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Telecom Regulatory Authority of India

Consultation paper on

Licensing Issues relating to Next Generation Networks

New Delhi, India

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Preface

The development of new applications, contents and converging technologies have created an environment where it has become necessary to deliberate on the type of future telecom, both in terms of technology and application. Though at present networks are virtually separated and provide fixed telecommunication, mobile telecommunication and Internet services; the reducing Average Revenue Per User (ARPU), increasing demand of value added services, and convergence advocate promoting concept of Next Generation Network (NGN).

Telecom operators in India have already initiated their move towards NGN by implementing IP based core network. The migration to NGN is likely to be in stages and will require huge investment by telecom operators. In addition to huge investment, there may be regulatory and technological issues, which have to be addressed on priority basis. In order to identify & address various issues related to Next Generation Networks like relevance and timing for transition to NGN and Migration related issues, Telecom Regulatory Authority of India (TRAI) initiated consultation process in January, 2006. Based on the deliberation and views of Stakeholders, certain recommendations were given to Government in March, 2006.

Consequent to the recommendations on NGN, a committee named NGN eCO (Next Generation Networks Expert Committee) was constituted having representatives from various sectors of the Stakeholders. The NGN eCO deliberated upon the licensing, interconnection and Quality of Service (QoS) issues related to NGN and submitted its final report to the Authority on 24th August 2007.

With an objective to develop a suitable regulatory framework for smoother and faster march towards NGN, TRAI has come up with the consultation paper on

"Licensing issues related to Next Generation Networks". This consultation paper focuses on the licensing issues for migration to NGN. The consultation paper has already been placed on TRAI's website (www.trai.gov.in). The Authority is also considering to bring out consultation papers on "NGN Interconnection Issues" and "NGN Quality of Service issues" at appropriate time to help smooth migration to NGN.

The stakeholders are requested to send their comments on the various issues mentioned in the consultation paper by 27th February 2009 preferably using electronic communication. In case of any clarification/information, please contact Sh. S. K. Gupta, Advisor (CN), Tel.No.+91-11-23217914, Fax: +91-11-23211998 or email at advcn@trai.gov.in or cn@trai.gov.in.

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CHAPTER 1

BACKGROUND

Present Telecom Scenario

1.1 Worldwide Telecom landscape is witnessing significant developments. Wireless telephony is growing with an impressive rate in many countries. Approx. 8 million wireless subscribers are being added per month in India. Allocation of 3G and Broadband Wireless Access (BWA) spectrum is likely to increase broadband penetration facilitating various IP based services and applications.

1.2 On one hand volume of IP based services (data, VoIP etc) is increasing every year, the traditional voice services, on other hand, are witnessing decline in revenues for plain telephone services. Various services on broadband networks are becoming popular. Acceptability of Internet based services such as Email, Chatting, VoIP, E-commerce, M-commerce etc. are increasing. Service providers are also adopting IP based backbone. As per the recent reports Multi Protocol Label Switching (MPLS) over IP backbone is being used for International trunk circuits to carry voice traffic. Service providers favour such deployments as it provides them economic and technological advantage. This is helping International long distance service providers to cut service provisioning costs. Consolidation of core networks on an all IP network is being adopted universally. Media Gateways (MG) are being used to facilitate interconnection of IP backbone to TDM networks and vice versa.

1.3 Landline operators, are now more and more vying upon provisioning of broadband services such as VoIP, IPTV etc in order to setoff the fall in revenue from plain voice traffic. Analysts are of the view that transition

from TDM to IP based traffic will accelerate in near future.

1.4 The increasing acceptability of common IP back bone, declining ARPU, intense competition, new value added services and applications necessitate migration to NGN platform worldover. It is argued that regulators must encourage NGN deployments to encourage broadband penetration and convergence. Long term predictable policies to promote these objectives are a prerequisite when creating an enabling environment for migration to NGN. World Summit on Information Society (WSIS) action plan noted "Governments should foster a supportive, transparent, pro-competitive and predictable policy, legal and regulatory framework, which provides the appropriate incentives to investment and community development in the Information Society". This is of paramount importance to facilitate NGN deployment. Regulators and policy makers must provide operators with stable regulatory and policy framework that will permit them to venture the risk associated with NGN deployments, particularly the high upfront investments required. It has to be ensured that incentives for efficient investments are not distorted particularly by excessive regulations.

1.5 The Authority has taken note of the plans of different countries encouraging migration to NGN. We need to look at impediments, if any, for migration to NGN and address them on priority basis.

1.6 This consultation paper focuses on various regulatory issues particularly licensing in the context of migration to NGN and seeks the comments of the stakeholders.

Regulatory Initiatives for NGN

1.7 TRAI took the initiative on NGN in July 2005 with an objective of awareness building and released a Study Paper. A questionnaire was also sent to major operators to obtain their preliminary comments on issues

related to NGN. A consultation paper on "Issues pertaining to Next Generation Networks (NGN)" was issued in January 2006. TRAI sent its recommendations on "Issues pertaining to Next Generation Networks (NGN)" in March 2006. The salient features of TRAI's recommendations were:

- Government should arrange to organize some interactive workshops / seminars through its various agencies like TEC, C-DOT, ALTTC etc. on various aspects of NGN to bring awareness among different stakeholders.

- It was re-emphasized that TRAI's recommendations for unified licensing regime dated 13th January 2005 should be considered expeditiously so that various operators can make best use of NGN platform to provide all types of voice, data, video and broadcast services through a single license.

- TEC to be entrusted the task to study and analyze various international developments pertaining to NGN in a time bound manner so as to incorporate the same in Indian context and develop interface requirements for the same.

- Cross industry joint consultative group consisting of TEC, Service providers, technical institutions, and vendors etc for analyzing NGN standards & their customization for national requirement to be set up.

- To setup an expert committee having experts from DOT, TEC, C-DOT, service providers, vendors and academicia to deliberate upon various issues related to NGN.

1.8 As per Authority's decision, an expert committee named 'NGN eCO' was constituted on 20th June, 2006 having 30 representatives from various

sectors of the Stakeholders. The major tasks entrusted to `NGN- eCO' were:

- NGN awareness building program.
- Timetable for NGN migration in the country.
- Background documents to be used for consultation on Interconnection and QOS issues by TRAI.

1.9 NGN-eCO further constituted three core sub-groups having representatives from different stakeholders to study the Licensing, Interconnection and Quality of services (QoS) related issues in detail. Based on the reports of these core groups, NGN eCO submitted its final report to the Authority on 24th August 2007.

1.10 In order to create further awareness about NGN among stakeholders, a one day national seminar was organized by TRAI on "Awareness Building on NGN' on 4th December, 2007 at New Delhi. This seminar was attended by delegates representing service providers, equipment vendors, industry organizations, government departments, PSUs, Academic institutions etc.

1.11 A significant number of telecom operators have begun deployment of NGN. In the transition phase to NGN, the existing licensing policy and regulatory framework need to be evaluated with regard to changing technology and market structure. The NGN concept of "one network - many services" underlines the necessity and explicitly forces a technology-neutral approach with service-agnostic licensing.

1.12 Migration to NGN could change the existing service providers' business models. On one hand, traditional service providers would see much greater efficiencies and lower costs by adopting NGN and likelihood to provide new services to their subscribers, thus boosting revenues and profitability. The service independence on the other hand could create

new category of service providers i.e. application & content service providers, encouraging launch of innovative services and sector specific solutions. This new development will compliment the traditional network service providers with minimal investment and will also facilitate many new services. A possible consequence of such new developments may change service provisioning profile. The traditional network service providers may become pure access providers, and many application services (voice, video, broadband and data, etc.) may be provided by application & content service providers. This could change the business model of the existing operators to an extent, which may require regulatory measures.

1.13 The deployment of NGN would require high upfront cost. The investor would require stable regulatory environment before putting such huge investments. The regulatory challenges and obstacles related to migration to NGN, emergence of new category of service providers, changing business models, network security risks, competition and level-playing field etc. need to be addressed on priority basis. Unless license conditions and regulations are properly redefined with a light touch regulatory approach, it would be difficult to encourage smooth migration to NGN.

1.14 Different options available to regulators are to support investment, encourage & support migration, encourage migration, or wait & watch. In all the above strategies, the higher rewards are associated with high risk. TRAI believes that being a technological advancement, the regulators role is to analyse the various impediments and initiate appropriate action to redress these impediments in a time bound manner so that service providers interested to migrate to NGN can do so without any regulatory hurdle.

1.15 Regulators in many developing nations have attempted to lay down broad

principles for NGN transition well in advance of the actual transition. This is unlike the legacy network where the business model, network and competition were established prior to regulation. Operators and regulators around the world are deliberating upon how to overcome technical challenges pertaining to interoperability, interconnection and how to encourage infrastructure investment with least possible risk in an open environment of NGN.

1.16 Considering all the above issues and given the stage of fast network and infrastructure development in India, the time is appropriate to address regulatory and licensing issues related to NGN. This will not only help to have a closer look at licensing and regulatory framework, but will also help in reducing investment risk for operators. The Authority has therefore suo-motu decided to float a consultation paper on "Licensing Issue relating to Next Generation Networks" to seek the comments of stakeholders on various issues. The Authority is also considering to bring out consultation papers on "NGN Interconnection Issues" and "NGN Quality of Service issues" at appropriate time to help smooth migration to NGN.

1.17 The paper is divided into five chapters. Second chapter deals with convergence and NGN. Third chapter deals with technical overview of NGN. Fourth chapter deals with regulatory issues related to NGN. Fifth chapter summarizes all the issues for consultation.

CHAPTER 2

CONVERGENCE AND NGN

2.1 World over the Digital Revolution is transforming the life of people and the ways they interact with each other. There are strong indications which suggest that now various sectors including the information and communications industries are moving towards convergence of networks, services, firms, and devices. It is claimed that this convergence will usher people to a new era with a new definition of mobility and presence that will mean always-on truly universal access any time, anywhere.

Convergence

2.2 While there is no universally accepted definition of convergence, it may be considered synonymous to blurring boundaries between traditional & new technologies and services. ITU has defined convergence as *"Coordinated evolution of formerly discrete networks towards uniformity in support of services and applications".* Further convergence is being seen at different layers of present networks architecture. This may transform the service delivery and manageability concept in ICT sector.

2.3 Convergence is primarily driven by three important technical aspects.

- **Digitization**,
- **Increasing processing power and form factor of devices**
- **Acceptability of IP backbone**

2.4 Digitization facilitated representation of any data in the digital form, including content for mass distribution such as movies and personal pictures etc. This made digital products popular among both business

and individual users.

2.5 The increasing processing power, higher form factor, low power consumption and integration of functionalities have facilitated manufacturing of smaller devices. The cost of these devices is reducing rapidly over a period of time, allowing digital devices to proliferate at a rapid rate. The above scenario has further resulted in data compression subsequently increasing channel's carrying capacity even if its bandwidth remains fixed. This has enabled introduction of digital broadcasting with reduction in the amount of spectrum used for broadcasting and hence sparing valuable spectrum to other services.

2.6 The universal acceptability of Internet Protocol (IP) has made it possible for different devices and applications to use the same networks, sharply reducing network costs and significantly reducing cost of service provisioning.

2.7 All of above factors are playing a role of catalysts to stimulate customer demands for different network services such as triple play (i.e. IPTV etc), quadruple-play services (i.e. Mobile TV). It is projected that future lies with any-play services which will be supported by an end-to-end all IP network.

Convergence as driver to NGN

2.8 Historically the telecommunication networks have evolved from a simple telephone network into a multi-service field, with new services implemented either as add-on to existing networks or by creating separate service specific networks. This hierarchical structure till now facilitates simple planning, operation and management. However different networks with one-to-one mapping of services (IP, ATM, PSTN & Internet) costs a lot to service providers. Huge CAPEX and OPEX to maintain parallel networks to provide various services have been

serious handicap to survive in highly competitive environments.

2.9 The technological advancements have facilitated separation of network, service and application layers. This has brought in a new concept and changed the hierarchy of the network. Now different services can easily be launched on common backbone drastically reducing time and service provisioning cost. IP Networks have emerged as one of the acceptable options for use as backbone as it is robust, resilient and efficient. The effective management features on IP have made it most acceptable option.

2.10 Increasing acceptability of IP platform to provide triple play services has become a major driver for NGN adoption globally. The end-users are now being given unified services easily. This convergence of access network across the wireline, wireless and internet domain is facilitating integrated billing, faster service provisioning and better customer relation management.

2.11 Service delivery platform is now becoming more and more flexible. Entire platform has now become web based and it is possible to provide different Value-added services and content quickly with minimum efforts. This has led to remodelling of ICT services. The reducing price of conventional services and increasing returns on value added services are driving service providers to be more flexible to provide new contents and value added service.

2.12 The competition in telecom sector has led to faster growth in terms of subscriber base however has resulted in steep fall in Average Revenue Per User (ARPU) both on Fixed and Wireless services. The need is felt to boost revenue earnings through launch of new value added services and applications specific to different regions and languages. Next Generation Networks (NGN) seem to be a solution.

