MOBILE COMPUTING

Unit III

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UNIT III
MOBILE TELECOMMUNICATION SYSTEM

Global System for Mobile Communication (GSM) – General Packet Radio Service (GPRS) – Universal Mobile Telecommunication System (UMTS).

GSM – GLOBAL SYSTEM FOR MOBILE COMMUNICATION

GSM SERVICE

GSM provides three categories of services.

I. Bearer service
II. Teleservices
III. Supplementary services

Bearer Services

- Bearer Services or Data services are used through a GSM phone to receive and send data is the essential building block leading to widespread mobile Internet access and mobile data transfer.
- GSM currently has a data transfer rate of 9.6k.
- New developments that will push up data transfer rates for GSM users are HSCSD (high speed circuit switched data) and GPRS (general packet radio service) are now available.

Teleservices

The abilities of a Bearer Service are used by a teleservice to transport data. These services are further transited in the following ways:

- ***Voice Calls***

The most basic Teleservice supported by GSM is telephony. This includes full-rate speech at 13 kbps

- ***Emergency calls***

where the nearest emergency-service provider is notified by dialing three digits.

- ***Short Text Messages***

SMS service is a text messaging service that allows sending and receiving text messages on your GSM mobile phone.

In addition to simple text messages, other text data including news, sports, financial, language, and location-based data can also be transmitted.

- ***Facsimile or Fax:*** Using modem fax data is transmitted as digital data over the analog telephone network.

Supplementary services

- Supplementary services are additional services that are provided in addition to teleservices and bearer services.
- These services include caller identification, call forwarding, call waiting, multi-party conversations, and barring of outgoing (international) calls

Building Blocks

- AMPS – Advanced Mobile Phone System
- TACS – Total Access Communication System
- NMT – Nordic Mobile Telephone System

Building Blocks
contd.

AMPS – Advanced Mobile Phone System

- analog technology
- used in North and South America and approximately 35 other countries
- operates in the 800 MHz band using FDMA technology

Building Blocks
contd.

TACS – Total Access Communication System

- variant of AMPS
- deployed in a number of countries
- primarily in the UK

Building Blocks
contd.

NMT – Nordic Mobile Telephone System

- analog technology
- deployed in the Benelux countries and Russia
- operates in the 450 and 900 MHz band
- first technology to offer international roaming – only within the Nordic countries

