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Telecommunication industry in the post-COVID-19 world

Report of the 7th ITU Economic Experts Roundtable

The telecommunication industry in the post-COVID-19 world

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1 ITU Economic Experts Roundtable on the Telecommunication Industry in the post-COVID-19 world (https://www.itu.int/en/ITU-D/Regulatory-Market/Pages/Events2020/EconomicRoundTable/home.aspx)

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Foreword

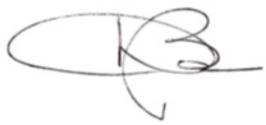
The 6th ITU Economic Experts Roundtable discussion, held at the outset of the COVID-19 pandemic in June 2020, highlighted the crucial role of digital technologies in keeping our societies and economies functioning. At the same time, experts warned that the persistence of the digital divide is acting as a major barrier preventing underserved populations from maintaining a semblance of "life as normal" under the pandemic. It was in this context that a second roundtable was held to look at specific solutions to address the chronic lack of digital access that is leaving the unconnected ever further behind.

This roundtable changed the focus from the assessment of the impact of the pandemic on the functioning of digital infrastructure and the implications for urgent actions, to the search for longer-term solutions.

As many experts warned, there is no "silver bullet" to solving the universal connectivity challenge. Country by country, region by region, ubiquitous broadband access will be achieved through the implementation of a combination of effective, enabling business models and financing approaches that stimulate investment, implemented according solid policy and regulatory frameworks that prioritize affordability, local innovation, human capacity building around digital skills, infrastructure and resource sharing, and more.

In line with the theme of the forthcoming World Telecommunication Development Conference (WTDC) – *Connecting the unconnected to achieve sustainable development* – the outcomes of this second roundtable offer a range of responses to the challenges wrought by the COVID-19 pandemic, identifying potential business models, innovative financing approaches and public-private collaboration opportunities that could help pave the way to universal, meaningful and sustainable connectivity.

It is my hope that this report proves useful, both to ITU members as well as to ICT stakeholders from across the entire digital ecosystem, as we learn from the lessons of this pandemic and strive to take concrete, actionable measures that will put access to quality digital networks within reach of all and actively support the development of a thriving global digital economy.



Doreen Bogdan-Martin
Director, ITU Telecommunication Development Bureau

List of acronyms and abbreviations

ARPU	average revenue per user
CAPEX	capital expenditure
CSR	corporate social responsibility
DSRA	debt service reserve account
DFI	development finance institution
ESG	environmental, social and governance
FCC	Federal Communications Commission
FTTx	fibre-to-the-“x”
GCC	Gulf Cooperation Council
GCCIA	Gulf Cooperation Council Interconnection Authority
MNO	mobile network operator
NBN	national broadband network
PPP	public-private partnership
ROE	return on equity
ROI	return on investment
SDGs	Sustainable Development Goals
SMEs	small- and medium-sized enterprises
SPV	special purpose vehicle
USF	universal service fund
WACC	weighted average cost of capital

Executive summary

The 7th ITU Economic Experts Roundtable was convened in order to understand the COVID-19 pandemic situation better and take stock of new business models and potential financing strategies to deliver universal connectivity in the post-COVID-19 world. The roundtable was structured around two panels:

- The first panel focused on a number of promising business and operating models that could be implemented to address the connectivity challenge.
- The second panel addressed financial models and instruments that can be used to mobilize development finance institutions (DFIs), institutional investors, private equity and public markets, as well as the public sector, in order to finance the required infrastructure projects.

The panels began by outlining the nature of the challenge that needs to be tackled:

- 49 per cent of the world's population does not use the Internet;
- Larger clusters of non-users are located in Africa (71 per cent), Asia and the Pacific (55 per cent) and Arab States (45 per cent);
- 19 per cent of the population in advanced economies are also non-users;
- Part of the digital divide can be explained by a lack of network infrastructure: 15.3 per cent of the world's population is not yet covered by 4G networks while 30.1 per cent is unserved by fixed broadband;
- The network coverage gap is even larger for state-of-the art technology: 83.9 per cent of the world's population is not covered by 5G, while 83.1 per cent of households have not adopted FTTx;
- A large portion of the rural population remains unserved by broadband networks: 29 per cent of the world's rural population is not served by 4G networks, while only 5 per cent of the world's urban population is unserved; and
- The unserved rural population is even higher in Africa (78 per cent), Arab States (56 per cent) and Eastern Europe (56 per cent).

The pandemic has exacerbated difficult economic conditions driving the digital divide, as economic contraction, slower growth and rising unemployment have resulted in significant economic challenges across digital service users. Furthermore, it has widened the divide in the availability and quality of connectivity between markets and, just as significantly, within individual markets (between urban and rural settings, primary vs. secondary cities, etc.). The reduction in capital expenditure (CAPEX) in telecommunications, as a result of the economic downturn induced by COVID-19, is having a negative impact on network expansion, particularly in rural areas. On a structural basis, the downward pressure on revenue owing to the fact that rising traffic does not necessarily translate into rising profitability is limiting the investment capacity and appetite of telecommunication service providers. As a roundtable expert reported, while the top five African telecommunication operators spent USD 6 billion in 2019, they only spent USD 4.5 billion in 2020.

In this context, the objective in terms of public policy is to broaden perspectives on how to address the connectivity challenge, beyond the use of Universal Service Funds (USFs). The views of the first panel on business models that can be implemented to tackle the digital divide are as follows:

- Global consensus is emerging that there is no "silver bullet" for the challenge of universal connectivity. On the contrary, ubiquitous broadband access will be achieved through the implementation of a combination of business models and financing strategies, according to specific economic and social conditions.
- Most innovative models to bridge the digital divide existed prior to the pandemic. The pandemic has merely reinforced the need to accelerate, scale up or expand them to more geographical contexts. The challenge, however, remains doing so in such a way that they can benefit the millions, rather than the thousands. Digital divide models require extensive cross-sector partnerships between diverse organizations with varied vested interests, which is fertile ground for coordination failures.
- It is important to create a suite of enablers for the development of alternative wholesale access and infrastructure providers to reduce deployment costs, such as by reducing taxation on equipment, streamlining relevant regulation and incentivizing infrastructure sharing.
- Infrastructure sharing has the potential to reduce deployment costs and ensure business viability through the following network components: backhaul, ducts, towers, spectrum and last-mile access. Some examples of successful infrastructure-sharing initiatives include: passive sharing partnerships (e.g. mast, sites), active network sharing; partnerships between complementary networks (e.g. backhaul access in exchange for meeting license obligations); revenue sharing between cell site, backhaul providers and operators; and partnerships with electric utilities and railways to enable network expansion.
- While shared network infrastructure agreements can help to drive coverage in remote areas, they may be difficult to implement in practice without government involvement. Operators can be at various stages of network roll-out and may, therefore, have different attitudes to infrastructure as a competitive advantage. If an operator has invested heavily in a national network, it will likely be loath to offer competitors access to that advantage. There are, however, examples where regulatory facilitation has addressed this issue successfully. For example, the United Kingdom's Shared Rural Network was developed by the country's four mobile network operators (MNOs) with government support. The project consists in MNOs investing to extend their coverage by upgrading their existing networks, working together on shared infrastructure and building new sites, with new government-funded masts being built to target areas with no mobile coverage from any operator.
- Another approach to network-infrastructure sharing for the purpose of expanding rural coverage is through the enablement of wholesale specialists. This model revolves around the creation of companies focused on specific stages of the value chain, thereby capturing the economies of scale and scope necessary to render the deployment financially viable. The examples are many at the infrastructure level and include tower and fibre companies.
- Open network environments can reduce deployment costs substantially. The concept involves the creation of a joint venture of telecommunication and platform companies, supported by DFIs to provide wireless service in rural areas, based on 4G technology. A good example of this model is the initiative "Internet Para Todos" implemented in Peru. The joint venture, co-owned by Telefonica, Facebook, IDB Invest and CAF Latin America Development Bank, deploys, operates and owns the mobile infrastructure. Relying on OpenRAN technology, this network provides a multivendor, multi-operator open ecosystem of interoperable components. Telefonica supplied over 3 000 sites and is planning to roll out additional ones. Facebook provides capital and technology, while the two development institutions provide additional financing.

- Another way to bridge the digital divide is by adopting a model where the downstream rural e-services (e.g. rural financing, e-commerce and media platforms) first drive demand, which will then encourage telecommunication operators to build up connectivity in rural areas. This model has been implemented successfully in China, where Internet platforms, such as Tencent and Alibaba, have been important actors in driving telecommunication network deployment.

With regard to financing models, the roundtable panellists agreed on the following points:

- In addition to traditional models such as the classic project financing model, public-private partnerships (PPPs), USFs and demand subsidization approaches, there are many other possibilities based on new financing models and financial instruments. They include loss guarantee schemes, collaborative deployment models, government anchor tenant model, multiple-financing models (including service providers and a second party such as a utility company or digital platform) and demand aggregation models.
- Blended finance is important owing to the concern that telecommunication projects in rural areas lack financial viability. Bridging the digital divide requires the crowding in of investment from diverse investors with different risk profiles from equity to senior debt. Those investors may be private equity, pension funds, DFIs, commercial banks or corporate investors. The challenge, though, is how to attract investors to make the projects not only viable but also render the financial benefit proportionate to the risk. In rural telecommunication projects, there is no offtake[1], so financiers need to bear the commercial risk. This is unusual in project finance structures – at least for risk-averse infrastructure investors.
- Pooled financing is a well-established and highly successful means of mobilizing private financing for small infrastructure projects in both developed and developing countries. In developed countries, such mechanisms are established as governmental, quasi-governmental or legally independent non-profit entities or agencies that aggregate a number of local projects for financing. By combining multiple borrowers' needs together, pooled funds, such as State bond banks, State revolving loan funds, county improvement authorities, city economic development agencies and similar agencies, can offer larger debt issues with better credit ratings. Because pooled issues can be structured to achieve high credit ratings in the primary market, debt-servicing costs are reduced. A pooled financing facility is created to finance multiple small rural telecommunication projects, with several lenders (public or private) taking pro rata exposure to each of the projects.
- More than ever, the public sector, particularly in developing countries, has limited resources to achieve the objectives that the current situation demands. Governments can, however, provide significant support to infrastructure projects through in-kind contributions and incentives such as tax credits, free or low-cost permits, such as rights of way, and financial guarantees to investors. In addition, governments can: (i) subsidize capital costs by offering below-market loans with a more extended tenor; (ii) co-invest with the private sector if deployment takes place in rural areas; (iii) offer grants through a USF; (iv) reduce property taxes for facilities deployed in rural areas; (v) exempt equipment acquired for deployment of network infrastructure in rural areas from sales taxes and import duties; (vi) promote aggregation of demand from public entities (education, safety, health care) in order to create an "anchor tenant" effect; (vii) promote synchronization of infrastructure development (e.g. trenching) across infrastructure-development parties; and (viii) provide access to cell deployment sites on public property (rooftops of public buildings).
- Another complementary approach would be to include connectivity in private sector companies' corporate social responsibility (CSR) contributions and consider connectivity expansion as part of environmental, social and governance (ESG) financing and investment objectives. These contributions are usually constrained by the objective or the target

[1] An offtake agreement is an arrangement between a producer and a buyer to purchase or sell portions of the producer's upcoming goods. An offtake agreement is normally negotiated prior to the construction of an infrastructure to secure a market for its future output.

industry of the CSR fund of companies in any industries. In most cases, connectivity is not listed among their objectives and telecommunications is rarely included in their target industries, as connectivity is not recognized as important to achieving typical social responsibility objectives, such as fighting hunger, improving education, reducing poverty or improving health care. Given the impact of Internet access on development and SDG attainment, however, advocacy for contributions to reducing the broadband gap should be focused on the importance of the contributions to achieving the SDGs, rather than as a standalone issue.

