Commerce Commission Conference on Unbundling

Murray Milner

Chief Technology Officer

Telecom New Zealand Limited

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Introduction

1. My name is Murray Milner. I am the Chief Technology Officer for Telecom New Zealand. I have responsibility for Technology Direction across our business. I am also the CTO for AAPT. During my briefings today, I will provide perspectives from a CTO of an incumbent in New Zealand and as a CTO of a new entrant in Australia.

2. This presentation is in three parts:

   Part I: This describes the technology available to provide access from customers to core networks. It contains a description of:

   - the risks of access technology investment;

   - the evolution of data communication and access;

   - the options available for infrastructure based access.

   Part II: This describes the basics of Telecom's Next Generation Network.

   Part III: This describes data access technology:

   - as used by Telecom;

   - as regulated in several overseas countries.

   Part IV: This revisits Telecom's NGN, in the context of the different types of unbundling considered in the Draft Report.

3. I will present each part of the day, with each part fitting in with other information provided by other speakers.

4. My powerpoint presentation illustrates the information I will speak to in each part.

Part I: Technology available for network access

Technology Risk

5. Technology is evolving at a rapid pace, largely in line with Moore's Law and related technology advancement principles:
   - functionality doubles every 18 months for the same cost;
   - optical communication transmission rate doubles every 9-12 months;
   - wireless communication is looking towards a 200 fold increase in functionality over the next 3 years;
   - software is rapidly moving from proprietary closed systems to open, distributed systems with commensurate reductions in cost per million lines of code; and
   - mass storage capacity is doubling every 9 months for the same cost.

6. Furthermore, Moore's Law is expected to continue as one of several key technology drivers for some years to come. Most experts in the field (based on a recent IEEE survey) believe these trends will be true for at least another 10 years.

7. These key technology drivers enable the development of ever more sophisticated technology. This has led to the rapid evolution of all forms of telecommunications technology including optical communications, DSL over copper, broadband wireless and mobile data communications.

8. Furthermore, people want increasingly sophisticated communications. At one stage in our history it was satisfactory to simply send smoke signals. Now voice is no longer the only application that must be supported - we must support all forms of multimedia applications and their associated content. Now it is essential to support a whole new set of voice data and video services within the modern telecommunications industry.

9. Driven by the above trends, today the telecommunications industry is going through a once in roughly 25 year transition. Back in the early 1980's, we made a transition from analogue to digital. This was a turning point in the evolution of telecommunications. The enormous advances in communications emerging over the last 20 years are all derived from this change.

10. Today we are entering the next momentous transition in telecommunications. This is the transition from digital to packet communications. This transition has been foreshadowed for the last 5 or so years, but it is only recently that the technology has become sufficiently mature to enable a complete transition from digital to packet technology in a scaleable, reliable and cost effective manner.

11. These major transitions in the industry are not driven by Telecom New Zealand - they are driven by global forces which can be sourced back to the two critical trends identified previously:

    - technology evolution focussed around Moore’s Law; and
    - the willingness of people to pay for and use the new services that the technology can deliver.

12. If we are to remain competitive and aligned to global telecommunications best practice, we MUST evolve along this globally defined path. However, it must be stressed that keeping up with technology change is by no means a simple task - it is highly risky for investment and must be managed extremely carefully as my colleague Stephen Crombie will describe later in the day.

13. Let’s look at an example of the risks involved. Digital Subscriber Line (DSL) technology has only been in existence for around 10 years. Telecom first invested in the first variant of DSL

back in the early 1990's - called High Speed DSL (HDSL). This technology provides the basis for the access for Digital Data Services. However, by the late 1990's a completely new variant of this technology had been developed and standardised. Hence, in 1998 we invested in scale deployment of the first generation of ADSL. Even then, in 1999, we had to replace most of the equipment deployed during 1998 to upgrade it to the newer standardised version of ADSL. In 2001 we started deploying the next version of g.HDSL equipment which offers symmetric upstream and downstream bit rates. This first generation of DSL equipment has been found to be excellent for the provision of standard fast internet grade services. However, it has major limitations for the provision of:

- high grade business broadband services that require differentiated quality of service (I will explain this concept in more detail later); and
- broadcast video type services that require multicast capability.

14. Hence in late 2002, we started deploying a new generation of DSL equipment. This equipment has the ability to overcome the two limitations identified above, but these fixes do come at a cost. There is also now a partial upgrade path for our first generation DSL equipment, but again it comes at a cost. In all cases, the capability within the equipment itself is not the only cost involved. As the services become more complex, so do the Support Systems to ensure a good customer experience. Even with these upgrades we still need to take another step if we want to deliver broadcast video and video on demand services. Neither generation of DSL equipment supports multicast capability without further upgrades. Again, an upgrade path is available for our second generation DSL equipment at a cost and with the provision of appropriate support systems.

15. Then there are the plethora of new standards emerging for DSL, to achieve even higher bitrates, both symmetric and asymmetric. Some of these are shown on the associated slide.

16. Hence it can be seen that deployment of technology today, in a rapidly advancing technology environment is inherently risky. Essentially, all technology has its risks. Some technology choices result in complete dead-ends with premature removal being the only option. A good example of this was our deployment of 70,000 lines of First Media capability in the mid 1990s at a cost of about $80 million. In the end, new versions of DSL technologies combined with the complexities of content acquisition drove Telecom to abandon this deployment about 2 years after the commencement. Other choices offer upgrade paths, but those upgrade paths can be very expensive and hence, are highly dependent on the market risk one is willing to accept before investment to add the new features. The continual question is does the market risk warrant the additional investment?

17. At the moment, we have the option to stay with current best efforts internet capability over DSL for the provision of services to the business market or the consumer market or both. This is the alternative to investing in the upgrade options. We can also make similar choices with respect to the multicast capability for video. We will only make these choices if the market conditions are not right. This may also mean that it might only be appropriate to invest to meet the needs of selected market segments, rather than the entire market.

18. Given these basic trends, the associated technology and market risks, the outcome of any longer term technology plan is not determined. It will be continually adjusted to reflect the risks visible at the time various choices are made.

Data Communications

19. Now let's look at data communications evolution in more detail. Data communications has evolved over the last 30 or so years from the use of simple low speed audible tone based modems (50 bit/s to 9.6kbits/s) over voice grade analogue circuits to sophisticated multi-gigabit speeds over fibre optics. During this period, the way in which the data has been formatted for carriage has evolved from simple circuit based (eg. an analogue voice channel),

through to Time Division Multiplexed (TDM) circuit based (eg. A 64 kbit/s or 2 Mbit/s TDM bitstream channel) and onto various forms of packet based channels (eg. x.25, frame relay, ATM and most recently IP).

20. The reason for the evolution is quite simple - the drive for speed of transmission to support an ever widening array of multimedia based applications, combined with the peaky nature of this data traffic.

