VoLTE & MR-DC Call Flows

https://nrcalculator.firebaseapp.com/cheatsheet.html

EN-DC / MR-DC

- Secondary Node Addition (SCG Add)
- Secondary Node Modification (SCG Mod on same gNB) – MN Initiated
    - Secondary Node Modification (SCG Mod on same gNB) – SN Initiated with MN Involved
    - Secondary Node Modification (SCG Mod on same gNB) – SN Initiated without MN Involved
    - Secondary Node Modification (SCG Mod on same gNB) – Continued from previous
    - Secondary Node Modification (SCG Mod on same gNB) – Continued from previous
- Secondary Node Release (SCG Release) – MN/SN Initiated
- Secondary Node Change (SCG handover) – MN Initiated
- Secondary Node Change (SCG handover) – SN Initiated
- Inter-MN Handover (with/without SN change)
- MN to eNB/gNB Change
- eNB/gNB to MN Change
- RRC Transfer (when split SRB is utilized)
- RRC Transfer (For special cases in red below)
- Secondary RAT Usage Reporting
- Inter-System Handover
- Supported Handover b/w MR-DC

VoLTE

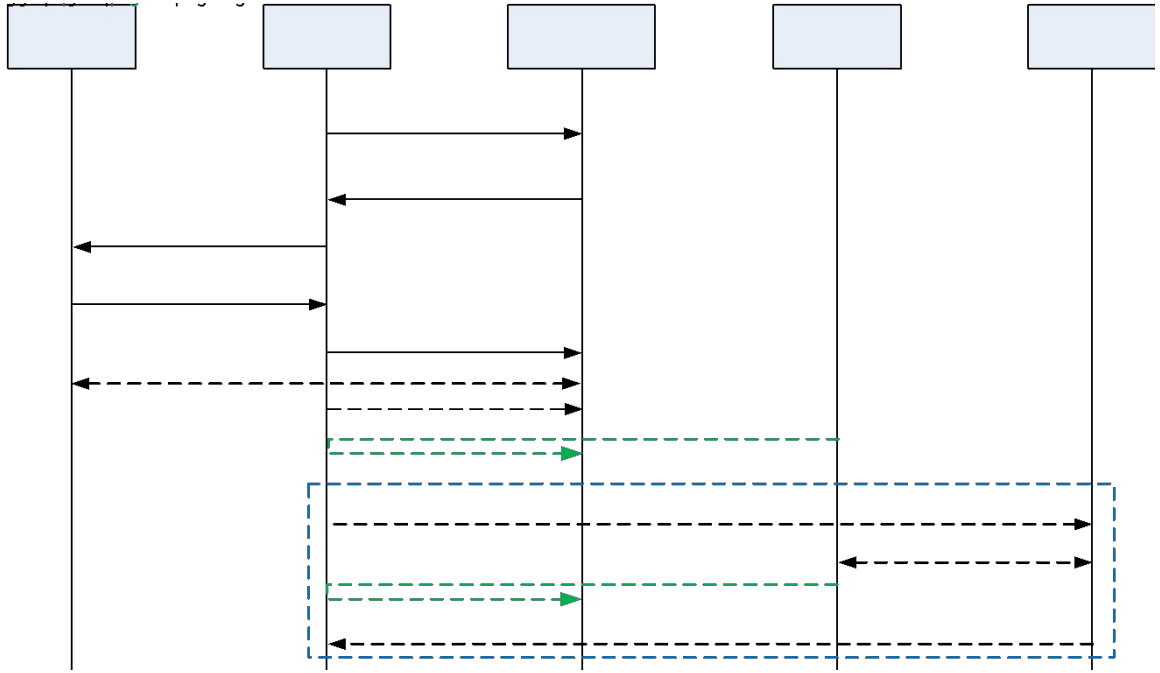
- **Local**
    - VoLTE UE Attachment and IMS Registration message sequence
    - VoLTE UE Attachment and IMS Registration message sequence – Continued from previous
    - VoLTE UE Initiated Detach & IMS Deregistration
    - VoLTE to VoLTE MO Call
    - VoLTE to VoLTE MT Call
    - VoLTE to VoLTE Call Clearing (Initiating Side Sequence)
    - VoLTE to VoLTE Call Clearing (Receiving Side Sequence)
    - VoLTE MO to CS Call
    - VoLTE MT to CS Call
    - VoLTE to CS Call Clearing (VoLTE Side Initiated)
    - VoLTE to CS Call Clearing (VoLTE is Receiving side)
    - QCI to DSCP Recommended Mapping
- **Interconnect**
    - VoLTE Interconnect Architecture
    - VoLTE UE to Peer IMS Call (MO)
    - VoLTE UE to Peer IMS Call (MT)
    - VoLTE UE to Peer IMS Call Clearing (VoLTE side initiated)
    - VoLTE UE to Peer IMS Call Clearing (VoLTE side receiving)
- **Roaming**
    - Roaming VoLTE Architecture
    - Roaming VoLTE UE Attach
    - Roaming VoLTE UE Initial IMS Registration
    - Roaming VoLTE UE IMS Deregistration
    - Roaming VoLTE UE Initiated Detach
    - Roaming VoLTE to VoLTE MO Call
    - Roaming VoLTE to VoLTE MT Call
    - Roaming VoLTE to VoLTE Call Clearing (Initiated by Roamer)
    - Roaming VoLTE to VoLTE Call Clearing (Received by Roamer)
- VoLTE Packet Drops

Please send any issues to Ali Asgher Mansoor Habiby [aliasgherman at gmail dot com]

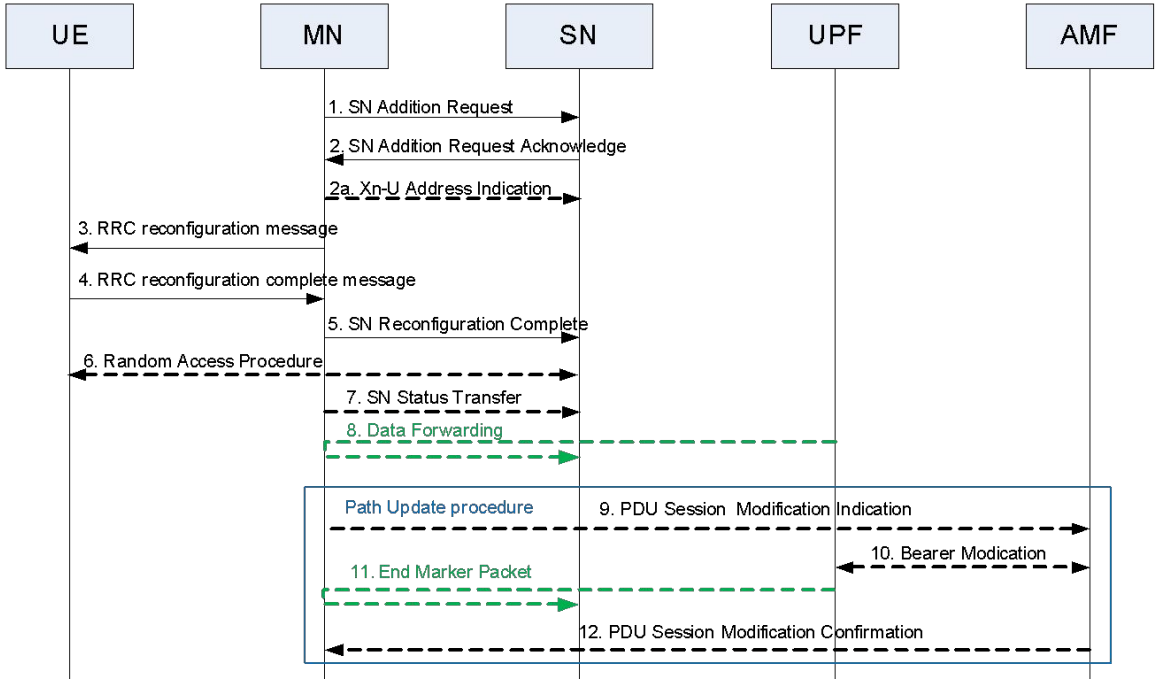
Ver: 0001

Procedure	Secondary Node Addition (SCG Add)
Specification	37.340
Section	10.2 [TS 37.340 V16.5.0]

EN-DC

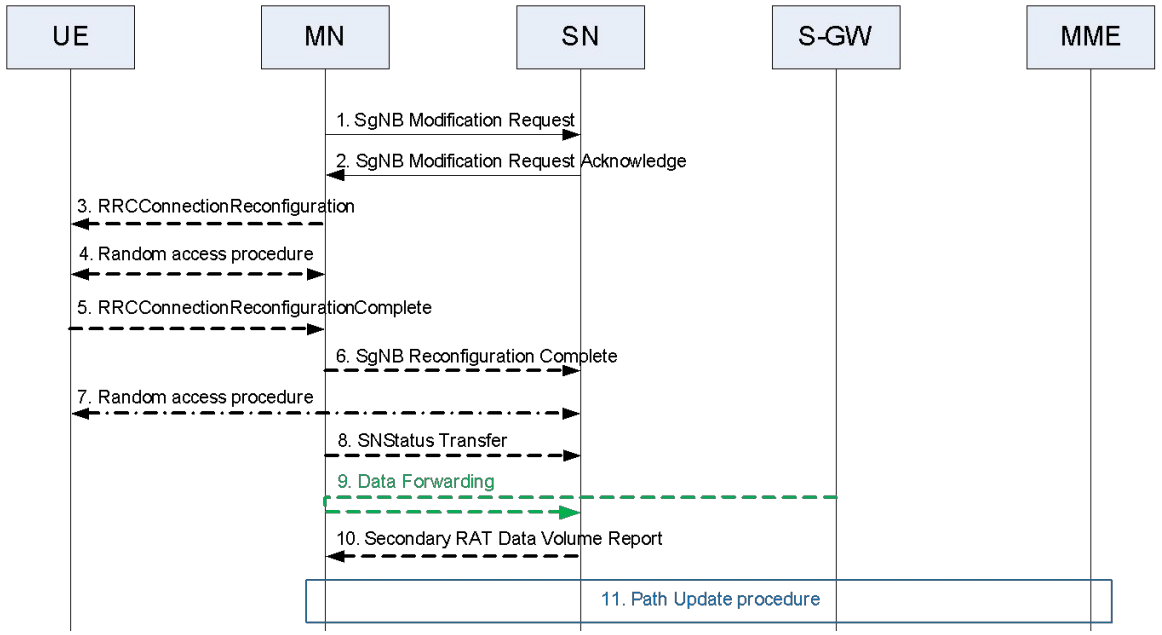


MR-DC with 5GC

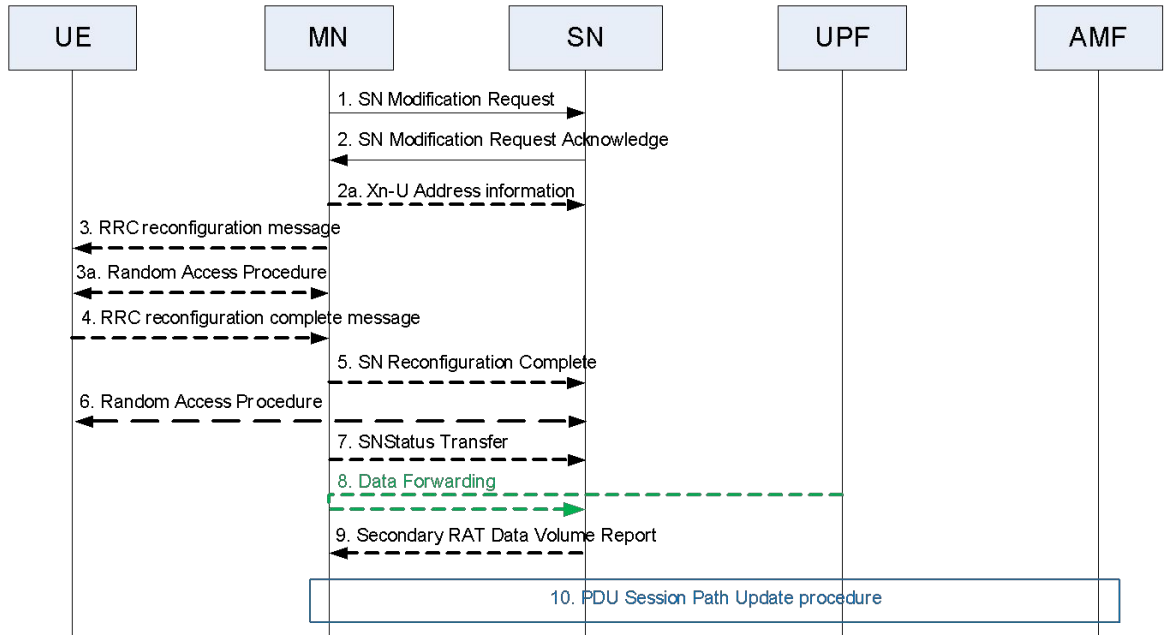


Procedure	Secondary Node Modification (SCG Mod on same gNB)
Specification	37.340
Section	10.3 [TS 37.340 V16.5.0]

EN-DC



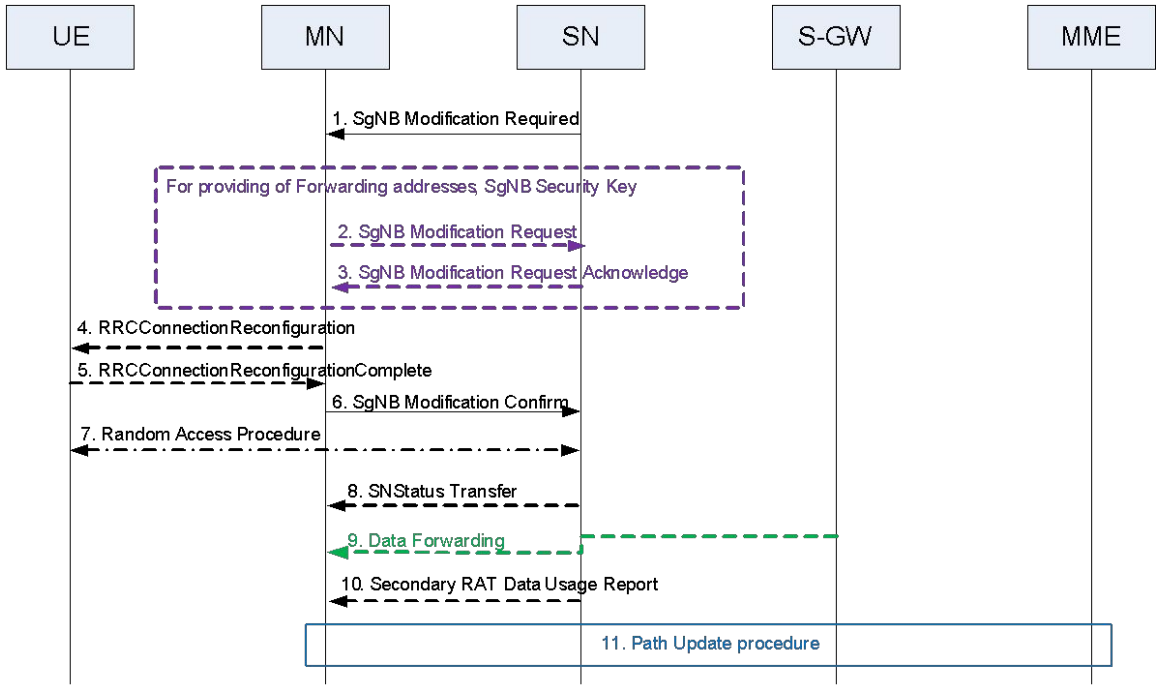
MR-DC with 5GC



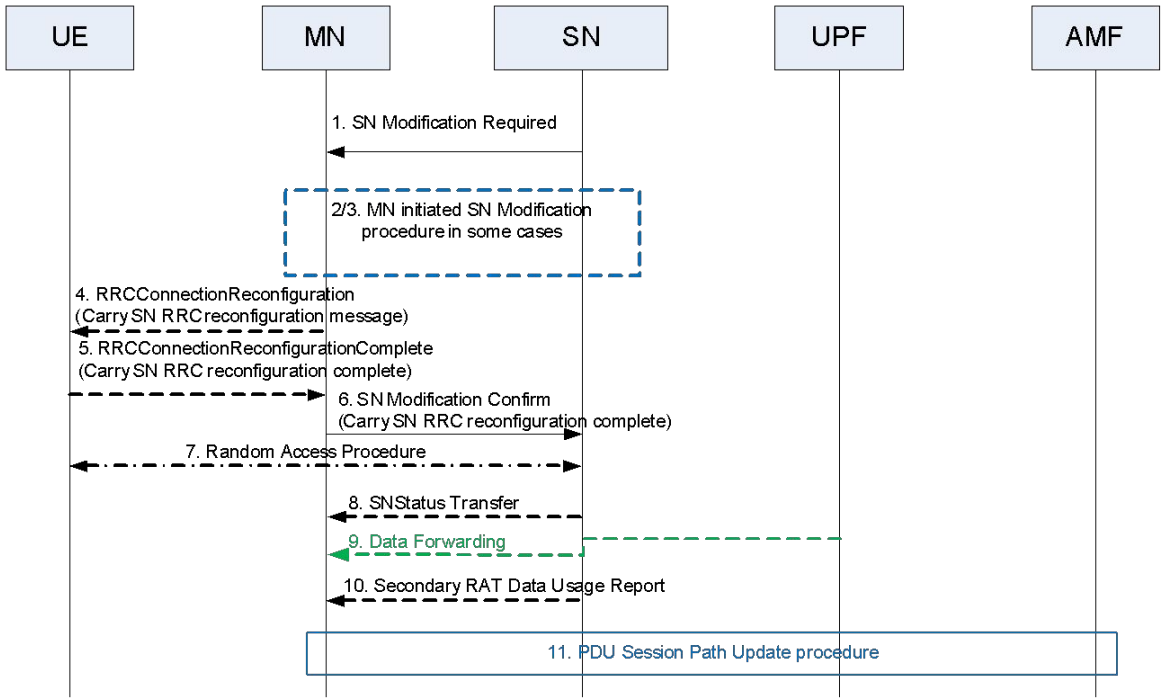
MN-Initiated SN Modification

Procedure	Secondary Node Modification (SCG Mod on same gNB)
Specification	37.340
Section	10.3 [TS 37.340 V16.5.0]

EN-DC



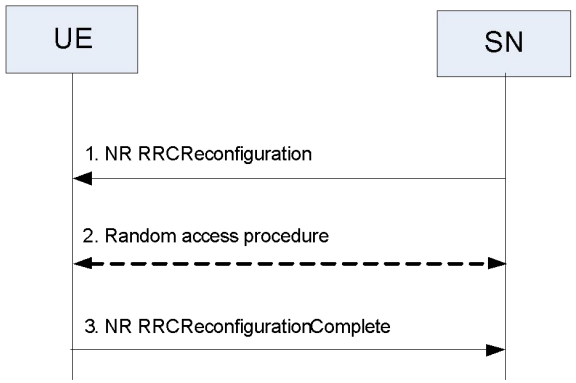
MR-DC with 5GC



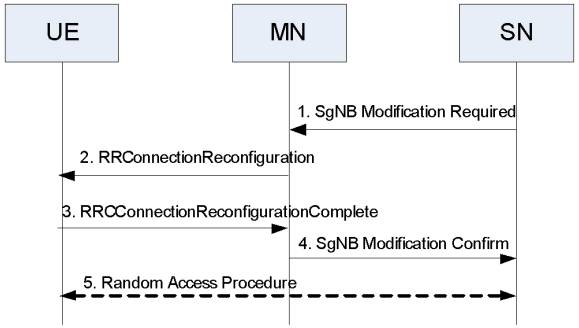
SN-Initiated SN Modification (with MN Involvement)

Procedure	Secondary Node Modification (SCG Mod on same gNB)
Specification	37.340
Section	10.3 [TS 37.340 V16.5.0]

EN-DC

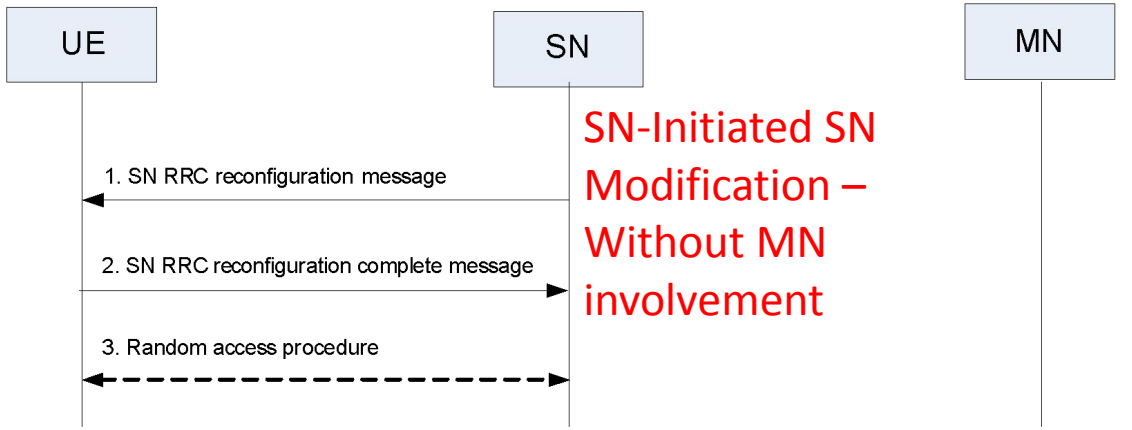


Transfer of an NR RRC message to/from the UE (when SRB3 is not used)

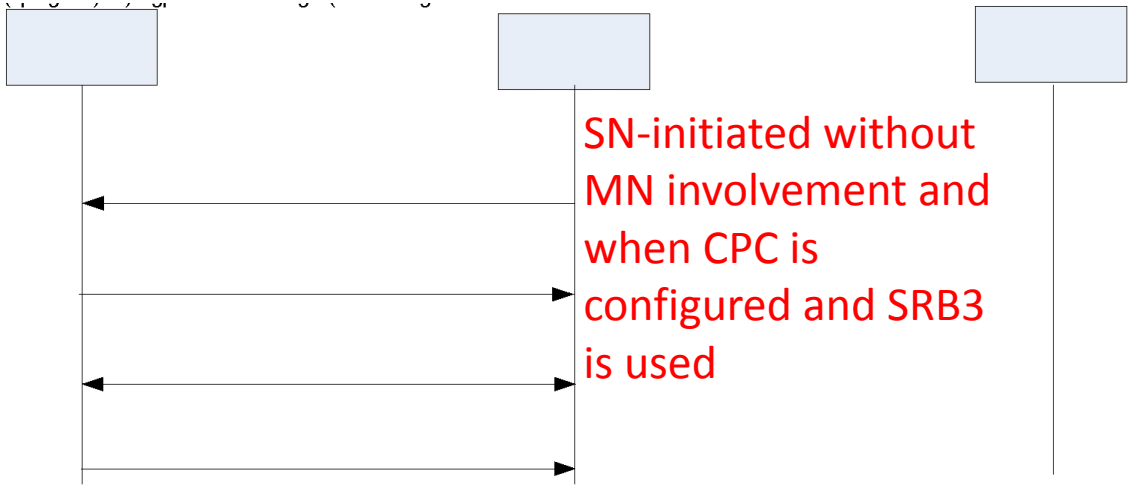


Transfer of an NR RRC message to/from the UE (when SRB3 is not used)

