# An Application of Services in GPRS technology

**by**
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# Abstract

The thesis has the point of departure in the GPRS characteristics by investigating which are the best techniques for location in emergency situations for the families and by improving our knowledge about the convergence between Mobile Internet and mobile phones.

I describe how the GPRS services can be used by family members in the Interliving project context. The aim of the Interliving project is to study and develop, together with families, technologies that facilitate communication between generations of family members.

The questions this report tries to answer are the following questions:

- Which are the characteristics of GPRS?
- Which are the different methods we can use for location?
- Which is the best way to get the location for individuals?
- The convergence between GPRS and Mobile Internet will bring some advantages. Which are those for families?

This report concludes that a Service Data Point database (SDP) can give a good solution for locating family members. And, further, the development of a business plan for a portal about health considered as an important application in the part of contents of the Mobile Internet. Everything will be reachable thanks to the GPRS technology.

# Acknowledgment

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# Contents

# Chapter 1

# Introduction

The General Packet Radio System (GPRS) is a 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. The increased functionality of GPRS will decrease the incremental cost to provide data services, an occurrence that will, in turn, increase the penetration of data services among consumers and business users. In addition, GPRS will allow improved quality of data services as measured in terms of reliability, response time, and features supported. In addition to providing new services for today's mobile user, GPRS is important as a migration step toward third-generation (3G) networks [20].

GPRS appeared in Interliving (project which aim is to develop, together with families, technologies that facilitate the communication between family members) as an alternative to the broadband due to many families have not many facilities to access to Internet at home. The knowledge and information that Interliving has about the families is also very helpful for the study of the Mobility Management. Some of the families of Interliving live in the countryside outside Stockholm, up to 50 kilometres from the town centre (and their work places).

## 1.1 A Statement of the Investigation

GPRS will enable a variety of new and unique services to the mobile wireless subscriber. Knowing which of these services can be useful for families is part of this research. These are the questions to answer:

- Which are the characteristics of GPRS?

- Which are the different methods we can use for location?

- Which is the best way to get the location for individuals?

- The convergence between GPRS and Mobile Internet will bring some advantages. Which are those for families?

## 1.2 CID

CID is one of the competence centres located at KTH. The centre was founded in 1995 and has its own locality adapted to the activities, including proper laboratories, technical installations and areas for visiting researchers. It is in close connection to IPLab, Interaction and Presentation Laboratory, at NADA, Numerical Analysis and Computer Science. [3]

CID has established an exciting research programme in the field of user-oriented IT design. It conducts research that focuses on ways to improve the interaction between people and computers. It also conducts leading research, at both the national and the international level. Its activities are based on a long tradition of research within the field of human-computer interaction at NADA, Royal Institute of Technology (KTH).

Its aim is also to develop and continue the study in work environment, working skills, and development of demonstrators and prototypes of usable IT products. CID is also involved in projects (funded by the EU) concerning "mixed reality" and communication between generations. One of these EU projects is called Interliving.

## 1.3 Interliving

The Interliving project [13, 14] aims to study and develop, together with families, technologies that facilitate the communication between generations of family members with the objectives:

- To understand the needs of diverse families.
- To develop innovative artefacts to support the needs of co-located and distributed families.
- To understand the impact such technologies can have on families.

Interliving wants to offer an alternative to today's technology-push and work-centred development of new computer artefacts. Rather than emphasising productivity, Interliving is about connections among human beings. Interliving technologies try to be less obtrusive than other technologies and merge seamlessly into daily life.

Interliving expects the approach of working with families, as design partners, will provide a unique opportunity to explore and reinterpret new technologies in the context of their use. Interliving is especially interested in emergent innovations and will encourage family members to reflect on their use-in-context throughout the co-design phase of the project.

The families of Interliving will be used in my project as a concrete example. I focus on use of GPRS for emergency situations. The families will need an urgent service when, for example, the oldest member has a heart attack or they have a car accident. But why have I chosen Interliving project? Because the Interliving project has the specific information about three families and this is very useful for my report. Thanks to the project, we have information about where the family members live, where they work, how many members live in each house, etc. A useful characteristic is that they live in a limited and known region, which facilitates the investigation about location services.

# Chapter 2

# Introduction to GPRS

The General Packet Radio Service (GPRS) is a new bearer service for GSM that improves and simplifies wireless access to packet data networks, e.g., to the Internet. It applies a packet radio principle to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. Packets can be directly routed from the GPRS mobile stations to packet switched networks. Networks based on the Internet Protocol (IP) (e.g., the global Internet or private/corporate intranets) and X.25 networks are supported in the current version of GPRS [7, 8, 9].

Users of GPRS benefit from shorter access times and higher data rates than they have now. In conventional GSM, the connection set-up takes several seconds and rates for data transmission are restricted to 9.6 kbit/s. GPRS in practice offers session establishment times below one second and ISDN-like data rates up to several tens kbit/s [20].

In addition, GPRS packet transmission offers a more user-friendly billing than that offered by circuit switched services. In circuit switched services, billing is based on the duration of the connection. This is unsuitable for applications with bursty traffic. The user must pay for the entire airtime, even for idle periods when no packets are sent (e.g., when the user reads a Web page). In contrast to this, with packet switched services, billing can be based on the amount of transmitted data. The advantage for the user is that he or she can be “online” over a long period of time but will be billed based on the transmitted data volume.

To sum up, GPRS improves the utilization of the radio resources, offers volume-based billing, higher transfer rates, shorter access times, and simplifies the access to packet data networks.

GPRS has been standardized by ETSI (the European Telecommunications Standards Institute) during the last five years. It finds great interest among many GSM network providers [6].

## 2.1 System Architecture

In order to integrate GPRS into the existing GSM architecture, a new class of network nodes, called GPRS support nodes (GSN), has been introduced. GSNs are responsible for the delivery and routing of data packets between the mobile stations and the external packet data networks (PDN) [9].

A serving GPRS support node (SGSN) is responsible for the delivery of data packets from and to the mobile stations within its service area. Its tasks include packet routing and transfer, mobility management (attach/detach and location management), logical link management, and authentication and charging functions. The location register of the SGSN stores location information and user profiles used in the packet data network of all GPRS users registered with this SGSN.

