Discussion Paper on Next Generation Networks

24 December 2008

Table of Contents

Executive Summary

Purpose of the Paper

In March 2008 the Commission commenced a study under Section 9A of the Telecommunications Act 2001 into Next Generation Networks (NGNs). The objective of the study is to establish an understanding of the opportunities and challenges of investment in NGN.

Section 9A(1) (b) provides that the Commission

> *may conduct inquiries, reviews, and studies (including international benchmarking) into any matter relating to the telecommunications industry or the long-term-benefit of end users of telecommunications services within New Zealand.*

The Terms of Reference of the NGN study indicate that the final study will:

- Provide a strategic assessment of the likely impact of technological change on market structure and competition;
- Provide guidance as to where regulatory intervention is unlikely to be warranted, and circumstances where regulation may be considered; and
- Identify the issues where there is consensus, and where and how views diverge.

The study comprises of five work streams:

- Industry questionnaire and consultation to ascertain the current state of NGN deployment in New Zealand and understand any issues the industry may have;
- Discussion Paper on drivers and implications;
- NGN Conference entitled "Broadband at a Crossroads" in Auckland on 26 & 27 February 2009;
- Draft NGN study report by the end of April 2009; and
- Final NGN study report by the end of June 2009.

The responses to the Commission's industry questionnaire have provided some guidance from stakeholders as to where the Commission can best add value in considering next generation network issues. Submissions have largely, although not exclusively, focused on regulatory issues, although there was a wide spectrum of views on the appropriate regulatory paradigm for NGNs.

The Discussion Paper provides additional information which will assist in assessing the likely impact of technological change on market structure and competition, and seeks comments from stakeholders. While there is some discussion of regulatory issues, the paper is not intended to present views on NGN regulation. The Commission is gathering additional information before scoping its views on the likely competitive environment in the draft NGN Study. The submissions already received on the industry questionnaire and the responses to the questions raised in this paper will be used in conjunction with analysis being undertaken by the Commission, as input to the final study report.

The Commission notes that there are already developments in the market and the regulatory environment that reflect the deployment of NGN. A number of players in the New Zealand market already operate NGNs. Telecom New Zealand has made a significant commitment to rolling out a fibre-to-the-node network, and has a migration plan for moving to an all IP network. The Commission is currently considering submissions on its draft Standard Terms Determinations on Sub Loop Services.

However, the Commission considers that there is value at this stage in identifying and seeking feedback on principles to take into account in the transition to next generation services:

- the scope for competition for the long term benefit of end users should be preserved and enhanced where possible in a next generation environment;

- incentives to invest in next generation infrastructure, including access networks, as well as applications and services, should be preserved;

- industry self regulation should be encouraged, where this mechanism can deal effectively with next generation network issues, particularly in relation to technical issues;

- regulation should be considered only where necessary to constrain market power - where, for example, it is conferred by control over bottlenecks;

- regulation should be scaled back as workable and effective competition develops.

The Commission seeks feedback from industry about whether these core principles provide a useful underpinning for considering these issues, or whether they should be modified or supplemented.

Next Generation Networks and the Drivers

From a policy perspective the term NGN is a concept which relates to several parts of a layered packet switched {all IP (Internet Protocol)} network. Their development enables different services, which previously could only be offered over purpose built networks, to be seamlessly provided over multiple platforms interactively.

The shift to digital technology and the subsequent convergence of markets, services and devices over which services can be delivered is a key driver for the deployment of NGN. The UK Telecommunication's regulator, Ofcom defined convergence as:

"The ability of consumers to obtain multiple services to a single platform or device or obtain any given service on multiple platforms or device".

Ofcom further stated that:

"Convergence is bringing sweeping changes to our communications markets, fuelling new patterns of demand amongst consumers and changing traditional business models. It is already brings great opportunities to consumers and to business. It is reshaping our communications markets and is at once both an exciting and complicated phenomenon. ……Convergence is all around us – mobile phones with video, radio and internet, radio over TV platforms and internet and TV over mobile platforms including digital radio and the internet – all facilitated by the move to digital technologies"[1].

The specific deployment strategies and types of network deployed vary between countries according to the competitive, economic, technological, social, and government influences of each country. While there are both supply and demand side drivers for NGN, it has been consistently recognised across international markets that the costs of NGN deployment are high. In particular, the investment required in the next generation access network technology required to support the high speed and high-quality data carriage will often be substantial, and certain areas may be unlikely to be economic to duplicate. A major consideration for regulators has therefore been how to balance the need to provide incentives for investments in an NGN, whilst still promoting competition in telecommunications markets. The choice of technology, the design of the network and how early consultation with potential access seekers occurs, all play a role in attempting to facilitate this balance.

Another common theme in the deployment of NGNs is the mis-alignment between the parties that bear the costs of investment, and those who receive the commercial and social benefits of the services that NGN makes available. This is particularly so as more user generated content and distribution occurs or where the services are related to community and social objectives. Other themes included new entrants being constrained by lack

[1] What is Convergence? Ofcom submission to the Convergence Think Tank, December 2007.

of access to premium content, and the uncertainty surrounding what content and services end users will want to pay for.

All of these factors are relevant to New Zealand as next generation core networks are already in existence today and the focus is now shifting to the next generation access networks. While there are lessons that we can learn from overseas jurisdictions the drivers for deployment of access and core networks in New Zealand need to be considered within the context of the New Zealand market and conditions.

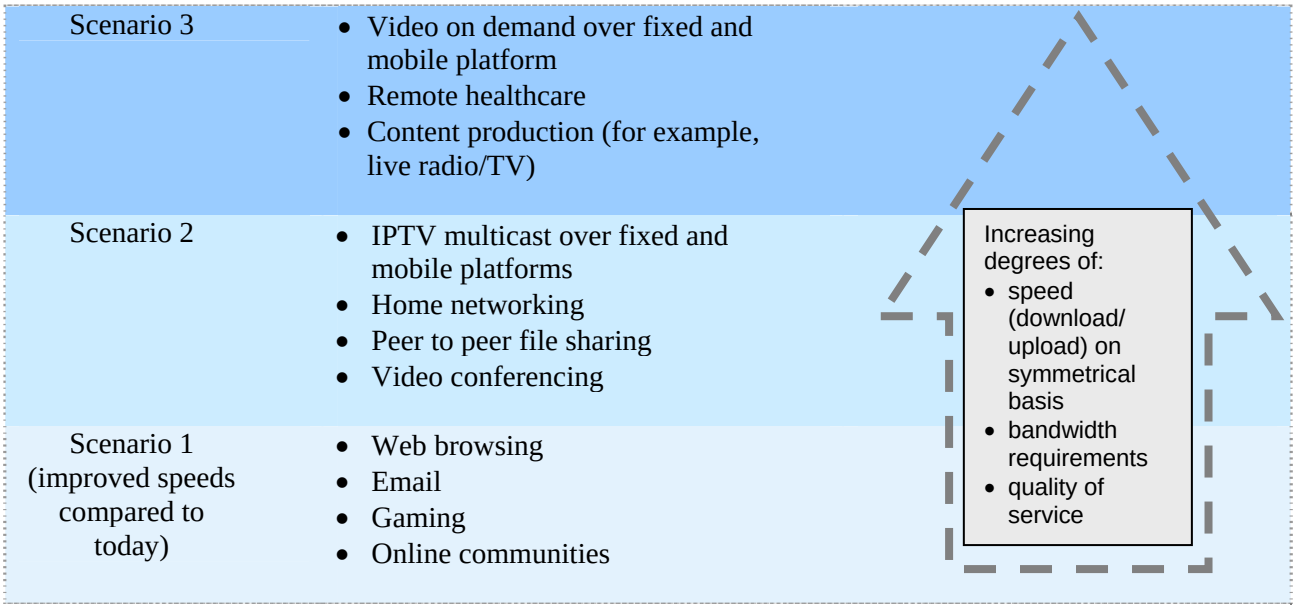
This process is part of a continuum. The developments today will rapidly shift the current and future market outcomes. It is therefore important an informed debate takes place to ensure investments in NGN deliver efficient results.

Commission Approach

To assist the thinking an analysis of the development of NGNs in New Zealand the Commission intends to evaluate potential market outcomes using scenarios of likely services and seeks input into both the approach and whether it will adequately capture the possible outcomes.

Four scenarios are considered. Three scenarios of commercial service increments of increasing speed and bandwidth requirements likely to be delivered on networks where commercial investment is the principle driver and a fourth scenario where the services take into consideration that the network rollout is not driven primarily by commercial factors (e.g., a public subsidised network).

The three scenarios of commercial service increments being considered are:



The report includes a brief overview of the impact of NGN deployment and analysis of the potential implications based on the various scenarios. Likely implications discussed in this Paper relate to the changes to the value chain, competitive environment, demand for capacity, quality of service, costs, interconnection and access.

Next Steps

The Commission is very interested in the views of all stakeholders about the issues raised in this Discussion Paper. It is seeking to be informed by all of the current activities that are occurring relating to the NGN in New Zealand.

Central to these will be a NGN conference which will be held on 26 and 27 February 2009 in Auckland. This is designed to facilitate robust market discussions on NGN issues by providing a range of national and international views and a forum for discussion.

The Commission also has a watching brief of the TCF's IP Interconnection Working Party which is seeking to establish a pan industry position on interconnection issues for voice and VPN services delivered over IP networks.

The Commission will release a draft NGN study report for consultation in April 2009. The draft report will include the Commission's views on NGN in New Zealand. That report will be informed by the IP Interconnection Working Party outputs, submissions received to the industry Questionnaire and this Discussion Paper as well as from the discussion arising at the Conference.

Section 1 Introduction

On March 2008, the Commerce Commission (Commission) commenced a study into Next Generation Networks (NGNs) under section 9A of the Telecommunications Act 2001, which empowers the Commission to conduct inquiries, reviews and studies into any matter relating to the telecommunications industry or long-term benefit of end-users of telecommunications services within New Zealand[2].

The aim of the NGN study is to facilitate a broad and informed discussion in the market place regarding NGN deployment. Through a consultative approach, the Commission seeks to provide leadership and proposals for how to progress the NGN debate in New Zealand.

The study identified three consecutive work streams that will feed into a final report:

- **NGN Questionnaire**: Start the discussion process to gain some level of understanding of the NGN climate in New Zealand;

- **Discussion Paper on NGN**: Facilitate a broad and informed discussion in the market place regarding NGN value chain as well as the technical, economic and social drivers for NGN deployment; and the

- **NGN Conference**[3]: Providing a discussion platform for wider audience.

This Discussion Paper sets out a discussion on the various aspects of NGN and:

- provides an overview of the NGN definition;
- identifies the general drivers for NGN development with international comparisons;
- examines the drivers for NGN deployment in New Zealand; and
- analyses the opportunities and implications based on the scenarios introduced.

The attachments to this Discussion Paper contain:

- links and literature on NGN;
- key themes from the industry Questionnaire submissions; and
- country-by-country comparisons of NGN drivers.

The Commission is seeking to generate a transparent and open debate on technological and service developments, possible business models and potential issues arising from NGN deployment. This Discussion Paper does not cover all of the issues raised in the submissions to the NGN Questionnaire issued by the Commission in August 2008.

The Commission is calling for responses to the questions raised in this Paper by 9 February 2009. Feedback from the Commission's Questionnaire and this Discussion Paper will be considered in the final report expected for release by the Commission in the second half of 2009.

Responses and Contact

The Commission is seeking responses to the questions posed in this Paper although respondents should not be constrained by the questions per se and may submit on related issues. Please forward all electronic versions of submissions and questions regarding this process to ngn@comcom.govt.nz.

[2] NGN Terms of Reference dated 9 May 2008 and Commission Statement of Intent which signalled the NGN study in 2008.
[3] 26-27 February 2009.

