A RESPONSE TO 'BROADBAND FACTS, FICTIONS, AND URBAN MYTHS', BY PROF. RODNEY TUCKER

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This paper responds to an earlier paper by Prof. Rodney Tucker, *'Broadband facts, fiction and urban myths'* (Tucker 2010), which suggested that many of the criticisms of Australia's NBN superfast broadband project were founded on myths. This paper argues that the 'myths' Prof. Tucker cites are in fact legitimate criticisms.

It points out that there are numerous examples of the benefits of technology being overestimated. For fibre broadband, high penetration in other countries has frequently depended on very aggressive pricing, perhaps because there are still no 'killer apps' that require it. Nor is the simultaneous usage of existing apps likely to add up to a high enough bandwidth requirement to justify fibre, and the rate of growth of domestic data consumption is likely to slow. Moreover, the capabilities of alternative, far cheaper technologies continue to grow rapidly, leaving a diminishing set of cases that actually require expensive fibre to the home.

INTRODUCTION

In August 2010 the *Telecommunications Journal of Australia* published a paper by Prof. Tucker (Tucker 2010), in which he sought to address a set of 'myths' he said had grown up about the NBN and to provide some basic facts on the topic. The objective of this current article is to provide a response, testing the logic and factual basis of Prof. Tucker's positions, and reviewing how they have stood up to the passage of 18 months since.

OVERLY PESSIMISTIC AND OPTIMISTIC FUTURE-GAZING

Prof. Tucker's paper opens by citing examples of people underestimating future demand for technology. Of course demand for technology *can* be underestimated – but equally it can be overestimated. That's the problem with the future, it's somewhat uncertain.

For balance with Prof. Tucker's quotes, consider the following:

> *'Introducing Pioneer LaserDisc. The biggest innovation in television since television'*
>
> Pioneer, 1980 (eBay 2012)

> *'Replacement of the ageing sub-sonic jets used on ranges above 2000 miles, plus an annual growth rate of about 5 per cent, could well require 1500 Concordes and Concorde development aircraft to be in service by the end of the century.'*
>
> Sir George Edwards, Chairman, British Aircraft Corporation, 1971 (Valery 1972)

> *'In the United States, the integrated services digital network (ISDN) is viewed as the ultimate network ... In Europe, where analog technology lags considerably behind that of North America, ISDN is also viewed as a vehicle for leapfrogging into state-of-the-art digital communications and attaining parity in technology and quality of*

service with the United States and Canada. That accounts for why, collectively and individually, European countries are so busy planning the early introduction of ISDN services'

Communications News, 1984 (Edwards 1984)

I predict that before the turn of the century Picturephone will … displace today's means of communication … the need for many ordinary trips for shopping, for conducting normal business, and for some social purposes should be greatly reduced. As a result, there will be less need for dense population centers. We can even hope to see an end to the continuing increase in city traffic and traffic jams. Picturephone is therefore much more than just another means of communication. It may in fact help solve many social problems'

Julius Molnar, Executive Vice President, Bell Telephone Laboratories, 1969 (Molnar 1969)

Of course laserdiscs, Concorde, ISDN and videophones all worked perfectly well as technologies – they just didn't live up to enthusiasts' expectations in terms of the level of demand. FTTP *may* live up to its advocates' hopes, but equally it may not, and precisely this risk is a key reason to be cautious about committing now to spending billions of dollars on superfast broadband.

International adoption of fibre

In seeking to disprove that NBN is a potential white elephant, Prof. Tucker then says (accurately) that fibre penetration in Australia lags other countries. Of course, just because other countries have already bought a white elephant doesn't prove that the animal you're considering buying isn't also a white elephant.

To put it another way, to see lagging in the fibre-race as a problem is to presume that national competitiveness depends on superfast broadband, which is not by any means a given. In fact, Prof. Tucker goes further, saying fibre is 'the most important infrastructure for the 21st century'. A bold claim indeed to make 10% into the century. More important than, say, fusion power might be?

Prof. Tucker then discusses what's happened in Japan, saying 'as a mature technology, ADSL penetration is now decreasing and it was overtaken by FTTP in 2008'. However, as in many other countries that have achieved meaningful fibre penetration, Japan has had to set fibre prices at similar levels, or indeed below ADSL prices.

