The Six Network Structural Levels

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Introduction

This might sound like an advertisement for make-up or a list of sins, but it really is the realisation that within the telecommunications and information technology (ICT) infrastructure, there are several distinctly different interfacing network structures that are effectively in sedimentary structured layers (much like lasagne). These network structures perform different functions and are usually geographically structured to maximise network functionality.

In simplistic terms there are three levels or layers of ICT networks, the premises network, the access network and the backhaul (or inter-exchange / switch) network. What is not obvious is that there actually four levels within the inter-exchange / switch (or backhaul) network structure, and it is all too easy to dismiss this network as a homogenous network because of inexperience with this relatively complex structure.
Most network providers and users – be they major or minor carriers, all businesses and all homes have some sort of an ICT network and some (or all) of the network levels described here. The purpose of this article is to identify these network structures for what they are!

1 - Customer Premises Network

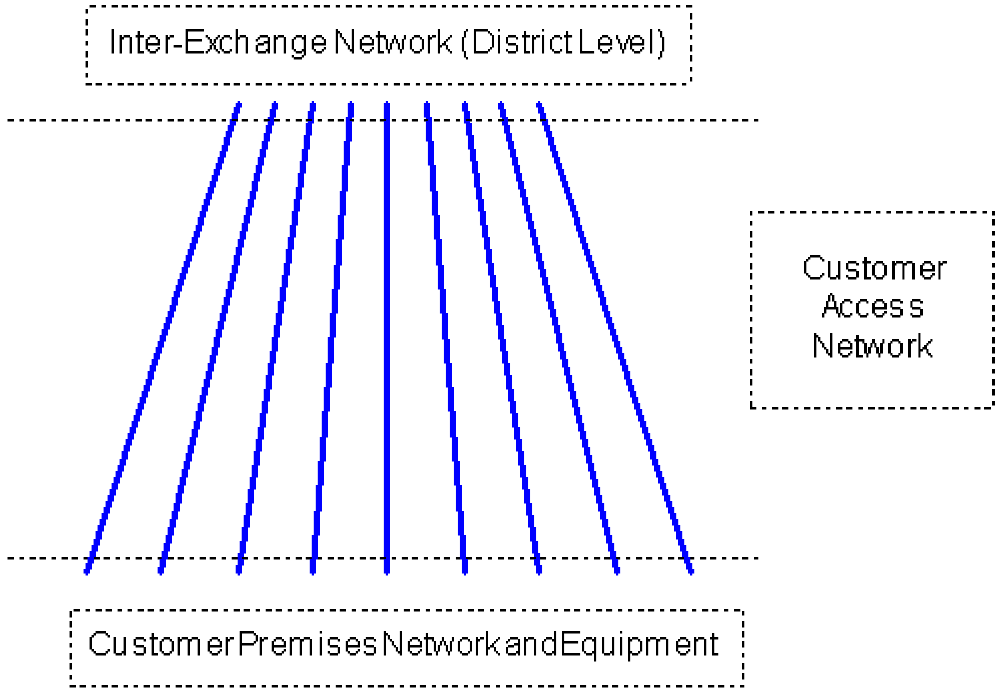
This network consists of the connections between and for the phone/fax, audio and television/CATV, data/Internet/computer, security and intercom wiring. It is a wide range of facilities depending on the premises use, but it is a time convergent network, that is most of these facilities in premises are standardising in form.

In businesses, the standard form of terminating is on a main distribution frame (MDF) with all external connections firstly appearing here then wired to where the associated equipment is through the Premises Network. For phone/fax, data/Internet/computers, and CATV this is already commonplace with external wiring coming to common interface points then feeding to translation equipment (eg premises based modems, routers and switches for Internet/computers, PABX/routers for telephony, and splitters for television. With Home Theatre the wiring process is slightly different, with most wiring (network) coming to a common facility switch/amplifier.

In most cases the business wiring takes the form of a Local Area Network (LAN) providing the physical level of connection to computers, phones, printers etc via LAN Switches and Routers running the Internet Protocol suite.

2 - Customer Access Network

The Customer Access Network (CAN) is very different from the other five network structures, as it is external to the internal telecommunications structure and it connects from the Customer Premises Network (CPN) to the Inter-Exchange Network (IEN).

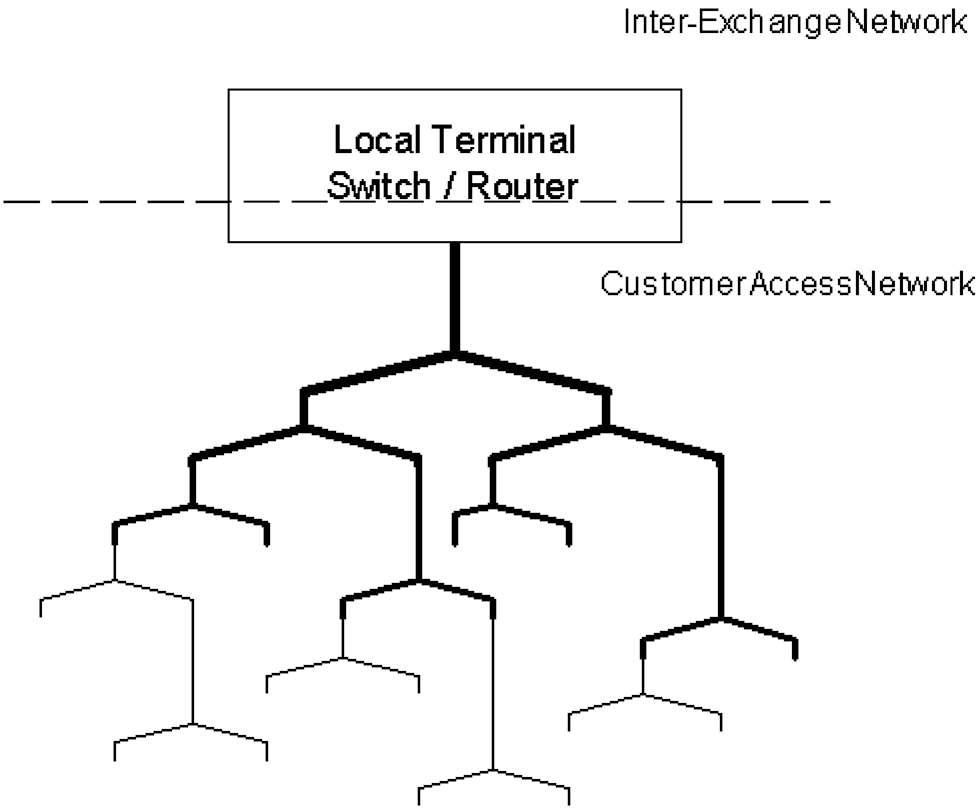


Some of this Customer Access Network (CAN) is highly visible because some parts of these CAN structures are not underground. A few examples are the overhead telephone wire lead-ins to many homes in older suburbs and most country towns; the relatively thick Hybrid Fibre Coax (HFC) cables that are slung under overhead power lines in all capital cities for Pay TV, and multiple arrays of Mobile Base Station (MBS) antennae on building sites and on communications towers. Almost all the rest of this network is not visible as it is either underground in trenches/conduits.