21. Audible tone based transmission is limited by the voice bandwidth of an analogue line - typically 3kHz. This limits the peak bandwidth on an analogue line to 56kbit/s using today's best technology. Furthermore, because of the peaky nature of data communication, the average throughput on such data connection is only a few kbit/s (typically <5kbit/s). In many applications (as illustrated) the peak to average ration can be as high as 100:1 or more.

22. When this type of modem based communication is put through a TDM based digital switch, each modem data stream is put through an analogue to digital converter and converted to 1s and 0s and put into a 64kbit/s digital channel. In a typical switch many of these 64kbit/s channels are time division multiplexed together onto a multiple 2Mbit/s trunks, with one 64kbit/s channel within the trunk allocated for synchronisation and signalling traffic.

23. If we look at the traffic streams resulting from dial-up modem traffic on 64kbit/s channels across the PSTN, we find that the utilisation of these channels is extremely low - typically less that 10% utilisation of the 64 kbit/s channel capacity. Alternatively, if we were to take the same volume of traffic and put it efficiently into packets and statistically multiplex the packets we would find that the same amount of bandwidth could support around 10 times the equivalent dial up traffic (as illustrated). This example shows the value of moving from TDM based circuit switched data to packet based data.

24. Several forms of packet data have emerged since about 1975. The first commercially deployed packet structure was X.25. This is still in limited use today for low speed data applications such as EFTPOS, Alarm Transport, Telemetry, Lotto, etc. However, it has significant limitations in terms of speed, being typically limited to below 128 kbit/s. The next form of packet communications to be widely commercialised was frame relay. This technology utilised longer packets and a more efficient packet structure which enabled data rates of 2Mbit/s and beyond to be achieved. This technology has proven to be very popular for business wide area networking as it provides adequate speed and supports a wide range of applications with adequate quality. It is still in widespread use today and is expected to peak in terms of global volumes over the next year or so.

25. Asynchronous Transfer Mode (ATM) is the next packet based technology to emerge in commercial deployment in the late 1980s. It has short packets, or cells as they are referred to, and is designed to support multiple services over a single bearer. The short cells enable the carriage of voice traffic very effectively, but can also carry all forms of data including video with reasonable efficiency and at speeds up to gigabit/s rates. Most telcos worldwide have significant deployments of ATM equipment, and Telecom New Zealand is no exception. ATM will remain in the network for some time to come as several access technologies, such as DSL and broadband wireless such as LMDS, use ATM as the base layer 2 transport technology.

26. However, ATM has not found favour in the customer Local Area Networking (LAN) environment. Instead another packet based technology has taken the lead in this sphere – a packet based technology, which uses Internet Protocol (IP). This packet based technology also emerged as the technology of choice for the Internet during the 1980s and flowed into widespread commercial use during the late 1990s.

27. In its basic form it is designed for interactive communication, wherein a client sends a request for information to a server, and the server sends back the requested information to the server. It is a very robust communications protocol as it was designed to meet the military scenario of

a wide area network under attack during a nuclear war. IP packets contain the destination address within the packet header and hence, will effectively seek a route to the end destination no matter how complex the route (as might be the case when parts of a network have been destroyed by a series of nuclear blasts).

28. In addition, unlike most other packet type communications protocols, the IP protocol, when combined with the TCP protocol, is robust under the situation of packets arriving at the destination end of a link out of order. The packets are kept in storage until sufficient packets arrive for the TCP protocol to reorder them and send them to the application for processing. Both these attributes are great for use in the public internet where requests for pages are sent out into the network from a user, wherein typically the user has no idea where the source of the information resides and which route around the globe the packets must go to reach this destination. The user simply sends out the request with the destination address defined in the packet headers, and the network then finds the destination by whatever route exists at that time. If parts of the network are congested the packets will simply find another route to the destination (within some limits). When the limits are reached, the packets are simply dropped and the TCP protocol takes over when it finds that a packet is missing after some delay in its storage buffer. It then simply sends out an automated request back to the source address (also contained within the packet header) and requests that the missing packets be resent. This is an ideal set of attributes for the delivery of a capability such as the public internet.

29. However, good as these attributes of the Internet protocol are, they have some distinct limitations. Some types of communication don't like to arrive at the end destination out of order. Others don't like to have packets dropped on the way to the end destination, even if they are resent. Others don't like being stored for a period in a buffer while being processed by the TCP protocol. In particular, voice is an application that doesn't respond well to any of these anomalies. Voice is a realtime communications service, so it doesn't respond well to:

- transmission delay (remember the difficulty of talking over a satellite voice connection);
- packets being received out of order (because the realtime requirement prevents the TCP protocol from doing its job, the packets end up being presented out of order and the speech becomes garbled); or
- packet loss (again, due to the inability of the TCP protocol to do its job, the lost packets remain lost and the voice again becomes garbled).

30. Other applications such as video, citrix, SAP, etc, are all impacted by one or more of the anomalies identified for voice. This means that we must implement a Quality of Service regime over the top of the basic IP packet layer. I will return to this issue later.

Infrastructure Based Access Options

31. Now that we have some background in data communications, lets look at the central issue of access deployment for the carriage of broadband data communications.

32. Access development in telecommunications today is all about the density Mbit/s per square kilometre required by people and businesses within a given geography. If we look at a simple model which helps portray this concept, we can divide all access situations into 4 broad quadrants as follows:
1. High / medium usage, with low density of sites (eg. A rural milk processing plant).
2. High / medium usage, with high density of sites (eg. The CBD or an industrial park).
3. Medium / low usage, with high density of sites (eg. Suburban residential development).
4. Medium / low usage, with low density of sites (eg. Rural residential New Zealand).

33. If I firstly put my hat on as the CTO of an incumbent operator, which comes from a position of having a high market share in all quadrants and typically has some form of universal service obligation to ensure the provision in quadrant 4, then I take one approach. In this case, I will generally aim to provide service across all of these quadrants and I will choose the best

technology to meet the needs of each quadrant, given my past legacy – typically this will result in the following outcome:

1. Fibre and high capacity wireless
2. Fibre and DSL over cooper
3. DSL over copper
4. DSL over cooper and broadband point to multipoint wireless, with satellite for the most remote customers.

34. Not surprisingly, this is exactly the access deployment approach being taken by Telecom New Zealand and in fact Telstra in Australia.

35. On the other hand, if I now put my hat on as CTO of a new entrant in a given geography, as I do as CTO for AAPT in Australia, I will take a totally different approach. Any new entrant to a market will start off business with a low market share in terms of sites served in all of the 4 quadrants. However, the advantage that the new entrant has is that it can select which markets it wishes to address and these will typically be the high value ones. The obvious starting point is selected areas within quadrant 2, with some evolution into quadrants 1 and 3 as they create synergies off the primary areas in quadrant 2. This will lead to the following technology preferences:

1. Point to point DMR to selected customers
2. Fibre and broadband wireless to selected areas such as CBDs, business parks and other concentrations of commercial sites
3. Broadband wireless to selected groups of high value customers and "spillover" from quadrant 2
4. Don't go there unless there is some incentive (eg. PROBE) or some synergy with the quadrant 2 activity (eg. Counties Power synergy with their Electricity business).

