GSM

Unit - III

GSM – System Architecture

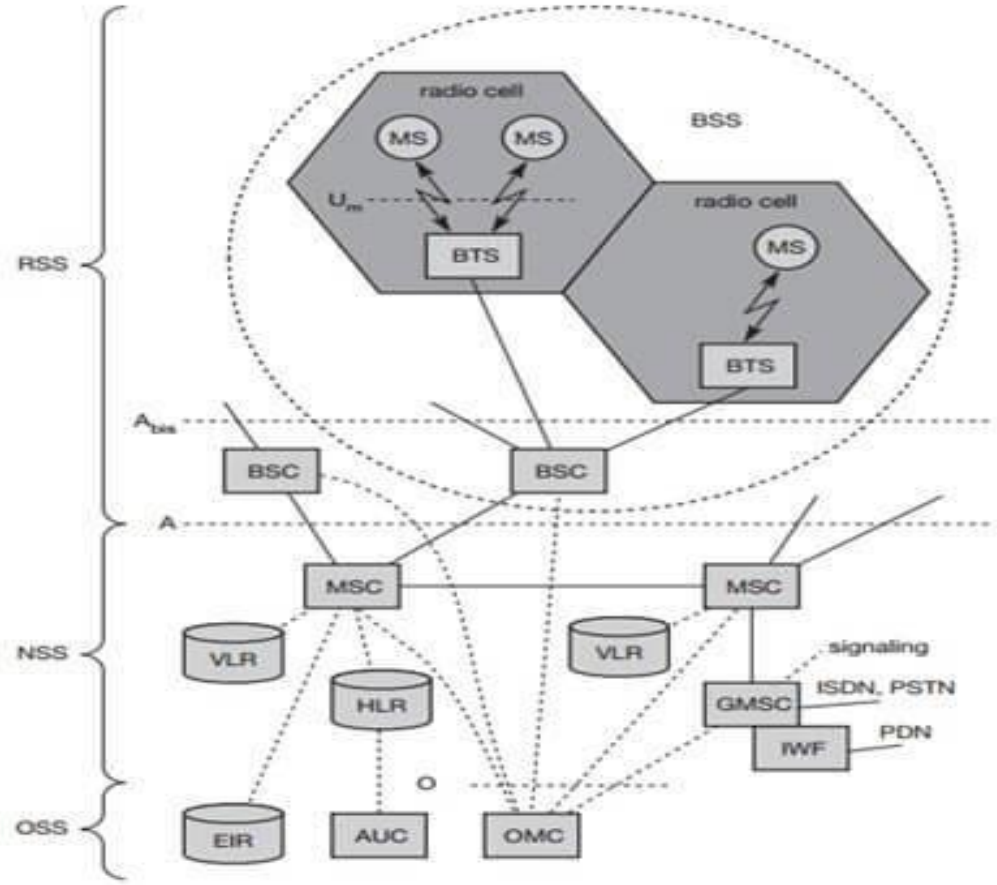


Figure 4.4
Functional architecture of a GSM system

GSM - Architecture

- GSM consist of 3 main sub systems:
- Radio Subsystem
- Networking and Switching Subsystem
- Operation Subsystem

Radio Subsystem (RSS)

- Consist of radio-specific entities
  - Mobile Station (MS)
  - Base Station Subsystem (BSS)
  - Base Transceiver Station (BTS)
  - Base Station controller (BSC)

RSS – Mobile Station (MS)

- MS contains 2 components – subscriber identity module (SIM) and Mobile device
- SIM removable smart card – contains unique identifier International Mobile Equipment Identity (IMEI)
- Other interfaces – USB, bluetooth etc.
- SIM – contains info about subscriber, key info to activate after powered on
- Contains microcontroller to store & retrieve data from flash storage
- Identification info stored in ROM, not changeable by customer

Contd...

- Additional flash memory to store addresses, picture, SMS etc.
- SIM contains many identifiers and tables – card type, serial no., list of subscribed services, Personal Identification Number (PIN)

Base Station Subsystem (BSS)

- GSM contains many BSSs
- Each BSS contains a Base Station Controller (BSC) and many Base Transceiver Station
- Base Transceiver Station
- Contains all radio equipment – antennas, signal processors, amplifiers needed for radio transmission
- Encodes received signal, modulates with carrier wave, feeds RF signal to antenna
- Communicates with both MS and BSC

Contd...

