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Softswitch in fixed networks

White Paper

The evolution to all-IP and IMS for public telephony services, and the role of the Telephony Softswitch in the evolution process.

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Contents

1 Executive summary

Wireline operators are under strong competitive pressure. They need a way of maintaining telephony margins, while establishing a platform that will generate revenue from new multimedia services for many years to come. Layered Architecture, including Telephony Softswitch solutions and IMS (IP Multimedia Subsystem) solutions, hold the key to meeting this challenge.

Layered Architecture separates, both physically and logically, the sub-networks responsible for service execution, service management and control and transport of service data. Not only does it improve efficiency through network consolidation, it also supports revenue generation from both fixed and mobile services in a way that meets telecom-grade demands for scalability and flexibility.

Telephony Softswitch solutions are being deployed to support today's legacy call-oriented traffic over an IP-based infrastructure, and a three-step telephony modernization evolution path is defined that will ultimately provide operators with a converged network that will deliver voice, data and multimedia services. This approach allows operators to target infrastructure investments at the emerging services that have the highest revenue flows.

Deployments of IP solutions have matured beyond the best-effort communications associated with everyday Internet. Now it's time to integrate the same level of service dependability offered by the Public Switched Telephony Network (PSTN) into Telephony Softswitch solutions. These solutions are key to operators' overall network evolution from circuit to packet operation.

2 All IP – from hype to reality

IP is now everywhere – from desktop PCs to the core of the world's largest networks – and it makes sense to utilize this resource as IP becomes better suitable to carry real-time traffic. After many years of promises and hype, IP voice services and solutions are beginning to make in-roads among operators, enterprises and consumers. IP networks can now offer telecom grade performance, rather than best-effort performance. It is clear that, whatever the technical challenges may be, a growing proportion of telephony traffic is going to be carried over IP networks.

2.1 Telephony - more than basic voice

The term Voice over IP (VoIP) is often used to describe anything to do with carrying voice over an IP network – from voice calls between PCs over the Internet, to full-scale Class 4 (transit application) and Class 5 (local application) PSTN telephony services delivered over an IP network that provides quality of service. However, much of the hype – and media interest – over recent years has been around the deployment of best-effort voice over the Internet.

VoIP services are growing rapidly as a low-cost alternative. To stay competitive, established operators need a way to deliver high-quality telephony services over IP in order to benefit from the same efficiencies as start-up VoIP providers.

For established operators who have made major investments in their networks and customer base, the natural progression is to deliver their full-scale telephony services over an IP network through a Telephony Softswitch solution. Also for new operators, a Telephony Softswitch solution is an efficient way of building a telephony network.

Telephony Softswitch solutions deliver full telephony services over an IP-based network with telecom-grade scalability and quality of service. Beyond the straightforward transport of voice calls, the functions and services provided by Telephony Softswitch solutions include the subscriber services, signaling interoperability, charging functions and operator services of the traditional PSTN. This is what makes the Telephony Softswitch solution complete compared to VoIP.

Beyond voice services, IP-based networks open up opportunities for integrated voice applications and services – such as Video Telephony and presence-aware telephony – that would be impossible (or prohibitively expensive) using traditional Time Division Multiplexed (TDM) technology. This means that

modern IP based networks will combine the characteristics of the traditional PSTN and services associated with the broadband world.

2.2 IP enters the mainstream

While revenue for voice services delivered over IP is still a tiny percentage of the worldwide telephony market, the mass market appears to be ready for take-off, as demand, technology, regulation and services are beginning to align. The number of broadband Internet connections is growing rapidly around the world: a key driver for the deployment of Telephony Softswitch solutions.

Demand for low-cost voice services is growing both among consumers, who have discovered the cost benefits of calling via their broadband Internet connections, and among enterprises, who recognize the cost, flexibility and productivity benefits of IP-based communications. The enterprises are increasingly looking for sourced telephony services.

2.3 Convergence

The successful operator will provide a multitude of new services. It is likely that these services will be used through various access methods, both fixed and mobile. Making this convergence of services come true requires that the enabling technology is in place. One of the most important roles IP has to play in the near future is the enabling of convergence.

Rapid development of fixed broadband access and radio technology, leading to increased bit rates and support for mobility, enables true converged services – the same end-user service can be reached by fixed and mobile access via the same user interface. And the introduction of Layered Architecture will improve efficiency, flexibility and a smooth introduction of new services.

