Telecommunications Regulatory Commission of Sri Lanka

Public Consultation on Policy & Regulatory Framework for Next Generation Networks (NGN)

29th September 2010

Table of Contents

1 Overview of the Consultation

The Telecommunications Regulatory Commission of Sri Lanka (TRCSL) is carrying out a consultation process as part of its development of a policy & regulatory framework for Next Generation Networks (NGNs) and the high-speed broadband services that may be provided over them. The objectives of this consultation are fourfold:

- To provide a general introduction to NGNs and the services that can be offered using these networks.
- To explain the potential benefits of the introduction of NGNs and corresponding services in Sri Lanka.
- To provide some insight into the main technical, economic and regulatory issues that may need to be addressed in order to accommodate the migration to and adoption of NGN, while at the same time protecting the interest of Sri Lankan customers.
- To obtain the views and the comments of the stakeholders with a view to formulate the NGN policy & regulatory framework

The TRCSL would like to seek views and comments from members of the public, the industry and equipment manufacturing sectors on any or all of the issues outlined in this document, or any other matter pertaining to an NGN policy & regulatory framework, in order to better understand the requirements and views of the different stakeholders. Views and comments of interested parties will be taken into account when formulating the NGN policy & regulatory framework report for Sri Lanka. The policy & regulatory framework report will be sent to the Cabinet for approval, and will then become a national policy document whose key recommendations will be implemented over the next few years.

Throughout this consultation paper there are a number of questions related to the topics being discussed. These questions are intended to stimulate discussion, and are in no way exhaustive: interested parties are free to raise any relevant point for discussion. For convenience, these questions are collected together in Section 6: *Summary of Questions*.

Details of how to take part in this consultation are provided in Section 7: *Submission of Comments and Views*.

2 Introduction to NGN

The introduction of NGN has significant impacts on network architecture, enabling multiple core networks to converge into a single core network that can be accessed by a variety of access networks. The result of this convergence is that the new NGN is then able to offer multiple services, including traditional voice and data services, along with video and other advanced services. This section introduces NGN and then discusses the general implications of convergence.

2.1 Introduction to NGN Technologies

Historically, incumbent operators built and operated the Public Switched Telephone Network (PSTN), which was exclusively designed to offer voice services. The PSTN consisted of an *access network*, which used copper loops to connect each end-user to a switch, and a *core network* that connected the switches to each other as well as to international routes.

New technologies and demands have led to two significant developments. First, at the core network level, a demand for data communications services over existing access networks has emerged, mainly motivated by the introduction of the Internet and the requirement from businesses and governments to be connected. Second, new access networks emerged, such as mobile, fixed wireless, and Internet-enabled cable TV, which are able to offer voice services, while also increasingly meeting the demand for Internet access services. Both of these developments have led to significant challenges for operators, which NGNs are able to address.

First, the response of incumbents to demand for data communications services was to build different physical core networks, each customised for particular types of new services. As a result, many operators today have at least a voice and data network, while large incumbent operators around the world operate in excess of 10 different network platforms (e.g. ATM, IP, Frame Relay, ISDN, PSTN, X.25 etc.).[1] This multitude of networks has created a number of inefficiencies: for example, an operator has to deploy multiple operation and maintenance teams, significantly increasing the company's operational expenditure (opex). Another inefficiency stems from the fact that legacy telecoms equipment is network-specific, so that equipment performing similar functions (e.g. switching the signals) has to be installed in each of the networks being operated, leading to an unnecessary duplication of capital expenditure (capex) for the operator.

Second, operators increasingly have the challenge of having to manage the services that they are offering across multiple access networks. Some operators, including typically the incumbent, may offer a variety of fixed and mobile services, and face the challenge of operating a core network that serves each of these access networks. Other operators may only operate a single access network (such as a mobile network), but face similar challenges in offering multiple services

[1] Please refer to the Glossary of Terms at the end of this document for a brief explanation of the meaning of these abbreviations and other technical terms used in this paper.

across that network while interconnecting with a variety of other core networks owned by other operators, to exchange traffic.

The inefficiencies described above are no longer sustainable in many countries: the revenues associated with traditional services are beginning to fall, and operators find it increasingly difficult to maintain their profit margin due to fierce competition. NGNs assist operators by reducing costs, and also provide opportunities to increase their revenues by offering new services. These benefits are described below.

NGN technology makes it possible to replace all the legacy core networks run by an operator with a single scalable next-generation core network (core NGN) capable of supporting all types of services. This is illustrated in Figure 2.1. With the implementation a core NGN, the operator will be able to significantly reduce its opex, as a single operational team will be able to operate and maintain the entire network. Also, since the NGN uses a single technology – typically based on Internet Protocol (IP) – all equipment in the network will be of the same type, leading to larger economies of scale and therefore a reduction in the operator's capex.

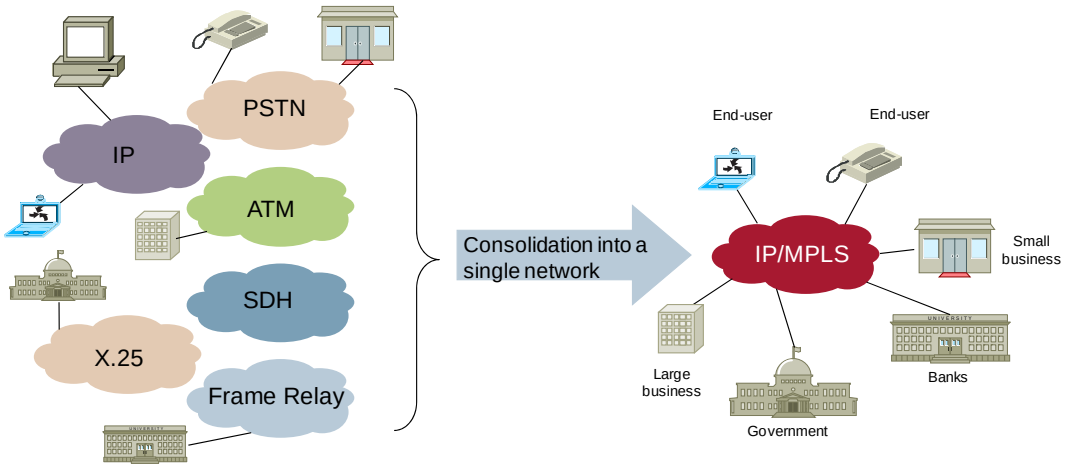

Figure 2.1: Consolidation of legacy core networks into a single core NGN [Source: Analysys Mason]

Another significant advantage is that the same NGN technology can operate over all of the different access networks, including copper wires, mobile (cellular) connections, and wireless radio networks. An access network that uses next-generation technology is called a Next Generation Access network (NGA network). By upgrading to NGA technology, operators that have multiple access networks will benefit from increased interoperability between these networks, and therefore lower costs. Even operators that only have a single access network will

also benefit from the lower cost of purchasing and operating NGA equipment, as well as the ability to offer new services over their network.

Finally, as illustrated in Figure 2.1, one of the key benefits of NGN is that it enables a wide range of services to be provided over a single network. This means that an operator can now provide new services without having to build new, dedicated networks. In other words, NGNs enable services to be provided independently from the physical network, and in particular, independently from the access network: for example, an operator with wireless access infrastructure will be able to provide the same services as a fixed-line operator. The result is convergence of both networks, and services, as described in the next section.

2.2 Introduction to Convergence

Historically, the types of services or content delivered over a particular network have been intimately tied to the nature of the communications network being used to deliver those services or content. Each access network was served by one or more overlapping core networks and offered a different service to a dedicated user device. For example, fixed telephony services and Internet access were provided over copper lines connected to telephones, mobile telephony was delivered using cellular technologies to mobile phones, and TV signals were broadcast using radio waves or via cable to TV sets. This historical situation is illustrated in Figure 2.2 below.

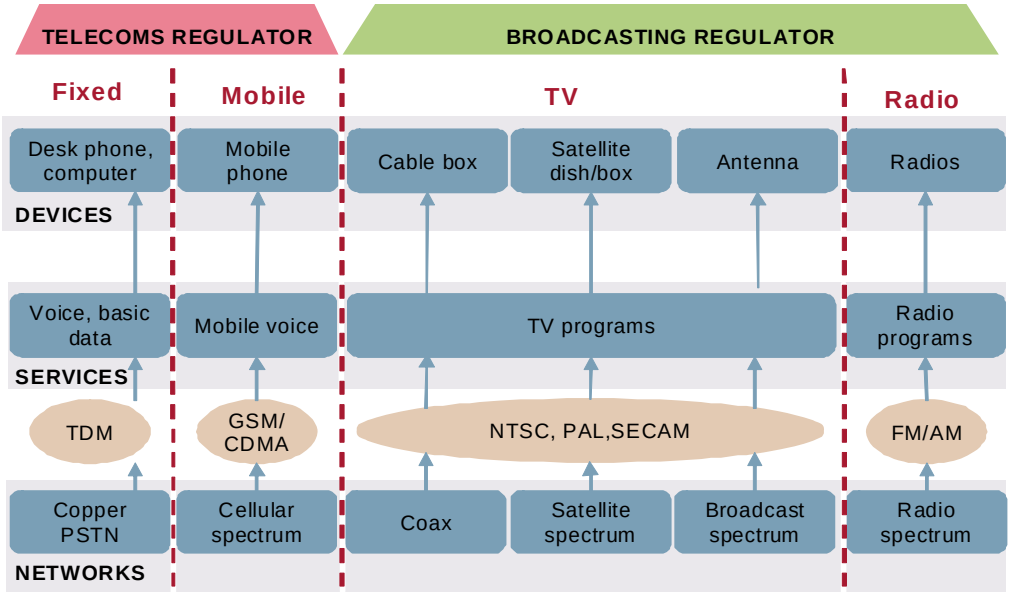

Figure 2.2: Telecoms, radio communications and media industries before convergence [Source: Analysys Mason]

The introduction of NGNs means that operators will have to depart from this legacy model and align their business models in order to enjoy the full benefits of the migration to NGN. The introduction of NGN results in two types of convergence:

- **convergence of networks** – the increasing ability of different types of networks to carry IP-based content means that multiple legacy networks become consolidated into a single NGN network
- **convergence of services** – the increasing ability to offer any subset of voice, data or video services over a single IP-enabled network means that it is no longer necessary to have a dedicated infrastructure to deliver each type of service,

At the same time, to support these developments, devices are beginning to converge to adapt to these networks, thereby increasing the ability to offer either multiple services over multiple networks using a single device.

Figure 2.3 below illustrates the structure of the communications and media industry as a result of convergence. Fixed-line, mobile and wireless NGA networks can connect to a single core NGN. Also, from a service perspective, users with any type of access infrastructure can access any services. Of particular interest is the separation of services and networks. Where formerly the network owner offered services over its own network, now under convergence it is possible for a service provider to offer services, such as VoIP telephony, with little or no interaction with the owner of the network.

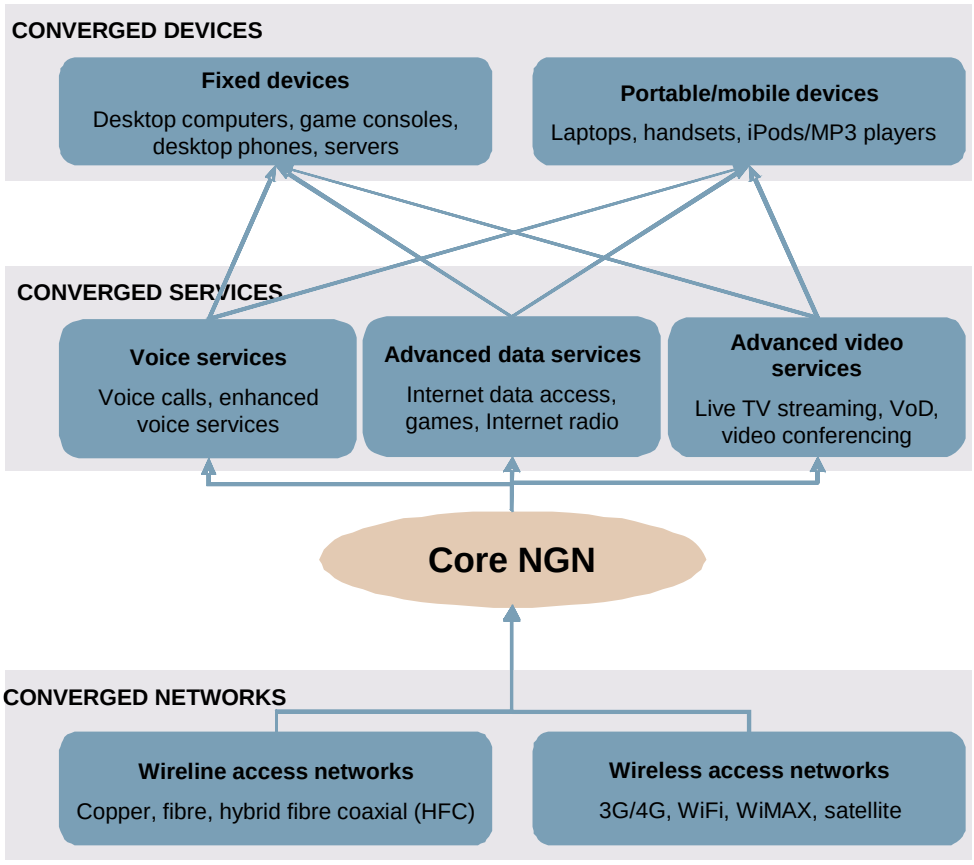

Figure 2.3: Communications and media industry after convergence [Source: Analysys Mason]

TRCSL believes that Sri Lanka has a unique opportunity in this convergent climate to rapidly close the gap that exists with the most technologically developed countries with regard to advanced communications and media services. The very swift process of convergence means that Sri Lankan network operators and service providers do not have to follow the same developmental path as followed in more developed countries: Sri Lanka could leapfrog certain steps and rapidly deploy the most optimal advanced technologies. This would provide a means to close the gap quicker than would otherwise be possible, and give users a chance to enjoy the benefits being experienced by consumers in more technologically developed nations. As discussed in the next section, this provides significant opportunities for benefits to a wide range of stakeholders.

2.3 Potential Benefits of NGN in Sri Lanka

The benefits of NGN will reach all stakeholders in Sri Lanka, including benefits to the operators deploying NGN technology, the broader society using services provided over NGN networks, and the goals of telecoms policy & regulation. Each of these is addressed in turn.

2.3.1 Benefits to Telecoms Operators

As mentioned above, one of the main reasons for operators to migrate to a single NGN network is to optimise both opex and capex, enabling them to maintain their profit margins in a telecoms market that is becoming increasingly competitive. Also, in Sri Lanka as in many other countries the public switched telephone network (PSTN) is reaching the end of its life and needs to be replaced. It is increasingly difficult and expensive to find equipment vendors that can support and maintain legacy telephone switches and it is even more difficult (and very expensive) to replace these switches as all the equipment vendors have now refocused their portfolio on NGN equipment. Therefore, there is a strong incentive for operators to migrate their voice services from the legacy PSTN onto an NGN network.

In addition to these cost savings, NGN provides opportunities for operators to generate new lines of revenue – which are much needed, given the competition in traditional voice services. For example, NGN allows operators to offer TV services such as Video on Demand (VoD). Because NGN networks can support all type of services, there is no requirement to build service-specific networks and therefore the time to market for new services is significantly lower than that associated with legacy networks.

2.3.2 National Benefits of NGN

In an era where many countries have embarked on a fundamental transformation catalysed by the progress in telecoms technology, it is important that Sri Lanka is not left behind. In order to better understand the impact of NGN on Sri Lanka, the potential benefits in three key areas are examined: (a) social benefits, (b) economic benefits and (c) environmental benefits.

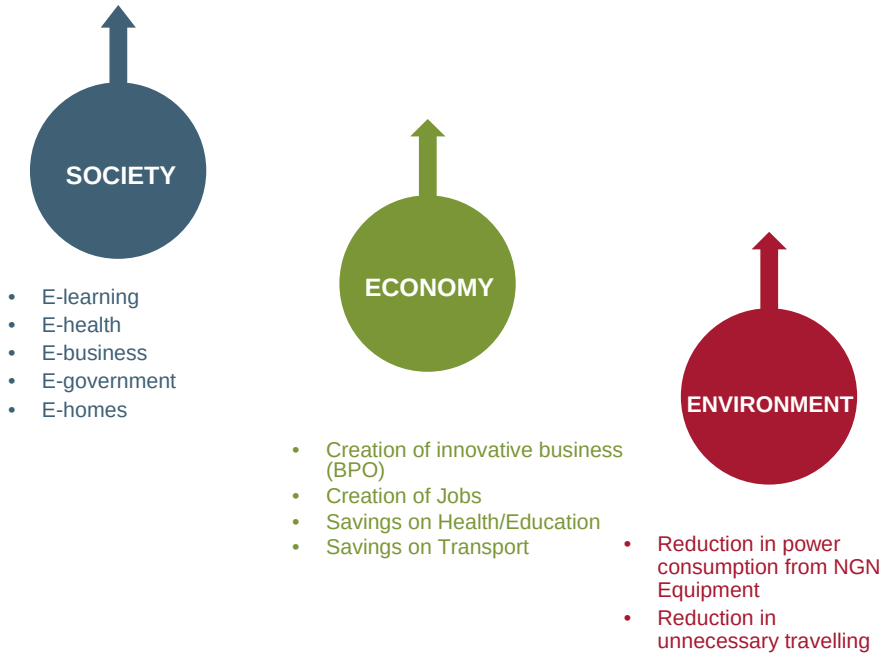

Figure 2.4: Benefits of NGN in Sri Lanka [Source: Analysys Mason]

Social Benefits

Many of the benefits of NGN result from lowering the cost of transactions between parties, such as the cost of conveying information, or the cost of travelling to receive or provide services. Below, the social benefits of NGN in terms of e-learning, e-health, e-business, e-government and e-homes are described.

- *E-learning*

Education is an area where arguably NGN could have the most significant impact in Sri Lanka. Students of both primary and secondary education are currently facing the problem that they have to take private tuition in addition to their state education in order to develop the full set of skills that employers' desire. As for tertiary level education, the availability of university places is decreasing alarmingly and as a consequence not all students wanting to access tertiary education are offered the opportunity to do so.