A gateway GPRS support node (GGSN) acts as an interface between the GPRS backbone network and the external packet data networks. It converts the GPRS packets coming from the SGSN into the appropriate packet data protocol (PDP) format (e.g., IP or X.25) and sends them out on the corresponding packet data network. In the other direction, PDP addresses of incoming data packets are converted to the GSM address of the destination user. The readdressed packets are sent to the responsible SGSN. For this purpose, the GGSN stores the current SGSN address of the user and his or her profile in its location register. The GGSN also performs authentication and billing functions.

In general, there is a many-to-many relationship between the SGSNs and the GGSNs: A GGSN is the interface to external packet data networks for several SGSNs; an SGSN may route its packets over different GGSNs to reach different packet data networks. The Gb interface connects the BSC with the SGSN. Via the Gn and the Gp interfaces, user data and signalling data are transmitted between the GSNs. The Gn interface will be used if SGSN and GGSN are located in the same public land mobile network (PLMN), whereas the Gp interface will be used if they are in different PLMNs.

All GSNs are connected via an IP-based GPRS backbone network. Within this backbone, the GSNs encapsulate the PDN packets and transmit (tunnel) them using the GPRS Tunnelling Protocol GTP. There are two kinds of GPRS backbones:

- Intra-PLMN backbone networks connect GSNs of the same PLMN and are therefore private IP-based networks of the GPRS network provider.
- Inter-PLMN backbone networks connect GSNs of different PLMNs. A roaming agreement between two GPRS network providers is necessary to install such a backbone.

## 2.2 Services

### 2.2.1 Bearer Services and Supplementary Services

The bearer services of GPRS offer end-to-end packet switched data transfer. There are two different kinds: The point-to-point (PTP) service and the point-to-multipoint (PTM) service. The latter will be available in future releases of GPRS. The PTP service offers transfer of data packets between two users. It is offered in both connectionless mode (PTP connectionless network service) and connection-oriented mode (PTP connection-oriented network service) [6, 20].

The PTM service offers transfer of data packets from one user to multiple users.

There exist two kinds of PTM services:

- Using the multicast service PTM-M, data packets are broadcast in a certain geographical area. A group identifier indicates whether the packets are intended for all users or for a group of users.
- Using the group call service PTM-G, data packets are addressed to a group of users (PTM group) and are sent out in geographical areas where the group members are currently located.

It is also possible to send SMS messages over GPRS. In addition, it is planned to implement supplementary services, such as call forwarding unconditional (CFU), call forwarding on a mobile subscriber not reachable (CFNRc), and closed user group (CUG) [9].

Moreover, a GPRS service provider may offer additional non-standardized services, such as access to databases, messaging services, and tele-action services (e.g., credit card validations, lottery transactions, and electronic monitoring and surveillance systems).

### 2.2.2 Quality of Service

The Quality of Service QoS requirements of typical mobile packet data applications are very diverse (e.g., consider real-time multimedia, Web browsing, and e-mail transfer). Support of different QoS classes, which can be specified for each individual session, is therefore an important feature. GPRS allows defining QoS profiles using the parameters service precedence, reliability, delay, and throughput.

- The service precedence is the priority of a service in relation to another service. There exist three levels of priority: high, normal, and low.
- The reliability indicates the transmission characteristics required by an application. Three reliability classes are defined, which guarantee certain maximum values for the probability of loss, duplication, mis-sequencing, and corruption (an undetected error) of packets.
- The delay parameters define maximum values for the mean delay and the 95-percentile delay. The latter is the maximum delay guaranteed in 95 percent of all transfers. The delay is defined as the end-to-end transfer time between two communicating mobile stations or between a mobile station and the Gb interface to an external packet data network. This includes all delays within the GPRS network, e.g., the delay for request and assignment of radio resources and the transit delay in the GPRS backbone network. Transfer delays outside the GPRS network, e.g., in external transit networks, are not taken into account.
- The throughput specifies the maximum/peak bit rate and the mean bit rate.

Using these QoS classes, QoS profiles can be negotiated between the mobile user and the network for each session, depending on the QoS demand and the current available resources. The billing of the service is then based on the transmitted data volume, the type of service, and the chosen QoS profile.

## 2.3 Different Classes of GPRS

There are three main classes of GPRS: A, B and C. Class A offers a data connection at the same time as the phone is used for a regular call [7]. Class B, on the other hand, offers only one of these connections at a time. Class C only offers a data connection. The transfer speed is divided into 18 subclasses, varying from 14.4 kbps in either direction for class 1 to 115.2 kbps for class 18. Class B 8, for example, has a transfer rate of 57.6 kbps to the phone and 14.4 kbps from the phone. Although theoretically GPRS could allow transfers at up to 171.2 kbps using all burst periods in each time of frame, in practice transfer speeds do not reach higher than 20 kbps depending on difficulties in the implementation, the traffic on the net, and other bottlenecks.

## 2.4 Mobility Management

### 2.4.1 Routing

We assume that the packet data network is an IP network. A GPRS mobile station located in PLMN1 (Public Land Mobile Network) sends IP packets to a host connected to the IP network, e.g., to a Web server connected to the Internet. The SGSN that the mobile station is registered with encapsulates the IP packets coming from the mobile station, examines the PDP context, and routes them through the intra-PLMN GPRS backbone to the appropriate GGSN. The GGSN does the opposite action to encapsulate the packets and sends them out on the IP network, where IP

routing mechanisms are used to transfer the packets to the access router of the destination network. The latter delivers the IP packets to the host. [18]

Now we assume the home-PLMN of the mobile station is PLMN2. An IP address has been assigned to the mobile by the GGSN of PLMN2. Thus, the Mobile Station's (MS) IP address has the same network prefix as the IP address of the GGSN in PLMN2. The host is now sending IP packets to the MS. The packets are sent out onto the IP network and are routed to the GGSN of PLMN2 (the home-GGSN of the MS). The latter queries the HLR (Home Location Register) and obtains the information that the MS is currently located in PLMN1. It encapsulates the incoming IP packets and tunnels them through the inter-PLMN GPRS backbone to the appropriate SGSN in PLMN1. The SGSN takes the packets and delivers them to the MS.

### 2.4.2 Location Management

The main task of location management is to keep track of the user's current location, so that incoming packets can be routed to his or her MS. For this purpose, the MS frequently sends location update messages to its current SGSN. If the MS sends updates rather seldom, its location (e.g., its current cell) is not known exactly and paging is necessary for each downlink packet, resulting in a significant delivery delay. On the other hand, if location updates happen very often, the MS's location is well known to the network, and the data packets can be delivered without any additional paging delay. However, quite a lot of uplink radio capacity and battery power is consumed for mobility management in this case. Thus, a good location management strategy must be a compromise between these two extreme methods [18, 25].

