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# SOFTSWITCH IN MOBILE NETWORKS

White Paper

The circuit switched core network handles over 90% of the revenue generating traffic in a typical mobile network. Case studies show that prudent application of softswitch technology can reduce core network Opex by up to 50%. It is also an essential step in the evolution to an IMS based All-IP network.

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# Contents

# 1 Executive summary

Softswitching separates the call control and switching functions into separate nodes and fundamentally changes the way mobile circuit switched services, like Voice and SMS, are handled. The MSC-Server handles call control while the Mobile Media Gateway handles switching.

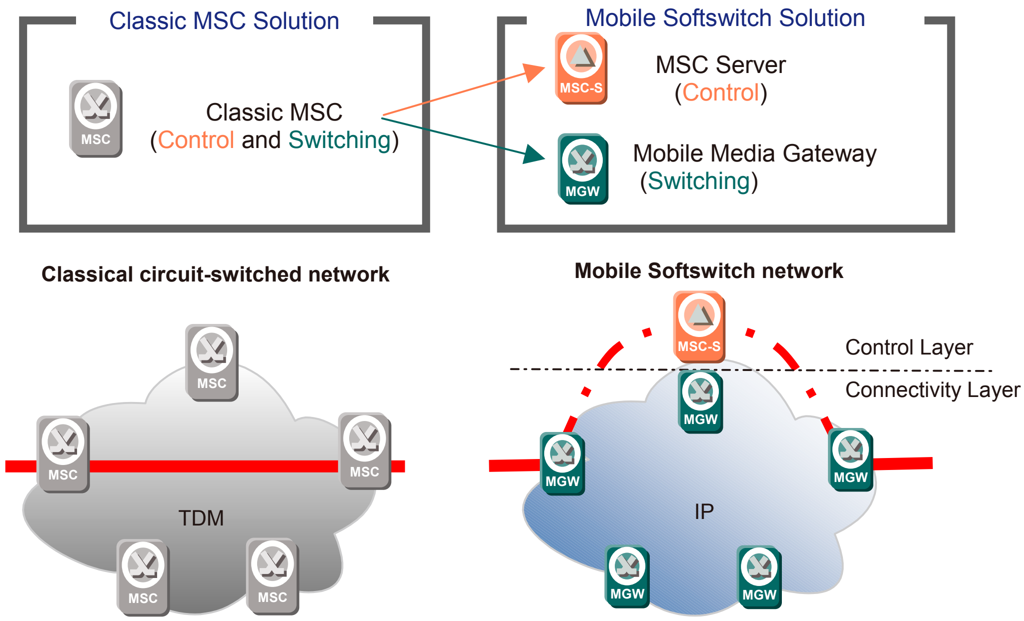


*Figure 1) A classic MSC architecture and a Mobile Softswitch side by side.*

This enables much more efficient network design through optimized equipment location, improved scalability and simplified O&M. Flexible support for new technologies powers ongoing network evolution and hardware modernization and complements IMS to provide a smooth and cost effective migration to the future “All-IP” network. Operator case studies, supported by early live, commercial experience, show that it can improve service capabilities, and resulting revenue potential, and save up to 50% of core network OPEX.

Safe introduction of softswitch technology in a sophisticated mobile network requires an open, standards-based solution designed for robust and resilient performance: i.e. modern softswitch technology applied to proven Telecom platforms. This approach provides full network design flexibility and all the resulting OPEX savings. It also retains the features, functionality and platform characteristics that have evolved over many years to meet specific operational needs and service requirements. Over time, these softswitch platforms will evolve towards generic, high-availability server architectures, using commercial of the shelf processors and open source operating systems. Such systems will integrate support for VoIP and traditional voice services.

# 2 Business Drivers for Evolution

Mobile Telephony is a large and dynamic business that continues to enjoy significant growth worldwide. Competition is often already intense amongst the established players. Additionally, there is a steady stream of new operators and service providers who build up their service capabilities with the latest technology, hoping to create a major competitive advantage.

Key needs for mobile operators are higher volumes and new services to sustain revenue growth and improved cost efficiency to protect margins. A prudent yet aggressive adoption of business enhancing technology is also needed to ensure current and future competitiveness: especially as future IP based communications creates the opportunity for much wider competition from Internet based Service Providers. **Business Growth, Cost Efficiency and Evolution** are therefore regarded as key drivers which can be addressed with softswitch technology.

