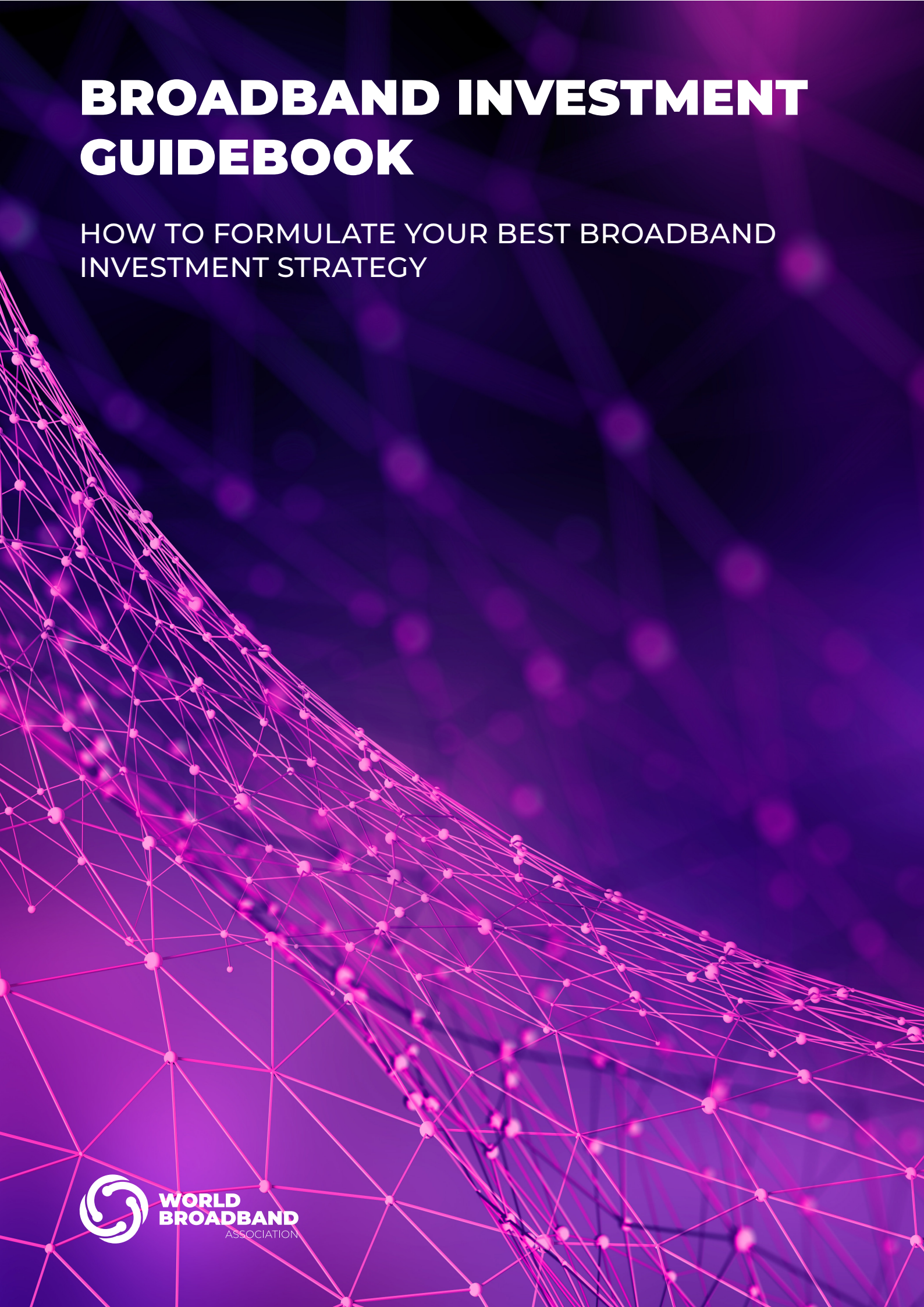
BROADBAND INVESTMENT GUIDEBOOK

HOW TO FORMULATE YOUR BEST BROADBAND INVESTMENT STRATEGY



WORLD BROADBAND ASSOCIATION

This guidebook provides guidance for stakeholders examining investment in broadband infrastructure. It provides insight on the key metrics stakeholders must consider, the ways in which broadband infrastructure investment can be made more viable as well as potential financing and business models for broadband infrastructure deployment.

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INTRODUCTION

This guidebook provides guidance and advice to all stakeholders considering investment in broadband infrastructure. The guidebook provides actionable insights related to broadband investment to stakeholders including the investment community, operators, and government and regulatory authorities. It comprises the following sections:

- An overview of the key trends in global broadband investment
- An analysis of the key supply, demand, and profit metrics for broadband investment
- An analysis of the challenges to broadband investment and how to improve the viability of broadband infrastructure development
- An analysis of the different funding models that can be used to enhance broadband infrastructure
- An analysis of the business models for broadband infrastructure

EXECUTIVE SUMMARY

- Interest in investing in broadband infrastructure is high, and there is a particular focus in many countries on investing in fiber-to-the-premises (FTTP) rollouts. In addition, in some countries there is a growing emphasis on investing in next-generation Passive Optical Network (PON) FTTP technologies.
- Investors in broadband infrastructure need to be aware of the key metrics that will help to determine the business case and how these metrics can vary depending on particular rollout circumstances. On the cost side investors must consider costs per premises passed and connected, and on the demand side subscription take-up rates per premises passed and ARPUs are relevant. For investment profitability investors can assess metrics such as return on investment, net present value, and payback period.
- All stakeholders should assess the many ways in which the viability of investment in broadband infrastructure can be improved. Broadly speaking, stakeholders can analyze measures that can help stimulate demand for broadband, initiatives that seek to reduce network rollout costs, operational best practices, policy and regulatory measures, and financing innovation.
- Many different funding models can be used to finance the rollout of broadband infrastructure. Operators will need to assess whether they can finance rollouts alone; an alternative option is to partner with other players to finance rollouts. Fiber carve-outs, where the operator splits off its current and/or future FTTP network into a separate subsidiary and ownership of this asset may be shared between the operator and the third party, have become common. Pure public financing and public-private partnerships also have a role to play in financing the rollout of broadband infrastructure.
- Investors in broadband infrastructure have many options when choosing a business model, and different business models will be most appropriate in different circumstances. Investors can choose from a range of options including adopting a vertically integrated model with a single retail service provider or using a wholesale-only business model. Vertically integrated models with no wholesale access offer the potential for the highest ARPUs but risk lower subscription take-up and may not match with the provision of public funding for broadband infrastructure deployment.

HOW TO USE THIS GUIDEBOOK

All stakeholders, whether from operators, governments, regulators, or the financial community, can deepen their understanding of broadband infrastructure investment by consulting this guidebook. The guidebook lays out the options for these different stakeholders that are looking to make a success of investment in broadband infrastructure. Its aim is to provide food for thought and help stakeholders understand which of the various options, for instance, for financing broadband rollouts, is most appropriate to their particular circumstances.

For those just embarking on considering investment in broadband infrastructure the guidebook provides useful input on the basic metrics that will determine the business case (see ***The key metrics stakeholders must consider when investing in broadband infrastructure***). For more seasoned investors the guidebook provides comparisons of how these key metrics such as cost per premises passed can vary between and within countries.

The guidebook will also assist stakeholders that are wrestling with questions of how to improve the business case for investing in broadband infrastructure. It contains a nonexhaustive list (see ***Improving the viability of investment in broadband infrastructure***) of measures that can help stakeholders come up with new innovations for their rollouts.

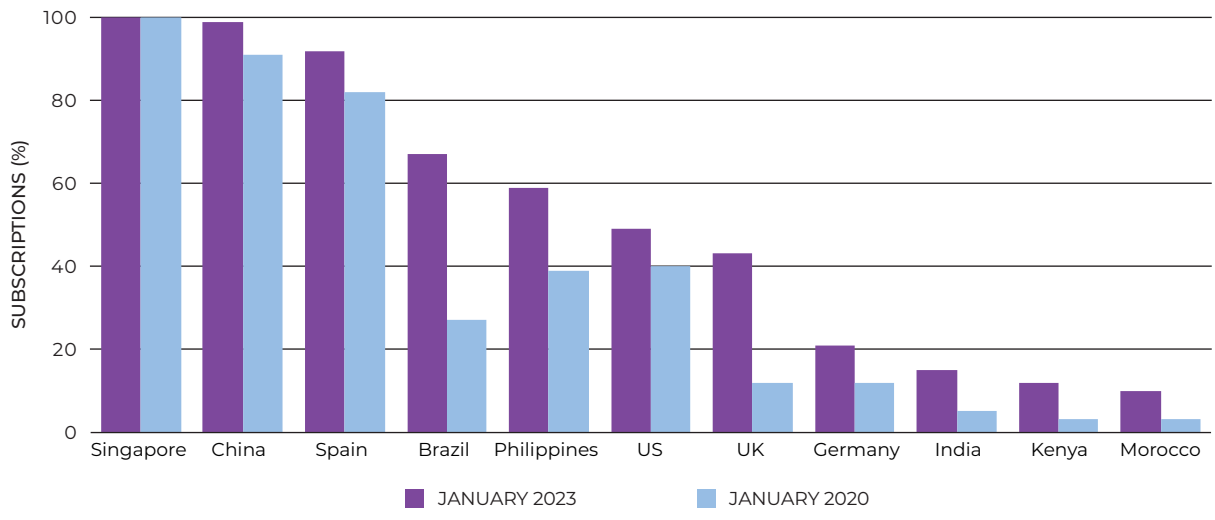
Those considering how to finance a broadband infrastructure rollout can use the guidebook to look at all the different options available and discover which mechanisms have been chosen and why in different cases (see ***Broadband financing model choices***). Public authorities can analyze which financing mechanisms have been chosen by their peers and assess which option provides the best fit for their circumstances.

The guidebook can also serve as a source of inspiration for stakeholders that are considering which business model—for instance, a vertically integrated model with wholesale access or a wholesale-only model—to choose for their broadband infrastructure rollout. The section ***Broadband business model choices*** can help stakeholders decide which model will work best for them and why.

GLOBAL BROADBAND INVESTMENT: AREAS OF FOCUS

Much of the global focus of investment in broadband infrastructure is on the rollout of FTTP. This is demonstrated by the way the percentage of premises in a country that are passed with FTTP has increased over recent years across countries in all global regions (see **Figure 1**). In addition, in many markets there is a substantial amount of FTTP overbuild such that more premises are being covered by more than one FTTP network. The growth in FTTP coverage does not also mean there is no interest in investment in other broadband technologies. For instance, over recent years there has been a substantial amount of investment in fixed wireless access (FWA) in the US as the number of subscribers using this technology has increased substantially.

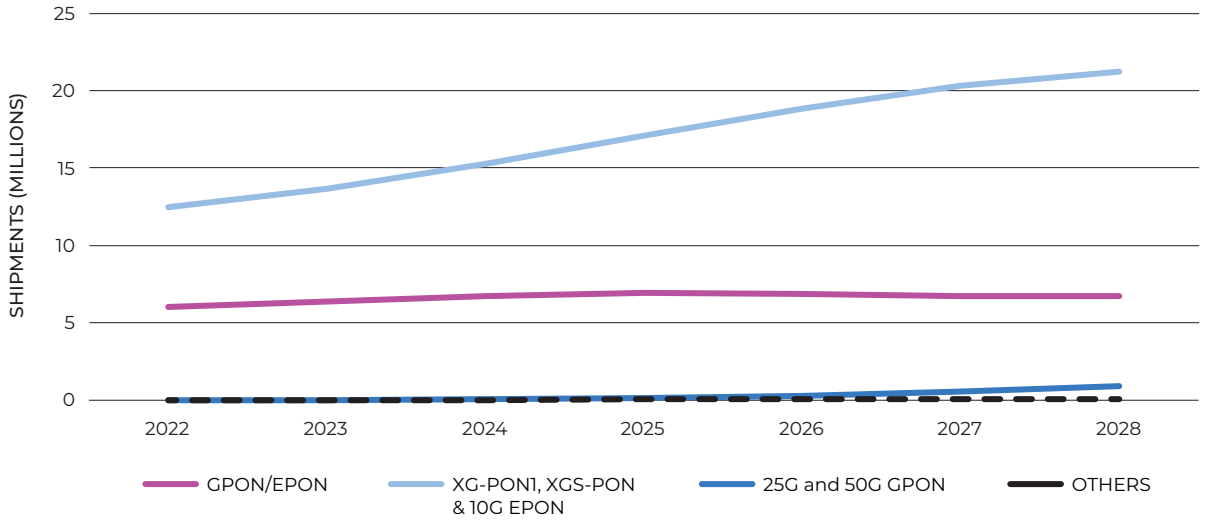
FIGURE 1: SELECTED COUNTRIES, FTTP COVERAGE OF TOTAL COUNTRY PREMISES, JANUARY 1, 2020 AND JANUARY 1, 2023



