Introduction to GSM

History of Cellular Mobile Radio and GSM(Global Systems for Mobile)

- Early 1980s there was analog technologies:
  - Advanced Mobile Phone Services(AMPS)in North America.
  - Total Access Communications System(TACS) in the UK.
  - Nordic Mobile Telephone(NMT) in Nordic countries.

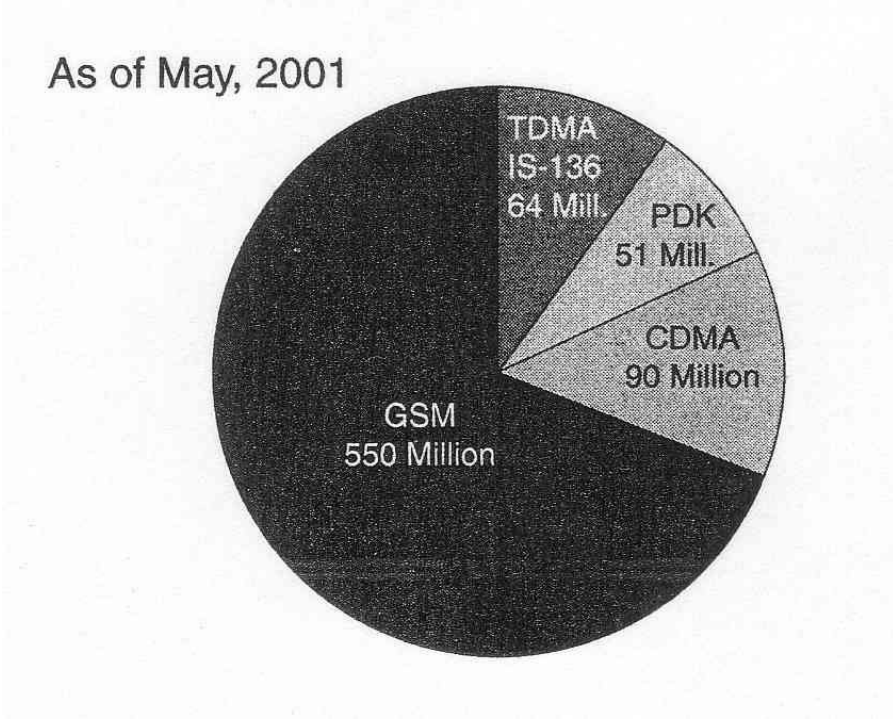
- Each country developed its own system, which caused problems:
  - System worked only within the boundaries of each country.
  - Mobile equipment manufacturers markets were limited by the operating system.

Solution was GSM, which is digital technology and was developed by CEPT(Conference of European Posts and Telecommunications)

- The Goals of GSM
  - Improved spectrum efficiency
  - International roaming
  - Low-cost mobile sets and base stations
  - High-quality speech
  - Compatibility with ISDN and other telephone company services.
  - Support for new services
  - QoS

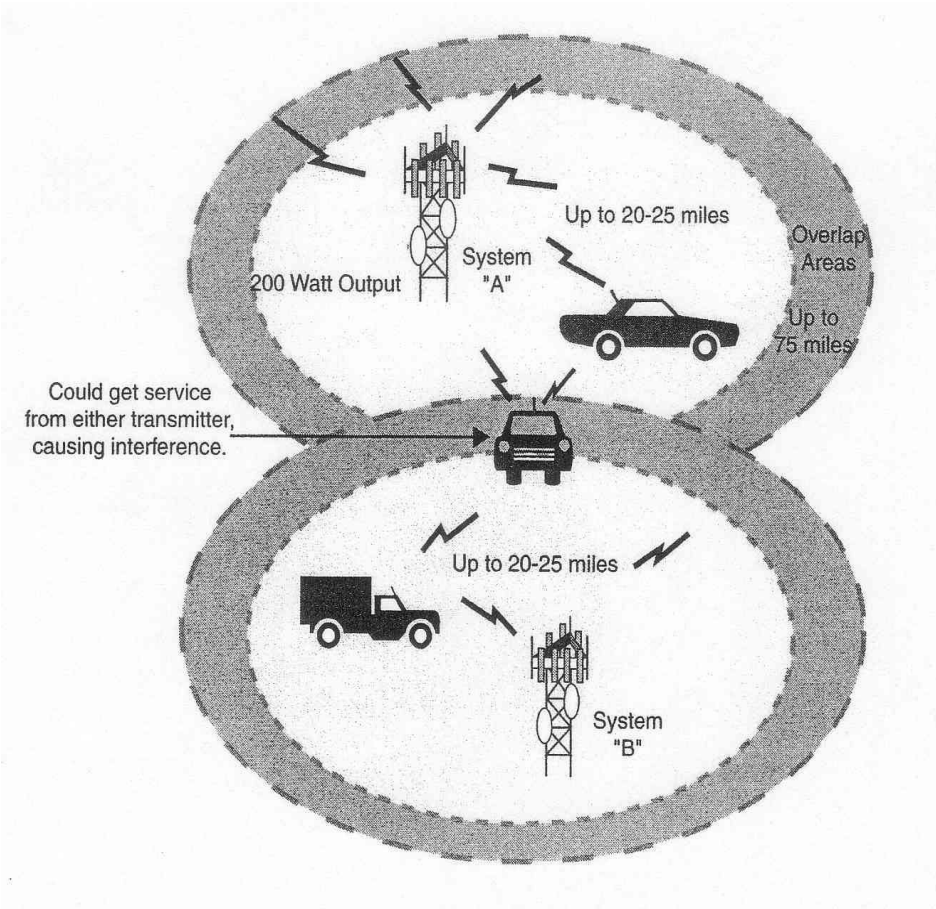
GSM facts(2001)