Approach

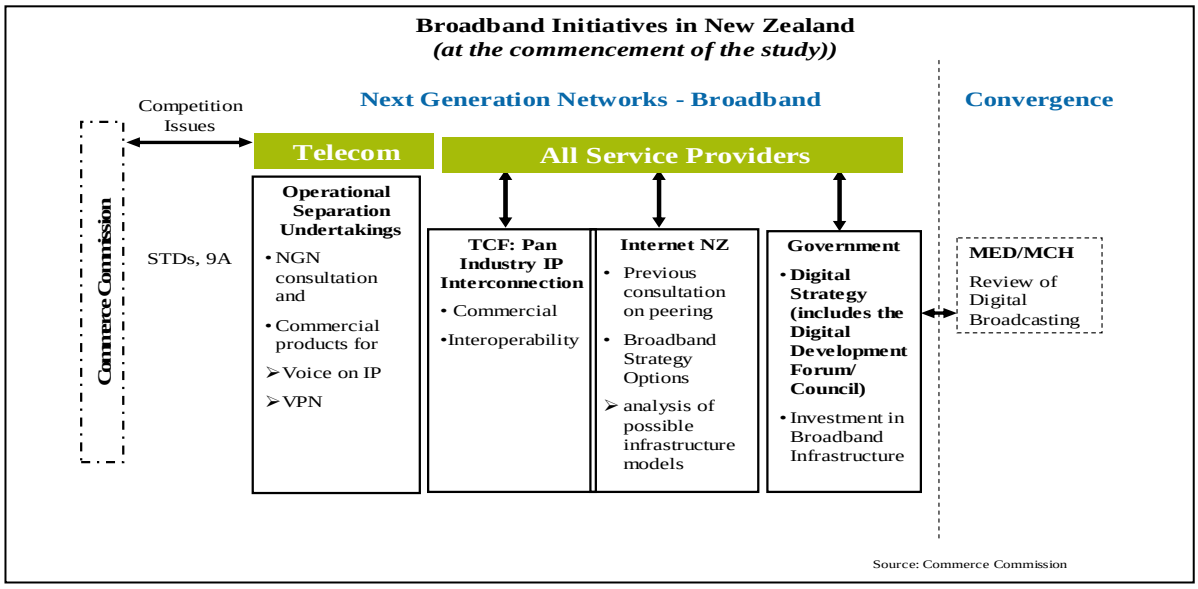
Next generation network deployment in New Zealand has been happening quietly over the last few years. However, the NGN debate is now gaining considerable interest from the public, media, industry and Government.

This has been triggered by a number of aspects including:

- increase in awareness amongst wider interest groups;
- the shifting in emphasis of NGN deployment from the core network to the access network. This includes the initiation of Telecom's fibre to the cabinet (FTTC) rollout;
- increased competition as the 2006 amendments to the Telecommunications Act start to take effect in the marketplace;
- the ageing of Telecom's PSTN (Public Switched Telephone Network). There is a need to ensure that the migration to NGN (which is based on the Internet Protocol) occurs at the right time to avoid service disruptions to fixed telephony users;
- the growing international debate on the role of public investment in broadband infrastructure;
- the increasing significance placed by the Government on broadband uptake and speeds;
- the release of the revised digital strategy in 2008; and
- the shift from analogue to digital broadcasting and the convergence of technology.

In addition, various studies of broadband and related developments in New Zealand have been undertaken over the last 18 months. These are set out in Diagram 1 below followed by an explanation of the relevant work streams.

Diagram 1: Broadband Initiatives in New Zealand



i. The **TCF IP Interconnection working party** is seeking to establish a pan-industry approach to commercial and technical issues relating to IP interconnection issues. Telecom New Zealand is consulting with industry via this working party on its commercial IP for VPN and IP for voice services in accordance with the separation undertakings. Telecom New Zealand is consulting with its customers on its cabinetisation plans and its greenfield fibre to the premise developments.

ii. Internet New Zealand previously carried out work on **Peering** and has currently initiated work on **broadband strategy** options.

iii. The **2008 Broadband Investment Fund.**

iv. A new detailed policy on government broadband investment currently being developed by the Government.

v. The joint Ministry of Culture and Heritage/Ministry of Economic Development **digital broadcasting review** is shown in the diagram, because access to content straddles both areas.

The Commission believes that it is important that a strategic approach be taken in developing the market framework for NGN deployment in New Zealand, as the industry attempts to work out the issues associated with the transition to NGN. The more informed the debate, the greater likelihood that a competitive NGN market will develop.

Internationally, varying approaches have been adopted to address the market framework for NGN. Examples include:

- *United Kingdom* - The Broadband Stakeholder Group is an industry-government forum tackling strategic issues across the converging broadband value chain. In addition, the Convergence Think Tank (CTT) has been set up to examine the implications of technological development for the media and communications industries, and the consequences for both markets and consumers. Ofcom is conducting a series of consultations on the regulatory framework and challenges of NGN access[4], superfast broadband and Ethernet against a policy backdrop to identify the important issues and approach for NGN development.

- *Netherlands* - NGN issues are addressed by the market participants with OPTA maintaining an oversight role.

- *Ireland* - The NGN Industry Steering Group (NISG) is a cross-industry forum set up to examine the technical, interconnect, regulatory and commercial issues associated with NGNs. The purpose of the NISG is to create, and manage the framework within which the communications industry can discuss issues, and agree plans, to facilitate the successful introduction and deployment of all next generation networks and next generation access in Ireland.

- *France* - The French Government has set out an action plan for high speed broadband rollout. A formalised system between operators, regulators and local authorities has been suggested for the exchange of information about civil works.

- *Korea* - Broadband rollout is based on a clear roadmap set out in its u-IT839 policy.

Question 1

What are your views on the approach to development of the market framework and industry consultation that should be considered in New Zealand?

Principles

As this is the first market study the Commission has undertaken under section 9A of the Telecommunications Act 2001, the Commission considers that there is value at this stage in identifying and seeking feedback on principles to take into account for the transition to next generation services:

[4] See http://www.ofcom.org.uk/consult/condics/nga/

- the scope for competition for the long term benefit of end users should be preserved and enhanced where possible in a next generation environment;
- incentives to invest in next generation infrastructure, including access networks, as well as applications and services, should be preserved;

- industry self regulation should be encouraged, where this mechanism can deal effectively with next generation network issues, particularly in relation to technical issues;

- regulation should be considered only where necessary to constrain market power - where, for example, it is conferred by control over bottlenecks;

- regulation should be scaled back as workable and effective competition develops.

Question 2

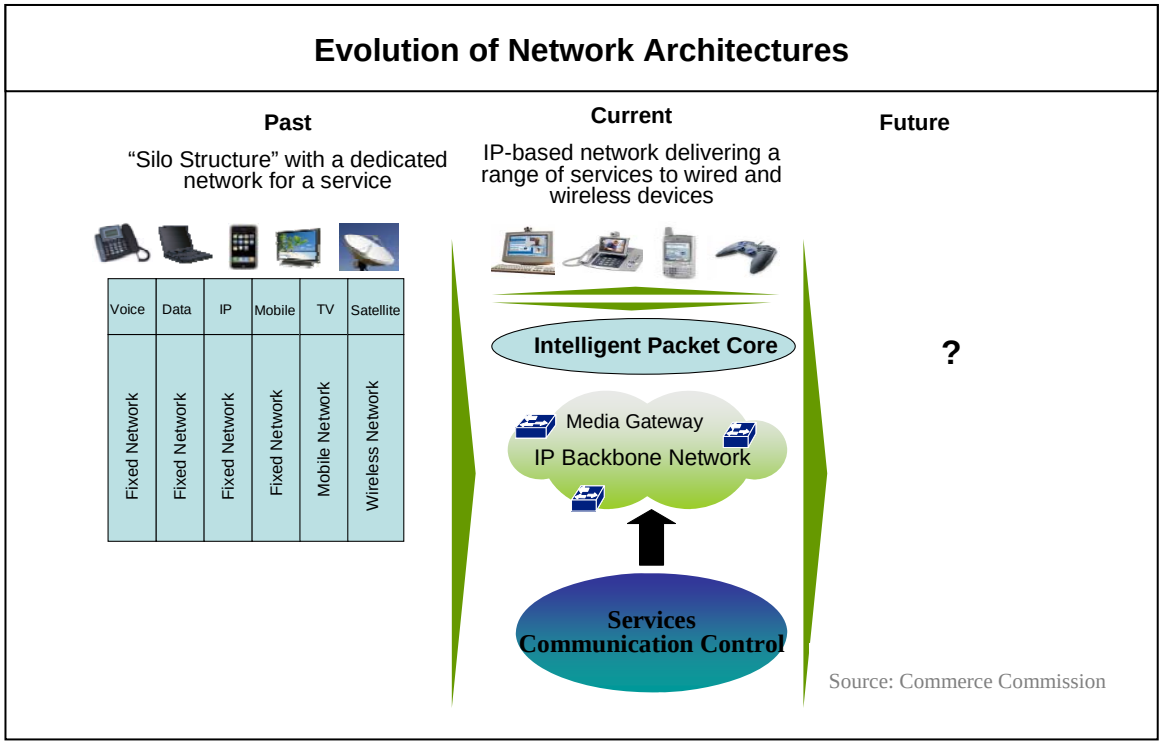
Do these core principles provide a useful underpinning for considering NGN issues, or whether they should be modified or supplemented?

Section 2 Characteristics of Next Generation Networks (NGN)

From a policy perspective, there is no settled definition of NGN. The term is representative of a concept which relates to several parts of a layered packet-switched architecture (or all-IP networks). All elements of an NGN architecture are designed to support a full range of services, largely independent of the underlying technology, where transport and service layers are separated, quality of services can be assured and cost savings can be achieved. This development represents a shift from the traditional "vertical silos" architecture where different services are provided through separate networks to a situation in which communications services will be seamlessly accessed and provided over multiple platforms, in an interactive way.

NGN combines the characteristics of the traditional telecommunications model, and of the internet model towards a harmonised approach, gradually bringing to full convergence fixed and mobile networks, voice and data services as well as broadcasting services. Diagram 2 provides an illustration of the convergence process.

Diagram 2: NGN Enabling Convergence of Networks and Services



This process of "convergence" is already taking place at various levels:[5]

- **networks**: Networks on all hierarchical and physical levels (access and core), as well as transport and interworking equipment shift to packet switched (IP) technologies;
- **services** : Access to services is facilitated via a multiplicity of devices, which are not dedicated to one single service;
- **industry/market**: Formerly separate markets of media, entertainment, and communications have become unified markets;

[5] OECD: "Convergence and Next Generation Networks", Ministerial Background Report, DSTI/ICCP/CISP(2007)2/Final.

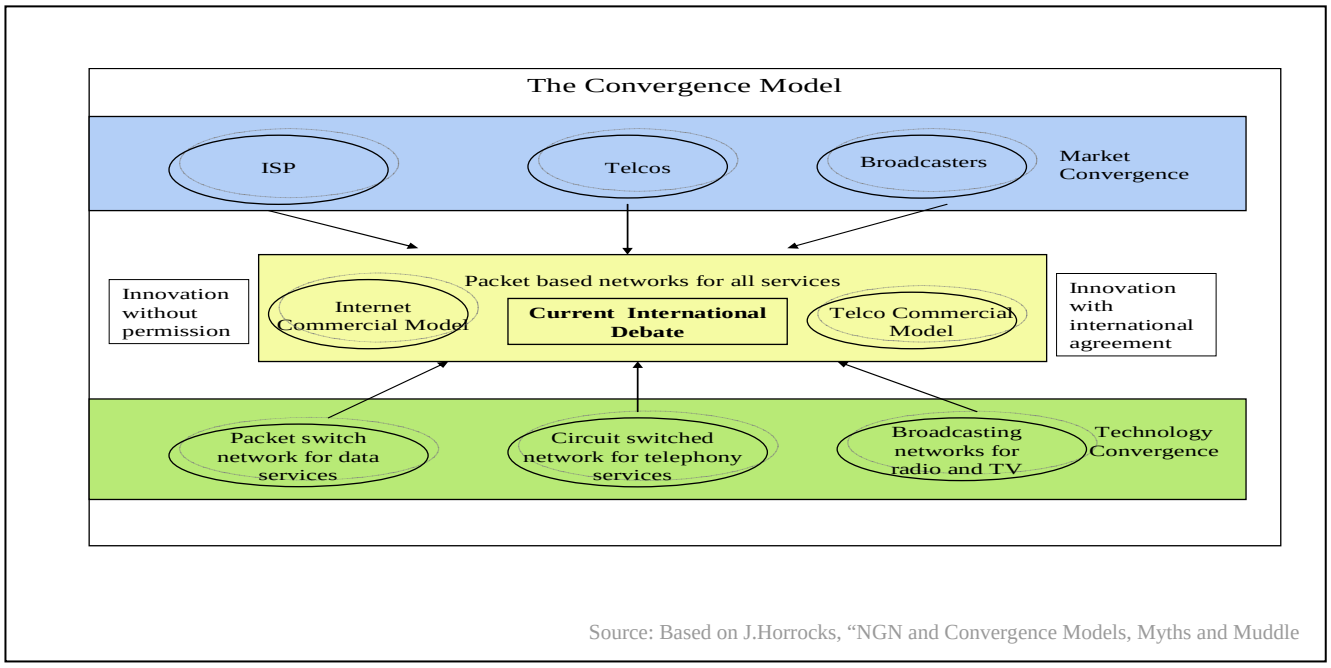
- **devices**: Provision of multiple communications functions and applications across different devices (e.g. mobile phones, palms, terminals, etc.);

- **user experience**: Unique interface between end-users and telecommunication, new media and computer technologies; and

- **legislative, institutional and regulatory framework**: the promotion of competitive entry via regulation and technological developments in communication markets means that policy makers may have to take into account more technology neutral approaches across the boundaries of broadcasting and telecommunications.