SOURCE: OMDIA

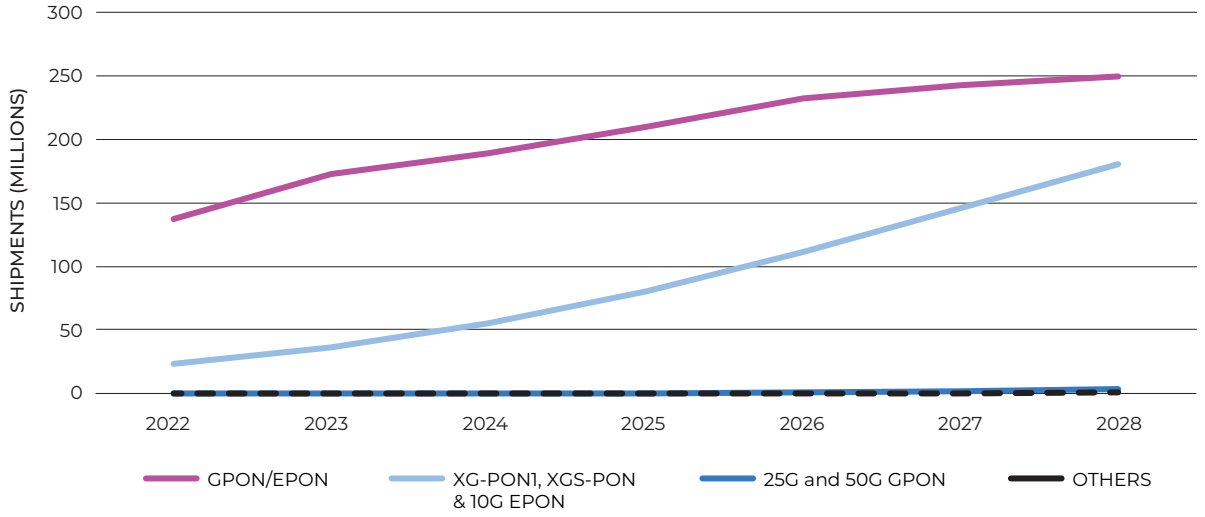
A further important trend for broadband investment is the increasing number of deployments of next-generation PON fiber technologies that can offer shared capacities of 10Gbps and above. This trend is reflected in the growing proportion of optical line terminal (OLT) and optical network terminal / optical network unit (ONT/ONU) shipments accounted for by these technologies (see **Figure 2** and **Figure 3**).

FIGURE 2: GLOBAL PON OLT PORT SHIPMENTS, 2022–28



SOURCE: OMDIA

FIGURE 3: GLOBAL PON ONU/ONT PORT SHIPMENTS, 2022–28



SOURCE: OMDIA

There is also investment in networks aside from last mile access networks. For datacentre networks (DCN), AI elaboration needs are increasing sharply. An AI request is estimated to require 10 times the elaboration needs of a traditional web search and in addition the number of customers using generative AI is increasing. In this context the DCN has to properly connect the compute elaboration of GPUs and CPUs. DCNs with speed of 400Gbps will become prominent in the coming years, with some experimental installation at higher speeds already ongoing. The trend to utilize standard Ethernet (400GE) switches in this domain is growing and such investment can prove beneficial.

In the WAN network domain, the need to properly connect the end user and the application sitting in the datacentre will increase. There will be an increase in the usage of 400GE links over

the coming years. The overall increase in speed provides better efficiency and results in lower energy needs to transmit a single data unit. IPv6 and end-to-end technologies like SRv6 enable the use of a single protocol to connect the application to the final user, with a defined path through the access, WAN and datacentre domains. This enables better control of the overall user experience for each service and increases resource utilization efficiency. There is also interest in digital map mechanisms which can implement a digital twin of the network, for instance, to help predict SLA breaches and reduce operational costs.

Investment in in-building Wi-Fi networks is also taking place. For campus, enterprise, and residential broadband networks there is an increasingly shift to using Wi-Fi inside the premises. The newest Wi-Fi products use the Wi-Fi 7 standard, which provides high bandwidth and can support SLAs. Wi-Fi 7 can support new and important applications, such as AR, VR, XR, and remote manufacturing for both business and consumer users. Wi-Fi 7 adoption is expected to grow significantly over the next few years. Across the consumer customer premises equipment (CPE) market (ie those devices purchased through the retail channel) 38% of shipments will be with Wi-Fi 7 in 2027 according to Omdia data.

THE KEY METRICS STAKEHOLDERS MUST CONSIDER WHEN INVESTING IN BROADBAND INFRASTRUCTURE

In order to develop accurate business plans when investing in broadband infrastructure, stakeholders must consider the key metrics that are included in such plans and assess whether their assumptions are realistic. Broadly speaking, the key metrics can be divided into three areas: supply-side metrics such as costs per premises passed, demand-side metrics such as subscription take-up rates per premises passed, and profitability metrics such as return on investment. This section provides guidance on what stakeholders should expect to see in terms of these key metrics.

SUPPLY-SIDE METRICS

The costs of broadband rollout are clearly a key consideration for investors in broadband infrastructure. The two main cost-related metrics relevant to broadband investment are *costs per premises passed* and *costs per premises connected*. Costs per premises passed refers to the cost of covering a premises with the broadband network regardless of whether a subscriber signs up. Costs per premises connected refer to costs that are incurred when a subscriber signs up for service and then must be connected to the network.

A further area to consider is the competitive environment. A relevant metric is the percentage of an operator's planned or actual footprint that is overbuilt by one or more FTTP players. The higher this figure the more challenging it will be to deliver a successful rollout. One point to consider is that even though, all other things being equal, lower costs per premises passed and connected in theory make it easier to deliver a profitable rollout, in some cases these lower costs can encourage greater overbuild, which can then hurt some of the demand-side metrics discussed later in this section.

COST PER PREMISES PASSED

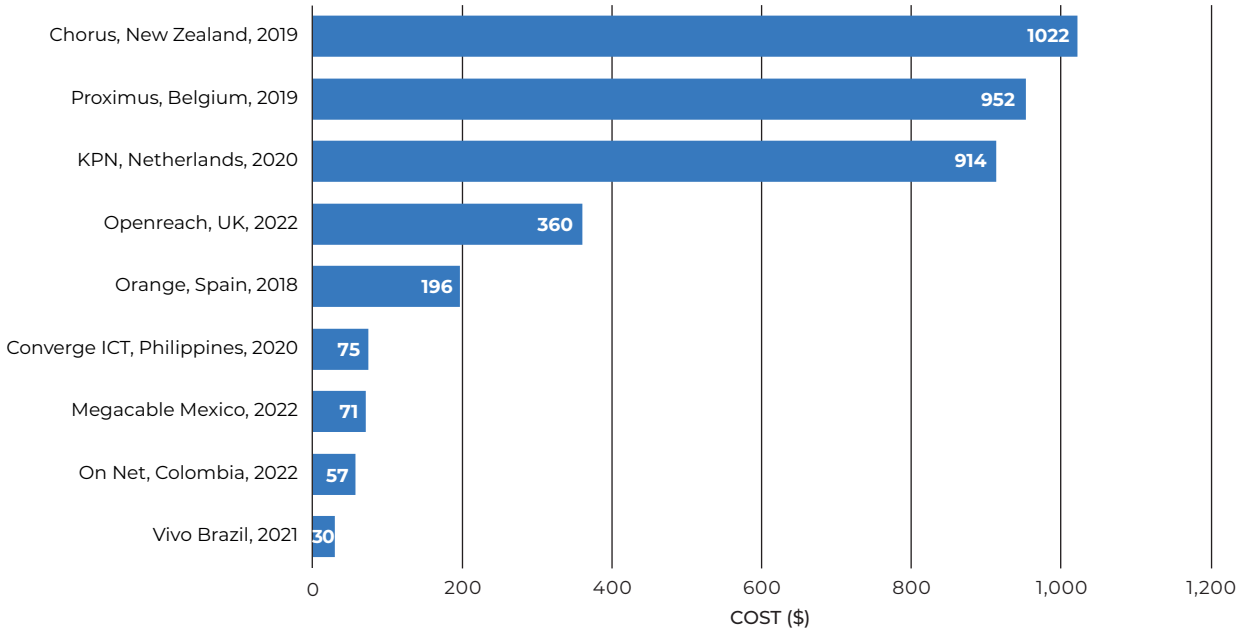
TYPICAL COSTS PER PREMISES PASSED

FTTP costs per premises passed vary hugely by country. Broadly speaking, they can range from thousands of US dollars in the most rural geotypes in developed markets to less than $100 in urban areas in emerging markets (see **Figure 4**).

Investors need to understand the drivers of these differences in order to realistically appraise potential rollout costs for their broadband deployment. Higher labor costs in developed markets mean costs per premises passed are higher there. However, the amount of labor required for a

broadband rollout will also vary depending on the particular rollout. Where good quality ducts and poles are available for FTTP rollout, costs per premises passed will be reduced, but where new ducts need to be built (for instance, in markets where copper cables have been direct buried), costs will be higher. The density of population in a given area will also affect costs per premises passed. In areas with more spread out single-dwelling units, costs per premises passed will be higher because more work will be required to deploy fiber.

FIGURE 4: SELECTED OPERATORS, FTTP COSTS PER PREMISES PASSED, VARIOUS DATES



SOURCE: OMDIA

FTTP equipment costs vary much less between markets. In developed markets the cost of the required civil infrastructure work will form the greatest part of the rollout cost. In emerging markets with lower civil infrastructure costs, equipment costs will form a much higher proportion of costs per premises passed than in developed markets.

VARIATIONS IN COSTS WITHIN COUNTRIES

Stakeholders also need to understand the very large differences there can be in costs per premises passed within the same country depending on the rollout geotype area. Costs can increase hugely as deployments cover the last part of the most rural and remote premises within a country. One example of this is the UK, where regulator Ofcom has noted that for up to 20 million premises (or roughly around two-thirds of the premises in the country) the cost per premises passed for FTTP rollout would always be less than £500 ($634). However, beyond this point costs increase rapidly: the cost of passing the 29 millionth premises would be around £2,400.

These in-country variations also form much of the rationale for government investment in broadband infrastructure in rural areas where operators do not consider their own fully financed infrastructure deployments to be viable. The various means of government funding are discussed in ***Public financing of the broadband infrastructure deployment***.

It is worth noting that in subsequent sections of this guidebook different measures to improve the viability of broadband infrastructure rollout are considered. All stakeholders must carefully consider how the different measures could be relevant in solving broadband rollout challenges in more rural areas.

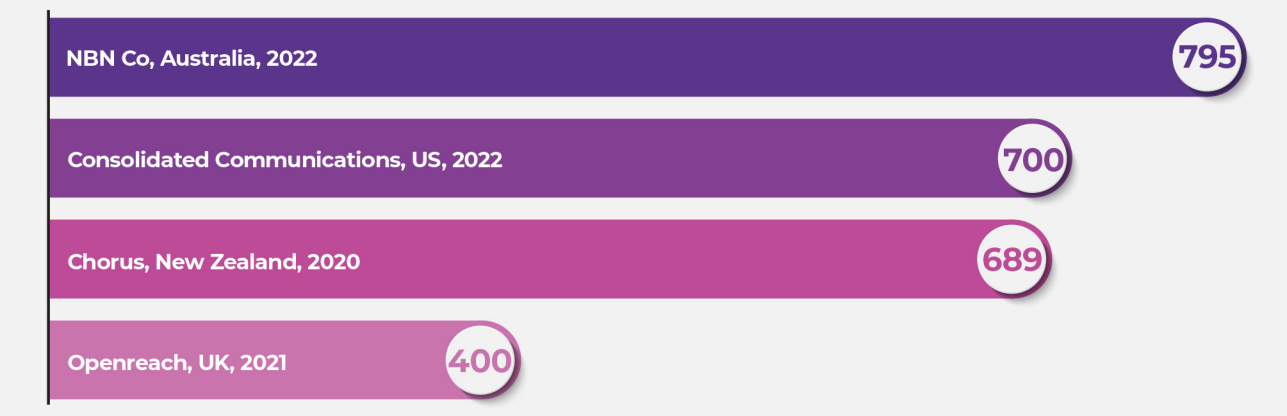
A further point for investors to consider is that many FTTP operators have observed falls in costs per premises passed over time even as they have moved into less dense geotypes. This reflects the opportunities that operators have to learn by doing.

COST PER PREMISES CONNECTED

TYPICAL COSTS PER PREMISES CONNECTED

As with costs per premises passed, costs per premises connected will be affected by labor costs in the particular market. Connecting customers to the FTTP network for the first time will require a visit from workers to install the final fiber drop and connect the ONT. Connection costs will also be higher in markets with bigger properties, for instance, those with large front lawns where more work is required to deploy the final fiber drop. Another factor to consider is that operators have some flexibility in deciding where to stop the homes passed phase of the deployment. If operators are more uncertain about subscription take-up, for instance, in lower-income emerging markets, it might make sense to stop the homes passed rollout further away from end-user premises and thereby switch more of the cost to the success-based cost per home connected element. Some of these factors help to explain the variation in costs per premises connected shown in **Figure 5**.

