

2 G ARCHITECTURE– GSM, GPRS AND OTHERS

Lesson 08

Protocol Layers in GSM

LAYERS DEFINED IN OPEN SYSTEM INTERCONNECTION (OSI) MODEL

- physical (layer 1)
- data link (layer 2)
- network (layer 3)
- transport (layer 4)
- session (layer 5)
- presentation (layer 6)
- application (layer 7)

TRANSCEIVER

- Receives signals
- Signals processed at the different layers arranged in order from layer 1 to layer 7
- Transmits the signals
- Signals processed at the different layers arranged in order from layer 7 to layer 1

EACH LAYER ADDITIONAL HEADERS (MESSAGES)

- Layer headers for each layer in specific formats
- Stripped by the transceiver at the receiving end
- Various operations can be performed on the received data

ACTUALLY USED LAYERS

- TCP/IP or GSM, a transceiver need not define protocols for all 7 layers
- Some layers perform the functions of neighbouring layer(s)
- MS, BTS, BSC, and MSC, for example, have just 3 layers—physical, data link, and network

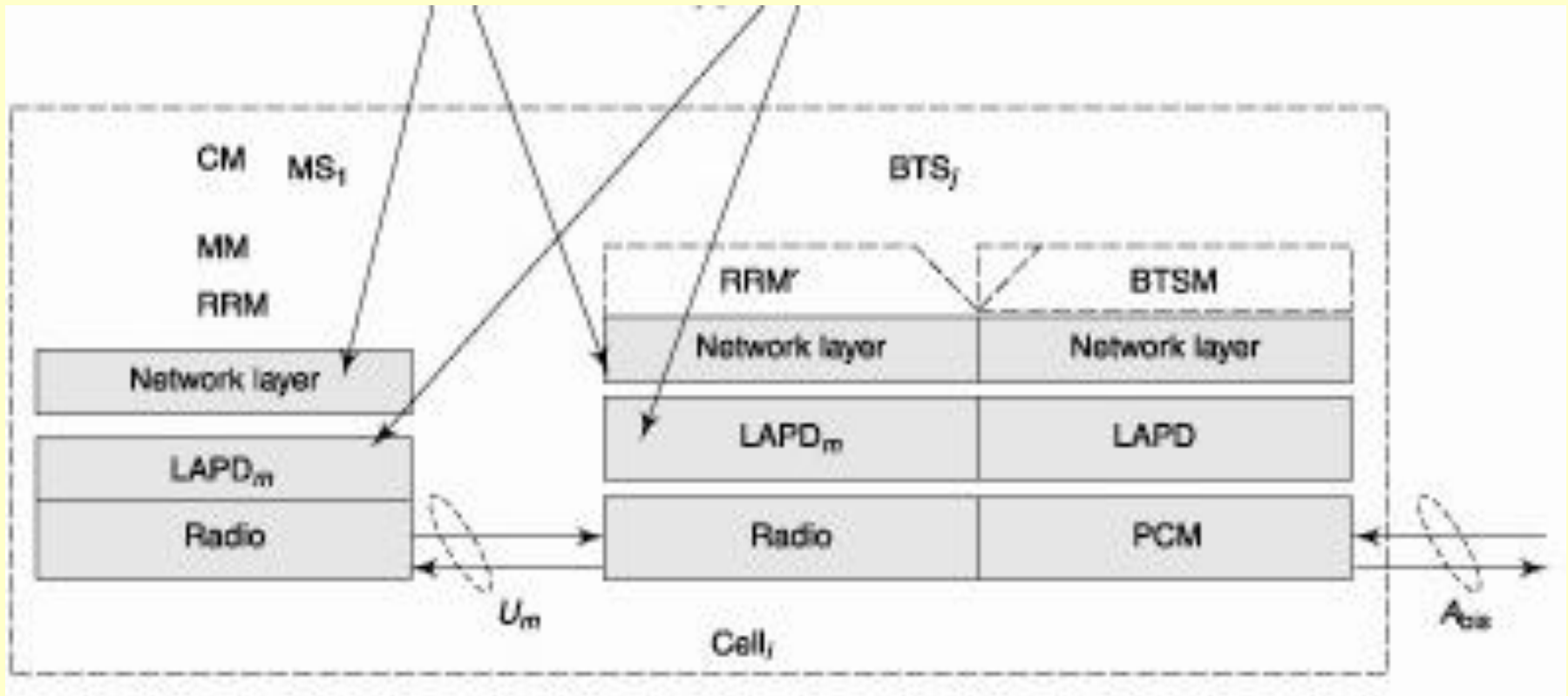
ACTUALLY USED LAYERS

- Transport and session layer functions are taken care of by network layer protocols
- Tasks of the presentation layer performed by other layers
- TE (user) application at either end (caller and connected ends) controls the application layer protocols

ACTUALLY USED LAYERS— EXAMPLES OF MOBILE STATION, BTS, BSC, AND MSC

- Have just 3 layers—physical, data link, and network
