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FttN and Local Loop Impact Report

Please find attached a report from Dr Paul Brooks, Managing Director of Layer10, specialists in telecommunications strategy and design. This report was commissioned and paid for by PIPE Networks.

ENDS
For more information: Bevan Slattery
Managing Director
T: 07 3233 9800
media@pipenetworks.com
FTTN: No Need to Cut the Copper

Introduction

I have been designing and working with DSL access networks and related technologies since 1996. I have been more or less continually involved with the initial development and subsequent revisions of ACIF (now Communications Alliance) C559 ULLS Deployment Rules Industry Code, a technical document governing the use of DSL technologies and the degree they may be permitted to interfere with each other, including as Editor and in performing the interference modelling required to propose the Annex M variants of ADSL2 for approval. I am currently engaged by the New Zealand Commerce Commission as an independent technical expert on copper network interference management, and have been engaged by Ericsson Australia to represent them on the current review of C559 to incorporate VDSL2 technology in Australia. I have in the past advised the ACCC on FTTN architectures, and as CTO of TransACT had engineering responsibility for their 30,000 customer FTTN network and triple-play services.

Telstra and G9 FTTN Proposals.

In September 2005 Telstra proposed that they would convert the existing copper access network to a FTTN architecture, installing street-cabinets near existing cross-connect pillars such that the longest customer phone line was about 1.5km from a node, and they would use ADSL2+ to guarantee at least 12 Mbps. All customer phone lines would be connected to a FTTN broadband-enabled port, even if the customer hadn’t subscribed to broadband.

The 1.5km line length, probably not coincidentally, corresponds closely with the typical serving area of an existing RIM cabinet. Soon after Labor has mooted a similar network, Telstra has updated their proposal to use VDSL2 instead of ADSL2+, and the G9 consortium has proposed a similar network. Each proposal has stated or hinted that once the optical fibre-fed Node is operating and all subscribers have been migrated, that the legacy copper main cables between the Node and the exchange would be disconnected. The justification is often stated as ‘technical reasons’, however I have not seen any good technical arguments made to justify this action.

To protect ADSL2+?

ADSL2+ services are already permitted to operate simultaneously from a node and from an exchange. Thousands of node-based ADSL2+ services based in RIM cabinets operate concurrently with exchange-based services today. Under current arrangements the node-based ADSL2+ transmissions must be at a reduced power so as not to cause too much
cross-talk interference to exchange-based services, however as the average line length is very short to a node (less than 1.5km) the reduced power still provides a considerable speed ADSL2+ service. **There is no need to cut the copper main cables to protect ADSL2+ services at the node or exchange.**

![Diagram of copper main cable and ADSL2+ services](image)

**To protect VDSL2?**

VDSL2 is essentially an extension of ADSL2+ technology that uses a very wide frequency range to provide very high broadband capacity to subscribers close to the DSLAM. The high frequency signals quickly weaken with line distance, and the most benefit is experienced within 500m - 1000m of the DSLAM. Because of its short effective range it is best deployed from an access node located much closer to the subscriber’s homes than a typical exchange building. Much beyond this distance, a VDSL2 service gracefully reduces to ADSL2+ and effectively becomes identical to an ADSL2+ service, providing the same performance out to approximately 5 km or so. The approach proposed by Telstra and adopted within the C559 working group is to treat VDSL2 as being composed of two components – essentially, as an ADSL2+ service (for frequencies up to 2.2 MHz) with an additional higher speed service ‘bolted on’ occupying frequencies above 2.2 MHz.

**VDSL2 Crosstalk Interference**

The major concern with VDSL2 – indeed any DSL technology – is the impact of cross-talk interference, where signals from adjacent lines can ‘leak’ across and distort the signal on the victim line. Crosstalk interference becomes worse at higher frequencies, so the extent of cross-talk interference on VDSL2 is a real concern. An important property of cross-talk interference is that, at any given frequency, cross-talk can only occur with another nearby service also using the same frequency – just like radio interference. This leads to the following observations:

- The ADSL2+ portion of a VDSL2 service is no more susceptible to cross-talk interference than a standard ADSL2+ service is. The C559 Deployment Rules already provide judicious rules that protect ADSL2+ services from excessive interference, whether deployed at an exchange or at a node, including in dual-feed scenarios where copper lines from the exchange are retained to the node, and they provide service side-by-side with lines from the node.

