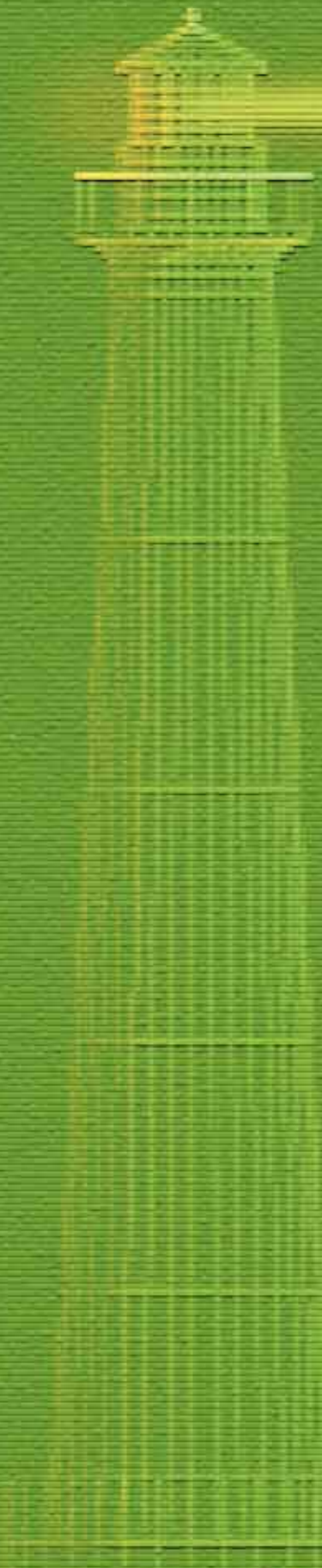
International Telecommunication Union



GSR 2007

DISCUSSION PAPER

NGN OVERVIEW

Comments are welcome and should be sent by 1 March 2007 to GSR07@itu.int

International Telecommunication Union

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NEXT GENERATION NETWORKS (NGN) REGULATION OVERVIEW

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*This paper has been prepared by **Dr. Tracy Cohen**[‡], Independent Communications Authority of South Africa (ICASA), as an input document for the 2007 Global Symposium for Regulators (GSR), organized by the Telecommunication Development Bureau (BDT). The views expressed in this paper are those of the author and do not necessarily reflect the opinions of the ITU or its membership. Comments are welcome and should be sent to gsr07@itu.int by 1 March 2007.*

The ICT sector once again stands on the cusp of a new era in technological development: the migration to fully Internet Protocol (IP) enabled networks and services or Next Generation Networks (NGN). NGNs are managed broadband networks that allow integrated data, voice and video services through the deployment of Internet Protocols. IP based networks will ultimately replace traditional circuit switched telecommunications networks (PSTN) and services and traditional fixed line carriers have begun to invest in and deploy IP based networks, usually as overlays of their existing networks which continue to offer traditional services. Due to the efficiencies and flexibility of IP technology, most new networks being established are also IP based. The ITU predicts that by 2008, at least 50 percent of all international minutes will be carried on IP networks and that many international carriers will have deployed all IP based networks. The OECD predicts that between 2002 and 2006, the market for NGN equipment will grow by 23 percent annually, with the optical switch market growing at 84 percent and the switching market by almost 12 percent.[1] While NGN migration is a gradual process, it is anticipated that in OECD countries, full fixed NGNs are expected to be in place by 2012 and mobile by 2020, enabling the full and true convergence of fixed and mobile, voice and data, data and video and the Information Technology (IT) and telecoms and broadcast sectors.[2] This means that the choice of technology used for infrastructure no longer has an impact on the kinds and variety of services that are delivered over that infrastructure. The advent of NGNs therefore heralds a shift from vertically to horizontally integrated networks, enabling unfettered, consistent and ubiquitous access for both users of these networks and competing service providers.[3] This presents many opportunities, challenges and innovative options and alternatives for the global ICT sector.

1 Introduction

The current circuit switched, telco regulatory model, with its oversight intensive approach to technical and economic regulation differs markedly from regulatory approaches to the packet based Internet, which is generally less subject to regulatory intervention. The two have evolved differently, requiring disparate approaches by regulators to new developments. In some cases, simply augmenting current practices is sufficient. For example, in countries where it is legal to offer Voice over IP services (VoIP), ensuring that VoIP operators have the right to interconnect to other operators and access to a national numbering plan. However, as NGNs combine the telco and the Internet model at a technical level, it will therefore require planning and foresight by regulators and policy makers at the legislative and policy level too, in order to ensure that regulatory frameworks are designed or augmented to facilitate NGN development and deployment.

This presents an opportunity for regulators and policy makers to analyze what impact their current regulatory framework has on innovation, investment and affordable access and to design frameworks for NGNs that ensure these goals are met, informed by their own domestic specific context. The NGN evolution thus presents another opportunity, heralded by technological innovation, to re-define regulatory ground rules in advance, audit and review approaches to regulation and policy that will seek to promote competition, investment and widespread end user access. Key regulatory questions emerge that need to be addressed. These include primarily whether an NGN regulatory framework should be regarded as a choice between two different regulatory approaches, or a hybrid system, or an entirely new model? For example, **West African** countries have agreed on a harmonized regulatory framework[4]. A new entrant in the fixed line space who may deploy a NGN network will certainly coexist with legacy networks that are sometimes analogous. In

this context the question of framework to be used is important, yet it remains unclear whether a new harmonized one or a hybrid one taking into account the diversity of coexisting networks would best facilitate for example, interconnection and tariffs regulation. Moreover, how should policy makers and regulators approach the migratory phase, while PSTNs, mobile networks, IP and NGN co-exist, without leading to a situation of different regulatory frameworks for different networks, leading to discriminatory regulatory treatment and fostering arbitrage? Is NGN an opportunity to lighten the regulatory burdens that were placed on PSTN operators, while at the same time cautiously moving toward *some* regulation of the Internet to protect the network and its users? It is an early phase in the regulatory history of NGNs and there exist more questions than answers to many of the challenges presented. This GSR Discussion Paper will highlight the main concerns that regulators and policy makers should begin to address as they decide if, when and how to approach aspects of regulating NGNs.

Box 1: What is Internet Protocol (IP)?

Traditionally, connections for voice communications using circuit switching require a physical path connecting the users at two ends of the network. That path must stay open until the communication session ends resulting in users having dedicated access to a direct connection. Over the Internet data (including voice) is delivered using the Internet Protocol. With this technology, the message is divided into packets containing both the sender's and receiver's IP addresses that identify them. Any packet is sent to a router that understands the destination address and forwards the packet to an adjacent router that in turn reads the destination address. This process will continue across the Internet until one router recognises the packet as belonging to within its immediate domain. That router then forwards the packet directly to where the address is specified. Since a message is divided into a number of packets, it can be sent by a different route across the Internet when necessary and the routes packets can take to the same destination may vary depending on the routing information available. In this way, IP networks allow communication flow without requiring the establishment of an end-to-end dedicated path.

These packets can also transmit voice information and as a result, a variety of platforms, including wireline and wireless communications standards and gaming systems, have evolved to include IP as a key component. For example, personal digital assistants (PDAs) have a capability to transmit voice and other data using IP technology. IP networks are currently used by a wide range of users from enterprise customers to residential VoIP subscribers. The most widely used version of IP today is Internet Protocol Version 4 (IPv4), but Internet Protocol Version 6 (IPv6) is already being deployed in many networks. IPv6 is expected to add a number of improvements to IPv4 in that the function of multicast is installed as a default which will ensure quality of service in telecommunications with a configuration where voice and image has a higher priority than data, in addition to significantly increasing the available address space.

Source: OECD (2006) and SearchMobileComputing.com

2 What do we mean by "Next Generation Networks"?

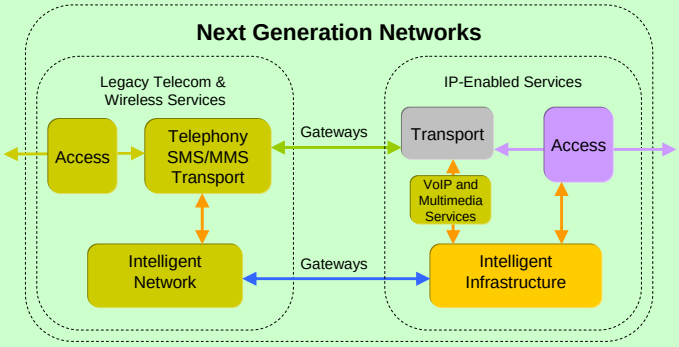
There are numerous views of what constitutes NGNs and different operators that have begun the process of migration or development refer to their networks differently: for example, Korea Telecom uses the name Broadband convergence Network (BcN) and British Telecom has named their NGN, "21CN". Deutsche Telekom calls their IP-based global network Telekom Global Network (TGN); NTT (Nipon Telegraph and Telephone) call their NGN Resonant Communication Network Architecture or RENA. There is however a tendency when using the term "NGN" for it to mean different things for companies and people using the term. For some, NGN simply means migration from the PSTN to an IP based network. For others, it is a more specific reference to, for example, international calling IP trunking, and/or IP in the local loop. Numerous vendors use the term NGN in their products and operators and providers setting out their vision refer to NGNs frequently for marketing and other purposes, but there is no reference to a single set of NGNs standards at this stage.

At a minimum, NGNs are generally packet-based, IP-based, multi-service networks.[5] Some definitions consider capacity for example, 20Mbps or more as definitive on the basis that such bandwidth would be the minimum required to support services that cannot be delivered using current broadband technologies.[6] At the broadest level, NGN's imply very fast access to and end to end IP based network.

NGNs can be developed using a number of technologies, including fibre, cable, fixed, mobile wireless, or further technology upgrades to the existing copper based networks. This heralds the shift from a "one

network-one service" approach, to a "one network–many services" one.[7] For operators NGNs are considered essential for strategically positioning networks to compete in the increasingly converged world of services and content where voice is no longer the sole source of revenue. While the Trends in Telecommunication 2007 chapter on NGN Technology will provide a detailed breakdown of the technical aspects of NGNs, an overview is offered here to set the context for understanding the regulatory, operational and financial issues that arise from NGN development.

Box 2: Legacy fixed and wireless networks and NGNs



Source: Anthony Rutkowski, Verisign

At a market level, NGNs are partially driven by the increased demand for ubiquitous, integrated data, voice and video, mobile and fixed broadband, alongside the increasing role of mobile services in the broadband domain. Demand and technological evolution has driven the inevitable convergence of IP based networks with traditional PSTNs and existing mobile networks. Operators and investors seek increased revenue and profitability, greater productivity and broader service offerings. These trends are facilitating the integration of separate and distinct mobile and fixed technologies (optimised for one service) to enable the seamless distribution of services over fixed and mobile broadband services and to create a unified IP-based multi-service network. Put simply, a NGN can be viewed as a "communication network that allows unfettered access to all communication products and services, irrespective of the service provider or network connection."[8]

At the technical level, NGN's are distinguished from legacy or traditional circuit switched networks in that all information is transmitted via packets, which are then labelled according to their type (data, voice, etc) and handled differently by traffic management equipment.

Box 3: ITU Definition of NGN

The ITU defines a **Next Generation Network** as a packet-based network able to provide services including telecommunication services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It offers unfettered access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.

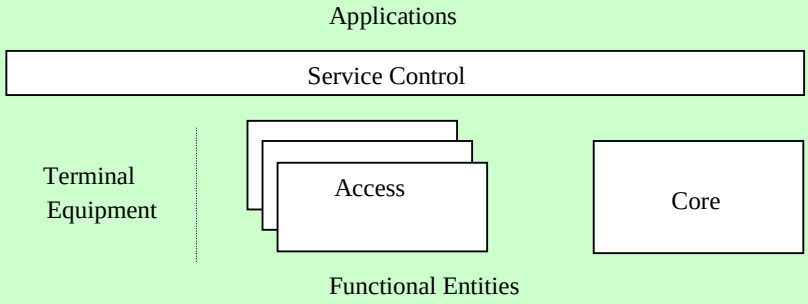
Source: ITU-T Recommendation Y.2001 (Study Group 13)

The above definition divides the NGN in two parts, namely the ***Core*** and the ***Access NGN***. The ***Core NGN*** is essentially the transport or backbone network, and uses digital technology to connect telephone calls and other network traffic more efficiently than traditional networks. **Access *NGNs*** involve an upgrading of the local loop to broadband, either through DSL technology or by deploying fibre into the loop for part, or all of the connection. Building a core NGN does not directly influence these access technologies.[9] At the core, providers need to upgrade the equipment in telephone exchanges (replacing switches, installing routers and VoIP equipment) but do not need to change existing wires and fibre in the ground."[10] This facilitates

converged technologies to carry multiple services (voice and data) over the *same* (horizontal) infrastructure and equipment, rather than using *separate* (vertical) equipment and/or infrastructure.[11]

In addition NGN's involve a *de-coupling or separation* between the transport (connectivity) portion of the network and the services that run on top of that transport. (see box below) By separating transport and service layers, a provider can enable a new service by defining it directly at the service layer without considering the transport layer – that is, service and transport layers are entirely independent, which has implications for competition and pricing.[12] Services may therefore be provided as *applications* on a NGN network.

Box 4: NGN - Core, Access, Services



The Next Generation Core: The next generation core network is a single converged fixed network, which can carry voice and data. The network technology of choice will be IP/MPLS and all traffic is transported as IP. This core network evolves from a complex environment of different boxes in today's core networks. The evolution to a next generation core network promises significant savings in the long run and a stable platform for converged services.

The Next Generation Access: The next generation access is a large digital bitpipe. The next generation access is service independent and allows multiple plays (TV broadcast, high speed internet access, telephony and others). There will not be a single platform to deliver next generation access. Platform competition is expected between copper lines, cable networks, mobile networks as well as wireless, satellite and fibre access.

The Next Generation Service Control: Today's service control is service specific. In a next generation network rapid service development and delivery is paramount. The next generation service control will provide a toolbox for operators, where converged service can be brought to market flexibly and quickly. Certain challenges arise regarding interoperability of services and service components.

