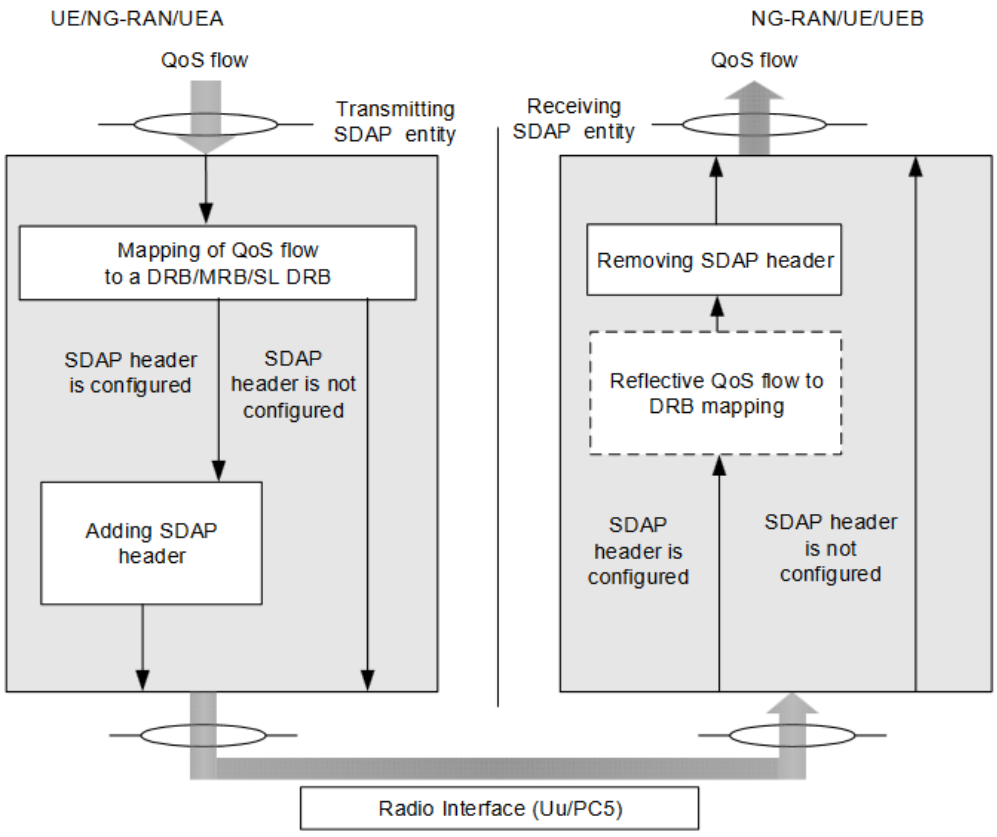
SDAP-->

The Service Data Adaptation Protocol (SDAP) is a crucial layer in the 5G New Radio (NR) user plane architecture, responsible for mapping between the Quality of Service (QoS) flows and data radio bearers (DRBs). SDAP plays a vital role in ensuring that data packets receive the appropriate QoS treatment as they traverse the 5G network.

It interfaces to upper layers via QoS flows and to the PDCP lower Layer via Data Radio Bearers(DRBs). Traffic from QoS flows are mapped to suitable DRBs. This is an essential role of sdap.



Functions->

The SDAP sublayer supports the following functions:

- transfer of user plane data;

- mapping between a QoS flow and a DRB for both DL and UL;

- mapping between an MBS QoS flow and an MRB for DL;

- mapping between a PC5 QoS flow and a SL-DRB for NR sidelink communication;

- marking QoS flow ID in both DL and UL packets;

- marking PC5 QoS flow ID in unicast of NR sidelink communication packets;

- reflective QoS flow to DRB mapping for the UL SDAP data PDUs.

1. SDAP Entity in User Equipment (UE)

Functions:

1. QoS Flow Determination: Identifies the QoS flow for each packet based on application requirements and network policies.

2. SDAP Header Addition: Adds the SDAP header to packets, including the QoS Flow Identifier (QFI) and optionally the Reflective QoS Indicator (RQI).

3. Mapping to DRBs: Maps the packets to the appropriate Data Radio Bearers (DRBs) based on the QFI.

4. Packet Transmission: Transmits the packets to the gNodeB, ensuring that QoS requirements are met.

Workflow:

1. Packet Generation: The UE receives data from applications that need to be transmitted.

2. QoS Flow Identification: The UE assigns a QFI to each packet based on the required QoS.

3. SDAP Header Addition: The UE adds the SDAP header to each packet.

4. DRB Mapping: Packets are mapped to the correct DRB.

5. Transmission: Packets with the SDAP header are sent to the gNodeB.

2. SDAP Entity in gNodeB

Functions:

1. Packet Reception: Receives packets from the UE, including the SDAP headers.

2. QoS Flow Identification: Reads the QFI from the SDAP header to determine the QoS requirements.

3. QoS Enforcement: Enforces QoS characteristics for each flow based on the QFI.

4. DRB Handling: Manages and maps packets to the appropriate DRBs for transmission.

5. Packet Forwarding: Forwards the packets to the core network or to the next node, ensuring QoS requirements are maintained.