## 2.1 Business Growth

Mobile Telephony is a mature industry that has been globally available for some time. Growth of subscribers, traffic, and most importantly revenues, is by no means automatic. Entry costs for new users and tariffs must be continuously reduced to increase subscriber numbers and minutes of use. Infrastructure solutions that deliver lower cost coverage and more efficient capacity are critical to drive up service volumes and revenues.

Per unit pricing for cash-cow voice and SMS services is falling sharply in most markets. New services are therefore also needed to drive revenue growth. Rich communications, such as Video Telephony and shared “you see what I see” multimedia content build on and add value to existing communications behaviors and can command premium tariffs. The IP Multimedia System (IMS) introduces new VoIP and multimedia communications services and supports a converged service offering. Providing an integrated service delivery infrastructure spanning fixed and mobile, home and business. Efficient interoperability between the mainstream cellular voice and SMS services and these new IP based multimedia communications is essential to keep mobile operators at the top of this value chain and support a controlled service-driven migration of the mobile users towards All-IP communications.

Mobile softswitching enables both lower cost coverage and capacity growth and efficient interworking with new IMS based services.

## 2.2 Cost Efficiency

Superior cost efficiency is used as a competitive weapon in many markets: e.g. by new Greenfield operators, using the latest technology, and by budget MVNO operations. Aggressive reduction of recurring costs is essential to maintain competitiveness, preserve margins, and secure the existing business.

Significant improvements in cost efficiency are most easily achieved by targeting the largest cost drivers. The largest addressable cost for the mobile infrastructure relates to Network OPEX, which typically accounts for some 20% of total revenue. Most of this is associated with the Circuit Switched infrastructure that handles the vast majority of network traffic.

Most mobile networks have grown quickly in a dynamic market. Large cost savings are possible by redesign and restructuring of the network: rationalizing sites, nodes, technology and operations. Softswitch solutions are essential to this process since they allow the application, control and connectivity functions to be independently optimized in terms of technology, location, capacity etc.

The ability to build a common backbone for all Circuit Switched and Packet Switched traffic is especially valuable in a dynamic world. Traffic in both domains can be expected to have strong but unpredictable growth over the next few years, especially on the Packet Switched side where the take-off of VoIP and Mobile Broadband services is difficult to accurately forecast. One certainty is that total traffic will grow indefinitely. Hence investment in a single, common backbone, which is capable of handling all network traffic, is secure and futureproof.

## 2.3 Evolution Needs

Mobile Telephony is a dynamic, high-technology industry and Operators must aggressively evolve their services and operational base to remain competitive. This becomes even more critical as services become increasingly IP based, opening up new opportunities and competitive threats. The following attributes support easier and earlier access to new, business-enhancing technology:

a) Layered Architecture networks: Separating the different functional layers of the network increases flexibility by allowing each layer to evolve independently and work seamlessly across multiple access networks.

b) Mobile softswitch: Softswitching of high volume CS traffic is instrumental in migrating today’s PLMNs from circuit to packet based technology.

c) Standards compliance: Full commitment to standards compliance and interoperability is essential to maintain an efficient multi-vendor network environment. It ensures that new technology is backwards and forwards compatible and preserves flexibility and choice.

# 3 Mobile Softswitch Solution Benefits

Introducing a Mobile Softswitch solution is the first step on the way toward an all-IP core network. In addition to powering network evolution, Mobile softswitch technology is fundamental for future revenue growth and cost efficiency:

## 3.1 Grow Revenue

**Increased Subscriber Penetration**

Efficient capacity: The greater power, flexibility and scalability of physically separated Servers and Gateways based on latest technology hardware provides much more efficient handling of traffic growth. This drives higher usage and subscriber growth within existing coverage areas.

**Expanded Coverage**

Efficient coverage: New coverage areas can be built with transport efficient solutions and utilizing MSC-Server pools in the already existing network. This means the core network operations for new coverage areas are handled centrally with existing resources and expertise.

