

NETWORK TECHNOLOGIES 2.5G (GPRS) AND 2.75G (EDGE)

Mohammad S. Hasan

2.5G, General Packet Radio Service(GPRS)

2

- Contents:
 - ▣ Why do we need it
 - ▣ Details of GPRS
 - ▣ Details of EDGE

The Need for GPRS

3

- Value Added Services
 - ▣ Operators - the use of data as a new source of revenue
 - ▣ The potential for data use is
 - To sell the users the data applications
 - To charge them for data needed to use them
 - To charge other developers to allow the applications on to the network

The Need for GPRS

4

- 3G data use
 - ▣ Although the UK operators have bought licenses to use 3G the infrastructure was not ready to be used
 - ▣ The operators paid a lot for the radio spectrum licenses
 - This left little available for infrastructure upgrades
 - Also devices were not ready to be used with 2 Mbps

<u>License</u>	<u>Company</u>	<u>Paid (Pounds)</u>
A	TIW (3)	4,384,700,000
B	Vodafone	5,964,000,000
C	MM02	4,030,100,000
D	One2One (T-Mobile)	4,003,600,000
E	Orange	4,095,000,000

GPRS Begins

5

- The GPRS standard was agreed by ETSI March 1998
- Designed to allow data communication within the existing GSM infrastructure and technology
- A few additional servers are added to the network to allow this and these will be discussed later
- This is described as being a 2.5G technology
- To use GPRS you will need a GPRS enabled device
 - ▣ Existing GSM devices will not be able to make use of the additional features



GPRS Features

6

- Theoretical Maximum of 171 Kbps without considering
 - ▣ Interference, Distance from transmitter
 - ▣ All GSM channels dedicated to GPRS communications
 - ▣ Does not take into account any error-correction
 - ▣ Does not consider a device uploading data
- Actual theoretical speed considering the factors is 53.6 Kbps Max
 - ▣ The average is usually about 30 – 40 Kbps
- Always on Data communications
 - ▣ No delay in setting up a data communication?

GPRS – Always on?

7

- To make a data call your device would phone the data centre which would make the data connection
 - ▣ This is a part of the circuit switched infrastructure
 - ▣ Have to pay for every second one is connected no matter if any data is sent or not
- Within GPRS you are always attached to the data infrastructure
 - ▣ When you first turn on your device you are authorised for GPRS communications
 - ▣ For data services you no longer have to dial a number
 - ▣ Once setup, the device can then start sending packets
 - ▣ There will be a very small delay in comparison to the GSM infrastructure

GPRS Devices

8

- There are three types of GPRS devices
 - ▣ A
 - Capable of Simultaneous data transfer and voice communications
 - ▣ B
 - Automatic switching between voice and data calls. This will need to be configured on the device itself
 - ▣ C
 - Switching between data and voice operated by the device user manually.
- All of these standards are backwards compatible with the GSM networks for voice communications

GPRS – Data in Packets

9

- Relies on the fact that Internet communications are bursty in nature
 - ▣ A large amount of data will be received and the user will process it before requesting more i.e. a web page
 - ▣ A single voice circuit from GSM will be broken into smaller parts and the GPRS data is sent on this circuit.
- All data is sent in packets
 - ▣ Data must be broken into small packets
 - ▣ These packets are re-assembled at the destination
 - ▣ Each packet has packet header overhead
 - Lower resource requirements than circuit switched communications

GPRS Channel Breakdown

10

Channel	Use of the Channel
0	Voice
1	AAAABBABBBAAAAFA
2	Voice
3	AAABAABAAAFAAAA
4	AAAFAFAFFFAFFFFB
5	BBBBBABABAFFFFFFFF
6	Voice
7	FFAFFAFFABBBBBBB

□ Example

▣ Data users

■ A = User 1

■ B = User 2

■ C = User 3

▣ 3 voice and 5 data channels

GPRS Channel Breakdown

11

- A channel which is being used for GPRS data
 - ▣ Can only be shared between other GPRS users
 - ▣ Can NOT be allocated for GSM voice in that time slot
 - Even if part of the time slot is available
 - ▣ The use of GPRS will reduce the amount of voice calls in that cell
 - ▣ With enough data calls a cell will become useless for voice callers

