Removing the Barriers

to Broadband Services Reaching Everyone

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While many homes and businesses are best served with Fibre To The Premises (FTTP), a "fibre only" strategy will exclude many customers due to various fibre roadblocks. Multi-gigabit broadband service may reach many more customers, at a much lower cost, if Fibre To The Extension Point (FFTep) is employed where necessary. FTTep delivers multi-gigabit service over existing phone wire, coax cables or radio for a short section of wire leading to the customer premises and inside the premises. This article dispels a good number of "fibre only" myths.

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Introduction

An apt joke says, "There are two types of people: those who think there are two types of people, and those who don't." Similarly, there are two types of telecommunications experts: those who think that everyone can be served with fibre to the premises if the government would provide enough incentive funding, and those who believe there will never be enough incentive funding or that the government would be wiser to spend its money on better healthcare, education and transportation. The authors agree with the second type of people.

The best way to provide broadband fibre service to the maximum number of people is to not unnecessarily limit what "broadband fibre" is. The notion requiring that optical fibres must reach all the way to every home and business results in excessive costs and delay.

Locations where fibre can reach easily at reasonable cost should certainly be served with fibre. Indeed, the deployment of broadband fibre has addressed these locations first. The "low hanging fruit" has already been picked in many countries. Serving the remaining locations with fibre will, in many cases, require greater effort, cost and complexity per location. Many of the remaining, underserved locations could get gigabit-class and even multi-gigabit access more quickly and at a much lower cost if served by Fibre To The Extension Point (FTTep), where fibre reaches close to the customer premises, but the last hundred metres are served with phone wire, coax cables or a combination of fixed wire-wireless.

Fibre to the Premises

Is fibre to the premises the only solution to deliver Broadband Services?

Although fibre to premises is the most prevalent approach, also other technologies can help to deliver on the promises made by 'fibre to the premises', as is shown in the following statements:

- *Fibre all the way to the premises is the only way to deliver true broadband access. FALSE*
  - Actually, Gigabit service is the same whether it is carried by fibre, copper, or radio.
- *Higher bitrates provide a better customer experience. FALSE*
  - This may be true for up to about 500Mb/s, but at higher rates, latency and jitter become more important. Wire-based technologies can provide sub-millisecond one-way latency with low jitter.
- *Fibre is the only future-proof access technology. FALSE*
  - Copper and coax wires can deliver 2Gb/s service today, and new standards address rates of 4 to 10Gb/s. Coax wire and CAT6 wire have the capacity for much higher rates than telephone wires.
- *Fibre provides higher quality service. FALSE*
  - This is certainly not true if you are unable to receive any service at all. Broadband access via copper and coax provides approximately the same quality of service as fibre for virtually all customers.
- *With enough government incentives, fibre can reach everyone. FALSE*
  - As discussed below, it is impractical or exorbitantly expensive to serve some locations with fibre.

Fibre roadblocks

In most places, fibre can be economically built from the nearest telecommunications switching centre (Central Office) or remote multiplexer to a point near the customer's premises. This is often the distribution point or the basement of a multiple dwelling unit, about one-hundred metres from the customer. Up to this point, fibre cost is shared by many customers and the fibre construction takes place within established utility right-of-way land. Fibre construction for the last few hundred metres, near the customer premises, is often the most difficult. Beyond this point, the fibre serves only one or a very few customers, so there is little cost-sharing.

The reasons why some homes and businesses may not get fibre all the way to the premises include the following barriers:

- Lack of funding for construction of new fibre cables
- Lack of construction crews or equipment
- Excessive cost per living unit due to low geographic density or low subscription
- Unable to gain construction permission from landowner
- Unable to gain civil works permission from local government or excessive cost for the permission
- Customer declines permission for technician to enter home or to drill holes in walls

- Unable to gain permission from building owner to install fibre inside the building
- Unable to gain construction permission for historically protected buildings
- Excessive cost to install fibre inside the building
- Excessive cost to restore landscaping or paving
- Excessive cost due to geological factors

To a large degree, these barriers are avoided if fixed-wireless or the existing copper telephone, coax, or CAT5 wires are used for the section near the customer. Over this short distance, more than a gigabit-per-second can be achieved, so there is no bitrate bottleneck.

