

Module 4- GPRS

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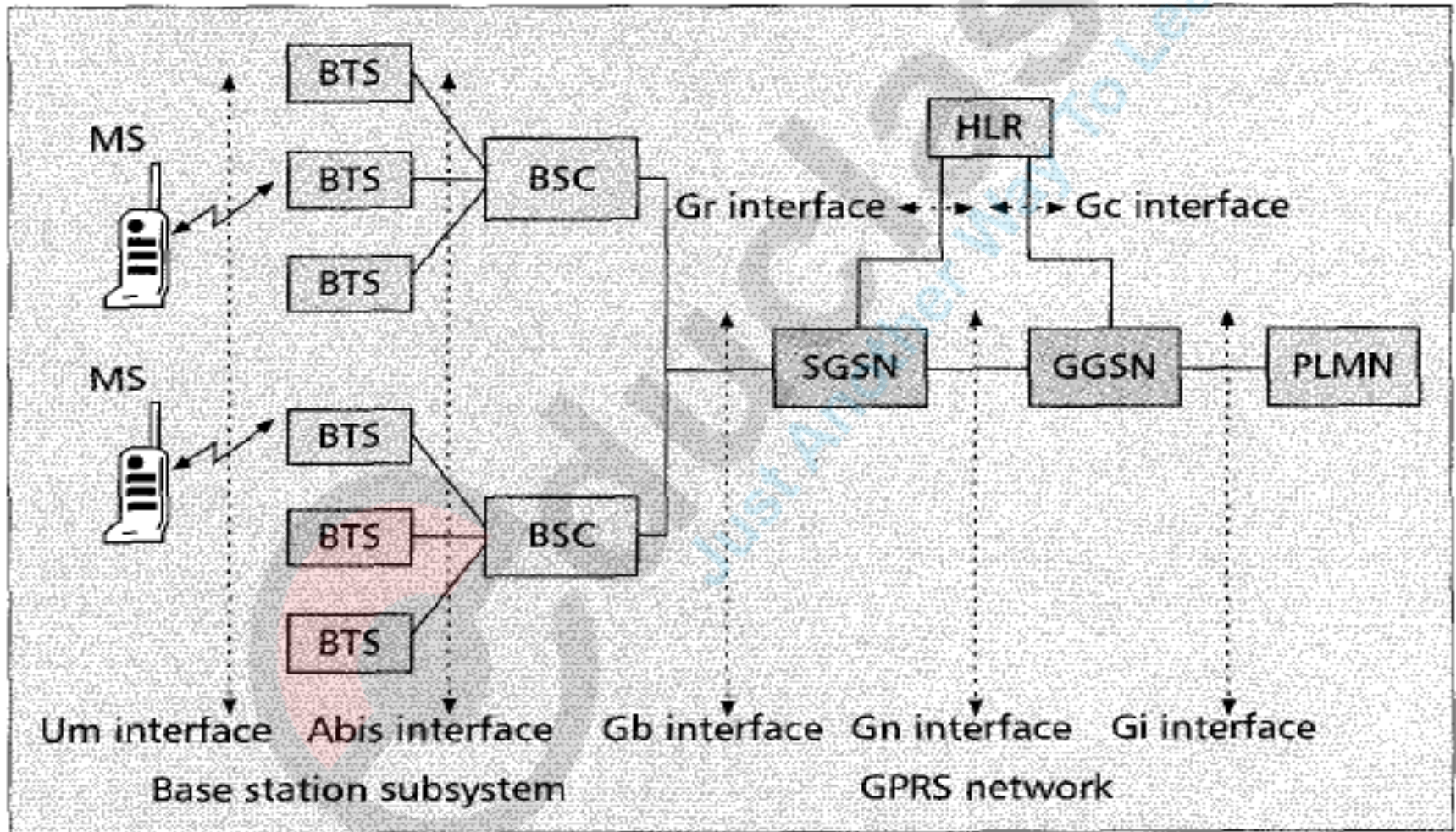
GPRS

- General Packet Radio Service.
- GSM evolved mobile network.
- Allows data services by sending and receiving IPv4/IPv6 data packets over the mobile networks.
- 2.5G standard.
- Of the “always connected” type.
- Advantages of GPRS:
 - Use of packet switching.
 - Efficient radio usage
 - Fast set up/access time
 - High bandwidth with multiple time slots
- GPRS integrates a packet based air interface into an existing circuit switched GSM network.

