Public Submission

to the

Expert Committee on Telecommunications

about the

National Broadband Network

2008

by

Malcolm Moore JP BE(Elect.)

Contents

National Broadband Network In Australia

This submission is in response to the call for submissions by the Minister for Broadband, Communications and the Digital Economy, Senator the Honourable Stephen Conroy, to provide submissions that will assist in the development of the National Broadband Network "Request for Proposals", and I thank the Minister for asking for submissions at this time.

In providing this submission, I have taken the opportunity to briefly summarise what I consider to be the current telecomms scenario in Australia, and then I have put forward some proposals that the Expert Committee can utilise for the basis of creating some alternative strategies to address the Australian National Broadband Network telecommunications infrastructure.

The Current Scenario

Decades of Technology Changes

Telecommunications infrastructure in Australia has over the last 50 years gone through a tremendous change where the capacity has remarkably increased, but the geographic coverage has barely changed its typical footprint from being primarily centred on the south east coastline of Australia and the Inter-Exchange Network [01] has continued to have a tiered star structure into the Regional, Rural and Remote areas. This footprint basically follows they majority of the population density, and it is most dense in the major (Metropolitan) capital cities and lesser (Regional) population centres, which are mostly on the coastline.

In these last five decades, technology advances were the primary drivers for telecommunications infrastructure development, making it far more reliable to operate which in turn has dramatically reduced management and maintenance overheads, [24] making telecommunications significantly cheaper to operate per unit customer, per year.

Business entrepreneurs visualised that a competitive regime would yield massive profits from the comparatively huge revenues and consequently, Australia now has a considerable duplication of telecommunications infrastructure – primarily in major urban (Metropolitan) areas, and a scarcity of telecomms infrastructure in Regional, Rural and Remote areas. Engineers Australia Report 13 on Telecommunications [18] is particularly critical of this waste in multi-duplicated resources.

The Davidson Report 1982 [15] was the catalyst to take the telecommunications business out of very constrictive Federal Government hands and move this business service into the private sector. This report anticipated the high differential in overhead costs in more sparsely populated areas and introduced a 'privatisation sweetener' called the Universal Services Obligation (USO) [25] to provide an ongoing fund to reconcile the non-metropolitan telecomms cost centre situation and set minimum service standards.

In the past 50 years several technological advances in the Inter-Exchange Network (IEN / Backhaul) [01] infrastructure include: Frequency Division Multiplex (FDM), Coaxial Cable and Radio Bearers for transmission, Stored Process Control, Crossbar and Reed Relay switching, Solid State (transistors and integrated circuits) electronics, Computing Systems, Personal Computers, Plesiosynchronous Digital Hierarchy (PDH) transmission, Digital Switching, Common Channel Signalling (CCS7), Single Mode Optical Fibre (SMOF) transmission, Synchronous Digital Hierarchy (SDH) transmission, Asynchronous Transmission Mode (ATM), Global Operations Management, Multiple Protocol Language Switching (MPLS), Internet Protocol (IP) Routing, IP based telephony switching, and this list is nowhere complete!

There have also been several advances in the Customer Access Network (CAN) [03] but the take-up of advance technologies is by far not as impressive as in the IEN / Backhaul – partially because the

CAN is not switched. Advances in CAN technologies in Australia over the same five decade period include; dropping of Magneto calling in favour of Central Battery analogue feeds, general replacement of Pulse Dialling by Dual Tone Multi Frequency (DTMF) dialling, Analogue Radio Concentrator Systems (ARCS), Digital Radio Concentrator Systems (DRCS), High Capacity Radio Concentrators (HCRC), Analogue Mobile Access, Digital (GSM) Mobile Access, Hybrid Fibre Coax (HFC) Pay-TV access network, Digital CDMA Mobile Access, 3G Mobile / Internet Wideband W-CDMA Access, Primary Rate Integrated Digital Services Networks (Pri-ISDN), 3G Mobile / Internet, Asynchronous Digital Subscribers Line 1 and 2+ (ADSL, ADSL2+), Wideband Business Systems, Fibre to the (Business) Premises (FTTP) [26] ; and again this list is far from complete.

This list of CAN transmission technologies is non-exhaustive, but it does show that just like its' diametrical associate (the IEN) the bearer technologies are also moving towards optical fibre (OF) and radio, and the CAN data rate speeds will only increase when the IEN and inter-continent networks have sufficient data speed capacity.

From my previous professional experience in the telecommunications industry, as a professional Electrical Engineer specialising in telecommunications equipment and network engineering, I have identified that each new technology takes about five years to implement, and about 10 years to mature, and the mature lifespan can run from about five to 40 years before it is obsolete.

The following Table is an update from "Australia's Converging Networks Technologies" [02] that shows the Australian Inter-Exchange Switching and Transmission technologies in a table form, with the dates rounded:

Inter-Exchange Technology	Implemented	Effective	Matured	Obsolete
Crossbar Mechanical Switching	1960	1965	1970	1995
10C Analogue Switching SPC	1970	1975	1980	1985
AXE Digital Switching	1980	1985	1993	2005
DMS Digital Switching	1985	1990	1995	2000
S12 Digital Switching	1990	1995	2000	2010
IP Switching / Routing	1995	2000	2005	2040
FDM on pair/quad cable	1935	1940	1950	1980
FDM on Coax Cable	1950	1955	1960	1985
FDM on Point-to-Point Radio	1960	1975	1985	1990
PDH on Pair Cable	1980	1985	1990	2005
PDH on Coax Cable	1980	1985	1990	1995
PDH on Point-to-Point Radio	1985	1990	1990	1995
PDH on Optical Fibre	1985	1990	2000	2005
SDH on Point-to-Point Radio	1990	1995	2005	2015
SDH on Optical Fibre	1990	1995	2005	2040
ATM on Point-to-Point Radio	1990	1995	2000	2005
ATM on Optical Fibre	1990	1995	2000	2005
MPLS on Point-to-Point Radio	1995	2000	2005	2040
MPLS on Optical Fibre	1995	2000	2005	2040
Optical Fibre – Single Mode	1985	1990	1995	2040
Optical Fibre – DWDM	2000	2005	2010	2040
Optical Fibre – CWDM	2000	2005	2010	2050

Table 1 Switching and Transmission Technologies in the IEN - Time

This table clearly shows that as from 2005, the only technologies in the IEN that will not be obsolete or very near obsolescence will be IP switching; and for transmission; Optical Fibre and point-to-point Radio.

Note: I have not included the synergetic and necessary associated Network Management structures that are essential for the cost-effective and efficient operation, management, metering, maintenance, signalling and support of these various switching and transmission infrastructure technologies.

The table below follows on directly from the above table, but looks at the combination of Broadband IP with Pay TV (Multimedia) and Radio/TV Programme distribution networks. This table of particular significance as it links bearer physics to traffic utilisation to a lifetime.

IEN (Tx) Application	Implemented	Effective	Matured	Obsolete
Programme Distribution Coax	1945	1950	1975	1985
Programme Distribution p-p Radio	1960	1965	1975	1990
Programme Distribution Satellite	1980	1985	1990	2000
Programme Distribution Optic Fibre	1990	1995	2000	2030
Programme Distribution OF Systems	2005	2010	2015	2040
Telephony – Open Wire	1850	1855	1920	1930
Telephony – Loaded Cable	1920	1925	1955	1985
Telephony – Coax Cable	1950	1955	1960	1985
Telephony – Point-to-point Radio FDM	1960	1975	1985	1990
Telephony – Optical Fibre PDH	1985	1990	2000	2005
Telephony – Point-to-point Radio PDH	1980	1985	1990	1995
Telephony – Optical Fibre SDH	1990	1995	2005	2040
Telephony – Point-to-point Radio SDH	1990	1995	2005	2040
Telephony – Optical Fibre IP/MPLS	1995	2000	2005	2040
Telephony – Point-to-point Radio IP/MPLS	1960	1975	1985	1990
DDN – Loaded Cable	1965	1970	1975	1985
DDN – Coax Cable	1965	1970	1975	1985
DDN – Point-to-point Radio FDM	1965	1970	1985	1990
DDN – Optical Fibre PDH	1985	1990	2000	2005
DDN – Point-to-point Radio PDH	1980	1985	1990	1995
DDN/Internet – Optical Fibre SDH	1990	1995	2005	2040
DDN/Internet – Point-to-point Radio SDH	1990	1995	2005	2040
Internet – Optical Fibre IP/MPLS	1995	2000	2005	2040
Internet – Point-to-point Radio IP/MPLS	1995	2000	2005	2040
Pay TV Centralised Optical Fibre	1992	1995	2000	2005
Broadband Multimedia Centralised OF	1995	2000	2005	2005
Broadband Multimedia Remote OF	2005	2010	2015	2030
Broadband Multimedia 10G+ OF Systems	2010	2015	2020	2040

Table 2 IEN Wholesale Applications over Time and Technology

All of these IEN Transmission Applications have high bandwidth requirements, but each network structure is significantly different – and each network structure is optimally engineered for efficient distance-related and capacity-related transport.

It is obvious that each incremental system grows on the backs of the previous technologies, and this is one of the integrated synergies that brings in higher speed networks at ‘competitive prices’

(Explanation: “Competitive Prices” in this text specifically means prices that are commensurate with existing prices for similar service standards, and costing proportionately more for increased service standards. “Competitive Prices” in this text specifically does not mean prices that are moved by marketing and advertising strategies to fight/battle/war for a larger portion of the available market.)

In just the same way that the Inter-Exchange Network has technologically morphed over several decades, the Customer Access Network (CAN) has also technologically morphed over several decades, and this too was described in “Australias’ Converging Network Technologies” [02].

Again I have produced a rather simple table that takes the various CAN technologies through their life cycles, and this should set the scene for sensible CAN forward network planning / engineering.

Customer Access Technology	Implemented	Effective	Matured	Obsolete
Open Wire Line	<1900	1900	1900	1970
Twisted Pair Cable	1940	1950	1980	2000
PGS Loaded Pair Cable	1940	1950	1970	1990
PGS VFHA – Pair Cable	1985	1990	1995	2005
PGS Remote Line Mux	1985	1990	1995	2000
PGS Remote Int Mux	1990	1995	2000	2005
PGS DDN 64 kb/s	1980	1985	1990	2000
PGS MegaLink 2 Mb/s	1980	1985	1990	2005
PGS ISDN 2 Mb/s	1980	1985	1990	2005
PGS Frame Relay 2 Mb/s	1980	1985	1990	2005
PGS Frame Relay 155 Mb/s	2000	2005	2005	2010
PGS Analogue Radio Conc. Sys.	1975	1980	1985	1990
PGS Digital RCS	1980	1985	1990	1995
PGS HCRC	1985	1990	1995	2000
Hybrid Fibre Coax (HFC)	1992	1995	2000	2010
HFC Analogue TV	1992	1995	2000	2005
HFC Digital TV	2005	2010	2010	2010
HFC IP/Internet DOCSIS2	1995	2000	2005	2010
HFC IP/Internet DOCSIS3	2005	2010	2015	2020
PGS ADSL DSLAM (IP)	1995	2000	2005	2010
PGS ADSL 2 / 2+	2005	2010	2010	2010
PGS ADSL on p-p Radio	2005	2010	2010	2015
Mobile – Analogue	1980	1985	1990	1995
Mobile – Digital GSM	1990	1995	2000	2005
Mobile – CDMA	1995	2000	2005	2010
Mobile – WCDMA (3GSM / IP)	2000	2005	2010	2030
Broadband – FTTNode 2 Mb/s (**ADSL**)	1990	1995	2000	2000
Broadband – FTTN 155 Mb/s (**ADSL**)	1995	2000	2005	2010
Broadband – FTTPremises 30 Mb/s	2000	2005	2010	2040
Broadband – FTTP 155 Mb/s	2005	2010	2015	2040
Broadband – FTTP 1 Gb/s	2015	2020	2025	2040
Broadband – FTTBusiness 2 Mb/s	1990	1995	2000	2005
Broadband – FTTB 155 Mb/s	2000	2005	2010	2020
Broadband – FTTB 1 Gb/s	2010	2015	2020	2040
Broadband – CWDM	2000	2010	2015	2050

Table 3 CAN Technologies over Time

In general, the Australian Customer Access Network (CAN) [03] has trailed the transmission technologies used in the Inter-Exchange Network [01] by several years, and in the more recent decades, these transmission technologies have considerably converged [02], faster with time (with the exception of Optical Fibre as a CAN transmission bearer, which is several years behind the general trend).

