Delivering on the Promise of Broadband

Six Challenges for Industry Stakeholders

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Contents

1. Introduction

Catalyst

The importance of broadband connectivity is indisputably greater now than ever. The immediate need to help mitigate the impacts of the COVID-19 pandemic, and the ongoing broader objectives of delivering on the UN Sustainable Development Goals (SDGs), are accelerating the requirement for broadband.
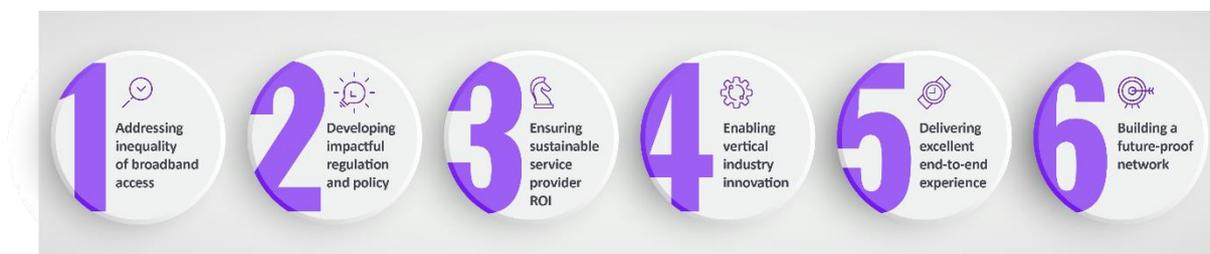
Macro trends in the ICT industry and technology evolution, and shifts in end-user and OTT demand, are also creating future opportunities for the broadband industry. The technological and commercial changes that these shifts drive also create new challenges, as broadband service providers and other stakeholders must try to keep ahead of changes while evolving sustainable business models.

Broadband market stakeholders include operators, technology vendors, OTTs, governments and regulators, vertical industries, and consumers. Each has different requirements around broadband infrastructure and services. Policy and regulation around broadband and infrastructure play a key role in driving investment, but are not always fully effective in creating a fair playing field that meets the needs of all stakeholders. This means widespread broadband access is still a goal rather than an achieved reality worldwide. It also means that the broadband industry itself is not developing as effectively as possible, which has knock-on impacts for both economic growth and social benefit.

Omdia view

Omdia has identified six key challenges that the broadband industry needs to address, in order to accelerate development to meet demand and provide key social and economic benefits.

Figure 1: Six key challenges for the broadband industry

1 Addressing inequality of broadband access
2 Developing impactful regulation and policy
3 Ensuring sustainable service provider ROI
4 Enabling vertical industry innovation
5 Delivering excellent end-to-end experience
6 Building a future-proof network

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Source: Omdia

The COVID-19 pandemic has highlighted and accelerated the critical role of broadband in enabling consumers and enterprises to access work, education, and healthcare, as well as providing the

means for enhanced communications as friends, families, and colleagues are separated for extended periods. This makes addressing the challenges facing the broadband industry even more urgent.

But to do so effectively is not simple or obvious for broadband industry stakeholders. Further complexity comes from the breadth and diversity of broadband stakeholders. These range from telecom service providers and technology vendors to a broad range of interested players, including vertical industries, regulators and governments, and internet/OTT providers.

To maximize the opportunity for positive development of the broadband industry, Omdia's view is that **the industry would benefit significantly from a new broadband industry organization to provide a neutral, collaborative platform for cooperation and partnership.** This would enable more effective collaboration and co-creation among all industry stakeholders, to jointly address technical development, standards, commercial models, and other industry objectives and challenges. Such an organization could help ensure that broadband networks and services are available for all, and accelerate the healthy development of the industry, with sustainable benefits for stakeholders, end users, and society.

Figure 2: New broadband industry organization provides a platform for collaboration and acceleration
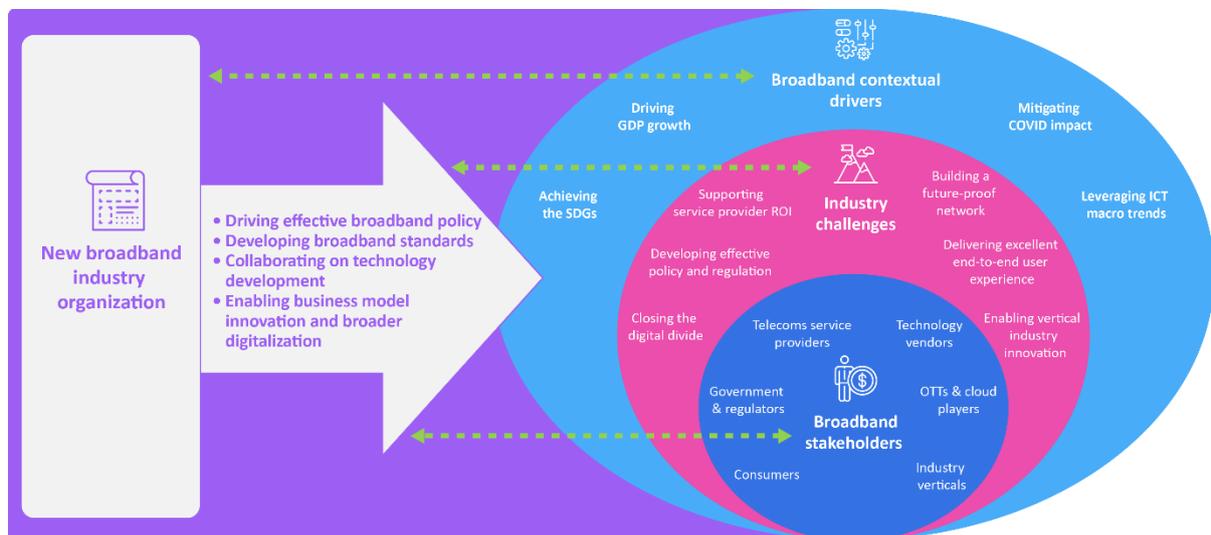
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Key messages

- The importance of enabling and delivering the SDGs, the urgency of mitigating impacts of COVID-19, and the wider macro technology trends in the ICT industry, are accelerating the need for, and role of, broadband.

- Inequality of broadband access is a continuing challenge for people, businesses, governments and the industry overall:

  – Current efforts to address the digital divide effectively are not delivering impact quickly enough.

- Developing impactful broadband and infrastructure policy and regulation is key to driving investment, creating a fair playing field and enabling widespread broadband access:

  – However, at present, broadband and digital policies plans are not consistent across countries, and regulators are not always able to tap into best practice examples effectively.

- Ensuring sustainable ROI for broadband service providers is a fundamental ingredient of efforts to improve access, speeds and coverage. Maximizing broadband infrastructure use is one key to helping operators and other infrastructure investors achieve the ROI needed to make broadband rollouts and operating models sustainable:

  – Achieving viable ROIs is very challenging for service providers, particularly those tasked with building out broadband access infrastructure to deliver on universal service obligations.

- Broadband is becoming a core enabler of vertical industry innovation. Industries from manufacturing to healthcare are looking to transform, by leveraging high-speed connectivity to develop new business models and customer engagement approaches:

  – Vertical industries need broadband to transform, and enterprises need it to support growing demand for high-bandwidth video and other services; but collaboration between industries and broadband service/infrastructure providers is relatively limited, which may limit the ability of industries to progress.

- Delivering an excellent end-to-end broadband user experience is critical for future development. Consumer expectations of broadband are growing rapidly; end-user demand for streamed over-the-top (OTT) content and services, growth of smart homes and smart cities, and greater data privacy and cybersecurity requirements are all placing heavy demands on broadband networks and providers:

  – The importance of end-to-end broadband user experience has never been greater, but the lack of a single unified set of broadband technical standards and approaches makes it difficult to deliver cost-effective and consistent QoS/SLAs, and slows time to market for new services, while end-to-end cybersecurity is becoming an ever-more-pressing concern.

- Building a future-proof broadband network is necessary to provide a strong platform for development of new services and business models. Broadband infrastructure does not only need to support today's requirements – it must also be ready to flex to enable future services. Fiber-to-the-home (FTTH) deployment, edge-cloud integration, and super-fast broadband services are all needed to support evolving demand for areas such as smart cities and autonomous driving,

rapid up-scaling and downscaling of bandwidth demand, and new bandwidth-hungry applications such as AR/VR and AI:

– Automation of network functions and more effective strategies for infrastructure sharing are needed to enable service providers and other stakeholders to deliver more flexible broadband networks that are ready for future evolution.

• COVID has highlighted the urgency of developing a new platform to jointly address key broadband issues. Supply-side (telecom operators and technology vendors), demand-side (OTT players, industry verticals, and consumers), and government/regulatory stakeholders have different objectives and pain points.

– The fragmentation and diversity of broadband industry stakeholders makes cooperation difficult, and is limiting the development and spread of broadband services and infrastructure.

– But broadband stakeholders also have important shared goals. In order to achieve these, to meet the challenges outlined above, and to maximize the social and economic benefit of broadband for all, the broadband industry would benefit significantly from a neutral, open organization for future-facing broadband cooperation and partnership. Such an organization would facilitate collaboration across technologies, standards, commercial strategies, regulatory approaches, and other common industry objectives and challenges.

2. Global context and drivers for broadband

Broadband drives economic growth and productivity

There is growing empirical evidence that ICT, and in particular broadband, helps economies to become more resilient and grow. In a virtuous circle, economic progress then supports additional ICT investments, fostering conditions for a healthier economy. There is a positive relationship between broadband access and GDP growth, as illustrated by a number of recent analyses; for example:

- A recent ITU analysis of more than 200 studies on broadband impact finds that a 10% increase in broadband penetration yields an increase in GDP ranging between 0.25% and 1.5%[1]

- The European Investment Bank (EIB) has found that a doubling of broadband speeds can result in 0.3% GDP growth.[2]

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[1] ITU (2016), "*Working Together to Connect the World by 2020: Reinforcing Connectivity Initiatives for Universal and Affordable Access,*" https://www.broadbandcommission.org/Documents/publications/davos-discussion-paper-jan2016.pdf

[2] Bohlin *et al* (2014), EIB Institute, "*The economic impact of broadband speed: Comparing between higher and lower income countries,*" https://institute.eib.org/wp-content/uploads/2014/04/EIB_broadband-speed_120914.pdf

Figure 3: Broadband access and GDP per capita, 2020
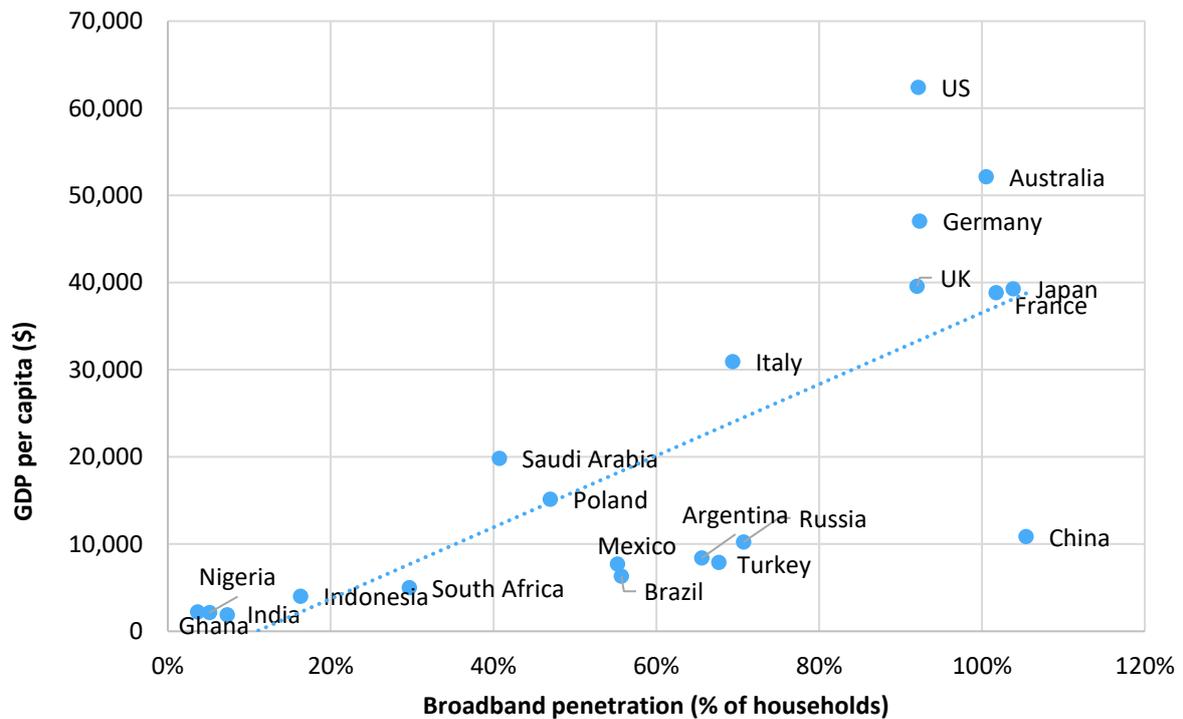
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Source: Omdia, IMF

Furthermore, ICT and broadband are not just drivers of growth, but also enable the adoption of more efficient business processes. This in turn enhances the competitiveness of entire industries, the attractiveness of economies for investment, and the positive development of societies. Evidence for productivity increases linked to broadband and ICT investment and access includes the following:

- The European Commission estimates that half of all productivity growth in the EU derives from ICT[3]

- The OECD estimates that a 10% increase in broadband penetration can raise labor productivity by 1.5%.[4]

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[3] "*The Digital Agenda for Europe – Driving European growth digitally*," Brussels, 18 December 2012, COM (2012) 784 final

[4] OECD (2011), "*National Broadband Plans*," OECD Digital, Economy Papers, No. 181, OECD Publishing. http://dx.doi.org/10.1787/5kg9sr5fmqwd-en

Broadband is an enabler for the SDGs

Broadband is also a key enabler of the important UN Sustainable Development Goals (SDGs). The 17 SDGs are a set of interlinked societal goals, designed by the UN to be a "blueprint to achieve a better and more sustainable future for all."

Figure 4: UN SDGs

1. NO POVERTY	2. ZERO HUNGER	3. GOOD HEALTH & WELLBEING	4. QUALITY EDUCATION	5. GENDER EQUALITY	6. CLEAN WATER & SANITATION
7. AFFORDABLE & CLEAN ENERGY	8. DECENT WORK & ECONOMIC GROWTH	9. INDUSTRY INNOVATION & INFRASTRUCTURE	10. REDUCED INEQUALITIES	11. SUSTAINABLE CITIES & COMMUNITIES	12. RESPONSIBLE CONSUMPTION & CONSTRUCTION
13. CLIMATE ACTION	14. LIFE BELOW WATER	15. LIFE ON LAND	16. PEACE, JUSTICE & STRONG INSTITUTION	17. PARTNERSHIPS FOR THE GOALS	UN SUSTAINABLE DEVELOPMENT GOALS

Source: United Nations (www.sgds.un.org)

The SDGs comprise more than 150 specific targets as part of the 17 development goals, and many are directly linked to broadband rollout and accessibility. ICT-specific targets are included in four of the 17 SDGs, while 38 further targets depend directly or indirectly on universal and affordable access to ICT and broadband services. ICT and broadband are implicated in SDG 9 in particular (helping to build resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation). Other targets that broadband investment supports are linked to availability of internet services and infrastructure, sustainable cities and communities, innovation, information access, increased efficiency, early warning, disaster risk management, knowledge sharing, and data openness and accessibility.

The UN and the Broadband Commission (jointly led by the ITU and UNESCO, with participation from multiple industry and governmental leaders) have recently highlighted universal broadband access as a vital catalyst to making faster progress toward achieving the SDGs, and also as a key enabler of global economic recovery in and after the current pandemic.

"Leaving no one behind means leaving no one offline, now more than ever before. Increasing and coordinating ICT infrastructure investments will be instrumental, not only in connecting the 3.6 billion people still offline, but also in driving the development of new technologies central to the digital economy." Houlin Zhao, Secretary-General of the ITU and Co-Vice Chair of the Broadband Commission

Broadband can help to mitigate the COVID-19 impact

The COVID-19 pandemic is dramatically impacting all aspects of business, society, and individual life. The economic impact of lockdowns to control the spread of the virus has had severe implications for employment and for the survival of many businesses. While the discovery of effective vaccines will lead to control of the virus, this will take at least 1–2 years to reach all people and all areas globally, and the economic and social fallout of COVID-19's impact will last many years beyond that.

- The OECD now projects a contraction in G20 economies of -7.3% on average, with the second wave of COVID-19 now underway.[5]

- The IMF has most recently estimated COVID-19 will lead to a $28 trillion loss of output (vs. previous projections) for the global economy over 2020–25. Emerging economies will be more severely impacted: by the end of 2021, the IMF forecasts that the loss in output relative to pre-pandemic projections will be -8.1% for emerging and developing economies (excluding China), versus a projected loss of -4.7% for advanced economies.[6]

- The World Bank expects extreme poverty globally to rise in 2020 for the first time in over 20 years, with an additional 88 million to 115 million people falling into extreme poverty this year, potentially rising to as many as 150 million by 2021.[7]

Technology – and especially broadband connectivity – will be absolutely critical to global recovery. With the ongoing necessity for home-working and remote education provision in many countries, and quarantining of people to limit spread of the virus, broadband access has become a critical lifeline. Without it, many people would not be able to maintain their livelihoods, receive education, purchase goods, and access healthcare. Furthermore, many would become isolated without visual contact with family and friends.

COVID-19 is also impacting the way businesses think about and plan for the future – and again, technology and digitalization are core to this shift. According to the OECD, industrial production declined by 28% globally between February and April 2020. With industrial productivity and investment severely impacted, businesses are looking to technology to help improve efficiencies.

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[5] https://www.ilo.org/wcmsp5/groups/public/---dgreports/---cabinet/documents/presentation/wcms_753607.pdf

[6] https://blogs.imf.org/2020/10/13/a-long-uneven-and-uncertain-ascent/

[7] https://www.worldbank.org/en/news/press-release/2020/10/07/covid-19-to-add-as-many-as-150-million-extreme-poor-by-2021

COVID-19 has also highlighted the need for stronger, more flexible business continuity plans. Connected workplace technologies – which include, and in most cases rely on, broadband – can help to support this. Significant increases in use of digital communication and collaboration tools, and in particular the use of videoconferencing platforms, will place increasing and ongoing demands on broadband networks, including home broadband access.
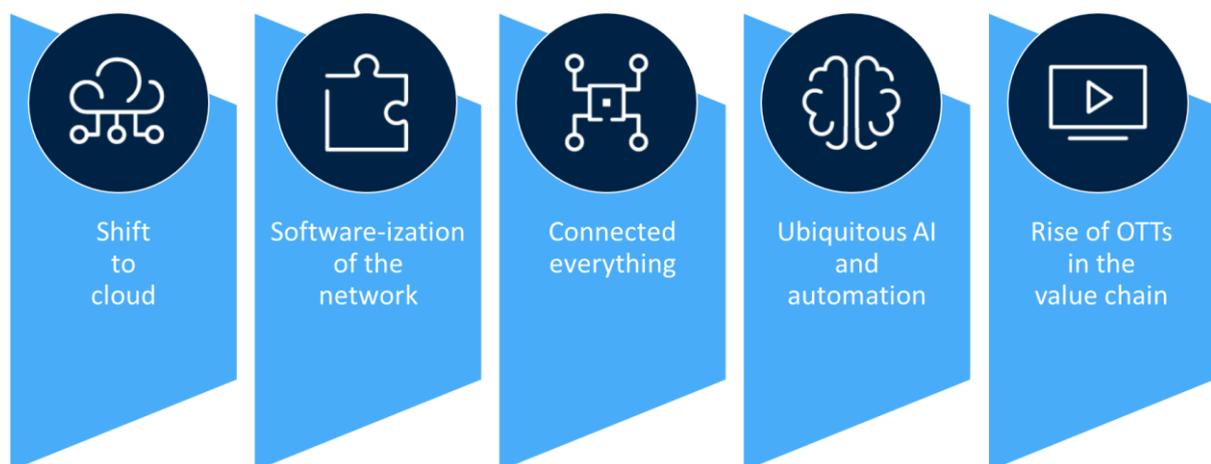
A further concern is the impact of COVID-19 on increasing the digital divide. In emerging markets, more limited access to broadband connectivity, as well as different economic structures, have made the shift to online activity far less viable – and this potentially means that these countries will take longer to recover from the COVID-19 economic downturn, leading to a widening of the digital divide (see Section 3 – challenge 1below for detailed discussion).

