters
5	IEEE Std 802.1D/Q parameters
6	IEEE Std 802.11 PV0 MPDU MAC header parameters
7	IEEE Std 802.11 downlink PV1 MPDU MAC header parameters (From DS field of the Frame Control field equal to 1)
8	IEEE Std 802.11 nondownlink PV1 MPDU MAC header parameters (From DS field of the Frame Control field equal to 0)
9	IEEE Std 802.11 PV1 MPDU Full Address MAC header parameters
~~7~~10–255	Reserved

Insert the following paragraphs after the sixth paragraph ("When the Classifier type is a value less than or equal to 5....") of 9.4.2.31:

The classifier type value of 6 applies only to frames with the Protocol Version subfield of the Frame Control field of the MAC header equal to 0.

The classifier type value of 7 applies only to frames with the Protocol Version subfield of the Frame Control field of the MAC header equal to 1, the Type subfield of the Frame Control field of the MAC header equal to 0 or 1, and the From DS subfield of the Frame Control field of the MAC header equal to 1.

The classifier type value of 8 applies only to frames with the Protocol Version subfield of the Frame Control field of the MAC header equal to 1, the Type subfield of the Frame Control field of the MAC header equal to 0 or 1, and the From DS subfield of the Frame Control field of the MAC header equal to 0.

The classifier type value of 9 applies only to frames with the Protocol Version subfield of the Frame Control field of the MAC header equal to 1 and the Type subfield of the Frame Control field of the MAC header equal to 3.

Change the now 11th paragraph (including reformatting it into three paragraphs) of 9.4.2.31 as follows:

When the Classifier Type is equal to 6, 7, 8, or 9, the Classifier Mask subfield is 3 octets in length~~. It~~ and contains a sequence of ~~nine~~ 2-bit Classifier Mask Control subfields. Each Classifier Mask Control subfield applies to a specific target field of the MAC header~~. It~~ of an MPDU and determines whether the target field is included in the comparison and whether an additional bitmask (the target field filter mask) is present.

When the target field filter mask is present, it determines which bits of the target field are used in the comparison.

The Classifier Mask Control subfield values are interpreted as follows:

- Setting the LSB of the two bits to 1 indicates the use of the corresponding MAC Header field for comparison, and setting the LSB of the two bits to 0 indicates the corresponding MAC header field is not used for comparison, and the corresponding Match Specification is not included in the Classifier.
- Setting the MSB of the two bits to 1 indicates the inclusion of the corresponding MAC Header Filter (a bit mask) in the corresponding Match Specification, and setting the MSB of the two bits to 0 indicates the MAC Header Filter is not included in the corresponding Match Specification and every bit of the Match Specification, if included in the Classifier Parameter, needs to be compared.
- If an optional MAC Header field needs to be compared, the LSB of the two bits in the Classifier Mask corresponding to the optional MAC header field is set to 1, and an MPDU that does not include the optional field is not a matching MPDU.

Table 9-146, Table 9-146a, Table 9-146b, and Table 9-146c specify~~ies~~ the interpretation of the Classifier Mask Control subfield for each of the Classifier Type values 6, 7, 8, and 9, respectively.

Change Table 9-146 in its entirety as follows:

Table 9-146—Classifier Mask for Classifier Type 6

Octet index	Bits index	Classifier parameters
0	B1B0	Frame Control
	B3B2	Duration/ID
	B5B4	Address 1
	B7B6	Address 2
1	B1B0	Address 3
	B3B2	Sequence Control
	B5B4	Address 4
	B7B6	QoS Control
2	B1B0	HT Control
	B3B2	Reserved
	B5B4	Reserved
	B7B6	Reserved

Insert Table 9-146a through Table 9-146c after Table 9-146:

Table 9-146a—Classifier Mask for Classifier Type 7

Octet index	Bits index	Classifier parameters
0	B1B0	Frame Control
	B3B2	Address 1 (AID)
	B5B4	Address 2 (BSSID)
	B7B6	Sequence Control
1	B1B0	Address 3
	B3B2	Address 4
	B5B4	Reserved
	B7B6	Reserved
2	B1B0	Reserved
	B3B2	Reserved
	B5B4	Reserved
	B7B6	Reserved

Table 9-146b—Classifier Mask for Classifier Type 8

Octet index	Bits index	Classifier parameters
0	B1B0	Frame Control
	B3B2	Address 1 (BSSID)
	B5B4	Address 2 (AID)
	B7B6	Sequence Control
1	B1B0	Address 3
	B3B2	Address 4
	B5B4	Reserved
	B7B6	Reserved
2	B1B0	Reserved
	B3B2	Reserved
	B5B4	Reserved
	B7B6	Reserved

Table 9-146c—Classifier Mask for Classifier Type 9

Octet index	Bits index	Classifier parameters
0	B1B0	Frame Control
	B3B2	Address 1
	B5B4	Address 2
	B7B6	Sequence Control
1	B1B0	Reserved
	B3B2	Reserved
	B5B4	Reserved
	B7B6	Reserved
2	B1B0	Reserved
	B3B2	Reserved
	B5B4	Reserved
	B7B6	Reserved

Change the titles of Figure 9-280 and Figure 9-282 through Figure 9-286 as follows:

Figure 9-280—Frame Control Match Specification subfield of Classifier Type 6, 7, 8, 9

Figure 9-282—Address 1 Match Specification subfield of Classifier Type 6, 8, 9

Figure 9-283—Address 2 Match Specification subfield of Classifier Type 6, 7, 9

Figure 9-284—Address 3 Match Specification subfield of Classifier Type 6, 7, 8

Figure 9-285—Sequence Control Match Specification subfield of Classifier Type 6, 7, 8, 9

Figure 9-286—Address 4 Match Specification subfield of Classifier Type 6, 7, 8

Insert the following paragraphs and Figure 9-288a through Figure 9-288e at the end of 9.4.2.31:

For Classifier Type 7, the format of the Frame Classifier field of an TCLAS element is illustrated in Figure 9-288a.

	Classifier Type (7)	Classifier Mask	Frame Control Match Specification	Address 1 (SID) Match Specification	Address 2 Match Specification	Sequence Control Match Specification	Address 3 Match Specification	Address 4 Match Specification
Octets:	1	3	0, 2, or 4	0, 2, or 4	0, 6, or 12	0, 2, or 4	0, 6, or 12	0, 6, or 12

Figure 9-288a—Frame Classifier field of Classifier Type 7

For Classifier Type 7, the formats of the Frame Control Match Specification subfield, Address 1 (SID) subfield, Address 2 (BSSID) subfield, Sequence Control subfield, Address 3 subfield, and Address 4 subfield of the Frame Classifier field of a TCLAS element are illustrated in Figure 9-280, Figure 9-288b, Figure 9-283, Figure 9-285, and Figure 9-284, and Figure 9-286, respectively. The Match Specification subfield contains the match specification (i.e., the parameters) of the corresponding MAC header field with which an MPDU needs to be compared. When the corresponding Filter Mask subfield is not present, every bit in a Match Specification needs to be compared; otherwise, only the bits with the same bit positions as the bits that are equal to 1 in the corresponding Filter Mask subfield are compared.

	Address 1 (SID) Match Specification	Address 1 Filter Mask
Octets:	2	0, or 2

Figure 9-288b—Address 1 (SID) Match Specification subfield of Classifier Type 7

For Classifier Type 8, the format of the Frame Classifier field of an TCLAS element is illustrated in Figure 9-288c.

	Classifier Type (8)	Classifier Mask	Frame Control Match Specification	Address 1 (BSSID) Match Specification	Address 2 (SID) Match Specification	Sequence Control Match Specification	Address 3 Match Specification	Address 4 Match Specification
Octets:	1	3	0, 2, or 4	0, 6, or 12	0, 2,or 4	0, 2 ,or 4	0, 6 ,or 12	0, 6, or 12

Figure 9-288c—Frame Classifier field of Classifier Type 8

For Classifier Type 8, the formats of the Frame Control Match Specification subfield, Address 1 (BSSID) subfield, Address 2 (SID) subfield, Sequence Control subfield, and Address 3 subfield are illustrated in Figure 9-280, Figure 9-282, Figure 9-288d, Figure 9-285, Figure 9-284, and Figure 9-286, respectively. The Match Specification subfield contains the match specification (i.e., the parameters) of the corresponding MAC header field with which an MPDU needs to be compared. When the corresponding Filter Mask subfield is not present, every bit in a Match Specification needs to be compared; otherwise, only the bits with the same bit positions as the bits that are equal to 1 in the corresponding Filter Mask subfield are compared.

	Address 2(SID) Match Specification	Address 2 Filter Mask
Octets:	2	0, or 2

Figure 9-288d—Address 2 (SID) Match Specification subfield of Classifier Type 8

For Classifier Type 9, the format of the Frame Classifier field of a TCLAS element is illustrated in Figure 9-288e.

	Classifier Type (9)	Classifier Mask	Frame Control Match Specification	Address 1 Match Specification	Address 2 Match Specification	Sequence Control Match Specification
Octets:	1	3	0, 2, or 4	0, 6, or 12	0, 6, or 12	0, 2, or 4

Figure 9-288e—Frame Classifier field of Classifier Type 9

For Classifier Type 9, the formats of the Frame Control Match Specification subfield, Address 1 subfield, Address 2 subfield, and Sequence Control subfield, are illustrated in Figure 9-280, Figure 9-282, Figure 9-283, Figure 9-285, respectively. The Match Specification subfield contains the match specification (i.e., the parameters) of the corresponding MAC header field with which an MPDU needs to be compared. When the corresponding Filter Mask subfield is not present, every bit in a Match Specification needs to be compared; otherwise, only the bits with the same bit positions as the bits that are set to 1 in the corresponding Filter Mask subfield are compared.

9.4.2.46 Multiple BSSID element

Change the fourth paragraph of 9.4.2.46 as follows:

When the Multiple BSSID element is transmitted in a Beacon, DMG Beacon, or Probe Response frame, the reference BSSID is the BSSID of the frame. More than one Multiple BSSID element can be included in a Beacon, S1G Beacon, or DMG Beacon frame. The AP or DMG STA determines the number of Multiple BSSID elements. The AP or DMG STA does not fragment a nontransmitted BSSID profile subelement for a single BSSID across two Multiple BSSID elements unless the length of the nontransmitted BSSID profile subelement exceeds 255 octets. When the Multiple BSSID element is transmitted as a subelement in a Neighbor Report element, the reference BSSID is the BSSID field in the Neighbor Report element.

Change the seventh paragraph of 9.4.2.46 as follows:

The Nontransmitted BSSID Profile subelement contains a list of elements for one or more APs or DMG STAs that have nontransmitted BSSIDs, and is defined as follows:

— For each nontransmitted BSSID, the Nontransmitted BSSID Capability element (see 9.4.2.72) is the first element included, followed by a variable number of elements, in the order defined in Table 9-27.
— The SSID and multiple BSSID-index subelements are included in the Nontransmitted BSSID Profile subelement.
— The FMS Descriptor element is included in the Nontransmitted BSSID Profile subelement if the Multiple BSSID element is included in a Beacon frame and if the TIM field indicates there are buffered group addressed frames for this nontransmitted BSSID.
— The Timestamp and Beacon Interval fields, DSSS Parameter Set, IBSS Parameter Set, Country, Channel Switch Announcement, Extended Channel Switch Announcement, Wide Bandwidth Channel Switch, Transmit Power Envelope, Supported Operating Classes, IBSS DFS, ERP Information, HT Capabilities, HT Operation, VHT Capabilities, ~~and~~ VHT Operation, S1G Beacon Compatibility, Short Beacon Interval, S1G Capabilities, and S1G Operation elements are not included in the Nontransmitted BSSID Profile subelement; the values of these elements for each nontransmitted BSSID are always the same as the corresponding transmitted BSSID element values.

9.4.2.79 BSS Max Idle Period element

Change the third paragraph of 9.4.2.79 as follows:

The BSSMaxIdlePeriod parameter ~~Max Idle Period field~~ indicates the idle timeout limit, as described in 11.24.13. In a non-S1G STA, the Max Idle Period field is a 16-bit unsigned integer that contains the value of the parameter BSSMaxIdlePeriod. In an S1G STA, the two MSBs of the Max Idle Period field contain the Unified Scaling Factor subfield and the remaining 14 bits contain the Unscaled Interval subfield (see Figure 9-71a). In an S1G STA, the value of BSSMaxIdlePeriod parameter used by the MLME primitives is in units of 1000 TUs and is equal to the value of the Unscaled Interval subfield, multiplied by the scaling factor that corresponds to the value indicated in the Unified Scaling Factor subfield. The Unified Scaling Factor subfield encoding is defined in Table 9-44a.

Change the last paragraph of 9.4.2.79 as follows:

The BSS Max Idle Period element is included in Association Request and Response frames, as described in 9.3.3.6 and 9.3.3.7, and Reassociation Request and Response frames, as described in 9.3.3.8 and 9.3.3.9. The use of the BSS Max Idle Period element and frames is described in 11.24.13.

9.4.2.82 WNM Sleep Mode element

Change the sixth paragraph of 9.4.2.82 as follows:

The WNM Sleep Interval field indicates to the AP how often a STA in WNM sleep mode wakes to receive Beacon frames, defined as the number of DTIM intervals. The value set to 0 indicates that the requesting non-AP STA does not wake up at any specific interval. In a non-S1G STA, the WNM Sleep Interval is a 16-bit unsigned integer. In an S1G STA, the two MSBs of the WNM Sleep Interval field contain the Unified Scaling Factor subfield and the remaining 14 bits contain the Unscaled Interval subfield (see Figure 9-71a). In an S1G STA, the WNM Sleep interval is equal to the value of the Unscaled Interval subfield, multiplied by the scaling factor that corresponds to the value indicated in the Unified Scaling Factor subfield. The Unified Scaling Factor subfield encoding is defined in Table 9-44a.

9.4.2.161 Wide Bandwidth Channel Switch element

Change the last paragraph of 9.4.2.161 as follows:

If the value of the New Operating Class field in the frame that contains this element does not indicate an S1G band, ~~T~~the subfields New Channel Width, New Channel Center Frequency Segment 0, and New Channel Center Frequency Segment 1 have the same definition, respectively, as Channel Width, Channel Center Frequency Segment 0, and Channel Center Frequency Segment 1 in the VHT Operation Information field, described in Table 9-252. Otherwise, the subfields New Channel Width and New Channel Center Frequency Segment 0 have the same definition, respectively, as the Channel Width and the Channel Center Frequency in the S1G Operation Information field, described in Table 9-262y. The New Channel Center Frequency Segment 1 subfield is reserved.

Insert the following subclauses (9.4.2.191 through 9.4.2.216, including Figure 9-589ac through Figure 9-589ci and Table 9-262j through Table 9-262y) after 9.4.2.190:

9.4.2.191 S1G Open-Loop Link Margin Index element

The S1G Open-Loop Link Margin Index element contains the link margin information. The S1G Open-Loop Link Margin Index element is optionally included in an S1G Beacon frame or a Probe Response frame without a corresponding request. The format of the S1G Open-Loop Link Margin Index element is shown in Figure 9-589ac.

	Element ID	Length	Open-Loop Link Margin Index
Octets:	1	1	1

Figure 9-589ac—S1G Open-Loop Link Margin Index element format

The Element ID and Length fields are defined in 9.4.2.1.

The Open-Loop Link Margin Δ_{OPLM} is defined as the summation of transmit power P_{tx} and the receiver sensitivity $RX_{sensitivity}$

$$\Delta_{OPLM} = P_{tx1} + RX_{sensitivity}$$

The transmit power P_{tx1} indicates the actual power used as measured at the output of the antenna connector, in units of dBm, by a STA when transmitting the frame containing the S1G Open-Loop Link Margin Index element. The receiver sensitivity $RX_{sensitivity}$ is the minimum required receive power for reception of MCS10 for 1 MHz channel.

The S1G Open-Loop Link Margin Δ_{OPLM} is calculated as (–128 + D × 0.5) dB, where D is called Open-Loop Link Margin Index. D is an unsigned integer value that is contained in S1G Open-Loop Link Margin Index field. For example, if the value D shown in S1G Open-Loop Link Margin Index field is 0, then it indicates the S1G Open-Loop Link Margin Δ_{OPLM} is –128 dB. If the value D shown in S1G Open-Loop Link Margin Index field is 255, then it indicates the S1G Open-Loop Link Margin Δ_{OPLM} is –0.5 dB.

The S1G Open-Loop Link Margin Index element can be used for open-loop link adaptation and open-loop transmit power control. When a STA receives the Open-loop link Margin index, it can calculate the S1G Open-Loop Link Margin Δ_{OPLM} by using (–128 + D × 0.5) dB. Then the SNR margin over the MCS 10 can be derived at the STA that receives the frame that contains S1G Open-Loop Link Margin Index based on its own transmit power P_{tx2} and the received RSSI measured for the packet containing the S1G Open-Loop Link Margin Index.

$$SNR_{Margin} = P_{tx2} - \Delta_{OPLM} + RSSI$$

9.4.2.192 RPS element

The RPS element contains one or more RAW Assignment subfields. Each RAW Assignment subfield contains parameters necessary to restrict medium access to one or multiple STAs within one RAW. The format of the RPS element is defined in Figure 9-589ad.

	Element ID	Length	RAW Assignments
Octets:	1	1	variable

Figure 9-589ad—RPS element format

The Element ID and Length fields are defined in 9.4.2.1.

The RAW Assignments field contains one or more RAW Assignment subfields.

The format of the RAW Assignment subfield is shown in Figure 9-589ae. The RAW Start Time, RAW Group, Channel Indication, and Periodic Operation Parameters subfields are conditionally present.

	RAW Control	RAW Slot Definition	RAW Start Time	RAW Group	Channel Indication	Periodic Operation Parameters
Octets:	1	2	0 or 1	0 or 3	0 or 2	0 or 3

Figure 9-589ae—RAW Assignment subfield format

The format of the RAW Control subfield is shown in Figure 9-589af.

	B0 B1	B2 B3	B4	B5	B6	B7
	RAW Type	RAW Type Options	Start Time Indication	RAW Group Indication	Channel Indication Presence	Periodic RAW Indication
Bits:	2	2	1	1	1	1

Figure 9-589af—RAW Control subfield format

The RAW Type indicates the type of the RAW defined by the RAW assignment. The interpretation of the RAW Type subfields is illustrated in Table 9-262j.

Table 9-262j—Interpretation of RAW Type and RAW Type Options

RAW Type	Description	RAW Type Options subfield
0	Generic RAW	Bit 0 (Bit 2 of RAW Control subfield): Paged STA Bit 1(Bit 3 of RAW Control subfield): RA Frame
1	Sounding RAW	0: SST sounding RAW 1: SST report RAW 2: Sector sounding RAW 3: Sector report RAW
2	Simplex RAW	0: AP PM RAW 1: Non-TIM RAW 2: Omni RAW 3: Reserved
3	Triggering frame RAW	Reserved

The different types of RAWs are interpreted as follows:

— Generic RAW: used to provide restricted medium access only to a group of STAs.

— Sounding RAW: either used for SST sounding/SST report (SST RAW) or sector sounding/sector report (Sector RAW) as indicated by the RAW Type Options subfield as follows:

  — When the sounding RAW is used as an SST sounding RAW or a sector sounding RAW, non-AP STAs do not initiate a TXOP during the RAW but elect to listen to sector sounding (described in 10.49.5.2) or SST sounding (described in 10.48). Non-AP STAs are allowed to transmit response frames during the RAW.

  — When the sounding RAW is used as an SST report RAW or a sector report RAW, as a response to the preceding SST sounding RAW or sector sounding RAW, STAs in the RAW Group can transmit a report frame to the AP during the SST report RAW as described in 10.48, or transmit sector ID feedback frame to the AP during the sector report RAW as described in 10.49.5 regardless of their corresponding TIM bits.

— Simplex RAW: the Slot Definition Format Indication, Cross Slot Boundary, and Number of Slots subfields of the Slot Definition field are set to 1, and the RAW is either used for AP Power Management (as described in 11.2.3.20), for reserving channel time for non-TIM STAs, or for the omni RAW depending on the values of RAW Type Options subfield as follows:

  — When the RAW is used as the non-TIM RAW as indicated by the RAW Type Options subfield, the access is restricted to non-TIM STAs that have been previously scheduled within the RAW such as TWT STAs or doze awake cycle rescheduled STAs (as described in 10.44.2). The RAW

Assignment subfield for non-TIM RAW also conditionally contains the RAW Start Time, Channel Indication, and Periodic Operation Parameters subfields.

- When the RAW is used as the AP PM RAW as indicated by the RAW Type Options subfield, the RAW Assignment subfield for AP PM RAW also conditionally contains the RAW Start Time and Periodic Operation Parameters subfields.
- When the RAW is used as the omni RAW as indicated by the RAW Type Options subfield of the RAW Assignment subfield for omni RAW, the access is not restricted for any specific STA and this duration can be used by non-AP STAs to communicate with the AP that has scheduled the omni RAW to send the Probe/Association Request. The RAW assignment subfield of the omni RAW also conditionally contains the RAW Start Time, and Periodic Operation Parameters subfields.

- Triggering Frame RAW: each paged STA belonging to the RAW group is allowed to send one specific trigger frame as described in 10.22.5.4 during its assigned RAW slot. The procedure of RAW slot assignment is described in 10.22.5.3.

The Start Time Indication subfield indicates whether the RAW Start Time subfield is present in the RAW Assignment subfield or not. If it is equal to 0, the RAW Start Time subfield is not present. If it is equal to 1, the RAW Start Time subfield is present. In the first RAW assignment, the Start Time Indication subfield equal to 0 indicates that the RAW starts immediately after the S1G Beacon, the Probe Response frame, or the PV1 Probe Response that includes the RPS element. For other RAW assignments, the Start Time Indication subfield equal to 0 indicates that the current RAW starts immediately after the end of the previous RAW.

The RAW Group Indication subfield indicates whether the RAW Group subfield is present in the RAW Assignment subfield and is interpreted as follows:

- When the RAW type is generic RAW, sounding RAW, or triggering frame RAW, the RAW Group Indication subfield indicates whether the RAW group defined in the current RAW assignment is the same RAW group as defined in the previous RAW assignment. When the RAW Group Indication subfield is equal to 0, the RAW group defined in the current RAW assignment is the same as the RAW group defined in the previous RAW assignment and the RAW Group subfield is not present in this RAW assignment. When the RAW Group Indication subfield is equal to 1, the RAW Group subfield is present in this RAW assignment. The RAW Group Indication subfield in the first RAW assignment is set to 0 to indicate the RAW group in the first RAW assignment is the same as the range of AIDs in all the TIM bitmaps in the S1G Beacon frame.
- When the RAW is a non-TIM RAW, the RAW Group Indication subfield is set to 0 and the RAW Group subfield is not present.
- When the RAW is an AP PM RAW, the RAW Group Indication subfield equal to 0 indicates that the RAW group does not include any of the non-AP STAs, and the RAW Group subfield is not present. When the RAW Group Indication subfield is equal to 1, the RAW Group subfield is present.

The Channel Indication Presence subfield indicates whether the Channel Indication subfield in the current RAW assignment is present or not. If it is equal to 0, the Channel Indication subfield is not present. If it is equal to 1, the Channel Indication subfield is present.

The Periodic RAW Indication subfield indicates whether the RAW is periodic. When the Periodic RAW Indication is equal to 1, the RAW is a periodic restricted access window (PRAW), and the Periodic Operation Parameters subfield is present. When the Periodic RAW Indication is equal to 0, the Periodic Operation Parameters subfield is not present.

The definitions of RAW Type Options subfield are specified in Table 9-262j. The RAW Type Options subfield is interpreted as follows:

— For generic RAW, Bit 0 of the RAW Type Options (Bit 2 of the RAW Control subfield) is Paged STA indication. When it is equal to 0, the RAW can be accessed by any STA (paged or unpaged) within the RAW group specified by the RAW Group subfield. When it is equal to 1, the RAW can only be accessed by paged STAs within the RAW group specified by the RAW Group subfield. Bit 1 of the RAW Type Options (Bit 3 of the RAW Control subfield) is RA Frame Indication. If it is equal to 1, the AP will transmit a Resource Allocation frame, as defined in 9.8.5.4, at the beginning of the RAW defined by the RAW Assignment subfield of the RPS element.

— For sounding RAW, the RAW Type Options subfield is treated as one subfield, the interpretation of which is defined in Table 9-262j.

— For Simplex RAW, the RAW Type Options subfield is treated as one subfield, the interpretation of which is defined in Table 9-262j.

— For Triggering Frame RAW, the RAW Type Options subfield is reserved.

The format of the RAW Slot Definition subfield is shown in Figure 9-589ag.

	B0	B1	B2 By+1	By+2 B15
	Slot Definition Format Indication	Cross Slot Boundary	Slot Duration Count	Number of Slots
Bits:	1	1	y	14-y

Figure 9-589ag—RAW Slot Definition subfield

The Slot Definition Format Indication subfield indicates the number of bits used for the Slot Duration Count subfield, i.e., the value y in Figure 9-589ag of the Slot Duration Count subfield. If it is set 0, the Slot Duration Count subfield is 8 bits (y=8). If it is equal to 1, the Slot Duration Count subfield is 11 bits (y=11). When the RAW Type is sounding RAW, the Slot Duration Count subfield is 8 bits in length (y=8).

The Cross Slot Boundary subfield indicates whether STAs are allowed to transmit after the assigned RAW slot boundary. If the bit is equal to 1, crossing a RAW slot boundary is allowed. If the bit is equal to 0, crossing a RAW slot boundary is not allowed for transmissions from STAs.

The Slot Duration Count subfield is y-bit unsigned integer and it is used to calculate the duration of a RAW slot, or the RAW slot duration. The RAW slot duration, D_{SLOT}, has time unit of microsecond and it is calculated as:

$$D_{\mathrm{SLOT}} = 500 + C_{\mathrm{SLOT}} \times 120$$

where

C_{SLOT} is the value of the Slot Duration Count subfield

The Number of Slots subfield is a (14–y)-bit unsigned integer and indicates the number of RAW slots (N_{RAW}) in the RAW.

The Slot Definition subfield is used to calculate the RAW duration. The RAW Duration indicates the duration, in units of microsecond, of the restricted medium access assigned to a RAW. The RAW duration, D_{RAW}, indicated by the corresponding RAW assignment can be calculated as follows:

$$D_{\mathrm{RAW}} = D_{\mathrm{SLOT}} \times N_{\mathrm{RAW}}$$

where

D_{SLOT} is the RAW slot duration, in microseconds
N_{RAW} is the value of the Number of Slots subfield

When the RAW Type is generic RAW or triggering frame RAW, the RAW Slot Definition subfield also provides the N_{RAW} and slot duration information for RAW slot assignment. The procedure of RAW slot assignment is described in 10.22.5.3.

The RAW Start Time subfield indicates the duration, in units of 2 TU, from the end of the S1G Beacon, the Probe Response, or the PV1 Probe Response frame transmission that includes the RPS element to the start time of the RAW.

	B0 B1	B2 B11	B12 B23
	Page Index	RAW Start AID	RAW End AID
bits:	2	11	11

Figure 9-589ah—RAW Group subfield

The RAW Group subfield indicates the STA AIDs that are allowed restricted access within the RAW period. The RAW Group subfield contains Page Index, RAW Start AID, and RAW End AID subfields according to the hierarchical addressing method of AIDs (see Figure 9-127c). The Page Index subfield indicates the page index of the subset of AIDs.

The RAW Start AID field indicates the 11 LSBs of the AID of the STA with the lowest AID allocated in the RAW.

The RAW End AID field indicates the 11 LSBs of the AID of the STA with the highest AID allocated in the RAW.

The RAW Group field is set to all 0s to indicate that all STAs are allowed to access within the RAW.

The format of the Channel Indication subfield is shown in Figure 9-589ai. The Channel Activity Bitmap subfield shows the allowed operating channels for the STAs indicated in the RAW, as defined in 10.22.5.1. Each bit in the bitmap corresponds to one minimum width channel within the current BSS operating channels, with the least significant bit corresponding to the lowest numbered operating channel of the BSS. The Maximum Transmission Width, UL Activity, and DL Activity subfields are defined similarly as in 9.4.2.202.

	B0 B7	B8 B9	B10	B11	B12 B15
	Channel Activity Bitmap	Maximum Transmission Width	UL Activity	DL Activity	Reserved
Bits:	8	2	1	1	4

Figure 9-589ai—Channel Indication subfield

The Periodic Operation Parameters subfield comprises the PRAW Periodicity, PRAW Validity, and PRAW Start Offset subfields.

	PRAW Periodicity	PRAW Validity	PRAW Start Offset
Octets:	1	1	1

Figure 9-589aj—Periodic Operation Parameters subfield

The PRAW Periodicity subfield indicates the period of current PRAW occurrence in the unit of beacon interval if dot11ShortBeaconInterval is false and in the unit of short beacon interval if dot11ShortBeaconInterval is true (see 11.1.3.10.2).

The PRAW Validity subfield indicates the number of periods that the PRAW repeats. A nonzero PRAW Validity subfield indicates the number of remaining PRAW occurrences, while a PRAW Validity subfield equal to 0 indicates that the PRAW validity is not determined.

The PRAW Start Offset subfield indicates the offset value from the end of the frame that carries the current RPS element to the S1G Beacon frame that the first window of the PRAW appears, in units of beacon interval or short beacon interval.

9.4.2.193 Page Slice element

The Page Slice element contains a subset of blocks from a single page, called a page slice. The STAs included in a page slice and indicated by the Page Slice element are served during the beacon intervals within a page period, starting from the Beacon frame that carries the Page Slice element for the page (see 10.47. The frame format of the Page Slice element is defined in Figure 9-589ak.

	Element ID	Length	Page Period	Page Slice Control	Page Bitmap
Octets:	1	1	1	3	0–4

Figure 9-589ak—Page Slice element format

The Element ID and Length fields are defined in 9.4.2.1.

The Page Period field indicates the number of beacon intervals between successive beacons that carry the Page Slice element for the associated page.

The Page Slice Control field format is shown in Figure 9-589al.

	B0 B1	B2 B6	B7 B11	B12 B16	B17 B20	B21 B23
	Page Index	Page Slice Length	Page Slice Count	Block offset	TIM Offset	Reserved
Bits:	2	5	5	5	4	3

Figure 9-589al—Page Slice Control field format

The Page Index subfield indicates the page whose slices are served during beacon intervals within a page period. A value of 1 in the Page Index subfield indicates the second page out of the four pages defined in the hierarchical AID addressing (see 9.4.2.6).

The Page Slice Length subfield indicates the number of blocks included in each TIM for the associated page except for the last TIM. The number of blocks in each page slice is equal to the value of the Page Slice Length subfield. The value 0 for the Page Slice Length subfield is reserved. For the last TIM, the size of the last page slice, PS_{last}, is computed as

$$PS_{\text{last}} = P_{\text{length}} - (PS_{\text{count}} - 1) \times PS_{\text{length}}$$

where

P_{length} is the length (in bits) of a page indicated in the Page Bitmap field and is calculated as $P_{\text{length}} = 8 \times PB_{\text{length}}$

PB_{length} is the length of the page (in octets) indicated in the Page Bitmap field

PS_{count} is the value indicated in the Page Slice Count subfield

PS_{length} is the value indicated in the Page Slice Length subfield

For example, with a Page Bitmap field of 2 octets, a value in the Page Slice Length subfield equal to 3, and a value in the Page Slice Count subfield equal to 5, the page slice consists of 4 (=16 – 3×4) blocks for the last TIM, i.e., a value greater than the value indicated in the Page Slice Length subfield. Again, for example, with a Page Bitmap field of 2 octets, a value in the Page Slice Length subfield equal to 6, and a value in the Page Slice Count subfield equal to 3, the page slice consists of 4 (=16 – 6×2) blocks for the last TIM, i.e., a value less than the value indicated in the Page Slice Length subfield.

The number of blocks assigned to all the TIMs, except the last TIM, within a DTIM interval, P_{rem}, is computed as

$$P_{\text{rem}} = P_{\text{length}} - PS_{\text{last}}$$

where

P_{length} is the length of a page indicated in the Page Bitmap field

PS_{last} is the size of the last page slice

For every TIM, a STA computes the location of its block within a page slice, SB_{STA}, using the following equation:

$$SB_{\text{STA}} = AID[6:10] - BO$$

where

AID is the association identifier of the STA

BO is the value indicated in the Block Offset subfield of the Page Slice element

If the SB_{STA} is greater than the P_{length} or less than zero, the STA is not included in the page slice for the Page Period, otherwise:

— If SB_{STA} is greater than P_{rem}, the page slice number for the STA indicated in the Page Slice Number field of the TIM element is equal to the value indicated in the Page Slice Count subfield of the Page Slice element

— Otherwise, the page slice number for the STA, PS_{number}, is computed as

$$PS_{\text{number}} = \lfloor SB_{\text{STA}} / PS_{\text{length}} \rfloor$$

The Page Slice Count subfield indicates the number of TIMs scheduled in one page period, except when the value is equal to 0. This field indicates a maximum of 31 TIMs that include page slices in a page period. The

Page Slice Count subfield is set to 0 to indicate signaling that depends on the value of the Page Slice Length subfield:

— If the Page Slice Length subfield is greater than 1 a value of 0 in the Page Slice Count field indicates that the 32nd TIM that is scheduled during this DTIM interval can contain DL BU information for non-AP STAs that do not support page slicing and for non-AP STAs whose AID is within the 32nd block of this page and do support page slicing.
— If the Page Slice Length subfield is equal to 1, a value of 0 in the Page Slice Count subfield indicates that all non-AP STAs for which the AP has DL BU are included in the only TIM that is scheduled within the DTIM interval.

The Block Offset subfield indicates the offset of the block in the first page slice from the first block in the page assigned within the page period. A value of 16 in the Block Offset field indicates that the first page slice starts at block 16, i.e., STAs in the second half of the page are assigned within this page period.

The TIM Offset subfield indicates the offset, in number of beacon intervals, from the DTIM Beacon frame that carries the Page Slice element of a page to the beacon that carries the first page slice of the page indicated by the corresponding Page Slice element in the DTIM Beacon frame.

The Page Bitmap field indicates presence of buffered data for each of the one or more blocks in a page slice or all the assigned page slices within a page period. A bit in the Page Bitmap field indicates information of buffered data for STAs in one block of a page slice corresponding to the location of the bit in the bitmap. The first block indicated in the Page Bitmap field is the block indicated in the Block Offset subfield. Based on the number of page slices assigned to the TIMs, this field is of variable length from 0 to 4 octets. For example, a value of 129 in the Page Bitmap field indicates that there is buffered data for at least one STA in the first block and at least one STA in the last block. The bit sequence also indicates that only a page slice of 8 blocks is assigned within a page period. Further, the bit sequence indicates that there is no downlink buffered data for any STA in blocks 2 to 7. Hence these STAs can enter the doze state after receiving the group addressed BUs that are delivered by the AP following the DTIM Beacon frame as described in 11.2.3 and can avoid to wake up for the assigned TIM in the following TBTTs or TSBTTs within the DTIM interval to check for downlink buffered data.

9.4.2.194 AID Request element

The AID Request element contains information related to the characteristics of the device of the non-AP STA requesting an AID. The format of the AID Request element is shown in Figure 9-589am.

	Element ID	Length	AID Request Mode	AID Request Interval (Optional)	Peer STA Address (Optional)	Service Characteristic (Optional)	Group Address (Optional)
Octets:	1	1	1	0 or 2	0 or 6	0 or 1	0 or 6

Figure 9-589am—AID Request element format

The Element ID and Length fields are defined in 9.4.2.1.

The format of AID Request Mode field is shown in Figure 9-589an.

	B0	B1	B2	B3	B4	B5	B6 B7
	AID Request Interval Present	Peer STA Address Present	Service Characteristic Present	Non-TIM Mode Switch	TIM Mode Switch	Group Address Present	Reserved
Bits:	1	1	1	1	1	1	2

Figure 9-589an—AID Request Mode field format

The AID Request Interval Present subfield of the AID Request Mode field is set to 1 if the AID Request Interval field is present in the AID Request element and set to 0 if no AID Request Interval field is present.

The Peer STA Address Present subfield of the AID Request Mode field is set to 1 if the Peer STA Address field is present in the AID Request element and set to 0 if no Peer STA Address field is present.

The Service Characteristic Present subfield of the AID Request Mode field is set to 1 if the Service Characteristic field is present in the AID Request element and set to 0 if no Service Characteristic field is present.

The Non-TIM Mode Switch subfield of the AID Request Mode field is set to 1 if the non-AP STA requests to switch from the TIM mode to non-TIM mode. Otherwise, it is set to 0.

The TIM Mode Switch subfield of the AID Request Mode field is set to 1 if the non-AP STA requests to switch from the non-TIM mode to TIM mode. Otherwise, it is set to 0.

The Group Address Present subfield of the AID Request Mode field is set to 1 if the Group Address field is present in the AID Request element and is set to 0 if no Group Address field is present.

The AID Request Interval field indicates to the AP:

— The listen interval, in units of beacon interval or short beacon interval as defined in 9.4.1.6, during which the TIM STA wakes to receive S1G Beacon frames when the Non-TIM Mode Switch field is equal to 0, TIM Mode Switch field is equal to 1, and the Group Address Present field is equal to 0.
— The listen interval, in units of beacon interval or short beacon interval as defined in 9.4.1.6, during which the non-TIM STA is required to transmit at least one PS-Poll or trigger frame to the AP when the Non-TIM Mode Switch field is equal to 1, TIM Mode Switch is equal to 0, and the Group Address Present field is equal to 0.
— The group listen interval, in units of beacon interval or short beacon interval (see 11.1.3.10.2), during which the non-AP STA wakes up to receive the S1G Beacon frames that signal the presence of group addressed BUs for the group MAC address contained in the Group Address field. In this case the Group Address Present field is equal to 1 and the TIM Mode Switch field and Non-TIM Mode Switch field are equal to any value.

The AID Request Interval field contains a Unified Scaling Factor subfield (see Table 9-44a) and has a format as defined in Figure 9-71a. The AID Request Interval field is calculated as the value of the Unscaled Interval subfield multiplied by the scaling factor that corresponds to the value indicated in the Unified Scaling Factor subfield.

The Peer STA Address field indicates the MAC address of the peer STA for STA-to-STA communication.

The Service Characteristic field indicates the service characteristic provided by the non-AP STA so that the AP can assign a particular AID to the STA based on the service characteristic when the STA associates or requests AID switch. The format of the Service Characteristic field is shown in Figure 9-589ao.

	B0	B1	B2	B3 B7
	Sensor	Offload	Critical Service	Reserved
Bits:	1	1	1	5

Figure 9-589ao—Service Characteristic field format

The Sensor subfield of the Service Characteristic field is set to 1 to indicate that the non-AP STA provides a sensor or a meter type services. Otherwise, it is set to 0. The Offload subfield of the Service Characteristic field is set to 1 to indicate that the non-AP STA provides a traffic offloading services. Otherwise, it is set to 0. The Critical Service subfield of the Service Characteristic field is set to 1 to indicate that it provides critical services such as health care, home, industrial, alarm monitoring or emergency services. Otherwise, it is set to 0.

The Group Address field indicates the group MAC address of the requesting STA. When the Group Address field is present in the AID Request element, the AID Request element is carried in an AID Switch Request frame to request a group AID.

9.4.2.195 AID Response element

The AID Response element defines information about the AID assignment. The format of AID Response element is shown in Figure 9-589ap.

	Element ID	Length	AID/Group AID	AID Switch Count	AID Response Interval
Octets:	1	1	2	1	2

Figure 9-589ap—AID Response element format

The Element ID and Length fields are defined in 9.4.2.1.

The AID/Group AID field, which has the same format as the AID field described in 9.4.1.8, indicates:

— The AID that is assigned to the non-AP STA if the AID Response element is not sent as a response to an AID Switch Request frame that contained a Group Address field. If the AP does not change the AID of the STA, this field indicates the current AID assigned to the non-AP STA. If the AP changes the AID of the STA, this field indicates the changed AID assigned to the non-AP STA.

— The group AID that is assigned to a group MAC address if the AID Response element is sent as a response to an AID Switch Request frame that contained a Group Address field carrying the group MAC address.

The AID Switch Count field indicates a countdown value, in units of beacon interval or short beacon interval, that the AP sets for the non-AP STA to switch to the new AID or to activate the group AID. The countdown value is expressed in units of beacon interval if dot11ShortBeaconInterval is false and in units of short beacon interval if dot11ShortBeaconInterval is true (see 11.1.3.10.2). The AID Switch Count field indicates the duration after which the (group) listen interval starts and the counter that corresponds to the AID Switch Count field starts upon transmission of the AID Response element. The AID Switch Count field is set to 0 in an AID Response element that is carried in a (Re)Association Response frame.

The AID Response Interval field indicates to the non-AP STA:

- The listen interval in units of beacon interval or short beacon interval as defined in 9.4.1.6, during which the TIM STA wakes to receive S1G Beacon frames. The S1G Beacon frames that the TIM STA wakes up to listen either include a TIM element that can include their new AID or include a Page Slice element that indicates the assignment of the new AID in the corresponding page slices.
- The listen interval in units of beacon interval or short beacon interval as defined in 9.4.1.6, during which the non-TIM STA is required to transmit at least one PS-Poll or trigger frame to the AP.
- The group listen interval, in units of beacon interval or short beacon interval (see 11.1.3.10.2), during which the non-AP STA is required to wake up for receiving the S1G Beacon frames that signal the presence of group addressed BUs for the group MAC address contained in the Group Address field of the eliciting AID Switch Request frame. The (group) listen interval will start from the first TBTT or TSBTT that follows the expiration of the AID switch counter obtained from the AID Switch Count field of this element.

The AID Response Interval field contains a Unified Scaling Factor subfield (see Table 9-44a) and has a format as defined in Figure 9-71a. The AID Response Interval field is calculated as the value of the Unscaled Interval subfield multiplied by the scaling factor that corresponds to the value indicated in the Unified Scaling Factor subfield.

9.4.2.196 S1G Sector Operation element

The S1G Sector Operation element includes the information necessary for a receiving STA to determine the type of sector operation, if it is allowed to transmit during a specified sector time interval and if it can perform sector training. The S1G Sector Operation element is optionally present in Probe Response, Beacon or Association Response frames.

The format of the S1G Sector Operation element is presented in Figure 9-589aq and later in this subclause in Figure 9-589ar.

	B0 B7	B8 B15	B16	B17 B22	B23	B24 B26	B27 B30			
	Element ID	Length	Sectorization Type	Period	Omni	Sector ID	Number of Groups	Grpl Ds	Sector Duration	Pad
Bits:	8	8	1	6	1	3	4	variable	6	1, 3, 5, or 7

Figure 9-589aq—S1G Sector Operation element (sectorization type is group sectorization)

The Element ID and Length fields are defined in 9.4.2.1.

The Sectorization Type field indicates the type of sectorization. When the Sectorization Type field is equal to 0, it indicates that the format of the S1G Sector Operation element is structured for group sectorization operation.

NOTE—The Sectorization Type field can be set to 0 only when the Sectorized Beam-Capable field setting is either 2 or 3.

The Period field specifies the time interval, in units of 10 ms, until the next transmission of frames in the sector identified by the Sector ID field.

The Omni field indicates if the present transmission is sectorized or omnidirectional. When it is equal to 0, it indicates sectorized. When it is equal to 1, it indicates omnidirectional.

The Sector ID field identifies the ID of the active sector. It is reserved when Omni field is equal to 1.

The Number of Groups field indicates the number of GrpID subfields in the GrpIDs field following this field.

Each GrpID subfield is 6 bits and identifies the group of STAs that are allowed to transmit during this sector interval. The grpID 0 STAs are allowed to transmit within a beacon interval regardless of whether it is a sectorized beacon interval or not.

The Sector Duration field indicates the duration of the current sector transmissions, in units of 10 ms.

The Pad field contains 1, 3, 5 or 7 bits of 0s to make the total number of bits in the S1G Sector Operation element equal to an integer number of octets.

S1G Sector Operation element can be provided in Association Response frame when dot11S1GSectorizationActivated is true and it indicates the grpID allocated to that STA to be used during the sectorization purpose, the type of sectorization method, the value of the Period field, and the Sector Duration field if all the sector durations are equal. If the Sector Duration field (the sector time duration) is not equal for all sectors the Sector Duration field provided at the association time is 0. The values of the Sector ID and Omni fields are omitted by the STA in the Association Response frame. By default all the STAs that support group sectorization consider themselves in grpID 0 unless is specified otherwise via the Association Response frame. This way all the STAs can transmit at any time before their association. It is expected that during the association, STAs receive a nonzero grpID, which will restrict their activity to a particular sector interval or during omnidirectional time interval. An AP can allow some STAs to have the group zero even after association, for instance public safety STAs or some high priority sensors.

The S1G Sector Operation element in the Beacon frame will provide:

- Information related to the type of sectorization operation;
- Indication if the Beacon frame is sectorized or not;
- The sector ID of the current sector;
- The grpID that identifies the group allowed transmitting during the current sector duration; and
- The duration of this sector.

A STA that receives a Beacon frame that includes an S1G Sector Operation element determines if the received Beacon frame is sectorized or omnidirectional. If the received Beacon frame is omnidirectional the STAs are allowed to transmit in all geographical sectors provided that their group ID is group zero or it is listed in S1G Sector Operation element. If the received Beacon frame is sectorized, the STAs with group zero from any sector are allowed to transmit and the STAs that receive the sectorized Beacon frame and have the grpID listed in the S1G Sector Operation element are allowed to transmit during the current sector duration. A Beacon frame that not carries an S1G Sector Operation element does not impose any sectorization restriction on the receiving STAs.

When the sectorization type is TXOP-based sectorization operation, the element is presented in Figure 9-589ar.

	B0 B7	B8 B15	B16	B17	B18 B23	B24 B29	B30 B31
	Element ID	Length	Sectorization Type	Periodic Training Indicator	Training Period	Remaining Beacon Interval	Reserved
Bits:	8	8	1	1	6	6	2

Figure 9-589ar—S1G Sector Operation element (sectorization type is TXOP-based sectorization operation)

The Sectorization Type field is set to 1 to indicate that the format of the S1G Sector Operation element is structured for the TXOP-based sectorization operation.

NOTE—The Sectorization Type field can be set to 1 only when the Sectorized Beam-Capable field setting is 1 or 3.

The Periodic Training Indicator field is set to 1 to indicate periodic sector training is conducted by the AP and STAs can perform sector training. The Periodic Training Indicator field is set to 0 to indicate periodic sector training is not conducted by the AP.

The Training Period field is set to the number of beacon intervals in which the AP repeats the sector training.

The Remaining Beacon Interval field is set to the number of beacon intervals remaining before the next sector training commences. A value of 0 indicates the sector training is conducted in the current beacon interval.

9.4.2.197 S1G Beacon Compatibility element

The S1G Beacon Compatibility element carries the information that is shown in Figure 9-589as.

	Element ID	Length	Compatibility Information	Beacon Interval	TSF Completion
Octets	1	1	2	2	4

Figure 9-589as—S1G Beacon Compatibility element format

The Element ID and Length fields are defined in 9.4.2.1.

The Compatibility Information field contains all the subfields defined in 9.4.1.4 except for the subfield located in B6 of the field which is defined as the TSF Rollover Flag subfield. An S1G AP sets the TSF Rollover Flag subfield to the value of the most significant bit of the 4 least significant octets of the TSF timer at the time the TSF timer is read for the purpose of creating the element carrying the Compatibility Information field.

The Beacon Interval field in the element is defined in 9.4.1.3.

The TSF Completion field carries the 4 most significant octets of the TSF timer at the AP at the time of generation of the element carrying the TSF Completion field.

9.4.2.198 Short Beacon Interval element

The Short Beacon Interval element carries the short beacon interval and its format is shown in Figure 9-589at.

	Element ID	Length	Short Beacon Interval
Octets	1	1	2

Figure 9-589at—Short Beacon Interval element format

The Element ID and Length fields are defined in 9.4.2.1.

The Short Beacon Interval field represents the number of time units (TU)s between target short beacon transmission times (TSBTT)s.

9.4.2.199 Change Sequence element

The Change Sequence element indicates a change of system information within a BSS. The format of the Change Sequence element is shown in Figure 9-589au.

	Element ID	Length	Change Sequence
Octets:	1	1	1

Figure 9-589au—Change Sequence element format

The Element ID and Length fields are defined in 9.4.2.1.

The Change Sequence field is 1 octet and is defined as an unsigned integer, initialized to 0, that increments when a critical update occurs to any of the elements inside an S1G Beacon frame; see 10.42.2.

9.4.2.200 TWT element

The TWT element is shown in Figure 9-589av.

	Element ID	Length	Control	Request Type	Target Wake Time	TWT Group Assignment	Nominal Minimum TWT Wake Duration	TWT Wake Interval Mantissa	TWT Channel	NDP Paging (optional)
Octets:	1	1	1	2	8 or 0	9 or 3 or 0	1	2	1	0 or 4

Figure 9-589av—TWT element format

The Element ID and Length fields are defined in 9.4.2.1.

The format of the Control field is shown in Figure 9-589aw.

	B1	B2	B3 B8
	NDP Paging Indicator	Responder PM Mode	Reserved
Bits:	1	1	6

Figure 9-589aw—Control field format

The NDP Paging field is present if the NDP Paging Indicator subfield is equal to 1; otherwise, the NDP Paging field is not present.

The Responder PM Mode subfield indicates the power management mode as defined in 11.2.

The format of the Request Type field is shown in Figure 9-589ax.

	B0	B1 B3	B4	B5	B6	B7 B9	B10 B14	B15
	TWT Request	TWT Setup Command	Reserved	Implicit	Flow Type	TWT Flow Identifier	TWT Wake Interval Exponent	TWT Protection
Bits:	1	3	1	1	1	3	5	1

Figure 9-589ax—Request Type field format

A STA that transmits a TWT element with the TWT Request subfield equal to 1 is a TWT requesting STA. Otherwise, it is a TWT responding STA.

The TWT Setup Command subfield values indicate the type of TWT command, as shown in Table 9-262k.

Table 9-262k—TWT Setup Command field values

TWT Setup Command field value	Command name	Description when transmitted by a TWT requesting STA	Description when transmitted by a TWT responding STA
0	Request TWT	The Target Wake Time field of the TWT element contains 0s as the TWT responding STA specifies the target wake time value for this case, other TWT parameters* are suggested by the TWT requesting STA in the TWT request.	N/A
1	Suggest TWT	TWT requesting STA includes a set of TWT parameters such that if the requested target wake time value and/or other TWT parameters cannot be accommodated, then the TWT setup might still be accepted.	N/A

Table 9-262k—TWT Setup Command field values *(continued)*

TWT Setup Command field value	Command name	Description when transmitted by a TWT requesting STA	Description when transmitted by a TWT responding STA
2	Demand TWT	TWT requesting STA includes a set of TWT parameters such that if the requested target wake time value and/or other TWT parameters cannot be accommodated, then the TWT setup will not be accepted.	N/A
3	TWT Grouping	N/A	TWT responding STA suggests TWT group parameters that are different from the suggested or demanded TWT parameters of the TWT requesting STA
4	Accept TWT	N/A	TWT responding STA accepts the TWT request with the TWT parameters (See NOTE) indicated in the TWT element transmitted by the responding STA
5	Alternate TWT	N/A	TWT responding STA suggests TWT parameters that are different from TWT requesting STA suggested or demanded TWT parameters
6	Dictate TWT	N/A	TWT responding STA demands TWT parameters that are different from TWT requesting STA TWT suggested or demanded parameters
7	Reject TWT	N/A	TWT responding STA rejects TWT setup
NOTE—TWT Parameters are TWT, Nominal Minimum TWT Wake Duration, TWT Wake Interval, and TWT Channel subfield values indicated in the element.			

When transmitted by a TWT requesting STA, the Implicit subfield is set to 1 to request an implicit TWT.

When transmitted by a TWT requesting STA, the Implicit subfield is set to 0 to request an explicit TWT.

The Flow Type subfield indicates the type of interaction between the TWT requesting STA and the TWT responding STA at a TWT. A value of 0 in the Flow Type subfield indicates an announced TWT in which the TWT requesting STA will send a PS-Poll or an APSD trigger frame (see 11.2.2.5) to signal its awake state to the TWT responding STA before a frame is sent from the TWT responding STA to the TWT requesting STA. A value of 1 in the Flow Type subfield indicates an unannounced TWT in which the TWT responding STA will send a frame to the TWT requesting STA at TWT without waiting to receive a PS-Poll or an APSD trigger frame from the TWT requesting STA.

The TWT Flow Identifier subfield contains a 3-bit value, which identifies the specific information for this TWT request uniquely from other requests made between the same TWT requesting STA and TWT responding STA pair.

In a TWT element transmitted by a TWT requesting STA, the TWT wake interval is equal to the average time that the TWT requesting STA expects to elapse between successive TWT SPs. In a TWT element transmitted by a TWT responding STA, the TWT wake interval is equal to the average time that the

TWT-responding STA expects to elapse between successive TWT SPs. The TWT Wake Interval Exponent subfield is set to the value of the exponent of the TWT wake interval value in microseconds, base 2. The TWT wake interval of the requesting STA is equal to (TWT Wake Interval Mantissa) $\times 2^{(\text{TWT Wake Interval Exponent})}$.

When transmitted by a TWT requesting STA, the Target Wake Time field contains a positive integer, which corresponds to a TSF time at which the STA requests to wake, or a value of zero when the TWT Setup Command subfield contains the value corresponding to the command "Request TWT". When a TWT responding STA with dot11TWTGroupingSupport equal to 0 transmits a TWT element to the TWT requesting STA, the TWT element contains a value in the Target Wake Time field which corresponds to a TSF time at which the TWT responding STA requests the TWT requesting STA to wake and it does not contain the TWT Group Assignment field.

When a TWT responding STA with dot11TWTGroupingSupport equal to 1 transmits the TWT element to the TWT requesting STA from which it received a frame containing an S1G Capabilities element with the TWT Grouping Support subfield equal to 1, the TWT element does not contain the Target Wake Time field and it does contain the TWT Group Assignment field in order to indicate the TWT group of the requesting STA and the assigned TWT value. The presence of the TWT Group Assignment field is indicated by a TWT responding STA by using the TWT Grouping command in the TWT Setup Command subfield (see Table 9-262k) within the TWT element.

	B0 B6	B7	B8 B55	B56 B59	B60 B71
	TWT Group ID	Zero Offset Present	Zero Offset of Group (optional)	TWT Unit	TWT Offset
Bits:	7	1	48 or 0	4	12

Figure 9-589ay—TWT Group Assignment field format

The TWT Group Assignment field provides information to a requesting STA about the TWT group to which the STA is assigned. This field contains the TWT Group ID, Zero Offset of Group (optional), TWT Unit, and TWT Offset subfields. The TWT Group Assignment field and the corresponding subfields are depicted in Figure 9-589ay.

The TWT Group ID subfield is a 7-bit unsigned integer and indicates the identifier of the TWT group to which the requesting STA is assigned. A TWT group is a group of STAs that have TWT values that lie within a specific interval of TSF values. The value zero in the TWT Group ID subfield is used to indicate the unique TWT group, which contains all STAs in the BSS.

The Zero Offset Present subfield indicates whether the following Zero Offset of Group subfield is included in the TWT Group Assignment field of the TWT element. A value of 0 in the Zero Offset Present subfield indicates that the Zero Offset of the Group subfield is not included in the TWT Group Assignment field.

The Zero Offset of Group subfield indicates the initial TWT value for the TWT group identified by the TWT group ID. The Zero Offset of Group subfield is six octets and contains the initial TWT value for the TWT group with the given TWT group ID. When the Zero Offset of Group subfield is present, it contains the lowest 6 octets of the TSF time corresponding to the TWT group offset time. The Zero Offset of Group subfield is optionally present in the TWT Group Assignment field. If a STA transmits multiple TWT requests for multiple TWT flows, the next TWT Group Assignment field transmitted in a response to a TWT request can optionally exclude the Zero Offset of the Group subfield from an included TWT Group Assignment field provided that a previous response included a Zero Offset of the Group subfield. The receipt of a TWT response with a TWT Group Assignment field with no Zero Offset of the Group subfield implies that the Zero Offset of the Group subfield value for that TWT is the same as the Zero Offset of the

Group subfield value for the most recently received Zero Offset of the Group subfield for the same TWT group ID from the TWT responding STA.

The TWT Unit subfield indicates the unit of increment of the TWT values within the TWT group identified by the TWT group ID. The TWT Unit subfield encoding is shown in Table 9-262l.

Table 9-262l—TWT Unit subfield encoding

TWT Unit subfield value	TWT Unit time value
0	32 µs
1	256 µs
2	1024 µs
3	8.192 ms
4	32.768 ms
5	262.144 ms
6	1.048576 s
7	8.388608 s
8	33.554432 s
9	268.435456 s
10	1073.741824 s
11	8589.934592 s
12–15	Reserved

The TWT Offset subfield indicates the position within the indicated group, of the STA corresponding to the RA of the frame containing the TWT element.

A non-AP STA uses the TWT Group ID, Zero Offset of Group, TWT Unit, and TWT Offset subfield values to compute its TWT value within the TWT group. A STA's TWT value is equal to the value of the Zero Offset of Group subfield plus TWT Offset subfield times the value of TWT Unit subfield.

The Nominal Minimum TWT Wake Duration field indicates the minimum amount of time, in units of 256 µs, that the TWT requesting STA expects that it needs to be awake in order to complete the frame exchanges associated with the TWT flow identifier for the period of TWT wake interval, where TWT wake interval is the average time that the TWT requesting STA expects to elapse between successive TWT SPs.

The TWT Wake Interval Mantissa subfield is set to the value of the mantissa of the TWT wake interval value in microseconds, base 2.

When transmitted by a TWT requesting STA, the TWT Channel field contains a bitmap indicating which channel the STA requests to use as a temporary primary channel during a TWT SP. When transmitted by a TWT responding STA, the TWT Channel field contains a bitmap indicating which channel the TWT requesting STA is allowed to use as a temporary channel during the TWT SP. Each bit in the bitmap corresponds to one minimum width channel for the band in which the TWT responding STA's associated BSS is currently operating, with the least significant bit corresponding to the lowest numbered channel of the operating channels of the BSS.The minimum width channel is equal to the SST Channel Unit field of the

SST Operation element if such an element has been previously received or is equal to 1 MHz for a BSS with a BSS primary channel width of 1 MHz and 2 MHz for a BSS with a BSS primary channel width of 2 MHz if no such element has been previously received from the AP to which the SST STA is associated. A value of 1 in a bit position in the bitmap transmitted by a TWT requesting STA means that operation with that channel as the primary channel is requested during a TWT SP. A value of 1 in a bit position in the bitmap transmitted by a TWT responding STA means that operation with that channel as the primary channel is allowed during the TWT SP.

A TWT requesting STA sets the TWT Protection subfield to 1 to request the TWT responding STA to provide protection of the set of TWT SPs corresponding to the requested TWT flow identifier by allocating RAW(s) that restrict access to the medium during the TWT SP(s) for that(those) TWTs. A TWT requesting STA sets the TWT Protection subfield to 0 if TWT protection by RAW allocation is not requested for the corresponding TWT(s).

When transmitted by a TWT responding STA that is an AP, the TWT Protection subfield indicates whether the TWT SP(s) identified in the TWT element will be protected. A TWT responding STA sets the TWT Protection subfield to 1 to indicate that the TWT SP(s) corresponding to the TWT flow identifier(s) of the TWT element will be protected by allocating RAW(s) that restrict access to the medium during the TWT SP(s) for that(those) TWT(s). A TWT responding STA sets the TWT Protection subfield to 0 to indicate that the TWT SP(s) identified in the TWT element might not be protected from TIM STAs by allocating RAW(s).

The format of the NDP Paging field is defined in Figure 9-589az.

	B0 B8	B9 B16	B17 B20	B21 B23	B24 B29	B30 B31
	P-ID	Max NDP Paging Period	Partial TSF Offset	Action	Min Sleep Duration	Reserved
Bits:	9	8	4	3	6	2

Figure 9-589az—NDP Paging field format

The P-ID field is the identifier of the paged STA, as described in 10.43.6.

The Max NDP Paging Period field indicates the maximum number of TWT wake intervals between two NDP Paging frames.

The Partial TSF Offset field includes timing indications, as described in 10.43.6.

Upon reception of an NDP Paging frame with matching P-ID field as defined in 10.43.6, the TWT STA that is an NDP Paging requester takes an action indicated by the Action field as described in Table 9-262m.

Table 9-262m—Action field

Action	Options
0	Send a PS-Poll or uplink trigger frame
1	Wake up at the time indicated by Min Sleep Duration
2	Wake up to receive the Beacon
3	Wake up to receive the DTIM Beacon
4	Wakeup at the time indicated by the sum of the Min Sleep Duration field and the ASD subfield in the APDI field of the NDP Paging frame
5–7	Reserved

The Min Sleep Duration field in the NDP Paging Request indicates in units of SIFS the minimum duration that STA will be in the Doze state after receiving an NDP Paging with matching P-ID.

9.4.2.201 S1G Capabilities element

9.4.2.201.1 S1G Capabilities element structure

An S1G STA declares that it is an S1G STA by transmitting the S1G Capabilities element.

The S1G Capabilities element contains a number of fields that are used to advertise S1G capabilities of an S1G STA. The S1G Capabilities element is defined in Figure 9-589ba.

	Element ID	Length	S1G Capabilities Information	Supported S1G-MCS and NSS Set
Octets:	1	1	10	5

Figure 9-589ba—S1G Capabilities element format

The Element ID and Length fields are defined in 9.4.2.1.

9.4.2.201.2 S1G Capabilities Information field

The structure of the S1G Capabilities Information field is defined in Figure 9-589bb.

	B0	B1	B2	B3	B4	B5	B6	B7
	S1G_LONG Support	Short GI for 1 MHz	Short GI for 2 MHz	Short GI for 4 MHz	Short GI for 8 MHz	Short GI for 16 MHz	Supported Channel Width	
Bits:	1	1	1	1	1	1	2	

	B8	B9	B10	B11	B12	B13		B15
	Rx LDPC	Tx STBC	Rx STBC	SU Beamformer Capable	SU Beamformee Capable	Beamformee STS Capability		
Bits:	1	1	1	1	1	3		

	B16		B18	B19	B20	B21	B22	B23
	Number Of Sounding Dimensions			MU Beamformer Capable	MU Beamformee Capable	+HTC-VHT Capable	Traveling Pilot Support	
Bits:	3			1	1	1	2	

	B24	B25	B26	B27	B28	B29		B31
	RD Responder	HT-Delayed Block Ack	Maximum MPDU Length	Maximum A-MPDU Length Exponent		Minimum MPDU Start Spacing		
Bits:	1	1	1	2		3		

	B32	B33	B34	B35	B36	B37	B38	B39
	Uplink Sync Capable	Dynamic AID	BAT Support	TIM ADE Support	Non-TIM Support	Group AID Support	STA Type Support	
Bits:	1	1	1	1	1	1	2	

	B40	B41	B42	B43	B44	B45	B46	B47
	Centralized Authentication Control	Distributed Authentication Control	A-MSDU Supported	A-MPDU Supported	Asymmetric Block Ack Supported	Flow Control Supported	Sectorized Beam-Capable	
Bits:	1	1	1	1	1	1	2	

	B48	B49	B50	B51	B52	B53	B54	B55
	OBSS Mitigation Support	Fragment BA Support	NDP PS-Poll Supported	RAW Operation Support	Page Slicing Support	TXOP Sharing Implicit Ack Support	VHT Link Adaptation Capable	
Bits:	1	1	1	1	1	1	2	

Figure 9-589bb—S1G Capabilities Information field

	B56	B57	B58	B59	B60	B61	B62	B63
	TACK Support as PS-Poll Response	Duplicate 1 MHz Support	MCS Negotiation Support	1 MHz Control Response Preamble Support	NDP Beamforming Report Poll Supported	Unsolicited Dynamic AID	Sector Training Operation Support	Temporary PS Mode Switch
Bits:	1	1	1	1	1	1	1	1

	B64	B65	B66		B68	B69	B70	B71
	TWT Grouping Support	BDT Capable	COLOR			TWT Requester Support	TWT Responder Support	PV1 Frame Support
Bits:	1	1	3				1	1

	B72	B73	B79
	Link Adaptation per Normal Control Response Capable	Reserved	
Bits:	1	7	

Figure 9-589bb—S1G Capabilities Information field *(continued)*

The subfields of the S1G Capabilities Information field are defined in Table 9-262n.

Table 9-262n—Subfields of the S1G Capabilities Information field

Subfield	Definition	Encoding
S1G_LONG Support	Indicates support for the reception of S1G_LONG PPDUs. See 23.3.2.	Set to 0 if not supported. Set to 1 if supported.
Short GI for 1 MHz	Indicates short GI support for the reception of packets transmitted with TXVECTOR parameters FORMAT equal to S1G and CH_BANDWIDTH equal to CBW1.	Set to 0 if not supported. Set to 1 if supported.
Short GI for 2 MHz	Indicates short GI support for the reception of packets transmitted with TXVECTOR parameters FORMAT equal to S1G and CH_BANDWIDTH equal to CBW2.	Set to 0 if not supported. Set to 1 if supported.
Short GI for 4 MHz	Indicates short GI support for the reception of packets transmitted with TXVECTOR parameters FORMAT equal to S1G and CH_BANDWIDTH equal to CBW4.	Set to 0 if not supported. Set to 1 if supported.
Short GI for 8 MHz	Indicates short GI support for the reception of packets transmitted with TXVECTOR parameters FORMAT equal to S1G and CH_BANDWIDTH equal to CBW8.	Set to 0 if not supported. Set to 1 if supported.

Table 9-262n—Subfields of the S1G Capabilities Information field *(continued)*

Subfield	Definition	Encoding
Short GI for 16 MHz	Indicates short GI support for the reception of packets transmitted with TXVECTOR parameters FORMAT equal to S1G and CH_BANDWIDTH equal to CBW16.	Set to 0 if not supported. Set to 1 if supported.
Supported Channel Width	Indicates the channel widths supported by the STA. See 10.42.	Set to 0 if the STA supports 1 MHz and 2 MHz operation. Set to 1 if the STA supports 1 MHz, 2 MHz, and 4 MHz operation. Set to 2 if the STA supports 1 MHz, 2 MHz, 4 MHz, and 8 MHz operation. Set to 3 if the STA supports 1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz operation.
Rx LDPC	Indicates support for receiving LDPC encoded packets.	Set to 0 if not supported. Set to 1 if supported.
Tx STBC	Indicates support for the transmission of at least 2x1 STBC.	Set to 0 if not supported. Set to 1 if supported.
Rx STBC	Indicates support for the reception of PPDUs using STBC.	Set to 0 if not supported. Set to 1 if supported.
SU Beamformer Capable	Indicates support for operation as an SU beamformer (see 10.34.5).	Set to 0 if not supported. Set to 1 if supported.
SU Beamformee Capable	Indicates support for operation as an SU beamformee (see 10.34.5).	Set to 0 if not supported. Set to 1 if supported.
Beamformee STS Capability	The maximum number of space-time streams that the STA can receive in an S1G NDP, the maximum value for $N_{STS,total}$ that can be sent to the STA in an S1G MU PPDU if the STA is MU beamformee capable and the maximum value of *Nr* that the STA transmits in a VHT Compressed Beamforming frame.	If SU beamformee capable, set to maximum number of space-time streams that the STA can receive in an S1G NDP minus 1. Otherwise reserved.
Number Of Sounding Dimensions	Beamformer's capability indicating the maximum value of the TXVECTOR parameter NUM_STS for an S1G NDP.	If SU beamformer capable, set to the maximum supported value of the TXVECTOR parameter NUM_STS minus 1. Otherwise reserved.
MU Beamformer Capable	Indicates support for operation as an MU beamformer (see 10.34.5).	Set to 0 if not supported or if SU Beamformer Capable is set to 0 or if sent by a non-AP STA. Set to 1 if supported and SU Beamformer Capable is equal to 1.
MU Beamformee Capable	Indicates support for operation as an MU beamformee (see 10.34.5).	Set to 0 if not supported or if SU Beamformee Capable is set to 0 or if sent by an AP. Set to 1 if supported and SU Beamformee Capable is equal to 1.
+HTC-VHT Capable	Indicates whether or not the STA supports receiving a VHT variant HT Control field.	Set to 0 if not supported. Set to 1 if supported.

Table 9-262n—Subfields of the S1G Capabilities Information field *(continued)*

Subfield	Definition	Encoding
Traveling Pilot Support	Indicates support for the reception of PPDUs with a traveling pilots. See 23.3.9.10.	Set to 1 if dot11S1GTravelingPilotOptionActivated is true, and reception of traveling pilot for one space-time stream is supported but reception of traveling pilot for two space-time streams with STBC is not supported. Set to 3 if dot11S1GTravelingPilotOptionActivated is true, and reception of traveling pilot for both one space-time stream and two space-time streams with STBC is supported. Set to 0 if dot11S1GTravelingPilotOptionActivated is false. Value 2 is reserved.
RD Responder	Indicates support for acting as a reverse direction responder, i.e., the STA can use an offered RDG to transmit data to an RD initiator using the reverse direction protocol described in 10.28.	Set to 0 if not supported. Set to 1 if supported.
HT-Delayed Block Ack	Indicates support for HT delayed Block Ack operation. See 10.24.8.	Set to 0 if not supported. Set to 1 if supported. Support indicates that the STA is able to accept an ADDBA request for HT-delayed Block Ack.
Maximum MPDU Length	Indicates the maximum MPDU length (see 10.12).	Set to 0 for 3895 octets. Set to 1 for 7991 octets.
Maximum A-MPDU Length Exponent	Indicates the maximum length of A-MPDU that the STA can receive. EOF padding is not included in this limit.	This field is an integer in the range 0 to 3. The length defined by this field is equal to $2^{(13+\text{Maximum A-MPDU Length Exponent})}-1$ octets.
Minimum MPDU Start Spacing	Determines the minimum time between the start of adjacent MPDUs within an A-MPDU that the STA can receive, measured at the PHY-SAP. See 10.13.3.	Set to 0 for no restriction Set to 1 for 1/4 µs Set to 2 for 1/2 µs Set to 3 for 1 µs Set to 4 for 2 µs Set to 5 for 4 µs Set to 6 for 8 µs Set to 7 for 16 µs
Uplink Sync Capable	If sent by an AP, this subfield indicates support for sync frame transmission for uplink. If sent by a non-AP STA, this subfield indicates request for sync frame transmission for uplink. See 10.45.1.	If sent by an AP: Set to 0 if not supported. Set to 1 if supported. If sent by a non-AP STA: Set to 0 if not requested. Set to 1 if requested.
Dynamic AID	The STA sets the Dynamic AID field to 1 when dot11DynamicAIDActivated is true, and sets it to 0 otherwise. See 10.20a.	Set to 1 if dot11DynamicAIDActivated is true. Set to 0 otherwise.

Table 9-262n—Subfields of the S1G Capabilities Information field *(continued)*

Subfield	Definition	Encoding
BAT Support	The BAT Support subfield indicates support for the use of the Block Acknowledgment TWT (BAT) frame in Block Agreements. When dot11BATImplemented is true, this field is set to 1 to indicate support for BAT frames as both originator and recipient.	Set to 1 if dot11BATImplemented is true. Set to 0 otherwise.
TIM ADE Support	This bit indicates support of the ADE mode of TIM bitmap encoding as described in 9.4.2.6.5.	Set to 1 if dot11TIMADEImplemented is true. Set to 0 otherwise.
Non-TIM Support	This bit indicates support of non-TIM mode.	In a non-AP STA: Set to 0: the non-AP STA does not support non-TIM mode, it needs TIM entry as in legacy PS mode Set to 1: the non-AP STA supports non-TIM mode and it does not need TIM entry when in non-TIM mode In an AP: Set to 0: the AP does not support the STA's non-TIM mode Set to 1: the AP supports the STA's non-TIM mode
Group AID Support	This bit indicates support of group traffic delivery using a group AID as described in 10.51.	Set to 1 if dot11GroupAIDActivated is true. Set to 0 otherwise.
STA Type Support	If sent by an AP, this subfield indicates the STA types that are supported by the AP. If sent by a non-AP STA, this subfield indicates the STA type of the non-AP STA.	If sent by an AP: Set to 0 if the AP supports both sensor STAs and non-sensor STAs. Set to 1 if the AP supports only sensor STAs. Set to 2 if the AP supports only non-sensor STAs. 3 is reserved. If sent by a non-AP STA: Set to 1 if the STA is a sensor STA. Set to 2 if the STA is a non-sensor STA. 0 and 3 are reserved.
Centralized Authentication Control	This field indicates support of the centralized authentication control defined in 11.3.9.2.	Set to 1 if dot11S1GCentralizedAuthenticationControlActivated is true. Set to 0 otherwise.
Distributed Authentication Control	This field indicates support of the distributed authentication control defined in 11.3.9.3.	Set to 1 if dot11S1GDistributedAuthenticationControlActivated is true. Set to 0 otherwise.
A-MSDU Supported	This bit indicates support of Aggregated MSDU	Set to 1 if dot11AMSDUImplemented is true. Set to 0 otherwise.
A-MPDU Supported	This bit indicates support of Aggregated MPDU	Set to 1 if dot11AMPDUImplemented is true. Set to 0 otherwise.

Table 9-262n—Subfields of the S1G Capabilities Information field *(continued)*

Subfield	Definition	Encoding
Asymmetric Block Ack Supported	This bit indicates support of Asymmetric Block Ack	Set to 1 if dot11AsymmetricBlockAckActivated is true. Set to 0 otherwise.
Flow Control Supported	Indicates support for flow control operation	Set to 0 if not supported Set to 1 if supported
Sectorized Beam-Capable	The Sectorized Beam-Capable subfield indicates which type of sectorization operation is supported by the STA.	If sent by an AP: Set to 0 if sectorization operation is not supported, Set to 1 if only TXOP-based sectorization operation is supported, Set to 2 if only group sectorization operation is supported, Set to 3 if both group sectorization and TXOP-based sectorization operations are supported. If sent by a non-AP STA: Set to 0 if not supported, Set to 1 if supported When equal to 1, a non-AP STA supports both group sectorization and TXOP-based sectorization operation.
OBSS Mitigation Support	The OBSS Mitigation Support subfield indicates whether the STA supports channel width reduction during a TXOP for OBSS mitigation.	Set to 1 to indicate that the STA supports channel width reduction during a TXOP for OBSS mitigation. Set to 0 otherwise.
Fragment BA Support	This bit indicates support of fragment BA procedure.	Set to 1 if dot11FragmentBAOptionImplemented is true. Set to 0 otherwise.
NDP PS-Poll Supported	This bit indicates support for NDP PS-Poll frames	Set to 1 if dot11NDPPSPollSupport is true. Set to 0 otherwise.
RAW Operation Support	This bit indicates support of RAW Participating as described in 10.22.5.1.	Set to 1 if dot11RAWOperationImplemented is true. Set to 0 otherwise.
Page Slicing Support	This bit indicates support of Page Slicing as described in 10.47.	Set to 1 if dot11PageSlicingImplemented is true. Set to 0 otherwise.
TXOP Sharing Implicit Ack Support	This bit indicates support of Implicit Ack in TXOP sharing.	Set to 1 if dot11TXOPSharingImplicitACKImplemented is true. Set to 0 otherwise.

Table 9-262n—Subfields of the S1G Capabilities Information field *(continued)*

Subfield	Definition	Encoding
VHT Link Adaptation Capable	Indicates whether or not the STA supports link adaptation using VHT variant HT Control field.	If +HTC-VHT Capable is 1: Set to 0 (No Feedback) if the STA does not provide VHT MFB. Set to 2 (Unsolicited) if the STA provides only unsolicited VHT MFB. Set to 3 (Both) if the STA can provide VHT MFB in response to VHT MRQ and if the STA provides unsolicited VHT MFB. The value 1 is reserved. Reserved if +HTC-VHT Capable is 0.
TACK Support as PS-Poll Response	This bit indicates whether the AP supports the using of TACK frame as the response to a PS-Poll frame with the Poll Type subfield equal to 1 as described in 10.44.2.	Set to 1 if dot11PollTACKResponseImplemented is true. Set to 0 otherwise.
Duplicate 1 MHz Support	This bit indicates support for transmission of 1 MHz duplicate PPDUs	Set to 1 if generation of a PPDU in duplicate 1 MHz format is supported as a response to an eliciting frame transmitted by the peer STA. Set to 0 otherwise
MCS Negotiation Support	Indicates if the STA supports control response MCS negotiation feature	Set to 0 if not supported Set to 1 if supported
1 MHz Control Response Preamble Support	Indicates if the STA supports transmitting control response frames with 1 MHz preamble as the response of ≥2 MHz PPDUs	Set to 0 if not supported Set to 1 if supported
NDP Beamforming Report Poll Supported	Indicates support for reception of NDP Beamforming Report Poll frames	Set to 0 if not supported Set to 1 if supported
Unsolicited Dynamic AID	The STA sets the Unsolicited Dynamic AID field to 1 when dot11UnsolicitedDynamicAIDActivated is true, and sets it to 0 otherwise. See 10.20a.	Set to 1 if dot11UnsolicitedDynamicAIDActivated is true. Set to 0 otherwise.
Sector Training Operation Supported	This bit indicates support of sector training operation described in 10.49.5.	Set to 0 if not supported, Set to 1 if supported When equal to 1, a STA supports sector training operation.
Temporary PS Mode Switch	This bit indicates whether the non-TIM STA supports the temporary PS Mode switch as described in 10.44.2.	Set to 1 if dot11TemporaryPSModeSwitch is true. Set to 0 otherwise.
TWT Grouping Support	This bit indicates support of TWT grouping described in 10.43.5	Set to 0 if not supported Set to 1 if supported
BDT Capable	Indicates the support of bidirectional TXOP operation described in 10.46.	Set to 0 if not supported Set to 1 if supported
COLOR	Indicates the value that is used for the TXVECTOR parameter COLOR in frames transmitted by members of this BSS, as described in 10.20b.	Set to an unsigned integer in the range 0 to 7 if sent by an AP. Otherwise reserved.

Table 9-262n—Subfields of the S1G Capabilities Information field *(continued)*

Subfield	Definition	Encoding
TWT Requester Support	This bit indicates support for the role of TWT requesting STA as described in 10.43	Set to 1 if dot11TWTOptionActivated is true and the STA supports TWT requester STA functionality (see 10.43) Set to 0 otherwise.
TWT Responder Support	This bit indicates support for the role of TWT responding STA	Set to 1 if dot11TWTOptionActivated is true and the STA supports TWT responding STA functionality (see 10.43) Set to 0 otherwise.
PV1 Frame Support	Indicates support for PV1 MPDUs	Set to 0 if not supported Set to 1 if supported
Link Adaptation per Normal Control Response Capable	Indicate whether or not link adaptation through normal control frame is allowed	Set to 0 if not supported. Set to 1 if supported.

9.4.2.201.3 Supported S1G-MCS and NSS Set field

The Supported S1G-MCS and NSS Set field is used to convey the combinations of S1G-MCSs and spatial streams that a STA supports for reception and the combinations that it supports for transmission. The structure of the field is shown in Figure 9-589bc.

	B0 B7	B8 B16	B17 B24	B25 B33	B34 B35	B36 B37	B38 B39
	Rx S1G-MCS Map	Rx Highest Supported Long GI Data Rate	Tx S1G-MCS Map	Tx Highest Supported Long GI Data Rate	Rx Single Spatial Stream and S1G-MCS Map for 1 MHz	Tx Single Spatial Stream and S1G-MCS Map for 1 MHz	Reserved
Bits:	8	9	8	9	2	2	2

Figure 9-589bc—Supported S1G-MCS and NSS Set field format

The Supported S1G-MCS and NSS Set subfields are defined in Table 9-262o.

Table 9-262o—Supported S1G-MCS and NSS Set subfields

Subfield	Definition	Encoding
Rx S1G-MCS Map	Indicates the maximum value of the RXVECTOR parameter MCS of a PPDU that can be received at all channel widths supported by this STA for each number of spatial streams.	The format and encoding of this subfield are defined in Figure 9-589bd and the associated description. If Rx Single Spatial Stream and S1G-MCS Map for 1 MHz subfield is greater than or equal to 1, then only the value of the Max S1G-MCS For 1 SS subfield that is indicated by the Rx Single Spatial Stream and S1G-MCS Map subfield is applicable for 1 MHz channel width.

Table 9-262o—Supported S1G-MCS and NSS Set subfields *(continued)*

Subfield	Definition	Encoding
Rx Highest Supported Long GI Data Rate	Indicates the highest long GI S1G data rate that the STA is able to receive.	The largest integer value less than or equal to the highest long GI S1G PPDU data rate in Mb/s the STA is able to receive (see 10.7.13.1). The value 0 indicates that this subfield does not specify the highest long GI S1G PPDU data rate that the STA is able to receive.
Tx S1G-MCS Map	Indicates the maximum value of the TXVECTOR parameter MCS of a PPDU that can be transmitted at all channel widths supported by this STA for each number of spatial streams.	The format and encoding of this subfield are defined in Figure 9-589bd and the associated description. If Tx Single Spatial Stream and S1G-MCS Map for 1 MHz subfield is greater than or equal to 1, then only the value of the Max S1G-MCS For 1 SS subfield that is indicated by the Tx Single Spatial Stream and S1G-MCS Map subfield is applicable for 1 MHz channel width.
Tx Highest Supported Long GI Data Rate	Indicates the highest long GI S1G PPDU data rate that the STA is able to transmit at.	The largest integer value less than or equal to the highest long GI S1G PPDU data rate in Mb/s that the STA is able to transmit (see 10.7.13.2). The value 0 indicates that this subfield does not specify the highest long GI S1G PPDU data rate that the STA is able to transmit.
Rx Single Spatial Stream and S1G-MCS Map for 1 MHz	Indicates whether only a single spatial stream PPDU can be received at 1 MHz channel width by this STA.	0: same number of spatial streams and same Max S1G-MCS as indicated by Rx S1G-MCS Map field. 1: single spatial stream only and with Max S1G-MCS as indicated by a value of 0 in the S1G-MCS for 1 SS subfield. 2: single spatial stream only and with Max S1G-MCS as indicated by a value of 1 in the S1G-MCS for 1 SS subfield. 3: single spatial stream only and with Max S1G-MCS as indicated by a value of 2 in the S1G-MCS for 1 SS subfield.
Tx Single Spatial Stream and S1G-MCS Map for 1 MHz	Indicates whether only a single spatial stream PPDU can be transmitted at 1 MHz channel width by this STA.	0: same number of spatial streams and same Max S1G-MCS as indicated by Tx S1G-MCS Map field. 1: single spatial stream only and with Max S1G-MCS as indicated by a value of 0 in the S1G-MCS for 1 SS subfield. 2: single spatial stream only and with Max S1G-MCS as indicated by a value of 1 in the S1G-MCS for 1 SS subfield. 3: single spatial stream only and with Max S1G-MCS as indicated by a value of 2 in the S1G-MCS for 1 SS subfield.

The Rx S1G-MCS Map subfield and the Tx S1G-MCS Map subfield have the structure shown in Figure 9-589bd.

	B0 B1	B2 B3	B4 B5	B6 B7
	Max S1G-MCS For 1 SS	Max S1G-MCS For 2 SS	Max S1G-MCS For 3 SS	Max S1G-MCS For 4 SS
Bits:	2	2	2	2

Figure 9-589bd—Rx S1G-MCS Map, Tx S1G-MCS Map and Basic S1G-MCS and NSS Set

The Max S1G-MCS for *n* SS subfield (where *n*=1,...,4) is encoded as follows:

- 0 indicates support for S1G-MCS 2 for n spatial streams
- 1 indicates support for S1G-MCS 7 for n spatial streams
- 2 indicates support for S1G-MCS 9 for n spatial streams
- 3 indicates that n spatial streams is not supported

NOTE 1—An S1G-MCS indicated as supported in the S1G-MCS Map fields for a particular number of spatial streams might not be valid at all bandwidths (see 23.5) and might be limited by the declaration of Tx Highest Supported Long GI Data Rates and Rx Highest Supported Long GI Data Rates and might be affected by 10.7.13.3.

NOTE 2—For 1 MHz, MCS10 is always supported.

9.4.2.202 Subchannel Selective Transmission (SST) element

The Subchannel Selective Transmission (SST) element is shown in Figure 9-589be.

	Element ID	Length	Channel Activity Schedule
Octets:	1	1	variable

Figure 9-589be—Subchannel Selective Transmission element format

The Element ID and Length fields are defined in 9.4.2.1.

The Channel Activity Schedule subfield contains one or more channel activity schedules.

The format of the Channel Activity Schedule subfield is shown in Figure 9-589bf and Figure 9-589bg.

	B0	B1 B8	B9	B10	B11 B12	B13 B31
	Sounding Option (=0)	Channel Activity Bitmap	UL Activity	DL Activity	Maximum Transmission Width	Activity Start Time
Bits:	1	8	1	1	2	19

Figure 9-589bf—Channel Activity Schedule subfield format (Sounding Option = 0)

	B0	B1 B8	B9	B10 B13	B14 B15	B16 B31
	Sounding Option (=1)	Channel Activity Bitmap	Sounding Start Time Present	Reserved	Maximum Transmission Width	Sounding Start Time (optional)
Bits:	1	8	1	4	2	0 or 16

Figure 9-589bg—Channel Activity Schedule subfield format (Sounding Option = 1)

The Sounding Option subfield is set to 0 to indicate that the Channel Activity Schedule field is the AP Activity schedule.

When the Sounding Option subfield is equal to 0, the Channel Activity Bitmap subfield contains a bitmap indicating on which channels transmission is either expected or permitted by the AP during a given time period. Each bit in the bitmap corresponds to one minimum width channel for the band of operation with the LSB corresponding to the lowest numbered operating channel of the BSS. A value of 1 in a bit position in the bitmap means that the AP expects activity and/or permits transmissions with bandwidth less than or equal to the bandwidth indicated in the Maximum Transmission Width subfield and that include that channel, after the time indicated in the Activity Start Time subfield. Only one bit in the bitmap can be set to 1 within each channel activity schedule. The minimum width channel is equal to the SST Channel Unit field of the SST Operation element if such an element has been previously transmitted or is equal to 2 MHz if no such element has been previously received from the AP to which the SST STA is associated.

The UL Activity subfield is set to 1 to indicate that the SST AP (that transmits the SST element) permits the STAs associated with it to transmit frames that are not immediate response frames on the channel(s) identified by the Channel Activity Bitmap and Maximum Transmission Width subfields at the time indicated in the Activity Start Time subfield. Otherwise it is set to 0.

The DL Activity subfield is set to 1 to indicate that the AP that transmits the SST element intends to transmit frames that are not immediate response frames on the channel(s) identified by the Channel Activity Bitmap and Maximum Transmission Width subfields at the time indicated in the Activity Start Time subfield. Otherwise it is set to 0.

The Maximum Transmission Width subfield indicates the maximum PPDU bandwidth permitted by the AP for a transmission on the indicated channel and cannot exceed the BSS operating channel width specified by the AP in a transmitted S1G Operation element. In order to abide by the rules of each regulatory domain, the maximum operating channel width is limited by the BSS operating channel width even if the Maximum Transmission Width field specifies otherwise. The maximum permitted PPDU bandwidth is in MHz and is determined based on the Maximum Transmission Width subfield as shown in Table 9-262p.

Table 9-262p—Mapping between Maximum Transmission Width subfield and maximum permitted PPDU bandwidth

Maximum Transmission Width	Maximum permitted PPDU bandwidth (MHz)
0	channel width unit
1	4
2	8
3	16

NOTE—The channel width unit is equal to 1 MHz if the SST Channel Unit field of the most recently received SST Operation element from the SST AP is equal to 1. If no SST Operation element has been received or the SST Channel Unit field of the received SST Operation element is equal to 0 then the channel width unit is equal to 2 MHz.

The Activity Start Time subfield contains a value that defines a start time for when the AP expects frame transmissions to begin on the channel(s) indicated in the corresponding Channel Activity Bitmap field. The start time is triggered when the 19 least significant bits of the TSF timer for the BSS match the value that is indicated in the Activity Start Time subfield of the SST element. The count down to the start time is initiated at the end of the transmission of the frame containing the SST element.

The Sounding Option subfield is set to 1 in order to indicate that the Channel Activity Schedule field is the SST sounding schedule.

When the Sounding Option subfield is equal to 1, the Channel Activity Bitmap subfield contains a bitmap indicating on which channels there is an SST sounding transmission activity at a given time. Each bit in the bitmap corresponds to one minimum width channel for the band of operation with the LSB corresponding to the lowest numbered operating channel of the BSS. A value of 1 in a bit position in the bitmap means that the AP transmits one more PIFS-separated sounding NDP frames.

The Sounding Start Time Present subfield indicates whether the Sounding Start Time subfield is present in the Channel Activity Schedule field. If the subfield is equal to 1, the Sounding Start Time subfield is present. If this subfield is equal to 0, the Sounding Start Time subfield is not present.

The Maximum Transmission Width subfield indicates the channel bandwidth of the sounding NDP and is shown in Table 9-262p.

The Sounding Start Time subfield contains a value that defines a start time when the AP transmits one or more sounding NDP frames on the channel(s) indicated in the corresponding Channel Activity Bitmap subfield. If the Sounding Start Time subfield is not present, the AP transmits one or more PIFS-separated sounding NDP frames starting after the transmission of the Beacon frame containing the SST element. If the Sounding Start Time subfield is present, the AP transmits one or more PIFS-separated sounding NDP frames starting at the time indicated in the Sounding Start Time field. The start time is triggered when the 16 least significant bits of the TSF timer for the BSS match the value that is indicated in the Sounding Start Time subfield of the SST element. The count down to the start time is initiated at the end of the transmission of the frame containing the SST element.

9.4.2.203 Authentication Control element

The notation of Authentication-Request and Authentication-Response refers to the definition in Clause 13.

The Authentication Control element contains the information required to mitigate contention among Authentication Request frames (see 11.3.9).

	Element ID	Length	Centralized Authentication Control Parameters
Octets:	1	1	2

Figure 9-589bh—Authentication Control element format (Control subfield equal to 0)

The Element ID and Length fields are defined in 9.4.2.1.

The Information field starts with a 1-bit Control subfield.

When the Control subfield is equal to 0, the Authentication Control element format is as shown in Figure 9-589bh. The Authentication Control element indicates whether the recipient STA can transmit an Authentication Request frame to the AP that sends the element. The remaining part of the Centralized Authentication Control Parameters field Information field following the Control subfield contains the Deferral, Reserved and the Authentication Control Threshold subfields.

The Centralized Authentication Control Parameters field format is shown in Figure 9-589bi.

	B0	B1	B2 B5	B6 B15
	Control (0)	Deferral	Reserved	Authentication Control Threshold
Bits	1	1	4	10

Figure 9-589bi—Centralized Authentication Control Parameters format

The Authentication Control Threshold subfield contains a number with a range from 0 to 1023. When the Deferral subfield is equal to 0, the value of the Authentication Control Threshold subfield is used by the recipient STA to determine whether or not the AP is allowing it to transmit an Authentication-Request frame. When the Deferral subfield is equal to 1, the Authentication Control Threshold subfield value is a time value, expressed in TUs, indicating a minimum amount of deferred time for channel access which is required before the transmission of an Authentication-Request frame and is set as described in 11.3.9.2.

When the Control subfield is equal to 1, the Authentication Control element contains the Distributed Authentication Control Parameters field as shown in Figure 9-589bj.

	Element ID	Length	Distributed Authentication Control Parameters
Octets:	1	1	3

Figure 9-589bj—Authentication Control element format (Control subfield equal to 1)

The Distributed Authentication Control Parameters field format is shown Figure 9-589bk.

	B0	B1 B7	B8 B15	B16 B23
	Control (1)	Authentication Slot Duration	Maximum Transmission Interval	Minimum Transmission Interval
Bits	1	7	8	8

Figure 9-589bk—Distributed Authentication Control Parameters format

The Authentication Slot Duration subfield is expressed in units of TUs and indicates the authentication slot duration.

The Minimum Transmission Interval subfield is expressed in units of BIs and indicates the minimum transmission interval (see 11.3.9.3).

The Maximum Transmission Interval subfield is expressed in units of BIs and indicates the maximum transmission interval (see 11.3.9.3).

9.4.2.204 TSF Timer Accuracy element

The TSF Timer Accuracy element, shown in Figure 9-589bl, specifies fields describing the accuracy of TSF timer. This information is used by a receiving STA to estimate the clock accuracy of the transmitting STA and to schedule wake-up time for Beacon frame reception by taking this clock accuracy into account.

	Element ID	Length	TSF Timer Accuracy
Octets:	1	1	1

Figure 9-589bl—TSF Timer Accuracy element format

The Element ID and Length fields are defined in 9.4.2.1.

The TSF Timer Accuracy field is a 1 octet unsigned integer that specifies the accuracy of the TSF timer of transmitting STA. The unit of the TSF Timer Accuracy field is PPM. The values between 125 and 255 are reserved for future expansion.

9.4.2.205 S1G Relay element

The S1G Relay element contains parameters necessary to support the relay operation and its format is shown in Figure 9-589bm.

	Element ID	Length	Relay Control	RootAP BSSID
Octets:	1	1	1	0 or 6

Figure 9-589bm—S1G Relay element format

The Element ID and Length fields are defined in 9.4.2.1.

The format of Relay Control is shown in Figure 9-589bn.

	B0 B6	B7
	Hierarchy Identifier	No More Relay Flag
Bits:	7	1

Figure 9-589bn—Relay Control field format

The Hierarchy Identifier subfield indicates whether the AP is a root AP or whether it relays an SSID, as specified in Table 9-262q.

Table 9-262q—Hierarchy Identifier subfield

Hierarchy Identifier	Meaning
0	Root AP
1	S1G Relay AP that relays frames within the BSS identified by the BSSID contained in the RootAP BSSID field
2–127	Reserved

The No More Relay Flag subfield is set to 1, to indicate that the AP does not accept any more requests for operating as relays from its associated non-AP STAs. Otherwise it is set to 0.

The RootAP BSSID field indicates the BSSID of the root AP. The RootAP BSSID field is present if the Hierarchy Identifier subfield is set to a nonzero value. Otherwise the RootAP BSSID field is not present.

9.4.2.206 Reachable Address element

The format of the Reachable Address element is shown in Figure 9-589bo.

	Element ID	Length	Initiator MAC Address	Address Count	Reachable Addresses
Octets:	1	1	6	1	variable

Figure 9-589bo—Reachable Address element format

The Element ID and Length fields are defined in 9.4.2.1.

The Initiator MAC Address field indicates the MAC address of the relay STA that transmits the Reachable Address element.

The Address Count field is an integer representing the number of addresses in the Reachable Addresses field.

The Reachable Addresses field contains one or more Reachable Address subfields

The Reachable Address subfields indicate the MAC addresses that can be reached through the relay STA. The format of the Reachable Address subfield is shown in Figure 9-589bp.

	B0	B1	B2 B7	B8 B55
	Add/Remove	Relay Capable	Reserved	MAC Address
Bits:	1	1	6	48

Figure 9-589bp—Reachable Address subfield format

The Add/Remove subfield is set to 1 if the MAC address is the address of a new STA joining the relay. Add/Remove subfield is set to 0 if the MAC address is the address of a STA leaving the relay. The Add/Remove subfield is set to 1 if the Reachable Address element is included within a (Re)Association Request frame.

The Relay Capable subfield is set to 1 if the STA is relay capable, otherwise it is set to 0.

The MAC Address subfield is set to the MAC address of the STA that joins or leaves the BSS.

9.4.2.207 S1G Relay Activation element

The format of the S1G Relay Activation element is shown in Figure 9-589bq.

	ElementID	Length	Relay Function	Number of STAs
Octets:	1	1	1	0 or 1

Figure 9-589bq—S1G Relay Activation element format

The format of the Relay Function field is shown in Figure 9-589br.

	B0	B1	B2	B3	B4 B7
	Relay Activation Mode	Direction	Enable Relay Function	Number of STAs Presence Indicator	Reserved
Bits:	1	1	1	1	4

Figure 9-589br—Relay Function field format

The Relay Activation Mode subfield is set to 1 to indicate that this element is a Relay Activation Request. The Relay Activation Mode subfield is set to 0 to indicate the Relay Activation Response.

The Direction subfield is set to 1 if the S1G Relay Activation element is sent by the AP. The Direction subfield is set to 0 if the S1G Relay Activation is sent by the non-AP STA.

The Enable Relay Function subfield is set to a value based on the Direction and Relay Activation Mode subfield as described in Table 9-262r.

Table 9-262r—Enable Relay Function subfield values

	Relay Activation Mode=1 (Request)	**Relay Activation Mode=0 (Response)**
Direction=1 (from AP)	If the Enable Relay Function subfield is set to 1, it indicates that the non-AP STA can operate as a relay and if it is set to 0 it indicates AP demands the non-AP STA to terminate the relay function.	If the Enable Relay Function subfield is set to 1, it indicates that the non-AP STA is allowed to operate as a relay and if it is set to 0, it indicates that the non-AP STA cannot operate as a relay.
Direction=0 (from non-AP STA)	If the Enable Relay Function subfield is set to 1, it indicates that the non-AP STA requests to activate its relay function and if it is set to 0, it indicates that the non-AP STA requests to terminate its relay function.	If the Enable Relay Function subfield is set to 1, it indicates that the non-AP STA activates its relay function and if it is set to 0, it indicates that the non-AP STA terminates its relay function.

When the S1G Relay Activation element is sent by an AP, the Number of STAs Presence Indicator subfield is set to 1 to indicate that a Number of STAs field is included in the S1G Relay Activation element. Otherwise, it is set to 0.

The Number of STAs field is one octet in length, and contains an 8-bit unsigned integer. The Number of STAs field is used to calculate the maximum number of STAs, N_{max}, that an S1G relay AP is allowed to associate. N_{max} is determined as follows:

$$N_{max} = \text{Number of STAs} \times 32$$

9.4.2.208 S1G Relay Discovery element

The S1G Relay Discovery element is shown in Figure 9-589bs.

	Element ID	Length	Relay Discovery Control	UL/DL Data Rate (optional)	Delay Bound Requirement/ Channel Utilization (optional)	Min PHY Rate Requirement/ Relay Station Count (optional)
Octets:	1	1	1	0 to 6	0 or 1	0 or 1

Figure 9-589bs—S1G Relay Discovery element format

The Element ID and Length fields are defined in 9.4.2.1.

The Relay Discovery Control field contains information indicating whether some or all following fields (see Figure 9-589bt) are included in the S1G Relay Discovery element. The structure of Relay Discovery Control field is shown later in this subclause in Figure 9-589bu.

	UL Min Data Rate (optional)	UL Mean Data Rate (optional)	UL Max Data Rate (optional)	DL Min Data Rate (optional)	DL Mean Data Rate (optional)	DL Max Data Rate (optional)
Octets:	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1	0 or 1

Figure 9-589bt—UL/DL Data Rate field format

When UL Min Data Rate field is included in an S1G Relay Discovery element in a Probe Request frame, it indicates the UL minimum data rate of the direct link between the non-AP STA and AP in the unit of 100 kbps. When UL Min Data Rate field is included in an S1G Relay Discovery element in a Probe Response or Beacon frame, it indicates the UL minimum data rate of the relay link between the relay and its associated AP in the unit of 100 kbps.

When UL Mean Data Rate field is included in an S1G Relay Discovery element in a Probe Request frame, it indicates the UL mean data rate of the direct link between the non-AP STA and AP in the unit of 100 kbps. When UL Mean Data Rate field is included in an S1G Relay Discovery element in a Probe Response or Beacon frame, it indicates the UL mean data rate of the relay link between the relay and its associated AP in the unit of 100 kbps.

When UL Max Data Rate field is included in an S1G Relay Discovery element in a Probe Request frame, it indicates the UL maximum data rate of the direct link between the non-AP STA and AP in the unit of 100 kbps. When UL Max Data Rate field is included in an S1G Relay Discovery element in a Probe Response or Beacon frame, it indicates the UL maximum data rate of the relay link between the relay and its associated AP in the unit of 100 kbps.

When DL Min Data Rate field is included in an S1G Relay Discovery element in a Probe Request frame, it indicates the DL minimum data rate of the direct link between the non-AP STA and AP in the unit of 100 kbps. When DL Min Data Rate field is included in an S1G Relay Discovery element in a Probe Response or Beacon frame, it indicates the DL minimum data rate of the relay link between the relay and its associated AP in the unit of 100 kbps.

When DL Mean Data Rate field is included in an S1G Relay Discovery element in a Probe Request frame, it indicates the DL mean data rate of the direct link between the non-AP STA and AP in the unit of 100 kbps. When DL Mean Data Rate field is included in an S1G Relay Discovery element in a Probe Response or Beacon frame, it indicates the DL mean data rate of the relay link between the relay and its associated AP in the unit of 100 kbps.

When DL Max Data Rate field is included in an S1G Relay Discovery element in a Probe Request frame, it indicates the DL maximum data rate of the direct link between the non-AP STA and AP in the unit of 100 kbps. When DL Max Data Rate field is included in an S1G Relay Discovery element in a Probe Response or Beacon frame, it indicates the DL maximum data rate of the relay link between the relay and its associated AP in the unit of 100 kbps.

When included in the S1G Relay Discovery element of a Probe Request frame and the Delay and Rate Requirement Included field in the Relay Discovery Control field of the S1G Relay Discovery element is equal to 1, the Delay Bound Requirement/Channel Utilization field indicates the delay bound requirement of the connection through the relay. When included in the S1G Relay Discovery element that is included in a Probe Response or a Beacon frame and the Utilization and Count Included field in the Relay Discovery Control field of the S1G Relay Discovery element is equal to 1, the Delay Bound Requirement/Channel Utilization field denotes the ratio of time that relay observes the busy level on the relay link between the relay and the AP, with value 100 indicating 100% busy level and value 0 indicating idle (values from 101 to 255 are reserved).

When included in the S1G Relay Discovery element of a Probe Request frame and the Delay and Min PHY Rate Requirement Included field in the Relay Discovery Control field of the S1G Relay Discovery element is equal to 1, the Min PHY Rate Requirement/Relay Station Count field indicates the minimum PHY data rate set required by the requesting STA. When included in the S1G Relay Discovery element of a Probe Response or a Beacon frame and the Utilization and Relay Count Included field in the Relay Discovery Control field of the S1G Relay Discovery element is equal to 1, the Min PHY Rate Requirement/Relay Station Count field denotes the number of non-AP STAs currently associated with the relay.

	B0	B1	B2	B3	B4	B5 B7
	Min Data Rate Included	Mean Data Rate Included	Max Data Rate Included	Delay and Min PHY Rate Requirement Included/Utilization and Relay Count Included	Information Not Available	Reserved
Bits:	1	1	1	1	1	3

Figure 9-589bu—Relay Discovery Control field format

The Min Data Rate Included field is set to 1 if UL Min Data Rate field and DL Min Data Rate field are included in the S1G Relay Discovery element. Otherwise, the Min Data Rate Included field is set to 0.

The Mean Data Rate Included field is set to 1 if UL Mean Data Rate field and DL Mean Data Rate field are included in the S1G Relay Discovery element. Otherwise, the Mean Data Rate Included field is set to 0.

The Max Data Rate Included field is set to 1 if UL Max Data Rate field and DL Max Data Rate field are included in the S1G Relay Discovery element. Otherwise, the Max Data Rate Included field is set to 0.

The Delay and Rate Requirement Included/Utilization and Count Included field is set to 1 if Delay Bound Requirement/Channel Utilization field and Min PHY Rate Requirement/Relay Station Count field are included in the S1G Relay Discovery element. Otherwise, the Delay and Rate Requirement Included/ Utilization and Count Included field is set to 0.

The Information Not Available field is set to 1 if the relay does not provide the requested information. Otherwise, the Information Not Available field is set to 0.

9.4.2.209 AID Announcement element

The AID Announcement element is used to provide the mapping table between STA MAC Address and STA AID.

			One or more entries
	Element ID	Length	AID Entry
Octets:	1	1	8*n*

Figure 9-589bv—AID Announcement element format

The Element ID and Length fields are defined in 9.4.2.1.

The AID Entry field includes one or more STA MAC address and association ID pairs. The format of AID Entry field is shown in Figure 9-589bw.

	STA MAC Address	Association ID
Octets:	6	2

Figure 9-589bw—AID Entry field format

The STA MAC Address field indicates the MAC address of STA. The Association ID field, which has the same format as the AID field described in 9.4.1.8, includes the AID for the corresponding STA. If AID Announcement element is included in a frame that is transmitted by a relay STA and the Association ID field equals to 0, the STA MAC Address field indicates the BSSID of the relay AP.

9.4.2.210 PV1 Probe Response Option element

The PV1 Probe Response Option element is included in the Probe Request frame to indicate which optional information is requested to be included in the PV1 Probe Response frame that is transmitted by the responding STAs.

The optional information requested by the STA is indicated as bitmaps in the PV1 Probe Response Option element.

The format of the PV1 Probe Response Option element is shown in Figure 9-589bx.

	Element ID	Length	Probe Response Group Bitmap (optional)	Probe Response Option Bitmaps
Octets:	1	1	0 or 1	variable

Figure 9-589bx—PV1 Probe Response Option element format

The Element ID and Length fields are defined in 9.4.2.1.

The Probe Response Group Bitmap field indicates which Probe Response Option Bitmap subfield is included in the PV1 Probe Response Option element. If Probe Response Option Bitmap subfield *i* is included in the PV1 Probe Response Option element, then *i*-th bit in the Probe Response Group Bitmap field is set to 1.

The Probe Response Option Bitmaps field contains one or more Probe Response Option Bitmap subfields.

Each Probe Response Option Bitmap subfield is one octet and indicates which optional information is requested to be included in the PV1 Probe Response frame by the responding STAs. Setting a bit in a Probe Response Option Bitmap subfield to 1 indicates that the corresponding information is requested to be included in the PV1 Probe Response frame if the responding STA supports the indicated information.The bit is set to 0 to indicate that the information is not requested.

The optional information requested to be included in the PV1 Probe Response is categorized into 8 bitmaps (Probe Response Option bitmap 0 ~ 7).

Only Probe Response Option Bitmap subfields with at least one bit equal to 1 is included in the PV1 Probe Response Option element. The Probe Response Group Bitmap field indicates which Probe Response Option Bitmap subfield is included in the PV1 Probe Response Option element. For example, if only Probe Response Option Bitmap subfield 0 and 2 have bits that are equal to 1, then these two Probe Response Group Bitmap fields are included in the PV1 Probe Response Option element and the Probe Response Group Bitmap field is set to 10100000 to indicate that only the Probe Response Option Bitmap subfields 0 and 2 are included in the PV1 Probe Response Option element. When the Probe Response Group Bitmap field is included in the PV1 Probe Response Option element, at least one bit of the Probe Response Group Bitmap field is equal to 1.

Probe Response Option Bitmap subfield 0 is defined to be a default bitmap that indicates most frequently requested information. If the default bitmap is the only Probe Response Option Bitmap subfield that is included in the PV1 Probe Response Option element, then the Probe Response Group Bitmap field is omitted. In that case, only Element ID, Length, and the default bitmap (Probe Response Option Bitmap subfield 0) are included in the PV1 Probe Response Option element.

Table 9-262s to Table 9-262x define the Probe Response Option bitmap from 0 to 5, respectively.

NOTE—Probe Response Option bitmap 6 and 7 are reserved for future extension.

Table 9-262s—Probe Response Option Bitmap subfield 0 (Default Bitmap)

Bit position	Subfield	Item requested	Reference
0	Request Full SSID	Full SSID element if the bit is set to 1, and Compressed SSID field if the bit is set to 0	9.4.2.2 and 9.8.5.3
1	Request Next TBTT	Next TBTT field	9.8.5.3
2	Request Access Network Options	Access Network Options field	9.4.2.92
3	Request S1G Beacon Compatibility	S1G Beacon Compatibility element	9.4.2.197
4	Request Supported Rates	Supported Rates and BSS Membership Selectors element	9.4.2.3
5	Request S1G Capability	S1G Capabilities element	9.4.2.201
6	Request S1G Operation	S1G Operation element	9.4.2.213
7	Request RSN	RSN element	9.4.2.25

Table 9-262t—Probe Response Option Bitmap subfield 1

Bit position	Subfield	Item requested	Reference
0	Request RPS	RPS element	9.4.2.192
1	Request Page Slice	Page Slice element	9.4.2.193
2	Request TSF Timer Accuracy	TSF Timer Accuracy element	9.4.2.204
3	Request S1G Relay Discovery	S1G Relay Discovery element	9.4.2.208
4	Request S1G Sector Operation	S1G Sector Operation element	9.4.2.196
5	Request Short Beacon Interval	Short Beacon Interval element	9.4.2.198
6–7	Reserved		

Table 9-262u—Probe Response Option Bitmap subfield 2

Bit position	Subfield	Item requested	Reference
0	Request Country	Country element	9.4.2.9
1	Request Power Constraint	Power Constraint element	9.4.2.14
2	Request TPC Report	TPC Report element	9.4.2.17
3	Request Extended Supported Rates	Extended Supported Rates element	9.4.2.13
4	Request Extended Capabilities	Extended Capabilities element	9.4.2.27
5	Request BSS Load	BSS Load element	9.4.2.28
6	Request EDCA Parameter Set	EDCA Parameter Set element	9.4.2.29
7	Request Supported Operating Classes	Supported Operating Classes element	9.4.2.54

Table 9-262v—Probe Response Option Bitmap subfield 3

Bit position	Subfield	Item requested	Reference
0	Request Measurement Pilot Transmission	Measurement Pilot Transmission element	9.4.2.42
1	Request Multiple BSSID	Multiple BSSID element	9.4.2.46
2	Request RM Enabled Capabilities	RM Enabled Capabilities element	9.4.2.45
3	Request AP Channel Report	AP Channel Report element	9.4.2.36
4	Request BSS Average Access Delay	BSS Average Access Delay element	9.4.2.39
5	Request Antenna	Antenna element	9.4.2.40
6	Request BSS Available Admission Capacity	BSS Available Admission Capacity element	9.4.2.43
7	Request BSS AC Access Delay	BSS AC Access Delay element	9.4.2.44

Table 9-262w—Probe Response Option Bitmap subfield 4

Bit position	Subfield	Item requested	Reference
0	Request Mobility Domain	Mobility Domain element	9.4.2.47
1	Request QoS Traffic Capability	QoS Traffic Capability element	9.4.2.78
2	Request Channel Usage	Channel Usage element	9.4.2.86
3	Request Time Advertisement	Time Advertisement element	9.4.2.61
4	Request Time Zone	Request Time Zone element	9.4.2.87
5	Request IBSS Parameter Set	IBSS Parameter Set element	9.4.2.7
6–7	Reserved		

Table 9-262x—Probe Response Option Bitmap subfield 5

Bit position	Subfield	Item requested	Reference
0	Request Interworking	Interworking element	9.4.2.92
1	Request Advertisement Protocol	Advertisement Protocol element	9.4.2.93
2	Request Roaming Consortium	Roaming Consortium element	9.4.2.96
3	Request Emergency Alert Identifier	Emergency Alert Identifier element	9.4.2.97
4	Request QLoad Report	QLoad Report element	9.4.2.123
5	Request Multi-band	Multi-band element	9.4.2.138
6	Request Multiple MAC Sublayers	Multiple MAC Sublayers element	9.4.2.153
7	Request Reduced Neighbor Report	Reduced Neighbor Report element	9.4.2.171

9.4.2.211 EL Operation element

The EL Operation element is used by a STA to inform the associated AP or peer TDLS STA about operating limitations of the STA, in terms of the maximum continuous time the STA is capable of being in the Awake state, and the minimum continuous time the STA stays in Doze state in between Awake periods.

	Element ID	Length	Max Awake Duration	Recovery Time Duration
Octets:	1	1	2	2

Figure 9-589by—EL Operation element format

The Element ID and Length fields are defined in 9.4.2.1.

The Max Awake Duration field indicates a time in units of 40 μs, used as defined in 11.48; a value 0 indicates that no limit applies.

The Recovery Time Duration field indicates a time in units of 40 μs, used as defined in 11.48.

9.4.2.212 Sectorized Group ID List element

The Sectorized Group ID List element includes the information necessary for a receiving STA to determine its sectorization group membership. An example of group use is the sector operation. In sector operation, only a set of STA groups is allowed to transmit during the sector duration. The Sectorized Group ID List element can be provided in Probe Response or (Re)Association Response frame.

The format of the Sectorized Group ID List element is presented in Figure 9-589bz.

	B0 B7	B8 B15	B16 B19		
	Element ID	Length	Sectorized Group ID Type	Sectorized Group IDs	Pad
Bits:	8	8	4	variable	0 or 4

Figure 9-589bz—Sectorized Group ID List element format

The Element ID and Length fields are defined in 9.4.2.1.

The Sectorized Group ID Type field indicates the sectorized group IDs usage. The value of 0 in the Sectorized Group ID Type field indicates that the values in the Sectorized Group ID subfields refer to STAs in sectorization use. The values of the Sectorized Group ID Type field other than 0 are reserved for other purposes.

The Sectorized Group IDs field contains one or more Sectorized Group ID subfields.

Each Sectorized Group ID subfield is 4 bits and indicates a new sectorized group ID that is associated with the receiver STAs. A value of 15 in the Sectorized Group ID subfield is reserved for padding bits.

The Pad field contains 0 or 4 bits of 1s to make the total number of bits in the Sectorized Group ID List element equal to an integer number of octets.

9.4.2.213 S1G Operation element

The operation of S1G STAs in the BSS is controlled by the S1G Operation element. The format of the S1G Operation element is defined in Figure 9-589ca.

	Element ID	Length	S1G Operation Information	Basic S1G-MCS and NSS Set
Octets:	1	1	4	2

Figure 9-589ca—S1G Operation element format

The Element ID and Length fields are defined in 9.4.2.1.

The structure of the S1G Operation Information field is defined in Figure 9-589cb.

	Channel Width	Operating Class	Primary Channel Number	Channel Center Frequency
Octets:	1	1	1	1

Figure 9-589cb—S1G Operation Information field

The subfields of the S1G Operation Information field are defined in Table 9-262y.

Table 9-262y—S1G Operation Information field

Fields	Definition	Encoding
Channel Width	This field defines the BSS operating channel width (see Table 10-20 in 10.42.1 also).	Bitmap of B0–B4 indicates the primary channel width, and the operating channel widths, 1/2/4/8/16 MHz. The Primary Channel Width subfield, located in B0 of this field, and the BSS Operating Channel Width subfield, located in B1–B4 of this field, are defined in Table 10-20. B5 bits indicates the location of 1 MHz primary channel within the 2 MHz primary channel — B5 is set to 0 to indicate that is located at the lower side of 2 MHz primary channel. — B5 is set to 1 to indicate that is located at the upper side of 2 MHz primary channel. B6 is reserved. B7 is set to 1 to indicate that it is recommended that a STA does not use MCS10.
Operating Class	This field defines the operating class that the BSS is operating in.	The operating class of the BSS
Primary Channel Number	Primary Channel Number field indicates the channel number of 2 MHz primary channel or 1 MHz primary channel.	Channel number of the primary channel
Channel Center Frequency	Defines the channel center frequency.	Indicates the channel index of the BSS operating channel (see 23.3.13)

The Basic S1G-MCS and NSS Set field indicates the S1G-MCSs for each number of spatial streams in S1G PPDUs that are supported by all S1G STAs in the BSS.

Each Max S1G MCS indicates the supported S1G-MCS set for NSS from 1 to 4 while each Min S1G-MCS indicates whether certain S1G-MCS values are not recommended for NSS from 1 to 4..

	B0 B1	B2 B3	B4 B5	B6 B7	B8 B9	B10 B11	B12 B13	B14 B15
	Min S1G-MCS For 1 SS	Max S1G-MCS For 1 SS	Min S1G-MCS For 2 SS	Max S1G-MCS For 2 SS	Min S1G-MCS For 3 SS	Max S1G-MCS For 3 SS	Min S1G-MCS For 4 SS	Max S1G-MCS For 4 SS
Bits:	2	2	2	2	2	2	2	2

Figure 9-589cc—Basic S1G-MCS and NSS Set

The Max S1G-MCS For *n* SS subfield (where *n* = 1,...,4) is same as the field with the same name that is defined in the S1G Capabilities element.

The Min S1G-MCS For *n* SS subfield (where *n* = 1,...,4) is encoded as follows:

- 0 indicates no minimum MCS restriction for n spatial streams.
- 1 indicates S1G-MCS 0 for *n* spatial streams is not recommended.
- 2 indicates S1G-MCS 0 and 1 for *n* spatial streams is not recommended.
- 3 is reserved.

9.4.2.214 Header Compression element

The Header Compression element is used by a STA to inform its intended receiver regarding frame header fields that will be compressed and which it needs to store. The format of the Header Compression element is illustrated in Figure 9-589cd.

	Element ID	Length	Header Compression Control	A3 (optional)	A4 (optional)	CCMP Update (optional)
Octets:	1	1	1	0 or 6	0 or 6	0 or 5

Figure 9-589cd—Header Compression element format

The Element ID and Length fields are defined in 9.4.2.1.

The Header Compression Control field is 1 octet and is illustrated in Figure 9-589ce.

	B0	B1	B2	B3	B4	B5 B7
	Request/ Response	Store A3	Store A4	CCMP Update Present	PV1 Data Type 3 Supported	Reserved
Bits:	1	1	1	1	1	3

Figure 9-589ce—Header Compression Control field

The Request/Response subfield is set to 0 to indicate a header compression request and set to 1 to indicate a Header Compression response.

The Store A3 subfield is set to 1 in the header compression request to request the intended receiver of the frame to store the A3 field and is set to 1 in the header compression response to confirm storage of the A3 field. Otherwise, it is set to 0 in the header compression request to indicate no storage request for the A3 field and is set to 0 in the header compression response to indicate unsuccessful storage or release of the stored A3 field.

The Store A4 subfield is set to 1 to request the intended receiver of the header compression request to store the A4 field and is set to 1 in the header compression response to confirm storing of the A4 field. Otherwise, it is set to 0 in the header compression request to indicate no storage request for the A4 field and is set to 0 in the header compression response to indicate unsuccessful storage or release of the stored A4 field.

The CCMP Update Present subfield is set to 1 to indicate the intended receiver of the header compression request to update the base packet number (BPN) and Key ID fields for the specified TID/ACI in the CCMP Update field and is set to 1 in the header compression response to confirm the update of the fields or to indicate decryption error for the specified TID/ACI. Otherwise, it is set to 0 in the header compression request to indicate no CCMP update request and is set to 0 in the header compression response to indicate no CCMP update confirmation.

The PV1 Data Type 3 Supported subfield is set to 1 to indicate that reception of PV1 frames with Type field equal to 3 is enabled. Otherwise, it is set to 0.

The A3 field in the Header Compression element is present if the Request/Response subfield is 0 and the Store A3 subfield is 1. Otherwise, it is not present.

The A4 field in the Header Compression element is present if the Request/Response subfield is 0 and the Store A4 subfield is 1. Otherwise, it is not present.

The CCMP Update field in the Header Compression element is present if the CCMP Update Present subfield is 1. Otherwise, it is not present.

The CCMP Update field is 5 octets and contains the BPN and Key ID for a given TID/ACI, as illustrated in Figure 9-589cf.

	B0 B31	B32 B33	B34 B37	B38 B39
	BPN	Key ID	TID/ACI	Reserved
Bits:	32	2	4	2

Figure 9-589cf—CCMP Update field

The BPN subfield contains the base packet number (BPN) for the TID/ACI in the CCMP Update field. The BPN subfield consists of the PN2, PN3, PN4, and PN5 octets, as illustrated in Figure 9-589cg.

	B0 B7	B8 B15	B16 B23	B24 B31
	PN2	PN3	PN4	PN5
Bits:	8	8	8	8

Figure 9-589cg—BPN subfield

The Key ID subfield contains the Key ID for the TID/ACI included in the CCMP Update field.

The TID/ACI subfield contains the TID/ACI for which the BPN and the Key ID subfields apply.

9.4.2.215 SST Operation element

The Subchannel Selective Transmission (SST) Operation element is shown in Figure 9-589ch

	B0 B7	B8 B15	B16 B23	B24 B26	B27	B28 B31
	Element ID	Length	SST Enabled Channel Bitmap	Primary Channel Offset	SST Channel Unit	Reserved
Bits:	8	8	8	3	1	4

Figure 9-589ch—SST Operation element format

The Element ID and Length fields are defined in 9.4.2.1.

The SST Enabled Channel Bitmap field contains a bitmap indicating which channels are enabled for SST operation. Each bit in the bitmap corresponds to one channel of width equal to the value of SST Channel Unit field, with the least significant bit corresponding to the lowest numbered subchannel in the SST Enabled Channel Bitmap field. The channel number of each of the channels in the SST Enabled Channel Bitmap field is equal to PCN minus OPC plus POS, where PCN is the value of the Primary Channel Number subfield in the most recently transmitted S1G Operation element, OPC is the offset of the primary channel relative to the lowest numbered subchannel in the bitmap as specified by the value of the Primary Channel Offset field and POS is the position of the channel in the bitmap. A value of 1 in a bit position in the bitmap indicates that the subchannel is enabled for SST operation but transmissions from SST STAs in that subchannel are allowed subject to the rules defined in 10.48. More than one bit in the bitmap can be equal to 1.

The Primary Channel Offset field indicates the relative position of the primary channel with respect to the lowest numbered channel in the SST Enabled Channel Bitmap field. For example, a value of the Primary Channel Offset equal to 2 indicates that the primary channel is the third subchannel in the SST Enabled Channel Bitmap.

The SST Channel Unit field indicates the channel width unit of each SST channel. A value of 1 indicates that the channel width unit is 1 MHz and a value of 0 indicates that the channel width unit is 2 MHz.

9.4.2.216 MAD element

The MAD element is shown in Figure 9-589ci.

	Element ID	Length	Max Away Duration
Octets:	1	1	2

Figure 9-589ci—MAD element

The Element ID and Length fields are defined in 9.4.2.1.

The Max Away Duration field indicates the maximum duration that the AP can be out of reach for the STA (operating in other channels, enter power save mode, or operating in other RAWs). The value of the Max Away Duration field is expressed in units of TU.

9.6 Action frame format details

9.6.4 DLS Action frame details

9.6.4.2 DLS Request frame format

Change the following row in Table 9-299 as shown:

Table 9-299—DLS Request frame Action field format

Order	Information	Notes
10	AID	The AID element containing the AID of the STA sending the frame is present if dot11VHTOptionImplemented <u>or dot11S1GOptionImplemented</u> is true.

Insert the following rows into Table 9-299:

Table 9-299—DLS Request frame Action field format

Order	Information	Notes
12	S1G Capabilities	S1G Capabilities element is optionally present if dot11S1GOptionImplemented is true.
13	EL Operation	EL Operation element is present if dot11S1GELOperationActivated is true.

9.6.4.3 DLS Response frame format

Change the following row in Table 9-300 as shown:

Table 9-300—DLS Response frame Action field format

Order	Information	Notes
10	AID	The AID element containing the AID of the STA sending the frame is present if dot11VHTOptionImplemented <u>or dot11S1GOptionImplemented</u> is true.

Insert the following rows into Table 9-300:

Table 9-300—DLS Response frame Action field format

Order	Information	Notes
12	S1G Capabilities	S1G Capabilities element is optionally present if dot11S1GOptionImplemented is true.
13	EL Operation	EL Operation element is present if dot11S1GELOperationActivated is true.

9.6.5 Block Ack Action frame details

9.6.5.1 General

Change 9.6.5.1 and Table 9-302 as follows:

ADDBA Request and ADDBA Response frames are used to set up or, if a STA is PBAC, to modify Block Ack operation for a specific TC, TS, or GCR group address. A Block Ack Action field, in the octet immediately after the Category field, differentiates the Block Ack Action frame formats. The Block Ack Action frames are used to negotiate several parameters of a BlockAck session and the type of BlockAck frames that are used: BlockAck, NDP BlockAck and Block Acknowledgment TWT frames (see 10.24.2). The Block Ack Action field values associated with each frame format within the Block Ack category are defined in Table 9-302.

Table 9-302—Block Ack Action field values

Block Ack Action field values	Meaning
0	ADDBA Request
1	ADDBA Response
2	DELBA
3–127~~255~~	Reserved
128	NDP ADDBA Request
129	NDP ADDBA Response
130	NDP DELBA
131	Reserved
132	BAT ADDBA Request
133	BAT ADDBA Response
134	BAT DELBA
135–255	Reserved

9.6.5.2 ADDBA Request frame format

Change the third paragraph of 9.6.5.2 as follows:

The Block Ack Action field is ~~defined~~ set to 0, 128, or 132 (representing ADDBA request). The meaning for each value is described in 9.6.5.1.

9.6.5.3 ADDBA Response frame format

Change the third paragraph of 9.6.5.3 as follows:

The Block Ack Action field is ~~defined~~ set to 1, 129, or 133 (representing ADDBA response). The meaning for each value is described in 9.6.5.1.

Change Table 9-304 as follows:

Table 9-304—ADDBA Response frame Action field format

Order	Information
1	Category
2	Block Ack Action
3	Dialog Token
4	Status Code
5	Block Ack Parameter Set
6	Block Ack Timeout Value
7	GCR Group Address element (optional)
8	Multi-band (optional)
9	TCLAS (optional)
10	ADDBA Extension (optional)
11	Originator Preferred MCS (optional)

Insert the following paragraph at the end of 9.6.5.3:

The Originator Preferred MCS field is present if dot11S1GOptionImplemented is true, and the Block Ack Action field is 1, and it is defined in 9.4.1.15a. Otherwise, it is not present.

9.6.5.4 DELBA frame format

Change the third paragraph of 9.6.5.4 as follows:

The Block Ack Action field is ~~defined~~ set to 2, 130, or 134 (representing DELBA). The meaning for each value is described in 9.6.5.1.

9.6.8 Public Action details

9.6.8.7 Extended Channel Switch Announcement frame format

Change the seventh paragraph in 9.6.8.7 as follows:

This Wide Bandwidth Channel Switch element is present either when extended channel switching is to a channel width wider than 40 MHz, or when extended channel switching is to a channel width wider than 1 MHz and the frame carrying the element is an S1G PPDU; otherwise, this element is not present. The Wide Bandwidth Channel Switch element is defined in 9.4.2.161. The Wide Bandwidth Channel Switch element indicates the BSS bandwidth after extended channel switching (see 11.40.1 and 10.42.1).

9.6.13 TDLS Action field formats

9.6.13.1 TDLS Setup Request Action field format

Change the following row in Table 9-343 as shown:

Table 9-343—Information for TDLS Setup Request Action field

Order	Information	Notes
19	AID	The AID element containing the AID of the STA sending the frame is present if dot11VHTOptionImplemented <u>or dot11S1GOptionImplemented</u> is true.

Insert the following rows into Table 9-343:

Table 9-343—Information for TDLS Setup Request Action field

Order	Information	Notes
21	S1G Capabilities	S1G Capabilities element is optionally present if dot11S1GOptionImplemented is true.
22	EL Operation	EL Operation element is present if dot11S1GELOperationActivated is true.

9.6.13.3 TDLS Setup Response Action field format

Change the following row in Table 9-344 as shown:

Table 9-344—Information for TDLS Setup Response Action field

Order	Information	Notes
20	AID	The AID element containing the AID of the STA sending the frame is present if dot11VHTOptionImplemented <u>or dot11S1GOptionImplemented</u> is true and the Status Code is SUCCESS and not present otherwise.

Insert the following rows into Table 9-344:

Table 9-344—Information for TDLS Setup Response Action field

Order	Information	Notes
23	S1G Capabilities	S1G Capabilities element is optionally present if dot11S1GOptionImplemented is true.
24	EL Operation	EL Operation element is present if dot11S1GELOperationActivated is true.

9.6.13.4 TDLS Setup Confirm Action field format

Insert the following row into Table 9-345:

Table 9-345—Information for TDLS Setup Confirm Action field

Order	Information	Notes
13	S1G Operation	The S1G Operation element is present if dot11S1GOptionImplemented is true and the status code is 0 (Successful). The S1G Operation element is defined in 9.4.2.213.

9.6.23 VHT Action frame details

9.6.23.1 VHT Action field

Change the text of 9.6.23.1 as follows (Table 9-418 remains unchanged):

Several Action frame formats are defined to support VHT functionality and S1G functionality. A VHT Action field, in the octet immediately after the Category field, differentiates the VHT Action frame formats. The VHT Action field values associated with each frame format within the VHT category are defined in Table 9-418.

Insert the following subclauses (9.6.25 through 9.6.28.3, including Table 9-421b through Table 9-421y and Figure 9-740b through Figure 9-740d) after 9.6.24.2:

9.6.25 Unprotected S1G Action frame details

9.6.25.1 Unprotected S1G Action field

Several Action frame formats are defined to support S1G functionality. An Unprotected S1G Action field, in the octet immediately after the Category field, differentiates the Unprotected S1G Action frame formats. The Unprotected S1G Action field values associated with each frame format within the Unprotected S1G category are defined in Table 9-421b.

Table 9-421b—Unprotected S1G Action field values

Value	Meaning	Time Priority
0	AID Switch Request	No
1	AID Switch Response	No
2	Sync Control	No
3	STA Information Announcement	No
4	EDCA Parameter Set	No
5	EL Operation	No
6	TWT Setup	No

Table 9-421b—Unprotected S1G Action field values *(continued)*

Value	Meaning	Time Priority
7	TWT Teardown	No
8	Sectorized Group ID List	No
9	Sector ID Feedback	No
10	Reserved	
11	TWT Information	No
12–255	Reserved	

9.6.25.2 AID Switch Request frame format

The AID Switch Request frame is an Action frame of category Unprotected S1G. A STA that is changing its device characteristic as defined in 9.4.2.194 uses the frame to request the frame's recipient to change its AID or to request a group AID from an AP. The Action field of the AID Switch Request frame contains the information shown in Table 9-421c.

Table 9-421c—AID Switch Request frame Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	Dialog Token
4	AID Request (see 9.4.2.194)

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

The Dialog Token field is a value chosen by the non-AP STA sending the AID Switch Request frame to identify the request/response transaction.

The AID Request field contains an AID Request element as specified in 9.4.2.194.

9.6.25.3 AID Switch Response frame format

The AID Switch Response frame is an Action frame of category Unprotected S1G. It is sent by an AP in response to an AID Switch Request frame, or sent by an AP to a non-AP STA to instruct the STA to change its AID or wakeup interval and it is sent by an AP to assign a group AID to a requesting STA. The Action field of the AID Switch Response frame contains the information shown in Table 9-421d.

Table 9-421d—AID Switch Response frame Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	Dialog Token
4	AID Response (see 9.4.2.195)

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

The Dialog Token field is the value in the corresponding AID Switch Request frame. If the AID Switch Response frame is not being transmitted in response to an AID Switch Request frame, then the Dialog token is set to 0.

The AID Response field contains an AID Response element as specified in 9.4.2.195.

9.6.25.4 Sync Control frame format

The Sync Control frame is an Action frame of category Unprotected S1G. It is transmitted by a non-AP STA to a UL-Sync capable AP to enable or disable sync frame transmission for uplink traffic (see 10.45.1). The Action field of a Sync Control frame contains the information shown in Table 9-421e.

Table 9-421e—Sync Control frame Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	Sync Control (see 9.4.1.58)

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

The Sync Control field is defined in 9.4.1.58.

9.6.25.5 STA Information Announcement frame format

The STA Information Announcement frame is an Action frame of category Unprotected S1G. It is either used by a non-AP STA to inform the peer STAs of the updated AID when a STA's AID is changed or used by a relay STA to inform the AP of a newly associated STA's AID or the updated AID when a STA's AID is changed. The Action field of the STA Information Announcement frame contains the information shown in Table 9-421f.

Table 9-421f—STA Information Announcement frame Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	AID Announcement (9.4.2.209)

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

The AID Announcement field contains an AID Announcement element as specified in 9.4.2.209.

9.6.25.6 EDCA Parameter Set frame format

The EDCA Parameter Set frame is used to update the EDCA Parameter Set at the recipient STA, as defined in 10.2.4.2).

Table 9-421g— EDCA Parameter Set frame Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	EDCA Parameter Set (9.4.2.29)

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

The EDCA Parameter Set field contains an EDCA Parameter Set element as specified in 9.4.2.29.

9.6.25.7 EL Operation frame format

The EL Operation frame is used to carry the EL Operation element (9.4.2.211).

Table 9-421h—EL Operation Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	EL Operation (9.4.2.211)

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

The EL Operation field contains an EL Operation element as specified in 9.4.2.211.

9.6.25.8 TWT Setup frame format

The TWT Setup frame is an Action frame of category Unprotected S1G. It is sent by a STA to request the setup of a TWT SP and it is sent by a responding STA to indicate the status of a requested TWT SP. The Action field of the TWT Setup frame contains the information shown in Table 9-421i.

Table 9-421i—TWT Setup frame Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	Dialog Token
4	TWT (9.4.2.200)

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

In a TWT Setup frame with a TWT Request field that is equal to 1, the Dialog Token field is set to a value chosen by the transmitting STA to identify the request/response transaction. In a TWT Setup frame with a TWT Request field equal to 0, the Dialog Token field is set to the value copied from the corresponding received TWT Setup frame with a TWT Request field equal to 1.

9.6.25.9 TWT Teardown frame format

The TWT Teardown frame is an Action frame of category Unprotected S1G. It is sent by a STA to request the teardown of a TWT agreement and is transmitted by either STA of an existing TWT agreement. The Action field of the TWT Teardown frame contains the information shown in Table 9-421j.

Table 9-421j—TWT Teardown frame Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	TWT Flow

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

The TWT Flow field contains the TWT Flow Identifier field and 5 reserved bits as shown in Figure 9-740b:

	B0 B2	B3 B7
	TWT Flow Identifier	Reserved
Bits:	3	5

Figure 9-740b—TWT Flow field format

The TWT Flow Identifier field is defined in 9.4.2.200. In a TWT Teardown frame, the TWT Flow Identifier field is set to the value of the TWT Flow Identifier field of the TWT element in the frame that successfully concluded the setup of the TWT that is the subject of the teardown request.

9.6.25.10 Sectorized Group ID List frame format

The Sectorized Group ID List frame is an Action or Action No Ack frame of category Unprotected S1G Action. The frame is used to allocate/change sectorized group IDs to a STA. The format of its Action field is defined in Table 9-421k.

Table 9-421k—Sectorized Group ID List frame Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	Sectorized Group ID List (9.4.2.212)

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

The Sectorized Group ID List field contains a Sectorized Group ID List as specified in 9.4.2.212.

9.6.25.11 Sector ID Feedback frame format

The Sector ID Feedback frame is an Action or Action No Ack frame of category Unprotected S1G. The format of its Action field is defined in Table 9-421l.

Table 9-421l—Sector ID Feedback frame Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	Sector ID Index

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

The Sector ID index field is shown in Figure 9-740c.

	B0 B2	B3 B7	B8 B15
	Preferred Sector ID	SNR	Receive Sector Bitmap
Bits:	3	5	8

Figure 9-740c—Sector ID Index format

The Preferred Sector ID field indicates the sector selected by the STA. The method in which a STA selects the Sector ID is out of the scope of this standard.

The SNR field indicates the received SNR at the preferred Sector, 0 to 30 represents SNR values from –3 to 27 dB, respectively. If the SNR value is less than –3 dB, set to 0. If the SNR value is greater than 27 dB, set to 30. 31 indicates no feedback.

The Receive Sector Bitmap field indicates a bit map. A bit position equal to 0 within the bit map indicates that the STA does not receive the AP signal in the corresponding Sector ID. A bit position equal to 1 within the bit map indicates that the STA does receive the AP signal in the corresponding Sector ID. The position of the bit map (0 to 7) corresponding to the sector ID (see Table 9-740d).

	B0	B1	B2	B3	B4	B5	B6	B7
	I_0	I_1	I_2	I_3	I_4	I_5	I_6	I_7
Bits:	1	1	1	1	1	1	1	1

Figure 9-740d—Receive Sector Bitmap format

9.6.25.12 TWT Information frame format

The TWT Information frame is an Action frame of category Unprotected S1G. It is sent by a STA to request or deliver information about a TWT agreement and is transmitted by either STA of an existing TWT agreement. The Action field of the TWT Information frame contains the information shown in Table 9-421m.

Table 9-421m—TWT Information frame Action field format

Order	Information
1	Category
2	Unprotected S1G Action
3	TWT Information (9.4.1.60)

The Category field is defined in 9.4.1.11.

The Unprotected S1G Action field is defined in 9.6.25.1.

9.6.26 S1G Action frame details

9.6.26.1 S1G Action field

The S1G Action field values are specified in Table 9-421n.

Table 9-421n—S1G Action field values

S1G Action field value	Description
0	Reachable Address Update
1	Relay Activation Request
2	Relay Activation Response
3	Header Compression Update
4–255	Reserved

9.6.26.2 Reachable Address Update frame format

The Reachable Address Update frame is used to update the addresses that can be reached through a relay STA. The format of the Reachable Address Update frame Action field is shown in Table 9-421o.

Table 9-421o—Reachable Address Update frame Action field format

Order	Information
1	Category
2	S1G Action
3	Reachable Address

The Category field is defined in 9.4.1.11.

The S1G Action field is defined in 9.6.26.1.

The Reachable Address element (as specified by 9.4.2.206) contains the addresses whose reachability through the S1G relay STA is being updated.

9.6.26.3 Relay Activation Request frame format

The Relay Activation Request frame is used by the STA or AP to Request start or terminate a relay function. The format of the Relay Activation Request frame Action field is shown in Table 9-421p.

Table 9-421p—Relay Activation Request frame

Order	Information
1	Category
2	S1G Action
3	Relay Activation

The Category field is defined in 9.4.1.11.

The S1G Action field is defined in 9.6.26.1.

The Relay Activation Mode subfield of the S1G Relay Activation element (as specified by 9.4.2.207) included in the Relay Activation Request frame is set to 1.

9.6.26.4 Relay Activation Response frame format

The Relay Activation Response frame is used by the STA or AP to confirm or reject the start or the termination of the relay function. The format of the Relay Activation Response frame Action field is shown in Table 9-421q.

Table 9-421q—Relay Activation Response frame

Order	Information
1	Category
2	S1G Action
3	Relay Activation

The Category field is defined in 9.4.1.11.

The S1G Action field is defined in 9.6.26.1.

The Relay Activation Mode subfield of the S1G Relay Activation element (as specified by 9.4.2.207) included in the Relay Activation Response frame is set to 0.

9.6.26.5 Header Compression frame format

The Header Compression frame is used to update information at the recipient STA, as defined in 10.54. The Header Compression frame contains the information shown in Table 9-421r.

Table 9-421r—Header Compression Action field format

Order	Information
1	Category
2	S1G Action
3	Dialog Token
4	Header Compression (see 9.4.2.214)

The Category field is defined in 9.4.1.11.

The S1G Action field is defined in 9.6.25.1.

The Dialog Token field is a value chosen by the STA sending the Header Compression frame to identify the request/response transaction.

The Header Compression field contains a Header Compression element as specified in 9.4.2.214.

9.6.27 Flow Control Action frame details

9.6.27.1 Flow Control Action field

The Flow Control Action field values are specified in Table 9-421s.

Table 9-421s—Flow Control Action field format

Flow Control Action field value	Description	Time priority
0	Flow suspension	Yes when transmitted as an Action no Ack frame
1	Flow resumption	Yes when transmitted as an Action no Ack frame
2–255	Reserved	

9.6.27.2 Flow Suspension frame format

The Flow Suspension frame is an Action or an Action No Ack frame of category Flow Control Action used by a STA to suspend incoming transmissions for an amount of time indicated in the Suspend Duration field. The format of the Flow Suspension frame Action field is shown in Table 9-421t.

Table 9-421t—Flow Suspension frame Action field format

Order	Information
1	Category
2	Flow Control Action
3	Suspend Duration

The Category field is defined in 9.4.1.11.

