GSM System Description

Product Description

ERICSSON

Contents

Please note that this description includes details on both basic and optional products. It does not necessarily correspond to any specific release or delivery time.

1 Introduction

The Ericsson GSM system is a platform for mobile telephony operating in the 900, 1800, 1900 MHz range. The platform supports standards from the European Telecommunications Standards Institute (ETSI) and the American National Standards Institute (ANSI).

Ericsson's GSM is a total system solution, including switching systems for packet and circuit switching, radio control nodes, and base transceiver stations; network data bases, service platforms, and network management nodes with an entire range of enterprise solutions and services. The system ensures that you get the system standard with open interface benefits, complete security, seamless global roaming, data communications, Internet access, secure and efficient billing, and a complete customer services portfolio that can do anything from helping you with getting a network started to maintaining your radio network equipment.

The system provides users with bearer and teleservices, to specifications. The need for flexible network solutions, innovative charging, service segmentation, service creation, and easy Operation and Maintenance (O&M) are available in a GSM/Intelligent Network (IN) integrated framework. Naturally, GSM also caters for packet and Internet Protocol (IP) techniques and services, and is a major flagstone on the path towards the Universal Mobile Telecommunications System (UMTS) in the 3rd Generation (3G) and beyond.

1.1 Update information, Rev D

In Rev D the following areas have been updated:

Revenue earning solutions: WISE™ section updated

Ericsson: your secure partner: GSM 400 removed, IP-BSS updated. Mobile Core Network (layered network) introduced. Future mobile systems added (glimpse of the Fourth Generation [4G]).

The Base Station System (BSS): RBS 200 removed, figures removed. Sunsite (power system solution) added.

Managing and planning GSM systems: OSS, NMS,TEMS: NMS edited, figures edited; text updated to R 8.1deliverables

The Ericsson service portfolio: Updated

1.2 Low total ownership cost

The Ericsson GSM system cooperates with other existing Ericsson cellular infrastructures, on site. Capabilities for high speed data and video telecommunications with GSM Phase 2 and 2+ are assured. Ericsson's GSM system can be migrated or be brought up to speed for UMTS global roaming capabilities in 3G. The system supports multiple frequency bands (that is, multiband support) meaning, for example, that operators can support both GSM 900 and GSM 1800 in a single network.

In the Ericsson solution, the following is achieved:

- Decreased network investments for operators with multiband frequencies, since the same Mobile Switching Centers (MSCs) / Base Station Controllers (BSCs) can be used for all.
- Decreased network operating cost due to infrastructure sharing and co-siting when using different systems (for example, GSM and Wideband Code Division Multiple Access [WCDMA]).
- Enough added flexibility to sign roaming agreements with other operators, broadening the operator's subscriber offerings.
- Strengthened competitiveness against other mobile telephony standards due to customers using 900 for coverage and 1800 for capacity.
- New segments are reached (the operator can differentiate charging depending on the frequency band used).

No other mobile communications system supports advanced roaming capability or implementation of roaming agreements like GSM does, and Ericsson has the best total solution. For GSM, the following types of roaming exist:

- National roaming and international roaming
- Roaming between different GSM frequency bands (that is, between GSM 900, GSM 1800 and GSM 1900 bands, and others)

The SIM card concept

GSM was specified with a strong influence from Integrated Services Digital Network (ISDN) concepts regarding service definition, as well as signaling protocols. Roaming between different applications is provided by Mobile Application Part (MAP) interfaces.

The SIM card concept can be found in no other mobile telecommunications system, and is increasing in use all the time, now that enterprise applications in wireless data are on the market. The SIM card lets operators check the subscriber's identity before a call is set up, can prevent unauthorized use of stolen SIM cards, or lets them bar subscribers who have not paid their bills. With dual band terminals, subscribers will use a single terminal (meanwhile, this is supported by Subscriber Identity Module [SIM] card roaming).

The dual band concept

It is a basic requirement that the system can support multiband operation between GSM 900 and GSM 1800 (for example, handover between these bands).

However, an optimized investment and an efficient network operation requires that the 900 and 1800 system have full flexibility both in terms of infrastructure and functional sharing for all involved nodes; that is, the Base Station Controller (BSC), Base Transceiver Station (BTS) and Operation and Maintenance Centers (OMCs) to reduce the total network ownership cost. This, since all the nodes can be configured to the desired frequency band.

By making additional frequencies available to the GSM operator, additional capacity can be achieved seamlessly by using dual band mobiles, dual-band functionality, and efficient traffic management features in the network. For many operators, this is the solution to future problems with congestion in the GSM 900 band. For 1800 operators, the same functionality can solve coverage issues.

The capacity potential in the dual band network depends, of course, on the amount of frequencies available in the two bands - but also on the penetration of dual band mobile terminals. It is clear that a significant portion of dual band mobile stations is needed. However, the long-term aspect should not be critical, since the majority of all new mobile terminals today support dual band.

Cost efficient network expansion, coverage, and quality

As radio network capacity increases and Transceivers (TRXs), or sites, are added, BSC capacity must be added, as well.

The Ericsson BSC makes network expansion easy and cost efficient. Traffic can be multiplexed from many RBS sites onto a single transmission link to BSC (in collocated MSC and BSC node situations). When traffic increases and the BSC capacity is increased, then the transmission hubs can be converted to unstaffed, remotely-controlled BSCs.

The Ericsson BSS (which the BSC and BTS make up) is a fully dual band system, as well. Being full-dual band means large savings in infrastructure for operators who have dual band as an alternative. The BSC handles both the 900 and 1800 frequency bands within the same node, with total transparency (or equality) regarding features and functionality. It is therefore actually one system with an extended frequency band (900+1800) rather than an integration of two different systems. This is what Ericsson means by a fully dual band system.

Ericsson GSM high-capacity solutions

Operators have traditionally been building smaller and smaller cells to increase network capacity. But, after satisfying indoor coverage demands, further macro cell network density is often not the best choice, either from an economic or a radio network performance point of view. Expanding the macro cell network is usually costly and frequently poses site acquisition problems. Ericsson suggests operators maximize existing GSM infrastructure capacity before investing in new sites.

The Ericsson GSM system offers an operator the following alternatives to continue increasing radio network capacity to meet demands. For all operators, a suitable combination of the available options will always provide the most cost-efficient and futureproof solution. Which methods to choose depends on matters like strategic choices, license restrictions, and so on.

Tighter frequency reuse

By using frequency hopping, Ericsson quality-based dynamic power control and discontinuous transmission, and innovative frequency allocation techniques such as Multiple Reuse Pattern (MRP) and Fractional Load Planning (FLP) can be implemented. These enable very tight frequency reuse patterns, allowing more transceivers per cell.

MRP uses baseband frequency hopping, where transceivers in a cell equal the number of frequencies. Each transceiver has it own frequency reuse pattern, which is successively tightened. An advantage of MRP is that the Broadcast Control Channel (BCCH) carrier can be included in hopping sequences, and a reuse of 12 will be enough for the transceiver configured as BCCH. Meanwhile, the other transceivers in the cell transmit only on traffic channels, and can have a tighter reuse. (An example of a MRP frequency allocation with four transceivers using 30 frequencies is 12/8/6/4, the average reuse is 7.5.)

FLP uses synthesizer frequency hopping, where the frequencies in a cell can be larger than the transceiver amount. Since there are more frequencies than transceivers, each frequency is only used a “fraction” of the time.

The most common FLP patterns are 1/1, where all cells in an area use the same Traffic Channel (TCH) frequencies, and 1/3 where every third cell use the same TCH frequencies. For both patterns, the result is much easier frequency planning compared to MRP. Another advantage of FLP is that when adding transceivers, no frequency replanning is necessary. The reuse is automatically tightened when new transceivers are taken into service.

Applying tighter frequency reuse enables a fast, cost-efficient alternative to increase capacity when the existing network is congested. It does not require additional spectrum, new mobiles, or new sites to be built. Simple expansion of transceivers in the existing cells is all that is needed.

For the areas with a very high capacity need, tighter frequency reuse, combined with the other main methods, provides a very spectrum efficient way forward to virtually unlimited capacity. The dedicated micro cell frequencies required can be made available by applying a tighter reuse on the macro cells. By using frequency hopping; that is, synthesized frequency hopping over many frequencies, in micro cells, it is also possible to keep frequencies required exclusively for the micro cells to a minimum.

Growing on site with the GSM Capacity Booster macro solution

Expand on existing sites in urban areas using the GSM Capacity Booster solution. The GSM Capacity Booster uses an RBS 2205, an adaptive antenna, and a cell planning application. In network areas where capacity cannot be increased without building new sites, the GSM Capacity Booster means huge advantages in the face of finding and acquiring new macro sites. This solution is intended to eliminate bottlenecks in GSM 900 networks by removing interference problems in congested areas, and allow further capacity expansion in neighboring cells. By monitoring traffic demand and sending narrow beams to each mobile station from a passive, eight-lobe array antenna, the GSM Capacity Booster greatly reduces interference.

GSM Capacity Booster achieves high capacity at low cost. It uses a multibeam antenna to dynamically transmit and receive only on the beam that is best suited for a specific mobile station. This dramatically reduces the interference in the network, allowing for a much tighter frequency reuse. GSM Capacity Booster can increase the capacity by up to 250% compared to the tightest frequency reuse possible today. Many surrounding cells can also be expanded with additional transceivers. By installing GSM Capacity Booster in less than 20% of the macro cells in an area, the macro cell network capacity in that area can be doubled. GSM Capacity Booster is most cost efficient up until approximately 20-25% of the cells in an area have been converted. As even more cells are converted, the network capacity will continue to increase until all cells are using GSM Capacity Booster.

Dual band suits higher data-capacity demands

The improved data capabilities of the GSM system introduced by High Speed Circuit Switched Data (HSCSD) and General Packed Radio Service (GPRS) means new ways to create attractive services to address new end user segments. Or to increase usage in existing segments. These services create greater demands for additional capacity.

For a single-band 900 MHz operator with limited bandwidth, greater capacity may be difficult to achieve. A 900 MHz operator can increase the capacity in the network by using tighter frequency reuse techniques, and by introducing micro cells. However, the 900/1800 dual band option makes it possible to significantly increase the capacity in a cost-efficient manner.

A single-band 1800 MHz operator usually has more available bandwidth and, consequently, the need for capacity increase is not as great as for 900 MHz operators. As it is a well-known fact that subscribers want to use their mobile phones wherever they are, offering wide area coverage is important. Wide area coverage is more costly for the single band 1800 MHz operator due to the reduced propagation qualities of the 1800 MHz band, compared to the 900 MHz band. Tri-band capability (900 MHz/1800 MHz/ and 1900 MHz) with handover to “world” phones, is now common.

Micro cells : finding “hot spots”

Introducing micro cells (that is, cells with antennas below rooftops, thus providing a more contained cell) is the next logical step in the process of building higher capacity.

Micro cells are usually introduced in a network to take care of traffic hot spots, quickly providing offload for congested macro cells, as more and more micro cells are deployed a contiguous micro cell layer will evolve.

The profitability of hot spot micro cells depends heavily on a precise location being found. To assist in this task, Ericsson has developed the Hot Spot Finder, which helps operators locate the precise position of a traffic hot spot. Then the actual minimum traffic level that a micro cell in this place would carry can be measured. The Hot Spot Finder can guarantee a profitable hot spot micro cell introduction.

Micro cells often provide additional coverage, thus increasing the traffic uptake in an area. Ericsson recommends introducing micro cells to areas not having a congested macro network.

The two-TRX micro base station, Radio Base Station (RBS) 2302, is designed for maximum efficiency in micro cell applications. It is HW prepared for a four or six transceivers solution by connecting two or three RBS 2302 base stations together. A RBS 2302 is a complete BTS site, including transmission, integrated power supply, and optionally integrated antennas. It is therefore extremely easy to install (see Maxite™, below).

Other capacity-enhancing solutions

In-building systems

As the network matures, more and more subscribers start making calls from indoor locations. In-building systems will also provide significant quality improvement in situations with difficult interference, indoors, such as top floors in high-rise buildings. Designed to provide capacity and quality in indoor situations like shopping malls, airports and train stations, in-building systems are providing operators with new traffic and revenue streams. People tend to make more and longer telephone calls in indoor networks where the coverage and quality is good.

The RBS 2401 is a small, high quality, 2 TRX GSM RBS optimized and designed for indoor applications. It is silent, has no moving parts, and together with its unobtrusive design, easily blends in with office surroundings. Its small size, easy handling and low ownership cost satisfies the operator’s needs for cost-efficient indoor solutions (see more on this in the chapter on RBSs in this document).

Dynamic overlaid/underlaid subcells

A concept that is designed to enhance the gain from tighter frequency reuse is dynamic overlaid/underlaid subcell. It is based on the idea of using certain frequencies close to the cell center, and thereby allows a tighter reuse for these frequencies.

Cell load sharing

Cell load sharing provides the possibility to increase the capacity by distributing the traffic load from busy cells to less-busy neighboring cells, as the traffic distribution is often uneven in real networks. An average radio network capacity increase of 10% is achieved simply by increasing the utilization rate of existing hardware.

Half rate

Half rate could more than double the capacity in a network. The reduced quality for Half Rate (HR) will require higher interference margins in the cell planning process, thus reducing the frequency reuse. The capacity increase is very dependent on the penetration of dual rate mobiles. The operator needs to consider the impact that the reduced speech quality will have on the subscriber perception of the network quality with half rate. However, when combined with dynamic half rate allocation, half rate can be used as a last resource to handle temporary traffic peaks. Consequently, cells can be dimensioned for a higher average traffic level.

Easily-installed RBSs: micro or macro - and DXX

Installation has been made far more easy by introducing the Radio Base Station (RBS) 2000 series into GSM, which comprises both indoor and outdoor versions, and micro RBSs. Quick ordering and installation procedures result in fast network roll outs. Furthermore, Ericsson RBSs have been made even more easy to maintain, and special features are available that enable remote operation and software downloading. All these features are very important when it comes to keeping life cycle costs low.

It is possible to minimize the number of sites needed for coverage during initial network rollout, yet maintain the possibility to expand the capacity by adding TRXs to existing sites, later. Furthermore, thanks to the modular architecture of RBS 2000, it is well suited for supporting both 900 and 1800 equipment in the same cabinet. Hence, a dual band RBS is also available

Multidrop functionality built into RBS 2000s make it possible to cascade (or, daisy chain) numerous RBSs together. The RBS 2000 series is also prepared for connecting to the Ericsson Cellular Transmission System (Digital Cross Connect [DXX]) transport network solution, by which transmission resources are managed in a very efficient way.

DXX allows for various kinds of networks – in star, cascade, ring, or mesh configurations.

