

FROM MOBILE-FIRST TO MOBILE-PLUS: CLOSING INDIA'S FIXED-MOBILE IMBALANCE

Policy Brief

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Abstract

India's broadband base is overwhelmingly wireless: of the 1080.15 million broadband connections in May 2026, only 47.40 million, less than 5 percent, were wireline. This unusually high mobile-fixed imbalance sets India apart from most countries, where the total volume of data on mobile networks is typically lower, not higher, than on fixed-line networks. While a mobile-first approach has enabled affordable access at scale and accelerated internet adoption in India, the absence of a complementary fixed-line backbone compromises quality and risks undermining productive end use, innovation, and more complex applications as networks mature. The high mobile-to-fixed ratio also has implications for network resilience, as mobile networks are more vulnerable to power outages and natural disasters than fixed networks.

Against this backdrop, this policy brief maps major policies and initiatives on fixed wireline connectivity across countries and translates these cross-country findings into targeted reforms for India's fixed-mobile imbalance. On public funding, it argues that the core flaw in the Universal Service Obligation Fund (now the Digital Bharat Nidhi) is structural: a 5 percent operator levy routed through the Consolidated Fund creates a collection-disbursement gap, and it recommends a ringfenced, legislatively mandated transfer mechanism. It also calls for accelerating PM-WANI and anchor-institution connectivity (schools, health centres, panchayats), while addressing the affordability, awareness, and digital-skills gaps that suppress demand even where supply exists. On infrastructure, it argues for nationally accelerated copper-to-fibre conversion at BSNL/MTNL, faster Right of Way implementation at the municipal level, and demand-risk-sharing tools drawn from Chile and Peru. On competition and licensing, it highlights India's telecom duopoly and the absence of an EU-style significant-market-power regime as barriers to fibre-sharing, and proposes mandatory wholesale access, a neutral reference interconnection offer, and an AGR levy offset for rural fibre capex. Finally, it addresses balancing fixed wireless as a complement to, rather than a substitute for, fixed wireline; harmonising state-level planning using subnational network-mix data that reveal acute imbalances in states such as Assam, Odisha, and Rajasthan; and technological and systems upgrades, including leveraging power-sector optical ground wire and strengthening network resilience against disasters and cyber threats.

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Glossary

5G	Fifth Generation Cellular network technology	OECD	The Organisation for Economic Co-operation and Development
ADSL	Asymmetric Digital Subscriber Line	OFC	Optical Fiber Cable
AGR	Adjusted Gross Revenue	PDO	Public Data Offices
AIFISPA	All India Fixed Internet Service Providers Association	PM-WANI	Prime Minister's - Wi-Fi Access Network Interface
BBNL	Bharat Broadband Network Limited	PPP	Public Private Partnership
BSNL	Bharat Sanchar Nigam Limited	RoW	Right of Way
DBN	Digital Bharat Nidhi	SMP	Significant Market Power
DCIP	Digital Connectivity Infrastructure Provider	TRAI	Telecom Regulatory Authority of India
DoT	Department of Telecommunication	TSP	Telecommunications Service Provider
DSL	Direct Subscriber Line	USOF	Universal Service Obligation Funds
EIB	European Investment Bank	VGF	Viability Gap Funding
EU	European Union	VNOs	Virtual Network Operators
FLB		xDSL	family of Direct Subscriber Line technologies
FTTH	Fibre-to-the-home	USA	
FWA	Fixed Wireless Access	BIP	Broadband Infrastructure Program
FY	Financial Year	BIL	Bipartisan Infrastructure Law (2021)
GBps	Gigabytes per second	NTIA	National Telecommunications and Information Administration
GDP	Gross Domestic Product	TBCP	Tribal Broadband Connectivity Program
GNI	Gross National Product	BEAD	Broadband Equity, Access, and Deployment Program
ISP	Internet Service Provider	CAF	Connect America Fund
KfW	Kreditanstalt für Wiederaufbau ("Credit Institute for Reconstruction") Bank	USF	Universal Service Fund
LCO	Local Cable Operator	Chile	
Mbps	Megabits per second	FON	Fibra Ótica Nacional
MDB	Multinational Development Bank	FOA	Fibra Óptica Austral
MoC	Ministry of Communications	Singapore	
MTNL	Mahanagar Telephone Nigam Limited	NBN	Next Generation Nationwide Broadband Network
NBM	National Broadband Mission	IDA	Infocomm Development Authority
NDCP	National Digital Communications Policy		
NIB	Nordic Investment Bank		