**Substitution of fixed line traffic**

Efficient, high quality mobile-to-mobile services are supported by introduction of Transcoder Free Operation (TrFO) for WCDMA/CDMA 2000 networks and by Tandem Free Operation –Transcoder Free Operation Interworking (TFO-TrFO Interworking) for GSM. Elimination of Transcoding from mobile to mobile calls means that enterprise VPN voice services can be offered more efficiently and with higher speech quality.

**Richer Communications**

Efficient support for Video telephony and multimedia calls through optimized dimensioning of Server and Gateway resources which can be adjusted as the traffic mix changes from simple voice calls to video and multimedia calls and/or from pre-paid to post-paid subscribers.

**Interworking with VoIP services**

IP telephony services using fixed, broadband access networks exist already today and will see significant growth over the few years in both the enterprise and domestic segments. Mobile operators can target new revenues through the efficient interworking with these new VoIP services that can be achieved by using softswitch technology.

**Increased Service Availability**

Pooling of servers, virtual media gateway capabilities and smart design of the connectivity layer provides efficient redundancy of network nodes along with redundant routing in the backbone. This effectively eliminates all network downtime for planned upgrades/maintenance and massively reduces the impact of unplanned outages. Significantly higher service availability levels will increase revenue potential.

**Revenue Growth Summary**

The revenue potential of Mobile Softswitching is summarized in the Figure 2*)* below which shows how the different softswitch solution attributes impact new service capabilities.

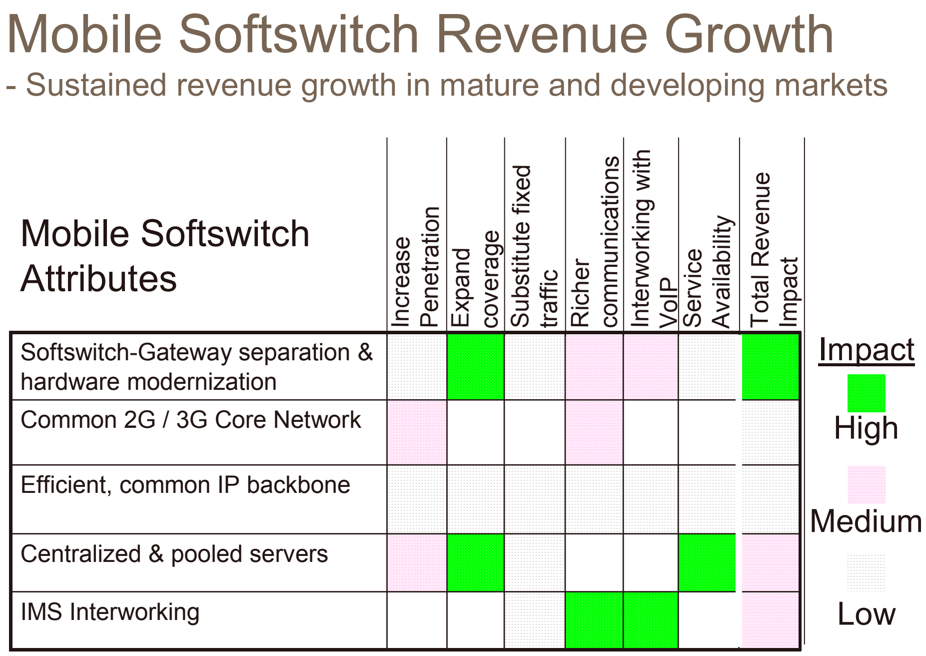


*Figure 2) Mobile Softswitch drives revenue growth*

## 3.2 Reduce OPEX

A number of case studies have been undertaken to evaluate how Mobile Softswitch technology can be used to reduce OPEX. These studies, together with the operational experience gained from commercial softswitch operations over the last 2 years, indicates that Core Network OPEX can be reduced by up to 50%, focusing on the following areas:

  

### Transmission

Transmission requirements are reduced in 2 ways:

a) Distribution of Mobile-Media Gateways to Radio Network concentration points enables local switching of mobile-to-mobile call and local breakout to PSTN. The majority of calls in a mobile network are locally terminated: up to 80% of all calls in many of the cases studied. All of this local call traffic can be off-loaded from the backhaul transmission network.

b) Packet backbone technology (IP or ATM) together with new standardized features for efficient voice coding reduces the bandwidth required for transmission of voice. IP can provide a bandwidth saving of some 60% compared to today's TDM backbone technology.

