NATIONAL BROADBAND NETWORK

SUBMISSION

Prepared for: National Broadband Panel of Experts

Date: 30 March 2008

Author: Dr Tony Kerr

Document Version: V1

Disposition: Final

TABLE OF CONTENTS

1 Purpose

This submission has been prepared in response to the Invitation to Comment, published in the Australian newspaper by the Department of Broadband, Communications and the Digital Economy.

It addresses some aspects of:

- The definition of requirements for the National Broadband Network (NBN)
- Operational Support Services (OSS) and Business Support Services (BSS) that might be relevant to the NBN
- Provision of a NBN that supports the continuing evolution of an information society in Australia
- Perspectives of the author who has had a long time involvement in broadband, including:
  - As a consultant, leading a team of some 20 Engineers in Telstra Multimedia during the definition of Bigpond and the early tendering for suppliers (which included working with ASIO staff to draft interception requirements for a broadband IP network). This also included analysis of requirements for Interactive Broadband Services (IBS) over a planned fibre optic network; development of tender and issuing the tender to interested companies
  - Performing quality assurance (design and process assurance) for the KPMG Consulting / Bearing Point team that developed the FAST functionality. FAST integrated the billing and provisioning systems for Bigpond cable and ADSL allowing customers to sign up and change plans via web services
  - Over 40 years involvement in the technical IT environment, including time with Defence Signals Directorate which is the Commonwealth's head Information Security organisation
  - Over 10 years working on a large and complex DoD project (>$1B)
  - Eight years providing first semester evening courses in Information Security to undergraduates and post graduates at Monash University

Available time has prevented development of reasoned arguments supporting the points made below. However, the author would welcome an opportunity to expand further on any issue. This submission does not pretend to address all matters, and it is also most probable that the Panel of Experts has already walked significantly more ground than is covered below.

Contact Information

Dr Tony Kerr

5 Beleura Avenue Vermont, 3133

0439 742 726

tonykerr@bigpond.net.au

2 Submission Comments

2.1 Introduction

A $4.7B project is a large and complex project. It is inevitable that the project costs will increase. It is a given that competing tenderers will vie to produce the minimum cost proposal. Assumptions will be made that will be alluded to in tender responses in such a manner that scope increases identified during project implementation will be deemed essential and levied against the Commonwealth.

Such processes are an inevitable outcome of most tender processes that require and specify functionality for software intensive systems.

This paper assumes that the NBN will be based on a Fibre-To-The-Node (FTTN) topology in which:

- Fibre optics extend far deeper into the network than is the case with current Hybrid Fibre Coax broadband networks provided by Telstra and Optus
- The fibre segments terminate in curb side nodes and interface with Plain Old Telephone System (POTS) local loops
- Nodes are located so that the remaining local loop distances will support bandwidths substantially higher than the quoted initial 12Mbps.
- No use will be made of the coax segments of the current HFC networks because bandwidth allocation to upstream traffic on such networks is inadequate for current and evolving web services, particularly those involving two way audio and video connections

2.2 Interfaces and Requirements

The following comments address a small segment of a formal Systems Engineering methodology.

2.2.1 New Environment

The NBN will change the relationships between broadband network Internet Service Providers (ISP) and the NBN infrastructure provider. For ADSL services, ISPs currently place their own equipment within Telstra exchanges to interface with local loop infrastructures. To a certain extent, this has provided a competitive pressure between ISPs to provide interfacing equipment that maximises their service provision to their clients.

A FTTN network removes this opportunity for ISPs. The curbside nodes will most probably be populated with standard devices that interface the fibre optics with the POTS local loop cables. The competitive pressure mentioned above will no longer exist. It is essential that this interface device be closely specified such that the installed device does not constrain the ability to implement yet-to-be-defined services. This is perhaps an impossible task. However, such devices should be amenable to hot-swapping with improved devices as they become available.

The fibre optic to local loop interface is but one of numerous interfaces between the NBN and the rest of the world. For example, numerous interfaces will be required between Operational Support Services (OSS) and Business Support Services (BSS).