NGN could alleviate these problems by making available virtual classrooms and virtual universities. In such an e-learning environment, school teachers or college professors can deliver a full lecture through a multi-party video conferencing facility, supported by appropriate material such as tutorials sent via email to the students. The key to virtual classrooms is that qualified teachers and professors can reach out to many more pupils and students, without requiring either party to travel to a school or university. This will have the advantages that, as more and more people are able to benefit from primary/secondary and university education, the average level of skills will increase, ultimately resulting in job creation. On the other hand, significant public-sector

savings can be achieved through the implementation of a leaner education system (e.g. less class rooms needed).

- *E-health*

The development of NGNs, and in particular the wide availability of broadband services, will also benefit health care services in terms of primary medical requirements. People with access to broadband facilities will be able to have a virtual medical consultation with a doctor by means of a video conference, and the resulting prescription or treatment can be recorded in an online system, providing access to the medical history of all patients. This advanced medical environment will help alleviate the efficiency issues that the healthcare sector faces in Sri Lanka.

- *E-business*

As an example of e-business applications facilitated through the deployment of NGNs, e-trading and online auctions are gathering significant momentum in Sri Lanka. For example, Alibaba[2] provides an online facility for citizens and businesses to advertise items for sale. At the same time, e-commerce websites enable Sri Lankans to easily access foreign markets in order to buy and sell products and services.

- *E-government and Social Cohesion*

Governments the world over are increasingly viewing Information and Communication Technology (ICT) as a key enabler for accelerating economic and social development in their countries.

The deployment of NGN throughout Sri Lanka will provide a solid platform for similar e-government initiatives in the future, and make a significant impact on the social cohesion of the country as these initiatives will provide connectivity to under-served areas, giving people in these areas the opportunity to take part in the ICT revolution currently underway in Sri Lanka. This is commonly referred to as bridging the digital divide. As a result, individuals will have increased opportunities to network with one another, using voice, video, and other innovative applications, and also will be able to access and develop new content.

- *E-homes*

The implementation of NGN will enable new applications in the home. For example, broadband connectivity will enable users to have access to electronic security systems at commercial and domestic levels. State-of-the-art services such as burglar and fire alarms, and surveillance cameras are all applications that can be developed to be accessed remotely (e.g. from a portable device while away from home) to help improve many security-related issues in Sri Lanka. Also, it will be important to ensure that the benefits of NGN are also brought to elderly Sri Lankans, with remote monitoring that makes it possible to extend the duration for which older people are able to remain living in their homes, bringing significant reductions in public health spending.

---

[2] Alibaba.lk is a full-service Internet marketing and advertising agency.

Economic Benefits

Several studies have shown that there is a correlation between the increase in broadband penetration within a country and the growth of its economy. For instance, the report *The Economic Impact of Stimulating Broadband Nationally*, published in February 2008 by Connected Nations (USA)[3] estimates that by increasing broadband penetration by 7% the USA could gain the following economic benefits:

- USD92 billion through 2.4 million jobs created or saved annually
- USD662 million per year savings in healthcare costs
- USD6.4 billion per year in savings from reduced driving
- USD35.2 billion in value from 3.8 billion hours saved per year from accessing broadband at home
- USD134 billion per year in total direct economic impact of accelerating broadband across the USA.

Also, on a smaller scale, the Australian Report *True Broadband: Exploring the economic impact*[4] estimates that the availability of broadband in the region of Brisbane and Moreton (in Queensland, Australia) would result in a more than AUD4 billion increase of output within 15 years, with more than two-thirds of the output increase coming from industries other than telecoms. This report also estimates that the availability of broadband in that region would lead to the creation of 1500 new jobs.

In the case of Sri Lanka, the deployment of NGNs and the wider availability of broadband services are likely to bring even bigger economic benefits, proportionately speaking, than those for the developed countries mentioned above. In general, emerging nations do not have extensive legacy ICT systems and networks, and therefore if they migrate to new systems the costs of maintaining and transitioning from these existing systems is not great.[5] Although the economic benefits in developing countries are likely to be larger, they are more difficult to measure given the relatively recent deployment and the low penetration to date. A recent World Bank paper estimates that in emerging markets a 1.38% increase in per-capita GDP will result from each 10% increase in broadband penetration[6] – a higher rate than in developed countries (but less statistically significant).

In Sri Lanka, the Business Process Outsourcing (BPO) sector provides an example of the economic benefits that could accrue from NGN. In BPO, an organisation outsources the operation and responsibilities of specific business functions or processes (e.g. customer care services) to a third-party service provider. Countries such as Sri Lanka are prime targets for such investment by

---

3 Available at http://connectednation.org/_documents/Connected_Nation_EIS_Study_Executive_Summary_02212008.pdf

4 http://www.citynet.nl/upload/ERN01_Final_Report_2_Broadbandproductivity_1.pdf

5 See: *Information and Communications for Development: Extended reach and increasing impact, Key trends in ICT development*, World Bank, 2009.

6 Id. at page 45.

multi-national companies due to the relatively low cost of labour. However, one of the key factors in deciding where to invest is the access to telecoms services and connectivity, as data centres have to be linked to other parts of the businesses they serve, which are usually located in a different country. Therefore, the early adoption of NGN in Sri Lanka would give the Sri Lankan BPO sector a competitive advantage over neighbouring countries such as India, and could attract significant investment from foreign companies.

Environmental Benefits

NGN networks can have both direct and indirect environmental benefits. In terms of direct benefits, as explained in Section 2.3.1, one of the key drivers for the adoption of NGN is the possibility of consolidating a number of different networks into one. This means that, as a whole, operators will need significantly less equipment to run their networks. Also, NGN equipment is more energy-efficient compared to legacy equipment, as it uses the latest technology. The combination of fewer items of equipment and decreased power consumption means that NGNs will be ecology-friendly, contributing to a decrease in CO_2 emissions.

In terms of indirect benefits, the services provided over NGNs can reduce the energy consumption of the people using them. For instance, travelling requirements can be significantly reduced through teleworking, e-learning applications or even e-health applications, which will significantly reduce CO_2 emissions from the vehicles used for this transportation. For example, in Europe the FTTH Council has estimated that the deployment of NGA networks could save the CO_2 equivalent of driving 4600km by car per year for every household in the country.[7]

2.3.3 Sectoral Benefits

Finally, NGN implementation and the resulting convergence would help to meet a number of goals for the telecoms sector in Sri Lanka. The lower cost of NGNs will help to promote the deployment of, and access to, networks and will result in increased Internet access and usage. At the same time, the convergence of services can facilitate increased entry of new service providers to compete with existing ones, and improve the delivery of existing services as well as allowing for new innovative services to emerge.

2.3.4 Summary

The migration to NGN technology in Sri Lanka promises significant benefits for operators, businesses, society and the telecoms sector. This migration also represents a significant shift from traditional business models, which is a cause of concern for both operators and regulators around the world. For operators, the migration to NGN represents a complex network transformation, and they will need to understand the benefits as well as the risks involved in order to plan appropriately.

---

7 FTTH Council, FTTx Summit in Munich, 2009

In addition, the migration to NGN provides a regulatory challenge, as networks and services that previously were distinct will begin to compete with one another. This document seeks to understand the views of all relevant stakeholders on these issues, as the TRCSL works towards developing an NGN policy & regulatory framework.

Question 1: Do you think that you or your company could benefit from the services that will be made possible by the implementation of NGN networks? If yes, please explain by means of examples.

Question 2: Do you think that the incentives available in the private sector for operators to begin to migrate to NGN are sufficient to promote adoption, or do you believe that the broader social benefits warrant additional steps being taken by the government to promote this migration? If so, what steps would you recommend the TRCSL investigate to promote such migration?

Question 3: Do you foresee any negative consequences of the migration to NGN for the telecoms sector or broader society? If so, please describe them, along with any steps that the TRCSL could investigate to mitigate or avoid those consequences.

---

3 Technical Issues

3.1 Definition of NGN

As explained in Section 2, NGNs essentially involve the replacement of all the different legacy networks with a single unified network, based on Internet protocol (IP) technology, which will provide all the different types of services. The International Telecommunications Union (ITU) provides the following more formal definition of NGN in its Y.2001 Recommendation:

> *A Next Generation Networks (NGN) is a packet-based network able to provide Telecommunication Services to users and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent of the underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and services of their choice. It supports generalised mobility which will allow consistent and ubiquitous provision of services to users.*[8]

The present paper follows this definition by the ITU, and in the rest of this section discusses the main technical issues that should be understood by stakeholders in this consultation.

3.2 NGN Architectures and Topologies

In order to understand the architecture of an NGN, it is important to differentiate between two parts of the network: (a) the core network (core NGN), which provides a unified packet-based network based on IP technology, and (b) the access network (NGA network), which connects end users to the core NGN by means of fixed, mobile or wireless infrastructure. Figure 3.1 below illustrates these two components of an NGN. A core NGN can support a multitude of access infrastructures, including wireline and wireless networks such as WiMAX, accessed by end users with a variety of devices. This means that the services can be provided irrespective of how users access the network.

[8] *ITU-T Recommendation Y.2001*, ITU, December 2004 – General overview of NGN.

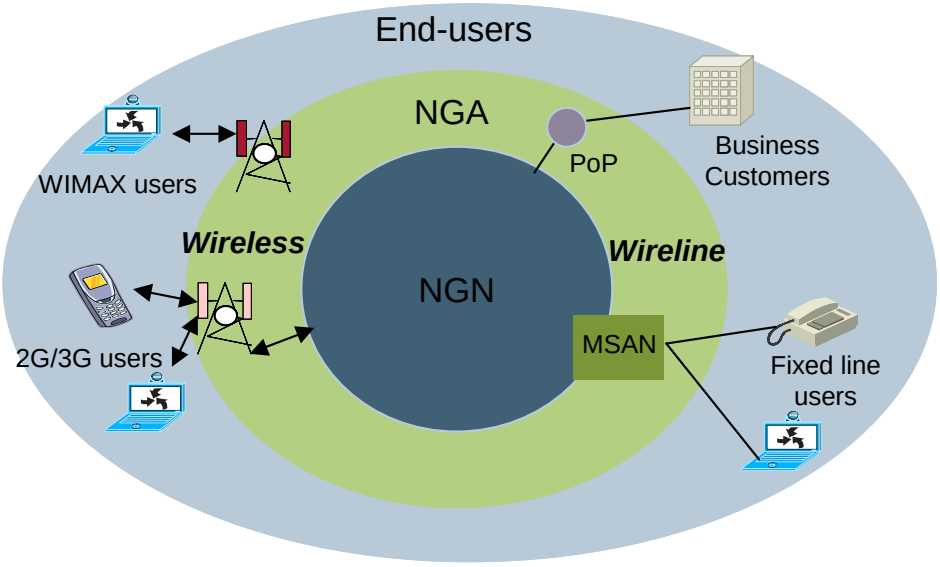

Figure 3.1: Illustration of the parts of an NGN [Source: Analysys Mason]

The architecture of NGNs includes the principle of separating, from a physical point of view, the transport and routing of traffic and the definition and creation of the service. This principle allows third party service providers to provision services on a host network via standardized and open interfaces between the third-party's server and the host's transport network. With reference to the Open Systems Interconnection (OSI) reference model there is some discussion about where the transport and service layer demarcation point is, however Figure 3.2 below illustrates the generally accepted definition.

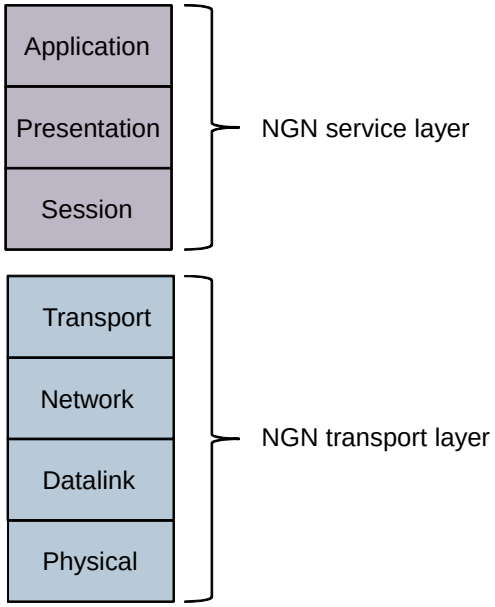

Figure 3.2: Service and transport layer demarcation of the OSI model [Source: ITU, NGNuk]

However, the host transport network must be able to support the specific characteristics of the service, in particular, bandwidth and quality of service. The aim of this architecture is to build a converged network where any service (e.g. voice and data) shares the same transport infrastructure. This architecture applies to both mobile and fixed networks. One other aim of this architecture is that it opens the way for a new breed of services, for example, converged multimedia services and converged fixed-mobile services.

It is not yet clear to what extent features such as the separation of service and transport will remain possible in the architectures finally implemented. A number of operators intend to implement their NGN using centralized platforms for service provision, affecting the ability of independent service providers to integrate their services into the NGN platform. Whether independent service providers will be able to do so also depends on the availability of open and standardized interfaces. Furthermore, such a configuration of services and the centralization of the control function have implications for the locations at which traffic can be exchanged between networks.

In most NGNs planned by incumbents, services tend to be provided using centralized platforms. Operators with market power may not have an incentive to open their networks to competition at the service level, and may instead want to limit use of these capabilities. This impacts on the ability of independent service providers to integrate their services into the NGN platform. The next subsection reviews the architecture of core NGNs and NGA networks, and then focuses on NGN-enabled services. Section 5 below discusses the policy issues relating to the impact that operators with market power may have on the ability of independent service providers to offer services on the NGN platform.

3.2.1 Next-generation Core Network

Legacy PSTN networks are based on *circuit-switched* technology, which allocates a dedicated physical path to each voice call and reserves an associated amount of dedicated bandwidth (usually a PSTN voice channel has a bandwidth of 64kbit/s) across the network. This bandwidth is dedicated to the call connection for the duration of the call whether or not any audio voice is being exchanged between the callers.

In contrast, NGNs are based on *packet-switched* technology, in which voice is sent in 'packets' of digitised data using Voice over IP (VoIP). Without any special network features being applied, i.e. Quality of Service (QoS) mechanisms, each voice data packet competes equally with any other data packets (voice or other types of data on the converged NGN) on the network for the available network resources, i.e. bandwidth. No dedicated bandwidth is reserved for voice data packets for the duration of the call. QoS mechanisms can prioritise voice data packets over other types of data packets, helping to ensure that the voice data packets pass through the network unhindered and within strict timing rules associated with the voice service.[9] Since voice streams have to compete (or 'contend') with other data streams for available resources in an NGN, voice packets can be

[9] *An abundance of bandwidth can also improve call quality without QoS mechanisms, if there is sufficient bandwidth for all services / calls. However, the lack of QoS mechanisms and constrained bandwidth can lead to unacceptable call quality at peak times, while requiring an inefficient investment in bandwidth.*

delayed in some routers in the network, having to "queue" before being processed. This may lead to a degradation in the quality of the service provided to the customer. Therefore, as mentioned in the ITU definition, a Quality of Service (QoS) mechanism has to be implemented in NGNs to ensure voice packets are prioritised over other data streams that may be less sensitive to delay, to provide the same quality for the voice service as in PSTN networks (see Section 3.3.1 for more details on Voice over IP).

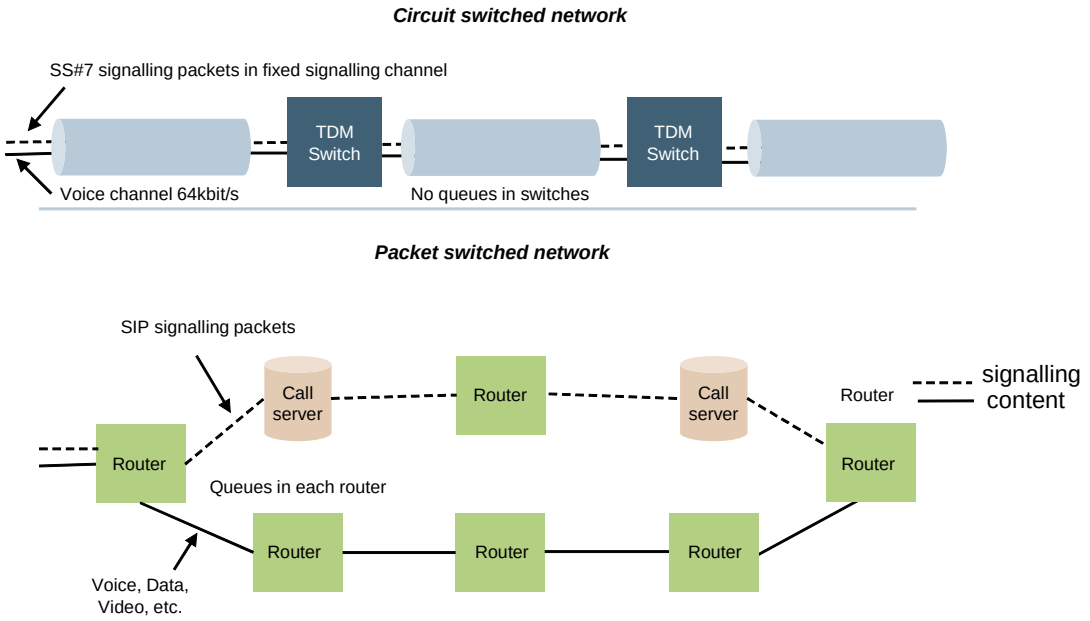

Figure 3.3: Comparison between circuit-switched and packet-switched networks [Source: Analysys Mason]

Figure 3.4 below compares the architecture of a legacy PSTN network with that of an NGN. It can be seen that the separate layers of local and transit switches are replaced by call servers in a single layer structure. Typically, a PSTN network of 100 local and 10 transit switches might be replaced by a few (less than five) call servers in an NGN. This implies that fewer network nodes are required, yielding the significant opex and capex savings as mentioned earlier (Section 2.3).

Interconnection with other operators' networks is implemented by border gateways that control access to the network. If the network interconnects with an older circuit-based network, media gateways may be needed to convert the signals from a packet-switched basis. Interconnection architecture is further discussed in Section 3.5 below.