Macro shifts in ICT evolution are driving the need for broadband

Along with the broader economic and social drivers accelerating the need for broadband, it is important to consider the context of technology evolution trends, and how these are also driving broadband requirements.

Five important macro trends are disrupting the ICT industry, from both the technological and the commercial/business model perspectives. These trends impact, and are in turn impacted by, broadband technologies and opportunities. We summarize the trends here, and also discuss the importance of broadband as an enabler for the future development of ICT networks and services in more detail below in the section entitled: "Building a future-proof broadband network."

Figure 5: Macro trends driving ICT industry development

Shift to cloud

Software-ization of the network

Connected everything

Ubiquitous AI and automation

Rise of OTTs in the value chain

Source: Omdia

The shift to cloud: Cloud storage and compute resources extend the capabilities of networks dramatically, by enabling applications and data to be stored and hosted remotely/virtually, rather than locally/on-premises. This requires fast, reliable, and consistently high-performance, high-speed broadband connectivity – to deliver data to the cloud, and to deliver services and applications to end users. These must be delivered wherever the end user is located – whether at home, in the office, or on the move.

"Software-ization" of the network: Refers to the increasing trend toward the virtualization of servers (compute), storage, and networks; allows network operators (or enterprise IT managers) to control network functions, optimization, and capacity allocation using software rather than manual reconfiguration. Increasingly, such software is also enabling more intelligent automated control of networks, driving positive impacts for broadband through zero-touch provisioning and maintenance. "Software-ization" can also shorten time to market for new communications and OTT services, which helps operators to vary their broadband offerings, providing differentiated QoS and other specs. It can also enable new models of broadband service provision.

"Connected everything:" The growth of the Internet of Things (IoT) in enterprises, cities, cars, and homes is a key trend for the coming decade. Connected IoT devices globally will grow to 46.8 billion by 2025. IoT impacts industries including energy, manufacturing and industrial, automotive, logistics, and healthcare. It encompasses simple sensors collecting and sharing limited amounts of data, and high-bandwidth low-latency applications (autonomous vehicles, streaming AR/VR interactive video). IoT drives efficiency and productivity, and provides critical data for AI and machine learning (ML) algorithms. Broadband connectivity is key to further IoT innovation, especially for gateways or where support for voice and data communications is needed alongside IoT.

Ubiquitous AI and automation: AI and automation are transforming ICT network operations and the delivery of consumer and enterprise services. Service providers use these capabilities to meet service needs flexibly, manage heterogeneous environments, and enhance reliability and performance. While the goal is a fully AI-enabled autonomous network, near-term focus is on AI for functions like smart maintenance, using real-time data collection to monitor network health and initiate corrective actions. This helps optimize broadband service quality, enable traffic prioritization, support customized resource allocation, and drive broadband service differentiation. AI and automation of access network management will also free up enterprise IT teams to focus on higher-value activities. For consumers, AI capabilities will be embedded in smart home devices and voice assistants, and will deliver personalized digital customer experiences. Broadband is needed to deliver AI and automation, layered with enhanced enterprise and consumer cybersecurity.

Rise of OTTs in the value chain

The rise of OTT players in the value chain: OTT players (OTTs) – e.g., Google, Amazon, Facebook, Alibaba, online media players – are taking on an ever more important role in driving forward the ICT industry. Amazon, for example, has not only become a dominant cloud services provider but is extending further into consumer markets with its Alexa voice assistant platform, Prime Video services, and healthcare initiatives. This trend is not new but it has important implications. It is driving a shift of value away from infrastructure toward data and OTT services, and a shift of revenue away from broadband service providers toward OTTs themselves. OTTs typically rely heavily on telcos and broadband players to provide broadband infrastructure that allows OTTs to deliver content and applications, and to collect, store, and analyze data from end users. Faster introduction of new OTT services has already strained broadband networks – and demand is growing. But as ICT revenue shifts away from telcos, this limits further broadband infrastructure investment.

Implications for industry stakeholders

The five major ICT trends highlighted above create new opportunities for broadband-based services, and also create additional demands on broadband infrastructure and availability. The three broader contextual drivers for broadband also discussed above – broadband as a GDP growth enabler, as a platform for delivering the SDGs, and as a tool to counter COVID's impact – have impact across the whole broadband value chain. But what does this mean for broadband industry stakeholders, and what are the implications for future industry growth and development?

As illustrated in Figure 6, there are six key groups of stakeholders in the broadband industry: telecom operators, technology vendors, OTT and cloud players, governments and regulators, enterprise end users, and consumers. Each stakeholder group has its own interests, pain points, and key objectives, and these do not always align.

Figure 6: Broadband industry stakeholders, contextual drivers, and key challenges
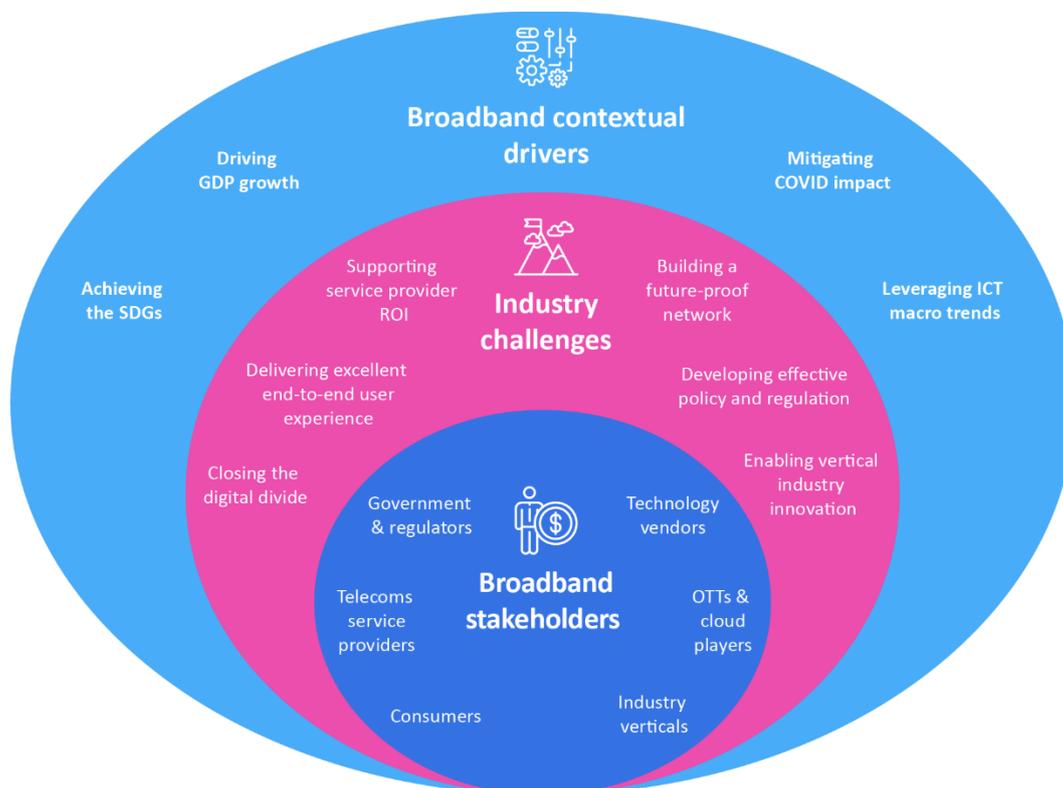
Source: Omdia

The contextual drivers and trends for broadband industry development will impact all stakeholders, although some drivers are more important to certain stakeholder groups than to others. For example, using broadband as a tool to drive GDP growth is a direct objective for governments and regulators but only indirectly relevant for OTTs and cloud players, although they will still benefit from increased economic output.

To benefit from these drivers, and deliver on broadband's promise for all, broadband industry stakeholders must find common ground in addressing six critical challenges, which we discuss in detail in the next section of this report. Industry stakeholders need to work together to accelerate efforts to address these challenges, which have taken on new urgency in the context of the COVID-19 pandemic. Only in doing so can broadband deliver on its potential to support the SDGs, enable GDP growth, and provide a strong platform for transformative ICT technologies.

Currently, however, different stakeholders across the broadband industry lack a unified platform for collaboration and cooperation. **A new broadband industry organization could provide a neutral, open platform for cooperation, discussion, and action, and take into account the interests and positions of *all* stakeholders**. This would enable a successful and collaborative approach to the six broadband industry challenges outlined below, and would accelerate positive and sustainable development across the spectrum of technological, commercial, policy, and strategic objectives.

3. Six broadband industry challenges

Inequality of broadband access – ensuring broadband availability for all

1 ADDRESSING INEQUALITY OF BROADBAND ACCESS

- The digital divide is not closing quickly enough – more than 3 billion people will still be unconnected in 2024.

- Coverage, speed, and affordability disparities remain between regions, within individual countries (urban/rural), and among enterprises (large enterprise/SME, different industry sectors).

Bridging the digital divide requires significant expansion of broadband and internet access

The benefits of improved broadband access, coverage, and technologies for both industry and society are significant, but the digital divide means that many people are still being left behind in the rush to connect ever-greater numbers of households, businesses and devices.

- Omdia's research shows that broadband coverage is currently only around 50% of population globally.

- According to a recent ITU analysis, internet adoption in Latin America and the Caribbean is 70%, in Sub-Saharan Africa 38%, and even advanced economies still have some gaps (91% in North America, and 86% in Western Europe)."[8]

While there has been significant progress in expansion of broadband access in the last couple of years, there remain large disparities in terms of coverage, not only among the developed and developing regions but also within individual countries.

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[8] "*Economic Impact of COVID-19 and the Digital Infrastructure*," https://www.itu.int/en/ITU-D/Conferences/GSR/2020/Documents/GSR-20_Impact-COVID-19-on-digital-economy_DiscussionPaper.pdf

- Omdia forecasts that 52% of households worldwide will have fixed broadband subscriptions by 2024. Only 25 countries will pass 80% household broadband penetration levels by 2024.

Figure 7: Fixed broadband household penetration by region
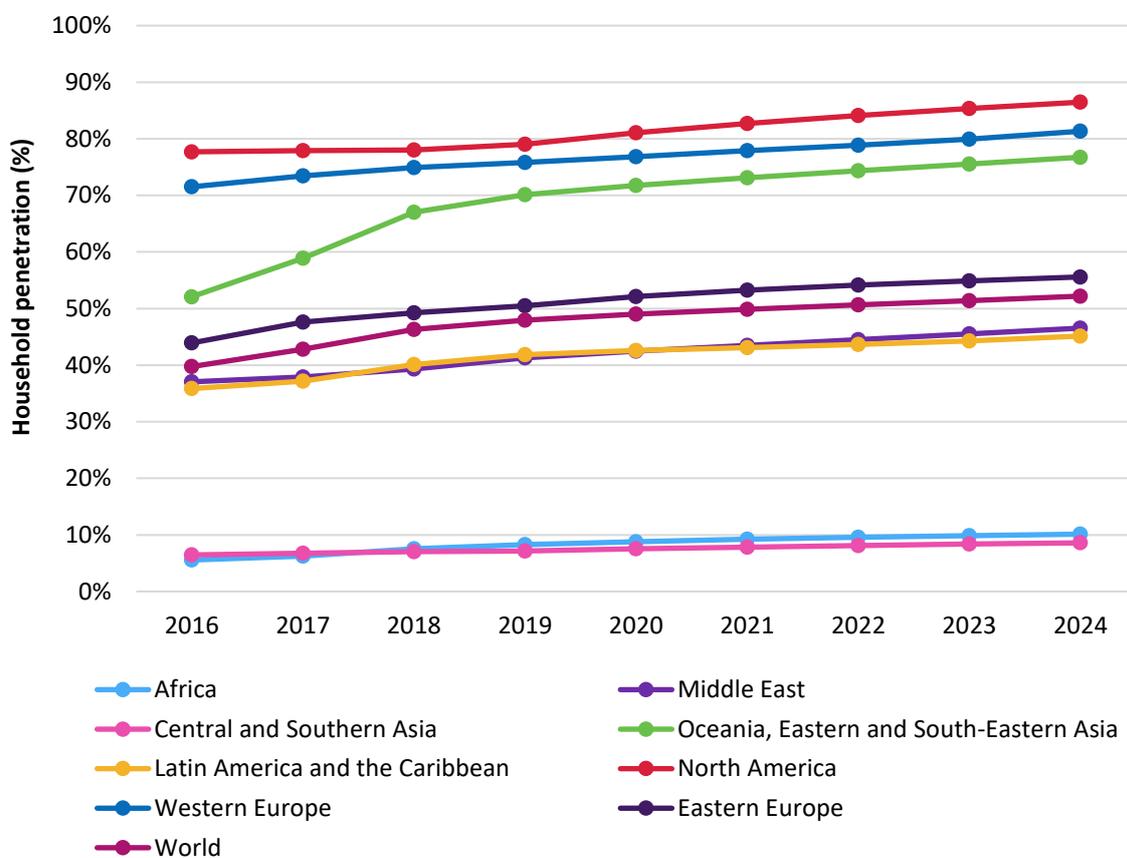
© 2020 Omdia

Source: Omdia

Even with accelerated mobile broadband, more than 3 billion households – mostly in emerging markets – will still be unconnected by 2024, with even greater numbers lacking access to high-speed broadband at home. And even within developed countries, populations face a digital divide depending on income levels and affordability, and on whether they live in urban or rural areas. The latter are typically not high priority for high-speed broadband deployments, which are more expensive to deploy in such areas, delivering lower (and slower) ROI.

Enterprises are also impacted by the digital divide, with small and medium-sized enterprises (SMEs) often having far more limited access to broadband. Large enterprises tend to have access to digital solutions and connectivity – for example, collaboration tools, employee devices, cloud applications

and storage, and secure VPNs, as well as broadband access. But for many SMEs, particularly in developing countries, such access is limited or non-existent. According to the ITU, the use of the internet for business purposes in Sub-Saharan Africa is as low as 7% of enterprises. And with the ongoing challenge of the pandemic, enterprises in those sectors that are not as advanced on the path to digital transformation (e.g., farming, retail, and hospitality) are also likelier to feel more significant impact from limited ability to leverage broadband.

The challenge of extending speed and affordability

Narrowing the broadband digital divide and achieving universal broadband access is not only about expanding broadband infrastructure **coverage**; it also requires narrowing the digital divide when it comes to broadband **speeds** and **affordability**.

As shown in Figure 8, average broadband download speeds vary dramatically by geography, with the average speed in Japan nearly double that of the UK, and nearly 15 times that in Nigeria. These differences have significant implications for the ability of citizens and businesses to access employment, education, online commerce, and even healthcare.

Figure 8: Fixed broadband and multiplay: average download speed by country, 2Q20


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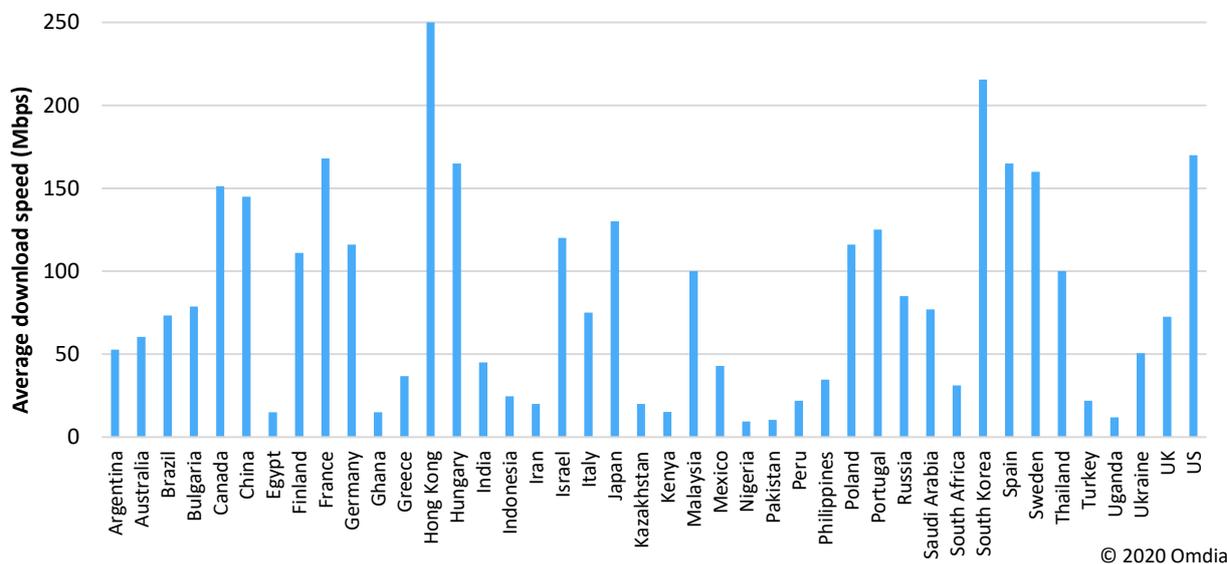
Source: Omdia

The COVID-19 pandemic has further intensified the impact of these differences. For example, with schools closed in many areas, remote online learning has become the norm for many students and parents. UNESCO estimates that nearly 1.4 billion children (60% of the world's student population) have been studying remotely since the outbreak of COVID-19.[9] Schools and universities have

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[9] https://en.unesco.org/covid19/educationresponse

implemented remote learning programs to mitigate the impact of the pandemic on education. But to effectively access online learning software, apps, virtual tutoring, and videoconferencing tools, students require stable, reliable, and reasonably high-speed broadband connections. But such access is still simply not available for many**.** As with extending coverage, acceleration is needed.

The prevalence of fiber access infrastructure is another key metric to consider when looking at inequality of broadband access speeds. Figure 9 below uses data from Omdia's recently published Global Fiber Development Index to illustrate how some advanced markets for broadband penetration (e.g., the UK, the US, and Canada) are still falling behind in terms of fiber access buildout (Cluster 2 countries), meaning citizens and businesses are not benefiting from the economic and social benefits that very high-speed broadband access can provide. Meanwhile, Cluster 3 countries such as Pakistan and Ghana are hampered by both low broadband penetration and low fiber coverage, leaving them trailing even further behind markets where access to these services is widely available.