If the Customer Premises Equipment (CPE) is connected to a fixed (customer) access network, then this network will usually be copper pair wire in a cable for telephony, and/or Internet, or coax cable for Pay TV and/or Internet. If the customer is a corporation in a CBD, then most likely the CAN will be Optical Fibre.

If the Customer Premises Equipment (CPE) is connected to a mobile (customer) access network, then this network will usually consist of a radio connection to the customer equipment from the Mobile Base Station (MBS) antennae, and either optical fibre or point-to-point radio back to the Inter-Exchange Network. If the Mobile Access Network is operating in the major metropolitan areas, then it will usually be running in the 1.8 GHz area of the spectrum because the effective distances are shorter and the user density is much greater. If the Mobile Access Network is operating in regional and remote (country / non-metropolitan) areas, then it will usually be running in the 850 MHz area of the spectrum because the effective distances are much longer and the user density is much smaller.

The structure of the CAN is essentially a physical star network from each Local/Terminal exchange site to the customer premises equipment (and that equipment can be fixed or mobile). This is not a switched network; it is simply a direct connect structure.



The figure above gives a visual of how cables that leave a Local Terminal site start off quite fat (for example 800 pairs in one cable), and are joined with smaller cables and finally 2-pair (quad) feeding off to households.

Ideally the Customer Access Network (CAN) is a full service network that is capable of true bi-directional Broadband IP and CATV and to do this the current copper pairs need to be replaced by optical fibre, as copper pair technology is totally unsuitable for true Broadband Internet because of severe distance and bandwidth limitations, as copper pair cable in the CAN was originally engineered only for Voiceband applications.

The introduction of ADSL (Asymmetric (directional data speed) Digital Subscribers Line) technology on copper pair has really pushed the physical limit of the existing copper pair cable technology. Even copper pair in CBD situations using any form of DSL is being pushed to its physical limits on these short distances! The application that will kill ADSL will be video conferencing, because the upstream channel is so slow, Video Conferencing will be the achillis heel (speed bottleneck) that has already made ADSL an instantly obsolete technology by 2008.

The structure of HFC also follows a similar pattern with optical fibre feeding out from headends, connecting with remote Coax headends that run 'past' houses where amplifiers and splitters keep the power levels reasonably constant. In the old days of Pay TV before Cable internet, the cable could run 'past' houses and they could be considered potential customers, as all that would be required would be a feed from a pre-positioned splitter. Since 1995 with the introduction of Cable Internet (which needs considerable IEN infrastructure to function), 'passing homes' was no longer a realistic measure. In any case, because the upstream channels are so slow, Video

Conferencing will be the achillis heel (speed bottleneck) that has already made Cable Internet an instantly obsolete technology by 2008.
Copper pair technology will have to be phased out in the very near future and be replaced by Optical Fibre To The Home (FTTH) for fixed access and Wideband Code Division Multiple Access (WCDMA) radio for mobile access in all situations in Australia. Whether the OF is a point to point (star) structure or a PON (tiered-star) structure is largely up to the demographics of the customer area. In rural and remote areas point-to-point radio (for true Broadband Internet only) is an obvious choice over the cost of trenching optical fibre up to 50 km.

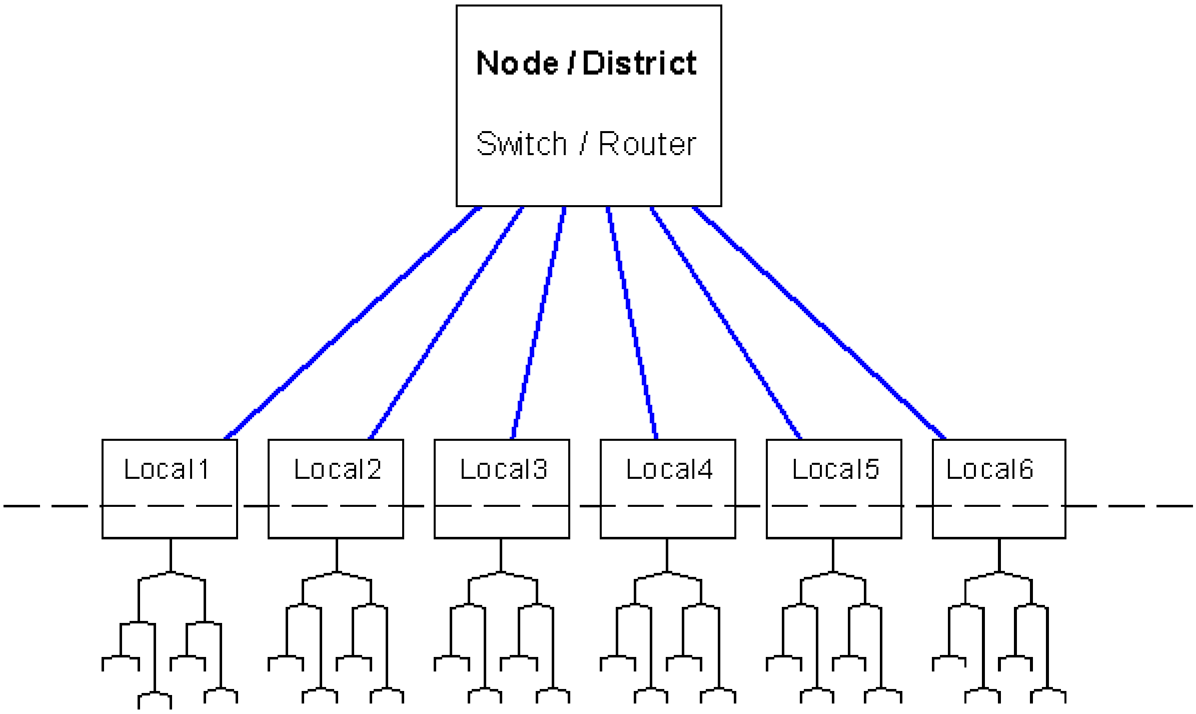
The need for satellite based access networks in Australia is virtually eliminated by including sufficient regional and district network infrastructure. Also, the metropolitan-based HFC cable network becomes obsolete with FTTH and WCDMA, and then this HFC eyesore can be removed.

