Consultation Paper on
Developing Regulatory Framework in the context of Next Generation Networks (NGN) in Nepal

Nepal Telecommunications Authority (NTA)

5th Floor, Blue Star Office Complex

Tripureshwor, Kathmandu

url: www.nta.gov.np

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Abbreviations

ASP	: Application Service Provider
CLIMS	: Centralized Lawful Interception and Monitoring System
CPNP	: Calling Party Network Pays
CSP	: Content Service Provider
EBC	: Element Based Charging
ETSI	: European Telecommunication Standard Institute
GoN	: Government of Nepal
ICT	: Information and Communication Technology
IETF	: Internet Engineering Task Force
IoT	: Internet of Things
ISP	: Internet Service Provider
ITU	: International Telecommunication Union
KPI	: Key Performance Indicator
NGN	: Next Generation Networks
QoS	: Quality of Service
RIO	: Reference Interconnection Offer
ROI	: Return on Investment
SLA	: Service Level Agreement
TISPAN	: Telecommunications and Internet converged Services and Protocols for Advanced Networking
VNO	: Virtual Network Operator

Executive Summary

The Next Generation Network (NGN) brings with it a multitude of interesting scenario such as potential future services, possibility of convergence of associated technologies, and the possibility of changes in usage habits of the users.

The effects that might arise due to diverse types of potential service offerings under the umbrella of NGN, raises profound challenges for the telecommunication regulators. In general, NGN is expected to be able to answer all possible implications related to migration from existing technology to IP technology and possible models for determining tariff, interconnection and security requirements. As IP has the power to de-couple services from the underlying network layers, there is a strong belief that NGN will continue to create new markets and new forms of competition among service providers.

Some of the regulatory authorities in different countries are handling problems in ways that suit their overall regulatory environment. Some other regulators have been working to draft recommendations on the type of regulatory ecosystem that would be appropriate to enable the operators to embrace NGN in a simple manner. It would be the responsibility of regulators to devise appropriate regulatory mechanism to adopt the fast paced technological developments.

This consultation paper covers 10 major issues related to regulatory mechanism in NGN environment as mentioned in the ANNEX-1 and is organized into eleven chapters. The "recommendations" are given in every chapter where appropriate. The list of those recommendations is listed in the following pages for convenience. These recommendations are made by a study group formed by NTA.

Nepal Telecommunication Authority (NTA) has issued this consultation paper for the valuable comments and suggestions from various stakeholders, experts and interested parties, either in electronic format or in written form, on the various issues raised in this consultation paper. The inputs provided by the stakeholders will help the Authority to devise appropriate regulatory framework for Next Generation Network. The comments and suggestion can be sent through email at ntra@nta.gov.np or through fax at 977-1-41010134 or in the address of NTA by the end of November, 2014. The consultation paper is available on NTA's website (www.nta.gov.np). For any clarification or information, the stakeholders may write to the email address ntra@nta.gov.np or contact Mr. Bijay Kumar Roy, Deputy Director, ICT Development, NTA (bkroy@nta.gov.np, telephone: 977-1-2046012).

Mr. Ananda Raj Khanal
Officiating Chief and Director
NTA

List of Recommendations

Recommendation 1(a):

In order to ensure delivery of healthy content, acceptable level of quality and protection from copyright infringement, the regulator is recommended to develop a separate guideline/directive for digital content regulation while the operators provide telecommunication/ICT services.

Recommendation 1(b):

A new type of license called "Application Service Provider(ASP) and/or Content Service Provider (CSP) license" under Value Added Service License category should be created and granted to the eligible applicants interested in providing commercial content services (aggregate contents produced by content developers/producers) and/or applications to its customers using network/infrastructure of other service providers.

Recommendation 1(c):

The regulator is recommended to initiate study and survey to assess the market for bulk selling and virtual network operators (VNO) in the context of NGN.

Recommendation 1(d):

Although Element Based Charging (EBC) is more efficient for costing, it may be challenging to implement as NGN environment consists of centralized multi-service platform. As such, it is recommended that capacity/service based charging model shall be applied for interconnection in NGN environment.

Recommendation 1(e):

The regulator is recommended to encourage or issue directives to the service providers to develop and apply Reference Interconnect Offers (RIOs) for efficient exchange of IP-based traffic among the operators, and with other industries (like broadcasting industry).

Recommendation 2:

The regulator is recommended to adopt technical standards set by different international organizations (such as ITU, ETSI, IETF, TISPAN etc.) working in NGN standardization activities and ensures interoperability among various systems and standards, and leave the task of preparing technical specifications to the operators themselves.

Recommendation 3(a):

Time limit should not be specified for migration to NGN and the decision of migration to NGN shall be left to the operators themselves.

Recommendation 3(b):

Migration to NGN should not be abrupt, and both the older and the newer technologies should co-exist for reasonable period of time, such that the customers are not forced to replace their terminal equipments for the reason that their service provider(s) has made complete replacement of the system(s).

Recommendation 3(c):

Migration to NGN should be encouraged to follow an overlay model to maximize utilization of resources and return on investment (RoI).

Recommendation 4(a):

In NGN environment, the regulator shall encourage new licensees (i.e. Application Service Providers and/or Content Service Providers) and telecommunication service providers to establish Service Level Agreements (SLAs) between themselves to establish norms for fair business and to encourage competition.

Recommendation 4(b):

Subsidy should be provided to build common infrastructure that would be required to introduce and expand NGN-based services throughout the country.

Recommendation 4(c):

The regulator shall adopt light touch regulation to encourage deployment of NGN in rural and far flung areas for proliferation of NGN-based services.

Recommendation 5(a):

The regulator shall conduct a study to identify suitability of "Interconnect Exchange model for NGN interconnection" in consultation with telecommunication licensees.

Recommendation 5(b):

The cost based interconnection charges shall be considered in NGN environment. Any of the suitable models such as CPNP, Bill and Keep, Charging based on Quality of Service or Capacity, Bulk billing can be adopted as interconnection charging models in consultation with the concerned stakeholders.

Recommendation 5(c):

Non-geographic numbering format with separate number scheme should be used to uniquely identify NGN services for billing and maintenance purposes.

Recommendation 6(a):

The cost based tariff model can be considered for new services carried by NGN. However, to reduce complications and avoid choking of billing system, flat rate billing would be more practical.

Recommendation 6(b):

The tariff models and the charging methodologies shall be capable of accounting packets separately based on the applications used, and the differences in QoS.

Recommendation 7(a):

The various network QoS classes and parameters defined by the ITU-T Y.1541 should be considered as the key performance indicators (KPI) for QoS in NGN environment for different services.

Recommendation 7(b):

Regarding benchmarking, the specific values defined by ITU-T Y.1541 should be considered and revised in consultation with the service providers.

Recommendation 7(c):

As multiple network operators can be involved in providing access to a service in a multi-operator scenario, the overall QoS is a function of QoS offered by the individual segments. Therefore, it is recommended that apportionment of impairment objectives among operators and number of operators shall be worked out in consultation with the service providers.

Recommendation 7(d):

Due to the possibility of a huge portfolio of services, the numbers of service providers and their dependencies on content developers, it is recommended that proper mechanism for SLA (Service Level Agreements) between service providers and subscribers should be enforced in the NGN environment.

Recommendation 8(a):

A study group should be formed to prepare Generic Interface Specification for Centralized Lawful Interception and Monitoring System (CLIMS) in NGN scenario.

Recommendation 8(b):

Considering the gravity of issues that the Centralized Lawful Interception and Monitoring System (CLIMS) shall be dealing with, especially issues concerning national security, the Government of Nepal (GoN) has to designate appropriate authority (or, entity) to own and operate the system. Therefore, it is recommended that any requirement for provisioning of CLIMS in the Telecommunication Act should also be initiated and taken care of by the competent authority assigned by the GoN in consultation with the regulator.

Recommendation 9(a):

The regulator should take initiative to increase consumer awareness as well as build mechanisms that explains and teaches them about potential risks and vulnerabilities to network related securities.

Recommendation 9(b):

As Security, including Network Security, is not a one-time activity, it is recommended that continuous alertness, regular assessment of preventive features and periodic upgrade of systems and software should be performed.

Recommendation 9(c):

All entities that operate servers and especially Internet Service Providers (ISPs) that connect to a huge number of subscribers should check and undertake preventive and corrective measures to minimize network related security vulnerabilities.

Recommendation 9(d):

The regulator should stay alert on new developments in security issues, and make necessary arrangements for timely submission of reports from relevant service providers on security incidents, failures and measures taken by them.

Recommendation 10:

As the Study Groups of ITU-T and ITU-D are expected to submit their final reports in the year 2014 and 2016 respectively, it is suggested to keep closer watch on the final reports for necessary adjustments/modifications in the regulatory framework as appropriate.

CHAPTER: ZERO

Preface

0. PREFACE

0.1 Background

The evolution of networks to NGN has been a result of convergence of different types of communication networks and their transport on IP (Internet Protocol), providing a unified service platform for communication services. Technological and market forces are driving network operators and service providers to migrate their traditional networks to an all-IP based networks which is referred to as "NGN (Next Generation Network)".

Some IP-based networks have been implemented and have become operational either as an overlay over the existing networks or as a separate network. With seemingly simple evolutionary steps, there is a general tendency to consider that this evolution towards IP would have little impact on regulation. However, as packet based IP networks provide a unified service platform for communication services, this evolution has the potential to cause substantial changes throughout the entire value chain of electronic communications service, and thereby raise challenges to the regulators. For example, one of the main issues is to determine the most appropriate interconnection model, which could possibly be based on IP interconnection model such as peering and transit; or possibly could be some form of modified PSTN interconnection and tariff regime.

Interestingly, on one hand, the telecommunication service providers consider NGN as a means of significantly reducing their network operating costs and complexity, while on the other hand, the market players from the IT world believe that NGN has the potential to change and revolutionize the organizational model of the entire communication network.

There is a worldwide trend in accepting NGN as the ultimate technology for telecommunications, and in the national context, the competing operators are already moving towards NGN-based services.

0.2 Scope of work

The major concern of the study was to identify possible implications that may arise in the regulatory regime when full potential of NGN is exposed for commercial use. Taking into consideration the multi-operator and multi-technology scenario in the country, the study had the scope of studying and analyzing different models of interconnection and tariffs, role of regulator, QoS, network security and then making recommendations wherever appropriate as per ANNEX-1.

0.3 Overview to NGN

Next Generation Network (NGN) is a broad term that is used to describe recent evolutionary trends in telecommunications, especially related to (i) core networks, and (ii) access networks.

According to ITU-T's definition of NGN[1], the vision behind NGN is packet-based network that provides services including telecommunication services and that the service level functions are independent of underlying transport-related technologies.

With this definition, the beauty of NGN is that it clearly separates (i) the transport (or, connectivity) portion of the network, and (ii) services portion that run on top of the transport layer. This would allow the operators to introduce and expand services independent of connectivity details. This would also mean that the applications (including voice) will tend to reside more on the end-user devices (e.g. phone set, PC, Set-top boxes, etc.). ITU's definition also includes that NGN shall support generalized mobility allowing consistent and ubiquitous provision of services to users.

In the traditional communication model, the circuit switched telephone networks provide customers with access to a single application using narrowband capacity, and the applications on the network are inherently tied to the underlying technologies. Unlike in the traditional model, NGNs are broadband networks, where digital applications and contents as well as standardized transmission protocols – like the Internet Protocol (IP) – allow many different applications such as voice, video and data applications, to ride on a single broadband platform. [ANNEX-2: "What is Internet Protocol"]

As mentioned in [5], NGNs are generally IP-based, packet-switched, multi-service networks, and migration to NGN simply means migration from the PSTN to the IP-based network. However, it is interesting to note that there are numerous views as to what constitutes NGNs, and as such different operators that have begun the process of migration to NGN are trying to name their projects differently. For example, Korea Telecom uses the name "Broadband convergence Network (BcN)", British Telecom has named their NGN initiative as "21st Century Network (21CN)", Deutsche Telekom calls their IP-based global network as "Telekom Global Network (TGN)", and NTT (Nippon Telegraph and Telephone) calls their NGN as "Resonant Communication Network Architecture (RENA)".

From a technology perspective, NGN is based on a new architecture that separates both the core and access parts of a telecommunication network, and thereby changes the way it delivers services to the end-users. The main difference between the architecture (or, building blocks) of NGNs and that of the legacy TDM networks is the layered structure of NGN, which separates different service related functions and provides freedom to the service providers to select vendors and products on different layers. [ANNEX-3: Architecture of NGN]

1 "A Next Generation Network (NGN) is a packet-based network able to provide services including 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 offers unrestricted access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users." [2]

The layers in NGN are: NGCN (Next Generation Core Network) and NGAN (Next Generation Access Network). The NGCN is essentially the transport or backbone network that uses switching, gateways, and transmission equipments in the core, and enables several access networks to use the same core network. In contrast to NGCN and as mentioned in [9], NGAN refers to new access networks, such as the deployment of optical fibers, or an upgrading of the local loop to broadband, either through DSL technology or by deploying fiber into the loop for part, or all of the connection. [ANNEX-4: "Characteristics of NGN"].

NGNs can be implemented using a number of technologies, including copper, fiber, cable, or mobile. As mentioned in [7], this heralds the shift from the traditional "one network-one service" model, to a "one network–many services" approach. With this flexibility, service providers need to upgrade their equipment (e.g. replacing switches, installing routers, etc.) at the core, but do not need to change existing wires and fibers on the ground.

Some of the main arguments for transition to NGN architecture can be stated as follows:

- It is not efficient to maintain several core networks for different access networks.
- The economy of scale inherent in a single converged network (e.g. NGN) can lead to substantial cost savings.
- NGNs enable improved time to market new services and improve customer experience.
- NGNs enable continuation in offering services under the legacy access networks.

NGNs are considered essential for strategically positioning networks to compete in the increasingly converged world of services and contents, where voice will not remain as the sole source of revenue. For ease of understanding, a comparison between PSTN and NGN networks is shown in [ANNEX-5: Difference between today's PSTN networks and NGN platforms].

0.4 General Observation

Competition in telecommunications sector is increasing, and the competing telecommunication operators in the country are introducing NGN for providing advanced, attractive services to the general public. As some of the telecommunication equipment vendors have already stopped providing spares and supports to the legacy non-NGN equipments, the service providers have no other option than to gradually replace them by NGN (or, NGN-like) equipments.

When NGN is considered as the substitute to fixed line network (i.e. PSTN), the general expectation is that NGN would help to solve obsolescence problem on both the transit and access levels. For the service providers, NGN is expected to make them capable of benefiting from convergence of existing services and the new multimedia rich applications on a single platform. Similarly, the incumbent operators or those operators with larger share in the market are moving towards NGN with the aim to aggressively capture new revenue opportunities through faster service provisioning, and thereby to compensate for reduction in revenue of their voice services.

As technologies, networks, and services are also undergoing convergence, the necessity of a new regulatory regime that would conveniently accommodate and respond to such changes can hardly be under-estimated. The government and the regulator will have to play an active role to facilitate deployment of NGN in the country, and to ensure that policies and regulations do not restrict opportunities for growth and sustainability.

In contrast, the inertia and interest of existing licensees may not favor changes in the regulatory regime that would facilitate the prospective service providers to obtain new licenses. Similarly, the existing licensees would tend to oppose amendments in the existing licenses, unless those modifications would ensure space for them to keep innovating new services and support their revenue generating opportunities.

Globally, in spite of the current economic challenges, implementation of NGN is progressing with investments being made in all regions. In Europe, many operators have already migrated to NGN core networks and the majority of them have chosen an overlay strategy. Although Next-Generation Access (NGA) network developments in Europe are mainly based on fiber, the roll-out of fiber to the home (FTTH) has been rather slow. The preference for FTTH has become apparent in some of the more developed and high-income Asian economies, such as Singapore, Japan, South Korea, Hong Kong and New Zealand. In contrary to this fiber network, wireless access networks seem to be a more attractive and more economical solution in rural and sparsely populated areas, and as such Latin American countries and African countries are considering deploying wireless networks for NGA.

0.5 NGN in Nepal

In Nepal, NGN based equipments have been deployed as a complement to existing PSTN and Mobile services, with no remarkable service differentiation to the conventional services. However, the potential of NGN to provide multiple of services ranging from simple voice services to VoIP-based services like IP-Centrex, wireless-virtual-PBX and messaging services that ride on the broadband service delivery platform makes the future scenario difficult to visualize.

0.6 NGN versus IMS

It is also a common preconception that NGN[2] is required merely as a replacement to existing switches, mainly in the fixed network side. This is one of the reasons, but the more important reason is maturity of evolving technologies and the customers' demand for advanced features and services.

IMS[3] is coming up with the expectations of linking the gap between existing traditional telecommunications technology and the Internet technology by enabling convergence of data, speech, and mobile network technology over an IP-based infrastructure. Basically, IMS uses SIP (Session Initiation Protocol) and SDP (Session Description Protocol) to communicate between various IMS components. IMS enables user-to-user communication services via a number of key mechanisms such as session negotiation and management, QoS and mobility management.

As mentioned in [12], the NGN Forum had focused its work based on Soft-switch to develop profitable business models for converged services targeting consumers and enterprise markets. That is, the NGN Forum traditionally had focused on overall IP migration. In contrast, IMS Forum was traditionally more focused on IMS interoperability. The article [16] mentions that NGN deployment is happening on an element-by-element basis, and the IMS services are being deployed on a service-by-service basis.