FIGURE 5: SELECTED OPERATORS, FTTP CONNECTION COSTS (USD), VARIOUS DATES



SOURCE: OMDIA

DEMAND-SIDE METRICS

In order to assess the viability of a broadband investment, stakeholders must also consider demand-side metrics. The two main demand-side metrics are the *subscription take-up rate of premises passed* and the *average revenue per user* (ARPU). The next section discusses in more detail each of these metrics and how they might vary by territory and also over time.

SUBSCRIPTION TAKE-UP RATE OF PREMISES PASSED

WHAT SUBSCRIPTION TAKE-UP RATES SHOULD OPERATORS AIM FOR?

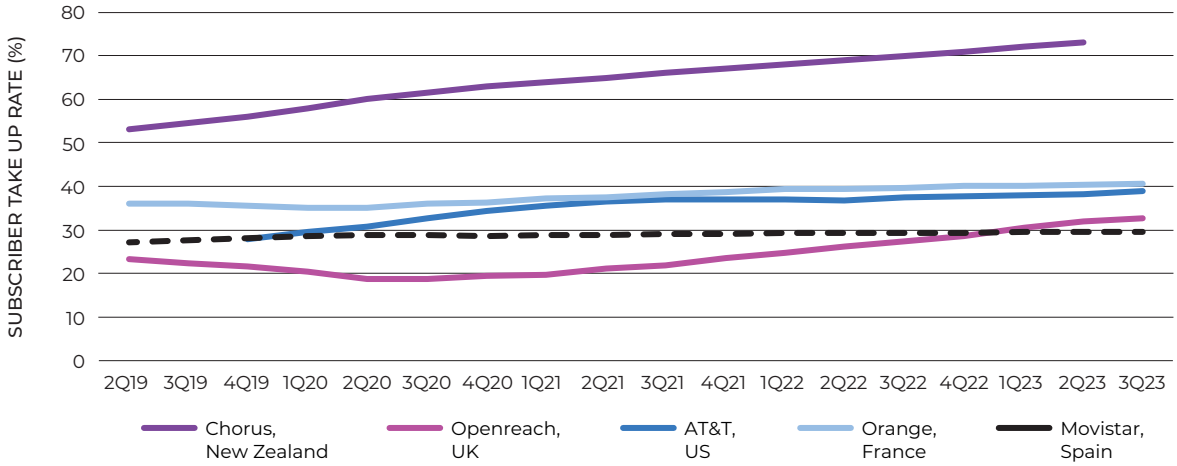
It is not possible to give a hard figure for what a good take-up rate looks like. This is because rollout costs vary so much by territory, time, and technology. All other things being equal, lower costs per premises passed with equivalent ARPUs means a lower subscription take-up rate is required to generate a return on investment. Over time we would also expect take-up rates to increase, for example, as subscribers migrate from legacy broadband technologies such as DSL. In addition, FTTP rollouts will generally have much higher costs per premises passed than fixed wireless rollouts so will require higher subscription take-up rates to generate a return on investment.

One factor investors must also consider is that subscription take-up rates alone may be misleading. For example, if an operator is rapidly increasing its premises passed base, then subscription take-up rates may fall even if the number of subscriptions is increasing rapidly. It is therefore important to consider the importance of take-up rates among particular cohorts representing take-up rates in a given time period from when the premises was passed by the broadband rollout.

Broadly speaking, the highest subscription take-up rates that have been observed so far on FTTP networks are in the 70%-plus range. This applies, for example, to the Chorus FTTP rollout in New Zealand (see **Figure 6**). Other operators may have FTTP take-up rates of less than 20%, but

this may reflect a rapidly growing homes passed base or be in a market with low rollout costs so in isolation does not reflect a lack of success. In a developed market such as the UK, many operators have noted that they are aiming for subscription take-up rates in the 30–40% range for mature deployments.

FIGURE 6: SELECTED OPERATORS, FTTP SUBSCRIPTION TAKE-UP RATE PER PREMISES PASSED, 2Q19–3Q23



SOURCE: OMDIA

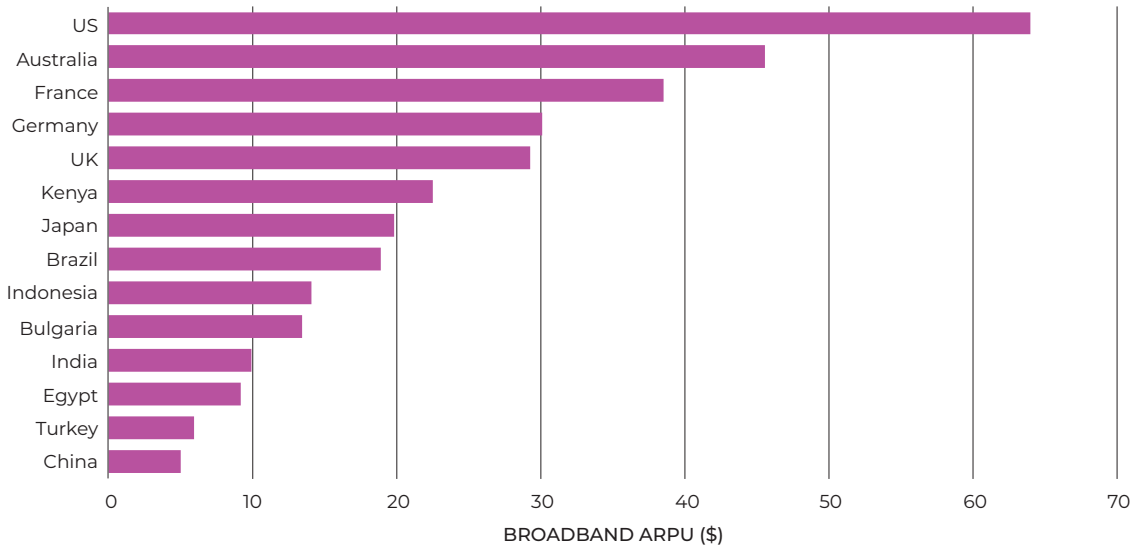
ARPU

WHAT ARPU LEVELS SHOULD OPERATORS AIM FOR?

Broadband ARPUs will vary substantially by territory as well as by technology. In emerging markets income levels place constraints on the affordability of fixed broadband, but the evidence does suggest that households are willing to pay up to around 5% of their income on a decent quality uncapped broadband connection. Technology choice also plays an important role in achievable ARPUs. Higher-speed and unlimited FTTP plans will tend to command the highest ARPUs of any broadband technology. Nevertheless, all stakeholders should be aware that the ARPU premium for FTTP versus other technologies will often be constrained, for example, by competition, and many operators have struggled to benefit from sizable ARPU increases even as they have migrated customers from legacy technologies such as DSL to FTTP.

Figure 7 provides some guidance on the extent to which broadband ARPUs vary by country.

FIGURE 7: BROADBAND ARPU BY COUNTRY, 2023



SOURCE: OMDIA

Operators must also understand actual and potential ARPU across various locations, customer groups, and subscription levels. This can assist stakeholders in developing a detailed business strategy and setting realistic financial targets.

A further important point that stakeholders must consider is how ARPUs could vary over time. If an operator in an emerging market has initially rolled out FTTP only to wealthier areas, then any coverage expansion might need to lead to a reduction in retail prices in order to overcome affordability constraints in lower-income areas. Operators in developed markets will need to consider the opportunities for price rises (for example, in line with inflation) in order to boost ARPUs.

Broadband investors will also need to move beyond merely considering broadband ARPUs to look at overall line ARPU, which considers all services that can be offered over the broadband line. For instance, fixed wireless operators will need to consider the viability of offering an IPTV service over these broadband connections, which could potentially boost ARPUs.

A further consideration is the extent to which the business model chosen will affect ARPUs. For instance, business models based on providing wholesale access will tend to have lower ARPUs than those using vertically integrated and closed networks. This is discussed in more detail in the ***Broadband business model choices*** section of this guidebook.

As discussed, network overbuild ratios are also related to the demand side of broadband infrastructure. The percentage of an operator's planned or actual footprint that is overbuilt by one or more FTTP players will be an important determinant of that operator's subscription take-up rate and ARPU.

PROFITABILITY AND RETURN ON INVESTMENT METRICS

This section of the guidebook covers classical metrics of business viability, such as *internal rate of return* and *net present value*. It analyzes the extent to which these metrics vary depending on the particular circumstances of the broadband deployment.

RETURN ON INVESTMENT

Return on investment (ROI) for a broadband infrastructure investment in simple terms refers to profits minus costs divided by costs. Return on investment can be expressed in percentage terms. An ROI calculation could be useful for investors attempting to calculate the attractiveness of different broadband infrastructure investments.

One drawback of the ROI calculation is that it does not take into account how the value of a given amount of money today is not the same as the value of the same amount of money in the future.

NET PRESENT VALUE

The net present value (NPV) metric involves discounting both all initial and future cash inflows and all initial and future cash outflows of the broadband infrastructure investment in order to reflect their present value. The discount rate that applies refers to the return that could be earned on an investment that has a similar risk. If the NPV of an investment is positive, the broadband investment will be regarded as being viable. Net present value is an absolute monetary value. A related metric to NPV is internal rate of return (IRR). This metric refers to the discount rate that is needed to make the NPV of all the cash flows for the investment equal to the initial investment outlay. This can help in calculating and comparing the attractiveness of different broadband infrastructure investment opportunities. Investors could assess whether the IRR is sufficient to make the investment worthwhile given the risks associated with the business plan for the broadband infrastructure rollout.

The challenge with using the NPV to calculate the value of investing in broadband infrastructure is that it may be difficult to make accurate assumptions about the specific discount rate that should be applied to the calculations. There are many uncertainties around the precise degree of risk involved in investing in FTTP networks, for instance, in terms of end-user demand. A

further challenge is that NPV does not tell us about the percentage rate of return on a particular investment.

PAYBACK PERIOD

The *payback period* refers to the length of time that will be required for the return on the investment to be greater than the total sum of the initial investment. The payback period is calculated by dividing the amount of the initial investment by the annual cash flow of the investment. Unlike the NPV method, the payback period calculation does not consider how the value of a given sum of money will be different over a period of time.

Investments in FTTP infrastructure might have a payback period ranging from a few to several years from the start of the deployment. This is because the investments incur high initial costs during the homes passed phase of the rollout, while subscription take-up will increase only gradually.

One challenge with the payback period metric in the context of investments in broadband infrastructure is that investments made in FTTP networks can continue to provide value for many years. The asset life of FTTP networks could easily be 30 years, for instance, and the payback period ignores what happens to the investment once the payback period has been reached. In other words, an FTTP infrastructure investment could take many years to generate payback but could still be attractive since there will be many more years for the asset to generate returns.

IMPROVING THE VIABILITY OF INVESTMENT IN BROADBAND INFRASTRUCTURE

It takes careful planning to successfully invest in broadband network infrastructure that is both financially sustainable and efficient. Making strategic choices about where and how to build calls for a thorough analysis of the data and the creation of a compelling business case.

Stakeholders will face a range of challenges in securing the viability of their investment in broadband infrastructure. Such challenges can be grouped into multiple areas. In the first instance demand may be a challenge; for example, in emerging markets some households may prefer to rely solely on cellular data plans for smartphones rather than also subscribe to a fixed broadband plan. A further challenge may be presented by the high costs involved in the broadband infrastructure rollout; for instance, if rollouts are being conducted in rural areas with low population density, costs per premises passed will be high. Stakeholders must also consider repeatable patterns of operational best practices to improve broadband investment viability, and this could include measures such as streamlining permitting processes. In some instances, even if some of the measures already described are carried out, there may still be no viable economic case for investment in broadband infrastructure and so some public intervention may be required, for instance, in terms of providing additional funding.

HOW TO IMPROVE THE VIABILITY OF INVESTMENT IN BROADBAND INFRASTRUCTURE?

As discussed, stakeholders have many means at their disposal to improve the viability of their investments in broadband infrastructure. This section of the guidebook first presents a nonexhaustive list of various initiatives that could be undertaken by different stakeholders to improve the viability of investment. In addition, it considers some of the broad categories stakeholders can consider in order to improve broadband investment viability before focusing on more specific measures within each category and examining the applicability of such measures as well as their advantages and disadvantages. The broad categories we consider are ways to stimulate broadband demand, network rollout cost reduction, operational best practice, policy and regulation, and financing innovation. Many of the measures that can be taken to improve the viability of broadband infrastructure investment straddle more than one of these categories.

