2016 08 27 ADSL Performance

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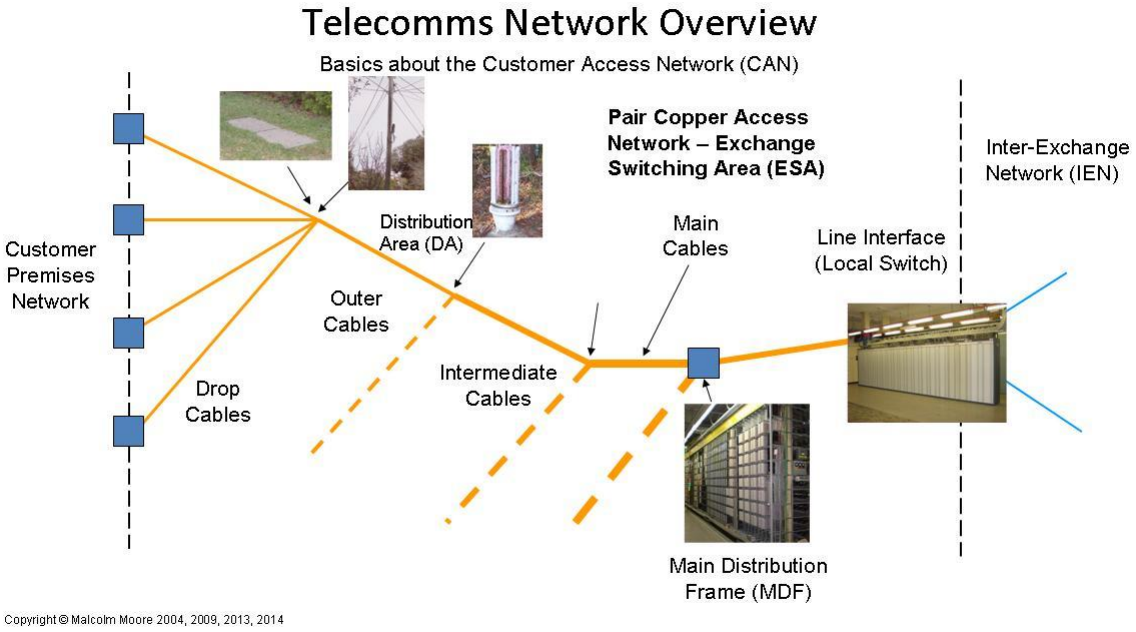
Introduction

The mybroadband.communications.gov.au website[1] has a wealth of data in the associated Excel workbook that when lightly analysed shows some very interesting results, outlined below.

Each row (recordset) of data relates to a DA (District Area) that is usually denoted by a Pillar or Sputnik, having somewhere between 200 and 800 premises connected from these Intermediate cables that often hang off the Main Cables. From here, (the Pillar or Sputnik, the pair copper connects through Outer cables to footpath pits that have short Drop cables connecting to the premises.



This simple picture shows the basic parts of the pair copper component of the Exchange Switching Area - which is part of the Customer Access Network (CAN) - excluding the Digital Services Line Access Multiplexer (DSLAM), which fits in parallel with the (telephone) Line Interface / Local Switch and back-connects to the Inter-Exchange Network[2] (IEN). The IEN is also called the Backhaul Network or the Core network, depending who you are talking to) in a very similar manner as the Local Switch also connects to the IEN highway through "edge routers".

In most cases the variable length of the Drops can be considered as a constant of say 30 m and the variable lengths of the Outers can be considered to be somewhere between 50 m and 250 m - say 150 m, so on average the typical Outer plus Drop length is about 180 m.

This then leaves the Main plus Intermediate cable lengths to be considered as one cable (for this exercise) and marked by a DA location, in the Exchange Switching Area (ESA).

[1] https://www.mybroadband.communications.gov.au/upload/documents/BQP_DATA_v4.xlsx
[2] http://www.moore.org.au/comms001.htm

What Data is Missing

If some useful forensic analysis was to be done, then a second database table would be required to link the Intermediate Cable to the Main Cable - and have the construction details of all these cables (length, insulation type, wire metal/alloy, wire diameter, parent Cable and or Local Exchange Code).

This table would be very big, but it would provide the necessary tell-tale data that would link underperforming ADSL connections to cables; and by associating a number of underperforming ADSL connections on common cables - this would associate cables where ADSL is underperforming, and from there identify where cables are electrically faulty, and then schedule what to do to fix the problems.

