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THE MIGRATION TO NGN FROM A REGULATORY PERSPECTIVE

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Abstract

Telecommunication networks around the world develop towards All-IP next generation networks (NGN). This migration is driven by higher economies of scale and scope, price reductions for IP network elements, opportunities for new services and an improved experience for the end users. As the telecommunication markets are typically regulated and governments around the world have issued policies for the sector, the developments towards NGN networks have outcomes on regulation and government policies.

This paper assesses the technological development towards NGN and the question on how and which initiatives regulatory authorities have implemented with regard to this development. With NGN, the development in the core networks is assessed, while the development in access networks (Next Generation Access Networks) is excluded.

The paper includes an empirical assessment identifying regulatory decisions and interventions initiated due to the migration to NGN taken in Australia, Brazil, Japan, Malaysia, UK and the USA. Thereby it is found that in these countries, regulatory policy documents are available and the approaches and focuses of the regulation in these countries are different, but a comprehensive regulation is still to be developed. E.g. in none of the countries there is a

regulated reference offer for IP Interconnection. In US though, FCC has actively started working on an adaptation of the regulatory regime to also consider IP-to-IP-Interconnection and in Brazil and in UK, there are regulatory plans for migration/implementation of IP Interconnection but in the other countries there aren't. Due to the fact that there are regulatory procedures initiated to deal with the migration to NGN in US, Brazil, Japan, Malaysia and UK, it is to be expected that the development of the regulatory frameworks to adapt to NGN is on its way in a large set of countries. Further, not directly related to regulation but still relevant, is that in all benchmarked countries but Japan, a national broadband plan has been introduced.

After the introduction in section 1 of the paper, the section 2 gives an overview of the driving factors behind the migration to NGN and the changes to the industry are identified, including changes to business models and networks. In section 3, the status of the NGN migration and the regulatory initiatives in six countries are assessed. The countries covered have been chosen in order to include Asia, Europe, North and South America. As a consequence, the countries chosen have different regulatory regimes, different market situations and regulatory aims.

1. INTRODUCTION

The telecommunications industry is regulated in most countries around the world. Important parts of this regulation are competition regulation and spectrum regulation. Further, in a large number of countries government initiatives for growth and development of the sector have been implemented (e.g. the NBN in Australia, the Lisbon Agenda in the EU and national broadband plans in numerous EU countries). When it comes to the regulation, this has evolved during the time as circuit based switching, PSTN/ISDN technologies and CS#7 protocols etc. were predominant technologies and standards. With the technological development, the prospect of new technologies and standards have arisen which changes to technological environment in which the regulation has evolved.

One of the substantial technological developments taking place is the migration of the networks to Next Generation Networks (NGN). These networks integrate a number of services into one single network (All-IP Networks), are IP based instead of circuit switched and have other standards and interfaces than the networks of the past. With regard to the government policies and the regulation, this raises the general question on how the governments and the regulatory authorities adapt to the technological development.

In this paper, the focus is on the Next Generation Networks (NGN). With the term NGN in this paper reference is made to the core network and not the access network. In the access network, the development is referred to as NGA (Net Generation Access Networks), which is not covered in this paper.

The research question of this paper is how the development towards NGN is driven and how the government policies and regulation have adapted to the changes in technology. To conduct this assessment, an empirical assessment, looking at the changes in the regulatory environment and the initiatives of the regulatory authorities with regard to the migration to NGN, has been undertaken.

2. NGN AND REASONS FOR MIGRATION

Chapter 2 starts with the ITU definition and outlines the elements of a next generation network. Chapter 2.1 describes how a NGN will look like and what characteristics it has. Thereby the physical as well as the functional structure is discussed. Chapter 2.2 analyses the implications of the migration towards NGN for the industry and for the environment which is aimed at when implementing the regulatory regime.

The definition of NGN is set out in ITU-T Y.2001 as follows:

„A Next Generation Network (NGN) is a packet-based network able to provide services including Telecommunication Services and able to make use of multiple broadband, QoS-enabled transport technologies and in which service- related functions are independent from underlying transport-related technologies. It offers unrestricted access by users to different service providers. It supports generalized mobility which will allow consistent and ubiquitous provision of services to users.”

Based on this definition, the key elements of NGN networks are:

- **IP-based networks:** In contrast to all telephone networks before NGN, the voice traffic is transported in packets based on the Internet Protocol (IP). This protocol has been used for some time transporting data traffic.
- **Service independent from transport:** a control and service layer separated from the transport of the IP packets constitutes a key element of NGN. The reason for this is to enable a more flexible approach where multiple different transport network technologies can be used within one integrated network. Further, changes to the transport technologies do not necessarily imply changes to the service/control functions and vice versa.
- **The implementation of one network for many services:** Instead of implementing one network for each telecommunication service, NGN enables multiple services to be implemented over one network. Thereby e.g. double play or triple play offerings (voice, internet and television services) can be implemented using one network.
- **Requirement of traffic management (QoS) functions:** As several different services share one network, different treatment of the services with regard to traffic management and quality of services is required, while otherwise some services will get marginalized within the network by other services.

- **Core and an access networks:** The NGN networks consist of access and core networks and integrates these into one through the service and control functions.

The ITU is the international standardisation organisation for telecommunications and accumulates the opinions of its member countries. The ITU focuses on the definition of a complete model of a worldwide telecommunications network including basic topologies and functions reflecting the transition from the PSTN/ISDN to packet based technology. In addition to ITU, two groups within the European telecommunications standardisation organisation (ETSI) work on standardisation of Next Generation Networks. ETSI TISPAN concentrates on the definition of workable migration scenarios from PSTN/ISDN towards NGN. ETSI 3GPP consist of mobile operators and develops a Next Generation Network based on UMTS-technology. Both ITU and ETSI see the IP multimedia subsystem (IMS) as an important part of NGN implementations. IMS is a complete implementation of the service layer in an NGN. IMS is built on IETF protocols with specific profiles and enhancements to provide a complete robust multimedia system. The enhancements provide support for operator control, charging, billing and security. ETSI TISPAN has defined two other implementations of the service layer, the PES and streaming services. The PSTN emulation subsystem (PES), also called softswitch solution is a viable alternative to IMS, is deemed less complex but might not deliver the optimal framework for implementation of open multimedia services.

2.1 NGN Architecture

The ITU has defined the functional architecture of NGN Release 1 in Rec. Y.2006. The NGN functions are divided into service stratum functions and transport stratum functions. This allows them to be offered separately and to evolve independently, a key NGN characteristic.

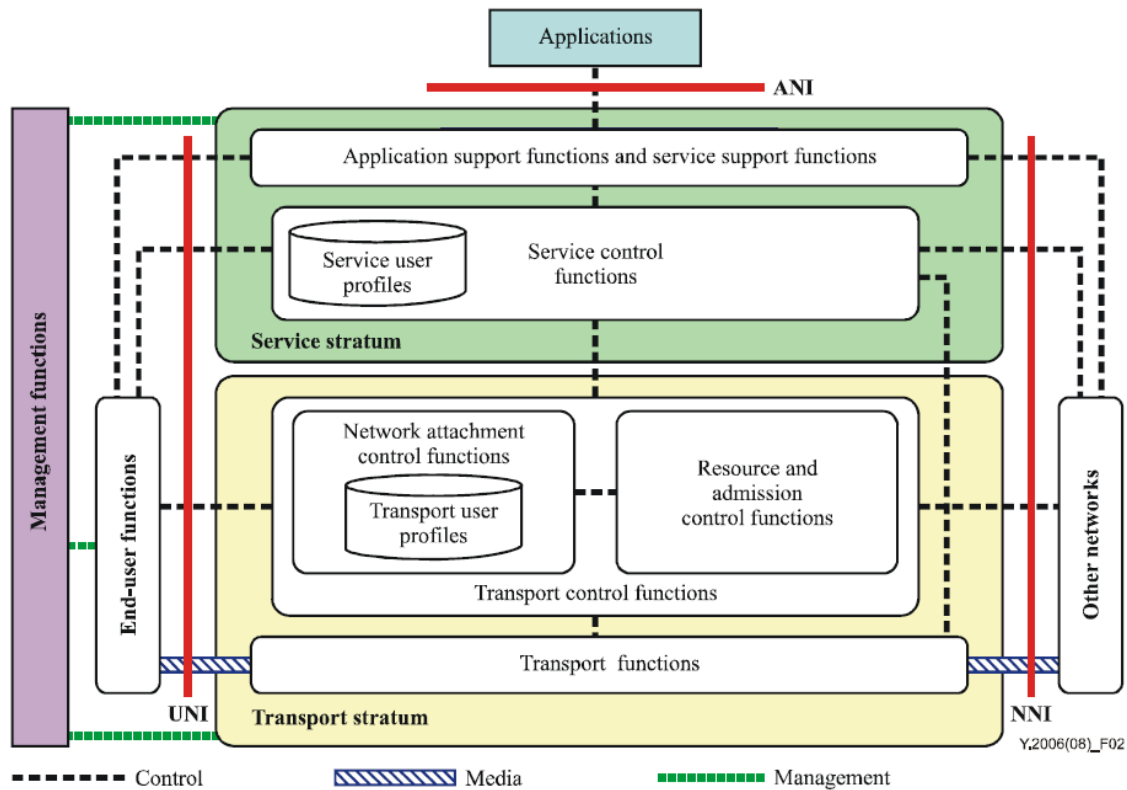


Figure 1: NGN architecture overview (Source: ITU Rec. Y.2006)

Service and transport stratum are defined as (see ITU-T Rec Y.2011):

- NGN service stratum:** That part of the NGN which provides the user functions that transfer service-related data and the functions that control and manage service resources and network services to enable user services and applications. User services may be implemented by a recursion of multiple service layers within the service stratum. The NGN service stratum is concerned with the application and its services to be operated between peer entities. For example, services may be related to voice, data or video applications, arranged separately or in some combination in the case of multimedia applications.
- NGN transport stratum:** That part of the NGN which provides transfer of data and the functions that control and manage transport resources to carry such data between terminating entities. The data so carried may itself be user, control and/or management information. The transport functions provide connectivity between two geographically separate points. Transport control functions include resource access control functions (RACF) and network attachment control functions (NACF).