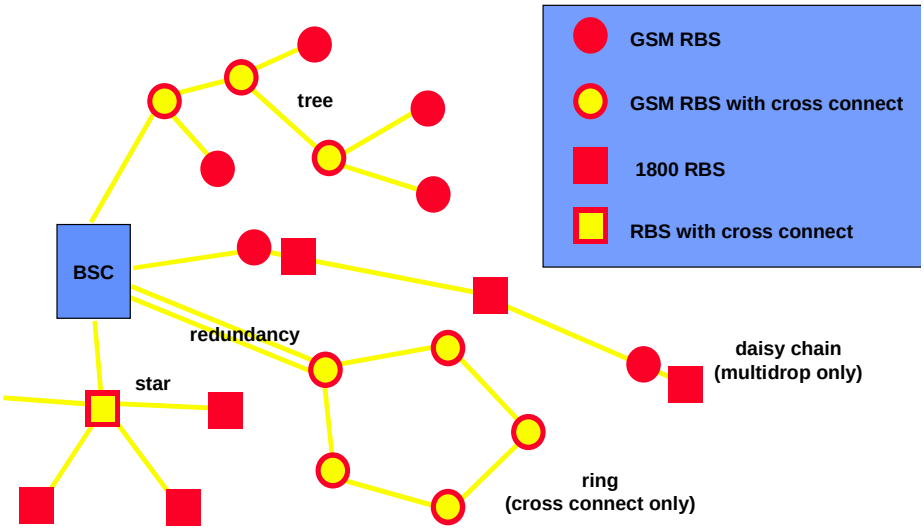

Figure 1-1. BSS network using DXX.

Flexible micro RBS applications with Maxite™

Maxite™ brings together one of the smallest GSM two-transceiver RBSs with an active antenna system and a battery-backed power supply. This gives a micro RBS solution with macro cell coverage for flexible placement. Maxite™ is a complete package with everything needed to build an entire radio site, consisting of a micro RBS, an active antenna, and power and battery cabinet.

Here are some probable applications for Maxite™ in radio networks:

- “Site-friendly" RBS concepts without floor space requirements
- Extended coverage overlay cell in networks with micro cell applications
- Wide area coverage in rural areas

Figure 1-2. . Maxite™ – (left to right) wall, rooftop, and split outdoor and indoor.

Self Configuring Systems (SCS)

Self configuring systems applies to many operation and maintenance processes in a network. Ericsson simplifies the operator's job by introducing a high degree of automation in handling complex, high growth, high -capacity networks.

To find and configure the right neighboring cells is very important for controlling traffic flow and minimizing call drops. With certain features, this task is simplified, due to the capability of the system for making measurements, and then self-propose, or even automatically introduce, changes in the neighboring cells' lists.

Frequency planning is one of could be the single most important activity for assuring high quality in a radio network. In a fast-growing network, constant replanning is needed when new capacity (in the form of additional cells or TRXs) is inserted. With certain features, the operator is freed from frequency planning tasks. Replanning can be kept to a minimum without jeopardizing the network quality, as the system performs measurements and automatically chooses the best frequency to use.

Ericsson concentrates on the self configuring radio network. This involves "smart" adaptive actions to optimize the quality and capacity in each cell, automatic test procedures to determine best settings for complex tuning problems, and perhaps automating manual processes meant for optimizing the whole radio network. This could even entail map data and propagation modeling, initial cell planning, site selection, and network design, verification, and tuning. "Closed loop" SCS is an example. Frequency Optimisation eXpert (FOX) and Neighbor cell Optimization eXpert (NOX) are radio network optimizers that automatically optimize allocated frequencies and cell neighbor relations.

1.3 Shorter time to market

Ericsson's on-line services

Ericsson builds and strengthens business partnerships with its customers through the extranet with e-business.

Efficient use of a range of different extranet solutions is designed to streamline key processes - such as ordering services and information access - both within customer's operations as well as within Ericsson.

On-line service means an extension to Ericsson's internal information network to facilitate communication with suppliers, customers, and integrated partners in a tangible way. While Internet provides public outreach and communication, and the Ericsson internal network serves internal business interests, the extended network serves the business-critical domain between these extremes – where the majority of business activity occurs. It is a hybrid of the two that allow suppliers and partners to work more closely with Ericsson, thus gaining the competitive edge in all aspects throughout the entire value chain.

The on-line service is Ericsson's solution for quick ordering and order-tracking of Ericsson infrastructure and services. Access to product information and knowledge is instant, around the clock, and year-round. Delivery of software and consultancy services is done through the net. There are also bulletin board services that can be used for questions and discussions about products and solutions.

The on-line service brings together and enables competence and knowledge sharing. Being an area of focus within Ericsson, there is a continuous development of on-line products and services.

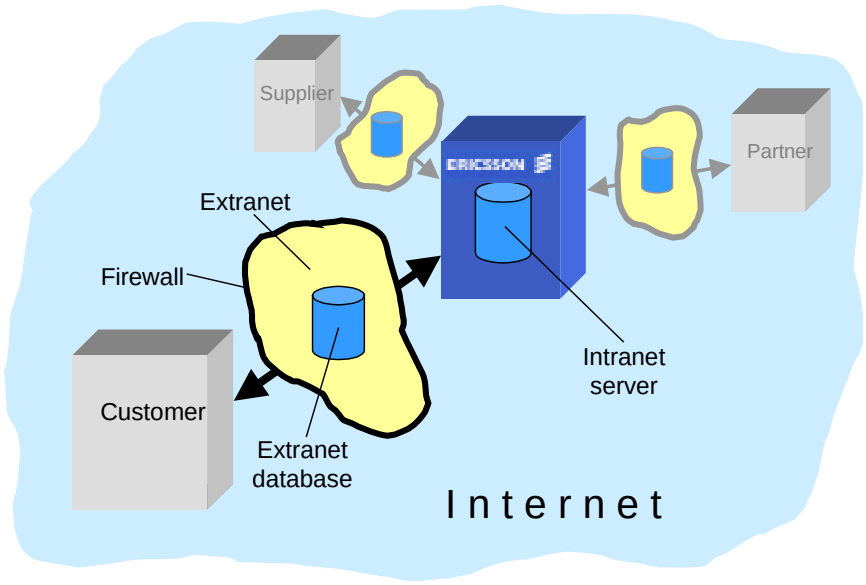

Figure 1-3. Ericsson's extranet: portals open Ericsson up to the market.

Ericsson: a world class supplier

Ericsson's logistic and supply processes take time and money out of all stages of the supply chain: from ordering, through manufacturing, to delivery and on-site installation work. Ericsson handles it all, from product packaging, supply units and improved test and implementation procedures.

By packaging the products in advance, a fast and secure way of building a GSM network is created. The emphasis is placed on system properties, rather than equipment specifications. The packages are customer and site independent. Packaging simplifies the whole ordering process. Since the contents of the products are pre-defined, there is no doubt about what is included or excluded. No time has to be spent on correcting misunderstandings. All product packages are pre-equipped and pretested, which ensures high quality and eliminates omission risks. Deliveries are completely packaged (even cables are prefabricated).

The other key element in the supply and logistics process is the supply unit. Supply units are logistics centers located strategically around the world. These handle order receiving, assembling, configuration, test, and shipping. The order process is streamlined: the customer turns directly to a supply unit (or to a local customer project team) without any extra contacts. And then, the products are assembled, configured, and tested, and sent directly to a specific customer site.

Production starts when orders are received. Minimum-inventory production techniques (also called just-in-in-time manufacturing) mean that needs for warehousing can be cut. A good, finished inventory is no longer necessary, since the packages are shipped directly after they are completed.

Your GSM system gets into use faster – and investments immediately start paying off.

1.4 Revenue earning solutions

Ericsson is creating the Mobile Internet world with new, wireless data communication terminal and infrastructure products, services, and solution packages.

Enterprises

Ericsson creates end-to-end wireless Internet solutions for its customers' use, suiting profit potentials all around. Simultaneously, Ericsson drives its leading position as the preferred mobile service supplier. Ericsson is building architecture between GSM networks and the Internet for enabling solutions within information services, "e-commerce"; media subscriptions, and so on. Ericsson goes out of its way to understand industry needs for the wireless market as the distance and difference between what is quality time and what is doing business diminishes. By prioritzing internal development, partnering, and (for example) stimulating open development for 3rd party products and services, Ericsson caters for "New Economy" solutions more than ever before.

Secure financial transactions

Ericsson now makes it easy for any mobile phone user to access financial services. Wherever they may happen to be – and get covered by GSM data security.

The solution is designed for financial institutions for enabling banking and trading. It supports any service that requires high-security transactions; for instance, account balances, between-account transfers, billing services, equities, and so on.

The end-to-end security this solution realizes means that the bank service Personal Identification Number (PIN) code is used to generate a digital signature. This signature offers the necessary authentication and data integrity required for verifying each transaction. And this solution also supports established techniques for data integrity and encryption – including Public Key Infrastructure (PKI). The solution can therefore easily integrate with the existing IT infrastructure and security features set up by service providers.

Internet services are extended over to wireless telephony. It gives users service on the mobile phone or device - anywhere, anytime. Additionally, this solution will integrate with Wireless Access Protocol (WAP), General Packet Radio Services (GPRS) and Wideband Code Division Multiple Access (WCDMA).

Wireless data management (e-mail on the move, etc.)

For travel vendors like airlines, a main focal point is keeping customers, rather than working at getting new ones (always a costly proposition). With wireless travel management, interesting opportunities are within reach for helping tie customers closer to their supplier, and so, reduce a supplier's churn.

Travelers will have wireless access to services like travel planning (timetables, available seats), travel information (maps, weather forecasts, destination information), travel booking (booking, paying, etc.), leisure (information, packages & offers), and frequent traveler program gateways. Access to the corporate Internet (wireless email, SMS, fax, etc.) is now possible

Terminals will support wireless travel management solutions. Ericsson's solutions here are open, and will migrate into the WAP and GPRS worlds.

Secure financial transactions and travel management are but two applications. With the use of, for example, Ericsson's Mobile e-Pay solution platform, shopping, gaming, and trading are even enabled. Wireless e-mail solutions, and the Ericsson Virtual Office (EVO) concept, for example, allows email to be retrieved while on the move for people who work as they go, or are just being social.

Smart card-based services

A billion smart cards could be in use, globally. One planned solution provides an easy and efficient way to access any smart card-based service.

It will use Bluetooth connections to mobile phones, or to any other Bluetooth-enabled device. Through this connectivity, services such as payment, identification, transfer of loyalty bonus points, and account enquiries can be accessed by the device (for example, on in the form of a wallet). One example of use could be when riding the subway, and the fee automatically gets charged to the traveler's account when passing a sensor - all this without even having to take the device out of one's pocket.

The concept incorporates a multiple smart card reader, Bluetooth connection to a terminal, a user application interface hosted by the terminal, and the server software interface to the offered services.

Mobile Positioning System (MPS) services

The Ericsson Mobile Positioning Center (MPC) is a gateway for the positioning procedure of the MPS. Mobile handsets (Mobile Stations [MSs]) can be located with Ericsson's solution for locating MSs through Internet. The MPC lies between the core network via CCITT Number 7, through intranet (and firewalls) to Positioning Information User Applications (PIUA) loaded onto operator's user terminals.

This server-based solution enables positioning services in GSM networks. Since mobile handsets are ubiquitous, location-based services are increasingly useful and profitable. Guard services, taxis, and trucking companies (fleets) can all utilize these to keep track of shipping, reach personnel, and so on. Such services can be used to locate stolen vehicles, find vehicle breakdowns, and perform accident reporting.

Localized Internet

Localized Internet is a solution giving mobile phone users information about their immediate surroundings over the Internet. Support for finding the route through a city with detailed street maps is one example of use. Localized traffic information about traffic jams in the region, localized yellow pages for finding nearby shops, restaurants, and so forth, are others. The mobile phone's position is determined by GSM positioning, upon user request.

This solution creates an important business opportunity for GSM operators. Revenue is made for the operator through service subscription fees, putting localized banners and advertisements on the localized Internet web sites; increasing data traffic, and attracting new subscribers, among others. Thanks to the Secure Socket Layer (SSL) secure connections are established through client browsers and the server.

“Live” phone directories

For GSM subscribers, the iPulse™ Locator is also a “live” mobile phone book. iPulse™ Locator shows the user where colleagues and friends are, and if they are busy or not. If requested, it is possible to get a notification when a busy friend becomes available. Because the iPulse™ Locator application supports the Short Message Service (SMS) and WAP, as well as the ordinary web interface, end users will be able to use iPulse™ Locator with the latest Ericsson mobile handsets and terminals, as well as with existing and future GSM mobile phones.

iPulse™ Locator is a server-based application that resides on a platform called User Service Center (USC) which is placed at the premises of the GSM operator. It is connected to various standard nodes in the GSM network, as well as to the MPS.

Some IN applications

Additionally, Intelligent Network (IN) services emcompass a wider range of services than ever before.

IN services cover the Service Data Point (SDP) – which is a large data base for services - the Service Control Point (SCP R 8.0) Service Management Application (SMA) Base V2 on either http or Common Object Request Broker Architecture (CORBA), and Service Control Point on Telecom purpose computers (SCP-T). Intelligent Network Application Part (INAP) Capability Set 1 (CS) 1 or Ericsson CS 1 + is enabled in most cases for roaming - and in some cases, CS 2. For getting a foot up in the deregulated market, route selection functionality is also possible. (For more information on IN services, see the sections on the Switching System [SS] and mobile IN integration elsewhere in this document.)

Mobile Virtual Private Network (MVPN)

Join an easy-to-understand management system (user interface) operating on CS 1 and CS 1+ with cost-controlling features, and operators have the Mobile Virtual Private Network (MVPN). MVPN can be used in public networks to link company sites, letting business subscribers create their own private network. They can also establish their own mobile extension numbering system.

Information and Business (I&B) services

Information and Business (I&B) services are actually three services in one converged . (Fixed Mobile Convergence [FMC]) package: Freephone, Universal Access Number, and Premium Rate. This package lets customers keep more easily in touch, increasing contact and driving up airtime use. Where Freephone and Universal Access Number encourages contact (one easy-to-remember number), Premium Rate offers a wide range of variable charging options for the operator to employ) I&B is available.

General Packet Radio Service (GPRS)

With GPRS, wireless datacom and Internet are combined – bringing Mobile Internet to the marketplace.

This packet-switched service will enable end-to-end IP connectivity that can deliver applications and content at speeds of up to 115 kbit/s.

GPRS is one of the keys in evolving to Enhanced Data rates for Global Evolution (EDGE) and UMTS. With GPRS, operators can develop core competencies, partnerships and market channels the Mobile Internet world requires. (For more on how GPRS functions in GSM systems, see the appropriate sections in Switching Systems [SS] elsewhere in this document.)