2.13 NGNs are commonly built around the Internet Protocol, and therefore the term "all-IP" is also used to describe NGN. A general layout of an all IP Network (NGN) is shown Figure 1

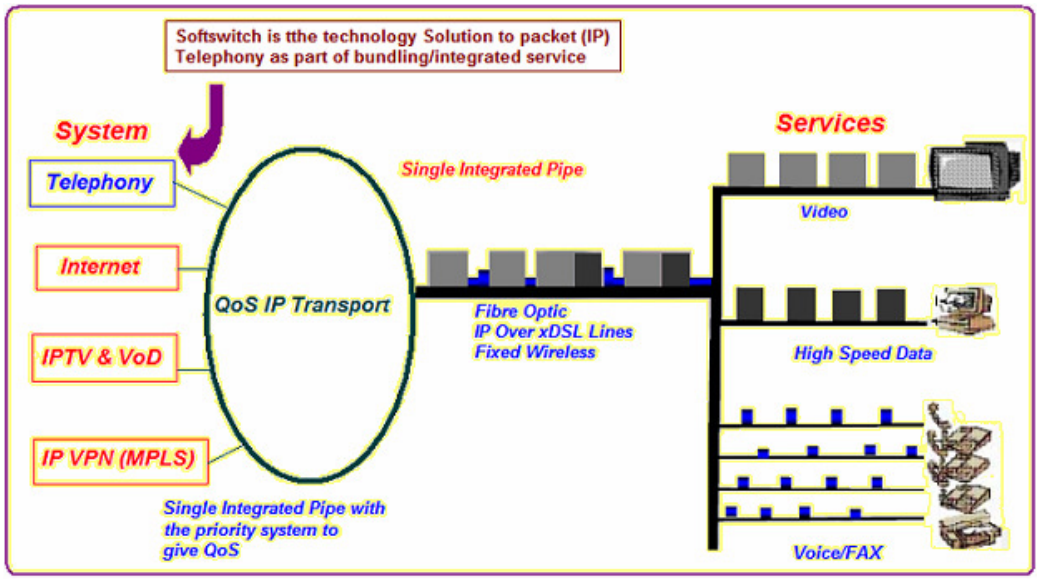

Figure 1: Use of IP based Network in Backbone

2.14 Although it will be difficult to project the future service scenario in NGN or an all IP era, the major service characteristics and capabilities in NGN environment can be forecasted by examining current services related to industry trends. The shift in transport layer from TDM to all IP is an enabler for dramatic change, which can be witnessed at the service layer in future. While existing services will remain part of service profiles of service providers in future as well, it is expected that market will migrate towards more advanced broadband multimedia and information based services. End-users may interact with the network via sophisticated CPEs and will be able to select from a wide range of Quality of Service and bandwidth options.

2.15 The primary goal will be to enable users to get the information content they want, in any media/format, over any facilities, anytime, anywhere and in any volume. A variety of services, some already available, others

still at conceptual stage, have been linked to NGN initiatives and considered to be services of future. Although emerging and new services are likely to be strongest drivers for NGNs, most of the initial NGNs profits may actually result from the bundling of traditional services. Thus bundled traditional services will pay for the network; whereas emerging services may fuel the growth.

2.16 Traditionally telecom services are related to basic access/ transport/ routing /switching services, session control services and various value added services. NGN is likely to enable a much broader array of service types including:

- Specialized resource services (e.g., provision and management of transcoders, multimedia multipoint conferencing bridges, media conversion units, voice recognition units, etc.)
- Processing and storage services (e.g., provision and management of information storage units for messaging, file servers, terminal servers, OS platforms, etc.)
- Middleware services (e.g., brokering, licensing, naming, transactions, security etc.)
- Application-specific services (e.g., e-Commerce applications, business applications, supply-chain management applications, interactive video games, etc.)
- Content provision services that provide or broker information content (e.g., electronic training, information push services, etc.)
- Interworking services for interactions with other types of applications, services, networks, protocols, or formats (e.g., EDI translation)
- Management services to maintain, operate, and manage communications/computing networks and services.

2.17 Table 1 depicts the services which will drive the NGN environment in future.

MAIN NGN SERVICE DRIVERS	IMPORTANT CHARACTERSTICS
VOICE TELEPHONY	Call waiting, Call forwarding, 3-Way Calling, AIN features and Centrex & CLASS features Focus may be more on marketable voice telephony services
DATA SERVICES	End-to-End real time connectivity Bandwidth-on-demand, Connection reliability, Resilient switched virtual connections and bandwidth management/call admission control
MULTIMEDIA SERVICES	Multiparty Voice, video and/or data conferencing Conversation with displaying visual information Collaborative computing and groupware
VIRTUAL PRIVATE NETWORKS	Voice VPN improves inter-location networking capabilities of business by allowing geographically dispersed organizations to combine their private networks with portions of PSTN Added security and Networking features allowing users to share IP Network as a VPN
PUBLIC NETWORK COMPUTING	Generic processing and storage capabilities SPs may not have information on specific content/application
UNIFIED MESSAGING	Delivery of voice mail, email, fax mail, and pages through common interface Independent of mean of access
INFORMATION BROAKERING	Information to consumers based on personal preference and behaviors patterns
E-Commerce	Allows purchase of goods and services electronically over the network Home banking, B2B (i.e. supply chain management and knowledge management)
CALL CENTER SERVICES	Call to a call-center through clicking webpage Queuing of voice calls and email message uniformly for the agents
INTERACTIVE GAMING	Offers consumers a way to meet online Interactive gaming sessions
DISTRIBUTED VIRTUAL REALITY	Technological generated representation of real world event, peoples etc.
HOME MANAGER	In-home Networking and intelligent appliance

Table 1: Services driving NGN Networks

2.18 From a traditional subscriber's point of view, present networks have long been fulfilling their purpose of enabling people and their machines to communicate at a distance. However, a key critical success factor (among many) of telecommunications industry attention is focused on NGN service concepts and how these concepts can be realized in an NGN environment, from the edges to the core of the network.

CHPATER 3

TECHNICAL OVERVIEW OF NGN

Introduction

3.1 Next Generation Networks are fast becoming popular. The separation of network, services and application layers has enhanced the capability and flexibility of such networks. We will deliberate various technical issues in this chapter.

Definition of Next Generation Network

3.2 NGN is essentially a managed IP-based (i.e., packet-switched) network that supports variety of high speed data intensive services including, IPTV, HDTV, videoconferencing, VoIP, Instant Messaging, e-mail, and other packet-switched communication services.

3.3 Next Generation Networks (NGN) broadly relates to next-generation broadband IP based networks presently being used by telecom carriers in their backbone. The ITU defined the term NGN in Recommendation Y.2001 as**: "A packet-based network able to provide telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and/or services of their choice. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users."**

NGN and Conventional Networks

3.4 NGNs and its conventional counterparts differ both in the architecture and services (refer Figure 2 & 3). While conventional networks comprised a series of vertically integrated independent networks, each designed

specifically for a separate service (telephone, mobile, leased line, broadcast, etc.); NGNs pair a network service control layer with a network layer that handles the actual transfer of data to create a hierarchical architecture that can be shared by multiple services. These two network architectures differs in the services provided as NGNs allow use of communication carriers' data and communication processing functionality via an API, whereas conventional communication carriers offered primarily audio and data transmission services.

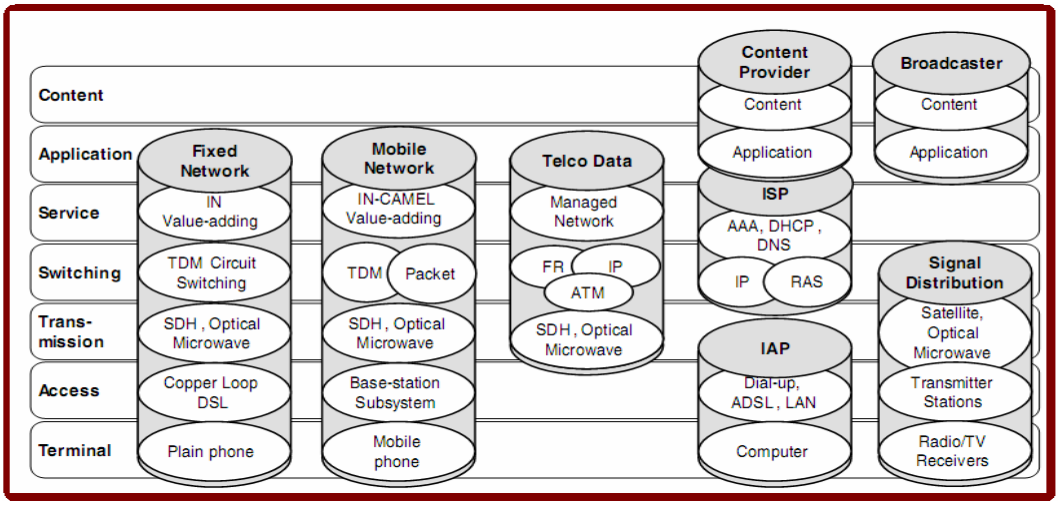

Figure 2: Vertically integrated traditional telecom and broadcasting platforms

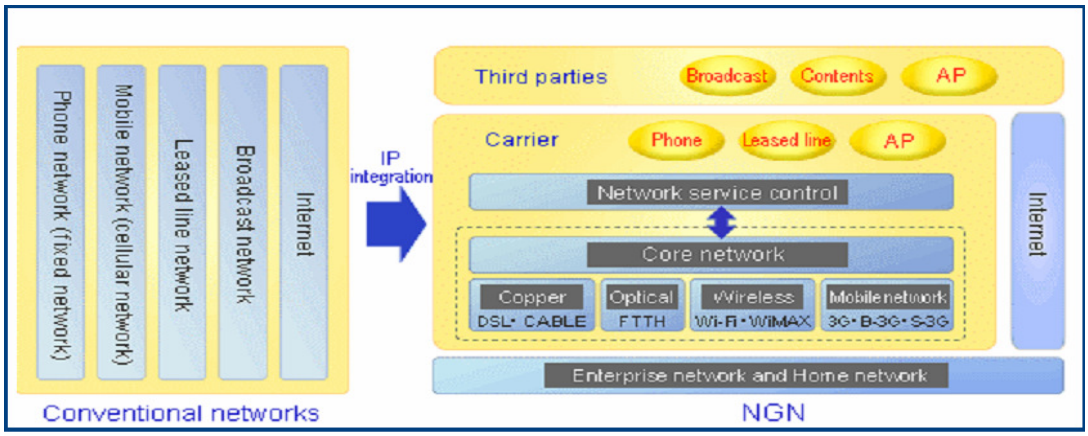

Figure 3: Comparisons of NGN and Conventional Networks

3.5 Another important aspect of NGN is that the access provider and service provider may be different unlike present scenario. For example presently a wireless access provider also gives mobile services to its subscribers, whereas in NGN it will be possible that different services are provided by various service providers (such as voice service provider, video service provider, e-mail service provider, stock quotes provider etc) on an access network provided by a particular access provider.

3.6 With deploying the Next Generation Network, users may have one or many access providers providing access in a variety of ways, including cable, DSL, Wi-Fi, WiMAX, fiber, etc. into the NGN. This may provide end users with virtually unlimited options to choose between service providers for voice, video, and data services in NGN environment.

Overview of NGN Functional Architecture

3.7 The NGN functional architecture is horizontally layered architecture with clear separation of services, transport, end-user management, and third party application functions as shown in figure 4. It supports the delivery of different services, which includes multimedia services (SIP based voice services), content delivery services (video streaming) and broadcasting. The NGN provides support for PSTN/ISDN emulation as well as simulation. In addition, it provides capabilities and resources to support third-party applications for value-added services. Each subscriber can avail services from different service providers.

