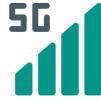


TELCOMA Global Whitepaper
RLC (Radio Link Control) in 5G

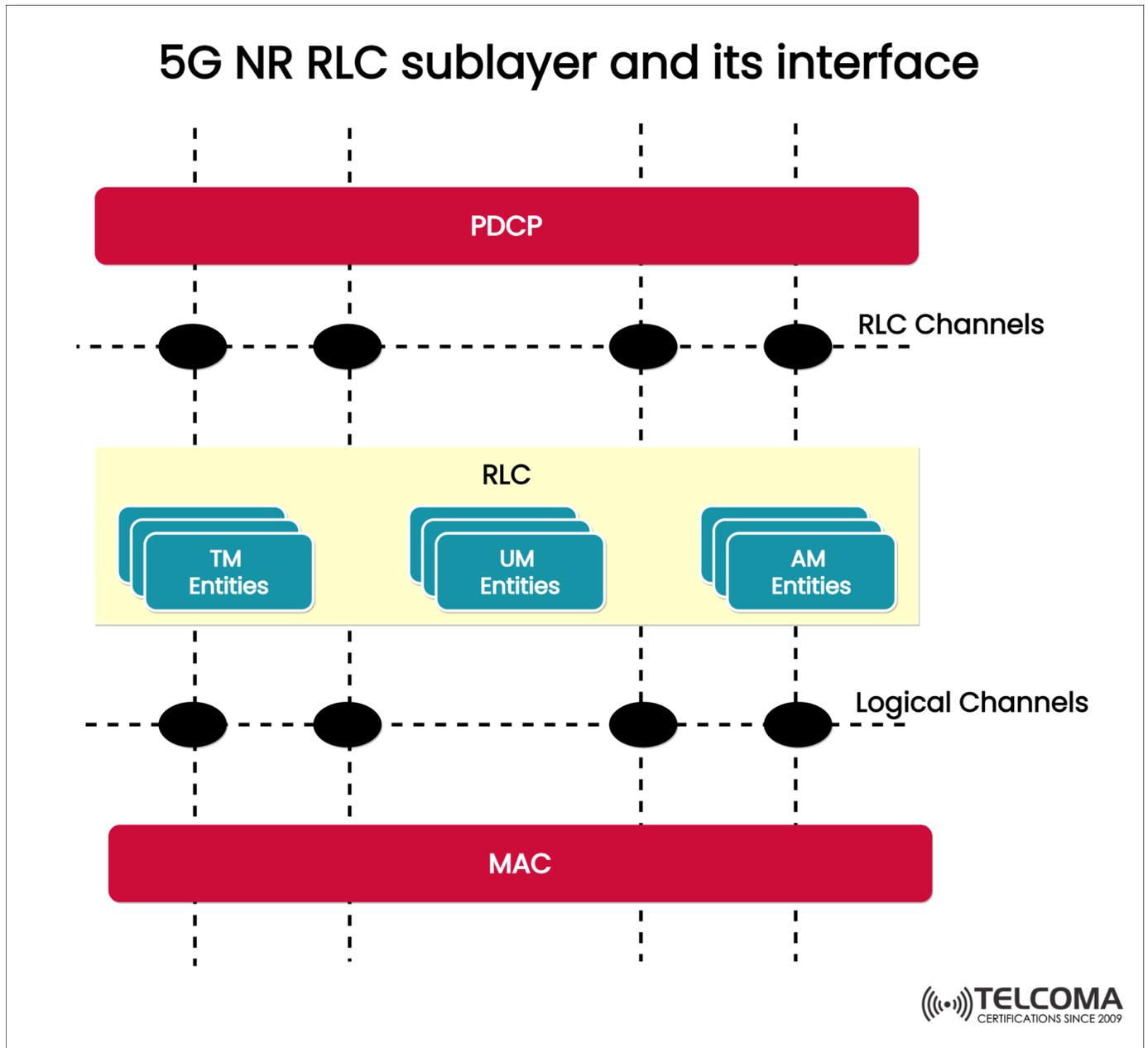


RLC (Radio Link Control) in 5G

Introduction to RLC

RLC (Radio link control) is a layer 2 protocol used on the Air interface. It is used in UMTS, LTE, and 5G NR technologies. The tasks performed by this layer are the transfer of upper layer Protocol Data Units (PDUs) in one of the three modes defined: AM (Acknowledged Mode), UM (Unacknowledged Mode), and TM (Transparent Mode), Error correction through ARQ (Automatic Repeat Request) for AM data transfer only, concatenation, segmentation, and reassembly of RLC SDU's, Re-segmentation of RLC data PDU's, reordering of RLC data PDU's, duplicate detection, RLC re-establishment and protocol error detection and recovery.

