5G NR (New Radio) protocol stack

he 5G NR (New Radio) protocol stack is a layered architecture that defines how data is transmitted and managed in a 5G network. It consists of several layers, each responsible for specific functions. The core layers include the Physical layer (PHY), Medium Access Control (MAC), Radio Link Control (RLC), Packet Data Convergence Protocol (PDCP), and the new Service Data Adaptation Protocol (SDAP). These layers work together to ensure reliable and efficient data transmission over the air interface.

1. Physical Layer
2. Layer 2 (Data Link Layer)
3. Layer 3 (Control Layer)

Physical Layer:

- It is the Lowest Layer of the 5G Protocol Stack.
- It send and received actual radio signal over the air.
- Handles modulation, coding, and beamforming to convert data into a format suitable for wireless transmission.
- Channel :it have Two channel also –
    1. Downlink Channel (DL)
    2. Uplink Channel(UL)

📥 Downlink Channel:

Data sent to gNB base station to UE (smart phone / device).

1. PBCH
2. PDCCH
3. PDSCH

Flow :

- gNB send system info via PBCH.
- gNB tell UE where data via PDCCH.

- UE received actual data via PDSCH.

Uplink Channel:

Data sent to UE to gNB.

1. PRACH
2. PHCCH
3. PUSCH

Flow :

- UE sent the access request via PRACH
- UE tell control via PHCCH.
- UE send user data via PUSCH.

Channel Mapping :

In 5G data flow through different Layer before transmitted in the air.

Channel Mapping is the process of connecting these layer.

Three types of channel are there –

1. Logical channel
2. Transport Channel
3. Physical channel

Logical channel -> Transport Channel -> Physical channel

Layer 2 & Data Link Layer

In the 5G NR (New Radio) protocol stack, the data link layer is comprised of the Medium Access Control (MAC), Radio Link Control (RLC), and Packet Data Convergence Protocol (PDCP) sublayers

1. MAC
2. RLC
3. PDCP
4. SDAP

Medium Access Control (MAC):

MAC stand for (Medium Access Control) It is the Sublayer of Data Link Layer in the OSI Model.

And plays Crucial role in managing how data is transmitted over the air interface between User Equipment(UE) and gNodeB (5G Base station).

It is the Between PHY & RLC.

Controls how the data sent over the air.

Main Function :

- Scheduling :
- HARQ
- RACH
- Multiplexing
- MAC PDU

Work Function :

- PDCCH
- PDSCH
- PUSCH
- PUCCH

MAC PDU (Protocol Data Unit) Structure :