System Architecture of GSM

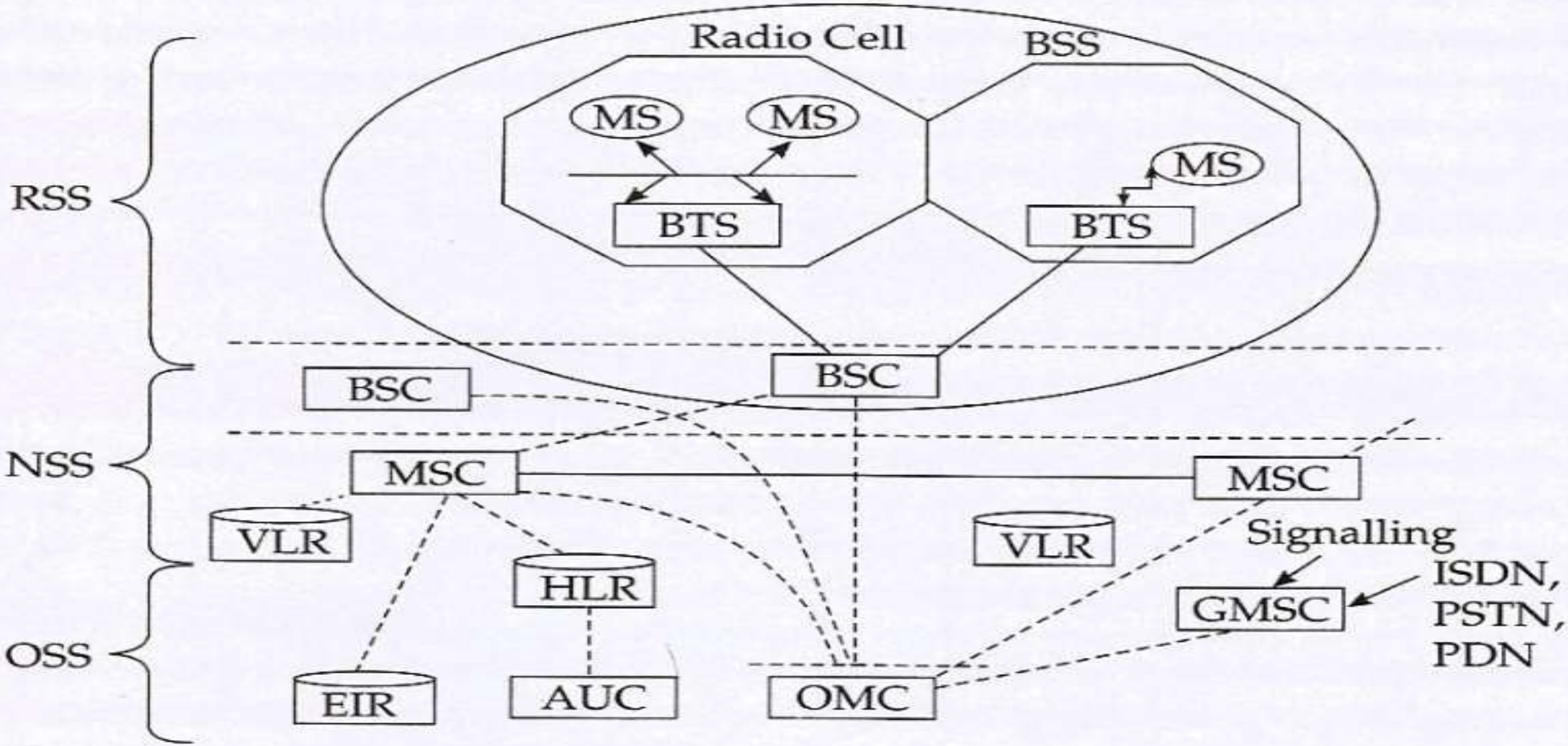
The three main subsystems are

I. Radio Subsystem (RSS)

II. Networking and switching subsystem(NSS)

III. Operation Subsystem (OSS)

Functional architecture of a GSM system



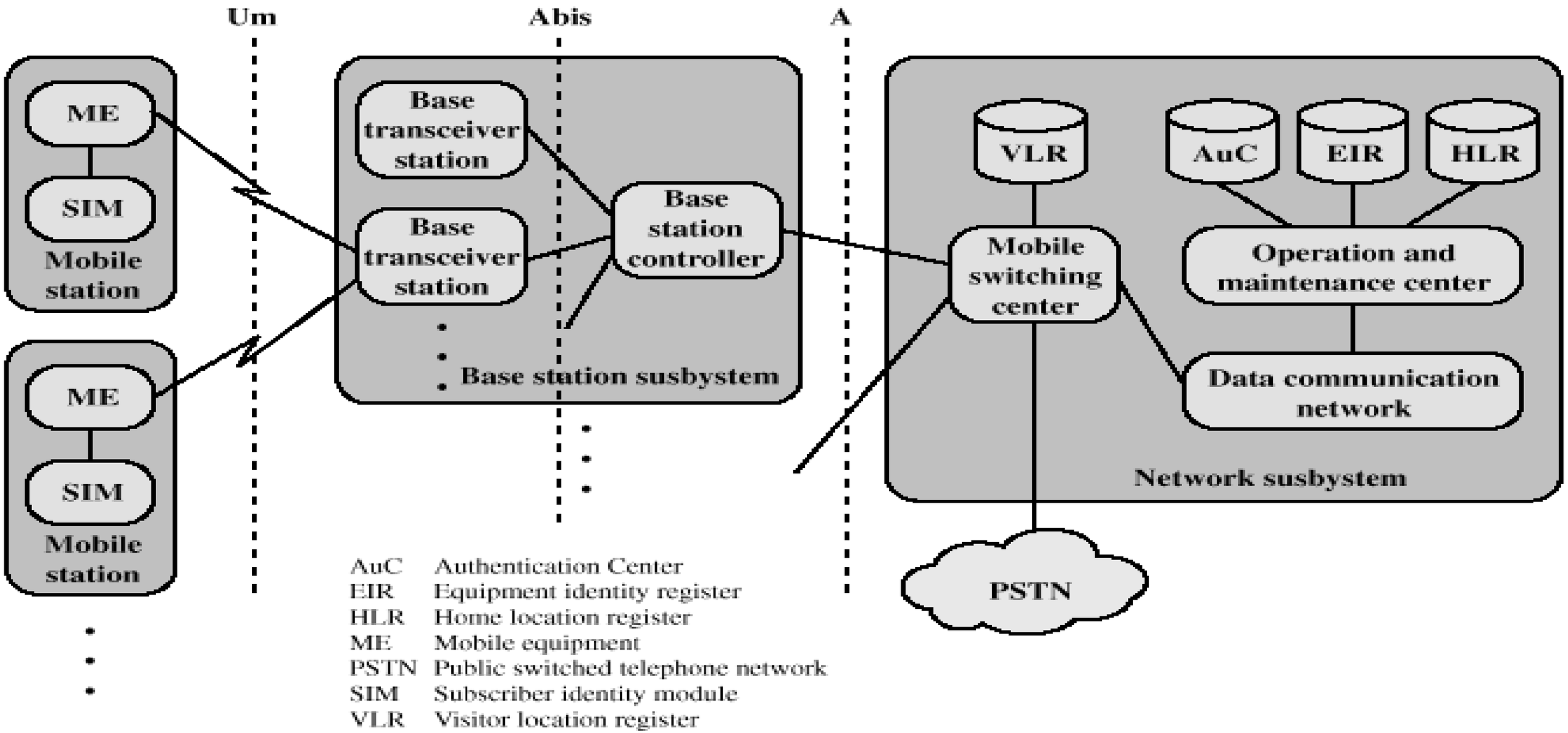
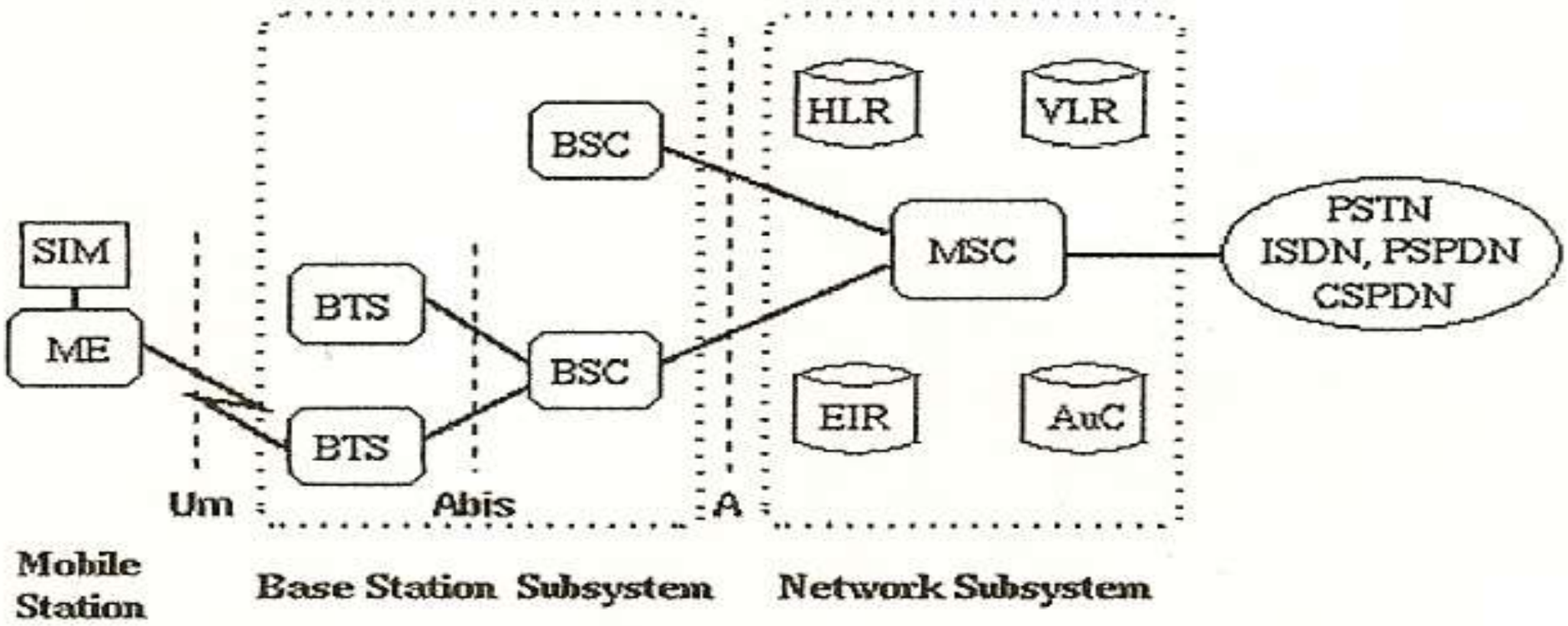


