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Contents

Foreword

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1 Scope

The present document defines the NR UE Radio Access Capability Parameters.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

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

[2] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception Part 1: Range 1 Standalone".

[3] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception Part 2: Range 2 Standalone".

[4] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception Part 3: Range 1 and Range 2 Interworking operation with other radios".

[5] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[6] 3GPP TS 38.211: "NR; Physical channels and modulation".

[7] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR Multi-connectivity".

[8] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[9] 3GPP TS 38.331: "NR; Radio Resource Control (RRC) protocol specification".

[10] 3GPP TS 38.212: "NR; Multiplexing and channel coding".

[11] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[12] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[13] 3GPP TS 38.215: "NR; Physical layer measurements".

[14] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA) radio transmission and reception".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Fallback band combination: A band combination that would result from another band combination by releasing at least one SCell or uplink configuration of SCell.

3.2 Symbols

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

MaxDLDataRate: Maximum DL data rate
MaxDLDataRate_MN: Maximum DL data rate in the MN
MaxDLDataRate_SN: Maximum DL data rate in the SN
MaxULDataRate: Maximum UL data rate

3.3 Abbreviations

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

DL Downlink
MAC Medium Access Control
MCG Master Cell Group
MN Master Node
MR-DC Multi-RAT Dual Connectivity
PDCP Packet Data Convergence Protocol
RLC Radio Link Control
RTT Round Trip Time
SCG Secondary Cell Group
SDAP Service Data Adaptation Protocol
SN Secondary Node
UL Uplink

4 UE radio access capability parameters

4.1 Supported max data rate

4.1.1 General

The DL and UL max data rate supported by the UE is calculated by band or band combinations supported by the UE. A UE supporting MR-DC shall support the calculated DL and UL max data rate defined in 4.1.2. A non MR-DC capable UE supporting a max data rate lower than the calculated max data rate indicates the DL and UL max data rate by the UE category as defined in 4.1.3.

4.1.2 Max data rate without *ue-CategoryDL* and *ue-CategoryUL*

For NR, the approximate data rate for a given number of aggregated carriers in a band or band combination is computed as follows.

$$\text{data rate (in Mbps)} = 10^{-6} \cdot \sum_{j=1}^{J} \left(v_{Layers}^{(j)} \cdot Q_m^{(j)} \cdot f^{(j)} \cdot R_{\max} \cdot \frac{N_{PRB}^{BW(j),\mu} \cdot 12}{T_s^{\mu}} \cdot \left(1 - OH^{(j)}\right) \right)$$

wherein

J is the number of aggregated component carriers in a band or band combination
R_{max} = 948/1024
For the j-th CC,

$v_{Layers}^{(j)}$ is the maximum number of layers

$Q_m^{(j)}$ is the maximum modulation order

$f^{(j)}$ is the scaling factor

The scaling factor can take the values 1, 0.8, 0.75, and 0.4.

$f^{(j)}$ is signalled per band and per band per band combination

μ is the numerology (as defined in TS 38.211 [6])

T_s^μ is the average OFDM symbol duration in a subframe for numerology μ, i.e. $T_s^\mu = \frac{10^{-3}}{14 \cdot 2^\mu}$. Note that normal cyclic prefix is assumed.

$N_{PRB}^{BW(j),\mu}$ is the maximum RB allocation in bandwidth $BW^{(j)}$ with numerology μ, as defined in 5.3 TS 38.101-1 [2] and 5.3 TS 38.101-2 [3], where $BW^{(j)}$ is the UE supported maximum bandwidth in the given band or band combination.

$OH^{(j)}$ is the overhead and takes the following values
[0.14], for frequency range FR1 for DL
[0.18], for frequency range FR2 for DL
[0.08], for frequency range FR1 for UL
[0.10], for frequency range FR2 for UL

NOTE: Only one of the UL or SUL carriers (the one with the higher data rate) is counted for a cell operating SUL.

The approximate maximum data rate can be computed as the maximum of the approximate data rates computed using the above formula for each of the supported band or band combinations.

