

May 2003

WHITE PAPER

How the public safety sector's communication needs can
be served by public mobile networks

Contents

Preface	3
Introduction	3
The outline of this white paper	4
Important trends in communications	4
Existing functionality in GSM, including upgrading to 3G	6
The evolution of GSM: new functions with 3G	7
Special functionality for public safety	8
Business relationships with public safety organizations	13
Scenario: major accident in a city center	14
Advantages of a GSM-based solution	15
Conclusions	17
Ericsson's position	17

Preface

This white paper describes how public mobile networks, specifically GSM and its evolution into 3G access, can be used to meet the communication demands of different agencies in the public safety sector. Such networks, using the latest technologies, will become a future-proof, technically and economically viable alternative to dedicated networks.

This white paper is intended to inform government bodies, various agencies, regulators and network operators about these possibilities and to outline Ericsson's intentions.

Introduction

Agencies, such as police, fire brigades, ambulance services and so on have traditionally used dedicated systems to handle their communication needs. In many countries this has resulted in a number of incompatible systems meeting only the demands of each separate agency.

Today the overall demands on these agencies are very different to what they were just a few years ago: key requirements today are co-ordinated operations with efficient sharing of information between agencies, as well as access to new data and databases, such as images, maps, and geographical, building and infrastructure information. These demands call for common information and communication systems with a high degree of flexibility for integration and information sharing with the digital information databases being developed in all parts of society.

When governments are planning to upgrade services for the public safety sector, two options exist:

- The traditional solution, to build one or more stand-alone networks that serve one or more of the public safety authorities
- A solution where the required services are implemented in the public mobile networks safely and with back-up systems.

This white paper will describe how the public safety sector's special needs for co-ordination and security can be met using public mobile networks. The proposed business arrangement is to provide these services via a special service provider or virtual operator. This follows the national and international standards for emergency call handling/dispatch for 112/911/999 services.

The tremendous build-out of GSM and 3G public mobile networks around the world - with nationwide coverage, international roaming and complete functionality for voice, messaging, data and imaging - gives the public safety sector a new option when considering how to upgrade its communication systems. The public mobile networks will be further enhanced by adding 3G capabilities to existing networks. This will give much higher data speeds, allowing introduction of new services such as fast data transmission and video telephony.

One example illustrates the capabilities of existing GSM networks: the US government, as a result of the events of September 11, 2001, requested that priority functionality for public safety users be available in public mobile networks. Based on these requests, operators and vendors have together specified, demonstrated and implemented priority for public safety users in GSM networks in the US.

The outline of this white paper

This white paper describes the functionality of existing GSM networks and the increased functionality and capabilities that will be available with the introduction of wideband access known as 3G, as applied towards the needs of emergency services.

It describes how an already-standardized GSM functionality, known as ASCI (Advanced Speech Call Item), can be used for public safety users. These functions have been specified and implemented in specialized GSM networks, such as those used by railway companies, but are generally not implemented in public mobile networks.

This paper also proposes a business arrangement with a service provider taking on the role as integrator between public safety agencies and as the interface to mobile operators.

Finally, the white paper describes the advantages of public networks compared with dedicated networks built for public safety users.

