

Modular Architecture of Mobile WiMAX MAC and Beyond With Case Studies

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Agenda

- Modularity of MAC- and its requirement
- Modules of MAC
- Partitioning of Modules in fast hardware
- Modules of Mobile WiMAX with HARQ
- Modularity in LTE-MAC with HARQ
- HARQ Mode
- HARQ and its relation with scheduler
- HARQ and its relation with Physical layer/Rate-matching & bit collection block
- Modularity in next generation wireless standards

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Modularity of MAC & its requirement

➤ Modularity

✓ Division of the MAC into modules

- Various functionalities and their implementation
- Real time activities.

➤ Requirement

✓ Demand of next generation wireless MAC

- High Speed/ Bandwidth
- QOS while serving different class of traffic.
- To meet the real-time requirement

➤ Case study

✓ Connection oriented MAC

- Mobile WiMAX with HARQ

✓ LTE with HARQ

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Modules of MAC

- Control Module
- Data Processing Module
- Admission Control Module
- Scheduler Module
- Resource Mapper Module
- Physical Layer Abstraction Module

Main functionalities –
Exchange of control messages – Connection establishment

Main functionalities –
Data buffering for transmission path,
Classify the packet based on upper (link or network) layers information; generate the MAC specific packet data unit (PDU) both for transmitted and received data.

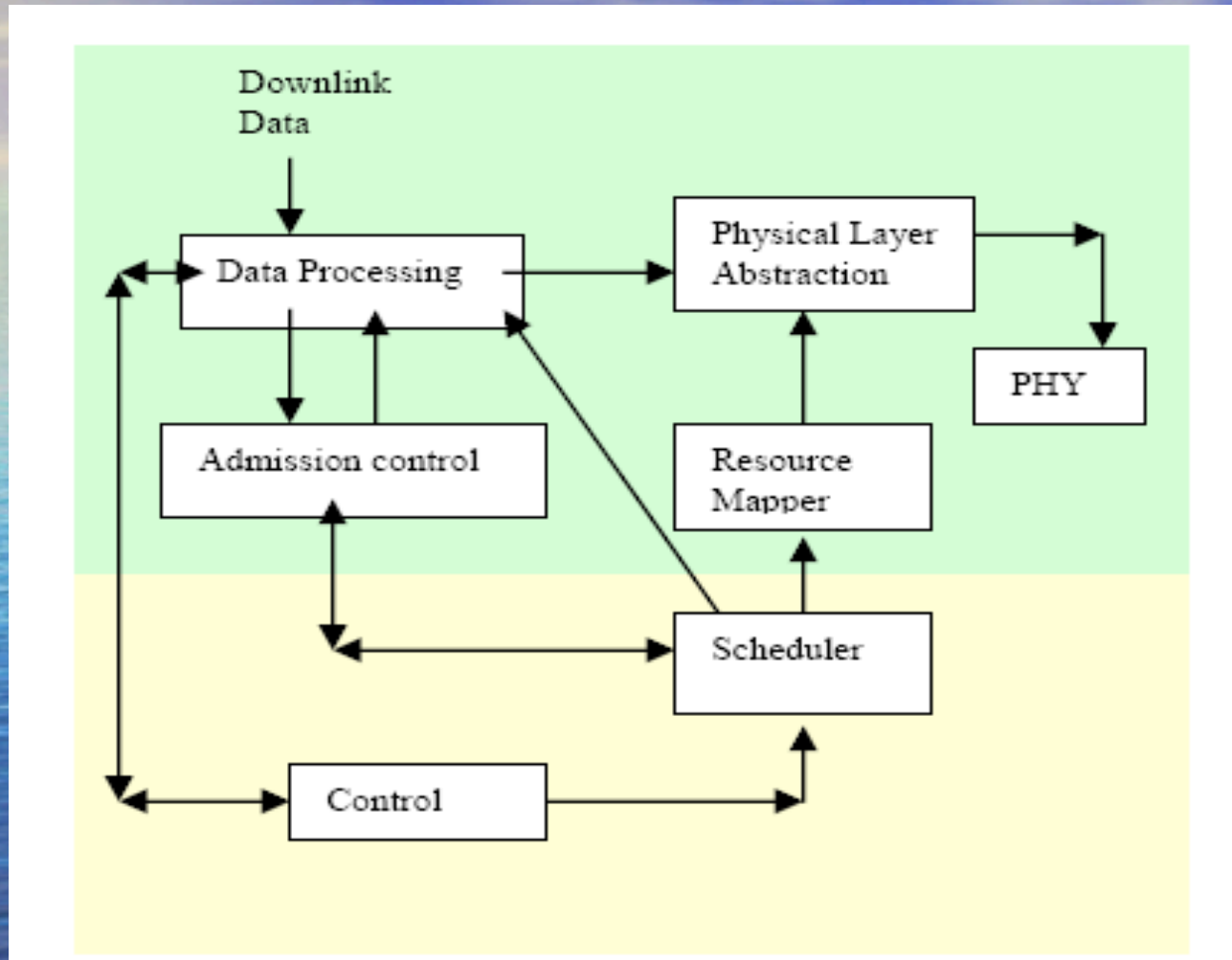
- Guarantees/Checks the required QoS of the entering traffic in the MAC
- Keeps the required QoS and associates them with every connection, used by scheduler
- Interacts with the scheduler if packets are required to be dropped in a specific connection of data
- Gets the information from the radio resource scheduler about the size of data to be transmitted and accordingly it generates the FDU, i.e. the length of the PDU depends on the scheduler's input.