Figure 9: Fiber access is also a factor in the digital divide

FTTH penetration vs. total broadband penetration, select countries, 2019

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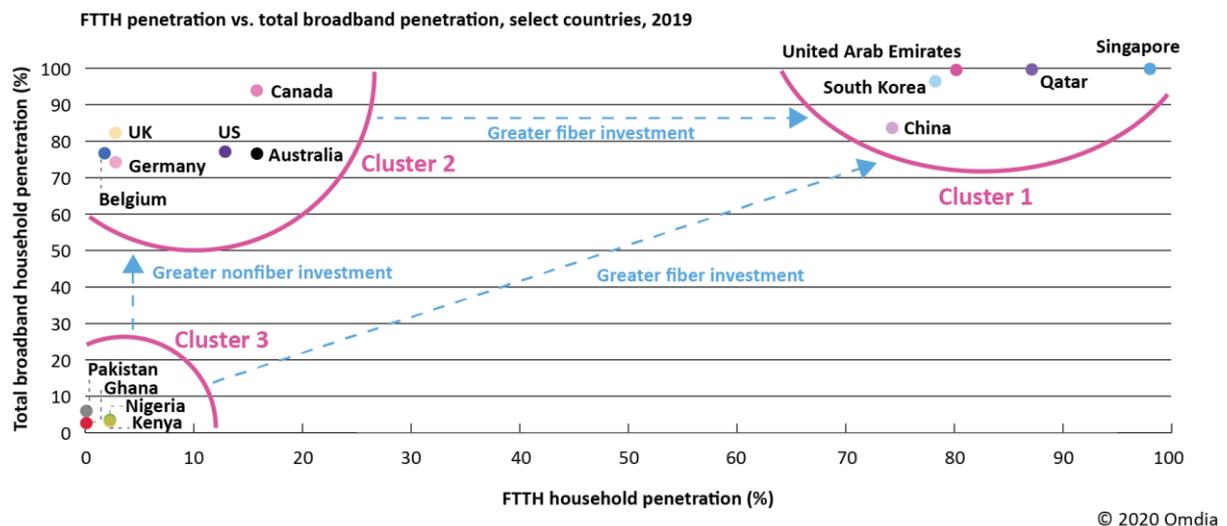
Source: Omdia

One major barrier to expanding high-speed fiber broadband connectivity, especially in rural areas, is the high cost of fiber-optic cable installation, which usually accounts for 70–80% of network capex. Conventional installation methods require specialized machinery and skilled labor, and ROI is constrained by the low densities of remote rural communities. Approaches such as the ITU's Broadband Infrastructure for Remote-Area Digitalization (BIRD) solution have been proposed to drive up rural fiber coverage. BIRD is a standardized fiber installation approach intended for rural and remote areas, "built on the affordability-first concept, lightweight robust optical cable, and simple do-it-yourself (DIY) installation by non-skilled local people."[10] In a prototype installation in a

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[10] https://www.itu.int/net4/wsis/forum/2020/en/Agenda/Session/267

mountain village in Nepal, which connected schools and a hospital, the capex requirement was estimated at half of that required for conventional cable installation. Such solutions can play an important role in narrowing the urban-rural digital divide, but at present they are fragmented rather than being adopted industry-wide.

Affordability of broadband services for end users is a further issue for improving broadband access globally. As shown in Figure 10, access to broadband comes at widely varying costs – but costs are highest in some of the lowest-income markets. This means that even if broadband is made more available in those markets, it may still be out of reach for many consumer households and businesses. A recent IFC report found that in emerging markets, the cost of basic fixed broadband internet access equates to an average of 54% of household income, significantly higher than in developed economies.[11]

Figure 10: Fixed broadband service costs: 2Q20

Average fixed broadband residential subscription cost per 1Mbps, selected markets (2Q20)
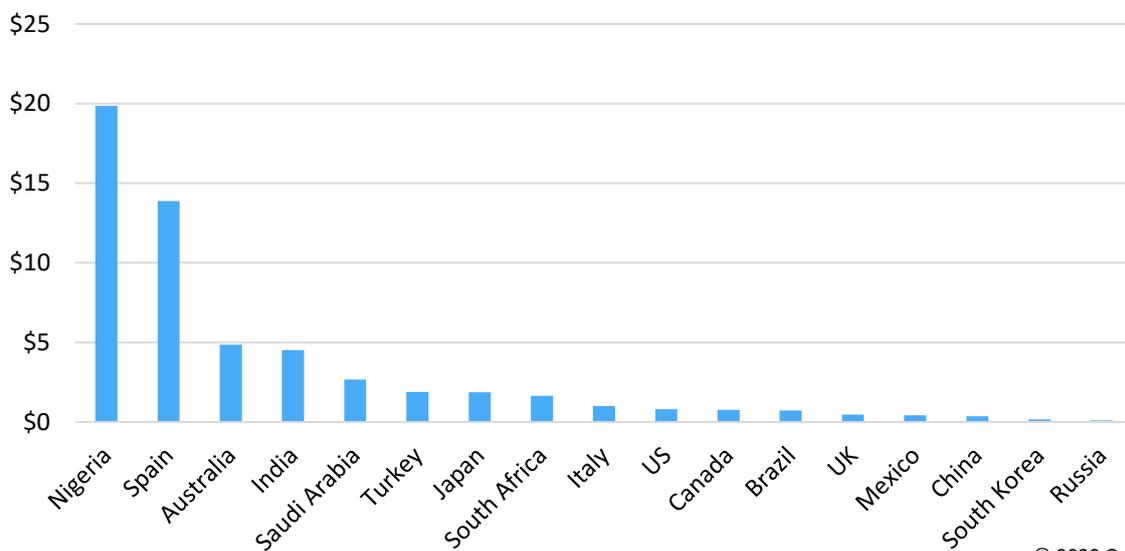
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Source: Omdia

Outlook and potential approaches

At present, the digital divide is arguably growing not shrinking. The pandemic has highlighted the fact that in many countries approaches to addressing the digital divide by improving access to

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[11] https://www.ifc.org/wps/wcm/connect/2d3c4eff-12a8-4b0b-b55d-9113a950ed33/EMCompass-Note-79-Digital-Infrastructure-Sharing.pdf?MOD=AJPERES&CVID=n2dwWtn

broadband are not achieving their goals. Even where broadband coverage is being addressed, issues around broadband speeds and affordability still may not be.

Extending availability of broadband requires significant investment and must be accelerated in order to extend access to the underserved. This requires developing business models that make it profitable (or at least viable) for operators to serve lower-income and/or hard-to-reach consumers.

Public funding, operator network sharing agreements to share cost and eliminate overbuild, re-using infrastructure owned by utilities and local municipalities, partnerships between local and global players and financial institutions to finance network construction, and cross-body subsidies are all potential approaches. All of these methods can be used to drive greater geographic coverage by broadband infrastructure, but there is no single approach that is guaranteed to work. Indeed, despite the best efforts of governments and global investment bodies, as shown above in Figure 7 progress in growing the percentage of households with access to broadband is still anticipated to be relatively slow – acceleration is needed.

A fresh, more coordinated, holistic approach to addressing the digital divide should include the following:

- A platform that enables all players in both public and private sector to share best practice approaches to addressing the digital divide

- A potential global broadband investment fund, which could focus on supporting governments and service providers in extending broadband infrastructure coverage and upgrades to underserved areas and enterprise sectors, and also in developing effective pricing models to ensure affordability of services

- Greater engagement from OTTs in addressing issues around the digital divide and improving broadband access. OTTs can benefit significantly from such efforts, and need to consistently be part of the conversation and the solutions for narrowing the digital divide. Initiatives such as Facebook Connectivity and Google's ConnectHome program are a great start, but these efforts are piecemeal and tend to focus on major markets such as the US

- Coordinated effort from all stakeholders, rather than the multiple fragmented approaches that characterize the current situation.

Driving broadband network development and investment through regulatory and policy incentives

> "Broadband access is essential for consumers and enterprises alike, and is now recognized as a key driver of economic growth. Countries need policies and investment strategies that enable and incentivize improved broadband availability, speed, and affordability, to help close the digital divide and establish a strong foundation for future economic development and digital transformation."
> Michael Philpott – Research Director, Omdia

Effective policy to drive ubiquitous access to broadband is core to national digital agendas

Accelerating digital infrastructure deployment and reducing the digital divide have risen up the policy agenda for governments and regulators worldwide.

But while policy and regulation are critical to successful broadband growth and investment, and incentives and structures are in place in many markets, they do not always have the desired impact. There is significant complexity and diversity of approaches in different countries for broadband infrastructure regulation, broadband investment models, and national broadband planning. This results in less than optimal approaches, and is slowing down both coverage growth and general broadband industry development.

Most countries have developed national broadband plans, with varying levels of continuity and success. (For a full list, see Table 4 in the *Appendix* of this report). These tend to focus on achieving set coverage targets by a certain date; for example:

- France's "Tres-Haut Debit" plan aims to provide 100% coverage of the country with minimum 30Mbps broadband access by 2022

- Brazil's National Connectivity Plan and Structural Plan of Telecommunications Networks aim to provide fiber coverage to 75% of unconnected municipalities by 2022.

Generally, most countries' national broadband targets have not been achieved within the desired timeframes, even in developed markets. And while COVID-19 has driven up consumer and business demand for broadband networks, restrictions on working conditions and access to buildings and homes have actually slowed broadband deployment in many markets.

Broader national "digital transformation" and "digital strategy" objectives are now being developed and implemented by regulators and governments in many countries, often including national broadband plans. Typically, national digital strategies also include specific investment policies, incentives or other tools to drive forward broader digitalization across the country's economy. The aim is to create an environment conducive to technology innovation and development, as well as driving digital adoption by consumers and businesses. Such policies are often closely tied to industrial policy and planning; they are sometimes also tied to national security strategies. Examples/case studies are shown in Table 1.

Table 1: Examples of national digital strategies

Country and plan name	Key plan elements
Brazil – Strategy for Digital Transformation (part of the "Brasil Eficiente" policy framework)	Led by Ministry of Science, Technology, Innovation, and Communication.
	Comprises initiatives across many areas of society and technology, the most important being "Network infrastructure and broadening Internet access" – some regions of the country have over 45% of households unconnected.
	To be delivered through 100 specific actions to drive digital development.
	Focus is on policies and initiatives to use technology to catalyze the economy and other segments of the tech industry in Brazil, and to improve social welfare.
	Recent actions include creation of government-telco joint commission to address the severe impacts of COVID-19 in Brazil using digital.
Saudi Arabia – Vision 2030	Launched in 2016.
	Phased targets, with aim of improving country's infrastructure and preparing it for digital transformation.
	Program includes development of ICT and broadband infrastructure, innovation in advanced technologies, and investment in the digital economy.
	Also includes initiatives for developing e-government, facilitating access to government services, and linking government agencies.
Singapore – Infocomm Media 2025 Plan	Launched in 2015.
	Three main pillars: capitalize on big data and analytics, continue to deepen the converged industry ecosystem, and better connect people.
	First phase – extending connectivity through the deployment of above-ground boxes and technologies from a heterogeneous network (HetNet) – completed at end of 2015.
	Next two phases will introduce real-time data collection through a mesh of sensors nationwide.

Source: Omdia

The role of USOs, investment policy, and financial incentives

Regulators and policymakers cannot rely on market forces alone to deliver ubiquitous high-speed broadband. In addition to introducing a national broadband plan and digital strategy, many regulators implement a universal service obligation (USO) to ensure that basic telecom services are available at an affordable price to all households and businesses. In some (but far from all) countries, functional internet access is now being included in USOs. This has usually been defined as basic dial-up speeds, but as demand for greater data volumes increases, and with improvements in average connection speeds, some are introducing a specific broadband USO.

USO broadband initiatives have been seen mostly in mature markets to date. Varying broadband speed targets have been mandated, ranging from 1Mbps to as high as 30Mbps. Some regulators limit the obligation to what is absolutely basic, while others are more forward looking, considering how the market is shaping new connected households and societies.

- Norway has recently worked on defining and implementing a universal service for broadband to reduce the digital divide. In September 2019, the Norwegian government proposed creating the right to access basic broadband in the country of either 10Mbps or 20Mbps. The latter would be far higher than those introduced in most other nations.

- Emerging markets including India, Brazil, and several African countries have started explicitly including broadband projects in their USO funding schemes, and should reap the benefits of such initiatives in the coming years.

Setting out targets and obligations is not sufficient to deliver universal broadband coverage in most countries; governments must also ensure they are incentivizing and supporting the right broadband investment models. Different models being applied internationally include:

- State-owned companies controlled and financed by the government

- Mixed public–private partnership (PPP) models combining public and private funding

- Privately led – with state support via investment incentives or universal service funds (USFs).

Figure 11: Telecom infrastructure investment models to bridge the digital divide

STATE-OWNED ENTERPRISES

Fully government controlled and financed

National networks
Retail: Uruguay, Costa Rica
Wholesale: Australia, Argentina

Municipal networks
Sweden, US

MIXED MODEL

Operated by private sector but financed publicly or through a combination of public and private funding

Direct subsidies
EU, US, Chile, Poland

PPP National wholesale:
Peru, Ireland
Municipal:
Germany, Spain, Sweden

PRIVATE OPERATORS

Private sector financed and operated with public investment incentives

Regulatory obligations
Chile, Brazil, Argentina, Colombia

Indirect subsidies/incentives
EU, UK, Poland, Peru, US

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Source: Omdia

However, USO-funding policies may fail when not implemented under the right legal framework or where there is a lack of transparency. For example, some USFs have performed poorly in achieving universal access due to a lack of disbursement, poor administration, excessive government intervention, or levies not being set correctly.

Alternative funding approaches for broadband investment plans focus more on incentivizing or partnering with the private sector. While these are more complex, they can be a very effective (and sometimes faster or lighter-touch) way for policymakers to drive forward broadband rollout and can encourage closer cooperation between government and commercial interests. These include:

- Encouraging public-private partnerships (PPPs)

- Using government incentives to introduce market-based solutions by, for example, reducing the burden from taxation and fees. (For example, the government of Malaysia offers a capex tax allowance of 100% to operators investing in last-mile broadband equipment, and exempts broadband equipment and consumer access devices from import duty and sales tax.)

Demand-side incentives for take-up are also being used as a broadband policy tool in some markets:

- The Malaysian government introduced the Lifestyle Tax Relief in 2017, to drive up the use of computers and internet. Purchasers receive tax relief up to a limit of $600 for internet subscriptions and purchasing connected devices such as smartphones, tablets, and laptops

- The Brazilian government recently suspended tax on IoT devices, as a way to incentivize growth in take-up.

Telecom infrastructure access, migration, and rights of way present broadband regulatory challenges

Broadband facilities access (including infrastructure sharing) is also an important focus for policymakers looking to accelerate broadband rollout. Like financing structures and incentives, such policies can be highly complex. Both the mechanisms for facilities access – whether passive or active sharing – and the pricing structure and levels for such access, vary considerably between countries:

- France and Portugal have adopted a volume-based pricing structure, which charges alternative operators by the amount of space they occupy (e.g., in a duct)

- Lithuania has adopted a length-based approach

- In some countries, prices vary geographically – either higher prices to reflect the increased costs of rolling out ducts in urban areas, or lower prices to encourage rollout in rural areas

- In the US, the FCC oversees the way parties agree on prices by issuing guidelines and detailed formulas to use in determining "just and reasonable" charges.

Pricing challenges and complexity may put off alternative operators from utilizing shared telecom facilities to deploy their own networks. And in many countries, infrastructure sharing is not mandated or price controlled. Other barriers to the shared utilization of poles and ducts for broadband rollout include:

- Response times required to process access requests

- Processes for duct and pole space capacity management

- Constraints on third-party work on carriers' infrastructure (physically accessing and pulling cable, attaching wireless to poles)

- Quality and accessibility of detailed geospatial planning data

- Effectiveness of the process for dispute resolution.

Right of Way (RoW) policies can also be useful in accelerating broadband network rollout. Securing RoW agreements can be lengthy and costly, especially in emerging markets, and is complex given that stakeholders may not be directly implicated in meeting broadband rollout objectives (e.g., utilities and railways).

- India has changed regulation of RoW applications and approvals with a view to speeding up the process. The Department of Telecommunications introduced the "Indian Telegraph RoW Rules" in 2016. This requires the government to appoint a specific officer to administer RoW applications, and provides a standardized framework with specified timelines for RoW approvals and an online application process. RoW applications must be assessed within 60 days and cannot be rejected without the applicant being given a chance to argue their case.

Another infrastructure-related broadband regulatory challenge is achieving copper switch-off. Particularly for countries with heavy reliance on copper networks, there are many barriers and challenges to achieving a transition to full fiber. For regulators, it is important that migration away from PSTN does not cause disruption for consumers.

- For example, in France, the regulator, ARCEP, has imposed requirements on incumbent telco, Orange, to minimize the effect on the market of retiring its copper network. The operator must give at least five years' notice of the shutdown of any part of the country and ensure the technological transition is carried out under fair and competitive terms.

Outlook and potential approaches

Effective regulation and policy can help to overcome or mitigate many barriers to broadband deployment and growth. It is a key tool to: ensure the successful deployment of next-generation broadband and to drive up adoption rates; avoid duplication of resources that reduces ROI and drive improvements in access to telecom facilities; and help mitigate operator and government concerns about financial resources to support the extension of coverage to underserved areas, and for the eventual deployment of full-fiber coverage.

Fundamentally, however, the complexity of policymaking around broadband is a major barrier to success. Policymakers should be working more closely with the wider broadband industry, both nationally and globally, to share best practice, in order to simplify policymaking and to make it more effective in achieving positive outcomes that both benefit society and create a strong investment environment. This can include taking common approaches across regions and types of markets, and enabling closer collaboration with industry so that innovation can be supported proactively, rather than simply being something that regulators and policymakers react to.

While there are currently a number of forums for such discussions, such as the ITU and the Broadband Forum, they often do not fully include the commercial side of the industry, and rarely extend the discussion to indirect stakeholders such as OTTs and cloud players. Ideally, a neutral platform could be provided to enable and facilitate discussions between *all* stakeholders. Activities could include:

- Best-practice sharing

- Innovation partnering

- Regular reviews of policy impact

- Two-way dialog between regulators and broadband operators aimed at ensuring regulation is developed with all views in mind.

# Ensuring sustainable service provider ROI

- Broadband operators are struggling to achieve attractive ROIs, which puts the expansion of broadband coverage and the overall ecosystem (including OTT opportunities) at risk.

- COVID and OTT demand are placing significant additional demands on broadband infrastructure, but the financial support or returns for operators are lacking.

- Strategies such as infrastructure sharing can help mitigate some aspects of service provider costs, but these are not sufficient to improve ROI without further change.

Service provider ROI and the investment gap

Ensuring sustainable ROI for broadband service providers is fundamental to efforts to improve broadband access, speeds, and coverage. Maximizing broadband infrastructure use is one key to helping operators and other infrastructure investors achieve the ROI needed to make broadband rollouts and operating models sustainable. But achieving viable ROIs is highly challenging for service providers, particularly those tasked with building out broadband access infrastructure to deliver on USOs.

As illustrated by Omdia's analysis of service provider ROI in 2Q20 shown in Figure 12 (longer-term trend shown in upper right of chart), ROIs for operators are very low, rarely going above 1%. This is driving operators to look beyond infrastructure for new revenue, but the ongoing requirements of network investment, maintenance, and operation are a significant burden that in most cases will not be offset by alternative (non-telecom/broadband) revenue.