High Speed Circuit Switched Data (HSCSD)

High Speed Circuit Switched Data (HSCSD) is a feature letting GSM users establish wireless data connections at speeds up to 38.4 kbit/s. This high data rate is achieved by assigning up to four full-rate channels to one data call. Providing the end user with dedicated resources, HSCSD is ideal for:

- Handling large documents such as email attachments and file transfers

- Web browsing
- Video applications.

Moreover, HSCSD gives both operators and end users a head start into the wireless data communications market of tomorrow. It is the perfect evolutionary step to offering data services such as General Packet Radio Services (GPRS) and Enhanced Data rates for Global Evolution (EDGE).

WISE™

WISE™ Ericsson's Wireless Internet Solution, integrates GSM and Internet to help GSM operators sell new data-related services. WISE™ can be solutions offered to GSM operators, products used to create solutions, and services selecting and integrating products according to operator requirements. Packaging in advance means fast time to market and easy installation and integration. Operators launch services, quickly.

Various solutions are available within WISE™ and new solutions are continually being developed. Examples of solutions are Internet Direct Access and High Speed Internet.

WISE™ Internet Direct Access

WISE™ Internet Direct Access connects the GSM exchange to Internet. Data calls are connected directly from GSM networks to Internet using the Ericsson Integrated Access System (IAS). IAS incorporates MSC hardware and software, as well as Ericsson's AXC Tigris access server. The AXC Tigris terminates the GSM modem and UDI (V.110) calls, as well as calls from the PSTN or ISDN networks. This means fast call set up times that eliminate connections via the PSTN. The GSM operator pays no fee to the PSTN carriers – meaning low ownership costs .

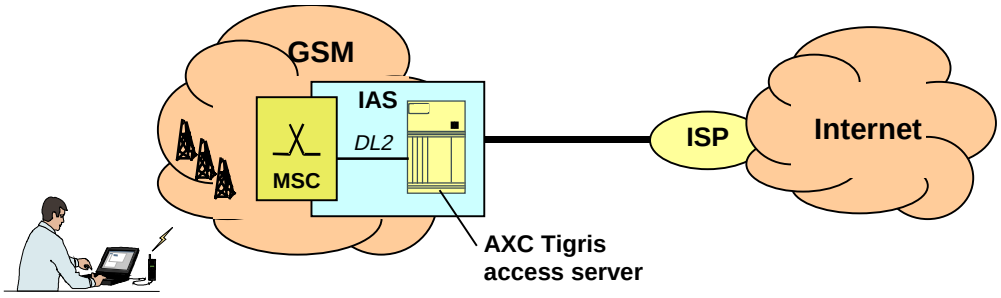

Figure 1-4. WISE™ Internet Direct Access.

This solution includes required MSC hardware and software, plus the Tigris access server – as well as installation, integration, and support services.

AXC Tigris access server

Figure 1-5. Ericsson AXC Tigris access server.

The AXC Tigris is a carrier-class, scalable access platform that copes with high levels of dial-up traffic.

The AXC Tigris connects directly to the GSM's MSC group switch using a proprietary interface. It can also be connected to any supplier's switch using ISDN Primary Rate Access (PRA) ports. Data calls are terminated on digital modems, allowing V.110 rate adaptation software downloads. An Ethernet port connects the access server to an ISP.

WISE™ High Speed Internet

WISE™ High Speed Internet integrates Ericsson infrastructure features and externally connected products to maximize throughput of data through GSM networks. Three techniques have been combined into one with this solution: increased data rate, reduced call setup time, and reduced amount of data. The solution consists of HSCSD, High-level Data Link Control (HDLC) encapsulation on ISDN; the Integrated Access System, WebOnAir™, and filter proxy integration services.

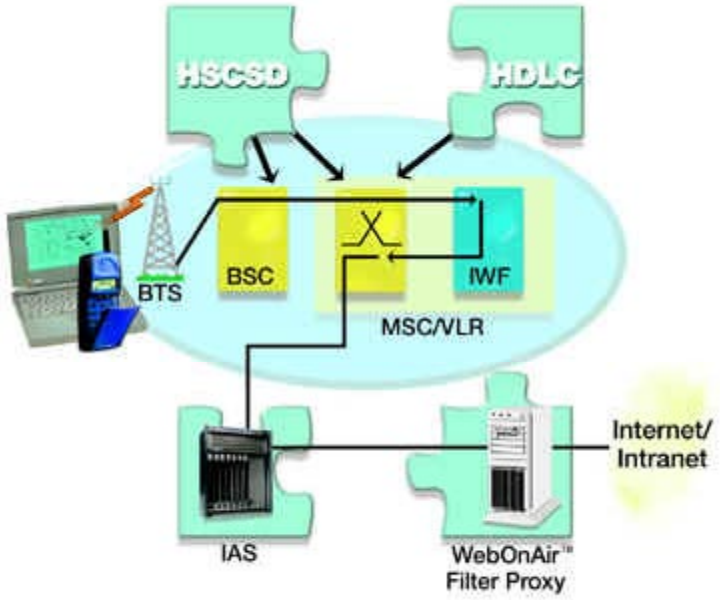

Figure 1-6. WISE™ High Speed Internet.

HSCSD & HDLC encapsulation on ISDN

High Speed Circuit Switched Data (HSCSD) and HDLC Encapsulation on ISDN are available as GSM features. HSCSD enables data transfer speeds from 38.4 kbit/s up to 57.6 kbit/s. HDLC encapsulation on ISDN is an optional network feature. Conventional modems or V.110 data calls are asynchronous with a start and stop bit added to every data byte transferred. HDLC provides synchronous data transmission through the IWF. Using HDLC increases the effective data rate by 25% via eliminating start and stop bits.

WebOnAir™ Filter Proxy & IAS

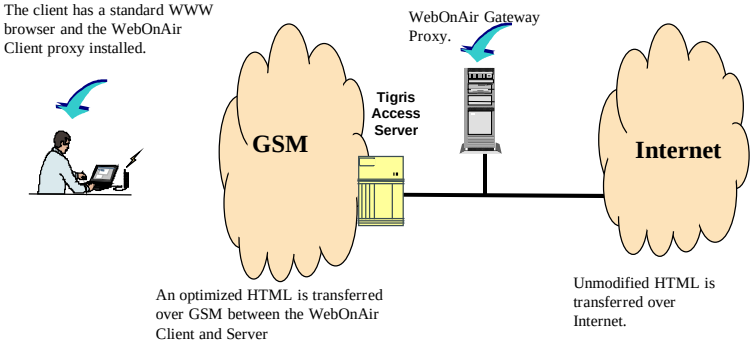

Figure 1-7. WebOnAir™ filter proxy.

Ericsson's Wireless WebOnAir™ Filter Proxy is a client-gateway solution that speeds up surfing on wireless networks.

The server is placed between the mobile client and the Internet at, for example, the operator 's location or with their ISP partners. The client proxy is installed in a Windows 95, Windows 98, Windows NT4, or Windows CE 2.0 device and interacts with standard web browsers. All web accesses to the Internet are passed through the gateway proxy, which optimizes downloading (distilled graphics, etc.) meaning high quality.

Some newer packages for WISE™ are WISE Trust (consultant service), WISE™ Time to Wap (solution) and WISE™ Services Unlimited (service package).

WISE™ Portal

With a technical platform (for an operator-branded portal), a content and application portfolio, and selected (professional) services, WISE™ delivers its portal solution. With this, operators obtain a “mobile window” to the customers.

This solution features Extensible Markup Language (XML) that allows new device type introduction, and separates the service from the service logic. WISE™ Portal is also access independent of bearers (GSM, GPRS, and WCDMA). End users can utilize services through any number of devices, such as personal computers, WAP phones, and Personal Digital Assistants (PDAs).

WAP

The Wireless Access Protocol (WAP) is a network-independent solution for providing Internet access and information over devices with low bandwidth, long latency, less connection stability, and lower reliability. With WAP, users get a standardized protocol and markup language that works with any vendor’s compatible terminal or handset. Ericsson offers a number of services available in the WAP application-server line.

Ericsson’s WAP Gateway is a link between information on the Internet and the GSM network. WAP-enabled mobile phones and Personal Digital Assistants (PDAs) contain micro-browsers, and these use any bearer service (like GPRS, for instance) to send and receive information via the WAP Gateway to an application server.

Ericsson also provides a WAP development toolkit, WAP Integrated Development Environment (WapIDE), which allows service developers to design, test, and implement WAP applications in an integrated environment. .

GSM on the Net

This Ericsson solution combines mobility with Internet networking cost efficiency.

This solution already can handle voice and some data (such as Internet and email) and macro GSM coverage. But a solution as such requires multiple support of various infrastructures, too many phone numbers, and less overall cost control.

GSM on the Net is a converged solution that will eliminate this. A common platform uses the existing large area network as an inside-the-office transmission access, and the existing macro GSM network for communications outside beyond the office. Accessing or using GSM on the Net will be done with GSM phones, IP phones, PCs, and others, enabling multi-mobility on a common, controllable platform. Reachability is constant, increased efficiency immediate, with optimized infrastructure : there is only one technology to control, maintain and manage.

The system has open standard APIs, for easy integration, is Bluetooth/ Qlan Hyperlan2 prepared, uses standard handsets and devices (CCITT Number 7 gateway for MAP signaling) and has H.323 for handling multimedia communications over the Internet. This means that GSM on the Net is a futureproof solution for companies wanting a secure and efficient place at the starting gate for the Mobile Internet race.

GSM Pro

GSM Pro is a Private Mobile Radio (PMR) concept and a GSM revenue-adding network solution consisting of a server, rugged terminals, and wireless dispatch consoles. Customers interested in this use mobile radio services and have a mobile work force spending a lot of their time out of the office, and often perform heavy-duty tasks for which GSM Pro has been tailored. Customers include utility repair forces (like plumbers, for example); security guards, police, truck drivers, forestry workers, construction workers, and so on. They need equipment and features such as:

- Rugged, waterproof, shock-resistant Mobile Stations (MSs) and terminals
- Chances to make group calls and person-to-person calls.

GSM Pro does not force the operator to get a whole new air interface, more or new radio base stations, or switches. Nor is it necessary for them to change or upgrade their GSM system network, except for adding capacity and standard interfaces with the appropriate signaling. GSM Pro can be added to most existing GSM networks - or be a part of a new GSM installation.

1.5 Ericsson is your secure partner

Ericsson has been designing cellular radio systems since the 1970s, and has been deeply involved in radio research and development for over sixty years.

Ericsson offers network products for all major cellular standards - such as the Nordic Mobile Telephone (NMT) system, the Total Access Communication System (TACS), Advanced Mobile Phone System (AMPS), Digital AMPS; the Personal Digital Cellular (PDC) standard (Japan), Global System for Mobile Communication (GSM); the CdmaOne and Cdma2000 standards, and the WCDMA standard. Ericsson also now has IP competence that caters for solutions that utilize most of these technologies.

Ericsson's involvement in research has also contributed to standardization activities world wide. Today, Ericsson participates in most standardization efforts, and this work is naturally implemented in the systems and products from Ericsson. Some recent examples of standardization work are Bluetooth, Customized Application for Mobile Enhanced Logic (CAMEL) for roaming, WAP, and 3rd Generation standards.

GSM : now and in the near future

GSM is a core out of which future mobile systems and many solutions will be built.

GSM is meeting the requirements for universal mobile telecommunications (3rd Generation) services. GSM can (or will) support (for example):

- Flexible bearer and bandwidth-on-demand services up to two Mbit/s for indoor environments and at least 144 kbit/s for wide area coverage, and higher.
- A variety of mixed traffic types and relevant charging capability for mobile multimedia applications
- Customized services, service creation environments, and service flexibility using, for example, Intelligent Network (IN) tools

- Wideband Wireless Local Loop (WLL) enhancements to fixed networks.

What makes GSM such a strong platform for future mobile systems is its global success. There are well over 300 million subscribers, worldwide. Ericsson supplies well over 40% of the GSM systems. And these figures grow constantly.

Because of its open architecture, GSM has allowed operators to “mix and match” equipment from numerous vendors, and this, combined with economies of scale in manufacturing, will continue to keep down implementation costs. Given the continuing investments in current systems, these networks are providing large and competitive platforms for mobile services into the future. (GSM systems can, for example, be made to interwork with satellite personal communications systems.)

Besides HSCSD and GPRS for wideband radio access, support for wireless local access at two Mbit/s enhanced bearer services is evolving through developing current GSM technology. Examples of this are multicarrier aggregation and high-level modulation methods.

GSM networks have always included IN functions. This has allowed for creating, controlling, and porting services. Roaming subscribers can have access to their full portfolio of IN services through CAMEL. This means that service providers are creating and deploying services through standard means, and that roaming subscribers’ home networks can remotely control services in the visited network.

GSM services and nodes are evolving and gradually being enhanced in a backwards-compatible way, so that operators and subscribers do not need to sacrifice existing services and infrastructure in order to enjoy newer ones on the road to 3G. Keeping customers currently in their digital mobile businesses, getting newer ones to grow – and helping to carve out the shape of the 3G world - is Ericsson’s business.

IP BSS

GPRS and EDGE will bring with it both an increased surge of applications – and place greater demand on the GSM network. Additionally, bursty packet data and circuit switched services will find themselves in a mixed service package for availability through GSM. IP-BSS is a futureproof IP based architecture that will handle this traffic.

Ericsson's IP BSS means transmission that is "connectionless" in GSM BSS, supporting ETSI and ANSI towards the Mobile Switching System's (MSCs) A interface, GPRS's SGSN Gb interface, and eventually, the radio interface (Um interface, in WCDMA infrastructure), with expansions.

IP-BSS is a supplementary technology to GSM-BSS, allowing IP-based GSM access networks to be built using realtime routers as main building blocks. IP-BSS is based on GSM, and there are no multi-vendor interoperability requirements on the A-bis interface. The experience gained from implementing IP-BSS will be used by Ericsson in the design of radio access networks for other cellular standards, (including cdmaOne, cdma2000 and WCDMA).

The IP-BSS will consist of a:

- Radio Network Server (RNS)
- IP network (realtime router, RXI 820 [with IPv4, IPv6 capability])
- BSS gateway
- RBSs
- O&M system

3G/UMTS: first phases

3G technology is turning mobile networks from "one-service mobile telephony networks" into *multi-service networks* (for example, the Mobile Internet). This change has already started with GPRS technology being introduced.

Over the next few years, GSM core architecture will move to meet UMTS for planned product and market availability, and vice versa. That is, the GSM platform is evolving into UMTS, with a new architecture, utilizing in its turn Radio Network Controllers (RNCs) and WCDMA radio base stations, etc, as it grows with existing, optimized 2G air interface nodes and functionality.

3G networks will provide a multitude of services. All these services (except voice) are based on IP technology, requiring a high capacity radio interface (WCDMA) and full global support for mobility. The long-term goal is to base all services on common IP technology.