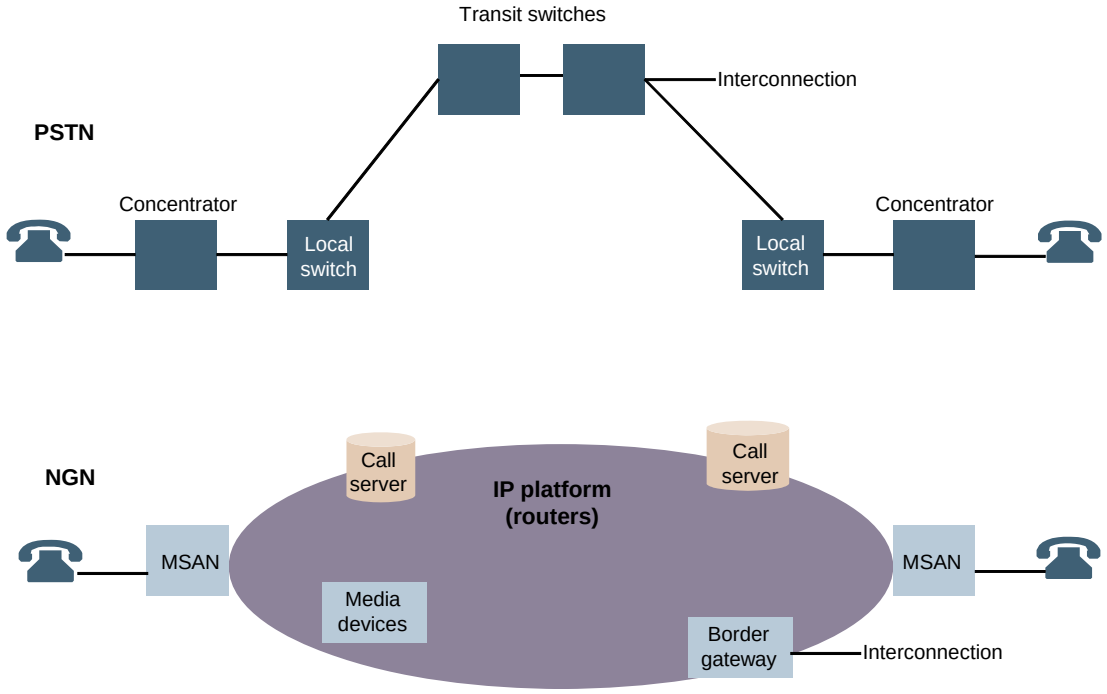

Figure 3.4: Comparison of the traditional PSTN and voice services on NGN [Source: Analysys Mason]

It is also worth noting that Sri Lanka has embarked on the construction of a National Backbone Network, which will further facilitate the migration to NGN for existing operators, especially in areas where they do not have any infrastructure. The deployment of a fibre-based backbone means that the network will be future-proof in terms of capacity, as fibre can support virtually unlimited bandwidth (in contrast with, for example, microwave technology). For example, fibre systems used in submarine cables can support bandwidths in excess of 3 terabits per second, which is 10 000 times the bandwidth supported by a typical microwave system.[10]

3.2.2 Next-generation Access Network

A core NGN has little benefit if end users cannot obtain a connection to it with a reasonable bandwidth. It is NGA networks that fulfil this role. It is important to note that core NGNs will inter-operate with legacy access networks (both wireline and wireless) as well as NGA networks, which will enable operators to make the transition to NGNs more smoothly. This consultation paper differentiates between two different types of NGA networks: wireline and wireless. In order to explain wireline NGA, one must first consider the legacy local-loop access architecture, and then the paper describes two different NGA architectures: (a) wireline NGA using the existing local loop, and (b) wireline NGA using fibre to the home.

[10] Assuming a microwave system based on 28MHz of spectrum in the 2.5GHz band.

Existing Local-loop Wireline Access

Figure 3.5 illustrates the legacy local-loop access network, which is based on twisted copper pairs. In order to access broadband, the user uses a Digital Subscriber Line (DSL) modem connected to the telephone line. At the Main Distribution Frame (MDF) in the local exchange, a splitter is used to separate the voice signal from the DSL-based Internet data stream. Telephony is handled by a remote concentrator unit, and Internet access by a Digital Subscriber Line Access Module (DSLAM) and an associated Network Access Server (NAS). The Network Termination Equipment (NTE) represents the demarcation between the operator and the end-user environment.

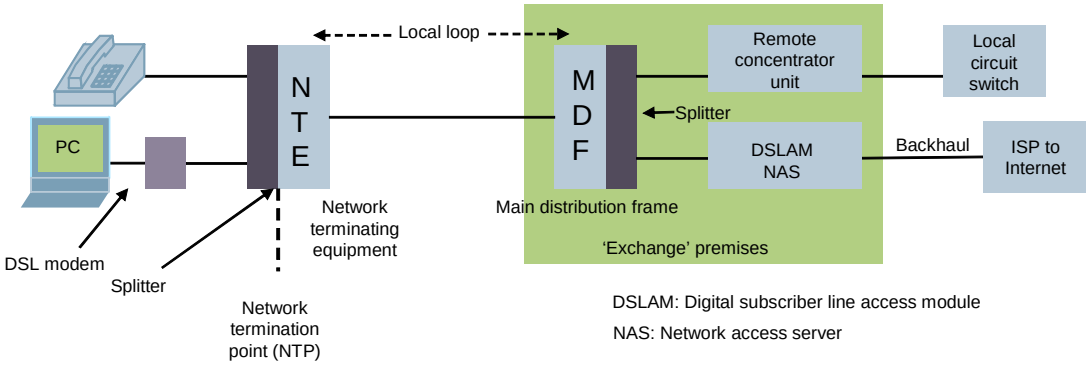

Figure 3.5: Legacy Local loop access network [Source: Analysys Mason]

Wireline NGA using the Existing Local Loop

Figure 3.6 illustrates how the current local access network can evolve to an NGA network, while keeping the copper-based local loop. In an NGA network, new equipment is provided to the end-user, normally by the service provider, to communicate with the new network. The main function of this equipment is to separate the different types of traffic. In the network, the DSLAM and telephone concentrator are both replaced by a single piece of equipment in the local exchange known as a Multi-Service Access Node (MSAN). The MSAN can handle traditional services such as telephony and Internet access but can also support new services such as Internet TV (IPTV) and Video on Demand (VoD).

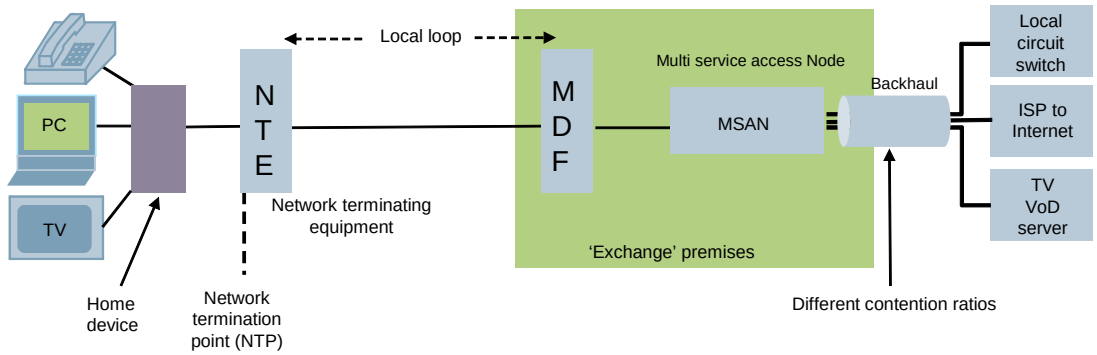

Figure 3.6: NGA architecture [Source: Analysys Mason]

In such an NGA network, the access speeds are limited by the length of the copper loop, and therefore shortening the copper loop yields higher speeds. One way to achieve this is for operators to replace the link between the exchange and the street cabinet near the customer with a fibre connection, while leaving the existing copper wires between the cabinet and the end user (the sub-loop). Since the copper sub-loop starts from the cabinet, in this configuration the MSAN needs to be sited in the street cabinet instead of in the local exchange. This architecture is known as Fibre to the Cabinet (FTTC). Typically, existing street cabinets cannot be used to house a 'mini-MSAN' as not enough space is available, and therefore new street cabinets need to be installed. A typical FTTC architecture is shown in Figure 3.7.

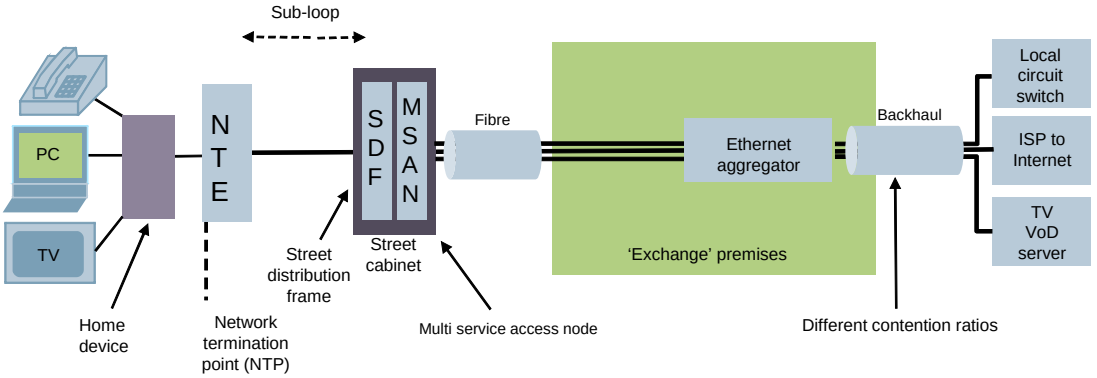

Figure 3.7: NGA using an FTTC architecture [Source: Analysys Mason]

Wireline NGA using Fibre to the Home

In order to achieve even greater speeds and support a wider range of applications, it is possible to remove the copper from the network completely and replace it with fibre all the way to the end user's premises. This solution is commonly referred to as Fibre to the Home (FTTH). There are two types of FTTH architectures: (a) Passive Optical Networks (PONs) and (b) Point-to-Point (P2P) networks. These are discussed below.

A PON has a point-to-multipoint, FTTH-based architecture, in which unpowered optical splitters are used to enable a single shared optical fibre to serve 16 to 1024 premises. The other PON components include the Optical Line Termination (OLT) at the service provider's central office, and the Optical Network Termination (ONT) located at the end user's premises. This is illustrated in Figure 3.8.

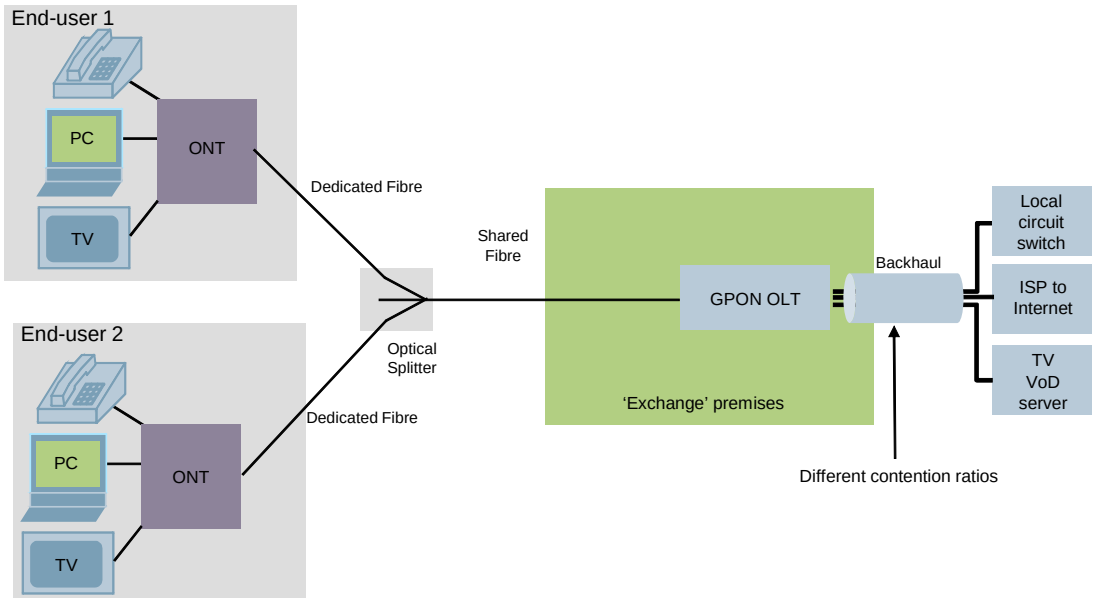

Figure 3.8: NGA network using FTTH: PON architecture [Source: Analysys Mason]

P2P architecture is based on Ethernet technology and uses a dedicated fibre for each individual user. This is illustrated in Figure 3.9 below.

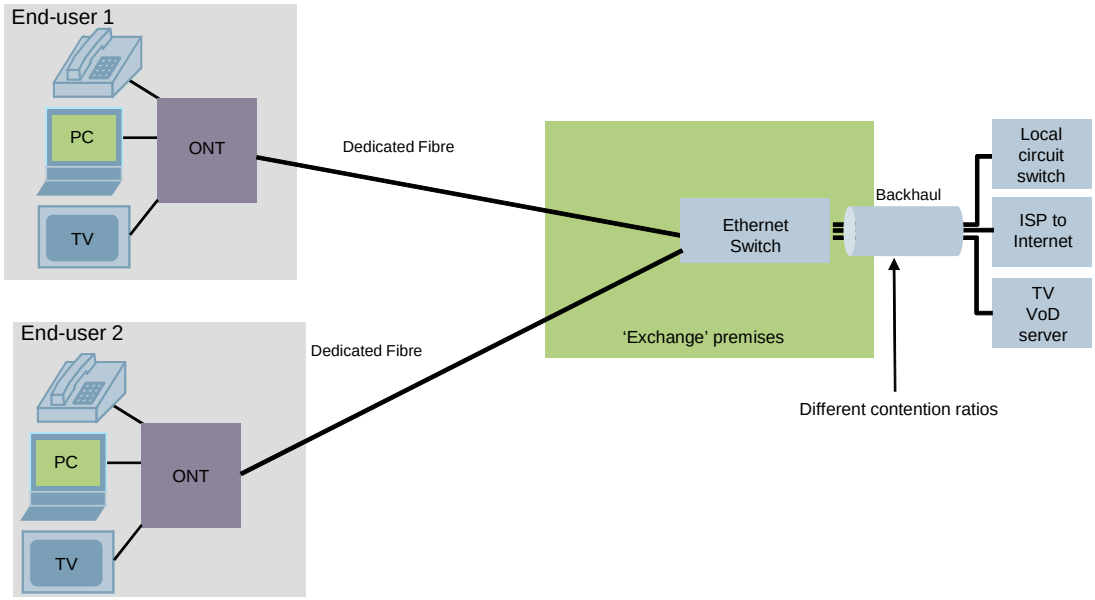

Figure 3.9: FTTH: P2P architecture [Source: Analysys Mason]

The difference between PON and P2P architecture is that in P2P each home has its own dedicated fibre from the exchange; this means higher speeds, but also greater costs. Figure 3.11provides a comparison of typical bandwidths available using the different architectures.

Wireless NGA

Wireless access networks are becoming increasingly popular to connect end users, especially in emerging economies where the wireline access infrastructure is not well developed. There are currently three families of mobile access technologies: GSM, CDMA and WiMAX. The evolution of these technologies is illustrated in Figure 3.10 below.

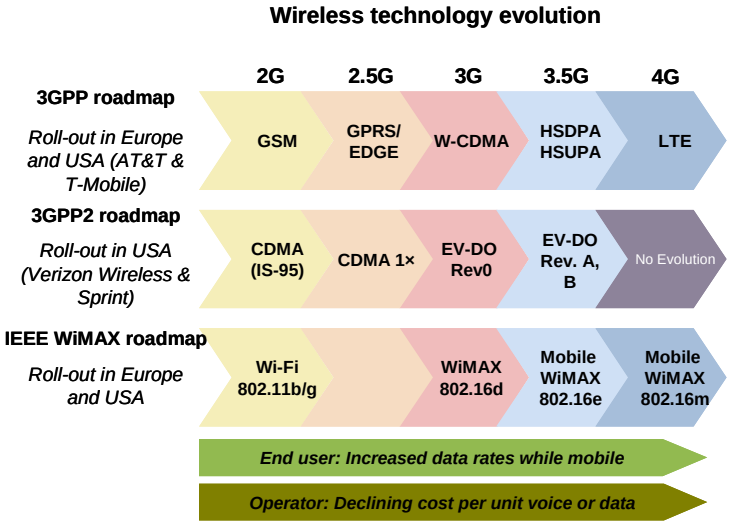

Figure 3.10: Wireless access technology roadmap [Source: Analysys Mason]

GSM (Global System for Mobile communications) and its associated family of standards are the most popular standards for mobile telephone access in the world; according to the GSM Association, as of the middle of 2009 there were over 3.5 billion mobile GSM subscribers in over 200 countries, representing a global market share of 89.5%. The development of these standards is supported by the Third-Generation Partnership Project (3GPP) which emerged from the collaboration of different groups of telecoms associations throughout the world.

CDMA (Code Division Multiple Access) and its family of standards originated from the Interim Standard 95 (IS-95), which was developed by Qualcomm. CDMA2000 was the first CDMA-based digital cellular system, and is therefore a second-generation (2G) mobile system. Supporting the development of these standards is the 3GPP2, which emerged from the collaboration of associations in Japan, China, North America and South Korea.

WiMAX (Worldwide Interoperability for Microwave Access) is a wireless broadband standard based on the 802.16 family of standards developed by the Institute of Electrical and Electronics Engineers (IEEE). There are two versions of WiMAX technology, fixed and mobile, and these have separate standards, namely 802.16d and 802.16e respectively.

As shown in Figure 3.10, the 3GPP and WiMAX standards are still both evolving and will both provide a fourth generation of devices and networks. However, the CDMA family of standards is not future-proof as its development has been stopped in favour of Long Term Evolution (LTE), a technology belonging to the 3GPP family. This is of concern in Sri Lanka as many operators use CDMA technology to provide fixed voice services.