A MS can be in one of three states depending on its current traffic amount; the location update frequency is dependent on the state of the MS. In IDLE state the MS is not reachable. Performing a GPRS attach, the MS gets into READY state. With a GPRS detach it may disconnect from the network and fall back to IDLE state. All Packet Data Protocol (PDP) contexts will be deleted. The STANDBY state will be reached when an MS does not send any packets for a longer period of time, and therefore the READY timer (which was started at GPRS attach) expires.

In IDLE state, no location updating is performed, i.e., the current location of the MS is unknown to the network. An MS in READY state informs its SGSN of every movement to a new cell. For the location management of an MS in STANDBY state, a GSM location area (LA) is divided into several routing areas (RA). In general, an RA consists of several cells. The SGSN will only be informed when an MS moves to a new RA; cell changes will not be disclosed. To find out the current cell of an MS in STANDBY state, paging of the MS within a certain RA must be performed. For MS in READY state, no paging is necessary.

Whenever an MS moves to a new RA, it sends a “routing area update request” to its assigned SGSN. The message contains the routing area identity (RAI) of its old RA. The base station subsystem (BSS) adds the cell identifier (CI) of the new cell, from which the SGSN can derive the new RAI. Two different scenarios are possible:

- Intra-SGSN routing area update: The MS has moved to an RA that is assigned to the same SGSN as the old RA. In this case, the SGSN has already stored the necessary user profile and can assign a new packet temporary mobile subscriber identity (P-TMSI) to the user ("routing area update accept"). Since the routing context does not change, there is no need to inform other network elements, such as GGSN or HLR.
- Inter-SGSN routing area update: The new RA is administered by a different SGSN than the old RA. The new SGSN realizes that the MS has changed to its area and requests the old SGSN to send the PDP contexts of the user. Afterward, the new SGSN informs the involved GGSN about the user's new routing context. In addition, the HLR and (if needed) the MSC/VLR are informed about the user's new SGSN.

There also exist combined RA/LA updates. These occur when an MS using GPRS as well as conventional GSM moves to a new LA. The MS sends a "routing area update request" to the SGSN. The parameter "update type" is used to indicate that an LA update is needed. The message is then forwarded to the VLR, which performs the LA update.

To sum up, GPRS mobility management consists of two levels: Micro mobility management tracks the current routing area or cell of the mobile station. It is performed by the SGSN. Macro mobility management keeps track of the mobile station's current SGSN and stores it in the HLR, VLR, and GGSN.

# Chapter 3

# Architectures and Protocols for Value-Added services

The protocols and architectures over which we will be able to get value-added services are:

- Intelligent Network.
- Customized Applications for Mobile Network Enhanced Logic.
- Mobile IP.

## 3.1 Intelligent Network

The intelligent network architecture was born fifteen years ago. The main idea of this architecture is to separate the control of services from the function of commutation, for building a new architecture of services easier for managing and more efficient in the creation of new services [12].

This architecture has basically two different levels:

- The control level, which contains the elements and the intelligence that allow the access and the service of the value-added services.
- The commutation level, which makes the tasks related with the establishment of calls between users.

The elements of this architecture are:

- Service Data Point (SDP): Is the data point of the service, which contains the needed information to service the value-added services implemented in the SCP.
- Service Control Point (SCP): Contains the algorithms that implement the value-added services and allow to control the routing and connection of the calls.
- Service Switching Point (SSP): Realizes the functions of routing and connection to the users, under the control of the SCP.

- Intelligent Peripheral: Gives the facilities to speak with the users, as recognition of the digits, voice and conversion text-voice.

## 3.2 Camel Architecture

When the Intelligence Network standards appeared, it could be seen that they could be useful for mobile networks, although what happened was that Intelligence Network could be used trivially to the mobile networks by the roaming effect [4].

Roaming makes that a user can be connected to a different network than the one with which it has the subscription and where it is possible to find all the subscriber's information. In other words, roaming requires an interaction between MSC (Mobile Service Switching Centre) in the "visited network", and the SCP (Service control Point) in the "home network".

To solve the problems that roaming gives rise to, the Customized Applications for Mobile network Enhanced Logic (CAMEL) architecture was defined. This architecture describes a similar architecture to Intelligence Network, but applied to mobile networks.

These are some of the new elements that appear in CAMEL:

- MSC and GMSC (Mobile Service Switching Centre and Gateway MSC). They make the routing and connection between users for voice services.
- SGSN (Serving GPRS Support Node). It is the element that realizes the user register in GPRS and participates in the creation of some different channels with the networks where the user wants to access.
- HLR (Home Location Register) is the database that contains user's data.
- SMSC (Short Message Service Centre). It allows the realization of the value-added services based in the analysis and control of short messages.

## 3.3 Mobile IP

One of the main problems has been the convergence between mobile networks and data services. It is one of the principal tasks that interest us in this thesis. Mobile IP was created to allow the mobile node the possibility to use two different IPO addresses: one address fixed to its network (home address) and the other one that depends of the connection point (care-of address) [17].

A new node is defined, the Home Agent (HA). Its function consists of taking the packets and leaving them in the mobile node. In every moment, the node in movement, visiting a network that is not its correspondent, indicates to its HA its new care-of address that means that it will be registered in this new HA. When a new packet arrives to HA, it makes a redirection modifying the composition of the packet and now the new address will be the care-of address in which one the mobile node is registered. This is called tunnelling IP.

It is also defined the Foreign Agent (FA). All the packets are routed to the mobile nodes going through this FA. So now we can resume the process: First, the discovery of the care-of address with which the mobile node gets its care-of address. Second, the register of the care-of address, very important because the HA must know it. And finally, when the HA has accepted the petition of the register, it will associate the network address of the mobile node with the care-of address.

# Chapter 4

# Wireless Location System

Though wireless users are mobile by nature, knowledge of their dynamic location is very useful information as, for example, in emergency situations where it is essential to know a wireless user's location for effective emergency management. It is also important to mention that this information of location we get can become into a problem of lost our personal integrity. On the other hand if the technology to accurately determine the location is available, location specific content (e.g. dosest airport, closest restaurant, closest hotels etc.) can be delivered to the user as an add-on wireless service. A wireless phone based solution will be very applicable in such cases since it is ubiquitous and is likely to benefit from economies of scale.

