

Submission to the Senate Select Committee on the National Broadband Network March 2010

John de Ridder



www.deridder.com.au

About the Author:

John de Ridder is a former chief economist of Telstra. His 18 year career at Telstra included a number of roles including broadband and data pricing and USO costing. Since leaving Telstra 7 years ago, he has consulted to various domestic and international organisations. His OECD report on broadbandⁱ was referred to extensively in the recent Berkman (Harvard) Centre Report to the FCC on US broadband policyⁱⁱ. He was also a key player in TransACT's proposal for NBN Mark 1ⁱⁱⁱ.

John de Ridder
Principal, De Ridder Consulting Pty Ltd
Tel: 02 4981 0953
Mob: 0409 804 278
Email: deridder@bigpond.com

Contents

Introduction	3
A Utility Vision for the NBN.....	3
Pricing Implications	5
1b(i) Service Availability	8
1b(ii) Competition.....	9
1b(iii) Economic Consequences	9
2a Cost Benefit Analysis.....	10
2b NBN Governance.....	10
2c Bond Funding.....	10
2d Regulation	10
2e Innovation	11
2f Geographical Equity	11
2g Demand	13
2h Barriers.....	13
2i Policy Goals	14
2j Role of Government.....	15
2k USO.....	16
2l OPEL	16

Introduction

Governments in many countries are beginning to intervene to accelerate the availability of affordable broadband. Some people think that the NBN broadband world will not be much different from today – same players, just faster pipes. The truth is that everything will be different. With the NBN, broadband access will become a utility. Recognising this and pricing access to the NBN as a utility will increase **adoption** and **use** which will transform economic and social relations.

A number of items listed in the terms of reference (TOR) will be addressed explicitly below. The comments about these will be understood better by first providing both a strategic vision for the NBN and the associated access pricing model.

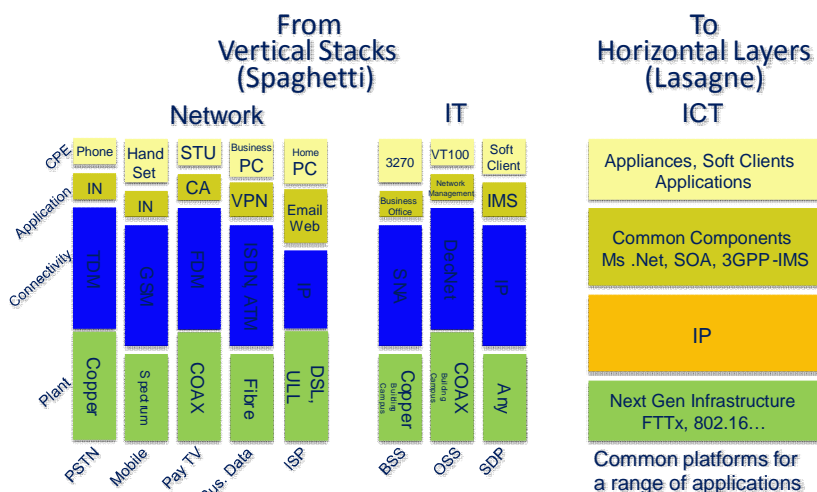
A Utility Vision for the NBN

We are on the cusp of achieving world-class high-speed broadband. To achieve this, the NBN will have these three features^{iv}.

- It will support any application from any provider.
- It will be delivered over an unrestricted pipe like water.
- It will be affordable with a high level of **adoption** and **use**.

The communications industry is seeing a shift from application specific (telephone) networks to application agnostic (all IP) networks (Figure 1)^v. This means network architectures shift from vertical integration (each network delivers a unique application) to horizontal integration with a single network supporting a multitude of uses.

Fig 1 - Evolution of technology



From purpose built to a network for any purpose

The corollary of this de-layering of the industry is that existing business models will no longer work. Until now, all fixed and mobile networks have cross-subsidised the costs of building access from usage revenues. Every fixed and mobile network has relied on cross-subsidies from calls to help fund the cost of providing access. This has made access affordable to all users while the largest users pay more. The NBN will be different because this kind of service cross-subsidy is not possible; so allowing NBN Co to retail services is not the answer:

- The cross-subsidy worked for networks when calls and access were joined in supply and demand. But NBN Co is supplying only a wholesale access service and does not have access to a cross-service subsidy. This means the access has to pay its own way.
- Even if NBN Co tried to emulate the business model of other network providers by providing retail services, this may fail because the service cross-subsidy is being eroded by changes in industry structure. Customers can take services from companies like Skype and Google without either the customer's telecoms provider or ISP deriving any benefit.

