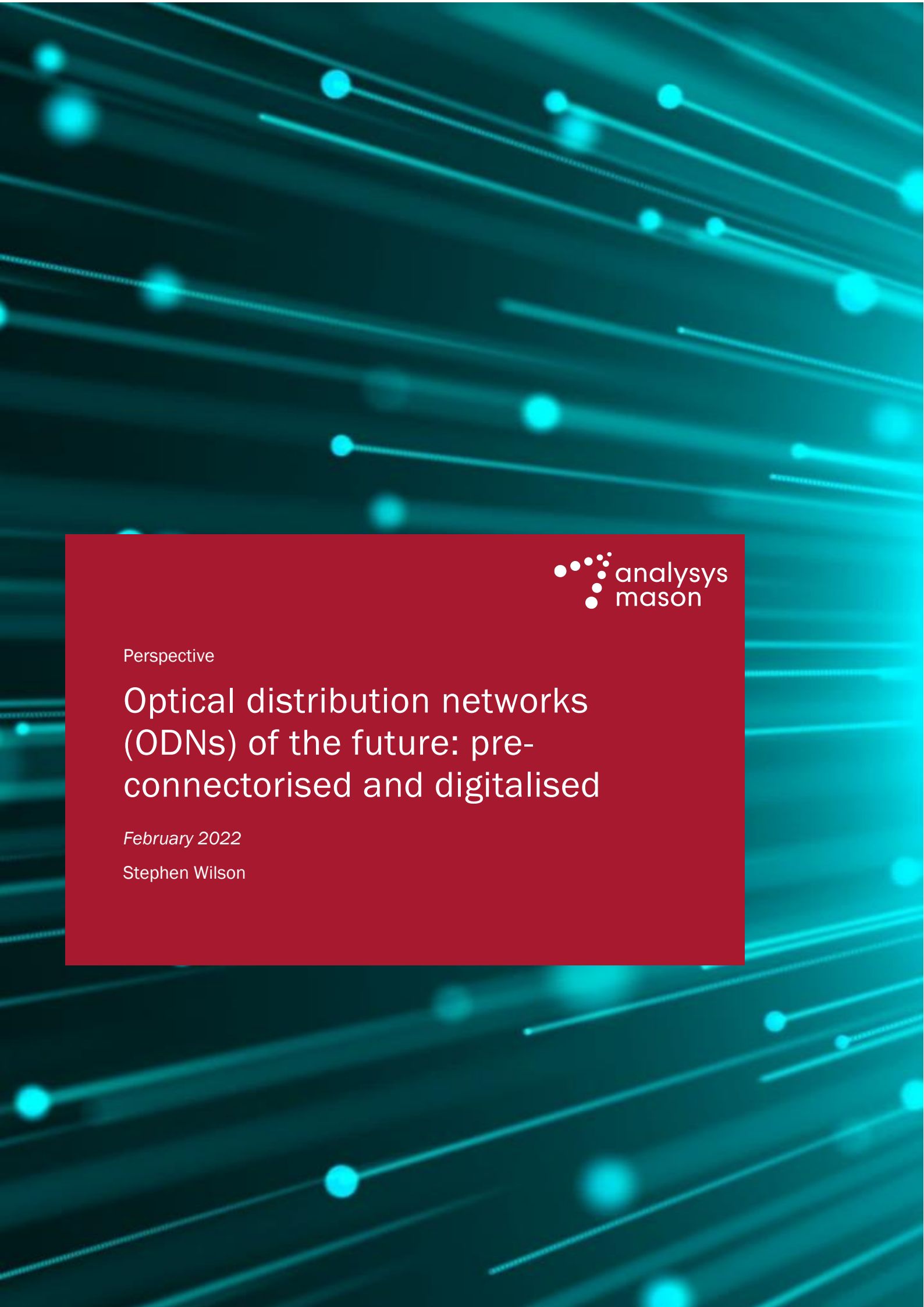


analysys mason

Perspective

Optical distribution networks (ODNs) of the future: pre-connectorised and digitalised

February 2022

Stephen Wilson

Contents

List of figures

1. Executive summary

This report examines the value of innovation in FTTP operators' optical distribution networks (ODNs). As FTTP coverage and subscriber numbers increase in the coming years, operators will need to strive to keep costs down, roll out FTTP rapidly, perform subscriber installations quickly and deliver an optimal customer experience, for example, by rapidly rectifying faults when they occur. In order to meet these challenges, operators will need to assess how they can transform their ODNs and make use of new technologies.

This report looks at the future evolution of FTTP operators' ODNs in terms of the benefits of deploying pre-connectorised fibre and digitalising the ODN. The report discusses the value of pre-connectorised fibre and digitalisation of the ODN based on the results of a survey of 15 operators carried out by Analysys Mason. In addition, it provides quantitative information on the expected rate of growth in the proportion of new FTTP homes that are passed with pre-connectorised fibre and explains the drivers behind the expected increase. The report also discusses the state of the vendor landscape for boxes for pre-connectorised fibre used in FTTP networks. With regard to ODN digitalisation, the report assesses the prospects for future take-up and outlines the factors that will encourage its adoption.