3 Decision time for wireline operators

Today's wireline operators are at a crossroad. They need to move to IP-based operations in order to compete, but they have made major investments in networks based on circuit switching, which are still delivering a major share of the total revenue. Should they continue to invest in their aging telephony infrastructure, or is there another way for them to evolve their operations – ultimately to full IP multimedia-capable networks?

For operators in developed markets, market expansion is no longer the main business focus, as it was during the dotcom boom. Now it's back to fundamentals: satisfying communication needs that customers are willing to pay for and doing it profitably.

With so much revenue – and profit – coming from telephony, operators are naturally keen to protect it. Deregulation and competition have driven down tariffs, and the market driver to go for IP based services is no longer simply cheaper long-distance voice. Instead it is seen as a way for operators to better meet customer needs while also reducing costs, and here Telephony Softswitch solutions have a vital role.

But what are the main issues and challenges that affect operators' investment decisions – decisions that have to be taken now if established operators are to survive and thrive in the coming years?

3.1 Revenue under threat

The wireline services landscape has changed dramatically over the past couple of years. A number of broadband access operators are fighting for market shares and consumers are increasingly aware that they can make low cost, or even free calls to any destination in the world. What's more, established operators are losing market share to mobile operators and new types of service providers with low overheads and no legacy millstones around their neck. Indeed, there is a small but growing trend for subscribers to do away with their traditional telephony service.

As growing competition drives down wireline prices, incumbent operators need to offer new added value while cutting the cost of delivering their services.

3.2 Network costs on the increase

Spending on modernizing and upgrading wireline telephony networks has been held back over the past few years, as shown in Figure 1. This situation

cannot go on indefinitely, as existing narrowband networks get older and become more expensive to maintain. The diagram shows the number of TDM-based nodes (blue bars) and the number of narrowband access lines (red line) installed annually outside the USA over recent years. It is clear that a lot of equipment needs to be changed out the coming years as it is getting close to its technical end-of-life. The economic end-of-life has probably already passed for the oldest parts of the installed base.

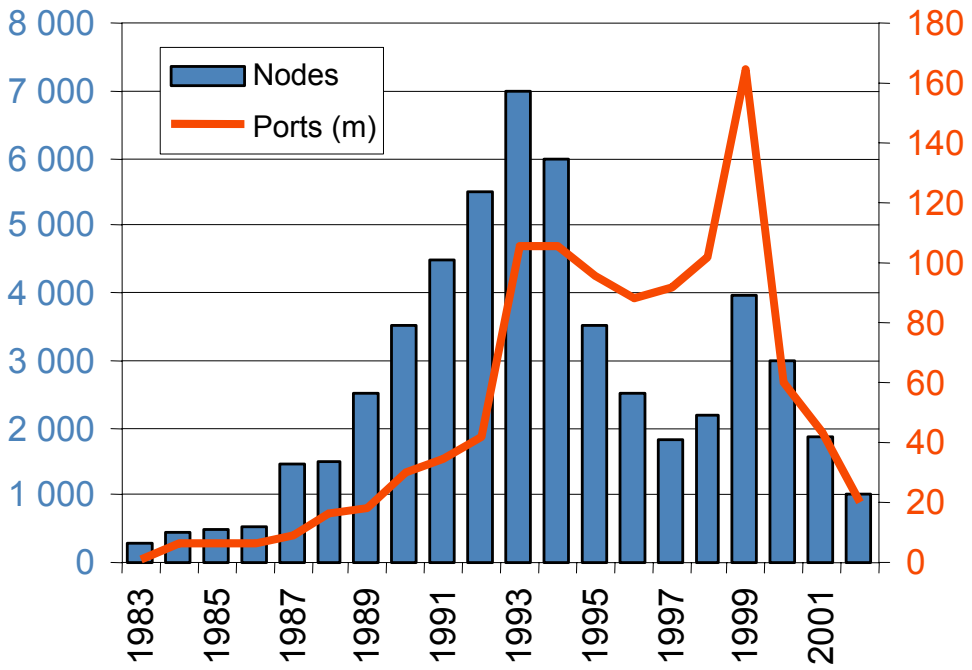


Figure 1. Digital switching base installed outside the USA annually (Source: Dittberner 2003).