The Flow Control Action field is defined in 9.6.27.1.

The Suspend Duration field is 2 octets and denotes the amount of time, in microseconds, during which the intended recipient STAs are not allowed to transmit data frames to the STA identified by the TA field of the Flow Suspension frame.

9.6.27.3 Flow Resumption frame format

The Flow Resumption frame is an Action or an Action No Ack frame of category Flow Control Action used by the STA identified by the TA field of the frame to cancel any outstanding flow suspension time the STA had previously invoked through the transmission of a Flow Suspension, BAT, TACK, STACK, or NDP Ack frame as described in 10.57. The format of the Flow Resumption frame Action field is shown in Table 9-421u.

Table 9-421u—Flow Resumption frame Action field format

Order	Information
1	Category
2	Flow Control Action

The Category field is defined in 9.4.1.11.

The Flow Control Action field is defined in 9.6.27.1.

9.6.28 Control Response MCS Negotiation frame details

9.6.28.1 Control Response MCS Negotiation Action field

The Control Response MCS Negotiation Action field values are specified in Table 9-421v.

Table 9-421v—Control Response MCS Negotiation Action field values

MCS Negotiation Action field value	Description
0	Control Response MCS Negotiation Request
1	Control Response MCS Negotiation Response
2–255	Reserved

9.6.28.2 Control Response MCS Negotiation Request frame format

The Control Response MCS Negotiation Request frame is used by a STA to negotiate with its peer STA the requested MCS for transmitting control response frame as defined in 10.7.6.5.3. The frame format of this frame is shown Table 9-421w.

Table 9-421w—Control Response Negotiation Request frame

Order	Information
1	Category
2	Control Response MCS Negotiation Action
3	MCS Difference

The Category field is defined in 9.4.1.11.

The Control Response MCS Negotiation Action field is defined in 9.6.28.1.

The MCS Difference field is 1 octet and is set to an unsigned value that represents the MCS difference between the index of the primary MCS and the index of the MCS that is preferred for use by the STA to transmit control response frame as described in 10.7.6.5.4b.

9.6.28.3 Control Response MCS Negotiation Response frame format

The Control Response MCS Negotiation Response frame is used to indicate a response to a received Control Response MCS Negotiation Request, which is either Accept or Reject, and the MCS Difference proposed by the Requesting STA. The frame format of this frame is shown in Table 9-421x.

Table 9-421x—Control Response Negotiation Response frame

Order	Information
1	Category
2	Control Response MCS Negotiation Action
3	Command

The Category field is defined in 9.4.1.11.

The Control Response MCS Negotiation Action field is defined in 9.6.28.1.

The Command field is 1 octet and is set to a value from the Table 9-421y to represent accepting or rejecting the proposed MCS Difference by the Control Response MCS Negotiation Request frame as described in 10.7.6.5.4b.

Table 9-421y—Command Values

Values	Description
0	Reject
1	Accept
2–255	Reserved

9.7 Aggregate MPDU (A-MPDU)

9.7.3 A-MPDU contents

Change the first paragraph of 9.7.3 as follows:

In a non-DMG PPDU, an A-MPDU is a sequence of A-MPDU subframes carried in a single PPDU with one of the following combinations of RXVECTOR or TXVECTOR parameter values:

— The FORMAT parameter set to VHT
— The FORMAT parameter set to HT_MF or HT_GF and the AGGREGATION parameter set to 1
— <u>The FORMAT parameter set to S1G, S1G_DUP_1M, or S1G_DUP_2M and the AGGREGATION parameter set to 1</u>

Change the following row of Table 9-424 as shown:

Table 9-424—A-MPDU contexts

Name of Context	Definition of Context	Table defining permitted contents
~~VHT single~~ S-MPDU context	The A-MPDU is transmitted within a VHT or S1G PPDU and contains an ~~VHT single~~ S-MPDU.	Table 9-429

Change the following row of Table 9-428 as shown:

Table 9-428—A-MPDU contents MPDUs in the control response context

MPDU	Conditions
Action No Ack	+HTC Action No Ack frames carrying a Management Action Body containing an explicit feedback response or BRP frame. Flow Control Action No Ack frames carrying a flow suspension frame or a flow resumption frame.

Change Table 9-429 as follows:

Table 9-429—A-MPDU contents in the ~~VHT single~~ S-MPDU

MPDU	Conditions
Any MPDU	An ~~VHT single~~ S-MPDU.

Insert the following subclauses (9.8 through 9.9.3.1.2, including Table 9-430 through Table 9-437 and Figure 9-748 through Figure 9-780) after 9.7.3:

9.8 MAC frame format for PV1 frames

9.8.1 Basic components

Each PV1 frame consists of the following basic components:

a) A PV1 *MAC header*, which comprises frame control, address, optional sequence control information;

b) A variable-length *frame body*, which contains information specific to the frame *type*;

c) An *FCS*, which contains an IEEE 32-bit CRC.

9.8.2 General PV1 frame format

Figure 9-748 depicts the general PV1 MAC frame format. The first three fields (Frame Control, A1 and A2) and the last field FCS are always present in PV1 frames. The Sequence Control, A3, A4 and Frame body fields are optionally present. Each field is defined in 9.8.3.

Octets:	2	2 or 6	2 or 6	0 or 2	0 or 6	0 or 6	variable	4
	Frame Control	A1	A2	Sequence Control	A3	A4	Frame Body	FCS

PV1 MAC header

Figure 9-748—PV1 frame format

NOTE—In Figure 9-748, a total octets of A1 and A2 fields is 8 or 12.

The Frame Body field is of variable size, constrained as defined in 9.2.4.7.1.

9.8.3 PV1 frame fields

9.8.3.1 Frame Control field

The general format of the Frame Control field of the PV1 MAC header is illustrated in Figure 9-749 except for the most significant octet of the Frame Control field of PV1 Probe Response frames (defined in 9.8.5.3), Resource Allocation frames (defined in 9.8.5.4, and PV1 Control frames (defined in 9.8.4).

	B0 B1	B2 B4	B5 B7	B8	B9	B10	B11	B12	B13	B14	B15
	Protocol Version	Type	PTID/ Subtyp e	From DS	More Fragm ents	Power Manage ment	More Data	Protect ed Frame	End of Service Period	Relayed Frame	Ack Policy
Bits:	2	3	3	1	1	1	1	1	1	1	1

Figure 9-749—Frame Control field

The Protocol Version subfield is defined in 9.2.4.1.2. For PV1 frames the value of the protocol version is 1.

The Type subfield identifies the type of the frame, as defined in Table 9-430.

Table 9-430—PV1 frame types

Type	Type description
0	QoS Data — Either A1 or A2 is an SID (defined in 9.8.3.2), as determined by the From DS subfield in the Frame Control field
1	Management — Either A1 or A2 is an SID (defined in 9.8.3.2), as determined by the From DS subfield in the Frame Control field — Both A1 and A2 fields contain MAC addresses for PV1 Probe Response frames.

Table 9-430—PV1 frame types *(continued)*

Type	Type description
2	Control — A1 is an SID and A2 is either an SID or contains a MAC address
3	QoS Data — Both A1 and A2 fields contain MAC addresses
4–6	Reserved
7	Extension (currently reserved)

PV1 frames with Type subfield value equal to 0 define a PV1 QoS Data frame where either A1 or A2 field is an SID as indicated in Table 9-431 and the other A1 or A2 field contains a MAC address. PV1 frames with Type subfield value equal to 1 define a PV1 Management frame where either A1 or A2 field is an SID as indicated in Table 9-431 and the other A1 or A2 field contains a MAC address. PV1 frames with Type subfield value equal to 2 define PV1 Control frames. PV1 frames with Type subfield value equal to 3 define a PV1 QoS Data frame where both A1 and A2 fields contain MAC addresses. All other values of the Type subfield are reserved.

The PTID/Subtype subfield, depending on the type of the PV1 frame, indicates:

- The 3 LSBs of the TID as defined in 9.2.4.5.2 for PV1 QoS Data frames (Type field equal to 0 and 3) transmitted by a QoS STA.
- The Subtype for PV1 Control frames (Type subfield equal to 2) as described in 9.8.4
- The Subtype for PV1 Management frames (Type subfield equal to 1) as described in 9.8.5

The From DS subfield, if present, defines the addressing of PV1 frames with values of the Type field less than 2, as defined in Table 9-431.

Table 9-431—From DS values in PV1 frames

From DS field	Meaning	Use
0	A1 contains the MAC address of the receiver A2 is an SID, which contains the AID of the transmitter — A2 contains the MAC address of the transmitter for PV1 QoS Data frames with Type subfield equal to 3 A3 (if present) contains the MAC address of the destination A4 (if present) contains the MAC address of the source	For frames transmitted by a non-AP STA to an AP For frames transmitted from a non-AP STA to non-AP STA (direct link)
1	A1 is an SID, which contains the AID of the receiver — A1 contains the MAC address of the receiver for PV1 QoS Data frames with Type subfield equal to 3 A2 is the MAC address of the transmitter A3 (if present) contains the MAC address of the destination A4 (if present) contains the MAC address of the source	AP to non-AP STA

The More Fragments subfield is described in 9.2.4.1.5.

The Power Management subfield is described in 9.2.4.1.7.

The EOSP subfield is described in 9.2.4.5.3.

The Protected Frame subfield is described in 9.2.4.1.9.

The More Data subfield is described in 9.2.4.1.8.

The Relayed Frame subfield indicates that the current TXOP is shared with the relay STA using the TXOP sharing procedures for relays described in 10.50.5.

The Ack Policy subfield identifies the acknowledgment policy that is followed upon the delivery of the MPDU, as defined in Table 9-432.

Table 9-432—Ack Policy subfield in the Frame Control field for PV1 frames

Ack Policy subfield	Meaning
0	Normal Ack or Implicit Block Ack Request. In a PV1 frame that is a non-A-MPDU frame or S-MPDU where either the originator or the addressed recipient does not support fragment BA procedure: The addressed recipient returns an Ack frame after a short interframe space (SIFS) period, according to the procedures defined in 10.3.2.9. In a PV1 frame that is part of an A-MPDU that is not an S-MPDU: The addressed recipient returns a BlockAck frame, either individually or as part of an A-MPDU starting a SIFS after the PPDU carrying the frame, according to the procedures defined in 10.3.2.9, , and 10.24.8.3. In a PV1 frame that is a fragment: When both the originator and the addressed recipient support the fragment BA procedure, the addressed recipient returns an NDP BlockAck frame after a SIFS, according to the procedure defined in 10.3.2.9a. Ack Policy 0 is limited to at most one MU recipient per MU PPDU.
1	No Ack or Block Ack Policy. In a PV1 frame that is a non-A-MPDU frame or S-MPDU: The addressed recipient takes no action upon receipt of the frame. More details are provided in 10.25. The Ack Policy subfield is set to this value in all individually addressed frames in which the sender does not require acknowledgment. The Ack Policy subfield is also set to this value in all group addressed frames. This combination is not used for PV1 Data frames with a TID for which a Block Ack agreement exists. In a PV1 frame that is part of an A-MPDU frame that is not an S-MPDU: The addressed recipient takes no action upon the receipt of the frame except for recording the state. The recipient can expect a BlockAckReq frame in the future to which it responds using the procedure described in 10.24.

9.8.3.2 Address fields

There are up to four address fields in the PV1 MAC frame format. These fields are used to indicate the recipient of the frame (A1), the transmitter of the frame (A2), and optionally the MAC address of the source and/or the MAC address of the destination of the frame (A3 and/or A4).

The recipient of the frame (A1) or the transmitter of the frame (A2) can be identified by the AID subfield located in the Short ID (SID) field depending on the value of the From DS subfield of the Frame Control field as described in 9.8.3.1. A group of receiving non-AP STAs of the frame can be identified by the AID subfield with a group AID value, as described in 10.51, located in the Short ID (SID) field. The length of the SID field is 2 octets and is illustrated in Figure 9-750.

	B0 B12	B13	B14	B15
	Association ID (AID)	A3 Present	A4 Present	A-MSDU
Bits:	13	1	1	1

Figure 9-750—SID field

The AID subfield contains an AID as specified in Table 9-431 in PV1 frames of Type 0, 1 and 2.

The A3 Present subfield is 1 if the A3 is present in the PV1 MAC header, otherwise it is 0.

The A4 Present subfield is 1 if the A4 is present in the PV1 MAC header, otherwise it is 0.

The A-MSDU subfield is 1 if the MPDU contains a Dynamic A-MSDU as described in 9.3.2.2.4.

NOTE—PV1 frames without an SID field do not contain A3 and A4 fields and do not carry A-MSDUs.

The A3 field is present if A3 is not equal to the address identified by A1 and an A3 is not stored at the receiver, or when A3 is not equal to an A3 stored at the receiver (as described in 10.54). When the A3 field is not present, A3 is either stored at the recipient of the frame or, if an A3 is not stored at the recipient of the frame then A3 is equal to the address identified by A1.

The A4 field is present if A4 is not equal to the address identified by A2 and an A4 is not stored at the receiver, or when A4 is not equal to an A4 stored at the receiver (as described in 10.54). When the A4 field is not present, A4 is either stored at the recipient of the frame or, if an A4 is not stored at the recipient of the frame then A4 is equal to the address identified by A2.

9.8.3.3 Sequence Control field

The Sequence Control field is present in all PV1 Data frames and PV1 Management frames other than PV1 Probe Response frames, and is described in 9.2.4.4. The Sequence Control field is not present in PV1 Control frames and in PV1 Probe Response frames.

9.8.3.4 Frame Body field

The Frame Body is a variable-length field and is described in 9.2.4.7.

9.8.3.5 Overhead for encryption

The overhead for encryption is described in Clause 12.

9.8.3.6 FCS field

The FCS field is described in 9.2.4.8.

9.8.4 PV1 Control frames

9.8.4.1 General

The subfields within the Frame Control field of PV1 Control frames are set as illustrated in Figure 9-751.

	B0 B1	B2 B4	B5 B7	B8 B10	B11	B12	B13	B14	B15
	Protocol Version (1)	Type (Control)	PTID/ Subtype	Bandwidth Indication	Dynamic Indication	Power Management	More Data	Flow Control	Next TWT Info Present
Bits:	2	3	3	3	1	1	1	1	1

Figure 9-751—Frame Control field subfield values within PV1 Control frames

Table 9-433 defines the different PV1 Control frame subtypes.

Table 9-433—PV1 Control frame subtypes

PTID/Subtype value b8 b7 b6	Subtype description
000	STACK
001	BAT
010–111	Reserved

The Bandwidth Indication subfield and the Dynamic Indication subfield are described in 9.2.4.1.11.

The Next TWT Info Present subfield is set to 1 if the Next TWT Info field is present in PV1 Control frames. Otherwise, it is set to 0.

The More Data subfield is described in 9.2.4.1.8.

The Flow Control subfield is used for flow suspension signaling as described in 10.57.

9.8.4.2 STACK frame format

The frame format of the short TWT acknowledgment (STACK) frame is defined in Figure 9-752:

	Frame Control	A1	A2	Tetrapartial Timestamp/ Next TWT Info/ Suspend Duration	FCS
Octets:	2	2	2	4	4

Figure 9-752—STACK frame format

The A1 is an SID field that contains the AID of the intended recipient of the frame in the AID subfield. A3 Present, A4 Present and A-MSDU subfields (B13, B14, and B15) of the SID field are reserved.

The A2 is an SID field that contains the bit sequence Scrambler Initialization[0:6] || FCS[23:31] obtained from the scrambler initialization value in the Service field (as defined in 23.3.9.2), prior to descrambling, and the FCS field of the PSDU that carries the soliciting frame. The scrambler initialization value is obtained from the RXVECTOR parameter SCRAMBLER_OR_CRC.

If the Next TWT Info Present subfield in the Frame Control field is equal to 0, the Tetrapartial Timestamp/ Next TWT Info/Suspend Duration field contains the least significant 4 octets of the value of the transmitting STA's TSF timer at the time that the start of the data symbol, containing the first bit of the Tetrapartial Timestamp field, is transmitted by the PHY plus the transmitting STA's delays through its local PHY from the MAC-PHY interface to its interface with the WM.

If the Next TWT Info Present subfield in the Frame Control field is equal to 1 and the Flow Control subfield of the Frame Control field is equal to 0, then the Tetrapartial Timestamp/Next TWT Info/Suspend Duration field contains the lowest 4 octets of the TSF timer for a next TWT logically ANDed with the value 0xFFFFFFF8 and then added to the value of the TWT flow identifier that corresponds to that next TWT value.

If the Next TWT Info Present subfield in the Frame Control field is equal to 1 and the Flow Control subfield of the Frame Control field is equal to 0 and the 29 MSBs of the Next TWT Info subfield is equal to all 0s, the transmitter does not currently have a next TWT value available for transmission for the TWT indicated by the TWT flow identifier corresponding to the value of the 3 LSBs of the Next TWT Info field.

If the Next TWT Info Present subfield in the Frame Control field is equal to 1 and the Flow Control subfield of the Frame Control field is equal to 1, then the Tetrapartial Timestamp/Next TWT Info/Suspend Duration field contains a flow suspension duration, in microseconds, during which the intended recipient TWT STAs are not allowed to transmit data frames to the STA identified by the RA field of the frame that elicited the STACK frame.

9.8.4.3 BAT frame format

The frame format of the Block Acknowledgment TWT (BAT) frame is defined in Figure 9-753:

	Frame Control	A1	A2	Beacon Sequence	Pentapartial Timestamp	Next TWT Info /Suspend Duration	Starting Sequence Control	BAT Bitmap	FCS
Octets:	2	2	6	1	5	6	2	4	4

Figure 9-753—BAT frame format

The A1 field is an SID field that contains the AID of the intended recipient of the frame in the AID subfield. A3 Present, A4 Present and A-MSDU subfields (B13, B14, and B15) of the SID field are reserved.

The A2 field contains the MAC address of the transmitter sending the frame.

The Beacon Sequence field contains the value of the Change Sequence field from the most recently transmitted Beacon frame.

The Pentapartial Timestamp field contains the least significant 5 octets of the value of the transmitting STA's TSF timer at the time that the start of the data symbol, containing the first bit of the Pentapartial Timestamp field, is transmitted by the PHY plus the transmitting STA's delays through its local PHY from the MAC-PHY interface to its interface with the WM.

If the Next TWT Info Present subfield in the Frame Control field is equal to 1 and the Flow Control subfield of the Frame Control field is equal to 0, then the Next TWT Info/Suspend Duration field contains a next TWT value for the intended recipient of the frame corresponding to the lowest 6 octets of the TSF timer for the next TWT logically ANDed with the value 0xFFFFFFFFFFF8 and then added to the value of the TWT flow identifier that corresponds to that next TWT value.

If the Next TWT Info Present subfield in the Frame Control field is equal to 1 and the Flow Control subfield of the Frame Control field is equal to 0 and the 45 MSBs of the Next TWT Info/Suspend Duration subfield is equal to all 0s, the transmitter does not currently have a next TWT value available for transmission for the TWT indicated by the TWT flow identifier corresponding to the value of the 3 LSBs of the Next TWT Info/Suspend Duration field.

If the Next TWT Info Present subfield in the Frame Control field is equal to 1 and the Flow Control subfield of the Frame Control field is equal to 1, then the Next TWT Info/Suspend Duration field contains a flow suspension duration, in microseconds, during which the intended recipient TWT STAs are not allowed to transmit data frames to the STA identified by the A2 field of the BAT frame.

If the Next TWT Info Present subfield in the Frame Control field is equal to 0, then the Next TWT Info/Suspend Duration field is reserved.

The Starting Sequence Control field contains the sequence number of the first MSDU and the TID for which this BAT frame is sent and is defined in Figure 9-754:

	B0 B3	B4 B15
	BAT TID	Starting Sequence Number
Bits:	4	12

Figure 9-754—Starting Sequence Control field

The BAT Bitmap field is used to indicate the received status of up to 32 MSDUs and A-MSDUs. Each bit that is equal to 1 in the BAT Bitmap field acknowledges the successful reception of a single MSDU or A-MSDU in sequentially increasing sequence number order, with the first bit of the BAT Bitmap field corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the BAT frame.

9.8.5 PV1 Management frames

9.8.5.1 Format of PV1 Management frames

The format of a PV1 Management frame is defined in Figure 9-755.

The Frame Control, A1, and A2 fields are present in all PV1 Management frame subtypes.

	Frame Control	A1	A2	Sequence Control	A3	Frame Body	FCS
Octets:	2	2 or 6	6 or 2	0 or 2	0 or 6	variable	4

Figure 9-755—PV1 Management frame format

The address fields A1 and A2 contain the receiver and transmitter addresses either of which can be an SID field as described in 9.8.3.2.

The Sequence Control field is described in 9.2.4.4 and is present in PV1 Management frames of subtype Action and Action No Ack.

The address field A3 (if present, as described in 9.8.3.2) is set to the BSSID.

The frame body consists of the fields followed by the elements defined for each PV1 Management frame subtype. All fields and elements are mandatory unless stated otherwise and appear in the specified, relative order. STAs that encounter an element ID they do not recognize in the frame body of a received PV1 Management frame ignore that element and continue to parse the remainder of the PV1 Management frame body (if any) for additional elements with recognizable element IDs. See 10.27.7. Unused element ID codes are reserved.

Table 9-434 defines the different PV1 Management frame subtypes.

Table 9-434—PV1 Management frame subtypes

PTID/Subtype value b8 b7 b6	Subtype description
000	Action
001	Action No Ack
010	PV1 Probe Response
011	Resource Allocation
100–111	Reserved

9.8.5.2 Action and Action No Ack frames

The frame body of a PV1 Management frame of subtype Action is described in 9.3.3.14 and the format of the Action field formats allowed is described in 9.6.

The frame body of a PV1 Management frame of subtype Action No Ack is described in 9.3.3.15 and the format of the Action field formats allowed is described in 9.6.

9.8.5.3 PV1 Probe Response frame format

The format of the PV1 Probe Response frame is shown in Figure 9-756.

	Frame Control	A1	A2	Times tamp	Change Sequence	Next TBTT (optional)	Compressed SSID (optional)	Access Network Options (optional)	Optional Elements	FCS
Octets:	2	6	6	4	1	0 or 3	0 or 4	0 or 1	variable	4

Figure 9-756—PV1 Probe Response frame format

The A1 field contains the MAC address of the intended recipient of the frame.

The A2 field contains the MAC address of the transmitter sending the frame.

The Timestamp field contains the 4 least significant octets of the transmitting STA's TSF timer at the time that the start of the data symbol, containing the first bit of the Timestamp, is transmitted by the PHY plus the transmitting STA's delays through its local PHY from the MAC-PHY interface to its interface with the WM.

The Change Sequence field is defined as an unsigned integer, initialized to 0, that increments when a critical update to the Beacon frame has occurred (see 10.42.2).

The Next TBTT field is present if the Next TBTT Present subfield in the Frame Control field is 1 and indicates the most significant 3 octets of the 4 least significant octets of the next TBTT. Otherwise, it is not present.

Either a Compressed SSID field or an SSID element is included in the PV1 Probe Response frame.

The Compressed SSID field is present if the Full SSID Present subfield in the Frame Control field is 0 and it contains a 32-bit CRC calculated over the SSID contained in the Probe Response or S1G Beacon frame (calculation is performed as defined in 9.2.4.8 where the SSID is the *calculation fields*). An SSID element is not present if the Full SSID Present subfield in the Frame Control field is 0.

An SSID element as defined in 9.4.2.2 is present in the Optional Elements field of the PV1 Probe Response frame if the Full SSID Present subfield in the Frame Control field is 1. The Compressed SSID field is not present if the Full SSID Present subfield in the Frame Control field is 1.

The Access Network Options field is present if the ANO Present subfield in the Frame Control field is 1 and is defined in 9.4.2.92. Otherwise, it is not present.

The Optional Elements field contains optional elements requested to be included in the PV1 Probe Response frame such as S1G Beacon Compatibility element. If the S1G Beacon Compatibility element is requested to be included, the PV1 Probe Response frame includes it as the first optional element.

The Frame Control field of the PV1 Probe Response frame is shown in Figure 9-757.

	B0 B1	B2 B4	B5 B7	B8	B9	B10	B11 B13	B14	B15
	Protocol Version	Type	PTID/ Subtype	Next TBTT Present	Full SSID Present	ANO Present	BSS BW	Security	1 MHz Primary Channel Location
Bits:	2	3	3	1	1	1	3	1	1

Figure 9-757—Frame Control field of PV1 Probe Response frame format

The Next TBTT present subfield is set to 1 if the Next TBTT field is included in the PV1 Probe Response frame and otherwise set to 0.

The Full SSID Present field indicates whether a Full SSID or a Compressed SSID is included in the PV1 Probe Response frame. A value of 1 indicates that an SSID element is included and the Compressed SSID field is not included in the PV1 Probe Response frame. A value of 0 indicates that the Compressed SSID field is included and the SSID element is not included in the PV1 Probe Response frame.

The ANO Present subfield equals 1 if the Access Network Options field is present; otherwise, it equals 0.

The BSS BW subfield indicates the minimum and the maximum operating bandwidths of the BSS and is defined in Table 9-4d.

The Security subfield equals 1 if the transmitting STA is an RSNA STA.

The 1 MHz Primary Channel Location subfield indicates the location of the 1 MHz primary channel. If it is equal to 0, it indicates that the 1 MHz primary channel is located at lower side of 2 MHz primary channel. If it is equal to 1, it indicates that the 1 MHz primary channel is located at upper side of 2 MHz primary channel.

9.8.5.4 Resource Allocation frame format

The Resource Allocation (RA) frame is broadcasted to all non-AP STAs that belong to the RAW group identified by the RAW Group field of a previously transmitted RPS element with the RAW Type subfield indicating a generic RAW and the RAW Type Options subfield indicating an RA frame (see 9.4.2.192). The RA frame signals the presence of downlink buffered data for paged STAs and their assigned RAW slots for both uplink and downlink service periods. The Resource Allocation frame has two kinds of format depending on the slot assignment mode indicated in the Frame Control field. The Resource Allocation frame formats are illustrated in Figure 9-758 and Figure 9-759.

	Frame Control	A1	BSSID	RAW Group	RAW Duration	Slot Assignment 1	…	Slot Assignment N	FCS
Octets:	2	2	6	3	2	3 or 4		3 or 4	4

Figure 9-758—Resource Allocation frame format when Slot Assignment Mode field is 0

	Frame Control	A1	BSSID	RAW Group	RAW Duration	Slot Assignment Indication	FCS
Octets:	2	2	6	3	2	variable	4

Figure 9-759—Resource Allocation frame format when Slot Assignment Mode field is 1

The Slot Assignment Indication field formats are illustrated in Figure 9-760, Figure 9-761, and Figure 9-762.

	B0	B1 B6	B7 B22	B23
	EOM Indicator	GID	Slot Start Offset	Reserved
Bits:	1	6	16	1

Figure 9-760—Slot Assignment Indication field for MU group when Slot Assignment Mode field is 0 and the Group Indicator field is 1

	B0 B8	B9 B24	B25 B31
	Partial AID	Slot Start Offset	Reserved
Bits:	9	16	B7

Figure 9-761—Slot Assignment Indication field for a STA when Slot Assignment Mode is 0 and the Group Indicator field is 0

	Slot Assignment Bitmap	Pad
Bits:	RAW Group size x 4 bits for each STA	0 or 4

Figure 9-762—Slot Assignment Indication field when Slot Assignment Mode field is 1

The Frame Control field of the Resource Allocation frame is shown in Figure 9-763.

	B0 B1	B2 B4	B5 B7	B8	B9	B10	B11	B12	B13	B14	B15
	Protocol Version (1)	Type	PTID/ Subtype	Slot Assignment Mode	More Fragments	Power Management	Group Indicator	Protected Frame	End of Service Period	Relayed Frame	Ack Policy
Bits:	2	3	3	1	1	1	1	1	1	1	1

Figure 9-763—Frame Control field format for Resource Allocation frame

The subfields of the Frame Control field, except for the Slot Assignment Mode and the Group Indicator subfields, are defined in 9.8.3.1. The Slot Assignment Mode and the Group Indicator subfields are defined as follows:

- The Slot Assignment Mode subfield indicates the format of the Resource Allocation frame:
  - If the Slot Assignment Mode subfield is equal to 0, the Resource Allocation frame format is as shown in Figure 9-758.
  - If the Slot Assignment Mode subfield is equal to 1, the Resource Allocation frame format is as shown in Figure 9-759.
- The Group Indicator subfield indicates whether any subfield of MU group is included or no subfield of MU group exists in the Slot Assignment field if Slot Assignment mode field is equal to 0. Otherwise, it is reserved.

The A1 field is an SID field that contains the value 0 in the AID subfield. A3 Present, A4 Present and A-MSDU subfields (B13, B14, and B14) of the SID field are reserved.

The BSSID field indicates the address of the AP transmitting the Resource Allocation frame.

The RAW Group field indicates the STA AIDs that are assigned the RAW as defined in 9.4.2.192. The AIDs in this RAW Group are identical to the AIDs in the RAW Group subfield with the value in the RAW Type subfield set to 0 and the value in the RAW Type Options subfield set to 1 in the RAW Control subfield within the RPS element. STAs that wake up and receive the Resource Allocation frame use this field to determine whether their AIDs are included within the RAW Group.

The RAW Duration field is an unsigned integer expressed in TUs that indicates the duration of the current RAW where the Resource Allocation frame is broadcasted. The value indicated in this field is either identical to the value of the RAW duration deduced from the value in the RAW Slot Definition subfield (9.4.2.192) or is modified from the value indicated in the RAW Slot Definition subfield of the RPS element (9.4.2.192).

The Slot Assignment field indicates a partial AID for an STA or a GID for STAs in the corresponding MU Group and their corresponding slot(s) of medium access within the current RAW. Since MU MIMO is used for DL traffic, the first bit, as called end of multi-user (EOM) Indicator, for the MU group block indicates whether the following subfields are used for the last MU group when this bit is 1 or more MU groups exist after subfields for this MU group when the bit is 0. This field is of length 3 octets for each MU Group and 4 octets for each STA and the length is determined based on the value in the EOM subfield.

If Slot Assignment Mode field is 0 and the Group Indicator field is 1, the Slot Assignment field is used for either MU group of STAs or an assigned STA as shown in Figure 9-760 and Figure 9-761. If Slot Assignment Mode field is 0 and the Group Indicator field is 0, the Slot Assignment field is not used for MU group of STAs. The Slot Assignment field for MU group of STAs is located first at the beginning of the Slot Assignment fields, if exists.

The Partial AID subfield indicates a partial AID for an assigned STA.

The Slot Start Offset subfield indicates the start time of a RAW slot, in TU, for a STA's or MU MIMO group of STAs' medium access, relative to the RAW Start Time field as defined in 9.4.2.192 and is of length 2 octets.

The RA frame contains Slot Assignment Indication field to indicate to each of the STA in the RAW group the number of UL/DL slot allocations within the current RAW.

The Slot Assignment Bitmap subfield indicates the number of RAW slots allocated for all STAs in the RAW group in ascending order with each 4 bits corresponding to one STA. The decimal number represented by the 4 bits indicates the number of allocation units for a STA. For example, a value of 0 indicates no allocation for a STA. A value of 1 indicates one RAW slot for a STA. All RAW slots have equal duration, in TUs, which is calculated by dividing the value of the RAW Duration field with the number of RAW slots allocated to all STAs in the RAW group. The first RAW slot starts at the end of the Resource Allocation frame while the start times of the remaining RAW slots are equal to the end times of their immediately preceding RAW slots as indicated in the Slot Assignment Bitmap subfield.

The Slot Assignment Bitmap subfield has a length in bits, SAB_{length}, which is determined as:

$$SAB_{\text{length}} = (\text{RAW End AID} - \text{RAW Start AID} + 1) \times 4$$

where
RAW End AID and RAW Start AID for the RAW group are defined in 9.4.2.192

The Pad subfield contains 0 or 4 bits of 0s to make the total number of bits in the Slot Assignment Indication field equal to an integer number of octets.

9.9 NDP CMAC frames

9.9.1 General

The format of NDP CMAC frames that use the S1G_1M format is shown in Figure 23-19. Figure 23-20 shows the SIG field format that contains the NDP CMAC frame body field. The NDP CMAC frame body field is 25 bits for NDP CMAC frames that are transmitted using the S1G_1M format (NDP_1M).

The format of NDP CMAC frames that use the S1G_SHORT format is shown in Figure 23-18. Figure 23-21 shows the SIG field format that contains the NDP CMAC frame body field. The NDP CMAC frame body field is 37 bits for NDP CMAC frames that are transmitted using the S1G_SHORT format (NDP_2M).

An NDP CMAC frame is indicated by setting the TXVECTOR parameter NDP_INDICATION to 1. The TXVECTOR parameter NDP_CMAC_FRAME_BODY is set to the concatenated bits of the NDP CMAC frame body field.

An RXVECTOR parameter NDP_INDICATION equal to 1 indicates reception of an NDP CMAC frame, and the NDP CMAC frame body field of the frame is obtained from the RXVECTOR parameter NDP_CMAC_FRAME_BODY.

The PHY preamble format for transmission of NDP CMAC frames is defined in 23.3.11.

This subclause describes the NDP CMAC frame body field content for each of the NDP CMAC frame types. The type of the NDP CMAC frame is indicated in the NDP CMAC Frame Type field and its values are defined in Table 9-435.

Table 9-435—NDP CMAC frame Type field values

Value	Meaning	See subclause
0	NDP CTS (control frame)	9.9.2.1
0	NDP CF-End (control frame)	9.9.2.2
1	NDP PS-Poll (control frame)	9.9.2.3
2	NDP Ack (control frame)	9.9.2.4
3	NDP PS-Poll-Ack (control frame)	9.9.2.5
4	NDP BlockAck (control frame)	9.9.2.6
5	NDP Beamforming Report Poll (control frame)	9.9.2.7
6	NDP Paging (control frame)	9.9.2.8
7	NDP Probe Request (management frame)	9.9.3.1

9.9.2 NDP control frame details

9.9.2.1 NDP CTS

9.9.2.1.1 NDP_1M CTS

The format of the NDP CMAC frame body field of the NDP_1M CTS frame is illustrated in Figure 9-764.

	B0 B2	B3	B4	B5 B13	B14 B23	B24
	NDP CMAC Frame Type	CTS/CF-End Indicator	Address Indicator	RA/Partial BSSID	Duration	Early Sector Indicator
Bits:	3	1	1	9	10	1

Figure 9-764—NDP CMAC frame body field of the NDP_1M CTS frame

The NDP CMAC Frame Type field is set to 0.

The CTS/CF-End Indicator field is set to 0.

The Address Indicator field is set to 0 to indicate that the RA/Partial BSSID field contains the partial identifier of the receiving STA. It is set to 1 to indicate that the RA/Partial BSSID field contains the partial BSSID of the AP transmitting the frame and is interpreted as a broadcast address (see 10.3.2.7 for the receiving STA's behavior). When the NDP CTS frame is used in the sector training it is set to 1.

The RA/Partial BSSID (PBSSID) field indicates:

— RA: the partial AID of the receiving non-AP STA or the partial BSSID of the receiving AP as described in 10.20b
— Partial BSSID: the partial BSSID of the transmitting AP as described in 10.20b

The Duration field is expressed in units of OFDM symbol duration (40 µs) (Table 23-4) and follows the definitions in 9.3.1.3.

The Early Sector Indicator field is set to 1 to indicate that the NDP CTS frame is followed by the sectorized beam frame exchange. It is set to 0 to indicate that the NDP CTS frame is not followed by the sectorized beam frame exchange.

9.9.2.1.2 NDP_2M CTS

The format of the NDP CMAC frame body field of the NDP_2M CTS frame is illustrated in Figure 9-765.

	B0 B2	B3	B4	B5 B13	B14 B28	B29	B30 B32	B33 36
	NDP CMAC Frame Type	CTS/ CF-End Indicator	Address Indicator	RA/ Partial BSSID	Duration	Early Sector Indicator	Bandwidth Indication	Reserved
Bits:	3	1	1	9	15	1	3	4

Figure 9-765—NDP CMAC frame body field of the NDP_2M CTS frame

The NDP CMAC Frame Type field is set to 0.

The CTS/CF-End Indicator field is set to 0.

The Address Indicator field is set to 0 to indicate that the RA/Partial BSSID field contains the partial identifier of the receiving STA. It is set to 1 to indicate that the RA/Partial BSSID field contains the partial BSSID of the AP transmitting the frame and is interpreted as a broadcast address (see 10.3.2.7 for the receiving STA's behavior). When the NDP CTS frame is used in the sector training it is set to 1.

The RA/Partial BSSID (PBSSID) field indicates

— RA: the partial AID of the receiving non-AP STA or the partial BSSID of the receiving AP as described in 10.20b
— Partial BSSID: the partial BSSID of the transmitting AP as described in 10.20b

The Duration field is expressed in units of microseconds and follows the definitions in 9.3.1.3.

The Early Sector Indicator field is set to 1 to indicate that the NDP CTS frame is followed by the sectorized beam frame exchange. It is set to 0 to indicate that the NDP CTS frame is not followed by the sectorized beam frame exchange.

The Bandwidth Indication field is described in 9.2.4.1.11.

9.9.2.2 NDP CF-End

9.9.2.2.1 NDP_1M CF-End

The format of the NDP CMAC frame body field of the NDP_1M CF-End frame is illustrated in Figure 9-766.

	B0 B2	B3	B4 B12	B13 B22	B23 B24
	NDP CMAC Frame Type	CTS/CF-End Indicator	Partial BSSID (TA)	Duration	Reserved
Bits:	3	1	9	10	2

Figure 9-766—NDP CMAC frame body field of the NDP_1M CF-End frame

The NDP CMAC Frame Type field is set to 0.

The CTS/CF-End Indicator field is set to 1.

The Partial BSSID field indicates the PARTIAL_AID of the address of the STA contained in the AP.

The Duration field is expressed in units of OFDM symbol time (40 μs) and follows the definitions in 9.3.1.6.

9.9.2.2.2 NDP_2M CF-End

The format of the NDP CMAC frame body field of the NDP_2M CF-End frame is illustrated in Figure 9-767.

	B0 B2	B3	B4 B12	B13 B27	B28 B36
	NDP CMAC Frame Type	CTS/CF-End Indicator	Partial BSSID (TA)	Duration	Reserved
Bits:	3	1	9	15	9

Figure 9-767—NDP CMAC frame body field of the NDP_2M CF-End frame

The NDP CMAC Frame Type field is set to 0.

The CTS/CF-End Indicator field is set to 1.

The Partial BSSID field indicates the PARTIAL_AID of the address of the STA contained in the AP.

The Duration field is expressed in units of microseconds and follows the definitions in 9.3.1.6.

9.9.2.3 NDP PS-Poll

9.9.2.3.1 NDP_1M PS-Poll

The format of the NDP CMAC frame body field of the NDP_1M PS-Poll frame is illustrated in Figure 9-768.

	B0 B2	B3 B11	B12 B20	B21 B23	B24
	NDP CMAC Frame Type	RA	TA	Preferred MCS	UDI
Bits:	3	9	9	3	1

Figure 9-768—NDP CMAC frame body field of the NDP_1M PS-Poll frame

The NDP CMAC Frame Type field is set to 1.

The RA field indicates the partial AID of the STA contained in the AP as described in 10.20b.

The TA field indicates the partial AID of the STA transmitting the frame as described in 10.20b.

The Preferred MCS field indicates the preferred MCS level for an 1 MHz channel width of the STA for downlink transmission. Mapping between Preferred MCS value and corresponding MCS index is shown in Table 9-436.

Table 9-436—Preferred MCS subfield values for NDP_1M PS-Poll frame

Preferred MCS value	MCS Index	Description
0	0	BPSK 1/2
1	1 or 2	QPSK 1/2 or QPSK 3/4
2	3 or 4	16-QAM 1/2 or 16-QAM 3/4
3	5 or 6	64-QAM 2/3 or 64-QAM 3/4
4	7 or 8	64-QAM 5/6 or 256-QAM 3/4
5	9	64-QAM 5/6
6	10	BPSK 1/4
7	No Preference	

The Uplink Data Indicator (UDI) subfield indicates if the STA has uplink data to transmit:

— Set to 0 to indicate that there is no uplink data present
— Set to 1 to indicate that there is uplink data present

9.9.2.3.2 NDP_2M PS-Poll

The format of the NDP CMAC frame body field of the NDP_2M PS-Poll frame is illustrated in Figure 9-769.

	B0 B2	B3 B11	B12 B20	B21 B24	B25 B36
	NDP CMAC Frame Type	RA	TA	Preferred MCS	UDI
Bits:	3	9	9	4	12

Figure 9-769—NDP CMAC frame body field of the NDP_2M PS-Poll frame

The NDP CMAC Frame Type field is set to 1.

The RA field indicates the partial AID of the address of the STA contained in the AP as described in 10.20b.

The TA field indicates the partial AID of the address of the STA transmitting the frame as described in 10.20b.

The Preferred MCS field indicates the preferred MCS level for a 2 MHz channel width of the STA for downlink transmission. Mapping between Preferred MCS value and corresponding MCS index is shown in Table 9-437.

Table 9-437—Preferred MCS subfield values for NDP_2M PS-Poll frame

Preferred MCS value	MCS Index	Description
0–9	0–9	The value represents MCS index for the STA's preferred MCS level.
10	No Preference	
11–15	Reserved	

The Uplink Data Indicator (UDI) subfield indicates if the STA has uplink data to transmit and is used by an SST STA to indicate its selected SST channel:

- Set to 0 to indicate that there is no uplink data present
- Set to 1 to indicate that there is uplink data present but the estimated time for the transmission of the uplink data frames that are present at the STA is not determined.
- Set to a value between 2 and 9 to indicate the relative position of the selected SST channel with respect to the lowest numbered channel in the SST Enabled Channel Bitmap field of a received SST Operation element. For example, a value of the UDI equal to 2 indicates that the selected SST channel is the first channel in the SST Enabled Channel Bitmap field, while a value of the UDI equal to 3 indicates that the selected SST channel is the second channel in the SST Enabled Channel Bitmap field, etc.
- Set to a value greater than 9 to indicate the estimated time, in units of 40 µs, required for the transmission of the uplink data frames that are present at the STA, excluding the duration of their response and applicable IFS durations.

9.9.2.4 NDP Ack

9.9.2.4.1 General

The NDP Ack frame, used to respond to an S1G frame, other than an NDP PS-Poll frame, is described in this subclause.

9.9.2.4.2 NDP_1M Ack

The format of the NDP CMAC frame body field of the NDP_1M Ack frame is illustrated in Figure 9-770.

	B0 B2	B3 B11	B12	B13	B14 B23	B24
	NDP CMAC Frame Type	Ack ID	More Data	Idle Indication	Duration	Relayed Frame
Bits:	3	9	1	1	10	1

Figure 9-770—NDP CMAC frame body field of the NDP_1M Ack frame

The NDP CMAC Frame Type field is set to 2.

The Ack ID field is set to the bit sequence Scrambler Initialization [0:6] || FCS[30:31] obtained from the scrambler initialization value in the Service field (as defined in 23.3.9.2) prior to descrambling, and the FCS field of the PSDU that carries the soliciting frame. The scrambler initialization value is obtained from the RXVECTOR parameter SCRAMBLER_OR_CRC.

The More Data field is described in 9.2.4.1.8.

The Idle Indication field is set to 0 if the value of the Duration field sets the NAV as described in 9.2.5.7). Otherwise, it is set to 1 if the value of the Duration field indicates an idle period.

If the Idle Indication field is 0, the Duration field is set as described in 9.2.5.7 where the value is expressed in units of 40 µs. If the Idle Indication field is 1, the Duration field is set to the duration of time, in milliseconds, during which an idle period (during which there is no frame transmission) is expected from the STA that elicited the response, starting from the end of the NDP Ack frame response.

The Relayed Frame field is set as described in 10.50.5 and 10.57.

9.9.2.4.3 NDP_2M Ack

The format of the NDP CMAC frame body field of the NDP_2M Ack frame is illustrated in Figure 9-771.

	B0 B2	B3 B18	B19	B20	B21 B34	B35	B36
	NDP CMAC Frame Type	Ack ID	More Data	Idle Indication	Duration	Relayed Frame	Reserved
Bits:	3	16	1	1	14	1	1

Figure 9-771—NDP CMAC frame body field of the NDP_2M Ack frame

The NDP CMAC Frame Type field is set to 2.

The Ack ID field is set to the bit sequence Scrambler Initialization [0:6] || FCS[23:31] obtained from the scrambler initialization value in the Service field (as defined in 23.3.9.2) prior to descrambling, and the FCS field of the PSDU that carries the soliciting frame. The scrambler initialization value is obtained from the RXVECTOR parameter SCRAMBLER_OR_CRC.

The More Data field is described in 9.2.4.1.8.

The Idle Indication field is set to 0 if the value of the Duration field sets the NAV as described in 9.2.5.7. Otherwise, it is set to 1 if the value of the Duration field indicates an idle period.

If the Idle Indication field is 0, the Duration field is set as described in 9.2.5.7 where the value is expressed in units of 1 microsecond. If the Idle Indication field is 1, the Duration field is set to the duration of time, in milliseconds, during which an idle period (during which there is no frame transmission) is expected from the STA that elicited the response, starting from the end of the NDP Ack frame response.

The Relayed Frame field is set as described in 10.50.5 and 10.57.

9.9.2.5 NDP PS-Poll-Ack

9.9.2.5.1 General

The NDP PS-Poll-Ack frame, used to respond to an NDP PS-Poll frame, is described in this subclause.

9.9.2.5.2 NDP_1M PS-Poll-Ack

The format of the NDP CMAC frame body field of the NDP_1M PS-Poll-Ack frame is illustrated in Figure 9-772.

	B0 B2	B3 B11	B12	B13	B14 B23	B24
	NDP CMAC Frame Type	Ack ID	More Data	Idle Indication	Duration	Reserved
Bits:	3	9	1	1	10	1

Figure 9-772—NDP CMAC frame body field of the NDP_1M PS-Poll-Ack frame

The NDP CMAC Frame Type field is set to 3.

The Ack ID field is set to the bit sequence CRC[0:3] || TA[4:8] obtained from the CRC and TA field of the NDP PS-Poll frame that elicited the response. The CRC value is obtained from the RXVECTOR parameter SCRAMBLER_OR_CRC.

The More Data field is described in 9.2.4.1.8.

The Idle Indication field is set to 0 if the value of the Duration field is an extension of the Ack ID. Otherwise, it is set to 1 if the value of the Duration field indicates an idle period.

If the Idle Indication field is 0, the Duration field is set to the bit sequence TA[3] || RA[0:8] obtained from the RA and TA fields of the NDP PS-Poll frame that elicited the response. If the Idle Indication is 1, the Duration field is set to the duration of time, in milliseconds, during which an idle period (during which there is no frame transmission) is expected from the STA that elicited the response, starting from the end of the NDP PS-Poll-Ack frame response.

9.9.2.5.3 NDP_2M PS-Poll-Ack

The format of the NDP CMAC frame body field of the NDP_2M PS-Poll-Ack frame is illustrated in Figure 9-773.

	B0 B2	B3 B18	B19	B20	B21 B34	B35 B36
	NDP CMAC Frame Type	Ack ID	More Data	Idle Indication	Duration	Reserved
Bits:	3	16	1	1	14	2

Figure 9-773—NDP CMAC frame body field of the NDP_2M PS-Poll-Ack frame

The NDP CMAC Frame Type field is set to 3.

The Ack ID field is set to the bit sequence CRC[0:3] || TA[0:8] || RA[6:8]] obtained from the CRC, TA, and RA field of the NDP PS-Poll frame that elicited the response. The CRC value is obtained from the RXVECTOR parameter SCRAMBLER_OR_CRC.

The More Data field is described in 9.2.4.1.8.

The Idle Indication field is set to 0 if the value of the Duration field sets the NAV as described in 10.3.2.14. Otherwise, it is set to 1 if the value of the Duration field indicates an idle period.

If the Idle Indication field is 0, the Duration field is set as described in 10.3.2.14, where the value is expressed in units of 1 microsecond.

If the Idle Indication field is 1, the Duration field is set to the duration of time, in milliseconds, during which an idle period (during which there is no frame transmission) is expected from the STA that elicited the response, starting from the end of the NDP PS-Poll-Ack frame response.

9.9.2.6 NDP BlockAck

9.9.2.6.1 NDP_1M BlockAck

The format of the NDP CMAC frame body field of the NDP_1M BlockAck frame is illustrated in Figure 9-774.

	B0 B2	B3 B4	B5 B16	B17 B24
	NDP CMAC Frame Type	BlockAck ID	Starting Sequence Control	Block Ack Bitmap
Bits:	3	2	12	8

Figure 9-774—NDP CMAC frame body field of the NDP_1M BlockAck frame

The NDP CMAC Frame Type field is set to 4.

The BlockAck ID field contains the identifier of the NDP BlockAck frame. It is set to the 2 LSBs of the bit sequence of the scrambler initialization value in the SERVICE field (as defined in 23.3.9.2), prior to descrambling, of the PSDU that carries the soliciting frame. The scrambler initialization value is obtained from the RXVECTOR parameter SCRAMBLER_OR_CRC.

The Starting Sequence Control field contains the sequence number of the first MSDU or A-MSDU for which the NDP BlockAck frame is sent. The value of this field is defined in when the NDP BlockAck is used during a BlockAck session and is defined in 10.3.2.9a when it is used during a fragment BA session.

The Block Ack Bitmap field of the NDP BlockAck frame is used to indicate the received status of:

- Up to 8 MSDUs and A-MSDUs when the NDP BlockAck is used during a BlockAck session. Each bit that is equal to 1 in the NDP BlockAck bitmap acknowledges the successful reception of a single MSDU or A-MSDU in the order of sequence number, with the first bit of the NDP BlockAck bitmap corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Control field.
- Up to 8 fragments of an MSDU when the NDP BlockAck is used during a fragment BA session (see 10.3.2.9a). Each bit that is equal to 1 in the BlockAck Bitmap acknowledges the successful reception of a single fragment of an MSDU, in the order of the fragment number, with the first bit of the BlockAck Bitmap corresponding to the MPDU with fragment number equal to 0 or 8.

The transmitting (receiving) STA encodes (decodes) the BlockAck ID field and the Starting Sequence Control field of the NDP BlockAck frames applying the protection mechanism described in 10.53.

9.9.2.6.2 NDP_2M BlockAck

The format of the NDP CMAC frame body field of the NDP_2M BlockAck frame is illustrated in Figure 9-775.

	B0 B2	B3 B8	B9 B20	B21 B36
	NDP CMAC Frame Type	BlockAck ID	Starting Sequence Control	Block Ack Bitmap
Bits:	3	6	12	16

Figure 9-775—NDP CMAC frame body field of the NDP_2M BlockAck frame

The NDP CMAC Frame Type field is set to 4.

The BlockAck ID field contains the identifier of the NDP BlockAck frame. It is set to the 6 LSBs of the bit sequence of the scrambler initialization value in the SERVICE field (as defined in 23.3.9.2), prior to descrambling, of the PSDU that carries the soliciting frame. The scrambler initialization value is obtained from the RXVECTOR parameter SCRAMBLER_OR_CRC.

The Starting Sequence Control field contains the sequence number of the first MSDU or A-MSDU for which the NDP BlockAck frame is sent. The value of this field is defined in when the NDP BlockAck is used during a BlockAck session and is defined in 10.3.2.9a when it is used during a fragment BA session.

The Block Ack Bitmap field of the NDP BlockAck frame is used to indicate the received status of:

- Up to 16 MSDUs and A-MSDUs. Each bit that is equal to 1 in the NDP BlockAck bitmap acknowledges the successful reception of a single MSDU or A-MSDU in the order of sequence number, with the first bit of the NDP BlockAck bitmap corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Control field.
- Up to 16 fragments of an MSDU when the NDP BlockAck is used during a fragment BA session (see 10.3.2.9a). Each bit that is equal to 1 in the BlockAck Bitmap acknowledges the successful reception of a single fragment of an MSDU, in the order of the fragment number, with the first bit of the BlockAck Bitmap corresponding to the MPDU with fragment number equal to 0.

The transmitting (receiving) STA encodes (decodes) the BlockAck ID field and the Starting Sequence Control field of the NDP BlockAck frames applying the protection mechanism described in 10.53.

9.9.2.7 NDP Beamforming Report Poll

9.9.2.7.1 NDP_2M Beamforming Report Poll

The format of the NDP CMAC frame body field of the NDP_2M Beamforming Report Poll frame is illustrated in Figure 9-776.

	B0 B2	B3 B11	B12 B24	B25 B32	B33 B36
	NDP CMAC Frame Type	AP Address	Non-AP STA Address	Feedback Segment Retransmission Bitmap	Reserved
Bits:	3	9	13	8	4

Figure 9-776—NDP CMAC frame body field of the NDP_2M Beamforming Report Poll frame

The NDP CMAC Frame Type field is set to 5.

The AP Address field indicates the partial BSSID of the AP as described in 10.20b.

The Non-AP STA Address field indicates the AID of the non-AP STA.

The Feedback Segment Retransmission Bitmap field indicates the feedback segments to be polled in a VHT Compressed Beamforming report, which is contained in one or more VHT Compressed Beamforming frames.

9.9.2.8 NDP Paging

9.9.2.8.1 NDP_1M Paging

The format of the NDP CMAC frame body field of the NDP_1M Paging frame is illustrated in Figure 9-777.

	B0 B2	B3 B11	B12 B20	B21	B22 B24
	NDP CMAC Frame Type	P-ID	APDI/partial AID	Direction	Reserved
Bits:	3	9	9	1	3

Figure 9-777—NDP CMAC frame body field of the NDP_1M Paging frame

The NDP CMAC Frame Type field is set to 6.

The P-ID field is the identifier of the NDP paging requester, as described in 10.43.6.

If the Direction field is 1 the APDI/partial AID field indicates the AP direction information (APDI), where

- The 8 MSBs of the APDI, depending on the value of the Action subfield of the NDP Paging Response, contain
  - The PTSF subfield if the Action subfield is not equal to 4. The PTSF subfield is set to the value of the partial TSF of the transmitting STA as defined in 10.43.6.

  - The ASD subfield if the Action subfield is equal to 4. The ASD subfield is the additional sleep duration and is set to the time, in units of SIFS, after which the receiver STA is in Awake state as described in 10.43.6.
- The LSB of the APDI is the Check Beacon Flag subfield and is an indicator of critical changes in the Beacon frame as described in 10.43.6.

If the Direction field is 0, the APDI/partial AID field indicates the partial AID of the NDP paging responder STA.

The Direction field is set to 1, if the NDP paging responder is an AP, otherwise it is set to 0.

9.9.2.8.2 NDP_2M Paging

The format of the NDP CMAC frame body field of the NDP_2M Paging frame is illustrated in Figure 9-778.

	B0 B2	B3 B11	B12 B20	B21	B22 B36
	NDP CMAC Frame Type	P-ID	APDI/partial AID	Direction	Reserved
Bits:	3	9	9	1	15

Figure 9-778—NDP CMAC frame body field of the NDP_2M Paging frame

The NDP CMAC Frame Type field is set to 6.

The P-ID field is the identifier of the NDP paging requester, as described in 10.43.6.

If the Direction field is 1, the APDI/partial AID field indicates the APDI (AP Direction Information) where:
- The 8 MSBs of the APDI, depending on the value of the Action subfield of the NDP Paging Response, contain:
  - The PTSF subfield if the Action subfield is not equal to 4. The PTSF subfield is set to the value of the partial TSF of the transmitting STA as defined in 10.43.6.
  - The ASD subfield if the Action subfield is equal to 4. The ASD subfield is the additional sleep duration and is set to the time, in units of SIFS, after which the receiver STA is in Awake state as described in 10.43.6.
- The LSB of the APDI is the Check Beacon Flag subfield and is an indicator of critical changes in the Beacon frame as described in 10.43.6.

If the Direction field is 0, the APDI/partial AID field indicates the partial AID of the NDP paging responder STA.

The Direction field is set to 1, if the NDP paging responder is an AP, otherwise it is set to 0.

9.9.3 NDP management frame details

9.9.3.1 NDP Probe Request

NDP Probe Request frames are used in the procedures described in 11.1.4.3.4b.

9.9.3.1.1 NDP_1M Probe Request

The format of the NDP CMAC frame body field of the NDP_1M Probe Request frame is illustrated in Figure 9-779.

	B0 B2	B3	B4 B19	B20	B21 B24
	NDP CMAC Frame Type	CSSID/ANO Present	Compressed SSID/ Access Network Option	Requested Probe Response Type	Reserved
Bits:	3	1	16	1	4

Figure 9-779—NDP CMAC frame body field of the NDP_1M Probe Request frame

The NDP CMAC Frame Type field is set to 7.

The CSSID/ANO Present field indicates if the NDP Probe Request frame contains a Compressed SSID field or an Access Network Option field:

— Set to 0 if the NDP Probe Request contains the Compressed SSID.
— Set to 1 if the NDP Probe Request contains the Access Network Option.

When CSSID/ANO Present field is 0, Compressed SSID/Access Network Option [0:15] are set to Compressed SSID, which is the 2 least significant octets of the 32-bit CRC calculated as defined 9.2.4.8, wherein the calculated fields is the Full SSID.

When CSSID/ANO Present field is 1, Compressed SSID/Access Network Option [0:7] are set to Access Network Option, which is defined in 9.4.2.92 (see Figure 9-439). Compressed SSID/Access Network Option [8:15] are reserved.

The Requested Probe Response Type field indicates the Probe Response type:

— Set to 0 if the STA requests a PV1 Probe Response frame.
— Set to 1 if the STA requests a Probe Response frame.

9.9.3.1.2 NDP_2M Probe Request

The format of the NDP CMAC frame body field of the NDP_2M Probe Request frame is illustrated in Figure 9-780.

	B0 B2	B3	B4 B35	B36
	NDP CMAC Frame Type	CSSID/ANO Present	Compressed SSID/Access Network Option	Requested Probe Response Type
Bits:	3	1	32	1

Figure 9-780—NDP CMAC frame body field of the NDP_2M Probe Request frame

The NDP CMAC Frame Type field is set to 7.

The CSSID/ANO Present field indicates if the NDP Probe Request frame contains a Compressed SSID field or an Access Network Option field:

— Set to 0 if the NDP Probe Request contains the Compressed SSID.
— Set to 1 if the NDP Probe Request contains the Access Network Option.

When CSSID/ANO Present field is 0, Compressed SSID/Access Network Option [0:31] are set to Compressed SSID, which is 32-bit CRC calculated as defined in 9.2.4.8, wherein the calculated fields is the Full SSID.

When CSSID/ANO Present field is 1, Compressed SSID/Access Network Option [0:7] are set to Access Network Option, which is defined in 9.4.2.92 (see Figure 9-439). Compressed SSID/Access Network Option [8:31] are reserved.

The Requested Probe Response Type field indicates the Probe Response type:
- Set to 0 if the STA requests a PV1 Probe Response frame.
- Set to 1 if the STA requests a Probe Response frame.

10. MAC sublayer functional description

10.2 MAC architecture

10.2.1 General

Change the first paragraph of 10.2.1 as follows:

The MAC architecture is shown in Figure 10-1, Figure 10-1a, and Figure 10-2.

Change the title of Figure 10-1 as follows:

Figure 10-1—Non-DMG non-S1G STA MAC architecture

Insert Figure 10-1a after Figure 10-1:

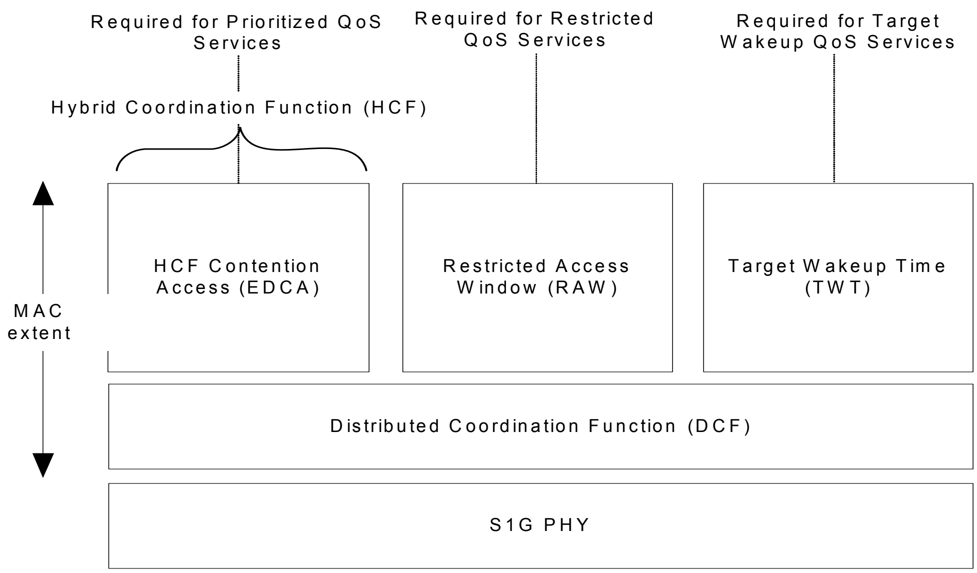


Figure 10-1a—S1G STA MAC architecture

Change the second paragraph of 10.2.1 as follows:

In a non-DMG and non-S1G STA:

— The MAC provides the PCF, HCF and MCF service using the services of the DCF.
— The PCF is optionally present in nonmesh STAs and absent otherwise.
— The HCF is present in QoS STAs and absent otherwise.
— The MCF is present in mesh STAs and absent otherwise.

Insert the following paragraph after the second paragraph of 10.2.1:

In an S1G STA:

— The MAC provides EDCA service using the services of the DCF.
— The RAW is optionally present.
— The TWT is optionally present.

10.2.4 Hybrid coordination function (HCF)

10.2.4.1 General

Change the last paragraph of 10.2.4.1 as follows:

Time priority Management frames are transmitted outside of the normal MAC queuing process as per individually described transmission rules. Frames listed in Table 9-333, ~~and~~ Table 9-418, Table 9-421b, and Table 9-421s with a value of "Yes" in the "Time Priority" column are time priority Management frames. No other frames are time priority Management frames.

10.2.4.2 HCF contention-based channel access (EDCA)

Change the following note after the first paragraph of 10.2.4.2 as shown:

NOTE—A DMG or S1G STA that implements a single AC (see 10.22.2.1) has all of its UP values in Table 10-1 mapped to AC_BE.

Change the fourth paragraph of 10.2.4.2 as follows (including splitting it into two paragraphs):

The QoS AP shall announce the EDCA parameters in selected Beacon frames and in all Probe Response and (Re)Association Response frames by the inclusion of the EDCA Parameter Set element using the information from the MIB entries in dot11ECDATable. If no such element is received, a STA shall use the default values for the parameters. The fields following the QoS Info field in the EDCA Parameter Set element shall be included in all Beacon frames occurring within two (optionally more) delivery traffic indication map (DTIM) periods following a change in AC parameters, which provides all STAs an opportunity to receive the updated EDCA parameters. If any associated STAs are in WNM sleep mode or using FMS, these fields should be included by the AP for as many DTIM periods as needed to exceed the longest interval any STA is expected to not receive Beacon frames.

A QoS STA shall update its MIB attributes that correspond to fields in an EDCA parameter Set element within an interval of time equal to one beacon interval after receiving an updated EDCA parameter set. QoS STAs update the MIB attributes and store the EDCA Parameter Set update count value in the QoS Info field. An S1G STA shall update its MIB attributes that correspond to fields in an EDCA parameter Set element if its STA type is indicated by the STA Type subfield contained in the received EDCA Parameter Set element (see 10.59). An AP may change the EDCA access parameters by changing the EDCA Parameter Set element in the Beacon frame, Probe Response frame, and (Re)Association Response frame. However, the AP should change them only rarely. A QoS STA shall use the EDCA Parameter Set Update Count Value subfield in the QoS Capability element of all Beacon frames to determine whether the STA is using the current EDCA Parameter Values. If the EDCA Parameter Set update count value in the QoS Capability element is different from the value that has been stored, the QoS STA shall query the updated EDCA parameter values by sending a Probe Request frame to the AP.

Insert the following paragraphs after the now fifth paragraph of 10.2.4.2:

The S1G AP shall set the STA Type subfield of EDCA Parameter Set elements it transmits as follows:

- 1 if it indicates support for sensor STAs but no support for non-sensor STAs
- 2 if it indicates support for non-sensor STAs but no support for sensor STAs

The S1G AP may set the STA Type subfield of EDCA Parameter Set elements to any value that is less than 3 if it indicates support for both sensor STAs and non-sensor STAs as described in 10.59.

An S1G AP may assign to an S1G STA EDCA parameters different from the ones in dot11EDCATable, by sending to the STA an EDCA Parameter Set frame with an EDCA Parameter Set element with the Override field equal to 1. An S1G STA receiving an EDCA Parameter Set element with the Override field equal to 1 shall update its MIB values of the EDCA parameters based on the values indicated by the EDCA Parameter Set element.

An S1G STA that receives an EDCA Parameter Set frame with an EDCA Parameter Set element with the Override field equal to 1 shall disregard any EDCA Parameter Set elements with the Override field equal to 0 received afterward during the current association until it receives the EDCA Parameter Set element with the Override field equal to 1 carried in an EDCA Parameter Set frame.

Change the now 14th paragraph of 10.2.4.2 as follows:

PS-Poll frames generated by a non-S1G STA shall be sent using the access category AC_BE for medium access (to reduce the likelihood of collision following a Beacon frame).

Insert the following paragraph after the now 14th paragraph of 10.2.4.2:

By default, an S1G STA that is a non-sensor STA shall transmit PS-Poll frames, PS-Poll+BDT frames and NDP PS-Poll frames using access category AC_VO. By default, an S1G STA that is a sensor STA shall transmit PS-Poll frames, PS-Poll+BDT frames and NDP PS-Poll frames using access category AC_BE. After reception of an EDCA Parameter Set element from the AP with which it is associated, an S1G STA shall transmit PS-Poll frames, PS-Poll+BDT frames and NDP PS-Poll frames using the access category indicated in the PS-Poll ACI subfield, if its STA type is indicated in the STA Type subfield in the received EDCA Parameter Set element (see 10.59).

10.2.7 Fragmentation/defragmentation overview

Insert the following note after NOTE 2 after the second paragraph in 10.2.7:

NOTE 3—A fragmented MSDU or MMPDU transmitted by an S1G STA to another S1G STA can be acknowledged either using immediate acknowledgment (i.e., transmission of an (NDP) Ack frame after a SIFS) or using the fragment BA procedure described in 10.3.2.9a.

10.2.8 MAC data service

Change the third paragraph of 10.2.8 as follows (including splitting it into two paragraphs):

When dot11SSPNInterfaceActivated is true, an AP shall distribute the group addressed message into the BSS only if dot11NonAPStationAuthSourceMulticast in the dot11InterworkingEntry identified by the source MAC address in the received message is true. When dot11SSPNInterfaceActivated is false, an AP shall distribute the group addressed message ~~shall be distributed~~ into the BSS, except when dot11RelayAPOperationActivated is true and the group addressed message is received from a STA. In that case, the group addressed message shall not be distributed into the BSS, and it shall be forwarded to the S1G relay STA in the same relay. The S1G relay STA shall send the group addressed message to the associated AP as an individually addressed frame using either a four address frame format (PV0 or PV1) or an A-MSDU format as specified in 10.50.4.

Unless the MPDU is delivered via DMS, the STA originating the message receives the message as a group addressed message (prior to any filtering). Therefore, a STA shall filter out group addressed messages that contain their address as the source address. When dot11SSPNInterfaceActivated is false, group addressed MSDUs shall be propagated throughout the ESS. When dot11SSPNInterfaceActivated is true, group addressed MSDUs shall be propagated throughout the ESS only if dot11NonAPStationAuthSourceMulticast in the dot11InterworkingEntry identified by the source MAC address in the received message is true.

10.3 DCF

10.3.2 Procedures common to the DCF and EDCAF

10.3.2.1 CS mechanism

Change 10.3.2.1 as follows:

Physical and virtual CS functions are used to determine the state of the medium. When either function indicates a busy medium, the medium shall be considered busy; otherwise, it shall be considered idle.

A physical CS mechanism shall be provided by the PHY. See Clause 8 for how this information is conveyed to the MAC. The details of physical CS are provided in the individual PHY specifications.

A first virtual CS mechanism shall be provided by all ~~the~~ MACs. A second virtual CS mechanism shall be provided by an S1G MAC.

~~This~~ The first mechanism is referred to as the *NAV*. The NAV maintains a prediction of future traffic on the medium based on duration information that is announced in RTS/CTS frames by non-DMG STAs and RTS/DMG CTS frames by DMG STAs prior to the actual exchange of data. The duration information is also available in the MAC headers of all frames sent during the CP other than PV1 MAC frames and PS-Poll frames and during the BTI, the A-BFT, the ATI, the CBAP, and the SP. The duration information in a frame transmitted by an S1G STA is also available in PS-Poll+BDT frames, in NDP CTS frames, in NDP Ack frames whose Idle Indication field value is 0, and in NDP_2M PS-Poll-Ack frames whose Idle Indication field is 0.

The mechanism for setting the NAV using RTS/CTS or RTS/DMG CTS in the DCF is described in 10.3.2.4, use of the NAV in PCF is described in 10.4.3.3, and the use of the NAV in HCF is described in 10.22.2.2 and 10.22.3.4. Additional details regarding NAV use appear in 10.3.2.5, 10.3.2.12, 10.36.10, and 10.26.

The second virtual CS mechanism is applicable only to S1G STAs and is referred to as *response indication deferral (RID)*. The mechanism for setting the RID is described in 10.3.2.4a.

The CS mechanism combines the NAV state, and in S1G STAs also the RID state, and the STA's transmitter status with physical CS to determine the busy/idle state of the medium. The NAV and RID may be thought of as ~~a~~ counters, which count~~s~~ down to 0 at a uniform rate. In non-S1G STAs, ~~W~~when the NAV counter is 0, the virtual CS indication is that the medium is idle; when the counter is nonzero, the indication is busy. In S1G STAs, when both NAV and RID counters are 0, the virtual CS indication is that the medium is idle; when either the NAV counter or the RID counter is nonzero the indication is that the medium is busy. If a DMG STA supports multiple NAVs as defined in 10.36.10 and all counters are 0, the virtual CS indication is that the medium is idle; when at least one of the counters is nonzero, the indication is busy. The medium shall be determined to be busy when the STA is transmitting.

At aRxTxTurnaroundTime + aAirPropagationTime + aRxPHYDelay + 10% × (aSlotTime – aAirPropagationTime) after each MAC slot boundary as defined in 10.3.7 and 10.22.2.4, the MAC shall issue a PHY-CCARESET.request primitive to the PHY, where aAirPropagationTime determined as described in 10.21.5.

10.3.2.3 IFS

10.3.2.3.2 RIFS

Change the first paragraph of 10.3.2.3.2 as follows:

The use of RIFS for a non-DMG STA is obsolete, and support for such use might be subject to removal in a future revision of the standard. A VHT or S1G STA shall not transmit frames separated by a RIFS.

10.3.2.3.3 SIFS

Change the second paragraph of 10.3.2.3.3 as follows (including splitting it into two paragraphs):

The SIFS shall be used prior to transmission of each of the following frames:

— A~~a~~n (NDP) Ack frame, a TACK frame, a STACK frame, NDP PS-Poll-Ack frame, a (NDP) CTS frame;~~,~~
— A~~a~~ PPDU containing a BlockAck frame, NDP BlockAck frame, or BAT frame that is an immediate response to either a BlockAckReq frame or an A-MPDU;~~,~~
— A~~a~~ DMG CTS frame, a DMG DTS frame, a Grant Ack frame;~~,~~
— A~~a~~ response frame transmitted in the ATI, the second or subsequent MPDU of a fragment burst, and by a STA responding to any polling by the PCF;~~.~~
— A frame within a series of NDP sector training frames transmitted by an S1G AP after a sector training announcement;
— An RTS frame that is sent as an immediate response to a PS-Poll(+BDT) frame.

The SIFS may also be within a TXOP or by a PC for any types of frames during the CFP (see 10.4), and by an S1G STA for an (NDP) PS Poll frame or uplink trigger frame that is a response to an NDP Paging frame (see 10.43.6.

10.3.2.3.4 PIFS

Insert the following list items at the end of the dashed list after the second paragraph ("The PIFS may ...:") of 10.3.2.3.4 as follows:

— An S1G STA performing clear channel assessment (CCA) in the secondary 2 MHz, 4 MHz, and 8 MHz channels before transmitting a 4 MHz, 8 MHz, or 16 MHz mask PPDU using EDCA channel access, as described in 10.22.2.5a
— An S1G AP transmitting sounding NDP(s) within an SST sounding RAW

10.3.2.3.6 AIFS

Change the first paragraph of 10.3.2.3.6 as follows:

The AIFS shall be used by QoS STAs that access the medium using the EDCAF to transmit: all Data frames (MPDUs) except during the ATI or an SP, all Management frames (MMPDUs) except during the ATI or an SP, all Extension frames except for the DMG Beacon frame, and the following Control frames:

— PS-Poll(+BDT)
— SSW (if first transmission by an initiator in a CBAP)
— Poll (if first transmission and when in a CBAP)
— Grant (if first transmission and when in a CBAP and not transmitted in response to a SPR frame)
— SPR (when in a CBAP and not transmitted as a response to a Poll)

- RTS (when not transmitted as a response to a PS-Poll(+BDT) frame by an S1G STA)
- CTS (when not transmitted as a response to an RTS frame)
- DMG CTS (when not transmitted as a response to an RTS frame)
- BlockAckReq
- BlockAck (when not transmitted as a response to a BlockAckReq frame)
- NDP PS-Poll

10.3.2.4 Setting and resetting the NAV

Change the second paragraph of 10.3.2.4 as follows:

A STA that receives at least one valid frame in a PSDU can update its NAV with the information from any valid Duration field in the PSDU. When the received frame's RA is equal to the STA's own MAC address, the STA shall not update its NAV. Further, when the received frame is a DMG CTS frame and its TA is equal to the STA's own MAC address, the STA shall not update its NAV. For all other received frames the STA shall update its NAV when the received Duration is greater than the STA's current NAV value. Upon receipt of a PS-Poll frame, a STA, except for an S1G STA for which the RXVECTOR parameter RESPONSE_INDICATION of the received PS-Poll frame is NDP Response, shall update its NAV settings as appropriate under the data rate selection rules using a duration value equal to the time, in microseconds, required to transmit one Ack frame plus one SIFS, but only when the new NAV value is greater than the current NAV value. If the calculated duration includes a fractional microsecond, that value is rounded up to the next higher integer. Various additional conditions may set or reset the NAV, as described in 10.4.3.3. When the NAV is reset, a PHY-CCARESET.request primitive shall be issued. This NAV update operation is performed when the PHY-RXEND.indication primitive is received.

Insert the following note and paragraphs after the second paragraph of 10.3.2.4:

NOTE—An S1G STA that receives a valid frame that does not include a valid Duration field does not update its NAV. However, it updates its RID as described in 10.3.2.4a.

An S1G STA that receives a PS-Poll frame with the RXVECTOR parameter RESPONSE_INDICATION equal to NDP Response shall update its NAV using a duration value equal to NDPTxTime (see 10.3.2.4a.2) plus one SIFS, but only when the new NAV value is greater than the current NAV value and the RA is not equal to the MAC address of the S1G STA. The NDPTxTime is calculated according to additional RXVECTOR parameters as described in 10.3.2.4a.2.

In addition to the NAV update rules described in this subclause, an S1G STA shall also update its NAV to a new NAV value if it receives information that the NAV is greater than the STA's current NAV value. This information shall be received in the Duration field of the following frames: NDP CTS, NDP Ack, NDP_2M PS-Poll-Ack, and S1G Beacon, except when the received frame is an:

- NDP CTS frame that is either addressed to the S1G STA as a response to an RTS frame, or that is an NDP CTS frame whose value of the Duration field can be disregarded as defined in 10.3.2.7.
- NDP Ack frame that is either addressed to the S1G STA, or that has the Idle Indication field equal to 1 (see 10.3.2.9).
- NDP_2M PS-Poll-Ack frame that is either addressed to that S1G STA, or that has the Idle Indication field equal to 1 (see 10.3.2.9).
- S1G Beacon frame that includes at least one TIM element in which there is an indication of available BUs for the receiving STA in at least one of the TIM elements.
- S1G Beacon frame that includes at least one TIM element and at least one RPS element that indicate both of the following:
  - There is no indication of available BUs for the receiving STA in any of the TIM elements

— The receiving S1G STA is allowed to access the first RAW immediately following the S1G Beacon frame as specified in at least one of the RPS elements.

Change the now seventh paragraph of 10.3.2.4 as follows:

In non-DMG BSS, NAVTimeout period is equal to (2 x aSIFSTime) + (CTS_Time) + aRxPHYStartDelay + (2 x aSlotTime). In a non-S1G STA, ~~T~~the “CTS_Time” shall be calculated using the length of the CTS frame and the data rate at which the RTS frame used for the most recent NAV update was received. In an S1G STA, the “CTS_Time” shall be calculated using the time required to transmit an NDP CTS frame that is equal to NDPTxTime, which is specified in 10.3.2.4a.2.

Insert the following subclauses (10.3.2.4a through 10.3.2.4a.2, including Table 10-1a, Table 10-1b, and Figure 10-5a) after 10.3.2.4:

10.3.2.4a Setting and resetting the RID

10.3.2.4a.1 General

This subclause describes the setting and resetting of the RID for S1G STAs.

An S1G STA that receives a frame that is not an NDP CMAC frame shall update its RID counter based on the values of the received frame’s RXVECTOR parameters FORMAT, PREAMBLE_TYPE, RESPONSE_INDICATION, AGGREGATION, MCS, PARTIAL_AID, COLOR, UPLINK_INDICATION, and CH_BANDWITH, as described in this subclause. An S1G STA that receives an NDP CMAC frame shall update its RID counter based on the values of the RXVECTOR parameter FORMAT, PREAMBLE_TYPE and the RESPONSE_INDICATION value, which is defined per type of NDP CMAC frame in Table 10-1a.

Table 10-1a—RESPONSE_INDICATION value for NDP CMAC frames

NDP CMAC Frame type	RESPONSE_INDICATION value
NDP Ack or NDP PS-Poll-Ack (NDP (PS-Poll-)Ack)	No Response if either Idle Indication field value is 0 or the Duration field value is not 0 Long Response if Idle Indication field value is 1 and Duration field value is 0
NDP Block Ack	No Response
NDP CTS	No Response
NDP PS-Poll	NDP Response
NDP Beamforming Report Poll	Long Response
NDP Paging	No Response
NDP Probe Request	No Response
NDP CF-End	No Response

A member PPDU is a PPDU transmitted by a STA that is a member of the same BSS of the receiving STA. A PPDU that is not a member PPDU is a nonmember PPDU.

An S1G STA that receives a member PPDU shall reset and update its RID counter, as defined in 10.3.2.4a.2, when the PHY-RXSTART.indication primitive corresponding to that PPDU is received. An S1G STA that receives a nonmember PPDU shall not reset the RID counter and shall update the RID counter, i.e., set it to a new value (as defined in 10.3.2.4a.2) that is not less than the value that the RID counter will have at the instant of time that corresponds to the end of the received PPDU.

The S1G STA shall classify a received PPDU as a member PPDU if it is an NDP CMAC frame, or an S1G_1M PPDU. The S1G STA shall classify a received PPDU as a member PPDU if its PREAMBLE_TYPE is either S1G_LONG_PREAMBLE or S1G_SHORT_PREAMBLE and either of the conditions below is satisfied:

— UPLINK_INDICATION is 1 and the PARTIAL_AID indicates that the PPDU is addressed to the AP with which the non-AP STA is associated.
— UPLINK_INDICATION is 0 and the COLOR indicates that the PPDU is generated by the AP with which the STA is associated.

Because the PARTIAL_AID and COLOR values obtained from received PPDUs are not globally unique, an S1G STA that has classified a PPDU as a member PPDU based on PARTIAL_AID and/or COLOR may additionally use the information contained in a valid MAC header (i.e., neither A1 nor A2 field contain a MAC address that corresponds to a STA that is a member of the same BSS as known at the STA) from an MPDU carried in the received PPDU to change the classification of the PPDU to a nonmember PPDU. If the classification of a PPDU is changed from member to nonmember PPDU, then the STA shall:

— Reload the RID counter to the value that the RID counter had at the time of the receipt of the PHY-RXSTART.indication primitive corresponding to this PPDU minus the difference between the current time and that time and
— Update the RID counter according to the rules for a nonmember PPDU.

NOTE—If the PHY-RXEND.indication primitive for the received S1G PPDU contains an ERROR or FormatViolation then the S1G STA sets the EIFS as described in 10.3.7.

If the RID counter is updated then it shall start counting down the RID counter at the end of the received S1G PPDU, except when the PPDU either contains a valid nonzero Duration field that is used for setting the NAV, as described in 10.3.2.4, or it is intended to the S1G STA. In both of these cases the RID shall be reset.

The received PPDU has an expected duration, in microseconds, of PSDU_RXTIME, starting from the moment the PHY-RXSTART.indication primitive is received. If the PPDU is an NDP CMAC frame, the PSDU_RXTIME is equal to 0. If the PPDU is not an NDP CMAC frame, the PSDU_RXTIME is calculated based on multiple RXVECTOR parameters and is equal to

— The RXTIME defined in Equation (23-65) for S1G_SHORT/S1G_1M formats
— The RXTIME defined in Equation (23-66) if the PPDU has S1G_LONG format and is an SU PPDU
— The RXTIME defined in Equation (23-66) minus ($T_{DSTF} + N_{LTF}\, D_{DLTF} + T_{SIG\text{-}B}$) if the PPDU has S1G_LONG format and is an MU PPDU

NOTE—T_{DSTF}, T_{DLTF}, and $T_{SIG\text{-}B}$ are defined in Table 23-4 while N_{LTF} is defined in Table 23-10.

Figure 10-5a indicates the RID for STAs that receive the PLCP Header of the Data frame whose MAC portion does not contain a valid Duration field that updates the NAV. The RID for STAs that receive the PLCP Header of the Ack frame but not that of the Data frame is 0 (i.e., no response is expected to the Ack frame in this example). The RID is reset for the STA to which the Data was addressed.

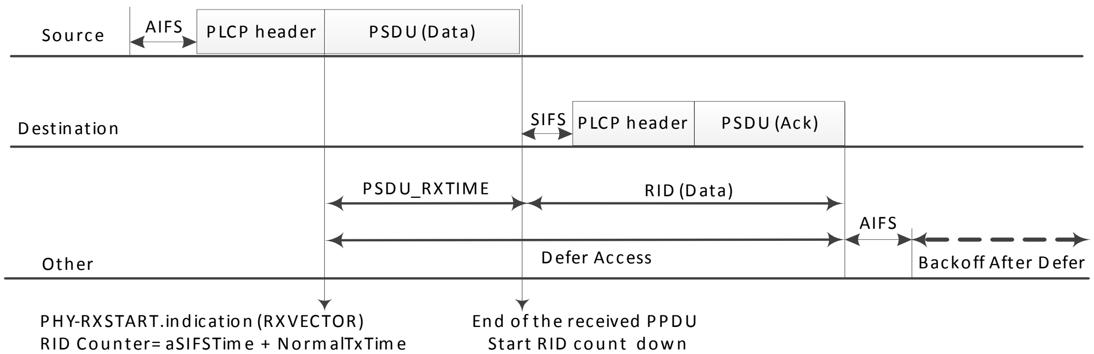


Figure 10-5a—Data/Ack with RID setting

10.3.2.4a.2 RID update

An S1G STA updates the value of the RID counter by setting it as described below.

If the value of the RESPONSE_INDICATION parameter is Long Response, the RID counter shall be set to LongTxTime + aSIFSTime, where LongTxTime is obtained as follows:

— If FORMAT is S1G and CH_BANDWIDTH is CBW1 or FORMAT is S1G_DUP_1M then LongTxTime is equal to the S1G PPDU duration as defined in Table 9-19
— If FORMAT is S1G and PREAMBLE_TYPE is S1G_SHORT_PREAMBLE or S1G_LONG_PREAMBLE then LongTxTime is equal to the largest value in the dot11EDCATableTXOPLimit
— If FORMAT is S1G_DUP_2M and PREAMBLE_TYPE is S1G_SHORT_PREAMBLE or S1G_LONG_PREAMBLE then LongTxTime is equal to the largest value in the dot11EDCATableTXOPLimit

If the value of the RESPONSE_INDICATION parameter is Normal Response, the RID counter shall be set to NormalTxTime + aSIFSTime. NormalTxTime is calculated based on the RXVECTOR parameters PREAMBLE_TYPE, AGGREGATION, MCS and CH_BANDWIDTH following the rules listed in Table 10-1b.

Table 10-1b—NormalTXTime duration based on RXVECTOR's parameters

PPDU format (see 23.1.4)	AGGRE-GATION	Expected Response Length (Type)	NormalTxTime
S1G_1M	0	14 octet MPDU (Ack)	The time, in microseconds, required to transmit one Ack frame, where the duration of the frame is calculated according to the rate selection rules described in 10.7.6.5 using its BSSBasicMCSSet parameter and with CH_BANDWIDTH RXVECTOR value equal to CBW1
	1	32 octet MPDU (BlockAck)	The time, in microseconds, required to transmit one BlockAck frame, where the duration of the frame is calculated according to the rate selection rules described in 10.7.6.5 using its BSSBasicMCSSet parameter and with CH_BANDWIDTH RXVECTOR value equal to CBW1.

Table 10-1b—NormalTXTime duration based on RXVECTOR's parameters *(continued)*

PPDU format (see 23.1.4)	AGGRE-GATION	Expected Response Length (Type)	NormalTxTime
S1G_SHORT or S1G LONG PREAMBLE	0	14 octet MPDU (Ack)	The time, in microseconds, required to transmit one Ack frame, where the duration of the frame is calculated according to the rate selection rules described in 10.7.6.5 using its BSSBasicMCSSet parameter and channel width selection rules for control frames described in 10.7.6.6.
	1	32 octet MPDU (BlockAck)	The time, in microseconds, required to transmit one BlockAck frame, where the duration of the frame is calculated according to the rate selection rules described in 10.7.6.5 using its BSSBasicMCSSet parameter and channel width selection rules for control frames described in 10.7.6.6.

If the value of RESPONSE_INDICATION parameter is NDP Response, the RID counter shall be set to NDPTxTime + aSIFSTime. NDPTxTime is calculated based on the RXVECTOR parameter PREAMBLE_TYPE and is equal to the time, in microseconds, required to transmit either an NDP_1M CMAC frame if the PPDU format is S1G_1M or an NDP_2M CMAC frame if PPDU format is either S1G_SHORT or S1G_LONG (see 23.1.4).

If the value of the RESPONSE_INDICATION parameter is No Response, the RID counter shall be set to 0.

Change the title of 10.3.2.6 as follows:

10.3.2.6 VHT <u>and S1G</u> RTS procedure

Insert the following paragraphs at the end of 10.3.2.6:

An S1G STA using dynamic bandwidth operation (see 10.3.2.7) that transmits an RTS carried in a greater than 2 MHz PPDU with TXVECTOR parameter FORMAT set to S1G_DUP_2M shall set the Dynamic Indication field in the Frame Control field of the RTS frame to 1. Otherwise, the S1G STA shall set the Dynamic Indication field in the Frame Control field of the RTS carried in any other PPDU to 0 to indicate that it shall not use dynamic bandwidth operation (see 10.3.2.7).

An S1G STA that transmits an RTS frame to another STA shall set the TXVECTOR parameter RESPONSE_INDICATION to NDP_RESPONSE unless the Link Adaptation per Normal Control Response Capable field of the S1G Capabilities element received from that STA contained a value of 1 in which case the S1G STA may set the RESPONSE_INDICATION to NORMAL_RESPONSE as described in 10.31.3.

An S1G STA that initiates a TXOP with a PV1 frame or an NDP CMAC frame shall not send an RTS frame to an S1G STA for the duration of the TXOP.

10.3.2.7 CTS and DMG CTS procedure

Change the first paragraph of 10.3.2.7 as follows:

A STA that receives an RTS frame addressed to it considers the NAV in determining whether to respond with CTS unless the NAV was set by a frame originating from the STA sending the RTS frame (see 10.22.2.2). In this subclause <u>for a non-S1G STA</u>, "NAV indicates idle" means that the NAV count is 0 or that the NAV count is nonzero but the nonbandwidth signaling TA obtained from the TA field of the RTS frame matches the saved TXOP holder address. In an S1G STA, "NAV indicates idle" means that both NAV and RID counters are 0 or that either NAV or RID counter is nonzero but the TA field of the RTS frame matches the saved TXOP holder address.

Insert the following paragraphs and note after the third paragraph ("A VHT STA...Dynamic behaves as follows....") of 10.3.2.7:

An S1G STA that is addressed by an RTS frame that has the Dynamic Indication field in the Frame Control field equal to 0 (Static) behaves as follows:

- If the NAV indicates idle and the CCA has been idle for all secondary channels within the channel width indicated in the Bandwidth Indication field of the Frame Control field of the RTS frame for a PIFS period prior to the start of the RTS frame, then the STA shall respond with an (NDP) CTS frame after a SIFS. The STA shall set the TXVECTOR parameter CH_BANDWIDTH to a value that is equivalent to the value of the Bandwidth Indication field of the Frame Control field in the received RTS frame. The (NDP_2M) CTS frame shall have the Bandwidth Indication field set to the value of the Bandwidth Indication field of the received RTS frame.
- Otherwise the STA shall not respond with an (NDP) CTS frame.

An S1G STA that is addressed by an RTS carried in a 2 MHz duplicate frame that has the Dynamic Indication field in the Frame Control field equal to 1 (Dynamic) behaves as follows:

- If the NAV indicates idle, then the STA shall respond with an (NDP_2M) CTS frame after a SIFS. The (NDP) CTS frame's TXVECTOR parameter CH_BANDWIDTH may be set to any channel width for which the CCA on all secondary channels has been idle for a PIFS prior to the start of the RTS frame and that is equal to or less than the channel width indicated in the Bandwidth Indication field of the Frame Control field of the RTS frame. The (NDP_2M) CTS frame shall have the Bandwidth Indication field set to a value that is equivalent to the value of the TXVECTOR parameter's CH_BANDWIDTH.
- Otherwise the STA shall not respond with an (NDP) CTS frame.

NOTE—The NDP_1M CTS frame is not used for dynamic bandwidth indication.

Change the now sixth paragraph of 10.3.2.7 as follows:

A non-VHT and non-S1G STA that is addressed by an RTS frame, or a VHT STA that is addressed by an RTS frame carried in a non-HT or non-HT duplicate PPDU that has a nonbandwidth signaling TA, or a VHT STA that is addressed by an RTS frame in a format other than non-HT or non-HT duplicate behaves as follows:

- If the NAV indicates idle, the STA shall respond with a CTS frame after a SIFS.
- Otherwise, the STA shall not respond with a CTS frame.

Insert the following paragraphs at the end of 10.3.2.7:

An S1G STA shall transmit NDP CTS frames instead of CTS frames with the following exception: transmission of an CTS frame is required if the link adaptation procedure is negotiated as described in 10.31.

The RA/Partial BSSID field of the NDP CTS shall be generated as described in 9.9.2.1. The Duration field in the NDP CTS frame shall be set to the same value as the Duration field from the received RTS frame, adjusted by subtracting the value of aSIFSTime and the NDPTxTime required to transmit the NDP CTS frame, where NDPTxTime is calculated according to 10.3.2.4a.2.

An S1G STA that receives an NDP CTS frame should disregard the value of the Duration field of the NDP CTS frame if any of the following conditions are satisfied:

— The Address Indicator field is equal to 1, and the Early Sector Indicator field is equal to 0, and the RA/PBSSID field is equal to the PBSSID of the AP with which the non-AP STA is associated (see 10.49.4).
— The Address Indicator field is equal to 0, and the RA/PBSSID indicates that the STA is the intended receiver of this frame, and the frame is received during the intervals of time negotiated with the UL-sync capable AP (see 10.45.1).

10.3.2.8 Dual CTS protection

10.3.2.8.1 Dual CTS protection procedure

Insert the following paragraph at the beginning of 10.3.2.8.1:

An S1G STA shall not support the Dual CTS Protection procedure defined in 10.3.2.8.

10.3.2.9 Acknowledgment procedure

Change the first paragraph of 10.3.2.9 as follows:

The cases when an Ack or BlockAck frame can be generated are shown in the frame exchange sequences listed in Annex G. During a TWT SP, either the STACK frame or TACK frame can be used in place of the (NDP) Ack frame according to the procedure described in 10.43 and otherwise shall not be used.

Change the sixth paragraph of 10.3.2.9 as follows:

If the STA does not recognize a valid Ack frame addressed to the STA, this condition shall be interpreted as as failure of its MPDU transmission, except as defined below. In this instance, the STA shall invoke its backoff procedure at the PHY-RXEND.indication primitive and may process the received frame. If the STA has transmitted a PS-Poll frame, then the STA's receipt and recognition of a valid Data or Management frame transmitted by the recipient of the PS-Poll frame shall also be accepted as successful acknowledgment of the PS-Poll frame.

Insert the following paragraphs at the end of 10.3.2.9:

Additional exceptions exist for S1G STAs for accepting a valid frame as successful acknowledgment as described in the following three paragraphs:

1) A STA that has enabled the implicit Ack procedure (see 10.50.5.3 shall consider a received S1G_SHORT/S1G_LONG PPDU as successful acknowledgment of a previously transmitted MPDU that was carried in an S1G_SHORT/S1G_LONG PPDU only in the following two cases:
   a) The STA is a non-AP STA associated to an S1G relay AP and all the conditions below are satisfied:
      — A PHY-RXSTART.indication primitive that corresponds to the received PPDU is detected within the AckTimeout interval that started as a result of the previously transmitted MPDU.
      — The RXVECTOR parameter PARTIAL_AID is either equal to the PARTIAL_AID that corresponds to the BSSID of the root AP or the PARTIAL_AID is equal to 0 and the PPDU contains an RTS frame with RA equal to the BSSID of the root AP.
      — The RXVECTOR parameter UPLINK_INDICATION is equal to 1.
   b) The STA is an AP that has an S1G relay STA associated to it and all the conditions below are satisfied:
      — A PHY-RXSTART.indication primitive that corresponds to the received PPDU is detected within the AckTimeout interval that started as a result of the previously transmitted MPDU.

— The RXVECTOR parameter PARTIAL_AID is equal to the 6 LSBs of the PARTIAL_AID that corresponds to the DA of the non-AP STA or the RXVECTOR parameter PARTIAL_AID is equal to 0 and the received PPDU contains an RTS frame with RA equal to the DA of the non-AP STA.
— The RXVECTOR parameter UPLINK_INDICATION is equal to 0 and the RXVECTOR parameter COLOR is equal to the COLOR value of the S1G relay AP.

2) Under BDT operation as described in 10.46: If a Data frame is sent as an immediate response to an MPDU requiring acknowledgment, the successful reception of the Data frame shall be accepted as successful acknowledgment of the eliciting MPDU.
3) The recognition of a valid S1G RTS frame, sent by the recipient of a PS-Poll frame or of a PS-Poll+BDT frame shall be accepted as successful acknowledgment of the PS-Poll or of the PS-Poll+BDT frame.

An S1G STA shall transmit NDP Ack frames for acknowledgment with the following exceptions:

1) Transmission of an Ack frame is required if link adaptation procedure is negotiated as described in 10.31.
2) Transmission of a TACK frame or a STACK frame is required if target wake time is negotiated as described in 10.43.
3) Transmission of a TACK frame is required as a response to a PS-Poll frame with the Poll Type subfield equal to 1 as described in 10.44.2.
4) Transmission of an NDP PS-Poll-Ack frame is required as a response to an NDP PS-Poll frame.

An S1G STA that satisfies any of the first three exceptions above shall transmit an Ack frame, TACK frame, or STACK frame instead of an NDP Ack frame as a response to an eliciting PPDU for which the RXVECTOR parameter RESPONSE_INDICATION is equal to Normal Response. The control response frame shall have a duration that is equal to NormalTXTime value for a 32 octet MPDU (see Table 10-1b) if the eliciting PPDU contains an S-MPDU.

A non-S1G STA shall not transmit NDP Ack and NDP PS-Poll-Ack frames.

An S1G STA that transmits or receives an NDP Ack or NDP PS-Poll-Ack frame shall follow the same rules described above for Ack frames with the following exceptions that apply only to NDP Ack and NDP PS-Poll-Ack frames:

1) An S1G STA that transmits an NDP Ack frame for acknowledgment shall generate the Ack ID field of the NDP Ack frame as described in 9.9.2.4.
2) An S1G AP that transmits an NDP PS-Poll-Ack frame for acknowledgment of an NDP PS-Poll frame shall generate the Ack ID field of the NDP PS-Poll-Ack frame as described in 9.9.2.5. In addition, if the eliciting NDP PS-Poll is an NDP_1M PS-Poll frame the Duration field of the NDP_1M PS-Poll-Ack is set as follows:
   a) If the eliciting NDP_1M PS-Poll frame has a value of the Preferred MCS field equal to “No Preference” the Duration field should indicate an idle period (i.e., the Idle Indication field should be set to 1 as described in 9.9.2.5).
   b) Otherwise, the Duration field should indicate an Ack ID extension (i.e., the Idle Indication field should be set to 0 as described in 9.9.2.5.
3) An S1G STA that expects an NDP Ack frame as a response, shall consider a received NDP Ack frame as a successful response if the Ack ID field of the NDP Ack frame equals the bit sequence generated from the Scrambler Initialization value and the FCS field of its immediately previously transmitted PSDU as described in 9.9.2.4.
4) An S1G STA that expects an NDP PS-Poll-Ack frame as a response to an NDP PS-Poll, shall consider a received NDP PS-Poll-Ack frame as a successful response if the Ack ID field, together with the extension of the Ack ID if present in the Duration field, of the frame equals the bit sequence

generated from the RA, TA and CRC fields of its immediately previously transmitted NDP PS-Poll frame as described in 9.9.2.5.

Upon successful reception of a PV1 frame that requires acknowledgment with the From DS field equal to 1, an S1G STA shall generate an acknowledgment frame in response if the AID subfield of A1 field is equal to the AID of the S1G STA and the A2 field is equal to the MAC address of its associated AP. Upon successful reception of a PV1 frame that requires acknowledgment with the From DS field equal to 0, an S1G STA shall generate an acknowledgment frame in response if A1 field is equal to the MAC address of the S1G STA.

In an S1G BSS, the AckTimeout interval depends on the TXVECTOR parameter PREAMBLE_TYPE. When the TXVECTOR parameter PREAMBLE_TYPE is equal to S1G_SHORT_PREAMBLE or S1G_LONG PREAMBLE, the AckTimeout interval is calculated with aRxPHYStartDelay value for ≥ 2 MHz short/long preamble except when the receiving STA has indicated use of 1 MHz control responses as described in 10.7.6.6 in which case the AckTimeout interval is calculated with aRxPHYStartDelay value for S1G_1M preamble. When the TXVECTOR parameter PREAMBLE_TYPE is equal to S1G_1M preamble, the AckTimeout interval is calculated with aRxPHYStartDelay value for S1G_1M preamble.

During a TWT SP, the BAT frame can be used in place of the (NDP) BlockAck frame, as described in 10.24 and otherwise, is not used.

Insert the following subclause (10.3.2.9a) after 10.3.2.9:

10.3.2.9a Fragment BA procedure

An S1G STA can partition an MSDU or an MMPDU into multiple fragments as described in 10.5 and send the frames containing the fragments of the MSDU or of the MMPDU as independent transmissions. In this subclause a fragment MPDU (F-MPDU) is an MPDU that contains a fragment of an MSDU or of an MMPDU.

An S1G STA indicates support of fragment BA using the Fragment BA Support subfield of the S1G Capabilities Information field in the S1G Capabilities element. An S1G STA shall set the Fragment BA Support subfield to 1 in S1G Capabilities element if the dot11FragmentBAOptionImplemented is true. Otherwise, the S1G STA shall set the Fragment BA Support subfield to 0. An S1G STA (known as the originator STA) with dot11FragmentBAOptionImplemented equal to true sending frames to another S1G STA shall use the fragment BA procedure described in this subclause if it has received from the STA (known as the recipient STA) a frame that included an S1G Capabilities element with the Fragment BA Support subfield equal to 1. Otherwise an S1G STA shall not use the fragment BA procedure described in this subclause. Non-S1G STAs shall not use the fragment BA procedure described in this subclause.

An originator STA may send F-MPDUs and set the Ack Policy field of the F-MPDU to Block Ack. A recipient STA shall not send any frame as an immediate response to an F-MPDU that has the Ack Policy field equal to Block Ack. An originator STA may solicit an immediate response following an F-MPDU by setting the Ack Policy field of the eliciting F-MPDU to Implicit Block Ack Request.

The receiving STA that is the intended receiver of either an F-MPDU with the Ack Policy field equal to Implicit Block Ack Request or a BAR frame shall send an NDP BlockAck frame after a SIFS, without regard of the idle/busy state of the medium, that is:

- An NDP_1M BlockAck frame if the eliciting F-MPDU is either carried in an S1G_1M PPDU or the receiving STA has indicated use of 1 MHz control response frames as described in 10.7.6.6.
- An NDP_2M BlockAck frame if the eliciting F-MPDU is carried in an S1G_SHORT/S1G_LONG PPDU and the receiving STA has not indicated use of 1 MHz control response frames as described in 10.7.6.6.

The receiving STA shall generate the BlockAck ID and the Starting Sequence Control field of the NDP BlockAck as described in 9.9.2.6.

The receiving STA shall include the receipt status of a set of the F-MPDUs in the BlockAck Bitmap field of the NDP BlockAck frame as follows:

1) If the originator STA elicits an NDP_1M BlockAck frame as a response, the BlockAck Bitmap field of the NDP BlockAck frame indicates the receipt status of a set of F-MPDUs which depends on the value of the Fragment Number subfield in the Sequence Control field of the F-MPDU that elicited the response:
    a) If the Fragment Number subfield is not greater than 7 then the BlockAck Bitmap field shall indicate the receipt status of F-MPDUs with fragment numbers from 0 to 7 (all inclusive).
    b) If the Fragment Number subfield is greater than 7 then the BlockAck Bitmap field shall indicate the receipt status of F-MPDUs with fragment numbers from 8 to 15 (all inclusive).
2) If the originator STA elicits an NDP_2M BlockAck frame as a response, the BlockAck Bitmap field of the NDP BlockAck frame shall indicate the receipt status of the F-MPDUs with fragment numbers from 0 to 15 (all inclusive).

NOTE—An NDP_1M BlockAck frame can acknowledge only a limited number of consecutive fragments because its BlockAck Bitmap field size is 8. Instead, an NDP_2M BlockAck frame can acknowledge up to the maximum number of fragments because its BlockAck Bitmap field size is 16.

The bitmap of the NDP BlockAck frame is protected using the encoding procedure described in 10.53.

An originator STA that elicits an NDP_1M BlockAck frame as a response shall not transmit an F-MPDU that has a Fragment Number subfield greater than 7 if it has not previously received an NDP_1M BlockAck frame that indicates successful reception of all F-MPDUs with fragment numbers from 0 to 7.

The originator STA shall consider an NDP_1M BlockAck frame (or an NDP_2M BlockAck frame) as successfully received if the BlockAck ID field value equals the 2 LSBs (or 6 LSBs) of the Scrambler Initialization value in the Service field and the Starting Sequence Control field value equals the Sequence Number of the F-MPDU that elicited the response. The Scrambler Initialization value shall be obtained from the PHY-TXEND.confirm parameter SCRAMBLER_OR_CRC.

The values of the BlockAck ID and Starting Sequence Number are obtained after decoding the NDP BlockAck frame as described in 10.53.

If the originator STA does not receive an NDP BlockAck frame as an immediate response, it may retransmit the last transmitted F-MPDU to resolicit an immediate NDP BlockAck response.

10.3.2.11 Duplicate detection and recovery

10.3.2.11.1 General

Change the second paragraph of 10.3.2.11.1 as follows:

Duplicate frame filtering is facilitated through the inclusion of a Sequence Control field (consisting of a sequence number and fragment number) within Data, Management, and Extension frames, a TID subfield in the QoS Control field within QoS Data frames, ~~and~~ an ACI subfield in the Sequence Number field within QMFs, and a PTID/Subtype subfield in the Frame Control field within PV1 Data frames.

10.3.2.11.2 Transmitter requirements

Insert the following rows into Table 10-3:

Table 10-3—Transmitter sequence number spaces

Sequence number space identifier	Sequence number space	Applies to	Status	Multiplicity	Transmitter requirements
SNS6	Individually addressed PV1 Data frame	A STA operating as an S1G STA transmitting a PV1 Data frame	Mandatory	Indexed by <STA MAC Address identified by Address 1, PTID>	
SNS7	Individually addressed PV1 Management frame	A STA operating as an S1G STA transmitting a PV1 Management frame	Mandatory	Indexed by <STA MAC Address identified by Address 1>	

10.3.2.11.3 Receiver requirements

Change the first paragraph of 10.3.2.11.3 as follows:

A STA maintains one or more duplicate detection caches. Table 10-4 defines the conditions under which a duplication detection cache is supported and the rules followed by the receiver of the cache. When a Data, Management, or Extension frame is received, a record of that frame is inserted in an appropriate cache. That record is identified by a sequence number and possibly other information from the MAC control fields of the frame. When a Data, Management, or Extension frame is received in which the Retry subfield of the Frame Control field is equal to 1, the appropriate cache, if any, is searched for a matching frame. In DMG, when a group addressed frame is received, the appropriate cache is searched for a matching frame. <u>When a PV1 Data frame or PV1 Management frame is received, the appropriate cache is searched for a matching frame, regardless of the presence of the Retry subfield of the Frame Control field.</u> If the search is successful, the frame is considered to be a duplicate. Duplicate frames are discarded.

Insert the following rows into Table 10-4:

Table 10-4—Receiver caches

Receiver cache identifier	Cache name	Applies to	Status	Multiplicity / Cache size	Receiver requirements
RC11	Individually addressed PV1 Data frame	An S1G STA receiving an individually addressed PV1 Data frame	Mandatory	Indexed by <STA MAC Address identified by Address 2, PTID, sequence number, fragment number>. At least the most recent cache entry per < STA MAC Address identified by Address 2, PTID> pair in this cache.	RR1
RC12	Individually addressed PV1 Management frame	An S1G STA receiving an individually addressed PV1 Management frame	Mandatory	Indexed by <STA MAC Address identified by Address 2, sequence number, fragment number>. At least the most recent cache entry per < STA MAC Address identified by Address 2 > pair in this cache.	RR1 RR2

10.3.2.12 NAV distribution

Insert the following paragraph at the end of 10.3.2.12:

When the NDP CTS frame is a CTS-to-self, the value in the Duration field of the NDP CTS frame shall protect the pending transmission, plus any expected (NDP) Ack frame in response.

Insert the following subclause (10.3.2.14, including Table 10-4a) after 10.3.2.13:

10.3.2.14 Response Indication procedure

An S1G STA distributes RID information in order to protect the response frame expected SIFS after the frame that elicits that response. The TXVECTOR parameter RESPONSE_INDICATION for S1G non-NDP PPDUs shall be set based on the expected response type, as described in Table 10-4a. The TXVECTOR parameter RESPONSE_INDICATION for S1G NDP PPDUs other than NDP CMAC frames is set as described in 10.34.7.

Table 10-4a—Setting the TXVECTOR's parameter RESPONSE_INDICATION

RESPONSE_INDICATION	Solicited Immediate Response
0 (No Response)	No immediate response. The Ack Policy subfield in any included QoS Control field or in the Frame Control field of the first MPDU in the PPDU is equal to No Ack or Block Ack (see 9.2.4.5.4 and 9.8.3.1).
1 (NDP Response)	The addressed recipient returns an individual NDP CMAC frame: — NDP Ack frame, as described in 10.3.2.9, — NDP CTS frame, as described in 10.3.2.7, — NDP BlockAck frame, as described in 10.24.7 and 10.3.2.9a. The Ack Policy subfield (if any) in the QoS Control field or in the Frame Control field is equal to Normal Ack or Implicit Block Ack Request.
2 (Normal Response)	The addressed recipient returns an individual control response frame: — Ack frame, as described in 10.3.2.9. — CTS frame, as described in 10.3.2.7 — BlockAck frame or BAT frame, as described in 10.3.2.9 and 10.43. — TACK frame or STACK frame as described in 10.43. The Ack Policy subfield (if any) in the QoS Control field or in the Frame Control field is equal to Normal Ack or Implicit Block Ack Request.
3 (Long Response)	The addressed recipient may return a response frame, which is not an individual control response frame. More details are provided in 10.46, 10.28, 10.32.3, and 10.50.5.2.

NOTE—The TXVECTOR parameter RESPONSE_INDICATION is not present for NDP CMAC frames.

An S1G STA shall not cause its intended receiver to generate a normal control response frame except as specified below:

a) If the intended receiver has indicated that it supports generating +HTC Control frames then the S1G STA can solicit +HTC Control frames of the types described in 10.31

b) If the intended receiver has negotiated with the S1G STA the generation of TACK frame or STACK frames then the S1G STA can solicit TACK frames or STACK frames as described in 10.43

c) If the intended receiver has indicated that it supports generating TACK frames then the S1G STA can solicit a TACK frame as described in 10.44.2

d) If the intended receiver has negotiated with the S1G STA the use of either BlockAck or BAT frames then the S1G STA can solicit either BlockAck or BAT frames as described in 10.24.6.

e) If the intended receiver has negotiated with the S1G STA the generation of control response frames with different MCSs than the primary MCS as described in 10.7.6.5.4b.

An S1G STA transmitting a PPDU that expects an NDP Response shall calculate the Duration/ID field of the transmitted PPDU as described in 9.2.5.2 where the estimated duration of "CTS frame," "Ack frame," or "BlockAck frame" is equal to NDPTxTime. NDPTxTime depends on the TXVECTOR parameter PREAMBLE_TYPE and is equal to the time in microseconds, required to transmit:

— An NDP_1M MAC frame if PREAMBLE_TYPE is an S1G_1M preamble or the intended receiver has indicated the use of 1 MHz control response frames (see 10.7.6.6)
— An NDP_2M MAC frame if PREAMBLE_TYPE is a ≥ 2 MHz short/long preamble and the intended receiver has not indicated the use of 1 MHz control response frames.

An S1G STA that expects a Normal Response that is a BAT frame or TACK frame shall calculate the Duration/ID field of the PPDU as described in 9.2.5.2 using the same estimated duration of a BlockAck frame. An S1G STA that expects a Normal Response that is a STACK frame shall use the estimated duration of an Ack frame.

An S1G STA that expects a Long Response shall calculate the Duration/ID field of the PPDU as described in 9.2.5.2 for multiple protection settings.

An S1G STA transmitting an eliciting frame for which it expects a response that is a BAT frame or BlockAck frame as described in 10.24.7 or a TACK frame as described in 10.43 and 10.44.2 shall carry the eliciting frame in an A-MPDU or in an S-MPDU (i.e., sets the TXVECTOR parameter AGGREGATION to 1). The intended recipient selects the type of control response frame based on the type of the eliciting frame and other information available in the PSDU such as Ack Policy field, EOF field, etc.

An S1G STA transmitting an eliciting frame for which it expects a response that is an Ack frame as described in 10.31 or a STACK frame as described in 10.43 shall carry the eliciting frame in an MPDU (i.e., sets the TXVECTOR parameter AGGREGATION to 0) except when the intended receiver has set the A-MPDU Supported field in the most recently transmitted S1G Capabilities element to 1, in which case the S1G STA may transmit the eliciting frame as an S-MPDU.

An S1G STA transmitting a CF-End frame shall set the TXVECTOR parameter RESPONSE_INDICATION to No Response.

An S1G AP sending an NDP Ack frame with the More Data field equal to 1 as a response to an eliciting PS-Poll frame may set the Duration field of the NDP Ack frame to the estimated duration of the BU frame that the S1G AP has buffered for the polling STA, plus SIFS, plus the duration of the response from the S1G non-AP STA, if required.

An S1G AP that sends an NDP_2M PS-Poll-Ack frame with the Idle Indication field equal to 0 and the More Data field equal to 1 as a response to an eliciting NDP PS-Poll frame may set the Duration field of the NDP_2M PS-Poll-Ack frame to the estimated duration of the BU frame that the S1G AP has buffered for the polling STA, plus SIFS, plus the duration of the response from the S1G non-AP STA, if required. An S1G AP that sends an NDP_2M PS-Poll-Ack frame with the Idle Indication field equal to 0 and the More Data field equal to 0 as a response to an eliciting NDP PS-Poll frame shall set the Duration field of the NDP_2M PS-Poll-Ack frame to 0.

An S1G STA that intends to transmit two or more SIFS-separated PV1 frames for which it does not follow the BDT rules defined in 10.46 should protect the sequence with a protective mechanism that uses multiple protection as described in 9.2.5.2.

10.3.6 Group addressed MPDU transfer procedure

Change the first paragraph of 10.3.6 as follows:

When a STA transmits group addressed MPDUs in which the To DS subfield is 0, the STA shall use the basic access procedure, unless these MPDUs are delivered using PCF or using the group addressed transmission service (GATS). When GATS is not used to deliver group addressed MPDUs the STA shall not use an RTS/(NDP) CTS or RTS/DMG CTS exchange, regardless of the length of the frame. In addition, no recipient of the frame shall transmit an Ack frame. A STA that transmits a group addressed MPDU in which the To DS subfield is 1 shall, in addition to complying with the basic access procedure of CSMA/CA, obey the rules for RTS/CTS exchange and the acknowledgment procedure because the MPDU is directed to the AP. For DMG STAs, the MPDU transmission shall also comply with the access procedures defined in 9.36.

Change the last paragraph of 10.3.6 as follows:

A STA that is not an S1G relay STA shall discard an MPDU with a group address in the Address 1 field if the value in the Address 1 field does not match any value in the dot11GroupAddressesTable and does not match the Broadcast address value. If an MPDU originates from an S1G relay STA's associated AP and if the MPDU has any group address in its Address 1 field, then the STA shall forward that MPDU to the S1G relay AP.

10.3.7 DCF timing relations

Change the sixth paragraph of 10.3.7 as follows:

In a non-S1G STA, w~~W~~hen dot11DynamicEIFSActivated is false or not defined, the EIFS is derived from the SIFS and the DIFS and the length of time it takes to transmit an Ack frame at the lowest PHY mandatory rate by Equation (10-7).

$$\text{EIFS} = \text{aSIFSTime} + \text{AckTxTime} + \text{DIFS} \tag{10-7}$$

where

AckTxTime is the time expressed in microseconds required to transmit an Ack frame, including preamble, PHY header, and any additional PHY dependent information, at the lowest PHY mandatory rate.

Insert the following paragraph after the sixth paragraph of 10.3.7:

In an S1G STA, the EIFS is equal to DIFS if the PPDU that causes the EIFS does not generate a PHY-RXEND.indication(FormatViolation) primitive. Otherwise, the EIFS for the S1G STA is derived by Equation (10-7), where ACKTxTime is equal to NDPTxTime as defined in 10.3.2.4a.2.

10.7 Multirate support

10.7.5 Rate selection for Data and Management frames

10.7.5.1 Rate selection for non-STBC Beacon and non-STBC PSMP frames

Insert the following paragraph at the beginning of 10.7.5.1:

In an S1G STA, non-STBC S1G Beacon frames shall be transmitted in an S1G 1 MHz PPDU, an S1G 2 MHz PPDU with short preamble, an S1G 1 MHz duplicate PPDU, or an S1G 2 MHz duplicate PPDU with short preamble using one of the mandatory PHY rates.

10.7.5.3 Rate selection for other group addressed Data and Management frames

Change the fifth paragraph of 10.7.5.3 as follows:

In a non-S1G STA, if ~~If~~ the BSSBasicRateSet parameter, the Basic HT-MCS Set field of the HT Operation parameter of the MLMESTART.request primitive or Basic HT-MCS Set field of the HT Operation parameter of the SelectedBSS parameter of the MLME-JOIN.request primitive, and the basic VHT-MCS and NSS set are empty (e.g., a scanning STA that is not yet associated with a BSS), the frame shall be transmitted in a non-HT PPDU using one of the mandatory PHY rates.

Insert the following paragraphs at the end of 10.7.5.3:

In an S1G STA, if the BSSBasicS1GMCS_NSSSet parameter is empty (e.g., a scanning STA that is not yet associated with a BSS), the frame shall be transmitted in an S1G PPDU using one of the mandatory PHY rates.

If the BSSBasicS1GMCS_NSSSet is not empty, the frame shall be transmitted in an S1G PPDU using an MCS and NSS from one of the <S1G-MCS, NSS> tuples included in the BSSBasicS1GMCS_NSSSet parameter.

10.7.5.7 Rate selection for other individually addressed Data and Management frame

Change 10.7.5.7 as follows:

A Data or Management frame not identified in 10.7.5.1 through 10.7.5.6 shall be sent using any data rate, MCS, ~~or~~ <VHT-MCS, NSS>, or <S1G-MCS, NSS> tuple subject to the following constraints:

— A STA shall not transmit a frame using a rate or MCS that is not supported by the receiver STA or STAs, as reported in any Supported Rates and BSS Membership Selectors element, Extended Supported Rates and BSS Membership Selectors element, or Supported MCS Set field in Management frames transmitted by the receiver STA.

— A STA shall not transmit a frame using a <VHT-MCS, NSS> tuple that is not supported by the receiver STA, as reported in any Supported VHT-MCS and NSS Set field in Management frames transmitted by the receiver STA.

— A STA shall not transmit a frame using a <S1G-MCS, NSS> tuple that is not supported by the receiver STA, as reported in any Supported S1G-MCS and NSS Set field in Management frames transmitted by the receiver STA.

- If at least one Operating Mode field with the Rx NSS Type subfield equal to 0 was received from the receiver STA:
  - A STA shall not transmit a frame with the number of spatial streams greater than that indicated in the Rx NSS subfield in the most recently received Operating Mode field with the Rx NSS Type subfield equal to 0 from the receiver STA.
- If at least one Operating Mode field with the Rx NSS Type subfield equal to 1 was received from the receiver STA:
  - A STA shall not transmit an SU PPDU frame using a beamforming steering matrix with the number of spatial streams greater than that indicated in the Rx NSS subfield in the most recently received Operating Mode field with the Rx NSS Type subfield equal to 1 from the receiver STA if the beamforming steering matrix was derived from a VHT Compressed Beamforming report with Feedback Type subfield indicating MU in the VHT Compressed Beamforming frame(s).
- A STA shall not transmit a frame using a value for the CH_BANDWIDTH parameter of the TXVECTOR that is not supported by the receiver STA, as reported in any HT Capabilities element, ~~or~~ VHT Capabilities element, or S1G Capabilities element received from the intended receiver.
- An HT STA that is a member of a BSS and that is not a VHT STA shall not transmit a frame using a value for the CH_BANDWIDTH parameter of the TXVECTOR that is not permitted for use in the BSS, as reported in the most recently received HT Operation element with the exception transmissions on a TDLS off-channel link, which follow the rules described in 11.23.6.2 and 11.23.6.3.
- A VHT STA that is a member of a BSS shall not transmit a frame using a value for the CH_BANDWIDTH parameter of the TXVECTOR that is not permitted for use in the BSS, as reported in the most recently received VHT Operation element with the following exceptions:
  - Transmissions on a TDLS off-channel link follow the rules described in 11.23.6.2 and 10.23.6.3.
  - Transmissions by a VHT STA on a TDLS link follow the rules described in 11.23.1 and 11.23.6.5.
- An S1G STA that is a member of a BSS shall not transmit a frame using a value for the CH_BANDWIDTH parameter of the TXVECTOR that is not permitted for use in the BSS, as reported in the most recently received S1G Operation element with the following exceptions:
  - Transmissions on a TDLS off-channel link follow the rules described in 11.23.6.2 and 10.23.6.3.
  - Transmissions by an S1G STA on a TDLS link follow the rules described in 11.23.1 and 11.23.6.5.

  Additionally, the value of the CH_BANDWIDTH parameter for a transmission by an S1G STA that is operating as an SST STA is limited by the Maximum permitted PPDU bandwidth as indicated in the Maximum Transmission Width field of the most recently received SST element or RPS element (see 10.48) and 10.22.5.
- If at least one Operating Mode field with the Rx NSS Type subfield equal to 0 was received from the receiver STA:
  - A STA shall not transmit a frame using a value for the TXVECTOR parameter CH_BANDWIDTH that is not supported by the receiver STA as reported in the most recently received Operating Mode field with the Rx NSS Type subfield equal to 0 from the receiver STA.

When the operational rate set of the receiving STA or STAs is not known, the transmitting STA shall transmit using a rate in the BSSBasicRateSet parameter, or an MCS in the Basic HT-MCS Set field of the HT Operation parameter of the MLME-START.request primitive or Basic HT-MCS Set field of the HT Operation parameter of the SelectedBSS parameter of the MLME-JOIN.request primitive, or a <VHT-MCS, NSS> tuple in the basic VHT-MCS and NSS set, or an <S1G-MCS, NSS> tuple in the BSSBasicS1GMCS_NSSSet parameter, or a rate from the mandatory rate set of the attached PHY if the

BSSBasicRateSet, the Basic HT-MCS Set field of the HT Operation parameter of the MLME-START.request primitive or Basic HT-MCS Set field of the HT Operation parameter of the SelectedBSS parameter of the MLMEJOIN.request primitive, ~~and~~ the basic VHT-MCS and NSS set, and the BSSBasicS1GMCS_NSSSet are empty.

The rules in this subclause also apply to A-MPDUs that aggregate MPDUs with the Type subfield equal to Data or Management with any other types of MPDU.

10.7.6 Rate selection for Control frames

10.7.6.1 General rules for rate selection for Control frames

Insert the following paragraph after the note ("The rules defined in....") after the first paragraph of 10.7.6.1:

A control frame shall be carried in an S1G PPDU with NSS equal to 1 without using long preamble, short GI, LDPC coding, STBC format, and traveling pilots when the control frame is transmitted by an S1G STA.

10.7.6.4 Rate selection for Control frames that are not control response frames

Insert the following paragraph at the end of 10.7.6.4:

A frame that is carried in an S1G PPDU shall be transmitted by the STA using a <S1G-MCS, NSS> tuple supported by the receiver STA, as reported in the Supported S1G-MCS and NSS Set field in the S1G Capabilities element received from that STA. When the Supported S1G-MCS for NSS set of the receiving STA or STAs is not known, the transmitting STA shall transmit using a <S1G-MCS, NSS> tuple in the BSSBasicS1GMCS_NSSSet parameter.

10.7.6.5 Rate selection for control response frames

10.7.6.5.2 Selection of a rate or MCS

Insert the following list items after the second item ("If a BlockAck frame...in an HT or VHT PPDU and....") in the dashed list after the first paragraph of 10.7.6.5.2:

- If a BlockAck frame is sent as an immediate response to either an implicit BlockAck request or to a BlockAckReq frame that was carried in an S1G PPDU, the primary rate is defined to be the highest rate in the BSSBasicS1GMCS_NSSSet parameter that is less than or equal to the rate of the previous frame. If no rate in the BSSBasicS1GMCS_NSSSet parameter meets these conditions, the primary rate is defined to be the highest mandatory rate of the attached PHY that is less than or equal to the rate of the previous frame. The STA may select an alternate rate according to the rules in 10.7.6.5.4. The STA shall transmit the BlockAck control response frame at either the primary rate or the alternate rate, if one exists.
- When in asymmetric block ack operation, the S1G STA shall transmit the BlockAck frame at the MCS according to the rules in 10.7.6.5.4a.
- When the S1G STA is not following asymmetric block ack operation, then
  - If the STA receives an Accept in the Control Response MCS Negotiation Response frame from a responding STA, then it shall transmit the BlockAck frame to the responding STA with the rate described in 10.7.6.5.3
  - Otherwise, the STA shall transmit the BlockAck frame at either the primary rate or the alternate rate (according to the rules in 10.7.6.5.4), if one exists.

Insert the following list item at the end of the dashed list after the first paragraph in 10.7.6.5.2:

— If the control response frame is carried in an S1G PPDU, then it is transmitted using an <S1G-MCS, NSS> tuple as determined by the procedure defined in 10.7.6.5.3.

Change the second paragraph of 10.7.6.5.2 as follows:

The modulation class of the control response frame shall be selected according to the following rules:

— If the received frame is of a modulation class other than HT, ~~or~~ VHT, or S1G and the control response frame is carried in a non-HT PPDU, the control response frame shall be transmitted using the same modulation class as the received frame. In addition, the control response frame shall be sent using the same value for the TXVECTOR parameter PREAMBLE_TYPE as the received frame.

— If the received frame is of the modulation class HT or VHT and the control response frame is carried in a non-HT PPDU, the control response frame shall be transmitted using one of the ERP-OFDM or OFDM modulation classes.

— If the control response frame is carried in an HT PPDU, the modulation class shall be HT.

— If the control response frame is carried in a VHT PPDU, the modulation class shall be VHT.

— If the control response frame is carried in an S1G PPDU, the modulation class shall be S1G.

10.7.6.5.3 Control response frame MCS computation

Insert the following paragraph after the first paragraph ("If a control response frame...within an HT or VHT PPDU....") of 10.7.6.5.3:

If a control response frame is to be transmitted within an S1G PPDU, the channel width (CH_BANDWIDTH parameter of the TXVECTOR) shall be selected first according to 10.7.6.6, and then the <S1G-MCS, NSS> tuple shall be selected from a set of <S1G-MCS, NSS> tuples called the *CandidateMCSSet* as described in this subclause.

Insert the following paragraph after the now fourth paragraph ("If the frame eliciting...by a VHT STA....") of 10.7.6.5.3:

The Rx Supported MCS Set is determined for S1G PPDUs as described in 10.7.13.

Change the now sixth paragraph of 10.7.6.5.3 as follows:

The CandidateMCSSet is determined using the following rules:

— If the frame eliciting the response was an STBC frame and the Dual CTS Protection bit is equal to 1, the CandidateMCSSet shall contain only the basic STBC MCS.

— If the frame eliciting the response had an L-SIG duration value (see 10.26.5) and initiates a TXOP, the CandidateMCSSet is the MCS Set consisting of the intersection of the Rx Supported MCS Set of the STA that sent the frame that is eliciting the response and the set of MCSs that the responding STA is capable of transmitting.

— For S1G STAs, if none of the above conditions is true, the CandidateMCSSet is the BSSBasicS1GMCS_NSSSet parameters. If the frame eliciting the response was an RTS frame, then the CandidateMCSSet may additionally include the <S1G-MCS, NSS> tuple with the same MCS and number of spatial streams as the S1G PPDU. If the combined BSSBasicMCSSet parameter is empty, the CandidateMCSSet shall consist of the set of mandatory <S1G-MCS, NSS> tuples corresponding to the mandatory S1G PHY MCSs with NSS = 1.

— For non-S1G STAs, if ~~If~~ none of the above conditions is true, the CandidateMCSSet is the union of the Basic HT-MCS Set field of the HT Operation parameter of the MLME-START.request primitive or Basic HT-MCS Set field of the HT Operation parameter of the SelectedBSS parameter of the MLME-JOIN.request primitive and the basic VHT-MCS and NSS set. If the frame eliciting the response was an RTS frame carried in a VHT PPDU, then the CandidateMCSSet may additionally include the <VHT-MCS, NSS> tuple with the same MCS and number of spatial streams as the VHT PPDU. If the combined Basic HT-MCS Set field of the HT Operation parameter of the MLME-START.request primitive or Basic HT-MCS Set field of the HT Operation parameter of the SelectedBSS parameter of the MLME-JOIN.request primitive is empty, the CandidateMCSSet shall consist of
  — The set of mandatory HT PHY MCSs if the STA eliciting the response is an HT STA that is not a VHT STA
  — The set of mandatory HT MCSs plus the set of <VHT MCS, NSS> tuples corresponding to the mandatory VHT PHY MCSs with NSS = 1 if the STA eliciting the response is a VHT STA

Insert the following list item into 10.7.6.5.3:

d) If the frame eliciting the response is within an S1G PPDU,
   1) Eliminate from the CandidateMCSSet all MCSs and all <S1G-MCS, NSS> tuples that meet any of the following conditions:
      i) Have a data rate that is higher than the data rate of the <S1G-MCS, NSS> tuple of the received frame using the largest possible value of CH_BANDWIDTH that is no larger than the value of CH_BANDWIDTH of the received frame
      ii) Have a number of spatial streams greater than one
   2) Find the highest rate MCS or <S1G-MCS, NSS> tuple of the CandidateMCSSet for which the modulation value of each stream is less than or equal to the modulation value of each stream of the MCS of the received frame and for which the coding rate is less than or equal to the coding rate of the MCS from the received frame. This MCS or <S1G-MCS, NSS> tuple is the primary MCS for the response transmission. The mapping from MCS or <S1G-MCS, NSS> tuple to modulation and coding rate is dependent on the attached PHY; see 23.5. For the purpose of comparing modulation values, the following sequence shows increasing modulation values: BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM.
   3) If no MCS meets the condition in step 2), then set the CandidateMCSSet to the S1G PHY mandatory MCSs. Repeat step 2) using the modified CandidateMCSSet.

Change the last paragraph of 10.7.6.5.3 as follows:

Once the primary MCS, ~~or~~ <VHT-MCS, NSS>, or <S1G-MCS, NSS> tuple has been selected, the STA may select an alternate MCS according to 10.7.6.5.4. If t~~T~~he STA has not negotiated the control response MCS negotiation as described in 10.7.6.5.4b or has received a Reject indication in the Control Response MCS Negotiation Response frame, then it shall transmit the control response frame using either the primary MCS or the alternate MCS, if one exists. If the STA has received an Accept indication in the Control Response MCS Negotiation Response frame from a responding STA, then it shall transmit the control response frame to the responding STA using the negotiated MCS or alternative MCS provided that the duration of the frame at the alternate MCS is the same as the duration of the frame at the negotiated MCS, if one exists. Negotiated MCS is computed as the highest MCS less than or equal to the MCS that is MCSDifference lower than the primary MCS if one exists, or the MCS10 otherwise.

Insert the following subclauses (10.7.6.5.4a and 10.7.6.5.4b) after 10.7.6.5.4:

10.7.6.5.4a MCS for asymmetric Block Ack operation

The primary MCS for asymmetric Block Ack operation is defined as the MCS that is MCSDifference (see 10.24.2) lower than that of the eliciting A-MDPU. An alternate MCS may be selected provided that the duration of the frame at the alternate MCS is the same as the duration of the frame at the primary MCS.

10.7.6.5.4b Control response MCS negotiation

Control response MCS negotiation allows two STAs with power imbalance to send the control responses with different MCSs than the primary MCS as defined by the rules in 10.7.6.5.3. A STA may initiate the Control Response Negotiation by sending a Control Response MCS Request frame. After reception of a Control Response MCS Response frame that indicates Accept, the STA sends the control response frames with the Negotiated MCS as defined in 10.7.6.5.3.

An S1G STA with dot11MCSNegotiation equal to true shall set the MCS Negotiation Support field of the S1G Capabilities element to 1. An S1G STA with dot11MCSNegotiation equal to false shall set the MCS Negotiation Support field of the S1G Capabilities element to 0.

An S1G STA shall not transmit a Control Response MCS Negotiation Request frame to another S1G STA unless the MCS Negotiation Support field of the S1G Capabilities element received from that STA contained a value of 1 and dot11MCSNegotiation is true.

An S1G STA shall transmit the Control Response MCS Negotiation Response frame to a STA from which it has received a Control Response MCS Negotiation Request frame. The STA shall include a value that indicates either Accept or Reject in the Command field of the Response frame as defined in Table 9-421y.

10.7.6.6 Channel Width selection for Control frames

Insert the following paragraphs at the end of 10.7.6.6:

An S1G STA that has set the 1 MHz Control Response Preamble Support field to 1 in the S1G Capabilities element transmitted to its peer STA shall use S1G_1M preamble transmission as the response of S1G_SHORT_PREAMBLE or S1G_LONG_PREAMBLE as follows:

— An S1G STA that sends a control frame in response to a frame carried in an S1G PPDU shall set the TXVECTOR parameter CH_BANDWIDTH to indicate a channel width that is the same or lower as the channel width indicated by the RXVECTOR parameter CH_BANDWIDTH of the frame eliciting the response.

— In a TXOP, a STA shall not set the TXVECTOR parameter CH_BANDWIDTH to a value greater than the RXVECTOR parameter CH_BANDWIDTH for the next frame exchange sequence.

Otherwise, in S1G BSS, S1G_1M preamble transmission as the response of S1G_SHORT_PREAMBLE or S1G_LONG_PREAMBLE is not allowed and the S1G STA behaves as follows:

— An S1G STA that sends a control frame in response to a frame carried in an S1G PPDU shall set the TXVECTOR parameter CH_BANDWIDTH to indicate a channel width that is the same as the channel width indicated by the RXVECTOR parameter CH_BANDWIDTH of the frame eliciting the response, except when the frame eliciting the response is an S1G RTS frame with the Dynamic Indication field in the Frame Control field equal to 1.

When both transmitting STA and receiving STA indicate OBSS mitigation support in the OBSS Mitigation Support subfield of the S1G Capabilities element, the receiving STA operating in a 2/4/8/16 MHz BSS that sends a (duplicate) NDP_2M Ack frame or NDP_2M BlockAck frame in response to a frame carried in an

S1G PPDU may set the TXVECTOR parameter CH_BANDWIDTH to indicate a channel width that is less than or equal to the channel width indicated by the RXVECTOR parameter CH_BANDWIDTH of the frame eliciting the response.

An S1G STA transmitting an S1G Control frame or an NDP Control frame shall set the TXVECTOR parameter FORMAT depending on the value of the TXVECTOR parameter CH_BANDWIDTH:

- If CH_BANDWIDTH is equal to CBW1 then the FORMAT shall be S1G
- If CH_BANDWIDTH is equal to CBW2 then the FORMAT shall be:
  - S1G_DUP_1M if the RXVECTOR parameter CH_BANDWIDTH of the eliciting S1G Control frame is equal to CBW1 and the Bandwidth Indication field in the Frame Control field is 1.
  - S1G_DUP_1M if the S1G STA intends to transmit a duplicate 1 MHz control frame to an S1G STA that supports duplicate 1 MHz frames as indicated in the duplicate 1 MHz Support field of the S1G Capabilities element received from that S1G STA.
  - S1G otherwise.
- Otherwise, the FORMAT shall be S1G DUP_2M.

10.7.11 Channel Width in non-HT and non-HT duplicate PPDUs

Insert the following paragraphs after the note ("A CTS frame,....") after the second paragraph of 10.7.11:

An S1G STA transmitting an S1G Control frame that is not a control response frame shall set the Bandwidth Indication field in the Frame Control field of the frame to a value that is equivalent to the TXVECTOR's parameter CH_BANDWIDTH.

An S1G STA shall not transmit an S1G Control frame or an NDP CMAC frame with the TXVECTOR parameter S1G_DUP_1M to another S1G STA, unless the Duplicate 1 MHz Support field of the S1G Capabilities element received from that STA contained a value of 1.

An S1G STA transmitting a non-NDP S1G Control response frame that is sent as a response to an S1G Control frame shall set the Bandwidth Indication field in the Frame Control field of the frame to the value of the Bandwidth Indication field in the Frame Control field of the eliciting frame, except for an S1G STA that has indicated the use of 1 MHz control response frames (see 10.7.6.6) in which case the Bandwidth Indication field in the Frame Control field of the non-NDP S1G Control response frame shall be set to 0.

An S1G STA shall set the Dynamic Indication field in the Frame Control field of S1G Control frames, other than RTS frame, to 0.

Insert the following subclauses (10.7.13 through 10.7.13.3) after 10.7.12.3:

10.7.13 Rate selection constraints for S1G STAs

10.7.13.1 RX supported S1G-MCS and NSS set

The Rx Supported S1G-MCS and NSS Set of an S1G STA is determined for each <S1G-MCS, NSS> tuple NSS = 1, …, 4 and bandwidth (1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz) from its Supported S1G-MCS and NSS Set field as follows:

- If support for the S1G-MCS for NSS spatial streams at that bandwidth is mandatory (see 23.5), then the <S1G-MCS, NSS> tuple at that bandwidth is supported by the STA on receive.
- Otherwise, if the Max S1G-MCS For n SS subfield (n = NSS) in the Rx S1G-MCS Map field indicates support and the Rx Highest Supported Long GI Data Rate subfield is equal to 0, then the <S1G-MCS, NSS> tuple at that bandwidth is supported by the STA on receive.

— Otherwise, if the Max S1G-MCS For n SS subfield (n = NSS) in the Rx S1G-MCS Map subfield indicates support and the data rate (expressed in megabits per second) for long GI of the MCS for NSS spatial streams at that bandwidth (if the data rate is not an integer, the data rate value is rounded down to the next integer) is less than or equal to the rate represented by the Rx Highest Supported Long GI Data Rate subfield, then the <S1G-MCS, NSS> tuple at that bandwidth is supported by the STA on receive.
— Otherwise the <S1G-MCS, NSS> tuple at that bandwidth is not supported by the STA on receive.

An S1G STA shall not, unless explicitly stated otherwise, transmit an S1G PPDU unless the <S1G-MCS, NSS> tuple and bandwidth used are in the Rx Supported S1G-MCS and NSS Set of the receiving STA(s).

NOTE—Support for a <S1G-MCS, NSS> tuple at a given bandwidth implies support for long GI.

10.7.13.2 Tx Supported S1G-MCS and NSS Set

The Tx Supported S1G-MCS and NSS Set of an S1G STA is determined for each <S1G-MCS, NSS> tuple NSS = 1, …, 4 and bandwidth (1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz) from its Supported S1G-MCS and NSS Set field as follows:

— If support for the <S1G-MCS, NSS> tuple at that bandwidth is mandatory (see 23.5), then the <S1G-MCS, NSS> tuple at that bandwidth is supported by the STA on transmit.
— Otherwise if the Max S1G-MCS for n SS subfield (n = NSS) in the Tx S1G-MCS Map subfield indicates support and the Tx Highest Supported Long GI Data Rate subfield is equal to 0, then the <S1G-MCS, NSS> tuple at that bandwidth is supported by the STA on transmit.
— Otherwise if the Max S1G-MCS for n SS subfield (n = NSS) in the Tx S1G-MCS Map subfield indicates support and the data rate (expressed in megabits per second) for long GI of the <S1G-MCS, NSS> tuple at that bandwidth (if the data rate is not an integer, the data rate value is rounded down to the next integer) is less than or equal to the rate represented by the Tx Highest Supported Long GI Data Rate subfield, then the <S1G-MCS, NSS> tuple at that bandwidth is supported by the STA on transmit.
— Otherwise the <S1G-MCS, NSS> tuple at that bandwidth is not supported by the STA on transmit.

10.7.13.3 Additional rate selection constraints for S1G PPDUs

The following apply for a STA that transmits an S1G PPDU:

— If the channel width of the PPDU is equal to CBW1, CBW2, CBW4, CBW8 or CBW16, then the STA should not use a <S1G-MCS, NSS> tuple if the S1G-MCS is equal to 0 and the Min S1G-MCS For n SS subfield in the Basic S1G-MCS and NSS Set field of the S1G Operation element of the receiver STA is equal to 1.
— If the channel width of the PPDU is equal to CBW1, CBW2, CBW4, CBW8 or CBW16, then the STA should not use a <S1G-MCS, NSS> tuple if the S1G-MCS is equal to 0 or 1 and the Min S1G-MCS For n SS subfield in the Basic S1G-MCS and NSS Set field of the S1G Operation element of the receiver STA is equal to 2.
— If the channel width of the PPDU is equal to CBW1, then the STA should not use a <S1G-MCS, NSS> tuple if the S1G-MCS is equal to 10 and the B7 of the Channel Width subfield in the S1G Operation Information field of the S1G Operation element of the receiver STA is equal to 0.