As increased government funding and incentives can help expand the number of locations served by fibre, the roll out of fibre continues to gain pace across both Europe and North America. For example, the UK Government has recently announced ambitious plans to build out a 100% Fibre To The Home (FTTH) landscape by utilising existing underground water pipes as a way of connecting remote households. This highlights the steps that national governments are taking to avoid the costly process of digging up roads and land, as well as pulling cables to the home.

However, this is best complemented with other strategies to reach the maximum number of locations.

Fibre Access Alternatives

Customers may be served by fibre all the way to the premises (FTTP) or nearly all the way (FTTep). Both alternatives deliver approximately the same bitrate, but for the situations discussed in the previous section, FTTep costs less and is more practical. FTTep's lower cost enables the delivery of multi-gigabit service to more homes, millions of more homes. In addition to avoiding the cost and logistical barriers of installing new fibre inside the building and in the last section leading to the building, FTTep can avoid the cost and inconvenience of the network technician entering the premises. In many cases, the customer can self-install the necessary equipment. FTTep speeds the deployment of broadband service by avoiding the delays of waiting for construction approvals and scheduling construction and installation crews.

As described in the Broadband Forum documents [1] and [2], fibre-to-the-extension-point (FTTep) consists of fibre from the network to an Optical to Electrical (O2E) conversion unit near the customer's premises, where the optical signal is converted to electrical signals traversing over phone wires, CAT5 wires, or a coax cable. The O2E unit may serve a single living unit via a single cable, or the O2E may serve multiple living units via separate wires to each customer premises. In the latter case, the O2E could be a Distribution Point Unit (DPU) as described in the Broadband Forum TR-301i2 [3]. Also, the O2E could employ radio signal such as Wi-Fi or 5G wireless to convey the signals over the last few hundred metres.

FTTP

A typical Fibre To The Premises (FTTP, see Figure 1) installation has fibre running all the way from An Optical Line Terminal (OLT) to an Optical Network Terminal (ONT, also known as an ONU) located at the outside wall of the building or inside the building. The ethernet signals run over CAT5 wire from the ONT to the Residential Gateway (RG). So, the difference between FTTP and FTTep is the length of copper wire in the last section, not the existence of any copper wire. In some cases, the ONT and RG functions are integrated into one box, with no connecting wire.

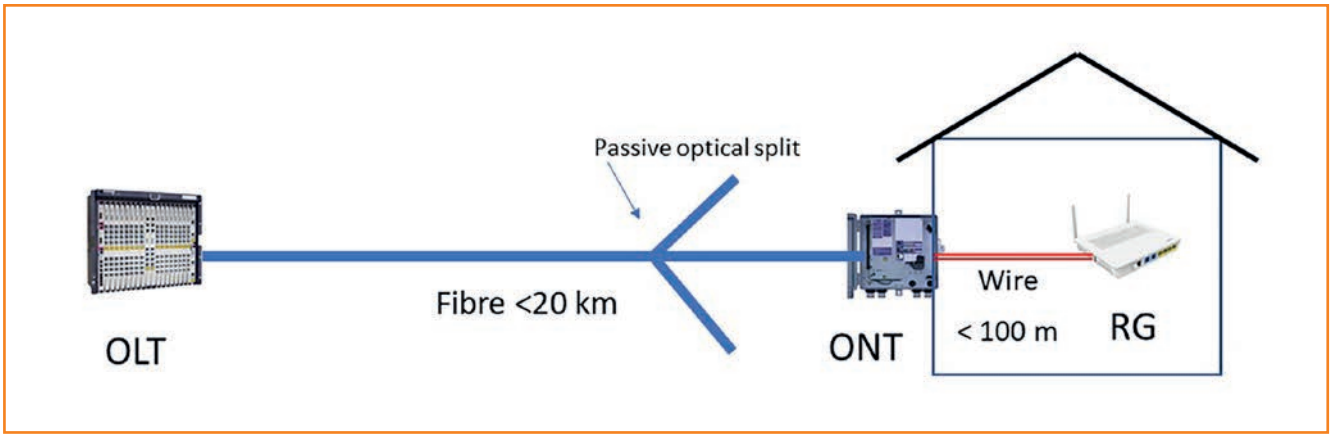

Figure 1: Fibre To The Premises (FTTP)