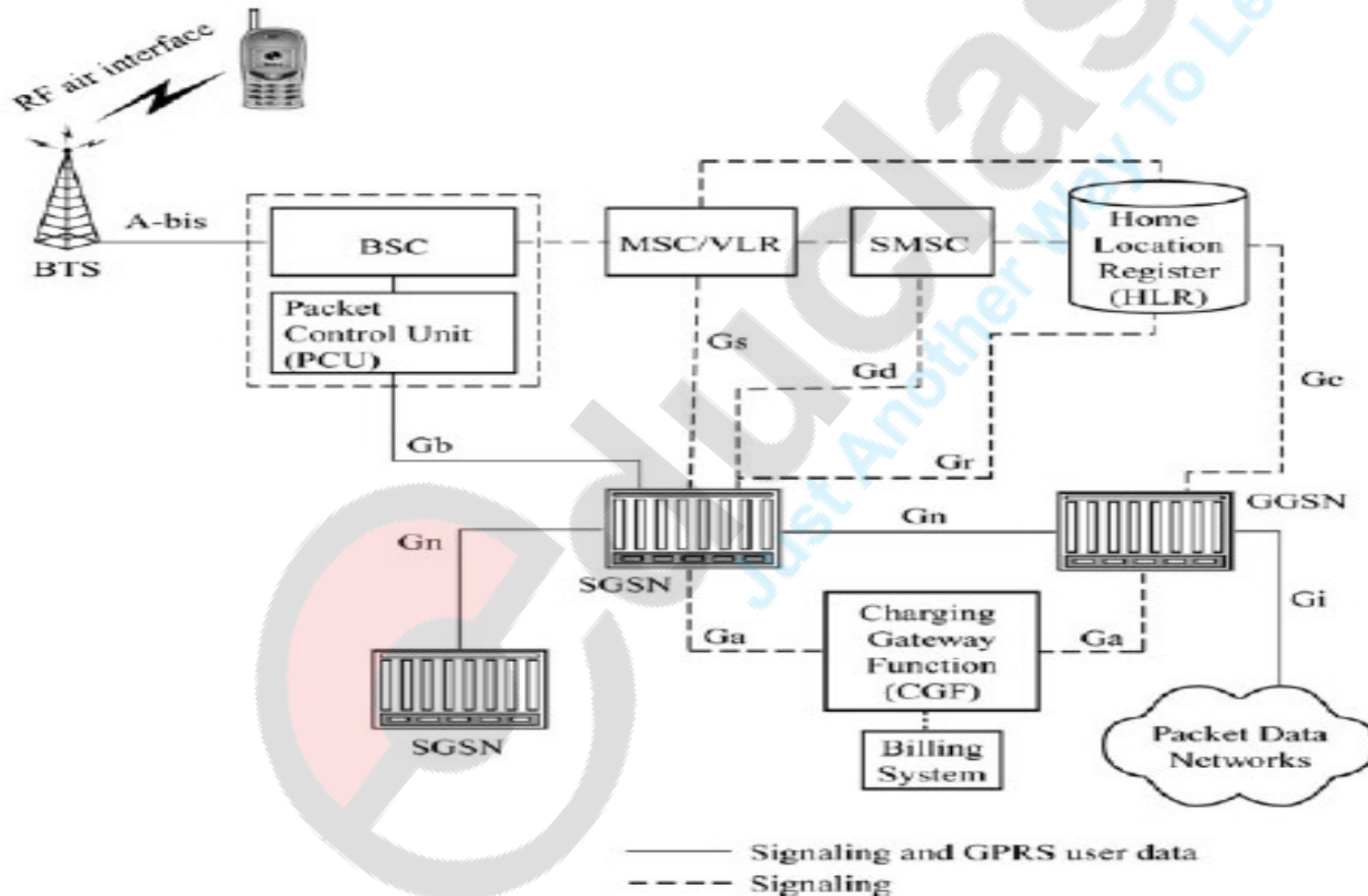
GSM v/s GPRS

	GSM	GPRS
Data Rates	9.6 Kbps	14.4 to 115.2 Kbps
Modulation Technique	GMSK	GMSK
Billing	Duration of connection	Amount of data transferred
Type of Connection	Circuit – Switched Technology	Packet - Switched Technology

1. GPRS Architecture-I



GPRS Architecture-II



Serving GPRS Support Node (SGSN)

- Switching centre like MSC.
- Delivery of data packets to and from MS.
- authentication of GPRS mobiles
- registration of mobiles in the network
- mobility management
- collecting information for charging for the use of the air interface

Gateway GPRS Support Node (GGSN)

- acts as an interface and a router to external networks.
- contains routing information for GPRS mobiles, which is used to tunnel packets through the IP based internal backbone to the correct Serving GPRS Support Node.
- collects charging information connected to the use of the external data networks.
- can act as a packet filter for incoming traffic.
- Has access to HLR.
- Converts GPRS packets from SGSN into PDP(packet data protocol) format.
- Communication between GGSN and SGSN through GTP (GPRS tunnelling protocol).

GPRS register

- GPRS Register is integrated with GSM-HLR.
- Maintains the GPRS subscriber data and Routing information.
- Stores current SGSN address.



