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1 Scope

The present document specifies the NR Radio Link Control (RLC) protocol for the UE – NR radio interface.

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 38.300: "NR Overall Description; Stage 2".

[3] 3GPP TS 38.321: "NR MAC protocol specification".

[4] 3GPP TS 38.323: "NR PDCP specification".

[5] 3GPP TS 38.331: "NR RRC Protocol specification".

[6] 3GPP TS 23.287: "Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services".

[7] 3GPP TS 38.340: "NR; Backhaul Adaptation Protocol (BAP) specification".

[8] 3GPP TS 23.304: "Proximity based Services (ProSe) in the 5G System (5GS)".

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3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 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 TR 21.905 [1].

Data field element: An RLC SDU or an RLC SDU segment that is mapped to the Data field.

NR sidelink communication: AS functionality enabling at least V2X Communication as defined in TS 23.287 [6] and ProSe communication (including ProSe Relay) as defined in TS 23.304 [8], between two or more nearby UEs, using NR technology but not traversing any network node.

RLC data volume: The amount of data available for transmission in an RLC entity.

RLC SDU segment: A segment of an RLC SDU.

Sidelink discovery: AS functionality enabling 5G ProSe UE-to-Network Relay Discovery or 5G ProSe Direct Discovery as defined in TS 23.304 [8], using NR technology but not traversing any network node.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 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 TR 21.905 [1].

AM	Acknowledged Mode
AMD	AM Data
ARQ	Automatic Repeat request
gNB	NR Node B
MBS	Multicast/Broadcast Services
MCCH	MBS Control Channel
MTCH	MBS Traffic Channel
PDU	Protocol Data Unit
RLC	Radio Link Control
SBCCH	Sidelink Broadcast Control Channel
SCCH	Sidelink Control Channel
SDU	Service Data Unit
SN	Sequence Number
STCH	Sidelink Traffic Channel
TB	Transport Block
TM	Transparent Mode
TMD	TM Data
UE	User Equipment
UM	Unacknowledged Mode
UMD	UM Data

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4 General

4.1 Introduction

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The objective is to describe the RLC architecture and the RLC entities from a functional point of view.

4.2 RLC architecture

4.2.1 RLC entities

The description in this clause is a model and does not specify or restrict implementations.

RRC is generally in control of the RLC configuration.

Functions of the RLC sub layer are performed by RLC entities. For an RLC entity configured at the gNB, there is a peer RLC entity configured at the UE and vice versa. In NR sidelink communication, in sidelink discovery, for an RLC entity configured at the transmitting UE, there is a peer RLC entity configured at each receiving UE.

An RLC entity receives/delivers RLC SDUs from/to upper layer and sends/receives RLC PDUs to/from its peer RLC entity via lower layers.

An RLC PDU can either be an RLC data PDU or an RLC control PDU. If an RLC entity receives RLC SDUs from upper layer, it receives them through a single RLC channel between RLC and upper layer, and after forming RLC data PDUs from the received RLC SDUs, the RLC entity submits the RLC data PDUs to lower layer through a single logical channel. If an RLC entity receives RLC data PDUs from lower layer, it receives them through a single logical channel, and after forming RLC SDUs from the received RLC data PDUs, the RLC entity delivers the RLC SDUs to upper layer through a single RLC channel between RLC and upper layer. If an RLC entity submits/receives RLC control PDUs to/from lower layer, it submits/receives them through the same logical channel it submits/receives the RLC data PDUs through.

NOTE 1: In case the upper layer is BAP as defined in TS 38.340 [7], an RLC channel refers to a Backhaul RLC channel.

An RLC entity can be configured to perform data transfer in one of the following three modes: Transparent Mode (TM), Unacknowledged Mode (UM) or Acknowledged Mode (AM). Consequently, an RLC entity is categorized as a TM RLC entity, an UM RLC entity or an AM RLC entity depending on the mode of data transfer that the RLC entity is configured to provide.