**Figure 12: Service provider ROI snapshot, 2Q20**
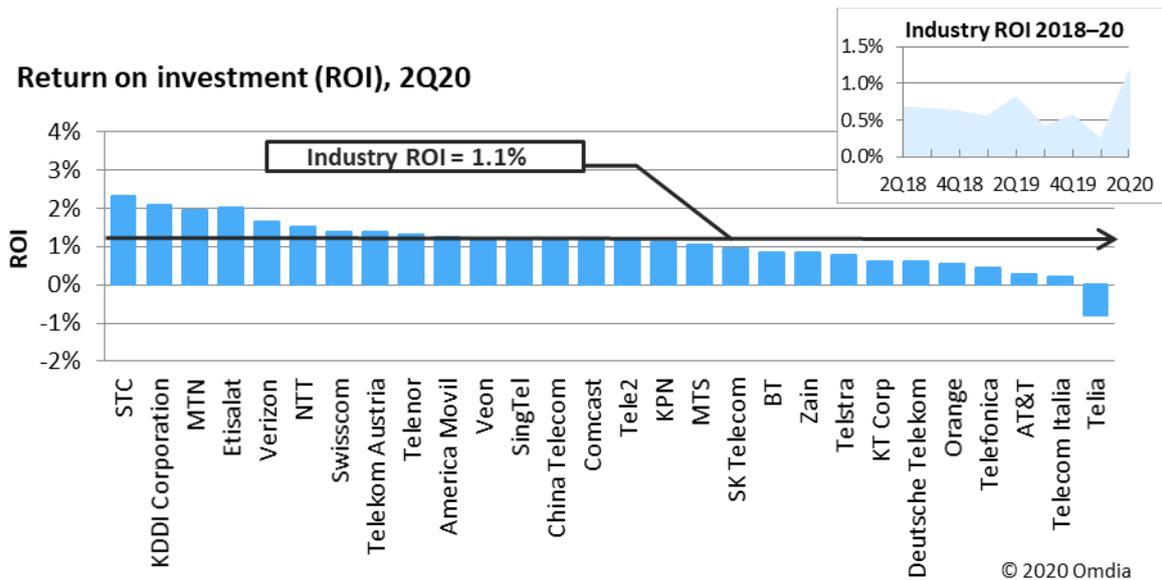
Source: Omdia World Telecoms Financial Benchmark

A further challenge for broadband operators is that the access network, which delivers broadband services to end users, accounts for the largest portion of operator capex (see Figure 13). This last-mile infrastructure – which is absolutely critical for services and content to be delivered to homes and businesses, and in many countries forms part of USO requirements for operators – is the costliest part of the network for operators to deploy and maintain, but in the vast majority of cases receives no upfront contribution from OTT content and media providers that rely on it.

Figure 13: Telecom operator capex by segment share (%)

Capex segments, as a % of total capex
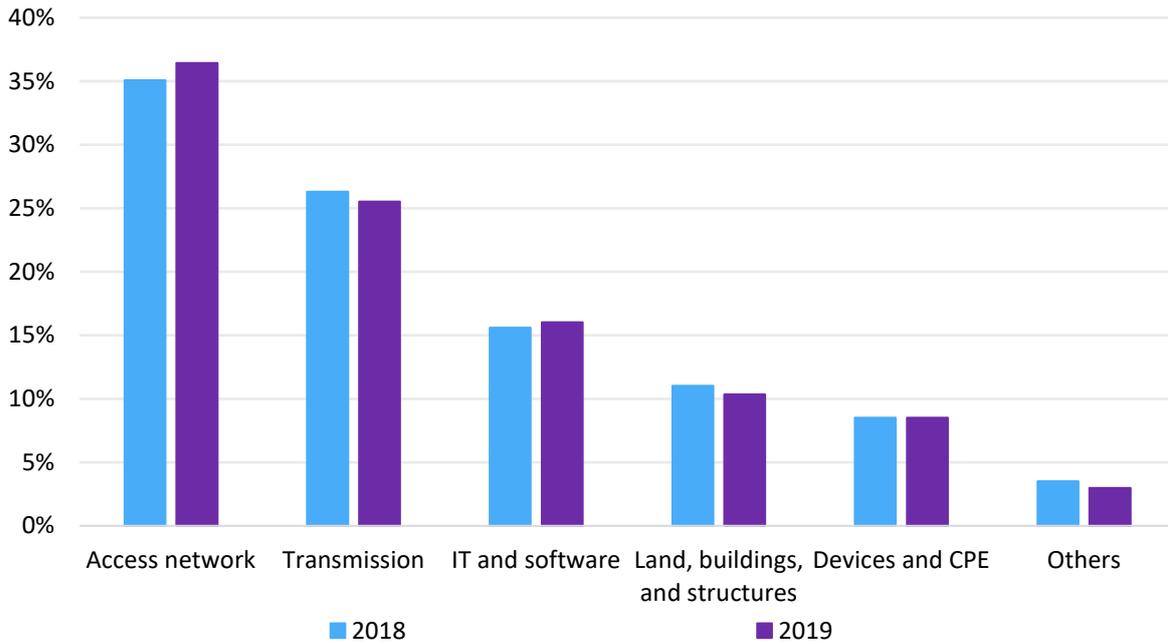
© 2020 Omdia
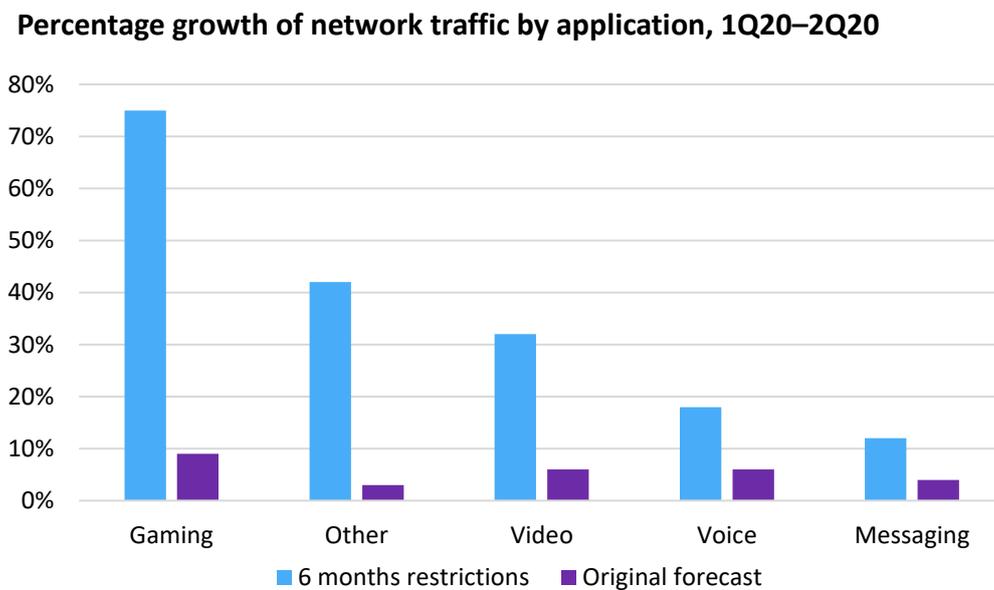
Source: Omdia

The impact of COVID on network demand

The COVID-19 pandemic has placed significant additional demands on broadband networks and infrastructure. According to a recent ITU report, providers globally have seen an 80% increase in PC uploads to cloud computing platforms during the peak period of the pandemic, with demand coming from video conference calls, among other applications.[12] Greater use of broadband for remote working, education, healthcare, and shopping are all contributing, as is the upsurge in demand for bandwidth to support increased use of home entertainment linked to ongoing population lockdowns.

These trends have driven up bandwidth demand, with significant impact on network traffic (see Figure 14). Network operators are seeing an unprecedented increase in traffic, a shift in the normal network busy hour, and to some extent a balancing out of download versus upload traffic.

Omdia estimates online gaming traffic has increased by 75% during the crisis, and video traffic (which already represents the biggest driver of traffic) by 32% (see Figure 14).

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[12] https://www.itu.int/en/ITU-D/Conferences/GSR/2020/Documents/GSR-20_Impact-COVID-19-on-digital-economy_DiscussionPaper.pdf

Figure 14: The COVID-19 crisis is driving an unprecedented increase in data traffic

Percentage growth of network traffic by application, 1Q20–2Q20

■ 6 months restrictions   ■ Original forecast

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Source: Omdia Network Traffic Forecast 2019–24

In some cases, higher demand has required additional spectrum to be assigned for unlicensed use (i.e., for Wi-Fi). It has also highlighted the advantage held by operators that have deployed next-generation networks. FTTH providers are far better placed to respond to spikes in broadband traffic, and countries with high availability of ultra-highspeed broadband have been better able to maintain quality of service with less slowdown in latency and download speed. But, as discussed in the section on "Building a future-proof broadband network," the challenge of obtaining reasonable ROI timeframes on fiber investment is even greater. In addition, this greater dependence on high-speed broadband has also emphasized the impact of the digital divide, both within and between countries.

This additional traffic is placing significant demands on networks, but is not necessarily driving significant additional revenue for broadband service providers. This fact, and the overall investment and operating conditions under the pandemic situation, are putting significant pressure on the financial performance of operators and other digital infrastructure companies. On one hand, digital infrastructure is recognized by governments and content/applications providers as absolutely critical to business continuity, social benefit, and the ongoing growth and recovery of the economy. On the other hand, owners and operators of this infrastructure are in many cases not being given sufficient financial support or returns to enable continued investment in broadband and transport networks.

The role of OTTs
The scale of OTT players, and their reliance on the access and distribution networks of telcos for delivering content and applications to customers, means they are critical stakeholders for ICT and broadband. As discussed in the introduction, their growing reach across the ICT value chain gives

them significant market power. The OTT video market alone had over 1 billion subscriptions worldwide as of mid-2020.

Figure 15: Stock market share value variation (selected shares) December 1, 2019–June 4, 2020 (6 months)

Source: Yahoo Finance, Verizon Media (December 1, 2019, to June 4, 2020), Omdia analysis

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This scale, and the fact that OTT players by their nature are relatively unencumbered by requirements to invest heavily in expensive access network infrastructure (at least compared to broadband operators), has translated into significantly higher market valuations, as shown in Figure 15 above. Differences between valuations of OTTs and telcos have been exacerbated during the COVID-19 pandemic, as use of online services has increased and a greater share of value goes to the OTT players. While commercial arrangements between infrastructure providers and OTT players may lead to a small transfer of value from the latter to the former, it is clearly not sufficient to level the playing field from investors' point of view.

There are also ongoing concerns over differing regulation of OTT players, versus both telco infrastructure providers and traditional retailers. These have been well documented, and include:

- Differing and more favorable tax treatment of online commerce providers

- Different and less onerous requirements on data privacy and protection

- Different or no requirement to support public safety requirements such as emergency services (e.g., for emergency calls)

- No requirement to invest in access infrastructure deployment or upgrades, or to be bound by USOs, or other government broadband targets.

This situation has naturally attracted a number of broadband providers to move into becoming digital content and commerce providers themselves; for example, by acquiring or investing in digital content services. Examples include Verizon and AT&T in the US, BT in the UK, and Telefonica in Latin

America. However, this is not always financially viable for broadband operators, and is not always successful given such initiatives lie outside of the core competence of many providers.

Governments have so far shown little appetite to mandate transfers of value from OTT players to infrastructure providers, or to impose equal regulations on both. Recently, Spain, for example, has proposed mandating a specific 5% tax on OTT streaming video players – but these funds are to be directed to local audiovisual content development, rather than being used to feed into a USO fund or expand broadband infrastructure.

The role of infrastructure sharing

One way that broadband operators could mitigate costs somewhat is through improved approaches to infrastructure sharing. Poor infrastructure use – or the lack of reuse – is costly for operators, enterprises/vertical industries, and consumers. But to improve this requires significant coordination of infrastructure development and planning, and effective infrastructure sharing arrangements.

Operators have built discrete networks to support different types of applications and users. This requires significant capex, as well as ongoing opex for operations and maintenance, and has hurt ROI for operators. At a minimum, these costs are passed along to subscribers, whether consumers or enterprises.

Since many operators have not achieved reasonable ROI from infrastructure investment, they lack the financial strength to invest meaningfully in next-generation networks and applications. Numerous incumbents are doing only minimal upgrades due to poor financial returns. Network sharing frees up capital to invest in next-generation technologies and networks, which can then further support growth and development of digital services such as cloud-based gaming, smart cities, and e-health. But, for the most part, these services are the province of OTT and cloud players, which dominate market share and revenue across the majority of home entertainment and smart-home applications, as well as enterprise applications. Without requirements to make significant investments in broadband access networks themselves, OTTs are also much better positioned to offer data center services to enterprises, driving vertical industries toward cloud usage and digitization.

Failure to maximize infrastructure use is also constraining operators' investment in future-generation network upgrades and expansions, as we discuss below in the "Building a future-proof broadband network" section. For example, there are compelling financial reasons to deploy next-generation PON FTTx networks to support residential subscribers, SMEs, larger enterprises, and mobile backhaul (see Figure 16). In addition, next-generation PON provides future-proofing as demand grows.

Figure 16: GPON versus XGS PON – monthly ARPU and years until payback (potential scenario)
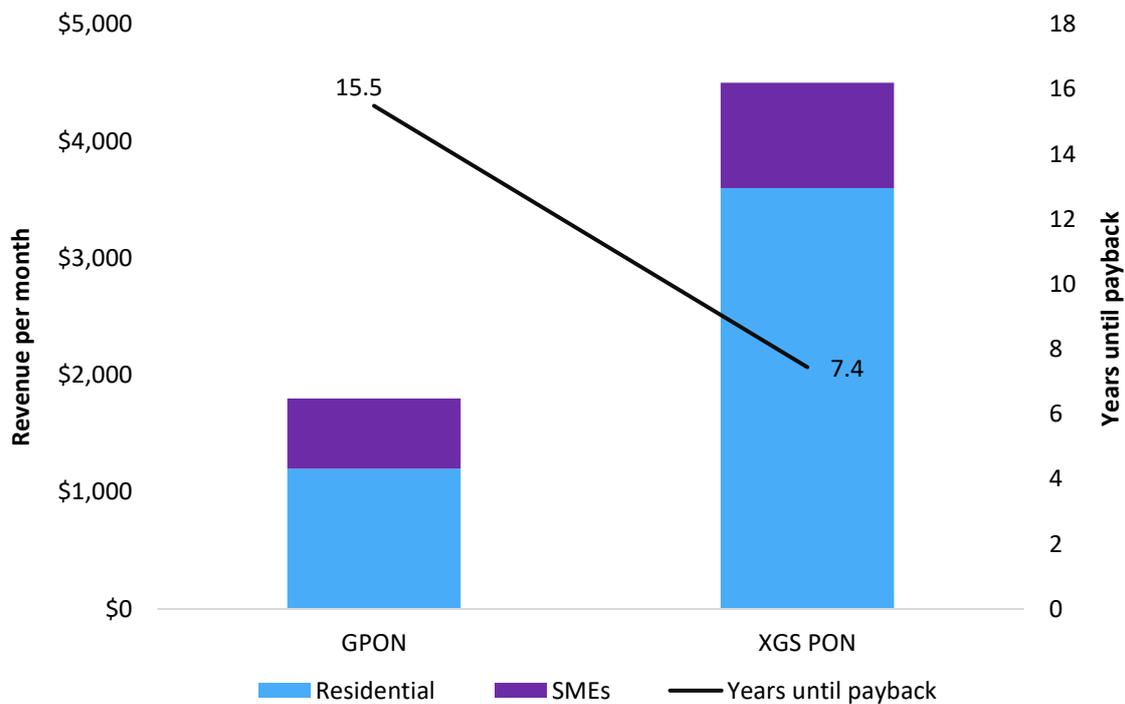
Source: Omdia

- **Swiss Fibre Net** (SFN) provides a best-practice example of fiber network asset sharing. This joint venture between local and regional energy providers in Switzerland offers standardized, nondiscriminatory access to an open FTTP fiber-optic network, enabling retailers to offer products and services to a wide range of customers across Switzerland. SFN combines fragmented local fiber-optic infrastructures to form a homogeneous, standardized, nationwide, and freely accessible fiber optic network. It offers high-quality, future-oriented transport services ("layer 1 services") to licensed national telecom providers. In May 2020, Swiss operators Salt and Sunrise entered a strategic joint venture partnership to deliver fiber-based broadband services to 1.5 million households. The joint venture, Swiss Open Fiber, will collaborate with Swiss Fibre Net, which will support setup and operating activities.

Outlook and approaches

Broadband operators will need further support if they are to improve ROI, which is necessary to achieve the objectives of expanding broadband coverage, speeds, and affordability, and to enable the wider digital transformation of businesses and society.

This is not solely a concern for operators but needs to be a concern for the entire broadband ecosystem. COVID-19 and OTT demand are placing significant additional demands on broadband infrastructure but the financial support or returns for operators are lacking.

Strategies such as infrastructure sharing can help mitigate some aspects of service provider costs but are not sufficient to improve ROI without further change. Approaches can include:

- Regulation to equalize the playing field between OTTs and operators more effectively, taking into consideration the broader societal and governmental objectives of expanding broadband access

- More effective forums for cooperation among different industry stakeholders, to encourage partnerships to support development of new cooperation business models, both among network operators themselves, and between OTTs and service providers

- Policy support and clear incentives to drive infrastructure sharing more broadly, particularly to incentivize and simplify this for next-generation access network infrastructure; e.g., some national governments have encouraged electric utility companies and coops to become wholesale network operators, while others restrict electric utility companies from becoming network providers, even at the wholesale level

- Potential direction of COVID-19-related investment or development funds toward broadband infrastructure providers, to accelerate the rollout of broadband to underserved areas or to boost access speeds.

Enabling vertical industry innovation

Broadband is becoming an important driver of industry transformation

Broadband has always been an important topic in the enterprise IT department. The difference today is that boardrooms and business owners are now discussing it too, and from a strategic point of view rather than simply as a basic platform for connectivity. Both enterprises and broader industry ecosystems are actively looking at broadband's role in enabling digital transformation for enterprises and industry verticals. Omdia's ICT Enterprise Insights Survey 2020 shows that although more than 50% of enterprises put modernizing legacy systems in their top-three priorities, only about 10–15% claim to have completed digital transformation (see Figure 17). In other words, most

enterprises are at the early stages when it comes to digital transformation. Broadband will be a key enabler for taking these initiatives forward.