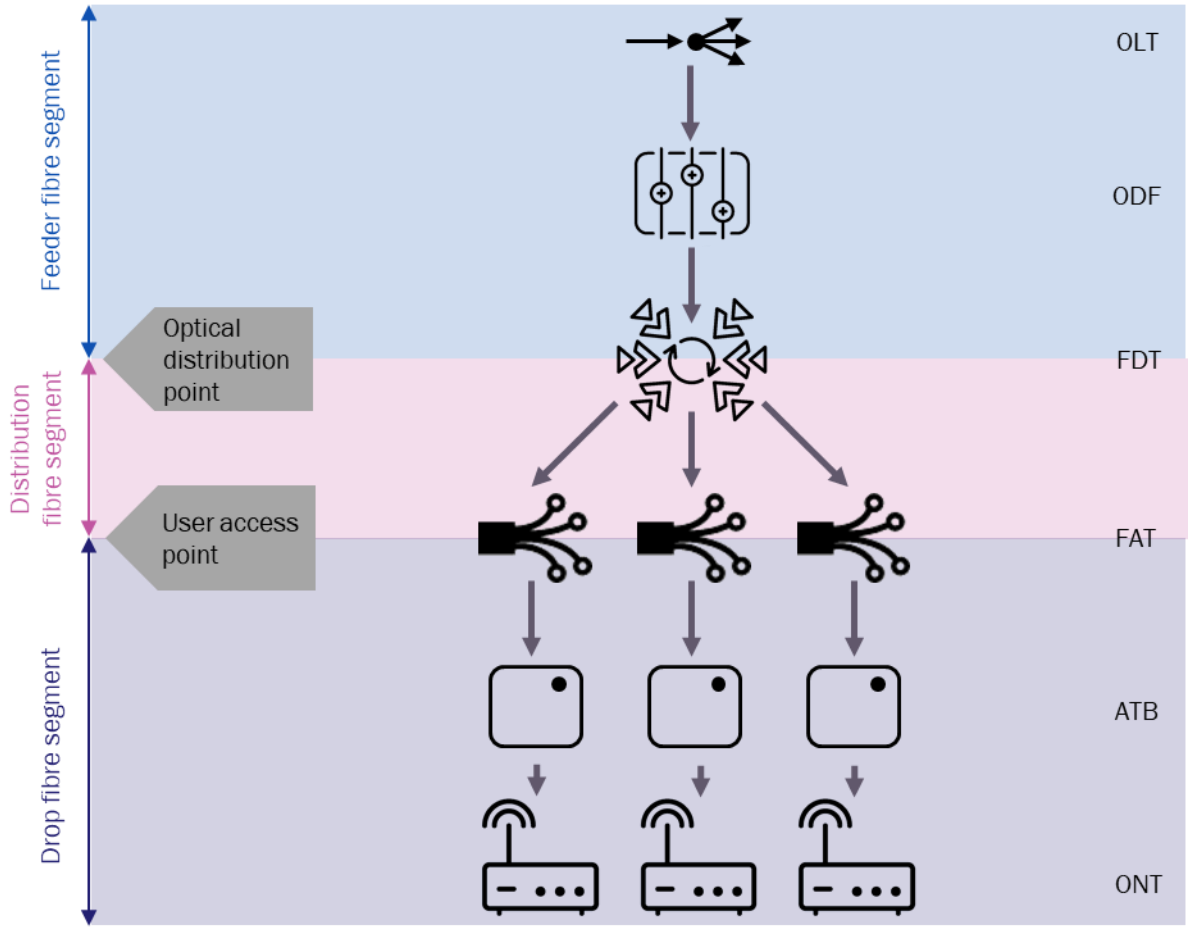
To conclude, the report provides some recommendations for FTTP operators that are examining how they can promote innovation throughout the ODN lifecycle.

2. ODN-related innovations can reduce FTTP roll-out costs, speed up deployments and deliver convenience for subscribers

2.1 Overview of the ODN

ODNs are the physical fibre networks used by FTTP operators. These networks can be broadly split into three segments: feeder, distribution and drop fibre (Figure 1). The feeder fibre network connects the optical line terminals (OLTs), the optical distribution frames (ODFs) and the fibre distribution terminals (FDTs). From here, the distribution fibre segment connects to fibre access terminals (FATs). The feeder and distribution segments of the ODN are those that an operator builds during the homes passed phase of FTTP roll-out. For the homes connected phase of FTTP roll-out, when a subscriber signs up for the service, drop cables are run from the FATs to access terminal boxes (ATBs) and subscribers' homes.

Figure 1: Schematic of an FTTP operator's ODN



Source: Analysys Mason, 2022

As operators roll out FTTP, one ODN-related challenge that they must address is how to connect the different segments of fibre cable. Various options are available to join fibre cables and in the next section of this report we discuss their relative merits.

The ODN has traditionally been non-digitalised and has relied on manual record keeping. However, manual recording and labelling of ODN resources is error-prone and can, for example, lead to difficulties in understanding which ports are connected to which homes. In order to address challenges related to the management of ODN resources, operators need to look at opportunities to introduce digitalisation into their ODNs, which we discuss in section 2.3 of this report.