   An additional benefit of these features is that transcoding is only performed when its needed (for example at interconnect to other fixed line networks). So mobile-to-mobile calls can eliminate transcoding altogether improving speech quality and network efficiency.

### Power Consumption

Simplifying the role of equipment as servers and gateways means that the latest technology can be used most effectively to achieve higher levels of integration and reduce size and power consumption. Ultra modern severs and gateways that are initially used for network capacity expansion can also support a phased replacement of older network switching equipment offering great savings in power consumption and network footprint.

### Site Rental

Reduced equipment footprint along with the centralization of control layer equipment can be used to close many sites and massively reduce the space needed at others. The flexibility of softswitch network design means that the main retained network sites can be located in low rental areas.

### Network Planning

Network planning efficiencies are achieved in a number of ways:

a) A common circuit core, handling GSM and WCDMA traffic in the same server pools and gateways, simplifies network planning by removing the need to forecast the split of GSM and WCDMA traffic or to plan and dimension two separate core networks.

b) Using a single transport infrastructure for all services and for traffic (signaling, user plane payload, billing data, O&M etc) simplifies planning. Additionally, making transport IP based greatly reduces the complexity of provisioning and dimensioning thousands of point-to-point TDM links, as is required for today's signaling and traffic networks.

c) Pooling of MSC servers makes it much easier to handle rapid and unpredictable subscriber and traffic growth since new MSC-Servers, BSCs and RNC can all be introduced much faster and with much less effort. For example pools remove the need for re-parenting of BSCs & RNCs to accommodate growth that is common in today's networks. The natural trunking efficiency and traffic smoothing effects from enlarged service areas also helps to handle abnormal traffic peaks.

**Operations & Maintenance (O&M)**

The network planning benefits listed above also apply directly to O&M as well. Additional O&M benefits include:

a) Separation of the network layers allows the sophisticated server equipment to be centralized close to the major network operations centers. This facilitates a substantial reduction in O&M heads and expenses.

b) Pooling of servers and network level redundancy of network equipment and transport reduces the number or severity of critical O&M events and allows maintenance with zero network downtime during normal working hours.

c) Rationalization of network technology and transport infrastructure reduces network complexity and the number and criticality of alarms.

**Spares, Support and Training**

Rationalizing the function of servers and gateways and modernization of the hardware reduces the number of hardware types. This in turn reduces hardware support costs and training needs. Such cost are further reduced if the softswitch solution is based on the same platforms as found elsewhere in the existing network.

**OPEX Benefits Summary**

The cost saving potential of Mobile Softswitching is summarized in the Figure *3)* below which shows how the different softswitch solution attributes impact the main OPEX drivers.