Source: European Telecommunications Platform

Next Generation Networks then is a catch-all phrase for the infrastructure that will enable the advanced new services that mobile and fixed network operators have started to offer, while continuing to support existing services. They will also support fixed, mobile and nomadic users and have the ability to carry voice, data and multimedia – real time interactive services.[13] These networks enable a range of new service offerings in a multi-vendor environment, such as for example, Voice over IP.[14]

As factors like interoperability and quality of service (QoS) are critical, work is underway in numerous organizations concerned with standards to ensure that NGN evolution and migration is being carried out coherently and effectively. Already, there are various interoperability issues between different VoIP soft client providers, which if not addressed, will hold back the development of this service segment. Some of these standards organizations include the European Telecommunications Standards Institute (ETSI), specifically the Telecoms and Internet Converged Services and Protocols for Advanced Networks (TISPAN); the ITU Standardization Bureau (ITU-T), specifically the NGN Global Standards Initiative (NGN-GSI), the 3rd Generation Partnership Project (3GPP) and the Fixed Mobile Convergence Forum.[15] There are also many organizations such as for example, the European Regulators Group (ERG); European Conference of Postal and Telecommunications Administrations (CEPT); the ITU and the Organization for Economic Cooperation and Development (OECD) to name a few, which are currently engaged in policy and regulatory based research on IP and NGN networks, considering the types of regulatory principles and

implementation issues that they involve. Many projects are also taking place regionally, for example, in Europe, the GÉANT project (including all research and education networks in Europe) and the Task Force on Next Generation Networking (TF-NGN) were established for collective investigations and deployment of NGN in 2001; NGN FOG in Australia under the auspices of the NGN Ventures conference in the USA, UNF in Japan and the BcN Forum in Korea are also joint activities related to technology and service development.[16] As mentioned above however, while there are characteristics of NGNs and services, there is not as yet a single standard or reference point for benchmarking them. This is still evolving as work in these organizations is underway.

Table 1: Major Characteristics of NGN

All IP or packet-based networks (Migration from circuit based ISDN to packet based ISDN)
Separate application/services from the transport networks
Open networks
Converged or integrated broadband networks
Distribution of network intelligence

Source: OECD

Table 2: Comparison of telco networks and the Internet

Current telco networks – closed	**Telco NGN networks –closed**	**Internet – open**
• Circuit switched technology	• ATM/IP based technology	• IP based technology
• Intelligent network	• Less intelligent network	• Dumb network
• Dumb terminal	• More intelligent terminal	• Intelligent terminal
• User-user services centrally controlled by provider of transport service	• User-user services centrally controlled, with much greater scope for third party services.	• User-user services run by users themselves. No service creation - services and applications run from edge.
• No client-host services		• Client-host services run by independent hosts at edge
• Usage related charges and quality control	• Usage related charges and quality control	• No usage-related charges and little quality control. Gateways to telco networks have control and charging.
• Access control for users and interconnection	• Access control for users and interconnection	• Access control for users but otherwise open.
• Interconnection is service related and controlled	• Interconnection may occur at various levels. Above the IP level it is likely to be service related and controlled.	• Interconnection is open and only at IP level.
• Few/no third party services	• Few/no third party services	• Numerous third party services

Source: CEPT, 2003.

Box 5: What is a Next Generation Network?

The NGN is characterized by:

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

3 Differences between NGNs in developed and developing markets

While there are commonalities between NGNs evolving in highly developed ICT markets and NGNs in less developed markets, like many other aspects of the ICT sector in these markets, there are many differences affecting regulatory, financial and operational issues. The most obvious of which are linked to questions of access and affordability. Developed markets generally boast high levels of PSTN, mobile, Internet and broadband penetration, while less developed markets generally have low penetration indicators and the presence of more mobile than fixed line networks. It is trite, but worth restating that in order for consumers to begin to reap the benefits of NGN services, greater attention needs to be paid to creating competitive environments. This pertains to both traditional fixed and mobile voice, which with NGN-related standards such as SIP, will seamlessly interface with each other in a wider IP based environment.

Other major differences in the NGN evolutionary path between developed and developing countries will be the pace and manner NGN assumes. One similarity is that full NGN evolution takes time and will not occur rapidly, with predictions of 2012 -2020 as the period in which most operators in developed countries will see NGN migration come to fruition. Convergence is driving new demand for the *variety* of service offerings that can now be delivered and while so doing, is blurring pre-existing boundaries between fixed, mobile and data networks. This means that the end user can request a range of services, regardless of the access technology used. This requires a "meta-infrastructure" beyond the existing, subordinated networks – a core network for all the access networks.[17] It is envisaged that developed countries, with already existing and evolved fixed line networks (predominantly fibre based) will more easily leverage existing fixed line networks for core and access NGN development. For example, British Telecom began its PSTN evolution in 2005 by deploying Multi Service Access Node (MSAN) devices to its edge network. The replacement of circuit switches by SoftSwitches started in 2005 and it is anticipated that 50% of all BTs circuit switches will have been replaced by 2007. Verizon has also adopted the SoftSwitch technology to upgrade already existing circuit exchanges in its local networks.[18]

On the contrary, where fixed line network development is not as evolved and considering the prevalence of mobile networks in relation to fixed in developing countries, it is arguable that NGN in developing countries will more likely be leveraged off existing 2G mobile networks, suggesting that they will be wireless. This is made possible through the IP Multimedia Subsystem (IMS). Generally, the core NGN will tend to be a fixed network, with the possibility of interconnection with a mobile network. However, both fixed and mobile are converging towards a unique type of core NGN architecture for fixed and mobile networks: the IMS (IP Multimedia Subsystem). Most cellular mobile operators in **Africa** have 2G GSM networks. Some of these networks are being transformed into intermediary generation networks (2.5G) like GPRS (General Packet

Radio Service). Outside of countries like South Africa, who have fully fledged third generation mobile networks (3G), it is difficult to predict the pace at which such transformation will take place. In any case, the evolution of second generation networks into 3G through 2.5G constitutes multi-faceted challenges for operators in this constantly changing environment. In essence, this suggests that developing countries may have less existing infrastructure to leverage in the evolution to NGNs. While the NGN migration path is likely to differ between developed and developing countries, and within developed and developing countries themselves, this does not however mean that developing countries are going to have to build out fixed, fibre networks to achieve full NGN migration.

The salient driver behind this migration is to reduce the costs of building and operating a number of separate networks. As fixed line voice service revenue continues to decline, network evolution consolidating existing legacy equipment regardless of the infrastructure, is a priority issue for operators. This will enable operators to optimize network resources by carrying a variety of services on a converged multi-service IP network, and by using node devices with higher processing and service interfacing capabilities to optimize the network structure. This will in turn enable the cost-efficient provision of innovative services. It is important to note however that there is no "one size fits all" network solution that can apply to all operators, as each has its own network scale and topology. One view argues that operators with large scale networks tend to adopt the smooth migration policy to upgrade their networks seamlessly, while operators with small scale networks tend to build new IP networks and migrate current services to the new networks.[19]

More critically for policy makers and regulators is the question whether to regulate IP network development or allow an evolutionary approach for IP networks. And where a decision is taken to regulate rather than evolve, what aspects of NGN migration should be regulated? On the one hand, deployment requires significant capital investment and oversight by regulators to ensure that investments are protected. On the other hand, it can be argued that opening access to all market segments will induce appropriate risk assessed investment and result in competition which should then be accompanied by regulatory forbearance except in the case of market failure. In many developed countries, this goal has prompted a preceding discussion on the benefits of *ex post* (after the fact) versus *ex ante* (before the fact) regulation. Some countries, like Canada are starting to move towards a framework in which *ex post* regulation begins to play a bigger role than *ex ante* regulation based on verified complaints of significant market power (SMP). This would see greater reliance placed on a country's competition authority rather than the sector regulator.[20] However, these developments tend to reflect more mature telecommunications markets which have seen a longer or faster period of market liberalisation than is the case in most developing countries. Nontheless, an underlying remaining requirement for the development of competition, and a clear requirement of the combined WTO GATS Agreements, is a clear, transparent and non discriminatory *ex ante* framework to promote competition that at the same time, reflects the needs of convergence and integrated services.[21]

This has importance beyond the sector. It speaks of creating credible commitments for investment generally. *Ex ante* rules are put in place to ensure that a baseline of regulatory uniformity and certainty for local and foreign investors is established. In an international trade context, this need for a minimum standard stems from the concern that domestic regulatory choices and actions can operate as non-tariff barriers, thwarting market access gains at the international level. Predictable and clear features common to regulatory systems attempt to avoid this outcome by reducing uncertainty and the high transaction costs associated with commercial exchange.[22] With the growing importance placed on foreign investment in developing countries, a sound *ex ante* framework allows a country to signal to investors that the terms upon which they expend large capital outlays in sunk costs will remain fixed and sheltered from arbitrary exercise of political or administrative discretion.[23] It has been documented that an inverse correlation exists between credibility and uncertainty, "confirming that the more credible a government and its institutions, the less investor uncertainty exists".[24] The optimum outcome for a country seeking to attract capital for network development is to have its reform programme, and the commitments made pursuant to that plan – including its regulatory institutions and rules - perceived as credible. A transparent and certain *ex ante* framework operates to minimize transaction costs and changes in the "rules of the game" at a later stage.[25] Central to this are national regulatory authorities to ensure that barriers to entry and to the use of new technologies are also reduced.

3.1 Broadband Policy

From a policy and regulatory point of view, the development of NGNs and IP-based services in developing countries can generally be characterised as policy absence or failure, usually with respect to broadband policy, and regulatory lag, coupled with affordability concerns. It is important to note however that there is an emerging coexistence of IP networks licensed to deploy NGNs for example, and IP networks largely using the Internet, which operate in the absence of any license, selling voice services (often through prepaid cards) which may be perceived as detrimental to the voice revenue of licensed operators, specifically for international calls. Although many countries in Africa for example, prohibit Internet voice traffic diversion, regulators by and large are technically not able to effectively prevent this. While this may have some cost savings for consumers in the short term, it may also be perceived as having a negative effect on the liberalisation of these fixed line markets and the introduction of new licensed NGNs. Nonetheless, the very fact that new IP services can be run over NGNs, does not necessarily alter the economics of supply and demand. While there may be some savings from network topologies, the basic issues of cost, access and rollout continues to plague developing countries. Few of these countries have yet to develop coherent broadband policies to give effect to the technological and business realities of converging networks and services.

The pre-requisite for the efficient use of a NGN is network access with high bandwidth for the end user. As such, the development of NGNs and the regulatory and policy frameworks that enable their deployment are inextricably linked to a country's national broadband policy debate and should be seen as part of that dialogue. It is countries that have extensive broadband penetration and usage such as Denmark, Iceland and South Korea, in which NGN development is best able to flourish and where the critical mass necessary for the network effects associated with economic growth are most likely to be realised. Similarly, facilitative broadband policy frameworks in India, Pakistan and Malaysia are fuelling the growth of broadband making these markets also ideal candidates for consideration of NGN migration.

Defining broadband as any access at speeds from 256Kbps and above, the ITU has noted that Africa as a whole accounts for 0.1 percent of broadband subscribers worldwide, when considered by region. Asia, Europe and the Americas account for 99 percent of all broadband subscribers, the majority of which are located in North America, Western Europe and Asia.[26] The OECD Broadband Statistics for 2006 reflect this with the highest broadband penetration rate of 29.3 subscribers per 100 inhabitants recorded in Denmark. The strongest per-capita subscriber growth (adding more than 6 subscribers per 100 inhabitants) was recorded in Denmark, Australia, Norway, the Netherlands, Finland, Luxembourg, Sweden and the United Kingdom.[27] By contrast, most African countries have yet to launch high-speed Internet services at all, although a few like Morocco, offer broadband services of up to 20Mbps and Sonatel in Senegal has rolled out a "triple-play" service bundle offering voice, Internet access and television programming.[28] It is worth noting however that in developing countries, the prevalence of fraudulent smart cards allowing access to paid satellite television programs at significantly reduced rates potentially hinders the development of television access offers in the context of triple play.

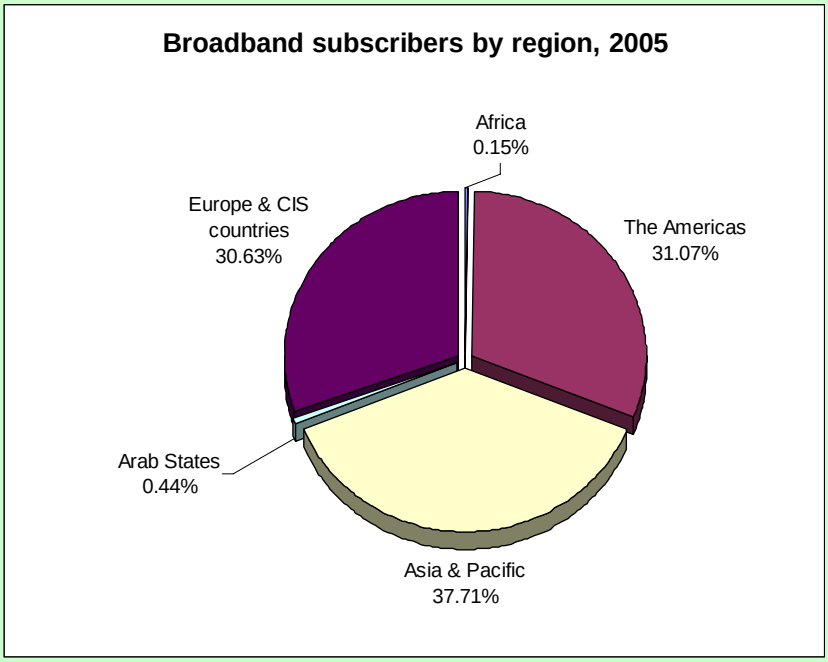
Where broadband development is occurring, it is usually led by the fixed line incumbent through DSL deployment, while still controlling access to its network for downstream competitors. The ResearchICTAfrica 2004 household study examined broadband usage across ten African countries and found it to be statistically insignificant. A similar 2005 study (although non representative) reflected a similar, negligible use of broadband services.[29] In many African countries, national penetration rates for fixed line remain exceptionally low, while high end mobile broadband services such as EDGE/GPRS, 3G and HSDPA where available, remain beyond the reach of the majority of the population. Without competition generally, prices in Africa and in developing countries generally, are magnitudes of scale higher than international benchmarks, which results in limited usage and undermines any of the economies of scale that would drive down prices.[30]

As such, structural market issues relating either to the continued monopoly of the incumbents in certain market segments or to their ability to leverage their dominance anti-competitively as a result of vertical integration across several market segments will need to be resolved to induce much needed private investment in broadband NGNs. Therefore, the issues affecting IP network and services development remain in many ways, the unaddressed "legacy" regulatory and competition issues from traditional PSTN regulation. The harmonization of regulation in different regions may however assist in addressing these legacy issues.

However, the lack of effective competition authorities (ex post regulation) in many countries may similarly serve to inhibit the attainment of this objective. Such institutional issues and where relevant, the benefits of harmonization for individual country's ICT development needs examined.

Like those countries that have been unable to develop their network extensively and are not constrained by protecting large legacy networks, those countries that have not proceeded with reform strategies and public commitments to investors and operators that may constrain them, have the potential to 'leapfrog' orthodox reform measures and adopt new strategies more appropriate to new, rapidly deployable, lower cost and higher efficiency networks. While the commercial value driver for broadband is a sound one, governments and regulators need to ensure that policy is in place to facilitate full broadband growth, outside of silo services, which are protected through legacy rate regimes, distorted interconnection frameworks and access restrictions. At this stage however, although legacy networks and NGNs will co-exist, it still remains an open question, informed by the context specific issues in each country as to whether this would be best achieved through the deployment of policy tailored for NGN development, or by developing NGN policy alongside the policy trajectory in place for legacy networks and operations.