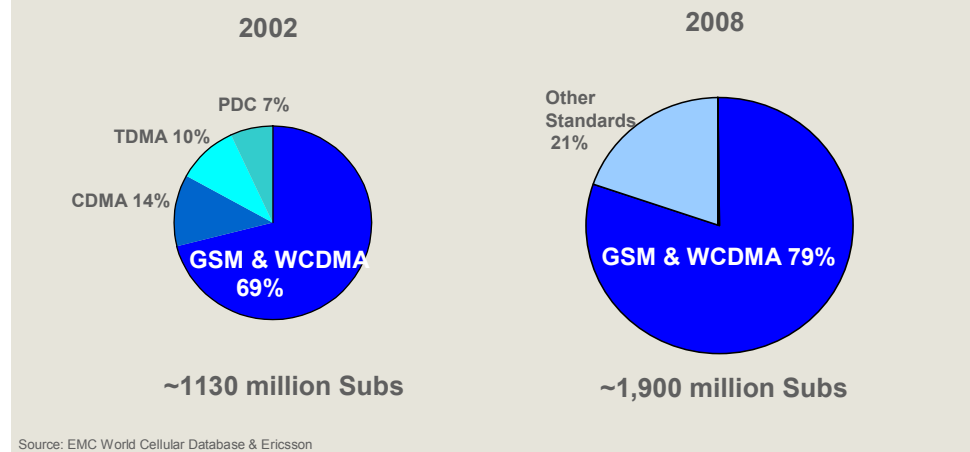
Important trends in communications

Before a major decision is made to invest in a new communication system, it is important to understand the major trends and driving forces in the communication industry.

New communication systems are becoming increasingly sophisticated and consequently increasingly expensive to develop. This development cost must be covered by users. Using a system developed for the mass market brings the lowest cost per user. GSM is by far the most used mobile technology today, with 69% market share in 2002 (see figure below), and its evolutionary path to 3G is forecast to be even more dominant. The GSM-track will consequently give the best economies of scale and migration to a true future-proof alternative.



Forecast - Global Mobile Subscriptions



As a consequence of September 11, the US government has actively worked with mobile operators and their suppliers to upgrade the mobile networks with priority functions to be used by the public safety sector in case of emergencies. Yet priority is only a single example and the functionality available, and mobile standards are being developed to embrace even more security-related functions.

Another important trend is that standard products developed for the Internet and 3G are also being deployed in other market segments. Most new military and tactical networks today are therefore designed with off-the-shelf products, built on open standards to take advantage of new technologies at the best possible price. This can be particularly important for high-performance applications, which otherwise can become very expensive because of their limited market volumes.

The focus of 3G technologies will largely be to offer a multitude of new end-user applications. Third-generation mobile networks are built in a layered structure with open interfaces to application developers. This will guarantee that there will be plenty of IT-companies developing different types of applications for users, both the general public and specialized users such as those in the public safety sector.

Existing functionality in GSM, including upgrading to 3G

When we consider the capabilities of GSM today, including upgrades to 3G, it is important to regard it as one single system that can use different forms of radio accesses with different capabilities.

Some of the main characteristics of existing GSM networks are:

- Nationwide coverage and capacity

One of the first lessons from the deployment of mobile networks, and one that is still relevant, is that coverage is the most important factor in making a service successful. GSM networks in most countries have been built with nationwide coverage and adequate capacity. These networks have now been complemented with packet-switching (GPRS) to offer always-on data communication. Moreover, most areas have multiple networks, run by several operators, thus increasing both coverage and resilience, if correctly designed.

- In-building coverage

Existing GSM systems are normally engineered and dimensioned for certain in-building coverage.

In-building solutions have been developed and extensively deployed for coverage in tunnels, underground locations and large buildings. These solutions assure coverage in areas that no other communication solution could normally reach.

- International roaming

International roaming is an integrated part of the GSM specification. End-users can roam to all countries with GSM networks, provided administrative agreements between the operators are in place.

- Data communication

GSM supports both circuit-switched and packet-switched data communication. These basic capabilities allow end-users to retrieve information from databases, send information to central locations, such as control centers, and exchange information with other users in their own group or in other user groups.

- Messaging

SMS, EMS and MMS offer messaging services from simple text messages to multimedia including transmission of pictures and photos.

- Positioning

The availability of end-user position information, including indoor coverage, is an integrated and advanced part of GSM.