The experience of the last decade is that no exciting new services have emerged that can be delivered only by the network owner. Many new services now exist independent of network owners – Google being a good example.

All this implies that access has to pay for itself – and still be affordable after spending billions of dollars on the NBN. This is the “Goldilocks” pricing conundrum – making prices high enough to justify investment but low enough to be affordable^{vi}.

To make these large investments viable while making access both self-funding and affordable depends upon reaching economies of scale and a new pricing model:

- Fixed broadband networks are largely fixed cost networks so high utilisation reduces average costs. The NBN is to connect 90 per cent of premises. But if the occupants continue to take services from a copper network (or from mobiles), that premise makes no contribution to lowering unit costs of the NBN.
- We also need a pricing model that funds the expansion of network capacity required for the increase in traffic caused by You Tube and others. The affordability and funding requirements point to a two-part tariff with a low monthly rental and a traffic charge; as explained below.

The goal should be to make the NBN another utility network like electricity and water. It's already hard to tell the difference between electricity, gas, water and broadband pipes. They all have the same distribution (tree and branch) architecture, the same dominating civil works costs (poles or ditches) and the same economics – two networks double the cost, but not the revenues.

Adoption is the next goal after the current NBN policy objective to “enable” 100Mbps

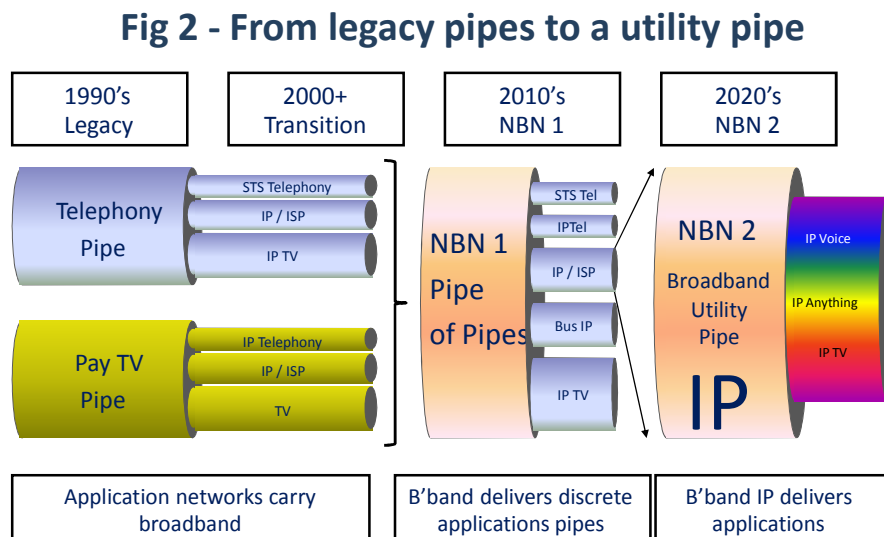
for at least 90 per cent of homes and businesses. **Adoption** and **use** are what generate the national benefits of productivity, investment, growth and social inclusion. And with a utility model for fixed broadband, that is achievable.

We expect every house in our street to be connected to electricity, gas and water because they are useful, affordable and allow users to regulate their bills by using only what they need or can afford. Consumer broadband is not yet in this situation. But the NBN could get it could get there; subject to reaching economies of scale and adopting the new access pricing model.

Pricing Implications

Just as a carpenter may see the solution to any problem as a hammer and nails, a telecommunications economist will see pricing as the lever that drives everything else. But it seems clear that pricing will be the moment of truth for the NBN.

Figure 2 places the current NBN in the evolutionary path of network development. Note that the end-game is where the NBN will serve all applications through a single Ethernet port. In the current NBN Co model, there will be separate ports with separate charges for standard telephony (including battery back-up), IP telephony (no battery), IP/ISP (broadband), tailored business applications and IPTV.