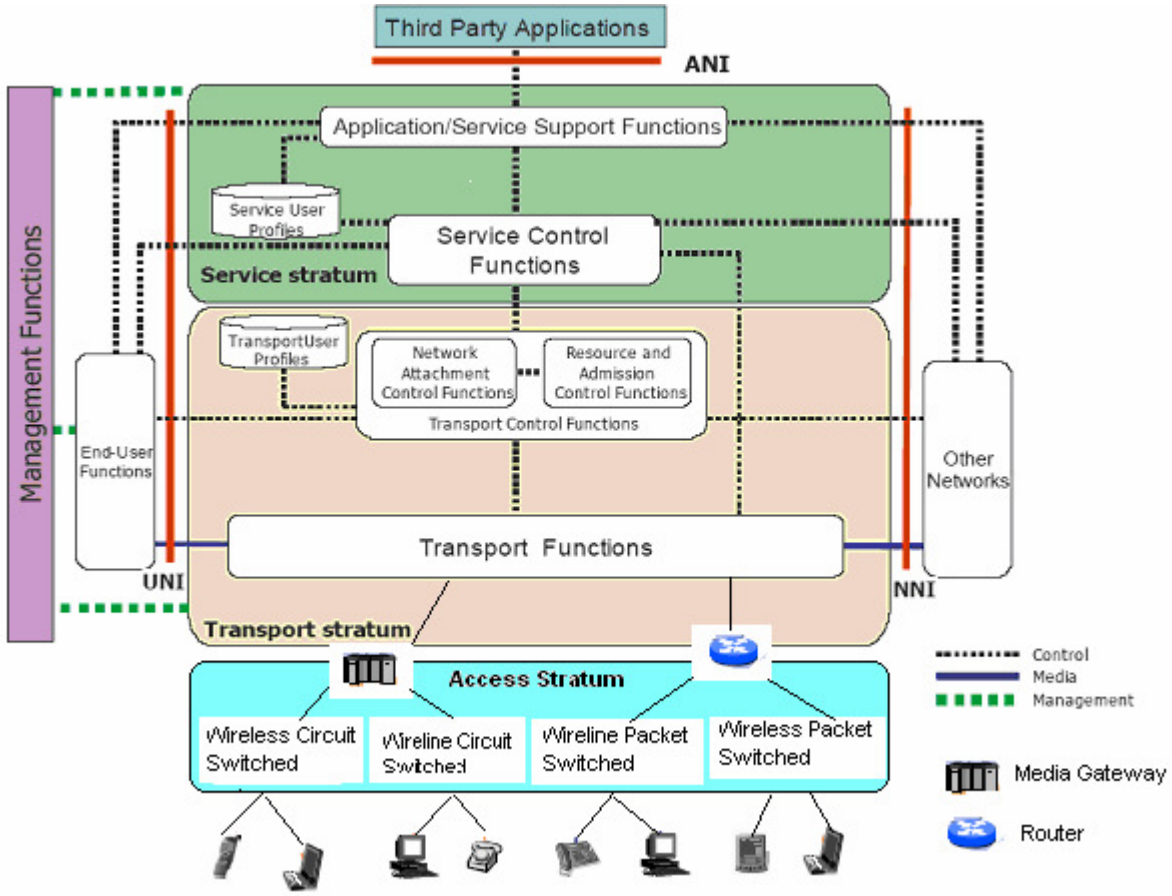

Figure 4: Overview of the NGN functional architecture

3.8 Table 2 summarises the functional architecture of the NGN:

(I) Transport Stratum	
(a) Transport functions	Transfers the information Provides connectivity for all components and physically separated function within NGN
(i) Access Network Function	*Access to the network as well as collects and aggregate the traffic coming from different access network toward the core network* *QoS control mechanism*
(ii) Edge Function	*Media and traffic processing on aggregated traffic*

(iii) Core transport functions	*Used for information transport throughout the core network. Provides QoS mechanism dealing directly with user traffic.*
(iv) Gateway functions	*Provides capabilities to interwork with end users functions and other network such as PSTN, ISDN etc.*
(b)Transport Control function	Control entry of users, resource of network Allowing attachment to the network
(i) Resource and Admission Control Function (RACF)	*QoS Control (including resource reservation, admission control and gate control)* *Admission control involves checking authorization based on user profiles, Service level agreements (SLAs), operator specific rules, service priority and recourse availability within access and core transport.* *Network Address and Port Translation* *Firewall (FW) traversal control function over access and core transport layers*
(ii) Network Attachment Control Functions (NACF)	*Responsible for registration at the access level for network level identification/authentication, manage IP address space of the access network and authenticate access sessions.*
(c) Transport User Profile	Functional database representing the combination of a user's information and other control data into a single "user profile" function in the transport stratum
(II) Service Stratum	
(a) Service Control function	Include session and non-session control, registration and authentication and authorization functions at service level

(b) Application/Service Support function	Include gateway, registration, authentication and authorization functions at the application level. Available to the "Third-Party Applications" and "End-User" functional groups. Works in conjunction with service control functions to provide end users with the requested valued added services
(c) Service User Profile functions	Represent the combination of user information and other control data into single user profile function in the service stratum
(III) End User Functions	**All types of legacy and next generation end-user interfaces and end-user network are to be supported by NGN access networks**
(IV) Management Functions	**Distributed in each functional entity of NGN.** **Management functions interact with network element (NE) management, network management and service management in following areas** **Fault Management** **Configuration Management** **Accounting Management** **Performance management** **Security management**

Table 2: Summary of NGN functional Architecture

3.9 NGN architecture defines a Network-Network Interface (NNI), User-Network Interface (UNI), and an Application Network Interface (ANI). The Transport stratum provides IP connectivity services to NGN users under the Transport control functions, including the Network Attachment Control Functions (NACF) and Resource and Admission Control Functions (RACF). The NACF and RACF are two important components of

NGN.

3.10 Terminals that talk to the NGN will authenticate with the Network Attachment Control Functions (NACF), receive an IP address, get configuration information, etc. Once attached to the network, terminals will communicate directly or indirectly with the Resource and Admission Control Functions (RACF) in order to get desired QoS for communication, get permission to access certain resources, etc. There are a number of components within this architecture, which would suggest a "freedom of services" to users. Users would potentially have access to RTSP-based streaming services, PSTN access, IMS access, and access to "other multimedia components". Legacy terminals (user devices) must pass through a gateway device to access NGN supported applications.

Migration to NGN networks

3.11 Considering present architecture of telecom networks, NGN migration can be classified in four steps:

- NGN in core network
- Migration of Conventional switches to IP soft switches
- NGN in Access networks
- Next Generation Service Control

3.12 **Next Generation Core:** The next-generation core network is a single converged IP network, which can carry multimedia signals including voice and data. Presently Multi Protocol Label Switching (MPLS) and Resilient Packet Ring (RPR) are some of the transport technology adopted. The evolution to a next-generation core network promises significant savings in terms of bandwidth saving in long run and provides a stable platform for converged services.

3.13 **Migration of Conventional switches to IP soft switches:** Migration from conventional switches to IP switches will result in saving on account of Capex, Opex, Space requirement, power requirement etc. Maintenance of such switches from central location is easy and scalability is high.

3.14 **NGN in Access networks:** The next-generation access will be a large digital pipe. It is service independent and allows multiple simultaneous services such as television broadcast, high-speed Internet access, voice telephony etc. Since it will be an IP based service, many different technologies can be used to provide next generation access network. This is likely to fuel competition among various technologies in access network to provide high speed dynamically configurable bandwidth at lower cost both in nomadic and mobile environment. End-user will have choice to have any broadband connection which will be able to deliver voice, data and other content-based services. Broadband access can be either through fixed-line technology such as Digital Subscriber Line (DSL), fibre-optic and cable TV etc or through wireless technology such as broadband wireless access (BWA), 3G etc. The high broadband penetration will be required to access NGN services in access network. This may be the trigger point for mass migration to NGN.

3.15 **Next Generation Service Control:** Today's service control is service specific. Next generation service control will provide a means for operators to bring converged services to market with flexibly, ease of roll out in reduced time. At service delivery level, NGN architecture expands on the concept of the Intelligent Network (IN) which allows the end-user access to any service, be it from the network to which the customer has subscribed or from any third-party service provider. Furthermore, NGN introduces the concept of ubiquity of access to services through any access network and any device.

3.16 As can be seen from above discussions, NGN is becoming a very powerful platform with capabilities to provide all type of services on common IP backbone with effective control on resource allocation, bandwidth utilization, yet providing full flexibility for launch of third party services and applications. The very nature and power of this technological advancement is driving the market and making it so popular technology across the globe.

CHAPTER 4

LICENSING AND REGULATORY ISSUES

4.1 Initially the regulatory framework envisaged access service providers' (viz. Basic Service Operators (BSO), Cellular Mobile Telecom Service Operators), Long Distance Service Providers' (viz. National Long Distance (NLD) and International Long Distance (ILD)) and Internet Service Providers (ISPs). The services under each licence were rigidly defined and likelihood of overlapping of any particular service under other telecom license was very remote. Later, Unified Access License was introduced under which a licensee can provide different access services i.e. Fixed Mobile & Internet. The licensing framework so evolved effectively brought huge investments in telecom sector resulting in enormous growth, better quality of service, competition, choice to the customer and above all availability of telecom services covering wide geographical area and population.

4.2 The success of the policy is evident from the fact that overall teledensity which was just 0.97 in 1991 has crossed 30 and presently it is 32.34% at the end of November 2008. However the penetration of telecom services in rural and far-flung areas are still limited with a teledensity of approx. 10%. It is hoped that growth in rural areas will pick up soon. The fast telecom growth in the sector has witnessed equally fast technological advancements. IP protocol which was not so popular in early 90's is now become one of the most accepted platform to provide different types of services as discussed in Chapter 2. The advanced network architecture and hierarchy has facilitated provision of new services and applications with ease which was not possible earlier when services were rigidly bind with type of switches (Exchange) installed.

These new developments are facilitating large number of value added services and applications which can be provided using different platforms blurring the boundaries between different licenses. As an example, Broadband is permitted to Internet Service Providers but same platform supports Internet telephony also. IPTV and many more triple play services, which are conventionally under access service provider's license, can technically be provided by ISPs over broadband services. The challenge before the Authority is how to maintain balance between existing regulatory framework and fast technological developments taking place in telecom sector. Sticking to the existing regulatory framework may restrict fruits of technological advancement to reach to the common masses; whereas permitting new technologies and applications and encouraging use of IP networks contradict existing regulatory provisions and may affect level playing field.

4.3 The higher penetration of telecom services and increasing competition has resulted in decline in Average Revenue per User (ARPU). Service Providers are forced to cut cost on service provisioning to remain competitive. NGN is broadly unification of networks in a common IP based backbone, which results in substantial savings in CAPEX, and OPEX and also enabling speedy launch of new value added services. This scenario drives new innovation towards NGN.

4.4 While one school of thought advocates support to encourage migration to NGN as it is user friendly and enables customers to access advanced services and applications at cheaper cost, others feel that NGN is nothing but technological advancement and therefore, they feel that there is no regulatory concern. The decision to either migrates to NGN platform or otherwise is commercial and therefore they feel that it may be left to service providers. According to them, existing time tested licensing framework should not be tampered with.

4.5 The increasing convergence of devices, acceptability of IP platform as robust and resilient network, new services like Internet telephony, IPTV, M-commerce etc points toward fast changing scenario. Such changes have been recognized by regulators world over to different degrees and accordingly various regulatory initiatives have been taken. While some countries have introduced the concept of facility based service providers and non-facility based service providers, others are deliberating to bring in a change from service specific licensing regime to service neutral licensing regime.

4.6 TRAI had sent the recommendations on 'Unified Licensing Regime' to Department of Telecom on 13th January, 2005. The key objective of the Unified Licensing Regime was to encourage growth of new applications and services leveraging on the technological developments in the Information and Communication Technology (ICT) area. It was also envisaged that under Unified Licensing Regime, the licensing procedure in the telecom sector would be simplified. One of the important recommendations was that there should be **four** categories of license.

4.6.1 **Unified License**: All Public networks including switched networks irrespective of media and technology capable of offering voice and/or non-voice services (data services). Internet Telephony, Cable Television (TV), Direct to Home (DTH), TV & Radio Broadcasting shall be covered in this category.

4.6.2 **Class License**: All services including satellite services, which do not have both-way connectivity with Public Network, shall be covered under Class license. This category excludes Radio Paging and Public Mobile Radio Trunking Systems (PMRTS) Services and includes Niche Operators.

4.6.3 **Licensing through Authorization:** This category will cover the services

for provision of passive infrastructure and bandwidth services to service providers, such as Radio paging, PMRTS, Voice Mail, Audiotex, Video conferencing, Videotex, E-mail service, Unified Messaging services, Tele-banking, Tele-medicine, Tele-Education, Tele-trading, E-commerce, Other Service Providers, as mentioned in NTP'99 and Internet Services including existing restricted Internet Telephony (Personal Computers (PC) to PC; within or outside India, PC in India to Telephone outside India, IP based H.323/SIP Terminals connected directly to ISP nodes to similar Terminals; within or outside India), but not Internet Telephony in general.

4.6.4 **Standalone Broadcasting and Cable TV license.** This category shall cover those service providers who wish to offer only broadcasting and /or cable services.

4.7 While recommendation on Unified Service Regime has not been accepted by the Government, there is a need to deliberate present licensing regime in context to increasing convergence and technical advancement. There are good numbers of examples where Governments are driving convergence and migration to NGN.

4.8 International Telecommunication Union (ITU) has also defined the objectives of NGN[1] to fulfill requirements such as:

- promote fair competition;
- encourage private investment;
- define a framework for architecture and capabilities to be able to meet various regulatory requirements;
- provide open access to networks;

ITU has also flagged that while encouraging NGN deployments care has to be taken to

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- ensure universal provision to access services;
- promoting equality of opportunity to the citizen;
- promoting diversity of content, including cultural and linguistic diversity;
- recognizing the necessity of worldwide cooperation with particular attention to less developed countries.

4.9 The growth of telecom sector depends on clear, stable and forward-looking supportive regulatory environment. Future investment and deployment of NGN will depend on regulatory clarity and flexibility to move towards NGN. There is a need to address impediments restricting migration to NGN in this era. The NGN capabilities and drivers as discussed in previous chapters are very promising. Considering the present world trend, NGN will soon be implemented in India also. This chapter will focus on important licensing and regulatory issues relating to migration of NGN and seek comments of the stakeholders to determine future course of action.