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Charging Gateway (CG)

- Takes the processing load off the SGSN and GGSN .
- Provides single logical links for the billing system.



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Lawful Interception Gateway (LIG)

- Monitoring traffic for the law enforcement agencies that require court order.
- Data packets may be intercepted and forwarded to the agencies.



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Domain Name System (DNS)

- When MS wants to connect to external network, it selects APN (access point name) from a list.
- DNS is required to get the correct GGSN according to the IP address of the GGSN.
- SGSN resolves APN to correct GGSN IP address.
- APN- can be in the form of text.
- Any network- net
- Wireless access point- WAP

Border Gateway (BG)

- Used as the gateway to a backbone network connecting different operators together and an IP router.
- Implemented as the same hardware platform as GGSN.
- Supports inter-PLMN (Public land mobile network) roaming facility with the help of GRX (global Roaming Exchange) .

Packet Control Unit (PCU)

- Distinguishes between Packet switched mode and Circuit switched mode.
- Routes voice calls to MSC and data calls to SGSN.
- Placed at the BSC site or at the BTS site.
- Performs following functions
 - Packet segmentation and reassembly on the uplink and downlink
 - Access control
 - Scheduling for all active transmissions including radio channel management
 - Controlling transmission for checking, buffering and retransmission

Classes of GPRS equipments

- **Class A**

- Equipment that handles voice calls and transfer data at the same time.

- **Class B**

- Handle voice or data traffic separately.
- Can put a packet transfer on hold to receive a phone call.

- **Class C**

- Can handle both voice and data.
- Has to be disconnected from one mode explicitly in order to enable the other.

GPRS Interfaces

- Gb – Connects BSC with SGSN
- Gn – SGSN – SGSN/GGSN (in the same network)
- Gp – SGSN –GGSN (in different networks)
- Gf – For equipment querying at registering time
- Gi – Connects PLMN with external Packet Data Networks (PDNs)
- Gr – To exchange User profile between HLR & SGSN
- Gs – To exchange Database between SGSN & MSC
- Gd – Interface between SMS & GPRS

GPRS Logical channels

GPRS Logical Channels			
Packet data traffic			↕
			↑
			→
			↑
			↑
			↑
			↕
			↕

Packet data traffic channel(PDTCH)

- Physical Channel for GPRS Traffic.
- PDCH are taken from all channels available in the cell.
- Depending on current traffic load and priority of service, the physical channel are allocated to either GPRS or GSM services.
- Physical channels not currently used by GSM can be allocated as PDCH to increase the QOS for GPRS.

2. GPRS Signalling

- Divided into 2 planes
 - User plane
 - transmission phase
 - Handles packet data transmission
 - Control plane
 - Signalling phase
 - Handles mobility management, session management and quality of service(QoS)

