

## Inexpensive Non-Urban FTTP

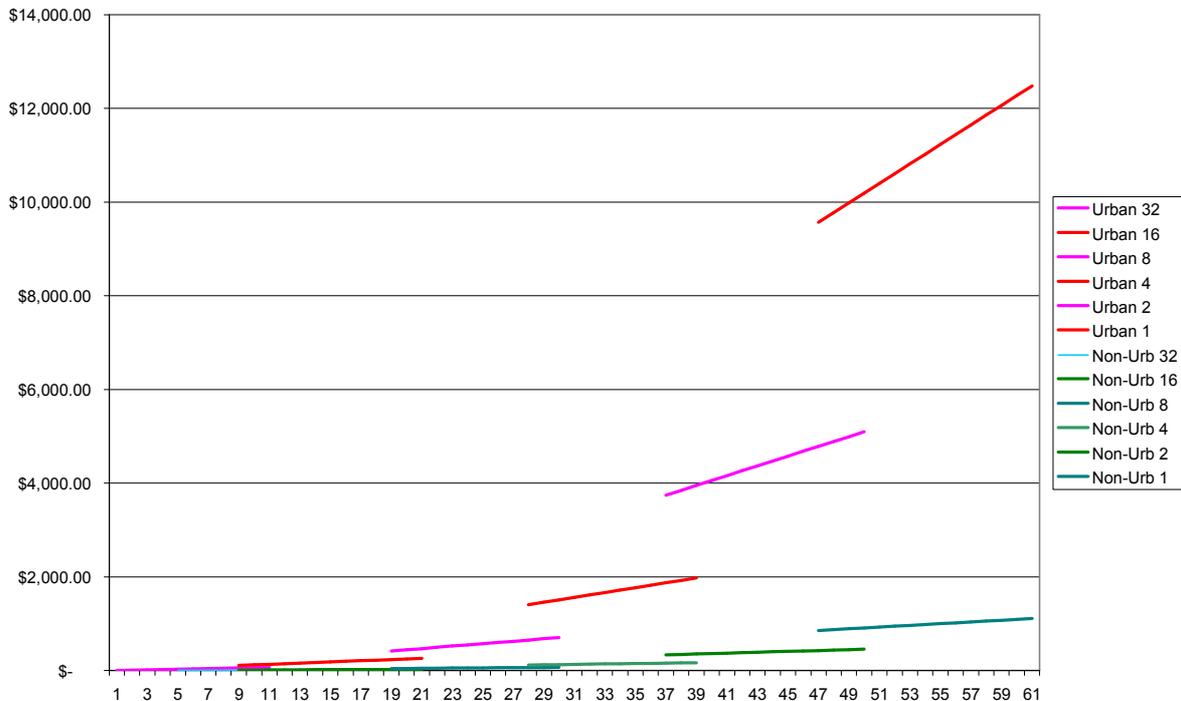
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### Introduction

This short document shows how the concept of very inexpensive Non-Urban dark fibre to the premises (FTTP) can be rolled out in Australia. The concept utilises proactive cooperation between Businesses (Units) instead of competition.

FTTP is very fast, secure, and can be rolled out at a price that is highly comparative to Fibre to Radio Base Stations (RBSs) as used in Long Term Evolution (LTE) Groupee Services Mobile (GSM) otherwise known as Third Generation (3G) and Fourth Generation (4G) radio for mobile Devices in non-urban areas of Australia.

Urban FTTP has a nominal distance limitation of 10 km. Non-Urban FTTP has a distance limit of 60 km and connects to far fewer premises per optical fibre strand from the local exchange's Optical Line Termination (OLT) equipment.



In the above chart, the horizontal axis is the FTTP length in km, comparing the Optical Fibre cost in the vertical axis. The “competition” model of Urban FTTP is shown by the Red / Pink lines, and the “proactively cooperating” Non-Urban FTTP synergy is shown by the Green lines.

Rolling out Non-Urban FTTP is extremely practical and very inexpensive, but to do so requires a mindset change away from “competition” into “cooperating”.

The standard Urban FTTP model plotted above in Red/Pink, shows that the fractional fibre cost quickly leaps from insignificance to prohibitively expensive as the distance (km) is increased. Meanwhile the Non-Urban FTTP model plotted in Green has a fractional fibre cost that is a relatively small proportion of the overall connection cost.