The wire-line phones are tied to a physical location. The serving exchange has a dedicated line number for that physical address. Technically, it is trivial to obtain that address. On the other hand the wireless service facilitates wide area roaming i.e. the user can be anywhere in the whole service area. Neither the mobile station nor the network around it has the capability to derive the mobile's exact location. Since the user might be moving from one area to another, dynamic update of the location is required as well. Wireless systems operate in hostile radio environment with respect to noise, interference and fading. Such effects are likely to affect the accuracy of the location technology [24, 25].

Another issue that adds complexity is the presence of multiple wireless standards (TDMA, CDMA, GSM). These standards often have incompatible physical interfaces. In order to be useful, any wireless location technology has to address a large segment of the users. Thus taking multiple interfaces into consideration appears to be inevitable. However, the wireless networks are well connected and higher level information can be exchanged rather easily i.e. once the location information is derived it can be made available to systems outside the service provider's network and even the regular wire-line network.

Since the location technology adds value to existing wireless service, the service providers will be interested in broadening the market by providing add-on services.

The law enforcement agencies and emergency management agencies will be immediate beneficiaries with increased efficiency and effectiveness. Thus, it appears that there is a market already for such a technology. Developing the technology with reasonable accuracy and making it applicable to a large number of wireless users are probably the most important factors in achieving success.

## 4.1 How to Get the Position

To get the individual location on mobile terminals, the information needed must allow locating the terminals one by one with a high level of truthfulness. This information can be reached from the terminals or from the nodes of the radio access network. There are two different possibilities to get this information: modify the terminals or modify the network nodes. Neither of these solutions is easy or economic.

### 4.1.1 Techniques Based on the Identity of Cells

The location of the mobile is realized from the information of the cell that gives it coverage and some parameters associated to the antenna. In this way we get a first geographic approximation. This technique has the important advantage of being already available without having to do any modification in the network. Its problem is that it is not so accurate as we need for our project, especially in some rural places.

### 4.1.2 Techniques Based in Modification of the Terminals

Several technology alternatives for locating cellular phones are Global Positioning System (GPS), Angle of arrival (AOA), time of arrival (TOA), and time difference of arrival (TDOA). All these technologies are based on knowing the location of reference points modifying the terminals and relating them to the location of the mobile station.

**Location based in GPS**

GPS, which stands for Global Positioning System, is the only system today able to show your exact position on Earth anytime, in any weather, anywhere above the ground. GPS satellites, 24 in all, orbit at 11,000 nautical miles above Earth. They are continuously monitored by ground stations located worldwide. The satellites transmit signals that can be detected by anyone with a GPS receiver. Using the receiver, you can determine your location with great precision [25].

GPS is in continuous development, and new uses for it are constantly being discovered. But one of the main problems is that you have to carry a GPS receiver with you. This is one of the reasons that makes the cars (where you have not to be worried about what you carry) the main users of this service.

**Time of arrival with modified terminals (TOA and TDOA)**

The techniques that use times of arrival of the signal between the terminal and the network can be TOA (Time of Arrival), based on absolute values of the arrival times, or TDOA (Time Difference of Arrival), based on differences between the times of arrival from some base stations [15].

When the position is calculated in the mobile, we say that the technique is called mobile-based, while if the mobile reports the information needed for the calculation in the network it is called mobile-assisted. The functions more representative of the techniques of the time of arrival are:

- Techniques of TOA:

The absolute time of arrival (TOA) of the signal between the terminal and the base stations can be estimated in different ways. If the terminal is able to note the exact instant of every out signal, the base station can determine the time that the signal needs to arrive there. This method is difficult in practice because we need an accurate synchronization between the terminal watch and the base stations.

- Techniques of TDOA:

For this technique we need a parallel network of base stations called "ghosts" in fixed locations (which are called Location Measurement Units). The comparison between the times of the base stations from terminals to LMUs, is used to determinate the position of the mobile terminal. We have three different variables, "x", "y" and "offset" of the times of the terminals, so we need the signals coming from three different base stations.

### 4.1.3 Techniques Based in the Network Infrastructures

There are several technology alternatives for locating cellular phones. Angle of arrival (AOA), time of arrival (TOA), and time difference of arrival (TDOA) are used to locate unmodified cellular telephones. All these technologies are based on knowing the location of reference points and then relating them to the location of the mobile station.

**Angle of Arrival (AOA)**

The Angle of Arrival method involves analysis of the angle of arrival (AOA) of a signal between the mobile phone and the cellular antenna. AOA PDE is used to capture AOA information to make calculations to determine an estimate of the mobile device position. Using this technique:

- A wireless subscriber can use any handset (digital, TDMA, CDMA, no special add-ons) to make a 112 call.

- The wireless phone's signal is received at various antenna sites. Each antenna site is also equipped with additional gear to detect the compass direction from which the caller's signal is arriving.
- The receivers send the caller's voice call and compass data on to the mobile switch, where the angles are compared and computed to generate a latitude and longitude for the caller.

**TOA**

One possibility of location can be the use of the time for going and coming back of a signal to determinate indirectly the distance from the terminal to the base station. The problem is that the time of processing in the terminal must be discounted.

**TDOA**

The TDOA is based in the correlation of the signal coming from a terminal in pairs of base stations. This correlation supplies the difference of times for that concrete par of base stations and then the geometric place of the points that keep that difference of time. The repetition for some pairs of base stations will allow to determinate the location.

**Differences between these techniques**

The TDOA technique works by measuring the exact time of arrival of a handset radio signal at three or more separate cell sites. The TDOA technique typically uses existing receive antennas already present at a cell site. In multi-path environments (urban areas) it may be necessary to make measurements with four antennas to overcome the effects of the multi-path. While typically the AOA technique is used to augment the TDOA approach of a location system. TDOA-only systems must overcome increased propagation loss for a three-site reception, but by including AOA on the highway sites, an accurate position calculation can be obtained from only two sites. Both location techniques work with any handset, including legacy units and require modifications to the network only.

### 4.1.4 Service Data Point (SDP)

The Service Data Point is a database system that runs on an industry-standard UNIX platform, and is connected to the AXE SCPs in the network. It provides the data capacity needed for services that are data intensive, services that require access to other external databases, and services where several SCPs need access the same data. Different services will use the information that appears in the database of the SDP, information about geography (zip codes, cities, maps, antenna locations) or other kinds of information like user’s data.