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From Mobile-First to Mobile-Plus: Closing India's Fixed-Mobile Imbalance

1. Introduction

The reliance on mobile-based internet over fixed-line internet is greater in low- and middle-income countries, partly due to leapfrogging to help overcome the cost and technological complexities of building and maintaining fixed-line broadband. India, specifically, has an unusually high imbalance between mobile and fixed-line networks. It is among the few countries where the total volume of data (i.e., overall traffic flow) on mobile networks is higher than on fixed-line networks.¹ While India's fixed broadband penetration is comparable to that of other countries with similar levels of GDP per capita, it lags behind similarly sized economies.² India's fixed broadband gap is in large part due to gaps in last-mile infrastructure, especially in rural areas, which accommodate over 60% of the population.³

India's broadband base is overwhelmingly wireless; of the 1080.15 million broadband connections in May 2026, only 47.40 million were wireline. Fixed-line infrastructure like fibre to the home (FTTH), fibre to the premises, and hybrid coaxial networks is required

because wireless broadband, including fixed wireless access (FWA) using 5G, cannot sustainably replace fibre in high-density or high-demand environments. Such infrastructure also provides the backhaul that makes mobile broadband quality viable. Upgrading fixed networks is therefore not a separate agenda from India's 5G and rural connectivity goals, but a precondition for both.

While a mobile-first network has enabled affordable access at scale and faster rollout, thus accelerating internet adoption in India, the lack of a complementary fixed-line backbone can compromise quality and undermine productive end use, innovation, and more complex applications as networks mature and evolve. For example, cloud-based artificial intelligence (AI) or remote solutions with the potential to transform services across various sectors require reliable, high-quality connectivity. The ratio of mobile-to-fixed internet also has implications for network resilience, with mobile networks being more susceptible to power outages and natural disasters than fixed networks.^{4,5}

1 Mishra, D., Kedia, M., Reddy, A., Ramnath, K., & Vanguri, S. (2025). State of India's Digital Economy 2025. IPCIDE, Indian Council for Research on International Economic Relations (ICRIER)