Convergence on all levels is pushing markets towards an environment that requires new investment in infrastructure. By enabling different types of content and communication services to be delivered through the same "pipe" by several operators and consumed over a variety of platforms and end-user devices, physical networks are likely to become a commodity. This development affects the markets along the value chain (using content as an example: production, packaging and distribution) and influences consumer behaviour significantly, creating new forms of usage, along with a greater choice and control over content. The convergence model is illustrated in Diagram 3.

Diagram 3: The Convergence Model



Source: Based on J.Horrocks, "NGN and Convergence Models, Myths and Muddle

New business models arising from the changing architecture and topology of the network will bring about new issues for all market participants (network operators, access seekers and regulators). Implications of NGN on investment costs, rollout of new services and applications as well as the timing of deployment are further discussed in Section 4 of this Discussion Paper.

From a technical point of view, NGN is defined by the International Telecommunications Union (ITU)[6] as "a *packet-based network able to provide Telecommunication Services to users and able to make use of multiple broadband, QoS*[7]*-enabled transport technologies and in which service-related functions are independent of the underlying transport-related technologies. It enables unfettered access for users to networks and to competing service providers and services of their choice. It supports generalised mobility which will allow consistent and ubiquitous provision of services to users."*

[6] http://www.itu.int/net/home/index.aspx
[7] QoS = Quality of Service.

From this broad definition, a number of fundamental characteristics can be derived:

- *packet based networks*
  - end-to-end transmission of packet-based data (rather than a service-specific transmission as in the traditional PSTN[8] world) using the Internet Protocol (IP) as a standard. Therefore literature often refers to "all-IP networks" which is broadly equivalent to NGN;

- *multiple broadband, QoS-enabled transport technologies*
  - the concept of NGN is not bound to a certain and proprietary transmission technology. A typical NGN will be able to deliver services in a technology-neutral manner, independently of the underlying technology (fibre, copper, coaxial, wireless, etc.) architecture or the underlying architecture. The transport of the packets does allow for a differentiation of end-to-end QoS characteristics ranging from slow non-real time or " best efforts" services (e.g., the traditional broadband internet access), over broadband streaming (e.g. internet radio), up to ultra-fast real-time services (e.g., real-time multimedia HDTV[9] download);

- *service-related functions are independent of the underlying transport-related technologies*
  - the service provision is decoupled from transport supporting a wide range of services, applications and mechanisms;

- *unfettered access*
  - NGN network technologies provide open interfaces and access to these interfaces by different service providers and users. The open interfaces are supporting interworking with legacy networks; and

- *supports generalised mobility*
  - this relates to the independence of service-related functions from underlying transport technologies where converged services are delivered over fixed and mobile networks. The delivery of services will support mobile, nomadic and fixed users.

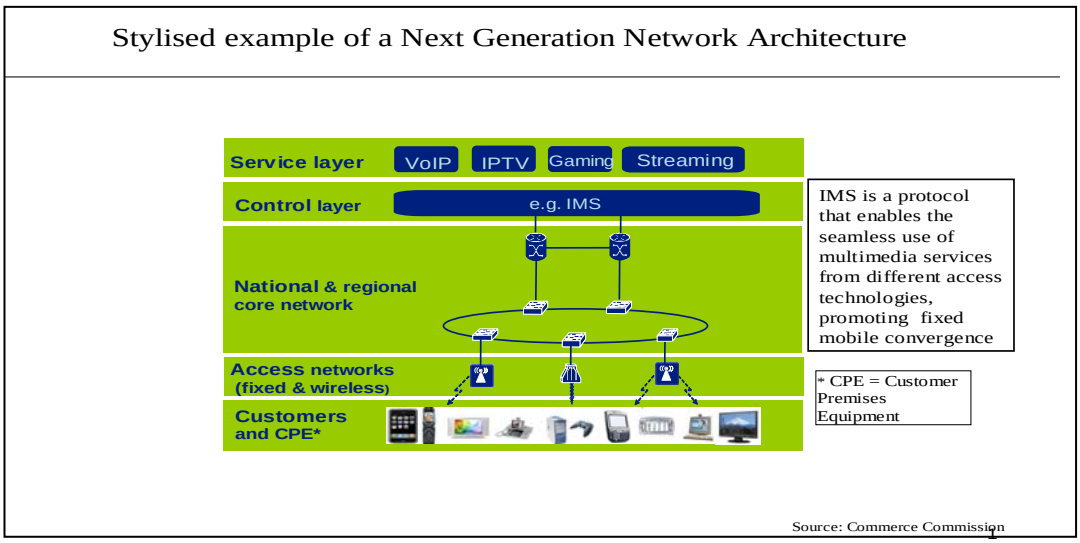
NGN typically comprises of the next generation "core" networks and "access" networks, although there are other parts along the end-to-end architecture that may be crucial for deploying a service (e.g., end-user equipment).

One of key features in the NGN architecture is the IP Multimedia Subsystem (IMS) for delivering internet protocol multimedia services. It is not intended to standardise applications but rather to aid the access of multimedia and voice applications from wireless and wireline terminals, i.e. create a form of fixed mobile convergence (FMC). This is done by having a horizontal control layer that isolates the access network from the service layer.

The following illustration in Diagram 4 shows a generic NGN network.

[8] Public Switched Telephone Network.
[9] HDTV (high definition television) is a television display technology that provides a very high picture quality for movies and with sound quality similar to that of today's compact disc.

Diagram 4: Stylised Example of NGN Architecture



NG Access Network

The access component refers to the segment which connects a customer's home or business premise to the nearest location which houses the provider's equipment. It is commonly defined on the basis of bandwidth and the kind of services that these networks can deliver. This definition is useful as next generation access can be delivered by a number of different technologies (as the control layer of the access network spreads further out to the edges). These include fibre, copper and coax based wired options, mobile, wireless and satellite although the debate internationally has been mainly focussed on wired access.

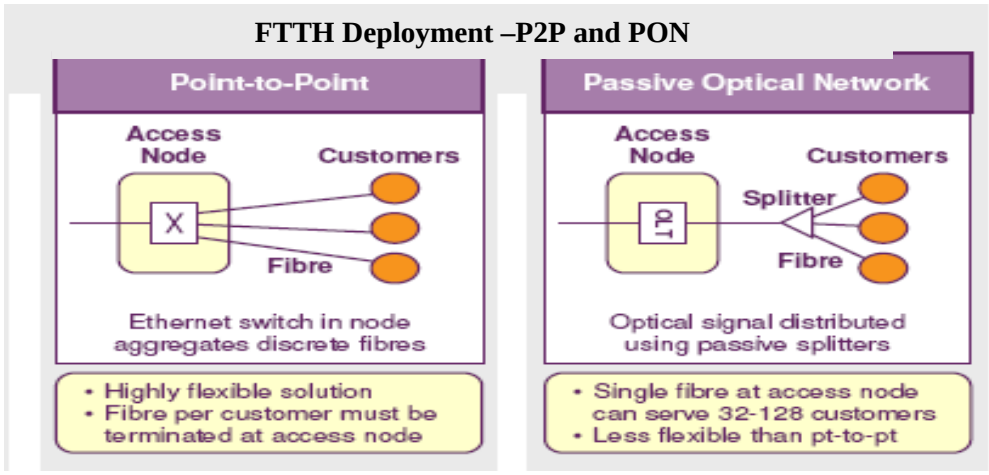
For wired access, a mix of fibre and copper based services can deliver a range of end user delivery options and speeds. The more common access network for an incumbent telecommunications operator is to use fibre fed cabinets and copper access from these to the end users, termed Fibre to the Cabinet (FTTCab). Depending on the distance from the cabinet to the user this can deliver access speeds up to around 50Mbps. Alternatively, by eliminating the copper and delivering fibre to the home (FTTH) much higher speeds can be provided with the actual speed delivered depending on other parts of the network including domestic and international links and policies that can be applied by ISPs, caching services and content delivery platforms.

FTTH deployment can be achieved by deployment of either a *point-to-point* (P2P)[10] or a *passive optical network* (PON)[11] topology as illustrated in Diagram 5.

[10] P2P is a dedicated fibre connection from each end-users premise. P2P is noted for its flexibility to handle most new bandwidth intensive applications while allowing for relatively easy upgrading of speeds. While more expensive than other alternatives, such as point to multipoint fibre-to-the-home, some operators believe that in the longer term point-to-point FTTH may be more cost effective. This architecture also has the competitive advantage in that it permits full unbundling.

[11] PON is a transmission scheme where a fibre transmission line uses splitters to fan out to multiple end points. It is passive with no active components such as amplifiers, repeaters, hubs or switches. PON networks differ from P2P-FTTH in that they use one fibre to connect multiple end customers so that fibre is shared by users. Cheaper than point-to-point FTTH, PON switches require more logic and encryption to integrate and separate customer streams.

Diagram 5: FTTH Deployment - P2P and PON



Source: Ofcom

The term next generation networks frequently encompasses some kind of fixed-mobile convergence, as it allows the transition from separate network infrastructures to a unified network based on IP.

Given that mobility is increasingly becoming a key requirement for users, wireless solutions such as WiMax and Long Term Evolution (LTE) have the potential to support high bandwidth and concurrent usage that may be demanded in the future. Take up may be further driven by user devices becoming more feature rich and improved download speeds. Satellite solutions on the other hand represent a viable option in hard to reach areas. The deployment of wireless solutions however, is restricted by a limited availability of spectrum that is shared between services and users.

The following illustration in Table 1 shows different access technologies and their theoretical down and upstream bandwidth[12].

Table 1: Bandwidth speeds for different access technologies

Access Technology	Upstream B/W (Up to)	Downstream B/W (Up to)
SHDSL	2000k	2000k
ADSL1 (128k up)	128k	1000 to 3.5Mk
ADSL1 (FS up)	800k	1000 to 7M
ADSL2+ (128k up)	128k	1000 to 3.5Mk
ADSL2+ (FS up)	500k to 2M	1000 to 12M
VDSL2	2M to 25M	5M to 50M
Dial-up	56k	56k
Cable Modem (TelstraClear13[1])	2M	2M to 25M
FTTP	500M on PON	500M on PON
Wireless Mobile (Telecom14[2])	100k to 300k	400k to 800k
Wireless Mobile (Vodafone, HSPA15[3])	1400k	1400k
Wireless Mobile (LTE)	<10M	<20M

Source: Commerce Commission

[12] It is important to note that restrictions with regards to bandwidth, speed, quality of service, etc., do not only occur in the access but also the core network and network upgrades have therefore take this restriction into account for end-to-end QoS service delivery.

NG Core Network

Next generation core networks are defined on the basis of its underlying core technological components which include IP based, packet based and separation of the transport and service layer. This fosters the development of new services and provide new opportunities for innovation and this allows for different market players to create value at the separate functional levels of transport, control and services.