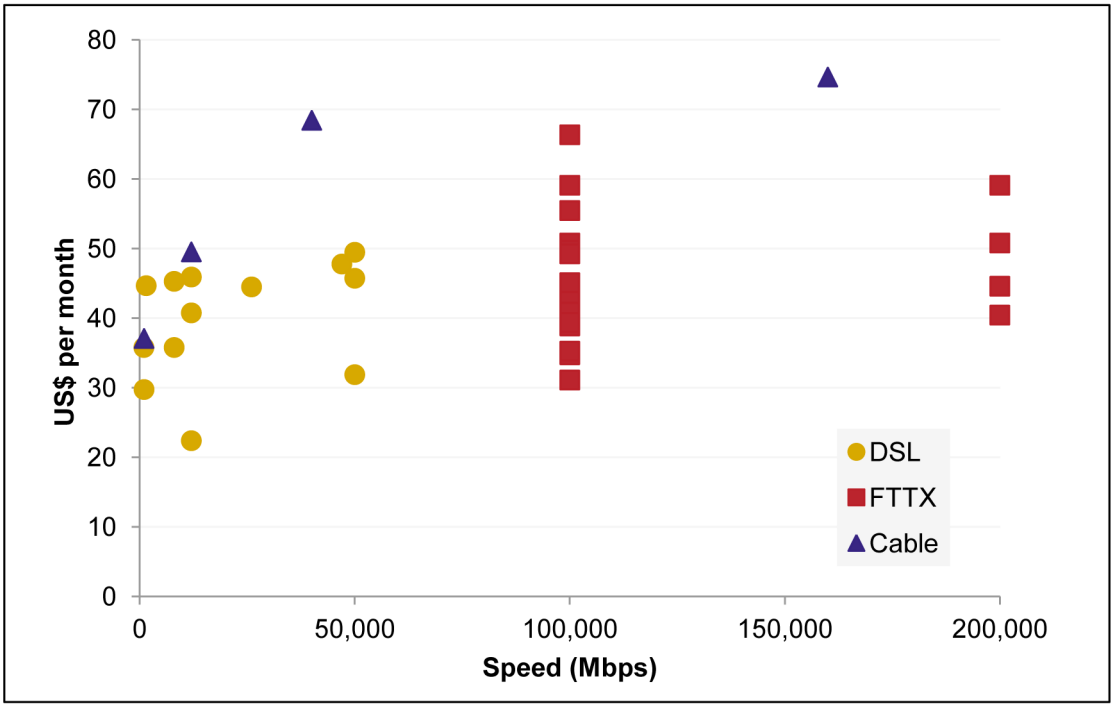

Figure 1: Broadband pricing in Japan

Indeed, in a 2009 survey 43% of FTTP users in Japan said one of the reasons they switched was because it was cheaper than alternative technologies (Takita 2011). The transition to fibre is not driven by ADSL being a mature technology (which, as we will see, it is not), but rather by aggressive fibre pricing that may well be loss making (and which bears little resemblance to the price premium assumed by the NBN Corporate Plan).

Prof. Tucker then reports 2010 forecasts from Graham Finnie of Heavy Reading (Finnie 2010), predicting fibre adoption around the world and Australia's relative standing. (Although Prof. Tucker doesn't mention it, this report was paid for by the FTTP Council, a leading pro-fibre lobby group). Again, it presumes the answer to the question, to worry that Australia might lag in forecasts of fibre penetration. Moreover, since Prof. Tucker's paper, Finnie has updated his presentation. Comments in the latest edition (Finnie 2011) include:

- *'Overall forecast down slightly on last year'*
- *'Generally very slow progress in Western Europe'*
- *'Incumbents, CLECs and munibuilders all missing targets'*
- *'Strong trend to higher-speed non-fiber products'*
- *'No really compelling application that requires a fiber connection'*
- *'Painfully slow new customer acquisition in many countries'*

It is particularly striking that work funded by a pro-fibre lobbying group is acknowledging that there are no compelling applications and, presumably in part for this reason, consumers are not interested. This highlights the risk in the presumption that fibre is the inevitable future, since today we simply don't have the applications that would make this so. (For completeness, we should note that Finnie was more optimistic about developments outside the EU, and felt that the leading indicators were positive for fibre).