Figure 10.14 Overall GSM Architecture

System Architecture



SIM Subscriber Identity Module
ME Mobile Equipment
BTS Base Transceiver Station
BSC Base Station Controller
HLR Home Location Register
VLR Visitor Location Register
MSC Mobile services Switching Center
EIR Equipment Identity Register
AuC Authentication Center

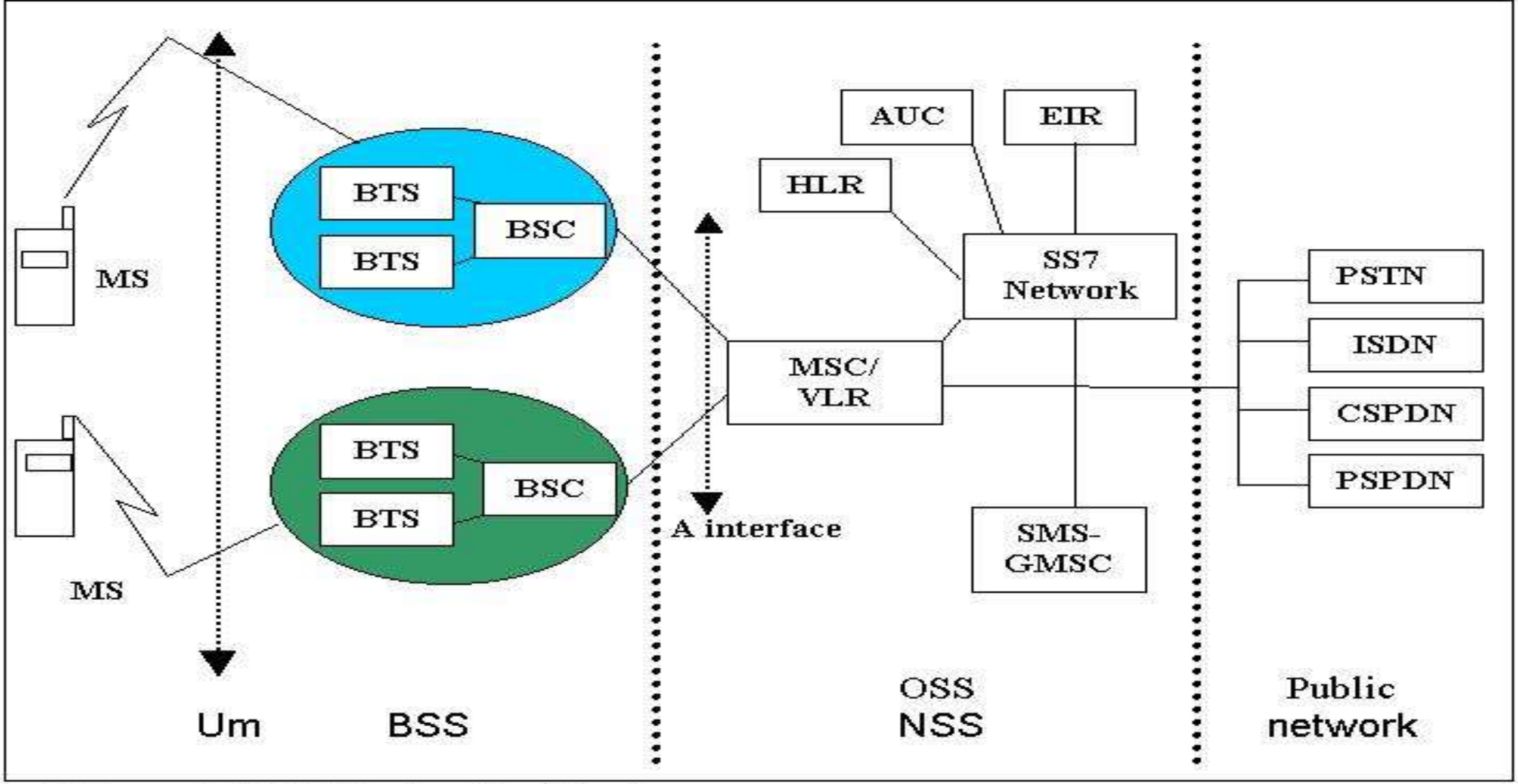


Figure 1: GSM System Architecture.

