Global Fiber Development Index: 2020

A global index comparing fiber development on a country-by-country basis

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Contents

Summary

Omdia's Fiber Development Index tracks and benchmarks fiber development across 81 countries. Fiber investment is vital to the quality delivery of all data services; therefore, unlike other fiber benchmarks that largely track coverage or household penetration, Omdia's benchmark takes into account a wider set of metrics including business penetration, mobile cell site fiber penetration, fiber backbone investment, overall average download and upload speed, and the standard fiber household coverage and household penetration.

Fiber investment is an essential measure for government institutions, network operators, and other stakeholders such as media companies and other interested parties to track. As a broadband-access technology, optical fiber provides an optimized and future-proof quality service. This superior level of quality is essential for the development of future digital services and applications across all verticals including (but not limited to) entertainment, education, home working, corporate services, smart city, and health. With increased efficiency stimulating greater innovation, high-speed broadband has been proven to drive not just consumer satisfaction but national GDP, with a growth in GDP of 0.25% to 1.5% for every 10% increase in household broadband penetration and a further 0.3% increase for every doubling of speed. Only by maximizing investment in next-generation access will countries optimize their growth potential, and fiber optics is key to that investment, whether it is in the backhaul or access network.

Singapore leads Omdia's 2020 Index with maximum scores in fiber-to-the-home (FTTH) penetration, fiber-to-the-cell-site (FTTS) fiber penetration, FTTH population coverage, and both download and upload speeds. It is closely followed by South Korea, the UAE, China, and Japan. All countries in the top five benefit from having a small geographical footprint and/or relatively highly urbanized populations with a high percentage of the population living in multidwelling-unit complexes. They all also benefit from strong national broadband plans with ambitious targets around ultra-high-speed services, often backed by generous government grants or subsidies.

In contrast, other otherwise highly developed countries that are placed lower down in the fiber index, such as the US, Australia, and the UK, all tend to suffer from a less clear or less ambitious national plan, leading to weaker incentives for operators to invest. To some extent, this is often linked to less favorable geographical and demographic conditions, meaning that government initiatives can be expensive and so come up against significant political objections. However, a reluctance to invest will only serve to restrict a country's ability to compete on the global stage in the long run.

Key points and recommendations

- **Fiber connectivity is the most future-proof access technology.** Future broadband applications will require a mix of certain network key performance indicators (KPIs) such as high download and upload speeds, low latency, and low jitter if they are to provide the right level of experience to the end user. Based on network measurement data, an end-to-end fiber-optic network is the best-performing type of network across all such metrics. Furthermore, it is virtually future-proof and is more reliable and secure than other forms of network, making it an ideal choice of infrastructure for residential and enterprise customers alike.
- **Fiber is essential for future GDP growth.** Because of the COVID-19 crisis, economic growth across the globe is at its lowest for many years. However, with significantly more people working and being educated at home, broadband access has never been more important. In order to achieve the best chance of bouncing back from the COVID-19 crisis, governments must look to invest in their national broadband networks.

- **Not all countries are equal.** Although the endgame is the same, countries are all at different starting points and face different sets of challenges. In this Index, Omdia has identified three broadband groups and, at a high level, recommends three separate paths toward the ultimate fiber network:
  - Where FTTH penetration is already high, continue to invest in the backhaul network and enterprise services to move to a gigabit network and beyond.
  - Where broadband penetration is high but FTTH penetration is still low, investment strategies to enable a faster migration to fiber access must be considered. Marketing strategies must then focus on the advantages of fiber-to-the-premises (FTTP) services to encourage fast customer takeup.
  - Where broadband is still in its infancy, a strategy to move to a fiber-first network, focusing initially on major cities, and to connect mobile base stations should be considered. In emerging broadband markets, focus should be first on fiber backhaul to enable other suitable technologies such as 5G fixed wireless access (FWA).
- **A comprehensive approach must be taken.** To stimulate private investment and speed up fiber rollout, a more comprehensive approach must be taken, including
  - A national broadband plan, with concrete and ambitious goals around coverage and ultra-high speeds matched by legislation designed to encourage investment
  - Removing all barriers to access to key infrastructure such as ducts and building access
  - Considering financial incentives such as taxation, subsidies, or public investment
  - Supporting network-sharing agreements between operators to eliminate network overbuild and help manage investment costs
- **Maximize the fiber network.** Deploying new optical fiber can be expensive, but this investment can be shared by exploring new use cases across consumer, enterprise, and wholesale markets. By maximizing fiber investment, countries can move toward next-generation, smart city networks.

Why fiber investment is critical

Optical fiber: A more future-proof network

Optical fiber is not the only broadband technology capable of delivering ultra-high-speed services. Cable and 5G-FWA technologies, for example, are both capable of delivering gigabit broadband speeds. However, optical fiber does have several characteristics that make it a truly future-proof transport technology:

- **Limitless and fully symmetrical speeds.** Fiber-optic cable supports extremely high bandwidth, limited only by the active components at either end. Once installed, the speed-upgrade potential of the actual fiber cable is, therefore, practically limitless. Fiber-optic cables also support full symmetrical services, allowing very-high-speed services to be delivered in the upstream as well as downstream direction.
- **Cost-neutral in greenfield situations and lower operational costs.** Although optical-fiber networks are perceived to be expensive to deploy, this is only when they are compared to existing copper or cable TV networks where the cost of physically laying the cables has already been borne. In greenfield situations, the cost of deploying fiber will be roughly equivalent to, if not cheaper than, that of copper or hybrid co-axial networks. Additionally, fiber optical cables have a long lifespan and require less active equipment, making them typically more operationally efficient than other types of cable.
- **High reliability.** As well as needing less physical maintenance, fiber-optic cables are also more reliable than copper: because they work on light and not electromagnetic waves, there is no interference between adjacent cables, and therefore there is less signal degradation.
- **More secure.** When light signals rather than electromagnetic waves are used, transmitted data is harder to intercept and read.

FTTH is a core ingredient of optimum quality of experience

Many broadband benchmarks look purely at headline download speed. However, increasingly, other network KPIs such as upload speed, latency, and jitter will become equally important if consumers' network demands are to be adequately satisfied. It will become important for benchmarks to consider network/service variance as well as headline metrics so that future application reliability requirements can also be met.

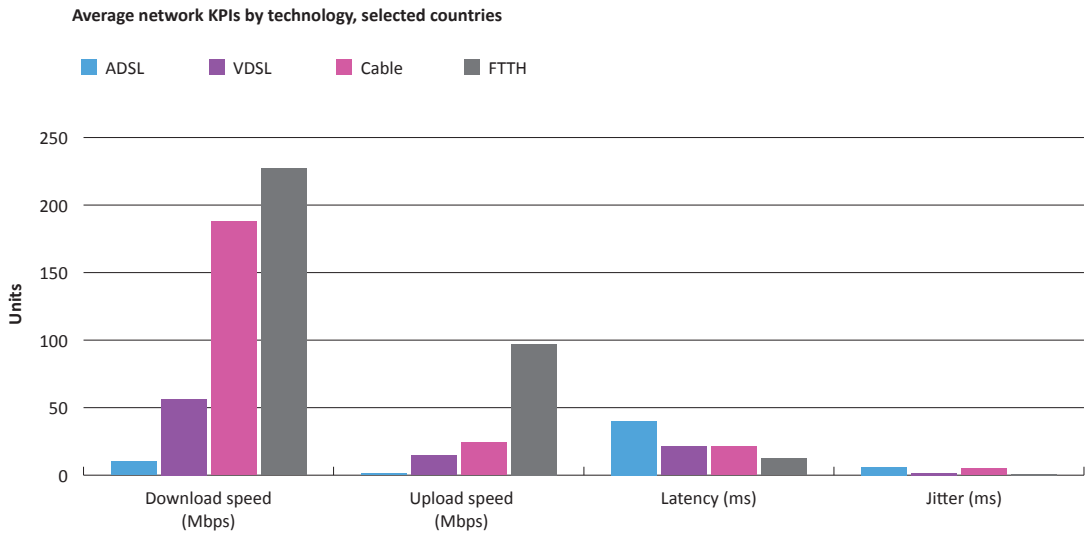
As a simple example, if we take a typical consumer application such as cloud gaming, for a perfect level of experience equipment vendor Huawei recommends

- Bandwidth of 48Mbps
- Latency of less than 20ms
- Jitter of less than 7ms

If only headline speed is considered, it would seem that all broadband technologies other than ADSL would be capable of meeting the minimum criteria. However, as shown in **Figure 1**, when the other

criteria are considered, data by MedUX (a network testing specialist) suggests that only FTTH services of those within its sample would be able to meet all criteria including latency.

Figure 1: Fiber networks provide a truly high-end experience



Source: MedUX, Omdia

Data provided by MedUX also indicates that FTTH has a lower variance than other technologies, especially around latency. As well as better headline speed metrics, therefore, MedUX data would also suggest that fiber-based architectures provide a more consistent experience.

Increase broadband, increase GDP

The growth and competitiveness of any economy in the world will increasingly depend on investments in information and communications technology (ICT). The European Commission estimates that half of all productivity growth in the EU derives from ICT.