The recent merger of IMS Forum and NGN Forum into IMS/NGN Forum is expected, initially, to promote understanding and adoption of these technologies, and, ultimately, to support merger of three specialized businesses – i.e. telecommunications, information technology and media - into a single market. This merger is also expected to support network operators to adopt gradual deployment of SIP-based architecture or complete IMS architectures. As mentioned in article [14], this merger is considered as a positive step towards quick delivery of quadruple play (i.e. voice, video, data/internet and mobile) services over broadband via wireless, cable and fixed networks. This merger has resulted into IMS-NGN-networks that

2 NGN is sometimes called as "Soft-switch". Soft switch is actually one of the important parts in NGN. Although definitions and functions of Softswitch may vary depending on equipment manufacturers, in general, Softswitch is the device to program VoIP calls, and enables correct integration of different protocols, and especially creating the interface to the existing telephone network (i.e. PSTN) through SG (Signaling Gateways) and MG (Media Gateways). The architecture of NGN enables deployment of access independent services over converged fixed and mobile networks.[8]

3 IMS (IP-based Multimedia Services) is a standardized NGN architecture for Internet media services capability defined by ETSI (European Telecommunications Standards Institute) and the 3GPP (3rd Generation Partnership Project). [8] The concept of IMS first appeared in 3GPP R5 specifications, and later on TISPAN (which is a European NGN standardization organization), introduced the 3GPP IMS concept into the NGN definition.

include developments and evolutions related to GSM, LTE, Femtocell, UMTS, Wi-Fi, WiMAX, DSL, Cable and Optical.

According to article [10], "IMS has become a way of thinking among network and operations planners. They have bought into it, and they think in IMS terms about all their future deployments, regardless of how gradually they go about it." It is interesting to note that all major equipment vendors, IT suppliers and even smaller specialist companies have committed to IMS architecture. However, according to the article [18], there are very few true IMS deployments to date, and many unanswered questions about where, why, and how IMS is best implemented.

The prospect of a complete IMS network that would replace traditional TDM or Softswitch-based NGN equipments in the foreseeable future is remote as there are several legacy applications like HTTP applications, peer-to-peer file sharing, etc., that are non-SIP in nature. These applications are expected to represent a substantial proportion of traffic on current and future IP-based NGNs.

0.7 Potential of NGN

The general expectation about NGN is that it should be a telecommunication-class full service network that is able to meet new communication demands. The services supported by NGN include telephone and other legacy services, high-speed Internet access and its applications, video (such as VoD and streaming media), and multimedia and digital TV broadcast. Basically, NGN is not a service but an access technology based on principle of convergence, and the combination of all these services is expected to fundamentally change the way people communicate.

From the network architecture point of view, NGN has the potential to provide:

- high operational efficiency achieved through single multiple-service network
- investment protection and faster roll-out of new services as the "control" and "service" layers can be upgraded separately regardless of the modifications in other layer
- different services through increased competition amongst the various service providers

In simple words, NGN brings together the best of:-

- TDM network: (a) QoS, (b) reliability and (c) security
- IP technology : (a) Efficiency, (b) flexibility and (c) innovation

CHAPTER: ONE

Impact of NGN

in

Regulatory Framework

1. IMPACT OF NGN IN REGULATORY FRAMEWORK

This chapter focuses on the impact of Next Generation Network in the existing regulatory arrangement – that is, mainly in "licensing framework" and "interconnection framework", and recommends for the changes that would be required in the current licensing regime to facilitate NGN deployment.

1.1 Existing Licensing framework

The existing regulatory framework in the country has allowed the regulator (i.e. NTA) to issue following categories of licenses:

1.1.1 Categories of licenses

(i) Basic Telecommunications Service License

As per the Telecommunication Regulation (2054), the Basic Telecommunication Service Provider's License is awarded through the Bid Evaluation Process. The scope of this license allows operators to build nationwide access network and transport network infrastructures; and provide voice services in addition to supplementary services.

(ii) Mobile Service License

The arrangement for providing mobile service license is same as that of the Basic Telecommunication Service License mentioned above.

(iii) Rural Telecommunications Service License

The Rural Telecom Service (RTS) Provider's License is awarded through the Bidding Process after Gazette notification by specifying the number of such licenses. The scope of RTS Licenses also allows these operators to build access and transport network infrastructures and provide voice services in the specified rural areas.

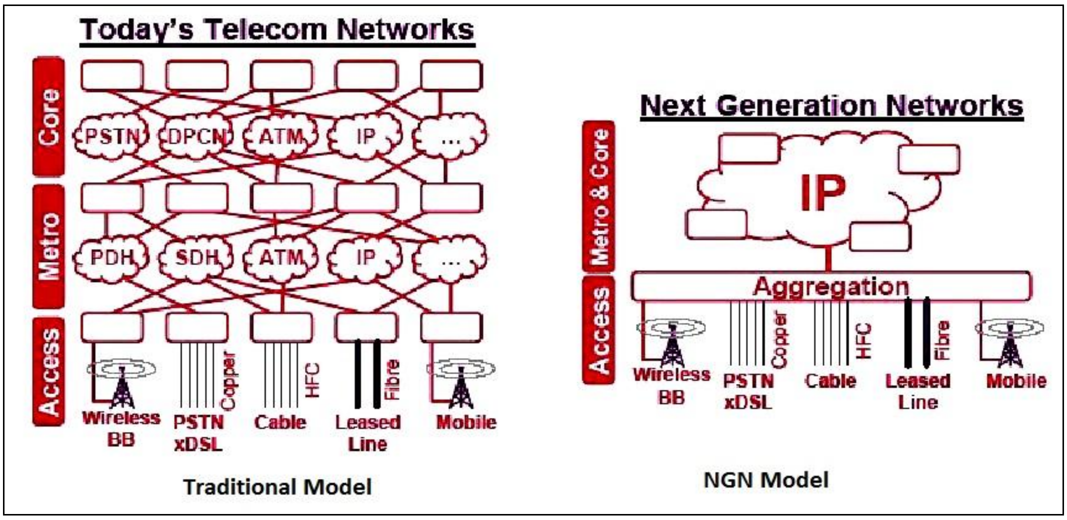
(iv) Value Added Service (VAS) Provider's License

The Value Added Service Provider's License such as Internet Service Provider (ISP) License, Network Service Provider (NSP) License etc., are opened through Gazette notifications. These are specific to a particular service without any limitations on the number of licenses. These licensees are allowed to build their own infrastructure (access and transport network) to reach the customers. Besides, they can also use infrastructure of the other licensees to access their network and service.

The VAS licenses are open to all. The applicant can obtain such license by satisfying specified criteria. These licenses do not allow provision of traditional voice services, but are limited to providing VAS as mentioned in their respective licenses. In addition to the existing value added licenses, new application/service licenses under VAS can be opened through Gazette notification.

1.1.2 Observation

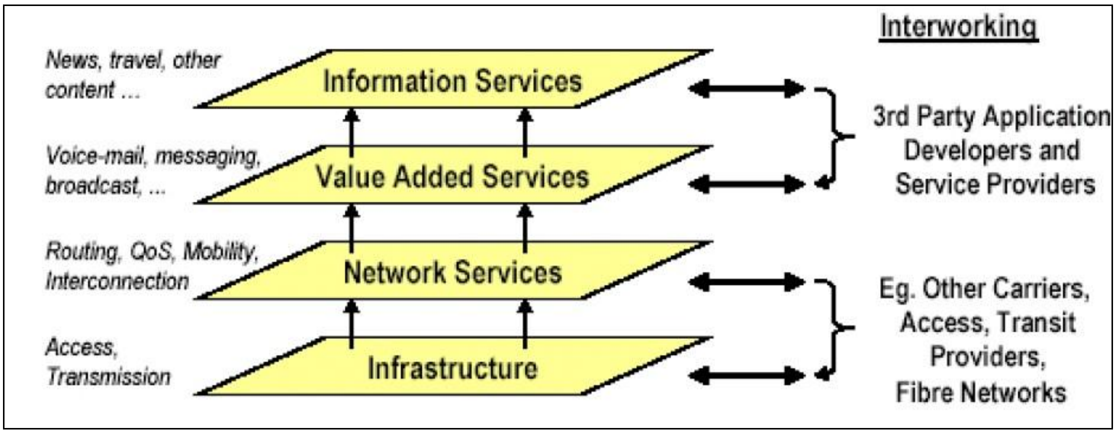
The above categories of licenses suggest that the licenses issued by NTA for providing telecommunication services (Basic, Mobile, ISP, NSP etc.) are vertically integrated in nature i.e. the operators are using separate infrastructures/networks to provide specific telecommunication services. Thus, we are following a traditional model that is different from that of the NGN model, as shown in figure below:



Source: www.ictregulationtoolkit.org

1.2 Impact of NGN on the existing licensing framework

The architecture of NGN introduces network design based on "layers" with open, standardized interfaces between each layer as shown in figure below. This will result into paradigm shift from the traditional model of service provisioning, and this will have implications for future industry structures.



Source: "Policy and Regulatory Considerations for New and Emerging Services" by ACIF Next Generation Network Project, NGN Framework Options Group, July 2004

The provisioning of infrastructure, particularly for access to the core network, will be a major requirement to support next generation services. Reliable access is essential, preferably over a wide range of access speeds which could be provided over the existing copper network (xDSL), existing coaxial networks (e.g. Cable TV), fixed wireless access (e.g. WiMAX, LTE or later standards), mobile phone networks and optical fiber.

Support of network services will require both access and core infrastructure, but will not be dependent on a particular technology. End-user services could be provided by facilities accessible over the network (e.g. servers) working in combination with customer equipment or by end-to-end customer equipment interaction alone.

Further, applications can be provided over these service layers, using their underlying facilities, and could be accessible from a range of networks and over a variety of access arrangements.

For example, different service providers may provide and specialize on the followings:

(i) physical infrastructure (e.g. Copper access);

(ii) basic network connectivity (e.g. IP over DSL, or IP carriage);

(iii) particular service over the network (e.g. Internet telephony services);

(iv) an application (e.g. video conferencing, voice to text conversion, IPTV etc.).

Point (iv) above introduces new concept called an Applications Service Provider (ASP) or Content Service Provider (CSP) who neither owns a network nor provides any carriage service.

This concept of ASPs or CSPs is not included in current legislation or existing regulatory framework (unless the service provider also provides a carriage service to the end-user). Furthermore, the current requirements of existing licensees may not be applicable for these ASPs or CSPs, because control of quality of service may be outside the ability of such providers.

Furthermore, distinct function of each layer could be provided by a single company, or by a number of providers working together, as follows:

- An end-user may be the customer of an application service provider, who contracts with the network provider for the provision of that particular application. The application service provider would have direct responsibility to the customer for delivery of service. The provision of a total end-to-end service architecture (i.e. offering any-to-any connectivity) with associated operational and maintenance arrangements will be a major challenge for the industry.
- Alternatively, a single company may provide all of the layers described above, and attempt to contain their customers within their own business area.

This horizontal fragmentation of service delivery, however, is likely to increase number of service providers involved in end-to-end service provisioning across a broader range of transmission network types. For instance, an end-user with a 3G mobile handset may access the Internet via a path from a mobile network to a VPN to a core network to the PSTN and then to the Internet. Each of these elements may be controlled by a different network operator, thereby necessitating an increased mesh of interconnection arrangements.

In NGN environment, either the telecommunication service providers will themselves provide innovative applications or will open access to their networks to the 3rd party applications. They would also depend on the content/application providers to provide innovative services/applications to subscribers. The provision of application and content to subscribers depend on success of mutual agreement between network/access providers and content providers. Sometimes, such agreements fail due to unjustifiable demands of one party or the other. Therefore, in order to facilitate the process, there may be the need to have well defined regulatory framework to facilitate 3rd party services and applications.

The existing licenses of basic, mobile and rural telecommunication operators allow them to provide a number of services and applications to their customers and envisage delivery of healthy content to the users. This means that telecom access/network providers are responsible for the content carried on their network and they have to take necessary measures to prevent contents that are objectionable or obscene in nature, possible infringement of copyright and intellectual property rights. They have the responsibility to stop carriage of such contents when so notified by the enforcement agencies. However, verification of the content especially in respect to infringement of copyrights, intellectual property rights, and nature of content is very difficult, and as such it is difficult to be controlled in real time by network access providers when content and services are provided by 3rd party operators.

The primary business of telecom providers is to carry signal and deliver it to the subscriber, and therefore, all responsibilities related to content must rest with the content provider. The content providers should be made fully responsible for adhering to the content code/regulation and ensure that no infringement of copyright or intellectual property right takes place while providing such contents. In this context of converged environment, the carriage and content, however, needs to be separated, and controlled under “content regulation” mechanism to ensure availability of good and healthy content including acceptable level of quality, protection from copyright infringement, etc.

Recommendation 1(a):

In order to ensure delivery of healthy content, acceptable level of quality and protection from copyright infringement, the regulator is recommended to develop a separate guideline/directive for digital content regulation while the operators provide telecommunication/ICT services.

Also, considering the key feature of NGN (i.e. decoupling of service provision from the underlying infrastructure) where application/service providers might have no relationship with the infrastructure provider, and could be geographically separated from its customers, a new type of license called “ASP/CSP license” under the category of value added service license would be required to provide on commercial level, the innovative NGN-based content services and applications.

Recommendation 1(b):

It is recommended that a new type of license called “Application Service Provider (ASP) and/or Content Service Provider (CSP) license” under Value Added Service License category should be created and granted to the eligible applicants interested in providing commercial content services (aggregate contents produced by content developers/producers) and/or applications to its customers using network/infrastructure of other service providers.

Further, considering the existing technology neutral policy and the present licensing framework in Nepal, the Basic Telecommunication Service Providers (either Fixed or WLL-based) are allowed to choose and deploy any technologies to provide wide range of telecommunication services (local telephone, STD, ISD and supplementary services). As the service provisioning is restricted only by the use of frequency and numbering resources, it seems that these operators can also implement NGN to provide NGN-based services. Similarly, the Mobile Operators can also provide mobile voice and supplementary services using any mobile technologies. In this context, the deployment of NGN by these Mobile operators cannot be restricted unless it is limited by frequency or numbering resources. The same applies to rural telecommunication service providers and they can also deploy NGN to provide NGN-based services. The ISPs, NSPs and other operators can also deploy NGN technology following the technology neutral policy. Hence, the existing licensing framework does not require any change for introducing NGN.

The NGN has standardized interfaces between different layers. With this, the biggest advantage of NGN is its inherent flexibility to launch value added services or contents. The capabilities of NGN can be utilized effectively only when entities having value added applications and contents are encouraged to use existing networks to provide their services and applications. The concept of Mobile Virtual Network Operator (MVNO)[4] is well accepted in developed countries, and as such, the virtual operators need to be encouraged in different fields so that innovative applications can reach to the end users.

As the present licensing regime does not recognize concept of virtual network operators, suitable amendments would be required to facilitate functioning of virtual network operators in the context of NGN.

4 A mobile Virtual Network Operator (MVNO) is an operator that offers mobile services but does not own its own radio frequency. Usually, this operator has its own network code and in many cases issues its own SIM card. The mobile VNO can be a mobile service provider or a value-added service provider. It is to be noted that there are differing views on how to define a mobile VNO.

Recommendation 1(c):

The regulator is recommended to initiate study and survey to assess the market for bulk selling and virtual network operations (VNO) in the context of NGN.

1.3 Existing Interconnection Framework

The Interconnection Guideline (2008) currently in place describes a whole process from setting up interconnection agreement to the mechanism of dispute resolution, and consists of the following eight sections:

(i) General Interconnection principles

(ii) Interconnection Negotiations

(iii) Reference Interconnection Offer (RIO)

(iv) Register of Interconnection Agreements and Determinations

(v) Technical Matters

(vi) Promotion of customer interests

(vii) Protection of Information

(viii) Dispute Resolution

The Guideline (2008) is intended to

- promote and maintain any-to-any connectivity,
- safeguard against any abuse of market power in provisioning telecommunications services,
- safeguard the interests of consumers,
- prevent and abolish discrimination in the provision of telecommunications services,
- promote and maintain co-operation and fair competition between licensees, and
- encourage orderly development of telecommunications

Regarding "Charging Principles", the Guideline states that the charges that a licensee offers for all Interconnection Services must be cost based and reflects the fact that relationship between licensees is a carrier-to-carrier relationship and where feasible, the licensees must use an established cost methodology. However, no specific cost model is explicitly mentioned in the Guideline.

Regarding the "Point of Interconnection" the Guideline states that the licensees shall mutually agree on the Points of Interconnection (POI) including the number and physical locations. Until agreed in writing by the Authority, such POIs are required to be located at least at the trunk or tandem exchanges in the regional offices of the licensee and the licensees have to ensure that sufficient POIs are established to enable agreed diversity of routing for interconnected domestic and international traffic. In the event that no agreement is reached between the licensees, the Authority determines the number of their physical locations in consultation with the licensees.

Regarding “Technical Considerations”, the Guideline states that the licensees have to consider following technical matters while negotiating interconnection agreement:

- ensure compliance with international standards and recommendations where feasible;
- ensure offering of technical and operational interconnection facilities on the basis of suitably unbundled system components, in accordance with general practice in the industry;
- ensure that the licensees’ switching and transmission facilities have the capacity to interconnect with other telecommunications systems and telecommunications networks;
- ensure preservation of network integrity and network security;
- comply with provisions and requirements of the national numbering plan;
- apply good engineering principles and practices; and
- ensure timely and efficient deployment of sufficient numbers and capacity of links to support required grade of service for customers

This Guideline requires operators to develop and publish RIO and necessitate them to take approval from the authority once they negotiate and enter into Interconnection Agreement. In the case that the negotiation between operators fails, the fixed interconnection usage charge prescribed by the authority prevails.[5]

1.4 Challenges posed by current interconnection regime

Current bilateral interconnection arrangements in a multi-operator, multi-service environment can lead to:

- high interconnection cost and port charges;
- asymmetric interconnection agreements and litigation due to ambiguities and a non-level playing field;
- delays in provisioning of interconnection due to capacity constraints;
- sub-optimal utilization of resources;

5 Nepal Telecommunications Authority (NTA), Interconnection Guideline, 2008(2065), Document No. GI065.01, Effective from May 1st, 2008 (Baishakh 19, 2065)

- inefficient handling of calls;
- high operational costs for managing inter-operator settlements;
- inter carrier billing;
- complexity in settlement of interconnect usage charges
- sharing of Intelligent Network Platform
- implementation of Number Portability
- Increase of CAPEX and OPEX making operation unviable

1.5 Impact of NGN on current interconnection framework

The technology and architecture of NGN differs from that of PSTN environment. NGN brings with it a new model in network topology, associated costs and interconnection models.