- Public-private partnerships (PPPs) are essential to satisfying and advancing telecommunication infrastructure needs. A PPP for the construction of telecommunication network infrastructure requires investors (e.g. construction companies, banks, pension funds and infrastructure funds) and lenders (e.g. private sector project finance banks) and, potentially (although more difficult), access to public bond markets. Under this framework, project finance is a specialized form of financing targeted at a standalone project (e.g. a special-purpose project company), whereby lending is based on project-specific cash flow, and lenders rely on project contracts, not physical assets, as a security, known as contract-based financial engineering.
- The role of Development Finance Institutions (DFIs) is important in bridging the digital divide. It should start with dispensing with the axiom that the telecommunication sector must almost exclusively be driven by private capital, a concept very relevant in the developing world. Such an approach has fostered a middle class-centric view of ICT markets, whereby private capital investments are focused primarily on the needs of the growing urban middle class.

Introduction

The 6th ITU Economic Experts Roundtable, convened by ITU in June 2020, concluded that the digital infrastructure sector needs to re-examine some of the sector's basic fundamental premises that prevailed before COVID-19. In particular, it was agreed that it is crucial for governments to learn from the lessons of the pandemic and take concrete, actionable measures to enable telecommunication operators and other stakeholders to provide universal access to quality digital infrastructure networks for all and support the development of a digital economy. In this context, there was agreement among roundtable participants that, going forward, regulatory frameworks may need to be adjusted to stimulate investment in network infrastructure, whilst maintaining a "sensible" level of competition and shifting from a "purist" to a "pragmatic" viewpoint on related State-aid regulations.

In line with this conclusion, the 7th ITU Economic Experts Roundtable was convened in order to understand the COVID-19 pandemic situation better and take stock of business models and potential financing strategies that might deliver universal connectivity in the post-COVID-19 world. While recognizing that the digital divide is driven by supply (i.e. network coverage) and demand (e.g. affordability, digital literacy, etc.), the primary focus of this roundtable was to explore the supply gap: what needs to be done from a business model and financing standpoint to deploy broadband network infrastructure with universal reach? It should be stated, however, that despite the intention to focus the roundtable on the supply side, some panellists emphasized that the primary driver of the digital divide was on the demand side and that demand, therefore, should be the focus of attention. As stated by one panellist, "the real problem is digital inequality, not connectivity".

In line with this, the focus of this roundtable was to:

(a) explore the business and operating models that will facilitate universal connectivity; and

(b) outline financial approaches that will facilitate the fulfilment of universal service.

A survey questionnaire was sent to roundtable panellists. They were also asked to share any relevant research that they had generated on the two topics. This report provides a summary of the responses to the survey, complemented with comments made during the course of the roundtable and references to existing research.

As will be explained throughout this report, there appears to be an emerging consensus that there is no "silver bullet" for the challenge of universal connectivity. On the contrary, ubiquitous broadband access will be achieved through the implementation of a combination of business models and financing strategies, according to specific economic and social conditions.

Chapter 1 sets the stage, using statistics to describe the extent of the digital divide around the world and of the problem that needs addressing. Chapter 2 explores different operational and business models that can facilitate the deployment of infrastructure among unserved populations.

Chapter 3 details the financing strategies and instruments to be considered and the expected role of DFIs, institutional investors, private equity, public markets and the public sector in financing required infrastructure.

Finally, Chapter 4 outlines potential obstacles to addressing the connectivity challenge.

1 The extent of the digital divide

According to ITU statistics, 49 per cent of the world's population does not access the Internet[1]. The digital divide varies from region to region, with 71 per cent of individuals in sub-Saharan Africa not using the Internet, compared to 17 per cent in Europe (see Table 1).

Table 1. Percentage of individuals not using the Internet (2019)

Sub-Saharan Africa	71 %
Arab States	45 %
Asia and the Pacific	55 %
Commonwealth of Independent States (CIS)	27 %
Europe	17 %
North America	9 %
Latin America	31 %
World	**49 %**

Source: ITU estimate

As the data show, the digital divide is not only a feature of developing countries: it stands at 19 per cent in developed countries but increases to 56 per cent in developing countries.

While Internet adoption can be explained by multiple demand variables, such as affordability of broadband services or digital literacy levels, the penetration gap can also be attributed in part to a lack of network coverage. For example, 84.7 per cent of the world population have access to 4G networks and 69.9 per cent to fixed broadband networks. Network coverage decreases significantly in the developing world (see Table 2).

[1] ITU defines Internet access as those individuals using the Internet from any device (including mobile phones) in the last 12 months. A growing number of countries are measuring this through national household surveys. In countries where household surveys are available, Internet penetration should correspond to the estimated number derived from the percentage of Internet users surveyed. If the survey covers percentage of the population for a certain age group (e.g. 15-74 years old), the estimated number of Internet users should be derived using this percentage. In situations where surveys are not available, an estimate can be derived based on the number of broadband subscriptions.

Table 2. Percentage of uncovered population (2020)

	4G networks	Fixed broadband
Africa	55.7 %	53.3 %
Arab States	38.1 %	23.9 %
Asia and the Pacific	5.8 %	37.6 %
Commonwealth of Independent States (CIS)	19.2 %	6.2 %
Europe	2.8 %	5.1 %
North America	2.1 %	4.1 %
Latin America	14.0 %	11.0 %
World	**15.3 %**	**30.1 %**

Source: (4G) ITU; Fixed broadband (Eurostat; OECD; Ovum; extrapolation to 2020 by Telecom Advisory Services)

While the coverage of 4G networks and fixed broadband has reached significant levels in recent years, the same cannot be said for more advanced technologies, such as 5G and FTTx. The share of the population covered by 5G and households served by FTTx or other state-of-the-art fixed broadband technology is significantly lower, even in some advanced economies (see Table 3).

Table 3. Percentage of households unserved by 5G and FTTx (2020)

	Uncovered by 5G	FTTx non-adopting households
Africa	100 %	99.2 %
Arab States	84.6 %	92.8 %
Asia and the Pacific	85.0 %	63.8 %
Commonwealth of Independent States (CIS)	83.6 %	70.4 %
Europe	75.8 %	63.7 %
North America	36.2 %	76.6 %
Latin America	96.8 %	86.8 %
World	**83.9 %**	**83.1 %**

Source: 5G (GSMA Intelligence); FTTx (IDATE; Fiber Connect LATAM; extrapolation to 2020 by Telecom Advisory Services)

As expected, the unserved population is primarily concentrated in rural areas: 29 per cent of the rural population are unserved by 4G networks, compared to 4 per cent of the urban population (see Table 4).

Table 4. Percentage of population uncovered by 4G networks (2020)

	Urban	Rural
Africa	23 %	78 %
Arab States	24 %	56 %
Asia and the Pacific	0 %	11 %
Commonwealth of Independent States (CIS)	0 %	56 %
Europe	0 %	11 %
The Americas	2 %	46 %
World	**5 %**	**29 %**

Source: ITU

In summary, the extent of the world's unserved population can be reflected as follows:

- 49 per cent of the world's population (or 3.341 billion individuals) do not use the Internet.
- Larger clusters of non-users are located in Africa (71 per cent or 425 million people), Asia and Pacific (55 per cent or 2.227 billion people) and Arab States (45 per cent or 121 million people).
- 19 per cent of the population of advanced economies (170 million individuals) are also non-users.
- The digital divide can be explained in part by the lack of network infrastructure: 15.3 per cent of the world population (1.043 billion people) are not yet covered by 4G networks while 30.1 per cent of households (or 540 million) are unserved by fixed broadband.
- The network coverage gap is even larger for state-of-the art technology: 83.9 per cent of the world population (5.721 billion people) are not covered by 5G, while 83.1 per cent of households (1.489 billion) have not adopted FTTx.
- As expected, the coverage gap for advanced network technologies is even larger in the developing world: 96 per cent of the population in the developing world are not served by 5G, while 93 per cent of households in the same regions have not adopted FTTx.
- A large portion of the rural population remains unserved by broadband networks: 29 per cent of the rural population are not served by 4G networks, compared to only 5 per cent of the urban population;
- The rural population unserved by 4G is even higher for Africa (78 per cent), the Arab States (56 per cent) and Eastern Europe (56 per cent).

COVID-19 has exacerbated difficult economic conditions driving the digital divide, as economic contraction, slower growth and rising unemployment have resulted in significant economic challenges across digital service users. Furthermore, it has widened the divide in the availability and quality of connectivity between markets and, just as significantly, within individual markets (between urban and rural settings, primary vs. secondary cities, etc.). As anticipated at the 6th ITU Economic Experts Roundtable, service providers in countries where 5G development is relatively advanced will continue with 5G roll-out plans, while operators in nations not as far along in this regard (e.g. developing countries) would slow down 5G investment. For carriers pursuing 5G roll-out, investment in network modernization would be primarily focused on urban environments, with deployment of new technology in suburban and/or rural areas postponed. The low average revenue per user (ARPU) in developing countries would force telecommunication operators to postpone CAPEX in 5G. As mentioned by one expert, "the reduction of CAPEX in telecommunications as a result of the COVID-19-induced economic downturn will have a negative impact on the rate of network expansion, particularly in rural areas". In addition, some experts considered that "delayed deployment of 5G and extended high-speed and fibre networks in many countries means a longer period before businesses and consumers in these markets get access to higher speeds and advanced services".