36. New entrant deployment will often start with high site broadband wireless coverage of selected areas (eg BCL, Pacific.Net and to a lesser extent Woosh). This approach leads to maximum market coverage at lowest up front fixed cost. BCL claim to have coverage of 600,000 customer sites from 28 high altitude wireless sites. However, the downside of this approach is that the incremental costs can be high for this model, and eventually if you acquire a large customer take-up within the coverage area, then the Mbit/s available to each customer become small. This latter distinction is a prime difference between wireless and wired access technologies – in the case of wired technologies the access is dedicated to an individual customer, where as in the wireless case the capacity is shared between all customers within the range of a given transmitter.

37. In order to overcome the two limitations mentioned above, as customers take up service the next step is to move to a low site broadband wireless approach, to offer improved capability often at lower incremental cost. More sites are required, which increases fixed costs, but the fixed costs are targeted to geographic areas where customer take-up is the highest, so achieving the best possible economics of scale. This is typically the approach taken by most cellular operators as they grow their cellular network to match the growth in customers. Vodafone have demonstrated their ability to execute this approach very successfully.

(Vodafone example)

38. As take up improves further it will be possible to identify small areas of significant take-up and bandwidth requirements - HOT SPOTS - these are areas with high bandwidth density.

39. Once Hot Spots are identified it can be economical to roll out fibre based solutions to these areas. The fibre might be direct to end customer sites and / or provide backhaul to some other last few hundred metres access technology such as:

- DSL over ULL extension to fibre
- Wireless LAN extensions to fibre
- Free Space Optics extension to fibre

40. In some circumstances, the above extension technologies might also be used in conjunction with broadband wireless backhaul (e.g. with LMDS).

41. Now let us look at the costs of some of these alternatives. BCL Wireless is a good example of a high site wireless technology and its cost structure is illustrated at paragraphs 321 - 335 of the Telecom submission. Woosh is a good example of a low site wireless technology and its cost structure is illustrated at paragraphs 223 - 241 of the Telecom submission. Fibre costs are very much dependent on the geographic situation involved. However, based on the multiple fibre deployment in the CBDs of most NZ cities it must be economical (eg Telecom, TelstraClear, CityLink etc). Wireless LAN costs using a Vivanti type of offering are described on at paragraph 212 of the Telecom submission.

42. Unbundled copper cost structures are also useful to consider. Telecom has deployed 22 nodes of DSL in Australia using Telstra unbundled copper. Based on the DSL technology available in 2001 the cost structure is as illustrated in the slide. In order to reach marginal cost some hundreds of connections are required on those DSLAMs per exchange site.

43. The above experience is based on the use of DSLAM technology, which was available in 2001. Today mini DSLAM technology is available, which has a much lower fixed cost and slightly higher variable cost. With a careful management of co-location and backhaul costs, our most recent analysis of costs for deployment of a mini DSLAM in the Australian ULL environment is as shown in the slide. Given these conditions it is looking to be practical to deploy a mini DSLAM on unbundled copper for around 10 connections of high grade broadband access, within an exchange area.

44. However, as indicated previously, if unbundled copper was not available, then we would use any one of the alternatives identified above.

45. Using such a mixture of technologies in an appropriate and well-managed manner can lead to an economic market entry / growth model for new entrants.

46. The hybrid model is clearly implemented by Counties Power in their rollout. Woosh and BCL are currently at the initial stages of their broadband wireless rollout and are showing signs of heading down this path. Many successful examples of this model are emerging around the world.

As the broadband wireless technologies become more capable, this model is expected to become more successful for the new entrants. The IEEE 802.16 standard offers great potential for use in this way, especially now that IBM is backing the chip development for this technology. Scale deployments of this technology are expected during 2004. Another very promising technology is that which is being defined under the IEEE 802.20 umbrella. This technology should be deployed in scale during 2005. These new developments combined with the evolution of existing wireless technologies suggests that broadband wireless offers great potential for successful new entrant business models going forward.

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Part II: Next Generation Network Basics

47. In previous sessions we have discussed:

- The opportunities and risks offered by rapidly evolving technology;
- The emergence of packet based communication as the prime form of communications for the next decade or so; and
- The types of access infrastructure that are being established by service providers, with a special emphasis on that being deployed by new entrants.

48. The fundamental building block for this new network is the Internet Protocol, which I described in a previous session today. In the case of the NGN though, we use the IP protocol in a particular manner. We create an environment wherein we can control the IP packets as they traverse the network from source to destination. This environment we call the managed or private IP network as compared to the alternative unmanaged or public IP network, which is the Internet as we know it today. Furthermore, we enable both of these IP environments to interact in a flexible manner, while always ensuring that the security and unmanaged aspects of the public IP network do not effect the determined characteristics of the private IP network. In both cases we use the Internet Protocol as the "service integrator" for voice data and video communications and we minimise the distinctions between fixed or mobile access. In addition, in the private IP network we aim to ensure that we have management control of the IP packets as they traverse the network from source to destination. In the public IP network this is impossible to achieve with any degree of certainty.

49. I would now like to build on this platform and describe the basic drivers and key components of the Telecom Next Generation Network (NGN). Telecom has made it quite clear in many public forums that this is its plan for the future delivery of rich mix of telecommunications services over the next several years. It will also be the platform for the replacement of most of our existing legacy voice and data platforms, including the Public Switched Telephone Network (PSTN). **Telecom is implementing a Multi-services packet based network of the future.**

50. As a result of this approach to IP networking, we create a network which uses the private and public IP networks in a complementary manner, with applications divided between these two domains in a manner which optimises the value of each. For example, a web browsing application which requires access to information across the globe is obviously best suited to the public IP network. On the other hand, if we wish to offer a simple and convenient telephone service which is highly reliable and offers guaranteed speech quality all the time, we will use the private IP network. Telecom is making its private IP network capable of supporting a wide range of multi-media applications, including realtime applications and business critical applications. These will be complemented by applications supported on the public internet.

51. Furthermore, the NGN will support any form of terminal to access these applications. This includes standard voice terminals through to TVs, PCs and Games consoles. These devices can be single media such as a simple telephone, EFTPOS terminal or fax machine or can be multi-service such as a PC or a modern mobile terminal. These devices can be connected to the network by a copper, fibre or wireless link and the wireless link can be fixed or mobile.