It is also important to note that the growing importance of pre-connectorisation and digitalisation in the ODN is reflected in the work of standards bodies. ETSI, for instance, has examined approaches covering both these areas.[1]

1 https://www.etsi.org/deliver/etsi_tr/103700_103799/103775/01.01.01_60/tr_103775v010101p.pdf.

2.2 ODN trend 1: the use of pre-connectorised fibre

Fibres in the feeder, distribution and drop segments of the ODN need to be connected to each other. Historically, this has been done by splicing two lengths of fibre cable together. In so-called 'fusion splicing', the ends of the fibre cables are lined up and then welded together. However, the drawbacks to such an approach are that fusion splicing can be a lengthy process and also requires expensive specialised splicing equipment and skilled splicers.

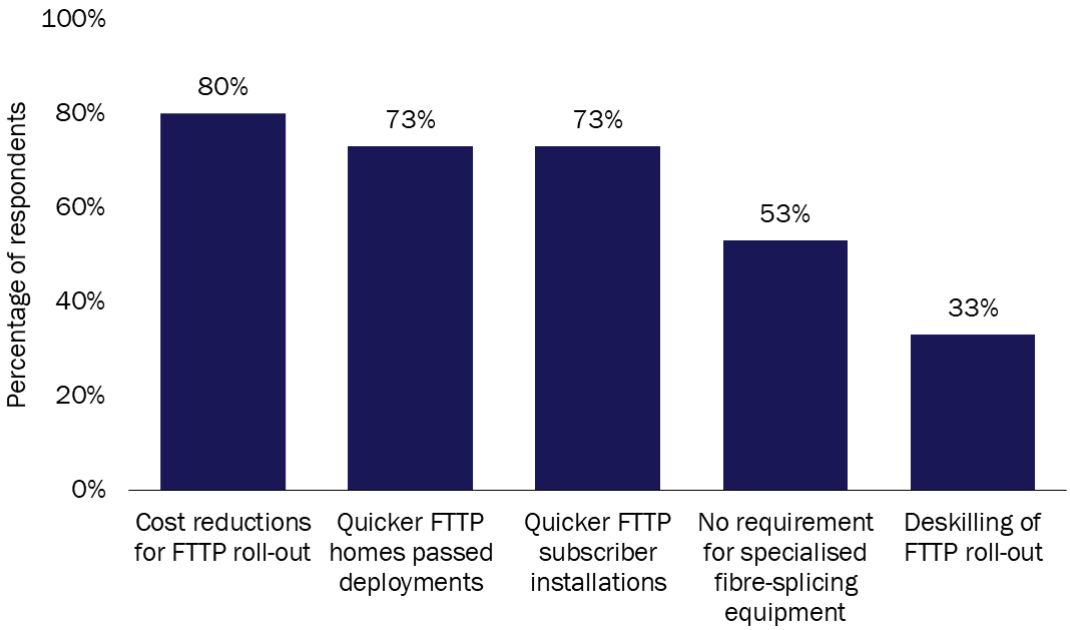
Alternatively, operators can join together fibre cables with connectors, which can in effect be plugged into each other. Field fit connectors refer to those that are added to fibre cables as workers are in the process of conducting the roll-out. However, while this removes the need for splicing equipment and skilled splicers, it can introduce reliability problems; for example, because water or dirt could get into the connection.

Pre-connectorised fibre refers to when connectors are added to the fibre cable in the factory. For this report, we define pre-connectorised fibre as those that use hardened connectors that can be exposed to the elements. The results of our survey of 15 FTTP operators worldwide demonstrate that deployments using pre-connectorised fibre can bring multiple benefits to FTTP operators (Figure 2).

Pre-connectorised fibre can reduce costs. While the initial material costs may be higher, pre-connectorised fibre removes the need for skilled splicing labour (a scarce resource in some territories), and avoids the need for fibre-splicing equipment. Deploying pre-connectorised fibre is quicker than using spliced fibre, which can also help to reduce labour costs while enabling operators to quickly begin to monetise their networks and meet government roll-out coverage targets.

The use of pre-connectorised fibre can also assist operators during the subscriber installation phase. Splicing fibre cables together can take up to 30 minutes at each end of the cable, a total of 60 minutes splicing time per installation. However, this can be reduced to below 10 minutes (5 minutes at each end of the cable) when using pre-connectorised fibre. This improvement in the speed of installation can have a noticeable impact on the customer installation experience, a metric that FTTP operators are beginning to track carefully. Delivering a positive customer installation experience can lead to potential benefits in improved customer satisfaction and subscriber take-up.

Figure 2: Benefits of pre-connectorised fibre solutions[2]



Source: Analysys Mason, 2022

2.3 ODN trend 2: digitalisation in the ODN

Another innovation that will be fundamental to the ODNs of the future is digitalisation, which involves the automation of construction, installation and maintenance processes. Digital tools such as AI-driven image-recognition and mobile apps can be used to significantly increase efficiency in processes that were previously long-winded and labour-intensive. Our survey of 15 operators indicates the multiple benefits that they expect from the digitalisation of ODNs (Figure 3).

