

LTE 5G-NR Dual Connectivity Non-Standalone Access Signaling Messages

This document details messages involved in the 5G non-standalone access attach and bearer setup procedure. These messages are referenced from the [5G Non-Standalone Access Sequence Diagrams](#).

Message	Path
LTE SIB2 ↳ PLMN-InfoList-r15	MN-eNB → UE
LTE Preamble	UE → MN-eNB
PDCCH DCI Format 1A ↳ Format 1A - CRC Scrambled with RA-RNTI	MN-eNB → UE
LTE Random Access Response ↳ LTE MAC PDU ↳ LTE MAC Payload for Random Access Response ↳ LTE RAR UL Grant	MN-eNB → UE
RRC Connection Request	UE → MN-eNB
PDCCH DCI Format 1A ↳ Format 1A - CRC Scrambled with C-RNTI	MN-eNB → UE
RRC Connection Setup	MN-eNB → UE
PDCCH DCI Format 0 ↳ Format 0 - CRC Scrambled with C-RNTI	MN-eNB → UE
RRC Connection Setup Complete ↳ Attach Request ↳ PDN Connectivity Request	UE → MN-eNB
Initial UE Message ↳ Attach Request ↳ PDN Connectivity Request	MN-eNB → MME
Authentication Request	MME → UE
Authentication Response	UE → MME
NAS Security Mode Command	MME → UE
NAS Security Mode Complete	UE → MME

Message	Path
Initial Context Setup Request ↳ Attach Accept ↳ Activate Default EPS Bearer Context Request	MME → MN-eNB
UE Capability Enquiry	MN-eNB → UE
UE Capability Information ↳ UE-MRDC-Capability ↳ SupportedBandListNR-r15	UE → MN-eNB
UE Capability Info Indication	MN-eNB → MME
AS Security Mode Command	MN-eNB → UE
AS Security Mode Complete	UE → MN-eNB
RRC Connection Reconfiguration ↳ Attach Accept ↳ Activate Default EPS Bearer Context Request ↳ MeasConfig ↳ MeasObjectToAddModList ↳ MeasObjectNR-r15	MN-eNB → UE
RRC Connection Reconfiguration Complete	UE → MN-eNB
Attach Complete ↳ Activate Default EPS Bearer Accept	UE → MME
Measurement Report ↳ MeasResults	UE → MN-eNB
SgNB Addition Request	MN-eNB → SN-gNB
SgNB Addition Request Acknowledge ↳ CG-Config	SN-gNB → MN-eNB
RRC Connection Reconfiguration for 5G-NR Bearer ↳ CG-Config	MN-eNB → UE
RRC Connection Reconfiguration Complete for 5G-NR Bearer ↳ NR RRCReconfigurationComplete	UE → MN-eNB
SgNB Reconfiguration Complete ↳ NR RRCReconfigurationComplete	MN-eNB → SN-gNB
SN Status Transfer	MN-eNB → SN-gNB
NR PSS	SN-gNB → UE
NR SSS	SN-gNB → UE

Message	Path
NR PBCH (MIB)	SN-gNB → UE
NR Preamble	UE → SN-gNB
NR PDCCH DCI Format 1_0 └Format 1_0 - CRC Scrambled with RA-RNTI	SN-gNB → UE
NR Random Access Response └MAC PDU └MAC Payload for Random Access Response └RAR UL Grant	SN-gNB → UE
PDCCH DCI Format 1_0 └Format 1_0 - CRC Scrambled with C-RNTI	SN-gNB → UE
NR MAC PDU	SN-gNB → UE
PDCCH DCI Format 0_0 └Format 0_0 - CRC Scrambled with C-RNTI	SN-gNB → UE
NR MAC PDU	UE → SN-gNB
Dual Connectivity PHR MAC CE	UE → MN-eNB
Measurement Report └MeasResults	UE → MN-eNB
RRC Transfer	MN-eNB → SN-gNB
Secondary RAT Data Usage Report └Secondary RAT Usage Report list	SN-gNB → MN-eNB
gNB Status Indication	SN-gNB → MN-eNB

LTE SIB2

MN-eNB → UE

[TS 36.331](#)

The SIB2 broadcast from the eNB signals the presence of 5G-NR PLMNs via the [PLMN-InfoList-r15](#).

```

SystemInformationBlockType2 ::=          SEQUENCE {
  ac-BarringInfo SEQUENCE {
    ac-BarringForEmergency          BOOLEAN,
    ac-BarringForMO-Signalling AC-BarringConfig OPTIONAL,      -- Need OP
    ac-BarringForMO-Data            AC-BarringConfig OPTIONAL  -- Need OP
  }
}

```

```

} OPTIONAL, -- Need OP

radioResourceConfigCommon          RadioResourceConfigCommonSIB,
ue-TimersAndConstants              UE-TimersAndConstants,
freqInfo                            SEQUENCE {
  ul-CarrierFreq                    ARFCN-ValueEUTRA          OPTIONAL, --
Need OP
  ul-Bandwidth                       ENUMERATED {n6, n15, n25, n50, n75, n100}
  additionalSpectrumEmission         AdditionalSpectrumEmission
},
mbsfn-SubframeConfigList           MBSFN-SubframeConfigList OPTIONAL, --
Need OR
timeAlignmentTimerCommon           TimeAlignmentTimer,
...,
lateNonCriticalExtension            OCTET STRING (CONTAINING
SystemInformationBlockType2-v8h0-IEs) OPTIONAL,
[[ ssac-BarringForMMTEL-Voice-r9    AC-BarringConfig
OPTIONAL, -- Need OP
  ssac-BarringForMMTEL-Video-r9     AC-BarringConfig
OPTIONAL -- Need OP
]],
[[ ac-BarringForCSFB-r10             AC-BarringConfig
OPTIONAL -- Need OP
]],
[[ ac-BarringSkipForMMTELVoice-r12   ENUMERATED {true}
OPTIONAL, -- Need OP
  ac-BarringSkipForMMTELVideo-r12   ENUMERATED {true}
OPTIONAL, -- Need OP
  ac-BarringSkipForSMS-r12          ENUMERATED {true}          OPTIONAL,
-- Need OP
  ac-BarringPerPLMN-List-r12        AC-BarringPerPLMN-List-r12  OPTIONAL
-- Need OP
]],
[[ voiceServiceCauseIndication-r12   ENUMERATED {true}
OPTIONAL -- Need OP
]],
[[ acdc-BarringForCommon-r13         ACDC-BarringForCommon-r13
OPTIONAL, -- Need OP
  acdc-BarringPerPLMN-List-r13      ACDC-BarringPerPLMN-List-r13
OPTIONAL -- Need OP
]],
[[
  udt-RestrictingForCommon-r13       UDT-Restricting-r13
OPTIONAL, -- Need OR
  udt-RestrictingPerPLMN-List-r13    UDT-RestrictingPerPLMN-List-r13
OPTIONAL, -- Need OR
  cIoT-EPS-OptimisationInfo-r13     CIOT-EPS-OptimisationInfo-r13
OPTIONAL, -- Need OP
  useFullResumeID-r13                ENUMERATED {true}          OPTIONAL
-- Need OP

```

```

]],
[[ unicastFreqHoppingInd-r13          ENUMERATED {true}
OPTIONAL      -- Need OP
]],
[[ mbsfn-SubframeConfigList-v1430     MBSFN-SubframeConfigList-v1430
OPTIONAL,    -- Need OP
  videoServiceCauseIndication-r14     ENUMERATED {true}
OPTIONAL      -- Need OP
]],
[[ plmn-InfoList-r15                  PLMN-InfoList-r15
OPTIONAL      -- Need OP
]],
[[ cp-EDT-r15                          ENUMERATED {true}
OPTIONAL,    -- Need OR
  up-EDT-r15                            ENUMERATED {true}          OPTIONAL,
-- Need OR
  idleModeMeasurements-r15             ENUMERATED {true}          OPTIONAL,
-- Need OR
  reducedCP-LatencyEnabled-r15         ENUMERATED {true}
OPTIONAL      -- Need OR
]],
[[ mbms-ROM-ServiceIndication-r15     ENUMERATED {true}
OPTIONAL      -- Need OR
]]
}

```

PLMN-InfoList-r15

Presence of PLMN-InfoList-r15 signals that PLMNs supporting 5G-NR services are available.

```

PLMN-InfoList-r15 ::= SEQUENCE (SIZE (1..maxPLMN-r11)) OF PLMN-Info-r15

PLMN-Info-r15 ::= SEQUENCE {
  upperLayerIndication-r15          ENUMERATED {true}          OPTIONAL      --
Need OR
}

```

LTE Preamble

UE → MN-eNB

[TS 36.213](#), [TS 36.321](#), [TS 36.211](#)

The UE picks a random preamble. The preamble is referenced with the Random Access Preamble Id (RAPID). The preamble transmission is a Zadoff-Chu sequence.

Each preamble transmission is associated with an [RA-RNTI](#).

LTE RA-RNTI

The RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

$$\text{RA-RNTI} = 1 + t_id + 10 \times f_id$$

Where:

Identifier	Description
t_id	The index of the first subframe of the specified PRACH ($0 \leq t_id < 10$)
f_id	The index of the specified PRACH within that subframe, in ascending order of frequency domain ($0 \leq f_id < 6$)

PDCCH DCI Format 1A

MN-eNB → UE

[TS 36.212](#)

DCI Format 1_0 is used to assign downlink resources.

Format 1A - CRC Scrambled with RA-RNTI

In response to a PRACH transmission, a UE attempts to detect a DCI Format 1A with PDCCH CRC scrambled by the RA-RNTI corresponding to the RACH transmission. The UE looks for message during a configured window of length `ra-ResponseWindow`.

The RA-RNTI scrambled DCI message signals the frequency and time resources assigned for the transmission of the Transport Block containing the Random Access Response message.

The following information is transmitted by means of the RA-RNTI scrambled DCI Format 1A:

Field	Bits
Carrier Indicator	0 or 3
Format Discriminator	1 (should be 1 for Format 1A)
Localized/Distributed VRB assignment flag	1 (should be set to 0 for random access)
Resource block assignment	$\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil$ N_{RB}^{DL} is the system bandwidth expressed in RBs
Preamble Index	6
PRACH Mask Index	4

Format 1A - CRC Scrambled with C-RNTI

The following information is transmitted by a DCI Format 1A with PDCCH CRC scrambled by the assigned C-RNTI:

Field	Bits
Carrier Indicator	0 or 3
Format Discriminator	1 (should be 1 for Format 1A)
Localized/Distributed VRB assignment flag	1
Resource block assignment	$\lceil \log_2(N_{RB}^{DL}(N_{RB}^{DL} + 1)/2) \rceil$ N_{RB}^{DL} is the system bandwidth expressed in RBs

LTE Random Access Response

MN-eNB → UE

[TS 36.213](#), [TS 36.321](#)

1. The UE listens on the PDCCH addressed by the RA-RNTI.
2. Once the PDCCH with the RA-RNTI is decoded, the UE uses the RB resources in the message to receive the downlink transport block.
3. The downlink transport block contains the MAC PDU.
 - The UE MAC PDU consists of one or more MAC subPDUs.
 - Since multiple UEs may send a Preamble in the same RACH opportunity, they will all be addressed by the same RA-RNTI.
 - Thus, multiple Random Access Responses (RAR) may be carried in a single MAC PDU (They correspond to different UEs that initiated the random access procedure in the same RACH opportunity).
 - Each RAR in the MAC PDU is addressed to a different UE via RAPID value.