The complexity of large projects rests primarily within the interfaces between the to-be-provided system and external current and new systems. There are numerous examples of cost blowouts and schedule blowouts attributable to poor interface specification and interface management.

2.2.2 Context Diagram

A high level view of interface requirements is provided within a Context Diagram. Used for decades within IT systems development, such a diagram places all project deliverable functionality within a circle. All external systems that need to connect to the new system are depicted outside the circle. All interfaces are clearly defined.

A Context Diagram is a very simple and easy to understand definition of what is included within the NBN project, and what is external to that system.

External interfaces certainly include all ISPs, Customer Premises Equipment (CPE), Security Services and many others. Other interfaces may include phone networks – land and cellular, and other broadband networks.

The majority of these interfaces will be Internet Protocol (IP) routers and Asynchronous Transfer Mode (ATM) switches. Most will need to be able to receive Quality-Of-Service (QOS) attributes enabling establishment of channels with specific transmission characteristics. This assumes that real-time voice and video services will be handled differently to other less demanding traffic streams. Or will the NBN provide the purest form of Network Neutrality characteristics under which all IP connections are accorded the same transmission attributes?

How will fault finding be managed? What access will ISPs have to various fault finding OSSs?

The Context Diagram is but a very high level view of interfaces. Interfaces are further defined both within the design and tendering process, as well as the subsequent build and testing processes, via a well-defined set of specification, design and build artefacts.

The project team(s) should implement comprehensive interface management processes to help mitigate substantial project risks which, if not mitigated, will impact schedule, budget and / or delivered NBN functionality.

2.2.3 Formal Requirements Management Process

Complex IT and telecom projects incur substantial risk if formal requirements management processes are not implemented during tender, build and test phases of the project.

The phrase “requirements management” has many interpretations.

Large DoD projects have formalised both the structure of good requirements and the essential functionality required to manage requirements during the project lifecycle. Correctly implemented, such processes lead to unambiguous, consistent and complete definitions of the attributes of the system, both functional and non-functional (or quality), while flagging each requirement with verification flags (such as “information”, “demonstration” and “test”). Formal change management processes reduce risks that scope changes will not inadvertently add risk to budget, schedule or delivered functionality.

2.3 Network Services and ISP Services

The tender needs to clearly identify various user classes, including:

- The NBN support organisation(s)
- ISPs who will provide services to customers
- Customers who will use the NBN

The tender should clearly specify if the NBN support organisation is allowed to provide ISP like services to customers (as is currently the case with Telstra, Optus and others).

Various conflicts of interest could arise if the NBN support organisation is allowed to directly compete with other ISPs.

2.4 Clear OSS / BSS division

The tender documents will need to provide a clear division between the Operational Support Services to be provided by the NBN infrastructure and the Business Support Services that ISPs will be able to place on the infrastructure.

Interfaces between OSS and BSS services will be required.

For example, how will ISPs manage bandwidth packaging for various customers? Presumably on today's ADSL networks the ISP supplied equipment within Telstra exchanges is involved in bandwidth management. The NBN will most probably have standard node based fibre optic to local loop interface devices. A major role for such devices will be multiplexing each very wide-band fibre signalling channel into many end user local loop channels. Presumably ISPs will continue to have a role in packaging download and upload bandwidths for end users (see later section on competition). This will require interfaces between ISP BSS services and NBN OSS services.

Presumably the tender documents will require responses to define OSS to be provided and BSS services to be enabled.

Will such responses be required to define such services using "enhance Telecommunications Operations Map" – eTOM?

2.5 Competitive Pressure

Competitive pressure drives the implementation of more efficient and higher functionality telecoms / Internet services. If the NBN provides standardised interfaces between the fibre world and the local loop world, one source of competition is removed. ISPs, currently installing their own ADSL interface devices within Telstra exchanges, will loose that competitive opportunity.

Should the NBN also provide standard CPE? If so, ISPs will have little capacity for pushing the competitive envelope. Competition is best helped if ISPs are allowed to provide CPE interface equipment between the local loop termination and other customer equipment.

2.6 Relationship to Telstra Land Line Services

How are the interfaces between the current land line phone services and the NBN to be implemented?