The dichotomy is clear in terms of network deployment: we are witnessing an acceleration of fibre/4G/5G deployments in some advanced markets while other regions continue to rely on 3G connectivity. Similarly, access to cloud services and applications remains highly uneven. This reinforcement of social and technology inequalities remains a long-term challenge with no visible short-term solutions. In the words of a panellist, "the divide may get worse before it gets better".

On the supply side, the pandemic has also affected the ability of ICT service providers to tackle the issue of unserved populations. A positive aspect, as explained by a panellist, is that "the old perception of lumbering telecommunications operators that lacked agility to respond to environmental changes has disappeared. Operators have been able to respond quickly in some of the direst circumstances". However, despite being largely resilient in the face of the pandemic, the ICT sector remains exposed to broader economic headwinds, with considerable pressure on working capital and liquidity. At the macrolevel, telecommunication service providers are facing limited incremental revenues, combined with rapidly increasing operating costs, which drive declining margins. For example, Asian telecommunication service providers have witnessed a decline in median earnings before income tax from 17 per cent in 2013 to 11 per cent in 2018 and 14 per cent in 2019.[2] As anticipated at the 6th ITU Economic Experts Roundtable, service providers' capital requirements are growing while their marginal profitability is under pressure[3]. On the one hand, there is strong pressure to increase CAPEX to expand capacity and coverage, compounded by a pressure to begin the next cycle of spectrum investments, i.e. 5G, with still limited visibility on revenue models. Moreover, strong data usage leads to a significant increase in base station requirements and, consequently, higher CAPEX demands. On the other hand, the downward pressure on revenues due to the fact that rising traffic does not necessarily translate into rising profitability is limiting investment capacity. As an indication of the declining ability of telecommunication service providers to capture value, it is estimated that more than 35 per cent of revenue created on content is being captured by content creators, compared to 12 per cent in 2008.[4] This situation on the supply side increases the pressure to find other innovative approaches to tackling digital access inequality.

On a related matter, a view was shared among panellists that USFs cannot address the huge connectivity demands on their own. As mentioned by a panellist: "if we look at Africa, for example, a study carried out in 2018 for 37 countries revealed a total of USD 408 million in undisbursed funds. This amount is insufficient when set against the gap of USD 100 billion, calculated by the recent Broadband Commission Working Group report on the Digital Infrastructure Moonshot, for Africa to achieve universal access to broadband connectivity by 2030". Simply put, we need other solutions.

2 Sullivan, J. (2021). *How we think about thinking about telcos*. J.P. Morgan Asia Pacific Equity Research (February), p. 15.

3 As stated by Sullivan, J. (2021). Ibid. "Since 1-Jan-2017: Telcos have underperformed by c.100% driven by three factors: (i) Market realization that increasing data usage does not lead to faster revenue growth; (ii) Market realization that increasing data usage leads to increasing CAPEX; (iii) Increasing CAPEX leads to higher OPEX, hence, lower returns on capital".

4 Ibid., p. 13.

2 Business and operating models

Innovative business models to bridge the digital divide existed prior to the pandemic. The pandemic has merely reinforced the need to accelerate, scale up or expand them to more geographical contexts. Technology-based operating models that considerably reduce the cost of delivering basic Internet access to lower-income groups already exist. For example, fibre and/or satellite backbones supplemented by Wi-Fi hotspots, the use of local caching and IXPs to reduce transmission costs and the use of renewable energy sources to power remote base stations are some of the approaches already used in developing markets, with a moderate level of success. In the words of a panellist, "the provision of a blend of mobile and fixed technologies to these economically challenging environments should become a very significant part of government and operator agendas".

Additionally, zero-rated models have also been implemented in a range of markets. Zero-rate access to key online health and education applications through mobile has become an important initiative. Once the COVID-19 health emergency has eased, it will be very hard for operators to roll these offers back, partly because operators have been required to consider these communities much more acutely than in the past, especially as lockdown has compromised so many vulnerable and at-risk groups.

In summary, in the view of a roundtable panellist, the problem is less about finding other models than it is scaling up existing ones so that they can benefit the millions, rather than the thousands. That remains extremely difficult to do. Digital divide models require extensive cross-sector partnerships between diverse organizations with varied vested interests. In this context, imposing a model at scale has consequences that are far reaching, difficult to appreciate and highly political". As stated in McKinsey's report on worldwide connectivity, "[closing the digital divide] would require the public sector and other private investors to step in to support rural coverage to ensure more inclusive access"[5]. In the words of a panellist: "There is a need for business models and regulations that make it possible for providers to move outside of the traditional profitability paradigms and expectations to deliver the type of access to connectivity that is both meaningful and affordable for most people".

The following section presents a list of business and operating models that will likely prove instrumental in closing the connectivity gap. It aims to offer a broader perspective on how to address the challenge of connectivity, without solely depending on USFs. In the words of a panellist, "USFs are not the ideal way to close the gap. Indeed, there are many potentially better and less distorted solutions to this problem. If a country wishes to establish or maintain a USF, two things need to happen: first, contributions to USFs that are and have been made need to be subject to effective disbursement mechanisms and used for the purposes for which they were collected as a necessary condition; and secondly, the total amount of the funds needs to grow. One way to achieve this is by broadening the contributing basis to include all those that derive economic benefit from the investment".

[5] Gripnik, F. et al. (2020). Connected world: an evolution in connectivity beyond the 5G revolution. McKinsey Global Institute.

2.1 Wireless infrastructure sharing

The potential for wireless infrastructure sharing to reduce deployment costs and make ventures financially viable exists along all elements of the network. Among the most common infrastructure sharing initiatives, the following should be considered:

- Network-infrastructure sharing partnerships;
- Partnerships between complementary networks (such as backhaul access in exchange for meeting license obligations);
- Revenue sharing between cell site, backhaul providers and operators; and
- Partnerships with electric utilities and railways to enable network expansion.

However, as stated by a panellist, "sharing is a great idea that is difficult to implement". While shared network-infrastructure agreements are the right way to approach the connectivity challenge in rural areas, some panellists recognized that they are difficult to implement without government intervention. Infrastructure sharing does not come as a natural strategy to operators, who can be at various stages of network roll-out and may, therefore, have different attitudes to network infrastructure as a competitive advantage. Clearly, if an operator has invested heavily in a national network, it will likely be loath to offer competitors access to that advantage[6]. As stated by one panellist, "under some competitive market conditions, operators might, on their own, arrange socially optimal solutions. In contrast, owners of infrastructure that confers dominant positions will be reluctant to share it". On the one hand, the competitive differentiator inherent in network investment and deployment is expected to increase with 5G. On the other hand, 5G technology, in its capacity to support broader network diversity, combined with the extent of cloud computing at the core and edge of networks could facilitate a rethink of new business models for infrastructure sharing.

Against the backdrop of a potential coordination challenge, some panellists considered that network-infrastructure sharing would require third-party management and likely legislative input, regulatory intervention and incentives. Regulators are actively promoting infrastructure sharing in the Arab States region, for example. The Communications and Information Technology Commission of Saudi Arabia announced in June 2020 the intention to introduce legislation to encourage existing and new tower owners to invest more in infrastructure sharing. Regulations are now being issued advocating strong support for both passive and active sharing. Elsewhere, the new National Broadband Plan of Albania includes active and passive infrastructure sharing as a key recommendation, including with other utility providers. Another option would be to add the need to achieve rural coverage through infrastructure network sharing to spectrum auction conditions. In the opinion of a panellist, however, this is unlikely to happen in some cases because governments, now more than ever, need to maximize financial proceeds from auctions and such a condition might undermine that.

Alternatively, some panellists considered that commercially driven infrastructure sharing appeared to be more effective. In this context, governments should create the necessary conditions and allow operators to formalize agreements on their own. Policies in this domain include allowing for active infrastructure sharing among telecommunication operators and between them and other infrastructure providers, such as electric utilities. A panellist observed

[6] This concept has been studied in depth in the context of platform industries. See Shapiro, C. and Varian, H. Information rules: a strategic guide to the networked economy. Harvard Business School Press: Boston, MA, 1999, and especially in Eisenmann, T. (2008). "Managing proprietary and shared platforms", California Management Review, Summer 2008, Vol. 50, No. 4.

that the pandemic had prompted some regulators in recent months to relax the conditions for infrastructure network sharing. In some cases, governments can also drive infrastructure sharing through, for example, public-private partnerships (see below).

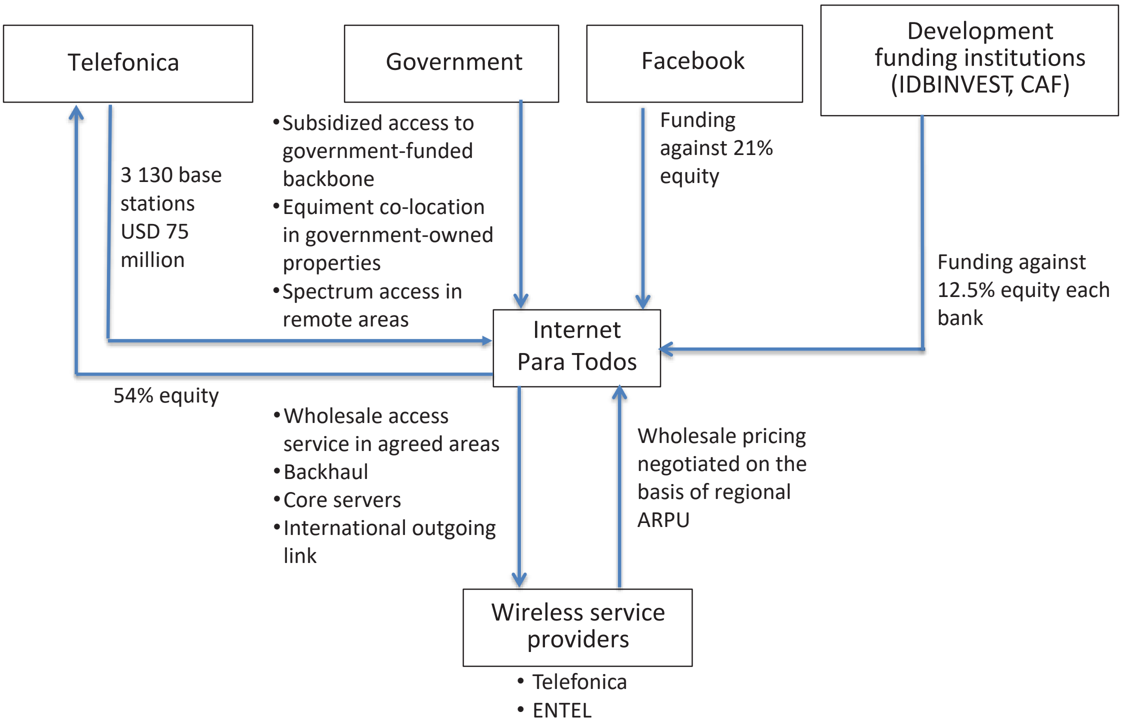
2.2 Creation of wholesale rural wireless infrastructure companies

One way to achieve network-infrastructure sharing and thereby extend rural coverage is through wholesale specialists. This model is based on the creation of companies focused on specific stages of the value chain, thereby capturing the economies of scale and scope necessary to render the deployment financially viable. The examples are numerous at the infrastructure level and include tower and fibre companies.