MR-DC with 5GC



SN-Initiated SN Modification – Without MN involvement



SN-initiated without MN involvement and when CPC is configured and SRB3 is used

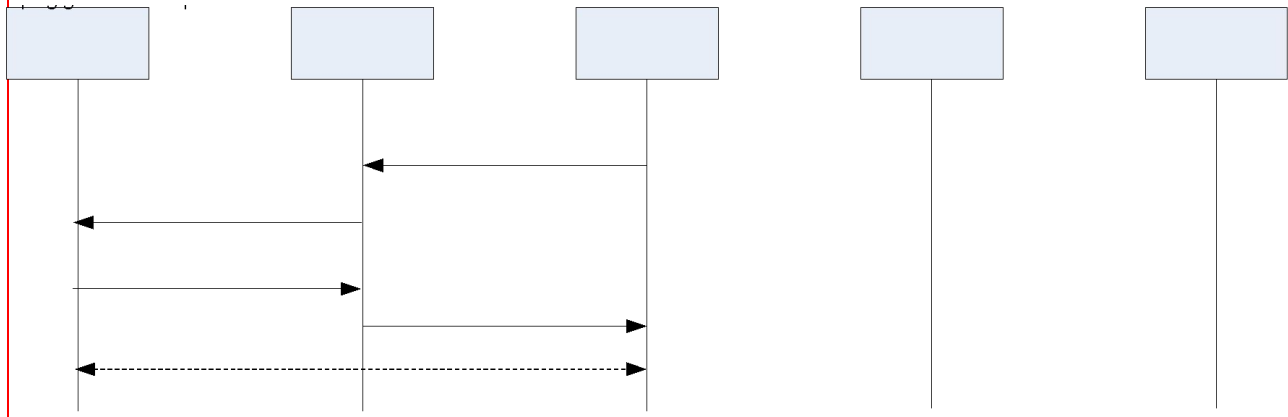
SN-Initiated SN Modification (without MN Involvement)

Procedure	Secondary Node Modification (SCG Mod on same gNB)
Specification	37.340
Section	10.3 [TS 37.340 V16.5.0]

EN-DC

Continued from previous

MR-DC with 5GC



Transfer of an NR RRC message to/from the UE (when SRB3 is not used)

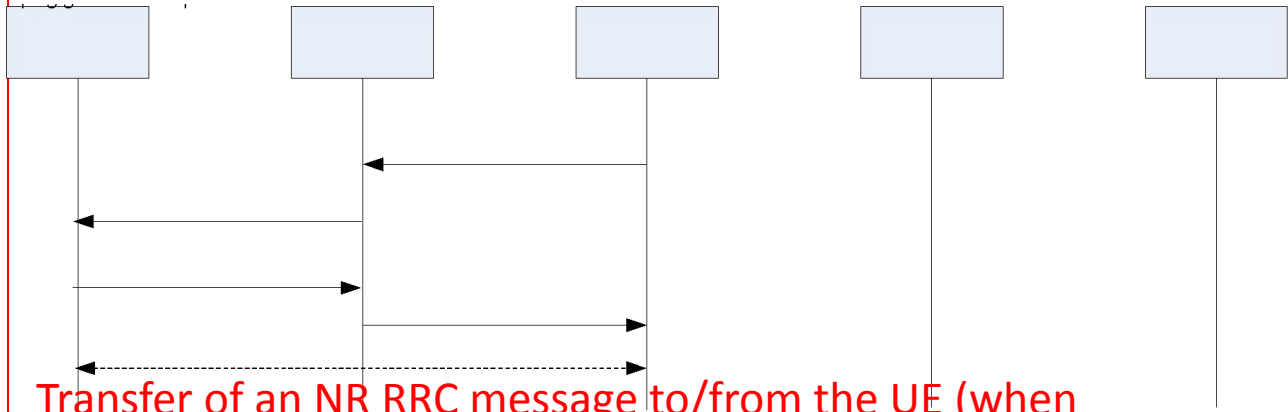
SN-Initiated SN Modification (without MN Involvement)

Procedure	Secondary Node Modification (SCG Mod on same gNB)
Specification	37.340
Section	10.3 [TS 37.340 V16.5.0]

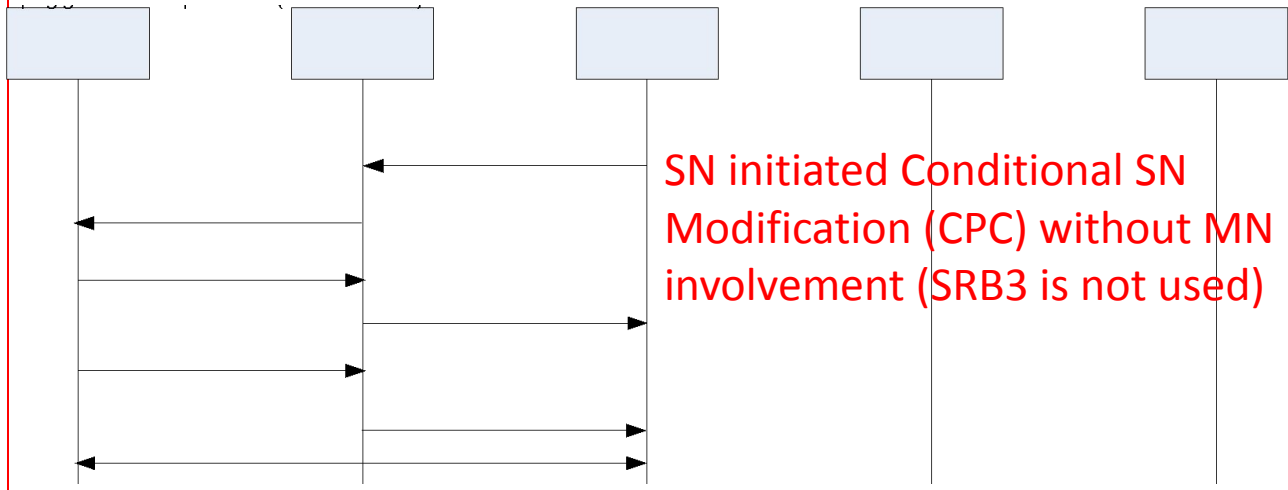
EN-DC

Continued from previous

MR-DC with 5GC



Transfer of an NR RRC message to/from the UE (when SRB3 is not used)

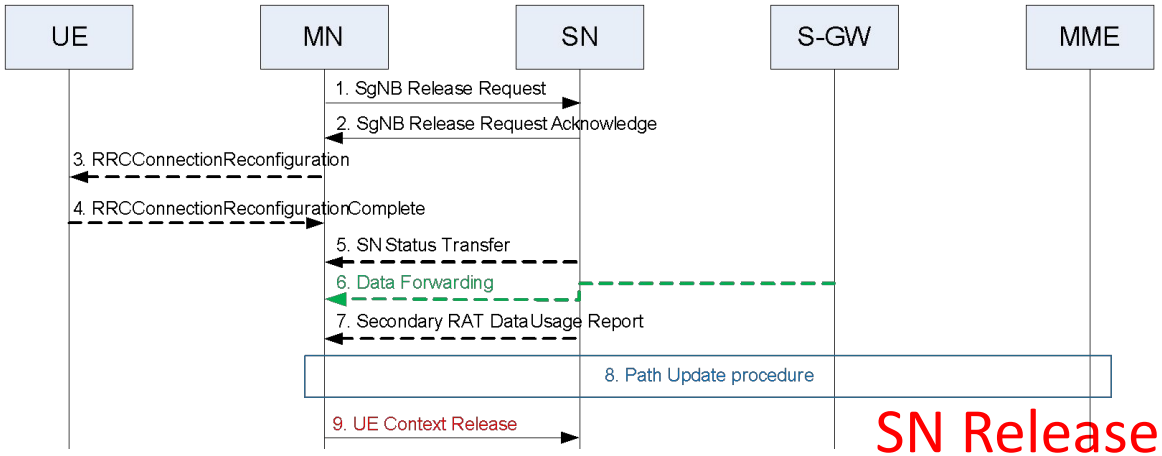


SN initiated Conditional SN Modification (CPC) without MN involvement (SRB3 is not used)

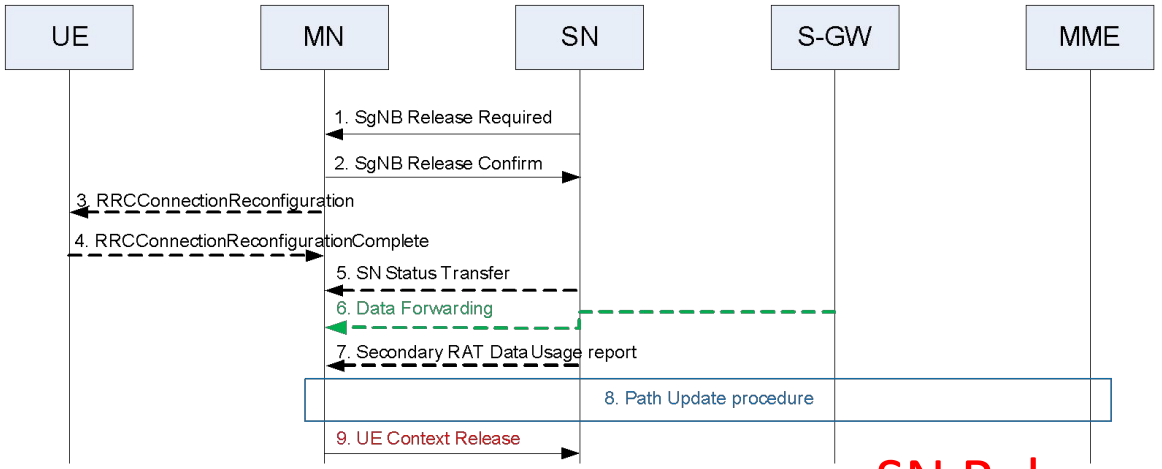
SN-Initiated SN Modification (without MN Involvement)

Procedure	Secondary Node Release (SCG Release)
Specification	37.340
Section	10.4 [TS 37.340 V16.5.0]

EN-DC

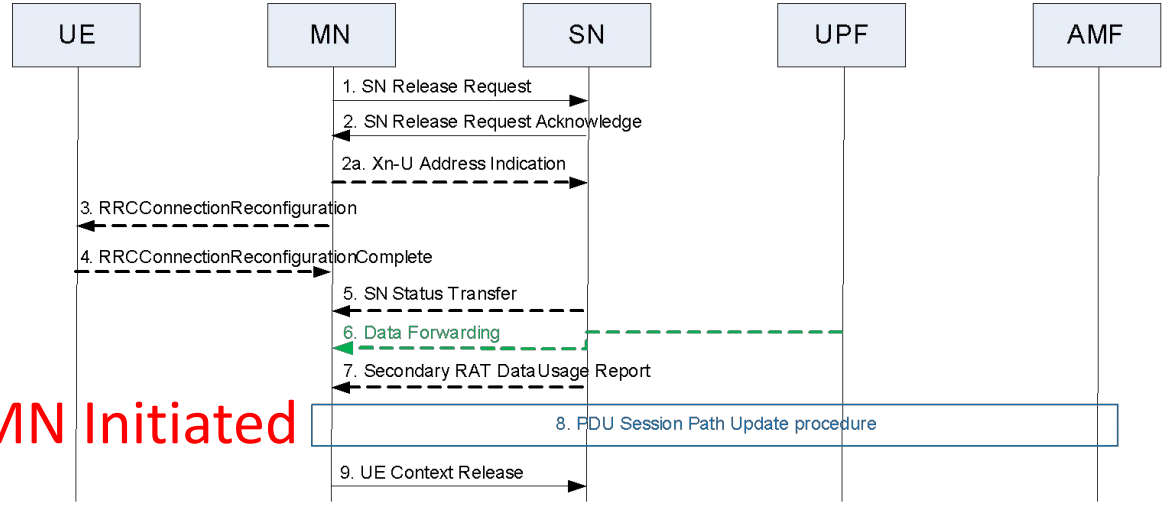


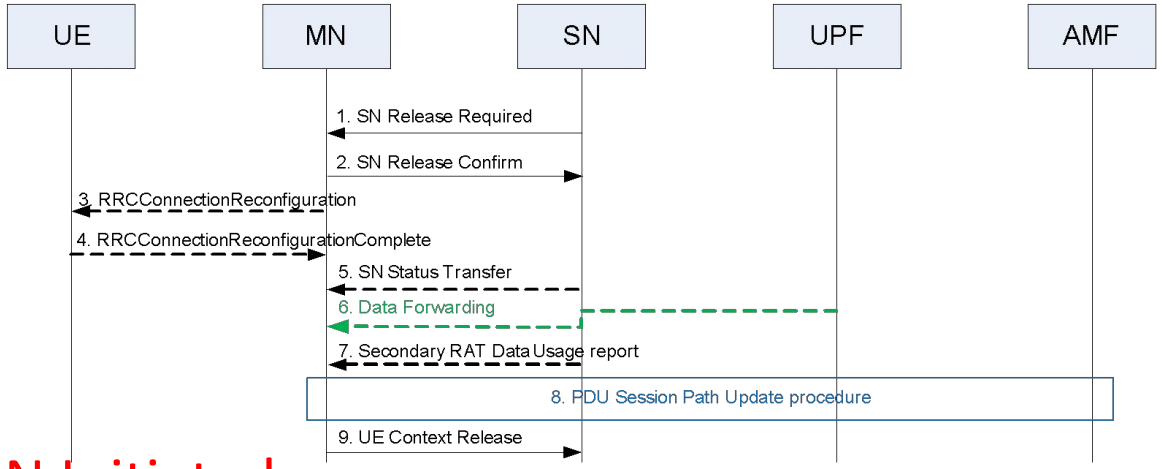
SN Release – MN Initiated



SN Release – SN Initiated

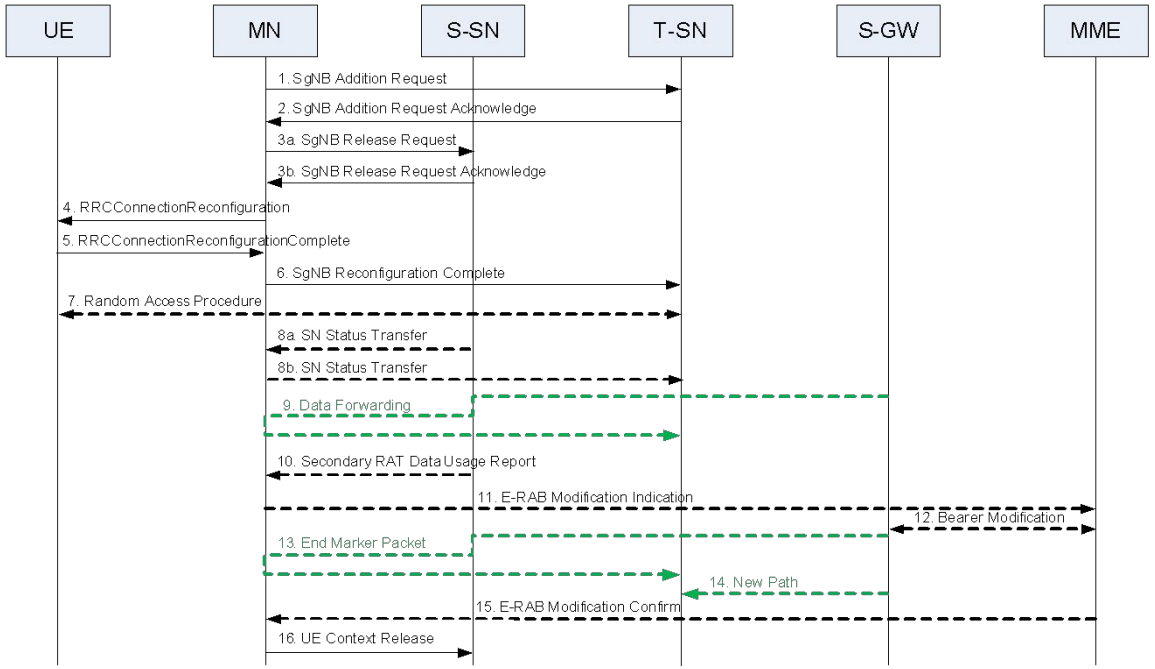
MR-DC with 5GC



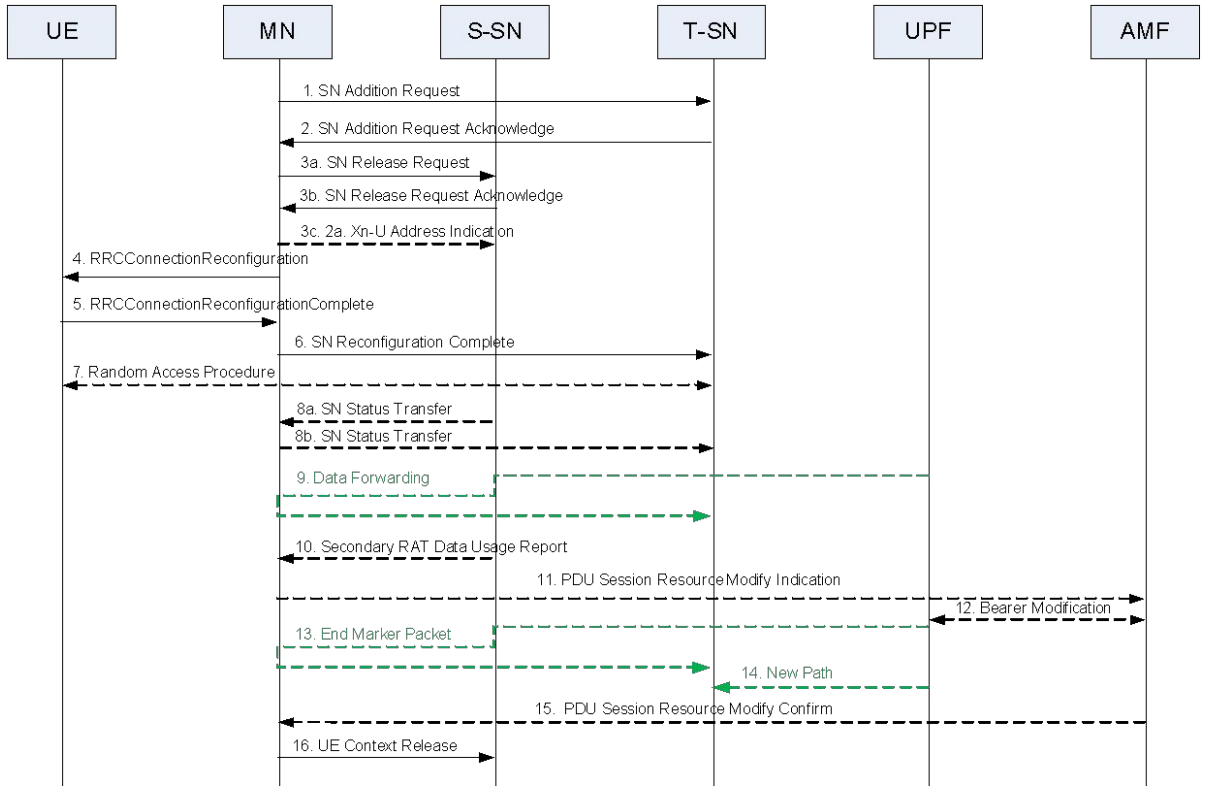


Procedure	Secondary Node Change (SCG handover) – MN Initiated
Specification	37.340
Section	10.5 [TS 37.340 V16.5.0]

EN-DC

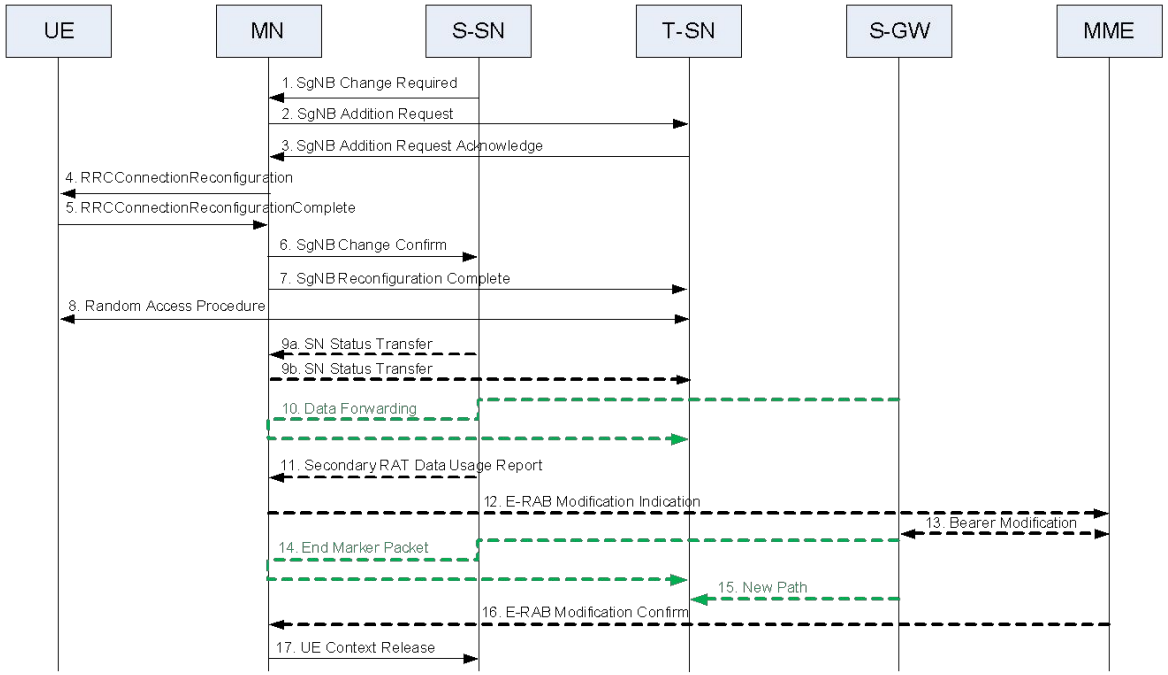


MR-DC with 5GC

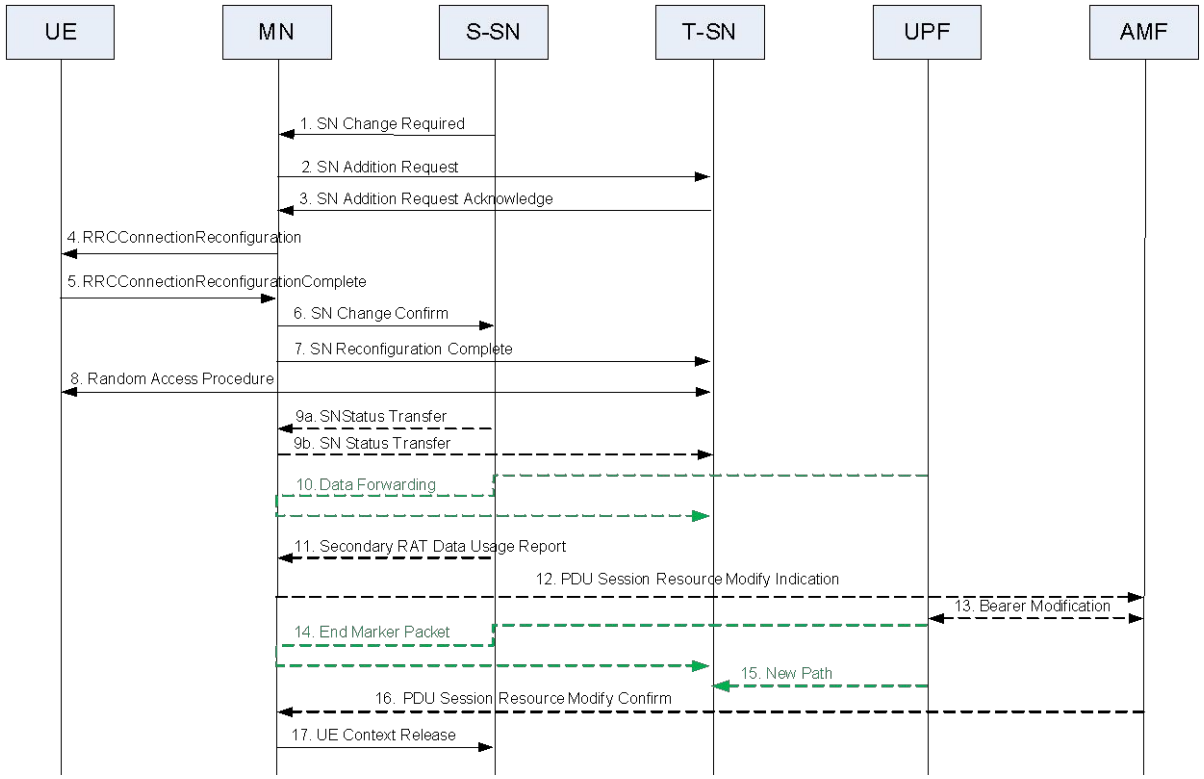


Procedure	Secondary Node Change (SCG handover) – SN Initiated
Specification	37.340
Section	10.5 [TS 37.340 V16.5.0]