- Used in over 170 countries
- Over 400 GSM network operators
- Over 550 million people were subscribers to GSM

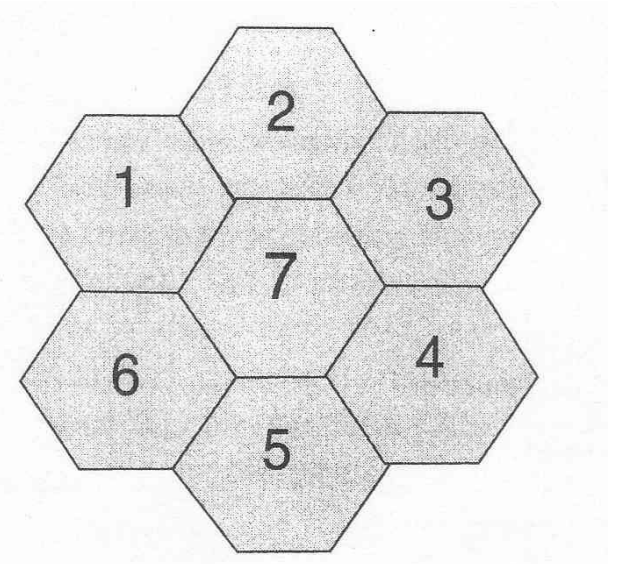


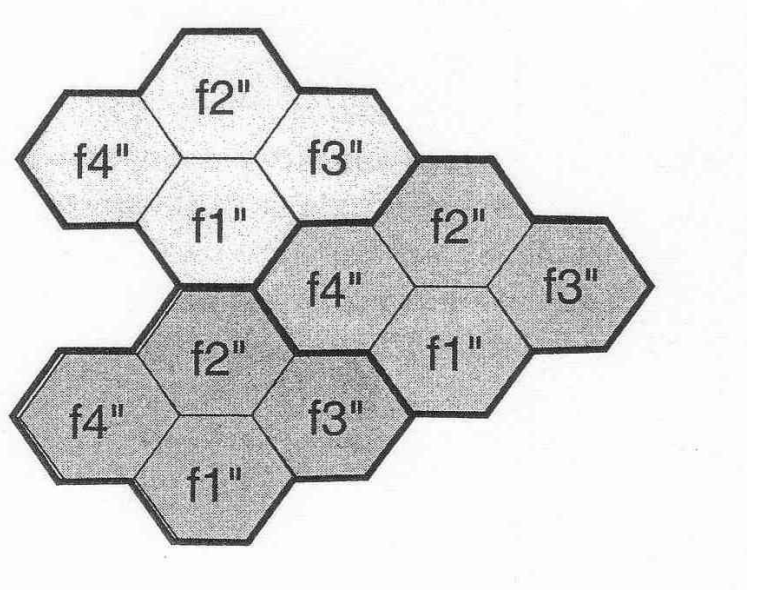
GSM Cell Structure

- The power level of a transmitter within a single cell must be limited to reduce the interference with the neighboring cells.



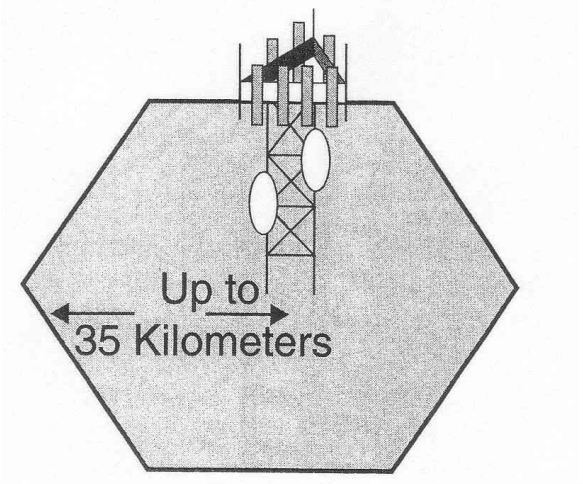
- Neighboring cells cannot share the same channels
- Different size of patterns: 4,7,12 or 21 cells in one cluster



