

## In-Lab

The Medium Access Control (MAC) layer of 5G New Radio (NR) serves as a bridge between the physical layer and the upper protocol layers, such as the Radio Link Control (RLC). It is responsible for managing the transmission of both User Plane and Control Plane data between the gNodeB (gNB) and the User Equipment (UE).

The MAC layer's primary role is 1.

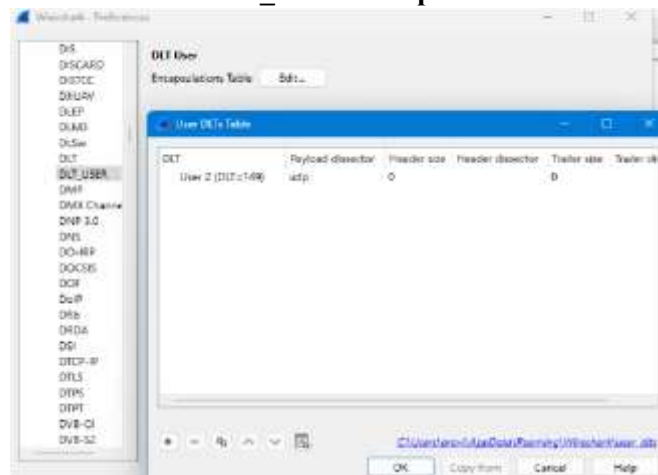
### Shared Channel Information

- a. Downlink Shared Channel (DL-SCH)
  - b. Uplink Shared Channel (UL-SCH)
  - c. Sidelink Shared Channel (SL-SCH)
2. Control Messages
- a. Buffer Status Report (BSR)
  - b. Power Headroom Report (PHR)
  - c. HARQ Feedback
  - d. Scheduling Request
  - e. Timing Advance Command
  - f. Discontinuous Reception (DRX) Command
3. Random Access Procedure Messages (RACH)
- a. MSG1
  - b. MSG2
  - c. MSG3
  - d. MSG4
  - e. Random Access Preamble
  - f. RAR
4. Broadcast and Paging messages
- a. BCH
  - b. PCH

Furthermore, we can observe the mapping of logical channels from the RLC layer to the transport channels, which are then sent to the physical layer for transmission through the antenna.

- BCCH
- PCCH
- CCCH
- DCCH
- DTCH

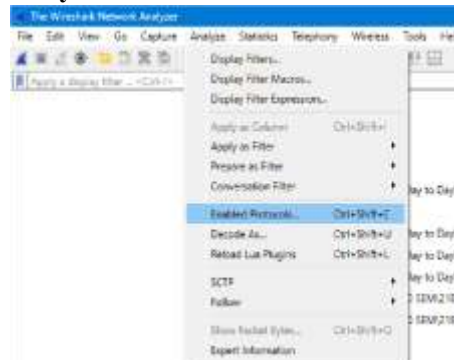
We will analyze the LCID, MAC sub-header, padding, and payloads in the MAC-layer PCAP files using Wireshark. NR-MAC layer messages will facilitate efficient, reliable, and synchronized communication among the User Equipment (UE), gNB, and 5G NR Core network.



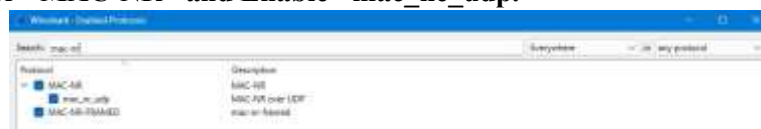
4. Click the "+" (Add) button to create a new entry.
  - a. **DLT:** Enter 149.
  - b. **Payload dissector:** Enter "udp."