RLC the sub-layer of the 5G Protocol stack. PDCP layer is present at its top and the MAC layer is present below it. PDCP layer is connected to RLC via RLC channels and RLC is connected to MAC via logical channels. There is a one-to-one mapping between the layers.



RRC (Radio Resource Control) is generally in control of the RLC configuration. Functions of the RLC sublayer are performed by RLC entities. An RLC entity in a 5G UE has its peer RLC entity in the gNB or other UE's. An RLC entity receives/delivers RLC SDU's from/to upper layers and sends/receives RLC PDU's to/from its peer RLC entity via lower layers. An RLC PDU could be a data PDU or a control PDU. An RLC entity is categorized as a TM RLC entity, a UM

RLC entity, or an AM RLC entity depending on the mode of data transfer that the RLC entity is configured to provide.

Services provided to the upper layer include TM data transfer, UM data transfer, and AM data transfer. Various services expected from the lower layer include data transfer, notification of a transmission opportunity.

Functions

- Transfer of upper layer PDU's
- Error correction
- Segmentation and reassembly of RLC SDU's
- Re-segmentation of RLC SDU segments
- Duplicate detection
- RLC SDU discard
- RLC re-establishment
- Protocol error detection

NR RLC is almost the same as LTE RLC. Each of these modes can both transmit and receive data. In TM and UM, a separate entity is used for transmission and reception, but in AM a single RLC entity performs both transmission and reception.

- BCCH, PCCH, CCCH uses RLC TM only
- DCCH use RLC AM only
- DTCH use RLC UM or AM

Since each RLC mode is associated with a specific set of logical channels, to associate this RLC mode procedure to the RLC layer processing mechanism for each of those channels.

The RLC sublayer can have multiple RLC entities. Each entity is of a specific mode. An RLC entity receives RLC SDUs from PDCP on an RLC channel and sends out RLC PDUs to MAC on a logical channel in the transmit direction. An RLC PDU contains an RLC header and the RLC SDU. AM RLC entity has the important feature of error correction through ARQ.

RLC entity establishment occurs when the upper layer requests an RLC entity establishment, the UE shall establish an RLC entity, and set the state variables of the RLC entity to initial values. RLC entity re-establishment occurs when the upper layer requests an RLC entity re-establishment, the UE shall: discard all RLC SDUs, RLC SDU segments and RLC PDUs, stops and resets all timers and reset all state variables to their initial values. RLC entity release occurs when UE shall discard all RLC SDUs, RLC SDU segments, and RLC PDUs, it releases the RLC entity.

Handling of RRC Entity

The RLC entity is established from the RRC layer whenever a radio bearer needs to be setup. The establishment involves creating the RLC entity and then initializing all the protocol state variables. Once the initialization is completed, the RLC entity moves into the ACTIVE state. In the Active state, the RRC layer can : re-establish the RLC entity if the session has been re-initiated due to the radio link failure, release the RLC entity if the radio bearer is released at the RRC level. The RLC layer uses the polling flag in the header to use a STATUS PDU from the peer RLC.

RLC modes

Transparent Mode

- No segmentation and reassembly of RLC SDUs
- No RLC headers are added
- No delivery guarantees
- Suitable for carrying voice

Unacknowledged Mode

- Segmentation and reassembly of RLC SDUs
- RLC headers are added
- No delivery guarantees
- Suitable for carrying streaming traffic

Acknowledged Mode

- Segmentation and reassembly of RLC SDUs
- RLC headers are added
- Reliable in sequence delivery service
- Suitable for carrying TCP traffic