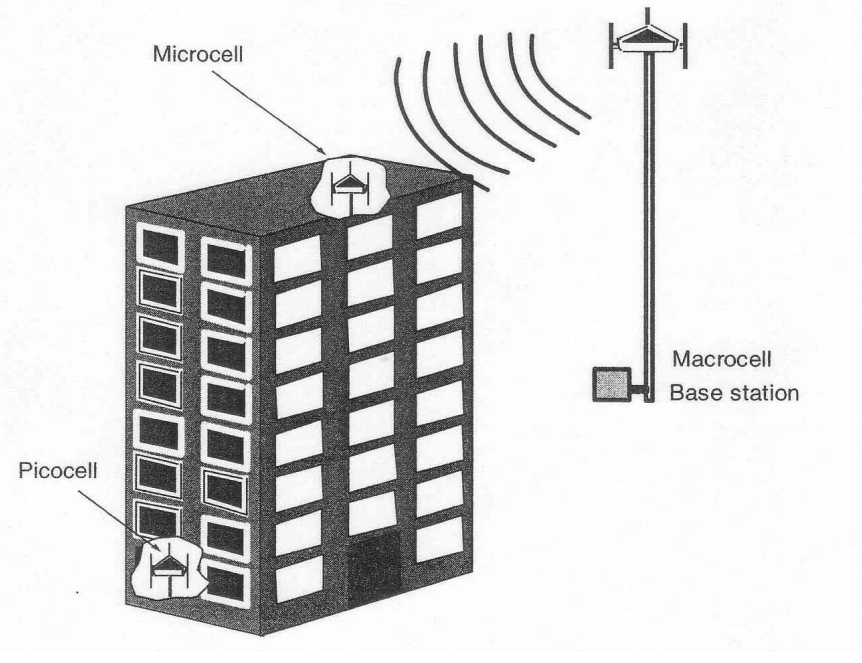


Types of Cells

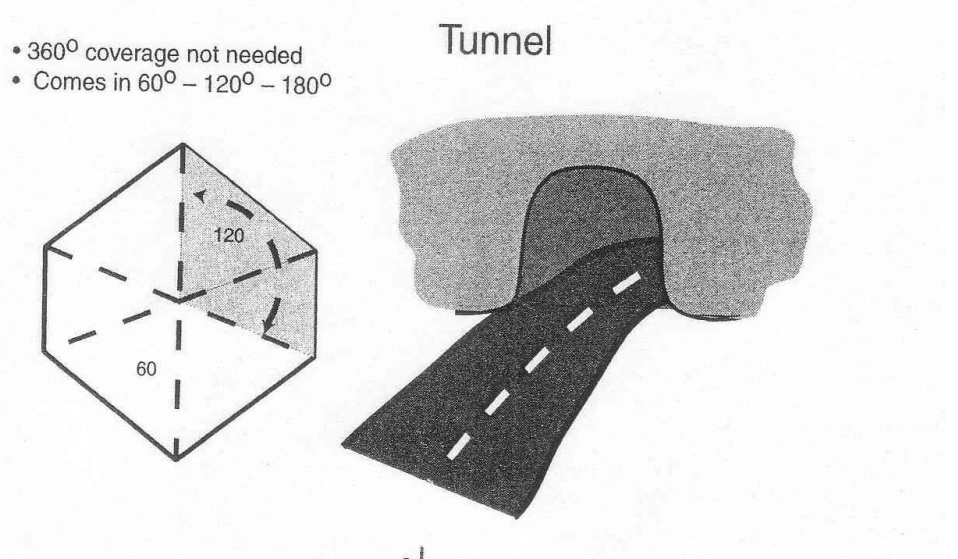
- Macrocells(3 to 35 km)



- Microcells(0,1 to 1 km)
  - Picocells(0,01 to 1km)
  - Nanocells(1m to 10m)

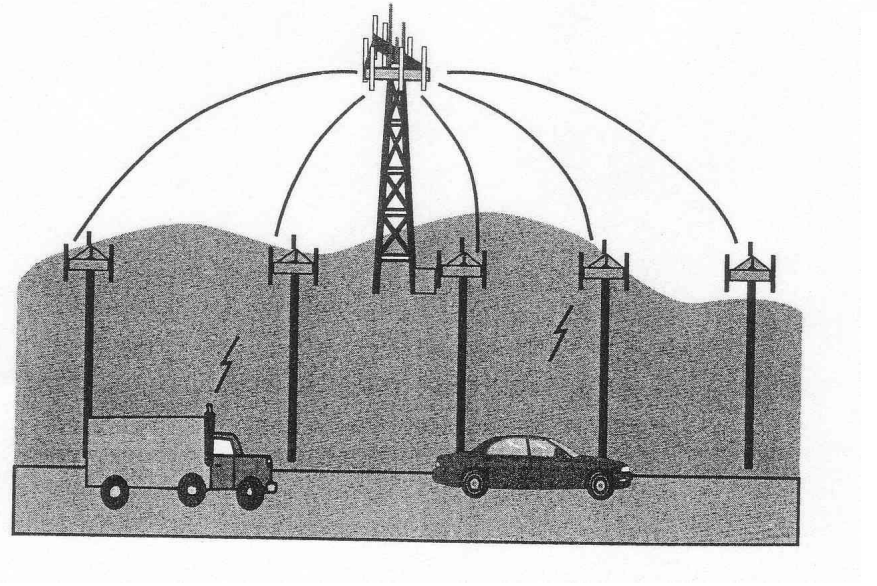


- Selective cells and tiered cells(two sectors, two frequencies)