EN-DC

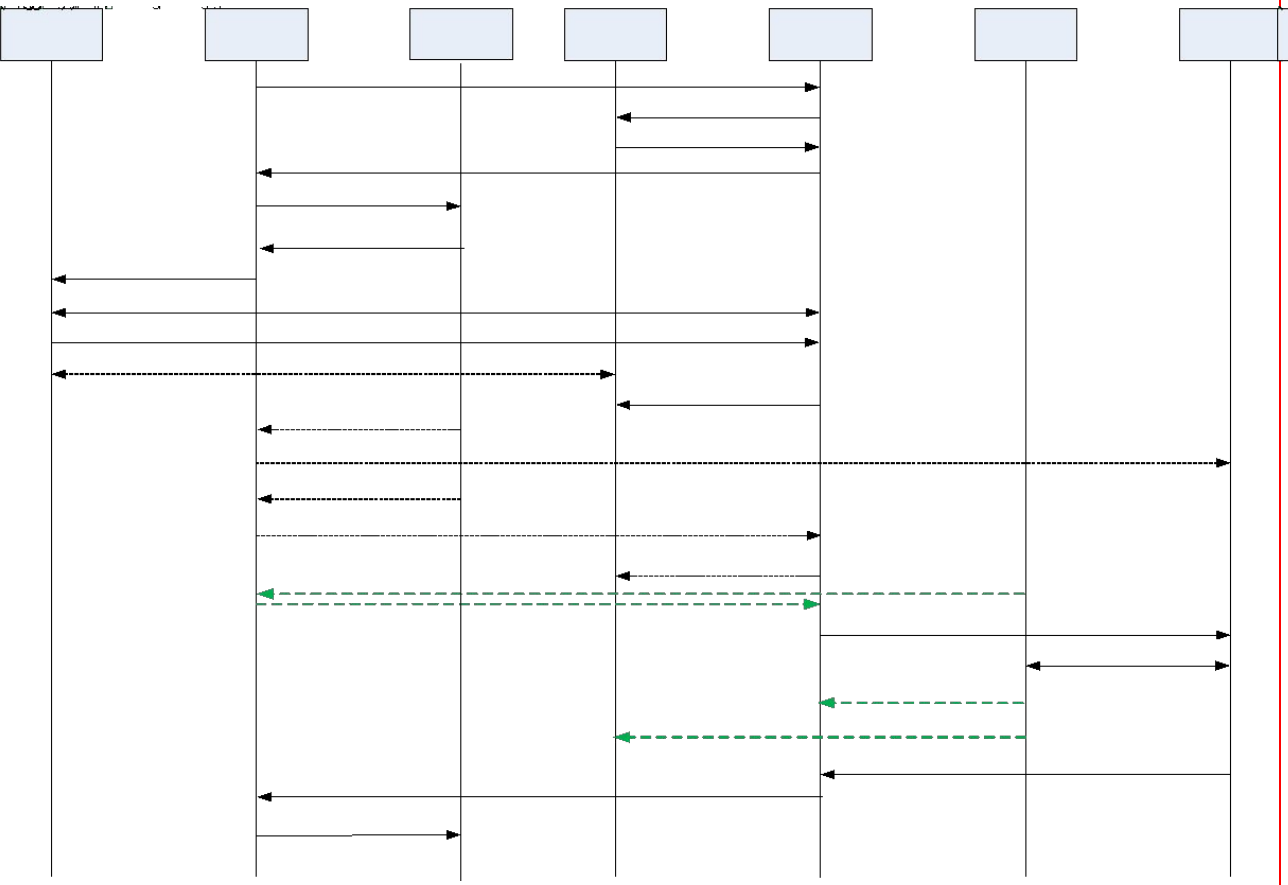


MR-DC with 5GC

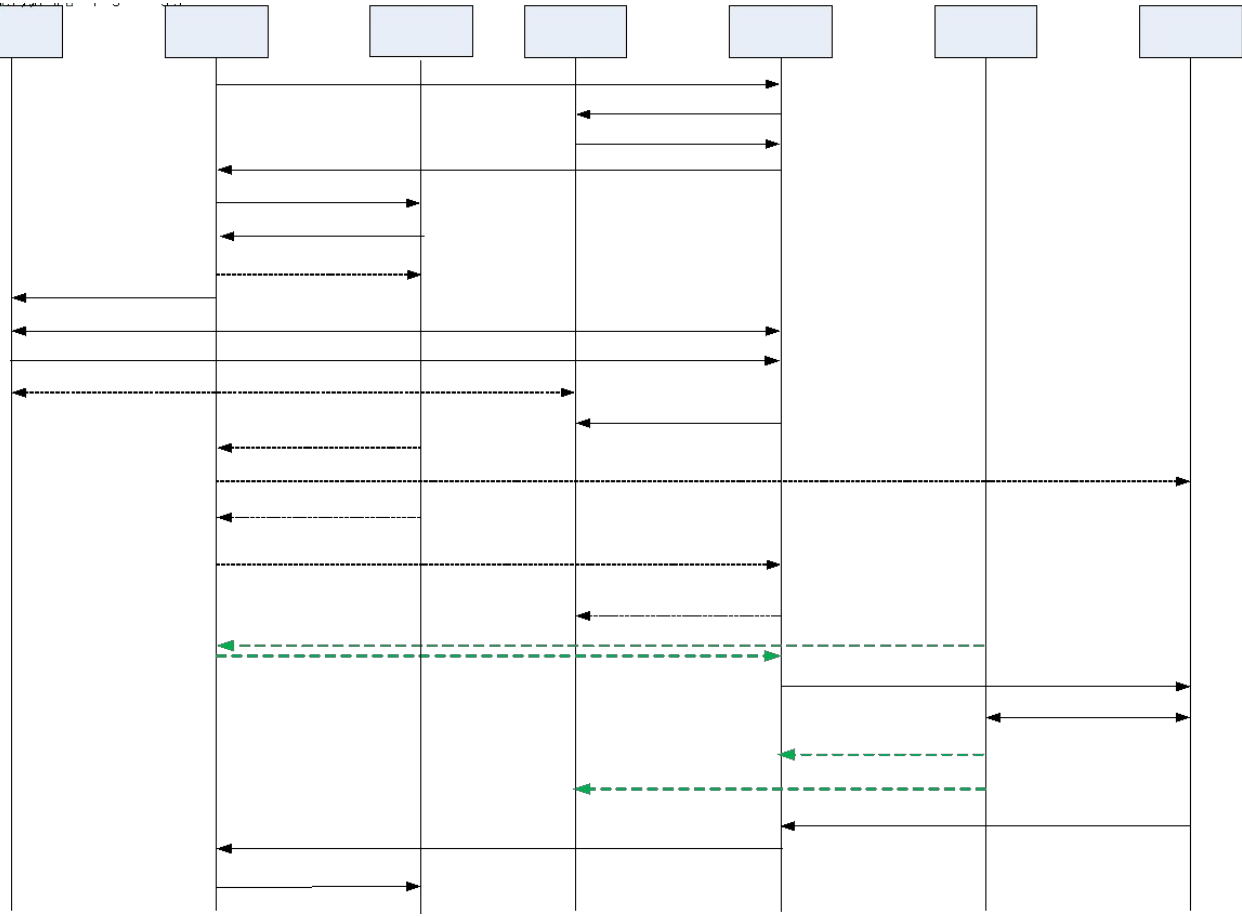


Procedure	Inter-MN Handover (with/without SN change)
Specification	37.340
Section	10.7 [TS 37.340 V16.5.0]

EN-DC



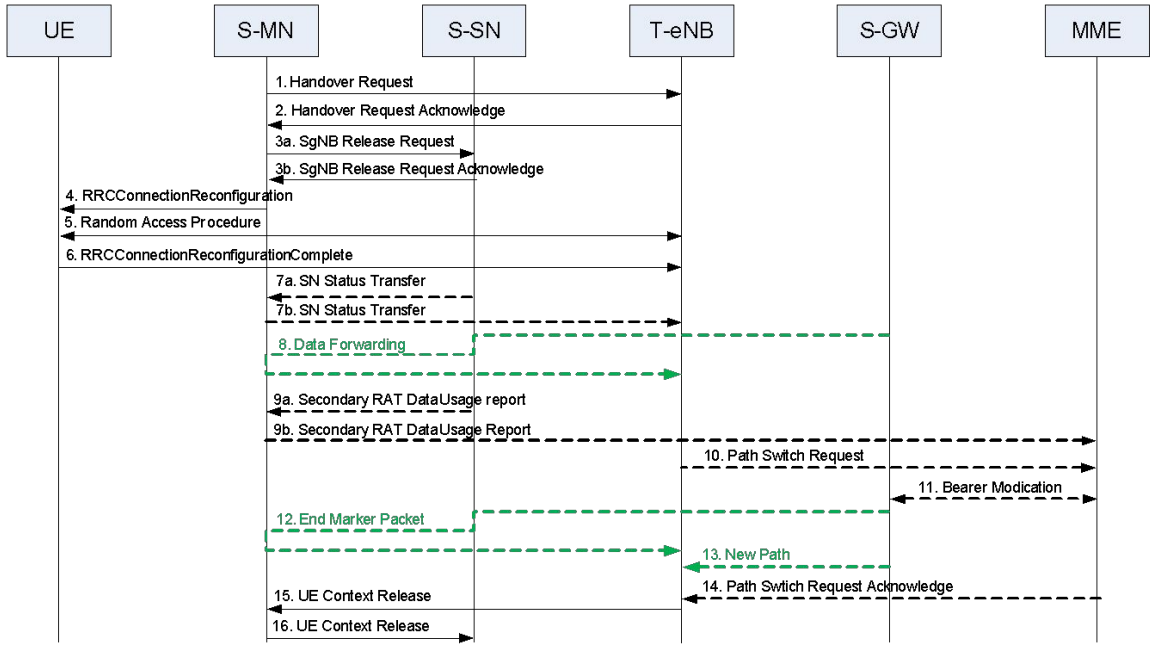
MR-DC with 5GC



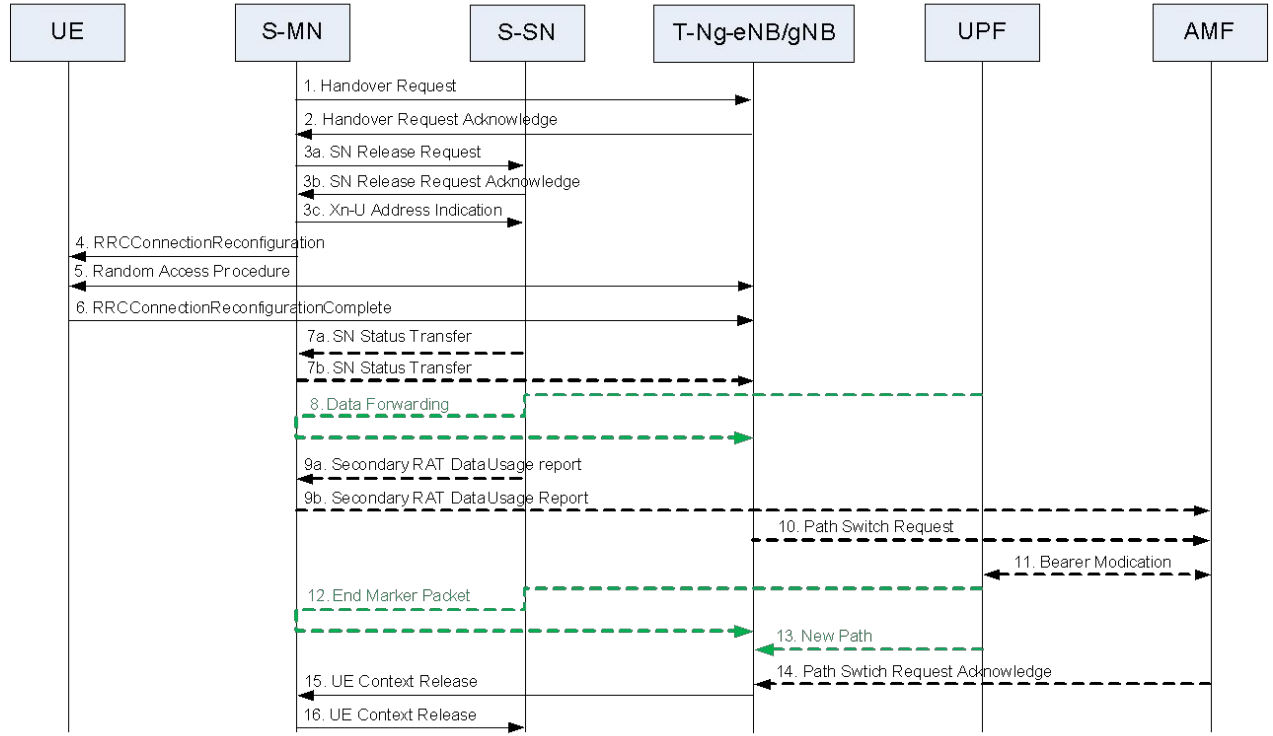
If SN change is not required, then assume that target SN is same as source SN

Procedure	MN to eNB/gNB Change
Specification	37.340
Section	10.8 [TS 37.340 V16.5.0]

EN-DC

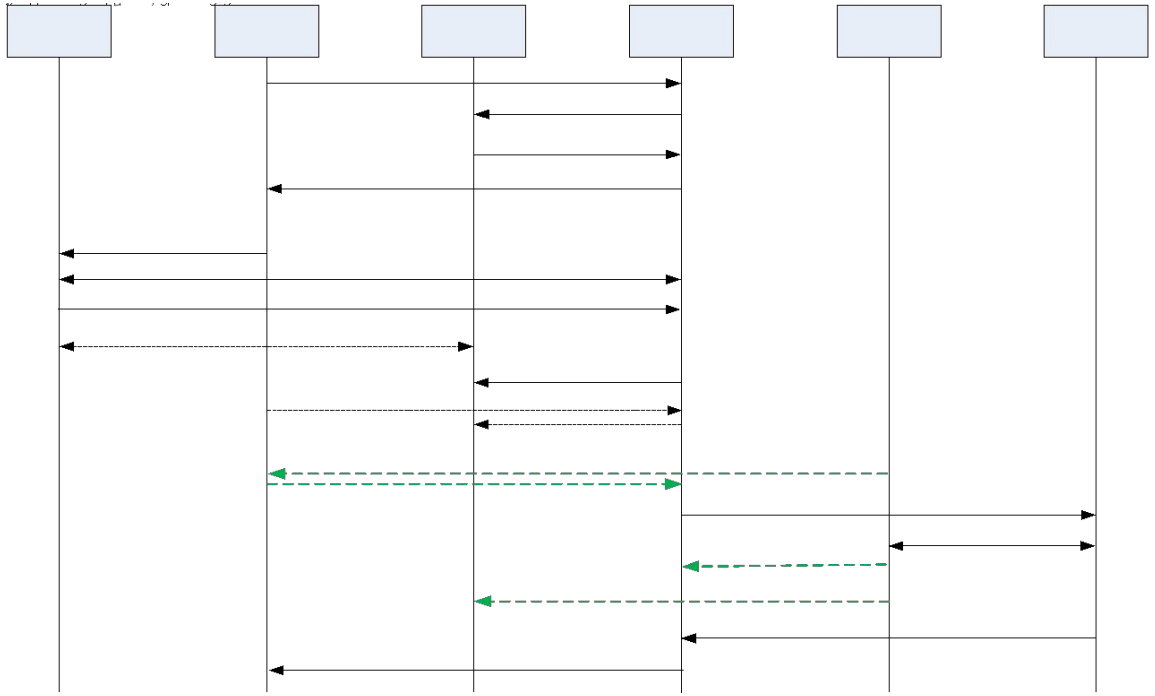


MR-DC with 5GC

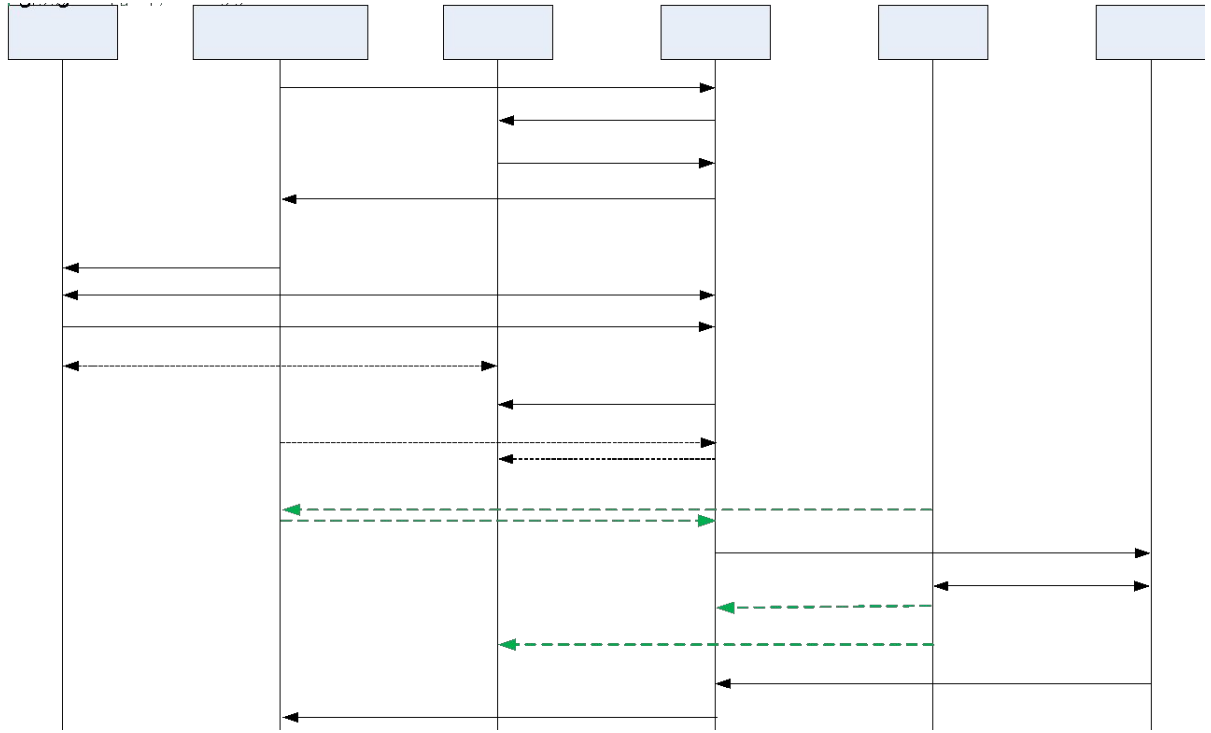


Procedure	eNB/gNB to MN Change
Specification	37.340
Section	10.9 [TS 37.340 V16.5.0]

EN-DC



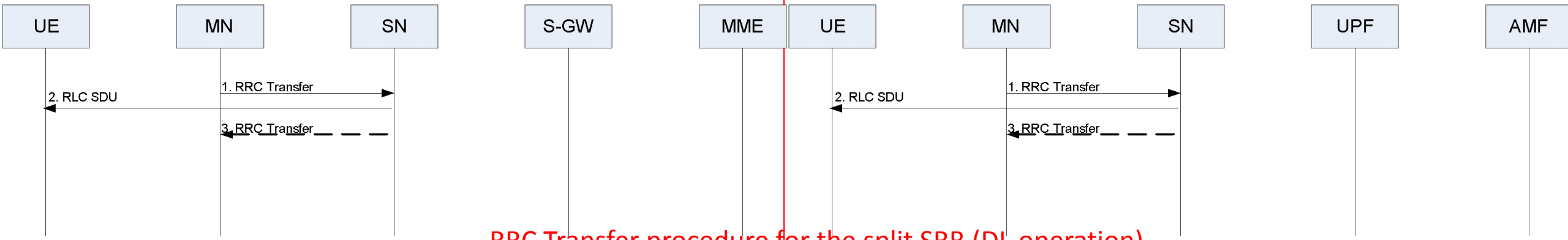
MR-DC with 5GC



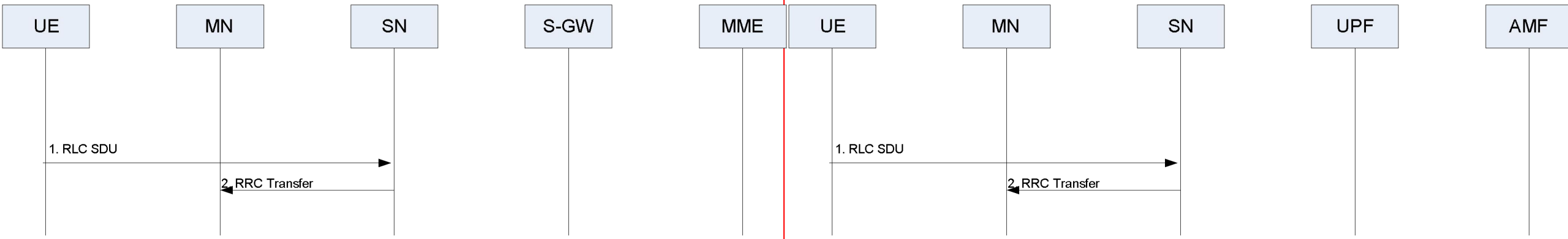
Procedure	RRC Transfer (when split SRB is utilized)
Specification	37.340
Section	10.10 [TS 37.340 V16.5.0]