NGNs have a different structure as earlier networks. While traditional networks are specialized for one specific service future networks allow flexible service creation using a

common packet core. Earlier networks integrate access, transport and switching. In NGN, the flexibility to use various transport technologies and connect them to a common core network is envisaged.

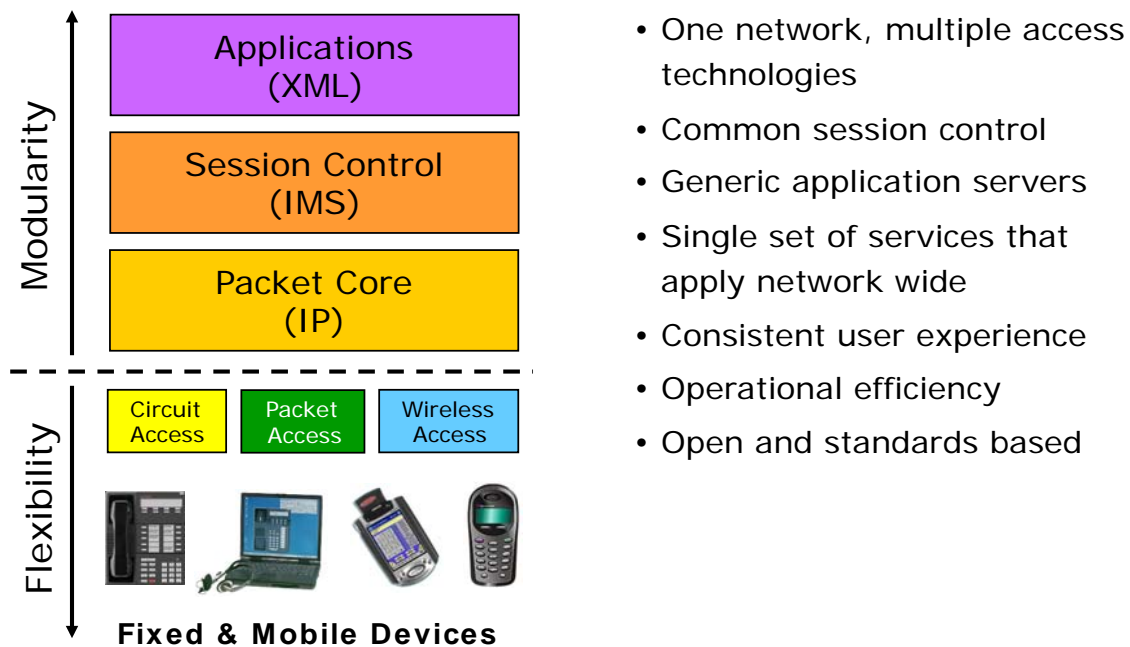


Figure 2: Structure of NGN (Example Source: Sonus)

Since networks follow different migration paths towards NGN, the integration of networks is a main challenge. This means that the implementation of the UNI, NNI and ANI should allow on the one hand a smooth migration and on the other hand the realization of the benefits of NGN. These are clearly conflicting goals, which require careful management.

Practical NGN architectures are found in supplier implementations. Darvishan et. al.¹ have

¹ Darvishan, A.; Yeganeh, H.; Bamasian, K.; Eghtedari, P.: "A Practical NGN Model By Evaluation of Various NGN Solutions and its Conformance with IMS-TISPAN," *Ubiquitous Information Technologies & Applications, 2009. ICUT '09, Fukuoka, Japan. Proceedings of the 4th International Conference*, pp.1-5, 20-22 December 2009 doi: 10.1109/ICUT.2009.5405726

developed an NGN model based on implementations by Nokia-Siemens-Networks, Ericsson, Huawei and ZTE. The following figure is based on the research by Darvishan et al.

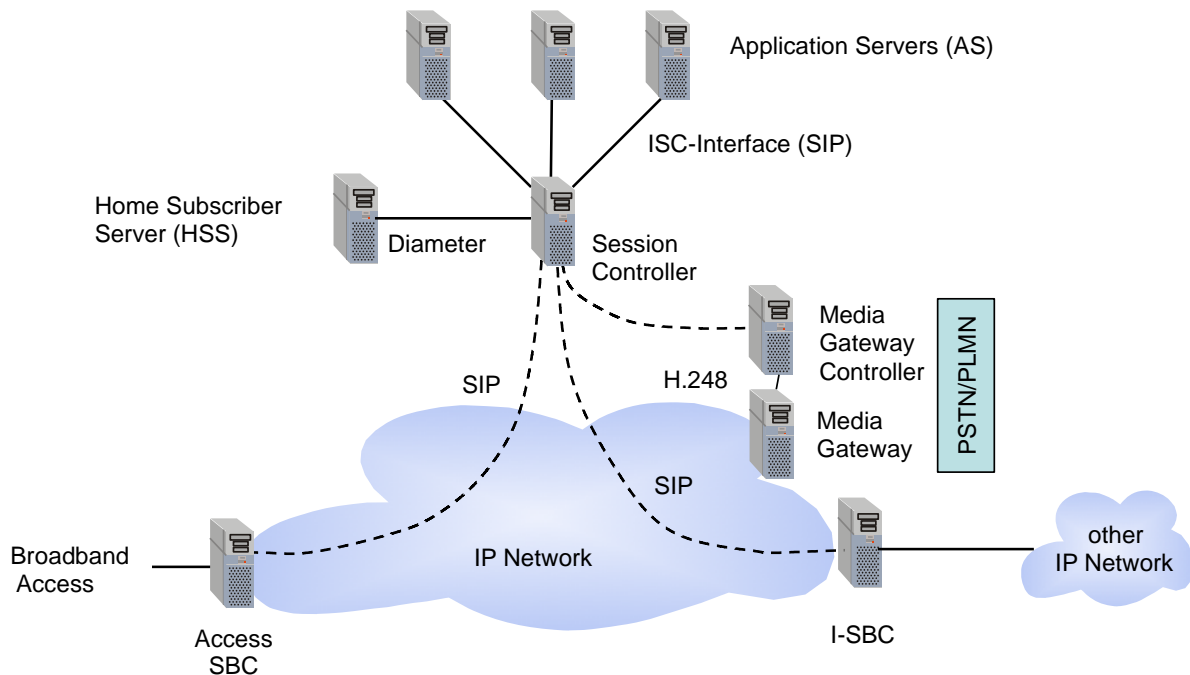


Figure 3: NGN architecture (Source: SBR, based on Darvishan et al.)

The main elements of this generalized NGN architecture are:

- **Home subscriber server (HSS):** The HSS is the database of all subscribers and service data, which includes user profile, roaming profile, authentication parameters and service information.
- **Session controller:** This functionality is responsible for registering the users and providing the services to them. It performs routing and translation, provides billing information to mediation systems, maintains session timers, and interrogates the HSS to retrieve authorization, service triggering information and user profile.
- **Media gateway controller:** This is the function that performs call control protocol conversion between SIP and ISUP and interfaces with the signalling gateway over SCTP. It also controls the resources in MGW across an H.248 interface.
- **Media gateway (MGW):** This is the function that interfaces with circuit switched network, terminates bearer channels from circuit switched networks and packet switches media streams, and handles DSP resources such as codecs, transcoder etc.
- **Application server (AS):** AS include enhanced service logic and can make use of the session control.

- **Broadband access:** Broadband access can be based on different technologies. Broadband access also provides NASS functionality. This is the function that provides registration at access level and initialization of user equipment for access to services. NASS provides network-level identification and authentication, manages the IP address space of the access network, and authenticates access sessions.
- **Session border controller (SBC):** The SBC provides the border to other IP networks. Access SBC and Interconnection SBC can be distinguished. The Access SBC usually includes the RACS functionality. SBC have evolved to address a wide range of issues like security and DOS prevention, policy enforcement and QoS control, firewall and NAT traversal.

Also other organisations like the OECD have dealt with NGN, at least with the definition of parts of these networks, however, not being that specific and detailed in their approach. In this spirit, the technical elements and features of NGN in the core network have been summarized by the OECD as follows:

“The next generation core networks are defined on the basis of their underlying technological “components” that include (...) packet-based networks, with the service layer separated by the transport layer, which transforms them into a platform of converged infrastructure for a range of previously distinct networks and related services. These features may have an impact on traditional business models and market structure, as well as on regulation:

- *IP-based network: “Next generation core networks” generally cover the migration from multiple legacy core networks to IP-based networks for the provision of all services. This means that all information is transmitted via packets. Packets can take different routes to the same destination, and therefore do not require the establishment of an end-to-end dedicated path as is the case for PSTN-based communications.*
- *Packet-based, multi-purpose: While traditionally separate networks are used to provide voice, data and video applications, each requiring separate access devices, with NGN different kinds of applications can be transformed into packets, labelled accordingly and delivered simultaneously over a number of different transport technologies, allowing a shift from single-purpose networks (one network, one service), to multi-purpose networks (one network, many services). Interworking between the NGN and existing networks such as PSTN, ISDN, cable, and mobile networks can be provided by means of media gateways.*
- *Separation of transport and service layer: This constitutes the key common factor between NGN and convergence, bringing about the radical change in relationship between network “layers” (transport infrastructure, transport services and control,*

content services and applications). In next generation networks service-related functions are independent from underlying transport-related technologies. The uncoupling of applications and networks allow applications to be defined directly at the service level and provided seamlessly over different platforms, allowing for market entry by multiple service providers on a non-discriminatory basis".²

2.2 Industry implications due to the migrating to NGN

The migration towards next generation networks covers a wide area of topics which are relevant for market development in economic and technical respect. New technical means of traffic transport (transmission, switching), management and routing, moving from circuit switched to packet switched technology are triggering this development. This development blurs boundaries which have previously existed in several areas which are described below. In the era of legacy networks market players, especially network operators have specialized in providing different services (TV, fixed voice, mobile voice, data) and their business models had not been interfering with each other. Usually, there were vertically integrated operators of telecommunications networks³, cable operators, broadcasting network operators⁴ (providing TV and/or radio via spectrum that was available to them), and finally mobile operators offering voice services via specifically dedicated spectrum. The change that has taken place by the introduction of IP-based transport technology, is a transition towards a model where telecommunications operators, cable operators, broadcasters and mobile operators are able

² See OECD: Convergence and Next Generation Networks, DSTI/ICCP/CISP(2007)2/FINAL, June 2008, p. 13

³ Service providers offering transport and voice and to a certain extent also data using copper networks.