### Step 2:

1. Navigate to the "Analyze" menu and select "Enabled Protocols."

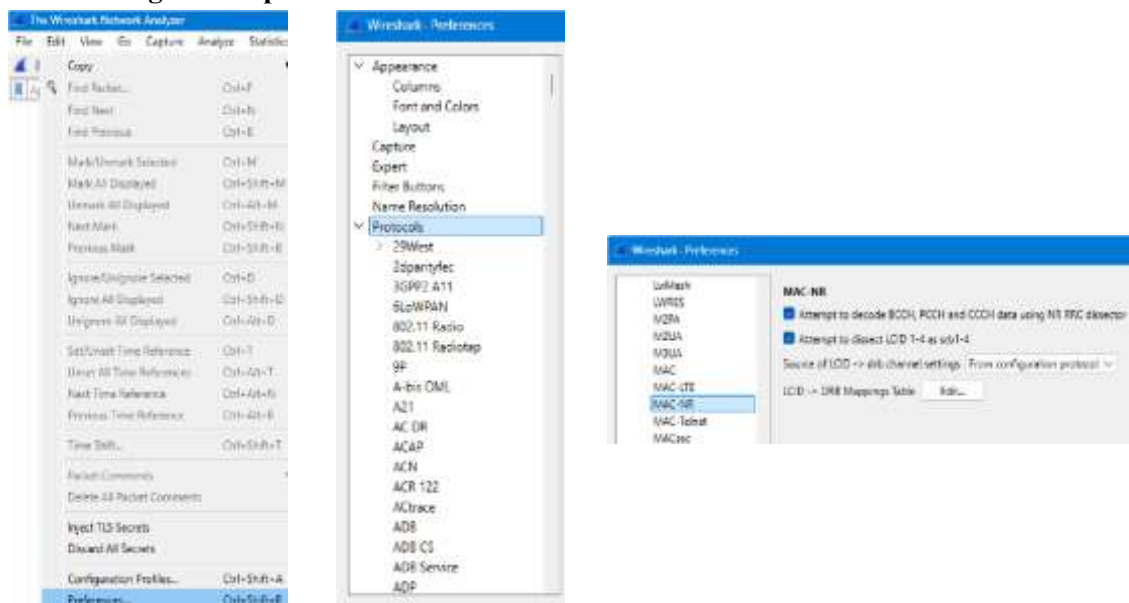


2. Search for "MAC-NR" and Enable "mac\_ne\_udp."



### Step 3:

1. Navigate to the "Edit" menu, select "Preferences."
2. Select "Protocols" and expand it. Then, scroll down to select "MAC-NR."
3. Enable both checkboxes "Attempt to...", Set LCID->DRB mapping to "From configuration protocol".



#### Step 4:

Open the "gnb\_mac" PCAP file using Wireshark and apply the filter "nas-5gs".

Note the control plane messages exchanged between the UE and gNB to the Core Network.

**Note:** "Uplink" refers to the communication from the User Equipment (UE) to the gNodeB (GNB), while "Downlink" refers to the communication from the gNodeB to the User Equipment.

#### Step 6:

Remove the "nas-5gs" filter and observe the messages exchanged between the UE and gNB to the Core Network, including acknowledgements.

**Note:** "Uplink" refers to the communication from the User Equipment (UE) to the gNodeB (GNB), while "Downlink" refers to the communication from the gNodeB to the User Equipment.

In the gnb\_mac PCAP file, access the **SIB1** information and record the **BCCH-DL-SCH** messages up to the cell identity.

#### Step 7:

In the gnb\_mac PCAP file, open the **SIB1** information and note down the important messages found in the **servingCellConfigCommon** section.

#### Step 8:

< 38.321- Table 6.2.1-1 Values of LCID for DL-SCH>

Index	LCID values
000000	CCCH
000001–100000	Identity of the logical channel
100001–101110	Reserved
101111	Recommended bit rate
110000	SP ZP CSI-RS Resource Set Activation/Deactivation
110001	PUCCH spatial relation Activation/Deactivation
110010	SP SRS Activation/Deactivation
110011	SP CSI reporting on PUCCH Activation/Deactivation
110100	TCI State Indication for UE-specific PDCCH
110101	TCI States Activation/Deactivation for UE-specific PDSCH
110110	Aperiodic CSI Trigger State Subselection
110111	SP CSI-RS / CSI-IM Resource Set Activation/Deactivation
111000	Duplication Activation/Deactivation
111001	SCell Activation/Deactivation (four octet)
111010	SCell Activation/Deactivation (one octet)
111011	Long DRX Command
111100	DRX Command
111101	Timing Advance Command
111110	UE Contention Resolution Identity
111111	Padding