## 4.2 Emergency Service 112

The emergency service 112 is the single emergency telephone number for the European Union. The number was established by Council Decision of July 29th, 1991 and reinforced through subsequently adopted legislation namely the Directive 98/10/EC of the European Parliament and of the Council of February 26th, 1998 on the application of open network provision (ONP) to voice telephony and on universal service for telecommunications in a competitive environment [27].

European citizens in distress situations should be able to call the 112 and get through to the emergency services in all member states. Thus, anyone travelling within the European Union has to remember only one number and this guarantees a quicker and more efficient intervention.

All member states have reported that the 112 has been implemented in their territory. This statement was made in 1999 in the European Commissions survey on implementation of 112 as general context: "Access to the emergency call number 112, and more generally to other emergency phone services, are important issues for all European citizens".

The emergency number 112 is a prime example of how a EU telecom regulation impacts directly on the individual citizen. It is important that EU citizens are aware of, and have confidence in, the service offered when calling 112. This implies that service 112 is both consistent and predictable throughout the community. Recent discussions in the European Parliament have highlighted specific concerns about the implementation of 112 and the fact that it remains relatively unknown to the general public.

In Sweden the state is responsible for the emergency number 112. The Ministry of Industry, Employment and Communications, has through an agreement tasked SOS Alarm AB to answer and relay calls to the emergency number 112. The State owns 50% of SOS Alarm AB through the Ministry of Industry, Employment and Communications. And the Swedish Federation of County Councils owns 25% and The Swedish Associations of Local Authorities owns 25%. This service is working since 1994 when the agreement was done [28].

### 4.2.1 Service Data Point Used for 112 Emergency Service for Families in Interliving

The idea is that the families can use the service data point (SDP) with the service of emergencies 112. The SDP could also be used for communication between family members instead of the 112 service if inside the SDP could appear all the information about the member families. More or less this could be the process to follow for the emergency situations:

The member of the family that is settled in different places around Stockholm makes a call to 112. This call is routed through the access network to the Mobile Switching Centre (MSC). In the MSC the call is identified as the Intelligent Network and

activates the service in the Service Control Point (SCP). The SCP realizes a consultant to the Service Data Point (SDP), asking for the telephone number that corresponds to the emergency local centre closer to the location of the mobile. The SDP obtains the location of the mobile from the cell identifier that indicates to it the SCP.

The SDP obtains the district that corresponds to treat the call and gives back to the SCP the information of the number; simultaneously the SDP sends (through TCP/IP) to the IP address of the emergency centre the information about the location of the user to be seen in the screen of his computer for the person who will attend the call.

It could be helpful to have in the SDP two different routes for sending the information through TCP/IP. Imagine the situation in which a family member settled in Sorunda (where he lives) makes the call to the emergency service 112 but there are some problems in the emergency centre of Sorunda. A possible solution could also be to send the information to the emergency centre of Ösmo, settled very close to Sorunda. This could save the life of someone that needs the service as fast as possible [16, 23].

Figure 1 shows us the emergency service 112 with the SDP:

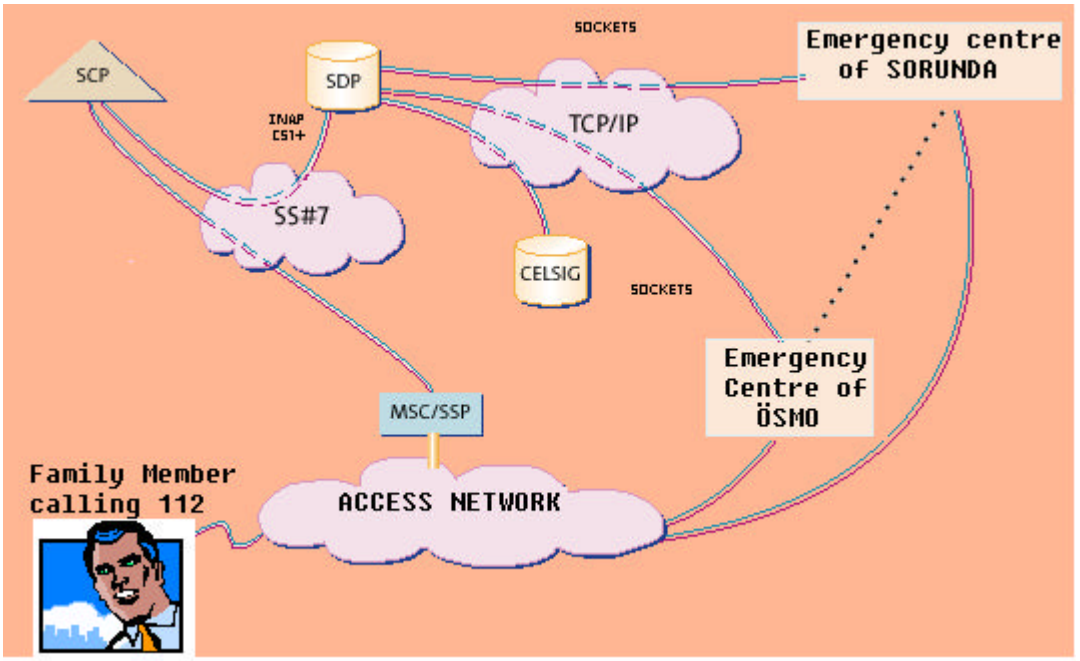


Figure 1: Emergency Service 112 with the SDP

Figure 2 shows the GPRS network to locate emergencies with the SDP. This diagram can be used to join all the background about GPRS and its relationship to the families of Interliving and the Emergency service 112.