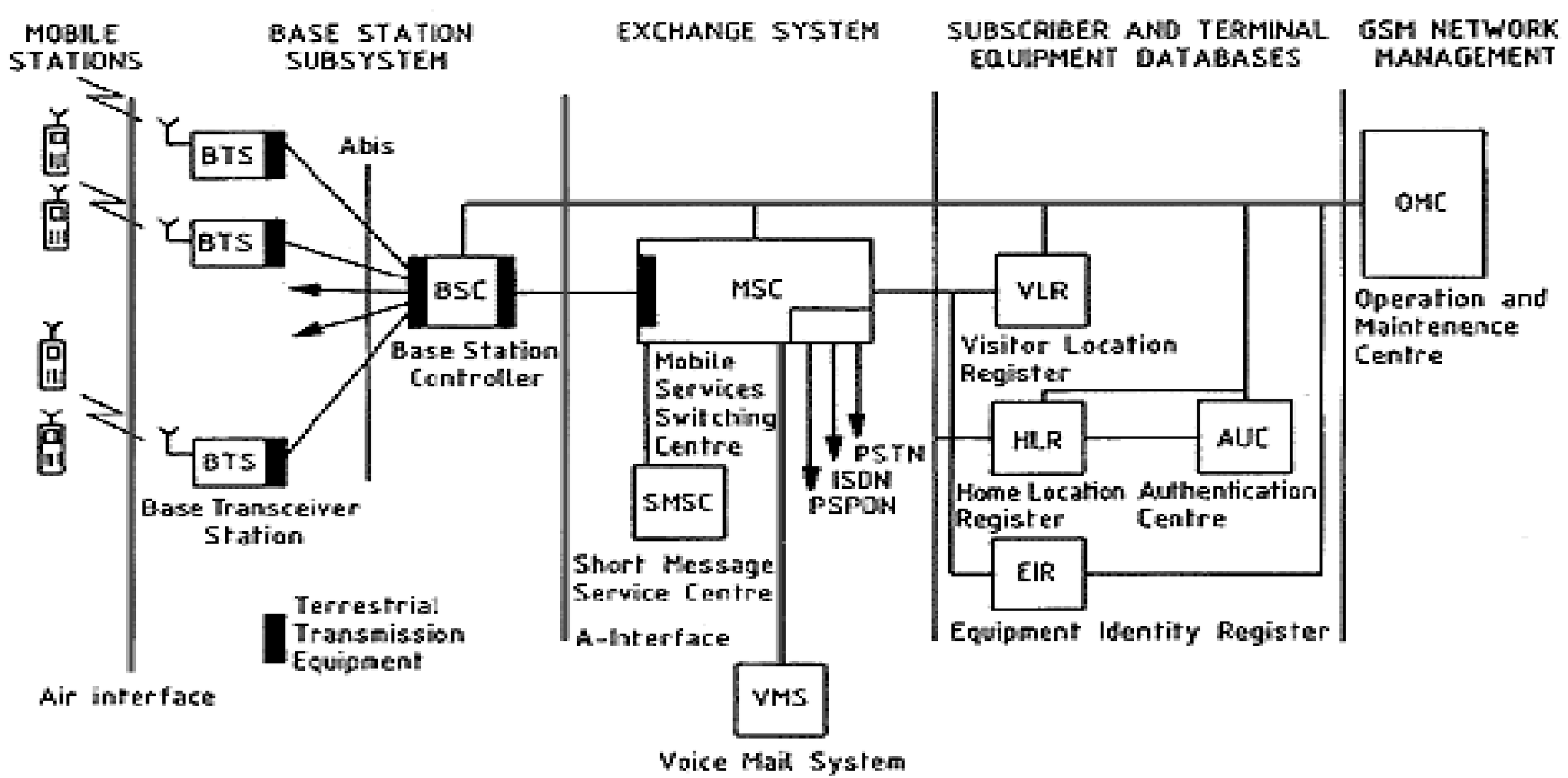


Fig. 1. GSM network architecture

Radio Subsystem (RSS)

This subsystem comprises all the radio specific entities.

1. Mobile Station (MS)

The Mobile Station is made up of two entities:

I. Mobile Equipment (ME)

II. Subscriber Identity Module (SIM)

Mobile Equipment

- Produced by many different manufacturers
- Must obtain approval from the standardization body
- Uniquely identified by an IMEI (International Mobile Equipment Identity)

Subscriber Identity Module (SIM)

- Smart card containing the International Mobile Subscriber Identity (IMSI)
- Allows user to send and receive calls and receive other subscribed services
- Encoded network identification details
- Protected by a password or PIN
- Can be moved from phone to phone – contains key information to activate the phone

Base Station Subsystem (BSS)

Base Station Subsystem is composed of two parts that communicate across the standardized Abis interface allowing operation between components made by different suppliers

1. Base Transceiver Station (BTS)

2. Base Station Controller (BSC)

Base Transceiver Station (BTS)

- A BTS comprises all radio equipment such as antenna, signal processors and amplifiers that are necessary for radio transmission.
- It encodes the received signal, modulates it on a carrier wave and feeds the RF signals to the antenna.
- It communicates with both the mobile station and the BSC

Base Station Controller (BSC)

- Manages Resources for BTS
- It assigns frequency and time slot for and MS for call set up
- It manages the handoff from one BTS to another within the BSS.
- BSC multiplexes the radio channel onto the fixed network connection to the Mobile Switching Centre.