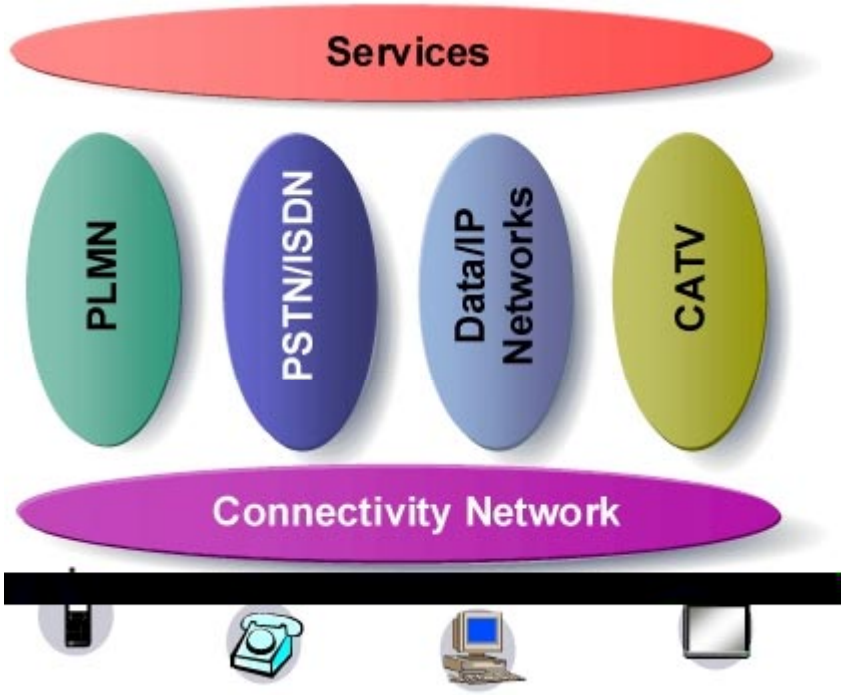

Figure 1-8. The “layered architecture”: the GSM mobile net evolves into UMTS and hosts multitudes of 3G services.

True multi-service networks of the future will need a:

- Layered network architecture with clear horizontal layers for a service network, network control, and connectivity network.
- IP based service network for flexible service deployment.
- IP packet transport technology flexible enough for all new services, and efficient for both data and telephony services

- IP multimedia call-control which enables realtime multimedia sessions over the IP network.

Coming networks for 3G/UMTS will be mega-networks compared with today's IP networks, as they are deployed for Internet and intranets. New functionality - and even new thinking - will be required to handle these networks with tens or even up to hundreds of millions of users. IPv6, with its extended addressing support, is an important component in extremely large, IP-based networks. Additionally, 3G networking is not limited to the WCDMA radio access technology, alone. 3G services will most likely be available on fixed access and fixed mobile access technologies, such as wireless LAN or Bluetooth.

As such, 3G mobile networks will be larger and more complex than GSM networks now in existence. This means that network operating costs must be rationalized even more than with GSM. So, good solutions for network and service management and competence development are crucial. Customer relationship management will be one of the most essential and business-worthy tasks of Ericsson.

Future generation mobile systems

Envisaged is growth in data speeds across a 5 MHz spectrum, over time, passing 2G (9.6-14.4 kbit/s) past “evolved 2G” (64-144 kbit/s) into 3G (384 -kbit/s – 2 Mbit/s); levels of evolved 3G (384 kbit/s – 20 Mbit/s) and eventually, “4G” where 100 Mbit/s speeds are visualized.

Whatever the future holds for GSM as a player in Ericsson’s mobile systems portfolio, it is sure to be a leading technology in, and benchmark for, future communications platforms.

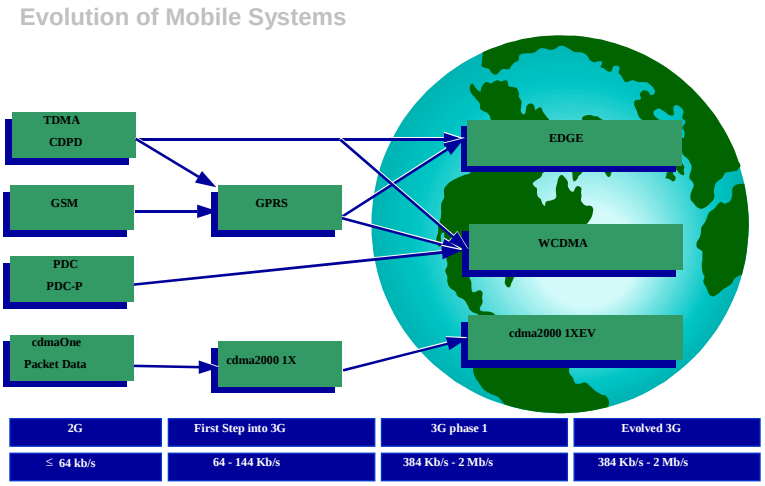

Figure 1-9. Network evolution from 2G through 3G.

2 Ericsson GSM's flexible platform

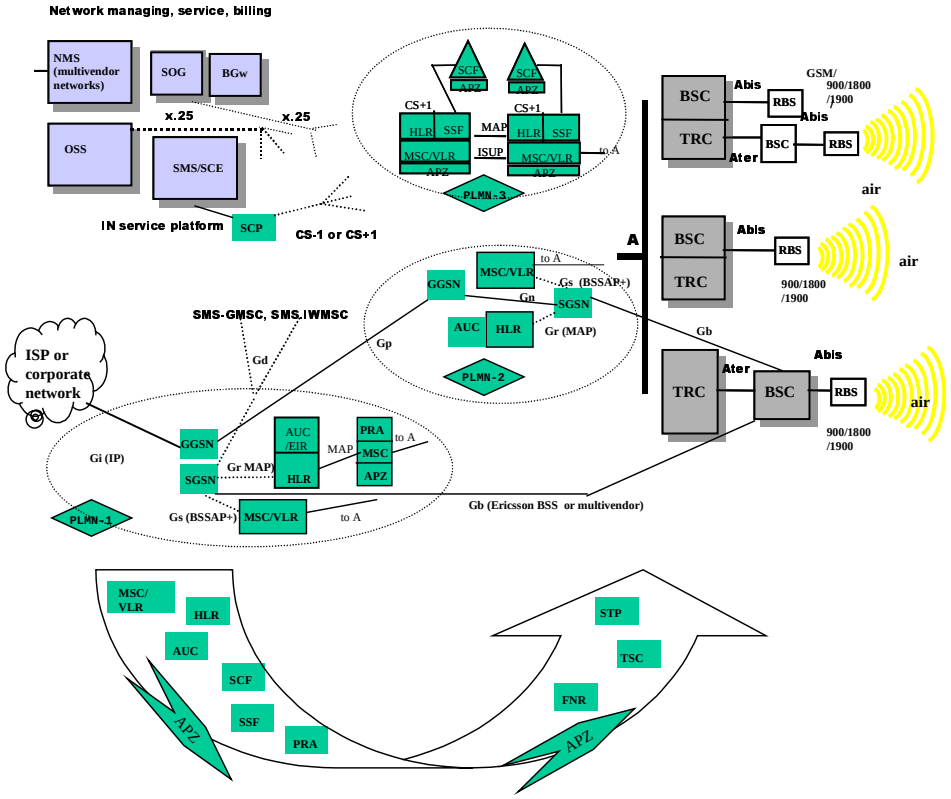

Figure 2-1. Ericsson's standard GSM platform, enhanced for GPRS: Three examples of public mobile networks are generically created using Ericsson's GSM. Flexible architecture:flexibility in creating applications and adding customers.

2.1 AXE – the Ericsson GSM common system platform

The AXE duplicated central processor is optimized for telephony. It serves as the base for implementing most leading telecom standards and applications beyond GSM. Additionally, AXE is ideal for router technology.

Having AXE means:

- That the same AXE system can be used for a wide variety of applications; from small, local exchanges, up to large international switching centers
- Each software module has complete control over its own data
- State-of-the-art hardware design and administration. (A “building-block” philosophy is applied, from the components on the Printed Circuit Boards [PCBs] to the cabinets that contain them)
- That new AXE technology is added regularly, so AXE is always state-of-the-art.

A major feature in the AXE platform is the ability to serve many node applications – from small, single cabinet, in-office nodes - to powerful and compact transit switches.

Some of AXE’s control systems are:

- APZ 212 20
  - Contains many features of the APZ 212 11, only with a higher clock speed, fewer boards, and higher memory
- APZ 212 25
  - A small, very powerful processor with the same characteristics as the APZ 212 20 – yet requires only half a subrack in the BYB 501.
- APZ 212 30
  - The highest-capacity AXE processor.

IOG

The I/O system is a common Hardware (HW) resource in AXE. The system can handle a full range of node applications, from those with low capacity requirements to some with extremely high capacity requirements - while always maintaining high reliability. The IOG 20 – handling alphanumeric and file data transport - is the most recent AXE HW platform.

ET-155 – high speed connection

The worldwide explosion of GSM networks has led to a demand for high capacity transport network solutions.

Ericsson is already the world leader in high capacity mobile networks, and will now also add a high capacity Synchronous Digital Hierarchy (SDH) interface - Exchange Terminal (ET) 155, to the switch nodes (ET 155 is an integrated part of AXE – and not the transport network). This SDH network will meet capacity demands of GSM networks, and will be the foundation for the 3rd Generation (3G) mobile systems.

ET-155 is an STM-1 interface in the mobile switch, enabling a high speed SDH connection directly to the transmission network. Some benefits for operators are:

- Less HW and cabling
- Less power consumption
- Very high reliability
- Reduced O&M cost, since no manual link handling at site is required.

ET-155 will be available for the BYB 501 building practice with optical interfaces.

AXE Application Modularity (AM) with GSM

The Application Modularity (AM) concept inherent in AXE technique allows for application modules to be flexibly built (that is, allowing for flexible configuration) onto AXE to suit a host of customer needs. Application modularity is used in mobile IN for implementing nodes for facilitating roaming with services.

An operator selects a module for their needs, then builds onto it later, getting newer applications, faster. With application modules, a flexible solution that can "mix and match" different Intelligent Network (IN) and GSM nodes and different APZs, drawn from "toolbox" configurations, is possible. For example:

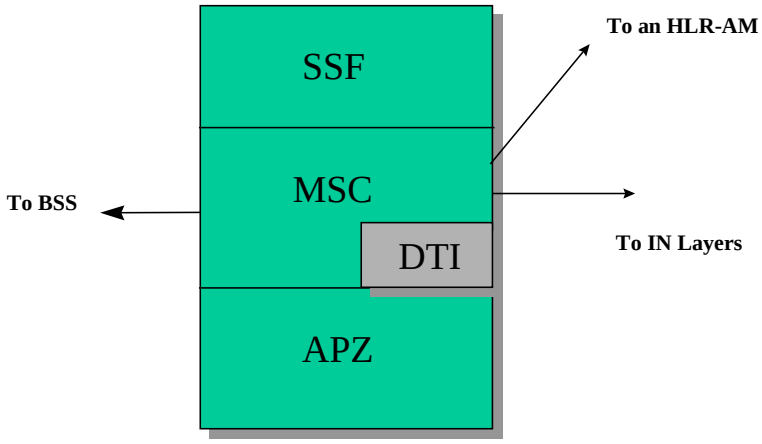

Figure 2-2. A generic switching-system choice.

In the case with the figure above, the Service Switching Function (SSF) and the Service Control Function (SCF) are integrated with a GSM network. The SSF allows access to IN functions in the SCF. SSF acts as a vehicle between the network and the SCF, providing the latter with information coming from the GSM network, and performing tasks ordered from the SCF towards GSM.

The application modularity concept[1]:

- Continuously evolves to adapt to AXE for meeting market demands
- Flexibly allows keeping many applications in one system (SCP [SCF, gsmSCF],MSC [SSF, gsmSSF], SDP [SDF] and other nodes like HLR, etc.)
- Allows for easier service introduction
- Increases customer focus
- Improves processing
- Easily introduces new technology
- Provides total solutions to customers

[1] Note: AMs will only work with other application modules and existing source systems through application module protocols. They will use Application Platform Service Interfaces (APSIs) to communicate with each other. Also, one module is independent, internally, from other AMs. If adhered to, each application module will have its own design and use the most suitable software structure, solutions, and techniques to suit a customer's needs; a minimal impact on existing applications, and porting existing modules between both systems and markets.

2.2 The Switching System (SS)

Packet switching: the GPRS service

GPRS is a bearer service that provides mobile data users with unprecedented high-speed data capabilities.

The data is sent in equal-sized packets. Each packet contains the destination address, meaning there is no need to reserve and establish paths. Using this packet switching technology, mobile data transmission rates leap from 14 kbit/s to a maximum of 115 kbit/s. GPRS achieves this by using up to eight timeslots. Another plus with GPRS is that radio resources are only used when data is being transmitted. When no data is being transmitted, radio resources can be used for other packet or circuit-switched traffic.

GPRS takes an operator's existing GSM infrastructure into account for quick and easy network introduction. To implement GPRS, there is a new hardware component called the GPRS Support Node (GSN). The GSN is flexible and can be configured in different ways. Here are examples of SGN configurations:

- A serving GPRS Support Node (SGSN)
- A combined SGSN/Gateway GPRS Support Node (GGSN)
- Conversion of a combined SGSN/GGSN to an SGSN or a GGSN with a software upgrade

GPRS capacity is gauged in Kilopackets per second (Kpps) where nodes are optimized for packets of 300 bytes in size. The GSN supports basic network interworking: Point-To-Point IPv4, an open Gb interface to BSS, and other standard interfaces, multiple backbone network interfaces; for Asynchronous Transfer Mode (ATM), and Internet Protocol (IP) address allocation. The GSN also support GPRS terminals in different classes, and contains built-in O&M and network management functionality.

The Ericsson GPRS:

- Uses scarce radio frequency very efficiently by dynamically allocating circuit or packet-switched traffic
- Enables many users to share radio resources, meaning better channel use. The end user remains connected to the data source

and can be charged in a number of different ways; for example, for the amount of data transmitted

- Is integrated into – and works within- existing GSM infrastructure
- Supports major datacom protocols that connect fixed or mobile terminal equipment to any data source
- Is convenient (since the user can remain connected without being charged for session duration) and gives fast call set up times.

Ericsson's GPRS solution targeting the mass market with data source applications such as Internet, email, corporate phone directories, multimedia training tools, and so on. GPRS applications are being developed for specific purposes, such as for vending and lottery machines (ticket vending); dispatch operations (taxis, police, medical emergency) telemetry, news sources (stock information) and more.

GPRS is literally an extension of GSM architecture. Packet data traffic runs on a backbone IP network, and is separate from the existing GSM core network that is used mainly for speech.

The Serving GPRS Support Node (SGSN) handles packet data traffic of users in a geographical area. The Gateway GPRS Support Node (GGSN) connects to outside data networks. SGSN and GGSN are routers that support terminal (handsets, etc.) mobility.

