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Exploration Programmes:
Corporate Technology Explores Future Telecommunications

GPRS Services, a Step Towards UMTS

There are two outstanding trends in today's telecom market – the rapid growth of GSM and the explosion of Internet-based services. With the immanent deployment of the General Packet Radio Service (GPRS), Mobile Communications and the Internet are about to converge. Soon, new Mobile Multimedia service opportunities will be enabled, preparing the market for full UMTS capabilities.

The programme "Advanced and Value-Added Communication Services" explores the technologies stemming from the convergence of the Internet and telecommunication worlds.
With its Exploration Programmes, Corporate Technology is exploring telecommunication technologies and new service possibilities with a long-term view of 2–5 years. Further, the expertise built up in the course of this activity enables active support of business innovation projects.

MONIRA ABU-EL ATA, SOUHEIL BEN-YACOUB AND J. CHARLES FRANCIS

It is anticipated that by 2002, there will be 1 billion active mobile subscribers in the world. By 2004, over 50% of the revenue for mobile communication systems will be generated from packet data exchange and IP telephony. The highest growth will be in Internet access and real-time multimedia applications. The growing demand for higher bandwidth IP services is an important driver for 3rd Generation (3G) mobile networks.
GSM was originally developed for voice and has been enhanced for the Short Message Service (SMS). This article addresses the further GSM evolution needed for GPRS and presents results from the European Union project Mobile Extranet Based Integrated User Services (Moebius). The issues addressed include the security of Mobile Multimedia applications and macro-mobility based on Mobile IP across various types of access.

The convergence of Internet and Mobile Networks, as well as the introduction of UMTS, necessitate new secure mobile multimedia services. The traditional provision of such services needs to be re-evaluated in order to meet customer expectations.

Swisscom is currently deploying GPRS technology, and in this context multimedia services will be very important for future commercial exploitation. GPRS will also provide some understanding of potential customer needs in the context of 3G mobile networks (UMTS).

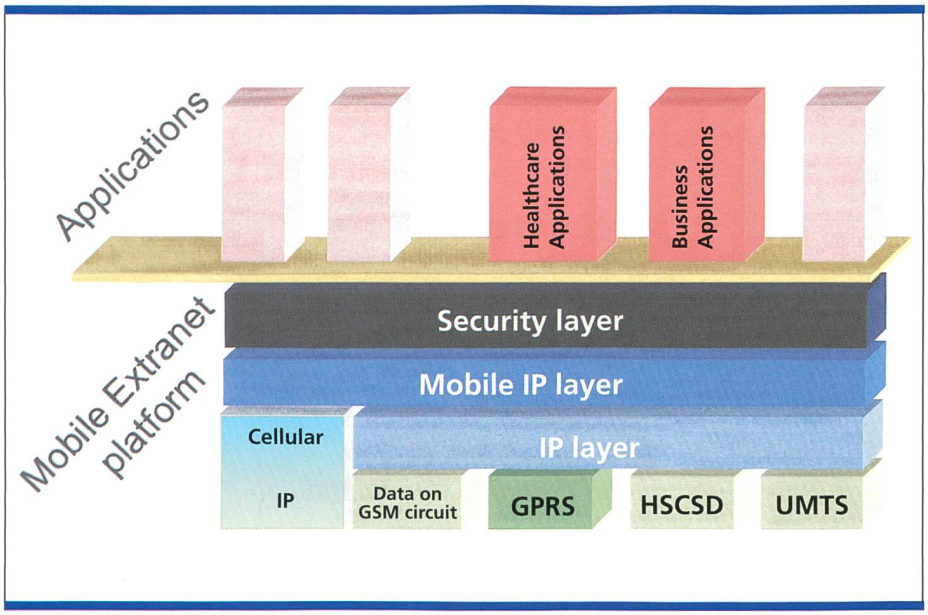

Fig. 1. The Moebius extranet mobile platform: Mobile networks (GSM, HSCSD, GPRS, UMTS, and Cellular IP) provide the basic transport layer. While these networks provide micro-mobility (i.e. inside a routing area), Mobile IP is introduced to provide macro-mobility (i.e. outside a routing area). The Security layer is used to provide authentication and confidentiality. The applications (Healthcare and Business) are built on top of the stack.