Network and Switching Subsystem(NSS)

It is the heart of the GSM system. It connects the wireless networks to the standard public networks. It carries out usage based charging, accounting and also handles roaming.

Mobile Switching Center (MSC)

- Heart of the network
- Switch speech and data connections between:
  - Base Station Controllers
  - Mobile Switching Centers
  - GSM-networks
  - Other external networks
- Three main jobs:
  1) connects calls from sender to receiver
  2) collects details of the calls made and received
  3) supervises operation of the rest of the network components

Home Location Registers (HLR)

- contains administrative information of each subscriber
- IMSI and current location of the mobile

Visitor Location Registers (VLR)

- A temporary database that is updated whenever a new MS enters its area by reaming.
- contains selected administrative information from the HLR
- authenticates the user
- tracks which customers have the phone on and ready to receive a call
- periodically updates the database on which phones are turned on and ready to receive calls

Operation subsystem (OSS)

The operation subsystem contains all the function necessary for network operation and maintenance.

Authentication Center (AUC)

- mainly used for security
- data storage location and functional part of the network
- Ki is the primary element

Equipment Identity Register (EIR)

- Database that is used to track handsets using the IMEI (International Mobile Equipment Identity)
- Made up of three sub-classes: The White List, The Black List and the Gray List
- Optional database

GSM Security

Security in GSM is broadly supported at three levels: Operator level, Customer's level and System level. These three levels help oversee aspects such as correct billing, avoiding fraud, protecting services and ensuring anonymity.

Authentication

- Protect the network against unauthorized use.
- Denying the possibility for intruders to impersonate authorized users.
- GSM network operator verify the identity , making it highly improbable to clone someone's mobile phone identity.
- Authentication can be achiced in a simple way by using a password such as PIN.

Confidentiality

- GSM network protects voice, data and sensitive information against eavesdropping on the radio path.
- It is achieved by using encryption techniques by GSM designers.
- Data on the radio path is encrypted between the ME and BTS against eavesdropping.

Anonymity

- GSM protects against someone tracking the location of a user or identifying calls made to the user by eavesdropping on the radio path.
- It is achieved by allocating Temporary Mobile Subscriber Identity (TMSIs) instead of permanent indentities.

Advantages of GSM

- Crisper, cleaner quieter calls
- Security against fraud and eavesdropping
- International roaming capability in over 100 countries
- Improved battery life
- Efficient network design for less expensive system expansion
- Efficient use of spectrum
- Advanced features such as short messaging and caller ID
- A wide variety of handsets and accessories
- High stability mobile fax and data at up to 9600 baud
- Ease of use with over the air activation, and all account information is held in a smart card which can be moved from handset to handset

General Packet Radio Service GPRS

GPRS when integrated with GSM significantly improves and simplifies Internet access.

- GPRS is a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM).
- GPRS was originally standardized by European Telecommunications Standards Institute (ETSI) in response to the earlier CDPD and i-mode packet-switched cellular technologies.
- It is now maintained by the 3rd Generation Partnership Project (3GPP).
- GPRS usage is typically charged based on volume of data transferred, contrasting with circuit switched data, which is usually billed per minute of connection time.

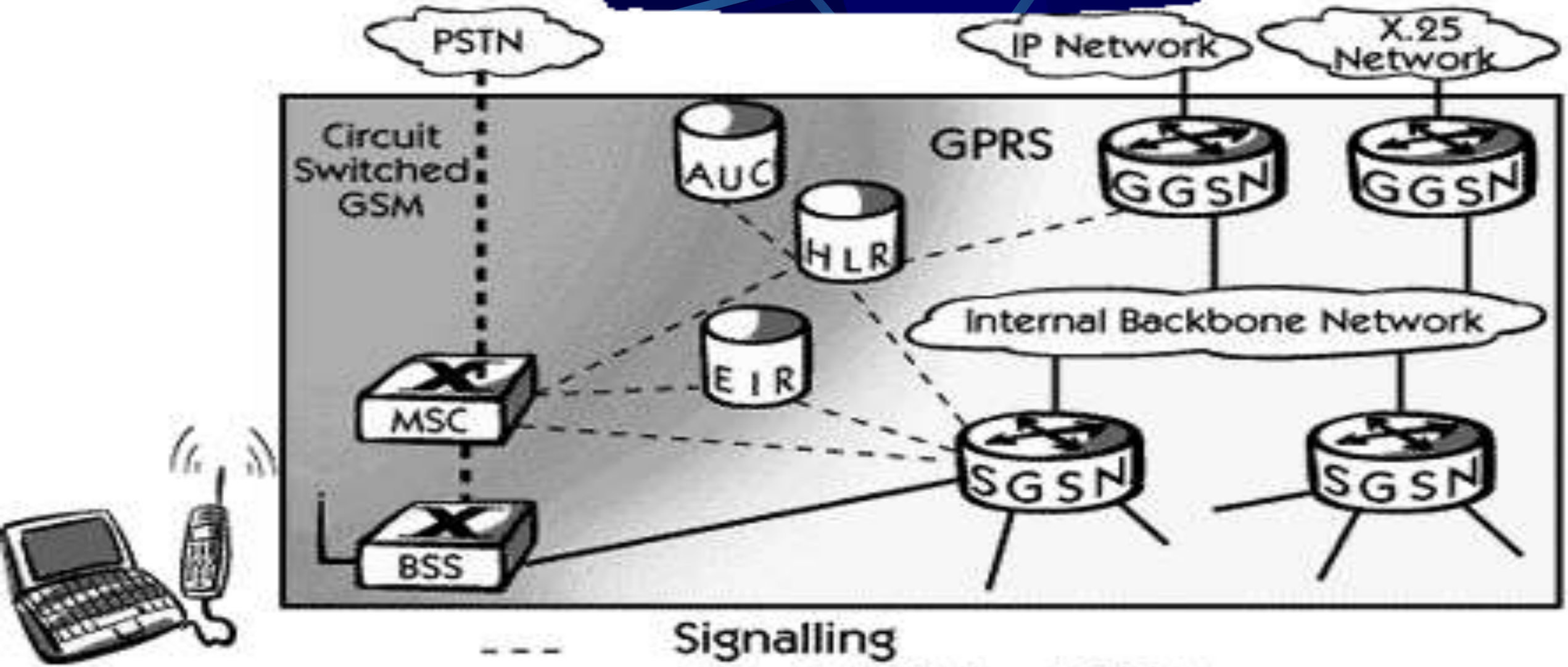
GPRS Services

GPRS offers end-to-end packet-switched data transfer services which can be categorized