In the wireless segment, open network environments can substantially reduce deployment costs. This concept involves the creation of a joint venture of telecommunication and platform companies, supported by DFIs to provide wireless service in rural areas, based on 4G technology.

One of the most prominent examples of this model is the initiative "*Internet Para Todos*" implemented in Peru. With a plan to provide coverage for over 30 000 remote communities, the joint venture, co-owned by Telefonica, Facebook, IDB Invest and CAF Latin America Development Bank, deploys, operates and owns the mobile infrastructure. Each partner contributes an equity investment resulting in the following ownership shares: Telefonica – 54 per cent, Facebook – 21 per cent, and the two Development Banks – 12.5 per cent each. In addition to a USD 75 million investment, Telefonica contributed 3 100 base stations. The Peruvian Government also contributes to the joint venture by providing access to the government-owned backbone network, the ability to co-locate equipment in government-owned facilities and access to licensed spectrum in isolated areas of the country. *Internet Para Todos* is completely autonomous from Telefonica, despite its majority holding, and does not consolidate financial results within the group. The four equity holders have equal decision rights over the venture. Relying on OpenRAN technology, this network provides a multivendor, multi-operator open ecosystem of interoperable components. It offers wholesale service in rural and isolated areas to wireless service providers, in addition to backhauling, core servers and international outgoing link. So far, Telefonica and ENTEL have signed service agreements, although the joint venture can also sell access to private companies deployed in remote areas, such as mining operations. As part of the service agreement, the operator defines the areas requiring coverage and negotiates a wholesale price per minute as a function of the ARPU in the area to be served, in order to avoid a potential price squeeze (see Figure 1).

Figure 1. Internet Para Todos model



Source: Internet Para Todos

Implicit in this model is the need to broaden the scope of investment in rural projects beyond conventional stakeholders (i.e. telecommunication service providers) and recognize that digital platforms should also play a role. A panellist went even further to suggest that Internet platforms should contribute to USFs.

2.3 Wireline infrastructure sharing

In addition to wireless-oriented sharing models, numerous initiatives have been developed in wholesale backhaul and last-mile shared wireline networks. The model can also include government-subsidized networks.

Within the first category, we count examples such as the National Optical Fibre Backbone Network in Peru and the State Information Technology Agency (ADIE) in Senegal. In Peru, the backbone network was conceived as a government sponsored neutral network where the State assigned a contract, with financing from the Telecommunication Investment Fund, to a private party for construction, operation and maintenance for twenty years. The network comprises a national backbone and a set of regional networks covering all of the country's districts and offering carrier services to other operators for a single national tariff.

Meanwhile, through ADIE, the Senegalese Government manages an optical fibre network that provides connectivity to government offices in all regional and municipal capitals. The network amounts to 4 045 km of optical fibre cable providing a capacity of 10 Gbit/s transmission and covering 14 regions and 31 departments. The ADIE network is currently undergoing expansion through a structural support project for the regional digital development strategy with the aim of extending the network by 340 000 km, improving backhaul links with 75 000 km of optical fibre cable and linking over 400 government buildings.

Multinational wireline sharing networks are also being developed. For example, the Gulf Cooperation Council (GCC), an institution formed by Gulf nations to promote coordination, integration and interconnection among the Member States, created the Gulf Cooperation Council Interconnection Authority (GCCIA), a joint-stock company subscribed to by the six Gulf States and based in Saudi Arabia. The core activities of GCCIA consist in linking power grids across the GCC countries and operating and maintaining the interconnection grid. In addition, GCCIA leases out its optical fibre network to telecommunication operators along its regional power-line network.

Under the last-mile optical fibre network model, there are numerous examples of municipally owned networks. For example, the Wireless Groningen Foundation signed an agreement in 2009 with Unwired Holding to deploy and manage a citywide wireless broadband network[7]. The project began as an "anchor tenant" model in which the founding members, the Municipality of Groningen, the Hanzehogeschool Groningen, the University of Groningen and the University Medical Centre, agreed to fund the network in return for the ability to use it for their own communications and services. Each of the initial members agreed to contribute EUR 1 million over four years in order to guarantee the initial financial stability of the network in its start-up phase and demonstrate the network's ability to deliver a wide range of services. The plan also calls for the Wireless Groningen Foundation and Unwired Holding to sell network access to government agencies, businesses and consumers.

As for government subsidized efforts, examples can be found such as the National Broadband Network (NBN) in Australia and Chorus in New Zealand. NBN is an Australian national wholesale open-access data network project. It includes wired and radio communication components rolled out and operated by NBN Co Limited. Internet service providers, known under NBN as retail service providers (RSPs), agree terms with NBN to access the network and sell fixed Internet access to end users[8].

Chorus is a provider of telecommunication infrastructure throughout New Zealand. It owns most of the country's telephone lines and exchange equipment and is responsible for building approximately 70 per cent of the new optical fibre ultra-fast broadband network. The company demerged from Telecom New Zealand in 2011, as a condition of winning most of the contracts for the Government's Ultra-Fast Broadband Initiative. By law, it cannot sell directly to consumers, instead it provides wholesale services to retailers[9].

2.4 The role of 5G in bridging the digital divide

The deployment of 5G technology is having an impact not only on standard mobility but also in a multiplicity of human endeavours (see Table 5).

[7] Vos, Esme. 2009. "Groningen, Netherlands Deploys Municipal Wireless Network". *MuniWireless*, April 15. http://muniwireless.com/2009/04/15/groningen-deploys-muni-wireless-network/.

[8] LeMay, Renai (9 March 2011). "NBN: What does 'retail service provider' actually mean?". *Delimeter*. Retrieved 21 August 2019.

[9] *"Chorus signs $1b broadband deals". 3 News NZ. April 17, 2013.*

Table 5. 5G impact domains and use cases

Domains	Use cases
5G on the move	1. Remote operations to manage workplaces, generating data-driven insights to ensure better productivity as well as safe and secure operations.
	2. Connected transport through real-time vehicle-to-vehicle communication enables a partly driverless future, making travel and transport safer and more efficient.
	3. Mass adoption brings a new wave of smart and personalized services to connect our increasingly integrated digital and physical lifestyles post pandemic.
5G on site	4. Smart monitoring enables the automation of asset-management processes, freeing up time for asset utilization and increasing workplace safety and security.
	5. Environmental protection will benefit from new management techniques, driven by the ability to monitor, assess and act in a sustainable manner as 5G scales up.
	6. Autonomous robotics allows real-time automation to improve efficiencies in carrying out complex and repeatable, sometimes hazardous, operational tasks.
5G in communities	7. Democratizing 5G enables a wider uptake of benefits across communities through public-private collaboration, resulting in a more efficient use of scarce resources.
	8. Regionalizing 5G by encouraging earlier deployment through incentives, benefiting people and businesses based outside major urban centres.
	9. Experiential living – transforming our interactions socially, in classrooms, while gaming, with families and in many other social and community settings.

Source: PwC (2021). 5G Outlook Series: Enabling Inclusive Long-term Opportunities

These multiple areas of impact will become more relevant in the post-COVID world. Stimulating 5G deployment in rural and isolated areas will enable communities to benefit from digital innovation. However, as expected, 5G deployment costs are extremely high in rural areas, relative to areas of high population density. The per capita cost of 5G deployment in a rural area has been estimated at USD 3 981 (see Table 6).

Table 6. United Kingdom: 5G capital expenditure (CAPEX)

	Town/city population (million)	Population distribution	5G CAPEX (USD billion)	5G CAPEX	CAPEX per population (USD)
Urban (cities >1 million)	19.42	29 %	0.89	1.66 %	45.71
Suburban	36.16	54 %	7.13	13.37 %	197.16
Rural	11.38	17 %	45.32	84.97 %	3 981.22
Total	**66.96**	**100 %**	**53.34**	**100 %**	**796.58**

Source: Oughton and Frias (2017). Exploring the cost, coverage and roll-out implications of 5G in Britain; Telecom Advisory Services analysis

Applying these benchmarks to a country like Mexico would result in an investment requirement of USD 27.18 billion[10], in a nation where wireless operators' annual CAPEX is approximately USD 2.07 billion[11]. This prompted one panellist to state: "5G will not solve the rural connectivity challenge in the developing world".

In this context, governments may choose to provide resources to promote 5G deployment in rural areas. The Federal Communications Commission (FCC) in the United States, for example, recently approved a rural 5G connectivity scheme. The scheme provides financing to private mobile telecommunication operators and enables them to bid for financial support specifically to deploy 5G networks in rural areas with population densities lower than in urban centres, raising the possibility that the country's citizens and businesses in rural areas could benefit from 5G sooner.

3 Innovative financing models

Initiatives to fund network infrastructure deployment in low-income and rural markets focus primarily on improving the investment risk/return profile. The reality is that digital divide projects tend to be unattractive in terms of return on investment (ROI). DFIs can use their scale and cross-purpose position to help reduce or redefine the investment's risk profile to attract other investors[12]. In that sense, roundtable participants agreed that DFIs have a vital leadership role to play in making this happen. In the view of a panellist, the first step should be "doing away with the axiom that the telecommunication sector must be almost exclusively driven by private capital. Such a view has fostered a middle class-centric view of ICT markets, whereby private capital investments are focused primarily on the needs of the growing urban middle class. While broadly successful from a middle-class perspective, the model has shown its limitations when it comes to connecting the unconnected and achieving the broader objective of digital inclusion". In this context, DFIs must play a more aggressive role in financing digital inclusion initiatives and encouraging operators to move out of their comfort zone.