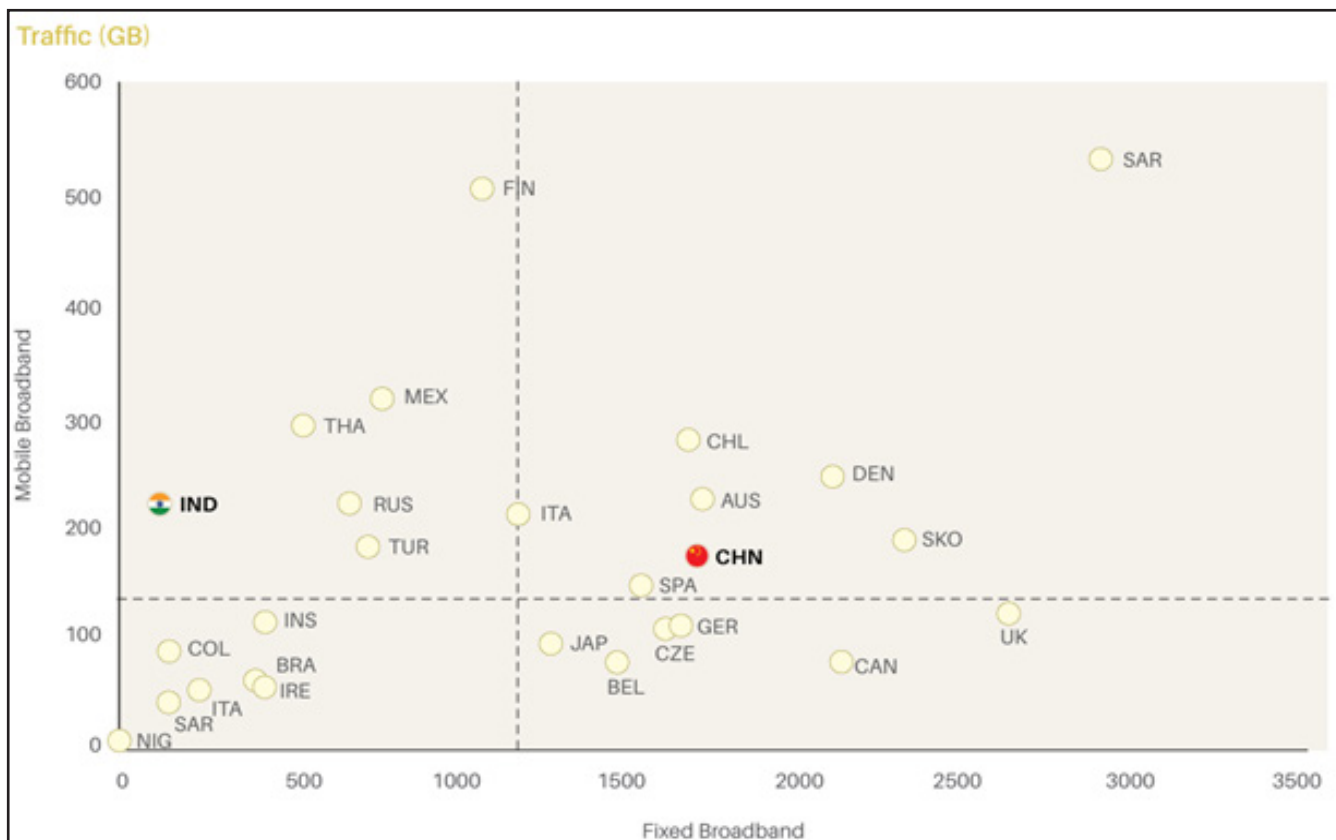
2 Opensignal (2025a)

3 Opensignal (2025a)

4 OECD (2025)

5 Fixed-line installations at customers' premises, however, are more susceptible to power outages, unless backup options, such as an inverter or generator, exist.

Figure 1: India's disproportionate reliance on mobile networks



Source: Mishra et al. (2025)⁶

Note: ARG: Argentina, AUS: Australia, BEL: Belgium, BRA: Brazil, CAN: Canada, CHL: Chile, CHN: China, COL: Colombia, CZE: Czechia, DEN: Denmark, EGY: Egypt, FIN: Finland, FRA: France, GER: Germany, IND: India, INS: Indonesia, IRE: Ireland, ITA: Italy, JAP: Japan, MEX: Mexico, NET: Netherlands, NIG: Nigeria, RUS: Russia, SAR: Saudi Arabia, SNG: Singapore, SAF: South Africa, SKO: South Korea, SPA: Spain, THA: Thailand, TUR: Turkey, UK: United Kingdom, USA: United States

The affordability of fixed-line internet in India is also low. Unlike mobile internet tariffs, which are lower than the global average, fixed-line tariffs are higher in India; the price of a fixed broadband basket as a percentage of monthly Gross National Income per capita is about three times the price of a data-only mobile broadband basket, and about two times the global average.⁷ The imbalance is also evident in quality: India's mobile internet speeds are higher than the median among 32 selected countries, while fixed-line internet speeds are lower (Figure 2), making it among the few countries with higher

mobile download speeds than fixed-line download speeds.