GPRS Multi Slot Classes

12

Class	Downlink	Uplink	Maximum Active
1	1	1	2
2	2	1	3
3	2	2	3
4	3	1	4
5	2	2	4
6	3	2	4
7	3	3	4
8	4	1	5
9	3	2	5
10	4	2	5
11	4	3	5
12	4	4	5

GPRS Coding Schemes

13

- Schemes CS-1 and CS-2 are usually used

Scheme	Max Throughput per 1 Time Slot	Error Checking
CS-1	8 Kbps	Good
CS-2	12 Kbps	Good
CS-3	14.4 Kbps	Moderate
CS-4	20 Kbps	Poor

GPRS Infrastructure

14

- Elements need changing
 - ▣ GSM Base Stations – needs a software upgrade
 - ▣ GSM Base Station controller – needs a software upgrade
- New parts need adding
 - ▣ Serving GPRS Support Node (SGSN)
 - Has VLR functionality - Authorise attached users
 - Details record of data packets to be charged for
 - Session Management
 - Router for packets which may be lost during a handover during a data call

GPRS Infrastructure

15

- Gateway GPRS Support Node (GGSN)
 - ▣ The connection into the GPRS network
 - ▣ It carries out all translations that are required
 - ▣ Firewall for the network
 - ▣ Collates data regarding the amount of packets received
 - Potentially in the future this will allow for competing GGSN's in a network! Free market choosing either the cheapest or most reliable GGSN!

Types of Gateway GPRS Support Node (GGSN)

16

- A – Near Future/Now
 - ▣ The GGSN becomes part of its own ISP and provides Internet services. The devices will be assigned IP address using DHCP.
- B – Now
 - ▣ The SSGN always selects the same GGSN to do the Internet work. The configuration will be done dynamically and on a temporary basis
- C – Future
 - ▣ This allows a private company to have its own GGSN, with an encryption key so that only authorised devices can gain access. i.e. a VPN into a network, constant email access etc.