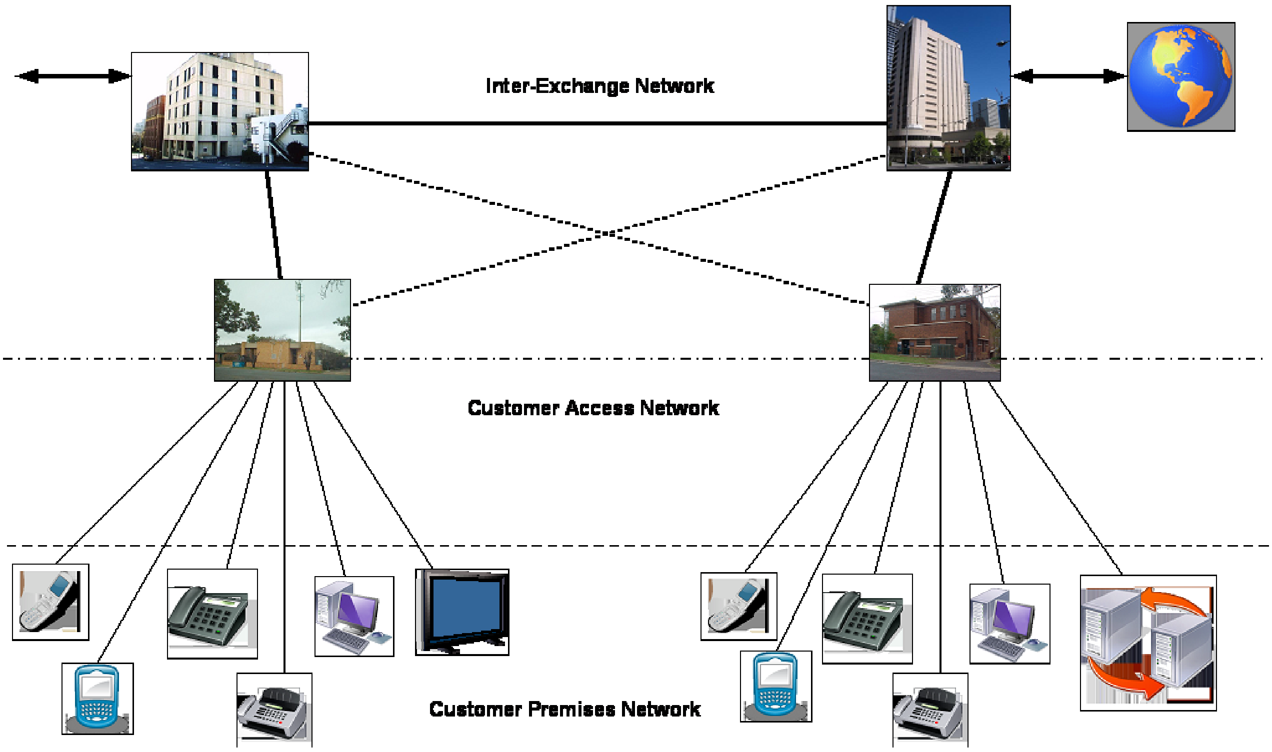
The Misinterpreted PSTN

The original meaning of the Public Switched Telephony Network (PSTN), was the total telephony network structure from one customer through their Customer Access Network (CAN) to their local exchange and then through the IEN / Backhaul to and through the distant end CAN into the distant end telephone. Telegraphy (and Internet) did not enter into this scenario, so in-effect, "telephony" really meant telecommunications to the general public. Fundamentally the PSTN was the total technology behind a fixed access phone call, and the general acceptance was that once the telephones' cable went into the wall in a house– that was then in the 'PSTN'.

Unfortunately, the Wikipedia Web reference [04] relates to the more recent AT&T version of the PSTN where ***this reference fails to include the Customer Access Network (CAN) as part of the total PSTN 'package'***, and the omission of the CAN as part of the PSTN is particularly perplexing.

In the days before Crossbar switching – where there was no automatic alternate path switching, the IEN / Backhaul and the CAN looked somewhat similar, and that whole network in Australia – including all the CANs: was the PSTN. When automatic path switching by stored program control was introduced (after 1960), the IEN component became a rather complex multi-level mesh, and this was the direct opposite structure of the CANs, which are simple non-switched Star networks.

Within the PSTN [05], by identifying and demarcating the CAN component, this leaves the IEN / Backhaul component as a multi-level switched, long transmission linked mesh, directly associating many scenarios of various telecommunications generic / wholesale products and unifies their alignment into separate CAN and IEN/Backhaul components.



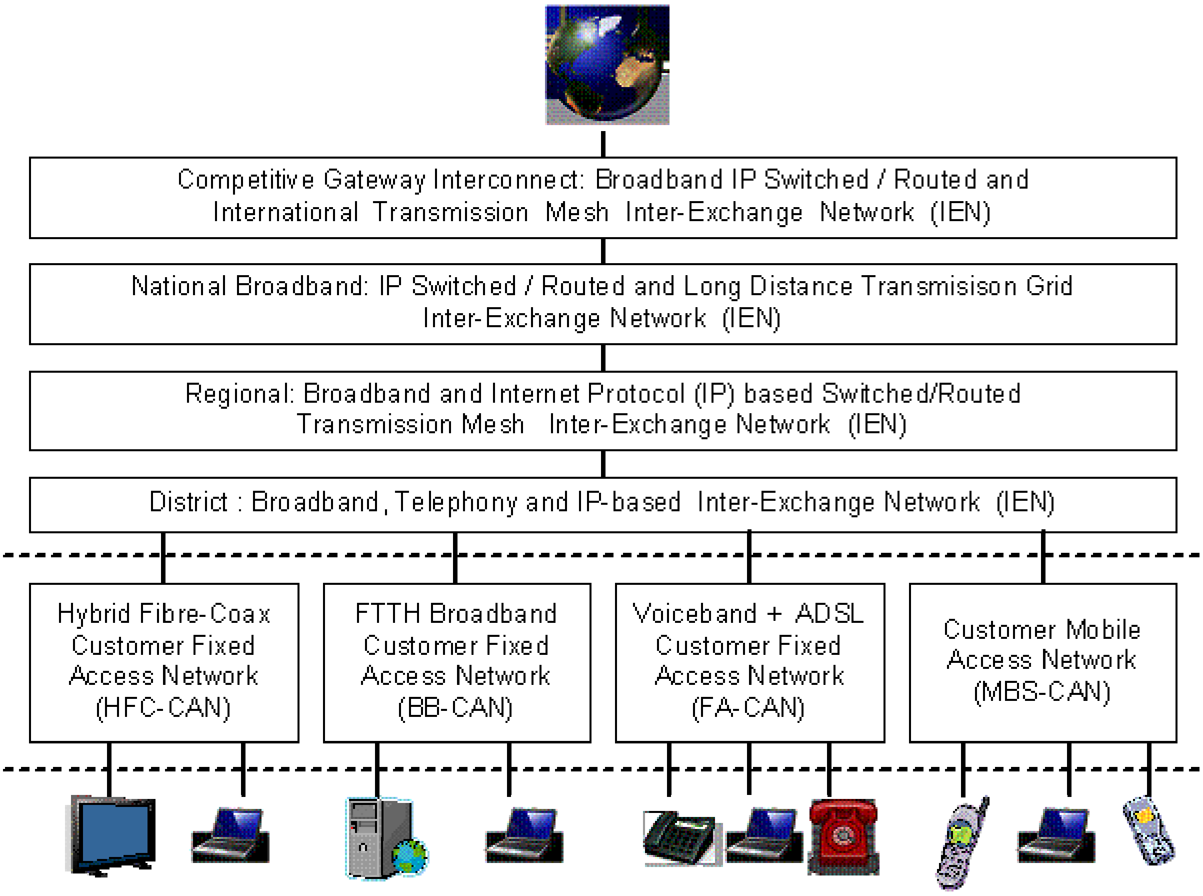
The picture above (extracted from [05]) shows that the IEN is separate to the CAN and it is the IEN component of the PSTN that provides the routing, switching, long distance transmission, and metering functions (at least), and the CAN in its' many forms has many access technologies to connect with the IEN. Consequently the CAN needs to be clearly demarcated from the IEN so that these very different functionalities can be entirely separately managed and marketed.

With this misunderstanding clarified, it makes sense not to refer to the Australian PSTN as the ***Public Switched Telephony Network*** but as the ***Publicly Switched Telecommunications Network,*** and it provides clear demarcation lines to separate the major sub-entities under the PSTN [05] as the CAN [03] and IEN (Backhaul) [01].

With this demarcation now clarified, it is now obvious that the CAN has a sub-component called the (Cellular) Mobile Access Network (MAN), which is a wireless/radio transmission medium, and this CAN sub-component connects mobile terminal equipment to the common IEN.

Similarly, the Fixed Access Network (FAN) refers to pair copper as the transmission medium, and is a sub-component of the CAN that connects fixed terminal equipment to the common IEN. The Hybrid Fibre Coax (HFC) Network is also a sub-component of the CAN that connects premises Pay TV and Broadband Internet terminal equipment to the common IEN. The Integrated Services Digital Network (ISDN) is another sub-component of the CAN that connects Business premises

terminal equipment to the common IEN. ADSL on pair copper (or point-to-point radio) another sub-component of the CAN that connects Broadband Internet premises terminal equipment to the common IEN.



The picture above (extracted from [01]) shows in a more graphical form some various CAN structures connecting wide ranges of Customer Equipment with the common IEN in its various geographical and competitive switching and transmission physical layers.

To further compound this situation, the ACCC Report on Telecommunications [07] has yet another implicit description of the PSTN as the (switched) Fixed Access Network for telephony. In this case, the ACCC document incorrectly assumes that the Fixed Access Network (FAN) is the PSTN (as a wholesale service) and the ACCC document also fails to acknowledge that there is a very large and common IEN / Backhaul [01] component within the total construct of the physical PSTN.

Building the Right Field Staff

As Australia embarks on FTTH, it needs well-trained field Staff to install and commission this Optical Fibre based equipment. My intuition from recent industry experience tells me that we probably have about 400 trained staff nationally. If we are going to splice and joint about 30 M splices and install about 10 M FTTH services then this works out at about 40 M man-hours or about 20,000 man-years, so we need about 2,000 trained people full time splicing, not counting travel and commissioning. We need about 4,000 well-trained field staff – right now!

The Divergent ACCC Telecomms Report

It is unfortunate that the first ACCC Report on Australian Telecomms [07] as contracted by BIS-Schrapnel [08] referred to the PSTN as the (switched) Fixed Access (telephony) Network (FAN), and because from this point, (early in the report) the correlation between actual existing equipment infrastructure with its associated wholesale products, and the reports' findings are rather divergent.

The ACCC report incorrectly assumed that the Mobile Access Network was an entirely different infrastructure than the PSTN, when in fact the Mobile Network has two main components being the Mobile Access Network (MAN) and the Inter-Exchange Network (IEN) / Backhaul, and this IEN is common to both the Fixed Access Network (FAN) and the Mobile Access Network (MAN). It is therefore imperative to comprehend that it is this common IEN infrastructure that facilitates calls to connect between mobiles and fixed services on their respective CAN sub-components.

This common Core IEN [01] is in fact predominantly a combination of Synchronous Digital Hierarchy (SDH) together with Multi Language Protocol Switching (MLPS), basically on SMOF transmission paths, where most of the content is in Internet Protocol (IP) packets (or datagrams) switching through District, Regional, National and Gateway Router / Switches. The 'edge' of the IEN consists of routing multiplexers telephony switches and other Customer Access Network interfaces located at Local and District communications sites.

When it comes to Digital Services (eg ISDN and Broadband Internet), the ACCC Report incorrectly assumes that these networks are separate infrastructure entities when in fact; the ISDN is a digital CAN technology that is terminated into the edge of the common (digital) IEN.