The telecommunication industry is evolving towards a future in which IP-based networks (NGNs) will gradually replace circuit-switched networks, both for fixed and mobile (2G, 3G and 4G) services. However, both the legacy and the IP-based network will remain for some time. The emergence of IP-based networks and the co-existence of substantially different environments are putting pressure on existing regulatory framework, especially interconnection. The established interconnection regulatory regime does not seem to be sufficiently flexible to effectively solve problems of the emerging markets. As the future interconnection models will extend beyond voice interconnection model, some changes in interconnection practices have already taken place naturally - such as, implementation of capacity-based interconnection. Additional changes will be required in future to sufficiently address the issues in NGN environment.

The transition to NGN will have several topological changes in the communication networks in terms of number and type of elements used and their geographical position within the network. Soft-switches in NGN are generally capable of handling more than ten-folds of traffic in comparison to legacy TDM switches. This results into lesser number of switching systems/nodes, which directly affects CAPEX and OPEX. As the operators may have to convey calls for long distances before termination, the variation in network topology and geographical positioning of switching systems will affect also not physical interconnection arrangements but also the interconnection charges. Second deviation can be QoS class-based interconnection charging/costing in Next Generation Interconnection. Third driver of change in interconnection arrangement and charging can be layered architecture of NGN. Interconnection can be established on each layer of NGN thus leading to a bigger number of interconnection products as compared to legacy networks.

As mentioned in [11], NGN is likely to lead development of new IP-based interconnection arrangements (models) that are service-based and capacity based, rather than based on minutes and miles. The regulatory and policy considerations include impact of IP-based networks (and traffic) on current interconnection arrangements; ensuring absence of any discriminatory access behavior and defining parameters of interconnection in a multi-service environment. It is uncertain that there will still be a need for mandated wholesale interconnection regimes, and need for revision of the charging principles. In the legacy network, interconnection charging methodologies are well established with a number of interconnection charging schemes like Calling Party Pays (CPP), Receiving Party Pays (RPP), Bill-and-Keep (or, Sender Keeps All) etc.

Different costing principles may be used for determination of wholesale interconnection charges like Distance Based, Element Based and Capacity Based[6]. Out of these, the cost of interconnection products is normally found either through EBC (Element Based Charging) or CBC (Capacity Based Charging). In capacity based interconnection model, operators request a specific capacity for interconnection and pay a flat CBC that reflects fixed cost nature of the interconnection capacity. That is, CBC reflects true economic costs and do not artificially spread such fixed costs over projected traffic minutes to arrive at a per-minute charge. On the other hand, EBC is more efficient for costing, and the method used for its determination is LRAIC (Long Run Average Incremental Cost) plus mark-up for common cost including an appropriate rate of return on capital employed (Weighted Average Cost of Capital). However, some of the experts have the opinion that Element Based Charging (EBC), which has been developed for legacy interconnection, will not be relevant in NGN interconnection scenario[7]. This non-relevance may be mainly because of change in interconnection products and integrated nature of NGN, where segregation of different activities of the interconnection product is difficult.

Recommendation 1(d):

Although Element Based Charging (EBC) is more efficient for costing, it may be challenging to implement as NGN environment consists of centralized multi-service platform. As such, it is recommended that capacity/service based charging model shall be applied for interconnection in NGN environment.

Calling Party's Network Pays (CPNP) is the most popular charging model; however, a less widely used system known as Sender-Keeps-All (also known as Bill-&-Keep) offers a number of advantages, particularly for countries where adoption of ICT service is already well advanced. Sender-Keeps-All is widely used for internet traffic where interconnection partners do not need to settle interconnection on the basis of capacity or duration/usage, and as such the traffic originating operator does not need to pay to the recipient operator for termination of traffic.

6 Document,SATRC-11/INP-05, 24 November 2009

7 Document,SATRC-11/INP-05, 24 November 2009

Generally, the Sender-Keeps-All model is applied where traffic volumes are symmetric. But, in case of NGN, the symmetry cannot be limited to traffic volume only as quality of service is also very important and plays a key role. Although the beauty of Sender-Keeps-All is that no regulatory intervention is required, the possible drawback in NGN environment may be topology of network and position of POIs, where NGN operators with high capacity switching systems and lesser number of POIs as compared to legacy networks may cause hot-potato-problem[8] as other operators will have to carry traffic to long distance before termination.

Besides interconnection charging regimes and costing methodologies, another crucial factor is interconnection billing options available in NGN environment. Contrary to the legacy networks, as NGNs are totally packet based, the concern is whether NGN components allow measuring of packets for various interconnection products, and if allowed, whether there would be any services that may choke the billing systems. Besides, some of the billing options may be flat rate on the basis of session duration, capacity based, quality based with no capacity charges, content based, flat service based, and so on. Hence, interconnection products can be categorized on the basis of network layers and QoS class and different charging regimes can be applied on them. For example, wholesale best-effort Video-on-Demand product can be charged on a different rate as compared to committed VoD product.

Recommendation 1(e):

The regulator is recommended to encourage or issue directives to the service providers to develop and apply Reference Interconnect Offers (RIOs) for efficient exchange of IP-based traffic among the operators, and with other industries (like broadcasting industry).

[8] Hot-potato-problem: tendency to pass on to the next entity soon after receiving the same from previous entity

CHAPTER: TWO

Technical Specifications

and

Standards of NGN

2. TECHNICAL SPECIFICATIONS AND STANDARDS OF NGN

2.1 Current arrangement for telecommunication equipment

As per the Telecommunications Act (2053), NTA is authorized to prescribe, fix and approve the standard and quality of plants and equipments related to telecommunications and telecommunication services. The operators, on the other hand, while providing telecommunications services, have the obligation to maintain standards prescribed by the regulator. This arrangement has been enforced by NTA through provisions in the licenses of the operator(s) that they must comply with the ITU, ETSI, TIA, ANSI and other international standards. The QoS parameters and their benchmarks have also been set and enforced by NTA. In addition, the regulator has started issuing certificates for the user terminals of telecommunication systems through "type approval process". However, NTA has not yet explicitly developed any specifications for the telecommunications equipment that the licensees install or operate for providing telecommunication services in the country.

2.2 Global efforts in standardization

As factors like interoperability and quality of service (QoS) are critical, work is underway in numerous organizations worldwide to formulate standards for ensuring acceptable levels of interoperability and quality in the course of NGN evolution. Some of the standards organizations are ETSI (European Telecommunications Standards Institute), the TISPAN (Telecoms and Internet Converged Services and Protocols for Advanced Networks), the ITU-T (International Telecommunications Union – Standardization Bureau), the NGN-GSI (NGN Global Standards Initiative), the 3GPP (3rd Generation Partnership Project) and the Fixed Mobile Convergence Forum. There are also many organizations for example, the European Regulators Group (ERG), European Conference of Postal and Telecommunications Administrations (CEPT), the ITU and the Organization for Economic Cooperation and Development (OECD) to name a few, which are currently engaged in policy and regulatory based research on IP and NGN networks. Many projects are also taking place regionally, for example, in Europe, the GÉANT project (including all research and education networks in Europe) and the TF-NGN (Task Force on Next Generation Networking) were established for collective investigations and deployment of NGN in 2001, NGN FOG in Australia under the auspices of the NGN Ventures conference in the USA, UNF in Japan and the BcN Forum in Korea are also joint activities related to technology and service development.

As the works related to listing of characteristics and services in the NGN environment are ongoing, establishing a standard or reference point for benchmarking is continuing to evolve.

2.3 Life Span of Technologies

Out of a number of major telecommunications systems and services (e.g. PSTN, Mobile, Telex, Fax, ISDN, Packet-switch, etc.), some of the services (like Telex, Packet-switch) have already become extinct in many countries. By considering the fact that different telecommunication installations and equipment have different life span, and that the cost involved in procuring and implementing the newer systems are not encouraging from economic perspectives, the service providers are, in general, not willing to put additional effort and increase investments for making complete replacements of the systems that are in operation.

Considering the fact that operators are, generally, not interested to make replacement of the equipment that are in satisfactory operation, the effort of the regulator in preparing specifications would not be attractive to the operators from their business and financial perspectives.

2.4 Competitive environment

As the operators have to put more effort in overcoming challenges (e.g. cost, quality, availability, etc.) in the competitive environment, it would be unattractive for the operators to spend time and energy on preparing "possibly the best" technical specifications. However, as the operators have to compete with each other by providing more advanced, attractive and user-desired services, they would, rather, be interested to procure equipment that are readily available in the market and that are flexible in customizing as per requirement of subscribers.

On the other hand, the multi-technology, multi-vendor situation in the country would seek regulatory intervention to ensure interoperability, efficient interconnection among the operators and better customer experience.

2.5 International Experience and Practice

As mentioned in a number of documents and specifically mentioned in [19], the regulators of the SATRC countries, Asia and the Pacific countries, European countries and the Americas are encouraging deployment of NGNs in their respective countries and regions. Some of the countries have provided funds for deployment of NGN, and some others have adopted PPP (Public-Private-Partnership) models to support migration to NGN. They have not prescribed any technical specifications for NGN equipment. However, most of the regulators are concerned with ensuring interoperability of the systems and compliance with the international standards for seamless operation of the systems.

Recommendation 2:

The regulator is recommended to adopt technical standards set by different international organizations (such as ITU, ETSI, IETF, TISPAN etc.) working in NGN standardization activities and ensure interoperability among various systems and standards, and leave the task of preparing technical specifications to the operators themselves.

CHAPTER: THREE

NGN Migration

3. NGN MIGRATION

3.1 Concept and necessity of migration

In order to keep pace with technological developments and market expectations, it is necessary that either the systems are regularly upgraded or the systems are replaced by new technology without hampering the service. Replacing and upgrading of the existing equipment to newer and advanced technologies is not only the requirement for providing newer services, but more often to cope with unavailability of hardware and software that the manufacturers consider as obsolete. From the manufacturers' perspective, the older versions of the equipments have to be displaced by more efficient, compact and reliable equipments that are as well expected to provide better quality of service to the users. The migration related jobs in telecommunications is more tedious and complicated due to interconnection issues among different service providers and compatibility issues of equipments at the user premises.

As the voice quality of PSTN service is regarded the best, any migration from this "best" service to IP-based NGN would require assurance of services that are comparable to those offered by the legacy Class 5 (or, TDM) infrastructure.

3.2 Reasons for migration to NGN

Although there are different business and technical reasons, migration to NGN is motivated by at least one of the following reasons:

- Reduced OPEX and enhanced streamlined operations
- Integrated platforms for provisioning various services and applications.
- Integrated operation platforms including integrated maintenance and training
- Centralized Management and Control
- Compensate voice revenue reduction and increase broadband related business
- Providing Service innovation (e.g. VPN)
- Decreased time to introduce and market new types of services and applications

3.2.1 From Technology Perspective

Many legacy networks are reaching the end of their life cycles and require replacement of equipment. Access carriers in many countries have started providing ADSL, ADSL2 and ADSL2+ through copper lines to cater for data demand of end-users. Some of the broadband service providers are trying to compete with cable TV operators, new VoIP providers, mobile operators and wireless carriers who can provide IP based services. The operators are also using wireless technologies like WiMAX, EDGE, HSDPA, HSPA+, LTE for provision of next generation access. Convergence of media, telecoms and IT coupled with the worldwide success of mobile services and the resultant mobility have changed the way by which consumers accomplish their daily communication needs. These technologies and their convergence, to some extent, are stimulating demand for NGN-based services.

3.2.2 From Market Perspective

Market deregulation and globalization has accelerated competition in the field of telecommunications. The competitive pressure by the cable TV and mobile operators, who are capable of providing IP-based voice, data and video services, have put increased pressure to the telecommunication operators for providing modern, innovative products and services.

3.2.3 From Operator's Perspective

Operators and investors seek increased revenue and profitability, greater productivity and broader service offerings. These trends are facilitating integration of different telecommunications technologies that have previously developed into separate and distinct services. The integration is expected to enable seamless distribution of services over fixed and mobile broadband networks, and to create a unified IP-based multi-service network.

Growing competition in newly liberalized markets and growing competition from new services and innovations are driving the operators to migrate their existing systems and services to NGNs. Similarly, declining call revenue and challenges of operating and maintaining multiple networks are compelling operators to re-think their business models and migrate to a fully IP-based architecture. In newly liberalized markets, legacy operators that are running separate networks for different services are at relative disadvantage in comparison to the new operators that can directly introduce integrated services.

From the implementation point of view, BT's original “21CN” plan was one of the most ambitious and comparatively the most exhaustive and thoroughly worked out plan to introduce NGN in UK. It is said that the plan was approved around operational cost savings, a shared IP Core and call servers to emulate the PSTN features to replace aging systems. However, now it is felt that there is nothing exclusively new for the customers with the NGN plan, as the services are considered as mere replication and not innovations. So, as mentioned in [21], the re-focus of BT's 21CN program is to be more customer-driven than engineering-led and influenced significantly by the recent prioritization of fiber deployment, rather than the previous plan for rapid end-user migration of traditional voice.

3.2.4 From End User's Perspective

Although it is difficult to estimate end-users' demands for future services, the extent to which NGN services would be popular depend on factors like “access” and “affordability”. With technological developments the telecommunication industry is moving towards more innovative services and at the same time, with device convergence, the end-user needs are maturing with increased offerings from service providers, decreasing tariffs and discounted bundled services. In addition to this, the business enterprises demand high speed connectivity and appropriate security for new services.

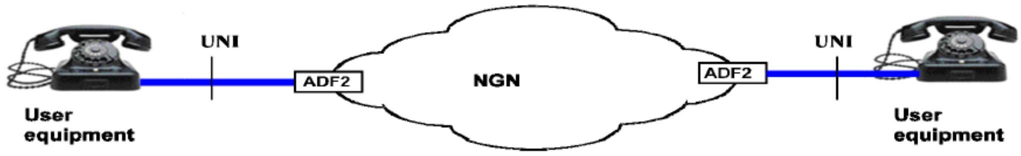
The inherent characteristic of NGN to provide services independent of the transport layer has shown possibilities to the end-users that their demands for a huge portfolio of services might be possible, and as such these have increased interest of the end-users towards NGN services.

3.3 NGN technology to support migration

NGN provides two distinct capabilities to help migration of legacy networks (at least for the voice based services) to NGN. The first one is "Emulation" which supports provision of PSTN/ISDN service capabilities and interfaces using adaptation to an NGN infrastructure using IP, and the second one is "Simulation" which supports provision of PSTN/ISDN-like service capabilities using session control over IP interfaces and infrastructure.

3.3.1 Emulation Scenario

The figure below shows a high level view of emulation scenario. The NGN Emulation capability provides "Adaptation Function (ADF)" to the legacy terminal devices (User Equipment) to the NGN such that all services are available to PSTN/ISDN users and that the user experience is not changed by the network transformation.

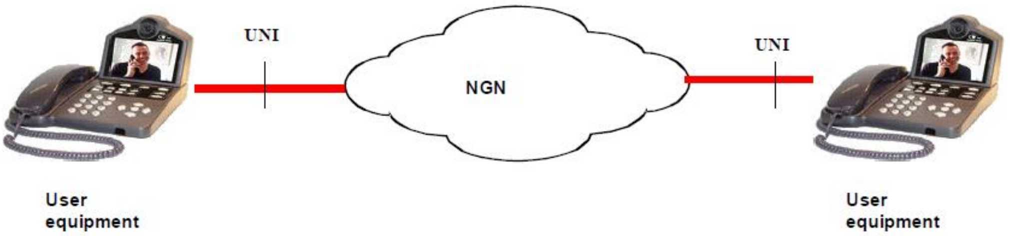


NGN Emulation of PSTN/ISDN

Source: ITU-D STUDY GROUP 2 4th STUDY PERIOD (2006-2010) QUESTION 19-1/2: “Strategy for migration from existing networks to next-generation (NGN) for developing countries.”

3.3.2 Simulation Scenario

Simulation is for providing PSTN/ISDN like service to the NGN users. The simulation capability allows the NGN users to communicate with PSTN/ISDN users. As the PSTN/ISDN-like services would be available, user experience is changed by the network transformation.