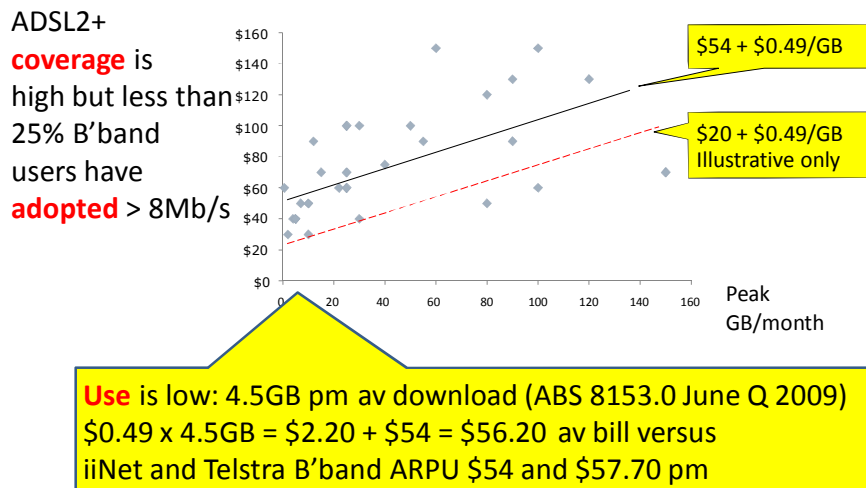
3

Pricing of telephony and IPTV ports is relatively straightforward. Pricing the port that underpins IP/ ISP broadband services is harder. Too high a price discourages adoption, too low ruins the business case – and as the ISP port grows in capability it will displace other ports.

A common assumption is that affordable access should be provided with a low-speed entry-level plan. Retail plans do this now but most customers offered access to higher speeds choose not to upgrade to them. If the NBN prices access on speed, nothing much will change. However, the proposed access pricing model allows not only full-speed to be turned on for all users on immediately but also affordable entry pricing without pre-empting the design of retail broadband plans. This approach is a game-changer.

The proposed two-part access pricing tariff is consistent with retail ADSL2+ broadband plans. Figure 3 show these plans with a “best-fit” (regression) line at \$54 per month plus \$0.49/GB. The red dotted line below it is an illustration of the access price.

Fig 3 - Retail ADSL2+ plans at Sept. 2009



There are a few interesting points to note about the data:

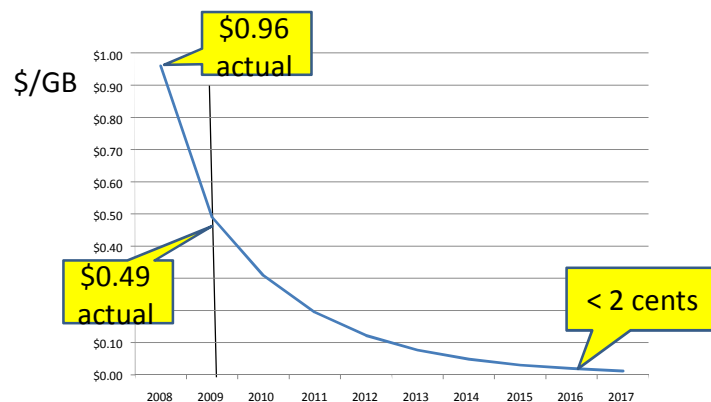
1. Although ADSL2+ plans were widely available, only a quarter of broadband customers chose speeds above 8Mbps (low **adoption**)
2. The average download per user was only 4.5GB per month (low **use**)
3. A sanity check shows the best-fit line at this average level of use has a broadband bill which sits between the iiNet and Telstra average broadband revenues per customer (ARPU)^{vii}.

There are also a few interesting points to make about the suggested access pricing:

1. The illustrative two-part wholesale price works out at \$22 pm at the average level of use above (counting only downloads) compared with \$16 pm for ULLS (and avoiding DSLAM costs)

2. It leaves room for a low entry level price; without a speed constraint. This encourages **adoption** and customers are then more likely to migrate to higher retail capped plans.
3. The access pricing model is consistent with current retail plans and reflects an important cost driver; neutralising the net neutrality debate (see below)
4. With data growing 60% pa,^{viii} access prices have to fall 37% pa to avoid exceeding the regulated rate of return; which leads to more traffic and further price cuts in a virtuous circle.
5. At less than 2cents/GB, the concept of a single pipe (NBN 2 in Figure 2) becomes feasible (Figure 4)
6. There is no price volatility; the only question is how fast access prices fall
7. The revenue model is self-funding: as data grows so does the capacity to augment the network to meet demand (ie prices fall a little less to fund expansion)
8. NBN Co has every incentive to encourage **use** of the network.

