PDCP-->

The Packet Data Convergence Protocol (PDCP) is a critical component in the 5G architecture that handles various functions to ensure efficient and secure data transfer between the user equipment (UE) and the core network. Here's a detailed overview of the PDCP layer, including its entities and procedures:

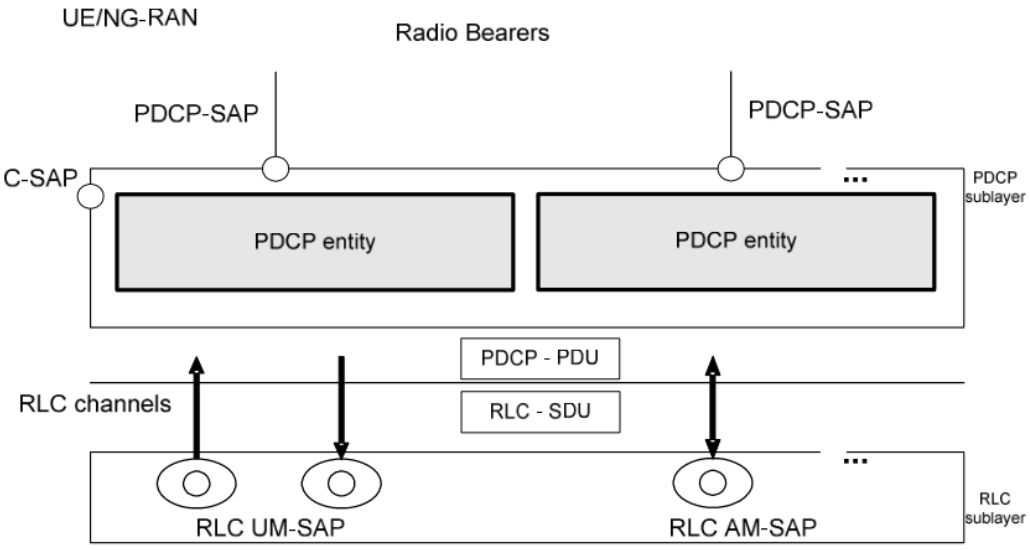

Figure 4.2.1-1: PDCP layer, structure view

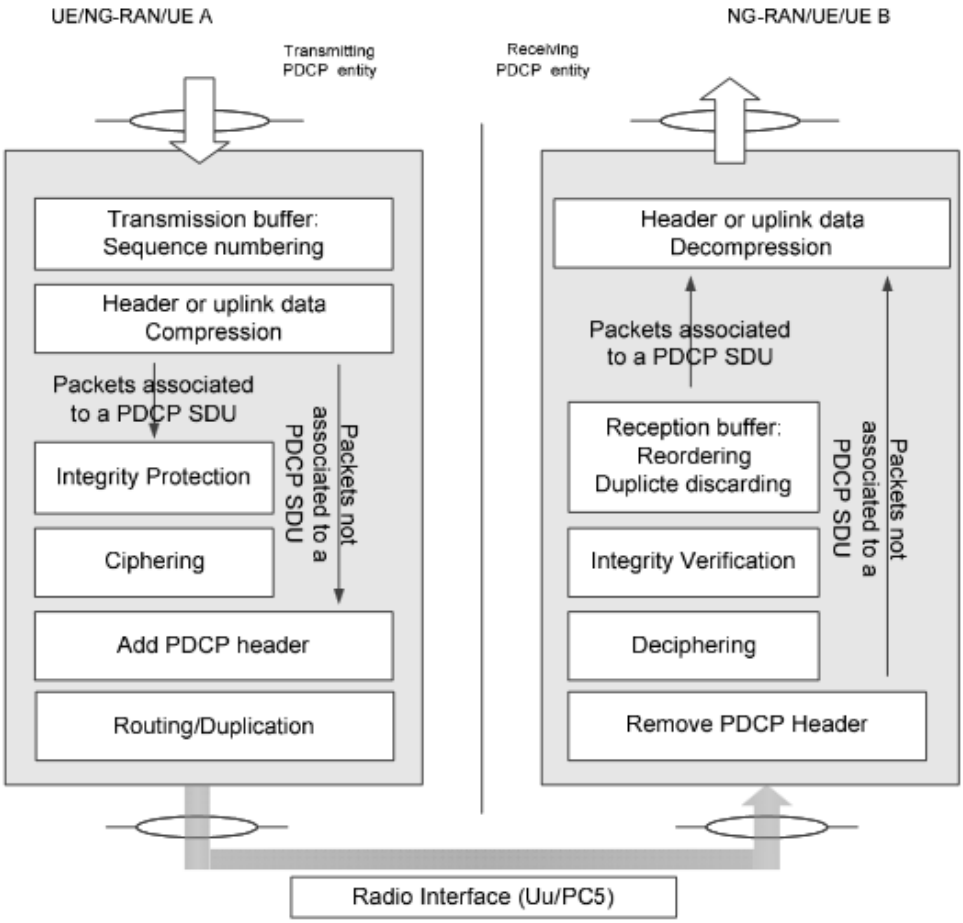

Figure 4.2.2-1: PDCP layer, functional view

The PDCP layer is responsible for:

-Header Compression/Decompression: Reduces the overhead of protocol headers to optimize bandwidth usage.