The IST Moebius Project

Swisscom Corporate Technology participates in the Moebius project together with European partners from industry and academia. The European Union and the Swiss government fund the project within the framework of the IST (Information Society Technology) research programme.
The main aim of Moebius is to create an experimental platform that can be used for integrating and testing new technologies and various multimedia applications (fig. 1). The addressed technologies include GPRS, Mobile IPv6, IPSEC and mobile terminals.
Swisscom participation has two objectives: on the one hand, the deployment, integration and testing of GPRS core network component interfaces in Switzerland, and, on the other, the development of a number of residential and business multimedia applications including end-to-end system testing.

Mobile Networks

Traditional GSM [1] networks only offer data services using circuit switched technology, and current GSM services such as SMS only exchange small volumes of data traffic. To efficiently unify the end-to-end transportation of data, it is necessary to modify GSM. Consequently, the GSM standards released in 1997 by the European Telecommunications Standards Institute (ETSI) specified a new packet-based data service and named it the General Packet Radio Service (GPRS). The GPRS-enhancement of GSM technology supports both the IP and X.25 protocols (i.e. existing applications based on IP and X.25).
GPRS offers Point-To-Point (PTP) and in future Point-To-Multipoint (PTM) services as well as efficient transfer of Short Messages. PTP allows a single user to communicate with another GPRS user or a server that is located in an external network using connection or connectionless services. The PTM service allows data packets from one sender to be received by many recipients.
The GPRS [2] core network consists of two main node types, the SGSN (Serving GPRS Support Node) and the GGSN (Gateway GSN). The main functions of the SGSN are handling of terminal registration, mobility management, traffic relay

and the collection of statistics and charging information. The GGSN, on the other hand, has capabilities similar to a router in data networks. It routes end-user data from external data networks to the SGSN and user. Fig. 2 illustrates the Swisscom mobile network, which will support the Moebius applications through GPRS.
Fig. 3 shows a typical message exchange between an end-user and an Application Server situated in a corporate Intranet. The scenario illustrates the role of several new technologies, including IPv6, IPSEC and Mobile IP. The message flow is as follows:

– The user switches on the terminal and enters a PIN-code, if required.
  No DHCP (Dynamic Host Configuration Protocol) router advertisement messages are received, as the terminal is not yet connected to the Intranet.
– The terminal initiates a mobility management session with the GPRS network and initiates PDP (Protocol Data Packet) context activation to retrieve an IPv4 temporary address from the mobile Internet Service Provider (ISPm).
– At this point there are two options to determine the IPv6 CoA (Care of Address). The first option (4a) derives the IPv6 CoA from the IPv4 temporary address. In the second option (4b), the IPv6 CoA is assigned by the ISPm with DHCP router solicitation and router advertisement messages. Option 4a is applicable when the ISPm supplies an IPv4 Internet Service only and simplifies the 6 to 4 tunnel configuration.
  The terminal then initiates a Mobile IP binding update with the Home Agent and Application Server.
– The terminal and server exchange IPv6 security information.
  Application-specific security like SSL (Secure Sockets Layer) or WTLS (Wireless Transport Layer Security) occurs according to the security policy of the Firewall.

The user now has access to the corporate Intranet. During the session, the terminal sends periodic binding update information to the Home Router and Application Agent. IPSEC negotiation may occur due to the end-of-life of session keys.