Fig 4 - Price/GB trajectory



**At 2 cents/GB, IPTV port can folded into single IP/ISP port:
 20Mbps * 3 hours/day * 2 cents/GB = \$16 pm**

7

The “Net Neutrality” debate in the USA was sparked by network owners complaining that increased costs without increased revenues are imposed upon them by services like Google and YouTube. But the suggested access pricing model is linked to the growth in traffic so the access network does have an incentive to augment capacity to meet demand.

This pricing model will encourage not only maximum **adoption** but also maximum **use** of the NBN. And, it solves the Goldilock’s conundrum – affordable prices can be combined with a large investment.

1b(i) Service Availability

To aid collation of this paper with other responses, the rest of this paper follows the order of the questions raised in the TOR.

1b(i) The implications of the NBN for consumers and tax payers in terms of service availability, choice and costs

The question of *service availability* follows the Government's narrow objective to "*enable broadband services with speeds of 100 megabits per second*". This is a **coverage** objective when what really matters for *national productivity investment and economic growth* is **adoption** and **use**.

There is a very real danger that billions of dollars could be spent providing capacity that is neither **adopted** nor **used**. This will be the case if premiums are charged for higher speeds because consumers are not prepared to pay for speed:

"(Telstra's) 100Mbps network in Melbourne is available in nearly 1 million premises. Just 0.2 per cent of those have signed-up." [Dominic White "Slow demand for broadband" in the AFR, 10 March 2010. This article also quotes Minister Conroy as saying the NBN was likely to offer ISPs various speeds at different prices.]

Worse, consumers could find themselves paying more on the NBN for the services they enjoy today:

"I don't understand how you can get someone in Chatswood to pay an extra 50 bucks a month for the same product and make them happy about it." [iiNet CFO David Buckingham, August 2008]

As discussed earlier, the main game is the de-layering of the industry. With IP in both access and core networks, the focus of competition will shift from access to applications and content. This is happening even without the NBN. The main differences that NBN Co can make are:

1. As a wholesale-only network funded through the pricing model suggested above, NBN Co has every incentive to encourage **use** of its access network. It has no legacy retail revenues to defend.
2. Employing the suggested pricing model, high-speed broadband access is the default option. This will encourage investment in backhaul and improved consumer PCs and other devices. Increased speed increases innovation and investment.

Currently, ISPs deliver broadband services over Telstra copper using either line-sharing or unbundled local loop at regulated prices that are currently less than what the NBN will probably need to fund its new network.

1b(ii) Competition

1b(ii) The implications of the NBN for consumers and tax payers in terms of service competition in telecommunications and broadband services

Currently, service competition is based around control of the customer access and carriage service. But that is changing. The NBN together with the progressive migration of all communications traffic to IP will change the nature of competition. Competition will shift to developing solutions for customers and away from supplying carriage, which will become the plain utility service.

Until now, regulatory policy focused on what might drive competition at the infrastructure level, rather than on how we can cooperate on infrastructure in order to create the shared foundations for competition at higher layers of the network – the level that makes a real difference to end users and the development of the digital economy. But the NBN will change that because it will provide the common, regulated, fixed access monopoly service used by ISPs.

Less competition at the infrastructure level lowers prices, increases **adoption** and so increases the markets for new applications and **uses** that can be delivered independently of networks. A little less competition at the infrastructure level generates much more service competition where it counts!^{ix}

1b(iii) Economic Consequences

1b(iii) The implications of the NBN for consumers and tax payers in terms of the likely consequences for national productivity, investment, economic growth, cost of living and social capital.

There is good reason to get excited about the NBN. Broadband communications promises to be an important transforming technology generating large economic benefits. Like steam and electricity, broadband communications is a General Purpose Technology (GPT) because it transforms economic relations, enhances productivity and enables new services and markets^x.

My own analysis of the productivity impacts of the NBN^{xi} found that the CIE study referred to by the Government^{xii} assumed the answer. That is, both this study and the Telstra-sponsored study by Access Economics^{xiii} used complex models mainly to work out scenario relativities (eg WACC or roll-out scenarios) and the distribution of impacts by industry or geography. In each case, the size of the benefit pie is hostage to the productivity assumptions borrowed from other studies.