LTE MAC PDU

Field	Description
LTE MAC Header	MAC header containing subheaders for each MAC PDU
LTE MAC Random Access Response 1	Random access response for UE 1
LTE MAC Random Access Response 2	Random access response for UE 2
LTE MAC Random Access Response ...	Random access response for UE ...
LTE MAC Random Access Response n	

LTE MAC Header

MAC subheader	1 bit	1 bit	6-bit
MAC subheader 1	E	T	RAPID 1
MAC subheader 2	E	T	RAPID 2
MAC subheader 3	E	T	RAPID 3

LTE MAC Payload for Random Access Response

Field	Description	Bits
R	Reserved bit (set to "0")	1
Timing Advance Command	The Timing Advance Command field indicates the index value TA used to control the amount of timing adjustment that the MAC entity must apply in TS 36.213.	11
LTE RAR UL Grant	The Uplink Grant field indicates the resources to be used on the uplink in TS 36.213	20
Temporary C-RNTI	The Temporary C-RNTI field indicates the temporary identity that is used by the MAC entity during Random Access.	16

LTE RAR UL Grant

RAR grant field	Number of bits
Hopping flag	1
Fixed size resource block assignment	10
Truncated modulation and coding scheme	4
TPC command for scheduled PUSCH	3
UL Delay	1
CSI request	1

RRC Connection Request

UE → MN-eNB

[TS 36.331](#)

```

RRCConnectionRequest ::= SEQUENCE {
    criticalExtensions CHOICE {
        rrcConnectionRequest-r8 RRCConnectionRequest-r8-IEs,
        rrcConnectionRequest-r15 RRCConnectionRequest-5GC-r15-IEs
    }
}

```



```

}
}

RRCConnectionRequest-r8-IEs ::= SEQUENCE {
    ue-Identity InitialUE-Identity,
    establishmentCause EstablishmentCause,
    spare BIT STRING (SIZE (1))
}

RRCConnectionRequest-5GC-r15-IEs ::= SEQUENCE {
    ue-Identity InitialUE-Identity-5GC,
    establishmentCause EstablishmentCause-5GC,
    spare BIT STRING (SIZE (1))
}

InitialUE-Identity ::= CHOICE {
    s-TMSI S-TMSI,
    randomValue BIT STRING (SIZE (40))
}

InitialUE-Identity-5GC ::= CHOICE {
    ng-5G-S-TMSI-Part1 BIT STRING (SIZE (40)),
    randomValue BIT STRING (SIZE (40))
}

EstablishmentCause ::= ENUMERATED {
    emergency, highPriorityAccess, mt-Access, mo-Signalling,
    mo-Data, delayTolerantAccess-v1020, mo-VoiceCall-v1280, spare1}

EstablishmentCause-5GC ::= ENUMERATED {
    emergency, highPriorityAccess, mt-Access, mo-Signalling,
    mo-Data, mo-VoiceCall, spare2, spare1}

```

RRC Connection Setup

MN-eNB → UE

[TS 36.331](#)

```

RRCConnectionSetup ::=SEQUENCE {
    rrc-TransactionIdentifier RRC-TransactionIdentifier,
    criticalExtensions CHOICE {
    c1 CHOICE {
        rrcConnectionSetup-r8RRCConnectionSetup-r8-IEs,
        spare7 NULL,
        spare6 NULL, spare5 NULL, spare4 NULL,
        spare3 NULL, spare2 NULL, spare1 NULL
    },

```

```

criticalExtensionsFuture SEQUENCE {}
}
}

RRCConnectionSetup-r8-IEs ::= SEQUENCE {
  radioResourceConfigDedicated RadioResourceConfigDedicated,
  nonCriticalExtensionRRCConnectionSetup-v8a0-IEs OPTIONAL
}

RRCConnectionSetup-v8a0-IEs ::= SEQUENCE {
  lateNonCriticalExtension OCTET STRING OPTIONAL,
  nonCriticalExtensionSEQUENCE {} OPTIONAL
}

```

PDCCH DCI Format 0

MN-eNB → UE

[TS 36.212](#)

DCI Format 0 is used to assign uplink resources to the UE.

Format 0 - CRC Scrambled with C-RNTI

The following information is transmitted by a DCI Format 0 with PDCCH CRC scrambled by the assigned C-RNTI:

Field	Bits
Carrier indicator	0 or 3
Identifier of DCI formats	1
Frequency hopping flag	1
Resource block assignment	$\lceil \log_2(N_{RB}^{UL}(N_{RB}^{UL} + 1)/2) \rceil$ N_{RB}^{UL} is the size of the uplink bandwidth expressed in RBs.
PUSCH	2
Modulation and coding scheme and redundancy version	5
New data indicator	1
HARQ process number	3
TPC command for scheduled PUSCH	2
Cyclic shift for DM RS	3

Field	Bits
CSI Request	1 or 2
SRS Request	0 or 1

RRC Connection Setup Complete

UE → MN-eNB

[TS 36.331](#)

The message also carries:

- [Attach Request](#): Registration request for connecting to the 4G core.
- [UE-MRDC-Capability](#): Signals that the UE supports EN-DC and can simultaneously connect to a 4G as well as 5G base station.
- [PDN Connectivity Request](#): Request to connect to a Packet Data Network.

```

RRCConnectionSetupComplete ::= SEQUENCE {
    rrc-TransactionIdentifier RRC-TransactionIdentifier,
    criticalExtensions CHOICE {
        c1 CHOICE{
            rrcConnectionSetupComplete-r8 RRCConnectionSetupComplete-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture SEQUENCE {}
    }
}

RRCConnectionSetupComplete-r8-IEs ::= SEQUENCE {
    selectedPLMN-Identity INTEGER (1..maxPLMN-r11),
    registeredMME RegisteredMME OPTIONAL,
    dedicatedInfoNAS DedicatedInfoNAS,
    nonCriticalExtension RRCConnectionSetupComplete-v8a0-IEs OPTIONAL
}

RRCConnectionSetupComplete-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension OCTET STRING OPTIONAL,
    nonCriticalExtension RRCConnectionSetupComplete-v1020-IEs OPTIONAL
}

RRCConnectionSetupComplete-v1020-IEs ::= SEQUENCE {
    gummei-Type-r10 ENUMERATED {native, mapped} OPTIONAL,
    rlf-InfoAvailable-r10 ENUMERATED {true} OPTIONAL,
    logMeasAvailable-r10 ENUMERATED {true} OPTIONAL,
    rn-SubframeConfigReq-r10 ENUMERATED {required, notRequired} OPTIONAL,
    nonCriticalExtension RRCConnectionSetupComplete-v1130-IEs OPTIONAL
}

```

```

RRCConnectionSetupComplete-v1130-IEs ::= SEQUENCE {
  connEstFailInfoAvailable-r11 ENUMERATED {true} OPTIONAL,
  nonCriticalExtension RRCConnectionSetupComplete-v1250-IEs OPTIONAL
}

```

```

RRCConnectionSetupComplete-v1250-IEs ::= SEQUENCE {
  mobilityState-r12 ENUMERATED {normal, medium, high, spare} OPTIONAL,
  mobilityHistoryAvail-r12 ENUMERATED {true} OPTIONAL,
  logMeasAvailableMBSFN-r12 ENUMERATED {true} OPTIONAL,
  nonCriticalExtension RRCConnectionSetupComplete-v1320-IEs OPTIONAL
}

```

```

RRCConnectionSetupComplete-v1320-IEs ::= SEQUENCE {
  ce-ModeB-r13 ENUMERATED {supported} OPTIONAL,
  s-TMSI-r13 S-TMSI OPTIONAL,
  attachWithoutPDN-Connectivity-r13 ENUMERATED {true} OPTIONAL,
  up-CIoT-EPS-Optimisation-r13 ENUMERATED {true} OPTIONAL,
  cp-CIoT-EPS-Optimisation-r13 ENUMERATED {true} OPTIONAL,
  nonCriticalExtension RRCConnectionSetupComplete-v1330-IEs OPTIONAL
}

```

```

RRCConnectionSetupComplete-v1330-IEs ::= SEQUENCE {
  ue-CE-NeedULGaps-r13 ENUMERATED {true} OPTIONAL,
  nonCriticalExtension RRCConnectionSetupComplete-v1430-IEs OPTIONAL
}

```

```

RRCConnectionSetupComplete-v1430-IEs ::= SEQUENCE {
  dcn-ID-r14 INTEGER (0..65535) OPTIONAL,
  nonCriticalExtension RRCConnectionSetupComplete-v1530-IEs OPTIONAL
}

```

```

RRCConnectionSetupComplete-v1530-IEs ::= SEQUENCE {
  logMeasAvailableBT-r15 ENUMERATED {true} OPTIONAL,
  logMeasAvailableWLAN-r15 ENUMERATED {true} OPTIONAL,
  idleMeasAvailable-r15 ENUMERATED {true} OPTIONAL,
  flightPathInfoAvailable-r15 ENUMERATED {true} OPTIONAL,
  connectTo5GC-r15 ENUMERATED {true} OPTIONAL,
  registeredAMF-r15 RegisteredAMF-r15 OPTIONAL,
  s-NSSAI-list-r15 SEQUENCE(SIZE (1..maxNrofS-NSSAI-r15)) OF S-NSSAI-r15 OPTIONAL,
  ng-5G-S-TMSI-Bits-r15 CHOICE {
    ng-5G-S-TMSI-r15 NG-5G-S-TMSI-r15,
    ng-5G-S-TMSI-Part2-r15 BIT STRING (SIZE (8))
  } OPTIONAL,
  nonCriticalExtension RRCConnectionSetupComplete-v1540-IEs OPTIONAL
}

```

```

RRCConnectionSetupComplete-v1540-IEs ::= SEQUENCE {
  gummei-Type-v1540 ENUMERATED {mappedFrom5G} OPTIONAL,
  guami-Type-r15 ENUMERATED {native, mapped} OPTIONAL,