Historic growth in bandwidth, and projecting forward

Prof. Tucker next reports the historic growth in available bandwidth. He says *'data rates in the telecommunications network have been growing exponentially for many years. Given the unbridled growth of new and emerging applications that use the Internet, one would have to be very brave or naive to suggest that this growth will suddenly stop'*. While no one is

suggesting it might suddenly stop, there are substantive reasons to believe that the increase in required access speeds may slow significantly.

Past growth in peak per-home usage (which drives access speed needs) has been driven two factors: firstly, by porting ever larger existing media-types onto the Internet – text, then photos, then video (initially standard definition and increasingly HD); and secondly by more simultaneous users per home. Today multiple individuals in a home will be Internet savvy, and WiFi networks enable them all to be online at the same time. However, neither of these trends is infinite.

Firstly, many people's connections today can carry HD video[1]. Cable broadband is well capable of this and increasingly so is DSL. Thus the content that would overwhelm today's connections is not anything that is widely available today. If 3D TV becomes widely adopted at home (likely many years away), and sees heavy on-demand use, and if compression does not bring the required bandwidth down to within the ever rising capabilities of copper, then maybe it will be an application that requires fibre. However, even then it is hard to see what the societal case is that justifies subsidising its availability, as with the NBN

Secondly, the rise of simultaneous use in home must slow once the number of online users per home stops growing, a point we are surely approaching as the Internet becomes ever more widespread and familiar. Of course, the same number of people may spend a greater percentage of their home time online, but there are only so many hours in a day. (Machine-to-machine usage of the Internet will continue to rise, but given that electricity meters and the like are not big watchers of video, their impact on bandwidth is not significant).

It is surely less naïve to take into account the issues above, which suggest a slowing in the growth of peak-bandwidth requirements, rather than simply to assume that historic growth rates will continue in perpetuity?

SIMULTANEOUS USAGE

Prof. Tucker then deploys the familiar argument that multiple simultaneous usage will require 100 Mbps, saying '[a] *number of high-definition, and perhaps 3D, video signals in a single house, together with some on-line gaming and some telecommuting could easily make large inroads in a 100 Mb/s link'*.

It is not clear what he means by 'a number', but let us assume three. This means five simultaneous tasks. The average Australian household size is 2.5 people (including small children). Of course there may be larger households that manage this level of simultaneous usage, but even in these it is likely to be a relatively rare scenario. Moreover, since this scenario that supposedly necessitates fibre for all involves four entertainment applications, it is not clear why the general taxpayer should be supporting it. Why should those who live in smaller or less prosperous households be subsidising the on-demand TV and gaming of a large family?

Finally, even this scenario could be readily handled by fibre to the cabinet, far cheaper than the fibre to the premises planned by NBN. Prof. Tucker posits that even more than FTTP's 100 Mbps might be needed because of additional applications such as on-line health monitoring, energy monitoring and home security. On line health monitoring is often low bandwidth (if, for instance, blood pressure or other such readings are being sent back to a health facility), with high bandwidth video needed only occasionally. And of course any such video for, say, a consultation, would represent a sixth person in the house using the Internet at the same time. Energy monitoring is a low bandwidth application, requiring kilobits per second not megabits per second. Home security as an additional simultaneous bandwidth user on top of those already raised by Prof. Tucker is surprising – how much security does a house with six people at home and awake require? (Of course, such security might be needed when they're out, but this bandwidth need cannot be added to gaming, TV and so on, since it takes place at a different time).

FTTP AND WIRELESS

Prof. Tucker then moves on to compare wireless to fibre. This includes the entertaining 'artist's impression' of a wireless network delivering 100 Mbps to every home, which shows a cell tower outside almost every house. Clearly this is an artist's impression, not that of a telecoms engineer, because the latter would know that the last thing you do in an area of dense usage is to put base stations on top of a tower. For a variety of technical reasons, it makes much more sense to put them at street level, perhaps attached to the outside of a premises, on a lamp post or similar. For such low power and dense uses, the equipment is in fact quite small, about the size of a box of cereal, and can be easily and discretely located in many locations. Thus the urban blight suggested by the artist's impression is myth-creation rather than myth-busting.