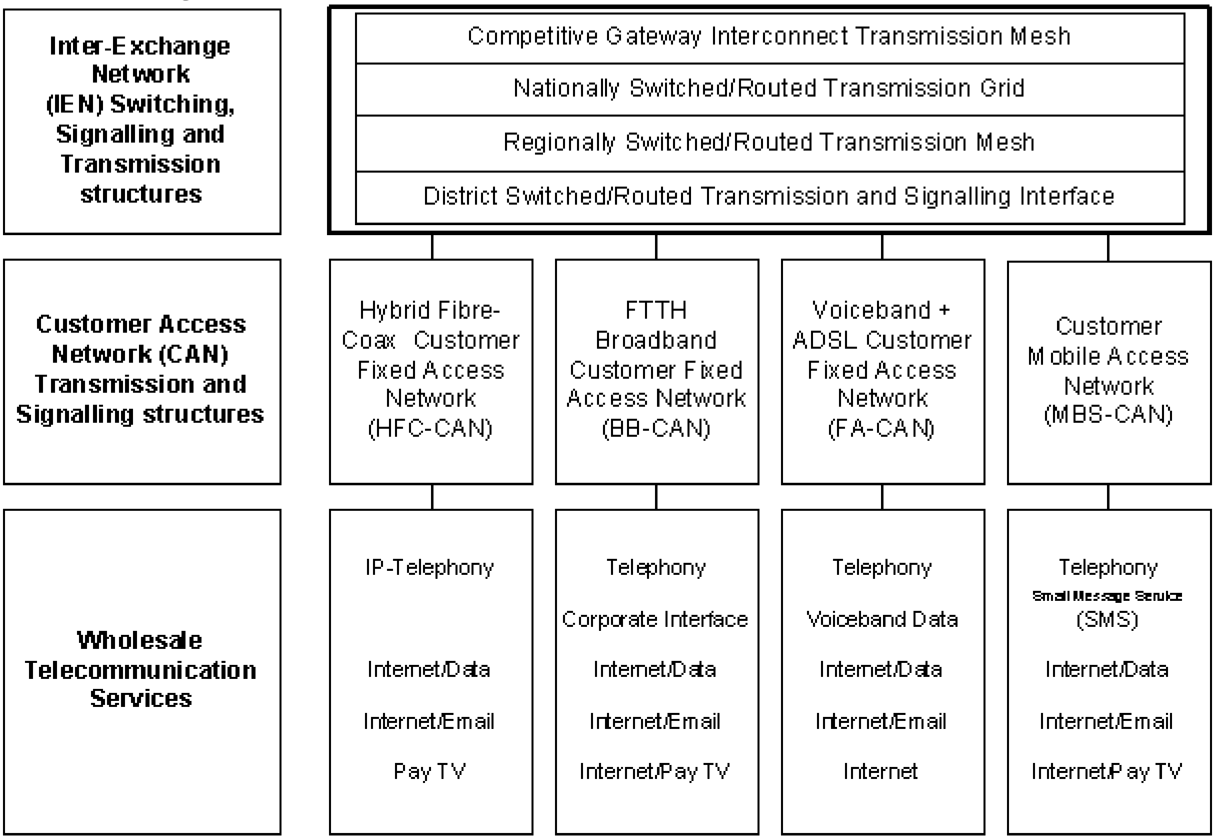
The Hybrid Fibre Coax (HFC) is treated as though it too is a separate telecomms infrastructure; when in fact this is another (Fixed Access) CAN technology that is also terminated into the IEN with 'Headends' off the edge of the core IEN. For Pay TV services the IEN contains a national program distribution infrastructure and the interfaces for this are 'Headends' that connect to the various HFC CANs. For Broadband Internet on HFC, the IEN is predominantly IP and there are DOCSIS [09] Broadband routers that interface IP as somewhat bi-directional TV channels in the Headends.

When it comes to Internet, this report has a major divergence with reality in that it incorrectly assumes that the Broadband Internet connectivity is again a separate entity to the IEN. As stated above the IEN is predominantly IP (especially for IEN-based telephony), and therefore the IEN is the common carriage for Internet services – be it via fixed or mobile access. In the last few years there was a huge increase in the installation of Fixed Access ADSL CAN facilities with Digital Line Access Multiplexers (DSLAMs) being installed in local exchanges. ADSL is a form of Fixed Access Network (FAN) for Broadband Internet that connects through a DSLAM at the local exchange as part of the CAN termed Fibre to the (Exchange) Node (FTTEN) or Fibre to the Neighbourhood Node (FTTNN) into an edge IEN IP Router into the Core IEN.

The extension of FTTN is Fibre to the Home (FTTH) or Fibre to the Premises (FTTP) – both acronyms have the same meaning. In these cases the local exchange has a Headend Line Access Multiplexer hanging off the edge IEN's local Router and Optical fibre is extended to the premises, either as a direct link (Direct FTTP), or as a Passive Optical Network (PON) link, that is passively split near the premises and shared by typically 32 premises.

Broadband Internet services on a Mobile Access Network have a very similar analogy to that of mobile phones connecting through a Cellular Mobile Access Network via a mobile Base Station into the IEN. In this case the Mobile Base Station (which provides the Mobile Access Network

facility) connects to a Broadband Service Access Router (which is part of the CAN) then connects to the IEN Edge Router into the Core IEN.



The diagram above (extracted from [01]) shows a breakdown of the PSTN into two fundamental layers, the IEN (on top and the CAN below that). Instead of customer equipment as the lowest layer in this diagram, this layer is now re-interpreted as wholesale customer services, and this diagram now links a range of Wholesale Telecommunications Services with a range of CAN technologies together with the common Inter-Exchange Network as the service interconnect.

This diagram and the previous two pictures step through from a structural interpretation of the PSTN with its IEN and CAN components, through to a physical layered understanding of the IENs' complexity, into a service oriented approach of aligning various CAN technologies attached to the IEN and providing a range of Wholesale Telecommunications Services that can be provided as "Open Access" products. This diagram also shows how various products align with a range of CAN technologies, all of which are connected through the common IEN infrastructure in the PSTN.

In this light, the ACCC Telecommunications Reports need an entire and rigorous restructuring so that the terminology topics are firstly aligned with reality, then the terminology is aligned with the physically existing technologies and that will in turn align with actual and practical divisions in management, sales and marketing.

It would even make sense to go back several years in this process and get it right so that trends can be much better understood in a light of reality. All competitive telecomms businesses would be in a much safer position to provide more complete and relevant information as the report would not then produce 'distorted' results.

Demographic v Telecom-ese Languages

As far as I understand from the Australian Bureau of Statistics (ABS), their definition of "**Metropolitan**" [21] ***refers to state capital cities***, and therefore everything else is "Non-Metropolitan". A further reference [22] holds definitions for Remote and Rural, which is somewhat quaint, and some of that detail is given here:

> **"Remote Australia**
> Remote Australia is a category in the ASGC Remoteness Structure. Remote Australia is defined as 'CDs with an average ARIA index value greater than 5.92 and less than or equal to 10.53. Examples of Remote Australia include Alice Springs, Mount Isa and Esperance. See ARIA, Remoteness, Remoteness Areas.
> **Rural**
> The ABS defines "Rural" in the ASGC Section of State Structure as areas, which are not part of any "Urban" area. The Bounded Locality and Rural Balance categories of SOS thus make up "Rural" Australia."

The problem is that the ABS demographic divisions are used for population densities on a national approach, but the telecommunications demographics are basically centred on the capabilities of the CAN technologies, together with the throughput capabilities of the associated IEN infrastructure. Going a little further the ABS definition for Urban [23] includes the following:

> **"Urban Centre/Locality (UC/L)**
> …An Urban Centre is generally defined as a population cluster of 1,000 or more people. A Locality is generally defined as a population cluster of between 200 and 999 people. People living in Urban Centres are classified as urban for statistical purposes while those in Localities are classified as rural (i.e. non-urban)…"

This leaves the ABS defined **Regional area** to be defined and this therefore sits in as ***any city and its immediate surrounds that is not a state capital city***.

So now we have consistent ABS terminology that defines in ABS terms the Metropolitan, Regional, Rural and Remote, and this is wonderful if we are talking generalised population densities, but we are actually talking about telecommunications facilities, and there is a major discord in the comprehension of the ABS terminology into '*telecom-ese*' language!

In "telecom-ese", a **CBD** area is premises that is nominally within 750 m pair copper cable distance of the local / district telephone exchange. In "telecom-ese", an **Urban** area is premises that is nominally beyond nominally 750 m and within 4 km pair copper cable distance of the local / district telephone exchange. It really does not matter if the location is in an ABS defined Metropolitan, Regional, Rural or Remote demographic.

In "telecom-ese", a **Rural** area is premises that is nominally beyond 4 km pair copper cable distance of the telephone exchange, and nearer than about 15 km of the local / district telephone exchange, so that usually excludes the ABS defined Metropolitan area but would include ABS defined Regional, Rural or Remote demographics.

In "telecom-ese", a **Remote** area is premises that is nominally beyond about 15 km of the local / district telephone exchange, so that usually excludes the ABS defined Metropolitan, and Regional areas but would include ABS defined Rural or Remote demographics.

The reasoning for these 'telecom-ese' definitions is that the pair copper CAN technology is essentially short distance defined and this technology has been in place for more than 100 years, and pair copper length is the effective 'yardstick' that has one of the biggest effects on customer service standards.

In terms of the IEN, there is very little that changes between ABS defined Metropolitan, Regional, and Rural areas – apart from the availability of high speed Internet facilities, which degrade in capacity the further the urban area is from the capital cities. The only way to address this issue is to position very high capacity IEN bearers through ABS defined Rural and Remote areas [22], so that

the telephone exchanges in these areas can be connected to use some of this Backhaul capacity in their CANs.

Engineers Australia: Report Card No. 13

In 2008, Engineers Australia did a Report Card 13 Telecommunications Infrastructure [18] on Service Standards in Australia by geographic areas, and the conclusions from this report reflects generally poor national telecommunication service standards.

Their results have been correlated back to ABS based nomenclature that refers the geographic areas and the double matrix was converted to a simple table, below so that this can be picked up by Excel and simply filtered to perform rather simple analysis.

State	Division	Fixed Access Ranking	Mobile Access Ranking	ABS Area
NSW	Sydney	B	B	Metro
NSW	Hunter	E	D	Rural
NSW	Illawarra	D	D	Regional
NSW	Richmond-Tweed	D	E	Rural
NSW	Mid-North Coast	D	E	Rural
NSW	Northern	D	D	Rural
NSW	North Western	E	E	Remote
NSW	Central West	D	E	Rural
NSW	South Eastern	D	D	Rural
NSW	Murrumbidgee	D	E	Rural
NSW	Murray	E	E	Rural
NSW	Far West	F	F	Remote
Victoria	Melbourne	B	B	Metro
Victoria	Barwon	D	D	Regional
Victoria	Western District	D	E	Remote
Victoria	Central Highlands	E	E	Remote
Victoria	Wimmera	F	E	Rural
Victoria	Mallee	F	E	Rural
Victoria	Loddon	E	E	Remote
Victoria	Goulburn	D	E	Rural
Victoria	Ovens-Murray	E	E	Rural
Victoria	East Gippsland	D	E	Remote
Victoria	Gippsland	D	E	Remote
Queensland	Brisbane	B	B	Metro
Queensland	Moreton	C	C	Regional
Queensland	Wide Bay – Burnett	D	E	Regional
Queensland	Darling Downs	D	E	Regional
Queensland	South West	E	F	Rural
Queensland	Fitzroy	E	E	Rural
Queensland	Central West	E	F	Remote
Queensland	Mackay	E	E	Regional
Queensland	Northern	E	E	Rural
Queensland	Far North	E	E	Remote
Queensland	North West	E	F	Remote
Western Australia	Perth	C	C	Metro
Western Australia	South-West	F	D	Regional
Western Australia	Lower Great Southern	F	E	Rural
Western Australia	Upper Great Southern	F	E	Rural
Western Australia	Midlands	F	E	Remote
Western Australia	South Eastern	F	E	Rural
Western Australia	Central	F	E	Remote
Western Australia	Pilbara	F	E	Remote
Western Australia	Kimberly	F	F	Remote
South Australia	Adelaide	D	C	Metro
South Australia	Outer Adelaide	D	D	Regional
South Australia	Yorke and Lower North	F	E	Rural
South Australia	Murray Lands	D	E	Rural
South Australia	South East	E	E	Remote
South Australia	Eyre	F	F	Remote
South Australia	Northern	F	E	Remote
Tasmania	Greater Hobart	D	E	Metro
Tasmania	Southern	D	E	Rural
Tasmania	Northern	F	E	Regional
Tasmania	Mersey-Lyall	F	E	Rural
Northern Territory	Darwin	D	E	Regional
Northern Territory	N. Territory - Balance	F	F	Remote
ACTerritory	Canberra	C	D	Regional

> ***"(*) Ratings:** The ratings are based on the number of fixed access points per household and mobile access points per user, and adjusted for population density.*
> ***A (Very Good)** - Availability of telecommunications infrastructure satisfies the current and future needs of the most demanding users;*
> ***B (Good) -** Implies that the availability of telecommunications infrastructure is adequate and can generally satisfy the needs of most users;*
> ***C (Adequate)** - Infrastructure adequate but does not meet the needs of most users;*
> ***D (Poor)** - Major expenditure on telecommunications infrastructure would be of benefit to users;*
> ***E (Very Poor)** - Major deficiencies, and requires substantial investment in existing and new technologies;*
> ***F (Inadequate)** - Cannot meet the minimal expectations of the majority of users."*

It is starkly obvious that the only areas that have relatively good reports are in the Metropolitan areas (which are major capital cities).

This information table is very basic and it like most other telecommunications infrastructure analyses, it approaches from a geographic perspective and not a telecom infrastructure perspective and therefore totally misses out on powerful and meaningful correlations could have been pulled together out of this, however the below excerpt is intuitive, and it sets the direction for addressing the IEN infrastructure problems in Australia beyond metropolitan areas:

> "The report card highlights the benefits centres such as Bendigo and the Gold Coast gain from being adjacent to high capacity links. Whereas the areas that received much poorer scores, as low as 'F', are away from high capacity links, and have low population density."