- No other technology than VDSL2 can interfere with the higher frequency portion of a VDSL2 service, as no other technology is permitted to transmit on the high frequencies that VDSL2 uses above 2.2 MHz.

- **The only thing that could impact on the high frequency portion of a VDSL2 service is another VDSL2 service.**

Concerns about exchange-based interference causing problems with node-based VDSL2 services can be managed simply by mandating that VDSL2 can not be deployed from the exchange. This would allow all the currently permitted technologies, including ADSL2+, to be used at the exchange, and would not require the copper lines between the node and the exchange to be cut.
**VDSL2 Current Research**

Around the globe, including at research institutions within Australia, engineers and scientists are investigating methods of improving the way exchange-based VDSL2 and node-based VDSL2 services can co-exist successfully. Dr Raphael Cendrillon, formerly of the University of Queensland, has developed Dynamic Spectrum Management (DSM) algorithms for adjacent services that significantly improve VDSL performance through intelligent allocation of frequencies and transmission power to exchange-based services and node-based services\(^1\)\(^2\).

Very recently Dr John Papandriopoulos, a PhD student from Melbourne University was awarded the University of Melbourne prize for developing technology to make VDSL2 systems operate faster, through cancelling crosstalk interference\(^3\). This was extensively reported in the popular press as heralding ‘up to 200x improvement in broadband speed’. He is now about to start working with one of the most advanced research groups in this form of signal processing, at Stanford University with John Cioffi.

Much of this research shows that mathematical techniques for DSM, when implemented in VDSL2 DSLAMs over the next few years, show promise in resolving some of the current issues surrounding VDSL2 operating from the node and the exchange – and that there is no fundamental technical reason to cut the copper in order to protect node-based VDSL2 – to do so would deprive subscribers still connected to the exchange from accessing VDSL2 services in the future.

**There is no need to cut the copper main cables to protect VDSL2 services at a node from non-VDSL2 services at the exchange. VDSL2 services from the exchange to a dual-fed node can not be permitted currently, as this would interfere significantly with node-based VDSL2 systems, however ADSL2+ services from the exchange can continue to be permitted, as can SHDSL-based business services and all other forms of transmission technology.**

**International Precedents**

I have looked at the equivalent documents to C559 for the UK, Ireland, and the USA. These govern the conditions under which technologies such as ADSL2+ and VDSL2 can be deployed within their country’s infrastructure.

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In Ireland, their Copper Loop Frequency Management Plan 2005 does not include VDSL2 yet, although Eircom has announced plans for an NGN access network including VDSL2.

The UK Access Network Frequency Plan explicitly allows for copper cables from the exchange to the node/cabinet, permitting VDSL2 services from the node but not from the exchange, as proposed above.

The USA T1.417 Spectrum Management for Loop Transmission also allows VDSL2 systems at a node to be provided in a dual-feed scenario.

The forthcoming revision of C559 for Australia is not expected to include any restriction on VDSL2 services operating from the node in a dual-feed scenario.

**There does not appear to be any requirement in international interference management specifications for VDSL2 services as a node to be protected from non-VDSL2 exchange-based services.**

**Businesses operating in residential areas, and demand for ‘non mainstream’ services.**

While not a technical issue, a major issue with removing the copper network between the node and the exchange is that all the subscribers within the node serving area are restricted to only accessing services that can be offered from the node electronics. The FTTN proposals all are aimed at providing mainstream residential services – telephone services and broadband Internet. Many homes currently use several other products that will likely not be able to provided by the node – alarm lines, ISDN, and any businesses that happen to be caught within the serving area may also have non-residential communications requirements – examples are X.25 and Frame Relay networking, leased-lines, ISDN PRI services for PABX interconnection. These are not high-volume products, which is why it is more efficient to aggregate the demand for such connections over a wide area and locate the infrastructure that provides the service at the exchange (connected via the main copper cable), leaving the node electronics to serve the high volume products. The alternative – that the subscriber might have to work out how to migrate the functionality over to the subset of options provided by the new network platform, or lose the use of the product – represents a reduction in customer service that seems a backwards step for such a network expenditure.

**In summary, there does not appear to be any technical or interference management basis that might justify removing the copper pairs between the exchange and a node once a FTTN network has been deployed.**

I trust this addresses your queries.

Yours Sincerely,