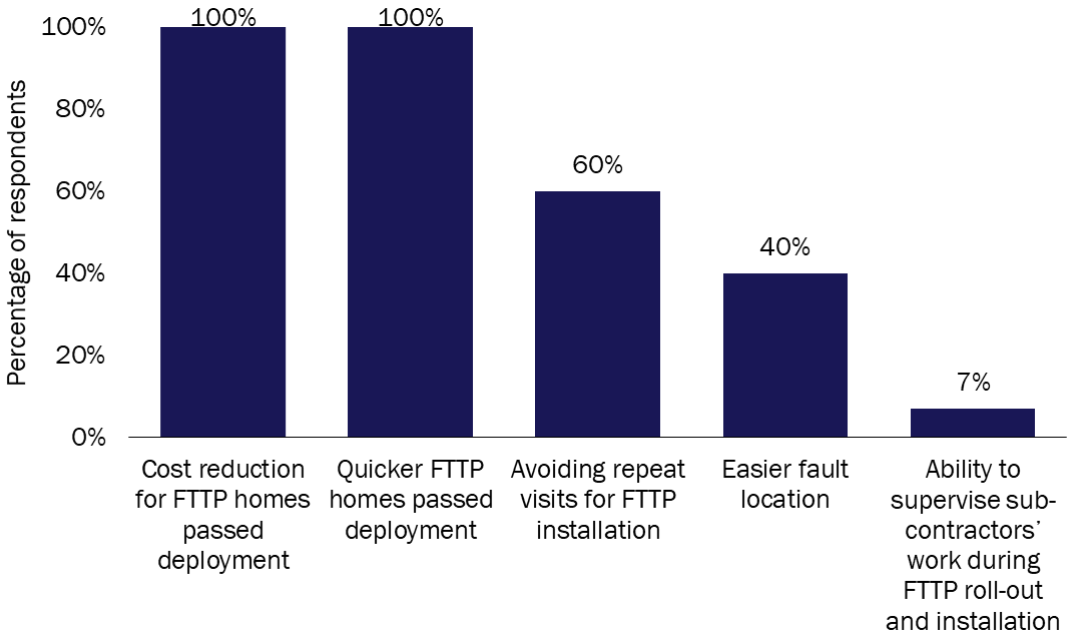
Digitalisation of the ODN can play an important role during the network construction phase. This is because it can provide better visibility of an operator's fibre network, which is important when, as is often the case, FTTP roll-outs are conducted by sub-contractors. During the construction phase of FTTP roll-out, digitalising the ODN means that roll-out standards can be quickly verified. This will result in a more cost effective, quicker and higher quality roll-out while also potentially removing the need for the use of specialised equipment like handheld optical time-domain reflectometers (OTDRs).

Digitalisation also has an important role to play in the FTTP subscriber installation phase. Up to 30% of FTTP installations can require a second engineer visit, for example, if fibres have been connected to the wrong ports. This problem can be avoided by uploading ODN resource information with AI-based image recognition technology and a mobile app. This can ensure that engineers have accurate information before performing FTTP installations and can remove the need for preparatory site visits to check on port availability. As FTTP subscriber numbers grow, and in some cases all fibre ports at drop locations are already in use, it will become ever more important for operators to have correct information on port usage to avoid the risk of disappointing potential subscribers.

2 Question: respondents were asked what the most important benefits of pre-connectorised fibre solutions for FTTP networks are; n = 15.

During the FTTP maintenance phase operators can benefit from the use of mobile apps that have accurately recorded the position of ODN resources. This can then allow much faster identification of potential fault locations and reduce the time taken for troubleshooting. Combined with remote diagnosis tools that can help to identify the nature of faults, troubleshooting time and the number of unnecessary site visits can be significantly reduced, which will result in sizeable cost savings and more satisfied subscribers.

Figure 3: Benefits of digitalising the ODN[3]