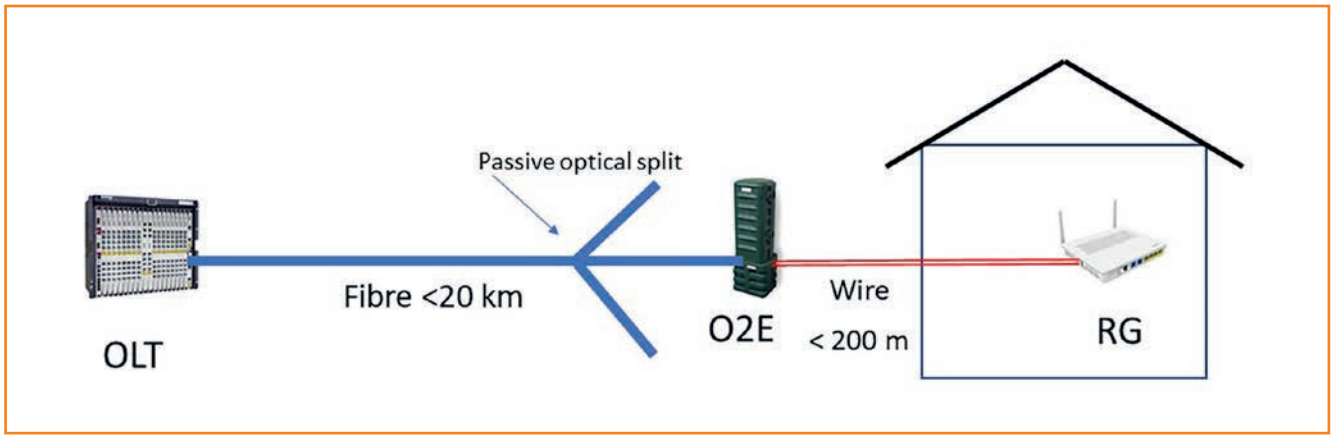

Figure 2: Fibre to the extension point for one home

Fibre to the extension point serving one home

A single home may be served by Fibre To The Extension Point (FTTep) with the fibre from the OLT running to a point near the home or business, where it connects to the Optical to Electrical (O2E) conversion unit which transmits electrical signals over exiting wire to the premises such as a telephone line, coax cable or CAT5 wire. See figure 2. Transmission techniques such as G.fast [3], G.hn [4] [5] [9], or MoCA Access [6] may be used. The O2E unit may be located a short distance from the premises or mounted to the outside wall of the premises. This configuration avoids the installation of new fibre inside the building and in the section near the building. The O2E may be powered by current fed from the Residential Gateway (RG) via the connecting wires. This is known as Reverse Power Feed (RPF) [8].

Fibre to the extension point serving multiple homes

As described in [7] and shown in figure 3, FTTep serves multiple homes from a Distribution Point Unit (DPU) that connects to the OLT via an optical fibre, and then multiplexes the data from individual wires from each home using transmission techniques such as G.fast [3], G.hn [4][5][9], or MoCA Access[6]. The DPU may be located in a pedestal enclosure, pole mounted, strand mounted, or placed in an underground case. As specified in [7] and [8], the DPU may be powered by current fed from the Residential Gateways via the connecting wires. This avoids the cost of arranging for commercial power at the DPU site and also avoids the cost of back-up batteries for the DPU. By using existing wires from the DPU to, and within, each living unit, the cost of building new fibre is avoided in the last section of access. Furthermore, FTTdp enables sharing of the fibre from the OLT by a larger number of customers than is possible with a conventional Passive Optical Network (PON) FTTP arrangement.