In wireless access systems, efficient use of the spectrum is crucial as spectrum is a finite resource that is highly valuable for both operators and regulators. The increase in bandwidth that can be provided using wireless technologies has mainly been achieved by maximising the spectrum efficiency of the technologies (i.e. increasing the number of Mbit/s that can be carried in each MHz of spectrum). 3GPP standards can provide mobile broadband to end users which, depending on the exact technology used, can achieve a peak bandwidth up to 100 Mbit/s, as shown in Figure 3.12.[11]

Technology	*Media*	*Shared/Dedicated*	*Typical peak bandwidth*
Dial-up	Wireline Copper	Dedicated	64kbit/s
ADSL	Wireline Copper	Dedicated	2-5Mbit/s
VDSL+	FTTC	Dedicated	20Mbit/s
PON/Ethernet	FTTH	Shared/Dedicated	10Mbit/s – 1Gbit/s
3G	Wireless	Shared	384kit/s
HSPA	Wireless	Shared	7.2Mbit/s
HSPA+	Wireless	Shared	28.8Mbit/s - 42Mbit/s
LTE	Wireless	Shared	100Mit/s

Figure 3.11: Comparison of fixed and wireless peak bandwidths [Source: Analysys Mason, 3GPP, Ericsson]

[11] In cellular wireless technologies a ‘cell’ is a common area within which users have to compete for shared resources. The figures quoted here are for HSPA+ technology.

However, the typical peak bandwidth available using mobile broadband (wireless) technology compares relatively poorly with the bandwidth possible via wireline technology, in particular when one considers that the above stated bandwidths must be shared between all active mobile users in the same cell sector. This is a significant issue in dense urban areas where the high population density means that there can be many simultaneous active users. This is why fixed access infrastructure is promoted by regulators in order to make possible the full benefits, such as, high definition TV, that NGN can bring.

Further, it should be noted that wireless bandwidth is directly related to how much spectrum is available for that network / technology. Spectrum has already been allocated to service providers for the provision of legacy mobile services in many countries. Policy makers and regulators must ensure that spectrum allocation and indeed re-allocation of spectrum through, for example, the so called 'digital dividend', does not hamper competition between established mobile operators and potential new entrant service providers and the deployment of new NGA networks and services. In many countries, established operators have delayed new entrant last mile connectivity and competitor access, therefore hampering competition. NGA networks, however, allow new entrants and other service providers to deploy alternative technologies such as WiMAX that facilitate high speed broadband Internet access over wireless connections. The TRCSL seeks to ensure that such deployments are possible and that healthy competition ensues for the benefit of the market.

Question 4: Do you see any issues or opportunities relating to access to, and use of spectrum now? Will issues and opportunities potentially emerge from telecommunications and broadcast convergence?

3.3 Next-generation Services

This section explains the two most relevant converged services – VoIP and IPTV services – being provisioned today by various converged operators around the world, and which are of interest in Sri Lanka.

3.3.1 Voice over IP (VoIP)

NGNs no longer support the circuit-switched technology that was used in the legacy PSTN network, and instead voice is sent in data packets over the IP-based network. This consultation paper loosely defines VoIP as the set of protocols required to transport voice services over an NGN. There are several types of implementation of VoIP that are found in various markets worldwide: enterprise VoIP, mass-market retail VoIP, and carrier internal VoIP (see Figure 3.12 below).

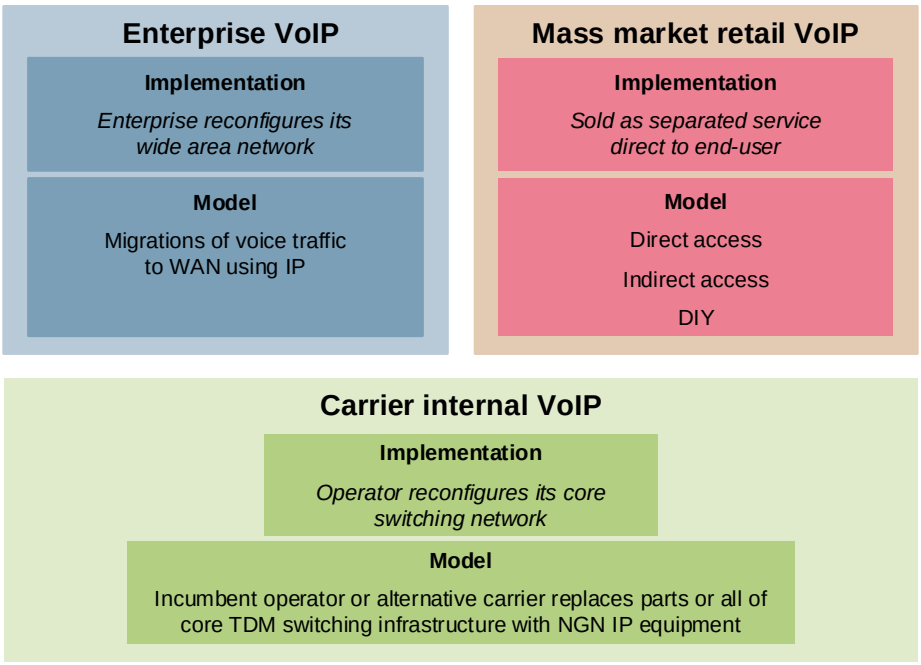

Figure 3.12: Implementations of VoIP [Source: Analysys Mason]

Of these different types of VoIP implementation, **carrier internal VoIP** is the result of operators (carriers) moving to NGN and carrying voice traffic using IP. This will become the norm as over time the majority of (or all) voice networks upgrade to NGN. Carrier internal VoIP will be a significant focus of the NGN policy & regulatory framework being put in place in Sri Lanka.

On the other hand, **enterprise VoIP** is a private service that businesses may deploy over their own internal wide area networks (WANs). Companies already using a WAN for data services to connect offices can utilize the WAN to also offer voice services between those offices, thus saving costs. Currently, calls to numbers outside of the company would exit the WAN and be delivered to the PSTN where they are terminated. As the PSTN migrates to NGN, it is expected that private WANs will interconnect with the NGN directly using IP. From the perspective of the policy & regulatory framework, enterprise VoIP services are typically not regulated since they used only internally within the organisation and not sold as a commercial service outside the company.

During the migration to NGN (resulting in carrier internal VoIP), the most significant impact on operators' business models – and therefore the most significant regulatory challenges – is likely to arise from three forms of **mass-market retail VoIP**:

- **Direct access** – This is the most common type of mass-market retail VoIP. In this model, the broadband access connection is sold by the same operator as the voice calls, for instance when a cable operator that can provide broadband service also offers voice services and interconnects with the PSTN. The provider usually offers a bundle of Internet access and voice services, but the broadband connection can be used for voice only. Full 'triple-play' bundles

(including IPTV as well as Internet access and voice) are increasingly common in many markets, including Sri Lanka.

- **Indirect access** – Another form of mass-market retail VoIP service is based on the indirect access model, in which a provider offers voice services over *another* operator's broadband network. An example of such a service, which is not available in Sri Lanka, is Vonage in the USA. Indirect access VoIP services can use traditional telephone handsets connected to an adaptor which in turn is connected to the broadband modem. As the adaptor can be moved while keeping the original phone number and service plan, these services are sometimes referred to as "nomadic" and can provide great flexibility for users.

- **Do-It-Yourself (DIY)** – The last type of mass-market retail VoIP is the DIY model popularized by services such as Skype. In the original model, the supplier provides software that enables free voice calls between end users with the same software. Calls generally can be made over any type of broadband connection, unless this is restricted by the broadband access provider. For example, Google recently launched a Skype-like service which allows broadband users to phone US landlines for free. This service is currently available in all countries, including Sri Lanka.

Note that *mobile* VoIP taking any of these three forms (particularly DIY) is also technically feasible.

Such services embody the possibilities of NGN by allowing entrants to provide voice services at relatively low cost, but also create significant challenges to the underlying network providers' business models that this consultation is seeking to understand.

Question 5: Do you believe that innovative voice services such as Skype and Google represent a threat or an opportunity for the Sri Lankan telecoms market? What are the roadblocks to realising benefits from such services?

3.3.2 Video over IP

There are two broad ways in which video and TV services can be delivered to consumers over NGNs. In **over-the-top video** the video content is streamed or downloaded by the user over a general Internet connection. In **dedicated delivery** the content is delivered using a dedicated system such as a satellite broadcasting system or a broadband telecoms network. Both of these delivery paradigms can be used to offer broadcast video (sometimes referred to as linear video) as well as Video on Demand (VoD).

IPTV is defined as TV and video services delivered to a TV set over a closed, managed IP network (fitting into the dedicated delivery paradigm). This definition *excludes* video services such as YouTube and iPlayer that are usually (though not always) delivered to the PC, rather than the TV, over the public Internet. While these services may not technically constitute IPTV, their usage can be significant and thus, such services should be included in a consideration of the impact of NGN services.

In many developed markets, a package of digital TV channels, supplemented by VoD and personal video recorders (PVRs), is no longer sufficient to attract and retain subscribers, no matter how competently it is delivered. IPTV operators need to clearly differentiate their services from those of their competitors. This is where the availability of content plays a key role in establishing fair competition. For example, Ofcom, the UK regulator, recently required Sky to provide two of its sports channels (Sky Sports 1 and Sky Sports 2) on a wholesale basis to other operators, to enable them to compete with this premium content effectively. This has vast implication in terms of regulation as it means that media content can no longer be treated in isolation from telecoms, and therefore implies a merging of the media content regulator and the telecoms regulator, as has already been done in the UK.

Question 6: Do you believe that the range of TV content available is an important or primary basis for customers' decision to purchase telecoms services? Do you believe that a merger between the media regulator and the TRCSL would provide an environment which promotes competition and increases user choice?

3.4 Migration Issues

The migration from legacy networks to NGNs represents a significant cost for operators, which they must consider closely. The process followed and its timing may have a significant impact: if regulation is introduced too early in the process, this may discourage operators from investing in NGNs, while if regulation is introduced too late this may result in the continued dominance of the incumbent operator. Therefore it is important for TRCSL to develop the roadmap of NGN migration for each operator in Sri Lanka. This will ultimately lead to the development of a suitable migration roadmap for harnessing telecommunication in to broader development goals of the country. In addition, given the interconnection and interoperability issues that will arise for operators (described in the next section), it is also important for them to understand the general migration roadmap as well as the regulatory roadmap, in order to guide their own investments.

For the core NGN, the migration options for operators include:

- retain the current legacy circuit-switched network
- introduce an overlay of soft switches for use where additional capacity is needed, or for business customers that need additional features
- replace the current circuit-switching equipment in a programme planned over several years.

For wireline NGA the options are:

- upgrade DSL modems for faster Internet access (e.g. by introducing ADSL 2+), and optionally offer IPTV/VoD over the broadband component
- replace DSLAMs with MSANs and offer triple-play services
- introduce FTTC or FTTH to offer an even wider range of services and higher bandwidths to customers.

For wireless operators, the options are:

- upgrade access network to latest standard, such as 4G
- upgrade core packet network including enabling QoS
- introduce packet switching in the backhaul network

As part of this consultation, a number of case studies have been developed to identify international best practice regarding migration to NGN. These are described in Annex A. The results are mixed: at one extreme, the incumbent in the UK is replacing the whole of its networks (both core and access) with NGNs, while Singapore is financing the deployment of a national broadband network. At the other extreme, in India the migration to NGN is driven the operators and likely to take many years.

The TRCSL considers that it can play a role in the migration to NGN by providing regulatory clarity with the forthcoming NGN policy & regulatory framework, which will be based in part on the results of this consultation.

Question 7: Please describe your planned migration to NGN. (a) What is your technical strategy to migrate to NGN, if any? (b) What will be the key phases in your migration to NGN, and what phase are you currently in? (c) What is your anticipated timescale for each of these phases? What technical issues need to be resolved to allow you to offer the services you would like to be able to offer today, and over the next four years?

Question 8: What is the impact of NGN on existing telecommunications networks and services revenues, in light of the overall benefit that may be derived from the introduction of NGN? Do you think the TRCSL should play an active role in the migration to NGN? If yes, what measures should the TRCSL take during the migration and in the course of the long-term adoption of NGN technologies and services?

3.5 Interconnection

3.5.1 Introduction to Interconnection

The interconnection between different NGNs run by different operators is a fundamental issue, especially during the migration phase when operators may have a mix of legacy networks and NGNs. This section concentrates on the *technical* implications of interconnection; the different models for the *governance* of interconnection are discussed in Section 5.2.3. Fundamentally, there are two interconnection scenarios: (a) interconnection of an NGN with a legacy network, and (b) interconnection between NGNs. These are described below. It should be noted that both scenarios can support interconnection based on TDM (legacy) protocols, or based on IP.

Interconnection of an NGN with a legacy network

Figure 3.13 and Figure 3.14 illustrate respectively TDM and IP interconnection between an NGN and a PSTN.

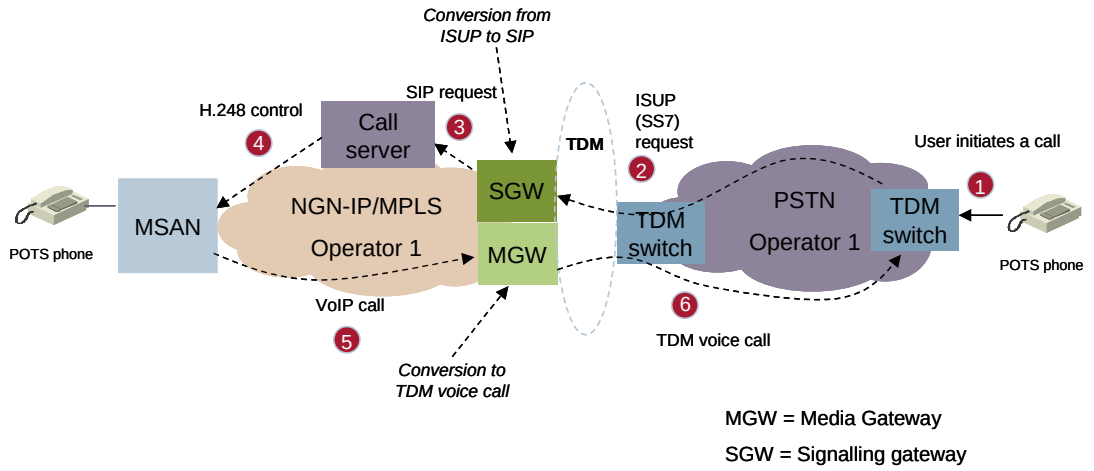

Figure 3.13: TDM-based interconnection between NGN and PSTN [Source: Analysys Mason]

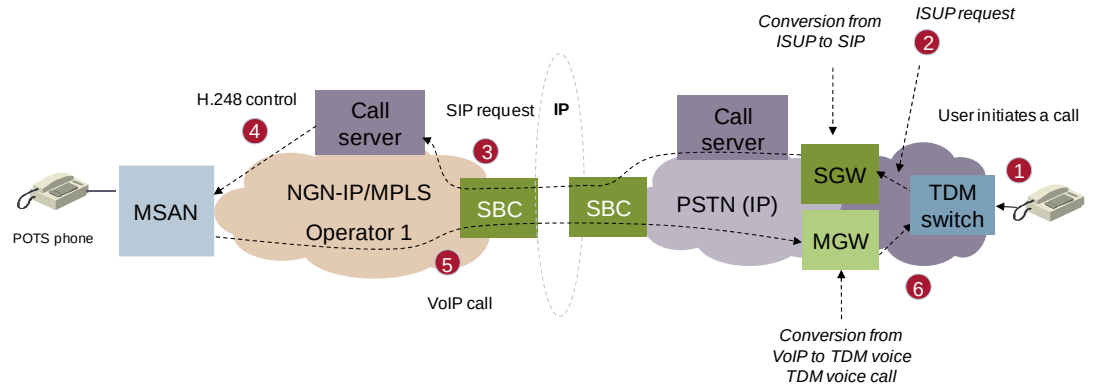

Figure 3.14: IP-based interconnection between NGN and PSTN [Source: Analysys Mason]

As illustrated in Figure 3.13, the interconnection between an NGN and a PSTN can be TDM-based. In this case the PSTN does not need any additional network nodes as the translation from TDM protocol to IP protocol for both the signalling and media planes are carried out in the NGN at little extra cost. In marked contrast, if the interconnection between NGN and PSTN is IP-based (Figure 3.13) the PSTN network has to implement the conversion functions between the TDM and IP protocols. This means that a Media Gateway needs to be implemented in the PSTN network to convert TDM voice to VoIP. An additional signalling gateway is also required to convert the legacy SS7 signalling message (such as ISUP) to SIP or H.323 signalling messages. Finally, as for every IP interconnection, a Session Border Controller (SBC) must also be added. Therefore, a significant amount of new equipment needs to be added to the PSTN in order for IP interconnection with NGNs to be possible: this is both time-consuming and expensive to implement.

Therefore, given the differences in network costs, the choice of TDM or IP interconnection during the migration has strong implications in terms of regulation. This is discussed in Section 5.2.3.

Interconnection between NGNs

As the migration to NGN is completed, the ultimate goal is to interconnect all networks using IP because this is more cost-effective than TDM, as gateways are not required. Figure 3.15 illustrates IP-based interconnection between NGNs.

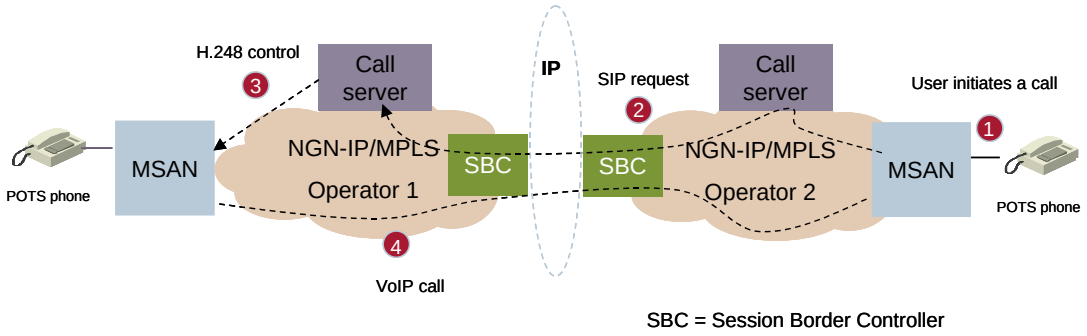

Figure 3.15: IP-based interconnection between two NGNs [Source: Analysys Mason]

There are three different versions of the SIP protocol that could be used for signalling within NGNs:

- Generation 1: SIP-I which encapsulates the legacy circuit-switched ISUP signalling protocol is within the SIP protocol.
- Generation 2: Pure SIP, where SIP is used without encapsulating ISUP.
- Generation 3: the IMS version of SIP which is being developed by the 3GPP that is hosted by ETSI, and which will be a common protocol suitable for both fixed and mobile networks.

In practice most current implementations in fixed networks use Pure SIP or SIP-I.

