NetComm

The Missing Link

More efficient FTTH roll-out with Reverse Powered Gfast DPUs

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Introduction

The demand for data has grown significantly, driven by HD video streaming, online gaming and content sharing. While originally that growth was fuelled by the ever-increasing amount of content consumed, now it's pushed by the rising number of gadgets used by households simultaneously, such as mobile phones, tablets, video game consoles, eBook readers and various IoT devices.

Latest research indicates that the number of connected devices per household worldwide is ranging from six to 10. In the next few years that number is predicted to have a tremendous growth reaching up to 50 connected devices per household. These additional devices are expected to come almost exclusively from the anticipated increase in the Internet of Things industry, connecting air conditioners, ovens, coffee machines, solar panels, door locks, hot water systems, sprinklers, light bulbs, security cameras and fridges at home.

Internet connectivity is becoming as necessary as electricity or gas, which means that the network infrastructure should be able to meet expanding customer needs and support the incremental growth in the number of connected devices, bandwidth and data required. Internet has become a utility and should therefore be highly available with the appropriate level of quality at all times.

To cater for the increased bandwidth needs, more and more operators have started to build fibre-to-the-home (FTTH) networks. Today 12 European countries have FTTH/FTTB networks, providing coverage for more than two million homes. On average, this means a coverage of 33%. However, only 32% of those homes are also actually connected to the fibre network. The other 68% either don't want to be connected or the cost of connecting the final drop is too high.

Connecting the last part of the network is the most challenging; there are a significant number of homes that are currently underserved and looking for higher speed alternatives. Reverse Powered Gfast Distribution Point Units (DPU) offer the missing link between the fibre running in the street and the copper lead-in, resolving all major concerns and challenges operators have with other Gfast deployment options.

In this white paper, this new solution is introduced to cater to a greater number of subscribers and, ultimately, increase the market share by winning more loyal customers through offering high-speed broadband services in a quicker, more cost-effective way.

