

# **E2-E3: CONSUMER MOBILITY**

## **CHAPTER-4**

### **GPRS, EDGE AND 3G**

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## **GPRS.EDGE,3G**

### **General Packet Radio Service (GPRS)**

General Packet Radio Service (GPRS) is a mobile data service available to users of GSM mobile phones. It is often described as "2.5G", that is, a technology between the second (2G) and third (3G) generations of mobile telephony. It provides moderate speed data transfer, by using unused TDMA channels in the GSM network.

GPRS is different from the older Circuit Switched Data (or CSD) connection included in GSM standards. In CSD, a data connection establishes a circuit, and reserves the full bandwidth of that circuit during the lifetime of the connection.

GPRS is packet-switched which means that multiple users share the same transmission channel, only transmitting when they have data to send. This means that the total available bandwidth can be immediately dedicated to those users who are actually sending at any given moment, providing higher utilization where users only send or receive data intermittently.

### **Key User Features of GPRS**

- Speed
- Rich Media Applications
- Internet on the mobile
- Always on

### **Main Advantages For Operators**

- More Revenue
- Huge Potential Market for Data Services
- Fast Roll-out and Continuous Network Expansion
- GPRS uses excess voice capacity for data

### **Typical GPRS Services**

- |                                    |   |
|------------------------------------|---|
| <b>Communications</b>              | - E-mail, fax, intranet/ internet access.                                 |
| <b>Value added services</b>        | - Information services, games, e-commerce.                                |
| <b>Location-based applications</b> | - Navigation, traffic conditions, airline/rail schedule, location finder. |

**Vertical applications**

- Freight delivery, fleet management, sales-force automation.

**Location sensitive Advertising**

- A user nearing a cinema hall or a restaurant receives flashes of advertisement

**GPRS System Architecture and Concepts**

Following figure shows the architecture of a GPRS network. The GPRS system brings some new network elements to an existing GSM network. These elements are:

- Packet Control Unit (PCU)
- Serving GPRS Support Node (SGSN): the MSC of the GPRS network
- Gateway GPRS Support Node (GGSN): gateway to external networks
- Border Gateway (BG): a gateway to other PLMN
- Intra-PLMN backbone: an IP based network inter-connecting all the GPRS elements
- Charging Gateway (CG)
- Legal Interception Gateway (LIG)
- Domain Name System (DNS)
- Firewalls: used wherever a connection to an external network is required.

Not all of the network elements are compulsory for every GPRS network.

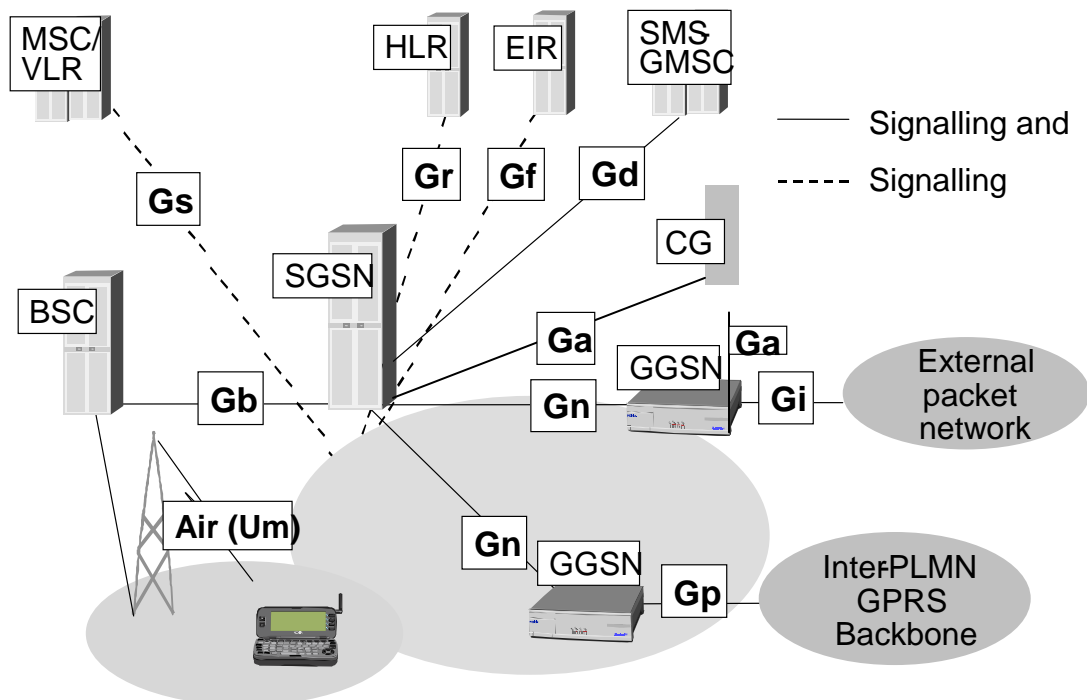


Fig. 1

## **GPRS architecture**

### **Packet Control Unit (PCU)**

The PCU separates the circuit switched and packet switched traffic from the user and sends them to the GSM and GPRS networks respectively. It also performs most of the radio resource management functions of the GPRS network. The PCU can be either located in the BTS, BSC, or some other point between the MS and the MSC.