Personally, I believe that this study has already been done (to a large degree), enough to identify that a very high proportion of the Main Cables (and Intermediate Cables) have "wet" insulation causing ADSL to really underperform in many areas.

The "wet" in cables is water / vapour, and water has a permittivity of about 80 times that of dry air, so the capacitance in these lengths if cables is dramatically increased, causing the attenuation to be significantly increased per unit length - resulting in premises that are connected through these cable to have unacceptably low ADSL data rates - compared to what would be expected.

Generations of ADSL Technologies

The next issue is that of appropriate exchange-based equipment. ADSL has gone through several iterations where the maximum downstream speed has increased from 6 Mb/s to 8 Mb/s to 12 Mb/s to 24 Mb/s over several years, and is now a mature and inexpensive technology.

Because downstream speeds are cable length related, it stands to reason that older exchange-located DSLAM equipment capable of much less than 24 Mb/s could be installed on relatively short customer cable pairs that would be capable of 24 Mb/s.

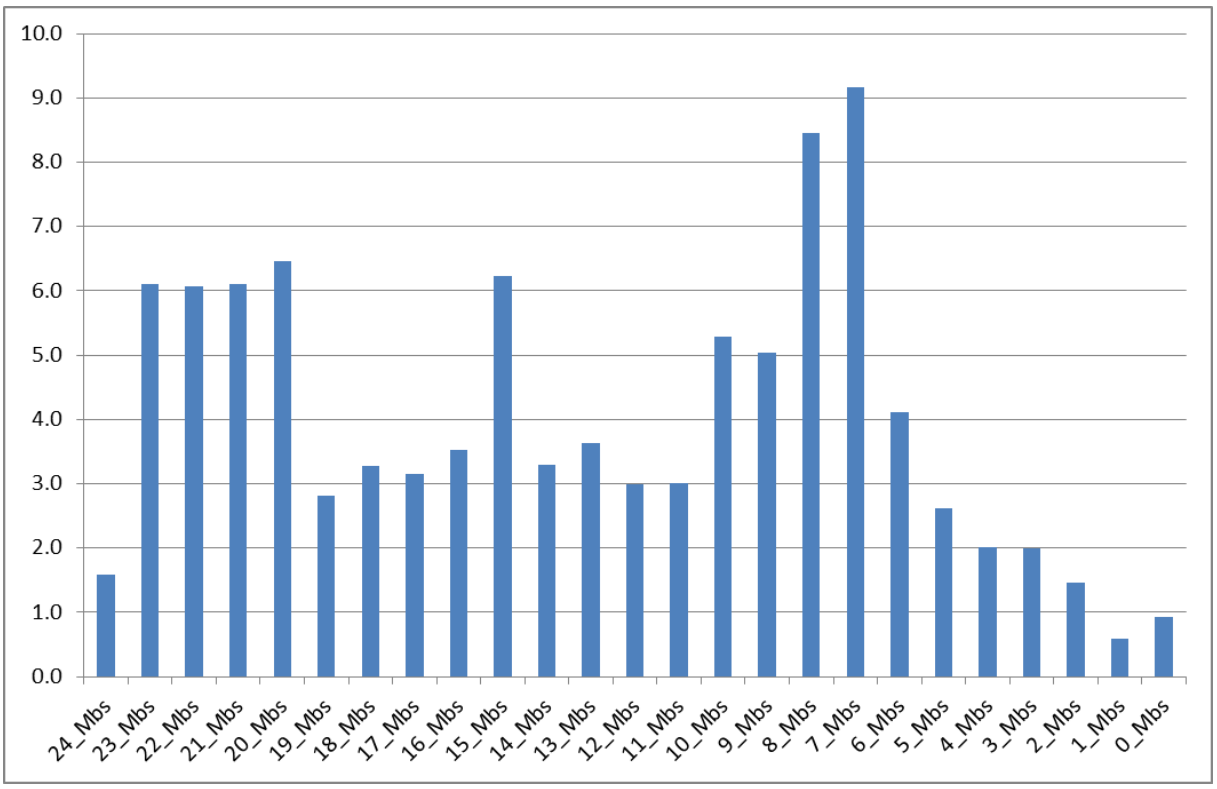
Similarly, it also stands to reason that a high proportion of longer customer cable pairs incapable of 12 Mb/s or even 6 Mb/s are connected to ADSL2+(M) technology DSLAMs that is capable of 24 Mb/s, but can never be realised because of the physical length of the cable pairs.