⁴ Terrestrial and satellite networks

to provide voice, video, audio and data services over the same infrastructure. This results in a converged world of provision of networks and services allowing every network to principally provide any service as depicted in the following figure.

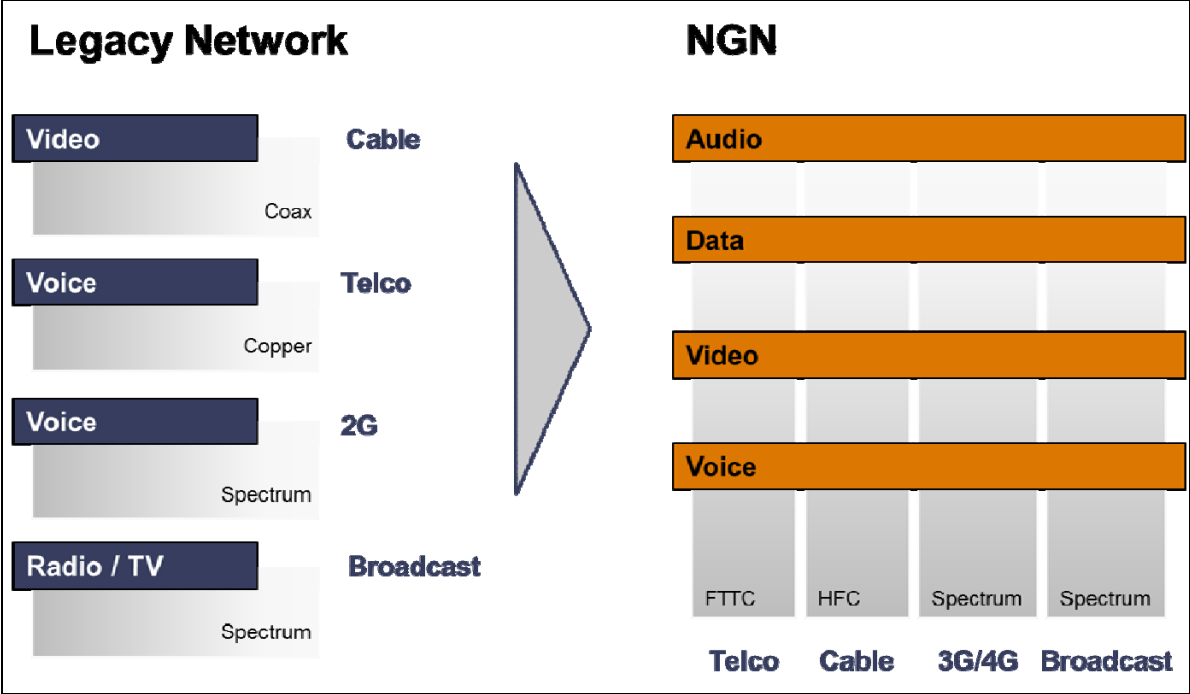


Figure 4: Structural change due to migration to NGN (source: SBR Juconomy)

The introduction of IP-technology thus has resulted in a different form of business models where a broad range of services can be offered by different types of operators using a variety of different technologies. This also implies that there is a decoupling of services from the underlying network. TV programs are not offered any longer only by broadcasters but also by telecommunications operators, which, in turn, do not have exclusive possibility any longer to provide voice communications, as voice over IP clients also can be realized in networks of cable operators. Thus, IP technology allows an intensified competition and has a strong economic impact on networks and services:

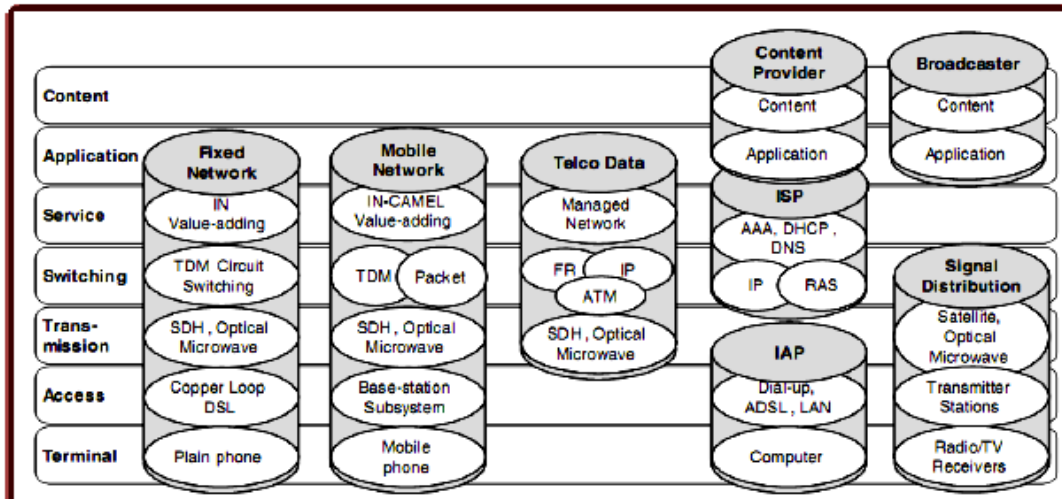


Figure 5: Stakeholders in an NGN environment

The conclusion from this is that networks that so far were not competing with each other enter into a significantly changed environment where competition between them is much fiercer, and that new roles and new business approaches have to be defined. One can see that fixed telecommunications operators, broadcasters and cable operators as well as mobile operators are competing with each other intensively and this has implications for the costs of services, for technologies used and also the regulatory approach. This implies that in such an environment the regulatory regime towards NGN may be very important. Against the background of the situation in India the specificities of the strong position of mobile networks as compared to fixed networks needs to be taken into account when analysing the situation. However, the principle trends of intensified competition and “movements” in the competitive landscape remain unchanged and are also applicable in India. There is a big likelihood that competition and changes will be driven by the mobile sector.

On the technical level the migration towards NGN implies that the substitution of PSTN by IP-technology leads to a different type of routing in the network. Communication is not any longer circuit-switched but packet-switched and the packets may travel via different routes, which may have an impact on the quality of service (depending on the type of service but especially relevant for real-time services like voice communications), the costs of providing the network and operating it, security issues, interception as well as interconnection. All these

aspects are technically related but they have either an economic impact or a social impact. It also exhibits influence on the treatment of certain technical and economic phenomena in the market. Thereby, a set of issues deal with the regulatory approach due to the competitive impact of NGN technology (related to costs, investments and interconnection), other aspects rather deal with social or political concerns (such as security and interception) and finally a third class of aspects is directed towards the service which is being offered to the customer (i.e. via quality of service).

According to OECD⁵ and the discussion above, the NGN migration offers a set of advantages to the service providers, the end users and the entire economy:

- Increased efficiency resulting in costs savings and thereby increased welfare:
 - Economies of scale: The migration to NGN will integrate all telecommunications traffic of an operator into one network. Due to the high proportion of fixed costs, the unit costs are plummeting as the traffic grows (which is specifically the case for data traffic in light of increasing internet and broadband penetration).
 - Economies of scope: As networks which are separated today into several networks are integrated into one, the amount of traffic in the NGN is extensively higher which leads so significant savings in the cost of unit due to the high proportionality of fixed costs.
 - Efficiency of IP: Transporting telecommunications traffic as IP packets instead of reserving a complete channel for each voice call through the network increases the efficiency. The packet switched network routes the packets through those parts of the network which have sufficient resources

⁵ See OECD: Convergence and Next Generation Networks, DSTI/ICCP/CISP(2007)2/FINAL, June 2008, p. 13

and it is able to dynamically reroute packets when a router is busy. In a circuit switched network, the call route is set up at the beginning of the call and thereafter it cannot be rerouted.

- Due to the separation of the network into layers, changes to the environment, the transport technologies, applications and services can be reflected on a flexible basis adapting only parts of the network. This means that the NGN networks are more flexible enabling the service providers to react quicker. As a consequence, the costs and the time to market for new services can be reduced.
- NGN enables new business models. The implementation of new services in the network can be made faster influencing only a part of the network. These new services might enable new business models. Further, the disintegration of the network function might imply that new, vertically disintegrated networks can be the basis for a new type of service providers. Last but not least, the implementation of traffic management might also enable new services and business models.

The overarching motives to migrate to NGN can be seen from the figure below:

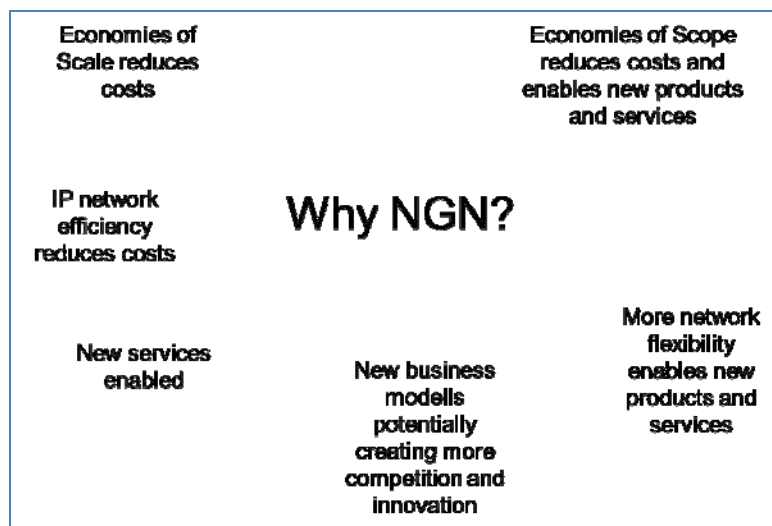


Figure 6: Advantages of NGN

Due to the migration, there are several specific topics of interest to be mentioned, derived from the changes as described above:

- 1) As boundaries between business models blur and as competition between different types of providers becomes stronger, one has to consider that for interconnection the telecommunications carriers so far have handled voice interconnection via PSTN and circuit-switched solutions. In the internet world the service providers wishing to exchange traffic do so via peering or transit agreements and require internet exchanges where they hand over or receive traffic from others. Due to the large amount of data and due to the increase of internet penetration IP-peering and transit become more and more relevant and also voice over IP applications are handled in this way. Nevertheless, for voice interconnection of telecommunications operators circuit-switched technology still prevails (especially for mobile network operators). So far a substitution towards exchanging this type of traffic via IP-networks and thus to introduce IP-interconnection in the carrier world, has not taken place. Nevertheless, the peering of voice traffic may be a trend that may be unstoppable in the future due to cost developments which make it more rationale to switch towards this type of technology and traffic exchange.
- 2) A problem which is related to interconnection especially for voice traffic is that competition was introduced between 10 and 20 years ago (in a large set of countries worldwide) and that investments have been undertaken by incumbent carriers as well as alternative operators into points of interconnection and other technical facilities to enable circuit-switched exchange of traffic. These investments have not fully paid-off yet and it seems as if the next technology would come on the horizon implying a substitution towards this new technology. This technology however would go along with lower operational expenditures due to improved cost efficiency in transporting traffic, on the other hand the migration would also “cost money” to achieve the lower cost level. This means that in the long run there are cost savings to be achieved, in the short run there are investments to be undertaken in order to achieve the local lower cost basis for IP-interconnection. This is an important economic decision that needs to be taken

especially in light of the question whether one would like to substitute the higher costs today by lower costs tomorrow if investments are needed to move forward.

- 3) Due to the fact that in the NGN core network the operational expenditures are lower, one could also raise the question whether the consequence of this is not that interconnection costs in general are going down significantly which could imply that the current charging regime (calling party pays and calling party network pays – CPP/CPNP) which involves termination charges and the economic problem of the termination monopoly may be substituted by a system that moves in the direction of a charging by “Bill & Keep”.
- 4) The impact of NGN on quality of service can be derived from the fact that the traffic now is not routed any longer on a specific circuit where all information is contained but that it is separated into different packets which travel different routes in the network. The consequence of this is that the quality of service will only be maintained if the networks used for the transport adhere to a certain degree of quality so that the information decomposed into packets can be composed at the end again and that the receiver has a decent degree of quality of service. This can be a concern especially for real time voice communication.
- 5) The aspect of IP technology also has consequences for lawful interception as the routing of separate packets on different paths poses new challenges for lawful interception. Previous “wiretapping” of voice communications needs to be substituted by solutions that allow intercepting data traffic transmitted by IP technology.
- 6) NGN also plays a role in terms of the migration of networks when one considers mobile and fixed networks. The increasing penetration in mobile technologies and the enhanced capabilities in mobile networks to transmit large amounts of data requires (which is also triggered by enhanced customer premises equipment) that spectrum is being allocated in order to make available these services. In many countries the debate on the digital dividend, i.e. the making available of spectrum that previously was used by broadcasters for mobile broadband technologies has intensified this discussion. It also moves a resource of communication between different business models in the market. Due to the

fact that mobile broadband is bandwidth-hungry, this has a strong impact on the number of market players and also licensing policy with respect for example to the number of operators, the spectrum to be used, and technologies to be used etc.

According to the aforementioned, the migration towards NGN implies that a number of economic and technical aspects in telecommunications networks need to be looked at in more detail. Whether or not they trigger specific regulation is difficult to say from the outset, however, the rules of the game change and some of these changes need to be taken into consideration. Thereby, there are basically two pillars which need further analysis and thought which are

- The impact of NGN on the end-users/customers and potential specific rules on customer protection, security etc.
- The impact of NGN on the competitive landscape especially with respect to changing business models, fiercer competition between previously separated entities and the possibility to offer any type of service via any network (which again can have an impact on licensing policies).

Based in this discussion, the following advantages of migrating to NGN can be identified, which lead to reduced cost, more service and product creation and potentially more competition. The advantages are grouped according to different beneficiaries:

Advantages general	Advantages for Service Providers	Advantages for Consumers
NGN enables the introduction of new converging services as several networks are integrated into one NGN network	Achieving higher economies of scale as new services can be introduced on the network and the traffic can be increased	As IP networks are more efficient (e.g. through higher capacity per network element and cheaper technologies as well as through the more efficient packet based transmission), costs can be reduced (and subsequently prices)
	Utilizing economies of scope as all services are using one	The introduction of new business models and the

Advantages general	Advantages for Service Providers	Advantages for Consumers
	single network, leading to a larger network (and respective network effects) and thereby lower costs per unit, due to the high fraction of fixed costs of telecommunications networks	convergence of existing models implies a potential for more competition and therefore also more innovation
	The innovative network architectures with separated layers facilitates the implementation of new services without changes to the entire network being necessary, which makes the introduction of new services less costly and time consuming	Competition with different infrastructures increases the chances of better quality and lower prices

Table 1: Advantages of migration to NGN

3. REGULATORY INTERVENTIONS

In section two it was concluded that there are several benefits reaped from the implementation of NGN. Due to the fact that the telecommunications industry is regulated, the development towards NGN might have some implications on the regulatory regimes. Such impact might for instance be the following:

- Interconnection: The interconnection between operators is regulated and based on standardization made for TDM and not IP technology. This implies that the migration to NGN will require the interconnection agreements to be changed. As the transition might change the cost structures and the underlying costs, and the tariffs in the interconnection agreements are in most cases regulated, the tariff regulation of interconnection services will have to be adapted.
- In a number of countries, including those within the EU, a competition regulation has been implemented including the obligations for dominant operator to provide certain wholesale offers such as bitstream access. Typically these offers also have regulated tariffs set by regulatory authorities. Due to the transition to NGN networks, these regulated offers will have to be adapted as well, including the interfaces, architectures and tariff regulation. Further, the transition to NGN might lead to more competition, which might lead to less regulation.
- The roll out of NGN gives the operators the opportunities to implement new offers to consumers, which might impact the consumer protection regulation implemented in many countries.
- As stated above, the quality of service mechanisms are different in an NGN world, which might requires changes to the current regulatory regimes.

These issues show that the transition to NGN is relevant for the regulation of telecommunications. The question in this paper is on how and which initiatives regulatory

authorities have implemented with regard to the transition to NGN. In section 3, the activities conducted in Australia, Brazil, Japan, Malaysia, UK and USA with regard to NGN are presented. The countries were selected to give an overview for several continents in order to detect different regulatory approaches.

3.1 Overview of the countries

Australia: The discussion in Australia with respect to Next Generation Networks has focussed on Next Generation Access and the development of a National Broadband Network (NBN). Australia took the decision to build the National Broadband Network (NBN) as a public broadband infrastructure. This implies that under the direction of the government the NBN builds layer 1 and 2 and invests up to 43 bn AUD. The goal was to enable 100 Mbit/s for 90% of the population, and 12 Mbit/s for the last 10%.⁶

The specific measures focused on have had the following characteristics:

- NBN Co builds and operates the network;
- The NBN is owned to >50% by the government;
- Privatization of NBN Co after 5 years of completion of the network;
- Open access, i.e. the network is providing wholesale services to other operators on a non-discriminatory basis;
- The NBN Co does not provide any retail services.⁷

⁶ For the original plans see http://www.minister.dbcde.gov.au/media/media_releases/2009/022 (retrieved 14 November 2010).

⁷ See http://www.minister.dbcde.gov.au/media/media_releases/2010/060, (retrieved 12 April 2011).

The interesting aspect of the approach was that Australia first took the political decision and then validated the plan with an implementation study. In the course of the discussion, some changes were introduced (100 Mbit/s to 93% of Australian premises and 12 Mbit/s to 7%,⁸ wholesale-only layer 2 bitstream access product).⁹ Given the focus on NGA, relatively little information or discussion takes place on NGN core. However, the NBN is still a plan and not yet reality. Many topics are under discussion but not all of them are resolved.

Previously, some activities in the market were reported, e.g., that in 2005, Telstra announced to transform its core infrastructure into a single IP backbone using Multiprotocol Label Switching (MPLS) to carry virtually any type of voice, video or data traffic. In April 2007 Telstra unveiled the network after having invested AUD 1.5 billion to establish this network, which serves over 95% of Australian businesses. Thereby, Telstra is moving to all next-generation networks. Also other operators have initiated Next Generation Networks (NGN) projects with the aim of saving costs and extending the coverage of new services.

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<http://www.nbnco.com.au/wps/wcm/connect/main/site-base/main-areas/our-network/fibre-wireless-and-satellite> (retrieved 14 November 2010). This plan was further refined in spring 2011 to cover 90% of the population by the fibre network and 10% by wireless and satellite technologies.

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<http://www.nbnco.com.au/wps/wcm/connect/main/site-base/main-areas/publications-and-announcements/latest-announcements/nbn-co-response-to-industry-submissions> (retrieved 14 November 2010). In spring 2011 some further specifications were introduced such as an obligatory 12 Mbit/s (download) / 1 Mbit/s (upload) product, the realization of 120 Points of Interconnection for access seekers. The legal framework was created by a National Broadband Network Companies Bill 2010 and a National Broadband Network-Access-Arrangements-Bill 2011.

Incorporating NGN functionality and service delivery options will be a core objective for operators in the medium term. ACMA is particularly interested in the development of standards for the end-to-end quality of service that could serve as a regulatory measure for the performance of IP-based networks and services, and participates in Communications Alliance's IP Quality of Service working groups. Most of the NGN standards work currently being undertaken is associated with architecture and protocols, end-to-end quality of service and security. In fact, very little of these announcements have materialized.

Brazil: In spite of its still low penetration rates, the Brazilian broadband market has displayed strong and continuous growth during the last years including fixed line telecommunications as well as the mobile sector. Due to the deployment of 3G mobile broadband services the latter acts currently as the major driver of growth. NGN development, and thus the necessity of NGN-interconnection arrangements are also fostered by the spread of IP-based services, such as IPTV. Up to now these arrangements are mainly based upon negotiations between operators as there is no specific regulation in place that addresses NGN explicitly. Regulatory interventions with regard to interconnection, cost-modelling etc. have been formulated in the context legacy communication systems. However, at the time of writing, there is a consultation process launched by the NRA, concerning regulatory measures which focus on the strengthening of competition in Brazilian telecommunications markets and which will include additional prescriptions regarding traffic exchange, once they are in place.