EN-DC

MR-DC with 5GC



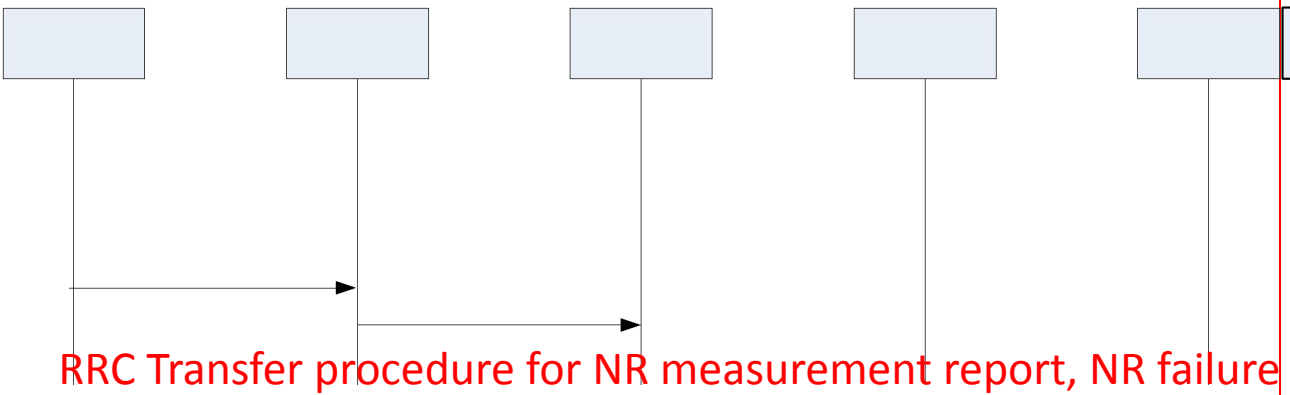
RRC Transfer procedure for the split SRB (DL operation)



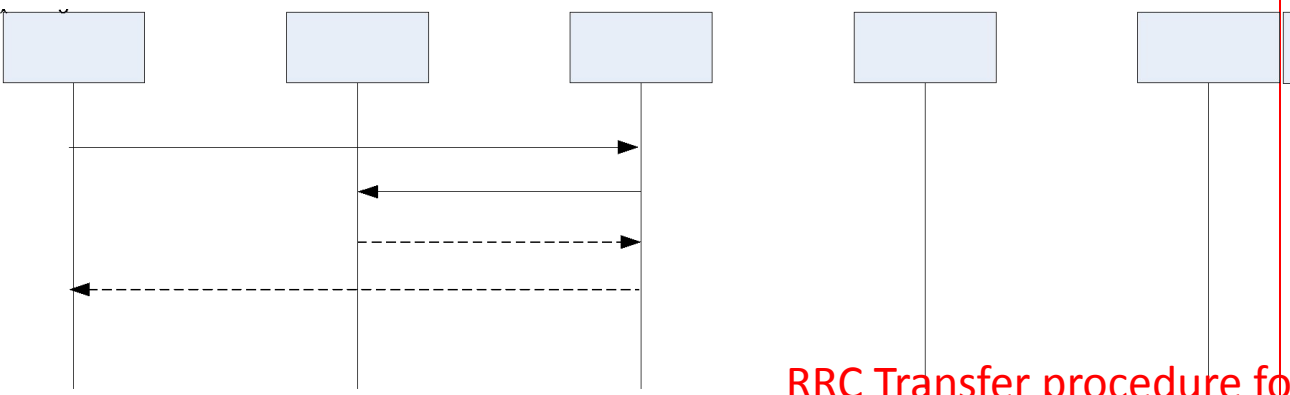
RRC Transfer procedure for the split SRB (UL operation)

Procedure	RRC Transfer (For special cases in red below)
Specification	37.340
Section	10.10 [TS 37.340 V16.5.0]

EN-DC

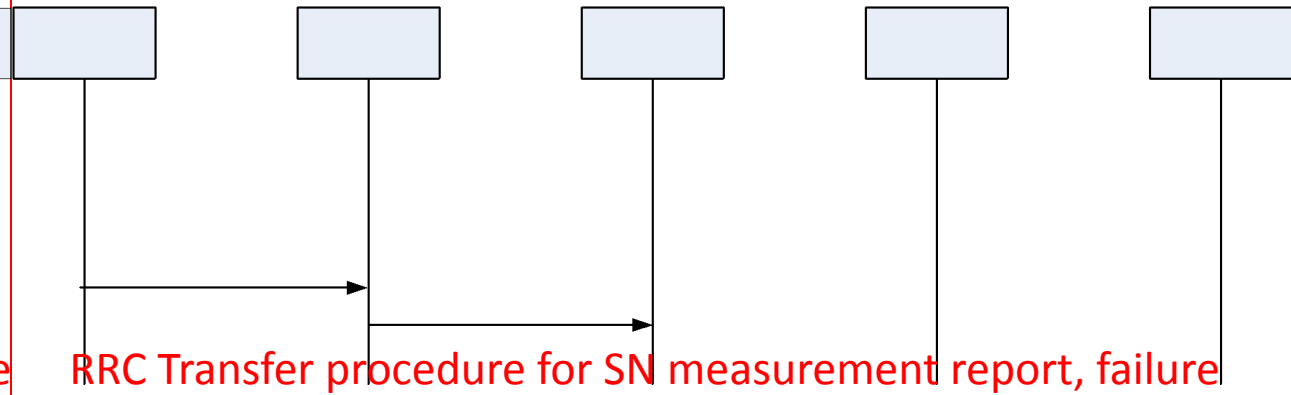


RRC Transfer procedure for NR measurement report, NR failure information, NR UE assistance information, NR IAB other information or CPC execution completion

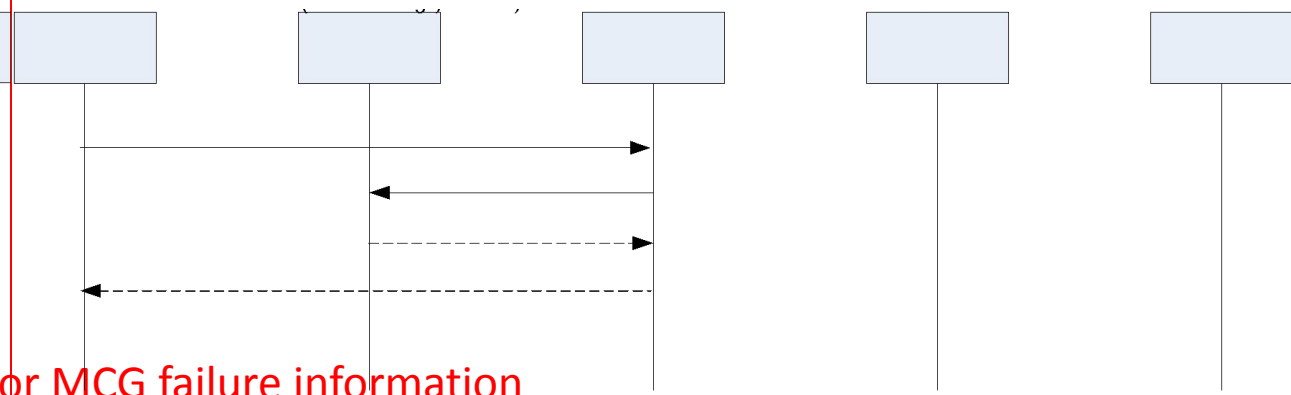


RRC Transfer procedure for MCG failure information

MR-DC with 5GC

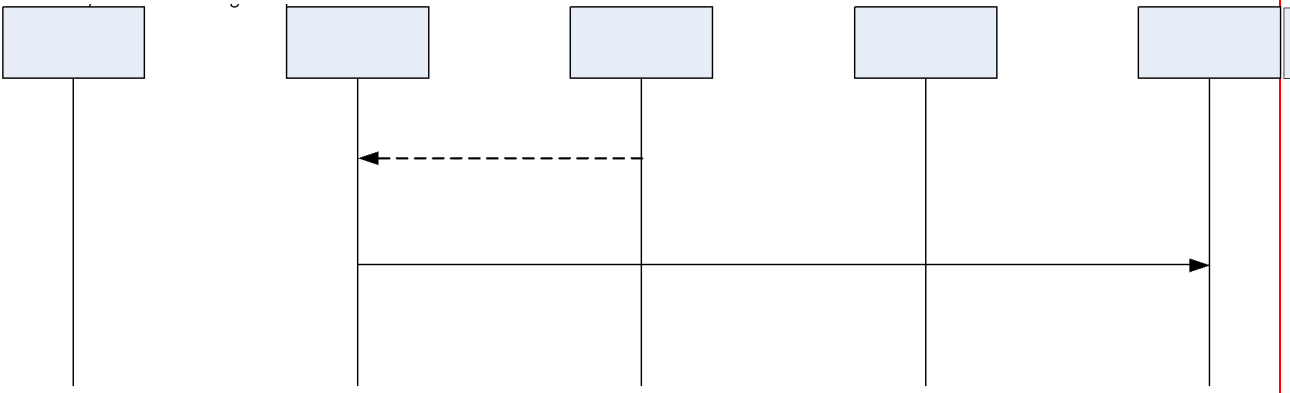


RRC Transfer procedure for SN measurement report, failure information report, SN UE assistance information or CPC execution completion

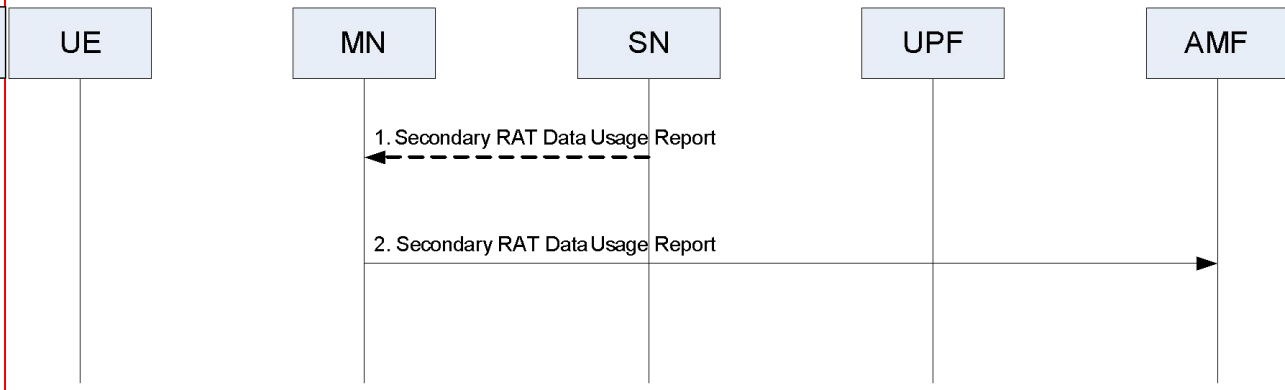


Procedure	Secondary RAT Usage Reporting
Specification	37.340
Section	10.11 [TS 37.340 V16.5.0]

EN-DC

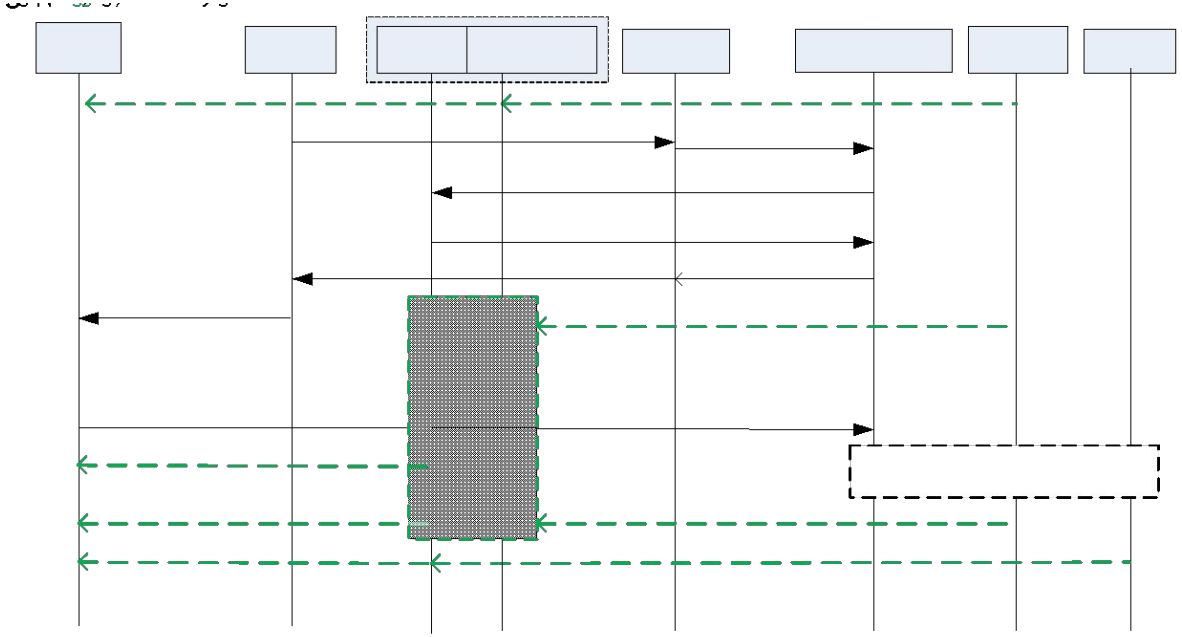


MR-DC with 5GC



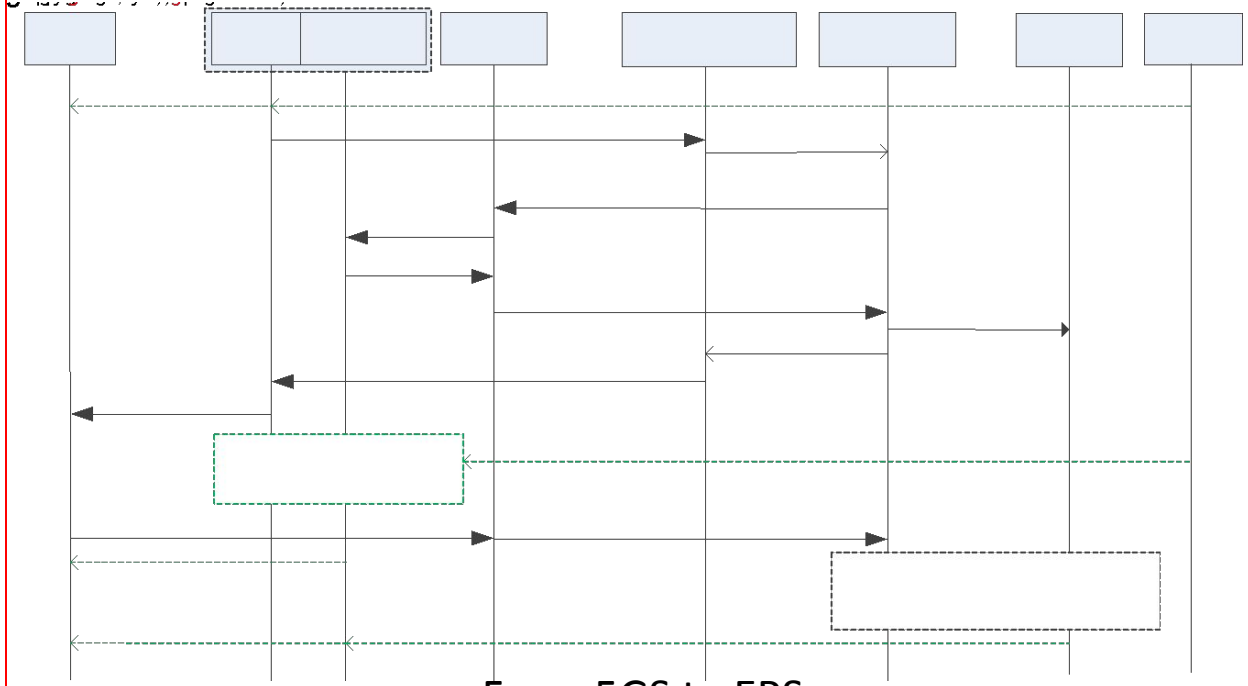
Procedure	Inter-System Handover
Specification	37.340
Section	10.16 [TS 37.340 V16.5.0]

EN-DC



From EPS to 5GS

MR-DC with 5GC



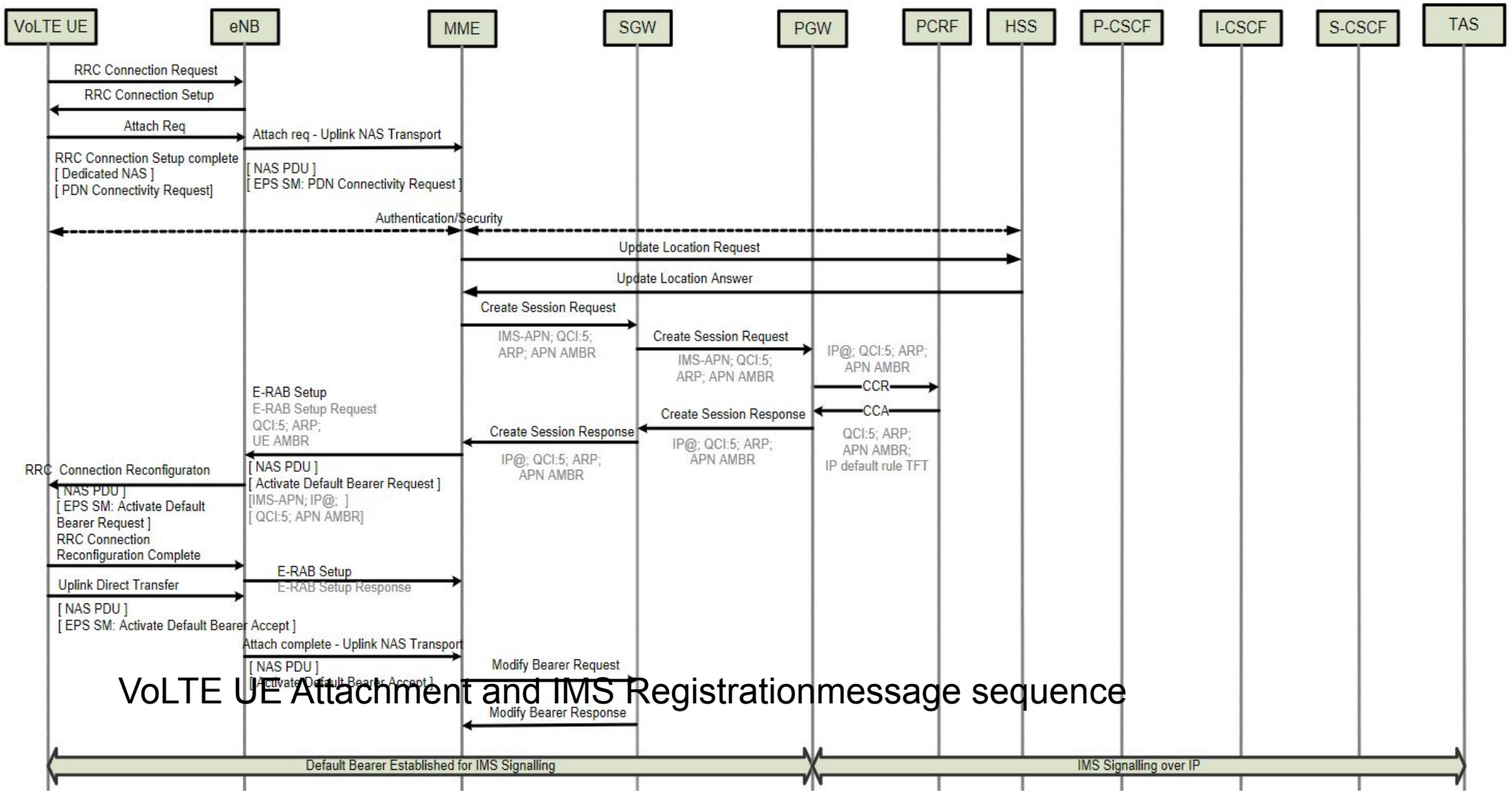
From 5GS to EPS

Procedure	Supported Handover b/w MR-DC
Specification	37.340
Section	Appendix B [TS 37.340 V16.5.0]

Table B-1: Supported MR-DC handover scenarios.