Graph 1 : Broadband Subscribers by Region



Source: ITU World Telecommunication Indicators Database, 2005

3.2 Regulating Legacy Issues

While the advent of IP networks and services pose new challenges around the world for operators, regulators and policy makers, for the latter two, these challenges tend to comprise two parts: first, whether to legalise new services enabled by NGNs and where legalised, what aspects of these new services to regulate and whether those aspects which they seek to regulate can technically be enforced. Second and more fundamentally, to enable widespread development of IP networks and NGN services, regulators need to re-examine their roles and the degree of regulation required and its timing and sequencing.

Many of these challenges may emanate from an attempt to regulate new services in a legacy fashion, or legacy failure to regulate the dominance of incumbents or essential facilities that may inhibit the entrance of new services. This is particularly acute in developing countries where markets are just gradually opening up to competition. For example, with regard to VoIP, standards remain critical to ensuring innovation; service quality, interoperability and competitiveness. How can regulators best approach these goals? Should VoIP

services be regulated like traditional voice services?[31] Is consumer interest regulation required to ensure fair pricing and quality of service (QoS) or would this not be required if markets were more open and there was sufficient competition? Even if there was effective competition would numbering allocation; interconnection; emergency services; directory assistance, privacy and security require regulation?

Yet, despite the potential of VoIP to undercut the exorbitant prices of telecommunications, the regulatory framework in many countries does not recognise alternative voice service providers to incumbent operators. In most of Africa for example, this is often the result of the fact that such providers are not licensed, which is still a pre-condition to offering public services. How should the regulator approach this and other innovations, like IPTV or broadband wireless access networks? Traditionally, broadcasting has attracted a more interventionist regulatory approach than telecoms – at least with respect to content. Promotion of such content or protection of audiences is often closely linked to a country's language or cultural values. Questions emerge as to whether it is possible to regulate content in a converged "always-on", on-demand broadband world where content is no longer delivered solely through a single point to multi point broadcasting service? Are platform independent approaches to regulation possible? How is the public interest to be promoted in the context of this rapidly evolving IP enabled communications environment? Many of the questions that need to be addressed also proceed from the assumption that the development of NGNs will increasingly undermine rationales for asymmetrical approaches to regulation across sectors. Reforming and tailoring existing legal and regulatory regimes to this end should remain a regulatory priority.

4 NGN Deployment Drivers

Drawing from the points above regarding the pace and manner of NGN migration in developing and developed countries, it is important to highlight that there will also likely be several different migratory paths towards NGN. NGN deployment can essentially take place in two ways: in a gradual, phased-in manner on existing circuit switched networks seeking to upgrade to a fully IP-enabled architecture, or by building a fully IP-enabled network from the outset. For example, British Telecom has favoured a rapid shift to IP technology, while Deutsche Telekom has expressed its preference to adopt the overlay model, where old networks are only gradually replaced by new IP networks. Both plan to extend their services into other countries. The more gradual approach to NGN migration may include the upgrade only of the core network and replacement of routers and switches; then migrate to IP trunking, implement at the local loop level and then at the user level. The second stage of change is to introduce IMS or similar for multimedia service. And of course, many of these changes can also run in tandem with one another. For example, Telecom Egypt and Maroc Telecom are offering IP-TV but have not as yet implemented VoIP.

Other elements of gradual evolution suggest upgrading the core in urban centres first and then slowly rolling out upgrades to peri-urban centres and rural areas. It is also important to note that many countries have been using IP in their core networks for voice traffic for some time. This may prove to be sufficient in some cases, while others may choose to undertake a full scale NGN migration of all networks. While it is likely that NGN migration is an inevitable course for the ICT sector, some operators may choose not to migrate fully to a NGN, but either remain in an outdated circuit switched environment or opt for a less optimal performing IP network. One view is that in developing countries, the introduction of competition in the fixed network will force new entrants will deploy a Greenfield NGN network and drive incumbents toward a strategy of gradual NGN deployment in order to cope with the competition they will face from new entrants that may be able to offer rapidly new and innovative services through their new NGN. Within developed countries, where fixed line competition has been in place for some time, all operators face the same challenge of what strategy to adopt for migration that will best enable them to cope effectively with the challenges of competition.[32] While predictions are not easy to make at this stage, for regulators and policy makers, the critical point is that few countries will effect a rapid NGN deployment route which suggests that legacy networks will co-exist with NGNs and that consequently, legacy and NGN regulation may co-exist for a period of time. It is important that while these two systems co-exist any efforts at arbitrage, particularly with respect to interconnection and access by incumbent operators should be minimized

Already various traditional carriers, cable, mobile and fixed line operators, new entrants and Internet Service Providers (ISPs) are developing plans to migrate to a NGN. Whichever is the preferred approach both are created as a result of a coalescing of pressures or drivers on the ICT sector creating the latest innovation. Technological evolution lies at the core of these changes enabled by developments in IP technology and applications. Moreover, many legacy networks are reaching the end of their life cycles and require

replacement equipment. Other drivers include the *de facto* convergence of media, telecoms and IT, coupled with the worldwide success of mobile services and the resultant mobility, which in an IP environment, have changed the way in which consumers relate to their daily communication needs. For example, South Africa is capitalising on the developments in 3G and digital migration to ensure that when it hosts the 2010 football world cup, every mobile phone in the country will be enabled to received mobile television, while MMS services will continue to enable visitors from around the world to send photographic and video footage from stadiums around the country over their mobile phones.

Other operators that have begun to implement NGN plans include NTT in Japan which has announced plans to establish a high security, high speed and large capacity network and end-to-end connectivity. While this list is not exhaustive, Korea Telecom plan to have replaced their PSTN with an all IP based network by 2012. Similarly, Telekom Austria plans to do the same by 2009 and began its first installations in 2004. Bell Canada and Telus in Canada have also announced plans to implement NGN, along with Telecom Italia, Sprint and Qwest, the US company that claims to have completed a transcontinental domestic IP network. Shanghai Telecom and Chunghwa Telecom have been undertaking NGN deployment since 2003 and Combellga in Russia announced plans to enhance its existing voice network with IP based infrastructure. Ceský Telecom in the Czech Republic began to introduce NGN solutions in 2002.[33] In Asia, the incumbent operator in Vietnam and India are also known to have similar plans.

Box 6: Reported NGN Deployments Around the World

Africa: In 2006, Gateway Communications completed what it claims to be the continent's "first long-distance NGN" by deploying a VoIP solution to upgrade and expand its existing international long distance network. This has enabled Gateway Communications to link mobile networks cost-effectively across over 30 African countries throughout Africa and to connect with their European gateway network. With a next-generation network in place, Gateway Communications is able to use VoIP to deliver new IP services over a converged IP network. In 2005, Chinese telecoms manufacturer ZTE established a NGN based on an IP platform using CDMA2000 1x and EV-DO technology, but this was limited to Angola. Gateway spent conservatively USD 1.4 million on upgrading the network which will benefit subscribers of all major pan-African mobile carriers and some fixed line carriers by lowering the cost of calls and improving their quality. Veraz Networks Inc, a global provider of VoIP softswitches, media gateways and digital compression products provided the technology solution.

Chile: In July 2006, Chilean telecommunications and cable provider VTR, partnered with Cisco to deploy the Cisco CRS-1 Carrier Routing System, the core component of the Cisco IP Next-Generation Network (IP NGN) architecture, to facilitate the growth of triple play (data, voice and video) services over residential broadband connections. VTR was the first company in Chile to offer triple play services, and VTR is now the first telco in Latin America to deploy the Cisco CRS-1. VTR has more than 2.2 million residential subscribers, with 1.2 million digital cable TV subscribers, 300.000 Internet subscribers and 400.000 IP telephony subscribers. This deployment is part of an extensive network upgrade.

China: Jilin Mobile Communications (Jilin MCC) has deployed a mobile NGN solution to expand the operator's existing mobile network. The cornerstone of this mobile NGN solution is the Alcatel 5020 Spatial Atrium Softswitch, a multi-standard mobile call server controlling distributed media gateways. Its distributed architecture results in significant cost efficiency and greater simplicity in the design of Jilin MCC's network. It is anticipated that the upgrade increase Jilin MCC's network capacity by 30 % to serve up to 8 million subscribers covering cities in Jilin province, including Chuangchun, Jilin, Yanji, Siping, Songyuan, Liaoyun, Baicheng, Baishan and Tonghua.

France: France Telecom will start its PSTN to VoIP evolution in 2007 using two evolution modes: the first will be VOICE DSLAM devices that integrate VoIP gateway functions with traditional DSLAM. The VoIP gateway module under the control of the call server or Softswitch will convert POTS into VoIP voices. The second mode is to use RGW devices or IP phones that are controlled by the SoftSwitch to realise VoIP voice access directly at the subscriber side. France telecom will use an IMS-based NGN which will use a core controlling architecture for universal functions and integrated services.

Japan: In November 2004, the NTT Group announced its plans for building a next-generation network and developing ubiquitous broadband services. NTT plans to build an open next-generation network that a variety of players outside NTT Group can use to pioneer and develop a variety of services and business models. Services that will be offered include: broadband Internet access, IP telephony, multicast communication for video distribution, bi-directional video (data) communications, and Ethernet services.

Russia: In 2006, regional operator, JSC Sakhatelecom announced its NGN plans to offer its customers various NGN services such as IP Centrex, videoconferencing, virtual private networks and unified messaging, as well as enhanced Internet services. The company is partnering with Alcatel, some of whose other NGN projects include British telecom; the Asia Pacific Telecom Group (Taiwan) and Telecom Austria. Alcatel will provide the telco with its IP multimedia subsystem (IMS)-compliant NGN solution including the Alcatel 5020 Softswitch and Alcatel 7515 family of media gateways and its Optical Multi-Service Node (OMSN) systems and the Alcatel 7750 Service Router. Alcatel will also provide a state-of-the-art broadband access network based on its 7302 ISAM, a leading high-end IP broadband services access platform which includes a Voice Package that adds a voice over IP media gateway as well as legacy POTS and ISDN line cards to support a smooth migration to an NGN/IMS network.

Saudi Arabia: Rawabi Telecom and Software (RTS) have announced plans to deploy integrated VoIP offerings, IPTV and mobile service bundles. This will include voice over broadband telephony; enterprise VoIP trunking; IP conferencing; and wholesale VoIP interconnection. RTS will provide these services initially in the Kingdom of Saudi Arabia and then in throughout the United Arab Emirates, Bahrain, Oman, Qatar and Kuwait working closely with NexTone and Verscom to bring to market NGN services as the region's telecom sector undergoes deregulation.

Sudan: Canar Telecommunications Company, a national provider of fixed lines, data and Internet services, has launched its IP-based network, making it one of the first national operators in Africa to roll-out a Next Generation Network. Canar has announced the commercial launch of Sudan's first 3Gwireless broadband Internet services under the name "Canar Go".

Source: Mena Press, ITWeb, Hauwei, Sudan Tribune and company press releases.

4.1 End User Drivers

Consumer demand for NGN services is difficult to quantify currently where large uncertainty remains regarding the exact nature and scope of services. However, where affordability and access are not barriers to development, consumer demand for high end, innovative and evolving services as user patterns change is matched only by limitations on bandwidth. A sampling of currently available bandwidth offerings includes in Morocco, 20Mbps; the UK, 8Mbps and upwards; 24Mbps in France, and 100Mbps and rising in markets like Japan, South Korea, Hong Kong and Singapore, the latter having set 1Gbps as a target. It is expected that access networks in the future will provide bandwidth of up to 100Mbps for individual users and transmission rates in the gigabyte range for commercial customers. These high bandwidth offerings are all able to support multi-play options including broadband Internet, telephony, television and mobile services. In countries with high broadband penetration levels, evolved DSL platforms and increasing fibre to the home offerings, VoIP telephony and video calling has become the norm for end user communication.[34] Fixed line usage is declining for classical voice services, mobile services growth continues and broadband Internet deployment is showing rapid growth as well. As newer and more innovative services and applications become available, operators worldwide are seeking new solutions to adequately address demands being placed on them by consumers and technological developments. At the same time, consumer needs are also maturing with increased choice in offerings, reduced prices and discounted bundled products. Consumers are also seeking simplicity in billing and increased personalization with full mobility and increased quality of service.

For individual consumers, the demand for broadband to the home, offering on-demand multimedia services is increasing in countries that have the infrastructure to support such demand. As services and platforms converge, consumers also seek attractive pricing bundles for their combined voice, data and video needs, across both fixed and mobile networks. This is also fuelled by increases in local and cross border communications for personal and business purposes, including telecommuters who work from home or abroad, requiring high performance, widely available, secure voice and data services.[35]

Similarly, business enterprise users are seeking integrated voice, data and video services as well as ubiquitously available electronic communications services with high speeds and flexibility. While business users also seek flexible virtual private network (VPN) solutions, overall, commercial customers are demanding more innovative services and network intelligence – security, storage, application layer routing and adaptability – to support the trend in enterprise markets toward better integration of their networking and information systems. [36]

Table 3: NGN Major Drivers

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

Source: OECD

4.2 Operator Drivers

The main factors driving operators to migrate to NGNs include growing competition in newly liberalised markets and growing competition from new serves and innovations in competitive markets. Declining call revenues and the multiple different networks from which these services are currently being delivered are promoting operators to re-think their business models and convert to a fully IP based architecture. This will enable the search for new profit and revenue streams other than traditional voice which is now being offered by multiple service providers using VoIP technology.

These drivers emanate from a need to address the market demands from end users. It is the traditional fixed line carriers that have generally been the leaders in broadband Internet access using DSL technologies over copper wire. Increasingly, they are faced with pressure from competitors such as mobile operators, new VoIP providers, other wireless carriers and where relevant, cable TV networks which can now support bi-directional IP-based services. Traditional operator's business models and investment plans have had to be altered to address these challenges, including the development of business models for data and audio-visual content. With historically separate infrastructures for voice and data, convergence and growing competition has forced traditional carriers to start investing in common IP-based core infrastructures. While significant investment will initially be required to integrate a common IP-based network, there will be savings down the line for operators who can then reduce the costs of running different networks, while increasing the subscriber base and service offerings over time.

It is these savings from network topologies that have largely prompted the consideration of switching to IP neworks. In this way, operators will be investing a single network that can be used more efficiently for many different forms of traffic. IP network deployment costs also often come in smaller increments than those required for telco switching facilities and dedicated circuits. It is possible to add capacity incrementally in a manner that will realise return on investment more quickly than the traditional multi-million dollar telecom equipment investments, which require many years to produce the required return. Smaller investments can often be financed from cash flow rather than requiring major external borrowing. Moreover, some components for new NGNs are items that can be found in retail electronics outlets rather than being sold as an "integrated solution" by a manufacturer. And cost reduction is a major priority as operators increasingly face competition and revenue erosion in traditional services from other services and service providers. For example, there is significant growth in data services such as text messaging and MMS on many networks in Africa as these networks invest in greater data capacity. This is manifested in the decreasing voice minutes of use and ARPUs. Although potentially offset by increased volume, Vodacom for example reports a 15 percent reduction in ARPU as a result of the higher proportion of lower ARPU connections as the lower end of the market is penetrated.