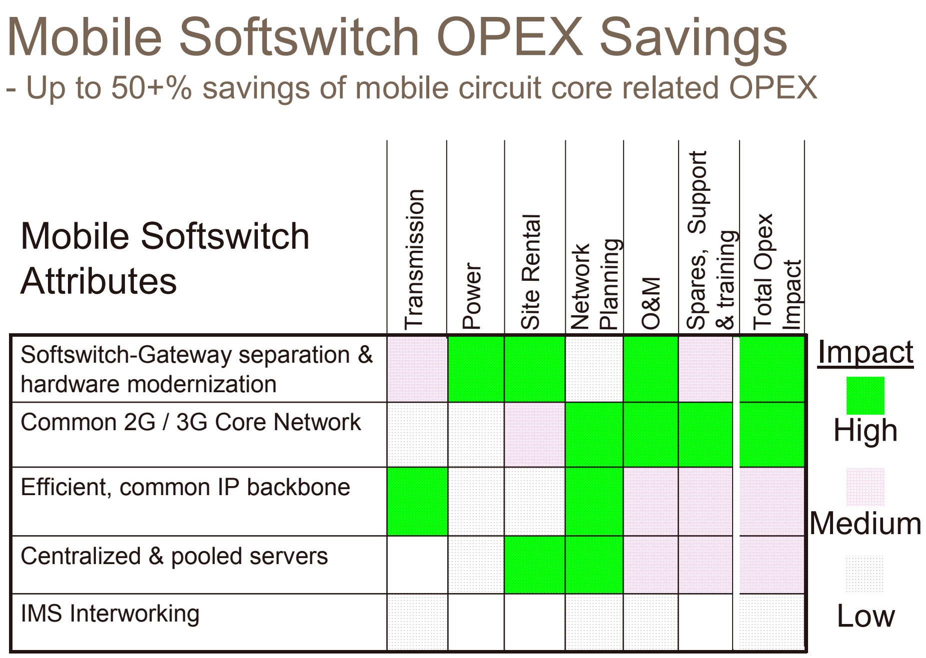


*Figure 3) Mobile Softswitch reduces OPEX*

# 4 Realizing Mobile Softswitch benefits

## 4.1 Main Solution Requirements

The mobile softswitch solution handles the mainstream communication services of Voice Telephony and SMS. Services that all subscribers use and expect to work all the time. System outages in the core network have occurred from time to time and can affect millions of customers. This demands a reliable and resilient solution, and a secure and reversible methodology for its stepwise commercial implementation.

The solution must be built on proven platforms with appropriate redundancy and with the fault and overload resilience expected from telecom grade equipment. It must facilitate cost efficient network design with flexible and dynamic many-to-many relations between gateways and servers offering network level redundancy mechanisms. Finally, realization of softswitch benefits requires fully featured, standards-compliant support for a common 2G/3G, IP based core network.

Planning, implementation and in-service support all require experience and expertise with the technology combined with robust and proven operating procedures for fault handling, fast recovery of service and rollback of problematic upgrades.

All of the above dictates a requirement for a proven telecom grade solution and a reliable and experienced solution vendor. Softswitch solutions built on generic computer platforms do not yet reach these standards for the following reasons:

- Application software in mobile networks has evolved over many years of commercial service to meet specific operational needs. The interoperability testing, verification and supply processes have likewise developed to meet ISP and multi-vendor support needs, and operator requirements for such things as documentation, training, life cycle management, and in-service support.

- Telecom platforms provide levels of robustness and resilience for high performance, high availability realtime applications that are simply unmatched by the generic server and gateway platforms. Such equipment is typically used in simpler or more controlled environments such as fixed line networks or enterprise VPNs.

- The generic softswitch solution often combines products and expertise from a number of different companies. This makes the overall solution support process difficult and long-winded.

Generic softswitch technology is currently best suited to less demanding mobile network functions such as Transit Switching Centers (TSC) and Gateway MSCs (GMSC), provided the requisite reliability can be achieved. Low cost, high capacity server and gateway hardware based on generic platforms are well suited to these roles that require little or no mobile specific functionality. Such solutions offer potential short-term Capex savings. However it is important to recognize that the role of such switches in the future target network is much diminished, and only the very largest networks will continue to use a hierarchical structure requiring dedicated TSC functionality. In the majority of networks the role of the TSC becomes a pure “Connectivity” function handled in the big backbone routers with no control layer intelligence needed. Likewise GMSC functionality will invariably be distributed over the normal mobile softswitch nodes.

## 4.2 MSC-Server and M-MGw requirements

Flexible network design requires both low-end and high-end scalability for M-MGws and the capability for MSC-S’s and M-MGws to interconnect in flexible many to many relationships. This enables efficient resource utilization and network level redundancy for servers (through MSC pools) and gateways (through flexible M-MGw selection and alternate routing of traffic). Complementary load control mechanisms are required in servers and gateways to proactively manage the network load and control admission to the IP backbone. This is vital since congestion in an IP network degrades performance for all users.

The MSC-S and M-MGw need full capabilities to interconnect with the legacy mobile network including efficient support for multiple E1/T1 interfaces, high-capacity, narrowband signaling etc. They must offer equally good support for future 3G services with ATM interfaces (over e.g. E1/T1 or STM1) and higher signaling loads. Flexible support for multiple transport technologies is also needed for smooth migration of both signaling and user plane traffic from TDM and ATM to IP.

Finally the ability to re-use existing classic network MSCs as MSC-S protects existing investment in hardware, software and management systems as well as O&M processes, experience, and know-how. If classic MSCs can simultaneously function as MSC-S this enables an extremely efficient introduction of mobile softswitching for capacity or coverage expansion and supports a phased migration of the existing network.