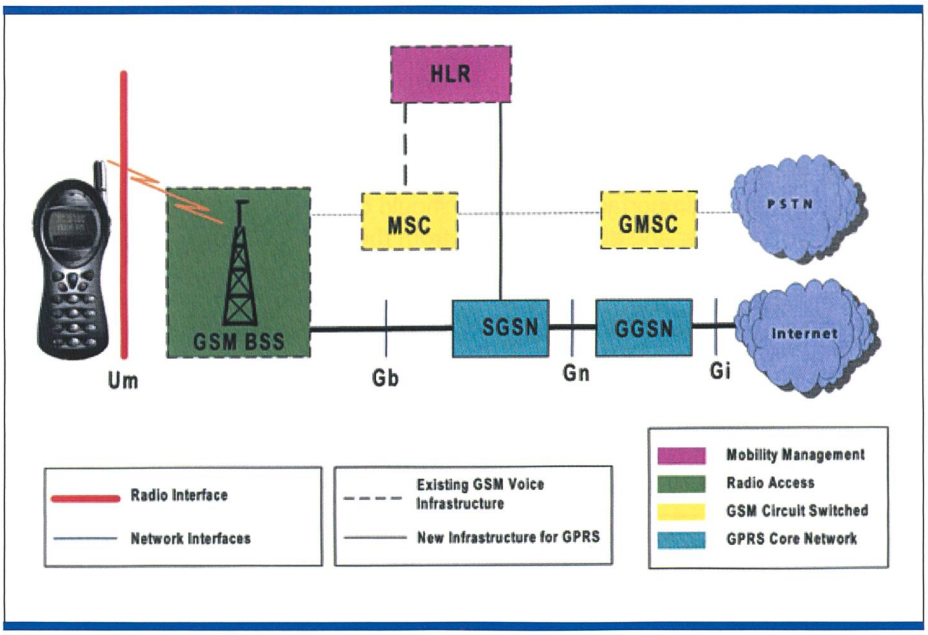

Fig. 2. Swisscom will support the Moebius Mobile Multimedia services through its GPRS network in Basel. The existing GSM-voice infrastructure consists of the GSM Base-Station Subsystem (GSM BSS), Mobile Switching Centres (MSC, GMSC) and a Home Location Register (HLR) which tracks the location of the terminal. The new infrastructure added for GPRS consists of the Serving GPRS Support Node (SGSN) and the Gateway GPRS Support Node (GGSN). The GSM radio interface has been enhanced for GPRS and is denoted by Um. The three network interfaces are denoted by Gb, Gn and Gi, respectively.

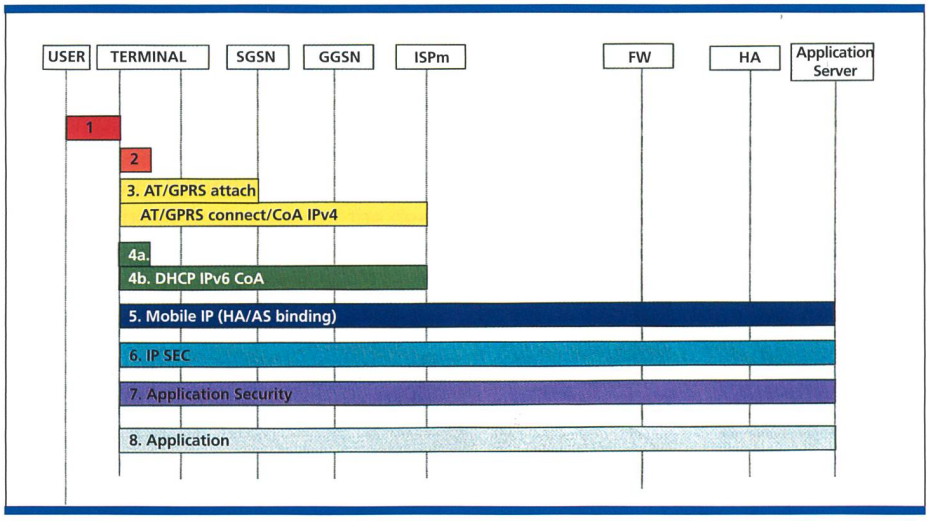

Fig. 3. A message exchange occurs when the GPRS terminal is switched on. The Mobile Internet Service Provider (ISPm) provides Internet connectivity for the GPRS user, while the Firewall (FW) is the boundary between the Internet and a corporate Intranet containing a Home Agent (HA) and Application Server. As a result of the above procedure, Moebius GPRS users can access corporate Intranets in a secure manner with macro-mobility provided by Mobile IP.