Figure 17: Enterprises are still on the journey to digital transformation

Digital transformation progress
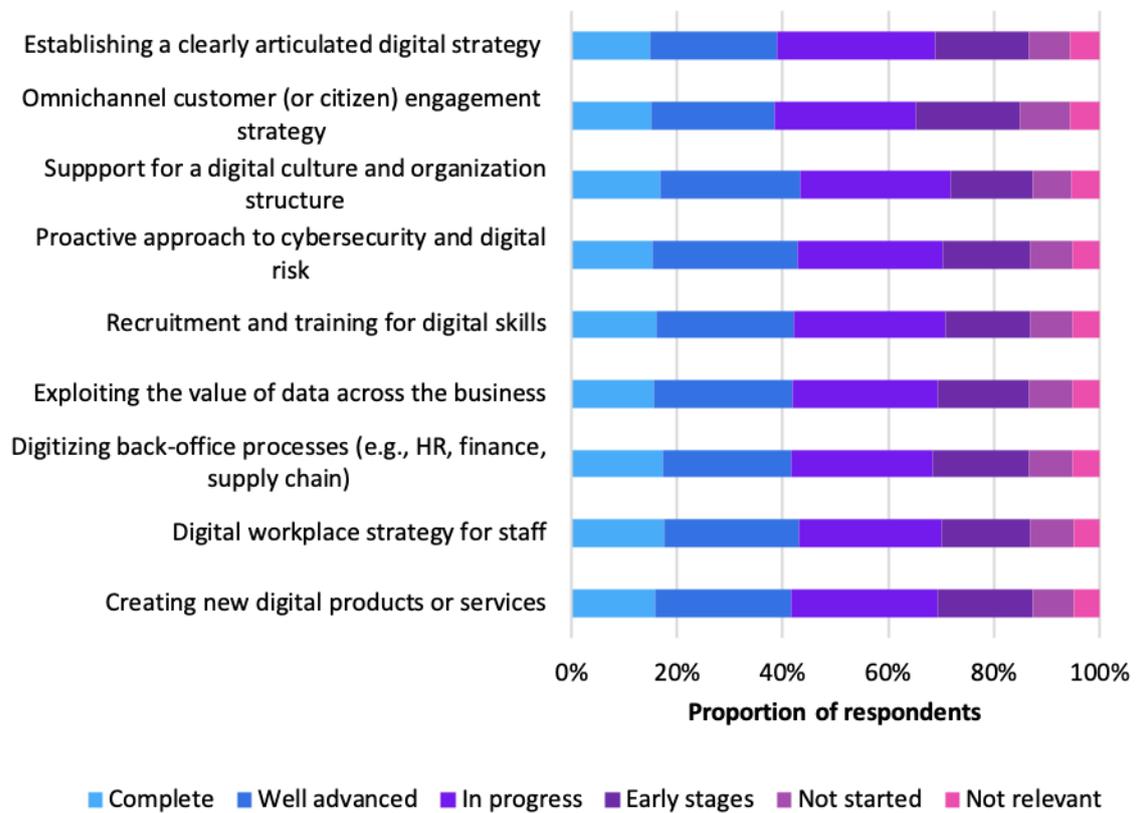
Sample: 4,961
Question: How would you rate your organization's progress for each of the above in support of digital transformation agenda?
Vertical: all; Subvertical: all; Country: all; Enterprise size: all

Source: Omdia ICT Enterprise Insights Survey

© 2020 Omdia

Source: Omdia

Faced with the challenges of COVID-19, enterprises need to be more agile than ever. They must be able to rapidly develop and support new applications, and adapt existing ones rapidly to suit new working patterns. They also need to engage more deeply with customers, and to find new ways to do this, providing additional information and keeping them informed on how they are conducting

business at this difficult time. Reliable high-speed connectivity is a key underpinning for these activities.

Looking further ahead, industries are moving toward more fundamental digital transformation. Manufacturers will use IoT and AI to automate their operations and "servitize" their offerings. Utilities will deploy autonomously managed, cloud-connected grids, which can incorporate numerous and diverse energy sources – and these will be digitally connected, monitored, and metered. These and other new business models will rely heavily on broadband connectivity to support transformation.

Vertical industries need broadband for IoT and industry transformation

IoT is the main platform for industry transformation. Ongoing growth of the number of connected devices is an important driver of broadband demand – and the data generated from these devices will be used both directly and indirectly to improve and transform industries. The IoT market will grow to 5.88 billion managed connections, 25.44 billion devices, and $597 billion in total service revenue by the end of 2024 – and much of this will rely on broadband connectivity.

IoT solutions are supporting automation and productivity enhancements across a wide range of industrial and public sector use cases. IoT applications come in many varieties; examples include:

- Asset tracking (e.g., logistics providers track exact location and condition of goods in transit)

- Asset monitoring (e.g., oil drillers remotely monitor oil well pressure to prevent costly failures and maximize production)

- Digital twin (e.g., utilities use digital replicas of physical devices or environments to test new designs and speed time to market, or to model impact of weather conditions or long-term wear on infrastructure).

IoT deployment varies across industries, as shown in Figure 18. The wide variety of applications and use cases have very different bandwidth, latency, and availability requirements.

Figure 18: IoT for industry verticals: speed and latency requirements

	Smart transport	Remote healthcare	Smart manufacturing
Applications	• Real-time sensing • Autonomous and semi-autonomous driving	• Real-time monitoring of physical conditions • Real-time diagnosis • Remote surgery	• Machine vision • Remote movement control • Mobile robotics
Bandwidth requirement	10 Mbps	100 Mbps	10 Mbps
Latency requirement	<3 ms	<1 ms	<0.5 ms–5 ms
Reliability requirement	>99.999%	>99.999%	>99.9999%

Source: Omdia

This means flexible IoT connectivity solutions are needed. While there is much talk about cellular/5G as an enabler for IoT, the reality – especially in sectors such as manufacturing – is that fixed broadband connectivity is one of the most important IoT connectivity technologies, thanks to its ability to ensure reliability, low jitter, and low latency. The very high speed and capacity and the low latency requirements for advanced IoT applications in sectors such as manufacturing (e.g., machine vision and digital twins) will use wireline fixed broadband connections in many cases.
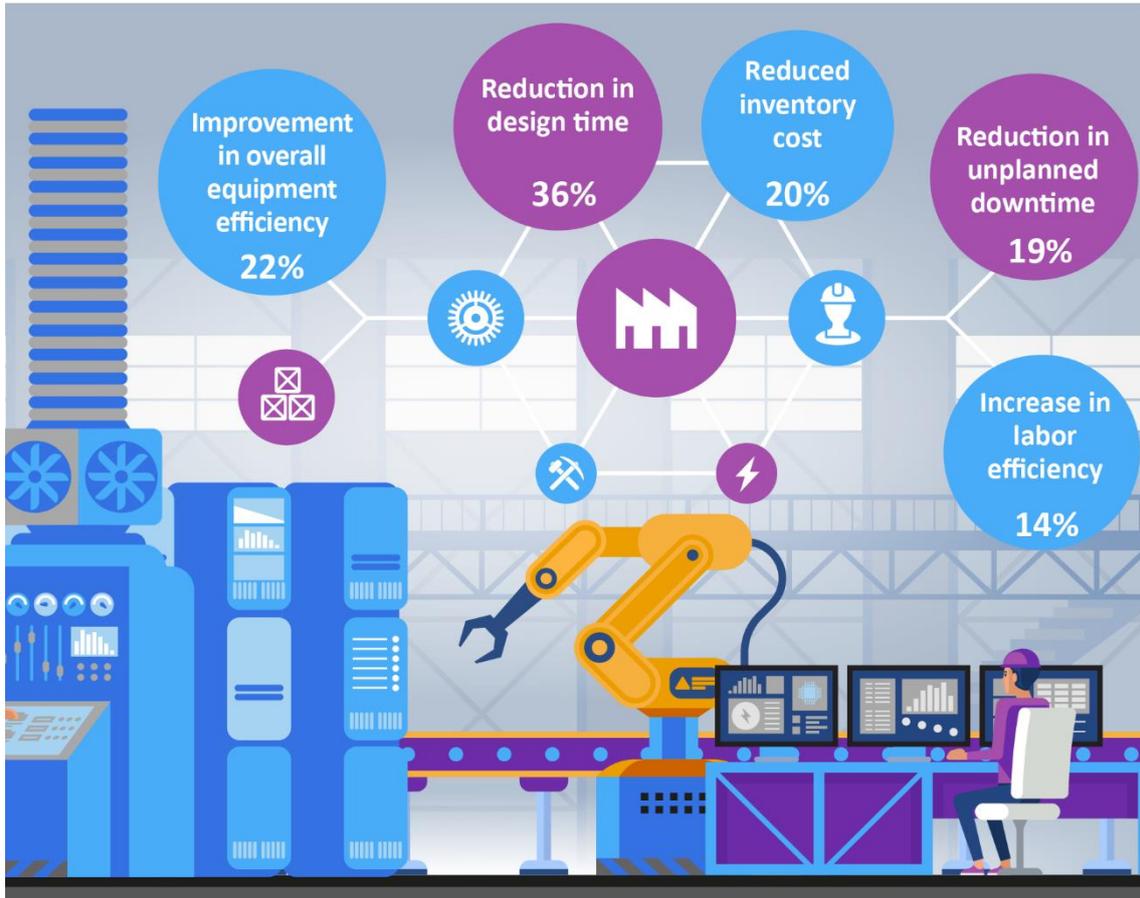
IoT is already delivering measurable business benefits for many organizations. According to a recent Cognizant report,[13] enterprises that adopt IoT have lowered supply chain costs by more than 20%, raised productivity by 10–20% and reduced design-to-market times by 20–50%.

But, more importantly, broadband-enabled IoT is also a key enabler for industry transformation and new business models. In segments such as manufacturing and industrial IoT, and utilities/smart grid, only a relatively small number of devices are connected already, so industries are just at the start of a long path toward fuller digitalization. But the prospects for both short-term benefit and longer-term industry transformation in domains are compelling. For example, in industrial IoT:

- In the short term, deploying connected devices and solutions on the manufacturing floor and in warehouses for asset tracking and machine performance monitoring drives significant efficiency improvements and cost savings (see Figure 19).

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[13] https://www.cognizant.com/whitepapers/the-five-essential-iot-requirements-and-how-to-achieve-them-codex4241.pdf

Figure 19: IoT cost savings and efficiency gains in a smart connected factory environment

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Cost savings/efficiency improvements are estimated based on data from Omdia's Industrial IoT Case Study Database.
Source: Omdia

- In the medium term, advanced applications, including digital twins, automated guided vehicles, and AR/VR headsets, will help move factories toward intelligent semi-autonomous operations, creating cost savings, efficiency gains, and new capabilities such as high-precision manufacturing and real-time control of remotely based machines and environments.

- Longer term, we will see the industry shifting toward fully autonomous factory operations – a "touchless" factory. Such a factory can be software-controlled and therefore extremely agile in both use of resources and ability to be easily and quickly reconfigured. This enables new business models; for example, the ability to deliver highly personalized or customized "job lots of one" for end customers.

None of the medium-term or longer-term transformation applications for IoT would be feasible without access to high-speed, low latency, extremely reliable connectivity – in other words, broadband.

Beyond the manufacturing and industrial sector, IoT devices and applications will enable transformation of business models and service delivery across a variety of other verticals.

Table 2: Impact of broadband-enabled IoT on industry transformation

Application	IoT impact/relevance
Connected and autonomous vehicles	Enables new business models around shared mobility services.
Smart metering and smart grid	Enables energy creation and distribution efficiencies. Supports development of dynamic pricing, microgrids for renewables and other new ways of generating and distributing energy.
Smart and precision agriculture	Enables agricultural producers and their suppliers to improve productivity. Enables shift to as-a-service/outcome-based business models focused on yields.
Connected healthcare	Shifts doctor-patient and clinic-patient relationships to more data-supported, personalized experiences, which can be delivered remotely and supported by remote monitoring or diagnostics.
Connected retail	Enables use of AR/VR and eventually digital sensing in retail outlets or at home, to show consumers how goods look, fit, smell, or even taste, without the need for consumer and item to be physically in the same location.

Source: Omdia

COVID-19 has accelerated the need for broadband to deliver on enterprise expectations

Digital transformation in many organizations has been accelerated by COVID-19. Restrictions on office-based working mean enterprises are having to adapt applications optimized for office-based teams extremely rapidly to support dispersed remote workers. Even those businesses that directly serve customers in physical spaces must adapt to social distancing, greater use of contactless payments and security authentication, and changes to stock management. Disruption to supply chains and logistics has been a further issue.

- Estimates from Eurofound indicate close to 40% of EU workers began to work from home/remotely full time as a result of the pandemic, versus an estimated 15% of employees working remotely (including those doing so part time rather than full time) prior to the pandemic.[14]

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[14] https://ec.europa.eu/jrc/sites/jrcsh/files/jrc120945_policy_brief_-_covid_and_telework_final.pdf

- A recent Accenture study found that 94% of Fortune 1000 companies were seeing supply chain disruptions due to COVID-19.[15]

COVID-19 is pushing enterprises toward a stronger appreciation of broadband's powerful role in supporting a necessary switch to digital operations. In tandem with this, enterprises and workers are becoming more and more intolerant of any broadband performance glitches. Demand for a persistent, secure, and high-quality digital environment is solidifying the need for fixed broadband across enterprises of all shapes and sizes.

Omdia's mid-2020 survey of European enterprises makes the importance of high-speed broadband for enterprises clear, and also highlights expectations:
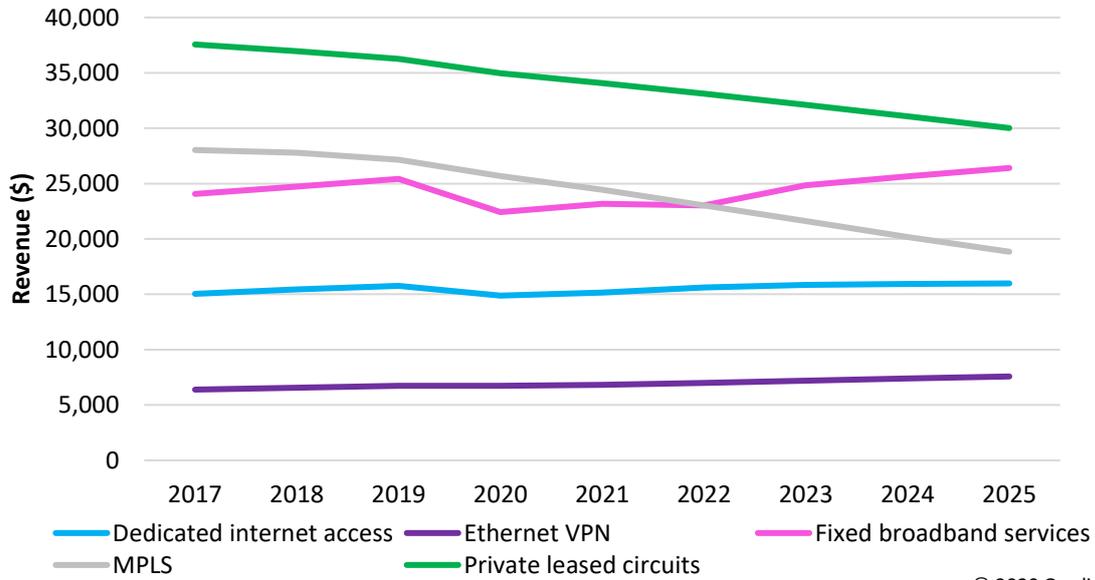
- 6 out of 10 enterprises said they expected to churn from xDSL over the next two years, and the majority plan to move to a fiber-optic connection.

- The top three reasons stated for change: poor network performance (52% of respondents), poor reliability (45%), and, not least, poor security (40%).

The importance of broadband is reflected in enterprises' reported spending intentions. While the pandemic has dampened investment plans among many, enterprise spending on fixed broadband is expected to recover well over time, as Figure 20 shows.

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[15] https://www.accenture.com/us-en/insights/consulting/coronavirus-supply-chain-disruption

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## Figure 20: Core network services – enterprise revenue by service type, 2017–25

Source: Omdia

Even SMEs – arguably the most exposed to liquidity challenges and threats to survival – are now realizing more acutely that their fixed broadband use must evolve. Dependency varies by industry, but the pattern is clear, as seen in Omdia's recent global SME and SoHo survey (see Figure 21).

Figure 21: SMEs' planned expenditure levels for fixed communications services, by industry

SMEs: How will your expenditure on fixed communications change this year compared to last year?
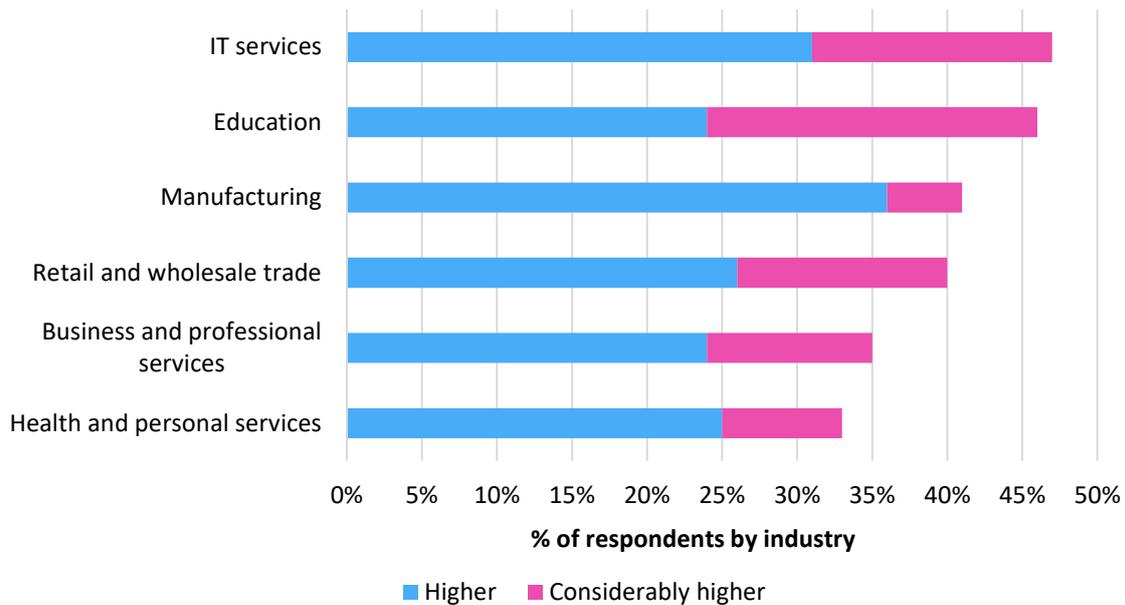
Note: n=877

Source: Omdia 2020 SoHo and SME Insights Survey, August 2020

Application and cloud service providers are also key stakeholders in the enterprise broadband ecosystem. Videoconferencing has played a huge role in driving up demand for reliable fixed broadband, especially during the COVID-19 pandemic, but it is not the only broadband-based application businesses really value. Businesses large and small want to transform, and need real-time access to business analytics and business intelligence to support rapid and effective decisions about their customers, operations or security risks, and customer service and satisfaction. Fixed broadband is an important conduit to the cloud and to on-premises databases. Broadband will be key to linking different elements in a hybrid cloud enterprise architecture for enterprises, in order to ensure latencies are reasonable and to support rapid data access, storage, and analytics.

Outlook and approaches

Broadband is a key enabler for vertical industry growth and evolution. It will be one of the most important bearers for applications from video to IoT, and a key element in delivering AI-enabled, high-bandwidth/low-latency applications that can transform industries and business models. But enterprises have widely varying requirements and widely varying IT environments. Most enterprise IoT (and IT) environments are heterogeneous in terms of connectivity. While the role of fixed broadband is key, enterprises need flexible and interoperable connectivity solutions and platforms that can serve as a strong base for developing new and disruptive business models for the future.

Enterprises and their broadband industry partners need to work together on the necessary changes to broadband architectures and deployments, so that enterprise broadband services can provide a robust platform for future evolution. However, at present, there is no open forum for such collaboration at industry scale. Instead, it tends to occur on a one-to-one basis, through trial partnerships and single pilot projects. While these are beneficial, they may not lead to scalable solutions and do not allow for broad best practice and knowledge sharing.

Looking ahead, enterprises in different sectors would benefit significantly from working together more closely with the broadband industry to support vertical industry transformation:

- Omdia recommends partnering both horizontally across the communications and ICT value chain, and vertically up and down the industry value chain within each sector, to jointly develop enterprise solutions that make the most of broadband capabilities.