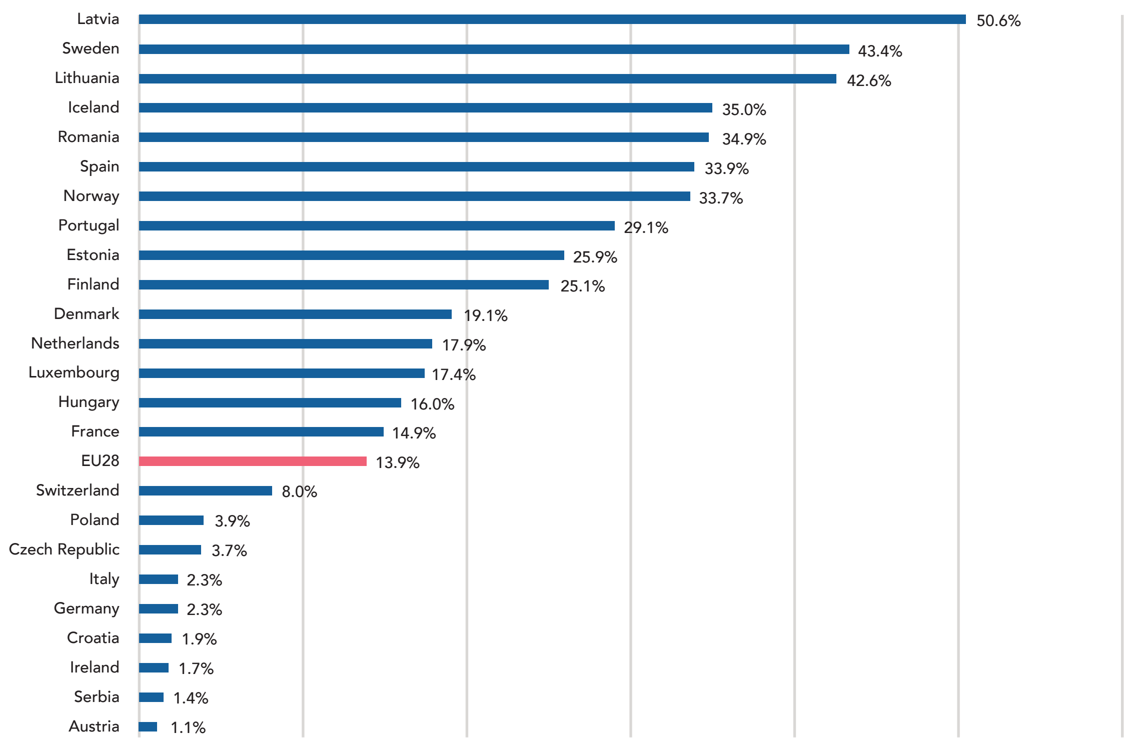
A massive expansion of fibre assets

There are clear socio-economic benefits arising from high-speed, low latency, super-fast broadband. These benefits are tangible at a national level in terms of permanent contribution to economic growth, employment, and the strength and diversity of the business ecosystem. Studies show that utility-grade broadband can help to increase GDP by up to 0.38% each year through information exchange and new services[1].

Fibre-to-the-Home (FTTH) was developed to satisfy the need for superior internet performance from households and businesses. FTTH bypasses phone lines and uses smaller, lighter fibre optic cables with glass conductors. These conductors transmit light signals rather than electricity, so they aren't subject to interference from electrical wires or damage from lightning strikes. Fibre optic cable can carry signals for around 200km without losing quality while capacity can be increased by adding additional wavelengths. Copper cables, on the other hand, begin to lose signal strength over relatively short distances. Fibre networks are faster and much more reliable in comparison to copper-based networks that were originally designed for voice calls and are not efficient for data transfers.

A smooth broadband end-user experience requires a ubiquitous, affordable end-to-end broadband infrastructure. Although FTTH is the most straightforward approach and some regions have been quite successful in deploying large scale FTTH networks, the average penetration remains low. In Europe, FTTH / FTTB coverage barely reaches 33%, but only 14% of homes are actually connected to the fibre network. This is because, in most cases, connecting the final fibre drop is the most expensive and time-consuming part of the network roll-out.

FTTH / FTTB household penetration



Source: IDATE for FTTH Council Europe, February 2017

1 Ofcom - *The economic impact of broadband: evidence from OECD countries*

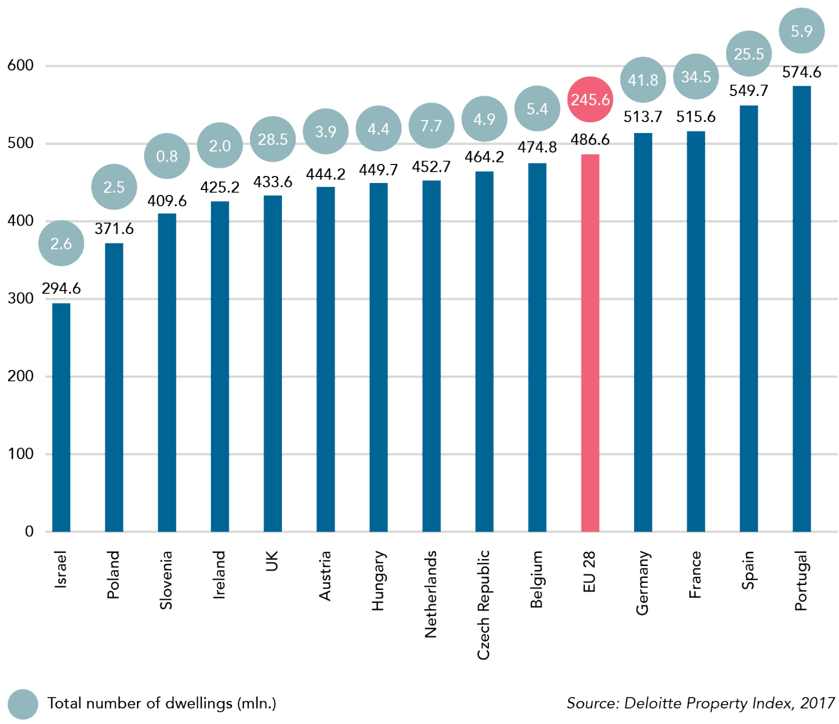
The challenge of connecting the fibre drop

There are multiple reasons why the take-up rate of FTTH services isn't high. In some cases, end-users are happy with their current service and have no interest in higher speeds and therefore don't need a fibre connection to the home. In other cases, end-users don't want to deal with the civil works associated with running fibre over the driveway, or they live in a historical building and don't want a hole drilled into the wall. Sometimes, the person simply doesn't have the authority to decide as they don't own the property or multiple properties need to be passed before it can reach a certain location.