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ALL PROTOCOL LAYERS BETWEEN THE MS AND BTS



RADIO PROTOCOL SUBLAYER FUNCTIONS AT PHYSICAL LAYER BETWEEN THE MS AND BTS

Radio:

- Full- or-half duplex access
- SDMA, TDMA, and FDMA
- Bursting and framing
- Synchronizing the MSs and path delays corrections
- Frequency correction
- Coding, FEC, CRC, data interleaving, and encryption
- Error detection, correction, and blocking the data not correctable
- GMSK digital modulation and transmission
- Demodulation and reception
- Decryption and decoding

DATA LINK LAYER SUBLAYER LAPD_M

- Controls the flow of packets to and from the network layer and provides access to the various services
- LAPD_m (link access protocol *D*-channel modified) for *Um*— data link layer protocol between the MS and BTS
- For accessing the *D*-channel link by GSM

DATA LINK LAYER SUBLAYER LAPD_M

- A modified version of the LAPD protocol for the D-channel of ISDN (integrated services digital network)
- No need of appending and stripping of synchronization bits, *S* flag, and error correction bits to and from the layer in LAPD_m because the radio interface (*Um*) performs these functions at the physical layer itself

DATA LINK LAYER SUBLAYER LAPD_M

- Communicates by wireless across the radio interface as opposed to the guided transmission of ISDN signals in case of the LAPD