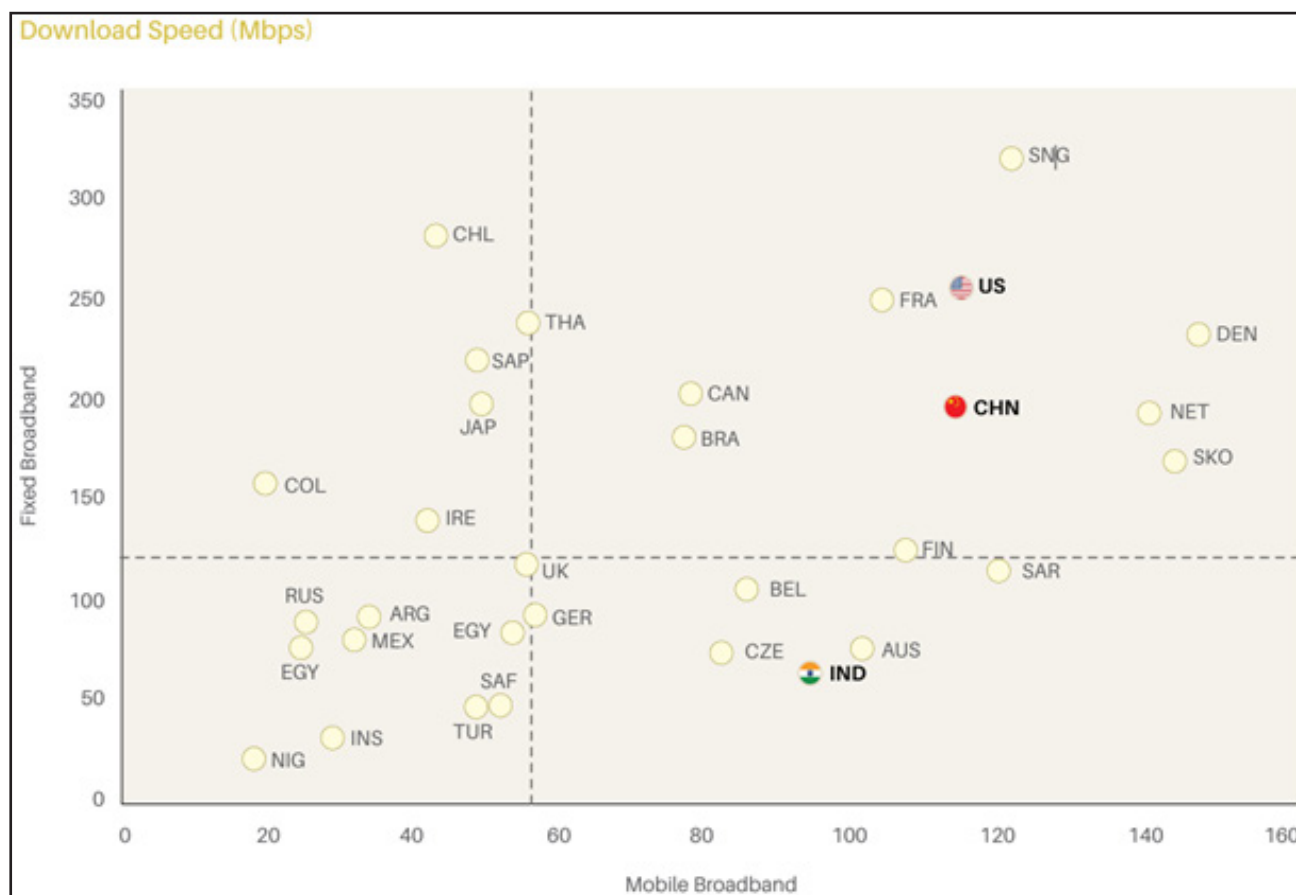
Improvements in the quality and affordability of fixed-line connectivity, although significant, lag behind improvements in mobile connectivity. According to Ookla's Speedtest Global Index, average mobile broadband download speed increased from 10.71 Mbps in 2019 to 100.78 Mbps in November 2024, while average fixed broadband download speed increased from 29.25 Mbps to 63.55 Mbps.⁸