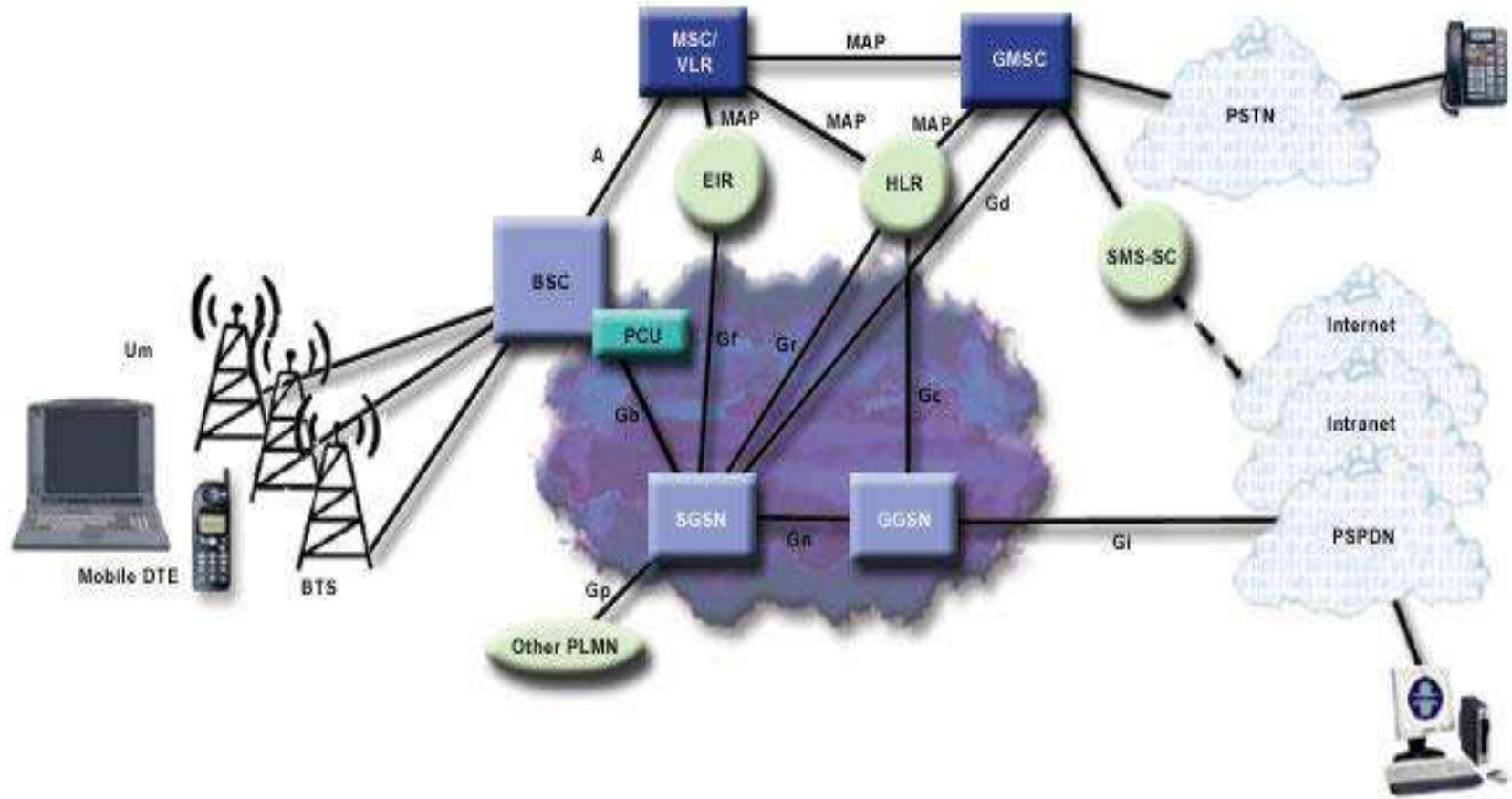
GPRS

17

- Packet Control Unit (PCU)
 - ▣ Logically part of the Base station controller
 - ▣ Responsible for the radio interface of GPRS
- GPRS and SMS
 - ▣ SMS messages are sent in GPRS as a part of the normal data channels
 - In GSM they are usually sent via the control channels
 - ▣ Why
 - This changes has taken place ready for the Multimedia Messaging service (MMS)
 - The size limits of SMS are removed with MMS

Generic GPRS infrastructure

18



GPRS Protocols

19

□ IP

▣ Internet Protocol

- Connectionless protocol, which delivers based on best effort
- Widely used in most networks

□ X.25

▣ Connection orientated communications

▣ Reliability built in with error checking the header

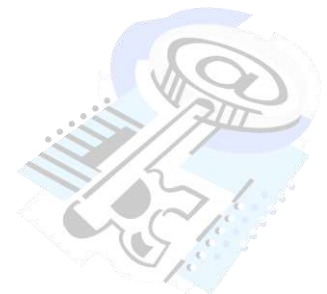
▣ Uses Virtual circuits

- Intended for terminal services
- Still used but is being replaced by other technologies

GPRS – IP Addresses

20

- Connect and disconnect will result in a new IP Address
 - ▣ Using Dynamic Host Configuration Protocol (DHCP)
 - ▣ Consider if you disconnect because a handover does not work
 - What happens to your packets, does another device get them ?
- Addresses Issues
 - ▣ Private - only available within the network
 - Network address translator (NAT) to get data from the Internet
 - ▣ Public – Available from outside of the network
 - Effectively the node is a part of the Internet
 - All of the PC security issues are still valid



GPRS Problems

21

- Initial problems existed in respect to the GPRS device
 - ▣ When launched - only a few compatible devices
 - ▣ Poor handset features and terrible battery life
 - ▣ There was nothing to use the increased data rate
 - ▣ Limited advertising of the features of GPRS
 - Potentially this was an issue around how much the advertising of the WAP services cost operators
- This is now changing
 - ▣ Vodafone published for 35% increase in data revenue in 2008
 - In the UK it is £383 Million