4.10 **Licensing and Regulatory Framework**

4.10.1 Across the world, existing service providers are facing fierce competition in the market and in order to remain competitive to survive they are trying to build cost-effective businesses on the one hand and create new business models and generate new revenue streams on the other hand. Operators are encouraging convergence of networks and the integration of voice and non-voice services because such an approach would lower operational costs and allow greater flexibilities for service innovation and increase their revenues.

4.10.2 Secondly, the increasing service requirements from end-users call for innovative applications and multimedia services, flexibility of access to service, high-access bandwidth, high quality of service etc. Apparently, the service providers' need for remaining competitive and the end-users'

demand for increased service requirements are together forming a strong driving force pushing the development of NGN globally with characteristics and features that would fulfill the needs of service providers and end-users.

4.10.3 Moving to NGN introduces a dramatic change to the traditional network architecture and business models. Most of the existing networks are TDM based having dedicated connection during service delivery. The NGN uses packet network and one channel can carry information for many user increasing the bandwidth utilization efficiency. This impacts service delivery cost and such costs can drastically get reduced in NGN environment. Due to this reason many see death of distance in future telecom networks. The consolidation in the development and provision of content and services is another factor driving the convergence. Due to investments, mergers and cross holding in the media and telecom industries, there is an increase in the instances of both content creators and network operators that have access to both the content and the delivery mechanism. As a result very different model of service provisioning can emerge. One such example is the emergence of online advertising while delivering the content. In such a scenario, service providers can offer their services either free or at significantly subsidized rates. Such an arrangement permits the subscriber to use such services at much cheaper rate and generates interest of the subscribers in such contents. This drastically increases demand of bandwidth for communication services able to support such content.

4.10.4 NGN facilitate clear distinction and separation of the network content and services. This separation allows the unbundling of services and physical facilities (network elements). In this regard, NGN will foster and facilitate competition and innovation among service providers, and enable the market entry for innovative service entrepreneurs as

application and content service providers, which will ride on a telecom service provider's network to directly serve customers. This can result in intense service-level competition (e.g. customer being able to buy services from many IP telephony providers or television/education/gaming providers that are independent of the network operator). The new trend to offer bundled services and deliver them over one network to the subscribers is also driving NGN. This reduced cost of bundled services to subscriber and increasing subscriber stickiness with service providers resulting in increased subscriber loyalty to the service providers. The increasing broadband penetration with "always on" access allows subscribers a chance to access high bandwidth contents and video streaming. The cost of access is decreasing due to advancements in fiber optic technology, which facilitates multifold increase in its capacity with nominal upgradation cost. Convergence is touching everyday lives of people around the world. From downloading of ring tones in mobile phones by individuals to large scale call-center and BPO services, convergence is present in one form or the other all around us. This indicates that convergence has had a profound impact on markets, economy and consumers. This is evident from the fact hitherto well-defined sector specific platforms such as cable TV and telephony delivery network have become capable of offering services so far "reserved" for the other sector. The industry has already experienced this when mobile telephone platforms started offering SMS services, where ISP's started offering telephony services, and recently when mobile operators started offering clips of TV programs. The developments in hardware and software have empowered digital signal processing to such an extent that with use of IP technology in information transmission, the networks and customers premises equipment have got empowered to introduce hitherto not known application and services.

Computerization has made available data processing capabilities, which can be applied for storage/manipulation/ transmission and distribution of Television content/ Voice Communications.

4.10.5 NGN is hallmark of present information age. The convergence of Computer, Communication, Consumer electronics, Broadcasting and Contents; Voice, data, video and computing; fixed and mobile telephony and telecom and IT networks is creating new businesses, giving flexibility in doing business and taking collaborative processes to a new level. Convergence is more like a mantra. It's meaning and content changes from person to person, from platform to platform.

4.10.6 Convergence of Wireless & Internet telecommunication services is universally accepted as an enabler for upliftment of lifestyle of common masses. The phenomenon is clearly visible in developing countries as well. Brazil, Sri Lanka, Nigeria, Egypt, Ukraine, Chile, Argentina and Polish are some of the recent examples where initiatives towards convergence have been taken. Today convergence is reality and will need regulatory attention. The fundamental source of this challenge is the need to reconcile different regulatory philosophies in the sub-sectors of the communication industries.

4.10.7 The emergence of application service providers may require reassessment of existing regulatory framework whether these will fit in the traditional end-service categories with their corresponding specific licensing regime or a new licensing regime has to be considered.

4.10.8 During 7th Global Symposium for Regulators, 2007, it was highlighted that by remaining static in the context of convergence and NGN migration, licensing framework can become an obstacle to development in following ways:

- Preserving unnecessary, onerous and complicated licensing

requirements can act as a barrier to market entry and hinder competition.

- Requiring operators seeking to offer multiple-service offers to obtain multiple licenses often with different fees, requirements, and geographic scope (i.e., national versus local or regional licenses) can limit competition and impede the deployment of new services to consumers.

- Maintaining outdated and irrelevant licensing classifications can hinder technological advancement and service development.

- Licensing classifications based on specific types of technologies can act as artificial barriers to the introduction of alternative new technologies.

4.10.9 During the symposium, Best Practice Guidelines were also identified to promote regulatory frameworks that foster innovation, investment and affordable access to NGNs and that facilitate the migration to NGNs. These guidelines suggested the following regulatory policies for Authorization in NGN regime:

- To adopt licensing frameworks which are flexible and technology neutral, recognizing that these attributes are vital for the transition towards an NGN world, characterized by the decoupling of service/application provision from the underlying infrastructure.

- To simplify procedural requirements to obtain a license by introducing registrations, notifications, and in certain instances, deregulation and to secure rights of way in order to facilitate the roll-out of NGN access networks. This will ultimately allow market players to make use of NGN to access global markets and consumers to benefit from such global competition in the provision

of services.

4.10.10 Policymakers and regulators around the world are already responding to the challenges posed by NGN by modifying aspects of its regulatory framework to foster new technologies, by establishing flexible environments. Some regulators and policymakers have modified their licensing regimes from the traditional one-service/technology license to a broad set of categories, and some have adopted the more simplified approach of unified licensing. In addition, the administrative procedures for obtaining licenses are being reduced as much as possible, and in some cases, even eliminated.

4.10.11 An example of simplifying licensing categories into broad categories of services is Malaysia, where the adoption of a new licensing framework simplified the existing 31 service-based licenses into four broad technology-neutral licensing categories: Network Facilities Provider (NFP); Network Services Provider (NSP); Application Services Provider (ASP); and Content Application Service Provider (CSP; a special subset of application services that includes television and radio broadcast services and Internet content services). The service providers that fall under any of these categories may request an individual license or a class authorization depending on the degree of control for each service that is deemed necessary.

4.10.12 Singapore's method is another example of license simplification. There are only two categories of licenses for the provision of telecommunications services: (1) Facilities- Based Operator (FBO) licenses and (2) Services-Based Operator (SBO). The FBO license is always an individual license, whereas the SBO may be an individual license or for some services, a class license.

4.10.13 Uganda also developed a new streamlined technology-neutral licensing

regime with three categories of licenses: (i) public service provider license; (ii) capacity provider license; (iii) special permission to construct; and (iv) general license.

4.10.14 Some countries including Peru, Tanzania, Nigeria and some EU member states are adopting models of simplification based on unified authorization system that covers most or all services.

4.10.15 Some countries have streamlined their licensing regimes and further reduced the administrative burdens to obtain a license by establishing a single market entry requirement for all telecommunications services. These countries have established different administrative procedures for requiring a license. The European Union has changed to the regime of notification while Argentina still continues with licensing regime. Japan adopted a system of authorization conducted through a registration or notification process. If the operations involve a network of a large size or scale, a registration must be filed that requires approval from the regulator; but in all other instances, only a notification is necessary.

4.10.16 **Issue for consultation:**

- **In view of emergence of NGN and technological innovation, do you perceive the need for change in present licensing and regulatory framework? If so, elaborate the changes required in existing licensing and regulatory framework? Give your suggestion with justifications.**

4.11 Future market developments and competition in the NGN context

4.11.1 NGN represents a paradigm shift where electronic communications becomes heavily integrated with information society services. With increasing popularity of Application Services, the concept of "on deck" value added service provision may become predominant. The

application service providers however may prefer “off Deck” value added service provisions and may demand easy access to telecom network to provide different services. This is likely to complicate interconnection and revenue sharing between access services providers and application service providers. Network service providers may not like themselves to become pure connectivity providers and thus suffering a huge erosion of revenues. In this scenario, Network Service Providers might intend to capture market power by controlling sets of functions and capabilities that are necessary for the provision of services to end users. Such functions and capabilities are commonly known as control points.

4.11.2 A real challenge posed by NGN is to understand where control points can appear in a new and fairly unknown environment. They could be related to any of the network layers and need not be owned by the network or application service provider, but could equally well be a critical software platform controlled by a software vendor.

4.11.3 The NGN architecture allows for potential control points to appear in any of the four functional planes, that is not only in the access and transport planes, but also in the higher planes of control and services for the provisioning of access to the underlying resources. Though there is no unanimous opinion in the market that such control points will emerge with NGN, some of the control points could be related to:

i) **Network capabilities** such as Network Address Translators, firewalls, Routing tables, Quality of service capabilities, interconnect Network coverage and termination capabilities;

ii) **Elementary services** such as Call set-up capabilities, Proprietary standards, Non-proprietary standards, Interoperability and Application Programming Interfaces;

iii) **User access capabilities** such as Unnecessary software and service

bundles, Walled gardens, Tunneling, Filter mechanisms and digital rights, End-user devices and Content;

iv) **Individual user information** such as Authentication, single logon and profile management, Customer billing information, Access to customer information systems, Resolution of names and numbers through customer identity systems and Functions for determining location.

4.11.4 In order to promote competition and to ensure level playing field, there will be a need to identify and address anticompetitive "control points," inherited or devised, that inhibit the normal functioning of a competitive marketplace.

4.11.5 However, unlike the monopoly era, in which control points resided primarily (though not exclusively) in the basic network, control points in NGN may reside in any layer of the network hierarchy, from basic access to services and content. It may be difficult to identify some control points as they may have less predictable consequences for competitive activity if left unchecked.

4.11.6 The challenge will be to distinguish *anti-competitive* control points from *competitive* control points. Competitive control points are those developed or discovered in search of a commercial edge that actually promote the normal functioning of a competitive marketplace. These should be left untouched, to better serve consumers and to promote innovation and investment.

4.11.7 The issue of importance is to identify the extent of regulatory attention these control points will require. Having discovered dominance over a given control point, a next step for a regulator would be to consider whether some type of ex ante regulatory action would be necessary. However, Regulators across the world are looking to move away from

detailed ex-ante regulation to "light-touch" that focuses on the main principles and leaves specific compliance to "ex-post" activities and general law relevant to the sector. Internationally, views are split on the issue of "light touch" regulation.

4.11.8 The complexity of the NGN environment makes it difficult to predict the consequences of any regulatory decision. There is significant danger that regulatory intervention could be counter-productive in the sense that the regulator would be micro-managing the market instead of letting the market find its own solutions. This may dampen the possibility of huge investments and adversely impact likely migration to NGN. At the same time, the major potential negative consequences of non-action could be overtaken by other types of market developments resulting in anti-competitive practices attempting to monopolize the market.

4.11.9 **Issue for consultation:**

- **Is there a need to identify the control points and monitor the market development to ensure smooth migration to NGN? In your opinion what should be the regulator's role in such context? Please give your suggestions with justification.**

4.12 **Provisioning of 3rd Party Services and Applications:**

4.12.1 Presently telecom service provider is responsible to provide all services and applications to its customers. The demand for new value added services and applications are increasing. Telecom service providers depend on content providers to support the requirement of the subscribers. Since content is provided by telecom service provider, it becomes responsible for ensuring intellectual property right (IPR), compliance to various content codes, program and advertisement code, IT act etc. Here it is important to note that primary business of telecom

providers is to carry the signal and deliver it to the subscriber and all responsibilities related to content must rest with the content provider.

4.12.2 The provision of application and content to subscribers depends mainly on success of mutual agreement between telecom access provider and content providers. Many a time such agreements fail due to unjust demands of one party or the other. In order to facilitate the process, there is a need to have well defined regulatory framework in licensing conditions to facilitate 3rd party services and applications.

4.12.3 The telecom operators feel that existing licensing framework hold them responsible for all services and contents being carried on their network. Therefore, telecom service providers will open access to their network to 3rd party services and applications once they are very sure that content being provided by such 3rd party does not violate any provision of the license. The relevant clauses of USAL, CMTS and ISP licenses are reproduced below for ready reference:

UASL Clause No.40.3:

"The LICENSEE shall take necessary measures to prevent objectionable, obscene, unauthorized or any other content, message or communications infringing copyright, intellectual property etc., in any form, from being carried on his network, consistent with the established laws of the country. Once specific instances of such infringement are reported to the LICENSEE by the enforcement agencies, the LICENSEE shall ensure that the carriage of such material on his network is prevented immediately".