A TM RLC entity is configured either as a transmitting TM RLC entity or a receiving TM RLC entity. The transmitting TM RLC entity receives RLC SDUs from upper layer and sends RLC PDUs to its peer receiving TM RLC entity via lower layers. The receiving TM RLC entity delivers RLC SDUs to upper layer and receives RLC PDUs from its peer transmitting TM RLC entity via lower layers.

An UM RLC entity is configured either as a transmitting UM RLC entity or a receiving UM RLC entity. The transmitting UM RLC entity receives RLC SDUs from upper layer and sends RLC PDUs to its peer receiving UM RLC entity via lower layers. The receiving UM RLC entity delivers RLC SDUs to upper layer and receives RLC PDUs from its peer transmitting UM RLC entity via lower layers.

An AM RLC entity consists of a transmitting side and a receiving side. The transmitting side of an AM RLC entity receives RLC SDUs from upper layer and sends RLC PDUs to its peer AM RLC entity via lower layers. The receiving side of an AM RLC entity delivers RLC SDUs to upper layer and receives RLC PDUs from its peer AM RLC entity via lower layers.

Figure 4.2.1-1 illustrates the overview model of the RLC sub layer.

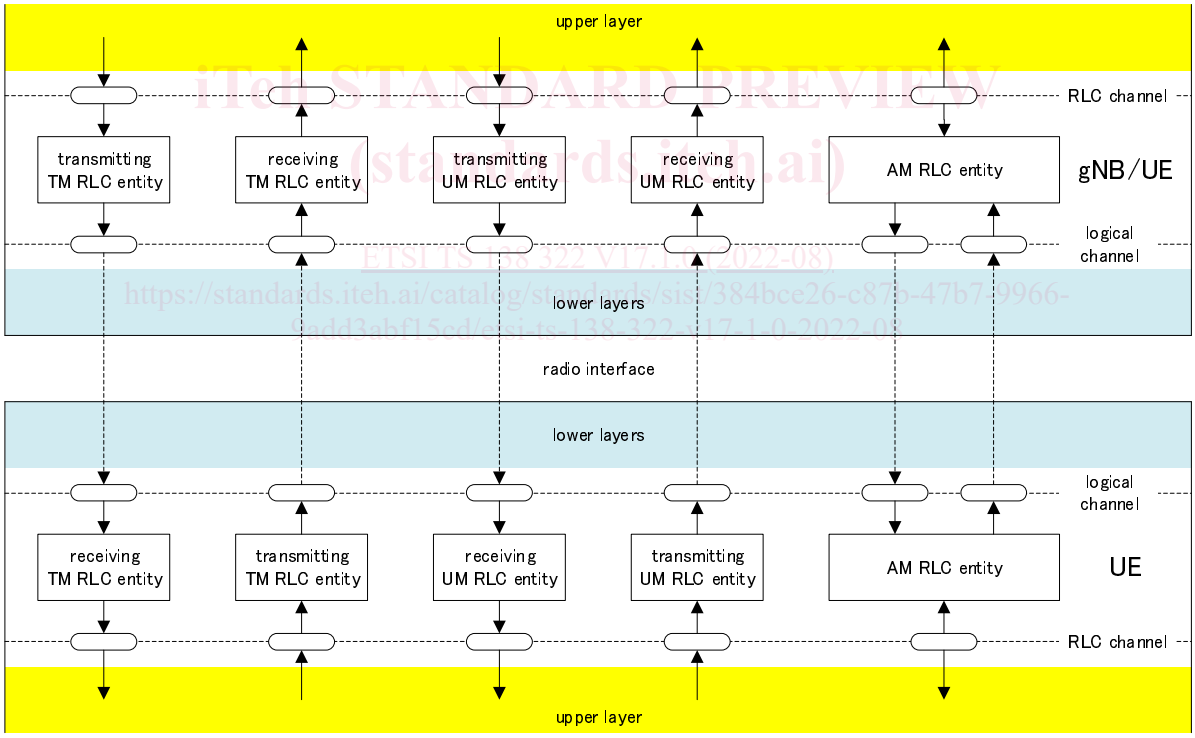

Figure 4.2.1-1: Overview model of the RLC sub layer

RLC SDUs of variable sizes which are byte aligned (i.e. multiple of 8 bits) are supported for all RLC entity types (i.e. TM, UM and AM RLC entity).