- At the same time, broadband industry stakeholders should all aim to understand and jointly develop new, disruptive vertical industry business models – these will both drive demand for, and be enabled by, broadband services.

- Doing the above within an open and collaborative broadband industry forum or organization could enable stronger knowledge sharing and broader, more impactful technology and business model partnerships.

Delivering excellent end-to-end customer experiences

5 DELIVERING EXCELLENT END-TO-END USER EXPERIENCE

- Consumer and enterprise use of broadband is growing dramatically, with more demanding use cases and applications, and this is further accelerated by COVID.

- End-user expectations for broadband are similar to those of a utility – "always-on" and fully reliable. Quality of experience (QoE) is becoming a key requirement.

- Developing integrated broadband standards and effective cybersecurity approaches are also needed to ensure excellent broadband quality of experience.

Broadband has become an essential service for consumers

Consumer broadband demand, take-up and usage are constrained by availability and affordability, but once consumers get a taste of what broadband offers, their usage of broadband-enabled services grows dramatically – as do their expectations. As consumer demand evolves, expectations around access to high-bandwidth applications such as streaming video and TV, remote working applications, and services such as cloud gaming will place increasing strain on broadband networks.

The advent of COVID-19 has accelerated and accentuated consumer reliance on broadband. Mass quarantining of people in their homes drove a rapid increase in the adoption of videoconferencing to stay in touch with friends and family, and a steep rise in online media (especially on-demand and streaming video), online shopping, e-education, and working from home. Many consumers who accelerated adoption of these broadband-based services during the pandemic are likely to continue using them more intensively, even after the pandemic has been brought under control.

## Broadband quality is a key element of customer experience

New services and revenue opportunities for consumers cannot be fully realized without improving quality of broadband delivery – both to the home and within the home.

Speed has been the marketing focus for broadband service providers for many years. End-to-end quality of experience (QoE) is now also becoming part of the requirement. Consumer expectations around broadband quality of service (QoS) parallel those of a utility – household broadband access is expected to work seamlessly and consistently, regardless of changes in demand, usage patterns, or applications.

Since the advent of COVID-19, consumers' understanding of QoE has grown. Though consumers may not be familiar with the terms "jitter," "latency," and "throughput," they certainly experience the impact, and understand that networks or service providers cause applications to perform poorly.

Figure 22: Broadband reliability, coverage, and customer service matter as much as high speed

**What consumers value from their service providers**
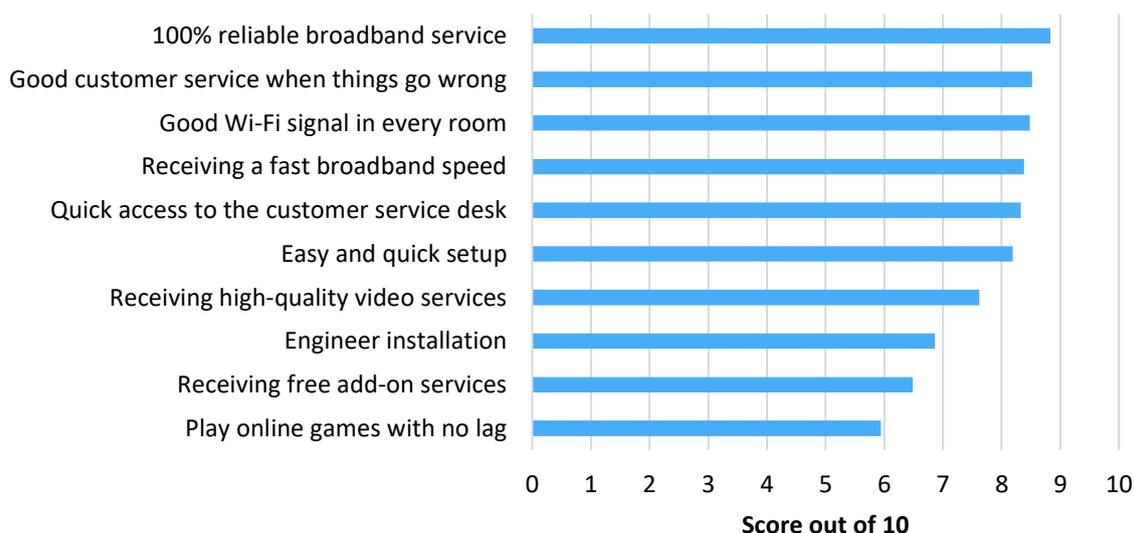
Note: n=3,000; 10=very important

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Source: Omdia

Delivering on the Promise of Broadband: Six Challenges for Industry Stakeholders   44

To differentiate service offerings, service providers are shifting focus to delivering improved overall broadband customer experience. This includes standard QoS indicators such as installation times and customer support efficiency, and KPIs around digital application performance.

Figure 23: Consumer broadband requirements and service provider responses
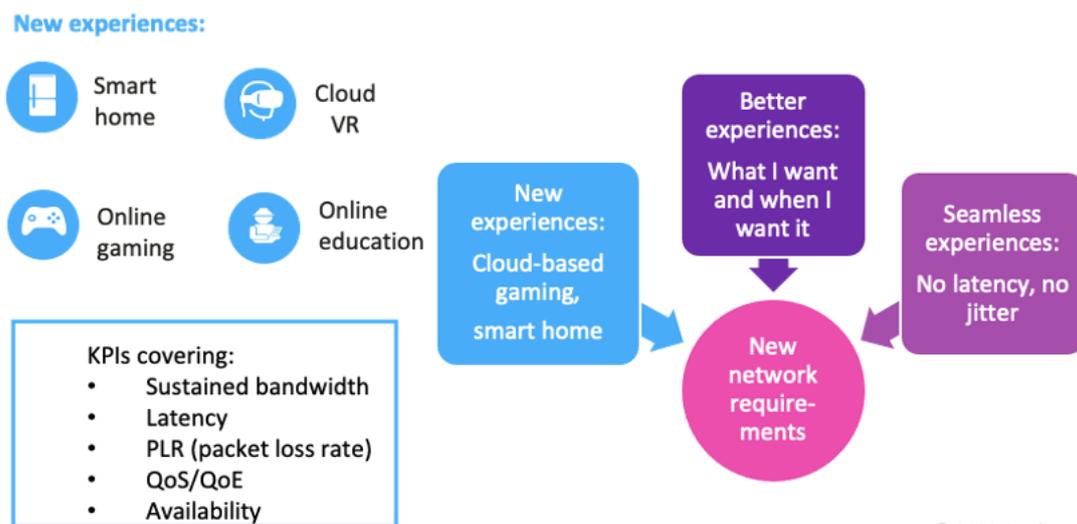

Source: Omdia

Meeting consumer expectations for broadband has presented a significant broadband QoE challenge during the COVID-19 pandemic, which has seen massive increases in traffic, and shifts in the normal network peak times and in download versus upload traffic. Omdia estimates online gaming traffic has increased by 75%, and video traffic (already the biggest driver of broadband traffic) by 32%. The shift to remote working is driving growth in videoconferencing and higher take-up of associated applications such as virtualized desktops. Healthcare is being delivered online increasingly, often supported via video diagnosis. All this places significant demands on home broadband connections, and impacts QoE.

COVID-19 is also highlighting the digital divide in broadband QoE. In some emerging markets, broadband speeds declined noticeably during the initial weeks of the pandemic, as lockdowns placed unprecedented demand on networks (see Figure 24) and connections that were in many cases already low speed or low quality were shared by multiple users and applications simultaneously.

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Figure 24: Fixed broadband speeds in some emerging markets declined significantly during the COVID-19 pandemic

Internet speed in selected countries – COVID-19 lockdown impact
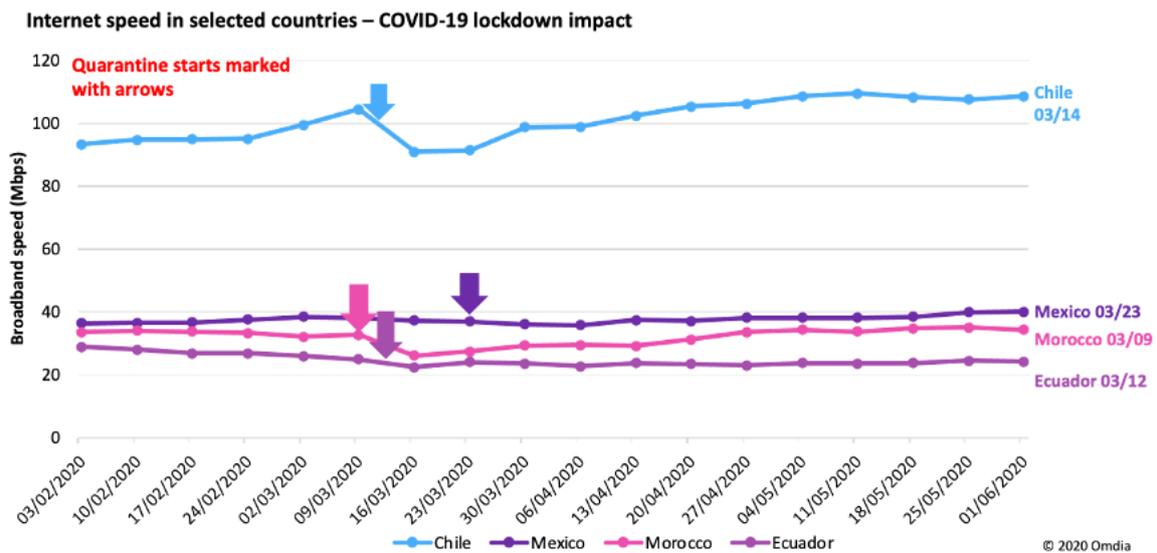
Source: Katz, R., Jung, J. and Callorda, F. (2020). Can digitization mitigate COVID-19 damages? Evidence from developing countries. SSRN. From Ooolka/Speedtest.

In some ways, COVID-19 has simply accelerated broadband usage trends that were already underway. Video services have been the most significant driver for consumer broadband take-up, and for usage of high-bandwidth connectivity. According to Omdia data, on a global basis, IPTV services counted for 24% of all pay-TV services by the end of 2019, and 31% of homes have at least one OTT video subscription. This trend is now accelerating as people shift more of their entertainment time and budget to in-home activities such as video and gaming. Applications such as online gaming demand very high-quality connectivity as well. The COVID-19 pandemic has enhanced an already-growing desire for online multiplayer games – not just competitive titles but also those that offer social spaces and activities for more casual players.

Technology advances on the device side also play a role in ratcheting up consumer broadband-based video requirements. The rapid increase in 4K TVs and other 4K-enabled devices in the home has driven demand for multiple high-quality video streams. As shown in Figure 25, each 4K video stream requires 20Mbps to 100Mbps, depending on the video quality.

Figure 25: Demand for greater video quality will drive the need for greater speed

Bandwidth, delay, and PLR requirements of 4K TV services

	Basic 4K	Real 4K	Ultra-4K
Resolution	3840x2160	3840x2160	3840x2160
Frame rate	30P	50/60P	100/120P
Sample bits	8	10	12
Bandwidth	20–30Mbps	30–50Mbps	50–100Mbps
Delay	6–11ms	6–11ms	6–11ms
PLR	1×10^{-4}	5×10^{-5}	5×10^{-5}

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Source: Omdia

Smart home and consumer IoT growth will also depend on access to high-quality broadband in the home. Some smart home devices (e.g., AI assistants) are already reaching a household penetration of 10% or more in advanced markets. Connected home IoT devices such as doorbells, appliances, and lighting may not require high bandwidth, but connections must be highly reliable and "always on." Connected home alarm systems and CCTV cameras are increasingly likely to be connected via home broadband systems to the cloud, to enable video storage. And AI-enabled digital assistants or smart home hubs will also be bandwidth hungry. While much of the needed processing and control will take place at the edge, reliable broadband connections will be required to support these devices and to connect them to the cloud to enable permissioning, storage, and security updates.

Telcos and their healthcare, app, and device partners will also be developing specific use cases for home healthcare. The COVID-19 crisis has driven up interest in such services, as consumers may be unable to access healthcare clinics in person, may need to self-isolate, or may need to support other isolated family members. Services range from simple remote monitoring for elderly family members living alone (see offerings from Telefonica, Telstra, and Orange), to more sophisticated offerings such as telehealth and remote diagnosis. According to a recent Harvard Business Review study, at the height of the COVID-19 pandemic, 50–80% of medical visits in the US were conducted via telemedicine, up from just 1% prior to the pandemic.[16] The necessity for such services to be highly reliable as well as highly secure puts additional pressure on broadband providers to deliver ever-greater levels of quality. It also once again highlights the digital divide – vulnerable or elderly populations (even in wealthy countries) are likelier to lack access to broadband as well as struggle to use telehealth platforms for consultations.

Lack of a coordinated broadband standards framework is adding complexity and limiting QoE

One hindrance to delivering optimal and well-controlled QoE is the lack of a coordinated framework of standards for broadband access and network equipment and services. To enable excellent broadband QoE, service and technology providers need to ensure the integration of multiple access technologies, including satellite, cable, optical fiber, and fixed wireless access. This stands in contrast to the mobile telecom sector where standards (centered on the SIM) are far more uniform and

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[16] https://hbr.org/2020/11/the-pitfalls-of-telehealth-and-how-to-avoid-them

comprehensive. A broadband standards framework would have to encompass physical components of networking and communications, such as consumer devices and the access, metro, and long-haul network; and selected aspects of applications and services, such as security and parental controls.

This lack of coordinated broadband standards contributes to a poor user experience for many broadband customers, and makes it more complex and more expensive for operators to configure and control networks and devices. For example, there is often no "one-stop" location or single method for setting parental controls on broadband devices, and no standardized "home middleware" solution that simplifies this process and ensures interoperability of security and access controls across multiple devices and applications (e.g., mobile phones, laptops, notebooks, and set-top boxes). This creates customer complexity as well as increasing cost for the service provider.

Another example is virus protection. Consumers assume that service provider-supplied devices come with virus protection. Even if this is the case, virus software needs to be updated to cover new threats, which often doesn't happen. In addition, end-to-end virus protection is needed to ensure that there are no gaps between devices, between devices and networking, between devices and applications, and between applications. A coordinated, holistic set of end-to-end broadband standards could help to address these issues.

Cybersecurity is also critical for delivering excellent end-to-end broadband experiences

For consumer and enterprise end users, cybersecurity and expectations of data privacy and protection increasingly form part of the quality of their broadband experience. COVID-19 is further emphasizing the importance of broadband cybersecurity: driving an increase in spam/phishing, exposing home and corporate networks to attack with the rise in remote working, and creating new demands for cloud security.

On the enterprise front, as more and more devices in the enterprise (and now remotely) join enterprise networks and cloud services, potential attack layers are added, and cybersecurity complexity grows. COVID-19 has also accelerated digital transformation activities, particularly moving data and workloads to the cloud. Even where businesses are aware of new security capabilities such as zero-trust architectures and intelligence services, they are often unsure how to apply them.

Figure 26: Enterprises must identify their most critical data and processes to apply appropriate protection
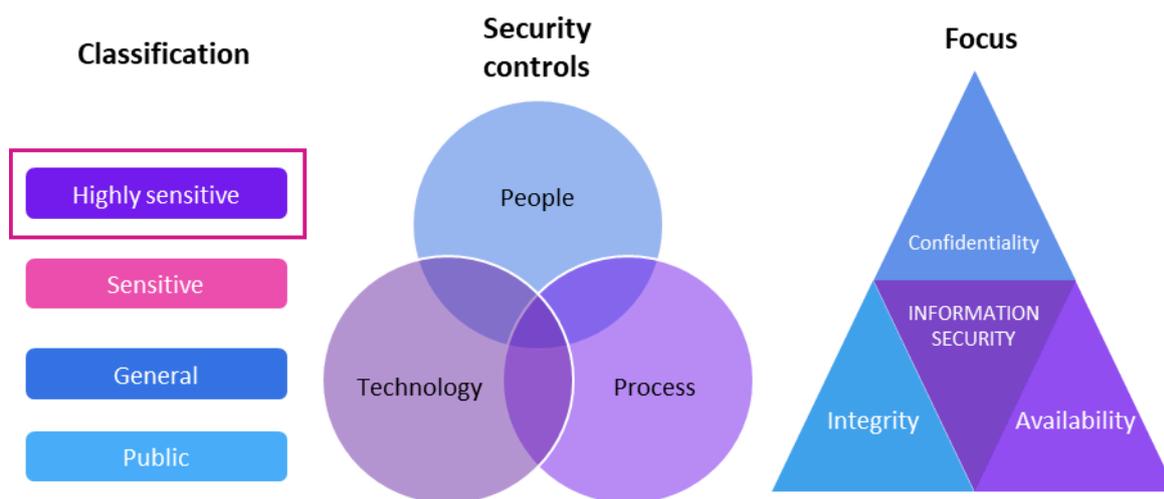
© 2020 Omdia

Source: Omdia

With the increase in broadband use for communications, media, and consumer IoT devices, cybersecurity is also becoming much more prominent for residential customers. Most consumers do not have the technical know-how to protect home networks and connected devices, which leads to a heightened level of concern about family security and privacy issues. This, in turn, creates new barriers that limit use of broadband services, and adoption of smart home technologies and services. IoT and media devices currently account for one-third of home network connections, representing thousands of device types and hundreds of brands. Many are poorly protected and easily hacked, allowing cyber-intruders to access personal data or to redirect functionality of the device in harmful ways, such as recording video/audio without the user's knowledge, or unlocking doors.

Regulators and governments are also beginning to act, but their efforts thus far are focused mainly on device manufacturers. For example, the US Federal Trade Commission (FTC) has stated that it will hold manufacturers and sellers of connected devices to account for failures that expose user data to the risk of compromise, while the British government has published its *Code of Practice for Consumer IoT Security* for manufacturers. But to help protect as well as reassure consumers, all players in the ecosystem, including communications service providers (CSPs) and OTTs, need to commit to making broadband-connected smart homes easier to manage and more secure.

Outlook and approaches

To help meet growing consumer and enterprise expectations around broadband, the industry needs to find ways to deliver consistent QoE for consumers, rather than looking to constrain usage. Robust underlying infrastructure – in particular fiber – is the key, as discussed in the next section. But

beyond infrastructure, broadband stakeholders need to coordinate on platform and application interoperability, security standards and best practice, and better customer support:

- It is in the interest of all players – including regulators and OTTs, as well as service providers and vendors – to ensure that consumer and enterprise expectations can be met, and that customer experience in utilizing broadband applications is seamless, secure, and inspiring.

- There will be strong interest in integrating household broadband and content/application usage with that on other consumer platforms such as mobile devices and in connected cars, which will require a more coordinated approach to broadband management across multiple technologies (satellite, fixed wireless, etc., as well as fixed broadband access).

- New partnerships across industry stakeholder groups – for example, between healthcare providers or cloud gaming providers and service providers that own broadband infrastructure and are able to guarantee QoE/QoS – will be increasingly important.

- The industry needs to focus more attention on services that support better broadband QoE, such as smart Wi-Fi and premium technical support services. These can provide a better smart home and connected broadband experience, enhance cybersecurity, and provide better control and more engaging usage of household connected devices.

- Device manufacturers, retailers, application developers, and broadband service providers must collaborate to simplify cybersecurity in a digital world. Failure to act will result in customer harm, and may lead to brand damage, loss of customer trust, regulatory fines, and connectivity outages. Both technical solutions (e.g., advanced Wi-Fi platforms) and improved information sharing with consumers, enterprises, regulators, and OTT partners are needed.