10.9 HT Control field operation

Change the fourth paragraph of 10.9 as follows:

A VHT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-VHT in the VHT Capabilities Information field of its VHT Capabilities element or in the S1G Capabilities Information field of S1G Capabilities elements that it transmits.

Insert the following paragraph at the end of 10.9:

If the value of dot11S1GControlFieldOptionImplemented is true, an S1G STA shall set the +HTC-VHT Capable subfield of the S1G Capabilities Information field of the S1G Capabilities element that it transmits to 1.

10.12 A-MSDU operation

Change the seventh paragraph of 10.12 as follows:

The following rules in this paragraph apply to the transmission of an A-MSDU:

— A non-DMG and non-S1G STA that has a value of false for dot11HighthroughputOptionImplemented shall not transmit an A-MSDU.
— A non-DMG STA and non-S1G STA shall not transmit an A-MSDU to a STA from which it has not received a frame containing an HT Capabilities element.

Insert the following paragraphs after the seventh paragraph of 10.12:

An S1G STA shall not transmit an A-MSDU to an S1G STA from which it received a frame containing an S1G Capabilities element with the A-MSDU Supported subfield equal to 0.

An S1G STA transmitting an A-MSDU shall use only the Dynamic A-MSDU subframe format (see 9.3.2.2.4). The DA Present and SA Present subfields in the Subframe Control field of each Dynamic A-MSDU subframe shall be set to 1 unless the frame carrying the A-MSDU is a PV1 frame (see 9.8).

An A-MSDU carried in a PV1 frame shall include the DA field in a Dynamic A-MSDU subframe if the value of this field:

— Is not equal to the value of the A3 stored at the recipient
— Is not equal to the value of the A3 field of the frame when an A3 is not stored at the recipient
— Is not equal to the value of the address identified by the A1 field when an A3 field is not present in the frame and an A3 is not stored at the recipient

Otherwise, the DA field shall not be included in the Dynamic A-MSDU subframe.

An A-MSDU carried in a PV1 frame shall include the SA field in a Dynamic A-MSDU subframe if the value of this field:

— Is not equal to the value of the A4 stored at the recipient
— Is not equal to the value of the A4 field of the frame when an A4 is not stored at the recipient
— Is not equal to the value of the address identified by the A2 field when an A4 field is not present in the frame and an A4 is not stored at the recipient

Otherwise, the SA field shall not be included in the Dynamic A-MSDU subframe.

A non-S1G STA transmitting an A-MSDU shall not use the Dynamic A-MSDU frame format.

The length of an A-MSDU transmitted in an S1G PPDU is limited by the maximum MPDU size supported by the recipient STA (see 10.13.5).

10.13 A-MPDU operation

10.13.1 A-MPDU contents

Change 10.13.1 as follows:

According to its context (defined in Table 9-420), an A-MPDU shall be constrained so that it contains only MPDUs as specified in the relevant table referenced from Table 9-420.

<u>The values of the Protocol Version field in the Frame Control field of the MPDUs contained in an A-MPDU shall be the same, except for a Control frame with the Protocol Version field equal to 0 in which case the Control frame can be aggregated with PV1 frame.</u>

When an A-MPDU contains multiple QoS Control fields, bits 4 and 8-15 of these QoS Control fields shall be identical.

<u>When an A-MPDU contains multiple MPDUs whose Protocol Version field value is 1, the values of EOSP and Relayed Frame fields in the Frame Control field, and A3 Present, A4 Present subfields in the SID field shall be identical across MPDUs within the A-MPDU.</u>

A DMG STA that transmits an A-MPDU shall do so only in the Data Enabled Immediate Response context or the Control Response context, with contents as specified in Table 9-425 and Table 9-428, respectively.

10.13.2 A-MPDU length limit rules

Change 10.13.2 as follows:

A STA indicates in the Maximum A-MPDU Length Exponent field in its HT Capabilities element the maximum A-MPDU length that it can receive in an HT PPDU. A STA indicates in the Maximum A-MPDU Length Exponent field in its VHT Capabilities element the maximum length of the A-MPDU pre-EOF padding that it can receive in a VHT PPDU. <u>A STA indicates in the Maximum A-MPDU Length Exponent field in its S1G Capabilities element the maximum length of the A-MPDU pre-EOF padding that it can receive in an S1G PPDU.</u> A DMG STA indicates in the Maximum A-MPDU Length Exponent field in its DMG Capabilities element the maximum A-MPDU length that it can receive. The encoding of these fields is defined in Table 9-163 for an HT PPDU, in Table 9-249 for a VHT PPDU, <u>in Table 9-262n for an S1G STA,</u> and in Table 9-229 for a DMG STA.

A VHT STA that sets the Maximum A-MPDU Length Exponent field in its VHT Capabilities element to a value in the range 0 to 3 shall set the Maximum A-MPDU Length Exponent in its HT Capabilities to the same value. A VHT STA that sets the Maximum A-MPDU Length Exponent field in the VHT Capabilities element to a value larger than 3 shall set the Maximum A-MPDU Length Exponent in its HT Capabilities element to 3.

Using the Maximum A-MPDU Length Exponent fields in the HT Capabilities and VHT Capabilities elements, the STA establishes at association the maximum length of an A-MPDU pre-EOF padding that can be sent to it. An HT STA shall be capable of receiving A-MPDUs of length up to the value indicated by the Maximum A-MPDU Length Exponent field in its HT Capabilities element. A VHT STA shall be capable of receiving A-MPDUs where the A-MPDU pre-EOF padding length is up to the value indicated by the

Maximum A-MPDU Length Exponent field in its VHT Capabilities element. An S1G STA that sets the A-MPDU Supported subfield in the S1G Capabilities element to 1 shall be capable of receiving A-MPDUs where the A-MPDU pre-EOF padding length is up to the value indicated by the Maximum A-MPDU Length Exponent field in its S1G Capabilities element.

A STA shall not transmit an A-MPDU in an HT PPDU that is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the HT Capabilities element received from the intended receiver. MPDUs in an A-MPDU carried in an HT PPDU shall be limited to a maximum length of 4095 octets. A STA shall not transmit an A-MPDU in a VHT PPDU where the A-MPDU pre-EOF padding length is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the VHT Capabilities element received from the intended receiver. An S1G STA shall not transmit an A-MPDU in an S1G PPDU where the A-MPDU pre-EOF padding length field is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the S1G Capabilities element received from the intended receiver. A DMG STA shall not transmit an A-MPDU that is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the DMG Capabilities element received from the intended receiver.

An S1G STA shall not transmit an A-MPDU, except for an S-MPDU, to an S1G STA from which it received a frame containing an S1G Capability element with the A-MPDU Supported subfield equal to 0.

10.13.3 Minimum MPDU Start Spacing field

Change the first paragraph of 10.13.3 as follows:

A STA shall not start the transmission of more than one MPDU within the time limit described in the Minimum MPDU Start Spacing field declared by the intended receiver. To satisfy this requirement, the number of octets between the start of two consecutive MPDUs in an A-MPDU, measured at the PHY SAP, shall be equal or greater than

$$t_{MMSS} \times r/8$$

where

t_{MMSS} is the time (in microseconds) defined in the “Encoding” column of Table 9-163 for an HT STA, of Table 9-262n for an S1G STA for the value of the Minimum MPDU Start Spacing field, and of Table 9-229 for a DMG STA for the value of the Minimum MPDU Start Spacing field

r is the value of the PHY Data Rate (in megabits per second) defined in 19.5 for HT PPDUs, in 21.5 for VHT PPDUs, in 23.5 for S1G PPDUs, and in Clause 20 for a DMG STA

10.13.4 A-MPDU aggregation of group addressed Data frames

Insert the following note after NOTE 3 after the first paragraph of 10.13.4:

NOTE 4—An S1G AP can transmit an A-MPDU containing MPDUs with a group addressed RA.

Insert the following list items at the end of the dashed list after the last paragraph (“When a STA transmits...:”) of 10.13.4:

— If the PPDU is an S1G PPDU, the value of maximum A-MPDU length exponent that applies is the minimum value in the Maximum A-MPDU Length Exponent subfields of the S1G Capabilities Information field of the S1G Capabilities elements across all S1G STAs associated with the transmitting AP.

— If the PPDU is an S1G PPDU, the value of minimum MPDU start spacing that applies is the maximum value in the Minimum MPDU Start Spacing subfields of the S1G Capabilities Information field of the S1G Capabilities elements across all S1G STAs associated with the transmitting AP.

10.13.5 Transport of A-MPDU by the PHY data service

Insert the following paragraphs at the end of 10.13.5:

A STA shall not transmit an MPDU in an S1G PPDU to a STA that exceeds the maximum MPDU length capability indicated in the S1G Capabilities element received from the recipient STA.

An S1G STA shall set the TXVECTOR parameter AGGREGATION to 1 when the length of the PSDU to be carried in the S1G PPDU is greater than aPSDUMaxLengthWithNoAggregation.

Change the title of 10.13.6 as follows:

10.13.6 A-MPDU padding for VHT PPDU or S1G PPDU

Change the first paragraph of 10.13.6 as follows:

A VHT STA that transmits a VHT PPDU or an S1G STA that transmits an S1G PPDU that contains one or more PSDUs, each of which contains an A-MPDU, shall construct the A-MPDU(s) as described in this subclause.

Change the fourth paragraph of 10.13.6 as follows:

This initial value of A-MPDU_Length[*n*] for user *n* is used as the APEP_LENGTH[*n*] parameter value for the PLME-TXTIME.request primitive (see 6.5.7). The PLME-TXTIME.request primitive is then invoked once for the VHT PPDU or the S1G PPDU. The PLME-TXTIME.confirm primitive (see 6.5.8) provides the TXTIME parameter and PSDU_LENGTH[] parameters for all the users for the transmission.

Change the first part of the fifth paragraph of 10.13.6 as follows:

Subsequently, for each user *n*, as permitted by the rules for EDCA TXOP Sharing (see 10.22.2.6), a VHT STA or S1G STA may add A-MPDU subframes to the A-MPDU for that user that meets either of the following conditions:

— Have a TID that maps to an AC that is not the primary AC
— Have 0 in the MPDU Length field and 0 in the EOF field

Change the first part of the sixth paragraph of 10.13.6 as follows:

Subsequently, for each user *n*, a VHT STA or S1G STA may add A-MPDU subframes to the A-MPDU for that user that meets the following condition:

— Have 0 in the MPDU Length field

Change the eighth paragraph of 10.13.6 as follows:

The final value of A-MPDU_Length[] shall be used as APEP_LENGTH[] in the PHY-TXSTART.request primitive for the VHT PPDU or S1G PPDU.

10.13.7 Setting the EOF field of the MPDU delimiter

Change the first paragraph of 10.13.7 as follows:

The EOF field may be set to 1 in an A-MPDU subframe carried in a VHT PPDU or S1G PPDU if the subframe's MPDU Length field is nonzero and the subframe is the only subframe that has a nonzero MPDU Length field. The EOF field of each A-MPDU subframe with an MPDU Length field with a nonzero value that is not the only A-MPDU subframe with MPDU Length field with a nonzero value in the A-MPDU carried in a VHT PPDU or S1G PPDU shall be set to 0. The EOF field shall be set to 0 in all A-MPDU subframes that are carried in an HT PPDU.

10.14 PPDU duration constraint

Insert the following paragraph at the end of 10.14:

A STA shall not transmit an S1G PPDU that has a duration (as determined by the PHY-TXTIME.confirm primitive defined in 6.5.8) that is greater than aPPDUMaxTime defined in Table 23-37.

10.16 LDPC operation

Insert the following paragraph after the second paragraph ("A VHT STA....") of 10.16:

An S1G STA shall not transmit a frame with the TXVECTOR parameter FEC_CODING set to LDPC_CODING unless the RA of the frame corresponds to a STA for which the Rx LDPC subfield of the S1G Capabilities element from that STA contained a value of 1 and dot11S1GLDPCCodingOptionActivated is true.

10.17 STBC operation

Change 10.17 as follows:

A STA that has not set the Tx STBC subfield to 1 in the HT Capabilities element shall not transmit HT PPDUs with a TXVECTOR parameter STBC set to a nonzero value. A STA that has not set the Tx STBC subfield to 1 in the VHT Capabilities element shall not transmit VHT SU PPDUs with a TXVECTOR parameter STBC set to a nonzero value. A STA that has not set the Tx STBC subfield to 1 in the S1G Capabilities element shall not transmit S1G SU PPDUs with TXVECTOR parameter STBC set to a nonzero value.

A STA shall not send an HT PPDU with the TXVECTOR parameter STBC set to a nonzero value to a recipient STA unless the recipient STA has indicated in the Rx STBC field of its HT Capabilities element that it supports the reception of PPDUs using STBC with a number of spatial streams greater than or equal to the number of spatial streams in the HT PPDU. A STA shall not send a VHT PPDU with the TXVECTOR parameter STBC set to a nonzero value to a recipient STA unless the recipient STA has indicated in the Rx STBC field of its VHT Capabilities element that it supports the reception of PPDUs using STBC with a number of spatial streams greater than or equal to the number of spatial streams in the VHT PPDU. A STA shall not send an S1G PPDU with the TXVECTOR parameter STBC set to a nonzero value to a recipient STA unless the recipient STA has indicated in the Rx STBC field of its S1G Capabilities element that it supports the reception of PPDUs using STBC with a number of spatial streams greater than or equal to the number of spatial streams in the S1G PPDU.

10.18 Short GI operation

Insert the following paragraphs after the fifth paragraph ("A STA may transmit a frame with TXVECTOR parameters FORMAT....") of 10.18:

An S1G STA may transmit a frame with TXVECTOR parameters CH_BANDWIDTH set to CBW1 and GI_TYPE set to SHORT_GI only if all of the following conditions are met:

- The RA of the frame corresponds to a STA for which the Short GI for 1 MHz subfield of the S1G Capabilities element is 1.
- dot11ShortGIOptionIn1MActivated is present and is true.

An S1G STA may transmit a frame with TXVECTOR parameters CH_BANDWIDTH set to CBW2 and GI_TYPE set to SHORT_GI only if all of the following conditions are met:

- The RA of the frame corresponds to a STA for which the Short GI for 2 MHz subfield of the S1G Capabilities element is 1.
- dot11ShortGIOptionIn2MActivated is present and is true.

An S1G STA may transmit a frame with TXVECTOR parameters CH_BANDWIDTH set to CBW4 and GI_TYPE set to SHORT_GI only if all of the following conditions are met:

- The RA of the frame corresponds to a STA for which the Short GI for 4 MHz subfield of the S1G Capabilities element is 1.
- dot11ShortGIOptionIn4MActivated is present and is true.

An S1G STA may transmit a frame with TXVECTOR parameters CH_BANDWIDTH set to CBW8 and GI_TYPE set to SHORT_GI only if all of the following conditions are met:

- The RA of the frame corresponds to a STA for which the Short GI for 8 MHz subfield of the S1G Capabilities element is 1.
- dot11ShortGIOptionIn8MActivated is present and is true.

An S1G STA may transmit a frame with TXVECTOR parameters CH_BANDWIDTH set to CBW16 and GI_TYPE set to SHORT_GI only if all of the following conditions are met:

- The RA of the frame corresponds to a STA for which the Short GI for 16 MHz subfield of the S1G Capabilities element is 1.
- dot11ShortGIOptionIn16MActivated is present and is true.

An S1G STA may transmit a frame with TXVECTOR parameters NUM_USERS set to greater than 1, and GI_TYPE set to SHORT_GI only if all of the following conditions are met:

- The RAs of all MPDUs in the S1G MU PPDU correspond to STAs for which the Short GI subfield of the following conditions are satisfied:
  - If the TXVECTOR parameter CH_BANDWIDTH is set to CBW2, the Short GI for 2 MHz subfield of the S1G Capabilities element is equal to 1, and dot11ShortGIOptionIn2MActivated is present and is true.
  - If the TXVECTOR parameter CH_BANDWIDTH is set to CBW4, the Short GI for 4 MHz subfield of the S1G Capabilities element is equal to 1, and dot11ShortGIOptionIn4MActivated is present and is true.
  - If the TXVECTOR parameter CH_BANDWIDTH is set to CBW8, the Short GI for 8 MHz subfield of the S1G Capabilities element is equal to 1, and dot11ShortGIOptionIn8MActivated is present and is true.
  - If the TXVECTOR parameter CH_BANDWIDTH is set to CBW16, the Short GI for 16 MHz subfield of the S1G Capabilities element is equal to 1, and dot11ShortGIOptionIn16MActivated is present and is true.

Insert the following subclauses (10.20a and 10.20b, including Figure 10-23a, Table 10-9a, and Table 10-9b) after 10.20:

10.20a S1G dynamic AID assignment operation

An S1G STA may support dynamic AID assignment. A STA with dot11DynamicAIDActivated equal to true is defined as a D-AID STA. A D-AID STA shall set the Dynamic AID field of the S1G Capabilities Information field in the S1G Capabilities element to 1. Otherwise it shall set the Dynamic AID field to 0.

A D-AID STA may transmit AID Switch Request or AID Switch Response frames to a D-AID STA. A STA shall not transmit an AID Switch Request frame or AID Switch Response frame to a STA from which it has received an S1G Capabilities element with the Dynamic AID field equal to 0.

When the traffic pattern or the service characteristic or the remaining battery life of a D-AID STA is changed, the D-AID STA may change its listen interval. If the listen interval of the STA is changed, the AID of the STA should be updated so that the STA belong to the STA group consisting of the STAs having the same listen interval. A D-AID STA requesting a new listen interval may transmit an AID Switch Request frame containing an AID Request element with the AID Request Interval Present subfield of an AID Request Mode field equal to 1 and the AID Request Interval field equal to the requested new listen interval to the AP. The Service Characteristic field may be included in the AID Request element with the Service Characteristic Present subfield of the AID Request Mode field equal to 1 to inform the AP of the service characteristic of the STA if it has been changed. After receiving the AID Switch Request frame, the AP with dot11DynamicAIDActivated equal to true shall respond with an AID Switch Response frame containing an AID Response element with the AID/Group AID field equal to a new AID and the AID Response Interval field equal to a new listen interval. The AP may assign a particular AID to the D-AID STA taking into account the received service characteristic information from the STA if it is included in the AID Switch Request frame.

An illustration of the dynamic AID assignment is shown in Figure 10-23a.

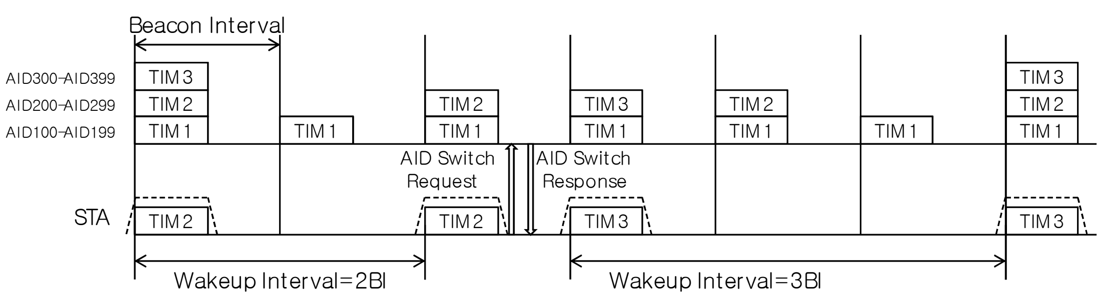


Figure 10-23a—Illustration of dynamic AID assignment

A D-AID STA may switch between TIM mode and non-TIM mode during operation.

The mode switching is initiated by a non-AP D-AID STA. When the D-AID STA switches from TIM mode to non-TIM mode, the STA should inform the AP of its switching through the AID Switch Request frame with the Non-TIM Mode Switch subfield of the AID Request element set to 1 and the TIM Mode Switch subfield set to 0, the STA otherwise should inform the AP of its switching through the AID Switch Request frame with the TIM Mode Switch subfield of AID Request element equal to 1 and Non-TIM Mode Switch subfield set to 0 when the STA switches from non-TIM mode to TIM mode. A D-AID STA that switches between TIM mode and non-TIM mode, which also wants to update its listen interval may request a listen interval change by including a listen interval value in the AID Request Interval field in the AID Request element. The Service Characteristic field may be included in the AID Request element if the service characteristic has been changed.

Upon receiving AID Switch Request frame with the Non-TIM Mode Switch subfield or TIM Mode Switch subfield of AID Request element equal to 1, the AP may reassign a new AID to the STA. The new AID is transmitted to the D-AID STA by including it in the AID Response element of the AID Switch Response frame. The AP may reassign a new value for the listen interval and include it in the AID Response Interval field of the AID Response element. The STA shall update its listen interval to the value indicated in the AID Response.

If the AID included in the AID Response element of the AID Switch Response frame is not the same as the STA's current AID, the STA shall use the AID included in the AID Response element as its new AID. The non-AP STA shall switch to the new AID after the duration specified by the AID Switch Count field in the received AID Response element.

An AP can change the group of a STA for load/traffic distribution of each group. An AP with dot11UnsolicitedDynamicAIDActivated equal to true may transmit an unsolicited AID Switch Response frame containing an AID Response element with the AID/Group AID field equal to a new AID and an the AID Response Interval field equal to a new listen interval to the STA that has the Unsolicited Dynamic AID bit equal to 1 in its S1G Capabilities element. The STA for which dot11UnsolicitedDynamicAIDActivated is true shall set the Unsolicited Dynamic AID field of the S1G Capabilities Information field in the S1G Capabilities element to 1.

When a D-AID STA has buffered frames for a peer non-AP STA, it may request to belong to the group of AIDs having the same listen interval with a the peer non-AP STA. A D-AID STA requesting the same listen interval with a the peer non-AP STA may transmit an AID Switch Request frame containing an AID Request element with the Peer STA Address Present subfield of an AID Request Mode field equal to 1 and a the Peer STA Address field equal to the MAC address of the peer non-AP STA to an the AP. After receiving the AID Switch Request frame, the AP with dot11DynamicAIDActivated equal to true shall respond with an AID Switch Response frame containing an AID Response element with an the AID/Group AID field equal to a new AID and the AID Response Interval field equal to the same listen interval with the peer non-AP STA.

When the AID of a non-AP D-AID STA has changed and that STA has direct connections with other peer STAs (e.g., TDLS/DLS), the AP shall transmit a STA Information Announcement frame (see 9.6.25.5) that contains the updated AID of the non-AP STA to each peer STA. A D-AID STA with direct connections with non-AP D-AID STAs that receives a STA Information Announcement frame shall update the AIDs of these STAs with the information contained in the received frame.

If a non-AP STA with direct connections receives a STA Information Announcement frame including an AID Announcement element from a peer STA, the non-AP STA updates the peer STA's AID to the received AID and sends the Ack frame after SIFS.

An S1G STA may indicate to the AP its service characteristic information by including the Service Characteristic field in the AID Request element in (Re)Association Request frames as described in 11.3.5.11 in which case the AID Request Interval field of the element is equal to the value of the Listen Interval field of the (Re)Association Request frame. Otherwise the AID Request element is not present in the (Re)Association Request frame.

10.20b Group ID, partial AID, Uplink Indication, and COLOR in S1G PPDUs

The S1G partial AID is a nonunique identifier of an S1G STA as defined in Table 10-9a and Table 10-9b. The partial AID is carried in the TXVECTOR parameter PARTIAL_AID of an S1G SU PPDU with the

TXVECTOR parameter CH_BANDWIDTH set to CBW2, CBW4, CBW8, or CBW16 and is limited to 9 bits.

A STA transmitting an S1G PPDU carrying one or more group addressed MPDUs that share a single, common group AID value shall set the TXVECTOR parameter PARTIAL_AID according to Table 10-9a and Table 10-9b. A STA transmitting an S1G PPDU carrying one or more group addressed MPDUs that do not share a common group AID and a common BSSID or that is transmitting an S1G NDP intended for multiple recipients shall set the TXVECTOR parameter PARTIAL_AID to 0. The intended recipient of an S1G NDP is defined in 10.34.7.

A STA transmitting an S1G SU PPDU carrying one or more individually addressed MPDUs or an S1G NDP intended for a single recipient shall select any one of the AIDs assigned to the recipient and then set the TXVECTOR parameter PARTIAL_AID as shown in Table 10-9a and Table 10-9b.

Table 10-9a—Settings for the TXVECTOR parameter PARTIAL_AID for NDP frames

Condition	PARTIAL_AID
A frame that is addressed to an AP or sent by an AP as a broadcast address	BSSID[39:47]$mod(2^9 - 1) + 1$
A frame that is sent by an AP and addressed to a STA associated with that AP or sent by a DLS or TDLS STA in a direct path to a DLS or TDLS peer STA, or to a group of STAs with a common group AID and a common BSSID	$(\mathrm{AID}[0:8] + 2^5 \times \mathrm{BSSID}[44:47] \oplus \mathrm{BSSID}[40:43])\,mod\ 2^9$ (10-12a)
Otherwise	0

Table 10-9b—Settings for the TXVECTOR parameter PARTIAL_AID for non-1 MHz PPDUs and non-NDP frames

Condition	PARTIAL_AID
A frame that is not a Control frame that is addressed to an AP	BSSID[39:47]$mod(2^9-1)) + 1$
A frame that is not a Control frame that is sent by an AP and addressed to a STA associated with that AP or is sent by a DLS or TDLS STA in a direct path to a DLS or TDLS peer STA or is sent to a group of STAs with a common group AID and a common BSSID	$(\mathrm{AID}[0:8] + 2^5 \times \mathrm{BSSID}[44:47] \oplus \mathrm{BSSID}[40:43])\,mod\ 2^6$ (10-12b)
Otherwise	0

NOTE—In Table 10-9a and Table 10-9b the last row includes the cases of a PPDU carrying MPDUs:

— sent by a STA that is a member of an IBSS to a STA or STAs that are members of an IBSS
— sent by an AP to a non associated STA
— any other condition not explicitly listed elsewhere in the table.

In Table 10-9a and Table 10-9b:

— AID[b:c] represents bits b to c inclusive of the AID of the recipient STA for an individually addressed frame with bit 0 being the first transmitted, and represents bits b to c inclusive of the group AID of the recipient STAs for a group-addressed frame with bit 0 being the first transmitted.
— BSSID[b:c] represents bits b to c inclusive of the BSSID, with bit 0 being the Individual/Group bit. In this representation, the Individual/Group bit is BSSID[0] and BSSID[47] is the last transmitted bit.

NOTE—When a STA for which dot11MultiBSSIDActivated is true is associated with *i*th BSSID of an AP, the BSSID means the value of BSSID(*i*).

An S1G STA shall include the values computed in Table 10-9a in the PHYCONFIG_VECTOR parameter PARTIAL_AID_LIST_GID00 and PARTIAL_AID_LIST_GID63.

An S1G STA that transmits an S1G PPDU to a DLS or TDLS peer STA obtains the AID for the peer STA from the DLS Setup Request, DLS Setup Response, TDLS Setup Request, or TDLS Setup Response frame.

An S1G AP should not assign to an S1G STA, an AID that results in the PARTIAL_AID value, as computed using Equation (10-12a) or Equation (10-12b), being equal to either

$$0 \text{ or } \mathrm{BSSID}[39:47]\,mod(2^9 - 1) + 1 \text{ or } \mathrm{OBSSID}[39:47]\mathrm{mod}(2^9 - 1) + 1$$

where OBSSID is the BSSID of a BSS that is not the BSS of which the AP is a member and for which the AP might be heard by the STA being assigned the AID.

An S1G STA transmitting an S1G MU PPDU sets the TXVECTOR parameter GROUP_ID as described in 23.3.10.4.

As an example of the PARTIAL_AID setting, consider the case of a BSS with BSSID 00-21-6A-AC-53-52 that has as a member a non-AP S1G STA assigned AID 5. In an NDP frame sent by the non-AP S1G STA to the S1G AP, the PARTIAL_AID is equal to 165. In an NDP frame sent by the S1G AP to the non-AP S1G STA associated with that S1G AP, the PARTIAL_AID is equal to 229. In a non-1 MHz S1G PPDU that is not an NDP frame and that is sent by the non-AP S1G STA to the S1G AP, the PARTIAL_AID is set to 165. In a non-1 MHz S1G PPDU that is not an NDP frame that is sent by the S1G AP to the non-AP S1G STA associated with that S1G AP, the PARTIAL_AID is set to 37.

NOTE 1—In the example above, BSSID[47:40] = 0x52, that is, BSSID[47] = 0, BSSID[46] = 1, BSSID[45] = 0, BSSID[44] = 1, etc.

NOTE 2—As described in IEEE Std 802-2001, the use of hyphens for the BSSID indicates hexadecimal representation rather than bit-reversed representation such that the leftmost octet in the representation is the first transmitted octet for 802.11. Using the BSSID vector numbering described above, the BSSID in IEEE Std 802-2001 hexadecimal representation is BSSID[7:0]-BSSID[15:8]- BSSID[23:16]-BSSID[31:24]- BSSID[39:32]-BSSID[47:40].

A STA transmitting an S1G PPDU that is not a 1 MHz PPDU and is not an NDP frame and that is addressed to an AP shall set the TXVECTOR parameter UPLINK_INDICATION to 1. The UPLINK_INDICATION parameter shall be set to 0 for all other cases. The TXVECTOR parameter UPLINK_INDICATION is not present for 1 MHz frames and is not present for NDP frames.

The TXVECTOR parameter COLOR is used to assist a receiving STA in identifying the BSS from which a received PPDU originates so that the receiving STA reduces intra-BSS collisions by reporting a busy medium regardless of the received power when COLOR indicates that the current PPDU might be intra-BSS and might reduce power consumption by terminating the reception process when the received PPDU could not be from the BSS with which the STA is associated. A STA transmitting an S1G PPDU that is not a 1 MHz PPDU and is not an NDP frame and that is addressed to an AP need not include the TXVECTOR parameter COLOR in the TXVECTOR. A STA transmitting an S1G PPDU that is not a 1 MHz PPDU and is not an NDP frame and that is sent by a DLS or TDLS STA in a direct path to a DLS or TDLS peer STA shall set the TXVECTOR parameter COLOR to the value of the COLOR parameter, if present, from the RXVECTOR of the most recently received frame from its associated AP or from the STA transmitting a beacon of the IBSS of which it is a member that contained a COLOR parameter. An AP transmitting an S1G PPDU that is not a 1 MHz PPDU and is not an NDP frame shall set the TXVECTOR parameter COLOR to a value of its choosing within the range 0 to 7 and shall maintain that value for the duration of the existence of the BSS. The AP which is a member of a Multiple BSSID Set shall set the TXVECTOR parameter COLOR for each different BSSID(*i*) to a same value.

An AP shall include the value within the range 0 to 7 that it is using for the TXVECTOR parameter COLOR in non-1 MHz, non-NDP frames in the COLOR field of the S1G Capabilities Information field of the S1G Capabilities element in all frames that contain that element. The COLOR field of the S1G Capabilities Information field of the S1G Capabilities element in all frames transmitted from a non-AP STA is reserved.

The partial BSSID is defined to be the PARTIAL_AID of the address of the STA contained in the AP and is equal to

$$\mathrm{BSSID}[39:47] mod (2^9 - 1) + 1$$

10.22 HCF

10.22.1 General

Change the last paragraph of 10.22.1 as follows:

HCCA is not used by <u>either </u>DMG <u>or S1G </u>STAs.

10.22.2 HCF contention based channel access (EDCA)

10.22.2.1 Reference model

Insert the following paragraph after the second paragraph ("For the case in which....") of 10.22.2.1:

An S1G STA shall be a QoS STA.

Change the now fourth paragraph and subsequent note in 10.22.2.1 as follows:

A DMG <u>STA or an S1G </u>STA <u>that is a sensor STA </u>may implement a single AC. If the <u>DMG or S1G </u>STA implements a single AC, all UP and frame types shall be mapped to AC_BE.

NOTE—A DMG <u>or S1G </u>STA that implements a single AC has only one queue in Figure 10-24.

10.22.2.2 EDCA backoff procedure

Change the following list item in the dashed list after the second paragraph ("For the purposes of this subclause...:") of 10.22.2.2 as shown:

— After transmitting an MPDU (even if it is carried in an A-MPDU or as part of a VHT<u> or S1G </u>MU PPDU that is sent using TXVECTOR parameter NUM_USERS > 1) that requires an immediate frame as a response:

10.22.2.3 EDCA TXOPs

Change 10.22.2.3 as follows:

There are three modes of EDCA TXOP defined: initiation of an EDCA TXOP, sharing an EDCA TXOP, and multiple frame transmission within an EDCA TXOP. Initiation of the TXOP occurs when the EDCA rules permit access to the medium. Sharing of the EDCA TXOP occurs when an EDCAF within an AP that supports DL-MU-MIMO has obtained access to the medium, making the corresponding AC the primary AC, and includes traffic from queues associated with other ACs in VHT or S1G MU PPDUs transmitted during the TXOP. Multiple frame transmission within the TXOP occurs when an EDCAF retains the right to access the medium following the completion of a frame exchange sequence, such as on receipt of an Ack frame.

10.22.2.4 Obtaining an EDCA TXOP

Change the following list items of 10.22.2.4 as shown:

a) Following AIFSN[AC] × aSlotTime - aRxTxTurnaroundTime of idle medium after SIFS (not necessarily idle medium during the SIFS) after the last busy medium on the antenna that was the result of a reception of a frame with a correct FCS or of an S1G frame. Note that upon reception of an S1G frame, an S1G STA updates its RID counter based on information obtained from the RXVECTOR as described in 10.3.2.4a and this update does not depend on the outcome of the FCS check.

b) Following EIFS – DIFS + AIFSN[AC] × aSlotTime + aSIFSTime – aRxTxTurnaroundTime of idle medium after the last indicated busy medium as determined by the physical CS mechanism that was the result of a non-S1G frame reception that has resulted in FCS error, or of a frame reception that has resulted in PHY-RXEND.indication (RXERROR) primitive where the value of RXERROR is not NoError.

Insert the following subclause (10.22.2.5a, including Table 10-10a) after 10.22.2.5:

10.22.2.5a EDCA channel access in an S1G BSS

If the MAC receives a PHY-CCA.indication primitive with the channel-list parameter present, the channels considered idle are defined in Table 10-10a.

Table 10-10a—Channels indicated idle by the channel-list parameter

PHY-CCA.indication channel-list element	Idle channels
primary1	None
primary2	primary 1 MHz channel
secondary2	primary 1 MHz channel, primary 2 MHz channel
secondary4	primary 1 MHz channel, primary 2 MHz channel and secondary 2 MHz channel
secondary8	primary 1 MHz channel, primary 2 MHz channel, secondary 2 MHz channel and secondary 4 MHz channel

When a STA and the BSS, of which the STA is a member, both support multiple channel widths, an EDCA TXOP is obtained based solely on activity of the primary channel. “Idle medium” in this subclause means “idle primary channel.” Likewise “busy medium” means “busy primary channel.”

In the following description, the CCA is sampled according to the timing relationships defined in 10.3.7. Slot boundaries are determined solely by activity on the primary channel. “Channel idle for an interval of PIFS” means that whenever CCA is sampled during the period of PIFS that ends at the start of transmission, the CCA for that channel was determined to be idle.

a) If an S1G STA invokes a backoff procedure at the primary 2 MHz channel for ≥ 2 MHz mask PPDU transmission using the CCA conditions defined in 23.3.17.5.4 and the S1G STA is permitted to begin a TXOP (as defined in 10.22.2.4) and the S1G STA has at least one MSDU pending for transmission for the AC of the permitted TXOP, the S1G STA shall perform exactly one of the following steps:
    1) Transmit a 16 MHz mask PPDU if the secondary 2 MHz channel, the secondary 4 MHz channel and the secondary 8 MHz channel were idle during an interval of PIFS immediately preceding the start of the TXOP
    2) Transmit an 8 MHz mask PPDU on the primary 8 MHz channel if both the secondary 2 MHz channel and the secondary 4 MHz channel were idle during an interval of PIFS immediately preceding the start of the TXOP
    3) Transmit a 4 MHz mask PPDU on the primary 4 MHz channel if the secondary 2 MHz channel was idle during an interval of PIFS immediately preceding the start of the TXOP
    4) Transmit a 2 MHz mask PPDU on the primary 2 MHz channel
b) An S1G STA that intends to transmit an 8 or 16 MHz PPDU may also invoke a backoff procedure at the primary 2 MHz channel using the CCA conditions defined in 23.3.17.5.4.2, if the S1G STA is permitted to begin a TXOP (as defined in 10.22.2.4) and the S1G STA has at least one MSDU pending for transmission for the AC of the permitted TXOP. In this case the S1G STA shall perform exactly one of the following steps:
    1) Transmit a 16 MHz PPDU if the secondary 2 MHz channel, the secondary 4 MHz channel and the secondary 8 MHz channel were idle during an interval of PIFS immediately preceding the start of the TXOP
    2) Transmit an 8 MHz PPDU on the primary 8 MHz channel if both the secondary 2 MHz channel and the secondary 4 MHz channel were idle during an interval of PIFS immediately preceding the start of the TXOP
    3) Invoke a new backoff procedure if the secondary 2 MHz and/or the secondary 4 MHz channel were busy.
c) If an S1G STA invokes a backoff procedure at the primary 1 MHz channel for 1 MHz PPDU transmission and the S1G STA is permitted to begin a TXOP (as defined in 10.22.2.4) and the S1G STA has at least one MSDU pending for transmission for the AC of the permitted TXOP, the S1G STA shall transmit a 1 MHz mask PPDU on the primary 1 MHz channel.

10.22.2.6 Sharing an EDCA TXOP

Change the first paragraphs and the note after the second paragraph of 10.22.2.6 as follows:

This mode applies only to an AP that supports DL-MU-MIMO. The AC associated with the EDCAF that gains an EDCA TXOP becomes the primary AC. TXOP sharing is allowed when primary AC traffic is transmitted in a VHT or S1G MU PPDU and resources permit traffic from secondary ACs to be included, targeting up to four STAs. The inclusion of secondary AC traffic in a VHT or S1G MU PPDU shall not increase the duration of the VHT or S1G MU PPDU beyond that required to transport the primary AC traffic. If a destination is targeted by frames in the queues of both the primary AC and at least one secondary AC, the frames in the primary AC queue shall be transmitted to the destination first, among a series of downlink transmissions within a TXOP. The decision of which secondary ACs and destinations are selected for TXOP sharing, as well as the order of transmissions, are implementation specific and out of scope of this standard.

When sharing, the TXOP limit that applies is the TXOP limit of the primary AC.

NOTE—An AP can protect an immediate response by preceding the VHT or S1G MU PPDU (which might have TXVECTOR parameter NUM_USERS > 1) with an RTS/CTS exchange or a CTS-to-self transmission.

10.22.2.7 Multiple frame transmission in an EDCA TXOP

Change the second paragraph of 10.22.2.7 as follows (including inserting NOTE 3):

Multiple frames may be transmitted in an EDCA TXOP that was acquired following the rules in 10.22.2.4 if there is more than one frame pending in the primary AC for which the channel has been acquired. However, those frames that are pending in other ACs shall not be transmitted in this EDCA TXOP except when sent in a VHT or S1G MU PPDU with TXVECTOR parameter NUM_USERS > 1 and if allowed by the rules in 10.22.2.6. If a TXOP holder has in its transmit queue an additional frame of the primary AC and the duration of transmission of that frame plus any expected acknowledgment for that frame is less than the remaining TXNAV timer value and, if dot11MCCAActivated is true, the remaining RAV timer value, then the TXOP holder may commence transmission of that frame a SIFS (or RIFS, if the conditions defined in 10.3.2.3.2 are met) after the completion of the immediately preceding frame exchange sequence, subject to the TXOP limit restriction as described in 10.22.2.8. A STA shall not commence the transmission of an RTS with a bandwidth signaling TA until at least a PIFS after the immediately preceding frame exchange sequence. An HT STA that is a TXOP holder may transmit multiple MPDUs of the same AC within an A-MPDU as long as the duration of transmission of the A-MPDU plus any expected BlockAck frame response is less than the remaining TXNAV timer value and, if dot11MCCAActivated is true, the remaining RAV timer value. An S1G STA that is a TXOP holder may transmit multiple MPDUs of the same AC within an A-MPDU as long as the duration of transmission of the A-MPDU plus any expected (NDP) BlockAck frame response is less than the remaining TXNAV timer value.

NOTE 1—PIFS is used by a VHT STA to perform CCA in the secondary 20 MHz, 40 MHz, and 80 MHz channels before receiving RTS (see 10.3.2).

NOTE 2—An RD responder can transmit multiple MPDUs as described in 10.28.4.

NOTE 3—Within a BDT, STAs can transmit multiple MPDUs as described in 10.46.

Change the fifth paragraph of 10.22.2.7 as follows:

Note that, as for an EDCA TXOP, a multiple frame transmission is granted to an EDCAF, not to a STA, so that the multiple frame transmission is permitted only for the transmission of a frame of the same AC as the frame that was granted the EDCA TXOP, unless the EDCA TXOP obtained is used by an AP for a PSMP sequence or a VHT or S1G MU PPDU with TXVECTOR parameter NUM_USERS > 1.

Insert the following paragraph at the end of 10.22.2.7:

An S1G STA that intends to transmit an 8 MHz or 16 MHz PPDU invoking a backoff procedure in the primary 2 MHz channel using the channel busy conditions defined in 23.3.17.5.4.2 shall not set the Dynamic Indication field to 1 in any RTS frame that is scheduled for transmission at the expiration of this backoff.

10.22.2.8 TXOP limits

Change the following list item in 10.22.2.8 as shown:

a) One of the following at any rate, subject to the rules in 10.7
   4) A QoS Null frame or PS-Poll frame that is not an PS-Poll+BDT frame

Change the following note after the third paragraph in 10.22.2.8 as shown:

NOTE 2—This rule prevents the use of RD, BDT, and TXOP sharing when the TXOP limit is 0.

10.22.2.9 Truncation of TXOP

Change the text of 10.22.2.9 as follows (Figure 10-28 remains unchanged):

When a STA gains access to the channel using EDCA and empties its transmission queue, it may transmit a CF-End frame provided that the remaining duration is long enough to transmit this frame. By transmitting the CF-End frame, the STA is explicitly indicating the completion of its TXOP. In a DMG BSS, the STA shall not send a CF-End frame with a nonzero value in the Duration/ID field if the remaining duration is shorter than $2 \times T_{CF\text{-}End} + 2 \times SIFS$, where $T_{CF\text{-}End}$ is the duration of the CF-End frame. A STA that is an S1G AP may transmit an NDP CF-End frame instead of a CF-End frame. A non-S1G STA shall not transmit an NDP CF-End frame.

An S1G STA that both

- Transmits either a PPDU with its TXVECTOR parameter RESPONSE_INDICATION value Long Response or an NDP (PS-Poll-)Ack frame with its Idle Indication field value 1 and Duration field value 0 and
- Does not receive (after a SIFS) a response with its RXVECTOR parameter RESPONSE_INDICATION value NDP Response or Normal Response

may, after PIFS, transmit an NDP CF-End frame to truncate any active RID or NAV.

A TXOP holder that transmits a CF-End frame shall not initiate any further frame exchange sequences within the current TXOP.

An S1G STA that transmits an NDP CF-End frame shall set the frame's Duration field to 0 and shall initiate no other frame exchange sequences in the current TXOP.

A non-AP STA that is not the TXOP holder shall not transmit a CF-End frame.

In a non-DMG BSS, a non-S1G STA shall interpret the reception of a CF-End frame as a NAV reset, i.e., it resets its NAV to 0 at the end of the PPDU containing this frame. After receiving a CF-End frame with a matching BSSID(TA) without comparing Individual/Group bit, an AP may respond by transmitting a CF-End frame after SIFS.

NOTE 1—The transmission of a single CF-End frame by the TXOP holder resets the NAV of STAs hearing the TXOP holder. There may be STAs that could hear the TXOP responder that had set their NAV that do not hear this NAV reset. Those STAs are prevented from contending for the medium until the original NAV reservation expires.

NOTE 2—A CF-End sent by a non-AP VHT STA that is a member of a VHT BSS can include the TXVECTOR parameter CH_BANDWIDTH_IN_NON_HT as defined in 10.7.6.6 in case it elicits a CF-End response.

In a DMG BSS, a STA that is not in the listening mode (9.36.6.6) shall interpret the reception of a CF-End frame as a NAV reset, i.e., it resets its NAV to 0 at the end of the time interval indicated in the value of the Duration/ID field of the received frame. The interval starts at PHYRXEND.indication primitive of the frame reception. The STA shall not transmit during the interval if the RA field of the frame is not equal to the STA MAC address. The STA may transmit a CF-End frame if the RA field of the received frame is equal to the STA MAC address and the value of the Duration/ID field in the received frame is not equal to 0.

Figure 10-28 shows an example of TXOP truncation. In this example, the STA accesses the medium using EDCA channel access and then transmits a nav-set sequence (e.g., RTS/CTS for non-DMG STAs or RTS/DMG CTS for DMG STAs) (using the terminology of Annex G). After a SIFS, it then transmits an initiator-sequence, which may involve the exchange of multiple PPDUs between the TXOP holder and TXOP responders. At the end of the second sequence, the TXOP holder has no more data that it can send that fits within the TXOP limit; therefore, it truncates the TXOP by transmitting a CF-End frame.

Non-DMG STAs that are not S1G STAs that receive a CF-End frame reset their NAV and can start contending for the medium without further delay. A DMG STA that receives a CF-End frame can start contending for the medium at the end of the time interval equal to the value in Duration/ID field of the frame if none of its NAV has a nonzero value (9.36.10).

An S1G STA that receives an NDP CF-End frame should reset its NAV and may start contending for the medium without further delay.

An S1G STA may transmit a CF-End frame containing a value greater or equal to 0 in the Duration/ID field.

An S1G STA shall interpret the reception of a CF-End frame with the Duration/ID field equal to zero as a NAV reset, i.e., it resets its NAV timer to 0 at the end of the PPDU containing this frame. After receiving a CF-End frame with the Duration/ID field equal to zero and a matching BSSID, an AP may respond by transmitting a CF-End frame with the Duration/ID field equal to zero after SIFS.

When an S1G STA receives a CF-End frame with the Duration/ID field equal to a nonzero duration value that falls in the range of [NAV value – 8, NAV value + 8] (microseconds) at the time of the reception of the PHY-RXEND.indication, it shall reset the NAV and may start contending for the medium without further delay. If the received duration value does not fall in the range of [NAV value – 8, NAV value + 8] microseconds at the time of the reception of the PHY-RXEND.indication, the STA shall discard the CF-End frame.

NOTE—A NAV value that varies within ± 8 microsecond boundaries accommodates almost all inaccuracies (e.g., due to clock drifting) to the NAV counter at the receiving STA.

After receiving a CF-End frame with a matching BSSID, an S1G AP may respond by transmitting a CF-End frame after SIFS in which the value of the Duration field is equal to the value obtained from the Duration field of the received CF-End frame adjusted by subtracting the value of aSIFSTime and the time required to transmit the CF-End frame, in units of microseconds. If the adjusted value is a negative value, the Duration field of the CF-End frame is set to 0.

TXOP truncation shall not be used in combination with L-SIG TXOP protection when the HT Protection field of the HT Operation element is equal to nonmember protection mode or non-HT mixed mode.

10.22.3 HCF controlled channel access (HCCA)

10.22.3.1 General

Change the fourth paragraph of 10.22.3.1 as follows:

A non-AP QoS STA that is a non-S1G STA shall be able to respond to QoS (+)CF-Poll frames received from an HC with the Address 1 field matching their own addresses.

Insert the following subclauses (10.22.5 through 10.22.5.8, including Figure 10-30a through Figure 10-30d) after 10.22.4.3:

10.22.5 Restricted Access Window (RAW) operation

10.22.5.1 General

Restricting uplink channel access to a small number of STAs and spreading their uplink access attempts over a period of time might improve the medium utilization's efficiency by reducing collisions. When dot11RAWOperationActivated is true, an AP may allocate a medium access interval called RAW (Restricted Access Window) for a group of STAs within a (short) beacon interval and broadcast this information using S1G Beacon frame.

An S1G STA whose dot11RAWOperationImplemented value is true shall set the RAW Operation Support field in the S1G Capabilities element it transmits to 1. An S1G STA whose dot11RAWOperationImplemented value is false shall set the RAW Operation Support field in the S1G Capabilities element it transmits to 0.

A non-AP STA whose dot11RAWOperationImplemented value is true shall be able to follow the RAW procedure, as described in this subclause.

An AP shall not include a non-AP STA in any RAW Group from which it has received an S1G Capabilities element whose RAW Operation Support field value is 0.

A TIM STA with dot11RAWOperationImplemented equal to false that successfully receives an RPS element from the AP it is associated shall not access the WM for the RAW duration indicated in the RPS element.

A TIM STA is in the RAW group indicated by the RAW Group subfield in the RAW Assignment subfield of the RPS element if the AID of the TIM STA (n) is greater than or equal to the lowest AID of the STA allocated in the RAW (N_1) and the AID of the STA is less than or equal to the highest AID of the TIM STA (N_2) allocated in the RAW (i.e., $N_1 \leq n \leq N_2$), where N_1 is constructed by concatenating the Page Index (2 bits) subfield and the RAW Start AID (11 bits) in the RAW Group subfield of the RPS element and N_2 is constructed by concatenating the Page Index (2 bits) subfield and the RAW End AID (11 bits) in the RAW Group subfield of the RPS element.

A TIM STA that receives an RPS element in an S1G Beacon frame transmitted by the AP with which it is associated determines the RAW timing as the RAW duration specified by RAW Slot Definition subfield in the RAW Assignment subfield of the received RPS element and the start time of the RAW specified by the RAW Start Time subfield in the RAW Assignment subfield of the received RPS element.

The RAW is divided into one or more RAW slots. The Slot Duration Count subfield of the RAW Slot Definition subfield in the RAW Assignment subfield of the RPS element defines the duration of a RAW slot in the RAW.

If the TIM STA belongs to the RAW group, it is allowed to contend for medium access at the start of its assigned RAW slot (see 10.22.5.3) and shall not contend for medium access within a RAW slot not assigned to it during that RAW.

An AP may allocate more than one RAW by including more than one RAW Assignment subfield in the RPS element within a (short) beacon interval with different RAW parameters. The AP may also assign periodic RAWs to a group of TIM STAs where the periodicity information is indicated in the RPS element (see 9.4.2.192).

An AP may assign to each TIM STA or a group of TIM STAs a RAW slot inside the RAW at which the STA(s) is (are) allowed to contend for medium access. After determining its channel access RAW slot assigned by the AP, the TIM STA starts to access the channel not earlier than its assigned RAW slot based on the S1G variant of EDCA (10.22.2.5a). A TIM STA that is not a member of the RAW group indicated by the RAW Group subfield in the RAW Assignment subfield of the RPS element or is not allowed to access the RAW implicitly indicated by the values of RAW Type and RAW Type Options subfield for which the RAW Group subfield is not present, shall not access the WM in the indicated channels of the RPS element or in the BSS operating channel if there are no indicated channels for duration of the RAW, except for a non-AP STA that is allowed not to check the Beacon frame (e.g., non-TIM STA). Upon receipt of any frame (e.g., PS-Poll frame or trigger frame) for the RAW duration from a TIM STA not within the RAW group indicated by the RAW Group subfield in the RAW Assignment subfield of the RPS element, the AP shall respond with a control frame (e.g., NDP PS-Poll ACK frame).

An AP may further indicate on which channel(s) the SST STA(s) that are granted access to the RAW are allowed to transmit for the RAW duration, through the Channel Indication subfield in the RAW Assignment subfield of the RPS element (see 9.4.2.192). An SST STA is an S1G STA that is associated with an AP and that chooses a subset of the allowed operating channels for the SST on which to operate when SST operation is activated by the AP as indicated in the Subchannel Selective Transmission element in Beacon frame. A value of 1 in a bit position in the Channel Activity Bitmap in the Channel Indication subfield of the RPS element indicates that operation is allowed on the BSS operating channel for the RAW duration, with any allowed operating bandwidth that includes that channel, subject to the limitations described in 10.48. Access to the channel shall be performed according to the signaling of the procedure described in 10.48 followed by the Channel Indication signaling in RPS element, assuming the primary channel is a channel identified by a value of 1 in one of the Channel Activity bits in the Channel Indication subfield in the RAW Assignment subfield of the RPS element. The channels that are allowed for SST operation in the RPS element can be different from the channels allowed for SST operation in the SST element. An AP shall not include a TIM STA that is not supporting the SST Operation in the RAW Group of an RPS element that has a Channel Indication that does not include the primary BSS operating channel.

An S1G AP may protect the access of sensor STAs in some S1G Beacon frames by allocating the PRAW (10.22.5.8). During the allocated PRAW, only sensor STAs can access the wireless medium. An S1G AP may determine the duration of the PRAW based on the number of sensor STAs in its network, their expected uplink data amount and data rate and any other factors that the S1G AP chooses.

AP may designate a RAW for non-TIM STAs by setting the RAW Type to Simplex RAW and setting the RAW Type Options to Non-TIM RAW in the RPS element. In a non-TIM RAW, only non-TIM STAs that have been previously scheduled within the RAW such as TWT STAs or doze awake cycle rescheduled STAs (as described in 10.44.2) are allowed to access the medium.

10.22.5.2 RAW structure and timing

An illustration of the RAW structure and timing diagram is shown in Figure 10-30a.

An AP indicates the RAW allocation and RAW slot assignment within the RAW by including the RPS element and the TIM element in an S1G Beacon frame.

An AP allows or prohibits transmission at the end of the assigned RAW slot by using the Cross Slot Boundary subfield in the RAW Slot Definition subfield within the RAW Assignment subfield of the RPS element (9.4.2.192).

If the Cross Slot Boundary subfield in the RAW Slot Definition subfield within the RAW Assignment subfield of the RPS element is set to 1, a STA is allowed to cross its assigned RAW slot boundary to complete the ongoing frame exchange sequence.

If the Cross Slot Boundary subfield in the RAW Slot Definition subfield within the RAW Assignment subfield of the RPS element is set to 0, a STA shall not transmit or cause to be transmitted a frame exchange sequence that would exceed boundary of its allocated RAW slot.

As shown in Figure 10-30a, if the Cross Slot Boundary subfield in RAW Assignment subfield of the RPS element is equal to 0, a STA may initiate frame transmission only if the remaining time to the end of the assigned RAW slot duration is greater than or equal to the transmission time and reception of any immediate response expected from the peer MAC entity prior to the end of the allocated RAW slot boundary. Otherwise, it shall not initiate transmission of a frame even though the remaining RAW slot duration is nonzero.

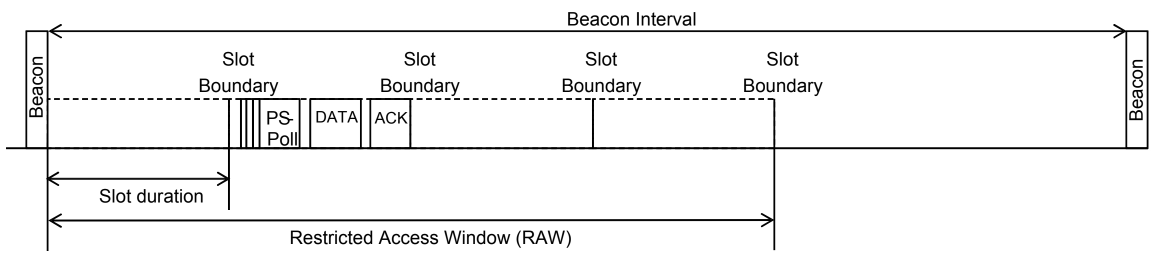


Figure 10-30a—Restricted Access Window (RAW)

10.22.5.3 Slot assignment procedure in RAW

This subclause defines a RAW slot assignment procedure for STAs that are allowed to access the medium within a RAW based on the RPS element and the TIM element in a Beacon frame. Further restrictions apply to a RAW for which the RA Frame Indication field in the RPS element is 1 as described in 10.22.5.7.

A STA shall obtain the number of RAW slots in the RAW (N_{RAW}) from the Number of Slots subfield in the RAW Slot Definition subfield of RAW Assignment subfield of the RPS element. The RAW slots in the RAW are indexed from 0 to (N_{RAW} – 1) as shown in Figure 10-30b.

The STA shall determine the index of the RAW slot, i_{slot}, in which the STA is allowed to start contending for the medium based on the following mapping function:

$$i_{slot} = (x + N_{offset}) \ mod \ N_{RAW}$$

where
- x is the position index of the AID of the STA or the AID of the STA
- N_{offset} represents the offset value in the mapping function
- N_{RAW} is the value of the Number of Slots subfield

The value x is the position index of the AID of the STA if the RAW is restricted to STAs whose AID bits in the TIM element are equal to 1 (the RAW Type field is equal to 0 and the Bit 0 of the RAW Type Options field is equal to 1 or the RAW Type field is equal to 3), and AIDs are arranged in ascending order and each AID is assigned with a position index, which starts from 0 (see Figure 10-30c). Otherwise, if the RAW is not restricted to STAs whose AID bits in the TIM element are equal to 1 (the RAW Type field is equal to 0 and the Bit 0 of the Raw Type Options field is equal to 0), x is the AID of the STA (see Figure 10-30b); N_{offset} represents the offset value in the mapping function, which improves the fairness among the STAs in the RAW, and the STA shall use the 2 least significant octets of the FCS field of the S1G Beacon frame for the N_{offset}.

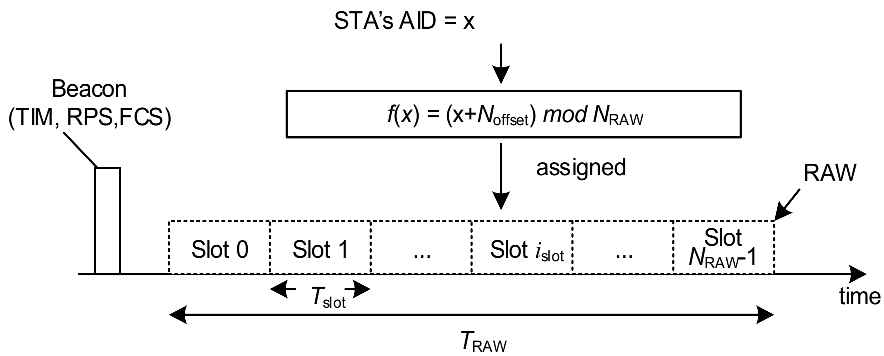


Figure 10-30b—Illustration of the RAW slot assignment procedure (RAW not restricted to STAs whose AID bits in the TIM element are equal to 1)

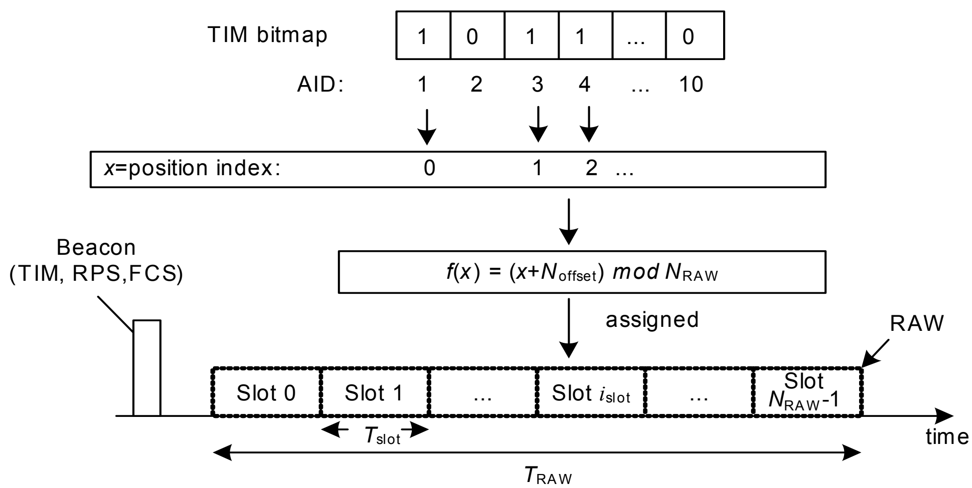


Figure 10-30c—Illustration of the RAW slot assignment procedure (RAW restricted to STAs whose AID bits in the TIM element are equal to 1)

10.22.5.4 Slotted channel access procedure in RAW

When the RAW is not restricted to STAs with DL BU indication in the TIM element (the RAW is a generic RAW and the Paged STA indication is equal to 0), all STAs that belong to a RAW group are allowed to access the medium in the RAW of the RAW group, an AP assigns a RAW slot for each STA that belongs to the RAW group (10.22.5.3). Each STA that belongs to the RAW group shall start to contend for the WM not earlier than the start of the assigned RAW slot. The channel access is based on EDCA.

When the RAW is restricted to STAs with DL BU indication in the TIM element (the RAW is a generic RAW and the Paged STA indication is equal to 1 or the RAW is a triggering frame RAW), paged STAs only are allowed to access the medium in the RAW, after receiving a TIM element, the paged STA starts to contend for the WM not earlier than the allocated RAW slot within the RAW defined as the function of STA position in the TIM element and the RAW group information in the RPS element (10.22.5.3), and non-paged STAs are not allowed to access the RAW.

AP may designate a RAW for trigger frames by setting the RAW type to Triggering Frame RAW. When the RAW type is Triggering Frame RAW, each STA in the RAW Group is only allowed to send up to one trigger frame during its assigned RAW slot as described in 10.22.5.3. In the Triggering Frame RAW, a trigger frame is limited to a QoS Null (no data) contained in a non-A-MPDU frame or a (NDP) PS-Poll frame. In the Triggering Frame RAW, the STA transmits a trigger frame to the AP not earlier than the start of its assigned RAW slot. The duration of the trigger frame exchange sequence shall not exceed a RAW slot duration calculated by the RAW Slot Definition subfield in the RAW Assignment subfield of the RPS element. And, in the Triggering Frame RAW, crossing RAW slot boundary is not allowed.

After receiving the trigger frame from the paged STA in the Triggering Frame RAW, the AP shall not respond with the downlink buffered BU during the Triggered Frame RAW and may deliver the downlink buffered BU for the corresponding paged STAs after the end of the current Triggering Frame RAW.

An AP may protect transmissions of PS-Poll or trigger frames by setting the NAV for the RAW immediately following the S1G Beacon frame as specified in at least one of the RPS elements (see 10.3.2.4). The STAs with dot11RAWOperationImplemented equal to true that are allowed to access the medium during this RAW shall ignore the NAV set by the S1G Beacon frame as described in 10.3.2.4.

10.22.5.5 EDCA backoff procedure in generic RAW or triggering frame RAW

An illustration of EDCA backoff procedure in RAW is shown in Figure 10-30d.

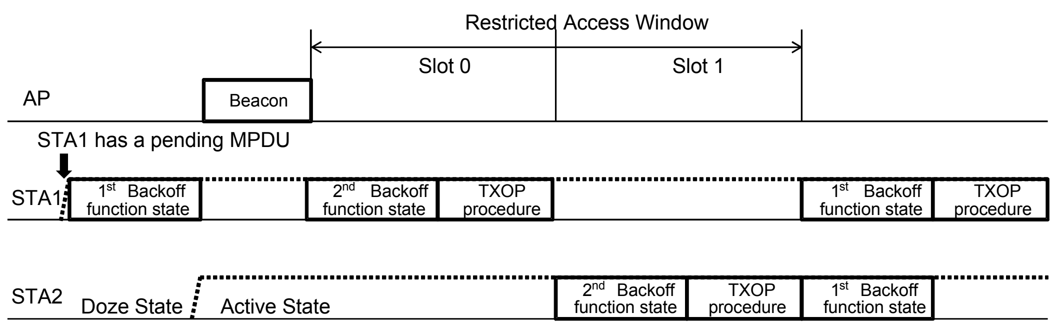


Figure 10-30d—Backoff procedure for restricted channel access control

For supporting the restricted channel access control based on EDCA, an STA maintains two backoff function states. First backoff function state is used outside RAW and second backoff function state is used inside RAW.

Each STA performing EDCA access suspends an operation of its EDCAF at the start of each RAW and stores the value of the backoff counter, CW[AC], QSRC[AC] and QLRC[AC] as the first backoff state. At the end of the RAW, the stored first backoff function state is restored and an operation of the EDCAF is resumed. If the previously stored first backoff function state is empty, the EDCAF of a STA shall invoke a backoff procedure, even if no additional transmissions are currently queued.

If the STA is participating in the RAW and has a pending MPDU, the EDCAF of the STA shall invoke a new backoff procedure for accessing the WM in the RAW using the access category indicated by the RAW_ACI subfield in an EDCA Parameter Set element. At the beginning of the allocated RAW slot, the STA/AP sets the CW[AC] of the secondary backoff procedure to CWmin[AC]. The values of the backoff and CW[AC] used in the RAW is called the second backoff function state.

If the Cross Slot Boundary subfield in RAW Assignment subfield of the RPS element is 0, the STA shall count down backoff only in its assigned RAW slots within the RAW. If the Cross Slot Boundary subfield in RAW Assignment subfield of the RPS element is 1, the STA shall continue to count down backoff after its assigned RAW slots within the RAW.

After the end of the RAW, STAs with the second backoff counter shall reset and disregard the second backoff function state.

10.22.5.6 EDCA backoff procedure in RAWs other than generic or triggering frame RAW

When the S1G STA is performing EDCA in any RAW other than generic or triggering frame RAW, it shall follow the rules defined in 10.22.2.

An S1G STA performing EDCA outside a RAW shall suspend an operation of its EDCA at the start of the RAW and may resume it at the end of the RAW if the STA is not included in that RAW.

An S1G STA performing EDCA outside a RAW shall continue its EDCA operation at the start of the RAW if it is included in that RAW.

10.22.5.7 RAW Operation with Resource Allocation frame

An AP transmits a Resource Allocation (RA) frame if Bit 1 of the RAW Type Options subfield is equal to 1 in the RAW Control subfield of the RAW Assignment subfield of the RPS element.

The AP transmits the RA frame to non-AP STAs belonging to the RAW group allocated to access the RAW as specified in the previously transmitted RPS element. A non-AP STA that does not belong to the RAW group may ignore the RA frame.

An AP shall schedule the Resource Allocation frame as the first frame to be transmitted at the beginning of the RAW following the channel access rules. The beginning of the RAW is further defined in the RAW start time subfield of the RAW assignment subfield of the RPS element.

AP shall defer the transmission of the RA frame till the channel is free but since the preallocated RAW duration information in the RPS frame may be shortened by the delay of the transmission of the RA frame, the AP and STA shall check the transmission time of the allocated RAW slot against the end of RAW period. If the transmission of the RA frame is later than the end of RAW period, the AP and STA shall discard the information indicated in the RPS element and follow the channel access rules defined outside the RAW (10.22.5).

The AP assigns a RAW slot to either an individual STA indicated by the Partial AID subfield or a group of STAs indicated by the Group ID subfield within the Slot Assignment field of the RA frame when Slot Assignment Mode subfield in the Frame Control field of the RA frame is equal to 0. The AP assigns a RAW slot to an individual STA indicated by the Slot Assignment Indication field of the RA frame when Slot Assignment Mode subfield in the Frame Control field of the RA frame is equal to 1.

An intended STA identified by the RPS element should wake up before the RAW start time indicated in the RAW start time subfield of the RAW assignment subfield of the RPS element to receive the RA frame. The STA shall not access the medium during its assigned RAW with the RA indication if it fails to receive the RA frame. The STA can resume medium access according to the channel access rule after the RAW.

An intended STA identified by the RPS element of a RAW learns its assigned RAW slots for both uplink and downlink service periods according to the Slot Assignment subfield or the Slot Assignment Bitmap subfield in Slot Assignment Indication field of the RA frame. The STA should be awake before the start of the RAW slot time assigned to it. The AP shall start the delivery of BUs addressed to the STA using the EDCA procedure at the beginning of the RAW slot assignment if the TIM bit for the STA in the TIM element is equal to 1 after receiving an (NDP) PS-Poll or trigger frame from the STA. The STA may transmit uplink data as listed below:

— When the AP explicitly signals permission for the non-AP STA to begin UL transmission using the explicit signaling provided by BDT (10.46) or RD protocol (10.28).
— Using EDCA procedure when the AP transmits a frame to the STA with more data bit equal to 0.
— Using EDCA procedure at the beginning of its RAW slot assignment if the TIM bit for this STA is 0 and this STA has not negotiated with the AP to use the UL- Sync procedure (10.45.1).
— After receiving a frame sequence that contains a Sync frame if the STA has negotiated with the AP to use the UL-Sync procedure.

10.22.5.8 Periodic RAW (PRAW) operation

An AP may schedule a RAW in periodic manner by setting Periodic RAW Indication subfield to 1 for the RAW Assignment subfield of an RPS element, and this RAW is called a PRAW.

PRAW allocation may be indicated by an RPS element included in S1G Beacon frames and/or Probe Response frames. Once a PRAW is allocated, the allocation indication is broadcasted by the AP such that every TIM STA can identify the allocation of PRAW. However, it is not necessary for an AP to indicate the PRAW allocation in every S1G Beacon frame transmitted in the beacon interval or short beacon interval, for which PRAW is allocated. The parameters in the RAW Assignment subfield for PRAW shall not be changed until updated PRAW information is broadcasted. A non-AP STA updates the PRAW information and accesses the channel according to the parameters in the RAW Assignment subfield of the PRAW indicated by the Periodic Operation Parameters subfield of the most recently received RPS element.

If an AP allocates more than one PRAW assignments, all active PRAW assignments shall be included in one or more RPS elements in the same S1G Beacon frame.

The S1G Beacon after which the first window of the PRAW appears is indicated by the PRAW Start Offset subfield of Periodic Operation Parameters of RPS element, and the starting time of the first window of the PRAW with respect to the S1G Beacon is equal to the RAW start time indicated by the same RAW Assignment.

The periodicity of RAW assignment for a group of STAs indicated in the RAW Group subfield of the RAW Assignment subfield of RPS element is valid for a fixed number of periods indicated in the PRAW Validity subfield of the Periodic Operation Parameters subfield in the RAW Assignment subfield of RPS element. An AP may extend current PRAW assignment by indicating the PRAW assignment with the PRAW Validity subfield value extended before it expires.

At each RPS element with one or more PRAW assignments included, an AP indicates next scheduled PRAW indication time at which the AP will send another RPS element with PRAW assignments. The next scheduled PRAW indication time is the closest DTIM Beacon frame before any of PRAW Validity subfield value of PRAW assignments included in current RPS element expires.

An AP may send another RPS element with PRAW assignments before next scheduled PRAW indication time. However, an AP shall not modify currently active PRAW assignment until next scheduled PRAW indication time. If an AP intends to add a new PRAW assignment, the new PRAW assignment shall be indicated from the next scheduled PRAW indication time.

10.24 Block acknowledgment (block ack)

10.24.1 Introduction

Insert the following paragraphs after the third paragraph ("The block ack mechanism does not....") of 10.24.1:

An S1G non-AP STA may negotiate an asymmetric block ack operation with an S1G AP as described in 10.24.2. A non-S1G STA shall not transmit NDP BlockAck frames and shall not initiate an asymmetric block ack operation. An S1G AP with dot11AsymmetricBlockAckActivated equal to false shall not support asymmetric block ack operation. Under asymmetric block ack operation, the responding S1G STA may use a lower MCS for transmitting the immediate Block Ack frame as described in 10.7.6.5.2. The intended recipient STA maintains a measure of the degree of asymmetry between the AP and the STA and implicitly indicates the value to the originator AP during the block ack setup phase. This degree of asymmetry is represented as the difference in MCS values between AP and STA, and referred to as MCSDifference (see 10.24.2). After an asymmetric block ack agreement is established, the originator AP uses the MCSDifference to calculate the Duration field of PV0 frames carried in the A-MPDU that elicits the BlockAck frame.

An S1G STA that sets the STA Type Support subfield in a transmitted S1G Capabilities element to 0 or 2, as described in 10.59), shall support the HT-immediate block ack extension. An S1G STA that sets the A-MPDU Supported field in the S1G Capabilities element to 1 shall support the HT-Immediate block ack extension. An S1G STA that sets the HT-Delayed Block Ack field in the S1G Capabilities element to 1 shall support the HT-delayed block ack extension.

10.24.2 Setup and modification of the block ack parameters

Change the original first three paragraphs of 10.24.2 as follows (including inserting four new paragraphs):

Where the generic terms ADDBA Request frame, ADDBA Response frame, and DEL BA frame are used throughout 10.24 in reference to a block ack agreement between S1G STAs, the appropriate variant according to this subclause (e.g., NDP ADDBA Request, BAT ADDBA Request, and ADDBA Request) is referenced by the generic term.

An originator that intends to use the block ack mechanism for the transmission of QoS Data frames to an intended recipient should first check whether the intended recipient STA is capable of participating in block ack mechanism by discovering and examining its Delayed Block Ack and Immediate Block Ack capability bits. If the intended recipient STA is capable of participating, the originator sends an ADDBA Request frame indicating the TID for which the block ack agreement is being set up. When a block ack agreement is set up between HT STAs or S1G STAs, the Buffer Size and Block Ack Timeout fields in the ADDBA Request frame are advisory. When a block ack agreement is set up between HT or DMG STAs, the Buffer Size and Block Ack Timeout fields in the ADDBA Request frame are advisory. When a block ack agreement is set up between a non-HT non-DMG STA and another STA, the Block Ack Policy and Buffer Size fields in the ADDBA Request frame are advisory.

If the intended S1G recipient is capable of participating in an HT-Immediate block ack session, the S1G originator shall send an NDP ADDBA Request to indicate that it expects only NDP BlockAck frames during the block ack session with the following exceptions:

a) If the S1G originator has the dot11BATImplemented equal to true and the BAT Support subfield in the S1G Capabilities element received from the S1G recipient is 1 and a TWT has been set up with the S1G recipient as described in 10.43, then the S1G originator shall send a BAT ADDBA Request to indicate that it expects only BAT frames during the block ack session.

b) When any of the conditions below is satisfied then the S1G originator may send an ADDBA Request to indicate that it expects only BlockAck frames during the block ack session:
   1) The value of the Buffer Size field in the ADDBA Request, carried in an S1G_LONG or S1G_SHORT PPDU, is greater than 16.
   2) The value of the Buffer Size field of the ADDBA Request, carried in an S1G_1M PPDU, is greater than 8.
   3) The dot11AsymmetricBlockAckActivated is true and Asymmetric Block Ack Supported field in the S1G Capabilities element received from the S1G recipient is 1.

The recipient STA shall respond by an ADDBA Response frame. The recipient STA has the option of accepting or rejecting the request. When the recipient STA accepts, then a block ack agreement exists between the originator and recipient.

When the S1G recipient STA rejects the request it may indicate a status code of 109 (REJECTED_NDP_BLOCK_ACK_SUGGESTED) to indicate to the S1G originator that it prefers to generate only NDP BlockAck frames.

When the recipient STA accepts, it indicates the type of block ack agreement, the type of BlockAck frames, and the number of buffers that it shall allocate for the support of this block ack agreement within the ADDBA Response frame and the block ack timeout that is used. Each block ack agreement that is established by a STA may have a different buffer allocation. If the intended recipient STA rejects the request, then the originator shall not use the block ack mechanism.

An S1G recipient STA that accepts an HT-Immediate block ack session shall respond with the following:

- An NDP ADDBA Response if the value of the Buffer Size field of the NDP ADDBA Response is not greater than the value of the maximum number of MSDUs and A-MSDUs that can be acknowledged with the selected NDP BlockAck frame and no TWT has already been set up with the S1G originator as described in 10.43.
  - This value is 8 for NDP_1M BlockAck frames and 16 for NDP_2M BlockAck frames as described in 9.9.2.6. The NDP ADDBA Response frame shall be carried in an S1G_1M PPDU to indicate the use of NDP_1M BlockAck frames and shall be carried in an S1G_SHORT or S1G_LONG PPDU to indicate the use of NDP_2M BlockAck frames.
- Otherwise, a BAT ADDBA Response as a response to a BAT ADDBA Request if a TWT has already been set up with the S1G originator as described in 10.43.
  - The value of the Buffer Size field in the BAT ADDBA Response shall not be greater than 32.
- Otherwise, a ADDBA Response to indicate the use of BlockAck frames.
  - The MCS subfield in the Originator Preferred MCS field shall be set to 15 unless the dot11AsymmetricBlockAckActivated is true and the Asymmetric Block Ack Supported field in the S1G Capabilities element received from the S1G originator is 1 in which case the MCS subfield may indicate the value of the preferred MCS if asymmetric block ack operation is used. The preferred MCS implicitly indicates the MCSDifference value, which is the difference between the preferred MCS and the MCS at which the ADDBA Response is sent.

Change the now tenth paragraph of 10.24.2 as follows:

When a block ack agreement is established between two HT STAs, ~~or~~ two DMG STAs, or two S1G STAs, the originator may change the size of its transmission window if the value in the Buffer Size field of the ADDBA Response frame is larger than the value in the ADDBA Request frame. If the value in the Buffer Size field of the ADDBA Response frame is smaller than the value in the ADDBA Request frame, the originator shall change the size of its transmission window (WinSizeO) so that it is not greater than the value in the Buffer Size field of the ADDBA Response frame and is not greater than the value 64.

10.24.5 Teardown of the block ack mechanism

Change the first paragraph of 10.24.5 as follows (the footnote remains unchanged):

When the originator has no data to send and the final block ack exchange has completed, it shall signal the end of its use of the block ack mechanism by sending the DELBA frame to its recipient. The DELBA frame sent by the S1G originator shall be a BAT DELBA if a BAT ADDBA Request was sent during block ack setup or NDP DELBA if an NDP ADDBA Request was sent during block ack setup or DELBA if ADDBA Request was sent during block ack setup. The recipient does not generate a Management frame in response to the DELBA frame.[41] The recipient of the DELBA frame shall release all resources allocated for the block ack transfer.

10.24.6 Selection of BlockAck and BlockAckReq variants

Change the fifth paragraph of 10.24.6 as follows:

Where the terms BlockAck and BlockAckReq are used within 10.24.7 and 10.24.8, the appropriate variant according to this subclause (e.g., Compressed, Multi-TID) is referenced by the generic term. The term BlockAck as used within 10.24.7 includes the additional NDP_1M BlockAck, NDP_2M BlockAck, BAT and BlockAck frame variants.

Insert the following paragraphs at the end of 10.24.6:

The S1G recipient of an accepted block ack agreement that was negotiated with NDP ADDBA shall use NDP BlockAck frames instead of BlockAck frames to acknowledge MPDUs within A-MPDUs during an HT-immediate block ack session.

The S1G recipient of an accepted block ack agreement that was negotiated with BAT ADDBA shall use BAT frames instead of BlockAck frames to acknowledge MPDUs within A-MPDUs during an HT-immediate block ack session. Otherwise, the S1G recipient of an accepted block ack agreement shall not use BAT frames.

The S1G recipient of an accepted block ack agreement that was negotiated with ADDBA shall use BlockAck frames to acknowledge MPDUs within A-MPDUs during an HT-immediate block ack session.

The S1G recipient of an accepted block ack agreement that was negotiated with either ADDBA Request/ NDP ADDBA Response or NDP ADDBA Request/ADDBA Response shall use either NDP BlockAck or BlockAck frames depending on the type of response frame elicited by the S1G originator. The type of response shall be:

— An NDP BlockAck frame if the RXVECTOR parameter RESPONSE_INDICATION of the eliciting PPDU that contains a BlockAckReq or an A-MPDU is equal to NDP Response
— A BlockAck frame if the RXVECTOR parameter RESPONSE_INDICATION of the eliciting PPDU that contains a BlockAckReq or an A-MPDU is equal to Normal Response
— A PPDU that contains a BlockAck frame if the RXVECTOR parameter RESPONSE_INDICATION of the eliciting PPDU is equal to Long Response

10.24.7 HT-immediate block ack extensions

10.24.7.3 Scoreboard context control during full-state operation

Change the following list items of 10.24.7.3 as shown:

b) For each received Data frame that is related with a specific full-state operation HT-immediate block ack agreement, the block acknowledgment record for that agreement is modified as follows, where *SN* is the value of the Sequence Number subfield of the received Data frame, and FN is equal to 0 except when the received data MPDU is part of an A-MPDU that is not an S-MPDU carried in an S1G PPDU in which case FN is equal to the value of the Fragment Number subfield of the received data MPDU:

   1) If $WinStart_R \le SN \le WinEnd_R$, set to 1 the bit in position *SN* within the bitmap.
      i) If $WinEnd_R \le SN + FN$, set $WinEnd_R = SN+FN$ and $WinStart_R = SN+FN–WinSize_R+1$.
   2) If $WinEnd_R < SN < WinStart_R+2^{11}$,
      i) Set to 0 the bits corresponding to MPDUs with Sequence Number subfield values from $WinEnd_R+1$ to $SN+FN – 1$.
      ii) Set $WinStart_R = SN + FN – WinSize_R + 1$.
      iii) Set $WinEnd_R = SN + FN$.
      iv) Set to 1 the bit at position *SN* in the bitmap.

Insert the following note after the now NOTE 1 after item b) 3) of 10.24.7.3:

NOTE 2—Fragmentation is not allowed during an HT-immediate block ack agreement as described in 10.2.7. All data MPDUs included in an A-MPDU that is not an S-MPDU generated during HT-immediate Block Ack with NDP BlockAck have the Fragment Number subfield equal to an offset to $WinEnd_O$ as described in 10.24.7.7.

10.24.7.4 Scoreboard context control during partial-state operation

Change the following list items of 10.24.7.4 as shown:

b) For each received Data frame that is related with a specific partial-state operation HT-immediate block ack agreement, when no temporary record for the agreement related with the received Data frame exists at the time of receipt of the Data frame, a temporary block acknowledgment record is created as follows, where *SN* is the value of the Sequence Number subfield of the received Data frame and *FN* is equal to 0 except when the received data MPDU is part of an A-MPDU that is not an S-MPDU carried in an S1G PPDU in which case FN is equal to the value of the Fragment Number subfield of the received data MPDU:

   1) $WinEnd_R = SN+FN$.

Change the title of 10.24.7.5 as follows:

10.24.7.5 Generation and transmission of BlockAck frames by an HT STA, ~~or~~ DMG STA, or S1G STA

Change the second paragraph of 10.24.7.5 as follows:

When responding with a BlockAck frame to either a received BlockAckReq frame or a received A-MPDU with Ack Policy equal to Normal Ack (i.e., implicit block ack request) during either full-state operation or partial-state operation, any adjustment to the value of WinStart_R according to the procedures defined within 10.24.7.3 and 10.24.7.4 shall be performed before the generation and transmission of the response BlockAck frame. The Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield of the BlockAck frame shall be set to any value in the range ($WinEnd_R$ – 63) to $WinStart_R$. The Starting Sequence Number stored in the Starting Sequence Control field of NDP BlockAck and BAT frames shall be set to $WinStart_R$. The values in the recipient's record of status of MPDUs beginning with the MPDU for which the Sequence Number subfield value is equal to $WinStart_R$ and ending with the MPDU for which the Sequence Number subfield value is equal to $WinEnd_R$ shall be included in the bitmap of the BlockAck frame. The bitmap of the NDP BlockAck frame is protected using the encoding procedure described in 10.53.

10.24.7.7 Originator's behavior

Insert the following paragraph after the first paragraph ("A STA may send....") of 10.24.7.7:

If the received BlockAck response is of an expected NDP_1M BlockAck frame (or an NDP_2M Block Ack frame), the S1G originator shall accept it as correctly received if the value obtained from the BlockAck ID field equals the 2 LSBs (or the 6 LSBs) of the Scrambler Initialization value of the immediately previously transmitted A-MPDU that is not an S-MPDU, or BlockAckReq frame and the Starting Sequence Number obtained from the Starting Sequence Control field equals $WinStart_O$. The Scrambler Initialization value is obtained from the PHY-TXEND.confirm parameter SCRAMBLER_OR_CRC. The values of the BlockAck ID and Starting Sequence Number fields are obtained after decoding the NDP BlockAck frame as described in 10.53. The S1G originator shall otherwise consider the NDP BlockAck frame to be lost.

Insert the following paragraphs after the now fifth paragraph ("A BlockAckReq frame....") of 10.24.7.7:

During an accepted HT-Immediate block ack session, the S1G originator shall set the TXVECTOR parameter RESPONSE_INDICATION of a PPDU transmitted to the S1G recipient that elicits a block acknowledgment frame to

— NDP Response if the block ack session was negotiated with NDP ADDBA Request/NDP ADDBA Response exchange
— Normal Response if the block ack session was negotiated with either BAT ADDBA Request/BAT ADDBA Response or ADDBA Request/ADDBA Response exchange

During an accepted HT-Immediate block ack session, the S1G originator is allowed to elicit an NDP BlockAck or a BlockAck frame on a per-PPDU basis only if the block ack session was negotiated with either ADDBA Request/NDP ADDBA Response or NDP ADDBA Request/ADDBA Response exchanges. In this case the S1G originator may set the TXVECTOR parameter RESPONSE_INDICATION of a PPDU transmitted to the S1G recipient that elicits a block acknowledgment frame to either NDP Response or Normal Response.

The S1G originator shall not set the TXVECTOR parameter RESPONSE_INDICATION to Long Response for a PPDU transmitted to the S1G recipient that elicits a block acknowledgment frame, if neither BlockAck frame nor BAT frames have been negotiated with the S1G recipient. The S1G originator may set the TXVECTOR parameter RESPONSE_INDICATION to Long Response if either BlockAck frame or BAT frames have been negotiated with the S1G recipient.

Insert the following paragraphs after the now ninth paragraph ("The originator may transmit....") of 10.24.7.7:

During an accepted HT-Immediate block ack session, the S1G originator of an A-MPDU that is not an S-MPDU eliciting an NDP BlockAck frame shall set the Fragment Number subfield in the Sequence Control field of each MPDU in the A-MPDU to $WinStart_O + WinSize_O - 1 - SN$, where SN is the value of the Sequence Number subfield in the corresponding MPDU within the A-MPDU.

10.24.8 HT-delayed block ack extensions

10.24.8.2 HT-delayed block ack negotiation

Change 10.24.8.2 as follows:

HT-delayed block ack is an optional feature. An HT STA declares support for HT-delayed block ack in the HT Capabilities element. An S1G STA declares support for HT-delayed block ack in the S1G Capabilities element.

An HT STA shall not attempt to create a block ack agreement under HT-delayed block ack policy unless the recipient HT STA declares support for this feature. An S1G STA shall not attempt to create a block ack agreement under HT-delayed block ack policy unless the recipient S1G STA declares support for this feature.

10.28 Reverse direction protocol

10.28.1 General

Change the first paragraph of 10.28.1 as follows:

The RD protocol may be supported by an HT STA, by an S1G STA, and by a DMG STA. A STA receiving an RDG is never required to use the grant. The RD protocol defined in this subclause applies to ~~both~~ any of these types of STA~~s~~.

Insert the following paragraph at the end of 10.28.1:

An S1G STA indicates support of the RD feature as an RD responder using the RD Responder subfield of the S1G Capabilities element. A STA shall set the RD Responder subfield to 1 in frames that it transmits containing the S1G Capabilities element if dot11RDResponderOptionImplemented is true. Otherwise, the STA shall set the RD Responder subfield to 0. For an S1G STA, the RDG/More PPDU subfield and the AC Constraint subfield are present in the HTC field,

10.28.2 Reverse direction (RD) exchange sequence

Insert the following note after NOTE 2 after the first paragraph of 10.28.2:

NOTE 3—If the RD responder is an S1G AP, the RD response burst can contain S1G MU PPDUs that might have TXVECTOR parameter NUM_USERS > 1.

10.28.3 Rules for RD initiator

Change the following list item of 10.28.3 as shown:

a) *Normal continuation:* The RD initiator may transmit its next PPDU a minimum of a SIFS after receiving a response PPDU that meets one of the following conditions:
    2) In an HT STA or an S1G STA, contains one or more received frames that are capable of carrying the HT Control field but did not contain an HT Control field

10.28.4 Rules for RD responder

Change the seventh paragraph of 10.28.4 as follows:

During an RD response burst any PPDU transmitted by an RD responder shall contain at least one MPDU with an Address 1 field that matches the MAC address of the RD initiator, and the inclusion of traffic to STAs other than the RD initiator in a VHT MU PPDU or an S1G MU PPDU shall not increase the duration of the ~~VHT MU~~ PPDU beyond that required to transport the traffic to the RD initiator. The RD responder shall not transmit any frame causing a response after SIFS with an Address 1 field that does not match the MAC address of the RD initiator. The RD responder shall not transmit any PPDUs with a CH_BANDWIDTH that is wider than the CH_BANDWIDTH of the PPDU containing the frame(s) that delivered the RD grant.

10.29 PSMP operation

10.29.1 General

Change 10.29.1 as follows:

A DMG or S1G STA shall not use PSMP.

10.31 Link adaptation

10.31.1 Introduction

Insert the following paragraph at the end of 10.31.1:

For an S1G STA, the same link adaptation procedure specified in 10.31.3 is applied with the following qualifications:

- “VHT” is replaced by “S1G” when referring to characteristics of an S1G STA or when referring to the contents of an S1G PPDU. More specifically:
  - “VHT Capabilities Info field in the VHT Capabilities element” is replaced by “S1G Capabilities Information field in the S1G Capabilities element”
  - “VHT NDP Announcement frame” is replaced by “S1G NDP Announcement frame”
  - “VHT MU PPDU” is replaced by “S1G MU PPDU”

10.31.3 Link adaptation using the VHT variant HT Control field

Change the first paragraph of 10.31.3 as follows:

This subclause applies to frame exchange sequences that include PPDUs containing ~~an~~ VHT variant HT Control field. The VHT variant HT Control field may be used by VHT STAs and S1G STAs.

Insert the following paragraphs after the second paragraph (“A STA that supports....”) of 10.31.3:

The MFB requester or MFB responder that is an S1G STA shall set the S1G subfield in the VHT variant HT Control field to 1. Otherwise the S1G field shall be reserved.

An S1G STA shall not transmit a +HTC Control frame to another S1G STA that does not support VHT link adaptation.

An S1G STA that sets the +HTC VHT Capable to 1 and supports sending normal control response frames for link adaptation shall set Link Adaptation per Normal Control Response Capable bit in the S1G Capabilities element to 1. Otherwise it shall set it to 0. An S1G STA shall not elicit normal control frame for link adaptation from another S1G STA when the received Link Adaptation per Normal Control Response Capable subfield in the received S1G Capabilities element from the STA is 0.

An S1G STA that is an MFB requester shall set the TXVECTOR parameter RESPONSE_INDICATION to NORMAL_RESPONSE if it intends to elicit link adaptation feedback in the immediate control response frame. Otherwise, it shall not set the TXVECTOR parameter RESPONSE_INDICATION to Normal Response, unless it is permitted to do so as described in 10.24, 10.3.2.9, and 10.43.

An S1G STA that is an MFB responder may transmit a +HTC Control frame as an immediate response to an eliciting frame for which the RXVECTOR parameter RESPONSE_INDICATION is equal to NORMAL_RESPONSE. The +HTC Control Response frame shall be one of the following:

— +HTC Ack frame if the eliciting frame requires an Ack frame as a response (see 10.3.2.9)
— +HTC BlockAck frame or +HTC BAT frame if the eliciting frame requires a BlockAck frame or BAT frame as a response (see 10.24)
— +HTC TACK frame or +HTC STACK frame if the eliciting frame requires a TACK frame or STACK frame as a response (see 10.43.2)
— +HTC CTS frame in the eliciting frame requires an CTS frame as a response (see 10.3.2.7)

Otherwise, the S1G STA shall not transmit a +HTC Control response frame.

Change the now 14th and 15th paragraphs of 10.31.3 as follows:

The MFB responder may send a solicited response frame with any of the following combinations of VHT-MCS, NUM_STS, and MFSI:

— VHT-MCS = 15, NUM_STS = 7 in the MFB subfield, and MFSI = 7 in a VHT PPDU; and VHT-MCS = 15, NUM_STS = 3, and MFSI = 7 in an S1G PPDU: no information is provided for the immediately preceding request or for any other pending request. This combination is used when the responder is required to include a VHT variant HT Control field due to other protocols that use this field (e.g., the Reverse Direction Protocol) and when no MFB is available. It has no effect on the status of any pending MRQ.
— VHT-MCS = 15, NUM_STS = 7 in the MFB subfield, and MFSI in the range 0 to 6 in a VHT PPDU; and VHT-MCS = 15, NUM_STS = 3, and MFSI in the range 0 to 6 in an S1G PPDU: the responder is not now providing, and will never provide, feedback for the request that had the MSI value that matches the MFSI value.
— VHT-MCS = valid value, NUM_STS = valid value in the MFB subfield, and MFSI in the range 0 to 6: the responder is providing feedback for the request that had the MSI value that matches the MFSI value.

An MFB responder that discards or abandons the MFB estimates computed in response to an MRQ may indicate that it has done so by setting the VHT-MCS to 15 and NUM_STS to 7 in the MFB subfield in the next VHT PPDU frame if the frame is carried in a VHT PPDU or by setting the VHT-MCS to 15 and NUM_STS to 3 if the frame is carried in an S1G PPDU addressed to the MFB requester that includes the VHT variant HT Control field. The value of the MFSI is set to the value of the MSI/STBC subfield of the frame that contains an MRQ for which the computation was abandoned, regardless of whether the MSI/STBC subfield contains an MSI or a Compressed MSI and STBC Indication subfields.

Change the now 24th paragraph of 10.31.3 as follows:

If the value of the NUM_STS subfield of the MFB field (solicited or unsolicited) is a smaller value than the RXVECTOR parameter NUM_STS of the received PPDU on which the MFB is based, the MFB responder shall estimate the recommended VHT-MCS under the assumption that the MFB requester will transmit the first N_{STS} space-time streams in the corresponding PPDU carrying MRQ. If the MFB is based on an SU PPDU the first N_{STS} space-time streams correspond to columns 1,..., N_{STS} of the spatial mapping matrix Q. If the MFB is based on a VHT MU PPDU, then for the user u the first N_{STS} space-time streams correspond to columns M_u+1,..., M_u+$N_{STS,u}$ of the spatial mapping matrix Q (M_u is defined in 21.3.10.11.1 and in 23.3.9.11.1). The VHT-MCS recommendation shall be a value from the peer's Tx Supported VHT-MCS and NSS Set (see 10.7.12.2).

10.34 Null data packet (NDP) sounding

10.34.5 VHT sounding protocol

10.34.5.1 General

Insert the following paragraph at the end of 10.34.5.1:

For an S1G STA, the same sounding protocol specified in 10.34.5 is applied with "VHT" is replaced by "S1G" excluding in following terms:

— VHT NDP Announcement frame
— VHT Compressed Beamforming Report field
— VHT MIMO Control field

10.34.5.2 Rules for VHT sounding protocol sequences

Insert the following paragraphs after the fifth paragraph ("A VHT beamformer that transmits...to a VHT SU-only....") of 10.34.5.2:

An S1G beamformee with dot11NDPBeamformingReportPollImplemented equal to true shall set the NDP Beamforming Report Poll Supported field in the S1G Capabilities element to 1. Otherwise it shall set the NDP Beamforming Report Poll Supported field in the S1G Capabilities element to 0.

An S1G beamformer may transmit NDP Beamforming Report Poll frames instead of VHT Beamforming Report Poll frames to an S1G beamformee from which it has received a frame containing an S1G Capabilities element with the NDP Beamforming Report Poll Supported field equal to true; otherwise, the S1G beamformer shall not transmit NDP Beamforming Report Poll frames to the S1G beamformee. A non-S1G beamformer or an S1G beamformer working on 1 MHz channel shall not transmit NDP Beamforming Report Poll frames. An S1G non-AP beamformer shall not transmit NDP Beamforming Report Poll frames to a non-AP beamformee.

Insert the following subclause (10.34.7) after 10.34.6:

10.34.7 Transmission of an S1G NDP Sounding Frame

An S1G NDP Sounding frame shall use the 2 MHz short format as described in 23.1.4. An S1G STA transmitting an S1G NDP Sounding frame shall use the following TXVECTOR parameters:

— APEP_LENGTH set to 0
— NUM_USERS set to 1

— CH_BANDWIDTH set to the same value as the TXVECTOR parameter CH_BANDWIDTH in the preceding S1G NDP Announcement frame
— NUM_STS indicates two or more space-time streams
— PARTIAL_AID are set as described in 10.20b
— NDP_INDICATION set to 0
— RESPONSE_INDICATION set to Long Response

The number of space-time streams sounded as indicated by the NUM_STS parameter shall not exceed the value indicated in the Beamformee STS Capability field in the S1G Capabilities element of any intended recipient of the S1G NDP. The NUM_STS parameter may be set to any value, subject to the constraint of the previous sentence, regardless of the value of the Supported S1G-MCS and NSS Set field of the S1G Capabilities element transmitted by either the transmitter or recipient of the S1G NDP.

The destination of an S1G NDP is equal to the RA of the immediately preceding S1G NDP Announcement frame.

The source of an S1G NDP is equal to the TA of the immediately preceding S1G NDP Announcement frame.

Insert the following subclauses (10.42 through 10.59, including Table 10-20 and Figure 10-90 through Figure 10-103) after 10.41.4:

10.42 S1G BSS operation

10.42.1 Basic S1G BSS functionality

An S1G STA has dot11S1GOptionImplemented equal to true.

An S1G STA that is starting a BSS shall be able to receive and transmit at each of the <S1G-MCS, NSS> tuple values indicated by the Basic S1G-MCS and NSS Set field of the S1G Operation parameter of the MLME-START.request primitive and shall be able to receive at each of the <S1G-MCS, NSS> tuple values indicated by the Supported S1G-MCS and NSS Set field of the S1G Capabilities parameter of the MLMESTART.request primitive.

An S1G STA declares its channel width capability in the Supported Channel Width subfield of the S1G Capabilities element S1G Capabilities Information field as described in Table 9-262n.

An S1G STA that is an S1G AP shall set the Channel Width subfield in the S1G Operation Information field of the S1G Operation element to indicate the BSS operating channel width as defined in Table 10-20, the location of 1 MHz primary channel as defined in Table 9-262y and whether MCS10 is permitted but not recommended as defined in Table 9-262y. Table 10-20 is the only combination allowed in an S1G BSS operation. The Channel Width field in the S1G Operation element not listed in Table 10-20 shall not be declared by an S1G STA that is an S1G AP.

An S1G STA shall determine the channelization based on the Channel Width, Primary Channel Number, and Channel Center Frequency subfields of the S1G Operation Information field (see 23.3.13).

An S1G STA that is a member of an S1G BSS with a 1 MHz, 2 MHz, 4 MHz, 8 MHz, or 16 MHz operating channel width and 1 MHz primary channel width shall not transmit a 1 MHz S1G PPDU that does not use the primary 1 MHz channel of the BSS, except for a 1 MHz S1G PPDU transmission on an off-channel TDLS direct link as constrained by 11.23.6.4.2 or a 1 MHz S1G PPDU transmission by an SST STA as constrained by 10.48.

Table 10-20—S1G BSS operating channel width

S1G Operation element Primary Channel Width subfield	S1G Operation element BSS Channel Width subfield	BSS primary channel width (MHz)	BSS operating channel width (MHz)
0	1	2	2
0	3	2	4
0	7	2	8
0	15	2	16
1	0	1	1
1	1	1	2
1	3	1	4
1	7	1	8
1	15	1	16

An S1G STA that is a member of an S1G BSS with a 2 MHz, 4 MHz, 8 MHz, or 16 MHz operating channel width and 2 MHz primary channel width shall not transmit a 1 MHz S1G PPDU in a 1 MHz channel that is not the 1 MHz channel indicated by B5 of the Channel Bandwidth subfield in the S1G Operation element as defined in Table 9-262y, except for a 1 MHz S1G PPDU transmission on an off-channel TDLS direct link or a 1 MHz S1G PPDU transmission by an SST STA as constrained by 10.48.

An S1G STA that is a member of an S1G BSS with a 2 MHz, 4 MHz, 8 MHz, or 16 MHz operating channel width shall not transmit a 2 MHz S1G PPDU that does not use the primary 2 MHz channel of the BSS, except for a 2 MHz S1G PPDU transmission either on an off-channel TDLS direct link or a 2 MHz S1G PPDU transmission by an SST STA as constrained by 10.48.

An S1G STA that is a member of an S1G BSS with a 4 MHz, 8 MHz, or 16 MHz operating channel width shall not transmit a 4 MHz S1G PPDU that does not use the primary 4 MHz channel of the BSS, except for a 4 MHz S1G PPDU transmission either on an off-channel TDLS direct link or by an SST STA as constrained by 10.48.

An S1G STA that is a member of an S1G BSS with an 8 MHz or 16 MHz operating channel width shall not transmit an 8 MHz S1G PPDU that does not use the primary 8 MHz channel of the BSS, except for an 8 MHz S1G PPDU transmission either on an off-channel TDLS direct link or by an SST STA as constrained by 10.48.

An S1G STA that is a member of an S1G BSS with a 16 MHz operating channel width shall not transmit a 16 MHz S1G PPDU that does not use the primary 8 MHz channel and the secondary 8 MHz channel of the BSS, except for a 16 MHz S1G PPDU transmission on an off-channel TDLS direct link.

An S1G STA shall not transmit to a second S1G STA using a bandwidth that is not indicated as supported in the Supported Channel Width subfield in the S1G Capabilities element received from that S1G STA.

An S1G STA shall set the BSS BW field in the Frame Control field of the S1G Beacon frame in line with the values defined in Table 10-20 that are included in the S1G Operation element transmitted by the STA.

10.42.2 System information update procedure

The S1G AP shall increase the value (modulo 256) of the Change Sequence field in the next transmitted S1G Beacon frame(s) when a critical update occurs to any of the elements inside the S1G Beacon frame. The following events shall classify as a critical update:

a) Inclusion of an Extended Channel Switch Announcement
b) Modification of the EDCA parameters
c) Modification of the S1G Operation element

An S1G AP can classify other changes in the S1G Beacon frame as critical updates and among these updates can be included those that are described in 11.2.2.17.

The S1G STA shall either be awake to receive the next S1G Beacon frame that is transmitted at a TBTT or shall queue for transmission a Probe Request frame when it receives a Change Sequence field that contains a value that is different from the previously received Change Sequence field. When an S1G STA transmits a Probe Request frame to obtain the updated system information, it may include the Change Sequence element in the Probe Request frame to request a compressed Probe Response frame.

When an S1G AP receives a Probe Request frame that contains a Change Sequence element from an S1G STA associated with the S1G AP, it compares the value of the received Change Sequence with the value of its current Change Sequence. If the value of the received Change Sequence is not equal to the value of the current Change Sequence, the S1G AP should send a compressed Probe Response frame, which is a Probe Response frame that includes the Change Sequence element and only the elements that need be updated by the STA. Otherwise, the AP shall send a Probe Response frame as defined in 11.1.4.3.4.

10.42.3 S1G BSS channel selection methods

Before an S1G STA starts an S1G BSS, the STA shall perform a minimum of dot11S1GOBSSScanCount OBSS scan operations to search for existing BSSs (see 10.42.5).

If an S1G AP starts an S1G BSS with a 2 MHz primary channel width that occupies some or all channels of any existing BSSs, the S1G AP may select a 2 MHz primary channel of the new S1G BSS that is identical to the 2 MHz primary channel of any one of the existing BSSs.

If an S1G AP selects a 2 MHz primary channel for a new S1G BSS with a 4 MHz, 8 MHz, or 16 MHz operating channel width from among the channels on which no beacons are detected during the OBSS scans, then the selected 2 MHz primary channel meets the following conditions:

— It shall not be identical to the secondary 2 MHz channel of any existing BSSs with a 4 MHz, 8 MHz, or 16 MHz operating channel width.
— It should not overlap with the secondary 4 MHz channel of any existing BSSs with a 16 MHz operating channel width.

An S1G STA that is an S1G AP should not start an S1G BSS with a 2 MHz operating channel width on a channel that is the secondary 2 MHz channel of any existing BSSs with a 4 MHz, 8 MHz, or 16 MHz operating channel width, or is overlapped with the secondary 4 MHz channel of any existing BSSs with a 16 MHz operating channel width.

NOTE—An S1G AP operating an S1G BSS with a 4 MHz, 8 MHz, or 16 MHz operating channel width, on detecting an OBSS whose primary channel is the S1G AP’s secondary 2 MHz channel, might switch to 2 MHz BSS operation and/or move to a different channel.

If an S1G AP starts an S1G BSS with a 1 MHz primary channel width that occupies some or all channels of any existing BSSs, the S1G AP may select a 1 MHz primary channel of the new S1G BSS that is identical to the 1 MHz primary channel of any one of the existing BSSs.

If an S1G AP selects a 1 MHz primary channel for a new S1G BSS with a 2 MHz, 4 MHz, 8 MHz, or 16 MHz operating channel width from among the channels on which no beacons are detected during the OBSS scans, then the selected 1 MHz primary channel meets the following conditions:

— It shall not be identical to the secondary 1 MHz channel of any existing BSSs with a 2 MHz, 4 MHz, 8 MHz, or 16 MHz operating channel width.

An S1G STA that is an S1G AP should not start an S1G BSS with a 1 MHz operating channel width on a channel that is the secondary 1 MHz channel of any existing BSSs with a 2 MHz, 4 MHz, 8 MHz, or 16 MHz operating channel width.

When establishing a BSS with a 2 MHz, 4 MHz, 8 MHz, or 16 MHz operating channel width, the S1G AP determines and announces the location of 1 MHz primary channel located at either upper or lower side of the 2 MHz primary channel.

10.42.4 S1G BSS channel switching methods

An S1G AP announces a switch of operating channel by using the Extended Channel Switch Announcement element, Extended Channel Switch Announcement frame or both, following the procedure described in 11.10.

An S1G AP may also announce a switch of operating channel width, a new Country String field (possibly including a new Operating Class table number), new operating classes or new TPC parameters for the BSS that come into effect at the same time as the switch of operating channel.

The New Channel Number field in the Extended Channel Switch Announcement element or Extended Channel Switch Announcement frame identifies the primary channel after the switch. The value of the New Channel Number field is set to the value that dot11CurrentPrimaryChannel (see 23.3.13) will have after the switch.

10.42.5 Scanning requirements for S1G STA

An OBSS scan operation is a passive or active scan of a set of channels that are potentially affected by S1G BSS operation (see 11.1.4.1). Each channel in the set may be scanned more than once during a single OBSS scan operation. OBSS scans are performed by S1G STAs that start an S1G BSS.

During an individual scan within an OBSS scan operation, the minimum per-channel scan duration is dot11OBSSScanPassiveDwell TUs (for a passive scan) or dot11OBSSScanActiveDwell TUs (for an active scan). During an OBSS scan operation, each channel in the set is scanned at least once per dot11BSSWidthTriggerScanInterval seconds, and the minimum total scan time (i.e., the sum of the scan durations) per channel within a single OBSS scan operation is dot11OBSSScanPassiveTotalPerChannel TUs (for a passive scan) or dot11OBSSScanActiveTotalPerChannel TUs (for an active scan).

NOTE—The values provided in the previous paragraph are minimum requirements. For some combinations of parameter values the minimum might be exceeded for some parameters in order to meet the minimum value constraints of other parameters.

10.42.6 NAV and RID assertion in an S1G BSS

An S1G STA shall update its NAV as described in 10.3.2.4 using the Duration/ID field value in any frame that does not have an RA matching the STA’s MAC address or the Duration field value in NDP CMAC frames of which it is not the recipient STA and that was received in a 1 MHz PPDU in the primary 1 MHz channel or received in a 2 MHz PPDU in the primary 2 MHz channel or received in a 4 MHz PPDU in the primary 4 MHz channel or received in an 8 MHz PPDU in the primary 8 MHz channel or received in a 16 MHz PPDU.

An S1G STA shall update its RID as described in 10.3.2.4a using the RXVECTOR parameters in any frame that was received in a 1 MHz PPDU in the primary 1 MHz channel or received in a 2 MHz PPDU in the primary 2 MHz channel or received in a 4 MHz PPDU in the primary 4 MHz channel or received in an 8 MHz PPDU in the primary 8 MHz channel or received in a 16 MHz PPDU.

NOTE—The PHY layer might filter out a PPDU as described in 23.3.19. If so, frames in the PPDU are not received by the MAC and have no effect on the NAV.

10.42.7 BSS basic S1G-MCS and NSS set operation

The BSS basic S1G-MCS and NSS set is the set of <S1G-MCS, NSS> tuples that are supported by all S1G STAs that are members of an S1G BSS, where the S1G-MCS values refer to those obtained from the Max S1G-MCS For n SS subfields of the S1G Operation element as defined in 9.4.2.213. It is established by the STA that starts the S1G BSS, indicated by the Basic S1G-MCS and NSS Set field of the S1G Operation element in the MLME-START.request primitive. Other S1G STAs determine the BSS basic S1G-MCS and NSS set from the Basic S1G-MCS and NSS Set field of the S1G Operation element in the BSSDescription derived through the scan mechanism (see 11.1.4.1).

An S1G STA shall not attempt to join (MLME-JOIN.request) a BSS unless it supports (i.e., is able to both transmit and receive using) all the <S1G-MCS, NSS> tuples in the BSS basic S1G-MCS and NSS set.

An S1G STA shall not attempt to (re)associate (MLME-ASSOCIATE.request and MLME-REASSOCIATE.request) with an S1G AP unless the S1G STA supports (i.e., is able to both transmit and receive using) all the <S1G-MCS, NSS> tuples in the Basic S1G-MCS and NSS Set field in the S1G Operation element transmitted by the S1G AP.

The BSS basic S1G-MCS and NSS set is defined by Max S1G-MCS, which indicate the mandatory values and Min S1G-MCS, which indicate the recommended values as defined in 9.4.2.213 and 10.7.13.

An S1G AP that indicates support for sensor STAs does not indicate minimum MCS restrictions.

10.42.8 S1G coexistence with non-IEEE-802.11 systems

This subclause describes the features available in this standard to improve coexistence with other systems operating in bands below 1 GHz, including IEEE Std 802.15.4 and IEEE Std 802.15.4g.

An S1G STA uses energy detection (ED) based CCA with a threshold of –75 dBm per MHz to improve coexistence with other S1G systems. If a S1G STA detects energy above that threshold on its channel, as described in 23.3.17.5, then the following mechanisms might be used to mitigate interference:

- Change of operating channel (11.10)
- Sectorized beamforming (10.49)
- Change the schedule of RAW(s) (10.22.5), TWT SP(s) (10.43), or SST operating channels (10.48)
- Defer transmission for a particular interval (10.57)

10.43 Target wake time (TWT)

10.43.1 TWT overview

Target wake times (TWTs) allow STAs to manage activity in the BSS by scheduling STAs to operate at different times in order to minimize contention and to reduce the required amount of time that a STA utilizing a power management mode needs to be awake.

STAs that request a TWT agreement are called TWT requesting STAs and the STAs that respond to their requests are TWT responding STAs. A TWT requesting STA is assigned specific times to wake and exchange frames with the TWT responding STA. A TWT requesting STA communicates wake scheduling information to its TWT responding STA and the TWT responding STA devises a schedule and delivers TWT values to the TWT requesting STA when a TWT agreement has been established between them. When explicit TWT is employed, a TWT requesting STA wakes and performs a frame exchange and receives the next TWT information in a response from the TWT responding STA. When implicit TWT is used, the TWT requesting STA calculates the Next TWT by adding a fixed value to the current TWT value. STAs need not be made aware of the TWT values of other STAs.

The maximum number of active TWT agreements between any pair of STAs cannot exceed 8, since the TWT Flow Identifier field of the TWT element comprises 3 bits. TWT responding STAs may protect TWT times with protection mechanisms including, but not limited to NAV-setting frame exchanges. TWT responding STAs that are APs may additionally protect TWT times using RAW scheduling. TWT requesting STAs may wake at times other than TWT. An AP that is a TWT requesting STA shall not be in Doze state for a duration that exceeds the value of the dot11MaxAwayDuration during a beacon interval or short beacon interval, as defined in 11.2.3.20.

A STA with dot11TWTOptionActivated equal to true and that operates in the role of TWT requesting STA shall set the TWT Requester Support subfield to 1 in all S1G Capabilities elements that it transmits. A STA with dot11TWTOptionActivated equal to true and that operates in the role of TWT responding STA shall set the TWT Responder Support subfield to 1 in all S1G Capabilities elements that it transmits.

If the TWT Responder Support subfield of the S1G Capabilities element received from its associated AP is equal to 1, a non-AP STA with dot11TWTOptionActivated equal to true may transmit a TWT element to the AP with a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and with the TWT Request field equal to 1.

An AP with dot11TWTOptionActivated equal to true shall transmit a TWT element to a STA that is associated to the AP and from which it received a frame containing a TWT element that contained a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and with the TWT Request field equal to 1. The transmitted TWT element shall be included in the frame that is the appropriate response frame to the received frame. The AP shall include a value of Accept TWT, Alternate TWT, Dictate TWT or Reject TWT in the TWT Command field of the response and shall set the TWT Request field to 0. If the AP response's TWT Command field includes anything other than Accept TWT or Reject TWT, the STA should send a new request for a TWT value by sending another frame that contains a TWT element, modifying the parameters of the request to indicate, for example, an acceptance of a proposed alternate TWT or dictated TWT value. If the STA receives a TWT response to a TWT request with the TWT Command value of Accept TWT, then the STA has successfully completed a TWT setup with that STA for the TWT Flow Identifier indicated in the TWT response and the STA becomes a TWT requesting STA and the STA may enter the Doze state until the TSF matches the next TWT value of the STA, provided that the STA has indicated that it is in a power save mode and no other condition requires the STA to remain awake. The AP becomes a TWT responding STA of the TWT requesting STA.

The receipt of a TWT command value of Suggest TWT implies that the STA sending the command will consider accepting a proposed TWT that differs from the value found in the TWT field of the element. The receipt of a TWT command value of Demand TWT implies that the STA sending the command will not consider accepting a proposed TWT that differs from the value found in the TWT field of the element. The receipt of a TWT command value of Alternate TWT implies that the STA sending the command will consider accepting a proposed TWT that differs from the value found in the TWT field of the element. The receipt of a TWT command value of Dictate TWT implies that the STA sending the command will not consider accepting a proposed TWT that differs from the value found in the TWT field of the element.

The MAC addresses of the TWT requesting STA and the TWT responding STA and the TWT Flow Identifier indicated in the TWT Response of a successful TWT setup between those two STAs uniquely identifies a TWT agreement. A MAC variable AdjustedMinimumTWTWakeDuration is defined for each TWT of each TWT agreement and has a value equal to Nominal Minimum TWT Wake Duration minus the elapsed time from the scheduled start of the TWT SP to the actual start of the SP, where the scheduled and actual start times of the TWT SP are determined after any necessary TSF adjustment. Because the value of the AdjustedMinimumTWTWakeDuration depends on the actual TWT SP start time, it is computed for each TWT SP once the TWT SP begins.

The TWT Wake Interval of a TWT agreement is the value calculated as shown in 9.4.2.200 from the TWT Wake Interval Mantissa and TWT Wake Interval Exponent of the TWT response that successfully completed the TWT agreement.

An AP may transmit a TWT element in an individually addressed TWT Setup frame with a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and with the TWT Request field equal to 1 to an associated non-AP STA if the TWT Responder Support subfield in the S1G Capabilities element received from the STA is equal to 1. An AP may transmit TWT Setup frames to more than one of its associated non-AP STAs.

A non-AP STA with dot11TWTOptionActivated equal to true shall transmit a frame containing a TWT element to the AP with which it is associated and from which it received an individually addressed frame containing a TWT element that contained a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and with the TWT Request field equal to 1. The transmitted TWT element shall be included in the frame that is the appropriate response frame to the received frame. The non-AP STA shall include a value of Accept TWT, Alternate TWT, Dictate TWT or Reject TWT in the TWT Command field of the response and shall set the TWT Request field to 0. If the non-AP STA response's TWT Command field includes anything other than Accept TWT or Reject TWT, the AP should send a new request for a TWT value by sending another frame that contains a TWT element, modifying the parameters of the request to indicate, for example an acceptance of a proposed alternate TWT or dictated TWT value. If the AP receives a TWT response to a TWT request with the TWT Command value of Accept TWT from an associated non-AP STA, then the AP has successfully completed a TWT setup with that STA for the TWT Flow Identifier indicated in the TWT response and the AP becomes a TWT requesting STA with respect to that STA.

A non-AP STA shall not transmit a frame containing a TWT element as a response to a group addressed frame with the TWT Request field equal to 1 that is transmitted by its associated AP.

If the NDP Paging field was not present in the TWT response corresponding to a TWT agreement, the TWT requesting STA shall be in the awake state following each TWT start time associated with each TWT agreement for the duration of the AdjustedMinimumTWTWakeDuration time associated with that TWT agreement even if no PS-Poll frame, NDP PS-Poll frame, or U-APSD trigger frame has been transmitted by the STA or until it has received an EOSP field equal to 1 from the TWT responding STA, whichever occurs first. If the NDP Paging field was present in the TWT response, the TWT requesting STA shall follow the operational rules defined in 10.43.6.

If the Implicit bit is equal to 1 in the TWT response for a TWT agreement, the TWT associated with that TWT agreement is an implicit TWT and the TWT SP associated with that TWT is an implicit TWT SP. A TWT SP that is not an implicit TWT is an explicit TWT SP.

A TWT requesting STA that is a non-AP STA should transmit frames only within TWT SPs.

A TWT requesting STA that transmits a frame during a TWT SP is not granted any special medium access privileges, nor is there any guarantee that the TWT responding STA assigned the TWT SP to only one TWT requesting STA.

A single pair of STAs can create multiple TWT agreements. Each unique TWT agreement is identified by a TWT Flow Identifier and the MAC addresses of the TWT requesting STA and TWT responding STA. Because the TWT Flow Identifier field is 3 bits in length, the maximum number of TWTs per STA pair is 8. There are no explicit restrictions on the class of traffic (i.e., EDCA Access Category) that can be transmitted within any specific TWT SP when multiple TWT agreements have been set up by a single TWT requesting STA.

A TWT requesting STA that is a non-AP STA may wake to receive Beacons that are transmitted outside of a TWT SP. A TWT requesting STA that is an AP generates S1G Beacon frames as described in 11.1.3 and operates in power save mode as described in 11.2.3.20.

A TWT responding STA should include a Pentapartial Timestamp field or a Tetrapartial Timestamp field or a Timestamp field in at least one frame transmitted to a TWT requesting STA during a TWT SP for that STA.

NOTE—When dot11TWTOptionActivated is true, a TWT responding STA might use the TWT Wake Interval in determining the lifetime of frames that it buffers for an TWT requesting STA.

The Flow Type field in the TWT response that successfully set up a TWT agreement indicates the type of interaction between the TWT requesting STA and the TWT responding STA within each TWT SP for that TWT agreement. Flow Type field equal to 0 indicates an announced TWT. The TWT responding STA of an announced TWT agreement shall not transmit a frame to the TWT requesting STA within a TWT SP until it has successfully received a PS-Poll frame or APSD trigger frame (see 10.2.2.5) from the TWT requesting STA. Flow Type field equal to 1 indicates an unannounced TWT. The TWT responding STA of an unannounced TWT agreement may transmit a frame to the TWT requesting STA within a TWT SP before it has successfully received a frame from the TWT requesting STA.

NOTE—-A TWT requesting STA that is an AP does not send PS-Poll frames, but it can send APSD trigger frames.

A TWT requesting STA indicates which single channel it desires to use as a temporary primary channel during a TWT SP by setting a single bit to 1 within the TWT Channel field of the TWT element, according to the mapping described for that field. A TWT responding STA indicates which single channel the TWT requesting STA is permitted to use as a temporary primary channel during a TWT SP by setting a single bit to 1 within the TWT Channel field of the TWT element, according to the mapping described for that field. During a TWT SP, access to a channel that is not the primary channel of the BSS shall be performed according to the procedure described in 10.48.

10.43.2 TWT acknowledgment procedure

STAs need to be able to predict the duration of response transmissions for Duration field calculations and in addition, TWT requesting STAs might need TWT start times delivered in response frames. This subclause contains rules for TWT acknowledgments that allow both objectives to be satisfied at once by requiring specific responses to be transmitted in specific circumstances and by specifying the use of frames that provide both acknowledgment and next TWT information.

A TWT responding STA shall transmit a STACK frame in response to a frame received from a TWT requesting STA, which has the value NORMAL_RESPONSE in the RXVECTOR parameter RESPONSE_INDICATION and that is not an A-MPDU and not an S-MPDU. A TWT responding STA shall transmit a TACK frame in response to a frame received from a TWT requesting STA, which has the value NORMAL_RESPONSE in the RXVECTOR parameter RESPONSE_INDICATION and that is an S-MPDU unless the S-MPDU contains a BAR frame, in which case, the response frame is a BAT frame. A TWT responding STA shall transmit a BAT frame in response to a frame received from a TWT requesting STA, which has the value NORMAL_RESPONSE in the RXVECTOR parameter RESPONSE_INDICATION and that is an A-MPDU.

A TWT requesting STA with the transmitted TWT Responder Support subfield in the S1G Capabilities element equal to 1 shall transmit a STACK frame in response to a frame received from a TWT responding STA, which has the value NORMAL_RESPONSE in the RXVECTOR parameter RESPONSE_INDICATION and that is not an A-MPDU and not an S-MPDU. A TWT requesting STA with the transmitted TWT Responder Support subfield in the S1G Capabilities element equal to 1 shall transmit a TACK frame in response to a frame received from a TWT responding STA, which has the value NORMAL_RESPONSE in the RXVECTOR parameter RESPONSE_INDICATION and that is an S-MPDU unless the S-MPDU contains a BAR frame, in which case, the response frame is a BAT frame. A TWT requesting STA with the transmitted TWT Responder Support subfield in the S1G Capabilities element equal to 1 shall transmit a BAT frame in response to a frame received from a TWT responding STA, which has the value NORMAL_RESPONSE in the RXVECTOR parameter RESPONSE_INDICATION and that is an A-MPDU.

A TWT requesting STA that transmits a frame containing a Pentapartial Timestamp field shall set the field to all 0s. A TWT requesting STA that transmits a frame containing a Tetrapartial Timestamp field shall set the field to all 0s. A TWT requesting STA that transmits a frame containing a Next TWT Info field shall set the field to all 0s. A TWT requesting STA that transmits a frame containing a Change Sequence field shall set the field to all 0s.

A TWT requesting STA with the transmitted TWT Responder Support subfield in the S1G Capabilities element equal to 0 that receives a frame that requires an immediate response shall transmit an appropriate response is determined in 10.3.2.14.

If a TWT responding STA or a TWT requesting STA receives a frame within a TWT SP that has a value other than NORMAL_RESPONSE in the RXVECTOR parameter RESPONSE_INDICATION, the appropriate response is as determined in 10.3.2.14.

10.43.3 Explicit TWT operation

Each TWT SP start value for an explicit TWT is transmitted by the TWT responding STA to the TWT requesting STA in the Next TWT Info/Suspend Duration field of a frame that can contain the field as described in this subclause. The TWT responding STA for an explicit TWT may provide TWT SP start times that are related to one another in a periodic or aperiodic manner.

During an explicit TWT SP, if a TWT responding STA receives a frame from a TWT requesting STA that permits a BAT frame, TACK frame or STACK frame to be sent in response, then the TWT responding STA shall respond with a frame that includes a Next TWT Info/Suspend Duration field either if it is required to do so according to 10.43.2, or if it has not already transmitted a nonzero Next TWT Info/Suspend Duration field to the STA within this TWT SP. If the TWT responding STA has already transmitted a nonzero Next TWT Info/Suspend Duration field to the STA within this TWT SP, and is not otherwise required to respond with a BAT frame, TACK frame or STACK frame, the TWT responding STA may respond to the STA with a frame that contains a Next TWT Info/Suspend Duration field. When present in the response frame, the Next TWT Info/Suspend Duration field may contain the value of the TSF timer corresponding to the next scheduled TWT SP for the STA that is the intended recipient of the frame or may contain the value 0 to indicate that the Next TWT is not currently available for this TWT.

A TWT requesting STA awake for an explicit TWT SP shall not transmit a PS-Poll frame with the Poll Type subfield equal to any value other than 2.

A TWT requesting STA that is awake for an explicit TWT SP shall not enter doze state until it has received a nonzero Next TWT Info/Suspend Duration field from the TWT responding STA and has either been in the awake state for at least Nominal Minimum TWT Wake Duration time from the TWT SP start time as identified by the TWT responding STA or has received an EOSP field equal to 1 from the TWT responding STA. If more than one nonzero Next TWT Info/Suspend Duration field is received from the TWT responding STA during a TWT SP, the receiving STA shall discard all but the most recently received value. If no nonzero Next TWT Info/Suspend Duration field is received from the TWT responding STA during the TWT SP, then following the end of the TWT SP when not otherwise prohibited from transmitting, the TWT requesting STA may transmit a frame that is addressed to the TWT responding STA as a means to solicit a response frame that contains a Next TWT value. Examples of frames that will solicit a Next TWT Info/ Suspend Duration field include

— A TWT Information frame with the TWT Flow Identifier subfield equal to the TWT Flow Identifier corresponding to the TWT agreement for which a Next TWT value is requested and with the Next TWT Size subfield equal to 0, soliciting a STACK frame response.
— An A-MPDU containing a TWT Information frame with the TWT Flow Identifier subfield equal to the TWT Flow Identifier corresponding to the TWT agreement for which a Next TWT value is requested and with the Next TWT Size subfield set to 0, soliciting a BAT frame response.
— An S-MPDU containing a TWT Information frame with the TWT Flow Identifier subfield equal to the TWT Flow Identifier corresponding to the TWT agreement for which a Next TWT value is requested and with the Next TWT Size subfield equal to 0, soliciting a TACK frame response.

A TWT requesting STA that transmits a PPDU containing a TWT Information frame receives a response frame that can include a Next TWT field, as indicated above, and therefore, is not required to set the value of the Next TWT Request subfield to 1 to solicit the response of a TWT Information frame that includes a Next TWT field.

During an explicit TWT SP, a TWT responding STA that has transmitted a frame containing a Next TWT subfield equal to 0 shall queue for transmission at least one frame to the same recipient containing the nonzero Next TWT corresponding to the TWT Flow Identifier indicated in the frame with the Next TWT subfield equal to 0.

If a TWT requesting STA has transmitted a frame soliciting a response that contains a Next TWT value and the STA is in a Power Save mode, the STA shall remain in the awake state following the transmission until it receives a response from the TWT responding STA that contains a nonzero Next TWT value. The TWT responding STA shall assume that the TWT requesting STA is in the doze state if the TWT requesting STA is in a Power Save mode, the TWT SP has ended and the TWT responding STA has not received a frame from the TWT requesting STA that solicits a response that contains a nonzero Next TWT value. If a TWT responding STA receives a TWT Information frame from a TWT requesting STA with the Next TWT Request subfield equal to 1, then the TWT responding STA shall queue for transmission a TWT Information frame that contains a nonzero Next TWT value corresponding to the TWT Flow Identifier of the received TWT Information frame and shall assume that the TWT requesting STA is in the awake state until the TWT responding STA has transmitted the frame containing the nonzero Next TWT value.

A TWT responding STA may include a nonzero Next TWT value in any TACK frame or STACK frame or BAT frame that is transmitted as a response to a TWT requesting STA.

The TWT responding STA shall include the initial TWT SP start time for an explicit TWT agreement in the Target Wake Time field of the TWT element, which contains a value of Accept TWT in the TWT Setup Command field, a value of 0 in the Implicit bit and the TWT Flow Identifier value corresponding to that TWT agreement in the TWT Flow Identifier subfield.

10.43.4 Implicit TWT operation

The TWT values for an implicit TWT are periodic. A TWT requesting STA operating with an implicit TWT agreement shall determine the next TWT SP start time by adding the value of TWT Wake Interval associated with this TWT agreement to the value of the start time of the current TWT SP. A TWT requesting STA operating with an implicit TWT agreement with a TWT flow identifier that matches the TWT flow identifier of a received TWT Information frame from its TWT responding STA shall replace its next TWT SP start time value with the value from the Next TWT subfield of the TWT Information frame.

The TWT responding STA shall include the start time for a series of TWT SPs corresponding to a single TWT Flow Identifier of an Implicit TWT agreement in the Target Wake Time field of the TWT element which contains a value of Accept TWT in the TWT Setup Command field and the TWT Flow Identifier value corresponding to that TWT agreement in the TWT Flow Identifier subfield. The start time of the TWT SP series indicates the beginning time of the first TWT SP in the series. Subsequent TWT SPs start times are determined by adding the value of TWT Wake Interval to the current TWT SP start time.

A TWT requesting STA awake for an implicit TWT SP may transition to the doze state after AdjustedMinimumTWTWakeDuration time has elapsed from the TWT SP start time as identified by the TWT requesting STA or after receiving an EOSP field equal to 1 from the TWT responding STA, whichever occurs first.

A TWT responding STA that receives a frame from a TWT requesting STA with which it has established an implicit TWT agreement may respond to the STA with a frame that contains a Next TWT Info/Suspend Duration field (e.g., BAT frame, TACK frame, STACK frame). A TWT requesting STA that is awake for an implicit TWT SP and receives a frame with a Next TWT Info/Suspend Duration field from its TWT responding STA shall use the received Next TWT Info/Suspend Duration field value as the start of the next TWT, instead of the TWT value calculated by adding the value of TWT Wake Interval associated with the TWT SP to the current TWT. Subsequent TWT start times associated with the same TWT agreement are calculated based on the next TWT that was sent by the TWT responding STA.

10.43.5 TWT grouping

An AP may include an S1G STA as a member of a TWT group if the STA indicated TWT requester support and indicated support for TWT grouping in the S1G Capabilities Information field in the S1G Capabilities element in its (Re)Association Request frame and may signal TWT times to that STA using the TWT Group Assignment field of the TWT element.

An AP shall not include a non-S1G STA within a TWT group.

When dot11TWTGroupingSupport is true, the AP may assign a TWT group ID to a TWT requesting STA when the TWT Grouping Support subfield is equal to 1 within the S1G Capabilities element received from that STA. The AP indicates the TWT value to the TWT requesting STA that supports TWT grouping by transmitting to the STA an individually addressed frame containing a TWT element, which includes

— The value of the assigned group ID in the TWT Group ID subfield.
— The lower 48 bits of a TSF value in the Zero Offset of Group subfield to indicate the TWT value corresponding to the first member of the TWT group that is identified by the TWT group ID.
— A TWT unit value in the TWT Unit (9.4.2.200) subfield.

— A positive offset value indicated in the TWT Offset (9.4.2.200) subfield. The allowed values in the TWT Unit subfield are given in Table 9-262l.

The intended recipient of the frame containing the TWT element calculates its TWT from the TWT Group Assignment field by multiplying the TWT Unit interpretation value with the value indicated in the TWT Offset subfield and adding the result to the value in the Zero Offset of Group field corresponding to the TWT Group ID subfield in the TWT Group Assignment field of the TWT element.

10.43.6 NDP Paging Setup

This subclause defines a protocol for power saving at a STA by using the TWT protocol to set up scheduled wakeup intervals and by defining efficient signaling for the presence of BUs and synchronization.

A frame including a TWT element with the NDP Paging field present is referred to as NDP Paging Request or NDP Paging Response as clarified later. A STA sending an NDP Paging Request is referred to as NDP Paging requester. A STA sending an NDP Paging Response in a response to an NDP Paging Request is referred to as NDP Paging responder.

A STA requests an NDP Paging TWT by sending an NDP Paging Request. A non-S1G STA shall not transmit NDP Paging frames.

The setup procedure follows the protocol described in 10.43.1, unless otherwise described in this subclause.

A non-AP STA sending an NDP Paging Request shall set the P-ID field of the NDP Paging Request to one of the partial AIDs assigned to it by the intended receiver of the NDP Paging Request (see 10.20b).

An AP sending an NDP Paging Request to a non-AP STA should set the P-ID field of the NDP Paging Request to the partial BSSID.

Upon receiving an NDP Paging Request, the recipient STA shall respond with an NDP Paging Response with the NDP Paging fields set as follows:

— The P-ID subfield should be set to the same value as the P-ID subfield of the NDP Paging Request.
— The Max NDP Paging Period subfield shall be set to any value that is less than or equal to the Max NDP Paging Period subfield of the NDP Paging Request.
— The Action subfield shall be set to one of the values in Table 9-262m.
— The Partial TSF Offset subfield and Min Sleep Duration subfield are reserved.

The NDP Paging setup is successful if the TWT Setup Command subfield of the Request Type field in the NDP Paging Response is equal to 4 (Accept TWT), otherwise the setup is considered as failed.

A STA that has sent an NDP Paging Response with the TWT Setup Command field equal to 4 (Accept TWT) shall schedule an NDP Paging frame as the first frame for transmission at the TWTs indicated by the NDP Paging Response, if any of the following conditions is satisfied:

— There are BUs for the requesting STA.
— No NDP Paging frame was sent in the *N* consecutive preceding TWT(s), where *N* is equal to the value of the Max NDP Paging Period subfield in the NDP Paging Response.

The AP shall schedule an NDP Paging frame if there are critical updates to the S1G Beacon frame as defined in 10.42.2 and 11.2.2.17. An AP may additionally send an NDP Paging frame at any of the TWTs indicated by the NDP Paging Response.

If the NDP Paging frame is sent by the AP to the NDP Paging requester then this frame shall precede any frame that is sent by the AP to it during its indicated TWT SP and shall have the Direction field equal to 1.

If any frame is sent by a non-AP STA to an NDP Paging requester during its indicated TWT SP then the first frame sent shall be an NDP Paging frame with the Direction field equal to 0.

The P-ID field of the NDP Paging frame shall be set to the same value as P-ID field in the NDP Paging Response if and only if there are BUs for the STA identified by the partial AID indicated in the P-ID field of the NDP Paging Request. The P-ID field shall be set to 0 to indicate the presence of group addressed BUs.

NOTE— When a group AID is assigned to the corresponding group MAC address as described in 10.51, then the P-ID field can be set to the partial AID that corresponds to the group AID as defined in 10.20b.

If the Direction field of the NDP Paging frame is equal to 1, the subfields of the APDI field of the NDP Paging frame shall be set as follows:

- The PTSF subfield is set to TSF[Partial TSF Offset+4: Partial TSF Offset+11] (inclusive), where TSF is the 8 octet value of the TSF timer and Partial TSF Offset is the value of the Partial TSF Offset field in the NDP Paging Request.
- The Check Beacon Flag subfield shall be set to the LSB of the Change Sequence field in the most recently transmitted S1G Beacon frame or of the Check Beacon field in the most recently transmitted TIM Broadcast frame, if any was sent before the NDP Paging frame.

If the Direction field of the NDP Paging frame is equal to 0, the Partial AID field of NDP Paging frame indicates the partial AID of the STA transmitting the NDP Paging frame.

If no NDP Paging frame is received during the TWT, the TWT requester STA may transition to Doze state at the end of the Nominal Minimum TWT Wake Duration for the TWT. If an NDP Paging frame is received, the TWT requester STA may transition to Doze state immediately after receiving the NDP Paging frame, unless Min Sleep Duration field was equal to 0 and Action subfield equal to 1 in the NDP Paging Response frame that successfully completed the NDP Paging setup, in which case the STA shall be in active mode.

Upon reception of an NDP Paging frame with the P-ID field matching the value of the P-ID field in the NDP Paging Response, the NDP Paging requester STA shall behave as follows:

- If the Action subfield of the NDP Paging Response is 0:
  - If the NDP Paging requester STA is a non-AP STA, it shall send a (NDP) PS-Poll frame or uplink trigger frame addressed to the NDP Paging responder, after either SIFS or using EDCA within Nominal Minimum TWT Wake Duration.
  - If the NDP Paging requester STA is an AP, it shall send an NDP CTS frame to self with the duration field equal to zero after either SIFS or using EDCA within Nominal Minimum TWT Wake Duration.
- If the Action subfield of the NDP Paging Response is 1, the STA shall be in the Awake state starting at a time indicated by the Min Sleep Duration field after the end of reception of the NDP Paging frame, and it shall remain in the Awake state until a frame is received from the NDP Paging responder with the EOSP subfield equal to 1.
- If the Action subfield of the NDP Paging Response is 2, the STA shall be in the Awake state at the first TBTT that occurs after a time indicated by the Min Sleep Duration field in the NDP Paging Response after the end of reception of the NDP Paging frame to receive the S1G Beacon frame.
- If the Action subfield of the NDP Paging Response is 3, the STA shall be in the Awake state at the first DTIM that happens after a time indicated by the Min Sleep Duration field in the NDP Paging Response after the end of reception of the NDP Paging frame to receive the DTIM Beacon frame.
- If the Action subfield of the NDP Paging Response is 4, the STA shall be in the Awake state starting at a time T after the end of reception of the NDP Paging frame and it shall remain in the Awake state

until a frame is received from the NDP Paging responder with the EOSP subfield equal to 1. The value of T is in units of SIFS and is equal to the value of the Min Sleep Duration field of the NDP Paging Request plus the value of the ASD subfield in the APDI field of the NDP Paging frame.

If the NDP Paging requester is an AP, values 2-7 (inclusive) of the Action subfield are reserved.

A non-AP STA that has set up NDP Paging and receives an NDP Paging frame with Direction field equal to 1 and the Check Beacon Flag subfield value different from the LSB of the most recently received Change Sequence value shall either be awake to receive the next S1G Beacon frame that is transmitted at a TBTT or TSBTT or shall queue for transmission a Probe Request frame to obtain the updated system information as described in 10.42.2.

10.43.7 TWT Sleep Setup

A Responder PM Mode bit in the Control field of the TWT response equal to 1 indicates that the Responder STA may be in Doze state outside the indicated TWT SP.

10.43.8 TWT Teardown

Either STA that is a party to an established TWT agreement may delete the TWT agreement by successfully transmitting a TWT Teardown frame. The TWT Flow Identifier field of the TWT Teardown frame shall be set to the value of the TWT Flow Identifier field of the TWT element of the frame that successfully concluded the setup of the TWT agreement that is the subject of the teardown request.

When a TWT Teardown frame is successfully transmitted or received, the TWT agreement corresponding to the TWT Flow Identifier field, TWT requesting STA MAC address and TWT responding STA MAC address of the TWT Teardown frame shall be deleted.

10.44 Non-TIM STA operation

10.44.1 Resource protection for non-TIM STAs

10.44.1.1 General

Resource protection for non-TIM STAs allows an AP to protect specific times for participating non-TIM STAs from medium access by TIM STAs. The objective of this procedure is to minimize contention between non-TIM STAs and TIM STAs and thus reduce power consumption of non-TIM STAs caused by medium contention with TIM STAs. For this purpose, an AP may set up RAW(s) for non-TIM STAs and then indicate to TIM STAs RAW information during which no TIM STA is allowed to contend. The RAW(s) is used for protecting either TWT(s) scheduled by the AP or specific interval(s) for non-TIM STAs.

When an AP schedules TWT(s) for non-TIM STAs, the AP may set up RAW(s) to protect the TWT(s) for non-TIM STAs. The AP may schedule more than one TWT for non-TIM STAs so that it can set up a RAW which covers the interval summing up the duration indicated by the corresponding Nominal Minimum TWT Wake Duration field assigned to each non-TIM STA in a sequence.

An AP is a TWT-protection capable AP if it sets both dot11RAWOperationActivated and dot11TWTOptionActivated to true.

A non-TIM STA with dot11TWTOptionActivated equal to true may request for a TWT protection to a TWT-protection capable AP when it sets up a TWT agreement with the AP. In the TWT setup procedure specified in 10.43.1, a non-TIM STA transmits a TWT element in a (Re)Association Request frame or a TWT Setup frame to the AP, and the non-TIM STA may request for a TWT protection by setting the TWT

Protection subfield in the Request Type field of the TWT element (9.4.2.200) to 1. If the protection is not required by the non-TIM STA, the TWT Protection subfield shall be set to 0.