Fibre serving customers in Multiple Dwelling Unit (MDU)

The DPU may be located in a Multiple Dwelling Unit (MDU) basement, wiring closets on various floors, or outside of the building. See figure 4. This case is often called Fibre To The Building (FTTB), where the wires connecting the DPU to each

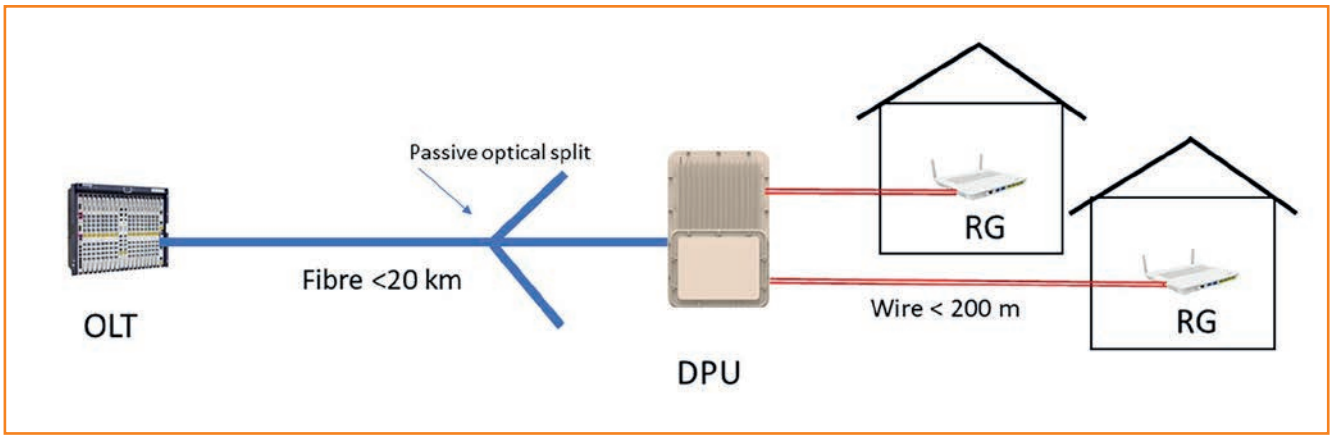

Figure 3: Fibre to the extension point serving multiple homes

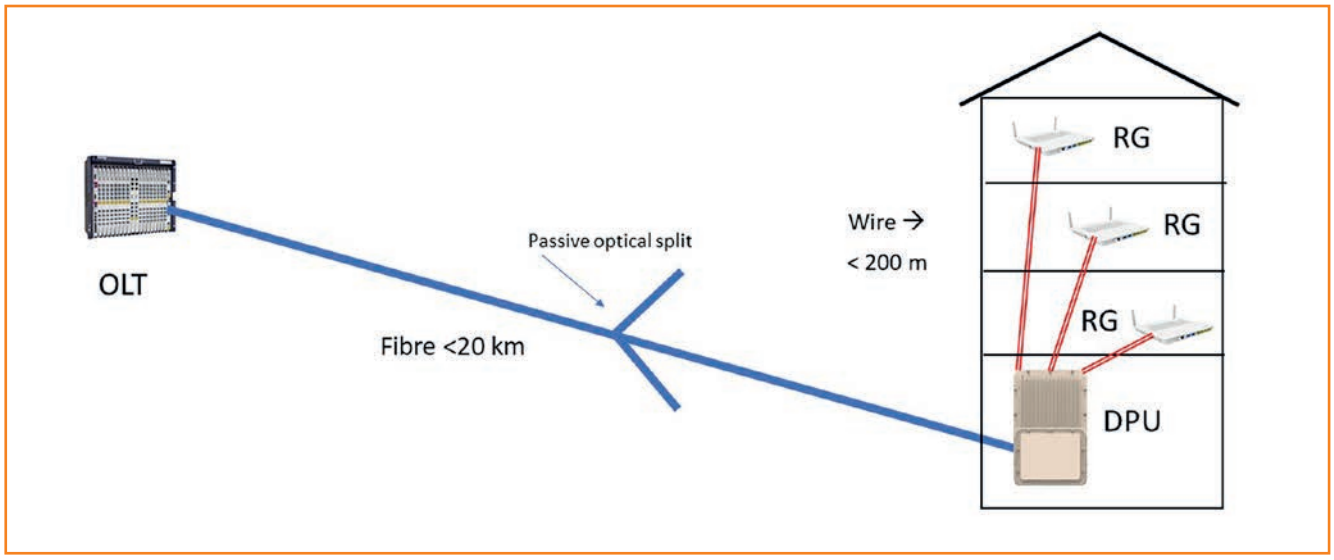

Figure 4: Fibre serving customers in Multiple Dwelling Unit (MDU)

living unit are entirely or mostly inside the building. In many existing buildings, it is impractical to install new fibre inside the building. The existing inside wires can be reused to convey very high bit rates. In this case, local power may be readily available, so there may be less need for reverse power feeding.