This means implementing approaches that, in the words of a panellist, "are better suited to conceptualizing and financing rural area projects, including new financing and implementation models, and fresh approaches to private sector incentivization". Grants, concessionary financing, earlier-stage investments in rural area projects can make them more palatable for other private sector investors. Other approaches include creating financing structures or mechanisms that are more suitable for rural area projects; redefining return expectations for bottom of the pyramid projects; and refocusing the role of DFIs towards coalescing resources and participation from governments, the private sector and local communities[13].

10 Katz, R. and Callorda (2021). Estimación del valor económico del uso no licenciado de la banda de 6 GHz en México. Washington, DC: Dynamic Spectrum Alliance.

11 Source: GSMA Intelligence.

12 See Zibi, G. (2018). *Multilateral Development Banks' Investments in the ICT sector*. Alliance for Affordable Internet and the World Wide Web Foundation.

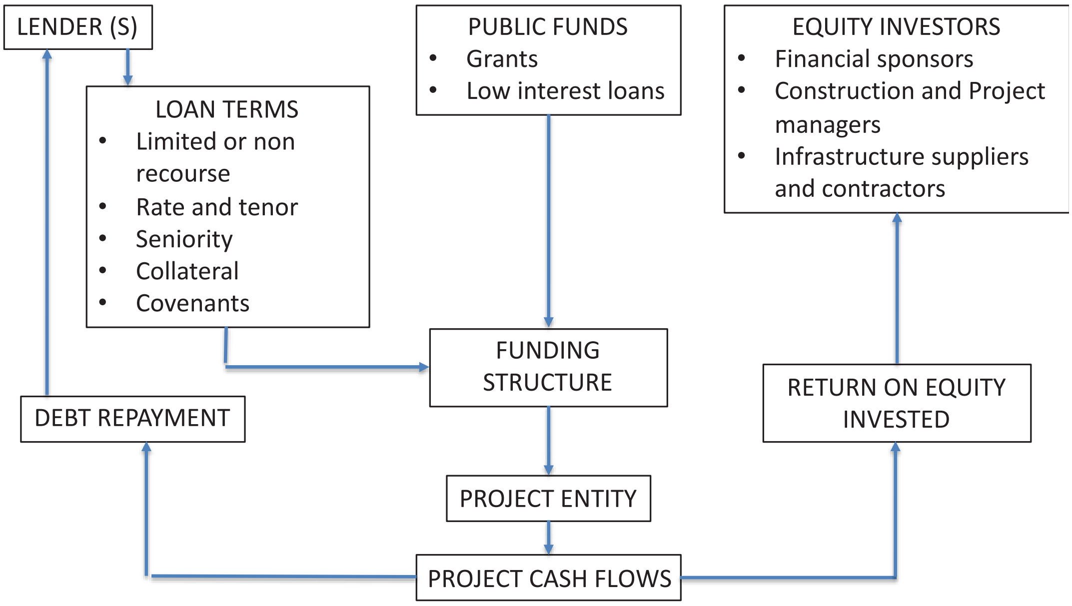
13 Based on Zibi, G. estimates conducted throughout 2017, multinational development banks (MDBs) have largely focused their ICT infrastructure investments over the past five years on submarine and terrestrial fibre projects. Around half of MDB ICT infrastructure commitments have gone to such fibre transmission projects, with the balance going to broadband connectivity projects (~25 per cent of ICT infrastructure commitments) and supporting cell tower companies (~20 per cent of ICT infrastructure commitments).

Bridging the digital divide requires the crowding in of investment from diverse investors with different risk profiles from equity to senior debt. Investors may be private equity, pension funds, DFIs, commercial banks or corporate investors. Key to attracting investors, though, is not only making projects viable but also defining a risk-proportionate financial benefit. In most rural telecommunication projects, there is no offtake[14]. As a result, financiers need to bear the commercial risk, which is unusual in project finance structures – at least for risk-averse infrastructure investors.

3.1 Traditional project finance model

The financing of a rural telecommunication project can be conceived as a particular case of project finance, where investment in a capital asset generates cash flows resulting in a return to equity investors and the ability to serve the acquired debt (see Figure 2).

Figure 2. Traditional project finance model



Source: Katz, R. (2014). Broadband Funding mechanisms. Working Paper. CAF Latin America Development Bank, September

The financing model in Figure 2 comprises three sources of funds: private lenders (through a single institution or a syndicate); public funds (through grants or low-interest loans); and equity investors. Debt financing often represents 50–80 per cent of total project cost. In the case of DFIs, for example, they do not typically provide credit facilities covering more than 50 per cent of project costs. The remainder needs to be covered through equity, grants or operating cash flow. The debt financing terms are generally based on a fixed-interest rate, resulting in fixed payments on the principal and interest, with a maximum tenor ranging between 7 and 20 years. Interest payments are tax deductible. Debt financing can be "on-balance sheet," whereby borrowed funds reside on the entity's balance sheet and repayment is secured by project cash

[14] An offtake agreement, typically used in electricity project financing, is an arrangement between a producer and a buyer to purchase or sell portions of the producer's anticipated goods. An offtake agreement is normally negotiated prior to the construction of a production facility–such as a mine or a factory–to secure a market for its future output. Offtake agreements are used to help the selling company acquire financing for future construction, expansion projects, or new equipment through the promise of future income and proof of existing demand for the goods.

flow and collateralized by the entity's assets. Under an "off-balance sheet" approach, the project is structured as a legally independent project company financed with non-recourse debt (and equity from one or more sponsoring firms), whereby the lender has no or limited recourse to other sponsor assets. This approach expands the universe of potential sponsors since it reduces their investment risk and provides them with more flexibility. Finally, the government can extend financing in the form of grants or low-interest loans.

An off-balance sheet approach is a typical financing approach for companies owning broadband infrastructure that sell capacity to service companies, i.e. network operators, which, in turn, develop and sell services to end customers, i.e. service companies. In this case, lending is provided to the infrastructure company, structured as a special purpose vehicle (SPV), and collateralized by the quality of assets owned by the SPV and its ability to service debt.

In addition to direct lending to the project company, banks can provide a loan in parallel to other financing partners, such as other investors, where the beneficiary is ultimately the project company. Alternatively, banks can provide a guarantee to the financing partners, thereby sharing credit risk and allowing for some capital relief.

As for equity investors, a controlling stake of the project entity's equity can be owned by a single sponsor or group of sponsors, who will generally be involved in project construction and management. As a result, financial investors also take an equity stake in the project. There are five types of financial investor:

- Institutional investors (pension funds, insurance companies, etc.) – such investors tend to focus on stock-exchange listed companies, rarely making exceptions, which would, at least for the time being, exclude a rural telecommunication company.
- Banking institutions – driven by current financial markets conditions, they are extremely risk averse, which means that they typically fund the replacement of existing networks rather than start-up businesses and their participation is through funded risk-sharing facilities. Typically, commercial banks do not handle equity financing because of its longer term.
- Private equity and venture capitalists – private equity funds would be willing to invest in telecommunication infrastructure, while venture capitalists, constrained by a short-term investment horizon, would shy away from doing so. In the case of venture capitalists, their willingness to invest is driven by a compelling investment thesis, generally focused on growing vertically integrated closed business models. There are two types of venture capitalist: seed/early stage funds and formal venture capital funds.
- Angel investors – these investors fund a business at a start-up point with the purpose of capturing a high upside by virtue of assuming a large equity position. These positions are typically taken at the front-end of a process of a greenfield deployment and are focused on providing seed financing and supporting investment readiness analysis.
- Governments – driven by policies aimed at stimulating telecommunication deployment, sources of public finance tend to adopt national blanket coverage approaches, typically focused on providing financing to open access business models.

Additionally, technology infrastructure suppliers can either assume an equity position or extend credit for payment of the equipment.

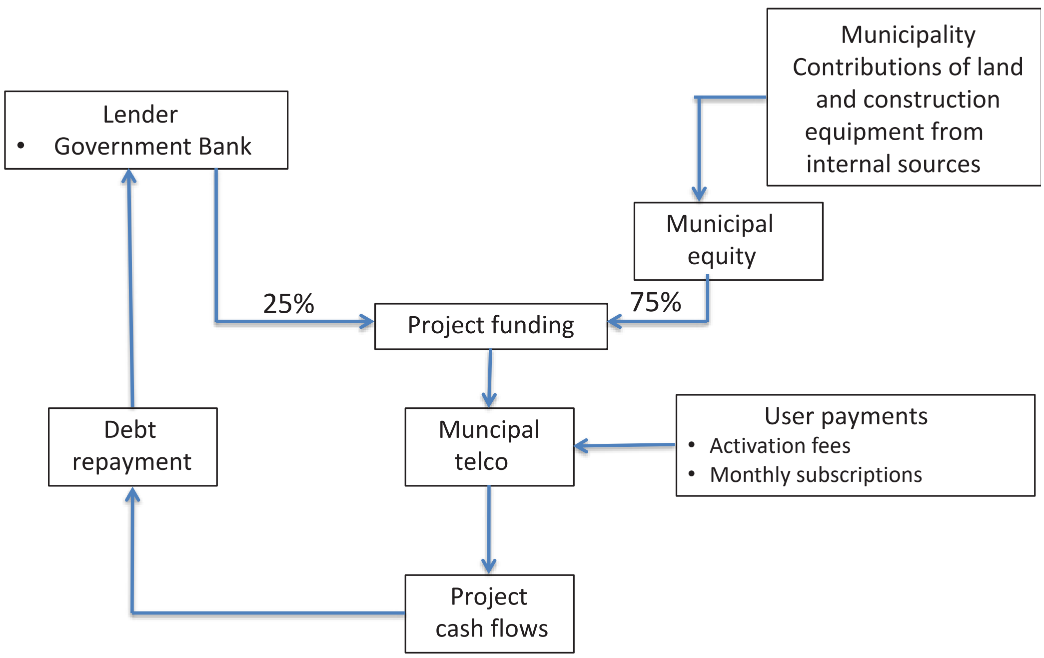
Project sponsor type influences the choice of financing strategies. If a large incumbent handles the telecommunication deployment, the financing model obviously differs in the sense that no sponsors beyond the incumbent would share in the equity. That said, co-investment models, where operators partner with investment funds are becoming increasingly common, especially in Europe. Financing for network roll-out could be handled through capital sourced from either cash flow or borrowed funds through bank loans and/or guarantees. While, as mentioned above, a bank typically finances up to 50 per cent of eligible project costs, the loan amount resides on the balance sheet of the corporation sponsoring the project under the on-balance sheet approach described above, as the guarantee is conceived as the ability of the company as a whole to service the debt. In this case, borrowing costs would benefit from the incumbent's weighted average cost of capital (WACC). In general, the WACC of an established incumbent is lower than that of a new entrant due to its lower risk profile.

