Submission

to the ACCC

on

Broadband Speed Claims

(Discussion Paper)

August 2016

22-August-2016

Malcolm Moore JP BE (Elect.)
Innovative Synergies
PO Box 45
St Ives 2075
Australia
mmoore@bigpond.net.au
www.moore.org.au

Contents

Defining Broadband

Some Background References

Well before Internet was a practical household term, virtually all consumer telecommunications was either telephony or telegraphs. Beyond the direct consumer market, television was also carried through the telecommunications network using wideband communication channels, radio programs were also carried through programme communications channels and there were also wideband connections between computers.

All these (analogue) telecommunications network components fitted together to form a very economic structure where very little telecommunications network infrastructure bandwidth was not used, or was otherwise redundant, or was simply underutilised.

With Telephony, the nominal "Voiceband" was 0.2 kHz to 3.4 kHz with a frequency response that was consistently flat (like a table top) through the Inter-Exchange (Backhaul) Network (IEN) . The (telephony) Customer Access Network (CAN) however was previously open (overhead) wire, which between 1950 and 1965 was totally replaced by trenched in pair copper cable. (*The Post Master General's Department (PMG) was an **Infrastructure Business** that was extremely efficient and did an immense of infrastructure work with virtually nil advertising or marketing.*)

Generally, this pair copper in the CAN does not have a "flat" frequency response (like it's IEN back-connection to the distant CAN), but has a monotonic (gradually / consistently increasing) attenuation with frequency and length resulting in the frequency response having a "slope" that makes some telephone calls sound "muffled" when on long CAN lines.

With Telegraphy, the nominal "Narrowband" was 120 Hz wide and it was common practice to fit / multiplex 24 "Narrowband" telegraph channels into one dedicated "Voiceband" channel in the Inter-Exchange Network, and cross-patch the Narrowband channels to pick up all the small Post Offices using spare channels in the Voiceband IEN infrastructure.

With Computers, one Voiceband channel was not enough because the data speeds were at the best 600 baud (0.0006 Mb/s), so a Group (or 12 Voiceband Channels) was used to provide a 48 kHz "Wideband" connection.

Again, this technology of 12 Channels, as a "Group" fitted perfectly into the Frequency Division Multiplex (FDM) telecommunications infrastructure of the then totally analogue Inter-Exchange Network.

So, the "Wideband" (analogue) CAN connection was essentially dedicated and basically consisted of two, two pair copper wire that usually did not require amplification and equalisation because the length was usually short enough (less than about 500 m).

With Radio Programmes, the nominal; bandwidth was 50 Hz to 15 kHz and usually flat to within +/- 0.5 dB overall for both AM and FM links. Like the "Wideband" analogue CAN connection, the Studio to Transmitter Link (STL) in most country cities and towns (that had their own AM or FM radio transmitters) the "Programme" link was standard two-pair cable (pairs chosen for lowest noise) as used for telephony, but amplified and equalised to better than +/- 0.1 dB with respect to 820 Hz.

With Television Programmes, the nominal "Wideband" bandwidth was 8 MHz which was the full line capacity of the bigger FDM systems; so for intra-State and inter-State transmission, dedicated Coaxial cables were used as the transmission medium, equivalent to about 4000 "Voiceband" telephony channels.

The meaning of "Broadband"

The term "Broadband" came about (circa 1998) as the digital equivalent to the analogue term "Wideband", which covers a wide range of frequency bandwidths beyond "Voiceband" as use in telephony, and "Narrowband" as used in telegraphy. The term "Wideband" was used for a range of analogue communications transmission purposes including at least analogue Data, (Audio) Programme, (analogue) Television transmission.

Functionally, the term "Wideband" covers a wide range of data speeds exceeding that possible through the standard telephony channel analogue bandwidth (0.2 kHz to 3.4 kHz), where the maximum data transfer rate is nominally 56 kb/s.

Functionally, the term "Broadband" covers a wide range of data speeds exceeding that possible through the standard Integrated Services Digital Network (ISDN) data connection of a "Megalink" with a digital data rate of 2.048 Mb/s (which is 32 voice / data channels of 64 kb/s). Practically, the term "Broadband" is deliberately loose and does not insist on symmetrical data speeds, so Website connectivity can be optimised with downstream speeds far exceeding upstream speeds.

Categorising Broadband Speeds

In the past 20 years (i.e. since 1996) there have been a few practical digital Customer Access Network (CAN) technologies that have provided a range of "Broadband" speeds that have ranged from about 4 Mb/s to over 100 Mb/s.

One of the casualties of "Privatisation" and "enforced Competition" was a very abrupt dropping of engineering standards with a replacement of marketing and sales hype (lies) that have culminated in an abnormally high percentage of consumers given to expect (and have paid) far more than what is physically possible.

The problem is that as Internet-based download speeds have dramatically increased, the latency (i.e. response delay) has also played a major part in limiting service Quality standards, especially with much faster "Broadband" downstream speeds. Once Broadband downstream speeds exceed about 17 Mb/s, latency in excess of about 100 msec starts to become a major factor to limit the "Internet Experience".

It seems that (as all too common) with the introduction of telecommunications "competition", certain CAN technologies for example, Satellite have been highly favoured in inland areas because those signing off on the engineering strategies had extremely little telecommunications engineering knowledge. Similarly, those that did the "global-based engineering" incorrectly used northern hemisphere non-urban templates for non-urban situations in Australia (in the southern hemisphere). The very economic alternative of re-using / re-vitalising existing telecomms long-haul radio CAN infrastructure[1] for a small fraction of the overall cost, was totally overlooked.

[1] http://www.moore.org.au/comms/03/201606RevitalisingtheDRCS.ppsx

Well before Broadband Internet connectivity was common, it was very well known in telecomms engineering that (geostationary) satellites are about 37,000 km above the earth's equator, and the signal path delay is at the best about 0.28 seconds (280 msec).

While this does not sound very long, in voice terms this is a significant echo because the echo would come back about 600 msec later; in terms of Internet this is a mild delay from a Web Host that would in most cases be un-noticeable unless if the data speed was in excess of about 17 Mb/s. If this link were to be used for Video Conferencing then the video delay would be in the order of at least 600 ms to 1000 ms and that would be rather annoying (compared to a terrestrial link with a delay of about 20 msec).

Categorising the Downstream

The downstream data rate can be categorised in somewhat logarithmic structure by using "downstream data rate bands" that are nominally root (2) or about 1.5 times as follows:

Downstream Category	Equal / Greater Than	Less Than
D1	1200 Mb/s	1700 Mb/s
D2	800 Mb/s	1200 Mb/s
D3	600 Mb/s	800 Mb/s
D4	400 Mb/s	600 Mb/s
D5	220 Mb/s	400 Mb/s
D6	120 Mb/s	220 Mb/s
D7	80 Mb/s	120 Mb/s
D8	46 Mb/s	80 Mb/s
D9	37 Mb/s	46 Mb/s
D10	25 Mb/s	37 Mb/s
D11	17 Mb/s	25 Mb/s
D12	12 Mb/s	17 Mb/s
D13	8 Mb/s	12 Mb/s
D14	6 Mb/s	8 Mb/s
D15	4 Mb/s	6 Mb/s
D16	3 Mb/s	4 Mb/s

Downstream Rating Table (first iteration)

This table would very quickly place every CAN technology into slots that can be directly related to marketing. This table also minimises false advertising and sets a very clear path for vendors to accurately place their products and concurrently for the buyers, they should know what to expect.

In practice Consumer uses will rarely require faster than 25 Mb/s and 100 Mb/s is a practical upper limit, so this table can be re-drawn with 100 Mb/s as the future base standard as follows:

Downstream Category	Equal / Greater Than	Less Than
D1	80 Mb/s	*120 Mb/s*
D2	46 Mb/s	80 Mb/s
D3	37 Mb/s	46 Mb/s
D4	25 Mb/s	37 Mb/s
D5	17 Mb/s	25 Mb/s
D6	12 Mb/s	17 Mb/s
D7	8 Mb/s	12 Mb/s
D8	6 Mb/s	8 Mb/s
D9	4 Mb/s	6 Mb/s
D10	3 Mb/s	4 Mb/s

Rationalised Downstream Categories table.

This table is concise, a geometric progression, and deliberately technology absent so that it can include any practical technology. The 120 Mb/s limit is in italics and can be omitted for practical purposes.

Categorising the Upstream

Ideally the Upstream and Downstream data rates should be Symmetrical - especially when considering interactive games. Basically a person's downstream is limited by the other end's (other person's) upstream data rate.

Asymmetry Rating	Min Upstream Speed	Max Upstream Speed
A0	=> 80% Downstream	= Downstream
A1	=> 20% Downstream	< 80% Downstream
A2	=> 10% Downstream	< 20% Downstream
A3	=> 5% Downstream	< 10% Downstream
A4	=> 1% Downstream	< 5% Downstream

Categorised Asymmetry Rating table

This table provides a very simple categorised Asymmetry Data Rating market / engineering tool that is technology independent. When this table is put with the Downstream Rating table, this starts to "pigeon hole" expected customer service Quality standards into broadly associated and comparative rating numbers.

Categorising the Latency

The missing part of the puzzle is Latency, which is largely to do with the physical length of the connection from the customers modem to the testing Website location including the Customer Access Network length (which is generally very short and therefore usually a very low latency / delay) and the Inter-Exchange Network (IEN) which is can be quite long usually very long depending on where the testing Website is located.