6 Mishra, D., Kedia, M., Reddy, A., Ramnath, K., & Vanguri, S. (2025). State of India's Digital Economy 2025. IPCIDE, Indian Council for Research on International Economic Relations (ICRIER)

7 ITU. (n.d.). ICT Prices. <https://www.itu.int/en/ITU-D/Statistics/Pages/ICTPrices/default.aspx>

8 Department of Telecommunications, Ministry of Communications. 2025. National Broadband Mission 2.0 2025-30. https://eservices.dot.gov.in/sites/default/files/user-manual/NBM%202-0%20Vision%20Document_Final_RoW-compressed.pdf

Figure 2: Average download speeds of mobile vs. fixed-line broadband



Source: Mishra et al. (2025)⁹

Note: ARG: Argentina, AUS: Australia, BEL: Belgium, BRA: Brazil, CAN: Canada, CHL: Chile, CHN: China, COL: Colombia, CZE: Czechia, DEN: Denmark, EGY: Egypt, FIN: Finland, FRA: France, GER: Germany, IND: India, INS: Indonesia, IRE: Ireland, ITA: Italy, JAP: Japan, MEX: Mexico, NET: Netherlands, NIG: Nigeria, RUS: Russia, SAR: Saudi Arabia, SNG: Singapore, SAF: South Africa, SKO: South Korea, SAP: Spain, THA: Thailand, TUR: Turkey, UK: United Kingdom, US: United States

The lower quality of fixed-line connections relative to their higher prices compared to mobile internet is also dampening demand. The low demand in turn affects service providers' revenue, preventing them from further investing in fixed-line infrastructure, which could help reduce unit prices and improve quality. Thus, there appears to be a self-reinforcing cycle between demand, prices, quality, and investment, which may require policy interventions. Fixed wireless, which is more affordable than fixed wireline, can ease challenges related to last-mile connectivity to some extent. While fixed wireless can be of higher quality than a mobile network, this is subject to having a clear line of sight between the fixed wireless transmitter and receiver, as well as the level

of network traffic at any point in time. Nevertheless, fixed wireless has expanded broadband access across India, especially in rural and remote areas. However, it still constitutes less than 20% of all fixed broadband subscriptions.¹⁰

2. The Current Landscape in India

While Jio and Airtel are the biggest fixed-line network providers, regional providers such as Excitel and legacy cable operators such as GTPL also play an important role. Relying mostly on FTTH, these regional providers are performing well on quality of service. Larger private operators are also leveraging the services of local cable operators (LCOs) to install

⁹ Mishra, D., Kedia, M., Reddy, A., Ramnath, K., & Vanguri, S. (2025). State of India's Digital Economy 2025. IPCIDE, Indian Council for Research on International Economic Relations (ICRIER)

¹⁰ Opensignal. (2025). Fixed broadband experience. India. <https://insights.opensignal.com/reports/2025/08/india/fixed-broadband-experience>

and maintain fibre networks. Additionally, the government has been providing state-run telecom providers BSNL and MTNL through revival packages for infrastructure upgrades and expansion of optical fibre networks.¹¹ The Indian government has introduced multiple programmes and initiatives that directly or indirectly aim to expand and improve the fixed wireline network. One such large-scale initiative is the Bharat Net Programme. Launched in 2011, the programme's primary objective is to bring affordable and high-quality broadband services to rural and remote regions of India. While it has improved rural connectivity, progress has been relatively slow and has faced various challenges.¹²

