Topic 4 Notes

4.1 General Packet Radio Service (GPRS)

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. This contrasts with circuit switching data, which is typically billed per minute of connection time, regardless of whether or not the user transfers data during that period. GPRS data is typically supplied either as part of a bundle (e.g., 5 GB per month for a fixed fee) or on a pay-as-you-use basis. Usage above the bundle cap is either charged per megabyte or disallowed. The pay-as-you use charging is typically per megabyte of traffic.

GPRS is a best-effort service, implying variable throughput and latency that depend on the number of other users sharing the service concurrently, as opposed to circuit switching, where a certain quality of service (QoS) is guaranteed during the connection. In 2G systems, GPRS provides data rates of 56–114 kbit/second. 2G cellular technology combined with GPRS is sometimes 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 time division multiple access (TDMA) channels in, for example, the GSM system. GPRS is integrated into GSM Release 97 and newer releases.

General Packet Radio Service, more commonly known as GPRS, is a new non-voice, value added, high-speed, packet-switching technology, for GSM (Global System for Mobile Communications) networks. It makes sending and receiving small bursts of data, such as email and web browsing, as well as large volumes of data over a mobile telephone network possible. A simple way to understand packet switching is to relate it to a jigsaw puzzle. Imagine how you buy a complete image or picture that has been divided up into many pieces and then placed in a box. You purchase the puzzle and reassemble it to form the original image. Before the information is sent, it is split up into separate packets and it is then reassembled at the receivers end.

GPRS offers a continuous connection to the Internet for mobile phone and computer users. Experience has shown that most data communication applications do not require continuous data transfer. Users may need to be connected to a data communication network (such as a LAN, WAN, the Internet, or a corporate Intranet), but that does not mean they are sending and receiving data at all times. Data transfer needs are not generally balanced. In the majority of cases, users will tend to send out small messages but receive large downloads. Therefore, most of the data transfer is in one direction.

GPRS is expected to provide a significant boost to mobile data usage and usefulness. It is expected to greatly alter and improve the end-user experience of mobile data computing, by making it possible and cost-effective to remain constantly connected, as well as to send and receive data at much higher speeds than today. Its main innovations are that it is packet based, that it will increase data transmission speeds, and that it will extend the Internet connection all the way to the mobile PC – the user will no longer need to dial up to a separate ISP.

4.2 GPRS History

Like the GSM standard itself, GPRS will be introduced in phases. Phase 1 became available commercially in the year 2000/2001.Point to Point GPRS, which is sending information to a single GPRS user, was supported, but not Point to Multipoint which is sending the same information to

several GPRS users at the same time. GPRS Phase 2 is not yet fully defined, but is expected to support higher data rates through the possible incorporation of techniques such as EDGE (Enhanced Data rates for GSM Evolution), in addition to Point-to-Multipoint support. See Table below for a timeline history of GPRS.

Table 4.1 GPRS timeline

DATE	MILESTONE
Throughout 1999-2000	Network operators place trial and commercial contracts for GPRS infrastructure. Incorporation of GPRS infrastructure into GSM networks.
Summer of 2000	First trial GPRS services become available. Typical single user throughput is likely to be 28 kbps. For example, T-Mobil is planning a GPRS trial at Expo2000 in Hanover in the Summer of 2000.
Start of 2001	Basic GPRS capable terminals begin to be available in commercial quantities.
Throughout 2001	Network operators launch GPRS services commercially an roll out GPRS. Vertical market and executive GPRS early adopters begin using it regularly for nonvoice mobile communications.
2001/2002	Typical single user throughput is likely to be 56 kbps. New GPRS specific applications, higher bitrates, greater network capacity solutions, more capable terminals become available, fueling GPRS usage.
2002	Typical single user throughput is likely to be 112 kbps.
	GPRS Phase 2/EDGE begins to emerge in practice.

2002	GPRS is routinely incorporated into GSM mobile phones and has reached critical mass in terms of usage. (This is the equivalent to the status of SMS in 1999)
2002/2003	3GSM arrives commercially.