Latency Rating	Min Latency	Max Latency
L0		<10 msec
L1	10 msec	<100 msec
L2	100 msec	<200 msec
L3	200 msec	<500 msec
L4	500 msec	

Categorised Latency Ratings table

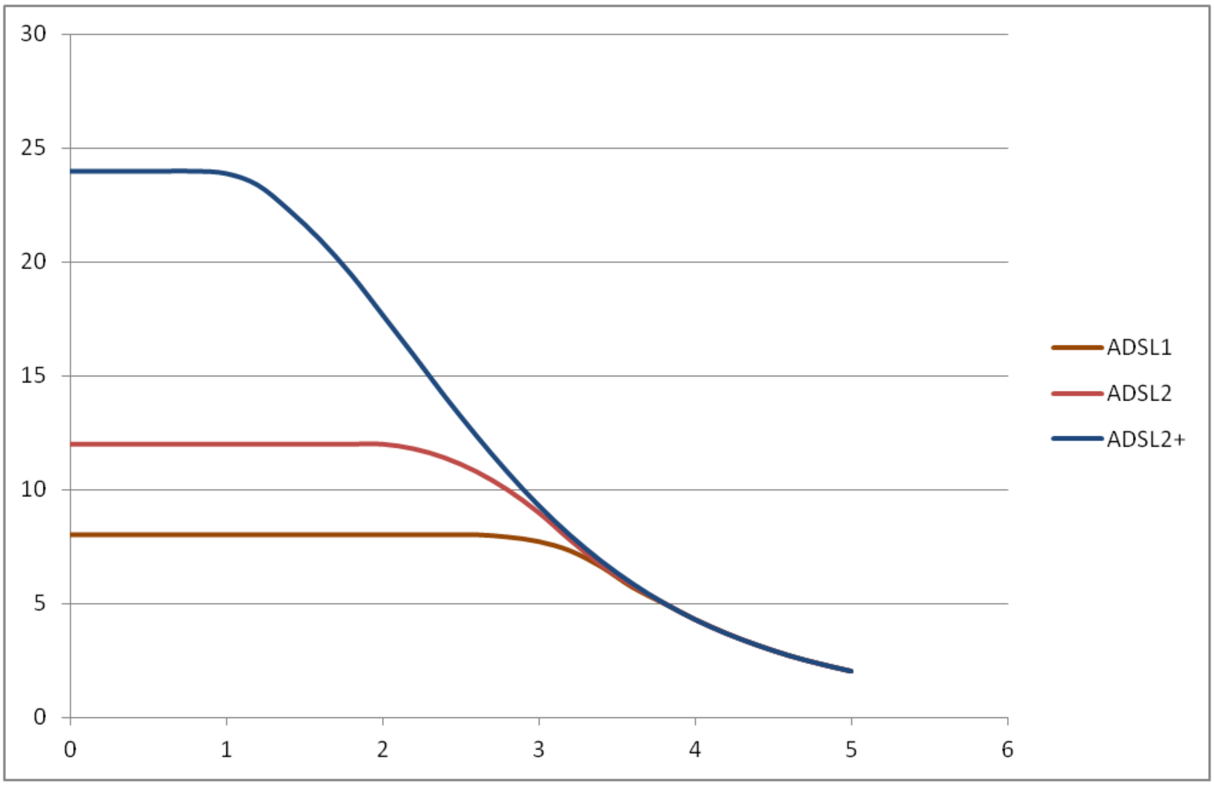
In most urban cases the Latency ratings will be well under 100 msec (L1) and generally not a major issue.

Situations with the premises CAN connection being by Satellite will have an exceptionally long latency delay because these geostationary satellites are typically about 36,000 km above the earth's equator. Considering the earth has a radius of about 6,400 km and a circumference of about 40,000 km, the satellite (double) hop transmission distance is equivalent to about two times around the earth.

Fitting ADSL Technologies

The problem with ADSL technologies is that the Downstream speed is highly dependent on longer pair copper line lengths (and wire diameter, and the maintenance state of the cable in the CAN).

ADSL is an "interesting" technology because it (like it's parents "Dial-Up") has data speeds that are highly dependent on the length, construction (and physical state of maintenance) of the pair copper that ADSL technology rides on.



The chart above gives an idea of the possible (practical) downstream data speeds based on overall CAN pair copper length - using 0.40 mm pair copper as in Australia (as is standard in all urban Australia from villages to large metropolitan suburbs).

Much like (digital) Mobile Phone technology, the technology of ADSL went through several technology improvements over a period of about 15 years. The table below gives a broad indication of the advancing technologies and the optimistic speeds limits for these variants on ADSL.

The table below shows the development of various phases of ADSL technologies as used in Australia.

Approved Date	Common Name - Standard	Upstream	Downstream
1998	ADSL (ANSI T1.413)	1.0 Mb/s	8.0 Mb/s
1999-2007	ADSL (ITU G992.1)	1.3 Mb/s	8.0 Mb/s
2001	ADSL (ITU G992.1 Annex A)	1.3 Mb/s	12.0 Mb/s
2002-2007	ADSL2 (ITU G992.3	1.3 Mb/s	12.0 Mb/s
2003-2005	ADSL2+ (ITU G992.5)	1.4 Mb/s	24.0 Mb/s
2008	ADSL2+M (ITU G992.5 Annex M)	3.3 Mb/s	24.0 Mb/s

The technology of ADSL has stabilised to ADSL2+(M) but, again because of competition the (Telstra) pair copper CAN was not (re)engineered for ADSL technologies.

It would have been very simple to specify ADSL2+(M) to be restricted to 1500 m total CAN length with a downstream speed of 18 Mb/s to 24 Mb/s and an upstream data rate speed of nominally 3 Mb/s, with low latency. This specification would really suit most rural areas, all Villages, all Towns, and city CBDs.

In a similar mindset, it would have been very simple to specify ADSL2 (and ADSL1) to be restricted to 2900 m total CAN length with a downstream speed of between 8 Mb/s and 12 Mb/s, and an upstream data rate speed of nominally 1 Mb/s, with low latency. This specification would really suit most suburban areas.

In working through this second specification with the realisation that 2900 m is the nominal average metropolitan (suburban) CAN pair copper length, this means that 50% of the pair copper metropolitan CAN will be longer than 2900 m and be out of specification for ADSL1 and ADSL2 technologies.

With consideration that (apparently) consumers are leaving fixed wire CAN in droves, this would mean that at least 20% of pair cables would be now spare, so the main cables pairs could be physically bonded to double the cross section area - effectively halving the electronic distance for ADSL so that Main pairs could be virtually halved in electronic length (halved in attenuation), so that premises beyond 50% distance of 2900 m could connect and be within "specification".

Putting this table and the above chart into practical text in the form of categorised Broadband connectivity, the following categories evolve:

ADSL Tech	Cable Length	D'nstream	Symmetry	Latency
ADSL1 / ADSL2	< 3300 m	D8	A4	L1
ADSL1 / ADSL2	3300 - 3800 m	D9	A4	L1
ADSL1 / ADSL2	3800 - 4100 m	D10	A3	L1
ADSL2+	< 1500 m	D5	A4	L1
ADSL2+	1500 - 2500 m	D6	A4	L1
ADSL2+	2500 - 3000 m	D7	A4	L1
ADSL2+	3000 - 3300 m	D8	A4	L1
ADSL2+	3300 - 3800 m	D9	A4	L1
ADSL2+	3800 - 4100 m	D10	A3	L1

This table really breaks up the range of ADSL technologies in terms of line lengths and provides an easy conceptual method to categorise this and other Broadband CAN technologies into common groupings that can then be directly compared.

Some Costs of Increased Competition

Increased competition has caused technologies to be introduced in areas where they are far from favourable (but will provide a short-term ROI), and not introduced into areas where these technologies would work extremely well (but because the ROI is external - competitive businesses deliberately avoid investing these infrastructures.

The Excel Spreadsheet in the My.Government / Communications website is (with a little bit of telecomms engineering experience) is rather easy to analyse and it shows some shocking problems that all thanks to increased competition in all the wrong places that (I believe) has cost Australia **well over $200 Bn** in the past 30 or so years.

Still the ACCC is fog-horning "Increased Competition" as the panacea when exactly the opposite "Substantially DECREASED Competition" is required to stop wasting the Federal and State funds (and get Australia out of debit ASAP).

> *In 2008, the World Broadband conference was held in Sydney and had about 120 delegates - mostly from Australia - but very notably missing Telstra representatives, which was interesting because Telstra had inherited about 80% of the total Australian telecomms network infrastructure in the metropolitan areas and has a higher percentage of telecomms infrastructure in the inland areas.*
>
> *With Global Engineering and Marketing, much of the "standard" engineering designs could (well before) then be sold from multi-national telecomms equipment manufacturers using urban-based global (northern hemisphere-based) templates. Consequently, by 2008, Lawyers / Sales / Marketing people filled most of Telstra's Senior Executive positions as Telstra was (and still is) really a Retail Reseller but with an inherited monopoly Wholesale telecomms infrastructure.*
>
> *This 3-day conference was packed with speakers from all avenues of telecomms Broadband businesses and technologies. By the third day we had all got to know each other and the guards were down. So - we held an open session where we all spoke our minds about the state of the telecomms infrastructure in Australia. This session stunned me.*

It became obvious that all these relatively small (in comparison to Telstra) Broadband Service Providers (including Optus) were literally strung up by Telstra to slowly die - because Telstra had an extremely economical telecomms infrastructure monopoly, and Telstra was screwing all the competition to Telstra's infrastructure in what are really essential, not discretionary products / services.