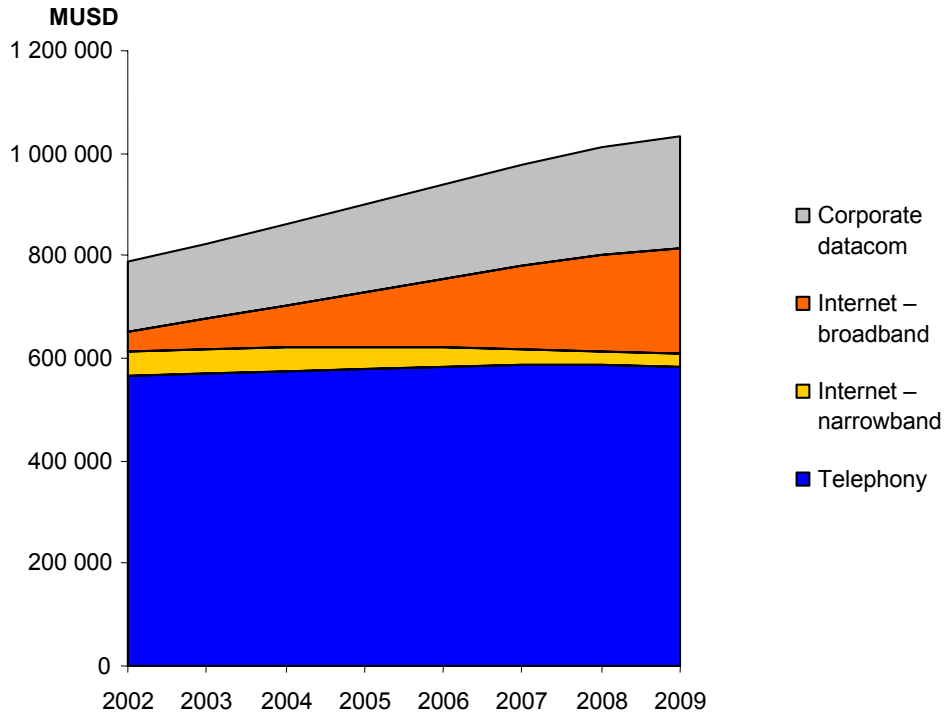
Another issue that contributes to ongoing additional costs for wireline operators is the multitude of networks they need to maintain for different services as long as they delay a move to Layered Architecture. Operators now need to decide how and where they will invest to ensure their networks meet future service demands profitably.

3.3 Wireline is still a growing business

Given the success of mobile communications, it may be tempting to think of wireline communications as a dying business. The truth is rather different – the overall state of the global wireline communications business is depicted in Figure 2.

The growth in broadband Internet and corporate datacom more than makes up for a decrease in dial-up Internet access and a flat telephony business. Over all, global wireline operator revenues are estimated to grow at a compound annual rate of four per cent between now and 2009. However, there are significant regional variations, especially in telephony where competitive pressures vary widely across different markets. In many markets, established telephony operators are fighting hard to maintain their market share.

While this revenue growth rate is not in itself stunning, it does represent an opportunity for wireline operators to boost profitability significantly – provided they invest now in cost-reducing infrastructure that enables them to serve the customer base effectively. In addition, new services are needed.



Source: Ericsson Analysis

Figure 2. Worldwide wireline operator revenues.

3.4 Technology challenges

Making an IP network suitable for voice communications poses a number of challenges based on the fact that IP wasn't designed for real-time services. While today's IP networks work very well for data, voice traffic demands some work in the areas of quality of service (QoS), availability and security.

Operators cannot build significant revenue streams from Telephony Softswitch solutions if customers aren't getting a reliable service. Service reliability is by far the most critical factor for operators to deliver if they are to avoid becoming bit-pipe providers in a best-effort world.

Moving voice from the TDM-based PSTN to an IP-based network is an evolutionary process that needs to combine the best of the PSTN with the best of the IP world. Guaranteeing all kinds of voice services in this network requires a rethink of how IP networks are designed and built. Not only will this network need to be flexible and ubiquitous, it must also provide 'five-nines' (99.999 per cent) availability and help the operator offer new, differentiated services that are both dynamic and personalized.

Traffic characteristics for voice and data are very different. Real-time, near real-time and best-effort communication requirements need to coexist under different service conditions. The greater the service mix, the more technical challenges operators will be faced with – although the economic benefits will be greater. Getting all services to work well over IP requires a multi-service network that meets both customer expectations and network service requirements.

3.4.1 Design principles

Transport of telephony places stringent requirements on design of an IP network. In particular, low delay, low jitter (variation in delay), packet loss, and protection from denial-of-service (DoS) attacks are of paramount importance. The design characteristics and the architectural choice that fulfils these requirements may be different in different network environments, depending on scaling requirements, the physical and routing topology of the existing network and relation to legacy services.