CMTS Clause No.43.3

"The LICENSEE shall take necessary measures to prevent objectionable, obscene, unauthorized or any other content, message or communications infringing copyright, intellectual property etc., in any form, from being carried on his network, consistent with the established laws of the

country. Once specific instances of such infringement are reported to the LICENSEE by the enforcement agencies, the LICENSEE shall ensure that the carriage of such material on his network is prevented immediately".

ISP Clause No. 1.12.9

"The LICENSEE shall take necessary measures to prevent objectionable, obscene, unauthorized or any other content, message or communications infringing copyright, intellectual property right and international and domestic cyber laws, in any form or inconsistent with the laws of India are not carried in his network, the ISP should take all necessary measures to prevent it. In particular, LICENSEE is obliged to provide, without delay, all the tracing facilities of the nuisance or malicious message or communications transported through his equipment and network, to authorized officers of Government of India/ State Government, when such information is required for investigations of crimes or in the interest of national security. The license shall be governed by the provisions of the Information Technology (IT) Act 2000, as modified from time to time. Any damages arising out of default on the part of licensee in this respect shall be the sole responsibility of the licensee".

4.12.4 The above clauses clearly indicate that telecom network providers definitely have responsibility to stop carriage of the contents when so notified by the enforcement agencies. Except ISP licensing, there is no specific clause indicating that telecom operators will be responsible for the content carried on their network. The clause expects telecom operators to take necessary measures to prevent contents objectionable or obscene in nature or a communication(s) infringing copyright, intellectual property right being carried on the network in any form. Verification of the content especially in respect of infringement of copyrights, intellectual property rights, and nature of content is very

difficult and hence difficult to be controlled in real time by network access providers when content and services are provided by 3rd party using telecom network.

4.12.5 It is widely expected that 3rd party content and services be encouraged to facilitate users to access variety of content as it is technically possible. This will not only increase the ARPU for telecom operators but will make available many useful contents and applications to the customers, bring in variety and increase competition. The responsibility of access service providers towards content carried on his network have to be reduced to encourage 3rd party content being provided to the customers. Permitting such contents will boost NGN migration and bring in number of other advantages. March of technology and innovation demand friendly regulatory environment. While recognizing the need and importance to check the content flow on the network and protect infringement of copyright, perhaps it will be important that these responsibilities are given to the content and application providers responsible for creation of such contents. The carriage and content in this converged environment needs to be separated. The telecom service operators responsible for carriage may only point to the source of the content in case any infringement of copyright or violation of content code is noticed. The content and value added service providers may be made fully responsible for adhering to the content code and ensure that no infringement of copyright or intellectual property takes place while providing such contents.

4.12.6 The nature of content industry and increasing need to give them responsibility requires well defined regulatory framework for 3rd party content and service providers. One of the options could be that such 3rd party content and service providers be registered/licensed. Their duties, responsibilities should be well defined. This may facilitate

growth of content industry as well as facilitate availability of value added services and contents to subscribers.

4.12.7 **Issues for consultation:**

- **In an NGN environment where the content provider and the carrier (Telecom Service provider) could be either same (On deck) or two different entities (Off deck), who should be responsible for ensuring content regulations? Should content provider (In off deck scenario) be made fully responsible for infringement of intellectual property right violation of advertisement code, program code or any other provisions as existing, in respect to his content? How such provision can be effectively implemented? Give your suggestions with justification.**

- **In case of off deck content provision, Should responsibility of telecom service provider be limited to prevent the flow of content notified as violation of various provision of IPR, program code, advertisement code etc to encourage flow of more content on the network? Give your suggestion with justification.**

4.13 **Service Level Agreement (SLA) :**

4.13.1 Interconnection in IP networks is very different from conventional TDM networks. In TDM networks circuit is switched and is dedicated to a particular subscriber/ application for full duration of call. Whereas in IP networks, there is a virtual connection and basically interconnection depends on volume of packets carrying capacity, delays, packet loss etc. Subscribers generally enter into service level agreements with IP service providers to ensure proper delivery of service and application. Since these services have to be provided across the networks and availability of guaranteed bandwidth have to be ensured between subscribers spread across the networks, service providers have to enter

into appropriate interconnections among them to comply with SLAs signed with subscribers. (Please refer fig. 5)

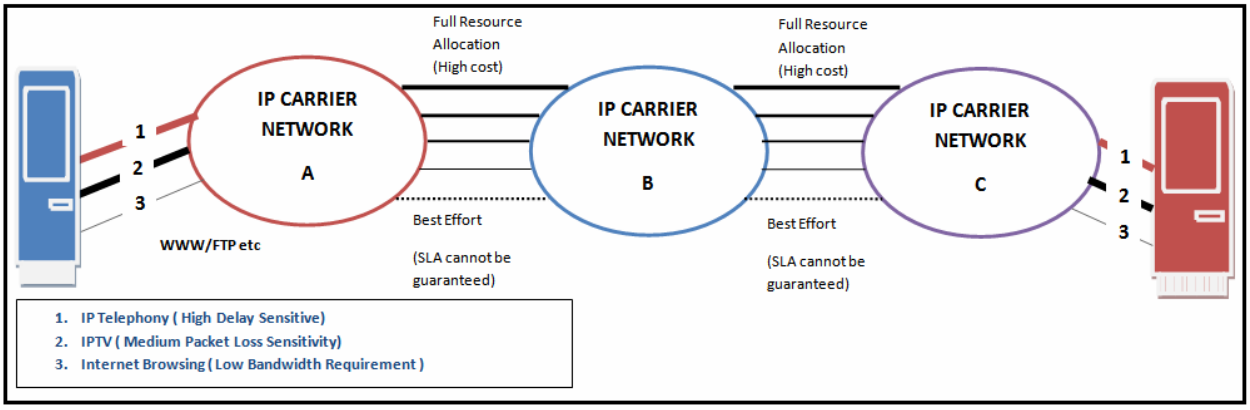

Figure 5: SLA across NGN networks in all IP Network Scenario

4.13.2 In TDM networks, the channel is held up for complete duration of the communication and total bandwidth is assigned to such applications. This type of complete allocation of resources for a particular application is not an efficient bandwidth management method but performance of the applications in such environment is best as complete resources are at its disposal. The IP network interconnections are different as in this case bandwidth is efficiently utilized and one single channel is shared among various applications. Hence cost of interconnection in such environment depends on the resource commitment required at such point of Interconnections (POI). If service providers seek complete resource allocation at POI, the basic advantage of application specific allocation of bandwidth and hence cost advantage is lost. Hence service providers have to have interconnection agreements based on the services and their bandwidth requirements. While service providers must have full flexibility to provide different service level agreements to effectively meet subscribers' requirements, technically numerous combinations of interconnections will be required. All operators may not support all combinations of SLA requirements and hence

supporting customers SLA across the network will be difficult. In order to solve this problem, there have to be few well defined interconnection parameters so that subscribers' SLA requirement can be mapped to facilitate interconnection among operators. Such well defined interconnection must be available between operators while having interconnection.

4.13.3 **Issue for consultation:**

In order to support subscribers' end-to-end SLA requirements across the networks, is there a need to well define different types of SLA at point of interconnect (POI) among operators in NGN environment? What parameters must be considered for defining such SLA? Please give your suggestions with justifications.

4.14 **Mandatory Interconnect Exchange:**

4.14.1 In order to provide seamless service across the networks, interconnections between the networks is of paramount importance. The present regulatory framework clearly defines the interconnection among the fixed and mobile networks however direct interconnection between ISP networks and PSTN/ PLMN has not been permitted.

4.14.2 Figure 6 indicates direct interconnection scenarios among different service providers. In this scenario, which is commonly adopted at present, each service provider is required to interconnect with all other service providers for seamless call flow. This is very complicated and costly as all the operators providing the services have to facilitate sufficient interconnection points for interconnection with all the entities in the network. The scalability of such links may be limited and management in long run will also be complicated.

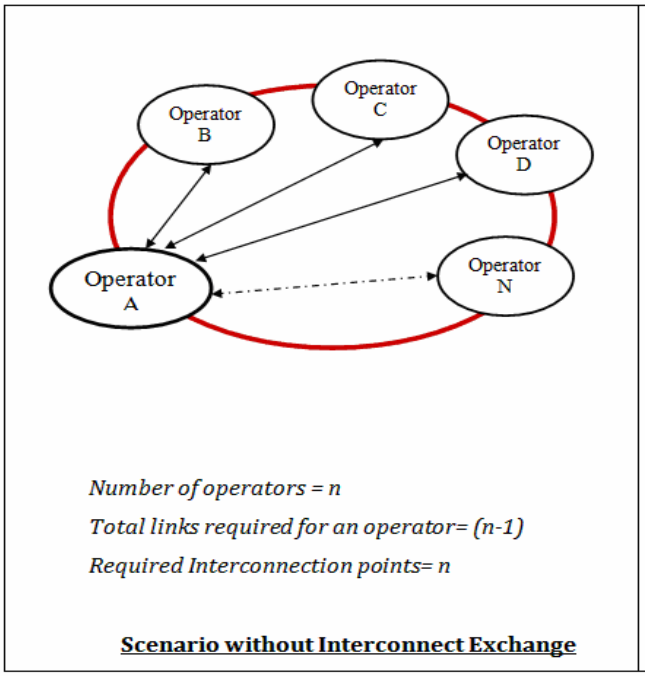

Figure 6: Direct Interconnection among service providers.

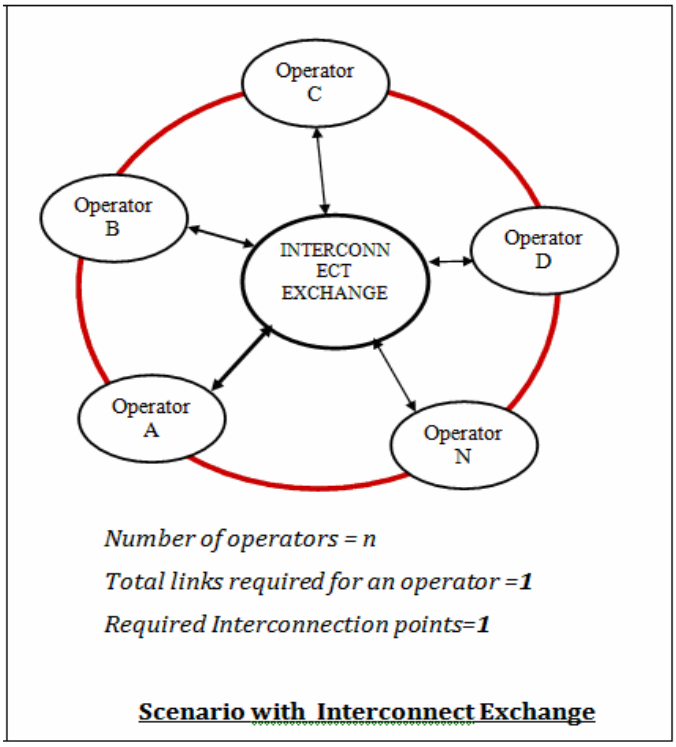

Figure 7: Interconnection among service providers using Interconnect Exchange.

4.14.3 Other option could be to use Interconnection exchange to facilitate interconnection among different entities/ exchanges (Refer figure 7). Here each service provider will be required to maintain only one connection to interconnect exchange. This will facilitate fast interconnection and easy manageability of the links but initial Capex to setup such Interconnection exchange will be high. Here it is important to mention that service providers can still have their own dedicated links where traffic is high and economically such links are justified. The pros and cons of two different methods of interconnection are given in table 3.

Table 3: Comparison of two methodology of Interconnection

Issue	Conventional Interconnection Scenario	Interconnect Exchange Scenario
Complexity of Network	Very High	Low
Interconnection and port charges	High	Low
Capacity Utilization	Inefficient	Efficient
Bandwidth Scalability	Low	High
CAPEX Requirement	Initially Low	Initially high, as cost of setting up Interconnect Exchange will be shared among all operators
OPEX Requirement	High	Low, however the OPEX involved in Exchange will have to be shared
Overall Performance	Depends on Individual Operator	May also depend on Interconnect Exchange
Call Handling	Inefficient	Efficient
IUC settlement	Difficult	Easy
Implementation of Number portability and carrier selection	Difficult	Easy
Sharing of IN platform	Difficult	Easy

4.14.4 In order to facilitate interconnection among entities, comparison given in table 4.1 favors Interconnect exchange option, however effectiveness

of Interconnect exchange will depend on number of entities connected to such an exchange. The returns on investment will not be commensurate if all entities/ exchanges do not have their presence at such interconnection exchanges.

4.14.5 Here we must take into consideration the past example of National Interconnect Exchange of India (NIXI). NIXI was setup to exchange the national IP traffic among the ISPs however it has not been very effective as only limited number of ISPs have joined NIXI. The exchange of IP traffic among service providers providing IP based services will be of great concern in NGN environment. Therefore appropriate regulatory framework has to be in position to facilitate such interconnections.

4.14.6 The present Indian telecom scenario is dominated by TDM based switches. However the technological innovations and economic advantages is driving a shift from TDM based switching infrastructure to IP based switching network. The operators have to use Media Gateways (MG) and Media Gateway Controllers (MGC) to ensure interconnect compatibility among TDM based networks and IP based networks. Interconnect exchanges can address this issue also very economically and effectively. Service providers may use appropriate interface for interconnection depending on the need with no additional expenditure.