```

```

nonCriticalExtension SEQUENCE {} OPTIONAL
}

RegisteredMME ::= SEQUENCE {
  plmn-Identity PLMN-Identity OPTIONAL,
  mmegi BIT STRING (SIZE (16)),
  mmec MMEC
}

RegisteredAMF-r15 ::= SEQUENCE {
  plmn-Identity-r15 PLMN-Identity OPTIONAL,
  amf-Identifrier-r15 AMF-Identifrier-r15
}

```

Attach Request

UE → MME

[TS 24.301](#)

Information Element	Type	Presence
Protocol discriminator	Protocol discriminator	M
Security header type	Security header type	M
Attach request message identity	Message type	M
EPS attach type	EPS attach type	M
NAS key set identifier	NAS key set identifier	M
EPS mobile identity	EPS mobile identity	M
UE network capability	UE network capability	M
ESM message container - PDN Connectivity Request	ESM message container	M
Old P-TMSI signature	P-TMSI signature	O
Additional GUTI	EPS mobile identity	O
Last visited registered TAI	Tracking area identity	O
DRX parameter	DRX parameter	O
MS network capability	MS network capability	O
Old location area identification	Location area identification	O
TMSI status	TMSI status	O

Information Element	Type	Presence
Mobile station classmark 2	Mobile station classmark 2	O
Mobile station classmark 3	Mobile station classmark 3	O
Supported Codecs	Supported Codec List	O
Additional update type	Additional update type	O
Voice domain preference and UE's usage setting	Voice domain preference and UE's usage setting	O
Device properties	Device properties	O
Old GUTI type	GUTI type	O
MS network feature support	MS network feature support	O
TMSI based NRI container	Network resource identifier container	O
T3324 value	GPRS timer 2	O
T3412 extended value	GPRS timer 3	O
Extended DRX parameters	Extended DRX parameters	O
UE additional security capability	UE additional security capability	O
UE status	UE status	O
Additional information requested	Additional information requested	O

UE Network Capability

TS 24.301

UE sets the DCNR bit in octet 9 to signal that it supports EN-DC dual connectivity

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	
EEA0	128- EEA1	128-EEA2	128- EEA3	EEA4	EEA5	EEA6	EEA7	octet 3
EIA0	128- EIA1	128-EIA2	128- EIA3	EIA4	EIA5	EIA6	EIA7	octet 4
UEA0	UEA1	UEA2	UEA3	UEA4	UEA5	UEA6	UEA7	octet 5
UCS2	UIA1	UIA2	UIA3	UIA4	UIA5	UIA6	UIA7	octet 6

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	
ProSe-dd	ProSe	H.245-ASH	ACC-CSFB	LPP	LCS	1xSRVCC	NF	octet 7
ePCO	HC-CP CloT	ERw/oPDN	S1-U data	UP CloT	CP CloT	Prose-relay	ProSe-dc	octet 8
15 bearers	SGC	N1mode	DCNR	CP backoff	RestrictEC	V2X PC5	multipleDRB	octet 9

PDN Connectivity Request

UE → MME

[TS 24.301](#)

Information Element	Type	Presence
Protocol discriminator	Protocol discriminator	M
EPS bearer identity	EPS bearer identity	M
Procedure transaction identity	Procedure transaction identity	M
PDN connectivity request message identity	Message type	M
Request type	Request type	M
PDN type	PDN type	M
ESM information transfer flag	ESM information transfer flag	O
Access point name	Access point name	O
Protocol configuration options	Protocol configuration options	O
Device properties	Device properties	O
NBIFOM container	NBIFOM container	O
Header compression configuration	Header compression configuration	O
Extended protocol configuration options	Extended protocol configuration options	O

Initial UE Message

MN-eNB → MME

[TS 36.413](#)

IE/Group Name	Presence	Description
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[↑top](#)

IE/Group Name	Presence	Description
Message Type	M	
eNB UE S1AP ID	M	
NAS-PDU - Attach Request	M	
TAI	M	Indicating the Tracking Area from which the UE has sent the NAS message.
E-UTRAN CGI	M	Indicating the E-UTRAN CGI from which the UE has sent the NAS
RRC Establishment Cause	M	
S-TMSI	O	
CSG Id	O	
GUMMEI	O	
Cell Access Mode	O	
GW Transport Layer Address	O	Indicating GW Transport Layer Address if the GW is collocated with eNB.
Relay Node Indicator	O	Indicating a relay node.
GUMMEI Type	O	
Tunnel Information for BBF	O	Indicating HeNB's Local IP Address assigned by the
SIPTO L-GW Transport Layer Address	O	Indicating SIPTO L-GW Transport Layer Address if the SIPTO L-GW is collocated with eNB.
LHN ID	O	
MME Group ID	O	
UE Usage Type	O	
CE-mode-B Support Indicator	O	
DCN ID	O	
Coverage Level	O	
UE Application Layer Measurement Capability	O	Each bit in the bitmap indicates an UE Application layer measurement capability.
EDT	O	

Authentication Request

MME → UE

TS 24.301

Information element	Type	Presence
Protocol discriminator	Protocol discriminator	M
Security header type	Security header type	M
Authentication request message type	Message type	M
NAS key set identifierASME	NAS key set identifier	M
Spare half octet	Spare half octet	M
Authentication parameter RAND (EPS challenge)	Authentication parameter RAND	M
Authentication parameter AUTN (EPS challenge)	Authentication parameter	M

Authentication Response

UE → MME

TS 24.301

Information element	Type	Presence
Protocol discriminator	Protocol discriminator	M
Security header type	Security header type	M
Authentication response message type	Message type	M
Authentication response parameter	Authentication response parameter	M

NAS Security Mode Command

MME → UE

TS 24.301

Information Element	Type	Presence
Protocol discriminator	Protocol discriminator	M
Security header type	Security header type	M
Security mode command message identity	Message type	M
Selected NAS security algorithms	NAS security algorithms	M
NAS key set identifier	NAS key set identifier	M

Information Element	Type	Presence
Spare half octet	Spare half octet	M
Replayed UE security capabilities	UE security capability	M
IMEISV request	IMEISV request	O
Replayed nonceUE	Nonce	O
NonceMME	Nonce	O
HashMME	HashMME	O
Replayed UE additional security capability	UE additional security capability	O

NAS Security Mode Complete

UE → MME

[TS 24.301](#)

Information Element	Type	Presence
Protocol discriminator	Protocol discriminator	M
Security header type	Security header type	M
Security mode complete message identity	Message type	M
IMEISV	Mobile identity	O
Replayed NAS message container	Replayed NAS message container	O

Initial Context Setup Request

MME → MN-eNB

[TS 36.413](#)

IE/Group Name	Presence
Message Type	M
MME UE S1AP ID	M
eNB UE S1AP ID	M
UE Aggregate Maximum Bit Rate	M
E-RAB to Be Setup List	
E-RAB to Be Setup Item IEs [E-RAB ID]	

IE/Group Name	Presence
E-RAB ID	M
E-RAB Level QoS Parameters	M
Transport Layer Address	M
GTP-TEID	M
NAS-PDU - Attach Accept	O
Correlation ID	O
SIPTO Correlation ID	O
Bearer Type	O

IE/Group Name	Presence
UE Security Capabilities	M
Security Key	M
Trace Activation	O
Handover Restriction List	O
UE Radio Capability	O
Subscriber Profile ID for RAT/Frequency priority	O
CS Fallback Indicator	O
SRVCC Operation Possible	O
CSG Membership Status	O
Registered LAI	O
GUMMEI	O
MME UE S1AP ID 2	O
Management Based MDT Allowed	O
Management Based MDT PLMN List	O
Additional CS Fallback Indicator C-ifCSFBhighpriorit	y
Masked IMEISV	O
Expected UE Behaviour	O
ProSe Authorized	O
UE User Plane Clot Support Indicator	O

IE/Group Name	Presence
V2X Services Authorized	O
UE Sidelink Aggregate Maximum Bit Rate	O
Enhanced Coverage Restricted	O
NR UE Security Capabilities	O
CE-mode-B Restricted	O
Aerial UE subscription information	O
Pending Data Indication	O
Subscription Based UE Differentiation Information	O

Attach Accept

MME → UE

TS 24.301

Information Element	Presence
Protocol discriminator	M
Security header type	M
Attach accept message identity	M
EPS attach result	M
Spare half octet	M
T3412 value	M
TAI list	M
ESM message container - Activate Default EPS Bearer Context Request	M
GUTI	O
Location area identification	O
MS identity	O
EMM cause	O
T3402 value	O
T3423 value	O
Equivalent PLMNs	O

Information Element	Presence
Emergency number list	O
EPS network feature support	O
Additional update result	O
T3412 extended value	O
T3324 value	O
Extended DRX parameters	O
DCN-ID	O
SMS services status	O
Non-3GPP NW provided policies	O
T3448 value	O
Network policy	O
T3447 value	O
Extended emergency number list	O
Ciphering key data	O

Activate Default EPS Bearer Context Request

MME → UE

[TS 24.301](#)

Information Element	Type	Presence
EPS bearer identity	EPS bearer identity	M
Procedure transaction identity	Procedure transaction identity	M
Activate default EPS bearer context request message identity	Message type	M
EPS QoS	EPS quality of service	M
Access point name	Access point name	M
PDN address	PDN address	M
Transaction identifier	Transaction identifier	O
Negotiated QoS	Quality of service	O

Information Element	Type	Presence
Negotiated LLC SAPI	LLC service access point identifier	O
Radio priority	Radio priority	O
Packet flow Identifier	Packet flow Identifier	O
APN-AMBR	APN aggregate maximum bit rate	O
ESM cause	ESM cause	O
Protocol configuration options	Protocol configuration options	O
Connectivity type	Connectivity type	O
WLAN offload indication	WLAN offload acceptability	O
NBIFOM container	NBIFOM container	O
Header compression configuration	Header compression configuration	O
Control plane only indication	Control plane only indication	O
Extended protocol configuration options	Extended protocol configuration options	O
Serving PLMN rate control	Serving PLMN rate control	O
Extended APN-AMBR	Extended APN aggregate maximum bit rate	O

UE Capability Enquiry

MN-eNB → UE

TS 36.331

```

UECapabilityEnquiry ::= SEQUENCE {
  rrc-TransactionIdentifier    RRC-TransactionIdentifier,
  criticalExtensions CHOICE {
    c1 CHOICE {
      ueCapabilityEnquiry-r8 UECapabilityEnquiry-r8-IEs,
      spare3 NULL, spare2 NULL, spare1 NULL
    },
    criticalExtensionsFuture    SEQUENCE {}
  }
}

```

```

UECapabilityEnquiry-r8-IEs ::= SEQUENCE {
  ue-CapabilityRequest UE-CapabilityRequest,
  nonCriticalExtension UECapabilityEnquiry-v8a0-IEs OPTIONAL
}

```

```

}

UE-CapabilityRequest ::= SEQUENCE (SIZE (1..maxRAT-Capabilities)) OF RAT-Type