Source: Analysys Mason, 2022

3. FTTP deployments using pre-connectorised fibre and a digitalised ODN will continue to grow

3.1 FTTP market context and forecast

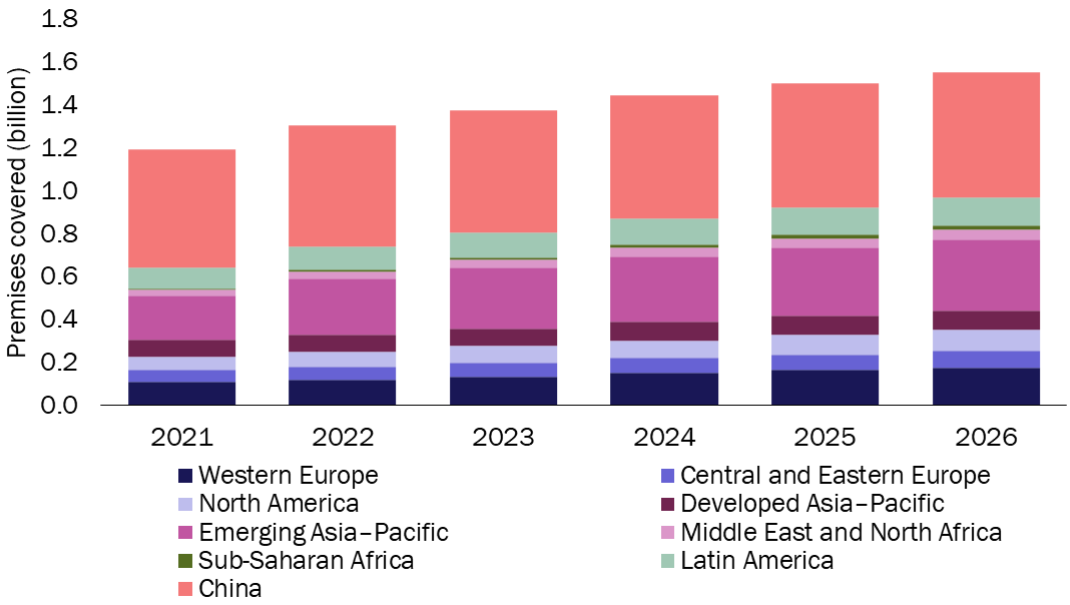
FTTP investment is at very high levels worldwide and the COVID-19 pandemic has heightened the need for ubiquitous and reliable fibre connectivity. As an illustration of the level of interest in FTTP, Analysys Mason estimates that worldwide FTTP coverage was around 49% of total premises worldwide at the end of 2021 and forecasts that this number will increase to about 61% by 2026 (Figure 5). This means around 361 million premises will be passed with FTTP for the first time over the forecast period. Moreover, the amount of overbuild between competing FTTP networks will increase. We estimate, for example, that non-incumbent operators will increase their FTTP coverage of premises from 37% worldwide at the end of 2021 to 46% at the end of 2026, and much of this growth will be in areas that are also covered by incumbents. These figures are impressive, but they also underestimate the scale of interest in FTTP roll-outs worldwide because they are

3 Question: respondents were asked what the most important benefits of digitalisation of the FTTP ODN are; *n* = 15.

skewed by FTTP roll-outs in China, the world's most populous country, where most premises are already covered by FTTP.

Growth in FTTP coverage is a worldwide phenomenon and reflects the fact that FTTP roll-outs will continue in developed **and** developing nations. We expect FTTP coverage in India, for example, to grow significantly to reach 43% of premises by the end of 2026. Another region of note is LATAM, where FTTP will cover 57% of premises at the end of 2026 up from 45% at the end of 2021.

Figure 4: FTTP premises passed, by region and China, 2021–2026



Source: Analysys Mason, 2022

The growth in the number of FTTP premises passed during the forecast period will also translate into a significant increase in the number of FTTP subscribers. We estimate that the total number of global FTTP subscribers will increase from 809 million at the end of 2021 to 1.112 billion at the end of 2026. This growth in subscriber numbers will reinforce the importance to fibre operators of ensuring that they have developed a well-designed and cost effective FTTP subscriber installation process.

3.2 Forecast for new FTTP homes passed with pre-connectorised fibre in the ODN

Pre-connectorised fibre is widely used both by operators in developed markets, for example, in North America and parts of Western Europe, but also in lower-income markets particularly those in Latin America. This reflects the fact that pre-connectorised fibre is a flexible solution that can cater to the needs of many kinds of operators. In Asia, the world's most populous continent, operators have so far generally preferred to use spliced fibre. The large scale of roll-outs in Asia means that spliced final fibre drops were more common worldwide than pre-connectorised drops in 2021. However, we believe that the proportion of new FTTP homes passed by pre-connectorised fibre in the ODN will increase. This trend will be driven by a number of factors.

- **Growing cable and copper migration to FTTP.** Cable operators may lack the in-house skills for fibre splicing and pre-connectorised fibre offers an attractive way for such operators to redeploy their existing

workforce. As HFC networks come under increasing strain, more cable operators will upgrade to FTTP and use pre-connectorised fibre. Some incumbents and altnets that have relied on copper may also lack splicing expertise and prefer to use pre-connectorised fibre.

- **Growing number of FTTP roll-outs from mobile operators and other new entrants.** Mobile operators that deploy FTTP may lack expertise in fibre splicing, which will encourage them to use pre-connectorised fibre. New FTTP entrants without a background in telecoms are also likely to use pre-connectorised fibre.