The following fundamental network design principles need to be considered:

- Mouth-to-ear delay
- Voice packet loss
- Average jitter
- Node availability

- Failure recovery time in the backbone
- Ability to carry multi-service and dedicated voice traffic
- Protection of telephony nodes from DoS attacks and IP spoofing

Obviously, there are other requirements for building an IP network for telephony services. These include multi-vendor capabilities with open and standards-based architecture, as well as sufficient scalability to handle hundreds of nodes. Such scalability is key for operators with big networks who want to achieve major cost savings through consolidation and simplified Operation and Maintenance. Other important requirements include billing systems, management systems and compatibility with existing networks.

All in all, the change from the classic telephony into the new IP-based telephony with its highly efficient infrastructure, new service architectures and new attractive end-user services is in no way insurmountable. It is, however important to realize the profound difference between a simple “VoIP for PC” implementation and an IP-based public telephony service capable of both interacting seamlessly with the existing telephony network, as well as enabling direct cost-efficiency and future service enhancements.

4 Three-step telephony modernization evolution

In view of the market trends and technical challenges outlined in Sections 2 and 3, operators must start to modernize their existing telephony networks and reduce costs, while enabling the introduction of IP multimedia services at the earliest opportunity. The ultimate goal is a common architecture for fixed and mobile services that delivers telephony, data and multimedia services.

This evolution, described in the following sections, supports a sustainable business model by enabling operators to modernize their telephony networks, introduce IP multimedia services and, ultimately, implement a converged IMS based architecture that handles PSTN services as well as new multimedia services.

4.1 Step 1 – Telephony Softswitch solution introduction

For providers of wireline telephony (PSTN) services, the first – and most urgent – step is cost reduction through the modernization of the aging circuit-switched network. This involves the introduction of the Telephony Softswitch solution that separates call control from connectivity and access, as shown in Figure 3.

Telephony Softswitch solutions achieve substantial cost reductions in the PSTN – whether in local, transit or international gateway applications. First, the capex required is lower than for traditional circuit-switched equipment, as the distributed switching architecture enables efficient node consolidation. Second, there is the continuing lower opex of running the services due to a simplified network structure.

With Telephony Softswitch solutions, call control is performed by the Telephony Servers (TeS) in the control layer. Switching and media inter-working, from TDM to IP is handled by the Media Gateways (MGW) in the connectivity layer.

One of the most important benefits of this architecture is that a lot of equipment can be reused, especially in the access network. When the Telephony Softswitch solution is introduced, access equipment can gradually be moved from the circuit-switched nodes to the Media Gateways.

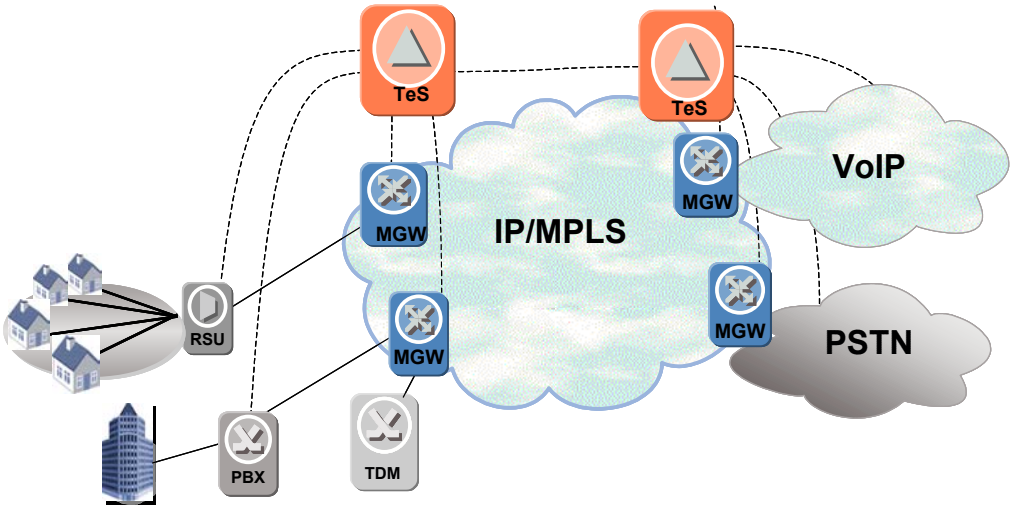


Figure 3. Evolution step 1 – telephony modernization.