```

RAT-Type

The IE RAT-Type is used to indicate the radio access technology (RAT), including E UTRA, of the requested/ transferred UE capabilities. A separate value applies for some EUTRA-NR capabilities that are transferred by a separate UE capability container, used in case of EN-DC.

```

RAT-Type ::= ENUMERATED {
    eutra, utra, geran-cs, geran-ps, cdma2000-1XRTT,
    nr, eutra-nr, spare1, ...}

```

UE Capability Information

UE → MN-eNB

[TS 36.331](#)

The message contains:

- UECapabilityInformation-r8-IEs
 - UE-CapabilityRAT-ContainerList
 - [UE-MRDC-Capability](#): Signals that the UE supports EN-DC and can simultaneously connect to a 4G as well as 5G base station.
- [UE-EUTRA-Capability-v15 IEs](#)
- [IRAT-ParametersNR-r15](#)
 - [SupportedBandListNR-r15](#)

```

UECapabilityInformation ::= SEQUENCE {
    rrc-TransactionIdentifier RRC-TransactionIdentifier,
    criticalExtensions CHOICE {
        c1 CHOICE{
            ueCapabilityInformation-r8 UECapabilityInformation-r8-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture SEQUENCE {}
    }
}

```

```

UECapabilityInformation-r8-IEs ::= SEQUENCE {

```

```

    ue-CapabilityRAT-ContainerList  UE-CapabilityRAT-ContainerList,
    nonCriticalExtension UECapabilityInformation-v8a0-IEs  OPTIONAL
}

UE-CapabilityRAT-ContainerList ::=SEQUENCE (SIZE (0..maxRAT-Capabilities)) OF UE-
CapabilityRAT-Container

UE-CapabilityRAT-Container ::= SEQUENCE {
    rat-Type RAT-Type,
    ueCapabilityRAT-Container OCTET STRING
}

```

UE-MRDC-Capability

[TS 38.331](#)

```

UE-MRDC-Capability ::= SEQUENCE {
    measAndMobParametersMRDC MeasAndMobParametersMRDC OPTIONAL,
    phy-ParametersMRDC-v1530 Phy-ParametersMRDC  OPTIONAL,
    rf-ParametersMRDC RF-ParametersMRDC,
    generalParametersMRDC GeneralParametersMRDC-XDD-Diff  OPTIONAL,
    rlc-Parameters RLC-Parameters  OPTIONAL,
    mac-Parameters MAC-Parameters  OPTIONAL,
    phy-Parameters Phy-Parameters,
    rf-Parameters RF-Parameters,
    measAndMobParameters MeasAndMobParameters OPTIONAL,
    fdd-Add-UE-NR-Capabilities UE-NR-CapabilityAddXDD-Mode  OPTIONAL,
    tdd-Add-UE-NR-Capabilities UE-NR-CapabilityAddXDD-Mode  OPTIONAL,
    fr1-Add-UE-NR-Capabilities UE-NR-CapabilityAddFRX-Mode  OPTIONAL,
    fr2-Add-UE-NR-Capabilities UE-NR-CapabilityAddFRX-Mode  OPTIONAL,
    featureSets FeatureSets  OPTIONAL,
    featureSetCombinations SEQUENCE (SIZE (1..maxFeatureSetCombinations)) OF
FeatureSetCombination  OPTIONAL,

    lateNonCriticalExtension OCTET STRING OPTIONAL,
    nonCriticalExtension UE-NR-Capability-v1530  OPTIONAL
}

UE-NR-Capability-v1530 ::= SEQUENCE {
    fdd-Add-UE-NR-Capabilities-v1530 UE-NR-CapabilityAddXDD-Mode-v1530  OPTIONAL,
    tdd-Add-UE-NR-Capabilities-v1530 UE-NR-CapabilityAddXDD-Mode-v1530  OPTIONAL,
    dummy ENUMERATED {supported}  OPTIONAL,
    interRAT-Parameters InterRAT-Parameters  OPTIONAL,
    inactiveState ENUMERATED {supported}  OPTIONAL,
    delayBudgetReporting ENUMERATED {supported}  OPTIONAL,
    nonCriticalExtension UE-NR-Capability-1540  OPTIONAL
}

```



```

UE-NR-Capability-1540 ::= SEQUENCE {
  sdap-Parameters SDAP-Parameters OPTIONAL,
  overheatingInd ENUMERATED {supported} OPTIONAL,
  ims-Parameters IMS-Parameters OPTIONAL,
  fr1-Add-UE-NR-Capabilities-v1540 UE-NR-CapabilityAddFRX-Mode-v1540 OPTIONAL,
  fr2-Add-UE-NR-Capabilities-v1540 UE-NR-CapabilityAddFRX-Mode-v1540 OPTIONAL,
  fr1-fr2-Add-UE-NR-Capabilities UE-NR-CapabilityAddFRX-Mode OPTIONAL,
  nonCriticalExtension SEQUENCE {} OPTIONAL
}

UE-NR-CapabilityAddXDD-Mode ::= SEQUENCE {
  phy-ParametersXDD-Diff Phy-ParametersXDD-Diff OPTIONAL,
  mac-ParametersXDD-Diff MAC-ParametersXDD-Diff OPTIONAL,
  measAndMobParametersXDD-Diff MeasAndMobParametersXDD-Diff OPTIONAL
}

UE-NR-CapabilityAddXDD-Mode-v1530 ::= SEQUENCE {
  eutra-ParametersXDD-Diff EUTRA-ParametersXDD-Diff
}

UE-NR-CapabilityAddFRX-Mode ::= SEQUENCE {
  phy-ParametersFRX-Diff Phy-ParametersFRX-Diff OPTIONAL,
  measAndMobParametersFRX-Diff MeasAndMobParametersFRX-Diff OPTIONAL
}

UE-NR-CapabilityAddFRX-Mode-v1540 ::= SEQUENCE {
  ims-ParametersFRX-Diff IMS-ParametersFRX-Diff OPTIONAL
}

```

UE-EUTRA-Capability-v15 IEs

TS 36.331

```

UE-EUTRA-Capability-v1510-IEs ::= SEQUENCE {
  irat-ParametersNR-r15 IRAT-ParametersNR-r15
  OPTIONAL,
  featureSetsEUTRA-r15 FeatureSetsEUTRA-r15
  OPTIONAL,
  pdcp-ParametersNR-r15 PDCP-ParametersNR-r15
  OPTIONAL,
  fdd-Add-UE-EUTRA-Capabilities-v1510 UE-EUTRA-CapabilityAddXDD-Mode-v1510
  OPTIONAL,
  tdd-Add-UE-EUTRA-Capabilities-v1510 UE-EUTRA-CapabilityAddXDD-Mode-v1510
  OPTIONAL,
  nonCriticalExtension UE-EUTRA-Capability-v1520-IEs
  OPTIONAL
}

```

```

UE-EUTRA-Capability-v1520-IEs ::= SEQUENCE {
    measParameters-v1520                MeasParameters-v1520,
    nonCriticalExtension                 UE-EUTRA-Capability-v1530-IEs
OPTIONAL
}

UE-EUTRA-Capability-v1530-IEs ::= SEQUENCE {
    measParameters-v1530                MeasParameters-v1530
OPTIONAL,
    otherParameters-v1530              Other-Parameters-v1530
OPTIONAL,
    neighCellSI-AcquisitionParameters-v1530    NeighCellSI-
AcquisitionParameters-v1530          OPTIONAL,
    mac-Parameters-v1530               MAC-Parameters-v1530
OPTIONAL,
    phyLayerParameters-v1530           PhyLayerParameters-v1530
OPTIONAL,
    rf-Parameters-v1530                RF-Parameters-v1530
OPTIONAL,
    pdcp-Parameters-v1530              PDCP-Parameters-v1530
OPTIONAL,
    ue-CategoryDL-v1530                INTEGER (22..26)
OPTIONAL,
    ue-BasedNetwPerfMeasParameters-v1530    UE-
BasedNetwPerfMeasParameters-v1530    OPTIONAL,
    rlc-Parameters-v1530               RLC-Parameters-v1530
OPTIONAL,
    sl-Parameters-v1530                SL-Parameters-v1530
OPTIONAL,
    extendedNumberOfDRBs-r15           ENUMERATED {supported}
OPTIONAL,
    reducedCP-Latency-r15              ENUMERATED {supported}
OPTIONAL,
    laa-Parameters-v1530               LAA-Parameters-v1530
OPTIONAL,
    ue-CategoryUL-v1530                INTEGER (22..26)
OPTIONAL,
    fdd-Add-UE-EUTRA-Capabilities-v1530    UE-EUTRA-CapabilityAddXDD-
Mode-v1530    OPTIONAL,
    tdd-Add-UE-EUTRA-Capabilities-v1530    UE-EUTRA-CapabilityAddXDD-
Mode-v1530    OPTIONAL,
    nonCriticalExtension                 UE-EUTRA-Capability-v1540-
IEs    OPTIONAL
}

UE-EUTRA-Capability-v1540-IEs ::= SEQUENCE {
    phyLayerParameters-v1540           PhyLayerParameters-v1540
OPTIONAL,
    otherParameters-v1540              Other-Parameters-v1540,
    fdd-Add-UE-EUTRA-Capabilities-v1540    UE-EUTRA-CapabilityAddXDD-

```

```

Mode-v1540      OPTIONAL,
  tdd-Add-UE-EUTRA-Capabilities-v1540      UE-EUTRA-CapabilityAddXDD-
Mode-v1540      OPTIONAL,
  sl-Parameters-v1540                      SL-Parameters-v1540
OPTIONAL,
  irat-ParametersNR-v1540                  IRAT-ParametersNR-
v1540      OPTIONAL,
  nonCriticalExtension                      SEQUENCE {}
OPTIONAL
}

```

IRAT-ParametersNR-r15

TS 36.331

```

IRAT-ParametersNR-r15 ::=
  en-DC-r15                ENUMERATED {supported}  OPTIONAL,
  eventB2-r15              ENUMERATED {supported}  OPTIONAL,
  supportedBandListEN-DC-r15 SupportedBandListNR-r15  OPTIONAL
}

```

SupportedBandListNR-r15

TS 36.331

```

SupportedBandListNR-r15 ::=
  SupportedBandNR-r15      SEQUENCE (SIZE (1..maxBandsNR-r15)) OF
SupportedBandNR-r15

SupportedBandNR-r15 ::=
  bandNR-r15              SEQUENCE {
  FreqBandIndicatorNR-r15
}

FreqBandIndicatorNR-r15 ::=
  INTEGER (1.. maxFBI-NR-r15)

```

UE Capability Info Indication

MN-eNB → MME

TS 36.431

IE/Group Name	Presence
Message Type	M

IE/Group Name	Presence
MME UE S1AP ID	M
eNB UE S1AP ID	M
UE Radio Capability	M
UE Radio Capability for Paging	O
UE Application Layer Measurement Capability	O
LTE-M Indication	O