4.14.7 TRAI in its recommendations on "Issues related to Internet telephony" dated 18th August 2008 recommended the termination of Internet telephony calls on PSTN/PLMN and vice-versa. National Long Distance (NLD) operators are permitted to connect to ISPs through public Internet (Internet cloud) for unrestricted Internet telephony. NLD operators willing to facilitate termination of Internet telephony shall make all technical arrangement necessary. These recommendations are major steps for marching towards NGN. Interconnection exchanges can

facilitate to connect to such NLD (IT) to carry IP telephony traffic and also function to facilitate connection of third party content and application providers to different network providers.

4.14.8 Above discussions clearly indicate that IP Interconnect exchange will be desirable in NGN environment to facilitating exchange of inter-network IP traffic. This will also be relevant in view of desired flexibility to place active network elements any where in the network as discussed in para 4.15. The figure 8 clearly indicates the interconnection scenario in NGN environment. The interconnection points of different service providers in a license area have to be at a common place to facilitate interconnection both technically and economically.

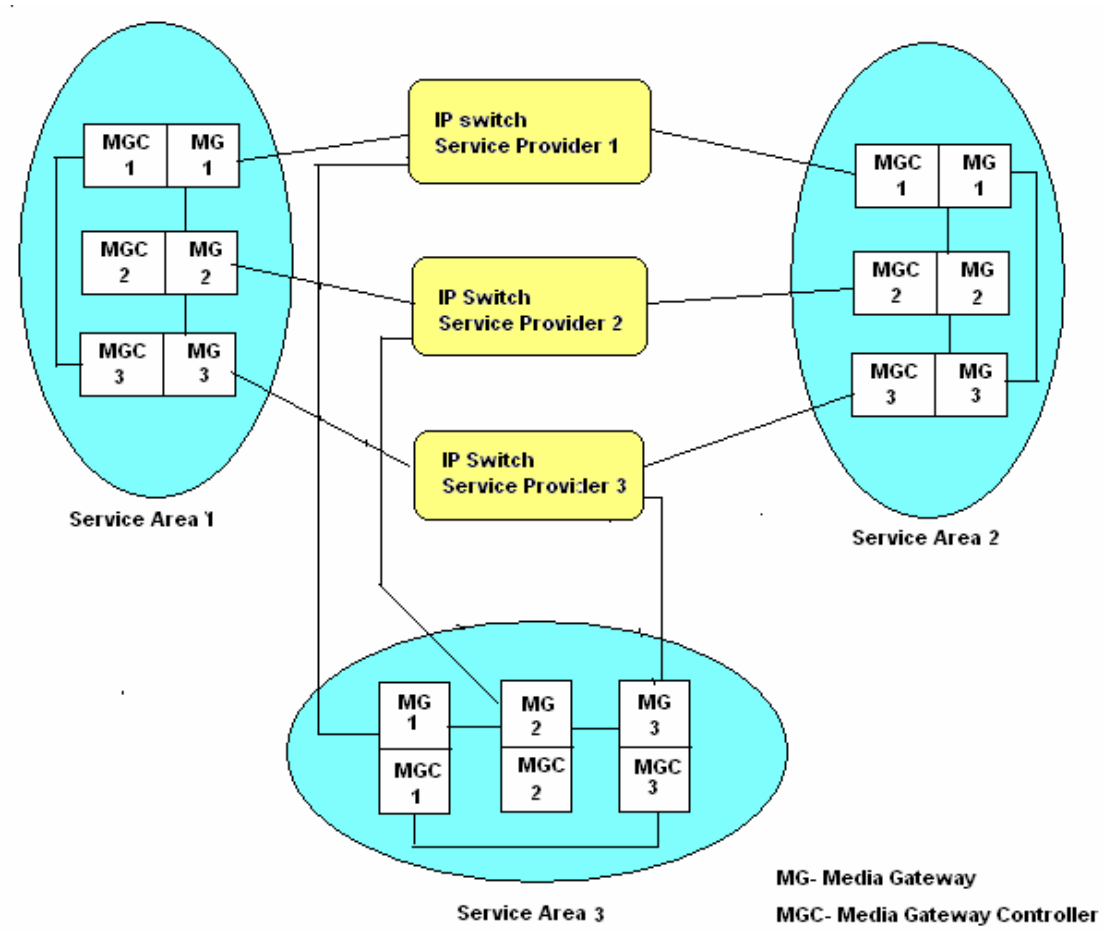

Figure 8: Interconnection Scenario in NGN using MGs and MGCs

4.14.9 The issue of concern is whether location of such interconnection points are mandated or left to the individual service providers? The second issue of concern is whether service providers are mandated to connect to Interconnect exchange so that such interconnect exchanges can effectively work to exchange the IP traffic among all service providers/ entities, or it is left to the individual service providers to be mutually decided based on the need? Comments of the stake holders are invited.

4.14.10 In addition to above, there are several other issues related to interconnection in the NGN environment. The need for an interconnect exchange and point of interconnection have been dealt here as they are likely to have direct impact on licensing terms and conditions. The Authority is actively considering to bring a paper on "NGN Interconnection Issues", which will deliberate Interconnection issues in detail.

4.14.11 **Issue for consultation:**

- **Do you agree that there is a need to define common point of interconnection to facilitate interconnection in NGN environment both technically and economically? Give your suggestions with justifications.**

- **Do you agree that interconnection of all service providers/ entities through Interconnect exchange will be desirable to facilitate peering of IP traffic in NGN environment? If yes, should all service providers be mandated to get connected (atleast with least defined capacity) to Interconnect exchange? Please give your comments with justifications.**

4.15 **PLACEMENT OF ACTIVE ELEMENT IN THE NETWORK:**

4.15.1 Present licensing conditions mandate service providers to install all the equipments to provide various services under the license within

licensing area. The relevant clauses of various licenses are reproduced below:

- **Unified Access Service License (UASL)**

  Provision of Service (Clause 2.2 (a) of Part I of Schedule II)

  The SERVICES cover collection, carriage, transmission and delivery of voice and/or non-voice MESSAGES over LICENSEE's network in the designated SERVICE AREA and includes provision of all types of access services.

- **Cellular Mobile Service Provider (CMSP) license :**

  Scope of Service (Clause 2.1 of Part I of Schedule II)

  The licensee shall be permitted to provide, in its area of operation, all types of mobile services including voice and non-voice messages, data services and PCOs utilizing any type of network equipment (however, the technology must be digital), including circuit and/or packet switches, that meet the relevant International Telecommunication Union (ITU)/Telecommunication Engineering Center (TEC) standards.

  Provision of Service (Clause 7.1 of Part I of Schedule II)

  The LICENSEE shall be responsible for, and is authorized to own, install, test and commission all the equipment to commission the Applicable system for providing the Cellular Mobile Telephone Service under this Licence agreement.

- **Basic Service Operator (BSO)**

  Para 1 of License agreement

  "….. this LICENSE to establish, install. Operate and maintain Basic Telephone Services (SERVICE) in the licensed SERVICE AREA on terms and conditions contained in the……."

4.15.2 Cost of the bandwidth in general both on national and International sector is reducing. Number of initiatives are being taken from time to time to reduce bandwidth cost further to make services more affordable to common masses. The effective utilization of the bandwidth by using IP based network may further reduce bandwidth cost for a particular application. The NGN will also facilitate provisioning of different services using common platform hence better bandwidth utilization. The combined impact of these developments will significantly reduce bandwidth related cost component in providing any particular service. This phenomenon is being termed as death of distance in future applications.

4.15.3 In such a scenario, the contribution of switching cost will be higher advocating effective planning and maintenance of switching capacities. Efforts must be made to reduce both Capex and Opex as cost of the switching equipment will contribute much higher as compared to the transmission equipment. The cost of basic switching equipment is generally high however its expansion cost is comparably low. This favors installation of higher capacity switches. Such high capacity switching installations will also reduce opex. In view of these technological developments the present restriction on putting switching equipments within licensing area may require reconsideration. A single switch may be adequate and economical to cater different services even in different licensing areas in NGN environment.

4.15.4 The only concern should be to facilitate interconnection in each licensing areas and virtual separation of the switching capacities wherever required to meet different regulatory requirements. The present concept of interconnection at SDCA level, SSA level is apparently getting changed and future NGN networks may not require interconnections at all SDCA or SSA level, reducing

complexities of the network.

4.15.5 As long as interconnection can be facilitated in each licensing areas either physically or virtually, the restrictions of putting all switching equipment within licensing area may not be strictly required in NGN environment. Comments of the stake holders in this regard are solicited.

4.15.6 **Issue for consultation:**

The present licensing conditions require installation of all switches within the licensing area. Do you feel that such restrictions may not facilitate best economical network model and may impact migration to NGN? If yes, what changes in licensing condition do you suggest? Please give your suggestions with justifications.

4.16 COMPATIBLE INTERFACE FOR INTERCONNECTIONS BETWEEN NGN AND TDM NETWORKS

4.16.1 NGN will be introduced by various service providers based on their perception and business model. As such migration to NGN is likely to be in different time frames. Since present telecom networks are mostly TDM, new technological developments must protect huge investments already made in existing networks. There is a need to ensure smooth interconnections between NGN networks and traditional TDM networks. The issue of ensuring such interconnection was discussed in detail in NGN-eCO, where many members were in favour of mandating such interconnections through modification in licensing conditions.

4.16.2 During discussions, it also emerged that service providers migrating to NGN networks will have to foot additional expenditure to set up Media Gateways (MG) and Media Gateway Controllers (MGC). The MG and

MGC will not be required subsequently once all networks migrate to IP platform. Therefore, the issue of concern is that if NGN network providers have to provide compatible interface for interconnection with TDM networks, then what shall be the duration of such obligations on part of service providers migrating to NGN. The time frame for NGN implementation by different service providers is not fixed. Government has also not declared any road map for total IP network in telecom. Therefore migration to NGN is likely to spread across years.

4.16.3 Some service providers echoed their concern in NGN-eCo and felt that perpetual obligation to provide compatible interconnection to TDM networks will be huge burden on part of operators migrating to NGN and therefore wanted that some upper time limit must be prescribed. The counter argument was that service providers who are migrating to NGN must ensure to provide compatible interconnection interface as they are the once who opted to change their equipment. According to them, no service provider would like to discard the present TDM network while others are migrating to NGN. Hence, it will be necessary to interconnect NGN networks with traditional networks at least during the time such networks are in existence. They opposed prescription of any time frame for provision of compatible interface.

4.16.4 **Issue for consultation:**

Whether there is a need to define any timeframe in which service providers migrating to NGN networks will be mandated to provide compatible interface for interconnection with TDM networks? If so, what should be the maximum time limit of such mandate to provide compatible interface for interconnection with traditional TDM networks? If no, what should be the method of interconnection to ensure compatibility? Please give your

suggestions with justifications.

4.17 INTERFACE APPROVAL IN NGN

4.17.1 The inter working between the networks is very important in order to transparently offer services across the networks. While Standardisation for NGN is being done to great extent by various International standards bodies, flexibility has been given in respect of certain parameters to vendors/ countries while implementing NGN solutions.

4.17.2 The optional fields in standardization are good and give flexibility in implementation, still proper coordination and standardization at country level becomes of prime importance. Our past experience indicate that inter-operability have created serious inter working problems during Intelligent Network (IN) implementation in India. Therefore, there is a need to be extra cautious while migration to NGN is starting in India. In this scenario, there may be a need for identifying important specifications and to come up with country specific NGN Standardisation. It may also be important to consider mandating interface approval to all operators migrating to NGN to ensure inter-operability subsequently.

4.17.3 **Issue for consultation:**

Do you consider country specific standardization will be necessary to ensure inter operability in NGN environment in view of many optional fields in existing standards? If so, is there a need to prescribe mandatory Interface approval to ensure the inter-operability in NGN? If no, then what should be done to ensure interoperability? Please give your suggestions with justifications.

4.18 EMERGENCY NUMBER DIALING

4.18.1 The popularity of IP networks is increasing. This is giving boost to Internet telephony. The internet telephony can be provided using

Internet / Broadband connection in fixed, nomadic and mobile mode. The direct linkage between the location of access of Internet / Broadband can be established if it is provided at the fixed location. Similarly, approximate location can also be derived if Internet/ Broadband is provided using nomadic mode. In both the above cases dialing emergency numbers (Police, Fire, Ambulance etc) is not difficult and certain translation can be used to correctly dial the number. As long as location of device using Internet/ Broadband for Internet telephony is identified and mapped with the appropriate emergency service, subscribers can access Emergency numbers from such Internet telephony platforms. In India, most of the Internet / Broadband connections are provided using fixed location at present. Therefore emergency numbers can easily be dialed from such platforms.

4.18.2 The problem arises when Internet/ broadband is used from mobile devices. Even in such cases location can be worked out easily. The only question is to what accuracy? The scenario is very similar to the present mobile network where emergency calls can be made but exact location is generally given by the caller. Similar arrangements can easily be done on IP platforms also.

