White Paper

Fixed-Mobile Convergence

Let's keep it simple

NOKIA
CONNECTING PEOPLE

Abstract

Fixed-Mobile Convergence allows network and service operators to make more efficient use of existing access technologies (GSM, DSL, WiFi), as well as takinge advantage of the roll-out of new access technologies such as 2.5/3G, DSL, WLAN, Bluetooth, UMA, etc by launching new voice & multimedia services and realising cost reductions by implementing common service machinery for different access networks.

Fixed-Mobile Convergence allows users to connect to complementary access networks, buy and use a wider range of personalised services using fewer terminal devices. The primary device will be portable and for most applications it will be a multi-radio device, supporting voice and multimedia services. Users can be contacted with a single number independent of the network connection. The value Nokia brings to convergence is to make it simple; to enable easy implementation for the operator and service provider, and easy usage of services for end users. This will enable true mobility for users in both the consumer and business environment.

This white paper addresses the issues facing network operators and service providers in relation to Fixed-Mobile Convergence. It provides a broad overview of fixed-mobile convergence and can be read by anybody interested in this important topic. It also highlights Nokia's view to utilise the Unified Core network for Fixed-Mobile Convergence. It does not make specific recommendations, other than the need to focus on business planning, consultation and technology trials in the short term.

Convergence is considered from two perspectives: service convergence and network convergence. This division is a convenient way of examining the different but closely related needs of users and network operators. The paper also considers the rationale behind convergence as well as trends and the functionality of the devices that will be employed to access the new services.

Sections on the transition to a unified service environment examine the migration to a unified core network; the multifaceted roles of IMS; SIP as the key convergence protocol; the need for centralized delivery and control; the new charging mechanisms that are enabled by IP flow analysis and finally management and self-provisioned services.

Contents

Executive summary

FMC is driven by the need for a better end user experience and operator competition.

Fixed-mobile convergence (FMC) is a generic term that embraces terminal devices, service and network convergence. Terminal device convergence and service convergence focus on end-user requirements and the service experience; network convergence is simply an enabler, the means by which network operators facilitate better access to value added services and applications.

The need to keep things simple for users results in networks for cost effective service differentiation.

The primary goal of service convergence is the concurrent delivery of all media types — voice, data, and video— to an easy-to-use graphical user interface, independent of location. The related goal of network convergence is to make all services profitable and enable multiple business models: these goals are related because services that are easy to use quickly become popular and help to increase revenues. Service bundling facilitates this, and helps to reduce churn.

Mobile users set to reach 1.87B by 2007 (27.4% of the world's population). Subscriber growth is over 100% p.a. in India. China has over 300M users, about 25% of its total population.

The market for these value-added services is relatively new and also we have transitioned from an information economy to one that is communications-centric. We can conclude that the opportunity will be huge, but the industry needs to address a number of issues. For example, there is a clear need to enable ubiquitous access from the user's preferred device. Right now we have too many devices that access different services on different networks in different ways. Usage of the various access networks should be seamless and it must involve personalization: my services delivered to my device using whatever access network is appropriate.

Smartphones is the popular term for multi-radio mobile devices. Both terms are used in this paper.

FMC involves a unified core network, multi-radio terminals as well as other terminal devices such as PCs, access networks that complement each other and common multi-access service delivery platforms. However, success or failure will be determined by user acceptance, not networking technology.

We have a well-defined set of drivers, enablers, opportunities and issues. The market is the all-important driver. Developments such as smartphones, SIP, digitalization of content and IMS are key enablers. The opportunity, in both the business and consumer sectors is clearly too big to ignore. And while there are many significant issues to consider, all the requisite standards, protocols and other technologies are falling into place.

Delivering what the market wants and what our communications age economy needs is a tall order, but one that has to be fulfilled if network operators are going to deliver long term profitability. Operators therefore need to evaluate the options, define their business objectives, and use the results to create a carefully constructed strategy for fixed-mobile convergence. Additionally, one must also recognize the importantance of generating new revenues from new services in a timely manner. Building on existing deployments of IMS with mobile operators, Nokia sees 2005 as being a time for FMC business planning, consultation, technical trials and early implementation, followed by commercial roll-out of FMC services.