Building a future-proof broadband network

Gigabit offerings – investing for tomorrow's network

Building a future-proof broadband network is necessary to provide a strong platform for development of new services and business models. Broadband infrastructure does not only need to support today's requirements; it must also be ready to flex to enable future services. Copper network upgrades, FTTH deployment, software-defined networking/network virtualization, and edge-cloud integration are all needed: they will support evolving demand for new services, enable rapid upscaling and downscaling of bandwidth requirements, deliver new bandwidth-hungry applications such as AR/VR and AI, and support operator cost savings. These technologies will enable more flexible network architectures, more agile operations, and better use and control of next-generation broadband network resources (e.g., FTTH/FTTP deployments and 10G PON).

Why are these technologies so important for the broadband industry to deploy now? Simply because without them, digital services and transformation cannot be delivered in the medium-to-long term. As discussed in the previous sections of this report, there are significant opportunities and challenges created by the demands of new fast-growing consumer and enterprise digital services, and the growing prevalence of AI and automation. For example, as shown in Figure 27, the next 10 years will see the evolution of today's disruptive consumer business models. OTT video, video advertising, games subscriptions (incl. cloud gaming), podcast advertising, and esports will bring a net revenue gain of $380bn over the next 10 years. Immersive media such as augmented reality (AR) and virtual reality (VR) will also grow rapidly, ramping up from 2025 onwards in mature markets. But the technology challenge of creating and delivering this content is immense, and will require a great deal of investment in infrastructure, especially at the network edge/access network.

Figure 27: Broadband-enabled consumer services growth to 2030, by service type
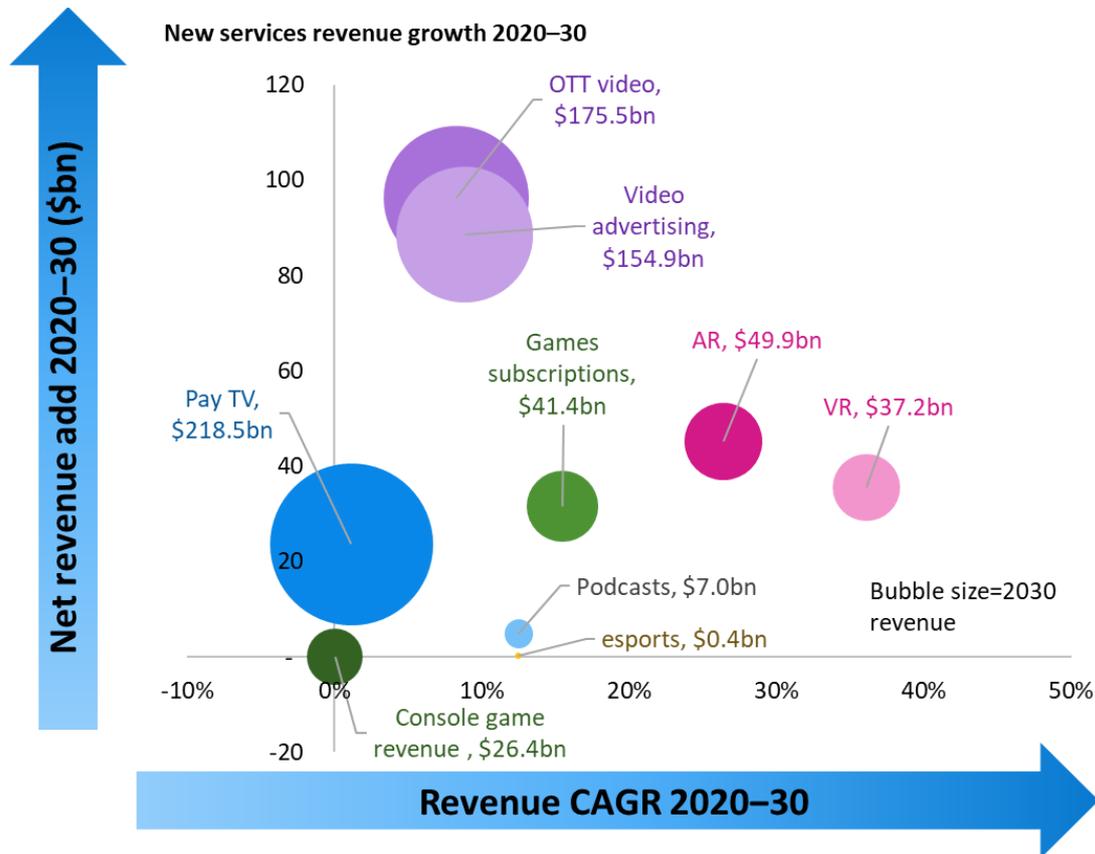
Source: Omdia's *Digital Consumer 2030: Services and Content* report

To address this, operators – particularly in Asia and North America – have been stepping up their gigabit offerings, with multiple South Korean and Japanese operators even selling 10Gbps residential broadband services via their next-generation 10G PON networks. COVID-19-related network demand is also accelerating the movement of operators to 10G networks.

Figure 28: The push toward a gigabit world
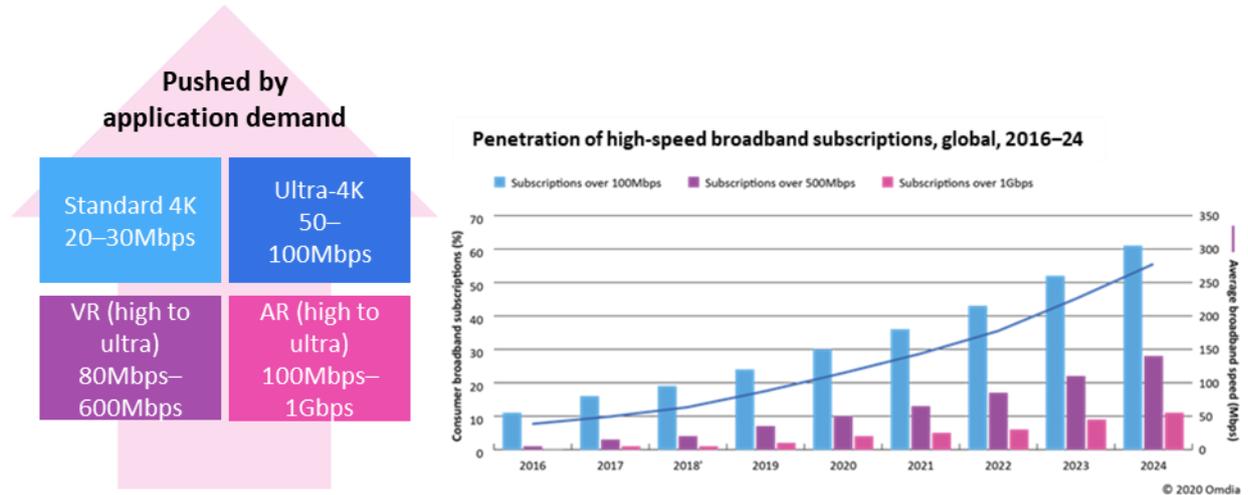
Source: Omdia

Looking ahead to 2024, China will take a giant gigabit leap, with 83 million gigabit subscriptions – 64% of a worldwide total of 130 million. The US, South Korea, and Japan will follow, using FTTP and next-generation DOCSIS deployments. Gigabit offerings are likely to become the norm in developed markets over the coming five years, and network operators must consider how to deploy these in a timely and cost-effective way.

## Figure 29: Top 10 countries with gigabit subscriptions (000s), 2024

© 2020 Omdia
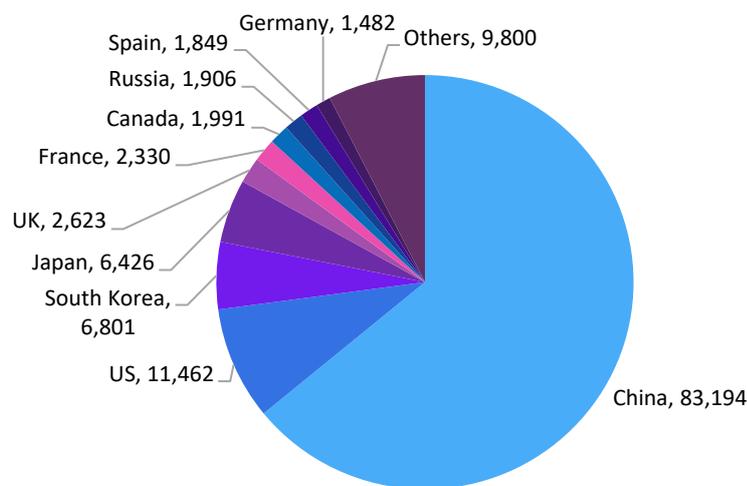
Source: Omdia

Access network technologies for delivering high-speed broadband

One of the challenges of managing broadband evolution is the diversity of technology options open to infrastructure providers. While fiber is the ultimate bearer for high-speed broadband, other technologies that layer onto and "stretch" the capacity of copper access networks are also playing an important role.

Figure 30: Options and requirements for delivering high-speed broadband access infrastructure
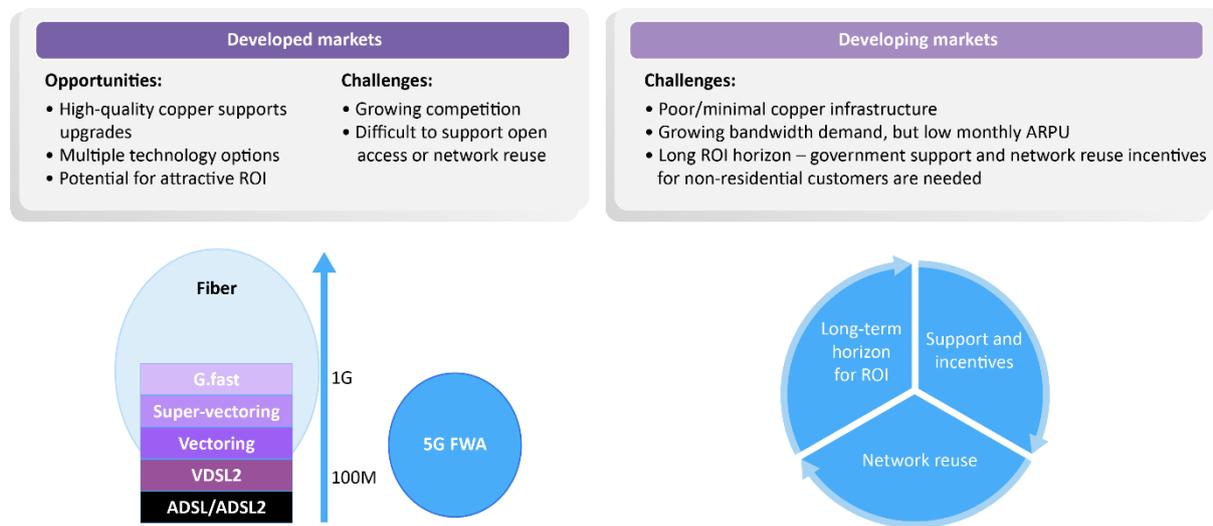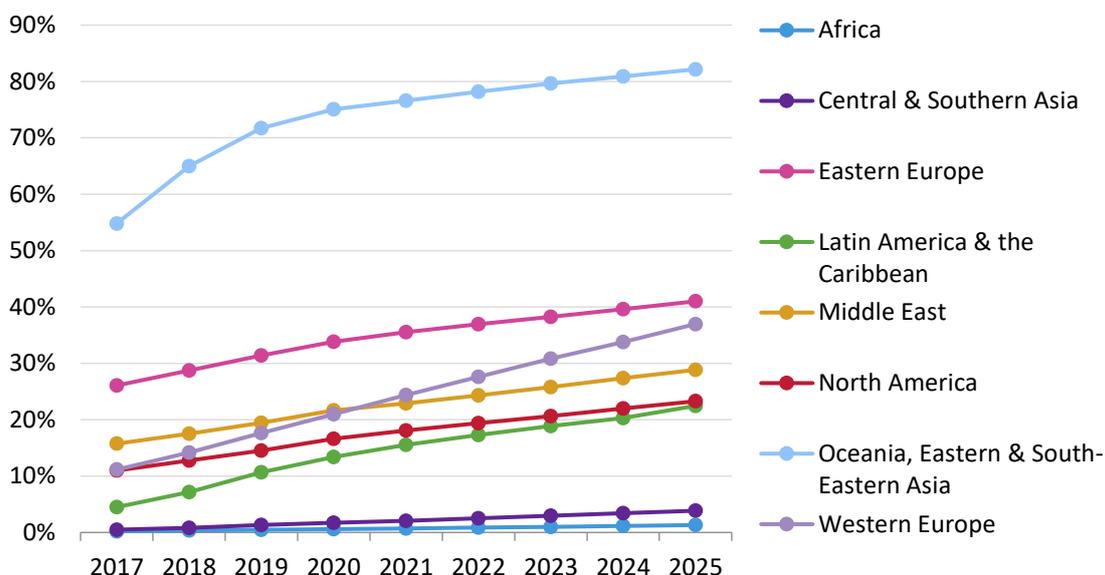

Source: Omdia

Copper upgrades are more suitable for selected developed markets, as shown in Figure 30 – depending on the local loop infrastructure being compatible (for example, super-vectoring requires short local loops). Next-generation technologies like super-vectoring and G.fast can deliver at the same speed as standard FTTH installations, under the right conditions, and can be significantly more cost-effective for operators to deploy as upgrades to existing infrastructure. These savings can then be passed on to consumers. Emerging markets, though, are unlikely to have significant copper infrastructure, and may have the potential to leapfrog directly to fiber rollout. This typically requires significant state support, however, and potentially investment from non-governmental organizations or public-private partnerships, and a plan for network reuse to recoup investment.

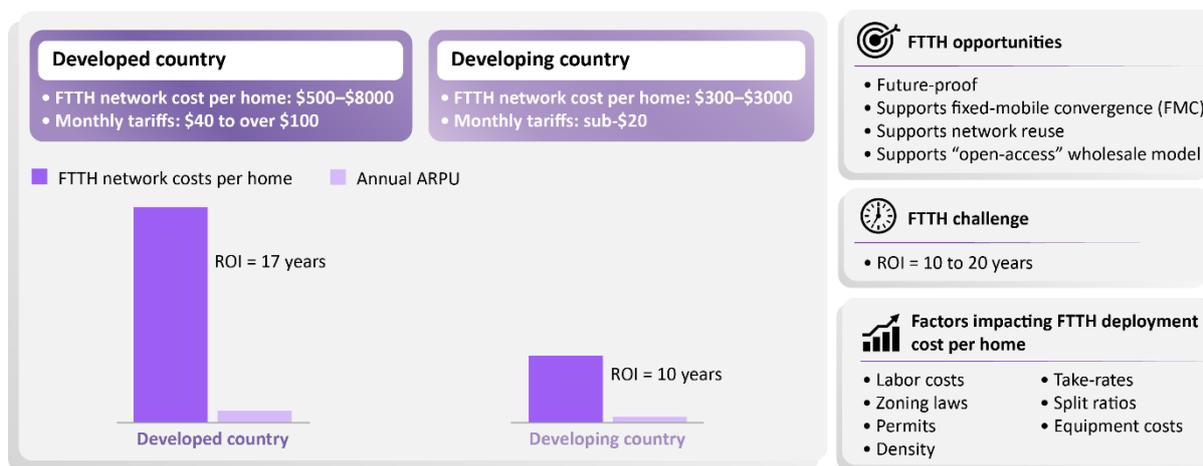**Figure 31: FTTx household penetration by region, 2017–25**

Source: Omdia

As shown above, FTTH deployment will be heavily skewed toward developed economies through 2025 and likely well beyond. This reflects the greater access to capital in these markets, and the higher customer ARPUs. It also reflects greater transparency of network and facilities sharing agreements in developed markets versus emerging ones (at least in most countries). However, the drivers for take-up and the significant customer interest in higher broadband speeds are very similar globally. Mid-market economies such as China and Turkey have undertaken significant FTTH rollout programs, and there are examples of FTTH deployment, even in the most emerging markets:

- Vietnam's integrated operator Viettel first awarded a GPON FTTH contract in 2014 in Danang. Since then, it has rolled out FTTH services to more than 1.2 million users (as of 2019), and is delivering its own IPTV and CATV services to subscribers over the network

- Vodafone Ghana is deploying an FTTH network covering multiple areas in the Greater Accra Region, which offers maximum download speeds of 50Mbps to consumers and businesses. As part of the initiative, which started in 2019, Vodafone is offering to upgrade the cables and routers of existing ADSL subscribers for free.

Figure 32 shows Omdia's analysis of costs and ROI for fiber deployment. While ROIs may appear more attractive in developing country markets, the reality is that finding investment for FTTH will be more difficult in emerging economies. Conversely, developed markets may be better able to access investment, but still face longer ROIs despite the ability to charge more for high-speed broadband services. This is because the costs associated with deployment can be considerably higher – in particular labor costs, rights of way and permits, and equipment costs.

Figure 32: FTTH ROI in developed and emerging market scenarios

Developed country
- FTTH network cost per home: $500–$8000
- Monthly tariffs: $40 to over $100

Developing country
- FTTH network cost per home: $300–$3000
- Monthly tariffs: sub-$20

FTTH network costs per home   Annual ARPU

ROI = 17 years

Developed country

ROI = 10 years

Developing country

FTTH opportunities
- Future-proof
- Supports fixed-mobile convergence (FMC)
- Supports network reuse
- Supports "open-access" wholesale model

FTTH challenge
- ROI = 10 to 20 years

Factors impacting FTTH deployment cost per home
- Labor costs
- Zoning laws
- Permits
- Density
- Take-rates
- Split ratios
- Equipment costs

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Source: Omdia

Network automation and the ability to integrate edge-cloud will support future flexibility for broadband

IT and software are driving network transformation for operators. Software is now required in almost every division of CSPs. Operators are spending significantly on software for network optimization, cloud migration, spectral efficiency, OSS/BSS, data analytics, and finding new monetization opportunities through IoT, AI, automation, and OTT applications.

- AT&T expects software to play a major role in digital transformation of the business and is on target for having 75% of its core network virtualized by the end of 2020.

- Telekom Malaysia (TM) has been a front-runner among emerging/mid-market economy telcos, for software-defined networking (SDN) and virtualization (NFV). TM is actively deploying use cases for broadband access networks, alongside investments in developing cloud, and is launching specific enterprise vertical initiatives around AI and IoT through TM ONE.

Automation of network functions, via software control and virtualization, can enable service providers and other stakeholders to deliver more flexible broadband services that are ready for future evolution. The virtualization of network operations drives efficiency and agility in ICT deployments, both for operators and for enterprises. The key driver for rapid adoption of SDNs is making the network more agile and responsive, as cloud and cloud-native solutions become more widely used. A second driver is the potential for operational cost savings. A third goal for operators is the ability to flexibly enable new service launches and differentiation.

Networks becoming more software controlled drives a number of positive impacts for broadband. Software control results in increased flexibility and agility in provisioning and configuring network functions. This allows operators to provide better responsiveness to the ebbs and flows of demand, and enables them to react quickly and effectively to rapid changes (whether from a pandemic, a massive sporting event, or a national emergency).