Broadband investment has an obvious impact on economic growth and overall competitiveness because it enables greater innovation and business efficiency. A number of studies have, therefore, been conducted around the world to try to quantify this impact:

- ITU's analysis of more than 200 studies on broadband impact notes that a 10% increase in broadband penetration yields an increase in GDP ranging between 0.25% and 1.5%.
- OECD estimates that a 10% increase in broadband penetration can raise labor productivity by 1.5%.
- An EIB study asserts that a doubling of broadband speeds can result in 0.3% GDP growth.

Greater fiber investment would, therefore, help drive a country's GDP by optimizing its national broadband capabilities. However, while FTTH deployments have accelerated in the last couple of years, large disparities still remain in terms of FTTH coverage, not only among the developed and developing regions but also within individual countries. The Pathways for Prosperity Commission estimates that as many as 3 billion people living in developing countries may still be unconnected by 2023, with even greater numbers lacking access to fixed fiber broadband. And even in developed countries, populations face digital divides depending whether they live in urban or rural areas. Rural areas are typically not a high priority for FTTH deployment because fiber-optic network rollouts tend to be more expensive with lower and slower ROI.

In the EU, a third of all households (34%) had access to FTTH services in 2019, but only 18% of Europeans living in rural areas had the same opportunity. Notably, the gap between total and rural FTTH coverage does not seem to be closing over time.

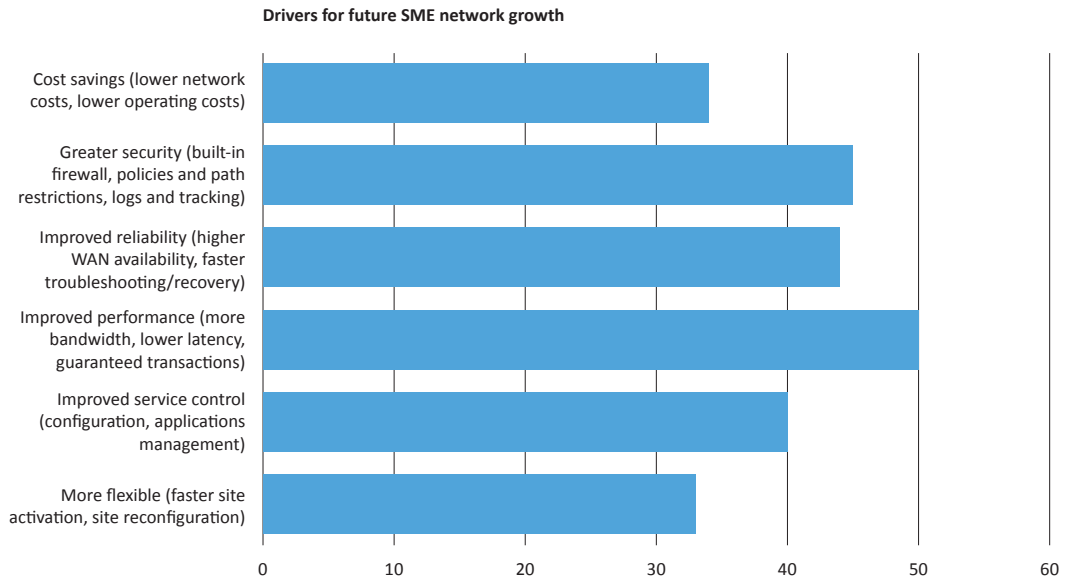
The challenge for fiber access is to find business models that make it profitable to serve the lower-income and/or hard-to-reach consumers. Some options include public funding, operator network-sharing agreements to share cost and eliminate overbuild, reusing infrastructure owned by utilities and local municipalities, partnerships involving global players and international financial institutions to finance wholesale network construction, or cross-body subsidies.

The importance of fiber to business

Much has been written about the level of fiber household coverage, but of course, fast, reliable, and stable broadband connections are also a critical element for the vast majority of businesses as they increasingly move to cloud-based applications and services.

Although access cost will always remain important to businesses as they look to manage both their capital and operational costs, businesses will also take a wider view and take into account broadband as a productivity tool that can in its own right increase other business efficiencies (such as enabling remote working, better access to cloud applications, and more efficient client communications).

Figure 2: Improved network performance is more important than lower network cost



Source: Omdia

Businesses will, therefore, view other KPIs such as security, reliability, latency, quality of customer service / service flexibility, and of course, speed to be equally important as, if not in some cases more important than, price alone (see **Figure 2**). As with consumer services, fiber to the business (FTTB) ensures businesses an optimal network performance with a more reliable, stable, and faster service, providing a future-proof network to maximize operational efficiencies, as long as it can be provided at the right cost.

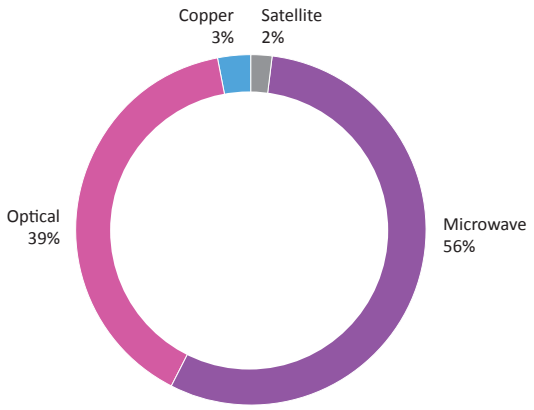
Backbone investment is critical to broadband development

Fiber is a key investment for a robust and thriving economy. Fiber networks provide connectivity for data centers, corporate facilities, government buildings, and mobile radio sites and the highway for residential broadband and video. Having a robust fiber network ensures that all applications can reliably be supported. These applications can range from low-latency critical financial transactions or smart city applications to high-bandwidth video or 3D gaming. A high degree of fiber investment suggests greater reliability with diverse paths and provides the necessary foundation for broadband services.

A deep fiber backbone provides diverse paths delivering high availability and supporting high-capacity connectivity from 200–800Gb. Availability is required for new 5G mobile applications and for new cloud applications. As the COVID-19 pandemic has shown, the network is critical when employees and executives are required to work from home and to connect via web-based meeting tools. Having too little bandwidth and single points of failure can lead to network outages that could result in poor economic outcomes. Single points of failure can happen when service providers have limited fiber or paths from a city or between cities and those fibers get cut by construction projects.

Mobile infrastructure relying on fiber can be upgraded to higher-speed 5G applications at a faster pace if fiber infrastructure is in place. **Figure 3** shows the current state of cell site connectivity excluding China. As we move to 5G, optical connectivity to cell sites will be critical to meet all the promises of all 5G applications including high availability.

Figure 3: Global backhaul, 2019



Note: data excludes China
Source: Omdia

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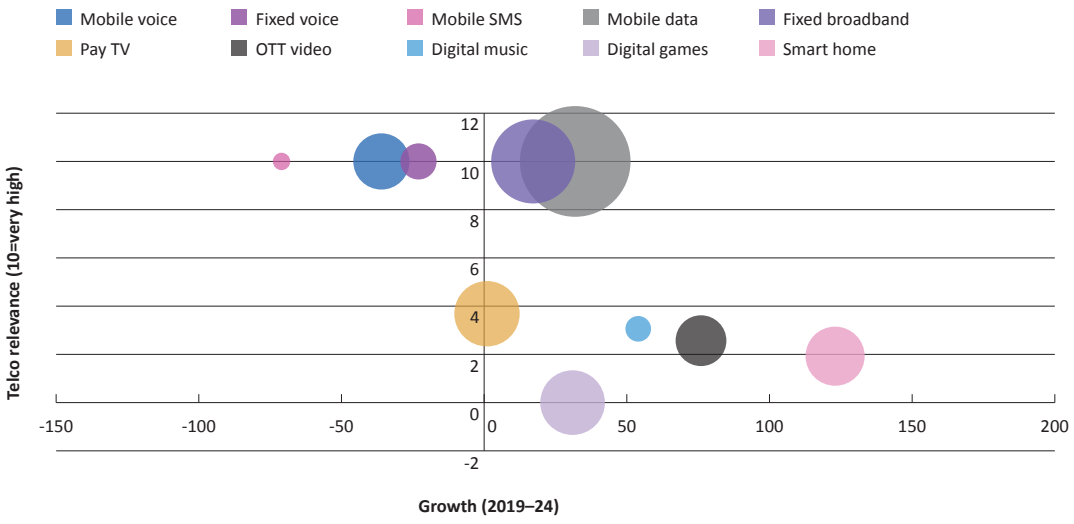
Quality of experience is vital to future broadband success

Broadband remains a key market for telecommunications service providers

Broadband access remains the biggest revenue opportunity for fixed-service providers. The digital consumer market continues to offer telecommunications providers good growth potential over the next five years. The combined traditional residential segments of fixed voice, broadband, and pay TV will be worth $590 billion globally by 2024, a growth of $33 billion over five years. Fixed broadband will account for 55% of this revenue (as well as the bulk of the revenue growth), and broadband represents the biggest overall opportunity in the fixed consumer sector globally in terms of overall growth and telco relevance (see **Figure 4**).