LAPD_M (LINK ACCESS D-CANNEL PROTOCOL FOR MOBILE) SUB-LAYER FUNCTIONS

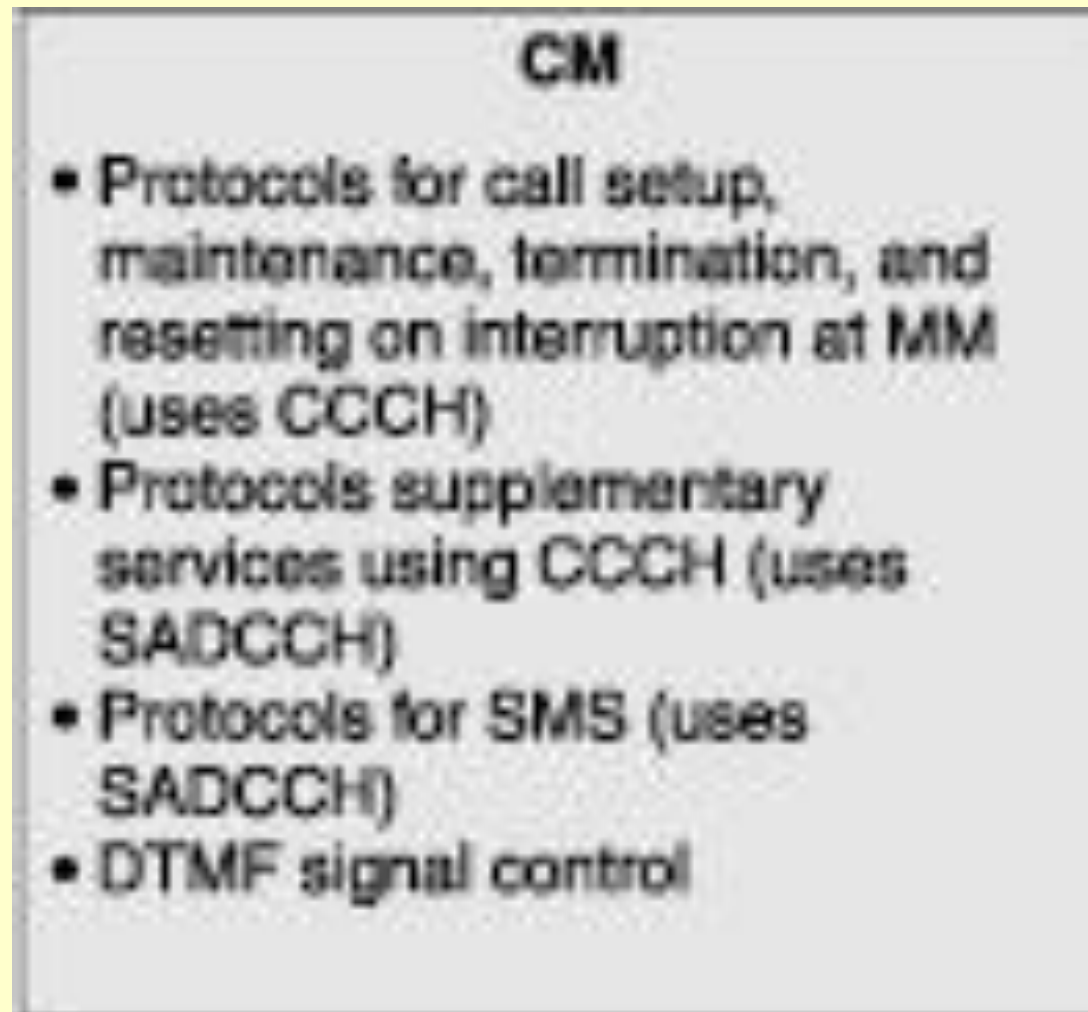
LAPD_m:

- Data flow control
- Acknowledged/unacknowledged data transmission
- Address and sequence number checks
- Access point for the multiple services
- Re-sequencing of data
- Segmentation
- Data re-assembly