HO from (row) \ To (column)	E-UTRA with EPC	E-UTRA with 5GC	NR	GERAN or UTRAN	EN-DC	NGEN-DC	NE-DC	NR-DC
E-UTRA with EPC	YES	YES	YES	YES	YES	NO	NO	NO
E-UTRA with 5GC	YES	YES	YES	NO	NO	YES	NO	NO
NR	YES	YES	YES	NOTE 1	YES	NO	YES	YES
GERAN or UTRAN	YES	NO	NO	YES	NO	NO	NO	NO
EN-DC	YES	YES	YES	YES	YES	NO	NO	NO
NGEN-DC	YES	YES	YES	NO	NO	YES	NO	NO
NE-DC	YES	YES	YES	NOTE 1	NO	NO	YES	NO
NR-DC	YES	YES	YES	NOTE 1	NO	NO	NO	YES

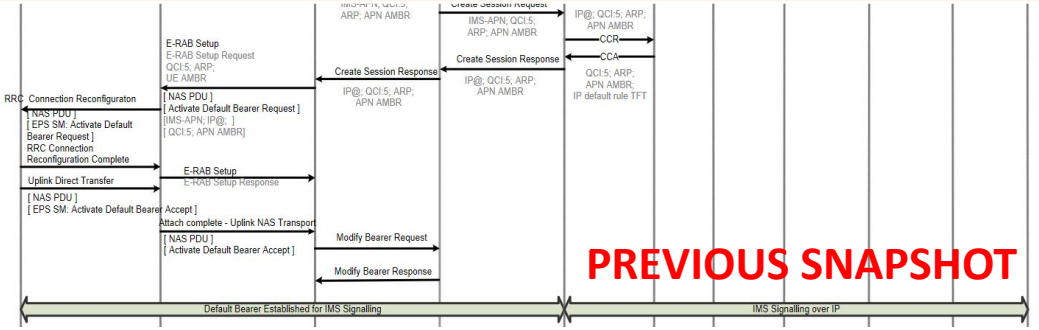
Procedure	VoLTE UE Attachment and IMS Registration message sequence
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 3



VoLTE UE Attachment and IMS Registrationmessage sequence

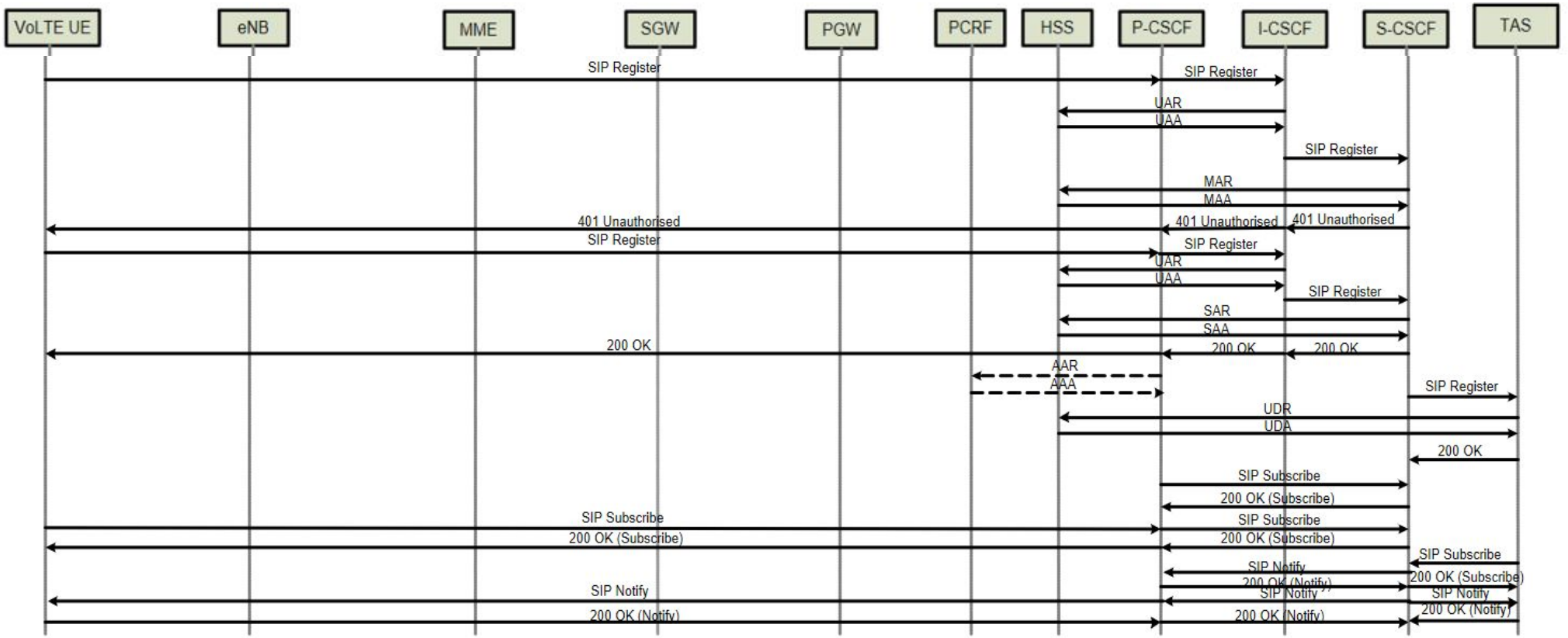
CONTINUED

Procedure	VoLTE UE Attachment and IMS Registration message sequence
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 3

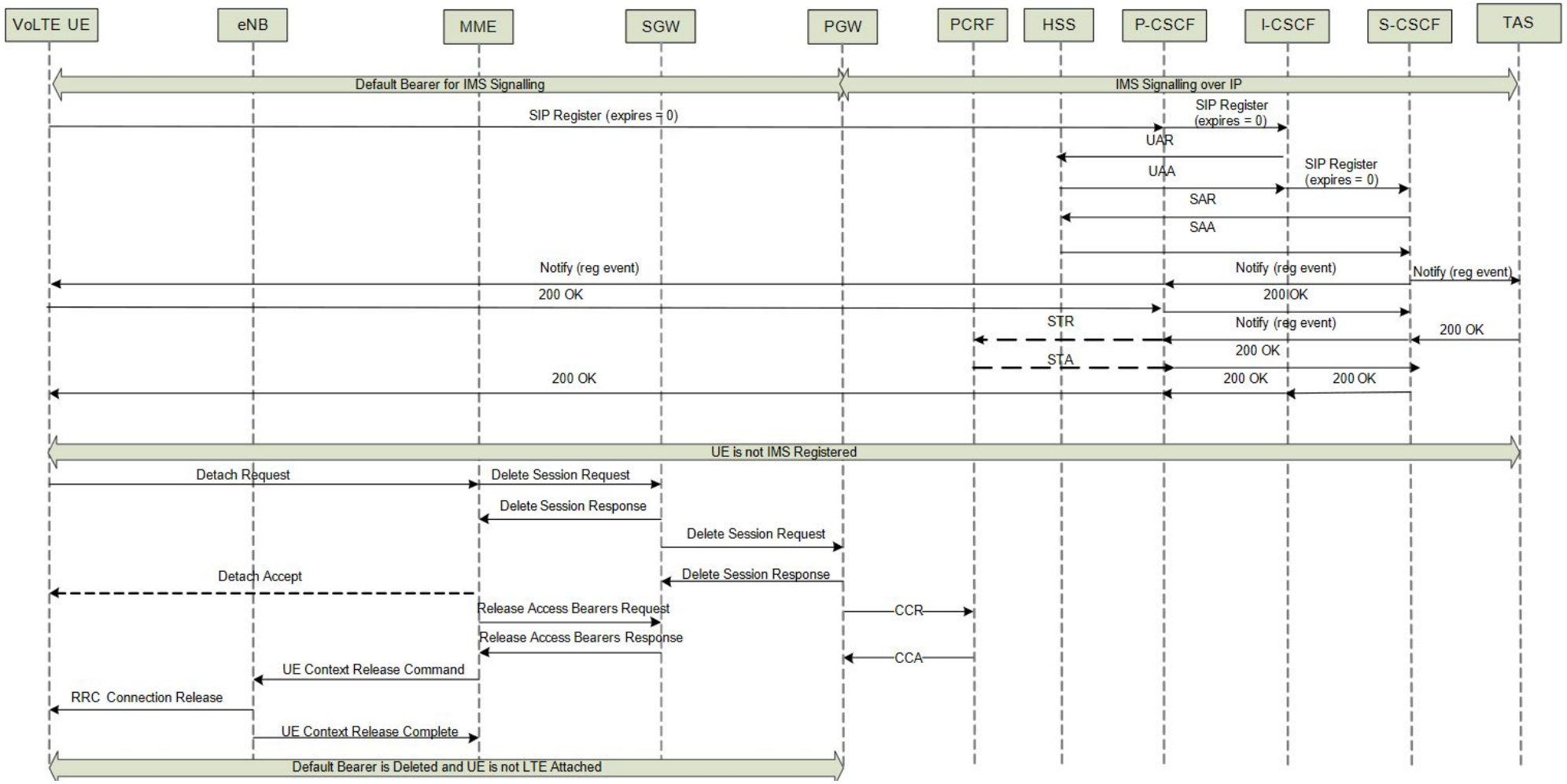


PREVIOUS SNAPSHOT

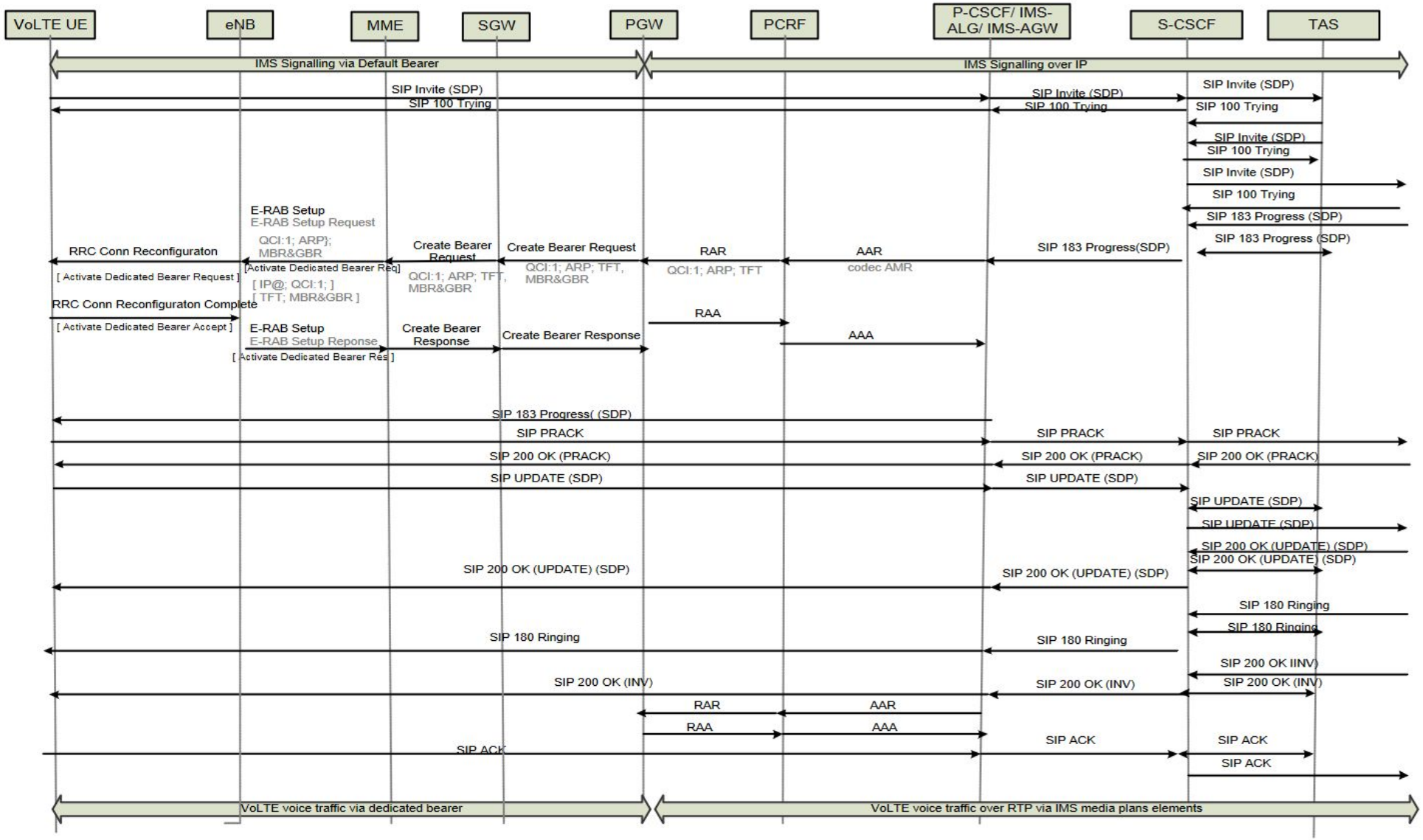
CONTINUED



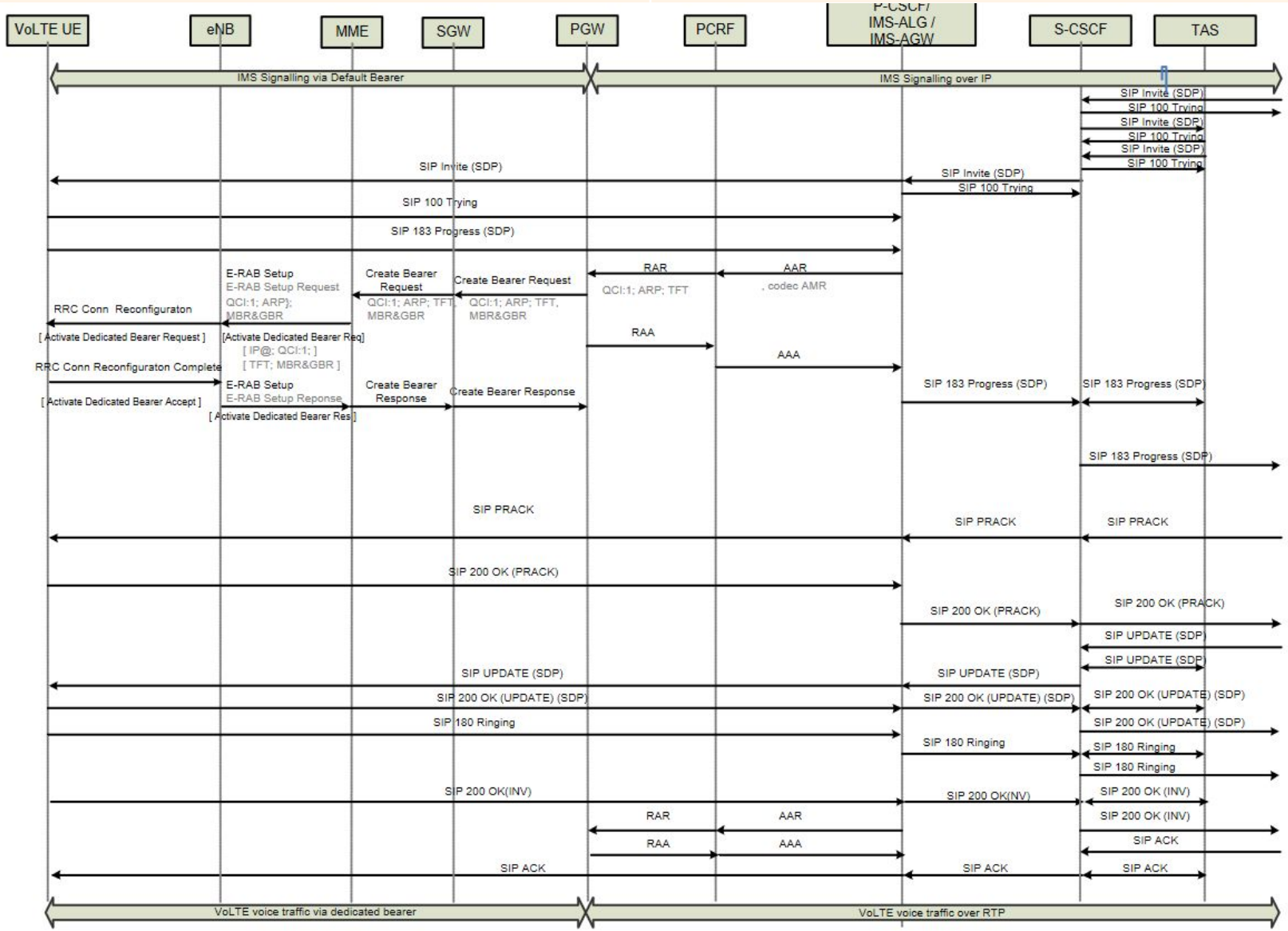
Procedure	VoLTE UE Initiated Detach & IMS Deregistration
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 4



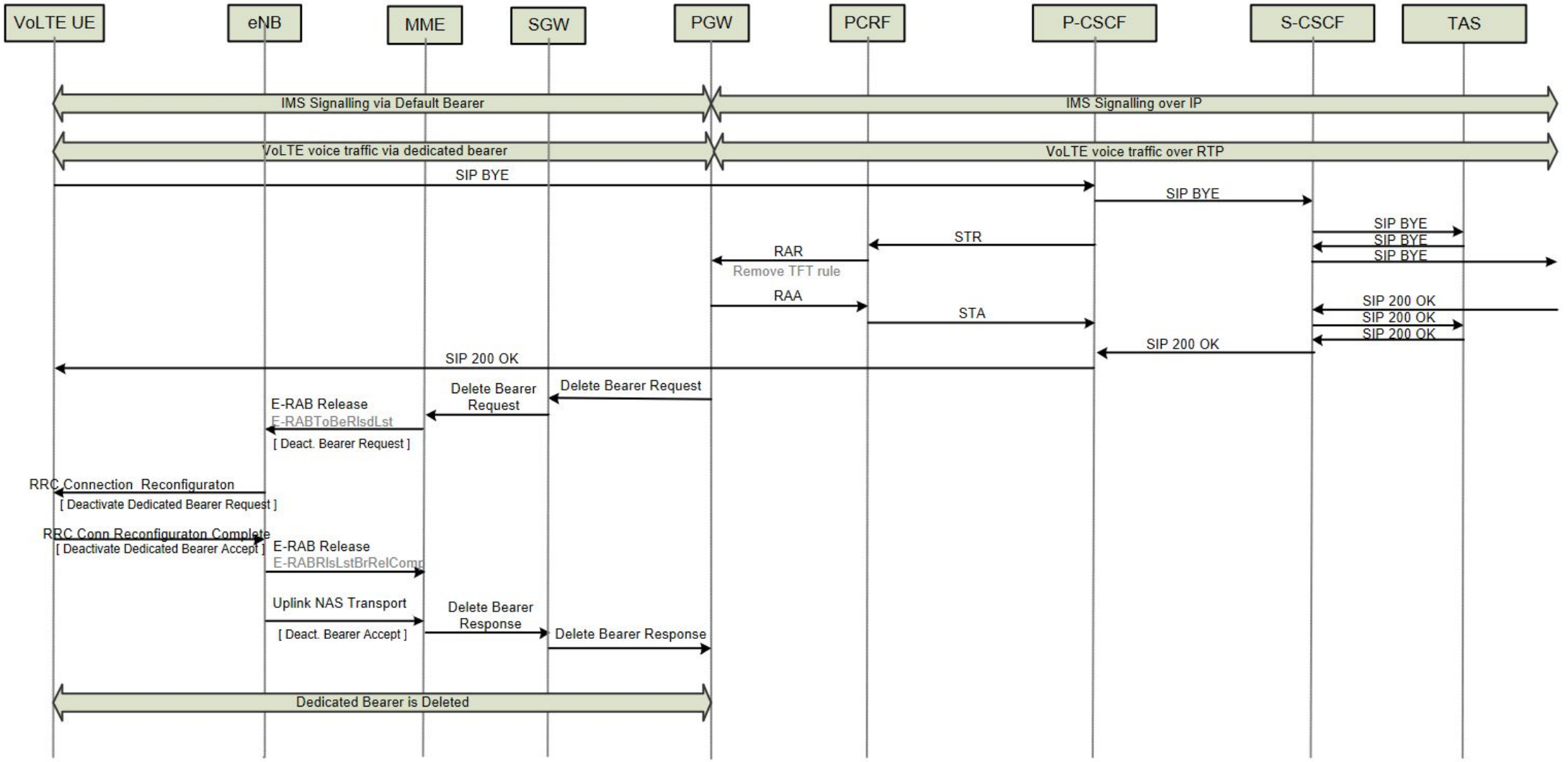
Procedure	VoLTE to VoLTE MO Call
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 5



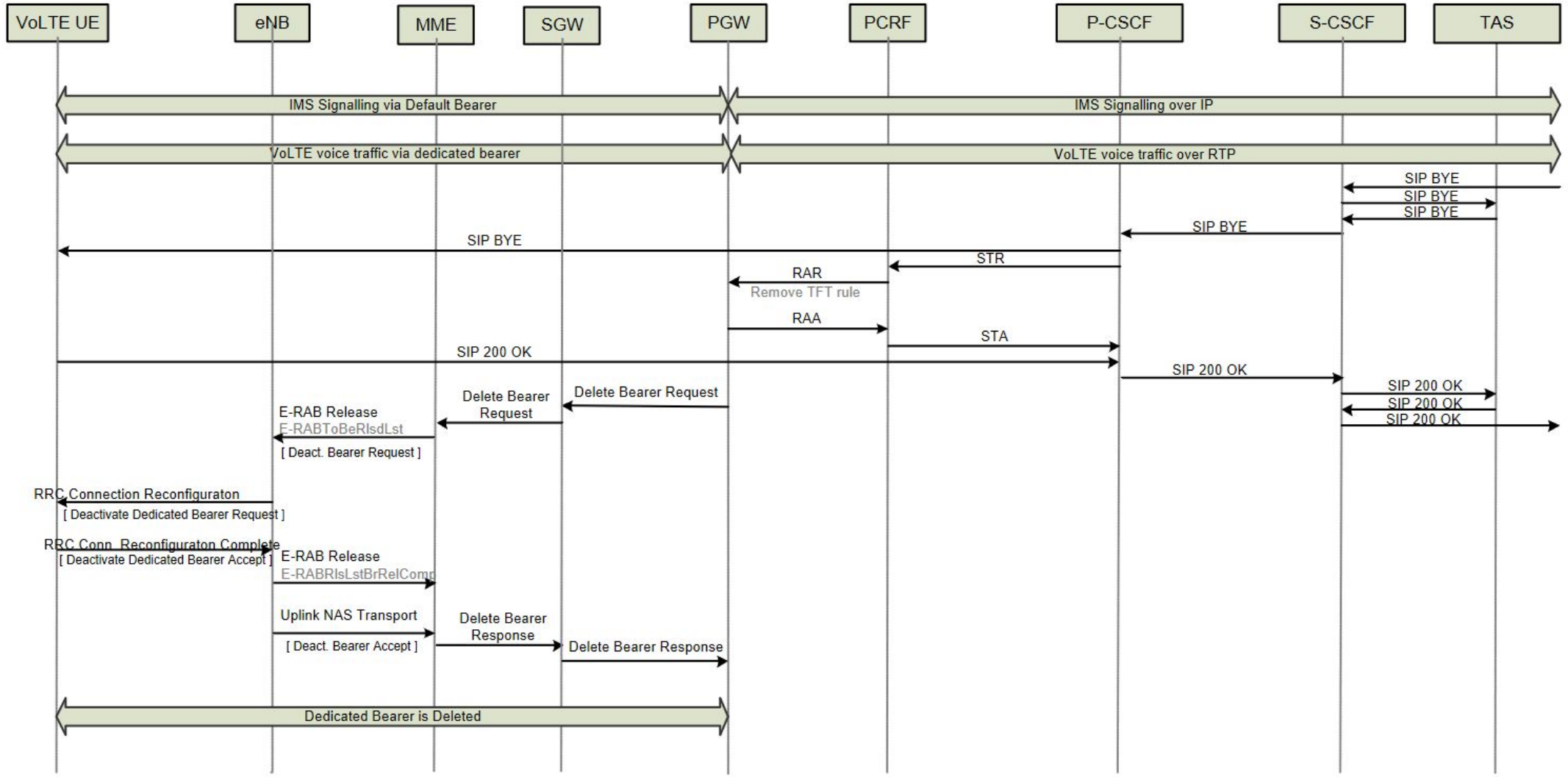
Procedure	VoLTE to VoLTE MT Call
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 6