Convergence is happening

We are witnessing a blurring of the boundaries between the business and personal sides of our lives and the emergence of new lifestyles. Broadband access in the home, for example, facilitates access to corporate resources using IP VPNs, as do packet-switched public network services (2.5/3G and WLAN). For new multimedia services, the combination of IP and SIP allows different sessions to be established over any IP network or combination of networks, thereby giving the perception that there is a single network. This represents network unification rather than physical convergence, but it is a key development since it enables greater usage of multimedia services.

Today's networks employ different access technologies so we employ different communications devices.

Service convergence is also starting and generating new revenue streams. SMS can now be sent between mobile and fixed line phones, and video calls can be made between fixed and mobile devices.

Convergence enables the same personalized set of services when mobile, in the office, or at home.

Multimedia and multimodal services take convergence to the next level, a subject that is widely covered in the media and by analysts. However we should not lose sight of the fact that voice is not only a feature-rich medium, it is the optimal way of communicating for almost everyone. Thus, making the voice service more convenient to use is just as important as the addition of new functionality. Voice is the basic service requirement: the one to which value-added services can be added.

The term multimodal refers to the ability of a device to function in two or more modes. In this case to function as a voice and data device.

Convergence trends

Telephony revenues and margins are in decline because of competition, and analysts foresee the day when, like email, the service will be virtually free. Technology allows new players to penetrate the traditional voice service business. The market perception of free phone calls is fuelled by the hype surrounding Internet telephony, but broadband access is enabling not only low-cost IP telephony, but also a wide range of new applications such as video telephony and video on demand. The traditional telco model is therefore being disrupted. ISPs and entrepreneurs, who are agile and can see a profitable niche, are entering the market.

SIP-compliant smartphones can make VoIP calls over WLAN networks. SIP also removes the need to upgrade access networks, which represent the largest part of the legacy investment. Different access networks therefore complement each other.

Photo taken on a Nokia 6260 camera phone.

The business model is changing. Bandwidth has become a commodity and this has led to the concept of xVNOs. These are virtual network operators that can be fixed (FVNO) or mobile (MVNO). And, apart from regulatory constraints, there is nothing to stop alliances that would allow a mobile operator, for example, from becoming a FVNO that offers DSL services.

The convergence spotlight is on voice and multimedia services and rightly so, given the number of users. However, the market for business services and applications generates high-margin traffic, has far less churn, and it is set for take-off. Even more significant is the fact that most enterprises and many Small Medium enterprises (SME) have converged local area networks and IP PBXs, which they have deployed in order to gain the cost and productivity benefits of IP telephony. This means that the business sector will compete with their network operator and push operators to implement very cost effective hosted voice services such as IP Centrex.

Strategic and investment decisions should not be made from a product perspective. The starting point has to be the business objectives and end-to end solution.

Why convergence?

Operators who do not embrace convergence and enable the delivery of third-party content will, in the final analysis, reduce the value of their network to that of a bit pipe. New services and applications will become the norm.

The Service Delivery Platform must map to the operator's strategy; it must not determine that strategy.

The technologies are in place and there is broad agreement about the need for standards based Service Delivery Platforms that deliver end-to-end solutions. Service convergence is facilitated by IMS, which was defined by 3GPP and adopted by 3GPP2. IMS allows different services, e.g. Presence, Push to Talk, to share common components. Thus, no more communication island solutions: no more service silos. Instead, operators can create a dynamic service environment with the ability to introduce new customised services, quickly and economically.