These next four transmission network structures all go together to form a composite mesh ***Inter-Exchange Network (IEN)*** (or Core Network) which consists of alternate layers of transmission systems and switching/routing systems.

The concept of the ***Public Switched Telephone Network (PSTN)*** has long gone by 1965.

3 - District Network

The centre or hub of a district network is the Node Switch / Router and it is this switch / router that provides the digital signalling interface to control the local switches / routers.



This is a visual of a simple District Network where there is one District Node Switch / Router that connects through a number of transmission systems (shown as a thick blue line) to a number of Local / Terminal Switches / Routers. Below the dotted line is the CAN - shown figuratively as a cable splitting off to thinner cables as it nears customer premises. Most non-metropolitan District networks are similar in structure as this (with only one District Node).

The Local Exchange Switch / Router site has a demarcation point (usually the Equipment side of the Main Distribution Frame - MDF) that is the interconnect point between the CAN and the IEN.

With telephony; immediately beyond the demarcation point, the customer-based signalling (Dual Tone Multi-Frequency - DTMF, Pulse Dialling, Ring Down, Loop Disconnect etc), is translated to network-based signalling (Channel Associated Signalling - CAS etc.), and the Local Switch identifies the Line Interface aligned with that customers Full National Number (FNN).

For originating calls; the Local/Terminal switch makes a connection through to the Node switch and Dial Tone is generated from the Local switch to tell the customer it is ready to receive dialling data. The Node switch then stores the dialled data and sends a series of request messages through Common Channel Signalling No7 (CCS7) network to the SSP to establish a voice path through the IEN to the distant end Node switch

For terminating calls, the Node switch responds to the CCS7 and identifies through the associated Local / Terminal switch that the called customer is not 'busy', then responds via the CCS7 network. If the called customer is busy then the call can be re-directed immediately, else the Local / Terminal switch will send out Ring Current to alert the called customer, and when they answer the channel connection is opened and the customers can then talk.

Depending on both customers access - be it fixed or mobile, the network signalling determines call cleardown mode and the call is cleared down immediately the customers have finished (mobiles have first party release). The CCS7 mesh network also manages the metering and network availability / congestion etc.

With ADSL Internet: The Digital Service Line Access Multiplexer (DSLAM) sits in the edge of the IEN and provides Broadband ADSL over the Voiceband used by the telephony-engineered cables in the CAN. (The filters of the DSLAM sit in the CAN).

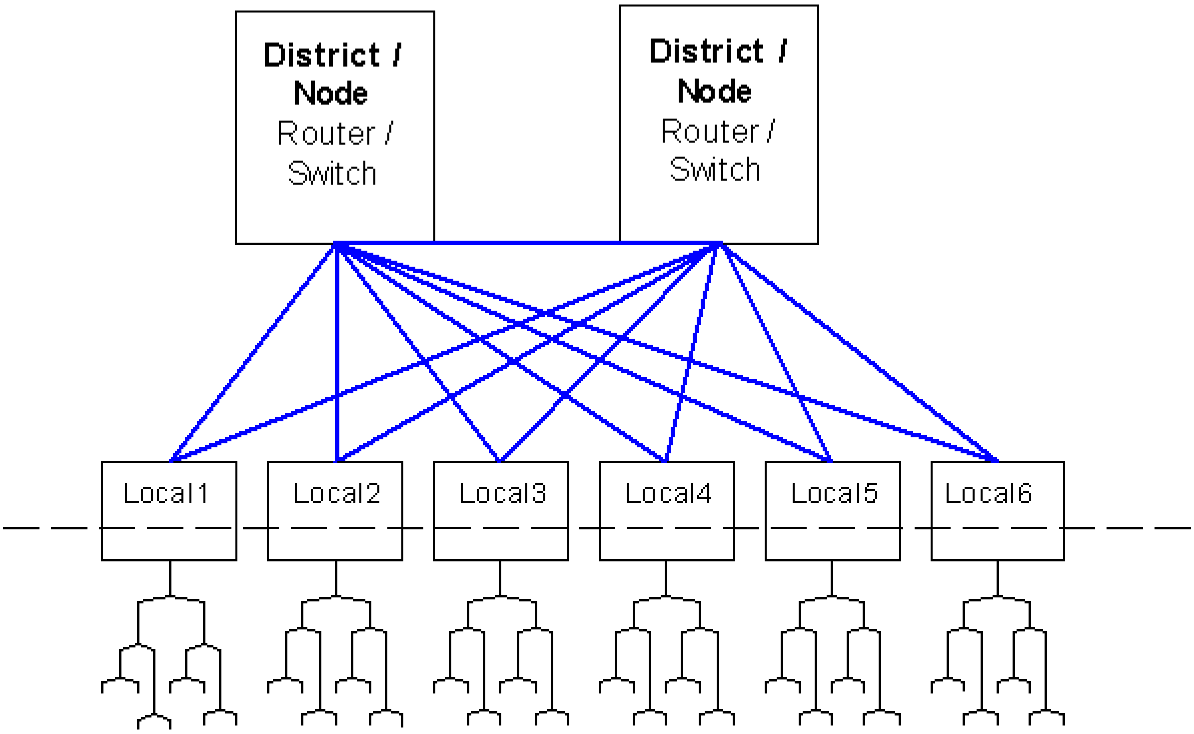
Most ADSL equipment now use optical fibre for 100BaseF or 1000BaseF - fed from the Node-based router (in the District Network); or 100BaseT, or 1000BaseT Ethernet (also in the district Network) from a local Node-based router.

In non-metropolitan regions, data transfer to DSLAM Equipment is far more difficult, because of the distances involved and the data streams have to be transported by SDH systems; not simply physical optical fibre pairs. Anyway - consider that ADSL is already obsolete!