TABLE 1: WAYS IN WHICH BROADBAND INFRASTRUCTURE INVESTMENT VIABILITY CAN BE IMPROVED

TYPE	CATEGORY	DESCRIPTION
ADVANCED CONTENT CREATION	Demand stimulation	Policies to encourage advanced digital content creation. Better content availability, for instance, in local languages, can increase the attractiveness of broadband to subscribers.
AFFORDABILITY TARGETS	Demand stimulation	Affordability is a key barrier to adoption of broadband services. Setting affordability targets for broadband tariffs puts pressure on governments and operators to bring prices down.
	Policy and regulation	
ASSET DATABASES	Operational best practice	The creation of single national databases of all networked utility physical infrastructure could greatly reduce planning time and costs for broadband infrastructure rollout.
	Policy and regulation	
	Network rollout cost reduction	
BROADBAND TARGET SETTING AND ADOPTION – INTERNATIONAL	Policy and regulation	Creation of a set of broadband policies, regulations, rules, and strategic funding for broadband deployment and service provision applicable to multiple countries. This is only applicable for organizations with an international legal remit.
BUILDING FIBER REGULATION (FIBER TO AND FIBER WITHIN)	Policy and regulation	Regulation specifying that all new homes, or those in certain regions, must have fiber to or within the premises. This policy encourages digital development, drives fiber adoption, and improves the fiber business case.
CITY NETWORKS – PASSIVE (LAYER 1)	Policy and regulation	Policies encouraging the creation of open access, noncompeting, fiber passive city networks. Access to physical infrastructure and dark fiber can be leased. Such networks could be deployed variously by local utilities, municipalities, or specifically created organizations.
CLOUD AND EDGE POLICY	Policy and regulation	High-level policies and projects designed to foster greater availability and use of cloud and edge infrastructures for the delivery of services to consumers and enterprises. The datacentre has to be ready to interact with end users in real time to deliver use cases like XR and remote manufacturing. 400GE can be used for both the datacentre and the WAN Network. Such cloud and edge policies can improve the attractiveness of broadband to end users.
	Demand stimulation	
COMMUNITY INITIATIVES	Demand stimulation	Encouraging community members and organizations or local municipalities to get actively involved in deploying the network, either individually or collectively, with work devolved to local workers or volunteers.
CONTENT AND APPLICATION PROVIDER INVESTS	Demand stimulation	Voluntary investment in local telecoms infrastructure (fiber, wireless, satellite, other) by large content and applications providers, primarily though not exclusively to further the aims of their core businesses.
	Financing innovation	
CONTENT AND APPLICATION PROVIDER PAYS – MANDATORY	Policy and regulation	Any of a number of actual or proposed mandatory schemes whereby content and applications providers, in particular those whose content and applications form a large part of IP traffic, are obliged to contribute to the cost of funding networks, principally in the form of network usage fees.
	Financing innovation	
DATACENTRE NETWORK WITH 400GE	Policy and regulation	Policies to stimulate the creation of central and edge datacentres to host AI and advanced applications and services, such as XR, utilizing 400GE datacentre networks.
DECOMMISSION LEGACY COPPER AND CABLE NETWORKS	Policy and regulation	The closure of copper networks (active and passive) and cable networks can drive migration of customers onto new network infrastructure (FTTP or FWA).
	Demand stimulation	
DEMAND AGGREGATION – COMMUNICATIONS "UNIONS"	Demand stimulation	Demand-aggregation policy that enables local community groups to create a legal entity working on their behalf as a "communications union." Suitable where local legal structures inhibit demand aggregation by multiple communities.
DEMAND AGGREGATION – PUBLIC SECTOR SITES	Demand stimulation	Pooling demand across schools, health facilities, post offices, police stations, and government offices to stimulate broadband network build. Suitable in regions where the market is failing.

DEMAND STIMULATION – DIGITAL TRAINING (ENTERPRISE)	Demand stimulation	Training designed to help companies take advantage of digital technologies can encourage broadband adoption and usage. This policy is generally applicable.
DEMAND STIMULATION – E-GOVERNMENT	Demand stimulation	This policy enables more efficient government and can also have the benefit of making people interacting with services obtain broadband access. This policy is generally applicable.
DEMAND STIMULATION – INTELLIGENT HOMES	Demand stimulation	Intelligent home ecosystem and certification of products designed to drive increased digitization and automation within the home. This can serve the goal of making broadband more attractive to end users while potentially boosting operator ARPUs. This is applicable in any market keen to promote and stimulate an ecosystem.
DEMAND STIMULATION – DIGITAL TRAINING (CONSUMER)	Demand stimulation	Training designed to increase the digital skills of people being left behind by the digital evolution because of economic status, age, or (lack of) education. This policy is generally applicable.
DEMAND STIMULATION – FUNDS TO KICK START THE MARKET	Demand stimulation Financing innovation	Governments offer subsidized broadband retail plans (often in the form of vouchers) as a tactic for increasing subscription take-up (and thereby improve the case for further investment) when normal commercial techniques have fallen short. These are in principle open to anyone.
DEMAND STIMULATION – SUBSIDIZED FREE DEVICES	Demand stimulation Financing innovation	Free or subsidized devices such as laptops, computers, tablets, and mobile phones to enable low-income or digitally isolated consumers to access digital services. Devices can either be brand new or refurbished.
DIGITAL ECONOMY MASTERPLAN	Policy and regulation	Policies enacted to ensure continued development of a digital economy to become or remain internationally competitive in the world digital economy.
DIGITALIZATION OF THE OPTICAL DISTRIBUTION NETWORK (ODN)	Network rollout cost reduction	Digitalization of the ODN to replace manual recordkeeping and associated human error. This can reduce network rollout costs while also making it easier for subscribers to be connected to the network.
DISPUTE RESOLUTION MECHANISM – PARALLEL CONCILIATION	Policy and regulation	Use of parallel conciliation mechanisms can enable dispute resolution in instances involving multiple parties (e.g., contractors and subcontractors). This is suitable where disputes or lack of trust are slowing down deployment.
DUCT MAPPING	Policy and regulation Operational best practices Network rollout cost reduction	Single information point with details on location of all ducts, wayleaves, and cables can make broadband infrastructure rollout quicker and easier.
END-USER SUBSIDIES – LOW-INCOME COMMUNITIES	Policy and regulation Demand stimulation	Subsidized home broadband subscriptions for low-income households. This intervention is targeted at homes that cannot afford broadband services, even where supply is available.
END-USER SUBSIDIES – RURAL COMMUNITIES	Policy and regulation Financing innovation Network rollout cost reduction	End-user subsidy initiatives targeted at rural and high-capex areas involve providing subsidies or vouchers to households and businesses in underserved and hard-to-reach communities where current broadband services may be slow, unreliable or even nonexistent.
ENTERPRISE WI-FI 7	Policy and regulation	Policies to stimulate Wi-Fi 7 usage in enterprise networks, for instance, to realize unmanned work in dangerous areas and increase production line flexibility.
FIBER CONNECTION TO PUBLIC BUILDINGS	Policy and regulation Financing innovation	Policy requiring state-funded installation of fiber to or within government properties and educational institutions.
FIBER TO EVERYWHERE AND F5G	Policy and regulation Demand stimulation	Policies to extends the reach of full-fiber networks from “to the premises” to “deep inside premises” (to the room, to the machine, to the desk) and to increase capacity to 10Gbps and beyond.

FIBER WITHIN SCHOOLS	Policy and regulation Financing innovation	State-funded deployment of fiber within educational institutions to enable advanced digital and multimedia-based learning.
FIXED-MOBILE NETWORK CONVERGENCE (INFRASTRUCTURE)	Network rollout cost reduction	Initiatives by operators that share assets across fixed and mobile networks, for instance, OLTs at cell sites, xhaul with FTTP, etc. This can help reduce rollout costs and speed up deployments.
400GE WAN NETWORK	Demand stimulation	Increase the access and WAN network bandwidth by using 400GE technologies, to provide optimal connections from home, enterprise and campus users to the applications sitting in the cloud and datacentres.
FREE OR LOW-COST SPECTRUM	Policy and regulation Network rollout cost reduction	Provision of free or low-cost spectrum that reduces the cost of supplying wireless services to poorer communities. This is distinct from the provision of spectrum set-asides to support rural network developments.
FREE PUBLIC WI-FI	Demand stimulation Financing innovation	Launch of free public Wi-Fi services in poorer, underserved communities. The use of Wi-Fi 7 will give end users the best experience. This can encourage broadband usage and improve the viability of subsequent broadband infrastructure investment.
FTTP-SPECIFIC APPROACHES	Policy and regulation	Specification of a fiber-only approach, either as a means of increasing the speed and quality of broadband in countries with good lower-speed broadband availability or as the future-proof option in greenfield deployments. This can help create a bigger market for FTTP access and improve the fiber business case.
GIGABIT CONNECTIONS FOR NEW HOMES	Policy and regulation Demand stimulation	Policy requiring new homes to be built with access to gigabit-ready connections. Suitable where new homes are being built without access to suitable broadband. Gigabit connections can improve the appeal of broadband to end users and have the potential to boost operator ARPUs. Installing 10Gbps network access can provide users with a superior experience and support future services in the holographic society.
IMPROVING IN-HOME NETWORKS	Demand stimulation	Operators deploying advanced in-home Wi-Fi, for instance, with the newest Wi-Fi 7 standard, and fiber to the room (FTTR) could drive improved subscription take-up with better-quality home networks.
IN-BUILDING FIBER SHARING	Policy and regulation Network rollout cost reduction	Obliging all operators to share in-building fiber with fees per meter and ducts for third-party access. This can help reduce the cost of fiber rollout.
IN-BUILDING FIBER SUBSIDIES – MULTI-TENANT BUILDINGS	Financing innovation	Provision of grants for owners of buildings with multiple business tenants to deploy fiber infrastructure within the building. This is a means of encouraging broadband deployment.
IN-BUILDING FIBER SUBSIDIES – NEW BUILDS	Financing innovation	Provision of grants or subsidies for the installation of ONTs in new builds.
INCREASING CHOICE OF TERMINATING EQUIPMENT	Network rollout cost reduction	Enabling consumer purchase of broadband terminating equipment (ONTs). Perceived as a way of decreasing cost and increasing choice where supply issues are keeping prices high.
INNOVATIVE FINANCING	Financing innovation	Use of innovative financing methods such as general obligation bonds to enable local authorities to raise funds for network construction.
INTEREST-FREE LOANS	Financing innovation	Provision of interest-free loans with long payback periods to encourage/facilitate network deployment.
INTERNATIONAL CABLE DEPLOYMENT	Network rollout cost reduction	In some countries, particularly in the southern hemisphere, access to the global internet is restricted by lack of access to overland or subsea cables. Investment in such infrastructure can improve the viability of last-mile broadband infrastructure investment.
JOINT DEPLOYMENT OF NETWORKS	Financing innovation	Enabling operators to jointly invest in shared networks, typically in medium-sized cities or for long-haul fiber.
LANDLORD AND LANDOWNER REGULATION	Policy and regulation	Regulation enabling broadband operators to get a court order granting property or land access to meet tenants' installation requests. This is a means of solving the problem of obstructive or unresponsive landlords.

LOCAL CABLE OPERATORS	Network rollout cost reduction Demand stimulation	The local cable operator model is a cost-effective fiber deployment strategy involving generally revenue-sharing partnerships between national telecom operators and local cable operators with the aim of achieving faster broadband network expansion and penetration into areas with low-rise housing.
MARGINALIZED POPULATIONS – SUPPLY-SIDE SUBSIDIES	Policy and regulation Financing innovation	Policy to improve broadband availability for marginalized society groups through grants and subsidies. Designed to stop "redlining" that prevents service provision in poor communities (which might equally be urban or rural).
REGULATORY MEASURES TO INTRODUCE RETAIL COMPETITION	Policy and regulation Demand stimulation	Ex post regulation to increase consumer choice of service providers, improve take-up, and/or reduce retail prices.
MOBILE FIRST	Demand stimulation	Initiatives to deploy mobile networks to provide broadband coverage where no fixed broadband exists.
MULTIFIBER DEPLOYMENT INSTEAD OF DUCT ONLY	Policy and regulation Network rollout cost reduction	As an alternative to duct build, a policy encouraging or mandating the building of networks with end-to-end multifiber (built into the design of the physical ODN).
NATIONAL AND AGGREGATION BACKBONE	Financing innovation Network rollout cost reduction	The deployment of a state-funded (or partially funded), open, and shared long-distance fiber-optic backbone network. This can improve broadband infrastructure investment viability by lowering the cost of supply to local areas.
NATIONAL BROADBAND PLAN – EX ANTE	Policy and regulation	Plans that set out a course of broadband development with rights and obligations on all parties and for all areas of a country. The outcome is a restructuring of the fixed access market.
NATIONAL BROADBAND STRATEGY – CONTROLLED WHOLESALE PROVIDER	Policy and regulation Financing innovation	Creation of a single state-owned wholesale open access broadband network operator with a remit to sell access to third-party retail service providers.
NATIONAL BROADBAND STRATEGY – DIRECTED ECONOMY	Policy and regulation	Creation of a national broadband plan with centrally directed mandates for deployment by one or more providers. Treatment of full-fiber networks as a national infrastructure. Only applicable to centrally directed economies.
NATIONAL BROADBAND STRATEGY – INFRASTRUCTURE AND SERVICE COMPETITION	Policy and regulation	Creation of a national strategy that envisages deployment of multiple privately owned networks alongside multiple service providers.
NATIONAL BROADBAND STRATEGY – PUBLIC-PRIVATE INVESTMENT	Policy and regulation Financing innovation	Combining investment from public and private investors to fund the deployment of an improved national broadband infrastructure.
NATIONAL BROADBAND STRATEGY – STATE-OWNED MONOPOLY	Policy and regulation Financing innovation	Creation of a national fully funded broadband plan based around a single state-owned monopoly provider of fixed infrastructure and services. Only applicable in some countries.
NEW TRENCHING TECHNIQUES	Network rollout cost reduction	Governments and operators can embrace the use of new trenching techniques such as microtrenching, or authorities could relax rules to enable their use. This could reduce deployment costs and improve the viability of broadband infrastructure investment.
ONE DIG POLICY	Policy and regulation Network rollout cost reduction	Coordinating the installation of ducts during public infrastructure projects. It aims to reduce costs and minimize road disruptions for fiber deployment.
OPERATOR BUNDLING	Demand stimulation	Bundling is a strategy used by telecom companies to attract new customers and to differentiate themselves in competitive markets. It reduces the cost for end users and can stimulate end-user demand and therefore improve the viability of broadband infrastructure investment.
OPERATOR CARVE-OUT	Financing innovation	The carve-out of network businesses (netcos) in which an equity stake is taken by third-party investors, typically infrastructure funds. This can provide additional funds for broadband infrastructure investment.