Case after case came up where competition had resulted in very uneconomic and expensive (uncompetitive) sub-infrastructures that seriously lacked traffic to support the finance; and this provoked others to "introduce competition" which really was never financially practical.

This was not economical for Australia, not economical for the competing infrastructure businesses, and it became obvious to me that the theoretical economics that we have been taught in schools and universities is deliberately incorrect and fundamentally flawed with "competition" extending well beyond what are "discretionary products and services".

Shortly after this Conference it became visually clear to me that Competitive Business has its place with Retail Reselling of Discretionary Products and Services - and nowhere else. This postulation then set the stage to recognise that there is no place for economical Competition within Infrastructure Business - and further these two economical business models are diametrically different to each other, but both have to be there to have an economically stable country.

This watershed moment about how incorrect the prevailing teachings of Economics in Australia are. It suddenly dawned on me that that the ACCC's mantra of "**competition is good - more competition is better**"; is a close parallel to a brain-fried druggie mindlessly fog-horning some religious faith while staring into the abyss.

The ACCC's mantra is so wrong and in so many ways - and **it is crippling Australia**.

My watershed moment took a couple of years to rationalise into logical economics, where I finally recognised that there are two distinctly different types of Businesses.

The one we all are taught about is Competitive Business and the one that we are deliberately not taught about is Infrastructure Business. Both Business mindsets require each other to be "efficient" and both Business mindsets are diametrically different, and have diametrically different measures - in every way!

If competition is so good, then why do we not privatise the current ACCC and set up several competing ACCC equivalent bodies to compete against the existing ACCC to make the ACCC more efficient?

The answer is that the ACCC / PC / Defence / Law / Police / Gaols / DFAT / Electricity / Roads / Rail / Ports / telecomms (i.e. transport infrastructure) etc. i.e. all Government Departments (including what was the Telecom Australia Commission) are essential services that operate as Infrastructure Businesses - not Competitive Businesses. All Infrastructure Businesses manage the Essential Products and Services. Competitive Businesses grow on discretionary Products and Services and specialise as being Retail Resellers of Wholesale products and Services and definitely not "Service Providers".

The PowerPoint reference[2] below gives a brief and concise description of the diametrical differences between these two business types and where they should be used - and not used; and where/why Infrastructure Competition kills National Productivity[3] and this is related in the Theory of the Second Best[4], which basically states that any level of Competition is Second Best to any form of Co-operation.

The other area of deliberately obliterated economics is revealed in an excellent set of publications by Professor Sharon Beder[5] (Wollongong University). "Powerplay - the fight for control of the World's Electricity" is an excellent starting point to realise how and why Federal Government Departments (like the ACCC) are being played as rank amateur fools by most Australian corporate businesses and international businesses.

Incorrect Economic Model

The primary problem is that the Australian telecommunications infrastructure is split between several competitive (and now privately owned) businesses. Economically, having several (i.e. more than one) infrastructure provider is economically very unproductive (inefficient) for all the reasons not taught about competitive economics being apparently very efficient (employing people).

By far the most economic model for providing infrastructure is to not have infrastructure competition and not run the provision of minimised services as a maximum-priced monopoly - but these attributes are totally associated with the "Competitive Business" economic model.

It therefore stands to reason that the "Competitive Business" economic model is the wrong economic model for (telecommunications) infrastructure in Australia. In direct contrast and with a diametrically opposite business mindset, the "Infrastructure Business" economic mindset is the perfect economic model for infrastructures.

Telstra is firmly entrenched as being a privatised "competitive business". Telstra's primary focus correctly is on maximising retail (short-term) profits for their shareholders (not necessarily Australians).

The telecommunications network is however a long-term infrastructure with a natural turnover of between 30 and 70 years, not a retail reselling business with a range of product lines that can be turned over within 6 months.

This business/economic problem would be very quickly and efficiently resolved by physically separating the telecommunications network (infrastructure) from the retail reselling (competition) so that the telecommunications infrastructure can be managed / operated along infrastructure business economics - out of the commercial ASX. Telstra can the really focus on its prime core product "retail reselling / bundling" and Telstra can then be operated as a major telecommunications retail reseller on a relatively level playing field (and a considerably larger Broadband / Mobile market).

Historically, metropolitan-based telecommunications infrastructure provides a far greater short-term return on investment (ROI). Naturally, the privatised / commercial

2 http://www.moore.org.au/busn/02/CompetitionInfrastructure.ppsx
3 http://www.moore.org.au/busn/02/privatecircle.ppsx
4 http://www.moore.org.au/busn/02/TheoryoftheSecondBest.pdf
5 https://www.uow.edu.au/~sharonb/power.html

business economic model's primary focus for maximised short term ROI is on high-use commercial products in the metropolitan areas where the profit margin can be maximised, and where marketing and advertising can be product tuned very quickly.

Non-metropolitan infrastructure is seen (by marketing types that live in metropolitan areas) as a "Cost Centre" problem because of high cost-related distance issues that are seen to impinge on maximising the profits of short-term high use retail products, minimising the ROI compared to that in metropolitan areas.

Because of this very myopic economic competitive business mindset (that is diametrically different to the infrastructure business mindset), Telstra provides an absolute minimum of new (and old) equipment into the non-metropolitan areas. The outcome has been a series of rolling complaints over what is now decades.

The Davidson Report Problem

The Davidson Report (1982) used the term "**telephony**", to implicitly mean the "**consumer telecommunications service standard**", which at that time, was based on "**Voice Band**" (0.2 kHz - 3.4 kHz) communications of the day. Consumer Dial-Up modem connections also used the Voice Band "**telephony**" Customer Access Network (CAN) as part of the "**consumer telecommunications service standard**".

In the late 1990s, the introduction of ADSL (Asymmetrical (data rate speeds) Digital Service Line) modem technology dramatically increased data communications speeds over the same "**telephony**" Customer Access Network - but with one difference: the bandwidth used for ADSL on pair copper extended well past the Voice Band limit of 0.0034 MHz, up to about 2.2 MHz.

This advance in Customer Access Network technology now includes ADSL (and other Broadband technologies, e.g. Cable Internet / Pay TV, Satellite Pay TV, and Satellite Internet, Radio Access: GSM (2G/ 3G/ 4G), FTTP etc.) and this advance has implicitly changed the meaning of the term "**consumer telecommunications service standard**" to <u>include Broadband connectivity</u>, not just Voice Band connectivity as used for Telephones and Dial-Up Modems.

As a direct consequence of the Davidson Report that introduced the concept of the Universal Service Obligation (USO) for the Federal Government to fund about $190 M pa to Telstra to provide equitable "**telephony**" standards (read: "**consumer telecommunications service standards**") in the non-metropolitan areas; it therefore directly follows that in Telstra receiving this funding, <u>Telstra is obligated to maintain consumer telecommunications service standards in all non-metropolitan areas that are directly comparable / equitable / consistent to the metropolitan areas</u>.

Technology Rollout Delay Problem

Traditionally, the non-metropolitan areas (State Capital Cities and their Suburbs) of Australia have trailed the metropolitan areas in terms of telecommunications technology by about five to 10 years.

In the past 30 years, (i.e. since the Davidson Report) the split in wholesale service delivery has substantially widened, resulting in the non-metropolitan areas having substantially lower consumer telecommunications service standards where Broadband connectivity to upwards of 250,000 non-metropolitan premises is virtually non-existent, though most of these premises in/near Villages and Small Towns have satisfactory (Voice Band) telephony infrastructure.

My recent study of the MyBroadband DataCube data clearly showed that a rather high proportion of non-metropolitan premises that do have ADSL connectivity, have ADSL1 (8 Mb/s) or ADSL2 (12 Mb/s) but not ADSL2+ (24 Mb/s), where the vast majority of metropolitan premises have ADSL services with ADSL2+ (24 Mb/s) installed.

The prime cause for this widening delay of comparative service standards was caused by privatising the Australian telecommunications infrastructure (circa 1975 - 1985), resulting in infrastructure investment only in high Return On Investment (ROI) products, with an absolute minimum of infrastructure. Compounding this widening delay was inept wording in the Davidson Inquiry / Report (outlined above) that for simplicity used "**telephony service**" to mean "**telecommunications service**".

This wording was taken in face value to mean just (fixed) "telephone" and the consumer service standards were consequently very tightly constricted to relate to only Voice Band (fixed) telephone service, even though the scope of metropolitan telecommunications now includes significantly oversupplied Broadband technologies as well as pre-existing Voice Band technologies.

There is no way that the non-metropolitan consumer telecommunications service standards are in any way directly comparable with that of the metropolitan consumer telecommunications service standards of these days.

The secondary cause for this widening was a substantial change in technologies from about 1985 onwards with the broad adoption of very inexpensive Single Mode Optical Fibre (SMOF) technology, particularly between metropolitan centres and later between metropolitan suburbs. Non-metropolitan SMOF was also introduced but only to replace existing (aged) Quad cable in a very minimalistic structure in the country areas; otherwise point-to-point radio is used.

In the metropolitan areas, replacing Plesiochronous Digital Hierarchy (PDH) 2 Mb/s links on ageing copper pair cable with inexpensive SMOF cable that has a nominal bandwidth exceeding 140 Mb/s at that time really didn't require a business case. Consequently a grid of cross-connecting SMOF cables were run in all metropolitan areas between the exchange sites, providing an abundance of alternate route connectivity for then and for the future.