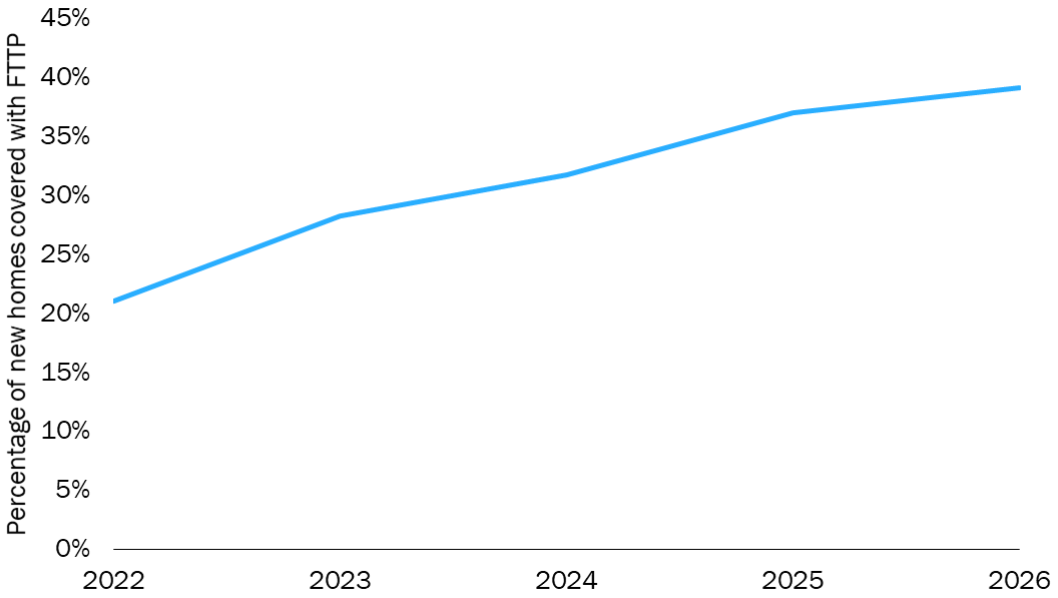
- **Governmental targets for FTTP coverage.** With current deployment plans, most European countries will miss the European Commission 2025 target for all households to have access to downlink speeds of at least 100Mbit/s upgradeable to 1Gbit/s. Pre-connectorised fibre use can help to speed up roll-outs and close this gap.

- **Growing FTTP overbuild and competition.** Growing interest in investing in FTTP means that operators that are slow to roll out, for instance, because they rely on fibre splicing, risk losing out on first-mover advantage and may be left having to overbuild competitors' FTTP networks. Multiple FTTP roll-outs in the same country can also put pressure on scarce fibre splicing workforce resources, which will push up deployment costs. FTTP roll-outs using pre-connectorised fibre can avoid such challenges.

- **Growth in FTTP subscriber numbers.** Removing the need for fibre splicing during FTTP subscriber installations can reduce the installation time, making it more convenient for subscribers. Moreover, if operators can perform more installations per day this will reduce subscriber waiting times when they sign up for an FTTP plan.

These factors mean that we estimate that the proportion of new FTTP homes passed that use pre-connectorised fibre will increase worldwide from 21% in 2022 to 39% in 2026 (Figure 5). In 2026, 33 million premises will be passed with pre-connectorised fibre. This will reflect the growing number of roll-outs in regions where pre-connectorised fibre already predominates, such as Latin America. In regions where FTTP roll-outs are nascent, such as Sub-Saharan Africa, pre-connectorised fibre usage will grow because operators that roll out FTTP will often be mobile operators that lack expertise in fibre splicing. In Asia, we forecast that some larger operators in markets such as the Philippines that have a growing amount of FTTP overbuild will adopt pre-connectorised fibre.

Figure 5: Share of new FTTP homes passed using pre-connectorised fibres in the ODN, worldwide, 2022–2026

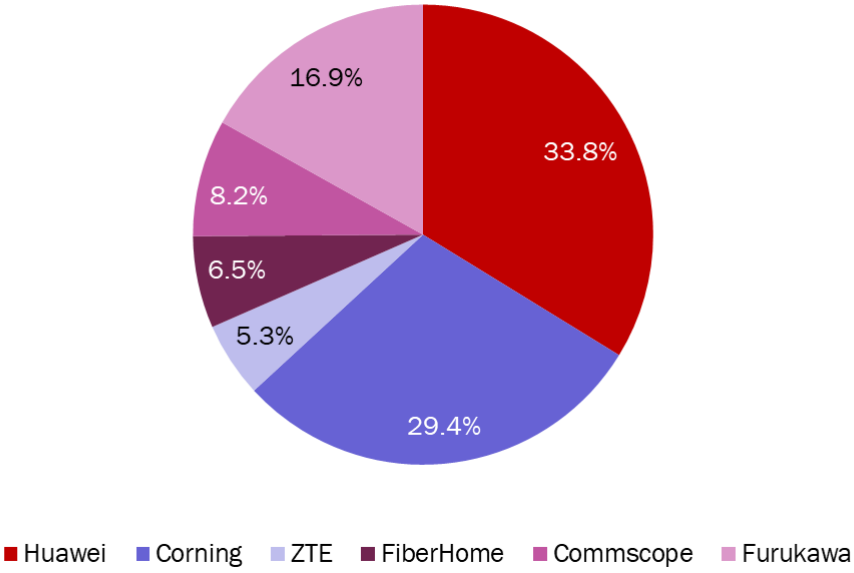


Source: Analysys Mason, 2022

3.3 Vendor market share for new FTTP homes passed with pre-connectorised fibre

Analysys Mason has also researched developments in vendor market shares for boxes using pre-connectorised fibre in the ODN. As part of this research, we surveyed 15 leading FTTP operators worldwide and asked them about the share held by different pre-connectorised box vendors in their ODN. We also analysed vendor announcements on contract wins and vendor statements on number of homes passed with pre-connectorised fibre. The chart below shows the market share of the world's six largest vendors for new FTTP homes passed using pre-connectorised fibre in the ODN in 2021.

