

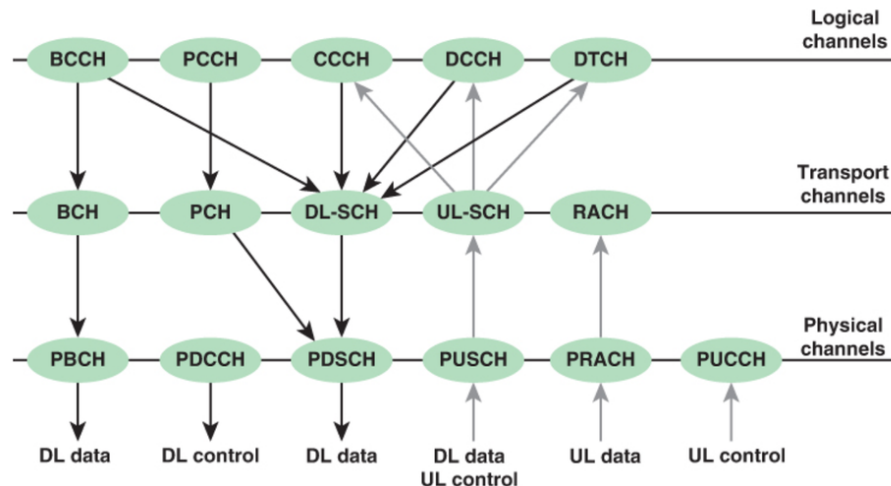
Channels



Owned by David Cherney DISH ...
Jul 03, 2023 • Initializing...

5G has three layers of radio channels corresponding to the three layers on DU functions (RLC, MAC, and PHY), as shown in the diagram below.

- Logical channels are characterized by their purpose and operate at the RLC layer.
- Transport channels are characterized by the way that data is transmitted in terms of support for transmission quality and operate at the MAC layer.
- physical channels are characterized by the exact frequency, coding scheme (FEC and MCS), and duplexing scheme used and operate at the physical layer.



Logical Channels

Definition: A logical channel is an information stream that is dedicated to transfer of a particular type of information over a radio interface.

Here, the logical channels in the diagram above are each described, from left to right, in terms of the purpose of the channel.

Broadcast Control Channel (BCCH)

The BCCH is for broadcasting information about gNB; it is in the downlink direction only. This information comes in two parts;

- the master information block (MIB) which contains basic information about the gNB and, more specifically, the cell broadcasting the signal. The MIB is sent to the BCH transport channel.
- system information blocks (SIBs), which contain much more extensive information about the RAN system. SIBs are sent to the DL-SCH transport channel.

Paging Control Channel (PCCH)

The PCCH is used to page UE.

Common Control Channel (CCCH)

The CCCH is for both the uplink and downlink data in initial access requests (and granting of those requests) from UE.

Dedicated Control Channel (DCCH)

The DCCH is for uplink and downlink data of control information after initial access has been granted.

Dedicated Traffic Channel (DTCH)

The DTCH is for transmission of user plane data.

Transport Channels

Here, transport channels are described in terms of

- what logical information they carry
- how that information is to be carried.

Broadcast Channel (BCH)

What: The master information block (MIB) from the BCCH is sent in the downlink direction on BCH channels.

How:

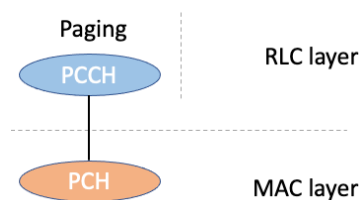
- A single message is sent in a single frame from gNB to UE.
- The message is sent over the entirety of each cell in a paging area using
 - multiple instances of broadcast channels
 - beamforming, with one beam for each instance
 - allowing the UE to learn where in the cell sector it is in terms of which beam gives the strongest signal.

Paging Channel (PCH)

What: Downlink paging information from the BCCH is sent on the PCH.