PARALLEL FIBER NETWORKS	Policy and regulation Network rollout cost reduction	The obligation to build parallel fiber networks in multidwelling units. This can reduce the cost of deployment for non-first-mover fiber operators.
PASSIVE SHARING	Financing innovation Network rollout cost reduction	The sharing of passive (unlit) fiber infrastructure between operators (not open wholesale access). Agreements can be bilateral or multilateral but involve a defined set of operators.
PERMIT EXEMPTIONS, STREAMLINED PERMITS	Policy and regulation Operational best practice	Removal of administrative barriers that slow down or prevent broadband network deployment. This is most applicable in markets with lots of competing local providers.
PHYSICAL INFRASTRUCTURE ACCESS (PIA)	Policy and regulation Network rollout cost reduction	Mandating access to physical infrastructure including pits, poles, ducts, and masts between operators. The broader principle of PIA can extend to use of physical infrastructure of other networked utilities. This can reduce the costs of broadband rollout and therefore improve the viability of broadband investment.
POOLED ACTIVE NETWORKS – MANDATED AND VOLUNTARY	Policy and regulation Network rollout cost reduction	A cooperative agreement between a group of operators to offer a common bitstream Layer 2 service to each other, allowing them to extend their service areas beyond their own infrastructure.
PRECONNECTORIZATION	Network rollout cost reduction	Using fiber where connectors are added in the factory (as opposed to field-fit connectors or fusion splicing techniques). This can speed up deployments while potentially lowering costs.
PRICE CAPS	Policy and regulation Demand stimulation	Taking the policy decision to restrict the price of retail or wholesale services. This can help stimulate end-user demand for broadband.
PUBLIC INVESTMENT IN PUBLIC-PRIVATE PARTNERSHIPS	Financing innovation	Public sector entities join together with private firms to provide services. There is a shared risk because the public entity either lends cash or provides equity to a joint venture.
REPURPOSING OF EXISTING INFRASTRUCTURE	Network rollout cost reduction	Many authorities recognize the benefits of low-cost aerial deployment on poles (telecoms and utility).
RURAL BROADBAND IMPROVEMENT PROGRAMS	Policy and regulation Financing innovation	Policy changes and/or subsidies introduced by governments to target rural areas with improved broadband.
SERVICE MAPPING	Policy and regulation Operational best practice	Regulator-run database with white-zone mapping. This can provide greater visibility to operators on the opportunities for viable broadband infrastructure investment.
SMART CITY DEPLOYMENTS	Demand stimulation	Creating city networks to underpin the digitalization of all aspects of urban life including transport, lighting, energy, health, crime prevention, and economic development. Increasing network utilization across multiple verticals can improve the viability of broadband infrastructure investment.
SOCIAL TARIFFS	Demand stimulation	Social tariffs are special discounted deals available for certain low-income customers. Such offers could increase take-up thereby improving investment viability.
SPECTRUM SET-ASIDE AND REGIONAL SPECTRUM LICENSING	Policy and regulation Network rollout cost reduction	Spectrum set-asides are used to enable smaller regional operators or new entrants to obtain spectrum at auctions. Set-asides exclude defined operators, generally the larger national mobile operators, from bidding for the spectrum. Spectrum can be set aside for FWA, which can improve the FWA business case.
SPEED-FOCUSED APPROACHES (NATIONAL AND REGIONAL TARGETS)	Policy and regulation Demand stimulation	Governments set service speed targets. Targets are not usually mandated; instead operators are provided with a set of incentives dependent on speeds delivered. This policy is suitable in markets where the government wants to improve the quality of broadband services. Better speeds can help stimulate end-user demand for broadband and therefore improve the viability of broadband investment.

STATE-OWNED FIBER CORRIDORS	Financing innovation Network rollout cost reduction	Construction of state or local government-owned dark-fiber corridors (ideally with access points in multiple rural locations along the route as opposed to access only at centralized points in towns). This can help facilitate last-mile network investment.
STATE-OWNED REGIONAL FIBER NETWORKS	Financing innovation	Deployment by the state of fiber networks in regions where commercial providers will not deploy for economic reasons.
STATE-OWNED SATELLITE FOR GAP FILLING	Financing innovation	Launch and operation of state-owned satellites to bring broadband to regions where terrestrial services cannot be delivered (physically or economically).
SUPPLIER-DRIVEN DEMAND AGGREGATION – COMMUNITY INVESTMENT MODEL	Financing innovation Demand stimulation	Supplier-driven aggregation of demand based on a community investment model: local people and businesses invest in shares.
TARIFF ENGINEERING WHOLESALE ACCESS BASED ON INDEFEASIBLE RIGHTS OF USES (IRU)	Financing innovation	Under an IRU, the ISP has an exclusive right to use a specified amount of capacity or bandwidth on the cable system for an agreed period of time. This can include dark-fiber IRUs.
TAX HOLIDAYS	Policy and regulation Financing innovation	Providing long-term income tax "holidays" to organizations deploying large-scale fiber-optic networks.
TAX INCENTIVES	Policy and regulation Financing innovation	Tax incentives for companies deploying fiber-optic networks. This can include depreciation or tax credits against capital equipment purchases, subsidies for loan interest, property tax reductions, etc.
TAX REBATES FOR END USERS	Policy and regulation Network rollout cost reduction	Provision of tax rebates to households enabling them to recover the cost of fiber installation.
TECHNOLOGY-AGNOSTIC APPROACHES	Policy and regulation	Initiatives designed to deliver broadband by whichever technology the market chooses, possibly with speed or coverage obligations.
THIRD-PARTY SATELLITE FOR GAP FILLING	Policy and regulation Network rollout cost reduction	Use of third-party satellite services to bring broadband to regions where terrestrial services cannot be delivered (physically or economically).
UNIVERSAL SERVICE FUND AUCTIONS	Policy and regulation Financing innovation	Contracts to supply broadband services to rural areas, with contracts awarded on the basis of a reverse auction to companies requesting the least amount of funding.
UNIVERSAL SERVICE OBLIGATIONS	Policy and regulation Financing innovation	The imposition of universal broadband service obligations on monopoly operators or operators with significant market power. This can involve requirements for providers to deliver services up to cost limits.
UNIVERSAL SERVICE OBLIGATIONS – POOL FUNDED	Policy and regulation Financing innovation	The imposition of universal service obligations onto designated operators, with costs shared by all operators.
UNIVERSAL SERVICE OBLIGATIONS – STATE FUNDED	Policy and regulation Financing innovation	The imposition of universal broadband service targets onto monopoly operators or operators with significant market power. Costs associated with such rollouts can be partially compensated by the state.
UNIVERSAL WHOLESALE SERVICE OBLIGATIONS	Policy and regulation	Requirement for designated wholesale providers to connect premises in their service areas and provide a wholesale service.
USE OF INTERNATIONAL DEVELOPMENT FUNDS TO IMPROVE BROADBAND	Policy and regulation Financing innovation	Strategy to tap into international funds (such as EU structural and development funds) to pay for deployment in deprived areas. Suitable for poorer, less developed regions.
WHOLESALE TARIFF CONTROL	Policy and regulation	Regulation of wholesale tariffs to ensure that ISPs can access fiber infrastructure at reasonable and nondiscriminatory rates. Suitable for markets with some level of separation of infrastructure and service provision.

SOURCE: HUAWEI, OMDIA

WAYS IN WHICH DEMAND AND REVENUE CAN BE STIMULATED

The viability of the investment model for broadband can be improved by finding ways to stimulate demand or ensure there is sufficient demand to justify a deployment. The following section looks at selected demand-side measures that operators can take to boost revenue and ensure a more viable broadband infrastructure rollout. Such measures could be grouped into a variety of different categories:

- **Optimization of network rollout areas.** Operators can carefully focus their broadband infrastructure rollouts on areas where they expect the highest take-up. Rollout areas could be optimized by using demand aggregation to secure commitments by end users to take a subscription before infrastructure is deployed. Operators can also seek to better understand the demographics of potential rollout areas in order to optimize their planned rollouts.
- **Innovation in retail tariffs to improve affordability.** Subscription take-up on broadband infrastructure could be increased by tariff innovation, which could include measures such as low-priced entry-level broadband tariffs or prepaid broadband offerings.
- **Product improvements to retail broadband offerings.** Enhancing the overall quality of the components of the broadband retail offer could also help increase demand.

EXAMPLE 1: DEMAND AGGREGATION

Demand aggregation means only committing to roll out broadband infrastructure once a certain percentage, typically 30% or so, commit to taking a service.

REASONS WHY THIS MODEL HAS BEEN CHOSEN AND WHERE IT IS APPLICABLE

Demand aggregation is important in scenarios where FTTP costs per premises passed are very high. This increases the risk for players that have not secured a customer base ahead of deployment. Such demand aggregation models are applicable for altnets that do not have existing customers on legacy broadband technologies that they can migrate to FTTP. This model has been used by players such as Altibox in Norway.

ADVANTAGES

Demand aggregation certainly reduces deployment risks by ensuring that there will be subscribers when the network is built.

DISADVANTAGES

The need to secure commitments from a certain percentage of customers risks slowing down the rollout of broadband infrastructure. Demand could also change over time, so failure to reach targets for precommitments does not necessarily reflect a long-term lack of demand.

EXAMPLE 2: FOCUSING ON THE OVERALL BROADBAND EXPERIENCE INCLUDING HOME WI-FI

REASONS WHY THIS MODEL HAS BEEN CHOSEN AND WHERE IT IS APPLICABLE

The basic rationale of offering an improved overall broadband experience is relevant in all territories. As FTTP becomes increasingly ubiquitous there will be a greater need for operators to move beyond the broadband access technology as a differentiator. Home Wi-Fi optimization can offer an improved broadband experience and can serve as the basis for offering new revenue-generating services associated with Wi-Fi. In addition, many operators report that a majority of calls to customer service are related to home Wi-Fi, so better managing such connections can provide significant opportunities to reduce operational costs.

ADVANTAGES

There are real opportunities for operators to benefit from reduced costs and improved revenue by focusing on the overall broadband experience including home Wi-Fi. Ultimately, it makes little sense for operators to invest hundreds of US dollars per premises passed when rolling out FTTP with the objective of offering a high-quality network and then not be prepared to spend much less on the various means to offer an enhanced customer experience.

DISADVANTAGES
Some investment is needed in order to improve the overall customer experience. If investors have a short-term horizon this may make it more difficult for them to invest in the various ways in which customer experience can be improved.

