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# Convergence In Future Wireless Network Technology

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**ABSTRACT**

The communications sector is undergoing significant changes, with the emergence of a number of platforms available to provide a different range of services. Some of these platforms are complementary to each other, while others are competitive, or can provide a valid substitute for some of the services provided. Up till now, the most important communications platform in most of the developing countries has been the public switched telecommunication network (PSTN) which provides access to all households and buildings. This universality in providing access has also meant that the network has generally been designated as one for universal service.

**Keywords**: Convergence, Converged Networks, NGN, IMS, Residential Network, FMC, CATV.

## INTRODUCTION

Communication networks have become a key economic and social infrastructure in many counties in the world. The telecommunication network infrastructure is crucial to the national and international exchange of goods and services, and acts as a main catalyst in changing economic interrelationships through rapid technological change and the proliferation of a range of new services. With the development of the Internet, the role of communication networks has evolved and their importance increased. The advent of higher access speeds, in many cases symmetric speeds, available to business and to residential subscribers, has also increased the role of communication infrastructures by expanding the available range of services. High speed networks are increasingly helping resolve ongoing societal concerns in areas such as the environment, health care and education, and are increasingly playing a role in social networking. However, for the potential of new network technologies to be realized, the market will require that these networks have universal, or close to universal coverage. The full potential of networks is only likely to be achieved where markets are effectively competitive and solutions have adequate coverage to most geographic areas. Technological innovation, stimulated through digitalization, has been a major factor in

driving change in the communications market. This innovation is reducing costs and enhancing the capability of networks to support new services and applications. A key innovation which is expected to bring further significant changes in the communications market is the transformation from circuit-based public switched telecommunication networks to packet-based networks using the Internet Protocol, so-called next generation networks (NGN). NGN is expected to completely reshape the present structure of communication systems and access to the Internet. The present structure of vertically independent, although interconnected, networks may be transformed into a horizontal structure of networks based on Internet Protocol. Investment requirements for NGN are high and, as for any investment, there are risks. Policies need to ensure that risks and uncertain returns are compensated while ensuring competition since, without competition, the benefits of high speed broadband and NGN will not be realized.

## 2 Convergence and future network

Convergence in network technologies, services and in terminal equipment is at the basis of change in innovative offers and new business models in the communications sector (Box 1). The utilization of the term "convergence" represents the shift from the traditional "vertical silos" architecture, i.e. a situation in which different services were provided through separate networks (mobile, fixed, CATV, IP), to a situation in which communication services will be accessed and used seamlessly across different networks and provided over multiple platforms, in an interactive way. Already in the 1990s, the possible impact of digitalization and convergence between telecommunications and broadcasting was under examination and proposals made for changes in existing regulation. The growing role of the Internet in the economy and society has enhanced the process of convergence and its rate of change[3].

## 3 Next-generation access networks

### Cable

Cable television (CATV) operators have begun to upgrade their infrastructure to hybrid fiber copper (HFC) allowing for bidirectional traffic and using Docsis[7] technology to increase network capacity. These developments are allowing CATV companies to offer voice and Internet access (data services) in competition with telecommunication companies which through their offer of Internet TV have begun to compete with CATV companies.

### Broadband wireless access

Broadband wireless access (BWA) technologies aim at providing high speed wireless access over a wide area. Certain early fixed wireless access technologies, such as local multipoint distribution service (LMDS) and multi-channel multipoint distribution service (MMDS), never gained widespread market adoption. WiMAX technologies, – the IEEE 802.16 set of standards that are the foundation of WiMAX certification, and similar wireless broadband technologies, are expected to address some of these shortcomings, and fill market gaps left by wired networks, or compete with wired access providers.

### Broadband over powerlines (BPL)

Use of the power grid as a communications network, or "powerline communications" appears to provide a series of advantages, offering not only voice, but also broadband services, with the connection speed not dependent on distance from the telephone exchange (as happens with DSL) or number of customers connected (as with cable).

### 3G mobile networks

The term NGN frequently encompasses some kind of fixed-mobile convergence (FMC)[13], as it allows the transition from separate network infrastructures into a unified network for electronic communications based on IP, which facilitates affordable multiple business models, seamlessly integrating voice, data and video. The introduction of 3G technology supports the transmission of high-speed data with speeds theoretically reaching 2/4 Mbit/s.