When roll-out responsibility does not lie with the incumbent, the financing model often requires the creation of a legally independent project company, funded with non- or limited recourse debt and equity provided by one or more project sponsors. Debt servicing and the return on equity (ROE) are typically funded out of the project cash flow, which means the security of project debt and reliability of ROE depend on project profitability. While project finance is a complex and slow form of financing, it is used for some municipal networks.

3.2 Municipal financing models

The traditional project finance model reviewed above can be adapted to a rural project where the primary equity holder might be the local municipality, through a cooperative structure, and funds are typically provided by a public sector government bank, although in advanced economies commercial banks have also provided financing. Borrowed from the electric-utility industry, a municipal telecommunication network financing model typically involves the participation of the municipality, a lender and maybe an investor. Based on the traditional project finance model presented in Figure 2, a municipal telecommunication project could be structured as shown in Figure 3. Note in this case the absence of an investor, though the presence of a platform Internet company might be envisioned.

Figure 3. Financing model for a rural telecommunication project



Source: Katz, R. (2014). Broadband Funding mechanisms. Working Paper. CAF Latin America Development Bank, September

As shown in Figure 3, the municipality, as project sponsor, assumes all responsibility for gaining access to financing and managing the project. Financing under this model may come from internal capital, a public sector or commercial government bank loan and in-kind contributions from the municipality. Debt repayment is enabled by charging an activation fee and monthly subscriptions. This type of financial model has proved to be suited to broadband projects in small urban centres in developed countries and certain areas of developing nations. The municipality, or its utility division, may provide financial and non-financial contributions to the project, such as for an initial feasibility study, acquisition of required permits and rights-of-way, existing dark fibre and infrastructure access to facilitate deployment. A potential investor would provide equity for a start-up network in exchange for a share of the operating company. Finally, long-term debt must be secured to complete the financing package. Equity investors might need to leverage their equity position by the use of debt and will not be willing to finance the entire project with equity. Typically, a project borrows as much as possible at the lowest interest rate possible and then complements that with investor equity. It is important to mention that lenders will require a collateral interest in the project's assets, which might include the rights to receive a senior pledge of revenues and receivables for debt payments.

There is no single financing model that fits the needs of these municipal ventures. At one end of the spectrum, there is a direct subsidy model, where public funds supplied by the government finance the project in its entirety. Under the second model, the local government invests as would a private player in a business venture and borrows funds from a public source. In the third case, the municipality borrows funds from private credit markets in order to finance the project. Such a model is more viable in developed markets, though it could apply to areas in the developing world with higher revenue potential. The fourth model is a hybrid of the second and third models, where the municipality or confederation of municipalities borrow funds from both public and private sources. Each of the four models has its own advantages and disadvantages (see Table 7).

Table 7. Advantages and disadvantages of municipal financing models

Model	Description	Advantages	Disadvantages
1. Direct Subsidy	• Public funds pay for broadband project for an open-access business model	• Local government retains ownership of infrastructure • Local government can ensure own needs are covered	• Ongoing financing required • Continued reliance on state aid • Public sector assumes market risk • Competitive encroachment could erode project viability
2. Local Investment	• Local government invests as would a private player in a private venture deploying the infrastructure	• No State aid • Local government bears the failure risk alone • More lenient credit terms (rates, maturity) based on municipal profile	• Need to rely on public funds to invest • Potential impact on local taxes • Potential competitive retaliation • Highly dependent on population income
3. Private credit financing	• Same as above, but funds borrowed from private sources • Service revenues are earmarked to service debt	• No impact on taxes • Does not need to reach critical mass in order to qualify for EIB support	• Potentially, but not necessarily, worse credit terms than from public sources • Forces a period of full service run by local government • Risk of bankruptcy unless favourable covenants are negotiated
4. Public-private credit financing	• Similar to above, but funds borrowed from public and private sources	• Private lenders tend to follow the more lenient credit terms of public sources, sometimes enabled by partial risk guarantees • No impact on local taxes	• Borrowing from private sources could be affected by restricted access to capital

Source: Katz, R. (2014). Broadband Funding mechanisms. Working Paper. CAF Latin America Development Bank, September

Based on the advantages and disadvantages of these alternatives, a model where public and private lenders share financing responsibility seems the most attractive. DFI involvement can provide a guarantee to private lenders, sharing the credit risk and providing for some capital relief. In addition, the reliance on subscription fees to support connection charges could reduce some of the venture's financing pressure. However, this option could be used by any of the municipal models above.

3.3 Pooled financing models as co-investment mechanisms

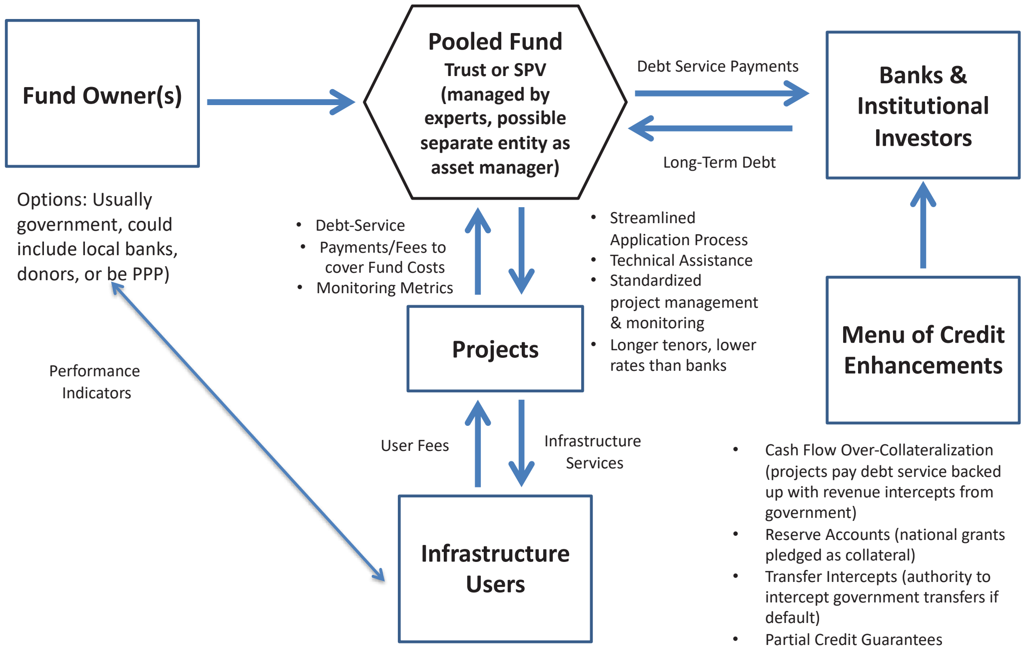
As reviewed in chapter 2, the most significant telecommunication investment gap is found in rural and isolated areas of the developing world. As stated by a roundtable panellist, bridging this gap is less a matter of developing new business models and more a matter of scaling existing ones and expanding them to more geographical contexts. Consequently, the challenge, as one panellist mentioned, is to scale the models so that they can benefit the millions rather than the thousands. Digital divide models require extensive cross-sector partnerships between diverse organizations with varied vested interests, which is fertile ground for market and coordination failures[15].

First, despite the effort of USFs to bridge the digital divide affecting rural and dispossessed populations, these programmes do not have sufficient financing to fulfil the enormous infrastructure deployment needs. Second, private sector financing is not often available for small telecommunication projects. The lack of access to private sector finance is due to a number of factors, including, but not limited to, a lack of working capital and equity, high transaction costs, lenders' perception of high risk, lack of sufficient revenue to cover debt service payments and the lack of technical capacity (both sector and finance) of project sponsors. Third, the small size of projects falls below the lenders' minimum funding size and projects often require longer tenors than available. Fourth, small projects cannot gain access to DFI support because the amounts required fall below the lender's facility limits. These barriers to finance can be addressed by pooled financing facilities.

Pooled financing is a well-established and highly successful means of mobilizing private financing for small infrastructure projects in both developed and developing countries. In developed countries, these types of pooled financing mechanisms are established as governmental, quasi-governmental or legally independent non-profit entities or agencies that aggregate a number of local projects for financing. By combining multiple borrowers' needs together, pooled funds, such as State bond banks, State revolving loan funds, county improvement authorities, city economic development agencies and similar agencies, can offer larger debt issues with better credit ratings. As pooled issues can be structured to achieve high credit ratings in the primary market, debt-servicing costs are reduced. Savings are also made through a reduction in transaction costs associated with economies of scale in the underwriting process. A generalized schematic view of the pooled financing structure is provided in Figure 4 below.

15 A coordination failure occurs when a group of firms could achieve a more desirable equilibrium but fail to do so because they do not coordinate their decision making (see Adserà, A. and Ray, D. (1998). "History and coordination failures" Journal of Economic Growth 3, 267-276.)

Figure 4. Common structures of pooled funds



Source: Katz, R., Samuels, B.; Shepard, B. Callorda, F., Bengyak, K. (2014). Innovative broadband financing mechanisms: Development of Pooled Finance Facilities for Latin American Telecommunications. Caracas: CAF Latin America Development Bank

Pooled financing provides access to private capital markets (bank finance and bonds) at advantageous terms for borrowers, such as communities, non-profit organizations, SMEs and micro-enterprises, sharing similar missions or business objectives and credit characteristics but lacking the financial scope and scale, expertise and credit history to access credit markets on their own. By providing credit enhanced financial structures, accountable management processes and lower transaction costs, pooled financing facilities can serve as efficient, creditworthy links between small projects and sources of private capital.

In developing countries there is a high demand for the financing of small telecommunication projects, particularly in last-mile fixed broadband networks, which can be met through pooled arrangements. Pooled funds can provide access to finance and reduce or avoid the project development and financing problems often associated with loans obtained from the public sector, i.e. governments and development banks, or from local banks, i.e. commercial and municipal banks. Importantly, they also serve as proven, cost-effective mechanisms to leverage limited public sector resources. The proposed financing model could have the following elements:

- A pooled financing facility is created to finance multiple small rural telecommunication projects, with several lenders, public or private, taking pro rata exposure to each project.
- The target size of the facility could be at least USD 20 million, which would be sufficient to handle approximately five or six small telecommunication projects, based on each project needing no more than USD 4 million.
- Projects would typically be majority-owned by public sector sponsors, e.g. municipalities and regional governments, though the private sector could have an ownership stake if it contributed cash, other assets or services.