In non-metropolitan areas, replacing antiquated analogue 12, 24 and 120 channel systems with Plesiochronous Digital Hierarchy (PDH) sub-systems was a tough business call that had to be made as the switches were also now becoming digital.

Consequently, a very thin (tiered) Star network of minimum strand SMOF cables were installed in the non-metropolitan (read: country areas) to replace the ageing (then high maintenance) quad and coax cables connecting between country cities and their nearby towns and villages; otherwise radio links were used, as these were sometimes cheaper but lacked digital bandwidth.

As alluded to above, competing telecommunications service providers saw their competition apparently making big ROI through installing long haul (distance) SMOF transmission systems between major (coastal) cities. In true competition style, these providers also rolled out their (expensive in small orders) SMOF-based transmission systems, but quickly found out that there was very little available traffic and/or potential traffic was already locked in long-term contracts. This competitive infrastructure economic disaster situation then produced a range of "fire sales" to foster traffic for all the wrong reasons.

The metropolitan areas were well-provisioned with multiple duplicated competitive Mobile Phone (Radio Base Stations), "competitive" (duplicated) Cable Pay TV infrastructure and some Satellite Pay TV infrastructure. The non-metropolitan areas are poorly provisioned with a minimum of Mobile Phone (Radio Base Stations), no Cable TV and some Satellite Pay TV infrastructures.

Telstra was looking at rolling out Fibre to the Premises (FTTP) from about 1990 to replace the then ageing pair copper cable infrastructure, but that initiative was trounced by (duplicated) Pay TV over Cable in metropolitan areas and by Pay TV over Satellite in non-metropolitan areas.

With the advent of ADSL technology from about 1997 over existing pair copper cable and the concurrent advent of Cable Internet technology, Broadband connectivity in metropolitan areas became highly predominant. ADSL has gone through nominally three stages of development with (very length dependent) maximum download speeds of ADSL1 (8 Mb/s), ADSL2 (12 Mb/s) and ADSL2+ (24 Mb/s).

My brief analysis of the MyBroadband DataCube data clearly shows that an abnormally high proportion of old ADSL2 and very old ADSL1 Digital Services Line Access Multiplexer (DSLAM) equipment is located in non-metropolitan (i.e. country) local exchanges, but conversely a much higher proportion of DSLAM2+ exchange equipment is located in metropolitan (i.e. capital city) exchanges.

Considering that the normal installation process is to initially roll out new technologies in the capital cities / suburbs (i.e. metropolitan) areas and then the non-metropolitan (i.e. country) areas, this analysis very strongly indicates that old DSLAM2 and really old DSLAM1 equipment has been physically removed from metropolitan exchange sites and re-located into non-metropolitan (country) sites; and that new DSLAM2+ equipment has been provisioned into metropolitan exchanges fully at the expense of non-metropolitan customers.

Not only are the non-metropolitan ADSL customers being deliberately short-changed with very out-dated DSLAM equipment, but a very high percentage of Large Towns, Small Towns and Villages have pair copper lines that are considerably less than 2 km long. If these local exchanges had DSLAM2+ equipment installed, then these customers (according to the Broadband DataCube data) would be able to download at faster than 20 Mb/s, but an abnormally high percentage of premises are restricted to just 8 Mb/s, or 12 Mb/s.

My definition of a Village is a locality with up to 250 premises / phone lines connecting to a Small Country Automatic Exchange or "SCAX hut" in these communities. On average, each SCAX hut connects about 91 premises.

There are about 2545 SCAX hut Villages in Australia and an extremely high proportion of the Villages, (about 1600 or 62%) have absolutely nil ADSL facilities, and this affects about 160,000 premises or about 448,000 people.

More recently, the introduction of Fibre to the Premises (FTTP) to replace the very ageing pair copper cable technology is being suppressed by the .

The Global Engineering Problem

In the northern hemisphere (Europe, Canada, North USA) it is common practice to have all homesteads (and even farm sheds) located in villages / towns and the villages are spaced by about 5 km to 10 km as a maximum.

In Australia / New Zealand, it is extremely rare to have homesteads in towns and rare to have homesteads in villages, so utilising "global engineering" (i.e. based on northern hemisphere demographics) is an extremely expensive mistake.

The McKinsey Report on Cost Benefit Analysis of the NBN for Australia (in my opinion) was a classical and extremely expensive mistake because it utilised what appears to me to be inexpensive northern-hemisphere based global analysis tools to connect urban (primarily metropolitan) premises with FTTP up to a maximum of 10 km and Satellite for the remainder. None of this fits the non-metropolitan Australian demographic, but really suits Europe etc..

The Radio Tower Problem

The next hopelessly failed inland scenario, again based on northern hemisphere demographics, is the use of Urban radio towers being used in the hope that Homesteads will be within reach and pay the price for 3G / 4G connectivity (and have a very small monthly budget in comparison to those using ADSL / Cable).

Most towns and villages that have a radio tower and RBS that is located in the town adjacent to the SCAX hut. The geographic problem is that most towns (and villages) are located in valleys, and the range of the radio tower RBS is extremely limited, so a high proportion of farms / homesteads are shaded from the radio area.

Even in metropolitan areas the small valleys have mini-base stations to eliminate Radio Black Spots so consider several farm, each say 5 km in radius - there is no way that a town-based RBS will connect with these Homesteads, and their land as the users move with their mobile devices.

Beaming RBS antenna along main roads has credit but not for the locals on the farms as they are in what are effectively "Radio Black Areas". Commercially (without any consideration to Farmers and Graziers). "Radio Black Areas" seem to be defined along roads where vehicle drivers lose 3G / 4G radio connection.

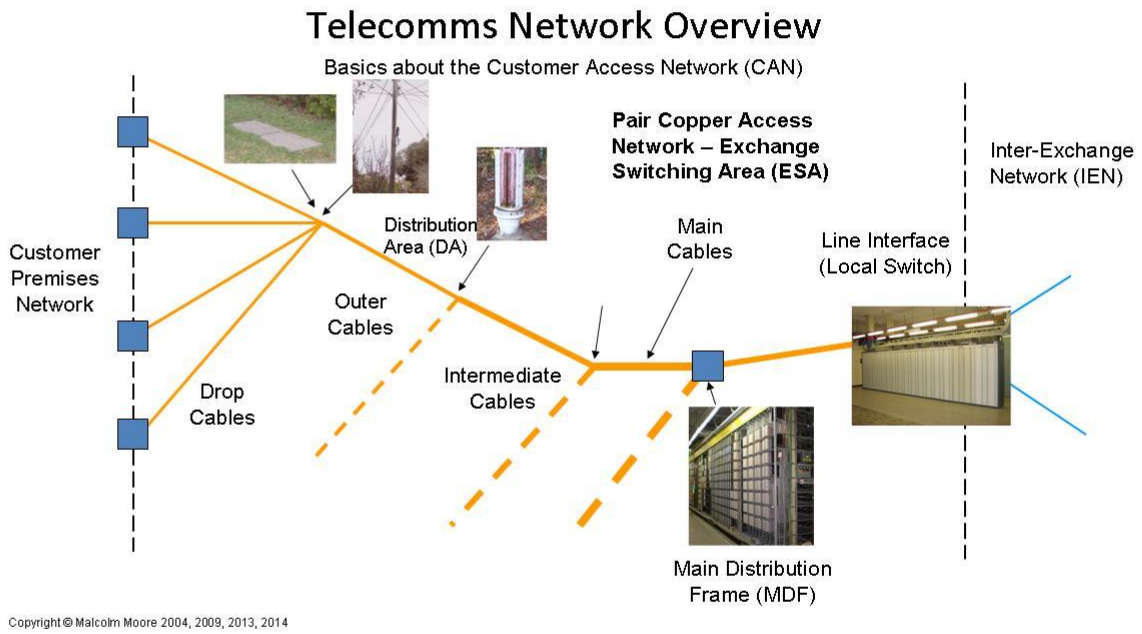
The Privatisation Problem

Since privatisation (circa 1975 - 1985) contractors have generally replaced full-time field staff and work is done to a Piece Rate (time) standard not to a Quality standard. Consequently, these pair copper cables are not particularly well sealed as they were before privatisation.

Further, these pair copper (customer) cables were never pressurised to keep water (vapour) out. The water vapour / moisture substantially increases the inter-wire capacitance per unit length, making the copper pair cable (particularly for frequencies used by ADSL) to appear far longer than it really is. So a (moist) cable that is physically say 3 km long may (at ADSL frequencies) appear as though it is 5 km long, or longer.

The Very Basics of Pair Copper CAN

The pair copper cables that connect from the Local Exchange Main Distribution Frame (MDF) are called Main cables. These main cables are thick and carry 400, 800 or 1200, pairs and some very big ones are apparently 2400 pair (and thick as your arm).



These Main cables extend to the main pit where they are jointed into several much smaller Intermediate cables that are typically 200 or 400 pairs, and usually connect at a Pillar or Sputnik beside the footpaths.

Recently Bill Morrow (CEO NBN) in a talk at the Press Club in Canberra said the cables were much better than expected, but then went and purchased several hundred km of Intermediate cable to re-join to the Pillars / Sputniks. The obvious question was why?

The Main and Intermediate cables are older (much older), and have probably been there since before 1965, if not before 1950, and because of competition and privatisation (the need to maximise short term profits) virtually nil of these cables are / were dry gas pressurised to keep the insulation dry.

