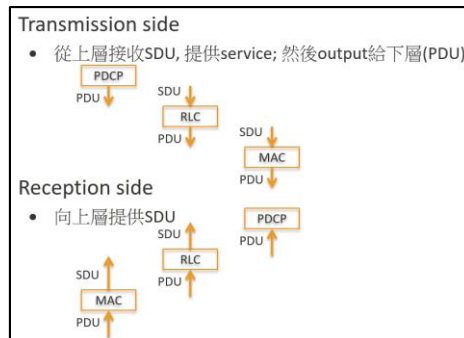


Three layers in User Plane

PDCP (Packet Data Convergence) layer protocol: Header compression, Security function, Handover, Discard data packet

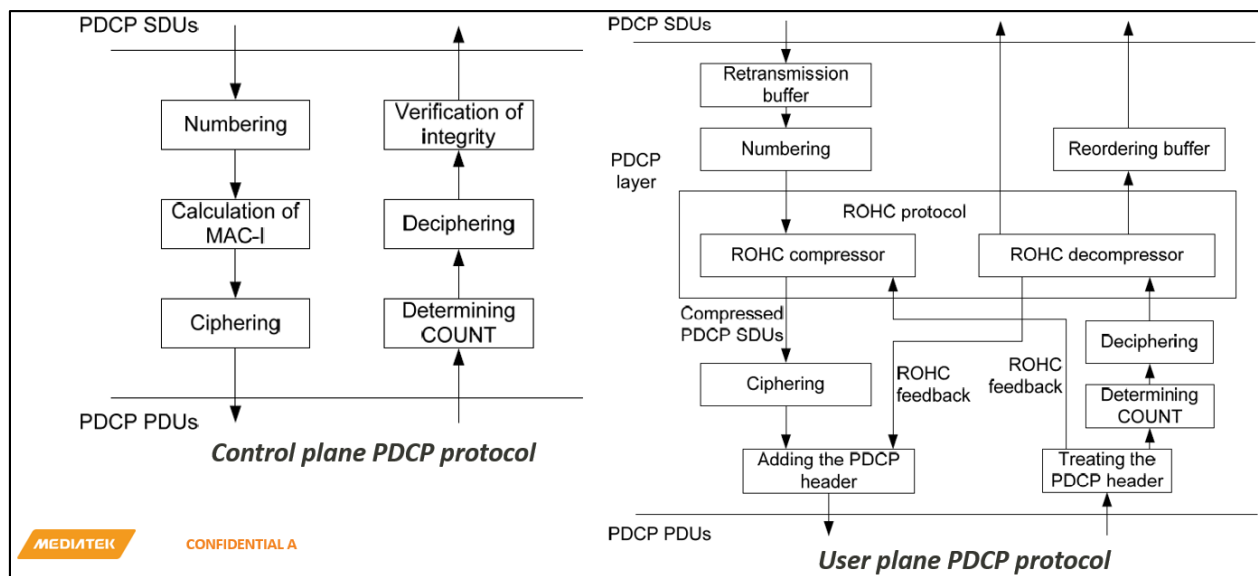
RLC (Radio Link Ctrl) layer protocol: TM/UM/AM RLC entity, segmentation and reassembly of upper layer packets, HARQ

MAC layer protocol: Logical channel-Transport channel mapping, Scheduling, Scheduling information transfer, DRX, Multiplexing



All the PDUs (Protocol Data Unit) and SDUs (Service) are byte aligned. Lengths of the PDUs and SDUs are multiples of 8 bits.

PDCP Flowchart



PDCP data PDU; used in control & user plane

PDCP control PDU: 只用在 ROHC feedback & PDCP status report when handover -> 僅用於 user plane

Header compression and decompression for user plane data

- ROHC: RObust Header Compression

Security functions:

- ciphering and deciphering for user plane and control plane data;
- integrity protection and verification for control plane data.

