Fiber Development Index Analysis: 2022

Brought to you by Informa Tech

OMDIA

Contents

Executive summary

The Fiber Development Index (FDI) tracks and benchmarks fiber development across 88 countries. Fiber investment is vital to the quality delivery of all data services and, therefore, merits thorough contextual analysis. Unlike other fiber benchmarks that largely track household coverage and/or penetration, the FDI includes a wider set of fiber investment metrics, including:

- Fiber to the premises (FTTP) coverage
- Fiber to the household (FTTH) penetration
- Fiber to the business (FTTBusiness) penetration
- Mobile cell site fiber penetration
- Advanced WDM technology investment

In addition to the fiber investment metrics, the FDI, based on Omdia's analysis of Ookla Speedtest data, goes on to quantify the overall broadband quality of experience improvements driven by that investment, namely:

- Median download speed
- Median upload speed
- Median latency
- Median jitter

Fiber investment is an essential metric for government institutions, network operators, and other stakeholders such as media companies to track. As a broadband-access technology, optical fiber provides an optimized, highly sustainable, 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 economic indicators, with additional GDP growth 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 can countries optimize their growth potential, and fiber-optic technology is key to that investment, whether this is in the backhaul or access network.

Singapore again leads the 2022 FDI, with maximum scores in seven of the nine metrics. It is closely followed by South Korea, China, the UAE, Qatar, and Japan, which complete the current Cluster 1 territories. Within the five chasing territories, China is currently the fastest developing and is the only territory in Cluster 1 to have increased its ranking. All territories in the leading cluster benefit

from strong national broadband plans with ambitious targets around ultra-high-speed services, often backed by generous government grants or subsidies.

In the past, several otherwise highly developed broadband territories that rank lower in the fiber index—such as the US, Australia, and the UK—tended to suffer from less clear or ambitious national plans, providing weaker incentives for operators to invest. To some extent, this was often linked to less favorable geographical and demographic conditions that made government initiatives expensive and, therefore, likely to come up against significant political objections. However, due in some part to the COVID-19 crisis demonstrating just how important broadband networks are, governments around the world are now strengthening their broadband targets and increasing their focus and investments in fiber-based infrastructure.

This white paper has been sponsored by Huawei, with all analysis and conclusions arrived at independently by Omdia.

Key points and recommendations

- **It's critical that the digital divide is not focused solely on being connected versus unconnected.** Broadband connectivity is now essential to everyday life. However, the quality of that connectivity is also vitally important. For many digital applications—such as video conferencing, gaming, and video streaming—to work well, they need high-speed, low-latency, and highly reliable and consistent networks. Those individuals and businesses that have such access will be at a significant advantage over those that don't.
- **Fiber is not just about high speed.** Concentrating only on speed makes the business case for investing in fiber access difficult to justify, especially as copper-based access technologies continue to improve their own speed capabilities. However, fiber also brings a range of other benefits to an operator, including higher overall quality of service (QoS), lower maintenance costs, lower energy costs, and smaller physical infrastructure requirements. All such characteristics need to be considered when developing fiber investment plans.
- **Governments must recognize the benefits to the wider society.** Investing in greater fiber development not only brings benefits to end users and network operators, but to society as a whole. The broadband industry supports a wider ICT industry that typically accounts for between 2% and 7% of a country's overall GDP and supports a vast range of industries, from manufacturing to health institutions to educational facilities, as well as supporting more social aspects such as well-being and social equality. Investment in advanced broadband technologies such as all-fiber-optical networks, therefore, will bring vital socioeconomic growth to a country.
- **Fiber is future-proof and more sustainable.** Beyond economic benefits, an all-fiber network is virtually future-proof and has significant environmental benefits over copper-based networks. In 2019, Telefónica (Spain) stated that its FTTH network was 85% more energy efficient than its old copper infrastructure. Over three years, the operator said its FTTH initiative had saved 208GWh, representing a reduction of 56,500 tons in CO2 emissions. As countries move to a greener future, fiber-optical-based communications must be part of that plan.

- **An end-to-end fiber network is fundamental to digital transformation.** Quality of experience guarantees will rely on end-to-end optical networking. This has led to a major industry mind-shift in flattening the metro network to a single-hop optical access that will ensure guaranteed bandwidth, higher network resiliencies and reliability, and service-level agreement (SLA) assurance for vertical business services and home users.
- **Leading territories will start to extend the access network deep into customer premises.** Enterprises increasingly rely on time-sensitive networks to optimize their performance. Therefore, we will see a push to implement FTTMachine to connect machines and industry robots in order to utilize fiber's high bandwidth, high reliability, low latency, anti-interference, and high-confidentiality features. Starting with the high-end segment of the market, we will also see FTTRoom technology increasingly used in residential settings.
- **Governments should pass legislation to enable gigabit societies.** Governments should ensure that telecommunications infrastructure can be deployed in the most efficient manner, by requiring all new developments/real estate to be equipped with in-building mini ducts, fiber, in-building access points, or other physical infrastructure to accelerate deployment and reduce rollout cost.
- **To encourage greater fiber deployment, all regulators must follow best-practice policies, including:**

– Facilitating deployment through municipality approvals, using existing resources (government buildings, streetlights, ducts etc.,) and sharing infrastructure/facilities.

– Introducing and enabling flexibility in partnership arrangements, such as allowing agreements between players; co-financing; collaborative models; public-private partnerships; and innovative partnerships.

– Providing financial support through investment, incentives, and subsidies (e.g., universal service funds).

– Implementing regulatory flexibility, including removal of outdated or nonessential regulations.

– Improving access to telecoms facilities and physical infrastructure; improving procedures for rights of way and accessing public infrastructure, as well as broadband mapping.

– Setting coverage/minimum speed targets through a national broadband plan or universal service obligation (USO).

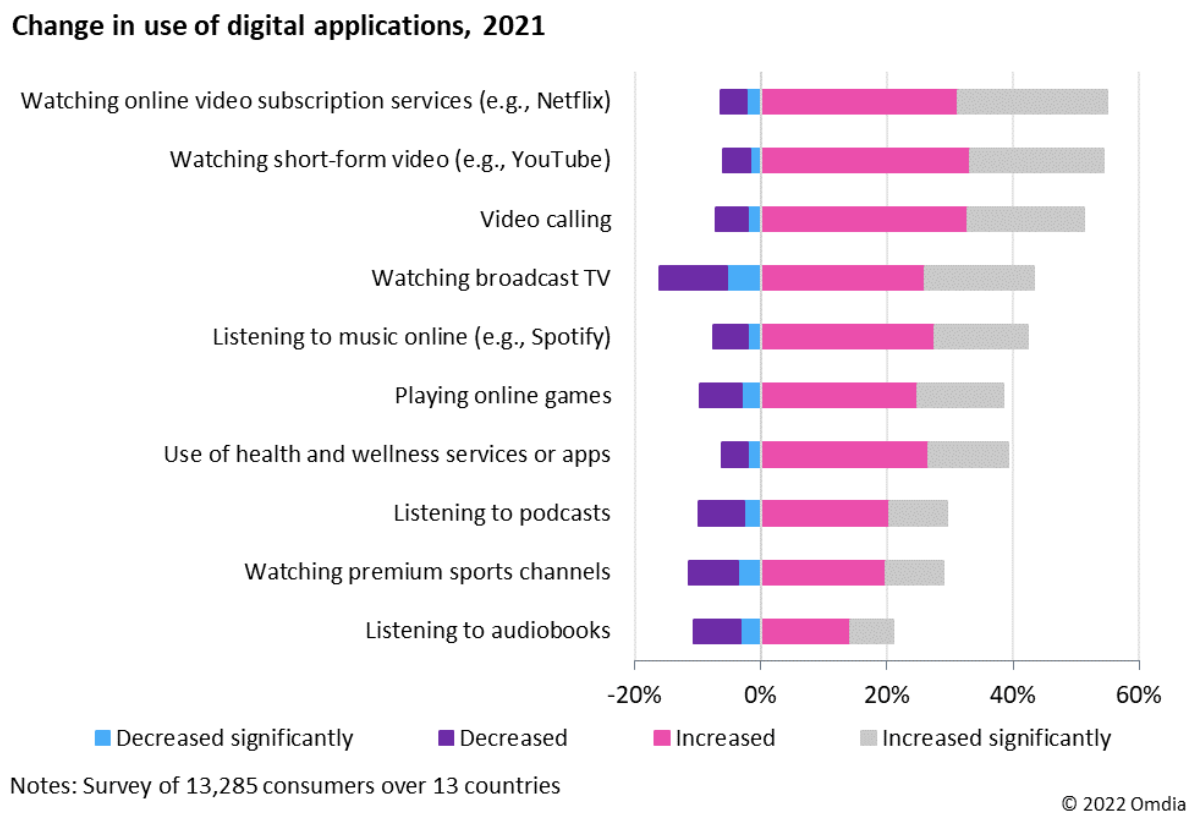
Why fiber investment is so critical

Our reliance on broadband access only continues to grow

Broadband access is rapidly changing the way we live, work, and play. Due to the impact of COVID-19, 2021 witnessed record uptake in many digital services and applications. Although in most countries and territories restrictions have now eased, the impact of the pandemic will continue to stretch far beyond the initial health and social crisis, with industry trends and people's behavior undergoing a long-term change.

Figure 1 shows that the use of video-based services in particular has grown, not just limited to entertainment applications. Also, 51% of respondents to Omdia's Digital Consumer Insights survey stated that their use of video calling had increased in 2021, with 18% noting the change as significant.

Figure 1: Reliance on digital applications continues to grow

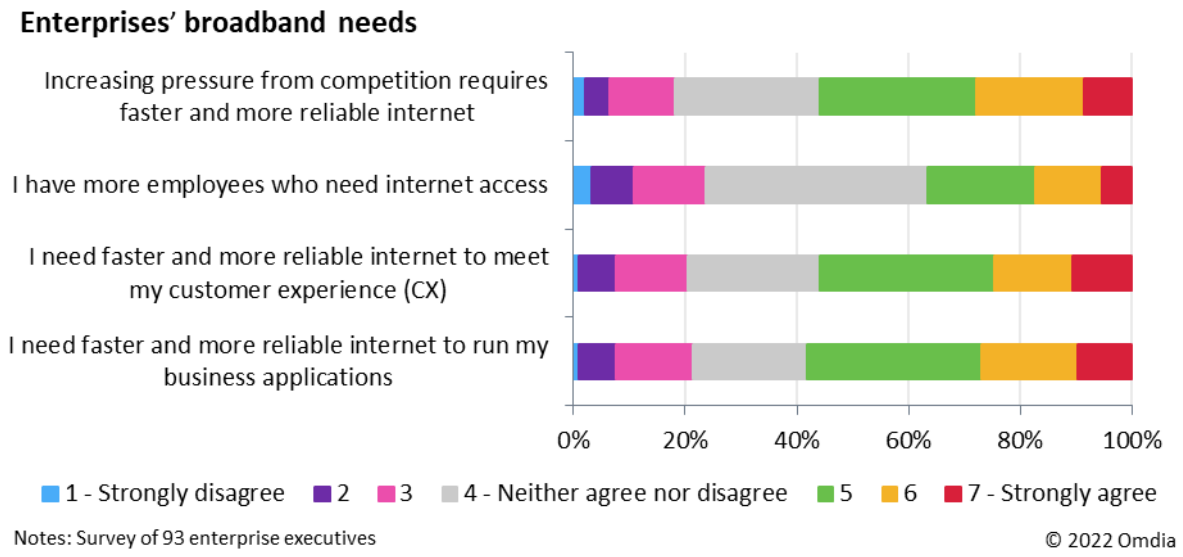


Source: Digital Consumer Insights 2021, Omdia

A rapid rise in home working was one driver of the increase in video-conferencing, and even though most places of work are now fully open, many workers have continued to work from home, at least on an occasional basis. In a survey by PwC of over 52,000 workers across 44 countries and territories (PwC's *Global Workforce Hopes and Fears Survey 2022),* 26% of respondents stated that they would prefer to continue to work from home full time; however, only 18% noted that their employer would expect this. On the flip side, only 11% of workers said that they would prefer to work full time in the office, with a greater 18% stating that this is likely to be their employer's preference. Therefore, hybrid working is likely to be the compromise made by many employers, making home working IT solutions a key growth segment moving forward.