4.3 GPRS Shortcomings

i. Limited radio resources - There are only limited radio resources that can be deployed for different uses – use for one purpose precludes simultaneous use for another. For example, voice and GPRS calls both use the same network resources.
ii. Speeds much lower in reality - Attaining the highest GPRS data transmission speed of 171.2 kbps would require a single user taking over all eight timeslots; therefore, maximum GPRS speeds should be compared against constraints in the GPRS terminals and networks.
iii. No support of mobile terminated calls - There has been no confirmation by any mobile phone provider that initial GPRS terminals will support mobile terminated GPRS calls (receipt of GPRS calls on the mobile phone). When a mobile phone user initiates a GPRS session, they are agreeing to pay for the content to be delivered by the GPRS service. Internet sources originating unsolicited content may not be chargeable. A worst case scenario would be that a mobile user would then be made responsible for paying for the unsolicited junk content that they received. This is one main reason why mobile vendors are not willing to support mobile terminated GPRS calls in their terminals.
iv. Suboptimal modulation - GPRS is based on a modulation technique known as Gaussian minimum-shift keying (GMSK). EDGE is based on a new modulation scheme that allows a much higher bit rate across the air interface – that is called eight-phase-shift keying (8 PSK) modulation. Since 8 PSK will also be used for 3GSM, network operators will need to incorporate it at some stage to make the transition to third generation mobile phone systems.
v. Transit delays - GPRS packets are sent in many different directions to reach the same destination. This makes room for the possibility for some of the packets to get lost or damaged during the transmission over the radio link. The GPRS standards are aware of this issue regarding wireless packet technologies and have worked to integrate data integrity and retransmission approaches to solving these problems. The result of this leads to possible transit delays.
vi. No store and forward - Currently, there is not a storage mechanism integrated into the GPRS standard.

4.4 Method of Operation

GPRS gives GSM subscribers access to data communication applications such as e-mail, corporate networks, and the Internet using their mobile phones. The GPRS service uses the existing GSM network and adds new packet-switching network equipment. GPRS employs packet switching, which means that the GPRS mobile phone has no dedicated circuit assigned to it. Only when data is transferred is a physical channel created. After the data has been sent, it can be assigned to other users. This allows for the most efficient use of the network.

When packet-switched data leaves the GPRS/GSM network, it is transferred to TCP-IP networks such as the Internet or X.25.Thus, GPRS includes new transmission and signaling procedures as well as new protocols for interworking with the IP world and other standard packet networks. Figure below is a diagram of the GPRS Network Architecture.

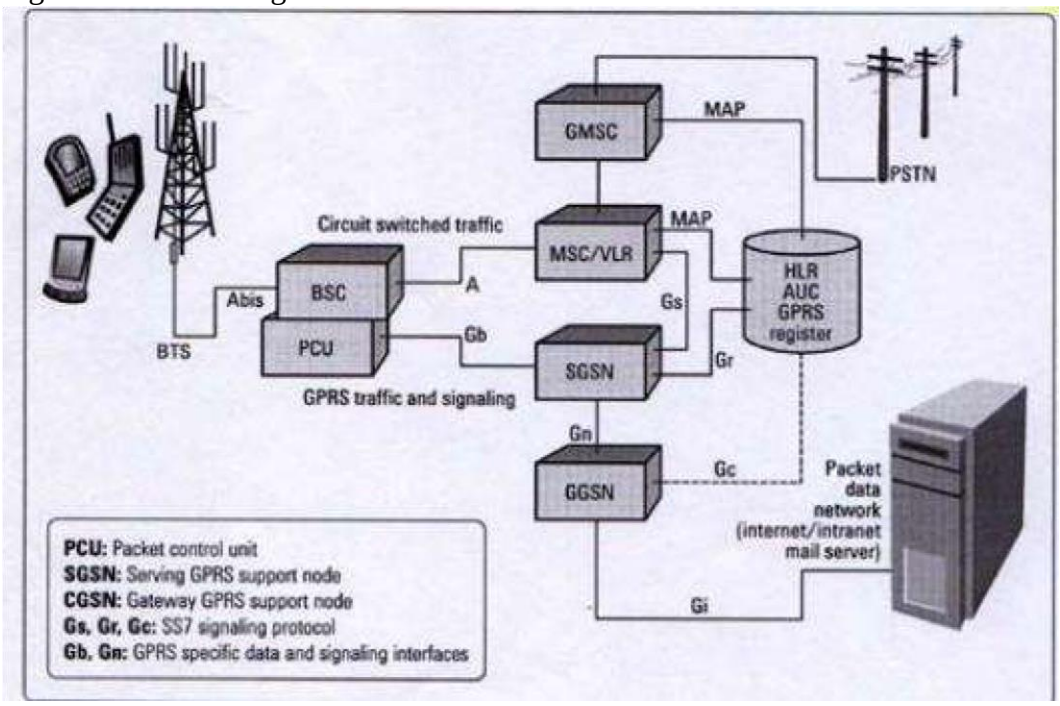

Fig 4.1: GPRS Network Architecture

User Features

i. Speed - The maximum speed of 171.2 kbps, available through GPRS, is nearly three times as fast as the data transmission speeds of fixed telecommunications networks and ten times as fast as the current GSM network services.