4.18.3 The matter was also discussed in NGN-eCo meeting. It was generally agreed that all service providers providing Internet telephony within country should ensure emergency number dialing from their networks. Number of alternatives are possible to implement such emergency number dialing such as using location based services, dialing area code along with (emergency number), translation of emergency number dialed to appropriate number in the city etc. All alternatives have certain advantage but also suffer some disadvantages. Since such IP devices used to provide Internet telephony may not always be fixed in nature and their location details may vary in accuracy but emergency

calls can effectively be routed.

4.18.4 The issue of dialing emergency numbers has been deliberated world over. Many countries feel that Internet telephony is a value added service and therefore such services may not be mandated to facilitate access to emergency numbers. They feel that subscribers must be clearly informed in advance accessibility of emergency numbers from such platforms.

4.18.5 Some other countries believe differently. As per them increasing convergence and popularity of Internet telephony demands that such devices must provide access to emergency numbers also. As per them, due to convergence, many subscribers may not subscribe to different telecom services. Therefore, in order to address emergency situation, Internet telephony device must be able to provide access to emergency numbers.

4.18.6 This issue was also deliberated with stakeholders during consultation on "Issued Related to Internet Telephony". Stakeholders were of the view that emergency number calling to Internet telephony service providers should not be mandated. It should be left to the service providers whether to provide emergency number calling or not. Almost all the stakeholders emphasised that status of emergency number calling facility must be informed to the subscribers by Internet Telephony service provider so that subscribers can take informed decision.

4.18.7 Keeping in view the stakeholders' comments, the Authority in its recommendations on "Issues related to Internet telephony" dated 18th August 2008 recommended not to mandate emergency number dialing for ISPs providing unrestricted Internet telephony. However, it was also recommended that Internet telephony service providers must inform

their subscribers' availability/ non-availability of emergency number calling facilities in unambiguous terms.

4.18.8 Views of the stakeholders' are solicited as to whether the above recommendations are relevant in the context of NGN also.

4.18.9 **Issue for consultation:**

Whether emergency number dialing be mandated from devices (Fixed, nomadic, and mobile) connected on IP platform in India? If so, is there a need to mandate location details of such devices by service providers? Please support your suggestions with suitable justification.

4.19 RE-AUTHENTICATION OF IDENTIFICATION OF CALLING AND CALLED PARTY

4.19.1 IP networks are different than traditional Public Switched Telecom Networks (PSTN) where location and identity is wired and rigidly bind. In IP networks, the subscriber is identified using user name and password. Due to the vary nature of hierarchal structure, IP networks are prone to vulnerabilities like identity theft, man in the middle, and IP spoofing. Though various remedial actions have come up to plug these vulnerabilities, reverse DNS verification, re-authentication of identities are some of the techniques advocated to be effective. Many feel that effectiveness of such techniques depend of use of such techniques uniformly across the network. This can be feasible if it is mandated through the license or specific instructions are issued in this regard.

4.19.2 **Issue for consultation:**

Whether use of re-authentication for identification verification be mandated across the networks? In your opinion, will this help to reduce vulnerabilities such as identity theft, man in the middle,

and IP spoofing?

4.20 **IPv6**

4.20.1 NGNs are basically IP based networks and all the services i.e. voice, video & data will be provided over such networks. All the devices connected to such networks will require IP addresses. Presently, the IP address requirement is not very high as NGN deployment is limited to core network only. As NGN deployment will take place in the access network, there will be huge requirement of IP addresses.

4.20.2 As per the OECD report "Economic Considerations in the Management of IPv4 and in the Deployment of IPv6" the currently used version of the Internet Protocol, IPv4, will run out of address space in 2010 or 2011, as only 16% of the total IPv4 address space remains unallocated in early 2008. Considering the current growth of telecom subscribers, there will be more than 500 million subscribers in the country by the time NGN migration starts. The situation may become critical in view of the limited availability of unallocated IPv4 addresses.

4.20.3 The next generation Internet protocol, IPv6, has been evolved capacity to expand the available address space on the Internet enormously as it uses 128 bits address fields vis-à-vis 32 bits of IPv4. IPv6 could solve the address scarcity problem that is currently being encountered. In addition IPv6 is designed to enable better QoS, enhanced security and mobility support. Looking at the features of IPv6 it may be desirable to incorporate IPv6 at the initial stage while finalising the specifications/ standards for NGN.

4.20.4 Some mechanisms like Network Address Translation (NAT) are currently being used in order to solve the problem of address scarcity, but these add complexity in the implementation of peer-to-peer

applications and are pointed out as a mechanism used by network operators to retain control over end users. It has been claimed that certain software developments have overcome the NAT limitations in peer-to-peer applications and therefore limit the need for operators to deploy IPv6 on their networks.

4.20.5 The migration from IPv4 to IPv6 may require hardware and software upgrades, in the operator's network as well as in the applications and programs used at the user's side. This will require some cost to be incurred by the operator as well as the users. It has been predicted that the migration towards IPv6 could take a long time and IPv4 networks will also exist for quite a long duration. Hence there will be a need for coexistence mechanisms for IPv4 and IPv6 in the mean time.

4.20.6 **Issue for consultation:**

Is IPv6 an essential feature of IP transport for the migration to NGN? If so, what should be the timeframe for migration from IPv4 to IPv6? Please support your suggestions with suitable justification.

CHAPTER 5

ISSUES FOR CONSULTATION

5.1.1 **In view of emergence of NGN and technological innovation, do you perceive the need for change in present licensing and regulatory framework? If so, elaborate the changes required in existing licensing and regulatory framework? Give your suggestion with justifications. (refer para 4.10.16)**

5.1.2 **Is there a need to identify the control points and monitor the market development to ensure smooth migration to NGN? In your opinion what should be the regulator's role in such context? Please give your suggestions with justification.(refer para 4.11.9)**

5.1.3 **(i) In an NGN environment where the content provider and the carrier (Telecom Service provider) could be either same (On deck) or two different entities (Off deck), who should be responsible for ensuring content regulations? Should content provider (In off deck scenario) be made fully responsible for infringement of intellectual property right violation of advertisement code, program code or any other provisions as existing, in respect to his content? How such provision can be effectively implemented? Give your suggestions with justification.**

(ii) In case of off deck content provision, Should responsibility of telecom service provider be limited to prevent the flow of content notified as violation of various provision of IPR, program code, advertisement code etc to encourage flow of more content on the network? Give your suggestion with justification. (refer para 4.12.7)

5.1.4 In order to support subscribers' end-to-end SLA requirements across the networks, is there a need to well define different types of SLA at point of interconnect (POI) among operators in NGN environment? What parameters must be considered for defining such SLA? Please give your suggestions with justifications. (refer para 4.13.3)

5.1.5 (i) Do you agree that there is a need to define common point of interconnection to facilitate interconnection in NGN environment both technically and economically? Give your suggestions with justifications.

(ii) Do you agree that interconnection of all service providers/ entities through Interconnect exchange will be desirable to facilitate peering of IP traffic in NGN environment? If yes, should all service providers be mandated to get connected (atleast with least defined capacity) to Interconnect exchange? Please give your comments with justifications. (refer para 4.14.11)

5.1.6 The present licensing conditions require installation of all switches within the licensing area. Do you feel that such restrictions may not facilitate best economical network model and may impact migration to NGN? If yes, what changes in licensing condition do you suggest? Please give your suggestions with justifications. (refer para 4.15.6)

5.1.7 Whether there is a need to define any timeframe in which service providers migrating to NGN networks will be mandated to provide compatible interface for interconnection with TDM networks? If so, what should be the maximum time limit of such mandate to provide compatible interface for interconnection with traditional TDM networks? If no, what should be the method of

interconnection to ensure compatibility? Please give your suggestions with justifications. (refer para 4.16.4)

5.1.8 Do you consider country specific standardization will be necessary to ensure inter operability in NGN environment in view of many optional fields in existing standards? If so, is there a need to prescribe mandatory Interface approval to ensure the inter-operability in NGN? If no, then what should be done to ensure interoperability? Please give your suggestions with justifications. (refer para 4.17.3)

5.1.9 Whether emergency number dialing be mandated from devices (Fixed, nomadic, and mobile) connected on IP platform in India? If so, is there a need to mandate location details of such devices by service providers? Please support your suggestions with suitable justification. (refer para 4.18.9)

5.1.10 Whether use of re-authentication for identification verification be mandated across the networks? In your opinion, will this help to reduce vulnerabilities such as identity theft, man in the middle, and IP spoofing? (refer para 4.19.2)

5.1.11 Is IPv6 an essential feature of IP transport for the migration to NGN? If so, what should be the timeframe for migration from IPv4 to IPv6? Please support your suggestions with suitable justification. (refer para 4.20.6)

ANNEXURE A

INTERNATIONAL EXPERIECNCES

I. APPROACH TOWARDS NGN MIGRATION

a. EUROPEAN COMMISSION

In its "Explanatory note: Accompanying document to the Commission Recommendation on Relevant Product and Service Markets within the electronic communications sector susceptible to ex-ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services" of 13 November 2007 the Commission stresses the ex-ante part of the regulator concerning NGNs:

"*In applying remedies, regulators need to find ways to promote the deployment of new and more efficient network architectures while at the same time recognizing the investments made by new entrants on the basis of current architectures. National authorities will need to carefully follow and evaluate developments in order to ensure that appropriate access remedies are maintained for the forward-looking periods for which competition is judged to be ineffective and to avoid undermining or discouraging efficient entry".*

It further emphasised the importance of the role the regulator in the Next Generation Networks by saying that the treatment of Next Generation Networks is one of the most important regulatory issues facing us over the coming years. Regulation should encourage investment in future networks. Instead of regulatory holidays **appropriate regulation** are required to safeguards competition whilst creating new incentives for investment. While clarifying the phrase appropriate regulations it says

"If we can cooperate and arrive at a consistent answer, we will have done our businesses, consumers and the wider EU economy a great service because consistency will level the playing field across the Community, consistency will reduce uncertainty. I don't need to tell you that increased certainty is a necessary

precondition if you are contemplating large-scale investments, especially if you are venturing into a new market. It means reduced risk and that means reduced capital costs".

Dealing with Next Generation technologies in the document "*Explanatory Note to the Commission Recommendation on relevant Products and Service markets"* of 13 November 2007 the European Commission states the following regarding **Next Generation Core Networks**:

"Because of the large investments in NGNs, some incumbents have called for a firm date to be set for the withdrawal of sector-specific ex ante regulation; others for 'regulatory holidays' for major new investments. Incumbents particularly criticize mandated access to their infrastructure and the price at which this is imposed (which they usually consider to be too low). On the other hand, new entrants fear that incumbents would be able to limit the availability of access, undermining existing investment. They therefore see that ex ante regulation and open access provisions on incumbents' networks correlate strongly with increased investment and innovation".

"In general, migration to next generation core networks has fewer regulatory implications. The EU's market-based approach to the regulation of services is independent of the technology used in the core network. To the extent that the new 'all-IP' core networks continue to support existing services, those services will be regulated as before; to the extent that next generation core networks allow new markets to be developed based on new products and services, those new markets will be treated in accordance with the procedures set out in the regulatory framework".

In that same document the Commission notes the following about **Next Generation Access**:

"In the case of VDSL and fibre to the street cabinet, the number of street cabinets is an order of magnitude greater than the number of MDF sites, and this can pose both economic and technical difficulties for competitors that currently offer broadband services using ULL and ADSL equipment at the MDF site. Their ability to roll out infrastructure similar to that of the incumbent is limited. In the local access network, costs are concentrated in civil engineering works.

These works can amount to 50%-80% of the total cost per customer depending on the deployed solution and specific local characteristics (such as customer density, availability of ducts, labour cost and digging conditions). Incumbents and cable TV companies can use their existing ducts and rights-of-way to minimize these costs. Other competitors a priori do not have the same advantages, except in rare cases where they may be granted access to other utilities' facilities".

Deployment of NG access networks modifies the competitive environment in a number of markets, in particular LLU and wholesale broadband access. However, as long as competitive conditions have not changed, the move to NGNs does not provide an opportunity to roll back regulation on existing services. For some time, competitors will have an ongoing need for access to copper at the MDF level or to bit stream type services at different levels in the network.

Planned changes in the access network may potentially make it more difficult to continue to carry forward regulated remedies such as local loop unbundling (at established access points), that are designed to address the lack of effective competition in the provision of broadband services.

In applying remedies, regulators need to find ways to promote the deployment of new and more efficient network architectures while at the same time recognising the investments made by new entrants on the basis of current architectures. National authorities will need to carefully follow and evaluate developments in order to ensure that appropriate access remedies are maintained for the forward-looking periods for which competition is judged to be ineffective, and to avoid undermining or discouraging efficient entry. Remedies such as duct sharing, access to dark fibre, mandated backhaul from the street cabinet, and new forms of bitstream access, could be considered where these are appropriate, bearing in mind that, in line with Article 8 of the Framework Directive, remedies should aim, inter alia, at stimulating economically efficient investment in infrastructure. This may call for some transitional arrangements to be considered, to allow time for adaptation of existing business models.