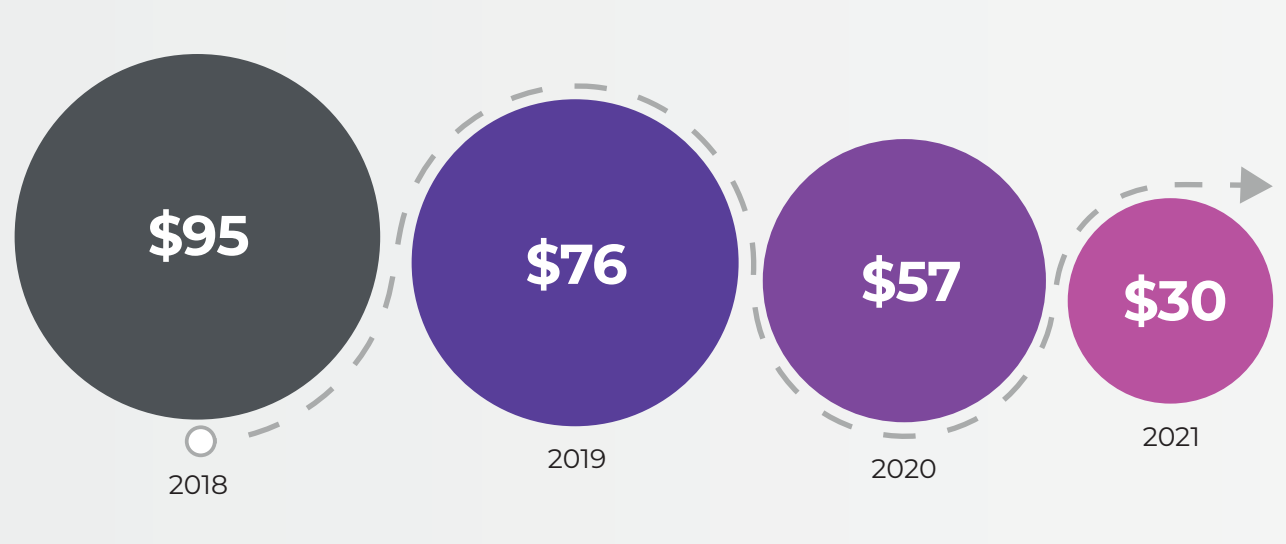
WAYS TO REDUCE NETWORK ROLLOUT COSTS

Operators rolling out FTTP often face the challenge of high costs per home passed. In order to improve the viability of investment in broadband such costs can be reduced to make sure that the broadband infrastructure investment is less risky.

Measures to reduce costs can be grouped into various categories:

- **Different construction methods.** Operators could look at whether fiber needs to use ducts or could be deployed using microtrenching or aerial poles. Operators could also examine the use of preconnectorized rather than spliced fiber.
- **Different rollout economic decisions.** Operators could also stop the homes passed phase of a fiber rollout further away from end premises thereby switching more of the cost to the homes connected phase.
- **Greater experience.** Experience of fiber rollout is also likely to help operators find ways to reduce costs per premises passed. Some operators have reported falling FTTP costs per premises passed over time, and Vivo in Brazil is one example of this (see **Figure 8**).

FIGURE 8: VIVO BRAZIL, FTTP COSTS PER PREMISES PASSED, 2018–21



SOURCE: OMDIA FROM TELEFÓNICA

EXAMPLE: AERIAL FIBER

Operators could choose to deploy segments of their FTTP networks aerially. This could incorporate aerial final-fiber drops to end-user premises.

REASONS WHY THIS MODEL HAS BEEN CHOSEN AND WHERE IT IS APPLICABLE
FTTP using aerial fiber deployments is a widely used deployment model. The model offers cost benefits since less civil infrastructure work is required and fiber rollout is therefore faster. It is the most common form of fiber deployment in emerging markets but is also used extensively in some developed markets such as the US.

ADVANTAGES
The rollout of fiber can be made substantially less costly. This will particularly be the case where operators would need to deploy new underground ducts to roll out fiber, for instance, because copper cables are directly buried and there are no existing ducts. Aerial fiber rollouts can also be quicker leading to improved time to revenue.

DISADVANTAGES
Aerial fiber may be more prone to breakage than underground fiber. This runs the risk of undermining the reliability benefits that FTTP deployments can deliver in comparison with other broadband technologies.

REPEATABLE PATTERNS OF OPERATIONAL BEST PRACTICES FOR OVERCOMING BROADBAND INVESTMENT CHALLENGES

Operational best practices are also important in overcoming broadband investment challenges. Such measures can be grouped into various categories:

- **Improving processes.** Measures to improve the efficiency of permit-granting procedures can improve the environment for broadband investment as can measures to ensure there are adequate dispute resolution mechanisms.

- **Improving access to relevant information.** Providing single information points is a means to overcome broadband investment challenges and is discussed below.

Much of the responsibility for achieving best practice in these areas lies with public authorities.

EXAMPLE: SINGLE INFORMATION POINTS

REASONS WHY THIS MODEL HAS BEEN CHOSEN AND WHERE IT IS APPLICABLE
Having a single information point means using a system (e.g., a geographic information system) to collect and record the location of existing physical infrastructure and ideally of planned civil works. The single information point comprises data from multiple sources such as local and national authorities.

ADVANTAGES
A single information point is highly advantageous in situations where operators are rolling out new broadband infrastructure. New entrants in particular might lack visibility on where existing physical infrastructure is located, and access to this information could potentially significantly reduce rollout costs while increasing the speed of deployments. Having access to information on planned civil works is beneficial because it means that potential synergies could be achieved by operators combining their deployments in some way if both are rolling out in a single area.

DISADVANTAGES
This model does require investment from different stakeholders and not just the authority responsible for maintaining the single information point but also, for instance, from operators that need to supply information on their networks. One challenge is to make sure that the data in the single information portal is as usable as possible. This will require the information to be recorded electronically and to be made easily accessible with the support of different file formats.

POLICY AND REGULATION AND FINANCING INNOVATION

Public authorities and regulatory authorities can impose measures that help improve the viability of broadband investment. Such measures could take a number of forms:

- **Regulation.** This could include providing cost-oriented access to ducts and poles to encourage fiber rollout. Another area could be to impose financial or structural separation as a means to encourage broadband investment.

- **Government funding.** A subset of direct public intervention measures include government funding to improve broadband investment viability.

EXAMPLE: COST-ORIENTED ACCESS TO INCUMBENT DUCTS AND POLES

One regulatory remedy that could be used specifically to make broadband investment more viable for nonincumbent altnets is to mandate that incumbents provide cost-oriented access to their duct and pole networks.

REASONS WHY THIS MODEL HAS BEEN CHOSEN AND WHERE IT IS APPLICABLE

Regulated access to ducts and poles allows altnets to deploy their own FTTP networks and promote the development of full infrastructure-based competition that provides such players with the maximum degree of flexibility to differentiate from the incumbent. Portugal, Spain, and the UK are some of the prominent markets where duct and pole access is used.

ADVANTAGES

Given that much of the cost of FTTP rollout often comes from civil infrastructure work, duct and pole access potentially serves to considerably reduce costs per premises passed. Duct and pole access can be used by multiple players at the same time. Real-world evidence also suggests that the model has often proven popular where it has been mandated.

DISADVANTAGES

The model is not applicable everywhere, for instance, because of the absence of suitable duct and pole infrastructure in some territories. Even if duct and pole access reduces fiber rollout costs, potential investors may still see a move to deploying FTTP without an existing customer base as too risky. More focus on providing other regulatory remedies such as bitstream access could allow broadband operators to initially build up a customer base before building their own networks.

BROADBAND FINANCING MODEL CHOICES

This section considers the different ways in which broadband infrastructure rollout can be funded. These different ways of funding broadband infrastructure rollout can also be considered as a category by which the viability of investment in broadband infrastructure can be improved.

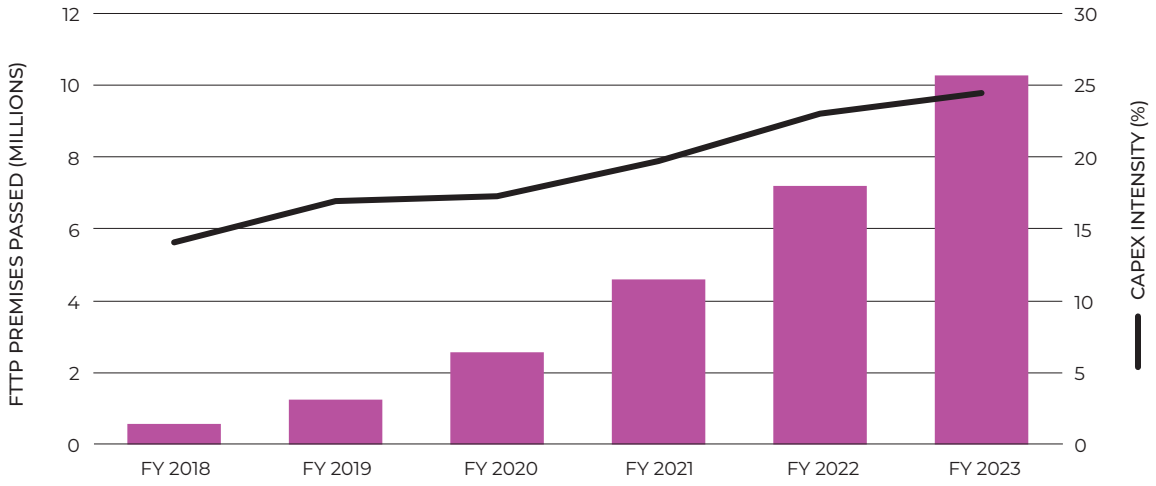
We consider three broad means of broadband financing: private financing (including from operators themselves), public financing, and public-private partnerships. Within each of these three broad categories we then consider more specific examples. For example, within the private financing category we consider examples such as where an operator funds the rollout only from its normal capital expenditure budget and where an operator creates carve-outs with third-party investors such as private equity firms in order to finance its broadband rollout. For each of these different models we consider where they are applicable and their advantages and disadvantages and provide actionable conclusions for different stakeholders, such as the private investment community, operators, and public authorities.

PRIVATE FINANCING OF BROADBAND INFRASTRUCTURE DEPLOYMENT

DEPLOYING FTTP WITHIN TYPICAL CAPEX ENVELOPES

Operators could choose to try to deploy FTTP within their typical capex envelopes. In many cases this will be challenging, so some bulge is likely during the peak years of rollout. This, for example, is the case for BT in the UK (see **Figure 9**). In Europe many operators have managed to cover 10% of total country premises in a single year at the peak of fiber rollout, and a temporary increase in capex will likely be needed to cover this. However, operators may not wish to risk delaying the investment, for instance, because of the risk of competitors gaining first-mover advantage by rolling out their own FTTP networks.

FIGURE 9: BT, FTTP PREMISES PASSED AND CAPEX INTENSITY, FY 2018 – FY 2023



SOURCE: OMDIA

SPREADING THE COST OF BROADBAND INFRASTRUCTURE ROLLOUT OVER A LONGER PERIOD

However, rapidly rolling out FTTP within an operator's typical capex budget may not always be possible because of the high costs of rollout. If competitive conditions allow, an operator could still choose to deploy FTTP but could spread the rollout over more years to ease the capex burden in any particular year. This is the option that Telekom Deutschland has chosen in Germany. The operator has already announced plans to roll out FTTP to 10 million premises (approximately 22% of the country total) by end-2024 with a further 2.5 million premises to be covered per year in subsequent years. If the operator had moved straight to deploying FTTP at a highly accelerated rate it would have seen a huge increase in capex. In recent years, Telekom Deutschland has had cash capex (excluding spectrum investment) of around €4.1–4.2bn. However, if the operator were to pass, say, 10% of German premises (a total of 4.5 million) in a single year with FTTP (a rate that is plausible given the pace of rollout of other European players) at a blended cost per home passed of €800, this alone would cost €3.6bn. To this sum would need to be added the cost of connecting customers to the network and capex for non-FTTP-related projects. As a result Telekom Deutschland is rolling out FTTP at a slower pace than many of its peers and has also invested in supervectoring, which provides download speeds of up to 250Mbps on its FTTC-VDSL network.

PRIVATE EQUITY FINANCED BROADBAND INFRASTRUCTURE ROLLOUTS

Many private equity firms have invested significant sums of money in altnet FTTP rollouts. Again, this is a global phenomenon and there are examples of such investments in a diverse set of markets including the UK, the US, and Brazil. By way of example, in 2020 in the UK, the London-focused FTTP altnet Community Fibre raised funds to the value of £400m from Warburg Pincus and Deutsche Telekom Capital Partners in exchange for equity in the company. Private equity firms may also play a role in consolidating smaller altnets and thereby deliver greater scale for further investments in broadband infrastructure.

Private equity firms typically invest in early-stage FTTP rollouts and may look to make an exit from the investment after a handful of years or so. At this point investors with longer-term horizons, such as pension funds and infrastructure funds, may look to acquire fiber assets.

ACCESS TO DEBT FOR BROADBAND INFRASTRUCTURE ROLLOUTS

Until the interest rate rises of the last couple of years there has been access to cheap capital for FTTP rollout. Partly as a result of this, many FTTP altnets have appeared in the UK. Access to debt has certainly tightened over the last couple of years, and in markets such as the UK this could lead to consolidation among the altnet community. However, great uncertainty remains about the future trajectory for inflation and interest rates, and though markets appear to be expecting a prolonged period of higher rates, this view is not shared by all economists. In this context it is also worth noting the long asset life of fiber and the fact that the global pandemic has served to reinforce the value of good-quality uncapped broadband connections. In addition, a combination of debt and equity financing could be used for FTTP rollouts. For instance, while Community Fibre has seen equity investment from private equity firms in 2022, it also secured a credit line of up to £985m from unnamed lenders.