NGN Simulation Scenario-1 of PSTN/ISDN

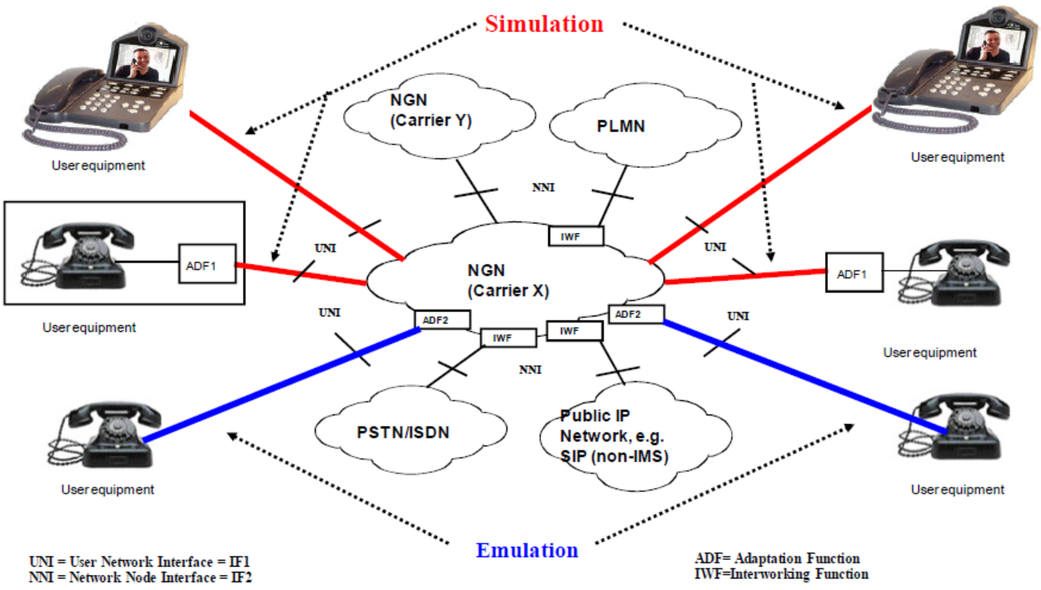
NGN Simulation Scenario-2 of PSTN/ISDN

Source: ITU-D STUDY GROUP 2 4th STUDY PERIOD (2006-2010) QUESTION 19-1/2: "Strategy for migration from existing networks to next-generation (NGN) for developing countries."

3.3.3 Overall view of using emulation and simulation

As PSTN/ISDN is a major network infrastructure, Emulation and Simulation technology has supported to continue use of the conventional voice oriented services and various other supplementary services.

NGN, with its potential to completely substitute the legacy systems, should also support emulation and simulation technologies to cover PSTN/ISDN and legacy IP based networks. Combination of these capabilities with proper interworking scenarios helps to support voice service requirements of the end users irrespective of whether the end user device is connected to fixed, mobile or legacy IP-based services. The figure below shows overall configuration model of using emulation and simulation for proper interworking among different technologies:-



Overall view of using NGN Emulation and Simulation

Source: ITU-D STUDY GROUP 2 4th STUDY PERIOD (2006-2010) QUESTION 19-1/2: "Strategy for migration from existing networks to next-generation (NGN) for developing countries."

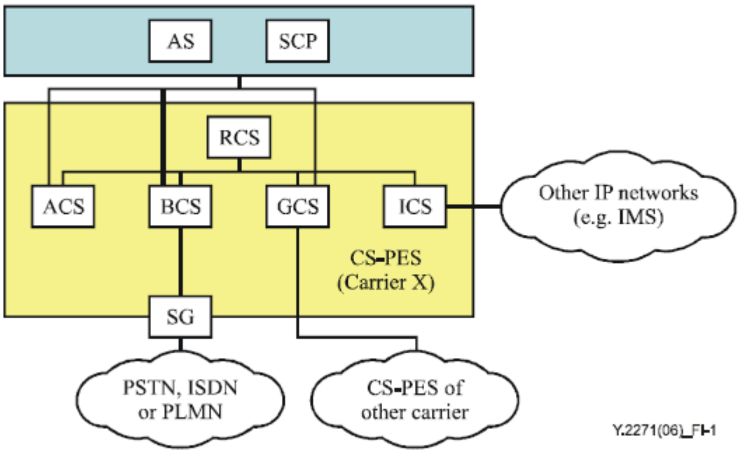
3.3.4 Call Server supporting Migration to NGN

The Call Server is the core element for PSTN/ISDN emulation which is responsible for call control, gateway control, media resource control, routing, user profile and subscriber authentication, authorization and accounting. The call server may provide PSTN/ISDN basic service and supplementary services, and may provide value-added services through service interaction with an external service control point (SCP) and/or Application Server in the service/application layer.

A call server may function in one or more of the following roles as identified in ITU-T Recommendation Y.2271 and Figure below shows an example of the deployment of:

- Access call server (ACS)
  - implements access gateway control and media resource control functions
  - provides PSTN/ISDN basic service and supplementary services
- Breakout call server (BCS)
  - implements interworking functions to enable interconnection with PSTN/ISDN networks
- IMS call server (ICS)
  - provides interoperability between PSTN/ISDN emulation components and IP multimedia components within a single NGN domain
- Gateway call server (GCS)

- provides interoperability between different NGN domains from different service providers
- Routing call server (RCS)
  - provides routing function between call servers



* AS: Application Server, SCP: Service Control Point, SG: Signaling Gateway, PES: PSTN Emulation Service Component

(Figure 1/Y.2271) Call Server Deployment Example

3.4 Factors, principles and choices regarding migration to NGN

The optimum degree of migration depends on each country's state of the existing network, notably the amortization time-frames and degree obsolescence of equipment, the demand for migration, and capacities for funding and investment.

According to the case study of ITU-D STUDY GROUP 1, 4th STUDY PERIOD (2006-2010) QUESTION 12-2/1: "Tariff policies, tariff models and methods of determining costs of services on national telecommunication networks including next-generation networks", the business strategy for migration is based on the investments to be made with regard to the core network, access network and service platforms, and organizational aspects.

In general, as the operators develop their migration plan based on the need to adapt to market requirements, competitor pressure and regulatory constraints, the situation may not be the same in all developing countries. If the operators fail to act preemptively by establishing a migration plan, then there could be the risk that migration to NGN is forced upon them as a result of technological obsolescence. Under such conditions, operators may not have sufficient time to assess carefully the profitability of investments in NGN. In all events, the basic motivation for migration remains either to meet demand or to overcome technological obsolescence.

According to the **ITU-D** STUDY GROUP 1, 4th STUDY PERIOD (2006-2010) (**QUESTION 12-2/1: "**Tariff policies, tariff models and methods of determining the costs of services on national telecommunication networks including next-generation networks"), migration in a developing country consists of three-phase migration, they are: (a) core subsystem network,

(b) access network, and (c) gradual replacement of the old exchanges from the highly profitable urban areas to the poorer, rural areas.

Recommendation 3(a):

It is recommended that time limit should not be specified for migration to NGN and the decision of migration to NGN shall be left to the operators themselves.

3.5 Challenges while migrating to NGN

3.5.1 Challenges to service providers

The key issue for operators is the action plan as to how migration towards NGN can be realized, and the consequences of migration plan. The investments made in the legacy systems/equipments may pose a major challenge because introducing NGN may not be a gradual upgrade job, but a replacement job requiring huge investments in equipments, training to the employees and deployment of the resources.

On the other hand, the host of advanced and new services that would be available with NGN system would require not only advertising but also educating the users. These would require changes from working styles to heavy investments in educating and training the staffs and the end users.

The flexibility of having a large collection of smaller, local networks and equipment centers poses a big challenge to the operator as the requirement for backup power like generators, solar energy, etc., have to be managed.

Capping of the existing TDM network, then gradually introducing NGN as a solution to introduce and expand present network and completely displacing the older network on the long run, looks to be the most reasonable option for developing countries like Nepal.

3.5.2 Challenges to customers

Migration of equipment at the customer end is always challenging – mainly due to economic reasons and sentimental factors involved in the replacement of customer owned equipments. For example, considering an initiative to introduce All-IP-CDMA, the strategy from the service provider side should be such that new end-to-end-IP applications do not replace but co-exist with the existing CDMA 2000 1x subscriber's applications and their end-equipments until there is insufficient subscriber-base to cover the overhead. Similarly, overlay of GSM-3G network on a larger 2G network would be a positive achievement to the service provider, and 3G mobile sets have the advantage of working in 2G networks in the absence of 3G coverage, but complete replacement of 2G system by the 3G system would require that all 2G mobile sets need to be replaced by 3G mobile sets, which may not be acceptable to the customers.

Recommendation 3(b):

It is recommended that migration to NGN should not be abrupt, and both the older and the newer technologies should co-exist for reasonable period of time, such that the customers are not forced to replace their terminal equipments for the reason that their service provider(s) has made complete replacement of the system(s).

3.6 Generic Migration procedure

Migration from legacy network to NGN is not an easy task because many things need to be considered from different perspectives. As migration of network infrastructure needs careful examination of the execution plan from different aspects, there is no single way or the best way for migration to NGN. Migration, as such, should be based on each country situation as well as each operator’s given condition.

ITU-D study group report on question 19-1/2 recommends considering following procedures for building migration plan of legacy network infrastructure to NGN:

(i) Provision of new communication services to broadband users in addition to the existing network

(ii) Migration of a significant portion of users to those services, and visible reduction in PSTN/ISDN usage

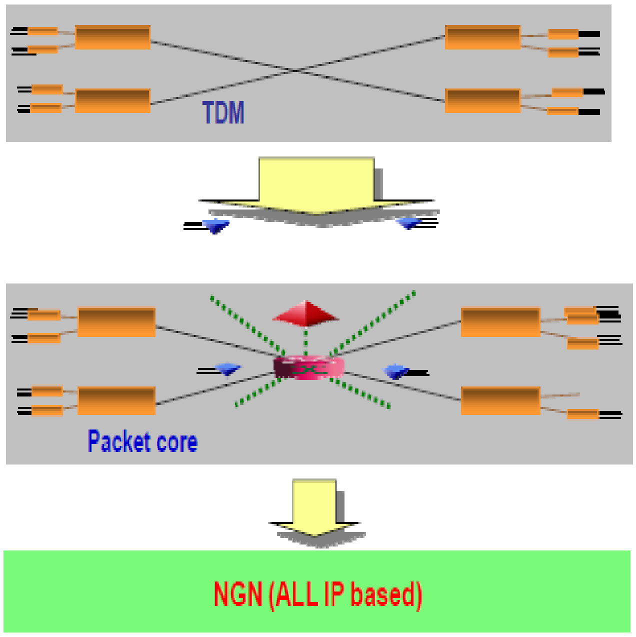
(iii) Begin replacement of infrastructure as the cost of maintaining both systems in parallel is not desirable

(iv) Replacement of part of the infrastructure (e.g. local switch) by new infrastructure, without forcing all users to migrate

(v) Complete migration to new infrastructure

(vi) Migrate remaining users to NGN

From technical perspective, migration to NGN is viewed as a change from "TDM based network" to "IP based network." Taking consideration of network possession portions between "Access Network domain" and "Core Network domain", migration procedure should be applied to one of such domains first. It is a general understanding that migration of "Core Network domain" is easier than migration of "Access Network domain" as the former will have less impact on service provision than the later. Figure below shows generic view of Core Network migration to NGN:-



Generic view of Core Network migration to NGN

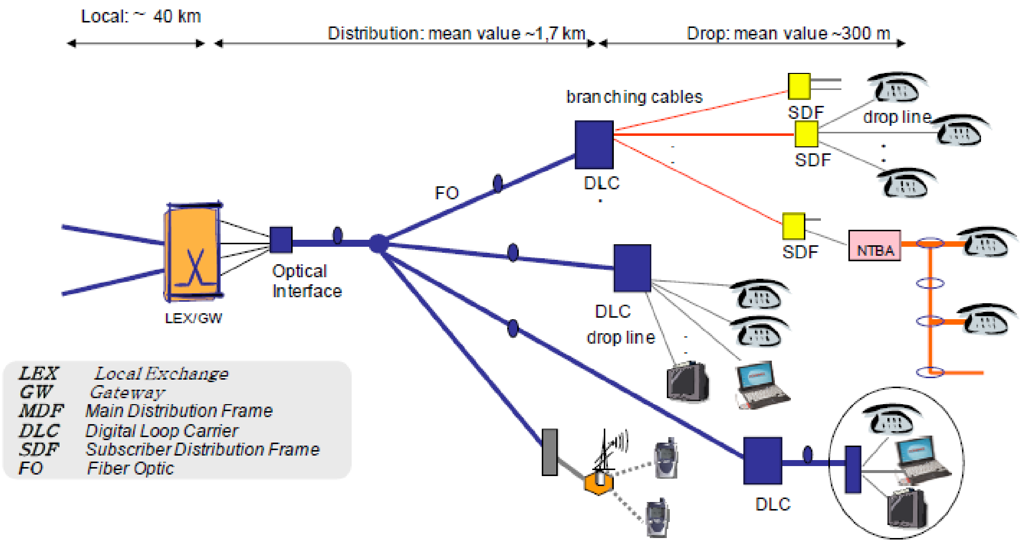
Source: ITU-D Study Group-2 Final Report on Question 19-1/2: strategy for Migration from Existing Networks to next generation network for developing countries

In the case of migration of Access Network Domain, it is quite complicated not only for technical reasons but also for geographical differences. As such, it is not recommended to choose one specific technology to replace any legacy access network systems as harmonization among different technologies to cover customer requests would be more flexible and economical.

Most of the different access technologies are developed on fixed and mobile systems supported by broadband connectivity. Most of the technologies also provide IP connectivity, where it is a critical technical feature to meet NGN requirements (e.g. Packet based transfer).

In case of fixed access networks, xDSL technology is mainly used to provide broadband services. xDSL is attractive to the service providers as it gives possibility to utilize existing copper infrastructure for deploying broadband (below 10 Mbps) in an economical way. However, the final goal in the fixed network environment is to deploy fiber based infrastructure. Fiber optics is a kind of target technology in the area of fixed networks with its unlimited capacity not only for core networks but also for access networks including home networks. However, there are major concerns on cost and construction in deploying optical fiber infrastructures. Considering the pros and cons of both the technologies, it is recommended to use both xDSL and Fiber together in the access network as a preparation for migrating to NGN, including preparation for sufficient broadband capability.

Another important area is to utilize mobile services (including wireless such as WiFi and WiMAX) to provide broadband connectivity. This aspect is also very important because many people, especially in developing regions, use mobile phones for their daily communication needs. There are many technologies to provide broadband capability in mobile access networks including IP connectivity but still has certain limits on providing bandwidth (around 10 Mbps). Standard organizations are working hard to develop technologies for improved bandwidth. The figure below shows how different access technologies are used in the access parts:-

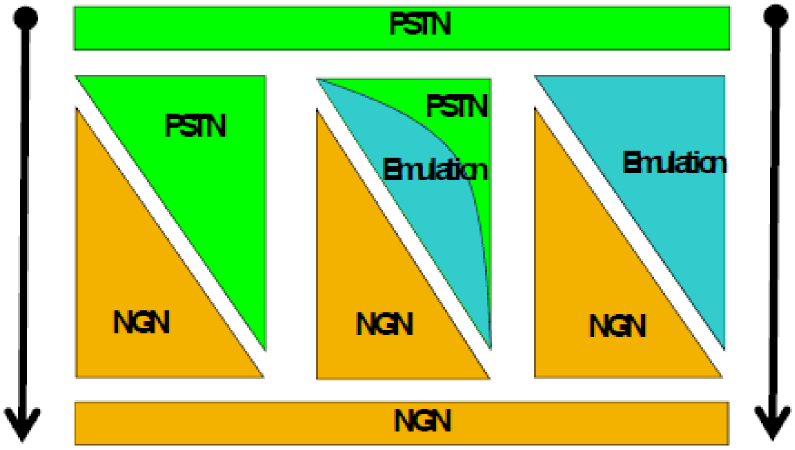


Generic view of Access Network (Mixed) migration to NGN

Source: ITU-D Study Group-2 Final Report on Question 19-1/2: strategy for Migration from Existing Networks to next generation network for developing countries

3.7 Migration Paths to NGN

According to the ITU-D STUDY GROUP 2, 4th STUDY PERIOD (2006-2010), (QUESTION 19-1/2: "Strategy for migration from existing networks to next-generation (NGN) for developing countries"), three different types of migration scenarios can be introduced as a framework for consideration without limiting the other possibilities of migration scenario. The figure below shows a pictorial explanation of different scenarios related to migration from PSTN/ISDN to NGN, namely (1) Overlay Scenario (Left Side of Figure); (2) Replace Scenario (Right Side of Figure) and (3) Mixed Scenario (Middle part of Figure).



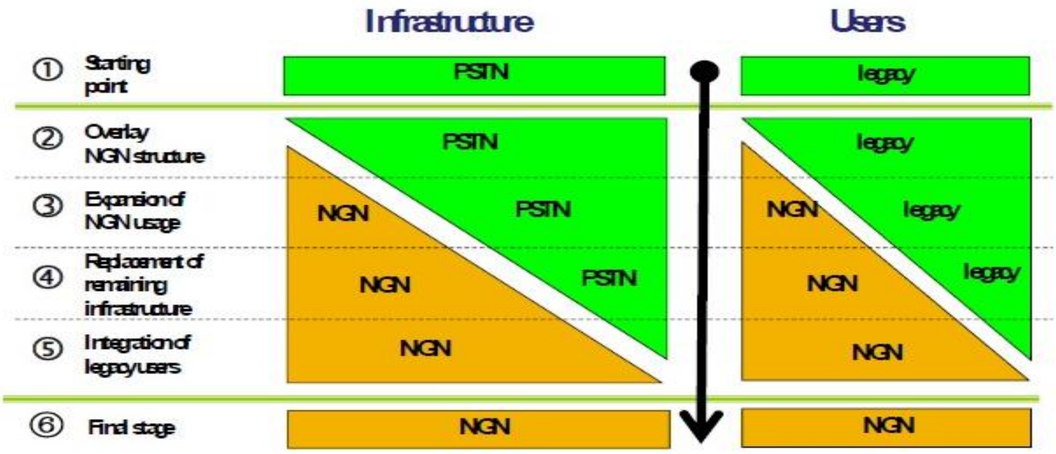
Overall migration scenarios

Source: ITU-D STUDY GROUP 2, 4th STUDY PERIOD (2006-2010), QUESTION 19-1/2

Overlay Scenario	Mixed Scenario	Replacement Scenario
⇨ NGN will be deployed and operated along with the existing PSTN/ISDN network; ⇨ NGN will occupy more portion while PSTN/ISDN will decrease continuously, and finally migrate to NGN	⇨ As both overlay and emulation is deployed, some PSTN user connection will be replaced by NGN emulation at the beginning, while other PSTN users will keep their PSTN connections; ⇨ With the increase in NGN deployment, Emulation and PSTN users will be replaced by NGN users	⇨ NGN emulation will be used widely to support voice oriented services; ⇨ End user could not recognize the change of technology behind their traditional terminal equipments

3.7.1 Overlay Scenario

The Overlay Scenario is useful in the case of countries or operators that have established good infrastructure (or, new PSTN/ISDN infrastructure). In this case, it is hard to justify replacement of all PSTN/ISDN equipment with NGN as this legacy infrastructure has yet to return value for the investments made and can be used for next several years without any serious amount of maintenance.