The Commission intends to publish a specific recommendation regarding the way in which NGNs are to be dealt with by mid-2008.

b. UNITED KINGDOM

British Telecom (BT) has embarked on its 21CN project to replace all of its core networks, including the PSTN, with a unified NGN. The 21CN project aims to substantially replace all of BT's existing network platforms (PSTN, ISDN, IP, ATM, Frame Relay, SHDS [Short Haul Data Service] etc.) with a single unified IP platform. The investment is envisaged in the period 2005 to 2008, and is estimated to be around £3-£5 billion. The primary benefit of 21CN will be cost reduction. BT's fragmented network platform is particularly costly to run, but it also supports a hugely complex legacy product portfolio. BT believes that the rationalization of this product set should yield very significant cost savings and manpower reductions.

New entrants and service providers can easily offer innovative services to users by buying capacity from incumbents. This can increase the competition in the market place by introducing resellers or non-facility based service providers. A core NGN is, in fact, a perfect platform for a reseller. The reseller can buy capacity with much greater ease, flexibility and affordability than is currently the case. This capacity can be repackaged in innovative ways before it is sold on to end users. Services can be monitored and managed much more easily than is the case with legacy network services.

Since 2005, BT has been heavily investing in its 21 CN project to replace all of its existing network platforms with a single unified IP-based platform. Starting in late November 2006, BT began to transfer the first customer lines to its 21 CN, a process expected to take several years to complete. Ofcom views this major change as an opportunity to ensure that the network of an incumbent operator accommodates competition from the outset. Accordingly, Ofcom sees its role as ensuring that clarity exists as to the regulatory policy requirements necessary to support effective competition. However, it has indicated that it does not wish to become involved in the detailed design of BT's network.

Because of this, Ofcom has emphasized industry-led processes to guide the transition. Ofcom has proposed a number of key regulatory principles to guide its approach towards the transition to NGN. In this regard it intends:

- to promote competition at the deepest levels of infrastructure, where it will be effective and sustainable;
- to focus regulation to deliver equality of access beyond those levels;
- to withdraw from regulation at other levels as soon as competitive conditions allow;
- to promote a favourable climate for efficient and timely investment and to stimulate innovation, in particular by ensuring a consistent and transparent regulatory approach;
- to accommodate varying regulatory solutions for different products and where appropriate, different geographies;
- to create scope for market entry that could, over time, remove economic bottlenecks; and
- in the wider communications value chain, unless there are enduring bottlenecks, to adopt light-touch economic regulation based on competition law and the promotion of interoperability.

Ofcom views its challenge as establishing an appropriate balance between its role to provide regulatory certainty and the role of the market in determining the commercial outcome of NGN-based competition. To this end, it has recently undertaken two initiatives:

- First, in recognizing the need to provide greater certainty as to the nature of the ex ante competition regime associated with NGN, Ofcom has proposed an approach to address the impact of IP-based convergence on existing market definitions and on the associated SMP analysis and remedies.
- Second, Ofcom has also indicated the need to establish an industry body capable of providing a strong strategic vision for the access and interconnection arrangements required to support NGN-based competition.

In addition, Ofcom has recognized that a third line of work is required to consider consumer protection issues raised by the migration to NGN.

c. SINGAPORE

Singapore's Next-Generation National Infocomm Infrastructure (Next Gen NII) Announced by Singapore's Prime Minister in February 2006 comprises fixed-line and wireless networks, is intended to be Singapore's new digital super-highway for super-connectivity. The wired broadband network or Next-Generation National Broadband Network (Next Gen NBN) will deliver broadband symmetric speeds of 1 Gbit/s and above to all homes, offices and schools, while the Wireless Broadband Network (WBN) will offer pervasive connectivity around Singapore.

- **Next Gen NBN**

  The Next Gen NBN is envisaged as a carrier-neutral, totally wired network. IDA has proposed this to be an open platform that supports multiple service providers in delivering multiple services to homes and offices. IDA expects the private sector to build, own and operate the NBN. However, IDA's proposal calls for structural separation of the Operating Company1 and the retail service providers (RSPs) to ensure that all RSPs are treated on an equitable basis in terms of pricing and contractual arrangements for equivalent services and volumes. The government has indicated that it will provide some funding to kick-start the project and to ensure that this ultra high-speed broadband service will be viable, affordable and sustainable in the long term. The process of deploying the NBN was initiated with a Request-For-Concept (RFC) in March 2006. By year-end 2007, a private sector partner will be announced. The appointed operator is expected to complete at least 50 per cent of network rollout within three years of the award and to complete the project within five years.

- **WBN**

  To complement the Next Gen NBN, the government will first work with the private sector to accelerate the deployment of the WBN in key "catchment" areas, such as places of interests, the central business district and suburban town centres. On 10 October 2006, IDA selected three operators for the project. These operators launched initial commercial services in January 2007 and are

expected to complete the project by year-end 2008.

II. NUMBERING

a. ITU

Many regulators have already established a technology neutral numbering plan to allow for technological innovations and number portability, in accordance with the ITU-T E.164 recommended international public telecommunication numbering plan. At present, E.164 is still required for the origination and receipt of VoIP calls from traditional voice services and is likely to remain important for VoIP services in the foreseeable future. Moving forward it may prove necessary to modify numbering plans and open up new number ranges, for example, to distinguish between general-purpose, nomadic and ENUM-based services.

ITU-T Study Group 2 and the Internet Architecture Board are working together on the implementation of ENUM. An interim procedure to administer the delegation of ENUM resources has already been approved by ITU-T Study Group 2. ENUM is currently in commercial operation in countries such as Austria, Finland, Germany, Netherlands, Poland and Romania. Other countries including Australia, China, Japan, the Republic of Korea, Sweden and the United States have started ENUM trials. As NGN will allow for ubiquitous communications both in fixed and mobile settings, issues such as fixed mobile convergence and inter-modal number portability will need to be addressed by regulators.

b. Singapore

Two sets of numbering ranges were assigned to VoIP services for this purpose. Under the new VoIP framework, operators providing VoIP services using level “3” numbers are not required to provide number portability, emergency service connection, directory enquiry and printed directory services, or to conform to QoS levels set by IDA. Operators, however, are obliged to keep their subscribers informed of any service limitations, for example, as to whether their service allows access to emergency services and whether it meets the minimum QoS levels set by IDA for local fixed-line services.

Facilities-based operators may also use level “6” numbers, the number

range currently reserved for fixed-line PSTN voice services, for VoIP services if they can provide number portability, connection to emergency services, directory enquiry and printed directory services, and ensure QoS levels that are currently required for local fixed-line services.

III. LAWFUL INTERCEPTION

In its recent report in May 2008 ITU-T Technology Watch group explains that any interception to be "lawful", it must be conducted in accordance with national law, following due process after receiving proper authorization from competent authorities. Typically, a national Law Enforcement Agency (LEA) issues an order for LI to a specific network operator, access provider, or network service provider, which is obliged by law to deliver the requested information to a Law Enforcement Monitoring.

NGN raises regulatory challenges that can be linked, in one way or another, to the convergence process at the service provision and network access levels. Lawful interception for packet-mode services is already enabled by GPRS in 2G mobile networks. GPRS has the capability to send a duplicate of all packets exchanged by a user over a PDP context as well as the address of the entity accessed through this context. Lawful interception was introduced from the first 3GPP IMS R5 specification.

a. Data protection in European Union

Lawful interception raised the issue of data protection for the end-users. In EU there are three directives which relate to protection of personal data. The first is the Directive of 24 October 1995 on the Protection of Individuals with Regard to the Processing of Personal Data and on the Free Movement of such Data. The 1995 Directive lays out six conditions of legitimate date processing. One such condition is the requirement for unambiguous consent before data may be collected, with limited exceptional cases. The 1995 Directive prohibits the collection of specific types of data such as race, ethnicity, religious beliefs, political opinions and health, unless under exceptional circumstances. It also requires those collecting, processing and retaining data to institute technical and organizational security measures to protect the data.

The second is the Directive 97/66/EC of 15/12/1997 concerning the Processing of Personal Data and the Protection of Privacy in the Telecommunications Sector. The 1997 Directive aims to harmonize and provide an equivalent level of privacy and data protection as provided by the 1995 Directive but specifically within the telecommunications environment. It includes responsibilities on telecoms providers to maintain security of the network, traffic and billing data, and the right of individuals not to appear in publicised directories.

The third is the Directive of 12 July 2002 Concerning the Processing of Personal Data and the Protection of Privacy in the Electronic Communications Sector. The 2002 Directive updates and replaces the 1997 Directive (97/66/EC) and deals specifically with Internet-related issues. It includes the legal protection of new Internet data, such as traffic data (e.g. routing information and session duration) and focuses on the confidentiality of electronic communications, data retention of users' online activities, spamming and inclusion of personal data in public directories.

IV. EMERGENCY NUMBER DIALLING

a. European Union

In the EU, the Regulatory Framework requires Member States to put in place arrangements to ensure that calls to emergency services are adequately answered and handled. The obligation to provide access to emergency services applies to providers of publicly available telephone services (PATS), if all of the following core elements are satisfied:

- The service is "available to the public";
- "for originating and receiving national and international calls and access to emergency services";
- "through a number or numbers in a national or international telephone numbering plan".

List of Acronyms

Sl. Nos.	Acronyms	Full Text
1	ADSL	Asymmetric Digital Subscriber Line
2	AIN	Advanced Intelligent Network
3	ALTTC	Advanced Level Telecommunication Training Centre
4	API	Application Programming Interface
5	ARPU	Average Revenue per User
6	ASP	Application Services Provider
7	ATM	Asynchronous Transfer Mode
8	BSO	Basic Service Operator
9	BT	British Telecommunications
10	BWA	Broadband Wireless Access
11	CAPEX	Capital Expenditure
12	C-DoT	Centre for Development of Telematics
13	CMSP	Cellular Mobile Service Providers
14	CMTS	Cellular Mobile Telecom Service
15	CN	Core Network
16	CPE	Customer-Premises Equipment
17	CSP	Content Application Service Provider
18	DNS	Domain Name Service
19	DoT	Department of Telecommunication
20	DSL	Digital Subscriber Line
21	DTH	Direct to Home
22	ENUM	Telephone Number Mapping
23	EC	European Commission
24	EDI	Electronic Data Interchange
25	FBO	Facilities Based Operator
26	FW	Firewall
27	3G	3rd Generation
28	HDTV	High Definition Television
29	ICT	Information and Communication Technology
30	IDA	Infocomm Development Authority
31	ILD	International Long Distance
32	IMS	IP Multimedia Sub-System
33	IN	Intelligent Network
34	IP	Internet Protocol
35	IPTV	Internet Protocol Television
36	IPR	Intellectual Property Right
37	IPv4/IPv6	Internet Protocol Version 4/6
38	ISDN	Integrated Services Digital Network
39	ISP	Internet Service Provider
40	IT	Information Technology
41	ITU	International Telecommunication Union

42	IUC	Interconnection Usages Charges
43	LLU	Local Loop Unbundling
44	LEA	Law Enforcement Agency
45	MDF	Main Distribution Frame
46	MG	Media Gateway
47	MGC	Media Gateway Controller
48	MPLS	Multi Protocol Label Switching
49	NACF	Network Attachment Control Functions
50	NAT	Network Address Translation
51	NE	Network Element
52	NFP	Network Facilities Provider
53	NGN	Next Generation Network
54	NGNeCO	Next Generation Networks Expert Committee
55	NII	National Information Infrastructure
56	NIXI	National Internet Exchange of India
57	NLD	National Long Distance
58	NNI	Network-Network Interface
59	NSP	Network Services Provider
60	OECD	Organization for Economic Cooperation and Development
61	OFCOM	Office of Communication
62	OPEX	Operating Expenses
63	PATS	Publicly Available Telephone Services
64	PC	Personal Computer
65	PMRTS	Public Mobile Radio Trunking Systems
66	POI	Point of Interconnection
67	PSU	Public Sector Undertaking
68	PSTN	Public Switched Telephone Network
69	QoS	Quality of Service
70	RACF	Resource and Admission Control Function
71	RFC	Request-For-Concept
72	RPR	Resilient Packet Ring
73	RSP	Retail Service Providers
74	RTSP	Real Time Streaming Protocol
75	SBO	Services Based Operator
76	SDCA	Short Distance Charge Area
77	SHDS	Short Haul Data Service
78	SIP	Session Initiation Protocol
79	SLA	Service Level Agreement
80	SSA	Secondary Service Area
81	RSP	Retail Service Providers
82	TDM	Time-Division Multiplexing
83	TEC	Telecom Engineering Centre
84	TRAI	Telecom Regulatory Authority of India
85	UASL	Unified Access Service License

86	ULL	Unbundling of Local Loop
87	UNI	User-Network Interface
88	VDSL	Very high speed Digital Subscriber Line
89	VoIP	Voice over Internet Protocol
90	VPN	Virtual Private Network
91	WBN	Wireless Broadband Network
92	Wi-Fi	Wireless Fidelity
93	WiMAX	Worldwide Interoperability for Microwave Access
94	WSIS	World Submit on Information society