It seems unlikely that studies of the kind just discussed will be useful. A more practical approach might be to estimate benefits directly. Or, better yet, we can compare impacts across regions and monitor roll-out impacts with a proper data collection framework^{xiv}.

2a Cost Benefit Analysis

2a. any economic and cost/benefit analysis underpinning the NBN;
--

No comment.

2b NBN Governance

2b. the ownership, governance and operating arrangements of the NBN company and any NBN related entities;

No comment.

2c Bond Funding

2c. any use of bonds to fund the NBN;

No comment.

2d Regulation

2d. any regulations or legislation pertaining to the NBN;

NBN Co should be regulated like any other network utility. With the suggested pricing framework and a regulated asset base, pricing regulation can be very simple – a revenue cap model in which NBN Co would be making frequent downward adjustments to the access price per GB of traffic; since traffic is growing at least 60 per cent pa (and may increase with a ubiquitous, full speed access network).

If NBN Co sticks to its wholesale-only charter, much of the ex-ante competition regulation should be redundant; at least for NBN Co.

The current legislation did not contemplate a wholesale-only access provider. Rights and obligations are defined for carriers and carriage service providers. But, there are some anomalies in trying to apply it to NBN Co. For example, Part 17 of the Telecommunications Act 1997 says “*The ACMA may require carriers and CSPs to provide pre selection in favour of CSPs. Pre selection must include over ride dial codes for selecting alternative CSPs on a call by call basis*”. But NBN Co will be a switch-less access provider that cannot do this.

More importantly, putting aside the wholesale-only NBN operator aspect, there have been other important changes since 1997 that require an overhaul of current arrangements. These include the inexorable shift to all-IP networks with ramifications for the standard telephone service and the impetus this has given to the development of new

services. The new IP based services drive the convergence between communications and other industries. This convergence needs to be reflected in future legislation.

2e Innovation

2e. the availability, price, level of innovation and service characteristics of broadband products presently available, the extent to which those services are delivered by established and emerging providers, and the prospects for future improvements in broadband infrastructure and services (including through private investment);

No comment.

2f Geographical Equity

2f. the effects of the NBN on the availability, price, choice, level of innovation and service characteristics of broadband products in metropolitan, outer-metropolitan, semi-rural and rural and regional areas and towns;

Cross-subsidy is inevitable when costs differ markedly across geography and universal service and uniform retail pricing are desired. Federal Communications Ministers in the past have shirked their responsibility for balancing equity and efficiency objectives. A geographically de-averaged access pricing regime for unbundled local loop (ULLS) was allowed to co-exist with politically mandated uniform retail pricing regime. But unless either both retail and access pricing are averaged or both are de-averaged, there will be inefficient by-pass. As Telstra put it,

“The policy-making branch of the government wants a national uniform price, the regulatory branch of the government is pushing for de-averaged prices which would have much lower prices in low cost areas like the central cities and much higher prices in the high cost areas like the bush”. [Phil Burgess at a Telstra investor briefing on 7 August 2006 after the collapse of its metro-only FTTN negotiations with the ACCC]

Both the Australian Competition Commission and the Australian Competition Tribunal have put economic efficiency ahead of equity in flat contradiction of government policy on telecommunications pricing. The Tribunal’s refusal of Telstra’s appeal against de-averaged pricing of unconditioned local loop is not as clear-cut as some think. All seven findings against Telstra were about the level and not the structure of prices. Yet, the key issue was about cross-subsidies.

The Tribunal did observe that without averaged ULL prices, Telstra was caught between a rock and a hard place. However, while the Tribunal decided that it can have regard to government equity objectives “*if relevant*”, it dismissed the equity objective because it does not support the efficiency objectives!

