LTE for Mobile Broadband Access

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Ericsson Research, Aachen

Multimedia - Changing the industry

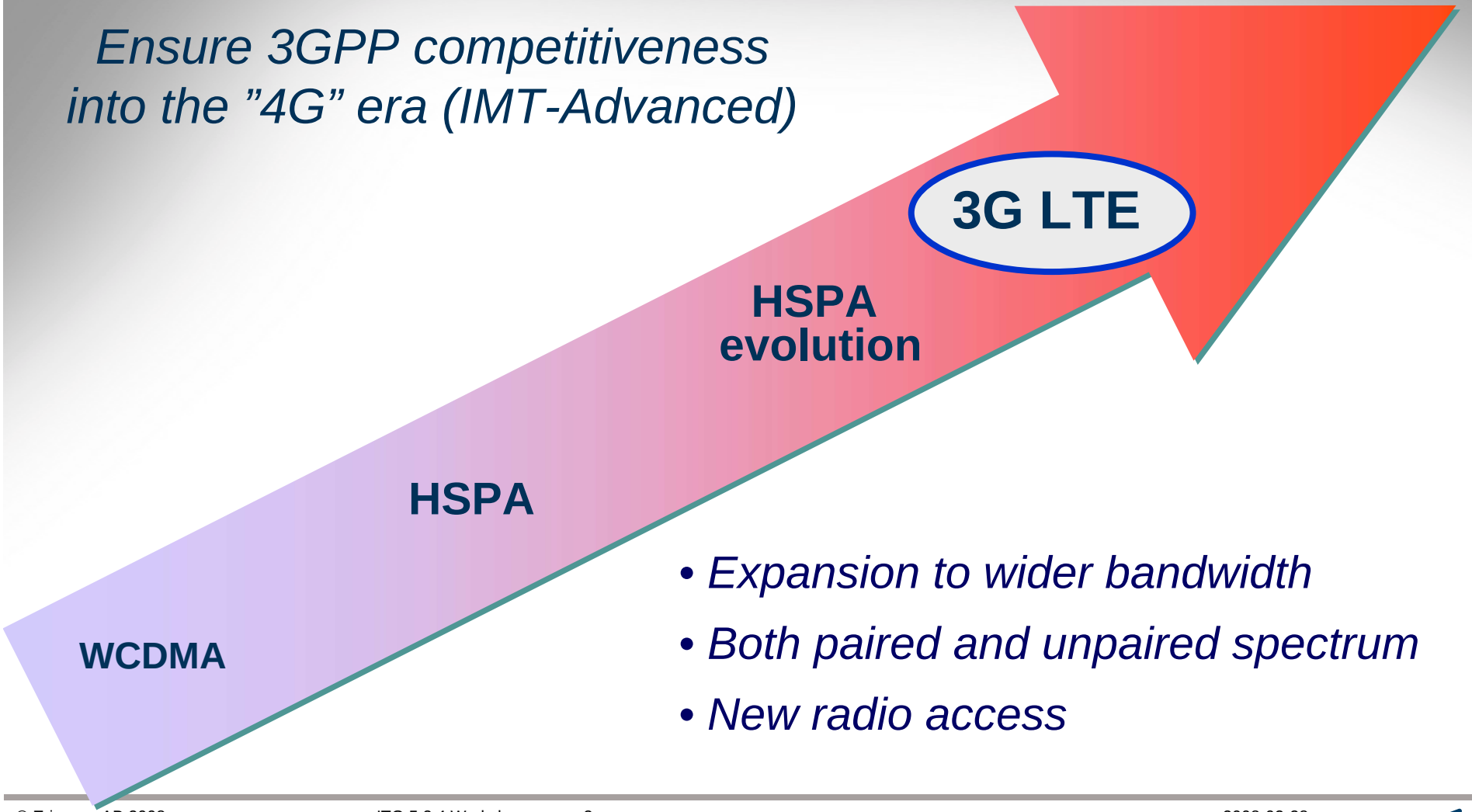
Just like mobile telephony once did

Source: OVUM, Strategy Analytics & Internal Ericsson

3GPP Long Term Evolution (LTE)

