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Significant Approach for GPRS and Its Applications

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ABSTRACT

The General Packet Radio System (GPRS) is a new service that provides actual packet radio access for mobile Global System for Mobile Communications (GSM) and time-division multiple access (TDMA) users. The main benefits of GPRS are that it reserves radio resources only when there is data to send and it reduces reliance on traditional circuit-switched network elements
Keywords: GPRS, VAS, TDMA, ISP, PCU, GTP

I. INTRODUCTION

GPRS will allow improved quality of data services as measured in terms of reliability, response time, and features supported. The unique applications that will be developed with GPRS will appeal to a broad base of mobile subscribers and allow operators to differentiate their services. One method GPRS uses to alleviate the capacity impacts is sharing the same radio resource among all mobile stations in a cell, providing effective use of the scarce resources. In addition, new core network elements will be deployed to support the high burstiness of data services more efficiently. In addition to providing new services for today's mobile user, GPRS is important as a migration step toward third-generation (3G) networks. GPRS will allow network operators to implement IP-based core architecture for data applications, which will continue to be used and expanded upon for 3G services for integrated voice and data applications. GPRS will prove a testing and development area for new services and applications, which will also be used in the development of 3G services.

II. METHODS AND MATERIAL

2. GPRS Applications

GPRS will enable a variety of new and unique services to the mobile wireless subscriber. These mobile applications contain several unique characteristics that enhance the value to the customers. First among them is mobility - the ability to maintain constant voice and data communications while on the move. Second is immediacy, which allows subscribers to obtain connectivity when needed, regardless of location and without a lengthy login session. Finally, localization allows subscribers to obtain information relevant to their current location In general, applications can be separated into two high-level categories: corporate and consumer.
These include:

- Communications - E-mail; fax; unified messaging; intranet/Internet access
- Value-added services (VAS) - Information services; games
- E-commerce - Retail; ticket purchasing; banking; financial trading
- Location-based applications - Navigation; traffic conditions; airline/rail schedules; location finder
- Vertical applications - Freight delivery; fleet management; sales-force automation
- Advertising

2.1 Communications

Communications applications include all those in which it appears to the users that they are using the mobile communications network purely as a pipe to access messages or information. This differs from those applications in which users believe that they
are accessing a service provided or forwarded by the network operator.

2.1.1 Intranet Access

The first stage of enabling users to maintain contact with their office is through access to e-mail, fax, and voice mail using unified messaging systems. Increasingly, files and data on corporate networks are becoming accessible through corporate intranets that can be protected through firewalls, by enabling secure tunnels (virtual private networks [VPNs]).

2.1.2 Internet Access

As a critical mass of users is approached, more and more applications aimed at general consumers are being placed on the Internet. The Internet is becoming an invaluable tool for accessing corporate data as well as for the provision of product and service information. More recently, companies have begun using the Internet as an environment for carrying out business, through e-commerce.

2.1.3 E-Mail and Fax

E-mail on mobile networks may take one of two forms. It is possible for e-mail to be sent to a mobile user directly, or users can have an e-mail account maintained by their network operator or their Internet service provider (ISP). In the latter case, a notification will be forwarded to their mobile terminal; the notification will include the first few lines of the e-mail as well as details of the sender, the date/time, and the subject. Fax attachments can also accompany e-mails.

2.1.4 Unified Messaging

Unified messaging uses a single mailbox for all messages, including voice mail, faxes, e-mail, short message service (SMS), and pager messages. With the various mailboxes in one place, unified messaging systems then allow for a variety of access methods to recover messages of different types. Some will use text-to-voice systems to read e-mail and, less commonly, faxes over a normal phone line, while most will allow the interrogation of the contents of the various mailboxes through data access, such as the Internet.

2.2 Value-Added Services

Value-added services refer strictly to content provided by network operators to increase the value of their service to their subscribers.
Two terms that are frequently used with respect to the delivery of data applications are push and pull, as defined below.
• **Push** refers to the transmission of data at a predetermined time, or under predetermined conditions. It could also apply to theunsolicited supply of advertising
• **Pull** refers to the demanding of data in real time by the user

To be valuable to subscribers, this content must possess several characteristics:

- Personalized information is tailored to user-specific needs with relevant information. A stock ticker, focusing on key quotes and news, or an e-commerce application that knows a user's profile are two examples of personalized information.
- Localized content is based on a user's current location; it can include maps, hotel finders, or restaurant reviews.
- Convenience suggests that the user interface and menu screens are intuitive and easy to navigate.
- Trust pertains primarily to e-commerce sites where the exchange of financial or other personal information is required.

2.2.1 E-Commerce

E-commerce is defined as the carrying out of business on the Internet or data service. This would include only those applications where a contract is established over the data connection, such as for the purchase of goods, or services, as well as online banking applications because of the similar requirements of user authentication and secure transmission of sensitive data.