52. The network will also include a number of middleware type capabilities to perform special functions which enhance the communication experience within the private IP network. These include such things as:

- Quality of Service policy management and associated Service Level Agreement management;
- a full suite of security services, including authentication, authorisation, accounting and auditing, combined with directory services, user profile management, firewall services and intrusion detection;
- Digital Rights Management (DRM) for the management of content and the settlement processes associated with content providers;
- storage for a wide range of applications, including Video on Demand, hosting of our own applications, hosting of third party applications, hosting of customer applications, backup and archival services, etc; and
- transaction management capability to assist the management of transactions across the network including signalling, network management, EFTPOS transactions, Alarm transactions, telemetry transactions, etc.

53. Having provided a brief overview of the Next Generation Network, I now want to emphasise a few of its characteristics which make it quite different from historical networks.

54. Firstly, this is a single physical network, which supports many services. If we look at a traditional method of providing services to meet the needs of a Service Station for example, we end up with the need to connect to multiple semi-independent networks each supporting a single service and each one requiring a separate access. For example, a Service Station requiring 5 different services:

- Voice telephony;
- Fire Alarm monitoring;
- EFTPOS;
- Point of Sale and inventory management with a supply chain; and
- Secure banking transactions.

55. Would require access to 6 different networks and would have the services delivered over 4 independent forms of access. It is also likely that these services would be requested asynchronously in time, thus requiring multiple truck rolls to install the different access based capabilities.

56. The equivalent scenario when service is delivered via the NGN is quite different. In this case the customer is supplied with a single access, sized to meet the expected 2-3 year needs of the customer site. The options will include:

- 2 Mbit/s Etherent over DSL
- 10Mbit/s Ethernet over DSL, Fibre or wireless
- 100 Mbit/s Ethernet over Fibre or Wireless
- 1000 Mbit/s Ethernet over Fibre

57. It may also include some mobile wireless access for telemetry or mobile working applications, which will be fully integrated into the basic service set. In most of the above cases, the customer can request diverse access for increased resiliency if the set of applications require such robustness.

58. Once the access is provided, requiring a single truck roll, then the services required by the customer are delivered across the multi-service access under software control from the private IP network. The customer can choose any number of services – either fulltime or on demand – until the access pipe is filled up (this won't occur for several years if the dimensioning rules are applied correctly) at which time another truck roll would be required to upgrade the access pipe. The services can be selected by the customer from a wide array, some of which will be delivered within the private IP network and some of which will be delivered across the Public IP network. Telecom can continue to add services as demand requires by simply adding addition servers itself or providing access to servers from third parties.

59. Within this scenario of multi-service access, the choice of access type becomes largely a matter of bandwidth required verses the coverage required. If large bandwidth is required to one or more fixed desktops in a relatively confined area, then the obvious solution is fibre. If the same location has a need for people to be more mobile but still confined within say a building or campus, then Wireless LAN capability might be the best option. If the bandwidth requirements are modest, such as at a branch office of a corporate or at a small business or in the home, then DSL over copper might be the best answer. For a new entrant, wireless would obviously be the best choice as discussed earlier.

60. When I carry around my PDA, my mobile phone and my laptop computer, the best form of communication between these devices is a Personal local Area Network (PLAN). This is best supported by a technology such as Bluetooth. Then when I am away from the office or the home, I need a mobile communications capability such as 2G or 3G cellular.

61. To the greatest extent possible, the services offered over the NGN should be independent of the medium used to carry the services. Today some technologies have greater challenges than others in meeting all the needs of a multi-service access environment. However, all access technologies are converging over time towards the same point.

62. In order to make the multi-service delivery over a single access provide the quality required by customers, we must implement Quality of Service differentiation across the Private IP network (we can't do this across the Public IP network as we have no control over how the IP packets traverse the Public IP network). Some services such as Web browsing, do no require any special QoS requirements, as explained earlier, and so this type of application can be classified as "Best Efforts" (we simply let the TCP/IP protocol do its work and supply sufficient bandwidth to deliver the required user experience). Email is a good example of a service which requires neither bandwidth nor QoS performance guarantees. Voice on the other hand, as explained earlier, definitely does need QoS guarantees, or the quality will be highly variable – becoming unintelligible as the latency, jitter or packet loss exceed certain limits. Video is also very sensitive to packet loss and business applications such as Citrix are sensitive to latency, jitter and packet loss as is voice.

63. Now there are those that say that QoS can be readily managed by simply providing more bandwidth. This is indeed true, however, in a multi-service access environment this solution is very expensive to deliver. It is much more economical, particularly for the residential market to provide QoS differentiation and support a regime of performance guarantees.

64. The other key aspect of the Next Generation Network is that it supports all customers and all services across a single integrated physical network and IT infrastructure. This approach enables maximisation of the benefits of economies of scope and scale. In order to ensure that the various services and customers using this single infrastructure can be logically separated, so that everyone does not have access to everyone else's information and applications, it is necessary to partition the network into a large number of zones, or "Virtual Private Networks" – we usually refer to these as IP-VPNs. The single private IP network infrastructure is structured so that any customer that wants a private network gets a logically partition piece of the network configured as an IP-VPN. All the packets from all the customers are still using the one infrastructure, but packets from one customer are securely separated from the packets

from all other customers. Only if a customer actually wants to communicate with another customer will the boundaries of the IP-VPN be broken under strictly controlled conditions so that the interchange can occur – this is called extranet communications or the provision of community of interest services.

65. Similarly, The Private IP Network is also logically divided to support various specific applications. For example, the PSTN of the future simply becomes one or a number of IP-VPNs incorporating special call server application capability. Other service specific IP-VPNs will include, audio conferencing, video conferencing, EFTPOS transactions, security surveillance, etc. Again all of the service specific IP-VPNs use the common Private IP Network infrastructure.

66. Once we bring all the above components together, we can see how they deliver rich business and residential telecommunications solutions for our customers. Russell Locke will talk about this in more detail shortly, but I will provide a brief introductory overview of what the picture will look like.

67. In the Business, IP-VPNs will provide integrated services connecting both large and small offices. This will include the major administration offices, data centres and distribution centres and the smaller branch and remote offices. Communications between all of these disparate parts of a business will be seamless for all applications, including multi-media applications. In addition, there will be controlled access to the Public IP network through appropriate security devices. However, the end user experience will be that the two IP spaces are a single integrated whole. Similarly, the network will support controlled interaction with partners (suppliers and customers) either via the private IP space (more appropriate for suppliers) or via the public IP space (more appropriate for consumers). Remote working solutions will also be easily accommodated. This will include:

- Home working;
- Remote working;
- Mobile work force; and
- Travelling workers.

68. All of these scenarios will be supported with near seamless interaction with company wide applications and information. Furthermore, appropriate security functions can be incorporated to ensure only appropriate information is provided to select people.