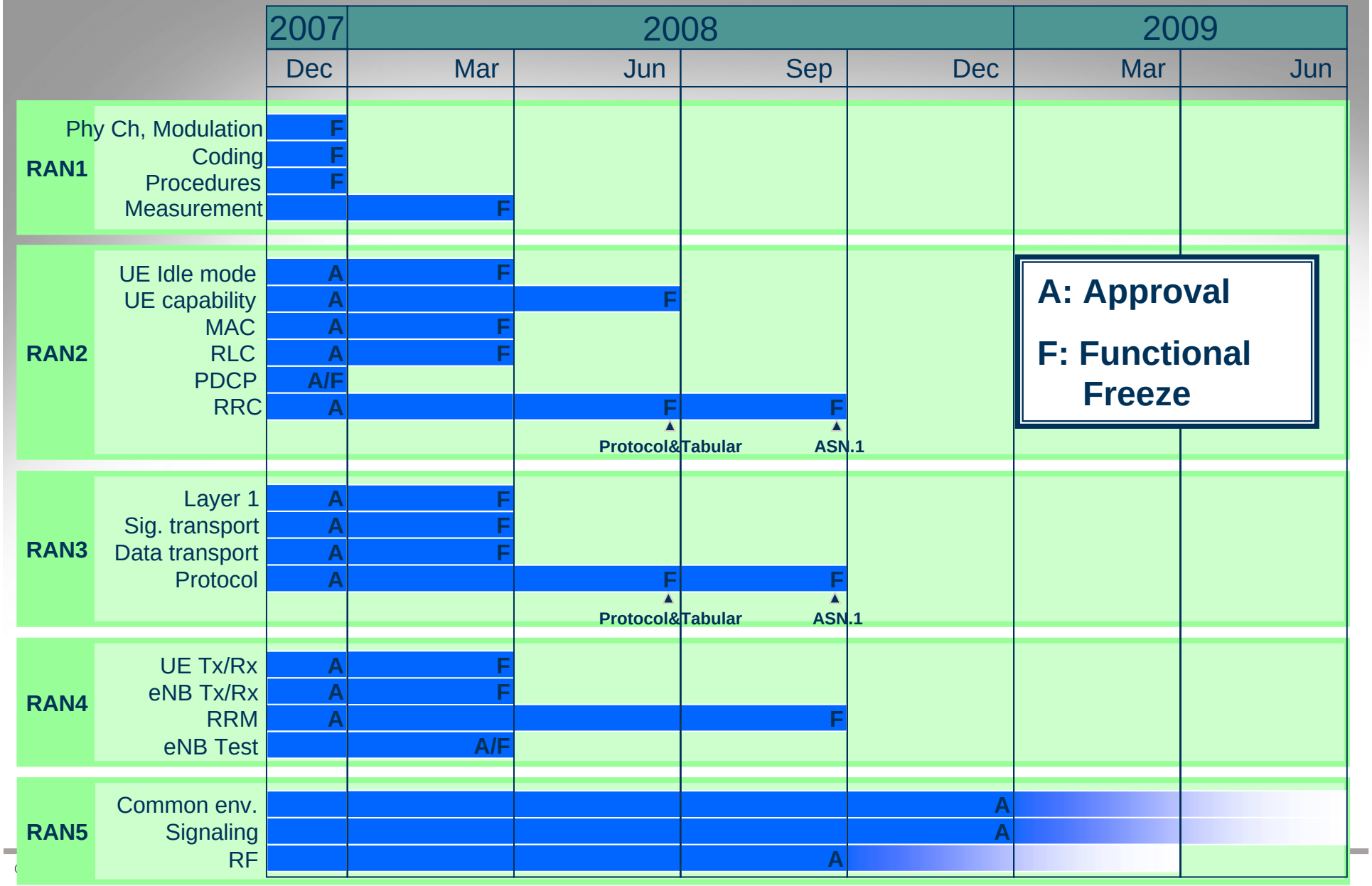
2003/4	2005/6	2007/8	2009/10	2011/12

Ensure 3GPP competitiveness into the ”4G” era (IMT-Advanced)



- *Expansion to wider bandwidth*
- *Both paired and unpaired spectrum*
- *New radio access*

Overall LTE Work Plan



3GPP LTE Performance Targets

- **High data rates**
  - Downlink: >100 Mbps
  - Uplink: >50 Mbps
  - Cell-edge data rates
    2-3 x HSPA Rel. 6

