

4.3 ENHANCED DATA SERVICES FOR GSM/DCS 1800

Dr. Zhichun Honkasalo
Nokia, ETSI SMG

1. Overview

GSM Phase 2+ work items :

- **General packet radio services (GPRS)**
- **Circuit switched high speed data services**
- **Data compression**

The GSM system has been in commercial operation for many years now and has been increasingly adopted throughout the world. Yet still there is a continuing effort in developing new features into GSM in order to enhance the services it offers to future public use. Among these developments enhanced data services are high on the priority list where strong emphasis has been given towards high data rate and flexibility for new applications. This is in response to the today's ever fast growing market of mobile data, aimed to extend the GSM service capability for a much wider range of new data applications and services of 90's, and some pre-FPLMTS multimedia services.

2. General packet radio services (GPRS)

- **Potential services**
 - ⇒ **Transaction applications :**
 - **Electronic fund transfer from point of sale.**
 - **Dispatch of vehicles, railway signalling.**
 - **Electronic mails.**
 - ⇒ **Interactive services :**
 - **Wireless PCs, remote terminal access.**
 - **Mobile offices, field services.**
 - ⇒ **Information broadcasting :**
 - **General information services.**
 - **Road traffic advice.**
 - **Advertising.**

Recent studies predict 25 million users of mobile data world wide by the year 2000, representing 30% of all mobile communications. Among these there has been very strong demand for packet switched mobile communications, coming from the growing market created by the synthesis between communication industry, computers and software. While GSM is continuing its success in operation, its data services have not yet been fully optimized for the range of applications whose data traffic can be best classified as "bursty" in nature. The current GSM standard has the capability to interwork with packet switched fixed networks, only the connection is in circuit switched mode at the air interface and throughout the GSM infrastructure. Within ETSI the clear need for GSM to develop a general packet radio system in order to attract these new businesses has been commonly recognized and the so called horizontal and vertical markets have been identified where those potential new services are further categorized into the above three groups.

- **GPRS Development targets**

- ⇒ **Efficient utilization of radio resources.**
- ⇒ **Highly standardized and feature rich services.**
- ⇒ **High capacity and low packet delay to meet the QoS.**
- ⇒ **Flexibility for the terminals and operators.**

The primary requirement of GPRS is the efficient utilization of the network resources for packet mode applications, which distinguishes it significantly from the existing circuit switched services. This will enable GSM to offer potentially competitive low cost data services to those users who need the network resources only during their data active periods, not during the long silent periods in between data bursts. This is because in packet switched mode no dedicated radio resource is allocated to a data call hence many users can share the same radio channel, leading to efficient use of the scarce air interface resource and potential low cost services where the user can be charged according to what he actually consumes.

Secondly, the Short Message Service (SMS) has already provided GSM a (pseudo) connectionless packet transfer mode service, designed as a messaging system for those applications needing relatively low capacity with non-critical time performance. Therefore missing from the GSM suite of services is a high capacity, low delay, flexible, "real" packet mode service which is able to cover a wide range of new applications, provide adequate Quality of Service (QoS), and bring real benefits to the customers and operators.

Furthermore, there has also been the requirement for GPRS to provide the capability of simultaneous operation with circuits switched speech and data services, and possible parallel services with SMS.

- **GPRS Status in ETSI**

- ⇒ **Phase 2+ work item.**

- ⇒ **Special task group formed in May 1994.**
- ⇒ **Currently working on Stage 1 and 2 documents, to be completed in this year.**
- ⇒ **The standard is expected to be stable in 1995.**

The discussion on GPRS within ETSI has started by the end of 1992. Initially it was handled within SMG1 and SMG4, aimed to define service requirement specification. During this process it became quite apparent that in order to bring cost effective solutions to GPRS, which have to come in the form of additions and/or modifications to the existing GSM network architecture, it would be very beneficial to start outline technical solutions in parallel to the finalization of the requirements. Consequently a temporary task group with suitable cross functional competence was formed whose task is to define service requirements from both the user and operator points of view, and to create system solution concepts, taking into account the required interworking between GSM/DCS network and other networks. The first GPRS TG meeting was hold during May of 1994, and the members so far meet regularly at the interval of roughly once every other month. The Stage 1 "Service Requirements" and Stage 2 "Service description" documents are expected to be ready this autumn. By definition Stage 2 development is aimed to identify the functional capabilities and information flows needed to support the services described in Stage 1, and also to define the possible locations of these functions. The output of Stage 2, will then be used at Stage 3 to design signalling system and air interface support.

- **GPRS Potential technical solutions**

- ⇒ **Network architecture :**
 - **Based on the current GSM structure with new network entities.**
 - **Number of new functionalities are under definition.**
- ⇒ **Interworking with Internet capability.**
- ⇒ **Flexible, high packet rate air interface access protocol.**

During the early phase of GPRS work, technical proposals were more concentrating on those giving minimum impacts to the existing GSM network in return for some moderate improvement of the system. However, as time went by, it became more apparent that certain amount of functional additions to the existing system is perhaps inevitable, if GPRS is to become a "true" competitive packet switched service, capable of offering high access speed, low packet delay, and large throughput.