### **Channel Codec Unit (CCU)**

The CCU is realized in the BTS to perform the Channel Coding (including the coding scheme algorithms), power control and timing advance procedures.

### **Serving GPRS Support Node (SGSN)**

The SGSN is the most important element of the GPRS network. The SGSN of the GPRS network is equivalent to the MSC of the GSM network. The SGSN has the following functions:

- Authentication, Authorization
- GTP tunneling to GGSN
- Ciphering & compression
- Mobility Management
- Session Management
- Interaction with HLR, MSC/VLR
- Charging & statistics
- NMS interfaces

### **Gateway GPRS Support Node (GGSN)**

The GGSN is the gateway to external networks. Every connection to a fixed external data network has to go through a GGSN. The GGSN acts as the anchor point in a GPRS data connection even when the subscriber moves to another SGSN during roaming. The GGSN may accept connection request from SGSN that is in another PLMN. The functions of a GGSN are given below:

- Interface to external data networks
- Encapsulate in GTP and forwards end user data to right SGSN
- Routes mobile originated packets to right destination
- Filters end user traffic
- Collects charging and statistic information for data network usage

**Domain Name Servers**

These devices convert IP host names into IP addresses.

**Firewalls**

A firewall protects an IP network against external attack (for example, hackers from the mobile users or from the Internet). In the case of GPRS, the firewall might be configured to reject all packets that are not part of a GPRS subscriber-initiated connection. The firewall can also include NAT (Network Address Translation).

**Border Gateway**

The Border Gateway (BG) is a router that can provide a direct GPRS tunnel between different operators' GPRS networks. This is referred to as an inter-PLMN data network. It is more secure to transfer data between two operators' PLMN networks through a direct connection rather than via the public Internet.

**Charging Gateway**

GPRS users have to be charged for the use of the network. In a GSM network, charging is based on the destination, duration, and time of call. However, GPRS offers connectionless service to users, so it not possible to charge subscribers on the connection duration. Charging has to be based on the volume, destination, QoS, and other parameters of a connectionless data transfer. These GPRS charging data are generated by all the SGSNs and GGSNs in the network. This data is referred to as Charging Data Records or CDRs. One data session may generate a number of CDRs. The CDR must be collected and processed. The Charging Gateway (CG) collects all of these records, sorts them, processes it, and passes it on to the Billing System.

**MS Class**

- Type A                      GPRS and Speech at the same time
  
- Type B                      GPRS and Speech (not at same time)  
                                    (Automatically switches between GPRS and speech modes)
  
- Type C                      GPRS only  
                                    (or manually switched between GPRS and speech modes)

### Enhanced Data Rates For GSM Evolution (EDGE)

GPRS networks are able to handle higher bit rates than GSM networks, but the data rates still fall short of what is required to make existing GSM networks deliver services at a speed comparable to that promised by third-generation networks. The delay in the deployment of third-generation systems led to the emergence of a technology known as EDGE. This was capable of delivering services similar to those of third-generation networks, yet with implementation on the existing second-generation networks (e.g. GSM). EDGE stands for 'enhanced data rates for GSM evolution'. The enhancement from GSM was to GPRS (i.e. voice and packet), while further enhancement of GPRS led to EDGE networks, as shown in Figure 2. The fundamental concept remains the same, i.e. voice, CS data and PS data being carried, and the network architecture is the same as in a GPRS network.