< 38.321- Table 6.2.1-2 Values of LCID for UL-SCH>

Index	LCID values
000000	CCCH of size other than 48 bits
000001–100000	Identity of the logical channel
100001	CCCH of size 48 bits
100010–110100	Reserved
110101	Recommended bit rate query
110110	Multiple Entry PHR (four octet C <sub>i</sub> )
110111	Configured Grant Confirmation
111000	Multiple Entry PHR (one octet C <sub>i</sub> )
111001	Single Entry PHR
111010	C-RNTI
111011	Short Truncated BSR
111100	Long Truncated BSR
111101	Short BSR
111110	Long BSR
111111	Padding

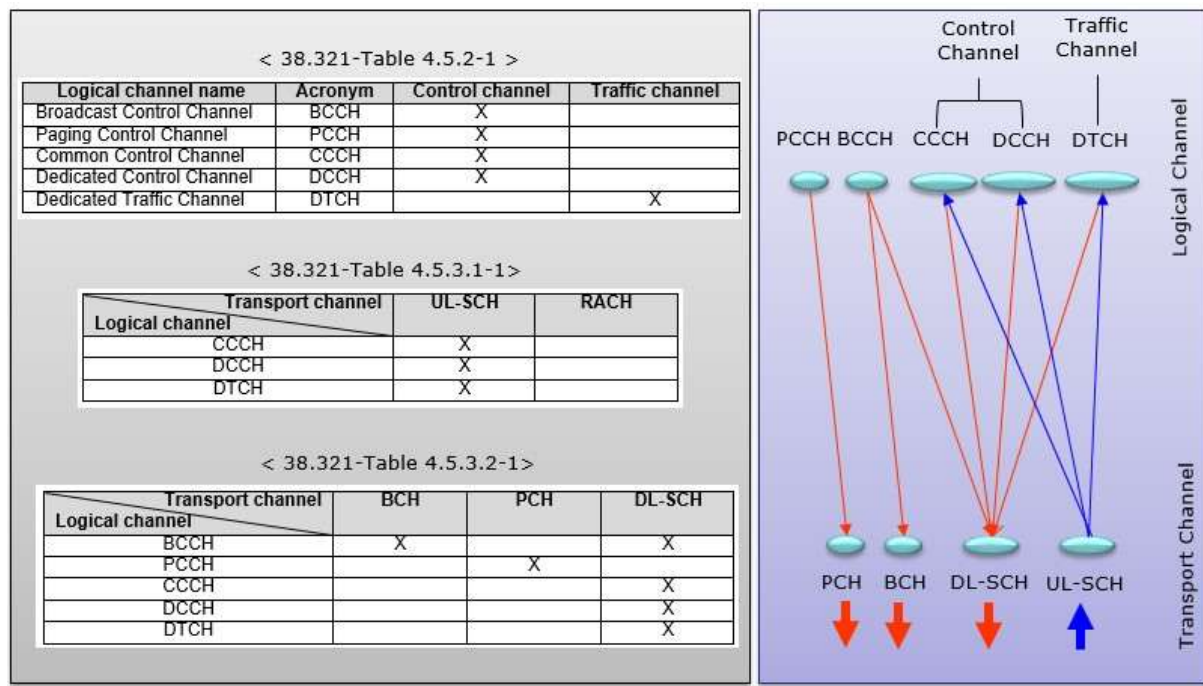
In the gnb\_mac PCAP file, access the DL-SCH. Use the LCID subheader to decode the message and interpret its frame structure.

### Step 9:

In the gnb\_mac PCAP file, access the UL-SCH. Use the LCID subheader to decode the message and interpret its frame structure.

### Step 10:

Literature indicates that MAC logical channels are mapped to transport channels. Using the gnb\_mac pcap file, identify the mapping of logical channels to transport channels.



### Step 11:

Identify the Control Messages like Buffer Status Report (BSR), Power Headroom Report (PHR), HARQ Feedback, Scheduling Request, Timing Advance Command, Discontinuous Reception (DRX) Command from the gnb\_mac pcap file.