It is also worth noting that the brief summary included the following:

> "While overall the report indicates that Australia is reasonably well served by its telecommunication infrastructure, Engineers Australia makes the following recommendations:
>
> 1. A long-term, rolling, regularly reviewed and updated strategic plan for telecommunications infrastructure development for the whole nation must be developed as a matter of urgency.
> 2. Government should ensure that regulations and subsidies (if appropriate) are regularly reviewed and adapted as necessary.
> 3. Unnecessary duplication of infrastructure must be avoided, particularly where government subsidies are given. Where there are no government subsidies, policies should encourage carriers to avoid duplication through appropriate third-party access regimes.
> 4. Inter-carrier roaming must be supported on all mobile infrastructure funded by government."

Point 3 is of particular note as it recognises that telecommunications resources are both expensive and scarce, and that duplicated infrastructures are inherently very wasteful. This statement effectively and directly opposes the 'competitive regime' approach that market forces of competitive (duplicated) resources will provide the best infrastructure results. This statement is particularly potent as Engineers Australia is a highly recognised body of very eminent Professional Engineers that have many decades of experience in all levels of business.

Point 3, which is highly critical of infrastructure duplication, coupled with the more recent publication [17] from the very eminent Economist Prof. Stephen Littlechild [16], expressing the situation that competition is not nearly as efficient as it was thought to be some decades ago in the Davidson Report 1982 [15]; really begs the question about the future of the need for the "Competitive Regime" to play any future part in the telecommunications industry in Australia.

The Competitive Regime has Not Delivered

Professor Littlechild [16] who was mentioned in the Davidson Report 1982 [15] has a far more recent PowerPoint Presentation [17], that places monopolies as being rather efficient compared to the competitive market, and this throws a lot of 'cold water' onto the premise that a competitive market is essentially the most efficient one – to the point that a competitive regime is not necessarily efficient at all! Interestingly, the Davidson enquiry discounted Professor Littlechilds' warnings on big inefficiencies due to competitive business overheads.

At the best, the "competition postulation" was a very long bow to draw on and the whole concept was seriously flawed in several areas. In the first case the assumption that competition would greatly improve service standards is far too simplistic, as it assumes that with increased competition

service maintenance standards will not be dropped, when in fact, in an competitive environment, the first cost cutting is aimed directly on reducing maintenance time, costs and changing maintenance practices back from preventative to reactive maintenance. This inevitably results in shoddily maintenanced equipment that is more prone to catastrophic failure in a shorter timeframe.

It is extremely fortunate for privatised competitors because more recent telecommunications technologies have Mean Time To Fail (MTTF) figures that are literally some orders of magnitude greater now than in the 1950s, and 1960s. In those days the CAN was considered low maintenance and comparatively complex, and now, CAN technologies are comparatively simple, yet are prone to be high maintenance (but that technology did not change)! Appendix 1 has details to support this.

There have been numerous news reports of telecommunications field staff being ‘released’ for ‘working too slowly’ or ‘working too diligently’, or ‘fixing non-existing faults’ when in fact these staff were the more experienced field staff that were performing preventative maintenance that would considerably reduce the ongoing fault rate. Their management have short-term (competitive) goals that are dollar driven and repetitively fail to comprehend that ‘***a stich in time saves nine***’.

There is general sentiment that the telecommunications Broadband Internet infrastructure should be universally available through “Open Access”, and there are obvious competitive business constraints that will do everything in their power to prevent this – and it comes under the guise of “managing the interests of our shareholders” – which basically means minimising the investment expense to provide a service and charge as much as possible to maximise the profit – for self gain. Competitive Business is not about nationally managing long-term infrastructure with minimised profits; that is what Infrastructure Business is all about (but you will have to look very hard to find this topic in Business / Economics courses).

It appears as though the staged privatisation of the telecommunications industry in Australia has systematically misappropriated the accrued funds that were set aside for infrastructure rebuilding, and syphoned these funds to advertising, marketing and the shareholders – which incidentally, are not the general public customers, but big business – which coincidentally big business gets very economic telecommunication service contracts.

The Federal Government of the day has to realise that the Competitive Regime has had its use-by date and it has proven to be a rather foul ‘White Elephant’ that we can all do well without – particularly in the telecommunications infrastructure business.

The Competitive Regime has negatively impacted on the advancement of Australian telecommunications infrastructure since about 2000 and there has been a large number of enquiries, reports and surveys that have all ‘pussy-footed’ about the situation but have never asked the direct question of what direct benefit has the Competitive Regime actually produced, and if so then give the figures, and directly compare these to that obtainable by the Infrastructure Regime.

In a speech at the Press Club in 2007 the then Minister of DCITA (Helen Coonan) complimented the effectiveness of competition in telecommunications industry for dropping end user call costs by an amazing 26% over the last 10 years (or in normalised terms about 3% per year accumulative).

Appendix 1 shows unequivocally that by replacing telecommunications equipment at the end of its useful life (typically about 20 to 30 years) by newer and more effective technology equipment, this has had a far greater effect on dropping overhead costs than so-called competition. Technology advances have exclusively caused at least a 73.5% drop in end user costs over the same 10-year period, compared to 26% as claimed by ‘competition’.

Australias' "Golden Boomerang"

Australia has a 'Golden Boomerang' corridor of heavy inter-capital traffic between Brisbane – Sydney – Melbourne and Adelaide. This high-density corridor is basically a profit centre and all the rest of the telecommunications infrastructure in Australia is basically a loss centre. The prime reason is that the Broadband Internet infrastructure in Australia has been developed along the same engineering lines as telephony infrastructure, and this infrastructure is very similar to the road / rail networks where the biggest centres have the highest density routes between them, and these are generally profitable because of the higher density of the passing / through traffic.

While not berating this infrastructure arrangement, it has to be understood that this structure was historically chosen for very good reason in that commercially it provided the biggest return on investment, and in a competitive environment this business structure is to be expected. This competitive thinking is naturally rather short-term, and many would argue that competitive thinking has to be short-term so that it can be agile and 'react to the market changes', but this approach is rather shallow, as infrastructure is in-place for the long-term, and therefore 'agility' is not in the repertoire of 'infrastructure' business.

Advances in Optical Fibre-based transmission and associated technologies have dramatically reduced the distance cost factors and immensely increased the route capacities (see Appendix 1) so much that distance is now no longer a major issue as it was with coaxial cable and radio bearers. This reduction in overhead costs is so dramatic that routes that were not profitable some decades ago are more than breaking even, through utilising Optical Fibre for the bearers.

Geographically, IEN direct Optical Fibre routes are only fractionally cheaper than rather indirect Optical Fibre routes, and to date, still very little inter-capital traffic in Australia is sent via geographically very indirect routes. Competitive pressures have severely crippled the engineering choices, simply to save minor expenses with short-term competitive strategies, and not allow long-term infrastructure strategies – in what is essentially a major infrastructure business in Australia.

Australia's Broadband Internet Multi-lemma

Internet Traffic Sources and Sinks

The commercial-competitive problem, is that Internet traffic is not strictly Australian inter-capital city; but far more-so International Internet traffic that is on average sunk into Australia, and this traffic presents a direct problem in that the major carrying routes are traffic links downloading back into Australia, because these Internet sources are to a large extent external to Australia.

So Australian telecommunications businesses in a rather difficult position where the data flows are fundamentally sunk into Australia and consequently these businesses are heavily disadvantaged in a competitive sense where they are most likely to pay a bounty in being internationally connected to the Internet world at large. This average traffic flow needs to be reversed.

Internet Traffic Content

At an ISP managers meeting in Sydney 2004 (where I represented the Australian Seniors Computer Clubs Association [10]), I was rather surprised to hear one ISP manager categorically state that he did not care what was passed through his ISP providing his customers "***got their daily dose of porn, because that is where I make my money***". The other ISP managers nodded concurrency and the discussions continued as though this was normal practice. From that open admission, I understood that upwards of 50% of all Internet traffic at that time was porn, and the remaining traffic was a mix of Business, Games and recorded Music and Videos.

This breakdown of the Internet data content somewhat surprised me, as I was under the impression that business data and information was the big user of Internet, but it appears that the major 'business' is essentially 'adult entertainment', and it is sourced from outside Australia. As long as

the status quo remains with other forms of entertainment being stationary, then this ratio of traffic will continue to be consistent. This average traffic flow needs to be reversed.

Content on Internet Servers

Some years ago we were struck with the very perplexing situation with a Senator Brian Harradine [28] gaining a pivotal role in virtually wiping out the Phone Sex industry out of Australia. Not only did this act wipe a very profitable international money earner from Australia, but it also created a substantial international money loser for Australia, as people were now calling overseas, instead of people from overseas calling into Australia. I also understand that this Act also incidentally wiped out part-time jobs for thousands of people who answered these calls from their homes, and it also cut off a valuable outlet for thousands of callers to manage their mental anxiety / health issues without further loading the public health system.

Taking this one step further, I believe that we now have the situation that Internet server hosts in Australia are not allowed to carry porn on them, and reading into the statement above from the ISP meeting in “Internet Traffic Content”, then I believe that it follows that Australia is losing out big time by ‘navel gazing’ while the globe carries on big business in transporting readily available soft core porn and general porn at a price that is very easily costed against every credit card system.

The workaround for not hosting porn in an Australian Website is almost too easy in that by simply creating a Website without the ‘.au’ on the end – it becomes an international Website, and it can be hosted from virtually anywhere globally (but not in Australia), and mirrored anywhere (but not in Australia) – and that is the stupidity of this legislation.

So, in the interests of ‘looking clean’ we have done ourselves out of untold millions of $$$$$ in international credit, and turned that into international debit, and we have one of the safest countries in the Asia block – yet we are not utilising this safety factor as a major drawcard to actively host Websites in Australia in favour of external countries!

Changing Technologies - Changing Requirements

From what I have seen on WhirlPool.net.au forum website [06] (2005-2007) it is rather clear to me that there are other forms of entertainment called 'gaming' (*as opposed to on-line gambling – which is also called gaming by those lying to conceal the facts of addictive gambling*). It seems that the number of players connected with on-line games (not gambling) appears to be on the increase – and its bandwidth needs for this can be quite large. Further, the upload speed requirement for gaming needs to be significantly faster than the nominal 64 kb/s. This up-load speed seems to need to be in the order of at least 512 kb/s.

There is a change in technology that is bringing in video-conferencing between Internet users. The problem with this technology is that the upload speeds need to be as fast as the download speeds; as the upload speed of one end is the effective download speed at the other end, and the speed needs to exceed 4 Mb/s bi-directionally. This is the virtually beyond the upload data speed limit of ADSL 2+, so this directly puts current ADSL technologies on notice that they may well be out-dated – even though they are currently being installed and commissioned!

As recently pointed out in the ATUG conference in Sydney 2008, [11] there is real concern that with changing end user technologies and their uses that the current IEN / Backhaul capacities may have to increase by some 300% at least in the next few years. This means that the current IEN infrastructure is totally insufficient and apart from replacing 1 Gb/s GBICs (GigaBit Interface Connectors) [12] with 10 Gb/s GBICs for direct link SMOF, bumping up the main long-haul route capacities by a factor of 10 times is a very major task, and not a simplistic ‘flick of a switch’ but a major network re-engineering that will take about five years (and may be expensive).

Physical Pair Specifications for ADSL

One of the biggest complaints registered on the Whirlpool.net.au website [06] is that the download speeds are not fast enough. There are major problems with getting connected onto ADSL with metropolitan (0.40 mm) pair copper lines, as these lines have too much attenuation, which cripples the available download speeds.

Now, the maximum specification for Voiceband attenuation at 820 Hz is 6.5 dB [19] and for ADSL the attenuation measurement (or calculation) at 300 kHz is not to exceed 56 dB. It just so happens that the in the metropolitan (or ‘urban’) areas, 0.40 mm pair copper case, if the ADSL spec is not met, then there is a very strong correlation that the Voiceband loss is not met either, as in this case the attenuation specifications correlate at about 4.1 km. Unfortunately, with a nominal attenuation of 56 dB at 300 kHz, this limits the available ADSL2+ download speed to just under 4 Mb/s which is well under the proposed 12 Mb/s minimum download speed [27].

In ‘non-urban’ cases where the physical CAN exceeds the nominal urban 4.1 km length; some of the cable distance is engineered with 0.64 mm pair cable to keep the Voiceband attenuation at (or just under) 6.5 dB. Pair copper at 0.64 mm can span 10.5 km for Voiceband, but because of the ‘Skin Effect’ [14] it can span only 7.7 km before the ADSL attenuation spec is exceeded, and that is about 71% of the Voiceband distance.

Understand that virtually all non-urban lines are usually engineered for an attenuation of 6.5 dB at 820 Hz, so the ADSL attenuation specification will be well outside the nominal 56 dB. Conversely, with pair copper exceeding 4.1 km length, Voiceband loss has to be well under 6.5 dB for the ADSL specification to also be within specification. ***This really means that virtually <u>no</u> non-urban telephony (Voiceband) physical pairs are OK for ADSL.***

For example, a ***typical 5 km rural customer line*** (consisting of 3.5 km 0.40 mm and 1.5 km of 0.64 mm pair copper) ***is in spec in the Voiceband and out of spec for ADSL***. At 820 Hz it would have an attenuation of 6.5 dB, and at 300 kHz, an attenuation of 58.7 dB. If this line was re-engineered to include a further 500 m of 0.64 mm cable in place of some 0.40 mm cable then the line would consist of 3.0 km 0.40 mm and 2.0 km of 0.64 mm pair copper will have an 820 Hz attenuation of 6.0 dB and at 300 kHz, an attenuation of 55.5 dB, which in spec for both Voiceband and ADSL.