- The pooled financing facility will have support from a public lender, such as a DFI, which would provide credit enhancements, e.g. loan guarantees, that could equal up to 50 per cent of the total amount of the facility. Other risk mitigation features, such as a first-loss facility could also be considered.
- The pooled facility will be ring fenced, whereby loans would be repaid solely from the cash flows generated by individual projects, without affecting the assets or financial resources of local sponsors.
- In addition, projects could apply, through the pooled facility, to receive output-based aid from public funds to supplement the amounts that certain users are to pay for subscription, which could contribute to narrowing the demand gap.
- Each project will be structured using a project finance approach, with construction cost and technical performance risks being assured through contracts with third parties.
- Project sponsors will develop telecommunication projects with technical and operational assistance provided by government entities.

A DFI could manage the pooled facility and take primary responsibility for the due diligence of prospective projects. At the same time, the pooled facility manager could seek to secure the involvement of as many commercial banks as possible in the facility and thereby maximize available funds. As is common practice with non-telecommunication infrastructure, after the project portfolio has been operating successfully for approximately two years, it could be sold to pension funds and other institutional investors, thereby allowing the banks to redeploy funds in additional projects.

The benefits of pooled financing include:

- Improved market access – pooled financing provides a structure that facilitates access to both public and private sector finance for many small projects and serves as a cost-effective creditworthy link between local projects and sources of capital.
- Lowered borrowing costs through credit enhancements not available to local banks – by pooling financing in a credit-enhanced structure, long-term financing can be provided to small projects at lower interest rates and with longer tenors than those available from local banks. Examples of credit enhancements that can be used at the pool level include reserve accounts[16], cash-flow over-collateralization[17], partial credit guarantees,[18] sovereign and local government guarantees[19], first-loss facilities[20] and subsidies (output-based aid).
- Reduced transaction costs – this is achieved by providing a streamlined process for project development and finance and the sharing of transaction costs across all projects.
- Streamlined project identification and vetting – pooled financing requires streamlined procedures and screening processes.
- Technical assistance that bridges the technical capacity gap for local governments and project sponsors – a significant impediment recognized by experts worldwide is the lack

16 In project finance, a debt service reserve account (DSRA) is a reserve account specifically set aside to make debt payments in the event of a disruption of cash flow to the extent that debt cannot be serviced.

17 Cash flow over-collateralization is used to offset revenue risk by adding assets as collateral on a loan.

18 A partial credit guarantee is a credit enhancement mechanism for debt instruments (bonds and loans). Typically, the guarantee is structured to cover 100 per cent of each debt service payment, subject to a maximum cumulative payout equal to the guaranteed amount.

19 Sovereign guarantees are given by host governments to assure project lenders that the government will take certain actions or refrain from taking certain actions affecting the project. Although a blanket sovereign guarantee of all project risks is impossible to obtain in any project finance transaction, many of the legal and political risk categories typically encountered in an infrastructure project will be well within the host government's control and may therefore be fairly allocated to any such host government.

20 First-loss facility represents the first level of financial support to a special purpose vehicle (SPV), such as a company organized around the provision of wholesale telecommunications, as part of the process in bringing the securities issued by the SPV to investment grade. The provider of this facility bears the bulk, or all, of the risks associated with the assets held by the SPV.

of capacity to identify and develop projects, especially by local governments and business communities.

- More effective and successful project development process – a critical infrastructure problem is project identification and development. By providing a standardized process, governments and private sector partners have a well-documented streamlined process for project development that reduces costs and is more likely to result in the successful development of bankable projects and access to finance.
- Provision of effectively targeted grants to unbankable projects that have large developmental impact – pooled funds are used to provide targeted grants that render projects financially viable. For example, if projects are considered of critical importance to development, the viability gap can be assessed, identifying the required amount of grant finance to be provided by the government and/or development partner, with the balance in private capital, i.e. blended finance.
- Ability to subsidize interest rates – some pooled funds use their financing structure to subsidize interest rates on projects.
- Greater domestic capital mobilization – as noted, pooled financing provides a gateway to capital market development, enabling the creation of an asset class for investment by institutional investors and local banks. The new asset-class provides high-quality fixed-income investment opportunities for domestic institutional investors, such as pension funds and insurance companies, that have a greater impact on development than alternatives, e.g. real estate, sovereign bonds, etc.
- No foreign exchange risk – for projects producing revenue in local currency, loans from international institutions, whether private or public, are risky for both parties given the mismatch in currencies. By using financing sources in local currency, pooled funds protect borrowers from the foreign-exchange risk that arises from a mismatch between the denomination of revenue produced by the project and of the debt service supported by that revenue.
- Leveraging public resources – by using pooled funds, local governments can transition away from a reliance on national government grants and towards private sector financing of local projects. In many countries, small project lending is limited, with any existing lending coming from on-lending funds from the national government and development banks. Pooled financing can help transition local governments away from a dependence on sovereign loan resources and towards private financing. Financing local infrastructure projects through national sovereign loans is not sustainable in the long term.
- Enhanced aid effectiveness – pooled funds in developing countries have often involved collaboration among several development partners, given that these financial mechanisms are recognized as effective ways to mobilize private capital.
- Self-sustaining operation – most well-designed pooled financing facilities are financially self-supporting and do not rely on the government or development partners to provide new capital grants each year.

3.4 Public-private partnerships

Public-private partnerships (PPPs) are an essential tool to satisfy and advance telecommunication infrastructure needs. A PPP for the construction of a telecommunication network requires investors (e.g. construction companies, banks, pension funds and infrastructure funds) and lenders (e.g. private sector project finance banks) and, potentially (although more difficult), access to public bond markets.

When planned, designed and implemented properly, PPPs can contribute to bridging the digital divide[21]. Multiple approaches to private-sector participation in such partnerships are

[21] See Arthur D. Little (2020). *Successful Public-Private Partnerships*. Luxembourg.

distinguished by the degree of risk private parties assume. PPPs are one in a continuum of approaches involving the private sector in public-service delivery and investment through a long-term contractual relationship. Particular to PPPs is the significant sharing of risk between the public and private sectors in three main areas: financing, ownership and revenue.

Strictly speaking, PPPs exist across the different financing models. At its most basic level, the public entity may be serving only as an issue of conduit debt, enabling the private party to gain access to tax-exempt financing. Alternatively, the public entity may be guaranteeing the private party's debt. Under this framework, project finance is a specialized form of financing targeted to a "stand-alone" project (a special purpose project company), whereby lending is based on project-specific cash flow, and lenders rely on project contracts, not physical assets, as a security ("contract-based financial engineering"). While project finance is a complex, slow form of financing, it is used for most major PPP projects.

The more traditional model involves the use of public resources or financing capabilities to implement a telecommunication project. Under this arrangement, the public entity, which can be a municipality, provides a combination of tax incentives, public land or other assets, infrastructure investment or financing methods, while the private entity makes capital investments, commits to provide jobs, contributes technological expertise and assumes financial risk.

Another model refers to an arrangement where the local government enters into a long-term lease of a major asset, such as the passive infrastructure of a broadband network, to a private company, transferring the right to and responsibilities for the leased asset to the private company. Under this framework, defined as a public-service delegation, a private player deploys the broadband network with or without partial public subsidy, while assuming the risk. Table 8 presents some of the most common models of PPP arrangements for telecommunication projects.

Table 8: Advantages and disadvantages of PPP financing models

Model	Description	Advantages	Disadvantages
1. Debt-facilitation model	• Public entity facilitates access to tax-exempt financing • No commitment to use public funds	• No public funds are placed at risk	• Potential misalignment of objectives between parties • Limited leverage of public party capabilities (RoW, facilities)
2. Debt-guarantee model	• Government guarantees debt, secured by private party	• Access to better financial terms of debt	• Public funds are placed at risk
3. Public service delegation	• Private player deploys broadband network with or without partial public subsidy • Player has a concession to resell the passive or active layers to service providers	• Risk is assumed by outside player	• Subsidy is needed to attract the concession holder • Lack of commitment of project sponsor might result in service failure

Source: Katz, R. (2014). Broadband Funding mechanisms. Working Paper. CAF Latin America Development Bank, September

The public-service delegation model is particularly attractive insofar that it shifts the deployment and operation risk away from the public sector. In this case, it is critical, however, to ensure a high level of commitment on the part of the private co-sponsor.

Their potential notwithstanding, there has been limited use of PPPs for rural infrastructure deployment for several reasons[22]:

- **High complexity** owing to the interaction of several public and private players, potentially from different countries.
- **High costs** requiring extensive legal expertise and monitoring due to the complex interaction of parties and the indexed nature of public repayments.
- **Need for an enabling environment** that can properly structure deals and monitor the work of the private parties and their remuneration.
- **Availability of bankable projects** to attract private parties and justify the transfer of risk.

Given the costly and time-consuming procurement process – about two years from preparation of business case through financial close, PPP agreements are more suitable for large, expensive projects. This is even more relevant for countries that are new to PPP procurement. One way to ensure the economic viability for PPP procurement is to establish eligibility thresholds. Under this approach, a minimum threshold is needed to:

- **From a public-sector view** – justify procurement cost incurred and maintain value for money.
- **From a private-sector view** – secure project financing. Typically, this does not make economic sense for banks/borrowers below certain amounts, and bidders would have to give full recourse to raise financing/justify transaction costs incurred by the bidder.