These concerns remain even more pressing for fixed line operators whose major revenue source emanates from voice services.[37] In Europe, telcos have experienced ARPU reductions in fixed line services from 33.50 Euro in 1998 to less than 31Euro in 2005 in residential markets, while business revenues have declined from 78 Euro to 63 Euro per month. This raises pertinent questions regarding the need to invest in new NGNs, and also, about the capacity to do so in light of declining revenue.[38] A recent study on telecoms investment in EU countries bears this out: it was noted that in "absolute terms, investments by fixed telephony incumbents were eight times higher than those by new entrants in 2004, reflecting their larger size and need to maintain their networks.[39] In South Africa, a new round of capex is emerging from existing operators destined for investment in NGN and general upgrading of data networks to counter ARPU reductions and increase customer loyalty. For example, Telkom SA, the largest fixed line incumbent on the continent has announced plans to invest about one third of 30 billion ZAR (4.2 billion USD) in NGN investment for IPTV and high speed broadband services as it begins to face competition in fixed line services from the new entrant, Neotel, which commenced wholesale operations in August 2006.

In addition to anticipated greater revenues and profitability from the value added services associated with NGNs, operational efficiencies are expected primarily as a result of labour reorganization, greater productivity and savings from a common, consistent infrastructure. British Telecom for example, estimates approximately 1 billion GBP per year in savings. These efficiencies will allow operators flexibility within their cost base to reduce operational and capital expenditure, although actual figures are difficult to obtain from operators at this stage and it is also dependent to some extent on the pricing models to be offered.

Anticipated cost reductions include those associated with network element costs; network maintenance and outsourcing and other operating costs such as IT, property and power costs.[40]

4.3 Other Drivers

While operators seek increased revenue from more customers, reduced cost through harmonized networks and the ability and flexibility to introduce new services to market as a more rapid rate, there are other market and social benefits and public policy elements that underlie this business case. For example, as discussed in section 1.3 above, competition and infrastructure concerns are more prevalent than in developed countries with more mature markets. Existing incumbent operators tend to exercise significant control on the market by retaining access over key facilities such as undersea cables, VSATs and leased lines, which has the effect of higher prices in downstream markets. Where DSL access is available, it is costly and not widely rolled out. While more competitive elements are present in the mobile space, there is usually no opportunity for wholesale arrangements between operators for either voice or data, which combined, serves to distort the market from a price and quality perspective.[41]

NGNs provide an opportunity to address the affordability and access issues and can also greatly assist in the optimum utilization of Radio Spectrum.[42] A recent consultation document by the Telecommunications Regulatory Authority of India (TRAI) for example, estimated that 70 percent of mobile calls are originated and terminated inside fixed locations.[43] If NGN is implemented in end-to-end networks, in access and core, such in-building/fixed location mobile calls could be completed on fixed/broadband networks, resulting in cost savings and more efficient utilization of scarce resources like spectrum. The convergence capability of terminal equipment is also a major driver of NGN, such as dual-mode handsets for 2G mobile and Wi-Fi. Moreover, triple play offerings also have the potential to open up television as a delivery platform for a far wider range of rich, multimedia services, overcoming to some extent, the lack of installed, Internet-connected computers in developing countries.[44] However, while this may be a solution for the urban poor, it still will not address lack of Internet access for those in rural areas without electricity or digital television coverage.

In addition, in cases where there are no existing and operational legacy infrastructures to bind migration to NGN, operators can more readily invest in markets on the basis of the so-called “ladder of investment”, or incremental, phased investment approach. As such, deployment can also be undertaken on a regional basis at first, starting with the most densely populated areas, and expanding roll-out to other areas incrementally. Where existing infrastructure in developing countries is well developed, NGN migration may allow operators, subject to competition concerns, to leverage effects within their current subscriber or customer bases. Another driver prompting IP enabled network development comes from equipment manufacturers, who are said to be increasingly withdrawing support for circuit switches and forcing a move to IP technology adoption.[45] Investment in NGN is expected to boost the equipment manufacturing market considerably, including the customer premises equipment market. While wider public policy debates are important to NGN policy development, OFCOM has noted that it may be premature to try and answer these questions on the current level of NGN deployment to date.[46] Nonetheless, they remain pressing and require targeted policy direction by regulators and policy makers.

Box 7: BTs 21st Century Network

- **Name:** 21st Century Network (21CN) is BT terminology for its NGN.
- **Competitors:** Cable & Wireless, Thus and Easynet, but none on the same scale of BTs NGN.
- **Cost:** £10bn to implement, but will save £1bn per year to run that the 16 networks that preceded it as all IP applications will be able to run over the same converged NGN.
- **Completion date:** between 2007 and 2011.
- **Suppliers:** Fujitsu, Huawei, Alcatel, Cisco, Siemens, Lucent, Ciena and Ericsson.
- **Highlights:** self-service portal for businesses to buy or change services and bandwidth in real-time and potential cost savings.
- **Status of regulatory oversight:** Consultation phase

Source: ZDNet UK

4.4 Challenges for Operators and New Entrants

4.4.1 Operators

While the drivers for NGN development present opportunities for operators, their development is not without challenge. For example, while new technology supply options and economies may exist, there are still concerns as to the integrity and the cost of the newer generation of network equipment - including Wi-Fi and Wi-MAX – as part of an IP network roll-out. These new wireless technologies can and are being deployed both to create local loop access and for backbone links. Again, it is argued that this is being done more cheaply than traditional copper or fibre networks, which in turn can challenge the market dominance of the fixed line operators. However, it may be premature to do a cost comparison with other technologies as the potential cost savings using wireless technologies like WIMAX are not absolutely quantifiable at this stage although incumbents worldwide are both deploying these technologies and at the same time, are threatened by them.

Likewise, incumbent mobile operators that have invested considerable sums in 3G licences and need to earn a return on their investment over five to ten years, are also threatened by the potential of wireless-enabled VoIP services, which offer the potential for cheaper voice service. Users of 3G networks can now use mobile phones for example, to make Skype calls to other Skype subscribers at cheaper data rates. This will particularly affect the high-price international roaming business. This presents a recurring dilemma for the regulator with respect to its role in encouraging investment: should it protect the investment of the mobile operator and delay cost-saving innovations for consumers or should it allow wireless-enabled, mobile VoIP to flourish, which may have the effect of undercutting investment returns of the mobile operators? And these questions are particularly pertinent for regulators and policy-makers in developing countries where the choice is often between defending a government-owned telco incumbent (for financial and social reasons) and the distributive policy aspiration of making cheaper communications available to a wider number of people, particularly in rural areas.[47] And at an even more fundamental level, there is the issue of whether technically many limitations on such IP based service innovations, such as VoIP can be enforced.

Challenges for incumbent operators essentially arise out of a lack of certainty as to what exactly is required to develop multi-service platforms capable of supporting multi-media services, enabling separation between service and application creation and basic transport. The key question appears to be whether NGNs need to include all PSTN functionality or can develop separately and in parallel to the slow migration of the PSTN to IP. This is important because it determines the extent to which the NGN needs to take account of the special features of the PSTN, some of which are required by regulation. If the two will develop separately and in parallel, then the NGN will not need to embrace the PSTN, although both will be supported on the same underlying infrastructure.[48]

Other more basic challenges for telcos still exists once they have assessed the validity of an economic case for replacing circuit switched network with IP based infrastructure.[49] These include managing competition from the Internet for the carriage of new services. Also, decisions will have to be made as to the substitutability of circuit based and packet based voice from a consumer perspective, where latency and jitter still remain present. However, once quality and price decisions are made, it is clear that circuit switched networks are likely to start experiencing reduced traffic loads –with the exception of dial-up traffic - which will have implications for terminating traffic and revenues. This balance will need to be struck for many telcos whose top priority remains how they manage their debt situation, while transmission and switching costs decline, yet infrastructure costs remain high. On the other hand, it might be argued that computer-based systems for voice over the Internet are unlikely to reach the levels of reliability of the PSTN for a long time and many customers may choose to retain their traditional PSTN connections for use when the PC or LAN malfunctions, even when they use the Internet for most of their voice traffic.[50] The ability to enter into service level agreements however may ensure certain quality levels that alter this assertion. It may also be said that this is less relevant given the fact that the poor quality on many mobile networks, including dropped calls and interference, have accustomed users to quality levels that would never have been accepted on the fixed line network, although quality concerns are offset by by other benefits of mobile that are not possible with the traditional PSTN fixed networks.

Regardless, it is still unclear how telecommunications networks will develop at a technical level over the coming years but it is clear that IP migration and ultimate full NGN transition represent a logical commercial

development for all operators as they increase efficiency, facilitate service and pricing innovation and allow for lower backbone transmission costs. Companies like MCI, Cable and Wireless and Viatel already operate converged core networks.[51]

4.4.2 New Entrants

Challenges for new entrants also present themselves for consideration, possibly the largest of which is the degree and intensity of competition on and between layers. NGNs provide the opportunity for third parties and service providers to develop and provide value added customer services over the networks owned by other operators. As such, the separate transport, control and application layers also enable different operators to compete with each other in different layers. As these layers should be open, competition is fierce, providing great consumer welfare benefits and opportunities to innovative service providers. This could also be advantageous for rural service delivery.[52] However, a clear and fair, transparent and well implemented ex ante competition regime will have to be in place for new entrants to be guaranteed timely entry to the market. However, it is also important for regulators to guard against any market dominance effects by incumbents. There remains a risk that operators of core NGNs may deny access to potential competitors, in the same way in which access to the local loop was withheld as an anti-competitive technique in the PSTN. This concern sees expression in the so-called "walled garden" concern, namely, that provision of a closed or exclusive set of information services for certain subscribers to a network. The term is used to describe service offerings from interactive television providers or mobile phone companies which provide custom content and not just common carrier functions. One of the best known examples of this was America Online (AOL) who until the mid-1990s had revenue sharing agreements with only certain information providers in their subscriber only space.[53]

It is also difficult to accurately quantify at this stage, but there will be increased additional costs for compliance with specific consumer focused issues, such as QoS or security requirements for emergency services and lawful interception. These may serve to be prohibitive for smaller players. The experience for consumers will evolve in the coming years but some of the features becoming available in corporate networks will become more widely available if there is a viable consumer market. The major determining factors will be the access devices used and the access technologies. Mobile phones and the Internet already provide an early "NGN" experience for many users with services such as push-to-talk, Instant Messaging, two-way video and content (video, audio and text) streamed and broadcast to the user. There is always concern by providers that a rigid and inappropriate application of current regulations may limit the consumer benefits. One additional serious risk to new entrants, notwithstanding the access concerns, is that established telcos who have a large share of the Internet access market could degrade the quality of Internet access so that real-time services and applications do not work adequately over the Internet and therefore try to retain voice traffic on the PSTN for longer.[54] However, the use of clear Service Level Agreements could go someway to mitigating this risk.

4.5 Investment

Although long term savings are expected for operators, the initial migration will require considerable investment to support the uptake of new NGN services. This investment is already underway in various countries, varyingly in the core and access networks: in addition to BT and Deutsche Telekom, Illiad in France and NTT in Japan are deploying fibre to the home and AT&T and Verizon are investing in faster broadband access networks in the USA. There still exist many questions regarding the effect regulation will have on investment in NGNs as well as the exact characteristics of NGN investment and the implications of economies of scale and scope. Policy makers need to consider ways in which to create incentives for both incumbents and new entrants to invest in NGNs. OFCOM believes that it is not the regulator's role to provide operators with incentives to make particular investments, but rather that the regulator should ensure that the incentives for efficient investment are not distorted, particularly as a result of disproportionate regulation.[55] Questions emerge when the nexus between regulation and investment is brought to the fore. For example, where should regulation appropriately be targeted or applied? Should NGN investment with its voice, data and content oriented services still be considered as traditional PSTN and as such, remain subject to regulation. That is, should regulation be jointly applied to the 'traditional' voice and data aspects of the regulated entity or should it be uncoupled from its content role?

One argument is that in order to foster NGN-investment, regulation should be substantially reduced or eliminated, as NGNs should be seen as constituting a nascent (emerging) market characterised by innovation, rapid market growth and volatile market shares. Regulatory instruments that can be considered in this regard include regulatory or access holidays combined with a commitment to a reduction or elimination in *ex ante* regulation and sunset clauses or time limited forbearance, which suggest to investors that regulation is only interim and once the market adjusts, regulation will be withdrawn.[56] While this will be discussed further below with a discussion on SMP, it is difficult at this stage to know definitively whether less regulation will translate into more investment by incumbents and less investment by new market entrants, or vice versa, and in advance, to know when existing regulation should be withdrawn. This question cannot however be divorced from the usual need to regulate ex ante where SMP is present, to foster competition and the consumer interest.[57]

Incumbent carriers however may argue that IP-enabled NGNs particularly the deployment of high speed access networks (e.g. FTTx, VDSL), require massive investments and that national regulatory moratoria for incumbents are appropriate. Competitive providers will argue the opposite and suggest that regulators need to ask whether, in the absence of wholesale economic regulation, market dynamics will be sufficient to ensure a competitive environment? They remain concerned that without the immediate attention by regulators to NGNs, carriers will rapidly vertically integrate services and that bottlenecks will emerge particularly for the delivery of audiovisual content.[58] As OFCOM points out, traditional access network investments have already been amortised, and as these were considered competitive bottlenecks, most (EU) regulators required that access to other operators be provided on a cost basis. However, the new access networks are different and it is not a foregone conclusion that consumer demand will sufficiently address the risks associated with such investments. If regulators impose a traditional cost base policy with a standard return on investment that does not consider this risk and its effect on the cost of capital, operators have little incentive to invest. Succinctly put, if demand does not materialise, operators will bear the loss, and if it does materialise, regulation may prevent them from benefiting.[59] The USA, Germany, the European Commission and the Netherlands are all considering the degree and implications of different regulatory approaches. It is worth noting that the debate overall, regardless of its precise detail, militates strongly for any regulatory approach to NGNs to be focussed on being light touch and creating an environment conducive to investment.

5 Market Power Regulation

The telco and Internet regulatory models are as divergent as the separate networks and services they offer. They have different market structures and technical architectures. The regulatory requirements with respect to both differ. As noted earlier, the telco model has historically attracted more regulatory oversight and intervention than the Internet, whose decentralized nature has not required the same level of regulation. For example, there is little need to regulate market access and pricing with the Internet, yet with respect to both telcos and the Internet, regulators need to ensure consumer protection, security and a viable competitive environment, although the enforcement aspects on the two are different. In EU market terms, this situation has emerged largely due the fact that there is no designation of significant market power (SMP) on the Internet which has also precluded any need for traditional telco regulation like tariff regulation. With the advent of NGN migration and the possibility of numerous erstwhile separate networks and services operating off one network, it is arguable that this has the capacity to change. For example, PSTN and cable TV companies can evolve into vertically integrated enterprises that are also Internet backbones and leverage the market power associated with last mile facilities into their Internet role. Competition questions may thus emerge, which require an examination of whether NGN migration may serve to create vertically integrated operators with incentives to keep other players out? Or will NGNs create vertically integrated operators that see business opportunities in opening different layers of their network to a full range of service and applications providers and users?