When the TWT-protection capable AP receives a TWT element from the non-TIM STA with the TWT Protection subfield equal to 1 during the TWT setup procedure, it is recommended that the AP allocates RAW(s) to protect the TWT SPs corresponding to the particular TWT Flow Identifier.

When the TWT-protection capable AP receives a TWT element from the non-TIM STA during the TWT setup procedure and if the AP can guarantee to protect the scheduled TWT(s) for the non-TIM STA by allocating RAW(s), it shall set the TWT Protection subfield in the TWT element included in the (Re)Association Response frame or a TWT Setup frame that is transmitted to the STA during the TWT setup procedure to 1. If the AP cannot guarantee to protect the scheduled TWT(s) by allocating RAW(s), it shall set the TWT Protection subfield in the TWT response to 0.

After the TWT-protection capable AP has successfully completed the TWT setup as described in 10.43.1 and if the AP has set the TWT Protection subfield in the TWT element to 1 during the TWT setup procedure with the STA, the AP shall set up RAW(s) that covers at least the duration indicated by the Nominal Minimum TWT Wake Duration field (9.4.2.200) assigned to the non-TIM STA. If the AP has set the TWT Protection subfield to 0, the AP may set up RAW(s) that covers at least the duration indicated by the Nominal Minimum TWT Wake Duration field.

To protect TWT requester non-TIM STAs' contention for medium access, the AP with dot11RAWOperationActivated equal to true may schedule their TWTs within a RAW that is not assigned to any TIM STA. When the AP is polled by TWT STAs that were not scheduled during the RAW duration, the AP may reschedule their awake/doze cycle as described in 10.44.2.

The AP uses either generic RAW(s) or non-TIM RAW(s) for protecting non-TIM STAs:

- In the generic RAW, medium access is only allowed to a group of STAs indicated by the RAW Group field as specified in 10.22.5.4.
- In the non-TIM RAW, the RAW Group field is not present and medium access is only allowed to non-TIM STAs that are scheduled within the duration calculated from RAW Slot Definition field as specified in 10.22.5.1.

10.44.1.2 Resource protection for non-TIM STAs using periodic RAW (PRAW) operation

In resource protection for non-TIM STAs specified in 10.44.1, PRAW, which is specified in 10.22.5.8 operation) can be used to indicate to TIM STAs information related to periodically scheduled RAWs during which no TIM STAs are allowed to contend.

An example of the basic operation of PRAW allocation is shown in Figure 10-90. In this figure, PRAW is allocated at every short beacon interval, but the allocation of the PRAW is indicated at every DTIM Beacon frame. STA1 is a TIM STA that is not included in the PRAW allocation and STA2 is a non-TIM STA for which the AP has scheduled TWT and is included in the PRAW allocation. When STA1 listens to the Beacon frame, it can identify the allowed user group, start time, duration, and the periodicity of the allocated PRAW. As STA1 is not included in the allowed user group of the PRAW, STA1 will not access the channel during allocated PRAW, which is indicated in the S1G Beacon frame that is transmitted every short beacon interval. And, STA2 wakes up at its scheduled TWT, which is within the PRAW, and send its uplink data if it has a Data frame to send.

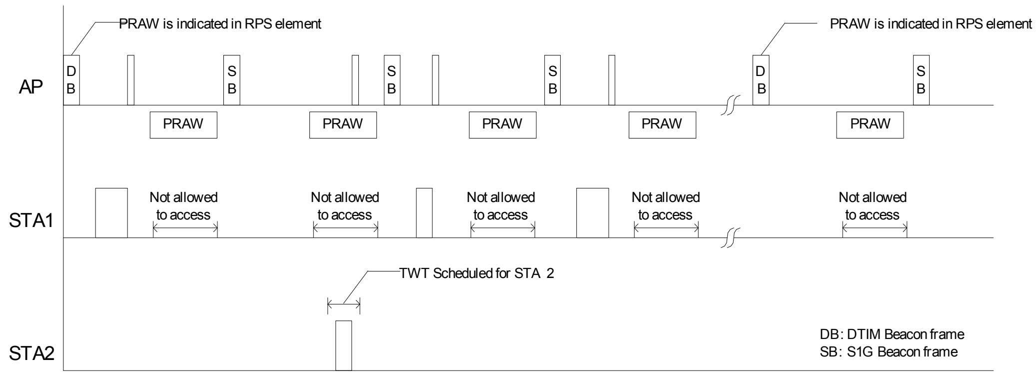


Figure 10-90—Example of PRAW operation

10.44.2 Rescheduling of awake/doze cycle

This subclause defines a procedure for the S1G AP to reschedule non-TIM STAs' awake/doze cycle.

An S1G non-TIM STA that transmits a PS-Poll frame may set the Poll Type subfield of the Frame Control field to

— 0 if it requests to the AP delivery of DL BUs but without a request for rescheduling of the doze/awake cycle.
— 1 if it solicits information regarding the change sequence of the Beacon and the partial timestamp.
— 2 if it is not a TWT STA and requests to the AP delivery of the DL BUs and resynchronizing to the next TBTT.
— 2 if it is a TWT requester STA that transmits the frame to the TWT responder AP within the negotiated TWT SP to request delivery of DL BUs and information for the next TWT.
— 3 if it requests to the AP to reschedule its doze/wake cycle to another service period.

Upon receiving an NDP PS-Poll frame, trigger frame or PS-Poll frame with the Poll Type subfield equal to 0 sent by an S1G STA, the S1G AP responds as described in 11.2.3.6.

NOTE—The S1G STA can be a TIM STA or a non-TIM STA.

Upon receiving a PS-Poll frame with the Poll Type subfield not equal to 0 sent by a non-TIM STA, the AP responds with different frames depending on the value of the Poll Type subfield in the Frame Control field of the PS-Poll frame that elicited the response as follows:

— If the Poll Type subfield is equal to 1 then the AP with dot11PollTACKResponseImplemented equal to true shall respond with a TACK frame that does not contain the Next TWT Info/Suspend Duration field. An S1G STA shall not send a PS-Poll frame with the Poll Type subfield equal to 1 to an AP unless the TACK Support as PS-Poll Response field of the S1G Capabilities element received from that AP is equal to 1.
— If the Poll Type subfield is equal to 2 and is sent by a TWT requester STA within the negotiated TWT SP then the AP responds with a TACK frame as described in 10.43. A TWT requester STA shall not send a PS-Poll frame with the Poll Type subfield equal to 2 to an AP unless the TWT Responder Support field of the S1G Capabilities element received from that AP is equal to 1.
— If the Poll Type subfield is equal to 2 and is either sent by a STA that is not a TWT requester STA or is sent by a TWT requester STA not within the negotiated TWT SP then the AP shall either respond with the DL BU or with an NDP Ack frame. The NDP Ack frame may include a wakeup timer value (i.e., its Idle Indication field is equal to 1) that expires at the next TBTT.

  - The AP may also respond with a control response frame that includes a Duration field that indicates a wakeup timer (i.e., an NDP Ack or NDP PS-Poll-Ack frame with Idle Indication field equal to 1) if it receives a trigger or NDP PS-Poll frame from a non-TIM STA that satisfies the criteria above.
  - The non-TIM STA may resynchronize to the S1G Beacon frame with the help of the wakeup timer.
- If the Poll Type subfield is equal to 3, then the AP may respond with an NDP Ack frame that includes a wakeup timer as described in 11.2.3.6:
  - If the STA has requested time slot protection and the AP is UL-Sync capable, then the AP shall protect the TXOP duration following the expiration of the wakeup timer as described in 10.45.1.
  - The UL-Sync capable AP may also respond with a control response frame that includes a Duration field that indicates a wakeup timer (i.e., an NDP Ack or NDP PS-Poll-Ack frame with Idle Indication field equal to 1) if it receives a trigger or NDP PS-Poll frame from a non-TIM STA that satisfies the criteria above.

The S1G AP shall set More Data field to 1 in the responding control frame if there is BU buffered for the non-TIM S1G STA. If the non-TIM S1G STA receives the responding control frame in which the Idle Indication field is equal to 1 and the Duration field is a nonzero value, there is no frame transmission for the STA in the indicated duration in which the S1G STA may enter the Doze state. After the amount of time that is equal to the value in the Duration field, it shall be in the Awake state.

An S1G AP may set the wakeup timer (Duration field) as the duration to a TBTT in the responding control frame (either NDP Ack frame or NDP PS-Poll-Ack frame) and treat the non-TIM STA as a TIM STA starting from the TBTT if the bit corresponding to the non-TIM STA in the traffic indication virtual bitmap is equal to 1 and the STA has indicated support of temporary PS mode switch by setting the Temporary PS Mode Switch subfield to 1 in the S1G Capabilities element it transmitted to the AP. After the amount of time that is equal to the Duration field value in the responding control frame from the S1G AP, the non-TIM S1G STA shall wake up to receive the Beacon frame. Upon receiving the Beacon frame, the non-TIM STA infers from the TIM element indicating that there is BU for it that it is treated as a TIM STA and operates as a TIM STA from then on, setting dot11NonTIMModeActivated to false and switching to TIM mode (see 11.2.3.2). The S1G STA returns to the non-TIM STA operation mode by setting dot11NonTIMModeActivated to true if the S1G AP indicates that there is no more data buffered for the S1G STA and the S1G STA indicates to the S1G AP that there is no more data to transmit. The S1G AP treats the S1G STA as a non-TIM STA if the STA indicates that there is no more data to transmit and the S1G AP indicates that there is no more data buffered for the STA.

10.45 Synchronization (Sync) frame operation

10.45.1 Sync frame transmission procedure for uplink traffic

This subclause describes a synchronization (sync) frame transmission procedure for uplink traffic, which minimizes the time for medium synchronization for a STA that is changing from Doze to Awake in order to transmit.

If dot11S1GUplinkSyncOptionImplemented is true, an AP shall set the Uplink Sync Capable field in the S1G Capabilities element to 1. If dot11S1GUplinkSyncOptionImplemented is false, the AP shall set the Uplink Sync Capable field in the S1G Capabilities element to 0.

An AP is an UL-Sync (Uplink Sync) capable AP if it sets the Uplink Sync Capable field to 1.

A STA may request to an UL-Sync capable AP to transmit a sync frame at the slot boundary of the STA in a RAW or at the target wake time of the STA.

A STA may request for a sync frame transmission to the UL-Sync capable AP either during association by sending a (Re)Association Request frame in which the Uplink Sync Capable field in the S1G Capabilities element is equal to 1 or at any time by sending a Sync Control frame (an Action frame of category S1G) in which the Uplink Sync Request field in the Sync Control field is equal to 1.

A STA may request to stop the sync frame transmission to the UL-Sync capable AP at any time by sending a Sync Control frame in which the Uplink Sync Request field in the Sync Control field is equal to 0.

When a STA is requesting for the sync frame transmission, a STA may also request to an AP to protect a RAW slot in a RAW defined in the Slot Duration field (9.4.2.192) or a time duration at a TWT defined in the Nominal Minimum TWT Wake Duration field (9.4.2.200), or by setting the Time Slot Protection Request field in the Sync Control field to 1. A STA may also request to an AP protection for a TXOP duration after the expiration of a wakeup timer as described in 10.44.2. The time slot protection is not requested, if the Time Slot Protection Request field is equal to 0. When an AP receives a Sync Control frame from a STA with the Time Slot Protection Request field equal to 1, the AP shall protect a time slot that is assigned for the STA in a RAW, or a time duration that is assigned for the STA at a TWT, or a TXOP duration after the expiration of a wakeup timer of the STA with NAV-setting frame exchanges. Note that NAV-setting frame exchanges refer to any frame that can set NAV to other third-party stations, and AP has the flexibility to choose any NAV-setting frame exchanges for protection.

For a STA that requested for a sync frame transmission, the UL-Sync capable AP shall schedule a sync frame at the slot boundary of the STA in the RAW if the Time Slot Protection Request field is equal to 1 or the Cross Slot Boundary field is equal to 1, or at the TWT of the STA, or at the expiration of the wakeup timer, as the next frame for transmission according to the medium access rules specified in Clause 10.

If the medium is busy at the slot boundary of the STA in the RAW or at the TWT of the STA, or at the expiration of the wakeup timer, or if the UL-Sync capable AP determines that the remaining time in the RAW slot or the TWT SP, or the TXOP duration to be too short to transmit a sync frame, the UL-Sync capable AP shall cancel the scheduled sync frame transmission. When the STA is changing from Doze to Awake in order to transmit, the STA shall follow the rules defined in 11.2.3.2.

The UL-Sync capable AP should use the NDP CTS frame as a sync frame.

When a STA receives an NDP CTS frame with the RA/Partial BSSID field equal to the S1G partial AID of the STA from the UL-Sync capable AP with which the STA is associated, the STA shall transmit a Data frame to the AP a SIFS after the reception of the NDP CTS frame if the STA has a Data frame to transmit to the AP and has requested the AP for a sync frame transmission. When a STA receives an NDP CTS frame with the RA/Partial BSSID field not equal to the S1G partial AID of the STA, the STA shall follow the NAV setting rules defined in 10.3.2.4. After transmitting the NDP CTS frame, the AP shall wait for an AckTimeout interval (as defined in 10.3.2.9), starting at the PHY-TXEND.confirm primitive. If a PHY-RXSTART.indication primitive does not occur during the AckTimeout interval, the AP may transmit a CF-End frame or an NDP CF-End frame to reset the NAV provided that the remaining duration is long enough to transmit this frame.

For a STA requesting for the sync frame transmission with the Time Slot Protection Request field set to 0, the AP should not send a sync frame at each slot boundary within a RAW period if the Cross-Slot Boundary field is equal to 0.

Figure 10-91 illustrates an example of the uplink sync frame transmission procedure in a RAW. STA1 is allocated Slot1 in the RAW and STA2 is allocated Slot3 in the RAW. Both STA1 and STA2 have requested the UL-Sync capable AP to transmit a sync frame at the slot boundary. At the slot boundary of Slot1, the medium is idle and thus the AP transmits a sync frame at the slot boundary. However, at the slot boundary of Slot3, the medium is busy and thus the AP cancels the scheduled sync frame transmission for STA2.

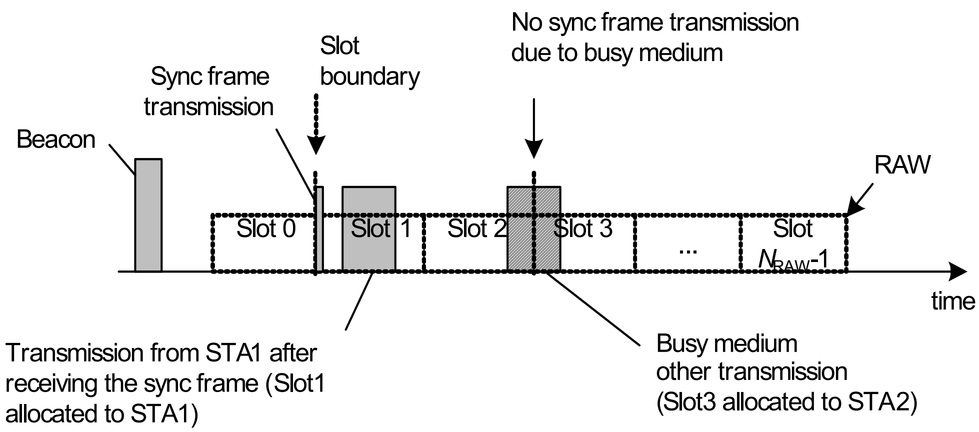


Figure 10-91—Example of uplink sync frame transmission procedure in RAW

10.46 Bidirectional TXOP

10.46.1 Overview

Bidirectional TXOP (BDT) allows an S1G AP and an S1G non-AP STA to exchange a sequence of uplink and downlink PPDUs separated by SIFS. This operation combines both uplink and downlink channel access into a continuous frame exchange sequence between a pair of S1G STAs. S1G STAs that participate in BDT use information that is present in the Frame Control field, PLCP Header Signal field and NDP CMAC frames to signal an undergoing BDT as described in 10.46.2. The objective of this operation is to minimize the number of contention-based channel accesses, improve channel efficiency by reducing the number of frame exchanges, and reduce S1G STA power consumption by shortening Awake times.

An S1G STA with dot11BDTImplemented equal to true shall set the BDT Capable field in the S1G Capabilities element to 1. An S1G STA with dot11BDTImplemented equal to false shall set the BDT Capable field in the S1G Capabilities element to 0. An S1G STA shall not use the BDT procedure to transmit frames to another S1G STA whose BDT Capable field is equal to 0.

10.46.2 Rules for BDT

Throughout this subclause, an S1G STA signals a Response Indication of Long Response by setting the TXVECTOR's parameter RESPONSE_INDICATION to Long Response for non-NDP frames and by setting the Idle Indication field to 1 and the Duration field to 0 for NDP (PS-Poll-)Ack frames. The S1G STA signals a Response Indication of No Response by setting the TXVECTOR's parameter RESPONSE_INDICATION to No Response for non-NDP frames or by setting the Idle Indication field to 0 and the Duration field to 0 for NDP (PS-Poll-)Ack frames. The S1G STA signals a Response Indication of Normal Response by setting the TXVECTOR's parameter RESPONSE_INDICATION to Normal Response for non-NDP frames.

An S1G AP may initiate a BDT exchange with an NDP PS-Poll-Ack frame that is sent as a response to a received NDP PS-Poll frame. An S1G non-AP STA shall not initiate a BDT exchange with a PS-Poll frame unless it is a PS-Poll+BDT frame with the More Data field equal to 1. A BDT exchange consists of one or more BDT sequences.

A BDT sequence comprises the following:

a) The transmission of one PPDU that is either an NDP PS-Poll-Ack frame or that satisfies the following conditions:
   1) Contains a Response Indication of Long Response
   2) Follows the same rule as the initial frame for TXOP as defined in 10.22.2 if the PPDU is the first frame sent by the BDT Initiator during this TXOP
   3) Contains a Duration/ID field that sets the NAV
   4) Contains no HT Control field with the RDG/More PPDU subfield equal to 1.

   An S1G STA that transmits this PPDU is known as the BDT Initiator.
b) The transmission of one or more PPDUs (BDT response burst) by the S1G STA addressed in the PPDUs transmitted by the BDT Initiator, separated by SIFS. Only the last (or only) PPDU of the BDT response burst may contain any MPDU requiring an immediate response. All the other PPDUs in the BDT response burst (if there are any) except the last one shall indicate "No Response" in the response indication field. The S1G STA that transmits the BDT response burst is known as the BDT Responder.
c) The transmission of one PPDU by the BDT Initiator containing an immediate response (the BDT Initiator final PPDU), if so required by the last PPDU of the BDT response burst.

NOTE 1—A BDT Initiator can include multiple BDT sequences, separated by SIFS, within a single TXOP.

NOTE 2—A BDT sequence cannot be started with a PPDU that can not signal a Response Indication, e.g., an NDP PS-Poll frame.

NOTE 3—A BDT sequence can be started with a PS-Poll+BDT frame.

The total duration of the BDT Initiator PPDUs shall not exceed the TXOP limit as described in 10.22.2.3. The BDT responder PPDU transmission(s) and any expected responses shall fit entirely within the remaining TXOP or SP duration, as indicated in the Duration/ID field of the latest MPDU transmitted by the BDT initiator. The PPDUs may carry Data frames of any TID. A BDT exchange is subject to TXOP duration limits for the current AC.

A BDT Responder sending a BDT response burst containing an immediate response to an eliciting PPDU that had the More Data field equal to 1 shall set the Response Indication to Long Response for the last PPDU in the BDT response burst.

A BDT Responder sending a BDT response burst containing an immediate response to an eliciting PPDU that had the More Data field equal to 0, shall not set the Response Indication of the last PPDU of the BDT response burst to Long Response.

A non-AP STA shall remain in the Awake state until the end of the current TXOP when one of the following conditions is met:

— It is the intended receiver of a frame with More Data field equal to 1 that is sent by the AP.
— It is a BDT Initiator of a BDT sequence within a single TXOP.

A non-AP STA may transition to the Doze state if it is the intended receiver of a frame with More Data field equal to 0 that is sent by the AP.

Upon receiving a PS-Poll+BDT frame with the More Data field equal to 0, the S1G AP that intends to respond with immediate Data frames may use the RTS/CTS scheme to send buffered data until it transmits a frame with MORE DATA equal to 0 or until the duration of the exchange, including the initial PS-Poll+BDT frame reaches the TXOP limit whichever comes first.

Figure 10-92 illustrates an example of BDT signaling. STA A initiates the BDT exchange by setting the Response Indication to Long Response in the PS-Poll+BDT frame and in the preamble of two PV0 PPDUs to allow STA B to transmit its BUs. At the end, STA B sends a PPDU with the Response Indication 2 (Normal Response) and STA A will terminate the BDT exchange by sending a PPDU with the Response Indication equal to 0 (No response).

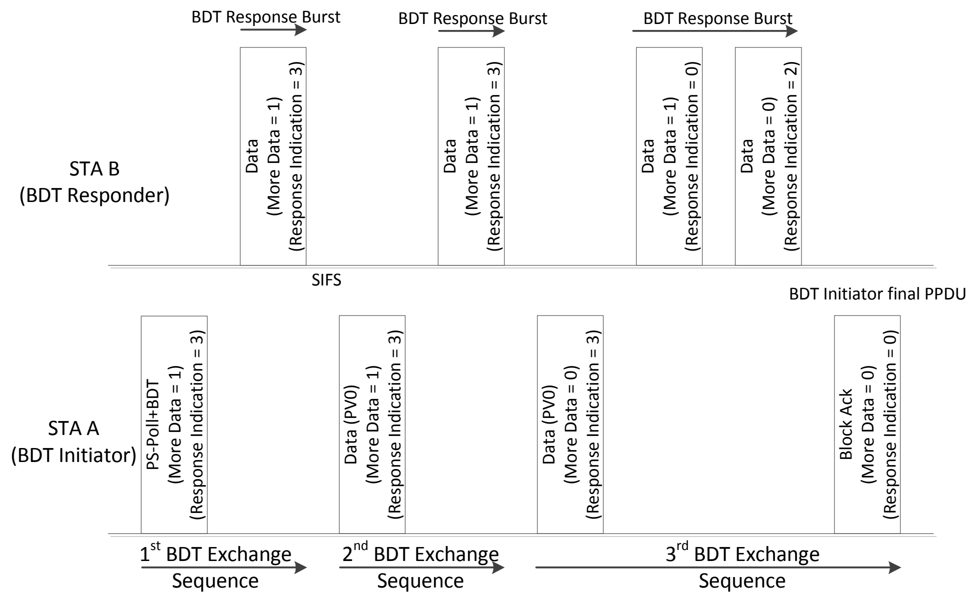


Figure 10-92—Example of BDT exchange

NOTE—For error recovery, a BDT initiator can transmit the next frame when the CS mechanism (see 10.3.2.1) indicates that medium is idle at TxPIFS slot boundary (defined in 10.3.7).

10.47 Page Slicing

A non-S1G STA shall not set dot11PageSlicingImplemented to true while an S1G STA shall set dot11PageSlicingImplemented to true if it supports page slicing.

The TIM element indicates downlink buffered data for all STAs in the BSS. However, in an S1G BSS with a large number of associated STAs corresponding to a single TIM and page, a single TIM element indicating the downlink buffered data for all STAs in the page can be quite large. To reduce the size of the element needed to communicate buffered data status to power save S1G STAs, an S1G AP may send one portion of a page in the TIM element virtual bitmap of each Beacon frame if dot11PageSlicingActivated is true as described in this subclause.

The traffic-indication virtual bitmap in a TIM includes a subset of the blocks from a single page. This subset of blocks is called a page slice and the size of the subset is indicated in the Page Slice Length subfield of the Page Slice element (9.4.2.193). An example with 4 TIMs and their 4 assigned page slices is depicted in Figure 10-93. All page slices corresponding to a single Page Slice element shall have equal size except for the last page slice.

An S1G STA for which dot11PageSlicingImplemented is true shall process all received TIM elements that include a Page Slice Number that matches its Page Slice Number and a page index that matches its Page index, and it shall follow the rules of 11.2.3.8 if the partial virtual bitmap of any of the processed TIM elements included the value of 1 in the position corresponding to any of its AIDs.

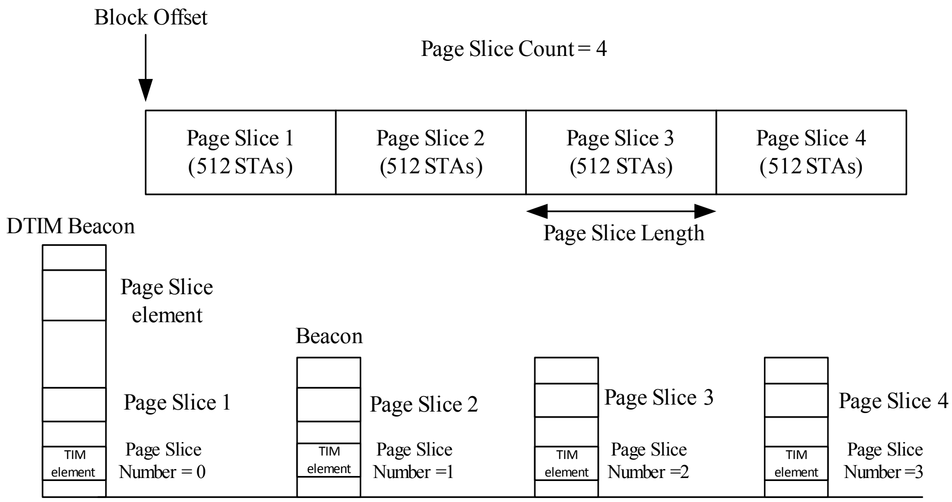


Figure 10-93—Illustration of Page Slicing with Page Slice element

An S1G STA with dot11PageSlicingImplemented equal to true shall set the Page Slicing Support field in the S1G Capabilities element to 1. An S1G STA with dot11PageSlicingImplemented equal to false shall set the Page Slicing Support field in the S1G Capabilities element to 0.

An S1G STA with dot11PageSlicingImplemented equal to true shall follow the page slicing rules as described in this subclause. An AP shall not include the bit in the partial virtual bitmap that corresponds to the AID of the S1G STA with dot11PageSlicingImplemented equal to false within a TIM element that has a value for the Page Slice Number field that is in the range of 0 to 30. An AP that has dot11PageSlicingActivated equal to false shall not transmit a TIM element that has a value for the Page Slice Number field that is in the range of 0 to 30.

If an AP meets the following conditions:

— Its dot11PageSlicingActivated is true.
— Has any STA(s) associated with it that has a value of false for dot11PageSlicingImplemented within a page.

then the AP shall:

— Include in all the S1G Beacons a TIM element with Page Index subfield equal to the corresponding page index and Page Slice Number field equal to 31, if there is buffered traffic for at least one of the STA(s)
— Set the bits in the virtual bitmap of that TIM for those STAs, according to the rules described in 11.2.3.6.

An AP with dot11PageSlicingActivated equal to true and that has at least one associated STA with dot11PageSlicingActivated equal to true and whose AID is contained in the

— Final block (32nd block) of a page, and has indicated a Page Slice Count equal to 0 and a Page Length greater than 1 in the Page Slice element shall include in the last S1G Beacon frame that precedes the next scheduled DTIM Beacon frame, a TIM element with Page Index subfield equal to the page index specified in the previously transmitted Page Slice element. The TIM element shall have the Page Slice Number equal to 31 for the indicated page, if there is buffered traffic for at least one of the STA(s) that support page slicing and belong in the final block of the page.

— Any block of a page, and has indicated a Page Slice Count equal to 0 and a Page Length equal to 1 in the Page Slice element shall include in the only S1G Beacon frame that precedes the next scheduled DTIM Beacon frame, a TIM element with Page Index subfield equal to the page index specified in the previously transmitted Page Slice element. The TIM element shall have the Page Slice Number equal to 31 for the indicated page, if there is buffered traffic for at least one of the STA(s) that support page slicing and belong in any block of the page.

The setting of the bits in the virtual bitmap of that TIM for STAs that do not support page slicing follows the rules described in 11.2.3.6.

For each page from which an AP with a value of false for dot11PageSlicingActivated has assigned at least one AID corresponding to STA(s) for which there is buffered traffic, the AP shall include in all the S1G Beacons a TIM element for that page, with Page Slice Number equal to 31 and shall set the bits in the virtual bitmap of that TIM for all the STAs indicated by the Page Index subfield, according to the rules described in 11.2.3.6.

An AP may include more than one TIM representing different page slices within a Beacon frame. An AP shall not transmit the Page Slice element in any frame other than a Beacon frame that has DTIM count equal to 0. Each page slice corresponding to a TIM, except the last TIM, shall have a size that is equal to the Page Slice Length subfield indicated in the Page Slice element. However, the length of page slice may vary over multiple page periods. The AP shall transmit the first page slice in the N-th Beacon frame after the DTIM in which the Page Slice element appears, where N is equal to the TIM offset subfield. Subsequent page slices indicated in the Page Slice element appear sequentially in the following Beacons, e.g., the second slice appears in (N+1)th Beacon frame after the DTIM that contained the Page Slice element. The value of zero for TIM offset corresponds to the DTIM Beacon frame. The TIMs can be flexibly scheduled for page slices of different pages over beacon intervals. Figure 10-93 is an illustration with 4 page slices, which appear in the DTIM Beacon frame and the three following Beacons when the TIM Offset subfield of the Page Slice element is equal to 0.

The Page slice element indicates assignment of STAs in page slices corresponding to their assigned TIMs. STAs within the assigned page slice wake up at corresponding TIM sequentially to receive buffered data from AP. In order to wake up at the appropriate TBTT to receive the Page Slice element, a STA may compute the page slice assignment to the TIMs using the length of the Page Bitmap field and the value in the Page Slice Length and Page Slice Count subfields of the Page Slice element. The length of the page slice that appears in each TIM, except for the last TIM identified by a Page Slice element, is indicated in the Page Slice Length subfield. The last TIM includes the blocks indicated by the bits of the Page Bitmap field that have not appeared in previous TIMs.

An S1G STA with dot11PageSlicingActivated equal to true wakes up to receive DTIM Beacon frame which contains the Page Slice element for its associated page slice from the AP. The STAs check the DTIM frame comprising of the Page Bitmap field and the Block Bitmap fields in Page Slice element and TIM, respectively. The Page Bitmap field in the Page Slice element provides an early indication of buffered data for all blocks in the assigned page slices. If a bit in the Page Bitmap field of the Page Slice element is equal to 0, it indicates that there is no buffered data for STAs with AIDs located in the block corresponding to that bit. These STAs may return to doze state immediately when there is no buffered group addressed data or after receiving buffered broadcast/group data as indicated in the DTIM. If the block bit in the Page Bitmap field is equal to 1, then it indicates that there is buffered data at the AP for at least one of the STAs with AIDs in that block.

For STAs that have their AIDs that correspond to a block for which the bit in the Page Bitmap field of the Page Slice element is equal to 1, they compute the length of the page slice and the corresponding TIM to wake up. If they are not assigned in page slice 1 that is allocated to DTIM slice, then these STAs may return to doze state immediately or after receiving buffered broadcast/group data as indicated in the DTIM till their scheduled TIM.

At the assigned page slice, the STAs decode the page slice in order to determine whether there is buffered data available at the AP.

When dot11PageSlicingActivated is true, an S1G AP may use the Listen Interval field and Page Slice element information in determining the lifetime of frames that it buffers for an S1G TIM STA that supports page slicing.

10.48 Subchannel Selective Transmission (SST)

10.48.1 SST overview

S1G STAs that are associated with an S1G AP transmit and receive on the channel or channels that are indicated by the AP as the enabled operating channels for the BSS.

An SST BSS is an S1G BSS for which the following conditions are satisfied:

a) The BSS operating channel width indicated in the Channel Width field of the S1G Operation Information element transmitted by the AP is less than or equal to 2 MHz.
b) The SST AP indicates that it enables SST operation by including the SST Operation element in the (Re)Association Response frame sent to the non-AP STA.

In an S1G BSS that is not an SST BSS, the enabled operating channels are indicated in the most recently received S1G Operation element transmitted by the AP. In an S1G SST BSS, the enabled operating channels are indicated in the most recently received SST Operation element transmitted by the AP.

An SST AP is an S1G AP with dot11SelectiveSubchannelTransmissionPermitted equal to true. During aperiodic SST operation, an SST AP indicates the set of enabled SST operating channels in an SST Operation element. During aperiodic SST operation, an SST AP indicates the subset of SST channels that SST STAs are allowed to access during a beacon interval or short beacon interval (see 11.1.3.10.2) in the SST element that is transmitted in the S1G Beacon frame that initiates that interval and/or in the Channel Indication subfield of RPS elements that include SST STAs in the RAW group. During periodic SST operation, an SST AP indicates the set of enabled SST operating channels in an SST Operation element and indicates the subset of SST channels that SST STAs are allowed to access during a beacon interval or short beacon interval in an RPS element with the Periodic RAW Indication subfield equal to 1.

An SST STA is an S1G STA that is associated with an SST AP and that chooses a subset of the operating channels enabled for SST operation on which to operate in the BSS, when SST operating channels are activated by the AP as indicated in the SST element, the SST operation element, or the RPS element.

SST STAs operating in an SST BSS are allowed to transmit on an SST channel during a beacon interval or short beacon interval only if the channel is permitted for SST use as indicated by the SST AP in an SST element included in the S1G Beacon frame that initiates that interval or as indicated by an RPS element in the case of periodic SST operation.

10.48.2 Aperiodic SST operation

An SST AP that sets up an SST BSS shall include the SST Operation element in (Re)Association Response frames sent during association. The S1G AP may include the SST Operation element in S1G Beacon frames. The SST AP indicates the set of enabled SST operating channels, the offset of the primary channel, and the channel width unit in the SST Operation element as described in 9.4.2.215. The set of enabled SST operating channels may include channels that are not in use by the BSS as specified by the SST Enabled Channel bitmap of the element. The SST AP that sets up an SST BSS shall choose the subset of allowed SST operating channels from the subset of enabled SST operating channels indicated in the SST Operation element. The set of enabled SST operating channels indicated by the AP is not static. The S1G AP may include the RPS element in S1G Beacon frames to signal additional channels allowed for SST operation within specific RAWs. The channels that are allowed for SST operation in the RPS element can be different from the channels allowed for SST operation in the SST element.

At each TBTT or TSBTT, an SST AP may send S1G Beacon frames on more than one channel from the set of enabled operating channels for the BSS either in parallel or in series or a combination of the two. A STA transmitting parallel S1G Beacons shall use either the value S1G_DUP_1M or the value S1G_DUP_2M for the TXVECTOR parameter FORMAT of the PHY-TXSTART.request for the transmission. An example of Beacons sent in parallel is when one Beacon frame is transmitted with a value of S1G_DUP_2M for the TXVECTOR parameter FORMAT and a value of CBW8 for the TXVECTOR parameter CH_ BANDWIDTH in a BSS with an operating width of 8 MHz. An example of Beacons sent in series is when several different Beacons are transmitted in sequence, each with a value of S1G for the TXVECTOR parameter FORMAT and a value of CBW2 for the TXVECTOR parameter CH_ BANDWIDTH and each transmitted on a different 2 MHz subchannel in a BSS with an 8 MHz operating width. When Beacons are transmitted in series, all of the Beacons may be queued for transmission at TBTT or TSBTT, but only one Beacon frame is transmitted at a time. SIFS or later after any Beacon frame in the series is transmitted, another Beacon frame may be transmitted in the series, provided that normal medium access rules for the channel of transmission of the Beacon frame have been satisfied.

NOTE—When a series of S1G Beacons is transmitted, the AP can use the Channel Activity Schedule of the SST element in those beacons to describe when UL transmissions are permitted by SST STAs in order to protect the beacon sequence and to avoid attempts to communicate with the AP during the beacon transmission sequence. RAW, CTS-to-self and other NAV-setting mechanisms can also be employed for this purpose.

An SST AP shall include the SST element in the S1G Beacon frame that immediately precedes a beacon interval or short beacon interval when it allows SST operation within that interval (see Figure 10-94).

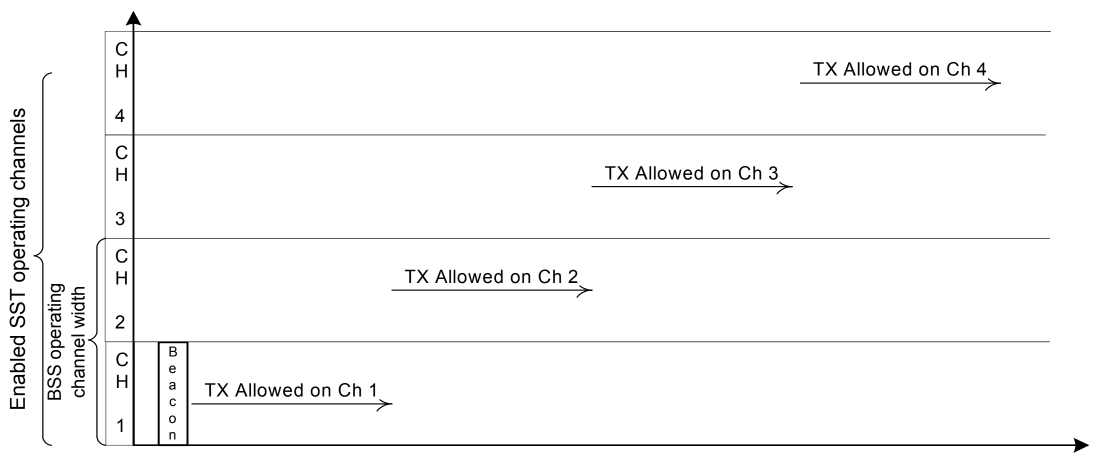


Figure 10-94—Selective Subchannel Transmission channel transmission permission allocations from SST element

An SST AP may include an SST element in transmitted S1G Beacon frames. An SST AP includes an SST element with the DL Activity bit in the SST element set to 1 and estimated start times and SST channels for DL transmissions in the Channel Activity Schedule field to indicate the expected times for the transmission of DL frames. These frames can be used by SST STAs to estimate the channel parameters which can be used as input to an algorithm for the selection of an SST channel.

The AP may transmit sounding frames to SST STAs for the purpose of estimating channel parameters. The AP may transmit sounding frames for SST STA channel estimation either in parallel or in series or a combination of the two, where a parallel transmission by an S1G AP shall use either the value

S1G_DUP_1M or the value S1G_DUP_2M for the TXVECTOR parameter FORMAT of the PHY-TXSTART.request for the transmission.

An S1G AP may include an SST element (see 9.4.2.202) in an S1G Beacon frame to indicate on which channels an SST STA is allowed to transmit within the BSS or SST BSS.

An S1G AP may indicate on which SST channels it intends to transmit sounding and non-sounding frames following the transmission of an S1G Beacon frame by including a SST element in the S1G Beacon frame with a nonzero value in at least one bit of the Channel Activity Bitmap subfield and a value of 1 in the corresponding DL Activity subfield. An SST STA may choose an SST channel for transmissions based on its analysis of the sounding signals and received transmissions.

In an SST BSS, an SST STA shall not transmit in a channel that is not the primary channel of the BSS if the corresponding bit of the Channel Activity Bitmap is 0 in the most recently received SST element or RPS element from its associated AP. An SST STA shall not transmit using a channel width that is greater than the value of the SST Channel Unit indicated in the most recently received SST Operation element from its associated AP.

When no SST Operation element has been received by an SST STA from its associated AP, the STA shall not transmit a frame with a BSSID that is equal to the BSSID of the BSS with which the STA is associated, in a channel of operation that is not included in the channels of operation of the BSS.

If the frames that are transmitted by an S1G AP in response to an announcement of transmission activity within a SST element are sounding frames, the S1G AP shall use the same value for the TXPWR_LEVEL parameter of the TXVECTOR for each of the sounding frame transmissions associated with the SST element announcement. An S1G AP should transmit SST sounding frames at times and on SST channels indicated for downlink activity in the Activity Start Time and Channel Activity Bitmap fields of the SST elements that it transmits.

The AP may signal the presence of a RAW for the purpose of SST sounding for a group of STAs using an SST sounding RAW as indicated within a transmitted RPS information element. Such an SST sounding RAW may be scheduled for periodic or nonperiodic operation. An additional RAW(s) may be scheduled as SST report RAW(s) (see 9.4.2.192) after the SST sounding RAW for the transmission of S1G NDP CMAC frames (e.g., NDP PS-Poll frame) by SST STAs on their selected channel(s) for the purpose of communicating a selected subchannel to the AP. The AP is not required to use a RAW for SST sounding.

In the SST report RAW, the STA transmits a report frame to the AP not earlier than the start of its assigned RAW slot, followed by the AP's response for confirmation after SIFS.

When the AP uses a RAW for SST sounding, the RAW Type subfield is equal to sounding RAW, and the RAW Type Options subfield is equal to SST sounding RAW in the RPS information element (see 9.4.2.192) transmitted by the AP. The SST sounding sequence within the SST sounding RAW comprises a series of S1G NDP CMAC frames (e.g., NDP CTS frames), each transmitted on one of the channels among those indicated by the Channel Indication field of the RAW, starting with lowest frequency channel and continuing in sequence with the next higher frequency channel if more than one channel is indicated. The RPS element for the SST sounding RAW specifies a start time, channel(s) and RAW duration for each RAW assignment. The AP shall not transmit any S1G NDP CMAC frame on a channel within an SST sounding RAW before the TxPIFS slot boundary as defined in 10.3.7. If the AP does not observe an idle medium condition within one PIFS after switching to a channel, then the AP shall not transmit an NDP, but shall wait for the duration of an NDP before switching to the next channel. This deterministic channel switching allows listening SST STAs to predict the timing of the sounding transmission for each channel. An AP may schedule multiple SST sounding RAWs to increase the probability that a sounding frame is transmitted on each SST channel. The amount of time allocated in the sounding RAW for the channel switch operations performed by the AP is implementation dependent, and is calculated at the non-AP STA by subtracting the value N * (PIFS + NDPTxTime) from the total RAW duration and dividing the result by N-1, where N is the number of channels to be sounded.

When the AP uses a RAW for SST operation and the RAW is not a sounding RAW, then the RAW Type is generic RAW and the Channel Indication Presence bit is set to 1 and the number of channels indicated in the Channel Indication in the RPS information element (see 9.4.2.192) transmitted by the AP shall be one, unless there is only one STA assigned to each slot in the RAW defined by the RPS element. An AP shall not schedule any non-SST STA within a RAW that has a Channel Indication Presence bit equal to 1.

A local S1G Beacon frame is one that was transmitted by the AP with which a STA is associated.

An SST STA may select one or more SST channels from the enabled SST operating channels as indicated in the SST Operation element transmitted by the SST AP with which it is associated. The SST STA may operate on those SST channels for the beacon interval or short beacon interval following a TBTT or TSBTT if a local S1G Beacon frame with an SST element indicating that a subset of the enabled SST channel(s) are allowed for SST operation has been received by the SST STA during that interval. The STA shall not transmit frames on the indicated allowed SST channels with a bandwidth that is wider than the Maximum Transmission Width specified in the SST element. If no local S1G Beacon frame is received following a TBTT or TSBTT, then no SST STA transmission is allowed during the beacon interval or short beacon interval that begins at that TBTT or TSBTT except on the primary channel of the BSS. If an SST STA receives a local S1G Beacon frame which contains no SST element, the SST STA may transmit on the primary channel of the BSS a PPDU of width up to the BSS bandwidth indicated in the S1G Beacon frame during the beacon interval or short beacon interval that immediately follows the reception of the S1G Beacon frame.

An SST STA that has selected an SST operating channel that is not the primary channel for the BSS shall operate on the selected channel as though the channel is the primary channel of the BSS, but only at the times allowed for operation on the selected channel as indicated in this subclause.

An SST STA that selected its best SST operating channel(s) may report its selection to the SST AP by sending an NDP PS-Poll frame on the primary channel of the BSS, including the selected SST channel offset in the UDI field. The transmission of any frame on an allowed subchannel by an SST STA is an implicit indication to the AP as to the subchannel selection made by the SST STA. An SST STA may queue for transmission, a QoS NULL frame addressed to the AP for this purpose. To avoid ambiguity in which subchannel has been selected by the STA as its primary channel, the STA can send the frame using the minimum width channel for the band of operation on the selected primary channel.

An SST STA that has selected a subchannel for operation should operate on that subchannel during times indicated for permitted downlink and uplink operation according to the DL Activity and UL Activity fields and the Activity Start Time field in the SST element. An AP should transmit frames to SST STA on their selected subchannels.

An SST STA shall not transmit to the AP on an SST operating channel that is not indicated as allowed by the AP in the SST element. The set of allowed SST channels indicated by the AP in the SST element is dynamic and can change every beacon interval or short beacon interval.

An SST AP shall not be away from the primary channel of the BSS for a duration of time that exceeds the value of the dot11MaxAwayDuration during a beacon interval or short beacon interval, as defined in 11.2.3.20.

10.48.3 Periodic SST Operation

During aperiodic SST operation, an SST AP signals explicit permission of SST STA transmissions during each single beacon interval or short beacon interval in which SST operation is activated by transmitting the

SST element. During periodic SST operation, an SST AP signals permission of SST STA transmissions over multiple beacon intervals or short beacon intervals through the transmission of the RPS element with the Channel Indication Presence bit equal to 1 and the Periodic RAW Indication bit equal to 1.

Periodic SST operation shall follow the procedure in 10.48.2 with the additional requirement that the SST AP shall transmit at least one RPS element with the Channel Indication Presence bit set to 1 and the Periodic RAW Indication bit set to 1 preceding the first beacon interval or short beacon interval during which SST operation is permitted and no SST element shall be transmitted. The periodicity, validity, and start offset of the periodic SST operation are indicated in the Periodic Operation Parameters subfield of the RAW Assignment subfield of RPS element. When the RPS element is used to indicate a periodic SST sounding schedule, the RAW Type subfield of the RPS element is set to sounding RAW and the RAW Type Options subfield of the RPS element is set to SST sounding RAW.

10.49 Sectorized beam operation

10.49.1 Introduction

The partition of the coverage area of a BSS into sectors, each containing a subset of STAs, is called sectorization. This partitioning is generally achieved by the AP transmitting or receiving through a set of antennas or a set of synthesized antenna beams to cover different sectors of the BSS. The goal of the sectorization is to reduce medium contention or interference by the reduced number of STAs within a sector. AP shall cover all STAs associated to it with at least one sector or an omnidirectional beam. STAs are allowed to move from one sector to another sector. The entire BSS is assumed to be covered by the omnidirectional beam or the omnidirectional antenna of the AP.

10.49.2 Sector Capabilities Exchange

After the sectorized beam-capable non-AP STA is associated with a sectorized beam-capable AP, the AP can transmit through its sectorized beam to the non-AP STA.

If dot11S1GSectorImplemented is true, a non-AP STA shall set the Sectorized Beam-Capable field in the S1G Capabilities element it transmits to 1. The sectorized beam-capable non-AP STA shall support both group sectorization and TXOP-based sectorization operations.

If dot11S1GSectorImplemented is true, an AP shall set the Sectorized Beam-Capable field in the S1G Capabilities element it transmits as follows:

— 1 if the AP supports only TXOP-based sectorization
— 2 if the AP supports only group sectorization
— 3 if the AP supports both TXOP-based sectorization and group sectorization

A STA with dot11S1GSectorImplemented equal to false shall set the Sectorized Beam-Capable field in the S1G Capabilities element to 0.

If dot11S1GSectorTrainingOperationImplemented is true, a STA shall set the Sector Training Operation Support field in the S1G Capabilities element to 1 in the Association Request frame. If dot11S1GSectorTrainingOperationImplemented is false, the STA shall set the Sector Training Operation Support field in the S1G Capabilities element to 0. If dot11S1GSectorTrainingOperationImplemented is true, the STA shall set dot11HTControlFieldSupported to true.

When the AP sets the Sectorized Beam-Capable field to 3 in the S1G Capabilities element it transmits then group sectorization and TXOP-based sectorization may be optionally used at the same time if

— The AP intends to apply TXOP-based sectorization during the omnidirectional beacon interval or the sectorized beacon interval to STAs with the corresponding Sector ID.
— The AP or non-AP STA, intending to apply TXOP-based sectorization during the omnidirectional beacon interval or the sectorized beacon interval, follows the rule according to which a non-AP STA is not allowed to transmit in certain beacon intervals as described in 10.49.3.

After the exchange of the S1G Capabilities element during the Association, a sectorized beam-capable AP supporting group sectorization operation shall transmit an S1G Sector Operation element with the Sectorization Type field equal to 0 to advertise the period of the current sector, omnidirectional or sectorized beam, the current sector ID, the allowable group IDs, and the duration of the current sector in the Beacon frame to start a beacon interval. A sectorized beam-capable AP supporting TXOP-based sectorization operation may transmit an S1G Sector Operation element with the Sectorization Type field set to 1 to advertise if periodic sector training is on or off, its training period, and the remaining beacon intervals to the next periodic training in the S1G Sector Operation element in a Beacon frame.

A sectorized beam-capable AP may (re)assign a specific Sector ID to a sectorized beam-capable STA after the Association. A sectorized beam-capable STA may optionally send Sector ID feedback to its associated sectorized beam-capable AP. A sectorized beam-capable STA may optionally request sector training from its associated sectorized beam-capable AP. A sectorized beam-capable AP has at least two sectors.

A STA, which is not sectorized beam-capable, may skip the S1G Sector Operation element in the Beacon frame. In a BSS where the AP does not support group sectorization, a STA, whether it is sectorized beam-capable or not, is allowed to transmit at any beacon interval.

10.49.3 Group sectorization operation

Group sectorization operation is based on the AP transmitting a sectorized Beacon frame. A sectorized Beacon frame is a Beacon frame transmitted through a sectorized beam, which covers a specific sector of the BSS.

A BSS that is employing a sectorization operation is called a Sectorized BSS. The sectorization scheme of operation in a BSS is signaled by the presence of an S1G Sector Operation element in Beacon frames, Probe Response frames, and Association Response frames.

In a Sectorized BSS, the AP may alternate the sectorized beacons and the nonsectorized (omnidirectional) beacons, as illustrated by the example in Figure 10-95. More than one sector could be active at the same time, i.e., they can overlap in time. In such case, STAs from different sectors are allowed to transmit while their sectors are active. During the omnidirectional beacon interval all the STAs in the BSS may transmit regardless of their geographical locations. Sectorized beacons are transmitted to selected geographical areas to inform groups of STAs that they are allowed to transmit during the sector intervals specified in the S1G Sector Operation element. The AP with group sectorization operation receives transmissions from all sectors continuously.

All beacons in a sectorized BSS carry the S1G Sector Operation element. The one-bit Omni field indicator within the S1G Sector Operation element distinguishes between the sectorized Beacon frame and the omnidirectional Beacon frame transmission. The S1G Sector Operation element further specifies the type of sectorization operation, the type of Beacon frame (sectorized or omnidirectional), the complete rotation period of all (sectorized and omnidirectional) beacons, the sub-period for the current Beacon frame, and the list of groups of STAs that are allowed to transmit during the current beacon interval.

In a Sectorized BSS with group sectorization operation, each STA is allocated a group ID related to the sectorization operation. STAs that have group ID zero are allowed to transmit in all beacon intervals. During a beacon interval, the STAs, which are sectorized beam capable and with its group ID (grpID) contained in the list of group IDs carried in the S1G Sector Operation element are allowed to transmit within that beacon interval. By default all STAs have grpID 0 unless otherwise specified at the association. Because by default all STAs that support group sectorization belong to grpID 0 before association, all the STAs can transmit at any time before their association. It is expected that during the association, STAs receive a nonzero grpID, which will restrict their activity to a particular sector interval and omnidirectional time interval. The AP may allow some STAs to have the group zero even after association, for instance public safety STAs or some high priority sensors.

A STA that receives a Beacon frame in a Sectorized BSS shall verify if its group ID is contained in the group ID list of the S1G Sector Operation element in the Beacon frame if it intends to transmit within the beacon interval. A STA that has a nonzero group ID, which is not listed in the S1G Sector Operation element of the Beacon frame, is not allowed to transmit during that sector duration.

The STAs that do not support the group sectorization operation are not subject to the rules defined in this subclause.

In a Group Sectorized BSS,

- The S1G AP shall transmit omnidirectional Beacon frames every dot11BeaconPeriod as described in 11.1.2.1.
- The S1G AP may transmit sectorized Beacon frames every sectorized beacon interval. A non-AP STA that is associated to the AP and is group sectorized capable shall wake up to read the sectorized Beacon frame if it intends to access the medium during the sectorized beacon interval. A non-AP STA that is not group sectorized capable may ignore the sectorized Beacon frame and is not subject to the rules described in this subclause.

The purpose of group sectorization operation is to allow the channel access of one or multiple groups of STAs at the time, where the STA group allocation is based on STA sector location and other grouping criteria (e.g., the device type, or traffic type, or the received SNR) in order to reduce the number of hidden nodes that simultaneously access the AP.

Two or more sectors may be active at the same time, i.e., their active time duration can overlap. In this case the STAs are allowed to transmit in more than one sector. Figure 10-95 presents an example of three nonoverlapping sectors followed by an omnidirectional period. Each sector starts with sectorized Beacon frame that provides the sector ID and the duration of sector activity.

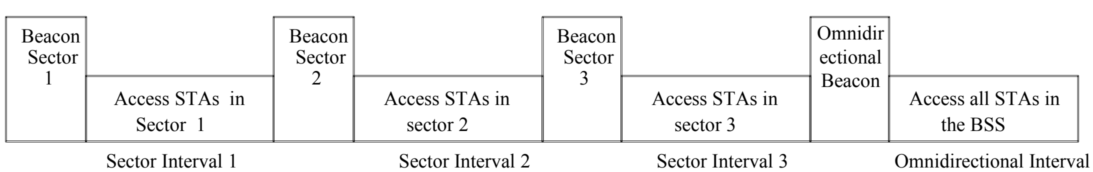


Figure 10-95—Sectorized BSS operation

10.49.4 TXOP-based sectorization operation

TXOP-based sectorization operation is based on an AP transmitting or receiving through the sectorized beam within a TXOP. At the beginning of a frame exchange, the AP may start with the omnidirectional beam transmission to establish a link with a STA and to set up protection duration within a TXOP before switching to the sectorized beam transmission and reception. In different TXOPs, the AP may use different sectorized beams to communicate with different STAs. A Sectorized beam capable AP supporting TXOP-based sectorization operation shall be able to transmit or receive through both the omnidirectional beam or the sectorized beams.

In a BSS with TXOP-based sectorization operation, the AP shall signal the operation in Beacon frames, Probe Response frames, Association Response frames, or other frames using the S1G Sector Operation element. The operation of TXOP-based sectorization is defined by the following rules:

- The switching from an omnidirectional beam transmission to a sectorized beam transmission occurs when the bit position corresponding to the sector is set to 1 in the TXVECTOR parameter SECTOR_ID.
- When an AP is aware of the sector in which a STA is in, AP may select the sectorized beam by setting the bit position corresponding to the sector to 1 in the TXVECTOR parameter SECTOR_ID when it transmits to or receives from the STA. Otherwise, the AP transmits or receives through the omnidirectional beam to the STA.
- Once AP transmits to a STA through a sectorized beam by setting the bit in the TXVECTOR parameter SECTOR_ID that corresponds to that sector to 1, it shall use the same sectorized beam to receive from the STA within the same TXOP.
- Once the AP switches to the sectorized beam transmission during an exchange, it shall continue with sectorized beam transmission using the same sectorized beam and the TXOP truncation is not allowed for the remaining duration of the NAV/RID protection.
- An AP shall use the same sectorized beam for transmission after PIFS recovery or back-off recovery in a TXOP.
- TXOP sharing for relaying shall not be used in a TXOP.

Note that a possible realization of an omnidirectional beam is by setting bit positions of all available sectors to 0. Another possible realization of omnidirectional beam is by setting all bit positions to 1 in the TXVECTOR parameter SECTOR_ID and the CSD are inserted to different sectorized beams to avoid unintentional beamforming.

In TXOP-based sectorization operation, during a frame exchange between the AP employing sectorized beamforming and a non-AP STA, spatial reuse by OBSS APs or OBSS non-AP STAs sharing the same wireless medium is allowed under the following rules:

When a protection NAV and RID for a TXOP is set up by an AP's omnidirectional beam transmission and a spatially orthogonal (SO) condition is confirmed by an OBSS non-AP STA or OBSS AP, the OBSS non-AP STA or OBSS AP may initiate an SO exchange after an SO-Backoff. For a non-AP STA the SO-Backoff is initialized with the AC_VO parameters from the most recently received EDCA parameter set element sent by the AP with which the STA is associated. For an AP the SO-Backoff is initialized with the AC_VO parameters of the AP. The SO-Backoff function begins or resumes when the SO condition is confirmed. The SO-Backoff function is independent of all other backoff functions but follows the EDCAF backoff procedure as defined in 10.2.4. An OBSS non-AP STA or OBSS AP that invokes or resumes an SO-Backoff at the confirmation of an SO condition shall set an SO timer to MAX(NAV, RID) and reset its NAV and RID and suspend EDCAF backoff procedures. At the expiry of the SO timer, the SO-Backoff is suspended and the suspended EDCAF backoff procedures resume. An OBSS non-AP STA or OBSS AP that initiates a new spatially orthogonal frame exchange after an SO-Backoff procedure shall start the exchange with a nonbeamformed RTS/CTS and shall limit the duration of the exchange such that it ends before the expiry of the SO timer. The new frame exchange as described is called a spatially orthogonal frame exchange. The new spatially orthogonal frame exchange initiator may transmit frames from any AC. The STA shall obey the TXOP limit of the AC of the frames transmitted within the SO frame exchange. A STA that transmits an SO frame exchange may transmit additional SO frame exchanges by continuing to use the SO-Backoff function until the expiry of the SO timer. If the ongoing frame exchange transmission is between a pair of STAs within its BSS, the STA does not reset its NAV and its RID even though the spatially orthogonal conditions are met. Within the new spatially orthogonal exchange, an OBSS AP shall use an antenna setting which is same as the antenna setting used to detect the spatially orthogonal (SO) condition for transmission.

The spatially orthogonal (SO) condition is satisfied if an OBSS non-AP STA or OBSS AP which receives the omnidirectional transmission but not the subsequent sectorized beam transmission from the AP and not the transmission from the STA involving in the frame exchange.

Four types of frame exchange sequences, which can lead to the SO conditions by OBSS non-AP STAs or OBSS APs are described.

a) SO frame exchange sequence 1: As illustrated in Figure 10-96, the AP starts a frame exchange with the omnidirectional beam to establish a link with a STA and set up the protection for the duration of the sectorized beam transmission. The second PPDU has a long format, AP switches to the sectorized beam transmission after the omnidirectional preamble of the long preamble. The AP continues with the sectorized beam transmission for the remaining duration of the NAV/RID protection. An OBSS non-AP STA or OBSS AP receives the omnidirectional beam transmission from the AP may attempt to start an SO frame exchange by detecting an SO condition. An SO condition is confirmed by an OBSS non-AP STA or OBSS AP, which observes the omnidirectional transmission of the AP but not the beamformed preamble of the AP and not the STA's transmission.

   Note that an OBSS non-AP STA or OBSS AP infers its spatial orthogonality by

   1) Observing the first omnidirectional beam packet and the omnidirectional preamble of the long preamble from the AP.
   2) Not observing the subsequent sectorized beam transmission from the AP for the duration of one symbol (D-STF as shown in Figure 23-2) following the omnidirectional portion of the S1G_LONG format.
   3) Observing a gap of no transmission between the first omnidirectional beam packet and the omnidirectional preamble of the long preamble by the AP.

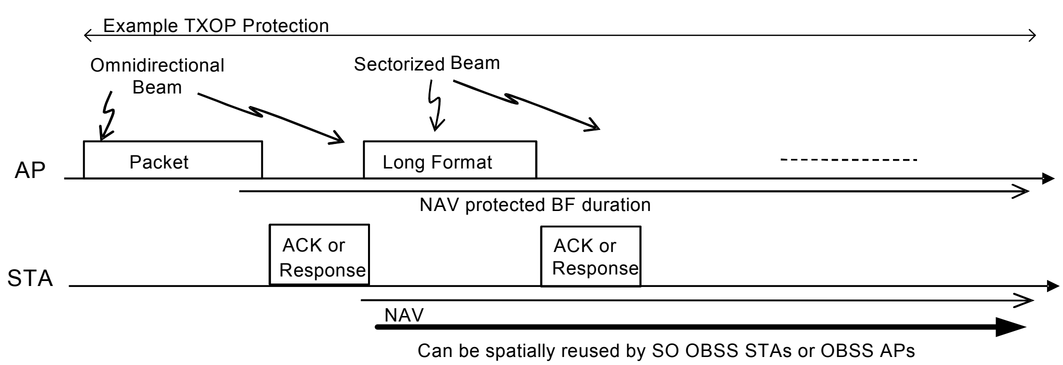


Figure 10-96—SO frame exchange sequence 1

b) SO frame exchange sequence 2: As illustrated in Figure 10-97, the AP starts a frame exchange with the omnidirectional transmission of a packet to establish a link with a STA and to set up the protection for the duration of the sectorized beam transmission. Subsequently, the AP switches to a sectorized beam transmission for the remaining duration of the NAV/RID protection. An OBSS non-AP STA or OBSS AP receives the omnidirectional beam transmission from the AP may attempt to start an SO frame exchange by detecting the SO condition. SO condition is confirmed by an OBSS non-AP STA or OBSS AP, which observes the omnidirectional transmission of the AP but not the beamformed transmission of the AP and not the STA's transmission.

   Note that an OBSS non-AP STA or OBSS AP infers its spatial orthogonality by

   1) Observing the omnidirectional beam transmission by the AP.
   2) Not observing the subsequent sectorized beam transmission by the AP for aSIFSTime + aSlotTime + aRxPHYStartDelay duration.
   3) Observing a gap of no transmission between the first two omnidirectional beam packets by the AP.

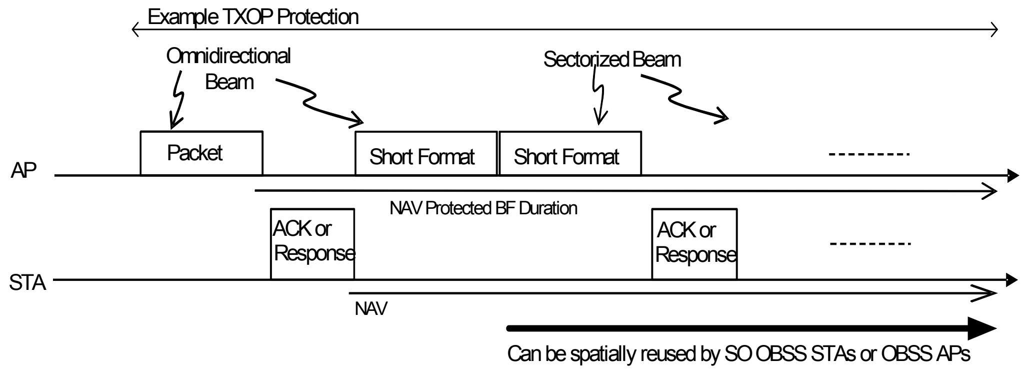


Figure 10-97—SO frame exchange sequence 2

c) SO frame exchange sequence 3: The AP starts a frame exchange with an omnidirectional RTS frame to solicit a CTS response from a STA and uses the omnidirectional transmission to set up the protection for the duration of the sectorized beam transmission and then switches to the sectorized beam transmission for the remaining duration of the NAV/RID protection. SO condition is confirmed by an OBSS non-AP STA or OBSS AP, which observes the omnidirectional transmission of the AP but not the beamformed transmission of the AP and not the STA's transmission. Note that in the first diagram in Figure 10-98, an OBSS non-AP STA or OBSS AP infers its spatial orthogonality with the AP by observing the omnidirectional beam RTS frame and the omnidirectional portion of the long format for the duration of one symbol (D-STF as shown in Figure 23-2) following the omnidirectional portion of the S1G_LONG format but not the subsequent sectorized beam transmission and with the STA by observing a gap of no transmission between the omnidirectional RTS frame and the omnidirectional preamble of the long preamble. Note that in the second diagram in Figure 10-98, an OBSS non-AP STA or OBSS AP infers its spatial orthogonality with the AP by observing the transmission of the omnidirectional beam RTS frame and the omnidirectional beam packet of the short format but not observing the subsequent sectorized beam transmission for aSIFSTime + aSlotTime + aRxPHYStartDelay duration and with the STA by observing a gap of no transmission between the omnidirectional RTS frame and the omnidirectional beam packet of the short format by the AP.

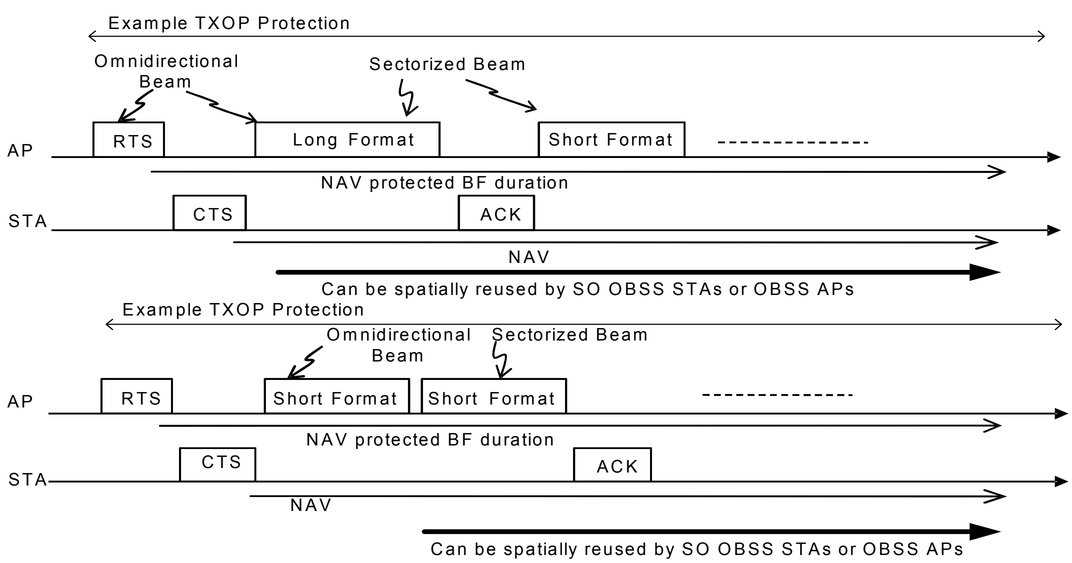


Figure 10-98—SO frame exchange sequence 3

d) SO frame exchange sequence 4: A STA starts with the omnidirectional beam to establish a link with the AP. AP uses omnidirectional transmission as the responding and to set up the protection for the duration of the remaining TXOP. Then the AP transmits the sectorized beam transmission (either an omnidirectional preamble of a long preamble or an omnidirectional transmission of a subsequent packet) and switches to the sectorized beam transmission. The AP continues with the sectorized beam transmission for the remaining duration of the NAV/RID protection. SO condition is confirmed by an OBSS non-AP STA or OBSS AP, which observes the omnidirectional transmission of the AP but not the beamformed transmission of the AP and not the STA's transmission.

Note that in the first diagram in Figure 10-99, an OBSS non-AP STA or OBSS AP infers its spatial orthogonality with the AP by observing the omnidirectional beam frame and the omnidirectional portion of the long format for the duration of one symbol (D-STF) following the omnidirectional portion of the S1G_LONG format but not the subsequent sectorized beam transmission and with the STA by observing a gap of no transmission before the AP response to PS-Poll frame or trigger frame from the STA. Note that in the second diagram in Figure 10-99, an OBSS non-AP STA or OBSS AP infers its spatial orthogonality by

1) Observing the omnidirectional beam packet of the short format from the AP.
2) Not observing the subsequent sectorized beam transmission by the AP for aSIFSTime + aSlotTime + aRxPHYStartDelay duration.
3) Observing a gap of no transmission before the first omnidirectional beam packet of the short format by the AP.

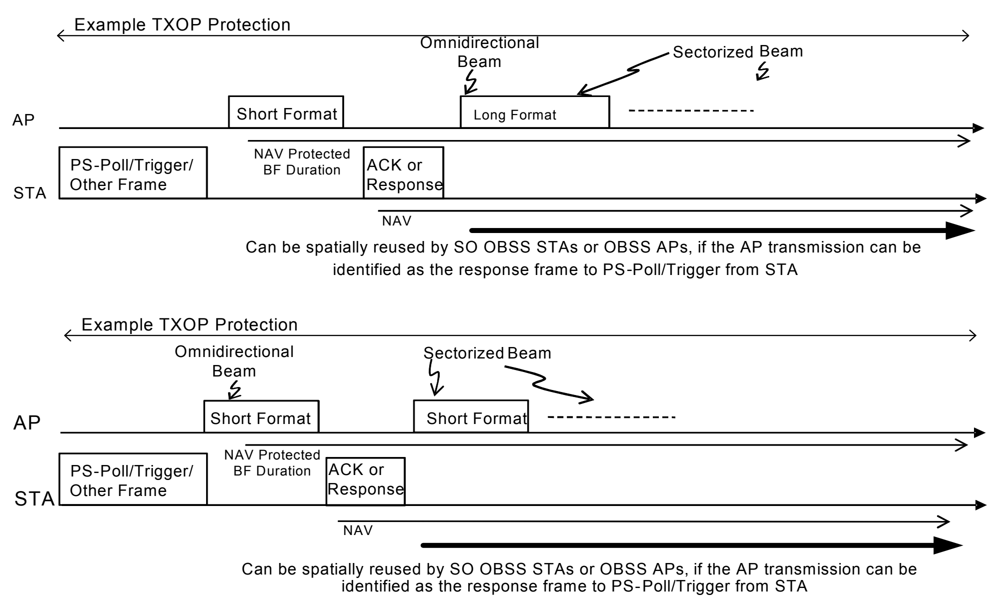


Figure 10-99—SO frame exchange sequence 4

To facilitate the detection of the spatially orthogonal conditions by OBSS non-AP STAs or OBSS APs, the NDP CTS frame may be transmitted preceding the SO frame exchange. If the Early Sector Indicator in the NDP CTS frame is equal to 1, it indicates that the NDP CTS frame is followed by the sectorized beam frame exchange. Setting the Early Sector Indicator to 1 and Address Indicator to 0 also indicates to the OBSS STAs that it might cancel its NAV and its RID setting if the spatially orthogonal conditions are subsequently met. If the ongoing frame exchange transmission preceding the NDP CTS frame is between a pair of STAs within its BSS, the STA does not reset its NAV and its RID even though the spatially orthogonal conditions are met. The RXVECTOR parameter COLOR is utilized to detect the SO condition by classifying the received PPDU between a same BSS transmission and an OBSS transmission. Hence, if the Early Sector Indicator is equal to 0, OBSS STA need not check for spatially orthogonal conditions. Figure 10-100 illustrates the frame exchange preceded by CTS-to-self using NDP CTS frame.

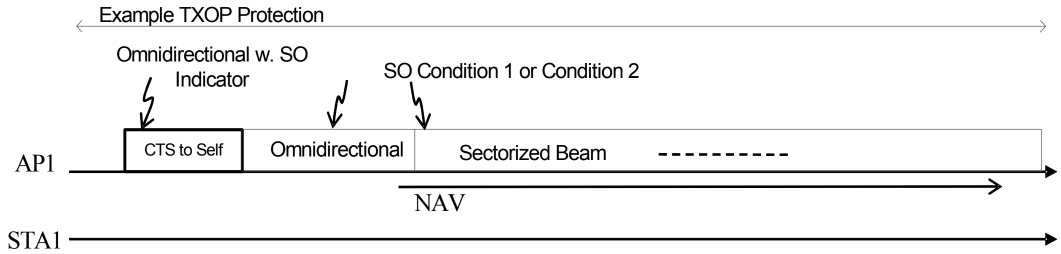


Figure 10-100—CTS-to-self preceding SO frame exchange sequence

10.49.5 Sector training operation

10.49.5.1 Introduction

Sector training is one way to help the STAs to determine the best sectors to communicate with the AP. In sector training, an AP with dot11S1GSectorTrainingOperationImplemented equal to true shall transmit training NDP CTSs over all sectors. The best sector might be chosen by a STA based on instantaneous or averaged CSI. The specific method of choosing the sector is beyond the scope of this standard. The results of sector training may be fed-back by the STAs to the AP using Sector ID feedback frame. These training NDP CTSs (with the Address Indication bit set to 1 and the RA/Partial BSSID field set to the partial BSSID of the AP) shall be transmitted consecutively and should be sent within a single TXOP. Sector training is set up or requested using the HT variant Control field. Sector training supports up to eight sectors. The AP may use other methods to determine the STA’s best sector.

10.49.5.2 Procedure

In sector training, the AP sends a sector training announcement followed by a series of NDP CTS sector training frames separated by SIFS.

In TXOP-based sectorization operation, sector training may occur periodically with the training period and the beacon interval in which the training occurs as indicated in S1G Sector Operation element (TXOP-based), in response to a request from a STA, or initiated by the AP. The STAs may perform sector training by receiving the training NDP CTSs from AP. When the AP receives the sector training request from a STA, the AP shall schedule sector training. AP supporting TXOP-based sectorization shall support sector training and sector training request. In the S1G Sector Operation element (TXOP-based) (see 9.4.2.196), which is transmitted in Beacon frame, Probe Response frame, or Association Response frame, the AP indicates in which beacon interval sector training occurs.

In group sectorization operation, a STA can find its best sector ID by listening to all the sectorized beacons transmitted during dot11BeaconPeriod. The S1G Sector Operation element (group) carried in the sectorized Beacon frame provides the sectorized beacons’ rotation period, current sector ID, the sub-period of the current sector and the group IDs of the groups of STAs, which are allowed to transmit within the current beacon interval. Sector training may also be used for STAs to reduce time for sector discovery and allow STAs, which do not listen to all the sectorized beacons for its power saving.

The STA may use the Sector ID feedback frame (see 9.6.25.11) to indicate to the AP which sector is selected.

The STA may request sector training from AP by using the HT Variant Control field if it is capable of sector training request. By setting the MAI=14 in the Link Adaptation Control subfield of the HT Variant Control field, the STA indicates HT variant control field is used for sector training (or Antenna Selection) information. Sector training (or sector training resumption) is requested by a STA when the ASELC subfield is equal to 1 and the ASEL Data subfield with values in the range of 1 to 15, being the number of the first NDP CTS training frames to be transmitted when the command is sector training resumption, where 0 corresponds to the first training frame in the sector training request. When the NDP Announcement field is also equal to 1, it indicates training NDP CTS frames to follow with consecutive training NDP CTS frames separated by SIFS.

The frame exchange sequence for sector training is shown in Figure 10-101, where the AP transmits training NDP CTS frames, and the STA provides Sector ID feedback. The frame exchange comprises the following steps:

a) (Optional) A STA may initiate sector training by sending a +HTC frame with the ASELC set to 1 for sector training request.

b) The AP sends out consecutive training NDP CTSs (with the Address Indication bit set to 1 and the RA/Partial BSSID field set to the partial BSSID of the AP) separated by SIFS in a TXOP of which it is the TXOP holder with no Ack over different sectorized beams. NDP CTS frames (9.9.2.1), with NDP CMAC Frame Type=0, are used in sector training. Each training NDP CTS frame is transmitted over one sector beam. The first training NDP CTS frame shall be preceded by a +HTC frame with NDP announcement subfield set to 1. The positions of the training NDP CTS frames correspond to the sector IDs of the sectorized beams, in ascending order starting with Sector ID =0.

c) The STA(s) may perform training by selecting the antenna sector based on NDP CTS training frames.

d) The STA(s) engages in the training by receiving the sector training frames may respond with a selected sector ID using the sector ID feedback frame in a subsequent TXOP or during sector report RAW, which may be indicated by Beacon frame for fast sector discovery of multiple STAs (see 10.49.5.4).

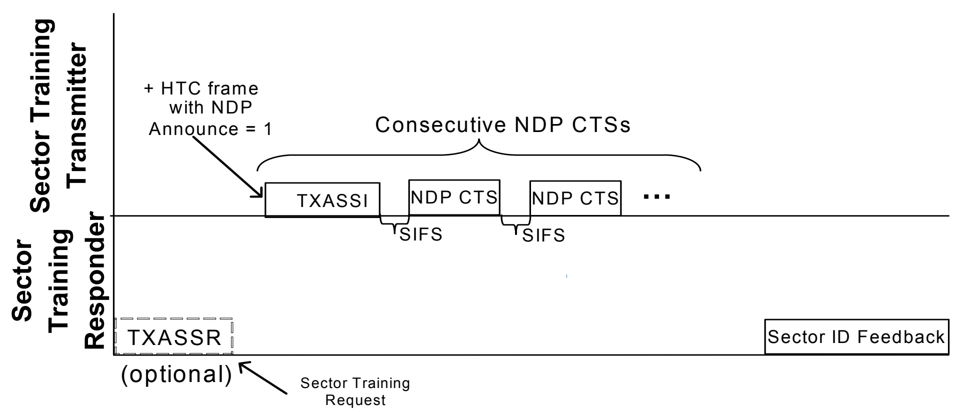


Figure 10-101—Sector training

If the AP receives a +HTC MPDU with the MAI subfield equal to 14, the ASEL Command subfield equal to sector training request (i.e., the value of the field is 1), and the ASEL Data subfield equal to a zero to correspond to the command sector training, the STA shall assume a total number of training NDP CTSs that corresponds to the total number of sectors. If the AP receives a +HTC MPDU with the MAI subfield equal to 14, the ASEL Command subfield equal to sector training request (i.e., the value of the field is 1), and the ASEL Data subfield equal nonzero value to correspond to the command sector training resumption (a resumption MPDU), the STA shall assume the number of training frames that follow the resumption MPDU is equal to the number of training NDP CTSs from the total number of sectors minus the order number transmitted in the ASEL Data subfield of the Resumption MPDU.

An AP may schedule sector sounding for multiple STAs by RAW in a beacon interval using the RAW Parameter Set element with the RAW Type field equal to sounding RAW and the RAW Type Options subfield equal to sector sounding RAW (see 9.4.2.192). During the sounding RAW, non-AP STAs that are associated with the AP are expected not to access the WM during the RAW duration as described in 10.22.5 and can elect to listen to the training NDP CTS frames transmitted by the AP. This sector sounding RAW may be scheduled as periodic or nonperiodic.

Sector training within the sector sounding RAW starts with a frame with NDP announcement indicator equal to 1 in the HT control field and is followed in SIFS by a number of NDP CTS frames, each transmitted through different antenna sector starting with Sector ID equal to 0, and separated by SIFS. If the RAW Type and the RAW Type Options subfield do not indicate that the RAW is a sector sounding RAW, no sector sounding is performed within the RAW.

Channel bandwidth for sector training shall be a width up to the BSS bandwidth indicated in the S1G Beacon frame during the beacon interval. The AP may transmit NDP CTS frames for sector sounding in parallel (e.g., with a value of S1G_DUP_2M for the TXVECTOR parameter FORMAT and a value of CBW8 for the TXVECTOR parameter CH_BANDWIDTH in a BSS with an operating width of 8 MHz). The Bandwidth Indication field in the sounding frames (in NDP_2M CTS frame) and the Channel Indication field in the sounding RAW shall comply with the TXVECTOR parameter CH_BANDWIDTH.

10.49.5.3 Sector ID feedback

A STA may optionally use an Unprotected S1G Action frame (see 9.6.25.11) for (solicited and unsolicited) Sector ID feedback.

10.49.5.4 Fast Sector Discovery

When multiple STAs report their sector IDs using the Sector ID feedback frames to AP, Sector ID feedback frames may be protected by sector report RAW(s) (see 9.4.2.192) indicated in the Beacon frame to avoid contentions with others. The sector report RAW(s) may be assigned after the sector sounding RAW for fast sector discovery of multiple STAs.

In the sector report RAW, the STA transmits a report frame to the AP not earlier than the start of its assigned RAW slot, followed by the AP’s response for confirmation after SIFS.

10.50 S1G Relay operation

10.50.1 General

An S1G relay consists of an S1G relay AP, an S1G relay STA and a relay function.

An S1G relay consists of an AP with dot11RelayAPImplemented equal to true and a STA with dot11RelaySTAImplemented equal to true.

An example of a relay function is illustrated in Figure 10-102, where Relay 1, Relay 2, and Relay 3 are S1G relays, each of which consisting of an S1G relay STA, an S1G relay AP and a relay function. The S1G relay STAs of Relay 1 and Relay 2 are associated with an AP that is an S1G root AP. The S1G relay STA of Relay 3 is associated with the S1G relay AP of Relay 1. STA 1 is a non-AP STA associated with the S1G relay AP of Relay 1. STA 2, and STA 3 are non-AP STAs associated with the S1G relay AP of Relay 3. STA 4 and STA 5 are non-AP STAs associated with the S1G relay AP of Relay 2. Frames from STA 1 are forwarded via the relay function of Relay 1 from the S1G relay AP to the S1G relay STA and then to the S1G root AP. Similarly, frames from the S1G root AP are forwarded to STA 1 via the S1G relay STA, the relay function and the S1G relay AP of Relay 1. Similar forwarding is done by Relay 3 and Relay 1 in sequence to handle frames from STA 2 and STA 3 relaying multiple times to or from the root AP.

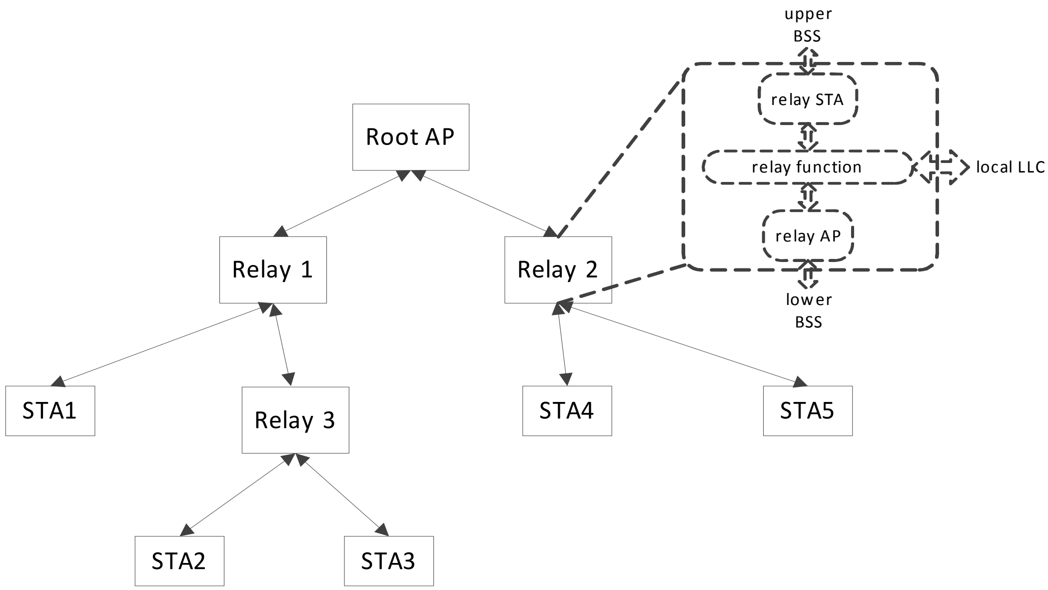


Figure 10-102— S1G Relay Architecture

Relay STA in this context refers to a non-AP STA.

10.50.2 S1G Relay operation

A non-AP STA with dot11RelaySTAImplemented equal to true shall include the S1G Relay Activation element in (Re)Association Request frames.

A non-AP STA with dot11RelaySTAImplemented equal to true may include an S1G Relay Activation element with Relay Activation Mode subfield equal to 1 in (Re)Association Request frames, Relay Activation Request frames or Relay Activation Response frames. A non-AP STA with dot11RelaySTAImplemented equal to true may transmit a Relay Activation Request frame to the AP with which it is associated.

A non-AP STA shall not transmit an S1G Relay Activation element that has the Enable Relay Function and the Relay Activation Mode subfields equal to 1 if the most recently received S1G Relay element from the AP to which it is associated had the No More Relay Flag subfield equal to 1.

A non-AP STA with dot11RelaySTAImplemented equal to false shall not include the S1G Relay Activation element in any frames that it transmits.

A non-AP STA transmitting an S1G Relay Activation element shall set the Direction subfield of the element to 0. An AP transmitting S1G Relay Activation element shall set the Direction subfield of the element to 1.

An AP that is the intended receiver of a frame that contains an S1G Relay Activation element with Relay Activation Mode subfield equal to 1 shall respond with the appropriate frame (Probe, (Re)Association, Relay Activation Response) that contains an S1G Relay Activation element with Relay Activation Mode subfield equal to 0.

A non-AP STA with dot11RelaySTAImplemented equal to true shall transmit a Relay Activation Response frame if it receives the corresponding S1G Relay Activation element in a Relay Activation Request frame.

A non-AP STA with dot11RelaySTAImplemented equal to true that is the intended receiver of a frame that contains an S1G Relay Activation element with Relay Activation Mode subfield equal to 1 and Enable Relay Function subfield equal to 0 shall respond with a frame that contains an S1G Relay Activation element with Relay Activation Mode and Enable Relay Function subfields equal to 0.

An AP may indicate the maximum number of STAs, N_{max}, that an S1G relay is allowed to associate by including a Number of STAs field in a S1G Relay Activation element with the Enable Relay Function subfield equal to 1 transmitted to the S1G relay.

A non-AP STA with dot11RelaySTAImplemented equal to true shall set dot11RelaySTAOperationActivated to false unless

a) It receives an S1G Relay Activation element from the AP to which it is associated with Enable Relay Function subfield equal to 1 and Relay Activation Mode subfield equal to 0 as a response of a transmitted S1G Relay Activation element with Enable Relay Function and Relay Activation Mode subfield equal to 1.
b) It transmits an S1G Relay Activation element to the AP to which it is associated with Enable Relay Function subfield equal to 1 and Relay Activation Mode subfield equal to 0 as a response of a received S1G Relay Activation element with Enable Relay Function and Relay Activation Mode subfield equal to 1.

If event a) or b) occurs, then it shall set dot11RelaySTAOperationActivated to true.

A non-AP STA with dot11RelaySTAOperationActivated equal to true is referred to as an S1G relay STA.

An AP with dot11RelayAPImplemented equal to true may include an S1G Relay Activation element with Relay Activation Mode subfield equal to 0 in (Re)Association Response frames, Probe Response frames, Relay Activation Request frames or Relay Activation Response frames.

An AP with dot11RelayAPImplemented equal to true (e.g., the AP in an S1G relay) shall set dot11RelayAPOperationActivated to true only if dot11RelaySTAOperationActivated of the non-AP STA in the relay is true, otherwise it shall set dot11RelayAPOperationActivated to false.

An AP with dot11RelayAPOperationActivated equal to true is referred to as an S1G relay AP.

An S1G relay AP shall include an S1G Relay element in transmitted Beacon frames, PV1 Probe Response frames and Probe Response frames.

An S1G relay AP shall set the No More Relay Flag subfield of an S1G Relay element to 1 if the No More Relay Flag subfield of the latest S1G Relay element received from its parent AP was set to 1. An S1G relay AP may set the No More Relay Flag subfield of the S1G Relay element to 1 in order to limit the number of Relays in its associated STAs.

An S1G Relay AP shall reject association requests when N_{max} has been reached, citing status code 17 (DENIED_NO_MORE_STAS).

An AP with dot11RelayAPImplemented equal to true shall include the S1G Relay element in its Beacon frames and may include the S1G Relay element in its Probe Response frames, PV1 Probe Response frames, and (Re)Association Response frames.

An S1G root AP is defined as an AP with dot11RelayAPImplemented equal to true that sets the Hierarchy Identifier field of transmitted S1G Relay elements to 0.

An S1G relay AP shall not set the Hierarchy Identifier field of transmitted S1G Relay elements to 0.

An S1G relay AP shall use the same SSID as the AP to which its S1G relay STA is associated.

An S1G relay STA shall send a Reachable Address element that contains the current list of reachable addresses, in the (Re)Association Request frame to the AP to which it is associating. In this frame the relay STA shall set the Initiator MAC address field of the element to its own MAC address, and the Add/Remove subfield to 1.

An S1G relay STA shall send a Reachable Address Update frame that contains the current list of reachable addresses to the AP to which it is associated when one of the following conditions occurs:

— A new non-AP STA associates with the S1G relay AP of the relay.
— A non-AP STA is disassociated or deauthenticated from the S1G relay AP of the S1G relay.
— A Reachable Address Update frame is received at the S1G relay AP of the S1G relay.

An S1G relay STA generating a Reachable Address frame (under conditions 1 and 2 of above) shall set the Initiator MAC address field of the element to its own MAC address.

An S1G relay STA shall set the Add/Remove subfield of a Reachable Address Update frame to 1 if the STA identified by the MAC Address subfield of Reachable Address subfield is associated to the relay AP of the S1G relay and shall set the Add/Remove subfield to 0 if the STA identified by the MAC Address subfield of Reachable Address subfield disassociated from the S1G relay AP of the S1G relay.

An S1G relay STA shall set the Relay Capable subfield of the Reachable Address subfield of the Reachable Address element to 1 only if the STA identified by the MAC address subfield of the Reachable Address subfield has indicated that it is capable of relay function, otherwise, it shall set it to 0.

An S1G relay STA that forwards the Reachable Address received at the S1G relay AP of the S1G relay shall not modify the element.

An S1G root AP shall update the DS upon receipt of a Reachable Address Update frame.

10.50.3 Addressing and forwarding of individually addressed relay frames

An MAC service tuple (including an MSDU) received via the WM at an S1G relay AP is examined by the relay function, and if the DA matches the address of the STA of the S1G relay the MAC service tuple is delivered via the MAC service to the local higher layer entity. Otherwise, the MAC service tuple is passed to the S1G relay STA and then is forwarded via the WM to the AP to which it is associated, using either a four-address frame format or an A-MSDU format except when the frame carrying the (A-)MSDUs is a PV1 QoS Data frame for which header compression is used as described in 10.54.

The addressing of the four-address frame shall be as follows in this case:

— Address 1 is the MAC address of the AP (the receiver of the MPDU)
— Address 2 is either the MAC address or the AID of the S1G relay STA (the transmitter of the MPDU)
— Address 3 is the DA of the MSDU (the destination address of the MSDU).
— Address 4 is the SA of the MSDU (the source address of the MSDU)

If the four-address frame is a PV1 QoS Data frame that contains an A-MSDU then the DA and/or SA field(s) shall not be present in any of the A-MSDU subframe headers unless the DA and/or SA for the MSDU contained in the A-MSDU subframe are not equal to the values contained in Address 3 and/or Address 4 of the frame.

Otherwise, the addressing of the frame containing an A-MSDU shall be as follows in this case:

- Address 1 is the MAC address of the AP (the receiver of the MPDU)
- Address 2 is either the MAC address or the AID of the S1G relay STA (the transmitter of the MPDU)
- Address 3 is the MAC address of the AP (the BSSID)
  - If the frame is a PV1 QoS Data frame then Address 3 is not present
- DA in A-MSDU subframe header is the DA of the MSDU (the destination address of the MSDU)
- SA in A-MSDU subframe header is the SA of the MSDU (the source address of the MSDU)

A MAC service tuple passed to a root AP from the DS, or received at an S1G relay STA via the WM, is examined by the relay function, and if the DA matches the address of the AP or an associated non-AP STA, it is delivered using legacy (non-relay) methods. Otherwise, the included MSDU is forwarded via the WM to the associated S1G relay STA, which most recently included the MSDU's DA in a Reachable Address element, using either a four-address frame format or an A-MSDU format.

The addressing of a four-address frame shall be as follows in this case:

- Address 1 is either the MAC address or the AID of the S1G relay STA (the receiver of the MPDU)
- Address 2 is the MAC address of the AP (the transmitter of the MPDU)
- Address 3 is the DA of the MSDU (the destination address of the MSDU)
- Address 4 is the SA of the MSDU (the source address of the MSDU)

If the four-address frame is a PV1 QoS Data frame that contains an A-MSDU then the DA and/or SA field(s) shall not be present in any of the A-MSDU subframe headers except when DA and/or SA for the MSDU contained in the A-MSDU subframe are different from the values contained in Address 3 and/or Address 4 of the frame.

Otherwise, the addressing of a frame containing an A-MSDU shall be as follows in this case:

- Address 1 is either the MAC address or the AID of the S1G relay STA (the receiver of the MPDU)
- Address 2 is the MAC address of the AP (the transmitter of the MPDU)
- Address 3 is the MAC address of the AP (the BSSID)
  - If the frame is a PV1 QoS Data frame then Address 3 is not present
- DA in A-MSDU subframe header is the DA of the MSDU (the destination address of the MSDU)
- SA in A-MSDU subframe header is the SA of the MSDU (the source address of the MSDU)

When the frame is a PV1 QoS Data frame and the intended receiver has confirmed storing A3 and/or A4 as described in 10.54 then the DA and/or SA should not be present in either the A3 and/or A4 fields of the frame or in the DA and/of SA of the A-MSDU subframe header contained in the frame except when the DA and/or SA for the MSDU are different from the stored values.

10.50.4 Addressing and forwarding of group addressed relay frames

An group addressed MAC service tuple (including an MSDU) received via the WM at an S1G relay AP is passed by the relay function to the S1G relay STA and then is forwarded via the WM to the AP to which the S1G relay STA is associated, using either a four-address frame format or an A-MSDU format except when the frame carrying the (A-)MSDUs is a PV1 QoS Data frame for which header compression is used as described in 10.54.

The addressing of the four-address frame shall be as follows in this case:

— Address 1 is the MAC address of its associated AP (the receiver of the MPDU)
— Address 2 is either the MAC address or the AID of the S1G relay STA (the transmitter of the MPDU)
— Address 3 is the DA of the MSDU (the group address).
— Address 4 is the SA of the MSDU (the source address of the group addressed MSDU)

If the four-address frame is a PV1 QoS Data frame that contains an A-MSDU then the DA and/or SA field(s) shall not be present in any of the A-MSDU subframe headers unless the DA and/or SA for the MSDU contained in the A-MSDU subframe are not equal to the values contained in Address 3 and/or Address 4 of the frame.

Otherwise, the addressing of the frame containing an A-MSDU shall be as follows in this case:

— Address 1 is the MAC address of its associated AP (the receiver of the MPDU)
— Address 2 is either the MAC address or the AID of the S1G relay STA (the transmitter of the MPDU)
— Address 3 is the MAC address of its associated AP (the BSSID)
    — If the frame is a PV1 QoS Data frame then Address 3 is not present
— DA in A-MSDU subframe header is the DA of the MSDU (the group address)
— SA in A-MSDU subframe header is the SA of the MSDU (the source address of the group addressed MSDU)

When the frame is a PV1 QoS Data frame and the intended receiver has confirmed storing A3 and/or A4 as described in 10.54 then DA and/or SA should not be present in either the A3 and/or A4 fields of the frame or in the DA and/of SA field(s) of the A-MSDU subframe header contained in the frame except when the DA and/or SA for the MSDU contained in the frame or in the A-MSDU subframe are different from the stored values.

A group addressed MAC service tuple passed to a root AP from the DS, or received at an S1G relay STA via the WM, is forwarded via the WM using a 3-address frame format.

The addressing of a 3-address frame shall be as follows in this case:

— Address 1 is the DA of the MSDU (the group address)
— Address 2 is the MAC address of the AP (the BSSID)
— Address 3 is the SA of the MSDU (the source address of the group addressed MSDU)

Group addressed MSDUs received via the WM at an S1G relay AP are not forwarded to the WM as a broadcast transmission, but are instead forwarded to the S1G relay STA as specified in 10.3.6. Therefore, group addressed MSDUs in a relay network first travel to the root AP as a unicast transmission, after which they travel down the tree as group transmissions by the S1G root AP and the S1G relay AP(s).

10.50.5 Procedures of TXOP sharing for S1G relay operation

10.50.5.1 General

An S1G STA that supports TXOP sharing procedure may set the Relayed Frame field in the Frame Control field of PV1 QoS Data frames (defined in 9.8), the Relayed Frame field in NDP Ack frames, and the Order field in the Frame Control field of an S1G RTS frame to 1. Otherwise, it shall set the Relayed Frame field or Order field in any frame to 0 unless the frame is an NDP Ack frame used for flow control as described in 10.57. The S1G STA may use TXOP sharing to transmit to the S1G relay (S1G relay AP or S1G relay STA) either one PV1 QoS Data frame in the TXOP or the last PV1 QoS Data frame of the TXOP where the TXOP is obtained as described in 10.22.2.4 and the PV1 QoS Data frame has the Ack Policy field equal to 0 and is carried in an MPDU or in an S-MPDU.

Reception of a valid PV1 QoS Data frame with the Relayed Frame field equal to 1 or of an S1G RTS frame with the Order field equal to 1 indicates a relay-shared TXOP.

An S1G STA indicates support of TXOP sharing with implicit Ack using the TXOP Sharing Implicit Ack Support subfield of the S1G Capabilities Information field in the S1G Capabilities element. If dot11TXOPSharingImplicitACKImplemented is true, the S1G STA shall set the TXOP Sharing Implicit Ack Support subfield to 1 in transmitted frames containing the S1G Capabilities element. Otherwise, the S1G STA shall set the TXOP Sharing Implicit Ack Support subfield to 0.

A non-S1G STA shall not perform TXOP sharing.

An S1G relay entity shall not perform TXOP sharing if the S1G relay STA and S1G relay AP are operating in different primary channels for the duration of the TXOP. An S1G relay that performs TXOP sharing shall use a channel width that is the same or narrower than the channel width indicated by the STA that initiated the TXOP.

The sequence of frames exchanged over the first hop and second hop during a relay-shared TXOP depends on the acknowledgment procedure used by the S1G relay.

When an S1G relay (S1G relay STA or S1G relay AP) receives a valid PV1 QoS Data frame with the Relayed Frame field in the Frame Control field equal to 1, the S1G relay may acknowledge the received PV1 QoS Data frame using the implicit or explicit Ack procedure. The S1G relay shall not acknowledge the received valid PV1 QoS Data frame using either implicit or explicit Ack procedure if the Relayed Frame field in the Frame Control field is equal to 0 in the received PV1 QoS Data frame.

NOTE—The frames transmitted over the first hop and second hop can be sent at two different MCSs.

For error recovery purposes, during a relay-shared TXOP, the TXOP owner may transmit its next PPDU when the CS mechanism (see 10.3.2.1) indicates that the medium is idle at the TxPIFS slot boundary (defined in 10.3.7) (this transmission is a continuation of the current TXOP or SP).

10.50.5.2 Explicit Ack procedure

Throughout this subclause, a Response Indication of Long Response is signaled in an NDP Ack frame by setting the Idle Indication field to 1 and the Duration field to 0 and a Response Indication of No Response is signaled by setting the Idle Indication field to 0 and the Duration field to 0 (see 10.3.2.14).

A non-AP STA (AP) that intends to start a relay-shared TXOP starts it by sending a PV1 QoS Data frame addressed to the S1G relay AP (S1G relay STA) with the Relayed Frame field equal to 1. The S1G relay AP (S1G relay STA), addressed by an RTS frame, that intends to use the explicit Ack procedure, shall respond with an NDP CTS frame with the Duration field set as described in 10.50.5.4.

When using the explicit Ack procedure, the S1G relay AP (S1G relay STA) shall signal a Response Indication of Long Response in the NDP Ack frame that is transmitted as an acknowledgment to the non-AP STA (AP). In addition it shall set the Relayed Frame field of the NDP Ack frame to 1. Otherwise, it shall signal a Response Indication of No Response in the NDP Ack frame and shall set the Relayed Frame field to 0.

When using the explicit Ack procedure, the S1G relay STA (S1G relay AP) shall forward the previously received PV1 QoS Data frame to the AP (non-AP STA), SIFS after the S1G relay AP (S1G relay STA) sent the NDP Ack frame to the non-AP STA (AP). In addition, the S1G relay STA (S1G relay AP) may protect the forwarded frame with a protection mechanism such as RTS/CTS exchange. Upon successful receipt of the relayed PV1 QoS Data frame, the AP (non-AP STA) shall transmit an NDP Ack frame to the S1G relay STA (S1G relay AP), which shall signal a Response Indication of No Response terminating this relay-shared TXOP.

NOTE—The description above applies to both uplink and downlink procedures with the non-AP STA (AP), i.e., either the non-AP STA or the AP is the TXOP owner for the TXOP sharing session.

10.50.5.3 Implicit Ack procedure

A STA that supports implicit Ack procedure and intends to transmit a frame to a next hop STA via an S1G relay (S1G relay STA or S1G relay AP) using the implicit Ack procedure needs to enable the implicit Ack procedure (and acquire the required information to operate using implicit Ack) with the S1G relay. The implicit Ack procedure is enabled between the STA and the S1G relay (S1G relay STA or S1G relay AP) if

- The STA is an AP to which the S1G relay STA of the S1G relay is associated and the S1G relay STA has successfully transmitted to the AP a STA Information Announcement frame containing the AID that the S1G relay AP of the S1G relay has assigned to the next hop non-AP STA.
  - The S1G relay STA may transmit a STA Information Announcement frame to its associated AP that supports the implicit Ack procedure when the S1G relay AP either assigns an AID to the next hop non-AP STA during association or changes the AID of the non-AP STA as described in 10.20a.
  - The AP shall determine the PARTIAL_AID of the next hop non-AP STA as described in 10.20b using the BSSID of the S1G relay AP and the AID of the next hop non-AP STA to be able to use the implicit Ack procedure.
- The STA is a non-AP STA that is associated to the S1G relay AP and the S1G relay AP has transmitted to the STA an S1G Relay element with the RootAP BSSID field containing the BSSID of the next hop AP to which the S1G relay STA of the S1G relay is associated.
  - The non-AP STA shall determine the PARTIAL_AID and the COLOR of the next hop AP as described in 10.20b using the BSSID and COLOR values used by the next hop AP to be able to use the implicit Ack procedure.

After the implicit Ack procedure is enabled and all the required information is acquired as described above, the implicit Ack may be used to acknowledge eliciting PV1 QoS Data frames carried in S1G_SHORT/ S1G_LONG PPDUs (i.e., that contain a PARTIAL AID, UPLINK_INDICATION, and COLOR in their PLCP header).

A STA that intends to share the TXOP with the S1G relay may start the TXOP by sending to the S1G relay an S1G RTS frame with the Order field set to 1 or a PV1 QoS Data frame that has the Relayed Frame field set to 1. An S1G relay (S1G relay STA or S1G relay AP) that is the intended receiver of the S1G RTS frame which intends to use the implicit Ack procedure shall respond with an NDP CTS frame with the Duration field set as described in 10.50.5.4.

When an S1G relay receives a PV1 QoS Data frame during a relay-shared TXOP, the S1G relay may directly forward the received frame without sending back an acknowledgment frame to the transmitter of the frame. If the PV1 QoS Data frame was preceded by an RTS frame then the S1G relay should protect the forwarded frame by sending an RTS frame to the intended receiver as described in 10.50.5.4.

If the MPDU is transmitted by a non-AP STA, which is associated to an S1G relay AP, to the AP, then the S1G relay AP forwards the received MPDU to the AP to which it is associated, using SIFS. After transmitting the MPDU, the non-AP STA shall wait for an AckTimeout interval to detect a PPDU that would acknowledge the reception of the MPDU as described in 10.3.2.9. An indication of successful reception allows the frame sequence to continue, or to end without retries, as appropriate for the particular frame sequence in progress.

If the MPDU is transmitted by an AP to an S1G relay STA, then the S1G relay STA forwards the received MPDU to the non-AP STA that is associated to the S1G relay AP, using SIFS. After transmitting the MPDU, the AP shall wait for an AckTimeout interval to detect a PPDU that would acknowledge the reception of the MPDU as described in 10.3.2.9. An indication of successful reception allows the frame sequence to continue, or to end without retries, as appropriate for the particular frame sequence in progress. If the RA of the forwarded MPDU is different from the DA of the MPDU transmitted by the AP, then the S1G relay STA shall use the explicit Ack procedure.

10.50.5.4 Relay-shared TXOP protection mechanisms

An S1G STA that supports TXOP sharing should initiate a relay-shared TXOP by sending an S1G RTS frame as the first frame in the exchange under EDCA. The S1G STA may set the Order field of the RTS frame to 0 to indicate that the duration of the initiated TXOP is limited as described in 10.22.2.8 and that it expects an NDP CTS frame whose Duration field is set as described in 10.3.2.7. Otherwise, it may set the Order field to 1 to indicate that the duration of the initiated TXOP can be extended (i.e., it is not necessarily limited as described in 10.22.2.8) and that it expects an NDP CTS frame whose Duration field is set as described in this subclause.

An S1G relay that is the intended receiver of the S1G RTS frame with the Order field equal to 1 and intends to use the relay-shared TXOP responds with an NDP CTS frame with a value of the Duration field that depends on the acknowledgment procedure it shall use during this relay-shared TXOP:

— If explicit Ack procedure (see 10.50.5.2) then the Duration field of the NDP CTS frame shall be set to a value D:

$$T_{\mathrm{RTS}} + T_{\mathrm{PENDING}} - T_{\mathrm{CTS}} <= D <= T_{\mathrm{TXOP\_REMAINING}} - T_{\mathrm{PPDU}}$$

where

T_{RTS}	is the value obtained from the Duration/ID field of the S1G RTS frame that elicited the response
T_{CTS}	is the time, in microseconds, between the end of the PPDU carrying the RTS frame and the end of the NDP CTS frame
T_{PENDING}	is the estimated time required for the transmission of the frame to be forwarded, its response if required, protection frame exchanges if required, plus applicable IFS durations
$T_{\mathrm{TXOP\_REMAINING}}$	is equal to any T_{TXOP} as defined in 9.2.5.2 minus T_{RTS}
$\mathrm{T}_{\mathrm{PPDU}}$	is the time required for transmission of the current PPDU

— If implicit Ack procedure (see 10.50.5.3), then the Duration/ID field of the NDP CTS frame shall be set according to 9.2.5.7. When using the implicit Ack procedure, upon successful reception of a PV1 QoS Data frame that is preceded by the transmission of an NDP CTS frame as described above, the S1G relay (S1G relay STA or S1G relay AP) should protect the PV1 QoS Data frame transmission with an RTS/CTS protection mechanism. The Duration/ID field of the RTS frame shall be less than or equal to T_{TXOP} for that AC, as defined in 9.2.5.2, minus the estimated time since the start of the reception of the RTS frame with the Order field equal to 1 that was sent by the relay-shared TXOP owner.

An S1G relay (S1G relay STA or S1G relay AP) that uses the relay-shared TXOP may transmit an (NDP) CF-End frame after successfully forwarding the PV1 QoS Data frame if the remaining duration is long enough to transmit this frame.

An S1G relay that is the intended receiver of the S1G RTS frame with the Order field equal to 0 responds with an NDP CTS frame as described in 10.3.2.7.

10.50.6 S1G Relay discovery procedure

A single hop link is an one-hop link between a non-AP STA and the root AP.

A relay link is a multi-hop link between a non-AP STA performing an active scan for S1G relays, and the S1G root AP through the S1G relay.

A non-AP STA that performs active scanning may use the Probe Request frame with an S1G Relay Discovery element when relay discovery procedure is implemented. A non-AP STA with dot11RelayDiscoveryOptionImplemented equal to true may transmit a Probe Request frame including an S1G Relay Discovery element with link budget information for the single hop link and additional QoS requirements for the relay link. This information shall be conveyed using the S1G Relay Discovery element as defined in 9.4.2.208 if present. The formulas for calculating link budget and QoS requirements are implementation specific.

An S1G relay with dot11RelayDiscoveryOptionImplemented equal to true that receives a Probe Request frame becomes eligible to be an S1G relay for this non-AP STA if the link budget and QoS requirements are met and the SSID and other capability parameters match. If these requirements are met, an S1G relay may respond to the non-AP STA with a Probe Response frame, or a PV1 Probe Response as an S1G relay candidate for this non-AP STA. When a non-AP STA uses the S1G Relay Discovery element to indicate the DL/UL maximum/minimum/mean data rates of the direct link or the Delay Bound Requirement of the connection through the S1G relay in the Probe Request frame, the S1G relay may also use those parameters as the criteria of responding to the Probe Request frame. The principle for this operation is to reduce the number of Probe Response, or PV1 Probe Response frames sent from S1G relays.

An S1G relay may optionally include link budget information along with other information in S1G Relay Discovery elements such as DL/UL maximum/minimum/mean data rates, Relay STA Count or Channel Utilization information in a Probe Response frame, a PV1 Probe Response frame, or a Beacon frame. This information is used for the non-AP STA, when multiple Probe Response, or PV1 Probe Response, frames are received, to select an S1G relay among multiple S1G relay candidates.

An S1G relay with dot11RelayDiscoveryOptionImplemented equal to true that receives a Probe Request frame with the S1G Relay Discovery element from a non-AP STA may respond to the non-AP STA with a probe response frame with the S1G Relay Discovery element carrying the Information Not Available field set to 1 to indicate that for the remaining duration of the current association it will not provide any requested relay discovery information.

10.51 Group AID

An S1G STA with dot11GroupAIDActivated equal to true supports the implementation of group addressed traffic delivery using group AID. An S1G STA with dot11GroupAIDActivated equal to true shall set the Group AID Support subfield in the S1G Capabilities element it transmits to 1. Otherwise, it shall set it to 0.

A group AID is an AID that is assigned by an S1G AP to identify a group of S1G STAs. A group AID corresponds to a bit in the traffic-indication virtual bitmap. An S1G AP signals the presence of group addressed BUs that correspond to a group AID using the same signalling as the signalling of individually addressed BUs, i.e., the AP sets the bit corresponding to the group AID in the traffic-indication virtual bitmap to 1 when BUs are present, and sets it to 0 otherwise.

An S1G STA with dot11GroupAIDActivated equal to true that has a group MAC address may request a group AID from the S1G AP to which it is associated to by sending an AID Switch Request frame. Upon receiving the AID Switch Request frame, the S1G AP that supports group AID responds with an AID Switch Response that contains the assigned group AID that corresponds to that group MAC address and the group listen interval as described in 10.20a. The S1G AP may assign different group AIDs to S1G STAs that have the same group MAC address but different group listen intervals. The S1G STA should maintain the link between the assigned group AID to its group MAC address and group listen interval.

An S1G AP that has negotiated a group AID shall indicate the presence of group addressed BUs corresponding to the group AID in the TIM included in the S1G Beacon frame that is sent every group listen interval, following the expiration of a counter that corresponds to the AID Switch Count included in the AID Response element containing the group AID and that started upon transmission of that element.

An S1G STA that has negotiated a group AID and has not negotiated TWTs (see 10.43) shall wake up every group listen interval that corresponds to the group AID to receive the S1G Beacon frame, starting from the TBTT or TSBTT that follows the expiration of a counter that corresponds to the AID Switch Count included in the AID Response element containing the group AID and that started upon receipt of that element. An S1G STA that has negotiated both group AID and TWTs wakes at specific target wake times as defined in 10.43.

For example, when S1G AP with dot11PageSlicingActivated equal to true has data buffered for a group of S1G STAs with dot11PageSlicingActivated equal to true that belong to a group AID, it indicates this condition in the Page Slice element (9.4.2.193) transmitted in a DTIM Beacon frame. The S1G STAs that detect this indication will wake up at the assigned beacon interval to determine the TIM and extract the assigned time slots that carry the buffered group data. The S1G AP transmits the buffered group data within the assigned time slots for the S1G STAs' reception.

The S1G AP that has indicated the presence of group addressed BUs for a given group AID in an S1G Beacon frame shall deliver these BUs using a PV1 frame with the group AID in the A1 field (see 9.8.3.2) and setting the partial AID as described in 10.20b. These group addressed frames should be delivered during the beacon interval or short beacon interval that follows the S1G Beacon frame or within negotiated TWT SPs if that group AID is assigned to a non-AP STA that follows 10.43.

An S1G STA that has a group AID assigned for a particular group MAC address shall discard any received frame that contains that group MAC address in the RA field.

NOTE—This avoids that the STA receives duplicate groupcast BUs with different group delivery procedures.

For the S1G STAs with the group MAC address, which do not have the group AID, the S1G AP does not follow this subclause to transmit group data.

10.52 Traveling Pilot Operation

An S1G STA with dot11S1GTravelingPilotOptionActivated equal to true shall set the Traveling Pilot Support field in the S1G Capabilities Info field of the S1G Capabilities element, as described in 9.4.2.201 to

— 1 (i.e., B22 = 1, B23 = 0) if reception of traveling pilots is supported only for one space-time stream
— 3 (i.e., B22 = 1, B23 = 1) if reception of traveling pilots is supported for both one and two space-time streams

An S1G STA with dot11S1GTravelingPilotOptionActivated equal to false shall set the Traveling Pilot Support field in the S1G Capabilities element to 0 (i.e., B22 = 0, B23 = 0).

An S1G STA shall not transmit a frame with TXVECTOR parameter TRAVELING_PILOTS equal to 1 to an S1G STA unless the Traveling Pilot Support field of the S1G Capabilities element received from that STA contained a value of 1 or 3 and dot11S1GTravelingPilotOptionActivated is true.

10.53 Bitmap Protection for NDP BlockAck frames

NDP BlockAck frames are protected by the 4 bit CRC of the S1G SIG-A field, which might not be enough to protect the BlockAck Bitmap field contained in the frame. This subclause describes a mechanism that offers increased protection for the BlockAck Bitmap field of NDP BlockAck frames.

The originator of an NDP BlockAck (NDP_1M BlockAck or NDP_2M BlockAck) frame (see 9.9.2.6) shall protect the BlockAck Bitmap field of the NDP BlockAck frame (shown in Figure 9-774 and Figure 9-775) by using the encoding procedure defined in this subclause.

Initially the bit sequences [B3: B10] for NDP_1M BlockAck and [B3:B18] for NDP_2M BlockAck frames are set as described in or 10.3.2.9a. Then, prior to transmission, the originator encodes the bit sequences following the procedure below.

Encoding Procedure:

For an NDP_1M BlockAck frame:
— [B3: B10] = XOR([B3: B10], [B17: B24]);

For an NDP_2M BlockAck frame
— [B3: B18] = XOR([B3: B18], [B21: B36]);

The intended recipient shall perform the same procedure to decode the bit sequences [B3: B10] for NDP_1M BlockAck and [B3:B18] for NDP_2M BlockAck frames.

10.54 Generation of PV1 MPDUs and header compression procedure

An S1G STA that sets the STA Type Support subfield in a transmitted S1G Capabilities element to 0 or 1, as described in 10.59, shall set the PV1 Frame Support subfield in the S1G Capabilities element to 1. An S1G STA that sets the STA Type Support subfield in a transmitted S1G Capabilities element to 2 may set the PV1 Frame Support subfield in the S1G Capabilities element to 0.

An S1G STA shall not transmit PV1 MPDUs with the Type subfield equal to 0, 1 or 3 to a peer STA unless the PV1 Frame Support subfield of the S1G Capabilities element received from the peer STA contained a value of 1. An S1G STA with dot11PV1MACHeaderOptionImplemented equal to true shall use the PV1 format instead of the PV0 format to transmit QoS Data, Action, and Action No Ack frames that are individually addressed to a peer STA from which it has received an S1G Capabilities element with PV1 Frame Supported subfield equal to 1.

NOTE—An S1G STA can use the PV1 format to transmit group addressed frames as described in 10.51.

The header compression procedure enables S1G STAs to store addresses and/or update security parameters at the receiver.

An S1G STA with dot11PV1MACHeaderOptionImplemented equal to true may include a Header Compression element in Header Compression frames. The STA may include the Header Compression element in (Re)Association Request frames and (Re)Association Response frames when management frame protection is not negotiated for the association. The STA may set the PV1 Data Type 3 Supported subfield in the Header Compression element to 1 to indicate that it supports reception of PV1 frames that have the Type subfield in the Frame Control field equal to 3.

After association, an S1G STA with dot11PV1MACHeaderOptionImplemented equal to true may transmit Header Compression frames and PV1 frames. An S1G STA shall not transmit PV1 frames with Type subfield equal to 3 to a peer STA unless the PV1 Data Type 3 Supported subfield is 1 in the most recently received Header Compression element sent by the peer STA. An S1G STA in an IBSS shall not transmit PV1 frames with a value of the Type subfield equal to 0 or 1.

NOTE—A PV1 frame is an MDPU with Protocol Version field in the Frame Control field equal to 1 (see 9.8).

The header compression procedure uses a Header Compression element, which is referred to as a header compression request or a header compression response, depending on the Request/Response subfield setting of the Header Compression element.

A STA that transmits PV1 frames with Type subfield equal to 0 shall include the A3 field if the value of this field:

— Is not equal to the address identified by the A1 field and an A3 is not stored at the receiver
— Is not equal to the A3 stored at the receiver.

Otherwise, the A3 field shall not be included in the frame.

A STA that transmits PV1 frames with Type subfield equal to 0 shall include the A4 field if the value of this field:

— Is not equal to the address identified by the A2 field and an A4 is not stored at the receiver
— Is not equal to the A4 stored at the receiver.

Otherwise, the A4 field shall not be included in the frame.

An S1G STA indicates a request to store address fields by sending a header compression request with the Store A3 and/or Store A4 subfields equal to 1. Upon receipt of such a request, the receiving STA shall respond with a header compression response indicating which of the optional fields it stores, by setting the Store A3 and/or Store A4 subfields in the transmitted header compression response to 1. Stored address fields can subsequently be omitted from the MAC header of PV1 frames transmitted by the STA that sent the header compression request. Address A3 and/or A4 fields for which the header compression response indicated 0 are not stored at the receiver and cannot be omitted by the transmitter when the A3 and/or A4 fields contain values that are different from the A1 and/or A2 fields of the same.

An S1G STA indicates a request to update security parameters by sending a header compression request with the CCMP Update subfield equal to 1. The receiver STA shall respond with a header compression response acknowledging receipt of the updated security parameters.

After sending a header compression request, an S1G STA shall postpone the transmission of PV1 frames that do not include the fields that were requested to be stored to the recipient of the header compression request until it receives the corresponding header compression response.

After receiving a header compression request, an S1G STA shall store and activate the included addresses it intends to store and/or the security information included in the header compression request before transmitting the corresponding header compression response.

When no header compression response has been received in response to a header compression request within dot11HeaderCompressionResponseTimeout, an S1G STA shall transmit another header compression request.

A STA that receives a PV1 frame with one or more compressed addresses that it has not stored or which causes a decryption error should transmit an unsolicited header compression response to the transmitter of the PV1 frames, in which the Store A3, and Store A4 fields are all equal to 0. The unsolicited header compression response shall include the TID/ACI of the received PV1 frame in the TID/ACI subfield of the

CCMP Update field if the received frame caused a decryption error, where the CCMP Update field shall indicate the stored values for the BPN and Key ID that correspond to the received PV1 frame.

A STA that has previously transmitted PV1 frames of a given TID/ACI to a peer STA and that receives an unsolicited header compression response from the peer STA relative to that TID/ACI shall transmit a header compression request to the transmitter of the header compression response. The header compression request shall include all the addresses that the transmitting STA requests to be stored at the receiver and/or the security information that corresponds to the indicated TID/ACI.

10.55 Transmission of an S1G NDP CMAC frame

An S1G STA transmitting an S1G NDP CMAC frame shall use the following TXVECTOR parameters:

- NDP_INDICATION set to 1
- NUM_STS indicates one space-time stream
- APEP_LENGTH set to 0
- NUM_USERS set to 1

An S1G STA in an IBSS shall not transmit an S1G NDP CMAC frame, except for an NDP Ack, NDP BlockAck or NDP Probe Request frame.

10.56 S1G_Long operation

An S1G STA with dot11S1GLONGOptionActivated equal to true shall set the S1G_LONG Support field in the S1G Capabilities element to 1. An S1G STA with dot11S1GLONGOptionActivated equal to false shall set the S1G_LONG Support field in the S1G Capabilities element to 0.

An S1G STA shall not transmit a frame with TXVECTOR parameter PREAMBLE_TYPE set to S1G_LONG_PREAMBLE to an S1G STA unless the S1G_LONG Support field of the S1G Capabilities element received from that STA contained a value of 1 and dot11S1GLONGOptionActivated is true.

10.57 S1G flow control

This subclause describes flow control operation for an S1G STA.

NOTE—The S1G relay operation can use the flow control mechanism described in this subclause to prevent from the overflow condition.

A STA that supports flow control shall set the Flow Control Supported subfield to 1 in the S1G Capabilities element it transmits. An S1G AP that implements flow control may refuse (re)association or can disassociate a non-AP STA that sets the Flow Control Supported subfield to 0 in the S1G Capabilities element. The S1G AP that refuses (re)association or disassociates the STA shall set the Status Code field in the (Re)Association Response frame or in the Disassociation frame to FLOW_CONTROL_OPERATION_SUPPORTED.

A STA that sets the Flow Control Supported subfield to 1 in the S1G Capabilities element that it transmits may instruct a second STA that sets the Flow Control Supported subfield to 1 in the S1G Capabilities element that it transmits to stop sending data frames using a flow-control instruction. The STA sending the flow-control instruction is called the flow-controlling STA. A STA that sets the Flow Control Supported subfield to 0 in the S1G Capabilities element that it transmits shall not instruct a second STA to stop sending data frames using a flow-control instruction as described in this subclause. A STA that is the intended recipient of a flow-control instruction and that correctly receives that instruction is called a flow-controlled STA. A flow-controlled STA does not transmit any data frames to the flow-controlling STA that transmitted the flow-control instruction, for the amount of time indicated in the flow-control instruction. A flow-control instruction is any of the following:

— A Flow Suspension frame
— A BAT frame with the Flow Control bit in the Frame Control field equal to 1
— A TACK frame with the Flow Control bit in the Frame Control field equal to 1
— A STACK frame with the Flow Control bit in the Frame Control field equal to 1
— An NDP Ack frame with the Relayed Frame field equal to 1 and the Idle Indication field equal to 1 and the Duration field equal to a nonzero value

NOTE—The transmission of BAT frames, STACK frames, TACK frames is only permitted within TWT SP as described in 10.43, 10.24, and 10.3.2.9.

The Suspend Duration field of the Flow Suspension frame listed above indicates the length of time during which a flow-controlled STA shall not transmit Data frames to the flow-controlling STA identified by the TA field of the Flow Suspension frame.

The Suspend Duration field of the TACK/BAT/STACK frame listed above indicates the length of time during which a flow-controlled TWT STA shall not transmit Data frames to the flow-controlling STA identified by the TA field of the TACK/BAT frame and the RA field of the frame that elicited the STACK frame.

The Duration field of the NDP Ack frame listed above indicates the length of time during which a flow-controlled STA shall not transmit Data frames to the flow-controlling STA identified by the RA field of the frame that elicited the NDP Ack frame.

A flow-controlled STA may resume transmission of data frames addressed to the flow-controlling STA that had previously suspended transmission after the expiration of the time indicated in the Suspend Duration field of a Flow Suspension frame, TACK frame, BAT frame, or TACK frame or in the Duration field of an NDP Ack frame.

A flow-controlling STA may send a Flow Resumption frame to cancel any outstanding flow suspension time for the flow-controlling STA identified by the TA field of the Flow Resumption frame.

A flow-controlled STA that receives a Flow Resumption frame with a BSSID that matches the BSSID of the BSS of which the flow-controlled STA is a member or with an RA field that matches the address of the flow-controlled STA shall cancel any outstanding flow suspension time, and may resume transmission of data frames to the flow-controlling STA identified by the TA field of the Flow Resumption frame.

A STA should send a next TWT value in the Next TWT Info/Suspend Duration field of the response frame it transmits to a TWT STA if the More Data bit is equal to 0 in the eliciting frame. A STA may send a suspend time value in the Next TWT Info/Suspend Duration field of a response frame it transmits to a TWT STA if the More Data bit is equal to 1 in the eliciting frame.

10.58 Energy limited STAs operation

An S1G STA keeps two timers, ELMaxAwakeTimer and ELRecoveryTimer, for each EL STA; and these timers are initialized upon successful reception of an EL Operation element from the EL STA:

— The ELMaxAwakeTimer is set to 0.
— The ELRecoveryTimer is set to the value of the Recovery Time Duration field of the EL Operation element.

These timers uniformly count down to 0 when their values are nonzero. Figure 10-103 shows an example of the EL STA frame exchanges with the S1G STA.

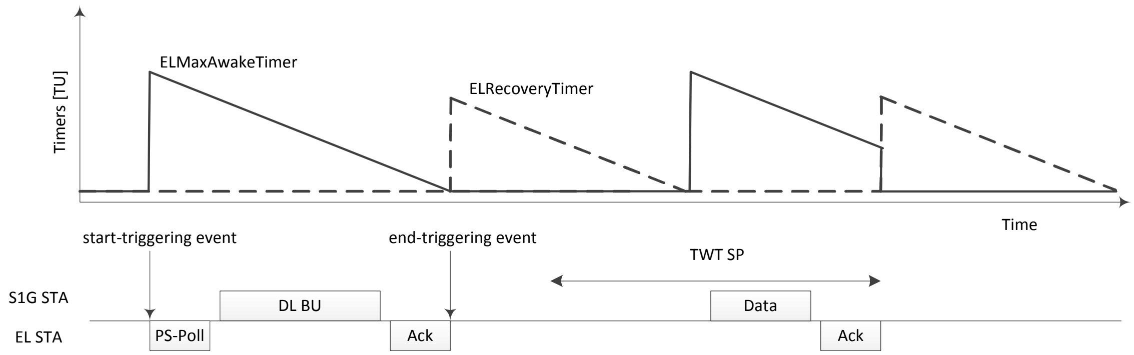


Figure 10-103—EL STA operation

The S1G STA shall not transmit to the EL STA, or cause the EL STA to transmit, an individually addressed PPDU whose duration would exceed the value of the ELMaxAwakeTimer.

The S1G STA shall set the ELMaxAwakeTimer to the value of the Max Awake Duration field of the most recently received EL Operation element from the EL STA and the ELRecoveryTimer to 0 when a start-triggering event occurs (see Figure 10-103 for an example). A start-triggering event occurs when both ELMaxAwakeTimer and ELRecoveryTimer are 0, and one of the following events that identify a transition of the EL STA from Doze to Awake state occurs:

- An (NDP) PS-Poll or trigger frame sent by the EL STA is received by the S1G STA.
- A TWT starts for the EL STA, where the TWT corresponds to any TWT agreement that the EL STA has set up with the S1G STA.
- A RAW slot allocated for the EL STA starts, where the RAW slot is scheduled in a RAW scheduled for the EL STA by the S1G STA.
- A TBTT or TSBTT at which the EL STA has to be awake is due, where the TBTT or TSBTT is the time the S1G STA sends an S1G Beacon frame that is intended to be received by the EL STA.

NOTE—An EL STA can send a frame that is not a trigger frame to the S1G STA anytime and the reception of this frame from the S1G STA does not qualify as a start-triggering event.

The S1G STA shall not schedule a transmission of a PPDU carrying an individually addressed MPDU intended for the EL STA, or cause the EL STA to transmit an individually addressed PPDU until the ELRecoveryTimer has reached 0.

The S1G STA shall set the ELRecoveryTimer to the value of the Recovery Time Duration field of the most recently received EL Operation element from the EL STA and the ELMaxAwakeTimer to 0 when an end-triggering event occurs (see Figure 10-103 for an example). An EL STA may indicate the Recovery Time Duration by including the Recovery Time Duration in the Duration field of an NDP (PS-Poll-)Ack frame with Idle Indication set to 1. An end-triggering event occurs when the ELRecoveryTimer is 0 and one of the following events that identify a transition of the EL STA to Doze state occurs:

- An acknowledgment is received from the EL STA as a response to the transmission of a BU, where the BU is sent by the S1G STA in response to an (NDP) PS-Poll or trigger frame generated by the EL STA.
- An acknowledgment is received from the EL STA as a response to of a frame with EOSP field equal to 1, where the frame is sent by the S1G STA.

- An NDP (PS-Poll-)Ack frame is received from the EL STA as a response to a frame generated by the S1G STA, where the NDP (PS-Poll-)Ack frame has an Idle Indication field equal to 1 and a nonzero value of the Duration field.
  - In this case, the ELRecoveryTimer is set to the value of the Duration field of the NDP (PS-Poll-)Ack frame when the Idle Indication field is 1.
- The AdjustedMinimumTWTWakeDuration for a TWT has ended, where the TWT corresponds to any TWT agreement that the EL STA has set up with the S1G STA.
- The RAW slot allocated for the EL STA has ended, where the RAW slot was scheduled in a RAW for the EL STA by the S1G STA.
- The transmission of an S1G Beacon frame has ended, where the S1G Beacon is sent at a TBTT or TSBTT at which the EL STA was expected to be awake.
- The transmission of group addressed BU(s) has ended, where the group addressed BU(s) are expected to be received by the EL STA following a DTIM Beacon.

When the S1G STA cannot complete frames exchanges within ELMaxAwakeTimer, a new backoff procedure is invoked after stopping the current transmission and once the ELRecoveryTimer has expired.

10.59 S1G BSS type and STA type

S1G non-AP STAs are categorized into two types, sensor STAs and non-sensor STAs.

A non-AP STA that is a sensor STA shall set the STA Type Support subfield in the S1G Capabilities element it transmits to 1. A non-AP STA that is a non-sensor STA shall set the STA Type Support subfield in the S1G Capabilities element it transmits to 2.

There are three types of S1G BSS that an S1G AP can set up: sensor BSS, non-sensor BSS, or mixed BSS. A sensor BSS only supports sensor STAs. A non-sensor BSS supports only non-sensor STAs. A mixed BSS supports both sensor STAs and non-sensor STAs.

An AP may declare a non-sensor BSS by transmitting the S1G Capabilities element in Beacon frames, Probe Response, or PV1 Probe Response frames in which the STA Type Support subfield is 2 (i.e., it indicates that only non-sensor STAs are allowed to associate and operate with that AP).

An AP may declare a sensor BSS by transmitting the S1G Capabilities element in Beacon frames, Probe Response frames, or PV1 Probe Response frames in which the STA Type Support subfield is 1 (i.e., it indicates that only sensor STAs are allowed to associate and operate with that AP).

An AP may declare a mixed BSS by transmitting the S1G Capabilities element in a Beacon, Probe Response or PV1 Probe Response frame, in which the STA Type Support subfield is 0 (i.e., it indicates that any type of STA is allowed to associate and operate with that AP).

An S1G AP that indicates support for sensor STAs shall not indicate minimum MCS restrictions as specified in 10.7.13.3.

11. MLME

11.1 Synchronization

11.1.2 Basic approach

11.1.2.1 TSF for an infrastructure BSS or a PBSS

Change the first and second paragraphs of 11.1.2.1 as follows:

In an infrastructure BSS or in a PBSS, the AP in the infrastructure BSS or the PCP in the PBSS shall be the timing master for the TSF. In a non-DMG and non-S1G BSS, the AP shall periodically transmit frames called *Beacon frames*. Instead of Beacon frames, an S1G AP shall periodically transmit S1G Beacon frames (as described in 11.1.3.10.1), which provide a similar function to the Beacon frame in a non-S1G BSS. Within an S1G BSS, the generation and/or reception of a Beacon frame and all references to it refer to that of the S1G Beacon frame. In a DMG BSS, the AP or PCP shall periodically transmit frames called *DMG Beacon frames* and *Announce frames*, which provide a similar function to the Beacon frame in a non-DMG BSS. Beacon, S1G Beacon, DMG Beacon, and Announce frames contain the value of the AP's or PCP's TSF timer in order to synchronize the TSF timers of other STAs in a BSS. A receiving STA shall accept the timing information in Beacon, S1G Beacon, DMG Beacon, and Announce frames sent from the AP or PCP servicing its BSS. An S1G STA that receives an S1G Beacon frame shall update its TSF timer according to the algorithm described in 11.1.3.10.3. If a STA's TSF timer is different from the timestamp in the received Beacon, S1G Beacon, DMG Beacon, or Announce frame, the receiving STA shall set its local TSF timer to the received timestamp value. A STA that receives a frame from its currently associated AP containing a Tetrapartial Timestamp or a Pentapartial Timestamp field may update its local TSF using the received portions of the AP's TSF timer contained in the received field, following the procedure described in 11.1.3.10.3.

In a non-DMG and non-S1G BSS, Beacon frames shall be generated for transmission by the AP once every dot11BeaconPeriod TUs. In an S1G BSS, the S1G AP shall generate S1G Beacon frames every dot11BeaconPeriod TUs; and if dot11ShortBeaconInterval is true, it shall additionally generate S1G Beacon frames every dot11ShortBeaconPeriod TUs as described in 11.1.3.10.1.

11.1.2.2 TSF for an IBSS

Change 11.1.2.2 as follows:

The TSF in an IBSS is implemented via a distributed algorithm that is performed by all of the members of the BSS. Each STA in the IBSS shall transmit Beacon or S1G Beacon frames according to the algorithm described in this subclause. Each IBSS STA shall adopt the TSF value received from any Beacon or S1G Beacon frame or probe response from the IBSS of which it is a member and which has a TSF value later than its own TSF timer. All Beacon frames transmitted in an S1G IBSS shall be S1G Beacon frames, and all references to the Beacon frame (generation and/or reception) in an S1G BSS refer to that of the S1G Beacon frame.

11.1.3 Maintaining synchronization

11.1.3.2 Beacon generation in non-DMG infrastructure networks

Change the first and second paragraphs of 11.1.3.2 as follows:

If t~~T~~he AP is a non-S1G AP, it shall define the timing for the entire BSS by transmitting Beacon frames according to dot11BeaconPeriod. If the AP is an S1G AP, it shall define the timing for the entire BSS by transmitting S1G Beacon frames according to dot11BeaconPeriod. This defines a series of TBTTs exactly dot11BeaconPeriod TUs apart. Time 0 is defined to be a TBTT with the Beacon frame being a DTIM. At each TBTT, the AP shall schedule a Beacon frame as the next frame for transmission according to the medium access rules specified in Clause 10.

The beacon period is included in Beacon and Probe Response frames, and a STA shall adopt that beacon period when joining the BSS, i.e., the STA sets dot11BeaconPeriod to that beacon period. A non-S1G AP shall not transmit S1G Beacon frames. The operation of an S1G AP is further defined in 11.1.3.10.1.

11.1.3.5 Beacon generation in an IBSS

Change the first paragraph of 11.1.3.5 as follows (the list after this paragraph remains unchanged):

Beacon generation in an IBSS is distributed. The beacon period is included in Beacon, Announce, and Probe Response frames, and a STA shall adopt that beacon period when joining the IBSS. All members of the IBSS participate in beacon generation. Each STA shall maintain its own TSF timer that is used for dot11BeaconPeriod timing. The beacon interval within an IBSS is established by the STA at which the MLME-START.request primitive is performed to create the IBSS. An S1G STA in an IBSS has dot11ShortBeaconInterval set to false. This defines a series of TBTTs exactly dot11BeaconPeriod TUs apart. Time zero is defined to be a TBTT. At each TBTT the STA shall

11.1.3.8 Multiple BSSID procedure

Change the first paragraph of 11.1.3.8 as follows:

Implementation of the Multiple BSSID capability is optional for a WNM STA ~~and for~~, a DMG STA and an S1G STA. Implementation of the Multiple BSSID capability is mandatory for a FILS STA. A STA that implements the Multiple BSSID capability has dot11MultiBSSIDImplemented equal to true. When dot11MultiBSSIDImplemented is true, dot11WirelessManagementImplemented shall be equal to true except for a DMG STA and for an S1G STA, in which case it may be equal to false. A STA in which dot11MultiBSSIDActivated is true is defined as a STA that supports the Multiple BSSID capability. The STA shall set to 1 the Multiple BSSID field of the Extended Capabilities elements that it transmits.

Change the fifth and sixth paragraphs of 11.1.3.8 as follows:

The Partial Virtual Bitmap field in the transmitted BSSID Beacon, S1G Beacon, ~~frame~~ or DMG Beacon frame shall indicate the presence or absence of traffic to be delivered to all stations associated to a transmitted or nontransmitted BSSID. The first 2^n bits of the bitmap are reserved for the indication of group addressed frame for the transmitted and all nontransmitted BSSIDs. The AID space is shared by all BSSs and the lowest AID value that shall be assigned to a ~~station~~ non-S1G STA is 2^n (see 9.4.2.6). The decimal value of the 11 LSBs of the AID assigned to an S1G STA shall be greater than 2^n. The Encoded Blocks that contain these first 2^n AIDs (if any) shall precede the Encoded Blocks that contain AIDs for the S1G STAs in the S1G Partial Virtual Bitmap field of each page.

Operation in a non-DMG and non-S1G BSS is subject to the following additional rules. If the Contention Free Period is supported and if more than one BSS's CFPCount becomes 0 in the same Beacon frame, the AP shall concatenate the Contention Free Periods of all CFPs that coincide and shall not transmit a CF-End or CF-End+Ack frame until the end of the concatenated CFP, indicated with a single CF-End or CF-End+Ack frame, if required. The CF Parameter Set in the transmitted BSSID contains times that are an aggregate of CFP times of the nontransmitted BSSIDs.

Insert the following subclauses (11.1.3.10 through 11.1.3.10.4) after 11.1.3.9:

11.1.3.10 Maintaining synchronization using S1G Beacon frames

11.1.3.10.1 General S1G synchronization

An S1G AP schedules an S1G Beacon frame at intervals given by the dot11BeaconPeriod or dot11ShortBeaconPeriod as described in 11.1.2.1. The Timestamp field of the S1G Beacon frame shall be set to the 4 least significant octets of the transmitting STA's TSF timer at the time that the start of the data symbol, containing the first bit of the Timestamp field, is transmitted by the PHY plus the transmitting STA's delays through its local PHY from the MAC-PHY interface to its interface with the WM.

An S1G Beacon frame scheduled at TSBTT that is not a TBTT may include the elements from the minimum set of elements shown in Table 9-41a. An S1G Beacon frame scheduled at TBTT shall include the S1G Beacon Compatibility element as the first optional element and may include all the other elements from the full set of elements shown in Table 9-41a. Note that the S1G Beacon Compatibility element replaces the following fields of the Beacon frame body: Timestamp, Beacon Interval and Capability Information which are not included in an S1G Beacon frame. The S1G Beacon Compatibility element shall be generated no later than the Timestamp field of the S1G Beacon frame that carries the element and not earlier than $2^{31}–1$ microseconds. A STA can reconstruct the 8 octet TSF timer at the AP by concatenating the 4 octet TSF Completion field in the S1G Beacon Compatibility element with the Timestamp field in the S1G Beacon frame as described in 11.1.3.10.3.

11.1.3.10.2 Generation of S1G Beacon frames

In an infrastructure BSS, S1G Beacon frames shall be transmitted by an S1G AP. Each S1G STA in an IBSS shall transmit S1G Beacon frames. An AP with dot11ShortBeaconInterval equal to true shall further define the timing for the BSS by sending S1G Beacon frames according to the dot11ShortBeaconPeriod. The value for the dot11ShortBeaconPeriod shall be such that dot11BeaconPeriod = n×dot11ShortBeaconPeriod, where n is a positive integer. This defines a series of TSBTTs exactly dot11ShortBeaconPeriod TUs apart. If n is greater than 1, the Next TBTT field shall be present in S1G Beacon frames transmitted at TSBTT that is not a TBTT; otherwise, it shall not be present in S1G Beacon frames.

Time 0 is defined to be a TBTT or TSBTT with the S1G Beacon frame being a DTIM. At each TBTT or TSBTT, the AP shall schedule an S1G Beacon frame as the next frame for transmission. At each TBTT or TSBTT the AP should suspend the decrementing of the backoff timer for any pending non-beacon transmission and transmit the S1G Beacon frame according to the medium access rules specified in Clause 10.