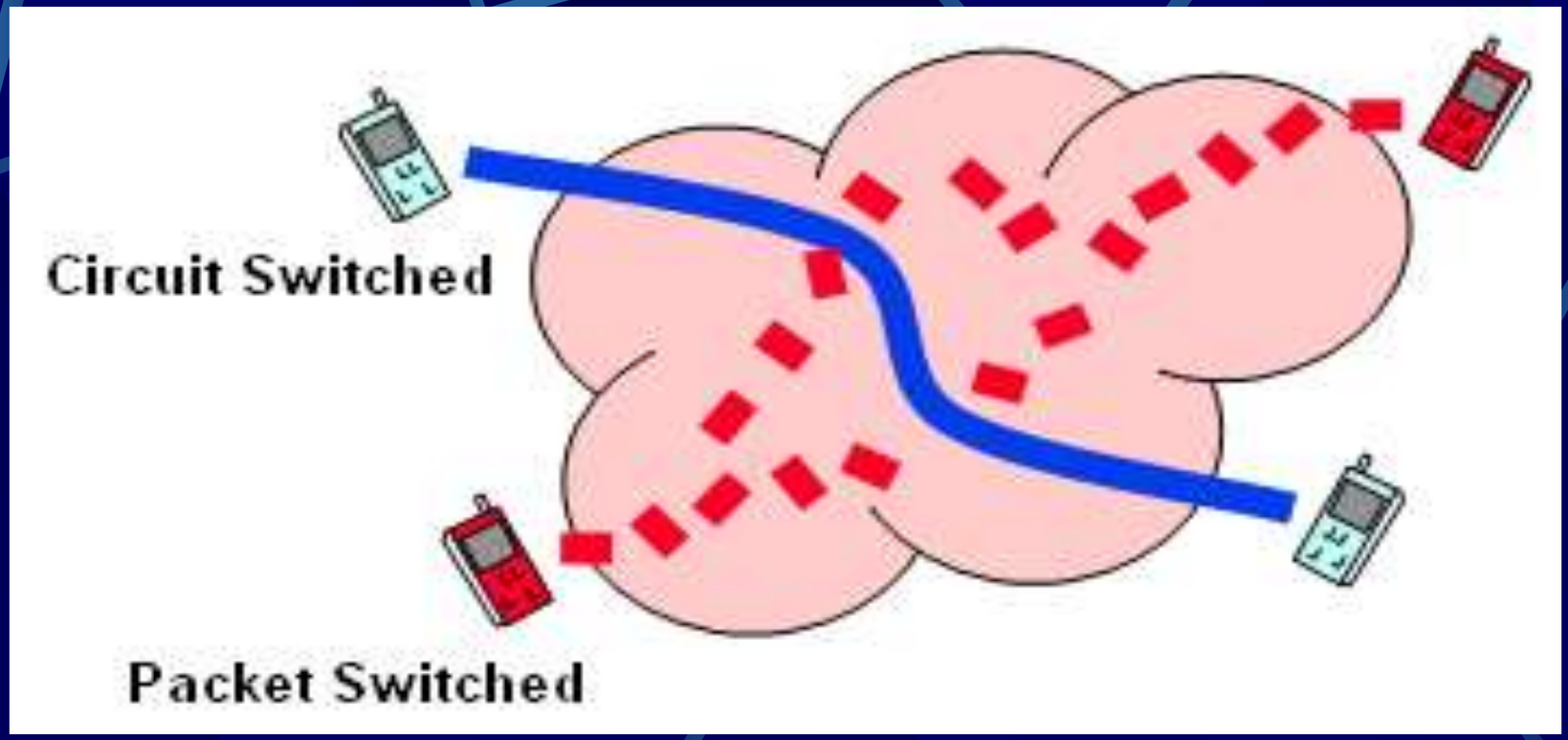
I. Point-to-point (PTP) services
II. Point-to-Multipoint (PTM) services