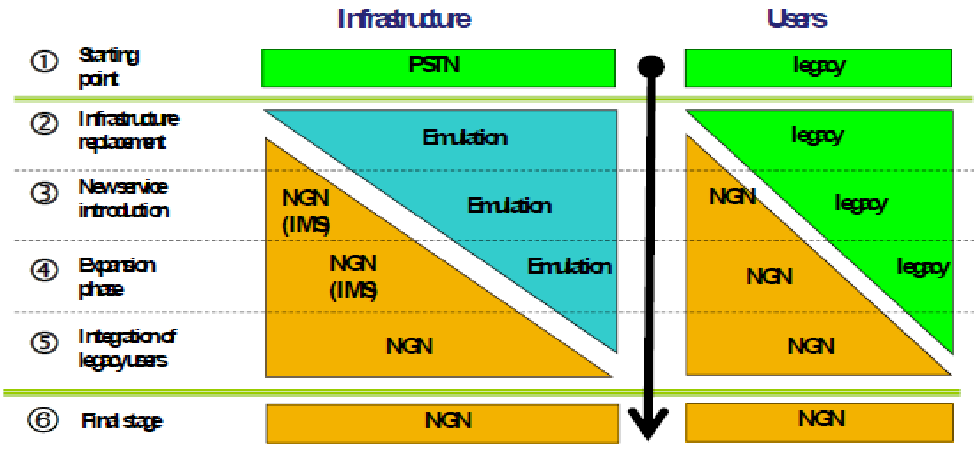
An overlay migration scenario

Source: ITU-D STUDY GROUP 2, 4th STUDY PERIOD (2006-2010), QUESTION 19-1/2

The operator will be gradually preparing enough resources for the next investment while keeping their customers in a good situation. In addition, operator will also deploy NGN and meet users' requirements through advanced capabilities of NGN. With the growth of subscribers who wish to use advanced capabilities and services, the operator will expand the coverage of NGN and consequently will decrease the customers/subscribers of legacy networks. Although it requires few years to completely migrate to NGN, the ultimate target is to cover all users by NGN technology.

3.7.2 Replacement Scenario

This scenario is useful in the countries or operators who do not have enough PSTN/ISDN infrastructures to the extent that there is lack of connectivity to support voice services. In this case, it is hard to continue deployment of PSTN/ISDN equipments as this will need new investment for NGN. However, the current users of the PSTN/ISDN network will be supported continuously without requiring replacement of their terminal equipments.



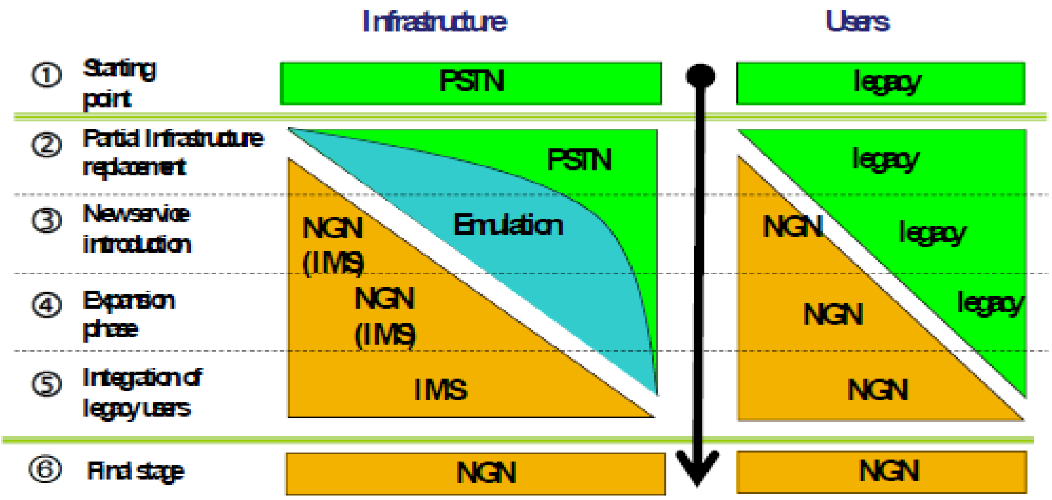
An Infrastructure replacement migration scenario

Source: ITU-D STUDY GROUP 2, 4th STUDY PERIOD (2006-2010), QUESTION 19-1/2

The steps for migration are shown in the above figure. The operator will stop deployment of PSTN/ISDN but make investment in NGN. The operator will provide ADF (Adaptation Function) to the current PSTN/ISDN users to provide continuous usage of voice services, and this means expansion of NGN emulation capabilities. According to the increasing number of users who wish to use advanced capabilities, the operator will expand coverage of NGN and consequently result into decrease of customers that require emulation services. Finally, all users will be fully covered by NGN capabilities.

3.7.3 Mixed Scenario

This scenario is useful for countries or operators that need to replace some parts of PSTN/ISDN but also possess some PSTN/ISDN networks that are still in good and stable condition. In this case, considerations from both overlay and replacement scenarios should be taken into account. That is, operator should keep PSTN/ISDN networks until the time their investments are recovered, or until the time when they come to logical conclusion that those should be replaced for reasons related to operation, administration and maintenance including fault management. Figure below shows the steps of this scenario:-



Mixed migration scenario

Source: ITU-D STUDY GROUP 2, 4th STUDY PERIOD (2006-2010), QUESTION 19-1/2

As shown above, the operator will gradually prepare enough resources for introducing NGN services while keeping their PSTN/ISDN customers. In addition to this, operator will also meet users' requirements which use advanced capabilities through newly deployed NGN. According to the increasing number of users who wish to use advanced capabilities, operator will expand coverage of NGN and consequently will decrease the number of customers in legacy networks. The final solution will be to fully deploy NGN to cover complete subscriber base.

For example, British Telecom had opted for a rapid shift to IP technology with 21CN project, while Deutsche Telekom has adopted the overlay model. The gradual approach to

NGN migration may include upgrade of the core network and replacement of routers and switches; then migrate to IP trunking, implement at the local loop level and then at the user level. The second stage of change is to introduce IMS or similar for multimedia services. However, many of these changes can also run in tandem with one another.

Recommendation 3(c):

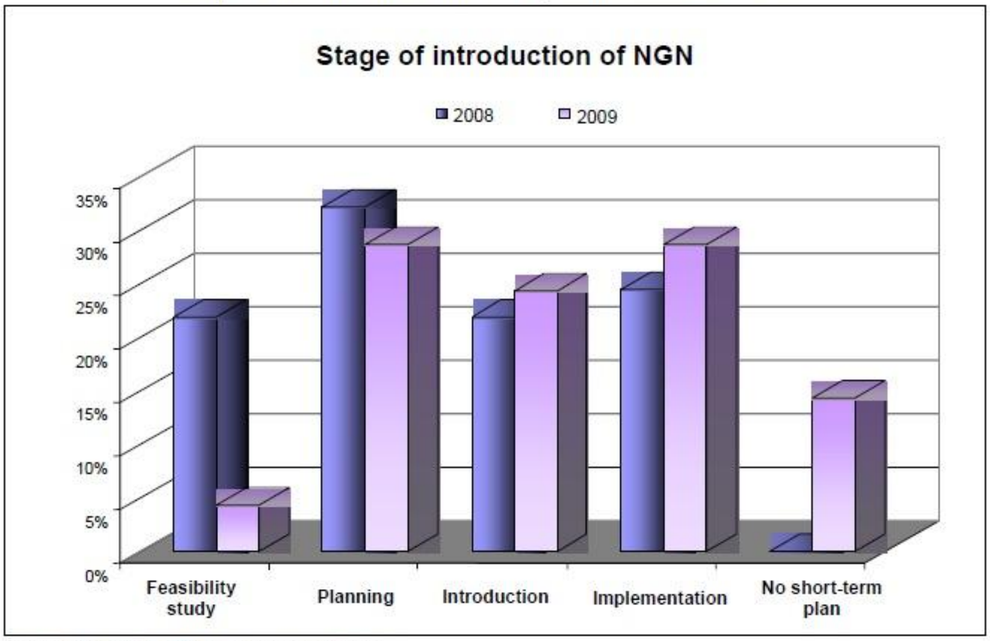
It is recommended that migration to NGN should be allowed to follow an overlay model to maximize utilization of resources and return on investment (RoI).

3.8 Stages to introduce NGN

As per the report of ITU-D STUDY GROUP 1, 4th STUDY PERIOD (2006-2010), QUESTION 12-2/1: "Tariff policies, tariff models and methods of determining the costs of services on national telecommunication networks, including next-generation networks", it is observed from the replies in the year 2008, 17 organizations declare being in the feasibility study phase, 25 in the NGN planning phase, 17 in the introduction phase, and 19 in the implementation phase.

Similarly, replies in the year 2009 indicate that one organization was in the feasibility study phase, 15 in the planning phase, 11 in the introduction phase and 15 in the implementation phase, and seven with no short-term plan yet.

Stage of introduction of an NGN system - 2008 and 2009



Source: ITU-BDT tariff policies survey, 2008-2009

It was observed that countries with high income (in terms of GDP) are in the implementation phase of establishing NGN networks. The challenges identified for the introduction of NGN generally relate to investment costs and problems related to regulatory framework, including interconnection. Regarding introduction of NGN, most countries do not have any applicable legislation, and there is often no appropriate regulatory framework to offer at least a minimum degree of protection. For many countries, particularly developing countries, migration to NGN network requires significant investment and the return on investment can be unbearably long.

Moreover, demand for the new NGN-generated services is relatively low, and the market is in its infancy. Nevertheless, most countries with a high standard of living have made significant progress in the implementation or introduction of NGN. On the one hand, demand puts pressure on the market and, on the other hand, for such countries, it is much easier to mobilize substantial funding required to invest in NGN networks.

CHAPTER: FOUR

Competition in NGN Environment

and

Subsidies for NGN Deployment

4. COMPETITION & SUBSIDY RELATED TO NGN

4.1 Encouraging competition in NGN environment

The basic characteristics of NGN services - that include voice, data and video over IP technology and specifically the possibility of providing simple voice services to advanced triple play services on the same network - seems to be appropriate to provide different services in the remotest villages having scattered population distribution.

The potential of NGN to provide mobile phones, especially in remote villages, can complement, and to some extent substitute travel requirements. The expansion of NGN-based services has the potential to provide fast and convenient access to information on market prices, news and views. This helps to enable the traders to reach wider markets and boost entrepreneurship. The potential of NGN for e-Governance, e-Health, distance education, etc., seems to be appropriate for overall development of the country.

In the present national scenario, there are altogether six telecommunication service licensees that include fixed, mobile and rural. Considering "Recommendation 1(b) (above)", the new license called "Application Service Provider (ASP)" can aggregate contents from different content providers and provide services to the customers through the network of telecommunication service providers.

Recommendation 4(a): In NGN environment, the regulator shall encourage the new licensees (i.e. Application Service Provider and/or Content providers) and telecommunication service providers to establish Service Level Agreements (SLAs) between themselves to establish norms for fair business and to encourage competition.

4.2 Relevance of subsidy in Competitive National Scenario

According to the latest MIS Report of NTA published in December 2012 (47^{th} Issue, Vol 95, the overall national teledensity has reached to 68.13% and Internet penetration to 19.92%. Every village development committee has access to telephone lines; however, this is not the case for Internet. Broadband access to these rural and far flung areas is still a dream today.

From literatures, we find that in many countries, the government has taken initiatives and deployed NGN backbone network to create competition and make NGN/broadband services available to its citizens.

As for the case of Nepal, to create competition and make the broadband service available to people living in rural and far flung areas, the government should also take initiative to create a NGN backbone which can be in the form of Optical fiber Network, and shall be allowed to share by the service providers to make the service affordable to the rural mass. The government in such case has to provide relevant subsidy.

Considering the fact that there are operators that have provided at least some forms of telecommunication services in all the VDCs, additional subsidy to the telecommunication service providers for introducing NGN services in under-served areas is not recommended.

> Recommendation 4(b):
>
> Subsidy should be provided to build common infrastructure that would be required to introduce and expand NGN-based services throughout the country.

4.3 Future of Regulation

The role of regulation is, on one hand, to make sure that effective competition can take place in the NGN era, and, on the other hand, to make sure that the level of services that the consumers receive are not affected in any way in the NGN environment.

On the long run, the principles of minimum intervention by the regulator – termed as "light touch regulation", will be more practical to encourage fair competition among the complex network of multiple layers of service providers with their particular focus and service expertise.

> Recommendation 4(c):
>
> It is recommended that the regulator shall adopt light touch regulation to encourage deployment of NGN in rural and far flung areas for proliferation of NGN-based services.

CHAPTER: FIVE

Interconnection, Numbering and Addressing in NGN

5. INTERCONNECTION, NUMBERING AND ADDRESSING IN NGN

5.1 Interconnection in NGN Environment

The legacy telecom networks have been operated by government owned entities for couple of decades. Most of the regulatory policies and interconnection guidelines in existence today have been developed after liberalization of telecom market over time with experience. The same development scenario is true to Nepal. Contrary to the ex-post[9] interconnection regulations of legacy networks, most of the regulators around the world are following ex-ante[10] interconnection regulations for NGNs in consultation with industry so that emerging interconnection regime is compatible with the existing one.

As interconnection has the potential to affect strategy and viability of telecom business, the emerging network architecture of NGN and the associated complications in interconnection under the NGN environment, is one of the most important areas for both regulators and operators.

With the passage of time and deliberations as and when needed, interconnection framework for legacy networks is well developed in many countries. The technologies and architecture of NGNs being different from the PSTN, will not only force operators to change interconnection arrangements but their layered architecture will lead to higher number of interconnection products. The interconnection products resulting from new interconnection points at different depths may demand preparation of new Reference Interconnect Offers (RIOs) or changes in already approved RIOs.

In legacy networks, interconnection has mostly been on the switch (or, core) level. In contrast to this, the provision of layered architecture in NGN results into vertical interconnection of service layers and horizontal agreements in access layers. The packet-based nature of NGNs also possesses challenges in interconnection charging methodologies and provision of "committed QoS". The telecom vendors are required to provide billing and accounting solutions capable of accounting for packets of various applications separately.

Thus, the next generation interconnection regime may have effects on interconnection interfaces, interconnection points, interconnection products, interconnection charging methodologies, consumer protection issues etc. Next generation interconnection will enable operators to enter into inter-industry interconnection because of its inherent capability to support any type of services/applications independent of underlying technologies.

Considering huge potential of NGN environment, there is possibility for the telecom companies to transform into broadcasting companies and vice-versa- thereby requiring further adjustments in policies and guidelines related to interconnection mechanisms, etc.

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9 Ex-post regulation i.e. based on analysis of past performance

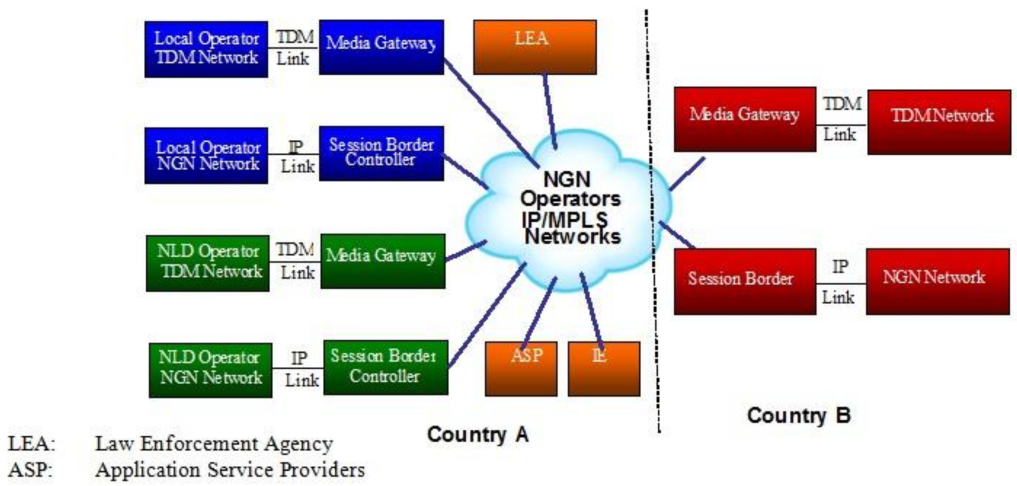
10 Ex-ante regulation i.e. based on anticipated changes or activity in an economy and expected before the event, based on predicted results

5.2 Interconnection Architecture

As mentioned in the ITU-D,STUDY GROUP 1, 4th STUDY PERIOD (2006-2010), QUESTION 6-2/1: “Regulatory impact of next generation networks on interconnection”, the possible interconnection architecture in the NGN environment is shown in figure below.

The interconnection with traditional PSTN and mobile networks based on the ISDN User Protocol (ISUP) may be via the Media Gateway for IP to TDM (and, for TDM to IP) conversion and the Signaling Gateway for SS7 transport over IP.