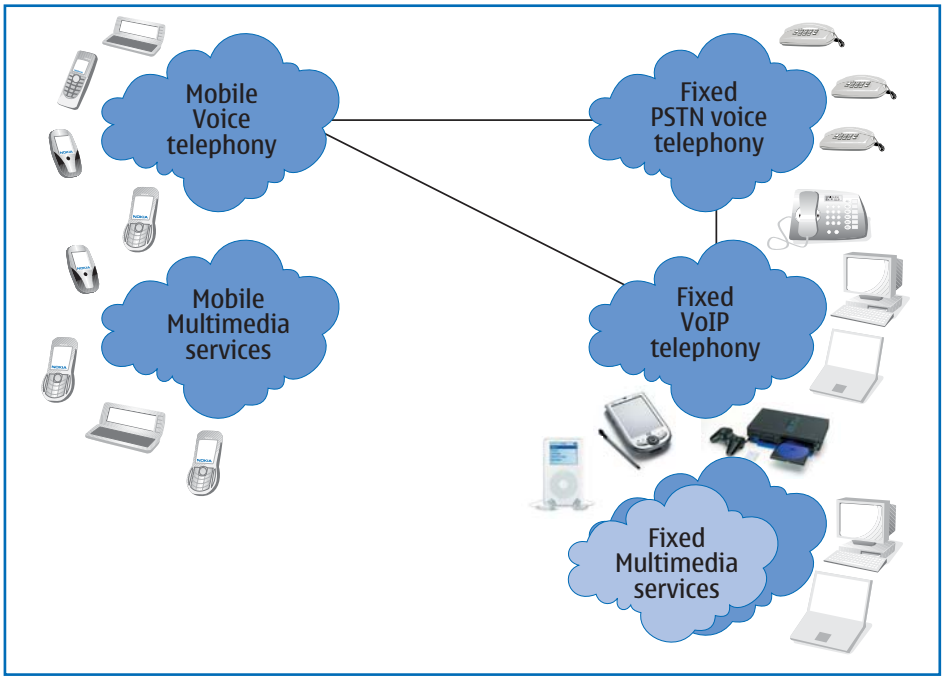


Figure 1. Services have become communications islands and right now are scattered throughout our daily lives

Many fixed operators are facing challenges of aging fixed switch networks with no added-value evolution path offered by many softswitch vendors. These factors indicate the need for a long-range strategy and investment decisions that will reshape not only operators' networks, but also their future success.

It is hard to overstate the importance of making the right decisions. The ability to create and implement new services in very short times — to offer the market a comprehensive portfolio and to introduce new services in line with market requirements is the key to success. Without fixed-mobile convergence operators will not be able to match the needs of a communications-centric economy.

Terminal Device Convergence

Most of the terminal devices we use for communication are constrained in one way or another. Devices may be limited by their functionality or the network they access. Sometimes the device is used for a single service; in other cases it performs two or more aligned tasks. Mobile phones with digital cameras are a good example. Smartphones can send and receive emails. These multi-modal devices complement each other and many business professionals employ a phone, PDA and notebook PC. This results in the need to synchronize messages, address books and agendas.

Communications complexity has become a serious issue in the business community, e.g. multiple voice mail and messaging 'solutions'.

It has become obvious that technology has, at times, dictated the way we use telecommunications. There are too many service islands, which leads to different user experiences from the different public and private networks. What's required is a unifying device and services that are employed in the same, easy way.

It is clear that there cannot be a single unifying device given that users have different needs, but the smartphones are a serious contender for voice plus multimedia services in a true mobility environment. Multiple air interfaces enable access over circuit- and packet-switched networks and SIP allows services and applications to traverse different IP networks.

The Nokia 7710 widescreen multimedia smartphone. Features include a 640x320 pixel screen; 90 MB internal memory (128 MB on an MMC). Enough for up to 800 photos.

Mobile phone development has been rapid in the last decade, but new models will take increased advantage of technological developments. They will have enhanced colour displays and higher quality imaging, developments that are needed to support new services and applications. The explosion in memory capacity and exponential growth in processing power will also allow smartphones to replicate the applications currently employed in notebook PCs and PDAs.

Service convergence

Fixed Mobile Service convergence focuses on subscribers and their needs.

It extends and improves network coverage and provides flexible, cost-effective access using different cellular and fixed broadband connections.

Mobility gives us the freedom to employ services from any location: at home, in the office or on the move. Services are therefore not constrained by the network, so they have become an integral part of our personal and business lives. In turn this means that personalised needs must be consistent: the individual experience should not change with the network.