- Encryption

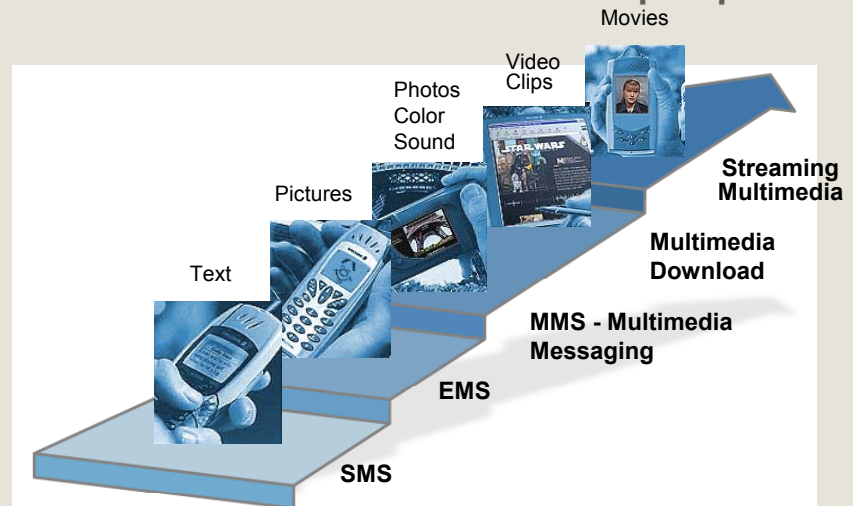
Encryption of voice and data can be provided in several ways, such as over the radio interface, which is standard in GSM, or between network equipment. End-to-end encryption of voice could be supported by special terminals or by carrying voice over an encrypted data channel. Experience so far shows that end-to-end encryption is more an administrative problem than a technical one.

The evolution of GSM: new functions with 3G

This is the year when we will see 3G in commercial operation. In a number of countries, operators will also share networks and we will see that the same core network will be used for GSM and 3G.

Based on these new high-potential networks, capable of carrying circuit-switched and packet-switched information, we will see a migration from voice-based services into IP-based multi-media services. The picture below shows the service evolution from the user's perspective.

Services evolution – from the user's perspective



Today we know that MMS, multimedia messaging, is being implemented all over the world; with 3G, real-time video transmission becomes possible. Real-time video can be an efficient way for public safety users to communicate between the scene of an accident and central locations such as control centers and hospitals.

Special functionality for public safety

It must be pointed out that a number of the functions listed below are already standardized for GSM, such as the ASCI (Advanced Speech Call Item) functions. These functions are implemented only in special networks, such as those used by railways, not usually in public networks. This is because of a lack of demand, as the public safety sector has so far built its own networks.

- Enhanced coverage

Most public mobile networks today have good coverage. However, if public safety authorities require better coverage in some areas than is provided by an existing public GSM network, the first alternative is to add new masts and antennas. This will also benefit public users in rural areas, for example. Obviously, this is far less costly than a complete rebuild, and the extra resources can directly improve the level of security.

To further enhance the coverage and availability for public safety users, *national roaming* can be used, as it is for the 112-service, the European equivalent of 911 or 999 services, today. This is not a technical issue but rather a legal and administrative issue for governments and operators.

It is also possible to communicate with users of satellite phones and other public telephone systems. Special communication systems can be connected via dispatch centers.

- Priority

A number of mechanisms in GSM allow public safety users to have reserved capacity or priority in case of emergencies. One alternative is to dedicate certain radio channels for public safety users, the equivalent of building a separate radio network. Another method is the priority functions implemented in the US, where in case of emergency, traffic channels can be handed over to high-priority users. These users get priority in queuing, while lower-priority users can be removed from a cell, for example by being handed over to another cell.

- Group communications

Group communication has an important role to play in the public safety sector. ASCI services provide group communication that can be configured in many flexible ways. These services use one radio traffic channel per cell for each group, avoiding unnecessary blocking of the radio network.

Ericsson can also offer duplex group calls, so everyone can listen and speak, using the Pro Server solution.

- Security

Security in GSM has many aspects. Besides built-in security functions such as authentication and encryption, additional security can be achieved by duplication of network components, national roaming to secure best possible coverage, redundancy and automatic switch-over in the network and base stations.