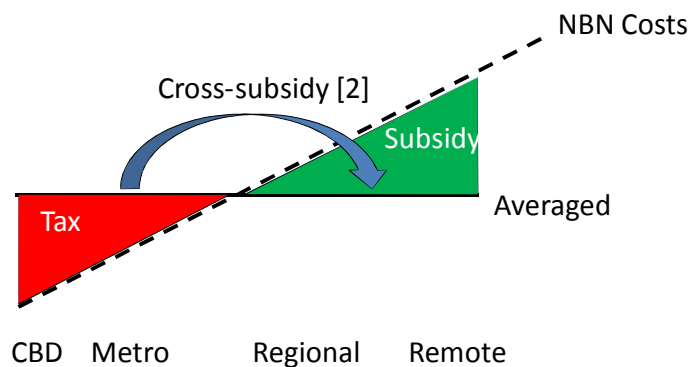
Four years later, Minister Conroy has said he now aims to fix this gap because it is,

“(my) ambition is that there will be the same wholesale price for every household for the same speed across wireless, satellite and fibre...this will be a cross-subsidy; one wholesale price across the country” [Minster, Senator Stephen Conroy, Tamworth, October 2009]

This should be done as a levy on all un-subsidised fixed lines to ensure the cross-subsidy is not undermined with bypass (Figure 5). The most significant form of by-pass would be from a continuation of the copper network alongside the NBN. This would not be infrastructure competition but economically inefficient regulated arbitrage.

Fig 5 - Cross-subsidy supports averaging

In the presence of by-pass, an “excise tax” [1] must be levied on all broadband access lines



[1] Laffont & Tirole, Competition in Telecommunications (pp 118-129)

[2] Bigger with the national NBN than a commercial access network

11

The cross-subsidy could be large. On a back-of-the-envelope calculation, assume there are 10m lines and that the average cost to build and operate the NBN is \$50/line/pm (ie appx. \$6 bn pa). Suppose also that urban and country areas account for 70 and 30 percent of lines with average monthly costs of \$20 and \$120 respectively. The difference between \$50 and \$20 amounts to a cross-subsidy from urban to country areas of \$2.5bn pa.

Mobile broadband will become a strong substitute for fixed broadband. So, there may be a case in technological neutrality for including mobile broadband. The Carter Report excludes mobiles from a similar levy in the UK on the basis that mobile operators already contribute with licence coverage requirements^{xv}. There may also be practical issues with the heterogenous nature of the mobiles market, but it is worth debating.

2g Demand

2g. the extent of demand for currently available broadband services, the factors influencing consumer choice for broadband products and the effect on demand if the Government's FTTP proposal proceeds;

As noted at Figure 3, current ADSL2+ and HFC capabilities have not been **adopted** as widely as one might hope. This probably reflects current pricing premiums for speed. If NBN Co does not provide innovative access pricing, nothing much will change.

According to the ABS^{xvi}, 72 per cent of Australian households had home internet access (includes dial-up) and 78 per cent of households had access to a computer in 2008-09. Between 1998 to 2008-09, household access to the internet at home has more than quadrupled from 16 per cent to 72 per cent, while access to computers has increased from 44 per cent to 78 per cent. This suggests demand saturation with over 20 per cent of households still having no use for a computer nor, presumably, broadband.

Broadband (over 256Kbps) is accessed by close to two-thirds (62 per cent) of all households in Australia and 86 per cent of all households with internet access. A small proportion of respondents (2 per cent) did not know the type of their internet connection at home.

Do we need an NBN? Only 57 per cent of Australia's broadband customers enjoyed download speeds in excess of 1.5Mbps and just 30.7 per cent of customers enjoyed download speeds over 8Mbps in the June quarter 2009 (ABS Cat 8153.0). This is less than half the 70 per cent of customers who have access to 24Mbps for ADSL2+ now.

The NBN will only have an effect on demand if pricing changes from pricing for speed. With the proposed access pricing model supporting full-speed for all customers, there can be a dramatic change to **adoption** and **use**.

2h Barriers

2h. any technical, economic, commercial, regulatory, social or other barriers that may impede attaining the Government's stated goal for broadband availability and performance in the specified timeframe;