Simplistically using thicker cable is a panacea, but it has to be realised that the 0.40 mm part of the line would be usually coming from the exchange and that a 0.64 mm cable would then be in a thicker sheath, making it possibly more difficult to later install FTTP through the same conduits. The service outage to replace a section could affect a majority of customers – who may all want higher speed ADSL!

Although replacing a (say) 1 km section of 0.40 mm cable with 0.64 mm cable would be an expensive outlay there are some hidden benefits that make this ‘maintenance’ financially viable, and ***a thicker cable section will substantially:***

- Increase the range for ADSL enabled customers to connect, and
- Reduce the complaints from unsatisfied ADSL customers, and
- Increase the available download speed for existing ADSL customers, and
- Reduce the requirement for Neighbourhood ADSL Nodes (FTTNN) to be installed.

Using an example of an urban District Area with an average customer distance of say 3.5 km with 0.40 mm pair copper, the Voiceband attenuation at 820 Hz would be about 5.5 dB, and the ADSL attenuation at 300 kHz would be about 47.8 dB. This corresponds to an ADSL (2+) download speed limit of about 6.35 Mb/s. If a (say) 2 km section of 0.40 mm cable was replaced by a 0.64 mm cable then the Voiceband attenuation at 820 Hz would be about 3.6 dB, and the ADSL attenuation

at 300 kHz would be about 35.0 dB. This corresponds to an ADSL (2+) download speed limit of about 12.73 Mb/s (which is above the expected minimum speed of 12 Mb/s specified [27] with the FTTN scenario), and it is passive – so FTTN would not be needed for about 50% of all urban areas.

If we took this a little further, and engineered around 12 Mb/s and 4.1 km, then approx 3 km of 0.64 mm is required and the remainder 1.1 km can be 0.40 mm. ***This scenario begs the value by installing 0.64 mm pair copper when we know ADSL (FTTN) is an obsolete technology!***

The figures in the above paragraphs were derived from the Internode Graph [13] for ADSL2+ speeds, based on 0.40 mm cable for various lengths; the knowledge that nominally 4.1 km of 0.40 mm cable is approximately 6.5 dB at 820 Hz and many iterations of ADSL1, 2+ etc. results reported from the Whirlpool.net.au Website [06] forums for various lengths of known cables, plus my practical engineering understanding of the 'Skin Effect' [14] in transmission cables, and my knowledge and experience of Telstra's CAN engineering practices.

Engineering Problems with FTTEN

The following short table was produced to provide a better understanding of the ADSL performance over various length pair copper cable, where the DSLAM is located in an exchange site.

Understanding that the 'average' urban cable length is about 3.2 km, and the maximum urban specification is about 4.1 km, and it typically uses 0.40 mm pair copper cable. The following table based on ASDSL2+ shows where copper fails over length:

Total Length (km)	0.64 mm Dia, Length (km)	0.40 mm Dia, Length (km)	Attenuation dB @ 820 Hz	Attenuation dB @ 300 kHz	Max. Download Speed Mb/s
1.0	0	1	1.6	13.7	23.86
2.0	0	2	3.2	27.3	17.73
2.6	**0**	**2.6**	**4.1**	**35.5**	**12.39**
3.0	**0**	**3**	**4.8**	**41.0**	**9.31**
4.0	**0**	**4**	**6.3**	**54.6**	**4.30**
2.0	2	0	1.2	14.5	23.74
3.0	2	1	2.8	28.1	17.20
4.0	**2**	**2**	**4.4**	**41.8**	**8.91**
5.0	**2**	**3**	**6.0**	**55.5**	**4.11**
3.5	**2**	**1.5**	**3.6**	**35.0**	**12.74**
4.0	**3**	**1**	**3.4**	**35.4**	**12.48**
4.0	**4**	**0**	**2.5**	**28.6**	**16.65**
4.9	**4.9**	**0**	**3.0**	**35.5**	**12.42**

In all urban cases where the cable is 0.40 mm and is less than 2.6 km (including the wiring from the DSLAM through the MDF and to the cable entrance – to the premises equipment), the ADSL modem can operate above 12 Mb/s download. This accounts for about 25 % of the total customers; so 75% of the customers ADSL equipment will not be working to minimum speed.

For all outer CAN runs, if a 0.64 mm pair copper cable is used in place of the 0.40 mm pair copper cable for the first 2 km, if the total length is less than 3.6 km, then the ADSL modem can operate above 12 Mb/s download. This is a likely scenario in small country exchanges, and this would satisfy all the urban customers, but chances are that most of the customers will be further than 5 km away, the exchange has a RIM but no DSLAM!

In other words this table shows that: ***wherever possible all CAN cabling should be done with 0.64 mm pair copper and 0.40 mm pair copper should be phased out as a mater of urgency.***

If there are any more customer pair copper cables to be run from any exchange then it is imperative that 0.64 mm pair copper is used for at least the first 2 km from the exchange as a minimum.

The above grouped solutions use 0.64 mm pair copper cable in place of the standard metro / urban 0.40 mm pair copper cable, and this scenario removes the need for Fibre to the Neighbourhood Node (FTTNN) in virtually all urban situations, while providing the environment for greater than 12 Mb/s download speeds, using ADSL2+ DSLAMs.

Engineering Problems with FTTNN

The technology of Fibre to the Neighbourhood Node (FTTNN) is far more expensive in life cycle terms than the technology of Fibre to the Exchange Node (FTTEN), where the DSLAM equipment is mounted within the existing exchange building where; superstructure, gantries, power, alarming, security, air conditioning and equipment space is available (in most instances).

The only reason to include neighbourhood nodes is so that DSL equipment can work optimally with a minimum length pair copper line. If this reasoning was taken to the limit, then the ideal pair copper line would be minimum length; and the customers line would be Single Mode Optical Fibre! As this FTTNN scenario is currently impractical, then the length of pair copper lines needs to be made ***to appear shorter by alternative means***.

For CANs longer than 4.9 km (using 0.64 mm) or longer than 2.6 km (using 0.40 mm) pair copper, then mid-point injection using Fibre to the Neighbourhood Node (FTTNN) is a solution, but with midpoint injection it is imperative that all cables that have ADSL already on them and are passing this point need to be in a separate cable to prevent ADSL induced crosstalk as noise into those pairs.

The problem here is that if the midpoint injected ‘O’ pairs (towards the customers) at a Neighbourhood Node are in a common cable with DSLAM equipment located at the local exchange; there is a differential in ADSL levels of about 30 dB. The half-baked ‘solution’ is to drop the ADSL levels in the Neighbourhood DSLAM so that the differential in ADSL levels is in the common cable minimised. (This also impinges on those customers intending to reap the benefits of having ‘mid-point injection’ as their ADSL speeds are now severely limited – as though they had the DSLAM in the local exchange!) A much better (customer oriented) solution would be to put those customers in their own cable towards the next pit, without having their ADSL levels severely attenuated. ***This scenario shows just how messy and complicated FTTNN really is and why FTTNN is destined to fail.***

‘Paired’ Pair Cables

This is an oxymoron in practice that is an alternate way to maximise CAN length is to increase the cross sectional area of a pair by paralleling two pairs together. From separate areas of a common cable, two pairs could be paralleled (so that the signal is shared in both pairs in parallel – leg ‘A’ of the first pair is paralleled with leg ‘A’ of the second pair, and leg ‘B’ paralleled of the first pair is paralleled with leg ‘B’ of the second pair)!

Not only is the cross section area doubled – so the low frequency resistance is halved, making the distance appear halved, but the surface area compared to the cross-section area is increased by about 1.4 times, considerably lowering the ‘Skin Effect’ [14] resistance that is predominant at ADSL frequencies (50 kHz – 2 MHz). Here is a table of some typical paired pair ADSL calculations:

Total Length (km)	Paired 0.64 mm Dia, Length (km)	Paired 0.40 mm Dia, Length (km)	Attenuation dB @ 820 Hz	Attenuation dB @ 300 kHz	Max. Download Speed Mb/s
2.0	0	2	1.59	14.9	23.78
3.0	0	3	2.37	21.3	21.29
4.0	0	4	3.17	28.5	16.98
5.0	**0**	**5.0**	**3.96**	**35.7**	**12.36**
4.0	4	0	1.24	14.4	23.74
6.0	6	0	1.86	21.7	21.10
8.0	8	0	2.48	28.9	16.65
10.0	**10**	**0**	**3.10**	**36.2**	**11.98**

This table shows that 0.40 mm paralleled pairs could extend to 5 km in urban areas, and get more than 12 Mb/s maximum download speed. In Rural areas, paired 0.64 mm cable could extend ADSL transmission up to 10 km and still be on the verge of 12 Mb/s download speeds. This would completely negate the need for FTTNN technology – if there were enough spare cable pairs!

The ACCC Telecommunications Report [07] shows that customers are moving from Fixed Access Network (FAN) telephones to Mobile Access Network (MAN) telephones, and therefore customer lines will be freed up both now and in the near future, leaving spare pairs that can be paralleled to provide apparently shorter lines for ADSL applications.

The problem is that by pairing pairs, this could upset the geometric balance in cables that inherently provides the excellent near end and far end crosstalk isolation, and the result could be a greatly increased noise floor that could directly defeat a large proportion of ADSL channels from working and hence the ADSL performance may be limited – and for other customer also.

Installation and commissioning would have to be far more thorough, and I believe that many of the experienced field staff have now left the workforce, so it is down to in-general rather inexperienced contracting and casual field staff to perform line maintenance, and my fear is that they will introduce a significant number of errors into the CAN while they perform maintenance.

This same scenario of poor workmanship introducing a significantly high proportion of faults while performing maintenance happened in the early 1990s with the push for 'efficiencies in competition' by the outsourcing of field staff. Remedial action was taken to retrain the field staff but it did not resolve the issue in the longer term.

The Under-Utilised HFC Access Infrastructures

Originally HFC was introduced to provide Pay-TV, and this was not that successful in Australia – primarily because Australia has the European PAL (Phase Alternated Line) modulation scheme that cancels out phase errors in the colour – compared to the USA that has the NTSC (National Television Standards Committee) scheme – sometimes smugly termed Never Twice Same Colour, because the colours are rather poor for Free to Air TV in the USA!

That aside, both Telstra and Optus have HFC access networks that have DOCSIS [09] Broadband Transmission carried over them, and this is rather successful – particularly for those customers with Cable TV. Telstra has a logon system that picks up the MAC (Media Access Control) address of the cable modem and refers this address to a large common database. If the MAC address is not recognised, then access is barred and the customers' modem is referred to a 'blank' logon web page.

With an "Open Access" agreement, several competitive ISPs could retail resell this wholesale connection facility, and grant their customers access, through the customer initially logging on (once) at the 'blank' logon website. They would be referred to their retail ISP for all intents and purposes without reference to Telstra (or Optus).

Because the Telstra (and Optus) HFC Access networks literally pass almost every premises in all capital cities (and I know that Telstra has the exchange floor space allocated in hundreds of local / district exchange sites for substantially increasing the number of Broadband Routers for their HFC access networks), this HFC accessed Broadband Internet could be wholesaled to many ISPs to provide a fairly cheap and on average, a much faster speed alternative to ADSL on pair copper.

Conservatively the existing HFC Broadband Internet could connect to at least 80% of all metropolitan premises in Australia greatly reducing the load on ADSL demand, and freeing up a high proportion of pair copper cables, and provide Broadband Internet at download speeds well over the nominal 12 Mb/s minimum standard proposed rate.

Status Quo with the USO

The Universal (telecommunication) Services Obligation (USO) was introduced by the Davidson Report [25] 1982, to offset the comparatively high overhead costs of telecommunications in non-urban areas. The prime resolve of the USO was that by the Federal Government putting in substantial funds to offset these overhead costs of non-metropolitan telecommunications services, then this situation would create an artificial competitive environment, so that competition would then be the catalyst for greatly improved service standards in these ‘non-metropolitan’ areas.

It is interesting to note that Telecom Australia / Telstra has always overstated the funds required to fund the USO, primarily because they do their accounting to cover their costs, and Optus (and others service carriers) always understate the funds required to fund the USO, primarily because these businesses have to pay Telstra to manage these Regional, Rural and Remote services!

The USO funding merely maintains the status quo, and as metropolitan service standards are improved with new technologies, some of these technologies inevitably spill over into the Regional, Rural and Remote areas – and that is how the status quo remains!