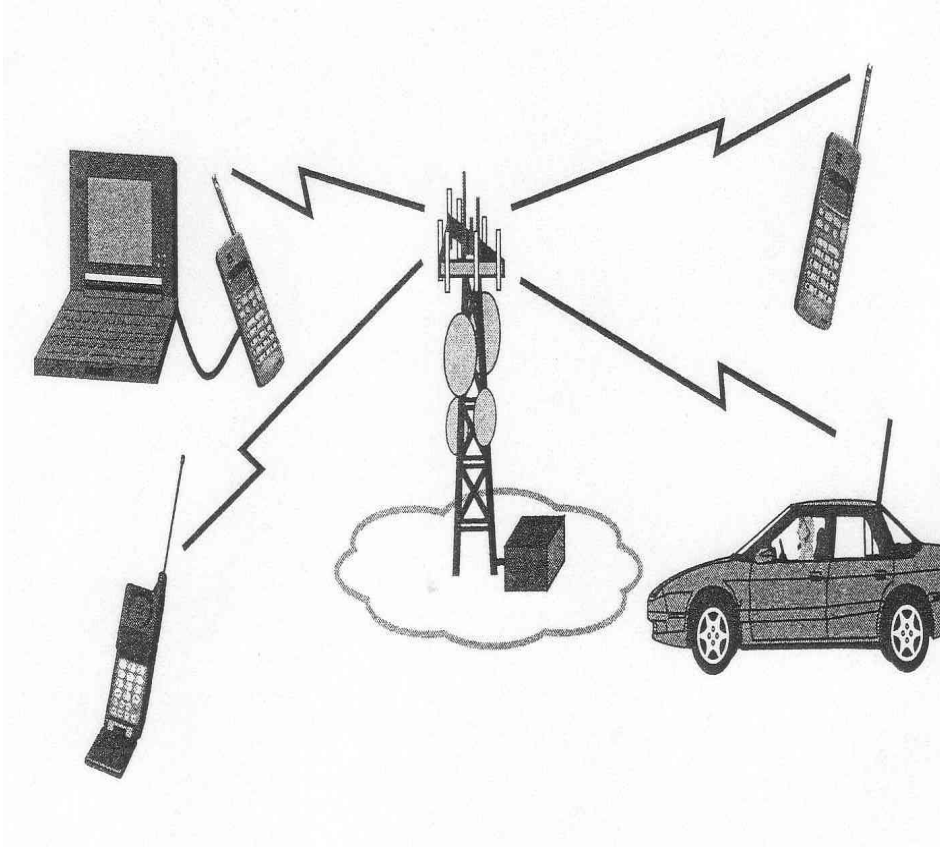
- Umbrella cells

  - covers several microcells



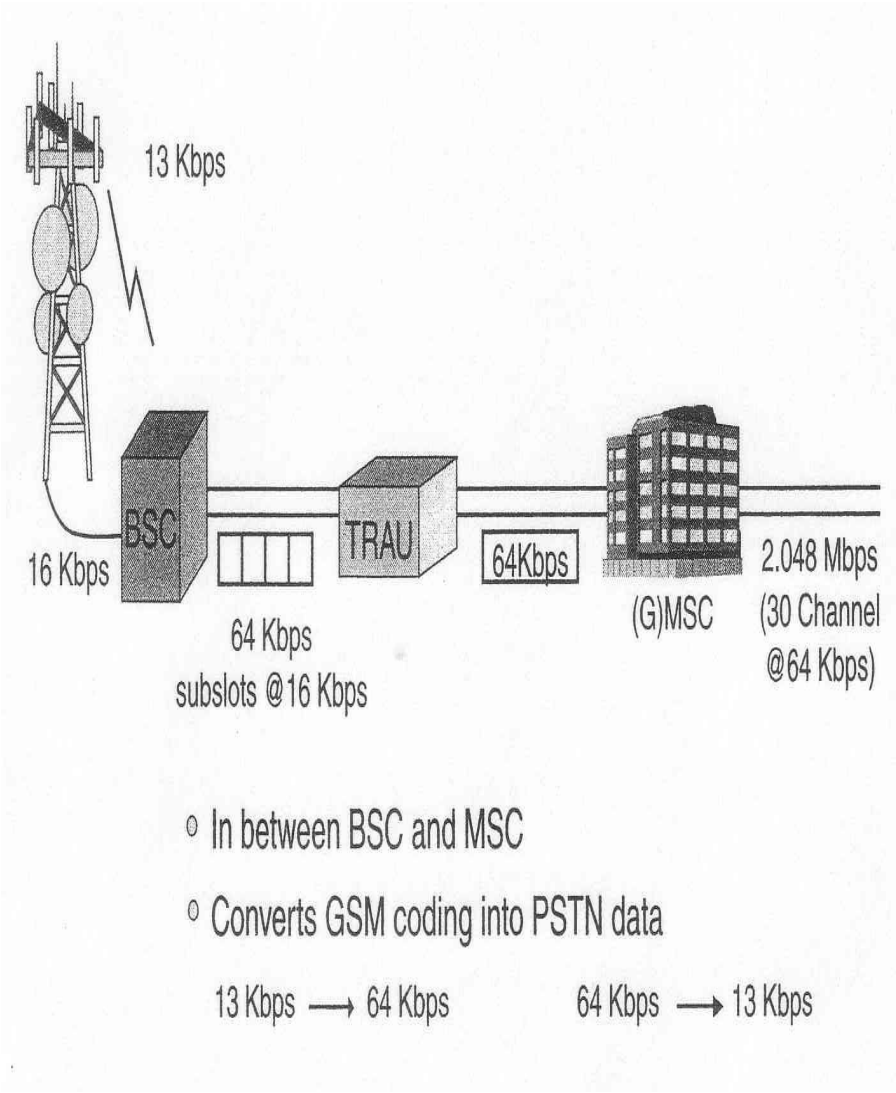
GSM Architecture

- Base Tranceiver Station (BTS)
  - serves a single cell
  - usually placed in the center of a cell
  - coding
  - crypting
  - multiplexing
  - modulating
  - synchronizing