Interconnection architecture of inter-operator environment in NGN scenario



Source: ITU-D Study Group-I, Final Report on Question 6-2/1: Regulatory impact of next generation networks on interconnection, 4th study period (2006-2010)

As shown above, NGN networks are interconnected by Session Border Controllers (SBCs), which are located at the administrative boundary of a network for enforcing policy on multimedia sessions. A session policy may be defined to manage security, service level agreements, network device resources, network bandwidth, inter-working and protocol interoperability between networks.

SBCs can perform a number of functions such as network security, denial of service attacks and overload control, network address translation and firewall traversal, lawful interception, quality of service (QoS) management, protocol translation and call accounting. The MGW (Media Gateway) will be controlled by a soft-switch deployed by the PSTN/mobile operators in NGN. A SGW (Signaling Gateway) can be integrated into the MGW or can also be a stand-alone device.

5.3 Location of Points of Interconnection (POI)

At present, the operators interconnect among themselves at mutually agreed POIs. At areas where the operators are unable to interconnect (or peer) among them, the network of other operators are used to transit their traffic. On the other side, at present, both peering partners must have TDM based switches at the POI locations. With implementation of MPLS networks, the concept of cost of carriage with respect to distance loses its relevance. NGN with its separation of control and media functions and distributed architecture eliminates this restriction.

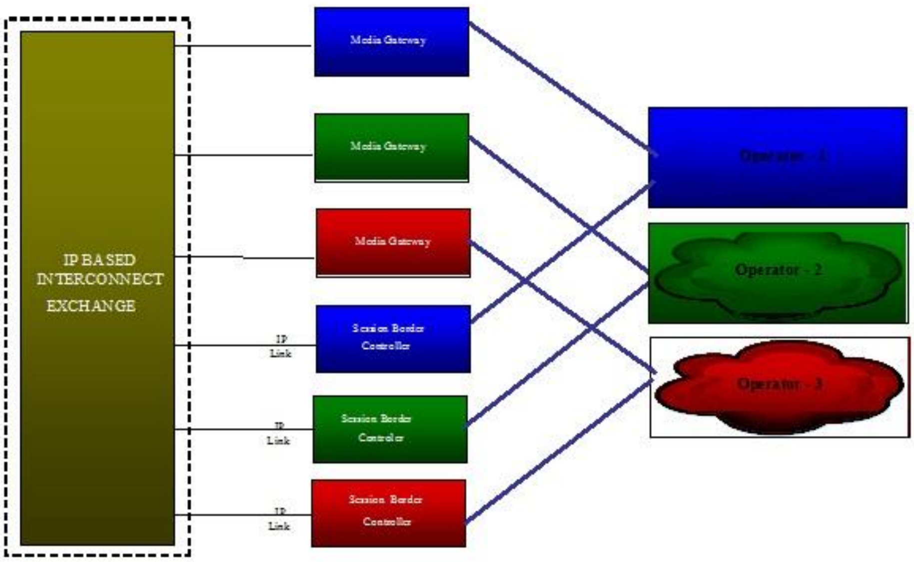
The ITU-D, STUDY GROUP 1, 4th STUDY PERIOD (2006-2010), QUESTION 6-2/1: “Regulatory impact of next generation networks on interconnection” proposes following methodology for PoIs in the NGN environment:-

i) The operators may be allowed to have option of (a) either a centralized control point in its network to control distributed media gateways, or (b) SBCs within its service area.

ii) The operator should be allowed to place media gateways and/or SBCs anywhere in the country, wherever POIs are desired.

iii) An Interconnect Exchange (IE) is proposed for interconnection between different operators in the NGN environment as shown in figure below:

Interconnect Exchange Model



Source: ITU-D Study Group-I, Final Report on Question 6-2/1: Regulatory impact of next generation networks on interconnection, 4th study period (2006-2010)

As shown above, one or more Interconnect Exchanges can be established at service area levels (geographically licensed area) depending on the traffic requirements, and at the locations where most of the operators have their presence. In the same (above mentioned) ITU-D Study, it is mentioned that the advantage of this model makes network planning more efficient as this enables every operator to roll-out transmission network in a more planned way.

The architecture for Interconnection in NGN should be comparable or more rugged than the current PSTN/ISDN/mobile network service since NGN is expected to replace these networks over time. Consequently, one of the key objectives of the architecture would be to have service restored with minimum downtime in case of failure of interconnection which implies that a resilient multiple node architecture has to be used along with IP protocols and networking technologies specially configured to meet the stringent requirements.

As per the ITU-D study group report (mentioned above), the interconnection in an NGN environment should operate at two logical layers – the Signaling Layer and the Media Layer. In order to minimize the cost and complexity of interconnection, L2 connectivity may be preferred over L3 interconnects with logical VLANs/VPNs (virtual local area networks/virtual private networks). Interconnection in an NGN environment would provide a secure, low latency environment in which the quality of wholesale interconnects is guaranteed between all operators.

The basic concept of the Interconnect Exchange (IE) is to enable different operators to interconnect to a common point, to exchange mutual traffic efficiently.

The advantages and features of IE are as follows:

- Inter-Carrier Billing:

  At present, Inter-Carrier Billing can be a major issue of dispute between various service providers and is likely to escalate unless corrective steps are put in place. The use of an interconnect exchange that also functions as an inter-carrier billing clearing house may provide a solution to this major challenge. Inter-operator charging could be a function of a) grade of service, b) content, and c) network elements used while carrying traffic to the Interconnect exchange.

- Intelligent Network Service:

  Intelligent Network Service in a multi-operator multi-service scenario could be provided through the combination of Interconnect Exchange having Inter-Carrier Billing Clearing House functionality.

- Number Portability:

  Number Portability could also be addressed for a multi-operator multi-service scenario through a centralized database available to the Interconnect Exchange having Inter-Carrier Billing Clearing House functionality.

- Simplification:

  Use of an Interconnect Exchange/Inter-Carrier Billing Clearing House could also lead to simplified network architecture, a reduction in the number of Points of Interconnection (POI), simplification in settlement of interconnect usage charges as well as shorter waiting periods for interconnection capacity.

With the above mentioned advantages, Interconnect Exchanges (IE) may be one option that the regulators have to consider as a model appropriate for NGN interconnection.

Recommendation 5(a):
The regulator shall conduct a study to identify suitability of “Interconnect Exchange model for NGN interconnection” in consultation with telecommunication licensees.

5.4 Interconnection Charges

The current concept of interconnection charges in the PSTN/mobile network environment is based on distance and the time or duration of call. In the world of IP-based network (NGN), the network provider, in most cases, will still be a service provider, but it will not necessarily be the only service provider. Vonage, Skype and SIPgate are examples of some competitive firms that provide services without operating a network of their own.

In the foreseeable future, integrated and independent service providers are likely to coexist and compete for the same end-users or customers. The separation of functionality as a result of NGN will have profound implications for both the network provider and the service provider. In theory, the network provider in an IP-based world does not know or care about the nature of application traffic that it is carrying – and in this context, voice is just another application. However, voice will have stringent requirements on delay, jitter and packet loss as it is a real time communication.

In an NGN environment, it will be important to develop an Interconnection Charge regime that provides certainty to inter-operator settlements and facilitates interconnection agreements. India, for example, currently has adopted cost-based Interconnection Usage Charges (IUCs) which include origination, carriage and termination charges.

In the NGN scenario interconnection charges could adopt a variety of models, including the Bill & Keep model. The charges could be based on bandwidth and application usage, quality of service provided, the number of network elements used, the volume of data exchanged during a session, time-of-day, etc. Therefore, NGN Networks may require many more features for charging as given below:

- Charging based on call duration, bearer capability, time and type of day, etc.
- Charging based on QoS, bandwidth, application etc.
- Charging based on party (calling, called or third party)
- Charging of supplementary and value added services

In any charging model, the basic features like Generation of CDR (Call Data Records), subscriber billing, trunk billing and automatic backup and format conversion functions should be possible. Standard interfaces and protocols will be required for sending relevant information to billing centers.

As per the ITU-D Study Group Report-I on Question 6-2/1, there are at least four possible models in NGN-based networks for interconnection charges. They are stated as below:

5.4.1 Calling Party Network Pays (CPNP):

In this model, the network that initiates the call pays for the call. The calculation is usually based on the duration of the call, and generally the party that receives or terminates the call pays nothing. In IP based networks, instead of duration of the call, the charging can be based on the number of packets transferred. This can either take the form of Element Based Charging (EBC) or Capacity Based Charging (CBC). Both systems, however, constitute cost-based systems.

The disadvantage of CPNP is that the interconnection rates depend on the number of network elements when EBC is used. The implementation of EBC (or CBC) for IP networks would cause transaction costs that considers, for example, determining IP points of interconnection. This arrangement may encourage "termination monopoly" where the operators are more interested on termination traffic and less interested on originating traffic.

5.4.2 Bill and Keep (or, Sender Keeps All / SKA):

In this regime there are no charges for call termination. Basically, Bill & Keep is a kind of barter exchange where network operator A terminates traffic from network B on its network and vice versa. As traffic flows may balance out in both directions, there are no payment flows. The price for A to get its traffic terminated on B's network consists of providing network capacities for terminating traffic coming from B. In that sense, interconnection services are not provided for free.

With Bill and Keep, transaction costs can be reduced and there is no termination monopoly problem. Without payments for termination services, the problem of arbitrage is avoided in this model. However, the disadvantage of Bill and Keep model is that the service providers want to hand over their traffic to another network for termination as early as possible, giving rise to the "hot potato" phenomenon. To counter this problem, it may be reasonable to make requirements with regard to the minimum number and location of interconnection points for Bill & Keep to be applicable for a specific network operator.

5.4.3 Charges based on Quality of service:

If the two providers intend to compensate one another for carrying their respective delay-sensitive traffic at a preferred Quality of Service, each of them seeks to verify that the other party has truly committed as expected. In the case of QoS, this would seem to imply measuring (1) the amount of traffic of each class of service exchanged in each direction between the providers; and (2) metrics of the quality of service actually provided. Measuring the QoS is much more complex, both at a technical level and at a business level.

The limitations of this charging model are:

- First, it is important to remember that this measurement activity implies a degree of cooperation between network operators which are direct competitors for the same end-user customers. Each operator will be sensitive about revealing the internal performance characteristics of its networks to a competitor. Neither would want the other to reveal any limitations in its network to prospective customers.
- Second, there might be concerns that the measurement servers – operated within one's own network, for the benefit of a competitor – might result into disputes and/or possible security exposure.

5.4.4 Bulk billing:

The legacy interconnection charging regime (i.e. per-minute basis), would certainly complicate smooth settlement of claims. This is due to the fact that NGN products will be based on capacity, quality of service and class of service. Since the aggregation of traffic would take place at the common node, it is necessary to mandate charging of applicable interconnection charges for NGNs on a bulk-usage basis rather than a per-minute basis that is presently in practice. Under NGN environment, total network costs and carriage would become much smaller relative to traffic volumes and thus average network costs associated with each traffic unit decreases. Charging of interconnect charges on a bulk basis would establish a clear level playing field among the operators. This also facilitates saving legal costs and time from unwanted litigation and dispute settlement. In this regard, it is also necessary to identify the issues that should be regulated and the other issues that can be left for mutual negotiation.

Determining interconnection charges involves an assessment of the various cost items attributable to different network elements involved in setting up of a call in the NGN environment, or conducted on a barter basis, or by measuring traffic sent (volume, level of QoS provided, etc). Even where the Bill & Keep model is used, some countries continue to use carrier charges paid by the originating operator to the access provider. When the interconnection charges are based on network elements, every effort would need to be made to accurately assess relevant network element costs based on inputs to be provided by various operators. The important issue is to identify network elements involved in completion of the carriage of a long distance call from its origin to destination in a multi-operator environment. It is very hard to find the contribution of each element involved to provide NGN applications or services.

Migration to NGN substantially affects the network costs and the relationship between the cost of carrying traffic and distance over which traffic is carried. The similarities between NGNs and the Internet have raised the question of whether the move to NGN will bring the "death of distance" in interconnection charges. As common to calculation of internet charges, it is expected that under NGNs, the charges would be independent of the distance over which data is conveyed. Therefore, cost based interconnection charges would help in bringing correct regulatory framework in facilitating faster deployment of NGNs in the market.

Recommendation 5(b):

It is recommended that the cost based interconnection charges shall be considered in NGN environment. Any of the suitable models such as CPNP, Bill and Keep, Charging based on Quality of Service or Capacity, Bulk billing can be adopted as interconnection charging models in consultation with the concerned stakeholders.

5.5 Numbering and Addressing in NGN environment

The targeted use of NGN as a substitution to PSTN would require that the numbering plan be non-geographic[11] in nature and a distinct code (separate numbering) should be allocated to NGN to identify NGN services. The provisioning of a distinct code for NGN numbers is useful for segregating calls from routing and security aspects.

> Recommendation 5(c):
>
> It is recommended that Non-geographic numbering format with separate number scheme should be used to uniquely identify NGN services for billing and maintenance purposes.

[11] Non-geographic numbering is suitable in Simulation Scenario (i.e. full NGN), and Geographic numbering is suitable in Emulation Scenario (i.e. PSTN like deployment).

CHAPTER: SIX

Tariff Models

6. TARIFF MODELS

6.1 Existing tariff policies and models

As per the provision in Telecommunication Act, 2053 (1997) pursuant to Section 42, the operators have to obtain approval from the regulator (i.e. Nepal Telecommunications Authority) for the charges of Telecommunications Services. Pursuant to Section 52 (b) of the same act, the regulator has developed a “Guideline for Tariff Approval for Telecommunications Services” to achieve the purpose laid down in the section 42 of the Act. That is, the above Guideline establishes policy objectives and the regulatory principles to be applied for approval of tariff that shall be charged to subscribers and any changes thereof for services provided by licensed network operators and service providers in Nepal.

The Telecommunications Policy, 2056 (1999) requires that the tariffs for telecommunications services are cost based to the extent possible with exception to rural telecom operators. The present Telecommunications Policy 2060 (2004), states that the price system of telecommunication service shall be guided by market and healthy competition.

The policy also mentions that the price may be regulated in the following cases:

- If unnatural and unhealthy competition taking place between the service providers
- In the event of monopoly practices in price

The existing tariff guideline has the provision that in cost based tariff model the maximum allowed rate of return on investment should be 25%. The guideline has set different principles for tariff regulation for different categories of services as shown in the table below:

S.N.	Category	Description
1	Fixed Tariff	The tariff approved by NTA shall remain unchanged until a new proposal is presented and approved by NTA.
2	Maximum Tariff	The tariff is fixed as maximum by NTA. The operator can decrease tariff without prior approval from the NTA, but prior notification to NTA is essential.
3	Non-regulated Tariff	The tariff is not regulated by NTA. The operator can decrease or increase tariff without prior approval from NTA, but prior notification to NTA is essential.

For the incumbent operator, that is, Nepal Doorsanchar Company Ltd., the guideline has explicitly set following models for different services:

Table-1, the tariff models for different services of the Incumbent Operator (NDCL)		
S.N.	Services	Tariff Model (Until 2004)
1	Local Call Charge	Fixed Tariff
2	Rental Charge	Fixed Tariff
3	STD Call Charge	Fixed Tariff
4	ISD Call Charge	Fixed Tariff
5	Connection Fee	Fixed Tariff
6	Deposit	Non-Regulated
7	Leased Line	Fixed Tariff

Price cap is a mechanism that controls annual rate of change in regulated tariffs in reference to some published index such as retail price index or the consumer price index. This is often expressed as:

Weighted average percentage change in regulated tariffs in year 't'

= (Percentage rate of inflation, year t-1) - "X".

where, X is the adjustment factor.

For the tariff of WLL operators, the following regulatory regime is set:-

Table-2, the tariff models for different services of the WLL Operator		
S.N.	Services	Tariff Model (Until 2004)
1	Local Call Charge	Fixed Tariff
2	Rental Charge	Fixed Tariff
3	STD Call Charge	Fixed Tariff
4	ISD Call Charge	Fixed Tariff
5	Connection Fee	Non-Regulated
6	Deposit	Non-Regulated
7	Leased Line	Fixed Tariff

For the cellular mobile operators, the following regulatory regime is defined:

Table-3, the tariff models for different services of the Cellular Mobile Operators	
S.N.	Services
1	Connection Fee and Activation Charge
2.	Deposit
3.	Air Time Charge
4.	Rental Charge
5.	Land Line Charge
6.	Roaming (International)

All types of tariffs for Value Added Services are regulated under the maximum tariff regime whereas other minor types of tariff (e.g. line transfer charge, ownership transfer charge etc.) are left unregulated.

The guideline has envisaged service-wise regulation for operators who are operating more than one service at a time as well as price cap regulation of tariffs.

6.2 Cost Model and Tariff Policies: International Practice

As per the study group report (ITU-D, Study Group-1, question 12-2/1), the followings are found from analysis on the use of cost models and tariff policy applied in different countries:

6.2.1 Cost Model

The prices of domestic telecommunication services, namely, local, long-distance and interconnection services are determined in many countries on the basis of individual production costs for each service. For example,

- Operators using a cost-based tariff model have generally selected a cost model developed by the company itself
- Most of the models developed by operators depend on cost accounting data
- Most of the tariff models are based on the two types of costs namely, historical costs (the majority) and long-run incremental cost
- In many cases, telecommunication service tariffs are calculated on the basis of fully distributed costs (FDC)
- Some operators, however, give a preference for incremental costs

6.2.2 Cost models used in setting up tariff for new services carried by NGN

The decoupling or separation of service and transport layers in NGN has significant implications for competition and pricing. For example, a provider can enable new services by defining them directly at the service layer without considering underlying transport layer.

As per the final report of ITU-D, Study Group-1, question 12-2/1, the results of the tariff policies questionnaire shows (see the figure below) that at least half of those administrations have mentioned that cost-based tariff models are more suited to the new services carried by NGN.