Question 9: What are your preferred protocols, architecture and interfaces for inter-connection with the PSTN, other NGNs, and with international networks (voice and Internet)? Please describe in detail the associated timeframe for each of your choices, in relation to your overall migration roadmap described above.

IP Interconnection

The TRCSL notes that the current interconnection and access regulatory regime in Sri Lanka was created in the era of traditional telephony-based operators. However, as services including voice migrate to NGNs, this interconnection model may become increasingly obsolete as Internet

interconnection is based on commercial negotiation and may involve unpaid exchange of traffic, known as 'peering'.[12]

NGN interconnection results in more Internet traffic exchange, which may increase the importance of Internet Exchanges Points (IXPs). IXPs are the meeting points where operators whose networks make up the Internet can interconnect with one another to exchange traffic. The primary benefit of an IXP is to reduce the cost of interconnection: rather than using a separate leased line to connect to each interconnecting network, operators can use a single leased line to reach a single location at which a number of networks can all interconnect. To the extent that an IXP promotes peering, it may also have a secondary benefit of more localised routeing of traffic, with fewer hops, leading to lower latency. This is becoming increasingly relevant – not just for new delay-sensitive applications like VoIP, but also for other Internet services such as distance learning and e-commerce.

The benefits of an IXP can extend to the NGN when calls begin to be exchanged using IP interconnection. Given the importance of Internet traffic exchange, a number of such exchanges have arisen around the world. A number of operators have created exchange points for commercial reasons, but international best practice is to establish independent IXPs, with each IXP either operated commercially or on a non-profit basis by a consortium of users of that exchange.

Question 10: Do you envisage any general issues in relation to NGN interconnect? In particular, do you envisage any issues in relation to current peering arrangements?

Question 11: Please describe any experiences that your company has of an Internet exchange point in Sri Lanka or elsewhere. Do you foresee that your company will have an increased reliance on an IXP in the future, for Internet applications including voice? If so, are there any roadblocks to such usage in Sri Lanka today? If so, please describe those roadblocks and the means to overcome them.

3.5.2 Interconnection and Interoperability

In order to ensure interoperability between different NGNs, a certain amount of collaboration between operators must take place to ensure that each NGN supports a minimum set of features. For example, in the UK two standardisation bodies have been set up to ensure interoperability between operators:

- **Network Interoperability Consultative Committee (NICC)** is a standards body that acts as a technical forum for the communications sector, and develops interoperability standards for public communications networks and services in the UK.

---

[12] Peering is a bilateral arrangement between two operators to exchange traffic originating from, and terminating with, their own customers with no fee settlement between them. In other cases, smaller operators that do not have the necessary traffic may have to pay the bigger operators for transit services – unlike traditional telephony, such charges are based on the capacity purchased and are independent of direction of traffic or even the location of users.

- **NGNuk** is a co-ordination forum in which key investors in NGN infrastructure and services can discuss, research, consider and, where possible, agree the direction for NGN in the UK.

This form of collaboration is key to providing true interoperability between different NGN operators. Taking the example of voice services, a vast number of features are available, but not all are implemented in different networks, for a variety of reasons. NGNuk suggests a number of mandatory, recommended and optional features to be supported by all operators, and this is provided in Figure 3.15 (note that this list is not exhaustive and is only intended as an illustrative example).

Mandatory	*Recommended*	*Optional*
Originating Identification Presentation (OIP)	Communication Diversion (CDIV)	Conference (CONF)
Originating Identification Restriction (OIR)	Communication Waiting (CW)	Advice of Charge (AOC)
Terminating Identification Presentation (TIP)	Communication HOLD (HOLD)	Reverse charging
Terminating Identification Restriction (TIR)	Communication Barring (CB)	
Malicious Communication Identification (MCID)	Completion of Communications to Busy Subscriber (CCBS)	
Anonymous Communication Rejection (ACR)	Message Waiting Indication (MWI)	
Relay Services for the Disabled	Support for SIP protocols	

Figure 3.16: Example of voice features to be supported by NGN operators [Source: NGNUK]

The TRCSL believes that a similar initiative may be beneficial to Sri Lanka to ensure interoperability of voice services and also of all other multi-media services when practically possible. Section 5.3.3 below explores whether it may be necessary to impose wholesale obligations on one or more operators to ensure that the agreed standards are adopted to promote entry.

Question 12: Do you believe that the establishment of a national body to standardise interconnection between NGNs is required in Sri Lanka? If so, what do you think would be the best governance model for it?

3.5.3 Quality of Service (QoS) Issues

As mentioned in the ITU definition of NGN, QoS mechanisms have to be implemented in NGNs in order to ensure that time-sensitive services such as voice are prioritised over other applications such as web browsing. Unlike the circuit-switched PSTN, many parameters of the services requested by a user could be under the user's control, either directly or in association with the end-to-end service required. In particular, the need for QoS will vary from the performance

required to support interactive, real-time communication (voice and multimedia) to the variable performance of the current public Internet.

In order to meet the need for QoS, the ITU-T standard Y.1541 defines five Classes of Service, each corresponding to a family of applications with different characteristics. Figure 3.17 illustrates the different classes of service.

Class Of Service	*Description*
0	Real-time, jitter-sensitive, high interaction (VoIP, VTC)
1	Real-time, jitter-sensitive, interactive (VoIP, VTC)
2	Transaction data, highly interactive (signalling)
3	Transaction data, interactive
4	Low loss only (short transaction, bulk data, video streaming)

Figure 3.17: Recommendation Y.1541: classes of service [Source: ITU]

Since each class of service has different requirements in terms of delay, delay variation (also called jitter), packet loss and bit error rate, the ITU formally defines the performance targets for each of class of service as shown in Figure 3.18.

Classes of service	Delay	Delay variation	Packet loss rate	Bit error rate
Class 0	100ms	50ms	10^-3	10^-4
Class 1	400ms	50ms	10^-3	10^-4
Class 2	100ms	U	10^-3	10^-4
Class 3	400m	U	10^-3	10^-4
Class 4	1s	U	10^-3	10^-4

Figure 3.18: Performance target of each class of service [Source: ITU]

This means that if an operator wants to support Class 0 services such as conversational voice, its network must ensure that:

- the end-to-end delay between source and destination is no more than 100ms
- the delay variation is less than 50ms
- the number of packets lost in the network is less than 1 for every 1000 transported
- the number of errored bits (within packets) is less than 1 for every 10 000 transported.

If these performance indicators are met by the network, the user should have a reasonable experience of the service. It is also important to be able to measure these parameters in all networks under different loads, to ensure that all NGNs perform similarly, especially if interconnection is required between different networks to provide a given service.

Question 13: Do you believe that the TRCSL should mandate that operator should put in place equipment to monitor its network performance in terms of delay, jitter, packet loss and bit error rate for different classes of service?

Question 14: Do you believe that other network performance parameters such as network availability should also be monitored by the TRCSL? Please use examples to illustrate your answer.

Question 15: If you answered yes to the previous questions, do you believe that the national standardisation body should take responsibility for specifying what should be monitored?

3.5.4 Security Issues

Since NGN is based on IP, it may be susceptible to the same attacks as made on the Internet. The traditional method to protect against these attacks is the use of firewalls, but in the case of NGN, standard firewalls can introduce delay and jitter, so may not be suitable for networks carrying time sensitive traffic such as voice. One issue that alleviates such security problems is that NGNs are essentially closed networks, with only one or two gateways to the outside world, so they should be easier to protect than the more open Internet.

Question 16: What are your views on security in NGN networks? In your view does current technology, such as firewalls, provide adequate security to NGNs? Do you believe that there needs to be national NGN security policies and standards?

3.6 Numbering and Addressing

3.6.1 Introduction

The migration to NGN will initiate a corresponding change in the numbering and addressing schemes used by end-users and operators to provide services. The Internet uses the Domain Name System (DNS), in which a *domain name* identifies a source or destination with a textual name that is easy to use and remember, while an *address* is a network identifier that enables the network to route data to its destination. Thus www.trcsl.gov.lk is the domain name of the website of the TRCSL, while 202.124.180.5 is the underlying IP address associated with the server that runs that website. On the other hand, legacy telephone numbers are based on the E.164 standard and can be viewed as functioning as both a name and an address, especially for fixed-line numbers.[13]

The migration from PSTN to NGN means that the telephone network will now run over IP-based facilities similar to those used for the Internet. Therefore, like websites, phones lines will be identified by an IP address. This does not imply fundamental changes to IP addressing or the DNS system: these naming and addressing systems are already nearly as mature as those used by the

[13] With number portability, this is no longer true – a telephone number then serves primarily as a key to a database look-up rather than itself being the basis for the physical routeing of a call to the customer's telephone.

PSTN. ENUM, a standard system that translates E.164 to IP addresses (see below), bridges the legacy PSTN and VoIP numbering domains.

Numbering, naming and/or addressing schemes will need to encompass legacy, transitional, and NGN services and associated directory services. The existing numbering and addressing schemes include some that are nationally based (e.g. telephone numbers and country domain names such as .lk) some that are global (e.g. IP addresses and generic domain names such as .com), and some that are proprietary (e.g. instant messaging). Further, certain NGN services such as VoIP can be nomadic, allowing formerly national telephone numbers to be used internationally, which may pose tariff transparency issues.

In an NGN world, where networks of all operators will be interconnected, there may be a requirement to harmonise naming and addressing conventions on at least a national basis. The inter-relationship of these number and addressing schemes, and their management during the transition to NGN, will be a major task

---

Question 17: Please comment on the need for revisions to numbering plans for new services, and the need or otherwise for non-geographic codes recognizing increasing user nomadicity?

Question 18: How do you think the harmonisation of naming and numbering of different networks should be addressed? At what stage of your migration plan will the harmonisation of naming and numbering be required? Do you think a national standardisation authority (mentioned in Section 3.5.2) should be in charge of implementing the harmonisation of the naming and numbering across the country? Do you see a future need for international coordination for any or all of Sri Lanka's naming and numbering schemes?

3.6.2 ENUM

In order to achieve the transition to NGN while enabling consumers to keep their phone numbers, operators will need a mechanism that maps telephone numbers to Internet services. The ENUM protocol was created for this specific purpose, using the underlying mechanisms of the DNS to provide look-up services. With ENUM, the telephone number truly becomes a name rather than an address, serving primarily as a key to identify the best way to reach a subscriber, based on their IP address, wherever they might be physically.

Question 19: Do you see ENUM as a fundamental stepping stone to true VoIP services? If yes, do you believe that ENUM should be implemented centrally by a third party (e.g. a government agency)? If no, what are your alternative plans to provide IP address look-up services (e.g. implementation of individual databases)?

Question 20: How important is it for you that a subscriber can keep their current phone number when migrating from PSTN to NGN? Do you think that a change in phone number may be a barrier for the adoption of NGN services?

3.6.3 IPv6

The current IP addressing system, based on IPv4, can accommodate at most approximately four billion addresses. At one time, this was felt to be hugely in excess of demand; however, today there are credible forecasts that this address space may be exhausted within five years. The Internet Engineering Task Force (IETF) defined a successor protocol (IPv6) many years ago; however, IPv6 has seen little deployment to date. The migration to NGN may create additional pressure for migration to IPv6. In particular, while the use of IPv6 is optional in NGN generally, it is mandatory in IMS.

Question 21: Do you plan to adopt IPv6 in your network? If so, when will you do so in relation to the milestones describe in your transition to NGN? What are the key transformation phases involved in migrating your IP network to IPv6?

---

4 Commercial Issues

The mission of the TRCSL includes creation of "the optimum conditions for the telecommunications industry in Sri Lanka by serving the public interest in terms of quality, choice, and value for money." To this end, the TRCSL has issued licences to a number of operators providing fixed and mobile telephony and data communication services, and to Internet service providers. In particular, four licences have been issued for fixed telephony, five for mobile telephony, six for data communication services, and more than twenty for ISPs. However, sub-markets for certain wholesale inputs such as domestic and international leased lines may not be subject to the same competitive forces as the downstream retail markets such as mobile telephony.

At present, competition is largely facilities-based, with operators building their own core and access networks to provide licensed services such as fixed voice. Traditionally, there has been a separation between the services offered over each network, based on licence requirements. As described above, the migration to NGN has the potential to change these divisions, and facilitate service-based competition in a variety of services over a single core network. As part of this consultation, the TRCSL aims to develop an improved understanding of the commercial impact of the current system, and how this might evolve in the future.

In particular, TRCSL understands that, for the reasons outlined above, operators are beginning to install NGN technology in their networks, and further that the operators are beginning to plan for the NGN National Backbone Network. The next section of the consultation paper discusses the regulatory issues that will arise during the migration to NGN, which will form the basis for the resulting NGN regulatory framework. This section seeks the informed views of external stakeholders on the current market status and future plans with respect to NGN upgrades.

Question 22: Please describe your views on the competitiveness of the markets for voice and data services today, including both domestic and international leased lines. What are the current roadblocks to increasing the competitiveness of these markets, if any? What regulations, if any, would you recommend to overcome these roadblocks?

Question 23: Please describe your current network architecture. What are your current plans to implement NGN networks and/or offer VoIP or other IP services? What are the roadblocks that you perceive to that migration? What regulations, if any, would you recommend to overcome these roadblocks?

---

5 Regulatory and Legal Issues pertaining to NGN

This section discusses the regulatory issues that will arise during the migration to NGN, and which will form the basis for the resulting NGN policy & regulatory framework.

5.1 Introduction

In order to understand the changes that the TRCSL is envisaging for the NGN policy & regulatory framework in Sri Lanka, it is helpful to consider how telecoms regulation typically evolves. One can distinguish three phases:

- **Phase I – Monopoly**: During this phase, telecoms was considered to be a natural monopoly. The telecoms operator was typically owned and operated by the government (as was the case in Sri Lanka), and tariffs were set to provide low prices and encourage universal access.

- **Phase II – Competition**: As new technologies were introduced, relevant markets were liberalised and competition was introduced where feasible. Many new technologies – wireless technologies in particular – were conducive to *facilities-based competition*, in which entrants built their own networks and competed on the basis of coverage, service quality and prices. At the same time, other technologies – such as ADSL – were conducive to *service-based competition*, in which entrants were given wholesale access to key parts of the incumbent's network in order to increase competition. Finally, the incumbent was typically corporatised and privatised so that it would compete on an equal basis with the entrants.

- **Phase III – NGN and convergence**: The introduction of NGN may facilitate competition at several levels. As discussed above, NGN core network equipment is less costly than that in traditional networks, thus fostering facilities-based competition, while at the same time on NGNs it is easier for providers to engage in service-based competition. As explored below, the TRCSL is seeking inputs to assist in designing an NGN policy & regulatory framework that is tailored to the unique conditions of Sri Lanka.

In Phase II, TRCSL notes that international best practice is to differentiate between facilities-based and service-based competition (as is the case in Sri Lanka). Under such a regime, more stringent regulatory control is asserted over facilities-based operators, while service-based operators are subject to comparatively 'light-touch' regulation. For example, service-based operations would have a simplified and more expedient licence application process, lower licence fees and fewer regulatory requirements than a facilities-based licence. In the long term, facilities-based competition may provide the most significant consumer benefits, while allowing for a significant reduction in regulatory intervention. In the short to medium term, however, service-based competition can play an important role in facilitating the launch of new innovative services. While this differentiation was aimed to promote the introduction of competition under traditional networks in Phase II of regulation, such policies may be even more relevant for an NGN policy & regulatory framework under Phase III, given how NGN networks favour service-based entry for VoIP and other advanced services. These issues are explored further below in Section 5.3.

A main building block for introducing a distinction between facilities-based and service-based competition is asymmetric regulation. Under asymmetric regulation, one or more operators are designated to be "dominant," based on having significant market power in one or more telecoms services. A number of regulations are then imposed on the dominant operator as a means of increasing competition through wholesale access, which can enable service-based competitors to enter the market and compete. The other aspect of asymmetric regulation is that competitors face only minimal regulations, in order to reduce the regulatory burden and promote entry and innovation. Again, just as asymmetric regulation is considered important for promoting entry under Phase II of regulation, TRCSL views that it is critical to maintain (and strengthen) an asymmetric regulatory framework under the NGN in order to enable providers to take advantage of the ease of entry under convergence.

Finally, in many countries, universal service obligations (USO) have been an important consideration during all phases of regulation. The important considerations for USO are how to raise the USO funds, and in turn how to disburse them. In Phase I, USO was essentially implicit, as the monopoly provider charged above-cost rates on certain services used mainly by businesses and high-income families in urban areas, such as international calls, in order to subsidize access and local calls targeted to low-income users or in high-cost areas. Under Phase II, USO became explicit, as competitors targeted services with the high rates such as international calls and business services, thereby creating a need to raise funds to continue to subsidize necessary services offered by the incumbent and competitors alike. Regulators around the world are considering how the model changes under the new Phase III of regulation.

A number of building blocks are needed to realise this vision:

- policies for NGN, including asymmetric regulation;
- wholesale obligations;
- retail obligations; and
- a migration roadmap.

5.2 Policies for NGN

The general policies that the TRCSL is considering for its NGN policy & regulatory framework are discussed here. While these policies are important for the NGN framework, they include regulations that many countries adopted under Phase II of regulation, but which may not have been fully implemented in Sri Lanka. The concept of asymmetric regulation is discussed, followed by a consideration of the distinction between facilities-based and service-based competition, which is typically embodied in the relevant licences. Finally, the impact of NGN on Universal Service Obligations is discussed.

5.2.1 Asymmetric Regulation

The TRCSL considers that asymmetric regulation, a principle underlying the policies of many developed and developing countries worldwide, may be particularly relevant and beneficial in promoting growth of the Sri Lanka telecoms industry, including its adoption of NGN and

corresponding services. Under such a model, greater regulatory controls would be imposed on carriers that have significant market power in the relevant telecoms market. Such a framework can be used to constrain anti-competitive market behaviour by the dominant player, while minimising the regulatory burdens on both new entrants and regulators.

In determining whether an operator is dominant, one possible approach is to conduct a market definition exercise and expressly set an objective criterion for defining a "dominant" operator in the relevant market, often defined as an operator with the ability to exercise "significant market power" in a particular market in which it provides telecoms services. In turn, "significant market power" can refer to the ability to unilaterally restrict output, raise prices, reduce quality or otherwise act, to a significant extent, independently of competitive market forces (i.e. independently of the operator's competitors, suppliers and customers). The effect of this approach is that the onus is on the regulator to demonstrate that an operator is dominant and thereby impose appropriate regulations. An example of this approach can be seen in the EU, under the European Regulatory Framework.