2.2.2 Banking

The popularity among banks of encouraging electronic banking comes from the comparable costs of making transactions in person in a bank to making them electronically. Specific banking functions that can be accomplished over a wireless connection include: balance checking, moving money between accounts, bill payment, and overdraft alert.

2.2.3 Financial Trading

The immediacy with which transactions can be made using the Internet and the requirement for up-to-the-minute information has made the purchasing of stocks a popular application. By providing push services such as those detailed in the VAS section earlier and coupling these with the ability to make secure transactions from the mobile terminal, a very valuable service unique to the mobile environment can be provided.

2.3 Location-Based Services and Telematics

Location-based services provide the ability to link push or pull information services with a user's location. Examples include hotel and restaurant finders, roadside assistance, and city-specific news and information. This technology also has vertical applications such as workforce management and vehicle tracking.

2.4 Vertical Applications

In the mobile environment, vertical applications apply to systems utilizing mobile architectures to support the carrying out of specific tasks within the value chain of a company, as opposed to applications that are then being offered for sale to a consumer.
Examples of vertical applications include:

- Sales support-Provision of stock and product information for sales staff, as well as integration of their use of appointment details
- and the remote placing of orders
- Dispatching-Communication of job details such as location and scheduling; permitting interrogation of information to support the job
- Fleet management-Control of a fleet of delivery or service staff, monitoring their locations and scheduling work
- Parcel delivery-Tracking the locations of packages for feedback to customers and performance monitoring

2.5 Advertising

Advertising services will be offered as a push type information service. Advertising may be offered to customers to subsidize the cost of voice or other information services. Finally, advertising may be location sensitive where, for example, a user entering a mall would receive advertising specific to the stores in that mall.

GPRS (General Packet Radio Service) is a packet based communication service for mobile devices that allows data to be sent and received across a mobile telephone network. GPRS is a step towards 3G and is often referred to as 2.5G. Here are some key benefits of GPRS:

Speed

GPRS is packet switched. Higher connection speeds are attainable at around 56-118 kbps, a vast improvement on circuit switched networks of 9.6 kbps. By combining standard GSM time slots theoretical speeds of 171.2 kbps are attainable. However in the very short term, speeds of 20-50 kbps are more realistic.

Always on connectivity

GPRS is an always-on service. There is no need to dial up like you have to on a home PC for instance. This feature is not unique to GPRS but is an important standard that will no doubt be a key feature for migration to 3G. It makes services instantaneously available to a device.

New and Better applications

Due to its high-speed connection and always-on connectivity GPRS enables full Internet applications and services such as video conferencing straight to your desktop or mobile device. Users are able to explore the Internet or their own corporate networks more efficiently than they could when using GSM. **GSM**

Operator Costs

GSM network providers do not have to start from scratch to deploy GPRS. GPRS is an upgrade to the existing network that sits alongside the GSM network. This makes it easier to deploy, there is little or no downtime of the existing GSM network implementation takes place, most updates are software so they can be administered remotely and it allows GSM providers to add value to their business at relatively small costs.

2.5 Simple GPRS Technical Overview

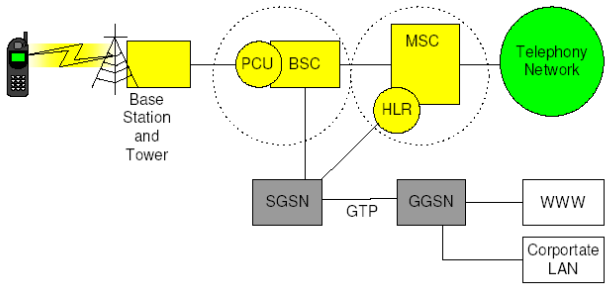

Figure 1: GPRS-System

There are however two new functional elements which play a major role in how GPRS works. The Serving GPRS Support Node (SGSN) and the Gateway GPRS support node (GGSN). These 2 nodes are new to the network with the other changes being small if any. Before explaining what these 2 new members of our network do it is important to ask how does the network differentiate between GSM (circuit) and GPRS (packet)? In simple terms there are in practice two different networks working in parallel, GSM and GPRS. In any GSM network there will be several BSC's (Base Station Controllers). When implementing GPRS software and hardware upgrade of this unit is required. The hardware upgrade consists of adding a Packet Control Unit (PCU). This extra piece of hardware differentiates data destined for the standard GSM network or Circuit Switched Data and data destined for the GPRS network or Packet Switched Data.