JOINT VENTURES WITH OTHER OPERATORS, UTILITIES, AND FINANCIAL INVESTORS

Operators can also choose to partner with third parties to roll out broadband infrastructure. Typical partners could include private equity firms, other telecom operators, or energy companies. One important reason for bringing in third parties is that operators alone might find the costs of FTTP rollout to be too high for them to finance from their own cash flows.

There have been some examples of operators forming joint ventures with energy utilities for the rollout of FTTP. Utilities could be valuable partners since they may have infrastructure such as poles or even a fiber backbone that can be used for fiber rollout. It is true that some utilities have launched their own vertically integrated broadband deployments, but partnering with an operator might be a preferred model since operators might be able to bring existing customers as well as expertise in the telecoms market. One example of a joint venture between a telecom operator and utility is SIRO in Ireland, a joint venture between Vodafone and the Electricity Supply Board (ESB) that is rolling out fiber in parts of Ireland including more suburban and rural geotypes where the use of ESB's pole network can help reduce FTTP deployment costs. SIRO offers wholesale access to multiple retail service providers including Vodafone.

Operators could also partner with financial entities to form joint ventures for the rollout of FTTP in new areas. Financial investors may be attracted by the potential steady returns and long asset life of FTTP networks. One recent example is AT&T forming the Gigapower joint venture with BlackRock Alternatives in December 2022 for the rollout of FTTP in areas outside the operator's traditional 21-state footprint. The Gigapower joint venture will offer wholesale access to multiple retail service providers including AT&T.

Generally speaking, there are relatively few examples of operators creating FTTP joint ventures together, perhaps a reflection of the difficulties of working so closely with competitors. In 2019 in Germany incumbent Deutsche Telekom created a joint venture with EWE for the rollout of FTTP to 1.5 million premises in parts of Lower Saxony, North Rhine-Westphalia, and Bremen. EWE is a utility company, but its telecoms arm, EWE Tel, has a significant number of broadband customers in these areas.

FIBER CARVE-OUTS

A specific type of model involving operators and other third-party investors is the fiber carve-out. In this case the operator splits off its current and/or future FTTP network into a separate subsidiary, and the ownership of this asset is often shared between the operator and the third party when the operator sells a typically minority stake. The operator's retail arm then uses wholesale access as a so-called anchor tenant on this FTTP network.

There are many examples of such fiber carve-outs, and there are examples from several regions, which reflects the global interest in rolling out fiber:

- **One example from Europe is Altice in France.** In 2018 Altice's French unit agreed to sell a minority 49.99% stake in its FTTP network to three investment funds, namely Allianz Capital Partners, AXA Investment Managers, and OMERS Infrastructure. The SFR FTTH vehicle had around 1 million premises passed at the end of 2018 and aimed to pass an additional 4 million premises in the medium term at the time of the transaction.

- **In Latin America Telefónica has engaged in a number of fiber carve-outs.** In 2021 Telefónica Colombia and private equity firm KKR announced the creation of a new company responsible for rolling out FTTP in Colombia. The company announced it intended to deploy FTTP to 4.3 million premises passed in about 90 cities over the subsequent three years. As part of the Colombia fiber carve-out Telefónica Colombia contributed its existing FTTP network, which had 1.2 million premises passed at the end of 1Q21. Most fiber carve-outs have involved sales of minority stakes as part of the creation of the carve-out, but in Colombia KKR took a 60% stake in the new vehicle and Telefónica Colombia took 40%.

This model has a number of different rationales. As with other partnership type models, such fiber carve-outs can supply additional funds for network rollout that an operator alone may not be able to provide. Overall subscription take-up on the fiber carve-out network may also be higher than if the operator fully owned the network. Other retail service providers may be more likely to use wholesale access offers on the fiber network because its shared ownership and separation from the operator owner's retail business gives them confidence that all operators will be treated equally. Separation of the operator's retail operations and infrastructure also provides potential opportunities to increase the value of these businesses, which may be more constrained with a vertically integrated model.

MINORITY COFINANCING BY OPERATORS THAT ARE GRANTED IRUS

A further option to consider is minority cofinancing of third-party fiber infrastructure. In this model, which, for example, is used in France, an operator first states that it will roll out an FTTP network in a particular area. Other players are at this point able to coinvest in the fiber rollout in exchange for long-term indefeasible rights of use (IRU) on the network. The operator that is coinvesting is able to commit to a certain capacity, for example, 5% of the network. Not all of the network is mutualized, and the coinvestors can roll out their own fiber to the point where the mutualized element of the network begins. This model differs from a more traditional wholesale-type model where access seekers do not initially invest in the network and then rent individual subscriber lines on a monthly basis rather than, say, for a 40-year period under an IRU.

PRIVATE COMMUNITY DRIVEN BROADBAND INFRASTRUCTURE DEPLOYMENT

A further example for stakeholders to consider is a local community-driven approach to broadband infrastructure deployment. There are examples of this kind of model in some Scandinavian countries. The involvement of the local community in the broadband rollout has the potential advantage of generating high subscription take-up rates and therefore a viable business model. Such models can generally benefit from demand aggregation approaches since the investors in the network are the local citizens of the area. One of the potential challenges for such a model is that the local community may lack expertise in broadband rollout, although there may be a role for public authorities to provide some guidance or support, for instance through the granting of rights of way for fiber deployment.

PUBLIC FINANCING OF THE BROADBAND INFRASTRUCTURE DEPLOYMENT

Governments can decide to fully finance the rollout of broadband infrastructure and can then choose to maintain ownership of the broadband network. This could apply to either central or local governments, which could choose to finance the broadband infrastructure deployment from normal tax and spending or through loans specifically designated for the particular project.

Examples of this model are rarer, but there are cases where private companies have not been prepared or able to contribute at least part of the funding required for broadband infrastructure rollout. One example is NBN Co in Australia, which was tasked with covering 93% of Australian premises with a mix of wireline broadband technologies with the remaining 7% covered with a mix of FWA and satellite broadband.

ADVANTAGES AND DISADVANTAGES OF PUBLIC FINANCING OF BROADBAND INFRASTRUCTURE DEPLOYMENT

One advantage of this model is that it gives the public authority full control over the broadband infrastructure rollout. Governments have different incentives from purely commercial operators and may be prepared to take a longer-term perspective on the value of investing in broadband infrastructure. This may mean they are more likely to fund investments in more expensive next-generation PON technologies such as XGS-PON, since the pressure to rapidly achieve payback is lower than for commercial operators. Another reason why this model may be chosen is because it may simply not be possible to work together with private companies for joint broadband financing because of a breakdown in relations.

On the other hand, governments may lack the commercial incentives to deploy the network as efficiently as possible, which may result in costs that are higher than necessary. If governments do choose to fully finance the rollout of broadband infrastructure then they must make sure to be able to fully draw on expertise from the private sector.

DIFFERENT MODELS FOR PUBLIC FINANCING

There are different variations within the overall concept of public authorities fully funding the broadband infrastructure deployment:

- The public entity could choose to also be active in the retail market and to compete with private companies active as retail service providers in a public build–design–operate model. The advantage of this kind of model is that the government can encourage greater competition in the retail market, which could potentially lower retail prices.
- Alternatively, as in the case of NBN Co in Australia or Stokab in Stockholm, Sweden, the government-funded entity could act as a wholesale-only operator. The advantage of this kind of model is that governments might perceive that the bottleneck to good availability and take-up of next-generation access is on the infrastructure side. Once the government has built a good-quality next-generation access network, this entity can offer wholesale access on attractive terms to multiple retail service providers. As discussed in the ***Broadband business model choices*** section of this guidebook, there are different means by which such operators can provide wholesale access. NBN Co, for instance, provides active wholesale access, while Stokab provides passive wholesale access in Stockholm.

HOW DOES THE GOVERNMENT FUND THE BROADBAND ROLLOUT?

When a government fully funds the deployment of broadband infrastructure in a particular area there could be different sources of the funding. The source of the revenue for rollout could be from government taxes. On the other hand, there are examples such as Stokab in Stockholm where the funding from the Stockholm municipality came from bank loans and then as dark fiber was leased on the network revenue was reinvested in the broadband deployment.

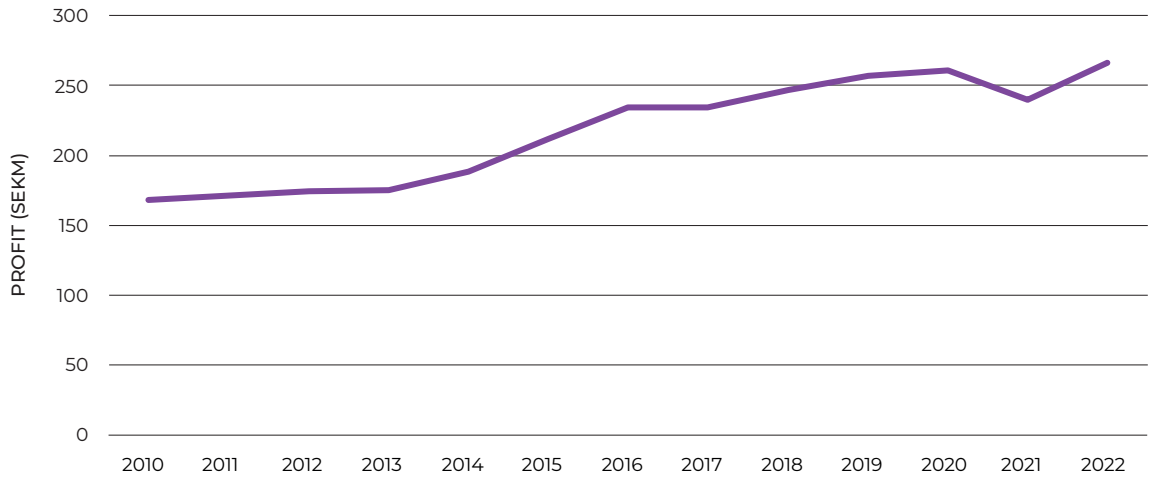
EXAMPLES OF PUBLICLY FUNDED BROADBAND INFRASTRUCTURE DEPLOYMENT: STOKAB, STOCKHOLM

Stokab is fully owned by the Stockholm municipality in Sweden. Stokab uses a wholesale-only business model and is not active in the retail market. It provides dark-fiber-based wholesale access to more than 100 retail service providers and also counts public entities and other players such as enterprises among its customer base. The initial Stokab deployment, which began as far back as 1994, was funded by private sector loans backed by the Stockholm municipality. The success of the model in attracting customers onto the network has helped generate cash to fund expansion of the network (see **Figure 10**).

The benefits of the municipality's involvement in broadband infrastructure deployment are seen in the fact that a number of sizable tech-focused businesses such as Spotify are located in Stockholm, creating jobs and generating tax revenue. Good-quality and reasonably priced

broadband infrastructure has played a role in making Stockholm an attractive location for such businesses and has also placed these businesses in a strong position to innovate. Investment in high-quality fiber infrastructure, including covering residential premises, also leaves citizens well placed to enjoy the benefits of e-government. The Stokab example is a clear demonstration that there are success stories among publicly financed rollouts of broadband infrastructure.

FIGURE 10: STOKAB PROFIT BEFORE FINANCIAL ITEMS, 2010–22



SOURCE: OMDIA

PUBLIC-PRIVATE PARTNERSHIP FINANCING OF THE BROADBAND INFRASTRUCTURE DEPLOYMENT

In some cases it will not be possible for private entities to fully finance the deployment of broadband infrastructure. This might apply to rural geotypes with high costs per premises passed for FTTP rollout that limit the purely commercial case for broadband infrastructure rollout. At the same time, the government may not wish to provide all the funding for the rollout of broadband infrastructure and may also not want to run the broadband network once it is built. In this case there are opportunities for public-private partnerships to finance broadband infrastructure deployment. Public-private partnerships can remove the need to fund the broadband infrastructure rollout from the government's balance sheet. Such models also have the potential to introduce competition, for instance, during tender processes launched by the government. Using a public-private partnership model can also in theory provide greater efficiency than traditional ways of providing public services.

GAP FUNDING FOR BROADBAND ROLLOUT

Governments could provide funding to bridge the gap between what private operators are prepared to contribute and the overall cost of the broadband infrastructure rollout. They could launch tenders whereby the operator committing to the biggest contribution to the broadband rollout gains the right to roll out, maintain, and operate the resulting broadband network. Governments could also attach rules to such tenders under which operators are only allowed to use certain technologies or the technology deployed must be capable of delivering certain speeds in order to qualify. Other rules for participating in tenders to receive public funds for broadband infrastructure rollout might include requiring the operator not to be active in the retail broadband market.

In the gap-funding model, which is also referred to as an operator subsidy model or private build–design–operate model, the public authority's role is limited to providing the subsidy to the private operator to deploy the network. The public authority does not build or operate the network and is not active in the retail broadband market. From the point of view of the

public authority this kind of model reduces complexity and could help to speed up rollout. Gap-funding models do, however, mean that the financial returns from the project flow to the private operator, and this limits the scope for the public authority to reinvest such returns in further expanding coverage.

