3GPP TS 38.202 V15.3.0 (2018-09)

Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
NR;
Services provided by the physical layer
(Release 15)

Keywords
3GPP, New Radio, Layer 1

3GPP

Postal address

3GPP support office address
650 Route des Lucioles - Sophia Antipolis Valbonne - FRANCE Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet
http://www.3gpp.org

Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document is a technical specification of the services provided by the physical layer of 5G-NR to upper layers.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications"

[2] 3GPP TS 38.201: "NR; Physical Layer – General Description"

[3] 3GPP TS 38.211: "NR; Physical channels and modulation"

[4] 3GPP TS 38.212: "NR; Multiplexing and channel coding"

[5] 3GPP TS 38.213: "NR; Physical layer procedures for control"

[6] 3GPP TS 38.214: "NR; Physical layer procedures for data"

[7] 3GPP TS 38.215: "NR; Physical layer measurements"

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

3.2 Symbols

For the purposes of the present document, the following symbols apply:

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

For the purposes of the present document, the following abbreviations apply:

ARQ   Automatic Repeat Request
BCH   Broadcast Channel
CA   Carrier Aggregation
CRC   Cyclic Redundancy Check
DC   Dual Connectivity
DL   Downlink
FEC   Forward Error Correction
GF   Grant-Free
MAC   Medium Access Control
MIMO   Multiple Input Multiple Output
PBCH   Physical Broadcast Channel
PCH   Paging Channel
PDCCH   Physical Downlink Control Channel
PDSCH   Physical Downlink Shared Channel

PRACH	Physical Random Access Channel
PUCCH	Physical Uplink Control Channel
PUSCH	Physical Uplink Shared Channel
RACH	Random Access Channel
RF	Radio Frequency
RNTI	Radio Network Temporary Identifier
SCH	Shared Channel
SI	System Information
SPS	Semi-Persistent Scheduling
SRS	Sounding Reference Signal
TPC	Transmit Power Control
UL	Uplink

4 Services and functions of the physical layer

4.1 General

The physical layer offers data transport services to higher layers.

The access to these services is through the use of transport channels via the MAC sub-layer.

A transport block is defined as the data delivered by MAC layer to the physical layer and vice versa.

4.2 Overview of L1 functions

As mentioned in [2, TS 38.201], the physical layer is expected to perform the following functions to provide the data transport service:

- Error detection on the transport channel and indication to higher layers;

- FEC encoding/decoding of the transport channel;

- Hybrid ARQ soft-combining;

- Rate matching of the coded transport channel to physical channels;

- Mapping of the coded transport channel onto physical channels;

- Power weighting of physical channels;

- Modulation and demodulation of physical channels;

- Frequency and time synchronisation;

- Radio characteristics measurements and indication to higher layers;

- Multiple Input Multiple Output (MIMO) antenna processing;

- RF processing.

L1 functions are modelled for each transport channel in subclause 5.

5 Model of physical layer of the UE

The 5G-NR physical-layer model captures those characteristics of the 5G-NR physical-layer that are relevant from the point-of-view of higher layers. More specifically, the physical-layer model captures:

- The structure of higher-layer data being passed down to or up from the physical layer;

- The means by which higher layers can configure the physical layer;

- The different indications (error indications, channel-quality indications, etc.) that are provided by the physical layer to higher layers.

5.1 Uplink model

5.1.1 Uplink shared channel

The physical-layer model for Uplink Shared Channel transmission is described based on the corresponding PUSCH physical-layer-processing chain, see Figure 5.1.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue.