Software control also enables competitive differentiation and shortens time to market for new services, which is critical for allowing operators to vary their broadband offerings and launch new ones, as well as providing differentiated QoS and other specs. The greater insight into network operations and customer experience that can be derived from software-controlled networks also helps operators provide more targeted customer care and a better overall customer experience for broadband users.

"Software-ization" also supports new business models for operators and greater financial flexibility. It allows operators to employ different models of asset ownership, rather than the classic "capex depreciation over x years." In addition, automation can significantly reduce the cost of managing networks. This can help free up operator resources for other uses, such as developing their own higher-value offerings.

Edge processing is also part of the required architecture for future high-speed broadband networks, particularly in data-heavy B2B use cases such as IoT and autonomous robotics. Using edge combined with cloud can help to keep processing and intelligence closer to the sources where data are generated, and fixed broadband can connect these two layers. Several of the major cloud service providers (e.g., Amazon's Wavelengths edge platform) are leading the drive to deliver this edge computing requirement. The distribution of computing power and services to the edge continues to put pressure on vendors to deliver cloud-native NFV that is distributed and agile, so operators can offer customers an enhanced digital experience. As such, edge computing, in line with more advanced 5G use cases, will be a growth driver for NFV investment.

Outlook and approaches

Building out the network of the future is a must-do rather than a nice-to-have for telecom operators and broadband providers. Demand in advanced economies is moving rapidly toward gigabit broadband connectivity. Cloud and edge solutions and integration are becoming prominent parts of broadband network architecture, so must be part of any network evolution plan.

- There are many complexities in deploying future-ready broadband networks: from varying requirements and different access to capital across countries, to integrating and supporting multiple heterogeneous technologies (copper, fiber, satellite, and fixed wireless access).

- Telecom operators need to deploy next-generation networks step-by-step, and balance investment with revenue and demand. Network virtualization, automation, and integration with cloud and edge are all important elements of forward-looking development strategies, but choosing the best deployment path is complex.

- Regulators and governments should consider specific actions and investment strategies to incentivize fiber and high-speed broadband deployment, with a view to maximizing the number of homes and businesses that can be reached by high-speed broadband.

- Operators are bearing much of the burden of next-generation infrastructure investment, even though other players such as OTT, cloud, and media players will benefit significantly from it. Network reuse and facilities sharing will be important ways to recoup investment and/or lower up-front costs.

- Operators should also look to save costs via network automation, and to capture new revenue by delivering premium or OTT services to broadband users.

4. A new platform for broadband industry collaboration

The broadband industry has many opportunities to drive economic growth, digital transformation, and social benefit. However, until now, it has been hampered by the fragmentation and conflicting goals of different market players. Broadband market stakeholders – operators, technology vendors, OTTs, governments and regulators, vertical industries, and consumers – each have their own requirements around broadband infrastructure and services. Bringing all of these parties to the table to discuss the future of broadband is yet to happen.

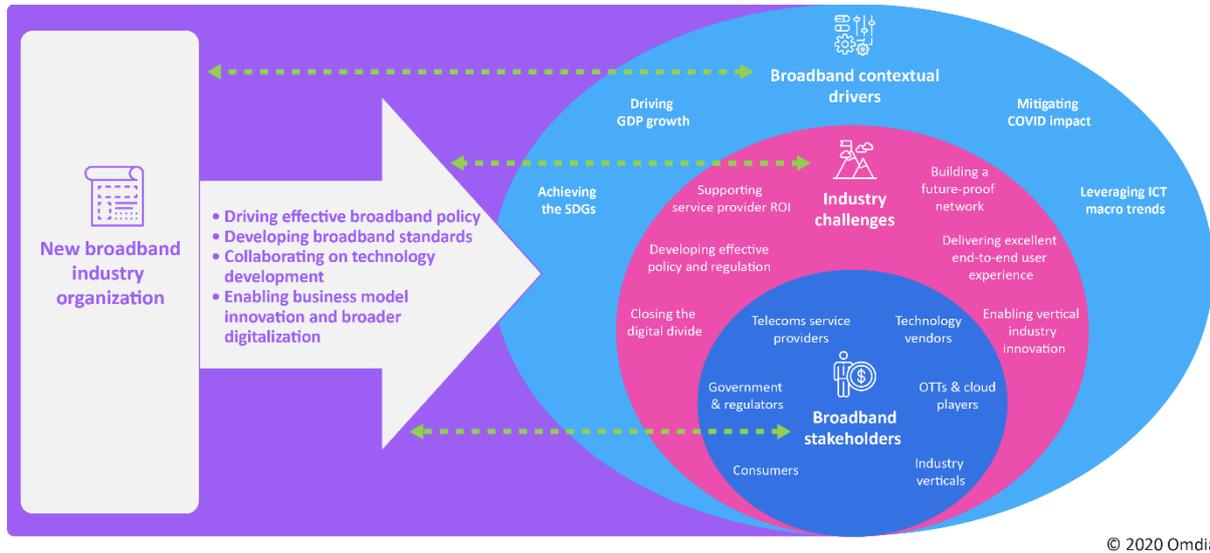**Figure 33: Broadband industry stakeholders, contextual drivers, and key challenges**
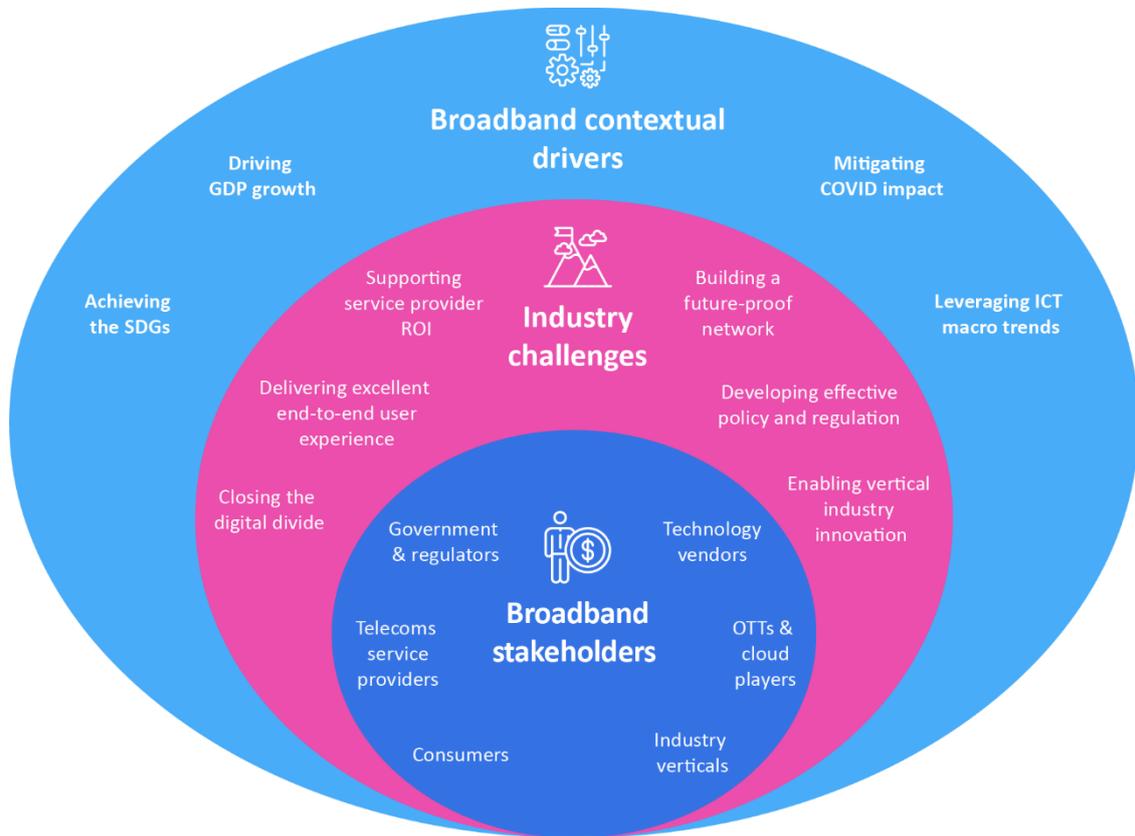
Source: Omdia

This means that the broader challenges that face the broadband industry as a whole – expanding coverage and availability and building a strong base to enable future innovation and technological development as Moore's Law comes to an end – are getting lost in the "noise" of multiple stakeholder agendas.

A new, neutral broadband organization that cuts across the different broadband stakeholder groups could be extremely effective as a platform for addressing the industry's complex challenges and accelerating growth. Such an organization would cross boundaries between different stakeholders, and could focus initially on four key areas (Figure 34) that would help to address the industry challenges outlined in this paper.

Figure 34: Remit for a new broadband industry collaboration and acceleration platform

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Source: Omdia

The organization's remit could provisionally focus on (subject to discussion among key industry stakeholders):

- Driving effective broadband regulation and policy

- Developing broadband standards

- Collaborating on technology development

- Enabling business model innovation and broader digitalization.

These objectives, if executed on effectively and collaboratively, would then support and accelerate the broader goals of using broadband to drive economic growth, deliver the SDGs, and mitigate the impacts of COVID-19 and other future shocks to global societies and economies.

We recommend establishing a set of key principles and objectives for such an organization, as follows:

- It should be based around **a neutral platform for open collaboration, cooperation, and discussion** around key broadband industry objectives, issues, and challenges

- It should enable **healthy development for all broadband industry players – the views of all stakeholders should be represented** – operators, technology vendors, OTTs, regulators, industry verticals, and consumers

- It should provide one or more **hubs to share both technical and commercial information** on broadband standards, best practices, and case studies

- It should **support partnerships and cooperative ventures**, making them easy to establish, develop, and expand

- It should **reference and support the development of standards, and should place interoperability at the heart of technical development for the sector**

- It should **facilitate cross-sector interactions and collaboration between the main broadband stakeholders and other relevant industry, enterprise vertical, and academic research groups**; e.g., media and advertising, mobile, applications developers, gaming, advanced AI, and analytics.

- It should aim to **deliver on concrete goals for the broadband industry and wider society**.

As shown in Table 3, there are already a number of existing industry organizations that address different aspects of broadband technology, standards, and policy. But these groups, whether global or regional, either cover a broad range of communications areas, or conversely, focus only on a narrow segment of the communications network, on specific policies or on particular geographies. This makes it difficult to develop an efficient and effective approach to drive forward cross-industry cooperation for fixed broadband access and related areas. Notably, these groups have little (if any) participation from OTTs, and unless they are industry-specific, little participation from vertical industry trade groups or other representatives.

Table 3: Major broadband industry organizations

Organization	Main focus area	Specific remit
ITU/ITU-T	Standards/policy	Standards for GPON and XGS-PON. ITU as part of the UN conducts general broadband industry tracking, advocacy, and policy, with specific focus on narrowing digital divide.
IEEE	Standards	Standards for EPON and 10G EPON.
Broadband Forum	Standards	Device interoperability, Software-defined access, and BNG.
CableLabs	Standards	Standards for DOCSIS 1.0, 2.0, 3.0, 3.1, 4.0, and DPoE.
ONF	Standards	Standards for software-defined access, including SEBA and VOLTHA.
Internet Engineering Task Force (IETF)	Standards	Layer 2 and Layer 3 standards.
ETSI	Standards	900+ member organizations including private companies, research entities, academia, and government. Responsible for standardization of ICT within the whole of Europe.
FTTH Council Europe/MENA + Fiber Broadband Assoc. Americas	Advocacy/policy	Accelerate ubiquitous fiber-based connectivity empowering a leading digital society throughout Europe, the Middle East, North Africa, and Latin America.
ITU-UNESCO Broadband Commission	Advocacy/policy	Boost importance of broadband on the international policy agenda, and expand broadband access in every country to drive economic development.
Industrial Internet Consortium	Industry organization	258 members from tech, industrial, government, and academic sectors. Identifies, assembles, tests, accelerates, and promotes best practices for IIoT and commercial use of advanced technologies.
Fiberoptic Industry Association	Industry association	UK organization for fiber-optic telecom industry stakeholders: manufacturers, distributors, consultants, integrators, etc.
Internet Service Providers Association UK	Industry association	UK trade association aimed at promoting collaboration and dialog between members and the wider internet community.
Internet Society	Advocacy/policy	Influential non-profit organization promoting internet growth, technical activities, community empowerment, and internet governance and policy. Multiple regional chapters.
Asia Internet Coalition	Advocacy/policy	Industry association to promote understanding and resolution of internet policy issues in the Asia Pacific region.

Source: Omdia

The GSM Association (GSMA) provides a potential model for the new broadband organization to follow. It successfully fulfills a broad role, bringing together stakeholders for the mobile industry.

While the GSMA was originally set up as a mobile operator industry association, its activities and membership now stretch well beyond that. It is involved in leading work on mobile standards; lobbying and advocacy for the industry; organizing and hosting the most important mobile industry trade show of the year; bringing mobile communications and applications to emerging markets;

publishing extensive and detailed industry research to disseminate to its members and the broader industry; and advocating for new mobile technologies (e.g., eSIM, NB-IoT, and mobile money). The organization now has 1,200 members, which it represents via working groups, industry programs, and industry advocacy initiatives. It has been notably successful in attracting a broad range of members that are not mobile operators but interact with the broader mobile ecosystem, and join as Associate members. These include major automotive OEMs, financial services providers, media companies, and utilities.

5. Conclusion

- The broadband industry is critical for economic growth and social development. However, the industry is currently fragmented. There is no unifying organization, there are many stakeholders, and these stakeholders have different objectives and many varied challenges.

- There is a need for a new broadband industry organization to bring all stakeholders together, in order to accelerate collaboration across many sectors to enable the full promise of broadband to be realized. The four main goals should be: driving effective broadband regulation and policy; developing broadband standards; collaborating on technology development; and enabling business model innovation and broader digitalization.

- Principal industry stakeholders from the supply side (vendors and service providers) should consider how best to engage with those broadband partners and stakeholders that have been left somewhat to one side by the existing set of industry organizations and groups.

- OTT, cloud, and media players need to be included in the discussion, given how critical broadband infrastructure is to their success, and how closely aligned they are with quickly evolving consumer needs and interests.

- Governments and standards organizations are also key stakeholders, as any broadband industry initiative will rely significantly on their support, as well as requiring their input to key decisions, to ensure collaborations are working in the interest of the widest possible number of people and countries.

- Vertical industries must also have a strong voice in taking forward a future vision for broadband industry evolution. Their progress depends heavily on availability of flexible, reasonably priced broadband services to enable new business models, secure access to data and compute power in the cloud, and integrate B2C and B2B services across multiple platforms and delivery modalities.

Bringing together this wide group of stakeholders on a regular basis, with shared goals and a neutral platform for discussion and collaboration, could lead to a smoother and faster development path for broadband to reach its full potential. This is important both to accelerate the healthy growth of the broadband industry itself, and as a catalyst for greater access to services, wider dissemination of information and opportunities, and more effective and impactful innovation by industry players to support broader social and economic goals.

Appendix

Methodology

This report has been produced via a mix of primary and secondary research. Primary research has been through our regular interactions with CSPs and technology vendors in the broadband space in person, via webinars, or interviews over the phone. Secondary research was made through web searches, gathering information from existing Omdia trackers and forecasts, previous custom projects on broadband, and through collaboration with various vertical-specific topic experts across the Omdia business.

Supplementary tables and charts for this paper are shown below.

Country	National broadband plan	Start year	Investment	Speed/technology objective	Coverage objective (year)
France	Plan Très Haut Débit 2022	2016	€13bn ($15bn) public fund.	30Mbps +	100% (2022)
Italy	National Ultra-Broadband Scheme 2022	2016	€1,106bn ($1,307bn) of state funds and private investments.	30Mbps 100Mbps	60% (2016) 100% (2020) 85% (2022)
Spain	Digital Agenda for Spain 2020	2013	State funding, loans, and subsidies. Loans and subsidies in the region of €200m.	FTTH HFC 30Mbps	50% (2015) 47% (2015) 100% (2020)
Germany	National Broadband Plan	2013 2018	Loans capped at €150m ($177m) from government development bank and €10m ($11.8m) from Landwirtschaftliche Rentenbank. Public financing of €10–12bn to achieve gigabit coverage.	50Mbps Gigabit	75% (2014) 100% (2018) 100% (2025)
South Korea	GigaTopia vision	2014	Government and private sector investments of over KRW550bn ($488m).	1Gbps fixed and 10Mbps mobile	100% (2020)
Japan	i-Japan strategy 2015	2009	Privately funded by the industry.	>100Mbps for mobile broadband and 1Gbps for fixed broadband. Investments have been financed by the industry	100% (2015)
Australia	National Broadband Network (NBN)	2014	Government investing A$37.4bn ($29.5m) in NBN. A public equity capital limit of A$29.5bn ($27.7bn) has been set.	25Mbps	4.4 million premises (2018) 8 million premises (2020)

Country	National broadband plan	Start year	Investment	Speed/technology objective	Coverage objective (year)
US	Connecting America: The National Broadband Plan	2010	In the first phase, about $115m of public funding was provided. Phase II will allocate a further $2bn.	25Mbps (revised from 4Mbps in 2015) 100Mbps	100% (2020) At least 100 million homes have affordable access (2020)
Brazil	National Connectivity Plan Structural Plan of Telecommunications Networks (PERT-2018)	2016 2018	The ministry has allocated $126m to finance network construction. A variety of funding sources.	Fiber connectivity Fiber connectivity	70% of municipalities (2019) 95% of the population (2019) 75% of unconnected municipalities (2022)
Mexico	National Infrastructure Program 2014–18 The Pact for Mexico	2014 2012	MXN70.7m ($3.7m) of public funding in conjunction with private funding. Public–private partnership (PPP) model	Broadband connectivity	65% uptake (2018) 50% of the population/56 million Mexicans with 4Mbps downlink per 1Mbps during peak hours (end 2019) 92.2% of the population with 4Mbps downlink per 1Mbps during peak hours (2024)
Oman	National Broadband Plan	2010	Funding of OMR92m ($239m) from the Asian Infrastructure Investment Bank for the development of the fiber network. OMR90m ($234m) agreement with the Asian Infrastructure Bank to invest in fiber-optic network expansion projects.	High-speed broadband The MOTC Broadband access Between 20Mbps and 100Mbps Fiber connections	50% (2020) 95% (2030) 60% (2017) 80% of urban areas (2020) 85% of residential properties (2020)

| Saudi Arabia | Saudi Arabia's Vision 2030

National Transformation Plan | 2016 | The government's Broadband Stimulation Fund was introduced in 2016 to accelerate the deployment of fiber optics in urban areas, with a five-year budget of SAR5.898bn ($1.5bn). | FTTH coverage in densely populated urban areas

FTTH coverage for urban areas

Wireless broadband coverage (10Mbps+) in remote areas

FTTH in the dense and urban areas | 80% (2020)

55% (2020)

70% (2020)

90% (2020) |

Source: Omdia

Country	USO minimum download speed	Cost and funding approach
UK	10Mbps	BT and Kcom cover costs up to a threshold of £3,400 ($4,192) and any further costs are payable by the consumer.
Slovenia	4Mbps	Operators contribute to a Universal Service Compensation Fund to fund costs of the USO.
Malta	4Mbps	Part privately funded by operators, and part public funding for unfair burden of net costs.
Switzerland	3Mbps	Swisscom covers the costs.
Finland	2Mpbs	Costs covered by USP.
Spain	1Mbps	Operators fund Telefonica's costs incurred for the USO.
Belgium	1Mbps	Operators with turnover higher than €50m per year contribute to a universal service fund to cover service costs.

Source: Omdia

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