AS Security Mode Command

MN-eNB → UE

[TS 36.331](#)

```

SecurityModeCommand ::= SEQUENCE {
  rrc-TransactionIdentifier RRC-TransactionIdentifier,
  criticalExtensions CHOICE {
    c1 CHOICE{
      securityModeCommand-r8 SecurityModeCommand-r8-IEs,
      spare3 NULL, spare2 NULL, spare1 NULL
    },
    criticalExtensionsFuture SEQUENCE {}
  }
}

SecurityModeCommand-r8-IEs ::= SEQUENCE {
  securityConfigSMC SecurityConfigSMC,
  nonCriticalExtension SecurityModeCommand-v8a0-IEs OPTIONAL
}

SecurityModeCommand-v8a0-IEs ::= SEQUENCE {
  lateNonCriticalExtension OCTET STRING OPTIONAL,
  nonCriticalExtension SEQUENCE {} OPTIONAL
}

SecurityConfigSMC ::= SEQUENCE {
  securityAlgorithmConfig SecurityAlgorithmConfig,
  ...
}

```

AS Security Mode Complete

UE → MN-eNB

[TS 36.331](#)

```

SecurityModeComplete ::= SEQUENCE {
  rrc-TransactionIdentifier RRC-TransactionIdentifier,
  criticalExtensions CHOICE {
    securityModeComplete-r8 SecurityModeComplete-r8-IEs,
    criticalExtensionsFuture SEQUENCE {}
  }
}

SecurityModeComplete-r8-IEs ::= SEQUENCE {
  nonCriticalExtension SecurityModeComplete-v8a0-IEs OPTIONAL
}

SecurityModeComplete-v8a0-IEs ::= SEQUENCE {
  lateNonCriticalExtension OCTET STRING OPTIONAL,
  nonCriticalExtension SEQUENCE {} OPTIONAL
}

```

RRC Connection Reconfiguration

MN-eNB → UE

[TS 36.331](#)

When configuring the default bearer:

- The message carries the [Attach Accept](#) NAS message.
- The [Attach Accept](#) message carries the [Activate Default EPS Bearer Context Request](#) NAS message.

```

RRCConnectionReconfiguration ::= SEQUENCE {
  rrc-TransactionIdentifier RRC-TransactionIdentifier,
  criticalExtensions CHOICE {
    c1 CHOICE{
      rrcConnectionReconfiguration-r8 RRCConnectionReconfiguration-r8-IEs,
      spare7 NULL,
      spare6 NULL, spare5 NULL, spare4 NULL,
      spare3 NULL, spare2 NULL, spare1 NULL
    },
    criticalExtensionsFuture SEQUENCE {}
  }
}

RRCConnectionReconfiguration-r8-IEs ::= SEQUENCE {
  measConfig MeasConfig OPTIONAL, -- Need ON

```

```

mobilityControlInfo MobilityControlInfo OPTIONAL, -- Cond HO
dedicatedInfoNASList SEQUENCE (SIZE(1..maxDRB)) OF
DedicatedInfoNAS OPTIONAL, -- Cond nonHO
radioResourceConfigDedicated RadioResourceConfigDedicated OPTIONAL, -- Cond HO-
toEUTRA
securityConfigHO SecurityConfigHO OPTIONAL, -- Cond HO-toEPC
nonCriticalExtension RRCConnectionReconfiguration-v890-IEs OPTIONAL
}
/*----clipped----*/

```

MeasConfig

```

MeasConfig ::=                               SEQUENCE {
    -- Measurement objects
    measObjectToRemoveList                   MeasObjectToRemoveList
OPTIONAL, -- Need ON
    measObjectToAddModList                   MeasObjectToAddModList
OPTIONAL, -- Need ON
    -- Reporting configurations
    reportConfigToRemoveList                 ReportConfigToRemoveList
OPTIONAL, -- Need ON
    reportConfigToAddModList                 ReportConfigToAddModList
OPTIONAL, -- Need ON
    -- Measurement identities
    measIdToRemoveList                       MeasIdToRemoveList
OPTIONAL, -- Need ON
    measIdToAddModList                       MeasIdToAddModList
OPTIONAL, -- Need ON
    -- Other parameters
    quantityConfig                           QuantityConfig
OPTIONAL, -- Need ON
    measGapConfig                             MeasGapConfig
OPTIONAL, -- Need ON
    s-Measure                                 RSRP-Range
OPTIONAL, -- Need ON
    preRegistrationInfoHRPD                   PreRegistrationInfoHRPD
OPTIONAL, -- Need OP
    speedStatePars                            CHOICE {
        release
    NULL,
        setup
    SEQUENCE {
        mobilityStateParameters
    MobilityStateParameters,
        timeToTrigger-SF
    SpeedStateScaleFactors
    }
}

```

```

/* ---- clipped ---- */
}

```

MeasObjectToAddModList

```

MeasObjectToAddModList ::= SEQUENCE (SIZE (1..maxObjectId)) OF
MeasObjectToAddMod

MeasObjectToAddMod ::= SEQUENCE {
    measObjectId          MeasObjectId,
    measObject            CHOICE {
        measObjectEUTRA   MeasObjectEUTRA,
        measObjectUTRA    MeasObjectUTRA,
        measObjectGERAN   MeasObjectGERAN,
        measObjectCDMA2000 MeasObjectCDMA2000,
        ...,
        measObjectWLAN-r13 MeasObjectWLAN-r13,
        measObjectNR-r15  MeasObjectNR-r15
    }
}

```

MeasObjectNR-r15

The IE MeasObjectNR specifies information applicable for inter-RAT NR neighboring cells.

```

MeasObjectNR-r15 ::= SEQUENCE {
    carrierFreq-r15          ARFCN-ValueNR-r15,
    rs-ConfigSSB-r15        RS-ConfigSSB-NR-r15,
    threshRS-Index-r15      ThresholdListNR-r15
OPTIONAL,                  -- Need OR
    maxRS-IndexCellQual-r15 MaxRS-IndexCellQualNR-r15
OPTIONAL,                  -- Need OR
    offsetFreq-r15         Q-OffsetRangeInterRAT
DEFAULT 0,
    blackCellsToRemoveList-r15 CellIndexList
OPTIONAL,                  -- Need ON
    blackCellsToAddModList-r15 CellsToAddModListNR-r15
OPTIONAL,                  -- Need ON
    quantityConfigSet-r15   INTEGER (1.. maxQuantSetsNR-r15),
    cellsForWhichToReportSFTD-r15 SEQUENCE (SIZE (1..maxCellSFTD)) OF
PhysCellIdNR-r15          OPTIONAL, -- Need OR
    ...,
    [[ cellForWhichToReportCGI-r15 PhysCellIdNR-r15
OPTIONAL,                  -- Need ON
    deriveSSB-IndexFromCell-r15  BOOLEAN

```

```

OPTIONAL,      -- Need ON
                ss-RSSI-Measurement-r15      SS-RSSI-Measurement-r15
OPTIONAL,      -- Need ON
                bandNR-r15                   CHOICE {
                                                release NULL,
                                                setup FreqBandIndicatorNR-r15
                                                }
OPTIONAL      -- Need ON
    ]]
}

RS-ConfigSSB-NR-r15 ::=
    measTimingConfig-r15      SEQUENCE {
                                MTC-SSB-NR-r15,
                                subcarrierSpacingSSB-r15      ENUMERATED {kHz15, kHz30, kHz120, kHz240},
                                ...
    }

CellsToAddModListNR-r15 ::=
CellsToAddModNR-r15          SEQUENCE (SIZE (1..maxCellMeas)) OF

CellsToAddModNR-r15 ::=
    cellIndex-r15             SEQUENCE {
                                INTEGER (1..maxCellMeas),
                                physCellId-r15                PhysCellIdNR-r15
    }

```

RRC Connection Reconfiguration Complete

UE → MN-eNB

[TS 36.331](#)

```

RRCConnectionSetupComplete ::= SEQUENCE {
    rrc-TransactionIdentifier RRC-TransactionIdentifier,
    criticalExtensions CHOICE {
        c1 CHOICE{
            rrcConnectionSetupComplete-r8 RRCConnectionSetupComplete-r8-IEs,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture SEQUENCE {}
    }
}

RRCConnectionSetupComplete-r8-IEs ::= SEQUENCE {
    selectedPLMN-Identity INTEGER (1..maxPLMN-r11),
    registeredMME RegisteredMME OPTIONAL,
    dedicatedInfoNAS DedicatedInfoNAS,
    nonCriticalExtension RRCConnectionSetupComplete-v8a0-IEs OPTIONAL

```



```

}

RRCConnectionSetupComplete-v8a0-IEs ::= SEQUENCE {
    lateNonCriticalExtension OCTET STRING OPTIONAL,
    nonCriticalExtension RRCConnectionSetupComplete-v1020-IEs OPTIONAL
}

RRCConnectionSetupComplete-v1020-IEs ::= SEQUENCE {
    gummei-Type-r10 ENUMERATED {native, mapped} OPTIONAL,
    rlf-InfoAvailable-r10 ENUMERATED {true} OPTIONAL,
    logMeasAvailable-r10 ENUMERATED {true} OPTIONAL,
    rn-SubframeConfigReq-r10 ENUMERATED {required, notRequired} OPTIONAL,
    nonCriticalExtension RRCConnectionSetupComplete-v1130-IEs OPTIONAL
}
/*-----clipped-----*/

```

Initial Context Setup Response

MN-eNB → MME

[TS 36.413](#)

IE/Group Name	Presence
Message Type	M
MME UE S1AP ID	M
eNB UE S1AP ID	M

E-RAB Setup List

E-RAB Setup Item IEs [E-RAB ID]

IE/Group Name	Presence
E-RAB ID	M
Transport Layer Address	M
GTP-TEID	M
E-RAB Failed to Setup List	O
Criticality Diagnostics	O

Attach Complete

UE → MME

TS 24.301

Information Element	Type	Presence
Protocol discriminator	Protocol discriminator	M
Security header type	Security header type	M
Attach complete message identity	Message type	M
ESM message container - Activate Default EPS Bearer Accept	ESM message container	M

Activate Default EPS Bearer Accept

UE → MME

TS 24.301

Information Element	Type	Presence
Protocol discriminator	Protocol discriminator	M
EPS bearer identity	EPS bearer identity	M
Procedure transaction identity	Procedure transaction identity	M
Activate default EPS bearer context accept message identity	Message type	M
Protocol configuration options	Protocol configuration options	O
Extended protocol configuration options	Extended protocol configuration options	O

Measurement Report

UE → MN-eNB

TS 36.331

```

MeasurementReport ::= SEQUENCE {
  criticalExtensions CHOICE {
    c1 CHOICE{
      measurementReport-r8 MeasurementReport-r8-IEs,
      spare7 NULL,
      spare6 NULL, spare5 NULL, spare4 NULL,
      spare3 NULL, spare2 NULL, spare1 NULL
    },
    criticalExtensionsFuture SEQUENCE {}
  }
}