The beacon period is included in S1G Beacon, Probe Response, and PV1 Probe Response frames, and a STA shall adopt that beacon period when joining the S1G BSS and S1G IBSS, i.e., the STA shall set its dot11BeaconPeriod to that beacon period. If dot11ShortBeaconInterval is equal to true, short beacon period included in the Short Beacon Interval element shall be carried in an S1G Beacon, Probe Response, and PV1 Probe Response frames. An S1G STA shall adopt that short beacon period when joining the S1G BSS or S1G IBSS, i.e., the STA shall set its dot11ShortBeaconInterval to true and its dot11ShortBeaconPeriod to that short beacon period.

11.1.3.10.3 TSF timer accuracy with S1G Beacon

Upon receiving an S1G Beacon frame with a valid FCS and BSSID, an S1G STA shall update its TSF timer according to the algorithm described below.

The received Timestamp value shall be adjusted by adding an amount equal to the receiving STA's delay through its local PHY components plus the time since the first bit of the Timestamp field was received at the MAC/PHY interface.

If the received S1G Beacon frame does not include an S1G Beacon Compatibility element:

- If the most significant bit (MSB) of the adjusted value of the received Timestamp is not equal to the MSB of the 4 least significant octets of the local TSF timer then the value of the 4 most significant octets of the TSF timer shall be adjusted to account for roll over as follows:
  - The value shall be increased by one unit (modulo 2^{32}) if LT > AT and LT > AT + 2^{31}
  - The value shall be decreased by one unit (modulo 2^{32}) if LT < AT and LT < AT - 2^{31}

  where AT is the adjusted value of the received Timestamp and LT is the value of the 4 least significant octets of the local TSF timer
- The 4 least significant octets of the STA's local TSF timer shall be set to the adjusted value of the Timestamp.

If the received S1G Beacon frame includes an S1G Beacon Compatibility element:

- The 4 least significant octets of the STA's TSF timer shall then be set to the adjusted value of the Timestamp.
- If the most significant bit of the adjusted value of the Timestamp is 0 and the value of the TSF Rollover Flag field in the S1G Beacon Compatibility element is 1, then the 4 most significant octets of the TSF timer shall be adjusted to account for roll over (i.e., the value obtained from the TSF Completion field shall be increased by one unit (modulo 2^{32}). Otherwise, the 4 most significant octets of the TSF timer shall be set to the value of the TSF Completion field in the S1G Beacon Compatibility element.

11.1.3.10.4 Passive scanning with S1G Beacon

If the ScanType parameter indicates a passive scan, the S1G STA shall listen to each channel scanned for no longer than a maximum duration defined by the MaxChannelTime parameter.

11.1.4 Acquiring synchronization, scanning

11.1.4.3 Active scanning

11.1.4.3.1 Introduction

Change 11.1.4.3.1 as follows:

Active scanning involves the generation of Probe Request frames and the subsequent processing of received probe responses. ~~Probe Response frames.~~ The details of the active scanning procedures are as specified in the following subclauses.

11.1.4.3.4 Criteria for sending a response

Change the now tenth paragraph of 11.1.4.3.4 as follows:

A ~~n~~non-S1G AP shall remain in the Awake state and shall respond to probe requests, subject to the criteria above.

Insert the following paragraph and note after the now tenth paragraph of 11.1.4.3.4:

An S1G AP that is awake shall respond to probe requests, subject to the criteria above. The response to the probe requests shall have the same CH_BANDWIDTH as the preceding probe request. The S1G AP may send a PV1 Probe Response frame instead of a Probe Response frame as specified in 11.1.4.3.4c.

NOTE—This rule does not allow an S1G AP to respond with a probe response in 1 MHz channel width after receiving a probe request in 2 MHz channel width.

Insert the following subclauses (11.1.4.3.4a through 11.1.4.3.4c, including Figure 11-5a) after 11.1.4.3.4:

11.1.4.3.4a Active scanning for relay discovery

An S1G STA that is performing an active scan to discover operating APs, or S1G relay APs may include the S1G Relay Discovery element (see 9.4.2.208) in the Probe Request frame. This element provides information on the QoS criteria on the relay path.

The active scanning procedure for relay AP is similar to the Active scanning procedure outlined in 11.1.4.3.

An S1G relay AP receiving Probe Request frames may respond with a Probe Response or a PV1 Probe Response, if the criteria outlined in 11.1.4.3.2 are met. An S1G relay AP shall not respond with a Probe Response, or a PV1 Probe Response, if the QoS criteria on the relay path specified in the S1G Relay Discovery element (see 9.4.2.208) cannot be satisfied.

An S1G relay AP sending Probe Response, or PV1 Probe Response frames may include the S1G Relay Discovery element (see 9.4.2.208) to carry link budget information between the S1G relay AP and S1G root AP.

An S1G STA may use the information received from different S1G relay APs to determine a suitable S1G relay AP for association. The S1G relay AP selection is made by the S1G STA, and the specific selection procedure is up to the implementation.

11.1.4.3.4b NDP Probing

An NDP Probing procedure is used to reduce the energy consumption during the scanning procedure. Upon receipt of the MLME-SCAN.request primitive with ActiveScanType parameter indicating an NDP, a STA for which dot11NDPProbingActivated is true shall transmit an NDP Probe Request frame that has either a compressed SSID or an access network option. The NDP probing procedure is allowed when an S1G STA knows the operating frequency bands and regulatory domains. A non-S1G STA shall not transmit an NDP Probe Request frame.

APs receiving an NDP Probe Request frame shall transmit a broadcast Probe Response only if

a) The compressed SSID in the NDP Probe Request frame is the specific compressed SSID of the AP.
b) The access network option in the NDP Probe Request frame is the access network option of the AP.

The response to the NDP Probe Request shall be a PV1 Probe Response frame if all the criteria below are satisfied:

— dot11PV1ProbeResponseOptionImplemented is true at the responding STA.
— The Requested Probe Response Type field in the NDP Probe Request frame is set to 0.

If any of the criteria above is not satisfied, then the response to the NDP Probe Request shall be a Probe Response frame. The AP shall follow the channel access procedure defined in 9.3.4.2 to transmit the probe response.

If PHY-CCA.indication (busy) primitive has not been detected before the ProbeTimer reaches MinChannelTime, then set NAV to 0 and scan the next channel. Otherwise, if it receives a PV1 Probe Response frame, the STA may transmit an Association Request frame, or may transmit a Probe Request frame or listen to a full Beacon frame for obtaining the more information. If it receives a Probe Response frame, the STA may transmit an Association Request frame.

An illustration of the NDP probing procedure is shown in Figure 11-5a.

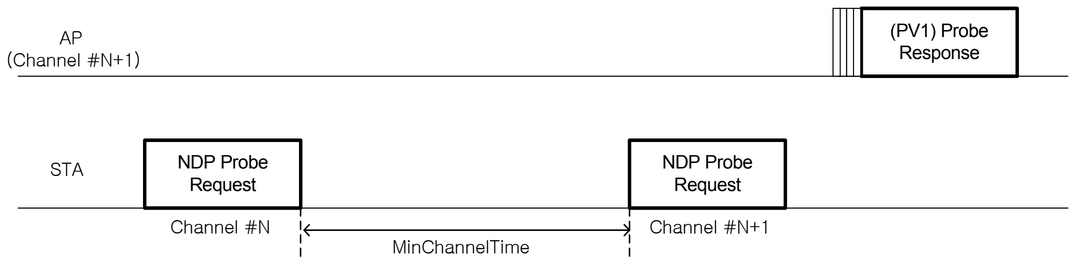


Figure 11-5a—NDP Probing Procedure

11.1.4.3.4c Active scanning using PV1 Probe Response

An S1G STA may use PV1 Probe Response frames as defined in 9.8.5.3 instead of Probe Response frames as defined in 9.3.3.11. PV1 Probe Response frame is used for reducing overhead of using long Probe Response frame in active scanning by optimizing the frame format and by allowing STA to request minimum information that is required for association with the responding STA to be included in the PV1 Probe Response frame.

An S1G STA may solicit PV1 Probe Response frames by including the PV1 Probe Response Option element defined in 9.4.2.210 in the Probe Request frames it transmits or by setting the Requested Probe Response Type field in the NDP Probe Request frame it transmits to 0.

A STA may include the PV1ProbeResponseOption parameter in the MLME-SCAN.request primitive to include the PV1 Probe Response Option element in the Probe Request frames. The requesting STA indicates which optional information is requested to be included in the PV1 Probe Response frame to the responding STA by setting one or more bits in the Probe Response Option bitmaps in the PV1 Probe Response Option element.

An S1G STA responds to the probe request subject to the criteria defined in 11.1.4.3.4. The response to the probe request shall be a PV1 Probe Response if all the criteria below are satisfied:

— dot11PV1ProbeResponseOptionImplemented is true at the responding STA.
— A PV1 Probe Response Option element is included in the received Probe Request frame.

If any of the criteria above is not satisfied, then the response to the probe request shall be a Probe Response frame.

When an NDP Probe request frame is used instead of a Probe Request frame, the response shall be either a PV1 Probe Response frame or a Probe Response frame as described in 11.1.4.3.4b.

If any of the criteria above is not satisfied, then the response to the NDP Probe Request shall be a Probe Response frame.

An S1G STA that responds with a PV1 Probe Response frame shall include the following information in the frame:

- The elements that are requested by the requesting STA as indicated in the PV1 Probe Response Option element contained in the received Probe Request frame.
  - If a bit in a Probe Response Option bitmap in the PV1 Probe Response Option element is equal to 1, then the corresponding information element is requested and it shall be included in the PV1 Probe Response frame (see 9.4.2.210).
  - If the S1G Beacon Compatibility element is included in the PV1 Probe Response frame, then it shall be included as the first optional element and shall be generated no later than the Timestamp field of the frame and not earlier than 2^{31} –1 microseconds.
- Either the SSID element or the compressed SSID field.
  - If the Request Full SSID bit in the PV1 Probe Response Option element is equal to 1, then the SSID element shall be present in the PV1 Probe Response frame and the Compressed SSID shall not be present. If it is equal to 0 or is not present in the PV1 Probe Response Option element, then the Compressed SSID shall be present and the SSID element shall not be present.
- The 1 MHz Channel Primary Location field in the Frame Control field shall indicate the location of the 1 MHz primary channel within the 2 MHz primary channel.

PV1 Probe Response frames shall be sent as directed frames to the address of the STA that generated the Probe Request frame.

Upon reception of a PV1 Probe Response frame that includes an S1G Beacon Compatibility element an S1G STA that included the PV1 Probe Response Option element in a previously transmitted Probe Request frame or that set the Requested Probe Response Type to 0 in a previously transmitted NDP Probe Request frame, may update its TSF timer using the same TSF timer update procedure described in 11.1.3.10.3 for S1G Beacon frames.

11.1.4.4 Initializing a BSS

11.1.4.4.1 General

Change 11.1.4.4.1 as follows:

Upon receipt of an MLME-START.request primitive, a STA shall determine the BSS's BSSID (as described in 11.1.4); select channel synchronization information; select a beacon period; initialize and start its TSF timer; and begin transmitting Beacon frames if the STA is neither a ~~non-~~DMG nor an S1G STA, or DMG Beacon frames if the STA is a DMG STA, or S1G Beacon frames if the STA is an S1G STA. See 9.3.3.3 for the description of a Beacon frame, and see 9.3.4.2 for the description of a DMG Beacon frame. Upon receipt of an MLME-START.request primitive, an S1G STA with dot11ShortBeaconInterval equal to true shall select a short beacon period and begin transmitting S1G Beacon frames.

11.1.5 Adjusting STA timers

Change 11.1.5 as follows:

A STA in an infrastructure BSS or PBSS shall adopt the TSF timer value in a Beacon, S1G Beacon, Probe Response, PV1 Probe Response, DMG Beacon, or Announce frame transmitted by the BSS's AP or PCP. The STA shall use the algorithm specified in 11.1.3.9.

In response to an MLME-JOIN.request primitive, a STA joining an IBSS shall initialize its TSF timer to 0 and shall not transmit a Beacon, S1G Beacon, Probe Response, PV1 Probe Response, or DMG Beacon frame until it receives from a member of the IBSS a Beacon, S1G Beacon, Probe Response, PV1 Probe

Response, or DMG Beacon frame that has a matching SSID. Consequently, the STA joining an IBSS adopts the timer from the next Beacon, S1G Beacon, Probe Response, PV1 Probe Response, or DMG Beacon frame from its IBSS.

All Beacon, S1G Beacon, Probe Response, PV1 Probe Response, DMG Beacon, and Announce frames carry a Timestamp field. A STA receiving such a frame from another IBSS STA with the same SSID shall compare the Timestamp field with its own TSF time. If the Timestamp field of the received frame is later than its own TSF timer, a ~~non-DMG~~ STA that is neither a DMG nor an S1G STA in the IBSS shall adopt all parameters contained in the Beacon frame according to the rule for that parameter found in the "IBSS adoption" column of the matching row of the BSSDescription table found in 6.3.3.2.2. An S1G STA shall adopt all parameters contained in the S1G Beacon frame according to the rule for that parameter found in "IBSS adoption" column of the matching row of the BSSDescription table found in 6.3.3.2.2 if the Timestamp field of the received frame is later than its own TSF timer and the TSF Completion field in the S1G Beacon Compatibility element is not less than the value of the 4 most significant octets of its own TSF timer. A DMG IBSS STA shall adopt each parameter contained in the DMG Beacon or Announce frames. Parameters adopted by a STA due to the receipt of a later timestamp shall not be changed by the STA except when adopting parameters due to a subsequently received Beacon, S1G Beacon, DMG Beacon, or Announce frame with a later timestamp.

11.1.6 Terminating a BSS

Change 11.1.6 as follows:

At any time an infrastructure BSS or PBSS may be terminated. At any time a STA may cease support for an IBSS that it formed. Upon receipt of an MLME-STOP.request primitive, a STA shall stop transmitting Beacon, S1G Beacon, Probe Response, PV1 Probe Response, DMG Beacon, and Announce frames and deauthenticate all associated STAs.

11.2 Power management

11.2.3 Power management in a non-DMG infrastructure network

11.2.3.1 General

Change 11.2.3.1 as follows:

A STA that is associated with an AP and that changes power management mode shall inform the AP of this fact using the Power Management subfield within the Frame Control field of transmitted frames. The STA shall remain in its current power management mode until it informs the AP of a power management mode change via a frame exchange that includes an acknowledgment from the AP. Power management mode shall not change during any single frame exchange sequence, as described in Annex G.

NOTE—This means the Power Management subfield is the same for all MPDUs in an A-MPDU.

The AP shall buffer individually addressed BUs addressed to STAs operating in a PS mode. These buffered BUs shall be transmitted only at designated times.

If any STA in its BSS is in PS mode, the AP shall buffer all non-GCR-SP group addressed BUs and deliver them to all STAs immediately following the next Beacon frame containing a DTIM transmission. If the AP is an S1G AP, the AP may additionally deliver these BUs using group AID as defined in 10.51.

An S1G AP with dot11NDPPSPollSupport equal to true shall set the NDP PS-Poll Supported field in the S1G Capabilities element to 1. Otherwise it shall set the NDP PS-Poll Supported field in the S1G Capabilities element to 0.

The STAs that currently have buffered BUs (excluding those BUs for a STA associated with ACs that are UAPSD delivery-enabled when not all ACs are delivery-enabled by that STA) within the AP are identified in a TIM, which shall be included as an element within all Beacon frames generated by the AP. A STA shall determine that a BU is buffered for it by receiving and interpreting a TIM.

In a non-S1G STA, the traffic-indication virtual bitmap, maintained by the AP, shall be transmitted in a TIM element. In an S1G STA, the traffic-indication virtual bitmap may be divided into more than one page and each page shall be transmitted in a TIM element, hence, more than one TIM element may appear in an S1G Beacon frame. If more than one TIM element is present, then the TIM elements shall be ordered based on their value of the Page Index and Page Slice Number subfields in the Bitmap Control field. TIM elements with Page Slice Number equal to 31 (if any) shall be the first ones and ordered from page 0 to page 3, and may be followed by TIM elements (if any when Page Slicing is supported) with Page Slice Number from 0 to 30 each of which shall also be ordered from page 0 to page 3. In an S1G STA, the traffic virtual bitmap shall be encoded as defined in 9.4.2.6 where the ADE mode may be used by the AP only if the TIM ADE Support field in the S1G Capabilities element received from every STA with AID included in the TIM element, is 1. Otherwise ADE mode shall not be used to encode the TIM element.

A STA operating in PS mode with dot11NonTIMModeActivated equal to false that is not in WNM sleep mode shall periodically listen for Beacon frames, as determined by the ListenInterval parameter of the MLME-ASSOCIATE.request or MLME-REASSOCIATE.request primitive and the ReceiveDTIMs parameter of the MLMEPOWERMGT.request primitive. STAs operating in PS modes with dot11NonTIMModeActivated equal to true transmit at least one PS-Poll or trigger frame that is individually addressed to the associated AP every ListenInterval parameter used by the MLME primitives starting from the last known transition of the non-TIM STA in doze state unless it follows the TWT or NDP Paging procedure.

WNM sleep mode enables an extended power save mode for non-AP STAs in which a non-AP STA need not listen for every DTIM Beacon frame, and need not perform GTK/IGTK updates. STAs in WNM sleep mode can wake up as infrequently as once every WNM sleep interval to check whether the corresponding TIM bit is set or group addressed traffic is pending.

NOTE—A STA may use both WNM sleep mode and PS mode simultaneously.

If an S1G AP with dot11NDPPSPollSupport equal to true has a buffered BU for a STA associated with the AP and receives an NDP PS-Poll frame from the STA, it should send the buffered BU with the MCS level that is calculated based on the value indicated in the Preferred MCS subfield in the received NDP PS-Poll frame unless the indicated MCS level violates rate selection rule for data frames (as defined in 10.7.5).

The Power Management subfield of the Frame Control field may be set to 0 or 1 within a frame sent by a STA in WNM sleep mode.

When a STA is in WNM sleep mode and in PS mode, the AP buffers unicast frames according to the traffic filtering agreement established between the AP and STA, as specified in 11.24.12.2. When a STA is in WNM sleep mode but not in PS mode, the traffic filtering agreement between the AP and STA and the timer for the WNM sleep interval remain in place, and the AP queues for nonbuffered delivery all matched frames (i.e., matched by the traffic filtering agreement) destined to the STA.

In a BSS operating under the DCF or EDCA, or during the CP of a BSS using the PCF, upon determining that a BU is currently buffered in the AP, a STA operating in the normal (non-APSD) PS mode transmits a (NDP) PS-Poll frame to the AP, which responds with the corresponding buffered BU immediately, or acknowledges the (NDP) PS-Poll frame and responds with the corresponding BU at a later time. If the TIM indicating the buffered BU is sent during a CFP, a CF-Pollable STA operating in the PS mode does not send a PS-Poll frame, but remains active until the buffered BU is received (or the CFP ends).

An S1G STA may transmit NDP PS-Poll frames instead of PS-Poll frames to an S1G AP from which it has received a frame containing an S1G Capabilities element with the NDP PS-Poll Supported field equal to 1; otherwise, the S1G STA shall not transmit NDP PS-Poll frames. If an S1G STA detects that the partial BSSID of its associated AP is equal to the partial BSSID of at least another AP (i.e., the other AP and the associated AP have a different BSSID) from which it successfully receives frames, then the S1G STA shall not transmit NDP PS-Poll frames to its associated AP to avoid ambiguity. A non-S1G STA shall not transmit NDP PS-Poll frames. An S1G STA shall set the Poll Type subfield in the Frame Control field of the transmitted PS-Poll(+BDT) frame to 0 unless it is a non-TIM STA that follows the procedures described in 10.44.2. An S1G TIM STA shall not send a PS-Poll with the Poll Type subfield equal to 1 to an S1G STA.

A non-AP QoS STA may be in PS mode before the setup of DLS or block ack. Once DLS is set up, both of the QoS STAs associated with a DLS link suspend the PS mode and shall be awake. BUs for a TID without a schedule are sent using Normal Ack following a PS-Poll frame as described in rest of 11.2.3. Uplink block ack agreements, block ack agreements for any TID with a schedule, and any block ack agreements to APSD STAs continue to operate normally.

NOTE—When a STA is in normal (non-APSD) PS mode, the rules described in 11.2.3.6 for PS-Poll operation apply to any downlink block ack agreement without an associated schedule. An (A-)MSDU delivered for this block ack agreement in response to the PS-Poll frame might be delivered in an A-MPDU.

An S1G AP may change its Power Management mode as described in 11.2.3.20.

An S1G STA in PS mode shall set the More Data field to 1 in a frame transmitted to its AP when the STA intends to transmit another frame to the AP within this SP. An S1G STA in PS mode shall set the More Data field to 0 in a frame transmitted to its AP when the STA does not intend to transmit another frame to the AP within this SP.

Change the title of 11.2.3.2 as follows:

11.2.3.2 Non-AP STA power management modes

Change the sixth paragraph of 11.2.3.2 as follows:

A non-S1G STA that is changing from doze to awake state in order to transmit shall perform CCA until a frame is detected by which it can set its NAV, or until a period of time indicated by the NAVSyncDelay from the MLME-JOIN.request primitive has transpired. An S1G STA that is changing from doze to awake state in order to transmit shall perform CCA until a frame is detected by which it can set its RID or NAV, or until a period of time indicated by the NAVSyncDelay from the MLME-JOIN.request primitive has transpired.

Insert the following paragraphs at the end of 11.2.3.2:

An S1G AP that sets the STA Type Support in a transmitted S1G Capabilities element to 0 or 1, as described in 10.59, shall set the dot11NonTIMModeActivated to true and shall set the Non-TIM Support field in the S1G Capabilities element to 1. An S1G AP that sets the STA Type Support in a transmitted S1G Capabilities element to 2, as described in 10.59, may set the dot11NonTIMModeActivated to false and the Non-TIM Support field in the S1G Capabilities element to 0 during the whole operation time. An S1G AP that sets the STA Type Support in a transmitted S1G Capabilities element to 2, as described in 10.59, may set the dot11NonTIMModeActivated to true and the Non-TIM Support field in the S1G Capabilities element to 1 during the whole operation time.

An S1G non-AP STA shall indicate its PS mode (TIM mode or non-TIM mode), during association, to the AP it intends to associate with. The STA shall set the Non-TIM Support field in the S1G Capabilities element included in the Association Request frame to 1 to request operation in non-TIM mode. Otherwise, it shall set the Non-TIM Support field to 0.

An S1G AP that sets the STA Type Support in the S1G Capabilities element to 2 in the Association Response frame transmitted to a STA may set the Non-TIM Support field in the S1G Capabilities element, included in the Association Response frame, to 1 if the Association Request frame previously sent by the STA had the Non-TIM Support field equal to 1.

An S1G AP that includes an AID Response element in a (Re)Association Response frame shall set the AID/Group AID field to the AID assigned to the (re)associating STA, the AID Switch Count field to 0, and the AID Response Interval field to the value of the Listen Interval field.

NOTE—The AP can specify a listen interval that is different from the listen interval requested by the non-AP STA in the (Re)Association Request frame if the AP cannot buffer the STA's BUs for the requested listen interval.

An S1G non-AP STA that has transmitted an Association Request frame with the Non-TIM Support field equal to 1 and that receives an Association Response frame with the Non-TIM Support field in the S1G Capabilities element equal to 1 shall set the dot11NonTIMModeActivated to true. Otherwise, it shall set the dot11NonTIMModeActivated to false. The STA shall operate in the negotiated PS mode during association unless a PS mode switch is negotiated as described in 10.20a or a temporary PS mode switch has occurred as described in 10.44.2. The STA shall update the value of the ListenInterval parameter it uses in invocations of primitives with the value of the AID Response Interval field in the AID Response element of the (Re)Association Response frame.

An S1G non-AP STA with dot11NonTIMModeActivated equal to false is a TIM STA. A TIM STA listens to selected Beacon frames (based upon the ListenInterval parameter of the MLME-ASSOCIATE.request or MLME-REASSOCIATE.request primitive) and sends PS-Poll frames to the AP if the TIM element in the most recent Beacon frame indicates an individually addressed BU is buffered for that STA.

An S1G non-AP STA with dot11NonTIMModeActivated equal to true is a non-TIM STA. A non-TIM STA shall transmit at least one PS-Poll or trigger frame that is individually addressed to the associated AP every listen interval and does not need to listen to selected S1G Beacon frames (based upon the ListenInterval parameter of the MLME-ASSOCIATE.request or MLME-REASSOCIATE.request primitive) unless it follows the TWT or NDP Paging procedure. A non-TIM STA may send (NDP) PS-Poll frames to an S1G AP regardless of whether individually addressed buffered BUs have been indicated by the S1G AP.

11.2.3.3 AP TIM transmissions

Change 11.2.3.3 as follows (footnote 42 remains unchanged):

The TIM shall identify the STAs for which traffic is pending and buffered in the AP. This information is coded in a *partial virtual bitmap*, as described in 9.4.2.6. In addition, the TIM contains an indication whether group addressed traffic is pending. Every STA is assigned an AID by the AP as part of the association process. AID 0 (zero) is reserved to indicate the presence of buffered non-GCR-SP group addressed BUs that are not delivered using group AID. The AP shall identify those STAs for which it is prepared to deliver[42] buffered BUs by setting bits in the TIM's partial virtual bitmap that correspond to the appropriate AIDs.

For S1G band, the TIM is coded in an S1G partial virtual bitmap, as described in 9.4.2.6. This information is constructed with one of the four encoding modes: the Block Bitmap mode, the Single AID mode, the OLB (offset, length, bitmap) mode, and the ADE (AID with differential encoding) mode. An S1G AP shall not transmit the TIM with the encoding mode in the Block Control subfield set to ADE mode to another S1G STA unless the TIM ADE Support field of the S1G Capabilities element received from that STA contained a value of 1 and dot11TIMADEImplemented is true.

11.2.3.4 TIM types

Change the first and second paragraphs of 11.2.3.4 as follows:

Two different TIM types are distinguished: TIM and DTIM. After a DTIM, the AP shall transmit buffered non-GCR-SP group addressed BUs, before transmitting any individually addressed frames. The AP may additionally deliver these BUs using group AID as defined in 10.51.

The AP shall transmit a TIM with every Beacon frame except when the frame is scheduled for transmission in a TSBTT that is not a TBTT. Every dot11DTIMPeriod, a TIM of type *DTIM* is transmitted within a Beacon frame, rather than an ordinary TIM. An S1G AP with dot11ShortBeaconInterval equal to true, may include a TIM in a Beacon frame that is scheduled for transmission in a TSBTT that is not a TBTT. An S1G AP with dot11ShortBeaconInterval equal to true may transmit a TIM of type DTIM in an S1G Beacon frame every dot11ShortBeaconDTIMPeriod.

11.2.3.6 AP operation during the CP

Change the following list items of 11.2.3.6 as shown:

c) At every beacon interval, the AP shall assemble the partial virtual bitmap containing the buffer status per destination for STAs in the PS mode and shall send this out in the TIM field of the Beacon frame. At every beacon interval, the APSD-capable AP shall assemble the partial virtual bitmap containing the buffer status of nondelivery-enabled ACs (if there exists at least one nondelivery-enabled AC) per destination for STAs in PS mode and shall send this out in the TIM field of the Beacon frame. When all ACs are delivery-enabled, the APSD-capable AP shall assemble the partial virtual bitmap containing the buffer status for all ACs per destination. If FMS is enabled, the AP shall include the FMS Descriptor element in every Beacon frame. The FMS Descriptor element shall indicate all FMS group addressed frames that the AP buffers. An S1G AP should set the value of the Duration field in the S1G Beacon frame to the estimated time required for all the S1G STAs that are indicated in the TIM elements and/or are allowed to access the first RAW immediately following the S1G Beacon frame as described in 10.22.5.4, to send the trigger or (NDP) PS-Poll frame and receive an acknowledgment from the AP. The operation described in this paragraph shall also be performed for every short beacon interval where a TIM is transmitted.

d) If a STA has set up a scheduled SP, it shall automatically wake up at each SP. Therefore, the APSD-capable AP shall transmit frames associated with admitted traffic with the APSD subfield equal to 1 in the TSPECs buffered for the STA during a scheduled SP. If the STA has set up to use unscheduled SPs, the AP shall buffer BUs using delivery-enabled ACs until it has received a trigger frame using a trigger-enabled AC from the non-AP STA, which indicates the start of an unscheduled SP. A trigger frame received by the AP from a STA that already has an unscheduled SP underway shall not trigger the start of a new unscheduled SP. The AP transmits BUs destined for the STA and using delivery-enabled ACs during an unscheduled SP. The bit for AID 0 (zero) in the Bitmap Control field of the TIM element shall be set to 1 when non-GCR-SP group addressed traffic that is not to be delivered using group AID is buffered, according to 9.4.2.6.

g) When the AP receives a PS-Poll frame from a STA is in PS mode, it shall forward to the STA a single buffered BU. The AP shall respond after SIFS either with a Data or Management frame, or with an Ack frame, in which case the corresponding Data or Management frame is delayed. Until the transmission of this BU either has succeeded or is presumed failed (when maximum retries are exceeded), the AP shall acknowledge but ignore all PS-Poll frames from the same STA. This prevents a retried PS-Poll frame from being treated as a new request to deliver a buffered BU.

   For a STA using U-APSD, the AP transmits one BU destined for the STA from any AC that is not delivery-enabled in response to PS-Poll frame from the STA. The AP should transmit the BU from the highest priority AC that is not delivery-enabled and that has a buffered BU. When all ACs associated with the STA are delivery-enabled, the AP transmits one BU from the highest priority AC that has a BU. Upon receiving a PS-Poll frame, the S1G AP that intends to respond with immediate Data frame may use the RTS/CTS scheme to protect the transmission of the frame.

An S1G AP that sends an acknowledgment frame of type (NDP) Ack or NDP PS-Poll-Ack in response to an (NDP)PS-Poll/trigger frame that is received from an S1G STA shall set the More Data subfield of the acknowledgment frame to 0 when no BU is buffered for the STA; otherwise, it shall set it to 1. The successful reception of the acknowledgment frame provides the following indications to the S1G STA:

1) If the More Data subfield is equal to 0 it indicates that no service period starts for the STA and that it may enter the doze state,
2) If the More Data subfield is equal to 1 it indicates that a service period starts for the STA after a time T, starting from the end of the acknowledgment frame, after which the S1G STA shall remain in the awake state until a frame is received from the S1G AP that has the EOSP subfield equal to 1. The time T is equal to one of the following:
    i) 0 if the acknowledgment frame is an Ack frame or is an NDP (PS-Poll-)Ack frame with the Idle Indication subfield equal to 0
    ii) The value indicated in the Duration field of the frame if the frame is an NDP (PS-Poll-)Ack frame with the Idle Indication subfield equal to 1.

For a STA in PS mode and not using U-APSD, the AP shall set the More Data subfield of the response Data or Management frame to 1 to indicate the presence of further buffered BUs (not including the BU currently being transmitted) for the polling STA.

For a STA using U-APSD, the AP shall set the More Data subfield to 1 to indicate the presence of further buffered BUs (not including the BU currently being transmitted) that do not use delivery-enabled ACs. When all ACs associated with the STA are delivery-enabled, the AP shall set the More Data subfield to 1 to indicate the presence of further buffered BUs (not including the BU currently being transmitted) using delivery-enabled ACs.

If there are buffered BUs to transmit to the STA, the AP may set the More Data bit in a QoS +CF-Ack frame to 1 in response to a QoS Data frame to indicate that it has one or more pending BUs buffered for the PS STA identified by the RA in the QoS +CF-Ack frame. An AP may also set the More Data bit in an Ack frame to 1 in response to a QoS Data frame to indicate that it has one or more pending BUs buffered for the PS STA identified by the RA in the Ack frame, if that PS STA has set the More Data Ack subfield in the QoS Capability element to 1.

Unless indicated above, the AP shall set the More Data bit to 0.

k) An AP may delete buffered BUs for implementation dependent reasons (subject to 11.2.3.12), including the use of an aging function and availability of buffers. The AP may base the aging function on the listen interval indicated by the STA in its (Re)Association Request frame or the WNM sleep interval specified by the non-AP STA in the WNM-Sleep Mode Request frame. In addition, the S1G AP may base the aging function on the listen interval indicated by the AP in the (Re)Association Response frame.

11.2.3.8 Receive operation for STAs in PS mode during the CP

Change the following list item and subsequent note in 11.2.3.8 as shown:

a) The STA with dot11NonTIMModeActivated equal to false shall wake up early enough to be able to receive the first Beacon frame scheduled for transmission at the time corresponding to the last TBTT or TSBTT for which the STA was awake plus the time interval indicated by the ListenInterval parameter of the MLME-ASSOCIATE.request or MLME-REASSOCIATE.request primitive. The STA with dot11NonTIMModeActivated equal to true is not required to wake up to receive a Beacon frame and shall transmit at least one PS-Poll or trigger frame that is individually addressed to the associated AP every listen interval starting from the last known transition of the non-TIM STA in doze state unless it follows the TWT or NDP Paging procedure.

NOTE—The STA might wake for a TBTT or TSBTT that is earlier than this deadline. In that case the previous requirement is reset based on a new "last TBTT or TSBTT".

Insert the following subclause (11.2.3.20) after 11.2.3.19:

11.2.3.20 AP Power management

This subclause describes AP power management procedure for an S1G AP.

An AP with dot11APPMActivated equal to false or not present shall operate in the Active mode. An AP with dot11APPMActivated equal to true may operate in the following Power Management modes:

- Active
- Power save

An AP in active mode shall be in Awake state and may receive frames at any time.

An AP with dot11APPMActivated equal to true in Power Save mode may be in any of the following two power states:

- Awake
- Doze

The AP with dot11APPMActivated equal to true may indicate that it is operating in Power Save mode by either:

- Setting the AP PM bit in the Frame Control field of the S1G Beacon frame to 1
- Including one or more RPS elements in the S1G Beacon frame that indicate AP PM RAWs (i.e., with the RAW Assignment Type equal to Simplex RAW and RAW Type Options equal to 0)

The AP shall operate in active mode during a beacon interval or short beacon interval if the AP PM subfield in the S1G Beacon frame transmitted at the TBTT or TSBTT is equal to 0. Similarly, the AP shall operate in active mode during one or more RAWs defined by an RPS element with the RAW Assignment type equal to generic RAW, sounding RAW, triggering frame RAW or simplex RAW with RAW Type Options equal to 1 or 2.

An AP that transmits an S1G Beacon frame with AP PM subfield equal to 1 may be in Doze state at any time until the next TBTT or TSBTT, except that it shall be in Awake state during any of the following intervals of time:

- Any RAW or PRAW intervals that are set up according to 10.22.5, except for RAWs that are defined by any RPS element with RAW Assignment Type equal to simplex RAW and RAW Type Options equal to 0
- Any TWT SPs that are negotiated according to 10.43

An AP that transmits an S1G Beacon frame whose AP PM subfield value is 1 should include an RPS element in the S1G Beacon frame that includes an omni RAW during which all STAs are allowed to access (i.e., the RPS element contains a RAW Assignment subfield with RAW Type field equal to 2 and RAW Type Options subfield equal to 2). The omni RAW may be used for association of new STAs. The AP that does not include the RPS element with the omni RAW, shall be awake for an amount of time not less than *BI* minus dot11MaxAwayDuration immediately following the S1G Beacon frame where *BI* is equal to the value of the beacon interval if dot11ShortBeaconInterval is false and is equal to short beacon interval if dot11ShortBeaconInterval is true.

An AP shall not be in Doze state for a duration of time that exceeds the value of the dot11MaxAwayDuration. The AP shall set dot11MaxAwayDuration to the lowest value obtained from the

Max Away Duration field that is contained in the most recently received MAD elements from any of its associated STAs.

An AP may reject a (re)association of a STA if the value of the Max Away Duration field in the MAD element in the (Re)Association Request frame transmitted by the STA is considered unacceptable. For example, an AP that schedules to be in Doze state for 100 ms can reject association of a STA that indicates in the Association Request frame a value of 30 ms in its Max Away Duration field.

An AP may disassociate an STA based on the value indicated by Max Away Duration of the latest MAD element received from that STA.

An AP may include a MAD element in the (Re)Association Response frame or Probe Response frame that indicates the suggested maximum away duration during which the AP can be considered in Doze state.

An STA may include a MAD element in the Probe Request or (Re)Association Requests frames.

Irrespective of the Power Management mode and Power States, an AP shall maintain the synchronization of the network by generating beacons as described in 11.1.3.

A STA that is the intended receiver of a frame transmitted by an AP that has the PM Mode subfield equal to 0 shall consider the AP in active mode.

An AP that has previously sent a frame to one or a group of STAs with PM bit equal to 0, shall send a frame with PM bit equal to 1 to the same set of STAs before changing its operation mode to Power Save mode.

A STA that is the intended receiver of a frame transmitted by an AP that has the PM Mode subfield equal to 1 shall consider the AP in Power Save mode.

11.3 STA authentication and association

11.3.5 Association, reassociation, and disassociation

Insert the following subclause (11.3.5.11) after 11.3.5.10:

11.3.5.11 Service characteristic indication during association

A sensor service is the service that a sensor STA is capable of provisioning that is usually delivered using small payload data frames. Non-sensor services include offloading and critical services. Different service characteristics may have different requirements on QoS, packet size, duty cycle, etc. An AP can optimize the system operating parameters with the knowledge of the service characteristic of each associated STA or place a high priority on association/reassociation for a STA that provides critical services such as health care, home, industrial, alarm monitoring or emergency service.

A non-AP STA may indicate to the AP its service characteristic information during association by including the Service Characteristic field in the AID Request element in the (Re)Association Request frame. The AP may assign a particular AID to the STA taking into account the received service characteristic information from the STA.

Insert the following subclauses (11.3.9 through 11.3.9.3) after 11.3.8:

11.3.9 Authentication Control

11.3.9.1 General

In infrastructure mode, an S1G AP can use the Authentication Control element to alleviate WM contention when a large number of STAs are trying to or are expected to send Authentication Request frames to the AP at about the same time.

11.3.9.2 Centralized authentication control

When dot11S1GCentralizedAuthenticationControlActivated is true, an S1G STA shall set the Centralized Authentication Control subfield to 1 in the S1G Capabilities Information field of the S1G Capabilities element. Otherwise, the STA shall set it to 0. A STA that transmits 0 as the value of the Centralized Authentication Control subfield of the S1G Capabilities Information field is not constrained by the requirements specified in this subclause.

A centralized authentication controller access point (CAC AP) shall set the Control subfield to 0 in the Authentication Control element in all transmitted Beacons and Probe Responses frames. A non-CAC AP shall not include an Authentication Control element with the Control field equal to 0 in a Beacon or Probe Response frame.

A CAC AP may include an Authentication Control element with the Control subfield equal to 0 and the Deferral subfield equal to 0 in a Beacon or a Probe Response frame to attempt to limit the number of STAs that can transmit an Authentication Request frame to it. The AP may transmit a different value in the Authentication Control Threshold subfield in the Authentication Control element included in each of Beacon and Probe Response frames that it transmits.

A CAC AP may include, within an individually addressed Probe Response frame that is transmitted in response to a Probe Request frame from a STA, an Authentication Control element that has the Control subfield equal to 0, the Deferral subfield equal to 1 and the Authentication Control Threshold subfield equal to a deferred channel access time. During the deferred channel access time that begins immediately following the reception of the Probe Response, a centralized authentication controlled station (CAC STA) shall not transmit an Authentication Request frame to the AP that transmitted the Probe Response.

A non-CAC STA is not constrained by the Authentication Control rules specified in this subclause when it transmits an Authentication Request frame to the AP. A CAC STA sets the local MAC variable AuthenticationRequestTransmission to true when it is initialized.

A CAC STA shall generate a random number v when it is initialized. The generated random number v shall be uniformly distributed between 0 and 1022 (inclusive). The STA may generate a new random value for v after receiving an Authentication Response from an AP.

A CAC STA shall compare v with the Authentication Control Threshold subfield value in the most recently received Authentication Control element from the AP to which it intends to send an Authentication Request frame if the Control and the Deferral subfields are equal to 0. If v is less than the value of the Authentication Control Threshold subfield, the STA may transmit an Authentication Request frame to the AP and shall set the local MAC variable AuthenticationRequestTransmission to true. Otherwise, the STA shall set the local MAC variable AuthenticationRequestTransmission to false and the STA shall not transmit an Authentication Request frame to the AP. A CAC STA shall update its MIB values of the CAC parameters based on the values received in the Authentication Control element.

A CAC STA shall set the local MAC variable AuthenticationRequestTransmission to false and shall defer the transmission of an Authentication Request frame to an AP from which it has received an individually addressed Probe Response if the Probe Response contains an Authentication Control element with the Control subfield equal to 0 and the Deferral subfield equal to 1. The deferral begins at the end of the reception of the Probe Response and extends for a period of time equal to the value contained in the Authentication Control Threshold subfield value in the Probe Response. At the end of the deferral time period, the STA shall set the local MAC variable AuthenticationRequestTransmission to true and may transmit an Authentication Request frame to the AP.

A CAC STA shall set the local MAC variable AuthenticationRequestTransmission to true when it receives a Beacon or Probe Response frame that does not include an Authentication Control element from the AP that it intends to join.

An S1G AP shall not set the Deferral subfield in the Authentication Control element of the Beacon frames or the broadcast Probe Response frames to 1.

An S1G STA does not follow the Authentication Control rules defined in this subclause if it receives a Beacon or Probe Response frame that includes an Authentication Control element from the AP that it does not intend to join, or is not intended to the STA.

11.3.9.3 Distributed authentication control

When dot11S1GDistributedAuthenticationControlActivated is true, an S1G AP shall set the Distributed Authentication Control subfield to 1 in the S1G Capabilities Information field of the S1G Capabilities element. Otherwise, the subfield is set to 0.

When an S1G STA receives an S1G Capabilities element with the Distributed Authentication Control field equal to 1, the STA shall determine when it is permitted to access the medium to transmit an Authentication Request frame to the AP from which it received the S1G Capabilities element based on the following procedure:

a) The STA maintains the following distributed authentication control (DAC) parameters:
   1) Authentication control slot duration (T_{ac}) in TU units. The default value is set to 10 TUs.
   2) Minimum transmission interval (TI_{min}) in BI units. The default value is set to 8 BIs.
   3) Maximum transmission interval (TI_{max}) in BI units. The default value is set to 256 BIs.
b) The STA maintains a transmission interval (TI) in BI units.
c) The TI is initialized to TI_{min}.
d) The STA chooses a random number *m* from [0, TI].
e) The STA chooses a random number *l* from [0, L], where $L = \lfloor BI/T_{ac} \rfloor$, *l*=0 is the first authentication control slot.
f) The STA may initiate normal EDCA access procedures for the transmission of the Authentication Request frame beginning at the authentication control slot *l* in the BI *m*, where *m*=0 is the current BI.
g) If the transmission of the Authentication Request frame fails, the TI is increased as follows:
   $TI = \min\{2\times TI, TI_{max}\}$.

An S1G AP may assign DAC parameters different from the default values by sending to the STA an Authentication Control element with the Control subfield equal to 1. An S1G STA receiving such an Authentication Control element shall update its MIB values of the DAC parameters based on the values received in the Authentication Control element.

11.5 Block ack operation

11.5.2 Setup and modification of the block ack parameters

11.5.2.2 Procedure at the originator

Change the following list items in 11.5.2.2 as shown:

b) If the peer STA is a non-DMG STA, check whether the intended peer STA is capable of participating in the block ack mechanism by discovering and examining its Delayed Block Ack and Immediate Block Ack capability bits. If the peer STA is an S1G STA and the recipient is capable of participating in an Immediate Block Ack session, the S1G originator shall send an NDP ADDBA Request to indicate that it expects only NDP BlockAck frames during the block ack session with the following exceptions:

   1) If the S1G originator's dot11BATImplemented is true and the BAT Support subfield in the most recently received S1G Capabilities element from the S1G recipient is 1 and a TWT has been set up with the S1G recipient as described in 10.43, then the S1G originator shall send a BAT ADDBA Request to indicate that it expects only BAT frames during the block ack session.

   2) When any of the conditions below is satisfied then the S1G originator may send an ADDBA Request to indicate that it expects only BlockAck frames during the block ack session:

      i) The value of the Buffer Size field in the ADDBA Request, carried in an S1G_LONG or S1G_SHORT PPDU, is greater than 16.

      ii) The value of the Buffer Size field of the ADDBA Request, carried in an S1G_1M PPDU, is greater than 8.

      iii) The dot11AsymmetricBlockAckActivated is true and Asymmetric Block Ack Supported field in the most recently received S1G Capabilities element from the S1G recipient is 1.

   If the recipient is capable of participating, the originator sends an ADDBA Request frame indicating the TID and the buffer size. If the recipient is capable of participating and the GCRGroupAddress parameter of the MLME-ADDBA.request primitive is present, the originator sends an ADDBA Request frame that includes a GCR Group Address element. All DMG STAs are capable of participating in the block ack mechanism.

11.5.2.3 Procedure at the recipient

Change the following list item in 11.5.2.3 as shown:

b) Upon receipt of the MLME-ADDBA.response primitive, the STA shall respond by an ADDBA Response frame with a result code as defined in 9.6.5.3.

   1) If the result code is SUCCESS, the block ack agreement is considered to be established with the originator. Contained in the frame are the type of Block Ack agreement, the type of BlockAck frames, and the number of buffers that have been allocated for the support of this block. If the recipient STA is an S1G non-AP STA and it has received from the AP a frame containing an S1G Capabilities element with the Asymmetric Block Ack Supported equal to 1, the Originator Preferred MCS field may be contained in the ADDBA Response frame.

Insert the following paragraphs at the end of 11.5.2.3:

For S1G STA, the ADDBA Response frame refers to

   1) An NDP ADDBA Response if the value of the Buffer Size field of the NDP ADDBA Response is not greater than the value of the maximum number of MSDUs and A-MSDUs that can be acknowledged with the selected NDP BlockAck frame and no TWT has already been set up

with the S1G originator as described in 10.43. This value is 8 for NDP 1M BlockAck frames and 16 for NDP_2M BlockAck frames as described in 9.9.2.6. The NDP ADDBA Response frame shall be carried in an S1G_1M PPDU to indicate the use of NDP_1M BlockAck frames and shall be carried in an S1G_SHORT or S1G_LONG PPDU to indicate the use of NDP_2M BlockAck frames.

2) Otherwise, a BAT ADDBA Response as a response to a BAT ADDBA Request if a TWT has already been set up with the S1G originator as described in 10.43. The value of the Buffer Size field in the BAT ADDBA Response shall not be greater than 32.

Otherwise, an ADDBA Response indicating the use of BlockAck frames. The MCS subfield in the Originator Preferred MCS field shall be set to 15 unless the dot11AsymmetricBlockAckActivated is true and the Asymmetric Block Ack Supported field in the most recently received S1G Capabilities from the S1G originator is 1, in which case the MCS subfield may indicate the value of the preferred MCS if asymmetric block ack operation is used. The preferred MCS implicitly indicates the MCSDifference value, which is the difference between the preferred MCS and the MCS at which the ADDBA Response is sent.

11.5.2.4 Procedure common to both originator and recipient

Insert the following rows at the end of Table 11-4:

Table 11-4—Types of block ack agreement based on capabilities and ADDBA conditions for non-DMG STAs

Capabilities condition	ADDBA condition	Type of block ack agreement
Both STAs are S1G STAs	Block Ack Policy subfield equal to 1	HT-Immediate
Both STAs are S1G STAs and support HT-Delayed Block Ack	Block Ack Policy subfield equal to 0	HT-Delayed

11.7 DLS operation

11.7.1 General

Change the following list items of 11.7.1 as shown:

a) A STA, STA-1, that intends to exchange frames directly with another non-AP STA and dot11DLSAllowed is true, STA-2, invokes DLS and sends a DLS Request frame to the AP (step 1a in Figure 11-25). This request contains the rate set, capabilities of STA-1, and the MAC addresses of STA-1 and STA-2. If STA-1 is an HT STA, this request also contains the HT capabilities of STA-1. If STA-1 is a VHT STA, this response also contains a VHT Capabilities element representing the VHT capabilities of STA-1. If STA-1 is an S1G STA, this request also contains the S1G capabilities of STA-1.

c) If STA-2 has dot11DLSAllowed true and accepts the direct stream, it sends a DLS Response frame to the AP (step 2a in Figure 11-25), which contains the rate set, (extended) capabilities of STA-2, and the MAC addresses of STA-1 and STA-2. If STA-2 is an HT STA, this response also contains an HT Capabilities element representing the HT capabilities of STA-2. If STA-2 is a VHT STA, this response also contains a VHT Capabilities element representing the VHT capabilities of STA-2. If STA-2 is an S1G STA, this response also contains an S1G Capabilities element representing the capabilities of STA-2.

11.7.3 Data transfer after setup

Change the first paragraph of 11.7.3 as follows:

For each active direct link, a STA shall record the MAC and PHY features, rates, and MCSs that are supported by the other STA participating in the direct link, according to the Supported Rates and BSS Membership Selectors, Extended Supported Rates and BSS Membership Selectors, Capability Information, HT Capabilities, ~~and~~ VHT Capabilities, and S1G Capabilities fields within the DLS Request and DLS Response frames that were used to establish the direct link.

11.14 SA Query procedures

Insert the following paragraph at the end of 11.14:

When an S1G STA in a power save mode wakes up with an interval longer than dot11AssociationSAQueryMaximumTimeout, an existing SA can be destroyed. So, to maintain its valid SA status, the S1G STA shall wake to listen to SA Query Request frame with the interval specified by dot11AssociationSAQueryMaximumTimeout. When dot11RSNAProtectedManagementFramesActivated is true, an S1G AP shall provide the Timeout Interval (Association Comeback time, which is set to dot11AssociationSAQueryMaximumTimeout) in an Association Response frame and Reassociation Response frame with a status code 0 to the S1G STA.

11.19 RSNA A-MSDU procedures

Change the second paragraph of 11.19 as follows (Table 11-12 remains unchanged):

Table 11-12 defines behavior related to the transmission and reception of individually addressed A-MSDUs of a first HT STA or S1G STA (STA1) that has successfully negotiated an RSNA (re)association with a second HT STA or S1G STA (STA2). Reception and transmission of A-MSDUs using a non-RSN association is unaffected by the values of the SPP A-MSDU Capable and SPP A-MSDU Required subfields.

11.23 Tunneled direct-link setup

11.23.1 General

Insert the following paragraph after the 11th paragraph ("When admission control....") of 11.23.1:

An S1G STA with a TDLS link that is not an off-channel direct link shall use as its primary channel the channel indicated by the Primary Channel Number field in the S1G Operation element. The channel width of an S1G TDLS link shall not be wider than the maximum channel width supported by either the TDLS initiator STA or the TDLS responder STA.

Insert the following paragraph at the end of 11.23.1:

The S1G Operation element shall be present in a TDLS Setup Confirm frame for S1G STA.

11.23.6 TDLS channel switching

11.23.6.5 Setting up a wide bandwidth off-channel direct link

11.23.6.5.1 General

Change the first through fourth paragraphs of 11.23.6.5.1 as shown:

A wideband TDLS off-channel TDLS direct link is a 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz off-channel TDLS direct link for VHT STAs or a 2 MHz, 4 MHz, 8 MHz, or 16 MHz off-channel TDLS direct link for S1G STAs.

A wideband off-channel TDLS direct link may be started if both TDLS peer STAs indicated wideband support in the VHT Capabilities element ~~VHT Capabilities Information field~~ or S1G Capabilities element included in the TDLS Setup Request frame or the TDLS Setup Response frame.

Switching to a wideband off-channel direct link is achieved by including any of the following information in the TDLS Channel Switch Request frame:

- An Operating Class element indicating 40 MHz Channel Spacing and a Secondary Channel Offset element indicating SCA or SCB
- A Wide Bandwidth Channel Switch element indicating 80 MHz, 160 MHz, or 80+80 MHz channel width for VHT STAs
- A Wide Bandwidth Channel Switch element indicating 4 MHz, 8 MHz, or 16 MHz channel width for S1G STAs

For VHT STAs, ~~T~~the operating class in TDLS Channel Switch Request frame shall have a value representing 5 GHz for the channel starting frequency.

Change the sixth paragraph of 11.23.6.5.1 as follows:

When announcing new operating classes or both a new operating class table index and new operating classes that come into effect at the same time as the switch to the direct link and that express new regulatory requirements, the TDLS peer VHT or S1G STA initiating the switch shall include a Country element in a transmitted TDLS Channel Switch Request frame. The Country element shall contain all of the Operating Classes for the off-channel direct link in Operating Triplet fields and zero Subband Triplet fields. The Country element shall include one Operating Triplet field that contains the same Operating Class as the Operating Class field in the same frame. The country indicated by the Country string in the TDLS Channel Switch Request frame shall be equal to the country indicated by the Country string of the BSS. The recipient TDLS peer VHT or S1G STA that has dot11MultiDomainCapabilityActivated, dot11SpectrumManagementRequired, or dot11RadioMeasurementActivated equal to true shall use the parameters in the received Country element in the TDLS Channel Switch Request frame in order to maintain regulatory compliance.

11.23.6.5.2 Basic wideband functionality

Insert the following paragraphs at the end of 11.23.6.5.2:

TDLS peer S1G STAs may transmit up to 4 MHz, 8 MHz, or 16 MHz PPDUs on a 4 MHz, 8 MHz, or 16 MHz off-channel TDLS direct link, respectively. An S1G STA determines the channelization based on the Wide Bandwidth Channel Switch element of the TDLS Channel Switch Request frame.

A TDLS peer S1G STA shall not transmit a 1 MHz PPDU in the nonprimary 1 MHz channel of its 4 MHz, 8 MHz or 16 MHz off-channel TDLS direct link. A TDLS peer S1G STA shall not transmit a 2 MHz PPDU in the nonprimary 2 MHz channel of its 4 MHz, 8 MHz, or 16 MHz off-channel TDLS direct link. A TDLS peer S1G STA shall not transmit a 4 MHz PPDU that does not use the primary 4 MHz channel of its 8 MHz or 16 MHz off-channel TDLS direct link. A TDLS peer S1G STA shall not transmit an 8 MHz PPDU that does not use the primary 8 MHz channel of its 16 MHz off-channel TDLS direct link.

11.23.6.5.3 Channel selection for a wideband off-channel direct link

Change 11.23.6.5.3 as follows:

If a non-S1G TDLS peer STA chooses to start a wideband direct link, the TDLS peer STA shall follow the primary channel selection rules defined in 11.40.2 and 11.24.15 and the secondary 80 MHz channel rule defined in 11.23.1.

If an S1G TDLS peer STA chooses to start a wideband direct link, the TDLS peer STA shall follow the primary channel selection rules defined in 10.42.4 and 11.24.15.

Change the title of 11.23.6.5.4 as follows:

11.23.6.5.4 Switching from a wideband to a 20 MHz, 1 MHz, or 2 MHz direct link

Change 11.23.6.5.4 as follows:

Switching from a wideband off-channel direct link to a 20 MHz, 1 MHz, or 2MHz off-channel direct link is established through a TDLS channel switch. A non-S1G STA operating on a wideband off-channel direct link shall accept a requested switch to a 20 MHz direct link. An S1G STA operating on a wideband off-channel direct link shall accept a requested switch to a 1 MHz or 2 MHz direct link.

Change the title of 11.23.6.5.5 as follows:

11.23.6.5.5 CCA sensing and NAV assertion in a 20 MHz, 40 MHz, 80 MHz, 160 MHz, ~~or~~ 80+80 MHz, 1 MHz, 2 MHz, 4 MHz, 8 MHz, or 16 MHz direct link

Insert the following paragraph at the end of 11.23.6.5.5:

TDLS peer S1G STAs shall follow the CCA rules defined in 10.3.2.6 and 10.22.2.7 and the NAV rules defined in 10.42.6.

11.24 Wireless network management procedures

11.24.13 BSS max idle period management

Change 11.24.13 as follows:

If dot11MaxIdlePeriod is a nonzero, the STA shall include the BSS Max Idle Period element in the Association Response frame or the Reassociation Response frame. Otherwise, the STA shall not include the BSS Max Idle Period element in the Association Response frame or the Reassociation Response frame. A non-S1G STA may send protected or unprotected keepalive frames, as indicated in the Idle Options field.

Extended BSSMaxIdlePeriod values are those that had a nonzero USF (Table 9-44a) value signaled by an S1G STA. An S1G STA may include the BSS Max Idle Period element in transmitted Association Request frames and Reassociation Request frames to indicate a preferred BSSMaxIdlePeriod value.The S1G AP selects a value for BSSMaxIdlePeriod based on the S1G STA's preferred BSSMaxIdlePeriod (if any) and the type of the S1G STA. The S1G AP indicates its chosen value to the S1G STA in the (Re)Association

Response frame. The value chosen by the AP is the value that the AP will use in making disassociate decisions based on the timeout value equal to BSSMaxIdlePeriod for the STA that is the recipient of the Association Response frame or Reassociation Response frame. An AP may provide different values for BSSMaxIdlePeriod to different STAs.

A STA may send at least one protected or unprotected keepalive frame per BSSMaxIdlePeriod, as indicated in the Idle Options field. When a STA transmits an unprotected keepalive frame, it shall use a frame that has 48-bit TA and RA fields.

The Max Idle Period field of the BSS Max Idle Period element indicates the time period during which a STA can refrain from transmitting frames to its associated AP without being disassociated. A non-AP STA is considered inactive if the AP has not received a Data frame, PS-Poll frame, or Management frame (protected or unprotected as specified in this paragraph) of a frame exchange sequence initiated by the STA for a time period greater than or equal to the time specified by the Max Idle Period field. If the Idle Options field requires protected keepalive frames, then the AP may disassociate the STA if no protected frames are received from the STA for a duration of BSSMaxIdlePeriod. ~~period indicated by the Max Idle Period field of the BSS Max Idle Period element.~~ If the Idle Options field allows unprotected or protected keepalive frames, then the AP may disassociate the STA if no protected or unprotected frames with 48-bit TA and RA fields are received from the STA for a duration of BSSMaxIdlePeriod. ~~indicated by the Max Idle Period field of the BSS Max Idle Period element.~~

NOTE—The AP can disassociate or deauthenticate the STA at any time for other reasons even if the STA satisfies the keepalive frame transmission requirements.

11.24.16 Group addressed transmission service

11.24.16.2 DMS procedures

Change the fourth paragraph of 11.24.16.2 as follows (including restructuring it and splitting it into two paragraphs):

Implementation of DMS is optional for a WNM STA and mandatory for a robust AV streaming STA (as defined in 11.27.1). A STA that implements DMS has dot11DMSImplemented equal to true. When dot11DMSImplemented is true,

— At least one of dot11WirelessManagementImplemented and dot11RobustAVStreamingImplemented shall be true.
— ~~When dot11DMSImplemented is true, either~~ dot11HighThroughputOptionImplemented shall be true for a non-DMG STA that is not a DMG or an S1G STA ~~or~~
— dot11DMGOptionImplemented shall be true for a DMG STA.
— dot11S1GOptionImplemented shall be true for an S1G STA.

A STA whose dot11DMSActivated is true shall support the directed multicast service ~~DMS~~ and shall set to 1 the DMS field of the Extended Capabilities element that it transmits.

11.41 Group ID management operation

Change the first paragraph of 11.41 as follows:

An AP determines the possible combinations of STAs that can be addressed by a VHT MU PPDU or an S1G MU PPDU by assigning STAs to groups and to specific user positions within those groups.

Change the fifth paragraph of 11.41 as follows:

A non-S1G AP may transmit a Group ID Management frame only if dot11VHTOptionImplemented is true. A Group ID Management frame shall not be sent to a VHT STA that does not have the MU Beamformee Capable field in the VHT Capabilities element equal to 1.

Insert the following paragraph after the fifth paragraph of 11.41:

An S1G AP shall not transmit a Group ID Management frame to an S1G STA that does not have the MU Beamformee Capable field in the S1G Capabilities element equal to 1.

Change the now 9th, 10th, and 11th paragraphs of 11.41 as follows:

Group ID values of 0 and 63 are used for SU PPDU and the PHY filtering of such PPDUs is controlled by the PHYCONFIG_VECTOR primitive LISTEN_TO_GID00 and LISTEN_TO_GID63 parameters. The User Position in Group ID information is interpreted by a STA receiving a VHT MU PPDU or an S1G MU PPDU as explained in 21.3.11.4 or 23.3.10.4, respectively.

Transmission of a Group ID Management frame to a STA and any associated acknowledgment from the STA shall complete before the transmission of a VHT MU PPDU and an S1G MU PPDU to the STA.

A VHT MU PPDU and an S1G MU PPDU shall be transmitted to a STA based on the content of the Group ID Management frame most recently transmitted to the STA and for which an acknowledgment was received.

11.42 Notification of operating mode changes

Change the first paragraph of 11.42 as follows:

A STA in which dot11OperatingModeNotificationImplemented is true shall set the Operating Mode Notification field in the Extended Capabilities element to 1. A VHT STA shall set dot11OperatingModeNotificationImplemented to true. An S1G STA may set dot11OperatingModeNotificationImplemented to true. A STA in which dot11OperatingModeNotificationImplemented is true is referred to as *operating mode notification capable*.

Change the 10th paragraph of 11.42 as follows (the dashed list after this paragraph remains unchanged):

A non-S1G AP should notify associated STAs of a change in its operating channel width through one or more of the following mechanisms:

Insert the following paragraph after the 10th paragraph of 11.42:

An S1G AP should notify associated STAs of a change in its operating channel width through one or more of the following mechanisms:

- Using the Extended Channel Switch Announcement element, Extended Channel Switch Announcement frame, or both, following the procedure described in 11.10
- Using individually addressed Operating Mode Notification frames
- Using the Channel Width subfield in the S1G Operation element

Insert the following paragraphs after the now 16th paragraph ("An HT AP....") of 11.42:

An S1G STA shall not transmit a Notify Channel Width frame.

An S1G AP that changes its operating channel width shall indicate the new operating channel width in the Channel Width field in the S1G Operation element.

Change the now 20th paragraph of 11.42 as follows:

A STA shall not transmit an Operating Mode field with the value of the Rx NSS subfield indicating a number of spatial streams not supported by the recipient STA. The number of spatial streams supported by the recipient STA is reported in the Supported Rates and BSS Membership Selectors element, Extended Supported Rates and BSS Membership Selectors element, Supported MCS Set field, ~~or~~ Supported VHT-MCS and NSS Set field, or Supported S1G-MCS and NSS Set field transmitted in Management frames by the recipient STA.

Change the now 21th paragraph of 11.42 as follows:

A STA shall not transmit an Operating Mode field with the value of the Channel Width subfield indicating a bandwidth not supported by the STA, as reported in the Supported Channel Width Set subfield in the HT Capabilities Information field, ~~or~~ in the VHT Capabilities Information field, or the S1G Capabilities Information field in Management frames transmitted by the STA.

Change the following note after the now 22nd paragraph of 11.42 as shown:

NOTE 2—To avoid possible frame loss, a VHT or S1G STA that sends an individually addressed Operating Mode Notification frame to a second VHT or S1G STA indicating reduced operating channel width and/or reduced active receive chains can continue with its current operating channel width and active receive chains until it infers that the second STA has processed this notification. The first VHT or S1G STA might make this inference from either of the following:

— By receiving a frame addressed to itself from the second VHT or S1G STA in a PPDU with a bandwidth and N_{SS} that are less than or equal to the channel width and N_{SS}, respectively, indicated in the Operating Mode Notification frame
— Based on the passage of time in some implementation-dependent way, which is outside the scope of this standard

Insert the following subclause (11.48) after 11.47.5.3:

11.48 Support for energy limited STAs

An energy limited (EL) STA is an S1G STA with dot11S1GELOperationActivated equal to true that is powered by a small energy supply and is limited in terms of its ability to transmit or receive in certain intervals of time. An EL STA may indicate these limitations to an S1G STA that intends to communicate with it by using the signalling described in this subclause. The procedure described below increases the likelihood that frame exchanges between these two STAs are performed successfully.

An EL STA receiving MLME-ELOPERATION.request primitive shall include an EL Operation element in Probe Request, DLS Request, DLS Response, TDLS Setup Request, TDLS Setup Response, and (Re)Association Request frames and may send EL Operation frames.

An S1G AP that sets the STA Type Support in the S1G Capabilities element to 2 (i.e., supports only non-sensor STAs), as described in 10.59, may refuse (re)association or can disassociate an EL STA. The S1G AP that refuses (re)association or disassociates an EL STA shall set the Status Code field in the (Re)Association Response frame or in the Disassociation frame to ENERGY_LIMITED_OPERATION_NOT_SUPPORTED.

Upon receipt of an MLME-ELOPERATION.indication primitive, an S1G STA shall maintain two timers, ELMaxAwakeTimer and ELRecoveryTimer according to the procedures defined in 10.58.

12. Security

12.5 RSNA confidentiality and integrity protocols

12.5.3 CTR with CBC-MAC protocol (CCMP)

12.5.3.2 CCMP MPDU format

Change the length of the CCMP header field of Figure 12-16 ("Expanded CCMP MPDU") as follows:

from "8 octets" to "0 or 8 octets"

Change the second paragraph of 12.5.3.2 as follows (including splitting it into three paragraphs and inserting Figure 12-16a):

For secure PV0 MPDUs, CCMP-128 processing expands the original MPDU size by 16 octets: 8 octets for the CCMP Header field and 8 octets for the MIC field. CCMP-256 processing expands the original MPDU size by 24 octets: 8 octets for the CCMP Header field and 16 octets for the MIC field. The CCMP Header field is constructed from the PN, ExtIV, and Key ID subfields. PN is a 48-bit PN represented as an array of 6 octets. PN5 is the most significant octet of the PN, and PN0 is the least significant.

The CCMP header is not included in secure PV1 MPDUs, but constructed locally at the STA as defined in 12.5.3.2a. For secure PV1 MPDUs, CCMP-128 processing expands the original MPDU size by 8 octets for the MIC field. CCMP-256 processing expands the original MPDU size by 16 octets for the MIC field. Figure 12-16a depicts the PV1 MPDU when using CCMP.

Note that CCMP does not use the WEP ICV.

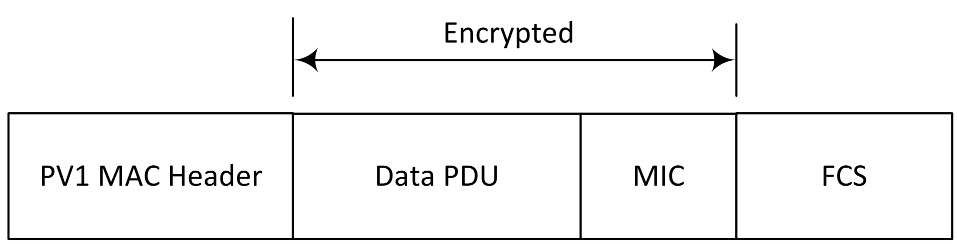


Figure 12-16a—Expanded PV1 CCMP MPDU

Insert the following subclause (12.5.3.2a) after 12.5.3.2:

12.5.3.2a Construction of the CCMP header for PV1 MPDUs

The CCMP header is not present in secure PV1 MPDUs, but constructed locally at the STA as follows:

- The PN is composed of the Sequence Control (SC) field and a base PN (BPN), as SC||BPN, where
  - The Sequence Control field is present in the MPDU header
    - PN0||PN1 = SC with the FN subfield masked to 0 when the PV1 MPDU is carried in an A-MPDU that is not an S-MPDU
  - The base PN is retrieved from the local storage at the receiver
    - PN2||PN3||PN4||PN5 = BPN
  - PN = PN0||PN1|| PN2||PN3||PN4||PN5 (= SC||BPN)
- The Key ID is retrieved from the local storage at the receiver

The locally stored BPN and Key ID are initialized at 0 when a secure link is established.

The locally stored BPN shall be incremented by 1 when the sequence number of the MPDU is less than the previous sequence number for that TID/ACI if any of the following two conditions is satisfied:

— Block Ack is not used
— Block Ack is used but decryption occurs after Block Ack reordering

When Block Ack is used and decryption occurs before Block Ack reordering, the BPN may be updated as follows. The receiver maintains a sequence number window of size w, which is equal to twice the Block Ack reorder window. The sequence number window has a lower edge *a* and an upper edge *b*. For a received sequence number SN (as part of the received sequence control field SC), the associated packet number (PN) is determined as follows (where b is initialized as $b = 0$):

if ($b \geq$ w) then
  $a = b -$ w
  if (SN < a) then BPN = BPN + 1
  PN = SC||BPN
  if not (a < SN < b) then b = SN
else (i.e., b < w) then
  $a = b - \mathrm{w} + 2^{12}$
  if (SN < a) then PN = SC||BPN
  if (SN ≥ a) then PN = SC||(BPN − 1)
  if (b < SN < a) then b = SN

The BPN can also be updated explicitly through a header compression request/response exchange, as defined in 10.54.

12.5.3.3 CCMP cryptographic encapsulation

12.5.3.3.1 General

Change the second paragraph of 12.5.3.3.1 as follows (including changing the list format):

a) For secure PV0 MPDUs, CCMP encrypts the Frame Body field of a plaintext MPDU and encapsulates the resulting cipher text using the following steps:
   1) ~~a)~~ Increment the PN, to obtain a fresh PN for each MPDU, so that the PN never repeats for the same temporal key. Note that retransmitted MPDUs are not modified on retransmission.
   2) ~~b)~~ Use the fields in the MPDU header to construct the additional authentication data (AAD) for CCM. The CCM algorithm provides integrity protection for the fields included in the AAD. MPDU header fields that may change when retransmitted are muted by being masked to 0 when calculating the AAD.
   3) ~~c)~~ Construct the CCM nonce block from the PN, A2, and the priority value of the MPDU where A2 is MPDU Address 2. If the Type field of the Frame Control field is 10 (Data frame) and there is a QoS Control field present in the MPDU header, the priority value of the MPDU is equal to the value of the QC field TID (bits 0 to 3 of the QC field). If the Type field of the Frame Control field is 00 (Management frame), and the frame is a QMF, the priority value of the MPDU is equal to the value in the ACI subfield of the Sequence Number field. Otherwise, the priority value of the MPDU is equal to the fixed value 0.
   4) ~~d)~~ Place the new PN and the key identifier into the 8-octet CCMP header.
   5) ~~e)~~ Use the temporal key, AAD, nonce, and MPDU data to form the cipher text and MIC. This step is known as CCM originator processing.

6) ~~f)~~ Form the encrypted MPDU by combining the original MPDU header, the CCMP header, the encrypted data and MIC, as described in 12.5.3.2

Insert the following paragraph after the second paragraph of 12.5.3.3.1:

b) For secure PV1 MPDUs, CCMP encrypts the Frame Body field of a plaintext MPDU and encapsulates the resulting cipher text using the following steps:
   1) When the Sequence Number of the MPDU is less than the previous Sequence Number and satisfies the BPN update conditions in 12.5.3.2a for that TID/ACI, increment the base PN so that the PN never repeats for the same temporal key and TID/ACI. Note that retransmitted MPDUs are not modified on retransmission.
   2) Use the fields in the MPDU header to construct the AAD for CCM. The CCM algorithm provides integrity protection for the fields included in the AAD. MPDU header fields that might change when retransmitted are muted by being masked to 0 when calculating the AAD.
   3) Construct the CCMP header as defined in 12.5.3.2a. If the Type field of the Frame Control field is 001 (Management frame) and the frame is a QMF, the priority value of the MPDU is equal to the value in the ACI subfield of the Sequence Number field. Otherwise, the priority value of the MPDU is equal to the fixed value 0.
   4) Construct the CCM nonce block from the PN, the A2, and the Priority field of the MPDU where A2 is the STA MAC address identified by MPDU Address 2.
   5) Use the temporal key, AAD, nonce, PN, and MPDU data to form the cipher text and MIC. This step is known as *CCM originator processing*.
   6) Form the encrypted MPDU by combining the original MPDU header, the encrypted data, and the MIC, as described in 12.5.3.2.

12.5.3.3.2 PN processing

Change 12.5.3.3.2 as follows:

The PN is incremented by a positive number for each MPDU. The PN shall be incremented in steps of 1 for constituent MPDUs of fragmented MSDUs and MMPDUs. For PV0 MPDUs, t~~T~~he PN shall never repeat for a series of encrypted MPDUs using the same temporal key. For PV1 MPDUs, the PN shall never repeat for a series of encrypted MPDUs using the same temporal key and TID/ACI.

NOTE—When a group addressed MSDU is retransmitted using GCR, it is concealed from non-GCR capable STAs using the procedures described in 11.24.16.3.5. The MPDU containing this concealed A-MSDU has a different PN from the MPDU that contained the original transmission of the group addressed MSDU.

12.5.3.3.3 Construct AAD

Change the first, second, and third paragraphs of 12.5.3.3.3 as follows (including changing the list format):

a) For PV0 MPDUs, t~~T~~he format of the AAD is shown in Figure .

	FC	A1	A2	A3	SC	A4	QC
Octets:	2	6	6	6	2	6	2

Figure 12-18—AAD construction for PV0 MPDUs

The length of the AAD for PV0 MPDUs varies depending on the presence or absence of the QC and A4 fields and is shown in Table 12-1.

Table 12-1—AAD length for PV0 MPDUs

QC field	A4 field	AAD length (octets)
Absent	Absent	22
Present	Absent	24
Absent	Present	28
Present	Present	30

The AAD is constructed from the MPDU header. The AAD does not include the header Duration field, because the Duration field value might change due to normal IEEE 802.11 operation (e.g., a rate change during retransmission). The AAD includes neither the Duration/ID field nor the HT Control field because the contents of these fields might change during normal operation (e.g., due to a rate change preceding retransmission). The HT Control field might also be inserted or removed during normal operation (e.g., retransmission of an A MPDU where the original A MPDU included an MRQ that has already generated a response). For similar reasons, several subfields in the Frame Control field are masked to 0. For PV0 MPDUs, the AAD construction is performed as follows:

1) ~~a)~~ FC – MPDU Frame Control field, with
   i) ~~1)~~ Subtype subfield (bits 4 5 6) in a Data frame masked to 0
   ii) ~~2)~~ Retry subfield (bit 11) masked to 0
   iii) ~~3)~~ Power Management subfield (bit 12) masked to 0
   iv) ~~4)~~ More Data subfield (bit 13) masked to 0
   v) ~~5)~~ Protected Frame subfield (bit 14) always set to 1
   vi) ~~6)~~ +HTC/Order subfield (bit 15) as follows:
      — ~~i)~~ Masked to 0 in all Data frames containing a QoS Control field
      — ii) Unmasked otherwise
2) ~~b)~~ A1 – MPDU Address 1 field.
3) ~~c)~~ A2 – MPDU Address 2 field.
4) ~~d)~~ A3 – MPDU Address 3 field.
5) ~~e)~~ SC – MPDU Sequence Control field, with the Sequence Number subfield (bits 4–15 of the Sequence Control field) masked to 0. The Fragment Number subfield is not modified.
6) ~~f)~~ A4 – MPDU Address field, if present.
7) ~~g)~~ QC – QoS Control field, if present, a 2-octet field that includes the MSDU priority. The QC TID is used in the construction of the AAD. When in a non-DMG BSS and both the STA and its peer have their SPP A-MSDU Capable fields equal to 1, bit 7 (the A-MSDU Present field) is used in the construction of the AAD. The remaining QC fields are masked to 0 for the AAD calculation (bits 4 to 6, bits 8 to 15, and bit 7 when either the STA or its peer has the SPP A-MSDU Capable field equal to 0). When in a DMG BSS, the A-MSDU Present bit 7 and A-MSDU Type bit 8 are used in the construction of the AAD, and the remaining QC fields are masked to 0 for the AAD calculation (bits 4 to 6, bits 9 to 15).

Insert the following paragraphs (including Figure 12-18a and Table 12-1a) at the end of 12.5.3.3.3:

b) For PV1 MPDUs, the format of the AAD is shown in Figure 12-18a.

	FC	A1	A2	SC	A3	A4
Octets:	2	6	6	2	0 or 6	0 or 6

Figure 12-18a—AAD construction for PV1 MPDUs

For PV1 MPDUs, the length of the AAD varies depending on the presence or absence of the A3 and A4 fields and is shown in Table 12-1a.

Table 12-1a—AAD length for PV1 MPDUs

Type subfield in the Frame Control	A3 field in uncompressed header	A4 field in uncompressed header	AAD length (octets)
0, 1 or 3	Absent	Absent	16
0, 1 or 3	Present	Absent	22
0 or 3	Absent	Present	22
0 or 3	Present	Present	28

For PV1 MPDUs, AAD construction is performed as follows:

1) FC – MPDU Frame Control field, with
   i) Power Management subfield (bit 10) masked to 0
   ii) More Data subfield (bit 11) masked to 0
   iii) Protected Frame subfield (bit 12) always set to 1
   iv) EOSP subfield (bit 13) masked to 0
   v) Relayed Frame subfield (bit 14) masked to 0
   vi) Ack Policy subfield (bit 15) masked to 0
2) A1 – MPDU Address 1 field if it contains a MAC address; otherwise, the MAC address that corresponds to the AID value contained in the SID field of the A1 field.
3) A2 – MPDU Address 2 field if it contains a MAC address; otherwise, the MAC address corresponding to the AID value contained in the SID field of the A2 field.
4) A3 – MPDU Address 3 field if present in the MPDU, the value of A3 stored at the receiver if A3 is stored at the receiver and is not present in the MPDU (see 10.54); otherwise, not present.
5) A4 – MPDU Address 4 field if present in the MPDU, the value of A4 stored at the receiver if A4 is stored at the receiver and is not present in the MPDU (see 10.54); otherwise, not present.
6) SC – MPDU Sequence Control field, with the Sequence Number subfield (bits 4–15 of the Sequence Control field) masked to 0. The Fragment Number subfield is not modified.

12.5.3.3.4 Construct CCM nonce

Change 12.5.3.3.4 as follows:

The Nonce field occupies 13 octets, and its structure is shown in Figure 12-19. The structure of the Nonce Flags subfield of the Nonce field is shown in Figure 12-20.

	Nonce Flags	STA MAC Address Identified By A2	PN
Octets:	1	6	6

Figure 12-19—Nonce construction

	B0 B3	B4	B5	B6~~5~~ B7
	Priority	Management	PV1	Zeros
Bits:	4	1	1	2~~3~~

Figure 12-20—Nonce Flags subfield~~s~~

The Nonce field has an internal structure of Nonce Flags || STA MAC Address Identified By A2 || PN ~~(“||” is concatenation)~~, where

- The Priority subfield of the Nonce Flags field shall be set to the priority value of the MPDU
- When management frame protection is negotiated, the Management field of the Nonce Flags field shall be set to 1 if the PV0 MPDU’s Type field of the Frame Control field is 00 (Management frame) or the PV1 MPDU’s Type field of the Frame Control field is 001 (Management frame); otherwise, it shall be set to 0.
- The PV1 subfield of the Nonce Flags field shall be set to 1 when the Protocol Version field of the Frame Control field of the MPDU header is equal to 1. The PV1 subfield of the Nonce Flags field shall be set to 0 otherwise.
- Bits ~~5~~6 to 7 of the Nonce Flags field shall be set to 0.
- STA MAC Address Identified By ~~MPDU address~~ A2 field occupies octets 1–6. This shall be encoded with the octets ordered with STA MAC Address Identified By A2 octet 0 at octet index 1 and STA MAC Address Identified By A2 octet 5 at octet index 6.
- The PN field occupies octets 7–12. The octets of PN shall be ordered so that PN0 is at octet index 12 and PN5 is at octet index 7.

12.5.3.3.6 CCM originator processing

Change the second paragraph of 12.5.3.3.6 as follows:

There are four inputs to CCM originator processing:

a) Key: the temporal key (16 octets).
b) Nonce: the nonce (13 octets) constructed as described in 12.5.3.3.4.
c) Frame body: the plaintext frame body of the MPDU.
d) AAD: the AAD (~~22~~16–30 octets) constructed from the MPDU header as described in 12.5.3.3.3.

12.5.3.4 CCMP decapsulation

12.5.3.4.1 General

Change the second paragraph of 12.5.3.4.1 as follows (including changing the list format):

a) For secure PV0 MPDUs, CCMP decrypts the Frame Body field of a cipher text MPDU and decapsulates a plaintext MPDU using the following steps:
   1) ~~a)~~ The encrypted MPDU is parsed to construct the AAD and nonce values.
   2) ~~b)~~ The AAD is formed from the MPDU header of the encrypted MPDU.
   3) ~~c)~~ The Nonce value is constructed from the A2, PN, and Nonce Flags fields.
   4) ~~d)~~ The MIC is extracted for use in the CCM integrity checking.
   5) ~~e)~~ The CCM recipient processing uses the temporal key, AAD, nonce, MIC, and MPDU cipher text data to recover the MPDU plaintext data as well as to check the integrity of the AAD and MPDU plaintext data.
   6) ~~f)~~ The received MPDU header and the MPDU plaintext data from the CCM recipient processing are concatenated to form a plaintext MPDU.
   7) ~~g)~~ The decryption processing prevents replay of MPDUs by validating that the PN in the MPDU is greater than the replay counter maintained for the session.

Insert the following paragraph after the second paragraph of 12.5.3.4.1:

b) For secure PV1 MPDUs, CCMP decrypts the Frame Body field of a cipher text MPDU and decapsulates a plaintext MPDU using the following steps:
   1) The encrypted MPDU is parsed to construct the AAD and nonce values.
   2) The CCMP header is constructed as defined in 12.5.3.2a.
   3) The AAD is formed from the MPDU header of the encrypted MPDU.
   4) The Nonce value is constructed from the STA MAC Address Identified By A2, PN, and Nonce Flags fields.
   5) The MIC is extracted for use in the CCM integrity checking.
   6) The CCM recipient processing uses the temporal key, AAD, nonce, MIC, and MPDU cipher text data to recover the MPDU plaintext data as well as to check the integrity of the AAD and MPDU plaintext data.
   7) The received MPDU header and the MPDU plaintext data from the CCM recipient processing are concatenated to form a plaintext MPDU.
   8) The decryption processing prevents replay of MPDUs by validating that the PN in the CCMP header is greater than the replay counter maintained for the session and TID/ACI.

Change the last paragraph of 12.5.3.4.1 as follows:

When the received frame is a CCMP protected individually addressed robust Management frame or PV1 Management frame, contents of the MMPDU body after protection is removed shall be delivered to the SME via the MLME primitive designated for that MMPDU or PV1 Management frame rather than through the MA-UNITDATA.indication primitive.

12.5.3.4.2 CCM recipient processing

Change the first and second paragraphs of 12.5.3.4.2 as follows:

CCM recipient processing uses the same parameters as CCM originator processing. A CCMP protected individually addressed robust Management frame or PV1 Management frame shall use the same TK as a Data frame or PV1 Data frame.

There are four inputs to CCM recipient processing:

— *Key:* the temporal key (16 octets).
— *Nonce:* the nonce (13 octets) constructed as described in 12.5.3.3.4.
— *Encrypted frame body:* the encrypted frame body from the received MPDU. The encrypted frame body includes the MIC.
— *AAD:* the AAD (~~2~~12–30 octets) that is the canonical MPDU header as described in 12.5.3.3.3.

12.5.3.4.4 PN and replay detection

Change 12.5.3.4.4 as follows:

To effect replay detection, the receiver extracts the PN from the CCMP header.

NOTE—The CCMP header is not present in secure PV1 MPDUs, but constructed locally at the STA as defined in 12.5.3.2a.

See 12.5.3.2 for a description of how the PN is encoded in the CCMP header.

The following processing rules are used to detect replay:

a) The receiver shall maintain a separate set of replay counters for each PTKSA, GTKSA, ~~and~~ STKSA, and protocol version value. The receiver initializes these replay counters to 0 when it resets the temporal key for a peer. The replay counter is set to the PN value of accepted CCMP MPDUs.
b) For each PTKSA, GTKSA, ~~and~~ STKSA, and protocol version value, the recipient shall maintain a separate replay counter for each TID, subject to the limitation of the number of supported replay counters indicated in the RSN Capabilities field (see 9.4.2.25), and shall use the PN from a received frame to detect replayed frames. A replayed frame occurs when the PN from a received frame is less than or equal to the current replay counter value for the frame's MSDU or A MSDU priority and frame type.
c) If dot11RSNAProtectedManagementFramesActivated is true, the recipient shall maintain a single replay counter for received individually addressed robust Management frames that are received with the To DS subfield equal to 0, and a single replay counter for received individually addressed robust PV1 Management frames and shall use the PN from the received frame to detect replays. If dot11QMFActivated is also true, the recipient shall maintain an additional replay counter for each ACI for received individually addressed Robust Management frames and Robust PV1 Management frames that are received with the To DS subfield equal to 1. The QMF receiver shall use the ACI encoded in the Sequence Number field of the received frame to select the replay counter to use for the received frame, and shall use the PN from the received frame to detect replays. A replayed frame occurs when the PN from the frame is less than or equal to the current value of the management frame replay counter that corresponds to the ACI of the frame.
d) The receiver shall discard any Data frame that is received with its PN less than or equal to the value of the replay counter that is associated with the TA and priority value of the received MPDU. The receiver shall discard MSDUs and MMPDUs whose constituent MPDU PN values are not incrementing in steps of 1. If dot11RSNAProtectedManagementFramesActivated is true, the receiver shall discard any individually addressed robust Management frame that is received with its

PN less than or equal to the value of the replay counter associated with the TA of that individually addressed Management frame.

e) When discarding a frame, the receiver shall increment by 1 dot11RSNAStatsCCMPReplays for Data frames or dot11RSNAStatsRobustMgmtCCMPReplays for robust Management frames.

f) For MSDUs or A-MSDUs sent using the block ack feature, reordering of received MSDUs or A-MSDUs according to the block ack receiver operation (described in 10.24.4) is performed prior to replay detection.

Insert Clause 23 after Clause 22:

23. Sub 1 GHz (S1G) PHY specification

23.1 Introduction

23.1.1 Introduction to the S1G PHY

Clause 23 specifies the PHY entity for an S1G orthogonal frequency division multiplexing (OFDM) system.

The S1G PHY is based on the VHT PHY defined in Clause 21, which in turn is based on HT PHY defined in Clause 19 and the OFDM PHY defined in Clause 17. The S1G PHY defines an OFDM PHY in the sub-1 GHz bands using narrower bandwidths than those in 2.4 GHz and 5 GHz bands, with maximum number of space-time streams supported being four, and with support for downlink multi-user (MU) transmissions. A downlink MU transmission supports up to four users with up to three space-time streams per user with the total number of space-time streams not exceeding four.

The S1G PHY provides support for 1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz contiguous channel widths. A tone spacing of 31.25 kHz is used in all the bandwidths.

Transmissions of PPDUs with channel bandwidth 2 MHz, 4 MHz, 8 MHz, and 16 MHz are in general modulated the same way as 20 MHz, 40 MHz, 80 MHz and 160 MHz contiguous mode as specified in Clause 21, respectively, except with a 1/10 clock rate. For details refer to Table 23-4 (in 23.3.6). Transmissions of PPDUs with 1 MHz channel bandwidth are modulated as described in 23.3.4.4.

The S1G PHY data subcarriers are modulated using binary phase shift keying (BPSK), quadrature phase shift keying (QPSK), 16-quadrature amplitude modulation (16-QAM), 64-QAM and 256-QAM. Forward error correction (FEC) coding (convolutional or LDPC coding) is used with coding rates of 1/2, 2/3, 3/4, and 5/6.

An S1G non-AP STA shall support the following Clause 23 features:

- 1 MHz and 2 MHz channel width
- S1G_1M, S1G_SHORT PPDU
- S1G_LONG PPDU, if ≥ 4 MHz channel width is supported
- Detect and decode SIG-A field of the S1G_LONG preamble.
- Single spatial stream MCSs 0 to 2, and MCS10 (for 1 MHz PPDU only)
- Binary convolutional coding
- Normal Guard Interval T_{GI} as defined in Table 23-4 (in 23.3.6)
- Fixed Pilots

An S1G AP STA shall support the following Clause 23 features:

- 1 MHz and 2 MHz channel width
- S1G_1M, S1G_SHORT PPDU
- S1G_LONG PPDU, if ≥ 4 MHz channel width is supported
- Detect and decode SIG-A field of the S1G_LONG preamble.
- Single spatial stream MCSs 0 to 7, and MCS10 (for 1 MHz PPDU only)
- Binary convolutional coding

— Normal Guard Interval T_{GI} as defined in Table 23-4 (in 23.3.6)
— Fixed Pilots

An S1G STA may support the following Clause 23 features:

— 2 or more spatial streams (transmit and receive)
— S1G_LONG preamble when maximum channel width supported is less than 4 MHz
— Beamforming sounding (through S1G NDP) for an AP
— Beamforming sounding response (i.e., providing compressed beamforming feedback) for a non-AP STA
— STBC (transmit and receive)
— LDPC (transmit and receive)
— S1G MU PPDUs (transmit and receive)
— 4 MHz channel widths
— 8 MHz channel widths
— 16 MHz channel widths
— S1G-MCSs 8 and 9 (transmit and receive) for an AP, and S1G MCSs 3-9 (transmit and receive) for a non-AP STA
— Short Guard Interval
— Traveling Pilots

23.1.2 Scope

The services provided to the MAC by the S1G PHY consist of the following protocol functions:

a) A function that defines a method of mapping the PSDUs into a framing format (PPDU) suitable for sending and receiving PSDUs between two or more STAs.
b) A function that defines the characteristics and method of transmitting and receiving data through a wireless medium between two or more STAs.

23.1.3 S1G PHY functions

23.1.3.1 General

The S1G PHY contains two functional entities: the PHY function, and the physical layer management function (i.e., the PLME). Both of these functions are described in detail in 23.3 and 23.4.

The S1G PHY service is provided to the MAC through the PHY service primitives defined in Clause 7. The S1G PHY service interface is described in 23.2.

23.1.3.2 PHY management entity (PLME)

The PLME performs management of the local PHY functions in conjunction with the MLME.

23.1.3.3 Service specification method

The models represented by figures and state diagrams are intended to be illustrations of the functions provided. It is important to distinguish between a model and a real implementation. The models are optimized for simplicity and clarity of presentation; the actual method of implementation is left to the discretion of the developer.

The service of a layer is the set of capabilities that it offers to a user in the next higher layer. Abstract services are specified here by describing the service primitives and parameters that characterize each service. This definition is independent of any particular implementation.

23.1.4 PPDU formats

The structure of the PPDU transmitted by an S1G STA is determined by the TXVECTOR parameters as defined in Table 23-1 (in 23.2.2).

The FORMAT parameter determines the overall structure of the PPDU, and the allowed values are:

— S1G, for S1G non-duplicate PPDUs
— S1G_DUP_2M, for S1G 2 MHz duplicate PPDUs
— S1G_DUP_1M, for S1G 1 MHz duplicate PPDUs

The PPDU bandwidth is determined by the CH_BANDWIDTH parameter, and the preamble type (i.e., S1G_1M_PREAMBLE, S1G_SHORT_PREAMBLE, S1G_LONG_PREAMBLE) is determined by the PREAMBLE_TYPE parameter.

— The 1 MHz format PPDU (S1G_1M) is used for non-duplicate S1G transmissions at 1 MHz bandwidth (i.e., CH_BANDWIDTH = CBW1), and for S1G_DUP_1M transmissions of any bandwidth (i.e., CH_BANDWIDTH = CBW1, CBW2, CBW4, CBW8, or CBW16). The PREAMBLE_TYPE = S1G_1M_PREAMBLE. Support for the S1G_1M is mandatory.
— The greater than or equal to 2 MHz short format (S1G_SHORT) is used for non-duplicate S1G transmissions and for S1G_DUP_2M transmissions, at bandwidths of 2 MHz and higher (i.e., CH_BANDWIDTH = CBW2, CBW4, CBW8, or CBW16). The PREAMBLE_TYPE = S1G_SHORT_PREAMBLE. This PPDU format is similar to the HT-greenfield format in Clause 19, which does not contain a legacy portion in the preamble. Support for S1G_SHORT is mandatory.
— The greater than or equal to 2 MHz long format (S1G_LONG) is used for non-duplicate S1G transmissions at bandwidths of 2 MHz and higher (i.e., CH_BANDWIDTH = CBW2, CBW4, CBW8, or CBW16). The S1G_LONG format is not used for S1G_DUP_2M transmissions. The PREAMBLE_TYPE = S1G_LONG_PREAMBLE. This PPDU format is similar to the HT-mixed format in Clause 19. Support for S1G_LONG is optional if a STA supports only 1 MHz and 2 MHz PPDUs, and is mandatory if a STA supports wider than 2 MHz PPDUs. All S1G STAs shall support detecting and decoding up to the SIG-A field of S1G_LONG PPDUs.

An S1G_LONG PPDU can be further categorized as an S1G SU PPDU or an S1G MU PPDU. An S1G_LONG PPDU with MU_SU = MU is an S1G MU PPDU, otherwise it is an S1G SU PPDU. An S1G MU PPDU carries one or more PSDUs to one or more STAs and shall be an S1G_LONG PPDU.

23.2 S1G PHY service interface

23.2.1 Introduction

The PHY provides an interface to the MAC through an extension of the generic PHY service interface defined in 8.3.4. The interface includes TXVECTOR, RXVECTOR, and PHYCONFIG_VECTOR.

The TXVECTOR supplies the PHY with per-PPDU transmit parameters. Using the RXVECTOR, the PHY informs the MAC of the received PPDU parameters. Using the PHYCONFIG_VECTOR, the MAC configures the PHY for operation, independent of frame transmission or reception.

23.2.2 TXVECTOR and RXVECTOR parameters

The parameters in Table 23-1 are defined as part of the TXVECTOR parameter list in the PHY-TXSTART.request primitive and/or as part of the RXVECTOR parameter list in the PHY-RXSTART.indication primitive.

Table 23-1—TXVECTOR and RXVECTOR parameters

Parameter	Condition	Value	TXVECTOR	RXVECTOR
FORMAT		Determines the format of the PPDU. Enumerated type: S1G indicates S1G PPDU format. S1G_DUP_1M indicates S1G 1 MHz Duplicate PPDU format S1G_DUP_2M indicates S1G 2 MHz Duplicate PPDU format	Y	Y
PREAMBLE_TYPE	FORMAT is S1G and (CH_BANDWIDTH is CBW2 or CBW4 or CBW8 or CBW16)	Determine the type of preamble of the S1G PPDU. Enumerated type: S1G_SHORT_PREAMBLE indicates the short preamble defined in 23.3.8.2.1. S1G_LONG_PREAMBLE indicates the long preamble defined in 23.3.8.2.2.	Y	Y
	FORMAT is S1G_DUP_2M	Determine the type of preamble of the S1G 2 MHz Duplicate mode PPDU. Enumerated type: S1G_SHORT_PREAMBLE indicates the short preamble defined in 23.3.8.2.1. S1G_LONG_PREAMBLE indicates the long preamble defined in 23.3.8.2.2.	Y	Y
	FORMAT is S1G and CH_BANDWIDTH equals CBW1	Not present	N	N
	FORMAT is S1G_DUP_1M	Not present	N	N
	Otherwise	See corresponding entry in Table 19-1.		
MU_SU	FORMAT is S1G and PREAMBLE_TYPE is S1G_LONG_PREAMBLE and CH_BANDWIDTH is CBW2 or CBW4 or CBW8 or CBW16)	Determine whether MU or SU of the S1G PPDU Enumerated type: Set to MU if NUM_USERS is 2 to 4. Set to SU if NUM_USERS is 1.	Y	Y
	Otherwise	Not present		
NDP_INDICATION	FORMAT is S1G, S1G_DUP_2M, or S1G_DUP_1M	Determine the type of S1G frame. Set to 1 if this packet is one of NDP CMAC frames as defined in 9.9. Set to 0 otherwise.	Y	Y
	Otherwise	Not present	N	N

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
NDP_CMAC_FRAME_BODY	NDP_INDICATION is 1	Set to concatenated bit fields, which describe the NDP CMAC frame body content in one of NDP CMAC frame types defined in Table 9-435. (See 9.9).	Y	Y
	Otherwise	Not present		
SMOOTHING	FORMAT is S1G and (CH_BANDWIDTH equals CBW2 or CBW4 or CBW8 or CBW16) and PREAMBLE_TYPE equals S1G_SHORT_PREAMBLE	Indicates whether frequency-domain smoothing is recommended as part of channel estimation. Set to 1 if frequency-domain smoothing is recommended. Set to 0 otherwise.	Y	Y
	FORMAT is S1G_DUP_2M and PREAMBLE_TYPE equals S1G_SHORT_PREAMBLE	Indicates whether frequency-domain smoothing is recommended as part of channel estimation. Set to 1 if frequency-domain smoothing is recommended. Set to 0 otherwise.	Y	Y
	FORMAT is S1G_DUP_1M	Indicates whether frequency-domain smoothing is recommended as part of channel estimation. Set to 1 if frequency-domain smoothing is recommended. Set to 0 otherwise.	Y	Y
	FORMAT is S1G and CH_BANDWIDTH equals CBW1	Indicates whether frequency-domain smoothing is recommended as part of channel estimation. Set to 1 if frequency-domain smoothing is recommended. Set to 0 otherwise.	Y	Y
	FORMAT is S1G and (CH_BANDWIDTH equals CBW2 or CBW4 or CBW8 or CBW16) and PREAMBLE_TYPE equals S1G_LONG_PREAMBLE	If NUM_STS is larger than 1, indicates whether frequency-domain smoothing is recommended as part of channel estimation. Set to 1 if frequency-domain smoothing is recommended. Set to 0 otherwise.	Y	Y
	FORMAT is S1G_DUP_2M and PREAMBLE_TYPE equals S1G_LONG_PREAMBLE	If NUM_STS is larger than 1, indicates whether frequency-domain smoothing is recommended as part of channel estimation. Set to 1 if frequency-domain smoothing is recommended. Set to 0 otherwise.	Y	Y
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
AGGREGATION	FORMAT is S1G	Indicates whether the PSDU contains an A-MPDU. Enumerated type: AGGREGATED indicates this packet has A-MPDU aggregation. NOT_AGGREGATED indicates this packet does not have A-MPDU aggregation.	Y	Y
	FORMAT is S1G_DUP_2M	Indicates whether the PSDU contains an A-MPDU. Enumerated type: AGGREGATED indicates this packet has A-MPDU aggregation. NOT_AGGREGATED indicates this packet does not have A-MPDU aggregation.	Y	Y
	FORMAT is S1G_DUP_1M	Indicates whether the PSDU contains an A-MPDU. Enumerated type: AGGREGATED indicates this packet has A-MPDU aggregation. NOT_AGGREGATED indicates this packet does not have A-MPDU aggregation.	Y	Y
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		
SECTOR_ID	Format is S1G and preamble type is S1G_LONG_PREAMBLE	Indicates which sectorized beam of the available sectorized beams are used in the transmission. The length of the parameter is 8 bits. A 1 in bit position n, relative to the LSB, indicates that Sector n is used. This parameter is present only if sectorization is applied.	O	N
	Otherwise	Not present	N	N
N_TX	FORMAT is S1G	Indicates the number of transmit chains.	Y	N
	FORMAT is S1G_DUP_2M	Indicates the number of transmit chains.	Y	N
	FORMAT is S1G_DUP_1M	Indicates the number of transmit chains.	Y	N
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
EXPANSION_MAT_TYPE	FORMAT is S1G and EXPANSION_MAT is present	Set to COMPRESSED_SV	Y	N
	FORMAT is S1G_DUP_2M and EXPANSION_MAT is present	Set to COMPRESSED_SV	Y	N
	FORMAT is S1G_DUP_1M and EXPANSION_MAT is present	Set to COMPRESSED_SV	Y	N
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		
EXPANSION_MAT	FORMAT is S1G	Contains a vector in the number of selected subcarriers containing feedback matrices as defined in 23.3.10.2 based on the channel measured during the training symbols of a previous S1G NDP PPDU.	MU	N
	FORMAT is S1G_DUP_2M	Contains a vector in the number of selected subcarriers containing feedback matrices as defined in 23.3.10.2 based on the channel measured during the training symbols of a previous S1G NDP PPDU.	MU	N
	FORMAT is S1G_DUP_1M	Contains a vector in the number of selected subcarriers containing feedback matrices as defined in 23.3.10.2 based on the channel measured during the training symbols of a previous S1G NDP PPDU.	Y	N
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
CHAN_MAT_TYPE	FORMAT is S1G and PSDU_LENGTH equals 0 and NDP_INDICATION equals 0	Set to COMPRESSED_SV	N	Y
	FORMAT is S1G_DUP_2M and PSDU_LENGTH equals 0 and NDP_INDICATION equals 0	Set to COMPRESSED_SV	N	Y
	FORMAT is S1G_DUP_1M and PSDU_LENGTH equals 0 and NDP_INDICATION equals 0	Set to COMPRESSED_SV	N	Y
	FORMAT is S1G and PSDU_LENGTH equals 0 and NDP_INDICATION equals 1	Not present	N	N
	FORMAT is S1G_DUP_2M and PSDU_LENGTH equals 0 and NDP_INDICATION equals 1	Not present	N	N
	FORMAT is S1G_DUP_1M and PSDU_LENGTH equals 0 and NDP_INDICATION equals 1	Not present	N	N
	FORMAT is S1G and PSDU_LENGTH is greater than 0	Not present	N	N
	FORMAT is S1G_DUP_2M and PSDU_LENGTH is greater than 0	Not present	N	N
	FORMAT is S1G_DUP_1M and PSDU_LENGTH is greater than 0	Not present	N	N
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
CHAN_MAT	FORMAT is S1G and PSDU_LENGTH equals 0 and NDP_INDICATION equals 0	Contains a set of compressed beamforming feedback matrices as defined in 23.3.10.2 based on the channel measured during the training symbols of the received S1G NDP PPDU.	N	Y
	FORMAT is S1G_DUP_2M and PSDU_LENGTH equals 0 and NDP_INDICATION equals 0	Contains a set of compressed beamforming feedback matrices as defined in 23.3.10.2 based on the channel measured during the training symbols of the received S1G NDP PPDU.	N	Y
	FORMAT is S1G_DUP_1M and PSDU_LENGTH equals 0 and NDP_INDICATION equals 0	Contains a set of compressed beamforming feedback matrices as defined in 23.3.10.2 based on the channel measured during the training symbols of the received S1G NDP PPDU.	N	Y
	FORMAT is S1G and PSDU_LENGTH equals 0 and NDP_INDICATION equals 1	Not present	N	N
	FORMAT is S1G_DUP_2M and PSDU_LENGTH equals 0 and NDP_INDICATION equals 1	Not present	N	N
	FORMAT is S1G_DUP_1M and PSDU_LENGTH equals 0 and NDP_INDICATION equals 1	Not present	N	N
	FORMAT is S1G and PSDU_LENGTH is greater than 0	Not present	N	N
	FORMAT is S1G_DUP_2M and PSDU_LENGTH is greater than 0	Not present	N	N
	FORMAT is S1G_DUP_1M and PSDU_LENGTH is greater than 0	Not present	N	N
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters ***(continued)***

Parameter	Condition	Value	TXVECTOR	RXVECTOR
DELTA_SNR	FORMAT is S1G and (CH_BANDWIDTH is CBW2 or CBW4 or CBW8 or CBW16)	Contains an array of delta SNR values as defined in 9.4.1.51 based on the channel measured during the training symbols of the received S1G NDP PPDU. NOTE—In the RXVECTOR this parameter is present only for S1G NDP PPDUs for MU sounding.	MU	Y
	FORMAT is S1G_DUP_2M	Contains an array of delta SNR values as defined in 9.4.1.51 based on the channel measured during the training symbols of the received S1G NDP PPDU. NOTE—In the RXVECTOR this parameter is present only for S1G NDP PPDUs for MU sounding.	MU	Y
	FORMAT is S1G and CH_BANDWIDTH is CBW1	Not present	N	N
	FORMAT is S1G_DUP_1M	Not present	N	N
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		
RCPI		Is a measure of the received RF power averaged over all the receive chains in the Data field of a received PPDU. Refer to 19.3.19.6 for the definition of RCPI.	N	Y
SNR	FORMAT is S1G	Contains an array of measures of the received SNR for each spatial stream. SNR indications of 8 bits are supported. SNR shall be the sum of the decibel values of SNR per tone divided by the number of tones represented in each stream as described in 9.4.1.49	N	Y
	FORMAT is S1G_DUP_2M	Contains an array of measures of the received SNR for each spatial stream. SNR indications of 8 bits are supported. SNR shall be the sum of the decibel values of SNR per tone divided by the number of tones represented in each stream as described in 9.4.1.49	N	Y
	FORMAT is S1G_DUP_1M	Contains an array of measures of the received SNR for each spatial stream. SNR indications of 8 bits are supported. SNR shall be the sum of the decibel values of SNR per tone divided by the number of tones represented in each stream as described in 9.4.1.49	N	Y
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
FEC_CODING	FORMAT is S1G	Indicates which FEC encoding is used. Enumerated type: BCC_CODING indicates binary convolutional code. LDPC_CODING indicates low-density parity check code.	MU	Y
	FORMAT is S1G_DUP_2M	Indicates which FEC encoding is used. Enumerated type: BCC_CODING indicates binary convolutional code. LDPC_CODING indicates low-density parity check code.	MU	Y
	FORMAT is S1G_DUP_1M	Indicates which FEC encoding is used. Enumerated type: BCC_CODING indicates binary convolutional code. LDPC_CODING indicates low-density parity check code.	Y	Y
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		
STBC	FORMAT is S1G	Indicates whether or not STBC is used. 0 indicates no STBC ($N_{STS}=N_{SS}$ in the Data field). 1 indicates STBC is used ($N_{STS}=2N_{SS}$ in the Data field).	Y	Y
	FORMAT is S1G_DUP_2M	Indicates whether or not STBC is used. 0 indicates no STBC ($N_{STS}=N_{SS}$ in the Data field). 1 indicates STBC is used ($N_{STS}=2N_{SS}$ in the Data field).	Y	Y
	FORMAT is S1G_DUP_1M	Indicates whether or not STBC is used. 0 indicates no STBC ($N_{STS}=N_{SS}$ in the Data field). 1 indicates STBC is used ($N_{STS}=2N_{SS}$ in the Data field).	Y	Y
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		
GI_TYPE	FORMAT is S1G	Indicates whether a short guard interval is used in the transmission of the Data field of the PPDU. Enumerated type: LONG_GI indicates short GI is not used in the Data field of the PPDU. SHORT_GI indicates short GI is used in the Data field of the PPDU.	Y	Y
	FORMAT is S1G_DUP_2M	Indicates whether a short guard interval is used in the transmission of the Data field of the PPDU. Enumerated type: LONG_GI indicates short GI is not used in the Data field of the PPDU. SHORT_GI indicates short GI is used in the Data field of the PPDU.	Y	Y
	FORMAT is S1G_DUP_1M	Indicates whether a short guard interval is used in the transmission of the Data field of the PPDU. Enumerated type: LONG_GI indicates short GI is not used in the Data field of the PPDU. SHORT_GI indicates short GI is used in the Data field of the PPDU.	Y	Y
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.	N	N

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
TXPWR_LEVEL	FORMAT is S1G	The allowed values for the TXPWR_LEVEL parameter are in the range from 1 to numberOfOctets(dot11TxPowerLevelExtended)/2. This parameter is used to indicate which of the available transmit output power levels defined in dot11TxPowerLevelExtended shall be used for the current transmission.	Y	N
	FORMAT is S1G_DUP_2M	The allowed values for the TXPWR_LEVEL parameter are in the range from 1 to numberOfOctets(dot11TxPowerLevelExtended)/2. This parameter is used to indicate which of the available transmit output power levels defined in dot11TxPowerLevelExtended shall be used for the current transmission.	Y	N
	FORMAT is S1G_DUP_1M	The allowed values for the TXPWR_LEVEL parameter are in the range from 1 to numberOfOctets(dot11TxPowerLevelExtended)/2. This parameter is used to indicate which of the available transmit output power levels defined in dot11TxPowerLevelExtended shall be used for the current transmission.	Y	N
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		
RSSI	FORMAT is S1G	The allowed values for the RSSI parameter are in the range 0 to 255 inclusive. This parameter is a measure by the PHY of the power observed at the antennas used to receive the current PPDU measured during the reception of the LTF field. RSSI is intended to be used in a relative manner, and it is a monotonically increasing function of the received power.	N	Y
	FORMAT is S1G_DUP_2M	The allowed values for the RSSI parameter are in the range 0 to 255 inclusive. This parameter is a measure by the PHY of the power observed at the antennas used to receive the current PPDU measured during the reception of the LTF field. RSSI is intended to be used in a relative manner, and it is a monotonically increasing function of the received power.	N	Y
	FORMAT is S1G_DUP_1M	The allowed values for the RSSI parameter are in the range 0 to 255 inclusive. This parameter is a measure by the PHY of the power observed at the antennas used to receive the current PPDU measured during the reception of the LTF field. RSSI is intended to be used in a relative manner, and it is a monotonically increasing function of the received power.	N	Y
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
MCS	FORMAT is S1G and (CH_BANDWIDTH equals CBW2 or CBW4 or CBW8 or CBW16)	Indicates the modulation and coding scheme used in the transmission of the PPDU. Integer: range 0 to 9	MU	Y
	FORMAT is S1G_DUP_2M	Indicates the modulation and coding scheme used in the transmission of the PPDU. Integer: range 0 to 9	MU	Y
	FORMAT is S1G and CH_BANDWIDTH equals CBW1	Indicates the modulation and coding scheme used in the transmission of the PPDU. Integer: range 0 to 10	Y	Y
	FORMAT is S1G_DUP_1M	Indicates the modulation and coding scheme used in the transmission of the PPDU. Integer: range 0 to 10	Y	Y
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		
REC_MCS	FORMAT is S1G and (CH_BANDWIDTH equals CBW2 or CBW4 or CBW8 or CBW16)	Indicates the MCS that the STA's receiver recommends. Integer: range 0 to 9	N	O
	FORMAT is S1G_DUP_2M	Indicates the MCS that the STA's receiver recommends. Integer: range 0 to 9	N	O
	FORMAT is S1G and CH_BANDWIDTH equals CBW1	Indicates the MCS that the STA's receiver recommends. Integer: range 0 to 10	N	O
	FORMAT is S1G_DUP_1M	Indicates the MCS that the STA's receiver recommends. Integer: range 0 to 10	N	O
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
CH_BANDWIDTH	FORMAT is S1G	Indicates the channel width of the transmitted PPDU: Enumerated type: CBW1 for 1 MHz CBW2 for 2 MHz CBW4 for 4 MHz CBW8 for 8 MHz CBW16 for 16 MHz	Y	Y
	FORMAT is S1G_DUP_2M	In TXVECTOR, indicates the channel width of the transmitted 2 MHz Duplicate PPDU. In RXVECTOR, indicates the estimated channel width of the 2 MHz Duplicate received PPDU. Enumerated type: CBW4 for 4 MHz CBW8 for 8 MHz CBW16 for 16 MHz	Y	Y
	FORMAT is S1G_DUP_1M	In TXVECTOR, indicates the channel width of the transmitted 1 MHz Duplicate PPDU. In RXVECTOR, indicates the estimated channel width of the 1 MHz Duplicate received PPDU. Enumerated type: CBW2 for 2 MHz CBW4 for 4 MHz CBW8 for 8 MHz CBW16 for 16 MHz	Y	Y
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		
LENGTH	FORMAT is S1G and AGGREGATION is AGGREGATED	Indicates the packet duration in number of symbols in the S1G PSDU.	Y	Y
	FORMAT is S1G_DUP_2M and AGGREGATION is AGGREGATED	Indicates the packet duration in number of symbols in the S1G 2 MHz Duplicate PSDU.	Y	Y
	FORMAT is S1G_DUP_1M and AGGREGATION is AGGREGATED	Indicates the packet duration in number of symbols in the S1G 1 MHz Duplicate PSDU.	Y	Y
	FORMAT is S1G and AGGREGATION is NOT_AGGREGATED	Indicates the packet duration in number of octets in the S1G PSDU.	Y	Y
	FORMAT is S1G_DUP_2M and AGGREGATION is NOT_AGGREGATED	Indicates the packet duration in number of octets in the S1G 2 MHz Duplicate PSDU.	Y	Y
	FORMAT is S1G_DUP_1M and AGGREGATION is NOT_AGGREGATED	Indicates the packet duration in number of octets in the S1G 1 MHz Duplicate PSDU.	Y	Y
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
APEP_LENGTH	FORMAT is S1G	If equal to 0, indicates an S1G NDP PPDU for both RXVECTOR and TXVECTOR. If greater than 0 in the TXVECTOR, indicates the number of octets in the A-MPDU pre-EOF padding (see 10.13.2) carried in the PSDU. This parameter is used to determine the number of OFDM symbols in the Data field that do not appear after a subframe with 1 in the EOF subfield.	MU	O
	Otherwise	See corresponding entry in Table 19-1 and Table 21-1.		
PSDU_LENGTH	FORMAT is S1G	Indicates the number of octets in the S1G PSDU. A value of 0 indicates an S1G NDP PPDU	MU	Y
	FORMAT is S1G_DUP_2M	Indicates the number of octets in the S1G 2 MHz Duplicate PSDU. A value of 0 indicates an S1G NDP PPDU.	Y	Y
	FORMAT is S1G_DUP_1M	Indicates the number of octets in the S1G 1 MHz Duplicate PSDU. A value of 0 indicates an S1G NDP PPDU.	Y	Y
	Otherwise	See corresponding entry in Table 20-1 and Table 22-1.		
USER_POSITION	FORMAT is S1G and MU_SU equals MU	Index for user in MU transmission. Integer: range 0–3. NOTE—The entries in the USER_POSITION array are in ascending order.	Y	Y
	FORMAT is S1G_DUP_2M and MU_SU equals MU	Index for user in MU transmission. Integer: range 0–3. NOTE—The entries in the USER_POSITION array are in ascending order.	Y	Y
	Otherwise	Not present		
NUM_STS	FORMAT is S1G	Indicates the number of space-time streams. Integer: range 1–4 per user in the TXVECTOR and 0–4 in the RXVECTOR. NUM_STS summed over all users is in the range 1 to 4 for MU-MIMO.	MU	Y
	FORMAT is S1G_DUP_2M	Indicates the number of space-time streams. Integer: range 1–4 per user in the TXVECTOR and 0–4 in the RXVECTOR. NUM_STS summed over all users is in the range 1 to 4 for MU-MIMO.	MU	Y
	FORMAT is S1G_DUP_1M	Indicates the number of space-time streams. Integer: range 1–4 per user in the TXVECTOR and 0–4 in the RXVECTOR.	Y	Y
	Otherwise	See corresponding entry in Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
GROUP_ID	FORMAT is S1G and MU_SU equals MU	Indicates the group ID. Integer: range 1–62 (see Table 23-14 in 23.3.8.2.2.1.5).	Y	Y
	FORMAT is S1G_DUP_2M and MU_SU equals MU	Indicates the group ID. Integer: range 1–62 (see Table 23-14 in 23.3.8.2.2.1.5).	Y	Y
	FORMAT is S1G and MU_SU equals SU	Not present	N	N
	FORMAT is S1G_DUP_2M and MU_SU equals SU	Not present	N	N
	FORMAT is S1G and CH_BANDWIDTH equals CBW1	Not present	N	N
	FORMAT is S1G_DUP_1M	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1.		
PARTIAL_AID	FORMAT is S1G and (CH_BANDWIDTH equals CBW2 or CBW4 or CBW8 or CBW16) and MU_SU equals SU	Provides an abbreviated indication of the intended recipient(s) of the PSDU (see 10.20b). Integer: range 0–511 if UPLINK_INDICATION is 1, and range 0–63 if UPLINK_INDICATION is 0.	Y	Y
	FORMAT is S1G_DUP_2M and MU_SU equals SU	Provides an abbreviated indication of the intended recipient(s) of the PSDU (see 10.20b). Integer: range 0–511 if UPLINK_INDICATION is 1, and range 0–63 if UPLINK_INDICATION is 0.	Y	Y
	FORMAT is S1G and MU_SU equals MU	Not present	N	N
	FORMAT is S1G_DUP_2M and MU_SU equals MU	Not present	N	N
	FORMAT is S1G and CH_BANDWIDTH equals CBW1	Not present	N	N
	FORMAT is S1G_DUP_1M	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1.		

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
NUM_USERS	FORMAT is S1G and MU_SU equals MU	Indicates the number of users with nonzero space-time streams. Integer: range 1 to 4.	Y	N
	FORMAT is S1G and MU_SU equals SU	Set to 1	Y	N
	FORMAT is S1G_DUP_2M and MU_SU equals MU	Indicates the number of users with nonzero space-time streams. Integer: range 1 to 4.	Y	N
	FORMAT is S1G_DUP_2M and MU_SU equals SU	Set to 1	Y	N
	FORMAT is S1G and CH_BANDWIDTH equals CBW1	Set to 1	Y	N
	FORMAT is S1G_DUP_1M	Set to 1	Y	N
	Otherwise	See corresponding entry in Table 21-1.		
BEAM_CHANGE	FORMAT is S1G and MU_SU equals SU and (CH_BANDWIDTH equals CBW2 or CBW4 or CBW8 or CBW16) and PREAMBLE_TYPE equals S1G_LONG_PREAMBLE and NUM_STS is 1.	Set to 1 if the Q matrix is changed from the omnidirectional portion to the beam changeable portion of the long preamble, in at least one of the nonzero sub-carrier of the omnidirectional portion as described in 23.3.8.2.2.1.5. Set to 0 if the Q matrix is unchanged in all the nonzero sub-carriers of the omnidirectional portion. NOTE—If BEAM_CHANGE is 0 and PREAMBLE_TYPE is S1G_LONG_PREAMBLE, the receiver may do channel smoothing. Otherwise, smoothing is not recommended.	Y	Y
	FORMAT is S1G_DUP_2M and MU_SU equals SU and PREAMBLE_TYPE equals S1G_LONG_PREAMBLE and NUM_STS is 1.	Set to 1 if the Q matrix is changed from the omnidirectional portion to the beam changeable portion of the long preamble, in at least on of the nonzero sub-carrier of the omnidirectional portion as described in 23.3.8.2.2.1.5. Set to 0 if the Q matrix is unchanged in all the nonzero sub-carriers of the omnidirectional portion. NOTE—If BEAM_CHANGE is 0 and PREAMBLE_TYPE is S1G_LONG_PREAMBLE, the receiver may do channel smoothing. Otherwise, smoothing is not recommended.	Y	Y
	Otherwise	Not present	N	N
RESPONSE_INDICATION	FORMAT is S1G, S1G_DUP_2M, or S1G_DUP_1M	Set to 0 if No Response. Set to 1 if NDP Response. Set to 2 if Normal Response. Set to 3 if Long Response.	Y	Y
	Otherwise	Not present	N	N

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
TRAVELING_PILOTS	FORMAT is S1G, S1G_DUP_2M, or S1G_DUP_1M	Set to 1 if traveling pilots are used in the packet. Set to 0 otherwise.	Y	O
	Otherwise	Not present	N	N
TIME_OF_DEPARTURE_REQUESTED		Boolean value: True indicates that the MAC entity requests that the PHY entity measures and reports time of departure parameters corresponding to the time when the first PPDU energy is sent by the transmitting port. False indicates that the MAC entity requests that the PHY entity neither measures nor reports time of departure parameters.	O	N
RX_START_OF_FRAME_OFFSET	dot11MgmtOptionTimingMsmtActivated is true	0 to 2^{32}– 1. An estimate of the offset (in 10 ns units) from the point in time at which the start of the preamble corresponding to the incoming frame arrived at the receive antenna port to the point in time at which this primitive is issued to the MAC.	N	Y
	Otherwise	Not present		
UPLINK_INDICATION	NDP_INDICATION is 0 and FORMAT is S1G and CH_BANDWIDTH is not equal to CBW1	Set to 1 if the S1G PPDU is addressed to AP Set to 0 otherwise (See 10.20b).	Y	Y
	Otherwise	Not present	N	N
COLOR	UPLINK_INDICATION is 0 and NDP_INDICATION is 0 and FORMAT is S1G or S1G_DUP_2M and CH_BANDWIDTH is not equal to CBW1 and MU_SU is SU.	Set to a value of its choosing within the range 0 to 7 and shall maintain that value for the duration of the existence of the BSS (See 10.20b).	Y	Y
	Otherwise	Not present	N	N

Table 23-1—TXVECTOR and RXVECTOR parameters *(continued)*

Parameter	Condition	Value	TXVECTOR	RXVECTOR
SCRAMBLER_OR_CRC	FORMAT is S1G and NDP_INDICATION is 0	Indicates the Scrambler Initialization value in the Service field (as defined in 23.3.9.2) prior to descrambling. Bit sequence of 7 bits in length: [B0:B6] of the SERVICE field value prior to descrambling.	N	Y
	FORMAT is S1G_DUP_2M and NDP_INDICATION is 0	Indicates the Scrambler Initialization value in the Service field (as defined in 23.3.9.2) prior to descrambling. Bit sequence of 7 bits in length: [B0:B6] of the SERVICE field value prior to descrambling.	N	Y
	FORMAT is S1G_DUP_1M and NDP_INDICATION is 0	Indicates the Scrambler Initialization value in the Service field (as defined in 23.3.9.2) prior to descrambling. Bit sequence of 7 bits in length: [B0: B6] of the SERVICE field value prior to descrambling.	N	Y
	FORMAT is S1Gand NDP_INDICATION is 1	Indicates the value of the calculated CRC in the SIG field. Bit sequence of 4 bits in length: Either [B26:B29] of the 1 MHz SIG field or [B38:B41] of the ≥ 2 MHz SIG field.	N	Y
	FORMAT is S1G_DUP_2M and NDP_INDICATION is 1	Indicates the value of the calculated CRC in the SIG field. Bit sequence of 4 bits in length: [B38:B41] of the ≥ 2 MHz SIG field.	N	Y
	FORMAT is S1G_DUP_1M and NDP_INDICATION is 1	Indicates the value of the calculated CRC in the SIG field. Bit sequence of 4 bits in length: [B26:B29] of the 1 MHz SIG field.	N	Y
	Otherwise	Not present	N	Y

NOTE—In the “TXVECTOR” and “RXVECTOR” columns, the following apply:
Y = Present;
N = Not present;
O = Optional;
MU indicates that the parameter is present once for an S1G SU PPDU and present per user for an S1G MU PPDU. Parameters specified to be present per user are conceptually supplied as an array of values indexed by *u*, where *u* takes values 0 to NUM_USERS-1.

23.2.3 Effect of CH_BANDWIDTH parameter on PPDU format

Table 23-2 shows the PPDU format as a function of the CH_BANDWIDTH parameter.

Table 23-2—PPDU format as a function of CH_BANDWIDTH parameter

FORMAT	CH_BANDWIDTH	PPDU format
S1G	CBW1	The STA transmits an S1G PPDU of 1 MHz bandwidth. If the operating channel width is wider than 1 MHz, then the transmission shall use the primary 1 MHz channel.
S1G	CBW2	The STA transmits an S1G PPDU of 2 MHz bandwidth. If the operating channel width is wider than 2 MHz, then the transmission shall use the primary 2 MHz channel.

Table 23-2—PPDU format as a function of CH_BANDWIDTH parameter *(continued)*

FORMAT	CH_BANDWIDTH	PPDU format
S1G	CBW4	The STA transmits an S1G PPDU of 4 MHz bandwidth. If the operating channel width is wider than 4 MHz, then the transmission shall use the primary 4 MHz channel.
S1G	CBW8	The STA transmits an S1G PPDU of 8 MHz bandwidth. If the operating channel width is wider than 8 MHz, then the transmission shall use the primary 8 MHz channel.
S1G	CBW16	The STA transmits an S1G PPDU of 16 MHz bandwidth.
S1G_DUP_2M	CBW4	The STA transmits an S1G 2 MHz Duplicate PPDU using two adjacent 2 MHz channels as defined in 23.3.9.12.2. If the operating channel width is wider than 4 MHz, then the transmission shall use the primary 4 MHz channel. Phase rotation pattern for each 2 MHz channel is [1 j] from the lowest frequency as defined in Equation (23-7)
S1G_DUP_2M	CBW8	The STA transmits an S1G 2 MHz Duplicate PPDU using four adjacent 2 MHz channels as defined in 23.3.9.12.2. If the BSS operating channel width is 16 MHz, then the transmission shall use the primary 8 MHz channel. Phase rotation pattern for each 2 MHz channel is [1 -1 -1 -1] from the lowest frequency as defined in Equation (23-8).
S1G_DUP_2M	CBW16	The STA transmits an S1G 2 MHz Duplicate PPDU using eight adjacent 2 MHz channels as defined in 23.3.9.12.2. Phase rotation pattern for each 2 MHz channel is [1 -1 -1 -1 1 -1 -1 -1] from the lowest frequency as defined in Equation (23-9).
S1G_DUP_1M	CBW2	The STA transmits an S1G 1 MHz Duplicate PPDU using two adjacent 1 MHz channels as defined in 23.3.9.12.1. If the operating channel width is wider than 2 MHz, then the transmission shall use the primary 2 MHz channel. Phase rotation pattern for each 1 MHz channel is [1 -1] from the lowest frequency as defined in Equation (23-10).
S1G_DUP_1M	CBW4	The STA transmits an S1G 1 MHz Duplicate PPDU using four adjacent 1 MHz channels as defined in 23.3.9.12.1. If the operating channel width is wider than 4 MHz, then the transmission shall use the primary 4 MHz channel. Phase rotation pattern for each 1 MHz channel is [1 j -j -1] from the lowest frequency as defined in Equation (23-11).
S1G_DUP_1M	CBW8	The STA transmits an S1G 1 MHz Duplicate PPDU using eight adjacent 1 MHz channels as defined in 23.3.9.12.1. If the BSS operating channel width is 16 MHz, then the transmission shall use the primary 8 MHz channel. Phase rotation pattern for each 1 MHz channel is [1 -1 1 1 1 1 -1 -1] from the lowest frequency as defined in Equation (23-12).
S1G_DUP_1M	CBW16	The STA transmits an S1G 1 MHz Duplicate PPDU using sixteen adjacent 1 MHz channels as defined in 23.3.9.12.1. Phase rotation pattern for each 1 MHz channel is [1 1 1 -1 1 1 1 -1 -1 -1 1 -1 1 1 -1 1] from the lowest frequency as defined in Equation (23-13).

23.3 S1G PHY sublayer

23.3.1 Introduction

This subclause provides the procedure by which PSDUs are converted to and from transmissions on the wireless medium.

During transmission, a PSDU (in the SU case) or one or more PSDUs (in the MU case) are processed (e.g., scrambled and coded) and appended to the PHY preamble to create the PPDU. At the receiver, the PHY preamble is processed to aid in the detection, demodulation and delivery of the PSDU.

23.3.2 S1G PPDU format

Three formats are defined for the S1G PHY: S1G_SHORT, S1G_LONG, and S1G_1M.

The general structure for S1G_SHORT is defined as in Figure 23-1. This format is used for SU transmission using 2 MHz, 4 MHz, 8 MHz, and 16 MHz PPDUs.

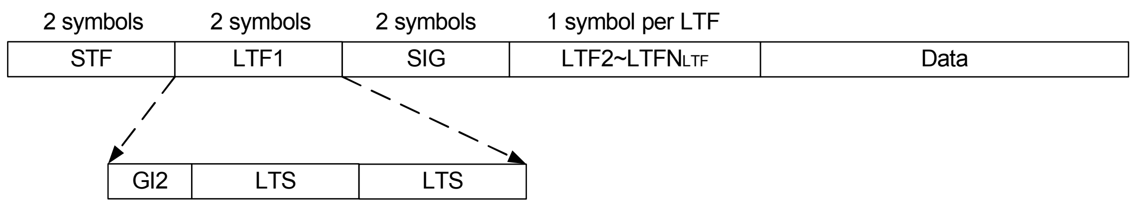


Figure 23-1—S1G_SHORT format

The general structure for S1G_LONG is defined as in Figure 23-2. This frame format can be used for MU and SU beamformed transmissions using 2 MHz, 4 MHz, 8 MHz, and 16 MHz PPDUs.

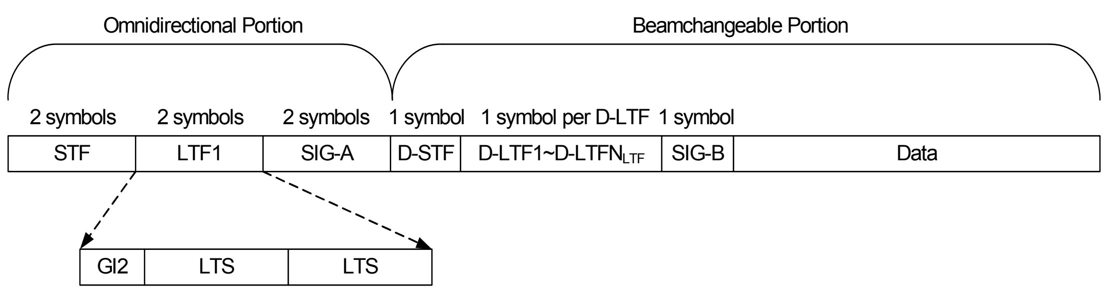


Figure 23-2—S1G_LONG format

The general structure for S1G_1M is defined as in Figure 23-3. This frame format is used for S1G_1M PPDU SU transmission.

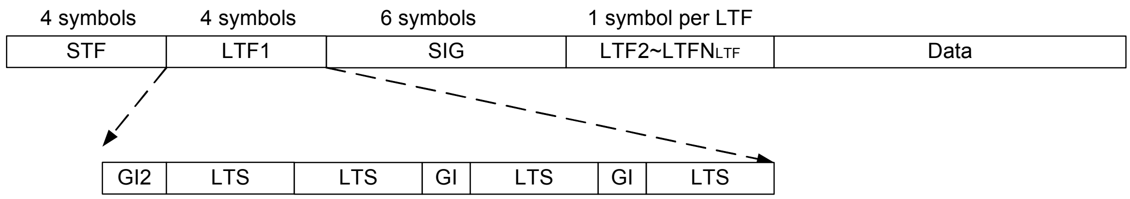


Figure 23-3—S1G_1M format

The fields of the S1G PPDU formats are summarized in Table 23-3.

Table 23-3—Fields of the S1G PPDU

Field	Description
STF	Short Training field
LTF	Long Training field
SIG	SIGNAL field
SIG-A	Signal A field
D-STF	Short Training field for the beam changeable portion
D-LTF	Long Training field for the beam changeable portion
SIG-B	Signal B field
Data	The Data field carries the PSDU(s)
GI	Guard interval
GI2	Double guard interval
LTS	Long training symbol

The SIG-A, D-STF, D-LTF, and SIG-B fields exist only in S1G_LONG format. In an S1G NDP, the Data field is not present (see 23.3.11. The number of symbols in the LTF field of S1G_1M and S1G_SHORT, or in the D-LTF field of S1G_LONG, N_{VHTLTF}, can be either 1, 2, or 4 and is determined by the total number of space-time streams across all users being transmitted in the S1G PPDU (see Table 23-10 in 23.3.8.2.1.3).

23.3.3 Transmitter block diagram

Each field in an S1G PPDU can be generated using a subset of the following blocks (only select blocks are listed below):

a) PHY Padding
b) Scrambler
c) BCC encoder parser
d) FEC (BCC or LDPC) encoders
e) Stream parser

f) Segment parser (for 16 MHz)
g) BCC Interleaver
h) Replicate the encoded bits (for 1 MHz MCS10)
i) Constellation mapper
j) Pilot insertion
k) Replicate over multiple 1 MHz or 2 MHz widths
l) Multiply by first column of P_{HTLTF}
m) LDPC tone mapper
n) Segment deparser (for 16 MHz)
o) Space-time block code (STBC) encoder
p) Cyclic shift diversity (CSD) per STS insertion
q) Spatial mapper
r) Inverse discrete Fourier transform (IDFT)
s) Cyclic shift diversity (CSD) per chain insertion
t) Guard interval (GI) insertion
u) Windowing

The general transmission flow for S1G_1M MCS0~9, and all the MCSs for S1G_SHORT and S1G_LONG formats are the same as the corresponding portions in 21.3.

Specifically, Figure 21-5, with “20 MHz” replaced by “2 MHz”, shows the transmit process for the SIG-A field of an S1G PPDU in S1G_LONG. These transmit blocks are also used to generate the omnidirectional portion of the S1G_LONG PPDU, except that the BCC encoder and interleaver are not used when generating the STF and LTF1 fields.

Figure 21-6 and Figure 21-7, with “20 MHz” replaced by “2 MHz”, show the transmit process for generating the SIG-B field of a 2 MHz, 4 MHz, and 8 MHz long format S1G PPDU for SU PPDU and MU PPDU, respectively. Figure 21-8, with “160 MHz” replaced by “16 MHz”, shows the transmit process for generating the SIG-B field of a 16 MHz long format S1G SU PPDU.

Figure 21-10 shows the transmitter blocks used to generate the BCC encoded Data field of a 2 MHz, 4 MHz, and 8 MHz SU PPDU in short or long format, and of an S1G_1M PPDU except MCS10. It should be noted that the number of encoders is fixed to one for BCC (i.e., N_{ES}=1), in S1G operation. A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial mapping block, are also used to generate the STF and LTF fields in S1G_1M and S1G_SHORT, or the D-STF and D-LTF fields in S1G_LONG. This is illustrated in Figure 23-6 in 23.3.8.2.1.3 for the mentioned LTF fields. A similar set of transmit blocks is used to generate the mentioned STF fields.

Figure 21-11 shows the transmitter blocks used to generate the LDPC encoded Data field of a 2 MHz, 4 MHz, and 8 MHz SU PPDU in short or long format, and of an S1G_1M PPDU except MCS10.

Figure 21-12 shows the transmit process for generating the Data field of a 2 MHz, 4 MHz, and 8 MHz MU PPDU in long format with BCC and/or LDPC encoding. The number of encoders is fixed to one (i.e., N_{ES}=1) for BCC in S1G operation.

Figure 21-13 and Figure 21-14 show the transmit process for generating the Data field of a 16 MHz SU PPDU in short or long format, with BCC and LDPC encoding, respectively. The number of encoders is fixed to one (i.e., N_{ES}=1) for BCC in S1G operation.

Figure 23-4 below shows the transmit process for generating the Data field of an S1G_1M PPDU with MCS10, either BCC or LDPC encoded.

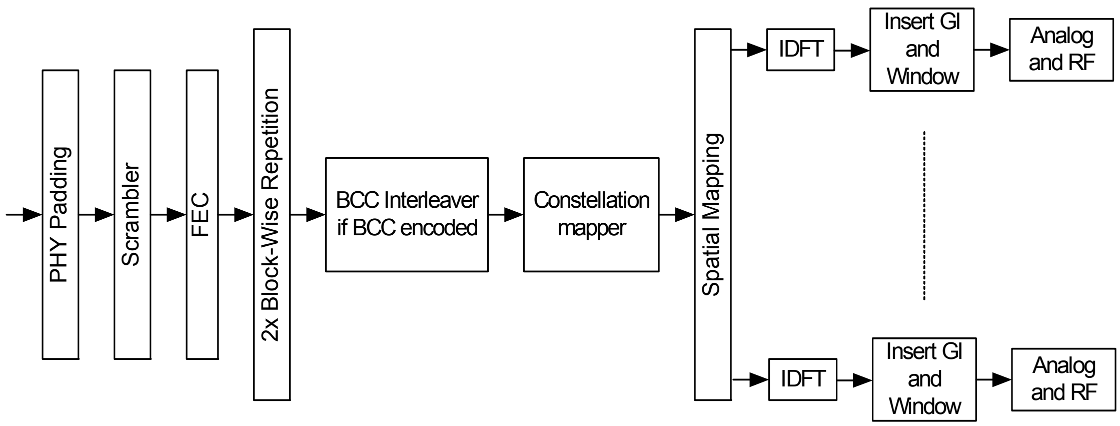


Figure 23-4—Transmitter block diagram for the Data field of an S1G_1M PPDU with BCC or LDPC encoding and MCS10

23.3.4 Overview of the PPDU encoding process

23.3.4.1 General

This subclause provides an overview of the S1G PPDU encoding process.