Another important aspect is access clearance and control of who has access to control and dispatch systems.

- Fast call set-up

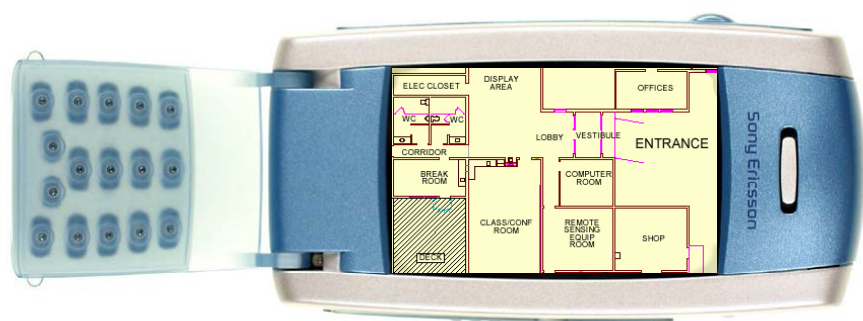
Some categories of public safety users, such as police officers, demand fast call set-up times in certain situations. GSM can provide this in several different ways, depending on the scenario. One method is that the dispatcher establishes group calls as soon as an alarm is received. In this way voice channels are available as soon as a rescue crew nears the scene of an accident. Another approach is to have one group call always set up for this purpose

In an unforeseen situation a user can send an emergency indication over an “always-on” packet channel to the dispatch centre.

- Terminals

With about 300 million new GSM/3G terminals sold every year, there is a constant flow of new and sophisticated terminals entering the market. One example of a high-end phone for professional use is P800 from SonyEricsson (see picture below).

Phones such as the P800 will be used by many public safety professionals, but we can also expect tailor-made versions for certain categories of users. The example below illustrates how a rescue worker using a P800 can get vital information about the floor plan of a building.



- Direct-mode terminals

In emergency situations, users often have a need for a direct-mode terminal: direct communication between two terminals without the need to communicate via a radio base station. This can be done either via two separate walkie-talkies or via special mobile terminals with direct-mode functionality. The mobile phone industry today is becoming “layered”, which means that different vendors specialize in different parts, chips, platforms, modules and so on. Using high-volume, GSM-based phones mean the best possible economies of scale can be achieved.

A direct-mode phone can be built based on a high-volume GSM module combined with a direct-mode module.

- Expansion of radio coverage

Additional radio capacity is sometimes needed at disaster scenes to support all rescue workers involved. Relay stations or additional complete base stations can be used to provide this additional capacity. These stations can for example be mounted in a fire truck or, as illustrated in the accompanying picture, be a complete mobile radio base station mounted in a container taken to the scene either by land, air or sea.



Mobile RBS

- Swesite
 - Fully equipped RBS site in a container
 - Mounted on truck, trailer etc ...
- Predefined in BSC for quick deployment
- Satellite or mini-link for quick transmission connection



- Dispatch centers

Dispatch centers and command centers are important parts of public safety networks. Existing or new types of dispatch and control centers are connected to a GSM network via open, standardized network interfaces. The figure below shows examples of the functions provided in the *CoordCom* dispatch center from Ericsson. *CoordCom* integrates system solutions for telephone and data communications for customers where 24-hour accessibility and reliability are absolutely essential.

CoordCom is built on a distributed IP WAN infrastructure, which enables specialists all over the area covered by the system to co-operate and share information. Alerts and actions can be directed to and shared by specialists in different locations.



Security Systems – CoordCom

One system integrating all information

Call-taking

- Intelligent Call Queue
- Geographic Information System, GIS
- Incident information, classification, logging, statistics ...



Dispatching

- Dispatching by using different techniques in the same manner
- Control of traffic signals, gates etc.
- Object information presented as text & images
- Status and position of available resources
- Planned decision support based on simulated scenarios
- Time-controlled responses

- Interworking with Wi-Fi (Wireless LAN or WLAN)

We have in applications supporting UN rescue operations, already seen how Wi-Fi (WLAN) can be used to establish communication quickly at disaster scenes. Ericsson offers Wi-Fi integrated into GSM systems as an additional radio access for limited coverage.

- Ericsson Pro Server

Ericsson Pro Server is an existing, off-the-shelf, vendor-independent and easy-to-integrate product, enabling duplex group communication services in mobile networks. The use of standard interfaces, standard signaling protocols and standard phone equipment makes it possible to create group calls, broadcast calls and open-channel operation for smaller user groups in any network. Pro Server systems have been delivered to a variety of organizations ranging from police to small businesses.

- Push-to-talk

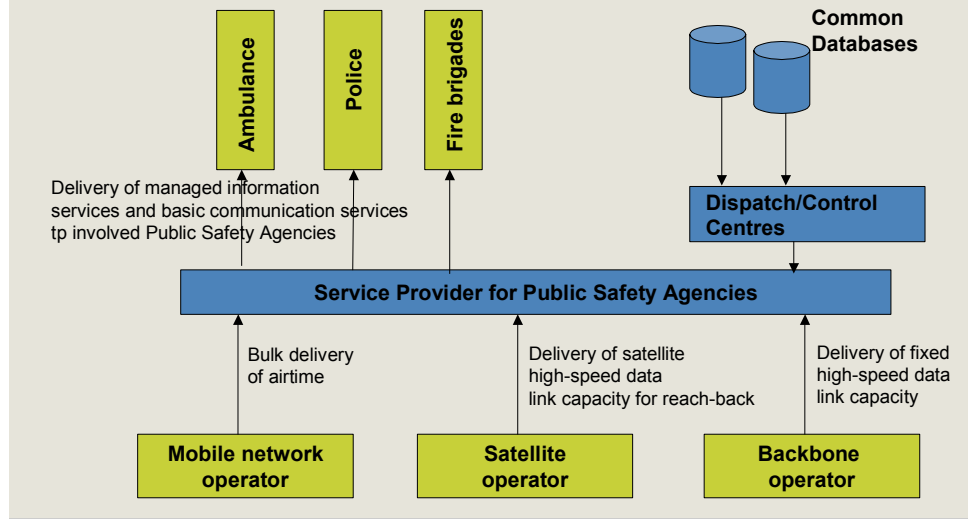
Push-to-talk is a function requested by end-users in public mobile networks today. This function allows pre-defined groups of users to communicate over a packet channel by pressing a special key. Push-to-talk is now being standardized for GSM and can be a useful service for public safety user groups.

Business relationships with public safety organizations

Besides the technical functions described so far, public safety users have special requirements for security, information sharing and support. Furthermore the personnel handling these systems, such as dispatch and control centers, must meet strict security rules. To meet these requirements, Ericsson proposes that a special service provider or virtual operator be formed in line with how call-taking/ dispatching for 112/911/999 service is set up.

The role of the service provider is illustrated in the figure below.

Service Provider for Public Safety Agencies



The role of the service provider is to be an integrator between the different public safety agencies. This role will include:

- Signing service-level agreements with network operators, ensuring that the necessary capacity and functionality is available in public networks, whether fixed, mobile or satellite
- Providing call-taking and dispatch services in common and dedicated centers according to the demands of the user organizations
- Providing means for information sharing of data that is of common interest for more than one agency, such as geographical information systems

Scenario: major accident in a city center

In this scenario, a major incident has occurred in a big office complex in a city area. Just as rescue teams, ambulances and police have to get access to the building, the incident causes severe traffic congestion and drivers start using their mobile phones extensively. Soon afterwards, television and radio teams start to report from the scene, creating even more telephone traffic to and from the area. This can also include high-bandwidth data streams for television-broadcasts.

When public safety users are using a service provider in a GSM network with the functionality described above, the following actions will be taken to ensure that rescue teams, ambulance staff and police officers get access to the communication channels they need, and to help them co-ordinate their activities.

- With the implemented priority function, a certain capacity in the network is always reserved for public safety users to ensure access
- When an alarm is received and the rescue teams travel to the scene of the incident, the dispatcher establishes group calls and broadcast groups
- If or when more capacity is required, the priority function ensures that the necessary number of channels is allocated
- The established work groups can be expanded, either by a pre-defined member of the group or by a dispatcher
- Established work groups can be combined. For example police and rescue team communications can be combined to help co-ordination
- In a long-lasting rescue operation, additional capacity can be established by bringing a mobile radio base station to the scene. This RBS will primarily give ordinary mobile subscribers the capacity they need while rescue workers are ensured the capacity they require through the priority function

The priority function guarantees that different types of emergency workers have access to group communication at the scene as well as being able to communicate with central locations such as control centers and hospitals.

Rescue workers will have access to information databases via the service provider, allowing them to retrieve information needed for the rescue operation. Other user categories, such as decision makers and politicians responsible for rescue operations, can be integrated into the information groups.

Advantages of a GSM-based solution

The examples given so far show what kinds of functions can be implemented and provided in public mobile networks if they are demanded and ordered by public authorities.

When governments and public authorities decide on whether to invest in a dedicated network or to buy services from service providers, a number of important issues such as coverage, reliability and security have to be considered. The final decision must also be based on costs. How do they get the most for the money they invest?

There are a number of advantages to a solution based on a public GSM network.

- Experience has shown that the most important and expensive factor in making a new mobile service successful is full coverage in the served area. This is also the basic prerequisite for the public safety sector. Taking advantage of investments already made in public mobile networks means there will be full coverage from day one. Such an approach also provides substantial cost benefits, as well as benefits in increased security since coverage can be complemented with modest investments in remote areas, in-doors, tunnels and so on
- A system based on the mainstream track of mobile system evolution provides a future-proof and cost-efficient solution for both system and terminals
- New services will have a “free ride” on the wave of new functionality, allowing the public safety sector to keep pace with commercial state-of-the-art products and services
- Advanced functionality is available from the start, such as positioning services (including indoor usage), advanced messaging services, high-speed circuit-switched and packet-switched data, a constant, always-on connection, video telephony, streaming services and roaming possibilities to all countries using GSM
- GSM with 3G access can already handle the high bandwidth demands of pictures and video streaming better than any proprietary communication system
- Any additional investments made to enhance coverage and capacity can also be beneficial for society in general
- The solution will allow priority access for public safety users even when network congestion occurs at temporary hot spots such as major incidents

- By buying communication services from service providers, public authorities will not need an organization to build and operate a communication network. Technical staff can be focused on specialized areas such as dispatch and control centers

Conclusions

These examples have demonstrated that public GSM networks have the potential to meet existing and future demands from the public safety sector.

Products built on open standards means that the public safety sector can take full advantage of new products and applications developed by different vendors following the set standards.

GSM and 3G, as the leading world standards, will offer the best economies of scale, and solutions based on public GSM networks will be substantially more cost-efficient to build and operate than separate networks based on other standards.

The public network solution will also allow the public safety sector to implement mobile applications based on 3G in its business operations. At the same time, this will promote IT-integration between fixed and mobile applications, leading to a more efficient organization.

With the existing and planned coverage of GSM networks, and the planned expansion in functionality to 3G, we are convinced that these networks will be the most cost-efficient and future-proof platform to deliver the communication functionality that users in the public safety sector need to carry out their duties efficiently.

Ericsson's position

Ericsson, as the leading infrastructure provider of mobile networks, is committed to support our customers by continuously improving the functionality of these networks to meet new demands. Priority functionality for the public safety sector has for example already been developed and implemented in the GSM networks in the US.

To improve the functionality of GSM networks further to meet public safety users' requirements, Ericsson is actively driving work to set new standards and to adopt GSM-defined standards such as ASCI for 3G as well.