This question sees some expression in the current US debate regarding “Net Neutrality”. This concept suggests that incumbents should not be allowed to determine how their networks are used by other operators, service providers or consumers. As “Net Neutrality” is underpinned by many well established principles of telecommunication regulation, such as mandatory interconnection and common carrier regulation, this remains critical in all countries where there are legacy telcos facing competition and liberalisation and thus responding to incentives to delay or block the entry of competitive operators. This is further complicated by widespread state equity (full or partial) in such incumbents, resulting in a conflict of interest between the

state as the agent responsible for policy formulation and the interests of its competitors and as the owner of the operator.

Box 8: Net Neutrality – A Primer

Net Neutrality is a simple principle of non-discrimination in network design. It requires that network service providers, such as telco and cable companies should not be permitted to dictate how those networks are used (not ban or block programmes; devices or favour carriage of traffic). It has its origins in the efforts by US broadband operators in the late 1990s, to impose contractual limits on the activities of their subscribers. Net Neutrality aims to secure the right of consumers to access any application, content or service, subject to certain exceptions, e.g. security purposes or specialized services like broadband video.

Underpinning Net Neutrality is the assumption that neutrality (non-discrimination) on a network, will promote evolutionary innovation of information technology. As such, a discriminatory network will distort markets that depend on the network and will deter future innovation and ultimately may slow economic growth. Those opposed to Net Neutrality (frequently traditional telcos and cable providers), argue that disallowing a network to discriminate against operators/services may affect future investment; may lead to congestion and poor network performance, and may attract more regulatory oversight than is warranted.

The debate is fuelled by the increased demand and use for high bandwidth applications, such as music and video; improvements in network technology, enabling cheaper broadband provision; government funded high speed networks and city wide wireless networks; increased home wireless network usage which enables sharing among neighbours and communities, reducing the revenue for providers, and high bandwidth video and audio telecommunications over the Internet, such as VoIP, which also threatens telco revenues. Net Neutrality has been adopted into legislation in various countries, notably those world leaders in broadband such as Japan, South Korea and the UK.

Source: Wikipedia

One of the clear additional new dimensions to the general ICT discourse on competition is that IP networks or NGNs both access and core, are going to have to compete with the open Internet (unrestricted access to content and services, as opposed to "walled gardens" or limited proprietary access) where the commercial arrangements are different to both legacy networks and the NGNs. OFCOM for example expects increased competition between NGN-based VoIP services and broadband-based VoIP services at the retail level. This may be accompanied by greater take-up of bundles comprising voice and broadband services. Many more end user services are available on the Internet and increasing rapidly, at zero marginal cost or lower cost than what a subscriber previously had to pay in terms of usage charges with fixed line telcos. The upfront costs remain, (a PC, Internet connection, subscription) although are declining globally, but the usage based model has been significantly altered by the Internet.

5.1 Regulating for Significant Market Power (SMP)

One of the key objectives of telecoms regulation is to ensure fair competition in the market. From a legislative perspective, while countries may approach this objective differently, common to all is the object of ensuring that dominance or market power on the part of operators is checked in the ICT sector through either ex ante (before the fact) or ex post (after the fact) competition promoting measures. This is usually done through a variety of procedures and mechanisms relevant to that country's legal and regulatory framework. The European Regulatory Framework for example requires that before any *ex ante* measures are imposed in a particular market, national regulatory authorities (NRA's) must define markets in accordance with accepted principles of competition law and such markets must, on the basis of various criteria, be considered susceptible to ex ante regulation. The starting point for the NRA's market analysis is the European Commission's Recommendation on relevant markets and the Guidelines on market analysis and assessment of significant market power (SMP) or dominance. Markets need to be defined according to national circumstances applicable in each member state, particularly the relevant geographic market, in accordance with the principles of competition law. For this to occur, it thus requires an evaluation, finding and assigning of significant market power (SMP) or dominant status to operators after a market analysis has taken place.[60] Once completed, such regulation may include proportionate pro competitive measures to counter potential competition problems. Increasingly, as markets evolve in developing countries, both regulators and operators alike are seeking more sound methodological approaches to imposing ex ante regulation. While some developing countries have adopted a variation of this model, the EU market approach

is not widely practiced in developing markets where insufficient levels of competition have not prompted a more rigourous treatment.

The constant evolution of technology and services requires that approaches to dominance and SMP be reviewed and monitored to ensure that the entry of new networks and services is not compromised by the market power certain operators may have in a given sector. In all countries, regulators and operators alike will have to be aware of the competition aspects of NGNs as they offer both positive and negative benefits. Certainly, concerns of SMP remain very valid as networks integrate. For example, voice, data and image convergence on IP networks allows users to combine these different forms of traffic and significantly expand the range of product and service offerings. Convergence also blurs the line between voice, data and television programming allowing operators to offer "triple-play" options that combines all three in a single service. Yet, this form of delivery has implications for competition as users increasingly seek a single provider and billing option. A single bill for all these services is undoubtedly convenient for consumers but the cost of each service is not transparent, making comparisons between services difficult for users.

Historically, a vertically-integrated incumbent carried traffic and offered services, usually from a monopoly position. In a more liberalised market, the same telco will sell international transmission to both external ISP customers and to its own ISP, leading inevitably to accusations of conflicts of interest. For VoIP service providers for example, the terms under which there is access to broadband therefore becomes a key question. As a result, many telcos have separated out their wholesale and retail functions in order to better understand the underlying cost structure of different parts of the business. Usually, this was prompted by regulators seeking to clarify terms of access to either the local loop or the network itself but sometimes by the companies themselves wanting answers to questions about costs of delivery.[61]

5.2 Emerging Markets

Following from the earlier discussion regarding the differences in approach between regulating the Internet and regulating traditional telcos, another reason the Internet has remained largely unregulated (outside of content regulation and domain name allocation) is for its "infant industry" or "emerging service" status: the fact that it was originally approached in many respects as a service for which the business case was unknown. The question of regulating for SMP in a NGN space is linked to whether NGN services can be defined as emerging markets or services.

It needs to be noted that the term "emerging markets" is usually used in the context of the European Union definition of markets, but for the purposes of this Paper refers to emerging services and networks as well. As many countries do not have the same framework for regulation as the EU, at the level of principle, it is possible to look to international trade practices with respect to "infant industry" protection to offer some guidance on how to approach these emerging markets and services.[62] This would signify that emerging market protection is warranted for operators offering new services that are untried and untested, without which such service offerings may have less chance to compete meaningfully with the established operators and other services in the market who have been operating longer and evolved efficiencies in production and delivery. It is however difficult to decide what can be classified as an emerging service in the ICT market generally within the continuous evolution of products and services across a horizontally integrated network.[63]

Drawing on the European regulatory model, the SMP *ex ante* approach can be very effective in current markets, but may have distorting effects in newly emerging markets, and as a result, the European Commission has cautioned against such an approach in these markets. Yet, the EU regulatory framework does not define what constitutes such a market or suggest where *ex* ante regulation is in fact appropriate. And as OFCOM points out, looking at the possible types of retail product offerings NGNs can deliver, it is also not clear what services might constitute a separate market.[64] Moreover, the discussion of when to regulate or forbear in emerging markets is somewhat tied to the existence of a regulatory framework that has a sophisticated and clear set of market definitions.[65] That said, the general principle of whether and how to regulate an emerging (product or geographical) market remains: namely, "how to attract investment in new multimedia platforms on which both emerging and well established services will run, without re-monopolization of established services."[66] More simply stated, the challenge is how to encourage investment in infrastructure in a manner that will ensure a return on that investment through the take up of services offered, while not unfairly protecting the dominant status of that operator in other services. This prompts an examination of whether these new services or markets should be targets of ex ante regulatory measures.

As no definition of an emerging market is supplied by the European Commission, OPTA has ventured a definition based on parameters drawn from the EU regulatory framework as a whole. OFTA views the absence of the information required to carry out the necessary market definition tests (in regard to demand, price, elasticity and entry behaviour) as determinative.[67] In that regard, OPTA suggests VoIP services; services based on next generation fixed access and core networks; service based on next generation mobile networks and fixed mobile integration services are unsuited to ex ante regulation and should be viewed as emerging markets. (See box below).

Box 9: Defining Emerging Markets

Category		*Characteristics of emerging markets*
VOIP Services	• PC client based (e.g. Skype) • Voice over broadband ("Double play") • VoIP through a NGN connection	1. New and uncertain markets; lack of information on their functioning, demand, pricing, etc. 2. Investment in new multimedia infrastructure; 3. Investments may generate new markets of bundled services, currently in separate markets; potential for substantial economies of scope; 4. Strong technology innovation with potential for increased functionality at reduced costs; 5. High investment risks.
Services from Next Generation Fixed access and core Networks	• ADSL2+ technology, VDSL, FTTP • Triple play	
Services from Next Generation Mobile Networks	• 3G W-CDMA and multimedia services	
Fixed Mobile integration services	• NGN core IP networks • Wireline and wireless access networks • Multiple radio interface devices e.g. WiFI, Bluetooth, GSM, W-CDMA	

Source: OPTA

Apart from its emerging service perception, an additional reason the Internet and its services have not been subject to regulation – and essentially treated as an emerging market in most jurisdictions - is due to its decentralized nature and open architecture which does not lend itself to easy regulation.[68] As such, the emerging market argument needs to be carefully parsed for it implications with respect to competition generally and the nature of the network on which the service is offered. It is not necessarily clear (and certainly in markets that lack a market definition framework) whether "services" or "networks" should be defined as "emerging" to qualify either for ex ante regulation or regulatory moratoria. Certainly from OPTA's perspective, ex ante regulation of services should be confined to only non-replicable assets used to provide the services.[69] Non-replicable assets are defined as those not commercially feasible to replicate in similar circumstances with no functional equivalent which can deliver comparable services. At the level of principle, the European Commission has cautioned that ex ante regulation in emerging markets "may unduly influence the competitive conditions taking shape within the new and emerging markets". Moreover, the Commission has suggested that it should not be a principle that the presence of market power should qualify that emerging market to ex ante regulation. While the Commission does not rule out such regulation completely, eager to ensure that it does not foreclose on competition in such markets, it cautions that if intervention is chosen, regulators should be fully able to justify their early entry into such markets as they retain the ability to intervene at a later stage as well.[70]

In this regard, also proposed by OPTA, is the question of regulatory holidays or moratoria comes to the fore. Regulatory holidays are a defined period of time in which investors can be confident that they will be fully rewarded for successful investment while the regulator can monitor competitive dynamics. While more at the level of principle than individual investors, the European Competitive Telecommunications Association (ECTA) has rejected claims that EU policy makers should grant a "NGN moratorium", in favour of a policy to boost investment confidence for the entire communications sector. That followed proposals from German politicians to grant a three-year regulatory moratorium on plans by the incumbent to upgrade its access

network, undermining competitors' current and future investment plans.[71] In arguing against the proposals, ECTA noted that markets with competition enjoy higher levels of innovation and recommend that policy makers maintain the pro-competitive approach that underpins the EU regulatory framework. The European Commission however, has spoken out against regulatory holidays on the basis that the effective implementation of a regulatory regime that promotes competition and open markets is the best driver of investment and innovation. Such regulation should only be phased out when competition is effective. The Commission has suggested that the mere installation of new access technologies or networks does not in itself change the access obligations required to foster competition and that any moratorium on regulation to "privileged the investment" of dominant players may simply serve to entrench their position compromising consumer benefit in the longer term.[72]

While the EC's position appears to be arguing against regulatory holidays for incumbents with market power, and not specifically against the idea of regulatory holidays as a concept, it is important to note that regulatory choices have to endure across technologies and over time. As convergence has started to occur and operators and service providers have entered new markets different from their traditional areas of service, new calls for regulation of services that have not been traditionally regulated, like the Internet, may well be heard as dominant operators begin to exert their market power derived from traditional services, into new services as well.[73] Regulators will have to be guided by the principle of balancing investment certainty with encouraging investment in, and take up of new services. This is a complex balancing act that while guided by best practice principles, is dependent on the specific legal and regulatory framework in each country, and the level of development and competition in each market.

A recent example of this issue, valid for its regulatory principles, is the recent Canadian Radio-television and Telecommunications Commission (CRTC) decision on VoIP.[74] Although not explicit, this decision to regulate VoIP services as local telephony services was taken with an emerging/nascent market angle and based on principles of technological neutrality, to ensure that incumbent operators did not dominate the VoIP space and that new entrants approach the market on an equal footing. The decision was later appealed to Cabinet and varied. (See box below)

Box 10: Canadian Approach to VoIP as an emerging market

In 2006, **Canada** lightened its regulation of certain VoIP services. In 2005, the CRTC denied a request from incumbent local exchange carriers (ILECs) to have certain forbearance rules applied to their VoIP offering. The determining factor in selection of the appropriate regulatory framework for VoIP services was not the technology used, but rather the nature of the services provided to customers. Although some VoIP services have distinct features, the CRTC found that they are marketed as, and intended for use as, a substitute to traditional telephone services. As such, the CRTC ruled that VoIP services, as a substitute of traditional telephone services, shall be subject to the existing regulatory regime applied to traditional local telephony. This effectively meant that incumbent phone companies like Bell Canada and Telus Corp., were subjected to the same regulatory requirements for their local VoIP services as they faced for their traditional telephone services. For example, the requirement to file tariffs, restrictions on marketing practices, service bundling and price floors. Competitive telephone service providers (including the cable companies like Rogers) were not subject to these economic requirements before the CRTC Decision and remain unaffected now.

On appeal to the Minister, following a reconsideration of the original CRTC decision by the regulator which confirmed the original decision, it was decided that there must be a distinction for different types of VoIP services for the purpose of economic regulation. Namely, "access dependent" (VoIP services which connect to customers making direct use of the service provider's own network, e.g. a cable company providing VoIP service over its own cable network) and "access independent" services (those which connect to customers using any high-speed internet connection and are therefore not tied to the service provider's network e.g. a phone company providing VoIP service to a customer through the customer's cable internet access). Access independent VoIP is accessible only to consumers who have a high-speed connection and must be accessed through the Internet. Access dependent VoIP is similar to traditional phone service, generating stronger arguments for applying the same regulatory regime. Conversely, access independent service has fewer similarities to traditional local telephony, the barriers to entry are lower, and therefore, the case for applying economic regulation is less convincing.

The appeal changes the CRTC's decision so that it forbears from the economic regulation of "access independent" VoIP services of incumbent telephone companies when offered in their incumbent territories. Such forbearance is justified on the grounds that access independent VoIP has lower barriers to entry and is a much less reasonable substitute for traditional wireline telephone service given quality of service issues and other distinguishing factors. When operating outside their incumbent territories, incumbent telephone companies are already deregulated to the same extent as new entrants. This does not however, vary the social and safety obligations imposed on VoIP service providers such as 911 emergency services, which were effectively applied to VoIP services under the CRTC's original decision.