Planning the last 200m of fibre deployments is the most expensive and time-consuming part of any fibre roll-out. Getting a connection from the main network to the premises in a cost-effective way, with minimal time, and without disrupting the local environment can seem nearly impossible to plan and implement.

Multi-dwelling units (MDUs) pose an even bigger challenge. In recent decades, the number of MDUs have increased significantly on the back of high levels of migration to cities. At this point in time, MDUs represent 35% of all housing units worldwide. Depending on the geographical region that number is even higher – over 50% in Europe and over 70% in major metropolitan areas. The globalization effect, including continuous migration to cities and rising property prices, indicates that the trend is going to continue.

Number of housing units in MDUs



Source: Deloitte Property Index, 2017

However, connecting MDUs to fibre has a number of operational and financial challenges. Variations in building sizes, ages, construction materials, limited cable pathways, hardware locations, power locations, building owner preferences, existing copper services and aesthetics – all contribute to the complexity of deploying new MDU networks, slowing down the installation process and increasing costs.

The difficulty of obtaining the necessary approvals from owners, tenants and other stakeholders is often underestimated. Apartment owners have generally been hesitant to approve installations, worried it might disturb the aesthetics and reduce the value of their properties. For obvious reasons apartment owners and tenants also tend to avoid construction noise and keep other disruptions to a minimum. Additionally, when introducing FTTH in an MDU, the whole building needs to be rewired without a guarantee that sufficient end-users will take on the service to justify the cost. As a consensus needs to be made with all owners in an apartment block to introduce FTTH, connecting MDUs are often more difficult than connecting Single Dwelling Units (SDUs).

Furthermore, some brand-new MDUs are still being built with copper and cable connectivity, requiring owners and occupants to go through the above challenges to migrate to fibre.

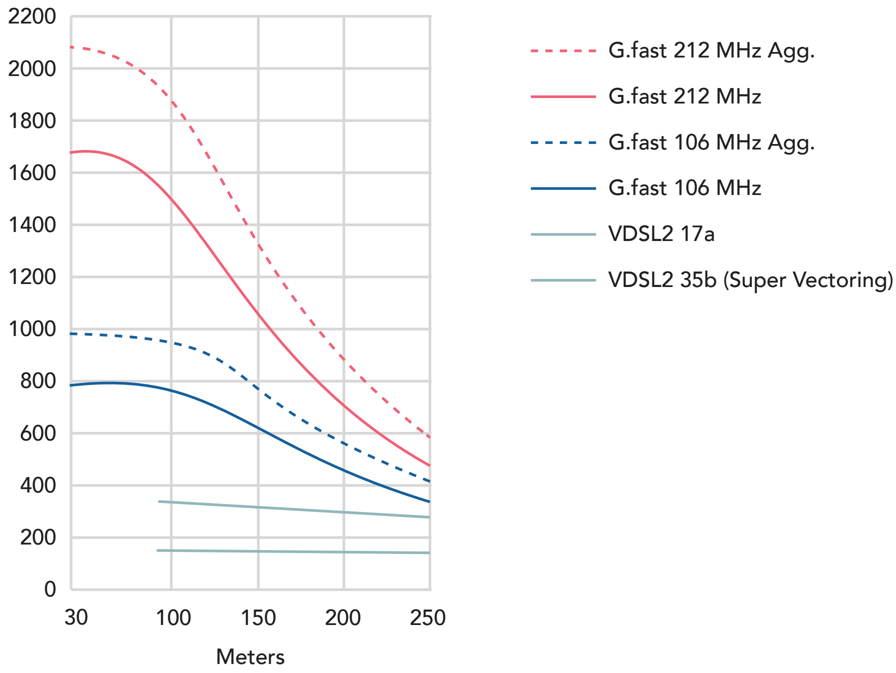
With fibre passing by many of these “hard to connect” SDUs and MDUs, operators have a huge opportunity to upsell higher-speed services by connecting these end-users to the fibre network. To do so, a high performance (fibre equivalent), cost-effective, easy-to-install solution is required to avoid the cost of bridging the gap between the fibre and the home.