The experiences of countries that have implemented NGN point to the fact that cost models depend on several factors, including:

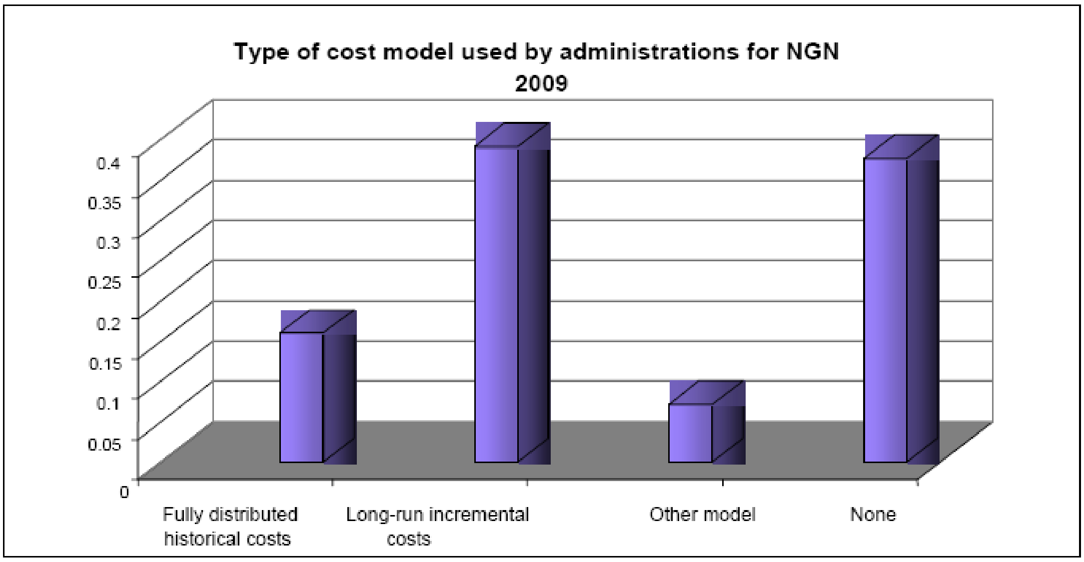
- volume of users by category
- demand for bandwidth according to place of origin/destination
- packet handling rates for control-related functions
- range of applications/services and related platforms
- storage and location of content on network
- rental of physical or communication resources

The user tariffs no longer depend intrinsically on the actual duration of usage. Tariffs are increasingly based on the portions of network reserved for the user in terms of bandwidth.

A combination of fixed and traffic-dependent charging rate is applied in the form of a lump sum for voice, DSL and Internet. The traffic-dependent part of the payment is based on a threshold for voice traffic, a threshold for downloads, and bandwidth on demand.

Regarding interconnection and access to the NGN network, charging principles must also evolve, as there is a school of thought that: "...IP traffic does not lend itself easily to per minute charging and it is technically complex to separate one kind of traffic (e.g. voice) from another (e.g. http traffic) where many different types of traffic may be carried simultaneously across the same interconnection link"

Contrary to the legacy networks, as NGN is totally packet based, the billing system in NGN may require measuring of packets for various interconnection products. As such, precise billing of all the services would be required and practically be complicated, and a simpler solution has to be found.



Source: ITU-BDT tariff policies survey, 2009

Recommendation 6(a):
The cost based tariff model can be considered for new services carried by NGN. However, to reduce complications and avoid choking of billing system, flat rate billing would be more practical.

Recommendation 6(b):
The tariff models and the charging methodologies shall be capable of accounting packets separately based on the applications used, and the differences in QoS.

CHAPTER: SEVEN

Key Performance Indicator (KPI)

and

Benchmarks for QoS

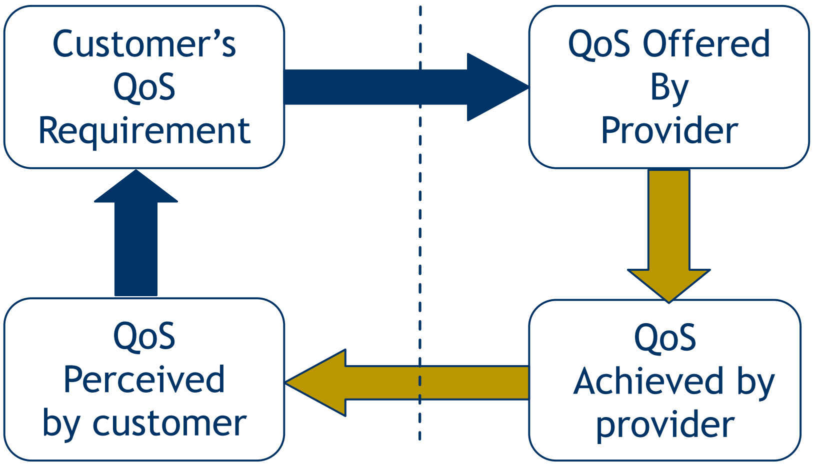
7. KEY PERFORMANCE INDICATOR (KPI) AND BENCHMARKS FOR QOS

7.1 Existing parameters and benchmarks

QoS parameters have been defined for Basic Services, Mobile Services and Internet Services. Activation Time, Service De-activation Time, Service Restoration Time, Customer satisfaction etc. are some of the parameters defined for above services. Those QoS parameters can also be considered for new services in NGN environment with some modifications.

7.2 QoS issues in NGN

As NGN is a Packet based network; quality of service (QoS) in the context of NGN is a complex issue and international standards are still evolving. The figure below describes the QoS from different viewpoints.

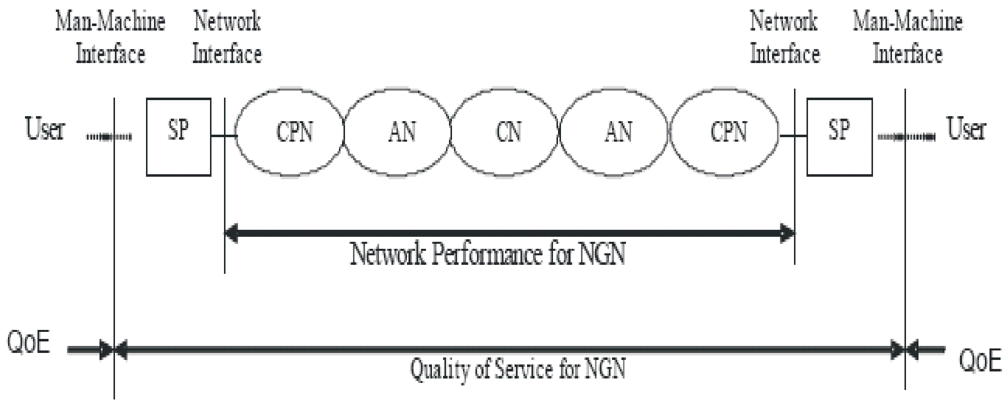


Source: ITU-T Recommendation G.1000

The basic definition of QoS (Quality of Service) is given by the ITU-T in Rec. No. E.800, as "the collective effect of service performance which determines the degree of satisfaction of a user of a service". Expanding on the E.800 QoS concept, ITU-T Rec. G.1000 breaks down service performance (or service quality) into functional components and links it to network performance.

Network Performance (as per ITU-T Rec. No. I. 350) is measured in terms of parameters which are meaningful to the network provider and are used for the purpose of system design, configuration, operation and maintenance. Network Performance (NP) is defined independently of terminal performance and user actions.

Most importantly, the end-to-end QoS must certainly capture the experience of the user which is suitably described by the term QoE (Quality of Experience). QoE is defined as the overall acceptability of an application or service, as perceived subjectively by the end-user. Quality of Experience includes complete end-to-end system effects (client, terminal, network, services infrastructure, etc). Overall acceptability may be influenced by user expectations and context. Figure given below illustrates how the concepts of QoS, NP and QoE are applied in the Next Generation Network (NGN) environment.



Source: ITU-T Recommendation Y.1541

SP	: Service Platform;	CPN	: Customer Premise Network;
AN	: Access Network;	CN	: Core Network

QoS Parameters are service or application specific. For example, call set-up delay, call completion rate and speech quality are some of the parameters for real-time voice service whereas for IPTV service, jitter and the channel change time could be important parameters. Therefore, IP Network QoS Classes definitions and Network Performance objectives defined in ITU-T Y.1541 recommendation is taken as a standard for defining the QoS parameters for services in NGN network. There are QoS classes other than those defined in ITU-T Y.1541, like ETSI TS 123 107 for UMTS. Mapping/harmonization of different technology specifications/QoS classes may be needed to be able to manage end-to-end QoS in NGN.

7.3 ITU-T Y.1541 Recommendations:

Network QoS class defines specific bounds on the network performance values. Various existing network QoS classes or levels defined by ITU–T in Y.1541 required by different types of applications are illustrated below:

ITU-T defines following QoS parameters corresponding to application requirement:

1. IP packet transfer delay (IPTD) or Latency:

   It is the time between the occurrences of two corresponding IP packet reference events.

2. IP packet delay variation (IPDV) or Jitter:

   It is the variation in IP packet transfer delay.

3. IP packet loss ratio (IPLR) or Packet Loss:

   It is the ratio of total lost IP Packets outcomes to total transmitted IP packets in a population of interest.

4. IP packet error ratio (IPER) or Packet Error:

   It is the ratio of total errors in IP packet outcomes to the total of successful IP packet transfer outcomes plus errors in IP packet outcomes in a population of interest.

Recommendation 7(a):

It is recommended that the various network QoS classes and parameters defined by the ITU-T Y.1541 should be considered as the key performance indicators (KPI) for QoS in NGN environment for different services.

Network Performance Parameter	Nature of Network Performance Objective	Class 0	Class 1	**Class 2**	**Class 3**	**Class 4**	Class 5 Un-specified
IPTD	Upper bound on the mean IPTD	**100ms**	400 ms	**100ms**	**400ms**	**1 s**	U
IPDV	Upper bound on the $1-10^{-3}$ quantile of IPTD minus the minimum IPTD	50ms	50 ms	**U**	**U**	**U**	U
IPLR	Upper bound on the packet loss probability	$1*10^{-3}$	$1*10^{-3}$	**$1*10^{-3}$**	**$1*10^{-3}$**	**$1*10^{-3}$**	U
IPER	Upper bound	$1*10^{-4}$					U

Source: ITU-T Recommendation Y.1541

In addition to network centric parameters, Service Activation Time, Service De-activation Time, Service Restoration Time, Clarity of Tariff Plans, Ease of switching between plans, Ease of getting Billing information, Ease of Bill payments, Ease of getting refunds, Network Availability, Billing Accuracy, Security of customer information, Grievance Redressal, Access to senior executives/ officers, Round the clock availability of customer care, Fault Repair Service, Redressal of Excess Metering Cases, Service availability etc. can be considered as Customer centric parameters for defining QoS.

Recommendation 7(b):

Regarding benchmarking, it is recommended that the specific values defined by ITU-T Y.1541 should be considered and revised in consultation with the service providers.

In addition to above parameters, Interconnection congestion limit and Call Completion rate within network and across networks (inter network) need to be specified. Some percentage level should also be defined for bandwidth utilization. (References ITU-T Y.1542)

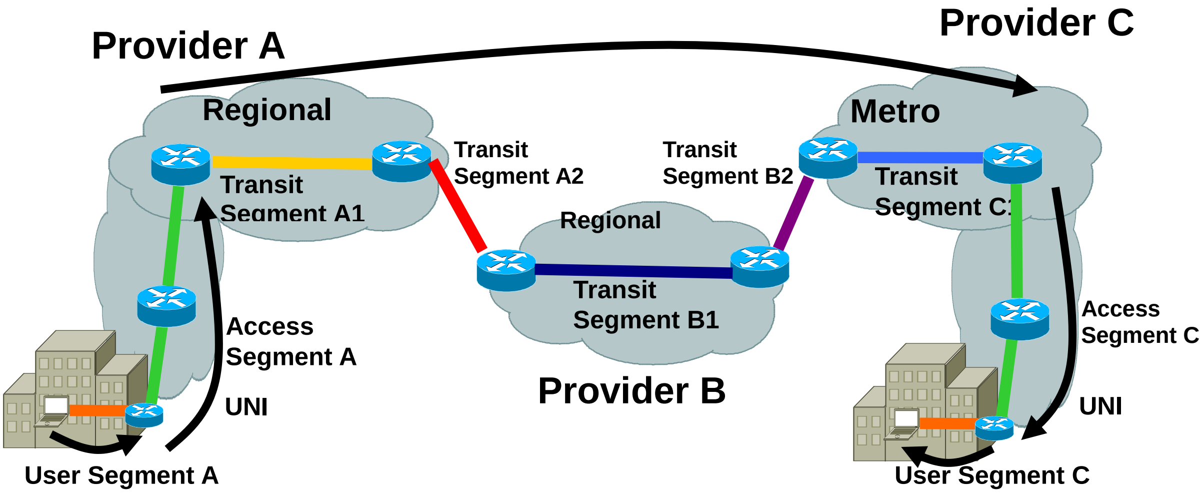


Figure 1/Y.1542 – Example topology for impairment allocation (Source ITU-T)

Recommendation 7(c):

As multiple network operators can be involved in providing access to a service in a multi-operator scenario, the overall QoS is a function of QoS offered by the individual segments. Therefore, it is recommended that apportionment of impairment objectives among operators and number of operators shall be worked out in consultation with the service providers.

Customer centric parameters such as Service Activation Time, Service De-activation Time, Service, Restoration Time, Service availability, customer satisfaction etc. may also be taken from the existing regulations for different services. New parameters like Guaranteed Bandwidth, Bandwidth-on-demand and Throughput (i.e. effective data transfer rate measured in bits per second) need to be specified particularly for the NGN scenario.

Considering flexibility in selecting the types and quality of services available under NGN, there should be some mechanisms like SLAs (Service Level Agreements) between the service providers and the subscribers. SLAs should be elaborated to the extent that subscribers are able to enjoy guaranteed services in terms of quality that determine price of such services (or, applications).

Recommendation 7(d):

Due to the possibility of a huge portfolio of services, the numbers of service providers and their dependencies on content developers, it is recommended that proper mechanism for SLA (Service Level Agreements) between service providers and subscribers should be enforced in the NGN environment.

CHAPTER: EIGHT

Lawful Interception

and

Privacy of Users

8. LAWFUL INTERCEPTION AND PRIVACY OF USERS

8.1 Existing arrangements for Lawful Interception and Privacy of Users

As per section 19 of the Telecommunication Act, 1997 in case it is required to stop the transmission of information or to control transmission system due to the state of emergency or national security, the Government of Nepal (GoN) may order to tape the information to trace the transmitter of the information or to stop such information related to any specific subject, person or community.

The licenses issued to operators (Basic, WLL, Mobile, ISP etc.) have provision for the confidentiality of communications and customer information. The licensees are required to take all reasonable steps to prevent information about its customers and their business from being disclosed to third parties except it is required under Section 19 of the Telecommunication Act, or for prevention and detection of crime, or the apprehension of offenders, or as may otherwise be authorized by, or under any law of Nepal.

8.2 Practical possibilities for Lawful Interception

Countries, all over the world are fighting against threat of terrorism, illegal financial transactions, and narcotics trafficking etc. by utilizing the services of the telecom and data networks. With the rapid development of technologies in the field of communication, the incidence of crime is also increasing. In order to tackle the new forms of crimes, there seems to be an urgent need to develop a centralized Lawful Interception Solution (LIS) to provide useful inputs to the national security agencies in multiple networks, viz. wire-line, wireless and IP.

The centralized Lawful Interception system should be based on state-of-art technologies using latest computational approaches such as artificial intelligence technique, grid surveillance, encryption/decryption, data mining etc. The centralized Lawful Interception system must provide transparent interception by extracting intelligence from Internet and telecom networks effectively and securely and make them available to security agencies to prevent unlawful activities and terrorism, at the same time maintaining privacy of the citizens as per law of the nation.

For realizing Centralized Lawful Interception system, a generic technical specification is required, and should be validated to ensure that telecommunication service providers are well informed of the equipments they need to procure, install and operate.

The system must maintain dependable, robust connectivity with all service providers and Law Enforcing Agencies (LEAs). Once the system is in operation, provisioning and monitoring of targets shall be possible from the centralized Lawful Interception system as required by Law Enforcing Agencies (LEAs) without intervention of the service providers.

In addition, the telecom and/or Internet Service Providers must provide interface including encryption keys for call content and call related information of the targets to Lawful Interception and Monitoring (LIM) over dedicated links. In case of data service, all target related information such as e-mail, instant message, VoIP, fax, HTTP browsing should be provided in a standard format as decided or approved by the regulator and/or other competent national authority.

As mentioned in [13], it is to be noted that the current trend in most countries is to apply legal intercept provisions in all systems uniformly without regards to their underlying technology. That is, the trend is to apply existing legal intercept provisions to all voice services without regard to whether or not IP-based networks are being used to deliver the service.

Recommendation 8(a):

It is recommended that a study group should be formed to prepare Generic Interface Specification for Centralized Lawful Interception and Monitoring System (CLIMS) in NGN scenario.

Recommendation 8(b):

Considering the gravity of issues that the Centralized Lawful Interception and Monitoring System (CLIMS) shall be dealing with, especially issues concerning national security, the Government of Nepal (GoN) has to designate appropriate authority (or, entity) to own and operate the system. Therefore, it is recommended that any requirement for provisioning of CLIMS in the Telecommunication Act should also be initiated and taken care of by the competent authority assigned by the GoN in consultation with the regulator.

CHAPTER: NINE

Network Security,

Spam, Viruses, Worms, etc.

9. NETWORK SECURITY, SPAM, VIRUSES, WORMS, ETC.

NGN being IP based network having open interfaces and standards, it may be more vulnerable to security related issues like DNS attack, SPAM, Virus, Identity theft, spoofing etc. The success of NGN largely depends in ensuring that such platform is free from common attacks on IP platforms.