2.5.1 SGSN

The Serving GPRS Support Node, or SGSN for short, takes care of some important tasks, including routing, handover and IP address assignment.The SGSN has a logical connection to the GPRS device. As an example, if you were in a car travelling up the M1 on a long journey and were browsing the Internet on a GPRS device, you will pass through many different cells. One job of the SGSN is to make sure the connection is not interrupted as you make your journey passing from cell to cell. The SGSN works out which BSC to "route" your connection through. If the user moves into a segment of the network that is managed by a different SGSN it will perform a handoff of to the new SGSN, this is done extremely quickly and generally the user will not notice this has happened. Any packets that are lost during this process are retransmitted. The SGSN converts mobile data into IP and is connected to the GGSN via a tunnelling protocol.

2.5.2 GGSN

The Gateway GPRS Support Node is the "last port of call" in the GPRS network before a connection between an ISP or corporate network's router occurs. The GGSN is basically a gateway, router and firewall rolled into one. It also confirms user details with RADIUS servers for security, which are usually situated in the IP network and outside of the GPRS network.

2.5.3 Connectivity between the SGSN & GGSN

The connection between the two GPRS Support Nodes is made with a protocol called GPRS Tunnelling Protocol (GTP). GTP sits on top of TCP/IP and is also responsible for the collection of mediation and billing information. GPRS is billed on per megabyte basis unlike GSM. In practice the two GSN devices may be a single unit.

2.5.4 HLR

The HLR or Home Location Register is a database that contains subscriber information, when a device connects to the network their MSISDN number is associated with services, account status information, preferences and sometimes IP addresses.

3 IP addressing

3.1 Allocating Addresses

Here are 3 different ways in which a device can be assigned an IP address.

Fixed IP Addressing:
Fixed IP addresses for mobile devices are not widely used due to shortages of Ipv4 addresses (see below). This information is stored in the HLR.

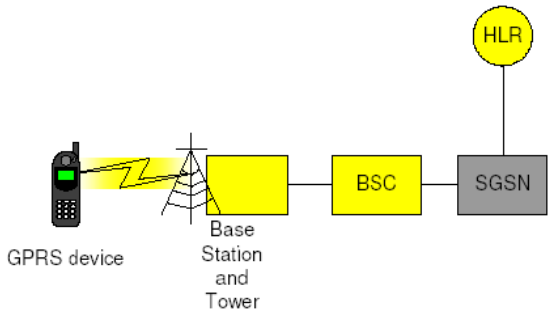

Figure 2: HLR - GPRS - System

Dynamic IP Addressing:
The second means of addressing is dynamic addressing. This is where a mobile device does not have its own IP address stored in the HLR. Instead the IP address is assigned to the GGSN domain.

The third method is also a type of dynamic IP addressing in which the IP address is assigned by RADIUS servers normally situated inside an IP network outside the mobile network, an example of this being when you dial up to an ISP from your home PC.

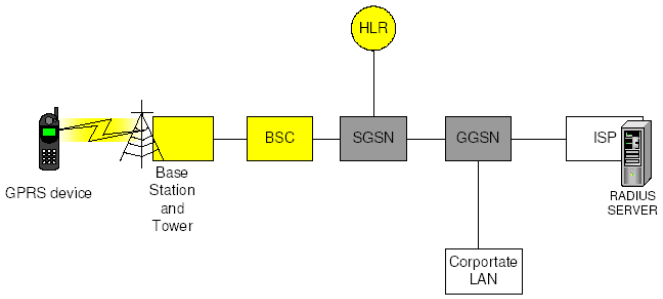

Figure 3: Dynamic IP Addressing

3.2 How Does the SGSN know which GGSN to direct you to?

A mobile device is programmed with one or more Access Point Names which are commonly referred to as the APN's. An APN consists of a fully qualified DNS name e.g. morgandoyle.co.uk. When a GPRS device wants to talk to morgandoyle.co.uk's network, the SGSN does a DNS lookup and resolves the name to the correct GGSN.You could have multiple APN's programmed into your phone so you are not limited to a single service or GGSN.

3.3 IP Version 6

This new version of IP corrects unanticipated Ipv4 design issues that have come about because of the popularity of the Internet. In short we are running out of addresses. IP version 4 is a 32-bit address that allows a maximum of around 4 billion IP addresses. It is estimated that by 2005 all the addresses in IP 4 will run out. Some say this will happen sooner - introduce millions of handheld devices all requiring IP addresses and suddenly there are none left. To truly enable the Internet to such devices there has to be more addresses. This is where IP version 6 comes in. Instead of a 32-bit address, IP6 is 128 bit with a maximum number of: 340,232,366,920,938,463,463,374,607,431,768,211,456 possible IP addresses. This amount of address space is ample for future foreseeable growth. At the moment there are around 1 billion addresses left for IP v 4 but many manufacturers of mobile devices especially in Asia are involving themselves heavily in IP v 6.

4. GPRS Handset Classes

GPRS devices are not as straightforward as you may think. There are in fact 3 different classes of device.