ii. Instant connections – immediate transfer of data - GPRS will allow for instant, continuous connections that will allow information and data to be sent whenever and wherever it is needed. GPRS users are considered to be always connected, with no dial-up needed. Immediacy is one of the advantages of GPRS (and SMS) when compared to Circuit Switched Data.High immediacy is a very important feature for time critical applications such as remote credit card authorization where it would be unacceptable to keep the customer waiting for even thirty extra seconds.

iii. New and better applications - General Packet Radio Service offers many new applications that were never before available to users because of the restrictions in speed and messaged length. Some of the new applications that GPRS offers is the ability to perform web browsing and to transfer files from the office or home and home automation, which is the ability to use and control in-home appliances.

iv. Service access - To use GPRS, the user will need:

- mobile phone or terminal that supports GPRS (existing GSM phones do not support GPRS)

- A subscription to a mobile telephone network that supports GPRS – use of GPRS must be enabled for that user. Automatic access to the GPRS may be allowed by some mobile network operators, others will require a specific opt-in
- Knowledge of how to send and/or receive GPRS information using their specific model of mobile phone, including software and hardware configuration (this creates a customer service requirement)
- A destination to send or receive information through GPRS.(Whereas with SMS this was often another mobile phone, in the case of GPRS, it is likely to be an Internet address, since GPRS is designed to make the Internet fully available to mobile users for the first time.

Network Features

GPRS offers many new network features to mobile service operators. These include packet switching, spectrum efficiency, Internet aware, and the support of TDMA and GSM.

- Packet switching - From a network operator perspective, GPRS involves overlaying packet-based air interference on the existing circuit switched GSM network. This gives the user an option to use a packet-based data service. To supplement a circuit switched network architecture with packet switching is quite a major upgrade. The GPRS standard is delivered in a very elegant manner – with network operators needing only to add a couple of new infrastructure nodes and making a software upgrade to some existing network elements.
- Spectrum efficiency - Packet switching means that GPRS radio resources are used only when users are actually sending or receiving data. Rather than dedicating a radio channel to a mobile data user for a fixed period of time, the available radio resource can be concurrently shared between several users. This efficient use of scarce radio resources means that large number of GPRS users can potentially share the same bandwidth and be served from a single cell.

The actual number of users supported depends on the application being used and how much data is being transferred. Because of the spectrum efficiency of GPRS, there is less need to build in idle capacity that is only used in peak hours. GPRS therefore lets network operators maximize the use of their network resources in a dynamic and flexible way, along with user access to resources and revenues.

GPRS should improve the peak time capacity of a GSM network since it simultaneously:

i. Allocates scarce radio resources more efficiently by supporting virtual connectivity
ii. Migrates traffic that was previously sent using Circuit Switch Data to GPRS instead
iii. Reduces SMS Center and signaling channel loading by migrating some traffic that previously was sent using SMS to GPRS instead using the GPRS/SMS interconnect that is supported by the GPRS standards.

4.5 Specialized Mobile Radio

Specialized Mobile Radio (SMR) may be an analog or digital trunked two-way radio system, operated by a service in the VHF, 220, UHF, 700, 800 or 900 MHz bands. Some systems with advanced features are referred to as an Enhanced Specialized Mobile Radio, (ESMR). Specialized Mobile Radio is a term defined in US Federal Communications Commission (FCC) regulations. The term is of US regulatory origin but may be used in other regions to describe similar commercial systems which offer a radio communications service to businesses.

Compatibility and purpose

Any company, such as a taxi service, towing service, or construction company, may use an SMR service. These concerns may rent radios from the SMR operator or may buy compatible radios. SMR systems use differing protocols, frequency ranges, and modulation schemes: not every radio is compatible with every SMR system.

These systems generally consist of one or more repeaters used to maintain communications between a dispatch fleet of mobile or hand-held walkie talkie radios. One- to five-channel systems may be conventional two-way radio repeaters. More than five channel systems must be trunked.

Fees

The radio system is operated by a commercial service. Paying a fee allows users to utilize the radio system backbone, increasing their range. Some SMR systems offer telephone interconnect. This allows telephone calls to be made from the mobile radio or walkie talkie. Some systems may also offer selective calling, allowing customers to communicate with individual radios or segments of their entire radio fleet. Users are charged a fee for some combination of:

i. Air time (the amount of time any of the user's radio units is talking).
ii. A monthly fee covering site lease costs, engineering, maintenance, and overhead.
iii. Rental of radio units, in some cases.

Revision questions

1. Define GPRS
2. Explain how communication is initiated through GPRS technology
3. What are the requirements for a user to communicate using GPRS?
4. What are the network requirements for a GPRS system?