```

```

}

MeasurementReport-r8-IEs ::= SEQUENCE {
  measResults MeasResults,
  nonCriticalExtension MeasurementReport-v8a0-IEs OPTIONAL
}

MeasurementReport-v8a0-IEs ::= SEQUENCE {
  lateNonCriticalExtension OCTET STRING OPTIONAL,
  nonCriticalExtension SEQUENCE {} OPTIONAL
}

```

MeasResults

```

MeasResults ::= SEQUENCE {
  measId MeasId,
  measResultPCell SEQUENCE {
    rsrpResult RSRP-Range,
    rsrqResult RSRQ-Range
  },
  measResultNeighCells CHOICE {
    ...,
    measResultNeighCellListNR-r15 MeasResultCellListNR-r15
  }
}

MeasResultCellListNR-r15 ::= SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultCellNR-r15

MeasResultCellNR-r15 ::= SEQUENCE {
  pci-r15 PhysCellIdNR-r15,
  measResultCell-r15 MeasResultNR-r15,
  measResultRS-IndexList-r15 MeasResultSSB-IndexList-r15 OPTIONAL,
  ...,
  [[ cgi-Info-r15 CGI-InfoNR-r15 OPTIONAL
  ]]
}

MeasResultNR-r15 ::= SEQUENCE {
  rsrpResult-r15 RSRP-RangeNR-r15 OPTIONAL,
  rsrqResult-r15 RSRQ-RangeNR-r15 OPTIONAL,
  rs-sinr-Result-r15 RS-SINR-RangeNR-r15 OPTIONAL,
  ...
}

```

SgNB Addition Request

MN-eNB → SN-gNB

TS 36.423

IE/Group Name	Presence
Message Type	M
MeNB UE X2AP ID	M
NR UE Security Capabilities	M
SgNB Security Key	M
SgNB UE Aggregate Maximum Bit Rate	M
Selected PLMN	O
Handover Restriction List	O

E-RABs To Be Added List**E-RABs To Be Added Item [E-RAB ID]**

IE/Group Name	Presence
E-RAB ID	M
DRB ID	M
EN-DC Resource Configuration	M
CHOICE Resource Configuration	M

PDCP present in SN

IE/Group Name	Presence
Full E-RAB Level QoS Parameters	M
Maximum MCG admissible E-RAB Level QoS Parameters	C-ifCGandSCGpresent_GBR
DL Forwarding	O
MeNB DL GTP TEID at MCG	C-ifMCGpresent
S1 UL GTP Tunnel Endpoint	M
RLC Mode	O

PDCP not present in SN

IE/Group Name	Presence
---------------	----------

IE/Group Name	Presence
Requested SCG E-RAB Level QoS Parameters	M
MeNB UL GTP TEID at PDCP	M
Secondary MeNB UL GTP TEID at PDCP	O
RLC Mode	M
UL configuration	C-ifMCGandSCGpresent
UL PDCP SN Length	O
DL PDCP SN Length	O
Duplication activation	O

IE/Group Name	Presence
MeNB to SgNB Container	M
SgNB UE X2AP ID	O
Expected UE Behaviour	O
MeNB UE X2AP ID Extension	O
Requested split SRBs	O
MeNB Resource Coordination Information	O
SgNB Addition Trigger Indication	O
Subscriber Profile ID for RAT/Frequency priority	O
MeNB Cell ID	M

SgNB Addition Request Acknowledge

SN-gNB → MN-eNB

[TS 36.423](#)

Nested payload::

Container	Payload
SgNB to MeNB Container	CG-Config

IE/Group Name	Presence
Message Type	M
MeNB UE X2AP ID	M

IE/Group Name	Presence
SgNB UE X2AP ID	M

E-RABs Admitted To Be Added List

E-RABs Admitted To Be Added Item [E-RAB ID]

IE/Group Name	Presence
E-RAB ID	M
EN-DC Resource Configuration	M
CHOICE Resource Configuration	M

PDCP present in SN

IE/Group Name	Presence
S1 DL GTP TEID at the SgNB	M
SgNB UL GTP TEID at PDCP	C-ifMCGpresent
RLC Mode	C-ifMCGpresent
DL Forwarding GTP Tunnel Endpoint	O
UL Forwarding GTP Tunnel Endpoint	O
Requested MCG E-RAB Level QoS Parameters	C-ifMCGandSCGpresent_GBRpresent
UL configuration	C-ifMCGandSCGpresent
UL PDCP SN Length	O
DL PDCP SN Length	O

PDCP not present in SN

IE/Group Name	Presence
SgNB DL GTP TEID at SCG	M
Secondary SgNB DL GTP TEID at SCG	O
LCID	O

IE/Group Name	Presence
E-RABs Not Admitted List	O
SgNB to MeNB Container - CG-Config	M

IE/Group Name	Presence
Criticality Diagnostics	O
MeNB UE X2AP ID Extension	O
Admitted split SRBs	O
SgNB Resource Coordination Information	O
RRC config indication	O

CG-Config

```

CG-Config ::=
    SEQUENCE {
        criticalExtensions
            CHOICE {
                c1
                    CHOICE {
                        cg-Config
                            CG-Config-IEs,
                        spare3 NULL, spare2 NULL, spare1 NULL
                    },
                criticalExtensionsFuture
                    SEQUENCE {}
            }
    }

CG-Config-IEs ::=
    SEQUENCE {
        scg-CellGroupConfig
            OCTET STRING (CONTAINING RRCReconfiguration)
        OPTIONAL,
        scg-RB-Config
            OCTET STRING (CONTAINING RadioBearerConfig)
        OPTIONAL,
        configRestrictModReq
            ConfigRestrictModReqSCG
        OPTIONAL,
        drx-InfoSCG
            DRX-Info
        OPTIONAL,
        candidateCellInfoListSN
            OCTET STRING (CONTAINING MeasResultList2NR)
        OPTIONAL,
        measConfigSN
            MeasConfigSN
        OPTIONAL,
        selectedBandCombinationNR
            BandCombinationInfoSN
        fr-InfoListSCG
            FR-InfoList
        OPTIONAL,
        candidateServingFreqListNR
            CandidateServingFreqListNR
        OPTIONAL,
        nonCriticalExtension
            CG-Config-v1540-IEs
        OPTIONAL
    }

CG-Config-v1540-IEs ::= SEQUENCE {
    pSCellFrequency
        ARFCN-ValueNR
    OPTIONAL,
    reportCGI-Request
        SEQUENCE {

```

```

        requestedCellInfo          SEQUENCE {
            ssbFrequency            ARFCN-ValueNR,
            cellForWhichToReportCGI PhysCellId
        }
    OPTIONAL
    }
    OPTIONAL,
        ph-InfoSCG                PH-TypeListSCG
    OPTIONAL,
        nonCriticalExtension       SEQUENCE {}
    OPTIONAL
    }

PH-TypeListSCG ::= SEQUENCE (SIZE (1..maxNrofServingCells)) OF
PH-InfoSCG

PH-InfoSCG ::= SEQUENCE {
    servCellIndex                ServCellIndex,
    ph-Uplink                    PH-UplinkCarrierSCG,
    ph-SupplementaryUplink       PH-UplinkCarrierSCG
    OPTIONAL,
    ...
}

PH-UplinkCarrierSCG ::= SEQUENCE{
    ph-Type1or3                  ENUMERATED {type1, type3},
    ...
}

MeasConfigSN ::= SEQUENCE {
    measuredFrequenciesSN       SEQUENCE (SIZE (1..maxMeasFreqsSN)) OF NR-
    FreqInfo OPTIONAL,
    ...
}

NR-FreqInfo ::= SEQUENCE {
    measuredFrequency            ARFCN-ValueNR
    OPTIONAL,
    ...
}

ConfigRestrictModReqSCG ::= SEQUENCE {
    requestedBC-MRDC             BandCombinationInfoSN
    OPTIONAL,
    requestedP-MaxFR1           P-Max
    OPTIONAL,
    ...
}

BandCombinationIndex ::= INTEGER (1..maxBandComb)

```



```

BandCombinationInfoSN ::= SEQUENCE {
    bandCombinationIndex      BandCombinationIndex,
    requestedFeatureSets      FeatureSetEntryIndex
}

FR-InfoList ::= SEQUENCE (SIZE (1..maxNrofServingCells-1)) OF FR-Info

FR-Info ::= SEQUENCE {
    servCellIndex      ServCellIndex,
    fr-Type            ENUMERATED {fr1, fr2}
}

CandidateServingFreqListNR ::= SEQUENCE (SIZE (1.. maxFreqIDC-MRDC)) OF ARFCN-
ValueNR

```

RRC Connection Reconfiguration for 5G-NR Bearer

MN-eNB → UE

[TS 36.331](#)

Nested payload::

Container	Payload
nr-SecondaryCellGroupConfig-r15	CG-Config

```

RRCConnectionReconfiguration ::= SEQUENCE {
    rrc-TransactionIdentifier RRC-TransactionIdentifier,
    criticalExtensions CHOICE {
        c1 CHOICE{
            rrcConnectionReconfiguration-r8 RRCConnectionReconfiguration-r8-IEs,
            spare7 NULL,
            spare6 NULL, spare5 NULL, spare4 NULL,
            spare3 NULL, spare2 NULL, spare1 NULL
        },
        criticalExtensionsFuture SEQUENCE {}
    }
}

RRCConnectionReconfiguration-r8-IEs ::= SEQUENCE {
    measConfig MeasConfig OPTIONAL, -- Need ON
    mobilityControlInfo MobilityControlInfo OPTIONAL, -- Cond HO
    dedicatedInfoNASList SEQUENCE (SIZE(1..maxDRB)) OF
    DedicatedInfoNAS OPTIONAL, -- Cond nonHO
    radioResourceConfigDedicated RadioResourceConfigDedicated OPTIONAL, -- Cond HO-

```

```

toEUTRA
  securityConfigHO SecurityConfigHO OPTIONAL, -- Cond HO-toEPC
  nonCriticalExtension RRCConnectionReconfiguration-v890-IEs OPTIONAL
}
/*---clipped---*/