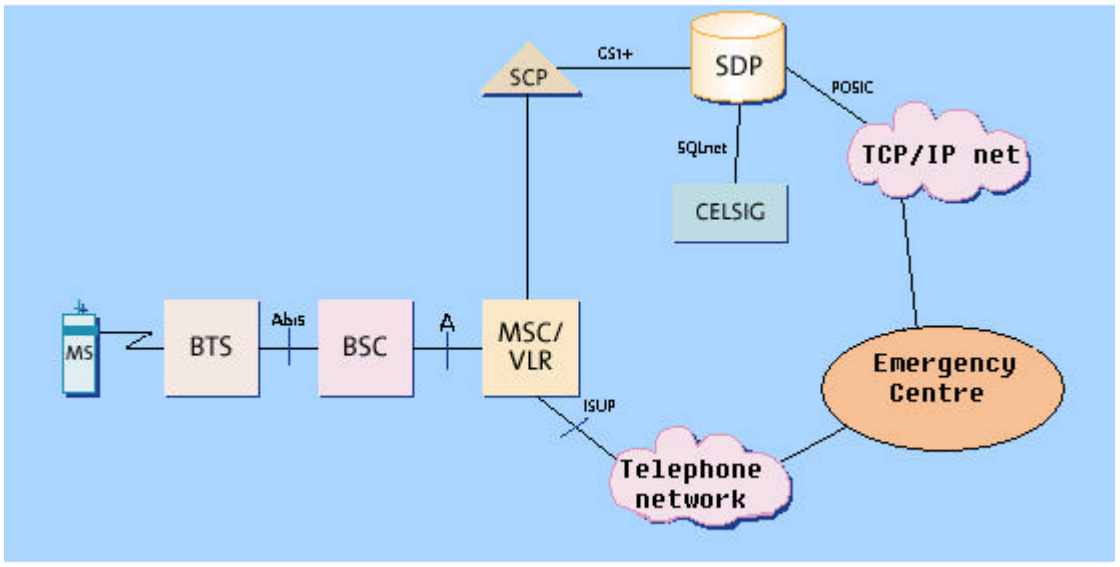


Figure 2: Diagram for GPRS to locate emergencies with the SDP

# Chapter 5

# Mobile Internet

Mobile Internet is the combination of the Internet and wireless access devices; the convergence of these technologies represents the Mobile Internet. Personalised access to Internet based products and services any time and place.

## 5.1 Components

There are some different components that constitute the Mobile Internet [2]:

1. **Access gateways and access ways.**

   Points from which users enter to the system.

2. **Mobile Internet Servers**

   The group of systems that gives some different services like translation, authentication, session information or location information. All are used for Mobile Internet and offered to the users.

3. **Mobile Internet Services**

   Last part of this value chain in Mobile Internet. Inside them, we can find the services, the contents and the information that is distributed thanks to any gateway access to the Mobile Internet users.

4. **Mobile Internet management plattform**

   Manage the equipment of the network and, services and the client management. It is completely essential for reaching the services in an efficient way.

## 5.2 Access with GPRS

The new generations of mobile telephony bring with them new and better methods of connectivity. It is based in packet-switching TCP/IP between diverse terminals and one data network, bringing new concepts like “always on”: the mobile terminal of the future will have a permanent connection with the net. Other concept that appears is the billing based on the amount of transmitted data, instead of time of connection [8].

GPRS adds data packet switching in all the different levels of the GSM network (radio, switching nodes, transmission network), optimising, in this way, the use of radio channels for bursty traffic (for example Internet navigation) and making an easier use of the resources of the network.

The codification in the radio channel in GPRS is designed to protect the transmitted data packets from errors. There are four different codifications, with different data transfer speed from 9,05 kbit/sec by timeslot to 21,4 kbit/sec by timeslot. The kind of codification used depends of the quality of the channel: if it has worse quality, it will use the codifications of lower transmission speed and it will have a higher fidelity. If the conditions of the channel are better, then it will use a faster transmission speed and using all the eight timeslots, we will get that speed of 171 kbit/sec.

It is necessary to add to the equipment two new nodes: the SGSN (Serving GPRS Support Node) and the GGSN (Gateway GPRS Support Node). A user with a GPRS terminal will connect himself with the SGSN closer. This node will route the packets of the user to closer and better the GGSN node.

The packets of the user circulate between the SGSN node and the GGSN, through the GPRS Tunnelling Protocol. From the GGSN, those packets will be able to have access to the different services.

Once the session is established with the IP network, the user can move and thus change his geographic area, which implies a change of SGSN. But the GGSN will be the same during session. All the nodes SGSN and GGSN must be united and, due to the roaming of the users, those nodes could be connected to other nodes of different operators. All of these nodes will constitute the “GPRS Backbone”. Figure 3 shows us the access.

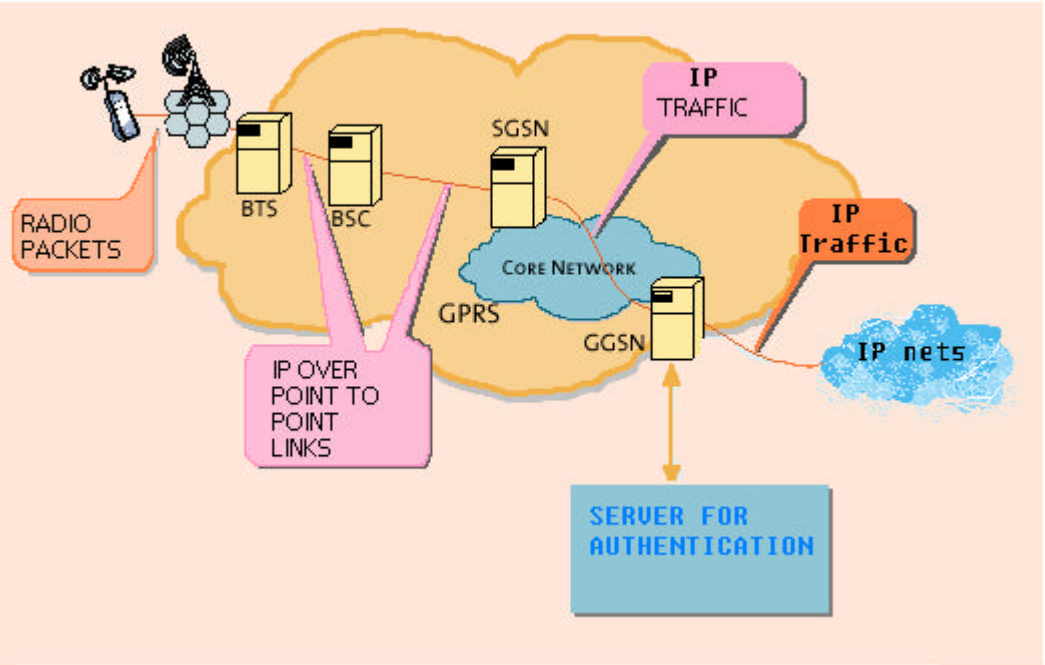


Figure 3: Diagram of access with GPRS

## 5.3 Platforms of Services in Mobile Internet

### 5.3.1 Portals of Mobile Internet

A portal of Mobile Internet of a company has the goal of showing some different services and contents to the Mobile Internet users. This presentation must be adjusted to some conditions that come with Mobile Internet.