Japan: Japan is far advanced compared to other countries not only in Asia but elsewhere when considering the roll out of NGN and also the regulation of issues associated with such developments. These developments have been going on since the last decade of the 20th century and the policy discussions, decisions and regulation are clearly set out in the relevant Ministry of Internal Affairs and Communications (www.soumu.go.jp). Relevant legislation as well as regulatory decisions are made public and translated into English and useful lessons may be learnt from them.

The Japanese telecommunications market has always been dynamic. In this respect the

government provides significant support to ensure a competitive environment in the market. Indeed, the Ministry of Internal Affairs and Communications (MIC) has implemented a series of policies to promote competition in the network business. Important policies that have been witnessed include the unbundling of interoffice dark fibre and subscriber dark fibre of the two incumbent providers in 2001. This policy is considered to be a promotional foundation for competition in the NGN. Apart from infrastructure unbundling, the MIC has implemented some policies regarding NGN unbundling. Since it is concerned with service-based competition, enabling a certain level of QoS, its policies aim towards interconnection arrangements rather than physical network detachment.

Malaysia: Despite a forward looking regulatory regime which is capable to cater to new developments in the telecom arena, the regulator, the Malaysian Communications and Multimedia Commission (MCMC) has acted with great caution and has taken a 'let the markets find a solution first' approach. Developments have therefore been patchy and slow. Nonetheless, with the political push for NGN roll out, steps have been taken, especially in the access networks, that continue to grant applicable standards to the service providers. As in the case of Australia, though, many issues are still under debate and not resolved by now.

UK: As a member of the European Union, the UK transposed the EU-regulatory framework of 1998, 2002, and 2009 into national legislation. The UK regulatory framework for telecommunications is based on market definition, market analysis and application of appropriate remedies. NGN is dealt with in this context.

The UK's position is specifically interesting with regard to NGN as the incumbent operator British Telecom has announced the rollout of its 21st century network (21CN) in June 2004. This is considered as the world wide most ambitious replacement of the traditional PSTN network by a common IP based multi-service network. It was intended to transfer 50% of all customers by 2008. BT has meanwhile changed its plans of the NGN rollout and replaces the PSTN only as and when needed. BT has shifted the focus of its investment to next-generation access ("NGA") infrastructure, with a view to making super-fast broadband services available

in areas covering 40% of the UK's population by the end of 2012.

The British regulator OFCOM was primarily concerned that the rollout of the 21CN does not foreclose competition and established a framework to support the development of NGNs. Main elements of this framework are unbundled network access, equivalence of input, continuity of existing SMP products and compensation arrangements for SMP product migration. Further OFCOM determined that effective industry led processes are required to ensure that the transition to NGNs is successful.

USA: NGN is not a term generally used in the U.S. Therefore, only little information is available on this subject that is directly relevant. As regards access in the National Broadband Plan, the broadband availability target is "Actual download speeds of at least 4 Mbps and actual upload speeds of at least 1 Mbps".¹⁰ That's rather different than what's understood as NGN among leading European or Asian countries. Some innovative Gigafiber projects are ongoing in the U.S. as well.¹¹ It has to be noted that a substantial share of the US population does not have access to broadband at all. Naturally this is also a limiting factor in terms of policy development towards NGN and NGA.

3.2 *Status of NGN implementation*

Taking into account the analysis of the six benchmark countries one can conclude that there is on the one hand a generally different understanding on what NGN contains and on the other hand there are different levels of the development of NGN infrastructures as well as the transition process.

¹⁰ See <http://www.broadband.gov/plan/8-availability>

¹¹ See, e.g. Google Fiber to Communities <http://googlefiberblog.blogspot.com/> and Gig.U. <http://www.gig-u.org/> which deal with next generation access

In **Australia** for instance, IP core networks were a major issue a few years ago (at least for Telstra, the incumbent operator) but no court proceedings have occurred on the 'NGN interconnection' issue. This is because in Australia NGN interconnection is more commercially/operationally seen rather than regulatory or legally. Due to that fact the implementation of NGNs has taken a "normal" development. To underline the latter, in May 2005, a 'primer' on NGN was published indicating that, in the Australian context, the issues seem largely resolved via market forces.¹²

Compared to Australia, **Brazil** is currently more intensely affected by upcoming technological, regulatory and economic challenges that arise from the migration from POTS/PSTN services towards NGN. The status as well as the underlying trends of NGN implementation can be tracked by considering the recent development of fixed broadband statistics. Throughout 2010, the number of broadband connections including ADSL, Pay TV and Radio has increased from 11.87 million by the end of Q1 to 14.49 million by the end of Q4.¹³ Beyond that, mobile broadband networks such as 3G-networks, which allow for IP-based applications, are currently growing at rates of approximately 14% per quarter, thus indicating a major impact of wireless technologies on the deployment of NGN.¹⁴

Up to the end of 2009, IP-interconnection has always been governed by commercial negotiations between operators and was not subject to any specific regulation by the Brazilian regulator. However this situation is currently changing, as the regulatory authority has initiated a consultation regarding the imminent introduction of regulatory measures, inter alia including

¹² http://www.dbcde.gov.au/__data/assets/pdf_file/0004/74083/NGN_Primer_May_05.pdf

¹³ http://www.teleco.com.br/en/en_blarga.asp

¹⁴ http://www.teleco.com.br/en/en_blarga.asp

internet traffic exchange, by means of its “General Plan for Competition” (PGMC).¹⁵

Besides the regulatory framework initiated by the NRA, the national Ministry of Communication has launched a national broadband plan in early 2010 (Plano Nacional de Banda Larga, also known as PNBL), which comprises the establishment of a national backbone network, controlled by the government. The government has appointed the incumbent operator Telebrás to manage the national backbone. In municipalities without competition regarding access of broadband services, additional measures will be taken in order to assure that customers will benefit from efficient prices. The plan foresees the completion of the backbone infrastructure by the end of 2014, ensued by the provision of 160 million broadband connections (thereof 25% via fixed line, 75% wireless) by 2018.

In **Japan** at the moment, the NGN is commercially provided by only the incumbent telecommunications network, which is Nippon Telegraph and Telephone Corporation (NTT). The NGN has been planned to be used as a platform for a variety of packet-based services such as video communication, video delivery, distance learning, teleworking, education and healthcare. Due to high demand for the advanced network, the NTT group provides fee-based interconnections to its NGN at various levels, namely NNI, SNI, and UNI.

Interestingly, no operator has used the unbundling service for NGN even though the network itself has an open access policy as of May 2011. The reason is that the local routers cannot divert all traffic to other networks. Thus, the NGN services can only be provided through NTT’s fibre network. Other providers cannot bypass the traffic via their relay networks. This is a major impediment for NGN competition in Japan.

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[http://sistemas.anatel.gov.br/SACP/Contribuicoes/ListaConsultasContribuicoes.asp?Tipo=1&Opc
ao=
andamento&SISQSmodulo=1442](http://sistemas.anatel.gov.br/SACP/Contribuicoes/ListaConsultasContribuicoes.asp?Tipo=1&Opc
ao=
andamento&SISQSmodulo=1442)

Furthermore many providers are currently more focused on the field of providing FTTH access services to end users. So FTTH has been deployed into new buildings since 2005. December 2006 saw the launch of the NGN field trials by NTT. The Strategy aim was to build a full-IP NGN with optical access, aiming to serve 30 million users by 2010, and invest 2 trillion yen annually in its construction. Meanwhile, competitive access providers from power utilities pursue fibre builds at least in the major metropolitan areas. This does not necessarily mean that all of the players mentioned before are currently deploying and owning fibre networks. In fact, some of them build their business model on fibre purchased from third parties.

The National Broadband Plan of **Malaysia** was already approved by the Government in October 2004. Subsequently, the MyICMS 886 strategy was developed by the Malaysian Communications and Multimedia Commission (MCMC) which also placed an emphasis on broadband and in particular, on high speed broadband.

On 15 May 2008, the Malaysian Government formally announced its decision to implement a national broadband network. The Government also decided to collaborate with Telekom Malaysia Berhad (TM) the country's incumbent operator, to enable a high speed broadband network to be deployed in high impact areas (the HSBB network).

In Malaysia NGN is inextricably linked with the HSBB project. The latter is based on a public private partnership agreement that has been signed in September 2008 by the Government of Malaysia and TM. It includes access, core and international capacity building investments. TM will roll out the HSBB network over a period of ten years and the government will co-invest approximately USD 8 billion over the initial 3 year period and TM approximately USD 3.3 billion over the entire 10 year period.

On 16 September 2008, the Minister of Energy, Water and Communications issued a Ministerial Direction on High-Speed Broadband and Access List, Direction No.1 of 2008 (the Ministerial Direction) under the Communications and Multimedia Act 1988 (CMA). The Ministerial Direction directed the MCMC on the access regulatory framework to be applied to

the TM HSBB network.

OFCOM the **UK** regulator has addressed to the issue of IP interconnection in its market analysis and in various consultations about Next Generation Networks. The market analysis for the fixed narrowband services wholesale market does not include an obligation on BT to provide NGN interconnection. There is no standard offer for IP interconnection, however BT has the obligation to offer access if reasonably requested to do so. Furthermore OFCOM will re-examine the issue of NGN interconnection in its next market analysis.

As in the **USA** NGN is not a term which is part of the overall broadband and new infrastructure discussion. Furthermore there is no clear definition of NGN, however, a recent Notice of Proposed Rulemaking states that the FCC sees advantages in IP interconnection and thus would like to set measures to achieve the migration process.