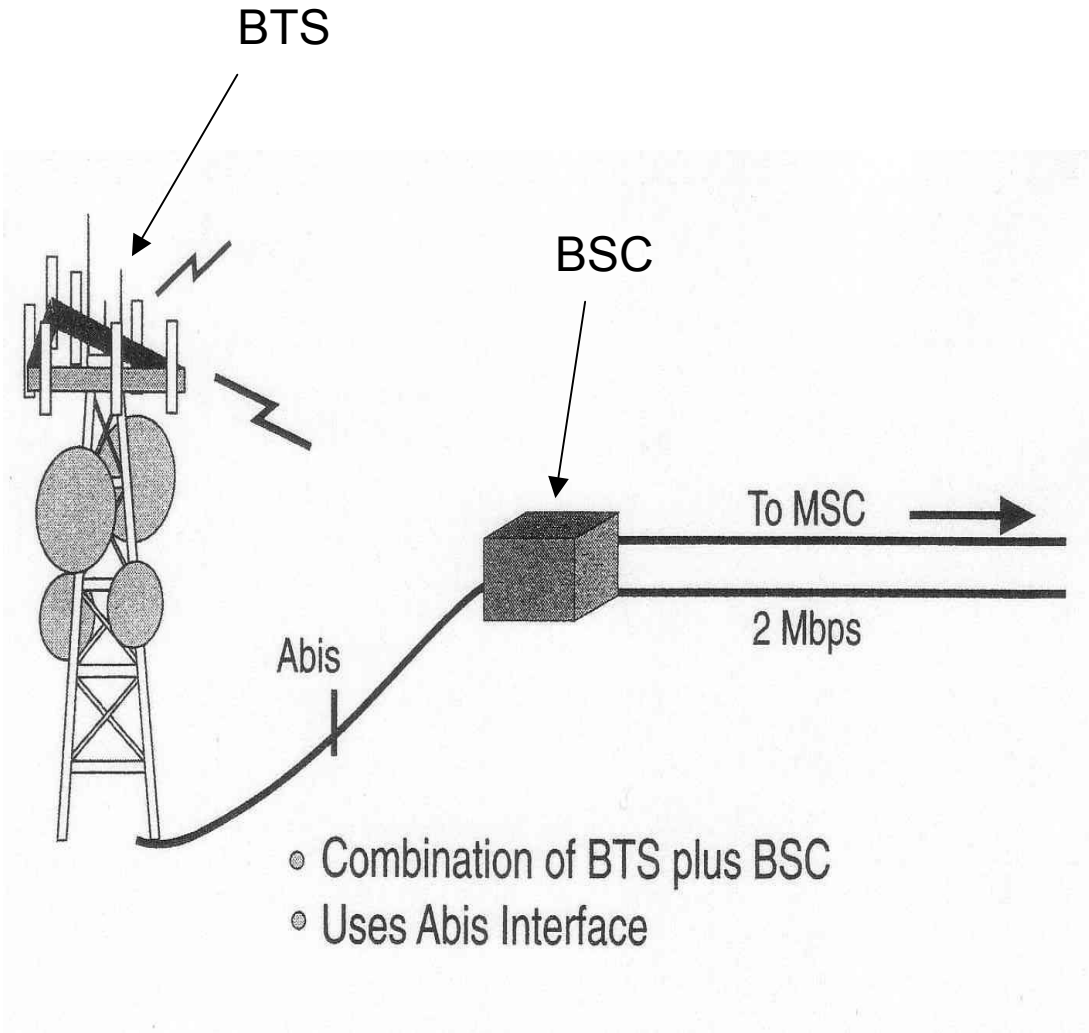


- Base Station Controller(BSC)
  - translates the 13-Kbps voice to the standard 64-Kbps channel (used by PSDN or ISDN)
  - frequency hopping
  - time and frequency synchronisation
  - power management
  - time delay measurements

- The Transcoder and adaptation unit(TRAU)
  - (13Kbps speech or data + 3Kbps additional synchronizing data)*4 =64Kbps (TRAU Standard rate)