Handover support functions:

- in-sequence delivery and reordering of PDUs for the layer above at handover;
- lossless handover for user plane data mapped on RLC AM

Discard for user plane data due to timeout

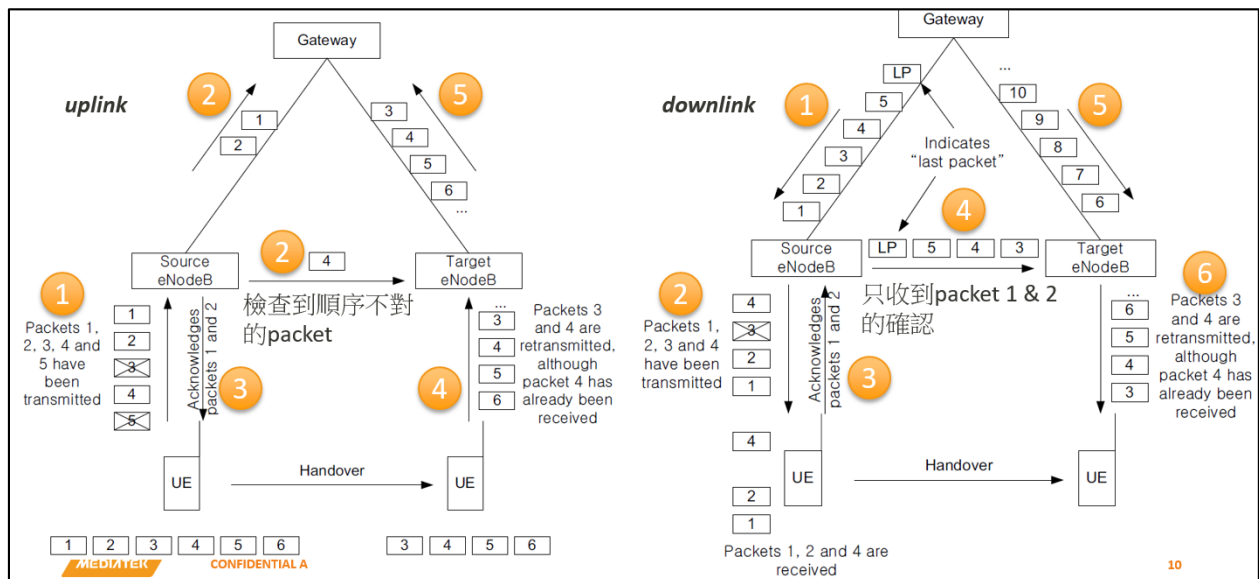
Handover

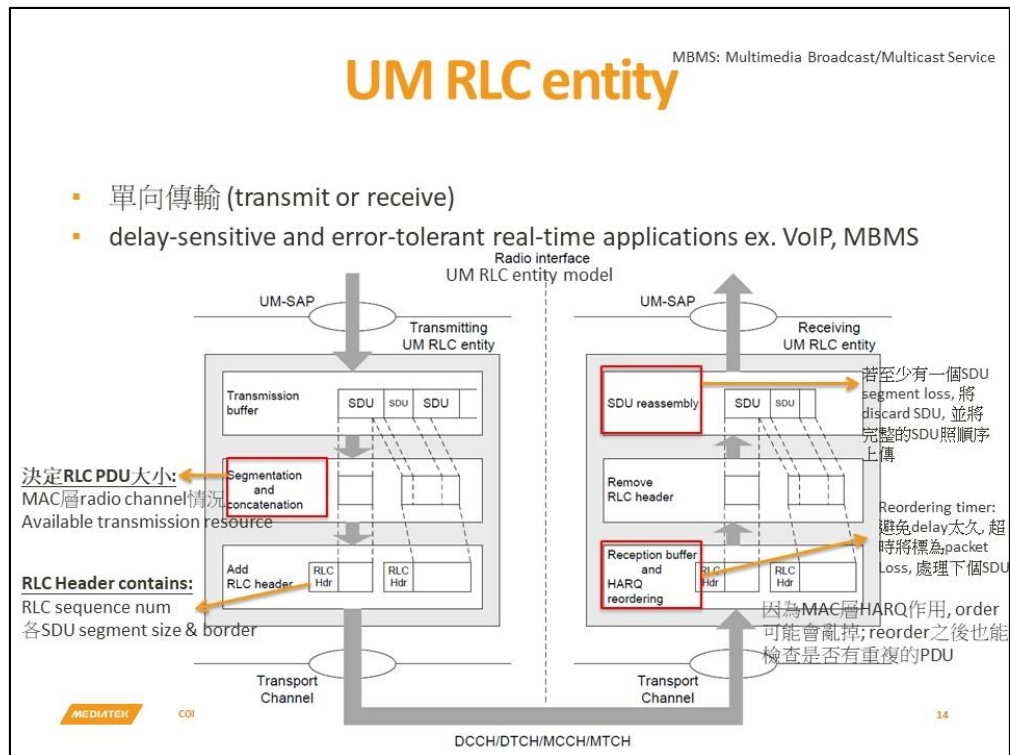
Seamless handover

- 對 time delay 忍受程度較低, 但 packet loss 比較不在意 ex. VoIP traffic
- 用在 control plane radio bearer, user plane radio bearer (RLC **UM**)