23.3.4.2 Construction of the Preamble part in an S1G_LONG PPDU

23.3.4.2.1 Construction of STF

Construct the STF field as defined in 23.3.8.2.1.2 with the following highlights:

a) Determine the CH_BANDWIDTH from the TXVECTOR.

b) Sequence generation: Generate the STF field sequence over the CH_BANDWIDTH as described in 23.3.8.2.2.1.3.

c) Phase rotation: Apply appropriate phase rotation for each 2 MHz subchannel as described in 23.3.9.11, 23.3.9.12, and 23.3.7.

d) IDFT: Compute the inverse discrete Fourier transform.

e) CSD: Apply CSD for each transmit chain and frequency segment as described in 23.3.8.2.2.1.2.

f) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 23.3.7.

g) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.2.2 Construction of the LTF1

Construct the LTF1 field as defined in 23.3.8.2.1.3 with the following highlights:

a) Determine the CH_BANDWIDTH from the TXVECTOR.

b) Sequence generation: Generate the LTF1 field sequence over the CH_BANDWIDTH as described in 23.3.8.2.1.3.

c) Phase rotation: Apply appropriate phase rotation for each 2 MHz subchannel as described in 23.3.9.11, 23.3.9.12, and 23.3.7.

d) IDFT: Compute the inverse discrete Fourier transform.

e) CSD: Apply CSD for each transmit chain and frequency segment as described in 23.3.8.2.2.1.2.

f) Insert GI and apply windowing: Prepend a GI of 16 μs in duration and apply windowing as described in 23.3.7.

g) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.2.3 Construction of SIG-A

The SIG-A field consists of two symbols, SIG-A1 and SIG-A2, as defined in 23.3.8.2.2.1.5 and is constructed as follows:

a) Obtain the CH_BANDWIDTH, STBC, MU_SU, GROUP_ID (MU only), PARTIAL_AID (SU only), NUM_STS, GI_TYPE, FEC_CODING, MCS (SU only), NUM_USERS, LENGTH, AGGREGATION (SU only), RESPONSE_INDICATION, BEAM_CHANGE (SU only for single space-time stream), SMOOTHING and TRAVELING_PILOTS from the TXVECTOR. Add the reserved bits, append the calculated 4 bit CRC, then append the N_{tail} tail bits as shown in 23.3.8.2.2.1.5. This operation gives as a result 48 uncoded bits.

b) BCC encoder: Encode the data by a convolutional encoder at the rate of R=1/2 as described in 18.3.5.6.

c) BCC interleaver: Interleave as described in 17.3.5.7.

d) Constellation mapper: QBPSK modulate the first 48 interleaved bits by rotating by 90° counter-clockwise relative to the original BPSK as described in 23.3.8.2.2.1.5 to form the first symbol of SIG-A field. BPSK modulate the second 48 interleaved bits to form the second symbol of SIG-A field.

e) Pilot insertion: Insert pilots as described in 17.3.5.10.

f) Duplication and phase rotation: Duplicate SIG-A1 and SIG-A2 over each 2 MHz of the CH_BANDWIDTH. Apply the appropriate phase rotation for each 2 MHz subchannel as described in 23.3.9.11, 23.3.9.12, and 23.3.7.

g) IDFT: Compute the inverse discrete Fourier transform.

h) CSD: Apply CSD for each transmit chain as described in 23.3.8.2.2.1.2.

i) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 17.3.2.5.

j) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.2.4 Construction of D-STF

The D-STF field is defined in 23.3.8.2.2.2.3 and constructed as follows:

a) Sequence generation: Generate the D-STF field in the frequency-domain over the bandwidth indicated by CH_BANDWIDTH as described in 23.3.8.2.2.2.3.

b) Phase rotation: Apply appropriate phase rotation for each 2 MHz subchannel as described in 23.3.9.11, 23.3.9.12, and 23.3.7.

c) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.2.2.1.2.

d) Spatial mapping: Apply the Q matrix as described in 23.3.10 and 23.3.9.11.1.

e) IDFT: Compute the inverse discrete Fourier transform.

f) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 17.3.2.5.

g) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.2.5 Construction of D-LTF

The D-LTF field is defined in 23.3.8.2.2.2.4 and constructed as follows:

a) Sequence generation: Generate the D-LTF field sequence in the frequency-domain over the bandwidth indicated by CH_BANDWIDTH as described in 23.3.8.2.2.2.4.

b) Phase rotation: Apply appropriate phase rotation for each 2 MHz subchannel as described in 23.3.9.11, 23.3.9.12, and 23.3.7.

c) A_{LTF} matrix mapping: Apply the P_{HTLTF} matrix to the D-LTF field sequence (the pilot tones are processed differently) as described in 23.3.8.2.2.2.4.

d) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.2.2.1.2.

e) Spatial mapping: Apply the Q matrix as described in 23.3.10 and 23.3.9.11.1.

f) IDFT: Compute the inverse discrete Fourier transform.

g) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 17.3.2.5.

h) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.2.6 Construction of SIG-B

The SIG-B field is constructed per user as follows:

a) Obtain the MCS (for MU only) from the TXVECTOR.

b) SIG-B bits: Set the MCS (for MU only) as described in 23.3.8.2.2.2.5. Add the reserved bits and N_{tail} bits of tail.

c) SIG-B field Bit Repetition: Repeat the SIG-B field bits as a function of CH_BANDWIDTH as defined in 23.3.8.2.2.2.5.

d) BCC encoder: Encode the SIG-B field using BCC at rate R=1/2 as described in 17.3.5.6.

e) Segment parser (if needed): For a 16 MHz transmission, divide the output bits of the BCC encoder into two frequency subblocks as described in 23.3.9.7. This block is bypassed for 2 MHz, 4 MHz, and 8 MHz S1G PPDU transmissions.

f) BCC interleaver: Interleave as described in 23.3.9.8.

g) Constellation mapper: Map to a BPSK constellation as defined in 17.3.5.8.

h) Segment deparser (if needed): For a 16 MHz transmission, merge the two frequency subblocks into one frequency segment as described in 23.3.9.9.3. This block is bypassed for 2 MHz, 4 MHz, 8 MHz S1G PPDU transmissions.

i) Pilot insertion: Insert pilots following the steps described in 22.3.10.10.

j) P_{HTLTF} matrix mapping: Apply the mapping of the first column of the P_{HTLTF} matrix to the data subcarriers as described in 23.3.8.2.2.2.5. The total number of data and pilot subcarriers is the same as in the Data field.

k) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.2.2.1.2.

l) Spatial mapping: Apply the Q matrix as described in 23.3.10 and 23.3.9.11.1.

m) Phase rotation: Apply the appropriate phase rotations for each 2 MHz subchannel as described in 23.3.9.11, 23.3.9.12, and 23.3.7.

n) IDFT: Compute the inverse discrete Fourier transform.

o) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 17.3.2.5.

p) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.3 Construction of the Preamble part in an S1G_SHORT PPDU

23.3.4.3.1 Construction of STF

The STF field is defined in 23.3.8.2.1.2 and constructed as follows:

a) Determine the CH_BANDWIDTH from the TXVECTOR.

b) Sequence generation: Generate the STF field in the frequency-domain over the bandwidth indicated by CH_BANDWIDTH as described in 23.3.8.2.1.2.

c) Phase rotation: Apply appropriate phase rotation for each 2 MHz subchannel as described in 23.3.9.11, 23.3.9.12, and 23.3.7.

d) P_{HTLTF} matrix mapping: Apply the mapping of the first column of the P_{HTLTF} matrix to the STF field sequence as described in 23.3.8.2.1.3.

e) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.2.1.1.

f) Spatial mapping: Apply the Q matrix as described in 23.3.10 and 23.3.9.11.1.

g) IDFT: Compute the inverse discrete Fourier transform.

h) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 17.3.2.5.

i) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.3.2 Construction of LTF1

The LTF1 field is defined in 23.3.8.2.1.3 and constructed as follows:

a) Determine FORMAT from TXVECTOR.

b) Sequence generation: If FORMAT is S1G, generate the LTF1 field sequence in the frequency-domain over the bandwidth indicated by CH_BANDWIDTH as described in 23.3.8.2.1.3. If format is S1G_DUP_2M, generate the LTF1 field sequence in the frequency-domain over a 2MHz bandwidth.

c) Phase rotation: Apply appropriate phase rotation for each 2 MHz subchannel as described in 23.3.9.11, 23.3.9.12, and 23.3.7.

d) A_{LTF} matrix mapping: Apply the mapping of the first column of the P_{HTLTF} matrix to the LTF1 field sequence (the pilot tones are processed differently) as described in 23.3.8.2.1.3.

e) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.2.1.1.

f) Spatial mapping: Apply the Q matrix as described in 23.3.10 and 23.3.9.11.1.

g) IDFT: Compute the inverse discrete Fourier transform.

h) Insert GI and apply windowing: Prepend a GI of 16 μs in duration and apply windowing as described in 17.3.2.5.

i) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.3.3 Construction of SIG

The SIG field is constructed per-user as follows:

a) Obtain the CH_BANDWIDTH, STBC, PARTIAL_AID, NUM_STS, GI_TYPE, FEC_CODING, MCS, SMOOTHING, NUM_USERS, LENGTH, AGGREGATION, RESPONSE_INDICATION, NDP_INDICATION, TRAVELING_PILOTS, UPLINK_INDICATION, and COLOR, from the TXVECTOR. Add the reserved bits, append the calculated 4 bit CRC, then append the N_{tail} tail bits as shown in 23.3.8.2.1.4. This operation gives as a result 48 uncoded bits.

b) BCC encoder: Encode the data by a convolutional encoder at the rate of R=1/2 as described in 17.3.5.6.

c) BCC interleaver: Interleave as described in 17.3.5.7.

d) Constellation mapper: QBPSK modulate the first 48 interleaved bits as described in 17.3.5.8 to form the first symbol of SIG field. QBPSK modulate the second 48 interleaved bits to form the second symbol of SIG field.

e) Pilot insertion: Insert pilots as described in 17.3.5.10.

f) P_{HTLTF} matrix mapping: Apply the mapping of the first column of the P_{HTLTF} matrix to the data subcarriers as described in 23.3.8.2.1.4.

g) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.2.1.1.

h) Spatial mapping: Apply the Q matrix as described in 23.3.10 and 23.3.9.11.1.

i) Duplication and phase rotation: Duplicate two symbols of SIG field over each 2 MHz of the CH_BANDWIDTH. Apply the appropriate phase rotation for each 2 MHz subchannel as described in 23.3.9.11, 23.3.9.12, and 23.3.7.

j) IDFT: Compute the inverse discrete Fourier transform.

k) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 17.3.2.5.

l) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.3.4 Construction of LTF2-LTF$_{NLTF}$

The LTF2-LTF$_{NLTF}$ field is defined in 23.3.8.2.1.3 and constructed as follows:

a) Sequence generation: Generate the LTF2-LTF$_{NLTF}$ field sequence in the frequency-domain over the bandwidth indicated by CH_BANDWIDTH as described in 23.3.8.2.1.3.

b) Phase rotation: Apply appropriate phase rotation for each 2 MHz subchannel as described in 23.3.9.11, 23.3.9.12, and 23.3.7.

c) A_{LTF} matrix mapping: Apply the mapping of the P_{HTLTF} matrix (from the second column to the last column) to the LTF2-LTF$_{NLTF}$ field sequence (the pilot tones are processed differently) as described in 23.3.8.2.1.3.

d) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.2.1.1.

e) Spatial mapping: Apply the Q matrix as described in 23.3.10 and 23.3.9.11.1.

f) IDFT: Compute the inverse discrete Fourier transform.

g) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 17.3.2.5.

h) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.4 Construction of the Preamble part in an S1G_1M PPDU

23.3.4.4.1 Construction of 1 MHz STF

The 1 MHz STF field is defined in 23.3.8.3.2 and constructed as follows:

a) Determine the CH_BANDWIDTH from the TXVECTOR if 1 MHz Duplicate PPDU.
b) Sequence generation: Generate the 1 MHz STF field in the frequency-domain over the bandwidth indicated by CH_BANDWIDTH as described in 23.3.8.3.2. Apply the 3dB power boosting if the MCS from the TXVECTOR equals MCS10 as described in 23.3.8.3.2.
c) Phase rotation: Apply appropriate phase rotation for each 1 MHz subchannel if 1 MHz Duplicate PPDU as described in 23.3.9.12 and 23.3.7.
d) P_{HTLTF} matrix mapping: Apply the mapping of the first column of the P_{HTLTF} matrix to the 1 MHz STF field sequence as described in 23.3.8.3.3.
e) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.3.1.
f) Spatial mapping: Apply the Q matrix as described in 23.3.9.11.1.
g) IDFT: Compute the inverse discrete Fourier transform.
h) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 17.3.2.5.
i) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.4.2 Construction of 1 MHz LTF1

The 1 MHz LTF1 field is defined in 23.3.8.3.3 and constructed as follows:

a) Determine FORMAT from TXVECTOR.
b) Sequence generation: If FORMAT is S1G, generate the 1 MHz LTF1 field sequence in the frequency-domain over the bandwidth indicated by CH_BANDWIDTH as described in 23.3.8.3.3. If FORMAT is S1G_DUP_1M, generate the LTF1 field sequence in the frequency-domain over a 1 MHz bandwidth.
c) Phase rotation: Apply appropriate phase rotation for each 1 MHz subchannel if 1 MHz Duplicate PPDU as described in 23.3.9.12 and 23.3.7.
d) A_{LTF} matrix mapping: Apply the mapping of the first column of the P_{HTLTF} matrix to the 1 MHz LTF1 field sequence (the pilot tones are processed differently) as described in 23.3.8.3.3.
e) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.3.1.
f) Spatial mapping: Apply the Q matrix as described in 23.3.9.11.1.
g) IDFT: Compute the inverse discrete Fourier transform.
h) Insert GI and apply windowing: Prepend a GI of 16 μs in duration for the first two symbols and insert a GI of 8 μs in duration per each subsequent symbol. Apply windowing as described in 17.3.2.5.
i) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.4.3 Construction of 1 MHz SIG

The SIG field is constructed per-user as follows:

a) Obtain the STBC, NUM_STS, GI_TYPE, FEC_CODING, MCS, SMOOTHING, LENGTH, AGGREGATION, RESPONSE_INDICATION, NDP_INDICATION and TRAVELING_PILOTS from the TXVECTOR. Add the reserved bits, append the calculated 4 bit CRC, then append the N_{tail} tail bits as shown in 23.3.8.3.4. This operation gives as a result 36 uncoded bits.

b) BCC encoder: Encode the data by a convolutional encoder at the rate of R=1/2 as described in 17.3.5.6 and apply the block-wise 2 times repetition on a per-OFDM symbol basis.

c) BCC interleaver: Interleave as described in 23.3.9.8.

d) Constellation mapper: BPSK modulate the interleaved bits as described in 17.3.5.8 to form the 6 symbols of SIG field.

e) Pilot insertion: Insert pilots as described in 17.3.5.10.

f) P_{HTLTF} matrix mapping: Apply the mapping of the first column of the P_{HTLTF} matrix to the data subcarriers as described in 23.3.8.3.4.

g) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.3.1.

h) Spatial mapping: Apply the Q matrix as described in 23.3.9.11.1.

i) Duplication and phase rotation: Duplicate 6 symbols of SIG field over each 1 MHz of the CH_BANDWIDTH if 1 MHz Duplicate PPDU. Apply the appropriate phase rotation for each 1 MHz subchannel as described in if 1 MHz Duplicate PPDU as described in 23.3.9.12 and 23.3.7.

j) IDFT: Compute the inverse discrete Fourier transform.

k) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 17.3.2.5.

l) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.4.4 Construction of 1 MHz LTF2-LTFNLTF

The 1 MHz LTF2-LTFNLTF field is defined in 23.3.8.3.3 and constructed as follows:

a) Sequence generation: Generate the 1 MHz LTF2-LTFNLTF field sequence in the frequency-domain over the bandwidth indicated by CH_BANDWIDTH as described in 23.3.8.3.3.

b) Phase rotation: Apply appropriate phase rotation for each 1 MHz subchannel as described in 23.3.9.12 and 23.3.7 if 1 MHz Duplicate PPDU.

c) A_{LTF} matrix mapping: Apply the mapping of the P_{HTLTF} matrix (from the second column to the last column) to the 1 MHz LTF2-LTFNLTF field sequence (the pilot tones are processed differently) as described in 23.3.8.3.3.

d) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.3.1.

e) Spatial mapping: Apply the Q matrix as described in 23.3.9.11.1.

f) IDFT: Compute the inverse discrete Fourier transform.

g) Insert GI and apply windowing: Prepend a GI of 8 μs in duration and apply windowing as described in 17.3.2.5.

h) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.5 Construction of Preambles for S1G_DUP_2M and S1G_DUP_1M

For S1G_DUP_2M and S1G_DUP_1M, the preambles are initially constructed according to 23.3.4.3 and 23.3.4.4, respectively.

In the case of S1G_DUP_2M, the initial 2 MHz preamble is duplicated in frequency with phase rotation as defined in 23.3.4.3 to fill the final transmission bandwidth (i.e., 4 MHz, 8 MHz, or 16 MHz) indicated by the CH_BANDWIDTH parameter in TXVECTOR.

In the case of S1G_DUP_1M, the initial 1 MHz preamble is duplicated in frequency with phase rotation as defined in 23.3.4.4 to fill the final transmission bandwidth (i.e., 2 MHz, 4 MHz, 8 MHz, or 16 MHz) indicated by the CH_BANDWIDTH parameter in TXVECTOR.

23.3.4.6 Construction of the Data field in an S1G SU PPDU for all cases except 1 MHz MCS10

23.3.4.6.1 Using BCC

The construction of the Data field in an S1G SU PPDU with BCC encoding proceeds as follows:

a) SERVICE field: Generate the SERVICE field as described in 23.3.9.2 and append the PSDU to the SERVICE field.
b) PHY padding: Append the PHY pad bits to the PSDU as described in 23.3.9.4.3.2.
c) Scrambler: Scramble the PHY padded data as described in 23.3.9.3.
d) BCC encoder: Divide the scrambled bits between the encoders by sending bits to different encoders in a round robin manner. The number of encoders is determined by rate-dependent parameters described in 23.5. BCC encode as described in 23.3.9.4.2 and 23.3.9.4.3.
e) Stream parser: Rearrange the output of the BCC encoders into blocks as described in 23.3.9.6.
f) Segment parser (if needed): For a contiguous 16 MHz transmission, divide the output bits of each stream parser into two frequency subblocks as described in 23.3.9.7. This block is bypassed for 1 MHz, 2 MHz, 4 MHz, and 8 MHz S1G PPDU transmissions.
g) BCC interleaver: Interleave as described in 23.3.9.8.
h) Constellation mapper: Map to BPSK, QPSK, 16-QAM, 64-QAM, or 256-QAM constellation points as described in 23.3.9.9.
i) Segment deparser (if needed): For a contiguous 16 MHz transmission, merge the two frequency subblocks into one frequency segment as described in 23.3.9.9.3. This block is bypassed for 1 MHz, 2 MHz, 4 MHz, and 8 MHz S1G PPDU transmissions.
j) STBC: Apply STBC as described in 23.3.9.9.4.
k) Pilot insertion: Insert pilots following the steps described in 23.3.9.10.
l) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.2.1.1 if S1G_SHORT preamble is used, 23.3.8.2.2.2.2 if S1G_LONG preamble is used and 23.3.8.3.1 if S1G_1M preamble is used.
m) Spatial mapping: Apply the Q matrix as described in 23.3.10 and in 23.3.9.11.1.
n) Phase rotation: Apply the appropriate phase rotations for each 2 MHz subchannel if 2 MHz preamble is used or for each 1 MHz subchannel if 1 MHz Duplicate PPDU as described in 23.3.9.11, 23.3.9.12 and 23.3.7.
o) IDFT: Compute the inverse discrete Fourier transform.
p) Insert GI and apply windowing: Prepend a GI and apply windowing as described in 18.3.2.5. If the GI_TYPE parameter in TXVECTOR equals LONG_GI, the GI duration shall be 8 μs. If the GI_TYPE parameter is SHORT_GI, the GI duration shall be 8 μs for the first OFDM symbol of the Data field, and 4 μs for all subsequent OFDM symbols.

q) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.6.2 Using LDPC

The construction of the Data field in an S1G SU PPDU with LDPC encoding proceeds as follows:

a) SERVICE field: Generate the SERVICE field as described in 23.3.9.2 and append the PSDU to the SERVICE field.
b) PHY padding: Append the PHY pad bits to the PSDU as described in 23.3.9.4.4.2.
c) Scrambler: Scramble the PHY padded data as described in 23.3.9.3.
d) LDPC encoder: The scrambled bits are encoded using the LDPC code with the LENGTH from the TXVECTOR as described in 23.3.9.4.4.
e) Stream parser: The output of the LDPC encoder is rearranged into blocks as described in 23.3.9.6.
f) Segment parser (if needed): For a contiguous 16 MHz transmission, divide the output bits of each stream parser into two frequency subblocks as described in 23.3.9.7. This block is bypassed for 1 MHz, 2 MHz, 4 MHz, and 8 MHz S1G PPDU transmissions.
g) Constellation mapper: Map to BPSK, QPSK, 16-QAM, 64-QAM, or 256-QAM constellation points as described in.23.3.9.9.
h) LDPC tone mapper: The LDPC tone mapping shall be performed on all LDPC encoded streams as described in 23.3.9.9.2. LDPC tone mapper is bypassed for 1 MHz transmission.
i) Segment deparser (if needed): For a contiguous 16 MHz transmission, merge the two frequency subblocks into one frequency segment as described in 23.3.9.9.3. This block is bypassed for 1 MHz, 2 MHz, 4 MHz, and 8 MHz S1G PPDU transmissions.
j) STBC: Apply STBC as described in 23.3.9.9.4.
k) Pilot insertion: Insert pilots following the steps described in 23.3.9.10.
l) CSD: Apply CSD for each space-time stream and frequency segment as described in 23.3.8.2.1.1 if S1G_SHORT preamble is used, 23.3.8.2.2.2.2 if S1G_LONG preamble is used and 23.3.8.3.1 if S1G_1M preamble is used.
m) Spatial mapping: Apply the Q matrix as described in 23.3.10 and in 23.3.9.11.1.
n) Phase rotation: Apply the appropriate phase rotations for each 2 MHz subchannel if 2 MHz preamble is used or for each 1 MHz subchannel if 1 MHz Duplicate PPDU as described in 23.3.9.11, 23.3.9.12 and 23.3.7.
o) IDFT: Compute the inverse discrete Fourier transform.
p) Insert GI and apply windowing: Prepend a GI and apply windowing as described in 17.3.2.5. If the GI_TYPE parameter in TXVECTOR equals LONG_GI, the GI duration shall be 8 μs. If the GI_TYPE parameter is SHORT_GI, the GI duration shall be 8 μs for the first OFDM symbol of the Data field, and 4 μs for all subsequent OFDM symbols.
q) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.7 Construction of the Data field in an S1G SU PPDU (1 MHz MCS10 mode)

23.3.4.7.1 Using BCC

The construction of the Data field in an S1G SU PPDU (1 MHz MCS10 mode) with BCC encoding proceeds as follows:

a) SERVICE field: Generate the SERVICE field as described in 23.3.9.2 and append the PSDU to the SERVICE field.
b) PHY padding: Append the PHY pad bits to the PSDU as described in 23.3.9.4.3.2.
c) Scrambler: Scramble the PHY padded data as described in 23.3.9.3.
d) BCC encoder: BCC encode as described in 23.3.9.4.2 and 23.3.9.4.3.
e) Block repetition: Apply the block-wise 2 times repetition on a per-OFDM symbol basis as described in 23.3.9.5.
f) BCC interleaver: Interleave as described in 23.3.9.8.
g) Constellation mapper: Map to BPSK constellation points as described in 23.3.9.9.
h) Pilot insertion: Insert pilots following the steps described in 23.3.9.10.
i) Spatial mapping: Apply the Q matrix as described in 23.3.9.11.1.
j) Phase rotation: Apply the appropriate phase rotations for each 1 MHz subchannel if 1 MHz Duplicate PPDU as described in 23.3.9.12 and 23.3.7.
k) IDFT: Compute the inverse discrete Fourier transform.
l) Insert GI and apply windowing: Prepend a GI and apply windowing as described in 17.3.2.5. If the GI_TYPE parameter in TXVECTOR equals LONG_GI, the GI duration shall be 8 μs. If the GI_TYPE parameter is SHORT_GI, the GI duration shall be 8 μs for the first OFDM symbol of the Data field, and 4 μs for all subsequent OFDM symbols.
m) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.7.2 Using LDPC

The construction of the Data field in an S1G SU PPDU (1 MHz MCS10 mode) with LDPC encoding proceeds as follows:

a) SERVICE field: Generate the SERVICE field as described in 23.3.9.2 and append the PSDU to the SERVICE field.
b) PHY padding: Append the PHY pad bits to the PSDU as described in 23.3.9.4.4.2.
c) Scrambler: Scramble the PHY padded data as described in 23.3.9.3.
d) LDPC encoder: The scrambled bits are encoded using the LDPC code with the LENGTH from the TXVECTOR as described in 23.3.9.4.4.
e) Block repetition: Apply the block-wise 2 times repetition on a per-OFDM symbol basis as described in 23.3.9.5.
f) Constellation mapper: Map to BPSK constellation points as described in 23.3.9.9.
g) Pilot insertion: Insert pilots following the steps described in 23.3.9.10.
h) Spatial mapping: Apply the Q matrix as described in 23.3.9.11.1.
i) Phase rotation: Apply the appropriate phase rotations for each 1 MHz subchannel if 1 MHz Duplicate PPDU as described in 23.3.9.12 and 23.3.7.
j) IDFT: Compute the inverse discrete Fourier transform.
k) Insert GI and apply windowing: Prepend a GI and apply windowing as described in 17.3.2.5. If the GI_TYPE parameter in TXVECTOR equals LONG_GI, the GI duration shall be 8 μs. If the

GI_TYPE parameter is SHORT_GI, the GI duration shall be 8 μs for the first OFDM symbol of the Data field, and 4 μs for all subsequent OFDM symbols.

l) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.4.8 Construction of the Data field in an S1G MU PPDU

23.3.4.8.1 General

For an MU transmission, the PPDU encoding process is performed on a per-user basis up to the input of the Spatial Mapping block except that the CSD is applied across users as described in 23.3.8.2.2.2.2 if an S1G_LONG preamble is used. All user data is combined and mapped to the transmit chains in the Spatial Mapping block. An S1G_1M PPDU, or an S1G_SHORT PPDU, or an 2 MHz duplicate PPDU in S1G_LONG format shall not be used for an MU transmission.

23.3.4.8.2 Using BCC

A Data field with BCC encoding is constructed using the process described in 23.3.4.6.1 and 23.3.4.7.1 before the spatial mapping block and repeated for each user that uses BCC encoding.

23.3.4.8.3 Using LDPC

A Data field with LDPC encoding is constructed using the process described in 23.3.4.6.2 and 23.3.4.7.2 before the spatial mapping block and repeated for each user that uses LDPC encoding.

23.3.4.8.4 Combining to form an S1G MU PPDU

The per-user data is combined as follows:

a) Spatial Mapping: Apply the Q matrix as described in 23.3.10. The combining of all user data is done in this block.

b) Phase rotation: Apply the appropriate phase rotations for each 2 MHz subchannel as described in 23.3.9.11 and 23.3.7.

c) IDFT: Compute the inverse discrete Fourier transform.

d) Insert GI and apply windowing: Prepend a GI and apply windowing as described in 17.3.2.5. If the GI_TYPE parameter in TXVECTOR equals LONG_GI, the GI duration shall be 8 μs. If the GI_TYPE parameter is SHORT_GI, the GI duration shall be 8 μs for the first OFDM symbol of the Data field, and 4 μs for all subsequent OFDM symbols.

e) Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the requested channel and transmit. Refer to 23.3.7 and 23.3.8 for details.

23.3.5 Modulation and coding scheme (MCS)

The S1G-MCS is a value that determines the modulation and coding used in the Data field of the PPDU. It is a compact representation that is carried in the SIG field or SIG-A field for S1G SU PPDUs and in the SIG-B field for S1G MU PPDUs using S1G_LONG. Rate-dependent parameters for the full set of S1G-MCSs are shown in Table 23-38 to Table 23-57 (in 23.5).

Table 23-38 through Table 23-57 give rate-dependent parameters for S1G-MCSs with indices 0 to 9 (and index 10 solely for 1 MHz, N_{SS} = 1), with number of spatial streams from 1 to 4 and bandwidth options of

1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz. Equal modulation is applied to all streams for a particular user.

23.3.6 Timing-related parameters

Table 23-4 defines the timing-related parameters for all S1G PPDU formats, except the SIG field in S1G_SHORT, and the SIG-A field in S1G_LONG. Note that the timing-related parameters for the SIG field in S1G_1M PPDU and the SIG-B field in S1G_LONG are the same as those defined for the Data field as shown in Table 23-4.

Table 23-4—Timing-related constants

Parameter	CBW1	CBW2	CBW4	CBW8	CBW16	Description
N_{SD}	24	52	108	234	468	Number of data subcarriers per OFDM symbol
N_{SP}	2	4	6	8	16	Number of pilot subcarrier per OFDM symbol
N_{ST}	26	56	114	242	484	Total number of useful subcarriers per OFDM symbol
N_{SR}	13	28	58	122	250	Highest data subcarrier index per OFDM symbol
Δ_F	31.25 kHz					Subcarrier frequency spacing
T_{DFT}	32 µs = $1/\Delta_F$					IDFT/DFT period
T_{GI}	8 µs = $T_{DFT}/4$					Guard interval duration
T_{GI2}	16 µs					Double guard interval
T_{GIS}	4 µs = $T_{DFT}/8$					Short guard interval duration
T_{SYML}	40 µs = $T_{DFT} + T_{GI} = 1.25 \times T_{DFT}$					Duration of OFDM symbol with normal guard interval
T_{SYMS}	36 µs = $T_{DFT} + T_{GIS} = 1.125 \times T_{DFT}$					Duration of OFDM symbol with short guard interval
T_{SYM}	T_{SYML} or T_{SYMS} depending on the GI used					OFDM symbol duration
T_{STF}	160 µs = $4 \times T_{SYML}$	80 µs = $2 \times T_{SYML}$				STF field duration
T_{DSTF}	N/A	40 µs = T_{SYML}				S1G_LONG preamble D-STF field duration

Table 23-4—Timing-related constants *(continued)*

Parameter	CBW1	CBW2	CBW4	CBW8	CBW16	Description
T_{LTF1}	160 µs = $4 \times T_{DFT} + 2 \times T_{GI} + T_{GI2}$	80 µs = $2 \times T_{DFT} + T_{GI2}$				First LTF field duration
T_{LTF}	40 µs = T_{SYML}					Second and subsequent LTF field duration
T_{DLTF}	N/A	40 µs = T_{SYML}				S1G_LONG preamble D-LTF field duration
T_{SIG}	240 µs = $6 \times T_{SYML}$	80 µs = $2 \times T_{SYML}$				SIG field duration
$T_{SIG\text{-}A}$	N/A	80 µs = $2 \times T_{SYML}$				S1G_LONG preamble SIG-A field duration
$T_{SIG\text{-}B}$	N/A	40 µs = T_{SYML}				S1G_LONG preamble SIG-B field duration
$N_{service}$	8					Number of bits in the SERVICE field
N_{tail}	6					Number of tail bits per BCC encoder
NOTE— $N_{ST} = N_{SD} + N_{SP}$.						

Table 23-5 defines the timing-related parameters for the SIG field in S1G_SHORT, or the SIG-A field in S1G_LONG. Note that short/double guard interval is not used for SIG/SIG-A field in ≥2 MHz PPDUs.

Table 23-5—Timing-related constants for SIG/SIG-A field in ≥ 2 MHz PPDUs

Parameter	CBW1	CBW2	CBW4	CBW8	CBW16	Description
N_{SD}	N/A	48	48	48	48	Number of data subcarriers per OFDM symbol per 2 MHz subchannel
N_{SP}	N/A	4	4	4	4	Number of pilot subcarrier per OFDM symbol per 2 MHz subchannel
N_{ST}	N/A	52	52	52	52	Total number of useful subcarriers per OFDM symbol per 2 MHz subchannel

Table 23-5—Timing-related constants for SIG/SIG-A field in ≥ 2 MHz PPDUs *(continued)*

Parameter	CBW1	CBW2	CBW4	CBW8	CBW16	Description
N_{SR}	N/A	26	56	120	248	Highest data subcarrier index per OFDM symbol
Δ_F	N/A	31.25 kHz				Subcarrier frequency spacing
T_{DFT}	N/A	32 μs = $1/\Delta_F$				IDFT/DFT period
T_{GI}	N/A	8 μs = $T_{DFT}/4$				Guard interval duration
T_{SYM}	N/A	40 μs = $T_{DFT} + T_{GI} = 1.25 \times T_{DFT}$				OFDM symbol duration
T_{SIG}	N/A	80 μs = $2 \times T_{SYM}$				SIG field duration
$T_{SIG\text{-}A}$	N/A	80 μs = $2 \times T_{SYM}$				S1G_LONG preamble SIG-A field duration

Table 23-6 defines parameters used frequently in Clause 23.

Table 23-6—Frequently used parameters

Symbol	Explanation
N_{CBPS}, $N_{CBPS,u}$	Number of coded bits per symbol for user u, $u = 0, ..., N_u$-1. For an S1G SU PPDU, $N_{CBPS} = N_{CBPS,0}$ For an S1G MU PPDU, N_{CBPS} is undefined
N_{CBPSS}, $N_{CBPSS,u}$	Number of coded bits per symbol per spatial stream. For the SIG-B field in S1G_LONG, $N_{CBPSS} = N_{SD}$ for all users. For the Data field, $N_{CBPSS,u}$ equals the number of coded bits per symbol per spatial stream for user u, $u = 0, ..., N_u$-1. For the Data field of an S1G SU PPDU, $N_{CBPSS} = N_{CBPSS,0}$ For the Data field of an S1G MU PPDU, N_{CBPSS} is undefined
N_{CBPSSI}, $N_{CBPSSI,u}$	Number of coded bits per symbol per spatial stream per BCC interleaver block. For an S1G SU PPDU, $N_{CBPSSI} = \begin{cases} N_{CBPSS}, \text{ for 1 MHz, 2 MHz, 4 MHz, or 8 MHz} \\ \dfrac{N_{CBPSS}}{2}, \text{ for a 16 MHz PPDU} \end{cases}$ For an S1G MU PPDU for user u, $u = 0, ..., N_u$-1 $N_{CBPSSI,u} = \begin{cases} N_{CBPSS,u}, \text{ for 1 MHz, 2 MHz, 4 MHz, or 8 MHz} \\ \dfrac{N_{CBPSS,u}}{2}, \text{ for a 16 MHz PPDU} \end{cases}$

Table 23-6—Frequently used parameters *(continued)*

Symbol	Explanation
N_{DBPS}, $N_{DBPS,u}$	Number of data bits per symbol for user u, u = 0, ..., N_u-1. For an S1G SU PPDU, $N_{DBPS} = N_{DBPS,0}$ For an S1G MU PPDU, N_{DBPS} is undefined
N_{BPSCS}, $N_{BPSCS,u}$	Number of coded bits per subcarrier per spatial stream for user u, u = 0, ..., N_u-1. For an S1G SU PPDU, $N_{BPSCS} = N_{BPSCS,0}$ For an S1G MU PPDU, N_{BPSCS} is undefined
N_{RX}	Number of receive chains
N_u	For S1G_LONG, the omnidirectional portion always has N_u = 1, and in the beam changeable portion, N_u represents the number of users in the transmission (equal to the TXVECTOR parameter NUM_USERS). For S1G_1M and S1G_SHORT, N_u = 1.
N_{STS}, $N_{STS,u}$	Number of space-time streams. For S1G_LONG, the omnidirectional portion always has $N_{STS,u}=1$ (see Note 1); and for the beam changeable portion $N_{STS,u}$ is the number of space-time streams for user u, $u = 0, \ldots, N_u-1$. For S1G_1M and S1G_SHORT,$N_{STS} = N_{STS,0}$. For an S1G SU PPDU,$N_{STS} = N_{STS,0}$; for an S1G MU PPDU,N_{STS} is undefined.
$N_{STS,total}$	For S1G_1M, S1G_SHORT, and the beam changeable portion of S1G_LONG, $N_{STS,total}$ is the total number of space-time streams in a PPDU. $$N_{STS,total} = \sum_{u=0}^{N_u-1} N_{STS,u}$$ For the omnidirectional portion of S1G_LONG, $N_{STS,total}$ is undefined. Note that $N_{STS,total} = N_{STS}$ for an S1G SU PPDU.
N_{SS}, $N_{SS,u}$	Number of spatial streams. For S1G_LONG, the omnidirectional portion always has $N_{SS,u}=1$ (see Note 2); and for the beam changeable portion $N_{SS,u}$ is the number of spatial streams for user u, $u = 0, \ldots, N_u-1$. For S1G_1M and S1G_SHORT, $N_{SS} = N_{SS,0}$. For an S1G SU PPDU,$N_{SS} = N_{SS,0}$; for an S1G MU PPDU,N_{SS} is undefined.
N_{TX}	Number of transmit chains
N_{ES}, $N_{ES,u}$	The number of BCC encoders. For the SIG-B field of S1G_LONG, $N_{ES}=1$ for each user. For the beam changeable portion of S1G_LONG, $N_{ES,u}$ is the number of BCC encoders for the Data field for user u, $u = 0, \ldots .Nu-1$. For the Data field of an S1G SU PPDU, $N_{ES} = N_{ES,0}$. For the Data field of an S1G MU PPDU, N_{ES} is undefined. For the Data field encoded using LDPC, N_{ES} = 1 for an S1G SU PPDU and $N_{ES,u}$ = 1 for an S1G MU PPDU for user u, u = 0, $\ldots N_u-1$
N_{LTF}	Number of long training fields in S1G_1M or S1G_SHORT; or the number of data long training fields in S1G_LONG (see 23.3.8.2.1.3, 23.3.8.2.2.2.3, and 23.3.8.3.3)

Table 23-6—Frequently used parameters *(continued)*

Symbol	Explanation
R, R_u	R_u is the coding rate for user u, $u = 0, ..., N_u$-1. For an S1G SU PPDU, $R = R_0$ For an S1G MU PPDU, R is undefined
M_u	For the omnidirectional portion of S1G_LONG, $M_u = 0$. Otherwise, $M_u = \sum_{u'=0}^{u-1} N_{STS,u'}$ with $M_0 = 0$.
NOTE—For the omnidirectional portion of S1G_LONG, u is 0 only since $N_u = 1$.	

23.3.7 Mathematical description of signals

For a description of the conventions used for the mathematical description of the signals, see 17.3.2.5.

For a 1 MHz S1G PPDU transmission, the 1 MHz is divided into 32 subcarriers. The signal is transmitted on subcarriers –13 to –1 and 1 to 13, with 0 being the center (DC) subcarrier.

For a 2 MHz S1G PPDU transmission, the 2 MHz is divided into 64 subcarriers. The signal is transmitted on subcarriers –28 to –1 and 1 to 28, with 0 being the center (DC) subcarrier.

For a 4 MHz S1G PPDU transmission, the 4 MHz is divided into 128 subcarriers. The signal is transmitted on subcarriers –58 to –2 and 2 to 58.

For an 8 MHz S1G PPDU transmission, the 8 MHz is divided into 256 subcarriers. The signal is transmitted on subcarriers –122 to –2 and 2 to 122.

For a 16 MHz S1G PPDU transmission, the 16 MHz is divided into 512 subcarriers. The signal is transmitted on subcarriers –250 to –130, –126 to –6, 6 to 126, and 130 to 250.

The transmitted signal is described in complex baseband signal notation. The actual transmitted signal is related to the complex baseband signal by the relation shown in Equation (23-1).

$$r_{RF}(t) = \mathrm{Re}\{r(t)\exp(j2\pi f_c t)\} \tag{23-1}$$

where

f_c represents the center frequency of the carrier

The transmitted RF signal is derived by up-converting the complex baseband signal, which consists of several fields. The timing boundaries for the various fields of the different frame formats are shown in Figure 23-5, where N_{LTF} is the number of LTF or D-LTF field symbols and is defined in Table 23-10 (in 23.3.8.2.1.3), for up to $N_{STS,Total} = 4$.

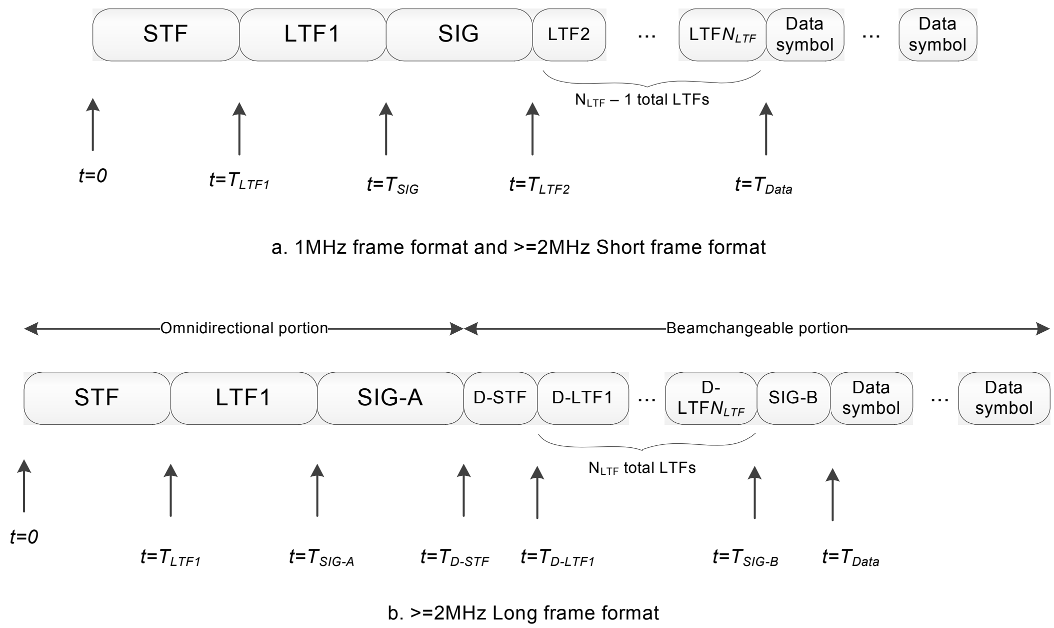


Figure 23-5—Timing boundaries for S1G PPDU fields

The time offset, t_{Field} , determines the starting time of the corresponding field.

For the S1G_1M PPDU frame format and the S1G_SHORT PPDU frame format, the signal transmitted on transmitted on transmit chain i_{TX} shall be as shown in Equation (23-2).

$$r_{PPDU}^{i_{TX}}(t) = r_{STF}^{i_{TX}}(t) + r_{LTF1}^{i_{TX}}(t - t_{LTF1}) + r_{SIG}^{i_{TX}}(t - t_{SIG}) \quad (23\text{-}2)$$

$$+ \sum^{N_{LTF}} r_{LTF}^{(i_{TX}, i_{LTF})}(t - t_{LTF2} - (i_{LTF} - 2)T_{LTF}) + r_{Data}^{i_{TX}}(t - t_{Data})$$

where

$t_{LTF} = T_{STF}$
$t_{SIG} = t_{LTF1} + T_{LTF1}$
$t_{LTF2} = t_{SIG} + T_{SIG}$
$t_{Data} = t_{LTF2} + (N_{LTF} - 1)T_{LTF}$

For the S1G_LONG PPDU format, the signal transmitted on transmit chain iTX shall be as shown in Equation (23-3).

$$r_{\mathrm{PPDU}}^{(i_{\mathrm{TX}})}(t) = r_{\mathrm{STF}}^{(i_{\mathrm{TX}})}(t) + r_{\mathrm{LTF1}}^{(i_{\mathrm{TX}})}(t - t_{\mathrm{LTF1}}) + r_{\mathrm{SIG\text{-}A}}^{(i_{\mathrm{TX}})}(t - t_{\mathrm{SIG}}) + r_{\mathrm{D\text{-}STF}}^{(i_{\mathrm{TX}})}(t - t_{D-STF}) \quad (23\text{-}3)$$

$$+ \sum_{i_{\mathrm{LTF}}=1}^{N_{\mathrm{LTF}}} r_{\mathrm{D\text{-}LTF}}^{(i_{\mathrm{TX}}, i_{\mathrm{LTF}})}(t - t_{\mathrm{D\text{-}LTF1}} - (i_{\mathrm{LTF}} - 1)T_{\mathrm{LTF}}) + r_{\mathrm{SIG\text{-}B}}^{(i_{\mathrm{TX}})}(t - t_{\mathrm{SIG\text{-}B}}) + r_{\mathrm{Data}}^{(i_{\mathrm{TX}})}(t - t_{\mathrm{Data}})$$

where

$$t_{\mathrm{LTF1}} = T_{\mathrm{STF}}$$
$$t_{\mathrm{SIG\text{-}A}} = t_{\mathrm{LTF1}} + T_{\mathrm{LTF1}}$$
$$t_{\mathrm{D\text{-}STF}} = t_{\mathrm{SIG\text{-}A}} + T_{\mathrm{SIG\text{-}A}}$$
$$t_{\mathrm{D\text{-}LTF1}} = t_{\mathrm{D\text{-}STF}} + T_{\mathrm{D\text{-}STF}}$$
$$t_{\mathrm{SIG\text{-}B}} = t_{\mathrm{D\text{-}LTF1}} + N_{\mathrm{LTF1}} \cdot T_{\mathrm{LTF}}$$
$$t_{\mathrm{Data}} = t_{\mathrm{SIG\text{-}B}} + T_{\mathrm{SIG\text{-}B}}$$

Each field, $r_{Field}^{(i_{\mathrm{TX}})}(t)$, is defined as the summation of one or more subfields, where each subfield is defined to be an inverse discrete Fourier transform as specified in Equation (23-4).

$$r_{\mathrm{Field}}^{(i_{\mathrm{TX}})}(t) = \frac{1}{\sqrt{N_{\mathrm{Field}}^{\mathrm{Tone}} N_{\mathrm{Norm}}}} w_{T_{\mathrm{Field}}}(t) \sum_{k=-N_{SR}}^{N_{SR}} \sum_{u=0}^{N_u-1} \sum_{m=1}^{N_{STS,u}} \left[Q_k\right]_{i_{TX},(M_u+m)} \Upsilon_{k,\mathrm{BW}} X_{k,u}^{(m)} \exp\left(j2\pi k\Delta_F(t - T_{GI,Field} - T_{CS}(M_u+m))\right) \quad (23\text{-}4)$$

This general representation holds for all subfields. When the bandwidth is greater than or equal to 2 MHz and the S1G_LONG format is used, the total power of the time domain beam changeable portion field signals summed over all transmit chains should not exceed the total power of the time domain omnidirectional portion signals summed over all transmit chains. For notational simplicity, the parameter BW is omitted from some bandwidth dependent terms.

Table 23-7 summarizes the various values of $N_{\mathrm{Field}}^{\mathrm{Tone}}$ as a function of bandwidth per frequency segment.

Table 23-7—Tone scaling factor and guard interval duration values for PHY fields

Field	$N_{\mathrm{Field}}^{\mathrm{Tone}}$ as a function of bandwidth per frequency segment					Guard interval duration
	1 MHz	2 MHz	4 MHz	8 MHz	16 MHz	
STF	6	12	24	48	96	N/A (See NOTE 2)
LTF1	26	56	114	242	484	For bandwidths ≥ 2 MHz, duration is T_{GI2}. For 1 MHz bandwidth, duration is T_{GI2} for first and second symbols, and T_{GI} for third and fourth symbols.
SIG	26	52	104	208	416	T_{GI}
SIG-A for long format	N/A	52	104	208	416	T_{GI}

Table 23-7—Tone scaling factor and guard interval duration values for PHY fields ***(continued)***

Field	$N_{\text{Field}}^{\text{Tone}}$ as a function of bandwidth per frequency segment					Guard interval duration
	1 MHz	2 MHz	4 MHz	8 MHz	16 MHz	
D-STF for long format	N/A	12	24	48	96	N/A
LTF2~N_{LTF}	26	56	114	242	484	T_{GI}
D-LTF for long format	N/A	56	114	242	484	T_{GI}
SIG-B for long format	N/A	56	114	242	484	T_{GI}
1st Data Symbol	26	56	114	242	484	T_{GI} (see NOTE 3)
From 2nd to the last Data Symbols	26	56	114	242	484	T_{GI} or T_{GIS} (see NOTE 3)
S1G_DUP_1M-Data (see NOTE 1)	N/A	52	104	208	416	T_{GI} or T_{GIS} (see NOTE 3)
S1G_DUP_2M-Data (see NOTE 1)	N/A	N/A	112	224	448	T_{GI} or T_{GIS} (see NOTE 3)

NOTE 1—For notational convenience, S1G_DUP_1M-Data and S1G_DUP_2M-Data is used as a label for the Data field of a duplicate PPDU with format type S1G_DUP_1M or S1G_DUP-2M, respectively.

NOTE 2—The OFDM symbols of the STF field do not have a guard interval, therefore its duration is not applicable.

NOTE 3—T_{GI} denotes guard interval duration when TXVECTOR parameter GI_TYPE equals LONG_GI, T_{GIS} denotes short guard interval duration when TXVECTOR parameter GI_TYPE equals SHORT_GI. Regardless of the GI_TYPE value in TXVECTOR, the first Data OFDM symbol always uses T_{GI} as its guard interval duration.

N_{Norm} for the omnidirectional portion of the S1G_LONG, $N_{\text{Norm}} = N_{\text{TX}}$, for all other cases, $N_{\text{Norm}} = N_{STS,total}$, where $N_{STS,total}$ is given in Table 23-6.

$w_{T_{\text{Field}}}(t)$ is a windowing function. An example function, $w_{T_{\text{Field}}}(t)$, is given in 18.3.2.5.

T_{Subfield} is time duration of the subfield being referenced, and its usage is as follows:
—T_{STF} for the STF field, $T_{D\text{-}STF}$ for the D-STF field
—T_{LTF1} for the LTF1 field
—T_{SIG} for the SIG field, $T_{SIG\text{-}A}$ for the SIG-A field
—T_{LTF} for the LTF2~LTF$_{NLTF}$ fields for the S1G_1M, the S1G_SHORT format, and for the D-LTFs fields in the S1G_LONG format
—$T_{SIG\text{-}B}$ field for the SIG-B

N_u is defined in Table 23-6.

N_{SR} is the highest data subcarrier index per frequency segment and has values listed in Table 23-4 and in Table 23-5.

$N_{STS,u}$ is defined in Table 23-6.

M_u is defined in Table 23-6.

$[X]_{a,b}$ indicates the element in row a and column b of the matrix X, where $1 \le a \le N_{\mathrm{row}}$, and $1 \le b \le N_{\mathrm{col}}$. N_{row} and N_{col} are the number of rows and columns, respectively, of the matrix X.

Q_k is the spatial mapping matrix for the subcarrier k. For the omnidirectional portion of S1G_LONG, Q_k is a column vector, denoted as $Q_k^{(omni)}$, with N_{TX} elements with element i_{TX} being $\exp(-j2\pi k\Delta_F T_{CS}^{i_{TX}})$, where $T_{CS}^{i_{TX}}$ represents the cyclic shift for transmitter chain i_{TX} whose values are given in Table 23-12 (in 23.3.8.2.2.1.2). For other cases, Q_k is a matrix with N_{TX} rows and $N_{STS,total}$ columns.

Δ_F is the subcarrier frequency spacing given in Table 23-4.

$X_{k,u}^{(m)}$ is the frequency-domain symbol in subcarrier k of user u for of space-time stream m. Some of the $X_{k,u}^{(m)}$ within $-N_{\mathrm{SR}} \le k \le N_{\mathrm{SR}}$ have a value of zero. Examples of such cases include the DC tones, guard tones on each side of the transmit spectrum, as well as the unmodulated tones of STF and D-STF fields.

$T_{GI,Field}$ is the guard interval duration used for each OFDM symbol in the field. The value for each field is as defined in Table 23-7. T_{GI}, T_{GI2} and T_{GIS} are defined in Table 23-4.

$T_{CS}(l)$ for the omnidirectional portion of S1G_LONG, $T_{CS}(l) = 0$. For the other cases, $T_{CS}(l)$ represents the cyclic shift per space-time stream, whose value is defined in Table 23-9 (in 23.3.8.2.1.1) for ≥ 2 MHz, and Table 23-17 (in 23.3.8.3.1).

The function $\Upsilon_{k,\mathrm{BW}}$ is used to represent a rotation of the tones. BW in $\Upsilon_{k,\mathrm{BW}}$ is determined by the TXVECTOR parameter CH_BANDWIDTH as defined in Table 23-8.

Table 23-8—CH_BANDWIDTH and Gamma sub$_{\mathrm{k,\ BW}}$

CH_BANDWIDTH	$\Upsilon_{k,\mathrm{BW}}$
CBW1	$\Upsilon_{k,1}$
CBW2	$\Upsilon_{k,2}$
CBW4	$\Upsilon_{k,4}$
CBW8	$\Upsilon_{k,8}$
CBW16	$\Upsilon_{k,16}$

For a 1 MHz PPDU transmission,

$$\Upsilon_{k,1} = 1 \quad (23\text{-}5)$$

For a 2 MHz PPDU transmission,

$$\Upsilon_{k,2} = 1 \tag{23-6}$$

For 4 MHz PPDU transmissions of S1G or S1G_DUP_2M frames,

$$\Upsilon_{k,4} = \begin{cases} 1, & k < 0 \\ j, & k \geq 0 \end{cases} \tag{23-7}$$

For 8 MHz PPDU transmissions of S1G or S1G_DUP_2M frames,

$$\Upsilon_{k,8} = \begin{cases} 1, k < -64 \\ -1, k \geq -64 \end{cases} \tag{23-8}$$

For 16 MHz PPDU transmissions of S1G or S1G_DUP_2M frames,

$$\Upsilon_{k,16} = \begin{cases} 1, & k < -192 \\ -1, & -192 \leq k < 0 \\ 1, & 0 \leq k < 64 \\ -1, & 64 \leq k \end{cases} \tag{23-9}$$

For 2 MHz PPDU transmissions of S1G_DUP_1M frames,

$$\Upsilon_{k,2} = \begin{cases} 1, k < 0 \\ -1, k \geq 0 \end{cases} \tag{23-10}$$

For 4 MHz PPDU transmissions of S1G_DUP_1M frames,

$$\Upsilon_{k,4} = \begin{cases} 1, k < -32 \\ j, -32 \leq k < 0 \\ -j, 0 \leq k < 32 \\ -1, 32 \leq k \end{cases} \tag{23-11}$$

For 8 MHz PPDU transmissions of S1G_DUP_1M frames,

$$\Upsilon_{k,8} = \begin{cases} 1, k < -96 \\ -1, -96 \leq k < -64 \\ 1, -64 \leq k < 64 \\ -1, 64 \leq k \end{cases} \tag{23-12}$$

For 16 MHz PPDU transmissions of S1G_DUP_1M frames,

$$\Upsilon_{k,\,16} = \begin{cases} 1, & k < -160 \\ -1, & -160 \le k < -128 \\ 1, & -128 \le k < -32 \\ -1, & -32 \le k < 64 \\ 1, & 64 \le k < 96 \\ -1, & 96 \le k < 128 \\ 1, & 128 \le k < 192 \\ -1, & 192 \le k < 224 \\ 1, & 224 \le k \end{cases} \tag{23-13}$$

23.3.8 S1G preamble

23.3.8.1 Introduction

Three preamble formats are defined that correspond to the three non-duplicate S1G PPDU formats: the S1G_1M preamble, the S1G_SHORT preamble, and the S1G_LONG preamble. The first two preamble formats are defined solely for single user, and the third preamble format may be used in either single user or multiuser PPDUs. The duplicate mode PPDU formats S1G_DUP_2M and S1G_DUP_1M use the S1G_SHORT and S1G_1M preambles, respectively.

23.3.8.2 Formats for greater than or equal to 2 MHz

This subclause describes the preamble formats used for non-duplicate S1G PPDUs of 2 MHz and greater and duplicate S1G_DUP_2M PPDUs.

23.3.8.2.1 S1G_SHORT preamble

The S1G_SHORT preamble is used for the S1G_SHORT and S1G_DUP_2M PPDU formats and is only used for SU transmissions. The S1G_SHORT preamble is structured similarly to the Greenfield format as defined in Clause 19.

23.3.8.2.1.1 Cyclic shift for S1G modulated fields

The cyclic shift values defined in this subclause apply to the STF, LTF, SIG and Data fields of the S1G_SHORT preamble PPDU, for ≥ 2 MHz Tx bandwidths. Throughout the S1G_SHORT preamble, cyclic shifts are applied to prevent beamforming when similar signals are transmitted in different space-time streams. The STF, LTF, and SIG fields start as single-stream during generation but are replicated up to $N_{STS,total}$ streams. For the LTF, these replicated streams undergo P-matrix mapping prior to CSD application as shown in Figure 23-6 (in 23.3.8.2.1.3). For the STF and SIG the CSDs are applied per stream immediately after replication. The same cyclic shift is applied to the $N_{STS,total}$ streams during the transmission of the Data field of the S1G_SHORT preamble PPDU. The cyclic shift value $T_{CS}(n)$ for space-time stream n out of $N_{STS,total}$ total space-time streams is shown in Table 23-9.

Table 23-9—Cyclic shift values for the S1G_SHORT preamble PPDU

$T_{CS}(n)$ for ≥ 2 MHz, S1G_SHORT Preamble PPDU				
Total number of space-time streams ($N_{STS,total}$)	**Cyclic shift for space-time stream *n* (μs)**			
	1	**2**	**3**	**4**
1	0	N/A	N/A	N/A
2	0	–4	N/A	N/A
3	0	–4	–2	N/A
4	0	–4	–2	–6
NOTE—N/A = not applicable.				

23.3.8.2.1.2 STF definition

The STF field for a 2 MHz or 4 MHz transmission is defined by Equation (19-8) and Equation (19-9), respectively, in 19.3.9.3.3. For a 8 MHz or 16 MHz transmission, the STF field is defined by Equation (21-18) and Equation (21-19), respectively, in 21.3.8.2.2. Note that these equations do not include the phase rotation per 2 MHz subchannel.

The time domain representation of the STF field signal at transmit chain i_{TX} shall be as specified in Equation (23-14).

$$r_{\mathrm{STF}}^{(i_{\mathrm{TX}})}(t) = \frac{1}{\sqrt{N_{\mathrm{STF}}^{\mathrm{Tone}} N_{\mathrm{STS}}}} w_{T_{\mathrm{STF}}}(t) \sum_{k=-N_{SR}}^{N_{SR}} \sum_{m=1}^{N_{STS}} \left[Q_k\right]_{i_{TX},m} \left[P_{HTLTF}\right]_{m,1} \Upsilon_{k,\mathrm{BW}} S_k \exp\left(j2\pi k \Delta_F (t - T_{CS}(m))\right) \quad (23\text{-}14)$$

where

N_{SR}	is defined in Table 23-4
$T_{CS}(m)$	represents the cyclic shift for space-time stream *m* with a value given in Table 23-9
$\Upsilon_{k,BW}$	is defined by Equation (23-6) through Equation (23-9)
Δ_F	is defined in Table 23-4
N_{STS}	is defined in Table 23-6
P_{HTLTF}	is defined in 19.3.9.4.6. (HT-LTF definition)
N_{STF}^{Tone}	has the value given in Table 23-7
Q_k	is defined in 23.3.7

23.3.8.2.1.3 LTF definition

The LTF field provides means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. The transmitter provides training for N_{STS} space-time streams (spatial mapper inputs) used for the transmission of the PSDU. For each tone, the MIMO channel that can be estimated is an $N_{RX} \times N_{STS}$ matrix. All S1G transmissions have a preamble that contains LTF symbols, where the data tones of each LTF symbol are multiplied by entries belonging to a matrix P_{HTLTF}, to enable channel estimation at the receiver.

The pilot tones of each LTF symbol are multiplied by the first column of the P_{HTLTF} matrix. The multiplication of the pilot tones in the LTF symbols by the first column of the P_{HTLTF} matrix instead of the whole P_{HTLTF} matrix is to allow receivers to track phase and frequency offset during MIMO channel estimation using the LTF. The number of LTF symbols, N_{LTF}, is a function of the total number of space-time streams N_{STS} as shown in Table 23-10. As a result, the LTF field consists of one, two, or four symbols that are necessary for the demodulation of the Data field in the PPDU or for channel estimation in an NDP.

Table 23-10— Number of LTFs required for different numbers of space-time streams

N_{STS}	N_{LTF}
1	1
2	2
3	4
4	4

The LTF field for a 2 MHz, 4 MHz, 8 MHz, or 16 MHz transmission is defined by Equation (21-36), Equation (21-37), Equation (21-38), and Equation (21-39), respectively, in 21.3.8.3.5. Note that these equations do not include the phase rotation per 2 MHz subchannel.

The generation of the time domain LTF symbols is shown in Figure 23-6 where A_{LTF}^{k} is given in Equation (23-15).

$$A_{LTF}^{k} = \begin{cases} [P_{HTLTF}]_{*,1} \times [1\ 1\ 1\ 1],\ if\ k \in K_{Pilot\_Fix} \\ P_{HTLTF},\ \text{otherwise} \end{cases} \tag{23-15}$$

where

K_{Pilot_Fix} is the subcarrier indices for the fixed pilot tones:

For a 2 MHz transmission, $K_{Pilot\_Fix} = \{\pm 7, \pm 21\}$

For a 4 MHz transmission, $K_{Pilot\_Fix} = \{\pm 11, \pm 25, \pm 53\}$

For an 8 MHz transmission, $K_{Pilot\_Fix} = \{\pm 11, \pm 39, \pm 75, \pm 103\}$

For a 16 MHz transmission, $K_{Pilot\_Fix} = \{\pm 25, \pm 53, \pm 89, \pm 117, \pm 139, \pm 167, \pm 203, \pm 231\}$

$[P_{HTLTF}]_{*,1}$ is the first column of the P_{HTLTF} matrix

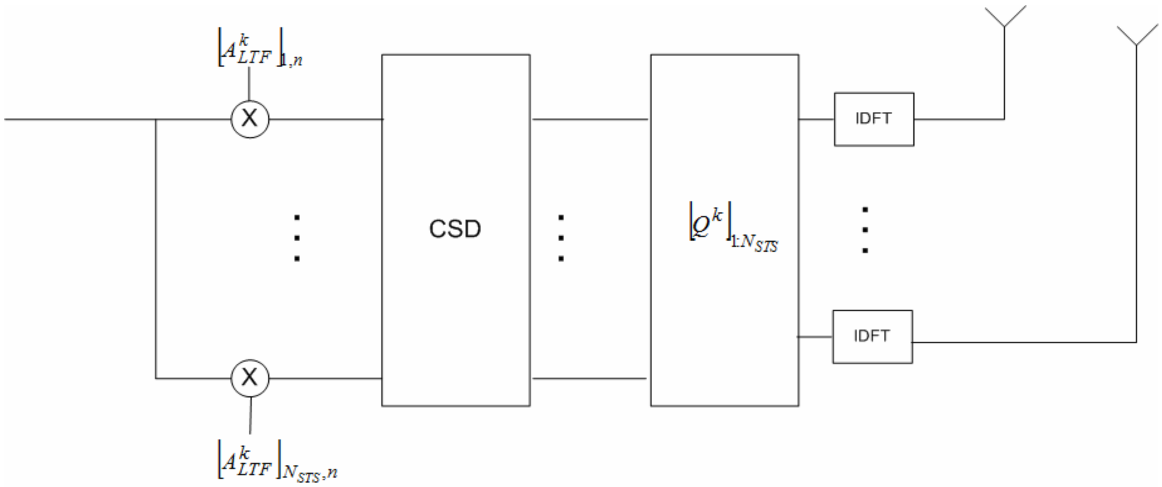


Figure 23-6—Generation of LTF symbols

The time domain representation of the LTF1 field, and LTF2~LTF$_{N_{LTF}}$ fields signals at transmit chain i_{TX} shall be as specified in Equation (23-16) and Equation (23-17), respectively.

$$r_{\mathrm{LTF1}}^{(i_{\mathrm{TX}})}(t)=\frac{1}{\sqrt{N_{\mathrm{LTF}}^{\mathrm{Tone}}N_{\mathrm{STS}}}}w_{T_{\mathrm{LTF1}}}(t)\sum_{k=-N_{SR}}^{N_{SR}}\sum_{m=1}^{N_{STS}}\left(\begin{array}{l}\left[Q_k\right]_{i_{TX},m}\Upsilon_{k,\mathrm{BW}}\left[A_{LTF}^{k}\right]_{m,1}LTF_k\\ \cdot\exp\left(j2\pi k\Delta_F\left(t-T_{GI2}-T_{CS}(m)\right)\right)\end{array}\right) \tag{23-16}$$

$$\begin{aligned}r_{\mathrm{LTF2\sim LTF_{N_{LTF}}}}^{(i_{\mathrm{TX}})}(t)=\frac{1}{\sqrt{N_{\mathrm{LTF}}^{\mathrm{Tone}}N_{\mathrm{STS}}}}&\sum_{n=1}^{N_{LTF}-1}w_{T_{\mathrm{LTF}}}\left(t-(n-1)T_{LTF}\right)\\ &\sum_{k=-N_{SR}}^{N_{SR}}\sum_{m=1}^{N_{STS}}\left(\begin{array}{l}\left[Q_k\right]_{i_{TX},m}\Upsilon_{k,\mathrm{BW}}\left[A_{LTF}^{k}\right]_{m,(n+1)}LTF_k\\ \cdot\exp\left(j2\pi k\Delta_F\left(t-(n-1)T_{LTF}-T_{GI}-T_{CS}(m)\right)\right)\end{array}\right)\end{aligned} \tag{23-17}$$

where

N_{SR} and T_{LTF}	are defined in Table 23-4
$T_{CS}(m)$	represents the cyclic shift for space-time stream m with a value given in Table 23-9
$\Upsilon_{k,BW}$	is defined by Equation (23-6) through Equation (23-9)
Δ_F	is defined in Table 23-4
N_{STS}	is defined in Table 23-6
A_{LTF}^{k}	is defined in Equation (23-15)
N_{LTF}^{Tone}	has the value given in Table 23-7
Q_k	is defined in 23.3.7

The first LTF (LTF1) field consists of two periods of the long training symbol, preceded by a double length (16 μs) cyclic prefix. The placement of the first and subsequent LTF fields in an S1G_SHORT PPDU is shown in Figure 23-1.

23.3.8.2.1.4 SIG definition

The SIG field carries information required to interpret S1G format PPDUs sent with a short preamble. The structure of the SIG field for the first symbol (SIG-1) is shown in Figure 23-7 and for the second symbol (SIG-2) is shown in Figure 23-8. The SIG field format of NDP CMAC frames is described in Figure 23-21 (in 23.3.11).

	B0	B1	B2	B3 B4	B5 B6	B7 B15	B16	B17	B18	B19 B22	B23
	Reserved	STBC	Uplink Indication	BW	Nsts	ID	SGI	Coding	LDPC Extra	MCS	Smoothing
Bits:	1	1	1	2	2	9	1	1	1	4	1

Figure 23-7—SIG-1 structure

	B0	B1 B9	B10 B11	B12	B13	B14 B17	B18 B23
	Aggregation	Length	Response Indication	Traveling Pilots	NDP Indication	CRC	Tail
Bits:	1	9	2	1	1	4	6

Figure 23-8—SIG-2 structure

The SIG field of S1G format PPDUs sent with a short preamble contains the fields listed in Table 23-11.

Integer fields are represented in unsigned binary format with the least significant bit in the lowest numbered bit position.

The SIG field is composed of two OFDM symbols, SIG-1 and SIG-2, each providing 24 data bits, as shown in Table 23-11. SIG-1 is transmitted before SIG-2. The SIG field symbols shall be BCC encoded at rate, R = 1/2, interleaved, mapped to a BPSK constellation, and have pilots inserted following the steps described in 17.3.5.6, 17.3.5.7, 17.3.5.8, and 17.3.5.9, respectively.

The first and second half of the stream of 96 complex numbers generated by these steps (before pilot insertion) is divided into two groups of 48 complex numbers $d_{k,n}$, $k = 0, \ldots, 47$, where $n = 0, 1$, respectively. All the 96 complex numbers are rotated by 90° counter-clockwise relative to their original BPSK constellation points in order to accommodate differentiation of the S1G_SHORT PPDU from an S1G_1M PPDU, or from an S1G_LONG PPDU. The first rotated 48 complex numbers form the first symbol of SIG field; and the second rotated 48 complex numbers form the second symbol of SIG field, which follow the constellation diagram shown in Figure 23-9.

Table 23-11—Fields in the SIG field of short preamble

Symbol	Bit	Field	Number of bits	Description
SIG-1	B0	Reserved	1	Reserved. Set to 1.
	B1	STBC	1	Set to 1 if all spatial streams have space-time block coding and set to 0 if no spatial streams has space-time block coding.
	B2	Uplink Indication	1	Set to the value of the TXVECTOR parameter UPLINK_INDICATION.
	B3–B4	BW	2	If FORMAT is S1G in TXVECTOR, set to 0 when CH_BANDWIDTH is CBW2 1 when CH_BANDWIDTH is CBW4 2 when CH_BANDWIDTH is CBW8 3 when CH_BANDWIDTH is CBW16 If FORMAT is S1G_DUP_2M in TXVECTOR, set to 0.
	B5–B6	Nsts	2	Set to 0 for 1 space-time stream Set to 1 for 2 space-time streams Set to 2 for 3 space-time streams Set to 3 for 4 space-time streams
	B7–B15	ID	9	If Uplink Indication is not present or set to 1, set to the value of the TXVECTOR parameter PARTIAL_AID. PARTIAL_AID provides an abbreviated indication of the intended recipient(s) of the PSDU (see 10.20b)). If Uplink Indication is set to 0, B7-B9 are set to the value of the TXVECTOR parameter COLOR and B10–B15 are set to the value of the TXVECTOR parameter PARTIAL_AID.
	B16	Short GI	1	Set to 0 if short guard interval is not used in the Data field. Set to 1 if short guard interval is used in the Data field.
	B17	Coding	1	Set to 0 for BCC and 1 for LDPC
	B18	LDPC Extra	1	If Coding field is 1, set to 1 if the LDPC PPDU encoding process (of an SU PPDU), results in an extra OFDM symbol (or symbols) as described in 21.3.10.5.4, otherwise set to 0. If Coding field is 0, this field is set to 1.
	B19–B22	MCS	4	MCS Index
	B23	Smoothing	1	A value of 1 indicates that channel smoothing is recommended. A value of 0 indicates that channel smoothing is not recommended.

Table 23-11—Fields in the SIG field of short preamble *(continued)*

Symbol	Bit	Field	Number of bits	Description
SIG-2	B0	Aggregation	1	Set to 1 when aggregation is ON (as indicated by AGGREGATION parameter of TXVECTOR), and 0 otherwise. NOTE— S1G PPDUs are transmitted with aggregation ON when PSDU to be carried is greater than 511 octets, as defined in 10.13.5.
	B1–B9	Length	9	When the Aggregation bit is equal to 0, set to the value of the PSDU_LENGTH parameter in TXVECTOR. When the Aggregation bit is equal to 1, set to N_sym, given in Section 23.4.3.
	B10–B11	Response Indication	2	Set to the value obtained from the TXVECTOR parameter RESPONSE_INDICATION. The Response Indication indicates the presence and type of frame that is expected to follow SIFS after the current frame transmission (see 10.3.2.4a).
	B12	Traveling Pilots	1	Set to 1 to indicate traveling pilots usage in packet. Otherwise 0 to indicate regular pilot tone locations.
	B13	NDP Indication	1	Used to indicate that frame is a Control NDP frame. If set to 1, then the SIG field format is shown in Figure 23-21 (in 23.3.11) and the SIG field contents follow the description in 9.9.
	B14–B17	CRC	4	CRC calculated as in 23.3.8.2.1.5.
	B18–B23	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

Figure 23-9—Data constellation in SIG field of S1G_SHORT

The time domain waveform for the SIG field in an S1G_SHORT PPDU at transmit chain i_{TX} shall be as specified in Equation (23-18).

$$r_{\mathrm{SIG}}^{(i_{\mathrm{TX}})}(t) = \frac{1}{\sqrt{N_{\mathrm{SIG}}^{\mathrm{Tone}} N_{\mathrm{STS}}}} \sum_{n=0}^{1} w_{T_{\mathrm{SYML}}}(t - nT_{SYML}) \sum_{i_{BW}=0}^{N_{2MHz}-1} \left(\sum_{k=-26}^{26} \sum_{m=1}^{N_{STS}} \Upsilon_{(k-K_{shift}(i_{BW})),\mathrm{BW}} \left[Q_k\right]_{i_{TX},m} \left[P_{HTLTF}\right]_{m,1} \left(j.D_{k,n,2} + p_n P_k\right) \cdot \exp\left(j2\pi(k - K_{Shift}(i_{BW}))\Delta_F(t - nT_{SYML} - T_{GI} - T_{CS}(m))\right) \right) \tag{23-18}$$

where

N_{2MHz} is the number of 2 MHz subchannels that are contained within the whole bandwidth of the current PPDU (e.g., $N_{2MHz} = 2$ for a 4 MHz PPDU).

$$K_{Shift}(i) = (N_{2MHz} - 1 - 2i).32 \tag{23-19}$$

$$D_{k,n,2} = \begin{cases} 0, & k = 0, \pm 7, \pm 21 \\ d_{M_2'(k),n}, & \text{otherwise} \end{cases} \tag{23-20}$$

where $M'_2(k)$ is defined in Equation (23-21)

$$M_2'(k) = \begin{cases} k+26, & -26 \le k \le -22 \\ k+25, & -20 \le k \le -8 \\ k+24, & -6 \le k \le -1 \\ k+23, & 1 \le k \le 6 \\ k+22, & 8 \le k \le 20 \\ k+21, & 22 \le k \le 26 \end{cases} \tag{23-21}$$

p_n and P_k are defined in 17.3.5.10
$T_{CS}(m)$ represents the cyclic shift for space-time stream *m* with a value given in Table 23-9
T_{SYML} is defined in Table 23-4
$\Upsilon_{k,BW}$ is defined by Equation (23-6) through Equation (23-9)
Δ_F is defined in Table 23-4
N_{STS} is defined in Table 23-6
P_{HTLTF} is defined in 19.3.9.4.6
N_{SIG}^{Tone} has the value given in Table 23-7
Q_k is defined in 23.3.7

NOTE—This definition results in a QBPSK modulation on the two symbols of SIG field, where the constellation of the data tones is rotated by 90º counter-clockwise relative to the third and fourth repetitions of LTF1 field in S1G_1M preamble, and relative to the second symbol of SIG-A field of the S1G_LONG preamble, respectively, as shown in Figure 23-1 to Figure 23-3), to facilitate the differentiation among the three preamble formats at the receiver.

23.3.8.2.1.5 CRC calculation for S1G SIG-A fields

The CRC protects bits 0–25 of the 1 MHz SIG field and bits 0–37 of the ≥ 2 MHz SIG-A field. The value of the CRC field shall be the 1s complement of

$$crc(D) = (M(D) \oplus I(D))D^4 \text{modulo } G(D) \tag{23-22}$$

where

$M(D) = m_0 D^N + m_1 D^{N-1} + \ldots + m_N D^0$ is the SIG field or SIG-A represented as a polynomial

where

N is 25 for the 1 MHz SIG field and 37 for the ≥ 2 MHz SIG-A field

m_i is the ith bit of the corresponding SIG/SIG-A field

$I(D) = \sum_{i=N-3}^{N} D^i$ are initialization values that are added modulo 2 to the first 4 bits of SIG/SIG-A field

$G(D) = D^4 + D^1 + 1$ is the CRC generating polynomial

$crc(D) = c_3 D^3 + c_2 D^2 + c_1 D^1 + c_0 D^0$

The CRC field is transmitted with c_3 first.

Figure 23-10 shows the operation of the CRC. First, the shift register is reset to all 1s. The bits are then passed through the XOR operation at the input. When the last bit has entered, the output is generated by shifting the bits out of the shift register, C3 first, through an inverter.

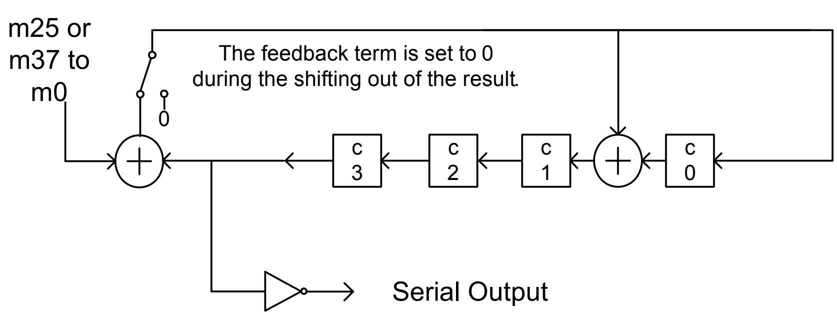


Figure 23-10—4-bit CRC calculation

As an example, if bits $\{m_0 \ldots m_{25}\}$ are given by {11 0110 0111 0110 1001 1110 1111}, the output bits $\{b_3 \ldots b_0\}$, where b_3 is output first, are {0101}.

23.3.8.2.2 S1G_LONG preamble

The S1G_LONG preamble is used for the S1G_LONG PPDU format. In contrast to the S1G_1M and S1G_SHORT preambles, the S1G_LONG preamble can be used for MU transmissions, in addition to SU transmissions. The S1G_LONG preamble is structured similarly to the Mixed mode format as defined in Clause 19 and Clause 21.

23.3.8.2.2.1 Omnidirectional portion

23.3.8.2.2.1.1 General

The omnidirectional portion of the S1G_LONG preamble is single user and single-space-time stream modulated. By definition, to be omnidirectional, no spatial mapping (Q-matrix multiplication) is applied.

23.3.8.2.2.1.2 Cyclic shift for S1G modulated fields

This subclause describes the set of cyclic shift values (defined per-antenna) to be applied to the omnidirectional portion of the S1G_LONG preamble, namely the STF, LTF, and SIG-A fields. The STF, LTF, and SIG-A fields start as single-stream during generation but are replicated up to N_{TX} streams. These fields are mapped to the transmit antennas, at which point the cyclic shifts are applied. The cyclic shift values are defined in Table 23-12, which specifies the per-antenna cyclic shift value $T_{CS}^{i_{TX}}$ for antenna i_{TX} of the N_{TX} total transmit antennas.

Table 23-12—Per antenna cyclic shift values of S1G_LONG preamble PPDU

$T_{CS}^{i_{TX}}$ for ≥ 2 MHz, omnidirectional portion of S1G_LONG Preamble PPDU				
Total number of Tx antennas	**Cyclic shift (for Tx Antenna i_{TX}) (µs)**			
	1	**2**	**3**	**4**
1	0	N/A	N/A	N/A
2	0	–4	N/A	N/A
3	0	–4	–2	N/A
4	0	–4	–2	–6
NOTE—N/A = not applicable.				

23.3.8.2.2.1.3 STF definition

The STF field for 2 MHz, 4 MHz, 8 MHz, and 16 MHz are the same as the STF field in short preamble as specified in 23.3.8.2.1.2.

The time domain representation of the STF field signal at transmit chain i_{TX} shall be as specified in Equation (23-23).

$$r_{STF}^{(i_{TX})}(t) = \frac{1}{\sqrt{N_{STF}^{Tone} N_{TX}}} w_{\mathrm{T}_{STF}}(t) \sum_{k=-N_{SR}}^{N_{SR}} [Q_k^{(\mathrm{omni})}]_{i_{TX},1} \Upsilon_{k,\mathrm{BW}} S_k \exp(j2\pi k \Delta_F t) \qquad (23\text{-}23)$$

where

N_{SR} is defined in Table 23-4

$\Upsilon_{k,BW}$ is defined by Equation (23-6) through Equation (23-9).

Δ_F is defined in Table 23-4

N_{STF}^{Tone} has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7

$Q_k^{(omni)}$ is as defined in 23.3.7.

23.3.8.2.2.1.4 LTF1 definition

The LTF1 field values for 2 MHz, 4 MHz, 8 MHz, and 16 MHz are the same as the LTF field in short preamble as specified in 23.3.8.2.1.3.

The time domain representation of the LTF1 field signal at transmit chain i_{TX} shall be as specified in Equation (23-24).

$$r_{\mathrm{LTF1}}^{(i_{TX})}(t) = \frac{1}{\sqrt{N_{LTF}^{Tone} N_{TX}}} w_{\mathrm{T}_{LTF1}}(t) \sum_{k=-N_{SR}}^{N_{SR}} [Q_k^{(\mathrm{omni})}]_{i_{TX},1} \Upsilon_{k,\mathrm{BW}} LTF_k \exp(j2\pi k \Delta_F (t - T_{GI2})) \quad (23\text{-}24)$$

where

N_{SR} is defined in Table 23-4

$\Upsilon_{k,BW}$ is defined by Equation (23-6) through Equation (23-9)

Δ_F is defined in Table 23-4

N_{STF}^{Tone} has the value given in Table 23-7

$Q_k^{(omni)}$ is as defined in 23.3.7.

The LTF1 field consists of two periods of the long training symbol, preceded by a double length (16 µs) cyclic prefix. The placement of the first and subsequent LTF fields in an S1G_SHORT PPDU is shown in Figure 23-1.

23.3.8.2.2.1.5 SIG-A definition

The SIG-A field of the long preamble carries information required to interpret S1G format PPDUs sent using the long preamble. The structure of the SIG-A field is different for SU PPDUs and MU PPDUs. The structure of the SIG-A field for SU PPDUs for the first symbol (SIG-A1) is shown in Figure 23-11 and for the second symbol (SIG-A2) is shown in Figure 23-12. The structure of the SIG-A field for MU PPDUs for the first symbol (SIG-A1) is shown in Figure 23-13 and for the second symbol (SIG-A2) is shown in Figure 23-14.

B0	B1	B2	B3 B4	B5 B6	B7 B15	B16	B17	B18	B19 B22	B23
MU/SU	STBC	Uplink Indication	BW	Nsts	ID	SGI	Coding	LDPC Extra	MCS	Beam-Change/ Smoothing Indication

Figure 23-11—SIG-A1 structure for SU PPDU

B0	B1 B9	B10 B11	B12	B13	B14 B17	B18 B23
Aggregation	Length	Response Indication	Reserved	Traveling Pilots	CRC	Tail

Figure 23-12—SIG-A2 structure for SU PPDU

B0	B1	B2	B3			B10	B11 B12	B13 B18	B19	B20 B23
MU/SU	STBC	Reserved	Nsts				BW	GID	SGI	Coding-I
			MU[0] Nsts	MU[1] Nsts	MU[2] Nsts	MU[3] Nsts				

Figure 23-13—SIG-A1 structure for MU PPDU

B0	B1	B2 B10	B11 B12	B13	B14 B17	B18 B23
Coding-II	Reserved	Length	Response Indication	Traveling Pilots	CRC	Tail

Figure 23-14—SIG-A2 structure for MU PPDU

The SIG-A field of S1G format PPDUs sent with an S1G_LONG preamble for SU contains the fields listed in Table 23-13 and for MU, the fields listed in Table 23-14.

Integer fields are represented in unsigned binary format with the least significant bit in the lowest numbered bit position.

The SIG-A field is composed of two OFDM symbols, SIG-A1 and SIG-A2, each containing 24 data bits, as shown in Table 23-13. SIG-A1 is transmitted before SIG-A2. The SIG-A field symbols shall be BCC encoded at rate, R = 1/2, interleaved, mapped to a BPSK constellation, and have pilots inserted following the steps described in 17.3.5.6, 17.3.5.7, 17.3.5.8, and 17.3.5.9, respectively. The first and second half of the stream of 96 complex numbers generated by these steps (before pilot insertion) is divided into two groups of 48 complex numbers $d_{k,n}$, $k = 0, \ldots, 47$, where $n = 0, 1$, respectively. The first group of the 48 complex numbers are rotated by 90° counter-clockwise relative to their original BPSK constellation points in order to accommodate differentiation of the S1G_LONG PPDU from an S1G_1M PPDU. The second group of the 48 complex numbers without rotations may be used to accommodate differentiation of the S1G_LONG PPDU from an S1G_SHORT PPDU. The first rotated 48 complex numbers form the first symbol of SIG-A; and the second unrotated 48 complex numbers form the second symbol of SIG-A, which follow the constellation diagram shown in Figure 23-15.

Table 23-13—Fields in the SIG-A field of S1G_LONG preamble SU PPDU

Symbol	Bit	Field	Number of bits	Description
SIG-A1	B0	MU/SU	1	Set to 0 for SU PPDUs.
	B1	STBC	1	Set to 1 if all spatial streams have space-time block coding and set to 0 if no spatial streams has space-time block coding.
	B2	Uplink Indication	1	Set to the value of the TXVECTOR parameter UPLINK_INDICATION.
	B3–B4	BW	2	Set to 0 for 2 MHz, 1 for 4 MHz, 2 for 8 MHz, 3 for 16 MHz
	B5–B6	Nsts	2	Set to 0 for 1 space-time stream Set to 1 for 2 space-time streams Set to 2 for 3 space-time streams Set to 3 for 4 space-time streams
	B7–B15	ID	9	If Uplink Indication is not present or set to 1, set to the value of the TXVECTOR parameter PARTIAL_AID. PARTIAL_AID provides an abbreviated indication of the intended recipient(s) of the PSDU (see 10.20b). If Uplink Indication is set to 0, B7-B9 are set to the value of the TXVECTOR parameter COLOR and B10–B15 are set to the value of the TXVECTOR parameter PARTIAL_AID.
	B16	Short GI	1	Set to 0 if short guard interval is not used in the Data field. Set to 1 if short guard interval is used in the Data field.
	B17	Coding	1	Set to 0 for BCC and 1 for LDPC
	B18	LDPC Extra	1	If Coding field is 1, set to 1 if the LDPC PPDU encoding process (of an SU PPDU), results in an extra OFDM symbol (or symbols) as described in 21.3.10.5.4, otherwise set to 0. If Coding field is 0, this field is set to 1.
	B19–B22	MCS	4	MCS Index
	B23	Beam Change/ Smoothing Indication	1	If Nsts subfield indicates 1 space-time stream, this field is a Beam Change Indication: — A value of 1 indicates that the Q matrix is changed from the omnidirectional portion to the beam changeable portion of the preamble, in at least one of the nonzero sub-carriers of the omnidirectional portion. — A value of 0 indicates that the Q matrix is unchanged in all the nonzero sub-carriers of the omnidirectional portion. If Nsts subfield indicates more than 1 space-time stream, this field is a Smoothing Indication: — A value of 1 indicates that channel smoothing is recommended, — A value of 0 indicates that channel smoothing is not recommended. See NOTE 1. See NOTE 2.

Table 23-13—Fields in the SIG-A field of S1G_LONG preamble SU PPDU *(continued)*

Symbol	Bit	Field	Number of bits	Description
SIG-A2	B0	Aggregation	1	Set to 1 when aggregation is ON (as indicated by AGGREGATION parameter of TXVECTOR), and 0 otherwise. NOTE— S1G PPDUs are transmitted with aggregation ON when PSDU to be carried is greater than 511 octets, as defined in 10.13.5
	B1–B9	Length	9	When the Aggregation bit is equal to 0, set to the value of the PSDU_LENGTH parameter in TXVECTOR. When the Aggregation bit is equal to 1, set to N_sym, given in Section 23.4.3.
	B10–B11	Response Indication	2	Set to the value obtained from the TXVECTOR parameter RESPONSE_INDICATION. The Response Indication indicates the presence and type of frame that is expected to follow SIFS after the current frame transmission (see 10.3.2.4a).
	B12	Reserved	1	Reserved. Bit set to 1.
	B13	Traveling Pilots	1	Set to 1 to indicate traveling pilots usage in packet. Otherwise 0 to indicate regular pilot tone locations.
	B14–B17	CRC	4	CRC calculated as in 23.3.8.2.1.5.
	B18–B23	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

NOTE 1—When the Nsts subfield indicates 1 space-time stream, if Beam Change/Smoothing Indication field is set to 0, the receiver may do channel smoothing. Otherwise, smoothing is not recommended.

NOTE 2—The Q matrix for omnidirectional portion is $Q_k^{(omni)}$ as defined in 23.3.7.

Table 23-14—Fields in the SIG-A field of S1G_LONG preamble MU PPDU

Symbol	Bit	Field	Number of bits	Description
SIG-A1	B0	MU/SU	1	Set to 1 for MU PPDUs
	B1	STBC	1	Set to 0 in MU PPDUs.
	B2	Reserved	1	Reserved. Set to 1.
	B3–B10	NSTS	8	NSTS is divided into 4 user positions of 2 bits each, denoted by 4 subfields MU[0] Nsts …MU[3] Nsts. User position *p*, where $0 \le p \le 3$, uses bits $B(3+2p) - B(4+2p)$. The space-time streams of user u are indicated at user position $p = \text{USER\_POSITION}[u]$ where $u = 0, 1, \ldots\text{NUM\_USERS} - 1$ and the notation A[*b*] denotes the value of array A at index *b*. Zero space-time streams are indicated at positions not listed in the USER_POSITION array. Set to 0 for 0 space-time streams Set to 1 for 1 space-time stream Set to 2 for 2 space-time streams Set to 3 for 3 space-time streams
	B11–B12	BW	2	Set to 0 for 2 MHz, 1 for 4 MHz, 2 for 8 MHz, 3 for 16 MHz
	B13–B18	GID	6	In an MU PPDU the Group ID is set as defined in 23.3.10.4
	B19	Short GI	1	Set to 0 if short guard interval is not used in the Data field. Set to 1 if short guard interval is used in the Data field.
	B20–B23	Coding-I	4	If the MU[0] NSTS field is nonzero, then B20 indicates coding for user 0: set to 0 for BCC, 1 for LDPC. If the MU[0] NSTS field is 0, then B20 is reserved and set to 1. If the MU[1] NSTS field is nonzero, then B21 indicates coding for user 1: set to 0 for BCC, 1 for LDPC. If the MU[1] NSTS field is 0, then B21 is reserved and set to 1. If the MU[2] NSTS field is nonzero, then B22 indicates coding for user 2: set to 0 for BCC, 1 for LDPC. If the MU[2] NSTS field is 0, then B22 is reserved and set to 1. If the MU[3] NSTS field is nonzero, then B23 indicates coding for user 3: set to 0 for BCC, 1 for LDPC. If the MU[3] NSTS field is 0, then B23 is reserved and set to 1.

Table 23-14—Fields in the SIG-A field of S1G_LONG preamble MU PPDU *(continued)*

Symbol	Bit	Field	Number of bits	Description
SIG-A2	B0	Coding-II	1	Set to 1 if at least one LDPC user's PPDU encoding process results in an extra OFDM symbol (or symbols) as described in 21.3.10.5.4 and 21.3.10.5.5. Set to 0 otherwise.
	B1	Reserved	1	Reserved. Set to 1.
	B2–B10	Length	9	Set to the N_{sym}, given in 23.4.3. NOTE— A-MPDU is always used for MU PPDUs.
	B11–B12	Response Indication	2	Set to the value obtained from the TXVECTOR parameter RESPONSE_INDICATION. The Response Indication indicates the presence and type of frame that is expected to follow SIFS after the current frame transmission (see 10.3.2.4a).
	B13	Traveling Pilots	1	Set to 1 to indicate traveling pilots usage in packet. Otherwise 0 to indicate regular pilot tone locations.
	B14–B17	CRC	4	CRC calculated as in 23.3.8.2.1.5.
	B18–B23	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

Figure 23-15—Data constellation in SIG-A field of S1G_LONG

The time domain waveform for the SIG-A field in an S1G_LONG PPDU at transmit chain i_{TX} shall be as specified in Equation (23-25).

$$r_{SIG-A}^{(i_{TX})}(t) = \frac{1}{\sqrt{N_{SIG-A}^{Tone} N_{TX}}} \sum_{n=0}^{1} w_{T_{SYML}}(t - nT_{SYML}) \sum_{i_{BW}=0}^{N_{2MHz}-1} \left(\sum_{k=-26}^{26} [Q_k^{(\mathrm{omni})}]_{i_{TX},1} \Upsilon_{(k-K_{Shift}(i_{BW})),BW}((-1)^n j^{n+1} D_{k,n,2} + p_n P_k) \exp(j2\pi(k - K_{Shift}(i_{BW}))\Delta_F(t - nT_{SYML} - T_{GI})) \right) \tag{23-25}$$

where

N_{2MHz}, $K_{Shift}(i)$, and $D_{k,n,2}$ are the same as those defined in 23.3.8.2.1.4

p_n and P_k are defined in 17.3.5.10

T_{SYML} is defined in Table 23-4

$\Upsilon_{k,BW}$ is defined by Equation (23-6) through Equation (23-9)

Δ_F is defined in Table 23-4

$N_{SIG\text{-}A}^{Tone}$ has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7

$Q_k^{(omni)}$ is as defined in 23.3.7

NOTE— As shown in Figure 23-1 to Figure 23-3, this definition results in a QBPSK modulation on the first symbol of SIG-A field, where the constellation of the data tones is rotated by 90º counter-clockwise relative to the third repetition of LTF1 field in S1G_1M preamble, facilitating its differentiation from S1G_1M; and the second symbol of SIG-A field is BPSK modulated, facilitating its differentiation from S1G_SHORT.

23.3.8.2.2.2 Beamchangeable portion

23.3.8.2.2.2.1 General

The beamchangeable portion of the S1G_LONG preamble can be either single-user or multiuser modulated with single or multiple space-time-streams. Beamforming can be applied through spatial mapping (Q-matrix multiplication) starting with the beamchangeable portion of the preamble and continuing into the Data field.

Beamchangeable portion of the long preamble could be either single user or multiuser modulated.

23.3.8.2.2.2.2 Cyclic shift for S1G modulated fields

This subclause describes the set of cyclic shift values (defined per-space-time-stream) to be applied to the beamchangeable portion of the S1G_LONG preamble, namely the D-STF, D-LTF, and SIG-B fields. In a transmission, these fields start as single stream and are replicated up to $N_{STS,total}$ streams at which point the cyclic shifts are applied. The cyclic shift values are defined in Table 23-15, which specifies the per-stream cyclic shift value $T_{CS}(n)$ for space-time stream n out of $N_{STS,total}$ total space-time streams.

When the S1G_LONG preamble PPDU is used for a MU transmission, the cyclic shifts of the beamchangeable portion are applied sequentially, first per user and then per space-time stream up to the total number of users and space-time streams $N_{STS,total}$ as follows: the cyclic shift of the space-time stream number m for user u is given by $T_{CS}(M_u + m)$, of the row corresponding to $N_{STS,total}$ in Table 23-15. In this case, the index *n* takes into account the cyclic shifts already applied to space-time streams of prior users (M_u), and the space-time stream index (*m*) of the current user *u* in the sequence.

M_u is given by Table 23-6.

Table 23-15—Per space-time-stream cyclic shift values of S1G_LONG preamble PPDU

$T_{CS,S1G}^{long}(n)$ for ≥2 MHz, beam changeable portion of S1G_LONG preamble PPDU				
Total number of space-time streams ($N_{STS,total}$)	Cyclic for space-time stream n (µs)			
	1	2	3	4
1	0	N/A	N/A	N/A
2	0	–4	N/A	N/A
3	0	–4	–2	N/A
4	0	–4	–2	–6
NOTE—N/A = not applicable.				

23.3.8.2.2.2.3 D-STF definition

The main purpose of the D-STF field is to improve automatic gain control estimation in a SU or MU MIMO transmission. The duration of the D-STF field is 40 µs. The frequency domain sequence $\{S_k\}$ used to construct the D-STF field is the same as the STF field in short or long preamble as indicated in 23.3.8.2.1.2.

The time domain representation of the D-STF field signals at transmit chain i_{TX} shall be as specified in Equation (23-26).

$$r_{\text{D-STF}}^{(i_{\text{TX}})}(t) = \frac{1}{\sqrt{N_{\text{D-STF}}^{\text{Tone}} N_{\text{STS,total}}}} w_{T_{\text{D-STF}}}(t) \sum_{k=-N_{SR}}^{N_{SR}} \sum_{u=0}^{N_u-1} \sum_{m=1}^{N_{STS,u}} \left(\begin{array}{l} \left[Q_k\right]_{i_{TX},(M_u+m)} \Upsilon_{k,\text{BW}} . S_k \\ \cdot \exp\left(j2\pi k\Delta_F (t - T_{CS}(M_u+m))\right) \end{array} \right) \quad (23\text{-}26)$$

where

N_{SR}	is defined in Table 23-4
$T_{CS(m)}$	represents the cyclic shift for space-time stream m with a value given in Table 23-15
$\Upsilon_{k,\text{ BW}}$	is defined by Equation (23-6) through Equation (23-9)
Δ_F	is defined in Table 23-4

$N_{STS,total}$, $N_{STS,u}$, N_u, and M_u are defined in Table 23-6.

$N_{\text{D-STF}}^{\text{Tone}}$	has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7.
Q_k	is defined in 23.3.7

The duration of the D-STF field is $T_{\text{D-STF}}$ regardless of the Short GI field setting in SIG-A.

23.3.8.2.2.2.4 D-LTF definition

The D-LTF field values for 2 MHz, 4 MHz, 8 MHz, and 16 MHz are the same as the LTF field in short preamble as specified in 23.3.8.2.1.3.

The generation of the time domain D-LTF field symbols per frequency segment is shown in Figure 23-6.

The time domain representation of the D-LTF field signals at transmit chain i_{TX} shall be as specified in Equation (23-27).

$$r_{\text{D-LTF}}^{(i_{\text{TX}})}(t) = \frac{1}{\sqrt{N_{\text{D-LTF}}^{\text{Tone}} N_{\text{STS,total}}}} \sum_{n=0}^{N_{LTF}-1} w_{T_{\text{D-LTF}}}(t - nT_{D-LTF}) \sum_{k=-N_{SR}}^{N_{SR}} \sum_{u=0}^{N_u-1} \sum_{m=1}^{N_{STS,u}} \begin{pmatrix} [Q_k]_{i_{TX},(M_u+m)} \Upsilon_{k,\text{BW}} \cdot [A_{LTF}^k]_{(M_u+m),(n+1)} LTF_k \\ \cdot \exp\left(j2\pi k\Delta_F(t - nT_{D-LTF} - T_{GI} - T_{CS}(M_u+m))\right) \end{pmatrix} \tag{23-27}$$

where

N_{SR}	is defined in Table 23-4
$T_{CS(m)}$	represents the cyclic shift for space-time stream *m* with a value given in Table 23-15
$\Upsilon_{k,\text{ BW}}$	is defined by Equation (23-6) through Equation (23-9)
Δ_F	is defined in Table 23-4
$N_{STS,total}$, $N_{STS,u}$, N_u, and M_u are defined in Table 23-6	
A_{LTF}^k	is defined in Equation (23-15).
$N_{\text{D-STF}}^{\text{Tone}}$	has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7.
Q_k	is defined in 23.3.7

As indicated by Equation (23-27), the duration of each symbol of the D-LTF field is $T_{\text{D-LTF}}$ regardless of the Short GI field setting in SIG-A.

The generation of the time domain D-LTF field symbols is the same as Figure 23-6, with N_{STS} replaced by $N_{STS,total}$.

23.3.8.2.2.2.5 SIG-B definition

If the SU/MU Indication subfield in SIG-A field is set to 0 (SU), then SIG-B field is one symbol that is identical to the first D-LTF field (D-LTF1). In this case, the time domain representation of the SIG-B field at transmit chain i_{TX} shall be as specified in Equation (23-27) with $n=0$.

If the SU/MU Indication subfield in SIG-A field is set to 1 (MU), then SIG-B field is one symbol and contains 26 bits in a 2 MHz PPDU, 27 bits in a 4 MHz PPDU and 29 bits in 8 MHz and 16 MHz PPDUs for each user. The fields in the SIG-B field are listed in Table 23-16.

Table 23-16—Fields in the SIG-B field for MU PPDU

Field	Bit Allocation (number of bits)				Description
	2 MHz	4 MHz	8 MHz	16 MHz	
MCS	B0–B3 (4)	B0–B3 (4)	B0–B3 (4)	B0–B3 (4)	Per-user MCS in MU-MIMO
Reserved	B4–B11 (8)	B4–B12 (9)	B4–B14 (11)	B4–B14 (11)	All 1s
CRC	B12–B19 (8)	B13–B20 (8)	B15–B22 (8)	B15–B22 (8)	
Tail	B20–B25 (6)	B21–B26 (6)	B23–B28 (6)	B23–B28 (6)	All 0s
Total # bits	26	27	29	29	

The 8-bit CRC is calculated according to the procedure described in 23.3.8.2.2.2.6.

In this case, the repetition, encoding, interleaving and modulation flow for the data subcarriers of SIG-B field in 2 MHz, 4 MHz, 8 MHz, and 16 MHz are identical to those specified for 20 MHz, 40 MHz, 80 MHz, and 160 MHz, respectively, as shown in 21.3.8.3.6. Different from the VHT-SIG-B field defined in Clause 21, the pilot subcarriers of SIG-B field are mapped by the first column of P_{HTLTF} matrix to N_{STS}, total space-time streams, and the pilot polarity of the SIG-B symbol is p_2 instead of p_3. The time domain representation for SIG-B field signal at transmit chain i_{TX} shall be as specified in:

$$r_{\text{SIG-B}}^{(i_{\text{TX}})}(t) = \frac{1}{\sqrt{N_{\text{SIG-B}}^{\text{Tone}} N_{\text{STS,total}}}} w_{T_{\text{SIG-B}}}(t) \sum_{k=-N_{SR}}^{N_{SR}} \sum_{u=0}^{N_u-1} \sum_{m=1}^{N_{STS,u}} \begin{pmatrix} \left[Q_k\right]_{i_{TX},(M_u+m)} \Upsilon_{k,\mathrm{BW}} \cdot \left[P_{HTLTF}\right]_{(M_u+m),1} \left(D_{k,BW}^{(u)} + p_2 P_0^k\right) \\ \cdot \exp\left(j2\pi k \Delta_F (t - T_{GI} - T_{CS}(M_u+m))\right) \end{pmatrix} \tag{23-28}$$

where

N_{SR}	is defined in Table 23-4
$T_{CS(m)}$	represents the cyclic shift for space-time stream *m* with a value given in Table 23-15
$\Upsilon_{k,\,\mathrm{BW}}$	is defined by Equation (23-6) through Equation (23-9)
Δ_F	is defined in Table 23-4

$N_{STS,total}$, $N_{STS,u}$, N_u , and M_u are defined in Table 23-6

P_{HTLTF}	is defined in Equation (20-27) in 20.3.9.4.6
p_n	is defined in 18.3.5.10
P_n^k	is defined in 22.3.10.10
$N_{\text{SIG-B}}^{\text{Tone}}$	has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7
Q_k	is defined in 23.3.7

For a 2 MHz transmission,

$$D_{k,2}^{(u)} = \begin{cases} 0, k = 0, \pm 7, \pm 21 \\ d_{M_2'(k)}^{(u)}, \text{otherwise} \end{cases} \tag{23-29}$$

$$M_2'(k) = \begin{cases} k+28, & -28 \le k \le -22 \\ k+27, & -20 \le k \le -8 \\ k+26, & -6 \le k \le -1 \\ k+25, & 1 \le k \le 6 \\ k+24, & 8 \le k \le 20 \\ k+23, & 22 \le k \le 28 \end{cases} \tag{23-30}$$

For a 4 MHz transmission,

$$D_{k,4}^{(u)} = \begin{cases} 0, k = 0, \pm 1, \pm 11, \pm 25, \pm 53 \\ d_{M_4'(k)}^{(u)}, \text{otherwise} \end{cases} \tag{23-31}$$

$$M_4'(k) = \begin{cases} k+58, & -58 \le k \le -54 \\ k+57, & -52 \le k \le -26 \\ k+56, & -24 \le k \le -12 \\ k+55, & -10 \le k \le -2 \\ k+52, & 2 \le k \le 10 \\ k+51, & 12 \le k \le 24 \\ k+50, & 26 \le k \le 52 \\ k+49, & 54 \le k \le 58 \end{cases} \tag{23-32}$$

For an 8 MHz transmission,

$$D_{k,8}^{(u)} = \begin{cases} 0, k = 0, \pm 1, \pm 11, \pm 39, \pm 75, \pm 103 \\ d_{M_8'(k)}^{(u)}, \text{otherwise} \end{cases} \tag{23-33}$$

$$M_8'(k) = \begin{cases} k+122, & -122 \le k \le -104 \\ k+121, & -102 \le k \le -76 \\ k+120, & -74 \le k \le -40 \\ k+119, & -38 \le k \le -12 \\ k+118, & -10 \le k \le -2 \\ k+115, & 2 \le k \le 10 \\ k+114, & 12 \le k \le 38 \\ k+113, & 40 \le k \le 74 \\ k+112, & 76 \le k \le 102 \\ k+111, & 104 \le k \le 122 \end{cases} \tag{23-34}$$

For a 16 MHz transmission

$$D_{k,16}^{(u)} = \begin{cases} 0, k = 0, \pm1, \pm2, \pm3, \pm4, \pm5, \pm25, \pm53, \pm89, \pm117, \pm127, \pm128, \pm129, \pm139, \pm167, \pm203, \pm231 \\ d_{M'_{16}(k)}^{(u)}, \text{otherwise} \end{cases}$$

$$M'_{16}(k) = \begin{cases} k+250, & -250 \le k \le -232 \\ k+249, & -230 \le k \le -204 \\ k+248, & -202 \le k \le -168 \\ k+247, & -166 \le k \le -140 \\ k+246, & -138 \le k \le -130 \\ k+243, & -126 \le k \le -118 \\ k+242, & -116 \le k \le -90 \\ k+241, & -88 \le k \le -54 \\ k+240, & -52 \le k \le -26 \\ k+239, & -24 \le k \le -6 \\ k+228, & 6 \le k \le 24 \\ k+227, & 26 \le k \le 52 \\ k+226, & 54 \le k \le 88 \\ k+225, & 90 \le k \le 116 \\ k+224, & 118 \le k \le 126 \\ k+221, & 130 \le k \le 138 \\ k+220, & 140 \le k \le 166 \\ k+219, & 168 \le k \le 202 \\ k+218, & 204 \le k \le 230 \\ k+217, & 232 \le k \le 250 \end{cases} \tag{23-35}$$

23.3.8.2.2.2.6 CRC calculation for S1G SIG-B field

The CRC protects the MCS and Reserved field bits of the SIG-B field. The value of the CRC field shall be the 1s complement of

$$crc(D) = (M(D) \oplus I(D))D^8 \text{modulo } G(D) \tag{23-36}$$

where

$M(D) = m_0 D^N + m_1 D^{N-1} + ... + m_N D^0$ is the MCS and Reserved field appended (bits 0~N of SIG B) and represented as a polynomial

where

N is 11, 12, 14, and 14 for 2 MHz, 4 MHz, 8 MHz, and 16 MHz SIG-B fields, respectively

m_i is the ith bit of the corresponding SIG-B field

$I(D) = \sum_{i=N-7}^{N} D^i$ are the initialization values that are added to the first 8 bits of the SIG-B field

$G(D) = D^8 + D^2 + D^1 + 1$ is the CRC generating polynomial

$crc(D) = c_0 D^7 + c_1 D^6 + \ldots + c_6 D^1 + c_7$

The CRC field is transmitted with c_7 first.

Figure 19-8 in 19.3.9.4.4 shows the operation of the CRC using the same generator polynomial. For SIG-B CRC operation specifically, the bits will be input serially from m_N to m_0.

23.3.8.3 Format for 1 MHz

This subclause describes the preamble format used for non-duplicate S1G PPDUs of 1 MHz and duplicate S1G_DUP_1M PPDUs.

23.3.8.3.1 Cyclic shift for S1G modulated fields

The cyclic shift values defined in this subclause apply to the STF, LTF, SIG and Data fields of the S1G_1M PPDU. Throughout the S1G_1M preamble, cyclic shifts are applied to prevent beamforming when similar signals are transmitted in different space-time streams. The STF, LTF, and SIG fields start as single-stream during generation but are replicated up to $N_{STS,total}$ streams. For the LTF, these replicated streams undergo P-matrix mapping prior to CSD application as shown in Figure 23-6. For the STF and SIG the CSDs are applied per stream immediately after replication. The same cyclic shift is applied to the $N_{STS,total}$ streams during the transmission of the Data field of the S1G_1M PPDU. The cyclic shift value $T_{CS}(n)$ for space-time stream n out of $N_{STS,total}$ total space-time streams is shown in Table 23-17.

Table 23-17—Cyclic shift values of S1G_1M PPDU

$T_{CS}(n)$ values for S1G_1M PPDU				
Total number of space-time streams ($N_{STS,total}$)	Cyclic shift for space-time stream n (μs)			
	1	2	3	4
1	0	–	-	-
2	0	–4	-	-
3	0	–4	–1	-
4	0	–4	–1	–5

23.3.8.3.2 STF definition

The STF field in S1G_1M preamble is repeated with 4 OFDM symbols, i.e., twice the duration of the STF fields in S1G_SHORT preamble and S1G_LONG preamble.

The time domain representation of the STF field signal at transmit chain i_{TX} shall be as specified in Equation (23-37).

$$r_{\mathrm{STF}}^{(i_{\mathrm{TX}})}(t) = \frac{\alpha(\mathrm{MCS})}{\sqrt{N_{\mathrm{STF}}^{\mathrm{Tone}} N_{\mathrm{STS}}}} w_{T_{\mathrm{STF}}}(t) \sum_{k=-N_{SR}}^{N_{SR}} \sum_{m=1}^{N_{STS}} \left[Q_k\right]_{i_{TX},m} \left[P_{HTLTF}\right]_{m,1} \cdot S_k \exp\left(j 2\pi k \Delta_F (t - T_{CS}(m))\right) \tag{23-37}$$

where

N_{SR} is defined in Table 23-4

$T_{CS}(m)$ represents the cyclic shift for space-time stream m with a value given in Table 23-17

Δ_F is defined in Table 23-4

N_{STS} is defined in Table 23-6

P_{HTLTF} is defined in Equation (20-27) in 20.3.9.4.6

$N_{\mathrm{STF}}^{\mathrm{Tone}}$ has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7

S_k has nonzero values $[0.5, -1, 1, -1, -1, -0.5] \times (1 + j) \times \sqrt{2/3}$ on tones $k = [-12,-8,-4,4,8,12]$, respectively

$\alpha(MCS)$ is an MCS dependent scaling factor, with the following value $\alpha(MCS) = \begin{cases} \sqrt{2}, & \text{MCS=10} \\ 1, & \text{otherwise} \end{cases}$

Q_k is defined in 23.3.7

23.3.8.3.3 LTF definition

The duration of the first LTF (LTF1) field in S1G_1M preamble is of 4 OFDM symbols with repetitions, i.e., twice the duration of the LTF1 fields in S1G_LONG preamble and S1G_SHORT preamble. The first two repetitions have the same structure as the LTF1 field in S1G_LONG preamble and S1G_SHORT preamble, i.e., they consist of two periods of the long training symbol, preceded by a double length (16 µs) cyclic prefix. Each of the last two repetitions of LTF1 field consists one period of the long training symbol preceded by a normal length (8 µ*s*) cyclic prefix. The duration of the each of the remaining LTFs in S1G_1M preamble is of one OFDM symbol.

The placement of the first and subsequent LTFs in an S1G_1M PPDU is shown in Figure 23-3.

The generation of the time domain LTF symbols is the same as Table 23-6.

The time domain representation of the first two repetitions of the LTF1 field, and the last two repetitions of the LTFs field shall be as specified in Equation (23-38) and Equation (23-39), respectively

$$r_{\mathrm{LTF1\_1,2}}^{(i_{\mathrm{TX}})}(t) = \frac{1}{\sqrt{N_{\mathrm{LTF}}^{\mathrm{Tone}} N_{\mathrm{STS}}}} w_{T_{\mathrm{LTF1}}}(t) \sum_{k=-N_{SR}}^{N_{SR}} \sum_{m=1}^{N_{STS}} \left(\begin{array}{c} \left[Q_k\right]_{i_{TX},m} \Upsilon_{k,\mathrm{BW}} \left[A_{LTF}^k\right]_{m,1} LTF_k \\ \cdot \exp\left(j2\pi k \Delta_F (t - T_{GI2} - T_{CS}(m))\right) \end{array} \right) \tag{23-38}$$

$$r_{\mathrm{LTF1\_3,4}}^{(i_{\mathrm{TX}})}(t) = \frac{1}{\sqrt{N_{\mathrm{LTF}}^{\mathrm{Tone}} N_{\mathrm{STS}}}} w_{T_{\mathrm{LTF}}}(t) \sum_{k=-N_{SR}}^{N_{SR}} \sum_{m=1}^{N_{STS}} \left(\begin{array}{c} \left[Q_k\right]_{i_{TX},m} \Upsilon_{k,\mathrm{BW}} \left[A_{LTF}^k\right]_{m,1} LTF_k \\ \cdot \exp\left(j2\pi k \Delta_F (t - T_{GI} - T_{CS}(m))\right) \end{array} \right) \tag{23-39}$$

where

N_{SR}, T_{LTF1}, and T_{LTF} are defined in Table 23-4

$T_{CS(m)}$ represents the cyclic shift for space-time stream m with a value given in Table 23-17

$\Upsilon_{k,\mathrm{BW}}$ is defined by Equation (23-6) through Equation (23-9)

Δ_F is defined in Table 23-4

N_{STS} is defined in Table 23-6

$N_{\mathrm{LTF}}^{\mathrm{Tone}}$ has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7

A_{LTF}^{k} is defined in Equation (23-40)

Q_k is defined in 23.3.7

$$A_{LTF}^{k} = \begin{cases} [P_{HTLTF}]_{*,1} \times [1 \quad 1 \quad 1 \quad 1], \text{ if } k \in K_{\text{Pilot\_Fix}} \\ P_{HTLTF}, \text{ otherwise} \end{cases} \tag{23-40}$$

where

$K_{\text{Pilot\_Fix}}$ is the subcarrier indices for the fixed pilot tones. For a 1 MHz transmission, $K_{\text{Pilot\_Fix}} = \{\pm 7\}$.

$[P_{HTLTF}]_{*,1}$ is the first column of the P_{HTLTF} matrix.

$LTF_{\text{-16:15}}$ = {0, 0, 0, 1, -1, 1, -1, -1, 1, -1, 1, 1, -1, 1, 1, 1, 0, -1, -1, -1, 1, -1, -1, -1, 1, -1, 1, 1, 1, -1, 0, 0}

NOTE 1—This LTF sequence is chosen to be orthogonal to both halves of the 2 MHz LTF sequence in order to facilitate the differentiation of S1G_1M preambles from S1G_SHORT and S1G_LONG preambles. The orthogonality metric used to select the sequences satisfied the criteria

$$\sum_{k} A(k)B(k)A(k+1)^{*}B(k+1)^{*} = 0$$

where {A} and {B} are the 1 MHz sequence and either of the halves of the 2 MHz sequence, and where k=1,2,3,...,16,18,19,...,31 skipping the 1 MHz DC location on k=17.

NOTE 2—This definition results in a BPSK modulation on the last two symbols of LTF1 field, to facilitate the differentiation of S1G_1M preambles from S1G_SHORT and S1G_LONG preamble.

The time domain representation of the LTF2~LTF$_{\text{NLTF}}$ field signals at transmit chain i_{TX} shall be as specified in Equation (23-41).

$$r_{\text{LTF2\sim LTF}_{N_{\text{LTF}}}}^{(i_{\text{TX}})}(t) = \frac{1}{\sqrt{N_{\text{LTF}}^{\text{Tone}} N_{\text{STS}}}} \sum_{n=1}^{N_{LTF}-1} w_{T_{\text{LTF}}}(t-(n-1)T_{LTF}) \sum_{k=-N_{SR}}^{N_{SR}} \sum_{m=1}^{N_{STS}} \left(\begin{array}{l} [Q_k]_{i_{TX},m} \cdot [A_{LTF}^{k}]_{m,(n+1)} LTF_k \\ \cdot \exp\left(j 2\pi k \Delta_F (t-(n-1)T_{LTF} - T_{GI} - T_{CS}(m))\right) \end{array} \right) \tag{23-41}$$

where

N_{SR} and T_{LTF} are defined in Table 23-4

$T_{CS(m)}$ represents the cyclic shift for space-time stream *m* with a value given in Table 23-15

Δ_F is defined in Table 23-4

N_{STS} is defined in Table 23-6

A_{LTF}^{k} is defined in Equation (23-40)

$N_{\text{LTF}}^{\text{Tone}}$ has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7

Q_k is defined in 23.3.7

23.3.8.3.4 SIG definition

The SIG field carries information required to interpret S1G_1M PPDUs. The structure of the 6 symbol SIG field (which carries 6 information bits per symbol) is shown in Figure 23-16. Note that unlike other SIG field structures the indexing of the bits incorporates all the SIG field symbols, i.e., B0–B5 denote the first symbol, B6-B11 the second, and so on. The SIG field format of NDP CMAC frames is described in Figure 23-20 (in 23.3.11).

	B0 B1	B2	B3	B4	B5	B6	B7 B10	B11	B12 B20	B21 B22	B23	B24	B25	B26 B29	B30 B35
	Nsts	SGI	Coding	LDPC Extra	STBC	Reserved	MCS	Aggregation	Length	Response Indication	Smoothing	Traveling Pilots	NDP Indication	CRC	Tail
Bits:	2	1	1	1	1	1	4	1	9	2	1	1	1	4	6

Figure 23-16—Structure of the 6 symbol SIG field of S1G_1M PPDU

The SIG field of S1G_1M PPDU contains the fields listed in Table 23-18.

Table 23-18—Fields in the SIG field of S1G_1M PPDU

Symbol	Bit	Field	Number of bits	Description
SIG-1	B0–B1	NSTS	2	Set to 0 for 1 space-time stream Set to 1 for 2 space-time streams Set to 2 for 3 space-time streams Set to 3 for 4 space-time streams
	B2	Short GI	1	Set to 0 if short guard interval is not used in the Data field. Set to 1 if short guard interval is used in the Data field.
	B3	Coding	1	Set to 0 for BCC and 1 for LDPC
	B4	LDPC Extra		If Coding field is 1, set to 1 if the LDPC PPDU encoding process (of an SU PPDU), results in an extra OFDM symbol (or symbols) as described in 21.3.10.5.4, otherwise set to 0. If Coding field is 0, this field is set to 1.
	B5	STBC	1	Set to 1 if all spatial streams have space-time block coding and set to 0 if no spatial streams has space-time block coding.

Table 23-18—Fields in the SIG field of S1G_1M PPDU *(continued)*

Symbol	Bit	Field	Number of bits	Description
SIG-2	B6	Reserved	1	Reserved. Set to 1.
	B7–B10	MCS	4	MCS Index
	B11	Aggregation	1	Set to 1 when aggregation is ON (as indicated by AGGREGATION parameter of TXVECTOR), and 0 otherwise. NOTE— S1G PPDUs are transmitted with aggregation ON when PSDU to be carried is greater than 511 octets, as defined in 10.13.5.
SIG-3 and SIG-4	B12–B20	Length	9	When the Aggregation bit is equal to 0, set to the value of the PSDU_LENGTH parameter in TXVECTOR. When the Aggregation bit is equal to 1, set to N_sym, given in Section 23.4.3.
	B21–22	Response Indication	2	Set to the value obtained from the TXVECTOR parameter RESPONSE_INDICATION. The Response Indication indicates the presence and type of frame that is expected to follow SIFS after the current frame transmission (see 10.3.2.4a).
	B23	Smoothing	1	A value of 1 indicates that channel smoothing is recommended. A value of 0 indicates that channel smoothing is not recommended.
SIG-5	B24	Traveling Pilots	1	Set to 1 to indicate traveling pilots usage in packet. Otherwise 0 to indicate regular pilot tone locations.
	B25	NDP Indication	1	Used to indicate that frame is a Control NDP frame. If set to 1, then the SIG field format is shown in Figure 23-20 (in 23.3.11) and the SIG field contents follow the description in 9.9.
	B26–B29	CRC	4	CRC calculated as in 23.3.8.2.1.5.
SIG-6	B30–B35	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

Integer fields are represented in unsigned binary format with the least significant bit in the lowest numbered bit position.

The SIG field of S1G_1M is composed of six OFDM symbols, SIG-1 ~ SIG-6, each containing 6 data bits, as shown in Table 23-18. SIG-1 is transmitted first and SIG-6 is the last. The SIG field symbols shall be BCC encoded at rate, R = 1/2, and repeated two times for the encoded bits within each OFDM symbol, interleaved, mapped to a BPSK constellation, and have pilots inserted, following the steps for MCS10 transmission flow described in Clause 23.3.9. The stream of 144 complex numbers generated by these steps (before pilot insertion) is divided into six groups of 24 complex numbers $d_{k,n}$, $k = 0, \ldots, 23$, where $n = 0, 1, \ldots, 5$, respectively. All the 144 complex numbers are BPSK modulated. The first 24 complex numbers form the first symbol of SIG field; and the second 24 complex numbers form the second symbol of SIG field, and so forth.

The time domain waveform for the SIG field in an S1G_1M PPDU at transmit chain i_{TX} shall be as specified in Equation (23-42).

$$r_{\mathrm{SIG}}^{(i_{TX})}(t) = \frac{1}{\sqrt{N_{\mathrm{SIG}}^{\mathrm{Tone}} N_{\mathrm{STS}}}} \sum_{n=0}^{5} w_{T_{\mathrm{SYML}}}(t - nT_{SYML}) \cdot \sum_{k=-13}^{13} \sum_{m=1}^{N_{STS}} [Q_k]_{i_{TX},m} [P_{HTLTF}]_{m,1} (D_{k,n,1} + p_n P_n^k) \cdot \exp(j2\pi k \Delta_F (t - nT_{SYML} - T_{GI} - T_{CS}(m))) \tag{23-42}$$

where

p_n	is defined in 17.3.5.10, and P_n^k for S1G_1M is defined in 23.3.9.10
$T_{CS(m)}$	represents the cyclic shift for space-time stream m with a value given in Table 23-17
T_{SYML}	is defined in Table 23-4
Δ_F	is defined in Table 23-4
N_{STS}	is defined in Table 23-6
P_{HTLTF}	is defined in Equation (19-27) in 19.3.9.4.6
$N_{\mathrm{SIG}}^{\mathrm{Tone}}$	has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7
Q_k	is defined in 23.3.7

$$D_{k,n,1} = \begin{cases} 0, & k = 0, \pm 7 \\ d_{M'_1(k),n}, & \text{otherwise} \end{cases} \tag{23-43}$$

where
$M'_1(k)$ is defined in Equation (23-54)

$$M'_1(k) = \begin{cases} k+13, & -13 \le k \le -8 \\ k+12, & -6 \le k \le -1 \\ k+11, & 1 \le k \le 6 \\ k+10, & 8 \le k \le 13 \end{cases} \tag{23-44}$$

23.3.9 Data field

23.3.9.1 General

The number of OFDM symbols in the Data field is determined by the Length field in SIG field or SIG-A field of the three S1G PPDU formats, the preamble duration and the setting of the Short GI field in SIG field or SIG-A field, (see 23.3.8.2.1.4, 23.3.8.2.2.1.5, and 23.3.8.3.4). When BCC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the PHY pad bits and the tail bits (bits for SU and bits for each user u in MU). When LDPC encoding is used, the Data field shall consist of the SERVICE field, the PSDU and the PHY pad bits. No tail bits are present when LDPC encoding is used.

23.3.9.2 SERVICE field

In S1G PPDUs, the SERVICE field has 8 bits, which shall be denoted as bits 0–7. The bit 0 shall be transmitted first in time.

The SERVICE field is as shown in Table 23-19.

Table 23-19—SERVICE field

Bits	Field	Description
B0–B6	Scrambler Initialization	Set to 0
B7	Reserved	Set to 0

23.3.9.3 Scrambler

The SERVICE, PSDU and PHY pad parts of the Data field shall be scrambled by the scrambler defined in 17.3.5.5.

23.3.9.4 Coding

23.3.9.4.1 General

The Data field shall be encoded using either the binary convolutional code (BCC) defined in 23.3.9.4.2 and 23.3.9.4.3, or the low density parity check (LDPC) code defined in 23.3.9.4.4. The encoder is selected by the coding bit(s) in SIG field or SIG-A field of the three S1G PPDU formats, as defined in 23.3.8.2.1.4, 23.3.8.2.2.1.5, and 23.3.8.3.4. When BCC FEC encoding is used, the number of encoders is determined by rate-dependent parameters as defined in 23.5. The operation of the BCC FEC is described in 23.3.9.4.2 and 23.3.9.4.3. The operation of the LDPC coder is described in 23.3.9.4.4. Support for the reception of a BCC encoded Data field is mandatory.

23.3.9.4.2 BCC encoder parsing operation

The BCC encoder parsing operation for S1G PPDUs is the same as those specified in 21.3.10.5.2.

23.3.9.4.3 Binary convolutional coding and puncturing

23.3.9.4.3.1 General

The binary convolutional coding and puncturing operation for S1G PPDUs is the same as those specified in 21.3.10.5.3.

23.3.9.4.3.2 Padding for BCC

For a BCC encoder, the number of PHY padding bits, $N_{PAD,u}$, is calculated as

$$N_{PAD,u} = N_{SYM} \times N_{DBPS,u} - 8 \times PSDU\_LENGTH_u - N_{service} - N_{tail} \times N_{ES,u}$$

where

$PSDU\_LENGTH_u$ is the value of the PSDU_LENGTH parameter in TXVECTOR for user u

N_{SYM} is the number of symbols in the Data field and is given in 23.4.3 by Equation (23-75) for S1G SU PPDUs and Equation (23-77) for S1G MU PPDUs

For SU, $N_{PAD} = N_{PAD,0}$.

The padding flow for BCC encoded PPDUs is as follows:

For an S1G MU PPDU, or an S1G SU PPDU with the Aggregation bit equal to 1 in its SIG field or SIG-A field, the MAC delivers a PSDU that fills the available octets in the Data field of the PPDU for each user *u* (i.e., append the maximum number of octets that is less than or equal to $N_{PAD,u}$). The PHY determines the number of PHY pad bits, which is $N_{PAD,u}$ modulo 8, and appends them to the PSDU, each of the PHY padding bits could be either 0 or 1. In this case, the Length subfield in SIG field or SIG-A field shall set the appropriate value indicating N_{SYM} data symbols.

For an S1G SU PPDU with the Aggregation bit equal to 0 in its SIG field or SIG-A field, MAC padding is not conducted and the PHY directly appends N_{PAD} padding bits to the PSDU, each of the PHY padding bits could be either 0 or 1. In this case, the Length field shall set the appropriate value indicating PSDU_LENGTH in number of octets.

Both the PSDU and the PHY padding bits are scrambled and finally the $6.N_{ES}$ zero tail bits are appended after the scrambled PSDU and PHY padding bits.

23.3.9.4.4 LDPC coding

23.3.9.4.4.1 General

The LDPC operation for S1G PPDUs is the same as those specified in 22.3.10.5.4.

23.3.9.4.4.2 Padding for LDPC

For LDPC encoding, the number of PHY padding bits for user *u*, $N_{PAD,\,u}$ is as

$$N_{PAD,\,u} = N_{SYM,\,init} \times N_{DBPS,\,u} - 8 \times PSDU\_LENGTH_u - N_{service}$$

where

$PSDU\_LENGTH_u$ is the value of the PSDU_LENGTH parameter in TXVECTOR for user *u*

$N_{SYM,\,init}$ is the initial number of symbols for the Data field when using LDPC given in 23.4.3 by Equation (23-75) for S1G SU PPDUs and Equation (23-77) for S1G MU PPDUs.

For SU, there is only one user, hence $N_{PAD} = N_{PAD,0}$.

The padding flow for LDPC encoded PPDUs is as follows:

The initial parameter computation $N_{SYM,init}$, N_{pld} and N_{avbits} are identical to those defined in 21.3.10.5.4.

For an S1G MU PPDU, or an S1G SU PPDU with the Aggregation bit equal to 1 in its SIG field or SIG-A field, the MAC delivers a PSDU that fills the available octets in the Data field of the PPDU for each user *u* (i.e., append the maximum number of octets that is less than or equal to N_{PAD} or $N_{PAD,u}$). The PHY determines the number of pad bits, which is N_{PAD} modulo 8 or $N_{PAD,u}$ modulo 8, and appends them to the PSDU, each of the PHY padding bits could be either 0 or 1. In this case, the Length subfield in SIG field or SIG-A field shall set the appropriate value indicating N_{SYM} data symbols.

For an S1G SU PPDU with the Aggregation bit equal to 0 in its SIG field or SIG-A field, MAC padding is not conducted and the PHY directly appends N_{PAD} padding bits to the PSDU, each of the PHY padding bits could be either 0 or 1. In this case, the Length field shall set the appropriate value indicating PSDU_LENGTH in number of octets

Both the PSDU and the PHY padding bits are scrambled, and then finally the scrambled PSDU and PHY padding bits are LDPC encoded according to 21.3.10.5.4.

In both cases, if $N_{SYM} > N_{SYM,\ init}$, the LDPC Extra subfield of SIG field or SIG-A field shall be set to 1 (see 23.3.8.2.1.4, 23.3.8.2.2.1.5, and 23.3.8.3.4).

23.3.9.4.5 Encoding process for S1G MU PPDUs

The encoding process for S1G MU PPDUs using S1G_LONG is the same as those specified in 21.3.10.5.5.

23.3.9.5 Repetition for 1 MHz MCS10

In an 1 MHz PPDU that is modulated by MCS10, the 6 information bits of each OFDM symbol are encoded with R=1/2, then the 12 encoded bits in each OFDM symbol is block-wise repeated by the following steps.

Assume that the sequence $[C_1 \ldots C_{12}]$ represents the 12 encoded bits in each OFDM symbol, the output bit stream after the repetition is:

$$C_{out}=[[C_1 \ldots C_{12}], [C_1 \ldots C_{12}] \text{ XOR } s], \tag{23-45}$$

where
$s = [1\ 0\ 0\ 0\ 0\ 1\ 0\ 1\ 0\ 1\ 1\ 1]$

The 24 output bits of the repetition are then sent to BCC interleaver (if BCC encoded) or the constellation mapper (if LDPC encoded).

23.3.9.6 Stream parser

The stream parser for S1G PPDUs is the same as those specified in 21.3.10.6 with up to 4 spatial streams.

For S1G_1M PPDU modulated using MCS10, more than one spatial stream shall not be applied.

23.3.9.7 Segment parser

The segment parser for S1G 16 MHz PPDUs is the same as those specified for 160 MHz PPDUs in 21.3.10.7.

23.3.9.8 BCC interleaver

The BCC interleavers for S1G 2 MHz, 4 MHz, 8 MHz, and 16 MHz PPDUs are the same as those defined for 20 MHz, 40 MHz, 80 MHz, and 160 MHz PPDUs, respectively, as specified in 21.3.10.8.

For S1G_1M PPDU, the interleaver parameters are defined by Table 23-20.

Table 23-20—Number of rows and columns in the interleaver for 1 MHz

Parameter	1 MHz
N_{COL}	8
N_{ROW}	$3 \times N_{BPSCS}$
N_{ROT} ($N_{SS} \leq 4$)	2

The interleaver parameters for 1 MHz MCS10 is identical to the parameters used for 1 MHz MCS0.

23.3.9.9 Constellation mapping

23.3.9.9.1 General

The constellation mappings for S1G PPDUs modulated using MCS0 to MCS9 are the same as those specified in 21.3.10.9.1 with the same MCS indices.

The constellation mapping for 1 MHz MCS10 is identical to the BPSK constellation mapping that is applied in MCS0.

23.3.9.9.2 LDPC tone mapping

The LDPC tone mappings for S1G 2 MHz, 4 MHz, 8 MHz, and 16 MHz PPDUs are the same as those defined for 20 MHz, 40 MHz, 80 MHz, and 160 MHz PPDUs, respectively, as specified in 21.3.10.9.2.

For LDPC encoded S1G_1M PPDU, LDPC tone mapping is not applied.

23.3.9.9.3 Segment deparser

The segment deparser for S1G 16 MHz PPDUs is the same as those specified for 160MHz PPDUs in 21.3.10.9.3.

23.3.9.9.4 Space-time block coding

The STBC for S1G PPDUs is the same as those specified in 21.3.10.9.4.

For S1G_1M PPDU modulated using MCS10, STBC shall not be applied.

23.3.9.10 Pilot subcarriers

For an S1G_1M SIG field and Data field, two pilot tones shall be inserted in subcarriers. For fixed pilots, the pilot mapping for subcarrier k for symbol n shall be as specified in Equation (23-46):

$$P_n^{\{-7,7\}} = \{\Psi_{(n \bmod 2)+2}, \Psi_{((n+1) \bmod 2)+2}\} \qquad (23\text{-}46)$$
$$P_n^{k \notin \{-7,7\}} = 0$$

where

Ψ_m is given in Table 21-21 in 21.3.10.10

For S1G_SHORT PPDU and S1G_LONG PPDU, with fixed pilots, P_n^k with same FFT sizes is identical to what is defined in 21.3.10.10.

For traveling pilots, at symbol n, P_n^k is defined as follows:

$$P_n^k = \begin{cases} 1.5 \times P_{n,\,\mathrm{fix}}^{k_{\mathrm{Pilot\_Fix}}^{(l)}}, k \in K_{\mathrm{Pilot\_Travel}}(n) \text{ and } k = K_{\mathrm{Pilot\_Travel}}^{(l)}(n) \\ 0, \text{otherwise} \end{cases} \tag{23-47}$$

where

$K_{\mathrm{Pilot\_Travel}}(n)$ is the set of traveling pilot subcarrier positions corresponding to data symbol n ($n = 0,1,2,\ldots.N_{SYM}-1$)

$K_{\mathrm{Pilot\_Travel}}^{(l)}(n)$ is the pilot tone position in the pilot subcarrier set $K_{\mathrm{Pilot\_Travel}}(n)$ corresponding to pilot index l, as shown in Table 23-21 through Table 23-28

$P_{n,\,\mathrm{fix}}^k$ is identical to P_n^k for fixed pilots

$k_{\mathrm{Pilot\_Fix}}^{(l)}$ is the pilot tone position corresponding to pilot index l in the case of fixed pilots, specifically:

For 1 MHz, $\{k_{\mathrm{Pilot\_Fix}}^{(0)}, k_{\mathrm{Pilot\_Fix}}^{(1)}\} = \{-7, 7\}$

For 2 MHz, $\{k_{\mathrm{Pilot\_Fix}}^{(0)}, \ldots, k_{\mathrm{Pilot\_Fix}}^{(3)}\} = \{-21, -7, 7, 21\}$

For 4 MHz, $\{k_{\mathrm{Pilot\_Fix}}^{(0)}, \ldots, k_{\mathrm{Pilot\_Fix}}^{(5)}\} = \{-53, -25, -11, 11, 25, 53\}$

For 8 MHz, $\{k_{\mathrm{Pilot\_Fix}}^{(0)}, \ldots, k_{\mathrm{Pilot\_Fix}}^{(7)}\} = \{-103, -75, -39, -11, 11, 39, 75, 103\}$

For 16 MHz,

$\{k_{\mathrm{Pilot\_Fix}}^{(0)}, \ldots, k_{\mathrm{Pilot\_Fix}}^{(15)}\} = \{-231, -203, -167, -139, -117, -89, -53, -25, 25, 53, 89, 117, 139, 167, 203, 231\}$

The traveling pilot positions for symbol n, $K_{\mathrm{Pilot\_Travel}}(n)$, are derived by the following paragraphs.

For an S1G SU PPDU where in its SIG field or SIG-A field the NSTS subfield indicates one space-time stream and the Traveling Pilots subfield is set to 1, the traveling pilots positions $K_{\mathrm{Pilot\_Travel}}(n)$ varies from symbol to symbol according to Table 23-21 through Table 23-24 for bandwidth 1 MHz, 2 MHz, 4 MHz, and 8 MHz. In this case, for data symbol n (n = 0,1,2,….N_{SYM}-1), the pilot positions $K_{\mathrm{Pilot\_Travel}}(n)$ equal to those in the column corresponding to the pattern index:

$$m(n) = n \text{ modulo } N_{TP,\,BW} \tag{23-48}$$

where

$N_{TP,\,BW}$ is the traveling pilot pattern period with the following values:

$N_{TP,\,1\mathrm{MHz}} = 13$

$N_{TP,\,2\mathrm{MHz}} = 14$

$N_{TP,\,4\mathrm{MHz}} = 19$

$N_{TP,\,8\mathrm{MHz}} = 32$

$N_{TP,\,16\mathrm{MHz}} = 32$

Table 23-21—Traveling pilot positions for NSTS=1, 1 MHz S1G PPDU

Pilot Index *l*	Pattern Index *m*												
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
0	–2	–10	–5	–13	–8	–3	–11	–6	–1	–9	–4	–12	–7
1	12	4	9	1	6	11	3	8	13	5	10	2	7

Table 23-22—Traveling pilot positions for NSTS=1, 2 MHz S1G PPDU

Pilot Index *l*	Pattern Index *m*													
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
0	–28	–24	–20	–16	–26	–22	–18	–27	–23	–19	–15	–25	–21	–17
1	–12	–8	–4	–2	–14	–10	–6	–11	–7	–3	1	–13	–9	–5
2	4	8	12	16	2	6	10	5	9	13	17	–1	3	7
3	20	24	28	26	14	18	22	21	25	23	27	11	15	19

Table 23-23—Traveling pilot positions for NSTS=1, 4 MHz S1G PPDU

Pilot Index *l*	Pattern Index *m*																		
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
0	–49	–41	–33	–25	–17	–9	–58	–50	–42	–34	–26	–18	–10	–2	–51	–43	–35	–27	–19
1	–30	–22	–14	–6	–55	–47	–39	–31	–23	–15	–7	–56	–48	–40	–32	–24	–16	–8	–57
2	–11	–3	–52	–44	–36	–28	–20	–12	–4	–53	–45	–37	–29	–21	–13	–5	–54	–46	–38
3	11	19	27	35	43	51	2	10	18	26	34	42	50	58	9	17	25	33	41
4	30	38	46	54	5	13	21	29	37	45	53	4	12	20	28	36	44	52	3
5	49	57	8	16	24	32	40	48	56	7	15	23	31	39	47	55	6	14	22

Table 23-24—Traveling pilot positions for NSTS=1, 8 MHz S1G PPDU

Pilot Index *l*	Pattern Index *m*															
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
0	–122	–118	–114	–110	–106	–102	–98	–94	–120	–116	–112	–108	–104	–100	–96	–92
1	–90	–86	–82	–78	–74	–70	–66	–62	–88	–84	–80	–76	–72	–68	–64	–60
2	–58	–54	–50	–46	–42	–38	–34	–30	–56	–52	–48	–44	–40	–36	–32	–28
3	–26	–22	–18	–14	–10	–6	–2	2	–24	–20	–16	–12	–8	–4	2	4
4	6	10	14	18	22	26	30	34	8	12	16	20	24	28	32	36
5	38	42	46	50	54	58	62	66	40	44	48	52	56	60	64	68
6	70	74	78	82	86	90	94	98	72	76	80	84	88	92	96	100
7	102	106	110	114	118	122	120	–120	104	108	112	116	120	122	–2	–122

Pilot Index *l*	Pattern Index *m*															
	16	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**
0	–121	–117	–113	–109	–105	–101	–97	–93	–119	–115	–111	–107	–103	–99	–95	–91
1	–89	–85	–81	–77	–73	–69	–65	–61	–87	–83	–79	–75	–71	–67	–63	–59
2	–57	–53	–49	–45	–41	–37	–33	–29	–55	–51	–47	–43	–39	–35	–31	–27
3	–25	–21	–17	–13	–9	–5	–2	3	–23	–19	–15	–11	–7	–3	2	5
4	7	11	15	19	23	27	31	35	9	13	17	21	25	29	33	37
5	39	43	47	51	55	59	63	67	41	45	49	53	57	61	65	69
6	71	75	79	83	87	91	95	99	73	77	81	85	89	93	97	101
7	103	107	111	115	119	121	2	–121	105	109	113	117	121	121	–2	–121

For an S1G SU PPDU where in its SIG field or SIG-A field the NSTS subfield indicates two space-time streams, STBC subfield is set to 1 and the Traveling Pilots subfield is set to 1, the traveling pilots positions $K_{\mathrm{Pilot\_Travel}}(n)$ varies every other symbol according to Table 23-25 through Table 23-28 for bandwidth 1 MHz, 2 MHz, 4 MHz, and 8 MHz. In this case, for data symbol n (n = 0,1,2,….N_{SYM}–1), the pilot positions $K_{\mathrm{Pilot\_Travel}}(n)$ equal to those in the column corresponding to the pattern index

$$m(n) = \left\lfloor \frac{n}{2} \right\rfloor \text{ modulo } N_{TP,\,BW} \tag{23-49}$$

where

$N_{TP,\,BW}$ is the traveling pilot pattern period with the following values:

$N_{TP,\,\mathrm{1MHz}} = 7$

$N_{TP,\,\mathrm{2MHz}} = 7$

$N_{TP,\,\mathrm{4MHz}} = 10$

$N_{TP,\,\mathrm{8MHz}} = 16$

$N_{TP,\,\mathrm{16MHz}} = 16$

Table 23-25—Traveling pilot positions for NSTS=2 and STBC=1, 1 MHz S1G PPDU

Pilot Index *l*	Pattern Index *m*						
	0	1	2	3	4	5	6
0	–3	–13	–9	–5	–1	–11	–7
1	11	1	5	9	13	3	7

Table 23-26—Traveling pilot positions for NSTS=2 and STBC=1, 2 MHz S1G PPDU

Pilot Index *l*	Pattern Index *m*						
	0	1	2	3	4	5	6
0	–28	–24	–20	–16	–26	–22	–18
1	–12	–8	–4	–2	–14	–10	–6
2	4	8	12	16	2	6	10
3	20	24	28	26	14	18	22

Table 23-27—Traveling pilot positions for NSTS=2 and STBC=1, 4 MHz S1G PPDU

Pilot Index *l*	Pattern Index *m*									
	0	1	2	3	4	5	6	7	8	9
0	–50	–44	–38	–32	–26	–20	–14	–8	–2	–56
1	–30	–24	–18	–12	–6	–58	–54	–48	–42	–36
2	–10	–4	–58	–52	–46	–40	–34	–28	–22	–16
3	10	16	22	28	34	40	46	52	58	4
4	30	36	42	48	54	58	6	12	18	24
5	50	56	2	8	14	20	26	32	38	44

Table 23-28—Traveling pilot positions for NSTS=2 and STBC=1, 8 MHz S1G PPDU

Pilot Index *l*	Pattern Index *m*															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	–122	–118	–114	–110	–106	–102	–98	–94	–120	–116	–112	–108	–104	–100	–96	–92
1	–90	–86	–82	–78	–74	–70	–66	–62	–88	–84	–80	–76	–72	–68	–64	–60
2	–58	–54	–50	–46	–42	–38	–34	–30	–56	–52	–48	–44	–40	–36	–32	–28
3	–26	–22	–18	–14	–10	–6	–2	2	–24	–20	–16	–12	–8	–4	2	4
4	6	10	14	18	22	26	30	34	8	12	16	20	24	28	32	36
5	38	42	46	50	54	58	62	66	40	44	48	52	56	60	64	68
6	70	74	78	82	86	90	94	98	72	76	80	84	88	92	96	100
7	102	106	110	114	118	122	120	–120	104	108	112	116	120	122	–2	–122

For a 16 MHz S1G PPDU with traveling pilots, in the data symbol n ($n = 0,1,2,\ldots N_{SYM}-1$), there are a total of 16 pilot subcarriers, whose positions $K_{\text{Pilot\_Travel}}(n)$ are expressed as

$$K_{\text{Pilot\_Travel}}(n) = \begin{cases} K_{\text{Pilot\_Travel,8MHz}}(n) - 128, \text{ for pilot indices } 0 \le l \le 7 \\ K_{\text{Pilot\_Travel,8MHz}}(n) + 128, \text{ for pilot indices } 8 \le l \le 15 \end{cases} \tag{23-50}$$

where $K_{\text{Pilot\_Travel,8MHz}}(n)$ is the traveling pilot positions of the 8 pilot subcarriers for symbol index n and 8 MHz, calculated based on Table 23-24 for a single space-time stream, or based on Table 23-28 for STBC with two space-time streams.