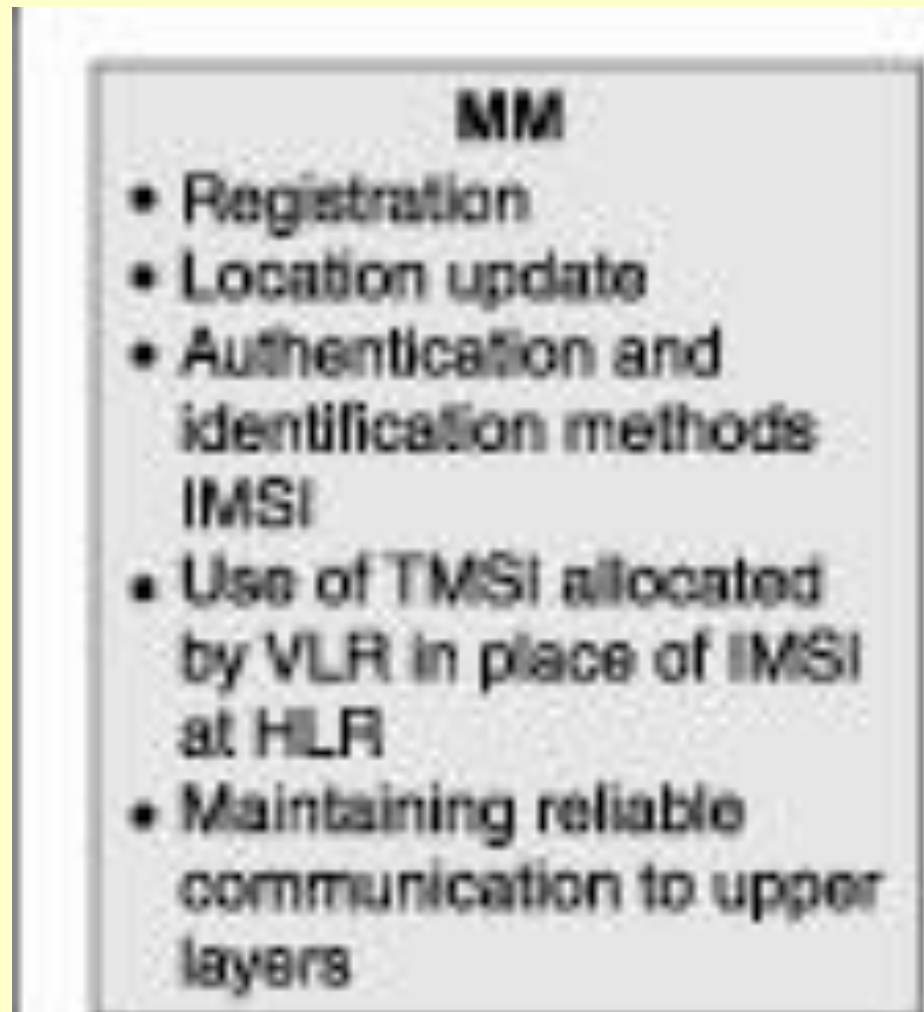
NETWORK LAYER

- Three sub layers—call (connection) management (CM), mobility management (MM), and radio resource management (RRM)