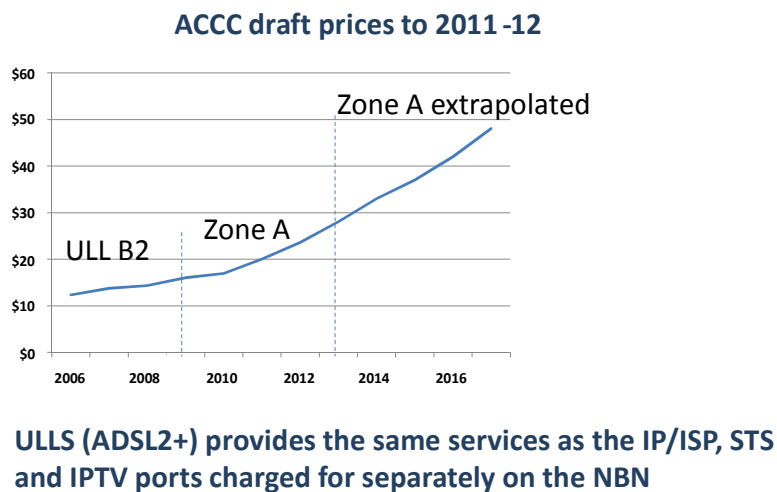
The risks from competition from the copper network (if customers are not migrated to the NBN) and from mobile broadband are probably well understood. The "elephant in the room" is the ISPs' commitment to the NBN. They will only give their support if the (access) price is right (low).

Even if Telstra can sell a negotiated NBN outcome to shareholders, access-seekers will prove more intransigent: "*we know where all our customers are by electorate*" [John Lindsay from Internode at the OVUM NBN Conference in Sydney, 8 December 2009]. This is because the current ISP business models based on ULLS and/or Line-Sharing will

be replaced by more expensive NBN access and a more competitive market due to lower barriers to entry. This means lower margins and fewer ISPs ^{xvii}.

The ACCC caught a glimpse of the elephant with the industry reaction to its draft pricing decision in August 2009. This draft decision took two steps in the right direction: (a) it foreshadowed increases in ULLS prices; which could start a “glide path” towards NBN compatible pricing to reduce the price shock of moving to the NBN (Figure 6) and (b) a move towards averaged wholesale access prices (Zone A straddles current ULLS Bands 1, 2 and part of 3 accounting for over 80 per cent of all fixed services). The “shock-horror” reaction of ISPs may help explain why the ACCC has left current prices on hold.

Fig 6 – The ULLS glide path?



10

Access seekers have no interest in scrapping their DSLAM investments to replace ULLS with more expensive NBN access. Despite what they say publicly about the NBN, it is in their interests to delay the NBN because their margins will be squeezed.

Both the Minister and the ACCC have to have the fortitude to take the industry to the next level where it is accepted that access is not going to be the competition space since broadband access will become a utility service.

2i Policy Goals

2i. the appropriate public policy goals for communications in Australia and the nature of any necessary regulatory settings to continue to develop competitive market conditions, improved services, lower prices and innovation;

The current NBN policy goals are about coverage; “*enabling*” 100Mbps to 90 per cent of premises but the focus needs to expand to include **adoption** and **use** for this is how the NBN makes a difference.

As an access monopoly, NBN Co must be regulated and the regime applied to it should be analogous to other regulated utility networks. The ACCC seems to be heading in this direction with a possible move towards a regulated asset base approach to determining revenue requirements. With the proposed pricing model, a revenue-cap monitoring system would seem a useful next step.

Assuming continuing bi-partisan political support for geographically uniform pricing, this has to be supported by price regulation. Above all, the implicit tax on metro areas from imposing averaged prices must be protected from by-pass of competing broadband networks that do not bear this implicit tax (ie avoid distorting investment in inefficient by-pass).

2j Role of Government

2j. the role of government and its relationship with the private sector and existing private investment in the telecommunications sector;

The public business case for the NBN is that everybody benefits as broadband changes the way we do business. But, without government support, the commercial business case for the NBN does not stack-up for three reasons.

First, a national network is not viable for private operators. Both the Telstra and G9 (FANOC) proposals were for metro areas only. Country areas are uneconomic. A national network needs to be supported with public subsidy and/or cross-subsidies that cannot be by-passed.

Second, there is market failure because many of the national benefits are not recognised in the private business case. The corollary of large national benefits (“externalities”) is public subsidy. Where investment in NBN access is commercial (ie private benefits exceed private costs), no public contribution is required.

Third, there is regulatory failure if the access pricing regime allows too much of the private benefits available to an NBN builder to be taken by other service providers using the NBN.

The scale of public funding and level of prices also depend on minimising the cost of the NBN roll-out. FTTP is a desirable goal but in the interim a mix of technologies would realise the same national benefits at less cost. VDSL2 could be turned on quickly to about 70% of customers^{xviii} for less than a third of the cost of the proposed NBN.