Source: CRTC and the Canada Gazette, Vol. 140, No. 24 — 29 November 2006.

In response to the possibility that NGNs should be treated in a similar way to existing networks with an emphasis on regulating where SMP is found to exist and in particular where there are enduring bottlenecks – an approach supported by OFCOM - it is unlikely that the migration to NGN will eliminate SMP concerns in entirety.[75] Market power associated with last mile bottlenecks will continue to be a significant regulatory concern for the future. However, migration to IP based NGNs will also tend to put pressure on interconnection arrangements that are widely at variance with cost and competition in services and will expand opportunities to bypass inefficient interconnection arrangements through competitive infrastructure provisioning.[76]

As so many of the technical, financial and regulatory questions remain open ended, pertinent questions emerge as to whether the SMP EU model is capable of universal application. Few developing countries, although many are beggining to consider market segmenatation and definition for the purposes of regulation, have such evolved competition principles. Many of these countries simply apply these principles *ex post,* where they exist.

The principle of technological-neutrality with respect to user choice or functional equivalence across a full range of features is being adopted by some regulators to determine whether a service can be classified as an emerging market. The Australian Communications and Media Authority (ACMA) developed a matrix to assess whether current regulatory requirements apply to new services on NGNs.[77] For the foreseeable future, it may be prudent to adopt an approach that suggests that the body of best practice regulation with respect to

competition should prevail, unless there are compelling reasons to do otherwise. The European Telecommunications Platform advoctes that the correct regulatory approach should be based on technology and provider neutral criteria; on legal principles drawn from competition law; that economic regulation if required should focus on enduring bottlenecks; non-economic regulation should be light touch and should foster innovation and investment, providing legal and investment certainty. These principles should also avoid the fragmentation of markets and focus on services not on technology, seeking to balance harmonisation and innovation, and where relevant, should address the question of cross border services.[78]

Box 11: ETP Regulatory Principles

- Technology and provider neutral;
- Focus on services, not technology;
- Informed by legal principles drawn from competition law;
- Focus on enduring bottlenecks;
- Be light touch;
- Foster innovation and investment;
- Provide legal and investment certainty.
- Avoid fragmentation of markets;
- Balance harmonisation and innovation;
- Address the question of cross border services.

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

6 NGN Regulatory Challenges

Next Generation Networks and services are still in an evolutionary phase and no country has as yet developed a specific regulatory framework for NGNs. However, regulators in various countries are currently considering the best way to facilitate regulation and create an investor friendly climate with sustainable business opportunities.[79] Some countries, notably the UK, India, Australia and Singapore amongst others, have begun detailed consultations on approach to NGN regulation to begin to address the significant regulatory challenges they present for the promotion of competition, interconnection, consumer protection, numbering, universal service and security concerns to name a few.[80] Many of these challenges arise from the obvious technical differences between circuit switched and packet switched networks as most of the current regulatory principles and practices worldwide are based on a circuit switched environment. While IP networks and services will offer consumers a greater degree of choice at lower costs, operators and service providers need to ensure that the technical and commercial aspects of service provision have been adequately addressed both in the interests of business and in the public interest. In rapidly changing and liberalizing telecoms environments, it is critical that regulation, where required, creates an enabling framework for the development of new services and sustainable business models.

Since IP services, such as VoIP are enabled by the existence of IP networks, it is imperative that regulators "get the framework right" for the regulation of these networks. Different policy choices applicable to different country's circumstances will dictate varying approaches to and pace of reform. However, the critical aspect is to ensure that clear rules are in place to facilitate NGN deployment, as without clear rules to forecast investment returns, fewer investments will be made. Applying traditional regulatory practices, developed for the circuit switched service provision model may be counter productive as many traditional regulatory requirements of NGNs are becoming increasingly less relevant and/or require modification.[81] At a minimum, getting the framework right suggests that the approach of treating different networks differently should be re-examined. This warrants a paradigm shift away from the assumption of distinct services running over separate networks and may also require regulators to reconsider their roles in light of a proposed distinction in roles between service provider; service platform provider (core network operator) and access network operator. This also requires a fundamental recognition of the convergence of telecommunications, broadcasting, media and IT and suggests a forward looking approach to regulation which envisages a single regulatory and unified licensing framework for all transmission networks and services.

It is suggested that the issues that have been identified to give a sufficient degree of certainty for efficient and effective market development, may not in all cases require new policy interventions or national regulatory intervention at all – some are capable of being left to self or industry regulation already in place.

Some policy interventions may simply require a degree of augmentation to the current regulatory process. However, others may require new and targeted policy decisions. As is the case generally with telecommunication reform, the sequencing and degree of reform is critical: the role of the regulator and the role of the market have to be carefully balanced. Regulation can bring certainty, but if it is premature or prescriptive, it can pre-empt the role of the market in determining the shape and form of competition. On the other hand, intervention that is too little regulation or which comes too late can result in foreclosure of competition. A balance needs to be carefully crafted between allowing nascent markets to develop without regulatory interference and ensuring that competitive forces can emerge in those new markets.[82]

It is imperative however to ensure that with planned migration to IP networks, already established competitive playing fields are likely to face some form of disruption, which should be the main regulatory concern. The view emanating from some countries that have embarked on consultative processes with regard to NGNs suggests that the central role of the regulator is to ensure that a level playing field amongst existing market players remains untouched and that given the innovative space in which NGNs are evolving, a light touch approach to regulation is appropriate. OFCOM's approach in this regard, is to attempt to balance greater industry involvement with greater certainty as to the application of ex ante competition rules.[83] The view from OFCOM's consultation in 2005 suggests that withdrawing regulation should not be hasty or before the impacts of next generation networking, on current and future products, is known.[84] While the GSR Discussion Paper on Creating an Enabling Environment will address the regulatory issues NGNs raise and other GSR Discussion papers deal with specific regulatory topics in detail, the following is a brief outline of the main issues for introductory purposes, in no specific order of importance:

Licensing: In the NGN context, countries increasingly recognize that service and technology specific licensing regimes restrict the way in which technology is used and can prevent operators from benefiting from economies of scope. Thus, many policy makers and regulators are reviewing the licensing and regulation of traditional markets structured around vertically integrated incumbents and developing horizontal licensing that better reflects the technical and logical separation of the core, access and service layers of NGNs. Where national policy has not yet matured organically, regulators and policy makers may consider classes and types of licences to be used and whether this will require a new set of licensing criteria and conditions to be developed, or whether existing ones will suffice. For example in India, the regulator has already recommended a single unified licence for all types of services and geographical locations, and also a category of class licence for all value added services.

Numbering: With the advent of IP based networks and the multiple service offerings (most notably, VoIP) new market players and VoIP providers must have access to numbering resources. At the same time, numbering, naming and/or addressing schemes will need to encompass legacy, transitional and NGN services and associated directory services will need to be developed. Regulators may have to review their numbering plans to ensure that it can support new resources while ensuring the interoperability of new and existing services. This may also necessitate a specific number allocation scheme to differentiate IP telephony from PSTN numbers.

Interconnection: The technologies and architecture of NGNs differ from the PSTN and results 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 interconnect 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 (isochronous).[85] Regulatory and policy considerations include the impact of IP based networks (and traffic) 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. For example, there is no Reference Interconnect Offer published as yet, the structure of which and the content of the interconnection agreement are also likely to see alteration. (See the GSR Discussion Paper on Access and Interconnection.)

Standards and Interoperability: Standardization is critical to ensure that there are no delays in the introduction of new services and providers in retail markets. For developing countries opening their fixed markets to competition, regulations ensuring the interface between legacy networks and NGNs are important as the new entrant is likely to be a full NGN operator. As a general rule of thumb, standards should be market driven, although regulatory oversight may be required to ensure transparency in standard setting procedures and other elements if no specific body is established in a country to address standardization, as is the case in the UK or France (e.g. comité d'interconnexion).

Spectrum*:* As many of the key spectrum assignments have already been made to incumbent operators for the provision of fixed, fixed-mobile and mobile services, policy makers and regulators have to ensure that legacy assignments do not hamper the introduction of new NGN operators and services. In many developing countries, numerous incumbents have delayed new entrant "last mile" and competitor access and consequently, competition by using the myriad issues involved in local loop unbundling and facilities leasing on a wholesale basis, while at the same time, building up their retail offerings in the same services. NGNs however, allow new entrants and other service providers to deploy alternative technologies like WiMAX facilitating high speed broadband Internet access over wireless connections. This should not be hampered by a lack of available spectrum for widespread deployment.

Universal Service and Access: As ICT penetration rates in developing countries still remain low and affordability and accessibility are key policy goals, current efforts to ensure universal access and service should not be abandoned or altered in a NGN environment. Rather, policy should be geared to utilize NGN migration as a means to further address accessibility deficits. The ongoing relevance of universal service obligations and levies remain a medium to long-term goal for NGN migration. At the same time, as service obligations can be costly to operators, the challenge remains to preserve the universal service objective, while fostering innovation in new networks and services. With more users switching to IP telephony, there are concerns that telco revenue loss could result in a subsequent loss in funding for Universal Access. This raises the questions as to whether VoIP providers should contribute to a national universal service or access fund; how to structure universal service contributions and to which technology or service should these attach?[86] (See the GSR Discussion Paper on Universal Access and Service.)

Consumer Protection*:* As is the case with PSTN services, NGN migration will continue to require adequate protections for consumers given the scale and complexity of the envisaged transition. The issues that will require attention include but are not limited to, quality of service; continued priority access to emergency services; the provision of location information; rights and presence management, number portability, operators' liability; privacy and security. Regulators around the world, such as OFCOM in the UK and TRAI in India, have started industry wide consultations of the consumer aspects of NGN migration to ensure that consumers are in no way adversely affected.[87] (See the GSR Discussion Paper on Consumer Protection and Quality of Service for NGNs.)

Box 12: Regulatory Consideration for NGN Migration

Licensing	Consider appropriate regime for classes and types of licences and licensing criteria, where licensing is required. There is a shift away from service and technology specific licensing towards horizontal licensing.
Numbering	To ensure access to numbering resources and ensure that numbering, naming and/or addressing schemes encompass legacy, transitional and NGN services and associated directory services.
Interconnection	Regulatory considerations include whether new interconnection models may be required; the impact of IP based networks and traffic 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.
Standards and Interoperability	Regulatory considerations include mandating standards and interoperability between operators and new entrants to ensure no delays in the introduction of new services and providers in retail markets and to coordinate standardization activity where no specific body has been established.
Spectrum	The main regulatory consideration is ensuring equitable access to spectrum required by new NGN operators and services and ensuring that competition is not hampered through legacy spectrum assignments to incumbent operators for the provision of fixed, fixed-mobile and mobile services.
Universal Service	Affordability and accessibility are key policy goals that should not be abandoned or altered in a NGN environment. There is ongoing relevance to the structure of universal service obligations and levies for NGN migration, whilst ensuring that these are not onerous on operators such that they compromise innovation and infrastructure development. Regulatory questions include whether VoIP providers should contribute to a universal service fund; how to structure universal service contributions and to which technology or service these should attach.
Consumer Protection	Issues that require attention include but are not limited to, quality of service; priority access to emergency services; the provision of location information; rights and presence management, number portability, operators' liability; privacy and security. Regulators around the world have started industry wide consultations of the consumer aspects of NGN migration to ensure that consumers are in no way adversely affected.

Box 13: Spectrum Sharing in South Africa

Numerous new players are seeking to offer WiMAX services on a national scale. Other licensed operators, such as the Under-serviced Area Licensees and the new national fixed line entrant licenced in 2005, require access to the 800Mhz Band (822-830MHz- Channel 65) for the deployment of non broadcasting services (essentially, CDMA). The regulator, ICASA recently embarked on a public process to assess the viability of new operators sharing this band for non-broadcasting purposes, with the incumbents in the band. The key objectives of this exercise were to provide spectrum for greater choice of access and distribution technologies to users and advance competitiveness in the telecommunications industry. At the same time, the process was mindful of wanting to encourage innovative applications without causing harmful interference to other services co-existing in the same spectrum. At the conclusion of the process, ICASA ruled that it is feasible to share the 800Mhz band based on spatial/geographic separation. TRAI in India has proposed in its consultations on NGNs, the de-licensing of 5.1 – 5.3 GHz band for outdoor usage for broadband access and the identification of additional spectrum bands, which are underutilized for deployment of broadband services.

Source: ICASA

6.1 Consultation

The existing resource challenges for regulators around the world will intensify under a new regulatory regime required to effectively and efficiently regulate NGNs. Many of the existing personnel within regulatory bodies are accustomed to neat divisional lines between telecommunications, broadcasting and spectrum management. Convergence and the move to horizontal and unified licensing frameworks have presented enormous challenges for this silo organizational design. Even where human resource and financial

capacity constraints are less in issue, regulators have begun to consult widely with stakeholders on NGN migration to allay concerns for operators and service providers in terms of business models and operations and to ensure consumer protection. The importance of joint consultation cannot be overstated as this interaction is essential for evolving regulation that benefits the operators, consumers and the ICT sector as a whole. Most of the developed countries in more advanced stages of NGN development have considered or are setting up cross industry bodies comprising the major players to manage the transition and deliberate upon the issues pertaining to standards, interconnection timeframe, etc. in addition to organizing awareness and educational programmes for stakeholders. The Bangladesh Regulator (BTRC) organised a workshop to cover various issues pertaining to NGN for regulatory staff as well as service providers by inviting international experts.

In Singapore, the Infocomm Development Authority (IDA) is playing a role in promoting the formation of industry-led alliances, exchanges and marketplaces while collaborating with industry to deploy infrastructure for ubiquitous offerings. Potential industry alliances will be forged in the areas of inter-roaming, interoperability and interworking in a multi-operator, multiplatform environment. This enables the regulator to engage with the cutting edge of the industry, to better understand the changing capital and operating expenditure requirements, the technical challenge of various aspects of social and security regulation in the new environment and how best to avoid regulatory induced failure in this now critical sector of any modern economy. OFCOM has established “NGN Co.”, a NGN industry coordination committee. This body is tasked to manage key aspects of transition to NGNs. The responsibilities of this body include producing a reference interconnect architecture for NGN, setting out detailed transition plan and also a plan for communication to consumers, in addition to overseeing the transition. TRAI in India has already established “NGN eCo” (NGN Expert Committee) to take forward ongoing joint consultation with consumers, industry players and policy makers to enrich the regulatory process. Issues that are being deliberated upon by this committee include interconnection, QOS and licensing as well as migration timetable for NGN in the country. It is also emphasized that in addition to industry wide consultation of matters of mutual interest, joint consultation with other regulators is critical for evolving regulation that benefits the operators, consumers and society as a whole.