These are some of the requisites [24]:

- Must operate with different types and technologies for accessing to the information: WAP, Web, SMS.
- Must adapt the contents to the limitations of the mobile terminals (size of the screen and the keyboard, speed of access and so on).
- Must offer contents based on the geographic location of the user.

It would be useful that the portals of Mobile Internet could have easy and friendly interfaces. The idea is that the user can access all the offered services. Inside those services, it can be included other services of information, using contents, services of m-commerce and other kinds of services oriented to the mobile business.

One of the main parts of the architecture of one company that pretends to supply this kind of services is the management of the contents. That means the possibility of presenting to the user different information from other providers and adapted to his terminal.

### 5.3.2 Convergence Between the Mobile Phone and Internet

Until now, the low speed for transmission offered by the networks make the Internet access from the mobile phone rather useless. However, coming the following years a series of events are going to appear and they will make possible the convergence between the mobile phone and Internet [19, 25].

Some of the most important reasons are:

- The number of users with Internet access is going to be closer to the number of users of the mobile phones and, in most cases, will be the same for both technologies.
- The new technologies are going to make possible to reach high speed for transmissions.
- The effect of diffusion of Internet that is being possible in the last years and the acknowledgment that the users are getting of it.
- The characteristic of the location and accessibility supplied for GPRS will make more attractive this convergence instead of others.

This convergence will make possible the convergence between the business models of both worlds. Figure 4 shows the Value Chain for the mobile telephony.

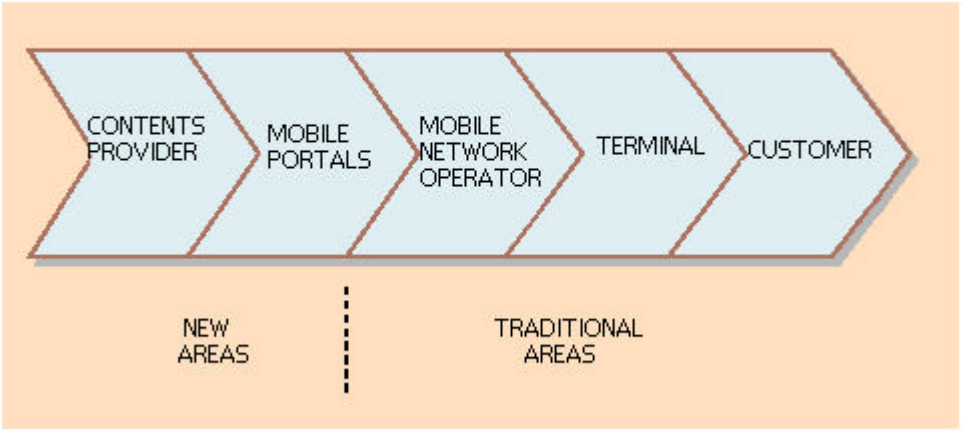


Figure 4: Value chain for the mobile telephony

However, the operator of the mobiles has a series of characteristics that will improve the operator's position in the market. Most of these are clearly different to the characteristics of the operators of other kinds of network. Some of the advantages presented for companies with success in the business of mobile networks are [5]:

- The operator of mobile phones will be able to continue supplying its traditional services.
- The new services of contents will increase the traffic of data and it will induce new revenues.
- The identity of the user will be known.
- Some special data like the location of the user will be known.
- Different methods to invoice the client will be reached.
- Many important contents for the user like the voice messages or the short messages will be reached.
- Guaranty that the quality of service that offers is not dependent of others will also be reached.

The advantages make me to conclude on two observations:

- The exploitation of contents is going to be very important in the new model of business.
- The operator is going to offer services like the mobile portals and content providers to different kinds of clients.

# Chapter 6

# A Health Portal for Families

A portal of Health for families is one example of the exploitation of contents that can be done within Mobile Internet. The main idea consists in how to help people using Internet and GPRS. I have chosen to focus on health, as one important issue for many people.

I will try to solve some problems about health service with the implementation of a business plan about one portal of health. The portal will consist of two big parts. The first one is the part in which family members will be free to ask their questions about health and they will get the information they need completely free. The Health Portal will offer this service for free because it is an offer I want to make to the customers and the money will be earned selling products.

If the question is included in the database the user will be able to get the information at the same moment. If the question is not there, then the professional staff will get the question required and they will give the response to the user in the next 24 hours.

The other big part of the portal will consist of an on-line shop in which each member of the families will find all the products they are looking for within many different categories such as baby-care or products for the teeth. How will it be possible? It will be possible navigating through the portal completed with categories of products. The implementation part is not considered in my report so it will have to be implemented in a future step [10, 11].

## 6.1 Relation to the Research Questions

The research questions formulated in the report involve the study of different methods for location and GPRS characteristics. The report shows methods for location as for example Angle of Arrival, Time of Arrival or Time Difference of Arrival.

How can the methods for location be useful for the Health Portal? They will be used for the Internet Service Providers (ISP) to locate the individual who is navigating on the ISP's contents. The ISP will use this information to know where the product must be delivered. The contents in which the user is navigating are the Health Portal described in the report.

Further, how will the GPRS characteristics be used with the Health Portal? GPRS will be the network that connects the user and the Internet Service Providers for getting the contents of the Health Portal [20]. After the study of the GPRS characteristics I have concluded that GPRS will be more helpful than GSM because of:

- Higher data rates for transmission, which will make faster the navigation.
- Facilities given for location (the Serving GPRS Support Node makes the user's registration to the GPRS network to create data channels between user and Health Portal).
- Method of payment based on the amount of data received for the user and not based on the time that the customer will use to look for the products he wants.

One of the research questions of the report is about the convergence between GPRS and Mobile Internet. One advantage consists of getting the contents of the Mobile Internet from the GPRS mobile phone because it makes the service of getting products and medical information to the customer easier and faster.

One example of the contents of Mobile Internet is the Health Portal. The portal gives to the user the possibility of getting medical information through a database and also buying medical products and getting them within two hours after the shopping. This will be possible through renting the services of different delivery companies and innovating a new service for delivering with motorcycles. The motorcycles belong to companies that sell fast food during the morning but they do not use them at night (after evening).