For EUTRA in case of MR-DC, the approximate data rate for a given number of aggregated carriers in a band or band combination is computed as follows.

Data rate (in Mbps) = $10^{-3} * \sum_{j=1}^{J} TBS_j$

wherein

J is the number of aggregated EUTRA component carriers in MR-DC band combination

TBS_j is the total maximum number of DL-SCH transport block bits received within a 1ms TTI for j-th CC, as derived from TS36.213 [22] based on the UE supported maximum MIMO layers for the j-th carrier, and based on the modulation order and number of PRBs based on the bandwidth of the j-th carrier.

The approximate maximum data rate can be computed as the maximum of the approximate data rates computed using the above formula for each of the supported band or band combinations.

For MR-DC, the approximate maximum data rate is computed as the sum of the approximate maximum data rates from NR and EUTRA.

4.1.3 Max data rate with *ue-CategoryDL* and *ue-CategoryUL*

4.1.4 Total layer 2 buffer size

The total layer 2 buffer size is defined as the sum of the number of bytes that the UE is capable of storing in the RLC transmission windows and RLC reception and reordering windows for all radio bearers, and for UEs capable of split bearers, also in PDCP reordering windows for all split radio bearers.

The required total layer 2 buffer size for split bearer operation in MR-DC is calculated by *MaxULDataRate * RLC RTT + MaxDLDataRate_SN * RLC RTT + MaxDLDataRate_MN * (RLC RTT + Xn delay + Queuing in SN)*. Otherwise it is calculated by *MaxDLDataRate * RLC RTT + MaxULDataRate * RLC RTT*. The required total layer 2 buffer size is determined as the maximum total layer 2 buffer size of all the calculated ones for each band combination in the supported MR-DC or NR band combinations.

wherein

Xn delay + Queuing in SN = 25ms

RLC RTT for EUTRA cell group = 75ms

RLC RTT for NR cell group is defined in Table 4.1.4-1

Table 4.1.4-1: RLC RTT per SCS

SCS (KHz)	RLC RTT (ms)
15KHz	TBD
30KHz	TBD
60KHz	TBD
120KHz	TBD

Editor's Note: Both MN terminated split bearer and SN terminated split bearers are considered for L2 buffer size calculation for MR-DC and discussion/decision on the detailed equation is needed.

4.2 UE Capability Parameters

4.2.1 Introduction

If the UE supports both FDD and TDD, set all fields in UE-MRDC-Capability and/or UE-NR-Capability, except fdd-UE-MRDC-Capability, tdd-UE-MRDC-Capability, fdd-UE-NR-Capability, and tdd-UE-NR-Capability, to include the values applicable for both FDD and TDD (i.e. functionality supported by both modes). If (some of) the UE capability fields have a different value for FDD and TDD, the UE includes supported FDD/TDD dedicated additional functionality by the field in fdd-UE-MRDC-Capability/tdd-UE-MRDC-Capability and/or fdd-UE-NR-Capability/tdd-UE-NR-Capability. If the UE supports either FDD or TDD only, set all fields in UE-MRDC-Capability and/or UE-NR-Capability, except fdd-UE-MRDC-Capability, tdd-UE-MRDC-Capability, fdd-UE-NR-Capability and tdd-UE-NR-Capability, to include the values applicable for the FDD/TDD supported by the UE.

4.2.2 General parameters

Definitions for parameters	Per	M	FDD-TDD diff
splitSRB-WithOneUL-Path Indicates whether the UE supports UL transmission via either MCG path or SCG path for the split SRB as specified in TS 37.340 [7].	UE	TBD	Yes
splitDRB-withUL-Both-MCG-SCG Indicates whether the UE supports UL transmission via both MCG path and SCG path for the split DRB as specified in TS 37.340 [7].	UE	TBD	Yes
srb3 Indicates whether the UE supports direct SRB between the SN and the UE as specified in TS 37.340 [7].	UE	TBD	Yes

4.2.3 SDAP Parameters

Editor's Note: Targeted for completion in June 2018.