Leverage copper lead-ins and improve the FTTH ROI

New innovations in DSL technologies allow for higher bandwidths over the traditional telephone lines. Gfast is the latest International Telecommunications Union (ITU) broadband standard that extracts more bandwidth from existing copper infrastructure. Current Gfast deployments largely utilise the 106MHz spectrum, but new Gfast devices are being introduced to extend the spectrum range to 212MHz to deliver download speeds of over 1 Gbps. This will continue to evolve in the future with extensions up to 424MHz and 848MHz with G.mgFast.

Using the spectrum up to 212MHz, aggregate speeds of 2Gbps over 200m are possible, well beyond the requirements of most households today. Network operators are finding that they are capable of deploying to fibre to within 100m of the premise in a cost-controlled and plannable way. By utilising their existing legacy asset (be it copper or coaxial lead-ins) for that final "drop" into the home, an elegant high-performance solution can be created to offer high-speed broadband services.

Gfast performance in function of distance



The biggest challenge when deploying Gfast however, is powering and finding the space to install a new device. Connecting fibre to the copper lead-in to use Gfast requires the introduction of new active equipment in the network. This equipment needs a location and access to power, something that isn't always available. Even in MDUs, where one might expect power to be available in the basement, these power sources typically can't be used for telecom equipment for a variety of reasons. If a standard plug is used, cleaners, workmen etc. can unplug it which makes the service go down. Installation requires telecom engineers who are electrically certified and a separate power meter to be installed. Additionally, the question remains who pays for the electricity as not all owners will sign up for the service. Bypassing the electricity challenge, will speed up deployment and avoid difficult and time-consuming negotiations.

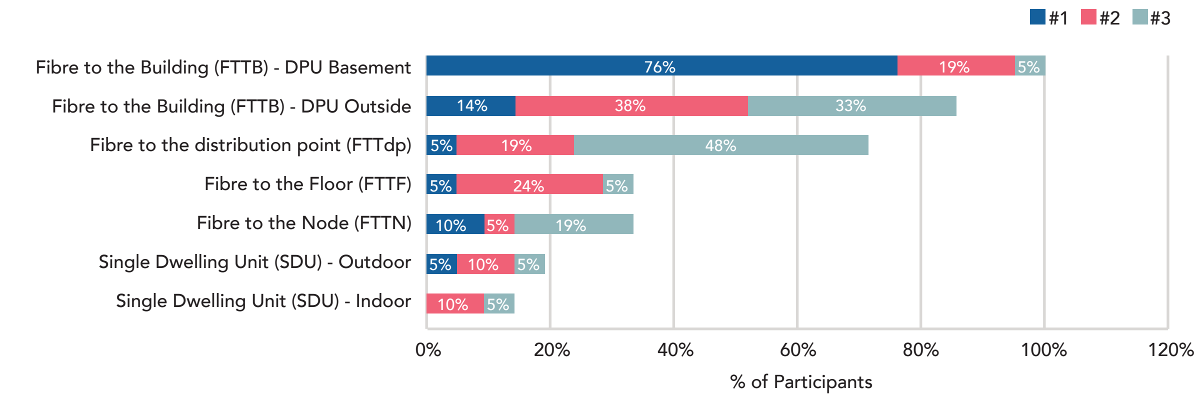
Gfast roll-out

In traditional "copper-based" telephone networks, dedicated central offices were built to provide Plain Old Telephone Service (POTS) and later Asymmetric Digital Subscriber Line (ADSL) services. These buildings would fit racks with active equipment and had one standard size for all. With Fibre-to-the-Node (FTTN) deployments, fibre needed to be brought to the neighbourhood and active cabinets were introduced on the sidewalks to connect homes with the higher speed Very-high-bit-rate Digital Subscriber Line (VDSL) services. Although minor optimizations were needed for the cabinet design, active equipment could still use standard sizes and one solution would be used for all.