## 4.3 Supporting GSM and WCDMA traffic in same node

All servers and gateways should have full, simultaneous GSM/WCDMA mobile service capabilities and support for standardized network interfaces (A, Iu, Nb…etc). This is essential for efficient network design and effective handling and management of inter-system handovers.

Building separate GSM and WCDMA core networks will be extremely inefficient from both an OPEX and CAPEX perspective since both networks must be accurately forecast, planned and managed and both dimensioned for peak load.

## 4.4 Building an efficient IP Backbone

IP backbones within current mobile networks tend to be quite simple: interconnecting relatively few nodes, with low traffic levels and quite simple QoS and traffic separation requirements.

Evolution of the network to handle all traffic over a common IP transport must take place through a series of well-defined steps during which capacity, functionality and competence must be grown.

Data service traffic is already growing rapidly and this will be accelerated in volume and complexity through increased enterprise and 3G usage, VoIP services like Push to Talk, and the launch of Mobile Broadband packages. Delay and error sensitive traffic on the IP backbone will increase through introduction of Signaling over IP based on the SIGTRAN standard to handle specific signaling bottlenecks.

These changes represent the next step in the development of the IP core network. They will provide significant early challenges for operators to optimize the IP network design for capacity, QoS handling and security whilst establishing new processes for network planning, dimensioning and O&M. High capacity, multi-service IP backbone design techniques are still relatively immature and access to reference designs and industry best practice is essential for a smooth evolution.

Handling of large volumes of delay and error sensitive Voice traffic on the IP backbone represents another step and a further major challenge. Voice traffic is the most demanding, the most important (from a user and operator revenue perspective) and, by far, the greatest in volume. Simple over-provisioning - the standard mantra of IP network design (and Router vendors!) - breaks down with such high proportions of realtime traffic because it ceases to provide an efficient solution. Hence the migration of voice traffic to the IP backbone first requires substantial development of functionality, design competence and operational procedures.

This step also requires new, standardized functionality in the softswitch solution. Specifically it requires features based on Bearer Independent Call Control (BICC) signaling that enable the MSC-S to determine if and where transcoding of the voice traffic takes place. This allows the efficient AMR or EFR coding used in the air interface can be utilized across the entire core network.

## 4.5 Pooling of MSC-Servers

Centralizing and modernizing the sophisticated equipment responsible for call control is one of the big efficiency drivers for the softswitch solution. Pooling of the MSC-S provides further benefits through increased capacity and service availability and reduced OPEX.

Capacity benefits come from reduced signaling and the trunking efficiency of distributing within the pool the peak loads of each individual MSC. Additionally, server pools provide always up service and can even support geographical redundancy, ensuring service continuity even if a major site goes down.

With pool operation all maintenance and upgrade activity can be performed during normal working hours with zero downtime. Benefits are even greater in a dynamic and growing network where pooling means nodes can be easily added without the need for re-parenting of equipment or reconfiguration of the network

## 4.6 IMS Interworking

Normal voice telephony will continue to be handled in the circuit switched mobile core for the foreseeable future. However, in fixed broadband networks, IP telephony services based on IMS/SIP are already launched and growing. Efficient interconnection of mobile telephony services with IMS/SIP based IP telephony services will be needed.

The MSC-S must therefore support the Media Gateway Control Function (MGCF): supporting SIP communications with external IP telephony servers.

Interworking support is also needed in the M-MGw in the form of VoIP Gateway functionality. This creates a gateway between the mobile circuit switched Voice network (AMR or EFR coded, carried on the Nb interface over IP, ATM or TDM) and the VoIP Network (coded voice carried over RTP on IP). Supported voice codecs on the VoIP side could include AMR but specific VoIP codecs may provide better end-to-end performance. Hence the M-MGw should also be capable of transcoding between mobile codecs and the more common VoIP codecs.

Specific interworking support between the circuit switched mobile core and IMS will also be required for Video Telephony.

# 5 Migration from Classic to Softswitch Architecture

This migration is considered in the context of three different scenarios. For each scenario the value and approach to a Mobile Softswitch Solution will be different.