OPERATIONS IN THE CM SUB LAYER



OPERATIONS IN THE MM SUB LAYER

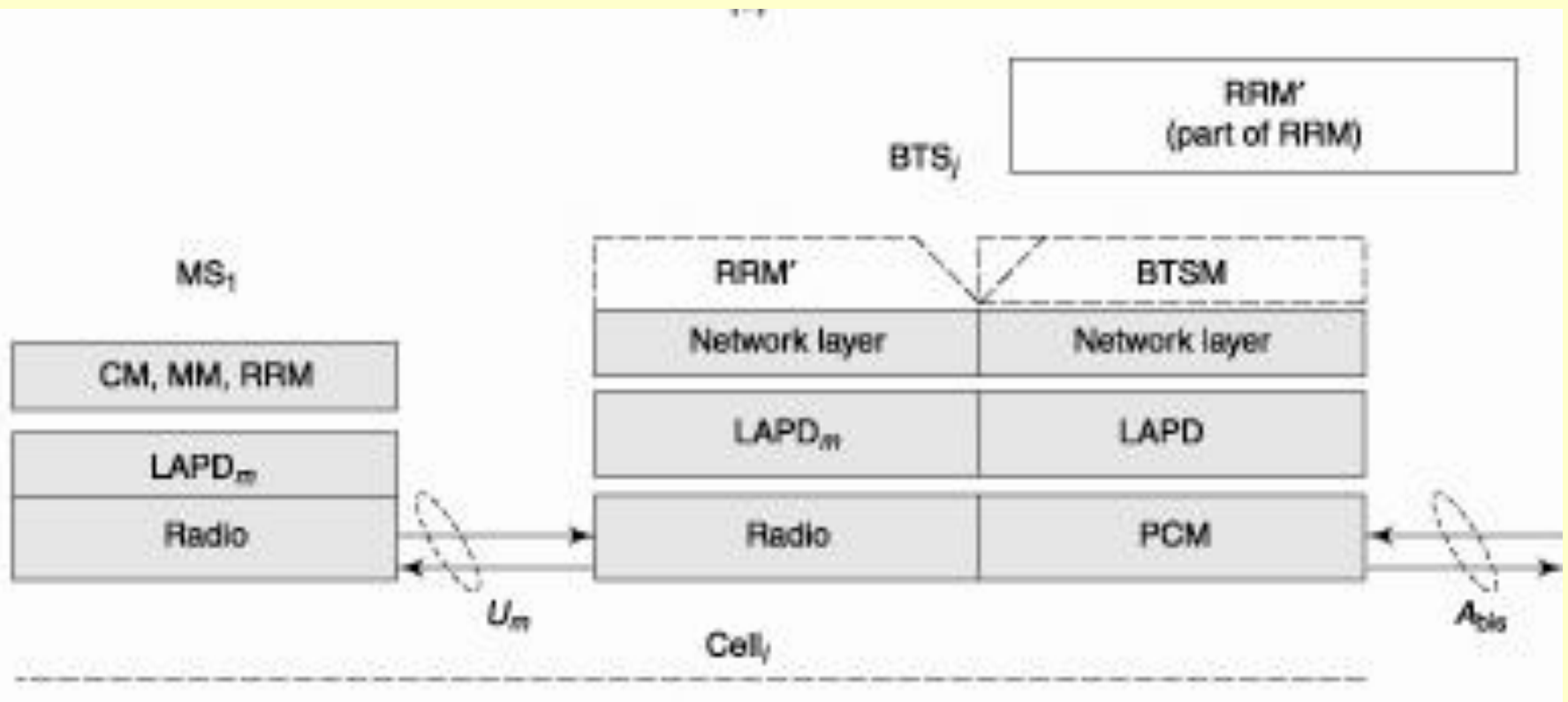


OPERATIONS IN THE RRM SUB LAYER

RRM

- Radio link quality management
- Frequency assignment
- Frequency hopping sequence option
- Signal measurements and handover management
- Adaptation of the timing advance for synchronization

INTERFACES OF THE NETWORK SUBLAYERS



CM SUB LAYER PROTOCOL

- Supports call establishment, maintenance, and termination
- CM sub layer also controls and supports the functioning of the SMS and supplementary services
- CM also supports DTMF (dual tone multiple frequency) signalling

MM LAYER

- Controls issues regarding mobility management when an MS moves into another cell (location area).
- RRM manages the radio resources
- BTS implements only RRM' (a part of RRM) as the BSC handles the handover.