To benefit from the capabilities Gfast can bring, copper loop lengths need to be shorter and therefore fibre needs to be brought deeper into the network. There are several methods to deploy Gfast. Some operators are upgrading existing VDSL cabinets to leverage the power and real estate available to upgrade end-users. However, this only provides better broadband for end-users close to the cabinet who already have a decent service. Others are looking to introduce new street equipment closer to the end-user, but this needs approval from local authorities and neighbourhoods to add new real estate in the street for yet another generation of DSL technology. For MDUs, small shelves are available that can be installed in the basement. However, as they need to be locally powered, the challenge remains who is responsible for the cost of providing power.

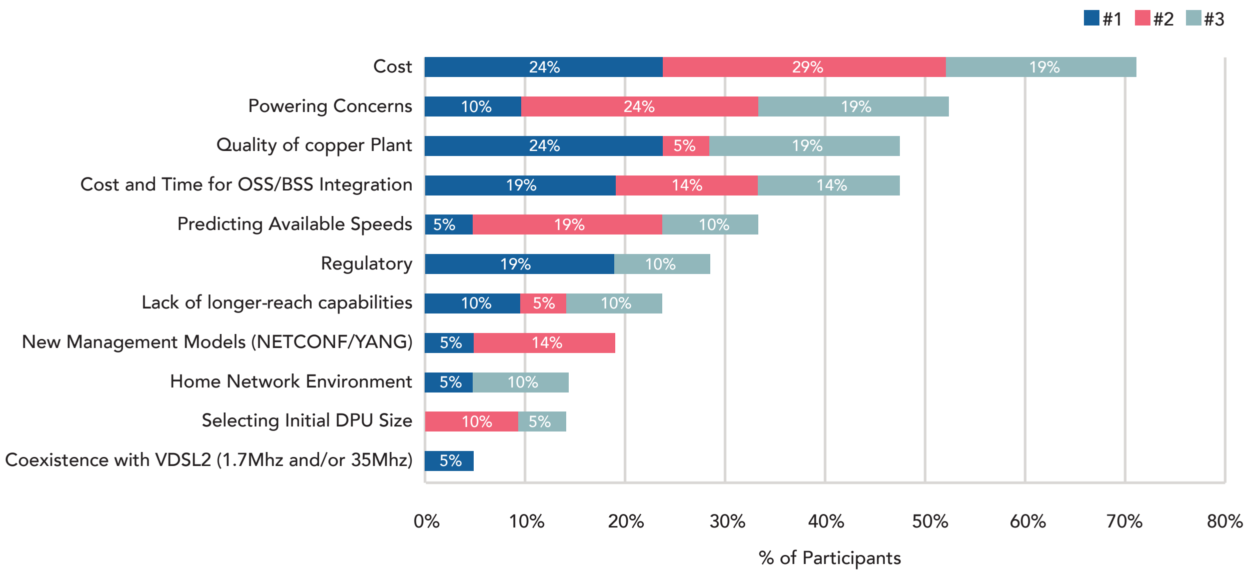
Therefore, it's becoming clear that the most effective way to deploy Gfast is to use a Reverse Powered Distribution Point Unit (DPU). This device needs to come in different configurations, shapes and sizes to meet the different requirements that operators have. A study done by Broadbandtrends where 33 key operators were interviewed, confirmed this. The number one use case for Gfast is deployment in the basement of an MDU, and the second biggest concern after cost when deploying Gfast is power. A Reverse Powered DPU is therefore the missing link that connects it all together.