## ***Implementing Non-Urban FTTP***

Consider two large towns 90 km from each other that were to be connected by a 12 strand SMOF cable for exclusive Backhaul Network (BN) use, there are several farms and some villages on the rolling hills between these towns and the pair copper telephone Customer Access Network (CAN) wiring is in poor condition.

By synergetic cooperation, the BN cable, route and pit specifications are slightly changed to include CAN fibre in a slightly thicker cable on almost the identical route:

- The combined BN and CAN technology co-operative agreement is to plough in a standard 144-strand OF cable instead of a 12-strand OF cable.
- The ploughing and cable costs increase from about \$30,000 to \$32,000 / km.
- The 12 fibres reserved for the BN are directly increased to a nominal 36 fibres (an increase of 200%), opening a large range of diverse geographic switching paths not possible before and future-proofing the Backhaul Network.
- *The nominal 108 remaining dark fibres can “sold” to the CAN Business (Unit) for about \$2,000 /km, and the cooperative (not competitive) books are balanced.*
- The 200% increase in BN dark fibres now comes at no cost to the Backhaul Network Business (Unit).
- *These increased available fibres will allow for the reticulation of Cable TV and Radio services, inland Website / Data storage hosting and inland Backhaul highways for faster and higher capacity diverse Geographic Backhaul networks.*
- The geographic route could be changed very slightly to facilitate inexpensive CAN connectivity to some homesteads and/or villages / towns en-route of the Backhaul Network.
- At every 10 km the cable ends will have to be spliced / joined in a pit. Some Non-Urban fibres can be made available through a sealed joint to provide a small number of CAN fibres to nearby homesteads / villages, via passive nodes.
- A few more similar pits could be installed in villages / near homesteads on the Backhaul Network route allowing for very inexpensive non-urban FTTP CAN to premises to be connected from these pits, via passive nodes using dark fibres.
- The homestead connection can be aerial (under the 11 kV mains), not trenched.
- *Because the High Speed Broadband capability is now available at homesteads, the Broadband use will be dramatically increased, so traffic on the associated Backhaul Network will be dramatically increased.*

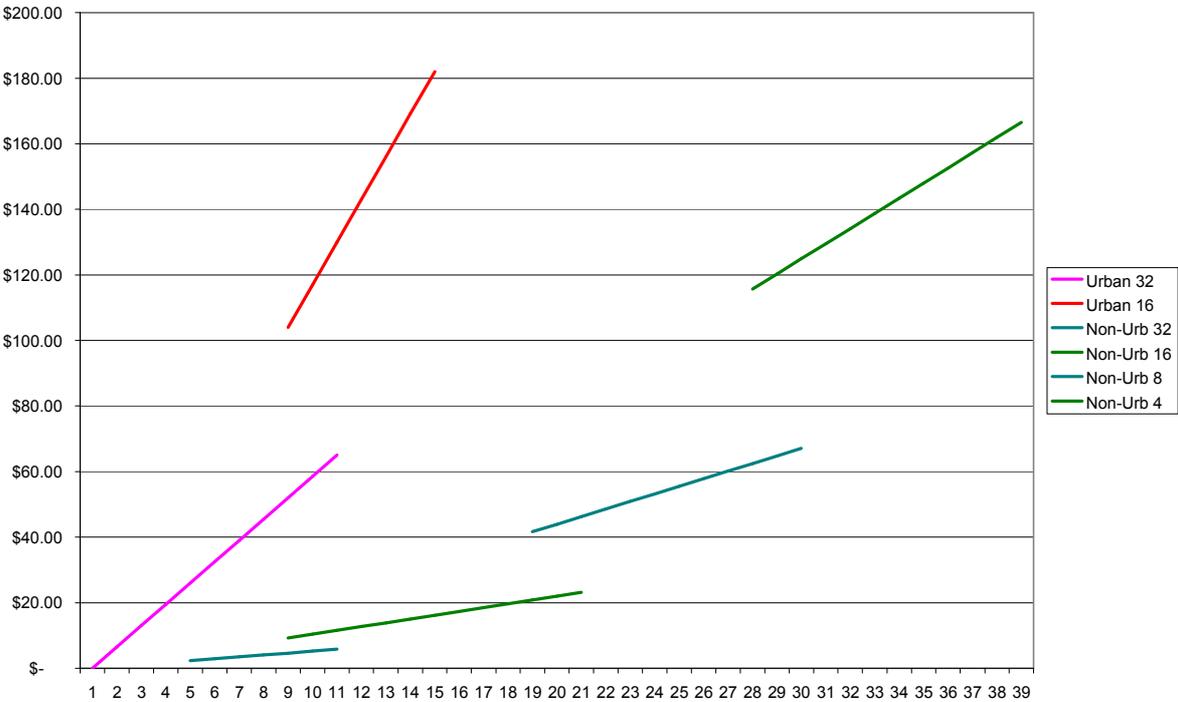
In this example given above the cooperatively BN shared FTTP CAN feeder costs about \$180,000 for 90 km of CAN utilised cable, or about \$2,000 per km for a total of 108 strands of dark fibre, or about \$18.50 per km per SMOF strand of dark fibre.