- 已被送出但尚未被接收的 PDCP SDU 將被 discard
- 尚未發送則透過 X2 interface forward 到 target eNB 再發送

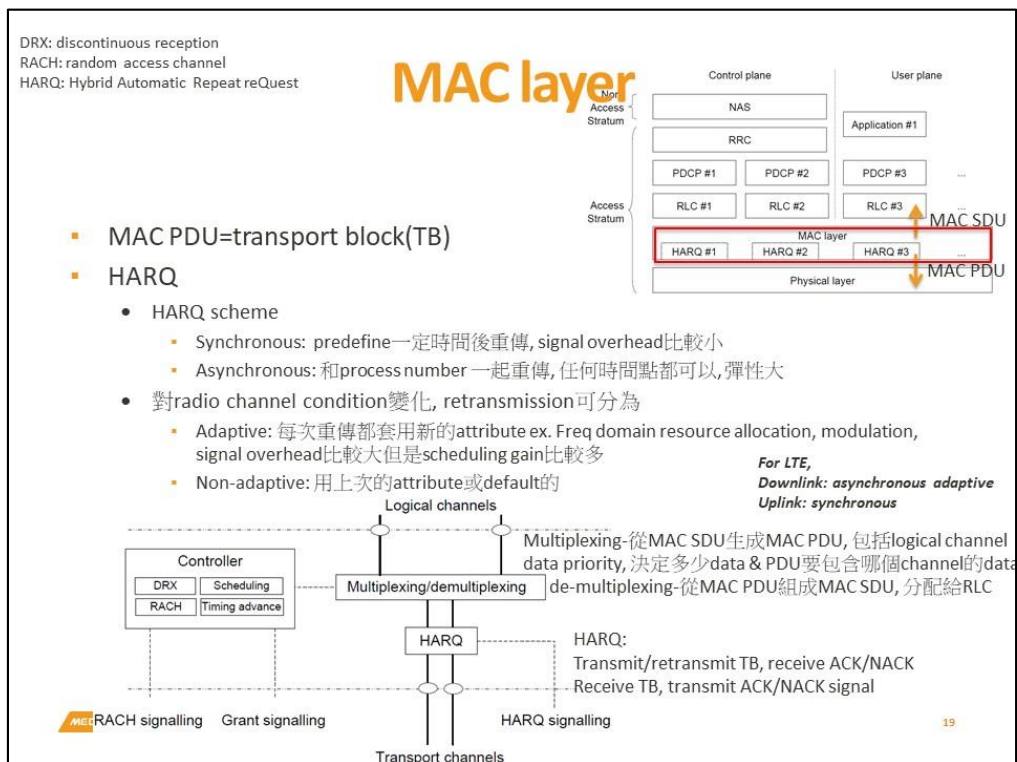
Lossless handover

- 對 time delay 忍受程度較高, 但不能忍受 packet loss ex. Download file
- 用在 user plane radio bearer (RLC **AM**)
- PDCP status report: Contained in PDCP control PDU, Avoid retransmission of correctly received data, Retransmission request of fail decompression SDUs