It is not just residential users that are increasingly turning to online applications. It is imperative that enterprises of all types digitize their operations to remain relevant to their customer base and drive greater efficiency—and this means an ever-increasing reliance on fast, reliable broadband access services. In a survey of just under 100 enterprise executives, over 55% of respondents stated that their businesses now required faster broadband access to meet the needs of their customers, run business applications, and remain competitive in general. Also, 38% noted that they have employees who also need to gain access to business broadband services (see **Figure 2**).

Figure 2: Enterprises require faster and faster broadband to run their business applications



Source: Thought Leadership – Enterprise Survey 2021, Omdia

Closing the true digital divide

Broadband investment is a key driver of country growth and development. Although complex to fully quantify, the importance of broadband connectivity in socioeconomic development is undeniable. The global broadband subscription market alone was worth over $356bn at the end of 2021 and supports a wider ICT industry that typically accounts for between 2% and 7% of a country's overall GDP.

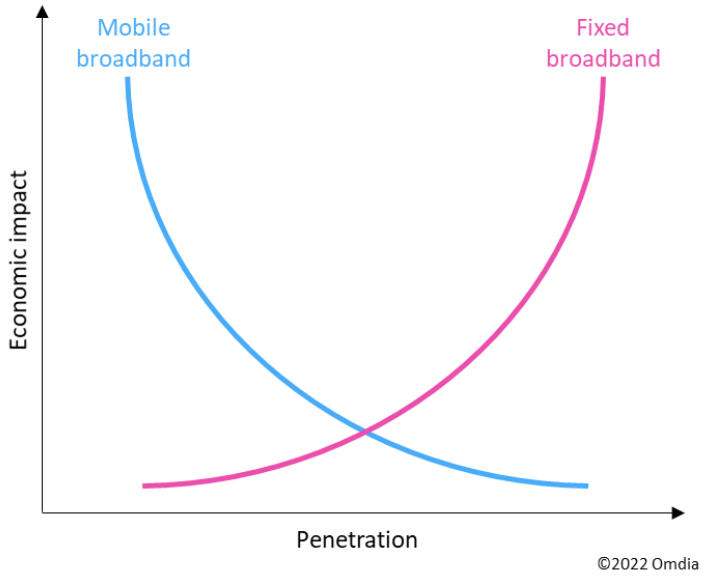
The benefits of broadband, however, spread far beyond those that can be directly monetized. For example, a study by the World Bank concluded that the chance of an educated population finding a job increases by 7–13% when it has access to fiber-optic infrastructure. Additionally, broadband networks are used to support a vast range of industries, from manufacturing to health institutions to educational facilities, as well as supporting more social aspects such as well-being and social equality.

Governments around the world now recognize the importance of broadband at a country level, with the majority setting out national broadband plans to drive greater connectivity penetration. To some extent, such efforts are working, with the global unconnected population dropping from 45% in 2019 to 27% by 2026. However, 30% of that connected population by 2026 will still only be connected via mobile access.

Mobile broadband connectivity can bring quick and significant economic impact in emerging economies, but as modeled by the ITU in its report *How broadband, digitization and ICT regulation impact the global economy*, this impact reduces due to diminishing returns as penetration increases. In contrast, the level of benefit increased in line with fixed-broadband penetration. Moreover, the greater the broadband maturity of a country, the more capable it is of increasing product digitization

and further driving its economic impact (see **Figure 3**). It is imperative, therefore, that countries do not push simply for 100% connectivity but 100% fixed-broadband connectivity.

Figure 3: Economic contribution of mobile versus fixed broadband



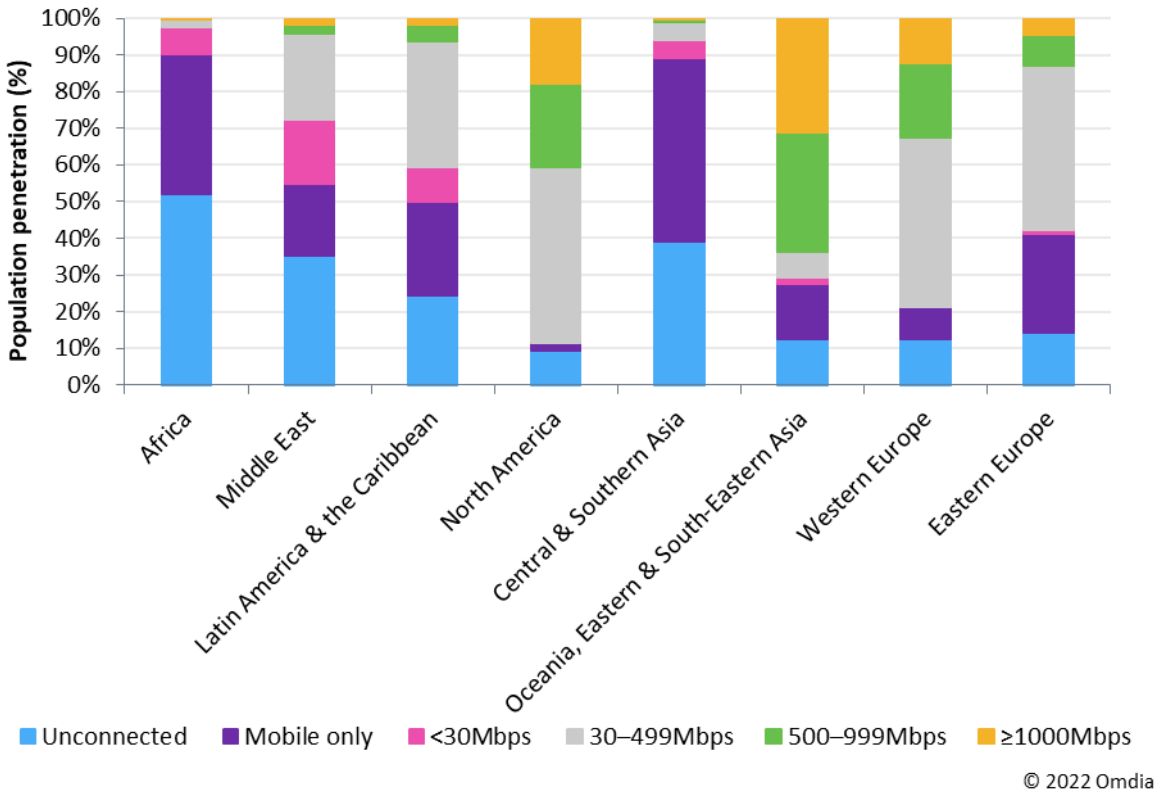
Source: *How broadband, digitization and ICT regulation impact the global economy*, ITU and Omdia

However, 100% fixed-broadband penetration is not the end goal. With broadband, the quality of a connection is just as important as the connection itself. Unlike other utility services such as gas and electricity, the quality of broadband network is important, as higher-speed, lower-latency networks can support a greater number of more sophisticated, cloud-based applications. This wider, more advanced set of internet applications can help further drive a country's wealth and overall efficiency.

The future digital divide, therefore, should not be measured by the level of connectivity, but by the level of high-speed fixed-broadband connectivity. By this measure, though, the divide is only growing bigger—not smaller.

Figure 4 shows the global population by region and how they will be connected by 2026. The chart shows that most regions other than Africa will have reached well over 50% connectivity penetration by 2026. However, in developed areas such as North America and Oceania, Eastern & South-Eastern Asia, this connectivity is almost all fixed broadband, and significant portions of the population receive high-speed broadband connections of over 500Mbps. In less-developed regions, however, the availability of such high-speed broadband access is still small. If such regions don't catch up quickly, then they will be left at a serious disadvantage—especially as the world moves to applications like XR and the metaverse.

Figure 4: Percentage of connected population, by fixed-broadband speed, by region, 2026



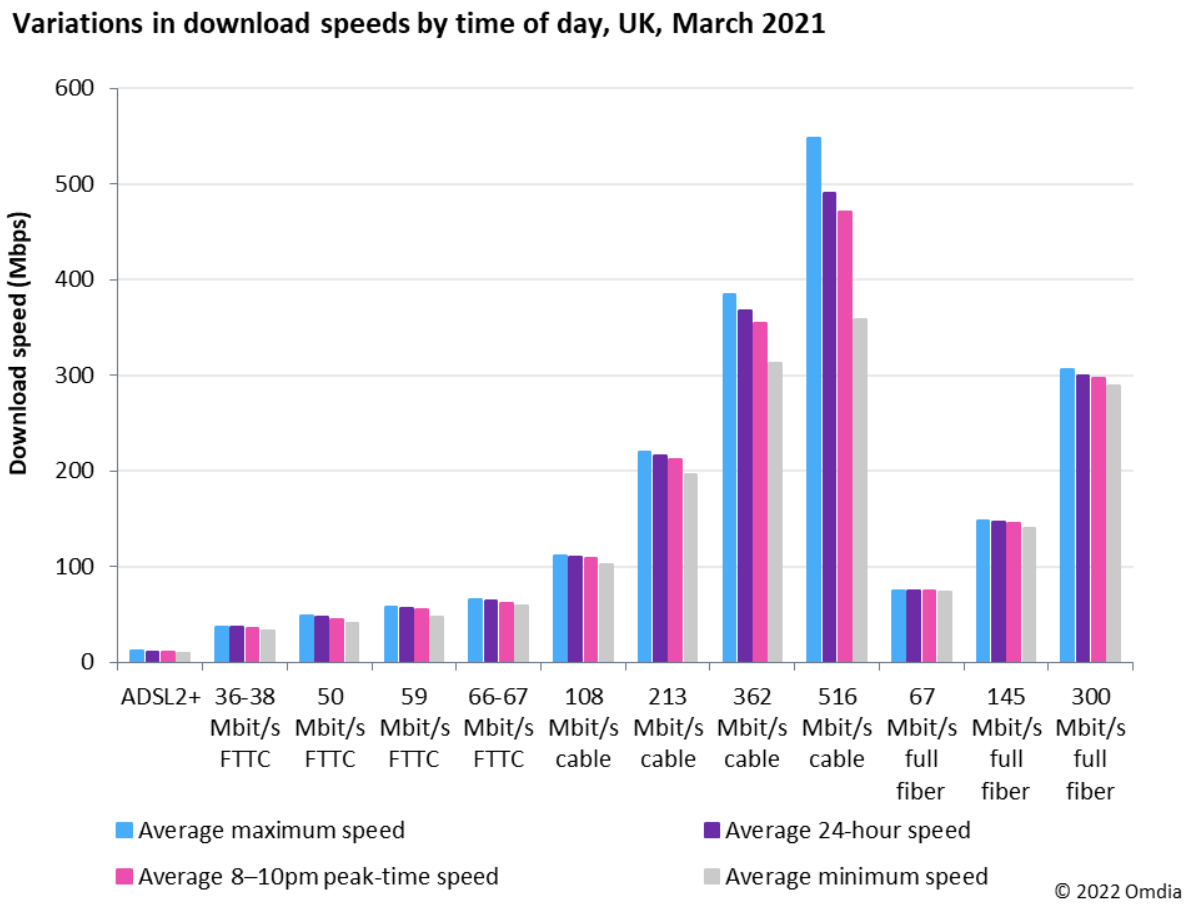
Source: Omdia

Fiber is the ultimate broadband technology

As discussed in the *Fiber Development Index Analysis: 2021* report, end-to-end optical-fiber networks outperform all other broadband technologies on all QoS metrics, including superior network consistency properties, thus ultimately providing the best quality of experience (QoE) to the customer.

In this report, we highlight the results of the most recent broadband QoE metric report, *UK Home Broadband Performance*, from the UK telecommunications regulator, Ofcom. In this report, data shows that although at the time of measurement, the UK cable broadband operators were offering higher top-download speeds than the newer FTTH operators, the average speeds over the cable network could vary considerably depending on the time of day and congestion on the network. In comparison, speeds across fiber networks remained highly consistent (**Figure 5**).