GAP-FUNDING EXAMPLES: PROJECT GIGABIT, UK

There are numerous examples of governments using gap-funding models to accelerate broadband infrastructure deployment. In the UK the Gigabit Infrastructure Subsidy component of the £5bn Project Gigabit scheme managed by Building Digital UK (BDUK) is focused on providing gap funding. The public subsidy offered as part of the scheme is the minimum amount necessary for the private sector to deliver the project while also making an acceptable rate of return. Winners of the tender process are selected on a mixture of price and quality considerations. Project Gigabit aims to ensure underserved areas outside of operators' commercial plans are covered with gigabit-capable broadband. The government's objective is to ensure coverage of 85% of UK premises with gigabit-capable broadband by 2025 and nationwide coverage by 2030.

Though there may be concerns that the legacy incumbent will be best placed to win tenders for gap-funded deployments, for Project Gigabit a range of altnets, including CityFibre, Freedom Fibre, Wessex Internet, Wildanet, Borderlink, and Fibrus, have won all the Project Gigabit tenders so far for all the different geographical areas. Gap-funding schemes can be designed so that reuse of existing infrastructure is encouraged and so that incumbent providers are not advantaged unduly by applying infrastructure sharing.

OWNERSHIP OF THE NETWORK WITH PUBLIC-PRIVATE PARTNERSHIP FINANCING

SHARED OWNERSHIP OF THE NETWORK BETWEEN PRIVATE AND PUBLIC AUTHORITIES: JOINT VENTURES

One question around public-private partnerships is the ownership of the resulting network. One model that could be used is one in which the state holds a part share in the broadband network. Shared ownership of the network between private and public authorities can be referred to as a type of joint venture. Within this model there are also different variations whereby the partnership might or might not involve the creation of a special-purpose vehicle.

CONCESSION MODELS

Build–operate–transfer concessions are somewhat different in the sense that the private sector is responsible for the initial funding for the infrastructure rollout and then after the construction phase operates and maintains the network as part of its concession. Ownership of the passive network infrastructure remains with the public authority. After this concession expires, the government takes over ownership of the active network infrastructure. The advantages of this kind of model are the limited financial risks that the public authority needs to take on. In addition, the model provides flexibility to public authorities once the initial concession period has expired because they can choose to extend the existing contract with the same operator or switch to another operator to run the network. The public authority could even choose to run the network itself once the initial concession has expired.

HOW GOVERNMENT FUNDS ARE PROVIDED: LOANS AND GRANTS

Governments also face choices in how they provide funds to private sector partners for broadband rollout. One option that could be used is to provide long-term low-interest loans for the rollout of broadband infrastructure. Such loans may only need to be repaid once certain thresholds are met in terms of subscription take-up on the broadband network. This, for example, is the case for Chorus in New Zealand. Governments could also provide a direct grant at the start of the broadband rollout.

BROADBAND BUSINESS MODEL CHOICES

Investors in broadband infrastructure must also decide on the business model they will use for their network. One key decision is whether to offer wholesale access to third parties on the network. Operators could even choose to not be active in the retail broadband market and to operate a wholesale-only business model. If an operator chooses to offer wholesale access it must then decide what kind of wholesale access to offer. Broadly speaking, operators could offer passive wholesale access, where access seekers deploy their own electronic (active) equipment, or active wholesale access, where the wholesaler deploys its own electronic (active) equipment. This section of the guidebook discusses where these different business models are relevant, outlines their advantages and disadvantages, and draws some conclusions for different stakeholders.

VERTICALLY INTEGRATED AND DEDICATED NETWORK

REASONS WHY THIS MODEL HAS BEEN CHOSEN AND WHERE IT IS APPLICABLE

This model does offer the benefits of simplicity, and it is common for those operating a network to also want to be involved in the retail market. This model is most common in emerging markets where there may be an absence of regulated access to incumbents' networks. Wholesale-based business models may also be less common more generally across emerging markets than in their developed-market counterparts.

ADVANTAGES

When operating a vertically integrated and closed network the operator is not sharing revenue with any wholesale customers. This means that of all the options it offers the highest potential ARPUs.

DISADVANTAGES

Operating a vertically integrated and closed network runs the risk of limiting overall broadband subscription take-up and network utilization. From an investor perspective this may lead to longer payback periods. Private investors may also view the lack of diversity of retail service providers on the network as a potential risk since the underperformance of just one retail service provider will mean low overall subscription take-up. Even for investors with relatively short investment timeframes overall subscription take-up rates will always be a key metric, and for smaller players without a well-known brand, high take-up rates may be difficult to achieve.

Operating a vertically integrated and closed network also limits consumer broadband choices from the deployment of the network. For this reason when governments provide funding for the rollout of broadband infrastructure, they often stipulate that such network must offer wholesale access.

CONCLUSIONS

Operating a vertically integrated and closed network is probably the most common business model across all broadband networks globally. However, operators operating closed networks should at least consider opening them up for wholesale access. Governments should also be wary of providing funding for vertically integrated and closed networks that limit end-user retail broadband operator choices.

VERTICALLY INTEGRATED AND OFFERS WHOLESALE ACCESS

REASONS WHY THIS MODEL HAS BEEN CHOSEN AND WHERE IT IS APPLICABLE

Operators could be vertically integrated with their own retail broadband arm and at the same time offer wholesale broadband access to third parties. Such an approach allows an operator to benefit from high retail ARPUs and also provides opportunities to maximize network

utilization by promoting competition between multiple retail ISPs. This model is most common in Europe, where incumbents are very often designated as players with significant market power that must open up their networks for wholesale access. In most cases for FTTP networks the mandated wholesale access is active access or bitstream, but there are variations. Some regulators mandate so-called virtual unbundling offers, where access seekers can use their own backhaul from central offices. Some altnets in Europe also offer wholesale access on a voluntary basis alongside running their own retail ISP.

ADVANTAGES

Providing wholesale access on the network does provide opportunities to increase overall network take-up. ISPs using wholesale access may be better able to target market niches that may not be reachable by the retail arm of the vertically integrated player. A strategy that some altnets and their investors might consider a good mix is to initially start with a vertically integrated network and attract high-value early fiber adopters as retail subscribers in order to boost ARPUs. Once this market has been exhausted, the network can be opened up for wholesale access to boost overall subscription take-up rates.

DISADVANTAGES

Potential access seekers may be discouraged from using the wholesale access offers because they believe a vertically integrated player will not be sufficiently neutral and will favor its own retail ISP arm.

CONCLUSIONS

An operator that both has a retail broadband arm and offers wholesale access could potentially allow investors to enjoy the best of both worlds in terms of higher ARPUs from retail customers and the higher subscription take-up that wholesale access can potentially help deliver. One option that is worth considering for investors is to initially offer retail access only in order to build up a base of high-ARPU customers. The network could then be opened up to wholesale customers in order to enhance network utilization.

WHOLESALE ACCESS ONLY WITH PASSIVE WHOLESALE ACCESS

REASONS WHY THIS MODEL HAS BEEN CHOSEN AND WHERE IT IS APPLICABLE

Most wholesale-only broadband operators offer some kind of active wholesale access even if they mainly focus on passive wholesale access. This is the case for Open Fiber in Italy, which has some major wholesale customers using its passive wholesale access offers.

ADVANTAGES

From an investor's point of view offering passive wholesale access significantly reduces the risk of another player overbuilding the FTTP network. Reducing the risk of overbuild in the long run is likely to be very important for investors, such as pension funds, that take a long-term view of their investment in fiber assets. Many potential access seekers may also have been used to deploying their own active equipment as copper local loop unbundling (LLU) players and as a result may expect and be satisfied with passive wholesale access offers.

DISADVANTAGES

The disadvantage of this approach is that it limits the ARPUs of the operator infrastructure owner, which means that, all other things being equal, higher network utilization will be required to generate a return on the infrastructure investment. Not all potential access seekers may be in a position to fully take advantage of the passive wholesale access offers. For instance, in a retail broadband market that has historically lacked competition it may be difficult for new ISPs to make sufficient investment to deploy their own active equipment or use their own fiber backbone networks.

CONCLUSIONS

Using a wholesale access only with passive wholesale access business model potentially imposes some challenges for investors because it limits ARPUs. Some access seekers might prefer to use this wholesale model but others may prefer active wholesale offers and so infrastructure owners must carefully consider the demand for passive wholesale access in their particular market. Governments and regulatory authorities should note that government funding has tended not to require the network to offer only passive wholesale access.

WHOLESALE ACCESS ONLY WITH ACTIVE WHOLESALE ACCESS

REASONS WHY THIS MODEL HAS BEEN CHOSEN AND WHERE IT IS APPLICABLE

In most cases wholesale-only broadband operators do offer some kind of active wholesale access. Many European wholesale-only operators, such as CityFibre in the UK, are focused on active wholesale access, and this is also the case with players such as NBN Co in Australia and Chorus in New Zealand.

ADVANTAGES

Active wholesale offers can potentially still allow access seekers to reutilize some of their existing investments. Alternative operators that have rolled out fiber to exchanges, for instance, to make use of copper LLU offers, could reuse this infrastructure if virtual unbundling offers are available. From the point of view of the infrastructure owner, offering active wholesale access will generate higher ARPUs than passive wholesale access. Government and regulatory authorities might also take the view that active wholesale access will still allow for sufficient competition at the retail level because access seekers will be able to differentiate themselves in terms of the retail services they provide even if active wholesale access may limit access seekers' retail pricing flexibility.

DISADVANTAGES

While offering attractive wholesale active access does reduce the risk of overbuild, which is important for investors such as pension funds, access seekers may not be wholly satisfied with this kind of wholesale offer. They may view active wholesale offers as providing insufficient space for reasonable profit margins. For access seekers the cost of active wholesale offers will form a higher proportion of retail prices than passive wholesale offers will.

CONCLUSIONS

In order to make this model (and other wholesale-only models) successful, operators will need to focus on attracting large ISPs to the network. This will help generate momentum behind the network and maximize network utilization, which is particularly important for wholesale-only players that have lower ARPUs than their vertically integrated and closed network peers. Investors need to be sure that active wholesale offers are attractive to important ISPs in the market. It may be challenging to generate sufficient network utilization if the retail ISPs on the network lack a customer base on legacy technologies (e.g., DSL) to migrate to the fiber network or if the retail ISPs lack brand awareness in the market.

WHOLESALE ACCESS ONLY WITH THREE-LAYER MODEL

REASONS WHY THIS MODEL HAS BEEN CHOSEN AND WHERE IT IS APPLICABLE

In the above examples there are two layers of companies involved in broadband supply: the infrastructure owner and the retail ISP. Depending on the model chosen, either the infrastructure owner or the retail ISP is responsible for the supply of the active equipment used in the network. Another business model involves a third layer that sits in between the infrastructure owner and the retail ISP, and these so-called netcos will be responsible for the active equipment used on the network. This model is often used in markets such as Sweden, where many municipalities have deployed their own fiber networks. It allows different players to best focus on their specialties.

ADVANTAGES

Players such as municipalities and energy companies that have invested in rolling out FTTP infrastructure may have little expertise in running a broadband network, so operating the network with a separate netco removes this challenge. This could also apply to cases where the government has purely financed the broadband infrastructure rollout.

DISADVANTAGES

Adding another layer to the business model potentially reduces profit margins for each layer of the hierarchy. Operators may feel that they are capable of serving as their own netco, and in Singapore, for example, retail ISPs tend to use their own active equipment rather than that of the designated netcos on the nationwide FTTP network.

CONCLUSIONS

All stakeholders should be aware that it is not necessary for networks to use a three-layer business model. There may be some inherent tension in the model given the need to share margins with an additional layer of players, which may reduce the attractiveness of the model. Nevertheless, if operators and investors lack expertise in running broadband networks, it may make sense for them to delegate the running of the active network to a separate netco.

WHOLESALE-ONLY ANCHOR TENANT MODELS

It is also worth noting that there is a further possible distinction between different players using some variant of any of the business models described above that include offering wholesale access. In some cases, such as with CityFibre and Vodafone in the UK, the infrastructure owner will sign an agreement with a single retail ISP or anchor tenant that offers them exclusive access to the network at favorable terms for a set period. This model has advantages in incentivizing that retail ISP to quickly maximize its subscription take-up and could also be a way of attracting a large ISP or anchor tenant to the network, which may not be possible without offering such exclusive access. However, the downside to such a model is that it relies on strong execution from the anchor tenant in order to drive subscription take-up. Competition between retail ISPs on the network is also absent, which could damage overall subscription take-up rates on the network.

Anchor tenant relationships might also encompass the access seeker committing to take a certain number of lines in advance in return for lower fees. This is another way of strengthening the relationship between wholesaler and access seeker and can further help drive overall subscription take-up on the network.

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