Issue / Criterion	AUS	BRA	JPN	MAL	UK	USA
Regulated standard offers or commercial offers for NGN interconnection?	No	No	n.a.	n.a.	No	n.a.
Regulatory plans for migration/implementation of NGN interconnection?	No	Yes	n.a.	n.a.	Yes	n.a.
Discussion or regulatory procedures initiated?	No	Yes	Yes	Yes	Yes	Yes
National broadband plan introduced?	Yes	Yes	No	Yes	Yes	Yes

Table 2: Status of NGN discussion in the benchmark countries

What can be derived from this comparison is that the process of development towards NGN is not necessarily one driven by regulation but by the markets. As can be seen in most countries which have experienced first the introduction and later the reduction of sector specific regulation, there are an increasing number of questions as to the extent and timing of regulatory intervention. Most countries have decided to refrain from too early regulation and to rather await market developments. This avoids regulatory failure in the sense of premature

intervention and allows markets to develop solutions which may suffice without regulation.

3.3 *Regulatory policies and regulation*

In **Australia** the focus has been on the deployment for the National Broadband Network in the access area. Concerning NGN, there are general interconnection rules/obligations in the Telecommunications Act and Competition and Consumer Act which apply. In 2004, a paper on the competition impact of voice over IP has been published but no specific provisions or regulations have been issued.

In August 2010 the Minister for Broadband, Communications and the Digital Economy proposed amendments to the Telecommunications (Low-Impact Facilities) Determination 1997 and the Telecommunications Regulations 2001 for public comment. The proposed amendments will facilitate the rollout of the National Broadband Network. This process is currently still ongoing.

Furthermore a special legislative framework for the NBN has been created¹⁶ consisting of the NBN Companies Act and the Telecommunications Legislation Amendment. The NBN Companies Act sets out key obligations that limit NBN Co to, and focus it on, wholesale-only telecommunications. It states that the Australian Government must retain full ownership of NBN Co until the NBN rollout is complete. This will give the government greater flexibility to pursue its objectives in the roll out of the network. Finally the NBN Access Act amends the Competition and Consumer Act 2010 (CCA), the Telecommunications Act 1997 (Tel Act) and the FOI Act to provide a regulatory framework for the NBN which is appropriate to its unique role.

The NBN Access Act also authorises, for the purposes of the CCA, certain conduct of NBN Co

¹⁶ See http://www.dbcde.gov.au/broadband/national_broadband_network/nbn_legislative_framework

that is necessary to achieve uniform national wholesale pricing. This conduct relates to the prohibition of interconnection to points of interconnection that are not listed, the bundling of services and cross-subsidising in charging for services. These authorisations are subject to review. Additionally, the requirement for both NBN Co and the ACCC to agree to any change to its list of points of interconnection expires when the NBN is built and fully operational.

NBN Co is subject to supply, equivalence and transparency obligations that will ensure it can provide a robust platform for vigorous retail competition. NBN Co's access arrangements are based on the telecommunications access regime that is already in place under the CCA, meaning that the Australian Competition and Consumer Commission (ACCC) will have powers to release access determinations and binding rules of conduct in relation to NBN Co's supply of services, and that NBN Co also has the option of giving the ACCC a Special Access Undertaking in relation to its services. As can be seen from these initiatives and steps, the process in Australia is still at an early stage and therefore, more detailed provisions with respect to NGN, access, interconnection etc. have not yet been issued.

The **Brazilian** regulator ANATEL has released several decrees. Regarding interconnection three documents could be identified, containing relevant information regarding regulation of interconnection. As there are no specific regulations for NGN in place, the related documents were created in the light of PSTN/POTS regulation and can be consulted following the weblinks below:

Mobile interconnection (2006)

- <http://www.anatel.gov.br/Portal/exibirPortalRedireciona.do?caminhoRel=Cidadao-Biblioteca-Acervo%20Documental&codigoDocumento=122954>.

Fixed line interconnection (2007)

- <http://www.anatel.gov.br/Portal/exibirPortalRedireciona.do?caminhoRel=Cidadao-Biblioteca-Acervo%20Documental&codigoDocumento=139467>.

The development of broadband infrastructure has steadily proceeded in **Japan**, but has been

delayed in some areas of poor reception due to lower investment efficiency. The Telecommunications Bureau organised "Strategic Meetings for Bridging the Digital Divide" from October 2007 to June 2008. Based on the reports from these meetings, "Strategies for Bridging the Digital Divide" were established in June 2008, with policies developed to eliminate the digital divide as soon as possible. For the development of broadband infrastructure, these strategies target the establishment of broadband in all regions lacking broadband capability. To achieve these development goals, broadband infrastructure was to be developed through "composite" projects that promote broadband infrastructure and mobile phone area development for the integrated development of environments by using satellite broadband in areas where other types of broadband infrastructure are difficult to develop. For the development of ultra-fast broadband infrastructure, approaches like supporting carriers and municipalities in developing fibre optic networks and introducing ultra-fast broadband in cable television networks were to be promoted.

For the development of mobile phone areas, support was provided in order to eliminate service dead zones for mobile phones by eliminating shares of burdens held by municipalities and private businesses through a higher percentage of government subsidies granted for supported projects or by easing the requirements for adopting and promoting efforts towards developing new technologies that may contribute to the development of areas facing severe conditions.¹⁷

The overarching policy in **Malaysia** has been the introduction of the Communications and Multimedia Act 1998 (CMA) which prepares for a new regulatory set up which acknowledges convergence and allows for a model of regulation covering both traditional telecommunications and broadcasting and new multimedia applications (for example based on NGN).

¹⁷ See Telecom Bureau at www.soumu.jp

The major regulatory and policy instrument that addresses NGN is the new licensing framework enabled by and implemented with the introduction of the CMA. Following the introduction of the CMA on 1 April 1999, a new convergent licensing framework has been introduced. No more telecom or broadcasting licences are now issued. Instead, the licences are technology neutral and cover the following four categories of activities: network facilities provider (NFP), network service provider (NSP), applications service provider (ASP) and content applications service provider (CASP) licences.

There are two categories i.e. individual licences which have to be applied for and are subject to Ministerial approval and class licences for which qualified persons need only register. The details of the licensing processes may be found in the Licensing Regulations 2000.¹⁸

Beyond that, the CMA defines 'access' as access to the facilities and services included in the Access List (see sections 6 and 145 of the CMA) and also includes 'other facilities and services which facilitate the provision of network services or applications services, including content applications services'. This means matters such as access to a tower for installation of mobile telephony or broadcast equipment could also be covered by the Access List. Access regulation (which includes interconnection) is intended to promote competition in the markets. The default position of the access regime under the CMA is determined by commercial negotiation between the relevant parties.

All NFP and NSP are obliged to supply access to their facilities and services which are included in the Access List (Access Providers). ASPs and CASPs have no such obligation. Seekers of access include NFPs, NSPs, ASPs and CASPs (Access Seekers). The inclusion of a facility or service in the Access List imposes the obligation on Access Providers to offer non-discriminatory access to Access Seekers (see section 149). This is called the standard

¹⁸ See: www.skmm.gov.my/index.php?c=public&v=art_view&art_id=30 and www.skmm.gov.my/link_file/Admin/FactsandFigures?Paper/62751407Info-Licence-new.pdf.

access obligation (SAO).

For facilities and services included in the Access List, parties have to enter into Access Agreements which must be registered with the MCMC in accordance with sections 150, 90 and 91 of the CMA. Only access agreements that have been registered can be enforced. The MCMC has power to direct any party to an access agreement to comply with its terms.

The Industry Forum on Access (the Access Forum) is empowered to develop an Access Code that sets out the model terms and conditions for compliance with the SAO. The MCMC may not register an access code unless it is satisfied that it is consistent with the SAOs.

A licensee has the option of giving an undertaking on the terms and conditions of access to a listed facility or service, in accordance with sections 110 and 155 of the CMA. Consistent with the criteria for registration of an access code, the SKMM must be satisfied that the undertaking is consistent with the SAOs.

The MCMC has also issued a mandatory standard on access (the MS on Access). Once a facility or service is included on the Access List, the process and timelines specified under the MS on Access such as the access request, forecasting obligation etc would need to be adhered to by the Access Providers and Access Seekers. Annexure A of the MS on Access also contains Dispute Resolution Procedures.

In **UK**, triggered by the announcement of BT to replace their voice and data network by a common IP based multi-service network, OFCOM has issued various consultations about the appropriate regulatory framework for Next Generation Networks. The main policy and regulatory documents are:

- Consultation: Next Generation Networks; future arrangements for access and interconnection, published 25. November 2004: This was the first consultation triggered by BT's announcement of the 21CN project. OFCOM analysed the application of the regulatory principles to Next Generation Networks. In this consultation the potential regulatory issues have been explored.

- Further Consultation: Next Generation networks; further consultation, published 30 June 2005: In this consultation OFCOM aim to establish a regulatory framework to address the issues explored in the previous consultation and to support the development of NGNs. In addition OFCOM stated that there needs to be effective industry led processes to ensure that the transition to NGNs is successful.
- Statement: Next Generation Networks; developing the regulatory framework, published 7 March 2006: One of the main issues was to ensure that BT's 21CN does not foreclose competition. In September 2005 BT agreed to undertakings in lieu of a reference under the Enterprise Act 2002 to support these aims including commitments to provide unbundled network access on an "equivalence of inputs" basis. This is also known as structural separation of BT and the founding of BT open reach. In this statement OFCOM focussed on an improved framework for industry engagement and on greater certainty as to the application of the ex-ante competition regime.
- A new industry body NGN UK was launched. Its purpose is to ensure that the UK telecoms industry moves forward in step on NGN development. The essential role of NICC in relation to technical aspects of network interoperability has been underlined.
- Consultation: Next Generation Networks; responding to recent developments to protect consumers, promote effective competition and secure efficient investment, published 31 July 2009: Based on practical experiences with the roll-out of NGNs OFCOM has initiated this consultation. OFCOM states: *"... it has become apparent that the move to NGNs is not likely to occur as the step change that was once expected. It now seems more likely that NGNs will be adopted gradually, forming part of the wider evolution of network technologies, and with many opportunities for changes in direction along the way."* (para 1.3). The main changes observed in the market are that investment has shifted from NGN to NGA.
- Statement: Next Generation Networks; responding to recent developments to protect consumers, promote effective competition and secure efficient investment, published 28 January 2010: In this statement OFCOM reiterates its policy objectives for NGN: to

provide incentives for efficient investment in NGNs, to promote effective competition based on NGN infrastructure; and to protect consumers from disruption during the transition to NGNs. The statement does not make regulatory decisions but sets out the current think of OFCOM with respect to the issues raised in the consultation.