This indicates that the mobility model has become me-centric. My phone book & contact info; my agenda; my messages, my availability & preferred communication method; my browser links, my pictures (received and shared); my personal and business email; my wall-paper, my music files and so on. Everything individuals need throughout the day goes with them.

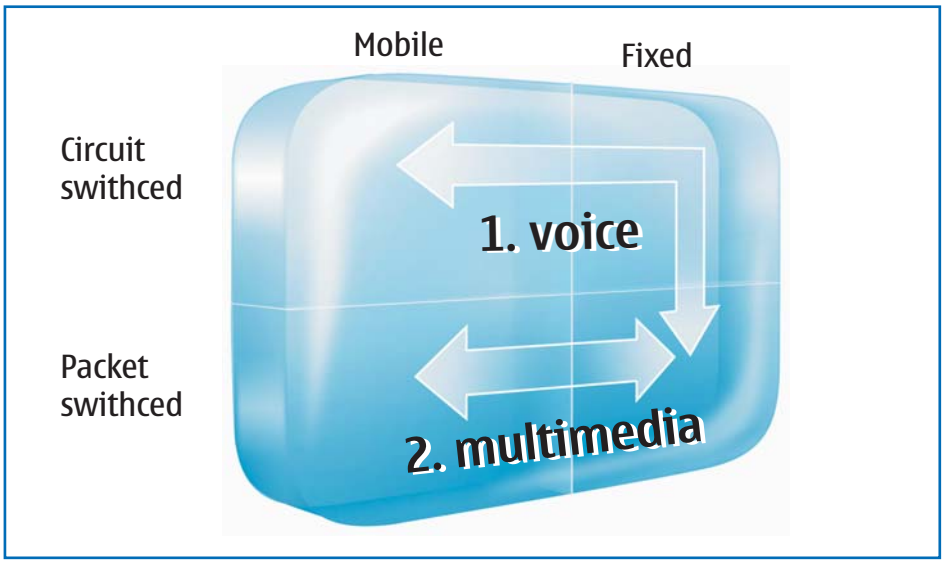


Figure 2. Fixed to Mobile Substitution and fixed VoIP is gradually replacing PSTN voice telephony. Multimedia services are being delivered over fixed and mobile packet networks.

As illustrated in the diagram above, convergence is also being driven by developments in the marketplace. Traditional PSTN voice telephony services are under severe pressure from Fixed to Mobile Substitution (FMS) in the circuit switched domain and also from fixed VoIP. Multimedia services (e.g. presence, push to talk, messaging, interactive applications, data or video sharing plus streaming, browsing and downloading) are being delivered over fixed and mobile packet networks.

The merger of wireless and IP technologies has also resulted in a new instant communications medium: Push-to-Talk. This service allows a user to talk to either a single person or a group with the push of a button.

VoIP and Instant Messaging were two of the developments that helped kick-start service convergence. VoIP has made a seismic impact on telephony within enterprises and as the penetration of broadband access increases, so does the availability of this transport mechanism within the home. VoIP is a positive, albeit challenging development and it is creating some interesting opportunities for operators, particularly when core networks are converged.

A Digital Subscriber Line Access Multiplexer (DSLAM) uses existing fixed copper lines to transmit high-speed data, voice and video services (up to rates above 20Mbit/s) over the last miles of a communications network

IP DSLAMs allow operators to offer both DSL access and traditional 2 wire POTS connections using a SIP client in the DSLAM. This development puts fixed line operators in an excellent position since they can offer multimedia services via DSL and offer attractive tariffs for analogue POTS connected to an IP network, thereby maintaining existing services where required whilst evolving the core network to an IP based solution.

Smartphones, on the other hand, have WLAN interfaces so they can access fixed broadband networks. This allows the mobile to be used as an IP phone and allows users to continue employing their personalized services at home, or via WLANs connected to DSL in hot spots or offices. Convergence in this case enables an interesting combination of cellular and fixed broadband access. The user experience doesn't change: the same voice and multimedia services are used in the same way.