Figure 6: Share of new FTTP homes passed with pre-connectorised fibre, top-six vendors, worldwide, 2021

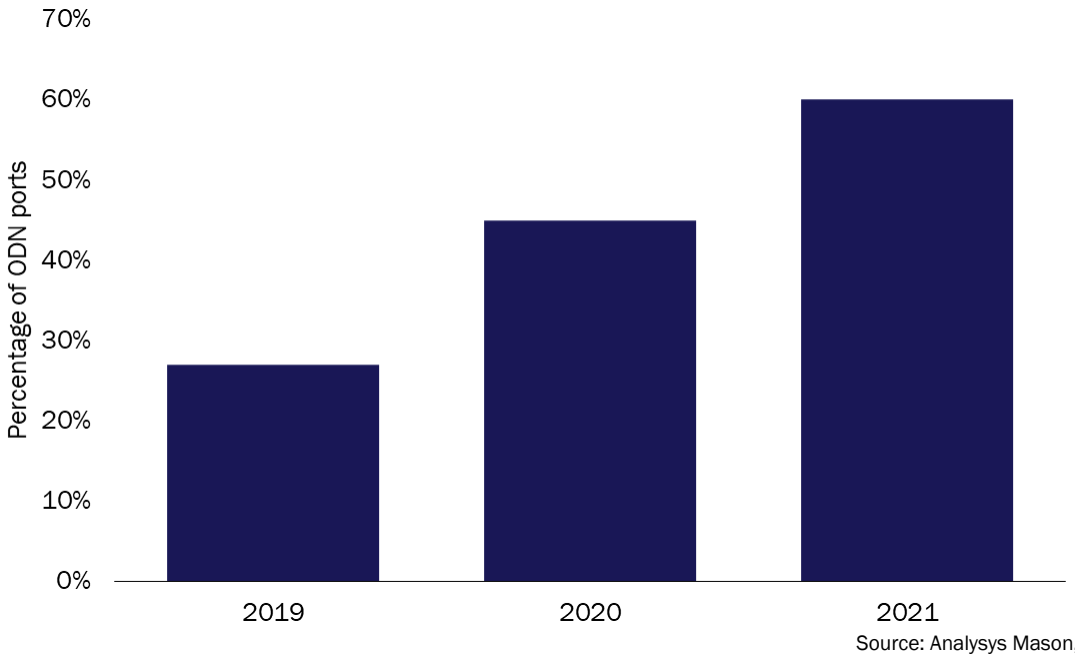


Source: Analysys Mason, 2022

3.4 Growth prospects for digitalisation in the ODN

Most FTTP operators have yet to digitalise their ODN but operators are moving in this direction. For example, one vendor notes that 60% of its ODN port shipments incorporate digitalisation via QR codes (Figure 7). In addition, this figure is likely to grow over time as operators increasingly see the benefits of digitalising their ODNs.

Figure 7: Share of ODN ports that support digitalisation via QR codes, one major vendor, 2019–2021



Source: Analysys Mason, 2022

We believe that ODN digitalisation will increase significantly over the next few years for the following reasons.

- **Growth of FTTP overbuild.** Growing fibre overbuild means that simply rolling out FTTP will not be sufficient to achieve success. Rather, operators will need to use ODN digitalisation to stand out from competitors by ensuring a high-quality build, efficient subscriber installations and rapid localisation and repair of faults.

- **Increased challenges with traditional ODN resource management.** As the coverage of FTTP deployments grows and FTTP subscriber numbers increase, it will become more and more difficult for operators to continue to manually record ODN resources. Manual record keeping will become increasingly complex and unmanageable and will act as an incentive for operators to digitalise their ODNs.

- **Growth in FTTP subscriber installations.** As the number of FTTP subscribers increases and subscribers increasingly switch between overlapping FTTP infrastructure it will be imperative for operators to perform fibre subscriber installations efficiently and reliably. ODN digitalisation can help to achieve these goals by significantly reducing repeat visits for subscriber installations.

- **Growing emphasis on maintaining the ODN.** FTTP is positioned as a premium solution and the COVID-19 pandemic has reinforced the value of reliable connectivity. This means that operators will place considerable value on tools that can help them to deliver an optimal customer experience. ODN digitalisation can help to achieve these objectives by making it easier and quicker to find faults.

4. Recommendations: pre-connectorisation and digitalisation are major trends in the FTTP space

- **FTTP operators must consider the benefits of deploying pre-connectorised fibre in the ODN.** The widespread deployment of pre-connectorised fibre in North and South America shows it is a solution for operators in markets with differing income levels and costs bases. Moreover, pre-connectorised fibre can appeal to operators with different backgrounds and without experience in fibre splicing, such as cable operators upgrading to FTTP or completely new FTTP entrants.

- **FTTP operators must focus on the speed of covering homes and subscriber installations.** The investor community is showing huge interest in FTTP deployments and this increases the risks of operators losing first-mover advantage if they are slow to deploy. Using pre-connectorised fibre can speed up roll-outs while simultaneously lowering costs. For FTTP installations, pre-connectorised fibre can also speed up the process again lowering costs and in addition delivering convenience for subscribers.