Each RLC SDU is used to construct an RLC PDU without waiting for notification from the lower layer (i.e., by MAC) of a transmission opportunity. In the case of UM and AM RLC entities, an RLC SDU may be segmented and transported using two or more RLC PDUs based on the notification(s) from the lower layer.

RLC PDUs are submitted to lower layer only when a transmission opportunity has been notified by lower layer (i.e. by MAC).

NOTE 2: The UE should aim to prevent excessive non-consecutive RLC PDUs in a MAC PDU when the UE is requested to generate more than one MAC PDU.

Description of different RLC entity types are provided below.

4.2.1.1 TM RLC entity

4.2.1.1.1 General

A TM RLC entity can be configured to submit/receive RLC PDUs through the following logical channels:

- BCCH, DL/UL CCCH, PCCH, and SBCCH.

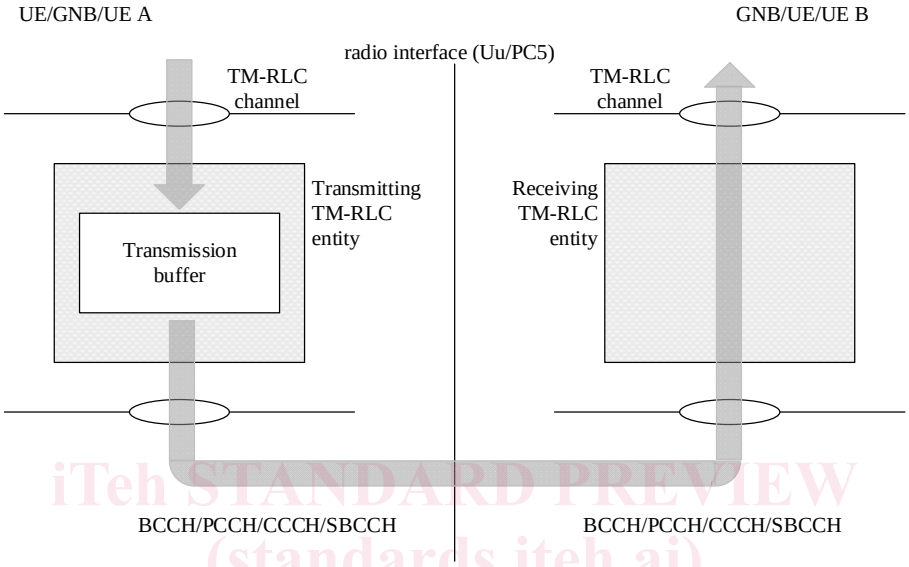

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Figure 4.2.1.1.1-1: Model of two transparent mode peer entities

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A TM RLC entity submits/receives the following RLC data PDU:

- TMD PDU.

4.2.1.1.2 Transmitting TM RLC entity

When a transmitting TM RLC entity forms TMD PDUs from RLC SDUs, it shall:

- not segment the RLC SDUs;
- not include any RLC headers in the TMD PDUs.

4.2.1.1.3 Receiving TM RLC entity

When a receiving TM RLC entity receives TMD PDUs, it shall:

- deliver the TMD PDUs (which are just RLC SDUs) to upper layer.

4.2.1.2 UM RLC entity

4.2.1.2.1 General

An UM RLC entity can be configured to submit/receive RLC PDUs through the following logical channels:

- DL/UL DTCH, SCCH, STCH, MCCH, and MTCH.