4.2.4 PDCP Parameters

Definitions for parameters	Per	M	FDD-TDD diff
continueROHC-Context Defines whether the UE supports ROHC context continuation operation where the UE does not reset the current ROHC context upon handover.	UE	No	No
dataRateDRB-IP Defines the upper bound of the aggregated data rate of user plane integrity protected data in either UL or DL DRBs. Value 64kbps corresponds to the aggregated data rate of user plane integrity protected data in either UL or DL cannot exceed 64kbps and so on. It is not supported in this version and is targeted for completion in June 2018. NOTE: It may be moved to NAS as part of the rest of the UE security capability (CT1/SA3 confirmation is needed).	UE	N/A	No
maxNumberROHC-ContextSessions Defines the maximum number of header compression context sessions supported by the UE, excluding context sessions that leave all headers uncompressed.	UE	No	No
outOfOrderDelivery Indicates whether UE supports Out of order delivery of data to upper layers by PDCP.	UE	TBD	No
shortSN Indicates whether the UE supports 12 bit length of PDCP sequence number.	UE	Yes	No
supportedROHC-Profiles Defines which ROHC profiles from the list below are supported by the UE: - 0x0000 ROHC No compression (RFC 5795) - 0x0001 ROHC RTP/UDP/IP (RFC 3095, RFC 4815) - 0x0002 ROHC UDP/IP (RFC 3095, RFC 4815) - 0x0003 ROHC ESP/IP (RFC 3095, RFC 4815) - 0x0004 ROHC IP (RFC 3843, RFC 4815) - 0x0006 ROHC TCP/IP (RFC 6846) - 0x0101 ROHC RTP/UDP/IP (RFC 5225) - 0x0102 ROHC UDP/IP (RFC 5225) - 0x0103 ROHC ESP/IP (RFC 5225) - 0x0104 ROHC IP (RFC 5225) A UE that supports one or more of the listed ROHC profiles shall support ROHC profile 0x0000 ROHC uncompressed (RFC 5795).	UE	No	No
uplinkOnlyROHC-Profiles Indicates which ROHC profile(s) from the list below are supported in uplink-only ROHC operation by the UE. - 0x0006 ROHC TCP (RFC [6846]) A UE that supports uplink-only ROHC profile(s) shall support ROHC profile 0x0000 ROHC uncompressed (RFC 5795).	UE	No	No

4.2.5 RLC parameters

Definitions for parameters	Per	M	FDD-TDD diff
am-WithShortSN Indicates whether the UE supports RLC AM with 12 bit length of RLC sequence number.	UE	Yes	No
um-WIthLongSN Indicates whether the UE supports RLC UM with 12 bit length of RLC sequence number.	UE	Yes	No
um-WithShortSN Indicates whether the UE supports RLC UM with 6 bit length of RLC sequence number.	UE	Yes	No

4.2.6 MAC parameters

Definitions for parameters	Per	M	FDD-TDD diff
lcp-Restriction Indicates whether UE supports the selection of logical channels for each UL grant based on RRC configured restriction.	UE	No	No
logicalChannelSR-DelayTimer Indicates whether the UE supports the logicalChannelSR-DelayTimer as specified in TS 38.321 [8]	UE	TBD	Yes
longDRX-Cycle Indicates whether UE supports long DRX cycle as specified in TS 38.321 [8].	UE	Yes	Yes
multipleConfiguredGrant Indicates whether UE supports [16] configured grant configurations per cell group.	UE	No	Yes
multipleSR-Configurations Indicates whether the UE supports [8] SR configurations per cell group.	UE	No	Yes
pucch-SpatialRelInfoMAC-CE Indicates whether the UE supports indication of PUCCH-spatialrelationinfo by a MAC CE per PUCCH resource.	UE	No	No
shortDRX-Cycle Indicates whether UE supports short DRX cycle as specified in TS 38.321 [8].	UE	Yes	Yes
skipUplinkTxDynamic Indicates whether the UE supports skipping of UL transmission for an uplink grant indicated on PDCCH if no data is available for transmission as specified in TS 38.321 [8].	UE	TBD	Yes