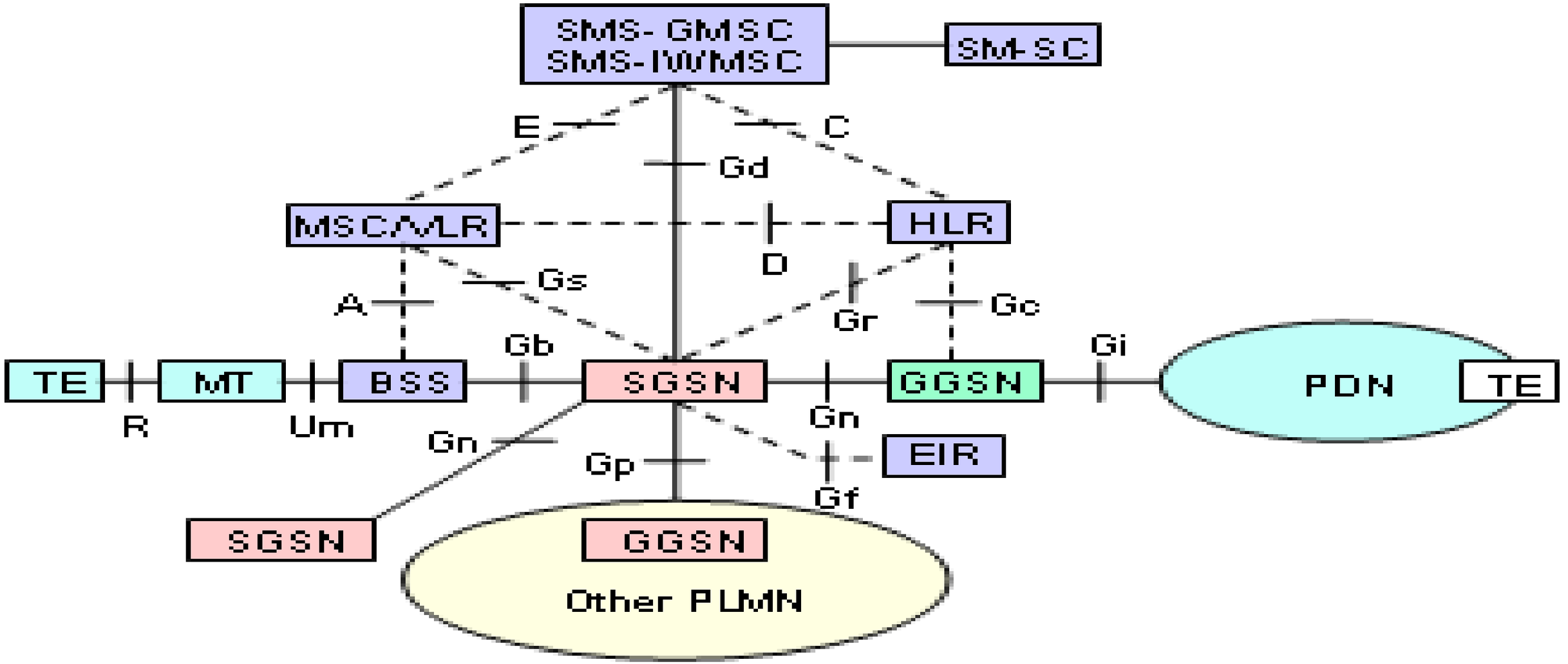
I. Point-to-point (PTP) service is between tow users and can either be connectionless ofr connection-oriented.
II. Point-to-Multipoint (PTM) services is data transfer from one user to multiple users. The two types of PTM services.
    I. One is multicast PTM where the data packets are broadcast in a certain area and
    II. The other is group PTM where the data packets are addressed to a group of users