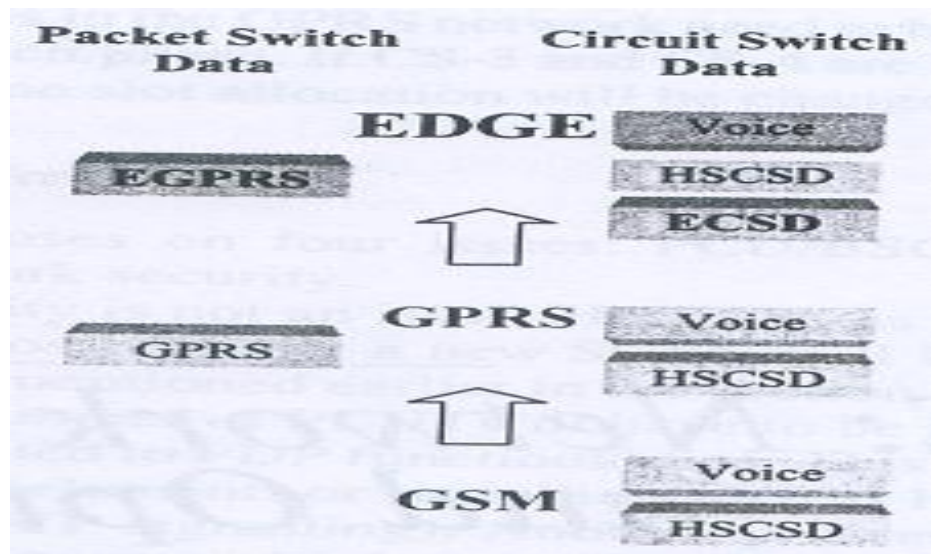


Fig. 2

**EDGE benefits****Short-term benefits:** Capacity and performance

- Easy implementation on a GSM/GPRS network
- Cost effective
- Increase the capacity and triples the data rate of GPRS
- Enabling new multimedia services

**Long-term benefit:** Harmonization with WCDMA**What EDGE would mean to subscribers**

- Streaming Applications
- Very high speed downloads
- Corporate Intranet connections
- Quicker MMS
- Video Phone
- Vertical corporate applications – Video Conference, Remote presentations.

**3<sup>rd</sup> Generation (3G) Communication**

The emergence of the Third Generation Mobile Technology (Commonly known as 3G), has been the latest innovation in the field of communication.

3G is the next generation of wireless network technology that provides high speed bandwidth (high data transfer rates) to handheld devices. The high data transfer rates will allow 3G networks to offer multimedia services combining voice and data. Specifically, 3G wireless networks support the following maximum data transfer rates:

- 2 Mbits/second to stationary devices.
  - 384 Kbits/ second for slowly moving devices, such as a handset carried by a walking user.
  - 128 Kbits/second for fast moving devices, such as handset in moving vehicles.
- Some characteristics of 3G services that have been proposed are:
- Always-on connectivity. 3G networks use IP connectivity, which is packet based.
  - Multi-media service with streaming audio and video.
  - Email with full-fledged attachments such as Power Point files.
  - Instant messaging with video/audio clips.

- Fast downloads of large files such as faxes and Power Point files.
- Access to corporate applications.

### Advantages Of 3G

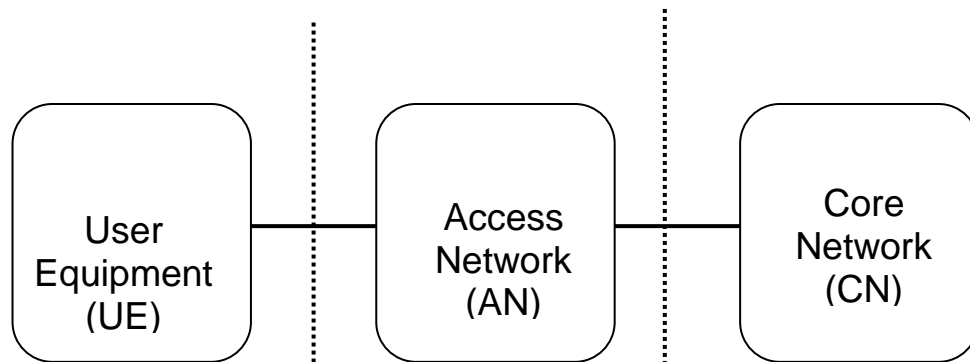
3G networks offer the users advantages such as:

- New radio spectrum to relieve overcrowding in existing systems.
- More bandwidth, security and reliability.
- Interoperability between service providers.
- Fixed and variable data rates.
- Asymmetric data rates.
- Backward compatibility of devices with existing networks.
- Always-online devices, 3G will use IP connectivity. IP is packet based (not circuit based).
- Rich multimedia services.

### 3G Network Architecture

The 3G network basically comprises of following three elements:

- a) Core Network
- b) Access Network
- c) Terminal or User Equipment.



**Figure 3 Basic Structure of 3G Network**

#### User Equipment (UE) –

It is the combination of User equipment and USIM. User equipment may be laptop or mobile phone and SIM of 3G Systems is referred as USIM.