The assumption that all telecommunications equipment is the same irrespective of location is also far too simplistic. Regional and Remote infrastructure usually has much larger spans between population centres, but with Optical Fibre transmission that is no longer a service standard issue (except for IEN capacity), the issue is primarily the longer length of the CAN compared to Metropolitan and Regional areas, and these transmission systems have to by highly fault tolerant.

In Rural and Remote areas, not only are the Voiceband transmission standards for physical CAN on their very limits in almost every case – making the intelligibility rather difficult and Broadband Internet virtually impossible, but the access services also have in many cases extra equipment (generally called Pair Gain Systems) to make the distance. Inevitably, these Pair Gain Systems (PGS) compromise the Voiceband by Digital-Analogue conversions resulting in extra Quantisation Distortion Units (QDU) that severely impinge on these customers being able to use Dial-Up Modems, Fax machines and xDSL interfaces with much degree of success – if at all.

The assumption that mobile phones would have the same range and feature capabilities as their ‘sisters’ in metropolitan areas is a myth. Cellular Mobile phones were engineered to work in metropolitan areas where the mobile base stations are plentiful and these days, there are even mini-base stations in small black spots (dips in the urban landscape where the signal would otherwise be far too faint and result in drop-outs).

Mobile phones have traversed several transmission technologies including Analogue, Digital GSM, Code Division Multiplex Multiple Access (CDMA), and most recently Wideband –CDMA (W-CDMA) to provide more user facilities and to less drop-outs during use. More recently W-CDMA has been introduced in two spectrum bands 850 MHz and 1800 MHz with the latter for use in metro areas and the former much better suited in non-urban areas.

Creating Country-Based Business Drivers

Topics under “Australias’ Multi-Lemma” show that if we really want to get out of the competitive telecommunications rut and into the National Broadband Education era, then the status quo is not the way of the future. The current scenarios must be seriously challenged as the existing position has the potential to maximise Internet costs while minimising Internet speeds, and minimising geographic areas where Australia’s Broadband Internet could be classed in the highest 20% connectivity and throughput standards on an OECD basis.

Currently, connecting the 'outback' is comparatively very expensive and has no direct business drivers to make it profitable. Further, the USO appears to be rather pointless as it keeps the status

quo, without providing real stimulus change the current situation by creative strategies. To date all competitive / commercial proposals have been major capital city-based and trickle towards the country areas with disproportionate cost relationships.

High Capacity IEN Essential for Non-Metropolitan Areas

The Engineers Australia Report 13 touched associating the high capacity IEN with improved customer perception, and this correlation clearly identified that if the telecommunication service standards differential in non-metropolitan areas was to be considerably narrowed, then the IEN capacity in non-metropolitan areas has to be considerably increased.

Some decades ago, I identified the correlation of radically improved service performance with an associated solid IEN infrastructure, but it was not until the introduction of SDH based Optical Fibre transmission systems together with IP router / switches, that ongoing overhead costs dropped by so much, that it is now highly practical (and profitable) to install high capacity Optical Fibre transmission systems via very indirect paths as demonstrated in this submission.

Inland Web Hosting Mirror Servers

Optical Fibre transmission systems are now so cheap that International transmission is considered the norm' with Broadband Internet, but I believe that Australia has an intrinsic deficit balance in traffic, because we have considerable Web hosting content that is constantly being imported. I have pointed out in this submission that there is a strong business synergy here in that by positioning high capacity Web hosting mirror servers in Regional / Remote areas along the corridors of the indirect Optical Fibre transmission paths that are well inland, then the International traffic deficit can be more than neutralised, and inland Australia can be seen as a prime safe location for major International Web servers. This synergy has the power to be a catalyst to create businesses beyond metropolitan cities and balance the number of professionals per capita per region.

Suggested Recommendations

Move on from the Competitive Regime

The Davidson Report (1982) heralded massive changes to the Australian Telecommunications industry to move it out of very constrictive Federal Government control into a competitive (and privatised) free market – and in hindsight any form of freedom from the then extremely conservative restraints would have been a positive move. Irrespective of this Report, the Australian telecommunications industry has paced with the globe until about 2000, when FTTH technology was not taken up to replace ageing pair copper CAN technologies – but shareholders were paid considerable dividends, and recent full-privatisation moves have aggravated the situation.

Since about 2000, competitive forces have actually hindered telecommunications infrastructure growth, and instead of moving towards FTTH as a priority (because Regional, Rural and Remote areas have a high proportion of their CAN technologies exceeding 4 km), Australia opted for ADSL on the existing pair copper, which I have demonstrated was a very short-sighted solution to partially solve urban situations.

The inefficiencies in competition then begs the question of how much Federal Government funding is required to foster competition in the Australian non-metropolitan telecommunications market, as that market cannot self-support competition? To date USO funding has been in place for over 20 years and there really has been no discernable closure in the differential service standards between Metropolitan and non-Metropolitan areas in this same time period.

I have absolutely no doubt that implementing FTTH [26] CAN in non-metropolitan areas will make an immense improvement to the customer service standards, but before FTTH becomes effective,

the capacity of the IEN in non-metropolitan areas needs to be increased by several 100% as warned in the 2008 ATUG Conference [11] so a radically different approach to providing enough IEN infrastructure engineering in non-metropolitan areas needs to be immediately applied.

If an alternatively different approach to IEN infrastructure provisioning, then there would be an abundance of Broadband carriage capacity to more than match the future requirements of Broadband Internet requirements in these areas with FTTH as the future standard CAN technology. In this situation, non-metropolitan areas would then use Broadband Internet far more frequently, and this would self-generate business prosperity, which would in turn create a somewhat competitive market, and the outshot is that the USO package could be considerably reduced or could be immediately terminated – if there was a radical change in the way the telecommunications infrastructure was managed in Australia.

Appendix 1 demonstrated very clearly that introducing new and more effective telecommunication technologies is far more effective than competitive forces to lower end-user prices, and it demonstrates with reasonably easily traceable figures that the ***Competitive Regime is responsible for at least a 10.8% per year increase in end-user costs - not a 3% decrease, and this is a immense 13.8% per annum accumulative differential!***

With these facts now facing the Government of the day,

- **it is high time that the telecommunications Competitive Regime is immediately scrapped, and**
- **be replaced by a infrastructure regime to synergetically coordinate the maximum use of telecomms infrastructure in Australia, and**
- **provide this wholesale to competitive telecomms resellers that can onsell the services to the public at comparable retail prices.**

The competitive regime would then have its rightful place out of telecommunications infrastructure, and only in competitive telecommunications wholesale reselling/retailing.

Correct the ACCC Telecommunications Report

It is embarrassing that the ACCC have had to resort to an external consultancy group to initiate a telecommunications industry report when the then Department of Communications and the Arts did not appear to have the internal expertise to do this themselves. It is astounding that this report seems to have not correlated the physical demarcation points between major wholesale product lines, and consequently has almost totally missed reporting on the Inter-Exchange Network (IEN), which is a major infrastructure component for all telecommunications products. It is confounding to see these mistakes being perpetuated in successive years without the Dept of Communications stepping in and aligning the report to reality. It is hoped that the Expert Panel can identify this issue and resolve it through the Department of Broadband and Digital Economy in the very near future.

- In this light, the ACCC Telecommunications Reports need an entire and rigorous restructuring so that the terminology topics are firstly aligned with reality, then the terminology is aligned with the physically existing technologies and that will in turn align with actual and practical divisions in management, sales and marketing.

- It would even make sense to go back several years in this process and get it right so that trends can be much better understood in a light of reality. All competitive telecomms businesses would be in a much safer position to provide more complete and relevant information as the report would not then produce ‘distorted’ results.

Align Customer Perception surveys with Infrastructure Technologies

Traditionally, telecommunication infrastructure product reporting is done by product over relatively large geographic areas, and it has always been done this way because the Marketing based Accountants behind the data gathering simply do not have the long-term Engineering experience and expertise to identify the prime factors that determine differential product performance in the telecommunications infrastructure industry in Australia.

The data needs to be correlated with 'telecom-ese' mapped areas – then the results would have a very high correlation of the service standards performance relating to the installed equipment, in telecom-ese locations, and then this can be correlated with meaningful knowledge with their overall ABS geographic area locations – not the other way around!

This submission contains the basic information so that meaningful analysis can take place, through understanding the physical limitations of both CAN and IEN technologies and where they are used, and it explains why data; that is grouped by ABS specified geographic areas, is almost useless.

Build the Inland High Capacity Transmission Ring

My first proposal is to turn this capital city-based thinking upside down and inside out so that the big communication links are country based as a national ring – but this ring is not costal – it is to be about 400 to 1500 km inland and has spurs that feed to the coast, picking up all the major routes towards the coast. If all major intercity routes would use this infrastructure as their first (or second) choice, then this inland high capacity ring would have extensive and inexpensive Regional, Rural and Remote wayside access points that would make business in the bush part of the profit-centres enjoyed with the capital cities.

In essence, install a multi SMOF cable transmission ring, capable of initially 100 Gb/s, and later 4,000 Gb/s (on multiple fibres) that links between: ***Mt Isa – Cloncurry – Winton – Longreach – Barcaldine – Blackall – Charleville – Cunnamulla – Bourke – Nyngan – Cobar – Hillston – Griffith – Hay – Mildura – Broken Hill – Port Augusta – Woomera – Coober Pedy – Alice Springs – Tennant Creek – Camooweal – Mount Isa.***

A second loop could take in the western half of Australia, although this link would not run inland like the one proposed for the eastern half of Australia, but it could also be rather high capacity for example 100 Gb/s to start and have enough dark fibre in place to allow it to grow to about 4,000 Gb/s also. This loop would basically pass through: ***Tennant Creek – Katherine – Kununurra – Halls Creek – Fitzroy Crossing – Derby – Broome – Port Headland – Newman – Meekatharra – Mt Magnet – Leinster – Kalgoorlie/Boulder – Cook – Glendambo – Coober Pedy – Agnes Creek – Alice Springs – Tennant Creek.***

There are several towns and villages not mentioned in this path but this is the first overview, and wherever possible wayside stations should be set up to provide local Customer access facilities for ample high capacity Broadband Internet.

This ring will provide transport between country centres, and a major bypass for inter-capital city traffic. The following sites could be ideal locations for major spurs to connect with nearby major cities and further outback locations: ***Tennant Creek*** – Darwin; ***Cloncurry*** – Normanton; ***Cloncurry*** – Hughenden, Charters Towers; ***Winton*** – Boulia; ***Longreach*** – Stone Henge, Galway Downs, Quilpie, ***Charleville***; ***Barcaldine*** – Emerald; ***Charleville*** – Roma; ***Cunnamulla*** – St George; ***Cunnamulla*** – Nockatunga, Tibooburra, ***Broken Hill***; ***Bourke*** – Brewarrina, Walgett; ***Nyngan*** – Dubbo; ***Griffith*** – Leeton, Narrandera; ***Mildura*** – Ouyen, Hopetoun, Warracknabeal; ***Mildura*** – Renmark, Burra; ***Port Augusta*** – Whyalla, Port Lincoln, ***Kalgoorlie/Boulder*** – Esperance, ***Kalgoorlie/Boulder*** – Albany, ***Mt Magnet*** – Perth, ***Mt Magnet*** – Geraldton, ***Wittenoom*** – Carnarvon.

The further outback locations should be capable of at least 10 Gb/s, considering the low density of customers in these regions.

Build the Inland Eastern Transmission Crescent

Because the Inland High Capacity Transmission Ring misses out on much of the higher density population in the eastern Australian states, this second proposal is to position a high capacity transmission crescent on the western side of the Great Dividing Range, roughly about 200 km inland, to support proposed high-density traffic between many regional areas. In essence the proposed transmission system would be a SMOF cable carrying at least 200 Gb/s initially and later 8,000 Gb/s (on multiple fibres) that links between: ***Cloncurry – Hughenden – Charters Towers – Clermont – Emerald – Roma – St George – Walgett – Dubbo – Orange – Cowra – Young – Cootamundra – Wagga Wagga – Narrandera – Finley – Deniliquin – Echuca – Kerang – Wycheproof – Beulah – Warracknabeal – Horsham – Hamilton – Casterton – Mt Gambier***.

Major nodes would then have multiple wayside spurs that feed off to rural and remote Customer Access Networks to provide high capacity Broadband Internet services.

The following locations could be ideal branch points to major costal cities: ***Charters Towers –*** Townsville; ***Charters Towers –*** The Lynd Junction, Atherton, Mareeba, Cairns; ***Clermont –***

Moranbah, Mackay; Emerald – Blackwater, Rockhampton; Roma – Miles, Chinchilla, Kingaroy, Gympie; ***St George –*** Moonie, Dalby, Toowoomba; ***St George –*** Goondiwindi, Texas, Tenterfield, Lismore; ***Walgett –*** Moree, Inverell, Glen Innes, Grafton; ***Walgett –*** Narrabri, Gunnedah, Tamworth, Port Macquarie; ***Gilgandra –*** Merriwa, Dunedoo, Denman, Singleton, Maitland; ***Orange –*** Bathurst, Lithgow, Bell, Richmond, Windsor, Dural; ***Young –*** Boorowa, Harden, Yass, Canberra, Queanbeyan, Braidwood, Bateman's Bay; ***Wagga Wagga –*** Tumbarumba, Adaminaby, Cooma, Nimmitabel, Bega; ***Finley –*** Corowa, Wangaratta, Bright, Swifts' Creek, Bairnsdale; ***Horsham –*** St Arnaud, Bendigo, Heathcote, Seymour; ***Horsham –*** Hamilton, Lismore, Geelong.