Unfortunately some problems can appear in the business. People are not ready to give their private information through their mobile phones and they still prefer to meet directly with the doctor and with the shop assistant [21].

The Health Portal is presented as an alternative compared to the actual service provided by drugstores and other kinds of stores. It is also necessary to say that it needs to be implemented and some steps must be given in a close future. Some of the steps are, for example, the creation and compilation of the databases with all the medical information and with all the products that will be provided by the shop. The one who implements this is who knows how to do it. Another step needed is searching for companies that will provide the starting capital for the business. This step as well as the implementation and the marketing part are not included in the report.

## 6.2 Evaluation

The Health Portal is an example of contents that could be offered by the Internet Service Providers for the Internet Mobile. Actually there are many other websites where it is possible to find products and also a database with medical information. The portal suggested in the report could have the some problems due to:

- The customer is loosing the contact with the shop assistant
- The mobile network is not always operable.
- The customer has terminals, which are not ready to receive graphical information.
- The search for companies providing starting capital will not become easy.

On the other hand some of the pros of the portal are that it belongs to a business area, which is growing fast, and, the number of users of both technologies (Internet and mobile phones) is increasing [19, 25]. Why is this a benefit? Because the exploitation of contents will become very important in the new model of business and the operator will offer services like the mobile portals and content providers to different kinds of clients [chapter 5].

Another important pro of the Health Portal is that it will reduce its costs due to a better delivery service and the free consultation service for users (a bad delivery service makes the companies to loose money). Why is reducing the costs a benefit? Because profit is equal to revenue minus costs and if the revenue is the same but the costs are less then we get a better profit.

But how possible is to get a delivery service at night within two hours after the user has ordered the product? The solution consists of hiring motorcycles from the companies that sell fast food during the day and are free during the night. The coverage of the service will increase. How will the coverage increase? First it will be deployed to the families of Interliving, then, once the business has shown success, it will be possible to sell products in Stockholm and then depending of the success to other main cities. How can this be possible? Because if there is more money earned by the portal, it will be possible to have more marketing and more infrastructures. Why do we need more infrastructures? To have more places to shore the products, and to have more motorcycles to deliver the products.

# Chapter 7

# Conclusion

The General Packet Radio Service has been shown in the report as a profitable technology for the user. Through the report I have developed the different characteristics of GPRS and which are the possible uses and advantages provided to the family members of Interliving. I conclude the work by explaining the answers to the questions presented at the beginning of the report inside the introduction part:

**Which are the characteristics of GPRS?**

GPRS applies a packet radio principle to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. Packets can be directly routed from the GPRS mobile stations to packet switched networks.

The increased functionality of GPRS will decrease the incremental cost to provide data services, an occurrence that will, in turn, increase the penetration of data services among consumers and business users. In addition, GPRS will allow improved quality of data services as measured in terms of reliability, response time, and features supported.

GPRS improves the utilization of the radio resources, offers volume-based billing, higher transfer rates, shorter access times, and simplifies the access to packet data networks. It also uses some architecture protocols like Mobile IP, Camel and Intelligent Network that has been shown in the report.

GPRS has been standardized by ETSI [6] (the European Telecommunications Standards Institute) and it finds great interest among many GSM network providers.

**Which are the different methods we can use for location?**

To get the individual location on mobile terminals, the information needed must allow locating the terminals one by one with a high level of accuracy. This information can be reached from the terminals or from the nodes of the radio access network.

I have considered two different possibilities to get this information: modify the terminals or modify the network nodes.

Throughout the report we could see very useful methods for location like Global Positioning System or other techniques such as Angle of Arrival, Time of Arrival or Time Difference of Arrival.

The needs of the users will exhibit which technologies are most suitable. Angle of Arrival and Time Difference of Arrival are, for example, very similar with respect to accuracy and broadband needed but they get the position from different ways.

**- Which is the best way to get the location for families?**

After the study of the techniques for location I have concluded a possible solution for getting the location of the families of the Interliving project. The solution comes with the Service Data Point (SDP). It is a database system that provides information about the users.

GPRS will be the intermediary between the Service Data Point and the final users. The process consists of recognise the family member from the GPRS terminal and access the information of the database. The report describes why GPRS is a profitable technology but it does not cover why GSM is not as good as GPRS.

The report also includes an investigation about how to connect this SDP and the emergency service 112 for the families and give them the possibility of being in contact with a medical centre as soon as possible. The member of the family makes a call to 112. This call is routed to the SDP and obtains the location of the mobile from the cell identifier. The SDP sends the information about the location of the user (through TCP/IP) to the IP address of the emergency centre. This information will be seen on the screen of the computer of the person who will attend the call. And finally from there it will be possible to attend the user.

**- The convergence between GPRS and Mobile Internet will bring some advantages. Which are those for the families?**

The report has treated the characteristics of the Mobile Internet and the possibilities that they will offer us thanks to the convergence with the mobile phones. GPRS can be used as an intermediate for getting in touch with Internet throughout the mobile phone. A faster connection and a better service of the Internet providers are some of the advantages for the users.

I have developed a business plan based on the need for a better medical service. With the help of this portal, the families will be able to be provided with products from the drugstore or obtain answers to the questions they have about health. All the service will be reached from their GPRS terminals.

# Discussions

The most interesting part of the work has been to deal with the necessities of the families. It has been very comforting to know that the research I have done can be useful to solve family problems as, for example, to get medical products or to get medical staff in an emergency situation. On the other hand, the most difficult part has been to adjust conveniently all the technical parts with the necessities of the families.

The Health Portal can be implemented easily in the future with other networks because GPRS is considered only an intermediary step between the GSM and the third generation. Fortunately most of the network aspects seen for GPRS will be valid and useful with the future networks.

The most difficult part I have found with the thesis has been the choice of the best service of location for the families. The information known about the families has helped me to consider the Service Data Point as a possible solution. Another difficult part of the work was to choose which kind of contents inside Mobile Internet could become useful to the families.

Fortunately, the Health Portal is only one of the possibilities that Mobile Internet can offer. This means that other implementations are also possible to solve the necessities of the individuals. The Health Portal was only one example of it. On the other hand, GPRS has many characteristics that make it very useful and helpful to the families as, for example, to access to Internet using GPRS as a modem from stationary devices.

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