- Higher-layer data passed to/from the physical layer

- CRC and transport-block-error indication

- FEC and rate matching

- Data modulation

- Mapping to physical resource

- Multi-antenna processing

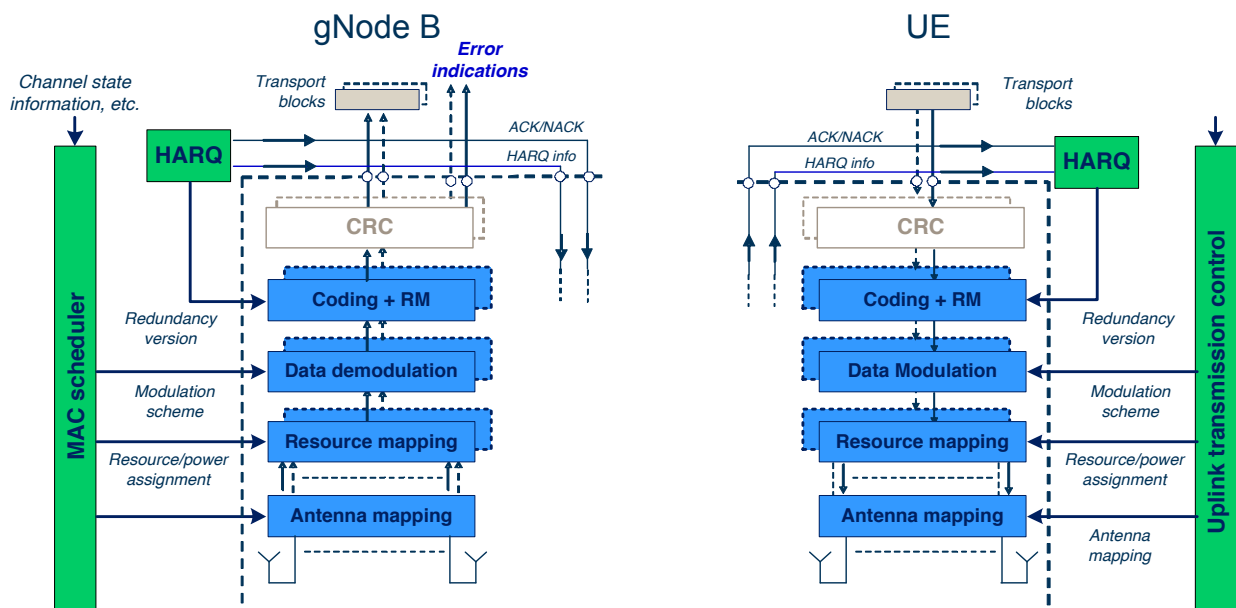- Support of L1 control and Hybrid-ARQ-related signalling

Figure 5.1.1-1: Physical-layer model for UL-SCH transmission

5.1.2 Random access channel

The physical-layer model for RACH transmission is characterized by a PRACH preamble format that consists of a cyclic prefix, a preamble, and a guard time during which nothing is transmitted.

5.2   Downlink model

5.2.1   Downlink shared channel

The physical-layer model for Downlink Shared Channel transmission is described based on the corresponding PDSCH physical-layer-processing chain, see Figure 5.2.1-1. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue.

-    Higher-layer data passed to/from the physical layer;

-    CRC and transport-block-error indication;

-    FEC and rate matching;

-    Data modulation;

-    Mapping to physical resource;

-    Multi-antenna processing;

-    Support of L1 control and Hybrid-ARQ-related signalling.

Figure 5.2.1-1: Physical-layer model for DL-SCH transmission

5.2.2   Broadcast channel

The physical-layer model for BCH transmission is characterized by a fixed pre-defined transport format. There is one transport block for the BCH every 80ms. The BCH physical-layer model is described based on the corresponding PBCH physical-layer-processing chain, see Figure 5.2.2-1:

-    Higher-layer data passed to/from the physical layer;

-    CRC and transport-block-error indication;

-    FEC and rate matching;

-    Data modulation;

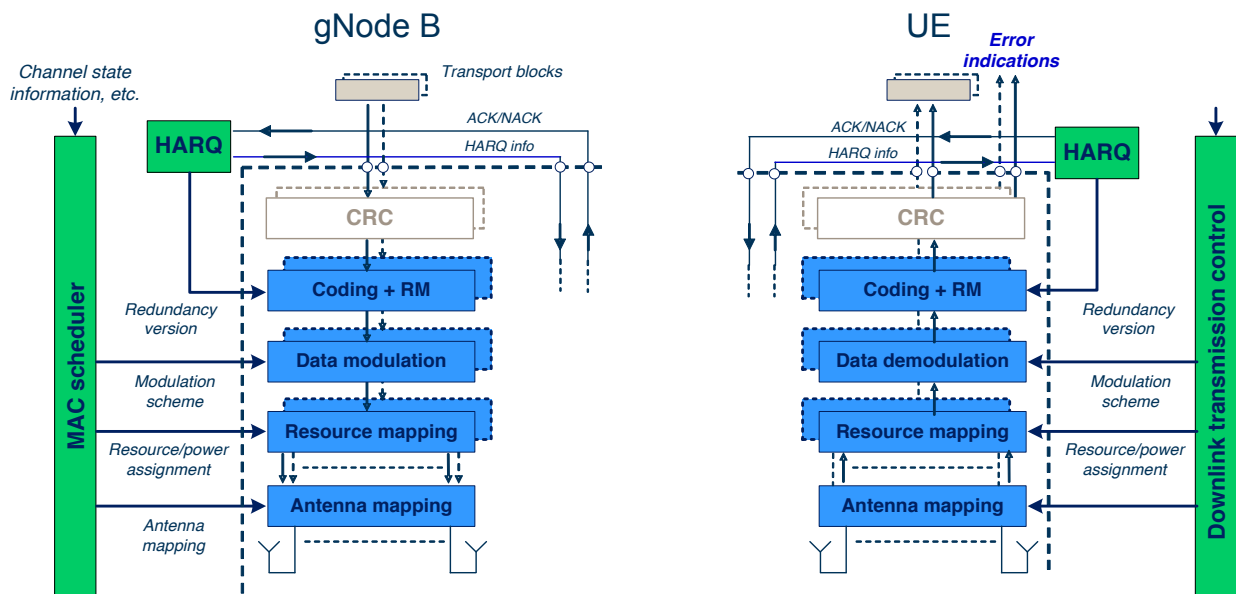- Mapping to physical resource;