Network convergence and Multi Access

From the user's perspective, network convergence is very simple. It's the development that's set to deliver a unified voice and multimedia service experience. Network convergence dissolves the barriers that currently separate today's network islands.

In some countries indoor cellular coverage is poor or even nonexistent, so enabling access over WLAN is an important user benefit. It also represents an innovative way of using the fixed DSL line to obtain increased cellular coverage and thereby enable additional revenue, which is a major benefit to cellular operators.

There are 2 options for improving cellular access over WLAN. The first is Unlicensed Mobile Access (UMA). UMA provides access to GSM voice services and GPRS data services over unlicensed spectrum technologies, including Bluetooth and WLAN (802.11). It utilises a Broadband IP access connection between the WLAN or Blue tooth Access Point, and the UMA Network Controller. By deploying UMA technology, service providers allow users to roam and handover between cellular networks and public and private WLAN sites using dual-mode (GSM & UMA) mobile handsets. The second option is also to utilize Broadband IP Access to provide an IP connection between the WLAN or Bluetooth Access Point and the IMS. The GPRS capability of UMA can also be used to provide an IP connection to the IMS.

So UMA can be considered as just one of a number of access technologies that include GSM, GPRS, EDGE, WCDMA, WLAN, xDSL and POTs. This is a prime example of convergence at both the physical access network level and also at the network operator level (especially for those operators that do not own the required physical access networks and must therefore consider strategic alliances). Convergence is needed to enable the new personalized model, but is also focused on the need to minimise operating costs and to provide cost-effective migration to an All-IP network.

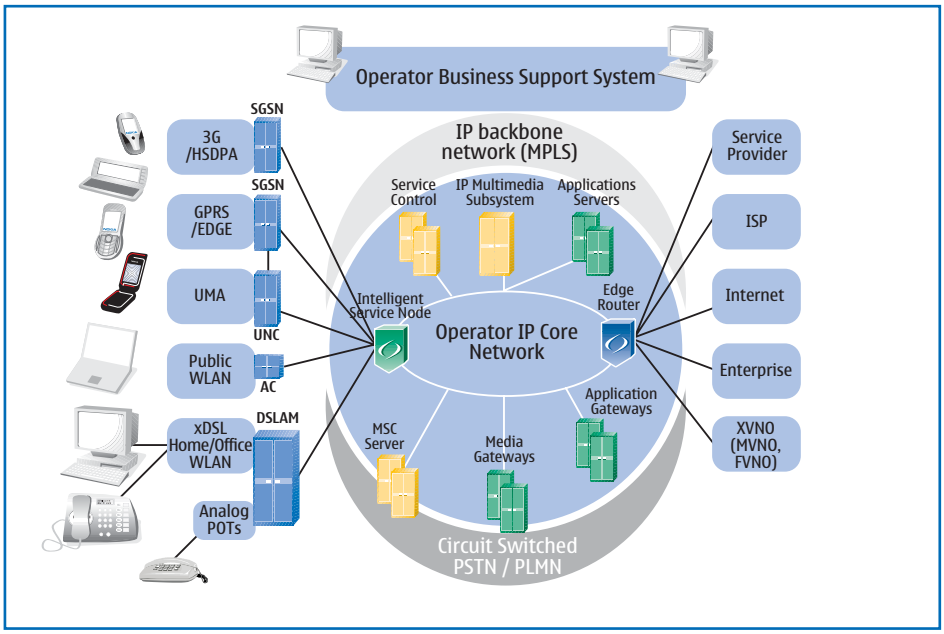
From an operator's perspective, the network convergence goal is to migrate today's separate circuit and packet switch core networks to a unified core network that supports existing access technologies in both the fixed and mobile domains. This evolution will obviously take some time to complete, but will be key to an operator's ability to reduce OPEX in the long term and increase competitiveness and profitability.

Smooth transitions to a Unified Core Network

Fixed-mobile convergence is a given. It will take time to achieve, so operators need a strategy that defines their business objectives and solutions that map to the various short-, medium- and long-term goals. In other words, convergence needs to evolve along a well-defined migration roadmap.