- Base Station Controller
- Manages radio resource of BTS – assigns frequency, time slots for all MSs
- Manages handoff between BTS inside BSS
- BSC multiplexes radio channels to fixed network connection to Mobile Switching Centre (MSC)

Network & Switching Subsystem (NSS)

- Heart of GSM
- Connects wireless networks to standard public n/ws
- Carries out – usage based charging, accounting, roaming
- Consist of switching centre and databases
- Mobile Switching Centre (MSC)
- Sets up connection with other MSCs and Public Data Network
- Does connection setup, release, call handoff to other MSC
- Gateway MSC (GMSC) – gateway to other networks while roaming
- Also does supplementary service – call forwarding, multiparty call etc.

NSS - HLR, VLR

- Home Location Register (HLR)
- Database stores info about each subscriber
- Info – Subscribers IMSI, pre/post paid, user's current location
- Visitor Location Register (VLR)
- Temporary database – updated when new MS enters in area
- Info about MS obtained from HLR
- VLR reduces no. of queries to HLR, user feels as home n/w

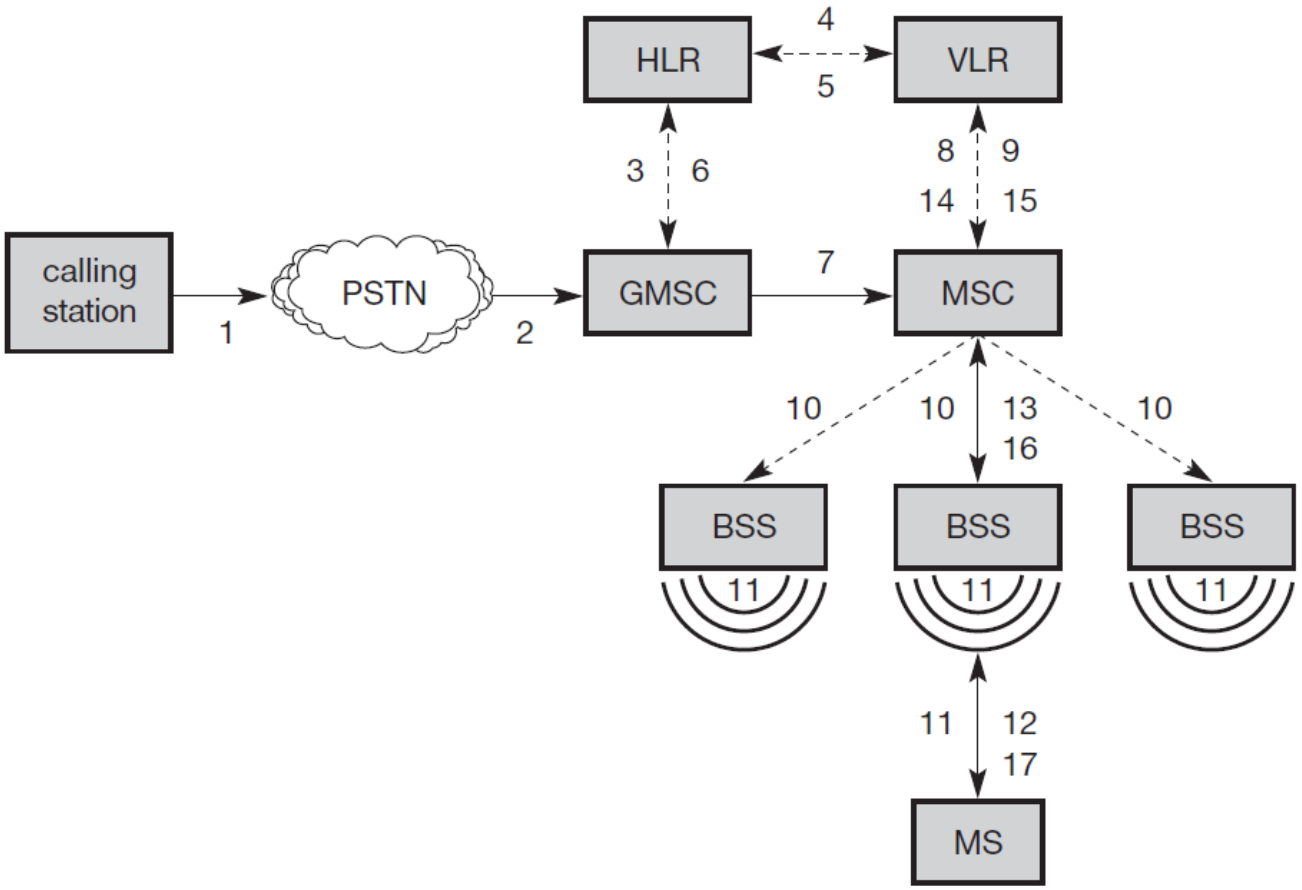
Operation Subsystem (OSS)