69. The residential environment of the future will also be greatly enhanced through the delivery of the Next Generation Network. Using a single DSL connection into the residential premises, we have demonstrated the ability to deliver any combination of the following, simultaneously:

- Multiple voice services
- Video telephony
- Video conferencing
- Remote working
- Fast Internet access
- Interactive gaming
- Broadcast video
- Video on Demand
- Security services
- Home control services

70. This will enable multiple people within the home environment to simultaneously use the telecommunication services that they want to enhance their lives, including:

- Remote working into a corporate Ip-VPN
- Gaming over the internet or into closed user group interactive gaming sites

- Community of interest interaction
- Education services
- Viewing of broadcast TV
- Viewing of interactive video services
- The making of voice and video telephony calls.

71. All this must be compared to the typical broadband connected home of today where it typically only possible for one person to use the telephone and one or two people to access fast internet services. The NGN offers a much richer user experience through multi-service, multi-user access, enabled by the QoS differentiation and IP-VPN architecture.

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Murray Milner
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Part III: Data Access

Data Service Provision in Telecom

72. The Draft Report is not clear about data unbundling. It could be read to include the "access" parts of Telecom's proposed mass market NGN. It appears to ignore the reality of the access services existing in New Zealand in the 2005 - 2008 timeframe. Here we will describe the data services operated by Telecom and explain the engineering implications for the NGN.

73. The typical residential access configurations supported by Telecom are:

- Copper feeder from exchange MDF to street cabinet based cross-connect with copper distribution.
- Multiplex over copper from exchange MDF to street cabinet based remote multiplexer with cooper distribution.
- Fibre feeder cable from exchange OFDF to street cabinet based remote multiplexer with cooper distribution.
- Wireless feeder from exchange MDF to remote radio terminal and multiplex unit with cooper distribution.

74. The above access configurations also apply to business customers, with the following additions:

- Fibre feeder cable from exchange OFDF to street cabinet based optical cross-connect with fibre distribution cable to a customer premises based network terminating unit.
- Multiplex over cooper to a copper cross-connect cabinet.

75. Inside the exchange building these access configurations all enter the building via the cable entry and generally terminate on either the main distribution frame or the optical distribution frame. Analogue voice lines over copper are connected directly to the switch over copper. All other circuits go through some from of terminal equipment before terminating on either a voice switch as a 2Mbit/s multiplexed digital interface or onto a data switch / multiplexer as a multiplexed data stream over copper or fibre.

76. Low speed digital data services (DDS) (64kbit/s and below) typically use copper access, with a type of voice band modem. Higher bit rate services up to 128Kbit/s use predominantly HDSL over copper today. Above 128 Kbit/s, a 2Mbit/s remote multiplexer using some form of line code is used over copper, or the circuit enters the exchange over a fibre access from a remote fibre multiplexer. The entire range of DDS services from 2.4Kbit/s through to 2Mbit/s originally terminated on a circuit cross-connect, where-in the component tributaries were switched across the network in n by 64 Kbit/s channels. The lower bit rate services are multiplexed up to 64Kbit/s for efficient carriage and the cross-connect has capability to extract and inject

these sub-rate tributaries. Several cross-connects are distributed around New Zealand to accommodated geographic reach.

77. The Digital Data Service utilises simple dedicated defined bitstream structures, which are transparent from end to end on any given connection (there are some service variants which include multi-point circuits, but these exceptions will not be considered further here for simplicity). As discussed earlier, this approach provides the customer with a well defined clear channel over which to operate his application. The characteristics of this channel are defined so that the bounds are deterministic (ie. The bit rate is constant from end to end) and this application will use this bandwidth to an efficiency level dependent solely on the application.

78. More recently, the DDS service has been complemented by the introduction of ATM based cross-connects. However, even though in this case, we have introduced a conversion to ATM packets, the ATM switches are configured in “Circuit Emulation” mode and hence, appear to the traffic traversing them to be exactly the same as the circuit switched cross-connects described above.

79. Frame Relay was introduced during the late 1980s to provide improved connectivity capability to support peaky data applications, which achieve very low utilisation efficiency across circuit switched data circuits such as those offered by the DDS. Initially the Frame Relay transmission was configured across an enhancement of our X.25 switching platform. However, today, all Frame Relay traffic is switched across our ATM platform. In this case though, the ATM platform is not configured in its circuit emulation mode, but rather in its stochastic packet mode, which enables bursty data traffic to be carried much more efficiently across a given bandwidth bearer (10-100 times more efficiently) as described earlier.

80. Packet access uses similar access technology to that employed for the DDS. Except that now a Frame Relay Access Device (FRAD) is incorporated at either the customer end of the access link or the exchange end of the customer link. The FRAD converts either IP based packets from the customer LAN environment or circuit based data from the customer premises into Frame Relay packets for transmission across the Wide Area Network (WAN). At the ATM switch the various Frame Relay packet streams from multiple customer sites terminating at that exchange are statistically multiplexed together to create the efficient data carriage. The output of the local ATM switch consists of a multiplexed stream of “Virtual Circuits” consisting of all the packets from all the customers presented to the switch – with one or more virtual circuits per customer site. These virtual circuits for each customer are all prioritised the same through the network and have defined guaranteed performance for each customer in terms of throughput. Typically the guaranteed throughput is defined as some fraction of the peak throughput where the fraction is never greater than 0.5. Under these conditions, there is a finite probability that some high burst packets will need to be buffered and hence delayed (causing jitter) and under some circumstances some packets will be dropped (causing packet loss). The Frame Relay protocol combined with any higher layer protocols are used to address these anomalies when they occur. Under suitable conditions, Frame Relay can be used for the provision of multiple services over a single access, however, because all Frame Relay packets in a given stream are treated equally, there is no way to identify those packets which need to be treated with high priority (such as voice) verses those that require low priority such as web browsing. Hence, the end user experience under multi-service conditions can be variable.

81. The use of IP packets across the network allows much more seamless delivery of multiple services over a single access, by supporting much higher bandwidths, but also brings with it the same set of problems associated with how to manage its limitations relating to QoS differentiation and hence latency, jitter and packet loss by application. Fortunately, the IP packets include mechanisms which enable prioritisation of one packet over another, when they are used correctly. Hence, it is possible to “tag” different packets with different priorities and have those packets treated through the network in different ways. For example, voice packets can be tagged so that they can be routed through the network with priority and hence

have minimum delay (latency), delay variation (jitter) and packet loss relative to all other packets traversing the network.

82. Let's look at how this capability can be used in a Next Generation Network. It is implemented a little differently depending on whether we use fibre access or copper access. In the context of this discussion, I will restrict my comments to DSL over copper.

83. A DSL connected customer comes into the exchange via the cable entry and copper MDF. The copper pair is then cabled to the input port of a DSLAM. At the out put of the DSLAM the DSLAM all the traffic from all DSL enabled customers are aggregated together onto one or more ATM virtual circuits for transmission over the ATM network to the nearest node of ATM aggregation. From this point in the network the virtual circuits are distributed in various directions depending on the functionality to be delivered. If the customer is only using a fast internet service, such as JetStream, then the virtual circuit is terminated on a Virtual router port and routed to the point of interconnection with the public network over an IP-VPN. The actual VPN used depends on the choice the customer has made as to their Internet Service Provider. The virtual router node also includes a number of additional functions, such as Authentication, Authorisation and Accounting.