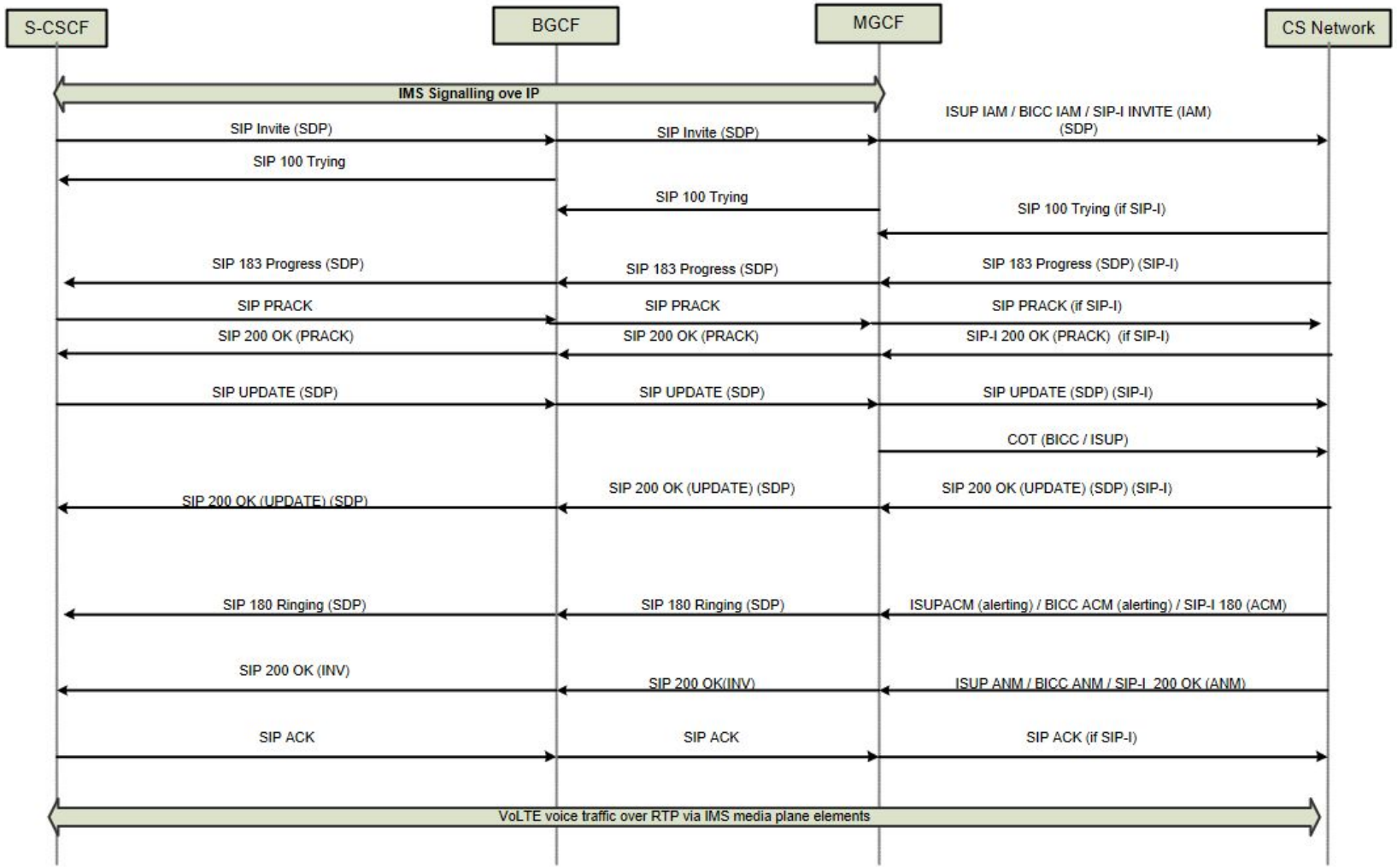
Procedure	VoLTE to VoLTE Call Clearring (Initiating Side Sequence)
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 7



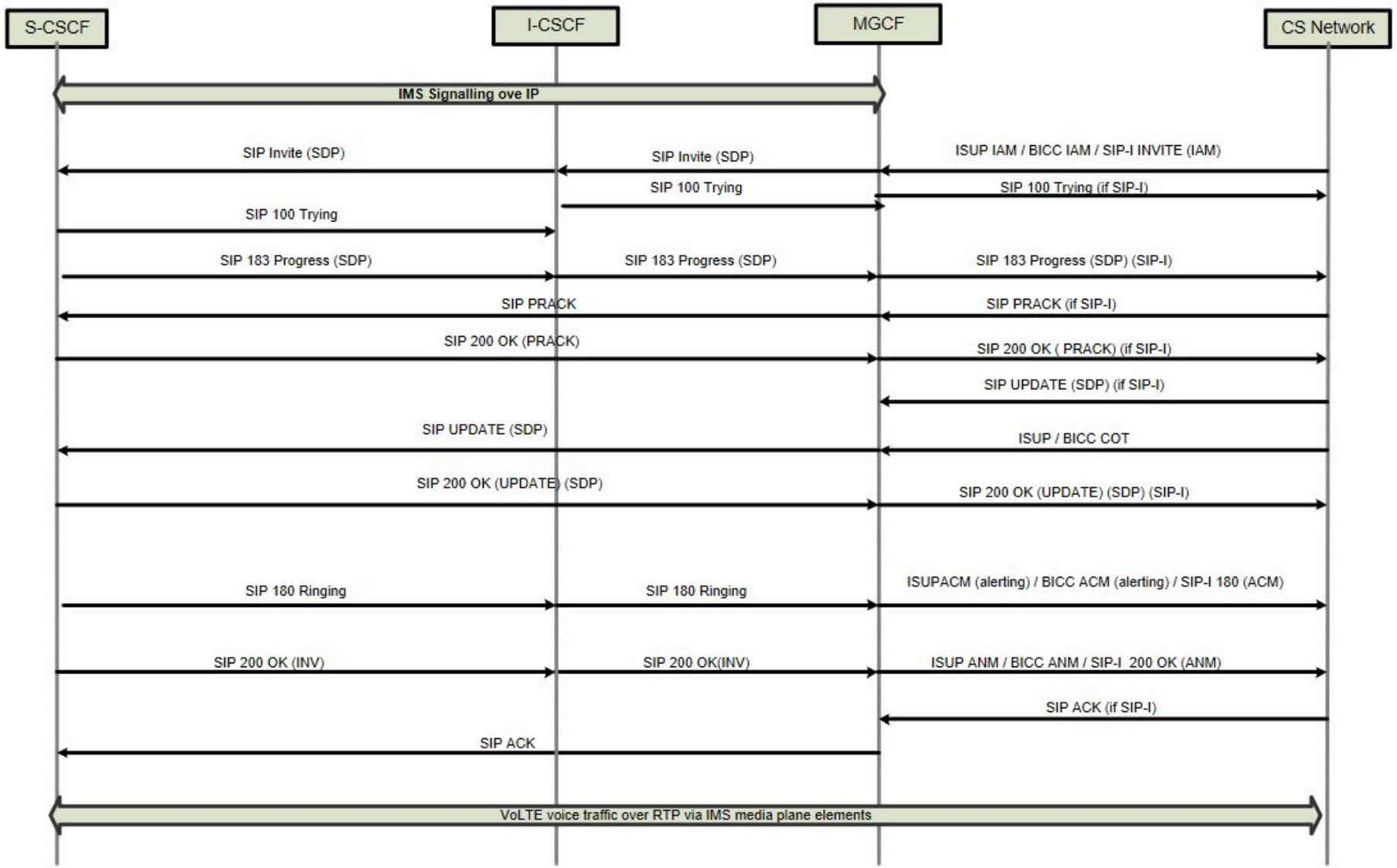
Procedure	VoLTE to VoLTE Call Clearring (Receiving Side Sequence)
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 8



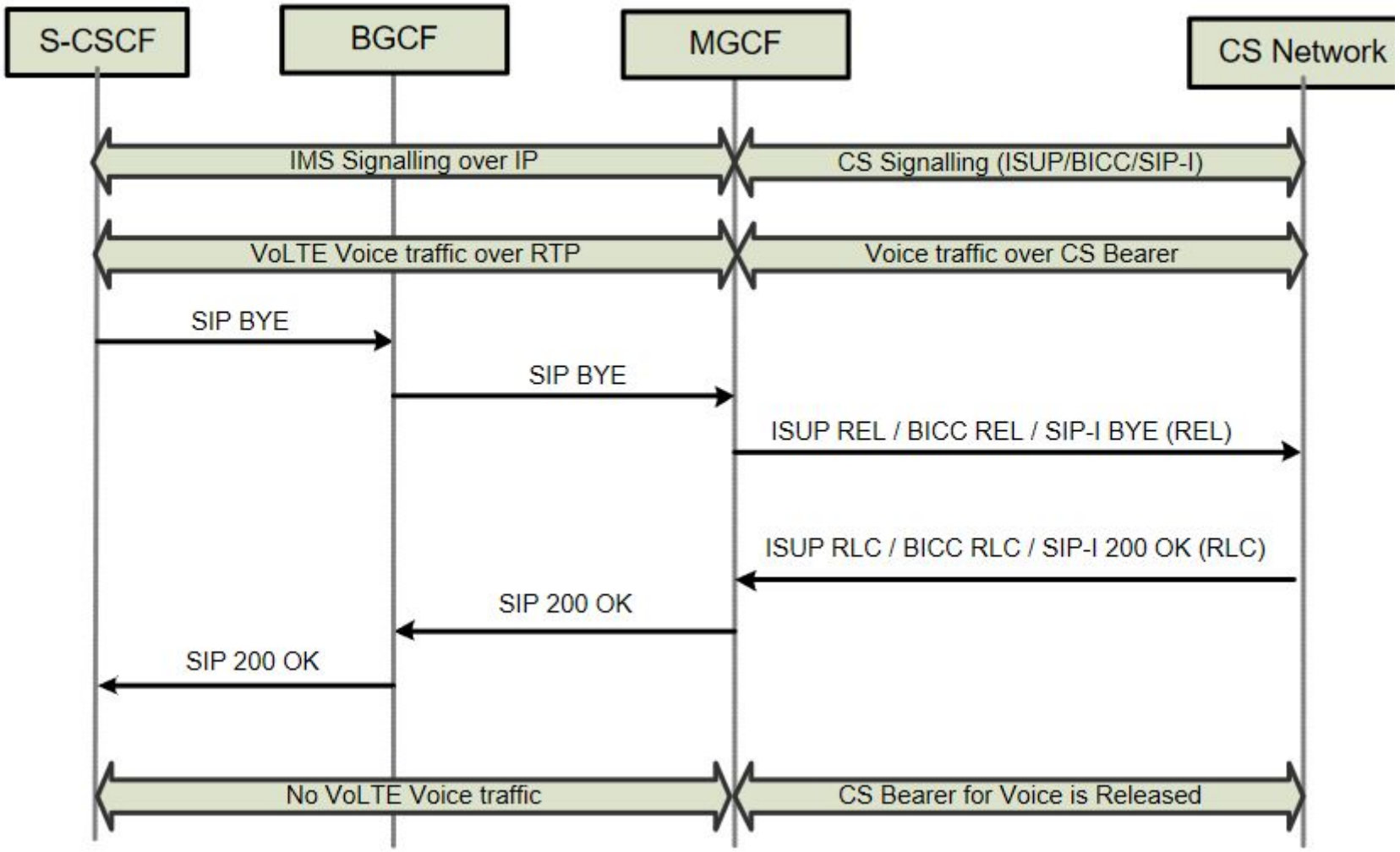
Procedure	VoLTE MO to CS Call
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 9



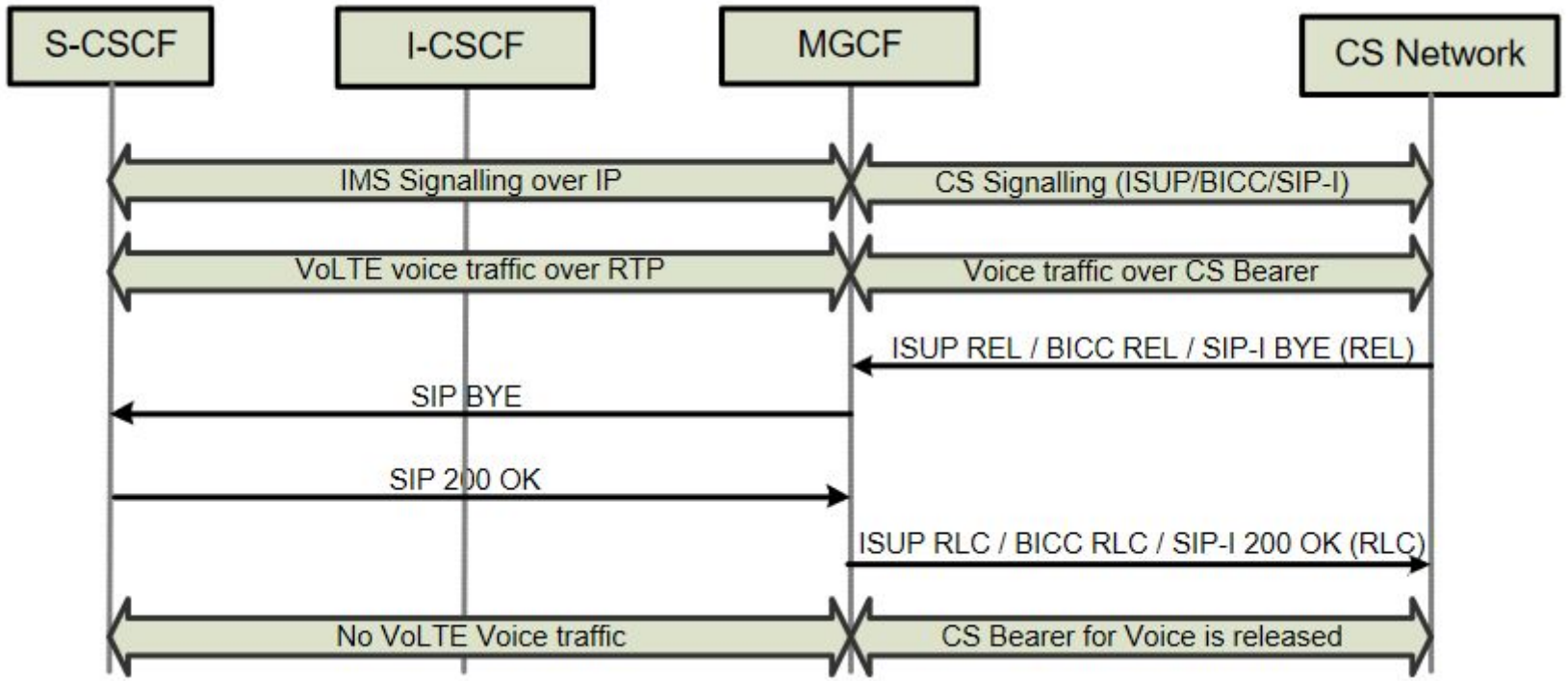
Procedure	VoLTE MT to CS Call
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 10



Procedure	VoLTE to CS Call Clearing (VoLTE Side Initiated)
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 11



Procedure	VoLTE to CS Call Clearing (VoLTE is Receiving side)
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 12



Procedure	QCI to DSCP Recommended Mapping
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Table 3 (3.7.4)

3.7.4 Mapping between QCI and DiffServ

GSMA PRD IR.34 [48] section 6.2 describes the different traffic classes that are used. These are shown in Table 3.

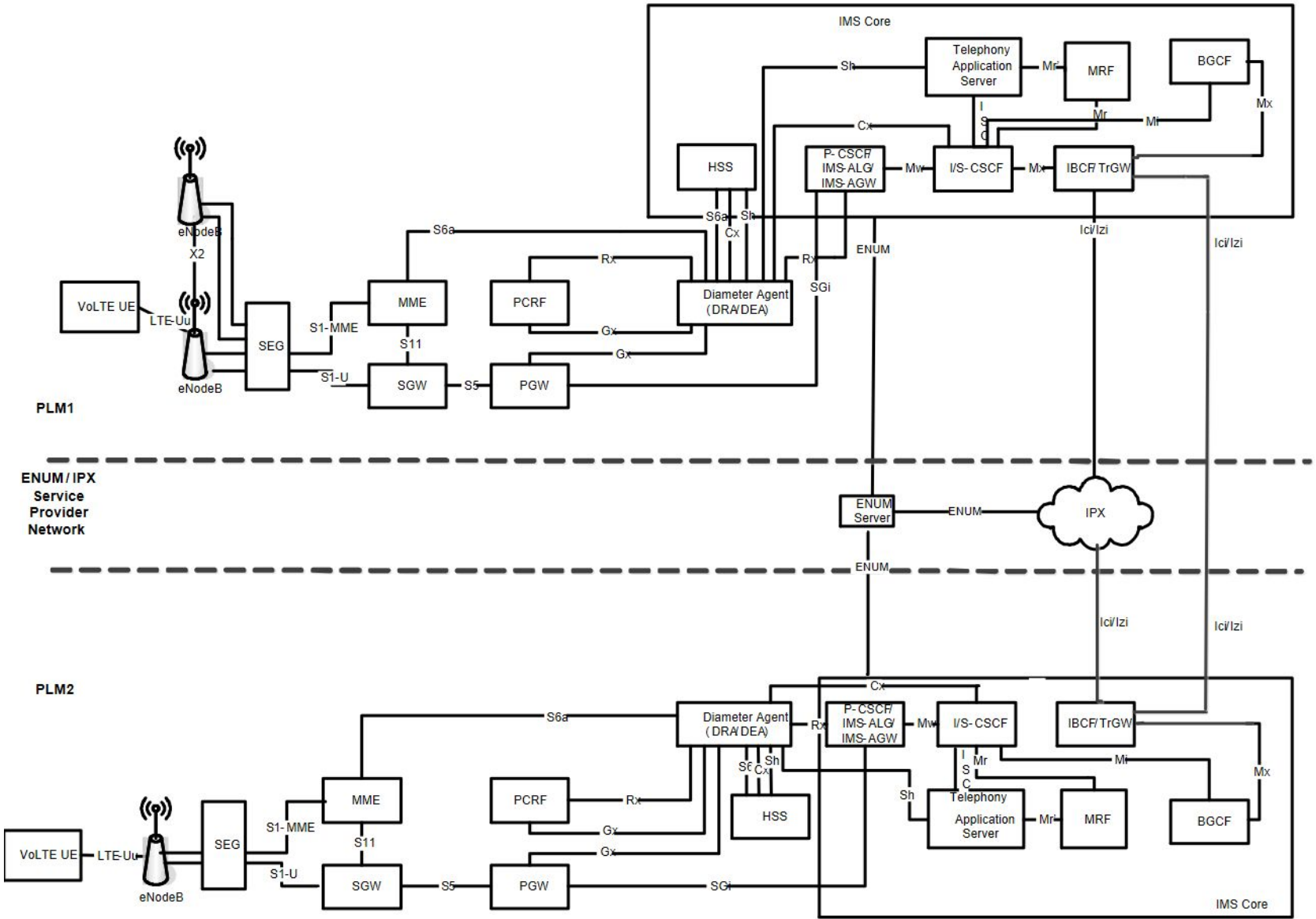
QCI	QoS Information			IP transport	
	Traffic Class	THP	Signalling indication	Diffserf PHB	DSCP
1	Conversational	N/A	N/A	EF	101110
2					
3					
4	Streaming	N/A	N/A	AF41	100010
5	Interactive	1	Yes (see note)	AF31	011010
6			No	AF32	011100
7		2	No	AF21	010010

V1.0

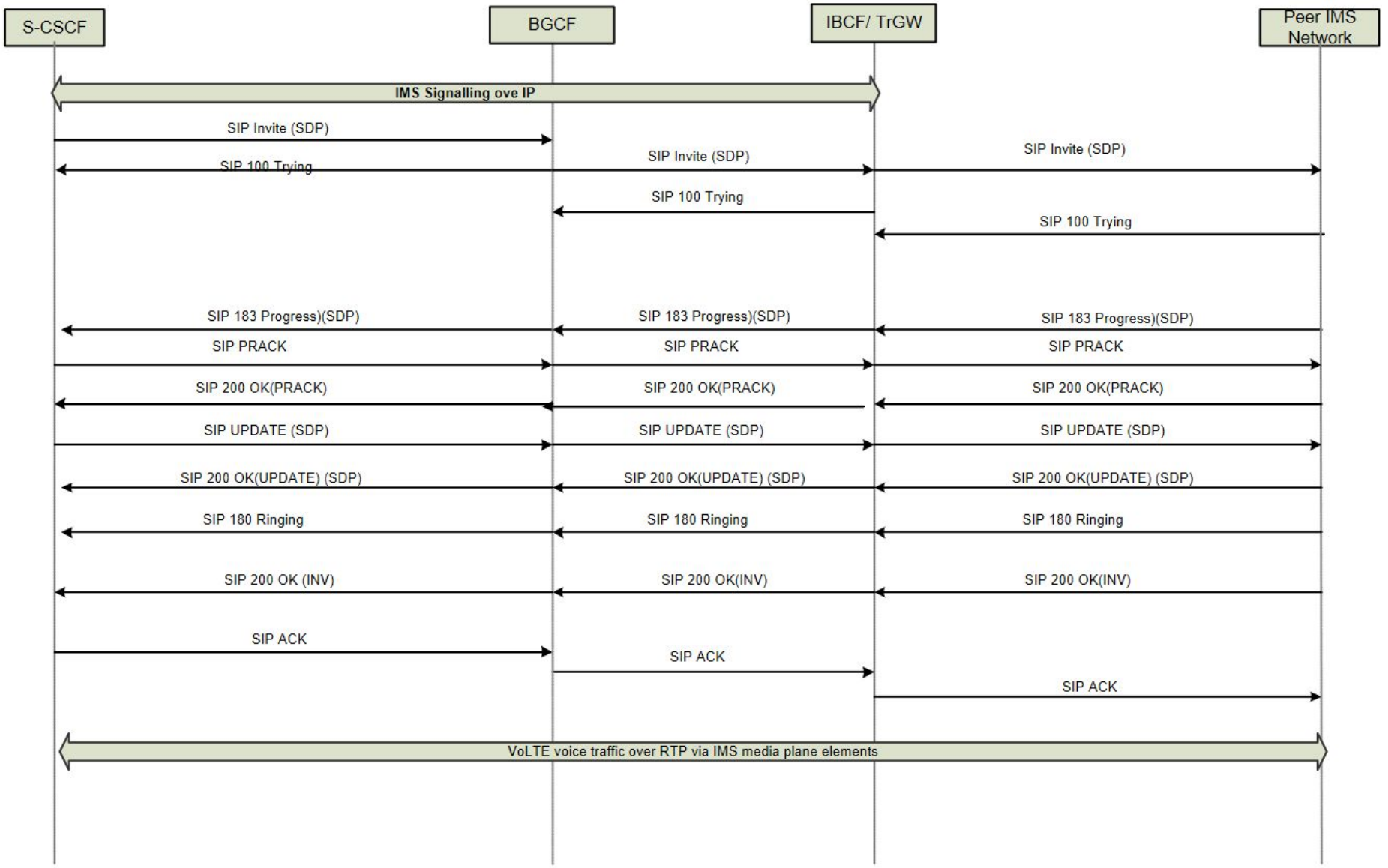
8		3	No	AF11	001010
9	Background	N/A	N/A	BE	000000