- **FTTP operators should use ODN digitalisation as a tool to ensure fibre sub-contractors have performed their work to the required standard.** Many FTTP operators use sub-contractors for their fibre roll-outs but such sub-contractors may be incentivised to perform work quickly without the required care. Using digital tools to verify the work of sub-contractors can reduce the need for repeat visits and thereby reduce costs and speed up deployments.

- **FTTP operators also need to understand the benefits of digitalising their ODN for both the fibre installation and maintenance phases.** Manual record keeping can produce problems in terms of

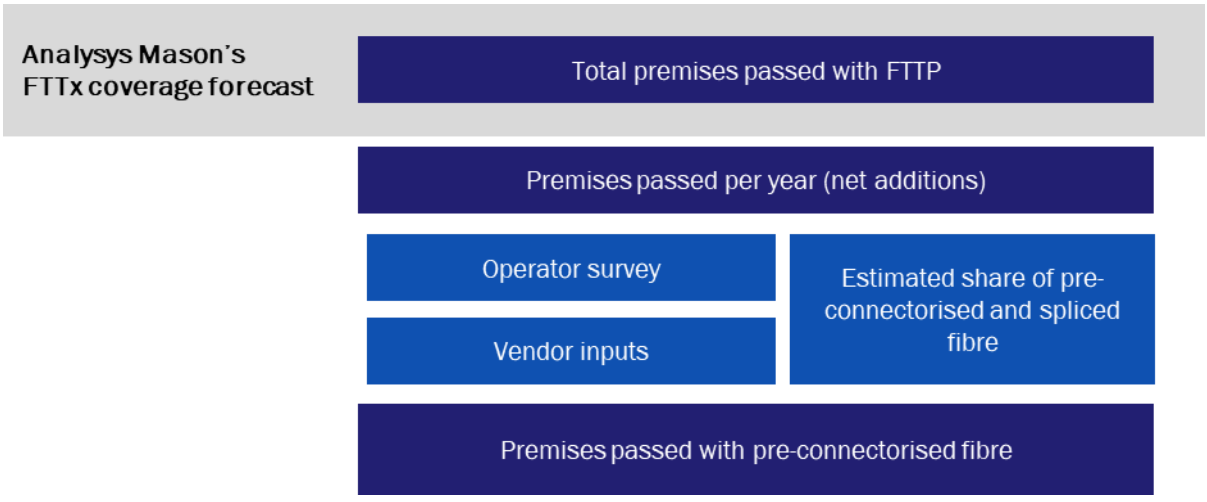
connecting ONTs to the wrong port during the installation phase, which risks leaving customers dissatisfied. Operators can also often struggle to find the precise location of faults in the ODN. ODN digitalisation can avoid these challenges and help to deliver a 'right-first-time' installation and quickly rectify faults when they occur.

5. Annex: methodology

The first objective of our quantitative research was to estimate major vendors' market share of shipments of pre-connectorised ODN boxes based on ports for premises passed. In addition, this research covers the proportion of new FTTP premises passed using pre-connectorised fibre worldwide for the period 2022–2026. It is based on several sources, including the following.

- Analysys Mason's internal research, including our annual fibre coverage forecasts. Our modelling and assumptions are informed by professionals in our offices worldwide.
- Ongoing engagements and additional primary research with stakeholders in the FTTP market, including operators and vendors.
- Analysys Mason's existing research on the number of premises passed with FTTP has been an important input for the estimates and forecasting in this report.[4]

Figure 8: Overview of the methodology used to estimate FTTP premises passed using pre-connectorised fibre



Source: Analysys Mason, 2022

Figure 8 summarises the modelling methodology. Using our FTTP homes passed research, we have estimated the number of new FTTP premises passed (net additions) per year in the period 2022–2026, by country and operator type (that is, incumbent or others), based on operators' reported plans. The share of these net additions using either pre-connectorised fibre or spliced fibre has then been estimated on a country and operator basis.

4 For more information, see *FTTx coverage and capex: worldwide trends and forecasts 2020–2026.*

This results in the share of new FTTP homes passed worldwide using pre-connectorised fibre during 2022–2026.

In order to formulate the parameters of the model, we have used additional primary research, as well as vendor inputs on the shipments of boxes for pre-connectorised fibre. A long list of major fibre network operators, accounting for almost 70% of premises passed worldwide, were invited to take part in an operator survey, resulting in 15 respondents having completed the survey in February 2022. Respondents to the survey were technical leaders in charge of the roll out of FTTP networks in major national markets. This survey asked about operators' strategies regarding the use of pre-connectorised fibre in their ODN networks, which vendors the operator has chosen to collaborate with and their plans over the next few years.

6. About the author

Stephen Wilson (Principal Analyst) leads Analysys Mason's *Fixed Broadband Services* and *Fixed–Mobile Convergence* research programmes. He leads Analysys Mason's annual FTTx coverage, capex and conversion forecasts, and other recent areas of focus include examining the retail tariff strategies employed by operators for early launches of 5G fixed-wireless access (FWA). Stephen has more than 12 years of experience in the telecoms sector and is a graduate in Philosophy, Politics and Economics from St Catherine's College, Oxford University.