Figure 4: Fixed and mobile broadband remain key revenue markets



Source: Omdia

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As well as offering direct subscription revenue, broadband access enables service providers to move into other areas such as TV and smart home. Just over 60% of telcos' pay-TV services are reliant on broadband access for service delivery, and new opportunities such as smart home will be worth a further $163 billion by 2024. Additionally, there is another $345 billion worth of revenue opportunity from applications such as over-the-top (OTT) video, digital music, and digital gaming.

The push for greater and greater speeds

Broadband has become an essential service for the modern home, powering everything including home entertainment, commerce, home working, and especially in recent times, home education. Video services, in particular, have been a big driver for both the broadband service and the bandwidth that is required. According to Omdia data, globally, IPTV services accounted for 24% of all pay-TV services by the end of 2019, and 31% of homes have at least one OTT video subscription.

With the rapid increase in 4K TVs and other 4K-enabled devices in the home, demand for multiple high-quality video streams has grown and is by far the biggest driver of data traffic. As shown in **Table 1**, each 4K video stream requires between 20Mbps and 100Mbps, depending on the video quality.

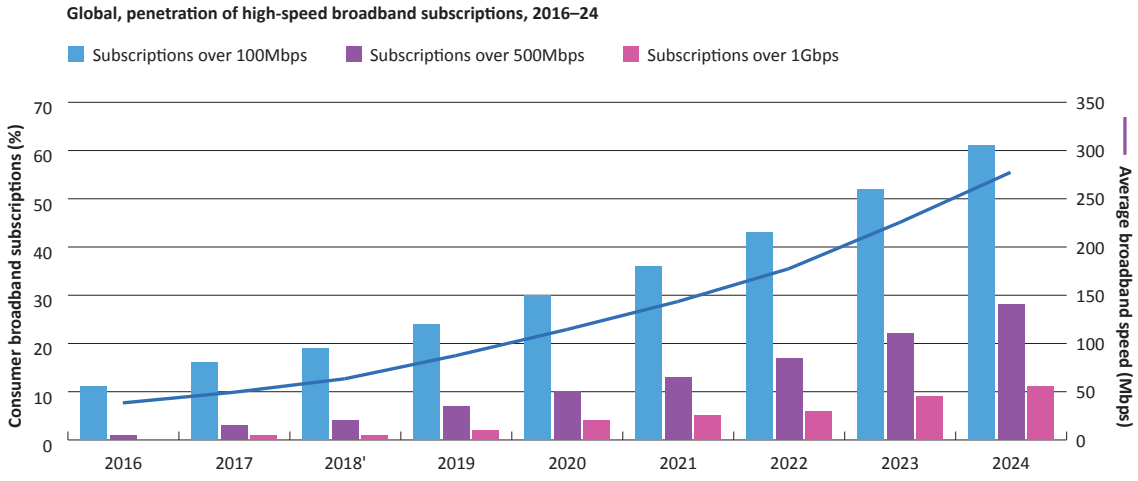
Table 1: Demand for greater video quality will push the need for greater speed

Bandwith, delay and PLR requirements of 4K TV services	Basic 4K	Real 4K	Ultra-4K
Resolution	3840×2160	3840×2160	3840×2160
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	$1x10^{-4}$	$5x10^{-5}$	$5x10^{-5}$

Source: Omdia © 2020 Omdia

Together with market competition that has heavily relied on speed as a service differentiator, demand for video service has pushed an increasing rise in both high-speed broadband tariffs and average download speed per household. Omdia predicts that by 2024, more than 60% of households globally will have a broadband speed of over 100Mbps, and the average download speed will be over 250Mbps.

Figure 5: Average broadband speeds will continue to grow exponentially

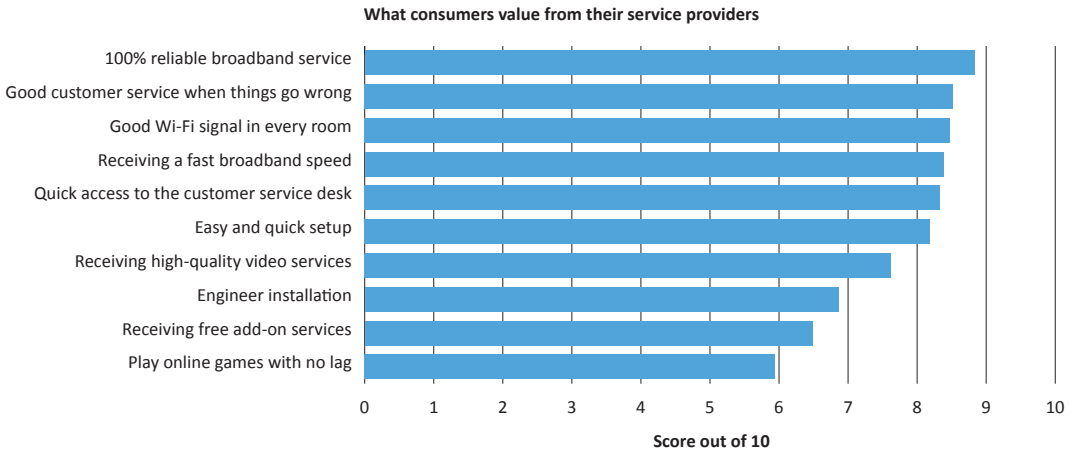


Source: Omdia © 2020 Omdia

The shift to marketing quality of experience

With speed being such an important element of a broadband service, it has been the marketing focus for broadband service providers for many years. However, with the increase in broadband speeds across all service tiers, consumers are becoming gradually insensitive to pure bandwidth improvement. To differentiate service offerings, therefore, service providers have shifted their service and marketing focus onto the overall customer experience. This includes standard quality of service (QoS) indicators such as installation times and customer support efficiency as well as KPIs around digital application performance.

Figure 6: Reliability, coverage, and customer service are as important as high speed



Source: Omdia

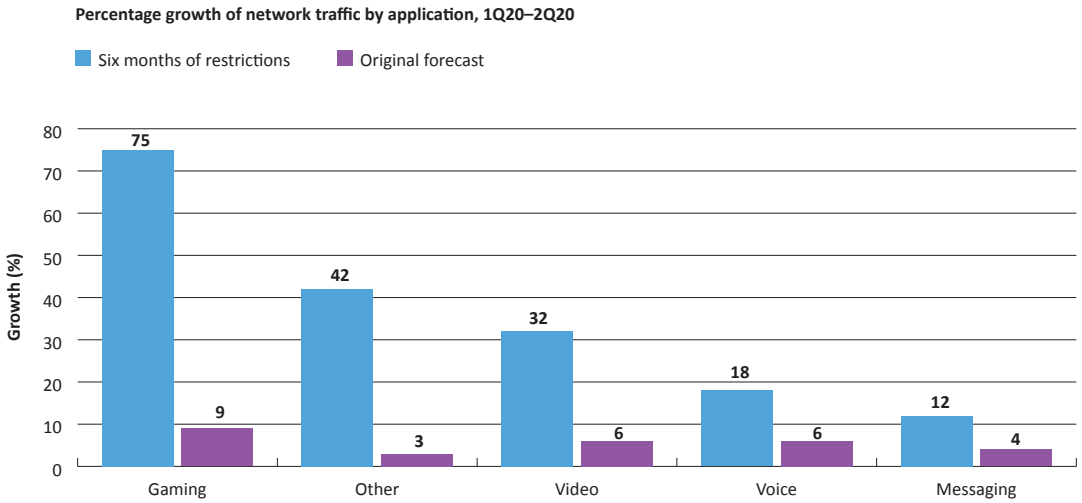
Many of today's consumer digital applications come from third-party sources, but if the applications do not perform to the required level of quality, then it is usually the network delivering the application that is blamed, whether that is justified or not. Consistent poor digital application performance is a major driver of broadband service churn. To differentiate their services, therefore, broadband service providers are investing heavily in intelligent networks and artificial intelligence (AI) data analytics capabilities to monitor and manage network QoS and application quality of experience (QoE).

COVID-19 has reinforced the importance of broadband

The mass quarantining of people in their homes drove a rapid increase in the adoption of videoconferencing to stay in touch with friends and family as well as a steep rise in use of online media (especially on-demand and streaming video) and other applications such as online shopping, e-education, and working from home.

This led to an unprecedented increase in traffic, a shift in the normal network-busy hours, and to some extent, a balancing out of download versus upload traffic. Omdia forecasts online gaming traffic has increased by 75% during the pandemic, and video traffic (which already represents the biggest driver of traffic) by 32% (see **Figure 7**).

Figure 7: The COVID-19 crisis drove an unprecedented increase in data traffic



Source: Omdia Network Traffic Forecast: 2019–24

Although, hopefully, the COVID-19 crisis will only be short term, the change in consumer behavior is unlikely to ever be fully reversed. Broadband service providers can, therefore, expect more working from home, more online education, and continued levels of consumer videoconferencing, all of which place significant demands on the network.

Broadband QoE was already important to consumers even before the pandemic, but since the crisis the consumer's understanding of QoE has risen to new levels, especially when the broadband service does not meet their expectations. Although consumers still do not understand such things as jitter, latency, and throughput, they can certainly experience their impact and understand it is the network that is causing their applications to perform poorly.