Table 3: EPC QoS information and mapping to DSCP

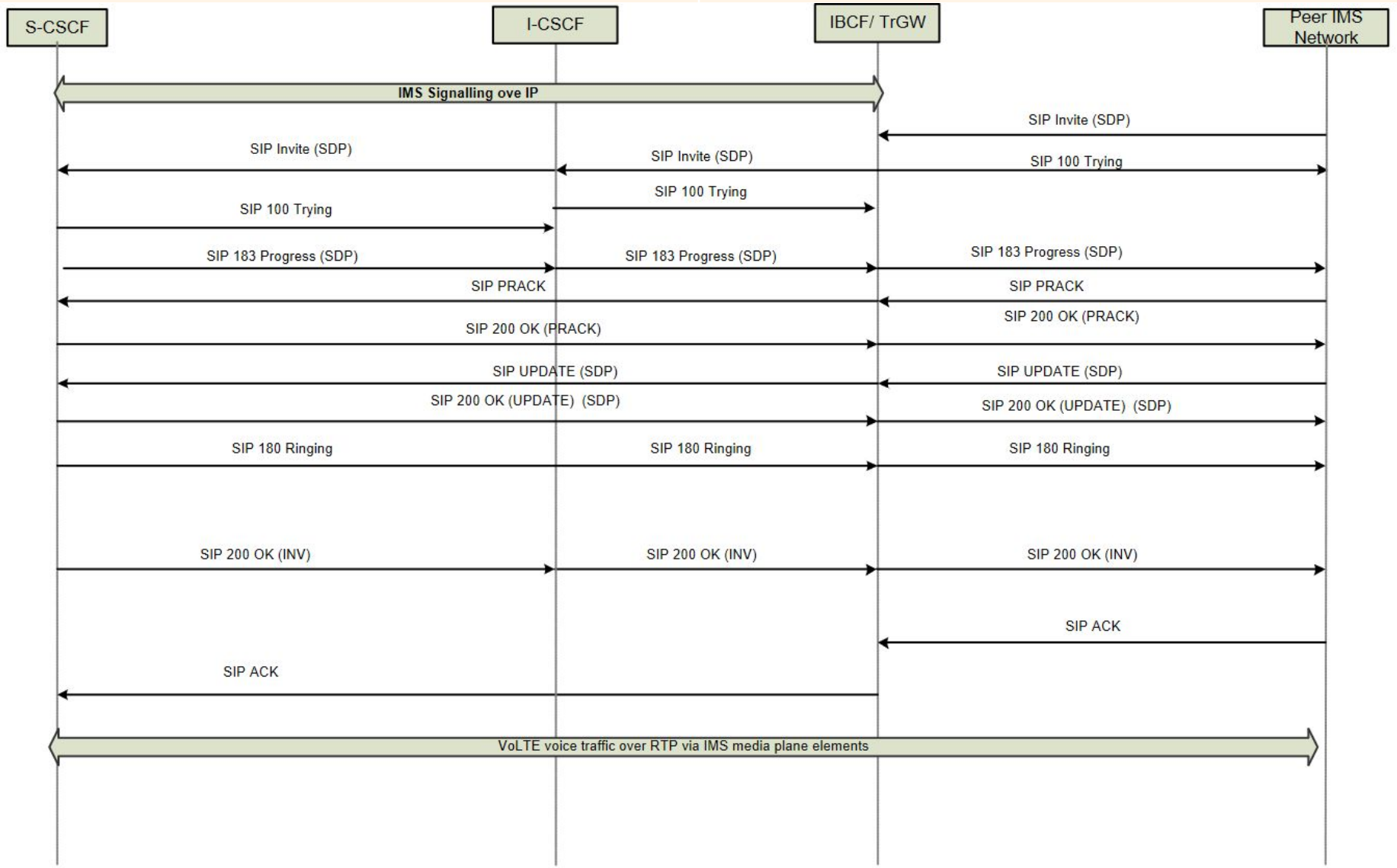
Procedure	VoLTE Interconnect Architecture
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 15



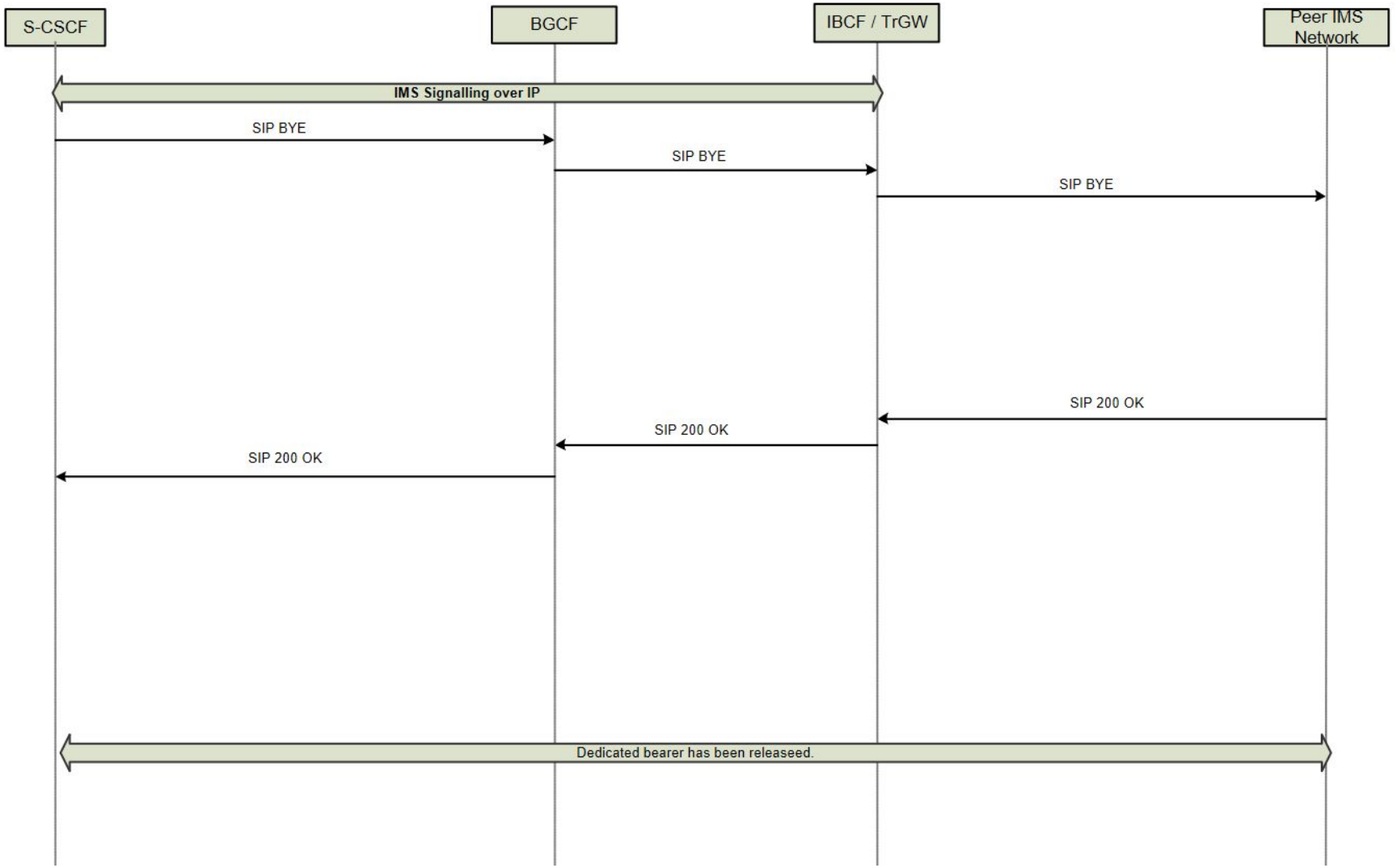
Procedure	VoLTE UE to Peer IMS Call (MO)
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 16



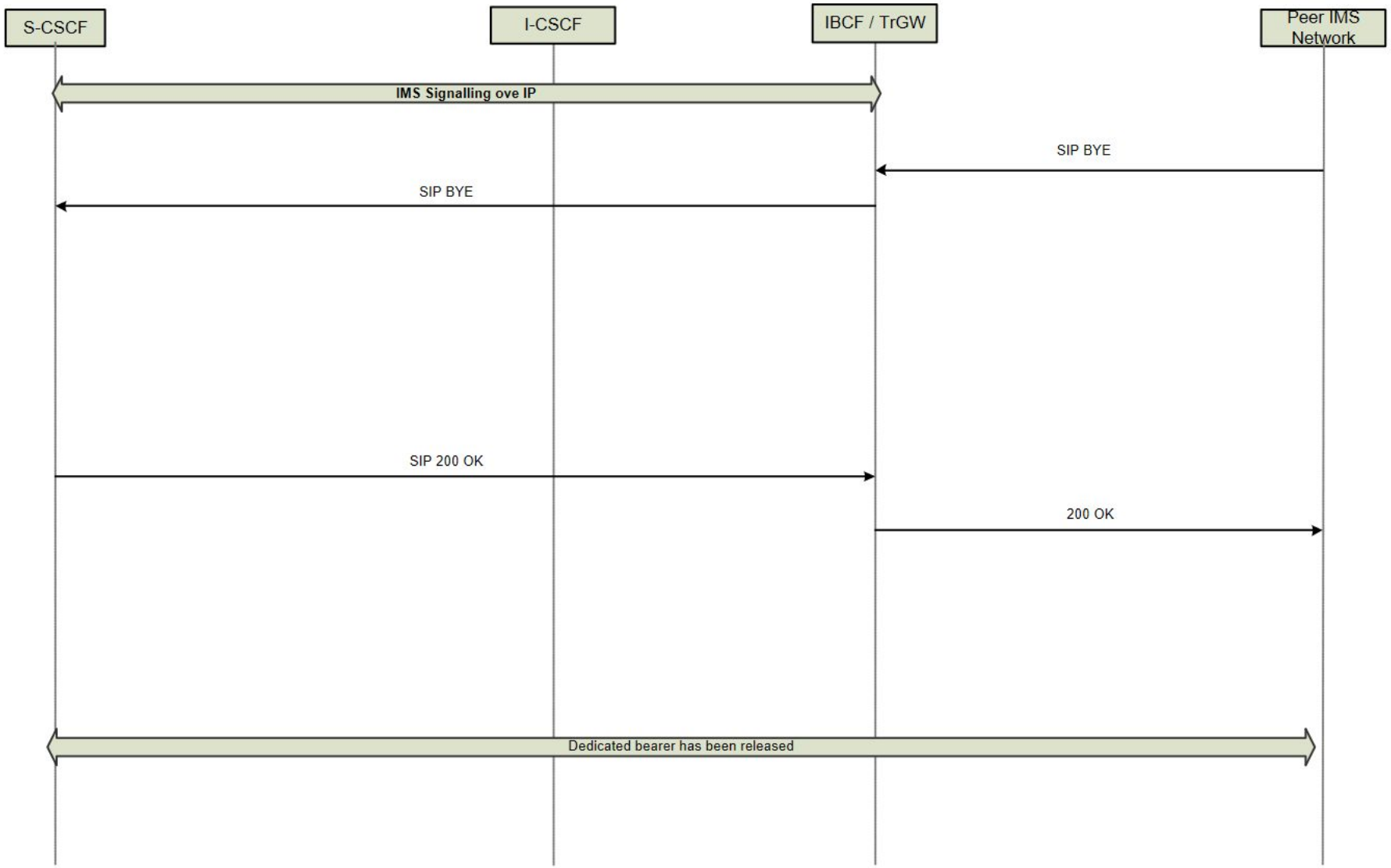
Procedure	VoLTE UE to Peer IMS Call (MT)
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 17



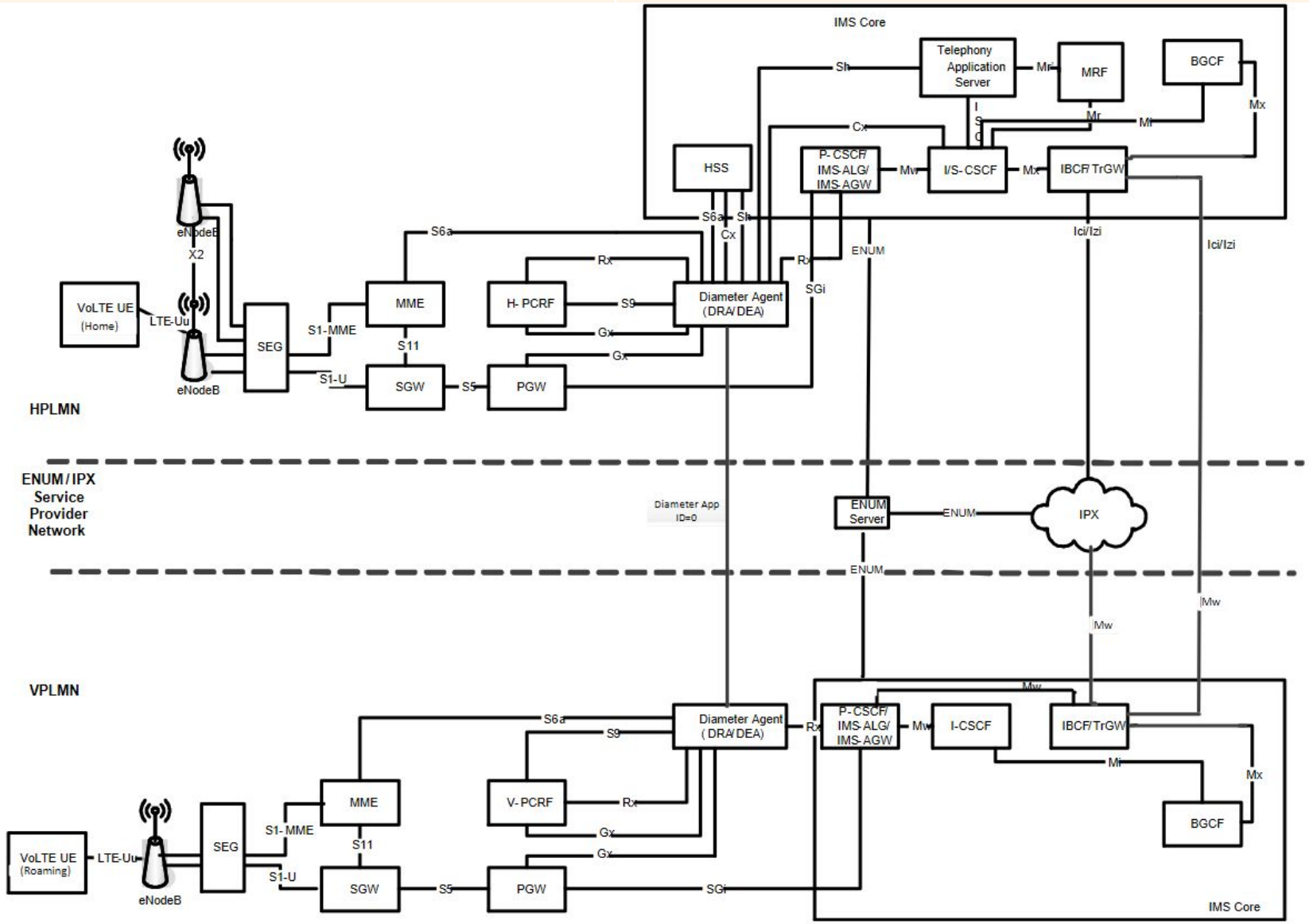
Procedure	VoLTE UE to Peer IMS Call Clearing (VoLTE side initiated)
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 18



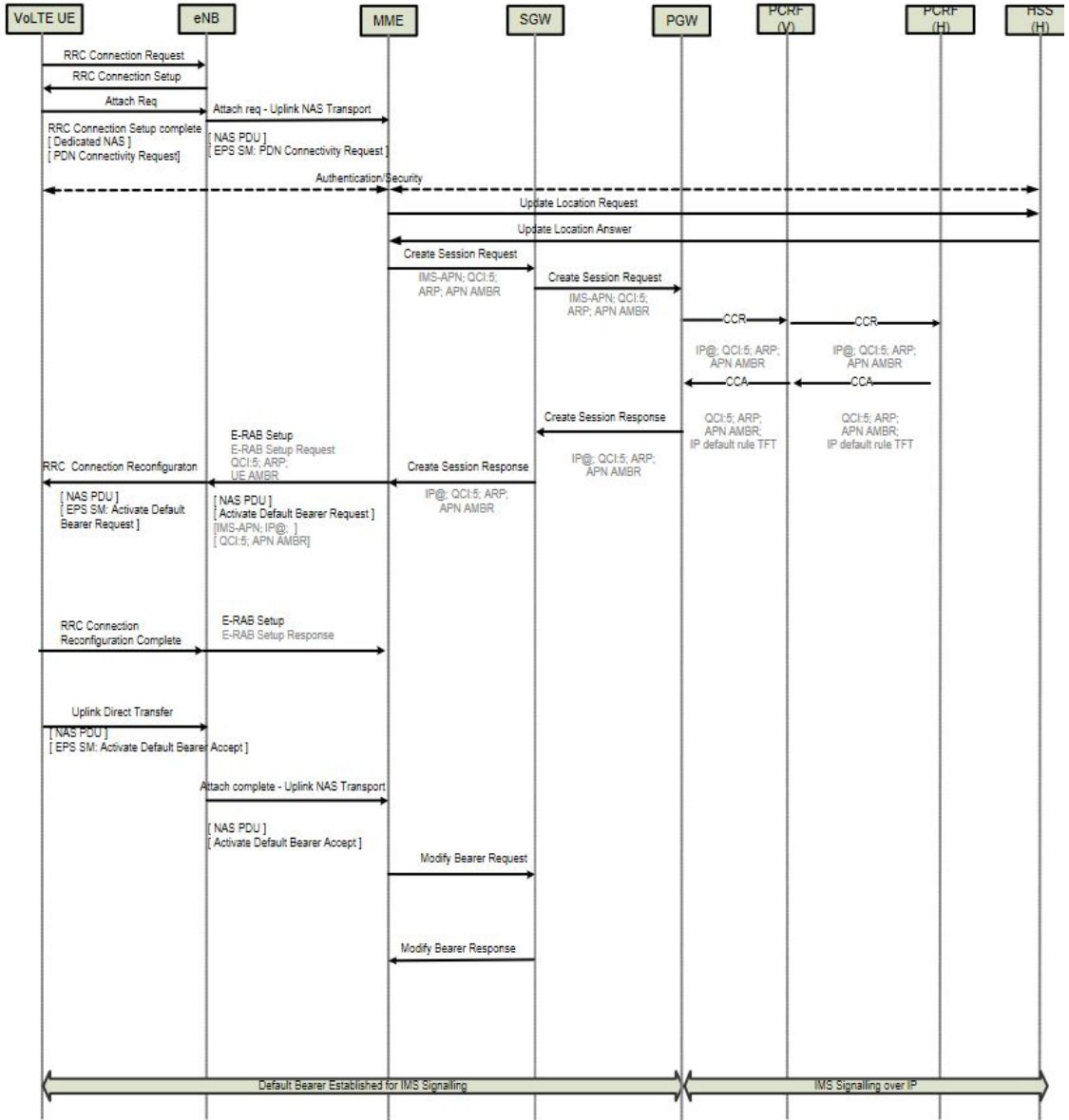
Procedure	VoLTE UE to Peer IMS Call Clearing (VoLTE side receiving)
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 19



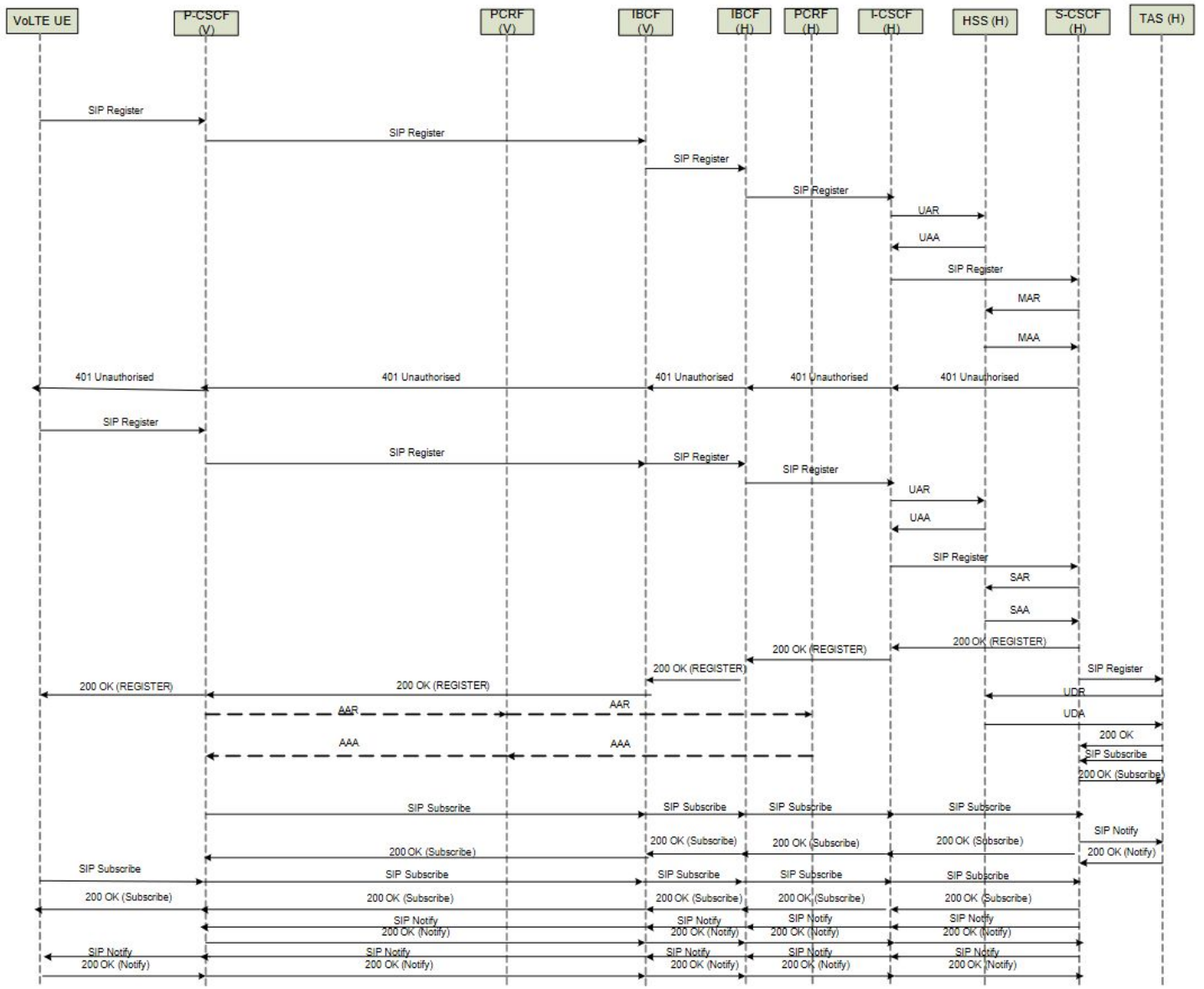
Procedure	Roaming VoLTE Architecture
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 20