Another possible approach is to designate as "dominant" an operator that operates infrastructure/facilities that are sufficiently costly or difficult to replicate that they present a significant barrier to timely entry by an efficient new entrant. This is an entity-based approach such that the operator is dominant in respect of all of the services it provides and the onus is on the operator to provide evidence to remove the dominance classification on a market-by-market basis. The advantage of such an approach is that the regulator can dispense with the need to undertake complex (and costly) market analysis, especially in the situation where significant market power can be assumed because of the entrenched position of the incumbent in a newly liberalised environment. Examples of countries where this approach has been taken include the USA and Singapore.

To the extent that a market is competitive, the TRCSL could rely primarily on market forces and industry self-regulation, subject to minimum regulatory requirements designed to protect consumers and to prevent anti-competitive conduct. However, to the extent that a market is not yet competitive, *ex-ante* regulatory measures may be necessary. By adopting asymmetric regulation such that special obligations are placed on the dominant operator, the regulator is seeking to establish a balance between the incumbent and new entrants that facilitates the growth of competition. In particular, many *ex-ante* regulatory interventions typically provide for wholesale access to those parts of the network that would allow entrants to compete in retail markets; additional regulatory interventions such as tariff control would regulate retail services where wholesale access may not quickly lead to competition. These regulatory interventions are discussed below in Sections 5.2.3 and 5.4 below.

To give effect to the proposed changes to the regulatory regime, the TRCSL recognises that existing legislation may need to be amended. However, an in-depth discussion of legislative amendments would be premature at this stage, given the exploratory nature of the present consultation; instead, legislative amendments (if necessary) will be addressed after the TRCSL has developed its policy for the Sri Lankan NGN policy & regulatory framework.

Question 24: Do you see asymmetric regulation as appropriate for regulating NGN in Sri Lanka? If so, what obligations should be imposed on the dominant operator(s) and the non-dominant operators? What do you see as the most significant advantages and disadvantages of such an approach in Sri Lanka, and what roadblocks do you see to its implementation?

5.2.2 Licensing

The NGN licensing framework would be developed to cater for integrated network platforms that deploy efficient and advanced technologies, and in future, will carry all forms of communication originating from various service providers. This includes fixed and mobile voice, data and multimedia applications. Due to the uncertainty of the evolution path for NGN, the new licensing structure should avoid reliance on any singular view of future market structures, whilst also avoiding unnecessarily complex licensing structures.

Present Licensing Framework

As presently provided for under the Telecommunications Act, No. 25 of 1991 (as amended by the Telecommunications (Amendment) Act, No. 27 of 1996), any person who wishes to operate a telecommunication system or to provide a telecommunication service in Sri Lanka must be licensed by the TRCSL. The current licences issued by TRCSL seek to be technology-neutral but service specific, as operators are licensed to provide either mobile or fixed telephony. Presently, the TRCSL adopts a licensing approach that differentiates between the provision of facilities-based operations and non-facilities-based operations. To elaborate:

- **Facilities-based operations**: typically require usage of natural resources (frequency spectrum and/or right of way, numbering), and refer to the establishment and operation of any form of public telecommunication network infrastructure systems and/or facilities for the purpose of providing public telecommunication services to third parties, which may include other licensed telecoms operators, business customers or the general public. An Individual Licence is issued for this purpose.

- **Non-facilities-based operations (i.e. Service-based operations)**: This refers to operators who intend to lease telecommunication network elements (including transmission capacity, switching services, ducts and fibre) from a facilities-based operator in order to offer their own telecoms services to third parties, or to resell the telecoms services of the facilities-based operators. TRCSL presently issues a Class Licence for this purpose.

A key objective of allowing service-based competition is to prevent the inefficient duplication of networks. The entry of a facilities-based competitor in a market with large economies of scale would result in significant duplication of facilities, which could be productively inefficient. Service-based competition may therefore play an important role in ensuring that existing infrastructure is used efficiently. On the other hand, the TRCSL recognises the need to ensure that the regulatory regime does not undermine efficient network investment and seeks to address this issue below in developing the NGN policy & regulatory framework.

NGN licensing framework

In the new NGN licensing framework, it is likely that integrated network platforms will carry all forms of communication, including fixed and mobile voice, data and video, originating from many different providers. In this regard, it is increasingly recognized that imposing a service-specific or technology-specific licensing regime may severely restrict the way in which technology is used and prevents operators from extracting the full benefits and flexibility afforded by the NGN infrastructure. For regulating service offerings in NGNs, the TRCSL observes a shift away from service-specific and technology-specific vertically integrated licensing regimes towards horizontal licensing regimes that better reflect the technical and logical separation of the core, access and service layers of NGNs. For example, the Indian regulator TRAI has recommended a single unified licence for all types of services and geographical locations.

As stated above, the TRCSL recognises that service-based competition will play an especially important role in facilitating the launch of new innovative services in the NGN environment, given how NGN networks favour service-based entry for VoIP and other advanced services. Accordingly, this paper seeks feedback on the maintenance of service-based competition under the NGN. To this end, the TRCSL intends to strengthen the present two-tier approach to differentiate between licences based on the nature of their operations, i.e. whether the licence relates to a facilities-based type of operations or a service-based type of operations.

Under the NGN, TRCSL considers that an Individual Licence will still be relevant for operators who establish and operate any form of telecommunication network infrastructure systems and/or facilities. To this end, TRCSL may impose varied conditions relating to, without limitation: service quality, wholesale access, interconnection, interoperability, number portability, consolidation (merger) review, and shareholding and management arrangements. The extent to which TRCSL imposes such conditions could depend on whether or not the operator is dominant.

Separately, the Class Licence could become the primary means of regulating the provision of innovative services under the NGN. The TRCSL would issue guidelines for the issuance of such service-based licences, listing the specific types of services that qualify for this ‘lighter’ form of licensing (e.g. for the provision of IP telephony, internet access services, and other value-added network services).

In addition to licence conditions, the TRCSL would also be empowered to give directions, issue codes of practice and standards of performance to its licensees where necessary. The intention is to ensure the provision of communications in a multi-network, multi-operator competitive environment in which end users will be able to access any service from any service provider, regardless of which network the end users are directly connected to.

A service-based licence can be sub-divided into at least two further categories – standard Class licensing and simplified Class licensing:

- **Standard Class licensing** applies to stipulated types of operation and service that may require closer regulatory scrutiny (such as the provision of IP telephony services or resale of fixed telephony)

- **Simplified Class licensing** can be issued for basic telecoms services that raise fewer regulatory concerns, such as possibly ISP services, which do not require licenses in a number of countries.

The TRCSL wishes to investigate these new licence structures in order to reduce regulatory burdens for operators and to promote the entry of competitors under the new NGN policy & regulatory framework.

Question 25: Do you see value in maintaining a two-tier regulatory structure (facilities-based and service-based licensing) to accelerate growth of the Sri Lankan telecoms industry particularly in light of NGN? What do you see as the most significant advantages and disadvantages of such an approach in Sri Lanka, and what roadblocks do you see to its implementation?

Question 26: Please propose any other specific amendments to the licensing framework to promote the growth of service-based competition for NGN. In particular, please identify any regulatory obligations that ought to be excluded from a service-based licence (i.e. Class Licence), citing detailed justifications.

Question 27: Do you agree with the above proposal to sub-divide service-based licences into two tiers, i.e. 'standard' and 'simplified' Class Licences, based on the service offered? If so, which services should be subject to the light-touch 'simplified' licence, and why?

5.2.3 Universal Service Obligations (USO)

The original goals of USO – affordability and accessibility – are key policy goals that should not be abandoned or altered in a NGN environment. During the migration to NGN, there is ongoing relevance to the existing structure of universal service obligations, with additional concern that the levies do not stifle investment and innovation in services that might otherwise undermine the source of these revenues.

At the same time, under NGN the challenge remains to preserve the objectives of USO, while fostering innovation in new networks and services. There are two parallel questions to be raised.

The first is whether NGN service providers should contribute to a USO fund, and on what basis. A key consideration is to minimize distortions to competition and usage of the relevant services. One idea that has been raised is to attach the USO obligation to the issuance of numbers, as these would be paid by all subscribers, and once subscribed would have no impact on usage of services based on those numbers, unlike levies that might raise the cost of certain calls.

The other question to be addressed relates to the disbursement of funds. In particular, should the funds go to operators to build networks and/or provide services, or should the funds go to users to increase their ability to pay for services. In addition, questions relate to whether the funds should promote basic voice services or broadband, and further whether they should differentiate between fixed or mobile networks and services.

Question 28: What are your views on how USO should be implemented for NGN technologies. How should the funds be raised, and how should they be disbursed? Should they target basic voice services or advanced data services?

5.3 Wholesale Obligations

For legacy networks, in order to promote competition by reducing the cost of entry, it is common for regulators to impose wholesale obligations on operators. International best practice is that many wholesale obligations are imposed only on dominant operators, in order to ensure competition in those areas where the operator would otherwise be dominant. Such wholesale obligations include interconnection requirements as well as targeted wholesale access. At the same time, as discussed above, NGN networks provide opportunities for service-based competition with less wholesale regulation, such as the ability of Skype or Google to facilitate VoIP calls over broadband connections.

Regulators recognize that the key issue in creating competition in an NGN environment is to take advantage of the new opportunities of NGN to enable service-based competition, without reducing incentives to invest in the new networks. In particular, the ability of providers to enter and compete vigorously with network owners in services such as voice can leave network operators providing only connectivity. The resulting reduction in NGN service revenues earned by the network operator can correspondingly reduce the incentive to invest in NGN networks. On the other hand, allowing the network operator an advantage in providing retail services may provide incentives for operators to invest and compete at the network level, but at the expense of service-based competition.

The result is a certain balance for regulators between promoting facilities-based competition versus service-based competition. As competition in NGN services is still nascent, there is an additional balance between imposing regulations that provide certainty to those seeking to invest in networks and service provision, while allowing markets to operate and determine successful business strategies. TRCSL thus seeks to identify the minimum obligations that are necessary to promote investment in NGN networks and services today, versus those obligations that may become necessary as market forces determine the development of network and service-based competition over time.

5.3.1 Interconnection

As a market is liberalised to introduce competition, interconnection requirements become a key part of the policy & regulatory framework aimed at facilitating new entry. Interconnection between networks is essential, to ensure that subscribers on different networks are able to communicate with one another. The TRCSL recognises that a dominant operator may lack the economic and commercial incentives to voluntarily enter into interconnection agreements (or do so in a timely manner) with competing operators or new entrants. This is particularly true since subscribers would be unlikely to migrate to a new network if they are unable to communicate with the bulk of subscribers who remain on the dominant operator's network.

Regulators typically impose a requirement for all operators to interconnect with one another, to prevent the dominant operator from blocking entry through a refusal to interconnect. Many regulators go further than this, and require a dominant operator to publish a Reference Interconnection Offer (RIO) that sets out the prices, terms and conditions on which the dominant operator will provide designated wholesale services to any competitor. These wholesale services can include interconnection for the transit or termination of voice calls, as well as wholesale access to network elements, as described in the next section.

The purpose of the RIO is to make the dominant operator the point of interconnection 'of last resort'. If the new entrants are able to commercially negotiate better terms for interconnection between themselves and/or the dominant operator, they have the flexibility to do so. However, they can fall back on the dominant operator and interconnect on the basis of the RIO offering if they are unable to do so. The RIO must thus be sufficiently detailed to enable a competing operator to accept the dominant operator's prices, terms and conditions *as is*, without having to engage in protracted negotiations with the dominant operator.

Under this model, the TRCSL would issue guidelines regarding the services and pricing methodology that would need to be incorporated into the RIO to ensure fairness, and would have to give its approval to the resulting RIO.

With respect to interconnection between non-dominant operators, the TRCSL could play a more limited role and instead rely on market forces and commercial negotiations to foster agreements. The TRCSL's role would be to act as adjudicator to resolve disputes over the terms of an agreement or in situations where no agreement can be reached. However, it should be noted that a number of regulators have determined that certain interconnection rates, such as mobile termination rates, should not be left to market forces even when the retail market is competitive.

Question 29: Please comment on whether a new set of interconnection rules should be promulgated, or whether the existing Interconnection Rules 2003 should be amended to provide for interconnection in IP-based networks.

Question 30: Is there a need for a RIO to be offered by a dominant operator? Please identify the terms and conditions you would require in a dominant operator's RIO. Is there any need to change the regulatory approval process for RIOs?

5.3.2 Wholesale Access

Wholesale access to key network elements is important in promoting entry and expansion by service-based providers; facilities-based providers can also benefit from such access as a means of reducing their costs of providing service and/or extending their services into new markets. For these reasons, wholesale access is mandated by regulators around the world, as a means of facilitating entry and competition in relevant retail markets. An understanding of the experience in Europe, which has one of the most developed wholesale access frameworks in the world, is useful to understand potential wholesale access issues.

Wholesale access in access networks is mandated across all EU countries, with significant success in creating competition. The European New Regulatory Framework (NRF) is composed of six Directives that address the convergence of telecommunications, media, and information technology, but does not specifically address any content regulation**.** This framework is built on the following principles:[14]

- technology- and provider-neutral
- focus on services, not technology
- informed by legal principles drawn from general competition law
- focus on enduring bottlenecks
- light-touch regulation
- foster innovation and investment
- provide legal and investment certainty
- avoid fragmentation of markets
- balance harmonization and innovation
- address the question of cross-border services.

Of particular interest is the fourth principle, namely 'focus on enduring bottlenecks'. This reflects the general *ex-ante* approach taken to regulation. The NRF states that *ex-ante* regulatory obligations (notably wholesale access) should only be imposed where there is not effective competition, i.e. in markets where there are one or more providers with SMP. As soon as wholesale competition creates significant retail competition, then any retail obligations are removed, and to the extent that wholesale competition becomes sustainable without regulatory obligations, then those obligations will be removed as well.

In many countries, including in Europe, wholesale access is applied to both core and access networks, which are reviewed here in turn.

Wholesale Services in the Core Network

As is the case in many countries, including in Europe ,the TRCSL recognises that local leased circuits (LLCs) are important elements in the telecoms market that are commonly used by telecoms service providers to provide services to wholesale and retail customers, and by business users to communicate with their local and international offices. For instance, mobile operators can use leased lines to connect their base stations, and also to provide backhaul to submarine cable landing stations. Internet access service providers also rely heavily on LLCs for connecting customers to their Points of Presence (PoPs) for provision of Internet access services. For these reasons, effective competition in the LLC market can make a positive contribution to the competitiveness of the overall economy (e.g. through growth of the business process outsourcing industry). The same is true for international core network access and infrastructure.

The TRCSL is considering the need to adopt additional regulatory measures to facilitate further competition in the core network, while at the same time being careful not to diminish the economic

14 Source: European Telecommunications Platform, (06) 01, 17 January 2006.

incentive for telecoms operators to deploy their own network infrastructure to serve their customers over the longer term. One possible regulatory measure is to designate the dominant operator's core network assets (such as LLCs) as a wholesale service that will be provided at a pre-approved wholesale price for a pre-determined number of years (subject to regular regulatory review). This could be included in the RIO, covering a variety of LLC bandwidths that would enable competitors to match all retail leased line services provided by the dominant operator, at the same QoS.

With increased competition in the core network, the TRCSL hopes to further reduce business costs and, ultimately, promote the economic growth of Sri Lanka and its attractiveness as a business location. The planned National Backbone Network, creating competition in backhaul services, would reduce or eliminate relevant wholesale obligations on any dominant operator in the relevant market.

Question 31: Do you think that further regulatory measures should be taken to promote competition in the core network in Sri Lanka? If so, which parts of the core network are most important to promote entry and competition in retail markets? Will these measures have an impact on NGN network investments?

Wholesale Services in the Access Network

As part of the wholesale regulatory regime for broadband, regulators in Europe generally have tried to establish a ladder of investment for new entrants offering data services. The ladder starts with resale, which requires the least investment by the entrant while providing the lowest wholesale discount, which in turn provides the least means for the entrant to differentiate its retail service, as it is essentially the service of the incumbent.

As soon as the entrant has enough customers it has an incentive to move up the ladder, to a form of bitstream access (differentiated by where in the network the entrant picks up traffic); this requires more investment by the entrant, but in return has a larger discount and provides more means for the entrant to differentiate its service. Again, when the entrant builds up a customer base, it has an incentive to take unbundled local loops, which requires yet more investment in return for more flexibility. The culmination of the ladder is infrastructure investment, where there is likely to be an appropriate return.

The most prevalent form of access in Europe is unbundled local loops, which provide the highest degree of flexibility for competitors – notably, a number of them used unbundled loops to offer IPTV services even before incumbent operators, creating a significant amount of competitive pressure in the process. However, as incumbents begin to invest in new NGA networks, such as FTTC or FTTH, it is increasingly difficult to unbundle the loop, as much of the fibre in the network is shared between the downstream households and therefore cannot be unbundled in the same manner as a copper local loop.

Bitstream access is also common in Europe. It tends to afford a great deal of flexibility for new entrants. Bitstream access can be illustrated with reference to Figure 3.5, where the incumbent

network operator continues to operate the access network and the exchange, and then the DSL bitstream traffic will go over the backhaul from the DSLAM to the competitive operator instead of the incumbent's ISP, with potential variations in whether the incumbent or the competitive operator provides the network access server. One of the strengths of bitstream is that, unlike with unbundled local loop, a similar model can be applied going forward to future NGA networks (as seen in Figure 3.6 and Figure 3.7, the entrant can continue to receive the bitstream at the backhaul level).

The bitstream offer can be put in the RIO for the dominant operator, and regulations must ensure that alternative operators are not at a disadvantage with respect to the incumbent when using wholesale inputs or services. In particular, the bitstream offer should provide enough variations to enable competitors to match the retail offers of the dominant operator, at similar quality of service, along with variations where the competitor accesses the bitstream offer within the dominant operator's network, with corresponding differences in the wholesale tariff.

Question 32: Do you think the introduction of wholesale access to the access network would benefit the consumer? What type of wholesale access would be most beneficial for Sri Lanka? Will these measures have an impact on NGN investments?