- Contains functions needed for network operation and maintenance
- Contains Operation and Maintenance Centre (OMC), Authentication Centre (AuC) and Equipment Identity Register (EIR)
- OMC – supervisors all network entities
- Functions – traffic monitoring, subscribers, security management and account billing
- AuC – protects from intruders from air interface
- Functions – security features such as user authentication, encryption

OSS

- Equipment Identity Register (EIR) – database used in tracking handsets using IMEI
- Helps to block calls from stolen, unauthorized or defective mobiles

Mobile Terminated Call (MTC)



MTC Steps (1)

- In step 1, a user dials the phone number of a GSM subscriber
- The fixed network (PSTN) notices the no. belongs to GSM user (looking at the destination code)
- Forwards the call setup to the Gateway MSC (2)
- The GMSC identifies the HLR for the subscriber (which is coded in the phone number)
- It signals the call setup to the HLR (3)
- HLR checks whether the number exists and user has subscribed to the requested services
- It requests an MSRN from the current VLR (4).

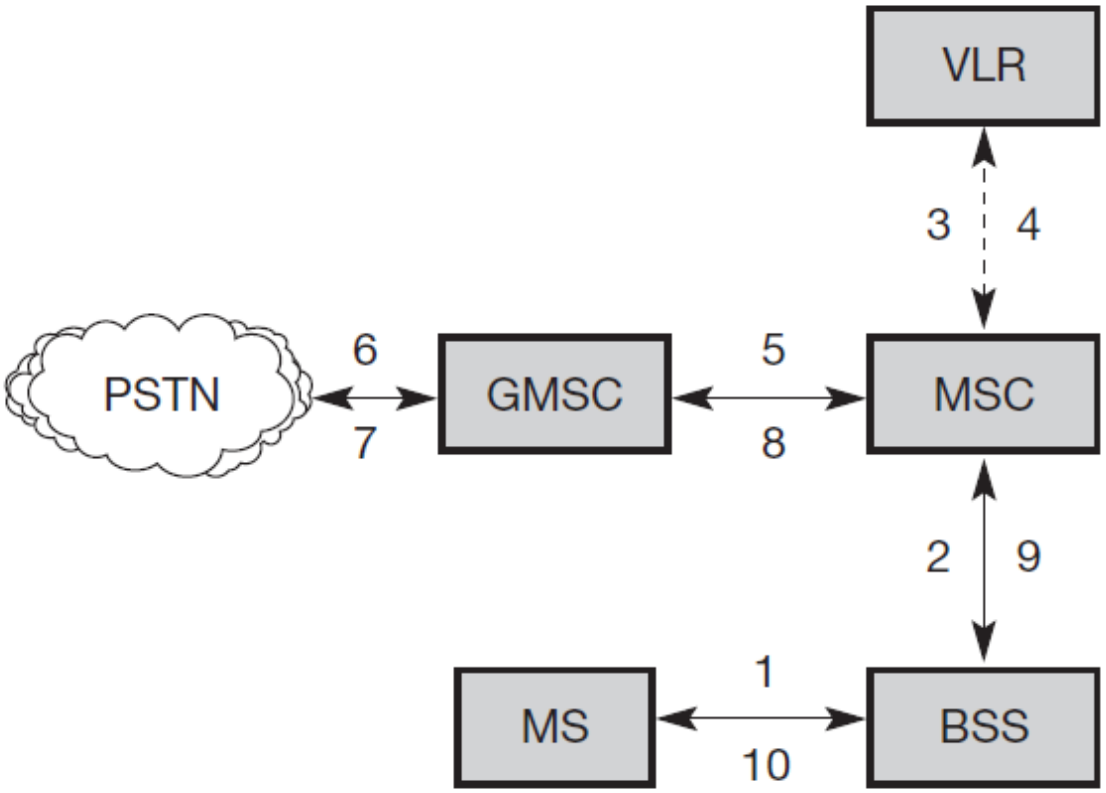
MTC Steps (2)