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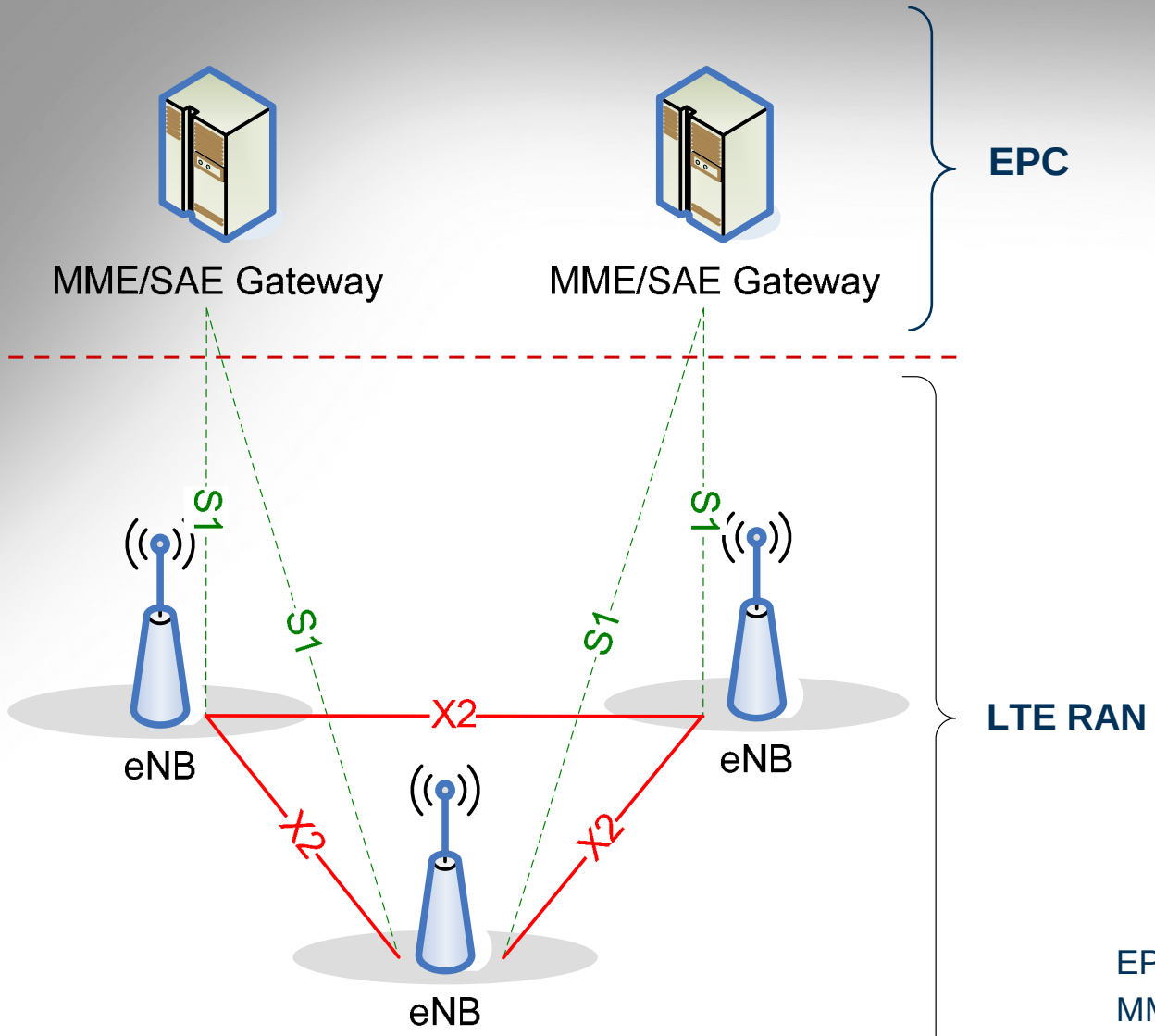
- **High Performance Broadcast services**
- **Cost-effective migration**

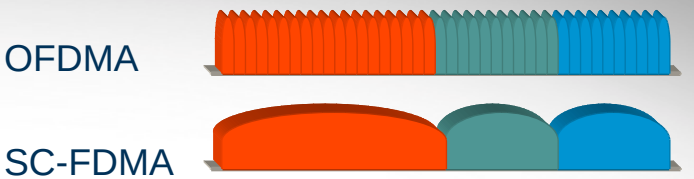
LTE/SAE – *Overall Architecture (simplified)*