- Multi-antenna processing.

Figure 5.2.2-1: Physical-layer model for BCH transmission

5.2.3 Paging channel

The physical-layer model for PCH transmission is described based on the corresponding physical-layer-processing chain, see Figure 5.2.3-1. The PCH is carried on PDSCH. Processing steps that are relevant for the physical-layer model, e.g. in the sense that they are configurable by higher layers, are highlighted in blue.

- Higher-layer data passed to/from the physical layer;

- CRC and transport-block-error indication;

- FEC and rate matching;

- Data modulation;

- Mapping to physical resource;
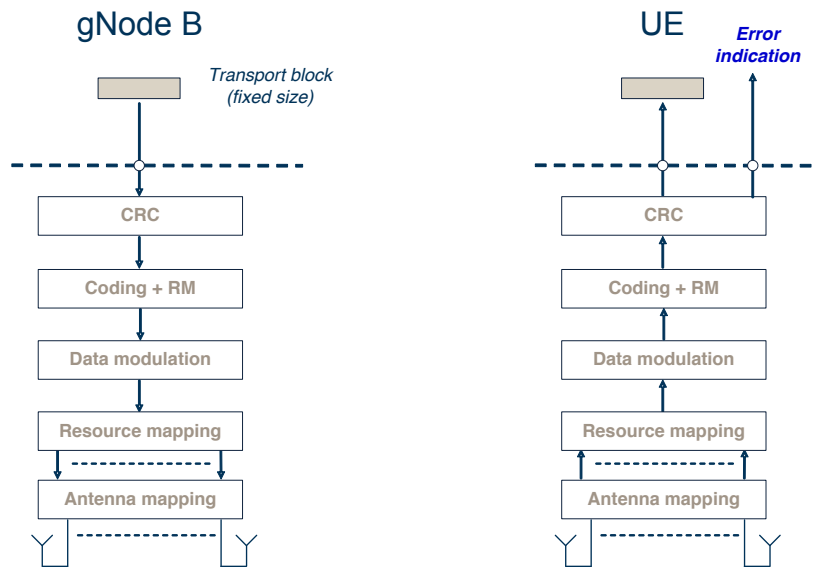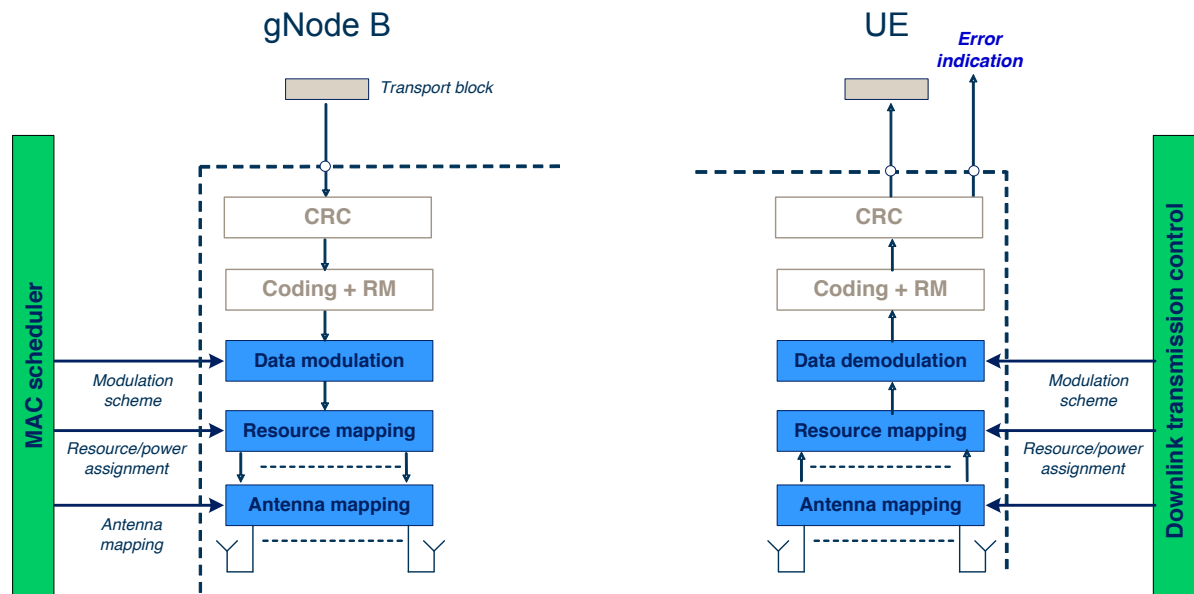
- Multi-antenna processing.