Workflow:

1. **Packet Reception**: The gNodeB receives packets from the UE, including the SDAP header.

2. **QoS Flow Processing**: The gNodeB reads the QFI from the SDAP header to determine the QoS requirements.

3. **QoS Enforcement**: The gNodeB enforces the QoS attributes, such as priority and bandwidth, as specified by the QFI.

4. **DRB Mapping**: Packets are mapped to the appropriate DRB based on the QoS flow.

5. **Forwarding**: Packets are forwarded to the core network or to other network elements while maintaining QoS.

SDAP Header Structure

The SDAP header added to the packets includes:

1. **QoS Flow Identifier (QFI):** A numerical value that uniquely identifies the QoS flow. It allows the network to apply the correct QoS treatment to the packet.

2. **Reflective QoS Indicator (RQI) (optional):** A flag that indicates if Reflective QoS is applied. Reflective QoS allows the network to derive QoS characteristics for downlink traffic from uplink traffic.

Functional View of the SDAP Layer

1. QoS Flow Mapping

Role: Maps QoS flows to Data Radio Bearers (DRBs).

Function: Each QoS flow, identified by a QoS Flow Identifier (QFI), is associated with a specific DRB that provides the required QoS characteristics (such as throughput, latency, or priority).

How It Works: When a packet arrives at the SDAP layer, the QFI is used to determine which DRB should handle the packet. This mapping ensures that each packet receives the appropriate QoS treatment.

2. SDAP Header Addition

Role: Adds an SDAP header to each data packet.

Function: The SDAP header includes the QFI and, optionally, the Reflective QoS Indicator (RQI).

How It Works: Before forwarding packets to the next layer (RLC), the SDAP layer inserts the SDAP header, which provides information necessary for QoS flow management. The QFI identifies the QoS flow, and the RQI indicates whether Reflective QoS is applied.

3. QoS Flow Identification

Role: Identifies and manages QoS flows.

Function: Uses the QFI to manage and process different types of traffic with varying QoS requirements.

How It Works: Based on the QFI included in the SDAP header, the layer determines the specific QoS flow and ensures that the corresponding DRB is used for transmitting the packet.

4. Reflective QoS

Role: Provides an optional mechanism for deriving QoS attributes.

Function: Allows the network to derive QoS characteristics for downlink packets based on uplink packets' QoS attributes.

How It Works: When Reflective QoS is enabled (indicated by the RQI), the network uses the QoS attributes of uplink packets to infer and apply similar attributes to downlink packets, simplifying QoS management.

5. Interaction with Other Layers

Interaction with PDCP Layer: Receives packets from the Packet Data Convergence Protocol (PDCP) layer, processes them by adding SDAP headers, and passes them to the Radio Link Control (RLC) layer.

Interaction with RLC Layer: Forwards packets to the RLC layer for further handling, including segmentation and reassembly, and error correction.

SDAP Layer in the Protocol Stack

The SDAP layer is positioned between the PDCP layer and the RLC layer in the 5G user plane protocol stack:

Packet Data Convergence Protocol (PDCP):

Function: Handles header compression, encryption, and integrity protection. Passes packets to the SDAP layer.

Role: Prepares packets for QoS handling and transmission.

SDAP Layer:

Function: Adds the SDAP header, maps QoS flows to DRBs, and manages QoS attributes.

Role: Ensures that packets are correctly mapped and transmitted with the required QoS.

Radio Link Control (RLC):

Function: Manages segmentation and reassembly, error correction (ARQ), and flow control. Receives packets from the SDAP layer.

Role: Handles the actual data transmission over the air interface.

Medium Access Control (MAC):

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

Role: Coordinates access to the radio resources and handles transmission.

Physical Layer (PHY):

Function: Performs modulation and demodulation, and handles the physical transmission of data.

Role: Transmits and receives data over the air interface.

Example Workflow

Packet Generation:

An application generates data packets, which are processed by the PDCP layer.

SDAP Processing:

The SDAP layer receives these packets, adds the SDAP header, and maps the packets to the appropriate DRB based on the QFI.

If Reflective QoS is enabled, the RQI indicates this, and the QoS attributes are applied accordingly.

Forwarding:

Packets are forwarded to the RLC layer for further processing and transmission over the air interface.

Benefits of SDAP

Efficient QoS Management: Ensures that each QoS flow is mapped to the correct DRB, optimizing network performance.

Flexibility: Supports a variety of traffic types with different QoS requirements, enhancing overall network efficiency.

Improved User Experience: By managing QoS effectively, SDAP helps in delivering a better quality of service for applications and services.