Multimedia Services

Due to the increasing success of nomadic computing, Internet and mobile telephony services, a large number of applications and services currently running on desktop computers will need to be migrated and adapted to the mobile world. The introduction of GPRS is one of the first opportunities to present Internet-based services to the nomadic user. Several initiatives, like the Mobile Applications Initiative (MAI), encouraged by operators and network manufacturers, have been launched to support this migration. It is foreseen that services shaped for 2.5G networks (GPRS) will also be relevant for 3G mobile networks with improved service delivery, end-user device characteristics and interfaces. The future increase in available bandwidth

for mobile networks will allow customers to access new services as illustrated in figure 4.

Audio-Video Streaming

Multimedia services rely on a set of applications and the most important of these is the ability to transfer and display audio-visual content. For a long time now, it has been possible to download and playback high-quality audio and video files from the Internet. Current web browsers and servers support the file transfer mode for data retrieval. However, file transfer often necessitates long, unacceptable, transfer times and playback latency. Ideally, video and audio should be streamed across the Internet from the server to the client in response to a user request. The client plays back the incoming multimedia stream in near real-time as the data is received.

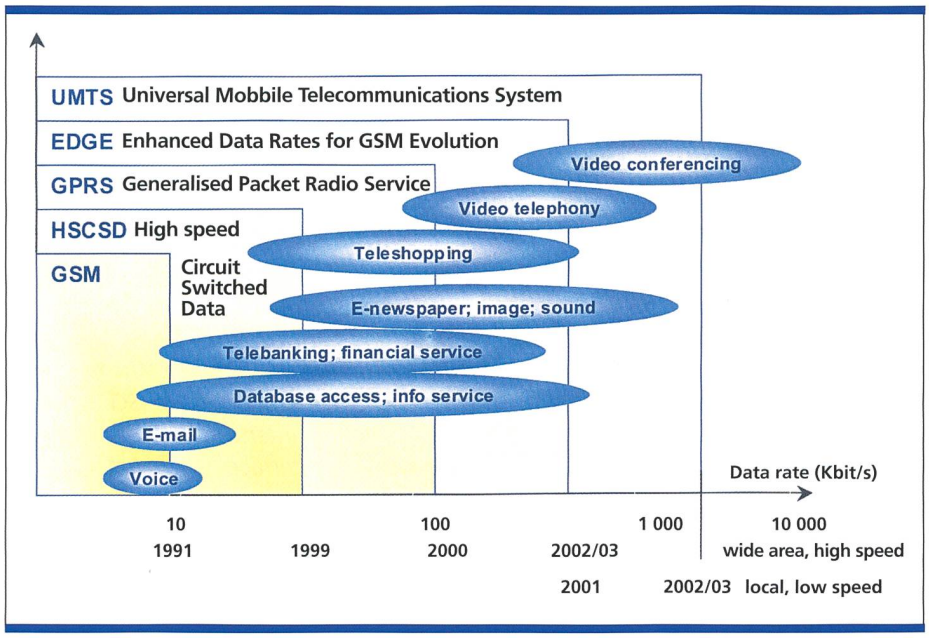

Fig. 4. Evolution of available bandwidth and potential services: Services shaped for 2.5G networks will also be relevant to 3G mobile networks with improved service delivery, end-user devices and interfaces.