Figure 5.2.3-1: Physical-layer model for PCH transmission

6 Simultaneous transmission and reception of physical channels and physical signals

This clause describes the requirements from the UE to send and receive multiple physical channels and physical signals simultaneously depending on the capabilities and service requirements. The following notation is used between both the uplink and downlink subclauses below.

- p is the number of uplink carriers configured for the UE on which physical channels can be transmitted

- p' is the number of uplink carriers configured for the UE on which SRS can be transmitted

- q is the number of downlink carriers configured for the UE

- j is the number of cell groups configured for the UE.

- k is the number of PUCCH groups configured for the UE.

6.1 Uplink

The tables 6.1-1 and 6.1-2 describe the possible combinations of physical channels and SRS that can be sent in simultaneously in the uplink by one UE. Table 6.1-1 introduces notation for a "Transmission Type" which represents a physical channel or sounding reference signal, and any associated transport channel. Table 6.1-2 describes the combinations of these "Transmission Types" which are supported by the UE depending on capabilities, and enumerates how many of each can be transmitted simultaneously.

Table 6.1-1: Uplink "Transmission Types"

"Transmission Type"	Physical Channel or SRS	Associated Transport Channel	Comment
A	PRACH	RACH	Note 1
B	PUCCH	N/A	
C	PUSCH	UL-SCH	Note 2
D	SRS	N/A	
Note 1: RACH corresponds to contention based.			
Note 2: UCI on PUSCH without UL-SCH is possible.			

Table 6.1-2: Uplink "Transmission Type" combinations

UE capability	Supported Combinations	Comment
	j x A	
	k x B	
	p x C	Note 1
	p' x D	Note 2
	$\tilde{j} \times$ A + $\tilde{k} \times$ B	Note 3
	$\tilde{j} \times$ A + $\tilde{p} \times$ C	Note 3
	$\tilde{j} \times$ A + $\tilde{p}' \times$ D	Note 3
	$\tilde{k} \times$ B + $\tilde{p}' \times$ D	Note 4
	$\tilde{p} \times$ C + $\tilde{p}' \times$ D	Note 4
Note 1: In the case there is one SUL carrier, then p-1 would be supported.		
Note 2: UE may be configured with p' but may also have capability to simultaneously sound less than this number.		
Note 3: Simultaneous PRACH with PUCCH (or PUSCH or SRS) is supported only in the case of inter-band CA, with $\tilde{j} \leq j$, $\tilde{k} \leq k$, $\tilde{p} \leq p$, and $\tilde{p}' \leq p'$ depending on the configuration.		
Note 4: Simultaneous SRS with PUCCH (or PUSCH) is supported only in the case of inter-band CA, with $\tilde{k} \leq k$, $\tilde{p} \leq p$, and $\tilde{p}' \leq p'$ depending on the configuration.		

6.2 Downlink

The tables 6.2-1, 6.2-2 describe the possible combinations of physical channels that can be received simultaneously in the downlink by one UE. Table 6.2-1 introduces notation for a "Reception Type" which represents a physical channel and any associated transport channel. Table 6.2-2 describes the combinations of these "Reception Types" which are supported by the UE depending on capabilities, and enumerates how many of each can be received simultaneously. The UE shall be able to receive all TBs according to the indication on PDCCH. Any subset of the combinations specified in table 6.2-2 is also supported.