The migration from traditional networks to NGN potentially entails several structural changes, such as to the core network nodes and in the number of network hierarchy levels. As a result, a reduction in the overall number of interconnection points is likely to take place. From the perspective of a vertically-integrated operator that is horizontally integrated with a fixed and mobile network, the expected cost savings from an IP core network are a key driver for investment to upgrade their network. For mobile-only operators, while there are lower transmission costs from upgrading to an IP core network, a more important consideration for upgrading their core network is the ability to offer richer IP multimedia services to customers through the IMS. IMS is an architectural framework that applies to both fixed and wireless networks although it was originally designed by the wireless standards body 3GPP.

Although core next generation networks tend to be based on fixed infrastructure, the possibility to improve interconnection with mobile networks is being explored to facilitate access to IP services from anywhere.

Question 3

Are there additional elements that have to be taken into account when defining NGN? If so, what are the additional elements, why should they be taken into account and what impact do they have?

Question 4

What do you think IMS fulfils? Is it necessary, or are there other ways of fulfilling its function? What are the implications of this layer for the future of NGNs?

Section 3 Drivers of Next Generation Networks

This section outlines the drivers behind the development of NGN internationally and considers them in the New Zealand context.

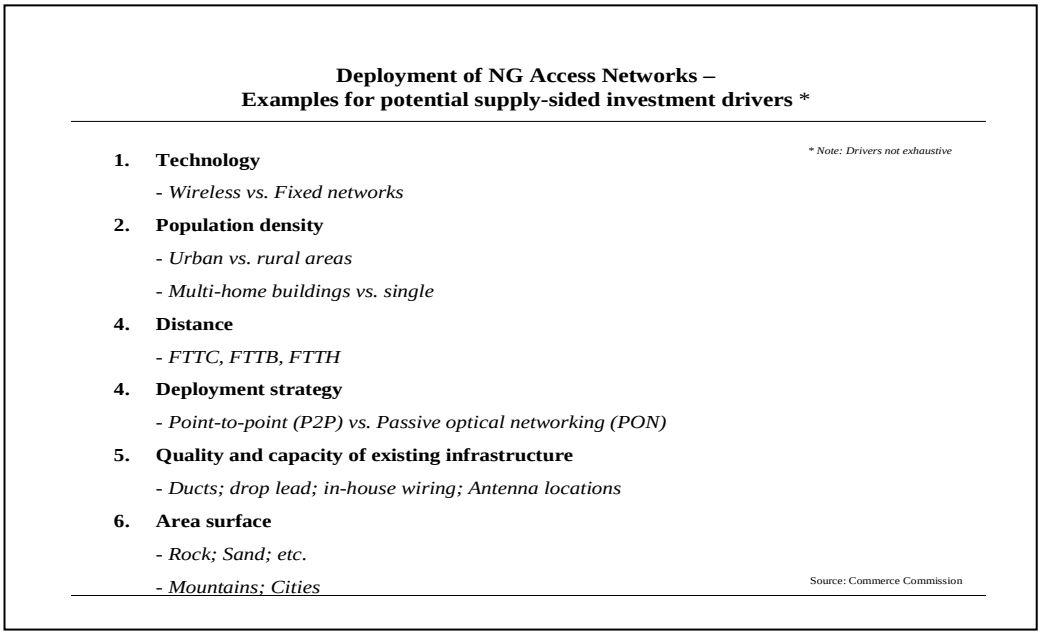
There is generally more than one driver behind NGN deployment in any country. Deployment strategies and the type of network deployed vary between countries depending on the economic, technological, social and Government influences of each country.

Economic Drivers

- ***Ability to expand to new market segments***
  Current integrated network operators may view the deployment of next generation access as an option to generate additional revenues along the value chain, particularly through the development of IPTV services where there is a relatively underdeveloped multi-channel or pay TV market and opportunity to provide bundling of services (e.g., triple play - provisioning high-speed internet access, television and telephone services over a single broadband connection and quadruple play – combination of the triple play service with wireless service provisions).

- ***Cost of deployment***
  - **access networks**
    Next generation access deployment investments vary depending on the specific requirements in the area of deployment (e.g., construction standards, local government rules, ability to sell or re-use equipment or sites from the previous network and population density). NG access networks investments can be significant, depending on the deployment strategy (see Section 2: different options to bring fibre to access networks) and the technology applied (wireless or fixed infrastructure). Diagram 6 sets out some examples of the supply-side investment drivers.

Diagram 6: Deployment of NG Access Networks – Examples of Supply-side Investment Drivers



  - **core networks**
    There has been a view that whilst the investment in NGN access networks was likely to involve significant cost, the transition to a single multi-service IP transport NGN core network will deliver increased network efficiencies and result in a long run decrease in operational costs and capital

expenditure[16]. For example, British Telecom announced that its new NGN IP core network was anticipated to deliver growing cash savings of £1billion per annum by 2008/09[17]. In practice, the expected efficiencies will arise from a reduction in the physical network layers, the increased technological capability of existing network elements (e.g., capacity), and the need for fewer network components.

While the next generation multi-service IP core network should result in lower costs in the longer term, as a common platform is used to deliver multiple services, there will be a higher proportion of common costs compared to legacy networks. As these common costs are likely to be allocated across an increased volume and number of services in the future, there should be greater economies of scale and scope realised across the network, which combined with the increase in efficiency of the NGN core network, will lead to lower costs per unit.

A number of operators have now deployed NGN IP core networks. The expected cost savings however, have yet to be realised. This has led some to question whether or not the cost efficiencies resulting from the transition to a single multi-service IP transport NGN core network have been overstated (i.e. the supply-side drivers). It may be the case that like the NGA network, the advantages of the NGN IP core network are also primarily derived from the revenue that new services are able to generate (i.e. the demand-side drivers).

Competition

- Competition from alternative providers such as cable, utility, local loop unbundlers (LLU) and mobile operators has been a key driver in NGN deployment.

Supply-side Technology

- ***Poor quality, age and length of copper loops***
  Poor quality, age and length of copper loops mean that exchange based DSL is subject to significant limitations on download and upload speeds.

- ***VoIP***
  The erosion of voice revenues as a result of the high efficiency and low cost VoIP services has been a driver for NGN deployment.

Social

- ***Demand for innovative, high bandwidth services***
  In recent times demand for broadband services such as streaming video and large file transfer (e.g. movies) has been accelerating. The large growth in internet use and new services has created a significant demand for capacity and this is likely to continue in the future as new services emerge. Peer to peer applications are estimated to account for close to half of the internet traffic today. There are some predictions that worldwide demand for capacity will exceed the supply by 2012 to 2013[18].

Public Sector Initiatives

[16] For example see Oxera, "Next Generation Networks: Old Generation Rules?", April 2007, p 1 at http://www.oxera.com/cmsDocuments/Agenda_April07/Next%20generation%20networks.pdf
[17] "BT Announces Network Transformation Timetable", BT Media Release, 9 June 2004, at http://www.btplc.com/News/Articles/Showarticle.cfm?ArticleID=500408a0-a768-46e7-9dec-ef4a199be68e
[18] See for example Nemertes Report (2008): "Internet Interrupted – Why Architectural Limitations Will Limit the Net".

- Central government intervention has played a key role in countries where NGN deployment has been outlined in national technology plans or broadband uptake has been seen as a key to national productivity. Local governments have also been involved in deploying municipally owned next generation networks.

- International comparisons on broadband uptake (especially among OECD countries) have also contributed to the broadband push.

Overview of Key Drivers for NGN

Table 2 provides an overview of the key drivers for NGN in various markets[19].

Table 2: Overview of Drivers of NGN in Various Markets

	Poor quality copper	**IPTV** (additional revenue stream)	**Cost Savings**	**Competition** (from alternative providers)	**Public Sector**
Belgium	✓	✓		✓	
France	✓	✓	✓	✓	
Germany	✓	✓	✓		
Japan			✓	✓	✓
Netherlands				✓	
Korea					✓
United States	✓	✓		✓	

Source: Commerce Commission on basis of Ofcom

Each country's deployment involves a combination of different drivers that are market specific. One of the common themes internationally is that costs for NGN deployment are high. Further, the existence of competitive pressure, such as that provided by cable operators competing in the supply of "triple play" services, plays an important role in the decision by telecommunications operators to invest in new generation networks. In those instances where there is no competing infrastructure, and the high cost leads to new generation networks being unlikely to be economic to duplicate, it may be necessary to balance the incentives for NGN investments with the desire to promote a competitive environment. The issues of choice of technology, the design of the specific network and the how early consultation with potential access seekers occurs will play a key role in facilitating that balance.

Deployment in New Zealand

Competition

Introduction of local loop unbundling in New Zealand through the Telecommucations (Amendment) Act 2006 is regarded as a significant factor in stimulating broadband uptake and therefore an essential component of a developing "information economy". In addition to this development, Telecom's cabinetisation plan (brought forward via the Operational Separation Undertakings) is intended by the Government to bring faster speeds closer to residential lines. Part of the agreement included a commitment by Telecom to rollout a $1.4 billion broadband network by 2012, providing speeds of more than 10Mbps to 80% of lines. Telecom has initiated some FTTH deployment in greenfield areas. Other commercial initiatives include those undertaken by TelstraClear, Vodafone, Woosh, Citylink, Vector and FX Networks.

[19] See Annex 3 for a more detailed overview of the drivers for NGN in these countries.

The discussions over Telecom's cabinetisation plans and the possible conflict between cabinetisation and the unbundling of the local loop (UCLL) highlight the possible tension New Zealand faces between broadband for the maximum geographic coverage and the delivery of higher speed broadband for a smaller proportion of the population. It also clearly raises questions about the role of competition in the New Zealand telecommunications market and the extent to which this could (or should) facilitate the balance between broadband speeds or greater broadband reach.

Question 5

Where and how should the balance between coverage and speed be struck?

Question 6

Is industry consultation necessary on network design for NGN?

Question 7

i. How does the deployment of NGN change bottleneck characteristics?
ii. Is access to the infrastructure still an issue? If not, what other elements could become important?

Funding

Government funding initiatives have to date included:

- *The Broadband Challenge Fund*
  - announced in 2005, $24 million to be used to establish fibre networks and improve broadband access to fibre networks; and

- *Broadband Investment Fund (BIF)*
  - announced in May 2008, $340 million was made available over a period of five years across public (health, education and government) and private sectors targeted at deploying high speed open access urban fibre networks, improved rural connectivity and improved international links.

Some regional broadband offerings involve public and private sector partnerships (NEAL, Smartlinx3).

Question 8

Part of the BIF is targeted at deploying open access urban fibre networks and the Government has indicated that it will set aside $1.5 billion for open access FTTH rollout that will reach 75% of the population. What is your understanding about what is meant by open access?

Question 9

What are the areas that are not likely to be commercially funded?

Demand

New Zealand is country with traditionally large proportion of "early adopters" – people who like to try new things[20]. However, this general trend is inconsistent with the fact that New Zealand has been relatively slow

[20] Keith Newman - Connecting the Clouds: The Internet in New Zealand.

to move from dial up internet access to broadband. This may be because of the availability of free local calling (one of the requirements of the TSO), making dial up more attractive.

The primary drivers of most residential broadband usage in New Zealand have been access to the internet and e-mail[21]. Broadband has in the past been of relatively poor quality (for example, with 128 kbps 'upstream') and uptake has generally been slower than was otherwise expected. Today, broadband uptake could largely be attributed to price reductions, giveaways (e.g., free modems) and the removal of the risk of 'bill shock'.

It is difficult to gauge the level of demand for broadband services in New Zealand. Aside from cost and speed, consumers are largely unaware of the range of broadband services that are available and find it is impossible to predict how useful to them a particular service will be as they have never used or seen it.

In some overseas jurisdictions (e.g., Belgium, Netherlands and Switzerland), telecommunication operators are competing with widespread cable operators that can deliver broadband and telephony as well as television programming. This inter-modal competition has been a major driver for NGN deployment in these countries. A number of studies have identified IPTV services as one of the single largest drivers for broadband.

In New Zealand, subscription television is largely delivered by a single provider with a satellite-based standard definition TV service. This has been a cost effective solution to the delivery of subscription TV over New Zealand's diverse geographic landscape and is one that an IP network will struggle to emulate. It appears unlikely that IPTV will be a significant driver of broadband in the near future in New Zealand.