It is through deliberate and overt cooperation between what are ignorantly competing technologies / business units / businesses that massive productivity gains can be made in realising inexpensive non-urban FTTP. The first round of massive productivity gains in farms, villages and small towns comes from the now highly economic Non-Urban FTTP strands that before were prohibitively expensive because of the mindset of isolated businesses in ignorant competition against each other.

As 60 km is the physical distance limit for Gigabit Passive Optical Network (GPON), then OLT equipment can now connect from both ends of the 90 km BN / CAN SMOF

cable and the OLT equipment in the local exchanges will in almost all cases be less than 45 km to the premises / homesteads.

In the chart below where most towns / villages and homesteads will be within 38 km of the OLT local exchange equipment, the fractional fibre costs for Urban (Red / Pink) and Non-Urban (Green) FTTP models are shown for direct comparison. The chart can now be radically simplified as below:



In the chart above, the distance in km horizontally, is the basis for a range of GPON FTTP CAN models, compared by the per-premises cost of the SMOF strand connection from the OLT equipment in the Local Exchange, based on the Optical Splitter ratio (1:32, 1:16, 1:8, 1:4, 1:2) in the Remote Passive Node.

The constant costs are: the Local Exchange’s Optical Line Termination (OLT) equipment (which is a bulk unit) and “optical wiring”, the Remote Passive Node and its’ Optical Splitters, the Optical Fibre tails from the Remote Passive Node to the Premises, and the in-premises Network Termination Unit (NTU).

The variable cost is the length of the previously dark optical fibre strand from the Local Exchange to the Remote Passive Splitter, divided by the splitter’s fan-out ratio.

As the fibre length from the Local Exchange to Premises is increased, the line attenuation is also directly proportionally increased. The fan-out ratio (and attenuation) of the passive optical splitter is stepped back from 1:32 to 1:16, to 1:8 to 1:4, to 1:2 to keep the optical budget within 20 dB. These steps in the fibre strand pricings are directly related to these fan-out ratio steps.

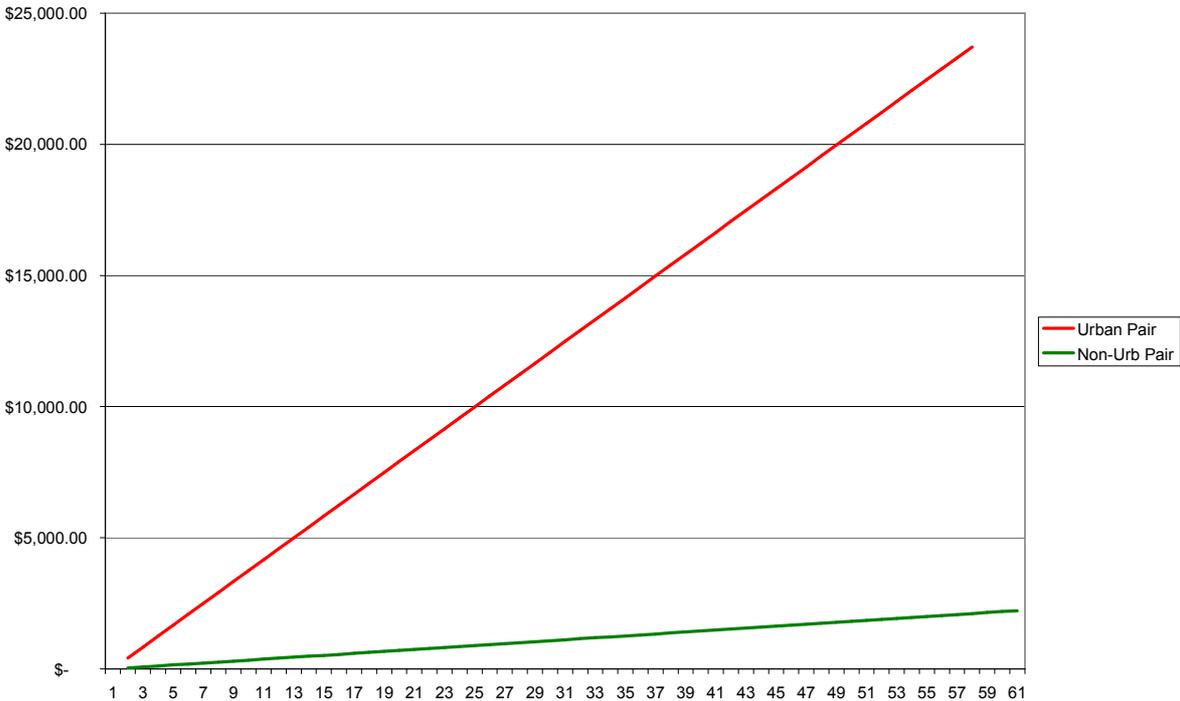
In a town of say 500 people with OLT equipment in the local exchange site, the Non-Urban FTTP can come into play earlier than 5 km from a local exchange, (on a Backhaul Network route). Similarly, the Non-Urban FTTP fractional fibre cost at 38 km is still only \$176, making this connection synergy extremely economic.