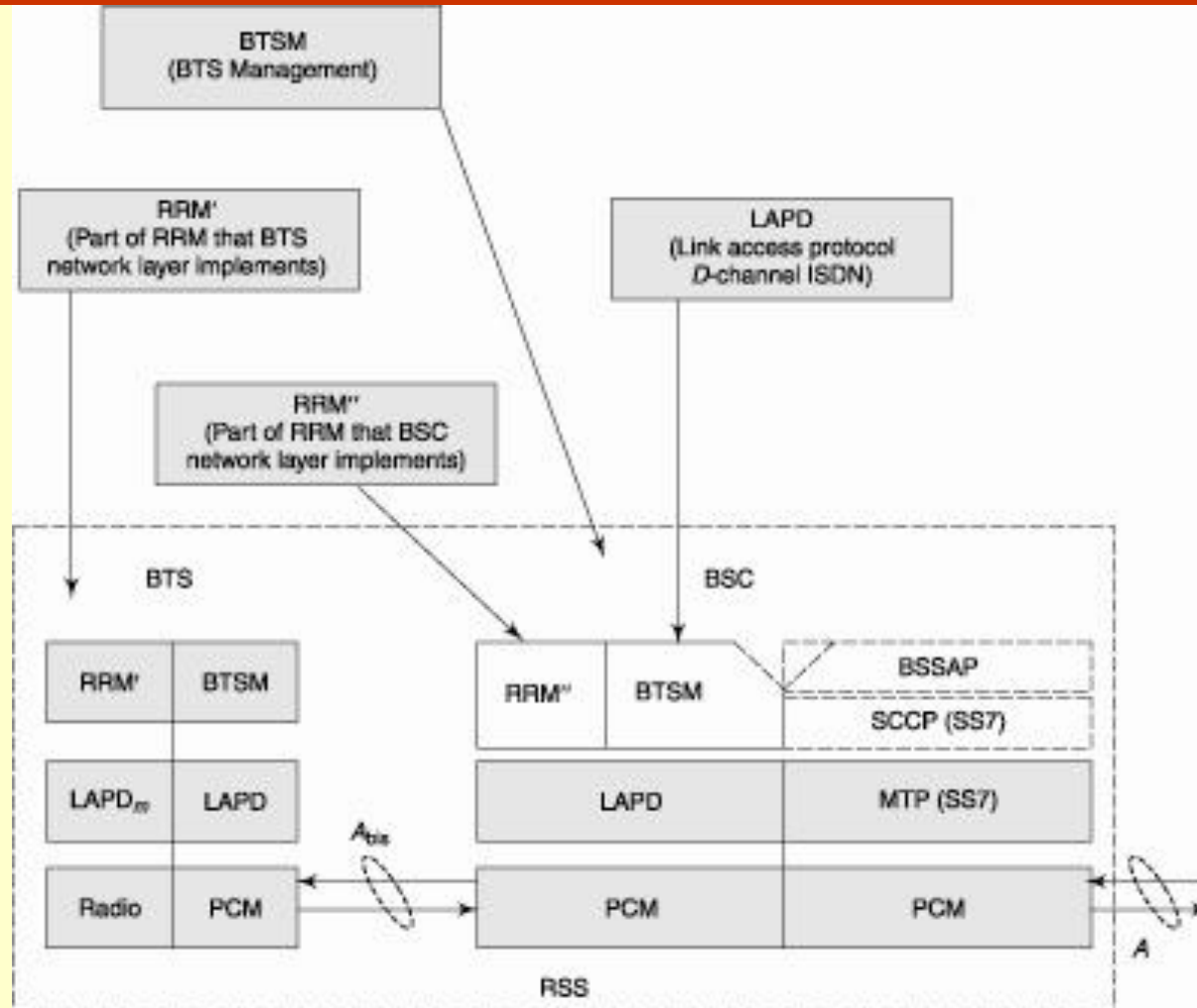
FUNCTIONS OF THE NETWORK LAYER

- Defines protocols for implementation of addressed messages received from the data link layer
- Defines addresses of the messages

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BASE TRANSCEIVER—BASE STATION CONTROLLER SIGNALLING PROTOCOLS



PHYSICAL LAYER BETWEEN BTS AND BSC

- A_{bis} interface (of the PSTN, ISDN, or PSPDN networks)
- The connection between the BTS and the BSC through a wired network (PSTN, ISDN, or PSPDN)

PHYSICAL LAYER BETWEEN BTS AND BSC

- Voice coded in the 64 kbps PCM (pulse code modulation) format in a PSTN network
- The A_{bis} interface between BTS and BSC, therefore, uses the 64 kbps PCM (or four multiplexed 16 kbps channels) format

PCM CODING TECHNIQUES

- Different from the 22.8 kbps TCH radio interface U_m (between MS and BTS)
- Translation between these coding formats performed by recoding the TCH bits received from the caller MS to 64 kbps PCM and from PCM to TCH for the receiver MS

EFFECT OF TRANSLATIONS

- This translation and retranslation from one coding format to another may affect voice quality
- Therefore, a procedure called TFO (tandem free operation) adopted at the BTSs, BSCs, and MSCs
- TFO means without performing translation and back retranslation processes repeatedly