One way would be to emulate current ADSL implementation that requires filters to be installed on in premise cabling to isolate NBN signalling from POTS signalling. This solution though perhaps the cheapest solution is rather messy (a meaningful engineering term….). Many houses with multiple telephone outlets require multiple filters.

Should customers requesting connection to the NBN be required to switch across to VoIP phone services? There would be many advantages for such a move including, but not limited to, an easy move to video messaging (as is currently provided by Microsoft's MSN Messenger, Skype and others).

Such a solution forces consideration of "life line" services provided by POTS. POTS provides its own power source allowing customers to make phone calls even if 240V power is not available.

Unfortunately, implementation schedules and available budgets will minimise the extent of POTS redesign that can be accommodated within the NBN. BUT – the NBN should be designed to enable such changes at a later time.

2.7 NBN Speed

In the context of this submission, the term "bandwidth" is synonymous with "bits per second".

The majority of current broadband services do not guarantee minimum upstream or downstream bandwidths.

Should this continue with the NBN? Or can services be provided with guaranteed minimums? Is 12Mbps a fixed minimum downstream service? While such a service cannot be guaranteed between a customer's CPE and any remote server, it should be possible to guarantee such speeds within the NBN. OSSs within the NBN could measure customer experiences and treat as a fault any downwards departure from 12Mbps lasting longer than, say, 30 seconds.

The tender specifications should clearly specify the bandwidth services that are being sought. Such specifications can be written as Service Level Agreements. These SLAs should also define any penalties that apply should agreed levels of service not be provided.

Presumably the proposed NBN will be extensively modelled as part of the tender definition process. Within a FTTC network, node positioning will impact the service levels able to be provided. Node throughput modelling will determine:

- How many down stream local loops can be supported from a single curb-side node
- The maximum length of local loop cable from a node to a customer's CPE

Hopefully such modelling will assume a high usage rate by downstream customers – at least 80% on-line during evening peak usage with various percentages downloading streaming media. It is guaranteed that the migration of existing and new multi-media services to the Internet will continue.

During the early lifetime of the NBN it would be expected that V&VoIP (Video and Voice) services will experience exponential growth.

And, of course, this service demands as much upstream bandwidth as downstream.

2.8 Upload Bandwidth

A NBN that is simply a faster version of current broadband networks will be inadequate.

The new NBN should provide standard services with symmetric upload and download bandwidths.

This will enable development of new broadband services while significantly improving useability of many existing services.

Initial broadband networks in Australia consisted of Telstra and Optus Hybrid Fibre Coax (HFC) networks. Their design primarily addressed cable TV needs. This resulted in a grossly inadequate upload spectrum. Although coaxial cable provides gigahertz overall bandwidth, all upload services are limited to analogue frequencies less than 50 MHz on the network's cable segments. As a consequence cable broadband is a highly asymmetric service. This is also true of most Digital Subscriber Loop (DSL) services – known as Asymmetric Digital Subscriber Loop (ADSL) services.

Services that would benefit from greatly increased upload bandwidth include:

- **Upload of digital photos and movies** – individuals are increasingly communicating with family members and networks of friends via the Internet. This frequently involves the full range of digital media. My wife and I frequently forward small movies to our daughter and grandchildren in Canada. Although we subscribe to an "unlimited" service from Telstra, uploading an email containing a two minute 10Mbyte movie attachment can take over 10 minutes. As well, we often have to reduce movie resolution to comply with mailbox restrictions. We should be able to forward 100Mbyte movies with ease.

  With decreasing computer storage costs and increasing computer processing power, it is reasonable to expect that mail box restrictions will soon be eased, allowing attachments greater than 10Mbyte, perhaps 100Mbyte or 1Gbyte, within the lifetime of the NBN. Note that Microsoft's Hotmail and Google's Gmail offer free mail boxes of almost unlimited sizes – when compared with ISP offerings

- **Access to home base Web Servers** – because of limited upload capacity on the current broadband networks, home based Web Servers are not encouraged. In fact, limits are placed on upload volumes on Telstra Bigpond cable.

  The NBS design should not preclude home based web services. With the increasing use of Web 3 technology, it is now possible for home offices to offer remote storage, payroll and other functions for small businesses.