1. **Incumbent** – Mature GSM networks with no short to medium term WCDMA roll-out plans and mature cdmaOne/CDMA2000 networks.

2. **Greenfield** – Pure, recently launched or soon to be launched, mobile networks (GSM, WCDMA or CDMA2000).

3. **Incumbent GSM adding WCDMA** – Combination of GSM and WCDMA network where most traffic is GSM. GSM traffic may continue to grow even as WCDMA traffic starts to explode.

## 5.1 Incumbent Operators

Incumbent operators must typically secure cost efficient capacity expansion whilst protecting investment in the large installed base.

Network expansion is becoming increasingly difficult due to issues like transmission port limits, signaling overload, and complicated reconfiguration of the switching network. A transit layer may already be implemented in the switching network.

A Mobile softswitch solution with features like MSC Pools and signaling over IP will help to reduce network complexity whilst fully reusing existing capacity. It can be introduced when coverage or capacity expansion is needed or as part of a phased modernization of older equipment: reducing complexity and providing significant savings in O&M, site rentals and power consumption.

## 5.2 Greenfield Operators

Greenfield operators have an excellent opportunity to build the most scalable, flexible and efficient network from the start using the very latest technology. A properly designed and implemented softswitch network offers better service capabilities and big cost efficiency advantages. These advantages can help build market share by supporting lower tariffs, wider coverage areas and better services than the incumbent operators.

## 5.3 Incumbent GSM adding WCDMA

Typically the WCDMA network is built as an overlay network with little network infrastructure shared with the GSM. The WCDMA network can thus be built from the start with the latest softswitch technology. There are two main ways to develop this into a common softswitch network.

The first is to use existing GSM MSCs as both classic MSCs and MSC-S. Traffic from a BSC controlled by such an MSC could be split with some continuing to go to the classic MSC and some going to a M-MGw controlled by the MSC. Over time more and more traffic can be transferred to the M-MGw providing a smooth transition to a common GSM/WCDMA softswitch architecture. This approach is highly attractive in terms of protecting existing investment but has a cost in terms due to increased network complexity over an extended period.

The second approach is to transfer complete BSCs one at a time to the overlay softswitch network to effectively create a common GSM/WCDMA network. This enables classic MSCs in the GSM network to be taken out of service and, where appropriate, re-configured as pure MSC-S. This approach can still protect existing investment and provides a much simpler migration.

# 6 Conclusion

Cost savings and debt reduction are amongst the top priorities for almost all operators. The Mobile Softswitch approach delivers significant OPEX savings, supports more efficient investment (CAPEX) in new capacity and drives evolution towards the All-IP network of the future.

The most important benefits of a Mobile Softswitch Solution are operational:

- Increased transmission efficiency.
- Flexible expansion and evolution of the network.
- Optimum network design with centralized call control and distributed switching reduces O&M and site costs.

All these benefits combined have the potential to reduce core network OPEX by up to 50%.

Mobile Softswitching also ensures the network is well prepared for the introduction of new business enhancing technologies like 3G, IP Transport and IMS.

In order to harvest these benefits operators need to develop a stepwise core network evolution plan that maximizes reuse of existing investments and guarantees future flexibility. Focus for this plan should be a cost efficient long-term target network with the service capabilities needed for supporting a competitive market offering.

Adhering to a standards compliant approach based on commercially proven solutions will be essential to create a network that is compatible with existing operations and preserves design flexibility and vendor selection choice for the future. This will be important in order to secure the financial benefits from this evolutionary step.

The Mobile Softswitch Solution is today a proven technology. The substantial benefits that can be achieved by this solution have generated a large interest among mobile operators and as a result it is today being implemented in an increasing number of networks.