Many of these links may well exist, but it is the capacity that needs to be considerable bolstered, as (according to the ATUG Conference 2008 [11]) Broadband Internet will be using at least 300% more IEN capacity in the very near future than it is now. Ideally these SDH transmission circuits should be engineered to be open rings and carry at least 10 Gb/s per system, that way these systems can carry MPLS as the support bearers for high capacity IP in the IEN.

Build Inland Internationally Mirrored Servers

With the large high capacity inland transmission ring and the inland transmission crescent being put in place, it is necessary to load this network, and unload the more congested capital city and international routes. As a large proportion of our Broadband Internet traffic comes in from outside Australia, it makes strong business sense to install very large mirrored servers of internationally based servers and locate these well inland at locations like: ***Charleville, Bourke, Cobar, Griffith, Mildura, Walgett, St George, Roma, Emerald, Kalgoorlie/Boulder***.

The premise would be that as a customer calls an international server, the gateway router first calls to the inland server to provide the page. The inland server downloads the page data directly from itself to the customer. The inland server may check to see if there is an update of more recent data. If there is more recent data, then the international server downloads into the inland server and then the inland server downloads on request into the customers' computer.

I am sure that this process is more complex than I have described, but the Server Access Network (SAN) described here has several distinct advantages for Australia:

- Only when the page is 'refreshed' is it necessary to download internationally, radically reducing Australia's load on importing Internet data.
- The Inland server can respond very quickly because the travel distance is typically about one tenth that of downloads from the USA and Europe, Asia.
- The Inland servers' upload speed can really be maximised as the Servers will be virtually sitting on at least 1 Gb/s feeds into the high capacity inland IEN.
- Australian Federal Police (AFP) can really get their teeth into financial scams and other highly illegal activities (eg child porn) as the server images would be locally located, giving the AFP staff unprecented access to search and annihilate the predators.
- Because inland servers mirror international servers, this would present a highly competitive scenario where the cost of server hosting in Australia would drop to comparative lows to compete with internationally mirrored servers.
- Other nearby countries would look as a first choice to utilise the Australian mirrored servers instead of the more distant direct servers with severely restricted upload speeds. Differential costing based on now greater traffic flows out of Australia would make Australia a premium sever site and this moves Australian Internet into a profit centre.

There are many inland cities that have trained IT personnel that are looking for work in those areas in favour of working in major coastal cities. This inland industry would be financial boom for many inland cities and set them on the path to financial recovery and a general redistribution of the

population out of major capital cities into regional cities and towns. This will bring other professional Engineers, Doctors, Lawyers and Accountants back into Regional and Rural Australia.

Address the ADSL Attenuation Problems

Cancel All Metropolitan FTTNN Proposals

Earlier in this submission I pointed out that mid-point injection of ADSL signals creates an ADSL signal differential of typically 30 dB, so the mid-point ADSL signal has to be decreased by the same amount, and this totally cripples the speed advantage that would have been gained if it was not for other pairs in the same cable having lower ADSL levels. In a competitive environment, this would be chaotic, leading to a huge number of never-ending disputes from all sides.

Although FTTNN sounds like a great idea to speed up ADSL2+ by having closer DSLAMs to the premises, ***I am strongly suggesting that all FTTNN proposals be totally scrapped as soon as possible, and that Direct FTTH be the immediate future direction for all new and non-metropolitan areas, and HFC be the immediate future direction for all existing metropolitan areas.*** Both FTTH and HFC need to be immediately structured so they have "Open Access".

Phase Out 0.40 mm Pair Copper Cable

Earlier in this submission, I pointed out that for ADSL/2+ that 0.40 mm pair copper cable is good up to 2.6 km and after that distance, thicker cable (0.64 mm) needs to be run in place of the 0.40 mm cable if the minimum speed of 12 Mb/s download is to be achieved. Unfortunately 2.6 km covers only about 25% of the total urban population, so that means ***almost 75% of the current 0.40 mm cable in the CAN, is useless for FTTEN situations.***

It is for this reason that I am suggesting that ***with ADSL/2+ to immediately phase out all 0.40 mm pair copper cable in favour if 0.64 mm pair copper cable, wherever possible.*** In line with this, I am also suggesting that ***Direct FTTH is be the immediate future direction for all new and non-metropolitan areas, and HFC be the immediate future direction for all existing metropolitan areas.*** Both FTTH and HFC need to be immediately structured so they have "Open Access".

Phase Out 0.64 mm Pair Copper Cable

Earlier in this response it was proved that: ***virtually <u>no</u> "non-urban" telephony (Voiceband) physical pairs are OK for ADSL,*** and this affects a very high proportion of non-urban customers.

The reason for this unfortunate situation is primarily that 0.64 mm cable is more affected by the 'Skin Effect' than 0.40 mm cable, and consequently the attenuation at 300 kHz (and above) is proportionally more than it would be for 0.40 mm cable, thus forcing the thicker cored cable to have an attenuation figure for ADSL that is not so favourable.

One very short-sighted workaround is to: ***Engineer all future CAN that is capable of ADSL to have an attenuation at 300 kHz of less than 56 dB, and not base the specification on a maximum attenuation on 820 Hz as 6.5 dB.*** The problem with this approach is that with ADSL/2+ on this cable it will not reach the 12 Mb/s minimum download speed, so a much tighter specification is required.

A longer-term workaround is to: ***Engineer all future CAN that is capable of ADSL to have an attenuation at 300 kHz of less than 35 dB, and not base the specification on a maximum attenuation on 820 Hz as 6.5 dB.*** The advantage of this approach is that ADSL/2+ on 0.64 mm cable it will reach to about 4.9 km and satisfy the minimum download speed of 12 Mb/s.

Unfortunately most metropolitan areas do not have 0.64 mm cable in the ground, very few Regional areas have 0.64 mm and this comes down to Rural and Remote areas – and they usually have much

of their cables engineered for 6.5 dB at 820 Hz as a minimum loss, so a very low proportion of customers will be ideally located to take advantage of this philosophy.

Pair copper cable is not the way of the future – it was the way of the past, and that is why 0.64 mm pair copper cable needs to be phased out as soon as practicable, and be replaced with Direct FTTH or W-CDMA Radio/Wireless CAN in the near future.

Pairing Pairs to Extend Useful Length

Although pair copper cable is not the way of the (shorter-term) future, these cables are in the ground and will be phased out as soon as practicable. As stated above, in most cases pair cable is not quite suitable for ADSL to operate at 12 Mb/s to the majority of customers, because the cross sectional area is too thin, and this causes the attenuation to be too great – at too short a distance.

I have demonstrated that 'pairing' pairs results in about half the attenuation ad ADSL frequencies and this effectively can double the radial distance that ADSL can work (but with half the available pairs). As pair cable is being phased out of service, this leads to the possibility of there being a proportion of spare pairs in situ for some time that can be paired with other pairs to bring these services within ADSL specification.

I am therefore suggesting that paired cable be utilised as a temporary ploy to provide ADSL services within spec (over 12 Mb/s download speed) in urban (< 5 km with 0.40 mm) and rural (<10 km with 0.64 mm) situations where practicable, until this is replaced with Direct FTTH.

Introduce Direct FTTH to replace FTTN

Using a simple formula to relate customer line lengths as to the square of the radius, (by assuming consistent section/block land plots) it comes out that the average urban customer length is about 3.2 km, and that about 75% of all metro customers have line lengths exceeding 2.6 km (so these customers will not be getting ADSL as good speeds and these same customers will have the highest complaint rates). With this in mind, and knowing that the forward direction is FTTH, then it makes sense to replace the outlying customers CAN first and then work in towards the exchange.

While this approach may not be feasible because of full cable conduits, a reverse approach may be necessary in some areas to free up some of the nearer conduits by placing Optical Fibre runs in adjacent conduits and then pulling out the thicker pair copper cables to free up more conduits to then facilitate the rodding and roping of conduits to draw in cables for the outer CAN areas as soon as available.

Introduce Appropriate FTTH Technologies

Considerable extra fibres in the Customer Access Network need to be included from the exchange site to cater for occupancy growth. In the ATUG Conference 2008 [07], there was real concern that the per-customer traffic density would increase by at least 300% in the next few years.

*Install Direct FTTH technology, **not PON***

Even though Direct FTTH is slightly more expensive to install than PON, Direct FTTH has a definite distance advantage, occupancy / use advantage, simple maintenance advantage and provides the ability for "Open Access" to be made available for all FTTH customers, so that customers can change retail resellers without complications.

When Australia finally moves to FTTH, it is strongly recommended that Direct FTTH is the national technology of choice <u>and not to install any Passive Optical Network (PON) FTTH</u>.

In Urban situations, virtually all consumer customers are within 4.1 km of the local telephone exchange. Before the Broadband Internet use ramps right up to high occupancy, there is a few years where Passive Optical Network (PON) [27] technology could be used effectively (but this is

not 'future proofing'). PON is distance limited to about 6 km because the fibre is split at a footpath cabinet to feed either 1:16 or 1:32 customers off one exchange fibre. Such an increase in usage rates would cut the PON split down to 1:8 at the most, making PON FTTH a rather questionable technology to install in the first instance. ***It is for this reason that I am suggesting that Australia should Direct FTTH [27] in all CAN instances.***

In Non-Urban situations, virtually all customers are beyond 4 km of the local telephone exchange. These customers should only use Direct FTTH [27] technology or Wireless. The power budget in Direct Optical Fibre systems is such that 60 km is not that difficult, and most equipment should have no problems working over 20 km, depending on the sensitivities of the optical line transmission equipment.

Phase-Out ADSL and FTTN

This submission has also highlighted a few major flaws in utilising existing pair copper CAN for ADSL, primarily that if the minimum download speed of ADSL2+ is to exceed 12 Mb/s, then with 0.40 mm pair copper, the cable distance must be shorter than 2.6 km, which is about 25% of the available customers. "Metropolitan" areas as a rule do not use 0.64 mm pair copper, but if they did then at 4 km distance ADSL2+ could download as fast as 16.65 Mb/s.

Again, instead of making the infrastructure move to FTTH, competitive businesses have then opted for FTTNN (Neighbourhood Node) as another apparent least cost solution, and yet again this has been shown as another partial urban-based very short-sighted approach, that is fraught with operational and legal problems, and I have strongly suggested that all proposals for FTTNN be dropped / scrapped immediately.

The ACCC Telecommunications report has (correctly) reported the decrease of customers using the Fixed Access Network (FAN) for telephony, yet the number of customers using ADSL is on a rapid increase. It will therefore not be too long when there will be significant spare pairs in CANs and this submission has demonstrated how these pairs can be 'paired' to reduce their attenuation losses and provide significantly greater ADSL speeds – without resorting to rather expensive and competitively exclusive FTTNN (Neighbourhood Node) systems.

Instigate "Open Access" HFC

This submission has also highlighted the fact that HFC CAN passes almost every premises in all metropolitan areas, and the infrastructure is in place to connect these customers to Broadband Internet, utilising an "Open Access" approach where retail resellers could be involved.

While this technology is not the fastest on the planet, it well exceeds 12 Mb/s, it is in situation and being severely under-utilised, and it has a life expectancy of about five years from now, and by then HFC will be replaced by Direct FTTH.

I am therefore suggesting that wholesale interfacing of the HFC be immediately structured to facilitate "Open Access" and retail resellers should be given every opportunity to market this product in all metropolitan areas – in preference to ADSL technologies.

I am also suggesting that all future HFC Broadband Routers be brought up to DOCSIS 3.0 specification (from DOCSIS 2.0), as the later specification enables 'channel bonding' for much faster download speeds (eg 120 Mb/s), and a much wider upstream channel so that upload speeds that will enable high definition videoconferencing.

Train Field Staff with Optical Fibre Expertise

Considering that we will have about 10 M FTTH services to replace the current in-ground cable systems, and assume that each service will take about 4 man-hours (on average) to install and

commission, then this works out at about 40,000,000 man hours. This does not take into account cable / equipment recovery, which would possibly be about 0.5 man-hours per customer on average.

Assuming there are about 250, 8-hour man-days per year, this works out at about 2000 hours in a year per man, so the FTTH work will take about 20,000 man-years to install and commission!

If this work is to be done within say five years then Australia needs a full time Optical Fibre trained workforce of at least 4,000 staff; over and above the current telecommunications workforce, and I do not believe that TAFE has the facilities to train these staff in the next 24 months, and get them up to speed as a high priority.