5.3.3 Impact of NGN on Wholesale Obligations

While the wholesale obligations discussed above will increase competition under the *status quo* in the current regulatory environment as well as in the future NGN environment, the nature of NGN lends itself to additional considerations regarding the promotion of competition. In particular, international best practice shows that certain regulatory principles may promote service-based competition, and also that the nature of interconnection may change as traffic migrates to IP-based NGN technologies.

Regulatory Principles for Service-based Competition

Although convergence into NGN can facilitate competition in services such as VoIP with little or no interaction with the owner of the network (as discussed in Section 2), international best practice shows that several regulatory principles can help to foster such competition while providing a level playing field. Two important principles that have been identified are technological neutrality and net neutrality:

- **Technological neutrality**: The general principle is that regulations should be applied to similar services regardless of the underlying platform. The corollary is that legacy regulations should not necessarily be applied to new services unless they are needed. In this light, one application is that important regulations, such as QoS or emergency access, should be applied to services that consumers would reasonably expect to be similar to their existing legacy service – for instance, any fixed telephone service using a traditional handset should have similar regulations regardless of the underlying transmission technology or access network. Likewise, such regulations should not be applied to a VoIP service such as Skype that is

offered on a computer, as consumers would not have an expectation of similar usage as with a traditional service.

- **Net neutrality**: The general principle is that an Internet access provider should not discriminate against any individual provider or class of services. However, in certain situations a provider may wish to manage the network to prevent congestion on contended resources, such as the wireless access network, or to offer a managed service with guaranteed quality of service such as IPTV. On the other hand, as discussed above, vertically-integrated providers may have an incentive to degrade or deny access to services such as VoIP or video services that compete with their own services. Principles that prevent such discrimination should be extended to the NGN policy & regulatory framework.

This section of the consultation seeks to understand whether, and if so how, these principles should be applied in TRCSL's NGN policy & regulatory framework, and identify any other such principles to be considered.

Question 33: Do you agree with the principles of net neutrality and technology neutrality for promoting service-based competition under NGN? If so, please provide suggestions for how to implement each principle. If not, please explain and provide any alternative or supplemental principles to consider. What impact, if any, will your suggestions have on incentives to invest and the ability to compete using NGN networks?

NGN Interconnection

As discussed above in Section 3.2, the technologies and architecture of NGNs differ from the PSTN and result in new network topologies, associated costs and interconnection models. This presents challenges to the current interconnection regime in many countries where the new value paradigms in NGN architectures mean that new models may be needed for settlement of interconnection service provision.

This is likely to lead to the development of new IP-based interconnection arrangements that are service-based and capacity based, rather than based on minutes and miles, particularly for certain types of traffic. Regulatory and policy considerations include the impact of IP-based networks on current interconnection arrangements; ensuring no discriminatory access behaviour; defining the parameters of interconnection in a multi-service environment and whether there will still be a need for mandated wholesale interconnection regimes, as well as a revision of the charging principles.

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. World Wide Web traffic) where many different types of traffic may be carried simultaneously across the same interconnection link. This raises issues about how service providers should charge for interconnection, and the issues are particularly complex when traffic has to be passed from a circuit-switched to an IP environment, or vice versa, during the migration to NGN.

In addition to charging issues, NGN interoperability may be critical to ensure that there are no delays in the introduction of new services and providers in retail markets, as discussed above. Regulations may be needed to ensure the interface between legacy networks and NGN, to enable entrants that have invested in NGN networks to interconnect with legacy networks. Standards should be market driven, although regulatory intervention may be required if no specific body such as NGNuk (as discussed in Section 3.5.2) is established in a country to address NGN standardization matters

---

Question 34: Do you believe that new charging arrangements should be imposed for NGN interconnection? Do you believe that interoperability standards need to be imposed for NGN networks? Should these new regulations be imposed on all operators, or only dominant operators?

5.4 Retail Obligations

In addition to wholesale obligations to promote competition, it is important for the TRCSL to protect users from a lack of competition in certain markets, and also to ensure that competitive operators continue to deliver service features that may be important to consumers today. The following subsections focus both on obligations relating to tariffs, which may only be necessary for dominant operators, and also on non-price protection (such as ensuring access to emergency services even in competitive markets).

5.4.1 Tariffs

International experience has shown that, in the absence of effective competition in the market, a dominant operator may have little incentive to keep its retail tariffs low. Regulatory oversight is therefore required to keep prices at a level deemed appropriate for consumers, while still allowing the operator to make a reasonable return on its investment.

In a market where competition has not developed sufficiently, it is common for tariff controls to be applied to all operators for all or specified services that they provide. Operators will be required to seek the regulator's approval before they can offer a new tariff or even a promotional tariff. The basis for tariff approval is typically the cost of service provision or some form of international benchmarking.

As competition develops in the market, a strict tariff control regime may create unnecessary delays for operators seeking to introduce new tariffs and to respond to competitive threats. In addition, such tariff control can also hamper the ability of operators to make longer-term strategic plans, as it creates uncertainty in terms of tariff level changes and therefore future revenue streams. Finally, in a competitive market, tariff review imposes a growing burden on the regulator as the number of tariffs it has to approve increases.

One possible approach to addressing these issues is to restrict tariff control to those operators with a dominant position in the relevant market. This gives operators in competitive markets the commercial flexibility to offer innovative tariff packages and the ability to respond quickly to

market changes. In contrast, in markets where there is a dominant operator, tariff control can not only continue to play the role of consumer protection, it can also prevent the dominant operator from abusing its market power to harm competitors.

As a particular telecoms market becomes more competitive, the dominant operator may be allowed to apply for a removal of tariff approval requirements for that market.

Question 35: Would it be appropriate to apply tariff control only to dominant operators? Please explain, and provide relevant examples where tariff review may be needed, or where it is not needed and imposes unnecessary regulatory burdens.

5.4.2 Consumer Protection

Consistent with the current regulatory requirements imposed by the TRCSL, a number of consumer protection measures are considered to be important to extend to NGN, including without limitation:

- compliance with QoS requirements issued by the TRCSL
- unrestricted access to emergency services (service-dependent)
- advanced disclosure of all prices, terms and conditions
- periodic, accurate and timely bills
- restrictions on service termination and suspension
- procedures to address unsolicited telecoms services or equipment
- dispute resolution procedures and safeguarding of end-user service information.

New protections may need to account for the new role of users in an NGN environment, as customer equipment and networks will be intelligent, with much services and equipment being able to be customized by the user, for example to increase usability and accessibility. Existing and new protections are likely to be important even under a competitive market, to ensure that competitive pressures do not result in an under-provision of service quality, emergency access, and other features that consumers rely on today.

The TRCSL will also closely examine whether there is a need to impose any additional duties on the dominant operator in each market. Such duties might include obligations to provide unbundled telecoms services, and to provide services to any end user upon reasonable request on non-discriminatory terms. In addition, the TRCSL seeks to understand whether the existing protection against anti-competitive consolidation is sufficient, or needs to be bolstered to prevent any loss of competitive gains in future.

Question 36: What kinds of consumer protection do you see being necessary to serve the needs of consumers in the NGN environment? For instance, are there any limitations to the provision of emergency services by IP-based telecom services provided over the NGN? Please list these, providing details and examples where possible. Do you foresee any specific difficulties/challenges in complying with consumer protection requirements in the

NGN environment? From the consumer protection perspective, what additional obligations should be imposed on a dominant operator in the NGN environment?

Question 37: Do you foresee any particular competition issues arising between NGN networks and services and legacy telecommunications networks and service? Are current regulations sufficient to restrain merger/acquisitions activities which may have an anti-competitive impact?

5.5 Regulatory Aspect of Migration to NGN

As indicated above in Section 4, competition in the Sri Lankan telecoms market is currently primarily facilities-based, with operators required to build their own core and access networks in order to provide specifically licensed services such as fixed voice. Further, there has traditionally been a separation between the services offered over each network, based on licence requirements.

The process of migration to NGN is likely to significantly alter these traditional divisions, with a move towards facilitating service-based competition for a variety of services over a single NGN core network. This is expected to fundamentally change the business models for existing operators. As indicated above in Section 2.2, a key objective of NGN is to attract and stimulate the growth of a full range of content, application and service providers that can offer retail services through the NGN infrastructure, and so avoid the need to commit substantial initial investment in their own infrastructure. To achieve this result, the policy & regulatory framework will have to progressively evolve.

At the same time, the TRCSL appreciates that investments in NGN involve commercial uncertainty and risks to service providers and that clear regulatory policies may help operators reduce this risk. A particular regulatory concern arises where NGN investments and decisions are left entirely to market forces, leading to haphazard NGN development and significant duplication of infrastructure, which may ultimately bring adverse impacts on the industry as a whole. Other regulatory concerns being considered by the TRCSL in migrating to NGN:

- Incumbents may reap the most advantages from a transition to NGN, in comparison with other operators, as they leverage on their competitive advantage in network depth and control over the transition timetable; or

- the converse is also possible, where existing legacy operators lose out to low-capex new entrants in the NGN (e.g. VoIP operators and IPTV content retailers who can avoid the costs of deploying their own telecoms infrastructure).

As many of the general changes discussed in Section 5.2 relate to licensing, the TRCSL places particular emphasis on how the current licensing structure for telecoms should be revised. TRCSL is considering a phased approach, in accordance with the progressive phases of NGN roll-out. The proposed migration enables the TRCSL to set in place policies in advance of the fundamental shift to NGN, as opposed to wholly maintaining the *ex post* policies imposed on legacy networks at the time of liberalization. In this regard, the transition process may require a three-phase

migration of licences to a regulatory model that allows for flexible facilities-based and service-based competition, with particular obligations on dominant operators in relevant markets:

- **Phase 1, Legacy Network**: For the remainder of their current licence terms[15], existing legacy operators may continue to be regulated under their existing telecoms licences issued under the Telecommunications Act No. 25 of 1991 (as amended). These licences are essentially facilities-based, in which operators maintain their own core and access networks to provide licensed services. Under this phase, the *status quo* would be preserved as far as practicable.

- **Phase 2, Transition to NGN**: Upon expiry of an operator's legacy licence, the TRCSL will issue appropriate new licences to the telecoms operator (possibly, in the form of an NGN Individual Licence), allowing a licensee to offer the full breadth of telecoms and/or broadcasting services that can be carried over its own telecoms network, systems and/or facilities. In this framework, a dominant operator framework may also be created, imposing appropriate wholesale obligations on the dominant operator – including a RIO, along with interconnection obligations appropriate to all facilities-based operators. To remove some of the investment risks and uncertainty associated with a new platform, in this Phase the TRCSL will consider the interoperability issues raised in Sections 3.5.2 and5.3.3. This is to address the situation where potential new entrants may be reluctant to invest in any particular technical specification, out of concern that their technical specifications may not be supported by the incumbent operator(s).

- **Phase 3, Full Migration to NGN**: In line with the implementation of a wholesale regime, a separate category of service-based licences (possibly an NGN Class Licence) will be created to allow operators (particularly new entrants) to offer retail telecoms services through the lease of telecoms network elements (on a wholesale basis) from the NGN Individual Licensee. A "light-touch" version of the Class Licence may also be introduced for basic telecoms services involving fewer regulatory concerns. Appropriate consumer protection obligations will be imposed on all operators, as discussed in Section 5.4.2 below.

The terms of the licences, and corresponding legislation, will ensure interconnection and interoperability of networks in order to promote entry and reduce investment risk. At the same time, during the migration of service offerings from the traditional PSTN to NGN, the TRCSL may require services provided by telecoms operators to have the following characteristics to protect consumers:

- **Continuity** – consumers must be able to continue using the legacy services they are used to, with essentially no change, if that is what they desire. Consumers must have the ability to choose services according to their specific needs.

- **Ease of migration** – to every practicable extent, consumers must be able to migrate seamlessly to new services offered by the same network operator. The TRCSL may issue further directions to telecoms licensees requiring them to submit detailed migration plans, with

[15] Most of the legacy PSTN licenses issued to present operators will expire within the next two years.

a view to ensuring that consumer inconvenience is minimised and consumers are not adversely affected by any service outage or degraded call quality during or after the migration process.

- **Ease of adoption** – in order to promote take-up of services offered through the NGN, existing telecoms licensees should not impose long-term contracts with the object or effect of 'locking in' customers to their existing service providers, and so prevent them from adopting competitive services offered through the NGN.

- **Timely migration customer support** – other than providing timely customer/technical support to address any issues flowing from the migration to NGN, any changes to services, or ways in which NGN services differ from legacy services, should also be explained to the consumer in a clear and timely manner.

Question 38: Do you agree that a change in the current licensing regime needs to be introduced to realise the full benefits of NGN? If so, what licence changes need to be introduced in the transitional period to NGN? Do you have a view as to what changes in licences you would favour at each milestone of the transformation to NGN?

Question 39: Do you agree that the TRCSL should take the lead in requiring all licensees in the NGN to adopt compatible/similar technical standards? Or should this be left to the determination of market forces?

Question 40: What consumer protection measures do you consider to be important for the migration period from PSTN to NGN?

---

6 Summary of Questions

For ease of reference, all the questions contained in this document are gathered together here.

Question 1: Do you think that you or your company could benefit from the services that will be made possible by the implementation of NGN networks? If yes, please explain by means of examples.

Question 2: Do you think that the incentives available in the private sector for operators to begin to migrate to NGN are sufficient to promote adoption, or do you believe that the broader social benefits warrant additional steps being taken by the government to promote this migration? If so, what steps would you recommend the TRCSL investigate to promote such migration?

Question 3: Do you foresee any negative consequences of the migration to NGN for the telecoms sector or broader society? If so, please describe them, along with any steps that the TRCSL could investigate to mitigate or avoid those consequences.

Question 4: Do you see any issues or opportunities relating to access to, and use of spectrum now? Will issues and opportunities potentially emerge from telecommunications and broadcast convergence?

Question 5: Do you believe that innovative voice services such as Skype and Google represent a threat or an opportunity for the Sri Lankan telecoms market? What are the roadblocks to realising benefits from such services?

Question 6: Do you believe that the range of TV content available is an important or primary basis for customers' decision to purchase telecoms services? Do you believe that a merger between the media regulator and the TRCSL would provide an environment which promotes competition and increases user choice?

Question 7: Please describe your planned migration to NGN. (a) What is your technical strategy to migrate to NGN, if any? (b) What will be the key phases in your migration to NGN, and what phase are you currently in? (c) What is your anticipated timescale for each of these phases? What technical issues need to be resolved to allow you to offer the services you would like to be able to offer today, and over the next four years?

Question 8: What is the impact of NGN on existing telecommunications networks and services revenues, in light of the overall benefit that may be derived from the introduction of NGN? Do you think the TRCSL should play an active role in the migration to NGN? If yes, what measures should the TRCSL take during the migration and in the course of the long-term adoption of NGN technologies and services?

Question 9: What are your preferred protocols, architecture and interfaces for inter-connection with the PSTN, other NGNs, and with international networks (voice and Internet)? Please describe

in detail the associated timeframe for each of your choices, in relation to your overall migration roadmap described above.

Question 10: Do you envisage any general issues in relation to NGN interconnect? In particular, do you envisage any issues in relation to current peering arrangements?

Question 11: Please describe any experiences that your company has of an Internet exchange point in Sri Lanka or elsewhere. Do you foresee that your company will have an increased reliance on an IXP in the future, for Internet applications including voice? If so, are there any roadblocks to such usage in Sri Lanka today? If so, please describe those roadblocks and the means to overcome them.

Question 12: Do you believe that the establishment of a national body to standardise interconnection between NGNs is required in Sri Lanka? If so, what do you think would be the best governance model for it?

Question 13: Do you believe that the TRCSL should mandate that operator should put in place equipment to monitor its network performance in terms of delay, jitter, packet loss and bit error rate for different classes of service?

Question 14: Do you believe that other network performance parameters such as network availability should also be monitored by the TRCSL? Please use examples to illustrate your answer.

Question 15: If you answered yes to the previous questions, do you believe that the national standardisation body should take responsibility for specifying what should be monitored?

Question 16: What are your views on security in NGN networks? In your view does current technology, such as firewalls, provide adequate security to NGNs? Do you believe that there needs to be national NGN security policies and standards?

Question 17: Please comment on the need for revisions to numbering plans for new services, and the need or otherwise for non-geographic codes recognizing increasing user nomadicity?

Question 18: How do you think the harmonisation of naming and numbering of different networks should be addressed? At what stage of your migration plan will the harmonisation of naming and numbering be required? Do you think a national standardisation authority (mentioned in Section 3.5.2) should be in charge of implementing the harmonisation of the naming and numbering across the country? Do you see a future need for international coordination for any or all of Sri Lanka's naming and numbering schemes?

Question 19: Do you see ENUM as a fundamental stepping stone to true VoIP services? If yes, do you believe that ENUM should be implemented centrally by a third party (e.g. a government agency)? If no, what are your alternative plans to provide IP address look-up services (e.g. implementation of individual databases)?

Question 20: How important is it for you that a subscriber can keep their current phone number when migrating from PSTN to NGN? Do you think that a change in phone number may be a barrier for the adoption of NGN services?

Question 21: Do you plan to adopt IPv6 in your network? If so, when will you do so in relation to the milestones describe in your transition to NGN? What are the key transformation phases involved in migrating your IP network to IPv6?

Question 22: Please describe your views on the competitiveness of the markets for voice and data services today, including both domestic and international leased lines. What are the current roadblocks to increasing the competitiveness of these markets, if any? What regulations, if any, would you recommend to overcome these roadblocks?

Question 23: Please describe your current network architecture. What are your current plans to implement NGN networks and/or offer VoIP or other IP services? What are the roadblocks that you perceive to that migration? What regulations, if any, would you recommend to overcome these roadblocks?

Question 24: Do you see asymmetric regulation as appropriate for regulating NGN in Sri Lanka? If so, what obligations should be imposed on the dominant operator(s) and the non-dominant operators? What do you see as the most significant advantages and disadvantages of such an approach in Sri Lanka, and what roadblocks do you see to its implementation?

Question 25: Do you see value in maintaining a two-tier regulatory structure (facilities-based and service-based licensing) to accelerate growth of the Sri Lankan telecoms industry particularly in light of NGN? What do you see as the most significant advantages and disadvantages of such an approach in Sri Lanka, and what roadblocks do you see to its implementation?

Question 26: Please propose any other specific amendments to the licensing framework to promote the growth of service-based competition for NGN. In particular, please identify any regulatory obligations that ought to be excluded from a service-based licence (i.e. Class Licence), citing detailed justifications.