The last category is where ADSL modems have been connected for a considerable time and have encountered noise that has sequentially turned off a high proportion of the otherwise working channels causing these ADSL connections to operate well below their expected speeds (until the modem is re-booted).

Current ADSL Performance Readings

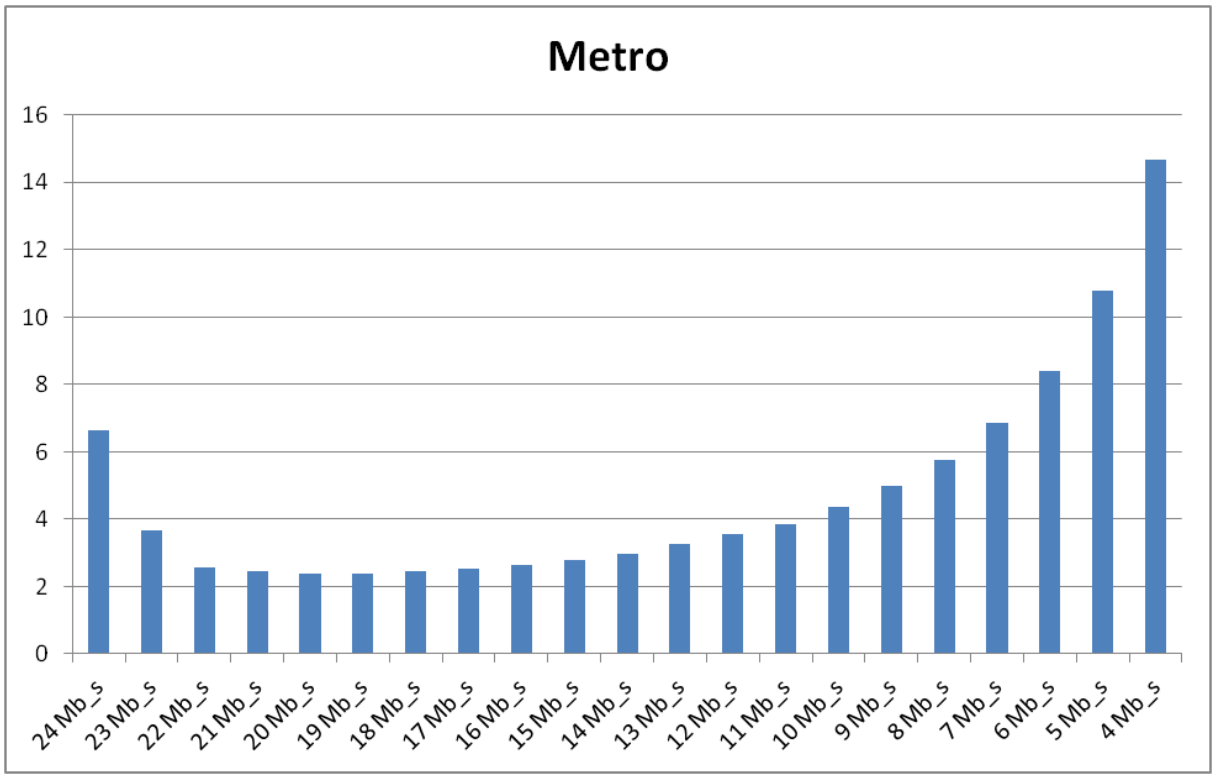
By grouping the DAs by parent local exchange, this gave the total number of pair cable connections per local exchange, and it matched my knowledge of reality. By categorising the local exchanges by the number of Customer lines, this gave the associated CAN structure **in percentage terms** of the urban surroundings (as Village, Small Town, Large Town, Country City / Metro Suburbs, Large CBD etc.), so that local demographics can come into play to define the CAN lengths.

Typically, the main urban areas (big City Centres, Urban Cities and Metropolitan Suburbs have much the same characteristic as shown in the chart below:



Generally in Australia, the land area for premises is relatively consistent in each (urban) Exchange Switching Area (ESA) and each ESA has unique characteristics - for example a big metropolitan CBD is very different to a Small Town, but both have about the same physical area (radius) of about 1000 m.