3. GPRS Mobility management

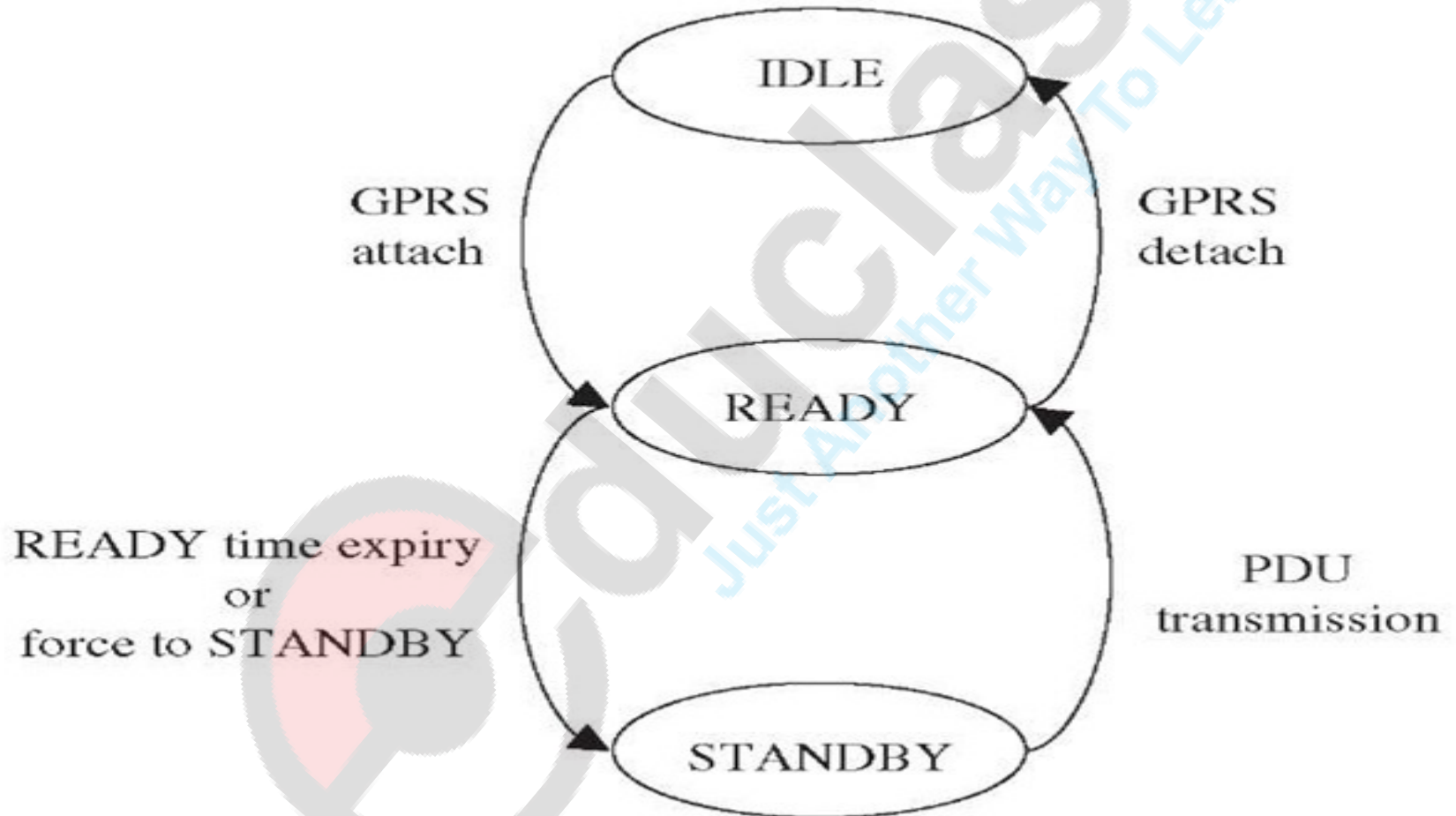
GPRS Attach function is similar to IMSI attach

- Authenticate the mobile
- Generate the ciphering key
- Enable the ciphering
- Allocate temporary identity
- Copy subscriber profile from HLR to SGSN

After GPRS attach

- The location of the mobile is tracked
- Communication between MS and SGSN is secured
- Charging information is collected
- SGSN knows what the subscriber is allowed to do
- HLR knows the location of the MS in accuracy of SGSN

GPRS states of Mobility management-I



GPRS states of Mobility management-II

Mobile station can be in 1 of the 3 states depending on traffic amount:

- **Idle** : In the idle state, the MS does not have a logical GPRS context activated or any packet-switched public data network (PSPDN) addresses allocated. MS is not using GPRS service.
- **Ready (Active state)** :Data is transmitted between an MS and the GPRS network only when the MS is in the active state. In the active state, the SGSN knows the cell location of the MS.
- **Standby** :In the standby state, only the routing area of the MS is known. When MS does not send any packets for longer period of time.

GPRS routing area update

- GSM Location Area(LA) is divided into several Routing Areas(RA)
- RA consists of several cells
- SGSN is informed when MS moves to a new RA
- MS sends a “Routing Area Update Request” to its assigned SGSN

When an MS that is in an active or a standby state moves from one routing area to another within the service area of one SGSN, it must perform a routing update. The routing area information in the SGSN is updated, and the success of the procedure is indicated in the response message.

4. GPRS Roaming

- To facilitate roaming, following conditions are required:
 - The operator for home PLMN must have agreement with the operator in the country user is visiting.
 - The mobile phone of user must be GSM compatible in the visited location and at the home PLMN.
 - The user must be entitled for roaming services that is stored in the HLR.
- GPRS roaming is more difficult than GSM because of the billing complexity that is measured on the volume of data transferred.
- GPRS roaming exchange service (GRX) can be used.

5. GPRS Inter-networking-I

- GPRS can interwork with GSM services through Gs-interface
- If no Gs interface exists:
 - Type of the location update procedure is indicated by the network in the response message to MS
- Effects on different MS classes if Gs does not exist:
 - A-class mobiles must use conventional GSM services via normal GSM channels
 - B-class mobiles won't get simultaneous support from the network. Depending on MS design
 - MS can try listen both paging channels simultaneously by themselves
 - MS does IMSI detach and use only GPRS service
 - No effect on C-class mobiles as simultaneous services are not supported

Reference book

- Wireless Communications and Networks, 3G and Beyond, Second Edition, ITI Saha Misra, McGraw Hill Education-Chapter 9



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University Questions

- May 16-
 - Explain the architecture and components of GPRS.- 8M
- Nov 16-
 - What modifications are made to the architecture of GSM to accommodate GPRS? Explain with the help of diagram with its components.- 8M