There are a number of milestones. The solution must support the introduction of IP-centric multimedia services that can be delivered to a variety of terminals. Delivery must be cost effective and employ complementaryaccess technologies. It must also bring operating costs down and allow traditional services and applications to be retained. The first step in the evolution path is to optimise the circuit switched core in order to improve the delivery of regular voice services. The second is to enhance the packet core network in order to enable the ability to rapidly deploy new value-added IP multimedia services in the most cost effective manner. A key feature of this strategy is the use of common components and service specific extensions that reduce the cost of service development and implementation. This is best achieved using an IP Multimedia Subsystem (IMS) as the service delivery engine within the unified core network. The result is a unified network that is optimized for: (1) the efficient delivery of services to users; (2)ease of interworking with business partners and other networks; and (3) effectively managing the operator's day-to-day operations.

Figure 3. Fixed – Mobile Convergence involves many elements in a complete solution



Voice services are still predominantly provided by circuit switched technology in both the fixed and mobile domains, although the introduction of VoIP services is gaining ground in the fixed operator domain and is well established as an Internet service. The evolution of the mobile circuit-switched network has been standardised by 3GPP and Release 4 allows control and user planes to be separated into MSC Server and Media Gateway functions. Media Gateways provide interworking between the IP Core network and the PSTN / PLMN.

Media Gateways and the MSC Server System help drive voice penetration and usage and enable a new core network structure; one that brings significant savings in both OPEX and CAPEX, thereby cutting the production cost of each voice minute. This is partly achieved by the use of IP as a transmission medium between multimedia gateways, reducing transmission network bandwidth requirements, and eliminating the need for transit switches based on TDM. This 3GPP Release 4 split architecture is the basis for later 3GPP releases where the IP Multimedia Subsystem (IMS) has been specified.

IP Multimedia Subsystem

IMS plays a crucial role in convergence, and with the use of Session Initiation Protocol (SIP) allows the introduction of IP services, including Voice over IP (VoIP), video sharing and other multimedia services. It can also provide the same supplementary services for VoIP calls as we have today for circuit switched calls, by connection to a Telephony Application Server (TAS).

For fixed operators, the IMS solution compares very favourably against the replacement of fixed switches with a softswitch which may only replicate existing services.

SIP: the key convergence protocol

The SIP protocol was originally defined by IETF and then adopted for mobile networks by 3GPP and 3GPP2. IMS supports SIP clients (3GPP and IETF) and can be connected to any compliant device: mobile terminals, wireline PCs or WLAN devices. SIP and IMS enable the creation of converged, unified communication domains using any fixed or mobile packet access network. SIP can also reside as a client on an access node such as a DSLAM or on a terminal device.