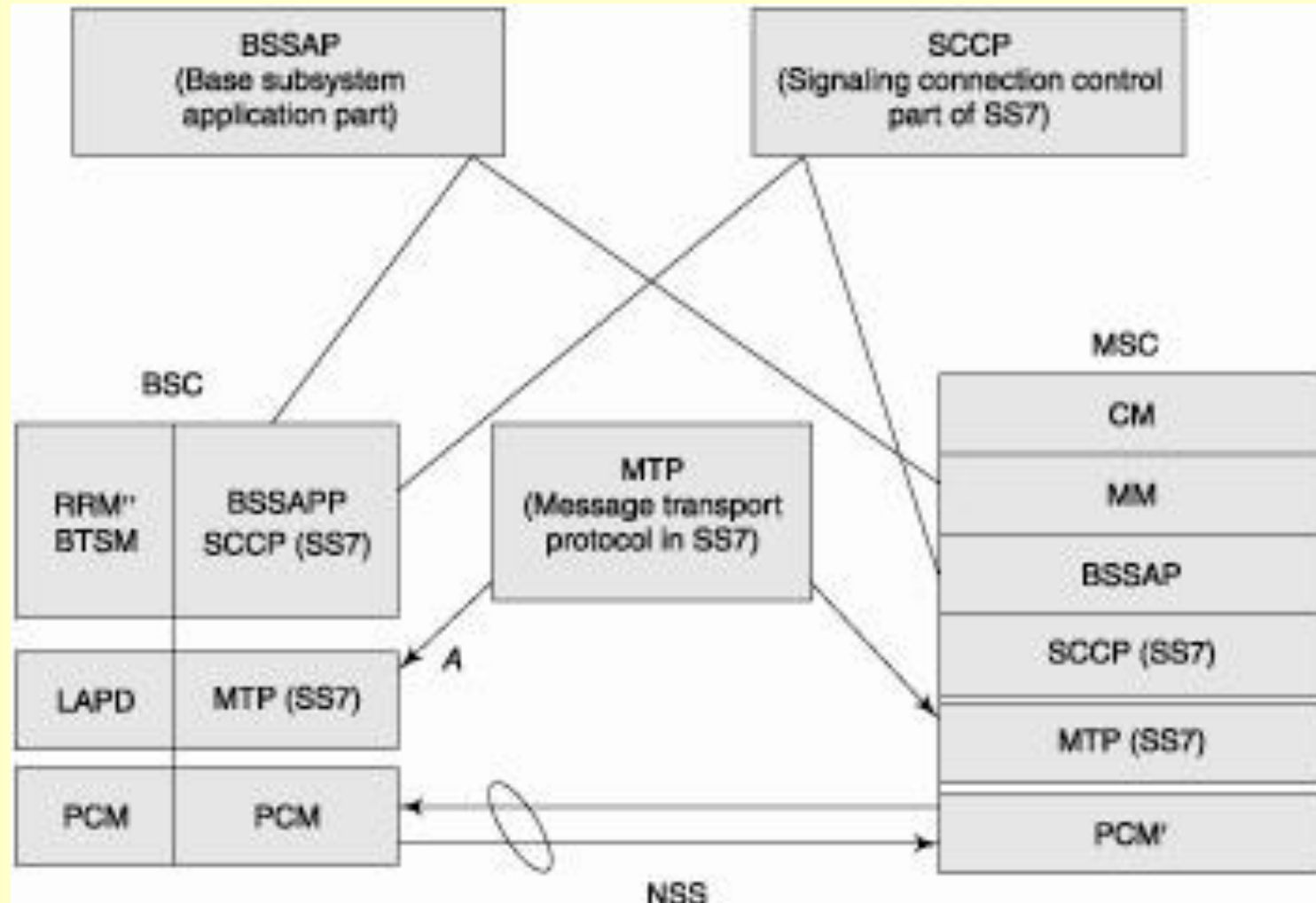
DATA LINK LAYER PROTOCOL BETWEEN BTS AND BSC

- LAPD (link access protocol *D*-channel) for A_{bis}
- The protocol prescribes the standard procedure for the *D*-channel of ISDN (integrated services digital network)

NETWORK LAYER PROTOCOL BETWEEN BTS AND BSC

- BTSM (BTS management)

PROTOCOLS LAYERS BETWEEN BSC AND MSC



DATA LINK LAYER PROTOCOLS BETWEEN BSC AND MSC

- MTP (message transfer protocol) and SCCP (signalling connection control protocol).
- MTP and SCCP are parts of the SS7 (signalling system No. 7) used by interface A

DATA LINK LAYER PROTOCOLS BETWEEN BSC AND MSC

- layer protocol prescribes a standard procedure for the MTP and SCCP for SS7 transmission and reception in a 2 Mbps CCITT PSTN/ISDN/PSPDN network

NETWORK LAYER PROTOCOL AT THE BSC

- Network layer protocol sub layers at the MSC are CM, MM, and BSSAP
- BSSAP (base subsystem application part

SUMMARY

- MS, BTS, BSC, and MSC, for example, have just 3 layers—physical, data link, and network
- Radio physical layer
- Data link LAPDm layer
- CM, MM and RRM at network layer

End of Lesson 08
Protocol Layers in GSM