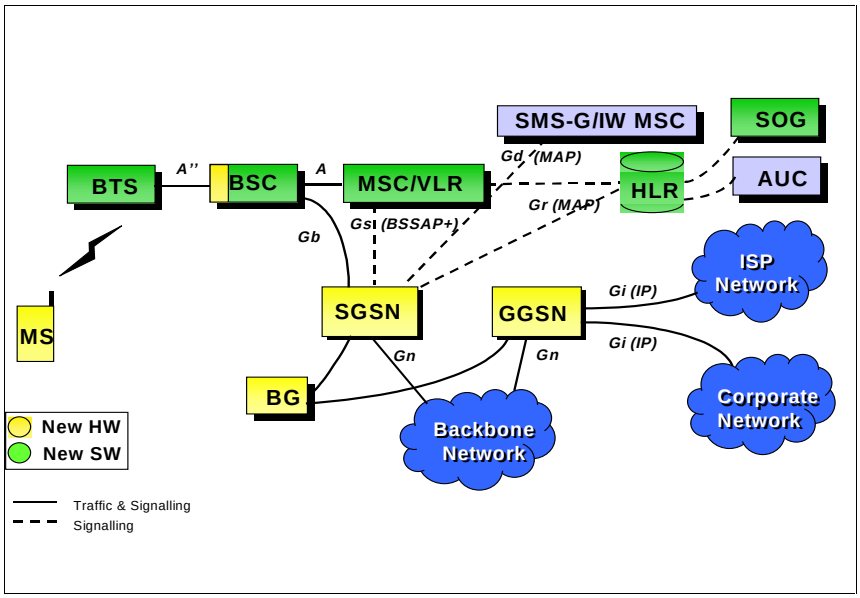

Figure 2-3. GPRS: cutting the Mobile Internet path.

MSC/VLR

The Mobile Services Switching Center (MSC) Visitor Location Register (VLR) handles call set up, call routing, and call termination - as well as inter MSC handovers, supplementary services, and collecting charging and accounting data. As GPRS is GSM's data heart, so is MSC the system's switching heart.

The VLR is a data base containing information about all mobile stations currently located in the MSC area. (For signaling reduction, the VLR is always integrated with the MSC.)

MSC interfaces with GPRS, and 14.4 kbit/s. To facilitate large data handling, throughput to other SS nodes (HLR, etc.) are catered for. Private Mobile Radio (PMR) is in focus with MSC/VLR, and enhanced Multi Level Priority Preemption (eMPP), location services, and CAMEL Phase 2. ET 155, and related BYB 501 HW, is supported.

PRA

With Primary Rate Access (PRA) Ericsson offers competitive access for Integrated Services Digital Networks (ISDN) Private Branch Exchanges (PBXs). With this, the operator can integrate PBX extensions as well as mobile station subscribers in the same switch or network. The ISDN PRA provides an interface that consists of 30 channels Pulse Code Modulation (PCM) (B-channels) and a additional D-channel for signaling control handling the ISDN PRA signaling protocols.

MSC/SSF

Mobile Switching Center / Service Switching Function (MSC/SSF) is an application module aiding IN service layers. With the SSF integrated in the MSC/VLR, IN calls do not need to be routed outside the MSC/SSF node, which significantly reduces the transmission that is needed.

The SSF and the Service Control Point (SCP) exchange only signaling information for executing IN services. When required, the integrated SSF can be configured as a stand alone Service Switching Point (SSP) product. The Capability Set 1 (CS 1) interface implemented in the SSF complies with the full scope of ETSI Core INAP CS 1 standards. The SSF can implement the CS 1+ , which is a proprietary superset of CS 1. CAMEL functionality, is also supported.

GMSC

The Gateway MSC (GMSC) is functionality towards the PSTN. It can be integrated with the MSC/VLR or be used in a “stand alone” capacity. For IN services, the GMSC can indicate to HLR that CAMEL Phase 1 or 2 is supported.

Transit Switching Center (TSC)

The Transit Switching Center (TSC) relieves gateway MSCs of transit traffic in Ericsson's GSM system. The TSC switches traffic between other exchanges. These other exchanges can then concentrate on intended functions, instead of on transiting traffic. So, if a GSM network grows in size and complexity, a more optimized situation is achieved (meaning in part that network efficiency is made optimal). This means reduced node accumulation (reduced start up cost) and low ongoing O&M costs. With TSC in a GSM network's architecture, there is no transit traffic in the MSC nodes, which means a requisite capacity gain in MSC nodes, depending on the MSC configuration. (Formerly, TSC was defined as an integral part of MSC. TSC can now stand alone.) Ericsson's GSM TSC can integrate with SSF for cost-effectively deploying IN services, as well.

Signaling Transfer Point (STP)

Reducing signaling in a GSM network saves cost, as not all MSCs have to be connected right to an HLR. The Signaling Transfer Point (STP) now provides stand alone signaling functions to transit signaling between nodes in Ericsson's GSM networks. STP is equipped with a Flexible Number Register (FNR) capability, as well. Like the TSC, STP reduces capacity demands on other nodes, letting them perform intended uses. Networks in turn are easier to manage, and evolve more naturally.

Data Transmission Interworking Unit (DTI)

The GSM Interworking Functions (GIWU) are met by the Data Transmission Interworking Unit (DTI) and are a part of the MSC. The DTI is a hardware platform implementing the interworking functions for data communications, bearer services, and fax teleservices. The DTI will serve as the basis for future data services. The DTI will be able to co-exist with the GIWU platform (existing hardware can still be used).

MSC/BSC (Mini and Maxi)

The Ericsson Mini MSC/BSC and Maxi are complete GSM switching systems. The equipment is integrated in one housing unit for the MSC and BSC, and for the Operation and Maintenance Center (OMC). The system is movable, and can be quickly installed. They support GSM 900, 1800, and 1900, or these can be combined. The system is pre-installed and tested at the factory, meaning a shorter installation time. The telecom housing has climate equipment for hot and cold, and wet and dry, conditions, which makes these houses possible to place wherever the customer likes.

The Mini MSC/BSC can be used for both permanent and temporary service. This complete GSM switching system in one container (exactly as described for the Mini) comes in a Maxi version (BYB 501, at maximum 2,500 Erl) as well, and can be extended in three steps: 750 Erl, 1,500 Erl, and 2,500 Erl.

HLR

The Home Location Register (HLR) is a realtime subscriber node and data base that stores and manages subscriptions. It contains permanent subscriber data such as subscription types, subscribed services, and call handling and termination. It also stores information about a subscriber’s location.

Enhanced HLR redundancy is possible. Redundancy means seamless shifting to the back up HLR to avoid revenue loss due to interrupted service, etc. The stand alone version is recommended for growing networks, but collocated solutions are available for small and rural networks. For migrating combined HLRs to stand alone HLRs, the GSM Database Reconfiguration Service is utilized.

The HLR interfaces IN and the Service Management System/ Service Creation Environment (SMS/SCE) as well as the GPRS. The HLR supports MAP and X.25 protocols to be able to communicate with MSC/VLR, GMSC, Short Message Service Interworking MSC (SMS-IWMSC) Authentication Centers (AUCs), Service Order Gateways (SOGs), Interworking Location Registers, Operations Support Systems (OSSs), and Customer Administrative Systems (CASs). Traffic distribution to HLR is done by Signaling Point Relays (SPRs) and other Signaling Connection Control Part (SCCP) functions.

HLR also supports certain GPRS features, and 14.4 Kbit/s channel coding. PMR is also a high point with HLR, and eMPP, location services, and CAMEL Phase 2. ET 155, and related BYB 501 HW, is supported.

Interworking location registers

Interworking location registers offer “intersystem” roaming between mobile telephony systems complying with different standards (like GSM to AMPS roaming using dual- band, dual-mode phones). One such product is the Mobility Gateway (MG), serving GSM to AMPS roaming. (For more information on interworking location registers, contact strategic product management.)

Flexible Number Register (FNR)

The FNR eliminates pre-packaging SIMs in multiple HLR environments. The operator will be able to allocate any Mobile Station ISDN (MSISDN) number to an International Mobile Subscriber Identity (IMSI) (such as SIM) and thereby decrease SIM card administration costs. The handset user will be able to choose freely among all the MSISDNs available to the operator when becoming a subscriber, and use the chosen number immediately. (It is also possible to change the MSISDN without changing the subscriber’s SIM.) FNR provides the number portability feature, which lets a subscriber retain their MSISDN number when they want to change operators. Number portability handles modifying routing information for both call and non call-related messages when E164 numbers are used for addressing.

Service Management System (SMS)/Service Creation Environment (SCE)

SMS/SCE is part of the Telecommunications and Management and Operations Support (TMOS™) family, Ericsson’s product for network management. SMS/SCE creates services and manages IN services. The Service Creation Environment (SCE) provides the design and management environments, and the service management functions. By using the “Service Script Concept” and the Service Independent Building Blocks (SIBs), flexibility can be achieved, in that new services can be designed and adapted to customer specific requirements. The management function supports statistics collection and presentation, and controls traffic levels to prevent Service Control Point (SCP) overload, and so on.

Service Control Point (SCP)

Each mobile IN call queries the SCP for instructions on mobile IN service execution. The Ericsson SCP product incorporates the Service Script Interpreter (SSI) and is a fully flexible and service independent platform allowing open ended services to be created and executed. The basic principle of the Service Script concept is the modularization of services into a range of SIBs. These SIBs are reusable, and can be freely combined into Service Scripts to create complex services. The SCP is the platform that supports the SIBs and their arrangement into services for mobile station subscribers. It is the platform on which the services are run, through the execution of Service Scripts. The SCP communicates with the SSF via the INAP protocol. The SCP is also equipped with an interface to SMS/SCE.

Service Switching and Control Point (SSCP)

The SSCP is a combination of the SCP and SSP into one product known as a (mobile) Service Switching and Control Point (SSCP). This product supports a method of introducing IN into networks, as it involves minimal adaptation to the existing network. For GSM networks, it represents a simple method of allowing new services to be offered without modifying the underlying network, as defined by the standard of the mobile network. When the SSF and the SCF are integrated into one node, the communication between the two is handled by an internal protocol still supporting all the functionality of the INAP protocol.

Mobile Intelligent Network (IN) integration

The Service Switching Function (SSF) is integrated into the MSC, meaning a significant reduction in overall transmission needs, since, “MIN calls” do not need to be routed from an MSC to a Service Switching Point (SSP). It is possible to transfer mobile specific information from the MSC/VLR to the SSF, and thus to the CS 1 and/or CS 1+ signaling protocols (enhanced INAP). (Enhanced INAP means capabilities such as call party handling and enhanced user interactions.) On such platforms, popular service applications like (mobile) Virtual Private Network (VPN) Personal Number (PN), Prepaid, and many others, are enabled.

CS 1 + between the SCF and the HLR allows the Service Control Function (SCF) to retrieve information on the mobile handset user’s status and location. The HLR in this circumstance can then be modelled as a Service Data Function (SDF) from the SCF’s perspective.

The communication interface between the SMS/SCE and the IN SCP is a man-machine oriented communication interface based on the Transmission Control Protocol/Internet Protocol (TCP/IP). This significantly improves performance for service provisioning and collecting statistics and call reports.

Application modularity according to the above means:

- Increased flexibility in planning your network
- Saving transmission costs by combining your nodes (such as with MSC/SSF)
- Saving on hardware by combining your nodes
- Flexibility to let your network grow the way you want it to (that is, choose combined nodes at an early stage and go for stand alone nodes as capacity need increases)
- That each AM can have its own design and use the most suitable software structure, solutions, and techniques.

2.3 Authentication, identification; service and billing

Authentication Center (AUC)

The Authentication Center (AUC) is a GSM specified entity that provides triplets to the authentication and ciphering process used within the Ericsson GSM system. The functionality the Authentication Center (AUC) provides generates authentication and ciphering data (triplets) as specified by GSM. The purpose of the authentication security feature is to protect the network against unauthorized use. It also protects PLMN subscribers by not letting intruders impersonate authorized users.

The AUC is implemented as an application module in AXE. It can support up to four million subscribers.

The AUC can be configured in the following way:

- Combined with the HLR it serves

- Combined with one HLR, and serving a number of other HLRs, as well
- As a stand alone node serving a number of HLRs

The HLR requests the AUC "triplets" via an internal or external MAP interface, depending on the configuration. The triplets consist of the following elements:

- RAND: Random Number (128 bits) based on the system time (used as a challenge)
- Kc: Ciphering Key (64 bits), based on the GSM A8 algorithm, using the RAND, and the secret Individual Subscriber Authentication Key (Ki) as input
- SRES: Signed Response (32 bits) is the result from a calculation based on the GSM A3 algorithm, using the RAND and the Ki as input

The triplets are calculated with an A3/A8 algorithm using RAND and Ki as input. The A3/A8 algorithm may either be the standard COMP128 algorithm recommended by MoU or an operator-specified one. The AUC supports different A3/A8 algorithms in parallel, so that parts of the subscriber base can be assigned to one A3/A8 algorithm, and other parts to other A3/A8 algorithms. Having a unique A3/A8 algorithm distinguishes an operator from others, increasing the operator's security against possible fraud attacks.

Equipment Identity Register (EIR)

Equipment Identity Registers let operators control access to their network for specific mobile handset and terminal equipment.

The EIR:

- Protects subsidized handsets
- Restricts handsets
- Reports handset changes.

The EIR communicates with the MSC/VLR using the GSM defined CheckIMEI MAP operation. The EIR interrogates three standard equipment lists (black, gray and white). Details of a particular piece of equipment may be stored in more than one list. This enables, for example, an entry to be added to the black list without needing to delete it from the white list. A search for a specific piece of equipment terminates when the first list containing the selected equipment is found. If the selected piece of equipment is not found in any of the lists, then the EIR returns ´Unknown Equipment´.

Equipment data may be loaded into the EIR either individually using the administration interface interactively, or via a bulk loading mechanism. Both methods may be used without interrupting service. Data may be stored in the lists as individual International Mobile Equipment Identities (IMEIs) or as a range of IMEIs which have a common type and final assembly code. This has the benefit of making the maintenance of the larger white lists simple.

The EIR is available with an optional interface to a central EIR, on some markets. This interface enables data in the EIR to be maintained without needing dedicated operations staff.

EIR interfaces with GPRS via CCITT Number 7 and MAP Version 1 or 2.

Service Order Gateway (SOG) and Billing Gateway (BGw)

The gateway products SOG and BGw provide single point, uniform interface connections between an operator’s administrative system and Ericsson’s GSM network. The gateway products help mobile operators become more competitive, and maximize efficiency and productivity by simplifying new service introduction and new network releases. SOG supports provisioning service order information, and BGw supports handling billing information.