```

5G NR Information Elements

```

RRCConnectionReconfiguration-v1510-IEs ::= SEQUENCE {
  nr-Config-r15 CHOICE {
    release NULL,
    setup SEQUENCE {
      endc-ReleaseAndAdd-r15 BOOLEAN,
      nr-SecondaryCellGroupConfig-r15 OCTET STRING OPTIONAL, -- Need ON /* Contains
cg-Config */
      p-MaxEUTRA-r15 P-Max OPTIONAL -- Need ON
    }
  } OPTIONAL, -- Need ON
  sk-Counter-r15 INTEGER (0.. 65535) OPTIONAL, -- Need ON
  nr-RadioBearerConfig1-r15 OCTET STRING OPTIONAL, -- Need ON
  nr-RadioBearerConfig2-r15 OCTET STRING OPTIONAL, -- Need ON
  tdm-PatternConfig-r15 CHOICE {
    release NULL,
    setup SEQUENCE {
      subframeAssignment-r15 SubframeAssignment-r15,
      harq-Offset-r15 INTEGER (0.. 9)
    }
  } OPTIONAL, -- Cond FDD-PCell
  nonCriticalExtension RRCConnectionReconfiguration-v1530-IEs OPTIONAL
}

```

```

RRCConnectionReconfiguration-v1530-IEs ::= SEQUENCE {
  securityConfigHO-v1530 SecurityConfigHO-v1530 OPTIONAL, -- Cond HO-5GC
  sCellGroupToReleaseList-r15 SCellGroupToReleaseList-r15 OPTIONAL, -- Need ON
  sCellGroupToAddModList-r15 SCellGroupToAddModList-r15 OPTIONAL, -- Need ON
  dedicatedInfoNASList-r15 SEQUENCE (SIZE(1..maxDRB-r15)) OF
DedicatedInfoNAS OPTIONAL, -- Cond nonHO
  p-MaxUE-FR1-r15 P-Max OPTIONAL, -- Need OR
  smtc-r15 MTC-SSB-NR-r15 OPTIONAL, -- Need OP
  nonCriticalExtension SEQUENCE {} OPTIONAL
}

```

```

SCellGroupToAddModList-r15 ::= SEQUENCE (SIZE (1..maxSCellGroups-r15)) OF
SCellGroupToAddMod-r15

```

```

SCellGroupToAddMod-r15 ::= SEQUENCE {
  sCellGroupIndex-r15 SCellGroupIndex-r15,
  sCellConfigCommon-r15 SCellConfigCommon-r15 OPTIONAL, -- Need ON

```

```

sCellToReleaseList-r15 SCellToReleaseListExt-r13 OPTIONAL, -- Need ON
sCellToAddModList-r15 SCellToAddModListExt-r13 OPTIONAL -- Need ON
}

SCellGroupIndex-r15 ::= INTEGER (1..maxSCellGroups-r15)

SCellConfigCommon-r15 ::= SEQUENCE {
  radioResourceConfigCommonSCell-r15 RadioResourceConfigCommonSCell-r10 OPTIONAL, --
Need ON
  radioResourceConfigDedicatedSCell-r15 RadioResourceConfigDedicatedSCell-r10
OPTIONAL,-- Need ON
  antennaInfoDedicatedSCell-r15 AntennaInfoDedicated-v10i0 OPTIONAL -- Need ON
}

SecurityConfigHO-v1530 ::= SEQUENCE {
  handoverType-v1530 CHOICE {
    intra5GC-r15 SEQUENCE {
      securityAlgorithmConfig-r15 SecurityAlgorithmConfig OPTIONAL, -- Cond fullConfig
      keyChangeIndicator-r15 BOOLEAN,
      nextHopChainingCount-r15 NextHopChainingCount,
      nas-Container-r15 OCTET STRING OPTIONAL -- Need ON
    },
    fivegc-ToEPC-r15 SEQUENCE {
      securityAlgorithmConfig-r15 SecurityAlgorithmConfig,
      nextHopChainingCount-r15 NextHopChainingCount
    },
    epc-To5GC-r15 SEQUENCE {
      securityAlgorithmConfig-r15 SecurityAlgorithmConfig,
      nas-Container-r15 OCTET STRING
    }
  },
  ...
}

```

RRC Connection Reconfiguration Complete for 5G-NR Bearer

UE → MN-eNB

Nested payload:

Container	Payload
scg-ConfigResponseNR-r15	NR RRCReconfigurationComplete

[TS 36.331](#)

```

RRCConnectionSetupComplete ::= SEQUENCE {
  rrc-TransactionIdentifier RRC-TransactionIdentifier,

```

```

criticalExtensions CHOICE {
  c1 CHOICE{
    rrcConnectionSetupComplete-r8 RRCConnectionSetupComplete-r8-IEs,
    spare3 NULL, spare2 NULL, spare1 NULL
  },
  criticalExtensionsFuture SEQUENCE {}
}
}

RRCConnectionSetupComplete-r8-IEs ::= SEQUENCE {
  selectedPLMN-Identity INTEGER (1..maxPLMN-r11),
  registeredMME RegisteredMME OPTIONAL,
  dedicatedInfoNAS DedicatedInfoNAS,
  nonCriticalExtension RRCConnectionSetupComplete-v8a0-IEs OPTIONAL
}

RRCConnectionSetupComplete-v8a0-IEs ::= SEQUENCE {
  lateNonCriticalExtension OCTET STRING OPTIONAL,
  nonCriticalExtension RRCConnectionSetupComplete-v1020-IEs OPTIONAL
}

RRCConnectionSetupComplete-v1020-IEs ::= SEQUENCE {
  gummei-Type-r10 ENUMERATED {native, mapped} OPTIONAL,
  rlf-InfoAvailable-r10 ENUMERATED {true} OPTIONAL,
  logMeasAvailable-r10 ENUMERATED {true} OPTIONAL,
  rn-SubframeConfigReq-r10 ENUMERATED {required, notRequired} OPTIONAL,
  nonCriticalExtension RRCConnectionSetupComplete-v1130-IEs OPTIONAL
}
/*-----clipped-----*/

RRCConnectionReconfigurationComplete-v1510-IEs ::= SEQUENCE {
  scg-ConfigResponseNR-r15 OCTET STRING OPTIONAL, /* Contains the NR
RRCReconfigurationComplete */
  nonCriticalExtension RRCConnectionReconfigurationComplete-v1530-IEs OPTIONAL
}

RRCConnectionReconfigurationComplete-v1530-IEs ::= SEQUENCE {
  logMeasAvailableBT-r15 ENUMERATED {true} OPTIONAL,
  logMeasAvailableWLAN-r15 ENUMERATED {true} OPTIONAL,
  flightPathInfoAvailable-r15 ENUMERATED {true} OPTIONAL,
  nonCriticalExtension SEQUENCE {} OPTIONAL
}

```

NR RRCReconfigurationComplete

TS 38.331

```

RRCReconfigurationComplete ::=
    rrc-TransactionIdentifier
    criticalExtensions
        rrcReconfigurationComplete
        criticalExtensionsFuture
    }
}

RRCReconfigurationComplete-IEs ::=
    lateNonCriticalExtension
OPTIONAL,
    nonCriticalExtension
OPTIONAL
}

RRCReconfigurationComplete-v1530-IEs ::=
    uplinkTxDirectCurrentList
OPTIONAL,
    nonCriticalExtension
OPTIONAL
}

SEQUENCE {
    RRC-TransactionIdentifier,
    CHOICE {
        RRCReconfigurationComplete-IEs,
        SEQUENCE {}
    }
}

SEQUENCE {
    OCTET STRING
    RRCReconfigurationComplete-v1530-IEs
}

SEQUENCE {
    UplinkTxDirectCurrentList
    SEQUENCE {}
}
    
```

SgNB Reconfiguration Complete

MN-eNB → SN-gNB

[TS 36.423](#)

Nested payload::

Container	Payload
MeNB to SgNB Container	NR RRCReconfigurationComplete

IE/Group Name	Presence
Message Type	M
MeNB UE X2AP ID	M
SgNB UE X2AP ID	M
Response Information	M

CHOICE Response Type	
Configuration successfully applied	
IE/Group Name	Presence

IE/Group Name	Presence
---------------	----------

MeNB to SgNB Container - NR RRCReconfigurationComplete	O
--	---

Configuration rejected

IE/Group Name	Presence
---------------	----------

Cause	M
-------	---

IE/Group Name	Presence
---------------	----------

MeNB UE X2AP ID Extension	O
---------------------------	---

SN Status Transfer

MN-eNB → SN-gNB

TS 36.423

IE/Group Name	Presence
---------------	----------

Message Type	M
--------------	---

Old eNB UE X2AP ID	M
--------------------	---

New eNB UE X2AP ID	M
--------------------	---

E-RABs Subject To Status Transfer List

E-RABs Subject To Status Transfer Item [E-RAB ID]

IE/Group Name	Presence
---------------	----------

E-RAB ID	M
----------	---

Receive Status Of UL PDCP SDUs	O
--------------------------------	---

UL COUNT Value	M
----------------	---

DL COUNT Value	M
----------------	---

Receive Status Of UL PDCP SDUs Extended	O
---	---

UL COUNT Value Extended	O
-------------------------	---

DL COUNT Value Extended	O
-------------------------	---

Receive Status Of UL PDCP SDUs for PDCP SN Length 18	O
--	---

UL COUNT Value for PDCP SN Length 18	O
--------------------------------------	---

DL COUNT Value for PDCP SN Length 18	O
--------------------------------------	---

IE/Group Name	Presence
Old eNB UE X2AP ID Extension	O
New eNB UE X2AP ID Extension	O
SgNB UE X2AP ID	O

SS/PBCH Block

SN-gNB → UE

[TS 38.211](#)

NR PSS

SN-gNB → UE

The Primary Synchronization Signal (PSS) is used for radio frame level synchronization. The PSS is a Linear Feedback Shift Register sequence that is designed to provide a long non-repeating sequence.

- The PSS is mapped to 127 sub-carriers around the lower end of the system bandwidth.
- The PSS helps the UE locate the first symbol of a downlink radio frame.

NR SSS

The Secondary Synchronization Signal (SSS) is used to subframe synchronization.

- The SSS helps the UE locate the first symbol in a downlink subframe.
- The PSS and the SSS are used to obtain the Physical Layer Cell Id (PCI).

NR PBCH

```

MIB ::=
    systemFrameNumber          SEQUENCE {
        subCarrierSpacingCommon    BIT STRING (SIZE (6)),
        ssb-SubcarrierOffset       ENUMERATED {scs15or60, scs30or120},
        dmrs-TypeA-Position        INTEGER (0..15),
        pdcch-ConfigSIB1          ENUMERATED {pos2, pos3},
        cellBarred                 PDCCH-ConfigSIB1,
        intraFreqReselection       ENUMERATED {barred, notBarred},
        spare                      ENUMERATED {allowed, notAllowed},
    }
    spare                      BIT STRING (SIZE (1))

```

Resources for SS/PBCH Block

Signal	OFDM symbol number relative to the start of an SS/PBCH block	Subcarrier number relative to the start of an SS/PBCH block
PSS	0	56, 57, ..., 182
SSS	2	56, 57, ..., 182
PBCH	1, 3	0, 1, ..., 239
PBCH	2	0, 1, ..., 47, 192, 193, ..., 239

NR Preamble

UE → gNB

[TS 38.213](#), [TS 38.321](#), [TS 38.211](#)

The UE picks a random preamble. The preamble is referenced with the Random Access Preamble Id (RAPID). The preamble transmission is a Zadoff-Chu sequence.