Triggered by the early announcement of BT to replace its network by an NGN, OFCOM has explored the impact of NGN thoroughly. Possible remedies like WVC (Wholesale voice connect) and xMPF (a metallic path facility for voice only) have been evaluated. Due to the shifted investment focus these have not materialized yet. Regulatory remedies have however been introduced in the WLA market in response to the roll-out of superfast broadband based on optical fibre. The industry has produced IP-interconnection standards that might be deployed based on commercial negotiations.

In the **USA** many pro-competitive regulatory instruments were eliminated during the George W. Bush years. The FCC Triennial Review (2003) eliminated most LLU requirements for fibre. Results have been mixed at best.

- Withdrawal of pro-competitive regulation has largely wiped out intra-modal competitors.
- Fibre deployments are impressive, but selective. It is difficult to see how the US might get beyond “cream skimming” deployments.
- A \$7 billion short term programme to expand coverage in unserved, underserved and/or rural areas.
- A National Broadband Plan (NBP) that seeks to provide broadband to all Americans.
- The former plan was funded, but is really about broadband coverage, not about NGA.
- For the latter plan, the difficult steps are all in the future. The plan essentially ignores the question of whether a competitive environment is needed in the US. Few of the concrete measures relate to NGA be implemented.

With respect to IP Interconnection, the Federal Communications Commission released on 18

November 2011 a report an order and further notice of proposed rulemaking (FNPRM) with respect to the Connect America Fund, A National Broadband Plan for Our Future and issues of Universal Service Support and Unified Intercarrier Compensation Regime.¹⁹ Comments on this document were open until 17 February 2012. The document addresses a broad range of issues with respect to technical as well as economic aspects of the rollout of broadband networks and the question of universal service. The link towards issues of interconnection, most specifically IP interconnection are in the intercarrier compensation regime due to the fact that Voice over IP issues are integrated into the discussion about interconnection and intercarrier compensation which is regulated in the United States in a quite specific way. In the document (No. 783) the FCC states that it believes that an end point of a low uniform per minute rate perpetuates the use of TDM networks, whereas the FCC's goal is to facilitate the transition to an all-IP network and to promote IP-to-IP interconnection. Due to the regulation of voice interconnection in the United States and its connection to areas where network rollout incurs significant costs, the question of IP Interconnection is therefore highly relevant. The FCC finds that the charging mechanism including a transition of inter-carrier compensation to a bill-and-keep mechanism with an accompanying federal recovery mechanism, best advances the policy goals of accelerating the migration to all IP networks and also facilitates IP-to-IP Interconnection. The FCC however, sees this as the start of a process and therefore is still in the process of laying out further specific elements that need to be contained in a policy framework for IP-to-IP Interconnection. This is contained in a further notice of proposed rulemaking (FNPRM).

¹⁹ FCC, in the Matter of Connect America Fund, A National Broadband Plan for Our Future, Establishing Just and Reasonable Rates for Local Exchange Carriers, High-Cost Universal Service Support, Developing an Unified Intercarrier Compensation Regime, Federal-State Joint Board on Universal Service, Lifeline and Link-Up, Universal Service Reform – Mobility Fund, see http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0206/FCC-11-161A1.pdf

As a general aspect, the FCC refers due to the fact that it has set the goal to move towards IP-to-IP Interconnection and that this is also contained as a recommendation in 4.10 of the national broadband plan. However, a specific step to promote this transition towards IP-to-IP Interconnection has not yet been made and the FCC struggles with a number of issues relating to this aspect, for example migration costs and possible arbitrage behaviour in the transition phase. Therefore, many of the relevant issues have not yet been addressed in the US context. In summary, the FCC notes:

“The voice communications marketplace is currently transitioning from traditional circuit-switched telephone service to the use of IP services. There are conflicting views regarding what role interconnection requirements should play in an increasingly IP-centric voice communications market. Some competitive providers seek to ensure that existing interconnection protections continue to apply as voice traffic migrates from TDM to IP. Other providers see various shortcomings in existing interconnection regimes, and advocate a modified regulatory approach for IP-to-IP interconnection that they believe would result in improvements over the existing regimes. Similarly, other providers seek to have interconnection requirements imposed more broadly than just for voice services. Even some smaller incumbent LECs cite concerns about a lack of negotiating leverage relative to other providers in the absence of a right to IP-to-IP interconnection.” (No. 1339)

The main aspect that the FCC believes motivates a move towards IP-to-IP Interconnection is that the inter-carrier compensation regime moves away from any “termination rates” and is only based on bill-and-keep as a charging mechanism.

In the United States, the question, whether interconnection can be ordered as a form of access relates to the content of section 251 of the Telecommunications Act. Therefore, the FCC also seeks comments on the proposals to require IP-to-IP Interconnection in particular circumstances under different policy frameworks. In this regard, the FCC observes that section 251 of the Act is one of the key provision specifying interconnection requirements and that its interconnection requirements are technology neutral which means that they do not vary based on whether one or both of the interconnecting providers is using TDM, IP or another technology in the underlying networks. Therefore, one of the questions the FCC faces is rather they are at all entitled to lay down a specific IP-to-IP Interconnection policy framework.

An important aspect of the FCCs policy is that the framework they say set up should be “narrowly tailored to avoid intervention in areas where the marketplace will operate efficiently”. This is very clear sign of the US policy only to regulated areas where the market does not functioned probably. This also implies that the intensity of regulatory intervention regarding IP-to-IP Interconnection is rather small. The idea is more to set a framework that motivates carriers to move to IP-to-IP Interconnection agreements on a market based solution.

One important element of discussion in the document is whether IP-to-IP Interconnection should relate to voice services or also to other services there in any form of other exchange of traffic and information (data etc.). The FCC has not decided on that issue yet.

With respect to IP-to-IP Interconnection the FCC clearly states that they see a requirement to negotiate in good faith should any party wish to implement IP-to-IP interconnection. Good faith negotiations are prerecorded for any regulatory intervention in case the negotiations do not lead to a result for both sides. In No. 1359 of the document it becomes clear that the FCC has not yet defined and found its role regarding IP-to-IP interconnection. The following aspects are discussed with the respect to measures to encourage efficient IP-to-IP interconnection:

- Responsibility for the Costs of IP-to-TDM Conversions (No.1361). The FCC refers to comments received which have proposed that carriers electing TDM interconnection should be responsible for the costs associated with the IP-TDM conversion. In particular, commenters contend that carriers that require such conversion, sometimes despite the fact that they have deployed IP networks themselves, effectively raise the costs of their competitors that have migrated to IP networks. If a carrier that has deployed an IP network receives a request to interconnect in IP, but, chooses to require TDM interconnection, the FCC proposes to require that the costs of the conversion from IP to TDM should be borne by the carrier that elected TDM interconnection.
- Possible measures of the commission to ensure the rates associated with those functionalities remain reasonable, and under which regulatory framework
- Direct vs. indirect Interconnection of IP networks
- Scope of Issues to Address Under Different Policy Frameworks Requiring IP-to-IP Interconnection: The FCC seeks comments on the general scope of the FCCs appropriate role concerning IP-to-IP interconnection, subject to certain baseline requirements. For example, if the baseline only extended to certain terms and

conditions, would providers have adequate incentives to negotiate reasonable IP-to-IP interconnection rates? What specific terms and conditions would need to be subject to the policy framework, and which could be left entirely to marketplace negotiations? These questions demonstrate that the discussion on IP-to-IP interconnection is rather at the beginning and it is guided by the regulatory principal of only intervening in cases where market failure is visible and not where market based solutions are available. Thus, the overall policy is not directly on forcing the market to migrate to IP-to-IP interconnection but to set the motivations and policy frameworks that this becomes possible by itself. There is no agenda or masterplan to orchestrate such transition.

- Another issue is the location of points of interconnection. The commission asks itself which factor it should consider in evaluating possible policy framework for physical points of interconnection, such as the appropriate burden each provider bears regarding the cost of transporting traffic.
- The FCC is uncertain whether it is entitled to require incumbent local exchange carriers to directly interconnect on the basis of IP-to-IP. This is a legal question regarding the interpretation of section 251 of the Telecommunications Act.
- The FCC is concerned by the fact that many providers interconnect indirectly today, and some commenters anticipate that indirect interconnection will remain important in an IP environment. This means that IP-to-IP interconnection between any two parties would be indirect and therefore specific considerations have to be made where in terms of the existence of TDM based networks in between.

Altogether the FCC is mostly concerned with the question of the legal basis in the content of any regulatory requirement to provide IP-to-IP interconnection. It mostly deals with questions on the legality of ordering IP interconnection possibly under the current rules of the telecommunications act. This also implies that any further considerations regarding IP interconnection such as requirements on quality of service levels, requiring a certain time frame, discussing the question of security and legal interception are not of relevance in the US as of today as the discussion on IP interconnection is just starting.

There are some further aspects which are related to Voice over IP such as call signalling rules and the move towards are of relevance and that the main questions are in the issue of regulatory or technical issues.

In the regulatory flexibility analyses, the FCC comes to the following conclusion regarding IP-to-IP interconnection:

- “We conclude that a uniform, national framework for the transition of intercarrier compensation to bill-and-keep, with an accompanying federal recovery mechanism, best advances our policy goals of accelerating the migration to all IP networks, facilitating IP-to-IP interconnection, and promoting deployment of new broadband networks by providing certainty and predictability to carriers and investors. We adopt a gradual transition for terminating access, providing price cap carriers six years and rate-of-return carriers nine years to reach the end state. We believe that initially focusing the bill-and-keep transition on terminating access rates will allow a more manageable process and will focus reform where some of the most pressing problems, such as access charge arbitrage, currently arise. The transition we adopt sets a default framework, leaving carriers free to enter into negotiated agreements that allow for different terms.” (No. 26)

“Finally, recognizing that IP interconnection between providers is critical, we agree with the record that, as the industry transitions to all IP networks, carriers should begin planning for the transition to all-IP networks, and that such a transition will likely be appropriate before the completion of the intercarrier compensation phase down. Even while our FNPRM is pending, we expect all carriers to negotiate in good faith in response to requests for IP-to-IP interconnection for the exchange of voice traffic. The duty to negotiate in good faith has been a longstanding element of interconnection requirements under the Communications Act and does not depend upon the network technology underlying the interconnection, whether TDM, IP, or otherwise.” (No. 37).