In 2016, the Telecom Regulatory Authority of India (TRAI) recommended public private partnership (PPP) models of implementation, inclusion of states and Union Territories through institutional mechanisms, and the deployment of other network infrastructure alongside optical fibre cables (OFCs). By December 2017, 254,000 km of OFC had been laid, covering over 1.09 lakh gram panchayats. In 2020, the scope of BharatNet was extended to cover all inhabited villages in the country. In 2021, the Cabinet approved the implementation of the BharatNet programme through a PPP model in 16 states, with an estimated maximum viability gap funding of over INR 19,000 crores. The revised scope included upgrading the existing network architecture from linear to ring topology, improving resilience and reliability. A financial outlay of INR 1.3 lakh crores was also approved to reach approximately 4.5 lakh unconnected villages and encourage partnerships with Village Level Entrepreneurs (VLEs) to expand last-mile connectivity to homes.¹³ However, the latest

data, as of early September 2025, shows that only a little over 2 lakh villages out of a total of over 6.5 lakh villages have been covered.¹⁴ The 2025-26 Union Budget increased allocation for BharatNet, with the aim of connecting all government schools and primary health centres in rural India.^{15, 16, 17}

While changes in regulation and licensing are intended to aid the broader deployment of fixed-line connections, compliance bottlenecks have been reported. In a 2021 letter to TRAI, the All India Fixed Internet Service Providers Association (AIFISPA) highlighted Right of Way charges as “the single biggest impediment to the adoption of wireline Fixed Line Broadband (FLB) services” and noted the cumbersome approval process.

In 2022, the Gati Shakti Portal was introduced as an integrated mechanism for RoW applications. The portal helped improve transparency and reduced paperwork and average disposal time of applications from 448 days in 2019 to about 60 days in 2024. The streamlining of approvals can be attributed to an increase in approved towers and OFCs. The new Right of Way Rules, 2024, effective January 2025, are also being incorporated into this portal.¹⁸ These new rules ensure alignment across states and aim to create a more enabling ecosystem for the private sector to lay out infrastructure.¹⁹ The Telecommunications Act, 2023 has also helped ease the RoW process by broadening the definition of public entities that are able to provide RoW. The Act establishes telecommunications infrastructure as distinct from the property on which it is installed and implements clear dispute-resolution mechanisms.^{20,21}

11 Telecom Review Asia. (2025, June 11). India's DoT urges states to prioritize BSNL, MTNL for telecom needs. <https://www.telecomreviewasia.com/news/policy-news/13666-indias-dot-urges-states-to-prioritize-bsnl-mtnl-for-telecom-needs/>

12 Das, B., & Ramnath, K. (2024). The evolution of BharatNet: Lessons from India's largest rural broadband project. In ViCT (ICRIER and Vodafone Idea Centre for Telecom). <https://icrier.org/pdf/pb-BharatNet.pdf>

13 Das, B., & Ramnath, K. (2024). The evolution of BharatNet: Lessons from India's largest rural broadband project. In ViCT (ICRIER and Vodafone Idea Centre for Telecom). <https://icrier.org/pdf/pb-BharatNet.pdf>

14 BBNL. <https://bbnl.nic.in/>

15 BharatNet. (2025). Union Budget 2025 news- Broadband connectivity announced in rural Areas under BharatNet Scheme. <https://bharatnet.in/broadband-connectivity-to-schools-healthcare-centres-in-rural-areas-under-bharatnet-scheme/>

16 IBEF Blog. (2025, August 21). BharatNet unplugged: Transforming rural connectivity in India. <https://www.ibef.org/blogs/bharatnet-unplugged-transforming-rural-connectivity-in-india>

17 Das, B., & Ramnath, K. (2024). The evolution of BharatNet: Lessons from India's largest rural broadband project. In ViCT (ICRIER and Vodafone Idea Centre for Telecom). <https://icrier.org/pdf/pb-BharatNet.pdf>

18 MoC (Ministry of Communications). (2024). DoT makes significant strides in strengthening the Indian telecom ecosystem [Press release]. <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2088195>

19 Rathee, K. (2024, November 21). Telecom Right of Way rules must for states from January 1. Economic Times.

20 Department of Telecommunications (DoT). (2023). Indian Telecommunications Act 2023. https://prsindia.org/files/bills_acts/bills_parliament/2023/The%20Telecommunications%20Bill,%202023.pdf