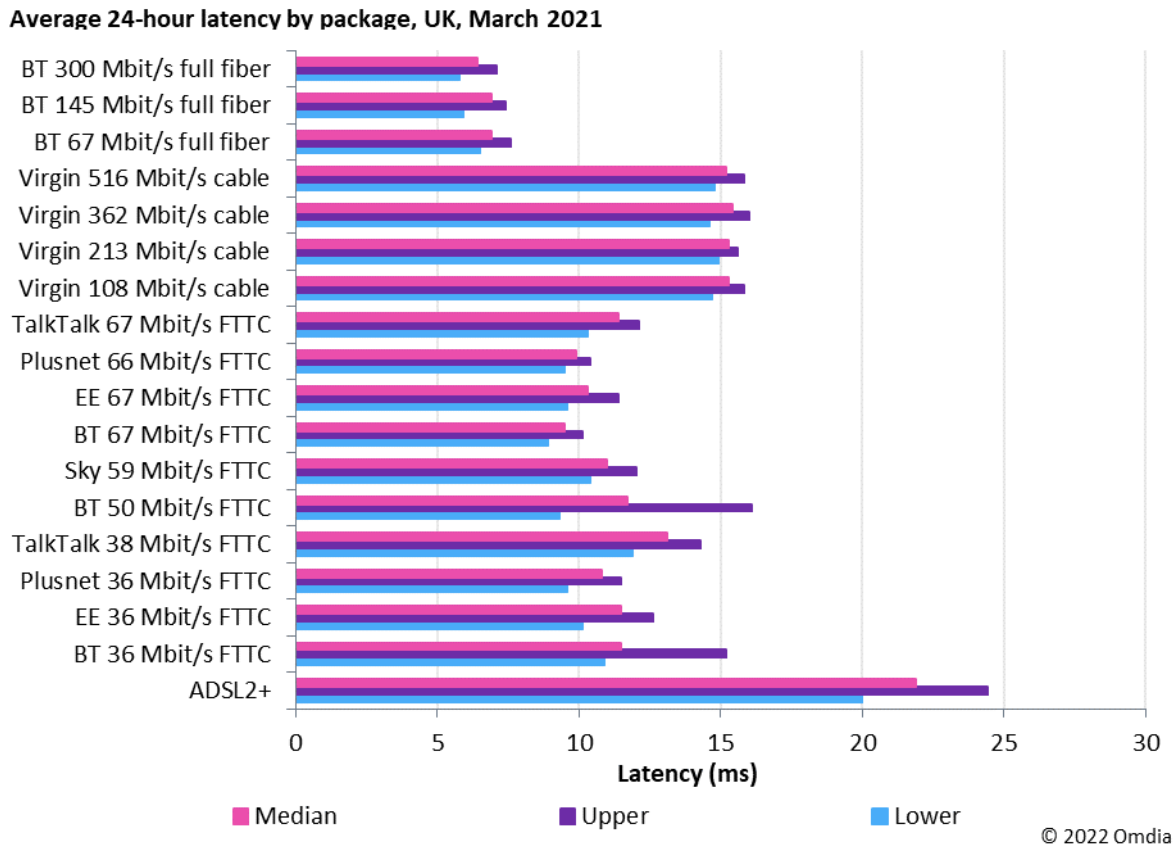
Figure 5: Fiber provides the most consistent download speed



Source: "UK Home Broadband Performance," Ofcom and Omdia

Ofcom's report also highlights fiber networks' low-latency characteristics. **Figure 6** shows that regardless of speed, the fiber-based offerings consistently offer lower latency than services provided over other broadband access networks.

Figure 6: Full-fiber networks offer lower latency



Source: "UK Home Broadband Performance," Ofcom and Omdia

Fiber brings business benefits beyond customer satisfaction

As well as delivering a superior QoS experience, full-fiber networks have several other network benefits that operators must consider when developing fiber investment business models. Compared to copper-based networks, full-fiber infrastructure is newer, made of highly resilient material, and is more passive. These features mean that full-fiber networks need far less maintenance, and as they don't require as much active equipment in the field to power them, their energy consumption is lower, and there is less need for field maintenance.

In addition, as optical-fiber cabling offers significantly higher bandwidth capacity at a fraction of the size and weight of copper wiring, it uses far less cabling and fewer racks and switches than copper-based networks—saving both physical space and money. Finally, the smaller size of the optical cables makes it possible to deploy using a technique known as "micro-trenching," which is cheaper, quicker, and less environmentally destructive than traditional telecom network trenches.

Fiber helps with the telco green agenda

The green agenda has become an important topic for national governments and private enterprises. Many broadband service providers have already adopted environmental elements to their list of corporate values. Moving to a 100% fiber-optical network can also help with such initiatives, as fiber has several inherent properties that make it more environmentally friendly compared to copper-based networks.

Full-fiber networks require much less active equipment in the field to power them, significantly reducing energy consumption. An optical distribution network (ODN) requires zero electrical power. In addition, due to fiber's significantly higher bandwidth capacity at a fraction of the size and weight of copper wiring, it requires significantly less power per bit. Typically, according to equipment vendor Huawei, for every 10,000 access connections that evolve from copper access to a FTTH Gigabit Passive Optical Network (GPON), the operator saves over 1,500kWhs of power.

In 2019, Telefónica (Spain) stated that its FTTH network was 85% more energy efficient than its old copper infrastructure. Over three years, the operator said its FTTH initiative had saved 208GWh, representing a reduction of 56,500 tons in CO2 emissions. In Belgium, incumbent telco Proximus noted that data transmission over its fiber network uses up to 12 times less energy than on its copper network. A large part of this energy saving is down to the significant reduction in the number of street cabinets, as well as the reduction in size of the remaining ones.

A study launched in 2017 by Europacable, a European organization representing wire and cable producers, concluded that fiber is 64% more energy efficient than hybrid fiber-coaxial (HFC) cable technology. It found that performing at 50Mbps, fiber networks consume 56kWh per capita per year compared to 88kWh for DOCSIS.

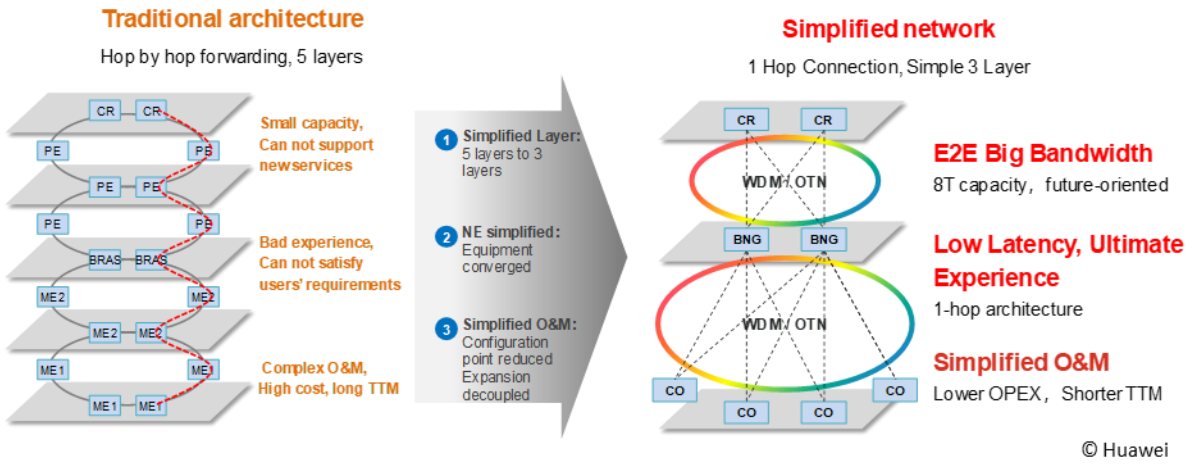
Due to its superior network qualities, the move to advanced fiber networks can also bring indirect environmental benefits by reducing commuting trips because of video conferencing and home working. Openreach in the UK, for example, estimated that moving to a full-fiber network would enable 230 million fewer commuting trips per year—equivalent to 700,000 tones of saved carbon.

Moving toward a gigabit society with advanced fiber technology

Fiber access improves end-to-end optical networking

PON-based access networks are already supporting residential and non-residential customers and applications. Next-generation PON variants, such as 10G PON, are optimized to support future FMC (fixed-mobile convergence) needs as transport traffic (such as wireless backhaul) can be supported over the same PON infrastructure as end-user services. This approach saves fiber assets and operational costs, thereby achieving faster ROI. In addition, next-generation PON access networks will be future-proofed to support all enterprise services and smart city applications.

Figure 7: Moving to a flat optical network for optimized efficiency



Source: Huawei

It's important to note that this future transport network will not be a dumb pipe that is fully dependent on IP capabilities, but it will rely on end-to-end optical networking to ensure guaranteed user experiences. This has led to a major industry mind-shift in flattening the metro from the

traditional five hops to one-hop optical access (see **Figure 7**). An underlying optical network—wavelength-division multiplexing (WD) and optical transport network (OTN)—that flattens the metro and backbone network with all-optical fiber, ensures guaranteed bandwidth, higher network resiliencies and reliability, and service-level agreement (SLA) assurance for vertical business services and home users.

End-to-end IP-based packet networking is the basis for true FMC network construction and provides fast service routing and switching capabilities. Network operators use IP ports to connect 5G RAN eNodeBs (base stations) with 10G or 25G interfaces to support 50G or 100G per ring and direct traffic to super-fast heavy-duty core routers via cloud metro aggregations. For edge computing and latency-sensitive applications, many use-case service centers will be near the edge and used in cloud metro for quick response time. An excellent example of such a service is an edge-distributed content delivery network (CDN). Segment routing removes the need for resource reservation protocol-traffic engineering. Moreover, the hardware and software of existing brownfield deployment routers require updates to support soft and hard slicing for many time-sensitive digital services. An all-optical network with smart protocols is a requirement for the gigabit society.

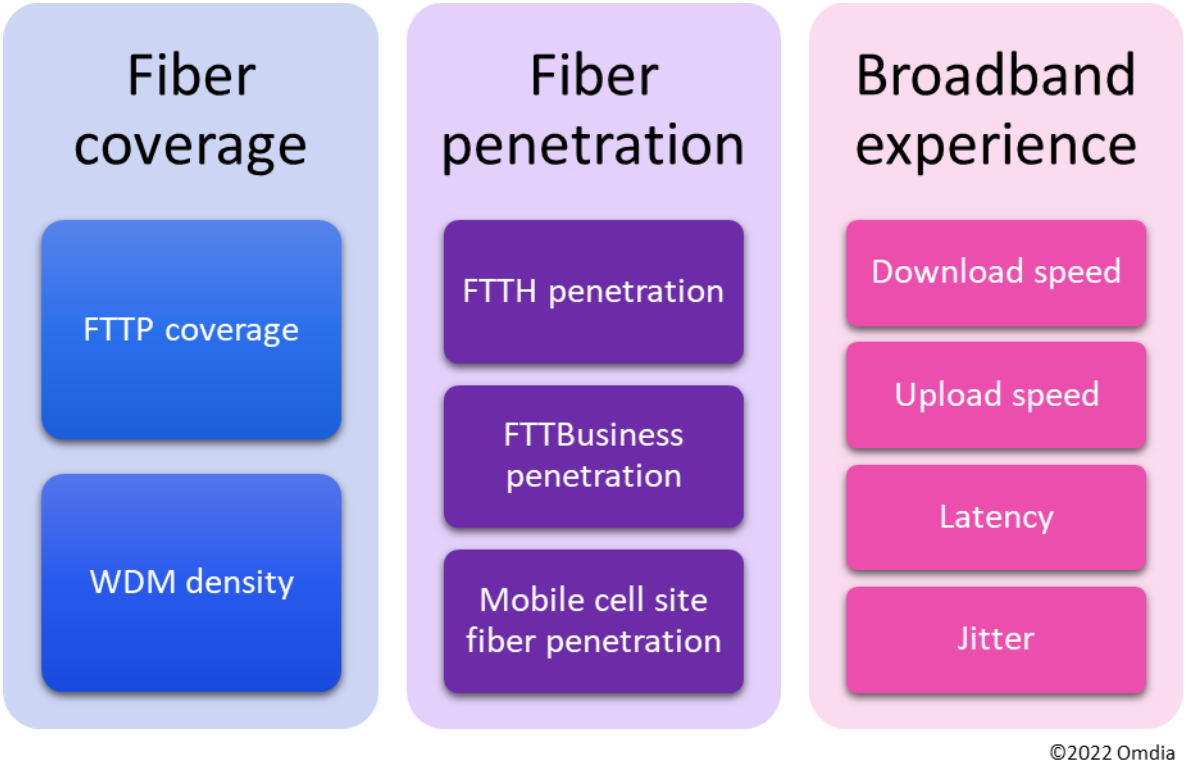
The FDI 2022: Key results

FDI 2022 methodology

Due to the importance of fiber investment and its impact on global development, Omdia has created a fiber benchmark known as the Fiber Development Index. Unlike other benchmarks that only track a single development metric such as coverage or household penetration, the Fiber Development Index aims to capture all elements of fiber network investment: overall fiber access coverage, fiber to the home (FTTH) penetration, fiber to the business (FTTBusiness) penetration, mobile fiber backhaul, and advanced fiber WDM core technology.