For S1G MU PPDUs, or S1G SU PPDUs with more than two space-time streams, or S1G SU PPDUs with two space-time streams without STBC, traveling pilots are not defined.

23.3.9.11 OFDM modulation

23.3.9.11.1 Transmission in S1G format

For S1G transmissions using S1G_SHORT, the Data field signal from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$, shall be as specified in Equation (23-51).

$$r_{Data}^{(i_{TX})}(t) = \frac{1}{\sqrt{N_{\text{Data}}^{\text{Tone}} N_{\text{STS}}}} \sum_{n=0}^{N_{SYM}-1} w_{T_{SYM}}(t - T_{Accum}(n)) \cdot \sum_{k=-N_{SR}}^{N_{SR}} \sum_{m=1}^{N_{STS}} \left(\begin{array}{l} [Q_k]_{i_{TX},m} \gamma_{k,BW} \left(\tilde{D}_{k,m,n,BW} + [P_{HTLTF}]_{m,g(n)} \cdot p_{n+2} P_n^k \right) \\ \cdot \exp\left(j 2\pi k \Delta_F (t - T_{Accum}(n) - T_{GI,Data}(n) - T_{CS}(m)) \right) \end{array} \right) \tag{23-51}$$

where

$$g(n) = \begin{cases} (n \bmod 2) + 1, \text{if the STBC bit and Traveling Pilots bit in SIG field are both set to 1} \\ 1, \qquad \text{otherwise} \end{cases}$$

For S1G transmissions using S1G_LONG, the Data field signal from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$, shall be as specified in Equation (23-52).

$$
{}^{(i_{TX})}_{Data}(t) = \frac{1}{\sqrt{N_{\mathrm{Data}}^{\mathrm{Tone}} N_{\mathrm{STS,total}}}} \sum_{n=0}^{N_{SYM}-1} w_{T_{SYM}}(t - T_{Accum}(n)) \cdot \sum_{k=-N_{SR}}^{N_{SR}} \sum_{u=0}^{N_u - 1} \sum_{m=1}^{N_{STS,u}} \left(\begin{array}{l} [Q_k]_{i_{TX},(M_u+m)} \gamma_{k,BW} \left(\tilde{D}_{k,m,n,BW} + [P_{HTLTF}]_{m,g(n)} \cdot p_{z(n)} P_{(z(n)-2)}^{k} \right) \\ \cdot \exp\left(j2\pi k \Delta_F (t - T_{Accum}(n) - T_{GI,Data}(n) - T_{CS}(m)) \right) \end{array} \right) \tag{23-52}
$$

where

$$
g(n) = \begin{cases} (n \bmod 2) + 1, & \text{if the STBC bit and Traveling Pilots bit in SIG-A field are both set to 1} \\ 1, & \text{otherwise} \end{cases}
$$

For S1G transmissions using S1G_1M, the Data field signal from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$, shall be as specified in Equation (23-53).

$$
r_{\mathrm{Data}}^{(i_{\mathrm{TX}})}(t) = \frac{1}{\sqrt{N_{\mathrm{Data}}^{\mathrm{Tone}} N_{\mathrm{STS}}}} \sum_{n=0}^{N_{SYM}-1} w_{T_{\mathrm{SYM}}}(t - T_{Accum}(n)). \sum_{k=-N_{SR}}^{N_{SR}} \sum_{m=1}^{N_{STS}} \left(\begin{array}{l} [Q_k]_{i_{TX},m} \gamma_{k,BW} \left(\tilde{D}_{k,m,n,BW} + [P_{HTLTF}]_{m,1} . p_{n+6} P_n^{\mathrm{k}} \right) \\ . \exp\left(j2\pi k \Delta_F (t - T_{Accum}(n) - T_{GI,Data}(n) - T_{CS}(m)) \right) \end{array} \right) \tag{23-53}
$$

where

N_{SR}	is defined in Table 23-4
p_n	is defined in 17.3.5.10
P_n^k	is defined in 23.3.9.10
$T_{CS(m)}$	represents the cyclic shift for space-time stream m with a value given in Table 23-9 in the case of ≥ 2 MHz formats, and in Table 23-17 in the case of S1G_1M
$\Upsilon_{k,\mathrm{BW}}$	is defined by Equation (23-6) through Equation (23-9)
Δ_F	is defined in Table 23-4
N_{STS}, $N_{STS,total}$, and $N_{STS,u}$	are defined in Table 23-6
P_{HTLTF}	is defined in Equation (19-27) in 19.3.9.4.6
$N_{\mathrm{Data}}^{\mathrm{Tone}}$	has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7
N_u, and M_u	are defined in Table 23-6

$z(n)$ in Equation (23-52) is defined as follows:

$$
z(n) = \begin{cases} n + 2, & \text{if the MU/SU bit in SIG-A field is set to 0} \\ n + 3, & \text{if the MU/SU bit in SIG-A field is set to 1} \end{cases}
$$

$T_{GI,Data}(n)$ is the guard interval duration with the value as follows:

$$T_{GI,Data}(n) = \begin{cases} T_{GI}, \text{ if } n = 0 \\ T_{GI}, \text{ if } n > 0 \text{ and Short GI subfield of SIG or SIG-A field is 0} \\ T_{SGI}, \text{ if } n > 0 \text{ and Short GI subfield of SIG or SIG-A field is 1} \end{cases} \quad (23\text{-}54)$$

$\tilde{D}_{k,m,n,BW}$ is as defined by Equation (23-55)

$$\tilde{D}_{k,m,n,BW} = \begin{cases} 0, \quad \text{if } k \in K_{\text{Pilot}}(\text{n}) \\ \tilde{d}_{M'_{BW}(k),m,n}, \text{ otherwise} \end{cases} \quad (23\text{-}55)$$

where

$$K_{Pilot}(n) = \begin{cases} K_{Pilot\_\text{Fix}}, & \text{if the Traveling Pilot bit in SIG or SIG-A field is set to 0} \\ K_{Pilot\_\text{Travel}}(n), & \text{if the Traveling Pilot bit in SIG or SIG-A field is set to 1} \end{cases} \quad (23\text{-}56)$$

in which $K_{\text{Pilot\_Fix}}$ is defined in 23.3.8.2.1.3 for ≥ 2 MHz and 23.3.8.3.3 for 1 MHz, and $K_{\text{Pilot\_Travel}}(n)$ is defined in 23.3.9.10; and $M'_{BW}(k)$ is defined in Equation (23-30) to Equation (23-35) in 23.3.8.2.2.2.5 for 2 MHz, 4 MHz, 8 MHz, and 16 MHz, as well as Equation (23-44) in 23.3.8.3.4 for 1 MHz.

$T_{Accum}(n)$ is the accumulated duration from data symbol 0 to data symbol (*n-1*):

$$T_{Accum}(n) = \begin{cases} 0, & \text{if } n = 0 \\ T_{SYML} + (n-1)T_{SYM}, & \text{if } n > 0 \end{cases} \quad (23\text{-}57)$$

where

T_{SYML} and T_{SYM} are defined in Table 23-4

Q_k is a spatial mapping/steering matrix with N_{TX} rows and N_{STS} or $N_{STS,total}$ columns for subcarrier *k*. Q_k may be frequency dependent. Refer to the examples of listed in 19.3.11.11.2 for examples of that could be used for S1G SU PPDUs. Note that implementations are not restricted to the spatial mapping matrix examples listed in 19.3.11.11.2 and the number of transmit chains N_{TX} could be up to 4. For SU PPDUs to which beamforming is applied, Q_k is a beamforming steering matrix and is derived from the TXVECTOR parameter EXPANSION_MAT. For S1G MU PPDUs, Q_k is the DL-MU-MIMO steering matrix and is derived from the TXVECTOR parameter EXPANSION_MAT. The beamforming steering matrices and DL-MU-MIMO steering matrices are implementation specific.

The auto-detection between 1 MHz and 2 MHz preambles assumes channel smoothness. It is recommended that the spatial mapping matrix Q_k applied to LTF1 field is chosen such that it preserves the smoothness of the physical channel. This can, for example, be achieved by minimizing the amplitude and phase variation of each element of Q_k in successive tones.

Examples:

a) The following may be used Q_k : Q_k as defined for cyclic shift diversity using the values specified in the corresponding tables.

b) The following Q_k should not be used:

— Antenna hopping as described in 19.3.11.11.2 c) 2)

— The values of Q_k on successive tones flip between 1 and 0

23.3.9.12 1 MHz and 2 MHz duplicate transmission

23.3.9.12.1 1 MHz duplicate transmission

A 1 MHz duplicate transmission is used to transmit to S1G STAs that may be present in a part of a 2 MHz, 4 MHz, 8 MHz, or 16 MHz channel.

In a 1 MHz duplicate PPDU, both the S1G_1M preamble and Data field are duplicated in each 1 MHz subchannel of the 2 MHz, 4 MHz, 8 MHz, or 16 MHz channel. Both an 1 MHz data PPDU and an 1 MHz NDP may be duplicated.

For 1 MHz duplicate transmission, the Data field signal from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$, shall be as specified in Equation (23-58).

$$r_{Data}^{(i_{TX})}(t) = \frac{1}{\sqrt{N_{\text{1MHz\_DUP\_Data}}^{\text{Tone}} N_{\text{STS}}}} \sum_{n=0}^{N_{SYM}-1} w_{T_{SYM}}(t - T_{Accum}(n)) \cdot \sum_{i_{BW}=0}^{N_{1MHz}-1} \left(\sum_{k=-13}^{13} \sum_{m=1}^{N_{STS}} \left(\begin{array}{l} [Q_k]_{i_{TX},m} \gamma_{1MHz,(k-K_{Shift,1MHz}(i_{BW})),BW} \left(\tilde{D}_{k,m,n,1MHz} + [P_{HTLTF}]_{m,g(n)} \cdot p_{n+6} P_n^k \right) \\ \cdot \exp \left(\begin{array}{l} j2\pi(k - K_{Shift,1MHz}(i_{BW}))\Delta_F \cdot \\ (t - T_{Accum}(n) - T_{GI,Data}(n) - T_{CS}(m)) \end{array} \right) \end{array} \right) \right) \tag{23-58}$$

where

p_n	is defined in 17.3.5.10
P_n^k	is defined in 23.3.9.10
$T_{CS(m)}$	represents the cyclic shift for space-time stream *m* with a value given in Table 23-17
$\Upsilon_{1MHz,k,\text{BW}}$	is defined by Equation (23-10) through Equation (23-13)
Δ_F	is defined in Table 23-4
N_{STS}	is defined in Table 23-6
P_{HTLTF}	is defined in Equation (19-27) in 19.3.9.4.6
$N_{\text{1MHz\_DUP\_Data}}^{\text{Tone}}$	has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7
$T_{GI,Data}(n)$	is defined in Equation (23-54)
$\tilde{D}_{k,\,n,\,n,\,BW}$	is defined in Equation (23-55)
$T_{Accum}(n)$	is defined in Equation (23-57)
N_{1MHz}	is the number of 1 MHz subchannels that are contained within the whole bandwidth of the current PPDU (e.g., $N_{1MHz} = 4$ for a 4 MHz PPDU)

$$g(n) = \begin{cases} (n \bmod 2) + 1, & \text{if the STBC bit and Traveling Pilots bit in SIG-A field are both set to 1} \\ 1, & \text{otherwise} \end{cases}$$

$$K_{Shift,1MHz}(i) = (N_{1MHz} - 1 - 2i).16 \tag{23-59}$$

23.3.9.12.2 2 MHz duplicate transmission

A 2 MHz duplicate transmission is used to transmit to S1G STAs that may be present in a part of a 4 MHz, 8 MHz, or 16 MHz channel.

In a 2 MHz duplicate PPDU, the S1G_SHORT preamble and Data field are duplicated in each 2 MHz subchannel of the 4 MHz, 8 MHz, or 16 MHz channel.

A 2 MHz NDP sounding shall not be duplicated. Instead, a 4 MHz, 8 MHz, or 16 MHz NDP shall be transmitted whenever needed. NDP CMAC frames transmitted over a 4 MHz, 8 MHz, or 16 MHz channel shall be carried in a 2 MHz duplicate frame.

For a 2 MHz duplicate PPDU, the Data field signal from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$, shall be as specified in Equation (23-60).

$$r_{Data}^{(i_{TX})}(t) = \frac{1}{\sqrt{N_{\text{2MHz\_DUP\_Data}}^{\text{Tone}} N_{\text{STS}}}} \sum_{n=0}^{N_{SYM}-1} w_{T_{SYM}}(t - T_{Accum}(n)) \cdot \sum_{i_{BW}=0}^{N_{1MHz}-1} \left(\sum_{k=-28}^{28} \sum_{m=1}^{N_{STS}} \left(\begin{array}{l} [Q_k]_{i_{TX},m} \gamma_{(k-K_{Shift}(i_{BW})),BW} \left(\tilde{D}_{k,m,n,2MHz} + [P_{HTLTF}]_{m,g(n)} \cdot p_{n+2} P_n^k \right) \\ \cdot \exp\left(\begin{array}{l} j2\pi(k - K_{Shift}(i_{BW}))\Delta_F \cdot \\ (t - T_{Accum}(n) - T_{GI,Data}(n) - T_{CS}(m)) \end{array} \right) \end{array} \right) \right) \tag{23-60}$$

where

p_n	is defined in 17.3.5.10
P_n^k	is defined in 23.3.9.10
$T_{CS(m)}$	represents the cyclic shift for space-time stream m with a value given in Table 23-9
$\Upsilon_{k,\text{BW}}$	is defined by Equation (23-6) through Equation (23-9)
Δ_F	is defined in Table 23-4
N_{STS}	is defined in Table 23-6
P_{HTLTF}	is defined in Equation (19-27) in 19.3.9.4.6
$N_{\text{2MHz\_DUP\_Data}}^{\text{Tone}}$	has the value given in Tone scaling factor and guard interval duration values for PHY fields in Table 23-7
$T_{GI,Data}(n)$	is defined in Equation (23-54)
$\tilde{D}_{k,n,n,BW}$	is defined in Equation (23-55)
$T_{Accum}(n)$	is defined in Equation (23-57)
N_{2MHz}	is the number of 2 MHz subchannels that are contained within the whole bandwidth of the current PPDU (e.g., $N_{2MHz} = 2$ for a 4 MHz PPDU)

$$g(n) = \begin{cases} (n \bmod 2) + 1, & \text{if the STBC bit and Traveling Pilots bit in SIG-A field are both set to 1} \\ 1, & \text{otherwise} \end{cases}$$

$K_{Shift}(i)$	is defined in Equation (23-19)

23.3.10 SU-MIMO and DL-MU-MIMO Beamforming

23.3.10.1 General

S1G SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. The general description of SU-MIMO and DL-MU-MIMO beamforming is identical to its VHT counterparts as described in 21.3.11.1with VHT replaced by S1G.

In S1G operation, the SU-MIMO allows beamforming up to 4 space-time streams, and DL-MU-MIMO beamforming allows up to 4 total number of space-time streams for all users each with up to 3 space-time streams.

S1G beamforming exchange is defined only for 2 MHz, 4 MHz, 8 MHz, and 16 MHz.

23.3.10.2 Beamforming Feedback Matrix V

The description of beamforming feedback matrix V in S1G band is identical to its VHT counterpart as described in 21.3.11.2 with VHT replaced by S1G.

Compressed beamforming feedback using 19.3.12.3.6 is the only beamforming feedback format defined for S1G operation. In certain cases when the ψ angle is not included in the feedback frame (e.g., for SU feedback with $N_c = 1$), the ψ angles not included in the feedback report are given the values below, which will correspond to a single column V matrix having elements with equal magnitude:

If $N_r \times N_c = 4 \times 1$, $\Psi_{21} = 0.25\pi$, $\Psi_{31} = 0.196\pi$, $\Psi_{41} = 0.167\pi$
If $N_r \times N_c = 3 \times 1$, $\Psi_{21} = 0.25\pi$, $\Psi_{31} = 0.196\pi$
If $N_r \times N_c = 2 \times 1$, $\Psi_{21} = 0.25\pi$

23.3.10.3 Maximum Number of Total Spatial Streams in S1G MU PPDUs

An MU capable STA shall support reception of S1G MU PPDUs with the total number of space-time streams across the NUM_USERS users being less than or equal to its Compressed Steering Number of Beamformer Antennas Supported in the S1G Capabilities Information field. The upper limit is 4 spatial streams.

23.3.10.4 Group ID

The description of Group ID in S1G band is identical to its VHT counterpart as described in 21.3.11.4 with VHT replaced by S1G.

23.3.11 S1G preamble format for NDPs

An NDP may be used for sounding or for NDP CMAC frames. In the case of NDP sounding, the SIG field in an NDP shall indicate multiple space-time streams and more than one LTF fields; NDP CMAC frames only contain single space-time stream with one LTF field.

NDP is the only S1G sounding format.

NDP for sounding is defined only using the S1G_SHORT, and NDP for sounding is not allowed for 1 MHz transmissions. NDP CMAC frames may either use an S1G_SHORT, or an S1G_1M.

The format of an S1G NDP PPDU for sounding is shown in Figure 23-17.

2 symbols	2 symbols	2 symbols	1 symbol per LTF
STF	LTF1	SIG	LTF2 ~ LTFNLTF

Figure 23-17—S1G NDP for Sounding Format

NOTE—The number of LTF symbols in the NDP is determined by the NSTS subfield in SIG field.

Transmission of an S1G NDP PPDU for sounding shall comply with the following rules:

- Shall use the S1G PPDU format but without the Data field.
- Shall use the S1G_SHORT.
- Shall use the following settings in SIG field:
  - MCS field is set to 0.
  - Length/Duration field is set to 0.
  - Bandwidth field is set to the same value as the TXVECTOR parameter CH_BANDWIDTH in the preceding S1G NDP Announcement frame.
  - NSTS field indicates two or more space-time streams.
  - Partial AID field is set as described in 10.20b.
  - The NDP indication bit is set to 0.

The format of an S1G NDP CMAC frame in 2 MHz, 4 MHz, 8 MHz, or 16 MHz is shown in Figure 23-18. The > 2 MHz S1G NDP CMAC frames are 2 MHz S1G NDP CMAC frames duplicated up to the transmission bandwidth according to CH_BANDWIDTH in TXVECTOR

2 symbols	2 symbols	2 symbols
STF	LTF1	SIG

Figure 23-18—S1G NDP CMAC frame for ≥ 2 MHz

The format of an S1G NDP CMAC frame in 1 MHz is shown in Figure 23-19. S1G NDP CMAC frames for 1 MHz are duplicated up to their transmission bandwidth according to CH_BANDWIDTH in TXVECTOR.

4 symbols	4 symbols	6 symbols
STF	LTF1	SIG

Figure 23-19—S1G NDP CMAC frame for 1 MHz

Transmission of an S1G NDP CMAC frame shall comply with the following rules:

- Shall use the S1G PPDU format but without the Data field.
- Shall use either the S1G_SHORT or the S1G_1M.
- Shall use the following settings in SIG field:
  - The NDP indication bit is set to 1.
- Shall contain only one LTF field.

The SIG field formats of NDP CMAC frames are shown in Figure 23-20 and Figure 23-21.

B0 B24	B25	B26 B29	B30 B35
NDP CMAC frame body	NDP Indication	CRC	Tail

Figure 23-20—SIG field format for 1 MHz NDP CMAC frame

B0 B36	B37	B38 B41	B42 B47
NDP CMAC frame body	NDP Indication	CRC	Tail

Figure 23-21—SIG field format for ≥ 2 MHz NDP CMAC frame

The NDP CMAC frame body field is described in 9.9.

The NDP Indication field is set to 1.

The CRC field is described in 23.3.8.2.1.5. Tail field is set to 0.

23.3.12 Regulatory requirements

WLANs implemented in accordance with this standard are subject to equipment certification and operating requirements established by regional and national regulatory administrations. The PHY specification establishes minimum technical requirements for interoperability, based upon established regulations at the time this standard was issued. These regulations are subject to revision, or may be superseded. Requirements that are subject to local geographic regulations are annotated within the PHY specification. Regulatory requirements that do not affect interoperability are not addressed in this standard. Implementers are referred to the regulatory sources in Annex D for further information. Operation in countries within defined regulatory domains may be subject to additional or alternative national regulations.

23.3.13 Channelization

STAs compliant with the physical layer defined in Clause 23 operate in the channels (700 MHz ~ 1 GHz) defined in Annex E.

The channel center frequency, f_c, is defined as

$$f_c = ChannelStartingFrequency + f_{separation} \times ChannelCenterFrequencyIndex$$

where

$f_{separation}$ is the frequency separation between channels, and has the value of 0.5 MHz

ChannelStartingFrequency and *ChannelCenterFrequencyIndex* are region and operating class specific and given in Annex E. The Channel Spacing field in Annex E denotes the corresponding bandwidth for S1G operation.

The center frequency of the primary 1 MHz or primary 2 MHz channel, $f_{c,\ primary}$, is defined as:

$$f_{c,\ primary} = ChannelStartingFrequency + f_{separation} \times PrimaryChannelNumber$$

where

$f_{separation}$ is the frequency separation between channels, and has the value of 0.5 MHz

PrimaryChannelNumber is the subchannel index of the primary 1 or 2 MHz channel within the overall bandwidth for S1G operation

23.3.14 Slot time

The slot time for the S1G PHY shall be 52 μs.

23.3.15 Transmit and receive port impedance

Transmit and receive antenna port impedance for each transmit and receive antenna is defined in 17.3.8.7.

23.3.16 S1G transmit specification

23.3.16.1 Transmit spectrum mask

NOTE 1—In the presence of additional regulatory restrictions, the device has to meet both the regulatory requirements and the mask defined in this subclause.

NOTE 2—Transmit spectral mask figures in this subclause are not drawn to scale.

NOTE 3—For rules regarding TX center frequency leakage levels see 23.3.16.4.2. Transmit modulation accuracy specifications are described in 23.3.16.4.2 and 23.3.16.4.3. The test method is described in 23.3.16.4.4. The spectral mask requirements in this subclause do not apply to the RF LO leakage.

For a 1 MHz mask PPDU, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 0.9 MHz, –20 dBr at 0.6 MHz frequency offset, –28 dBr at 1 MHz frequency offset and –40 dBr at 1.5 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 0.45 and 0.6 MHz, 0.6 and 1 MHz, and 1 and 1.5 MHz shall be linearly interpolated in dB domain from the requirements for 0.45, 0.6, 1 and 1.5 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –40 dBm/MHz at any frequency offset. Figure 23-22 shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –40 dBm/MHz.

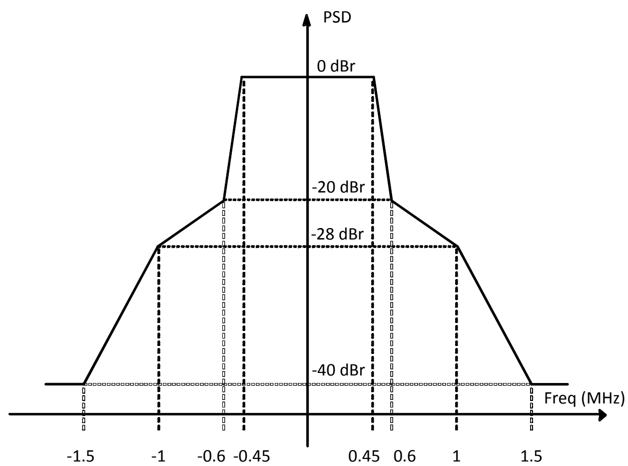


Figure 23-22—Transmit spectral mask for 1 MHz channel

For a 2 MHz mask PPDU, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 1.8 MHz, –20 dBr at 1.1 MHz frequency offset, –28 dBr at 2 MHz frequency offset and –40 dBr at 3 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 0.9 and 1.1 MHz, 1.1 and 2 MHz, and 2 and 3 MHz shall be linearly interpolated in dB domain from the requirements for 0.9, 1.1, 2 and 3 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –43 dBm/MHz at any frequency offset. Figure 23-23 shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –43 dBm/MHz.

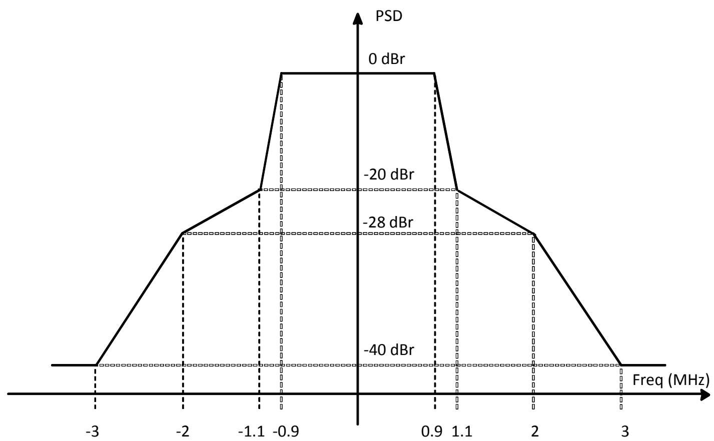


Figure 23-23—Transmit spectral mask for 2 MHz channel

For a 4 MHz mask PPDU, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 3.8 MHz, –20 dBr at 2.1 MHz frequency offset, –28 dBr at 4 MHz frequency offset and –40 dBr at 6 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 1.9 and 2.1 MHz, 2.1 and 4 MHz, and 4 and 6 MHz shall be linearly interpolated in dB domain from the requirements for 1.9, 2.1, 4 and 6 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –46 dBm/MHz at any frequency offset. Figure 23-24 shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –46 dBm/MHz.

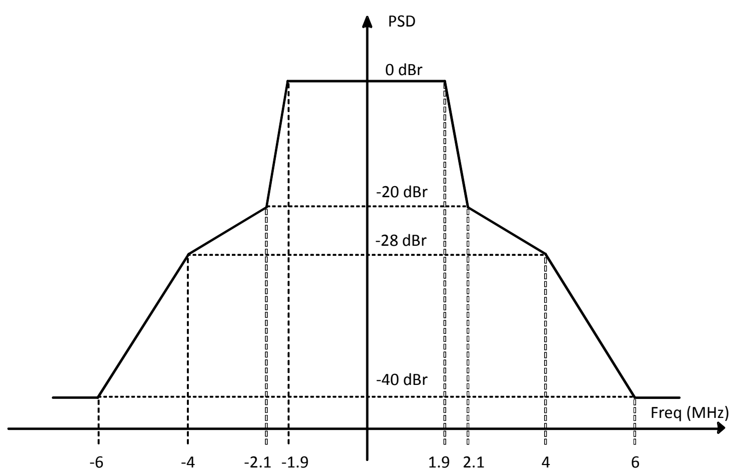


Figure 23-24—Transmit spectral mask for 4 MHz channel

For a 8 MHz mask PPDU, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 7.8 MHz, –20 dBr at 4.1 MHz frequency offset, –28 dBr at 8 MHz frequency offset and –40 dBr at 12 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 3.9 and 4.1 MHz, 4.1 and 8 MHz, and 8 and 12 MHz shall be linearly interpolated in dB domain from the requirements for 3.9, 4.1, 8 and 12 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –49 dBm/MHz at any frequency offset. Figure 23-25 shows an example of the resulting overall spectral mask when the -40 dBr spectrum level is above -49 dBm/MHz.

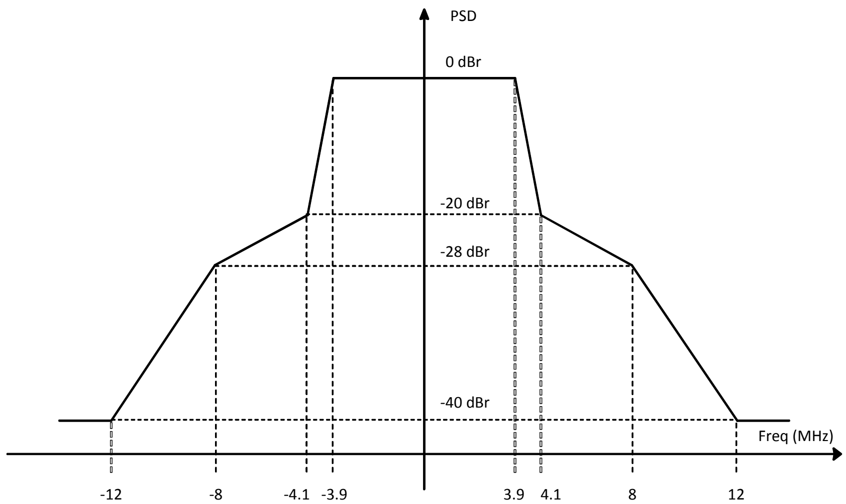


Figure 23-25—Transmit spectral mask for 8 MHz channel

For a 16 MHz mask PPDU, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 15.8 MHz, –20 dBr at 8.1 MHz frequency offset, –28 dBr at 16 MHz frequency offset and –40 dBr at 24 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 7.9 and 8.1 MHz, 8.1 and 16 MHz, and 16 and 24 MHz shall be linearly interpolated in dB domain from the requirements for 7.9, 8.1, 16 and 24 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –49 dBm/MHz at any frequency offset. Figure 23-26 shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –49 dBm/MHz.

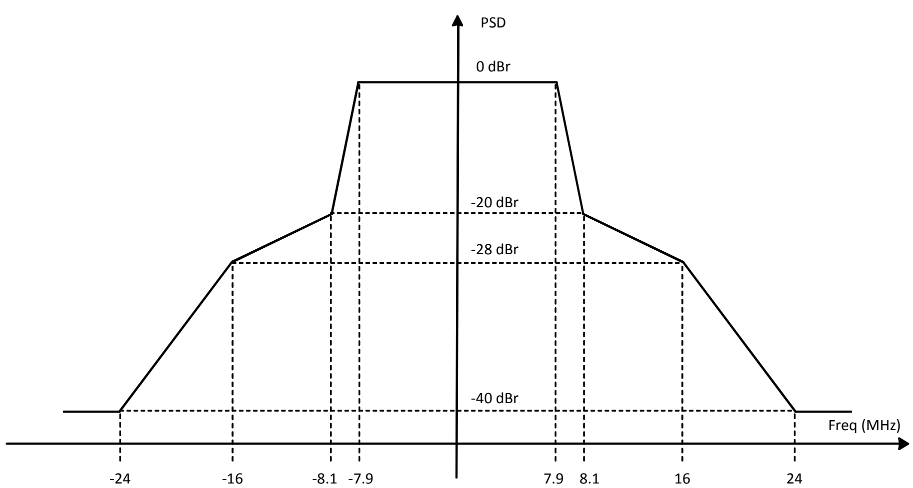


Figure 23-26—Transmit spectral mask for 16 MHz channel

Measurements shall be made using a 10 kHz resolution bandwidth and a 100Hz video bandwidth.

23.3.16.2 Spectral flatness

Spectral flatness measurements shall be conducted using BPSK modulated PPDUs.

Let $E_{i,avg}$ denote the average constellation energy of a BPSK modulated subcarrier i in an S1G data symbol.

In a normal mode S1G transmission or contiguous 1 MHz or 2 MHz Duplicate mode transmission having a bandwidth listed in Table 23-29, $E_{i,avg}$ of each of the subcarriers with indices listed as tested subcarrier indices shall not deviate by more than the specified maximum deviation in Table 23-29 from the average of $E_{i,avg}$ over subcarrier indices listed as averaging subcarrier indices. Averaging of $E_{i,avg}$ is done in the linear domain.

For the spectral flatness test, the transmitting STA shall be configured to use a spatial mapping matrix Q_k with flat frequency response. Each output port under test of the transmitting STA shall be connected through a cable to one input port of the testing instrumentation. The requirements apply to 1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz normal mode transmissions and transmissions based on 1 and 2 MHz duplicated segments.

Table 23-29—Maximum spectral flatness deviations

Format	BW of Transmission (MHz)	Averaging subcarrier indices (inclusive)	Tested subcarrier indices (inclusive)	Maximum Deviation (dB)
Normal Mode S1G	1	–8 to –1 and +1 to +8	–8 to –1 and +1 to +8	±4
			–13 to –9 and +9 to +13	+4/–6
	2	–16 to –1 and +1 to +16	–16 to –1 and +1 to +16	±4
			–28 to –17 and +17 to +28	+4/–6
	4	–42 to –2 and +2 to +42	–42 to –2 and +2 to +42	±4
			–58 to –43 and +43 to +58	+4/–6
	8	–84 to –2 and +2 to +84	–84 to –2 and +2 to +84	±4
			–122 to –85 and +85 to +122	+4/–6
	16	–172 to –130, –126 to –44, +44 to +126, and +130 to +172	–172 to –130, –126 to –44, +44 to +126, and +130 to +172	±4
			–250 to –173, –43 to –6, +6 to +43, and +173 to +250	+4/–6

Table 23-29—Maximum spectral flatness deviations *(continued)*

Format	BW of Transmission (MHz)	Averaging subcarrier indices (inclusive)	Tested subcarrier indices (inclusive)	Maximum Deviation (dB)
1 MHz Duplicate Mode	2	–15 to –3 and +3 to +15	–15 to –3 and +3 to +15	±4
			–29 to –17 and +17 to +29	
	4	–42 to –35, –29 to –17, –15 to –3, +3 to +15, +17 to +29, and +35 to +42	–42 to –35, –29 to –17, –15 to –3, +3 to +15, +17 to +29, and +35 to +42	±4
			–61 to –49, –47 to –43, +43 to +47, and +49 to +61	+4/–6
	8	–84 to –81, –79 to –67, –61 to –49, –47 to –35, –29 to –17, –15 to –3, +3 to +15, +17 to +29, +35 to +47, +49 to +61, +67 to +79, and +81 to +84	–84 to –81, –79 to –67, –61 to –49, –47 to –35, –29 to –17, –15 to –3, +3 to +15, +17 to +29, +35 to +47, +49 to +61, +67 to +79, and +81 to +84	±4
			–125 to –113, –111 to –99, –93 to –85, +85 to +93, +99 to +111, and +113 to +125	+4/–6
	16	–172 to –163, –157 to –145, –143 to –131, –125 to –113, –111 to –99, –93 to –81, –79 to –67, –61 to –49, –47 to –44, +44 to +47, +49 to +61, +67 to +79, +81 to +93, +99 to +111, +113 to +125, +131 to +143, +145 to +157, and +163 to +172	–172 to –163, –157 to –145, –143 to –131, –125 to –113, –111 to –99, –93 to –81, –79 to –67, –61 to –49, –47 to –44, +44 to +47, +49 to +61, +67 to +79, +81 to +93, +99 to +111, +113 to +125, +131 to +143, +145 to +157, and +163 to +172	±4
			–253 to –241, –239 to –227, –221 to –209, –207 to –195, –189 to –177, –175 to –173, –43 to –35, –29 to –17, –15 to –3, +3 to +15, +17 to +29, +35 to +43,+173 to +175, +177 to +189, +195 to +207, +209 to +221, +227 to +239, and +241 to +253	+4/–6
2 MHz Duplicate Mode	4	–42 to –33, –31 to –6, +6 to +31, and +33 to +42	–42 to –33, –31 to –6, +6 to +31, and +33 to +42	±4
			–58 to –43 and +43 to +58	+4/–6
	8	–84 to –70, –58 to –33, +33 to +58, +70 to +84	–84 to –70, –58 to –33, –31 to –6, +6 to +31, +33 to +58, +70 to +84	±4
			–122 to –97, –95 to –85 and +85 to +95, +97 to +122	+4/–6
	16	–172 to –161, –159 to –134, –122 to –97, –95 to –70, –58 to –44, +44 to +58, +70 to +95, +97 to +122, +134 to +159, +161 to +172	–172 to –161, –159 to –134, –122 to –97, –95 to –70, –58 to –44, +44 to +58, +70 to +95, +97 to +122, +134 to 159, +161 to +172	±4
			–250 to –225, –223 to –198, –186 to –173, –43 to –33, –31 to –6, +6 to +31, +33 to +43, +173 to +186, +198 to 223, +225 to +250	+4/–6

23.3.16.3 Transmit center frequency and symbol clock frequency tolerance

The symbol clock frequency and transmit center frequency tolerance shall be ±20 ppm maximum. The transmit center frequency and the symbol clock frequency for all transmit antennas and frequency segments shall be derived from the same reference oscillator.

23.3.16.4 Modulation accuracy

23.3.16.4.1 Introduction to modulation accuracy tests

Transmit modulation accuracy specifications are described in 23.3.16.4.2 and 23.3.16.4.3. The test method is described in 23.3.16.4.4.

23.3.16.4.2 Transmitter center frequency leakage

TX LO leakage is a consequence of the RF local oscillator (LO) and is the DC power emitted at its tuned center frequency. This TX LO leakage shall meet the following requirements for all formats and bandwidths:

- When the RF LO is in the center of the transmitted PPDU BW, the power measured at the center of transmission BW using resolution BW 31.25 kHz shall not exceed the average power per-subcarrier of the transmitted PPDU, or equivalently,($P - 10\log_{10}(N_{ST})$), where P is the transmit power per antenna in dBm, and N_{ST} is defined in Table 23-4.
- When the RF LO is not at the center of the transmitted PPDU BW, the power measured at the location of the RF LO using resolution BW 31.25 kHz shall fall within that resolution BW of a 2 MHz channelization boundary and shall not exceed the maximum of –27 dB relative to the total transmit power and –15 dBm, or equivalently max(P–27,–15), where P is the transmit power per antenna in dBm. If 2 MHz channelization is not allowed in the regulatory region of operation, the TX LO leakage shall fall within the resolution BW of a 1 MHz channelization boundary and shall not exceed the maximum of –27 dB relative to the total transmit power and –15 dBm, or equivalently max(P–27,–15), where P is the transmit power per antenna in dBm.

The transmit center frequency leakage is specified per antenna.

23.3.16.4.3 Transmitter constellation error

The relative constellation RMS error, calculated by first averaging over subcarriers, OFDM PPDUs and spatial streams (see Equation (19-89)) shall not exceed a data-rate dependent value according to Table 23-30. The number of spatial streams under test shall be equal to the number of utilized transmitting STA antenna (output) ports and also equal to the number of utilized testing instrumentation input ports. In the test, N_{SS}=N_{STS} (no STBC) shall be used. Each output port of the transmitting STA shall be connected through a cable to one input port of the testing instrumentation. The requirements apply to 1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz transmissions.

Table 23-30—Allowed relative constellation error versus constellation size and coding rate

Modulation	Coding rate	Relative constellation error (dB)
BPSK	1/2 with 2x repetition	–4
BPSK	1/2	–5
QPSK	1/2	–10
QPSK	3/4	–13
16-QAM	1/2	–16
16-QAM	3/4	–19
64-QAM	2/3	–22
64-QAM	3/4	–25
64-QAM	5/6	–27
256-QAM	3/4	–30
256-QAM	5/6	–32

23.3.16.4.4 Transmitter modulation accuracy (EVM) test

The transmit modulation accuracy test shall be performed by instrumentation capable of converting the transmitted signals into a stream of complex samples at sampling rate greater than or equal to the bandwidth of the signal being transmitted; except that for duplicate transmissions, each 1 MHz or 2 MHz subchannel may be tested independently while all subchannels are being transmitted.

The instrument shall have sufficient accuracy in terms of I/Q arm amplitude and phase balance, DC offsets, phase noise, and analog to digital quantization noise. A possible embodiment of such a setup is converting the signals to a low IF frequency with a microwave synthesizer, sampling the signal with a digital oscilloscope and decomposing it digitally into quadrature components. The sampled signal shall be processed in a manner similar to an actual receiver, according to the following steps, or equivalent procedure:

a) Start of PPDU shall be detected.
b) Transition from STF field to LTF1 field shall be detected and fine timing shall be established.
c) Coarse and fine frequency offsets shall be estimated.
d) Symbols in a PPDU shall be derotated according to estimated frequency offset.
e) For each LTF symbol, transform the symbol into subcarrier received values, estimate the phase from the pilot subcarriers, and derotate the subcarrier values according to the estimated phase.
f) Estimate the complex channel response coefficient for each of the subcarriers and each of the transmit streams.
g) For each of the data OFDM symbols: transform the symbol into subcarrier received values, estimate the phase from the pilot subcarriers, derotate the subcarrier values according to the estimated phase, group the results from all the receiver chains in each subcarrier to a vector, and multiply the vector by a zero-forcing equalization matrix generated from the estimated channel.
h) For each data-carrying subcarrier in each spatial stream, find the closest constellation point and compute the Euclidean distance from it.

i) Compute the average across PPDUs of the RMS of all errors per PPDU as given by Equation (19-89).

The test shall be performed over at least 20 PPDUs (as defined in Equation (19-89)). The PPDUs under test shall be at least 16 data OFDM symbols long. Random data shall be used for the symbols.

23.3.16.5 Time of Departure accuracy

The Time of Departure accuracy test evaluates TIME_OF_DEPARTURE against aTxPHYTxStartRMS and aTxPHYTxStartRMS against TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH as defined in Annex T with the following test parameters:

— MULTICHANNEL_SAMPLING_RATE is:

$1 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{1\text{ MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW1

$2 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{2\text{ MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW2

$4 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{4\text{ MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW4

$8 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{8\text{ MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW8

$16 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{16\text{ MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW16

where
f_H is the nominal center frequency in Hz of the highest channel in the channel set
f_L is the nominal center frequency in Hz of the lowest channel in the channel set, the channel set is the set of channels upon which frames providing measurements are transmitted.

— FIRST_TRANSITION_FIELD is the STF field.

— SECOND_TRANSITION_FIELD is the LTF1 field.

— TRAINING_FIELD is the LTF1 field windowed in a manner that should approximate the windowing described in 17.3.2.5 with TTR = 1000 ns.

— TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH is 80 ns for a CH_BANDWIDTH parameter equal to CBW16, and unspecified otherwise.

NOTE—The indicated windowing applies to the time of departure accuracy test equipment, and not the transmitter or receiver.

23.3.17 S1G receiver specification

23.3.17.1 Receiver minimum input sensitivity

The packet error ratio (PER) shall be less than 10% for a PSDU length of 256 octets with the rate-dependent input levels listed in Table 23-31. The test in this subclause and the minimum sensitivity levels specified in Table 23-31 apply only to non-STBC modes, 8 μs GI, BCC, and S1G PPDU**.**

Table 23-31—Receiver minimum input level sensitivity

Modulation	Rate (R)	Minimum Sensitivity (1 MHz PPDU) (dBm)	Minimum Sensitivity (2 MHz PPDU) (dBm)	Minimum Sensitivity (4 MHz PPDU) (dBm)	Minimum Sensitivity (8 MHz PPDU) (dBm)	Minimum Sensitivity (16 MHz PPDU) (dBm)
BPSK	1/2 with 2x repetition	–98	N/A	N/A	N/A	N/A
BPSK	1/2	–95	–92	–89	–86	—83
QPSK	1/2	–92	–89	–86	–83	–80
QPSK	3/4	–90	–87	–84	–81	–78
16-QAM	1/2	–87	–84	–81	–78	–75
16-QAM	3/4	–83	–80	–77	–74	–71
64-QAM	2/3	–79	–76	–73	–70	–67
64-QAM	3/4	–78	–75	–72	–69	–66
64-QAM	5/6	–77	–74	–71	–68	–65
256-QAM	3/4	–72	–69	–66	–63	–60
256-QAM	5/6	–70	–67	–64	–61	–58

23.3.17.2 Adjacent channel rejection

Adjacent channel rejection for *W* MHz channels (where *W* is 1, 2, 4, 8, or 16) shall be measured by setting the requested signal's strength 3 dB above the rate dependent sensitivity specified in 23.3.17.1 and raising the power of the interfering signal of *W* MHz bandwidth until 10% PER is caused for a PSDU length of 256 octets. The power difference between the interfering and requested channel is the corresponding adjacent channel rejection. The center frequency of the adjacent channel shall be placed *W* MHz away from the center frequency of the requested signal.

The interfering signal in the adjacent channel shall be a conformant S1G signal, unsynchronized with the signal in the channel under test, and shall have a minimum duty cycle of 50%. For a conforming S1G PHY, the corresponding rejection shall be no less than specified in Table 23-32.

The test in this subclause and the adjacent sensitivity levels specified in Table 23-32 only apply to non-STBC modes with 8 μs GI and BCC.

The measurement of adjacent channel rejection for 2/4/8/16 MHz operation in a regulatory domain is only required if such a frequency band plan is permitted in that regulatory domain.

23.3.17.3 Nonadjacent channel rejection

Nonadjacent channel rejection for *W* MHz channels (where *W* is 1, 2, 4, 8, or 16) shall be measured by setting the requested signal's strength 3 dB above the rate-dependent sensitivity specified in Table 23-32, and raising the power of the interfering signal of W MHz bandwidth until a 10% PER occurs for a PSDU length of 256 octets. The power difference between the interfering and requested channel is the corresponding nonadjacent channel rejection. The center frequency of the nonadjacent channel shall be placed 2×*W* MHz or more away from the center frequency of the requested signal.

Table 23-32—Minimum required adjacent and nonadjacent channel rejection levels

Modulation	Rate, R	Adjacent Channel Rejection (dB)		Nonadjacent Channel Rejection (dB)	
		1 MHz Channel	2/4/8/16 MHz Channel	1 MHz Channel	2/4/8/16 MHz Channel
BPSK	1/2 with 2x repetition	19	N/A	35	N/A
BPSK	1/2	16	16	32	32
QPSK	1/2	13	13	29	29
QPSK	3/4	11	11	27	27
16-QAM	1/2	8	8	24	24
16-QAM	3/4	4	4	20	20
64-QAM	2/3	0	0	16	16
64-QAM	3/4	–1	–1	15	15
64-QAM	5/6	–2	–2	14	14
256-QAM	3/4	–7	–7	9	9
256-QAM	5/6	–9	–9	7	7

The interfering signal in the nonadjacent channel shall be a conformant S1G signal, unsynchronized with the signal in the channel under test, and shall have a minimum duty cycle of 50%. For a conforming OFDM PHY, the corresponding rejection shall be no less than specified in Table 23-32.

The test in this subclause and the nonadjacent sensitivity levels specified in Table 23-32 only apply to non-STBC modes with 8 μs GI and BCC.

The measurement of nonadjacent channel rejection for 2/4/8/16 MHz operation in a regulatory domain is only required if such a frequency band plan is permitted in that regulatory domain.

23.3.17.4 Receiver maximum input level

The receiver shall provide a maximum PER of 10% at a PSDU length of 256 octets, for a maximum input level of –30 dBm, measured at each antenna for any baseband S1G modulation.

23.3.17.5 CCA sensitivity

23.3.17.5.1 General

The thresholds in this subclause are compared with the signal level at each receiving antenna.

23.3.17.5.2 Type 1 and type 2 channelization for CCA levels

In S1G operation, the CCA sensitivity levels are defined such that they are dependent and specific to country channelization and channel location within the frequency band. For S1G channelizations in all regions of the world, there are to be two available classifications for channels and CCA levels, defined as type 1 and type 2.

For BSSs set up on channels classified as using type 1, the AP and non-AP STA devices are to use what are referred to in this subclause as type 1 CCA levels when performing their CCA procedures. Likewise, if the BSS is set up on channels classified as type 2, the AP and non-AP STA devices are required to use type 2 specific CCA levels. For SST BSS setups (see 10.48) where the SST BSS can include both type 1 and type 2 channels, the device in the SST BSS shall use the CCA level (type 1 or type 2) that corresponds to the current channel that is being accessed when performing their CCA procedures. The type 1 and type 2 channel classification for different operating classes in different regions of the world are denoted by “CCA Level Classification” in Table E-4 through Table E-4a in Annex E.

In general, type 1 channels have CCA levels set to favor protection of ongoing transmissions and range of devices, relative to type 2 channels. Type 2 channels have CCA levels set to favor higher bandwidth and data rate transmissions, and to allow for higher reuse within the total network across different BSSs (relative to type 1 channels). To achieve this, type 2 channel CCA levels (i.e., thresholds) are defined to be higher than type 1 channel CCA levels.

CCA levels will impact system behavior and performance increasingly with loading, therefore it is generally advantageous for BSSs primarily serving devices requiring more channel and transmission protection to set up on type 1 channels, and for BSSs expected to service devices with higher bandwidth and data rate transmissions to set up on type 2 channels if the region/country has both type 1 and type 2 channels available.

An S1G STA configures its active CCA conditions by generating a PHY-CONFIG.request(PHYCONFIG_VECTOR) primitive with the CCA_SENSITIVITY_TYPE parameter. For operating in type 1 channels, the MAC sublayer generates a PHY-CONFIG.request primitive with a PHYCONFIG_VECTOR parameter CCA_SENSITIVITY_TYPE set to CCA_SENSITIVITY_TYPE_1. For operating in type 2 channels, the MAC sublayer generates a PHY-CONFIG.request primitive with a PHYCONFIG_VECTOR parameter CCA_SENSITIVITY_TYPE set to CCA_SENSITIVITY_TYPE_2. For operating the 8/16 MHz intended channel width in type 2 channels, the MAC sublayer generates a PHY-CONFIG.request primitive with a PHYCONFIG_VECTOR parameter CCA_SENSITIVITY_TYPE set to CCA_SENSITIVITY_TYPE_2_WIDEBAND.

23.3.17.5.3 CCA sensitivity for operating classes requiring CCA-ED

For the operating classes requiring CCA-Energy Detect (CCA-ED), CCA shall also detect a medium busy condition when CCA-ED detects a channel busy condition.

For improved spectrum sharing, CCA-ED is required in some bands. The behavior class indicating CCA-ED is given in Table E-1 through Table E-4. The operating classes requiring the corresponding CCA-ED behavior class are given in Annex E. A STA that is operating within an operating class that requires CCA-ED shall operate with CCA-ED.

There is no distinction between type 1 and type 2 channel CCA levels for CCA-Energy Detect threshold levels, and all channels will use the same set of values: CCA-ED shall indicate a channel busy condition when the received signal strength exceeds the CCA-ED threshold of –75 dBm for the primary 1 MHz, –72 dBm for the primary 2 MHz channel and the secondary 2 MHz channels, –69 dBm for the secondary 4 MHz channel, and –66 dBm for the secondary 8 MHz channel.

23.3.17.5.4 CCA sensitivity for signals occupying the primary 2 MHz and/or primary 1 MHz channel

23.3.17.5.4.1 General

In S1G operation, the CCA sensitivity levels a device shall use when detecting the start of S1G PPDUs are based on whether the occupied primary channel in question is classified as type 1 or type 2.

For devices operating in type 1 channels, the PHY shall issue a PHY-CCA.indication(BUSY, {primary1}) if one of the following conditions is present in an otherwise idle primary 1 MHz channel:

— The start of an S1G_1M PPDU or duplicate S1G_1M PPDU detected in the primary 1 MHz channel at or above –98 dBm within the primary 1 MHz channel with > 90% probability within a period aCCATime (see 23.4.4).

— Any S1G PPDU detected at or above –89 dBm within the primary 1 MHz channel with > 90% probability within a period of aCCAMidTime (see 23.4.4).

For devices operating in type 2 channels, the PHY shall issue a PHY-CCA.indication(BUSY, {primary1}) if one of the following conditions is present in an otherwise idle primary 1 MHz channel:

— The start of an S1G_1M PPDU or duplicate S1G_1M PPDU detected in the primary 1 MHz channel at or above –89 dBm within the primary 1 MHz channel with > 90% probability within a period aCCATime (see 23.4.4).

— Any S1G PPDU detected at or above –86 dBm within the primary 1 MHz channel with > 90% probability within a period of aCCAMidTime (see 23.4.4).

The device shall not issue a PHY-CCA.indication(BUSY, {primary2}), PHY-CCA.indication(BUSY, {secondary2}), PHY-CCA.indication(BUSY, {secondary4}), or PHY-CCA.indication(BUSY, {secondary8}) until the end of the duration indicated by the packet or until all conditions above are no longer satisfied. Additionally, for both type 1 and type 2 channels, the device shall issue a PHY-CCA.indication(BUSY, {primary1}) if any received signal in the primary 1 MHz channel exceeds the CCA-ED threshold of –75 dBm within a period aCCATime.

For devices operating in type 1 channels, the PHY shall issue a PHY-CCA.indication(BUSY, {primary2}) if the conditions for issuing PHY-CCA.indication(BUSY, {primary1}) are not present and one of the following conditions is met in an otherwise idle 2 MHz, 4 MHz, 8 MHz, or 16 MHz operating channel width:

— An S1G_1M PPDU detected in the nonprimary 1 MHz portion of the primary 2 MHz channel at or above –89 dBm within the nonprimary 1 MHz with > 90% probability within a period of aCCAMidTime (see 23.4.4).

— A ≥ 2 MHz S1G PPDU at or above –89 dBm within the primary 2 MHz channel with > 90% probability within a period of aCCAMidTime (see 23.4.4).

— Any of the applicable conditions listed in Table 23-33. An applicable condition shall be met (i.e., triggered) if the PHY detects the start of the described PPDU(s) in Table 23-33 with > 90% probability within a period of aCCATime (see 23.4.4).

For devices operating in type 2 channels, the PHY shall issue a PHY-CCA.indication(BUSY, {primary2}) if the conditions for issuing PHY-CCA.indication(BUSY, {primary1}) are not present and one of the following conditions is met in an otherwise idle 2 MHz, 4 MHz, 8 MHz, or 16 MHz operating channel width:

— An S1G_1M PPDU is detected in the nonprimary 1 MHz portion of the primary 2 MHz channel at or above –86 dBm within the nonprimary 1 MHz with > 90% probability within a period of aCCAMidTime (see 23.4.4).
— A ≥ 2 MHz S1G PPDU at or above –86 dBm within the primary 2 MHz channel with > 90% probability within a period of aCCAMidTime (see 23.4.4).
— Any of the applicable conditions listed in Table 23-34. An applicable condition shall be met (i.e., triggered) if the PHY detects the start of the described PPDU(s) in Table 23-34 with > 90% probability within a period of aCCATime (see 23.4.4).

The device shall not issue a PHY-CCA.indication(BUSY, {secondary2}), PHY-CCA.indication(BUSY, {secondary4}), or PHY-CCA.indication(BUSY, {secondary8}) until the end of the duration indicated by the packet or until all conditions above are no longer satisfied. Additionally, for both type 1 and type 2 channels, the device shall issue a PHY-CCA.indication(BUSY, {primary2}) if any received signal in the primary 2 MHz channel exceeds the CCA-ED threshold of –72 dBm within a period aCCATime.

Additionally, when a STA detects an S1G_SHORT or S1G_LONG PPDU with a Partial AID field of its SIG field indicating a partial AID or COLOR value that matches its own partial AID or BSSID, the PHY shall issue a PHY-CCA.indication(BUSY, {primary2}) for the remaining duration of the PPDU as indicated in its preamble.

Table 23-33—Additional conditions for CCA BUSY on the primary 2 MHz in type 1 channelization

Operating Channel Width	Conditions
2 MHz, 4 MHz, 8 MHz, 16 MHz	The start of a 2 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –92 dBm in the primary 2 MHz channel.
4 MHz, 8 MHz, 16 MHz	The start of a 4 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –89 dBm in the primary 4 MHz channel.
8 MHz, 16 MHz	The start of an 8 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –86 dBm in the primary 8 MHz channel.
16 MHz	The start of a 16 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –83 dBm.

Table 23-34—Additional conditions for CCA BUSY on the primary 2 MHz in type 2 channelization

Operating Channel Width	Conditions
2 MHz, 4 MHz, 8 MHz, 16 MHz	The start of a 2 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –89 dBm in the primary 2 MHz channel.
4 MHz, 8 MHz, 16 MHz	The start of a 4 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –86 dBm in the primary 4 MHz channel.
8 MHz, 16 MHz	The start of an 8 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –83 dBm in the primary 8 MHz channel.
16 MHz	The start of a 16 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –80 dBm.

23.3.17.5.4.2 CCA sensitivity for devices in type 2 channels implementing intended 8 or 16 MHz transmit channel width channel access procedure

For devices operating in type 2 channels, if the device intends to transmit an 8 or 16 MHz channel width PPDU and the device implements the procedure and rules for high intended BW transmission channel access described in 10.22.2.5a, the PHY shall issue a PHY-CCA.indication(BUSY, {primary1}) if one of the following conditions is present in an otherwise idle primary 1 MHz channel:

— The start of an S1G_1M PPDU or duplicate S1G_1M PPDU detected in the primary 1 MHz channel at or above –86 dBm within the primary 1 MHz channel with > 90% probability within a period aCCATime (see 23.4.4).
— Any S1G PPDU detected at or above –86 dBm with > 90% probability within a period of aCCAMidTime (see 23.4.4).

The device shall not issue a PHY-CCA.indication(BUSY, {primary2}), PHY-CCA.indication(BUSY, {secondary2}), PHY-CCA.indication(BUSY, {secondary4}), or PHY-CCA.indication(BUSY, {secondary8}) until the end of the duration indicated by the packet or until all conditions above are no longer satisfied. Additionally, the device shall issue a PHY-CCA.indication(BUSY, {primary1}) if any received signal in the primary 1 MHz channel exceeds the CCA-ED threshold of –75dBm within a period aCCATime.

The PHY shall issue a PHY-CCA.indication(BUSY, {primary2}) if the conditions for issuing PHY-CCA.indication(BUSY, {primary1}) are not present and one of the following conditions is met in an otherwise idle 8 MHz or 16 MHz operating channel width:

— An S1G_1M PPDU is detected in the nonprimary 1 MHz portion of the primary 2 MHz channel at or above –86 dBm within the nonprimary 1 MHz with > 90% probability within a period of aCCAMidTime (see 23.4.4).
— A ≥ 2 MHz S1G PPDU at or above –86 dBm within the primary 2 MHz channel with > 90% probability within a period of aCCAMidTime (see 23.4.4).
— Any of the applicable conditions listed in Table 23-35. An applicable condition shall be met (i.e., triggered) if the PHY detects the start of the described PPDU(s) in Table 23-35 with > 90% probability within a period of aCCATime (see 23.4.4).

The device shall not issue a PHY-CCA.indication(BUSY, {secondary2}), PHY-CCA.indication(BUSY, {secondary4}), or PHY-CCA.indication(BUSY, {secondary8}) until the end of the duration indicated by the packet or until all conditions above are no longer satisfied. Additionally, for both type 1 and type 2 channels, the device shall issue a PHY-CCA.indication(BUSY, {primary2}) if any received signal in the primary 2 MHz channel exceeds the CCA-ED threshold of –72 dBm within a period aCCATime.

Additionally, when a STA detects an S1G_SHORT or S1G_LONG PPDU with a Partial AID field of its SIG field indicating a partial AID or COLOR value that matches its own partial AID or BSSID, the PHY shall issue a PHY-CCA.indication(BUSY, {primary2}) for the remaining duration of the PPDU as indicated in its preamble .

Table 23-35—Additional conditions for CCA BUSY on the primary 2 MHz in type 2 channelization for 8/16 MHz intended channel width

Operating Channel Width	Conditions
8 MHz, 16 MHz	The start of a 2 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –86 dBm in the primary 2 MHz channel.
8 MHz, 16 MHz	The start of a 4 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –83 dBm in the primary 4 MHz channel.
8 MHz, 16 MHz	The start of an 8 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –80 dBm in the primary 8 MHz channel.
16 MHz	The start of a 16 MHz S1G_SHORT or S1G_LONG PPDU, or of a duplicate S1G_SHORT or S1G_LONG PPDU at or above –77 dBm.

23.3.17.5.5 CCA sensitivity for signals not occupying the primary 2 MHz channel

In S1G operation, the CCA sensitivity levels for detecting signals in the Secondary channels may be classified separately for type 1 or type 2 channels.

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary2}) if the conditions for issuing PHY-CCA.indication(BUSY, {primary2}) are not present and one of the following conditions are present in an otherwise idle 4 MHz, 8 MHz, 16 MHz operating channel width:

— For both type 1 and type 2 channels, any signal within the secondary 2 MHz channel at or above a threshold of –72 dBm within a period of aCCATime after the signal arrives at the receiver's antenna(s); then the PHY shall not issue a PHY-CCA.indication(BUSY,{secondary4}), PHY-CCA.indication(BUSY,{secondary8}) or PHY-CCA.indication(IDLE) while the threshold continues to be exceeded.
— For type 1 channels, a 2 MHz S1G PPDU detected in the secondary 2 MHz channel at or above –86 dBm with > 90% probability within a period aCCAMidTime (see 23.4.4).
— For type 2 channels, a 2 MHz S1G PPDU detected in the secondary 2 MHz channel at or above –82 dBm with > 90% probability within a period aCCAMidTime (see 23.4.4).

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary4}) if the conditions for issuing PHY-CCA.indication(BUSY, {primary2}) and PHY-CCA.indication(BUSY, {secondary2}) are not present and one of the following conditions are present in an otherwise idle 8 MHz, 16 MHz operating channel width:

- For both type 1 and type 2 channels, any signal within the secondary 4 MHz channel at or above a threshold of –69 dBm within a period of aCCATime after the signal arrives at the receiver's antenna(s); then the PHY shall not issue a PHY-CCA.indication(BUSY, {secondary8}) or PHY-CCA.indication(IDLE) while the threshold continues to be exceeded.
- For type 1 channels:
  - A 4 MHz S1G PPDU detected in the secondary 4 MHz channel at or above –86 dBm with > 90% probability within a period aCCAMidTime (see 23.4.4).
  - A 2 MHz S1G PPDU detected in any 2 MHz subchannel of the secondary 4 MHz channel at or above –86 dBm with > 90% probability within a period aCCAMidTime.
- For type 2 channels:
  - A 4 MHz S1G PPDU detected in the secondary 4 MHz channel at or above –82 dBm with > 90% probability within a period aCCAMidTime (see 23.4.4).
  - A 2 MHz S1G PPDU detected in any 2 MHz subchannel of the secondary 4 MHz channel at or above –82 dBm with > 90% probability within a period aCCAMidTime.

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary8}) if the conditions for PHY-CCA.indication(BUSY, {primary2}), PHY-CCA.indication(BUSY, {secondary2}) and PHY-CCA.indication(BUSY,{secondary4}) are not present and one of the following conditions are present in an otherwise idle 16 MHz operating channel width:

- For both type 1 and type 2 channels, any signal within the secondary 8 MHz channel at or above –66 dBm.
- For type 1 channels:
  - An 8 MHz S1G PPDU detected in the secondary 8 MHz channel at or above –83 dBm with > 90% probability within a period aCCAMidTime (see 23.4.4).
  - A 4 MHz S1G PPDU detected in any 4 MHz subchannel of the secondary 8 MHz channel at or above –86 dBm with > 90% probability within a period aCCAMidTime.
  - A 2 MHz S1G PPDU detected in any 2 MHz subchannel of the secondary 8 MHz channel at or above –86 dBm with > 90% probability within a period aCCAMidTime.
- For type 2 channels:
  - An 8 MHz S1G PPDU detected in the secondary 8 MHz channel at or above –79 dBm with > 90% probability within a period aCCAMidTime (see 23.4.4).
  - A 4 MHz S1G PPDU detected in any 4 MHz subchannel of the secondary 8 MHz channel at or above –82 dBm with > 90% probability within a period aCCAMidTime.
  - A 2 MHz S1G PPDU detected in any 2 MHz subchannel of the secondary 8 MHz channel at or above –82 dBm with > 90% probability within a period aCCAMidTime.

23.3.17.6 RSSI

The RSSI parameter returned in the RXVECTOR shall be calculated during the reception of the (D-)LTFs and shall be a monotonically increasing function of the received power.

23.3.18 PHY transmit procedure

The typical transmit procedure is shown in Figure 23-27, Figure 23-28, and Figure 23-29. For this transmit procedure, the FORMAT parameter of the PHY-TXSTART.request(TXVECTOR) primitive is S1G. These transmit procedures do not describe the operation of optional features, such as LDPC, STBC, or MU.

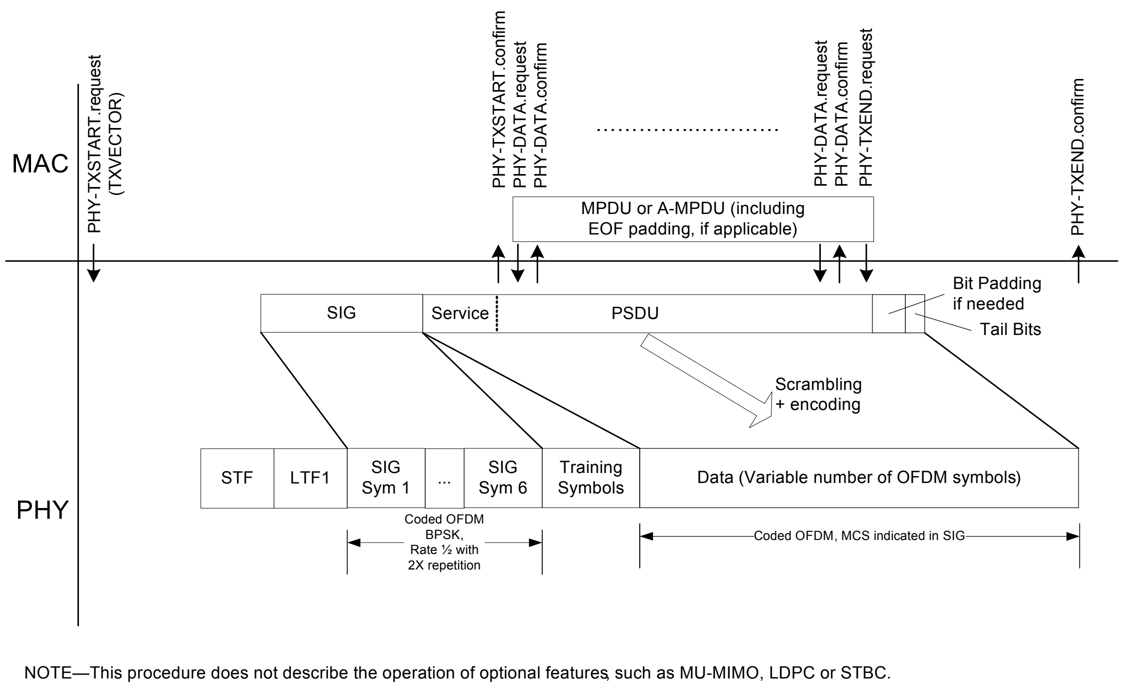


Figure 23-27—PHY transmit procedure for a SU transmission using S1G_1M preamble

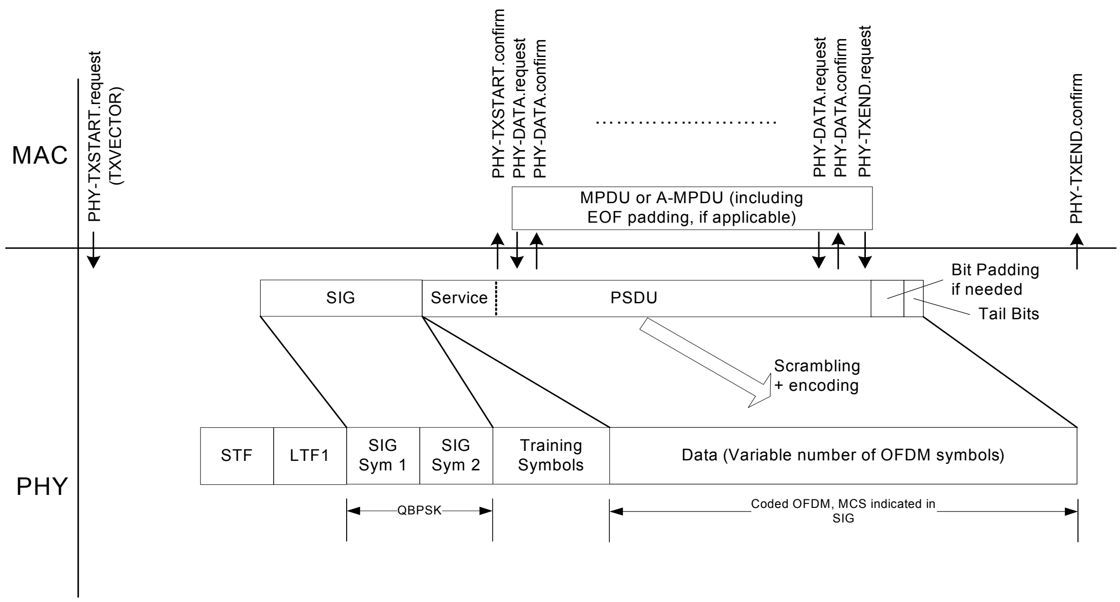
NOTE—For an MU PPDU the A-MPDU is per user in the MAC sublayer and the S1G Training Symbols, SIG-B, and Data are per user in the PHY layer in Figure 23-29, with the number S1G Training Symbols depending on the total number of space-time streams across all users.

In order to transmit data, the MAC generates a PHY-TXSTART.request primitive, which causes the PHY entity to enter the transmit state. Further, the PHY is set to operate at the appropriate frequency through station management via the PLME, as specified in 23.4.

Other transmit parameters, such as S1G-MCS Coding types and transmit power, are set via the PHY-SAP using the PHY-TXSTART.request(TXVECTOR) primitive, as described in 23.2.2.

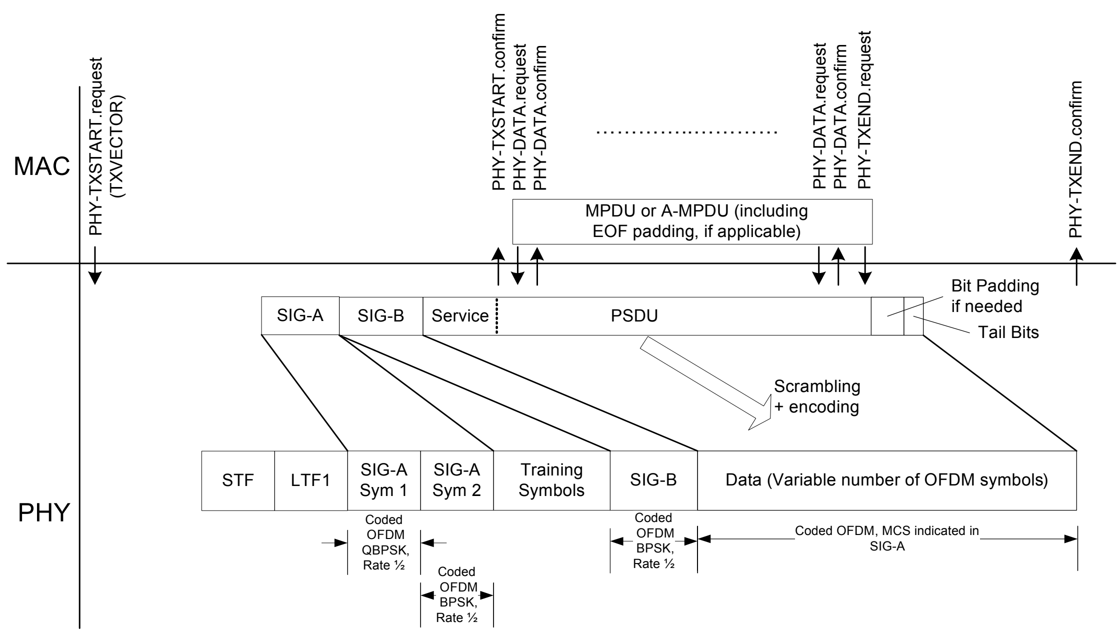
The PHY indicates the state of the primary channel and other channels (if any) via the PHY-CCA.indication primitive (see 23.3.17.5) and 8.3.5.12). Note that under some circumstances, the MAC uses the value of the PHY-CCA.indication primitive before (and if) issuing the PHY-TXSTART.request primitive. Transmission of the PPDU shall be initiated by the PHY after receiving the PHY-TXSTART.request(TXVECTOR) primitive. The TXVECTOR elements for the PHY-TXSTART.request primitive are specified in Table 23-1.

Transmission of the PHY preamble shall start immediately, using the parameters passed in the PHY-TXSTART.request primitive and the PHY shall issue a PHY-TXSTART.confirm (TXSTATUS) primitive to the MAC.



NOTE—This procedure does not describe the operation of optional features, such as MU-MIMO, LDPC or STBC.

Figure 23-28—PHY transmit procedure for a SU transmission using S1G_SHORT preamble



NOTE—This procedure does not describe the operation of optional features, such as MU-MIMO, LDPC or STBC.

Figure 23-29—PHY transmit procedure for a SU transmission using S1G_LONG preamble

After the PHY preamble transmission is started, the PHY entity immediately initiates data scrambling and data encoding. The encoding method for the Data field is based on the FEC_CODING, CH_BANDWIDTH, NUM_STS, STBC, MCS, and NUM_USERS parameter of the TXVECTOR, as described in 23.3.2.

The SERVICE field and PSDU are encoded as described in 23.3.3. The data shall be exchanged between the MAC and the PHY through a series of PHY-DATA.request(DATA) primitives issued by the MAC, and PHY-DATA.confirm primitives issued by the PHY. Zero to seven PHY padding bits are appended to the PSDU to make the number of bits in the coded PSDU an integral multiple of the number of coded bits per OFDM symbol.

Transmission can be prematurely terminated by the MAC through the primitive PHY-TXEND.request. PSDU transmission is terminated by receiving a PHY-TXEND.request primitive. Each PHY-TXEND.request is acknowledged with a PHY-TXEND.confirm primitive from the PHY. In an SU transmission, normal termination occurs after the transmission of the final bit of the last PSDU octet, according to the number of OFDM symbols indicated by NSYM (see 23.4.3).

In the PHY, the GI or short GI is inserted in every data OFDM symbol as a countermeasure against delay spread.

When the PPDU transmission is completed the PHY entity enters the receive state.

A typical state machine implementation of the transmit PHY for an SU transmission is provided in Figure 23-30. Request (.request) and confirmation (.confirm) primitives are issued once per state as shown. This state machine does not describe the operation of optional features, such as multi-user, LDPC, or STBC.

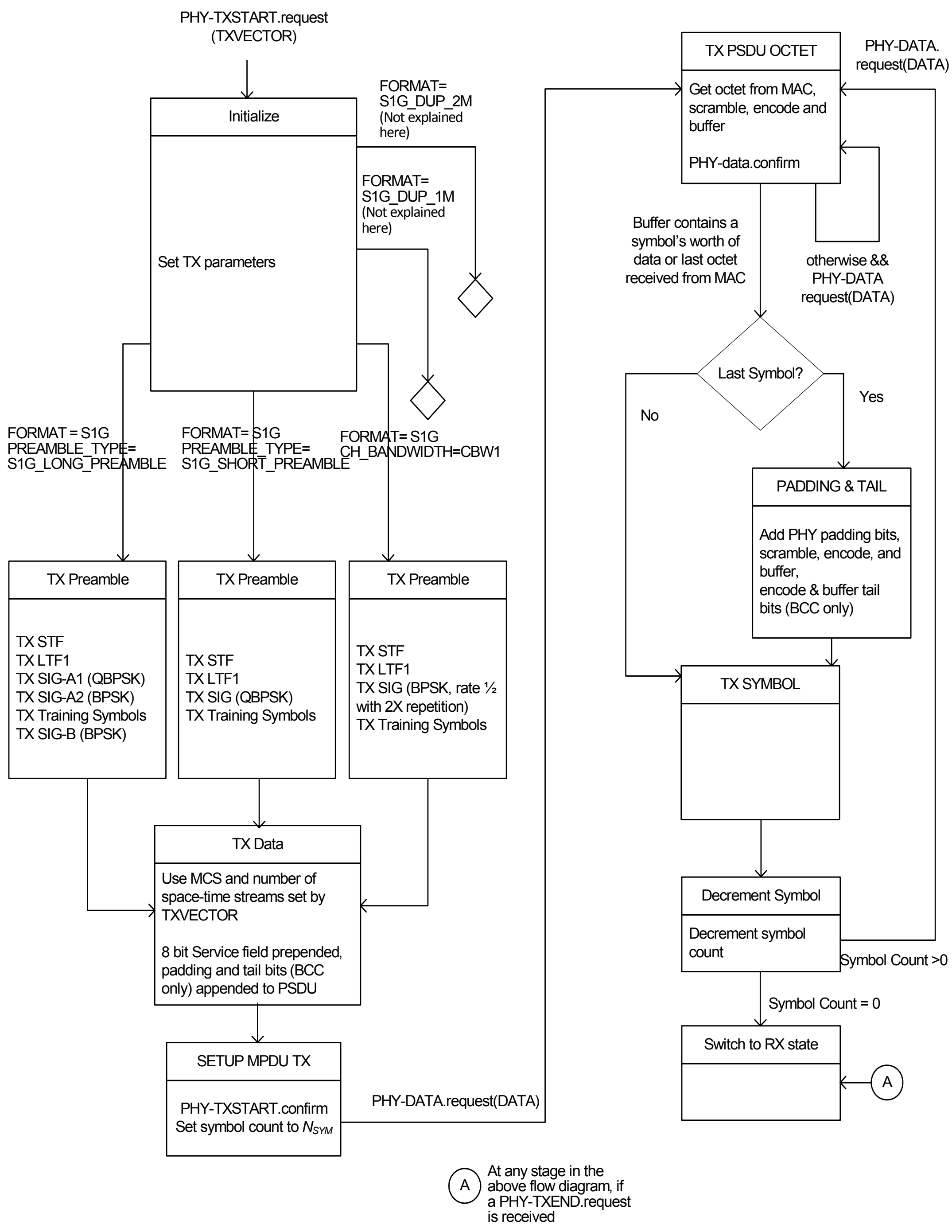
23.3.19 PHY receive procedure

Typical PHY receive procedures are shown in Figure 23-31, Figure 23-32, and Figure 23-33, corresponding to S1G_1M preamble format, S1G_SHORT preamble format, and S1G_LONG preamble format, respectively. A typical state machine implementation of the receive PHY is given in Figure 23-34. This receive procedure and state machine do not describe the operation of optional features, such as LDPC or STBC. Through station management (via the PLME) the PHY is set to the appropriate frequency, as specified in 23.4. The PHY has also been configured with group information (i.e., group membership and position in group) so that it can receive data intended for the STA. Other receive parameters, such as RSSI and indicated DATARATE, may be accessed via the PHY-SAP.

Upon receiving the transmitted PHY preamble overlapping the primary 2 MHz channel in a greater than or equal to 2 MHz BSS, or primary 1 MHz channel in a 1 MHz BSS, the PHY measures a receive signal strength. This activity is indicated by the PHY to the MAC via a PHY-CCA.indication primitive. A PHY-CCA.indication(BUSY, channel-list) primitive is also issued as an initial indication of reception of a signal as specified in 23.3.17.5. The CH_BANDWIDTH parameter indicates one of the 1 MHz, 2 MHz, 4 MHz, 8 MHz and 16 MHz channel widths.

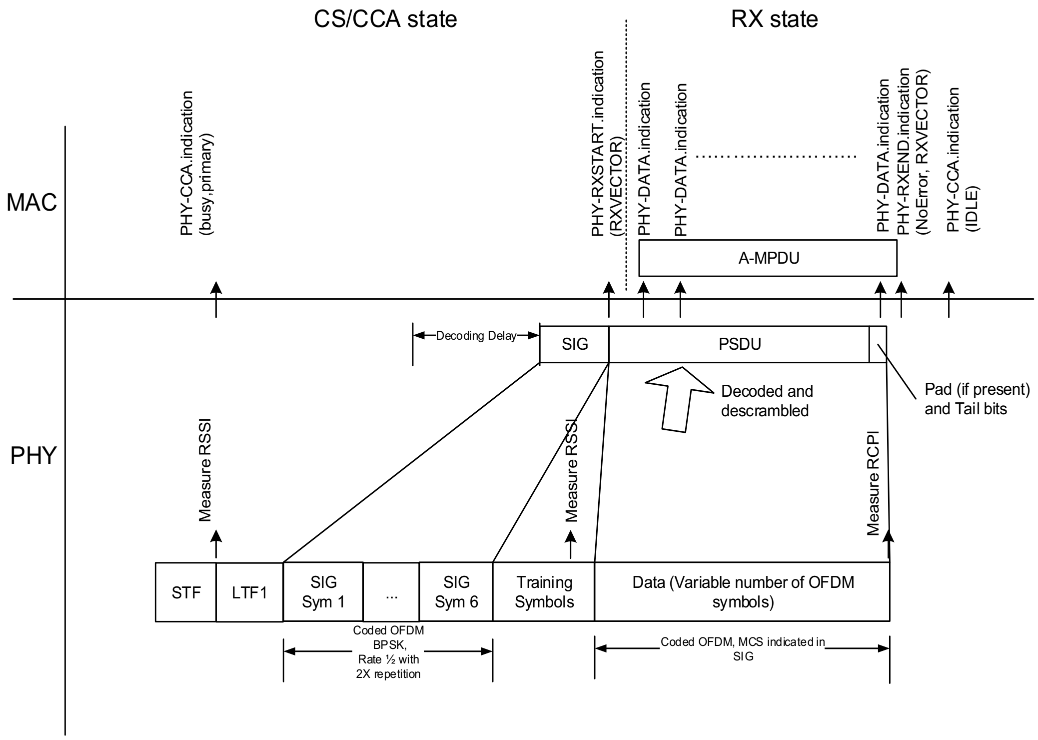
The PHY shall not issue a PHY-RXSTART.indication primitive in response to a PPDU that does not overlap the primary channel.

The PHY includes the most recently measured RSSI value in the PHY-RXSTART.indication(RXVECTOR) primitive issued to the MAC.



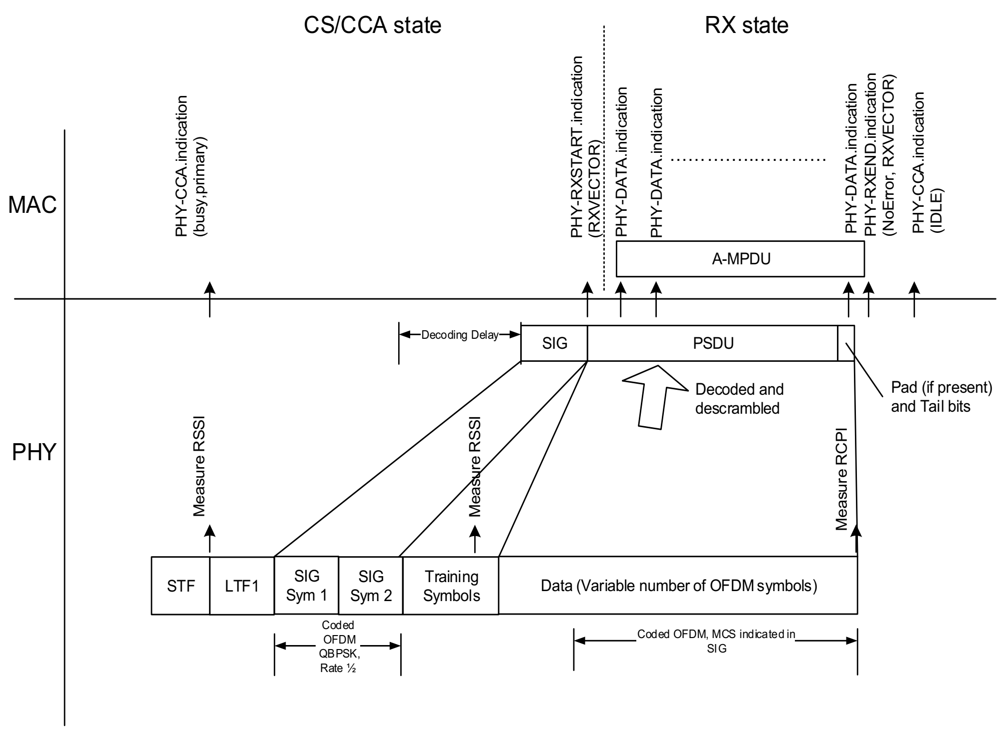
NOTE—This state machine does not describe the operation of optional features, such as MU-MIMO, LDPC or STBC.

Figure 23-30—PHY transmit state machine for a SU transmission



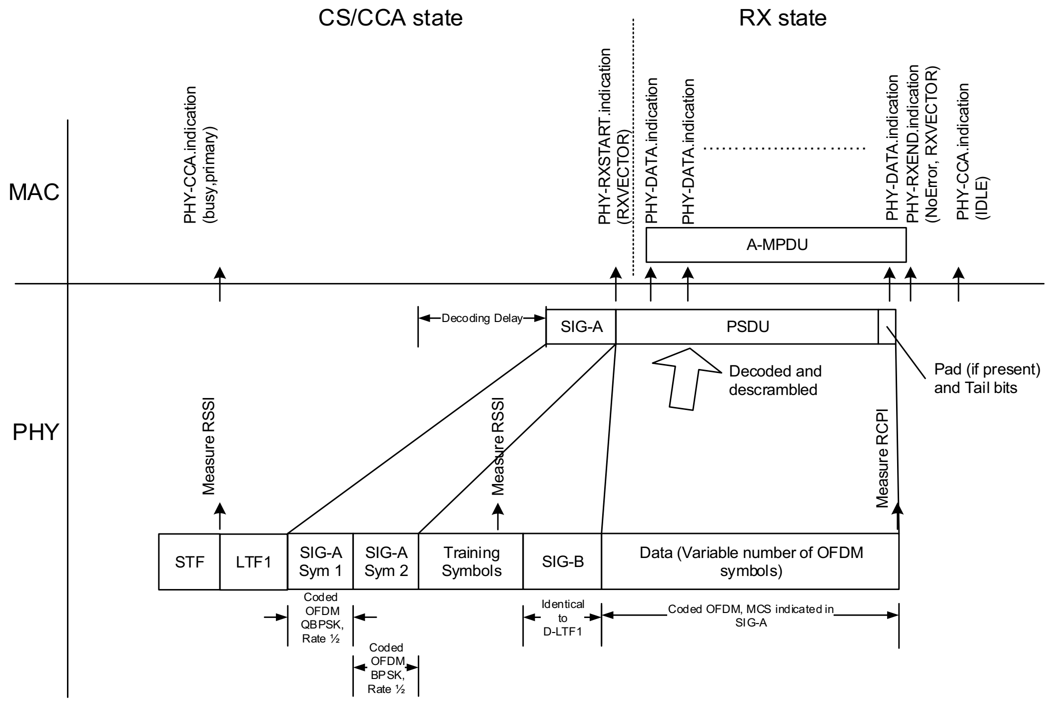
NOTE—This procedure does not describe the operation of optional features, such as LDPC or STBC.

Figure 23-31—PHY Receive procedure for a SU transmission, S1G_1M preamble



NOTE—This procedure does not describe the operation of optional features, such as LDPC or STBC.

Figure 23-32—PHY Receive procedure for a SU transmission, S1G_SHORT preamble



NOTE—This procedure does not describe the operation of optional features, such as LDPC or STBC. This procedure describes the case where SIG-A indicates a mode not requiring decoding of SIG-B.

Figure 23-33—PHY Receive procedure for a SU transmission, S1G_LONG preamble

After the PHY-CCA.indication(BUSY, channel-list) is issued, the PHY entity shall begin receiving the training symbols and searching for SIG or SIG-A in order to set the maximum duration of the data stream and get other PHY parameters such as the demodulation type, code type, and the decoding rate. If the check of the SIG or SIG-A CRC is not valid, a PHY-RXSTART.indication primitive is not issued, and instead the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation) primitive, and set PHY_CCA.indication(IDLE) when receive level drops below threshold (minimum modulation and coding rate sensitivity + 20 dB). If a valid SIG or SIG-A CRC is indicated, and the Uplink Indication bit is 1 and the ID field value matches the PBSSID of the BSS of which the STA is a member or the Uplink Indication bit is 0 and the COLOR field value matches the COLOR indicated by the AP to which the STA is associated, then the S1G PHY shall maintain PHY-CCA.indication(BUSY, channel-list) for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (23-65) or Equation (23-66), for all supported modes, unsupported modes, and Reserved SIG or SIG-A Indication. If a valid SIG or SIG-A CRC is indicated, and the Uplink Indication bit is 1 and the ID field value does not match the PBSSID of the BSS of which the STA is a member or the Uplink Indication bit is 0 and the COLOR field value does not match the COLOR indicated by the AP to which the STA is associated, then the S1G PHY shall maintain PHY-CCA.indication(BUSY, channel-list) for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (23-65) or Equation (23-66), for all supported modes, unsupported modes, and Reserved SIG-A Indication if the reception meets the minimum CCA sensitivity level specified in 23.3.17.5.4. Reserved SIG or SIG-A Indication is defined as an SIG or SIG-A with Reserved bits equal to 0 or a combination not valid as defined in 23.3.8.2.1.4, 23.3.8.2.2.1.5, or 23.3.8.3.4, or a combination of S1G-MCS and NSTS not included in 23.5 or any other SIG or SIG-A field bit combinations that do not correspond to modes of PHY operation defined in Clause 23.

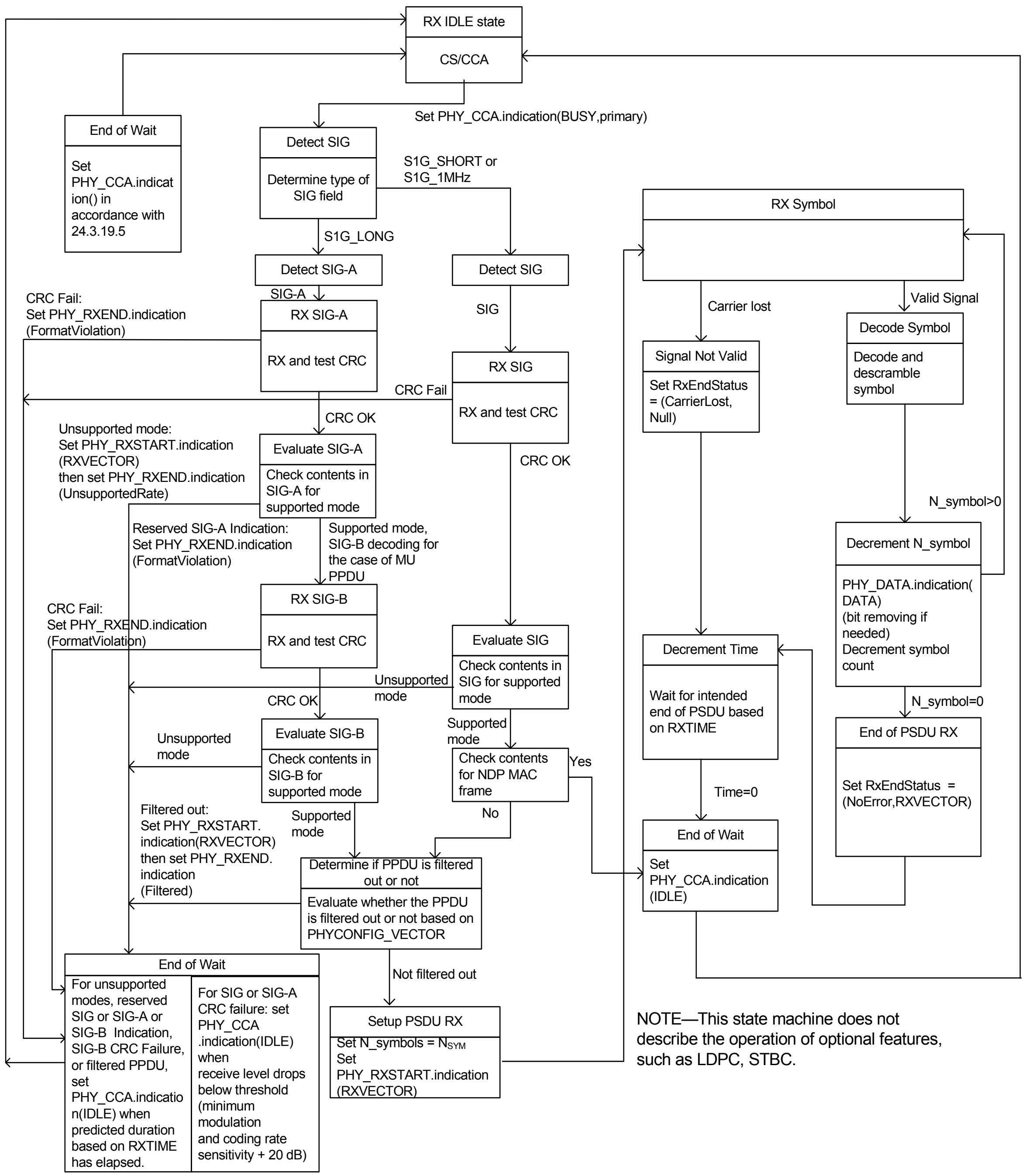


Figure 23-34—PHY receive state machine

Subsequently, if dot11TimingMsmtActivated is true, a PHY-RXSTART.indication (RXVECTOR) shall be issued and RX_START_OF_FRAME_OFFSET parameter within the RXVECTOR shall be forwarded (see 23.2.2).

NOTE—The RX_START_OF_FRAME_OFFSET value is used as described in 6.3.57 in order to estimate when the start of the preamble for the incoming frame was detected on the medium at the receive antenna connector.

If the SIG or SIG-A indicates an unsupported mode, the PHY shall issue PHY-RXEND.indication(UnsupportedRate). If the SIG or SIG-A indicates an invalid CRC or Reserved SIG or SIG-A Indication, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation).

If the PHY preamble reception is successful and a valid SIG or SIG-A CRC is indicated:

— Upon reception of an S1G_LONG format preamble, after receiving a valid SIG-A indicating a supported mode, the PHY entity shall begin receiving the rest of S1G training symbols and SIG-B. If the received MU/SU subfield in SIG-A has a value indicating SU PPDU (see 23.3.8.2.2.1.5), the PHY entity does not need to decode SIG-B since in this case SIG-B does not carry any information bit (see 23.3.8.2.2.2.5). If the SIG-B is not decoded, subsequent to an indication of a valid SIG-A, a PHY-RXSTART.indication (RXVECTOR) primitive shall be issued.

  If the received MU/SU subfield in SIG-A has a value indicating MU PPDU (see 23.3.8.2.2.1.5), SIG-B shall be decoded. If the check of the SIG-B CRC is not valid, a PHY-RXSTART.indication primitive is not issued, and instead the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation) primitive, and the S1G PHY shall maintain PHYCCA.indication(BUSY, channel-list) for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (23-65) or Equation (23-66), for all supported modes, unsupported modes, and Reserved SIG-B Indication. If the SIG-B indicates an unsupported mode, the PHY shall issue the error condition PHY-RXEND.indication(UnsupportedRate) primitive, and a PHY-RXSTART.indication primitive shall not be issued. If the check of the SIG-B CRC is valid and it indicates a supported mode, a PHY-RXSTART.indication(RXVECTOR) primitive shall be issued. The RXVECTOR associated with this primitive includes the parameters specified in Table 23-1.

— Upon reception of an S1G_SHORT or S1G_1M format preamble, after receiving a valid SIG indicating a supported mode, the PHY entity shall begin receiving the rest of S1G training symbols, and then A PHY-RXSTART.indication(RXVECTOR) primitive shall be issued. The RXVECTOR associated with this primitive includes the parameters specified in Table 23-1.

  In this case, if the NDP Indication subfield in SIG field has a value indicating an NDP CMAC frame, the PHY shall generate a PHYCCA.indication(IDLE) primitive and return to RX IDLE state, and it shall not issue the PHY-RXSTART.indication(RXVECTOR) primitive.

The PHY optionally filters out the PPDU based on the GID, MU[0-3] NSTS, UPLINK_INDICATION and ID fields of SIG or SIG-A and the contents of the PHYCONFIG_VECTOR as follows:

— The PHY shall not filter out the PPDU if one of the following is true:
  — ($g = 0$) and (l_{00} is true) and (*partialaid* is included in PARTIAL_AID_LIST_GID00)
  — ($g = 63$) and (l_{63} is true) and (*partialaid* is included in PARTIAL_AID_LIST_GID63)
  — ($1 <= g <= 62$) and (MembershipStatusInGroupID[g] = 1) and (n_{STS}[UserPositionInGroupID[g]] > 0)
— where
  — l_{NN} is the one of the LISTEN_TO_GID*NN* parameters of the PHYCONFIG_VECTOR
  — MembershipStatusInGroupID[g] is the Membership Status Array field of the GROUP_ID_MANAGEMENT parameter of the PHYCONFIG_VECTOR for group g
  — g is defined to be
    — The value of the GroupID field of the SIG-A for an S1G MU PPDU
    — 0 for an S1G SU PPDU when UPLINK_INDICATION is equal to 1
    — 63, in all other cases
  — $n_{STS}[u]$ is the value of the MU[u] NSTS field of SIG or SIG-A
  — UserPositionInGroupID[g] is the User Position Array field of the GROUP_ID_MANAGEMENT parameter of the PHYCONFIG_VECTOR for group g
  — *partialaid* is the value of the ID field of SIG or SIG-A
— Otherwise, the PHY may filter out the PPDU.

If the PPDU is filtered out, the PHY shall issue a PHY-RXEND.indication(Filtered) primitive.

The Data field follows the training and signal fields. When the Coding subfield in SIG or SIG-A field indicates BCC, the number of symbols in the Data field is determined by Equation (23-61).

$$N_{SYM} = \begin{cases} \text{LENGTH}, & \text{if Aggregation} = 1 \\ m_{STBC} \times \left\lceil \dfrac{8.LENGTH + N_{service} + N_{tail}.N_{ES}}{m_{STBC}.N_{DBPS}} \right\rceil, & \text{if Aggregation} = 0 \end{cases} \tag{23-61}$$

where

N_{ES} and N_{DBPS}	are defined in Table 23-6
$N_{service}$ and N_{tail}	are defined in Table 23-4
m_{STBC}	is equal to 2 when STBC is used, and 1 otherwise
LENGTH and Aggregation	are the values indicated by the LENGTH and Aggregation subfields of SIG or SIG-A field, respectively

When the Coding subfield in SIG or SIG-A indicates LDPC and Aggregation subfield in SIG or SIG-A field is 1, the number of symbols in the Data field is determined by Equation (23-62).

$$N_{SYM} = LENGTH \tag{23-62}$$

where

LENGTH is the value indicated by the LENGTH subfield of SIG or SIG-A field

When the Coding subfield in SIG or SIG-A indicates LDPC and Aggregation subfield in SIG or SIG-A field is 0, the parameter $N_{SYM,\ init}$ is determined by Equation (23-63)

$$N_{SYM,init} = m_{STBC} \times \left\lceil \frac{8.LENGTH + N_{service}}{m_{STBC}.N_{DBPS}} \right\rceil \tag{23-63}$$

where

N_{DBPS}	is defined in Table 23-6
$N_{service}$	is defined in Table 23-4
m_{STBC}	is equal to 2 when STBC is used, and 1 otherwise
LENGTH	is the value indicated by the LENGTH subfield of SIG or SIG-A field

In this case, the number of symbols in the Data field N_{SYM} is determined by Equation (23-64)

$$N_{SYM} = \begin{cases} N_{SYM,init}, & \text{if LDPC Extra OFDM Symbol} = 0 \\ N_{SYM,init} + 1, & \text{if LDPC Extra OFDM Symbol} = 1 \text{ and STBC} = 0 \\ N_{SYM,init} + 2, & \text{if LDPC Extra OFDM Symbol} = 1 \text{ and STBC} = 1 \end{cases} \tag{23-64}$$

where

LENGTH	is the value indicated by the LENGTH subfield of SIG or SIG-A field
LDPC Extra OFDM Symbol	is the value indicated by LDPC Extra subfield in SIG or SIG-A field
STBC	is the value indicated by the STBC subfield in SIG or SIG-A field

The PHY parameter RXTIME for the case of S1G_SHORT or S1G_1M format is determined by Equation (23-65)

$$RXTIME(\mu s) = \begin{cases} T_{DSTF} + T_{LTF}(N_{LTF} - 1) + N_{SYM} T_{SYML}, & \text{if Short GI} = 0 \\ T_{DSTF} + T_{LTF}(N_{LTF} - 1) + T_{SYML} + (N_{SYM} - 1).T_{SYMS}, & \text{if Short GI} = 1 \end{cases} \tag{23-65}$$

where

T_{LTF} , T_{SYML} and T_{SYMS} are defined in Table 23-4

N_{LTF} is defined in Table 23-10

The PHY parameter RXTIME for the case of S1G_LONG format is determined by Equation (23-66)

$$RXTIME(\mu s) = \begin{cases} T_{DSTF} + N_{LTF} T_{DLTF} + T_{SIG-B} + N_{SYM} T_{SYML}, & \text{if Short GI} = 0 \\ T_{DSTF} + N_{LTF} T_{DLTF} + T_{SIG-B} + T_{SYML} + (N_{SYM} - 1).T_{SYMS}, & \text{if Short GI} = 1 \end{cases} \tag{23-66}$$

where

T_{DLTF} , T_{SIG-B} , T_{SYML} and T_{SYMS} are defined in Table 23-4

N_{LTF} is defined in Table 23-10

When the Aggregation bit in the SIG or SIG-A field is equal to 0, the value of the PSDU_LENGTH parameter returned in the RXVECTOR using is set to the LENGTH field of the SIG/SIG-A.

When the Aggregation bit in the SIG or SIG-A field is equal to 1, the value of the PSDU_LENGTH parameter returned in the RXVECTOR using BCC encoding is calculated using Equation (23-67).

$$\text{PSDU\_LENGTH} = \left\lfloor \frac{N_{SYM} N_{DBPS} - N_{service} - N_{tail} \cdot N_{ES}}{8} \right\rfloor \tag{23-67}$$

where

N_{ES} is defined in Table 23-6

N_{DBPS} is defined in Table 23-6

$N_{service}$ and N_{tail} are defined in Table 23-4

The value of the PSDU_LENGTH parameter returned in the RXVECTOR using LDPC encoding is calculated using Equation (23-68)

$$PSDU\_LENGTH = \left\lfloor \frac{N_{SYM} \cdot N_{DBPS} - N_{service}}{8} \right\rfloor \tag{23-68}$$

where

N_{DBPS} is defined in Table 23-6

$N_{service}$ is defined in Table 23-4

When the Aggregation bit in the SIG or SIG-A field is equal to 1, the value of the PSDU_LENGTH parameter returned in the RXVECTOR for an NDP sounding or an NDP CMAC frame is 0.

If signal loss occurs during reception prior to completion of the PSDU reception, the error condition PHY-RXEND.indication(CarrierLost) shall be reported to the MAC. After waiting for the end of the PSDU as determined by Equation (23-65) or Equation (23-66), the PHY shall set the PHY-CCA.indication(IDLE) primitive and return to the RX IDLE state.

The received PSDU bits are assembled into octets, decoded, and presented to the MAC using a series of PHY-DATA.indication(DATA) primitive exchanges. Any final bits that cannot be assembled into a complete octet are considered pad bits and discarded. After the reception of the final bit of the last PSDU octet, and possible padding and tail bits, the receiver shall be returned to the RX IDLE state, as shown in Figure 23-34.

23.4 S1G PLME

23.4.1 PLME_SAP sublayer management primitives

Table 23-36 lists the MIB attributes that may be accessed by the PHY entities and the intra-layer of higher level LMEs. These attributes are accessed via the PLME-GET, PLME-SET, PLME-RESET, and PLME-CHARACTERISTICS primitives defined in 6.5.

Table 23-36—S1G PHY MIB attributes

Managed Object	Default value/ range	Operational Semantics
dot11PHYOperationTable		
dot11PHYType	s1g	Static
dot11PHYTxPowerTable		
dot11NumberSupportedPowerLevels	Implementation dependent	Static
dot11TxPowerLevel1	Implementation dependent	Static
dot11TxPowerLevel2	Implementation dependent	Static
dot11TxPowerLevel3	Implementation dependent	Static
dot11TxPowerLevel4	Implementation dependent	Static
dot11TxPowerLevel5	Implementation dependent	Static
dot11TxPowerLevel6	Implementation dependent	Static
dot11TxPowerLevel7	Implementation dependent	Static
dot11TxPowerLevel8	Implementation dependent	Static
dot11CurrentTxPowerLevel	Implementation dependent	Static

Table 23-36—S1G PHY MIB attributes *(continued)*

Managed Object	Default value/ range	Operational Semantics
dot11TxPowerLevelExtended	Implementation dependent	Static
dot11CurrentTxPowerLevelExtended	Implementation dependent	Static
dot11PHYS1GTable		
dot11CurrentPrimaryChannel	Implementation dependent	Dynamic
dot11CurrentChannelWidth	Implementation dependent	Dynamic
dot11CurrentChannelCenterFrequencyIndex	Implementation dependent	Dynamic
dot11S1GChannelWidthOptionImplemented	Implementation dependent	Static
dot11ShortGIOptionIn1MImplemented	False/Boolean	Static
dot11ShortGIOptionIn1MActivated	False/Boolean	Dynamic
dot11ShortGIOptionIn2MImplemented	False/Boolean	Static
dot11ShortGIOptionIn2MActivated	False/Boolean	Dynamic
dot11ShortGIOptionIn4MImplemented	False/Boolean	Static
dot11ShortGIOptionIn4MActivated	False/Boolean	Dynamic
dot11ShortGIOptionIn8MImplemented	False/Boolean	Static
dot11ShortGIOptionIn8MActivated	False/Boolean	Dynamic
dot11ShortGIOptionIn16MImplemented	False/Boolean	Static
dot11ShortGIOptionIn16MActivated	False/Boolean	Dynamic
dot11S1GLDPCCodingOptionImplemented	False/Boolean	Static
dot11S1GLDPCCodingOptionActivated	False/Boolean	Dynamic
dot11S1GTxSTBCOptionImplemented	False/Boolean	Static
dot11S1GTxSTBCOptionActivated	False/Boolean	Dynamic
dot11S1GRxSTBCOptionImplemented	False/Boolean	Static
dot11S1GRxSTBCOptionActivated	False/Boolean	Dynamic
dot11S1GMaxNTxChainsImplemented	Implementation dependent	Static
dot11S1GMaxNTxChainsActivated	Implementation dependent	Dynamic
dot11S1GTravelingPilotOptionImplemented	Implementation dependent	Static
dot11S1GTravelingPilotOptionActivated	Implementation dependent	Static

Table 23-36—S1G PHY MIB attributes *(continued)*

Managed Object	Default value/ range	Operational Semantics
dot11S1GTransmitBeamformingConfigTable		
dot11ReceiveStagggerSoundingOptionImplemented	False/Boolean	Static
dot11TransmitStagggerSoundingOptionImplemented	False/Boolean	Static
dot11ReceiveNDPOptionImplemented	False/Boolean	Static
dot11TransmitNDPOptionImplemented	False/Boolean	Static
dot11ImplicitTransmitBeamformingOptionImplemented	False/Boolean	Static
dot11CalibrationOptionImplemented	Implementation dependent	Static
dot11ExplicitCSITransmitBeamformingOptionImplemented	False/Boolean	Static
dot11ExplicitNonCompressedBeamformingMatrixOptionImplemented	False/Boolean	Static
dot11ExplicitTransmitBeamformingCSIFeedbackOptionImplemented	Implementation dependent	Static
dot11ExplicitNoncompressedBeamformingFeedbackOptionImplemented	Implementation dependent	Static
dot11ExplicitcompressedBeamformingFeedbackOptionImplemented	Implementation dependent	Static
dot11NumberBeamformingCSISupportAntenna	Implementation dependent	Static
dot11NumberNonCompressedBeamformingMatrixSupportAntenna	Implementation dependent	Static
dot11NumberCompressedBeamformingMatrixSupportAntenna	Implementation dependent	Static
dot11S1GSUBeamformerOptionImplemented	False/Boolean	Static
dot11S1GSUBeamformeeOptionImplemented	False/Boolean	Static
dot11S1GMUBeamformerOptionImplemented	False/Boolean	Static
dot11S1GMUBeamformeeOptionImplemented	False/Boolean	Static
dot11S1GNumberSoundingDimensions	Implementation dependent	Static
dot11S1GBeamformeeNTxSupport	Implementation dependent	Static

23.4.2 PHY MIB

S1G PHY MIB attributes are defined in Annex C with specific values defined in Table 23-36. The "Operational semantics" column in Table 23-36 contains two types: static and dynamic.

— Static MIB attributes are fixed and cannot be modified for a given PHY implementation.
— Dynamic MIB attributes are interpreted according to the MAX-ACCESS field of the MIB attribute.

When MAX-ACCESS is read-only, the MIB attribute value may be updated by the PLME and read from the MIB attribute by management entities. When MAX-ACCESS is read-write, the MIB attribute may be read and written by management entities but shall not be updated by the PLME.

23.4.3 TXTIME and PSDU_LENGTH calculation

For S1G_SHORT preamble, the value of the TXTIME parameter returned by the PLME-TXTIME.confirm primitive shall be calculated for an S1G PPDU using Equation (23-69) for short GI and Equation (23-70) for long GI.

$$\mathrm{TXTIME} = \begin{cases} T_{PREAMBLE} + T_{SIG} + T_{LTF} \cdot (N_{LTF} - 1), \text{ if } N_{SYM} = 0 \\ T_{PREAMBLE} + T_{SIG} + T_{LTF} \cdot (N_{LTF} - 1) + T_{SYML} + T_{SYMS} \cdot (N_{SYM} - 1), \text{ if} N_{SYM} > 0 \end{cases} \tag{23-69}$$

$$\mathrm{TXTIME} = T_{PREAMBLE} + T_{SIG} + T_{LTF} \cdot (N_{LTF} - 1) + T_{SYML} \cdot N_{SYM} \tag{23-70}$$

where

$T_{PREAMBLE} = T_{STF} + T_{LTF1}$

T_{STF}, T_{LTF1}, T_{LTF}, T_{SYML} and T_{SYMS} are defined in Table 23-4

T_{SIG} is defined in Table 23-5.

N_{LTF} is defined in Table 23-10

For S1G_LONG preamble, the value of the TXTIME parameter returned by the PLME-TXTIME.confirm primitive shall be calculated for an S1G PPDU using Equation (23-71) for short GI and Equation (23-72) for long GI.

$$\mathrm{TXTIME} = \begin{cases} T_{PREAMBLE} + T_{SIG-A} + T_{D\_PREAMBLE} + T_{SIG-B}, \text{ if } N_{SYM} = 0 \\ T_{PREAMBLE} + T_{SIG-A} + T_{D\_PREAMBLE} + T_{SIG-B} + T_{SYML} + T_{SYMS} \cdot (N_{SYM} - 1), \text{ if } N_{SYM} > 0 \end{cases} \tag{23-71}$$

$$\mathrm{TXTIME} = T_{PREAMBLE} + T_{SIG-A} + T_{D\_PREAMBLE} + T_{SIG-B} + T_{SYML} N_{SYM} \tag{23-72}$$

where

$T_{PREAMBLE} = T_{STF} + T_{LTF1}$

$T_{D\_PREAMBLE} = T_{DSTF} + T_{DLTF} \cdot N_{LTF}$

T_{STF}, T_{LTF1}, T_{DSTF}, T_{DLTF}, T_{SIG-B}, T_{SYML} and T_{SYMS} are defined in Table 23-4

T_{SIG-A} is defined in Table 23-5.

N_{LTF} is defined in Table 23-10.

For S1G_1M preamble, the value of the TXTIME parameter returned by the PLME-TXTIME.confirm primitive shall be calculated for an S1G PPDU using Equation (23-73) for short GI and Equation (23-74) for long GI.

$$\mathrm{TXTIME} = \begin{cases} T_{PREAMBLE} + T_{SIG} + T_{LTF} \cdot (N_{LTF} - 1), \text{ if } N_{SYM} = 0 \\ T_{PREAMBLE} + T_{SIG} + T_{LTF} \cdot (N_{LTF} - 1) + T_{SYML} + T_{SYMS}(N_{SYM} - 1), \text{ if } N_{SYM} > 0 \end{cases} \tag{23-73}$$

$$\mathrm{TXTIME} = T_{PREAMBLE} + T_{SIG} + T_{LTF} \cdot (N_{LTF} - 1) + T_{SYML} N_{SYM} \tag{23-74}$$

where

$T_{PREAMBLE} = T_{STF} + T_{LTF1}$

T_{STF}, T_{LTF1}, T_{LTF}, T_{SIG}, T_{SYML} and T_{SYMS} are defined in Table 23-4

N_{LTF} is defined in Table 23-10

For an NDP, there is no Data field and $N_{SYM} = 0$.

For an S1G SU PPDU using BCC encoding, the total number of data symbols in the Data field is given by Equation (23-75).

$$N_{SYM} = m_{STBC} \times \left\lceil \frac{8 \cdot APEP\_LENGTH + N_{service} + N_{tail} \cdot N_{ES}}{m_{STBC} \cdot N_{DBPS}} \right\rceil \tag{23-75}$$

where

m_{STBC} is equal to 2 when STBC is used, and 1 otherwise

N_{ES} and N_{DBPS} are defined in Table 23-6

$N_{service}$ and N_{tail} are defined in Table 23-4

For an S1G SU PPDU using LDPC encoding, the total number of data symbols in the Data field, N_{SYM}, is given in 23.3.9.4.4.

For an S1G MU PPDU, the total number of data symbols in the Data field, N_{SYM}, is given by

$$N_{SYM} = \max\{N_{SYM,u}\}_{u=0}^{N_{user}-1}$$

where

$N_{SYM,u}$ is defined in Equation (23-75) for BCC and in 23.3.9.4.4 for LDPC

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an S1G SU PPDU using BCC encoding is calculated using Equation (23-76)

$$PSDU\_LENGTH = \left\lfloor \frac{N_{SYM} \cdot N_{DBPS} - N_{service} - N_{tail} N_{ES}}{8} \right\rfloor \tag{23-76}$$

where

N_{SYM} is given by Equation (23-75)

N_{ES} and N_{DBPS} are defined in Table 23-6

$N_{service}$ and N_{tail} are defined in Table 23-4.

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an S1G SU PPDU using LDPC encoding is calculated using Equation (23-77)

$$PSDU\_LENGTH = \left\lfloor \frac{N_{SYM,init} \cdot N_{DBPS} - N_{service}}{8} \right\rfloor \tag{23-77}$$

where

$N_{SYM,init}$ is given by Equation (21-62)

N_{DBPS} is defined in Table 23-6
$N_{service}$ is defined in Table 23-4.

The value of the PSDU_LENGTH parameter for user u returned in the PLME-TXTIME.confirm primitive and in the RXVECTOR for an S1G MU PPDU is calculated using Equation (23-78)

$$PSDU\_LENGTH_u = \begin{cases} \left\lfloor \dfrac{N_{SYM} \cdot N_{DBPS,u} - N_{service} - N_{tail} N_{ES,u}}{8} \right\rfloor & \text{when BCC is used for user } u \\ \left\lfloor \dfrac{N_{SYM\_\max\_init} \cdot N_{DBPS,u} - N_{service}}{8} \right\rfloor & \text{when LDPC is used for user } u \end{cases} \tag{23-78}$$

where
$N_{SYM\_\mathrm{max\_init}}$ is given by Equation (21-65)
$N_{ES,u}$ is N_{ES} for user u, where N_{ES} is defined in Table 23-6
$N_{DBPS,u}$ is N_{DBPS} for user u, where N_{DBPS} is defined in Table 23-6
$N_{service}$ and N_{tail} are defined in Table 23-4

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an NDP is 0.

23.4.4 PHY characteristics

The static S1G PHY characteristics, provided through the PLME-CHARACTERISTICS service primitive, shall be as shown in Table 23-37. The definitions for these characteristics are given in 6.5.

Table 23-37—S1G PHY characteristics

Characteristics	Value
aSlotTime	52 µs
aSIFSTime	160 µs
aCCATime	< 40 µs
aRxPHYStartDelay	600 µs for S1G_1M preamble; 280 µs for S1G_SHORT preamble and S1G_LONG preamble.
aRxTxTurnaroundTime	Implementation dependent, see 10.3.7.
aTxPHYDelay	Implementation dependent, see 10.3.7.
aRxPHYDelay	Implementation dependent, see 10.3.7.
aRxTxSwitchTime	Implementation dependent, see 10.3.7.
aTxRampOnTime	Implementation dependent, see 10.3.7.
aAirPropagationTime	6 µs
aMACProcessingDelay	Implementation dependent, see 10.3.7.
aPreambleLength	160 µs

Table 23-37—S1G PHY characteristics *(continued)*

Characteristics	Value
aSTFOneLength	80 µs
aLTFOneLength	80 µs
aLTFOneLength	40 µs
aPLCPHeaderLength	80 µs
aPLCPSIGTwoLength	80 µs
aPLCPServiceLength	8 bits
aDTT2UTTTime	320 µs
aCCAMidTime	212 µs
aPPDUMaxTime	27,920 µs (see NOTE 1)
aPSDUMaxLengthWithNoAggregation	511 octets (see NOTE 2)
aPSDUMaxLength	797159 octets (see NOTE 3)

NOTE 1—This is the maximum PPDU duration in µs for an S1G_1M PPDU with a bandwidth of 1 MHz, S1G-MCS10 and 1 spatial stream, limited by PSDU length of 511 octets.

NOTE 2—This is the maximum PSDU length in octets for an S1G PPDU supported by the Length field in the S1G SIG field when the Aggregation field is 0.

NOTE 3—This is the maximum length in octets for an S1G SU PPDU with a bandwidth of 16 MHz, S1G-MCS9 and 4 spatial streams, limited by 511 data symbols supported by the Length field in the S1G SIG field, excluding the SERVICE field and tail bits.

23.5 Parameters for S1G-MCSs

The rate-dependent parameters for 1 MHz, 2 MHz, 4 MHz, 8 MHz, and 16 MHz, N_{SS} = 1,...,4 are given in Table 23-38 through Table 23-57. Support for 4 µs GI is optional in all cases. Support for MCS 8 and 9 (when valid) is optional in all cases. An S1G AP-STA shall support single spatial stream MCSs within the range MCS 0 through MCS 7 for all channel widths for which it has indicated support regardless of the Tx or Rx Highest Supported Data Rate subfield values in the VHT Supported MCS Set field. An S1G non-AP-STA shall support single spatial stream MCSs within the range MCS 0 through MCS 2 for 1 and 2 MHz channel widths. When more than one spatial stream is supported, the Tx or Rx Highest Supported Data Rate subfield values in the VHT Supported MCS Set field may result in a reduced MCS range (cut-off) for greater than one spatial stream. Support for 1 MHz and 2 MHz with N_{SS} = 1 is mandatory. Support for 1 and 2 MHz with N_{SS} = 2,3,4 is optional. Support for 4 MHz, 8 MHz, and 16 MHz with N_{SS} = 1,...,4 is optional.

NOTE—When LDPC is used with MCS 10, the resulting N_cbps is 12 because the 2x repetition is applied after the LDPC encoding procedure.

Table 23-38—S1G MCSs for 1 MHz, N_{SS} = 1

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	24	2	24	12	1	300.0	333.3
1	QPSK	1/2	2	24	2	48	24	1	600.0	666.7
2	QPSK	3/4	2	24	2	48	36	1	900.0	1000.0
3	16-QAM	1/2	4	24	2	96	48	1	1200.0	1333.3
4	16-QAM	3/4	4	24	2	96	72	1	1800.0	2000.0
5	64-QAM	2/3	6	24	2	144	96	1	2400.0	2666.7
6	64-QAM	3/4	6	24	2	144	108	1	2700.0	3000.0
7	64-QAM	5/6	6	24	2	144	120	1	3000.0	3333.3
8	256-QAM	3/4	8	24	2	192	144	1	3600.0	4000.0
9	256-QAM	5/6	8	24	2	192	160	1	4000.0	4444.4
10	BPSK	1/2 with 2x repetition	1	24	2	24	6	1	150.0	166.7

Table 23-39—S1G MCSs for 1 MHz, N_{SS} = 2

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	24	2	48	24	1	600.0	666.7
1	QPSK	1/2	2	24	2	96	48	1	1200.0	1333.3
2	QPSK	3/4	2	24	2	96	72	1	1800.0	2000.0
3	16-QAM	1/2	4	24	2	192	96	1	2400.0	2666.7
4	16-QAM	3/4	4	24	2	192	144	1	3600.0	4000.0
5	64-QAM	2/3	6	24	2	288	192	1	4800.0	5333.3
6	64-QAM	3/4	6	24	2	288	216	1	5400.0	6000.0
7	64-QAM	5/6	6	24	2	288	240	1	6000.0	6666.7
8	256-QAM	3/4	8	24	2	384	288	1	7200.0	8000.0
9	256-QAM	5/6	8	24	2	384	320	1	8000.0	8888.9

Table 23-40—S1G MCSs for 1 MHz, N_{SS} = 3

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	24	2	72	36	1	900.0	1000.0
1	QPSK	1/2	2	24	2	144	72	1	1800.0	2000.0
2	QPSK	3/4	2	24	2	144	108	1	2700.0	3000.0
3	16-QAM	1/2	4	24	2	288	144	1	3600.0	4000.0
4	16-QAM	3/4	4	24	2	288	216	1	5400.0	6000.0
5	64-QAM	2/3	6	24	2	432	288	1	7200.0	8000.0
6	64-QAM	3/4	6	24	2	432	324	1	8100.0	9000.0
7	64-QAM	5/6	6	24	2	432	360	1	9000.0	10000.0
8	256-QAM	3/4	8	24	2	576	432	1	10800.0	12000.0
9	256-QAM	5/6	8	24	2	576	480	1	12000.0	13333.3

Table 23-41—S1G MCSs for 1 MHz, N_{SS} = 4

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 µs GI	4 µs GI
0	BPSK	1/2	1	24	2	96	48	1	1200.0	1333.3
1	QPSK	1/2	2	24	2	192	96	1	2400.0	2666.7
2	QPSK	3/4	2	24	2	192	144	1	3600.0	4000.0
3	16-QAM	1/2	4	24	2	384	192	1	4800.0	5333.3
4	16-QAM	3/4	4	24	2	384	288	1	7200.0	8000.0
5	64-QAM	2/3	6	24	2	576	384	1	9600.0	10666.7
6	64-QAM	3/4	6	24	2	576	432	1	10800.0	12000.0
7	64-QAM	5/6	6	24	2	576	480	1	12000.0	13333.3
8	256-QAM	3/4	8	24	2	768	576	1	14400.0	16000.0
9	256-QAM	5/6	8	24	2	768	640	1	16000.0	17777.8

Table 23-42—S1G MCSs for 2 MHz, N_{SS} = 1

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 µs GI	4 µs GI
0	BPSK	1/2	1	52	4	52	26	1	650.0	722.2
1	QPSK	1/2	2	52	4	104	52	1	1300.0	1444.4
2	QPSK	3/4	2	52	4	104	78	1	1950.0	2166.7
3	16-QAM	1/2	4	52	4	208	104	1	2600.0	2888.9
4	16-QAM	3/4	4	52	4	208	156	1	3900.0	4333.3
5	64-QAM	2/3	6	52	4	312	208	1	5200.0	5777.8
6	64-QAM	3/4	6	52	4	312	234	1	5850.0	6500.0
7	64-QAM	5/6	6	52	4	312	260	1	6500.0	7222.2
8	256-QAM	3/4	8	52	4	416	312	1	7800.0	8666.7
9	Not valid									

Table 23-43—S1G MCSs for 2 MHz, N_{SS} = 2

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 µs GI	4 µs GI
0	BPSK	1/2	1	52	4	104	52	1	1300.0	1444.4
1	QPSK	1/2	2	52	4	208	104	1	2600.0	2888.9
2	QPSK	3/4	2	52	4	208	156	1	3900.0	4333.3
3	16-QAM	1/2	4	52	4	416	208	1	5200.0	5777.8
4	16-QAM	3/4	4	52	4	416	312	1	7800.0	8666.7
5	64-QAM	2/3	6	52	4	624	416	1	10400.0	11555.6
6	64-QAM	3/4	6	52	4	624	468	1	11700.0	13000.0
7	64-QAM	5/6	6	52	4	624	520	1	13000.0	14444.4
8	256-QAM	3/4	8	52	4	832	624	1	15600.0	17333.3
9	Not valid									

Table 23-44—S1G MCSs for 2 MHz, N_{SS} = 3

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 µs GI	4 µs GI
0	BPSK	1/2	1	52	4	156	78	1	1950.0	2166.7
1	QPSK	1/2	2	52	4	312	156	1	3900.0	4333.3
2	QPSK	3/4	2	52	4	312	234	1	5850.0	6500.0
3	16-QAM	1/2	4	52	4	624	312	1	7800.0	8666.7
4	16-QAM	3/4	4	52	4	624	468	1	11700.0	13000.0
5	64-QAM	2/3	6	52	4	936	624	1	15600.0	17333.3
6	64-QAM	3/4	6	52	4	936	702	1	17550.0	19500.0
7	64-QAM	5/6	6	52	4	936	780	1	19500.0	21666.7
8	256-QAM	3/4	8	52	4	1248	936	1	23400.0	26000.0
9	256-QAM	5/6	8	52	4	1248	1040	1	26000.0	28888.9

Table 23-45—S1G MCSs for 2 MHz, N_{SS} = 4

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 µs GI	4 µs GI
0	BPSK	1/2	1	52	4	208	104	1	2600.0	2888.9
1	QPSK	1/2	2	52	4	416	208	1	5200.0	5777.8
2	QPSK	3/4	2	52	4	416	312	1	7800.0	8666.7
3	16-QAM	1/2	4	52	4	832	416	1	10400.0	11555.6
4	16-QAM	3/4	4	52	4	832	624	1	15600.0	17333.3
5	64-QAM	2/3	6	52	4	1248	832	1	20800.0	23111.1
6	64-QAM	3/4	6	52	4	1248	936	1	23400.0	26000.0
7	64-QAM	5/6	6	52	4	1248	1040	1	26000.0	28888.9
8	256-QAM	3/4	8	52	4	1664	1248	1	31200.0	34666.7
9	Not valid									

Table 23-46—S1G MCSs for 4 MHz, N_{SS} = 1

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 µs GI	4 µs GI
0	BPSK	1/2	1	108	6	108	54	1	1350.0	1500.0
1	QPSK	1/2	2	108	6	216	108	1	2700.0	3000.0
2	QPSK	3/4	2	108	6	216	162	1	4050.0	4500.0
3	16-QAM	1/2	4	108	6	432	216	1	5400.0	6000.0
4	16-QAM	3/4	4	108	6	432	324	1	8100.0	9000.0
5	64-QAM	2/3	6	108	6	648	432	1	10800.0	12000.0
6	64-QAM	3/4	6	108	6	648	486	1	12150.0	13500.0
7	64-QAM	5/6	6	108	6	648	540	1	13500.0	15000.0
8	256-QAM	3/4	8	108	6	864	648	1	16200.0	18000.0
9	256-QAM	5/6	8	108	6	864	720	1	18000.0	20000.0

Table 23-47—S1G MCSs for 4 MHz, N_{SS} = 2

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	108	6	216	108	1	2700.0	3000.0
1	QPSK	1/2	2	108	6	432	216	1	5400.0	6000.0
2	QPSK	3/4	2	108	6	432	324	1	8100.0	9000.0
3	16-QAM	1/2	4	108	6	864	432	1	10800.0	12000.0
4	16-QAM	3/4	4	108	6	864	648	1	16200.0	18000.0
5	64-QAM	2/3	6	108	6	1296	864	1	21600.0	24000.0
6	64-QAM	3/4	6	108	6	1296	972	1	24300.0	27000.0
7	64-QAM	5/6	6	108	6	1296	1080	1	27000.0	30000.0
8	256-QAM	3/4	8	108	6	1728	1296	1	32400.0	36000.0
9	256-QAM	5/6	8	108	6	1728	1440	1	36000.0	40000.0

Table 23-48—S1G MCSs for 4 MHz, N_{SS} = 3

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	108	6	324	162	1	4050.0	4500.0
1	QPSK	1/2	2	108	6	648	324	1	8100.0	9000.0
2	QPSK	3/4	2	108	6	648	486	1	12150.0	13500.0
3	16-QAM	1/2	4	108	6	1296	648	1	16200.0	18000.0
4	16-QAM	3/4	4	108	6	1296	972	1	24300.0	27000.0
5	64-QAM	2/3	6	108	6	1944	1296	1	32400.0	36000.0
6	64-QAM	3/4	6	108	6	1944	1458	1	36450.0	40500.0
7	64-QAM	5/6	6	108	6	1944	1620	1	40500.0	45000.0
8	256-QAM	3/4	8	108	6	2592	1944	1	48600.0	54000.0
9	256-QAM	5/6	8	108	6	2592	2160	1	54000.0	60000.0

Table 23-49—S1G MCSs for 4 MHz, N_{SS} = 4

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	108	6	432	216	1	5400.0	6000.0
1	QPSK	1/2	2	108	6	864	432	1	10800.0	12000.0
2	QPSK	3/4	2	108	6	864	648	1	16200.0	18000.0
3	16-QAM	1/2	4	108	6	1728	864	1	21600.0	24000.0
4	16-QAM	3/4	4	108	6	1728	1296	1	32400.0	36000.0
5	64-QAM	2/3	6	108	6	2592	1728	1	43200.0	48000.0
6	64-QAM	3/4	6	108	6	2592	1944	1	48600.0	54000.0
7	64-QAM	5/6	6	108	6	2592	2160	1	54000.0	60000.0
8	256-QAM	3/4	8	108	6	3456	2592	1	64800.0	72000.0
9	256-QAM	5/6	8	108	6	3456	2880	1	72000.0	80000.0

Table 23-50—S1G MCSs for 8 MHz, N_{SS} = 1

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	234	8	234	117	1	2925.0	3250.0
1	QPSK	1/2	2	234	8	468	234	1	5850.0	6500.0
2	QPSK	3/4	2	234	8	468	351	1	8775.0	9750.0
3	16-QAM	1/2	4	234	8	936	468	1	11700.0	13000.0
4	16-QAM	3/4	4	234	8	936	702	1	17550.0	19500.0
5	64-QAM	2/3	6	234	8	1404	936	1	23400.0	26000.0
6	64-QAM	3/4	6	234	8	1404	1053	1	26325.0	29250.0
7	64-QAM	5/6	6	234	8	1404	1170	1	29250.0	32500.0
8	256-QAM	3/4	8	234	8	1872	1404	1	35100.0	39000.0
9	256-QAM	5/6	8	234	8	1872	1560	1	39000.0	43333.3

Table 23-51—S1G MCSs for 8 MHz, N_{SS} = 2

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	234	8	468	234	1	5850.0	6500.0
1	QPSK	1/2	2	234	8	936	468	1	11700.0	13000.0
2	QPSK	3/4	2	234	8	936	702	1	17550.0	19500.0
3	16-QAM	1/2	4	234	8	1872	936	1	23400.0	26000.0
4	16-QAM	3/4	4	234	8	1872	1404	1	35100.0	39000.0
5	64-QAM	2/3	6	234	8	2808	1872	1	46800.0	52000.0
6	64-QAM	3/4	6	234	8	2808	2106	1	52650.0	58500.0
7	64-QAM	5/6	6	234	8	2808	2340	1	58500.0	65000.0
8	256-QAM	3/4	8	234	8	3744	2808	1	70200.0	78000.0
9	256-QAM	5/6	8	234	8	3744	3120	1	78000.0	86666.7

Table 23-52—S1G MCSs for 8 MHz, N_{SS} = 3

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	234	8	702	351	1	8775.0	9750.0
1	QPSK	1/2	2	234	8	1404	702	1	17550.0	19500.0
2	QPSK	3/4	2	234	8	1404	1053	1	26325.0	29250.0
3	16-QAM	1/2	4	234	8	2808	1404	1	35100.0	39000.0
4	16-QAM	3/4	4	234	8	2808	2106	1	52650.0	58500.0
5	64-QAM	2/3	6	234	8	4212	2808	1	70200.0	78000.0
6	64-QAM	3/4	6	234	8	4212	3159	1	78975.0	87750.0
7	64-QAM	5/6	6	234	8	4212	3510	1	87750.0	97500.0
8	256-QAM	3/4	8	234	8	5616	4212	1	105300.0	117000.0
9	256-QAM	5/6	8	234	8	5616	4680	1	117000.0	130000.0

Table 23-53—S1G MCSs for 8 MHz, N_{SS} = 4

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	234	8	936	468	1	11700.0	13000.0
1	QPSK	1/2	2	234	8	1872	936	1	23400.0	26000.0
2	QPSK	3/4	2	234	8	1872	1404	1	35100.0	39000.0
3	16-QAM	1/2	4	234	8	3744	1872	1	46800.0	52000.0
4	16-QAM	3/4	4	234	8	3744	2808	1	70200.0	78000.0
5	64-QAM	2/3	6	234	8	5616	3744	1	93600.0	104000.0
6	64-QAM	3/4	6	234	8	5616	4212	1	105300.0	117000.0
7	64-QAM	5/6	6	234	8	5616	4680	1	117000.0	130000.0
8	256-QAM	3/4	8	234	8	7488	5616	1	140400.0	156000.0
9	256-QAM	5/6	8	234	8	7488	6240	1	156000.0	173333.3

Table 23-54—S1G MCSs for 16 MHz, N_{SS} = 1

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	468	16	468	234	1	5850.0	6500.0
1	QPSK	1/2	2	468	16	936	468	1	11700.0	13000.0
2	QPSK	3/4	2	468	16	936	702	1	17550.0	19500.0
3	16-QAM	1/2	4	468	16	1872	936	1	23400.0	26000.0
4	16-QAM	3/4	4	468	16	1872	1404	1	35100.0	39000.0
5	64-QAM	2/3	6	468	16	2808	1872	1	46800.0	52000.0
6	64-QAM	3/4	6	468	16	2808	2106	1	52650.0	58500.0
7	64-QAM	5/6	6	468	16	2808	2340	1	58500.0	65000.0
8	256-QAM	3/4	8	468	16	3744	2808	1	70200.0	78000.0
9	256-QAM	5/6	8	468	16	3744	3120	1	78000.0	86666.7

Table 23-55—S1G MCSs for 16 MHz, N_{SS} = 2

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	468	16	936	468	1	11700.0	13000.0
1	QPSK	1/2	2	468	16	1872	936	1	23400.0	26000.0
2	QPSK	3/4	2	468	16	1872	1404	1	35100.0	39000.0
3	16-QAM	1/2	4	468	16	3744	1872	1	46800.0	52000.0
4	16-QAM	3/4	4	468	16	3744	2808	1	70200.0	78000.0
5	64-QAM	2/3	6	468	16	5616	3744	1	93600.0	104000.0
6	64-QAM	3/4	6	468	16	5616	4212	1	105300.0	117000.0
7	64-QAM	5/6	6	468	16	5616	4680	1	117000.0	130000.0
8	256-QAM	3/4	8	468	16	7488	5616	1	140400.0	156000.0
9	256-QAM	5/6	8	468	16	7488	6240	1	156000.0	173333.3

Table 23-56—S1G MCSs for 16 MHz, N_{ss} = 3

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	468	16	1404	702	1	17550.0	19500.0
1	QPSK	1/2	2	468	16	2808	1404	1	35100.0	39000.0
2	QPSK	3/4	2	468	16	2808	2106	1	52650.0	58500.0
3	16-QAM	1/2	4	468	16	5616	2808	1	70200.0	78000.0
4	16-QAM	3/4	4	468	16	5616	4212	1	105300.0	117000.0
5	64-QAM	2/3	6	468	16	8424	5616	1	140400.0	156000.0
6	64-QAM	3/4	6	468	16	8424	6318	1	157950.0	175500.0
7	64-QAM	5/6	6	468	16	8424	7020	1	175500.0	195000.0
8	256-QAM	3/4	8	468	16	11232	8424	1	210600.0	234000.0
9	256-QAM	5/6	8	468	16	11232	9360	1	234000.0	260000.0

Table 23-57—S1G MCSs for 16 MHz, N_{ss} = 4

MCS Idx	Mod	R	N_bpscs	N_sd	N_sp	N_cbps	N_dbps	N_es	Data_rate (kbps)	
									8 μs GI	4 μs GI
0	BPSK	1/2	1	468	16	1872	936	1	23400.0	26000.0
1	QPSK	1/2	2	468	16	3744	1872	1	46800.0	52000.0
2	QPSK	3/4	2	468	16	3744	2808	1	70200.0	78000.0
3	16-QAM	1/2	4	468	16	7488	3744	1	93600.0	104000.0
4	16-QAM	3/4	4	468	16	7488	5616	1	140400.0	156000.0
5	64-QAM	2/3	6	468	16	11232	7488	1	187200.0	208000.0
6	64-QAM	3/4	6	468	16	11232	8424	1	210600.0	234000.0
7	64-QAM	5/6	6	468	16	11232	9360	1	234000.0	260000.0
8	256-QAM	3/4	8	468	16	14976	11232	1	280800.0	312000.0
9	256-QAM	5/6	8	468	16	14976	12480	1	312000.0	346666.7

Annex A

(informative)

Bibliography

Insert the following reference into Annex A in alphanumeric order:

[B10a] ERC Recommendation 70-03, Relating to the use of Short Range Devices (SRD).[2]

[2]ERC Recommendations are available from the Electronic Communications Committee (ECC) of the European Conference of Postal and Telecommunications (CEPT) Administrations (http://erodocdb.dk).