How:

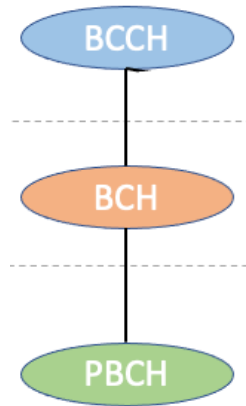
- A single message is sent in a single frame, from gNB to UE.
- UE in cm state `idle` are expected to wake up at predesignated times to be available to receive pages.
- The information can either be
 - broadcast without beamforming
 - sent with beamforming if the device's location is sufficiently well known.



DownLink Shared Channel (DL-SCH)

What:

- The system information blocks (SIBs) from the broadcast control channel (BCCH) is sent on the DL-SCH
- Downlink data for Initial access (primary authentication) requests from the CCCH are sent on the DL-SCH.
- Downlink control plane information sent after primary authentication is sent on the DL-SCH.
- Downlink user plane traffic from the DTCH is sent on the DL-SCH.

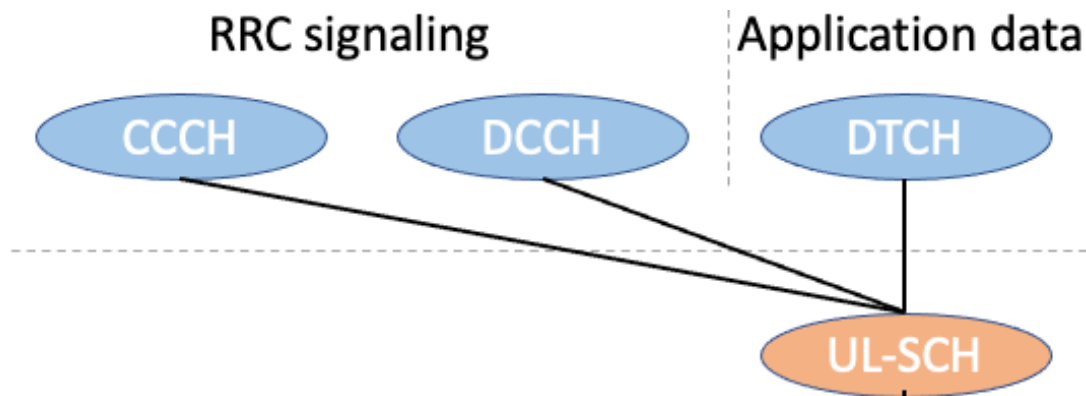


How: HARQ and other transmission quality control mechanisms are applied to data sent on DL-SCH.

UpLink Shared Channel (UL-SCH)

What:

- Uplink control plane data for initial access requests (primary authentication) from CCCH are sent on UL-SCH.
- Uplink control plane information data sent after primary authentication from the DCCH are sent on UL-SCH.
- Uplink user plane data from the DTCH is sent on the UL-SCH



How: HARQ and other transmission quality control mechanisms are applied to data sent on DL-SCH.

Random Access Channel (RACH)

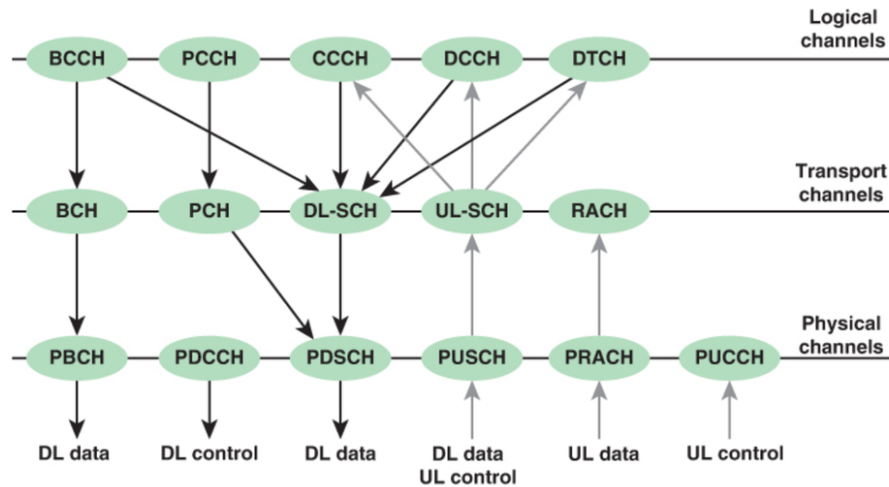
What: Uplink information that consists of short messages (functioning as preambles to larger communication to be done on different channels) are sent on RACH.