Generally, Australian urban areas are rather consistent with the number of premises increasing to the square of the radial distance from a central point (nominally the local exchange building), so theoretically the chart above (using only ADSL2+) should look like the chart below:



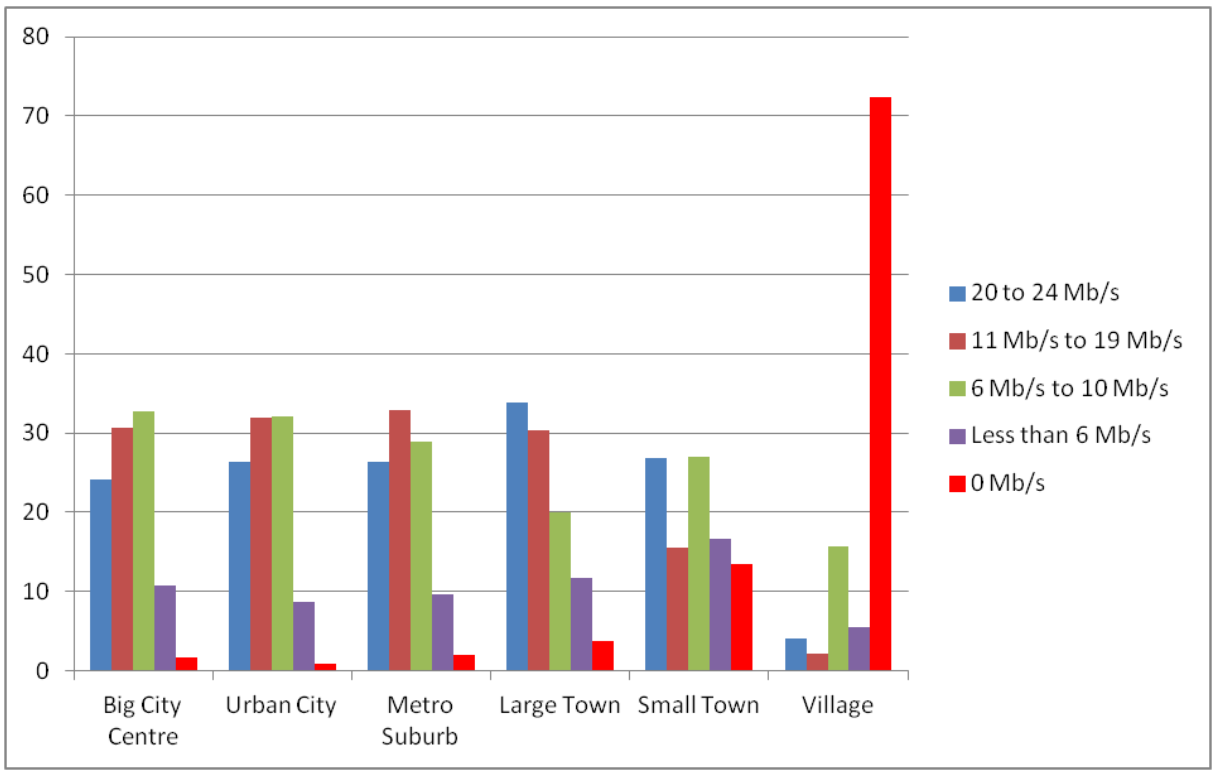
The practical chart is showing that generally the CBD areas of high cable / premises density extend to about 20 Mb/s (which is equivalent to about 1700 m). This distance seems excessive and I am suspicious that many short Main cables are faulty. There is a broad alignment with theory until about 9 Mb/s (about 3000 m) and this is reassuring, but there is an over-abundance of 7 Mb/s and 8 Mb/s that is most probably due to ADSL1 DSLAM equipment on short lines, capable of 24 Mb/s.

Beyond 7 Mb/s (about 3350 m) the tail falls away quickly - indicating there are few pair copper lines longer than 3500 m, but experience tells me otherwise as 4100 m is the practical limit, and there are downstream speeds below 4 Mb/s, telling me these pair copper cable are (in my opinion) faulty, most probably with moisture damage.

Looking at this in another light if the speeds bands are grouped 24 - 20 Mb/s, 19 - 11 Mb/s, 10 - 6 Mb/s, 5 - 1 Mb/s, and 0 Mb/s; this throws up an interesting chart of comparisons based on urban location and the relative sizes of the locations:

In this first case (below), the striking comparison is the Red column showing the percentage of lines without ADSL connectivity - and where these are located by categorised local exchange size.