It should also be noted that while the current focus has been on coverage, the national benefits we all want are realised only with **adoption**. The higher the level of adoption, the lower the average cost.

2k USO

2k. the effect of the NBN on the delivery of Universal Service Obligations services;
--

In its last report, the Committee expressed its concern that none of the legislation tabled so far has addressed how USOs and CSGs will apply once the NBN is in operation^{xix}.

In my view, the cost of the current telephony USO will necessarily increase as it is migrated from the PSTN to the NBN. However, for the same cost it can include broadband. But, the funding mechanism has to change.

Since NBN Co is obliged to connect 90 per cent of premises, it could be the designated USO provider in its fixed network footprint. Then, the most sustainable way to underwrite universal service is through a levy mechanism that cannot be by-passed; as discussed in 2f above. This meets all stakeholders' interests.

2l OPEL

2l. whether, and if so to what extent, the former Government's OPEL initiative would have assisted making higher speeds and more affordable broadband services available.

No comment.

John de Ridder
29 March 2010

-
- ⁱ *Catching-up in Broadband – What Will it Take?* – an econometric study for the OECD, Sept. 2007
- ⁱⁱ Final report available at http://cyber.law.harvard.edu/publications/2010/Next_Generation_Connectivity
- ⁱⁱⁱ A public document is *The National Broadband Network: A blueprint for the 5th utility* June 2008 published as TransACT's regulatory submission and which explains the industry economics and strategy http://www.dbcde.gov.au/communications_for_business/funding_programs_and_support/request_for_submissions_on_regulatory_issues/submissions
- ^{iv} This section draws on John de Ridder *Piped broadband will deliver all the promises* on the opinion page of the AFR on 13 February 2009 and Bob James and John de Ridder, *Fixed broadband - Australia's next utility?*, Communications Policy & Research Forum, September 2008
- ^v Figures 1 and 2 were devised by Bob James; now a consultant at Nokia Siemens Networks
- ^{vi} See John de Ridder, *Goldilocks pricing for broadband*, Telecommunications Journal of Australia, Vol. 58, No. 1, May 2008 published by Monash University ePress and John de Ridder, *Broadband pricing to achieve net neutrality – Goldilocks revisited*, Telecommunications Journal of Australia, Vol. 59, No. 2, July 2009 published by Monash University ePress
- ^{vii} iiNet Full Year Results Presentation, 18 August 2009 and Telstra 200 Annual Report p14
- ^{viii} See <http://www.dtc.umn.edu/mints/home.php> for reports on traffic growth
- ^{ix} Bob James and John de Ridder, *Broadband policy is on track – or why we need infrastructure for competition, not competition for infrastructure*, in the AFR, 3 May 2008
- ^x A GPT has the following three characteristics: (a) *Pervasiveness*: It spreads to most sectors. That is why impacts should be measured at a higher level than the firm or individual sectors. Only higher levels of aggregation capture the externalities or spill-over impacts that arise at firm and sector levels, (b) *Improvement*: GPTs get better and better, lowering the costs to users and (c) *Innovation spawning*: GPTs make it easier to invent and produce new products or processes. That is, they allow us not only to do things better but to do better things. New possibilities are created and specialisation raises productivity.
- ^{xi} John de Ridder, *Broadband – How big are the benefits?*, April 2009
- ^{xii} *NBN: Regulatory Reform for the 21st Century*, April 2009
- ^{xiii} Access Economics, *Impacts of a high speed national broadband network*, March 2009
- ^{xiv} I should declare here that I am working with the Strategic Networks Group that is employing such methodologies in the USA and Europe www.sngroup.com
- ^{xv} *Digital Britain – Building Britain's Future*, report to UK Parliament, June 2009. The Carter Report said the UK needed a levy of only 50p (A\$1) per month to reach the final third of premises with broadband. But Australia faces much greater geographical challenges.
- ^{xvi} ABS Cat No. 8146.0 - *Household Use of Information Technology, Australia, 2008-09* - 16/12/2009
- ^{xvii} John de Ridder, *Investigating options for NBN pricing*, OVUM Conference presentation, 8 December 2009
- ^{xviii} Telstra proposal at 26 November 2008
- ^{xix} Para 8.78, Third Report.