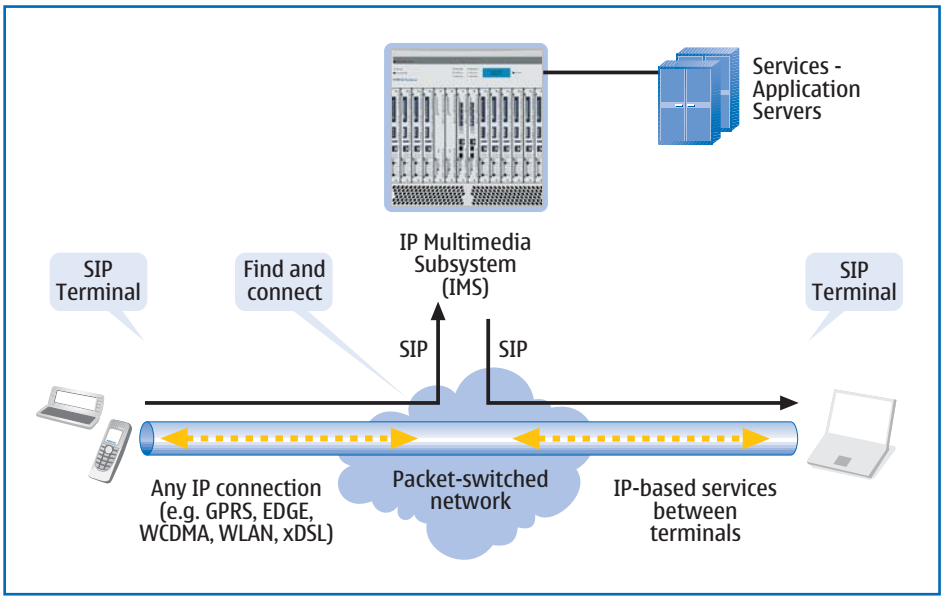


Figure 4. Nokia's solution includes a 3GPP compliant IMS and it is a true end-to-end solution for SIP based applications.

As illustrated in figure 4, SIP based session management and the IMS enable the applications in SIP devices to establish peer-to-peer connections over any IP network. P2P connectivity is new for telephony but something we take for granted in the Internet. This development allows services having a relativity low penetration to stay profitable. Operators wishing to generate new revenue streams by introducing IP multimedia services need the IMS functionality to enable optimized mobility, centralized control, roaming, cost efficient service delivery and interworking between operators.

Embedding SIP in various terminals allows users to select the device best suited for the task. However, as covered earlier, in future we will gravitate towards a single, multimodal terminal such as a smartphone having multiple air interfaces. A key feature is the use of a single number. These devices will connect to the converged core via the complementary access networks, i.e. the mix of xDSL connections, WLAN hotspots and cellular access. However, from an operator's perspective, the convergence challenge is to provide seamless services across a variety of terminal types and access technologies. This represents a significant challenge. The issues include access awareness, session continuity and service capability across different networks (eg: service hand up & hand down across 2.5G and 3G networks).

The network has to support multiple business models.Pricing models must be simple and understandable.

A zero fraud mechanism for pre-paid users is essential. Online charging mechanisms must make sure that sufficient funds are reserved before the service is consumed.

Service delivery and service control

The IMS functions as a centralized service delivery engine but it is only part of the solution (hence the term sub-system). It must support multi-vendor implementations and builds upon the operator's existing investments. In addition, IMS must provide a set of common tools that can be used by all IP based services. This is a key requirement since it reduces service deployment costs and shortens development times.

Operators need to differentiate their service offer and that is best achieved by having a comprehensive portfolio of easy-to-use services that are competitively priced. The billing mechanisms must incorporate pre-and post-paid charging options along with effective credit and fraud control. In addition, there must be open systems and standards-based interfaces so that content from third parties can be added to the portfolio. Charging methods for all services should be intuitive and based on their value to the user. Streaming video, for example, can command a higher tariff than Instant Messaging, but IMS allows users to add and drop services during the same session, which means that the billing system must be able to detect the change and switch to another tariff in real time.

These requirements can be met by advanced network services systems that not only route traffic but can also analyze and control both IP traffic and content, control subscriptions and generate charging data. These systems must scale in order to support millions of users with a personalized suite of services.