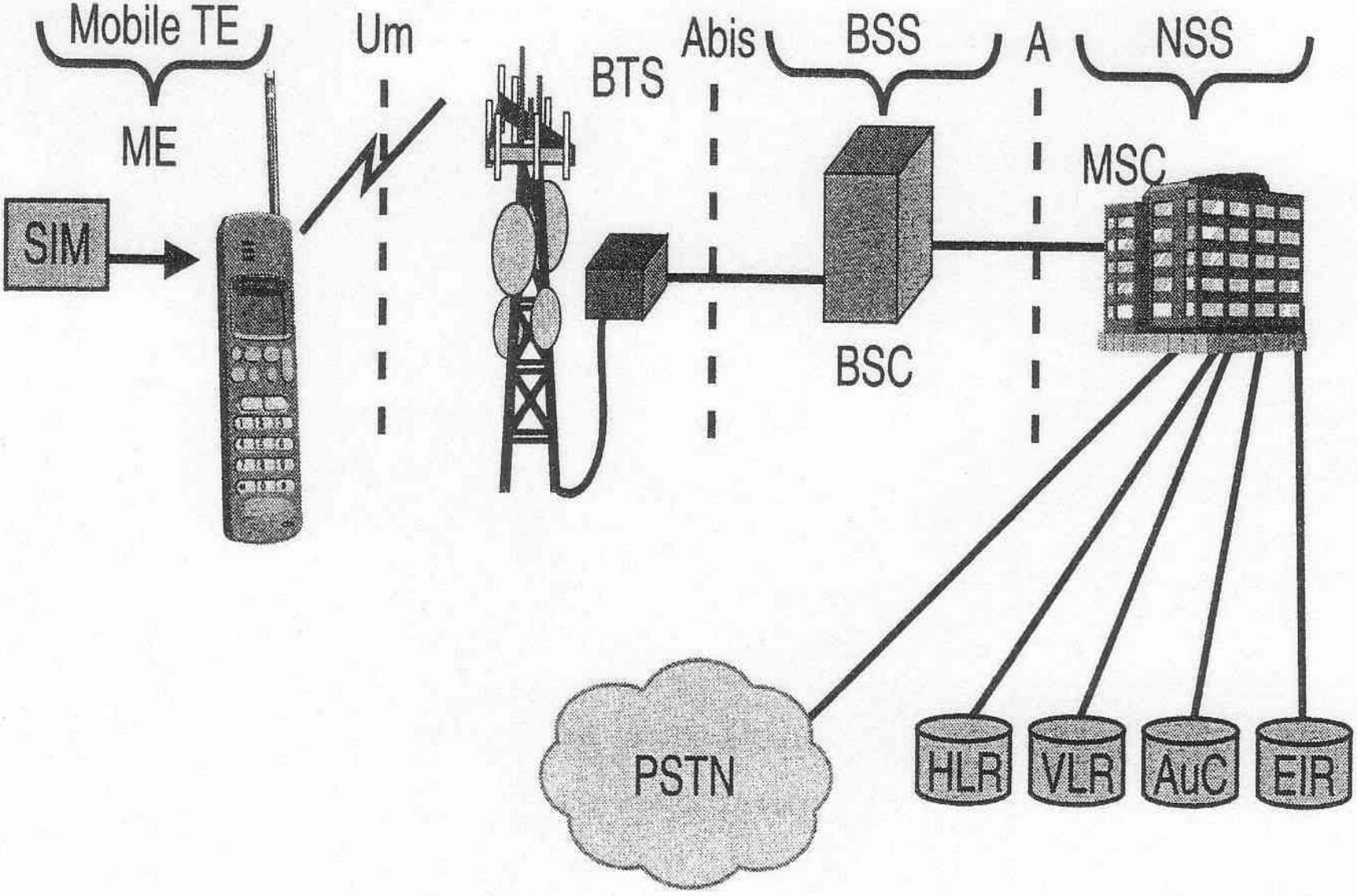
- Base Station Subsystem(BSS)
  = BTS + BSC