21 Prasad, R., Sridhar, V., & Kedia, M. (2025). Functional separation and a restructured licensing framework for Indian telecommunications; Vikalpa: The Journal for Decision Makers, 50(4), 295-309. <https://doi.org/10.1177/02560909251330750>; Ministry of Communications. (2024). The Telecommunications Act, 2023: Ushering in new era of connectivity [Press release]. <https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2027941®=48&lang=2>

The introduction of virtual network operators' (VNOs) licensing in 2016 enabled service providers to lease network infrastructure on a wholesale basis from incumbent network providers such as BSNL and MTNL, helping address the high upfront costs as well as the logistical and technical challenges of deploying middle-mile and long-haul infrastructure while also helping address challenges in last-mile connectivity.²² A VNO Category B licence for wireline was introduced in 2018, which refined service areas to the district level, allowing smaller operators to participate.²³ The design of licensing and authorisation regimes is also key to promoting the optimal utilisation of infrastructure and fair competition²⁴ by ensuring service providers' access to network infrastructure in an efficient, accessible, neutral, and non-discriminatory manner. The VNO Category B licence enables this. TRAI's 2021 Consultation Paper also highlighted the need for network providers to integrate and streamline access to network infrastructure for service providers in order to reduce the transaction costs of negotiating and managing multiple entities within the infrastructure ecosystem.²⁵

Proposals to waive or reduce licence fees for ISPs to augment capacity have not materialised.²⁶ For

example, the AIFISPA argued that fixed wireline broadband is a separate class that cannot be compared with wireless service providers due to its capital-intensive nature, the high costs of laying last-mile optical fibre, and the quality and consistency of the service unmatched by other types of connections. The core tension they identified was that fixed broadband is being regulated like large Telecom Service Providers (TSPs) despite being capital-intensive, spectrum-free, and building last-mile infrastructure, and have asked for licence-fee and RoW reforms in addition to capital subsidies.²⁷

While some of these efforts are helping rebalance India's telecom network towards more robust fixed-line infrastructure, an examination of international best practices can help gain valuable insights to further strengthen these efforts.

3. Global Policies and Initiatives in Fixed Wireline Connectivity

Table 1 provides a summary of some global policy actions and initiatives aimed at promoting fixed wireline connectivity. Additional details are provided in Annexure 1.

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- 22 Ministry of Communications. (2022, 17th January). Guidelines for Frant of Unified License (Virtual Network Operators). <https://eservices.dot.gov.in/sites/default/files/2024-11/UL%20VNO%20Guidelines.pdf>; Prasad, R., Sridhar, V., & Kedia, M. (2025). Functional separation and a restructured licensing framework for Indian telecommunications. *Vikalpa: The Journal for Decision Makers*, 50(4), 295-309. <https://doi.org/10.1177/02560909251330750>
- 23 DoT. (2018, June 19). Amendment to the UAS licence on internet telephony; Prasad, R., Sridhar, V., & Kedia, M. (2025). Functional separation and a restructured licensing framework for Indian telecommunications. *Vikalpa: The Journal for Decision Makers*, 50(4), 295-309. <https://doi.org/10.1177/02560909251330750>
- 24 The technological convergence of multiple types of services (e.g., telephony, internet, and broadcasting), i.e., the ability to provide all three using the same medium, has given rise to additional considerations in terms of ensuring competitive markets. One such consideration is the functional separation of service provision from infrastructure facilities. Fixed wireline services are bundled with over-the-top (OTT) services that have replaced traditional cable TV. For example, Jio is bundling JioCinema, their OTT service, with JioFibre. JioCinema also recently merged with Hotstar, which is now part of their OTT offerings. Thus, licensing regimes and competition considerations for fixed wireline are increasingly intertwined with those for other closely linked layers and need to be considered together. Prasad, R., Sridhar, V., & Kedia, M. (2025). Functional separation and a restructured licensing framework for Indian telecommunications. *Vikalpa: The Journal for Decision Makers*, 50(4), 295-309. <https://doi.org/10.1177/02560909251330750>
- 25 Prasad, R., Sridhar, V., & Kedia, M. (2025). Functional separation and a restructured licensing framework for Indian telecommunications.
- 26 Singh, P. V. (2025, September 4). The licence-fee dilemma in India's wireline broadband push. *The Captable*. <https://the-captable.com/2025/09/license-fee-dilemma-for-india-broadband-push>; Rathee, K.. (2023, April 28). Reduction of licence fees not on the table, DoT tells telcos. *The Economic Times*. <https://economictimes.indiatimes.com/industry/telecom/telecom-news/reduction-of-licence-fees-not-on-the-table-dot-tells-telcos/articleshow/99825492.cms?from=mdr>
- 27 AIFISPA. (2021, June 10). Response from All India Fixed Internet Service Providers Association (AIFISPA) to the Supplementary Consultation Paper (SCP) on Roadmap to promote Broadband Connectivity and Enhanced Broadband speed. https://www.trai.gov.in/sites/default/files/2024-11/AIFISPA_11062021.pdf