84. If we look more closely at the logical functions provided by the DSLAM in the Fast Internet scenario initially, we find that the DSLAM simply aggregates all of the traffic from the multiple input ports and directs it to a single virtual circuit. This virtual circuit is effectively designated for best efforts traffic only. It has a high degree of concentration, reflecting the highly bursty nature of internet type traffic. This model applies to all Jetstream type traffic operating on the Telecom network today. For our other DSL based services, we provide a separate virtual circuit for each service. For example. Private Office Networking has a separately defined virtual circuit with quite different concentration characteristics, to reflect the design speed and throughput expectations associated with this service. However, to date, there is no QoS differentiation applied to any of the traffic flowing through any of the DSLAMs.

85. Now let's look at the situation which occurs when the DSLAM is used in a multi-service, multi-user NGN configuration. In this configuration, each DSL customer, will originate multiple IP traffic streams which are tagged with the QoS parameters required for the particular traffic stream. The IP tags are then reflected into appropriate ATM QoS classes for carriage across the DSL to the DSLAM. So for example, if the Telecom was to offer simultaneous voice, video and fast internet services over DSL, then the DSLAM would need to be logically configured to:

- Map all the voice traffic onto a single virtual path on the output of the DSLAM, while retaining the separation of the individual voice customer streams at this stage for security and accounting reasons. All the virtual circuits on this virtual path will be designated for realtime interactive QoS and also come under the direction of voice Call Admission Control.
- Map all the Fast Internet traffic onto a single virtual circuit as previously, with the same QoS class.
- Map all the video traffic onto a single virtual path, while retaining the separation of all the individual video customer streams for accounting reasons. All the virtual circuits on this virtual path will be designated for realtime streaming QoS and come under the direction of the video Session Admission Control.

86. As can be realised, this now creates a much more complex model of aggregated traffic at the output of the DSLAM. Although the Fast Internet traffic can continue to be configured through the network in the same manner as previously, the voice and video traffic must take a much more complex route.

87. Before looking at regulated offerings offshore, it is useful to look at the unregulated wholesale DSL bitstream product offered by Telstra, in the light of this discussion of New Zealand DSL based services. This type of service is not regulated in most places around the world, except

for Europe where it is typically regulated at retail minus type prices. However, it will provide a useful lead-in to the regulated data services discussion to follow.

88. The Telstra DSL based bitstream service consists of three parts:

- the end user access component which includes the DSL tail circuit from the customer to the first ATM aggregation point in the network;
- the interstate aggregated ATM virtual circuit to the ATM Point of Presence; and
- the wholesale ATM service from the ATM POP to the service providers premises.

89. The important feature to note in this structure is that the service is defined at an ATM Point of Presence on a per state basis with traffic from all DSLAMs within a state aggregated into one virtual circuit. In fact, it is possible to have all traffic from across the entire Australian continent aggregated into this one Virtual circuit if this desired. The traffic within the virtual circuit is treated as a Layer 2 tunnel using the Layer 2 tunnelling protocol (L2TP) with one end of the tunnel established within the Telstra network and the other end terminated in the service provider premises. Within the Telstra DSLAMs and ATM aggregation network the traffic from all the customer DSLAMs is concentrated onto a single virtual circuit. Typical aggregation in this model is defined as between 50-100 to 1. As discussed previously, this is an entirely adequate concentration factor for best efforts type internet traffic. Web browsing and email type applications will function entirely adequately. However, many other applications such as voice and video will only function satisfactorily at times of low traffic congestion and certainly there is no way that this form of service offering could be used to deliver multi-service access.

Regulated Data Services Around the World

90. I have provided an overview of the data services offered by Telecom into the retail market in New Zealand. I have also introduced some of the complexity involved in interpreting how the configuration of different services dramatically affects the way in which they perform and hence can be used. I now want to move on to look at the various types of regulated data services that exist around the world. In this section I will show that:

- No other regulator has even attempted to regulate an NGN like our NGN:
- Wherever transparent transmission capacity services (ie Partial Private Circuits) are regulated offshore they are defined in terms of the end service and are, therefore, defined in an asset neutral manner;
- The Commission's proposed form of PDN unbundling, that it has likened to Partial Private Circuits, is different from the regulation of Partial Private Circuits in the UK, the DDAS and DTCS in Australia or DS1 and DS3 loops in the US.

91. In its Draft Report, the Commission compares the form of regulation of the fixed PDN it proposes to the UK's regulated Partial Private Circuits.

92. For the reasons set out in Telecom's submission in response to the Draft Report, we consider that the fixed PDN regulation proposed by the Commission is different from the UK's Partial Private Circuits and comparable regulated data services in other jurisdictions. In fact, by my assessment it appears that the Commission's proposed form of PDN unbundling is different from the PDN regulation in any other jurisdiction.

93. Personally, I am still somewhat confused as to exactly what the Commission means by a PDN. However, based on the Draft Report and as stated clearly in our submission, we have to assume that the Commission's proposed form of PDN unbundling encompasses all of the assets in Telecom's PDN. It would thus include:

- all of the assets an access provider would provide a leased line/Partial Private Circuit over;

- all of the assets used to provide bitstream access (despite the Commission declining to propose in its Draft Report the regulation of bitstream access at retail minus prices); and
- all other assets that make up Telecom's data networks, including assets and networks that are yet to be built,

at cost based prices.

94. Furthermore, the Commission's Draft Report does not make it clear whether, in regulating Telecom's fixed PDN, a distinction should be made between the circuit-based technologies, functionalities and equipment of Telecom's data networks and their packet-based technologies, functionalities and equipment. As I will show, most other jurisdictions do make this distinction (for good reasons) and hence they:

- do not generally regulate packet-based technologies, functionalities and equipment, recognising the inherent risk and complexity of new technology and the importance of protecting the incentive to invest in it by guaranteeing that carriers who deploy it receive a sufficient return for the risks they bear. Instead,

- do regulate circuit based data services provided using legacy equipment and expressed in technologically neutral terms.

95. Where packet-based technologies are regulated in some European countries (such as, the UK's regulated ATM interconnection service, for example), that regulation relates to a simpler and less risky investment than Telecom's NGN, which has not yet been built.

96. I have already provided an in depth description of the differences between circuit based and packet based technologies. This background will be used to draw out the distinctions in what is actually done in various jurisdictions around the world.

Regulated data services in other jurisdictions

97. I will now briefly discuss the overseas approaches to regulating data services, and how the data services provided in other jurisdictions compare with the data services provided by Telecom.

UK

98. In its Draft Report, the Commission compares the form of regulation of the fixed PDN it proposes to the UK's regulated Partial Private Circuits.