A key requirement of this Telephony Softswitch solution – besides the usual telecom-grade demands of scalability, quality and cost-efficiency – is the compatibility of subscriber services, signaling and billing systems with existing legacy networks, in order to protect current telephony revenues and margins. As today's networks are so widely deployed, with many legacy functions developed over several decades, they cannot be changed out overnight.

The migration from circuit switching to the modern Telephony Softswitch solution will likely be carried out in parallel with evolution step 2.

4.2 Step 2 – IP multimedia service introduction

While operators modernize their PSTN networks to reduce costs, step two in the telephony evolution process is to introduce new IP multimedia services in order to gain new revenues, as illustrated in Figure 4. Here, IMS solutions will play an important role.

IMS solutions offer a wide range of SIP (Session Initiation Protocol) based multimedia services capabilities. The same IMS core is used for fixed and mobile systems, meaning it will support fixed-mobile convergence with services like IP Centrex and Push To Talk (PoC-standard).

For users, IMS-based services enable person-to-person and person-to-content communications in a variety of modes – including voice, text, pictures and video, or any combination of these – in a highly personalized and controlled way. IMS solutions offer operators a golden opportunity to get a quicker return on their broadband investments: presence, video telephony and instant messaging are all services that will contribute to operators' top line.

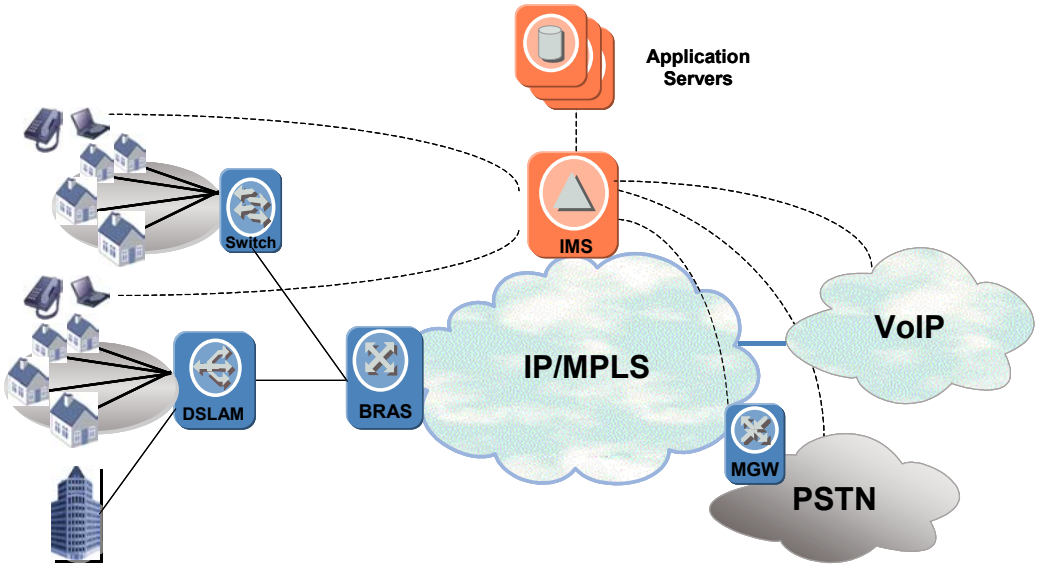


Figure 4. Evolution step 2 – introduction of IP multimedia services based on IMS.

In addition, IMS takes the concept of Layered Architecture a step further by defining an architecture where service enablers and common functions can be reused for multiple applications. The architecture in IMS also specifies interoperability and roaming, and provides bearer control, charging and security, well integrated with existing voice and data networks.

For these reasons, IMS is likely to become the preferred solution for both fixed and mobile operators' multimedia business. IMS enables services to be delivered in a standardized, well-structured way that truly makes the most of Layered Architecture. At the same time, it provides a future-proof architecture that simplifies and speeds up the service creation and provisioning process, while enabling legacy interworking.

4.3 Step 3 – Converged IMS-based architecture

The focus of Step 1 in the evolution process is to deliver traditional PSTN services over a more modern and cost-efficient network than today's. In Step 2, which is carried out in parallel with Step 1, multimedia services, such as Video Telephony, Instant Messaging and IP Centrex, are introduced to boost operators' top line. These services are SIP-based and the network is based on the IMS standard.