The gateway products minimize dependencies between the mobile network and administrative system(s). When new functions, updates, or system version changes are introduced in the network, these will have little impact on customer care and billing systems. This allows operators to focus on increasing their revenues instead of building and maintaining infrastructure.

SOG and BGw provide full support for today's mobile networks, and are also important tools for simplifying migration into the third generation mobile systems. They also support convergence scenarios, like fixed mobile convergence or telecom datacom convergence. SOG supports GPRS, 14.4 kbit/s, eMPP, and CAMEL Phase 2. BGw also supports GPRS.

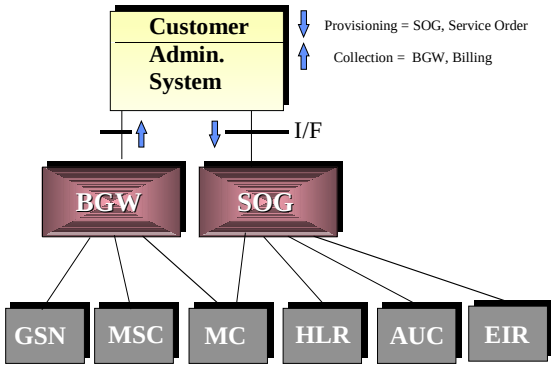

Figure 2-4. Gateway Products for billing information and service orders.

One SOG can handle networks with up to 2,500,000 subscribers, and can add 120,000 subscribers per day. Many SOG systems can be configured in order to support larger networks.

Some features of SOG:

- Interfaces data bases in HLRs, AUCs, EIRs, and other mobile network elements
- Supports redundant networks
- Transparent handling of different network element versions

Some features of BGw:

- Collects and distributes billing data
- Hot billing
- Flexible billing data processing
- Flexible formatting

All processing features are easily configurable in runtime via a Graphical User Interface (GUI) and require no software upgrade or recompilations. This allows BGw to be adapted exactly to the operator's network and organization.

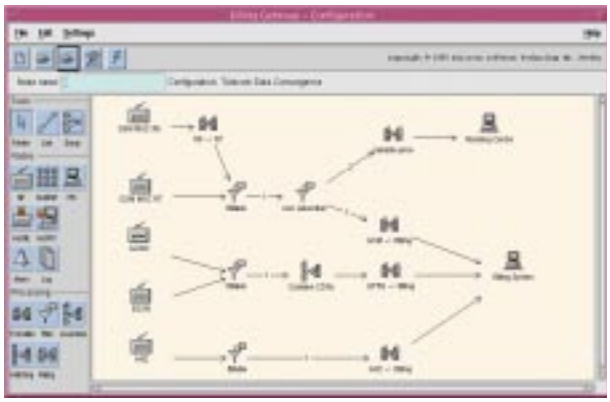

Figure 2-5. BGw configuration for managing numerous network types.

Location Dependent Charging (LDC)

This is a feature related to SOG and network management, helping operators earn more revenue or distribute more services on deregulated markets. LDC can coordinate differentiated tariffs, access authorities, or services – big concerns in times when tariffing and service spreading are major operator headaches. LDC helps with making the necessary changes to your network, utilizing statistics from the radio network provided, for example, by the Operations Support System (OSS). If connected to Customer Administration Systems (CASs) or Service Order Gateways (SOGs), subscribers can be tariffed or offered services. This occurs in a zone provided by LDC. Zones (ZAS) are scrutinized by Ericsson functionality.

2.4 The Base Station System (BSS)

BSC products

The Ericsson GSM system contains the most flexible BSS product portfolio available on the market.

Ericsson's BSS is both ETSI 32 and ANSI 24 channel transmission and signaling-capable. The portfolio accommodates GPRS (approximately 160 channels per Regional Processor Power PC [RPP]).

No other vendor can provide the same flexibility in terms of node capacity, extendibility or support for different topologies (that is, network node combinations). The BSS product family consists of three node types:

- BSC/TRC:
  - A high capacity BSC with included transcoders (same HW package as TRC)
- BSC
  - Stand alone low and high capacity BSC
- TRC
  - Stand alone low and high capacity transcoder controller (same HW package as BSC/TRC)

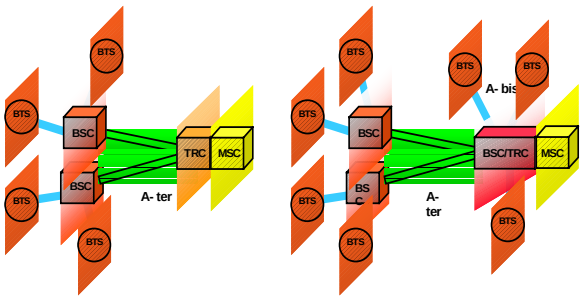

Figure 2-6. Different network node combinations (topologies) the Ericsson BSS supports.

The Ericsson BSS can support any type of network topology, such as remote BSCs, MSC collocated BSC/TRCs with integrated transcoders - but also the unique MSC co-located BSC/TRC with remote BSCs connected to it. (The last one being good for extending a single band 1800 MHz city area network into becoming a dual band network with full wide area coverage. This keeps transcoder investments to a minimum.) Additionally, The BSC/TRC can be expanded for ET 155 – the high speed AXE connection.

With the flexibility Ericsson's BSS offers, it is possible to adapt to any existing topology applied in the original single band network. For new operators with dual band, Ericsson's BSS lets them choose the optimal network topology with high capacity nodes in city areas, and remote low capacity BSCs for rural ones

High capacity BSC

The main strength in the Ericsson BSC concept, particularly applicable for dual band networks, is its ability to support high capacity networks.

These high capacity BSC nodes can handle more than 500 cells, both 900 and 1800 MHz, and more than 1000 transceivers in the same BSC. One BSC will be able to handle all or most of the new second band cells needed in an area, like a city, where additional capacity is needed. This yields numerous benefits, like less inter-BSC handovers, a unique control of the dual band radio network with better control of the traffic flow, and it also evens out traffic peaks in different areas.

The need for network care is significantly reduced due to the flexible modularity of the BSC. The possibility to start with a node supporting 144 TRXs, but extendable in five steps to reach 1020 TRXs, reduces the need for re-homing BTSs (that is, the RBSs) to a minimum when rolling out a dual band network.

Remote BSC

Whenever the operator goes for wide area coverage, the remote, one – two cabinet BSC, with capacity for 144-336 TRXs, and with transcoders located at the MSC, becomes an attractive choice in keeping transmission cost low.

However, the Ericsson BSS also offers a unique high capacity remote BSC node, supporting between 240 - 1020 TRXs. It is particularly suitable initially in medium size cities that do not have MSCs. It allows starting up in small scale, increasing the capacity as the traffic grows, and eventually, when traffic demands it, installation of an MSC, and migration over to a network with high-capacity nodes as required by a fully extended dual band network.

Ericsson's Base Station System (BSS) architecture allows for integrated transcoders or ones separated from the rest of the BSC. This means more flexible access networks, where Ericsson can offer solutions rational to operators' businesses, and be cost effective. That is, a centralized powerful BSC/Transcoder Controller (TRC) for urban areas, and for rural areas, decentralized BSCs. The remote BSC enables savings in transmission costs, since it concentrates the traffic towards the MSC. Up to 16 decentralized BSCs can be connected to a central BSC/TRC, or to a TRC, and share the same transcoder resources. Transmission efficiency on the Abis interface is achieved by using the Link Access Protocol of D channel (LAPD) concentration or LAPD multiplexing features that can save signaling transmission resources by up to 33%.

For operators with a single band network, it is attractive to use 900/1800 site sharing to reduce cost and speed up network rollout. It then becomes important that the BTS equipment has a small enough footprint to fit into the sites, often designed to house only one system. The chance to share transmission, antenna feeders, power equipment, and battery backup, must also be taken into consideration. But Ericsson offers a wealth of RBSs that can save time, money, and worry in this regard.

Figure 2-7. A three-cabinet BSC/TRC (336 TRXs).

2.5 Radio base stations and radio base station solutions

There are two product families for the Base Transceiver Station: RBS 200 and RBS 2000 (though backward compatible for two years, RBS 200 is being phased out). The two families could be installed at the same site and be handled in a uniform way from the BSC. Various functions and features are provided to make the base station flexible, reliable, easy to install, and easy to maintain.

The RBS 2000 product family - macro models

The table below shows the product offering in the RBS 2000 macro product family:

RBS 2101	Outdoor	2 Transceiver	1-3 Cells[2]
RBS 2102	Outdoor	6 Transceiver	1-3 Cells
RBS 2202	Indoor	6 Transceiver	1-3 Cells
RBS 2205[3]	Indoor	12 Transceiver	
RBS 2206		12 Transceiver	

Table 1. RBS 2000 macro.

The RBS 2000 series supports the GSM 900, GSM 1800, and GSM 1900 frequency bands. The RBS 2000 series supports the GSM 900, GSM 1800, and GSM 1900 frequency bands.

RBS 2000 is a complete concept, a one-cabinet turnkey solution for both indoor and outdoor installations for GSM 900, GSM 1800 and GSM 1900 networks. RBS 2000 offers high capacity and stable radio network control functionality. The indoor model has minimal footprint, noise, and heat generation. The self contained outdoor models are vandal resistant and designed to operate under extreme environmental conditions. The outdoor base stations can be installed at ground level, in masts, on roofs, or be mounted on walls. The RBS 2000's hallmarks are:

- Flexible design
- Rapid installation and commissioning
- Good coverage and high capacity.

[2] With more than one cabinet
[3] Same footprint as 2202

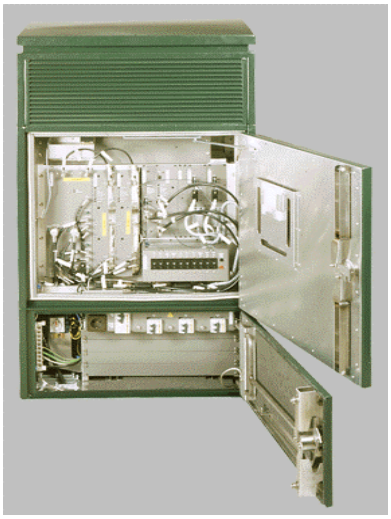

Figure 2-8. RBS 2101.

The RBS 2101 is an indoor or outdoor self-contained cabinet with up to two transceivers. It can be configured for omni cells, or up to three sector cells (with more than one cabinet). There are different climate solutions for every requirement. RBS 2101 can be installed at ground level, in masts, on roofs, or be mounted on walls.

Figure 2-9. RBS 2102.

The RBS 2102 is an outdoor, self-contained cabinet with up to six transceivers. It can be configured for omni or up to three sector cells. RBS 2102 can be installed at ground level, on roofs, or be mounted on walls.

Figure 2-10. RBS 2202

The RBS 2202 is an indoor cabinet with up to six transceivers. It can be configured for omni or up to three sector cells. It could be installed in any indoor environment.

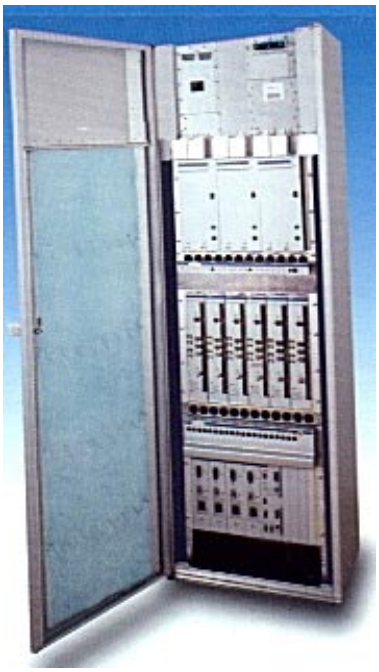

Figure 2-11. RBS 2206.

The RBS 2206 can contain from two to 12 transceivers, and is part of Ericsson's "grow-on-site" solution for dense areas where interference is bad. It contains a double Transceiver Unit (dTRU). Six dTRUs means 12 TRUs. Improved radio performance with the RBS 2206 means increased site-to-site distance, or, 15% less total sites required. RBS 2206 supports GPRS and EDGE without limit; all speech codecs, and is dual-band capable. Along with adaptive antennas and cell planning tools, the RBS 2206 provides a solution for urban areas: a no-new-sites-required option for expanding capacity in GSM 900 networks.

RBS 2000 - micro models

RBS 2301	Indoor/outdoor, 2 TRX
RBS 2302	Indoor/outdoor, 2 TRX – 6 TRX possible
RBS 2401	Dedicated indoor, 2 TRX

Table 2. RBS 2000 micro models.

RBS 2301

The RBS 2301 is an indoor/outdoor, two transceiver micro RBS with a total volume (including mounting base) of less than 33 liters. It uses integral antennas and is optimized for being a high capacity solution. Some features it utilizes are DTX, dynamic power control, EFR, half rate, 14.4 kbit/s, receiver diversity, and is GPRS prepared.

RBS 2301's hallmarks are that it:

- Cuts site costs by up to 70%
- Can be put almost anywhere
- Has a higher capacity, yet from a smaller unit.

The RBS 2301 can be pole or wall mounted and includes optional multiple transmission interfaces. The antennas are integral or external.

RBS 2302

RBS 2302 is also an indoor/outdoor, two-transceiver micro RBS. It is optimized for high capacity solutions, and uses integral antennas. RBS 2302 accesses most of the features of RBS 2301, and is also HW prepared for half rate and data communication such as GPRS, HSCSD and 14.4 kbit/s. It also supports the GSM MaxiteTM concept.

RBS 2302 is HW prepared for a four or six transceiver solution (multi extension) by adding two or three RBS 2302 base stations beside each other. The capacity is increased to 22 Erlang for a four transceiver solution, and to 36 Erlang for a six transceiver solution.

The RBS 2302:

- Is small and discreet
- Has two transceivers
- Can have up to six transceivers in one cell.

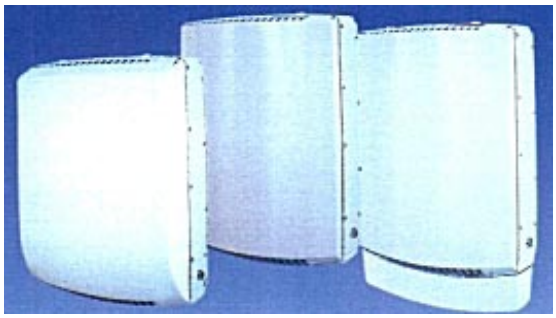

Figure 2-12. RBS 2302.

RBS 2401

The RBS 2401 is the first dedicated indoor radio base station designed for indoor applications.

RBS 2401 is a complete RBS in itself, including transmission and integrated power supply. The product is designed for maximum efficiency in indoor situations, like office solutions and public hot spot indoor applications. Together with flexible transmission solutions and antenna configurations, RBS 2401 means the most efficient and flexible indoor RBS solution available today.