Additionally, the index then aims to measure the outcome of this investment in terms of the country's overall broadband experience, measured in terms of median download and upload speeds, as well as median network latency and jitter (see **Figure 8**).

Figure 8: The Fiber Development Index



Source: Omdia

Improvements to the FDI: 2022

The Fiber Development Index has been further developed in 2022 to enhance three of the existing metrics and add two new experience-related metrics on latency and jitter.

- **New WDM density metric**. In previous versions, the Fiber Development Index had a "fiber density" metric that measured the level of optical-fiber infrastructure deployed per household in a country. In the 2022 version, this metric has been changed to measure the level of advanced WDM equipment installed on a per-household basis, to better measure the migration from basic fiber to advanced fiber technology. Please note that as WDM density metric data is not available for 2020 and 2021, no scores for those years have been included in the index.
- **Change from mean to median speeds**. In this year's index, Omdia is delighted to announce a new partnership with Ookla. In previous versions of the index, Omdia used its own estimated average download and upload broadband speeds. In the 2022 iteration, the index uses measured median speeds experienced by the end user based on Ookla's Speedtest data. This upgrade brings three clear benefits:

– Speed metrics are based on end-user measurement data.

– The change to median speed data provides a more realistic view of the speed the average user receives in each market. Please note this is based on the speed the customer receives on the end device and includes the home Wi-Fi network.

– An up-to-date view of the market is provided by using the latest available data.

- **Addition of new median latency and jitter metrics.** Further, due to its partnership with Ookla, Omdia has added two new important metrics on latency and jitter. Latency and jitter are essential metrics for a number of broadband applications and are key performance indicators (KPI) of overall broadband QoE. The addition of latency and jitter to the Fiber Development Index represents a significant and important upgrade.

Please note that historic 2020 and 2021 data for all QoE metrics has also been included, and all previous territory scores and rankings have been updated to reflect these changes.

Methodology

To quantify the level of investment in each segment, Omdia has used a selection of metrics as outlined and defined in **Table 1**.

Table 1: Individual metrics used in the Fiber Development Index

Group	Metric	Definition	Importance
Coverage	FTTP coverage	The total number of residential and business premises covered by the optical-fiber network.	Represents the current potential of the fiber-access network. A limited coverage will mean that only a small selection of households and businesses can gain access to the full benefits of a fiber network.
	WDM density	The total WDM port shipments over 100Gbps over the past five years, divided by the number of households.	Fiber throughout the network supports the necessary quality of experience and reliability that broadband services need. Therefore, a more advanced core fiber network drives greater reliability and performance for broadband networks.
Penetration	FTTH penetration	The number of FTTH subscriptions divided by the total number of households.	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.
	FTTBusiness penetration	The number of FTTBusiness subscriptions divided by the total number of business premises.	FTTBusiness penetration represents the current take-up of FTTBusiness services. The greater the take-up, the more businesses will take advantage of FTTBusiness services, enabling a more efficient and more dynamic enterprise.
	Mobile cell site fiber penetration	The percentage of total mobile cell sites that are fiber-connected.	Mobile cell sites need high-speed and high-quality backhaul capabilities to optimize mobile-access performance. A high FTTSite penetration will therefore mean a more optimized mobile data network.
Experience	Download speed	The median end-user download speed in Mbps.	Advanced fiber networks can 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	The median end-user uplink speed in Mbps.	Unlike most other access network technologies, fiber networks can also offer symmetrical services. Although historically deemed more suitable for business, symmetrical services are becoming increasingly important in the residential market.
	Latency	The median end-user latency in ms.	Latency is the response time between an input and an outcome. This is particularly

			important in applications such as online gaming but can affect most online activities.
	Jitter	The median end-user jitter in ms.	Low jitter is important for streaming services such as video streaming, online gaming, and video conferencing.

Source: Omdia

Index ranking methodology

The index aims to combine the individual metrics outlined in **Table 1** of this report into a single benchmark measure following a five-step process.

Step 1: Data collection and analysis

For each metric, various datasets were used to gather as accurate information as possible for each country. Sources include

- National regulators
- National broadband operators
- Omdia's own databases and market forecasts
- Ookla's Speedtest data

Where data does not yet exist for a metric in a particular country, estimates were made based on other relevant market information.

Step 2: Data normalization

The data for each metric was then normalized to offer the same unit of measurement and scale before generating a single overall measure. This is a vital step as many of the datasets can be expressed in different ways—perhaps a percentage or some other metric such as Mbps or km per household. Normalizing the metrics transforms these different measures into a standard scale—in this case, 0–100.

Datasets expressed in a percentage were directly converted into a score out of 100. For other metrics, calculations were based on a reference measure—that is, the ideal goal or using the top country as the reference if the objective is open ended. It is important to note that in such cases, the goals or calculation methods are likely to change as markets develop over time.

Step 4: Weighting and index calculation

In each case, the metric and metric group (see **Table 2**) are weighted to apply differential levels of importance for the final index calculations. For the FDI 2022, the weighting has been set as per **Table 2** to reflect the current importance of continued fiber rollout investment.

In the FDI 2022:

- Within coverage, FTTP coverage is weighted over WDM density as it is still vitally important in the majority of cases that territories continue to push toward 100% coverage. As more territories reach this goal, it is expected that the weighting will shift more toward investments in WDM so that territories can continue to move toward more advanced fiber core capabilities.
- In penetration, FTTH and FTTBusiness penetration are slightly weighted over mobile cell site fiber penetration to favor territories that have strategies to push fiber further in the access network over those that have more of a 5G strategy focus.
- In the broadband experience section, download speed remains the highest-weighted metric, as this continues to be the most important characteristic for many of today's applications. This is then followed by latency, upload speed, and finally jitter. As the demands of future applications change, these weightings will be updated accordingly.

Table 2: Metric weightings, FDI 2022

Group	Group weighting	Metric	Metric weighting within group
Coverage	33%	FTTP coverage	60%
		WDM density	40%
Penetration	33%	FTTH penetration	35%
		FTTBusiness penetration	35%
		Mobile cell site fiber penetration	30%
Experience	33%	Downlink speed	40%
		Uplink speed	20%
		Latency	30%
		Jitter	10%

Source: Omdia

The final index measure was calculated as follows: the group score was created by summing the metrics in that group, multiplying these totals by their weightings, and then summing the group scores multiplied by their weightings.

Step 5: Sensitivity analysis

Finally, sensitivity analysis was carried out to investigate the robustness of the overall index result. To this end, different methods were used to calculate the individual metric scores and the global measure to estimate the general impact on the index results. Such an approach is essential, as data sources can vary from country to country and can often change as their processes are reviewed or local definitions change.

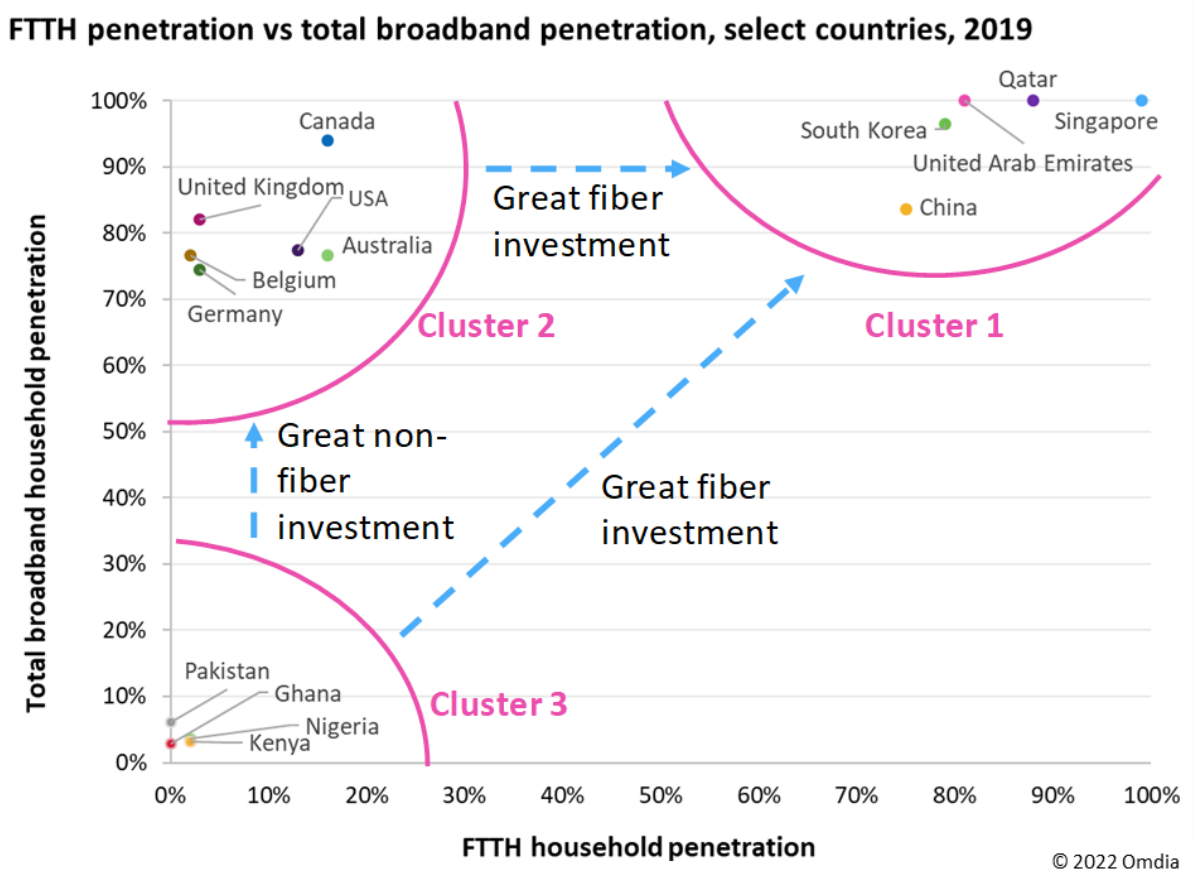
Fiber Development Index clusters

The Fiber Development Index covers 88 territories of varying sizes, demographic and geographical profiles, and levels of broadband development. Due to these widely differing characteristics, it makes it difficult to directly compare them; in Omdia's opinion, comparison would only lead to unfair and unhelpful conclusions and recommendations.