Given that IPTV has been a significant driver of NGN overseas, the nature of New Zealand's subscription TV market is likely to impact NGN take up in New Zealand. In order to be considered a viable alternative to a satellite based delivery platform, an IP network would likely need to:

- have wide population coverage (NB: people in remote areas are often good subscription TV subscribers because they get poor free to air reception); and

- either provide a delivery mechanism that competes on price with the satellite platform, or one that provides significantly more valuable capability (e.g., video on demand).

Question 10

i. What do you believe is needed to drive broadband penetration and speed in the future in New Zealand?
ii. Do you agree that cost savings are one of the core drivers for NGN deployment in New Zealand?
iii. How will competition enable innovation?

Question 11

Many are of the view that the pipes should be built first and services will then follow. Others believe that a lack of services and demand for broadband services are an issue. What is your view?

Question 12

Is content ownership or access to content a hindrance to the development of broadband in the New Zealand market?

Question 13

How is the nature of New Zealand's subscription TV market likely to impact the development and take up of NGN in New Zealand?

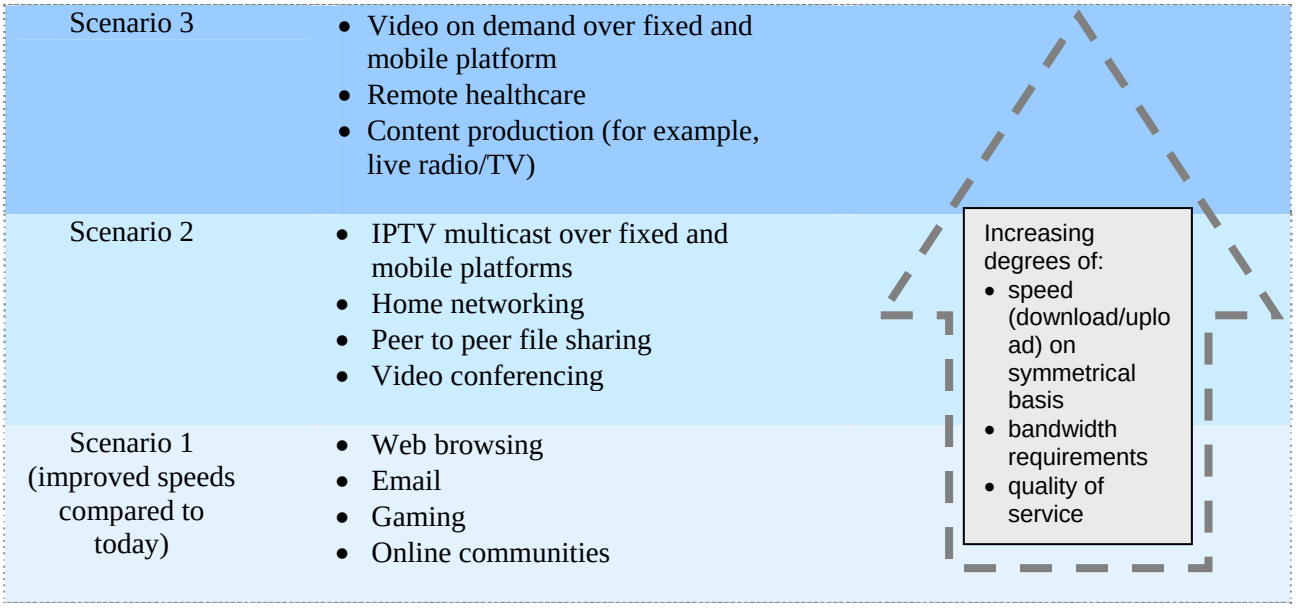
[21] This has been complemented by a small gaming community with its own set of needs.

Section 4 Implications of NGN

This section discusses some of the potential implications of a move to NGN. It is not intended to cover all aspects of NGN in detail. Rather, it aims to provide a broad and generic overview of the relevant issues during and after the transition phase.

The Commission is using 'service scenarios' to assist its thinking and analysis of the development of NGNs in New Zealand. It is proposing four possible scenarios – three commercial service increments likely to be offered by the industry with increasing degrees of scope, speed and quality and one where network rollout is not driven primarily by commercial factors at all. The three commercial service scenarios are as follows in Diagram 7.

Diagram 7: Commercial Service Scenarios



The fourth scenario relates to subsidised roll-out. Any subsidised rollout needs to consider the impact on private investment.

Question 14

Is the service scenario approach seen as a useful one for the purpose of studying the New Zealand NGN market, and if so what would be the elements of practical and relevant scenarios?

From the commercial services scenario settings, it is obvious that the services listed in Scenario 1 are currently available on the networks today. Increased competition through the introduction of local loop unbundling and unbundled bitstream access are only just starting to have an effect, but it is unlikely that these services in themselves will trigger the evolution in NGN. Improved speeds and quality of service can be adequately managed by the existing networks.

On the other hand, the indicative list of services in Scenarios 2 and 3 could be delivered over NGNs. Although some of these services such as online gaming and peer to peer file sharing can be delivered on existing networks, high speed broadband could allow for more efficient transfers and these applications to be more complex and engaging. The implications of these indicative service scenarios are discussed accordingly.

Impact on the value chain

As previously noted, technological, economic and social developments are likely to lead to a fundamental transformation of traditional value chains as operators move from traditional networks to all-IP networks.

On the supply side the co-existence of parallel (core and access) infrastructures are likely to increase the level of competition forcing traditionally integrated operators to invest in order to provide more efficient services[22]. Streamlining networks allows operators to alleviate the redundancies inherent in the traditional network model and create a more efficient operational environment[23].

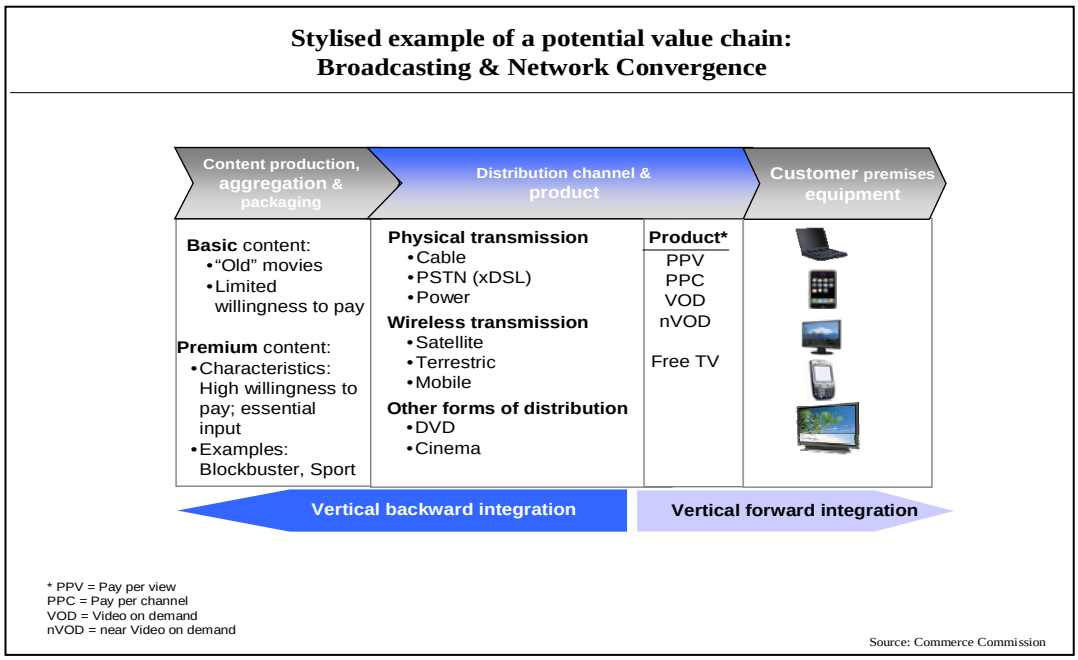
On the demand side operators are likely to try to increase revenues by offering new services and applications, new customer segments and an increase in the level of usage.

This transformation process will potentially lead to a new competitive landscape and affect the strategic direction of the operators. In particular "forward" and "backward integration" initiatives may play an increasingly important role amongst suppliers of services.

The increasing convergence of broadcasting and telecommunication sectors is one good example where backwards integration is taking place. Broadcasters, telecommunication operators and newly emerging IPTV providers (along with broadband services) are offering access to content over IP and increasing competition for audio-visual content. Overseas, some non incumbents increasingly find content a crucial component of their business case. Similar to the developments in the fixed network sector, the development of next generation mobile services enables the delivery of high quality audio-visual content to portable devices and mobile phones.

The illustrative example in Diagram 8 outlines the potential transformation processes along the stylised value chain of broadcasters and network operators due to convergence and its potential impact on competition. Operators with a core business in the physical or wireless distribution of content are likely to think about how to increase revenues and how to decrease costs as competitive pressures increase. In overseas jurisdictions such as the US, Belgium, Netherlands and Switzerland, traditional telecommunication incumbents, as well as alternative network operators such as cable providers, are competing along the value chain for content production and potential distribution channels.

Diagram 8: Stylised Example of Potential Value Chain: Broadcasting and Network



[22] Costs per user are likely to decrease due to a reduction of operating costs, common platforms and automated processes, by running a common, shared IP infrastructure.
[23] Reduction of capital expenditures, support and maintenance costs in the network and OSS/BSS (Operational and Business Support Systems) domains.

Service providers such as *msn*, *AOL*, *YAHOO*, *skype*, *Google* or *myspace* which typically do not own their own physical or wireless transmission/distribution channels, will potentially influence the competitive landscape of infrastructure providers that deliver the content subject to increasing bandwidth demand. This can be done either by service providers and infrastructure suppliers entering commercial agreements (e.g., revenue share agreements) or by bundling their services across the different fixed and wireless networks and end-customer devices.

Question 15

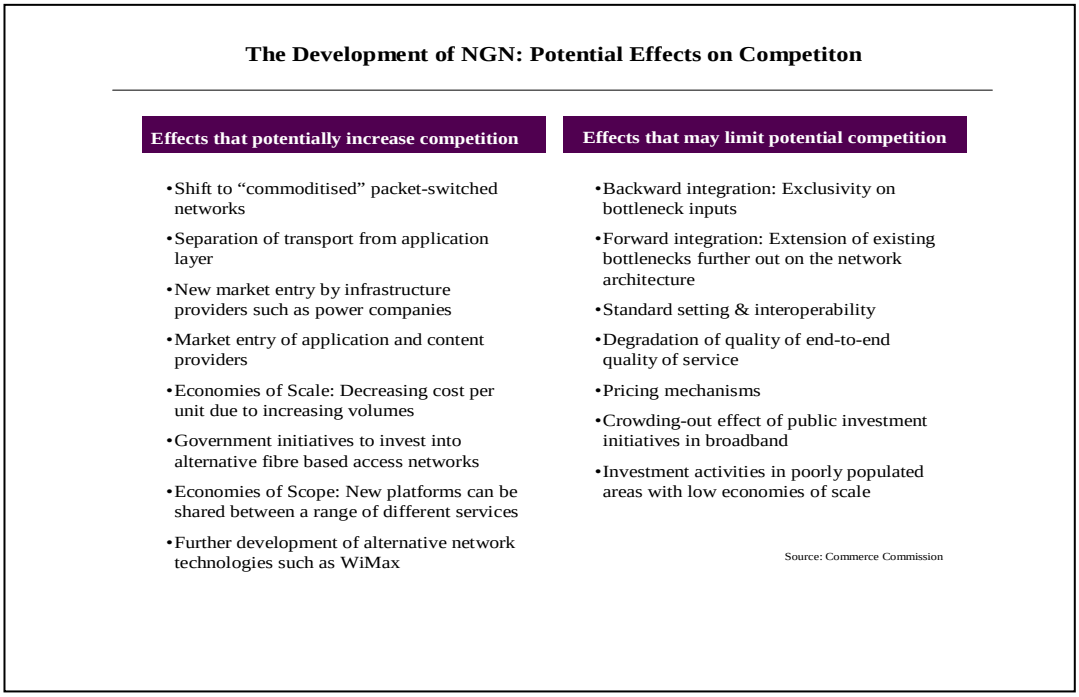
What other implications for the value chain of traditional operators and suppliers can be expected when moving towards an all-IP environment?