4.1 Class A

Class A terminals have 2 transceivers which allow them to send / receive data and voice at the same time. This class of device takes full advantage of GPRS and GSM. You can be taking a call and receiving data all at the same time.

4.2 Class B

Class B devices can send / receive data or voice but not both at the same time. Generally if you are using GPRS and you receive a voice call you will get an option to answer the call or carry on.

4.3 Class C

This device only allows one means of connectivity. An example would be a GPRS PCMCIA card in a laptop.

5. GPRS QoS

Just because GPRS uses many of the components of a standard GSM network it would be foolhardy to assume that the same standards should apply. Things to be taken into account include provider general network architecture, radio interface and throughput. Here are some of the key elements briefly explained.

5.1 Network Architecture

Provider networks have to be upgraded. As mentioned earlier the GSN's are new to the standard GSM network. If GPRS is to stand-up to customer expectations network performance will be vital.

5.2 Radio Interface

The ETSI (European Telecommunications Standard Institute) has defined 3 new coding schemes for Radio Interface. When the GPRS device talks to the base station they can use 1 of the 4 schemes. The schemes are CS - 1 through CS - 3 where CS - 1 is the same as standard GSM. In simple terms CS - 1 is highly redundant but because of this is slow, 2 and 3 have less redundancy, whilst 4 has the least - removing all forward error control - but is capable of maximum throughput. If radio quality is bad then coding scheme 1 is used, as the quality improves less error control is needed.

5.3 Classes of GPRS services

Mobile devices can request different types of traffic to be prioritised in an attempt to give the user their desired level of connectivity. There are 4 types of class:

Precedence Class

An application can be assigned a Precedence Class 1, 2 or 3. If an application has a higher precedence (1) than another (3) then its traffic will be given a higher priority.

Delay Class

Applications can request predictive delay classes which guarantee an average and 95- percentile delay. There are 4 classes, 1 being the fastest.

Reliability class

Applications can request differing levels of reliability for its data depending on its tolerance to data loss.

Throughput Class

Applications can choose different profiles for throughput. There are 2 distinctions in class, peak and mean. Peak throughput class is used mainly for bursty transmissions with a variable in octets per second describing the throughput required for burst of specified size. Mean is the average data transfer rate over a period of time measured in octets per hour.

Other factors can affect QoS. Things like Radio quality, basic LAN / WAN and Internet congestion, faults on GSM and GPRS network' etc.

III. RESULTS AND DISCUSSION

Problems with GPRS

Although GPRS has many benefits there have been a few problems. Connection speeds until the end of last year performed badly on some networks running at around 12Kbps, a far cry from the expected. This year however there do not seem to be as many problems, probably due to the fact that operators are improving due to trial and error. GPRS is after all a pretty new technology. Another problem sometimes encountered is customer expectation. Many companies have applications running on a 10 megabyte LAN and expect the same performance from their GPRS devices. Although the connection speeds these days are pretty good it still is not as fast as ISDN or Local Area Networks. .Earlier problems with things like mail servers not sending mail because of latency problems to GPRS devices have all been pretty much eradicated through optimisation programs. People running Citrix Thin Client has also encountered problems with latency although a few Thin Client forums suggest that Citrix are addressing the issue. Deployment on some networks has been slow. There still is a major UK network provider who does not offer the service.

GPRS roaming has not been implemented in many countries on a lot of networks as yet. This is where a user can use the GPRS service from any network

operator. At the moment although your GSM mobile will work, GPRS may not work at all. Accesses by third party application providers are having a lot of difficulty obtaining an APN from providers to offer their own GPRS services. This somewhat limits services to that provided by the GPRS operator.

IV. CONCLUSION

GPRS enables GSM operators to offer efficient mobile access to external packet switched networks, such as the Internet and corporate intranets. Several users can share the same network resources at the same time and enjoy transfer rates of up to 115 kbit/s. To support GPRS, two new nodes - the SGSN and the GGSN - must be added to the GSM network. Ericsson has developed a complete family of products for GPRS

- The SGSN and GGSN are based on the AXB 250, a new packet-switching platform;
- Apart from the BSC, existing nodes in the network solely require a software upgrade to support GPRS. The BSC requires new software and hardware.

GPRS promises to benefit mobile data users greatly by providing always on higher bandwidth connections than are widely available today. In order to be successful, data connections must be secure and be available anytime and from anywhere. The lack of security inherent in GTP, the protocol used between roaming partners, represents a significant threat. The security of the roaming network is only as good as that of the weakest operator. Implementing IPSec between roaming partners, traffic rate limiting, and GTP stateful inspection can mitigate a significant number of threats on the roaming network. Stateful packet inspection, traffic rate limiting, and logical separation of traffic for each corporate network and the public network can significantly reduce the threat between the operator's network, subscribers, and these networks.

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