Looking back to the My.Communications website the fairly simple 95,000 line Excel Spreadsheet in there tells the truth - but it takes a little bit of engineering knowhow to forensically analyse and identify the problems.

The maximum urban line length is 4100 m - and this was engineered around telephone signalling, not around ADSL modem data speed limits. This length was also used as the basis for the maximum Voiceband Attenuation and "Slope" in the CAN specifications.

At 4100 m the typical downstream data speed is about 3.98 Mb/s. So, any ADSL speed lower than nominally 4 Mb/s is on a faulty pair copper line.

It would be a rather safe guestimation that in these <4 Mb/s cases the Main Cable and/or Intermediate cable is not dry-gas pressurised and consequently it is "wet", and consequently the capacitance and leakage is unacceptable; and/or the joint at the pit for the outer / drop part of the CAN cable is "wet" (faulty).

A simple merging of this Data Cube data with the cable construction and length would come up with a very simple what to fix next programme to get it working properly without racing off to 4G radio as another panacea that undoubtedly will have a myriad of Radio Black Spot problems because there was never any real planning to roll out SMOF cable in these country areas.

The ADSL Fiasco

One of the major problems with ADSL technologies is that these telecomms sub-infrastructures were introduced in a "Competitive Business" mindset environment that did everything engineering wrong and for all the wrong reasons.

Purely because of "Competition" we have the worst possible engineering solutions for ADSL technologies (and telecomms in Australia at large) that have resulted in a plethora of extremely expensive customer complaints to the TIO (telecomms industry ombudsman), the ACCC (Australian Consumer and Competition Commission) and virtually every Federal Minster; years of Select Senate Inquiries and Regional Telecomms Reviews, and the cost of the NBN, the cost of the USO plus the cost of lost GDP, the cost of extra Social Services outside the capital cities, the list goes on.

When ADSL technology was introduced it was "expensive" so instead of engineering the pair copper cable CAN lines to work optimally (as it would have been done in an Infrastructure Business environment), the DSLAMs were installed in local exchange sites where the perceived ROI would be maximised in the short term.

The high ROI exchange sites were obviously the major metropolitan CBDs, and these local exchanges generally have rather short length pair copper CAN cables (usually barely longer than 1000 m, where the suburban / metropolitan cable lengths are on average about 3000m and max out at about 4100 m).

As it turned out the first (and second) generation of ADSL had a maximum downstream data rate of 8 Mb/s, that can be seen from the below chart would keep that data rate until about 3000 m, so these would work perfectly in metropolitan CBD arrangements.

When the next generation of DSLAMs came out a couple of years later, these were considerably less expensive and had a maximum downstream speed of 12 Mb/s up to about 2500 m. But they were 50% faster, so no real guesses in what happened to "maximise the short term profit.

Yes, many of the existing ADSL1 DSLAMs were removed from CBD based local exchanges and re-located into suburban and Country City local exchanges (because these were perceived as lower ROI areas) - for Competitive Business.

For the Infrastructure Business mindset however, putting ADSL into Country Cities and Towns would be a major Federal Government saving as this would have facilitated a significant reduction in Social Service costs and created the facility for more employment in Country cities - which means more tax.

When the next generation of DSLAMs came out a couple of years later, these were again considerably less expensive and had a maximum downstream speed of 24 Mb/s up to about 1100 m, and by about 2000 m the downstream data rate was about 17 Mb/s. But they were 100% faster, than the 12 Mb/s ADSL2 DSLAMs and 200% faster than the ADSL1 DSLAMs - if your line was less than 1100 m long!

So the vast majority of these DSLAMS were "competitively" located in metropolitan local exchanges and a good proportion of the ADSL2 and ADSL1 DSLAMS were "relocated" to lower ROI areas. Simple engineering analysis of the My.Broadband Excel Spreadsheet[6] supports this theory of competitive stupidity and waste.

This Spreadsheet also shows where ADSL is (and is not) a facility! In other words, a little more simple analysis shows that because of the "Competitive Business" mindset within Telstra (and other "competitors"), a rather high (disproportionate) percentage of the metropolitan areas are fitted out with ADSL2+(M) DSLAMs while a disproportionately low percentage of the country Cities have ADSL2+(M) and a much lower proportion of the larger country towns have and ADSL, while virtually nil Villages and small Towns have any ADSL[7], and this accounts for over about 209,000 services in the inland.

Now, with a Competitive Business mindset, installing DSLAMs in these 2,545 Village locations is a waste of money because these are low ROI and the maintenance wound not make this profitable. (Also, with consideration of the Universal Services Obligation (USO) becoming in doubt if country people use their phones / Internet like their city cousins, and continue costing the Federal Government about $300 M pa (or about $10 Bn to date in waste due to "competition").

With an Infrastructure Business mindset these DSLAMs as ADSL2+(M) would have been installed several years ago with a total cost[8] of about $13.6 M and 6.8 M and $3.4 M = $23.8 M **and at about 1% that of Satellite connectivity**. The pair copper would have been in good order by preventative maintenance techniques instead of reactive maintenance as done by Competitive Business.

A Little Data Cube Engineering Analysis

Here is a really easy way to get a jump start on inexpensively rolling out inexpensive ADSL2+ Broadband well beyond the main cities, significantly increase Telstra's Broadband market share, take the load off the dismal / expensive NBN Satellite apparent solution, and quickly provide considerable Broadband connectivity to over 1600 Villages, about 222 Small Towns and their surrounding Farm areas, accounting for about 727,000 Australians who currently have no ADSL2+ Broadband connectivity.

The first issue to resolve is that Australia has a very high percentage of ADSL2+ broadband connectivity (particularly in the capital cities and suburbs), and that the maximum downstream speed is 24 Mb/s - so - we should not be hyping for much faster speeds in the Consumer / Small Business market.

To me, it makes very good Engineering sense to consider that currently and until about 2020, that 24 Mb/s is a "maximum speed" and that all other Broadband CAN

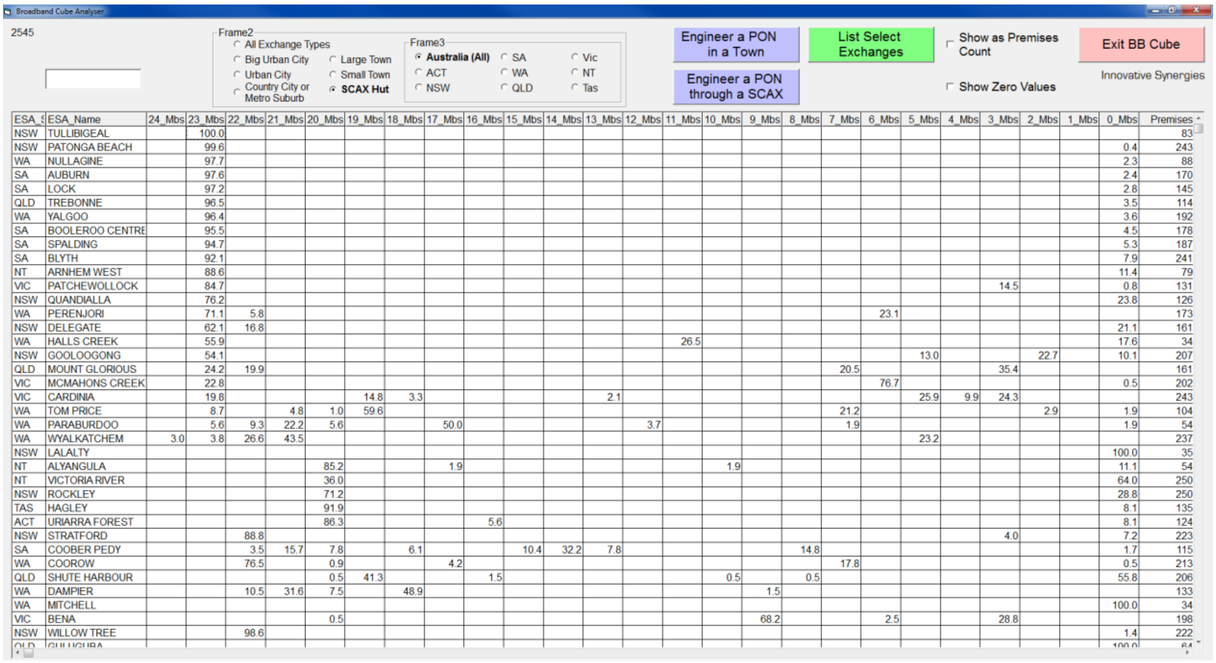
[6] https://www.mybroadband.communications.gov.au/upload/documents/BQP_DATA_v4.xlsx
[7] http://www.moore.org.au/comms/03/201601inlandADSLbb.ppsx
[8] http://www.moore.org.au/comms/03/201601inlandADSLinSCAX.ppsx

technologies that are capable of faster downstream speeds should be "throttled" to provide Consumer / Small Business conformity of 24 Mb/s.

My relatively simple forensic analysis of the MyBroadband Data Cube[9] ADSL data showed me that about 1600 country Villages with Small Country Automatic Exchanges (SCAX huts) with up to 250 lines to premises, (average about 90 lines per village SCAX hut), have absolutely nil ADSL facilities in them. This accounts for about 1600 * 90 * 2.5 = 360,000 country Australians not getting inexpensive ADSL2+ Broadband Internet at their premises.