99. A Partial Private Circuit is part of an end-to-end leased line. It is: [1]

> "…a generic term used to describe a category of private circuits that terminate at a point of connection between two operators' networks. It is therefore the provision of transparent transmission capacity between a customer's premises and a point of connection between the two operators' networks. It may also be termed a part leased line."

100. A Partial Private Circuit is defined in terms of capacity, for example, a 2 Mbit/s Partial Private Circuit, and are linked to TDM interfaces (ie typically only circuit switching functions of the access provider's network are used to deliver them). The length of the Partial Private Circuit will depend on where the access seeker builds out to.

101. This type of service is closely aligned to the Telecom DDS described earlier in this session. The key difference is that Telecom in its retail service offers the customer tail at the other end of the circuit (ie. the bit that in the Oftel model is provided by the access seeker).

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[1] Oftel, *Final direction on LLU backhaul services*, 8 August 2002, p 16.

102. Oftel has regulated Partial Private Circuits of bandwidths up to and including 155Mbit/s. Oftel considers that regulation of the high bandwidth market (above 155Mbit/s) is not appropriate as it does not consider BT to have significant market power in this market.

103. Partial Private Circuits are defined as a service. They are technology neutral and, as such, are not defined in an asset specific manner. Access to switches is expressly excluded. Partial Private Circuits are regulated in the UK by Oftel at cost oriented prices. This technology neutral stance enables BT to use any form of technology to deliver the service, including circuit emulation over an ATM network.

US

104. The equivalent data services in the US are DS1 loops and DS3 loops. DS1 and DS3 loops are transmission capacity services (a DS1 loop provides transmission capacity of ~1.5Mbit/s and a DS3 ~45Mbit/s). They are also defined in terms of TDM network functions and capacity. Typically, therefore, only the circuit switching functions of the access provider's network are used to deliver them. They are regulated at cost orientated prices.

Australia

105. In Australia, there are two equivalent regulated data services - the Digital Data Access Service ("**DDAS**") and the Domestic Transmission Capacity Service ("**DTCS**"). The DDAS provides transparent transmission capacity (between a point of interconnection and an end user's premises) at various capacities (from 1200 bit/s to 48 Kbit/s) and using various TDM interfaces.[2] At the point of interconnection, access seekers receive a transparent "data tail", which they can connect to their network by way of interworking. Telstra provides a commercial service based on the specifications of the DDAS. This service is based on very similar technology to that used by Telecom in its DDS and hence provides very similar service attributes.

106. The other regulated data service in Australia is the DTCS. The DTCS provides transparent 2 Mbit/s transmission capacity between a point of interconnection and an end user's premises, and between points of interconnection[3] - except for intercapital transmission routes, which the ACCC held, in 1998, to be competitive. It is a generic service that can be used for the carriage of voice, data or other communications. Access seekers can use the transmission capacity provided to set up their own network for aggregated voice or data channels, or for integrated data traffic (such as voice, video and data). Access seekers who wish to use bandwidth of a capacity greater than 2 Mbit/s can combine groupings of the declared capacity of 2 Mbit/s. The ACCC is currently conducting a public inquiry to review the declaration of the DTCS.

107. The key point about all of these services is that (despite some differences in technical jargon and service description) they are asset neutral, and are not based on the physical network architecture. They are also both designed exclusively around the use of circuit based TDM point to point transport technology. Hence they are simple to define and simple to implement, compared to the complexities of packet based equivalents. Of course, packet based services can be run over these circuits, by providing the appropriate terminal equipment on each end. QoS differentiation can even be applied on a given circuit if it is supported by the terminal equipment on each end of the link. However, the link itself is simply a deterministic bandwidth pipe. The access seeker needs to invest in the equipment on each end of the pipe and the associated support systems to make it do smart things, like provide multi-service, multi-user access services.

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[2] See ACCC, *Register of Declared Services*.

[3] See ACCC, *Register of Declared Services*.

Regulated Packetised Functions/Elements

108. From the above brief overview, combined with more comprehensive material in our submission it should be clear that most regulated services offered in various global markets today are simple circuit based TDM defined bandwidth pipes. However, some regulated packet based services do exist in some countries.

109. The European Union has specified the "Wholesale Broadband Access Market" as a market which the various National Regulatory Authorities of EU member states are required to assess in their alignment of national regulation with the new EU regulatory framework. Accordingly, the regulation of EU member states is currently in a state of flux as the various regulatory authorities carry out the assessments of competition and appropriate regulation in the various telecommunications markets.

110. Of all of the EU countries, the UK is particularly advanced in its process of alignment to the proposed framework. It has conducted its review of the wholesale broadband access market to assess whether the existing regulation is appropriate and as such it is useful to look at the UK as an example of what regulated packet based services might look like.

UK

111. The UK's ATM interconnection service provides connectivity to ADSL enabled lines and is, therefore, a bitstream access service.

112. BT was approached by access seekers seeking connectivity at BT's parent and distant ATM switches. BT was obliged to negotiate an interconnection agreement for the supply of connectivity with BT's xDSL products at the ATM level of BT's network. Following a dispute between the parties, mainly regarding pricing, Oftel imposed an obligation on BT to provide network access in the form of ATM interconnection on a retail minus pricing basis.

113. Connectivity is provided at the parent ATM switch (ie the first ATM switch to which end users are connected) and the distant ATM switch. If connectivity at the distant ATM switch is sought, BT is required to provide ATM conveyance of the DSL traffic across its ATM network. Accordingly, the ATM interconnection service is comprised of two basic services:

(a) Service A: This comprises an ADSL enabled end user data path and ATM backhaul; and

(b) Service B: In addition to Service A, this provides ATM conveyance to a distant ATM switch.

114. There are four ADSL enabled end user data path data rate options available from BT. Each of these data rate options includes concentration within the DSLAM and ATM aggregation network to and including the parent ATM switch. Further, ATM backhaul and ATM conveyance is available with a virtue circuit capacity of 4Mbit/s with a defined single ATM class of service.

115. When the Director General of Telecommunications issued his determination on the ATM interconnection service last year he considered that there was a great deal of uncertainty as whether the market will become effectively competitive and that it was important that innovation and investment were not deterred. Oftel, therefore, considered a retail minus pricing approach to be the most appropriate pricing methodology.[4]

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[4] Oftel. *Direction to resolve a dispute between BT, Energis and Thus concerning xDSL interconnection at the ATM switch* of 21 June 2002, para 15.

