PROTOCOLS

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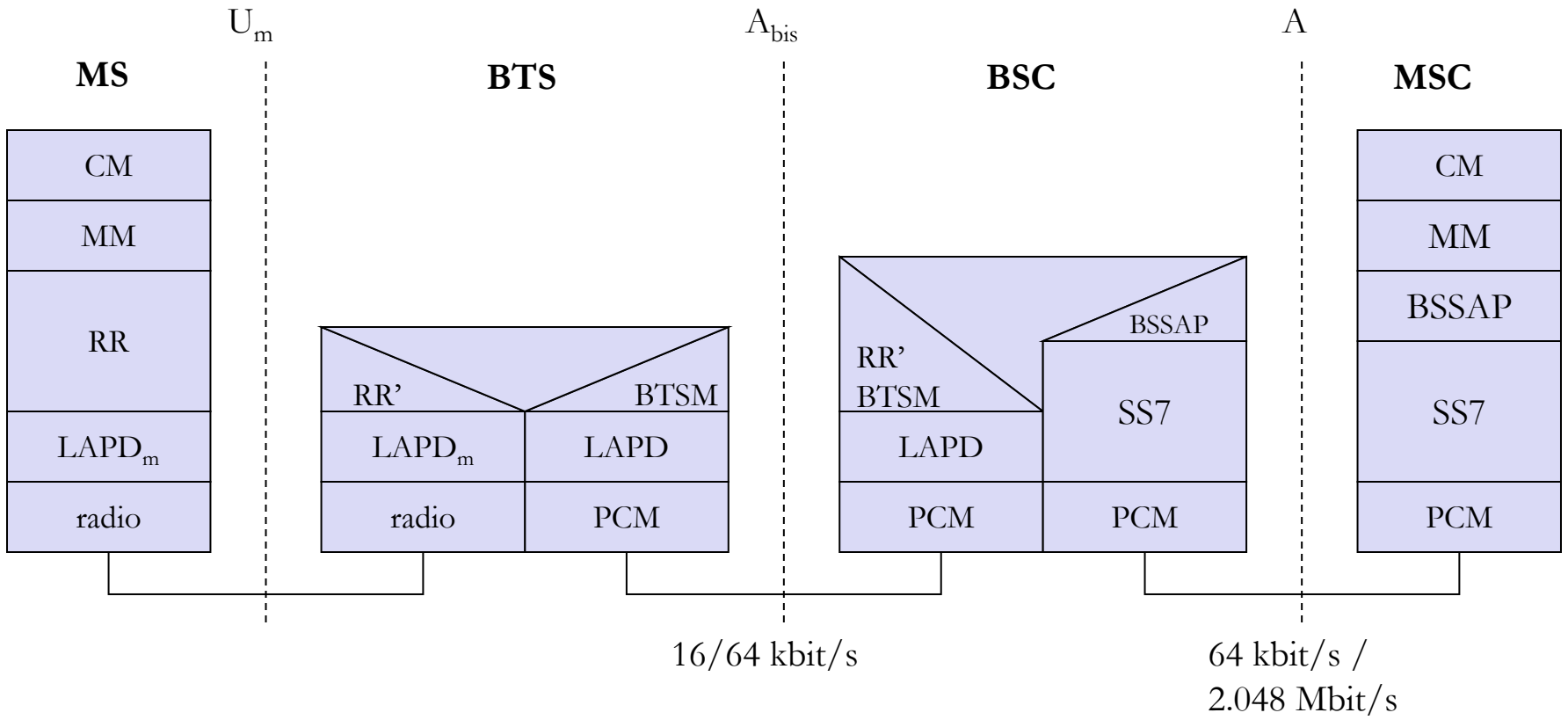
AP/CSE

GSM protocol layers for signaling



Layer 1

- Um interface is the only air interface.
- **Layer 1**
  - the physical layer, handles all radio-specific functions.
    - creation of bursts according to the five different formats,
    - Multiplexing of bursts into a TDMA frame,
    - synchronization with the BTS,
    - Detection of idle channels,
    - measurement of the channel quality on the downlink.
  - The physical layer at Um uses GMSK for digital modulation and performs encryption/decryption of data,
    - **encryption is not performed end-to-end,** but only between MS and BSS over the air interface.