3.5 Policies and regulations to reduce the cost of network development inputs

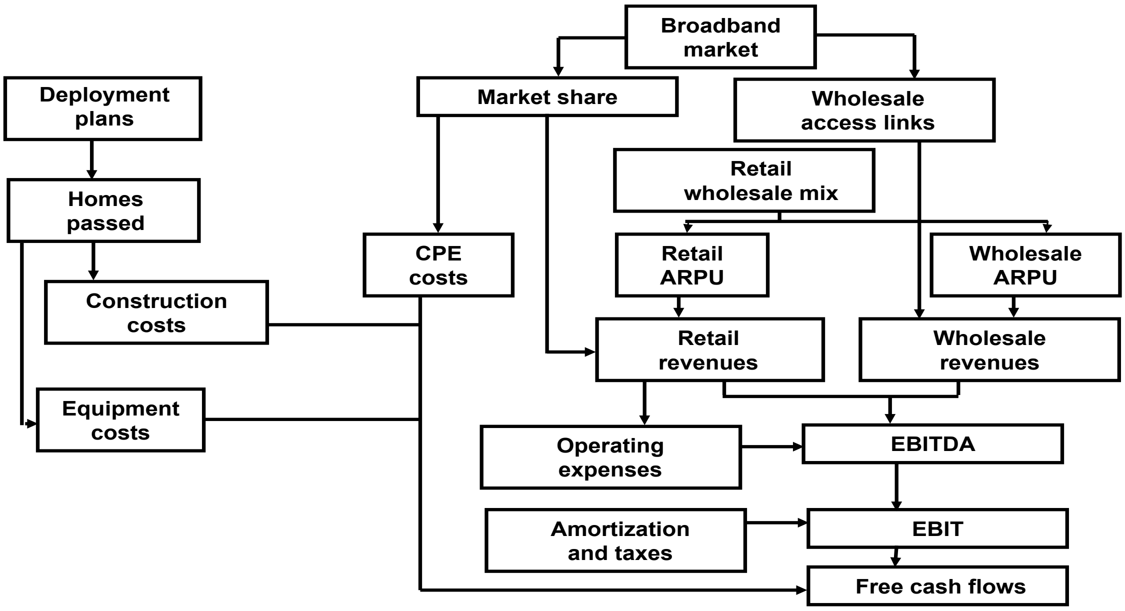
The commercial deployment of fixed broadband networks is constrained by a number of factors:

- The number of homes passed – a factor driven by population density.
- The number of subscribers – a variable driven by uptake, which in turn is conditioned by affordability and other demand factors.
- Retail average revenue per user – or subscription price.
- Wholesale average revenue per user – if access is sold to other service providers.
- Equipment costs – driven by the technology selected.

These factors can be arranged in a conceptual business-plan structure as shown in Figure 5 below.

[22] Source: Arthur D. Little (2020). *Successful Public-Private Partnerships*. Luxembourg.

Figure 5. Conceptual structure of a broadband business plan



Source: Katz, R. (2008). Ultrabroadband Investment Models. Communications and Strategies, November

The commercial business plan to deploy a broadband network in a rural area is constrained by basic economics and market factors. The cost to pass a home in a rural setting with a density of 63 homes per square mile is approximately USD 3 656[23]. In general terms, a positive net present value (NPV) is fulfilled if the adoption of homes passed ranges between 60 per cent and 70 per cent. Under these conditions, however, if uptake is less and revenue falls under USD 60 per month, the investment's NPV is negative.

What can governments do to alleviate some of the constraints of the commercial business plan in order to incentivize broadband deployment? Public incentives to stimulate deployment of telecommunication infrastructure in rural areas are based on an understanding of primary business-plan bottlenecks and reducing some of the so-called choke points[24]:

- Subsidize capital costs by offering below-market loans with a more extended tenor.
- Public sector co-invests with private sector if deployment takes place in rural areas.
- Offer grants through a USF.
- Allow for tax exemptions for deployment taking place in rural and unserved areas.
- Reduce property taxes for facilities deployed in rural areas.
- Exempt equipment acquired for deployment of networks in rural areas from sales taxes and import duties.
- Reduce cost of right-of-way access.
- Promote aggregation of demand from public entities (education, safety, health care) in order to create an "anchor tenant" effect.
- Promote synchronization of infrastructure development (e.g. trenching) across infrastructure development parties.
- Streamline processes to obtain rights of way and for tower deployment.
- Provide access to cell deployment sites on public property (rooftops of public buildings).

[23] See Cartesian (2019). *All-Fiber Deployment Cost Study 2019: Report to Fiber Broadband Association* (September 10).

[24] Some of these initiatives are alluded to in World Economic Forum (2020). Accelerating Digital Inclusion in the New Normal, July.

Some of these approaches have already been implemented in certain countries. In Japan, for example, while FTTH deployment is considered a private-sector responsibility, the government provides two types of incentive for deployment: below-market loans are made available to any carrier with a fibre-network installation plan; and tax deductions are offered to carriers involved in fibre deployment. In Europe, the broadband development programmes of the United Kingdom and France focus on capital funding only, without addressing ongoing subsidies for recurrent operational costs. In doing so, they comply with the European Commission's guidelines in terms of providing third-party access, being technology neutral and using existing infrastructure. In Malaysia, the government allows for import-duty exemptions on equipment acquired for deployment in rural areas. Similarly, the Brazilian Government has reduced import duties on small cell equipment.

A related but very important issue to improve projects' financial viability is the reduction of spectrum-access costs. In the words of a panellist, "I would suggest that governments, particularly in emerging markets, look at the spectrum as a development issue and not a fundraising vehicle".

Based on the understanding of the economic and financial drivers of an infrastructure deployment plan, such as the one provided in Figure 5, it would be highly advantageous for policy-makers and regulators to model the impact of the above initiatives in order to appreciate their effect on the business case and facilitate deployment by private sector operators. Along these lines, one panellist mentioned that this exercise would help to understand which inputs have the greatest impact on project viability and, consequently, prioritize initiatives to reduce deployment costs. In the view of the panellist, "equipment represents a small portion of overall deployment costs. More importantly, labour costs, the costs associated with deploying assets underground, for example, or such as the concrete base that a mobile cell site may sit on could be higher in absolute terms than network equipment, particularly in rural areas. In addition, there are other costs – power, backdoor connectivity, site rents and material – which are not driven by equipment costs. Thus, I do not imagine that tax or import duty exemption on equipment will have a significant impact on the business case for infrastructure deployment in rural areas. Taxation on profits, however, might have a larger impact, though providing tax exemptions for services to be deployed in rural areas could be harder to implement in practice".

3.6 Auctions for subsidies

This concept for allocating funds to support network deployment in rural areas is based on the general idea that the operator with the lowest bid for subsidies in a reverse auction will deploy the network and provide the service. The model has been used frequently in the past 20 years when allocating subsidies in the provision of universal service by a wide group of countries, including Australia, Chile, Colombia, India, Nepal, Peru and the United States[25]. The World Bank is currently conducting a reverse auction for a project to deploy network in or reconnect 2 000 villages in Ethiopia.

In general, reverse auctions have proved an effective means of reducing expenditure on universal service and getting a firm understanding of the true costs of supplying service in a rural area. For example, the average reserve price for service deployment in rural areas, as recently conducted by the United States Rural Digital Opportunity Fund, Phase I, was USD 5 008 per household, while the average subsidy assigned was USD 1 768 or 35 per cent of the reserve

[25] See a survey of approaches in Wallsten, S. (2008). *Reverse auctions and Universal Telecommunications Service: Lessons from Global Experiences*. Washington, DC: Technology Policy Institute (April).

price. Reverse auctions are, however, less effective in promoting competition, as incumbent operators tend to have the upper hand in terms of an accurate understanding of service cost and economies of scale in service provision. This advantage allows them to win auctions and thereby consolidate market position, while receiving a government subsidy.

4 Risks to development of low-cost operating models to bridge the digital divide

While the business models and financing strategies outlined throughout this report can contribute to the bridging of the digital divide, roundtable panellists mentioned that there are still risks involved in some of these options.

Competition patterns in the network infrastructure vendor space, which is now being reshaped by a variety of forces, may have an impact on deployment costs. In the words of a panellist, "increased network vendor diversity can offer lower-cost high-impact infrastructure within the next three years that will alter network economics.

The challenges in the business cases for the deployment of innovative connectivity technologies (e.g. Loon[26] or OneWeb) suggest that devising a silver-bullet solution to resolve connectivity issues is likely impossible. In the opinion of a panellist, "you cannot imagine the digital divide and try to solve it from Silicon Valley or London. In my opinion, most of the solutions have lost touch with the business case and cultural reality in the less developed countries". The problem in addressing the digital divide is the combination of the high CAPEX required for remote areas and the areas' low ARPU, with people unable or unwilling to pay, which new technologies are not necessarily able to overcome. That being said, other technology-based ventures, such as Starlink and Space X, are still undergoing deployment.

According to a panellist, bridging the digital divide requires a "ground-shot" rather than "moon-shot" approach. A holistic mindset and practical approach are needed to solve this issue: co-development of fibre with other infrastructure to reduce costs; education and upskilling to enable the adopting population to appreciate and realize more value-adds from digital connectivity so they will be willing and able to pay more. Such solutions may sound less exciting but often work better.

[26] Loon was wound down after Google was unable to find a sustainable business model and partners for the project. Westgarth, A. (2021). *Saying goodbye to Loon*, January 21.

5 Conclusions

The roundtable provided an opportunity for dialogue on the critical business model and financing issues required to address and bridge the digital divide. As indicated at the beginning of the session, the challenge remains front and centre within the ICT sector in the light of the ongoing pandemic. The roundtable was a very useful platform and allowed panellists to present their views, which are indicated below:

- Innovative models to bridge the digital divide existed prior to the pandemic. The pandemic has merely reinforced the need to accelerate, scale up or expand them to more geographical contexts. The challenge, however, remains doing so in such a way that they can benefit the millions, rather than the thousands.
- Digital divide business models require extensive cross-sector partnerships between diverse organizations and sectors which might have varied vested interests, raising the potential for coordination failures.
- In that context, several opportunities exist that the ICT sector can implement following verification of their compatibility with the radiocommunication regulatory framework:
    - On the regulatory side, enable the deployment of alternative access and infrastructure providers to reduce deployment costs; reduce excise taxation on devices and digital services; promote wholesale access regulation; and incentivize infrastructure sharing.
    - In addition, regulators should create the necessary conditions to stimulate infrastructure sharing.
    - Promote the development of rural e-services, such as rural financing, e-commerce and media platforms, as catalysts for network deployment.
- On the financing side, the important role of DFIs in making this happen must be recognized.
- In addition, tackling the infrastructure-related aspects of the digital divide requires the crowding in of investment from diverse investors with different risk profiles from equity to senior debt. Those investors may be private equity, pension funds, development finance institutions, commercial banks or corporate investors. The challenge, though, is how to attract investors to make the projects not only viable but also render the financial benefit proportionate to the risk.
- In addressing project financing for the infrastructure-related aspects of the digital divide, the ICT sector has a lot to learn from other sectors, such as renewable energy and water and sanitation, which have been tackling the issue of universal access for a long time.

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