Enhanced Data Rate for the GSM Environment (EDGE) – Newer Tech

22

- EDGE was another step towards 3G
- Developed by Erricson (bought by Sony now)
- EDGE builds upon the infrastructure which is installed for GPRS
- QOS supported
- Improved air interface technology
- Increased throughput from the new encoding method
 - ▣ 384 Kbps (theoretical)
 - ▣ 80 – 100 Kbps (closer to reality)

EDGE – UK usage

23

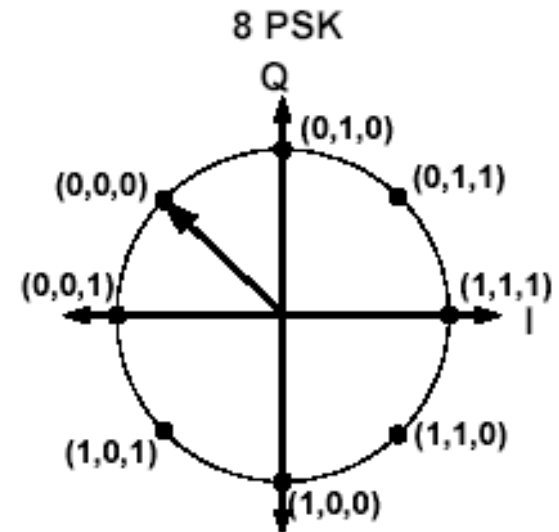
- Three operators
 - ▣ Orange, T-Mobile, O2
- These upgraded their infrastructure to EDGE to support the Apple i-phone
- Apple used EDGE as it was the relatively more available than 3G at that time
- Reduced battery requirements of EDGE
- Apple have now released the 3G, 4G version (iPhone 4, 4S, 5)



EDGE – The Changes to the Infrastructure

24

- The BS needs a new transceiver
 - ▣ To deal with the 8 Phase shifting Key (8 PSK) encoding used
 - This method will encode 3 bits in each modulation
 - This is the one of the reasons why it is 3 times faster than GPRS
 - ▣ New software on the BS
 - To deal with the new encoding method
 - ▣ The other required changes would have been carried out during the GPRS upgrades



EDGE – Quality of Service (QoS)

25

- EDGE supports the same QoS classes for UMTS
 - ▣ Conversational
 - Real-Time communications highest priority - Two way communications
 - ▣ Streaming
 - Video – audio files, time dependent - One way communication
 - ▣ Interactive
 - WWW usage, telnet etc. - Reduced request response time
 - ▣ Background
 - SMS, email, MMS - Best effort delivery
- Each communication is issued with one of these classes.
 - ▣ This will depend on the technology being used for EDGE

EDGE – QOS

26

□ Air Interface Improvements

▣ Improved Retransmission procedures

- Lower modulation quality techniques can be used
- Packets can then be resent at the new level
- Addressing of frames has been increased to 2048 from the 128 of GPRS

▣ Improved Forward error checking

▣ Continuous measurements for correct sending rate

- The coding technique can then be changed to the appropriate rate

EDGE – 3G?

27

- The International Telecommunication Union (ITU) made some definitions for 3G
 - ▣ A minimum speed of 384 Kbps to be classed as 3G
- EDGE does meet this requirement and as such can be considered as a 3G technology
 - ▣ Others describe it as a 2.5G or 2.75G technology!

EDGE – Roll out stages

28

- Phase 1
 - ▣ Introduce single and multi-slot packet switched services
 - ▣ Introduce single and Multi-slot circuit switched services
- Phase 2
 - ▣ Web Use
 - ▣ Email
 - ▣ Real-time services
 - VOIP
 - Video Conferencing

GPRS and EDGE Summary

29

- Key Points of lecture
 - ▣ GPRS increases the data rate of GSM
 - 20-40 Kbps
 - ▣ Uses current GSM infrastructure, with small changes
 - Additional servers
 - ▣ How GPRS operates
 - Dividing the time slots between multiple users
 - ▣ EDGE Technology
 - What is it
 - What is needed
 - ▣ Issue of IP packets in a network
 - Changing IP Addresses