Therefore, to compare individual results, the Fiber Development Index splits territories into three different country clusters:

- Cluster 1: Countries with highly developed fiber-based broadband networks
- Cluster 2: Developed broadband countries that are moving toward greater fiber broadband adoption
- Cluster 3: Emerging broadband countries that have a low level of broadband household penetration

Figure 9: Fiber development clusters enable more focused recommendations



Source: Omdia

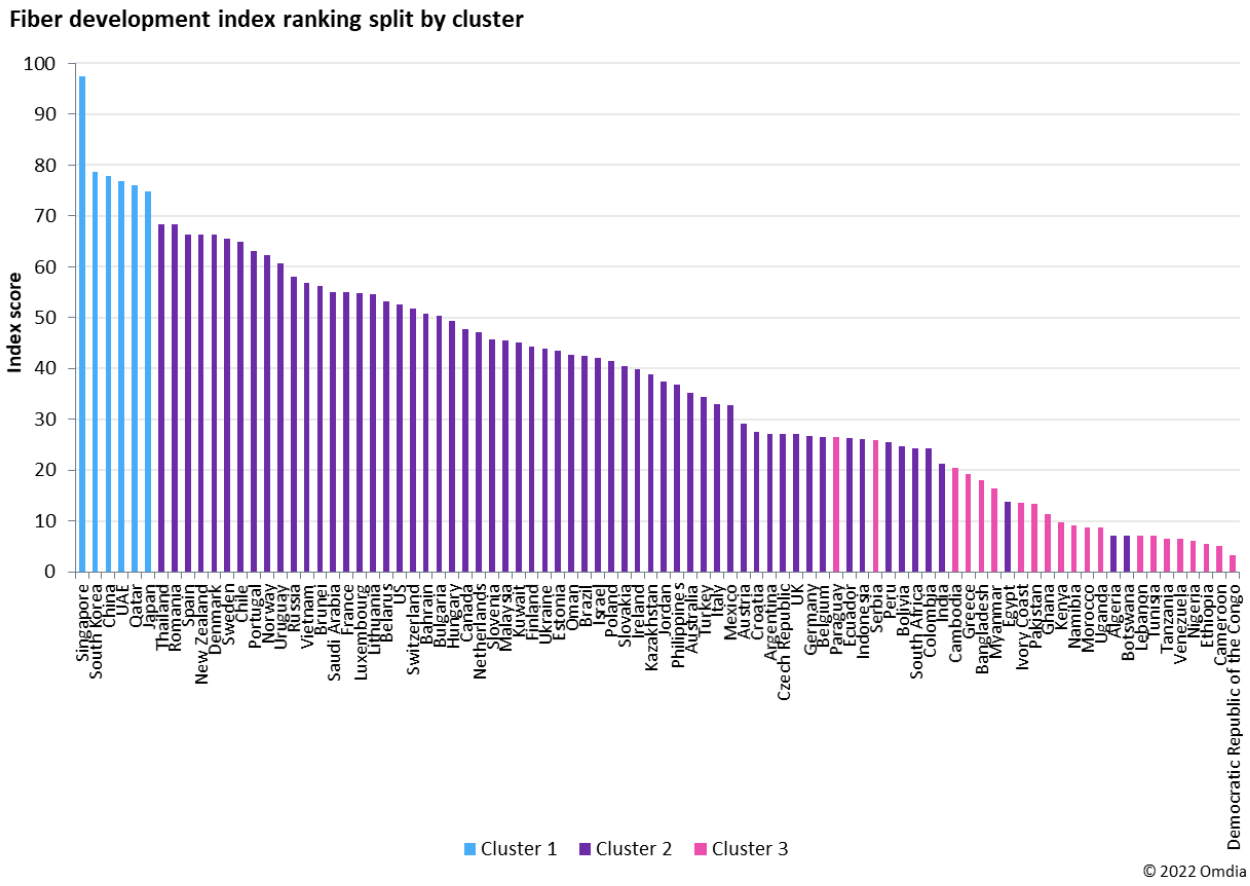
In terms of future development, countries or territories in Cluster 2 can only move from left to right (see **Figure 9**) over time as they continue to replace legacy technologies with fiber-based ones. However, Cluster 3 countries can move up by investing in alternative technologies first (fixed wireless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

FDI 2022 ranking results

Singapore continues to lead Omdia's Fiber Development Index, and if anything, it has stretched its lead over all other territories in Cluster 1, with maximum scores in seven out of the nine metric categories. Within the entire index, Chile is the biggest mover in the rankings, increasing an impressive 15 places since 2021, and is now the leading Latin American territory. The UAE continues to be the leading Middle Eastern country, in fourth place overall, although it has dropped one place in 2022 to China. Romania is the leading European country, closely followed by Spain, which jumped one place in this index; however, Sweden (the previous European leader) has dropped five places to

12th overall. The US continues to be the leading North American territory, in 25th place, with South Africa the leading African nation in 64th place (see **Figure 10**).

Figure 10: Fiber Development Index 2022 ranking



Source: Omdia

Cluster 1 movers and shakers

Singapore continues to not only remain in the Fiber Development Index's top spot but to extend its lead as the territory continues its path toward a gigabit society. China has also continued to expand its fiber capabilities, overtaking the UAE to move into third position and closing in fast on South Korea in second place. The remaining Cluster 1 territories have seen no further movement in this update (see **Figure 11**).

Figure 11: Cluster 1 scores and changes in the Fiber Development Index ranking

Rank	Country/territory	Rank change 2021–22	2020 index score	2021 index score	2022 index score	Cluster
1	Singapore	0	85	86	98	Cluster 1
2	South Korea	0	74	72	79	Cluster 1
3	China	1	69	69	78	Cluster 1
4	UAE	-1	69	71	77	Cluster 1
5	Qatar	0	68	69	76	Cluster 1
6	Japan	0	60	65	75	Cluster 1

Source: Omdia

Cluster 2 movers and shakers

Within Cluster 2, there is significant movement in the rankings as territories continue to evolve to fiber-based broadband networks. New Zealand, which has seen a significant expansion in fiber coverage in recent years due to its Ultra-fast Broadband Program, has entered the top 10 for the first time as FTTH and FTTBusiness penetration continue to increase, in turn leading to growth in broadband quality metrics such as download and upload speeds.

However, the biggest mover is Chile, rising 15 places to 13th position. Driven by a mix of public funds as part of the country's National Fiber Optic project and private investment, Chile has seen a rapid increase in FTTP coverage (from 29% back in 2020 to 64% in 2022), which in turn has led to FTTH penetration more than doubling and also, therefore, a significant improvement in overall broadband experience. Other countries that have seen big improvements in their ranking include the US, Canada, the Netherlands, and Ecuador.

It is also worth noting some of the territories in this Cluster that had taken an early leading position in previous rankings, such as Sweden, Portugal, and Norway, but are now starting to slip down the index (see **Figure 12**). This is often due to an early investment in FTTP coverage, followed by a slower move to advanced broadband technologies and FTTP penetration. This then leads to a stall in the overall broadband experience improvement compared to other territories. This shows how vital it is that after an initial investment in fiber access infrastructure, territories continue to invest in the core of the network and push customer penetration if they are to evolve to gigabit societies.

Figure 12: Cluster 2 scores and changes in the Fiber Development Index ranking

Rank	Country/territory	Rank change 2021–22	2020 index score	2021 index score	2022 index score	Cluster
7	Thailand	1	52	57	68	Cluster 2
8	Romania	1	54	56	68	Cluster 2
9	Spain	1	55	55	66	Cluster 2
10	New Zealand	5	50	52	66	Cluster 2
11	Denmark	0	50	54	66	Cluster 2
12	Sweden	-5	59	58	65	Cluster 2
13	Chile	15	26	39	65	Cluster 2
14	Portugal	-2	51	54	63	Cluster 2
15	Norway	-1	52	53	62	Cluster 2
16	Uruguay	2	48	48	61	Cluster 2
17	Russia	-4	52	53	58	Cluster 2
18	Vietnam	-2	46	50	57	Cluster 2
19	Brunei	5	41	45	56	Cluster 2
20	Saudi Arabia	3	44	45	55	Cluster 2
21	France	5	34	41	55	Cluster 2
22	Luxembourg	-5	45	49	55	Cluster 2
23	Lithuania	-1	46	46	55	Cluster 2
24	Belarus	-4	45	47	53	Cluster 2
25	US	6	37	38	53	Cluster 2
26	Switzerland	-1	41	41	52	Cluster 2
27	Bahrain	-6	39	46	51	Cluster 2
28	Bulgaria	-9	45	47	50	Cluster 2
29	Hungary	5	35	37	49	Cluster 2
30	Canada	6	36	37	48	Cluster 2
31	Netherlands	6	35	36	47	Cluster 2
32	Slovenia	-3	36	39	46	Cluster 2
33	Malaysia	2	36	37	46	Cluster 2
34	Kuwait	4	28	35	45	Cluster 2
35	Finland	-2	35	38	44	Cluster 2
36	Ukraine	-9	40	40	44	Cluster 2
37	Estonia	-7	36	39	43	Cluster 2
38	Oman	3	25	31	43	Cluster 2
39	Brazil	5	25	31	42	Cluster 2
40	Israel	-1	30	34	42	Cluster 2

41	Poland	-1	29	34	41	Cluster 2
42	Slovakia	0	29	31	41	Cluster 2
43	Ireland	0	28	31	40	Cluster 2
44	Kazakhstan	-12	34	38	39	Cluster 2
45	Jordan	0	26	31	38	Cluster 2
46	Philippines	0	21	30	37	Cluster 2
47	Australia	1	27	28	35	Cluster 2
48	Turkey	-1	26	28	34	Cluster 2
49	Italy	1	23	25	33	Cluster 2
50	Mexico	1	22	25	33	Cluster 2
51	Austria	2	20	23	29	Cluster 2
52	Croatia	4	20	22	28	Cluster 2
53	Argentina	4	18	21	27	Cluster 2
54	Czech Republic	-5	26	27	27	Cluster 2
55	UK	4	19	21	27	Cluster 2
56	Germany	-2	20	22	27	Cluster 2
57	Belgium	-2	22	22	27	Cluster 2
59	Ecuador	8	14	17	26	Cluster 2
60	Indonesia	-8	21	23	26	Cluster 2
62	Peru	-4	19	21	26	Cluster 2
63	Bolivia	-3	17	21	25	Cluster 2
64	South Africa	-2	18	20	24	Cluster 2
65	Colombia	3	14	17	24	Cluster 2
66	India	-1	17	19	21	Cluster 2
71	Egypt	2	7	10	14	Cluster 2
79	Algeria	2	6	7	7	Cluster 2
80	Botswana	0	6	7	7	Cluster 2

Source: Omdia

Cluster 3 movers and shakers

Cluster 3 is made up of emerging broadband markets where FTTP coverage is typically less than 10%. Indonesia and Paraguay are two exceptions: both have relatively high FTTP coverage of 46% and 27%, respectively. However, both territories have still to turn that coverage into a high level of fiber penetration—something they should both now focus on.

Many of the other territories in this cluster, such as Nigeria, for example, are only now starting to see early shoots of FTTP investment. Others, such as Uganda and Morocco, have already seen some increase in FTTP penetration, which has led to increased scores around broadband experience, but FTTP coverage still remains very low (see **Figure 13**). All these territories must continue to look for ways to increase fiber coverage as they try and move toward fiber-first broadband nations.

Figure 13: Cluster 3 scores and changes in the Fiber Development Index ranking

Rank	Country/territory	Rank change 2021–22	2020 index score	2021 index score	2022 index score	Cluster
58	Paraguay	5	16	19	27	Cluster 3
61	Serbia	0	19	20	26	Cluster 3
67	Cambodia	-3	18	19	20	Cluster 3
68	Greece	2	13	14	19	Cluster 3
69	Bangladesh	0	15	16	18	Cluster 3
70	Myanmar	-4	18	18	16	Cluster 3
72	Ivory Coast	-1	6	12	14	Cluster 3
73	Pakistan	2	7	8	13	Cluster 3
74	Ghana	-2	11	11	11	Cluster 3
75	Kenya	1	8	7	10	Cluster 3
76	Namibia	-2	7	8	9	Cluster 3
77	Morocco	1	6	7	9	Cluster 3
78	Uganda	5	5	6	9	Cluster 3
81	Lebanon	-4	6	7	7	Cluster 3
82	Tunisia	-3	7	7	7	Cluster 3
83	Tanzania	-1	8	6	7	Cluster 3
84	Venezuela	1	5	5	6	Cluster 3
85	Nigeria	-1	4	6	6	Cluster 3
86	Ethiopia	1	4	3	6	Cluster 3
87	Cameroon	-1	7	4	5	Cluster 3
88	Democratic Republic of the Congo	0	3	3	3	Cluster 3

Source: Omdia

Legislation best practice

Robust regulatory policies facilitate fiber deployment, uptake, and QoE

One of the most cited barriers in fiber rollouts is either the lack or inefficiency of regulation. To promote fiber development, governments must adopt concrete legislation that targets inefficiencies such as insufficient access to existing telecoms and public infrastructures, improves rights of way, and promotes investment and partnership agreements