Impact on the competitive environment

Investments into (access) infrastructures are likely to occur on a case-by-case basis taking into account the competitive environment and any economies of scope, scale and density that can be achieved. Services that were previously regulated may be subject to increasing competition in certain parts of the value chain, or alternative bottleneck problems may "move" to other parts of the value chain. To the extent that these outcomes have an impact on the existing market structure, competition assessments and market delineations will need to take this into account.

The potential effects on competition resulting from NGN are set out in Diagram 9 below.

Diagram 9: Potential Effects of Competition



Question 16

What other effects on the competitive environment could be expected when rolling out next generation networks?

Question 17

How do these effects influence the roll out of next generation networks and innovative services?

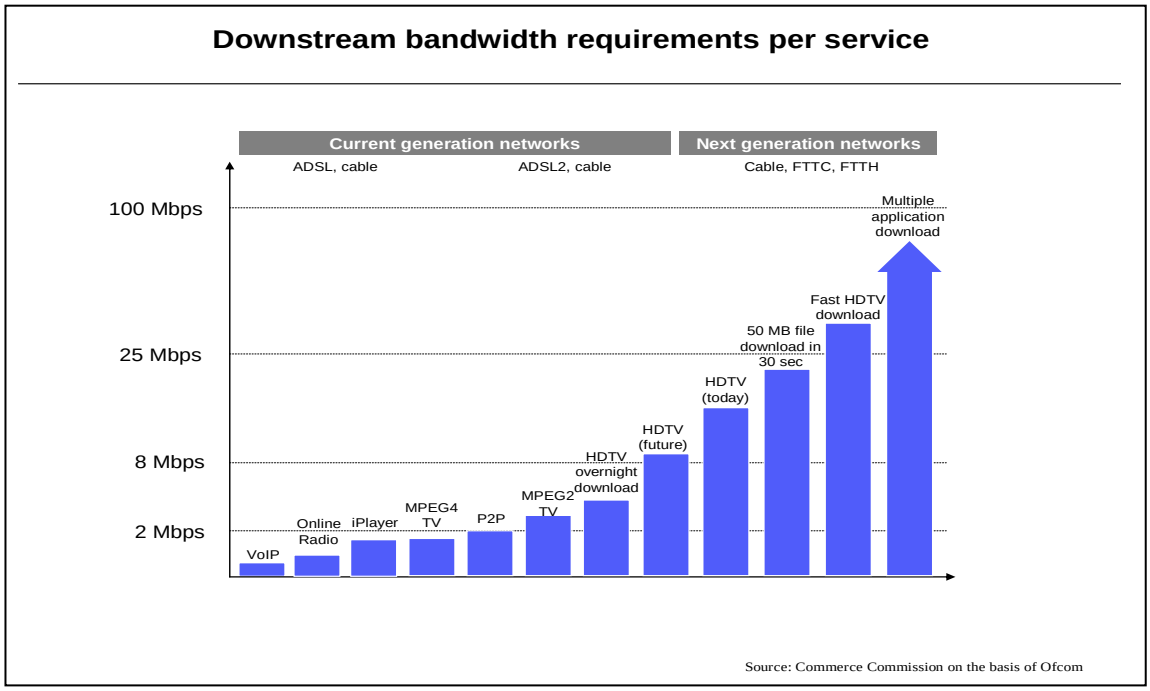
Impact on demand for capacity

An increasing demand for capacity is not only driven by the downstream traffic created by the consumption of services. One of the crucial advantages of NGN is the symmetric service speed (up- and download). This has become more important as end-users are increasingly producing and distributing their own content[24].

User produced and distributed content has implications for how networks are managed to provide different QoS over a range of different services. Furthermore, the demand for capacity is extremely volatile, planning and costing becomes crucial for operators.

A breakdown of the capacity or bandwidth required to deliver different services to end-users, with current and future networks is shown in Diagram 10[25].

Diagram 10: Downstream Bandwidth Requirements per Service



Question 18

To what extent is symmetric speed or capacity necessary to provide future services to customers?

Question 19

What are the most important and significant drivers of bandwidth demand?

Impact on the quality of service (QoS)

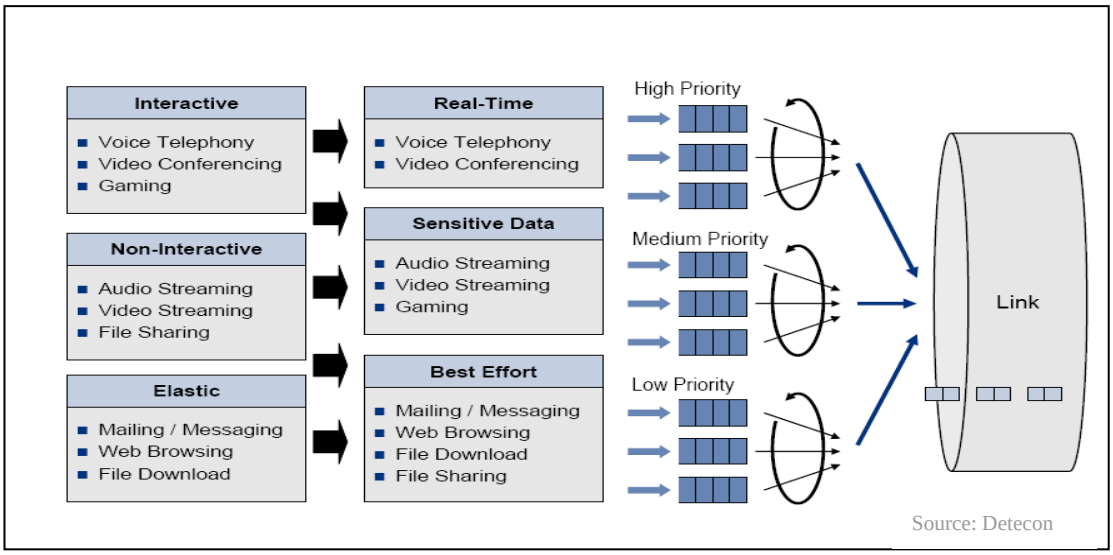
Quality of Service in IP networks using packet-switched technology is becoming increasingly important not only for end-to-end services within one particular network, but across different types of network (wireless and fixed). In traditional circuit-switched PSTN networks a standardised and fixed resource is dedicated to a service (e.g., fixed routing per call), whereas NGN-type networks use a shared transmission medium based on packet-

[24] Typical examples may be youtube (where own content is uploaded), or iTunes (where private users can provide streamed radio channels to other users).
[25] The bandwidth limitation is generally set by current generation access networks and in-house wiring (based on copper technology), which tend to be gradually upgraded as demand or competition arises. The bandwidth requirements as shown in the illustration are only indicative and may vary depending on the underlying network architecture and the compression methodology.

switched technology that does not provide a fixed transmission channel per service. This shared transmission means that there is no guaranteed level of performance, but rather the service is based on a “best-effort” philosophy, which varies with the traffic load of the network.

If an IP-based network is congested, it may delay or even drop certain packets, leading to a decrease in QoS. For some services such as TV or voice services, a best-effort transmission quality may not be acceptable from an end-customers perspective. In the context of an end-user, the term quality of experience (QoE) is sometimes used. In contrast to the supply side hardware/software definition of QoS, the QoE measures the overall level of satisfaction a customer has with its supplier. A reduction in QoS/QoE could be avoided by introducing several different transport classes, with different priorities given in respect of reliability and transmission characteristics. However, some issues such as cross technology QoS for end-to-end services (e.g., between mobile and fixed networks) as well as the treatment of QoS for international traffic remain to be discussed in detail. The generic illustration in Diagram 11 shows a possible approach to differentiate service classes.

Diagram 11: Possible Approach to Differentiate Service



Question 20

Is a differentiation of classes of services an appropriate approach for solving QoS degradation for end-to-end services?

Question 21

What issues and effects could possibly arise due to a differentiation of services classes?

Question 22

Will the approaches to pricing change for NGN, particularly where different classes of service are offered?

Impact on cost

In order to provide end-to-end services in an NGN environment, it has been established that additional investment will be necessary. The cost structures of NGN will differ from legacy networks due to the different layers of the new networks, the new equipment required, and the new services being supplied.

Section 3 implies that one of the drivers for operators deploying NGN IP core networks has been the likely long run cost savings associated with such an investment. In contrast, there may not be the same cost savings associated with next generation access networks.

The extensive literature on the investments costs associated with next generation fibre access networks, such as fibre to the node, curb, or home — referred to generically as "FTTx" — suggests that there are likely to be high costs and risks due to the uncertainty surrounding future technology standards and customer demand for new services. Some technology such as PON by nature is difficult to unbundle retrospectively in the way that copper can be with UCLL. More expensive technologies such as P2P are able to be unbundled but are generally more expensive to deploy. Aside from fibre, there are a number of alternative technologies capable of supporting next generation networks. These include, coax-based cable, mobile and fixed wireless networks. The cost drivers or supply-side factors for operators undertaking access investments in different technologies will depend on such things as, the current state of the access network architecture, the relative network costs, population density (for economies of scope and scale), geo-typical restrictions, and building standards.

In addition to the costs associated with upgrade of core network equipment, management systems, and access networks, such things as in-house wiring, drop leads and customer premises equipment (CPE) may also have a major impact on the cost of providing end-to-end high quality services. The construction cost at the end-users location and CPE costs will need to be taken into account any cost analysis of the deployment of next generation network, as on a per customers basis, these elements may account for a significant share of the total investment cost. In particular, at the beginning of investment cycles where standards are not defined by the industry as a whole, these can represent a risk for the business case of a single operator.

For operators and regulators, the existing principles of cost causality are still likely to remain valid in a NGN environment. However, new cost drivers may need to be taken into account. For example, for cost-based pricing and cost recovery purposes, the higher proportion of common costs resulting from the multi-service NGN IP core network will need to be attributed across services or service bundles. Traditional cost drivers such as minutes, volumes or distance may also be less relevant, while other new drivers such as capacity, number of packets, delay, priority and coverage, could become more important for pricing structures within an NGN context.

Question 23

Beyond the costs for NGN core, access, CPE and drop lead, are there additional costing elements to be taken into account? If so, what is their likely impact?

Question 24
Do you agree that in an NGN environment, a higher proportion of cost of the network is shared in common cost? What in you view is the best method for allocating costs, i.e., should it be based on volume, minutes or new drivers such as capacity?

Question 25

What is your view on the benefits and constraints of PON (Passive Optical Network) and P2P (Point to Point)?

Impact on Interconnection & Access

As in the PSTN world, in order to assess pricing, it is useful to draw a line between *interconnection* and *access services*[26]. For the purposes of this paper the term *interconnection* relates to a service that allows different

[26] While this distinction is useful, in practice the PSTN interconnection has often involved an overlap between the two services, as interconnection has included a share of access services (carriage of traffic).

network operators to interconnect with each other. *Access* on the other hand relates to a service which is designed to carry traffic between the point of interconnection to another handover point (transit or transport) or to the final destination (termination), for example an end-customer. There are some important differences between interconnection in PSTN and NGN/IP-based networks, which need to be addressed as new networks with new technological characteristics are built.

The focus of PSTN networks is on voice services, where transport and services are combined and usually not provided separately. In contrast, IP-based networks are designed to deliver multiple services and a differentiation between the transport and the application layer is possible. One implication of this is that transport and service interconnection can be provided separately.

A specific feature of traditional PSTN networks is that the phone number[27] is generally assigned to the operator that provides the service to its customer, whereas in an IP world the service provider controls the necessary routing information but usually does not provide the physical transport of a service. This feature could potentially have an impact on the termination of a service, depending on how connectivity for transport is shaped (eg., best-effort versus real-time services).

A contentious issue in telecommunications is related to the wholesale pricing mechanisms that apply for interconnection and access to bottleneck infrastructures and services. In PSTN networks there has been the traditional regulation of the "termination bottleneck", where the operator terminating a call charges the originating operator a termination fee, usually based on a mechanism called *Calling Party Network Pays* (which is described below). While it is unclear what the predominant charging mechanism in an all-IP world might look like, it is worthwhile noting that unlike PSTN interconnection, the current IP-interconnection arrangements for the public Internet are commercially negotiated and involve no regulation. The commercially negotiated IP-interconnection arrangement are based on a mechanism called *Bill and Keep* or *Receiving Party Network Pays* (which are both described below). The migration from traditional PSTN to IP-based networks will inevitably lead to discussions around the appropriate charging mechanisms.