Top Use Cases for Gfast Deployment (33 respondents)



Source: broadbandtrends

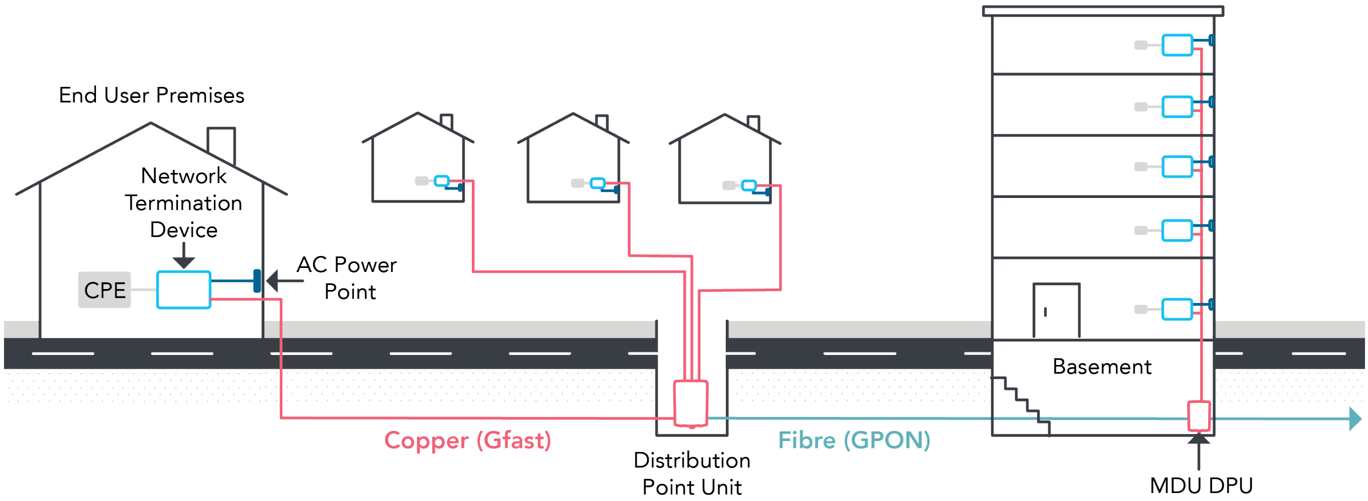
Key Challenges for Gfast Deployment (33 respondents)



Source: broadbandtrends

Reverse Powered Distribution Point Unit (DPU)

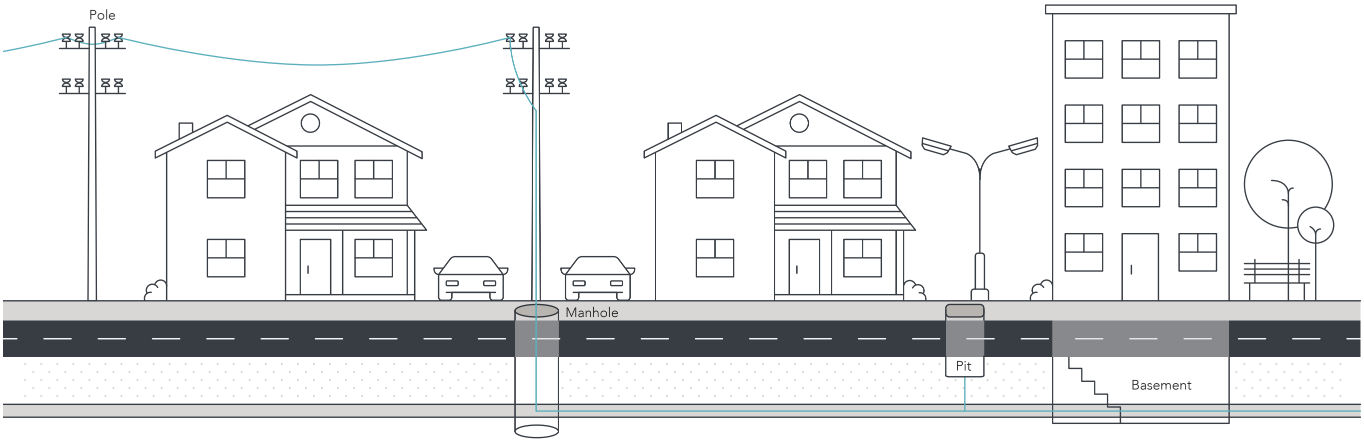
The basic principle of the solution is explained in the picture below. A DPU is connected to the GPON network, terminating the GPON protocol and connecting to the copper lead-in running into the homes. A Network Termination Device (NTD) in the home serves both as the Reverse Power Unit (RPU) and the modem, providing connectivity inside the home.