Table 6.2-1: Downlink "Reception Types"

"Reception Type"	Physical Channel(s)	Monitored RNTI	Associated Transport Channel	Comment
A	PBCH	N/A	BCH	
B	PDCCH+PDSCH	SI-RNTI	DL-SCH	Note 1
C0	PDCCH	P-RNTI	N/A	Note 2
C1	PDCCH+PDSCH	P-RNTI	PCH	Note 1
D0	PDCCH+PDSCH	RA-RNTI or Temporary C-RNTI	DL-SCH	Note 1
D1	PDCCH+PDSCH	C-RNTI, CS-RNTI, MCS-C-RNTI	DL-SCH	
E	PDCCH	C-RNTI	N/A	Note 3
F	PDCCH	C-RNTI, CS-RNTI, MCS-C-RNTI	UL-SCH	
G	PDCCH	SFI-RNTI	N/A	
H	PDCCH	INT-RNTI	N/A	
J0	PDCCH	TPC-PUSCH-RNTI	N/A	
J1	PDCCH	TPC-PUCCH-RNTI	N/A	
J2	PDCCH	TPC-SRS-RNTI	N/A	
K	PDCCH	SP-CSI-RNTI	N/A	
Note 1: These are received from PCell only.				
Note 2: In some cases UE is only required to monitor the short message within the DCI for P-RNTI.				
Note 3: This corresponds to PDCCH-ordered PRACH.				

Table 6.2-2: Downlink "Reception Type" combinations

UE capability	Supported Combinations			Comment
	PCell	PSCell	SCell	
1. RRC_IDLE				
	A + (B and/or C1 and/or D0)			Note 1
2. RRC_INACTIVE				
	A + (B and/or C1 and/or D0)			Note 1
3. RRC_CONNECTED				
	A + C0 + (B and/or (D0 or D1)) + E + F + G + H + J0 + J1 + J2 + K	A + C0 + D1 + E + F + G + H + J0 + J1 + J2 + K	D1 + F + G + H + J0 + J1 + J2 + K	Note 2
Note 1: UE is not required to decode more than two PDSCH simultaneously, and decoding prioritization when more than two are received is up to UE implementation.				
Note 2: UE is not required to decode SI-RNTI PDSCH simultaneously with C-RNTI PDSCH, unless in FR1.				

7 Measurements provided by the physical layer

7.1 UE measurements

The list and detailed definition of UE measurements is provided in [7, TS 38.215].

Annex A (informative):
Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2017-05	RAN1#89	R1-1712013				Draft skeleton	0.0.0
2017-07	AH_1706	R1-1712013				Update for agreements from meetings up to RAN1 NR AH2	0.0.1
2017-08	RAN1#90	R1-1713371				Update for agreements from meetings up to RAN1 NR AH2	0.0.2
2017-08	RAN1#90	R1-1714655				Update with change marks removed for RAN1 #90 endorsement	0.1.0
2017-09	RAN1#90	R1-1715320				Updated with minor editorial changes for review after RAN1 #90	0.1.1
2017-09	RAN#77	RP-172006				For information to plenary	1.0.0
2017-10	RAN1#90b	R1-1719229				Updated for agreements from meetings up to RAN1 #90b	1.0.1
2017-11	RAN1#91	R1-1721047				Updated after email discussion	1.1.0
2017-12	RAN1#91	R1-1721340				Updated to reflect agreements from RAN1 #91	1.2.0
2017-12	RAN#78	RP-172630				Endorsed version for approval by plenary	2.0.0
2017-12	RAN#78					Approved by plenary – Rel-15 spec under change control	15.0.0
2018-03	RAN#79	RP-180200	0001	-	F	CR capturing the Jan18 ad-hoc and RAN1#92 meeting agreements	15.1.0
2018-06	RAN#80	RP-181172	0002	1	F	CR to 38.202 capturing the RAN1#92bis and RAN1#93 meeting agreements	15.2.0
2018-06	RAN#80	RP-181257	0003	-	B	CR to 38.202 capturing the RAN1#92bis and RAN1#93 meeting agreements related to URLLC	15.2.0
2018-09	RAN#81	RP-181789	0004	-	B	CR to 38.202 capturing RAN1#94 meeting agreements	15.3.0