There are three different concepts that have generally been applied:

> *Calling party (network) pays (CPP)*: The calling party (or the sending party's network) pays the network of the party receiving a service. CPP is commonly used for fixed and mobile services. Under a CPP arrangement the termination monopoly is likely to continue to persist as long as there is only one operator terminating a call to a single customer. A CPP regime can be either based on Element Based Charging (EBC – prices according to network elements used) or alternatively on Capacity Based Charging (CBC – prices according to maximum capacity used by the requesting operator).
>
> *Receiving party pays (RPP)*: The receiving party (or receiving party's network) pays the calling party's network for interconnection but bears the cost of termination on its own network. This has been used for mobile voice interconnection in the US. In the absence of competition in the retail market, the application of RPP may require some form of retail price control. This could be the case in remote areas where end-customers cannot choose between different competing infrastructures.
>
> *Bill and Keep (B&K)*: Neither the sending nor receiving parties' network pays the other (but importantly this does not imply interconnection at no costs). B&K can reduce incentives to rely on arbitrage to maximise payments from other carriers, and is significantly less costly and complicated to implement than other forms of pricing. B&K has been an important principle in the establishment and development of the Public Internet, and today takes place in the form of "peering", where no charge is paid for termination. That is, network operator A terminates its network traffic coming from network B at no charge, and vice versa. The network covers its own costs for traffic in both directions.[28] At the retail level, the end-user's internet access rates include payment for connectivity and the option to receive and transmit data[29]. However for B&K to operate efficiently, it is essential to know what part of the end-to-

[27] Often referred to as the E.164 number standard.
[28] In this sense, at the retail level, B&K is also related to the RPP principle
[29] On the retail level there are usually flat fees applied, but there exist also charging mechanisms based on data volume.

end service is called “termination” and at what point traffic is handed over to the terminating operator. B&K may lead to the “hot potato routing” problem. That is, in a peering arrangement as networks incur the cost of IP traffic on their network, they have an incentive to transfer the traffic at the nearest point of interconnection possible. This short exit strategy leads to costs being pushed onto the other network, and these higher costs are not accounted for as the zero interconnection fee remains. There is subsequently the potential for costs to be under-recovered, leading to network underinvestment.

Beside the potential interconnection charging mechanisms outlined above, there are a number of other possible charging systems, usually involving a blend of the concepts described above. Furthermore, as the use of CPP or RPP wholesale charging will generally have an impact on the retail pricing structure, this needs to be into account when assessing the alternative options for the appropriate charging mechanism.

Charging mechanisms based on a B&K seem to have become increasingly popular for interconnection, as empirical data suggests that usage will be higher and prices lower than under the alternative interconnection agreements. By applying B&K for the terminating segment in an NGN world, the termination bottleneck for transport could potentially be avoided, given that there is sufficient competition at the retail level.

Question 26

Do you agree with the generic definition of the terms interconnection and access? If not, what would be the alternative definitions?

Question 27

Do you agree with the pricing concepts outlined for NGN? What other pricing mechanisms could be applied?

As pointed out above, the location of the handover of traffic as well as the charging mechanism applied will influence the market outcome. In general there is a trade-off between the hot-potato problem and a high number of points of interconnection. As it is possible in an all-IP world to interconnect at the transport level, structural changes may take place, such as the rearrangement of core network nodes (and many network hierarchy levels). These developments are likely to have an impact on the number of points of interconnection moving from PSTN to NGN architectures, traffic costs may become less dependent on distances, bigger “transport pipes” involve greater economies of scale than smaller ones. This combined with a greater centralisation under an NGN architecture tends to justify a reduction of interconnection points compared to the PSTN world.

It has equally been argued that if the network provides sufficient bandwidth and no traffic engineering due to interconnection being needed, it could make sense to have only one point of interconnection. However, it may also be argued that there is an opposing effect to the extent that streaming services require interconnection points to be located closer to the end-user due to higher capacity and traffic demand of new emerging services. In terms of hierarchical structures of a network, the three levels defined for PSTN “local, regional, national” may not be applicable for IP networks as the equivalent equipment is located at a higher level in the network (e.g., BRAS[30]). An all-IP world may provide for even simpler interconnection, as the emergence of Ethernet networks allow local concentrators to facilitate other networks to interconnect easily at the transport level.

[30] BRAS = Broadband Remote Access Server; A BRAS sits at the core of an network, and aggregates user sessions from the access network. It is at the BRAS that policy management and IP Quality of Service (QoS) can be injected.

These developments may lead to an approach where transport and service interconnection may occur at different nodes and hierarchy levels. Given the distinction between the transport and application layer, transport interconnection could occur at a greater number of locations than service interconnection.

Question 28

What additional factors have to be taken into account with regards to point of interconnection in an NGN environment and what is their effect?

Network security, single user identification (or identity management) and interoperability are other key subjects that arise when deploying NGN. These issues are likely to have a major impact in the market or on market players moving forward and therefore should be dealt with carefully.

Other issues

International literature on NGN and the submission received have identified other issues that arise with the migration to NGN. These include:

- management of emergency services;
- the approach taken to spectrum management;
- numbering;
- rights of use of public corridors;
- content – protection of minors etc.

In the New Zealand environment, responsibility for these issues rests with various regulatory and policy agencies.

Question 29

What are the implications for these issues in New Zealand? Are there specific regulatory issues anticipated?

Question 30

What additional factors have to be taken into account and what is their effect?

Section 5 Next Steps

The migration to NGN is likely to result in fundamental changes to the current and future market framework. As such, the Commission is very interested in the views of all stakeholders about the issues raised in this Paper. It is seeking to be informed by all of the current activities that are occurring relating to the NGN in New Zealand.

Central to these will be a NGN conference which will be held on 26 and 27 February 2009 in Auckland. This is designed to facilitate robust market discussions on NGN issues by providing a range of national and international views and a forum for discussion.

The Commission also has a watching brief of the TCF's IP Interconnection Working Party which is seeking to establish a pan industry position on interconnection issues for voice and VPN services delivered over IP networks.

The Commission will release a draft NGN study report for consultation in April 2009. The draft report will include the Commission's views on NGN in New Zealand. That report will be informed by the IP Interconnection Working Party outputs, submissions received to the industry Questionnaire and this Discussion Paper as well as from the discussion arising at the Conference. By understanding the implications and issues of NGN including where current bottlenecks may shift or disappear, the Commission will be more able to consider if and when it should roll-back regulation. The final NGN study report will be released in June 2009.

Annex 1

International Links and Literature on Next Generation Networks, all IP and Convergence

European Regulators Group

ERG Common Statement on Regulatory Principles of IP-IC/NGN Core -
A work program towards a Common Position
http://www.erg.eu.int/doc/publications/erg_08_26_final_ngn_ip_ic_cs_081016.pdf

Supplementary Document to the ERG Common Statement on Regulatory Principles of IP-IC / NGN Core - A work program towards a Common Position

ERG Opinion on Regulatory Principles of NGA
http://www.erg.eu.int/doc/publications/erg07_16rev2_opinion_on_nga.pdf

EU Commission

EU Commission of the European communities. Commission recommendation on regulated access to Next Generation Access Networks
http://ec.europa.eu/information_society/policy/ecomm/doc/library/public_consult/nga/dr_recomm_nga.pdf

Broadband Stakeholders Group – UK

http://www.broadbanduk.org/content/view/66/43/

Costs of deploying fibre based superfast broadband
http://www.broadbanduk.org/component/option,com_docman/task,doc_view/gid,1036/Itemid,63/

Framework for evaluating the value of broadband
http://www.broadbanduk.org/component/option,com_docman/task,doc_view/gid,1009/Itemid,63/

Convergence - understanding the commercial marketplace
http://www.broadbanduk.org/content/view/63/43/

Models for Efficient and Effective public sector intervention in next generation access networks
http://www.broadbanduk.org/component/option,com_docman/task,doc_view/gid,1008/Itemid,63/

OECD

OECD Workshop on fibre investment and policy challenges. Norway April 2008
http://www.oecd.org/document/56/0,3343,en_2649_34225_40460600_1_1_1_1,00.html

Useful Primer on Fibre from the above workshop

http://www.oecd.org/dataoecd/36/27/40460656.pdf

Convergence and Next Generation Networks
http://www.oecd.org/dataoecd/14/52/40869934.pdf
http://www.oecd.org/dataoecd/25/11/40761101.pdf
http://www.oecd.org/document/12/0,3343,en_2649_201185_37392780_1_1_1_1,00.html

Public rights of way for fibre deployment to the home
http://www.oecd.org/dataoecd/49/9/40390753.pdf

Developments in Fibre Technology and investment
http://www.oecd.org/dataoecd/49/8/40390735.pdf

Wissenschaftliches Institut fuer Kommunikationsdienste (WIK)

The Future of IP Interconnection: Technical, Economic and Public Policy Aspects.
http://ec.europa.eu/information_society/policy/ecomm/doc/library/ext_studies/future_ip_intercon/ip_interc on_study_final.pdf

Regulatory Approaches to Next Generation Networks (NGNs):
An International Comparison
http://web.si.umich.edu/tprc/papers/2007/800/Regulatory%20Approaches%20to%20NGNs%20v1.2%20FI NAL.pdf

Regulatory Challenges of NGN
http://www.tk.gov.tr/Etkinlikler/Uluslararasi_Etkinlikler/2007/konferanslar/sunumlar/IIhazar/Dieter.ppt#59 8,1, Regulatory Challenges of Next Generation Networks (NGN)

International Telecommunications Union (ITU)

Link to selected ITU resources and policy papers on NGN
http://www.itu.int/osg/csd/wtpf/wtpf2009/ngn.html

Economic Study of IP Interworking
http://www.itu.int/ITU-
D/treg/Events/Seminars/GSR/GSR07/Documents_presentations/IP%20Interconnection%20-
%20GSMA%20White%20paper%20-%20FINAL.pdf

Workshop on Tariff Polices, Tariff Models and Methodologies for the determination of costs of services provided with NGN. Geneva September 2008
http://www.itu.int/ITU-D/finance/work-cost-tariffs/events/tariff-seminars/Geneva-SG-08/agenda.html

Trends in Telecommunications Reform 2008: Six Degrees of Sharing

http://www.convergedigest.com/regulatory/regulatoryarticle.asp?ID=26045
http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR08/papers.html
http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR08/discussion_papers/Overview_Final_web.pdf

Office for Communication UK – (Ofcom)

Next Generation New Build – September 2008
http://www.ofcom.org.uk/consult/condocs/newbuild/statement/new_build_statement.pdf

Delivering Superfast Broadband in the UK: Setting the Right Policy Framework
http://www.ofcom.org.uk/consult/condocs/nga_future_broadband/

Future Broadband: Policy approach to next generation access - 2008
http://www.ofcom.org.uk/consult/condocs/nga/

2006 document on framework development
http://www.ofcom.org.uk/consult/condocs/nxgnfc/statement/

Ethernet in the Access study and Ethernet line access
http://www.ofcom.org.uk/telecoms/discussnga/eala/eas/
http://www.ofcom.org.uk/telecoms/discussnga/eala/
http://www.ofcom.org.uk/telecoms/discussnga/eala/eas/csmg.pdf
http://www.csmg-global.com/PDFs/TMNG_CSMG_Ethernet%20in%20the%20Access.pdf

Regulatory alternatives to fibre loop unbundling, FTTx Forum, 17 June 2008
http://www.ofcom.org.uk/media/speeches/2008/06/fibre

Irish – Department of Communications, Energy and Natural Resources (DCENR)

Next Generation Broadband Consultation Paper
http://www.dcenr.gov.ie/Communications/Regulation+and+Postal+Division/Public+Consultations/

Commission for Communications Regulation (Comreg) – Irish Telecommunications Regulator

Response to the DCENR consultation paper

http://www.comreg.ie/publications/comreg_s_response_to_dcenr_consultation_on_next_generation_broadband.506.103204.p.html