EPC: *Evolved Packet Core*
MME: *Mobility Management Entity*

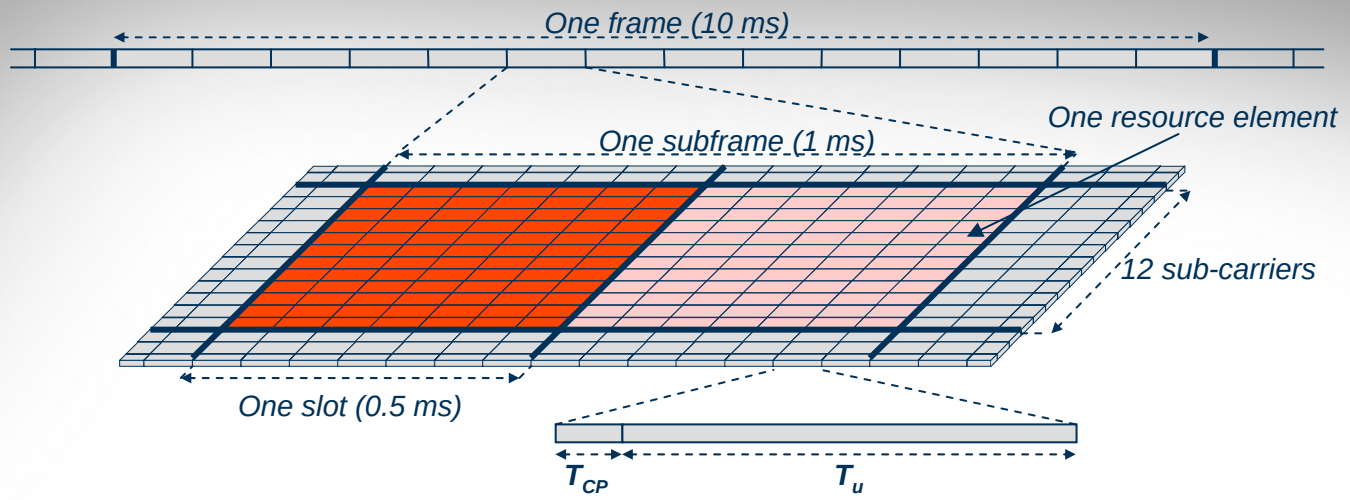
Key LTE radio access features

- **LTE radio access**
  - Downlink: OFDM
  - Uplink: SC-FDMA



The downlink physical resource

A ”time-frequency” grid



- Time domain structure:
  - 10 ms **Frame** consisting of 10 **Subframes** of length 1 ms
  - Each subframe consisting of 2 **Slots** of length 0.5 ms
  - Each slot consisting of 7 **OFDM symbols**
    (6 symbols in case of extended CP)
- Resource blocks:
  - 12 sub-carriers during one slot
  - Assigned in pairs of two consecutive resource blocks

Key LTE radio access features

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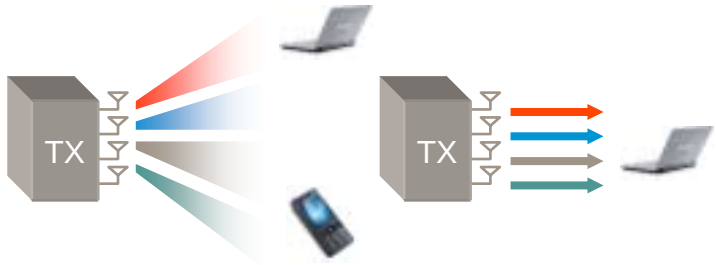
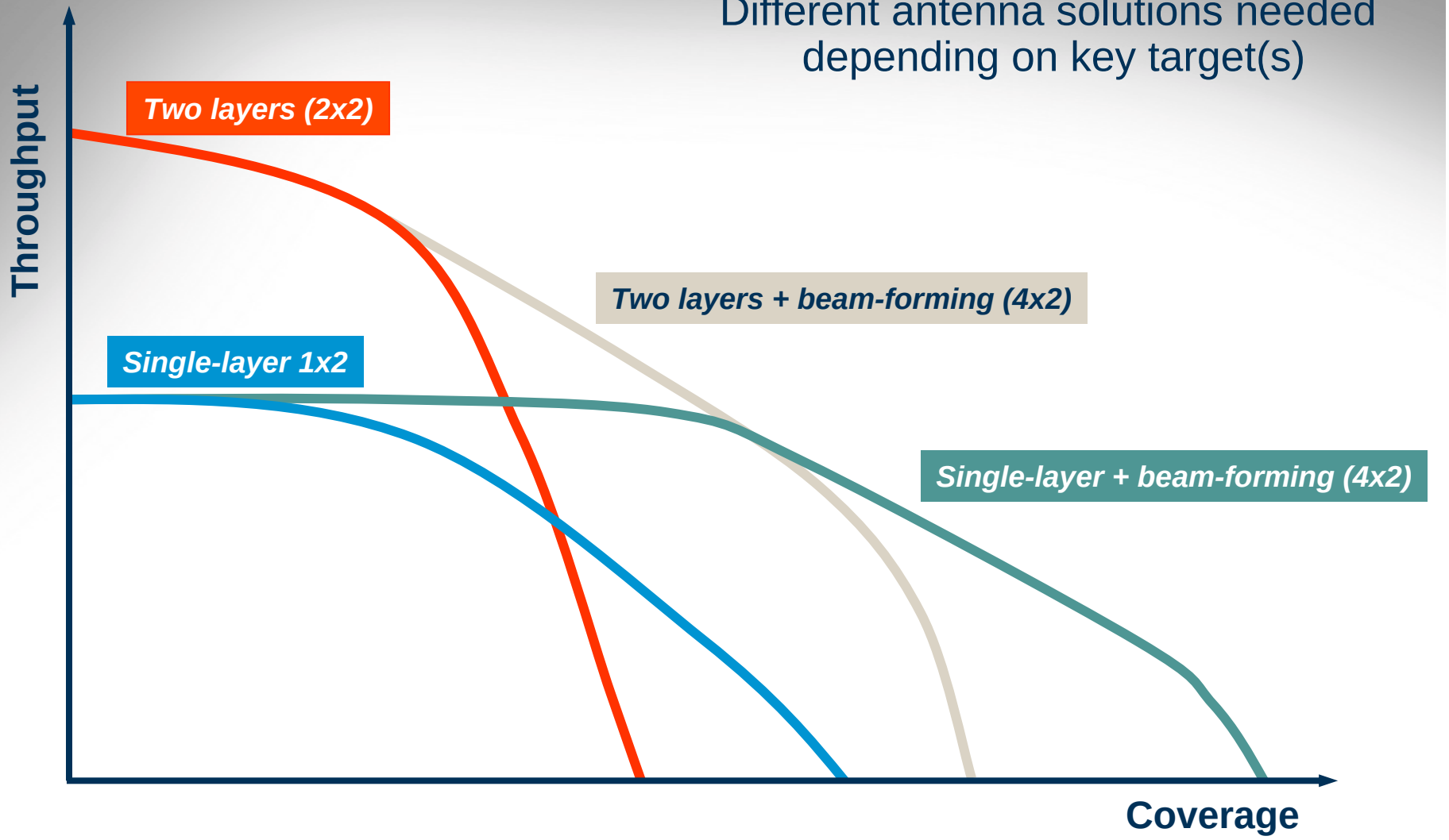
  - Uplink: SC-FDMA