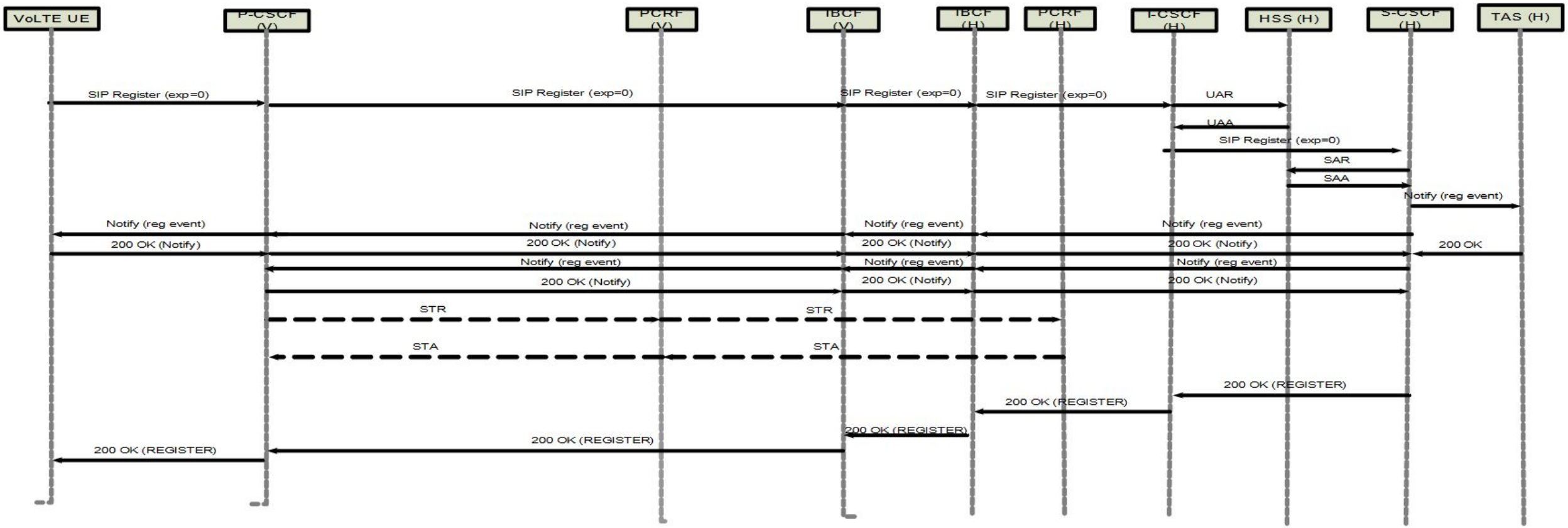
Procedure	Roaming VoLTE UE Attach
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 21



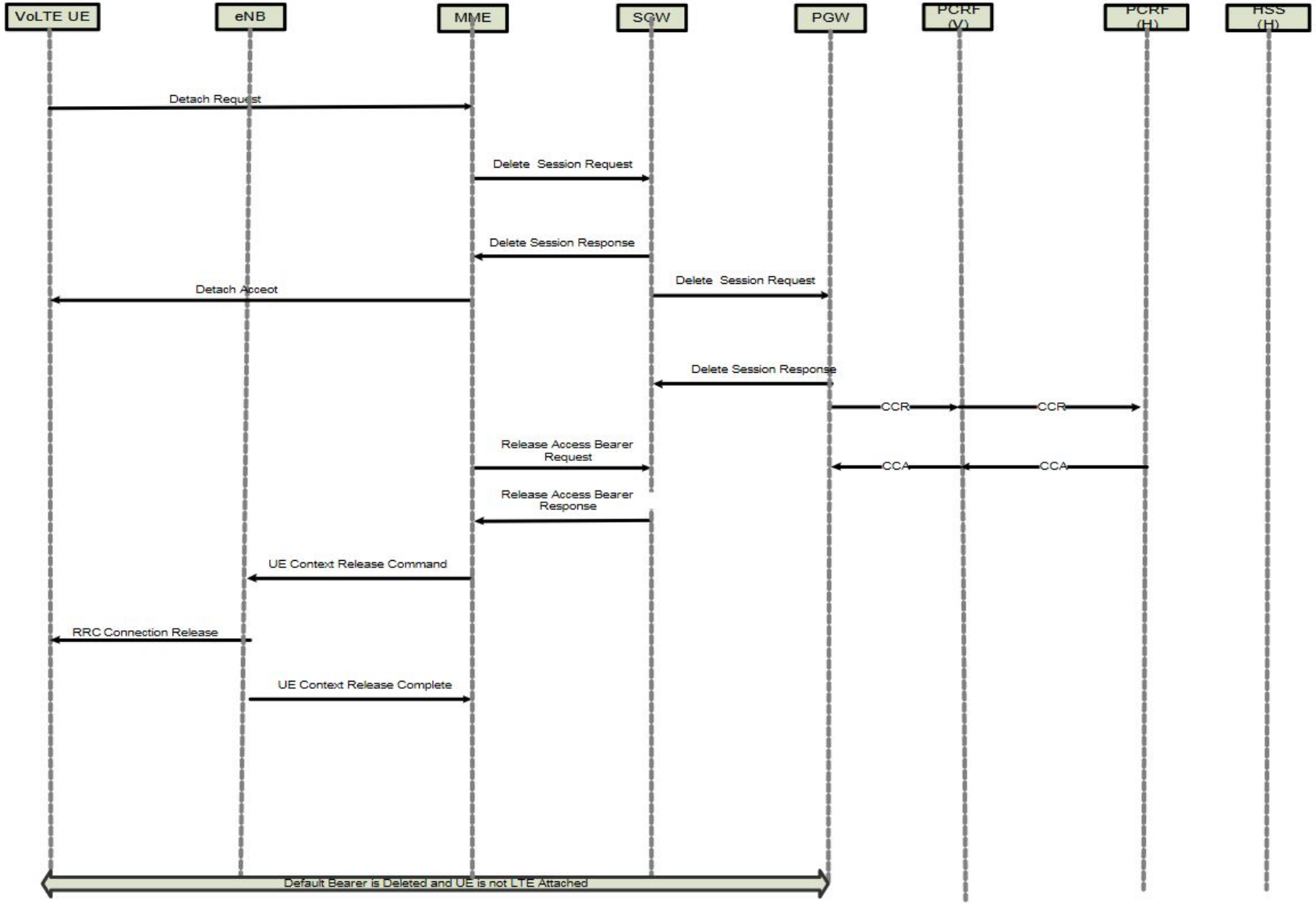
Procedure	Roaming VoLTE UE Initial IMS Registration
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 22



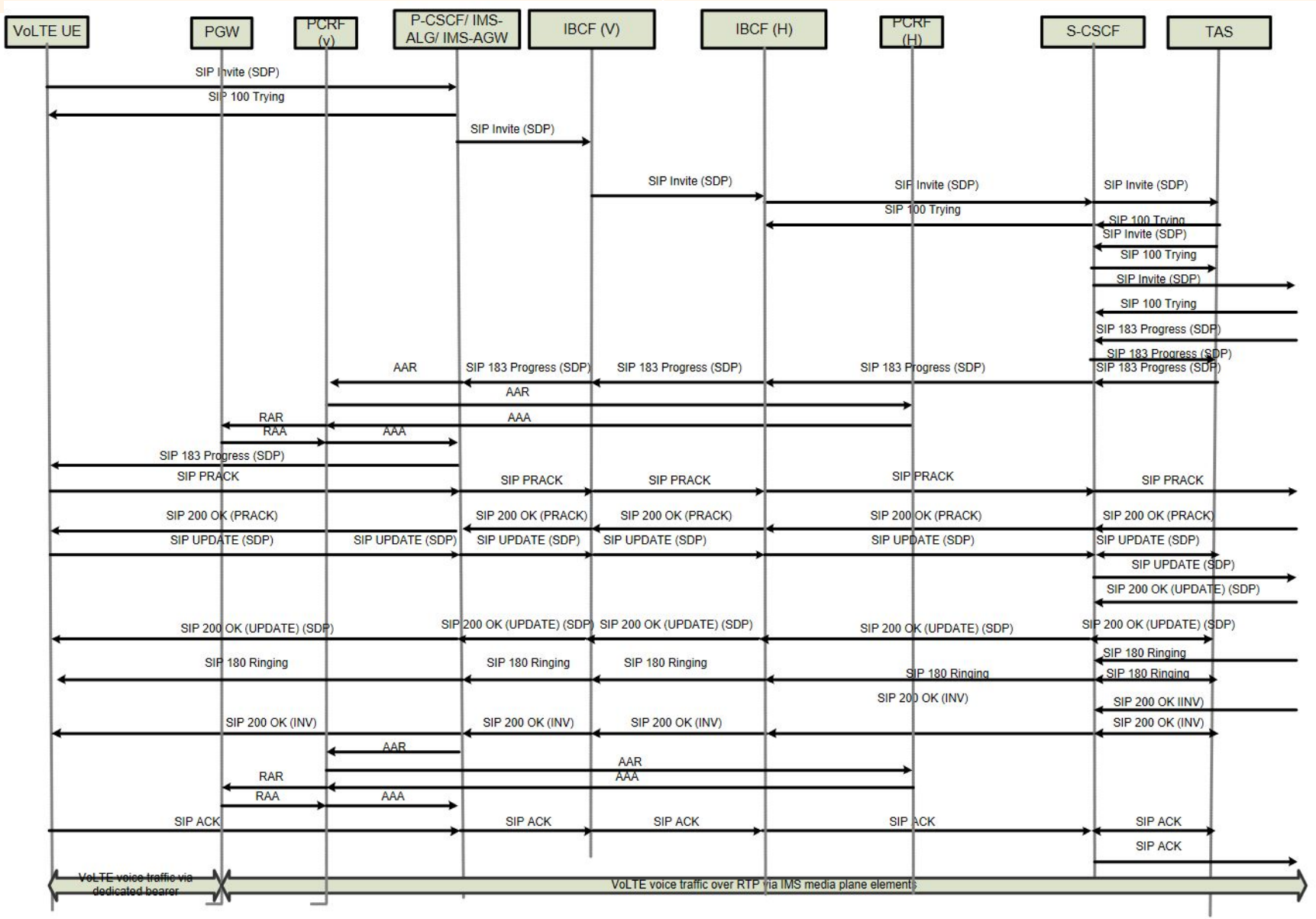
Procedure	Roaming VoLTE UE IMS Deregistration
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 23



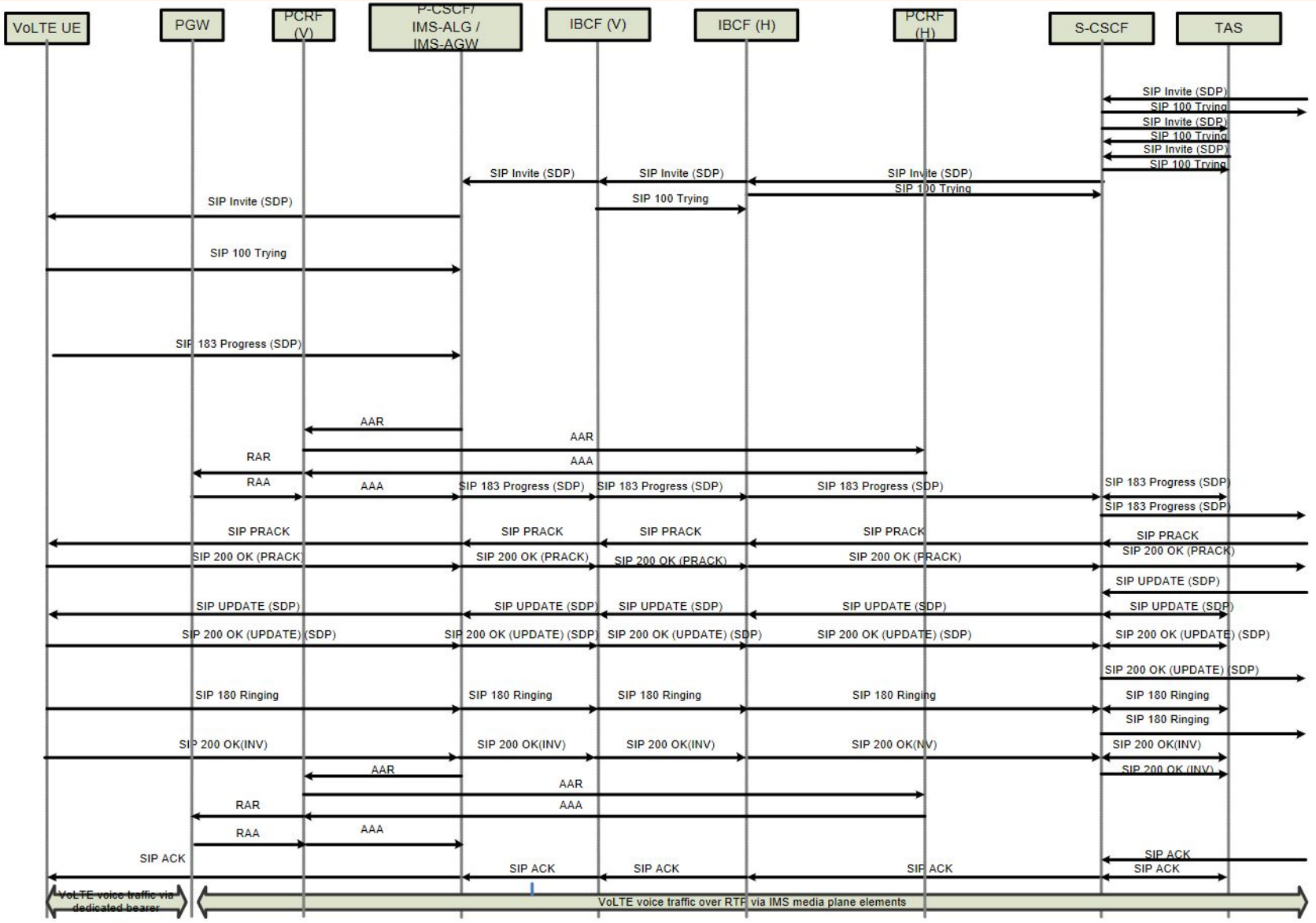
Procedure	Roaming VoLTE UE Initiated Detach
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 24



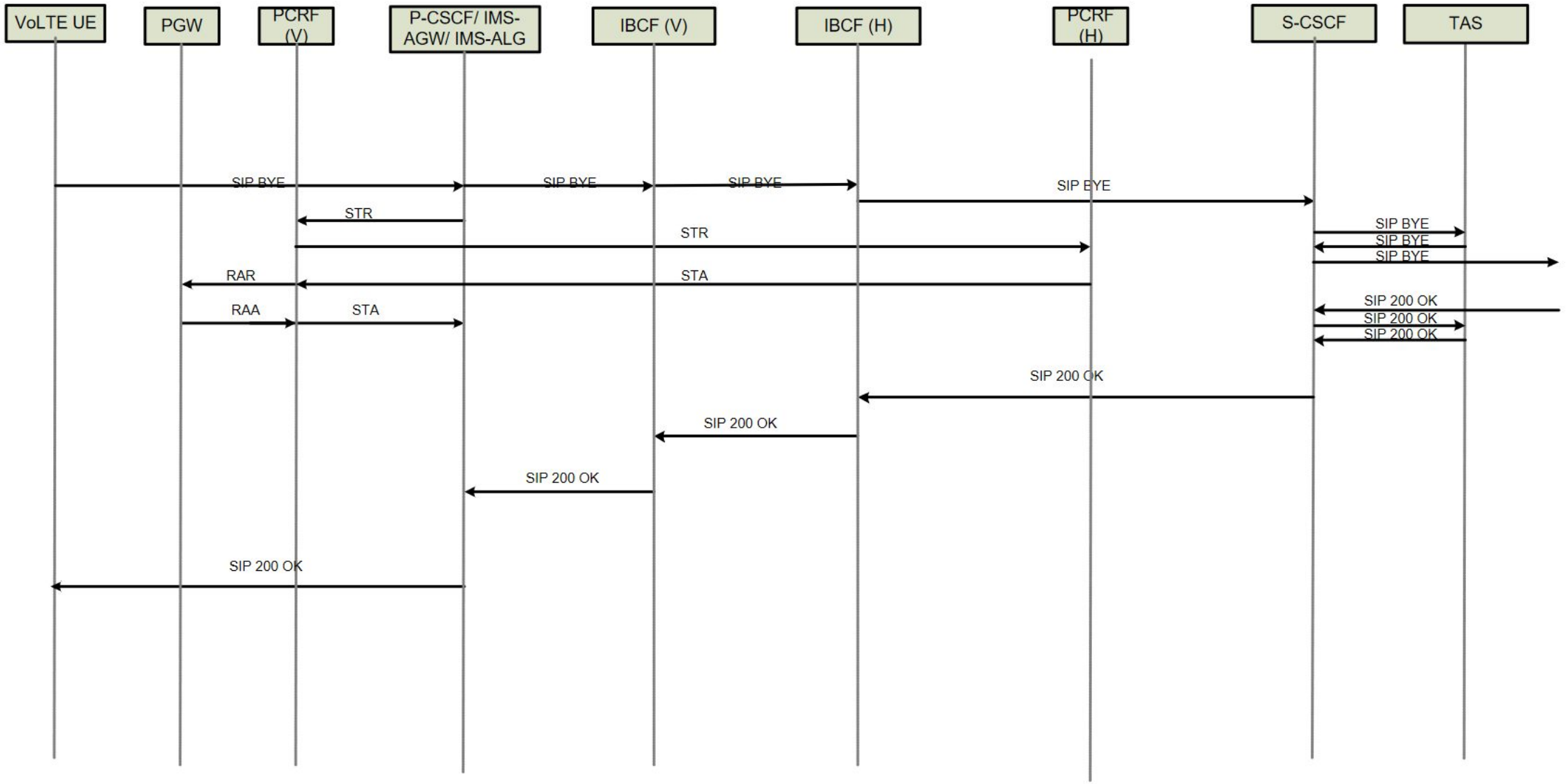
Procedure	Roaming VoLTE to VoLTE MO Call
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 25



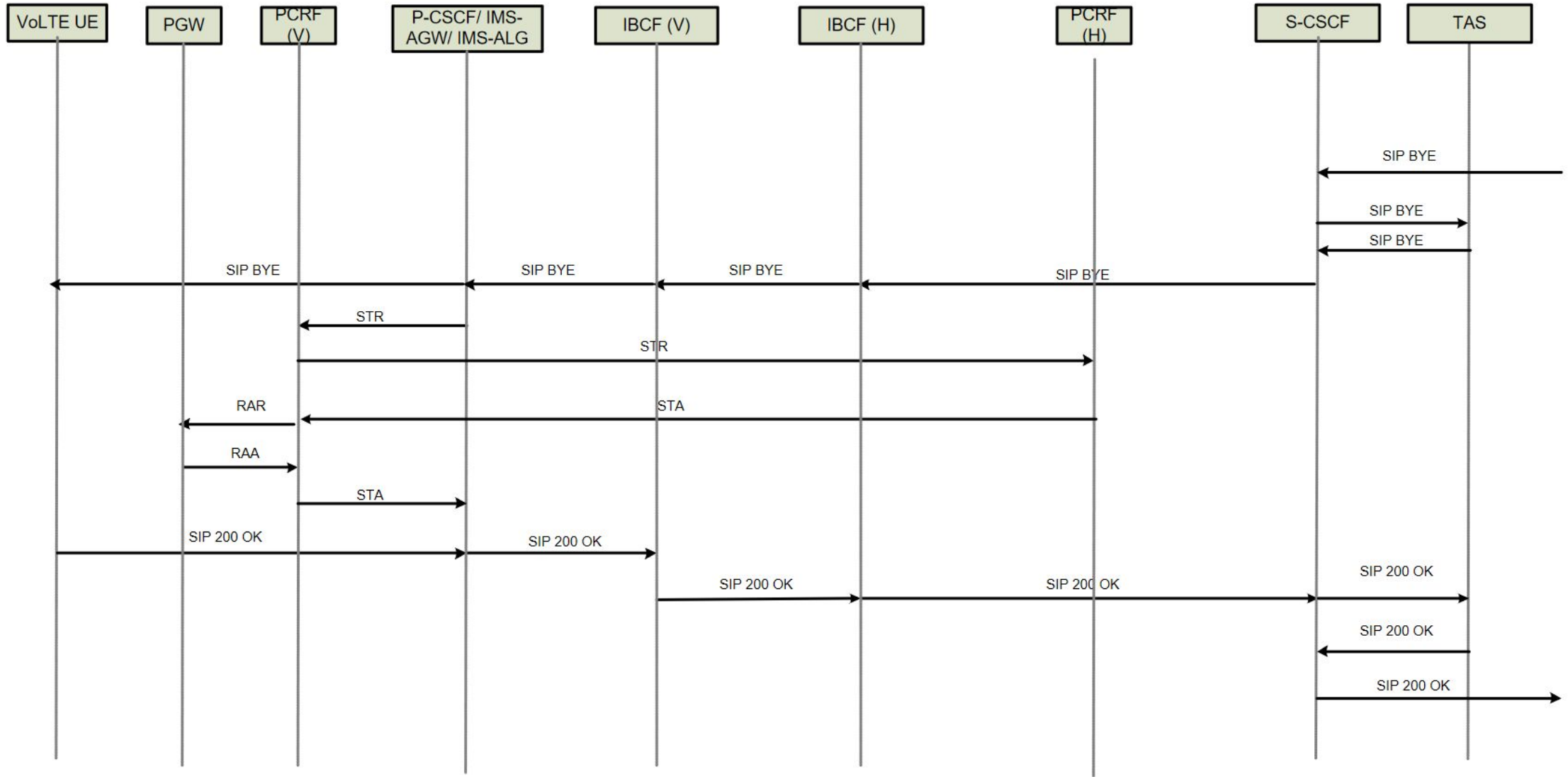
Procedure	Roaming VoLTE to VoLTE MT Call
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 26



Procedure	Roaming VoLTE to VoLTE Call Clearing (Initiated by Roamer)
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 27



Procedure	Roaming VoLTE to VoLTE Call Clearing (Received by Roamer)
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	Figure 28



Procedure	VoLTE Packet Drops
Specification	https://www.gsma.com/futurenetworks/wp-content/uploads/2014/05/FCM.01-v1.1.pdf
Section	6.1.2.2

6.1.2.2 VoLTE UE exceeds the link MTU-size – IP Layer fragmentation – Packets dropped

Title	VoLTE UE exceeds the link MTU-size – IP Layer fragmentation – Packets dropped
Reference ID	ID_Device_02
Priority	High
Date Submitted	08/07/2013
Date Modified	08/07/2013
Overview	IP fragmentation may occur between the UE and the PGW if the UE sends packets that exceed the maximum link MTU size that is supported in the network as part of IP configuration. IP fragmentation is not recommended by 3GPP due to significant transmission overhead. If the UE exceeds the limit and IP fragmentation is not supported in the EPC, the result is packet loss.
Status	Closed
Detailed Description	3GPP TS 23.060 [3] Annex C provides information related to Link MTU considerations. The maximum size of the link MTU size is currently set to 1500 octets. Taking into account the headers for GTP packets that may be further encapsulated within an IPSec tunnel, the overall UE link MTU size is set at 1358 octets. The link MTU size of the network can be requested by the UE in the Protocol Configuration Options (PCO) during LTE Attach. This enables the UE to discover the link MTU size and be compatible with the network IP configuration. It has been discovered that not all UE's request the link MTU size, and regularly exceed this limit when sending SIP messages (e.g. particularly in downloadable clients). If the network does not support procedures for IP fragmentation, then the packets are discarded which in turn results in loss of VoLTE functionality.
Solution	VoLTE UE's shall request the link MTU size from the network (requested in the PCO during attach) and utilise this value when transmitting data packets. NOTE: For IPv6 implementations, the link MTU size is present in the IPv6 Router Advertisement.