Report by WIK consulting on Next Generation Bitstream Access
http://www.comreg.ie/publications/wik-consult_report_-_next_generation_bitstream_access.597.102870.p.html

National Communications Authority – Hungary

http://www.nhh.hu/dokumentum.php?cid=16248

BERR – UK Convergence Think Tank
http://www.culture.gov.uk/Convergence/

Convergence Conversations - Deloitte
http://www.deloitte.com/dtt/press_release/0,1014,sid%253D%2526cid%253D140029,00.html

GSMA Evolution to IP
http://www.gsm.org/our-work/public-policy/regulatory-affairs/evolution_to_ip.htm
http://www.gsm.org/documents/ip_intercon_full.pdf

National Telecom Authority of India
Convergence- what is it and what does it mean for the players ?
http://www.tra.gov.eg/convergence/content/89f10a1c-5ca6-4f34-a3e9-bea79489a529/File/NTRA%20Convergence%20Presentation%20March%202007.PDF

Annex 2

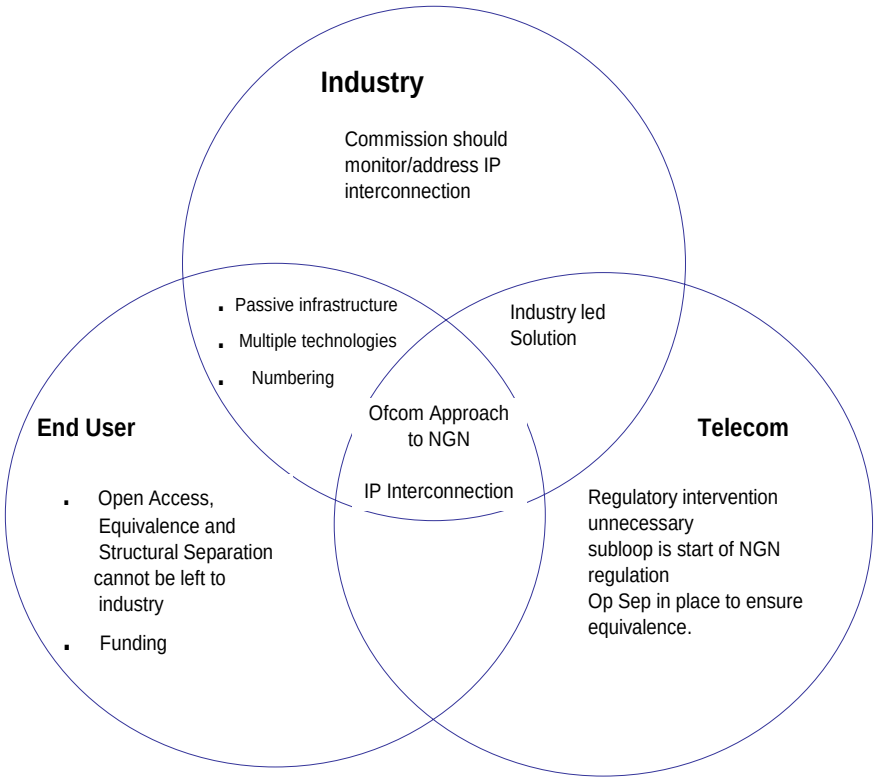
Key Themes from the Industry Questionnaire submissions

This summary provides an overview of the key themes and issues raised in the submissions to the industry questionnaire. Full downloadable copies of the submissions can be found on the Commission web site.

It is noted that the Commission has stated that the study is being undertaken as a strategic study under Section 9A of the Telecommunications Act and is not a signal that the Commission is considering additional regulation. The aim of the questionnaire was to assess the current state of NGN deployment and industry knowledge in New Zealand.

The overall intent of the study is that, by having an informed debate of the issues, industry will be better able to develop an industry led market framework and solutions. Notwithstanding this some parties did submit seeking regulatory solutions. For this reason this overview groups the submissions under general, IP interconnection, technical, commercial and regulatory. This should not be perceived as a change in the Commission's aim to facilitate industry led solutions.

Key Themes Observed



This diagram reflects where there are common views on issues and where there are differences as a result of the perspective the submissions represent.

GENERAL

- Important Commission Initiative which should have specific outputs relating to what if any regulation action should be taken including:
    - Regulator signals
    - Not just adding services to the Act

- Timing of work on future networks and the market framework is important.

Industry	Users
• Industry led solutions should prevail. • TCF self regulatory role is important	• Approach taken by Ofcom from strategic analysis through to detail is a good exemplar of the approach for the Commission. • Commission should consider establishing a 'think tank' similar to Broadband Stakeholders Group in the UK • Intervention should not be delayed. TCF does not represent all parties.

- Operational Separation does not overcome the bottleneck problem entirely. Open Access and Equivalence issues cannot be left to the industry alone to address and resolve.

- Public investment and funding (at both local and central government) need to be taken into account in the study. Regulatory barriers that increase the cost of civil works can act as a barrier to infrastructure build and should also be included in the study.

- Convergence of technology and markets is a key consideration.

IP INTERCONNECTION

- No clear models exist yet of interconnection and service migration.
- Interoperability between service and application systems important.
- Need to review both transport and service level interconnection.
- Peering, number of POI , charging regime and net neutrality are all issues yet to be resolved. A "Big Picture approach" is required.
- There are a number of issues that the TCF cannot resolve e.g., pricing needs to be considered as part of the NGN study

Industry	End Users
Industry led solutions being developed through the TCF should prevail. Advise from the regulator only where industry consensus cannot be reached. Commission to maintain a watching brief and step in when necessary.	Commission should obtain an experts report on IP interconnection. The regulator must have oversight of the market and be ready to address any market issues/ limitations to effective competition. The Commission study should identify areas that may require future regulatory action.

REGULATORY

- Fresh regulatory approaches are required in NGN world. Models, definitions and principles framed in the PSTN context (including IP interconnection) are likely to require amendment – possibly through Schedule 3 of the Act).

- Commission needs to develop clear regulatory principles and framework as there is a risk that any reaction by the regulator to develop a standard may restrict innovation.

- Regulation of passive infrastructure (dark fibre, ducts, etc.,) remains a key feature overseas to ensuring the success of NGN.

- Open access should be at the appropriate layer to retain incentives to invest in the widest possible range of access technologies.

- Regulators prime objective must be to provide a stable environment which will facilitate effective competition and give incentives for private investment.

- "One size does not fit all" – analysis of the New Zealand market must be reflected in solutions.

- Service descriptions in Act can be too prescriptive and restrictive.

- Some regulation is needed – overseas experience shows that a high QoS ethernet bitstream service over FTTx (service-based competition product) is likely to be warranted. Pricing and the description of such a service are unlikely to be resolved quickly by industry and regulatory intervention may be warranted.

- Access to fibre served premises in metropolitan areas is a constraint.

- Emergency Service calls code of practice currently being developed by the TCF – moving forward the successful provision will need wider involvement than the TCF.

COMMERCIAL

- The two commercial models that will need to change with the migration to NGN are IP interconnection and coded and non-coded access.

- Commercial terms need to reflect the potential of service providers to acquire service from a range of network providers.

- Number Management – Commission should look at overseas jurisdictions for guidance. Issues likely to include non-geographic codes, portability, interception and the blurring distinction between fixed and mobile.

- Apportionment of the QoS budget for the delivery of end-to end services will need to be addressed.

TECHNICAL

- Technology neutrality is fundamental to making NGN competitive.

- Common understanding of QoS and defining the user experience and how to support that across multiple networks is an issue that may be resolved via international standards.

- Network topology not technology is the issue. Different topologies may warrant different treatments as the control points may vary for each functional layer. The level of control that access seekers have over QoS, functionality and speed.

- Current spectrum rules need to realise the potential of NGN technologies, e.g., VDSL2 and LTE.

- All networks must meet minimum architecture standards set by the industry.

- IP4 v IP6 is an issue that has gained significant international focus over the last 18 months. IP6 is a service provider/industry issue that government does not need a role in. Timing of migration likely to be consumer driven.

- Interoperability standards laid down in NGN will form the basis of minimum standards of connection for NGAN.

- Technology choices impose unreasonable costs on parties, e.g., the choice of voice technology to interconnect can influence market position and dominance.

Annex 3 Country-by Country Comparisons of NGN Drivers

Country	Country Specific Conditions	Technology	Key Drivers	Regulatory Approach
United Kingdom	• mature IPTV market • costly deployment as infrastructure is mainly underground • good quality copper and length of local loop	FTTH/FTTC/cable upgrades beginning to be deployed.	Expected increase in consumer demand for high speed broadband	Ofcom has developed a framework for action which includes: • provide clarity and consistency on the pricing mechanisms that may be most appropriate for NGA; • work with industry to develop fit for purpose product set, comprising passive (to conduct duct access study) and active remedies (Ethernet ALA); • guidance for public sector intervention; • ensuring equivalence and the Undertakings supports and addresses issues posed by NGA deployment. Ofcom has also produced a statement on the regulatory regime for fibre in new build developments.
United States	Cable infrastructure deployed on large scale	Cable modem FTTH	Competition from cable operators Revenue from IPTV Poor performance of copper and long local loops resulting in exchange based DSL having significant limitations in download and upload speeds Cost savings as a result of cheaper	FCC acknowledged that unbundling can bring competition to markets faster than it might otherwise develop. However, it has decided that excessive network unbundling requirements tend to undermine the incentives of both incumbent operators and new entrants to invest in new facilities and deploy new technologies.
Belgium		FTTC (VDSL2)	Competition from cable operators	Regulation is in place for: • VDSL2 is regulated under the subloop

			Increased revenue from IPTV	and bitstream markets. • Backhaul from cabinet to exchange and Ethernet.
Hong Kong	High urban density (entire population accounts for less than 100 00 buildings)	Combination of copper and fibre or hybrid fibre coaxial (HFC)	Large scale deployment of competing networks	OFTA completely withdrew existing obligations from legacy, copper based local loops (policy should be viewed in context of the territory's high density and coverage of 53% of households by at least 2 access infrastructure networks was deemed sufficient to trigger forbearance of access regulations by OFTA).
France		FTTH – announced in 2006 for main cities by France Telecom and alternative providers (Iliad and Neuf Cegetel) Introduction of VDSL2+ on Frances Telecom's local loop is under study. No operator has announced FTTC yet because France Telecom's subloop is too long.	Competition Reduced cost – ability to access existing infrastructure (Paris sewers) Public intervention through local authorities	ARCEP's approach: • assessing access to existing civil works infrastructure - ARCEP launched 2 public consultations on FttH; - competitive situation concerning access to ducts and possible; regulation of ducts with a view to rolling out high speed broadband local loops. • sharing of the last part of fibre networks.
Germany	Short average loop length	FTTC/VDSL Deutsche Telekom rolling out VDSL (FttC))and ADSL2+ intended to further push IPTV. FTTH - by energy utility (Netcologne)	Competition Customer demand	Germany – Deutsche Telekom actively sought relief from the extension of existing unbundling and wholesale obligation to it's NGN by strongly lobbying for regulatory holidays that it deems indispensable to recoup its investments. Although German regulator agreed but the EC expressed serious doubts regarding the exclusion of VDSL connections from relevant markets as defined by the regulator. Consequently, amendments to their local Telco Act exempting "new and emerging markets" from regulation were introduced.

				Amendments would effectively exempt DT's NGN infrastructure from regulation. EC vehemently disagreed.
Netherlands		FTTC - KPN migrating to full fledge NGN. Plan includes phasing out local exchanges and providing access street cabinets	Competition from LLU Reduced operating – sale of exchange buildings Local Government involvement	OPTA has proposed for the need to provide a "fully fledged alternative" access offer that guarantees connectivity between KPN and the networks of other providers in a way that adequately compensates for the modifications made to current unbundled access offers. KPN has offered to provide an adjusted WBA solution and maintain MDF access to 50% of Dutch households OPTA conducting new market analysis based on KPN's plans.
Korea	Significant number of broadband customers already use next generation access	FTTH	Government intervention	
Japan		FTTH	Reduced cost – telecoms networks have high degree of infrastructure installed overhead Public sector intervention Competitive pressure from electricity companies	MIC has mandated access to fibre deployed by incumbents NTT.