  It is easy to envision a future version of Microsoft's O/S, Linux or other operating systems being provided with easy to use web servers. House holders, small businesses and others should be able to provide web based services to family, friends and clients. Such a capability would aid the development of many small businesses (thousands, tens of thousands?).

- **Peer-to-Peer Networking –** was previously (and is) the mechanism for illegal distribution of music and movies.

  However, P2P networking is now increasingly being seen as the preferred mechanism for legal distribution of digital media, including TV.

  Using P2P to receive a movie or TV show reduces overall bandwidth and server demands as

the material is sourced from nearby computers that have previously downloaded the material. Depending on the popularity of the movie, hundreds of home based "servers" may be accessed for different segments of a particular movie.

"Properly managed and implemented, P2P is the future of Hollywood and television," says Dmitry Shapiro, CEO of Veoh Networks, which lets broadband users create virtual television networks[1].

P2P QOS is very dependent on upload bandwidth.

- **Remote Computer Access** – While the current asymmetric broadband services enable remote access to home computers, a symmetric NBN would increase functionality and QOS.

  Remote access to one's home computer should, ideally, be at LAN speeds. It should be possible to 'quickly' gain access to material on the home computer. A worker splitting time between an office and home should be able to quickly access small files (email, for example) and large files – say a 100Mbyte multi media presentation.

  Secure and wide bandwidth access to home and office based computers would enable working couples to more effectively time share time between office and home.

- **Multi Media Online Communications** – MSN Messenger, SKYPE and similar services are providing video, audio and file sharing online services. Partly because of upload bandwidth restrictions, upstream video is reasonably low resolution.

  A symmetric NBN enables such services to improve, both in functionality and QOS. A natural expansion will be the provision of video conferencing between home based and small business computers.

  A symmetric NBN will enable readily affordable small business video conferencing. The substantial reduction in travel times and costs will provide a measurable boost to small business productivity.

2.9 Network Neutrality

Political decisions on the extent of Network Neutrality within the NBN will drive both OSS and BSS definitions. This topic has seen much debate with Congress in the US. Should the NBN carry all traffic transparently with equal priority and equal access to all who wish to use it? Or should the NBN, for example, provide filters to prevent carriage of certain types of content, such as pornography. Should an ISP be able to block access to other web sites for competitive or other reasons? Should certain traffic streams be afforded higher throughput or other QOS levels?

Such decisions are inherently political, although there are sound technical reasons for diverting from aspects of pure Network Neutrality.

Audio and video streams could have QOS attributes that minimise jitter and delays that otherwise might detract from user experience.

Where possible, implementation of OSS and BSS should have as few interfaces as possible. It is interfaces between systems that incur cost, during design and implementation, and during operational support. By minimising such interfaces it is easier during the support phase to change an OSS with little consideration of the higher level BSS. Attempting to implement, for example, a porn filtering

[1] http://www.fastcompany.com/magazine/101/open_hollywood-p2p.html

functions within the NBN as a service would necessitate numerous interfaces with ISP BSSs - the implementation of such a filter must take into account the age of a particular user which might only be known to the ISP.

The cheapest NBN to build, implement and support is one that, as much as possible, provides a transport infrastructure that is independent of content. However, the transport mechanisms will need to understand types of content, or meta data about the content, to be able to set appropriate QOS parameters for audio and video streams.

2.10 New Services

The NBN must be designed to meet current BSS needs. Importantly, it should also be provisioned to enable development and implementation of new services. While we cannot define such services at the moment, the traditional way to enable future change is to ensure that at key locations interfaces comply with appropriate international standards. It is essential that the NBN be implemented in a manner that facilitates continual technology update.

Potential new services could include:

- **Integrated IP based phone services** – cellular and land line phone services are being integrated with broadband services. A customer's Point-of-Presence is known to the network and all requests for an audio conversation are automatically diverted to that POP. If at home, all connections would be to a broadband connected IP phone. If not at home, calls would be automatically diverted to a cellular phone or some other land-line. The Telephone Numbering Mapping (ENUM) suite of protocols aims to unify the telephone numbering system E.164 with the Internet addressing system DNS.