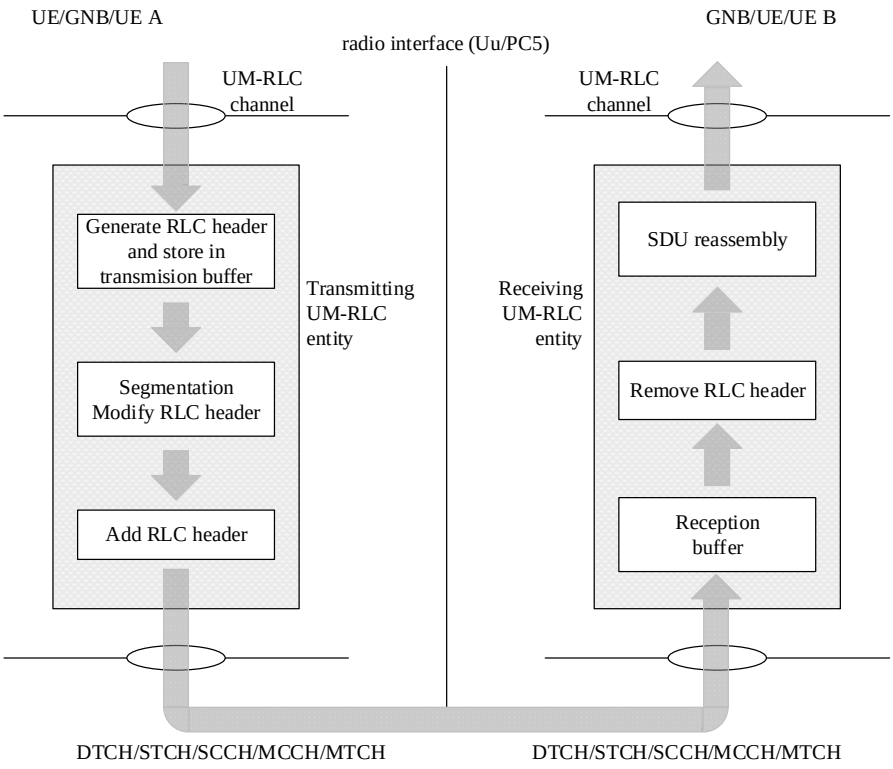

Figure 4.2.1.2.1-1: Model of two unacknowledged mode peer entities

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An UM RLC entity submits/receives the following RLC data PDU:

- UMD PDU.

An UMD PDU contains either one complete RLC SDU or one RLC SDU segment.

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NOTE: For groupcast and broadcast of NR sidelink communication or for sidelink discovery only uni-directional UM mode is supported.

4.2.1.2.2 Transmitting UM RLC entity

The transmitting UM RLC entity generates UMD PDU(s) for each RLC SDU. It shall include relevant RLC headers in the UMD PDU. When notified of a transmission opportunity by the lower layer, the transmitting UM RLC entity shall segment the RLC SDUs, if needed, so that the corresponding UMD PDUs, with RLC headers updated as needed, fit within the total size of RLC PDU(s) indicated by lower layer.

4.2.1.2.3 Receiving UM RLC entity

When a receiving UM RLC entity receives UMD PDUs, it shall:

- detect the loss of RLC SDU segments at lower layers;
- reassemble RLC SDUs from the received UMD PDUs and deliver the RLC SDUs to upper layer as soon as they are available;
- discard received UMD PDUs that cannot be re-assembled into an RLC SDU due to loss at lower layers of an UMD PDU which belonged to the particular RLC SDU.

4.2.1.3 AM RLC entity

4.2.1.3.1 General

An AM RLC entity can be configured to submit/receive RLC PDUs through the following logical channels:

- DL/UL DCCH, DL/UL DTCH, SCCH, and STCH.