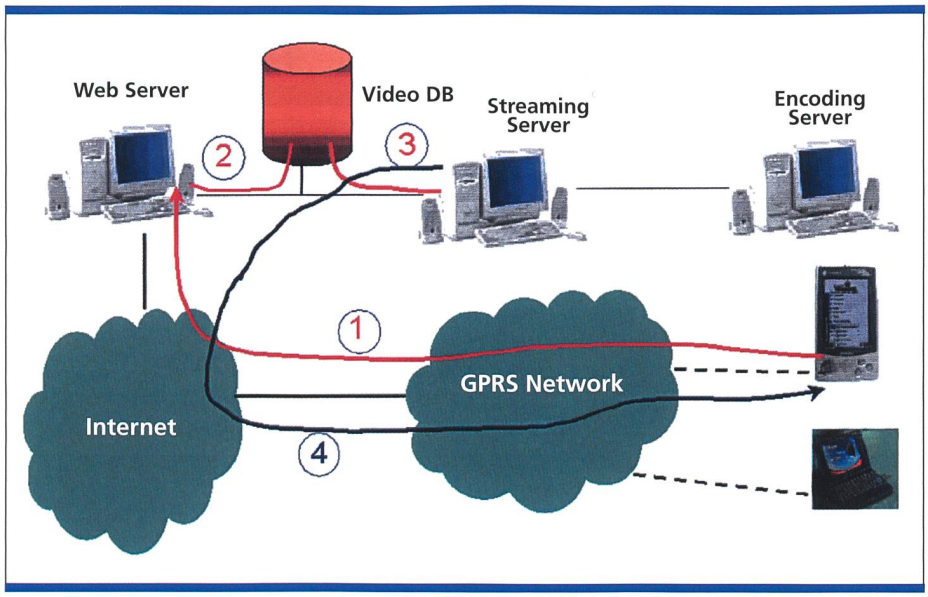

Fig. 5. Streaming request sequence: The client requests specific content from a Web Server (1). The server sends an SQL request to the Video Database for a list of matching videos which are displayed on the user terminal (2). A video is selected (3) and the content is streamed directly to the terminal (4). The encoding server streams live content if required.

GPRS:
http://www.mobilegprs.com

IST Moebius:
http://www.ist-moebius.net

UMTS Forum:
http://www.umts-forum.org

MAI:
http://www.gprsworld.com

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[1] Moe Rahnema: "Overview of the GSM system and protocol architecture". IEEE Communications Magazine, April 1993.

[2] C. Bettstetter, H. Vögel and J. Eberspächer: "GSM Phase 2+ General Packet Radio Service GPRS: Architecture, Protocols and Air Interface". IEEE Communications Survey, July 1999.

Audio streaming is becoming widely accepted. In particular, Progressive Networks' Real Audio software is in high demand. Although streaming audio programs are more evolved than video, they have yet to achieve hi-fi sound quality. Video streaming is an object of increasing interest. Compared to video codecs for CD-ROM or TV broadcast, the codecs designed for the Internet require greater scalability, lower computational complexity, greater resiliency to network losses, and lower encode/decode latency to achieve the highest possible frame rates and picture quality. Research is currently underway looking at both new scalable, flexible codecs, and ways of scaling existing codecs using transcoding and filters. Currently, the state-of-the-art scalable codec for the Internet is MPEG-4.

Moebius Multimedia Applications

The mobile multimedia applications for Moebius will enable nomadic users to search and stream video data (news, trailers etc.) and display the content on GPRS-capable devices (fig. 5). The user interface to the service is a multimedia portal enabling search and personalisation functionalities. The raw content, along with annotation information (author, copyright, production date etc.) are stored in a database. A software agent will interface the client request to the database (fig. 6).