Moreover, in painting this picture Prof. Tucker sets the objective of a network that could deliver 100 Mbps to *all houses simultaneously*. As we have seen, even a single house using 100 Mbps is an unlikely scenario any time soon. That all adjacent houses would each be using 100 Mbps at the same time is even less likely. It is a fundamental principle of telecoms network design that not all users will fully use the network at the same time. It would be vastly wasteful to build the network so that they could, since it is such an extremely improbable event.

This is the principle behind 'contention ratios' – the ratio between the total bandwidth of the Internet access links (be they fibre or DSL or cable) to an aggregation point, and the bandwidth from that aggregation point to the rest of the Internet. Contention ratios for domestic broadband are often in the range of 20:1 to 50:1. In other words, in the former case if all users were to be online simultaneously, they would only get 1/20th of their advertised access link bandwidth. Of course in practice this doesn't happen. At any given point, many are not online, or only need a portion of their bandwidth. Consequently, the contention ratio need not materially degrade perceived performance.

Wireless can take advantage of the same phenomenon. Because one antenna can serve multiple houses, it can provide high bandwidth to each, because for all of them to simultaneously need maximum bandwidth is unlikely.[2] Consequently, Prof. Tucker's suggestion that one antenna per household is required is a significant overstatement.

Prof. Tucker sees wireless and FTTP as complementary: the former providing mobility and the latter high speeds. To an extent this is true, but mobile phones are rapidly becoming a requirement of life. This means that mobile broadband will increasingly be a given for consumers, with fixed broadband at home being seen as incremental expense. While for the foreseeable future it is likely that fixed services will offer faster speeds, consumers may well decide that these extra speeds are not worth the cost. This is certainly the trend in the UK, where of those with broadband, 9.5% have wireless broadband only, up from 4.4% two years ago (Ofcom 2011). To the extent to which Australian consumers go down the same path, this will shrink the addressable market for NBN.

FTTP AND DSL

Prof. Tucker dismisses DSL on the basis that delivering 100 Mbps to each home would require a node outside each house, and says that DSL technologies are now mature. Again, Prof. Tucker is more myth creating than myth busting. He includes an (unsourced) chart showing that VDSL2 speeds drop to about 25 Mbps once you are 400m from a node. However, Alcatel recently announced (Spruyt & Vanhastel 2011) that they were achieving speeds of 100 Mbps at distances of 400m (after field trials with a range of European carriers). That the speed at 400m has quadrupled in the less than two years since Prof. Tucker's paper rather suggests that the technology is not quite mature yet. Moreover, if 100 Mbps can be delivered over 400m, then certainly a node is not required outside each house. For a typical Sydney suburb, 800m of street (400m on either side of a node) might have over 100 houses.[3]

One node per 100 houses sounds rather less alarming than one per house, Prof. Tucker's suggestion.

FTTP AND HFC

Prof. Tucker dismisses HFC as an alternative high speed network, saying it is better to have a 'single advanced network rather than multiple networks', which he suggests would be wastefully duplicative. This is puzzling logic – it seems to miss the fact that the HFC network *already exists*. It is the NBN that is wastefully duplicative, an overbuilding of a perfectly functional existing network, providing similar capabilities. The incremental benefit of building the NBN in cable areas is even slimmer than everywhere else in the country, but the costs are the same.

FTTP AND THE ENVIRONMENT

In making the environmental case for FTTP, Prof. Tucker cites a study by CTC for the City of Seattle (CTC 2009). As we will see, this study had a number of serious flaws, both in its analysis of environmental and its treatment of other issues.

The study claimed that fibre would reduce Seattle's CO_2 emissions by 600,000 tonnes per year, the bulk of this benefit coming from reduced traffic congestion due to telecommuting. However, the basis for this calculation is consumer research commissioned by CTC that found that 29% of respondents claimed they needed home broadband of 100 Mbps or more in order to telecommute. This simply does not pass the common sense test – what possible applications for work at home that needed 100 Mbps could 29% of respondents have in mind? This result tells us much more about the dangers of asking survey respondents technical questions regarding Internet speeds than it does about the impact of fast broadband on telecommuting.