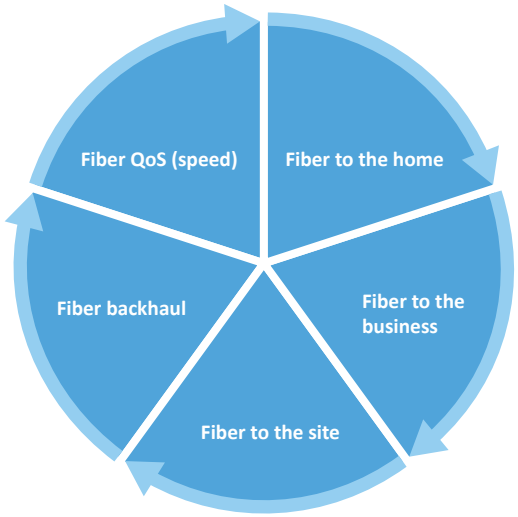
Fiber Development Index 2020

Introducing the Fiber Development Index

Because of the importance of fiber investment and its impact on global development, Omdia has created a new fiber benchmark called the Fiber Development Index. Unlike some other benchmarks that only track a single development metric (such as, say, coverage or household penetration), the Fiber Development Index aims to capture all elements of fiber investment, specifically fiber access, mobile fiber backhaul, core fiber backhaul, and the overall fiber QoS, which is currently measured by overall average download and upload speed (see **Figure 8**).

Only by optimizing each of these separate investment areas can a country maximize the overall end-user broadband experience, whether that is provided via a fixed or mobile access connection.

Figure 8: Omdia's Fiber Development Index



Source: Omdia

To quantify the level of investment in each segment, Omdia used a selection of metrics that are outlined and defined in **Table 2**.

Table 2: Individual metrics used in the Fiber Development Index 2020

Metric	Definition	Importance
FTTH penetration (%)	FTTH subscription household penetration	FTTH household penetration represents the current take up of FTTH services. The greater the percentage, the higher the number of households that can take advantage of fiber network characteristics.
FTTB penetration (%)	FTTB subscription against total enterprise connections	FTTB business penetration represents the current takeup of FTTB services. The greater the takeup, the more businesses will be taking advantage of FTTB services, enabling more efficient and more dynamic businesses.
FTTS fiber penetration (%)	Percentage of total mobile cell sites that are fiber connected	Mobile cell sites need high-speed and high-quality backhaul capabilities if they are to optimize the mobile-access performance. A high FTTS penetration will therefore signal a more optimized mobile data network.
FTTH population coverage (%)	Percentage of households that are covered by FTTH	FTTH coverage represents the current potential of FTTH connections. A limited coverage will mean that only a small selection of households and businesses can gain access to the benefits of a fiber network.
Fiber backbone length	Ratio of backbone fiber length to households	Fiber backbone supports the necessary quality of experience and reliability broadband services need. So a higher amount of backbone fiber per household drives greater reliability and performance for broadband networks.
Download speed (MBps)	Average end-user download speed	Fiber networks have the capability to deliver very-high-speed broadband services. Although not the only important network metric, speed is essential for delivering bandwidth-hungry applications such as 8K video in a quality fashion.
Upload speed (Mbps)	Average end-user upload speed	Unlike most other access network technologies, fiber networks can also offer symmetrical services. Although historically deemed more important in business, symmetrical services are now becoming increasingly important even in the residential market

Source: Omdia © 2020 Omdia

Introducing Fiber Development Index clusters

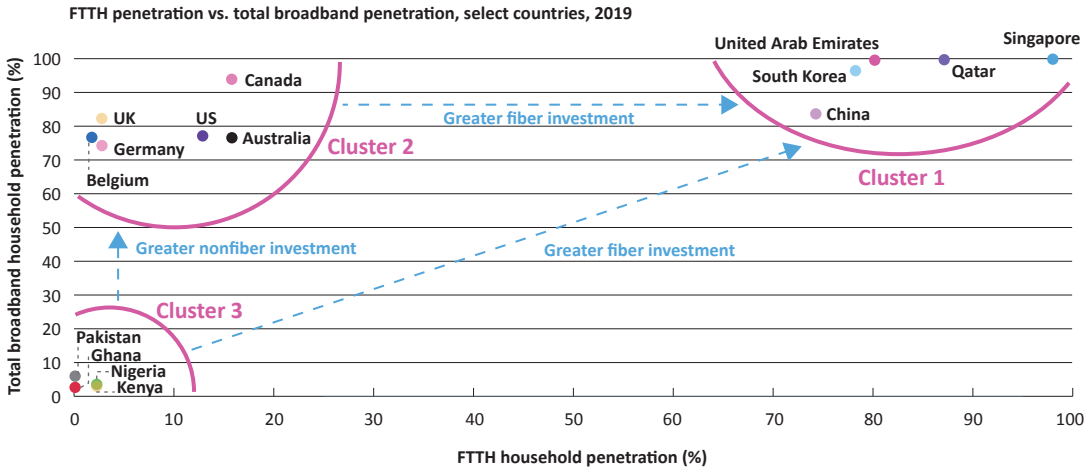
The Fiber Development Index covers 81 territories of varying sizes, demographic and geographical profiles, and levels of broadband development. Because of these widely differing characteristics, to compare them directly would, in Omdia's opinion, only lead to unfair and unhelpful conclusions and recommendations.

Therefore, to compare the individual results of the Fiber Development Index, Omdia created three different country clusters:

- Cluster 1: countries with highly developed broadband and FTTH penetration
- Cluster 2: countries with developed broadband and a high level of broadband household penetration but relatively low FTTH penetration
- Cluster 3: countries with emerging broadband that have a low level of broadband household penetration and a relatively low FTTH penetration

Typical country characteristics, broadband development, levels of competition, and broadband national plans from example countries in each cluster are explored later in this report.

Figure 9: Fiber development clusters allow for more focused recommendations



Source: Omdia

In terms of future development, countries or territories in Cluster 2 can only move from left to right (see **Figure 9**) over time as they continue to replace legacy technologies with fiber-based ones. However, Cluster 3 countries could move up by investing in alternative technologies first (fixed-wireless technologies, for example) and then in fiber over time, or in a more diagonal direction where fiber investment goes hand in hand with broadband development.

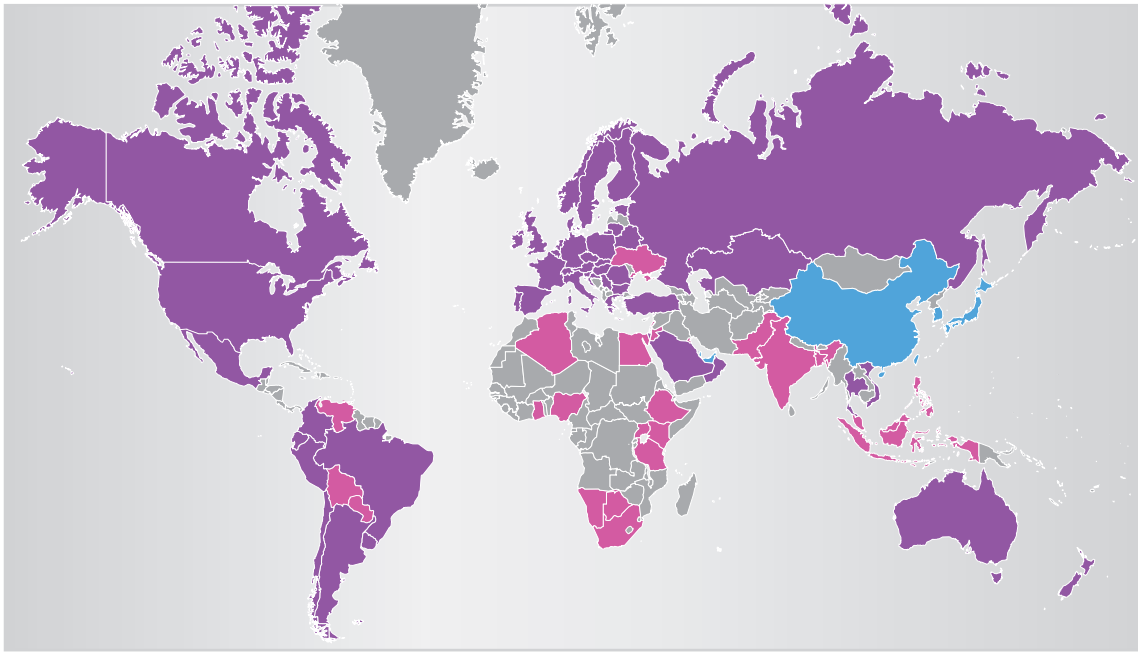
Fiber Development Index top-level results

Omdia's Fiber Development Index maps fiber investment in more than 80 of the world's leading broadband countries. Singapore leads the 2020 index with an overall score of 8.3 out of 10. South Korea (7.6), the UAE (7.1), China (6.5), and Japan (6.4) make up the rest of the top five countries.

The first European country in the ranking is Sweden, in seventh position with a score of 5.1. Sweden is closely followed by Spain (5.0), Denmark (4.9), and Norway (4.8). The US heads the Americas region with a score of 3.7 and is 19th in the world overall.