Allocates radio resource through the radio channel
Determines MCS (modulation and coding scheme), number of data bytes required.
Mobile WiMAX scheduler provides the radio resource on the subchannelization, start frequency, number of OFDM symbols (logically mapped sub-carriers) and frequency-offset in Hz.

Maximum traffic data size in DL & UL
Call with number of subcarriers
data to be transmitted to this module that data is received from the scheduler, and generates the resource mapping information for both downlink and uplink in the received data.
Performs the resource mapping information to the physical layer.
Physical layer sends this information to the physical layer.

Physical layer sends this information to the physical layer.
physical layer.
processing module, to get the MAC PDUs and sends data to the physical layer. It does the buffering of the received data, passes a trigger to data processing module to generate the MAC PDUs based on the received data.
In case of receive path it processes the user request of bandwidth requirement if any, and passes this information to the scheduler, so that scheduler can meet the user requirement while doing the uplink scheduling in the coming frames. It sends a trigger to scheduler for scheduling the next frame

Partitioning of Modules in fast hardware



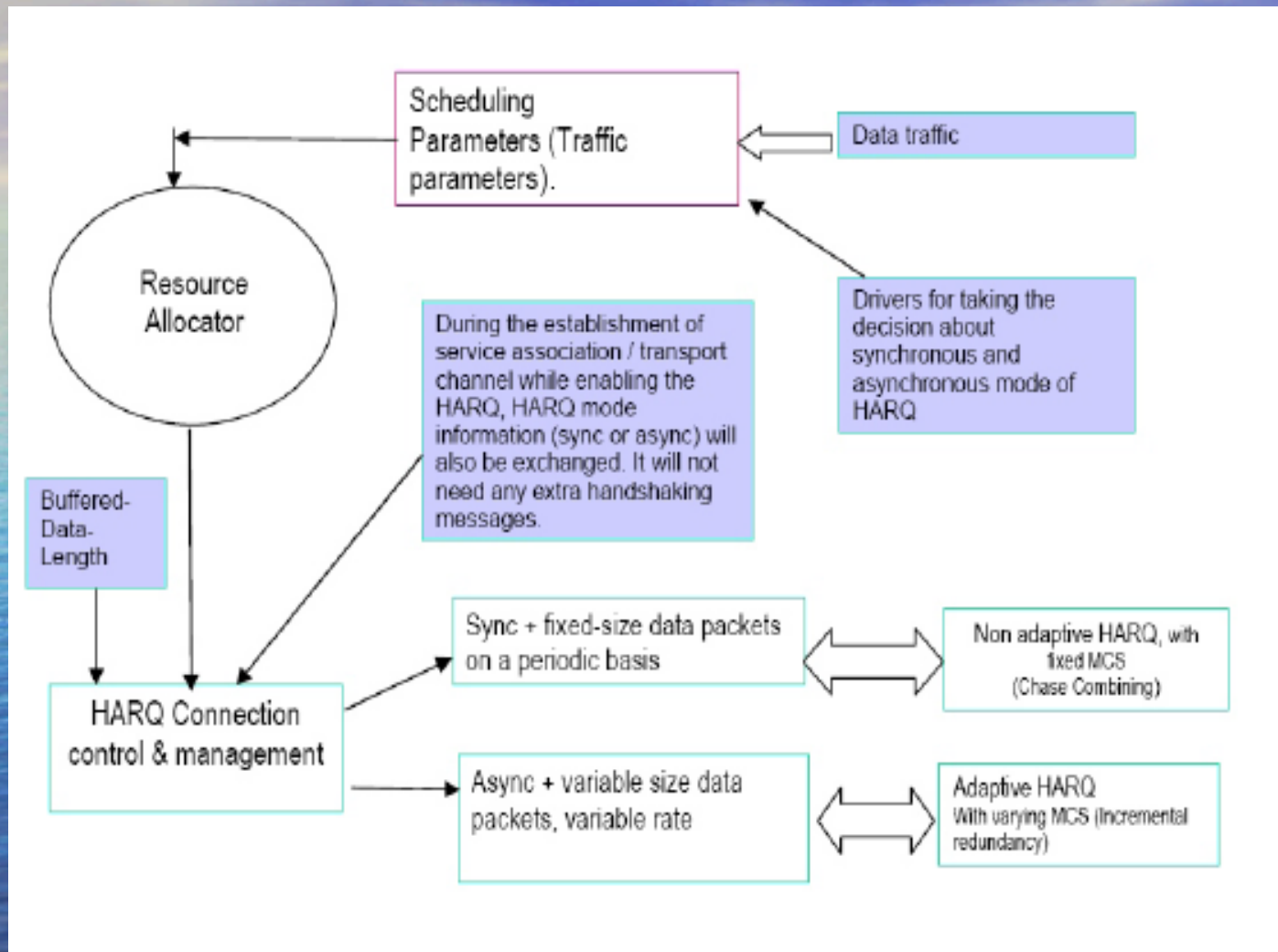
Fast-Hardware

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HARQ Modes

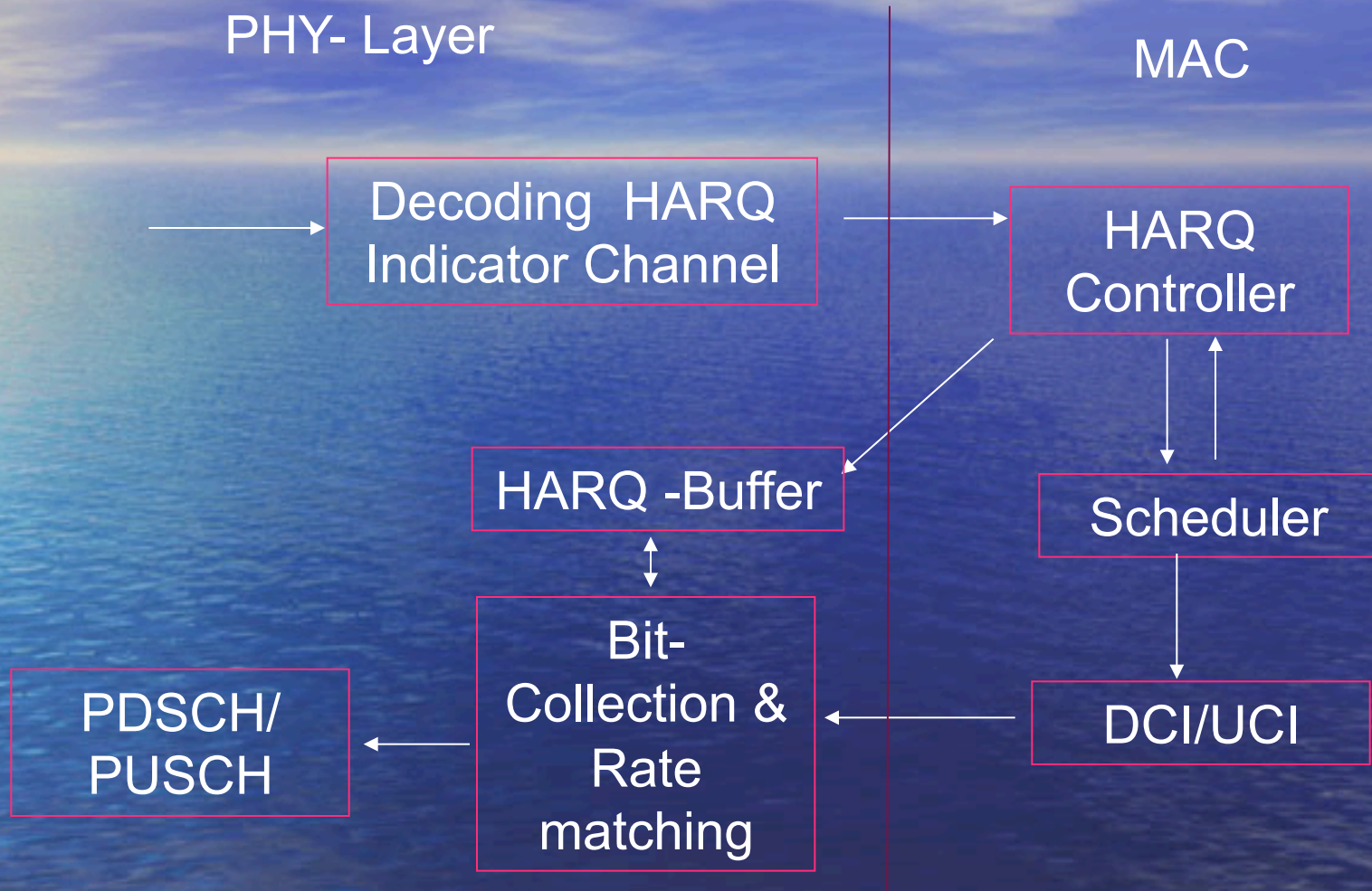
- Modes of HARQ
 - ✓ Based on retransmission timing:
Synchronous and Asynchronous
 - ✓ Based on Modulation coding scheme variation
Adaptive and non-adaptive
 - ✓ Redundancy bits variation
IR and Chase (subset of IR)