### Convergence using IMS

In this section, we present an illustrative case study on convergence using IMS in a residential environment. First we describe the requirement of a converged residential environment. Bundling up of communication services has been very successful of late. Companies have been providing Internet, voice telephony, and digital entertainment services to residential subscribers with the convenience of a

single bill. These services include cellular telephony also. What lacks in this environment is interworking among various services. A converged environment would allow for rich multimedia applications to be accessed by the users on any device and retain the user profile and other settings. The idea is to be able to communicate, establish multimedia sessions, and perform control and configuration operations on all the networked elements in the residential environment. The following are the typical requirements of a converged residential network:

The system should allow multiple user profiles with different levels of control over services and the systems.

- It should also allow integration of wireline and wireless (cellular) voice communication, or should allow the users to make and receive phone calls on wireline-based digital/ analog phone and the wireless cellular phone interchangeably as per personal preference.
- The system should allow for multimedia sessions to be established between the various terminals (audio/video database server, TiVo etc) in the network. The users should be able to access the content within the residential environment on any terminal or from outside the residential environment (restricted only by the capabilities of the device and the available bandwidth).
- The nodes in the residential environment may use either wired or wireless connectivity. The local area network should support secure wired and wireless access (WiFi or WiMAX).
- The network must support application or service hosting and the application server should be remotely manageable. These applications may include but are not limited to residential security system (monitoring, configuring and authorization), web hosting services, residential power/gas monitoring and control etc.
- The residential environment should be secure, easy to manage, and efficient, and should provide effective means of managing and configuring devices in the network.

**Scenarios in Converged Residential Network**

We shall consider a family comprising four people, two parents and two children. Each of these four users might need different services and will have different levels of authority over the system. Let's consider a problem or a convergence requirement of this residential network and work on providing a solution for it. We assume that say the father (John) has a cell phone (GSM/UMTS). He also subscribes to digital television services from the same company which provides him with a digital telephone and Internet assess. This is a typical scenario at present for a customer of triple play services. What John desires from this converged system is to have the following features:

- When at home, he should be able to make and receive calls (voice and maybe video) using his home digital phone or cell phone interchangeably. This means that once he gets home his cell phone calls should be automatically routed to his home phone to save minutes.
- The home phone is connected to a high bandwidth connection; it's an IP phone and should be allowed to be implemented over the WiFi network. The cell phone used by John may be a smart phone which has WiFi connectivity, so he can continue to use his handset to receive calls intended for both his home phone number and cell phone number but with enhanced bandwidth, improved display and reduced cost of access.
- Other members of the house may or may not have a cell phone account; if they do same should apply for them. Also the system has to be smart enough to identify the called party and not alert John on his phone if the call is for his children. This needs to work both ways as he does not need to his calls to be forwarded to other members of his family. The system should be configurable to manage this.
- He should be able to continue to access the internet from any other device, including a desktop, a laptop, a PDA/Smart phone etc. Also he should be able to receive communication (voice call, email, voice mail, instant message, video call, etc.) addressed

to his various accounts (email, home phone number, cell phone number, etc.) on any of the devices listed above. They have different abilities in terms of processing power, screen size, etc.

- The entertainment services being subscribed by the family may include digital TV, access to other online multimedia services, music, videos etc. The family must have access to the entertainment services from any network node capable of playing audio and video. This includes watching a particular TV channel on a PC, a laptop or a PDA.

**Achieving converged residential network using IMS**

There are certain pre-requisites for establishing a session in the IMS environment in the residential network described in the previous section. We first present these re-requisites:

- **Establishing an IMS service contract**: This includes establishing a subscription with the IMS service provider. During this process, the service provider will provide the customer with the appropriate identities and the service profiles will be created depending on the user's requirements in terms of services, bandwidth for those services, and access to various other applications being provided by the service provider. After the service contract is established, the user profile will be stored in the HSS and will be used during various operations in IMS, including Authentication, Authorization and Accounting purposes etc.
- **Obtaining and IP address**: Every IS terminal needs to get connected to the IMS core network. The connectivity is provided by the IP-CAN (IP-Connectivity Access Network). This could be any IP-based transport network such as GPRS (as in GSM/UMTS network), xDSL, Wireless LAN through Wi-Fi (IEEE 802.11) or WiMAX (IEEE 802.16) networks etc. IMS uses only IPv6 address.
- **Discovery of P-CSCF**: After the IMS terminal obtains IPv6 address; the next step is to locate a P-CSCF. This procedure includes the discovery of the IP address of the P-CSCF, which acts as an inbound/ outbound SIP proxy server and will interact with the IMS core network.