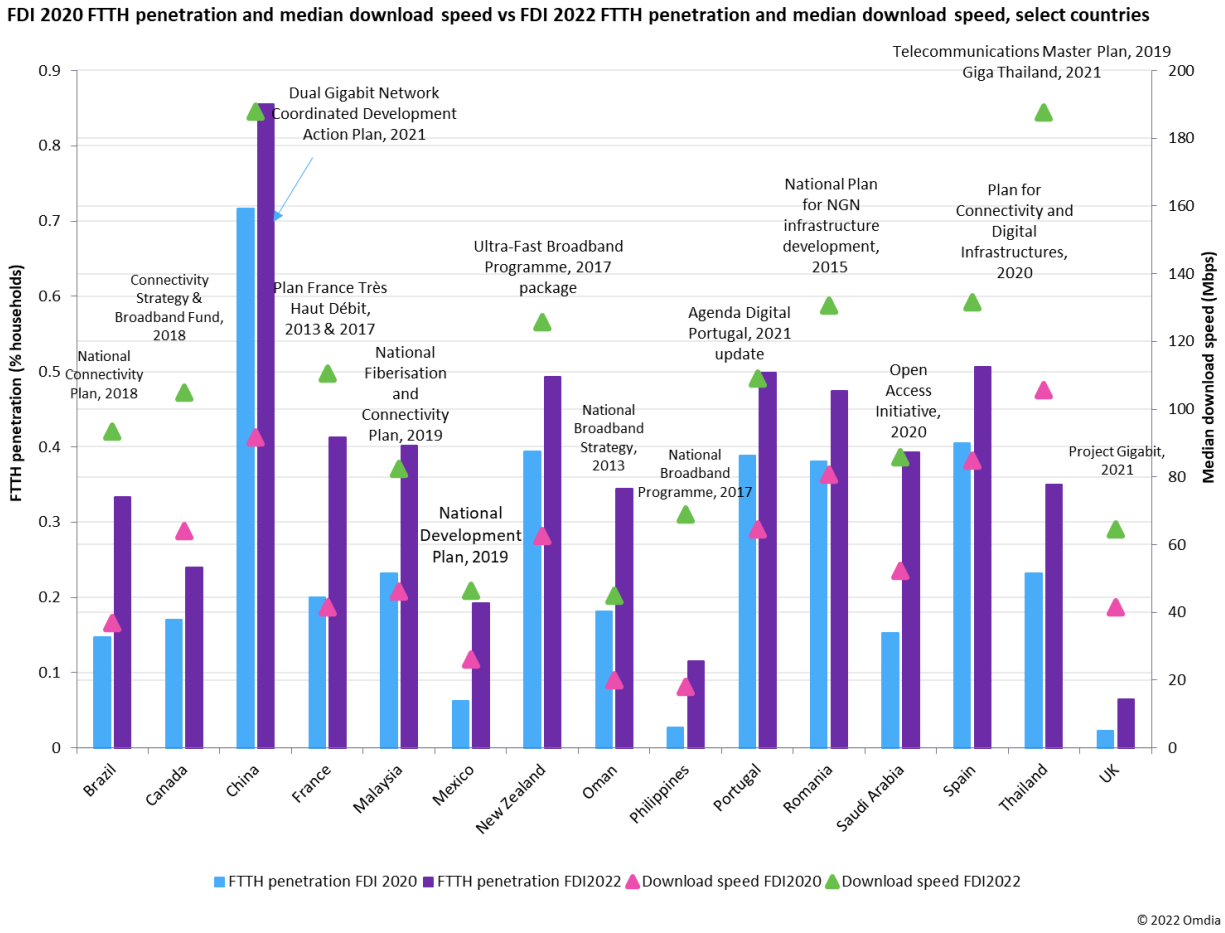
Most countries in the FDI have a national broadband agenda in place; however, it is not enough to publish a national broadband strategy without also ensuring its implementation. Successful countries follow through on their broadband initiatives, creating sufficient supporting funding and tracking progress of reaching the goals set out in the broadband plans, while taking advantage of new technologies and innovations that may be better suited to achieve these targets. Generally, there tends to be a significant lag between a national broadband strategy's introduction and the tangible results being noticeable in the field. However, a review of select markets that have seen significant improvements in fiber uptake, median download speeds, and regulatory policies implemented over the last couple of years clearly shows a positive impact on fiber development in these countries (see **Figure 14**).

Some countries, such as France or the UK, have only recently recognized the importance of fiber in their national broadband strategy and have since made significant and rapid progress in fiber deployment. In 2021, the UK government launched a £5bn government infrastructure project called "Project Gigabit," aimed at getting gigabit broadband access to more than one million hard-to-reach homes and businesses. In France, the 2017 amendment to the original 2013 ultra-fast broadband plan (Plan Très Haut Débit) gave preference to fiber over other access technologies. In Brazil, a 2017 revamped version of the national broadband plan originally drafted in 2010 also seeks to expand fiber-based network throughout the country. The strategy passed a bill modifying the country's telecom legislation, unfroze resources from the telecom universalization fund, and modified fines-for-investments deals between telecom regulator Anatel and telecom operators. The approach has led to substantial improvements in both fiber access and quality of experience for consumers.

In other countries, additional funding and amendments to existing strategies were necessary to boost broadband network deployments in hard-to-reach areas. In New Zealand and Canada, funding packages adopted in 2017 and 2018, respectively, have led to fiber-network expansions. In Oman, there was a delay between strategy adoption and securing sufficient funding. Oman's government adopted its National Broadband Strategy in 2013 but did not receive financing for its fiber network rollout from the Asian Infrastructure Investment Bank (AIIB) until 2017. A second financing extension from the AIIB was awarded in 2021. Only after the government was able to secure this investment has the country seen a substantial increase in fiber deployment and uptake.

Focusing on cooperation among network operators is an essential part of successful gigabit broadband strategy, as recognized by the Saudi Open Access Initiative adopted in 2020. All six telecommunications companies entered into the Open Access agreement, guaranteeing the provision of broadband services through any subscriber-selected service provider, independent of infrastructure ownership.

Figure 14: National broadband plans and initiatives and progress in FDI metrics for select countries



Source: Omdia, Ookla

Broadband policy examples

China

China continues to be one of the most ambitious countries when it comes to connectivity targets, especially considering the size of the country and scale of the population. The country now sits in third position in the Fiber Development Index, having witnessed the highest increase in its FDI score out of the top 10 countries.

The State Council launched its national broadband strategy—Broadband China—in 2013. Initially the increasing ratio of FTTH users was slow. In 2014, to push forward with the fiber access network construction, the MIIT together with the MHURD made a joint announcement about the new national standards for fiber preinstallation and sharing with operators in new buildings. The strategy created a clear requirement for fiber cabling and installation engineering and removed obstacles from property management organizations. According to the new standards, before new buildings receive a sales permit, the access fibers to every household and the rooms for communication device deployment must be completed and have passed the acceptance tests. All engineering costs should be covered by building developers. With the strong support from the government, the fiber access ratio among all broadband users increased significantly from 2015. By the end of 2021, 99% of homes in China had access to FTTH technology, and FTTH penetration sat at 85%.

Between 2016 and 2018, the MIIT and the National Development and Reform Commission (NDRC) led a three-year action plan for the construction of communications infrastructure, with a budget of CNY1,200bn ($181bn). The plan aimed to support the development of high-speed fiber optics, the construction of advanced mobile broadband systems, and global network facilities. To execute this plan, the government focused on 92 selected infrastructure projects, with a total investment budget of CNY902.2bn ($136.3bn). Prioritizing certain projects allowed the government to focus on the areas most in need.

In 2019, the MIIT then proposed a “dual-gigabit acceleration, same speed for same network” plan to promote fixed-broadband gigabit applications in order to keep pace with bandwidth-hungry services. This involves utilizing 10G Passive Optical Network (PON) technology to create a dual gigabit broadband service that features both wired and wireless gigabit broadband.

There is currently no regulation imposing a broadband USO across the entire country. However, the MIIT supports the upgrade of fiber broadband in 130,000 administrative villages, including 43,000 poor villages. By November 2018, 96% of administrative villages achieved optical-fiber access, and the country expanded broadband infrastructure to 94% of underserved villages. This was ahead of schedule according to the country’s broadband strategy, which required operators to expand broadband infrastructure to 98% of underserved villages by 2020.

In 2021, China shifted its focus from broadening the coverage of the fiber network to increasing the speed and improving the quality of broadband services. In March 2021, the MIIT released a plan to expand the gigabit network to cover 200 million people by the end of the year and 400 million by the end of 2023. The government targeted 10 million gigabit users by the end of 2021—a goal it smashed, with more than 34 million 1Gbps users at the end of 2021 and just under 46 million by March 2022. As of the same date, 93% of broadband users had access to speeds of 100Mbps, and as of June 2022, China had the third-fastest median broadband speed in the FDI.

EU

The European Union, through its European Commission (EC) governing body, sets out policies to encourage digital opportunities and enhance Europe’s leading position in the digital economy. In May 2015, the Digital Single Market (DSM) strategy was adopted to eliminate online barriers. These barriers hamper free movement of goods and services online and mean that businesses, governments, and individuals cannot fully benefit from digital tools that would be available to them but that are currently locked in 27 different regulatory environments.

The EC estimates that once completed, the DSM could create up to €415bn per year and generate hundreds of thousands of new jobs. The DSM strategy is based on three pillars:

- Access: better access for consumers and businesses to digital goods and services across Europe
- Environment: creating the right conditions and a level playing field for digital networks and innovative services to flourish
- Economy and society: maximizing the growth potential of the digital economy

However, for consumers, businesses, and governments to fully benefit from the provisions of the DSM, it is essential that access to digital infrastructure is ensured by facilitating rollout of reliable, high-speed broadband networks across Europe. In September 2016, the EC introduced a new set of competitive Gigabit Society connectivity targets to be achieved by 2025. These targets include:

- All main socioeconomic drivers, such as schools, transport hubs, and main public service providers, as well as digitally intensive enterprises will have gigabit connectivity.
- All urban areas and all major terrestrial transport paths will have uninterrupted 5G coverage.
- All European households, rural or urban, will have access to internet connectivity offering a download speed of at least 100Mbps, upgradable to gigabit speed.

Moreover, the Digital Compass communication adopted in March 2021 set out ambitious “Digital Decade” 2030 targets, which further highlight gigabit connectivity for everyone and 5G coverage everywhere by 2030. In September 2021, the “Path to the Digital Decade” proposal then identified and confirmed the importance of investment-friendly regulatory and policy frameworks, which would facilitate collaboration between national and EU-level policies and foster investment to achieve the Digital Decade 2030 targets. This framework includes stipulations for multi-country projects under the auspices of the newly established European Digital Infrastructure Consortium (EDIC). Under the EDIC procedure, at least three member states can present large-scale projects that facilitate the digital transformation targets and channel coordinated investments between the EU, the participating member states and, where applicable, other public or private stakeholders.

In addition to its digital strategies, the EC also sets forth concrete policies focused on broadband infrastructure deployment. In 2014, the EU established the “Broadband Cost Reduction Directive,” which aimed to “facilitate and incentivize the rollout of high-speed electronic communication networks.” The regulation promoted measures for facilitating the joint use of existing physical infrastructure and more efficient deployment of new physical infrastructure at a lower cost. The EU member states implemented the directive into their national rules. However, in 2018, the EC reviewed the directive’s implementation and found problems related to its efficiency and consistency.

In 2020, the EC launched a further review and created the European Electronic Communications Code to improve the regulatory conditions to incentivize private investment and deploy and take up high-speed broadband networks. The European Electronic Communications Code also addressed the timely and investment-friendly access to the 5G spectrum. The EU instructed member states to transpose and apply the code’s provision by December 21, 2020.

In September 2020, the EC adopted a recommendation calling for all member states to develop and agree on a common Union toolbox of best practices to foster connectivity. In terms of reducing network deployment costs, the best practices are as follows:

- Streamlining permit-granting procedures for civil works
- Improving transparency and reinforcing the capabilities of the single information point
- Expanding the right of access to existing physical infrastructures controlled by public sector bodies
- Improving the effectiveness and efficacy of the dispute-resolution mechanism
- Reducing the environmental footprint of networks
- Performing environmental impact assessments and taking account of the results

As a result of the unified digital strategies and regulations, there has been great improvement in fiber availability and take-up across the EU, with Romania and Spain ranked in the top 10 countries/territories in Omdia's FDI and Denmark, Sweden, and Portugal in the top 15. However, there remain large differences among the EU member states in terms of fiber rollout, and penetration and achieving universal gigabit connectivity will be challenging in some markets.