In comparison, the Urban FTTP fractional fibre cost at 38 km is \$1,976. This cost is greater than 10 times more expensive than Non-Urban FTTP, making the Urban FTTP a prohibitively expensive comparative commercial / “competitive” technology.

The chart above clearly demonstrates the first order productivity gain from the win-win situation where the synergetic cooperation between the Backhaul Network and CAN SMOF cable trenching is more than 10 times economic than being in competition and ignoring the immense synergetic benefits.

***IT Business in the Bush***

The next consideration is that IT businesses will now grow outside State Capital Cities and outside country towns. These businesses will need pair fibre connectivity for Website hosting, Remote Data Storage and Management (ie Cloud Computing within Australia), International Website mirroring, Broadcast Conference facilities etc.



The chart above shows very clearly that the competitive (Urban) modelling is extremely expensive compared to the proactively cooperating (Non-Urban) modelling for a pair of optical fibres connecting directly from a local exchange to a homestead / “bush premises” / “bush-located business”, physically bundled within the sheath of a deliberately “thick” Backhaul route’s SMOF ploughed-in cable.

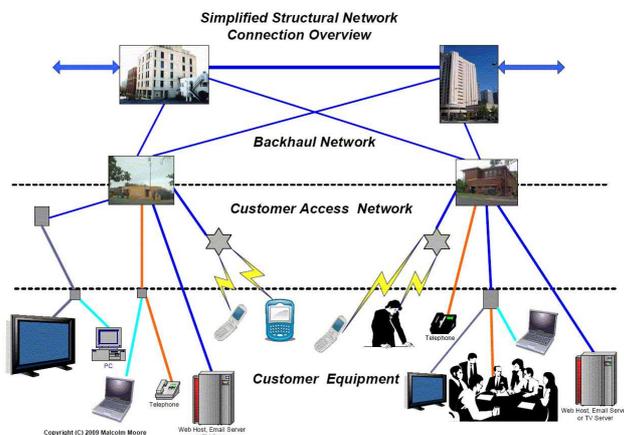
***Understanding the Backhaul Network***

With all transport processes (including the Internet, Broadcasting, Trains, Airlines, Roads, Footpaths etc), there is a local short-distance network that connects from various premises to a main highway mesh system.

In telecommunications, the short-distance network from the local exchange sites connecting to home / business premises / mobile phones is called the Customer Access Network (CAN). The main highway long-distance mesh between the exchange sites is called the “Inter-Exchange Network” or the “Backhaul Network”.

The Customer Access Network (CAN) connects in much the same way that local roads connect home / business premises driveways to major highways / motorways.

Just as Motorways have no premises directly connected, the Backhaul Network (BN) has no premises directly attached to it, just the Points of Interconnect (POIs), and this is where the NBN infrastructure connects, purely as CAN infrastructure to connect premises with a Broadband (high-speed) service into the Backhaul Network. The footnoted reference<sup>1</sup> has far more detail on these telecomms network structures.



The conceptual diagram above shows how and where the CAN and BN inter-connect to make a through connection. Above right shows typical BN equipment.