  The NBN should provide an ENUM capable infrastructure. But, in so doing, a number of interface issues arise in providing the E.164 / DNS integration. Such integration would primarily be in the OSS realm however numbers of interfaces into ISP BSS would be required. Or, would all such an integrated services be the province of the NBN infrastructure operations company?

  Who would provide message bank facilities for such an integrated service? The NBN infrastructure operator, or ISPs? Maximising competition would suggest such facilities be provided by ISPs. If so, what are the interfaces that are required between ISPs and the NBN?
- **Video messaging** – a messaging facility like Telstra's Message Bank should be provided that can store video messages. Should this be a NBN OSS or an ISP BSS? Perhaps this is a function of ISP provided CPE equipment which could provide always-on flash memory storage sufficient for such purposes.
- **Short term purchase of enhanced capability** – provided appropriate OSS and BSS design, ISPs may be able to offer short term instantaneous access to enhanced capability. For example, a small business might normally be satisfied with a lower bandwidth connection, with occasional video conferencing sessions needing higher bandwidth with real time audio / video QOS.

  Such a capability requires near real-time interfacing between the appropriate ISP BSS and the NBN OSS that provisions services for customers.

2.11 Internet Addressing

2.11.1 IPv6

Consideration should be given to use of IPv6 within the NBN. Wikipedia comments[2]:

> **Government incentives**
>
> A number of governments, however, are starting to require support for IPv6 in new equipment. The U.S. Government, for example, has specified that the network backbones of all federal agencies must be capable of deploying IPv6 by 2008,[10] and spent the money to acquire a /16 block (281 trillion network addresses) to start the deployment.[11][12][13]
>
> The Peoples Republic of China has a 5 year plan for deployment of IPv6 called the China Next Generation Internet.

2.11.2 Permanent Address Allocation

Consideration should be given to permanent address allocation – which is more feasible using IPv6.

A number of popular Web services provide access to a users computer from others users. Examples include MSN Messenger and Skype. Because most user computers sit behind a router's Network Address Translation (NAT) functionality, such services only work if a user's computer first logs onto a MSN Messenger or Skype server to provide it with the user's current IP address. All who log-on to such a server become a member of a closed community within which IP connections can be established. When using MSN Messenger, for example, I can see on my screen which of my contacts are currently on-line. I can then initiate voice, video and other sessions with one or more of those contacts.

In effect, the MSN Messenger and Skype servers act as updateable Domain Name Servers (DNS).

There are a number of services a user might wish his or her computer to provide that would possible if such a centralised log-on server were not required. The prime example is the provision of home based web servers. An external computer wanting to connect to my system would need the web servers IP address / port number – presumable 80.

Such services require Domain Name Servers to translate URL names, such as Bigpond.net.au, into IP addresses. Local caches within a user's computer can maintain the IP address of URLs previously visited. Such cache information is only useful if IP addresses are static.

How many addresses should be allocated to a customer? With IPv6, 100 sequential addresses could easily be allocated to each customer. A customer's router could then dispense with NAT functionality and use fixed addresses for each service the customer wishes to attach to a domain name.

This is a non-trivial area and has most probably already had much attention within the expert group. Security management is a major issue. Also, self installation kits must assume a minimum of understanding of such issues by the average user.

[2] http://en.wikipedia.org/wiki/IPv6

2.12 Multicast

To ease convergence between the Internet, broadcast TV and Radio, the NBN should enable the multicast capabilities available within IPv6. This would reduce network bandwidth demands and the capacity needs for streaming servers.

Note that a simple Google search identifies many thousand streaming TV stations on the net today. Admittedly most provide only low resolution within small windows. As worldwide broadband networks increase bandwidth and other QOS parameters, streaming TV will increase resolution, image size and bandwidth needs.

2.13 Fibre to the Home

A “best of breed” NBN would provide a Fibre-To-The-Home (FTTH) topology. However, the majority of the speculation within the media is that the NBN will be a FTTN network. The prime reason for this lesser network appears to be the additional costs required to lay fibre to individual premises.