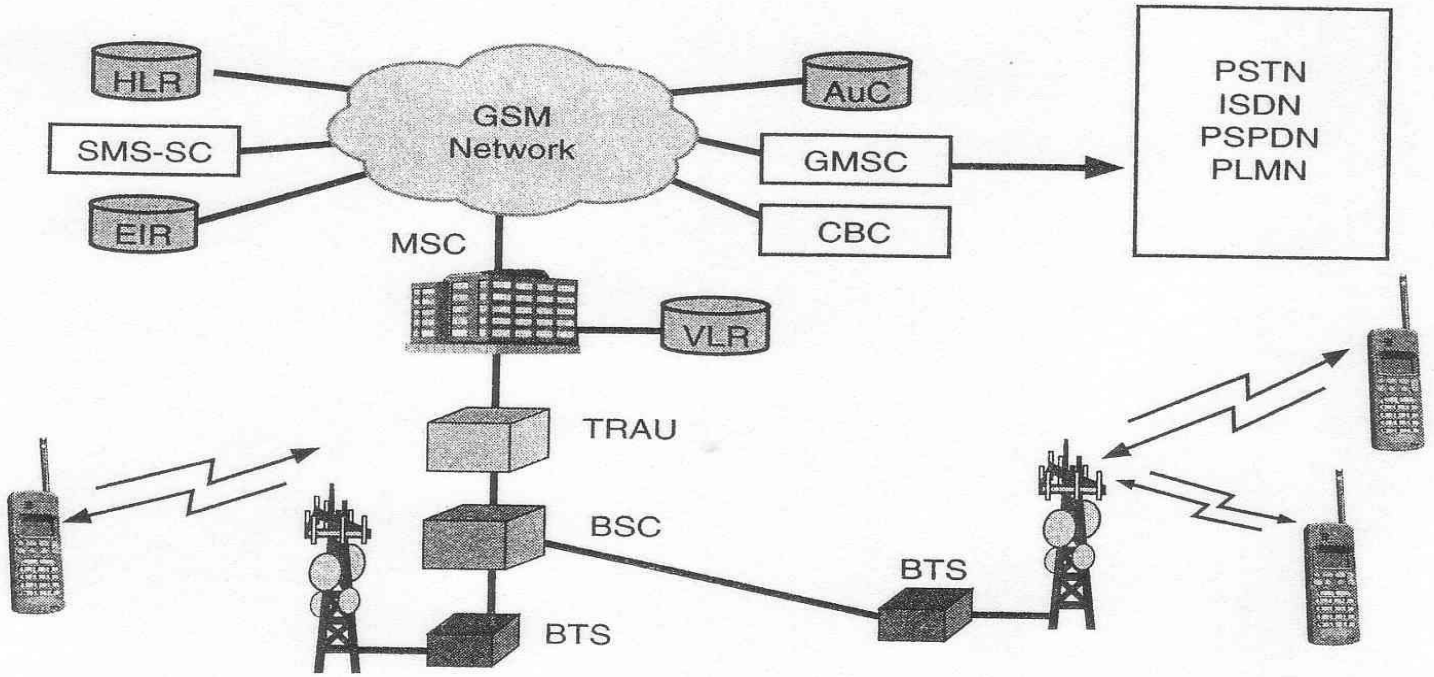


- Mobile Switching Center(MSC)
  - The central component of the Network Subsystem
  - (30 + 2)* 64Kbps = 2,048Mbps(E1) or better to the other network interfaces(PSDN,ISDN)
  - Billing
  - Location registration
  - Gateway to SMS
  - Synchronizing BSS
  - Handover management

GSM Architectures 3 broad parts

1. Subcribers carries MOBILE STATION
2. BSS controls the radio link with the mibile station
3. NETWORK SUBSYSTEM, which main part is MSC