Each preamble transmission is associated with an [RA-RNTI](#).

NR RA-RNTI

The RA-RNTI associated with the PRACH in which the Random Access Preamble is transmitted, is computed as:

$$\text{RA-RNTI} = 1 + s_id + 14 \times t_id + 14 \times 80 \times f_id + 14 \times 80 \times 8 \times ul_carrier_id$$

Where:

Identifier	Description
s_id	Index of the first OFDM symbol of the specified PRACH ($0 \leq s_id < 14$)
t_id	Index of the first slot of the specified PRACH in a system frame ($0 \leq t_id < 80$)
f_id	Index of the specified PRACH in the frequency domain ($0 \leq f_id < 8$)
ul_carrier_id	Uplink carrier used for Msg1 transmission (0 for NUL carrier, and 1 for SUL carrier)

PDCCH DCI Format 1_0

gNB → UE

[TS 38.212](#)

DCI Format 1_0 is used to assign downlink resources.

Format 1_0 - CRC Scrambled with RA-RNTI

In response to a PRACH transmission, a UE attempts to detect a DCI Format 1_0 with PDCCH CRC scrambled by the RA-RNTI corresponding to the RACH transmission. The UE looks for message during a configured window of length $ra\text{-ResponseWindow}$.

The RA-RNTI scrambled DCI message signals the frequency and time resources assigned for the transmission of the Transport Block containing the Random Access Response message.

The following information is transmitted by means of the RA-RNTI scrambled DCI Format 1_0:

Field	Bits
Frequency domain resource assignment	$\lceil \log_2(N_{RB}^{DL,BWP}(N_{RB}^{DL,BWP} + 1)/2) \rceil$ $N_{RB}^{DL,BWP}$ is the size of CORESET 0
Time domain resource assignment	4
VRB-to-PRB mapping	1
Modulation and coding scheme	5
TB scaling	2
Reserved bits	16

Format 1_0 - CRC Scrambled with C-RNTI

The following information is transmitted by a DCI Format 1_0 with PDCCH CRC scrambled by the assigned C-RNTI:

Field	Bits
Identifier of DCI formats	1
Frequency domain resource assignment	$\lceil \log_2(N_{RB}^{DL,BWP}(N_{RB}^{DL,BWP} + 1)/2) \rceil$ $N_{RB}^{DL,BWP}$ is the size of the active DL bandwidth part in case DCI format 1_0 is monitored in the UE specific search space if DCH sizes ≤ 4 and DCI size with C-RNTI ≤ 3 . Otherwise $N_{RB}^{DL,BWP}$ is the size of CORESET 0
Time domain resource assignment	4
VRB-to-PRB mapping	1
Modulation and coding scheme	5
New data indicator	1
Redundancy version	2

Field	Bits
HARQ process number	4
Downlink assignment index	2
TPC command for scheduled PUCCH	2
PUCCH resource indicator	3
PDSCH-to-HARQ_feedback timing indicator	3

NR Random Access Response

gNB → UE

[TS 38.213](#), [TS 38.321](#)

1. The UE listens on the PDCCH addressed by the RA-RNTI.
2. Once the PDCCH with the RA-RNTI is decoded, the UE uses the RB resources in the message to receive the downlink transport block.
3. The downlink transport block contains the MAC PDU.
 - The UE MAC PDU consists of one or more MAC subPDUs.
 - Since multiple UEs may send a Preamble in the same RACH opportunity, they will all be addressed by the same RA-RNTI.
 - Thus, multiple Random Access Responses (RAR) may be carried in a single MAC PDU (They correspond to different UEs that initiated the random access procedure in the same RACH opportunity).
 - Each RAR in the MAC PDU is addressed to a different UE via RAPID value.

NR RAR MAC PDU

subPDU	1 bit	1 bit	6-bit	MAC subPDU payload
MAC subPDU 1	E	T	RAPID 1	MAC payload for Random Access Response
MAC subPDU 2	E	T	RAPID 2	MAC payload for Random Access Response
MAC subPDU 3	E	T	RAPID 3	MAC payload for Random Access Response
⋮				
MAC subPDU n				
Padding (optional)				

NR E/T/RAPID MAC subheader

1 bit	1 bit	6-bit
E	T	RAPID

NR MAC Payload for Random Access Response

Field	Description	Bits
R	Reserved bit (set to "0")	1
Timing Advance Command	The Timing Advance Command field indicates the index value TA used to control the amount of timing adjustment that the MAC entity must apply in TS 38.213.	12
RAR UL Grant	The Uplink Grant field indicates the resources to be used on the uplink in TS 38.213	27
Temporary C-RNTI	The Temporary C-RNTI field indicates the temporary identity that is used by the MAC entity during Random Access.	16

NR RAR UL Grant

RAR grant field	Number of bits
Frequency hopping flag	1
Msg3 PUSCH frequency resource allocation	14
Msg3 PUSCH time resource allocation	4
MCS	4
TPC command for Msg3 PUSCH	3
CSI request	1

NR MAC PDU

SN-gNB → UE

UE → SN-gNB

TS 38.321

subPDU	1 bit	1 bit	6-bit	Length	MAC subPDU payload
MAC subPDU 1	R	F	LCID	2 byte	Payload
MAC subPDU 2	R	F	LCID	1 byte	Payload
⋮					

subPDU	1 bit	1 bit	6-bit	Length	MAC subPDU payload
MAC subPDU n					
Padding (optional)					

PDCCH DCI Format 0_0

gNB → UE

[TS 38.212](#)

DCI Format 0_0 is used to assign uplink resources to the UE.

Format 0_0 - CRC Scrambled with C-RNTI

The following information is transmitted by a DCI Format 0_0 with PDCCH CRC scrambled by the assigned C-RNTI:

Field	Bits
Identifier of DCI formats	1
Frequency domain resource assignment	$\lceil \log_2(N_{RB}^{UL,BWP}(N_{RB}^{UL,BWP} + 1)/2) \rceil$ $N_{RB}^{UL,BWP}$ is the size of the active UL bandwidth part in case DCI format 0_0 is monitored in the UE specific search space if DCH sizes ≤ 4 and DCI size with C-RNTI ≤ 3 . Otherwise $N_{RB}^{UL,BWP}$ is the size of the initial UL bandwidth part.
Time domain resource assignment	4
Frequency hopping flag	1
Modulation and coding scheme	5
New data indicator	1
Redundancy version	2

Field	Bits
HARQ process number	4
Downlink assignment index	2
TPC command for scheduled PUSCH	2
UL/SUL indicator	1

Dual Connectivity PHR MAC CE

C ₇	C ₆	C ₅	C ₄	C ₃	C ₂	C ₁	R
C ₁₅	C ₁₄	C ₁₃	C ₁₂	C ₁₁	C ₁₀	C ₉	C ₈
C ₂₃	C ₂₂	C ₂₁	C ₂₀	C ₁₉	C ₁₈	C ₁₇	C ₁₆
C ₃₁	C ₃₀	C ₂₉	C ₂₈	C ₂₇	C ₂₆	C ₂₅	C ₂₄
P	V	PH (Type 2, PCell)					
R	R	P _{C_{MAX,c} 1}					
P	V	PH (Type 2, PSCell)					
R	R	P _{C_{MAX,c} 2}					
P	V	PH (Type 1, PCell)					
R	R	P _{C_{MAX,c} 3}					
P	V	PH (Type x, Serving Cell 1)					
R	R	P _{C_{MAX,c} 4}					
...					
...					
P	V	PH (Type x, Serving Cell n)					

R	R	$P_{\text{CMAX},c}$ m
---	---	-----------------------

RRC Transfer

IE/Group Name	Presence
---------------	----------

Message Type	M
--------------	---

MeNB UE X2AP ID	M
-----------------	---

SgNB UE X2AP ID	M
-----------------	---

split SRB

IE/Group Name	Presence
---------------	----------

RRC Container	O
---------------	---

SRB Type	M
----------	---

Delivery status	O
-----------------	---

NR UE Report

IE/Group Name	Presence
---------------	----------

RRC Container	M
---------------	---

IE/Group Name	Presence
---------------	----------

MeNB UE X2AP ID Extension	O
---------------------------	---

Secondary RAT Data Usage Report

SN-gNB → MN-eNB

[TS 36.423](#)

IE/Group Name	Presence
---------------	----------

Message Type	M
--------------	---

MeNB UE X2AP ID	M
-----------------	---

SgNB UE X2AP ID	M
-----------------	---

Secondary RAT Usage Report list	M
---	---

MeNB UE X2AP ID Extension	O
---------------------------	---

Secondary RAT Usage Report List

[TS 36.423](#)

This IE provides information on the NR resources used with EN-DC.

Secondary RAT Usage Report List**Secondary RAT usage report Item [Bearer Id]**

IE/Group Name	Presence
E-RAB ID	M
Secondary RAT Type	M
E-RAB Usage Report List	

E-RAB Usage Report Item [Start Time:End Time]

IE/Group Name	Presence
Start timestamp	M
End timestamp	M
Usage count UL	M
Usage count DL	M

gNB Status Indication

SN-gNB → MN-eNB

[TS 36.423](#)

IE/Group Name	Presence	Value
Message Type	M	
Enum:		
gNB Overload Information	M	<ul style="list-style-type: none"> • overloaded • not-overloaded

5G specifications

Specification	Version	Description
TS 38.211	V15.4.0 (2018-12)	NR; Physical channels and modulation
TS 38.212	V15.3.0 (2018-09)	NR; Multiplexing and channel coding

Specification	Version	Description
TS 38.213	V15.3.0 (2018-09)	NR; Physical layer procedures for control
TS 38.321	V15.3.0 (2018-09)	NR; Medium Access Control (MAC) protocol specification
TS 38.331	V15.4.0 (2018-12)	NR; Radio Resource Control (RRC); Protocol specification

4G specifications

Specification	Version	Description
TS 24.301	V15.5.0 (2018-12)	Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS)
TS 36.211	V15.3.0 (2018-09)	E-UTRA; Physical channels and modulation
TS 36.212	V15.3.0 (2018-09)	E-UTRA; Multiplexing and channel coding
TS 36.213	V15.3.0 (2018-09)	E-UTRA; Physical layer procedures
TS 36.321	V15.4.0 (2018-12)	E-UTRA; Medium Access Control (MAC) protocol specification
TS 36.331	V15.4.0 (2018-12)	E-UTRA; Radio Resource Control (RRC); Protocol specification
TS 36.413	V15.4.0 (2018-12)	E-UTRA; S1 Application Protocol (S1AP); Protocol specification
TS 37.340	V15.4.0 (2018-12)	E-UTRA and NR; Multi connectivity; Stage 2