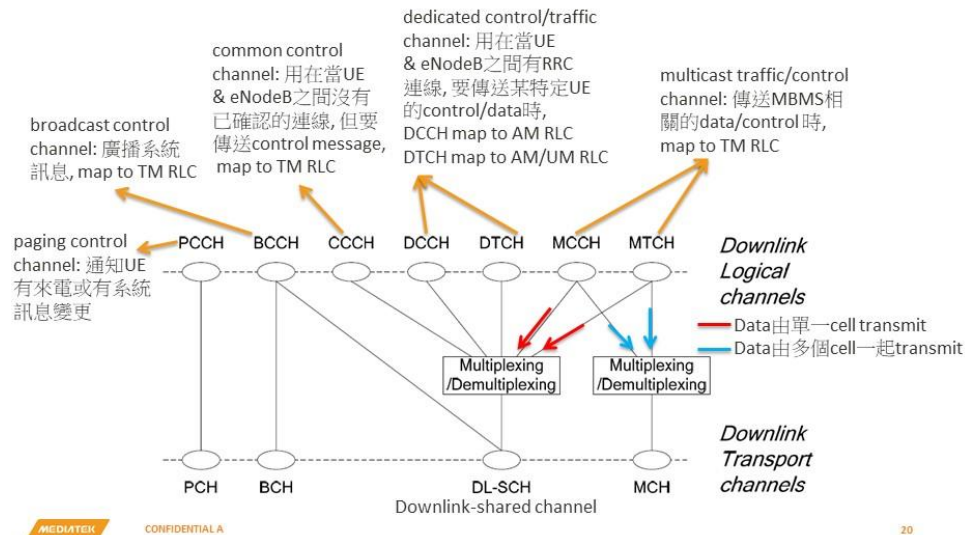




MAC: performs MUX and deMUX between logical channels and transport channels



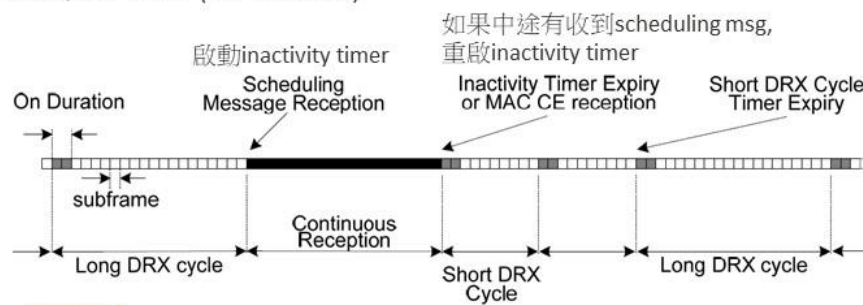
Logical channel to Transport channel-downlink



MAC function-DRX

MAC CE: MAC control element
RTT: round trip time

- DRX(discontinuous reception)
 - Under RRC_CONNECTED, UE can be configured DRX cycle
 - UE does not always need to monitor the downlink channels(PDCCH)
 - DRX cycle 2 states
 - "on duration"-monitor PDCCH
 - "DRX period"-skip downlink channel, for saving power purpose
 - Short DRX, Long DRX, continuous reception tradeoff-*battery saving & latency*
 - 為了滿足這些tradeoff, UE可以config多種DRX cycle, 用eNodeB command或timer切換
 - "HARQ RTT timer"(see Ch10.3.2)



MAC function-Multiplexing

■ Multiplexing and Logical Channel Prioritization

- For uplink, UE利用分配到的radio resource組成MAC PDU, 並滿足各radio bearer的QoS
- 根據PDCCH的uplink grant message, 必須決定要包含在MAC PDU的各channel data量
- Service by priority -> starvation of logical channel with lower priority
- Service by PBR & priority
 - PBR(prioritized bit rate) is configured by eNodeB for each logical channel
 - Service by PBR first for each channel
 - 剩下有空間再依照priority分
 - 優先順序
 - (1)handover RRC message
 - (2)MAC control elements
 - (3)each logical channel