- Receiving MSRN (5), the HLR can determine the MSC responsible for the MS
- Forwards this information to the GMSC (6).
- GMSC forwards the call setup request to the MSC indicated (7)
- **From this point on, the MSC is responsible for all further steps**
- MSC requests the current status of the MS from the VLR (8)
- If the MS is available, the MSC initiates paging in all cells it is responsible for

MTC (3)

- BTSs of all BSSs transmit this paging signal to the MS (11)
- If the MS answers (12 and 13), VLR has to perform security checks (set up encryption etc.)
- VLR then signals to the MSC to set up a connection to the MS (steps 15 to 17).

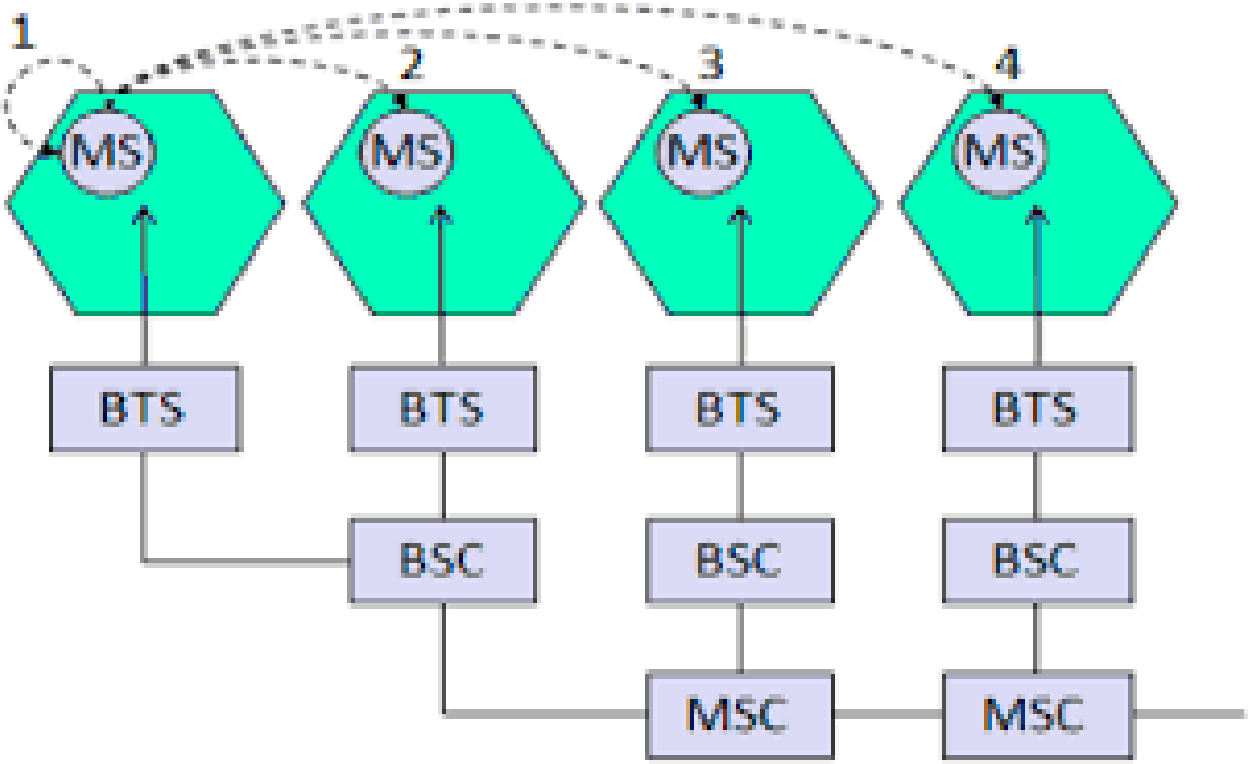
Mobile Originated Call (MOC)



MOC Steps

- MS transmits request for a new connection (1)
- BSS forwards this request to the MSC (2)
- The MSC then checks if this user is allowed to set up a call with the requested service (3 and 4)
- Checks the availability of resources through the GSM network and into the PSTN
- If all resources available, MSC sets up a connection between the MS and the fixed network

Different types of Handoff



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- **Intra-cell handover**
  - Within a cell, narrow-band interference could make transmission at a certain frequency impossible
  - BSC could then decide to change the carrier frequency (scenario 1)
- **Inter-cell, intra-BSC handover**
  - Mobile station moves from one cell to another, but stays within the control of the same BSC
  - BSC performs a handover, assigns a new radio channel in the new cell and releases the old one

Contd...