Thailand

With 32% of the country's population still accessing the internet only through mobile networks and with just 56% fixed-broadband household penetration, Thailand could still be thought of as a largely "mobile-first" country. However, 63% of those connected households are connected via FTTH technology, and so where broadband is available, the QoE is very high. Therefore, Thailand already sits in seventh place in the Fiber Development Index. The challenge for the Thai government now, therefore, is to continue to expand the fiber coverage and encourage further take-up.

The aim of the original Thai national broadband plan was to cover 95% of the population with its fixed-broadband network by 2020, but it missed this target by some margin. Where the country has been successful is in its fiber-first broadband strategy, achieving FTTP coverage of 56% at the end of 2021.

Fiber is seen by the Thai government as a key investment to drive economic growth and to make Thailand an "ASEAN digital hub." In November 2021, NBTC announced a partnership with Huawei at an event—Giga Thailand: Broadband Forum—to accelerate fixed-broadband coverage and upgrade to gigabit-speed standards.

Under new policies set out by the Thailand Digital Economy and Society Development Plan from MDES (MDES Action Plan 2018–22, and ONDE Action Plan 2022–27), the Thai government developed five key targets related to the development of fixed-broadband networks:

- Target 1: By 2022, the country's fixed-broadband network is expected to be expanded to all villages and by 2027, to 100% of Thai households. This includes expanding fixed-broadband

coverage to cover all households, particularly those in rural areas, unattractive investment areas, and private areas (networks in private areas such as residential buildings, office buildings, housing estates, and industrial parks).

- Target 2: By 2022, every village will have access to fixed-broadband speeds greater than 100Mbps, and by 2027, speeds of at least 1Gbps will be available in the municipality, economic zone, public utility, and learning centers. Currently, the mean average download speed of fixed-broadband connections in urban areas is just under 2Gbps, but there are still many households on copper and coaxial cables. To meet the speed requirement, therefore, the Thai government is recommending that all infrastructure in urban areas be upgraded to fiber-optic networks.
- Target 3: By 2022, the target is to increase household fixed-broadband penetration to more than 70% and to more than 80% by 2027. FTTH penetration should also be increased to 50% of households by 2022 and to 75% by 2027.
- Target 4: By 2022, the goal is to reduce the price of fixed broadband to 2.5% of GNI per capita and to less than 1% by 2027. To achieve the goal of 1% of GNI per capita by 2027, fixed-broadband service prices must be reduced by 1.8% of GNI per capita or approximately 281THB per month. As a result, the target monthly fee for fixed broadband is around 263THB.
- Target 5: By 2027, the digital economy contribution level is targeted to be 25% of the Thai GDP, up from 17% in 2017. To accomplish this goal, the Thai government is focused on increasing the investment value from digital and e-commerce sectors.

Malaysia

In 2018, the Malaysian Communications and Multimedia Commission (MCMC) carried out a review of its national broadband strategy and found a number of performance challenges that were holding back the country's broadband development. Although at that time broadband services were available to 92% of the population in populated areas, rural areas were still less well served. It also found that even where available, the quality of the broadband infrastructure could also be low, while prices were still relatively high.

The organization, therefore, set out its "National Fiberisation and Connectivity Plan (NFCP) 2019-2023," with the specific aim of

- Addressing the issues that hinder the availability of affordable and high-quality broadband connectivity
- Supporting the needs of the country as it evolves while harnessing the opportunities offered by new digital services and technologies
- Providing a clear strategic direction for initiatives that support the digital economy and the adoption of future technology

To meet these aims, the MCMC set out a new fiber-first national broadband plan with the following targets:

- Entry-level broadband packages equivalent to 1% of GNI by 2020

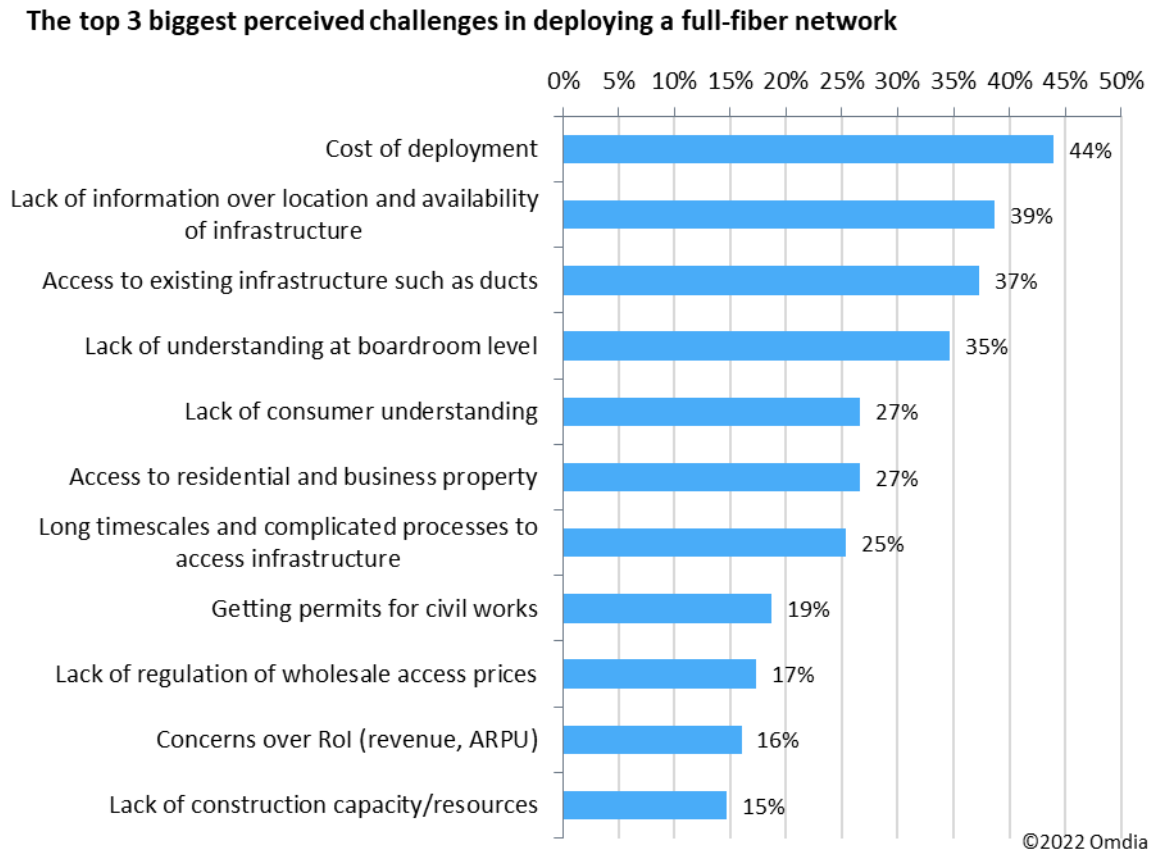
- Gigabit broadband services available in industrial areas by 2020 and all state capitals by 2023
- 100% availability of a minimum 500Mbps to premises in state capitals and selected high-impact areas and 20% availability for premises in suburban and rural areas with speeds up to 500Mbps by 2022
- The fiber network to pass 70% of schools, hospitals, libraries, police stations, and post offices by 2022
- An average speed of 30Mbps in 98% of populated areas by 2023

The results of these initiatives are that FTTP coverage is now 53% (up from 45% in 2020) and FTTH penetration is 40%. Overall broadband speeds, however, are still quite low, and the government should look to policies that will encourage greater investment in the fiber core to enable more advanced broadband services and applications in the future.

Best practice for fiber development and key tools to enable faster deployment

Operators looking to deploy fiber infrastructure face many challenges, some of which require intervention from regulators and governments to overcome them. In a survey by the World Broadband Association of 75 broadband operator senior executives, cost of deployment—as perhaps to be expected—was highlighted as the number one perceived challenge, closely followed by a lack of information on the location and availability of key infrastructure, as well as easy access to that infrastructure (see **Figure 15**).

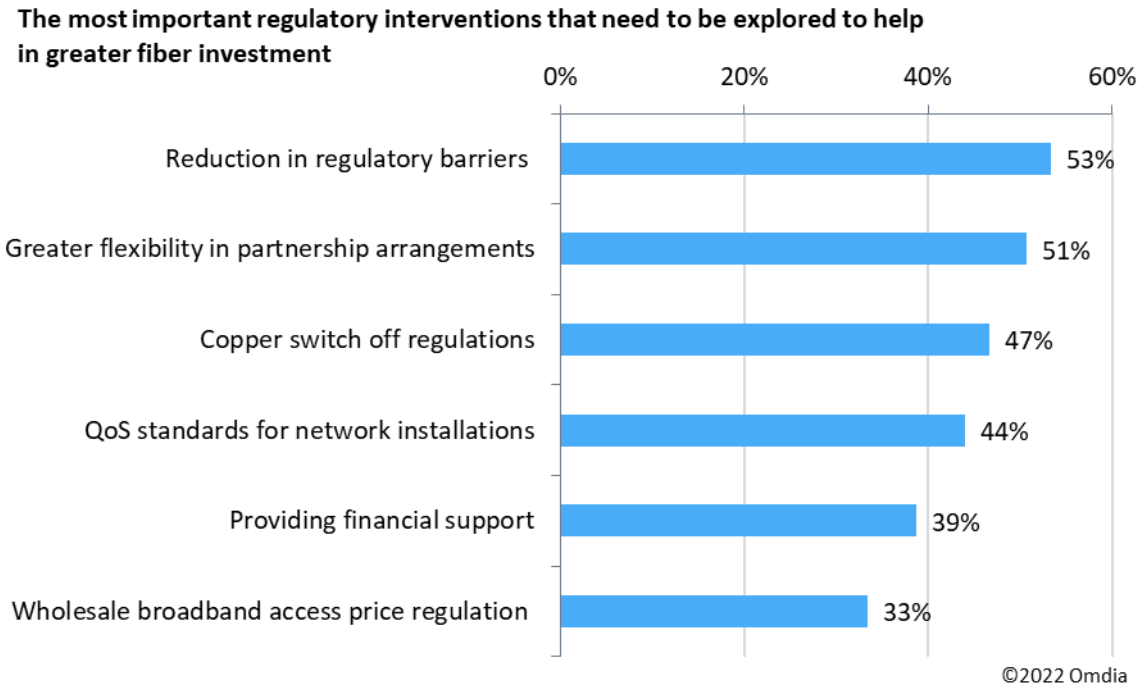
Figure 15: Cost of deployment is not the only hurdle when deploying full-fiber networks



Source: Omdia and Thought Leadership Service Provider Survey, World Broadband Association, n = 75

When asked about areas where governments/regulators could help, the survey found that it is less about financial assistance (although that will still be necessary in most territories to connect the really hard-to-reach customers) and more about providing greater flexibility and changing regulations where possible to make fiber investment easier (see **Figure 16**). Legislation to make it easier to locate and gain access to key infrastructure such as ducts, poles, and so on would also help with new infrastructure deployment. More complex legislation should also consider non-telecom infrastructure, such as access to infrastructure deployed for other utility purposes, to gain maximum efficiencies.

Figure 16: Financial support is not the only help governments can provide



Source: Omdia and Thought Leadership Service Provider Survey, World Broadband Association, n = 75

Therefore, regulation and public policy have a key role to play in removing any barriers, and a better-connected world can only emerge if there is collaboration between governments, regulators, and operators to encourage investment. While governments and regulators can set clear connectivity targets and lower the financial and regulatory barriers to broadband access, private investment must also be fostered and conditions for good levels of competition must be set.

There are several regulatory policies that are seen as best practice for encouraging the deployment of very high-capacity networks, such as:

- Facilitating deployment through municipality approvals, using existing resources (government buildings, streetlights, ducts etc.,) and sharing infrastructure/facilities.

- Introducing flexibility in partnership arrangements such as allowing agreements between players/co-financing/collaborative models/public-private partnerships/innovative partnerships.
- Providing financial assistance through investment support, incentives, and subsidies (e.g., universal service funds).
- Implementing regulatory flexibility, including the removal of outdated or nonessential regulations.
- Improving access to telecoms facilities and physical infrastructure; improving procedures for rights of way and accessing public infrastructure, as well as broadband mapping.
- Setting coverage/minimum speed targets through a national broadband plan or universal service obligation.

