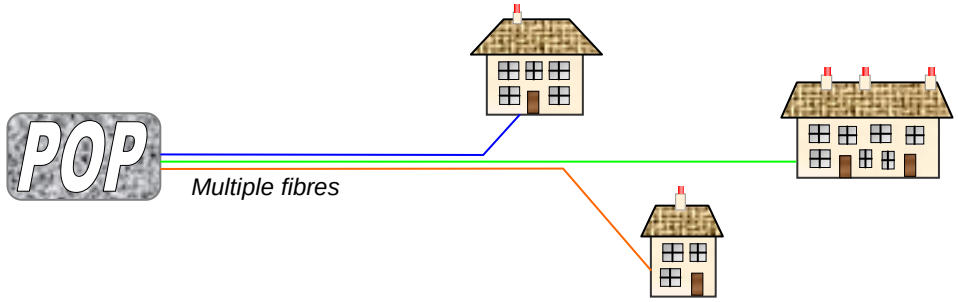
"In for a penny, in for a PON"

The aim of this short article is not to criticise the Passive Optical Networks (PONs) being planned or considered as Fibre To The Home (FTTH) access networks, but rather to point our why rural areas in particular should consider the advantages of a point-to-point fibre access network as the ultimate architecture.

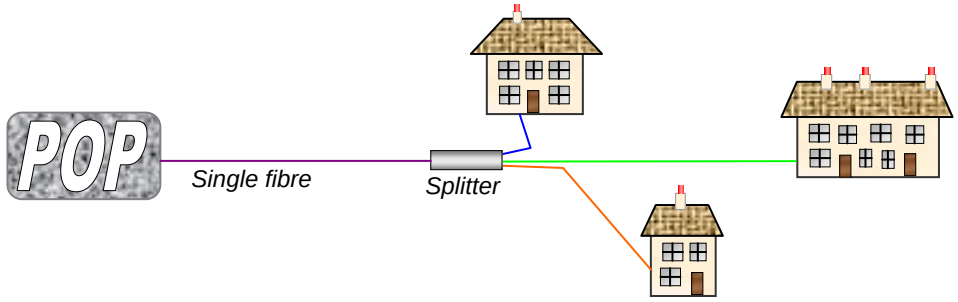
PONs, make excellent, high-speed access networks. They offer the advantage of extremely high broadband speeds plus additional services such as telephony and high definition TV. They are clearly superior to copper twisted pair wires, coaxial cable and wireless access except where mobility is a requirement.

Given these great PON features, begs the question "what is wrong with a PON architecture?", to which the answer is "not much", except that where a new fibre optic access network is being installed, there is a superior architecture. This is the point-to-point access network that is sometimes referred to by our cousins in the USA as a "home-run" architecture.

Point-to-point architecture
The point-to-point architecture is arguably the simplest architecture in that it consists of one or more fibres running directly from the point of presence (POP) or head-end equipment room to each property served.



PON architecture
The concept of the PON architecture was developed to reduce the fibre count from the POP or head-end in order to save limited space in duct systems and equipment rooms, hence signals for multiple properties are sent out down just one fibre and are then split to serve many properties.



There are several different flavours of PON, each with their own particular features, advantages and disadvantages in relation to each other, but we will not concern ourselves with these details here, but rather will focus on the basic physical architecture of a typical splitting PON.

Such a PON will typically employ Time-Division Multiplexing (TDM) technology to address individual properties, with a typical network employing 1 by 32 splitters, or in other words up to 32 properties served from just one fibre from the POP. Such a 32-way splitter will have an intrinsic loss of 15 dB, or over 96% signal loss, plus some 'excess loss' from the device and joining into the network.

It is also useful to note that a point-to-point network can use any active equipment, since a splitter can be positioned at the POP to enable PON active equipment to be utilised. By contrast a PON must have specialist PON active equipment.

PON versus Point-to-point fibre?
So what are the advantages and drawbacks of the PON versus a direct, point-to-point, fibre connection? A typical summary could be:

Network Architecture	**Advantages:**	**Disadvantages:**
PON	✓ Low fibre count cables ✓ Fewer connections at POP ✓ Easier fibre management	× Requires splitters × Splitters have high loss × Higher bit-rate transceivers
Point-to-point	✓ Lowest loss ✓ Simplest premises equipment ✓ Simple network testing	× More fibres to manage at POP × Larger fibre cables

From a telecommunications company (telco) perspective, this brief summary table may be sufficient to make an informed decision, but this is to miss the point for rural access networks. For a telco, the choice will be made around the needs of the bulk of their network, and this means access networks in urban and suburban areas where an exchange POP might serve many thousands of premises, and space will likely be limited.

By contrast, a rural access network may be serving relatively few properties, but over longer distances, and this has another consequence – the priority of the rural POP, or exchange, for later upgrades is very low. The consequence of this if a property desires or requires a different service, is that it would be very unlikely to be available until some time after the urban and suburban exchanges have been upgraded.

This point becomes the most significant, if you consider that since PONs were first designed, fibre optic cables have become far more compact with high fibre-counts in very small diameter cables now possible, fibre management at POPs has also improved significantly, and high density patch panels are now commonplace. In essence the advantages of a PON have been significantly eroded.

To be fair, the disadvantage of the higher bit rate transceivers in a TDM PON, or more expensive equipment in a WDM PON, have also been eroded, through developments in technology and economies of scale. The higher loss of the splitters is a principle of their operation and so will always be a factor, but with most access networks the distances are relatively short so this is not a critical issue.

By way of contrast, with a point-to-point access network, a fibre from any one property can easily be moved in the POP to any new equipment and hence desired or upgraded service. This can be done for an individual customer without having to upgrade others, and could more easily accommodate a significant upgrade such as a domestic premises adapting a high-end business use.

Conclusion
In a rural environment the advantages of a PON architecture are minimal, and the advantages of a point-to-point architecture are well worth the price of the extra fibre. The recommendation is to do more than just spend a penny, since in a rural environment it could well be a case of "*penny wise PON foolish*"!

Fibre GarDen Approach
By planning for a fibre-rich point-to-point network, we are aiming to ensure we have a future-proof solution with the capacity and flexibility to readily adapt to whatever the future throws up. It is actually quite likely that fibre GarDen, or a partner organisation, will use PON equipment on our network, but this does not mean a network user could not readily request and be moved onto a non-standard service that may not be supported by the PON equipment.

*This information note was written for **fibre GarDen** by John Colton, FInstP. John is a director of fibre GarDen,technical director of Lucid Optical Services, a fibre optic technology specialist training company, and a director of the Fibre-optic Industry Association (FIA).*