In Australia, almost all the BN transport is done through SMOF cables that connect between cities, towns, villages and in larger cities; between suburbs. In 1920 the BN and the CAN was all copper wires, but now they are fast converging<sup>2</sup> into SMOF cables (with Radio Base Stations for mobile connectivity in more urban areas).

As Broadband connectivity for country premises is being radically improved with FTTP GPON CAN being nationally rolled out by the NBN project; the associated Backhaul Network bulk bandwidth requirement (particularly in the inland of Australia) will need to be immensely greater than what is currently available.

To radically increase the Backhaul Network data though-put capacity, a large amount of Backhaul Network SMOF cables will need to be ploughed in between country cities and towns to meet this critical demand. Also, large Switch / Routers will be necessary in these country cities to direct and control the expected massive data flows outside the capital cities.

### ***The Synergy in Backhaul and CAN SMOF***

Appendix 9 in the footnoted reference<sup>3</sup> provides the detail of the locations for my initial guesstimation of the nominally 23,000 km of Backhaul and associated switches including the SMOF cable that needs to be immediately ploughed in at an approximate cost of about \$ 750 M, so that the proposed NBN can have good Backhaul Network connectivity.

In virtually all cases, this Backhaul Network SMOF cable will pass through and past farms / homesteads and villages as it connects between country cities and towns, where the Backhaul equipment will have switches and Optical Line Termination equipment for connectivity to CAN fibre.

<sup>1</sup> <http://www.moore.org.au/comms001.htm>

<sup>2</sup> <http://www.moore.org.au/comms/02/20051126%20Australias%20Converging%20Telecomms%20Networks.pdf>

<sup>3</sup> <http://www.moore.org.au/senh/2010/NBN%20Business%20Case%202.pdf>

The very strong synergy is that both the Backhaul Network and CAN use SMOF cable. There are massive savings in infrastructure costs if one thicker cable is ploughed in, with pits deliberately built-in on the route so that some of this SMOF cable's fibres can be fanned out at these pits for FTTP CAN connection to homesteads and village premises.

The several decades old technology of copper cables used for Backhaul Network was significantly different that the cables used for CAN connectivity, so this was never a synergy. With SMOF cables, the technology of these cables (and their route) is identical so the productivity available through sharing the cable use is immense.

When this \$0.75 Bn expenditure is considered against the nominal \$35 Bn, with the realisation that in facilitating highly economic Non-Urban FTTP within this "thick" Backhaul Network SMOF cable will cost less than \$0.1 Bn; the immense productivity benefits of this shared Broadband technology presents an extremely strong case for including Non-Urban FTTP at every possible opportunity of the NBN rollout. ***The problem is that competition between businesses is preventing this productivity.***

### ***Using the Cooperative Strategy***

There are several massive productivity gains for Australia that can be harvested by using the "Synergetic / Cooperative" business strategy as proven by Lipsey and Livingstone (Theory of the Second Best).

***By proactively sharing the Backhaul Network (BN) ploughing-in costs with the Customer Access Network in the same SMOF cable on Backhaul Network routes, then a massively productive number of win-win situations come up.***

### ***Conclusion***

The main variable cost factor in GPON FTTP CAN is the length of the ploughed-in SMOF cable from the OLT equipment to the Remote Passive Node. If these "CAN fibres" are cooperatively included into the one "thicker" ploughed-in Backhaul Network SMOF cable, then this cooperative infrastructure synergy facilitates the reality of highly economic Non-Urban FTTP CAN up to 60 km long.

The first order productivity gain is for towns, villages and homesteads in close proximity to the "thick" Backhaul Network SMOF cable routes. These premises can be very inexpensively connected with fast, secure and reliable non-urban FTTP CAN.

Non-Urban FTTP at 27 km costs no more than Urban FTTP at 10 km. The very low component cost of shared "thick" Backhaul Network SMOF cable routes from local exchanges makes Non-Urban FTTP economically practical, all the way to 60 km.

A slight variation of Non-Urban FTTP would significantly reduce the connectivity costs for LTE / 3G, 4G Radio Base Stations, making these too, far more economic.

The innovative synergy of including previously dark fibre as Non-Urban FTTP with "thick" Backhaul fibre in the same cables, trenched into Australia's inland will be a very inexpensive big advantage for Australia's telecommunications infrastructure.

This thicker BN cable with integrated Non-Urban FTTP will facilitate inland Website / Data / Cloud hosting, inland Cable TV connectivity, Broadband connected farming and grazing, an inland Broadband businesses culture, new inland Broadband businesses, and far more connected and healthy inland Australians.