Annex B

(normative)

Protocol Implementation Conformance Statement (PICS) proforma

B.2 Abbreviations and special symbols

B.2.2 General abbreviations for Item and Support columns

Insert the following abbreviation definitions into B.2.2:

RL S1G Relay features

S1GM Sub 1 GHz (S1G) medium access control (MAC) features

S1GP Sub 1 GHz (S1G) physical layer (PHY) features

B.4 PICS proforma—IEEE Std 802.11-<year>

Change and insert the following rows in B.4.3 as shown:

B.4.3 IUT configuration

Item	IUT configuration	References	Status	Support
	What is the configuration of the IUT?			
*CFOFDM	Orthogonal frequency division multiplexing (OFDM) PHY	---	O.2 CFHT5G:M CFTVHT:M CFS1G:M	Yes ☐ No ☐
* CFQoS	Quality of service (QoS)	10.22, 10.24, 4.3.13, 4.3.20.3	O CFHT OR CFMBSS OR CFQMF OR CFAVT:M CFDMG:M CFTVHT:M CFS1G:M	Yes ☐ No ☐ N/A ☐
*CFMBSS	Operation in a mesh BSS (MBSS)	4.3.20	(NOT CFDMG) AND (NOT CFS1G):O.1	Yes ☐ No ☐ N/A ☐
* CFS1G	Sub 1 GHz (S1G) features	9.4.2.201	O.2	Yes ☐ No ☐ N/A ☐
*CFS1GRelay	S1G Relay	10.50	(CFAP AND CFIndepSTA): O	Yes ☐ No ☐ N/A ☐

B.4.4 MAC protocol

Change and insert the following rows in B.4.4.2 as shown:

B.4.4.2 MAC frames

Item	MAC frame	References	Status	Support
	Is transmission of the following MAC frames supported?	Clause 9		
FT7	Beacon	Clause 9	(CFAP OR CFIBSS OR CFMBSS) AND (not CFDMG AND (NOT CFS1G)):M	Yes ☐ No ☐ N/A ☐
FT14	CTS	Clause 9	not CFDMG AND NOT CFS1G):M (CFS1G AND VHTM3.1):O	Yes ☐ No ☐
FT15	Acknowledgment (Ack)	Clause 9	NOT CFS1G:M CFS1G AND VHTM3.1 OR S1GM28):O	Yes ☐ No ☐
FT43	TACK	Clause 9	S1GM6.2:M (CFS1G AND NOT S1GM6):O	Yes ☐ No ☐ N/A ☐
FT44	S1G Beacon	Clause 9	((CFAP OR CFIBSS) AND CFS1G):M	Yes ☐ No ☐ N/A ☐
FT45	PV1 frame	9.8	CFS1G:O	Yes ☐ No ☐ N/A ☐
FT45.1	STACK frame	9.8	(S1GM6.2: OR S1GM6.1):M	Yes ☐ No ☐ N/A ☐
FT45.2	BAT frame	9.8	(S1GM6.2 AND QB4.1):M	Yes ☐ No ☐ N/A ☐
FT45.3	PV1 Action frame	9.8	CFS1G:O	Yes ☐ No ☐ N/A ☐
FT45.4	PV1 Action No Ack frame	9.8	CFS1G:O	Yes ☐ No ☐ N/A ☐
FT45.5	PV1 Probe Response frame	9.8	(CFAP AND CFS1G):O	Yes ☐ No ☐ N/A ☐
FT45.6	PV1 Data frame	9.8	CFS1G:O RL6:M S1GM13:M	Yes ☐ No ☐ N/A ☐
FT45.7	Resource Allocation	9.8	(CFAP AND S1GM22.5):O	Yes ☐ No ☐ N/A ☐
FT46	NDP CMAC frames	9.9	CFS1G: M	Yes ☐ No ☐ N/A ☐
FT46.1	NDP CTS	9.9	CFS1G: M	Yes ☐ No ☐ N/A ☐
FT46.2	NDP PS-Poll	9.9	(CFIndepSTA AND CFS1G): O	Yes ☐ No ☐ N/A ☐

B.4.4.2 MAC frames *(continued)*

Item	MAC frame	References	Status	Support
FT46.3	NDP Ack	9.9	CFS1G: M	Yes ☐ No ☐ N/A ☐
FT46.4	NDP PS-Poll-Ack	9.9	(CFAP AND CFS1G AND FR47.2): M	Yes ☐ No ☐ N/A ☐
FT46.5	NDP BlockAck	9.9	(CFS1G AND HTM5.3): M	Yes ☐ No ☐ N/A ☐
FT46.6	NDP Beamforming Report Poll	9.9	CFS1G AND CFAP: O	Yes ☐ No ☐ N/A ☐
FT46.7	NDP Paging	9.9	S1GM6.11: M	Yes ☐ No ☐ N/A ☐
FT46.8	NDP Probe Request	9.9	(CFS1G AND CFIndepSTA AND S1GM4.5):M	Yes ☐ No ☐ N/A ☐
FT46.9	NDP CF-End	9.9	CFS1G:O	Yes ☐ No ☐ N/A ☐
FT47	Unprotected S1G Action frame	9.6.25	CFS1G:M	Yes ☐ No ☐ N/A ☐
FT47.1	AID Switch Request frame	9.6.25	(CFIndepSTA AND CFS1G AND (S1GM13 OR S1GM18)):M	Yes ☐ No ☐ N/A ☐
FT47.2	AID Switch Response frame	9.6.25	(CFAP AND CFS1G AND (S1GM13 OR S1GM18)):M	Yes ☐ No ☐ N/A ☐
FT47.3	Sync Control frame	9.6.25	(CFAP AND CFS1G AND S1GM8.2):M	Yes ☐ No ☐ N/A ☐
FT47.4	STA Information Announcement frame	9.6.25	(CFIndepSTA AND CFS1G AND S1GM18):M	Yes ☐ No ☐ N/A ☐
FT47.5	EDCA Parameter Set frame	9.6.25	(CFAP AND CFS1G):O	Yes ☐ No ☐ N/A ☐
FT47.6	EL Operation frame	9.6.25	(CFIndepSTA AND CFS1G AND S1GM21):M	Yes ☐ No ☐ N/A ☐
FT47.7	TWT Setup frame	9.6.25	(CFS1G AND S1GM6.3):M	Yes ☐ No ☐ N/A ☐
FT47.8	TWT Teardown frame	9.6.25	(CFS1G AND S1GM6.5):M	Yes ☐ No ☐ N/A ☐
FT47.9	Sectorized Group ID List frame	9.6.25	(CFAP AND CFS1G AND S1GM11):M	Yes ☐ No ☐ N/A ☐
FT47.10	Sector ID feedback frame	9.6.25	(CFIndepSTA AND CFS1G AND S1GM11):M	Yes ☐ No ☐ N/A ☐

B.4.4.2 MAC frames *(continued)*

Item	MAC frame	References	Status	Support
FT47.11	Header Compression frame as a request		(CFS1G AND S1GM16):O	Yes ☐ No ☐ N/A ☐
FT47.12	Header Compression frame as a response		CFS1G:M	Yes ☐ No ☐ N/A ☐
FT47.13	TWT Information frame		(CFS1G AND S1GM6.1):O (CFS1G AND S1GM6.2):O	Yes ☐ No ☐ N/A ☐
FT48	S1G Action frame	9.6.26	RL1:M	Yes ☐ No ☐ N/A ☐
FT48.1	Reachable Address Update frame	9.6.26	RL1:M	Yes ☐ No ☐ N/A ☐
FT48.2	Relay Activation Request frame		RL1:O	Yes ☐ No ☐ N/A ☐
FT48.3	Relay Activation Response frame		RL1:M	Yes ☐ No ☐ N/A ☐
FT49	Flow Control Action frame	9.6.27	CFS1G:M	Yes ☐ No ☐ N/A ☐
FT49.1	Flow Suspension frame	9.6.27	(CFS1G AND S1GM17.1):M	Yes ☐ No ☐ N/A ☐
FT49.2	Flow Resumption frame	9.6.27	(CFS1G AND S1GM17.1):O	Yes ☐ No ☐ N/A ☐
FT50	Control Response MCS Negotiation frame	9.6.28	CFS1G AND S1GM28:M	Yes ☐ No ☐ N/A ☐
FT50.1	Control Response MCS Negotiation Request	9.6.28	(CFS1G AND S1GM28):O	Yes ☐ No ☐ N/A ☐
FT50.2	Control Response MCS Negotiation Response	9.6.28	(CFS1G AND S1GM28):M	Yes ☐ No ☐ N/A ☐
	Is reception of the following MAC frames supported?	Clause 9		
FR7	Beacon	Clause 9	(NOT CFOCB AND (NOT CFS1G)):M not CFDMG AND (NOT CFS1G)):M	Yes ☐ No ☐ N/A ☐
FR14	CTS	Clause 9	not CFDMG AND NOT CFS1G):M (CFS1G AND VHTM3.1):O	Yes ☐ No ☐
FR15	Ack	Clause 9	NOT CFS1G:M CFS1G AND VHTM3.1 OR S1GM28):O	Yes ☐ No ☐
FR44	TACK	Clause 9	(CFAP AND CFS1G):O (CFIndepSTA AND CFS1G AND S1GM7.3 OR S1GM6.1):M	Yes ☐ No ☐ N/A ☐
FR45	S1G Beacon	Clause 9	CFS1G:M	Yes ☐ No ☐ N/A ☐
FR46	PV1 frame	9.8	CFS1G:O	Yes ☐ No ☐ N/A ☐

B.4.4.2 MAC frames *(continued)*

Item	MAC frame	References	Status	Support
FR46.1	STACK frame	9.8	(CFS1G AND S1GM6.1):M	Yes ☐ No ☐ N/A ☐
FR46.2	BAT frame	9.8	(CFS1G AND S1GM6.1 AND QB4.1 OR):M	Yes ☐ No ☐ N/A ☐
FR46.3	PV1 Action frame	9.8	CFS1G AND (S1GM20.1 OR S1GM20.3 OR S1GM20.5):M CFS1G AND (S1GM20.2 OR S1GM20.5):O :O	Yes ☐ No ☐ N/A ☐
FR46.4	PV1 Action No Ack frame	9.8	CFS1G AND (S1GM20.1 OR S1GM20.3 OR S1GM20.5):M CFS1G AND (S1GM20.2 OR S1GM20.5):O	Yes ☐ No ☐ N/A ☐
FR46.5	PV1 Probe Response frame	9.8	CFS1G:O	Yes ☐ No ☐ N/A ☐
FR46.6	PV1 Data frame	9.8	CFS1G AND (S1GM20.1 OR S1GM20.3 OR S1GM20.4):M CFS1G AND (S1GM20.2 OR S1GM20.5):O	Yes ☐ No ☐ N/A ☐
FR46.7	Resource Allocation	9.8	(CFIndepSTA AND CFS1G AND S1GM22.5):M	Yes ☐ No ☐ N/A ☐
FR47	NDP CMAC frames	9.9	CFS1G:M	Yes ☐ No ☐ N/A ☐
FR47.1	NDP CTS	9.9	CFS1G:M	Yes ☐ No ☐ N/A ☐
FR47.2	NDP PS-Poll	9.9	(CFAP AND CFS1G):O	Yes ☐ No ☐ N/A ☐
FR47.3	NDP ACK	9.9	CFS1G:M	Yes ☐ No ☐ N/A ☐
FR47.4	NDP PS-Poll-Ack	9.9	(CFIndepSTA AND CFS1G AND FT46.2):M	Yes ☐ No ☐ N/A ☐
FR47.5	NDP BlockAck	9.9	(CFS1G AND HTM5.3):M	Yes ☐ No ☐ N/A ☐
FR47.6	NDP Beamforming Report Poll	9.9	(CFIndepSTA AND CFS1G):O	Yes ☐ No ☐ N/A ☐
FR47.7	NDP Paging	9.9	(CFS1G AND S1GM6.9):M	Yes ☐ No ☐ N/A ☐
FR47.8	NDP Probe Request	9.9	(CFAP AND CFS1G):M	Yes ☐ No ☐ N/A ☐

B.4.4.2 MAC frames *(continued)*

Item	MAC frame	References	Status	Support
FR47.9	NDP CF-End	9.9	(CFIndepSTA AND CFS1G):O	Yes ☐ No ☐ N/A ☐
FR48	Unprotected S1G Action frame	9.6.25	CFS1G:M	Yes ☐ No ☐ N/A ☐
FR48.1	AID Switch Request frame	9.6.25	(CFIndepSTA AND CFS1G AND (S1GM13 OR S1GM18)):M	Yes ☐ No ☐ N/A ☐
FR48.2	AID Switch Response frame	9.6.25	(CFAP AND CFS1G OR (S1GM13 OR S1GM18)):M	Yes ☐ No ☐ N/A ☐
FR48.3	Sync Control frame	9.6.25	(CFIndepSTA AND CFS1G AND S1GM8.1):M	Yes ☐ No ☐ N/A ☐
FR48.4	STA Information Announcement frame	9.6.25	(CFAP AND CFS1G AND S1GM18):M	Yes ☐ No ☐ N/A ☐
FR48.5	EDCA Parameter Set frame	9.6.25	(CFIndepSTA AND CFS1G):M	Yes ☐ No ☐ N/A ☐
FR48.6	EL Operation frame	9.6.25	(CFAP AND CFS1G AND S1GM21):M	Yes ☐ No ☐ N/A ☐
FR48.7	TWT Setup frame	9.6.25	(CFS1G AND S1GM6.2):M	Yes ☐ No ☐ N/A ☐
FR48.8	TWT Teardown frame	9.6.25	(CFS1G AND S1GM6.5):M	Yes ☐ No ☐ N/A ☐
FR48.9	Sectorized Group ID List frame	9.6.25	(CFIndepSTA AND CFS1G AND S1GM11):M	Yes ☐ No ☐ N/A ☐
FR48.10	Sector ID feedback frame	9.6.25	(CFAP AND CFS1G AND S1GM11):M	Yes ☐ No ☐ N/A ☐
FR48.11	Header Compression frame		CFS1G: M	Yes ☐ No ☐ N/A ☐
FR48.13	TWT Information frame		(CFS1G AND S1GM6):M	Yes ☐ No ☐ N/A ☐
FR48.12	Header Compression frame		(CFS1G AND FT47.11):M	Yes ☐ No ☐ N/A ☐
FR49	S1G Action frame	9.6.26	(CFAP AND CFS1G):O	Yes ☐ No ☐ N/A ☐
FR49.1	Reachable Address Update frame	9.6.26	RL1:M	Yes ☐ No ☐ N/A ☐
FR49.2	Relay Activation Request frame	9.6.26	RL1:M	Yes ☐ No ☐ N/A ☐
FR49.3	Relay Activation Response frame	9.6.26	RL1:M	Yes ☐ No ☐ N/A ☐

B.4.4.2 MAC frames *(continued)*

Item	MAC frame	References	Status	Support
FR50	Flow Control Action frame	9.6.27	(CFIndepSTA AND CFS1G):O	Yes ☐ No ☐ N/A ☐
FR50.1	Flow Suspension frame	9.6.27	(CFIndepSTA AND CFS1G AND S1GM17):M	Yes ☐ No ☐ N/A ☐
FR50.2	Flow Resumption frame	9.6.27	(CFIndepSTA AND CFS1G AND S1GM17):M	Yes ☐ No ☐ N/A ☐
FR51	Control Response MCS Negotiation frame	9.6.28	CFS1G AND S1GM28:M	Yes ☐ No ☐ N/A ☐
FR51.1	Control Response MCS Negotiation Request	9.6.28	(CFS1G AND S1GM28):M	Yes ☐ No ☐ N/A ☐
FR51.2	Control Response MCS Negotiation Response	9.6.28	(CFS1G AND S1GM28):M	Yes ☐ No ☐ N/A ☐

Insert the following rows in B.4.4.4:

B.4.4.4 MAC addressing functions

Item	MAC Address function	References	Status	Support
	Are the following MAC Addressing functions supported?			
AD12	Group addressed Data frame addressing (4 address frame)	9.2.3, 9.2.4.1, 8.2.4.3	CFS1GRelay: O RL2:O CFAP: O CFIndepSTA: O	Yes ☐ No ☐ N/A ☐
AD13	Individually addressed Data frame addressing (4 address frame)		CFS1GRelay: O RL2:O CFAP: O CFIndepSTA: O	Yes ☐ No ☐ N/A ☐
AD14	Group addressed PV1 Data frame addressing (4 address frame)	9.8 10.50.4 10.50.3	CFS1GRelay: O RL2:O CFS1G: O	Yes ☐ No ☐ N/A ☐
AD15	Individually addressed PV1 Data frame addressing (4 address frame)		CFS1GRelay: O RL2:O CFS1G: O	Yes ☐ No ☐ N/A ☐

Change the following rows in B.4.13 as shown:

B.4.13 QoS enhanced distributed channel access (EDCA)

Item	Protocol capability	References	Status	Support
QD1	Support for four transmit queues with a separate channel access entity associated with each	10.2.4.2, 10.22.2.1	not CFDMG AND CFQoS:M CFS1G AND S1GM20.5: M CFS1G AND S1GM20.4:O	Yes ☐ No ☐ N/A ☐
QD3	Multiple frame transmission support	10.22.2.7	CFQoS OR CFDMG OR CFS1G:O	Yes ☐ No ☐ N/A ☐
QD4	Maintenance of within-queue ordering, exhaustive retransmission when sending non-QoS Data frames	10.22.2.11	(CFQoS AND NOT CFS1G) OR CFDMG:M	Yes ☐ No ☐ N/A ☐

B.4.17 High throughput (HT) features

Change the following rows in B.4.17.1 as shown:

B.4.17.1 HT MAC features

Item	Protocol capability	References	Status	Support
HTM3	MPDU aggregation			
HTM3.1	Reception of A-MPDU	9.4.2.56.3, 12.5, 10.13.2	(CFHT AND NOT CFS1G):M CFS1G: O	Yes ☐ No ☐ N/A ☐
HTM3.2	A-MPDU format	9.7.1	(CFHT OR CFS1G):M	Yes ☐ No ☐ N/A ☐
HTM3.3	A-MPDU contents	9.7.3	(CFHT OR CFS1G):M	Yes ☐ No ☐ N/A ☐
HTM3.4	A-MPDU frame exchange sequences	10.22.2.7	(CFHT AND NOT CFS1G):M CFS1G: O	Yes ☐ No ☐ N/A ☐
HTM3.5	Transmission of A-MPDU	9.4.2.56.3, 12.5	CFHT:O CFVHT:M CFS1G: O	Yes ☐ No ☐ N/A ☐
HTM4	MSDU aggregation			
HTM4.1	Reception of A-MSDUs	9.2.4.5, 9.3.2.2	(CFHT AND NOT CFS1G):M CFS1G:O	Yes ☐ No ☐ N/A ☐

B.4.17.1 HT MAC features *(continued)*

Item	Protocol capability	References	Status	Support
HTM4.2	A-MSDU format	9.3.2.2	(CFHT AND NOT CFS1G):M CFS1GRelay AND ((NOT AD12) AND (NOT AD14)): M CFS1GRelay AND ((NOT AD13) AND (NOT AD15)): M RL2 AND ((NOT AD12) AND (NOT AD14)): M RL2 AND ((NOT AD13) AND (NOT AD15)): M CFS1GRelay AND (AD12 OR (AD14): O CFS1GRelay AND (AD13 OR AD15): O RL2 AND (AD12 OR AD14): O RL2 AND (AD13 OR AD15): O	Yes ☐ No ☐ N/A ☐
HTM4.3	A-MSDU content	9.3.2.2	(CFHT AND NOT CFS1G):M	Yes ☐ No ☐ N/A ☐
HTM4.4	Transmission of A-MSDUs	9.3.2.2 format), 9.2.4.5	CFHT:O CFS1G:O	Yes ☐ No ☐ N/A o
HTM5.3	HT-immediate block ack extensions	10.24.7	(CFHT AND NOT CFS1G):M CFVHT:M CFS1G:O (CFS1G AND (S1GM20.2 OR S1GM20.3 OR S1GM20.5)): M	Yes ☐ No ☐ N/A ☐

B.4.17.1 HT MAC features *(continued)*

Item	Protocol capability	References	Status	Support
HTM5.4	HT-delayed block ack extensions HT-delayed block ack is obsolete. Support for this mechanism might be removed in a later revision of the standard.	10.24.8	CFHT AND QB4.2:O CFTVHT AND QB4.2:O CFS1G:O	Yes ☐ No ☐ N/A ☐
HTM16.2	Dual CTS protection The use of the dual CTS mechanism is deprecated.	10.3.2.8	HTP2.11 AND NOT CFS1G: O	Yes ☐ No ☐ N/A ☐

Change the following row in B.4.19 as shown:

B.4.19 WNM extensions

Item	Protocol capability	References	Status	Support
*WNM11	BSS max idle period	11.24.13	(CFWNM OR CFS1G):M	Yes ☐ No ☐ N/A ☐

B.4.25 Very high throughput (VHT) features

Change the following rows in B.4.25.1 as shown:

B.4.25.1 VHT MAC features

Item	Protocol capability	References	Status	Support
VHTM3	Link adaptation			
*VHTM3.1	Use of the VHT variant HT Control field for link adaptation in immediate response exchange.	9.2.4.6, 9.3.3.15, 10.31.3, 10.9	CFVHT:O CFS1G: O	Yes ☐ No ☐ N/A ☐
VHTM11	~~VHT single~~ S-MPDU format	10.13.7	CFVHT:M CFS1G: M	Yes ☐ No ☐ N/A ☐

Insert the subclauses (B.4.28 through B.4.28.2 and B4.29) after B.4.27:

B.4.28 Sub 1 GHz (S1G) features

B.4.28.1 S1G MAC features

Item	Protocol capability	References	Status	Support
	Are the following MAC protocol features supported?			
S1GM1	S1G capabilities signaling		CFS1G:M	Yes ☐ No ☐ N/A ☐
S1GM1.1	S1G Capabilities element	9.4.2.201	CFS1G:M	Yes ☐ No ☐ N/A ☐
S1GM1.2	Signaling of S1G capabilities in Probe Request, (Re)Association Request frames	9.4.2.201, 9.3.3.6, 9.3.3.8, 9.3.3.10	(CFIndepSTA AND CFS1G):M	Yes ☐ No ☐ N/A ☐
S1GM1.3	Signaling of S1G capabilities in S1G Beacon, Probe Response, (Re)Association Response frames	9.4.2.201, 9.3.4.3, 9.3.3.7, 9.3.3.9, 9.3.3.11	(CFAP AND CFS1G):M	Yes ☐ No ☐ N/A ☐
S1GM2	S1G operation		CFS1G:M	Yes ☐ No ☐ N/A ☐
S1GM2.1	S1G Operation element	9.4.2.213	CFS1G:M	Yes ☐ No ☐ N/A ☐
S1GM2.2	Signaling of S1G operation in S1G Beacon, Probe Response	9.4.2.213, 9.3.4.3, 9.3.3.11	((CFAP OR CFIndep-STA.2) AND CFS1G):M	Yes ☐ No ☐ N/A ☐
S1GM3	MSDU aggregation	10.12, 9.2.4.5, 9.8.3.2, 9.3.2.2.4	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM3.1	Transmission of Dynamic A-MSDU		CFS1G:O (CFS1G AND HTM4.4):M	Yes ☐ No ☐ N/A ☐
S1GM3.2	Reception of Dynamic A-MSDU		CFS1G:O (CFS1G AND HTM4.1):M	Yes ☐ No ☐ N/A ☐
S1GM3.3	Transmission of Dynamic A-MSDU in PV1 frame		(CFS1G AND HTM4.4 AND FT45):M	Yes ☐ No ☐ N/A ☐
S1GM3.4	Reception of Dynamic A-MSDU in PV1 frame		(CFS1G AND HTM4.1 AND FT46):M	Yes ☐ No ☐ N/A ☐
S1GM3.5	Reception of Dynamic A-MSDU		(CFS1G AND (HTM4.1 OR HTM4.4 OR S1GM3.3 OR S1GM3.4)):M	Yes ☐ No ☐ N/A ☐
S1GM4	Timing synchronization function (TSF)		CFS1G:M	Yes ☐ No ☐ N/A ☐
S1GM4.1	Generation of S1G Beacon	11.1.3.10.2	(CFAP AND CFS1G): M	Yes ☐ No ☐ N/A ☐
S1GM4.1.1	S1G Beacon generation at TBTT		(CFAP AND CFS1G): M	

Item	Protocol capability	References	Status	Support
S1GM4.1.2	S1G Beacon generation at TSBTT		(CFAP AND CFS1G): O	Yes ☐ No ☐ N/A ☐
S1GM4.1.3	S1G Beacon reception at TBTT		(CFIndepSTA AND CFS1G): M	Yes ☐ No ☐ N/A ☐
S1GM4.1.4	S1G Beacon reception at TSBTT		(CFIndepSTA AND CFS1G): M	Yes ☐ No ☐ N/A ☐
S1GM4.2	TSF timer accuracy with S1G Beacon	11.1.3.10.3	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GM4.3	TSF timer accuracy with TACK, STACK, BAT, PV1 Probe Response frames		CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GM4.4	Signaling PV1 Probe Response Option element in Probe Request frame		CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GM4.5	Active scanning using NDP Probe Request frame	11.1.4.3.4b	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GM4.6	Sending PV1 Probe Response frame	11.1.4.3.4c, 11.1.4.3.4b	(CFAP AND CFS1G): O	Yes ☐ No ☐ N/A ☐
S1GM5	Reverse direction protocol	10.28	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM5.1	Initiation of RD protocol		CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM5.2	Response to RD request		CFS1G:O	Yes ☐ No ☐ N/A ☐
*S1GM6	Target wake time (TWT) operation	10.43	CFS1G:O	Yes ☐ No ☐ N/A ☐
*S1GM6.1	Assume the role of TWT requesting STA	10.43.1	S1GM6:O.1	Yes ☐ No ☐ N/A ☐
*S1GM6.2	Assume the role of TWT responding STA	10.43.1	S1GM6:O.1	Yes ☐ No ☐ N/A ☐
S1GM6.3	Request TWT Setup	10.43.1	S1GM6.1:O	Yes ☐ No ☐ N/A ☐
S1GM6.4	Response to TWT Setup request	10.43.1	S1GM6.2:M	Yes ☐ No ☐ N/A ☐
S1GM6.5	TWT Teardown	10.43.8	S1GM6:O	Yes ☐ No ☐ N/A ☐
S1GM6.6	TWT acknowledgment procedure	10.43.2	S1GM6:M	Yes ☐ No ☐ N/A ☐
S1GM6.7	Explicit TWT operation	10.43.3	S1GM6:O.2	Yes ☐ No ☐ N/A ☐
S1GM6.8	Implicit TWT operation	10.43.4	S1GM6:O.2	Yes ☐ No ☐ N/A ☐
S1GM6.9	Request NDP Paging Setup	10.43.6	S1GM6.1:O	Yes ☐ No ☐ N/A ☐
S1GM6.10	Accept the NDP Paging Setup request	10.43.6	S1GM6.2:O	Yes ☐ No ☐ N/A ☐
S1GM6.11	Schedule NDP Paging frame as the first frame in a TWT		S1GM10:M	Yes ☐ No ☐ N/A ☐
S1GM6.12	TWT grouping	10.43.5	S1GM6:O	Yes ☐ No ☐ N/A ☐

Item	Protocol capability	References	Status	Support
S1GM7	Non-TIM STA operation	10.44	(CFIndepSTA AND CFS1G):O (CFAP AND CFS1G AND (S1GM20.1 OR S1GM20.3)): M	Yes ☐ No ☐ N/A ☐
S1GM7.1	Request non-TIM Mode	11.2.3.2	(CFIndepSTA AND S1GM7):O	Yes ☐ No ☐ N/A ☐
S1GM7.2	Response to non-TIM Mode request	11.2.3.2	(CFAP AND S1GM7):M	Yes ☐ No ☐ N/A ☐
S1GM7.3	Request rescheduling of awake/doze cycle	10.44.2	(CFIndepSTA AND S1GM7):O	Yes ☐ No ☐ N/A ☐
S1GM7.4	Reschedule awake/doze cycle of non-TIM STAs	10.44.2	(CFAP AND S1GM7):O	Yes ☐ No ☐ N/A ☐
S1GM7.5	Temporary PS Mode Switch to TIM mode	10.44.2	(CFIndepSTA AND S1GM7):O	Yes ☐ No ☐ N/A ☐
S1GM7.6	Listen interval update procedure for non-TIM STAs		S1GM7:O	Yes ☐ No ☐ N/A ☐
S1GM7.7	Resource protection for non-TIM STAs	10.44.1	(CFAP AND S1GM7):O	Yes ☐ No ☐ N/A ☐
S1GM7.8	Resource protection for non-TIM STAs using periodic RAW (PRAW) operation	10.44.1.2	(CFAP AND S1GM7):O	Yes ☐ No ☐ N/A ☐
S1GM8	Synchronization (Sync) frame operation	10.45	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM8.1	Request for a sync frame transmission	10.45.1	(CFIndepSTA AND S1GM8):O	Yes ☐ No ☐ N/A ☐
S1GM8.2	Schedule a sync frame transmission	10.45.1	(CFAP AND S1GM8):M	Yes ☐ No ☐ N/A ☐
S1GM8.3	Request for time slot protection	10.45.1	(CFIndepSTA AND S1GM8):O	Yes ☐ No ☐ N/A ☐
S1GM8.4	Protect the time slot assigned to the STA that requested for time slot protection.	10.45.1	(CFAP AND S1GM8):M	Yes ☐ No ☐ N/A ☐
S1GM8.5	Respond to sync frame	10.45.1	(CFIndepSTA AND S1GM8):M	Yes ☐ No ☐ N/A ☐
S1GM9	Bidirectional TXOP	10.46	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM9.1	Act as BDT Initiator	10.46.2	S1GM9:O	Yes ☐ No ☐ N/A ☐
S1GM9.2	Act as BDT Responder		S1GM9:M	Yes ☐ No ☐ N/A ☐

Item	Protocol capability	References	Status	Support
S1GM10	Subchannel Selective Transmission (SST)	10.48	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM11	Sectorized beam operation	10.49	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM11.1	Support for Group Sectorization Operation	10.49.3	(CFAP AND S1GM11):O.3 (CFIndepSTA AND S1GM11):M	Yes ☐ No ☐ N/A ☐
S1GM11.2	Support for TXOP-based Sectorization Operation	10.49.4	(CFAP AND S1GM11):O.3 (CFIndepSTA AND S1GM11):M	Yes ☐ No ☐ N/A ☐
S1GM11.3	Transmission of S1G Sector Operation element with Sectorization Type field equal to 0	10.49.2	(CFAP AND S1GM11.1):M	Yes ☐ No ☐ N/A ☐
S1GM11.4	Transmission of S1G Sector Operation element with Sectorization Type field equal to 1	10.49.2	(CFAP AND S1GM11.2):M	Yes ☐ No ☐ N/A ☐
S1GM11.5	Sector training operation	10.49.2	S1GM11:O	Yes ☐ No ☐ N/A ☐
S1GM11.6	Send back Sector ID feedback to associated AP	10.49.2	(CFIndepSTA AND S1GM11):O	Yes ☐ No ☐ N/A ☐
S1GM12	1 MHz Control Response Preamble Support	10.7.6.6	CFS1G: O	Yes ☐ No ☐ N/A ☐
*S1GM13	Group AID	10.51	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM14	Traveling Pilot Operation	10.52	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM15	Bitmap Protection for NDP Block-Ack frames	10.53	(CFS1G AND (FT47 OR FR 48)): M	Yes ☐ No ☐ N/A ☐
S1GM16	Header compression procedure	10.54	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM16.1	Signaling Header Compression element in (Re)Association Request frames	10.54	(CFIndepSTA AND S1GM16):O	Yes ☐ No ☐ N/A ☐
S1GM16.2	Signaling Header Compression element in (Re)Association Response frames	10.54	(CFAP AND S1GM16):M	Yes ☐ No ☐ N/A ☐
S1GM16.3	Request header compression procedure		S1GM16:O	Yes ☐ No ☐ N/A ☐
S1GM16.4	Store the optional fields indicated in the Header Compression frame request		S1GM16:O	Yes ☐ No ☐ N/A ☐
S1GM16.5	Send back the Header Compression frame response		CFS1G:M	Yes ☐ No ☐ N/A ☐
S1GM17	Flow control	10.57	CFS1G:M	Yes ☐ No ☐ N/A ☐
S1GM17.1	Request flow suspension/resumption	10.57	CFS1G:O	Yes ☐ No ☐ N/A ☐

Item	Protocol capability	References	Status	Support
S1GM17.2	Flow suspension in response to Flow Suspension frame or NDP ACK frame	10.57	(CFIndepSTA AND CFS1G):M	Yes ☐ No ☐ N/A ☐
S1GM17.3	Flow suspension in response to STACK or BAT or TACK frame		(CFIndepSTA AND S1GM6.6):M	Yes ☐ No ☐ N/A ☐
S1GM17.4	Flow resumption upon receiving a Flow Resumption frame		(CFIndepSTA AND CFS1G):O	Yes ☐ No ☐ N/A ☐
*S1GM18	Dynamic AID assignment operation	10.20a	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM18.1	Request AID switch	10.20a	(CFIndepSTA AND S1GM18):O	Yes ☐ No ☐ N/A ☐
S1GM18.2	Respond to request for AID switch	10.20a	(CFAP AND S1GM18):M	Yes ☐ No ☐ N/A ☐
S1GM18.3	Issue unsolicited AID switch instruction	10.20a	(CFAP AND S1GM18):O	Yes ☐ No ☐ N/A ☐
S1GM18.4	Respond to unsolicited AID switch instruction	10.20a	(CFIndepSTA AND S1GM18):O	Yes ☐ No ☐ N/A ☐
S1GM19	System information update procedure	10.42.2	CFS1G:M	Yes ☐ No ☐ N/A ☐
S1GM19.1	Update the Change Sequence field in S1G Beacon frame		(CFAP AND CFS1G):M	Yes ☐ No ☐ N/A ☐
S1GM19.2	Respond to changes in the Change Sequence field in S1G Beacon frame		(CFIndepSTA AND CFS1G):M	Yes ☐ No ☐ N/A ☐
S1GM19.3	Respond to probe request frames that contain the Change Sequence field		(CFAP AND CFS1G):O	Yes ☐ No ☐ N/A ☐
S1GM20	STA types	10.59	CFS1G:M	Yes ☐ No ☐ N/A ☐
S1GM20.1	Support for sensor STA	10.59	(CFAP AND CFS1G):O.5	Yes ☐ No ☐ N/A ☐
S1GM20.2	Support for non-sensor STA	10.59	(CFAP AND CFS1G):O.5	Yes ☐ No ☐ N/A ☐
S1GM20.3	Support for both sensor and non-sensor STA	10.59	(CFAP AND CFS1G):O.5	Yes ☐ No ☐ N/A ☐
S1GM20.4	Assume the role of sensor STA	10.59	(CFIndepSTA AND CFS1G):O.6	Yes ☐ No ☐ N/A ☐
S1GM20.5	Assume the role of non-sensor STA	10.59	(CFIndepSTA AND CFS1G):O.6	Yes ☐ No ☐ N/A ☐

Item	Protocol capability	References	Status	Support
S1GM21	Support for energy limited STAs	11.48	(CFAP AND CFS1G AND (S1GM20.1 OR S1GM20.3)):M (CFAP AND S1GM20.2):O (CFIndepSTA AND S1GM20.4):O	Yes ☐ No ☐ N/A ☐
S1GM22	S1G Channel Access		CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GM22.1	Response indication deferral (RID) function	10.3.2.1, 10.3.2.4, 10.3.2.4a, 10.3.2.14	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GM22.2	Dynamic bandwidth operation	10.3.2.7	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GM22.3	Fragment BA procedure	10.3.2.9a	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GM22.4	Support for at least one transmit queue with AC_BE access category	10.2.4.2, 10.22.2.1	S1GM20.4: M	Yes ☐ No ☐ N/A ☐
S1GM22.5	Restricted Access Window (RAW) Operation	10.22.5	CFS1G:O	Yes ☐ No ☐ N/A ☐
S1GM22.5.1	EDCA backoff procedure in generic RAW or triggering frame RAW	10.22.5.5	(CFAP AND S1GM22.5):O (CFIndepSTA AND S1GM22.5):M	Yes ☐ No ☐ N/A ☐
S1GM22.5.2	Deferral for generic RAW, triggering RAW, sounding RAW and simplex RAW when RAW Type Options subfield indicates non-TIM RAW		(CFIndepSTA AND S1GM7): O (CFIndepSTA AND CFS1G AND (NOT S1GM7)): M	
S1GM22.5.3	Deferral for simplex RAW when RAW Type Options subfield does not indicate non-TIM RAW		(CFIndepSTA AND CFS1G): O	
S1GM23	Traffic indication map (TIM)	11.2.3.3, 11.2.3.4	CFAP: M	Yes ☐ No ☐ N/A ☐
S1GM23.1	Encode partial virtual bitmap in Block Bitmap mode	9.4.2.6	(CFAP AND CFS1G): O.5	Yes ☐ No ☐ N/A ☐
S1GM23.1.1	Encode partial virtual bitmap in Single AID mode		(CFAP AND CFS1G): O.5	Yes ☐ No ☐ N/A ☐
S1GM23.1.2	Encode partial virtual bitmap in OLB mode		(CFAP AND CFS1G): O.5	Yes ☐ No ☐ N/A ☐
S1GM23.1.3	Encode partial virtual bitmap in ADE mode		(CFAP AND CFS1G): O	Yes ☐ No ☐ N/A ☐

Item	Protocol capability	References	Status	Support
S1GM23.1.4	Decode partial virtual bitmap encoded in Block Bitmap mode		(CFIndepSTA AND CFS1G AND NOT S1GM7):M (CFIndepSTA AND S1GM7):O	Yes ☐ No ☐ N/A ☐
S1GM23.1.5	Decode partial virtual bitmap encoded in Single AID mode		(CFIndepSTA AND CFS1G AND NOT S1GM7):M (CFIndepSTA AND S1GM7):O	Yes ☐ No ☐ N/A ☐
S1GM23.1.6	Decode partial virtual bitmap encoded in OLB mode		(CFIndepSTA AND CFS1G AND NOT S1GM7):M (CFIndepSTA AND S1GM7):O	Yes ☐ No ☐ N/A ☐
S1GM23.1.7	Decode partial virtual bitmap encoded in ADE mode		(CFIndepSTA AND CFS1G AND NOT S1GM7):O	Yes ☐ No ☐ N/A ☐
S1GM23.2	Page slicing	10.47	(CFAP AND CFS1G): O (CFIndepSTA AND CFS1G):O	Yes ☐ No ☐ N/A ☐
S1GM23.2.1	Divide the TIM into page slices		(CFAP AND S1GM23.2): O	Yes ☐ No ☐ N/A ☐
S1GM23.2.2	Decode the TIM divided into page slices		(CFIndepSTA AND S1GM23.2):M	Yes ☐ No ☐ N/A ☐
S1GM24	AP power management	11.2.3.20	(CFAP AND CFS1G): O	Yes ☐ No ☐ N/A ☐
S1GM25	Association and reassociation	11.3	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GM25.1	Service characteristic indication during association	11.3.5.11	(CFIndepSTA AND CFS1G AND PC14):O	Yes ☐ No ☐ N/A ☐
S1GM25.2	Authentication Control	11.3.9	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GM25.2.1	Centralized authentication control		(CFAP AND S1GM25.2): O.2 (CFIndepSTA AND S1GM25.2): O	Yes ☐ No ☐ N/A ☐

Item	Protocol capability	References	Status	Support
S1GM25.2.2	Distributed authentication control		(CFAP AND S1GM25.2): O.2 (CFIndepSTA AND CFS1G): M	Yes ☐ No ☐ N/A ☐
S1GM26	Robust security network association (RSNA)		O	Yes ☐ No ☐
S1GM26.1	PV1 CCMP MPDU format	12.5.3.2	CFS1G AND (FT45 or FR46): M	Yes ☐ No ☐ N/A ☐
S1GM26.2	Local construction of CCMP Header for PV1 MPDUs	12.5.3.2a	CFS1G AND FR46: M	Yes ☐ No ☐ N/A ☐
S1GM26.3	CCMP cryptographic encapsulation procedure for PV1 MPDUs	12.5.3.3	CFS1G AND FT45: M	Yes ☐ No ☐ N/A ☐
S1GM26.4	CCMP decapsulation procedure for PV1 MPDUs	12.5.3.4	CFS1G AND FR46: M	Yes ☐ No ☐ N/A ☐
S1GM27	Asymmetric Block Ack Operation	10.7.6.5.2, 10.7.6.5.4a	CFS1G: O	Yes ☐ No ☐ N/A ☐
*S1GM28	Control Response MCS Negotiation	10.7.6.5.4b	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GM29	OBSS Mitigation Support	10.7.6.6	CFS1G: O	Yes ☐ No ☐ N/A ☐

B.4.28.2 S1G PHY features

Item	Protocol capability	References	Status	Support
	Are the following PHY protocol features supported?			
S1GP1	BSS bandwidth			
S1GP1.1	1 MHz operation	10.42.1 & 23.1.1	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP1.2	2 MHz operation	10.42.1 & 23.1.1	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP1.3	4 MHz operation	10.42.1 & 23.1.1	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP1.4	8 MHz operation	10.42.1 & 23.1.1	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP1.5	16 MHz operation	10.42.1 & 23.1.1	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP2	Coding scheme			
S1GP2.1	Use of BCC code	23.1.1 & 23.3.4	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP2.2	Use of STBC code	23.1.1 & 23.3.4	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP2.3	Use of LDPC code	23.1.1 & 23.3.4	CFS1G: O	Yes ☐ No ☐ N/A ☐

Item	Protocol capability	References	Status	Support
S1GP3	Demodulation scheme			
S1GP3.1	SIG-A of greater than or equal to 2 MHz long preamble format PPDU	23.1.1 & 23.3.4.2.3	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP4	PHY timing parameters			
S1GP4.1	Normal (long) guard interval	23.1.1 & 23.3.6	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP4.2	Short guard interval	23.1.1 & 23.3.6	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP5	Use of S1G beamforming	23.1.1 & 24.3.10	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP6	PPDU format			
S1GP6.1	1 MHz short preamble format PPDU	23.1.1 & 23.3.2	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP6.2	2 MHz short preamble format PPDU	23.1.1 & 23.3.2	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP6.3	Greater than 2 MHz short preamble format PPDU	23.1.1 & 23.3.2	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP6.4	Greater than or equal to 2 MHz long preamble format PPDU	23.1.1 & 23.3.2	CFS1G AND S1GP1.1: O CFS1G AND S1GP1.2: O CFS1G AND S1GP1.3: M CFS1G AND S1GP1.4: M CFS1G AND S1GP1.5: M	Yes ☐ No ☐ N/A ☐
S1GP6.5	S1G 1 MHz duplicate PPDU	23.3.9.12.1	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP6.6	S1G 2 MHz duplicate PPDU	23.3.9.12.2	CFS1G AND S1GP1.3: M CFS1G AND S1GP1.4: M CFS1G AND S1GP1.5: M	Yes ☐ No ☐ N/A ☐
S1GP6.7	Use of fixed pilots	23.3.9.10	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP6.8	Use of traveling pilots	23.3.9.10	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7				
S1GP7.1	MCS0, Nss = 1	23.1.1 & 23.5	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP7.2	MCS0, Nss = 2	23.1.1 & 23.5	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.3	MCS0, Nss = 3	23.1.1 & 23.5	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.4	MCS0, Nss = 4	23.1.1 & 23.5	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.5	MCS1, Nss = 1	23.1.1 & 23.5	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP7.6	MCS1, Nss = 2	23.1.1 & 23.5	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.7	MCS1, Nss = 3	23.1.1 & 23.5	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.8	MCS1, Nss = 4	23.1.1 & 23.5	CFS1G: O	Yes ☐ No ☐ N/A ☐

Item	Protocol capability	References	Status	Support
S1GP7.9	MCS2, Nss = 1	23.1.1 & 23.5	CFS1G: M	Yes ☐ No ☐ N/A ☐
S1GP7.10	MCS2, Nss = 2	23.1.1 & 23.5	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.11	MCS2, Nss = 3	23.1.1 & 23.5	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.12	MCS2, Nss = 4	23.1.1 & 23.5	CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.13	MCS3, Nss = 1	23.1.1 & 23.5	CFAP AND CFS1G: M CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.14	MCS3, Nss = 2	23.1.1 & 23.5	S1GP7.13: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.15	MCS3, Nss = 3	23.1.1 & 23.5	S1GP7.13: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.16	MCS3, Nss = 4	23.1.1 & 23.5	S1GP7.13: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.17	MCS4, Nss = 1	23.1.1 & 23.5	CFAP AND CFS1G: M CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.18	MCS4, Nss = 2	23.1.1 & 23.5	S1GP7.17: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.19	MCS4, Nss = 3	23.1.1 & 23.5	S1GP7.17: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.20	MCS4, Nss = 4	23.1.1 & 23.5	S1GP7.17: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.21	MCS5, Nss = 1	23.1.1 & 23.5	CFAP AND CFS1G: M CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.22	MCS5, Nss = 2	23.1.1 & 23.5	S1GP7.21: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐

Item	Protocol capability	References	Status	Support
S1GP7.23	MCS5, Nss = 3	23.1.1 & 23.5	S1GP7.21: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.24	MCS5, Nss = 4	23.1.1 & 23.5	S1GP7.21: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.25	MCS6, Nss = 1	23.1.1 & 23.5	CFAP AND CFS1G: M CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.26	MCS6, Nss = 2	23.1.1 & 23.5	S1GP7.25: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.27	MCS6, Nss = 3	23.1.1 & 23.5	S1GP7.25: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.28	MCS6, Nss = 4	23.1.1 & 23.5	S1GP7.25: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.29	MCS7, Nss = 1	23.1.1 & 23.5	CFAP AND CFS1G: M CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.30	MCS7, Nss = 2	23.1.1 & 23.5	S1GP7.29: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.31	MCS7, Nss = 3	23.1.1 & 23.5	S1GP7.29: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.32	MCS7, Nss = 4	23.1.1 & 23.5	S1GP7.29: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.33	MCS8, Nss = 1	23.1.1 & 23.5	CFAP AND CFS1G: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.34	MCS8, Nss = 2	23.1.1 & 23.5	S1GP7.33: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐

Item	Protocol capability	References	Status	Support
S1GP7.35	MCS8, Nss = 3	23.1.1 & 23.5	S1GP7.33: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.36	MCS8, Nss = 4	23.1.1 & 23.5	S1GP7.33: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.37	MCS9, Nss = 1	23.1.1 & 23.5	CFAP AND CFS1G AND (NOT S1GP1.2): O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.38	MCS9, Nss = 2	23.1.1 & 23.5	CFAP AND CFS1G AND S1GP7.37 AND (NOT S1GP1.2): O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.39	MCS9, Nss = 3	23.1.1 & 23.5	CFAP AND CFS1G AND S1GP7.37: O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.40	MCS9, Nss = 4	23.1.1 & 23.5	CFAP AND CFS1G AND S1GP7.37 AND (NOT S1GP1.2): O CFIndepSTA AND CFS1G: O	Yes ☐ No ☐ N/A ☐
S1GP7.41	MCS10, Nss = 1	23.1.1 & 23.5	CFS1G: M	Yes ☐ No ☐ N/A ☐

B.4.29 S1G Relay features

Item	Protocol capability	References	Status	Support
RL1	S1G Relay operation	10.50	CFS1GRelay: M	Yes ☐ No ☐ N/A ☐
RL2	S1G Relay Support		CFAP: O	Yes ☐ No ☐ N/A ☐
RL3	S1G Relay element		RL1 OR RL2:M	Yes ☐ No ☐ N/A ☐
RL4	Signaling of S1G Relay element in Probe Request, (Re)Association Request frames		CFS1GRe-lay:M	Yes ☐ No ☐ N/A ☐
RL5	Signaling of S1G Relay element in S1G Beacon, Probe Response, PV1 Probe Response frames and (Re)Association Response frames		(RL2):M	Yes ☐ No ☐ N/A ☐
RL6	TXOP sharing	10.50.5	(CFS1G AND RL1):O (CFS1G AND RL2):O (CFIndepSTA AND CFS1G):O	Yes ☐ No ☐ N/A ☐
RL6.1	Explicit Ack procedure	10.50.5.2	RL6:O.4	Yes ☐ No ☐ N/A ☐
RL6.2	Implicit Ack procedure	10.50.5.3	RL6:O.4	Yes ☐ No ☐ N/A ☐
RL7	S1G Relay discovery procedure	10.50.6, 11.1.4.3.4a	(CFS1G AND RL1):O CFAP: O CFIndepSTA: O	Yes ☐ No ☐ N/A ☐

Annex C

(normative)

ASN.1 encoding of the MAC and PHY MIB

C.3 MIB detail

Change the Dot11StationConfigEntry sequence in C.3 as follows:

```
Dot11StationConfigEntry ::= SEQUENCE
    {
        ...,
        dot11S1GOptionImplemented                              TruthValue
    }
```

Insert the following text after dot11DynamicEIFSActivated (dot11StationConfigEntry 158) in C.3:

```
dot11S1GOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates whether the entity is S1G Capable."
    DEFVAL { false }
    ::= { dot11StationConfigEntry 159 }
```

Change dot11BeaconRprtPhyType in C.3 as follows:

```
dot11BeaconRprtPhyType OBJECT-TYPE
    SYNTAX INTEGER {
        dsss(2),
        ofdm(4),
        hrdsss(5),
        erp(6),
        ht(7),
        dmg(8),
        vht(9),
        tvht(10),
        s1g(11)}
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the SME when a measurement report is completed.

        This attribute indicates the PHY Type for this row of Beacon report."
    ::= { dot11BeaconReportEntry 9 }
```

Change dot11FrameRprtPhyType in C.3 as follows:

```
dot11FrameRprtPhyType OBJECT-TYPE
   SYNTAX INTEGER {
      dsss(2),
      ofdm(4),
      hrdsss(5),
      erp(6),
      ht(7),
      dmg(8),
      vht(9),
      tvht(10),
      s1g(11) }
   MAX-ACCESS read-create
   STATUS current
   DESCRIPTION
      "This is a status variable.
      It is written by the SME when a measurement report is completed.

      This attribute indicates the PHY used for frame reception in this row of
      the frame report."
   ::= { dot11FrameReportEntry 10 }
```

Change dot11RMNeighborReportPhyType in C.3 as follows:

```
dot11RMNeighborReportPhyType OBJECT-TYPE
   SYNTAX INTEGER {
      dsss(2),
      ofdm(4),
      hrdsss(5),
      erp(6),
      ht(7)
      dmg(8),
      vht(9),
      tvht(10),
      s1g(11) }
   MAX-ACCESS read-create
   STATUS current
   DESCRIPTION
      "This is a status variable.
      It is written by the SME when a measurement report is completed.

      This attribute indicates the PHY Type of the neighbor AP identified by
      this BSSID."
   ::= { dot11RMNeighborReportEntry 15 }
```

Insert the following table after the dot11STALCI TABLE (dot11smt 33) in C.3:

```
-- ********************************************************************
-- * dot11S1GStationConfig TABLE
-- ********************************************************************
dot11S1GStationConfigTable OBJECT-TYPE
   SYNTAX SEQUENCE OF Dot11S1GStationConfigEntry
   MAX-ACCESS not-accessible
   STATUS current
   DESCRIPTION
      "Station Configuration attributes. In tabular form to allow for multiple
      instances on an agent."
   ::= { dot11smt 34 }

dot11S1GStationConfigEntry OBJECT-TYPE
```

```
    SYNTAX Dot11S1GStationConfigEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
       "An entry (conceptual row) in the dot11HTStationConfig Table.

       ifIndex - Each IEEE 802.11 interface is represented by an ifEntry. Inter-
       face tables in this MIB module are indexed by ifIndex."
    INDEX { ifIndex }
    ::= { dot11S1GStationConfigTable 1 }

Dot11S1GStationConfigEntry ::=
    SEQUENCE {
       dot11S1GMaxMPDULength                                   INTEGER,
       dot11S1GMaxRxAMPDUFactor                                Unsigned32,
       dot11S1GControlFieldOptionImplemented                   TruthValue,
       dot11S1GRxS1GMCSMap                                     OCTET STRING,
       dot11S1GTxS1GMCSMap                                     OCTET STRING,
       dot11S1GOBSSScanCount                                   Unsigned32,
       dot11ShortBeaconInterval                                TruthValue,
       dot11ShortBeaconPeriod                                  Unsigned32,
       dot11ShortBeaconDTIMPeriod                              Unsigned32,
       dot11PV1MACHeaderOptionImplemented                      TruthValue,
       dot11PV1ProbeResponseOptionImplemented                  TruthValue,
       dot11HeaderCompressionResponseTimeout                   Unsigned32,
       dot11TSFTimerAccuracyImplemented                        TruthValue,
       dot11NonTIMModeActivated                                TruthValue,
       dot11PageSlicingImplemented                             TruthValue,
       dot11PageSlicingActivated                               TruthValue,
       dot11DynamicAIDActivated                                TruthValue,
       dot11GroupAIDActivated                                  TruthValue,
       dot11AMSDUImplemented                                   TruthValue,
       dot11AMPDUImplemented                                   TruthValue,
       dot11MCSNegotiation                                     TruthValue,
       dot11AsymmetricBlockAckActivated                        TruthValue,
       dot11FragmentBAOptionImplemented                        TruthValue,
       dot11RAWOperationImplemented                            TruthValue,
       dot11RAWOperationActivated                              TruthValue,
       dot11S1GUplinkSyncOptionImplemented                     TruthValue,
       dot11TWTOptionActivated                                 TruthValue,
       dot11BATImplemented                                     TruthValue,
       dot11PollTACKResponseImplemented                        TruthValue,
       dot11NDPProbingActivated                                TruthValue,
       dot11NDPPSPollSupport                                   TruthValue,
       dot11RelayAPImplemented                                 TruthValue,
       dot11RelayAPOperationActivated                          TruthValue,
       dot11RelaySTAImplemented                                TruthValue,
       dot11RelaySTAOperationActivated                         TruthValue,
       dot11RelayDiscoveryOptionImplemented                    TruthValue,
       dot11TXOPSharingImplicitACKImplemented                  TruthValue,
       dot11S1GELOperationActivated                            TruthValue,
       dot11S1GCentralizedAuthenticationControlActivated       TruthValue,
       dot11S1GDistributedAuthenticationControlActivated       TruthValue,
       dot11SubchannelSelectiveTransmissionActivated           TruthValue,
       dot11S1GSectorImplemented                               TruthValue,
       dot11S1GSectorizationActivated                          TruthValue,
       dot11S1GSectorTrainingOperationImplemented              TruthValue,
       dot11NDPBeamformingReportPollImplemented                TruthValue,
       dot11UnsolicitedDynamicAIDActivated                     TruthValue,
       dot11TIMADEImplemented                                  TruthValue,
       dot11SelectiveSubchannelTransmissionPermitted           TruthValue,
       dot11MaxAwayDuration                                    Unsigned32,
       dot11APPMActivated                                      TruthValue,
       dot11BDTImplemented                                     TruthValue,
```

```
        dot11S1GCACDeferral                                     TruthValue,
        dot11S1GCACThreshold                                    Unsigned32,
        dot11S1GDACTac                                          Unsigned32,
        dot11S1GDACTImin                                        Unsigned32,
        dot11S1GDACTImax                                        Unsigned32
        }

dot11S1GMaxMPDULength OBJECT-TYPE
    SYNTAX INTEGER { short(3895), long (7991) }
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the supported maximum MPDU size."
    DEFVAL { short }
    ::= { dot11S1GStationConfigEntry 1 }

dot11S1GMaxRxAMPDUFactor OBJECT-TYPE
    SYNTAX Unsigned32 (0..7)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the maximum length of A-MPDU that the STA can
        receive. The maximum receive A-MPDU defined by this field is equal to
        2^(13+dot11S1GMaxRxAMPDUFactor) -1 octets."
    DEFVAL { 0 }
    ::= { dot11S1GStationConfigEntry 2 }

dot11S1GControlFieldOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA implementation is
        capable of receiving the VHT variant HT Control field."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 3 }

dot11S1GRxS1GMCSMap OBJECT-TYPE
    SYNTAX OCTET STRING (SIZE(4))
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        Each octet represents the highest S1G-MCS supported (for Rx) on the number
        of streams represented by the octet position (e.g., first octet represents
        1 stream, second octet represents 2 streams). A value 0 indicates that
        S1G-MCSs 0-2 are supported. A value 1 indicates that S1G-MCSs 0-7 are
        supported. A value 2 indicates that S1G-MCSs 0-9 are supported. A value 3
        indicates no support for that number of spatial streams. For 1 MHz, MCS10
        is always supported."
    ::= { dot11S1GStationConfigEntry 4 }

dot11S1GTxS1GMCSMap OBJECT-TYPE
```

```
    SYNTAX OCTET STRING (SIZE(4))
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
       "This is a capability variable.
       Its value is determined by device capabilities.

       Each octet represents the highest S1G-MCS supported (for Tx) on the number
       of streams represented by the octet position (e.g., first octet represents
       1 stream, second octet represents 2 streams). A value 0 indicates that
       S1G-MCSs 0-2 are supported. A value 1 indicates that S1G-MCSs 0-7 are
       supported. A value 2 indicates that S1G-MCSs 0-9 are supported. A value 3
       indicates no support for that number of spatial streams. For 1 MHz, MCS10
       is always supported."
    ::= { dot11S1GStationConfigEntry 5 }

dot11S1GOBSSScanCount OBJECT-TYPE
    SYNTAX Unsigned32 (3..100)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity or the SME.
       Changes take effect as soon as practical in the implementation.

       This attribute indicates the minimum number of scan operations perfomed on
       a channel to detect another OBSS."
    DEFVAL { 3 }
    ::= { dot11S1GStationConfigEntry 6 }

dot11ShortBeaconInterval OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity.
       Changes take effect for the next MLME-START.request primitive.

       This attribute, when true, indicates that the AP schedules for transmis-
       sion a Beacon frame in a TSBTT that is not a TBTT."
    ::= { dot11S1GStationConfigEntry 7 }

dot11ShortBeaconPeriod OBJECT-TYPE
    SYNTAX Unsigned32(1..65535)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity.
       Changes take effect for the next MLME-START.request primitive.

       This attribute specifies the number of TUs that a STA uses for scheduling
       S1G Beacon transmissions in a TSBTT that is not a TBTT. This value is
       transmitted in the S1G Beacon, Probe Response, and PV1 Probe Response
       frames."
    ::= { dot11S1GStationConfigEntry 8 }

dot11ShortBeaconDTIMPeriod OBJECT-TYPE
    SYNTAX Unsigned32(1..255)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
```

```
      It is written by an external management entity.
      Changes take effect for the next MLME-START.request primitive.

      This attribute specifies the number of short beacon intervals that elapse
      between transmission of S1G Beacon frames containing a TIM element whose
      DTIM Count field is 0. This value is transmitted in S1G Beacon frames."
   ::= { dot11S1GStationConfigEntry 9 }

dot11PV1MACHeaderOptionImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the STA implementation is capa-
      ble of generating frames with PV1 MAC Header. The capability is disabled,
      otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 10 }

dot11PV1ProbeResponseOptionImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the STA implementation is capa-
      ble of supporting PV1 Probe Response frames. The capability is disabled,
      otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 11 }

dot11HeaderCompressionResponseTimeout OBJECT-TYPE
   SYNTAX Unsigned32(1..4294967295)
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity.

      This attribute indicates the amount of time, in units of milliseconds, the
      STA waits before timing out a Header Compression frame request."
   DEFVAL { 5 }
   ::= { dot11S1GStationConfigEntry 12 }

dot11TSFTimerAccuracyImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the STA implementation is capa-
      ble of supporting the TSF Timer Accuracy option. The capability is dis-
      abled, otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 13 }

dot11NonTIMModeActivated OBJECT-TYPE
```

```
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the non-TIM mode is enabled. The
        non-TIM mode is disabled otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 14 }

dot11PageSlicingImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA implementation is capa-
        ble of supporting the page slicing option. The capability is disabled,
        otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 15 }

dot11PageSlicingActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the page slicing option is
        enabled. The page slicing option is disabled otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 16 }

dot11DynamicAIDActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the dynamic AID is enabled. The
        dynamic AID is disabled otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 17 }

dot11GroupAIDActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.
```

```
      This attribute, when true, indicates that the group AID is enabled. The
      group AID is disabled otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 18 }

dot11AMSDUImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the device is capable of receiv-
      ing A-MSDU carried in S1G PPDUs."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 19 }

dot11AMPDUImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the device is capable of receiv-
      ing an A-MPDU frame that is not a S-MPDU carried in S1G PPDUs."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 20 }

dot11MCSNegotiation OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity or the SME.
      Changes take effect as soon as practical in the implementation.

      This attribute, when true, indicates that the MCS negotiation is enabled.
      The MCS negotiation is disabled otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 21 }

dot11AsymmetricBlockAckActivated OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity or the SME.
      Changes take effect as soon as practical in the implementation.

      This attribute, when true, indicates that the asymmetric Block ACK is
      enabled. The asymmetric Block ACK is disabled otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 22 }

dot11FragmentBAOptionImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
```

```
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA implementation is capa-
        ble of supporting the fragment block ack option. The capability is dis-
        abled, otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 23 }

dot11RAWOperationImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA implementation is capa-
        ble of supporting the RAW operation. The capability is disabled, other-
        wise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 24 }

dot11RAWOperationActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the RAW operation is enabled.
        The RAW operation is disabled otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 25 }

dot11S1GUplinkSyncOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA implementation is capa-
        ble of supporting the uplink synch option. The capability is disabled,
        otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 26 }

dot11TWTOptionActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the STA capability for the tar-
        get wake time function is enabled. A value of false indicates that the STA
        has no capability for the target wake time function, or that the capabil-
        ity is present, but disabled."
```

```
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 27}

dot11BATImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA implementation is capa-
        ble of supporting BAT operation. The capability is disabled, otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 28 }

dot11PollTACKResponseImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA implementation is capa-
        ble of generating a TACK frame as a response to a PS-Poll with the Poll
        Type subfield equal to 1. The capability is disabled, otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 29 }

dot11NDPProbingActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the NDP Probing is enabled. The
        NDP Probing is disabled otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 30 }

dot11NDPPSPollSupport OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the NDP PS-Poll operation is
        enabled. The NDP PS-Poll operation is disabled otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 31 }

dot11RelayAPImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
```

```
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the STA permits association by a
      relat STA. The capability is disabled, otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 32 }

dot11RelayAPOperationActivated OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity or the SME.
      Changes take effect as soon as practical in the implementation.

      This attribute, when true, indicates that the relay AP operation is
      enabled. The relay AP operation is disabled otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 33 }

dot11RelaySTAImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the STA implementation is a
      relay STA inside a relay. This should not be modified during the life of
      the STA."
   DEFVAL { true}
   ::= { dot11S1GStationConfigEntry 34 }

dot11RelaySTAOperationActivated OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity or the SME.
      Changes take effect as soon as practical in the implementation.

      This attribute, when true, indicates that the relay STA operation is
      enabled. This attribute can be modified during the life of the STA in the
      BSS by sending Relay Activation element. The relay STA operation is dis-
      abled otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 35 }

dot11RelayDiscoveryOptionImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the STA implementation is capa-
      ble of supporting Relay Discovery option. The capability is disabled, oth-
      erwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 36 }
```

```
dot11TXOPSharingImplicitACKImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the TXOP sharing implicit Ack
        operation is enabled. The TXOP sharing implicit Ack operation is disabled
        otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 37 }

dot11S1GELOperationActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the EL operation is enabled. The
        EL operation is disabled otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 38 }

dot11S1GCentralizedAuthenticationControlActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the Centralized Authentication
        Control operation is enabled. The Centralized Authentication Control oper-
        ation is disabled otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 39 }

dot11S1GDistributedAuthenticationControlActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the Distributed Authentication
        Control operation is enabled. The Distributed Authentication Control oper-
        ation is disabled otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 40 }

dot11SubchannelSelectiveTransmissionActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
```

```
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the Subchannel Selective Trans-
        mission is enabled. The Subchannel Selective Transmission is disabled oth-
        erwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 41 }

dot11S1GSectorImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA implementation is capa-
        ble of supporting S1G Sector option. The capability is disabled, other-
        wise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 42 }

dot11S1GSectorizationActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the S1G Sector operation is
        enabled. The S1G Sector operation is disabled otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 43 }

dot11S1GSectorTrainingOperationImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or the SME.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the STA implementation is capa-
        ble of supporting the S1G Sector Training option. The capability is dis-
        abled, otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 44 }

dot11NDPBeamformingReportPollImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the NDP Beamforming Report Poll
        operation is enabled. The NDP Beamforming Report Poll operation is dis-
```

```
      abled otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 45 }

dot11UnsolicitedDynamicAIDActivated OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity or the SME.
      Changes take effect as soon as practical in the implementation.

      This attribute, when true, indicates that the unsolicited dynamic AID is
      enabled. The unsolicited dynamic AID is disabled otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 46 }

dot11TIMADEImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the STA implementation is capa-
      ble of supporting the ADE mode of TIM bitmap encoding. The capability is
      disabled, otherwise."
   DEFVAL { false }
   ::= { dot11S1GStationConfigEntry 47 }

dot11SelectiveSubchannelTransmissionPermitted OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity.
      Changes take effect as soon as practical in the implementation.

      When this object is true, this indicates that Selective Subchannel Trans-
      misison is permitted by this entity."
   DEFVAL { false }
::= { dot11S1GStationConfigEntry 48}

dot11MaxAwayDuration OBJECT-TYPE
   SYNTAX Unsigned32(0..65535)
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      " This is a control variable.
      It is written by an external management entity.
      Changes take effect as soon as practical in the implementation.

      This attribute indicates from the STA, the maximum allowed duration for
      the AP to be not reachable, from the AP, the maximum duration that AP
      guarantees to be reachable by the STA."
   DEFVAL { 65535 }
   ::= { dot11S1GStationConfigEntry 49}

dot11APPMActivated           OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
```

```
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity.
       Changes take effect as soon as practical in the implementation.

       This attribute indicates if the AP may go to doze state."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 50}

dot11BDTImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by an external management entity.
       Changes take effect as soon as practical in the implementation.

       This attribute, when true, indicates that the station implementation is
       capable of supporting the bidirectional TXOP Operation. The capability is
       disabled, otherwise."
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 51}

dot11S1GCACDeferral OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by the MAC upon receiving an Authentication Control Element
       with Control subfield equal to 0.
       Changes take effect as soon as practical in the implementation.

       This attribute specifies whether the deferred channel access is used by
       the Centralized Authentication Control operation. "
    DEFVAL { false }
    ::= { dot11S1GStationConfigEntry 52 }

dot11S1GCACThreshold OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by the MAC upon receiving an Authentication Control Element
       with Control subfield equal to 0.
       Changes take effect as soon as practical in the implementation.

    This attribute specifies the threshold value that is used by the Centralized
       Authentication Control operation. "
    DEFVAL { 1024 }
    ::= { dot11S1GStationConfigEntry 53 }

dot11S1GDACTac OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
       "This is a control variable.
       It is written by the MAC upon receiving an Authentication Control Element
       with Control subfield equal to 1.
       Changes take effect as soon as practical in the implementation.
```

```
        This attribute specifies the Authentication Slot Duration that is used by
        the Distributed Authentication Control operation. "
    DEFVAL { 10 }
    ::= { dot11S1GStationConfigEntry 54 }

dot11S1GDACTImin OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by the MAC upon receiving an Authentication Control Element
        with Control subfield equal to 1.
        Changes take effect as soon as practical in the implementation.

    This attribute specifies the minimum transmission interval that is used by
        the Distributed Authentication Control operation. "
    DEFVAL { 8 }
    ::= { dot11S1GStationConfigEntry 55}

dot11S1GDACTImax OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by the MAC upon receiving an Authentication Control Element
        with Control subfield equal to 1.
        Changes take effect as soon as practical in the implementation.

        This attribute specifies the maximum transmission interval that is used by
        the Distributed Authentication Control operation. "
    DEFVAL { 256 }
    ::= { dot11S1GStationConfigEntry 56 }

-- ********************************************************************
-- * End of dot11S1GStationConfigTable TABLE
-- ********************************************************************
```

Change dot11PHYType in C.3 as follows:

```
dot11PHYType OBJECT-TYPE
    SYNTAX INTEGER {
        dsss(2),
        ofdm(4),
        hrdsss(5),
        erp(6),
        ht(7)
        dmg(8),
        vht(9),
        tvht(10),
        s1g(11) }
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a status variable.
        It is written by the PHY.

        This is an 8-bit integer value that identifies the PHY type. Currently
        defined values and their corresponding PHY types are:

        DSSS 2.4 GHz = 2, OFDM = 4, HRDSSS = 5, ERP = 6, HT = 7, DMG = 8, VHT = 9,
```

```
      TVHT = 10, S1G = 11"
   ::= { dot11PhyOperationEntry 1 }
```

Insert the following tables ("dot11 Phy S1G" and "dot11 S1G Transmit Beamforming Config") after the dot11 TVHT Transmit Beamforming Config TABLE (dot11phy 26) in C.3:

```
-- ********************************************************************
-- * dot11 Phy S1G TABLE
-- ********************************************************************

dot11PhyS1GTable OBJECT-TYPE
   SYNTAX SEQUENCE OF Dot11PhyS1GEntry
   MAX-ACCESS not-accessible
   STATUS current
   DESCRIPTION
      "Entry of attributes for dot11PhyS1GTable. Implemented as a table indexed
      on ifIndex to allow for multiple instances on an Agent."
   ::= { dot11phy 27 }

dot11PhyS1GEntry OBJECT-TYPE
   SYNTAX Dot11PhyS1GEntry
   MAX-ACCESS not-accessible
   STATUS current
   DESCRIPTION
      "An entry in the dot11PhyHTEntry Table. ifIndex - Each IEEE 802.11 inter-
      face is represented by an ifEntry. Interface tables in this MIB module are
      indexed by ifIndex."
   INDEX {ifIndex}
   ::= { dot11PhyS1GTable 1 }

Dot11PhyS1GEntry ::=
   SEQUENCE {
      dot11S1GChannelWidthOptionImplemented                 INTEGER,
      dot11S1GCurrentPrimaryChannel                         Unsigned32,
      dot11S1GCurrentChannelWidth                           INTEGER,
      dot11S1GCurrentChannelCenterFrequencyIndex            Unsigned32,
      dot11ShortGIOptionIn1MImplemented                     TruthValue,
      dot11ShortGIOptionIn1MActivated                       TruthValue,
      dot11ShortGIOptionIn2MImplemented                     TruthValue,
      dot11ShortGIOptionIn2MActivated                       TruthValue,
      dot11ShortGIOptionIn4MImplemented                     TruthValue,
      dot11ShortGIOptionIn4MActivated                       TruthValue,
      dot11ShortGIOptionIn8MImplemented                     TruthValue,
      dot11ShortGIOptionIn8MActivated                       TruthValue,
      dot11ShortGIOptionIn16MImplemented                    TruthValue,
      dot11ShortGIOptionIn16MActivated                      TruthValue,
      dot11S1GLDPCCodingOptionImplemented                   TruthValue,
      dot11S1GLDPCCodingOptionActivated                     TruthValue,
      dot11S1GTxSTBCOptionImplemented                       TruthValue,
      dot11S1GTxSTBCOptionActivated                         TruthValue,
      dot11S1GRxSTBCOptionImplemented                       TruthValue,
      dot11S1GRxSTBCOptionActivated                         TruthValue,
      dot11S1GMUMaxUsersImplemented                         Unsigned32,
      dot11S1GMUMaxNSTSPerUserImplemented                   Unsigned32,
      dot11S1GMUMaxNSTSTotalImplemented                     Unsigned32,
      dot11S1GMaxNTxChainsImplemented                       Unsigned32,
      dot11S1GMaxNTxChainsActivated                         Unsigned32,
      dot11S1GTravelingPilotOptionImplemented               TruthValue,
      dot11S1GTravelingPilotOptionActivated                 TruthValue,
      dot11S1GLONGOptionImplemented                         TruthValue,
      dot11S1GLONGOptionActivated                           TruthValue
   }
```

```
dot11S1GChannelWidthOptionImplemented OBJECT-TYPE
   SYNTAX INTEGER { contiguous2(0), contiguous4(1), contiguous8(2), contigu-
      ous16(3) }
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute indicates the channel widths supported: 1/2 MHz, 1/2/4 MHz,
      1/2/4/8 MHz or 1/2/4/8/16 MHz."
   DEFVAL { contiguous2 }
   ::= { dot11PhyS1GEntry 1 }

dot11S1GCurrentPrimaryChannel OBJECT-TYPE
   SYNTAX Unsigned32
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a status variable.
      It is written by the PHY.

      This attribute indicates the channel number of the 2 MHz primary channel
      or of the 1 MHz primary channel."
   ::= { dot11PhyS1GEntry 2 }

dot11S1GCurrentChannelWidth OBJECT-TYPE
   SYNTAX INTEGER { cbw1(0), cbw2(1), cbw4(2), cbw8(3), cbw16(4) }
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a status variable.
      It is written by the PHY.

      This attribute indicates the operating channel width."
   DEFVAL { cbw1 }
   ::= { dot11PhyS1GEntry 3 }

dot11S1GCurrentChannelCenterFrequencyIndex OBJECT-TYPE
   SYNTAX Unsigned32 (0..200)
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a status variable.
      It is written by the PHY.

      For a 1 MHz, 2 MHz, 4 MHz, 8 MHz, or 16 MHz channel, denotes the channel
      center frequency."
   DEFVAL { 0 }
   ::= { dot11PhyS1GEntry 4 }

dot11ShortGIOptionIn1MImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the device is capable of receiv-
      ing 1 MHz short guard interval packets."
   DEFVAL { false }
   ::= { dot11PhyS1GEntry 5 }
```

```
dot11ShortGIOptionIn1MActivated OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity.
      Changes take effect as soon as practical in the implementation. Changes
      made while associated with an AP or while operating a BSS should take
      effect only after disassociation or the deactivation of the BSS, respec-
      tively.

      This attribute, when true, indicates that the reception of 1 MHz short
      guard interval packets is enabled."
   DEFVAL { false }
   ::= { dot11PhyS1GEntry 6 }

dot11ShortGIOptionIn2MImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the device is capable of receiv-
      ing 2 MHz short guard interval packets."
   DEFVAL { false }
   ::= { dot11PhyS1GEntry 7 }

dot11ShortGIOptionIn2MActivated OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity.
      Changes take effect as soon as practical in the implementation. Changes
      made while associated with an AP or while operating a BSS should take
      effect only after disassociation or the deactivation of the BSS, respec-
      tively.

      This attribute, when true, indicates that the reception of 2 MHz short
      guard interval packets is enabled."
   DEFVAL { false }
   ::= { dot11PhyS1GEntry 8 }

dot11ShortGIOptionIn4MImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indicates that the device is capable of receiv-
      ing 4 MHz short guard interval packets."
   DEFVAL { false }
   ::= { dot11PhyS1GEntry 9 }

dot11ShortGIOptionIn4MActivated OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-write
   STATUS current
```

```
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation. Changes
        made while associated with an AP or while operating a BSS should take
        effect only after disassociation or the deactivation of the BSS, respec-
        tively.

        This attribute, when true, indicates that the reception of 4 MHz short
        guard interval packets is enabled."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 10 }


dot11ShortGIOptionIn8MImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the device is capable of receiv-
        ing 8 MHz short guard interval packets."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 11 }

dot11ShortGIOptionIn8MActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation. Changes
        made while associated with an AP or while operating a BSS should take
        effect only after disassociation or the deactivation of the BSS, respec-
        tively.

        This attribute, when true, indicates that the reception of 8 MHz short
        guard interval packets is enabled."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 12 }

dot11ShortGIOptionIn16MImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the device is capable of receiv-
        ing 16 MHz short guard interval packets."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 13 }

dot11ShortGIOptionIn16MActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
```

```
        Changes take effect as soon as practical in the implementation. Changes
        made while associated with an AP or while operating a BSS should take
        effect only after disassociation or the deactivation of the BSS, respec-
        tively.

        This attribute, when true, indicates that the reception of 16 MHz short
        guard interval packets is enabled."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 14 }

dot11S1GLDPCCodingOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the LDPC coding option for S1G
        packets is implemented."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 15 }

dot11S1GLDPCCodingOptionActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation. Changes
        made while associated with an AP or while operating a BSS should take
        effect only after disassociation or the deactivation of the BSS, respec-
        tively.

        This attribute, when true, indicates that the LDPC coding option for S1G
        packets is enabled."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 16 }

dot11S1GTxSTBCOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the device is capable of trans-
        mitting S1G PPDUs using STBC."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 17 }

dot11S1GTxSTBCOptionActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation. Changes
        made while associated with an AP or while operating a BSS should take
        effect only after disassociation or the deactivation of the BSS, respec-
        tively.
```

```
        This attribute, when true, indicates that the entity's capability for
        transmitting S1G PPDUs using STBC is enabled."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 18 }

dot11S1GRxSTBCOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the device is capable of receiv-
        ing S1G PPDUs using STBC."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 19 }

dot11S1GRxSTBCOptionActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation. Changes
        made while associated with an AP or while operating a BSS should take
        effect only after disassociation or the deactivation of the BSS, respec-
        tively.

        This attribute, when true, indicates that the entity's capability for
        receiving S1G PPDUs using STBC is enabled."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 20 }

dot11S1GMUMaxUsersImplemented OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the maximum number of users to which this device
        is capable of transmitting within an S1G MU PPDU."
    DEFVAL { 1 }
    ::= { dot11PhyS1GEntry 21 }

dot11S1GMUMaxNSTSPerUserImplemented OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the maximum number of space-time streams per user
        that this device is capable of transmitting within an S1G MU PPDU."
    DEFVAL { 1 }
    ::= { dot11PhyS1GEntry 22 }

dot11S1GMUMaxNSTSTotalImplemented OBJECT-TYPE
    SYNTAX Unsigned32
```

```
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the maximum number of space-time streams for all
        users that this device is capable of transmitting within an S1G MU PPDU."
    DEFVAL { 1 }
    ::= { dot11PhyS1GEntry 23 }

dot11S1GMaxNTxChainsImplemented OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the maximum number of transmit chains within this
        device."
    DEFVAL { 1 }
    ::= { dot11PhyS1GEntry 24 }

dot11S1GMaxNTxChainsActivated OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation.

        This attribute indicates the maximum number of transmit chains that are
        activated within this device, unless this attribute exceeds dot11S1GMax-
        NTxChainsImplemented, in which case  the maximum number of transmit chains
        that are activated within this device is equal to dot11S1GMaxNTxChainsIm-
        plemented."
    DEFVAL { 1 }
::= { dot11PhyS1GEntry 25 }

dot11S1GTravelingPilotOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indictes that the traveling pilot option is
        implemented."
    DEFVAL { false }
    ::= { dot11PhyS1GEntry 26 }

dot11S1GTravelingPilotOptionActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation.

        This attribute, when true, indicates that the traveling pilot option is
```

```
      enabled."
   DEFVAL { false }
   ::= { dot11PhyS1GEntry 27 }

dot11S1GLONGOptionImplemented OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a capability variable.
      Its value is determined by device capabilities.

      This attribute, when true, indictes that the S1G_Long operation is imple-
      mented."
   DEFVAL { false }
   ::= { dot11PhyS1GEntry 28 }


dot11S1GLONGOptionActivated OBJECT-TYPE
   SYNTAX TruthValue
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity.
      Changes take effect as soon as practical in the implementation.

      This attribute, when true, indicates that the S1G_Long operation is
      enabled."
   DEFVAL { false }
   ::= { dot11PhyS1GEntry 29 }

-- **********************************************************************
-- * End of dot11PhyS1G TABLE
-- **********************************************************************

-- **********************************************************************
-- * dot11 S1G Transmit Beamforming Config TABLE
-- **********************************************************************

dot11S1GTransmitBeamformingConfigTable OBJECT-TYPE
   SYNTAX SEQUENCE OF Dot11S1GTransmitBeamformingConfigEntry
   MAX-ACCESS not-accessible
   STATUS current
   DESCRIPTION
      "Entry of attributes for dot11S1GTransmitBeamformingConfigTable. Imple-
      mented as a table indexed on ifIndex to allow for multiple instances on an
      Agent."
   ::= { dot11phy 28 }

dot11S1GTransmitBeamformingConfigEntry OBJECT-TYPE
   SYNTAX Dot11S1GTransmitBeamformingConfigEntry
   MAX-ACCESS not-accessible
   STATUS current
   DESCRIPTION
      "An entry in the dot11S1GTransmitBeamformingConfig Table.
      ifIndex - Each IEEE 802.11 interface is represented by an ifEntry. Inter-
      face tables in this MIB module are indexed by ifIndex."
   INDEX {ifIndex}
   ::= { dot11S1GTransmitBeamformingConfigTable 1 }

Dot11S1GTransmitBeamformingConfigEntry ::=
   SEQUENCE {
      dot11S1GSUBeamformerOptionImplemented                 TruthValue,
```

```
        dot11S1GSUBeamformeeOptionImplemented                  TruthValue,
        dot11S1GMUBeamformerOptionImplemented                  TruthValue,
        dot11S1GMUBeamformeeOptionImplemented                  TruthValue,
        dot11S1GNumberSoundingDimensions                       Unsigned32,
        dot11S1GBeamformeeNTxSupport                           Unsigned32
    }

dot11S1GSUBeamformeeOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA supports the SU Beamfor-
        mee role."
    DEFVAL { false }
    ::= { dot11S1GTransmitBeamformingConfigEntry 1 }

dot11S1GSUBeamformerOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA supports the SU Beam-
        former role."
    DEFVAL { false }
    ::= { dot11S1GTransmitBeamformingConfigEntry 2 }

dot11S1GMUBeamformeeOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA supports the MU Beamfor-
        mee role."
    DEFVAL { false }
    ::= { dot11S1GTransmitBeamformingConfigEntry 3 }

dot11S1GMUBeamformerOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA supports the MU Beam-
        former role."
    DEFVAL { false }
    ::= { dot11S1GTransmitBeamformingConfigEntry 4 }

dot11S1GNumberSoundingDimensions OBJECT-TYPE
    SYNTAX Unsigned32 (1..8)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
```

```
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the number of antennas used by the beamformer
        when sending beamformed tansmissions."
    ::= { dot11S1GTransmitBeamformingConfigEntry 5 }

dot11S1GBeamformeeNTxSupport OBJECT-TYPE
    SYNTAX Unsigned32 (1..8)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the maximum number of space-time streams that the
        STA can receive in an S1G NDP, the maximum value for NSTS,total that can
        be sent to the STA in an S1G MU PPDU if the STA is MU beamformee capable
        and the maximum value of Nr that the STA transmits in an S1G Compressed
        Beamforming frame."
    ::= { dot11S1GTransmitBeamformingConfigEntry 6 }

-- **********************************************************************
-- * End of dot11 S1G Transmit Beamforming Config TABLE
-- **********************************************************************
```

Insert the following compliance objects after dot11HTMACAdditions2 in C.3:

```
dot11S1GTransmitBeamformingGroup OBJECT-GROUP
    OBJECTS {
        dot11S1GSUBeamformerOptionImplemented,
        dot11S1GSUBeamformeeOptionImplemented,
        dot11S1GMUBeamformerOptionImplemented,
        dot11S1GMUBeamformeeOptionImplemented,
        dot11S1GNumberSoundingDimensions,
        dot11S1GBeamformeeNTxSupport }
    STATUS current
    DESCRIPTION
        "Attributes that configure S1G transmit beamforming for IEEE 802.11."
    ::= { dot11Groups 88 }

dot11PhyS1GComplianceGroup OBJECT-GROUP
    OBJECTS {
        dot11S1GChannelWidthOptionImplemented,
        dot11S1GCurrentPrimaryChannel,
        dot11S1GCurrentChannelWidth,
        dot11S1GCurrentChannelCenterFrequencyIndex,
        dot11ShortGIOptionIn1MImplemented,
        dot11ShortGIOptionIn1MActivated,
        dot11ShortGIOptionIn2MImplemented,
        dot11ShortGIOptionIn2MActivated,
        dot11ShortGIOptionIn4MImplemented,
        dot11ShortGIOptionIn4MActivated,
        dot11ShortGIOptionIn8MImplemented,
        dot11ShortGIOptionIn8MActivated,
        dot11ShortGIOptionIn16MImplemented,
        dot11ShortGIOptionIn16MActivated,
        dot11S1GLDPCCodingOptionImplemented,
        dot11S1GLDPCCodingOptionActivated,
        dot11S1GTxSTBCOptionImplemented,
        dot11S1GTxSTBCOptionActivated,
        dot11S1GRxSTBCOptionImplemented,
        dot11S1GRxSTBCOptionActivated,
```

```
        dot11S1GMUMaxUsersImplemented,
        dot11S1GMUMaxNSTSPerUserImplemented,
        dot11S1GMUMaxNSTSTotalImplemented,
        dot11S1GMaxNTxChainsImplemented,
        dot11S1GMaxNTxChainsActivated,
        dot11S1GTravelingPilotOptionImplemented,
        dot11S1GTravelingPilotOptionActivated,
        dot11S1GLONGOptionImplemented,
        dot11S1GLONGOptionActivated }
    STATUS current
    DESCRIPTION
        "Attributes that configure the S1G PHY."
    ::= { dot11Groups 89 }

dot11S1GComplianceGroup OBJECT-GROUP
    OBJECTS {
        dot11S1GOptionImplemented,
        dot11S1GMaxMPDULength,
        dot11S1GMaxRxAMPDUFactor,
        dot11S1GControlFieldOptionImplemented,
        dot11S1GRxS1GMCSMap,
        dot11S1GTxS1GMCSMap,
        dot11S1GOBSSScanCount,
        dot11ShortBeaconInterval,
        dot11ShortBeaconPeriod,
        dot11ShortBeaconDTIMPeriod,
        dot11PV1MACHeaderOptionImplemented,
        dot11PV1ProbeResponseOptionImplemented,
        dot11HeaderCompressionResponseTimeout,
        dot11TSFTimerAccuracyImplemented,
        dot11NonTIMModeActivated,
        dot11PageSlicingImplemented,
        dot11PageSlicingActivated,
        dot11DynamicAIDActivated,
        dot11GroupAIDActivated,
        dot11AMSDUImplemented,
        dot11AMPDUImplemented,
        dot11MCSNegotiation,
        dot11AsymmetricBlockAckActivated,
        dot11FragmentBAOptionImplemented,
        dot11RAWOperationImplemented,
        dot11RAWOperationActivated,
        dot11S1GUplinkSyncOptionImplemented,
        dot11TWTOptionActivated,
        dot11BATImplemented,
        dot11PollTACKResponseImplemented,
        dot11NDPProbingActivated,
        dot11NDPPSPollSupport,
        dot11RelayAPImplemented,
        dot11RelayAPOperationActivated,
        dot11RelaySTAImplemented,
        dot11RelaySTAOperationActivated,
        dot11RelayDiscoveryOptionImplemented,
        dot11TXOPSharingImplicitACKImplemented,
        dot11S1GELOperationActivated,
        dot11S1GCentralizedAuthenticationControlActivated,
        dot11S1GDistributedAuthenticationControlActivated,
        dot11SubchannelSelectiveTransmissionActivated,
        dot11S1GSectorImplemented,
        dot11S1GSectorizationActivated,
        dot11S1GSectorTrainingOperationImplemented,
        dot11NDPBeamformingReportPollImplemented,
        dot11UnsolicitedDynamicAIDActivated,
        dot11TIMADEImplemented,
```

```
        dot11SelectiveSubchannelTransmissionPermitted,
        dot11MaxAwayDuration,
        dot11APPMActivated,
        dot11BDTImplemented,
        dot11S1GCACDeferral,
        dot11S1GCACThreshold,
        dot11S1GDACTac,
        dot11S1GDACTImin,
        dot11S1GDACTImax }
    STATUS current
    DESCRIPTION
        "Attributes that configure the S1G Group for IEEE 802.11."
    ::= { dot11Groups 90 }
```

Change Compliance Statements (dot11Compliances 1) in C.3 as shown:

```
dot11Compliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
        "The compliance statement for SNMPv2 entities that implement the IEEE
        802.11 MIB."
    MODULE  -- this module
    MANDATORY-GROUPS {
        dot11SMTbase13,
        dot11MACbase4,
        dot11CountersGroup4,
        dot11SmtAuthenticationAlgorithms,
        dot11ResourceTypeID,
        dot11PhyOperationComplianceGroup2 }

    GROUP dot11PhyDSSSComplianceGroup
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType is
        dsss.
        This group is mutually exclusive to the following groups:
        dot11PhyOFDMComplianceGroup3
        dot11PhyHRDSSSComplianceGroup
        dot11PhyERPComplianceGroup
        dot11PhyHTComplianceGroup
        dot11DMGComplianceGroup
        dot11PhyVHTComplianceGroup
        dot11PhyTVHTComplianceGroup
        dot11PhyS1GComplianceGroup"

    GROUP dot11PhyOFDMComplianceGroup3
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType is
        ofdm.
        This group is mutually exclusive to the following groups:
        dot11PhyDSSSComplianceGroup
        dot11PhyHRDSSSComplianceGroup
        dot11PhyERPComplianceGroup
        dot11PhyHTComplianceGroup
        dot11DMGComplianceGroup
        dot11PhyVHTComplianceGroup
        dot11PhyTVHTComplianceGroup
        dot11PhyS1GComplianceGroup"

    GROUP dot11PhyHRDSSSComplianceGroup
    DESCRIPTION
        "Implementation of this group is required when object dot11PHYType is
        hrdsss.
        This group is mutually exclusive to the following groups:
```

```
    dot11PhyDSSSComplianceGroup
    dot11PhyOFDMComplianceGroup3
    dot11PhyERPComplianceGroup
    dot11PhyHTComplianceGroup
    dot11DMGComplianceGroup
    dot11PhyVHTComplianceGroup
    dot11PhyTVHTComplianceGroup
    dot11PhyS1GComplianceGroup"

GROUP dot11PhyERPComplianceGroup
DESCRIPTION
    "Implementation of this group is required when object dot11PHYType is erp.
    This group is mutually exclusive to the following groups:
    dot11PhyDSSSComplianceGroup
    dot11PhyOFDMComplianceGroup3
    dot11PhyHRDSSSComplianceGroup
    dot11PhyHTComplianceGroup
    dot11DMGComplianceGroup
    dot11PhyVHTComplianceGroup
    dot11PhyTVHTComplianceGroup
    dot11PhyS1GComplianceGroup"

GROUP dot11PhyHTComplianceGroup
DESCRIPTION
    "Implementation of this group is required when object dot11PHYType has the
    value of ht.
    This group is mutually exclusive to the following groups:
    dot11PhyDSSSComplianceGroup
    dot11PhyOFDMComplianceGroup3
    dot11PhyHRDSSSComplianceGroup
    dot11PhyERPComplianceGroup
    dot11DMGComplianceGroup
    dot11PhyVHTComplianceGroup
    dot11PhyTVHTComplianceGroup
    dot11PhyS1GComplianceGroup"

GROUP dot11PhyVHTComplianceGroup
DESCRIPTION
    "Implementation of this group is required when object dot11PHYType has the
    value of vht.
    This group is mutually exclusive to the following groups:
    dot11PhyDSSSComplianceGroup
    dot11PhyOFDMComplianceGroup3
    dot11PhyHRDSSSComplianceGroup
    dot11PhyERPComplianceGroup
    dot11DMGComplianceGroup
    dot11PhyHTComplianceGroup
    dot11PhyTVHTComplianceGroup
    dot11PhyS1GComplianceGroup"

GROUP dot11PhyTVHTComplianceGroup
DESCRIPTION
    "Implementation of this group is required when object dot11PHYType has the
    value of tvht.
    This group is mutually exclusive to the following groups:
    dot11PhyDSSSComplianceGroup
    dot11PhyOFDMComplianceGroup3
    dot11PhyHRDSSSComplianceGroup
    dot11PhyERPComplianceGroup
    dot11PhyHTComplianceGroup
    dot11DMGComplianceGroup
    dot11PhyVHTComplianceGroup
    dot11PhyS1GComplianceGroup"
```

```
GROUP dot11PhyS1GComplianceGroup
DESCRIPTION
   "Implementation of this group is required when object dot11PHYType has the
   value of s1g.
   This group is mutually exclusive to the following groups:
   dot11PhyDSSSComplianceGroup
   dot11PhyOFDMComplianceGroup3
   dot11PhyHRDSSSComplianceGroup
   dot11PhyERPComplianceGroup
   dot11PhyHTComplianceGroup
   dot11DMGComplianceGroup
   dot11PhyVHTComplianceGroup
   dot11PhyTVHTComplianceGroup"

GROUP dot11DMGComplianceGroup
DESCRIPTION
   "Implementation of this group is required when the object
   dot11PHYType is dmg.
   This group is mutually exclusive to the following groups:
   dot11PhyDSSSComplianceGroup
   dot11PhyOFDMComplianceGroup3
   dot11PhyHRDSSSComplianceGroup
   dot11PhyERPComplianceGroup
   dot11PhyHTComplianceGroup
   dot11PhyVHTComplianceGroup
   dot11PhyTVHTComplianceGroup
   dot11PhyS1GComplianceGroup"
```

Insert the following text after "GROUP dot11VHTMACAdditions" in Compliance Statements (dot11Compliances 1) in C.3:

```
GROUP dot11S1GTransmitBeamformingGroup
DESCRIPTION
   "The dot11S1GTransmitBeamformingGroup group is optional."

GROUP dot11S1GComplianceGroup
DESCRIPTION
   "The dot11S1GComplianceGroup group is optional."
```

Change OPTIONAL-GROUPS in Compliance Statements (dot11Compliances 1) in C.3 as follows:

```
-- OPTIONAL-GROUPS {
   -- dot11SMTprivacy
   -- dot11MACStatistics,
   -- dot11PhyTxPowerComplianceGroup,
   -- dot11PhyRegDomainsSupportGroup,
   -- dot11PhyAntennasListGroup,
   -- dot11PhyRateGroup,
   -- dot11MultiDomainCapabilityGroup,
   -- dot11RSNAadditions,
   -- dot11OperatingClassesGroup,
   -- dot11Qosadditions,
   -- dot11RMCompliance,
   -- dot11FTComplianceGroup,
   -- dot11PhyAntennaComplianceGroup2,
   -- dot11HTMACadditions2,
   -- dot11PhyMCSGroup,
   -- dot11TransmitBeamformingGroup,
   -- dot11TVHTTransmitBeamformingGroup,
   -- dot11PhyTVHTComplianceGroup,
   -- dot11S1GTransmitBeamformingGroup,
```

```
    -- dot11PhyS1GComplianceGroup,
    -- dot11S1GComplianceGroup,
    -- dot11WNMCompliance,
    -- dot11BSSStatisticsGroup,
    -- dot11VHTTransmitBeamformingGroup,
    -- dot11PhyVHTComplianceGroup,
    -- dot11VHTMACAdditions,
    -- dot11TVWSComplianceGroup,
    -- dot11FILSComplianceGroup }
```

Insert the following text after Compliance Statements - TVWS (dot11Compliances 15) in C.3:

```
-- ********************************************************************
-- * Compliance Statements - S1G
-- ********************************************************************
dot11S1GCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "This object class provides the objects from the IEEE 802.11
        MIB used to operate at sub 1 GHz."
    MODULE -- this module
    MANDATORY-GROUPS { dot11PhyS1GComplianceGroup, dot11PhyTxPowerCompliance-
        Group2, dot11S1GTransmitBeamformingGroup, dot11S1GComplianceGroup }
-- OPTIONAL-GROUPS { }
    ::= { dot11Compliances 16 }
```

Annex D

(normative)

Regulatory references

D.1 External regulatory references

Change Table D-1 as follows:

Table D-1—Regulatory requirement list

Geographic area	Approval standards	Documents	Approval authority
Australia	Federal Register of Legislative Instruments	Radiocommunications (Low Interference Potential Devices) Class Licence 2000, Sections 132 and 135	FRLI
Canada	Minister of Industry	RSS-210 — Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment	Industry Canada
China	Ministry of Industry and Information Technology (MIIT)	Xin Bu Wu [2002] #353, Xin Bu Wu [2002] #277, Gong Xin Bu Wu Han [2012] #620, MIIT Wireless [2005] 423	MIIT
Europe	European Conference of Postal and Telecommunications (CEPT) Administrations and its Electronic Communications Committee (ECC). Also, European Radiocommunications Office, European Telecommunications Standards Institute (ETSI)	ECC DEC (04) 08, ETSI EN 300 328 [B13], ETSI EN 301 893, ETSI ES 202 663 [B15], ETSI EN 302 571 [B14], Clause 5, ERC Recommendation 70-03 [B10a]	CEPT
Japan	Ministry of Internal Affairs and Communications (MIC)	MIC Equipment Ordinance (EO) for Regulating Radio Equipment Articles 7, 49.20, 49.21[a], 49.14, 54.5	MIC
New Zealand	Radio Spectrum Management	Section 111 of Radiocommunications Act 1989, Regulation 9 of Radiocommunications Regulations 2001	Ministry of Economic Development
United States	Federal Communications Commission (FCC)	47 CFR [B9], Part 15, Sections 15.205, 15.209, and 15.247; and Subpart E, Sections 15.401–15.407, Section 90.210, Sections 90.371–383, Sections 90.1201–90.1217, Sections 90.1301–90.1337, Section 95.639, Sections 95.1501–1511	FCC

Table D-1—Regulatory requirement list *(continued)*

Geographic area	Approval standards	Documents	Approval authority
Singapore	Infocomm Development Authority of Singapore	IDA TS SRD 2011 Technical Specification for Short Range Devices	IDA
South Korea	Ministry of Science, ICT and Future Planning / Radio Research Agency (MSIP RRA) Public Regulations Announcement	Doc. No. 2012-101 “Wireless Facilities”	MSIP RRA

[a]Frequency planning for licensed STAs in Japan is performed by the regulatory authority and the licensees, addressing the coexistence among STAs operating with a variety of air propagation times and the coexistence between STAs using 20 MHz channel spacing, STAs operating with 10 MHz channel spacing, and STAs operating with 5 MHz channel spacing. Note also the CCA mechanism is preserved in licensed operation.

D.2 Radio performance specifications

D.2.2 Transmit power levels

Insert the following paragraph and Table D-3a at the end of D.2.2:

The maximum allowed transmit power and maximum bandwidth (BW) limits for an S1G STA are shown by country in Table D-3a.

Table D-3a—Maximum STA transmit power and maximum BW allowed

Geographic area	Frequency (MHz)	Maximum BW allowed (MHz)	Maximum STA transmit power (Max e.i.r.p (mW))
Australia	915–928	8	Note 1
China	775–779	1	5
	779–787	Not defined	10
Europe	863–868.6	Not defined	25.12
Japan	915.9–929.7	1	Note 2
	920.5–923.5		Note 3
New Zealand	915–928	8	Note 4
Singapore	866–869, 920–925	8	500
South Korea	917–923.5	Not defined	3, 10
United States	902–928	Not defined	1000

NOTE 1—Max e.i.r.p. <= 30 dBm and PSD <= 25 mW/3 kHz

NOTE 2—1 or 20 mW transmitter output power plus up to 3 dBi antenna gain (maximum power is 1 or 20 mW + 3 dBi)

NOTE 3—250 mW transmitter output power plus up to 3 dBi antenna gain (maximum power is 250 mW + 3 dBi)

NOTE 4—Max e.i.r.p. <= 5 dBm (915 MHZ to 928 MHz) for general sensor-type devices and Max e.i.r.p. <= 36 dBm (921.5 MHz to 928 MHz) for digital modulation transmitters

Annex E

(normative)

Country elements and operating classes

E.1 Country information and operating classes

Insert the following rows into Table E-4, and change the reserved row as shown:

Table E-4—Global operating classes

Operating class	Nonglobal operating class(es)	Channel starting frequency (GHz)	Channel spacing (MHz)	Channel set	Channel center frequency index	Behavior limits set
1–60	—	Reserved	Reserved	Reserved	—	Reserved
61	E-4a→9	0.755	1	—	Reserved	Reserved
62	E-4a→10	0.779	1	—	Reserved	Reserved
63	E-4a→11	0.779	2	—	Reserved	Reserved
64	E-4a→12	0.779	4	—	Reserved	Reserved
65	E-4a→13	0.779	8	—	Reserved	Reserved
66	E-4a→6, 17	0.863	1	—	Reserved	Reserved
67	E-4a→7, 19	0.863	2	—	Reserved	Reserved
68	E-4a→1, 18, 22, 26	0.902	1	—	Reserved	Reserved
69	E-4a→2, 20, 23, 27	0.902	2	—	Reserved	Reserved
70	E-4a→3, 21, 24, 28	0.902	4	—	Reserved	Reserved
71	E-4a→4, 25, 29	0.902	8	—	Reserved	Reserved
72	E-4a→5	0.902	16	—	Reserved	Reserved
73	E-4a→8	0.9165	1	—	Reserved	Reserved
74	E-4a→14	0.9175	1	—	Reserved	Reserved
75	E-4a→15	0.9175	2	—	Reserved	Reserved
76	E-4a→16	0.9175	4	—	Reserved	Reserved
77–80	—	Reserved	Reserved	Reserved	—	Reserved

Insert the following paragraph and Table E-4a into E.1 after Table E-4:

S1G operating classes are enumerated in Table E-4a. Definition of type 1 and type 2 channels for CCA Level Classification and required behavior is described in 23.3.17.5.4 and 23.3.17.5.5.

Table E-4a—S1G Operating classes

S1G operating Class	Global operating Class (See Table E-4)	Channel starting frequency (GHz)	Channel spacing (MHz)	Channel center frequency index	CCA Level Classification	Behavior limits set
1 (United States)	68	0.902	1	1, 3, 37, 39, 41, 43, 45, 47, 49, 51	Type 1 (902–904 MHz, 920–928 MHz)	Reserved
				5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35	Type 2 (904–920 MHz)	
2 (United States)	69	0.902	2	2, 38, 42, 46, 50	Type 1 (902–904 MHz, 920–928 MHz)	Reserved
				6, 10, 14, 18, 22, 26, 30, 34	Type 2 (904–920 MHz)	
3 (United States)	70	0.902	4	40, 48	Type 1 (920–928 MHz)	Reserved
				8, 16, 24, 32	Type 2 (904–920 MHz)	
4 (United States)	71	0.902	8	44	Type 1 (920–928 MHz)	Reserved
				12, 28	Type 2 (904–920 MHz)	
5 (United States)	72	0.902	16	20	Type 2 (904–920 MHz)	Reserved
6 (Europe)	66	0.863	1	1, 3, 5, 7, 9	Type 1 (863–868 MHz)	Reserved
7 (Europe)	67	0.863	2	2, 6	Type 1 (863–868 MHz)	Reserved
8 (Japan)	73	0.9165	1	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21	Type 1 (916.5–927.5 MHz)	Reserved
9 (China)	61	0.755	1	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47	Type 1 (755–779 MHz)	Reserved
10 (China)	62	0.779	1	1, 3, 5, 7, 9, 11, 13, 15	Type 1 (779–787 MHz)	Reserved

Table E-4a—S1G Operating classes ***(continued)***

S1G operating Class	Global operating Class (See Table E-4)	Channel starting frequency (GHz)	Channel spacing (MHz)	Channel center frequency index	CCA Level Classification	Behavior limits set
11 (China)	63	0.779	2	2, 6, 10, 14	Type 2 (779–787 MHz)	Reserved
12(China)	64	0.779	4	4, 12	Type 2 (779–787 MHz)	Reserved
13 (China)	65	0.779	8	8	Type 2 (779–787 MHz)	Reserved
14 (Korea)	74	0.9175	1	1, 3, 5, 7, 9, 11	Type 1 (917.5–923.5 MHz)	Reserved
15 (Korea)	75	0.9175	2	2, 6, 10	Type 1 (917.5–923.5 MHz)	Reserved
16 (Korea)	76	0.9175	4	8	Type 1 (917.5–923.5 MHz)	Reserved
17 (Singapore)	66	0.863	1	7, 9, 11	Type 1 (866–869 MHz)	Reserved
18 (Singapore)	68	0.902	1	37, 39, 41, 43, 45	Type 1 (920–925 MHz)	Reserved
19 (Singapore)	67	0.863	2	10	Type 1 (866–869 MHz)	Reserved
20 (Singapore)	69	0.902	2	38, 42	Type 1 (920–925 MHz)	Reserved
21 (Singapore)	70	0.902	4	40	Type 1 (920–925 MHz)	Reserved
22 (Australia)	68	0.902	1	27, 29, 31, 33, 35	Type 1 (915–920 MHz)	Reserved
				37, 39, 41, 43, 45, 47, 49, 51	Type 2 (920–928 MHz)	
23 (Australia)	69	0.902	2	28, 32	Type 1 (915–920 MHz)	Reserved
				38, 42, 46, 50	Type 2 (920–928 MHz)	
24 (Australia)	70	0.902	4	30	Type 1 (915–920 MHz)	Reserved
				40, 48	Type 2 (920–928 MHz)	
25 (Australia)	71	0.902	8	44	Type 2 (920–928 MHz)	Reserved

Table E-4a—S1G Operating classes *(continued)*

S1G operating Class	Global operating Class (See Table E-4)	Channel starting frequency (GHz)	Channel spacing (MHz)	Channel center frequency index	CCA Level Classification	Behavior limits set
26 (New Zealand)	68	0.902	1	27, 29, 31, 33, 35, 37, 39, 41, 43	Type 1 (915–924 MHz)	Reserved
				45, 47, 49, 51	Type 2 (924–928 MHz)	
27 (New Zealand)	69	0.902	2	28, 32, 36, 40	Type 1 (915–924 MHz)	Reserved
				46, 50	Type 2 (924–928 MHz)	
28 (New Zealand)	70	0.902	4	30, 38	Type 1 (915–924 MHz)	Reserved
				48	Type 2 (924–928 MHz)	
29 (New Zealand)	71	0.902	8	34	Type 1 (915–924 MHz)	Reserved

Annex G

(normative)

Frame exchange sequences

G.1 General

Insert the following rows at the end of Table G-1:

Table G-1—Attributes applicable to frame exchange sequence definition

Attribute	Description
non-S1GAP	Frame is transmitted by a non-AP S1G STA.
S1GAP	Frame is transmitted by an S1G AP.

G.2 Basic sequences

Change the second paragraph of G.2 as follows:

(* This rule defines all the allowable frame exchange sequences *)
frame-exchange-sequence =

([**CTS**] (**Management** +*broadcast* | **Data** +*group*)) |
([**CTS** | **RTS CTS** | **PS-Poll**] {frag-frame **Ack**} last-frame **Ack**) |
(**PS-Poll Ack**) |
([**Beacon** +*DTIM*] {cf-sequence} [**CF-End** [+*CF-Ack*]])|
hcf-sequence |
mcf-sequence |
s1g-sequence;

G.3 EDCA and HCCA sequences

Change the 10th paragraph of G.3 as follows:

(* These frames provide acknowledgment to the txop-part-requiring-ack *)
txop-part-providing-ack=

Ack | NDP-Ack |
cf-ack-piggybacked-qos-poll-sequence | (* An HC responds with a new polled TXOP on expiration of current TXOP *)
cf-ack-piggybacked-qos-data-sequence | (* An HC responds with CF-Ack and its own data on expiration of TXOP *)
Data +*CF-Ack*;

Change the subclause title for G.4 as follows:

G.4 HT and VHT and S1G sequences

Change the 11th, 12th, and 13th paragraphs of G.4 as follows:

(* This is an initiator sequence. The different forms arise from whether the initiator transmits a frame that requires a BlockAck frame, and whether it delivers an RDG. When an RDG is delivered, the response is distinguished according to whether it demands a BlockAck frame response from the initiator. *)

initiator-sequence = (* No BlockAck frame expected, no RDG *)
burst |

(* block ack request delivered, BlockAck frame expected. No RD *)
(burst-bar (**BlockAck**[+*HTC*] |**Ack**~~)~~ [+*HTC*] | **NDP-BlockAck | NDP-Ack**) |

(* No block ack request delivered, RDG *)
(burst-rd (
burst |
burst-bar initiator-sequence-ba
)
) |

(burst-rd-bar (**BlockAck**[+*HTC*]| **Ack**~~)~~ [+*HTC*] | **NDP-BlockAck | NDP-Ack**) |
(burst-rd-bar (
burst-ba |
burst-ba-bar initiator-sequence-ba
)
) |
ht-ack-sequence |
psmp-burst |
link-adaptation-exchange ;

(* This is the same as the initiator-sequence, except the initiator is constrained to generate a BlockAck frame response because a previous RD response contained a block ack request *)

initiator-sequence-ba = burst-ba |
(burst-ba-bar (**BlockAck**[+*HTC*]| **Ack**~~)~~ [+*HTC*] | **NDP-BlockAck | NDP-Ack**) |
(burst-ba-rd (
burst |
burst-bar initiator-sequence-ba
)
) |
(burst-ba-rd-bar (**BlockAck**[+*HTC*]| **Ack**~~)~~ [+*HTC*]| **NDP-BlockAck | NDP-Ack**)
|
(burst-ba-rd-bar (
burst-ba |
burst-ba-bar initiator-sequence-ba
)
);

(* These are sequences that occur within an ht-txop-sequence that have an ack response *)

ht-ack-sequence = (**BlockAck**+*delayed*[+*HTC*] [+*mu-user-respond* other-users]**Ack**[+*HTC*]) |
(**BlockAckReq**+*delayed*[+*HTC*][+*mu-user-respond* other-users] **Ack**[+*HTC*]) |

(**Data**[+*HTC*]+*individual*[+*null*][+*QoS*+*normal-ack*][+*mu-user-respond* other-users] **Ack**[+*HTC*] **| NDP-Ack** **)**);

Change the 27th paragraph of G.4 as follows:

(* A PPDU containing a block ack request is either a non-A-MPDU BlockAckReq frame, or an A-MPDU containing Data carrying implicit block ack request*).
ppdu-bar= ((**BlockAckReq**[+*HTC*] | **NDP-BlockAck** |
(**1**{**Data**[+*HTC*]+*QoS*+*implicit-bar*+*a-mpdu*} + *a-mpdu-end*);
) [+*mu-user-respond* other-users];

Change the 45th paragraph of G.4 as follows:

(* The VHT beamforming sequence starts with a VHT NDP Announcement frame, followed by a VHT NDP. One of the STAs in the sequence responds immediately with explicit feedback. The VHT AP might transmit Beamforming Report Poll to poll the other STAs to obtain their feedback before generating an MU tranmission. The S1G AP might transmit Beamforming Report Poll or NDP Beamforming Report Poll to poll the other STAs to obtain their feedback before generating an MU transmission. The names of the frames include spaces, so they are delimited using parentheses. *)
vht-bf =
(**VHT NDP Announcement**) (**VHT NDP**) vht-feedback
{(**Beamforming Report Poll | NDP-Beamforming-Report-Poll**) vht-feedback};

Insert the following paragraphs at the end of G.4:

(* An s1g-sequence represents additional sequences that may be generated by an S1G STA using EDCA channel access.*)
s1g-sequence =
([**CTS** | **NDP-CTS**] **1**{(**Data** +*group* +*QoS* | **Management** +*broadcast*) +*pifs*} |
([**CTS** | **NDP-CTS** | **RTS** (**CTS** | **NDP-CTS**) | **PS-Poll** | **NDP-PS-Poll**] {frag-frame (**Ack** | **NDP-Ack**)} last-frame (**Ack** | **NDP-Ack**)) |
(**PS-Poll Ack**) | (**NDP-PS-Poll NDP-PS-Poll-Ack**) |
([**CTS** | **NDP-CTS**] **1**{s1g-txop-sequence});

(* A TXOP may be filled with s1g-txop-sequences, which are initiated by the S1G TXOP holder. *)
s1g-txop-sequence =
(((**RTS** (**CTS** | **NDP-CTS**)) | **CTS**+*self* | **NDP-CTS** +*self*) **Data** +*individual* +*QoS* +(*block-ack* | *no-ack*)) |
[**RTS** (**CTS** | **NDP-CTS**)] (txop-part-requiring-ack txop-part-providing-ack)|
[**RTS** (**CTS** | **NDP-CTS**)] (**Management** | (**Data** +*S1GAP*)) +*individual* (**Ack** | **NDP-ACK**) |
[**RTS** (**CTS** | **NDP-CTS**)] (**BlockAckReq** (**BlockAck** | **NDP-BlockAck**)) |
s1g-nav-protected-sequence |
1{initiator-sequence};

(* an s1g-nav-protected sequence consists of setting the NAV, performing one or more initiator-sequences and then resetting the NAV if time permits *)
s1g-nav-protected-sequence = s1g-nav-set **1**{initiator-sequence} [s1g-resync-sequence] ;

(* These are the series of frames that establish NAV protection for an S1G sequence *)

s1g-nav-set = (**RTS**[+*HTC*] (**CTS**[+*HTC*]) | **NDP-CTS**) |
CTS+*self* | **NDP-CTS**+*self* |
(**Data**[+*HTC*]+*individual*[+*null*][+*QoS*+*normal-ack*] (**Ack** | **NDP-Ack**)) |
Data[+*HTC]*+*individual*+*QoS*[+(*no-ack*|*block-ack*)] |
Data+*group*[+*null*]+*QoS* |
(**1**{ **Data**[+*HTC*]+*individual*+*QoS*+*implicit-bar*+*a-mpdu*}+*a-mpdu-end*
(**BlockAck**[+*HTC*] | **NDP-BlockAck**)) |
(**BlockAckReq**[+*HTC*] (**BlockAck**[+*HTC*] | **Ack**[+*HTC*]) | **NDP-BlockAck** |
NDP-Ack)) |
1{s1g-rts-cts};

(* The s1g-rts-cts term applies to RTS transmitted by an S1G STA to another S1G STA. When the RTS is transmitted using an S1G non-duplicate PPDU or S1G 2 MHz duplicate PPDU, the transmission of the RTS is delayed so that at least a PIFS has elapsed since the previous frame exchange sequence (see 10.22.2.7) and the RTS is transmitted with a Dynamic Indication field set to 1 (see 10.3.2.6). *)
s1g-rts-cts = **RTS**+*pifs* [+*HTC*] (**CTS**[+*HTC*] | **NDP-CTS**);

s1g-resync-sequence = **CF-End** | (**CF-End**+*non-S1GAP* **CF-End**+ *S1GAP*) | **NDP-CF-End** | (**NDP-CF-End**+*non-S1GAP* **NDP-CF-End**+ *S1GAP*) | ;

Annex J

(informative)

RSNA reference implementations and test vectors

J.6 Additional test vectors

J.6.4 CCMP test vectors

Insert the following text at the end of J.6.4:

```
CCMP PV1 test vectors


BSSID: a2:ae:a5:b8:fc:ba
DA: 02:d2:e1:28:a5:7c
SA: 52:30:f1:84:44:08
Association ID: 7
Base PN: 123 (0x0000007b)
SC = 0x3380 (FragNum=0 SeqNum=824)
TID = 3
Key ID: 0
TK - hexdump(len=16): c9 7c 1f 67 ce 37 11 85 51 4a 8a 19 f2 bd d5 2f
PN = SC||BPN
PN (PN0..PN5) - hexdump(len=8): 80 33 7b 00 00 00 00 00


PV1 test vector #1:
Header compression used and A3 was previously stored at the receiver


FC=0x0061 (PV=1 Type=0 PTID/Subtype=3 From_DS=0 More_Fragments=0 Power_Manage-
       ment=0 More_Data=0 Protected_Frame=0 End_of_SP=0 Relayed_Frame=0 Ack_Pol-
       icy=0)
A1=a2:ae:a5:b8:fc:ba
A2=07 00 (SID: AID=7 A3_Present=0 A4_Present=0 A-MSDU=0); corresponds to
       52:30:f1:84:44:08 in uncompressed header
Sequence Control: 80 33 (FN=0 SN=824)
A3 not present; corresponds to 02:d2:e1:28:a5:7c in uncompressed header
A4 not present
Plaintext Frame Header - hexdump(len=12): 61 00 a2 ae a5 b8 fc ba 07 00 80 33
Plaintext Frame Body - hexdump(len=20): f8 ba 1a 55 d0 2f 85 ae 96 7b b6 2f b6 cd
       a8 eb 7e 78 a0 50
CCMP AAD - hexdump(len=22): 61 10 a2 ae a5 b8 fc ba 52 30 f1 84 44 08 00 00 02 d2
       e1 28 a5 7c
```

```
CCMP nonce - hexdump(len=13): 20 52 30 f1 84 44 08 00 00 00 7b 33 80

CCM B_0 - hexdump(len=16): 59 20 52 30 f1 84 44 08 00 00 00 7b 33 80 00 14

CCM T - hexdump(len=8): 50 be 59 0a 6a 05 a2 8a

CCM U - hexdump(len=8): 82 62 ff 2d b5 77 65 73

CCMP encrypted - hexdump(len=20): dd d7 40 e2 a5 86 e1 2b 06 0e 45 69 d0 a3 93 61
       60 41 2e 45

Encrypted Frame Header - hexdump(len=12): 61 10 a2 ae a5 b8 fc ba 07 00 80 33

Encrypted Frame Frame Body - hexdump(len=28): dd d7 40 e2 a5 86 e1 2b 06 0e 45 69
       d0 a3 93 61 60 41 2e 45 82 62 ff 2d b5 77 65 73

Encrypted Frame FCS - hexdump(len=4): 97 3e b8 a7


PV1 test vector #2:

Header compression used and A3 was not previously stored at the receiver


FC=0x0061 (PV=1 Type=0 PTID/Subtype=3 From_DS=0 More_Fragments=0 Power_Manage-
       ment=0 More_Data=0 Protected_Frame=0 End_of_SP=0 Relayed_Frame=0 Ack_Pol-
       icy=0)

A1=a2:ae:a5:b8:fc:ba

A2=07 20 (SID: AID=7 A3_Present=1 A4_Present=0 A-MSDU=0); corresponds to
       52:30:f1:84:44:08 in uncompressed header

Sequence Control: 80 33 (FN=0 SN=824)

A3=02:d2:e1:28:a5:7c

A4 not present

Plaintext Frame Header - hexdump(len=18): 61 00 a2 ae a5 b8 fc ba 07 20 80 33 02
       d2 e1 28 a5 7c

Plaintext Frame Body - hexdump(len=20): f8 ba 1a 55 d0 2f 85 ae 96 7b b6 2f b6 cd
       a8 eb 7e 78 a0 50

CCMP AAD - hexdump(len=22): 61 10 a2 ae a5 b8 fc ba 52 30 f1 84 44 08 00 00 02 d2
       e1 28 a5 7c

CCMP nonce - hexdump(len=13): 20 52 30 f1 84 44 08 00 00 00 7b 33 80

CCM B_0 - hexdump(len=16): 59 20 52 30 f1 84 44 08 00 00 00 7b 33 80 00 14

CCM T - hexdump(len=8): 50 be 59 0a 6a 05 a2 8a

CCM U - hexdump(len=8): 82 62 ff 2d b5 77 65 73

CCMP encrypted - hexdump(len=20): dd d7 40 e2 a5 86 e1 2b 06 0e 45 69 d0 a3 93 61
       60 41 2e 45

Encrypted Frame Header - hexdump(len=18): 61 10 a2 ae a5 b8 fc ba 07 20 80 33 02
       d2 e1 28 a5 7c

Encrypted Frame Frame Body - hexdump(len=28): dd d7 40 e2 a5 86 e1 2b 06 0e 45 69
       d0 a3 93 61 60 41 2e 45 82 62 ff 2d b5 77 65 73

Encrypted Frame FCS - hexdump(len=4): a3 04 e8 51


PV1 test vector #3:

Type 3 frame from SA to DA(=BSSID) (i.e., no separate DA in this example)


FC=0x006d (PV=1 Type=3 PTID/Subtype=3 From_DS=0 More_Fragments=0 Power_Manage-
```

ment=0 More_Data=0 Protected_Frame=0 End_of_SP=0 Relayed_Frame=0 Ack_Policy=0)

A1=a2:ae:a5:b8:fc:ba

A2=52:30:f1:84:44:08

Sequence Control: 80 33 (FN=0 SN=824)

A3 not present; corresponds to 02:d2:e1:28:a5:7c in uncompressed header

A4 not present

Plaintext Frame Header - hexdump(len=16): 6d 00 a2 ae a5 b8 fc ba 52 30 f1 84 44 08 80 33

Plaintext Frame Body - hexdump(len=20): f8 ba 1a 55 d0 2f 85 ae 96 7b b6 2f b6 cd a8 eb 7e 78 a0 50

CCMP AAD - hexdump(len=22): 6d 10 a2 ae a5 b8 fc ba 52 30 f1 84 44 08 00 00 02 d2 e1 28 a5 7c

CCMP nonce - hexdump(len=13): 20 52 30 f1 84 44 08 00 00 00 7b 33 80

CCM B_0 - hexdump(len=16): 59 20 52 30 f1 84 44 08 00 00 00 7b 33 80 00 14

CCM T - hexdump(len=8): cd ef 4a 4f 36 3b bb 26

CCM U - hexdump(len=8): 1f 33 ec 68 e9 49 7c df

CCMP encrypted - hexdump(len=20): dd d7 40 e2 a5 86 e1 2b 06 0e 45 69 d0 a3 93 61 60 41 2e 45

Encrypted Frame Header - hexdump(len=16): 6d 10 a2 ae a5 b8 fc ba 52 30 f1 84 44 08 80 33

Encrypted Frame Frame Body - hexdump(len=28): dd d7 40 e2 a5 86 e1 2b 06 0e 45 69 d0 a3 93 61 60 41 2e 45 1f 33 ec 68 e9 49 7c df

Encrypted Frame FCS - hexdump(len=4): aa df 86 de

Annex L

(informative)

Examples and sample code for encoding a TIM Partial Virtual Bitmap

L.2 Examples

Change the first paragraph of L.2 as follows:

The following examples help clarify the use of TIM values, both with and without the multiple BSSID capability for non-S1G STAs, with multiple BSSID Capability for S1G STAs as well as the use of the encoding modes of Block Bitmap, Single AID, OLB, ADE, Inverse Bitmap + Block Bitmap, Inverse Bitmap + Single AID, Inverse Bitmap + OLB and Inverse Bitmap + ADE of TIM element for S1G STAs.

Insert the following paragraphs and Figure L-8 through Figure L-15 at the end of L.2:

The examples listed above describe the construction of the TIM Virtual Bitmap for non-S1G STAs. The following eight examples demonstrate how to construct the TIM element for S1G STAs.

The first example is one in which group addressed MSDUs are buffered in the AP as well as traffic for S1G STAs. The TIM element uses the encoding mode of Block Bitmap. The DTIM Count field in the TIM element equals 0. The Group Addressed Traffic Indicator field is 1, the Page Slice Number field in the TIM element is 0 and the Page Index field is 0. The STAs with AID 1, AID 6, AID 21 and AID 23 have data buffered in the AP. Figure L-8 shows the values of the Bitmap Control and Partial Virtual Bitmap fields. The Partial Virtual Bitmap field consists of only one encoded block in which the Block Control field is 0 and the Block Offset field is 0. The Encoded Information Block field in the Partial Virtual Bitmap field consists of Block Bitmap field with the value of 3 and two Subblock fields with the value of 66 and 160, respectively.

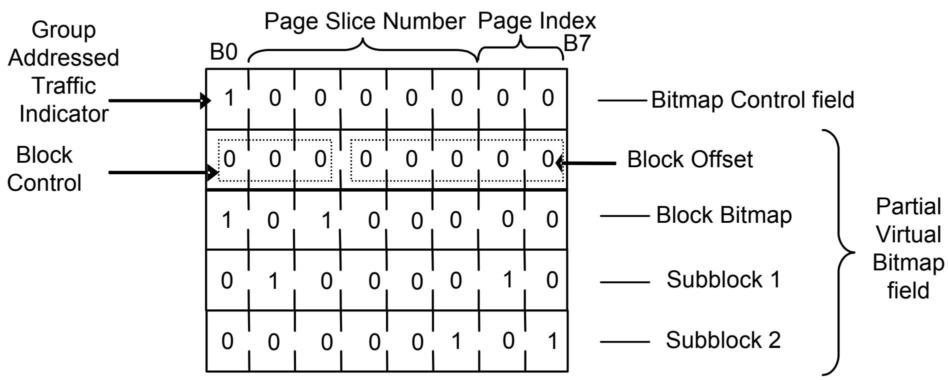


Figure L-8—Partial Virtual Bitmap example #7 for S1G STAs, Block Bitmap mode

The second example is one in which group addressed MSDUs are buffered in the AP as well as traffic for S1G STAs. The TIM element uses Single AID mode. The DTIM Count field in the TIM element equals 0. The Group Addressed Traffic Indicator field is 1, the Page Slice Number field in the TIM element is 0 and the Page Index field is 0. Only the STA with AID 31 has data buffered in the AP. Figure L-9 shows the values of the Bitmap Control and Partial Virtual Bitmap fields. The Partial Virtual Bitmap field consists of only one encoded block in which the Block Control field is 1 and the Block Offset field is 0. The Encoded Information Block field in the Partial Virtual Bitmap field consists of one Single AID field with the value of 31.

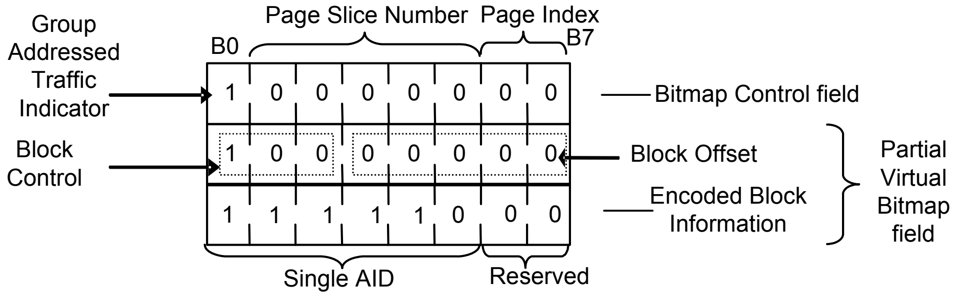


Figure L-9—Partial Virtual Bitmap example #8 for S1G STAs, Single AID mode

The third example is one in which group addressed MSDUs are buffered in the AP as well as traffic for S1G STAs. The TIM element uses OLB mode. The DTIM Count field in the TIM element equals 0. The Group Addressed Traffic Indicator field is 1, the Page Slice Number field in the TIM element is 0 and the Page Index field is 0. The STAs with AID 1, AID 6, AID 13, AID 15, AID 17, AID 22, AID 29, AID 31, AID 38, AID 43, AID 50, AID 52, AID 59, AID 64, AID 71, AID 73, AID 80 and AID 85 have data buffered in the AP. Figure L-10 shows the values of the Bitmap Control and Partial Virtual Bitmap fields. The Partial Virtual Bitmap field consists of only one encoded block in which the Block Control field is 2 and the Block Offset field is 0. The Encoded Information Block field in the Partial Virtual Bitmap field consists of one Length field with the value of 9 and nine Subblock fields with the value of 66, 160, 66, 160, 66, 160, 66, 160, and 66, respectively.

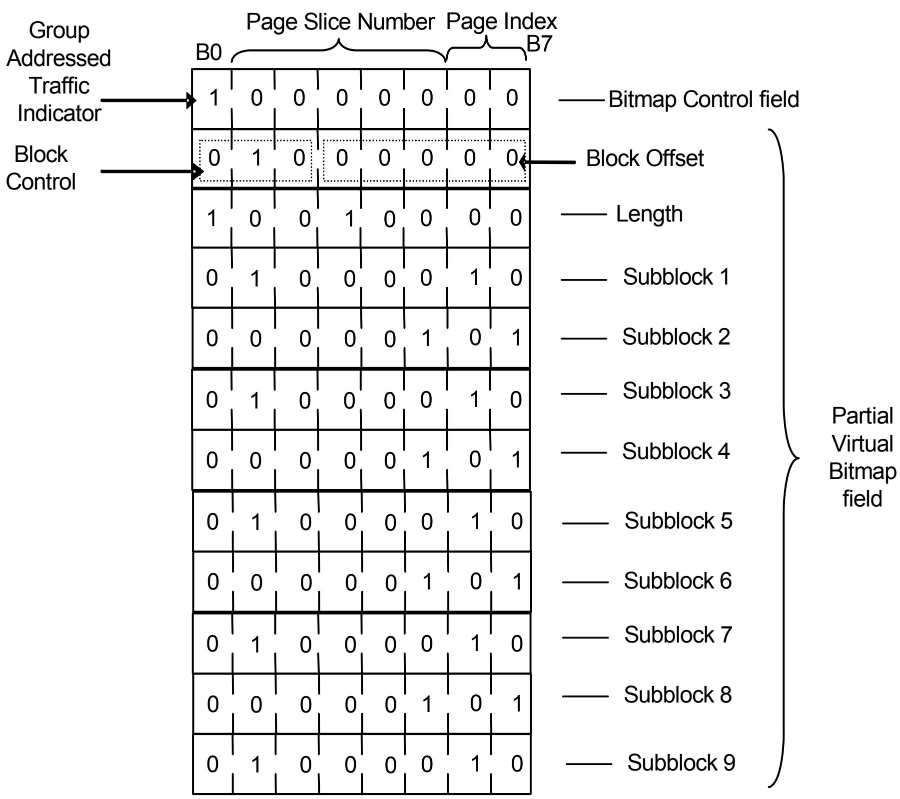


Figure L-10—Partial Virtual Bitmap example #9 for S1G STAs, OLB mode

The fourth example is one in which group addressed MSDUs are buffered in the AP as well as traffic for S1G STAs. The TIM element uses ADE mode. The DTIM Count field in the TIM element equals 0. The Group Addressed Traffic Indicator field is 1, the Page Slice Number field in the TIM element is 0 and the Page Index field is 0. The STAs with AID 1, AID 6, AID 21 and AID 23 have data buffered in the AP. Figure L-11 shows the values of the Bitmap Control and Partial Virtual Bitmap fields. The Partial Virtual Bitmap field consists of only one encoded block in which the Block Control field value is 3 and the Block Offset field value is 0. The Encoded Information Block field in the Partial Virtual Bitmap field consists of only one ADE Block in which the EWL field is 4 and the Length field is 2. Four differential AID values (ΔAID), i.e., 1, 5, 15, and 2 are encoded in the Encoded Information Block that has zero padding bits.

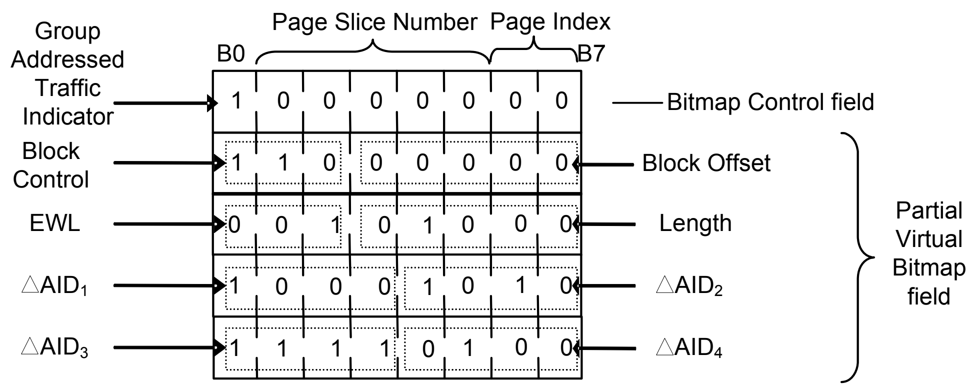


Figure L-11—Partial Virtual Bitmap example #7 for S1G STAs, ADE mode

The fifth example is one in which group addressed MSDUs are buffered in the AP as well as traffic for S1G STAs. The TIM element uses the encoding mode of Inverse Bitmap + Block Bitmap. The DTIM Count field in the TIM element equals 0. The Group Addressed Traffic Indicator field is 1, the Page Slice Number field in the TIM element is 0 and the Page Index field is 0. All the STAs with the AID value smaller than 64 except AID 1, AID 6, AID 21 and AID 23 have data buffered in the AP. Figure L-12 shows the values of the Bitmap Control and Partial Virtual Bitmap fields. The Partial Virtual Bitmap field consists of only one Encoded Block in which the Block Control field is 4 and the Block Offset field is 0. The Encoded Information Block field in the Partial Virtual Bitmap field consists of Block Bitmap field with the value of 3 and two Subblock fields with the value of 66 and 160, respectively.

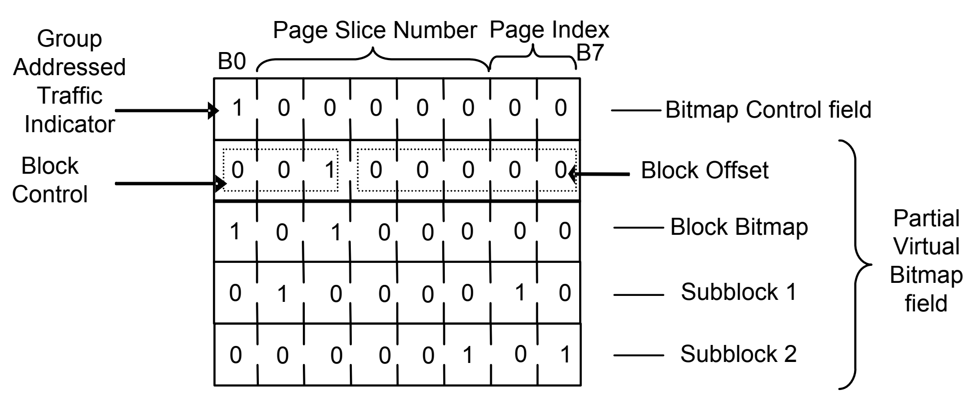


Figure L-12—Partial Virtual Bitmap example #10 for S1G STAs, Inverse Bitmap + Block Bitmap mode

The sixth example is one in which group addressed MSDUs are buffered in the AP as well as traffic for S1G STAs. The TIM element uses the encoding mode of Inverse Bitmap + Single AID. The DTIM Count field in the TIM element equals 0. The Group Addressed Traffic Indicator field is 1, the Page Slice Number field in the TIM element is 0 and the Page Index field is 0. All the STAs with the AID value smaller than 64 except AID 31 have data buffered in the AP. Figure L-13 shows the values of the Bitmap Control and Partial Virtual Bitmap fields. The Partial Virtual Bitmap field consists of only one Encoded Block in which the Block Control field is 5 and the Block Offset field is 0. The Encoded Information Block field in the Partial Virtual Bitmap field consists of one Single AID field with the value of 31.

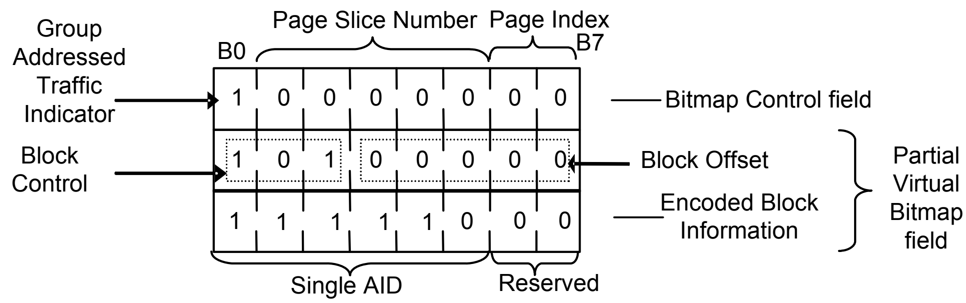


Figure L-13—Partial Virtual Bitmap example #11 for S1G STAs, Inverse Bitmap + Single AID mode

The seventh example is one in which group addressed MSDUs are buffered in the AP as well as traffic for S1G STAs. The TIM element uses the encoding mode of Inverse Bitmap + OLB. The DTIM Count field in the TIM element equals 0. The Group Addressed Traffic Indicator field is 1, the Page Slice Number field in the TIM element is 0 and the Page Index field is 0. All the STAs with the AID value smaller than 128 except AID 1, AID 6, AID 13, AID 15, AID 17, and AID 22, AID 29, AID 31, AID 38, AID 43, AID 50, AID 52, AID 59, AID 64, AID 71, AID 73, AID 80 and AID 85 have data buffered in the AP. Figure L-14 shows the values of the Bitmap Control and Partial Virtual Bitmap fields. The Partial Virtual Bitmap field consists of only one Encoded Block in which the Block Control field is 6 and the Block Offset field is 0. The Encoded Information Block field in the Partial Virtual Bitmap field consists of one Length field with the value of 9 and nine Subblock fields with the value of 66, 160, 66, 160, 66, 160, 66, 160, and 66, respectively.

The eighth example is one in which group addressed MSDUs are buffered in the AP as well as traffic for S1G STAs. The TIM element uses the encoding mode of Inverse Bitmap + ADE. The DTIM Count field in the TIM element equals 0. The Group Addressed Traffic Indicator field is 1, the Page Slice Number field in the TIM element is 0 and the Page Index field is 0. All the STAs with the AID value smaller than 64 except AID 1, AID 6, AID 21 and AID 23 have data buffered in the AP. Figure L-15 shows the values of the Bitmap Control and Partial Virtual Bitmap fields. The Partial Virtual Bitmap field consists of only one Encoded Block in which the Block Control field value is 7 and the Block Offset field value is 0. The Encoded Information Block field in the Partial Virtual Bitmap field consists of only one ADE Block in which the EWL field is 4 and the Length field is 2. Four differential AID values (ΔAID), i.e., 1, 5, 15, and 2 are encoded in the Encoded Information Block that has zero padding bits.

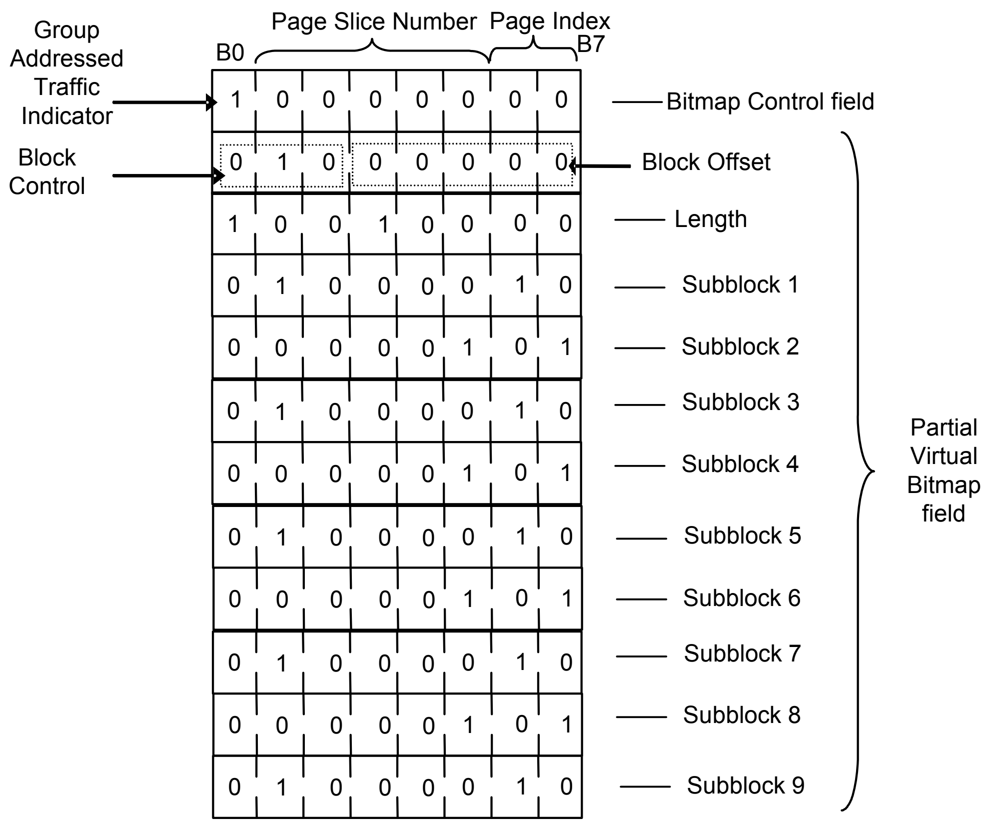


Figure L-14—Partial Virtual Bitmap example #12 for S1G STAs, Inverse Bitmap + OLB mode

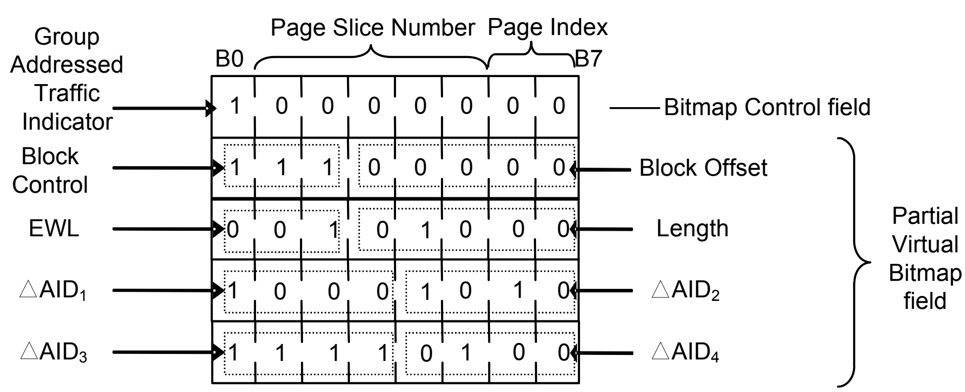


Figure L-15—Partial Virtual Bitmap example #10 for S1G STAs, Inverse Bitmap + ADE mode

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