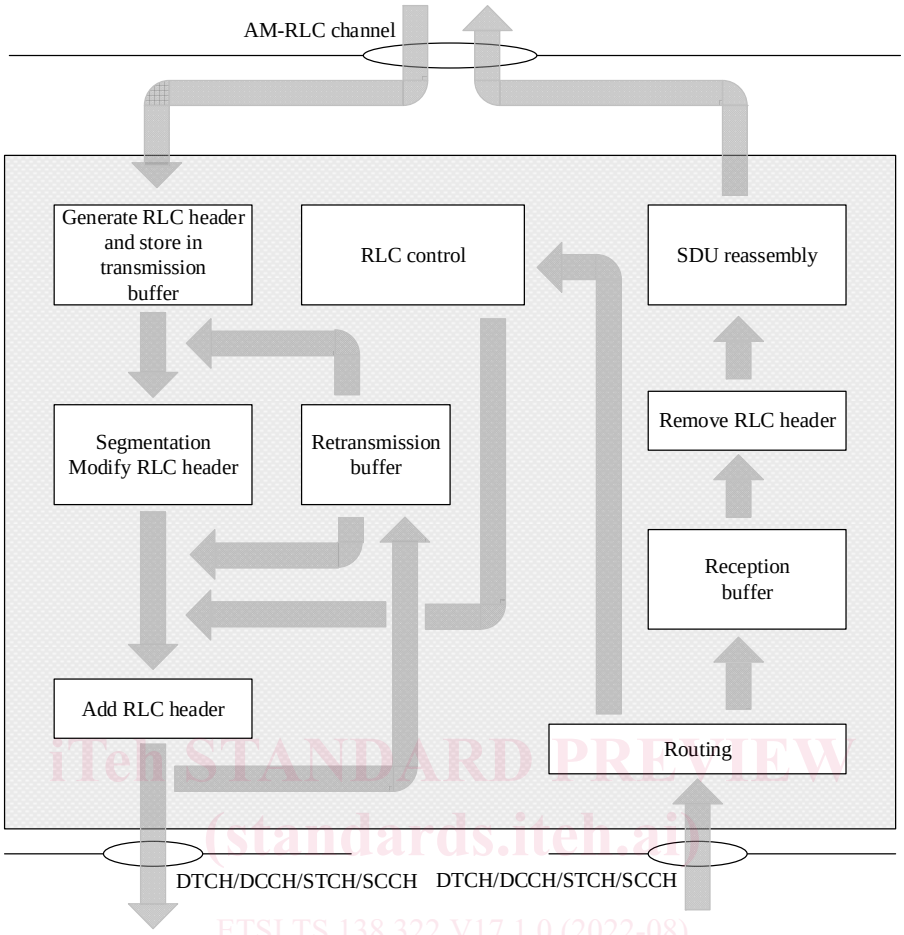

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Figure 4.2.1.3.1-1: Model of an acknowledged mode entity

An AM RLC entity delivers/receives the following RLC data PDUs:

- AMD PDU.

An AMD PDU contains either one complete RLC SDU or one RLC SDU segment.

An AM RLC entity delivers/receives the following RLC control PDU:

- STATUS PDU.

4.2.1.3.2 Transmitting side

The transmitting side of an AM RLC entity generates AMD PDU(s) for each RLC SDU. When notified of a transmission opportunity by the lower layer, the transmitting AM RLC entity shall segment the RLC SDUs, if needed, so that the corresponding AMD PDUs, with RLC headers updated as needed, fit within the total size of RLC PDU(s) indicated by lower layer.

The transmitting side of an AM RLC entity supports retransmission of RLC SDUs or RLC SDU segments (ARQ):

- if the RLC SDU or RLC SDU segment to be retransmitted (including the RLC header) does not fit within the total size of RLC PDU(s) indicated by lower layer at the particular transmission opportunity notified by lower layer, the AM RLC entity can segment the RLC SDU or re-segment the RLC SDU segments into RLC SDU segments;

- the number of re-segmentation is not limited.

When the transmitting side of an AM RLC entity forms AMD PDUs from RLC SDUs or RLC SDU segments, it shall: