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GSM & WCDMA SEAMLESS NETWORK

White Paper

GSM networks will evolve and interwork with WCDMA to form a seamless network.

ERICSSON

TAKING YOU FORWARD

Preface

This white paper is intended for GSM operators who are interested in understanding Ericsson's view on how existing GSM networks will evolve and interwork with WCDMA. This white paper focuses on Ericsson's system evolution for GSM, the introduction of third-generation (3G) services and the integration of GSM and WCDMA to form a seamless network. A seamless network supports the growth of today's services as well as the creation and growth of tomorrow's advanced services.

This document takes into consideration the entire infrastructure or system. It does not address which applications to develop or what the terminals should look like in order to attract a certain market segment. This document does, however, address how and why Ericsson's systems offer superior evolution of GSM and WCDMA toward 3G and services beyond voice.

The GSM and WCDMA evolution raises several critical questions for the operator. How can operators maximize and reuse current GSM assets? How can they deploy WCDMA while maintaining profitability in GSM? How do they best allocate investments between GSM and WCDMA infrastructures? How will users experience the new combined GSM and WCDMA services?

The evolution scenarios, operator needs and suggested solutions described in this paper are based on Ericsson's leading position within GSM and WCDMA networks and its active and driving efforts within standardization organizations for both GSM and WCDMA.

Contents

1 Introduction

A new generation of wireless systems will provide users with easy-to-use access to voice, data, multimedia or any combination of services. The key lies in the evolution of GSM and WCDMA networks as a single, unified seamless network that shares core, transmission, radio and application resources. This has been made possible through ongoing standardization work of the Third Generation Partnership Project (3GPP).

A seamless network offers a wide range of options for third-generation (3G) solutions that take wireless communications to a higher level. These solutions address the business requirements of operators before, during and after deployment of 3G and mobile services beyond voice. What's more, the seamless network provides more flexibility, enhances the user experience, protects investments and increase efficiency.

Provides more flexibility. The highly flexible seamless network uses different technologies to provide the capacity needed to deliver the same kind of services to subscribers. Complete WCDMA coverage, for example, is not required to provide 3G services. When users who require both voice and multimedia services move out of the WCDMA coverage area, the seamless network automatically switches to GSM and EDGE to deliver similar services (service quality restricted by radio access).

Enhances the user experience. The seamless network provides transparency of services to users. Users are not aware of the various technologies involved in delivering high-quality services, but do notice the high quality and broad range of services they receive.

Protects investments. Operators make the best use of existing investments by reusing 2G and 2.5G equipment for their 3G networks. Shared resources, including common transport, site re-use and open interfaces, offer a cost-effective and easy-to-manage network solution.

Increases efficiency. Effectively combining GSM, EDGE and WCDMA technologies provides full coverage for voice, data, multimedia or any combination of these services. The seamless network automatically selects the best technology or combination of technologies to meet subscribers' particular needs during any given period of time. Users receive the best possible quality of service while operators are assured that the network selects the most cost-effective method of delivering these services.

The white paper describes the Seamless Network and its various components. It sets forth strategies for operators to employ when introducing 3G as well as explains the benefits of a seamless GSM and WCDMA network. Ericsson's

seamless network solutions help operators satisfy the increasing demands of current GSM subscribers while laying the foundation for future 3G businesses.

2 Background

In July 2000, the standardization work of GSM was moved into 3GPP because there was clear recognition from the industry that GSM and WCDMA must work and evolve together.

With the enormous success of GSM and the large number of customers using existing GSM networks, this development was necessary. Capitalizing upon the GSM subscriber base, frequencies and networks already in place ensures that GSM investments will continue to be profitable for years to come.

2.1 A changing industry

The Western European and some Asian markets have reached a very high level of mobile usage penetration. The same is true for the American market when considering moderate- to high-level spending customers. However, this does not necessarily mean that the growth in number of subscriptions will end, since there is still a large untapped subscriber potential in new markets as well as emerging applications such as machine-to-machine communication.

To enable growth in already saturated markets with high penetration figures, the focus for future growth must be on making current subscribers use their telephones more, either by increasing the minutes of use from current voice-centric services or by offering new attractive data services.

A key issue will be the ability to implement a quick, cost-effective 3G rollout while retaining profitability with current GSM business.

2.2 Operator assets

Because the need for capacity and bandwidth will drive the requirements for efficient resource utilization, Ericsson considers the seamless network of GSM and WCDMA as one of the most valuable solutions for the future.

Existing GSM operators have several advantages. These include existing network and spectrum, as well as distribution channels (that is, established means of communication between operators and their subscribers). And above all, existing operators already have their own subscribers. Acquiring new subscribers is a huge expense to all operators, and the cost of churn is large. It is much less expensive to keep an existing subscriber than to acquire or “buy” a new one. Today, most existing subscribers are GSM subscribers. The

challenge for an existing GSM operator is how to evolve its 2G network to provide 3G services to subscribers.

2.3 Evolution to 3G

Moving from GSM to 3G entails adding more functionality, more possibilities and more value to the existing GSM network and business. This is *not* a revolution but an evolution, in which each part adds value to the whole.

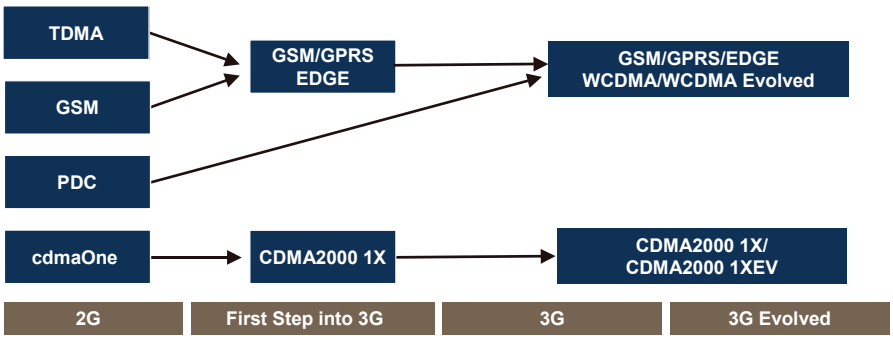

Figure 1) Evolution paths of 2G standards

The evolution begins with an upgrade of the GSM network with packet-data capabilities by adding GPRS. This introduces end users to the “always-connected” experience.

The next step is the introduction of 3G services, during which the GSM standard is developed in two ways: (1) WCDMA as the 3G radio access for the wideband spectrum and (2) EDGE as the 3G radio access for the existing GSM spectrum WCDMA is a new, highly efficient technology for both packet- and circuit-switched traffic. It provides more capacity and higher data rates to enhance the user’s experience of existing voice and data services as well as new advanced mobile services beyond voice.

EDGE is a standardized set of improvements to the GSM radio interface that brings higher data rates and increased spectral efficiency for data services. With EDGE, the operator can have three times more subscribers than with GPRS or triple the data rate. EDGE provides in principle the same type of 3G services as WCDMA, but with lower data transfer rates. Implementing EDGE is fast and cost-efficient. EDGE uses the same channel structure, frequency planning, protocols and coverage as today’s GSM. Operators will be able to achieve *more* with the same physical resources.

Because the GSM frequency bands are a substantial part of an operator’s total spectrum assets, it will become increasingly important to be able to use the GSM spectrum for 3G services. The choice will not be between WCDMA and EDGE, but how to best utilize *both* WCDMA and EDGE.

In the American and Latin American markets, as well as in some Asian and African markets, EDGE is used in the initial rollout of 3G services, and will add WCDMA later dependent on spectrum availability. In Europe, EDGE is seen as a complement to WCDMA, adding 3G coverage and capacity to the GSM band.

3 The seamless network

A seamless network is the merger of GSM and WCDMA networks that enables an operator to offer quality service, for voice, data and multimedia, in the most cost-effective and resource-efficient way.

The seamless network solution is comprised of multimode handsets that work on both GSM and WCDMA frequencies and a network that combines the GSM and WCDMA resources. Services are provided over GSM or WCDMA radio access, depending on radio resource availability and service demand.

3.1 User experience

How will users experience a seamless network? First of all, users should not take much notice of the network. Just as users today should not notice when a GSM handover from the 1800 MHz to the 900 MHz band occurs, users of a seamless network should not notice whether services are delivered on GSM or WCDMA.

Take, for example, a user who boards a train in a large city and heads for the countryside. The user has a multimode GSM/WCDMA handset and has a subscription with an operator having a GSM network with nationwide EDGE coverage. The operator also has a WCDMA network with coverage in all major cities.

As the user initially is in an area with WCDMA coverage, he starts his call there. The call begins as a voice call. During the call, the user decides to use a digital camera to show a friend a previously recorded video. This is done by adding a streaming video session while maintaining the voice call.

As the train moves out of the WCDMA coverage area, the network moves the call to the GSM network, renegotiates the data transfer with the handset application, and uses EDGE functionality in the GSM network to continue to send both voice and video. The user now experiences the same voice quality as before but lower quality for the streaming video.

3.2 Seamless services

GSM operators that deploy WCDMA and evolve to a seamless network have the opportunity to segment their markets and to differentiate services based on the type of service.

Because WCDMA handsets will be multi-mode GSM/GPRS/EDGE/WCDMA terminals capable of handling GSM and WCDMA voice and data, users will be able to access services from both networks. The multimode handsets will provide users with seamless services.

There are several good examples of successful segmentation practices when launching new advanced mobile data services. One such example is Turkcell, an operator that currently offers a broad range of mixed voice services, short messaging service (SMS) and GPRS services without focusing on the technology behind them.

3.3 Flexible 3G deployment

A major strength of the Ericsson Seamless Network is that it enables flexibility in 3G deployments. The seamless network ensures that services introduced on GSM or WCDMA will work seamlessly on both GSM and WCDMA. The services are only limited by the bandwidth offered at that time. This benefit enables operators to provide mobile services beyond voice using WCDMA in areas where it is commercially beneficial and, at the same time, provide the same types of services nationwide using EDGE on the GSM network.

3.4 Retention of GSM subscribers

It is important for subscribers to have a positive experience during the migration to 3G. With a well thought-through seamless network strategy, it is possible to offer generic services on both GSM and WCDMA. In other words, a service that is initially launched on GSM can easily be made available on WCDMA. Subscribers who are accustomed to certain types of service (e.g., an e-mail account or information service) will maintain the same service; however, the quality of service will improve when using a multimode WCDMA handset.

There is a risk that operators may loose subscribers to competitors when GSM subscribers are required to exchange their GSM handsets for multimode WCDMA models. Rather than move to the current operator’s newly available WCDMA services, some subscribers may opt to choose another operator’s services. Several commercial measures can be taken by operators to counteract this user behaviour, such as bundling offers, marketing campaigns, etc.

3.5 Standardization

The functionality described in this document is based on available standards. The next evolutionary step for GSM systems includes standardization of enhancements that will lead to alignment with WCDMA. Those enhancements are now being specified as part of the GSM/EDGE radio access network (GERAN) standard in upcoming releases of the 3GPP standard. The GERAN standard will support the same quality of service (QoS) classes, such as conversational multimedia and streaming video, as those defined for WCDMA.

By doing so, a new range of applications, including multimedia applications, can be supported.

4 GSM and WCDMA evolution

When discussing a seamless network we can, for simplicity's sake, divide the network into three areas: (1) the GSM radio access network area, (2) the WCDMA radio access network area, and (3) the common area (see *Figure 2) The Seamless Network*).

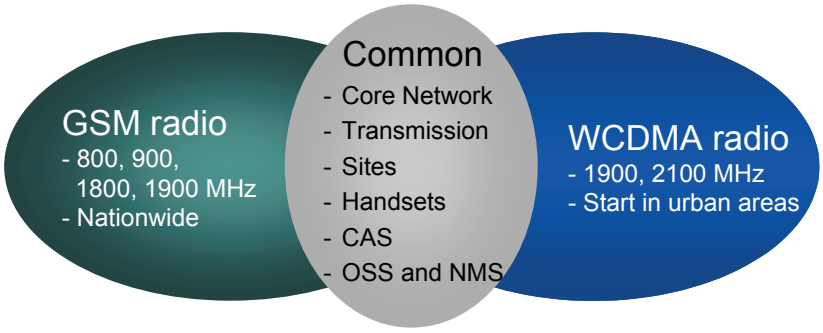

Figure 2) The Seamless Network

In a seamless network the GSM and WCDMA radio access networks will not be common in the near future, but radio control features will make them work as a single common resource. The features enabling a seamless radio network will be described in detail in the next section.

The common area in the seamless network consists of all the areas that are, or will be, shared between the GSM and WCDMA networks. This includes the common core network with its multi-service packet backbone network (M-PBN), transmission, sites, handsets, the service network, customer administration system (CAS), operation support system (OSS) and network management system (NMS). These areas will be described in detail in the section, "Common infrastructure".

5 Radio network integration

A main component in combining the GSM and WCDMA radio access networks is to have radio traffic control that is able to handle the entire spectrum allocated by the two systems as a single unit. Ericsson has chosen to implement traffic control using inter-system traffic control functionality and Self-Configuring Systems functionality.

5.1 Traffic Control

Ericsson's traffic control mechanisms ensure full utilization of the combined GSM and WCDMA spectrum and resources, with seamless handover and transfer of connections between the two systems.

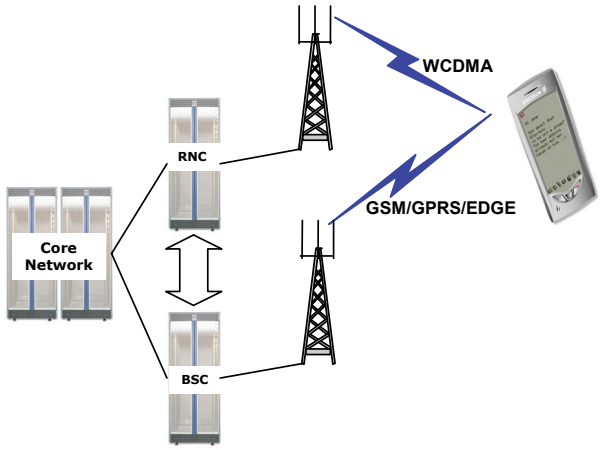

Figure 3) Traffic Control

Traffic control functionality includes handover control, service differentiation and load control. Real-time power control, packet scheduling and channel switching are handled within each system due to the timing requirements necessary when executing these functions.

The functionality is based on existing (A, Gb and Iu) and currently standardized interfaces for intersystem communication for information, such as configuration and load.

Handover Control.

When introducing WCDMA, intersystem handover from GSM to WCDMA occurs based on the load situation in GSM, whereas handover from WCDMA to GSM occurs based on lack of coverage or load.

Service Differentiation and Load Control.

Service differentiation and load control is enabled with traffic control mechanisms in different ways:

(1) *Policy-based service differentiation*, which enables the operator to set up service differentiation policy depending on system. For example, the operator can assign GSM to handle speech and WCDMA to handle data.

(2) *Load Control mechanisms* balances the load based on the application. For example, when the GSM load is heavy, users are moved to WCDMA.

(3) *Subscriber-based service differentiation* makes assigning priority based on type of subscription possible. Users with gold subscriptions could by general rules be transferred to the system with lowest load, or with the best available bearer services. Users with speech only subscriptions, or combined with services requiring low bandwidth data, could be kept in GSM even when within WCDMA coverage.

5.2 Self-Configuring Systems

Ericsson's current and planned functionality for Self-Configuring Systems (SCS) analyzes conditions in the combined GSM and WCDMA radio network as well as guiding principles from the operator. It then recommends optimal network settings and can automatically configure these settings. This leads to improved network performance by minimizing radio interference, which leads to maximized radio network capacity.

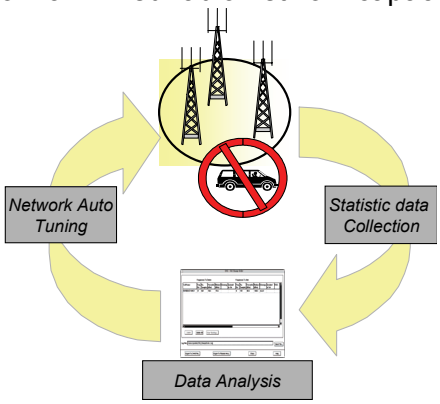

Figure 4) Self-Configuring Systems

The SCS automates the settings of the most frequently changed cell and neighbour parameters for traffic control in the systems, using real-time performance monitoring and configuration data from the network. These include real-time statistics and recordings from *all active mobiles* in the network on both the up- and downlink.

5.3 Benefits

Together, traffic control mechanisms and SCS provide increased spectrum efficiency, which results in less congestion, higher average bit rates and voice traffic *without* the introduction of new nodes or network elements. Traffic control functionality and SCS simply add or enhance functionality for intelligent node communication in the combined GSM/WCDMA radio network.

Traffic control mechanisms manage the multiple access technologies involved in a combined GSM/WCDMA radio network. This maximizes spectrum efficiency and use of system resources.

This functionality provides operators who do not see a need to provide extensive WCDMA coverage early on with an opportunity to limit initial capital and operational expenditures through gradual rollout. With traffic control functionality, GSM network resources continue to be used efficiently in a combined GSM/WCDMA environment.

6 Common infrastructure

6.1 Evolved GSM core network and M-PBN

Ericsson has a comprehensive range of solutions for evolving the GSM core network to support both GSM and WCDMA. These solutions are introduced with core network release CN3.0 (available now) and the Mobile Packet Backbone Network (M-PBN) solutions (available now). The M-PBN is a generic solution for the WCDMA and GSM core packet backbone network. It includes interconnection of sites and nodes within a site via an IP or IP/ATM multi-service backbone network.

The CN3.0 and M-PBN introduce a fully layered core network architecture, which separates the different connection layers. The core network will control the combined, seamless GSM/WCDMA access through a common backbone network. On top of the core network there is a common service network with common applications for GSM and WCDMA.

6.2 Handsets

From the outset, all WCDMA handsets will be multimode GSM/WCDMA voice and data. For the European market, 3G multimode (GSM/GPRS/EDGE/WCDMA) handsets are already available from several suppliers. Triple mode GSM/GPRS/EDGE handsets are available for the

American market today. During 2005, WCDMA will be added and multimode terminals (GSM/GPRS/EDGE/WCDMA) will be available for the American frequencies.

6.3 Radio base stations

Because base station sites represent a large portion of network investments, there is a lot to gain by sharing the same sites. For operators with a GSM network, up to 80 percent of WCDMA sites can be shared with the existing GSM sites.

Ericsson's WCDMA and GSM radio base stations (RBSs) are designed for matching coverage in urban areas. This provides maximum intersystem offload and trunking gain in a macro-coverage scenario. With a proven track record of delivering high output power, high receiver sensitivity and low power consumption, the co-sited WCDMA and GSM RBS's from Ericsson provide state-of-the-art radio performance.

6.4 Network management

Ericsson's management solution for a combined GSM/WCDMA network drastically reduces the effort required to configure and to optimize the radio network. The Ericsson common operation and support system (OSS) provides the following benefits:

- There is no need to add an extra tool to handle external cell data between the systems.
- The same definitions (planned, valid area, adjust, etc.) are valid in all subsystems.
- User interaction with the network is the same, regardless of which system technology (GSM or WCDMA) is used.

The Ericsson OSS solution, OSS-RC, a management system for the combined GSM/WCDMA radio network, increases efficiency, minimizes the number of required staff and reduces training costs.

6.5 Transmission network

The transmission in a radio access network must evolve to meet the requirements for increased flexibility, capacity and availability. The main drivers for this evolution are subscriber growth, the introduction of new bandwidth-demanding services and the introduction of packet-based transport with asynchronous transfer mode (ATM) in WCDMA now and with IP later on.

Transmission resources are then used in the most efficient way, especially when higher data rate packet-based services become a substantial part of the total traffic. Another benefit with a seamless network is simplified maintenance and faster expansion and configuration of the network.

7 From 2G to 3G - an operator model

To highlight the challenges an operator will face when introducing 3G, we have developed a 3G-transition model. The model describes the different phases an operator will encounter. Here, we present three potential WCDMA introduction strategies along with the factors driving the move to 3G, how they impact the selection of the strategy and the resulting operator requirements. The three transition strategies are (1) aggressive WCDMA deployment, (2) WCDMA deployment at moderate speed and (3) alternative 3G deployment.

7.1 3G transition model

Many GSM operators will aggressively deploy WCDMA on their markets. This will result from regulatory demands or from being in a very competitive market where quick WCDMA rollout is seen as the right strategy.

For others, market conditions and other factors may dictate that they continue competing solely with GSM for a few more years and then take the step to WCDMA when licenses are available.

Most operators, however, will introduce WCDMA and multimedia services with the intention of offering both high-speed and narrow-bandwidth data services for several years. The challenge then will be to segment the market and position services and handsets to different segments.

In view of this evolution, GSM and WCDMA operators will go through three distinct phases as time progresses and market conditions change. They will move from (I) current voice-centric GSM-only businesses to (II) nationwide low-speed GPRS wireless data services, with high-speed WCDMA services in certain areas, to (III) focusing solely on high-speed multimedia mobile internet WCDMA and GSM services (see *Figure 5) GSM and WCDMA transition phases*).

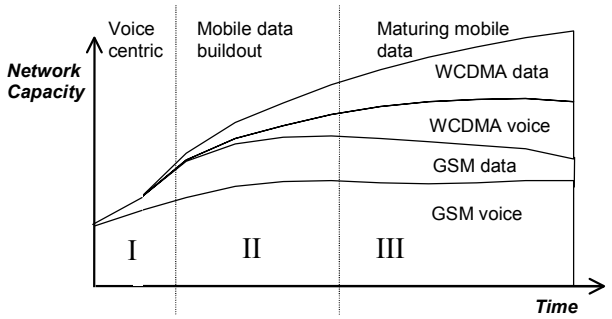

Figure 5) GSM and WCDMA transition phases

Each phase is characterized by different subscriber base growth and usage rates. Phase I illustrates the growth of an operator's GSM subscriber base, which is the only subscriber base. Phase II shows the continuing growth of an operator's voice subscriber base while GSM and WCDMA data usage is increasing at a higher rate. Phase III indicates stagnation of voice growth and the decline of low-speed data usage as users migrate to combined GSM/WCDMA handsets with high-speed data multimedia capabilities.

GSM operators will move through all three of these phases as the market evolves. Each operator must determine the best evolution strategy based upon its specific situation and a range of factors, including spectrum availability, subscriber maturity and size/growth of different segments, Mobile Internet services, competition, handsets and financial situation.

The strategy adopted will determine the start and duration of each phase as well as the type of solutions the operator will choose at different times.

7.2 Aggressive WCDMA deployment

From an infrastructure perspective, this strategy consists of aggressively deploying the WCDMA overlay network. From a subscriber point of view, it means that within three to five years of launching WCDMA services, the operator will have migrated a vast majority of its current GSM subscribers to the new combined network. Subsidies of handsets will be important as incentives for subscribers to upgrade their handsets. Therefore operators adopting this strategy need to segment their subscriber base to determine which segments that should be migrated to the combined network. Focus will be on mobile data services. Operators adopting this strategy will leave Phase I and spend a rather short period in Phase II before entering and remaining in Phase III.

Factors such as a highly competitive environment, regulatory requirements, a strong financial situation, limited GSM capacity in the current network, high

churn rates and/or high ambitions in market share or ARPU growth would lead operators to adopt this strategy.

OPERATOR SCENARIO: Aggressive WCDMA deployment

A European GSM operator with a million subscribers is in a fierce competitive environment where the market is characterized by high churn rates. The operator has a strong ambition to reduce its churn and strengthen its position in the market. The operator believes that the WCDMA handset's advantages and high-end data services would be a good way to compete and to brand their services. This operator has GSM radio frequencies in the 900 and 1800 MHz bands but is fully utilizing the capacity with its existing GSM subscribers. The operator has launched nationwide GPRS services but feels that this is not sufficient to differentiate itself from competitors.

The fierce competition experienced in this market and the end user's perception of data services will force the operator to immediately deploy WCDMA nationwide, both for data and voice services. The high capacity of the WCDMA network will enable the operator to aggressively launch new voice and data services to gain market share.

Because this is a high-churn market, the operator must replace a large share of its subscriber base every year in order to maintain its market share. The new subscribers acquiring new handsets provide the operator with the opportunity to smoothly introduce the WCDMA service by offering new multimode GSM/GPRS/WCDMA handsets instead of GSM-only handsets. Statistics show, for instance, that at least one of every four subscribers will acquire a new handset each year in markets experiencing a 25 percent annual churn rate. These subscribers, therefore, are potential users of new WCDMA services.

Within the context of the GSM and WCDMA evolution, an operator pursuing this strategy would primarily be interested in solutions that quickly and smoothly support the rapid introduction of WCDMA. At the same time, an operator wants to protect its investment in GSM as well as ensure smooth transition of subscribers from GSM-only handsets to multimode handsets. These solutions are discussed later in this paper.

7.3 WCDMA deployment at moderate speed

From a network perspective, this strategy consists of deploying WCDMA in urban areas while continuing to invest in GSM to add capacity for growth of voice traffic and nationwide low-speed data services on GPRS.

From a subscriber point of view, it means that advanced multimedia Mobile Internet services will initially be available only in urban areas, while more basic data services will still be available outside of the WCDMA coverage area.

The operator will gradually introduce multimode GSM/GPRS/WCDMA handsets, depending on demand and availability. Operators choosing this strategy will leave Phase I, remain in Phase II for a longer period and then enter and remain in Phase III.

Factors that will influence some operators to adopt this strategy include strong GSM and GPRS growth, current GSM quality and capacity problems, a very large GSM network and subscriber base, availability of terminals, a gradually increasing maturity of the wireless data market and a stable financial situation.

OPERATOR SCENARIO: WCDMA deployment at moderate speed

Consider an Asian GSM operator with 5 million subscribers in a fast-growing market, with a growing Mobile Internet market. To protect its market share, the operator must offer high-quality voice services while positioning itself as an innovative Mobile Internet provider. To raise capital, this publicly traded company must have a healthy balance sheet as well as a sound profit and loss statement. The operator will focus on being profitable while introducing WCDMA.

These factors lead this operator to continue building out GSM to maintain its high-quality network and to launch new nationwide GSM data services (using GPRS and EDGE) while building out WCDMA coverage and migrating high-end users to GSM/WCDMA multimode handsets.

Deployment of WCDMA to gain coverage in major cities can begin immediately, and then capacity and coverage may increase, depending on market maturity. By gradually building out WCDMA and introducing WCDMA handsets, the operator minimizes financial risk while the market matures. This is possible due to the seamless functionality that enables handsets to use the EDGE network outside of WCDMA coverage areas.

The subscriber base or traffic of the two networks will continue to grow for several years until WCDMA coverage is equal to GSM coverage. At this point, the operator will be able to market advanced Mobile Internet services that combine the total capacity of the two networks as it best sees fit to implement its strategies and achieve its goals.

Operators following this strategy would be interested in solutions that enable the operator to offer services that work on both the GSM and WCDMA networks. They would consider incremental investments in GSM for capacity as well as for new GSM data services that can quickly be introduced in GSM to test the market. By building loyalty among its subscriber base, this operator would then be ready to introduce WCDMA capability while retaining its customers.

7.4 Alternative 3G deployment

This strategy is based on the operator remaining in Phase II and continuing to compete solely by using its existing GSM network. The WCDMA network will be deployed, but at a later stage.

OPERATOR SCENARIO: Alternative 3G deployment

Consider a GSM operator in the Latin America with a million subscribers and a dominant 40 percent market share. Its' subscriber base is still voice-centric but the operator has successfully launched data services using SMS and GPRS. Due to regulatory issues, no WCDMA frequencies are currently available. Its main competitor, a code division multiple access (CDMA) rival, holds 30 percent of the market share and is aggressively introducing new mobile data services.

Fierce competition in this market will lead the operator to carefully plan services that help differentiate it from its rivals in order to maintain its market share.

The strategy of this operator is to leverage on the existing nationwide GPRS network to aggressively launch 3G services with the EDGE system upgrade. The operator could also look into network quality and coverage to counter the strong competition by maintaining the high quality of its current voice offerings.

Operators implementing this transition strategy will require, in the short to medium term, new and stronger data services deploying GPRS and EDGE to compete successfully in their markets. It is important for these operators to invest in GSM infrastructure that smoothly supports the future introduction of WCDMA while at the same time ensuring that GSM services remain competitive and profitable.

8 Cost savings with the seamless network

When evolving from a pure GSM network to a seamless GSM/WCDMA one, two different areas are sources of cost savings: capital expenditures (CAPEX) and operating expenditures (OPEX). Both will be analyzed here with regard to potential savings.

8.1 CAPEX saving areas

The seamless network protects an operator's GSM investment by reusing GSM resources when evolving toward a 3G network. There are several areas in which operators can realize savings: (1) the radio access network, (2) the

packet-switched core network, (3) the circuit-switched core network and (4) charging and billing.

The radio access network, one of the most expensive parts of a wireless network, offers several areas for potential savings when building the UTRAN. The most important are:

- Sharing the UTRAN with other operators. Ericsson fully supports the concept of shared networks.
- Co-location and coexistence of GSM and WCDMA provide opportunities to share small sites due to the small footprint of the cabinet, antenna and feeder equipment, power equipment and transmission lines. Co-location of Ericsson-only equipment on a site increases the potential for savings because Ericsson's WCDMA solutions are designed to coexist with Ericsson's GSM solutions.
- Using common operations and management subsystems for both Ericsson GSM and WCDMA radio access networks.
- Having cabinet footprint and installation methods be the same in 2G and 3G, which reduces training costs for field installation engineers.

Packet-switched core network. Ericsson products for the packet-switched core network provide smooth migration from GSM/GPRS to WCDMA. Both the serving GPRS support node (SGSN) and gateway GPRS support node (GGSN) can be fully reused in the WCDMA network topology, enabling the best possible protection of an operator's investment. While in an initial phase, the spare capacity in GPRS can be used for dedicated WCDMA support. The core network nodes will support both GSM/GPRS and WCDMA.

Reusing existing infrastructure not only provides investment savings but other advantages, too.

- It reduces signalling overheads.
- It reduces operation and maintenance costs.
- It reduces training costs.

Thanks to a proven network management platform, reducing costs for operation and maintenance and training activities provides major savings in the operations area.

Additional savings in the operations field are possible because all the established procedures for maintenance, technical support and spare parts management remain the same. What's more, little to no additional training is required for the field support engineers.

Circuit-switched core network. If upgraded to a layered architecture, all existing Ericsson Mobile Switching Centers/Visitor Location Registers (MSCs/VLRs) can be reused to handle both GSM and WCDMA circuit-switched traffic.

Ericsson has designed these products to support a smooth migration. Depending on the future need and traffic growth, the operators can migrate the circuit-switched part of the network to a combined or to a split architecture.

When choosing the combined architecture, the 2G MSC/VLR platforms can be migrated to full-featured 3G MSCs. If the operator decides to introduce the split architecture, the 2G MSC/VLRs can be migrated to MSC servers. In both cases, the migration of the Ericsson products ensures the highest possible investment protection and leads to cost savings.

Reusing the 2G MSCs also leads to cost savings in the operational area.

Charging and billing. Choosing to reuse and to migrate Ericsson's equipment in the core network does not require introducing new devices to interface with the existing billing system. The Ericsson Billing Gateway used in today's GPRS network can be fully reused in the 3G network.

8.2 OPEX saving areas

There are many benefits from operating the GSM and WCDMA networks as a single network, especially when it comes to saving operational costs. With two separate networks, the complexity of running the operator's business increases exponentially. The operator can also realize significant savings by choosing fewer vendors to provide its network.

Here, we will analyze the major aspects of the single network and the vendor-operator relationship with regard to potential savings and ease of operations. These include: (1) customer service management, (2) technical planning, (3) training, (4) installation services, (5) interoperability testing, (6) operations, maintenance and support and (7) processes and human interfaces.

Customer service management is one of the biggest expenses of running a mobile operator business. Having a common customer care system, a single subscription and one billing system leads to substantial OPEX savings, both in terms of personnel and training costs. The layered architecture of the seamless network makes it possible to realize these savings.

Technical planning. For every network and vendor, the operator needs to establish an interface team in order to plan and to coordinate ongoing operations. This results in additional costs for highly skilled personnel on both the management and technical levels.

Training. Maintaining two separate networks, each with its specific products, significantly increases the cost of training. Bringing in network equipment from

a new vendor automatically leads to new training requirements for operating, maintaining and supporting the new products.

Installation services, especially in the radio access network, comprise a major portion of operational costs. Efforts behind the initial deployment of all network elements are much higher when co-siting equipment from different vendors. Using Ericsson's equipment, with its smooth evolutionary paths, enables predefined interconnection and facilitates upgrade procedures. This requires less material and offers smoother installation compared to overlaying equipment from other vendors. It also reduces the human effort and leads to cost reductions.

Interoperability testing. The amount of interoperability testing to verify interworking of network elements increases with the introduction of each new vendor into a network. This may cause delays in rolling out new features and capabilities and requires involvement from operators at a later stage during multi-vendor integration. Multi-vendor integration requires dedicated operator personnel and, in many cases, other purchase obligations in terms of equipment.

Operations, maintenance and support. Regardless of the amount and type of equipment deployed, the operator needs to secure operation, maintenance and support agreements with all vendors. Because highly skilled, and thus expensive, staff is required both on the operator and the supplier sides, increasing the number of suppliers automatically leads to higher costs.

Processes and human interfaces. Maintaining vendor contacts, well-proven human interfaces and processes is a major aspect of the vendor-operator partnership. Introducing a new vendor will create the need to spend time on these issues, thus reducing work productivity and increasing costs.

9 Conclusion

A seamless network supports the growth of today's services as well as the creation and growth of mobile services beyond voice.

Radio network control, base station co-siting and common backbone solutions are some parts of the seamless network that help address the challenges of the network evolution.

The concept of a seamless network adds flexibility in the 3G deployments, enhances system performance, and protects network investments through re-use of resources.

These solutions will help the operator secure the satisfaction and loyalty of its current GSM subscriber base. This vital asset must be protected during this transition period, because it is the foundation for future 3G businesses.

Ericsson has vast experience in helping operators make smooth transitions and can help operators in developing a strategy that is right for their businesses.

10 Acronyms

3GPP	Third-Generation Partnership Project
BSC	Base Station Controller
BSS	Base Substation Systems
CAPEX	Capital Expenditures
CAS	Customer Administration System
CDMA	Code Division Multiple Access
EDGE	Enhanced Data rates for Global Evolution
GERAN	GSM/EDGE Radio Access Network
GGSN	Gateway GPRS Support Node
GPRS	General Packet Radio Services
GSM	Global System for Mobile communications
GSN	GPRS Support Node
HLR	Home Location Register
HRAN	High-capacity Radio Access Network
IP	Internet Protocol
MGW	Media Gateway
M-PBN	Multi-service Packet Backbone Network
MSC	Mobile Switching Center
MVNO	Mobile Virtual Network Operator
NMS	Network Management System
OPEX	Operating Expenditures
OSS	Operation Support System

QoS	Quality of Service
RBS	Radio Base Station
RNC	Radio Network Controller
SCS	Self-Configuring Systems
SGSN	Serving GPRS Support Node
SMS	Short Messaging Service
TDMA	Time Division Multiple Access
UTRAN	WCDMA Terrestrial Radio Access Network
VLR	Visitor Location Register
WCDMA	Wideband Code Division Multiple Access