As for network architecture there can be many possibilities, ranging from the close integration approach where packet routing is via the existing GSM network with a new Packet Service Functionality integrated into MSC/VLR, to the complete separation approach where BTSs are direct connected to an independent Packet Service Center. The more promising solution is somewhere in between these two extremes. It is based on the existing GSM network structure, with two new network

entities added : (a) GPRS Support Node where the functionality needed to support GPRS will be located, and (b) GPRS Register, which contains subscriber database needed for GPRS operation. A number of protocols, including CCITT X.25, SS#7 and Internet have been considered as the possible candidates for the "Backbone" network standard. The new functional entities are currently under definition, these include Interworking function (IWF), subscriber management, billing, security, packet relay, roaming, mobility management, connection control, and routing.

Most significantly, IWF will be developed to support interworking with Internet, enabling the GPRS subscribers to gain access to those services supported on Internet.

For air interface, the proposals are moving toward high performance systems based on the advanced Packet Reservation Multiple Access (PRMA) technology, and at the same time build in flexibility for GPRS resource allocation. Among which, there has been the proposal on a flexible high packet rate air interface where the access protocol is capable of supporting different logical channels types up to the entire carrier using multiple time slots per TDMA frame. This enables the operator to start GPRS service with low radio resources and gradually expand to a high capacity system where high end (extremely low delay) services and low end (low data rate) simple applications are supported simultaneously using the same access protocol.

3. Circuit switched high speed data services

- **Potential new bearer capability from 19.2kbps up to 64kbps :**
 - **Transparent and non-transparent services.**
 - **High speed modem/fax services.**
 - **Mobile video applications.**
- **Realization using access of multiple timeslots per TDMA frame :**
 - **2-slot access mode leading to simple solution for MS.**
 - **Moderate impacts on air interface signalling.**
 - **Full service coverage based on the current network.**
- **Phase 2+ work item.**

The other significant development in GSM data services is the potential new bearer services of higher access rate, at least 19.2kbps, with the possibility for 64kbps to enable direct connection to high speed data network like ISDN. This is aimed to provide the platform for GSM to support new circuit switched data services which already exist, or are under specification, in the fixed networks. The examples are 14.4 and 19.2 kbps modem/fax services, 16kbps to 64kbps video applications. The requirement for the latter comes from the newly merging market of multimedia services and at the same time the significant progress in the advanced low-bit rate video codec technology. The examples of video mobile services include such as remote video database access, field service business, remote camera for security monitoring, and mobile video for entertainment.

One of the potential technical solutions for providing the high data rate is to allow access of multiple TCH/Fs or multiple air interface time slots per TDMA frame by a single mobile station (MS). In particular the use of two timeslots means, from the MS manufacturers point of view, the terminal complexity is close to that for 1-timeslot and therefore it is quite feasible to develop a MS supporting 2-slot access that is close to the "standard" GSM speech/data products in terms of cost and size, leading to a potentially very attractive terminal product to users.

4. Data compression

- **Potential benefits :**
 - **Increase effective throughput by pre-processing user data using a compression algorithm.**
 - **Possible 2 to 4 times improved bit rate from 9.6kbps.**
- **Possible technical solutions :**
 - **Various compression techniques exist.**
 - **ITU standard known as V.42bis.**
- **Status in ETSI :**
 - **Phase 2+ work item.**
 - **Network description and IWFs are under definition.**
 - **The specification is expected to be available in 1995.**

The principle of data compression technique is to make use of the clever coding of character oriented data and thus reducing the actual amount of data transferred in such a way as to appear to the user as though the throughput of the communication link has been increased. Various standard data compression algorithms exist and it is a function which is widely used by PSTN users and is built into many modems as a standard function.

For GSM data compression is to be employed over the radio link between the MS and IWF where additional functionality is needed to provide the coding/decoding. Non-transparent mode bearer services are used to transport the compressed data since an error free channel is required. A number of possible variants of service configuration are under consideration. These are : (a) use of low speed modem (up to 9.6kbps) from GSM/IWF to the fixed network, implying that PSTN side needs own error correction/data compression and the compression in GSM side would be e.g. from 9.6kbps to 4.8kbps, and (b) mostly interesting, the use of high speed modem or data link between GSM/IWF and the fixed network, where data compression terminates in the IWF, leading to enhancement of the basic bearer services available from GSM.

Currently SMG4 is working towards the definition of service descriptions and interworking function requirements. It is expected that the standard will be available by June 1995.

5. *Summary*

- **Enhanced bearer capability with high data rate and flexibility.**
- **Extension for a wide range of new data applications, both packet and circuit switched services.**
- **Platform for successful competition with other existing and future digital cellular standards.**

The development in ETSI towards the enhanced data services in GSM/DCS 1800 has a very clear goal in mind, and that is to enhance the basic bearer **capability** and to offer a broader range of new mobile data services and applications of 90's. These enhancements have been widely recognized as building a platform for GSM in order to extend its lifetime and compete successfully with other existing and future digital cellular standards. Because it is based on the existing infra-structure and mobile terminal technology, in many cases this can lead fast and low-cost introduction of the new services, accomplished by less implementation effort for the manufacturers and network operators and less standardization work.