- **Advanced antenna solutions**
  - Diversity
  - Beam-forming
  - Multi-layer transmission (MIMO)



Advanced Antenna Schemes

Different antenna solutions needed depending on key target(s)



Key LTE radio access features

- **LTE radio access**
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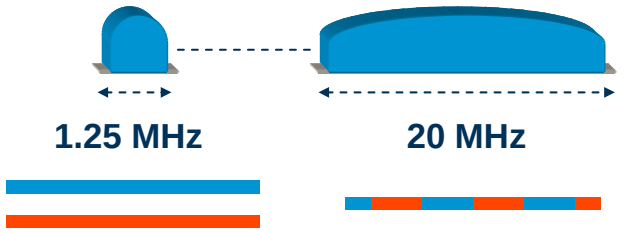
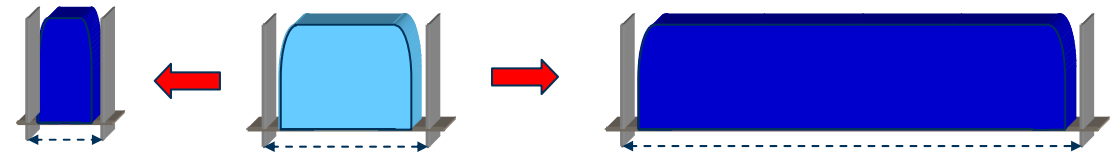
- **Advanced antenna solutions**
  - Diversity
  - Beam-forming
  - Multi-layer transmission (MIMO)
- **Spectrum flexibility**
  - Flexible bandwidth
  - New and existing bands
  - Duplex flexibility: FDD and TDD



LTE – *Spectrum flexibility*

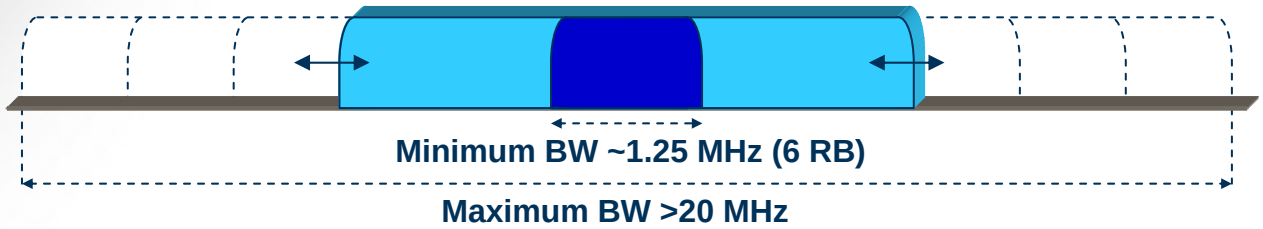
- Allow for operation in a wide range of different spectrum
  - *Current and future 3G spectrum (2 GHz, 2.6 GHz, …)*
  - *Migration of 2G spectrum (e.g. 900 MHz)*
  - *Re-farming of other spectrum, e.g. UHF bands*
- Uncertain size of future spectrum assignments
- Efficient operation in differently-sized spectrum allocations
  - *Up to 20 MHz to enable very high data rates*
  - *Less than 5 MHz to enable smooth spectrum migration*