Layer 1

- Synchronization with the BTS
  - includes the correction of the individual path delay between an MS and the BTS.
  - All MSs within a cell use the same BTS and thus must be synchronized to this BTS.
  - The BTS generates the time-structure of frames, slots etc.
  - Different round trip times (RTT) is the disadvantage
    - An MS close to the BTS has a very short RTT, whereas an MS 35 km away already exhibits an RTT of around 0.23 ms.
    - If the MS far away used the slot structure without correction, large guard spaces would be required, as 0.23 ms for each slot.
    - Therefore, the BTS sends the current RTT to the MS, which then adjusts its access time so that all bursts reach the BTS within their limits.
    - This mechanism reduces the guard space to only 30.5 μs

Layer 1

- **Channel coding and error detection/correction**
  - Channel coding makes extensive use of different **forward error correction (FEC) schemes.**
  - FEC adds redundancy to user data, allowing for the detection and correction of selected errors.
  - Advantage of an FEC scheme depends on the amount of redundancy, coding algorithm and further interleaving of data to minimize the effects of burst errors.
  - The FEC is also the reason why error detection and correction occurs in layer one and not in layer two as in the ISO/OSI reference model.
  - The GSM physical layer tries to correct errors, but it does not deliver erroneous data to the higher layer.

Layer 2

- Link Access Protocol in the D channel (**LAPDm)**
  - Signaling between entities in a GSM network requires higher
  - LAPDm is a lightweight LAPD because it does not need synchronization flags or check summing for error detection.
  - LAPDm offers reliable data transfer over connections, re-sequencing of data frames, and flow control
  - As there is no buffering between layer one and two, LAPDm has to obey the frame structures, recurrence patterns etc. defined for the Um interface.
  - Further services provided by LAPDm include segmentation and reassembly of data and acknowledged/unacknowledged data transfer.

Layer 3

- **Radio resource management (RR)**
  - Only a part of this layer, **RR', is implemented in the BTS, the remainder is situated in the BSC**.
  - The functions of RR' are supported by the BSC via the **BTS management (BTSM).**
  - The main tasks of RR are **setup, maintenance, and** release of radio channels.
  - RR also directly accesses the physical layer for radio information and offers a reliable connection to the next higher layer.

Layer 4

- **Mobility management (MM)**
  - registration,
  - authentication,
  - Identification,
  - location updating,
  - the provision of a temporary mobile subscriber identity (TMSI) that replaces the international mobile subscriber identity (IMSI) and which hides the real identity of an MS user over the air interface.
- While the IMSI identifies a user, the TMSI is valid only in the current location area of a VLR.
- MM offers a reliable connection to the next higher layer.

Layer 5

- **Call management (CM)**
  - call control (CC),
    - CC provides a point-to-point connection between two terminals and is used by higher layers for call establishment, call clearing and change of call parameters.
  - short message service (SMS)
    - SMS allows for message transfer using the control channels SDCCH and SACCH
  - supplementary service (SS).

Pulse code modulation (PCM)

- **PCM systems** offer transparent 64 kbit/s channels, GSM also allows for the submultiplexing of four 16 kbit/s channels into a single 64 kbit/s channel (16 kbit/s are enough for user data from an MS).

Signaling system No. 7 (SS7)

- Signaling system No. 7 (SS7) is used for signaling between an MSC and a BSC.
- This protocol also transfers all management information between MSCs, HLR, VLRs, AuC, EIR, and OMC.
- An MSC can also control a BSS via a BSS application part (BSSAP).

Test your Knowledge

- How is synchronization achieved in GSM? Who is responsible for synchronization and why is it so important?

Summary

- Protocol stack
  - Different layers between entities in GSM

References

Jochen H. Schller, “Mobile Communications”, Second Edition, Pearson Education, New Delhi, 2007.