HARQ and its relation with scheduler



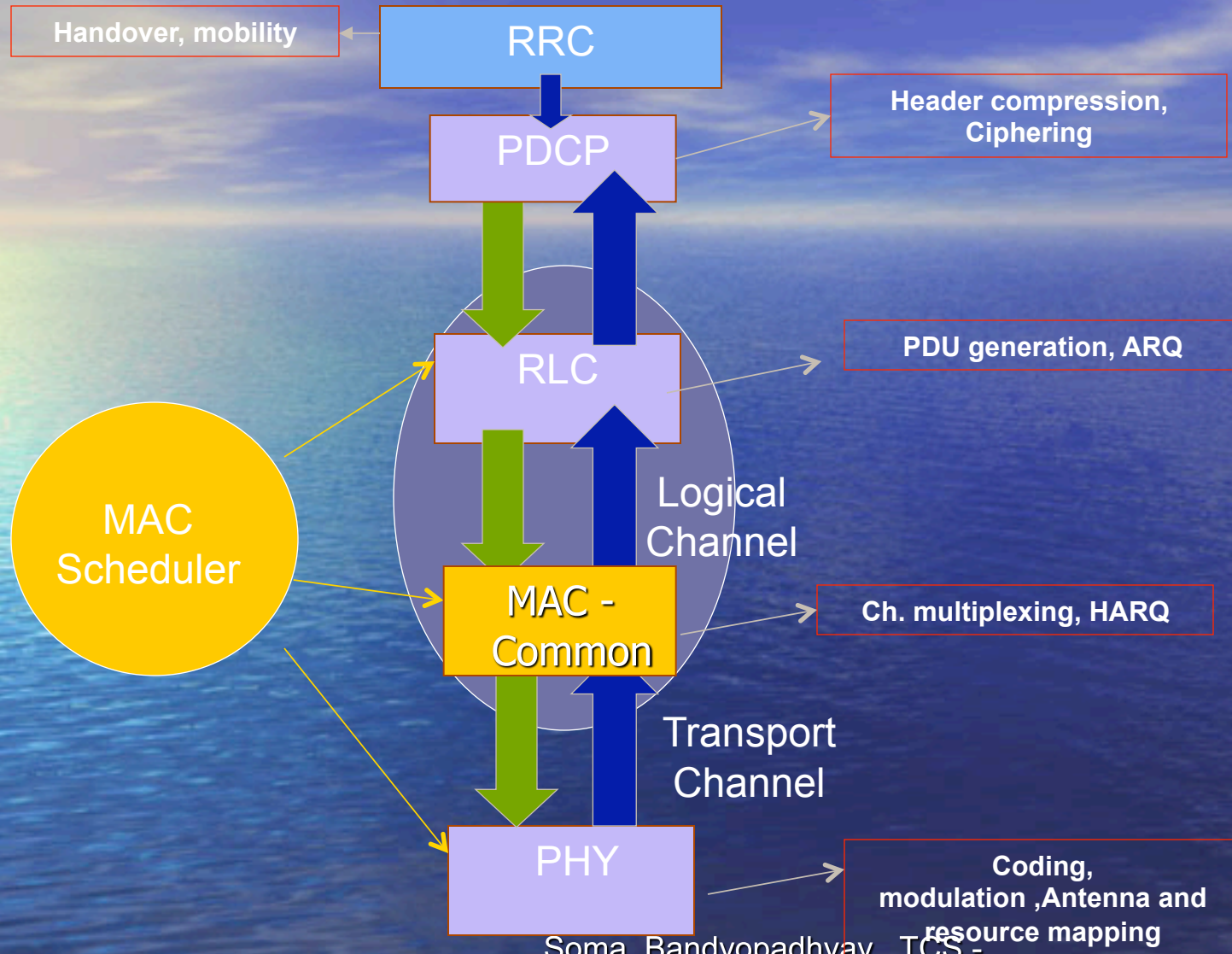
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Modularity in LTE-MAC with HARQ



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LTE-MAC- Components



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HARQ - its relation with Physical layer

➤ The core blocks of HARQ

✓ Physical layer

Rate matching and bit collection block

Guarantees MCS requirement as given by scheduler.

Adds repetition to add additional bits.

Performs puncturing to reduce no. of bits.

Varies combination of redundancy bits, maintains the buffering.

The collected bits can be buffered and divided further into code blocks with different combination of systematic as well as redundancy bits – IR and Chase

✓ MAC layer

HARQ Controller (Lower MAC)

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Modularity in next generation Wireless

➤ 802.16m – WiMAX-II

➤ CS- Convergence sub-layer

➤ CPS -Common Part Sublayer

✓ Radio Resource Control and Management (RRCM)

✓ MAC

Separate block for link and phy control

HARQ:

Synchronous in uplink Asynchronous in
downlink. Only IR. Adaptive and non
adaptive