The CTC study also takes a completely one-sided view of the impact of fibre on CO_2 emissions. For instance, it does not mention the increase in emissions caused by teleworkers having to heat or cool homes during the working day that would otherwise be unoccupied.

Prof. Tucker is similarly one-sided. He compares the power consumption of various access networks, with FTTP having low consumption. But the environmental issue with FTTP is not its ongoing power consumption, but rather the fact that it involves substantial construction, which has its own environmental impact, both in the civil works (digging up the roads and so on) and in the manufacture of the necessary fibre. It also requires in-home battery back-up, which also carries an environmental cost. This is not necessarily to argue that these costs overwhelm the benefits – rather it is to make the simple point that one should not suggest (as Prof. Tucker does) that you have disproved a myth that FTTP is environmentally unfriendly simply by saying FTTP has some environmental benefits.

ECONOMIC JUSTIFICATION FOR NBN

Here Prof. Tucker again cites the CTC paper, mentioning the environmental and healthcare benefits CTC forecast for Seattle. As we have seen, the estimate of environmental benefits was on very shaky ground. CTC's estimate of healthcare benefits is even more questionable.

CTC forecast medical savings of US$600M per annum. This is based on a 30% reduction in the cost of treatment for chronic illness, a figure sourced to research by economist Robert Litan (Litan 2005). However Litan in turn sources the 30% figure to a *McKinsey Quarterly* article that said: *'disease-management programs combining a smart mix of technology and operational excellence would let insurers reap net savings of 10 to 30 percent for specific patient groups'* (Adomeit et al 2001). The first point to note is that a 30% upper bound in the McKinsey analysis is used as a midpoint forecast in the CTC report. However, the second more important point is that the McKinsey article dates to 2001. Given the date and the content of the article, it is clear that the mooted savings have nothing to do with superfast

broadband. CTC's sources simply provide no basis whatsoever for its estimate of the healthcare savings due to fibre.[4]

Prof. Tucker goes on to cite an OECD report (OECD 2009) in favour of the economic benefits of fast broadband. Unfortunately this report too had serious problems. For instance, as Prof. Tucker quotes, this report claimed that '*smart electrical grids ... will require fast communications networks'*. This belief seems to have been based on a simple misreading of sources. The OECD report cites a figure of 100 Kbps needed for smart grids. However, this figure (from Flynn 2007) is not a per-household requirement, but rather that for a system of 'several thousand meters'. In practice smart meters have already been installed in millions of homes without making use of fibre.

CONCLUSION

Prof. Tucker seeks to position some of the criticisms of NBN as myths. However, these criticisms seem to have rather more validity than he has credited them with. Indeed, some of them look stronger by the day.

FTTP is substantially more expensive than alternate broadband infrastructures. This incremental expense must be justified on the basis of applications that depend on the very fast broadband that only FTTP can deliver. However, advocates for FTTP very often blur the benefits of very fast broadband with the benefits of simple broadband. This is exactly what the OECD and CTC do in the papers Prof. Tucker cites.

What makes this problem worse is that, as we have seen, the capabilities of far cheaper technologies such as fibre-to-the-cabinet are getting ever better. This means that the unique capabilities of FTTP are getting narrower. Consequently, it is an ever-narrower set of applications that must be used to justify the incremental costs. Advocates of FTTP resort to discussing 3D TV and the like. Not only is the level of consumer demand for such services highly speculative at this stage, it is hard to see that there is a case for subsidising them out of general taxation – these are not services with 'externalities', benefits to the wider community beyond those directly using them.

The NBN is an expensive project involving a substantial restructuring of the telecoms industry. It is also an experiment, in that no other government in the world has intervened on this scale. None of these features of NBN prove that it is a bad idea. However, it suggests there is a high burden of proof on those advocating this path, and conversely says that it may be rash to dismiss criticisms as myths.

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ENDNOTES

1. Though congestion elsewhere in the network may make it impractical, a problem FTTP won't solve.

2. Though because of the statistics of small versus large numbers, a 20:1 contention ratio for a small group of households would certainly not be viable.

3. This is a conservative estimate – depending on the layout of the existing copper, the node could theoretically serve all the houses in a circle with a diameter of 800m, not just those on a single street length of 800m.

4. For further discussion of the CTC paper, see Kenny & Kenny 2011.

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