No surprises that it is the Village SCAX huts that have literally nil ADSL connectivity, **all with absolutely nil thanks to "privatisation"**. This serious lack of appropriate ADSL equipment follows a curve that aligns with lower internal ROI showing that these areas would produce substantially lower internal ROI so there is virtually nil ADSL installed in these areas. If it followed the general trend then this would be at about 30% but is it over 70%, and in reality it should be about 3% or less.



The next more noticeable statistic is the olive green column that gets smaller as the general size of the ESA also gets smaller - as in the transfer from Metro suburb to Large Town - and from Large Town to Small Town to Village, it should virtually be extinct. The Small Town column is out of proportion (far too big) compared to the

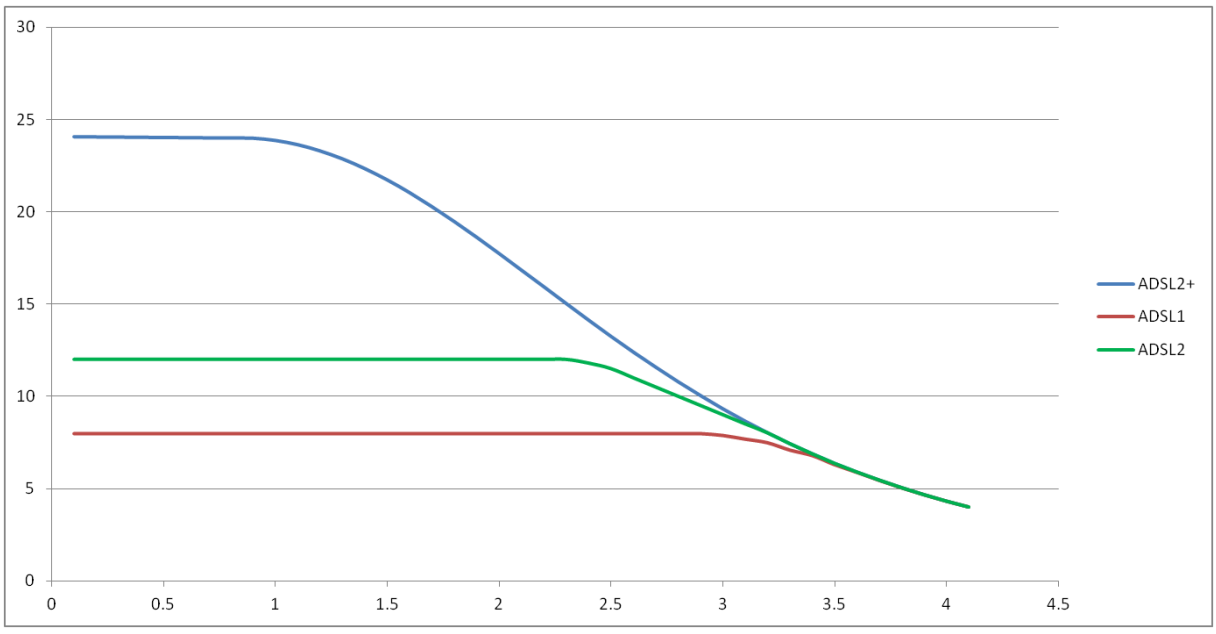
Large Town and the olive green column in the Village is immense. Something is really wrong here, **and again it is all with nil thanks to Privatisation!**

Basically what has happened here is that original (6 Mb/s then 12 Mb/s) ADSL equipment was installed in the big Metro CBD areas because these were deemed to have the highest internal ROI (biggest P&L profits in the short term). As new less expensive ADSL technologies (24 Mb/s) came out and the high internal ROI was in the big CBD cities, then the obvious action was to install this new equipment in the cities and transfer the old equipment to the suburbs and country cities, towns, (and leave the villages with nothing) - **because with Privatisation / Competition**[3] **it is all about maximised internal ROI, not about building Australia's prosperity**.

Now; with "more competition" being introduced, ADSL connectivity was provided without consideration of the actual line length, so 12 Mb/s and 24 Mb/s DSLAMs at the exchanges were connected to cable lengths that far exceeded 2.5 km (12 Mb/s max length) and 1 km (24 Mb/s max length) respectively, **resulting in ADSL speeds <u>that are far under what could be provided</u> - and could be provided by the older DSLAM equipment already in these exchange sites - at virtually nil expense**.