The RBS 2401:

- Has a small, discreet design
- Has two transceivers
- Is light and easy to handle
- Can be optimized for indoor applications.

RBS 2401 is hardware prepared for HR and EFR, as well as for data communication features like HSCSD, including 14.4 kbit/s, and GPRS. The Abis Gateway (AGW) in the RBS 2401 is configured for GSM on the Net applications.

Figure 2-13. RBS 2401.

Ericsson RBS antennas and battery backup, and novel power systems

Ericsson's dual polarized and adaptive antennas

To reduce fading on the uplink in cellular systems, there is a need for receiver diversity. The traditional way is to have two antennas separated by a distance of approximately 20 wavelengths. Polarization (space) diversity gives approximately the same diversity gain, but without the antennas separated in space. Dual polarized antennas contain two separate antenna arrays with linear polarization in orthogonal planes. The polarization could be either vertical/ horizontal (0 */90 *) or slant (+/- 45 *).The advantage here is that less antennas means simplified installation and maintenance, which in turn results in reduced site costs and easier-to-find sites. The choice of antenna type depends on configuration and system. A range of approved antennas is available, including 8-lobe array antennas (passive) for use in capacity increasing in GSM 900 networks.

Ericsson's repeaters

Repeaters are the solution for coverage in the following situations:

- Stand alone Radio Frequency (RF) repeaters for coverage of indoor and outdoor dark areas, like suburbs and short tunnels. The purpose is to extend the cell range. The link between the radio base station and the repeater is in the air, with high gain antennas pointed towards the radio base station.
- Optical interfaces to the radio base station to provide distributed coverage and capacity in high traffic areas like busy streets, exhibition centers, airports, stations, subways, shopping malls, etc. The link between the radio base station and the repeater is handled

by fiber optics. The repeater is directly connected to the radio base station.

Battery backup

Battery backup is integrated in outdoor radio base station models, and guarantees the radio base stations will operate without any traffic losses.

For the indoor model, a separate battery back up system can be connected to the radio base station. Supervising and controlling the back up system is handled via the same control channel as the radio equipment.

Via optical fiber, batteries are supervised by units in the radio base station. Backup times from one to eight hours are available. A priority load disconnection gives the transmission equipment extended backup time.

Small solar power system

Ericsson always seizes the chance to innovate with clean, effective, environmentally safe solutions when opportunity permits. For example, in sun-drenched climates. Sunsite, a solar power solution, is an RBS 2302, MiniLink E Micro, and an obstruction light. The Sunsite is designed for continuous + 24 V DC power consumption.

2.6 Managing and planning GSM systems: OSS, NMS,TEMS

The Ericsson network management solution centers around:

- An integrated data communication network
- Operations Support System (OSS) for managing Ericsson GSM network elements (it enables centralized and remote operation and maintenance of GPRS nodes)
- Network Management System (NMS) for handling multivendor equipment, and work force management
- Services for network installation, operation, and optimization.

Operations Support System (OSS)

OSS contains fault, performance, and configuration management applications (except for subscriber and billing management) for Ericsson GSM network elements BSC, BTS (RBS) MSC, HLR, AUC, EIR, SCP, and others. Customer care and service management are also main foci. OSS is designed to suit different phases of a GSM network lifecycle, from rollout to network maturity. OSS is an integrated part of the Ericsson GSM solution and it is upgraded and released in tandem with network element evolution.

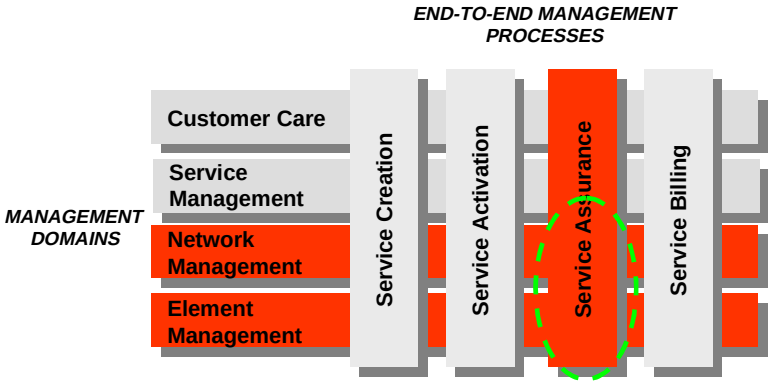

Figure 2-14. End user satisfaction is the OSS's main goal.

OSS integrates all management functions into one system, and creates application synergies by information sharing. The common activity manager shows all planned, running and finished activities. The geographical and logical presentation function is a part of the integrated management concept. Frequency plans, measurement results, and network fault status are graphically displayed, with all equipment located at its correct geographical position.

Special emphasis is placed on managing the radio network. There are functions to guide the operator in setting parameters, and parameter consistency checks assure that radio network configuration parameters are correct across cell and node (network element, or "managed object") borders. OSS has numerous interfaces for exchanging fault, performance, and configuration data with other systems. Capacity is a prioritized characteristic. With newer features like the Active Library Explorer™ connected to OSS or GPRS, information on O&M for the entire GSM network can be accessed through a standard browser.

Optional features like the OSS Airtime Expander package contain these capabilities:

- Network surveillance
- Performance statistics (network statistics being an entire capacity package)
- Radio network optimization/network configuration (“network configurators”)
- Software management

Basic fault management features consist of standard and viewer capabilities. Security management, such as TMOS™ security services, are available, and a host of generic management functionality, such as file store functionality, report generation, AXE interface, and TMOS™ activities are enabled.

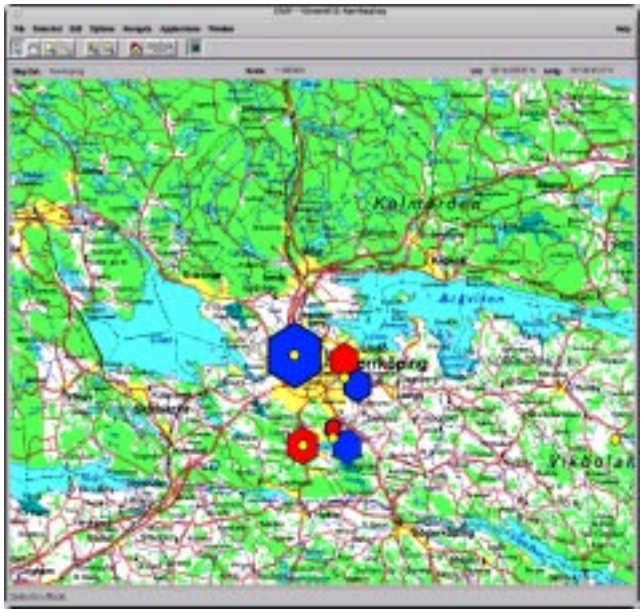

Figure 2-15. Geographical and Logical Network Information Presentation – an example of generic management tools in OSS.

Network multivendor management scenario: OSS, NMS

The OSS and NMS for GSM system management could be equipment sharing the same infrastructure. The integration between the systems is small at the network lifecycle's beginning, and increases as the network matures. Ericsson supplies services and equipment to implement the scenario according to operator specific needs. This includes network architecture investigations, installation of a data communication network; connecting management and planning systems, user terminals and printers, as well as customized security systems.

TEMS CellPlanner

A good cell plan is a key to an operator's success, since it will directly effect the perceived user quality in the system. TEMS CellPlanner can provide just such plans. TEMS CellPlanner works in a PC Windows environment and is based on standard relational data bases using open data base connectivity. The TEMS CellPlanner runs on stand alone or networked PC workstations. It is built around the familiar Microsoft Windows graphical user interface and is highly user friendly, mouse operated software .

TEMS CellPlanner offers:

- Wave propagation modelling for macro cells
- Wave propagation modelling for micro cells (urban environment)
- Automatic frequency planning
- TEMS log file import
- Automatic tuning of wave propagation models.

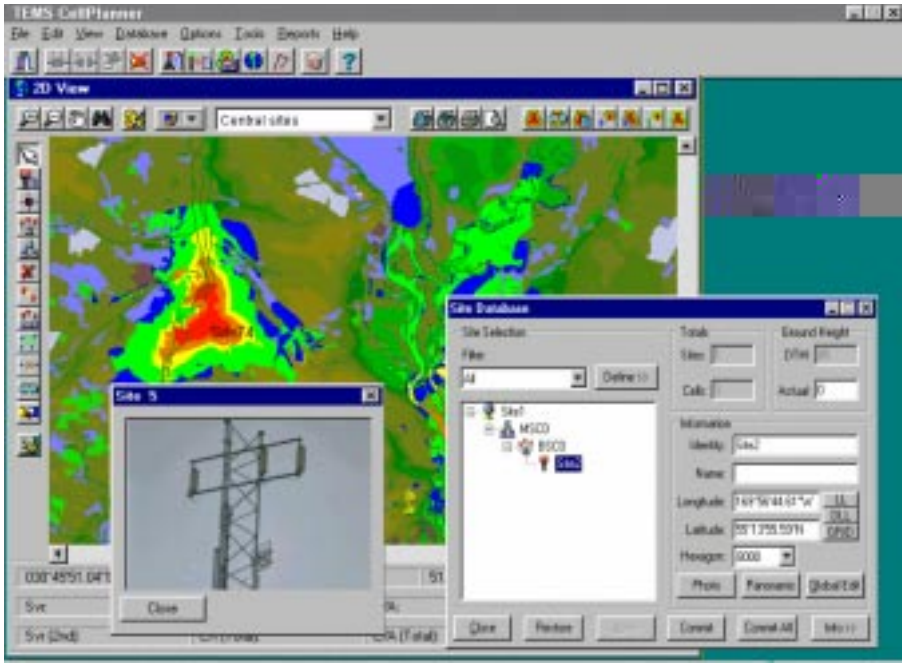

Figure 2-16. TEMS CellPlanner 2D View window.

3 Standard features of Ericsson's GSM system

Basic telecommunication services can be divided into two main categories: teleservices and bearer services. These "basic services" are augmented by various supplementary services, such as call forwarding, call transfer, and so on.

Teleservices let the MS subscriber communicate with another subscriber (usually voice, fax, and Short Message Services).

Bearer services let the MS subscriber send data communication (transmitting signals between two access points that provide an interface to the network) to each other. Some of these mean Internet, voice conferencing, and other data communication possibilities.

3.1 Examples of end user features

- Roaming, or, a mobile station's ability to move freely throughout the entire service area, irrespective of the network operator.
- Integrated voice and data communication. Not only does the system give its users excellent mobile voice communication, it also enables data communication handling to and from mobile station subscribers.
- Security. Subscriber authentication, transmitted information encryption, and using temporary subscriber identities in the network protects the user against false call charges and ensures total privacy. (Security aspects of the system are catered for, via equipment validity checking in the EIR.)
- An extensive set of supplementary services for call forwarding, call barring, multiparty conversations, and so on
- The Short Message Service makes it possible to send a short text (alphanumeric) message to, or from, mobile stations. (The short message service can be viewed as an advanced form of alphanumeric paging.)

- Network-wide, active handover between:
  - Physical channels within one cell
  - Cells controlled by the same BSC
  - BSCs connected to MSC
  - MSCs belonging to a certain service area.

3.2 Examples of operator features

- Operation and maintenance functions inherent in the MSC/VLR, HLR, and the BSC are virtually identical to the functions in a general AXE telephone exchange. These functions provide continuous exchange performance supervision and statistics collection, as well as automatic reconfiguration during restarts.
- Remote control and supervision of RBSs from the BSC (including software updates that decrease the need for RBS site visits).
- Link Access Protocol on D Channel (LAPD) multiplexing and concentration minimizes the transmission costs between the BSC and RBSs.
- Drop/insert functionality and Digital Cross Connect in RBSs makes it possible to connect numerous RBSs (BTSs) on the same 1.5 or 2.0 Mbit/s PCM path (creating a very efficient and redundant transmission network topology).
- Discontinuous Reception (DRX) and Uplink Discontinuous Transmission (DTX). All paging requests are transmitted at predefined time intervals, allowing the mobile station to switch off the receiver between paging intervals. Additional battery power is saved with a voice activity detector that suppresses the handset's transmissions during speech pauses.
- Frequency hopping, Downlink Discontinuous Transmission (DTX), intra-cell handover, and dynamic mobile and radio base station power control. These functions maintain cell call quality levels as the number of subscribers grows in a network.
- Mobile station subscriber activity supervision. A mobile station subscriber will automatically be pointed out and not paged if the subscriber has been inactive (or is in an idle state) or is beyond coverage for a certain time period. Such call supervision decreases the load on paging channels, and instantly tells other networks the mobile station user cannot be reached.

- Charging features for both voice and data traffic (including Short Message Services) is done on a per call basis using toll ticketing.
- Accounting functions collect and administer data needed for remuneration purposes between network operators.

4 The Ericsson service portfolio

Ericsson’s Global Services is the world's leading services delivery machine for mobile and next-generation networks. Our portfolio of services is available on a global basis, delivered by people from the local culture who understand our customers and their way of doing business, and it is based on a wealth of expertise gained from implementing GSM networks all over the world. These services cover all product areas in GSM, including GPRS, as well as all other Ericsson mobile and wireline systems.

Ericsson’s global services portfolio is based on four service areas that will help customers maximize the benefit of infrastructure, and the investments are designed to help them cut time to market, reduce risk, and maximize revenues.

Network Roll-Out, Competence Development, Customer Services and Telecom Management & Professional Services addresses different parts of a customer's operation. Service concepts that the four areas can offer are a grouping of services that address certain customer's business needs. Ericsson’s GSM service concepts cover every aspect of network and business operations, from initial business planning through design and integration, all the way to maintenance, performance tuning and management. A tailored set of services can be created to meet specific demands, whether customers are about to apply for their licence, or have been operating a mobile network for years. Our extensive market knowledge means that all the latest trends in technology and business strategy can be brought to bear in a project while minimizing exposure to financial risk.

4.1 Competence Development

The need to understand how core solutions can be applied successfully in live environments is essential. Customers need to be assured they have access to skills, knowledge and expertise so that they can guarantee end-user services. In the world of the mobile Internet and next generation networks, competence development is crucial.

The Ericsson Competence Development services portfolio addresses more than just crucial product training needs. Through our consultancy services we help our customers analyze their competence needs, and deliver to those requirements from Online Training through to On the Job Training and the Knowledge Step, and validate their investment through the Ericsson Certification Program.

4.2 Customer Services

Operating in a tough environment characterized by rapid change, increasing competition and tighter margins, network operators need as much help and assistance as they can get to retain their existing subscribers, attract new ones, and still make a profit. Ericsson Customer Services is organized to provide just the type of support operators need - helping them to control their costs and reduce risk while increasing overall subscriber satisfaction.