Singapore scored a maximum 10 out of 10 in FTTH penetration (99%), FTTS penetration (94%), FTTH population coverage (100%), and both download (195Mbps) and upload speeds (204Mbps). Two areas where Singapore does not lead are FTTB penetration (which China leads with 44%) and fiber backbone length (Oman is the leading country here). Note also that two other countries (Oman and South Korea) get maximum scores along with Singapore for FTTH population coverage.

Figure 10: Omdia's Fiber Development Index (FDI) 2020 ranking



Cluster 1

1	Singapore	8.3
2	South Korea	7.6
3	United Arab Emirates	7.1
4	China	6.5
5	Japan	6.4
6	Qatar	5.8
7	Sweden	5.1
8	Spain	5
9	Denmark	4.9
10	Norway	4.8
11	New Zealand	4.5
12	Portugal	4.3
13	Romania	4.2
14	Russia	4.2
15	Luxembourg	4.2
16	Switzerland	3.9

Cluster 2

17	Israel	3.7
18	Saudi Arabia	3.7
19	US	3.7
20	France	3.7
21	Canada	3.6
22	Oman	3.6
23	Finland	3.5
24	Lithuania	3.5
25	Thailand	3.5
26	Uruguay	3.5
27	Vietnam	3.4
28	Netherlands	3.3
29	Malaysia	3.1
30	Ukraine	3.1
31	Hungary	3
32	Bahrain	3
33	Slovenia	2.9
34	Estonia	2.8
35	Kuwait	2.8
36	Bulgaria	2.8
37	Slovakia	2.6
38	Czech Republic	2.5
39	Australia	2.5
40	Poland	2.5
41	Chile	2.4
42	Belarus	2.3
43	Ireland	2.3
44	Turkey	2.3
45	Italy	2.1
46	Belgium	2.1
47	Germany	2
48	Mexico	1.9
49	UK	1.9
50	Jordan	1.9

Cluster 3

51	Indonesia	1.9
52	Croatia	1.9
53	Kenya	1.8
54	Brazil	1.8
55	Austria	1.8
56	Kazakhstan	1.8
57	Venezuela	1.7
58	Uganda	1.6
59	Argentina	1.6
60	Greece	1.6
61	Tanzania	1.5
62	Namibia	1.4
63	Peru	1.4
64	South Africa	1.4
65	Bolivia	1.3
66	India	1.3
67	Botswana	1.3
68	Paraguay	1.3
69	Colombia	1.2
70	Ecuador	1.2
71	Philippines	1.1
72	Algeria	1.1
73	Serbia	1.1
74	Lebanon	1
75	Morocco	1
76	Ghana	1
77	Egypt	0.9
78	Pakistan	0.9
79	Nigeria	0.9
80	Ethiopia	0.9
81	Bangladesh	0.9

Source: Omdia

Country clusters analysis

As previously mentioned, in order to allow countries to be compared with other countries at a similar level of broadband and fiber development, Omdia created three different country clusters. This section explores some of the typical country characteristics, broadband development, and levels of competition in select countries in each cluster.

Cluster 1

Cluster 1 countries are characterized by high broadband penetration levels (above 80%) and high FTTH penetration (above 75%).

Table 3: Overview of Cluster 1 country Fiber Development Index data

Example countries	Singapore	South Korea	UAE	China	Qatar
FTTH penetration (%)	99	79	81	75	88
FTTB penetration (%)	20	28	27	44	12
FTTS fiber penetration (%)	94	92	92	90	77
FTTH population coverage (%)	100	100	97	91	100
Fiber backbone length (score)	3.6	1.9	9.1	2.8	6
Download speed (Mbps)	195	160	85	95	60
Upload speed (Mbps)	204	182	46	28	35
Index ranking	1	2	4	5	6

Source: Omdia © 2020 Omdia

Although there are other factors that help drive fiber investment, geographical and demographic factors certainly have a significant impact in most Cluster 1 countries:

- **Geography.** Countries with smaller, more compact territories have a significant advantage because the backbone investment required to reach all populated areas is relatively low. Not all Cluster 1 countries have smaller territories, as shown by China, but it is certainly easier for smaller countries to reach this segment.
- **Demographics.** Cluster 1 countries also tend to be highly urbanized countries with a high percentage of people living in multidwelling-unit (MDU) complexes. Such infrastructure can significantly reduce the average cost of deploying the access fiber network to households.
- **Alternative technologies.** Cluster 1 countries typically have low (or zero) levels of alternative infrastructure competition such as cable networks.
- **Government policy.** Cluster 1 countries tend to have very strong national broadband policies with ambitious broadband-connectivity and FTTH and/or ultra-high-speed goals, often with government subsidies and grants available, leading to strong incentives for large operators to invest in fiber networks. A summary of each plan for the example Cluster 1 countries is shown in **Table 4**.

Government initiatives and national broadband plans

Table 4: Cluster 1, national broadband plans

Country	National broadband plan	Next-generation-network initiatives
Singapore	Established in 2015, Singapore's National Broadband Plan aims to provide 90% of the population with competitively priced broadband speeds of 1Gbps by 2025.	In 2007, the IDA sought to promote the development of next-generation access by conducting tenders for the Next Gen NBN. A total of S$1bn ($734m) was offered to build and operate an FTTH network, with mandatory structural and operational separation between passive and active network infrastructures.
South Korea	The Giga Korea project, which succeeded a previous Broadband Convergence Network (BCN) Program, was launched in 2012. Its aim was to prepare the country for the next generation, moving toward the goal of realizing a "smart" South Korea by 2020. Its targets include providing speeds of 1Gbps through fixed-line connections and 100Mbps over wireless connections. It required investments from the government and the private sector of more than KRW550bn ($461m) in the ratio 75:25 (government to private).	To meet the national broadband plan objectives, the fixed operator KT announced a plan to upgrade its wired and wireless networks to giga speeds by 2017. The upgrading of existing broadband networks is expected to cost about KRW28bn ($23.5m) and will be partially funded by the South Korean government through direct subsidies totaling KRW1.1bn ($0.92m).
United Arab Emirates	The first of its kind in the Arab world, the ICT Fund was launched in 2007 by the Telecommunications Regulatory Authority to achieve rapid, progressive, and concrete developments within the ICT sector in the UAE. The Fund launched its operations to jump-start innovation within the ICT sector in the UAE, mainly in the fields of intellectual capital, technological leadership, smart research, innovative ideas, and incubating startups.	Etisalat, one of the major network providers in the country, invested more than AED31bn in the network infrastructure.
China	The MIIT and NDRC jointly passed a three-year action plan for the construction of information infrastructure, which aimed to spend a total of CNY1,200bn ($170.41bn) over 2016–18. The plan aimed to support the development of high-speed fiber optics, the construction of advanced mobile broadband systems and global network facilities, and the strengthening of capabilities. To execute this plan, the government focused on 92 selected infrastructure projects with an investment budget of CNY902.2bn ($128.12bn).	In June 2019, China Mobile announced plans to build 300 "Gigabit Cities," with fixed broadband access at gigabit speed, covering 200 million potential fixed broadband customers. By the end of 2018 China Telecom's FTTH network fully covered all cities and towns in the service area of the company.
Qatar	Qatar's broadband plan was set in 2013 with an aim to ensure all the population could choose between a minimum of two broadband retail providers by 2016, irrespective of location, and that 95% of households could access affordable and high-quality broadband service of at least 100Mbps effective download and 50Mbps effective upload speeds by 2016. In 2008 Qatar also set out its National Vision 2030, with the aim for Qatar to become an advanced society capable of sustaining its development and providing a high standard of living for its people. Qatar's National Vision defines the long-term goals for the country and provides a framework in which national strategies and implementation plans can be developed.	Qnbn provides a high-speed fiber-optic broadband infrastructure by providing access to citizens and businesses alike. Qnbn focuses on the deployment of a passive dark-fiber network infrastructure, providing equal and open access to telecommunications service providers on a wholesale basis and owners and operators of private networks on a retail basis, thereby enabling end users to efficiently leverage high-speed fiber in Qatar.