Need for flexible transmission bandwidth



LTE – *Bandwidth flexibility*

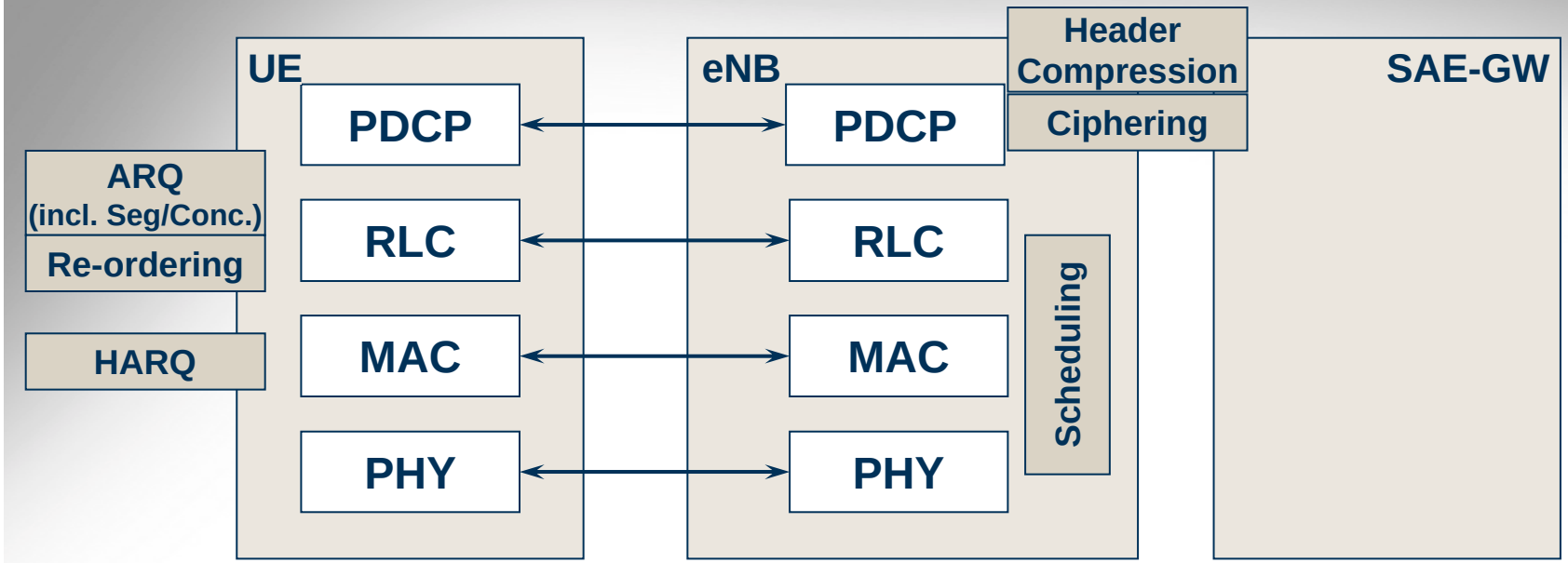
- LTE physical layer supports any bandwidth from ~1.25 MHz to well beyond 20 MHz in steps of ~200 kHz (one "*Resource Block*")



- RF complexity/requirements limit set of bandwidths actually supported
  - *e.g. 1.25 MHz, 1.8 MHz, 5 MHz, 10 MHz, 20 MHz*

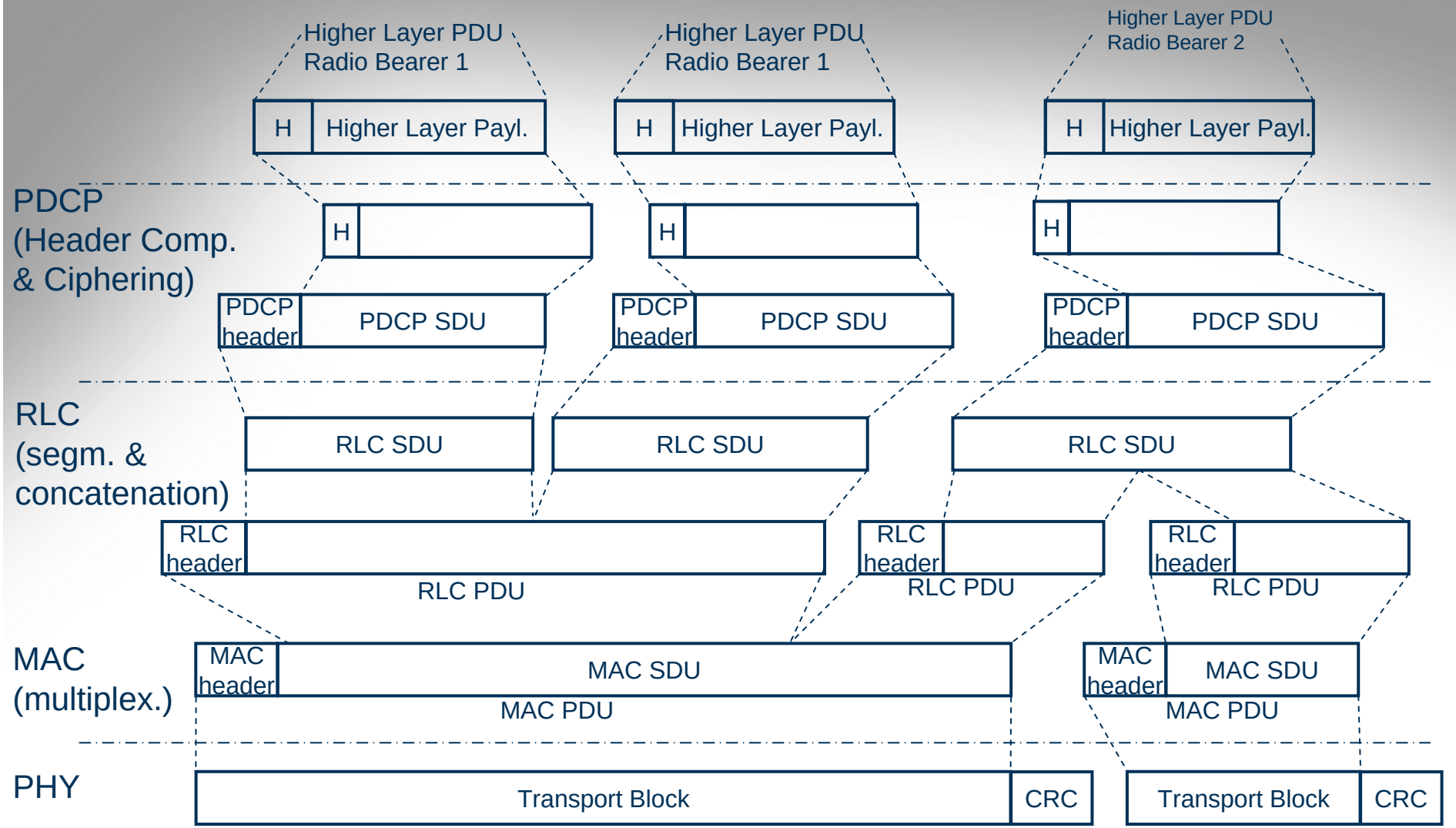
All LTE terminals must support the maximum bandwidth (up to 20 MHz)