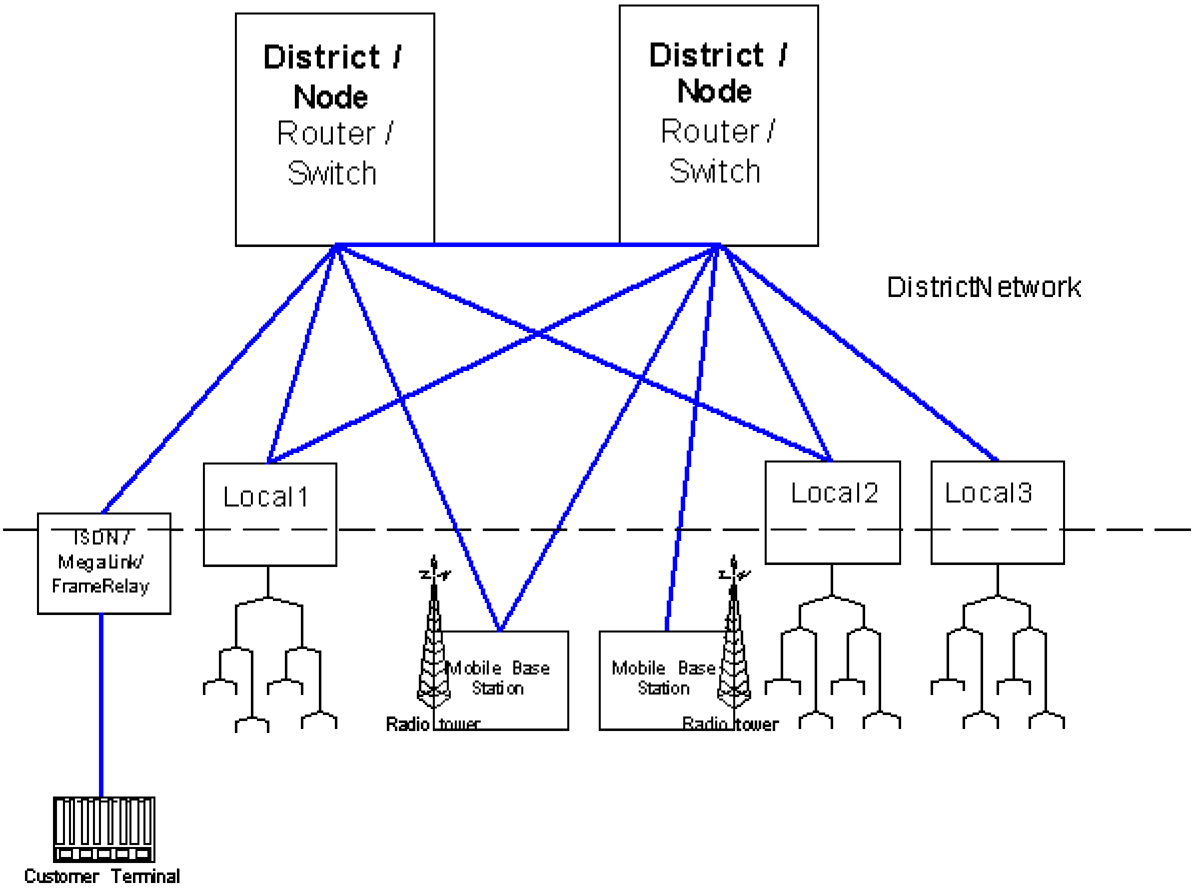
With Cable Internet: In a similar fashion to DSLAMs, the Universal Broadband Router sits on the edge of the IEN (Core Network) and provides TV Equivalent channels for downstream Internet and narrowband channels for upstream.

With the growth of Cable Internet since 2000 the 'single headend per capital city' solution for Universal Broadband Routers (that talk to home-based cable modems) was no longer practical and one very large Australian Telco has made a concerted effort to decentralise the headends and Universal Broadband Routers (uBR) into Node exchange sites. These uBRs now connect with 1000BaseT to nearby Node routers (that are also be capable of feeding DSLAM Routers, and FTTH router/switches)

Cable Internet beyond major metropolitan cities is commercially impractical because the HFC is not there and the distances from the parent nodes will require major SDH transmission systems - and HFC is about to reach its use-by date in 2008 because Video Conferencing requires high speed bi-directional Internet.



Ideally, District networks are essentially dual centred star optical fibre (and point-to-point radio) networks from District centres to Local /Terminal exchange switching sites via diverse geographical routes. The purpose is that this network provides at least dual parenting to every district/local switch/router so that in the bad case scenario the transmission capacity is halved, not lost.