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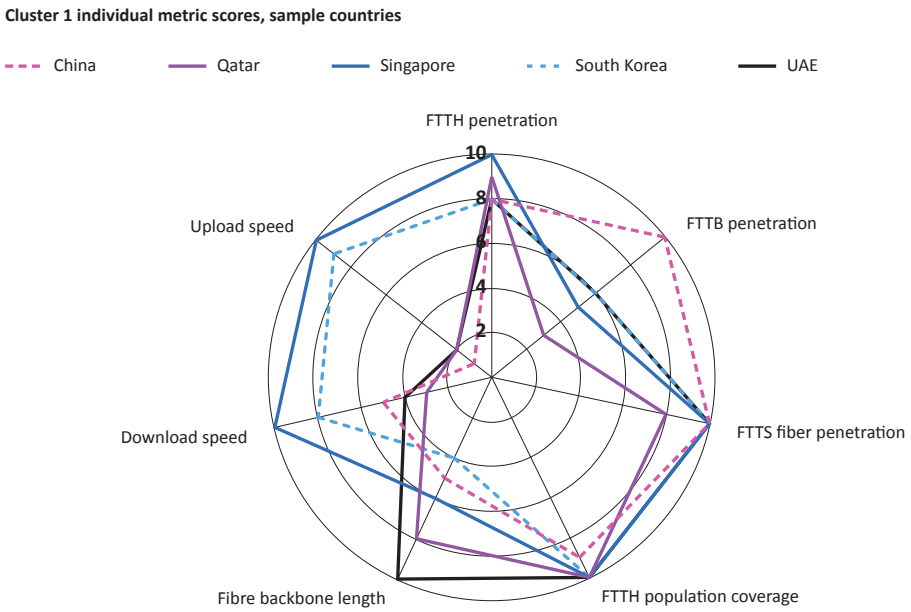
Network competition overview

- **Singapore.** Although other access technologies were once popular in the Singapore market, today it is virtually a 100% FTTH country. As recently as 2016, 22% of broadband connections were provided by alternative technologies such as xDSL, cable modem, and FWA. As of December 2019, this percentage had reduced to just 1%, and all the major competitors have moved to purely FTTH.
- **South Korea.** Other forms of access technology are still used by 17% of customers in South Korea, but this has dropped from 26% in 2019, and certainly the main service providers, SK Telecom, KT, and LG U+ are now heavily reliant on FTTH.
- **UAE.** The UAE moved early to fiber-access technology, which even back in 2016 accounted for 88% of all connections. By 2019 this had increased to 91%. The largest competitive operator, du, is particularly reliant on FTTH, although it is now also investing in 5G FWA. The incumbent, Etisalat, has also invested heavily in FTTH, and its DSL network is now in decline. Like du, Etisalat is now also investing in 5G FWA to complement FTTH, and such connections are expected to grow over the next five years. However, by 2024 FTTH connections will still have grown by 15% and will represent 84% of broadband lines.
- **China.** Thanks to government initiatives and heavy market competition between the three main players—China Telecom, China Unicom, and China Mobile—there has been a huge boost in FTTH connections in China over the past few years. As of 2019, 91% of all broadband connections are supplied over a FTTH network. Only China Unicom now has a significant portion of customers utilizing xDSL , and it is expected that FTTH will continue to gain strength over the next five years.
- **Qatar.** Like the UAE, Qatar moved quickly to FTTH technology. The incumbent, Ooredoo, still dominates the market, and 99% of its customer base is served by FTTH technology. Vodafone is the next-biggest competitor and also operates a FTTH network, although is now starting to invest in 5G FWA. Its FWA operation is still small but is expected to grow to be 30% of its connections by 2024. Ooredoo is also investing in 5G FWA to increase its broadband footprint; however, its FTTH network will still supply 90% of all broadband lines by 2024.

Sample country results and analysis

One might expect countries within the top fiber-development cluster to have little further investment to make. However, **Figure 11** illustrates that although all countries in Cluster 1 have very high FTTH coverage and penetration, many still score relatively low in other areas, especially around overall broadband speeds and FTTB penetration. Further investment will therefore still be needed to maintain their leadership positions in the future.

Figure 11: Cluster 1 countries still have room for improvement



Source: Omdia

Cluster 2

Cluster 2 countries are characterized by high broadband penetration levels (above 40%), but fiber-optic rollouts in these countries have so far remained limited.

Table 5: Overview of selected Cluster 2 countries, Fiber Development Index data

Example countries	US	Canada	Australia	Germany	UK
FTTH penetration (%)	13	16	16	3	3
FTTB penetration (%)	6	3	13	6	6
FTTS fiber penetration (%)	79	62	58	48	46
FTTH population coverage (%)	43	36	19	12	12
Fiber backbone length (score)	2.3	2.1	1.7	0.6	0.7
Download speed (Mbps)	118	100	45	74	62
Upload speed (Mbps)	42	44	19	19	20
Index ranking	23	31	42	49	54

Source: Omdia

There are several reasons for low FTTH penetration levels in these countries:

- **Geography.** Vast sparsely populated areas and difficult terrain, such as mountains, deserts, and plains, make nationwide fiber-optic deployments challenging and economically unfeasible.
- **Demographics.** While generally highly urbanized, the majority of people in Cluster 2 countries tend to live in single-home units, meaning that each house needs to be fitted with an individual connection, which is more time-consuming and costly than deploying fiber networks to multistory/MDU buildings.

- **Alternative technologies.** Incumbents and large operators in Cluster 2 countries have been traditionally focusing on upgrading their existing network technologies (copper or cable) to provide high-speed broadband services, investing in VDSL Vectoring, G.Fast, and DOCSIS 3.0/3.1 upgrades. This allowed operators to manage investment costs in the short term, but many have since shifted their strategy to full fiber, especially after facing increasing competition from smaller alternative operators that have been deploying fiber networks.
- **Government policy.** Lack of clear national policy or ambitious broadband connectivity goals meant there were not enough incentives for large operators to invest in fiber networks. Some countries, such as Australia or France, initially set out full-fiber initiatives, but these have been revisited amid political and economic pressures.

Government initiatives and national broadband plans

Cluster 2 countries tend to lack strong national broadband policies or ambitious broadband connectivity, FTTH, and/or ultra-high-speed goals. A summary of each plan for the example Cluster 2 countries is in **Table 6**.

Table 6: Selected Cluster 2 countries, national broadband plans

Country	National broadband plan	Next-generation-network initiatives
US	In March 2010, the Federal Communications Commission (FCC) introduced the "Connecting America: The National Broadband Plan," setting up six key goals to be completed by 2020 including: at least 100 million US homes (approx. one-third of all households) to have access to actual download speeds of at least 100Mbps and upload speeds of 50Mbps; every American to have affordable access to a robust broadband service (i.e., 4Mbps downstream and 1Mbps upstream); and all anchor institutions such as schools, hospitals, and government buildings to have affordable access to at least 1Gbps broadband service.	In 2015, the FCC raised the broadband benchmark speeds to 25Mbps (down) / 3Mbps (up) from the previous 4Mbps/1Mbps, aiming to close the digital divide between urban and rural areas. The FCC recognizes both fixed and mobile broadband technologies as vital to developing a sustainable infrastructure model. It hopes 5G FWA will boost rural connectivity and provide high-speed broadband in hard-to-reach areas. Traditional operators have been upgrading to VDSL and DOCSIS 3.0/3.1, deploying FTTH only in selected areas. Google Fiber launched small-scale FTTH deployments in 2010, providing 1Gbps broadband services in areas previously neglected by traditional operators and thus serving as a market disruptor. A number of municipalities, such as Chattanooga, TN, have started their own open fiber network deployments, but following a strong telco lobbying campaign these have been restricted.
Canada	Canada has long lacked a coordinated nationwide broadband plan. In its Budget 2019, the government announced a national target of 95% of Canadian homes and businesses to have access to internet speeds of at least 50/10Mbps by 2026 and 100% by 2030, no matter where they are located in the country. To deliver these targets, the Budget 2019 proposed a coordinated plan delivering C$5–6bn in investments in rural broadband over a 10-year period. These objectives are in line with targets set by the Canadian Radio-television and Telecommunications Commission (CRTC), which has set up a C$750m Universal Broadband Fund focused on extending "backbone" infrastructure to underserved communities. For the most difficult-to-reach communities, funding may also support "last-mile" connections to individual homes and businesses.	Cable is the leading network access technology, and operators have focused on DOCSIS 3.0/3.1 upgrades. All operators have been deploying FTTH networks in selected areas. Telus has been deploying its PureFiber network in western Canada, while Bell Canada also invested heavily in fiber rollouts in recent years.

Source: Omdia © 2020 Omdia

Table 6: Selected Cluster 2 countries, national broadband plans (continued)		
Country	**National broadband plan**	**Next-generation-network initiatives**
Australia	Australia launched the construction of its government-owned, wholesale-only National Broadband Network (NBN) in 2009, with an ambitious plan to reach 93% of premises with FTTH. The approach was altered to a multitechnology mix in 2013 to reduce cost and increase rollout speed. The whole project is expected to cost the Australian government around A$51bn and is scheduled to be completed by mid-2020.	The final technology mix includes FTTH, FTTN/C, and DOCSIS 3.1 cable. In rural areas, fixed wireless and satellite have been deployed.
Germany	In 2013, the German government extended its 2009 broadband strategy "Breitbandstrategie der Bundesregierung" with a plan to reach 100% of the population with at least 50Mbps broadband download speeds by 2018. By the end of 2018, 88% of households had access to the target speeds, thus missing the strategy's objective. In March 2017, the Federal Ministry of Transport and Digital Infrastructure (BMVI) adopted a Gigabit Germany initiative in line with the EU's Gigabit Society strategy, and a plan for converged gigabit-ready infrastructure is to be achieved by the end of 2025.	Deutsche Telekom, the dominant incumbent in the German broadband market, has been largely focusing on VDSL upgrades, resulting in very low FTTH coverage and uptake levels. Vodafone has partially upgraded its network DOCSIS 3.1 and plans to deploy FTTH networks in selected areas.
UK	The Building Digital UK (BDUK) initiative was introduced in 2013 as part of the Department for Digital, Culture, Media & Sport (DCMS). The original targets included provision of superfast broadband at speeds of 24Mbps or more for 90% of premises and at least 2Mbps broadband for all UK premises by 2015 and the stimulation of private investment in a full-fiber connection by 2021. In 2016, a new National Broadband Scheme for 2016–20 was announced aiming to extend the superfast (at least 24Mbps) network to 95% of homes and businesses by 2017 and as far as possible across the remaining 5% of premises. In 2018, the DCMS introduced two consultations to improve gigabit connectivity and encouraged incumbent BT Openreach to deploy full-fiber networks. In 2019, the government committed £5bn to help the hardest-to-reach areas gain access to gigabit broadband services and ensure a goal of all premises having access to gigabit broadband by 2025.	Most of the superfast 24 Mbps broadband targets were reached by upgrading the incumbent's BT Openreach's legacy copper network to VDSL. But both the government and Openreach have faced criticism that a 24Mbps target is not sufficient. In 2018, Openreach shifted its network strategy to Fiber First. FTTH deployments have been traditionally limited to small local players such as CityFiber or Hyperoptic. The government has been offering voucher schemes and Local Full Fiber Networks (LFFN) programs to stimulate rural fiber-network rollouts. Much of the UK's gigabit connectivity target will be initially served by Virgin Media's cable network, which the operator began to upgrade to DOCSIS 3.1 in late 2019. Virgin Media has also been deploying FTTH networks in greenfield deployments.
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Network competition overview