Question 27: Do you agree with the above proposal to sub-divide service-based licences into two tiers, i.e. ‘standard’ and ‘simplified’ Class Licences, based on the service offered? If so, which services should be subject to the light-touch ‘simplified’ licence, and why?

Question 28: What are your views on how USO should be implemented for NGN technologies. How should the funds be raised, and how should they be disbursed? Should they target basic voice services or advanced data services?

Question 29: Please comment on whether a new set of interconnection rules should be promulgated, or whether the existing Interconnection Rules 2003 should be amended to provide for interconnection in IP-based networks.

Question 30: Is there a need for a RIO to be offered by a dominant operator? Please identify the terms and conditions you would require in a dominant operator's RIO. Is there any need to change the regulatory approval process for RIOs?

Question 31: Do you think that further regulatory measures should be taken to promote competition in the core network in Sri Lanka? If so, which parts of the core network are most important to promote entry and competition in retail markets? Will these measures have an impact on NGN network investments?

Question 32: Do you think the introduction of wholesale access to the access network would benefit the consumer? What type of wholesale access would be most beneficial for Sri Lanka? Will these measures have an impact on NGN investments?

Question 33: Do you agree with the principles of net neutrality and technology neutrality for promoting service-based competition under NGN? If so, please provide suggestions for how to implement each principle. If not, please explain and provide any alternative or supplemental principles to consider. What impact, if any, will your suggestions have on incentives to invest and the ability to compete using NGN networks?

Question 34: Do you believe that new charging arrangements should be imposed for NGN interconnection? Do you believe that interoperability standards need to be imposed for NGN networks? Should these new regulations be imposed on all operators, or only dominant operators?

Question 35: Would it be appropriate to apply tariff control only to dominant operators? Please explain, and provide relevant examples where tariff review may be needed, or where it is not needed and imposes unnecessary regulatory burdens.

Question 36: What kinds of consumer protection do you see being necessary to serve the needs of consumers in the NGN environment? For instance, are there any limitations to the provision of emergency services by IP-based telecom services provided over the NGN? Please list these, providing details and examples where possible. Do you foresee any specific difficulties/challenges in complying with consumer protection requirements in the NGN environment? From the consumer protection perspective, what additional obligations should be imposed on a dominant operator in the NGN environment?

Question 37: Do you foresee any particular competition issues arising between NGN networks and services and legacy telecommunications networks and service? Are current regulations sufficient to restrain merger/acquisitions activities which may have an anti-competitive impact?

Question 38: Do you agree that a change in the current licensing regime needs to be introduced to realise the full benefits of NGN? If so, what licence changes need to be introduced in the transitional period to NGN? Do you have a view as to what changes in licences you would favour at each milestone of the transformation to NGN?

Question 39: Do you agree that the TRCSL should take the lead in requiring all licensees in the NGN to adopt compatible/similar technical standards? Or should this be left to the determination of market forces?

Question 40: What consumer protection measures do you consider to be important for the migration period from PSTN to NGN?

7 Submission of Comments and Views

Written comments and views will be posted on the TRCSL's web site (trc.gov.lk), except where a respondent indicates that their submission, or part of it, is confidential. Respondents are requested to submit such confidential information separately, with the relevant part provided under separate cover and clearly marked.

The TRCSL welcomes views on additional technical, regulatory or economic issues that are not addressed in this consultation document. All views and comments should be submitted in writing, sent **in hard copy** to the following address

Director General of Telecommunications
Telecommunications Regulatory Commission of Sri Lanka
276, Elvitigala Mawatha
Colombo 08

In addition to the hard copy, submissions may also be sent **in electronic form** in either Microsoft Word 2000 format or as a PDF. Soft copies should be emailed to hpkaru@trc.gov.lk.

Contributions may be submitted in any of the three official languages. Please submit your responses by **29th October 2010**.

8 Glossary of Terms

Term	*Description*
ADSL	Asymmetric Digital Subscriber Line. A digital technology that allows the use of a copper line to support high bandwidths in one direction and a lesser bandwidth in the other.
ATM	Asynchronous Transfer Mode, a standard for cell- based high speed data communications.
Bitstream access	A wholesale packet based transport service.
Bottleneck	The part of a network where the economics of building alternative networks are such that effective competition is unlikely to emerge.
Broadband	A data connection defined as 'always-on', and capable of providing a download speed of a minimum of 256kbit/s.
Bundling	Linking the purchase of one product or service to another, either by selling as a package, or through the use of discounts for joint purchasing.
CDMA	Code Division Multiple Access. This family of mobile telephone access standards originated from the Interim Standard 95 (IS-95), which was developed by Qualcomm.
Contention ratio	The contention ratio is the ratio of the potential maximum demand to the actual bandwidth. The higher the contention ratio, the greater the number of users that may be trying to use the actual bandwidth at any one time and, therefore, the lower the effective bandwidth offered, especially at peak times. Source: Ofcom
Core network	The centralised part of a network, characterised by a high level of traffic aggregation, high capacity links and a relatively small number of nodes.
COS	Class of Service e.g. Committed Access Rate (CAR), Waited Random Early Detection (WRED), Waited Fair Queuing (WFQ) in context of MPLS.
DSL	Digital Subscriber Line.
E.164	E.164 is an ITU-T recommendation which defines the international public telecommunication numbering plan used in the PSTN and some other data networks. It also defines the format of telephone numbers.
ENUM	Electronic Numbering. A suite of protocols to unify the telephone system with the Internet by using E.164 addresses with DNS and IP addressing system.
Ex ante	Before an event takes place.
Ex post	After an event takes place.
FM/AM	Frequency Modulation / Amplitude Modulation. Radio modulation schemes that differentiate signals by varying their frequency or amplitude respectively.
Frame Relay	Legacy data network technology.
FTTH	Fibre to Home. Refers to a broadband telecommunications system based on fibre-optic cables and associated optical electronics for delivery of multiple advanced services such as the triple-play of telephony broadband Internet and Television Video to homes and businesses.
GSM	Global System for Mobile communications. This is the most popular standard for mobile telephone access in the world.
IMS	IP-based Multimedia Sub-system.
IP	Internet Protocol. The packet data protocol used for routing and carriage of messages across the internet and similar networks.
IPTV	Internet Protocol TV Video over Internet Protocol.
LLU	Local Loop Unbundling. A process by which incumbent's direct exchange lines (DELs) are used fully or shared by other operators. This enables other operators to provide various services to customers.

Local loop	The access network connection between the customer's premises and the local exchange or remote switching unit, usually a loop comprising of two copper wires.
MDF	Main Distribution Frame. The equipment where local loops terminate and cross connection to competing providers' equipment can be made by flexible jumpers.
MPLS	Multi-Protocol Label Switching, a technology agnostic protocol used in NGN Networks to help ensure QoS especially for real-time applications. MPLS is a standards-approved technology for speeding up network traffic flow and making it easier to manage. MPLS involves setting up a specific path for a given sequence of packets, identified by a label put in each packet, thus saving the time needed for a router to look up the address to the next node to forward the packet to. MPLS is called multiprotocol because it works with the Internet Protocol (IP), Asynchronous Transport Mode (ATM), and frame relay network protocols. With reference to the standard model for a network (the Open Systems Interconnection, or OSI model), MPLS allows most packets to be forwarded at the layer 2 (switching) level rather than at the layer 3 (routing) level.
MSAN	Multi-Service Access Node, a common access Point Of Presence (POP) for providing different services.
NGN	Next Generation Network.
NICC	Network Interoperability Consultative Committee of UK.
NTSC	National Television System Committee, North American broadcast TV standard.
Ofcom	Office of Communications. The converged regulator for the communications industries, created by the Communications Act in UK.
PAL	Phase Alternate Line, European broadcast TV standard.
PoP	Point of Presence, a network location where access can be obtained by a third-party.
PSTN	Public Switched Telecommunications Network.
QoS	Quality of Service
RIO	Reference Interconnect Offer
SDH	Synchronous Digital Hierarchy. A transmission standard widely used for leased line services
SECAM	*Sequential couleur a memoire* – alternative European broadcast TV standard.
SIP	Session Initiation Protocol, an NGN signalling protocol.
TDM	Time Division Multiplexing a data multiplexing scheme using defined time slots to multiplex data.
USO	Universal Service Obligation
VDSL	VDSL (very high bit-rate DSL) is an xDSL technology providing data transmission up to a theoretical limit of 52 Mbit/s downstream and 12 Mbit/s upstream over a single twisted pair of wires.
VoIP	Users to send voice calls using Internet Protocol, using either the public internet or private IP networks.
VPN	Virtual Private Network. A technology allowing users to make point-to-point connections over a public telecommunication network to emulate the service offered by a dedicated point-to-point private circuit.
WiMAX	Worldwide Interoperability of Microwave Access, a wireless WAN technology
X.25	Legacy packet switched technology.

Annex A: International case studies

As part of this consultation, a number of case studies have been developed to identify international best practice regarding migration to NGN. Five countries were reviewed: the UK, Ireland, India, Singapore and Australia.

A.1 United Kingdom

Introduction

Overall, the UK has seen widespread growth in broadband in the past few years, and at the end of 2009 had over 18 million high speed internet subscribers in the country, making it the world's fifth largest broadband market.

The incumbent, BT, is in the process of migrating its entire PSTN network to a single NGN capable of handling the next generation of converged, multimedia communications services, known as the 21st Century Network (21CN). This network will allow high speed internet access, TV, and VoIP on both fixed and wireless networks. At the end of June 2010, BT had enabled roughly 55% of exchanges, and expects to connect approximately 75% of households by the end of 2011. In addition to 21CN, BT also announced plans in July 2008 to invest GBP1.5 billion to rollout a fibre-based network capable of delivering speeds of up to 100Mbit/s.

Virgin Media has also rolled out increased broadband speeds in its fibre network, announcing plans to offer speeds of up to 200Mbit/s by 2012 and eventually 400Mbit/s over its existing network using a combination of DOCSIS 3.0 technology, channel bonding, and the introduction of a new cable modem to handle increased speeds.

Regulatory developments

The *Digital Britain* report in June 2009 detailed proposals for improving and expanding the national's digital infrastructure, and contained more than 20 separate recommendations, including specific proposals on NGNs. An NGN consultation in July 2009 revealed that existing regulatory priorities for NGNs remained the same: providing incentives for efficient investment in NGNs, promoting effective competition based on NGN infrastructure, and protecting consumers from disruption during the transition to NGNs.

Furthermore, the Network Interoperability Consultative Committee (NICC) recently delivered two releases of an entirely new suite of interconnection standards for IP interconnection. Though BT's 21CN originally intended for voice services moving quickly towards IP interconnection, revised plans mean that TDM and IP will co-exist for the foreseeable future and other operators may be forced to lead the adoption of IP interconnection.

A.2 Ireland

Introduction

At the end of March 2010, Ireland was home to more than 1 million broadband connections, with household penetration at 66%. It is noteworthy that due to the rural nature of the country, 20% of broadband connections are provided via wireless access networks. The regulator ComReg has become aware that growth in the telecoms sector is slowing and voice and data revenues have also taken a downward turn. The incumbent and former monopoly operator eircom has been attempting to protect its leading position in the sector, and has been recently accused of damaging the competitiveness of the telecoms market by mounting legal challenges to ComReg's rulings.

In response to the regulator's call for improvement concerning the slow pace of broadband development, eircom rolled out 125 digital exchanges in the early part of 2009 to increase its total to 680, and also launched a new information portal that details NGN deployments and rollout schedules. eircom has also planned to invest EUR60 million to upgrade parts of its core network to handle IPTV and provide a minimum 8Mbit/s download speed.

Other providers are also emerging, primarily to champion alternative forms of broadband access based on wireless technology. AirSpeed Telecom was awarded 10.5GHz radio spectrum in July 2009 to roll out 10Mbit/s services for business users in these countries, allowing them to access high capacity bandwidth services with fast, uncontended internet, data, and voice applications. Imagine Communications, in partnership with Motorola, has also rolled out a national 4G mobile WiMAX network.

Regulatory developments

The roll-out of NGNs has been a priority for the regulator. In July 2009, ComReg warned that the implementation of a cohesive national ultra-high-speed network could take three to five years to complete, in which time Ireland was in danger of being left behind in the smart-economy race. ComReg commissioner Alex Chisholm stated that a timely roll-out of very high speed broadband networks in Ireland 'should not be taken for granted', given the potentially multi-million pound deployment costs in achieving the goal, and claimed that ComReg would do everything in its power to facilitate cooperation between operators in their plans to roll out high speed networks capable of connections speeds of 25Mbit/s and above. To that end, ComReg has ordered that unbundled broadband connection costs be lowered from EUR8.41 to EUR0.77, and has awarded spectrum for fixed wireless services, including WiMAX.

A.3 India

Introduction

NGN deployment in India remains in its infancy. Though the country has 15.2 million Internet subscribers, fixed broadband penetration remains extremely low, and at the end of 2009 stood at 0.7%, up from just 0.4% in 2008. While there has been some migration to NGN technologies in

the core networks owned by the fixed incumbents, it will take many years to fully transition to NGN. Newer technologies such as WiMAX have recently been deployed, but the transition to NGA is critically dependent on variables such as the success of alternate access technologies such as WiMAX, and the unbundling and market success of triple-play services which are now being offered by operators such as BSNL, MTNL and Airtel.

Regulatory developments

The Indian regulator TRAI published its report *Issues Pertaining to Next Generation Networks (NGN)* in March 2006. This identified the urgent need for the creation of a high-level cross-industry NGN coordination committee to examine all relevant issues, so that the transition from legacy networks to NGN would be smooth and systematic. Ultimately, a Next Generation Network Expert Committee (NGN-eCO) was established.

In January 2008, TRAI released recommendations on the *Growth of Broadband*, making WiMAX and 3G frequencies available for high speed service, allowing cable TV operators to deploy broadband over their networks, and creating a universal service obligation (USO) fund to provide subsidies for providing broadband services. Provisions were also made for IPTV services – with telecoms operators owning licences to provide triple-play services, and ISPs with a significant net worth being allowed to provide IPTV services without additional licences.

The spectrum auction for 3G was completed in May 2010 and was allocated on a regional basis. In India, there are 22 regions or "circles". The main winners of the 3G auction included Vodafone(10 circles), Barthi (12 circels), Reliance (13 circles), Aircel (13 circles), Idea (11 circles), Tata (9 circles) and STel (3 circles)[16]. Also, some Broadband Wireless Access (BWA) Spectrum, mainly used with the WiMAX technology, was successfully auctioned in June 2010 and the six winners were Infotel (all 22 circles), Qualcomm (4 circles), Barthi-Airtel (4 circles), Aircell (8 circles), Tikona (5 circles) and Augere (1 circle). It is interesting to note that four of the country's leading mobile operators – Reliance Communications, Vodafone, Tata and Idea – had backed out of the BWA auction midway on grounds that the intensity of bids had driven the price of the BWA spectrum "beyond rational levels."

A.4 Singapore

Introduction

Singapore is one of the most connected cities in the world, with some surveys reporting that up to 99% of the population is covered by broadband networks. Singapore is currently in the process of planning the deployment of a national NGN, the Next Generation National Broadband Network (NGNBN). In 2007, a dozen companies pre-qualified to construct the network. A consortium was established the following year, comprising SingTel, Singapore Press Holdings, SP Tele-communications and Axia Netmeida. SGD750 million was invested by the Singapore regulator

[16] 3G Auction daily public report, End of day 34, Indian government, 19 May 2010.

IDA for the network, and an additional SGD100 million invested by the consortium. All homes and offices are expected to be connected by 2012, providing broadband Internet access speeds of up to 1Gbit/s.

The consortium will ultimately be required to offer wholesale prices of SGD15 per month for each residential fibre connection, and SGD50 per month for each non-residential fibre connection. The consortium will also be required to waive installation charges for home and building owners when the network first reaches their address, in order to encourage owners to connect homes and businesses to the network.

Regulatory developments

Singapore has embarked on a ten-year ICT master plan called iN2015, with the goal of achieving 100% computer ownership in homes with children, 90% home broadband usage, and the creation of 80 000 additional jobs. As part of its plan, the government has established more than 7500 free public hotspots island-wide in a programme called Wireless@SG, and there are plans to auction spectrum in the 2.3GHz and 2.5GHz bands for wireless broadband services such as WiMAX. The Wireless@SG programme offers free Wi-Fi throughout Singapore, and in addition to recent new features such as location-based services, is expected to remain free until at least 2013.

The IDA requires licensees to interconnect with each other. In 2006, it published a *Framework Governing Interconnection between IP Telephony Operators and Existing Network Operators*, which required operators of IP-based networks to acquire a facilities-based operator (FBO) licence or a services-based operator (SBO) licence, but did not require them to provide number portability or emergency service connections.

A.5 Australia

Introduction

NGN development has been hindered in recent years due to disputes between the regulator ACCC and the incumbent Telstra, primarily over the pricing of unbundled local loop and wholesale bitstream services. These disputes have resulted in delays in the development of NGNs. In July 2006, Telstra cancelled plans to roll out nationwide FTTN infrastructure after the regulator denied its request to make the network exempt from regulations requiring it to be leased to competitors.

However, in late 2009, an agreement was reached with Telstra to migrate its customers to a new public-private company that would implement a National Broadband Network (NBN), and an agreement was finalized in June 2010 for Telstra to officially participate in the roll-out of the NBN. There are two stages of roll-out trials currently underway, one on island of Tasmania and one on the mainland, connecting almost 60 000 premises.

Other operators have also pursued alternative wireless broadband technologies such as WiMAX, including Internode, Unwired and Personal Broadband Australia.

Regulatory developments

In 2008, the regulator announced the NBN project, in which the state would invest AUD4.7 billion to oversee the construction of a new high-speed fibre-optic network that would cover 98% of the country. Bids were submitted, but the government rejected all of them, electing instead to create a new public-private company, NBN Co, that would oversee the project. The government holds a 51% stake in NBN Co. and will sell its shares five years after the network has become fully operational. The regulator has stated that speeds of up to 100Mbit/s will be made available to roughly 90% of homes, utilizing FTTH technology, and that the remaining 10% of homes (primarily in remote areas) will receive speeds of up to 12Mbit/s. The network will operate on a wholesale-only, open-access basis with retail services being provided by separate, third-part operators.

The recent 2010 elections saw the NBN almost scrapped, as the opposition party was firmly against it. A hung election resulted in a single independent MP supporting a second term of Labour rule, and it appears that the NBN project will proceed.