In the event of a power failure, the DPU could revert to Reverse Power Feeding (RPF) from the RGs in each living unit. Clearly, if all the RGs also lose power, then it does not matter if the DPU also loses power. Avoiding a back-up battery at the DPU may avoid a large cost because regulations in some countries would require a very large battery.

Service providers can leverage G.fast, G.hn Access or MoCA Access technology as components of the FTTep in MDUs, by capitalising on their complementary architectures to extend the fibre connectivity from the basement of the building with phoneline or coax-based infrastructure, all the way to each floor of the building [6] or [10].

Fixed Wireless Access

As shown in Figure 5, fibre access may be extended using wireless technology for the last section to the premises. This is known as Fixed Wireless Access (FWA also called Fixed Wireless Loop) and may employ 4G, 5G or Wi-Fi radio technology. The cost for commercial power delivery and back-up batteries at the serving site should be considered. Also, regulators should decide if fixed-location service or mobile service is the best used of precious radio spectrum, especially since higher frequency radio signals may be highly attenuated by walls and windows.

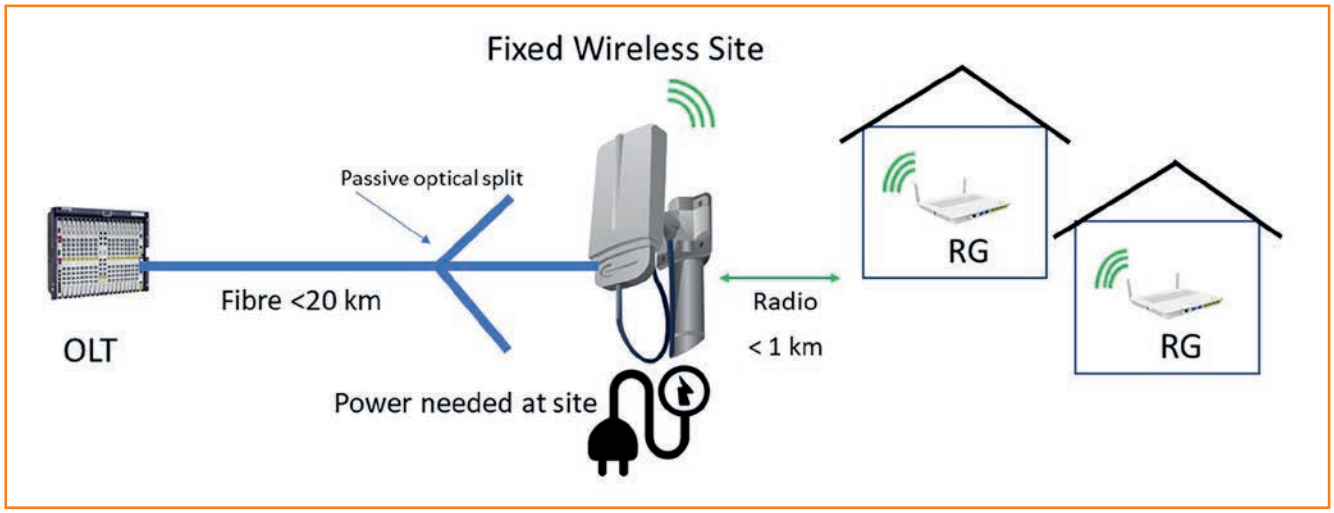

Figure 4: Fibre serving customers in Multiple Dwelling Unit (MDU)

Conclusion

Where fibre can be economically provided to reach the homes, this is the right thing to do. But there are some locations where the use of existing wires to the customer premises and inside the premises is necessary to enable affordable delivery of gigabit-class internet service. A fibre-only strategy would perpetuate the "digital divide" leaving many people with inferior internet access. Gigabit-class internet access can be provided to the largest population by using FTTep – Fibre To The Extension Point, which can also be thought of as Fibre To The most Economic Point. FTTep avoids the cost of building new fibre for the last section to the premises and also within the premises. Furthermore, in many cases, FTTep enables the customer or building owner to install the equipment inside their premises, avoiding the cost and inconvenience of a service technician visiting inside the home.

References

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