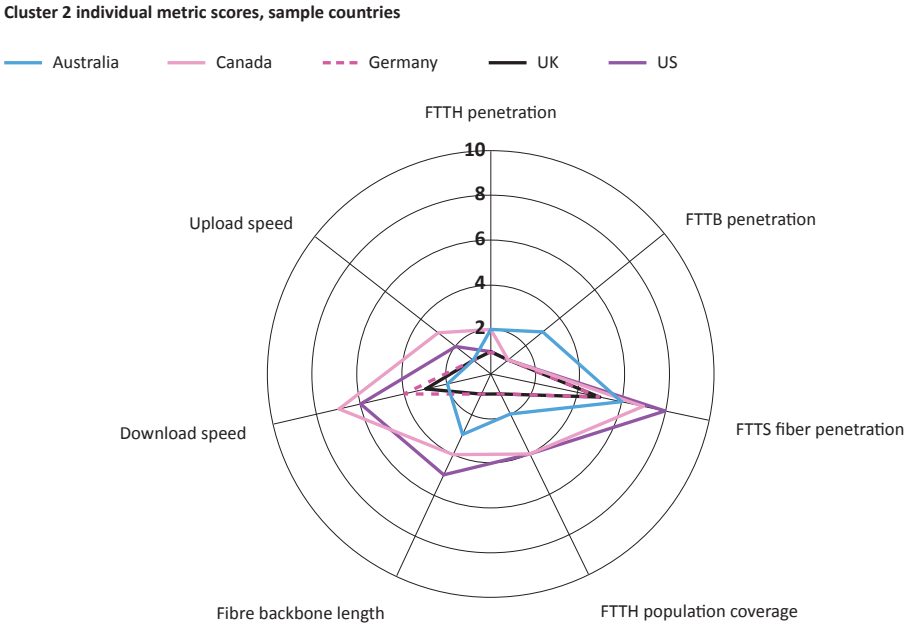
- **US.** Cable is the leading broadband technology with 64.5% of all broadband subscriptions in 2019 and is projected to remain stable. Comcast and Charter are the two leading cable providers with 24.7% and 22.9% market share respectively. Both operators have been focusing on DOCSIS 3.1 upgrades with only very limited FTTH rollouts in greenfield deployments. Verizon has been the leader in terms of FTTH deployment, deploying its FiOS network since 2005, primarily on the US East Coast. AT&T initially focused on VDSL upgrades but has been deploying FTTH networks in selected areas, particularly those where it faces competition from cable or alternative providers such as Google Fiber. Typical for the US broadband market is a lack of competition: certain areas have only one or two operators, either telco or cable, to choose from, leading to a lack of incentives for operators to invest in full-fiber rollouts.
- **Canada.** More than half (54.2%) of all broadband subscriptions are based on cable technology; xDSL has been declining rapidly and accounted for 29.8% of all subscriptions in 2019. Most xDSL subscriptions are those of incumbent BCE, which is leading the broadband market with 24.8% market share. However, BCE has been investing heavily in FTTH since 2010, mainly in Ontario, Quebec, and the Atlantic provinces. Telus has been deploying FTTH networks in western Canada.
- **Australia.** Despite significant declines, xDSL remains the most widespread access technology, accounting for 51.0% of all broadband subscriptions, followed by cable with 21.2%. As part of the NBN arrangement, operators are required to migrate their consumer and small and medium-sized enterprise (SME) customers to the NBN. Legacy copper- and cable-based services are deactivated 18 months after NBN becomes available in an area.
- **Germany.** The dominant broadband access technology is xDSL with 71.6% of all broadband subscriptions, underlining incumbent Deutsche Telekom's longstanding focus on its legacy copper-network upgrades. Cable provides broadband connectivity to 23.7% of subscriptions, and only 4.5% of broadband connections were based on FTTH at the end of 2019. Deutsche Telekom is the leading broadband provider with 39.5% market share. Following the 2019 acquisition of Liberty Global's Unitymedia, Vodafone boosted its standing in the German market and reached 29.9% market share. Vodafone is now the only operator capable of competing with Deutsche Telekom at scale. Both operators have begun investing in full-fiber rollouts, but these remain limited to only selected (and most-profitable) areas. FTTH deployments are thus driven mainly by smaller local network operators.
- **UK.** The vast majority of broadband subscriptions (77.4%) in the UK are provided via xDSL as a result of incumbent BT and its infrastructure arm Openreach giving a preference to VDSL upgrades. Only in the last 18 months, when faced with growing political pressure and increasing competition from smaller operators such as wholesale provider CityFiber and Hyperoptic, has BT Openreach stepped up its FTTH deployments as part of its Fiber First strategy. BT is the dominant player in the broadband market with 33.9% market share, followed by Sky with 23.0%. However, most of Sky's broadband connections are provided over Openreach's copper network, with the operator partnering with CityFiber and alternative provider TalkTalk on limited FTTH deployments in only a couple of cities. Virgin Media is the only cable broadband operator in the UK with 19.7% market share. Virgin Media's cable network currently provides the only alternative to BT/Openreach's legacy copper products, and with the operator deploying DOCSIS 3.1 across its network footprint reaching approximately half of UK households, it will be the only operator able to offer gigabit broadband services at scale.

Sample country results and analysis

Cluster 2 countries are starting to push fiber deeper into the access network, although there can be significant differences between the leading and laggard countries within this group. However, even in countries that do have higher levels of coverage, customer penetration is still low compared with in Cluster 1 countries, suggesting that there will need to be a bigger focus on marketing the benefits of those fiber services once they are available.

Because of the availability of other alternative next-generation access technologies such as cable, average download speeds in some Cluster 2 countries can be relatively high, such as in Canada and the US, for example. However, this is not the case for more xDSL-dominated countries such as the UK and Germany, and all countries have relatively low upload speeds. Further investment in FTTP networks will lead to better overall broadband QoE scores across all countries.

Figure 12: Cluster 2 countries are pushing fiber further into the access network



Source: Omdia

Cluster 3

Cluster 3 countries are characterized by very low total broadband penetration levels with less than 40% of households subscribing to any fixed broadband service. Consequently, FTTH penetration in Cluster 3 countries is also very limited.

Table 7: Overview of selected Cluster 3 country Fiber Development Index data

Example countries	Tanzania	India	Ghana	Nigeria	Pakistan
FTTH penetration (%)	0	1	0	0	0
FTTB penetration (%)	20	9	6	2	3
FTTS fiber penetration (%)	13	17	11	4	5
FTTH population coverage (%)	2	5	1	4	6
Fiber backbone length (Score)	0.3	0.6	0.3	0.1	0.3
Download speed (Mbps)	8	30	10	9	10
Upload speed (Mbps)	8	27	9	8	8
Index ranking	63	67	76	79	79

Source: Omdia

These emerging broadband markets face a number of challenges affecting the progress toward achieving high levels of broadband connectivity:

- **Geography.** They have vast areas with sparse population and difficult terrain such as mountains, deserts, and plains, which makes nationwide fiber-optic deployments challenging and economically unfeasible.
- **Demographics.** In many countries, less than half the population lives in cities, and only a handful of people have sufficient means to afford fixed broadband services. Operators tend to deploy FTTH networks in the most affluent areas. Cluster 3 countries also have very young populations that generally prefer mobile over fixed connectivity.
- **Mobile technology dominance.** Most people in developing countries rely on mobile broadband because of its affordability and ease of access.
- **Government policy.** While most countries have adopted national broadband plans or strategies, these tend to focus on general broadband availability and often lack meaningful objectives and specific policies.
- **Insufficient backbone capacity.** In many developing countries, fiber backbone has not yet been built out to support widespread rollouts of FTTH access networks.

Government initiatives and national broadband plans

Cluster 3 countries have adopted national broadband plans or strategies, but these tend to focus on general broadband availability and often lack meaningful objectives and specific policies. A summary of each plan for the example Cluster 3 countries is shown in **Table 8**.