116. In April this year, in his *Review of the Wholesale Broadband Access Market*, the Director General of Telecommunications made the following comments in respect of his decision to maintain retail minus pricing of the ATM interconnection service: [5]

> "Under the conditions of uncertainty about the scope for future competitive developments in the longer term the Director considers that it would be more appropriate that competition in the market decides which technologies and providers are more efficient than for such decisions to be pre-determined through a regulator's judgement of the regulated interconnection charge. Given the immaturity and uncertainty associated with both the demand and supply side, **the Director considers that it would be a greater concern if intervention were to stifle the growth of competition in broadband access which is danger of adopting a LRIC + approach**." [Telecom emphasis]

Australia

117. Australia does not have regulated bitstream access. When the ACCC was investigating whether to unbundle Telstra's copper local loop (in 1999), it weighed up whether to declare a bitstream access service. However, in its final report (the *Declaration of Local Telecommunications Services*, in 1999),[6] the ACCC refused to regulate the bitstream access service proposed by Telstra.[7] The ACCC has not since then, considered whether to regulate a bitstream access service.

118. *Telstra does provides bitstream access services at commercially negotiated prices. The service currently has 6 offerings - DSL-L3A, L35, DSL-L2 Internet Grade, DSL-L2 Business Grade, DSL-L1 HDSL and DSL-L1 SHDSL.* ***[***

119. At paragraph 5(l) "Key Points" and paragraph 5.49 of its submissions on the Draft Report, TelstraClear states that the provision of regulated bitstream at cost based prices in the UK and Australia stimulates rapid broadband growth. As I have explained above, neither the UK nor Australia has a bitstream product regulated at cost-based prices.

US

120. The US arguably has the most extensive and intrusive unbundling regime in the world. However, there is no regulated bitstream access service in the US. As discussed in Section 8 of the submission, the FCC has recently (in its *Triennial Review* of unbundling obligations) drawn a bright line distinction between legacy (TDM) and new (packet switching) technology. In the Order emanating from the Triennial Review ("**Triennial Review Order**"), the FCC held:

> "We decline to require incumbent LECs to unbundle the next-generation network, packetized capabilities of their hybrid loops to enable requesting carriers to provide broadband services to the mass market . . . We conclude . . . that applying section 251(c) unbundling obligations to these next-generation network elements would blunt the deployment of advanced telecommunications infrastructure by incumbent LECs and the incentive for competitive LECs to invest in their own facilities, in direct opposition to the express statutory goals authorised in section 706."

121. The FCC regulated access to circuit-based "wholesale leased lines" (DS1 and DS3 loops) but expressly excluded the electronics and other equipment used to transmit packetised information, because:[8]

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[5] Oftel, *Review of the Wholesale Broadband Access Market,* 28 April 2003, p 67.

[6] ACCC, *Declaration of Local Telecommunications Services*, Final Report (July 1999).

[7] ACCC, *Declaration of Local Telecommunications Services*, Final Report (July 1999), p 16.

[8] Triennial Review Order, para 295.

> "… the costs associated with unbundling these packet-based facilities outweigh the potential benefits …"

122. The elimination of these unbundling obligations is intended to increase the incentives for incumbent carriers to invest in new technology, by removing the distortionary effect of unbundling on the risk/return calculation. The FCC outlined this aim in the introductory section of its Triennial Review Order:[9]

> "While unbundling can serve to bring competition to markets faster than it might otherwise develop, we are very aware that excessive network unbundling requirements tend to undermine the incentives of both incumbent LECs and new entrants to invest in new facilities and deploy new technology. The effect of unbundling on investment incentives is particularly critical in the area of broadband deployment, since incumbent LECs are unlikely to make **[**the**]** enormous investments required if their competitors can share in the benefits of these facilities without participating in the risk inherent in such large scale capital investments."

123. Later on, FCC noted that:[10]

> "By prohibiting access to the packet - based networks of incumbent LECs, we expect that our rules will stimulate competitive LEC deployment of next - generation networks."

EU

124. The European Commission has recently had prepared a report on the regulatory implications of next generation networks. The report suggests that fresh analysis and assessment will be required to apply the principles of the EU's new telecommunications regulatory package to next generation networks, and that regulation in the initial stages of development of such networks may be premature. The report recommends that:[11]

> "As NGN develops, the wholesale markets for interconnection should be narrowly defined in terms of the services requiring interconnection, rather than broadly defined in terms of networks."

125. The report also states that:[12]

> "▫ search for success is a natural business objective that may lead to a strong but not necessarily dominant market position warranting regulatory action. Inappropriate intervention would alter the risk and reward calculations that drive investments and could create the impression that success will be punished by regulators. This could chill investments in the NGN sector and retard NGN development;"

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[9] Triennial Review Order, para 3.

[10] Triennial Review Order, para 290.

[11] *Regulatory implications of the introduction of next generation networks and other new developments in electronic communications*, Brussels, 16 May 2003, p 100.

[12] *Regulatory implications of the introduction of next generation networks and other new developments in electronic communications*, Brussels, 16 May 2003, p 105.

Commerce Commission Conference
on Unbundling

Murray Milner
Chief Technology Officer
Telecom New Zealand Limited

11 November 2003

Part IV: NGN Refresher

126. The fundamental building block for the NGN is the Internet Protocol. In the NGN we create an environment wherein we can control the IP packets as they traverse the network from source to destination. This environment we call the managed or private IP network as compared to the alternative unmanaged or public IP network, which is the Internet as we know it today. As a result of this approach to IP networking, we create a network which uses the private and public IP networks in a complementary manner, with applications divided between these two domains in a manner which optimises the value of each.

127. Telecom is making its private IP network capable of supporting a wide range of multi-media applications, including realtime applications and business critical applications. These will be complemented by applications supported on the public internet.

128. Furthermore, the NGN will support any form of terminal to access these applications. This includes standard voice terminals through to TVs, PCs and Games consoles. These devices can be single media such as a simple telephone, EFTPOS terminal or fax machine or can be multi-service such as a PC or a modern mobile terminal. These devices can be connected to the network by a copper, fibre or wireless link and the wireless link can be fixed or mobile.

129. The network will also include a number of middleware type capabilities to perform special functions which enhance the communication experience within the private IP network. These include such things as QoS, management , security management, Digital Rights Management, etc.

130. The key characteristics of this network which make it quite different from historical networks include:

- Multi-service access – multiple services operating simultaneously over a single access;
- A high degree of service independence form the physical type of access – whether it is fibre, copper or wireless;
- Quality of Service differentiation between services to ensure that all services operating simultaneously across an access operate to customer expectations;
- The use of a single network and IT infrastructure to support many services, many customers and all forms of access creating significant economies of scope and scale; and
- The use of IP virtual private networks to separate customers from each other and to separate the different services operating across the single infrastructure.

131. As illustrated earlier by both myself and Russell Locke, this combination produces a much richer communication environment for our customers than exist today – both business and residential.

132. Before handing over to my colleague Stephen Crombie, I would like to highlight one further point. That is the difference in complexity between a simple high speed internet broadband model and that offered by the NGN. This can be seen most simply by the difference in complexity between the logical configuration of the DSLAM when configured for only fast internet services, vs when it is configured for the delivery of multi-service, multi-user access.

133. Now I will hand over to Stephen to address the investment issues around the NGN.