**Convergence Standardization Organizations**

Packet-based transfer

- Separation of control functions among bearer capabilities, call/session, and application/ service.
- Decoupling of service provision from network, and provision of open interfaces
- Support for a wide range of services, applications and mechanisms based on service building blocks (including real time/streaming/non-real time services and multimedia)
- Broadband capabilities with end-to-end QoS and transparency
- Interworking with legacy networks via open interfaces • Generalized mobility
- Unrestricted access by users to different service providers • A variety of identification schemes which can be resolved to IP addresses for the purposes of routing in IP networks
- Unified service characteristics for the same service as perceived by the user
- Converged services between fixed/mobile
- Independence of service-related functions from underlying transport technologies
- Compliant with all regulatory requirements, for example, concerning emergency communications and security/privacy, etc.

**Future Trends**

**Subscriber growth**: The rural subscriber base has been growing substantially due to greater focus of the telecom service providers on rural operations. The rural subscribers accounted for almost 30% of the total subscriber base as of December 2008. However, there is an untapped potential in rural areas (where almost 70% of the population resides), as rural teledensity is quite low at 12.6% vs. urban teledensity of 81.3%. Quarterly rural subscriber additions have begun to exceed urban subscriber additions. Also, growth in rural subscribers has exceeded that in urban subscribers. Going forward, with a shift in focus towards rural areas, it is logical to believe that rural subscriber growth will continue to outpace urban subscriber growth. Although rural

areas would be the next growth driver, operators are expected to face certain challenges:

- High network OPEX: Operation and maintenance costs of cell sites in rural areas are high due to lower availability of electricity and thus operators are forced to depend on diesel for power supply. According to the FICCI-BDA wireless broadband report, cell site operating costs in rural areas are estimated to be 25% higher at $1,410/month vs. $1,050/month in urban areas.
- Low ARPUs and MOU: Due to lower per capita income and low usage, ARPUs and MOU are lower in rural areas than in urban areas. Apart from huge CAPEX and OPEX requirements, other constraints in increasing penetration in rural areas include acquisition of land, unavailability of cheap and fast backhaul connectivity, lack of continuous power supply, and low literacy levels. To increase rural penetration, TRAI has taken numerous initiatives such as recommending bringing mobile services under the ambit of USOF and sharing of infrastructure to receive support from USOF, and supporting backbone infrastructure through USOF. Therefore, low penetration, coupled with factors such as increasing affordability, lower handset prices and TRAI initiatives, suggests significant potential in rural areas. It is possible that the operators will expand coverage in rural areas to gain the first-mover advantage. This in turn should help improve rural teledensity. Launch of new services: Services like IPTV and DTH services are being provided by some operators. For example, to leverage its existing fixed line infrastructure, Bharti Airtel has started to offer IPTV and DTH services. While IPTV is limited initially to few cities, the company believes that DTH would become a mass product. Bharti will provide bundled services, commonly known as triple play – voice, broadband and TV services on one platform. Declining ARPUs to put pressure on margin: The telecom industry is seeing adds of over 10 million subscribers every month, but the increasing base is not resulting in an increase in usage, as reflected by MOU. On the revenue front, growth is slowing down with a higher base and due to the consistent fall in ARPU. Going forward, a shift in the operators' focus towards low-usage rural subscribers would further contribute to a fall in ARPU. Furthermore, the competitive pressure will likely heighten with new operators rolling out services, which in turn would lead to downward pressure on tariffs. TRAI recently reduced the termination charges for all domestic calls to INR0.2/ min from INR0.3/min from April onwards, which should further aid the tariff decline, pressurizing ARPUs. This, along with slow subscriber base growth, might result in slowing top-line growth, which, together with increasing competition and higher CAPEX to expand business, should put pressure on margins. However, to scale down the effect, the wireless operators are looking to increase value added service revenue similar to the developed markets, where operators have shifted focus towards data revenue, which has led to an improvement in margins.

## RESULT AND CONCLUSION

This paper has provided a clear picture of a converged, all ip communications environment, which fulfils almost all the expectations and requirements of a ngn system. The aim was to help the reader comprehend the concept of convergence, its drivers and enablers in ngn. Various issues of ngn are discussed and the current and future trends of standardization activities for ngn are presented in detail. Ims is depicted as a major enabler for achieving convergence. the paper had presented a case study to illustrate how ims can be used to achieve convergence in a residential networking environment. some of the applications mentioned may be a bit advanced and not feasible from the perspective of india, they are certainly going to be deployed in near future.

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