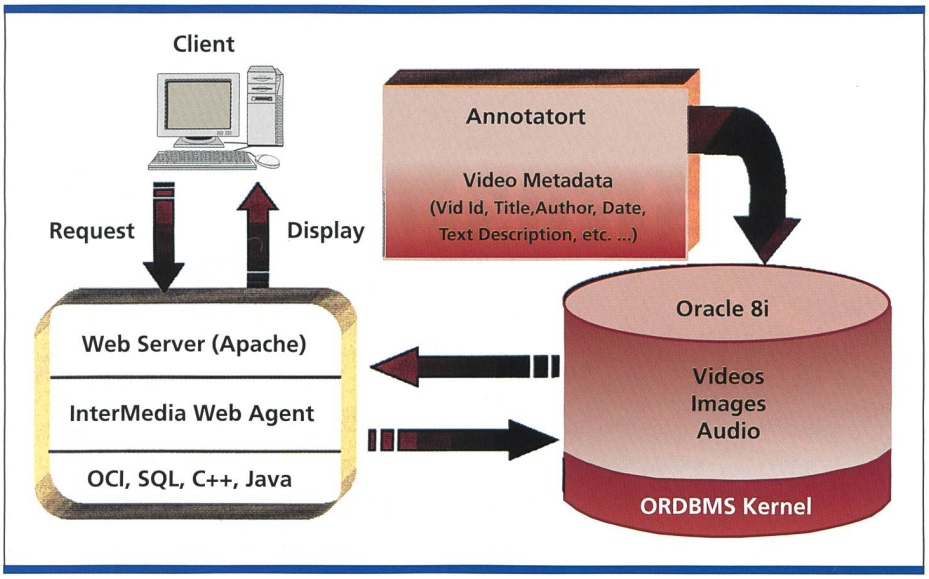

Fig. 6. The Oracle Intermedia database handles multimedia content. The content (audio, video etc.) has been annotated with information (author, actors, date, movie director etc.). The Web Agent acts on behalf of the user and provides the interface between the stored content and the Web Server. The requests are handled by the Web Agent and forwarded to the database for retrieval.

Conclusions

The convergence of Internet and Mobile technologies implies a new framework for service provision. The Moebius Mobile Extranet Platform provides access to an Intranet home environment using public network access which includes GPRS. The platform is designed to demonstrate an integrated secure service platform spanning public and private operating environments. It supports a range of applications with different demands on the GPRS network. The effectiveness of this platform, as well as the user acceptance, will be tested during field trials in healthcare (remote monitoring of patients) and through business applications.
The experience gained in the Moebius project will be of great value for the deployment of 3G-services.

Abbreviations

BSS:	Base Station System
CODEC:	Coder-Decoder
DHCP:	Dynamic Host Configuration Protocol
EDGE:	Enhanced Data rate for GSM Evolution
GGSN:	Gateway GPRS Support Node
GMSC:	Gateway Mobile Switching Center
GPRS:	General Packet Radio Service
HLR:	Home Location Register
HSCSD:	High Speed Circuit Switched Data
IST:	Information Society Technology (EU project framework)
MSC:	Mobile Switching Center
PDP:	Protocol Data Packet
SGSN:	Serving GPRS Support Node
SSL:	Secure Sockets Layer
UMTS:	Universal Mobile Telecommunications System
WTLS:	Wireless Transport Layer Security

Zusammenfassung

Zwei Trends sind im heutigen Telekommunikationsmarkt auffallend, nämlich das ungebrochene rasche Wachstum von GSM sowie die explosionsartige Zunahme internetbasierter Dienste. Die jetzt anlaufende Einführung von GPRS (General Packet Radio Service) bedeutet ein Verschmelzen der beiden Bereiche Mobilkommunikation und Internet. Dadurch entstehen bereits in naher Zukunft mobile Multimedia Dienste und der Markt wird auf die umfassenden Möglichkeiten von UMTS vorbereitet.

Outlook

The Enhanced Data rate for GSM Evolution (EDGE) technology currently being finalised by the 3rd Generation Partnership Project (3GPP) will increase the bandwidth capabilities of the GSM radio interface. The GPRS higher layer protocols will stay the same, however, with the result that EDGE will deliver higher data rates while still using the same GPRS network infrastructure. The Universal Mobile Telecommunications System (UMTS) will use new radio frequencies and will support even higher bit rates and full multimedia capabilities. [7]

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