A very high proportion of these Village premises are very close (<750 m) to the SCAX hut sites. If these SCAX huts had inexpensive DSLAM2+ equipment installed in them, then this simple strategy would be a very quick and inexpensive fix to provide 24 Mb/s Internet to most (about +80%) of all these premises.

The screenshot below, of my simple analysis if the Broadband DataCube (for ADSL) shows a very high percentage of Villages that actually have DSLAM2+ equipment connect at virtually 24 Mb/s downstream speeds.

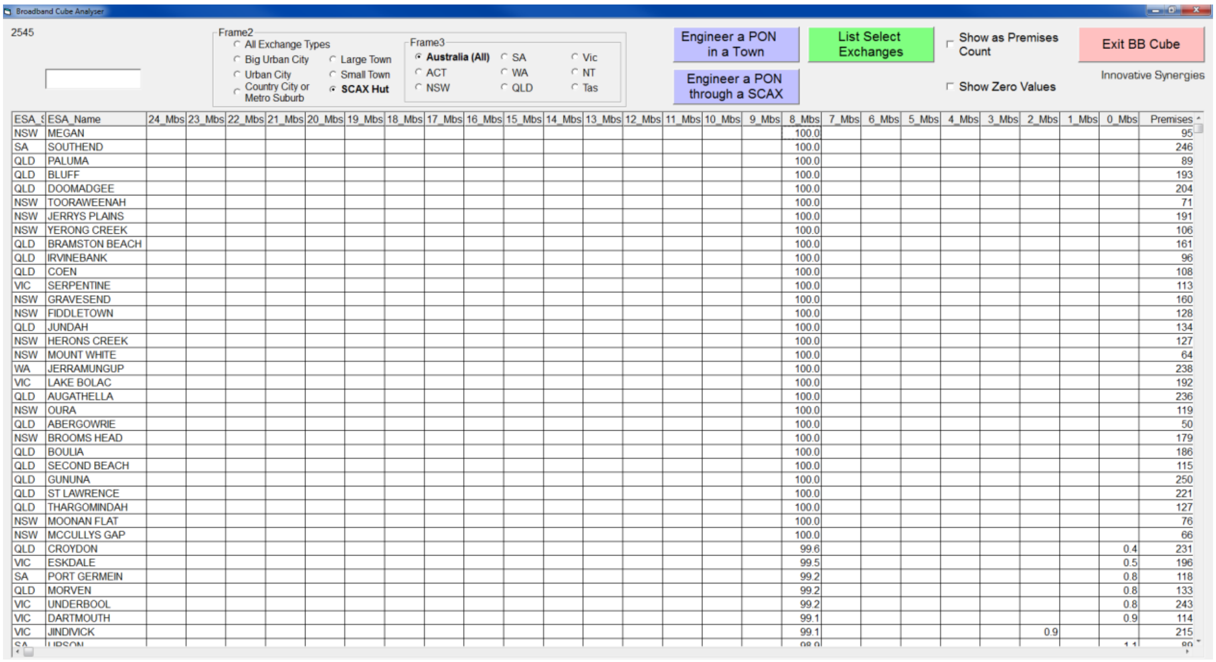


ESA_S	ESA_Name	24_Mbs	23_Mbs	22_Mbs	21_Mbs	20_Mbs	19_Mbs	18_Mbs	17_Mbs	16_Mbs	15_Mbs	14_Mbs	13_Mbs	12_Mbs	11_Mbs	10_Mbs	9_Mbs	8_Mbs	7_Mbs	6_Mbs	5_Mbs	4_Mbs	3_Mbs	2_Mbs	1_Mbs	0_Mbs	Premises
NSW	TULLIBIGEAL		100.0																								83
NSW	PATONGA BEACH		99.6																							0.4	243
WA	NULLAGINE		97.7																							2.3	88
SA	AUBURN		97.6																							2.4	170
SA	LOCK		97.2																							2.8	145
QLD	TREBONNE		96.5																							3.5	114
WA	YALGOO		96.4																							3.6	192
SA	BOOLEROO CENTRE		95.5																							4.5	178
SA	SPALDING		94.7																							5.3	187
SA	BLYTH		92.1																							7.9	241
NT	ARNHEM WEST		88.6																							11.4	79
VIC	PATCHEWOLLOCK		84.7																				14.5			0.8	131
NSW	QUANDIALLA		76.2																							23.8	126
WA	PERENJORI		71.1	5.8																23.1							173
NSW	DELEGATE		62.1	16.8																						21.1	161
WA	HALLS CREEK		55.9												26.5											17.6	34
NSW	GOOLOOGONG		54.1																		13.0			22.7		10.1	207
QLD	MOUNT GLORIOUS		24.2	19.9															20.5				35.4				161
VIC	MCMAHONS CREEK		22.8																	76.7						0.5	202
VIC	CARDINIA		19.8				14.8	3.3					2.1								25.9	9.9	24.3				243
WA	TOM PRICE		8.7		4.8	1.0	59.6												21.2					2.9		1.9	104
WA	PARABURDOO		5.6	9.3	22.2	5.6			50.0					3.7					1.9							1.9	54
WA	WYALKATCHEM	3.0	3.8	26.6	43.5																23.2						237
NSW	LALALTY																									100.0	35
NT	ALYANGULA					85.2			1.9							1.9										11.1	54
NT	VICTORIA RIVER					36.0																				64.0	250
NSW	ROCKLEY					71.2																				28.8	250
TAS	HAGLEY					91.9																				8.1	135
ACT	URIARRA FOREST					86.3				5.6																8.1	124
NSW	STRATFORD			88.8																			4.0			7.2	223
SA	COOBER PEDY			3.5	15.7	7.8		6.1			10.4	32.2	7.8					14.8								1.7	115
WA	COOROW			76.5		0.9			4.2										17.8							0.5	213
QLD	SHUTE HARBOUR					0.5	41.3			1.5						0.5		0.5								55.8	206
WA	DAMPIER			10.5	31.6	7.5		48.9									1.5										133
WA	MITCHELL																									100.0	34
VIC	BENA					0.5											68.2			2.5			28.8				198
NSW	WILLOW TREE			98.6																						1.4	222
QLD	GULLUGUBA																									100.0	64

Villages in the screen shot below are obviously fitted with very old hand-me-down DSLAM1 equipment removed from the metropolitan areas and having a maximum downstream speed of only 8 Mb/s where if they had reasonable DSLAM2+ equipment they would be downloading at nominally 24 Mb/s.

To get a price on this little project, a 128 port DSLAM2+ costs about $6,000 https://www.google.com.au/#q=MA5616+ports+adsl+DSLAM+ and double that price to include labour and contract management plus ancillary materials and this is about $12,000 per SCAX hut. Count in say 1,600 SCAX huts and this is a grand total of $19.2 M all done and dusted. Cost per premises is about $133, paid for, well inside 24 months and the rest is profit.