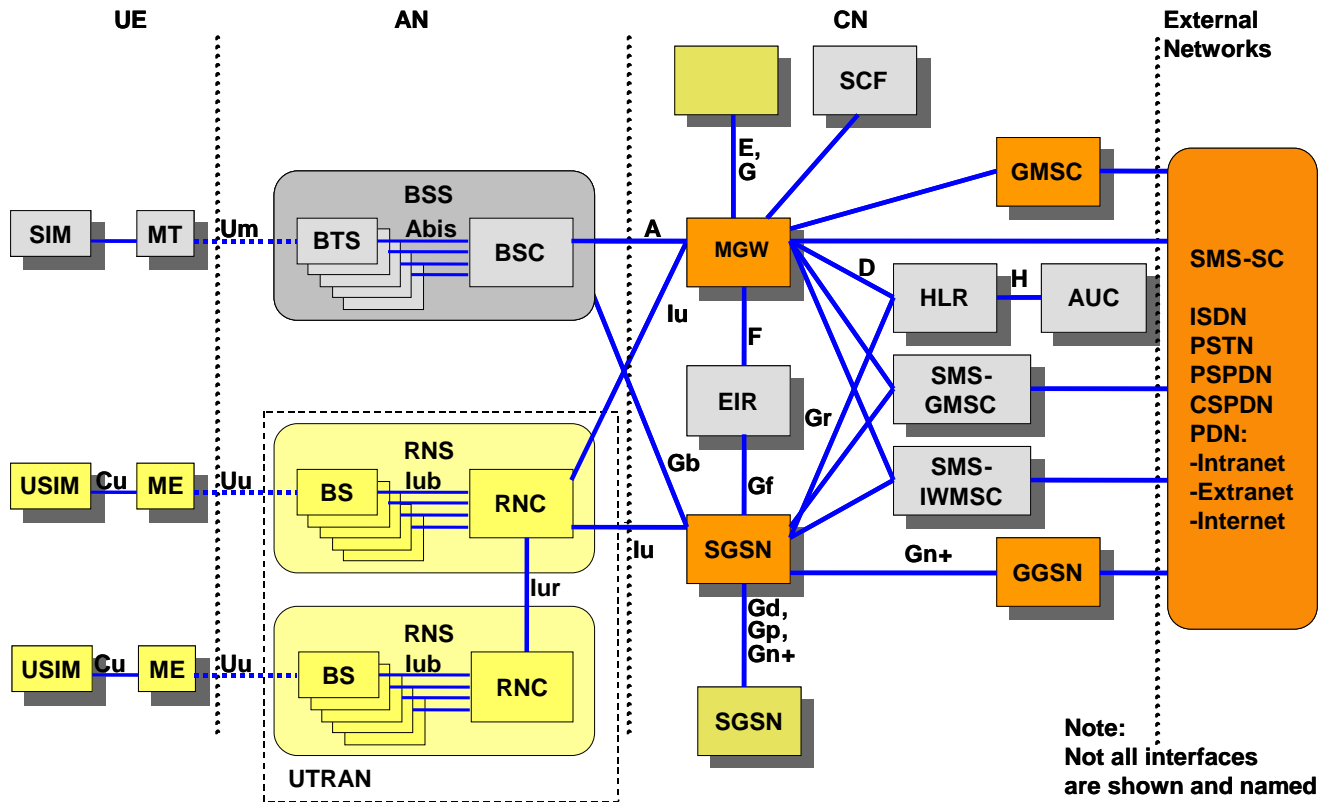
**Access Network (AN)-** Access network in 3G system is called RAN (Radio Access Network). Node-B (Equivalent to 2G BTS) , RNC (Equivalent to 2G BSC) are the main nodes of RAN.

**Core Network (CN)-**

The basic function of core network can be broadly classified as follows:

- a) Switching and routing
- b) Call Control
- c) Mobility Management (MM)
- d) Managing the Subscriber Information

**3G Network Architecture**



**Main Nodes in Core Network**

- MSC-Server(MSC-S)
- Media Gateway (MGW)
- SGSN
- GGSN
- HLR
- EIR
- AUC

## **Chapter 4: GPRS,EDGE and 3G**

### **Sample self study Questions**

1. GPRS provides moderate speed data transfer, by using unused TDMA channels in the GSM network. (T/F)
2. The SGSN of the GPRS network is equivalent to the MSC of the GSM network.(T/F)
3. The GGSN is the gateway to external networks(T/F)

### **Short answer questions**

1. What are the key features of GPRS?
2. State typical GPRS services.
3. What are network elements of GPRS network?
4. What are different GPRS MS classes?
5. What are benefits of EDGE?
6. What are the maximum data transfer rates supported by 3G wireless networks?
7. What are advantages of 3G?
8. The 3G network basically comprises of which three elements?