# 7 Glossary

| | |
|---|---|
| 2G | 2nd generation mobile communication services offered through digital systems like GSM, cdmaOne, TDMA, etc |
| 3G | 3rd generation mobile communication services offered through digital systems like WCDMA, CDMA2000 EV-DO/ EV-DV and EDGE |
| 3GPP | 3rd Generation Partnership Project – Collaboration between global standardization bodies for GSM/WCDMA services |
| 3GPP2 | 3rd Generation Partnership Project 2 – Collaboration between global standardization bodies for CDMA2000 services |
| All-IP | 'All-IP' refers to a network where all transport and service control is IP based |
| AMR | Adaptive Multi Rate – Speech codec for mobile systems that has the capability to adapt the level of coding to the quality of the radio channel optimizing the use of the radio resources |
| ARPU | Average Revenue Per User – Indicator for the average revenues generated by the users of mobile services |
| ATM | Asynchronous Transfer Mode – Connection oriented packet based switching technology |
| BICC | Bearer Independent Call Control – Signaling protocol separating the call control from the bearer connection control |
| BSC | Base Station Controller – Node aggregating traffic from a number of radio sites also responsible for radio resource management |
| CAPEX | Capital Expenditure – Expenditure on assets, such as buildings and network equipment, that may be depreciated over many years |
| CDMA2000 | CDMA2000 is an evolutionary path from narrowband cdmaOne/IS-95 to 3G |
| E1 | Digital transmission technology supporting data rates of 2Mbps (European standard) |
| EFR | Enhanced Full Rate – Advanced speech codec defined by ETSI commonly used in GSM networks |
| GMSC | Gateway Mobile Switching Centre – Switch responsible for routing calls coming into PLMN from PSTN |
| GSM | Global System for Mobile Communication – 2nd generation |

| | |
|---|---|
| | mobile system defined by ETSI (European standardization organization) |
| IMS | IP Multimedia Subsystem - IP Multimedia Subsystem is defined by 3GPP/3GPP2 as a new core and service ‘domain' that enables the convergence of data, speech and network technology over an IP-based infrastructure |
| IP | Internet Protocol - IP is set of technologies used to transport information as a series of ‘packets’, rather than as a continuous stream of data |
| MGCF | Media Gateway Control Function – Protocol for control of media gateways and protocol conversion |
| M-MGw | Mobile Media Gateway – Node responsible for switching, media stream processing and transmission resource management |
| MSC | Mobile Switching Centre – Node traditionally responsible for both call control, mobility management and transmission resource handling |
| MSC-S | MSC Server – Node responsible for call control and mobility management |
| MVNO | Mobile Virtual Network Operator – A mobile telephony service provider that typically uses licensed spectrum and network infrastructure from a 3rd party network operator. |
| OPEX | Operating Expenditure – The recurring costs of running the business including customer care, recurring site costs and network operations. |
| O&M | Operations and management – Term often used to encompass the activities within an operator responsible for network surveillance, maintenance and system support |
| PBN | Packet Backbone Network – Part of the core network responsible for transmission using either IP or ATM as a single packet based transport technology |
| PCM | Pulse Code Modulation – the voice coding scheme typically used to transport voice traffic in the core network and for network interconnection |
| PLMN | Public Land Mobile Network – mobile network offering services to the general public |
| PSTN | Public Switched Telephone Network – Network providing fixed telephony to the general public |
| RNC | Radio Network Controller – Node in WCDMA aggregating traffic from a number of radio sites also responsible for radio resource management |

| | |
|---|---|
| SIP | Session Initiation Protocol - The Session Initiation Protocol is a protocol standardized by the Internet Engineering Task Force (IETF) for initiating interactive user sessions with multimedia components such as video, voice, chat and gaming |
| SMS | Short Message Service – Mobile service supporting the exchange of short text messages |
| STM1 | Synchronous Transport Modules – Transmission standard for synchronous data transmission over optic fibers |
| T1 | Digital transmission technology supporting data rates of 1.5 Mbps (American standard) |
| TDM | Time Division Multiplexing – Multiplexing of data by assignment of different time slots. Usually combined with Pulse Code Modulated data streams in E/T-carrier systems |
| TFO | Tandem Free Operation – Removal of the double speech encoding/decoding made in traditional mobile-to-mobile calls |
| Transcoding | Conversion between two different types of data codecs |
| TrFO | Transcoder Free Operation – Flexibility of choice of coding scheme depending on source and target network optimizing the use of transmission resources |
| TSC | Transit Switching Centre – Switch responsible for carrying traffic between different geographical areas without active participation in call control and mobility management |
| WCDMA | Wideband Code Division Multiple Access – 3rd generation mobile system defined by 3GPP |
| VoIP | Voice over IP - A technology for transmitting telephone calls using packet-linked routes. Often also called IP telephony |