To streamline deployment, the DPU can be installed without activating any of the end-users. The DPU can have a built-in POTS bypass which means that if the end-user doesn't sign up for the service (there is no NTD connected), the end-user remains connected to the traditional legacy xDSL service coming from the central office or cabinet. Once the end-user self-installs the NTD, the higher-speed Gfast service is turned on and the end-user can benefit from high-speed broadband.

Different deployment options

Every network has natural points that can be used to install new equipment. When the fibre is underground, it might be running through manholes and/or pits already in the sidewalks which could fit a DPU. In networks where the fibre is running over poles, DPUs could be connected to those. To connect MDUs, a small space in the basement of the building would be enough.



Depending on the application, there is a DPU that will fit. For outdoor environments, DPUs can be ruggedized to withstand any condition and passively cooled to avoid noisy fans. Different sizes are available as well to cater for different MDU sizes and neighbourhood configurations. As every operators' network is different, there won't be one solution that fits all and a variety of options, all based on the same technology, are needed.

Reverse Powering

To avoid the cost of running a powerline to individual units, the DPU can be powered through reverse powering from the customer premises using a Reverse Power Unit (RPU), which can be combined with the modem to make a NTD (Network Termination Device) or a residential gateway to reduce the number of devices in the home. Reverse powering the DPU does come with its own challenges.

First of all, the DPU needs to be powered even if only one end-user takes on the service. As there is no guarantee that everyone in the neighbourhood or MDU will sign up for the higher-speed services, the DPU needs to be functional, independent of the number of end-users connected.

Secondly there needs to be equal power sharing between subscribers. When multiple NTDs are connected to the DPU, each NTD needs to provide an equal amount of power to ensure one end-user doesn't get loaded with the entire cost of powering the device.

Reverse Powered by single user

Reverse Powered by multiple users equally

And last but not least, the DPU needs to work at all times, even during the edge cases. This solution is utilising the legacy copper pair for high speed data and power – neither of which were envisaged when the cable was installed many years ago. Consequently, there are numerous transition "edge" situations, such as switching NTDs on and off, that can induce undesirable effects. In addition, being connected to the copper network means lightning effects need to be considered carefully in relation to device protection and continuity of reverse powering for all subscribers. Optimization is required to ensure an always-on network.

What NetComm brings

NetComm is a leading developer of end-to-end DPU solutions, supporting the biggest reverse powered field deployment in the world. NetComm is currently trialling its reversed powered DPUs with many service providers looking for new innovative ways to connect more end-users to their fibre network and increase the return on investment of fibre assets.

Wide portfolio to serve all deployment options

Every network is different, and every operator has its own requirements. With fibre running deeper and the use case becoming more specific, there is no one solution that fits all anymore. NetComm offers a wide range of options in terms of DPU port count, as well as device sizes to cater for those differences. And that's not all. NetComm works closely with its customers to develop a solution that perfectly caters to the network's requirements to ensure an optimal fit in every case. There is no problem too hard to solve and operators are provided a solution that fits their needs.

World-leading Reverse Powering technology

The biggest challenge when deploying a DPU network, is solving the power equation. There are multiple aspects that need to be considered to ensure a high quality, always-on connection. NetComm has conducted extensive testing optimising the design to guarantee optimal performance at all times.

Through advanced DPU power management techniques as well as an understanding of reverse power feed constraints within telecommunications networks, Netcomm's solution can provide reverse power over a long reach safely while still assuring high rate DSL performance. Understanding the effects of transition in power-sharing between ports, variable copper line lengths and the impacts on power supply stability for optical interfaces, the product is rock solid no matter the configuration. NetComm's solution is currently in deployment with over 35,000 live customers and growing weekly.

Optimized installation process to simplify deployment

When developing a solution, NetComm doesn't only consider the technical requirements. To introduce a new network element, it's important to understand the installation process and design the product with operational efficiency in mind. With a Reverse Powered DPU, there is no power available during installation. This makes it challenging to test the device during installation and can result in additional truck rolls once end-users are activated. To allow basic testing during installation, NetComm has developed the Installation Assistant.