- Encryption/Decryption: Provides security by encrypting data before transmission and decrypting it upon reception.

- Integrity Protection/Verification: Ensures data integrity and prevents tampering.

- **In-Order Delivery**: Handles the reordering of packets to ensure they

are delivered in the correct sequence.

PDCP Entities

1. PDCP Entity in User Equipment (UE)

- Function: Performs header compression, encryption, and ensures the packets are sent correctly to the gNodeB. It also handles packet reordering.

- Processes:

- Compresses headers to reduce data size.

- Encrypts user data for security.

- Ensures packets are delivered in order and handles any reordering if necessary.

2. PDCP Entity in gNodeB

- Function: Receives data from the UE, performs header decompression, decryption, and forwards the packets to the next layer (SDAP) or the core network. It also handles packet reordering.

- Processes:

- Decompresses headers to retrieve the original data.

- Decrypts user data to ensure it is in a readable format.

- Forwards data to the appropriate layer or core network, ensuring packets are in the correct order.

PDCP Procedures

1. Header Compression and Decompression

- Header Compression: Reduces the size of protocol headers to optimize network resources. In 5G, this is done using the Robust Header Compression (ROHC) protocol.

- Procedure:

- Compression: Before sending data to the gNodeB, the PDCP layer compresses the headers.

- Decompression: The gNodeB decompresses the headers to retrieve the original data format.

- Header Decompression: Ensures that headers are reconstructed accurately for proper interpretation of the data.

- Procedure:

- Decompression: Upon receiving data, the gNodeB decompresses the headers to restore the original packet structure.

2. Encryption and Decryption

- Encryption: Protects the confidentiality of user data by encrypting it before transmission.

- **Procedure:**

  - **Encryption:** The PDCP layer in the UE encrypts the data using algorithms like AES (Advanced Encryption Standard) before sending it to the gNodeB.

- **Decryption**: Restores the original data format from the encrypted data.

  - **Procedure:**

    - **Decryption:** The PDCP layer in the gNodeB decrypts the received data using the same algorithms to retrieve the original information.

3. Integrity Protection and Verification

- **Integrity Protection:** Ensures that data has not been tampered with during transmission.

  - **Procedure:**

    - **Protection:** The PDCP layer adds a cryptographic checksum or hash to the data for integrity protection before sending it.

- **Integrity Verification**: Validates that data has not been altered.

  - **Procedure:**

    - **Verification**: The PDCP layer in the gNodeB verifies the integrity

of the data by checking the cryptographic checksum or hash.

4. In-Order Delivery and Reordering

- In-Order Delivery: Ensures that packets are delivered in the sequence they were sent.

- Procedure:

- Reordering: If packets arrive out of order, the PDCP layer in the gNodeB reorders them before forwarding them to the next layer or the core network.

- Retransmission: Handles retransmissions of lost or corrupted packets.

- Procedure:

- Retransmission Request: If packets are lost or corrupted, the receiving PDCP entity requests retransmission of those packets from the sender.

PDCP Layer in the Protocol Stack

The PDCP layer is situated above the Radio Link Control (RLC) layer and below the Service Data Adaptation Protocol (SDAP) layer in the 5G protocol stack:

1. RLC Layer:

- Function: Manages segmentation and reassembly, error correction (ARQ), and flow control. Passes data to the PDCP layer for further processing.

2. PDCP Layer:

- Function: Handles header compression, encryption, integrity protection, and packet reordering. Passes data to the SDAP layer.

3. SDAP Layer:

- Function: Manages QoS flow identification and mapping to Data Radio Bearers (DRBs). Receives data from the PDCP layer and forwards it to the RLC layer.

4. MAC Layer:

- Function: Manages scheduling, multiplexing, and logical channel prioritization. Receives data from the RLC layer.

5. Physical Layer (PHY):

- Function: Handles the physical transmission and reception of data over the air interface.

Example Workflow

1. Packet Generation:

- An application generates packets in the UE.

2. PDCP Processing in UE:

- Header Compression: PDCP compresses the headers.

- **Encryption**: PDCP encrypts the data.

- **Packet Forwarding**: PDCP forwards the processed packets to the SDAP layer.

3. PDCP Processing in gNodeB:

- Decompression: PDCP decompresses the headers.

- Decryption: PDCP decrypts the data.

- Reordering: If necessary, PDCP reorders packets and then forwards them to the SDAP layer or core network.

Benefits of PDCP

- Efficiency: Reduces overhead with header compression, optimizing bandwidth usage.

- Security: Provides encryption and integrity protection to safeguard

data.

- Reliability: Ensures packets are delivered in the correct order and handles retransmissions if needed.