[9] https://www.mybroadband.communications.gov.au/resources.aspx

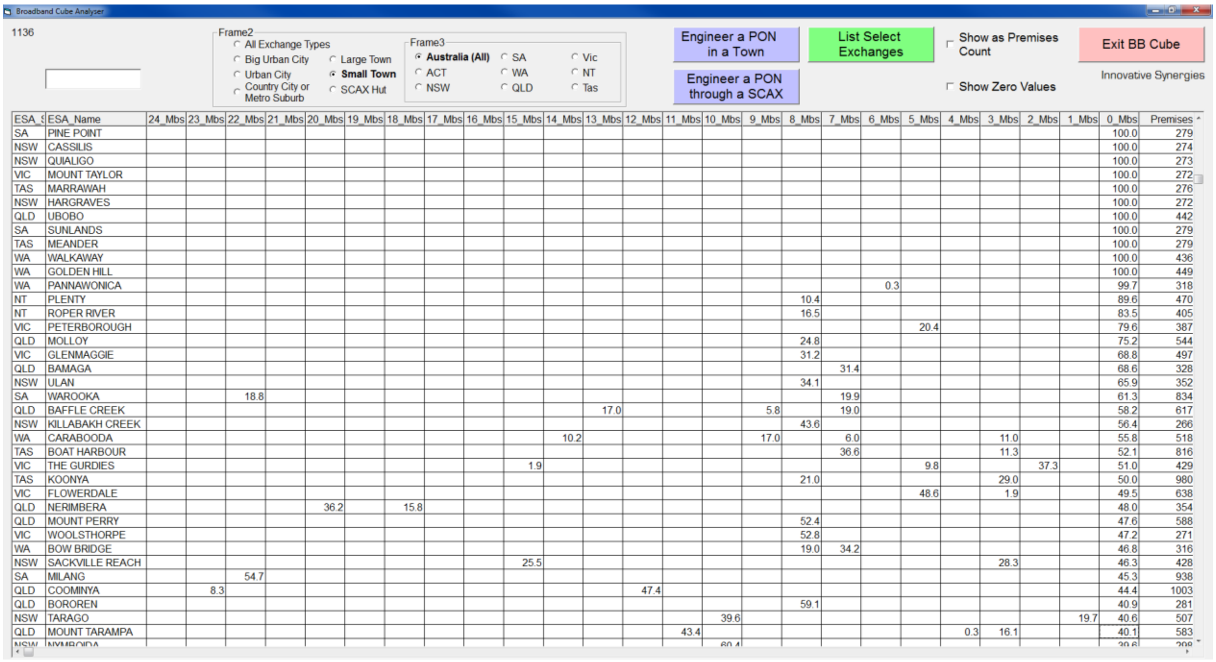


ESA_S	ESA_Name	24_Mbs	23_Mbs	22_Mbs	21_Mbs	20_Mbs	19_Mbs	18_Mbs	17_Mbs	16_Mbs	15_Mbs	14_Mbs	13_Mbs	12_Mbs	11_Mbs	10_Mbs	9_Mbs	8_Mbs	7_Mbs	6_Mbs	5_Mbs	4_Mbs	3_Mbs	2_Mbs	1_Mbs	0_Mbs	Premises
NSW	MEGAN																	100.0									95
SA	SOUTHEND																	100.0									246
QLD	PALUMA																	100.0									89
QLD	BLUFF																	100.0									193
QLD	DOOMADGEE																	100.0									204
NSW	TOORAWEENAH																	100.0									71
NSW	JERRYS PLAINS																	100.0									191
NSW	YERONG CREEK																	100.0									106
QLD	BRAMSTON BEACH																	100.0									161
QLD	IRVINEBANK																	100.0									96
QLD	COEN																	100.0									108
VIC	SERPENTINE																	100.0									113
NSW	GRAVESEND																	100.0									160
NSW	FIDDLETOWN																	100.0									128
QLD	JUNDAH																	100.0									134
NSW	HERONS CREEK																	100.0									127
NSW	MOUNT WHITE																	100.0									64
WA	JERRAMUNGUP																	100.0									238
VIC	LAKE BOLAC																	100.0									192
QLD	AUGATHELLA																	100.0									236
NSW	OURA																	100.0									119
QLD	ABERGOWRIE																	100.0									50
NSW	BROOMS HEAD																	100.0									179
QLD	BOULIA																	100.0									186
QLD	SECOND BEACH																	100.0									115
QLD	GUNUNA																	100.0									250
QLD	ST LAWRENCE																	100.0									221
QLD	THARGOMINDAH																	100.0									127
NSW	MOONAN FLAT																	100.0									76
NSW	MCCULLYS GAP																	100.0									66
QLD	CROYDON																	99.6								0.4	231
VIC	ESKDALE																	99.5								0.5	196
SA	PORT GERMEIN																	99.2								0.8	118
QLD	MORVEN																	99.2								0.8	133
VIC	UNDERBOOL																	99.2								0.8	243
VIC	DARTMOUTH																	99.1								0.9	114
VIC	JINDIVICK																	99.1						0.9			215

This is a tiny project for Telstra, and it really takes the weight off the NBN Satellite congestion disaster; that turned out exactly as I forecast some years ago.

If all the "Village" SCAX huts (up to 250 lines) were fitted with small DSLAM equipment then this would cost about 2,545 * $12,000 = $30.54 M, ($133 per premises). This would take a tremendous weight off the Federal Government and NBN problems, and provide Telstra with a ready market of another 229,050 ADSL2+ customers. Again this is tiny money for Telstra for big profits and it would go a long way to support those in the inland who vote for the National / Liberal coalition.

Look a little further and the Small Town scenario (251 to 1,000 lines SCAX huts), average 520 lines per Small Town, about 1,136 Small Towns, total lines 591,768, immediate people affected about 2.5 * 591,768 = 1,479,420 people, and more than half these people vote). Again in a Small Town scenario most premises are <1000 m from the SCAX hut so all premises should be able to connect at 24 Mb/s.

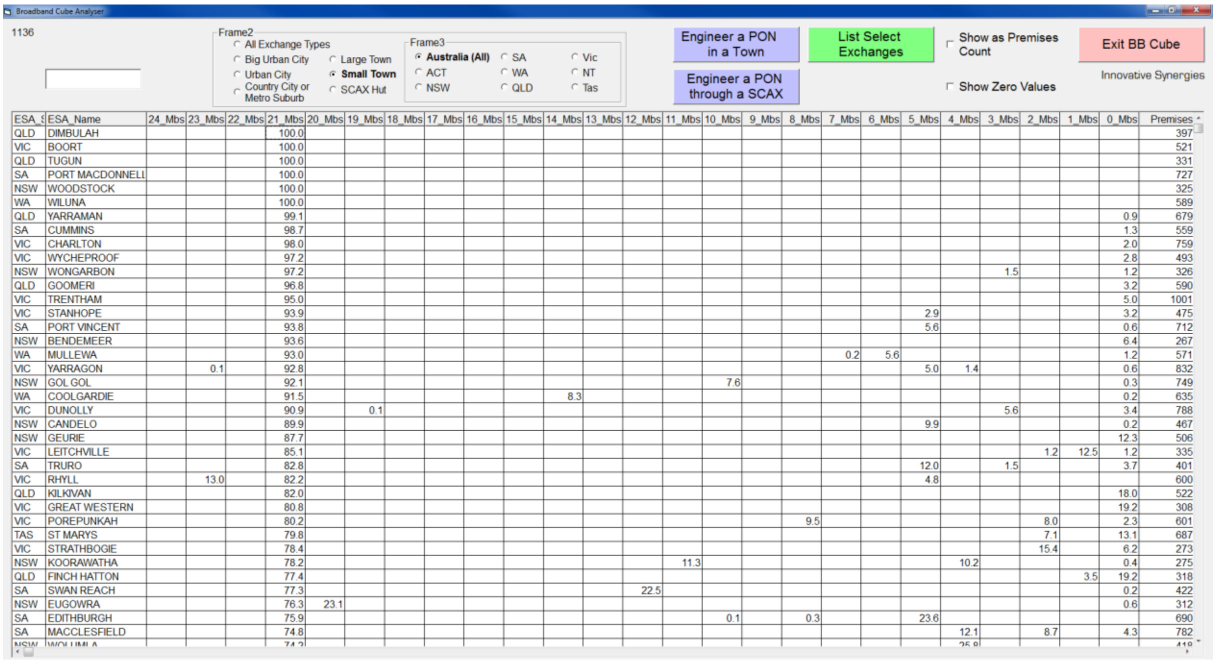


ESA_S	ESA_Name	24_Mbs	23_Mbs	22_Mbs	21_Mbs	20_Mbs	19_Mbs	18_Mbs	17_Mbs	16_Mbs	15_Mbs	14_Mbs	13_Mbs	12_Mbs	11_Mbs	10_Mbs	9_Mbs	8_Mbs	7_Mbs	6_Mbs	5_Mbs	4_Mbs	3_Mbs	2_Mbs	1_Mbs	0_Mbs	Premises
SA	PINE POINT																									100.0	279
NSW	CASSILIS																									100.0	274
NSW	QUIALIGO																									100.0	273
VIC	MOUNT TAYLOR																									100.0	272
TAS	MARRAWAH																									100.0	276
NSW	HARGRAVES																									100.0	272
QLD	UBOBO																									100.0	442
SA	SUNLANDS																									100.0	279
TAS	MEANDER																									100.0	279
WA	WALKAWAY																									100.0	436
WA	GOLDEN HILL																									100.0	449
WA	PANNAWONICA																			0.3						99.7	318
NT	PLENTY																	10.4								89.6	470
NT	ROPER RIVER																	16.5								83.5	405
VIC	PETERBOROUGH																				20.4					79.6	387
QLD	MOLLOY																	24.8								75.2	544
VIC	GLENMAGGIE																	31.2								68.8	497
QLD	BAMAGA																		31.4							68.6	328
NSW	ULAN																	34.1								65.9	352
SA	WAROOKA			18.8															19.9							61.3	834
QLD	BAFFLE CREEK												17.0				5.8		19.0							58.2	617
NSW	KILLABAKH CREEK																	43.6								56.4	266
WA	CARABOODA											10.2					17.0		6.0				11.0			55.8	518
TAS	BOAT HARBOUR																		36.6				11.3			52.1	816
VIC	THE GURDIES										1.9										9.8			37.3		51.0	429
TAS	KOONYA																	21.0					29.0			50.0	980
VIC	FLOWERDALE																				48.6		1.9			49.5	638
QLD	NERIMBERA					36.2		15.8																		48.0	354
QLD	MOUNT PERRY																	52.4								47.6	588
VIC	WOOLSTHORPE																	52.8								47.2	271
WA	BOW BRIDGE																	19.0	34.2							46.8	316
NSW	SACKVILLE REACH										25.5												28.3			46.3	428
SA	MILANG			54.7																						45.3	938
QLD	COOMINYA		8.3											47.4												44.4	1003
QLD	BOROREN																	59.1								40.9	281
NSW	TARAGO															39.6									19.7	40.6	507
QLD	MOUNT TARAMPA														43.4							0.3	16.1			40.1	583

This screenshot above is typical of Small Towns as ADSL speeds by percentage of premises lines and this is the 4th screen from the top, so all the above have no DSLAM2+ facilities AFAIK.

The screenshot below is typical of Small Towns with DSLAM2+ facilities by percentage in download data rates of the premises count.

On average each Small Town SCAX would require $24,000 in project costs including DSLAM2+, ancillaries, labour and project management; and the total outlay would be about 1,136 * $24,000 = $27.26 M, again small bickies, massive (political) ROI.