Mobile TE
ME
SIM
Um
BTS
Abis
BSS
BSC
A
NSS
MSC
PSTN
HLR
VLR
AuC
EIR

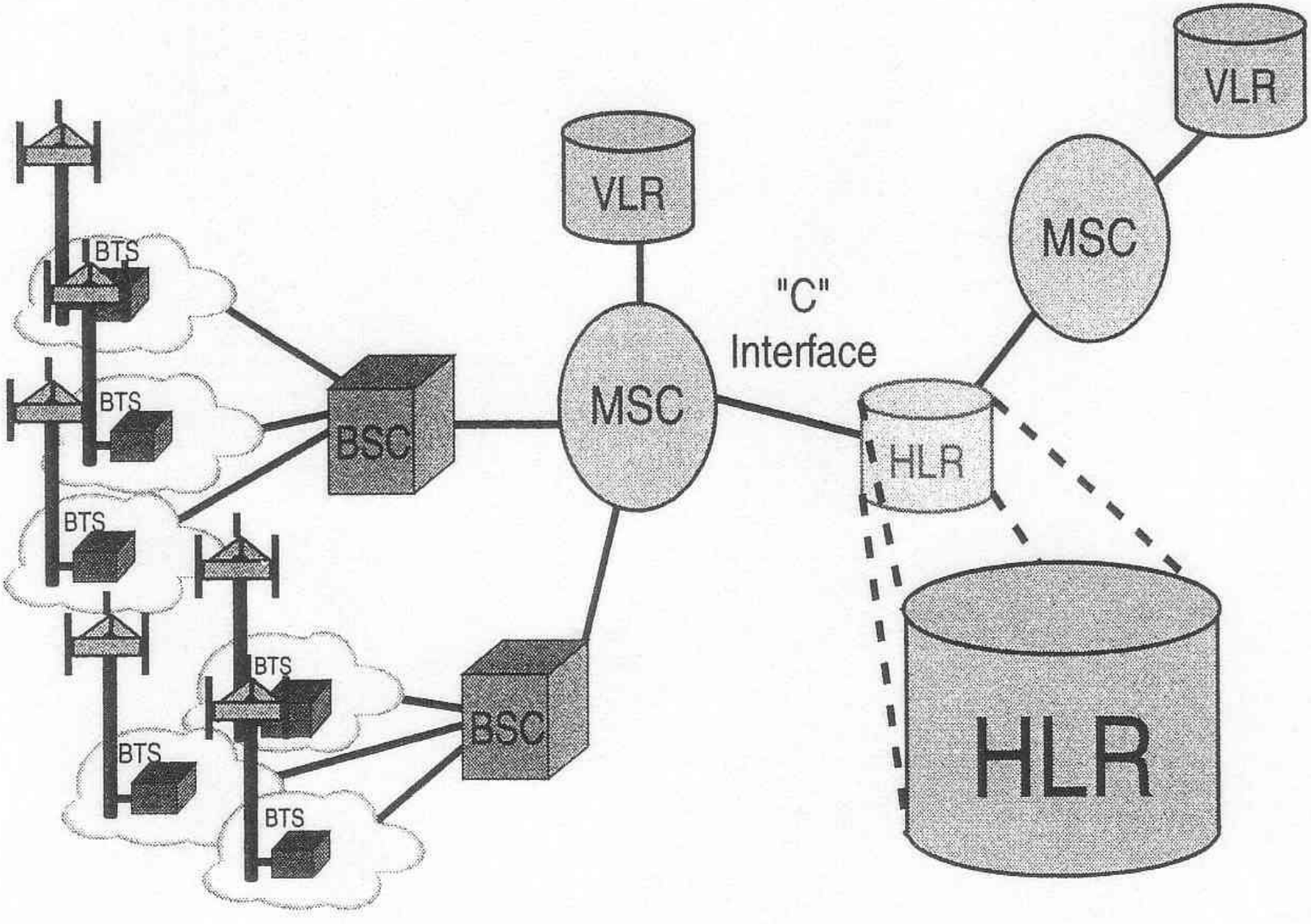


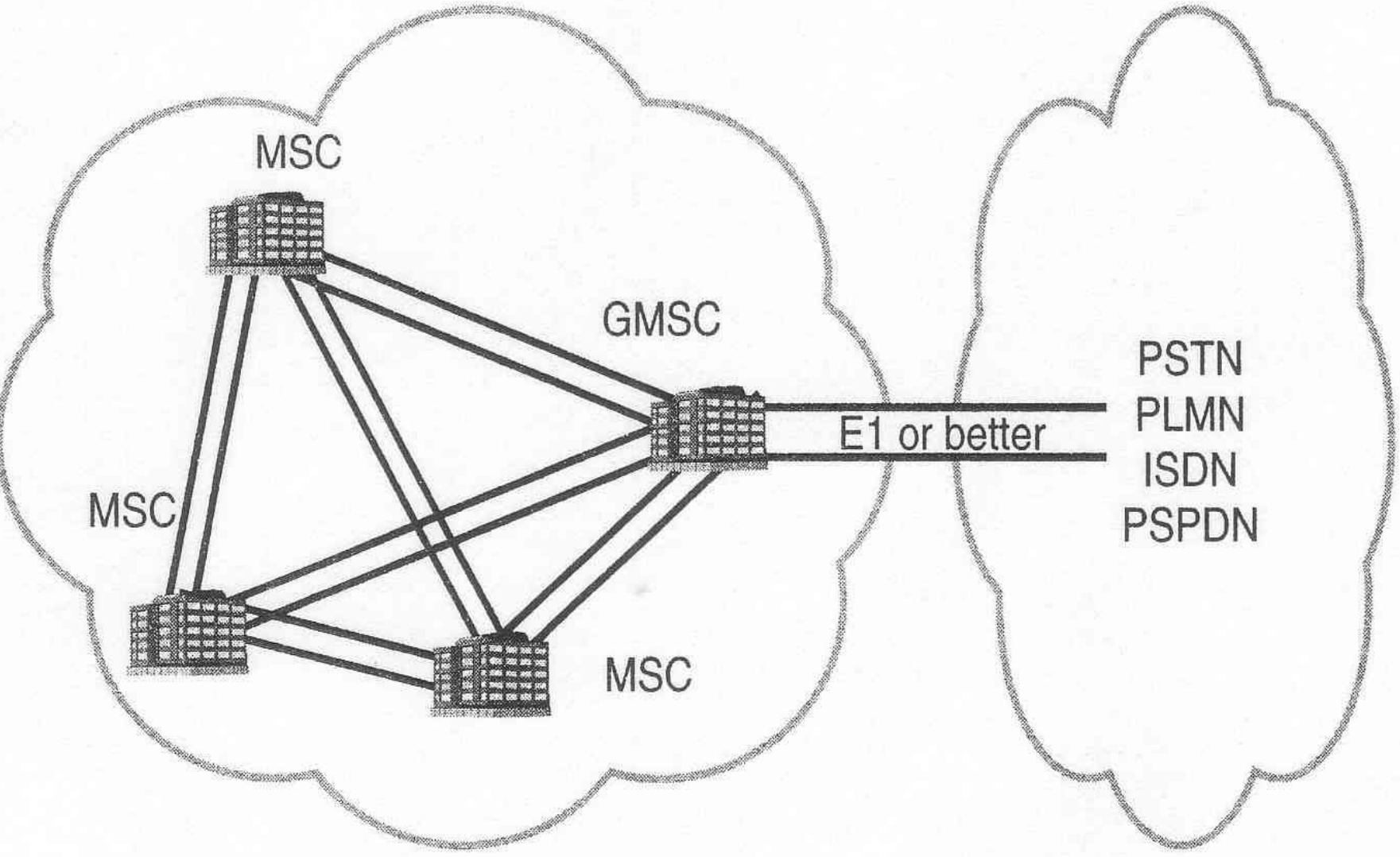
- *Equipment Identity Register* (EIR)
- *Authentication Center* (AuC)
- *SMS Serving Center* (SMS SC)
- *Gateway MSC* (GMSC)
- *Charge Back Center* (CBC)
- *Operations and Support Subsystem* (OSS)
- *Transcoder and Adaptation Unit* (TRAU)

The Registers Completing the NSS

- Home Location Register (HLR) contains all information of each subscriber registered in the corresponding GSM network
- Visitor location Register (VLR) contains selected information from the HLR, which is necessary for call control and provision of the subscribed services, for each mobile currently located in the geographical area controlled by the VLR
- NSS = HLR + VLR + MSC

- Equipment Identity Register (EIR) contains a list of all valid mobile equipment on the network
- Authentication Center (AUC) stores a copy of the secret key stored in each subcribers SIM card
- EIR and AUC are used for security and authentication purposes


VLR
VLR
MSC
"C"
Interface
BTS
BTS
BTS
BTS
BTS
BSC
MSC
HLR
BSC
HLR


MSC
GMSC
MSC
MSC
E1 or better
PSTN
PLMN
ISDN
PSPDN