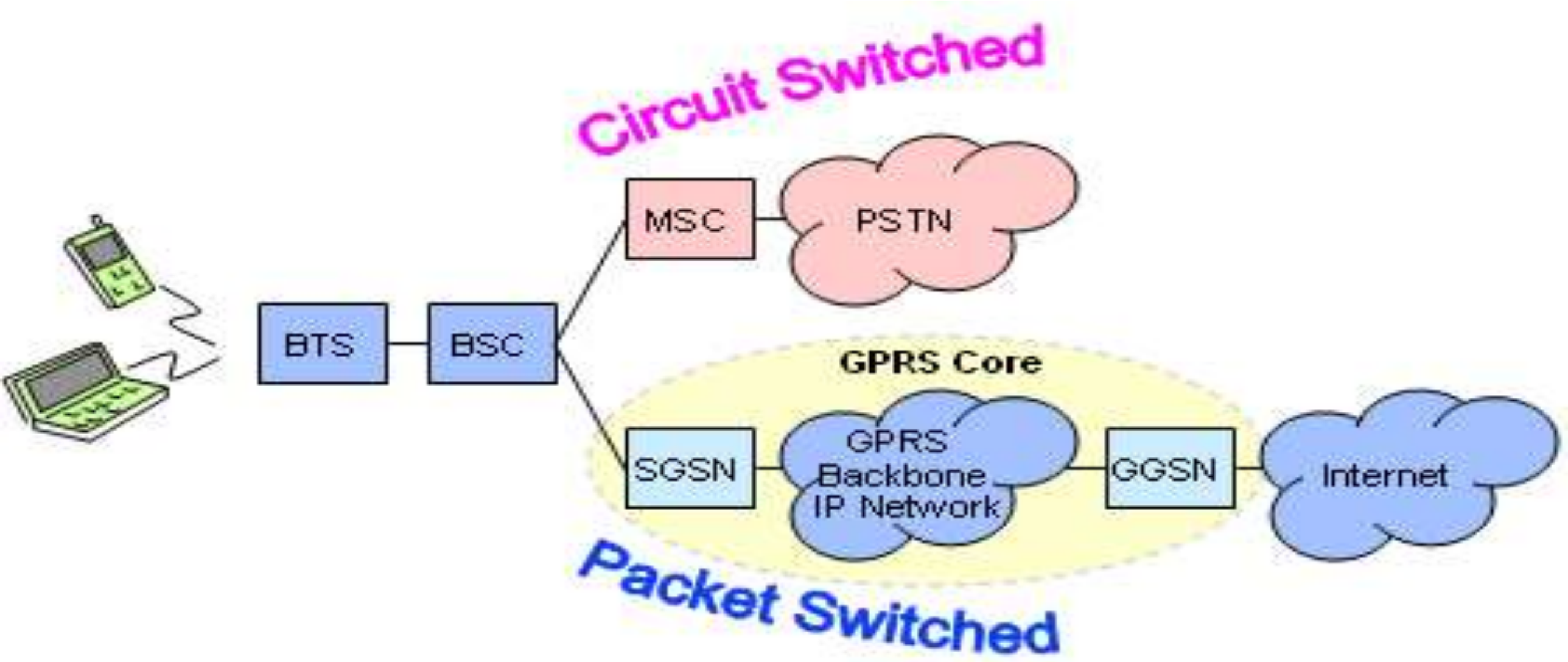
GPRS Architecture



GSM Network Element	Modification or Upgrade Required for GPRS.
Mobile Station (MS)	New Mobile Station is required to access GPRS services. These new terminals will be backward compatible with GSM for voice calls.
BTS	A software upgrade is required in the existing base transceiver site.
BSC	The base station controller (BSC) requires a software upgrade and the installation of new hardware called the packet control unit (PCU). The PCU directs the data traffic to the GPRS network and can be a separate hardware element associated with the BSC.
GPRS Support Nodes (GSNs)	The deployment of GPRS requires the installation of new core network elements called the serving GPRS support node (SGSN) and gateway GPRS support node (GGSN).
Databases (HLR, VLR, etc.)	All the databases involved in the network will require software upgrades to handle the new call models and functions introduced by GPRS.


Circuit Switched
Packet Switched


SMS- GMSC
SMS-IWMSC
SM-SC
E
C
Gd
MSC/VLR
HLR
D
Gs
A
Gr
Gc
Gb
Gi
TE
MT
BSS
SGSN
GGSN
PDN
TE
R
Um
Gn
Gn
Gp
EIR
Gf
SGSN
GGSN
Other PLMN
Signalling Interface
Signalling and Data Transfer Interface


Circuit Switched
MSC
PSTN
BTS
BSC
GPRS Core
SGSN
GPRS
Backbone
IP Network
GGSN
Internet
Packet Switched

Universal Mobile Telephone System (UMTS)

- Reasons for innovations
  - new service requirements
  - availability of new radio bands
- User demands
  - seamless Internet-Intranet access
  - wide range of available services
  - compact, lightweight and affordable terminals
  - simple terminal operation
  - open, understandable pricing structures for the whole spectrum of available services

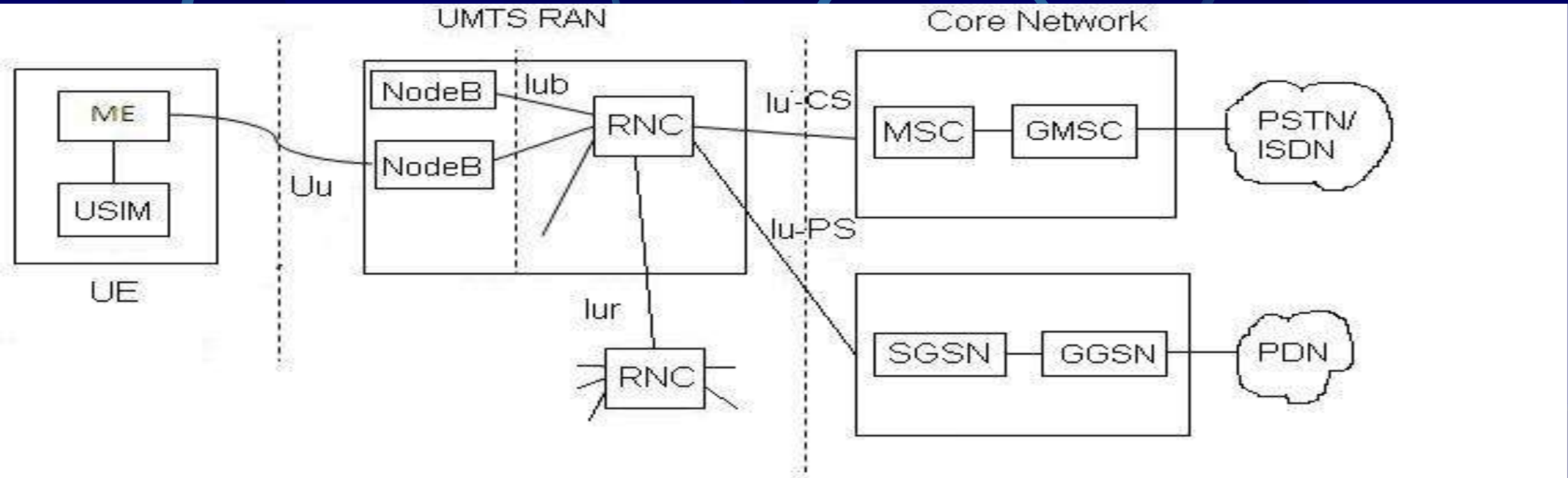
- The UMTS was developed mainly for countries with GSM networks and it is compatible with GSMall
- All GSM networks will be upgraded to UMTS
- The UMTS network is different from the 2G networks in the following respects.

- ***Higher speech quality***: In addition to speech traffic, it supports advanced data and information service – true multimedia network
- ***Higher data rate***: The UMTS supporst 2 Mbps data rate much higher than 2G
- ***Virtual home environment***: A user roaming from his network to other UMTS network will not feel any discontinuity or service diffrence – giving the feeling of being in the home network. In 2G a user registered to a visitor location and is also charged a roaming overheads.

UMTS Network Architecture

The UMTS network architecture is divided into three main elements

I. User Equipment (UE),
II. Radio Network Subsystem(RAN)
III. Core Network



User Equipment (UE)

- UE incorporates greater functionality
- compared to a cell phone.
- It can be thought of as both a mobile phone used for talking and a data terminal attached to a computer with no voce capability.

Radio Network Subsystem(RAN)

- The RNS is the equivalent of BSS in GSM.
- It provides and mages the wireless interface for the overall network.

Core Network

- The Core network is the equivalent of the GSM Network Switching Subsystem(NSS)

References

- Book: Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt. Ltd, New Delhi – 2012.
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- *www.harding.edu/white/classes_old/engr475/.../lecture_12_**gsm.ppt***

Thank You

- Questions and Comments?