User Plane Protocol Stack

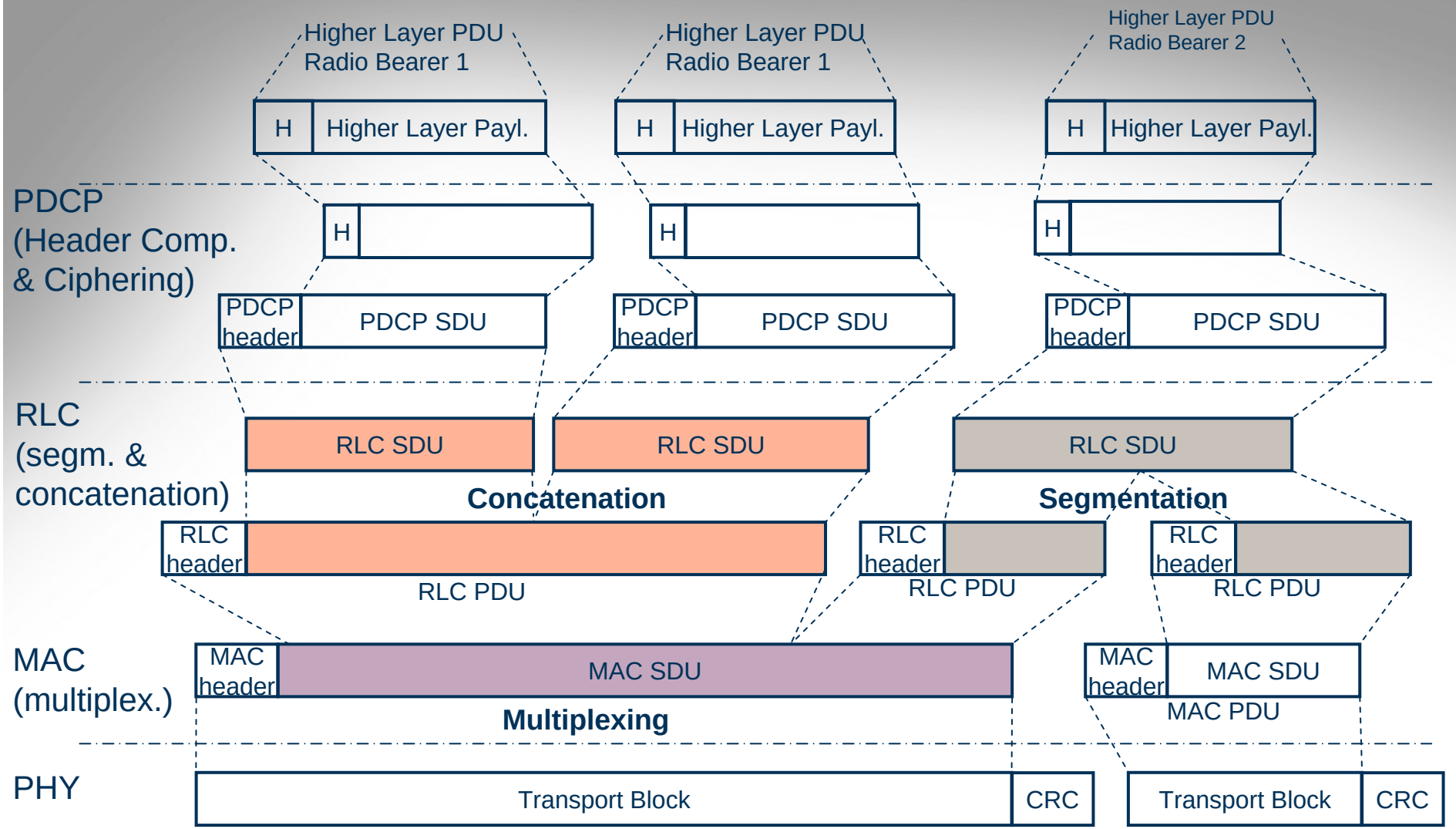


- PDCP, RLC, MAC and PHY terminated in eNode

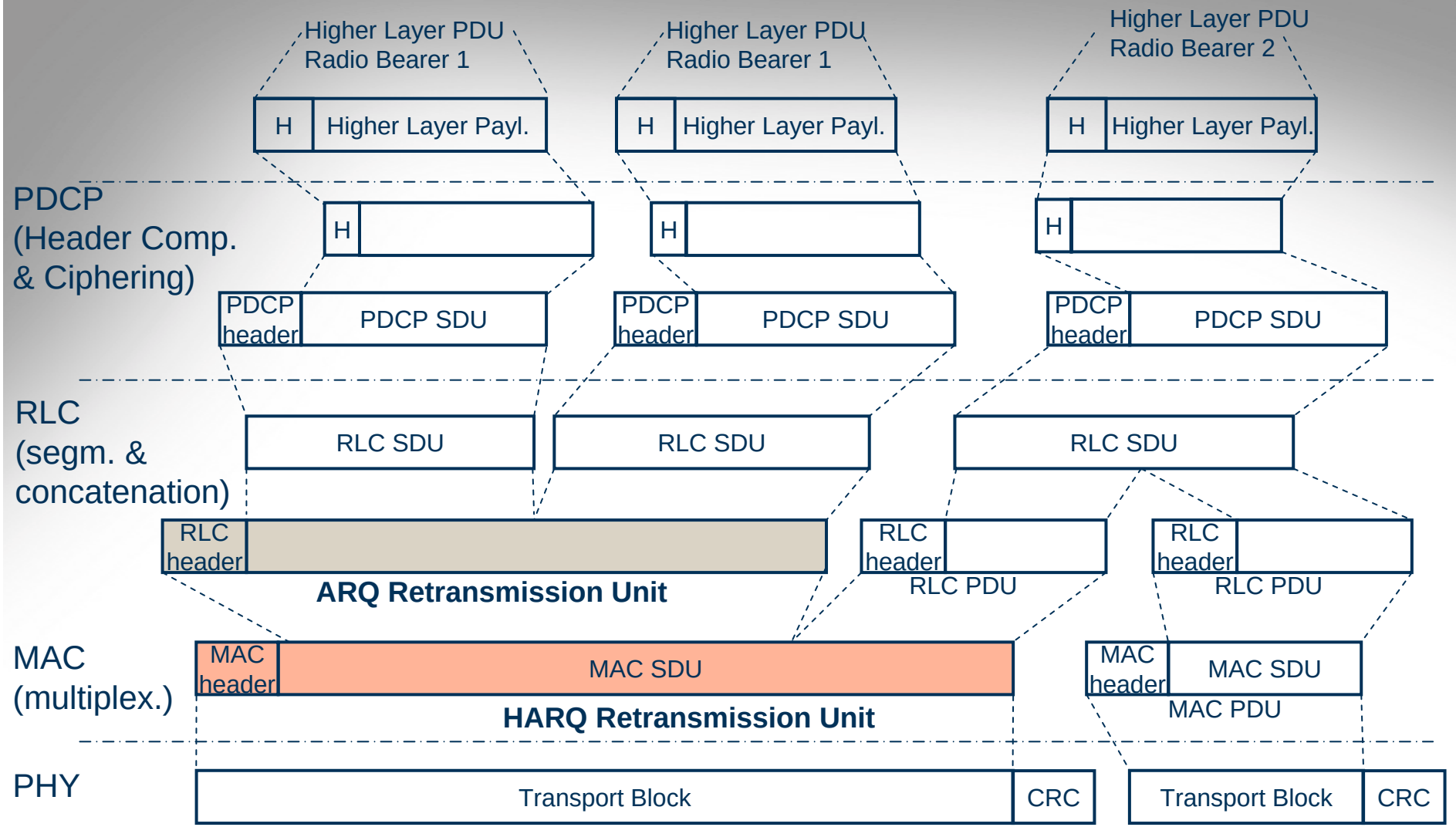
User Plane Data Flow



Segmentation/Concatenation/Multiplexing



ARQ & HARQ Retransmission Unit



Three (future) user scenarios

LTE fully supported by Ericsson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