Table 8: Selected Cluster 3 national broadband plans		
Country	**National broadband plan**	**Next-generation-network initiatives**
Tanzania	The National ICT Policy 2003 was revised in 2016 with the aim of providing affordable access to ICT services to as many people as possible in both urban and rural areas. In 2009, the National ICT Broadband Backbone (NICBB) was launched, connecting the majority of regional headquarters across the country and providing connectivity to eight neighbouring countries (Kenya, Uganda, Rwanda, Burundi, Democratic Republic of Congo, Zambia, Malawi, and Mozambique). In 2016, the Universal Communications Service Access Act was adopted to ensure the availability of ICT services in underserved rural and urban areas. The importance of ICT has also been stressed in the Tanzania Development Vision 2025. However no specific broadband targets have been set by the government.	Since 2011, the government is collaborating with private companies to implement Metro Optical rings to extend the NICTBB infrastructure nationwide, particularly in urban areas. The government signed an MoU with network operator Viettel to jointly invest in construction of 20,000km of the optical fiber network to cover 150 district councils in the country.
India	In 2018, the government approved a new National Digital Communications Policy 2018 (NDCP), which replaced the National Telecom Policy 2012. The NDCP objectives include universal broadband connectivity at 50Mbps for everyone by 2022; 1Gbps connectivity to all Gram Panchayats by 2020 and 10Gbps by 2022; access to 100Mbps broadband services for all key development institutions; and ensuring connectivity of all uncovered areas.	In 2012 the government established Bharat Broadband Network Limited (BBNL) to build out national fiber-optic network with a focus on rural areas. Up to 100,000 village councils were covered by 2017, and an additional 150,000 village councils are planned to be covered by 2020. Other alternative operators have also been deploying their own FTTH networks, most notably Reliance Jio, a disruptor mobile operator that began building its full-fiber network in 2019.
Ghana	The National Broadband Strategy adopted in 2012 set out a number of very ambitious objectives to improve broadband connectivity including an aim for 40% of households in Ghana, including those in underserved areas, to have access to broadband services by 2015 and ensuring universal penetration of 90% by 2020. However, these targets have been largely unmet.	Vodafone and MTN Ghana have been deploying FTTH networks in affluent urban areas, primarily in the Greater Accra Region. Google has also been building FTTH network via its broadband infrastructure company Csquared and launched "Project Link" in 2015.
Nigeria	Nigeria launched its first broadband plan in 2013 for the next five years. The plan set out to achieve at least 30% coverage of broadband access with minimum download speeds of 1.5Mbps and an objective of achieving 3G coverage to at least 80% of the population. In April 2020, a new National Broadband Plan 2020–2025 has been developed and approved for implementation. It aims to deliver download speeds across Nigeria of a minimum 25Mbps in urban areas and 10Mbps in rural areas, with effective coverage available to at least 90% of the population by 2025 at a price not more than NGN390 per 1GB of data (i.e., 2% of median income or 1% of minimum wage).	Most operators have been focusing on deploying 4G/LTE mobile networks and providing FWA services. There are a number of small local operators, such as ipNX and Spectranet, rolling out fiber networks, but their deployments are limited to the most wealthy neighbourhoods of big cities (Lagos, Abuja) and often target business and enterprise customers.
Pakistan	The 2015 Telecommunications Policy set a goal for "widespread availability of affordable broadband services provided over fixed or mobile networks with characteristics that support contemporary and new digital applications and content." While the policy does not include any specific speed or coverage objectives, it includes provisions enabling deployment of fiber networks such as a fast-track process for rights of way, use of utility infrastructure, infrastructure sharing, development of standards for fiber rollout plans, introduction of wholesale fiber services, inclusion of broadband in the Universal Service Fund (USF), and favoring fiber over copper access technology.	The national incumbent operator has been deploying FTTH networks in major cities across the country since 2011 and has been upgrading its copper network to VDSL. Smaller alternative operators such as FiberLink, StromFiber, Wateen, and Nayatel have also launched FTTH networks in major cities including Islamabad, Karachi, Lahore, Faisalabad, and Rawalpindi.
Source: Omdia		© 2020 Omdia

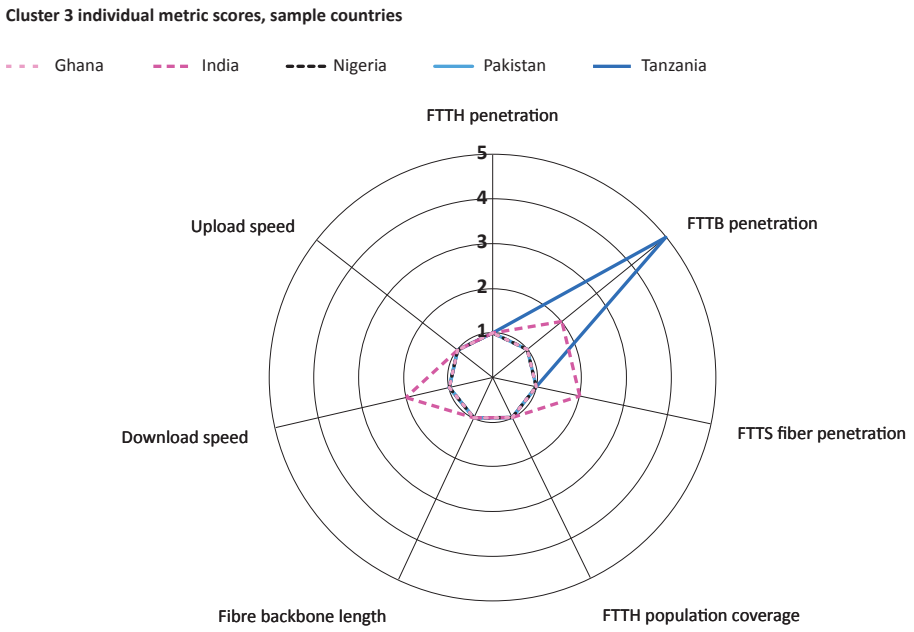
Network competition overview

- **Tanzania.** With less than 1% total broadband penetration, fixed broadband services are very limited in Tanzania. The fixed broadband market is dominated by xDSL services, accounting for 60.5% of all fixed broadband subscriptions and provided by the incumbent operator, TTCL. However, TTCL and several small local operators have been deploying FTTH networks in urban areas.
- **Ghana.** FWA is the leading broadband access technology in Ghana with 76.6% of all broadband subscriptions being provided via either WiMAX or fixed LTE services. Internet Ghana is the leading fixed broadband operator, providing FWA to 38.5% of total broadband subscriptions. Vodafone Ghana, with 23.4% market share, is the only provider operating xDSL and fiber networks in the country.
- **India.** The leading fixed broadband access technology in India is xDSL with 57.6% of all broadband subscriptions. Most xDSL services are provided by the dominant national broadband operator, BSNL, which had reached 45.3% market share at the end of 2019. However, BSNL has been losing its market share to other operators such as Bharti, Hathaway, and most notably, Reliance Jio, originally a mobile network operator, which disrupted the mobile broadband market by offering affordable mobile services. Reliance Jio launched its FTTH broadband service in early 2019 and reached nearly 5% market share by the end of the year.
- **Nigeria.** The fixed broadband market is very fragmented with many small, primarily FWA, operators, and FWA LTE accounts for 94.0% of all fixed broadband subscriptions. Smile is leading the market with 18.5% market share. Mobile network providers MTN and Globacom are leveraging their LTE network to provide fixed-wireless broadband access, and at the same time, they are rolling out FTTH networks, targeting high-end and business areas. Other operators such as ipNX and Spectranet have also been deploying FTTH networks in the most affluent areas.
- **Pakistan.** The fixed broadband market is dominated by xDSL, which accounts for 82.6% of all fixed broadband connections. The incumbent, PTCL, is leading the market with 40.9% market share, providing mostly xDSL services. However, the provider has launched some limited FTTH deployments in major cities. Other smaller operators that have been deploying FTTH networks are Wateen and NayaTel.

Sample country results and analysis

Cluster 3 countries tend to focus their fiber investment on a particular area, usually around FTTB, FTTS, and fiber backbone. This results in spikes, as illustrated by Tanzania in **Figure 13**. In these emerging markets, this more focused strategy is to be expected, but what is important is that over time they build on these investments and expand into the other areas of investment.

Figure 13: Cluster 3 countries focus their investments in key areas



Source: Omdia

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Appendix

Methodology

Metric data has been gathered for each individual index factor. There are seven index factors in total: *FTTH penetration, FTTB penetration, FTTS fiber penetration, FTTH coverage, fiber backbone length, upload speed,* and *download speed*.

Where at all possible, independent, country-level data sources (such as the national telecommunications regulatory authority) are used. All data is for December 2019. Where data does not exist, Omdia has tried to provide realistic estimations based on other factors such as leading service provider data or information. Once data for each country has been entered, a score out of 10 is generated with the top country in that factor scoring 10. The lowest score a country can achieve in each individual factor is 1.

Once all countries have individual scores for all index factors, a final score is calculated based on the average score per factor. Because weighting in this Index is equal across factors, the final score is based on a straight average.

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