How: The gNB stays open to receiving such messages, and since the various user equipment sends these messages as needed, and since there are a large number of UE, the gNB sees the timing of these messages as random. In case of reception of near simultaneous messages, the gNB needs to have collision avoidance mechanisms.

Physical Layer

Definition: A physical layer channel is specified by a frequency of transmission, coding scheme in terms of FEC and MES, and duplexing mode (time or frequency duplexing).

Here, physical channel types are described in terms of what is carried on the channel, and the coding scheme. The frequency and duplexing will vary, and so is not specified.

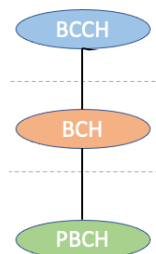


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Physical Broadcast Channel (PBCH)

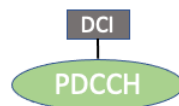
What: The MIB is sent in one block (frame) from the BCH transport channel for synchronization of clocks between UE and gNB.

How: All physical broadcast channels broadcast with QPSK and with transmission time interval (TTI) 80 ms.



Physical Downlink Control Channel (PDCCH)

What: Downlink control information (DCI) which advises radio control is sent on PDCCH. There is no transport layer channel above this.



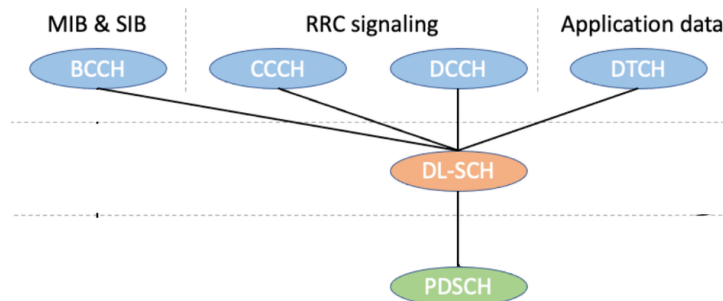
How: All physical broadcast channels broadcast with QPSK and polar FEC.

Physical DownLink Shared Channel (PDSCH)

What:

- SIB from DL-SCH from BCCH
- Primary authentication from DL-SCH from CCH
- Control plane data from DL-SCH from DCCH

- User plane data from DL-SCH from DTCH

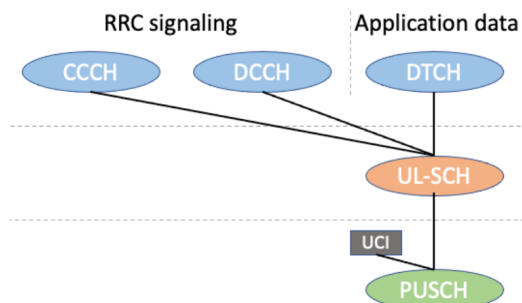


How: All DL-SCH transmission is done with adaptive modulation (e.g. changing from 16-QAM to 64-QAM when signal is good) based on signal to noise ratio. The forward error correction scheme FEC can vary.

Physical Uplink Shared Channel (PUSCH)

What:

- Uplink data for primary authentication from UE to UL-SCH to CCCH is sent on PUSCH.
- Uplink data for post authentication control plane functionality is sent to UL-SCH to DCCH from PUSCH.
- Uplink user plane data to UL-SCH to DTCH.
- Sometimes uplink control information (UCI) is sent on PUSCH. More often that data is sent on a PRACH. (See below.) The UCI contains HARQ retransmission requests from the UE to the gNB.



How: Adaptive modulation scheme and variable FEC.

Physical Random Access Channel (PRACH)

What: Preambles to initiate communication are sent from UEs on PRACH.



How: There are long and short versions of the preamble format for low and high 5G frequencies, respectively.

Physical Uplink Control Channel (PUCCH)

What: Uplink control information (UCI) for radio control is sent on PUCCH and contains HARQ repeat requests from the UE to the gNB. It is used to advise radio resource decisions.

How: (No information found).