- **Inter-BSC, intra-MSC handover**
  - BSC only controls a limited number of cells
  - GSM also has to perform handovers between cells controlled by different BSCs
  - This handover then has to be controlled by the MSC (scenario 3)
- **Inter MSC handover**
  - A handover could be required between two cells belonging to different MSCs
  - Both MSCs perform the handover together (scenario 4)

Handover Procedure

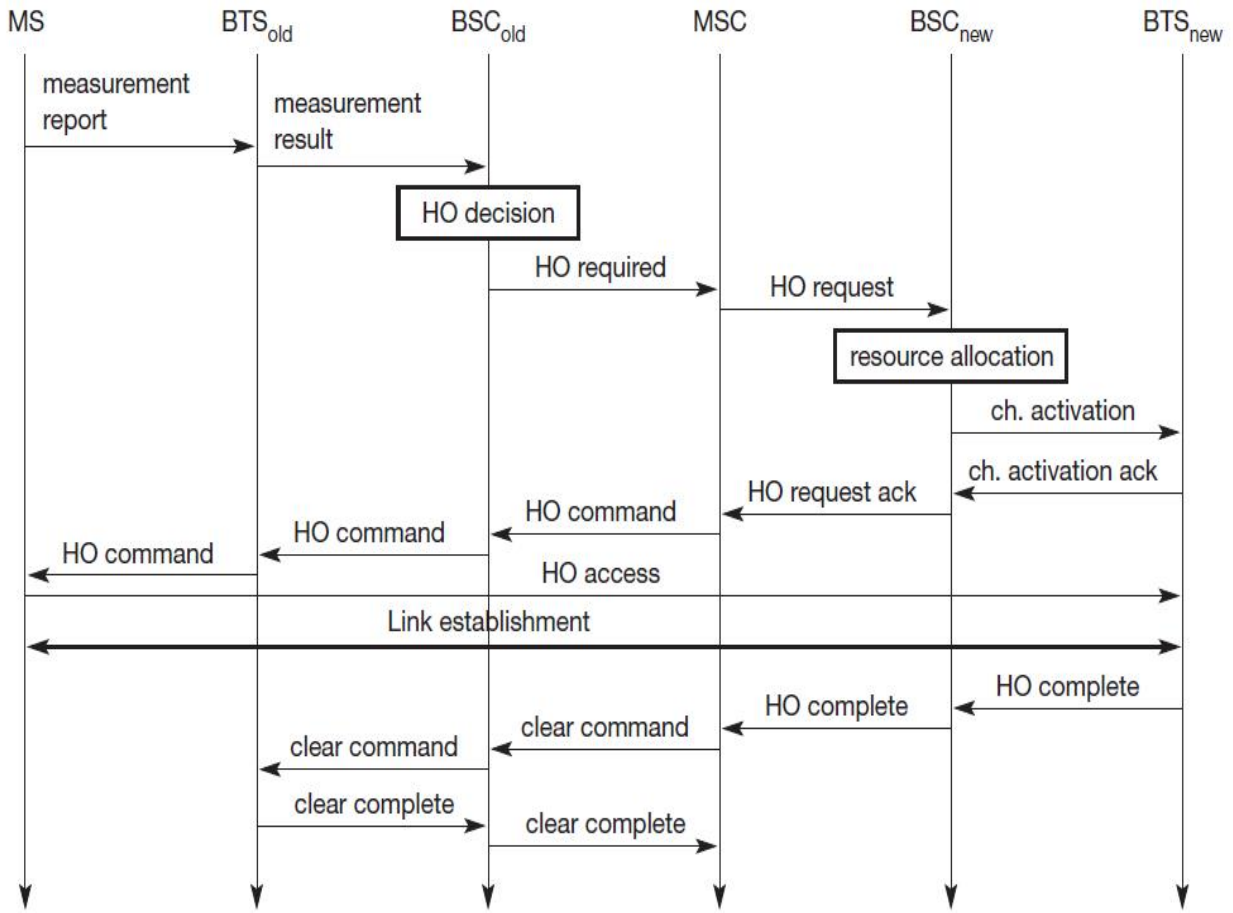

Figure 4.13
Intra-MSC handover