This simple chart (below) is based on Australian conditions of a nominally 0.40 mm pair copper Access Network.

With a Competitive Business mindset - you would connect any DSLAM to any cable length to get the money (maximised ROI) and deflect the mountain of complaints to the TIO. With an Infrastructure Business mindset, you would connect all pair cables to DSLAMs that would optimally operate at their maximum capability and have an absolute minimum of complaints to the TIO.

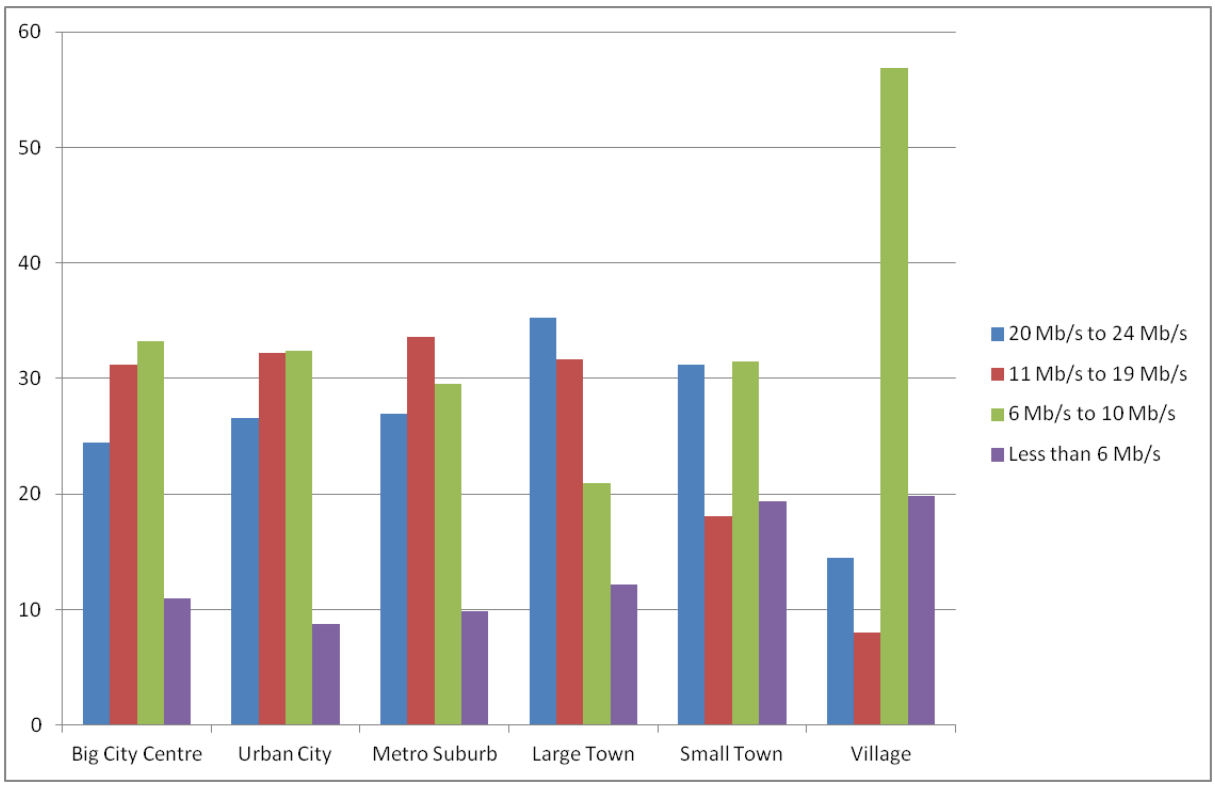


Considering the national ADSL characterisation as shown in the column chart on the previous page, if the 0 Mb/s column is neglected (as these are phone lines that have no ADSL equipment attached to them at the local exchange sites; and the columns re-calculated for a total of 100% based on the remaining ADSL equipped lines, now we get a much clearer picture as shown below.

[3] http://www.moore.org.au/busn/02/CompetitionInfrastructure.ppsx

The 80% Rule

The first three sets of columns (Big City Centre, Urban City, Metro suburbs) account for about 8 M pair copper cables connected to ADSL technology and this is about 80% of the total fixed access lines in Australia. The other 20% make up all the rest.