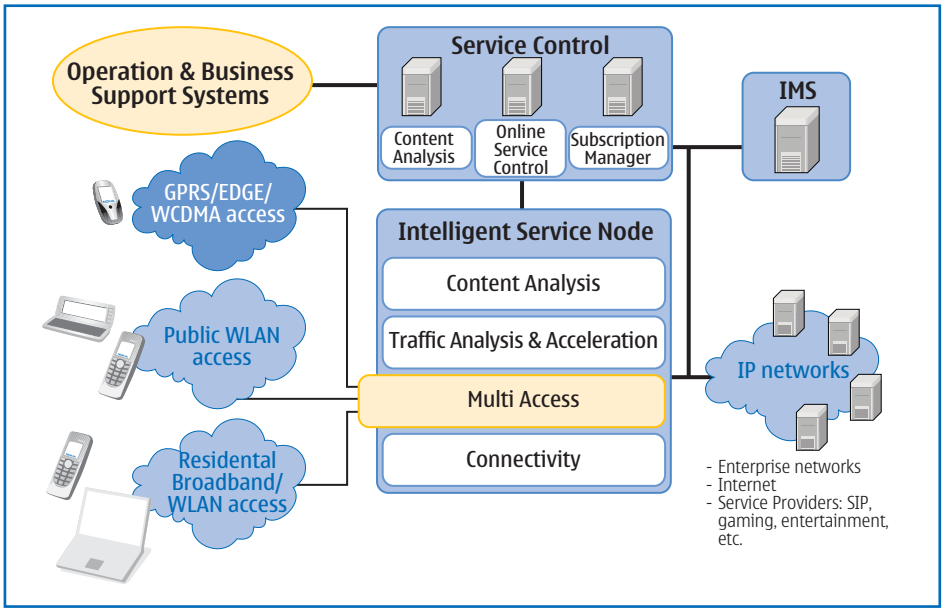


Figure 5. The Intelligent Service Node enhances and unites current charging mechanisms.

Network Service Functions with IP flow analysis
Nokia's Intelligent Service Node (ISN) and Service Control System provide operators with the requisite functionality. They allow a range of charging models that match the different traffic types to be implemented and in turn this minimizes the cost of adding new services to the network.

IP Content to Person traffic (layers 3 through 7) is analysed in order to give operators detailed information on the service being used. This information allows operators to add value to all services irrespective of the position in the value chain. For example, it can be used to enhance the performance of email traffic, perform virus scanning, enable easy access to services or bar users from services, perform intuitive service or access charging or to help users to control their budgets. It also can manage Quality of Service (QoS) on a per service basis, enabling service delivery in line with user expectations (e.g. increased QoS for realtime video) and delivering services in line with an operator's profitability targets.

IP flow analysis increases the granularity of volume-based and time-based charging information; it can also bring event-based charging to the packet core. One key advantage of this flow analysis is that it is not necessary to create a charging interface between the third party and operator domains for third party content. This makes it easier to integrate third party content into the value chain. It also makes it possible to use subscriber and session related information such as QoS and access network type (e.g. home/roaming, cellular/WLAN) in order to charge differentially.

Management and self-provisioned services
The true value of multimedia and other value-added services can only be realized through rapid creation, deployment and billing. This requires a state of the art system that allows both the operator and the end user to manage the provision of new services, typically via a Web interface. In addition, the operator must be able to manage the network elements, maintain effective data management across the different systems, and provide a comprehensive single billing system for the bundle of services required by each end user.

These stringent requirements are solved using Nokia's suite of management tools, which interface seamlessly with existing business and operational support systems. The Nokia Subscription Manager, Online Service Controller, Charging Gateway (all of which form part of the Service Control function) and NetAct management tools support the requirements for the supervision, control and service deployment.

Conclusions

The long-term profitability of fixed and mobile businesses is predicated on the delivery of a wide range of user-centric services that can be self-provisioned and personalised. In addition, the industry should enable a unified user experience combined with complementary access. These are the key drivers behind fixed-mobile convergence and when these criteria are met, we can start to realise the full potential of new communications technology.

There is broad agreement within the industry on standards based initiatives such as IMS and the need for fast service creation and deployment. Usage of these services must be intuitive and have a unified experience across the different fixed and mobile access networks. Success in the emerging FMC environment will be determined by user acceptance, not networking technology, although IP, VoIP and SIP are important enablers.

We are in a communications-centric era: this equates to a huge market for smarter, tailored services and an unprecedented opportunity for network operators and service providers. We have the technology to create and deploy virtually anything for which there is a need. However, the size of the market, combined with other factors such as broadband access and location-agnostic delivery, allows new players to enter the arena. This results in new business models and the concept of xVNOs.

In the final analysis, the convergence requirement from users is simple – access to personalised voice, data and video services over any access network. From the operator's and service provider's perspective, the challenge is to meet this requirement with long term profitable business. The value that Nokia can bring is simple – providing an end to end solution and working closely with operators and service providers to meet their goals.

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Nokia Corporation
Networks
P.O.Box 300
FIN-00045 Nokia Group, Finland
Tel. +358 7180 08000
Fax: +358 7180 24287
www.nokia.com

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