It is hoped that the FTTN hubs will be designed such that conversion to FTTH will be possible with little change required to the network upstream from the nodes. This would allow new estates to be provided with FTTH and for community groups to petition for FTTH and, perhaps, to pay for the additional cabling costs.

Schools and similar groups of end-users may need to FTTH to provide adequate bandwidth.

2.14 Competition

I understand that Telstra had enabled ADSL2 in many exchanges but did not make the service immediately available to customers. Telstra only enabled ADSL2 in some exchanges when other ISPs began installing ADSL2 equipment.

If there is any doubt that competition fosters innovation? And that the consumer benefits?

How will the NBN foster competition?

Today there are numerous ISPs competing for customers within the broadband market. This has led to lower prices and service innovation.

How do ISPs currently compete? They package different combinations of bandwidth and download volumes in various pricing ranges. They may offer differences in web based services. However, the characteristics that consumers base their selections on are:

- Costs of bandwidth – primarily downstream, and then upstream
- Costs of traffic per month (measured in bytes)

If the NBN does not allow ISPs to bundle products with different bandwidth and volume options, there will be very little discrimination between ISPs.

So, if the NBN offers a flat 12Mbps symmetric bandwidth to all users, ISP competition will fold.

Will the NBN count bytes? Many countries simply charge for the bandwidth. Counting bytes consumes server and router capacity. It complicates plan changes when users move to different plans. It might prevent real-time purchase of additional bandwidth for short periods as time delays in

registering counted bytes against a particular user and plan may take excessive time. It may mean, for example, that bytes per hour per customer need to be counted. And with bandwidth increasing and streaming media usage increasing, counting bytes becomes increasingly not feasible.

So, should the NBN simply note bandwidth that is allocated to a user and log the time the user is on the network? Charges could then be set to encourage large downloads to occur after midnight for example.

If bytes are not counted, how is fair use determined? How can congestion be controlled if excessive users cannot be identified? Or should the NBN be configured for continuous 12Mbps for all users – or some percentage of users? If the NBN is just a transport infrastructure and not a content provider should it worry about network usage?

There needs to be some constraints on profligate use by power users. How should this be done? And if it is to be done, by whom? By the NBN operators or ISPs? If byte counting is needed, where would it be performed? At the node's fibre to local loop interfaces? Or at ISP provided CPE?

What organisation will provide the router gateways to the internet for a user? An ISP or the NBN? Technically the NBN should provide these gateways. But, would ISPs then have any role in providing Internet access? An ISP's farm of servers would just be like any other servers on the Internet. Although they could still provide email and similar services.

But, if the NBN provides Internet access, for a fee, why would users sign up with an ISP for email when Hotmail, Gmail and others provide perfectly adequate free services (although there may be some privacy issues to content with).

There seems to be great difficulty in seeing what the business propositions for ISPs will be. Where will they be able to compete?

Perhaps the only solution is to:

- Prohibit the NBN from connecting to the broader Internet
- Ensure that all Internet connections are routed through an ISP
- Require all CPE equipment to be ISP provided
- Require the CPE equipment to contain hard-coded gateway router IP addresses that are unique for each ISP

This solution has a number of pitfalls, however:

- The CPE equipment needs to be hacker proof
- A potential new ISP would require a very limited capital outlay compared with today. Just a router, a few standard CPE units and a server of some sort. In other words, this solution could facilitate requests from thousands of potential new ISPs.

--- END ---

It is now 1100pm on 30th March – and my time has expired. There is much more analysis and thought that could have been provided if normal retirement activities such as camping, cycling, etc had not intervened.

Thanks for reading this far.

3 Acronyms

ADSL	Asymmetric Digital Subscriber Loop
ATM	Asynchronous Transfer Mode
BSS	Business Support Systems
DNS	Domain Name Server
DSL	Digital Subscriber Loop
FTTH	Fibre-To-The-Home
FTTN	Fibre-To-The-Node
ISP	Internet Service Provider
IT	Information Technology
NAT	Network Address Translation
NBN	National Broadband Network
OSS	Operational Support Systems
POTS	Plain Old Telephone System
QOS	Quality Of Service
VoIP	Voice Over the Internet