Customer Services provides essential hardware and software support and operational services to all Ericsson operator customers, thereby enabling them to secure their network investments and helping them to expand their operations. Furthermore, e-support provides a proactive way of service enhancement, a set of web-enabled tools, processes and value systems so as to increase customer satisfaction, operational flexibility and process efficiencies.

4.3 Network rollout

When building new packet-based infrastructures or migrating from 2G to 3G, an operator’s main concern is to earn revenue as quickly as possible. However, integrating and implementing complex new technologies can be time-consuming and costly.

Through its skills and competence in network build, migration, integration and implementation, Ericsson takes responsibility for a customer’s needs and enables a fast project turn-around and quick Time-To-Revenue. This total turnkey responsibility from design to acceptance includes project management, site acquisition and civil works activities.

4.4 Telecom management & professional services

To guarantee that end users receive uninterrupted service, operators need to focus on how to keep network operations running efficiently. When subscriber levels increase and new services are introduced, how can they ensure the continued performance of the networks and service quality levels? How will they make sure that revenues are earned by means of new billing methods? And how will they be able to quickly transform their operations to the new 3G world and still focus on their core business?

Through Ericsson Telecom Management & Professional Services, we provide network and service assurance solutions that allow operators to keep networks operating to agreed service levels, whether it is a multi-service, 2G or 3G network. We also provide solutions for billing & customer care, e-payments and fraud management. And if the operator wants help from Ericsson to run their operations, we offer managed services on different levels. We also enable customers to enhance the performance of their networks to get the most from their investment.

5 Specific products, services and solutions

There are many Ericsson-produced products or related products or services that are subsidiary or useful for GSM systems, now and towards 3G. Below are just some that are offered.

5.1 User Service Center (USC)

The USC is a complete ISP solution on a scalable platform. For GSM operators hoping to expand their service offering by introducing Internet and data services, USC is an answer. USC provides solutions for “wireless ISP”, and is optimized for wireless access. USC also provides ISP functionality for Internet access via fixed line access.

Building a mobile ISP with USC, operators link advantages of GSM and GPRS, to WAP, and various applications – such as those offered by MPS, unified messaging, and so on.

USC is based on open standards and APIs, and so, is ideal for mass market uses. It consists of an IAS server, a WAP gateway, and SUN software. Lower-end clients could be any that send or receive SMS are: SIM toolkit phones, PDAs, and PCs can all utilize higher functionality in a USC environment.

5.2 RXI 820 realtime router

The RXI 820 is an Internet Protocol (IP) router optimized for handling requirements made by IP-based wireless networks. The Ericsson RXI 820 router provides:

- A dual IPv4/IPv6 stack for optimum scalability and security
- An advanced QoS mechanism for delay-sensitive traffic

- Hardware accelerators that yield outstanding performance
- Support for secure IP networking and management with IPSec and SNMPv3
- Automatic configuration for reduced operational expenditure
- Operation on a true telecommunications-grade platform with no single point of failure

Additionally, the RXI 820 router is based on the same system platform as 3G wireless products, such as the Media Gateway (MG) and the Radio Network Controller (RNC). This means that the same router functionality can be used as integrated parts of those systems. For operators, all IP networking has many advantages.

5.3 Mobiles and test mobiles

Besides the broad range of commercially available mobile stations developed and manufactured by Ericsson Mobile Communications, a number of test mobiles can also be supplied. One is the Test Mobile System (TEMS) Pocket. This is a modified Ericsson mobile station that can monitor setting and network information.

5.4 Digital Cross Connect (DXX)

DXX is intended for use by large cellular networks marketing mixed batches of services.

DXX gives optimal bandwidth use and reduced line costs through flexible cross connect-based networking. Ericsson's DXX transport network is an ideal transmission solution for mobile communications networks with such needs.

DXX is a highly flexible modular hardware and management software system especially designed for quickly deploying and expanding public telecom transport networks. It can be configured as anything from a high-capacity digital cross connect system to flexibly integrated compact RBSs and mini nodes, such as the Mini-DXC or the DXX-Plugin (the Plugin supports 1:1 protection and traffic recovery in ring and star configurations) in Ericsson RBS 2000 family RBSs. DXX offers enhanced BSS access, supporting eight, 16, 32, and 64 kbit/s or higher to fill standard two Mbit/s links, and caters for network expansion.

The DXX Micro-E grooms two Mbit/s trunks in Mini Link links. Ericsson's DXX is particularly effective where mixed services are provided (supervision is from the DXX □NMS□) over a common network, where leased transmission costs are high - and need to be minimized - and where maximum flexibility is needed to cope with technology swings and network growth.

5.5 Short Message Service (SMS) center

The Ericsson MXE is a multimedia messaging system capable of a wide array of services - voice, fax, Short Message Service (SMS) and electronic messaging, etc. This single-system approach to many applications in one is a huge cost saver for the operator, and means personalized, anytime, anywhere communications access for the end user.

Ericsson supports a range of voice mail systems, short message centers, and fax mail from different vendors. All products and systems are tested, and functionality is verified together with Ericsson's GSM system.

5.6 The Mini-Link™ - Ericsson's microwave link

Ericsson's microwave solution - Mini-Link - is designed for operation in any type of network.

The compact Mini-Link microwave radio contains the latest technology and provides maximum reliability. With a Mean Time Between Failure (MTBF) of 30 years, Mini-Link offers continuous high performance. Standardized interfaces ensure integration in all types of transport networks.

Mini-Link can be configured to meet any network requirement for capacity and range. It provides radio transmission links from two up to 17x2 Mbit/s, operating within the seven to 38 GHz frequency bands. Mini-Link terminals can be mixed-and-matched in any type of network - star, tree or ring. For protection, it can be configured either as a 1+1 system or as a ring structure.

The Mini-Link product range for cost-efficient solutions especially in high-density networks include:

- The self-contained Mini-Link all-outdoor(Mini-Link C).
- The flexible Mini-Link E and split for optimal solutions at multi-terminal sites..
- A broadband access version for point to multipoint solutions (Mini-Link BAS). ATM technology makes Mini-Link BAS futureproof: it supports IP and GSM core network (legacy) services

The element manager Mini-Link Netman is a powerful tool supervision tool designed for centralized network management. It can be used as a stand-alone system or be integrated with a Network Management System (NMS). All necessary functions such as fault, performance, and configuration management are supported.

Cross-connect functionality

Mini-Link cross-connect Units (MXUs) support grooming on a timeslot level for optimal use of bandwidth and hardware capacity. The MXU is fully compatible with the comprehensive Ericsson DXX family.

Figure 5-1. Mini Link.

5.7 Combined Gateway (CGW) (NMT, TACS, GSM)

Seamless synergies of different technologies will mean revenue saving and reduced churn. Operators with analog and digital based networks today want to keep subscribers within their networks when migrating from analog to digital, and reduce costs for the switching equipment. This is achieved by number portability and support for many standards within one node.

CGW is a combined gateway solution for GSM, Nordic Mobile Telephone (NMT) and Total Access Communications (TACS). It can handle all incoming traffic from PSTNs, do number analysis, HLR interrogation, charging, and other tasks. The CGW node handles 5,000 Erlang, or 300,000 subscribers.

5.8 Tower Mounted Amplifier/Antenna-mounted Low Noise Amplifier (TMA / ALNA)

Antenna-mounted Low Noise Amplifiers (ALNA) is Ericsson's name for Tower Mounted Amplifier (TMA). An ALNA works as an antenna amplifier on the uplink, eliminating the cable losses between the antenna and the radio base station. The receiver gain is extended up to three dB. The cell range can then be extended. An improvement of three dB of the link budget means that the number of radio base station sites could be reduced by as much as 30 per cent. The ALNA could be built for narrow or wide band frequencies, depending on the requirements.

6 Some interfaces and protocols

Table 3. Some common interfaces and protocols used in Ericsson's GSM system.

Interface	Description
A	Interface between MSC and BSC ("Open", meaning multivendor situations are possible)
Abis	BSC-RBS interface ("Proprietary", meaning Ericsson only)
ASN.1	Abstract Syntax Notation One
AGW	Abis Gateway
Ater	Interface between BSC and TRC ("Proprietary", meaning Ericsson only)
ATM	Asynchronous Transfer Mode
Air Interface	RBS to handset interface
BER	Basic Encoding Rules
CMISE	OSI Standard
CS-1 and CS-1+	Capability Set (enhanced INAP)
E1T1	Line standards for European and non-.European
FTAM	File Transfer and Access Management
FTP	File Transfer Protocol
Gb	Open interface for BSS to SGSN
Gd	Interface between am SMS-GMSC and an SGSN, and between an SMS-IWMSC and an SGSN
Gi	GPRS-external packet data network reference point.
Gn	Interface between two GSNs in same PLMN
Gp	Interface between two GSNs in differing PLMNs
Gr	Interface between SGSN and HLR
Gs	Interface between SGSN and MSC/VLR

Ipv4, Ipv6	Point to Point IP
INAP	Intelligent Network Application Part
ISUP	ISDN for User Part (for ITU Number 7 Signaling)
MAP	Mobile Application Part
MML	Man Machine Language
MTP OSI	Message Transfer Part Open Systems Interconnection
TCP/IP	Transmission Control Protocol/Internet Protocol
TUP	Telephone User Part
Um	Um interface to RNC
X.25	OSI (ITU Standard)

7 Acronyms and abbreviations

3G	Third Generation
4G	Fourth Generation
AGW	Abis Gateway
ALNA	Antenna mounted Low Noise Amplifier
AM	Application Module
AMPS	Advanced Mobile Public System
ANSI	American National Standards Institute
APSI	Application Platform Service Interface
APZ	Control (or, computer) part of AXE
ASIC	Application Specific Integrated Circuit
ATM	Asynchronous Transfer Mode
AUC	Authentication Center
BCCH	Broadcast Control Channel
BG	Border Gateway
BGw	Billing Gateway

BSC Base Station Controller

BSS Base Station System

BTS Base Transceiver Station

C/I Carrier to Interference Ratio

CAMEL Customized Application for Mobile Enhanced Logic

CAI Customer Administration Interface

CCITT 7 Signaling System Number 7

CDMA Code Division Multiple Access

CGW Combined Gateway

CHAT Channel Allocation Tiering

CORBA Common Object Request Broker Architecture

dB Decibel

dTRU Double Transceiver Unit

DRX Discontinuous Reception (mechanism)

DTI Data Transmission Interface

DTX Discontinuous Transmission (mechanism) (uplink and downlink)

DXX Digital Cross Connect

EDGE Enhanced Data rates for Global Evolution

EFR Enhanced Full Rate

EIR Equipment Identity Register

eMPP Multi Level Priority Preemption

Erl Erlang

ET Exchange Terminal

ETSI European Telecommunications Standards Institute

EVO Ericsson Virtual Office

FLP Fractional Load Planning

FMC Fixed Mobile Convergence

FNR Flexible Number Register

FOX Frequency Optimization eXpert

GGSN Gateway GPRS Support Node

GIWU GSM Interworking Unit

GPRS General Packet Radio Services

GMSC Gateway Mobile Services Switching Center

GSN GPRS Support Node

GSM Global System for Mobile Communication

GUI Graphical User Interface

GW Gateway

HDLC High-level Data Link Control

HLR Home Location Register

HR Half Rate

HSCSD High Speed Circuit Switched Data

HW Hardware

I&B Information and Business

IAS Integrated Access System

IMEI International Mobile Equipment Identity

IMSI International Mobile Subscriber Identity

IN Intelligent Network

I/O Input/Output

IOG Input/Output Group

IP Internet Protocol

ISDN Integrated Services Digital Network

ISP Internet Service Provider

ISUP ISDN User Part

ITU International Telecommunications Union

IWMSC Interworking MSC

kbit/s Kilobits per Second

Kc Ciphering Key

Ki Individual (secret) Subscriber Authentication Key

Kpps Kilopackets per second

LAPD Link Access Protocol on D channel

LDC Location Dependent Charging

Mbit/s Megabits per Second

MAP Mobile Application Part

MG Mobility Gateway

MG Media Gateway

MIN Mobile Intelligent Network

MMIS Maintenance Management Information System

MPS Mobile Positioning System

MRP Multiple Reuse Planning

MSISDN Mobile Station ISDN

MS Mobile Station

MSC Mobile Switching Center

MTBF Mean Time Between Failure

MTP Message Transfer Part

MVPN Mobile Virtual Private Network

MXE Message System

MXU Mini-Link cross connect Unit

NE Network Element

NMC Network Management Center

NMS Network Management System

NMT Nordic Mobile Telephone System

NOX Neighboring Optimization eXpert

NO&M Network Operation and Maintenance

O&M Operation and Maintenance

OMC Operation and Maintenance Center

OSS Operations Support System

PAN Personal Access Network

PBX Private Branch Exchange

PC Personal Computer

PCB Printed Circuit Board

PCM Pulse Code Modulation

PCU Packet Control Unit

PDA Personal Digital Assistant

PIUA Positioning Information User Application

PKI Public Key Infrastructure

PLMN Public Land Mobile Network

PMR Private Mobile Radio

PN Personal Number

PTM Point to Multipoint

PRA Primary Rate Access

PSTN Public Switched Telephone Network

RAND Random Access Number

RBS Radio Base Station

RF Radio Frequency

RNC Radio Network Controller

RNS Radio Network System

RPP Regional Processor Power PC

SCCP Signaling Connection Control Part

SCE Service Creation Environment

SCF Service Control Function

SCM Service Control Management

SCP Service Control Point

SCP-T Service Control Point on Telecom purpose computers

SCS Self Configuring Systems

SCSA Service Capability and Application Servers

SDF Service Data Function

SDH Synchronous Digital Hierarchy

SDP Service Data Point

SGSN Service GPRS Support Node

SIB Service Independent Building Blocks

SIM Subscriber Identity Module

SMA Service Management Application

SMS/SCE Service Management System/Service Creation Environment

SMS Short Message Service

SMS-IWMSC Short Message Service Interworking MSC

SOG Service Order Gateway

SPR Signaling Point Relay

SRES Signed Response

SSCP Service Switching and Control Point

SSF Service Switching Function

SSI Service Script Interpreter

SSP Service Switching Point

STM Synchronous Transfer Mode

STP Switching Transfer Point

TACS Total Access Communications System

TCH Traffic Control Channel

TEMS Test Mobile System

TDMA Time Division Multiple Access

TMA Tower Mounted Amplifier

TMOS™ Telecommunications Management and Operations Support

TRA Transcoder

TRC Transcoder Controller

TRX Transceiver

TSC Transit Switching Center

UMTS Universal Mobile Telecommunications System

USC User Service Center

VLR Visitor Location Register

VPN Virtual Private Number

WAP Wireless Access Protocol

WapIDE WAP Integrated Development Environment

WCDMA Wideband Code Division Multiple Access

WISE™ Wireless Internet/Intranet Solution for Ericsson

WLL Wireless Local Loop

ZAS Administration of ZoneCodes