ESA_S	ESA_Name	24_Mbs	23_Mbs	22_Mbs	21_Mbs	20_Mbs	19_Mbs	18_Mbs	17_Mbs	16_Mbs	15_Mbs	14_Mbs	13_Mbs	12_Mbs	11_Mbs	10_Mbs	9_Mbs	8_Mbs	7_Mbs	6_Mbs	5_Mbs	4_Mbs	3_Mbs	2_Mbs	1_Mbs	0_Mbs	Premises
QLD	DIMBULAH				100.0																						397
VIC	BOORT				100.0																						521
QLD	TUGUN				100.0																						331
SA	PORT MACDONNELL				100.0																						727
NSW	WOODSTOCK				100.0																						325
WA	WILUNA				100.0																						589
QLD	YARRAMAN				99.1																					0.9	679
SA	CUMMINS				98.7																					1.3	559
VIC	CHARLTON				98.0																					2.0	759
VIC	WYCHEPROOF				97.2																					2.8	493
NSW	WONGARBON				97.2																		1.5			1.2	326
QLD	GOOMERI				96.8																					3.2	590
VIC	TRENTHAM				95.0																					5.0	1001
VIC	STANHOPE				93.9																2.9					3.2	475
SA	PORT VINCENT				93.8																5.6					0.6	712
NSW	BENDEMEER				93.6																					6.4	267
WA	MULLEWA				93.0														0.2	5.6						1.2	571
VIC	YARRAGON		0.1		92.8																5.0	1.4				0.6	832
NSW	GOL GOL				92.1											7.6										0.3	749
WA	COOLGARDIE				91.5							8.3														0.2	635
VIC	DUNOLLY				90.9		0.1																5.6			3.4	788
NSW	CANDELO				89.9																9.9					0.2	467
NSW	GEURIE				87.7																					12.3	506
VIC	LEITCHVILLE				85.1																			1.2	12.5	1.2	335
SA	TRURO				82.8																12.0		1.5			3.7	401
VIC	RHYLL		13.0		82.2																4.8						600
QLD	KILKIVAN				82.0																					18.0	522
VIC	GREAT WESTERN				80.8																					19.2	308
VIC	POREPUNKAH				80.2													9.5						8.0		2.3	601
TAS	ST MARYS				79.8																			7.1		13.1	687
VIC	STRATHBOGIE				78.4																			15.4		6.2	273
NSW	KOORAWATHA				78.2										11.3							10.2				0.4	275
QLD	FINCH HATTON				77.4																				3.5	19.2	318
SA	SWAN REACH				77.3									22.5												0.2	422
NSW	EUGOWRA				76.3	23.1																				0.6	312
SA	EDITHBURGH				75.9											0.1		0.3			23.6						690
SA	MACCLESFIELD				74.8																	12.1		8.7		4.3	782

According to the My Broadband DataCube data, my quick analysis of this shows that about 222 Small Towns about (521 * 222 * 2.5) = 289,155 people have nil ADSL2+ facilities and that fix should cost about $5.4 M, which again is a very small expenditure for such a massively big political return.

With this infrastructure, a high percentage of Rural Homesteads will be within 10 km of the SCAX huts, but the ADSL will be rather slow (1.3 Mb/s to 4.5 Mb/s) - but something is far better than nothing – and right now they have nothing.

Further analysis of the MyBroadband DataCube showed me that about 35 farms are on average connected to each SCAX hut. I have an inexpensive strategy that I believe can bring these ADSL2+ speeds to Homesteads to be over 11 Mb/s for up to 10.5 km away from the SCAX huts.

Worst Case Customer Cables

From about 1987 to about 1993, most of the metropolitan Inter-Exchange Network (IEN) analogue sub-infrastructure consisting of thousands of km of 0.64 km pair copper cables (the telecomms highways that inter-connect the telecomms exchanges, so the CAN will through-connect end-to-end) was replaced with an optical fibre (digital) sub-infrastructure.

This part of the metropolitan IEN was kept in a pristine state as these cables were dry gas-pressurised to keep moisture and corrosion out. In almost all cases, these cables ran parallel to their Customer Access Network (CAN) sub-infrastructures - in the same or parallel sub-footpath conduits for some km from each telephone exchange.

The Customer Access Network (CAN) cables (connecting the "subscribers") were generally in a much poorer physical condition as few were actually dry gas pressurised, and were typically 0.40 mm pair copper. Why? Because as far as I know, there were no Executive KPIs (key performance indicators) attached to the performance of the "subscribers" pair copper cables.

With an Infrastructure Business mindset, the sensible strategy would be to replace the much poorer sections of main cable (i.e. directly from the local Exchanges to the main pits / sputniks) with the much better physical condition 0.64 mm pair copper and give the customers an extremely low maintenance metropolitan CAN infrastructure for at least the next 20 years. The much poorer condition, high maintenance 0.40 mm pair copper main cables would be removed and sold as clean scrap copper for increased revenue.

With a Competitive Business mindset, the sensible strategy was to rip out the high value 0.64 mm pair now unused Junction copper cables and cash in the cables for maximised shoer term shareholder dividends; even though there was a shortage of customer lines at that time, and after then.

Telstra was "effectively" privatised (it has a "Competitive Business" executive mindset and Board) so instead of really capitalising on the excellent state of the Junction network, this was ripped out and converted to short term cash.

Thinking with engineering in mind, the maximum urban CAN length using 0.40 mm pair copper is nominally 4100 m and in the metropolitan areas, the average length was / is about 2900 m, so the telephony calls were to a large degree "muffled" because of the length with 0.40 mm pair copper having considerable "slope" in the Voiceband resulting in the sibilances being to a large degree "lost".

Consider if these Junction cables were re-used in the CAN for nominally 815 m = to the first loading coil (remove) and cross connect to the "outer"; 1830 m = full length and cross connect to the "outer"; and 2745 m = to the first loading coil (remove) and continue then cross connect to the "outer".

Customers on 4100 m of 0.40 mm pair copper would have been on 2745 m of 0.64 mm + 1355 m of 0.40 mm, which would equate to about only 2.8 km of 0.40 mm pair copper and sound very clear (and very low maintenance).

Customers on 2500 m total distance would have had the first 1830 m on 0.64 mm pair copper and the remainder (670 m) on 0.40 mm pair copper. This would equate to about 1.7 km of 0.40 mm pair copper and sound very clear (and very low maintenance).

Customers on say 2000 m total distance would have their first 915 m on 0.64 mm pair copper and the remainder (1085 m) , which would equate to about only 1.6 km of 0.40 mm pair copper and sound very clear (and very low maintenance).

Lost Business Opportunity

As alluded to above, if an Infrastructure Business mindset of long term planning and consequences had prevailed (and not the short-term quick-money - neglect the consequences mindset of Competitive Business) then the frustrating ADSL story would have been entirely different.

Consider the three cases above

Line Length (m)	Construction	ADSL Speed (Mb/s)
1000	1000 m 0.40 mm	23.8
1000	915 m 0.64 mm + 85 m 0.40 mm	23.8
2000	2000 m 0.04 mm	17.7
2000	915 m 0.64 mm + 1085 m 0.40 mm	21.2
2000	1830 m 0.64 mm + 170 m 0.40 mm	23.5
2500	2500 m 0.40 mm	13.2
2500	915 m 0.64 mm + 1585 m 0.40 mm	16.7
2500	1830 m 0.64 mm + 670 m 0.40 mm	20.7
3000	3000 m 0.40 mm	9.3
3000	915 m 0.64 mm + 2085 m 0.40 mm	12.6
3000	1830 m 0.64 mm + 1170 m 0.40 mm	16.5
3000	2745 m 0.64 mm + 255 m 0.40 mm	20.2
3500	3500 m 0.40 mm	6.4
3500	915 m 0.64 mm + 2585 m 0.40 mm	8.8
3500	1830 m 0.64 mm + 1670 m 0.40 mm	12.1
3500	2745 m 0.64 mm + 755 m 0.40 mm	15.8
4000	4000 m 0.40 mm	4.3
4000	915 m 0.64 mm + 3085 m 0.40 mm	6.0
4000	1830 m 0.64 mm + 2170 m 0.40 mm	8.4
4000	2745 m 0.64 mm + 1255 m 0.40 mm	11.5

This table shows that if the Junction cables had been left in place and re-used as Main cables, and the older main cables pulled out, then the thicker pair copper being re-used in the CAN (from the IEN) could have considerably reduced the line attenuation and "slope" in the Voiceband, but also significantly decreased the attenuation in the Broadband used for ADSL.

The lost opportunities by having the wrong business mindset in ADSL productivity are astounding. Where currently most of the customer complaints are because "the Internet is too slow", a very high percentage of customer could have ADSL exceeding 12 Mb/s, where they are really struggling with lower than 4 Mb/s.

With a little more engineering knowledge, it has to be realised that no network is engineered with 100% connectivity for all subscribers / customers all the time.

Just like roads are engineered for a few lanes for several thousand vehicles, the occupancy rules apply to produce an economic inter-centre network; so too are the inter-centre telecomms highways (and road traffic uses the same traffic dimensioning rules as telecomms networks)!

With (fixed access) consumer situations the maximum usage is about 13% and most metropolitan suburban local exchanges have between 4,000 and 8,000 premises connected with typically 5 to 10 main cables that are typically 800 pair each. So the maximum number of pairs in Junction cables would be in the order of 520 to 1040.

Taking this a bit further, each Junction cable would be typically 50, 100 or 200 pairs connecting to (multiple) parent (tandem) switches, and half would be for incoming, the other half for outgoing.

So, at the best only about 10% of the poorly kept CAN cables could have been replaced unused IEN Junction cables. But on long runs the difference would have been amazing for ADSL (but these cables were in a competing Business Unit - and more competition would have made them even less available; i.e. Buckley's and none!

++++++++++++++++