The Installation Assistant is a portable, battery-operated installation tool designed for single-handed operation to assist with the DPU installation. It can be re-used for different DPU types and therefore only one device per installer is needed. It provides power to the DPU to allow for GPON registration and connection testing before leaving the site. This helps guarantee the DPU is functional and avoids an unnecessary truck roll (and costs) when issues arise during activation. In combination with already available test equipment, additional functionality can be introduced.

Persistent Management Agent Aggregator (PMAA)

A Persistent Management Agent Aggregator (PMAA) is used to allow Network Management Systems to manage DPU systems that may not be online. This is particularly useful where a DPU is reverse powered and there is a possibility that it can have power disconnected. This could happen in cases where there is a general power outage or in the remote scenario where customers turn off all connected modems.

A PMAA acts as an intelligent proxy for each registered DPU, storing commands when they can be executed, saving configuration settings and more. The PMAA also allows monitoring and diagnostics reporting on the actual line performance making it easier for the operator to troubleshoot potential issues. The PMAA aggregates all the agent setting from the different DPUs in the network, allows for a more efficient and streamlined management of the network, reducing IT complexity and cost. Additionally, the PMAA can be seamlessly integrated into existing network management systems, enabling the DPUs to be managed as an extension of the existing network.

Conclusion

Fibre-to-the-home (FTTH) is the most favourable solution to deliver high speed broadband services. However, the direct connection of the customer premises to the fibre network has proven to be challenging, both in terms of roll-out time and cost. Especially in Multi-Dwelling-Units (MDUs) it is hard to obtain consensus with all owners to introduce fibre inside the building. With more than 50% of householders living in an apartment, this is not something to ignore.

Many operators have started rolling out fibre, aiming to connect more end-users to the FTTH network. However, bridging the gap between the fibre running in the street and the home has proven to be challenging, resulting in a lower return on investment than anticipated. Reverse Powered Gfast DPUs are the missing link between the fibre assets and the widely available copper lead-ins, which if utilised correctly can still allow operators to increase the ROI in fibre.

Reverse Powered Gfast DPUs in combination with the NTD allow for a cost-effective, efficient and quick solution to offer high-speed broadband services without the cost of running fibre all the way to the home. With a self-installable NTD, the DPU can be installed first and activated later, improving on the efficiency of the roll-out as well.

NetComm is the leading supplier for Reverse Powered DPU solutions, powering the largest deployment in the world. With a wide variety of shapes and sizes and our Listen. Innovate. Solve. Approach, NetComm builds the right solution to fit every operators' exact needs, improving not only the service offered, but also taking into account the installation process to reduce the total cost of ownership (TCO).

GLOSSARY	
ITU	International Telecommunications Union
POTS	Plain Old Telephone Service
ADSL	Asymmetric Digital Subscriber Line
VDSL	Very-high-bit-rate Digital Subscriber Line
FTTN	Fibre-to-the-Node
FTTB	Fibre-to-the-Building
FTTH	Fibre-to-the-Home
DPU	Distribution Point Unit
NTD	Network Termination Device
CPE	Customer Premises Equipment
RPU	Reverse Power Unit
GPON	Gigabit Passive Optical Network
MDU	Multi-Dwelling Unit
SDU	Single Dwelling Unit
PMA	Persistent Management Agent
PMAA	Persistent Management Agent Aggregator
ROI	Return on Investment

About NetComm

NetComm is a global developer of solutions that bridge the gap between fibre and the end-user. In a world where everyone's connected life matters – no home, device or machine is too hard to connect. Fibre networks create new revenue streams while delivering the minimum bandwidth needed by all today, but the final connection of fibre to end-user equipment has proven to be challenging. New technologies such as VDSL, Gfast, 4G and 5G are therefore used to speed up deployment and reduce costs. At NetComm we understand that no one-solution fits all. Every operator is different, so we build the right technology, enclosure and size, to meet specific network, market and geographic conditions worldwide.

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