7 Recommendations

Although NGN development globally on average is still in its nascent phase, there are numerous recommendations for designing and implementing policy and regulation in a manner that will best facilitate NGN deployment and development. These are drawn from best practice principles of regulation applied to existing networks and services. However, many of these depend on various different assumptions about the state of competition in a country, the market structure, regulatory capacity and the like.

Moving forward from a regulatory perspective also requires a sober examination of what works for PSTN regulation that can be carried over to a NGN space, and what does not and should be left behind. We know for example that interconnection agreements, frameworks and current charging principles are likely to change. Moreover, we know that the principle of universal access and ensuring priority access for operators to emergency calling can never be compromised in a NGN environment. Regulatory oversight will continue to be applicable. But as the NGN transition takes on increasing IP functionalities more closely resembling elements of the Internet which has generally attracted less regulation, regulators and policy makers need to question the applicability of legacy regulatory frameworks, for example content rules and quotas in broadcasting. Will these be easily applicable beyond public broadcasters who may be governed under a different mandate? Should voice (including VoIP) be distinguished as a service still needing to be treated with a distinct set of policy, legislative and regulatory provisions? Will competitive market dynamics be sufficient to secure a competitive environment in the absence of wholesale regulation? What prospects remain for incumbents to further entrench their market position through vertical integration? Is it more urgent to rapidly address legacy competition issues to prevent entrenching already unfair advantages in the market? Is it just incumbents that might need regulatory oversight or new entrants as well, and if so, to what degree? Is there an increased role for stakeholders in guiding regulatory and policy outcomes? While numerous questions still remain unanswered and will no doubt be resolved as the NGN migration gathers pace, the following is an attempt to extract general principles to be considered:

- If they have not already done so, regulators and policy-makers can begin to consider the processes required to address IP based and full NGN transition. This may include research, training, consultations with the industry and the public.
- For those markets that have not reached mature levels of competition, regulators and policy makers can explore measures to facilitate competition and promote efficiency in telecoms operations to facilitate growth and bring about improvements in roll-out and services. For example, unbundling the local loop to avoid duplication in the access network.
- Regulators can encourage a competitive market based outcomes rather than regulatory intervention, which should be used to pre-empt and address market failure.
- Universal access policies will remain vital. However, strategies to achieve these need to move away from protection of existing networks to more competitive strategies where pent up demand can be met more efficiently by the market and obligations to address market failure spread among all players.
- Policy-makers and regulators, rather than promoting certain technologies through technology and service-specific licensing, can explore a move towards unified and technology neutral licensing.
- Consumer education and participation is critical and it is the regulators responsibility, in consultation with operators to educate consumers on benefits and risks of new services and technologies. This could be effectively communicated to consumers and enforced for operators through the publication of guidelines or codes of good practice.
- Voice communications are starting to migrate away from the PSTN and the migration onto the Internet will gather pace. Regulators need to ensure that the consumer focused and regulatory issues are addressed in advance.
- Policy should encourage the continued operation and maintenance of legacy circuit switched PSTN until users are successfully migrated to new networks and services.
- Policy should create reasonable certainty for the industry and investment.
- Where industry self regulation is feasible, the regulator may consider the establishment of a self-regulatory body representative of all stakeholders in a convergent industry, particularly in relation to development of standards.
- Where content concerns emerge, (e.g. advertising, objectionable content, fraudulent behaviour, etc) policy makers should consider appropriate content protection rules and institutions to enforce them depending on the particular circumstances and context in that particular country. Many of these are effectively managed through industry self regulation and codes of conduct.
- Where relevant, regulators should be ready to accelerate the type approval process for NGN devices and rapid deployment. A memorandum of understanding may be helpful, as is the case with regard to GSM.
- Policy makers should address the issues of security and access to emergency services for consumers.
- A roadmap should be developed to revisit laws and regulations (specifically addressing interconnection and access issues) on an ongoing basis to ensure their suitability for sound NGN development.

Box 14: Policy Challenges for NGN

- Addressing Significant Market Power (SMP) issues and promoting fair competition
- Maintaining and open and competitive market in infrastructure and services
- Encouraging innovation and long-term investment
- Removing barriers to the development of emerging markets;
- Ensuring proportionality of regulation, including forbearance;
- Ensuring technologically neutral regulatory framework, allowing market players freedom of choice;
- Ensuring the optimal balance in spectrum management
- Ensuring consumer protection and QoS

Source: OECD

Box 15: Regulatory Principles for NGNs

- Technology and provider neutrality – to promote investment and innovation
- Market driven, commercial imperative to drive investment and technology decisions
- Light touch regulation: reduce barriers to entry
- Consistent and transparent regulation
- Regulation of non economic goals to be proportionate
- Reduced or no limits on foreign ownership
- No restriction on licences within technical or spectrum constraints
- Withdraw from regulation at levels not required
- Develop varying regulatory solutions for different products
- Promote infrastructure investment
- Expand capacity for external connections (landing stations; satellite etc)
- Removal of bottlenecks to access by end users to telecom services
- Fair regulatory framework for interconnection
- Promote effective competition and protection of consumers interests
- Comply with WTO non discrimination requirements
- Regulate to foster market growth to satisfy user needs

Source: OFTA and OFCOM

8 Regulating NGN: the Future

While much is known and can be anticipated with respect to the regulation of NGNs, it is simply too early in their evolution to determine prescriptive and definitive principles and approach, beyond a light touch, facilitative regulatory stance. What is certain is that the NGN evolution is underway and promises to fundamentally alter the ICT landscape. It will bring opportunities for operators and benefits for consumers and will pose challenges for regulators and policy makers. Regulation in this regard is a true work in progress. There is much to be learned from those countries at more advanced levels of technological development and policy consultation. As is the case in all ICT developments, there will be world leaders in NGN development and regulation. Those countries that are at less developed stages will have the opportunity to benefit from the experiences, mistakes and gains experienced by other countries and these should be leveraged wherever possible. At a minimum, there is clear guiding value in the established principles of regulation that seek to foster competition and investment. In most cases, there is yet to be a convincing case to depart from these tried and tested principles. Where necessary, departure from these principles should be capable of justification and modelled to promote competition, investment certainty and consumer welfare.

References

Analysys, "Sophisticated Broadband Services: Final Report for the Department of Trade and Industry (DTI)", 28 November 2005 at http://www.broadbanduk.org/reports/dti/051128_sophisticated_broadband_services_report2.pdf

Australian Communications Industry Forum, ACIF Next Generation Network project, NGN Framework Options Group (NGN FOG), *Policy and Regulatory Considerations for New and Emerging Services,* July 2004.

Australian Communications Authority, "Next Generation Networks: An ACA perspective on Regulator and Policy Issues", May 2003 at http://www.aca.gov.au/aca_home/about_aca/futures_panel/next_gen_networks_persp_may_2003.pdf

de Streel, Alexander, "A New Regulatory Paradigm for European Electronic Communications: On the Fallacy of the "Less Regulation" Rhetoric, at http://www.tilburguniversity.nl/tilec/events/seminars/streel.pdf.

Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), "*A Model for Interconnection in IP Based Networks*", ECC Report 75, Vilnius, October 2005.

Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), "*Next Generation Network Developments and their Implications for the New Regulatory Regime*", ECC Report 27, Bornholm, October 2003.

European Competitive Telecommunications Association, "Comments on NGN Public Policy", See http://www.itu.int/osg/spu/ngn/documents/ECTA0NGN.doc

European Telecommunications Platform (ETP), "On the technology, business models and regulatory aspects of NGN", ETP (06) 01, 17 January 2006.

Gillwald, A., (ed) *Towards an African e-Index: Household and Individual ICT access and usage across 10 Africa countries*, 2006, LINK Centre, Witwatersrand University, Johannesburg.

Hauwei, "Network Evolution- View from NGN Practice of Global Carriers," at http://www.huawei.com/publications/view.do?id=259&cid=93&pid=61

International Telecommunication Union, *Ruling the New and Emerging Markets in the Telecommunications Sector, Challenges: The Emergence of Next Generation Networks* Background Paper, NGN/01, 23 March 2006, p. 14.

International Telecommunication Union, *Interconnection in an NGN Environment*, Background Paper, NGN/02, 23 March 2006.

International Telecommunication Union, *What Rules for Universal Service in an IP enabled NGN Environment?* Background Paper, NGN/03, 23 March 2006.

International Telecommunication Union, "VoIP and Regulation" in *Trends in Telecommunication Reform 2006, Regulating in the Broadband World.*

International Telecommunication Union, "ITU-D Question 18/2 – Strategy for Migration of mobile networks to IMT-2000 and beyond: Mid-term Guidelines (MTG) on the smooth transition of existing mobile networks to IMT 2000 for developing Countries" at http://www.itu.int/pub/D-STG-SG02.18-2006/en

London Economics in Association with Price Waterhouse Coopers, "An Assessment of the Regulatory Framework for Electronic Communications – Growth and Investment in the EU e-Communications Sector: Final Report To The European Commission DG Information Society and Media, July 2006.

Marcus, S., "Interconnection in an NGN Environment", ITU, Background Paper, NGN/02, 23 March 2006.

Claire Milne, et al., **"**Telecoms demand: measures for improving affordability in developing countries, June 2006, at http://www.regulateonline.org/content/view/619/31/

OECD, Directorate for Science, Technology and Industry Committee for Information, Computer and Communications Policy, Working Party on Telecommunication and Information Services Policies, *Rethinking Universal Service for a Next Generation Network Environment*, DSTI/ICCP/TISP(2005)5/FINAL, 18 April 2006.

OECD, Directorate for Science, Technology and Industry Committee for Information, Computer and Communications Policy, Working Party on Telecommunication and Information Services Policies, *VoIP: Developments in the Market,* DSTI/ICCP/TISP(2004)3/FINAL, 10 January 2006.

OECD, Directorate for Science, Technology and Industry Committee for Information, Computer and Communications Policy, Working Party on Telecommunication and Information Services Policies, *Next Generation Network Development in OECD Countries*, DSTI/ICCP/TISP(2004)4/FINAL, 18 January 2005.

Office of the Director of Telecommunications Regulation, Briefing Note Series, *Next Generation Networks*, Odtr01/88, 16 November 2001, http://www.odtr.ie/docs/odtr0188.doc

OPTA, "Regulating Emerging Markets" Economic Policy Note No. 5, April 2005 at http://www.opta.nl/download/EPN05_uk.pdf

OVUM, "Next-Generation Networks: Challenges Ahead" at http://www.ovum.com/go/content/c,64671

UK Office of Communications, "Regulatory Challenges posed by Next Generation Access Networks: Public Discussion Document", 23 November 2006.

UK Office of Communications, *Next Generation Networks: Developing the Regulatory Framework*, 7 March 2006, http://www.ofcom.org.uk/consult/condocs/nxgnfc/statement

Sinclair, G. Intven, H., Tremblay, A. *Telecommunications Policy Review Panel, Final Report*, 2006. See http://www.telecomreview.ca/epic/internet/intprp-gecrt.nsf/en/h_rx00054e.html

Telecom Regulatory Authority of India, *Consultation Paper on Issues Pertaining to Next Generation Networks (NGN)*, 12 January 2006, Consultation Paper No: 2/2006

Telecom Regulatory Authority of India, *Recommendations on Issues Pertaining to Next Generation Networks (NGN)*, 20 March 2006.

T-Systems, "White Paper Next Generation Network: Motivation and Challenges for Incumbents," at http://www.t-systems.com/en/Home/AboutTSystems/Company/id=206648.html

Xavier, P., "What Rules for Universal Service in an IP-Enabled NGN Environment," ITU, Background Paper, NGN/03, 23 March 2006.

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[1] OECD, Directorate for Science, Technology and Industry Committee for Information, Computer and Communications Policy, Working Party on Telecommunication and Information Services Policies, "Next Generation Network Development in OECD Countries", DSTI/ICCP/TISP(2004)4/FINAL, 18 January 2005, p.12.
[2] OVUM, "Next-Generation Networks: Challenges Ahead" at http://www.ovum.com/go/content/c,64671.
[3] ITU-T Recommendation, Y.2001, December 2004.
[4] See ICT Market Harmonization for ECOWAS/UEMOA at http://www.itu.int/ITU-D/treg/projects/itu-ec/index.html
[5] Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), "*Next Generation Network Developments and their Implications for the New Regulatory Regime*", ECC Report 27, Bornholm, October 2003, p. 6.
[6] OFCOM, "Regulatory Challenges posed by Next Generation Access Networks: Public Discussion Document", 23 November 2006, p.10.
[7] European Telecommunications Platform, "On the technology, business models and regulatory aspects of NGN", ETP (06) 01, 17 January 2006, p.5.
[8] The South African Next Generation Network Forum at http://www.sangn.za.org/
[9] Telecom Regulatory Authority of India, *Consultation Paper on Issues Pertaining to Next Generation Networks (NGN)*, 12 January 2006, Consultation Paper No: 2/2006, at http://www.trai.gov.in/trai/upload/ConsultationPapers/3/cpaper12jan06.pdf
[10] Ofcom, *Next Generation Networks: Developing the Regulatory Framework*, 7 March 2006.
[11] Ofcom, *Next Generation Networks: Developing the Regulatory Framework*, 7 March 2006.
[12] Wikipedia, http://en.wikipedia.org/wiki/Next_Generation_Networking
[13] Australian Communications Industry Forum, ACIF Next Generation Network Project, NGN Framework Options Group (NGN FOG), *Policy and Regulatory Considerations for New and Emerging Services*, July 2004. p.1.
[14] Also IPTV, where a digital television service is delivered to consumers using IP over a broadband connection. IPTV is viewed as part of the shift to IP-based NGN infrastructure, in an attempt to offer triple-play video, voice and data services.
[15] ETSI: http://www.etsi.org/tispan; ITU-T http://www.itu.int/ITU-T/ngn/index.phtml; The Fixed-Mobile Convergence Alliance (FMCA) http://www.thefmca.com/
[16] OECD, Directorate for Science, Technology and Industry Committee for Information, Computer and Communications Policy, Working Party on Telecommunication and Information Services Policies, "Next Generation Network Development in OECD Countries", DSTI/ICCP/TISP(2004)4/FINAL, 18 January 2005, p.4.
[17] T-Systems, "White Paper Next Generation Network: Motivation and Challenges for Incumbents," at http://www.t-systems.com/en/Home/AboutTSystems/Company/id=206648.html
[18] Huawei, "Network Evolution – View from NGN Practice of Global Carriers" at http://www.huawei.com/publications/view.do?id=259&cid=93&pid=61
[19] Huawei, "Network Evolution – View from NGN Practice of Global Carriers" at http://www.huawei.com/publications/view.do?id=259&cid=93&pid=61
[20] G. Sinclair, et al, *Telecommunications Policy Review Panel, Final Report*, 2006. See http://www.telecomreview.ca/epic/internet/intprp-gecrt.nsf/en/h_rx00054e.html
[21] WTO, *General Agreement on Trade in Services*, contained as Annex 1B to the Agreement Establishing the World Trade Organization, 15 April 1994, Final Act Embodying the Results of the Uruguay Round of Multilateral Trade Negotiations, *Legal Instruments – Results of the Uruguay Round*, 33 I.L.M. 1143, 1168 [GATS]; *Fourth Protocol to the Basic Agreement on Trade in Services*, 30 April 1996, WTO Doc. S/L/20
[22] Ronald H. Coase, "The New Institutional Economics" (1984) 140 Journal of Institutional and Theoretical Economics. at 229-31.
[23] Douglass C. North and Barry Weingast, "Constitutions and Commitment: The Evolution of Institutions Governing Public Choice in Seventeenth Century England" (1989) 49 Journal of Economic History 803 at 806.
[24] Allison Fine, "Contracting for Credibility in International Telecommunication Investments" (Paper presented for The International Society for New Institutional Economics (ISNIE) Conference, September 2000). Online: International Society for New Institutional Economics http://www.isnie.org/ISNIE00/Papers/fine.pdf at 3, and Brian Levy and Pablo T. Spiller, *Regulations, Institutions and Commitment: Comparative Studies of Telecommunications (*Cambridge, Cambridge University Press, 1996).
[25] Douglas C. North, *Institutional Change and Economic Performance* (Cambridge University Press, 1990) and Oliver E. Williamson, *The Economic Institutions of Capitalism* (New York: Free Press, 1985).
[26] ITU, *Trends in Telecommunication Reform 2006, Regulating in the Broadband World*, p.3.
[27] OECD, Broadband Statistics, June 2006 released 13 October 2006 at http://www.oecd.org/sti/ict/broadband.
[28] It is however noted that while Africa has the fewest number of broadband subscribers globally, the number of subscribers increased thirty times between 2002 and 2004 and where there is growth particularly in mobile broadband, it is at a significant uptake rate, although off a low base and limited to those higher income consumers.