9.1 Existing regulatory arrangements to deal with network security

Most countries have provisions to protect the identities of parties that are communicating, and also the content of their communications. These provisions are, of course, subject to being over ridden by legal intercept. Most countries have provisions requiring users to prove their identity when they register to use certain telecommunications services and also encourage publication, with certain safeguards, of directories of such information. In many cases, privacy and security provisions are very general and apply to any medium, not just to telecommunications.

Recommendation 9(a):

It is recommended that the regulator should take initiative to increase consumer awareness as well as build mechanisms that explains and teaches them about potential risks and vulnerabilities to network related securities.

Recommendation 9(b):

As Security, including Network Security, is not a one-time activity, it is recommended that continuous alertness, regular assessment of preventive features and periodic upgrade of systems and software should be performed.

Recommendation 9(c):

All entities that operate servers and especially Internet Service Providers (ISPs) that connect to a huge number of subscribers should check and undertake preventive and corrective measures to minimize network related security vulnerabilities.

9.2 Role of Regulator to address issues related to network security

The requirement for a generic network security framework has been originated from different sources:

- Customers/Subscribers need confidence in the network and the services offered, including availability of services (especially emergency services) in case of major catastrophes (including terrorist actions)
- The Public Community/Authorities demand security by Directives and Legislation, in order to ensure availability of services, fair competition and privacy protection

- Network Operators/Service Providers themselves need security to safeguard their operation and business interests, and to meet their obligations to the customers and the public

Considering above issues, the regulator in the NGN environment has following important roles to play:-

- prepare & enforce guidelines
- educate users and service providers
- monitor and evaluate initiatives and efforts of the licensees
- disallow use of 'free-wares' in paid, commercial services

Recommendation 9(d):
The regulator should stay alert on new developments in security issues, and make necessary arrangements for timely submission of reports from relevant service providers on security incidents, failures and measures taken by them.

CHAPTER: TEN

Miscellaneous Issues

10. MISCELLANEOUS ISSUES

10.1 The Global Paradigm Shift

It is very important to note the conceptual paradigm shift that is taking place at present. The legacy systems operate on dedicated resources and provide services that are network dependent (i.e. one service per network), employ comparatively unintelligent devices at the user ends, and are specific to geography. This conventional model is losing its relevance with introduction and expansion of NGN-based services.

10.1.1 FMC (Fixed Mobile Convergence)

The global trend is towards convergence of the infrastructure. In this, the transmission, service delivery (or, session control) and the back office systems of the separate networks would result into a single transmission infrastructure, a single control infrastructure and a single back-office system. In contrast to the legacy systems that are based on smart network but dumb terminals, the concept of convergence is expected to be realized with adoption of NGN architecture (either Softswitch-based or IMS-based), where this development relies on comparatively dumb network but smart terminals. Conceptually, as mentioned in [23], FMC refers to "one terminal, one number, one bill, and one consistent service experience".

Although the technology has not matured to the level of replacing PSTN or GSM network, the beauty of FMC would be advantageous to both the fixed network operator as well as to the mobile operator. In the case of fixed operator, FMC (e.g. with GSM/CDMA and Wi-Fi dual mode phones) would allow making calls via Wi-Fi in the area under Wi-Fi coverage making the network utilization higher. On the other hand, mobile operators get benefit by utilizing their scarce spectrum for "practically mobile" situations as the stationary users in the hot-spot area, office/enterprise areas and inside the huge buildings would be using Wi-Fi frequency instead of the scarce GSM/CDMA frequency bands. This concept of FMC also allows the mobile operators to enter into serving enterprise areas that are being served at present by the fixed service providers. The subscribers also benefit from FMC as they can conveniently make cheaper calls from mobile-like Wi-Fi terminals in the areas under Wi-Fi coverage, and make GSM/CDMA calls in the areas where Wi-Fi coverage is absent. Use of dual-mode/ multi-mode mobile phone and multimode data cards would also be attractive to the users.

10.1.2 Proliferation of IP and mobile services

In NGN, the core network would evolve into a single converged network that can carry voice and data. All types of traffic are transported as IP via IP/MPLS network technology. This evolution to a next generation core network promises a stable platform for converged services and significant savings in the long run.

The present limitation of making VoIP calls is that the caller has to be at a computer. The technological developments has allowed VoIP to go wireless by using 802.11 networking, or Wi-Fi. Wi-Fi phones use the same wireless network technology that computers use, making VoIP a lot more portable. Both the mobile phones and the Wi-Fi phones send and receive signals as radio waves, but the Wi-Fi phones use frequencies different from that of cellular frequencies. For example, the Wi-Fi phones that use the 802.11b or 802.11g standards transmit at 2.4 GHz, and the phones that use 802.11a standard transmit at 5 GHz. For making outgoing calls, the Wi-Fi phone user can dial the number of the person as with a cell phone. And, for making calls to another VoIP user, the caller just needs to enter a VoIP address instead of a phone number, depending on the service provider's requirements. Until now, depending upon the service providers requirements, the Wi-Fi phones either use a specific network of the Wi-Fi service provider thereby requiring sign-up with that particular provider (e.g. SKYPE), or there are some other Wi-Fi phone manufacturers (like ZyXEL and Linksys) that work with one of the VoIP protocols (e.g. SIP).

End-to-end IP services may be the reality, but this will create additional security issues, and complexities in billing, etc.

10.1.3 Proliferation of Optical Fibers

Basically, the access portion in NGN involves deployment of fiber as far as possible towards the end-user's premises. Initially, the fibers may be laid up to street cabinets (or, FTTC), and then would be expanded up to customer premises (FTTH). It is expected that the next generation access is a large digital bit-pipe that function independent of the services and would allow multiple play (e.g. TV broadcast, high speed internet, voice telephony etc.).

10.1.4 Increased access to Broadband services

In many countries it is regarded that the national economic opportunity depends on the deployment of broadband network. Broadband would be the major stake in NGN market place, and as such there is increased need to regulate broadband services that may be through wired or mobile media. Wire-line broadband access provision may be cost prohibitive, so limited role of fixed-line wholesale provision would be required.

The article [6] mentions that "Digital Broadband Migration" is a fundamental shift in technology and competition policy, which is not optional, but will occur whether policy makers recognize its relevance or ignore its long term importance.

10.2 The Ongoing Works in NGN

ITU-D Study Group 2, for the period 2010-2014, is currently conducting a study on Question 26/2 - *Migration from existing networks to next-generation networks for developing countries: technical, regulatory and policy aspects*. The Rapporteur Group for ITU-D Study Group 2 Question 26/2 (Migration from existing networks to next-generation networks for developing countries: technical, regulatory and policy aspects) met in Geneva on 20 September 2012. (*The report of the Rapporteur Group meeting on Question 26/2 is available at: http://www.itu.int/md/D10-SG02-R-0031/; the current Draft Report for Question 26/2 and Annexes are available online at: http://www.itu.int/md/D10-SG02-C-0169/ Main Draft Report and http://www.itu.int/md/D10-SG02-C-0192/ Annexes to the Draft Report*). The Report contains studies of various issues related to the migration from existing networks to next-generation networks**,** and among other things the description of the technical, legislative and regulatory frameworks that are needed to implement appropriate interconnection arrangements for new generation networks. Economic impacts to implement these interconnection arrangements will also need to be included.

ITU-T Study Group 13 leads ITU's work on "Standards for next generation networks (NGN) and future networks" for the period of 2013-2016. Study Group 13 is responsible for

(i) studies relating to the requirements, architectures, capabilities and mechanisms of future networks including studies relating to service awareness, data awareness, environmental awareness and socio-economic awareness of future networks,

(ii) studies relating to cloud computing technologies such as virtualization, resource management, reliability and security;

(iii) studies relating to network aspects of Internet of Things (IoT) and network aspects of mobile telecommunication networks, including International Mobile Telecommunications (IMT) and IMT-Advanced, wireless Internet, mobility management, mobile multimedia network functions, internetworking and enhancements to existing ITU-T Recommendations on IMT; and

(iv) studies relating to NGN/IPTV enhancements, including requirements, capabilities, architectures and implementation scenarios, deployment models, and coordination across Study Groups.

The Rapporteur Group of ITU-D Study Group 2 Question 26/2 noted that the study of ITU-T Study Group 13 (especially Question 16 (Q16/13)) on next generation networks including telecommunications/ICT security may be pertinent and important to the work of the Question 26/2 and relevant references would be made in its Final Report of Question 26/2 which will be finalized in 2013.

Recommendation 10:
As the Study Groups of ITU-T and ITU-D are expected to submit their final reports in the year 2014 and 2016 respectively, it is suggested to keep closer watch on the final reports for necessary adjustments/modifications in the regulatory framework as appropriate.

Issues for Consultation

(1) The study has recommended in 1(a) for a separate guideline/directive for the regulation of digital content while the operators provide telecommunication/ICT services. Do you think that a separate guideline/directive is required? Please suggest with justifications.

(2) Do you think that a New license called "ASP or CSP" is required under value added service license (VAS) category should be created as recommended in 1(b)? Please suggest with justifications.

(3) Do you think that Virtual Network Operators will have a scope and is required in the context of NGN to further create competition in Nepal as recommended in 1(c)?

(4) Capacity/Service based charging model is recommended in 1(d) for interconnection in NGN environment. Do you think that this model is suitable or other alternatives have to be considered as made in recommendation 5(b)? Please suggest.

(5) Should the regulator issue directives to service providers to apply RIO for efficient exchange of IP-based traffic and with other industries? Suggest with justifications.

(6) The recommendation 2(a) mentions that the regulator has to ensure interoperability among various systems and standards and leave the task of preparing technical specs to the operators themselves. Do you agree with this recommendation? Please suggest if you have other alternatives.

(7) Should there be the deadline for migration to NGN or it has to be left to the operators? Suggest with justifications.

(8) Should there be the abrupt migration or in a phase-wise manner as made in recommendation 3(b) and 3(c)? Please suggest with justifications.

(9) Should there be SLA between ASP/CSP and telecommunication service providers? Suggest.

(10) Should subsidy be provided to build common infrastructure that would be required to expand NGN-based services as recommended in 4(b)? Please suggest with justifications.

(11) Would there be the need to establish "Interconnect Exchange" for interconnection in NGN environment and suitable to give a license for such interconnection exchange? Please suggest with justifications.

(12) Should there be non-geographic numbering format with separate number scheme uniquely identifying NGN services for billing? Suggest with justifications.

(13) Would flat rate billing be appropriate for tariff in NGN environment as recommended in 6(a) and be capable of accounting for packets separately based on the applications used and differences in QoS?? Suggest with justifications.

(14) Should the various QoS classes and parameters in NGN be as made in recommendations 7(a), 7(b), 7(c) and 7(d)? Suggest other alternatives with justifications.

(15) Should there be the need of Generic Interface Specification for centralized lawful interception and monitoring (CLIMS) in NGN scenario as mentioned in recommendation 8(a) and 8(b)? Suggest with justifications.

(16) Would it be required to build a mechanism to create the consumer awareness of the vulnerabilities related to IP-based services and networks as mentioned in recommendation 9(a), 9(b), 9(c) and 9(d)? Suggest with justifications.

(17) You may suggest on any other issues that you think relevant in the context of NGN and the recommendations made in this consultation paper on different issues.

ANNEXES

ANNEX - 1

ToR (Terms of Reference) of the study group

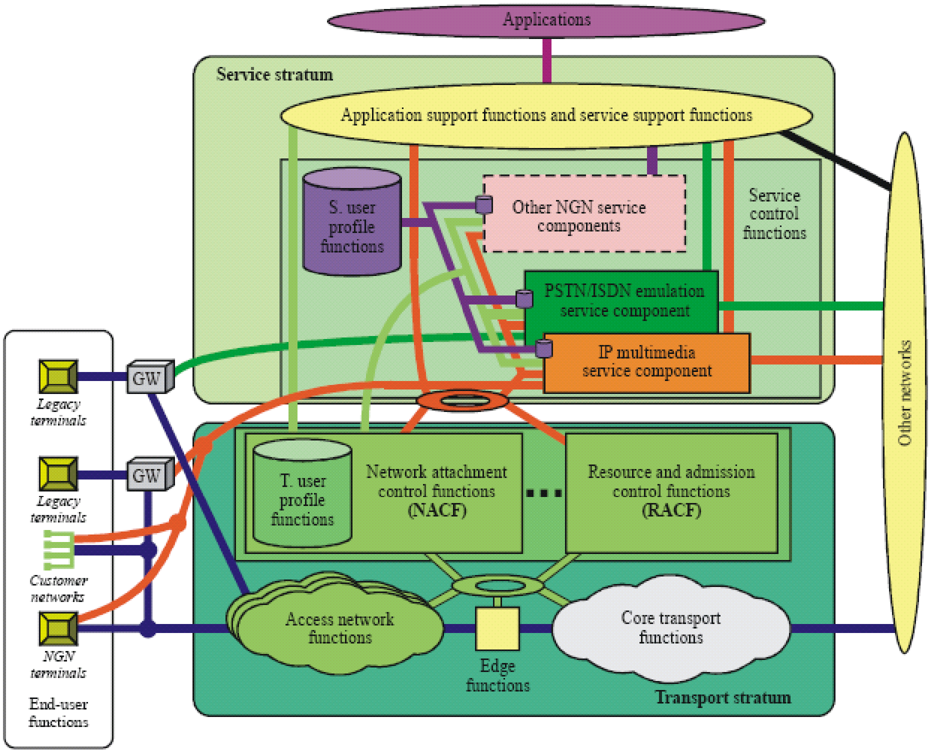
1. To study and analyze the impact of Next Generation Network (NGN) in the existing regulatory arrangement and recommend for any changes that would be required in the current licensing regime to facilitate the NGN Deployment?
2. To study, analyze and recommend the role of regulator for preparing technical specifications for the NGN? Or this should be left to the Industry?
3. To study and recommend possible regulatory actions to help operators for smooth migration to NGN and the likely time frame for complete migration to NGN.
4. To study and recommend how the competition can be encouraged in NGN environment? And what kind of subsidies would be required to facilitate NGN deployment in underserved areas?
5. To study and recommend on technical issues that need to be considered for interconnection, numbering and addressing in NGN environment as well as new models for settlements.
6. To study and recommend on the tariff models that would still be relevant for future IP based Voice services to be charged on a per minute basis or there should be other charging scheme (e.g. flat rate) i.e. volume of packet based or size of pipe base.
7. To study and recommend the key performance parameters for QoS in NGN environment for different services.
8. To study and recommend how the implementation of lawful interception can be enforced and how the privacy of users on IP enabled networks can be maintained.
9. To study and recommend the role of regulator to address the issues of network security, spams, viruses and worms in IP enabled/NGN environment.
10. To study and recommend for any other issues to be considered by a regulator in NGN context.

ANNEX: 2

What is Internet Protocol (IP)? Traditionally, connections for voice communications using circuit switching require a physical path connecting the users at two ends of the network. That path must stay open until the communication session ends resulting in users having dedicated access to a direct connection. Over the Internet data (including voice) is delivered using the Internet Protocol. With this technology, the message is divided into packets containing both the sender's and receiver's IP addresses that identify them. Any packet is sent to a router that understands the destination address and forwards the packet to an adjacent router that in turn reads the destination address. This process will continue across the Internet until one router recognizes the packet as belonging to within its immediate domain. That router then forwards the packet directly to where the address is specified. Since a message is divided into a number of packets, it can be sent by a different route across the Internet when necessary and the routes packets can take to the same destination may vary depending on the routing information available. In this way, IP networks allow communication flow without requiring the establishment of an end-to-end dedicated path. These packets can also transmit voice information and as a result, a variety of platforms, including wire-line and wireless communications standards and gaming systems, have evolved to include IP as a key component. For example, personal digital assistants (PDAs) have a capability to transmit voice and other data using IP technology. IP networks are currently used by a wide range of users from enterprise customers to residential VoIP subscribers. The most widely used version of IP today is Internet Protocol Version 4 (IPv4), but Internet Protocol Version 6 (IPv6) is already being deployed in many networks. IPv6 is expected to add a number of improvements to IPv4 in that the function of multicast is installed as a default which will ensure quality of service in telecommunications with a configuration where voice and image has a higher priority than data, in addition to significantly increasing the available address space. Source: GSR 2007, Discussion Paper, NGN Overview

ANNEX-3

NGN Architecture



Source: ITU-T Y.2012 Rev.-1

Characteristics of NGN **ANNEX: 4**

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

Source: Development of Next Generation Networks (NGN): Country Case Studies, ITU, 2009

Difference between today's PSTN networks and NGN platforms **ANNEX-5** Source: NGN Overview, ITU, GSR 2007 Discussion Paper	
PSTN Networks	**NGN Networks**
Circuit switched technology	ATM/IP based technology
Intelligent network	Less intelligent network
Dumb terminal	More intelligent terminal
User-user services centrally controlled by provider of transport service	User-user services centrally controlled, with much greater scope for third party services.
No client-host services	
Usage related charges and quality control	Usage related charges and quality control
Access control for users and interconnection	Access control for users and interconnection
Interconnection is service related and controlled.	Interconnection may occur at various levels. Above the IP level it is likely to be service related and controlled.

NGN Major Drivers

Structural changes in telecoms markets	Decrease in PSTN subscribers and PSTN revenue
	Increased competition, privatization
	Market deregulation (e.g. LLU)
	Globalization
Changes in services and user needs	Rapid diffusion of broadband Internet
	VoIP
	Cellular, 3G, WLAN, Wi-Fi
	Digital TV
Technological evolution	Creating innovative, interoperable, scalable solutions in the IP environment
	Ipv6
	Digitalization
	Central Processing Unit (CPU) power and memory capacity, mass storgae
	Optics

Source: OECD

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