Generally, these big urban situations have an average pair copper line length of about 2.9 km, (and a maximum of 4.1 km) so, referring to the ADSL speeds chart on the previous page it should be no surprise that the olive green (6 Mb/s to 10 Mb/s) columns are predominant over the purple (<6 Mb/s) columns. But -

This situation also means that if this DSLAM equipment was economically rolled out using an Infrastructure Business mindset, then about 40% of all this equipment would be ADSL1 (capable of a maximum of 8 Mb/s), not ADSL2+, and connected to the longest main cables.

From extensive previous Australian telecomms professional and technical experience I know that it is common (Competitive Business mindset) practice provide newer technologies into the city areas (high ROI) first, and to re-locate older equipment into country areas (lower ROI) to extend the ROI life.

The brown columns in these three main categories is "interesting" because this is ADSL2+ DSLAMs connected to lines that are too long (or faulty) and the first chart (all blue columns) shows there is not a predominance of 12 Mb/s (ADSL2) DSLAMs installed, so this technology was largely "hopped".

The Remaining 20%

Large Towns

The big telling point starts at the Large Towns category (1040 - 2400 customer lines).

The CAN structure in Large Towns is not homogeneous (consistent) like that of its much bigger brothers, but has an urban (relatively high density) range of about 2.0 km with an average distance of about 1.5 km. Beyond the 2 km distance it is typically rural with a low number of Homesteads up to 4 km (connected with 0.40 mm pair copper cable) and beyond that to about 11 km using a mix of 0.40 mm and 0.64 mm pair copper cable, engineered for telephony, not for ADSL technology.

At last the multi-coloured columns seem to make sense! In the Large Town case, most of the ADSL is at nominally 24 Mb/s (as expected) and the rest of the ADSL reading run down to 10 Mb/s (as expected again), but there is a significant 6 Mb/s to 10 Mb/s column (about 21%) that really should not be there because there is generally very little comparative premises numbers in the 2.8 km to 3.9 km range.

Purely because of the fundamental mistakes made through "**Privatisation**" I am fully expecting a proportion of these Main cables to be "wet" and appearing to be electronically much longer than they physically really are.

> *Since privatisation brought in "efficiencies" such as Contractors that work to a time / piece rate and got rid of experienced Lines staff that worked to a Quality level, the standard of lines maintenance of the pair copper CAN has substantially fallen into disrepair. So again, because of "increased Competition", the service standards have considerably reduced - **exactly the opposite of what the ACCC keeps fog-horning**.*

Similarly, again because of "Privatisation" which forcibly introduces and promulgates the immensely destructive cancer of "Infrastructure Competition" (as mentioned before) to maximise internal ROI profits.

It is rather clear to me from this data (and from extensive telecomms hands-on experience), that old ADSL1 exchange equipment (which would really be optimally left in situ in metropolitan exchange sites for the nominal 50% of pair cable longer than 2.9 km) has been re-located to Towns (and Country cities) in a senseless bid to "better connect with customers" and **offer them unreal data speeds**.

Because the length of Customer Access pair copper cables in Large Towns is generally less than 2.0 km and averages about 1.5 km, if the correct ADSL2+ equipment had been installed (to maximise Service Quality) then the Blue column (20 Mb/s - 24 Mb/s) **would be about 72% not about 35%**, and the minimum Downstream Speed for Large Towns would be in the order of 17 Mb/s, and there would be a small tail (say 5% of premises connecting at less than 6 Mb/s).

Small Towns

The Small Town results are a shocker! The characteristics of a Small Town ESA (251 - 1040 Premises or Lines) is very much like a Large Town ESA, except the maximum radial length is about 1.5 km meaning that every urban Village connection should be at 20 Mb/s - 24 Mb/s, but the physical results prove they are not near the minimum standard.

The Brown and Olive Green columns should be virtually zero. The Purple column should be less than 5% and the Blue column should be about 95%.

Clearly old ADSL1 equipment is installed in Small Towns en-masse and this has a maximum speed of 8 Mb/s, not 24 Mb/s - of which well over 95% of the pair copper lines would be capable of in these Small Towns. **This situation is criminal**.

Villages

Considering the extremely poor state of ADSL connectivity (if at all) in Small Towns, then the **extreme lack of ADSL technology in Villages (<251 premises or Lines) should come as no surprise at all - and all no thanks to "Privatisation" and again no thanks to "Increased Competition"** - both of which have combined to provide the worst case scenario of either nil ADSL equipment and where it is installed very little of it is ADSL2+ standard - even though a good 95% of the ESA line lengths do not exceed 750 m and should readily provide 24 Mb/s connectivity in every urban case.