Summing up, the authorities of all benchmark countries – ministries, regulators and other commissions and authorities – have released several acts, decrees, policies or regulations to promote the deployment of new infrastructures. These do not only focus on NGN core networks but also on NGA infrastructures. Nevertheless, the existence of such policy documents does not necessarily imply that a high level of details is addressed. On the contrary, the regulation of NGN is in most countries yet to be developed in detail.

Issue / Criterion	AUS	BRA	JPN	MAL	UK	USA
Regulatory policy documents available?	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: Availability of regulatory policy documents

3.4 Other issues

In **Brazil**, **UK** and the **USA** no further information or issues related to the NGN transition process are available.

There are several convergence issues in **Australia**, i.e. a change from circuit to packet switched technology, the integration of NGN and NGA as well as media and content convergence. None of these are specifically addressed in the Act but in working papers and industry working groups.

The ACCC can declare any service to become subject to regulation by designation and lay out within the service description which features have to be provided. Therefore, also technical changes can be embodied in such designations. With the deployment of the National Broadband Network new technologies are being introduced and the change from circuit switched to packet switched technology is thus implicitly covered by the regulatory approach.

The situation in Australia is amongst others characterised by the fact that the government has decided to invest heavily into the roll-out of fibre networks. The national broadband network is one of the biggest projects in Australia's history. This NBN (see http://www.dbcde.gov.au/broadband/national_broadband_network) which brings a new player to the market of course has to interact with other existing networks. Therefore, the government has also investigated its possibilities to cope with this challenge. The relevant provisions regarding NBN are laid down in a specific National Broadband Network Company's Bill from 2010 which also deals with the access arrangements for that network. The background is that for NBN it is intended to be operated as an open access network to which providers of retail services shall have access.

The approach in Australia is itself technology neutral, although this has not been stated

explicitly. Convergence aspects are covered including access to transmission towers for mobile networks and wholesale products for the National Broadband Network (NBN).

The interconnection and access framework addresses to all kinds of infrastructures (fixed, wireless) and has developed provisions and regulatory frameworks for access and interconnection irrespective of the technology used.

Japan issued an explicit law regarding the improvement and penetration of new infrastructure and services (Provisional Measures Law for Telecommunications Infrastructure Improvement). The regulatory framework explicitly addresses the issue of convergence and the roll-out of infrastructure that contributes to the formation of an advanced information and telecommunications network society, by improving and constructing an infrastructure that facilitates the flow of information, through adoption of measures for promoting the construction of advanced telecommunications facilities, facilities to improve reliability and advanced cable television broadcasting facilities, as well as measures for improving personnel abilities engaged in specified expert work.

In terms of NGN, there is room for resolution policy in two priority issues. First, according to the fact that the government has succeeded in nationwide-infrastructure development for ultra-high speed Internet connection, it may seem optimistic regarding the promotion of NGN and its services. Nevertheless, a big problem has remained as the utilization of such Internet service is only 30% compared to the approximate coverage of 90% in 2010. Since NGN is based on the ultra-high speed technology, there is obviously a problem of low demand for NGN services. This can raise some concerns over profitability and market opportunity for the NGN service provider resulting in non-ubiquitous provision and utilization. Second, it is indeed the technical difficulty that hinders competition in NGN market, not to mention there is only one provider of NGN services at the moment.

The incumbent NTT group has been providing NGN services for commercial purposes for a while also providing interconnection services to a certain extent as it claims that the current underlying technology does not allow for other operators to bypass the company's network.

Some recommendations arise from urgent establishment of NGN standardization in order to ensure efficient interconnection, which will result in free and fair competition within the market. In fact, Japanese the telecommunications market has been developed by competition-promotional policies such as unbundling and co-location since the copper era. Such the policy is believed to generate similar effects on the NGN market. With full-scale interconnection along with unbundling policies for NGN, there will be more service providers.

Each of them will forcefully compete for subscribers resulting in a variety of applications and contents to serve different individuals. The utilization paradox will be eliminated.

The HSBB network in **Malaysia** is being rolled out by TM which thereby effectively becomes dominant in the HSBB network area. Under the CMA, it is possible for the MCMC to determine that TM is dominant in this field and thereby apply stricter competition rules to minimise abuse of its position.

Although no steps have been formally announced, it may well be the next step in the regulation of TM's HSBB network and services and thereby NGN in Malaysia.

4. DISCUSSION

This paper has looked at the migration to NGN and the regulatory initiatives taken with regard to this migration. When it comes to the reasons for the migration to NGN, there are several factors that drive the development:

- Increased efficiency resulting in costs savings and thereby increased welfare:
 - Economies of scale and scope due to the integration of all telecommunications traffic of an operator into one network.
 - Cost reductions due to the efficiency of IP compared to circuit switched network technologies
- NGN networks are more flexible enabling the service providers to react quicker. As a consequence, the costs and the time to market for new services can be reduced.
- NGN enables new business models due to the network architecture and the principle of All-IP networks.

The resulting development towards Next Generation Networks implies changes to the regulatory environment:

- 1) The implementation of interconnection will change. Due to the implementation of IP transmission, large amount of data and due to the increase of internet penetration IP-peering and transit become more and more relevant and also voice over IP applications might be handled in this similar way.
- 2) The charging for interconnection might change, i.e. due to the fact that in the NGN core network the operational expenditures are significantly lower, which could imply that the current charging regime (calling party pays and calling party network pays – CPP/CPNP) may be substituted by a system such as “Bill & Keep”.

- 3) The quality of service becomes an issue for regulation regarding traffic routed through two or more networks. The traffic now not routed on a specific circuit with low complexity regarding QoS will be replaced by a more dynamic routing where traffic is routed separated into different packets which travel different routes in the network. This can be a concern especially for real time voice communication.
- 4) The aspect of IP technology also has consequences for lawful interception as the routing of separate packets on different paths poses new challenges for lawful interception.

In section three, the regulatory development associated with NGN was highlighted in six countries including Australia, Brazil, Japan, Malaysia, UK and USA. What can be derived from this comparison is that the process of development towards NGN is not necessarily one driven by regulation but by the markets. As can be seen in most countries which have experienced first the introduction and later the reduction of sector specific regulation, there are an increasing number of questions as to the extent and timing of regulatory intervention. Most countries have decided to refrain from too early regulation and to rather await market developments. This avoids regulatory failure in the sense of premature intervention and allows markets to develop solutions which may suffice without regulation.

The regulatory authorities in all benchmark countries (including ministries, regulators and other commissions and authorities) have released several acts, decrees, policies or regulations to promote the deployment of new infrastructures. These do not only focus on NGN core networks but also on NGA infrastructures. Nevertheless, the existence of such policy documents does not necessarily imply that a high level of details is addressed. On the contrary, with regard to the specific challenges to be dealt with including new interconnection regimes, the tariff regulation, quality of service regulation etc., the regulation of NGN is in most countries yet to be developed. E.g. in none of the countries there is a regulated reference offer for IP Interconnection. In US though, FCC has actively started the work on adapting the regulatory framework to deal with IP-to-IP-Interconnection.

5. BIBLIOGRAPHICAL NOTES

Darvishan, A.; Yeganeh, H.; Bamasian, K.; Eghtedari, P.: "A Practical NGN Model By Evaluation of Various NGN Solutions and its Conformance with IMS-TISPAN", Ubiquitous Information Technologies & Applications, 2009. ICUT '09, Fukuoka, Japan. Proceedings of the 4th International Conference, pp.1-5, 20-22 December 2009 doi: 10.1109/ICUT.2009.5405726

European Parliament, Directorate-General for Internal Policies: Next Generation Networks (NGN); 2009

FAQ at www.skmm.gov.my/index.php?c=public&v=art_view&art_id=75.

Gig.U. <http://www.gig-u.org/>

Google Fiber to Communities, <http://googlefiberblog.blogspot.com/>

<http://sistemas.anatel.gov.br/SACP/Contribuicoes/ListaConsultasContribuicoes.asp?Tipo=1&Opcao=andamento&SISQSmodulo=1442>

http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0206/FCC-11-161A1.pdf

<http://www.broadband.gov/plan/8-availability>

http://www.dbcde.gov.au/__data/assets/pdf_file/0004/74083/NGN_Primer_May_05.pdf

http://www.dbcde.gov.au/broadband/national_broadband_network/nbn_legislative_framework

<http://www.fcc.gov/encyclopedia/information>

http://www.minister.dbcde.gov.au/media/media_releases/2009/022 (retrieved 14 November 2010).

http://www.minister.dbcde.gov.au/media/media_releases/2010/060, (retrieved 12 April 2011).

<http://www.nbnco.com.au/wps/wcm/connect/main/site-base/main-areas/our-network/fibre-wir>

eless-and-satellite (retrieved 14 November 2010).

http://www.teleco.com.br/en/en_blarga.asp

OECD: Convergence and Next Generation Networks, DSTI/ICCP/CISP(2007)2/FINAL, June 2008

Telecom Bureau at www.soumu.jp

www.skmm.gov.my/index.php?c=public&v=art_view&art_id=124.

www.skmm.gov.my/index.php?c=public&v=art_view&art_id=30

www.skmm.gov.my/link_file/Admin/FactsandFigures?Paper/62751407Info-Licence-new.pdf.

www.soumu.go.jp/s-news/2004/pdf/040305_6_b1.pdf and

www.soumu.go.jp/main_sosiki/joho_tsusin/eng/Releases/Newsletter/Vol14/Vol14_24/Vol14_24.pdf

www.soumu.jp/johotsusintokey/whitepaper/eng/WP2010_index.html