Financing tools

The pandemic has highlighted the remaining holes in broadband maps and reinforced the need to close the digital divide and designate networks as critical infrastructure. So, ubiquitous broadband access is a key element in any country's digital agenda. High-speed network rollout is often commercially viable only in densely populated areas; therefore, nationwide deployment will normally require some form of government funding. The key challenge is ensuring widespread broadband rollout is funded while also being fiscally sustainable and still preserving private incentives to invest. This challenge will grow in the coming years when economically viable areas are covered, but the gap in rural regions with scattered populations widens.

Various forms of financing are being used to ensure that these areas are not left behind—for example, publicly built networks (e.g., Australia and Argentina); publicly built municipal networks (e.g., Sweden and Germany); public-private partnerships (PPPs) (e.g., Mexico and Peru); direct/indirect subsidies (e.g., the EU); physical resources access, that is ducts, poles, and land access (e.g., Mexico and Sweden); and regulatory coverage or service obligations (e.g., Chile and Brazil). There is no single right answer, but at the very least, governments should get more involved in guaranteeing broadband connectivity for all citizens. However, it is also crucial to adopt the most suitable investment model to reflect national circumstances. This doesn't necessarily involve a state-owned company that is controlled and financed by the government—public-private partnerships or private-led deployment with government incentives could be more relevant in some cases. Regardless of the model, best practice dictates that any state intervention must limit the risk of crowding out or replacing private investments, altering commercial investment incentives, or distorting competition.

National broadband plan targets and universal service obligations

To varying degrees of detail, most countries around the world have outlined some form of national broadband plan. For the less economically developed nations, these plans should focus on improving broadband coverage before looking to expand high-speed networks such as fiber. Meanwhile, the

more progressive countries should focus on developing national digital strategies. Developing comprehensive national digital strategies that ensure citizens can use connectivity in a transformative way to bring about innovation and growth, rather than focusing purely on broadband infrastructure deployment, will be crucial in building the case for fiber deployment and encouraging further investment.

National broadband plans aim to only guarantee infrastructure availability and deployment and have proven insufficient on their own since the targets of many countries have not been achieved, so gaps are widening. Governments that have seen the most success have been those that proactively prioritize developing their own unique, integrated, and comprehensive national digital strategy for both broadband infrastructure and how to get citizens to use it effectively. Combining these strategies to reflect each country's resources and capabilities maximizes the benefits of digital transformation for innovation, growth, and social prosperity. Within the best digital strategies, governments still tend to set coverage objectives in an effort to ensure that connectivity continues to improve on an ongoing basis. Leaders agree that unlocking the benefits of ongoing digital transformation means addressing the challenges this creates, particularly for jobs, skills, and trust. A few advanced countries have already defined their national digital strategy, but many more are expected to do so in the coming years.

There are many examples of governments around the world that have already moved from pure national broadband infrastructure deployment plans to comprehensive national digital strategies. The UK, for example, launched its national digital strategy in 2017. The strategy looks at connectivity, digital skills and inclusion, development of digital sectors, helping businesses go digital, cybersecurity, digital government, and unlocking the power of data. Meanwhile, Singapore's Infocomm Media 2025 plan has three main pillars: capitalize on big data and analytics, deepen the converged industry ecosystem, and better connect people. The first phase, involving extending connectivity through the deployment of above-ground boxes and technologies from a heterogeneous network (HetNet), was completed at the end of 2015. The other two phases involve introducing real-time data collected through a mesh of sensors nationwide.

In addition to introducing a national broadband plan and digital strategy, many regulators look to implement a universal service obligation (USO) to ensure that basic telecoms services are available at an affordable price to all households and businesses. For many countries, functional internet access has been included in universal service obligations for some time. However, 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, there is an argument for introducing a broadband USO that better reflects today's technological capabilities. However, these are mostly in mature markets, and usually the broadband speed targets that have been adopted are fairly low, ranging from 1Mbps to a potential 30Mbps. Smaller countries are generally ahead on this issue, but larger countries are catching up. Most of the countries where broadband USOs have been introduced are geographically relatively small. That is hardly surprising since small countries are more easily covered in a ubiquitous way—for example, Singapore, where an operator faces a USO to install fiber-optic connections upon request. It is clear that regulators and policymakers cannot rely on market forces alone to deliver ubiquitous high-speed broadband without some kind of regulatory intervention, but universal service obligations have not been universally proven to be the best means of achieving this goal. Rather than explicitly setting universal service obligations to install fiber connections, many

countries have instead been using the universal service funds as a source of financing to support one-off investment projects to deploy higher capacity networks.

Copper switch-off rules and regulating fiber services

As legacy copper networks become harder to maintain, operators around the world are starting to consider phasing them out, but this generally requires input from regulators. It is important to retire legacy copper networks so that incumbents do not encounter the unnecessary costs of running two parallel networks and can free up investment for further fiber deployment. Best practice for countries heavily reliant on copper commands that migration away from copper does not cause disruption for consumers. Therefore, some regulators have imposed minimum notice periods to minimize the effect on the market and ensure the transition is carried out under fair and competitive terms. This needs to be coupled with the removal of regulation on the incumbent's copper products in areas where full fiber is built and the transfer of regulations, including price protections, from copper to new fiber services during the transition. This would encourage customers to switch over to the new fiber network, while also protecting them during the transition period and thereby building the case for more investment in underserved areas. Until the deployment of fiber has been sufficiently accelerated, it is better for regulators to continue not to regulate full-fiber services. In Spain, for example, fiber services offering speeds of more than 30Mbps have not been regulated, and full-fiber investment has been successfully stimulated, with fiber cables being rolled out not only by the incumbent but also by its rivals.

Infrastructure sharing

Facilities sharing is becoming an increasing focus for regulators as the desire for competition in next-generation network deployments grows. In markets where there is the perception of market failure, through lack of attainment of national broadband plan objectives, regulatory intervention in infrastructure sharing can be beneficial. To encourage private investment in fiber infrastructure, barriers to entry and the cost of laying fiber need to be addressed, access to ducts and poles must be simplified, and a stable regulatory environment needs to be maintained. Comprehensive passive infrastructure regulation has had a significant impact on the deployment of next-generation networks.

Alternative operators generally attribute high importance to the presence of offers of passive infrastructure access. Regulatory approaches do vary, though. Those that have seen the greatest success rely on a clear, simple, and certain regulatory framework and on an effective dispute-resolution process, as well as on outlined maximum timelines regarding repairs and installations. Transparency can be assured with the use of online broadband network maps. It is good practice that the role facilities sharing takes in a given country varies according to the degree that competitive outcomes are supported by infrastructure-based competition and the level of intervention perceived to be necessary to achieve investment. Best practice often involves regulators adopting a combination of symmetric and asymmetric regulation. Symmetric regulation has been extended in some markets to include utilities and asset owners beyond the communications industry because there is increasing recognition of the need for investment

coordination within the sector and with other infrastructure verticals. Meanwhile, asymmetric regulation remains a key tool for regulators in recognition of the ownership of bottleneck assets by incumbent service providers. Spain is a market with considerable asymmetric regulation, as Telefónica alone is subject to duct and pole access (DPA) obligations. DPA regulation can also be limited to certain use cases (e.g., allowing access to ducts to support fiber-to-the-x [FTTx] deployments).

The early adoption of a facilities-sharing policy contributes to improved fiber connectivity availability. In countries with significant uptake of duct access, this has driven infrastructure-based competition in next-generation access (NGA) broadband. Requiring incumbents to grant access to telegraph poles and underground tunnels to all alternative providers makes it quicker and easier for them to build their own full-fiber networks, which cuts the upfront costs associated with laying fiber cables by approximately 50%, a considerable incentive for investment.

Access to other civil engineering and rights of way are also vital to rolling out fiber networks. Ensuring a streamlined approach to permit-granting procedures for civil works is essential, and the best way of achieving this is to adopt a single information point where operators can access information and apply for permits for civil works.

In-building networks

The final few meters of a wired-broadband network can often be the most complex part because, more often than not, it will cross privately owned land or some type of building such as an apartment block (often referred to as a multi-dwelling unit or MDU). It is one of the advantages of wireless broadband technologies that they can bypass this requirement and, therefore, greatly speed up installation.

However, for wired-broadband operators to gain access to the building or to cross private land, they must have a written agreement (known as a wayleave agreement) from the land or property owner, which, due to simple logistics, can cause a significant bottleneck to deployment. If not regulated properly, in-building access agreements in the case of large MDUs can also lead to a form of service monopoly where residents of that MDU can only access a certain service provider as only that service provider has access to the building.

To stimulate greater FTTH deployments, therefore, it is vital that national regulations are created that simplify the wayleave-agreement process and that wholesale agreements are put in place that provide fair access for all operators looking to access that building.

To accelerate future rollouts, property developers could help by preinstalling fiber infrastructure in the buildings and local areas. Preinstallation of fiber-optic cables reduces cost and disruption caused by any future deployments. Therefore, governments should explore schemes that guarantee such investment as part of the planning process. In France, for example, a preinstallation policy was put in place back in 2008 as part of its “Law for the Modernization of the Economy” scheme, which required all new residential developments to be equipped with optical fiber. China has also since adopted a similar policy. In other countries, such as New Zealand and Singapore, property developers are not mandated to preinstall fiber, but they can opt to be connected to the fiber network, making the development more attractive and saving future costs and disruption.

Appendix

Methodology

The Fiber Development Index is based on data that has been gathered for each individual index metric. There are nine index metrics in total, split into three key areas:

- Fiber supply: FTTP coverage, advanced WDM density
- Fiber demand: FTTH penetration, FTTBusiness penetration, mobile cell site fiber penetration
- Broadband experience: median download speed, median upload speed, median latency, median jitter

Fiber supply and fiber demand metrics are based on Omdia research and analysis, using independent country-level data sources (such as the national telecommunications regulatory authority) where possible. All data in these sections are for January 1, 2022. Where data does not exist, Omdia has provided realistic estimations based on other factors such as leading service provider data or other related information.

All broadband experience measures are based on Omdia's analysis of Ookla Speedtest data.

All other research presented in this paper is based on Omdia's extensive research around broadband and optical-fiber networks, including market trackers, in-depth market forecasts, and consumer and enterprise surveys.

Authors

Michael Philpott, Research Director, Service Provider - Consumer
Alzbeta Fellenbaum, Principle Analyst, Service Provider – Consumer
askananalyst@omdia.com

Get in touch

www.omdia.com
askananalyst@omdia.com

Omdia consulting

Omdia is a market-leading data, research, and consulting business focused on helping digital service providers, technology companies, and enterprise decision-makers thrive in the connected digital economy. Through our global base of analysts, we offer expert analysis and strategic insight across the IT, telecoms, and media industries.

We create business advantage for our customers by providing actionable insight to support business planning, product development, and go-to-market initiatives.

Our unique combination of authoritative data, market analysis, and vertical industry expertise is designed to empower decision-making, helping our clients profit from new technologies and capitalize on evolving business models.

Omdia is part of Informa Tech, a B2B information services business serving the technology, media, and telecoms sector. The Informa group is listed on the London Stock Exchange.

We hope that this analysis will help you make informed and imaginative business decisions. If you have further requirements, Omdia's consulting team may be able to help your company identify future trends and opportunities.

Copyright notice and disclaimer

The Omdia research, data and information referenced herein (the "Omdia Materials") are the copyrighted property of Informa Tech and its subsidiaries or affiliates (together "Informa Tech") or its third party data providers and represent data, research, opinions, or viewpoints published by Informa Tech, and are not representations of fact.

The Omdia Materials reflect information and opinions from the original publication date and not from the date of this document. The information and opinions expressed in the Omdia Materials are subject to change without notice and Informa Tech does not have any duty or responsibility to update the Omdia Materials or this publication as a result.

Omdia Materials are delivered on an "as-is" and "as-available" basis. No representation or warranty, express or implied, is made as to the fairness, accuracy, completeness, or correctness of the information, opinions, and conclusions contained in Omdia Materials.

To the maximum extent permitted by law, Informa Tech and its affiliates, officers, directors, employees, agents, and third party data providers disclaim any liability (including, without limitation, any liability arising from fault or negligence) as to the accuracy or completeness or use of the Omdia Materials. Informa Tech will not, under any circumstance whatsoever, be liable for any trading, investment, commercial, or other decisions based on or made in reliance of the Omdia Materials.