However, as mentioned earlier, IMS will become the preferred solution for fixed and mobile operators' multimedia business, including telephony. It is also

foreseen that IMS telephony services will be well standardized and eventually may replace traditional PSTN services. It is clear that demand for traditional PSTN services will continue for many years and that a full migration, once started, to IMS based telephony is likely to take several years. To reduce risk and uncertainty in this process, a smooth migration from traditional PSTN services to IMS based telephony is required.

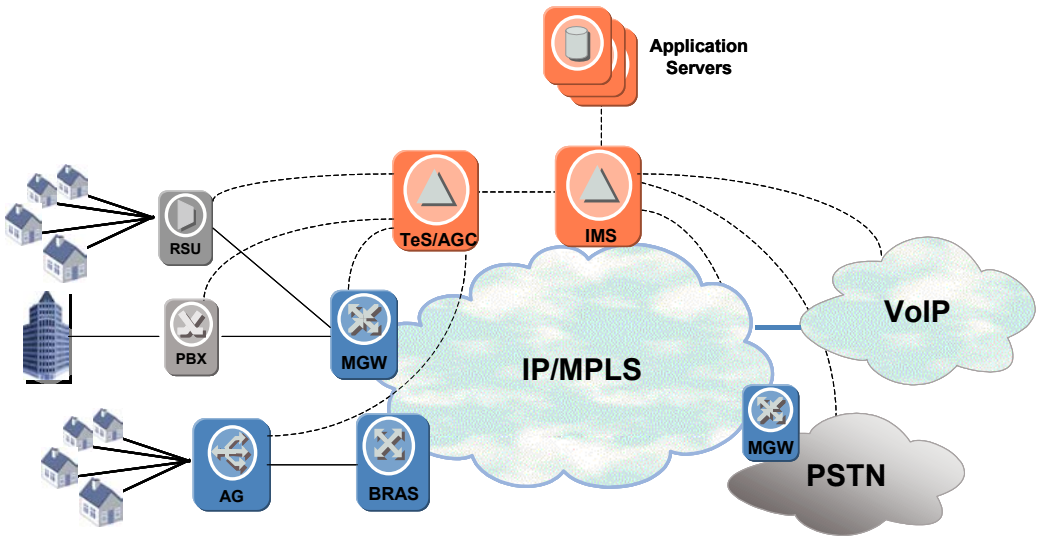


Figure 5. Evolution step 3 – classic telephony services based on IMS and Access Gateway.

As aging access equipment is being replaced, Access Gateways are being introduced in the network as shown in Figure 5. The Access Gateway provides telephony services over packet networks. Access Gateways are controlled by the Telephony Server through the H.248 protocol and are normally implemented on multi-service access nodes.

As the migration to IMS based telephony starts the, Telephony Server from Step 1 in the evolution process will remain in the network as a combined Access Gateway Controller and Telephony Server. This protects investments and allows a smooth migration, on a user port-by-port basis, from the full PSTN service set provided by the Telephony Softswitch to IMS based telephony. The Telephony Softswitch will remain in the network as long as there is legacy equipment left in the network that requires PSTN services not supported by the IMS based telephony service.

This approach ensures that operators can start to modernize their PSTN networks in volume, while also having a clear roadmap to the IMS world for

PSTN services. When all legacy equipment has been removed and SIP is fully introduced, the target network has been reached.

5 Conclusion

Today's telephony operators need to modernize their existing telephony networks to maintain QoS and reduce costs in order to stay competitive. At the same time, they need to introduce IP multimedia services at the earliest opportunity in order to capture new revenues. Operators need to take these actions now.

A three-step telephony modernization evolution strategy has been developed to help operators achieve these short-term business goals, and evolve to a Layered Architecture suitable for both fixed and mobile services that delivers voice, data and multimedia services.

Central to this evolution is a full-featured Telephony Softswitch solution that enables operators to maintain their existing voice offerings and margins. The parallel introduction of IMS solutions enables expansion into new areas and the enhancement of service offerings – boosting the top line.

Over time, IMS will also provide the architecture for traditional telephony services in addition to multimedia services. But making this happen requires experience and know-how of both the IP networking and telecoms worlds. It demands the best of both worlds in order to meet customer expectations.

6 Glossary

AGC	Access Gateway Controller
DoS	Denial of Service
DSLAM	Digital Subscriber Line Access Module
IMS	IP Multimedia Subsystem
IP	Internet Protocol
MGW	Media Gateway
PoC	Push-To-Talk over Cellular
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RSU	Remote Subscriber Unit
SIP	Session Initiation Protocol
TDM	Time Division Multiplexing
TeS	Telephony Server
VoIP	Voice over IP