[29] Alison Gillwald (ed) Towards an African e-Index: Household and Individual ICT Access and Usage across 10 African Countries, Research ICTAfrica.net, 2005. The countries surveyed in respect of ICT access and usage were Botswana; Cameroon; Ethiopia; Ghana; Namibia; Rwanda; South Africa; Tanzania; Uganda and Zambia.
[30] See ITU-D Question 18/2 – Strategy for Migration of mobile networks to IMT-2000 and beyond: Mid-term Guidelines (MTG) on the smooth transition of existing mobile networks to IMT 2000 for developing Countries at http://www.itu.int/pub/D-STG-SG02.18-2006/en.
[31] For a comprehensive discussion in this regard, see Chapter 6, ITU, "VoIP and Regulation" in *Trends in Telecommunication Reform 2006, Regulating in the Broadband World.*
[32] Juin 2005 UIT/BDT Passage aux réseaux NGN - O.G.S. - Séminaire régional du BDT/UIT
Coûts et tarification pour les pays membres du Groupe de tarification pour l'Afrique Midrand, République sudafricaine,28 juin – 1er juillet 2005, Passage aux réseaux NGN Oscar González Soto.
[33] OECD, Directorate for Science, Technology and Industry Committee for Information, Computer and Communications Policy, Working Party on Telecommunication and Information Services Policies, "Next Generation Network Development in OECD Countries", DSTI/ICCP/TISP(2004)4/FINAL, 18 January 2005, p.14-15.
[34] According to the OECD, Japan is the leader in fibre-to-the-premises (FTTP) with 6.3 million fibre subscribers in June 2006. Fibre subscribers alone in Japan outnumber total broadband subscribers in 22 of the 30 OECD countries. Moreover, the total number of ADSL subscriptions in Korea and Japan has continued to decline as more users upgrade to fibre-based connections. See OECD, Broadband Statistics, June 2006, released 13 October 2006 at http://www.oecd.org/sti/ict/broadband. See also Analysys, "Sophisticated Broadband Services: Final Report for the Department of Trade and Industry (DTI)", 28 November 2005 at http://www.broadbanduk.org/reports/dti/051128_sophisticated_broadband_services_report2.pdf
[35] European Telecommunications Platform, "On the technology, business models and regulatory aspects of NGN", ETP (06) 01, 17 January 2006, p.4
[36] European Telecommunications Platform, "On the technology, business models and regulatory aspects of NGN", ETP (06) 01, 17 January 2006, p.4.
[37] Vodacom Group Interim results for the 6 months ending 30 September 2006 at http://www.vodacom.co.za/about/company_info_financial.jsp
[38] See speech 06/772 by Viviane Reding, Member of the European Commission responsible for Information Society and Media entitled, "Connecting up the Global Village: a European View on Telecommunications Policy" at ITU "Telecom World 2006", Hong Kong, China, 4 December 2006.
[39] However, when expressed as a percentage of revenues, new-entrant operators have been investing three to four times more than incumbents over the period. See London Economics, "An Assessment of the Regulatory Framework for Electronic Communications – Growth and Investment in the EU e-Communications Sector: Final Report To The European Commission DG Information Society and Media, July 2006.
[40] European Telecommunications Platform, "On the technology, business models and regulatory Aspects of NGN", ETP (06) 01, 17 January 2006, p.7.
[41] Ewan Sutherland, "Convergence for Corporations" at http://www.3wan.net
[42] Claire Milne, et al., **"**Telecoms demand: measures for improving affordability in developing countries, June 2006, at http://www.regulateonline.org/content/view/619/31/
[43] TRAI, *Consultation Paper on Issues Pertaining to Next Generation Networks (NGN)*, 12 January 2006, Consultation Paper No: 2/2006 at http://www.trai.gov.in/trai/upload/ConsultationPapers/3/cpaper12jan06.pdf
[44] ITU, VoIP and Regulation" in *Trends in Telecommunication Reform 2006, Regulating in the Broadband World* , p 93
[45] John Horrocks, "The Future of Telecommunications: a view", at http://www.ero.dk/E334BEEC-60D3-4717-BF6F-8EA8CBACED3D?frames=no&
[46] OFCOM, "Regulatory Challenges posed by Next Generation Access Networks: Public Discussion Document", 23 November 2006.
[47] These arguments are drawn from ITU, "VoIP and Regulation" in *Trends in Telecommunication Reform 2006, Regulating in the Broadband World.* They are gratefully acknowledged and further expanded upon there.
[48] Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), "*Next Generation Network Developments and their Implications for the New Regulatory Regime*", ECC Report 27, Bornholm, October 2003, p.6.
[49] Whilst there is a clear case for migrating private and corporate networks to an IP platform to provide integrated voice and data, the case for doing so for public networks is less clear cut. Several operators have undertaken studies of the economic benefits of replacing circuit switched networks with IP based NGNs but have found that the benefits do not necessarily outweigh the costs but other operators such as Telcom Italia and Telekom Austria are embarking on replacement programmes and various others have announced intended roll-out timeframes.
[50] Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), "*Next Generation Network Developments and their Implications for the New Regulatory Regime*", ECC Report 27, Bornholm, October 2003, p. 10.
[51] European Competitive Telecommunications Association, "Comments on NGN Public Policy", See www.itu.int/osg/spu/**ngn**/documents/ECTA-NGN.doc

[52] Telecom Regulatory Authority of India, Recommendations on Issues Pertaining to Next Generation Networks (NGN), 20 March 2006, p.3.
[53] Other examples of semi–walled gardens include NTT DoCoMo's i-mode, which signs on content partners, but also allows open access to certain sites and Apple's iTunes which allows iPod owners access to purchase and play digitally rights managed (DRM) songs from its service. See Wikipedia at http://en.wikipedia.org/wiki/Walled_garden_(media).
[54] Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), "*Next Generation Network Developments and their Implications for the New Regulatory Regime*", ECC Report 27, Bornholm, October 2003, p. 11.
[55] OFCOM, "Regulatory Challenges posed by Next Generation Access Networks: Public Discussion Document", 23 November 2006, p.16.
[56] Hasan Alkas, "The Technology Neutrality Concept Used to Perpetuate Regulation into NGN" Presentation for ITU NGN Workshop, 23-24 March 2006, Geneva.
[57] TRAI, *Consultation Paper on Issues Pertaining to Next Generation Networks (NGN)*, 12 January 2006, Consultation Paper No: 2/2006 at http://www.trai.gov.in/trai/upload/ConsultationPapers/3/cpaper12jan06.pdf, see pp. 26-35.
[58] Robert Shaw, "What Rules for IP-Enabled NGNs: Next Generation Networks – Investment and Regulation", Presentation to London Business School, 29 June 2006 http://www.itu.int/osg/spu/presentations/2006/**shaw**-what-**rules**-for-ip-enabled-**ngn**s-29-june-2006.pdf
[59] OFCOM, "Regulatory Challenges posed by Next Generation Access Networks: Public Discussion Document", 23 November 2006, p.7.
[60] There are three criteria that must ALL be present: there must be substantial and non-transitory barriers to market entry, the market is not tending towards a state of effective competition and competition law alone cannot address the problems that which arise in the market.
[61] This is discussed in further detail in ITU, "VoIP and Regulation" in *Trends in Telecommunication Reform 2006, Regulating in the Broadband World*.
[62] See the case of ex ante regulation of VOIP international benchmark as an example of SMP regulation evolution in: http://strategis.gc.ca/epic/internet/insmt-gst.nsf/vwapj/Attachment%201_GilbertandTobin_060412.pdf/$FILE/Attachment%201_GilbertandTobin_060412.pdf
[63] For a detailed discussion on ex ante regulation within the framework of emerging technology such as NGN, see Alexander de Streel, "A New Regulatory Paradigm for European Electronic Communications: On the Fallacy of the "Less Regulation" Rhetoric, at http://www.tilburguniversity.nl/tilec/events/seminars/streel.pdf.
[64] OFCOM, "Regulatory Challenges posed by Next Generation Access Networks: Public Discussion Document", 23 November 2006.
[65] OPTA, "Regulating Emerging Markets" Economic Policy Note No. 5, April 2005 at http://www.opta.nl/download/EPN05_uk.pdf, p.1.
[66] OPTA, "Regulating Emerging Markets" Economic Policy Note No. 5, April 2005 at http://www.opta.nl/download/EPN05_uk.pdf
[67] OPTA, "Regulating Emerging Markets" Economic Policy Note No. 5, April 2005 at http://www.opta.nl/download/EPN05_uk.pdf, p.3.
[68] For a discussion on the layers of Internet regulation, see Larry Lessig, *Code and other Laws of Cyberspace* (Basic Books: 2000)
[69] OPTA, "Regulating Emerging Markets" Economic Policy Note No. 5, April 2005 at http://www.opta.nl/download/EPN05_uk.pdf, p.18
[70] OPTA, "Regulating Emerging Markets" Economic Policy Note No. 5, April 2005 at http://www.opta.nl/download/EPN05_uk.pdf, p.2.
[71] European Competitive Telecommunications Association, "Comments on NGN Public Policy", at http://www.itu.int/osg/spu/ngn/documents/ECTA-NGN.doc
[72] See speech 06/772 by Viviane Reding, Member of the European Commission responsible for Information Society and Media entitled, "Connecting up the Global Village: a European View on Telecommunications Policy" at ITU "Telecom World 2006", Hong Kong, China, 4 December 2006.
[73] An interesting argument in this regard is advanced by Eli Noam, suggesting that the Internet which has been traditionally "unregulated" will become heavily regulated along the telco model of regulation as most media will be provided over the Internet as the main delivery platform attracting many of the rationales for the regulation of telcos. For example, he notes that the principle of Net Neutrality sought by the Internet community is simply a version of telecom common carrier regulation for broadband. See Eli M. Noam, "Why TV regulation will become telecom regulation", in http://www.ofcom.org.uk/research/commsdecade/section1.pdf
[74] CRTC, Telecom Decision CRTC 2006-53at http://www.crtc.gc.ca/archive/ENG/Decisions/2006/dt2006-53.htm and Order Varying Telecom Decision CRTC 2005-28, P.C. 2006-1314, November 9, 2006, Vol. 140, No. 24 — November 29, 2006 at http://canadagazette.gc.ca/partII/2006/20061129/html/sor288-e.html. See also http://strategis.gc.ca/epic/internet/insmt-gst.nsf/vwapj/Attachment%201_GilbertandTobin_060412.pdf/$FILE/Attachment%201_GilbertandTobin_060412.pdf

[75] Fur a detailed treatment of the principles and in the context of the UK and EU, see OFCOM, "Regulatory Challenges posed by Next Generation Access Networks: Public Discussion Document", 23 November 2006, section 4: Wholesale access to next generation access networks.
[76] Robert Shaw, "What Rules for IP-Enabled NGNs: Next Generation Networks – Investment and Regulation", Presentation to London Business School, 29 June 2006 at http://www.itu.int/osg/spu/presentations/2006/**shaw**-what-**rules**-for-ip-enabled-**ngn**s-29-june-2006.pdf
[77] Australian Communications Authority, "Next Generation Networks: An ACA perspective on Regulator and Policy Issues", May 2003 at http://www.aca.gov.au/aca_home/about_aca/futures_panel/next_gen_networks_persp_may_2003.pdf
[78] European Telecommunications Platform, "On the technology, business models and regulatory aspects of NGN", ETP (06) 01, 17 January 2006.
[79] With the notable exception of India, there is no other developing country process or experience documented as yet. See http://www.itu.int/osg/spu/ngn/ngn-policy-regulatory-resources.html.
[80] These initiatives have been aggregated on the ITU NGN Resource page and may be accessed at http://www.itu.int/osg/spu/ngn/ngn-policy-regulatory-resources.html
[81] See OFCOM's findings following its consultation process of 13 January 2005, "Next Generation Networks: Developing the Regulatory Framework" 7 March 2006, at http://www.ofcom.org.uk/consult/condocs/nxgnfc/statement/ngnstatement.pdf
[82] OECD, Directorate for Science, Technology and Industry Committee for Information, Computer and Communications Policy, Working Party on Telecommunication and Information Services Policies, "Next Generation Network Development in OECD Countries", DSTI/ICCP/TISP(2004)4/FINAL, 18 January 2005, p.5
[83] OFCOM, *Next Generation Networks: Developing the Regulatory Framework*, http://www.ofcom.org.uk/consult/condocs/nxgnfc/statement
[84] OFCOM, "Next Generation Networks - Future arrangements for access and interconnection" 13 January 2005 at http://www.ofcom.org.uk/consult/condocs/ngn/ at p5.
[85] Australian Communications Industry Forum, ACIF Next Generation Network Project, NGN Framework Options Group (NGN FOG), *Policy and Regulatory Considerations for New and Emerging Services*, July 2004. p.16. But see OFCOM regarding this particular aspect at http://www.ofcom.org.uk/consult/condocs/nxgnfc/statement/gradients/gradients.pdf
[86] For a comprehensive list of the issues, see Patrick Xavier, "What Rules for Universal Service in an IP_Enabled NGN Environment," ITU, Background Paper, NGN/03, 23 March 2006.
[87] Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), "*Next Generation Network Developments and their Implications for the New Regulatory Regime*", ECC Report 27, Bornholm, October 2003.