The figures in the mybroadband.communications website[4] (Excel) very closely align with theoretical figures, and my practical knowledge.

It is however an utter disgrace that although there are about 2545 "Village" SCAX huts sites in Australia only a handful have ADSL connectivity and of that only about 24 (i.e. 0.9%) have ADSL2+ (24 Mb/s downstream capability), and about 2000 SCAX huts have nil ADSL capability at all. **This situation is unconscionable.**

Conclusion

Although the fundamental strategy of the Davidson Report (circa 1980-1982) was to put a telecomms sector on the ASX, this sector should be a range of competing retail resellers of wholesale telecomms products and services; and definitely not a set of highly fractionated, vertically structured, uneconomically competing infrastructure services providers.

The combination of fractionating a highly efficient sub-government telecomms commission with virtually all the national telecomms infrastructure under one umbrella into several very uneconomic and squabbling "competing" private sector retail (partial) service providers has introduced a raft of increasing consumer complaints that have in turn caused an ever-growing stream of regulation.

In this case the ever-growing complaints about unachievable ADSL speeds was caused by the retail resellers being in charge of the infrastructure - much like letting Dracula be in charge of the Blood Bank; or allowing the ugly step-sisters force-fit into Cinderella's crystal-glass slipper, and expecting it to be not shattered...

Because the Competitive Business[5] mindset was in charge of the ADSL rollout (and in charge of the pair copper CAN maintenance) - optimum ADSL performance was inherently and economically doomed because this infrastructure is / was not being managed by an Infrastructure Business mindset.

Some simple analysis of the mybroadband.communications.gov.au Website data showed that all Large Towns, Small Towns and Villages all have the large majority of

[4] https://www.mybroadband.communications.gov.au/upload/documents/BQP_DATA_v4.xlsx
[5] http://www.moore.org.au/busn/02/CompetitionInfrastructure.ppsx

pair copper line lengths less than 2.0 km (typically less than 1.5 km) and as such all these locations should have been 100% Main cable connected with ADSL2+(M) technology DSLAM equipment at the local exchange sites. In these situations all premises in these situations should have ADSL downstream speeds exceeding 17 Mb/s and a very high percentage will operate at 24 Mb/s.

Taking this a bit further: With the consideration that urban Outer and Drop cables total up to about 180 m on average, and that ADSL2+ has a maximum downstream data rate speed of 24 Mb/s up to about 1100 m, and at 2900 m total the downstream data rate speed is limited to about 12 Mb/s, then **all Main plus Outer cables with a summed length less than 2750 m should (must) be connected to ADSL2+(M) (24 Mb/s max.) technology at the Local Exchange sites**.

All premises that are connected by Main plus Outer cables that sum to be 2750 m to or more should be connected with ADSL2 (12 Mb/s max) DSLAM equipment at the Local Exchange site. All premises that are connected by Main plus Outer cables that sum to be beyond 3200 m should be connected with ADSL1 (8 Mb/s max) DSLAM equipment at the Local Exchange site.

Why? Because it is technically impossible for premises further than these cable distances to have (noticeably) faster speeds with newer technology DSLAMs. Also utilising less than 24 Mb/s ADSL technology on lines shorter than 2750 m will at the best provide only 12 Mb/s or 8 Mb/s when the vast majority of these shorter CAN cables are capable of over 17 Mb/s (2000 m).

Economically, the suburbs and cities nominally have 4100 m maximum pair copper CAN length, and an average length of about 2900 m - **so these demographic areas should comprise of 50% ADSL1 / ADSL2, and 50% ADSL2+ / ADSL2+(M) and the DSLAMS fully connected by (infrastructure) Main Cable** - not selectively by (competitive) "Broadband Subscribers".

All Villages, Small Towns, then Large Towns must all be connected with 100% ADSL2+(M) technology DSLAMs in Small Country Automatic Exchange (SCAX) huts[6] a matter of economic urgency for inland Australia. Almost all of these 1,480,000 services will connect at nominally 24 Mb/s and very inexpensively minimise the telecomms digital divide in Australia.

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[6] http://www.moore.org.au/comms/03/201601inlandADSLinSCAX.ppsx