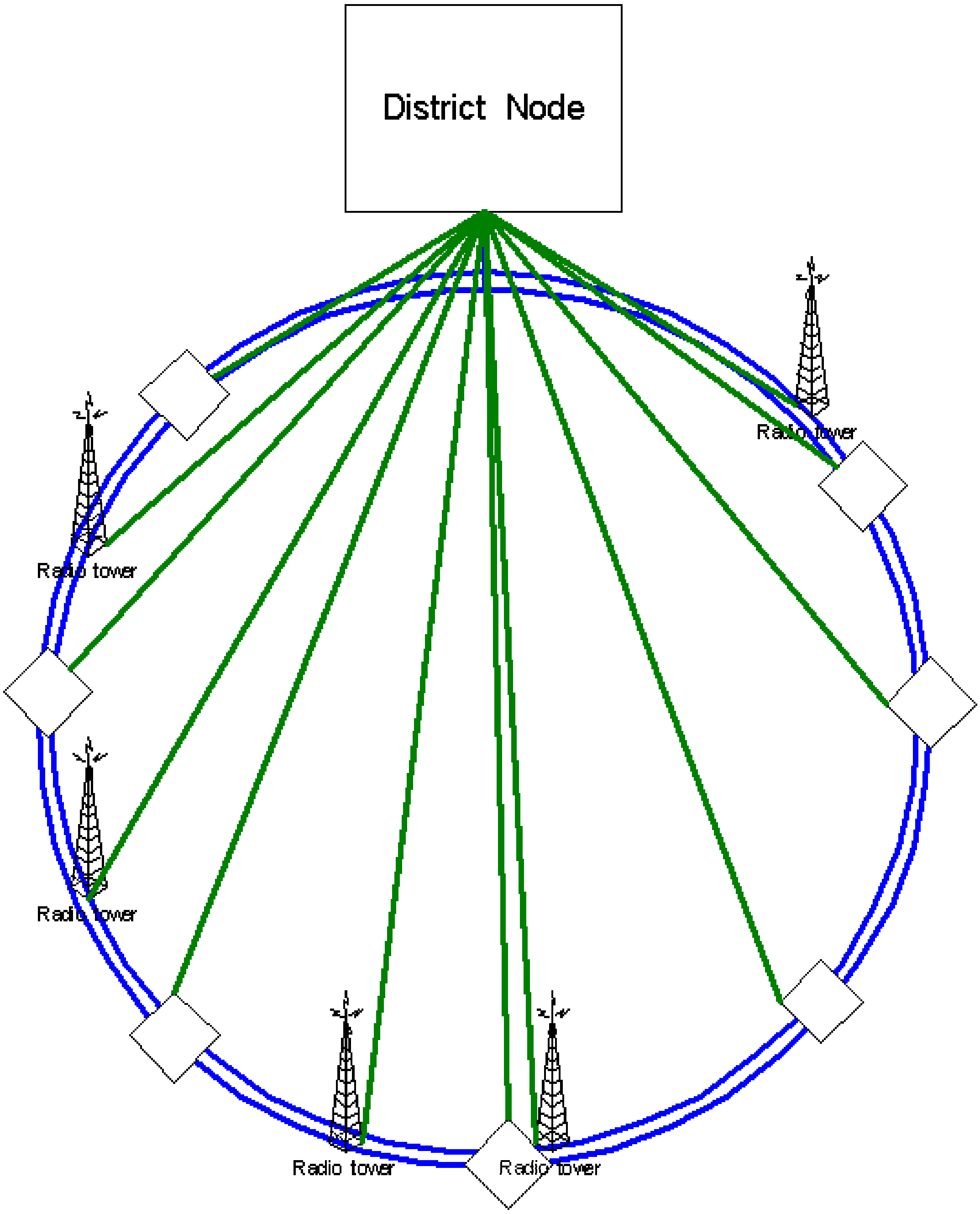


This is a diagrammatic visualisation of a District network connecting with ISDN / MegaLink / Frame Relay / Customer Wideband services, Local Terminal exchanges and Mobile Base Stations. It is only representative, but it shows links to various CAN interfaces connecting through into the District network.

In Australia, almost all metropolitan networks are this structure, and the transmission links (shown in thick blue lines) are almost all physical optical fibre pairs that have virtually replaced copper pair 'junctions'. (The term 'junctions' meant a transmission path that joined to the next switching stage at another switching site. This term probably had its origins from the switching install/maintenance areas - who basically saw the switches being 'joined' by copper paired cable and not understanding that the cable is actually a transmission system.)

In non-metropolitan areas, the distances are often too far for physical optical fibre and it is necessary to include optical fibre (and/or radio based) SDH rings as the transport bearers. The next generation of transmission equipment for non-metropolitan District networks will move towards SDH rings probably running STM-16 (1.2 Gb/s) with Multi Protocol Language Switching (MPLS) as the more common transmission protocol.

These SDH-based rings can vary from about 10 km to 400 km in length and while some will be flat to pick up one or two Local/Terminal switches and or Mobile Base Stations, some will tend to be orbital and pick up several Local/Terminal switches and several Mobile Base Stations. The orbital loop will not represent a 'star' network - but the connections from these switches and bases will represent a star (and this concept takes some time to come to terms with)!



This diagram tries to explain the paradoxical structure where the Blue Rings represent the physical SDH system on a pair of Optical Fibres forming a ring, (with Network Elements along the path); but the configuration of the SDH system in this case is a simple star with every network element being terminated at the District Node site.

The hidden advantage of SDH-based rings is that if there is a break in a part of the SDH network, in most cases, there is enough redundancy built in so the whole network can automatically re-configure itself in a few milliseconds and keep running without falling over.

With impending VoIP and Video-Conferencing becoming standard services on true Broadband Internet, all District Networks need to be considerably thickened (or hardened), and the local switches need to be changed over from telephony only to VoIP interfacing the new optical/digital CAN (fibre to the home - FTTH) in most cases, and Wideband Code Division Multiple Access (W-CDMA) that is 3G mobile for the rest, as soon as humanly possible.

In the CAN, ADSL will become immediately obsolete as FTTH is installed, and FTTH is highly integrated between the CAN and Node in the Local optical interface, and competitive duplication of this network infrastructure would be extremely cost-expensive and very wasteful.

Pay TV / Internet via distributed HFC is another poor choice for future CAN technology (although much better than ADSL). Even though the newly constructed distributed District network has been well structured with almost 100 nodes being recently installed in every major capital city (2007) to cater for future Internet requirements; the upstream (backward) channel is very slow in comparison to the downstream data rate. Internet-based Video Conferencing which will be the next killer application in 2008 and HFC CAN will be a major casualty.

Since 2000 there has been a concerted effort in removing telephony based switches and replacing these with IP-based switch/routers. The ideal conversion location will be District Node exchange sites, as these are the CCS7 Switch terminating Point (STP) interface. With this move all telephony, data and Internet will be transported by IP, under MPLS, and the packing density of VoIP can be closely controlled in the network that is prioritised for VoIP as the latency delay is critically small (not so for data)!

With this structure, the District Node exchanges will accept the originating call (from the dialling customer), and pass the called number to the STP which will analyse the route availability to the distant District Node and then prioritise a virtual path to the required District Node, where that District Node will direct the terminating call to the called numbers equipment interface (Line Access Card, Mobile Base Station, Recorded Voice Announcement, Intelligent Voice Responder etc.).

The big advantages are that the IP network can handle both incoming and terminating call directions equally well (not possible with telephony switched equipment), the call density can be significantly thicker, path routing is determined by traffic densities far more dynamically than with the almost static call routing structures used in telephone traffic - and Internet traffic can travel alongside too. This if course is too good to be true and the drawback is that VoIP requires priority switching over data so that the datagrams both keep their order and don't get 'lost' (unreasonably delayed) - and one way to make this work is to have a thick network prioritised for telephony (Voiceband) transmission.

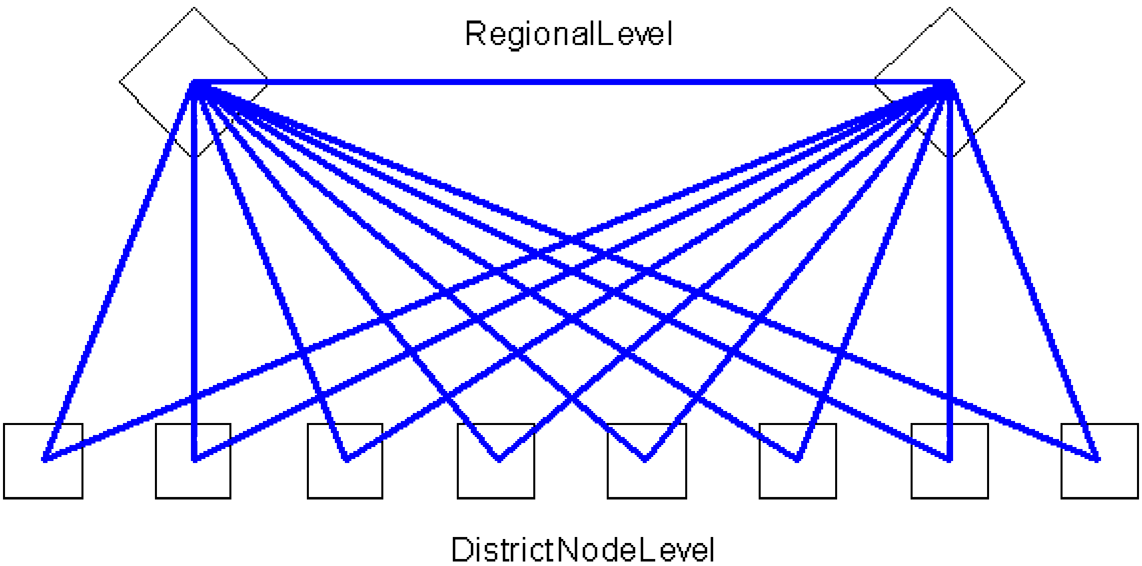
In non-metropolitan areas this District Network I believe that the IEN structure is generally thin and there is very little cross connection between District / Node switches as most of the cross connections happen at regional switches, without diverse regional routing and is incapable of true Broadband Internet applications and I believe this part of the IEN is currently really struggling to carry the ADSL based Internet Broadband payloads in 2007. Not only do the Local / Terminal switches need to be changed over to optical fibre interfacing instead of copper pair interface, but also CATV interoperability needs to be included through this level of the IEN beyond metropolitan areas into solid Regional Networks.

4 - Regional Network

In many cases this layer of switching and transmission is a 'phantom layer' as it either simply does not exist, or it is so thin that it appears on the side of direct links from district switches connecting to Main / Primary switches in the National network grid. Ideally, this is a series of large/regional interconnecting SDH-based rings consisting of highly redundant optical fibre (and/or radio links), where each region would have its own SDH managed ring (or more) and these rings connect Internet (and telephony) using MPLS and SDH to the District Node switches through the regions. These transmission rings would typically have a circumference of 100 km to 1000 km, and would digitally cross-connect at some centres so that this structure can provide alternate transmission paths between capital cities - if and when required.

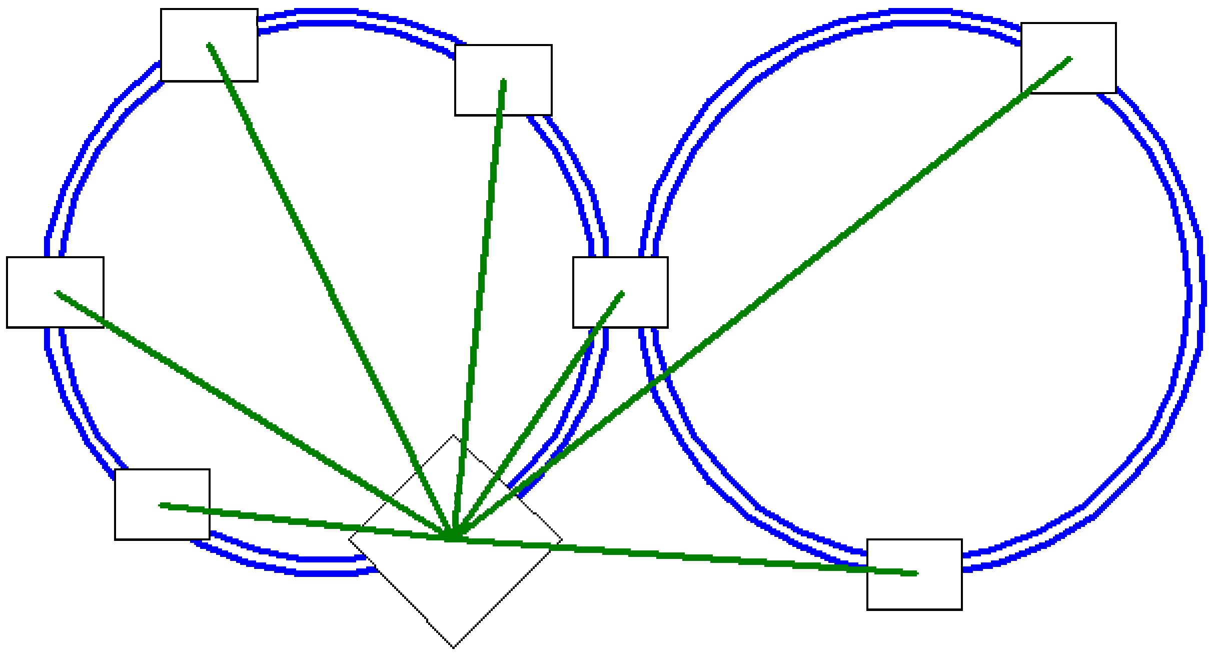
to the associated national network forming a highly redundant transmission network. In emergencies, the regional rings are used for national traffic, and provide a highly geographic and robust diverse path routing.

Each District Node switch in a Region should have at least two diverse geographic paths through the SDH-based rings to the Regional switch pair, and at this level (above the district Nodes, all Voiceband traffic should be converted to IP from G.703, A Law PCM to maximise the bandwidth usage and provide alternate IP routing if a network hit happens. from the regional cross connect switches so that if one path is suffering poor throughput, the alternate path can carry the load with minimum degradation.



The general structure of networks at the Regional level look like this (above) where each District Node is connected directly with the Regional Switch/Router, and the Regional Switch/Routers are connected (usually in pairs) at the regional level for alternate path routing. In metropolitan areas these paths are usually physical optical fibre (because the lengths rarely exceed 30 km) and these are capable of at least 1Gb/s (if not 10 Gb/s)

In non-metropolitan areas, this network is not really functional as the structure still hangs off capital cities, and not regional cities in the country. With the emerging 3G Network, this structure will be necessary to carry the traffic and this will materialise most probably in the form of STM-64 (10 Gb/s) intersecting Optical Fibre rings as the base.



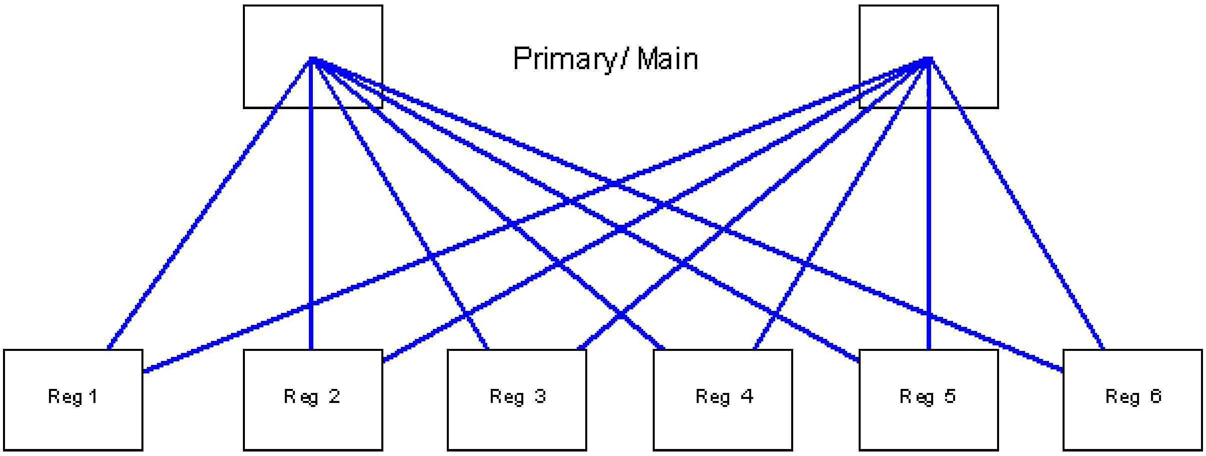
This picture shows two transmission rings that intersect at a District Node site and all the virtual paths are connected to the Regional Switch/Router site. This could well be part of a much larger structure where there are other virtual paths to an alternate Regional Switch/Router.

In Australia, most major capital cities have internal regional networks consisting of SDH managed rings carrying IP via ATM and looping the major metropolitan suburban switching exchange sites within these cities. This structure is somewhat default because of the distributed nature of metropolitan switching.

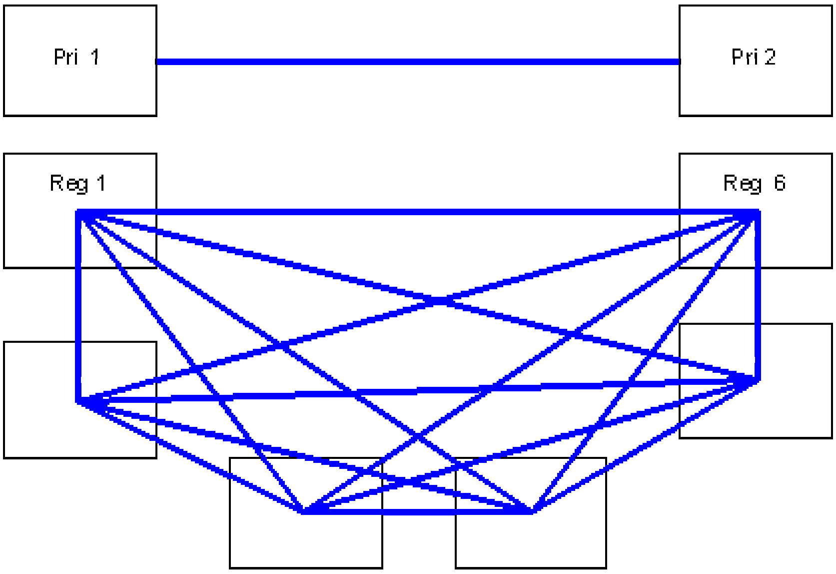
Outside the major metropolitan cities there are virtually no regional ring networks and this is the major network problem as this structure is necessary (as backhaul) to carry the Internet and CATV demands of the immediate future. More than about 40 SDH based regional rings are necessary, and many of these can be configured through changing the current star structures that exist into regional rings – but in most cases a large amount of optical fibre and radio systems may have to be installed to make the existing star networks thick enough to be converted into regional rings.

5 - National Network

Ideally this is a full mesh network with major transmission links between all major capital cities, constructed with optical fibre rings utilising SDH to provide diverse geographic network routing redundancy, together with MPLS / IP to provide data services and Internet based services. At major capital cities this mesh of inter-capital transmission links would terminate onto pairs or quads of digital cross connects to then connect to lower level Regional networks and connect with Gateway switches for competitive interconnect and international routing. This transmission mesh provides extensive network redundancy and the digital cross connects provide alternate routing in emergencies and better traffic flow management (load sharing).
In Australia, I believe that the National Network Telecommunications Grid is more like a multiple star network than a full mesh with most major capital cities having star structures to the nearest capital cities some of the nearest other major capital cities using 'flat ring' structures cascaded to make the distances between major capital cities. The structure has been significantly 'hardened' (thickened) in the last few years, with new geographically diverse routes between capital cities through rural and remote areas.



This is the first part of the National Network showing a full inter-level mesh between the Primary / Main Routers / Switches and the Regional Router / Switches. There is also a 'peer level' of connection paths that also exist



This is the 'peer level' switching paths, and these are highly traffic route and distance dependent (some might not even exist) because the backbone through the Primary / Main may be the major path.

Where these inter-capital transmission links used to be high capacity SDH 'flat rings' for maximum distance, I believe that these are now changing to multiple large intersecting SDH rings (several hundred km in circumference) to provide extra diversity, and much thicker traffic densities necessary for 3G (mobile) / Broadband Internet.

The second part of the Australian National Network Transmission Grid has multiple high capacity links to the Regional network switches/routers, and this was essentially a star formation in each case from each capital city. In synergy with the new inter-capital optical fibre routes being created with large intersecting SDH rings, these alternate routes will, I believe have enough dark fibre in these cables to support a significant 3G (mobile) / Broadband Internet presence in non-metropolitan areas through wayside Regional networks.

6 - Inter-Connect Network

This is the highest level network structure where telcos interconnect and it includes the global network where countries interconnect. This network is characterised by high-density transmission links connected to large Gateway switches. These transmission links are usually SDH managed MLPS / IP and uses a range of bandwidth compaction techniques to maximise the available occupancy, and most now use VoIP – as well as bandwidth reduction with adaptive PCM. There is very little redundancy here as the links are exceedingly expensive and are usually a combination of satellite and optical fibre cables over very long distances.

At these Gateway switches it is here that protocol isolation takes place to connect ‘competitive’ carriers so that telephone users can seamlessly connect within the one country – without having to start with a carrier code to force their calls via a particular carrier. Internationally these Gateway telephone exchanges act like major airports and shipping terminals to ensure that the signalling and transmission protocols are suitable for the network being connected to and they prevent hostile competitive attacks by competitive carriers.

In the case of Internet, the transmission network structure is seemingly identical as that for telephony traffic, but the transmission protocol is essentially IP contained with SDH and ATM for maximum throughput – with internal network management facilities. The ‘Gateways switches’ are digital cross-connect structures to the network followed by programmed routers that can manage the throughput from various sources to various sinks.

In Australia, there are Gateway switches for international traffic in a few capital cities, as these capital cities have the international connections through cable and satellite to them. Unfortunately, Australia is somewhat isolated from the rest of the prominent land masses, and it does not have a thick mesh network of submarine optical fibre cables linking to the rest of the 'highly developed' world. Much of Australian's Web based Internet data is sourced from the USA and Europe, and as this star connecting network is comparatively thin, this is a prime reason why downloading into Australia is relatively slow.

There are also Gateway switches in every capital city to connect to competitive carriers. These Gateway switches are connected through specific transmission links to a large number of 'Points of Presence' geographically distributed in Australia so that competitive carriers can connect their networks.

While this might sound highly sensible for high population density locations (capital cities), the reverse is that regional and remote calls need to work their way to a capital city Gateway before connecting to a competitive carrier. (It just ain't that simple!) This process doubles the network requirements while lowering the service standards and it should be the obvious reason why competitive / overlapping telecommunications service footprints are absolutely uneconomical.

Competitive mobile networks are the classic case of massively redundant infrastructure due to totally unnecessary multi duplication of very expensive equipment, managements and their staff, advertising, sponsoring and network utilisation. These networks have literally the same geographic footprints and their tower locations are in the most case shared. Not only do these networks have similar 'black spots' but every call that has to go to a competitors (mobile) network has to work its way all the way through to the Gateway switch, then interconnect to the competitors (Gateway) network and work its way all the way down to the competitors Mobile Base Station in the competitors CAN to connect to the mobile phone.

It is very common for competitive carriers to send signalling sequences and/or calling patterns into other competitive carriers in the hope to bring down those networks (after all, competition is effectively war). In defence, telephony / Internet network providers have deliberately structured their Gateway Switches and Routers to mitigate these attacks. With Internet, because the address data is the leading part of the datagram carrying the data packet, it is particularly difficult to isolate and eliminate viruses, spams, malware and spyware without screening datagram sequences; and that is why these do get through causing havoc to end users.

Internet Gateway router / switches could easily be programmed to reject all addresses of known 'Adult Entertainment' Websites, and socially this could be an excellent and very inexpensive approach to provide a sizable section of the community with a 'CleanNet' or "ClearPond' but commercially the usage rates could be substantially lower.

With Internet, the Gateway network structure is very similar to telephony where remote 'points of presence' need to tunnel directly through to the Gateway Router/Switch network before they too, work their way down to their called party. Again this competitive infrastructure arrangement is extremely cost-expensive - particularly with a so-called 'unbundled' CAN, and again, competitive infrastructures do everything to drive operating (and user) costs up, not down.

Conclusion

These six levels of network structure that need to be considered on their own merits as they are structurally different. In Australia there is a very large disparity between the metropolitan and non-metropolitan telecommunication networks, and one main issue is distance related transmission technologies. In one sense I forgive the various Governing bodies at all levels for being so ignorant in believing that competition will 'force' improvements in telecommunication, and not realising that technology advances have been the only reason why telecommunications standards have improved over decades.

Australian telecommunications infrastructure is now an essential service and so this infrastructure needs to be responsibly managed, and in my opinion, any proposal or action to sell-off essential infrastructure is grossly irresponsible bordering on treason. The failed Optus experiment (to introduce competition to force telecommunications improvement and drive down user prices) was an utter failure with prices not falling and now Australia has a competitive metropolitan telecommunications infrastructure which is extremely cost-expensive, almost redundant, and foreign owned.

Non-metropolitan areas really do not have regional rings but thin tiered-star structures, and this is one reason why communications in non-metropolitan areas is so different from that in metropolitan areas. Without this level of essential infrastructure it is impossible to conduct “Business in the Bush” on a similar level to that in metropolitan cities. This is one of the main factors that draws people to the major cities for employment, causing housing to be over-priced and this cripples our national productivity.

It is not simply a matter of making telecommunications in non-metropolitan areas ‘adequate’ as stipulated by some astoundingly inept advisors. It is a matter of distributed national security, a diverse national economic future, and the ability to do "Business in the Bush" so that massive workforces are not tied into a couple of major cities in the future.

The copper-based CAN is a major concern, as this infrastructure is incapable of carrying (ADSL limited) Broadband Internet beyond a few kilometres, and HFC is in the same useless situation; and it certainly cannot carry true Broadband Internet. All this infrastructure has to be totally replaced in the very near future with a non-competitive Optical Fibre to the Home (FTTH) structure and in more remote areas with point-to-point radio.

In round figures, consider that there are about 10,000,000 copper pair lines in Australia, that I guess will cost about $2,000 per line to replace – plus customer terminal equipment; then this comes to about $24Bn. But wait there is more! The District level 'backhaul' equipment will cost about this much again, that is about $12 Bn. If the regional level backhaul equipment costs about $22Mn per ring and there are about 45 rings, so this is another $1.0Bn, so my high-end estimate for equipment to be purchased, installed and commissioned is about $61Bn over the next four to 10 years.

Considering that there are about 20 M people in Australia, and that telecomms infrastructure costs are rapidly diminishing, then the more conservative cost would be much more like about $30 Bn and that works out at about $1500 per person for the next five years – not that much in those terms ($300 pa/pp)!

Comments and Corrections are welcome