I am therefore suggesting that TAFE be involved in the early stages to get their expertise on the ground and running in all states and territories, so that they can meet this challenge successfully. Further there will have to be a recruitment drive to bring the next generation into these TAFE courses to skill them as a priority.

Fixed or Mobile Telephone as an Essential Service

In Australia, we appear to have more mobile phones than we have population – or so it seems! We also have about 10 M fixed access telephones (in a population of about 21 M). With the imminent change of telephony from fixed access to mobile access it makes common sense to provide customers on fixed access services with mobile phone services as direct replacements (particularly while the pair copper CAN is being pulled out and being replaced with FTTH).

This approach gives Telstra or whomever the chance to get the right Broadband Internet technology installed and properly commissioned before handing back over to the customers.

I am therefore suggesting that the Fixed Access telephone be put on a par with Mobile Access telephones and that either can suffice as an essential service.

Conclusion

In this submission I have briefly summarised what I consider to be the current telecomms scenario in Australia and this submission includes some seemingly unconventional suggestions for the Expert Committee to consider and hopefully favourably recommend so that Australia's telecommunications industry can advance from the competitive rut that it is in where USO funding for more than 20 years has simply maintained the status quo for differential telecommunication service standards in metropolitan and non-metropolitan areas.

Malcolm Moore JP BE(Elect.)
PO Box 147
Turramurra NSW 2074
Australia

P 02 9440 0541
E mmoore@bigpond.net.au
W www.moore.org.au

Appendix 1

Savings Due to Improved Technologies

Timeframe	Base Year	From Technology	To Technology	Service / Bandwidth Improvement Ratio	Technology Area	% Tech. Area Affected	Technology Cost Savings / Bandwidth Improvement (%)	Technology Accumulative Improvement Figure %
1995-1995	1995			1	All	100		120.12
1995-2000	1996	PDH	SDH	2	IEN	20	10.00	108.11
1995-2000	1997	Dial IP on Cu pair	ADSL IP on Cu	2	CAN	15	7.50	**100.00**
1995-2000	1998	HFC (Pay TV only)	HFC with Internet	1.8	CAN	20	8.89	91.11
1997-2002	1999	SDH STM-1	SDH STM-4	4	IEN	20	15.00	77.44
1999-2004	2000	SDH isolated	SDH with SCN	1.5	IEN	40	13.33	67.12
2000-2005	2001	ADSL iosolated	ADSL with OOB	1.3	CAN	30	6.92	62.47
1998-2003	2002	ISDN (2 Mb/s)	VCTS (155 Mb/s)	50	CAN	5	4.90	59.41
2000-2005	2003	CCS7	CCS7 on IP	4	IEN	35	26.25	43.82
2000-2005	2004	Digital Switching	IP Routing/Switching	3	IEN	40	26.67	32.13
2002-2007	2005	GSM	CDMA	1.5	CAN	30	10.00	28.92
2003-2008	2006	ADSL	ADSL 2+	1.5	CAN	8	2.67	28.15
2005-2010	2007	HFC with Internet	HFC dig TV	1.4	CAN	20	5.71	**26.54**
2005-2010	2008	HFC with Internet	HFC with Broadband	4	CAN	20	15.00	22.56
2005-2010	2008	1 Gb/s OF	10 Gb/s OF	10	IEN	10	9.00	20.53
2005-2010	2009	STM-4	STM-64	16	IEN	10	9.38	18.60
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The above excerpt of the associated Excel Spreadsheet shows that over several years, replacement technologies have caused massive bandwidth improvements, and/or greatly reduced maintenance overheads in specific technology areas (simplified into Customer Access Network – (CAN) and Inter-Exchange Network (IEN)), together with a minimal extra purchase costs – and in some cases much cheaper. These savings / benefits have been calculated to give a percentage savings / bandwidth figure totally based on changed technologies and excluding competition.

With 1997 as the base date these savings have then been multiplied on each other to give an accumulative improvement figure normalised at 100.

By 2007, the normalised technology accumulative improvement figure is 26.54. The means that due to replacing end of life cycle technology with new technology, the network utilisation gains and overhead cost reductions had reduced the end-user / overhead costs by 73.46%.

These figures seriously challenge the philosophy that competition is the prime reason for improved business performance. Many economists will remain highly sceptical of these figures as this philosophy does not sit comfortably with what they had been taught. The painful problem for these (brainwashed) economists is that these figures are reasonably traceable and these figures do therefore do have a solid basis to stand by themselves. That then brings into very serious question the validity of figures bandied about to praise competition.

The natural approach is to disbelieve the savings due to replacing end of life technologies with new technologies, and an easy way to do this is to ‘discount’ the technology figures so that they become far less significant. This is radical – but we are trying to save the faces of thousands of so-called eminent economists that have made their living through praising the unquestionable virtues of the Competitive Regime!

Let us assume that the gains through technology advances are double overstated and therefore the technology-based figures should be reduced by 50%. This would give the eminent economists some face:

Base Year	From Technology	To Technology	Technology Cost Savings / Bandwidth Improvement (%)	50% Discounted Savings	Technology Accumulative Saving
1995	0	0	0.00	0.00	109.36
1996	PDH	SDH	10.00	5.00	103.89
1997	Dial IP on Cu pair	ADSL IP on Cu	7.50	3.75	**100.00**
1998	HFC (Pay TV only)	HFC with Internet	8.89	4.44	95.55
1999	SDH STM-1	SDH STM-4	15.00	7.50	88.39
2000	SDH isolated	SDH with SCN	13.33	6.67	82.49
2001	ADSL iosolated	ADSL with OOB	6.92	3.46	79.64
2002	ISDN (2 Mb/s)	VCTS (155 Mb/s)	4.90	2.45	77.69
2003	CCS7	CCS7 on IP	26.25	13.13	67.49
2004	Digital Switching	IP Routing/Switching	26.67	13.33	58.49
2005	GSM	CDMA	10.00	5.00	55.57
2006	ADSL	ADSL 2+	2.67	1.33	54.83
2007	HFC with Internet	HFC dig TV	5.71	2.86	**53.26**
2008	HFC with Internet	HFC with Broadband	15.00	7.50	49.27
2008	1 Gb/s OF	10 Gb/s OF	9.00	4.50	47.05
2009	STM-4	STM-64	9.38	4.69	44.84

Yet again these 50% technology discounted figures speak for themselves and they show that technology replacements still far exceed the gains made by competition and now this is getting embarrassing! *Can the truth come out?* By cutting the 50% discounted figures by another 50% - the technology based cost reductions should appear as miniscule!

Base Year	From Technology	To Technology	Technology Cost Savings / Bandwidth Improvement (%)	75% Discounted Savings	Technology Accumulative Saving	Technology Accumulative Saving %	Claimed Competitive Saving %
1995	0	0	0.00	0.00	104.52	-4.52	
1996	PDH	SDH	10.00	2.50	101.91	-1.91	
1997	Dial IP on Cu pair	ADSL IP on Cu	7.50	1.88	**100.00**	**0.00**	**0.00**
1998	HFC (Pay TV only)	HFC with Internet	8.89	2.22	97.77	2.23	3.00
1999	SDH STM-1	SDH STM-4	15.00	3.75	94.11	5.89	5.91
2000	SDH isolated	SDH with SCN	13.33	3.33	90.97	9.03	8.73
2001	ADSL iosolated	ADSL with OOB	6.92	1.73	89.40	10.60	11.47
2002	ISDN (2 Mb/s)	VCTS (155 Mb/s)	4.90	1.23	88.30	11.70	14.13
2003	CCS7	CCS7 on IP	26.25	6.56	82.51	17.49	16.70
2004	Digital Switching	IP Routing/Switching	26.67	6.67	77.01	22.99	19.20
2005	GSM	CDMA	10.00	2.50	75.08	24.92	21.63
2006	ADSL	ADSL 2+	2.67	0.67	74.58	25.42	23.98
2007	HFC with Internet	HFC dig TV	5.71	1.43	**73.51**	**26.49**	**26.26**
2008	HFC with Internet	HFC with Broadband	15.00	3.75	70.76	29.24	28.47
2008	1 Gb/s OF	10 Gb/s OF	9.00	2.25	69.17	30.83	30.62
2009	STM-4	STM-64	9.38	2.34	67.54	32.46	32.70

The bold numbers in the above table appear to tell the story that internationally a massive lie in economics has been promulgated for some decades. Even with discounting the technology based gains by an enormous 75% the result still comes in at about equal to that claimed by the competitive regime. In this bad-case scenario, the technology-based gains easily account for the apparent gains claimed by eminent economists who have praised the competitive regime.

With the situation now clearly showing that technology-based service gains are real and very substantial, and are reasonably accountable (and this is a short list), then the Technology Accumulative Improvement Figure of 100:26.54 as given in the first table is highly realistic. In direct contrast, the Competitive Accumulative Improvement Figure is (100 – 26) or 100:74. In other words, the Competitive Regime can claim a mere 26% while the Technology / Infrastructure Regime can claim 73.46% reduction in end-user costs and/or improved network capability over the same timeframe.

It is now very clear that through using the Infrastructure Regime, the overhead costs would have dropped by 73.46%, but the Competitive Regime have let the overhead costs drop by only 26%, and we know that all of this is entirely due to savings through technology replacement.

So in other words ***there is direct inflationary pressure caused by the Competitive Regime in the order of 185% over the 10-year period, or at least 10.8 % per year/ per year inflation*** **–** not negative 3% per year / per year inflation as claimed by the then Minister of Telecommunications, IT and the Arts (Helen Coonan) in her speech at the Press Club in 2007. The difference is almost 14% per year/per year and this is huge, and cannot be ignored **–** no matter how embarrassing it is.

It is now very clear that the Productivity Commission will need to completely revise its philosophy to factor in technology changes as the major reason for telecommunications productivity and not competition. The Productivity Commission will have to comprehend that telecommunications infrastructure operating in a Competitive Regime is extremely inefficient and not highly efficient as taught in schools and universities.

This revision in philosophy could radically change the direction of the Productivity Commission to drop the Competitive Regime in relation to telecommunication infrastructures and quickly adopt the Infrastructure Regime. This finding will have direct implications to the Trade Practices Act; particularly with those sections involving telecommunications infrastructure – and competing infrastructure businesses like Optus, Orange, Soul, Vodafone, Macquarie, Telstra etc.

Telstra may have to be split into two separate bodies Telstra (infrastructure) and Bigpond (retail reselling), and competing telecommunications businesses with infrastructure could be then coerced by the ACCC to sell their infrastructures over to Telstra and become competitive resellers (on a level playing field)! I believe that is the school definition for competition.

The simple results from my brief calculations may have a knock-on effect that puts the ACCC in step with infrastructure business, so it should then protect Telstra (infrastructure) from national and international competitive predators, while fostering robust competition between wholesale resellers /retailers.

This strategy suggested above would be excellent for all Australians and Australian business, including the equities markets.

Acronyms

3G	Third Generation (Digital Mobile) technology
ACCC	Australian Consumer and Competition Commission
ADSL	Asynchronous Digital Subscribers Line
ADSL2+	ADSL Version 2+
ARCS	Analogue Radio Concentrator System
ATM	Asynchronous Transmission Mode
Backhaul	Inter-Exchange Network
CAN	Customer Access Network, one sub-component of the PSTN (see IEN)
CCS7	Common Channel Signalling
CDMA	Code Division Multiple Access
Direct FTTH	Fibre from the Exchange to the Home/Premises as a direct link
DTMF	Dual Tone Multi Frequency
DRCS	Digital Radio Concentrator Systems
DSLAM	Digital services Line Access Multiplexer
FAN	Fixed Access Network (nominally pair copper)
FDM	Frequency Division Multiplex
FTTH	Fibre (from the Exchange) to the Home (or Premises)
FTTP	Fibre (from the Exchange) to the Premises (or Home)
FTTN	Fibre (from the IEN) to the (DSLAM) Node
FTTEN	Fibre (from the IEN) to the (DSLAM) Node (in the Exchange building)
FTTNN	Fibre (from the IEN) to the (DSLAM) Node (in the Neighbourhood)
GSM	Groupe Speciale Mobile (a Digital Mobile Phone technology)
HCRC	High Capacity Radio Concentrators
HFC	Hybrid Fibre Coax
IEN	Inter-Exchange Network, the other sub-component of the PSTN (see CAN)
IP	Internet Protocol
ISDN	Integrated Digital Services Networks
ISP	Internet Service Provider
MAC	Media Address Control
MAN	Mobile Access Network
MPLS	Multiple Protocol Language Switching (MPLS)
PDH	Plesiosynchronous Digital Hierarchy
PON	Passive Optical Network
PON FTTH	Fibre to the Home through a shared optical fibre link
Pri-ISDN	Primary Rate - Integrated Digital Services Networks
PSTN	Publicly Switched Telecommunications Network, previously: Publicly Switched Telephony Network
SMOF	Single Mode Optical Fibre
SDH	Synchronous Digital Hierarchy
W-CDMA	Wideband W-CDMA

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