Table 1: Mapping of major policies and initiatives related to fixed wireline connectivity across countries

Country	Policies and Initiatives Related to Fixed Wireline									
	National Plans and Strategies to Enable Fibre Rollout	Access to Public Funds	Subsidies	Tax Benefits	Regulation	Support from MDBs	Private-Sector Engagement	Performance Management	Compliance	Promoting an Innovative Ecosystem
India										
Canada										
United Kingdom										
Denmark										
Germany										
Spain										
Czech Republic										
Belgium										
Italy										
Finland										
Ireland										
South Korea										
Japan										
Australia										
Russia										
Chile										

Note: Green boxes indicate current or past initiatives that directly mention fibre rollout, and orange boxes indicate initiatives indirectly linked to fibre rollout.

The majority of countries that were analysed have national plans and strategies for fibre rollout, supported by public funding, particularly for increasing access to remote and rural areas. Many countries with higher fixed broadband penetration appear to have a combination of private-sector participation and regulation.

Chile, which has a relatively balanced use of mobile and fixed broadband, has effective PPPs and a regulatory environment that supports competition. Singapore and South Korea have also leveraged PPPs to balance quality and spending and ensure faster upgrading of the network.²⁸ Brazil has connected institutions, leveraged social infrastructure, simplified regulation, and maintained competitive markets. The UK provides an example of the use of demand-side subsidies, and Belgium provides an example of the role of systems improvements in improving fixed networks.

3.1 Boosting Public Funding

Expanding fixed wireline networks and upgrading existing networks require significant investments, which the private sector may not support on its own, especially in remote regions, public funding important. Most countries with strong fixed wireline networks have raised and allocated public funding to support deployment – some in the form of broader programmes to promote broadband access or universal access to the internet and some specifically to lay out fibre networks for “white areas” that lack broadband infrastructure or to help bridge the digital divide. Ensuring the right design and timing of public funding is important to ensure its efficient use and avoid the crowding out of private-sector investment.²⁹ While there is much debate on what is the best way to administer public funding to boost supply side efforts efficiently, there is agreement that it has been critical in expanding coverage in most countries, particularly in hard-to-reach areas.

²⁸ Telecom Review. (2025, November 12). Why China, South Korea, Singapore are racing to construct the fastest, smartest networks. <https://www.telecomreviewasia.com/news/featured-articles/26896-why-china-south-korea-singapore-are-racing-to-construct-the-fastest-smartest-networks/>

²⁹ See Appendix 2 for a table summarising national broadband programmes in OECD countries till 2018. Briglauer, W., & Grajek, M. (2024). Effectiveness and efficiency of state aid for new broadband networks: evidence from OECD member states. *Economics of Innovation and New Technology*, 33(5), 672-700. <https://doi.org/10.1080/10438599.2023.2222265>

The US allocated USD 288 million through its Broadband Infrastructure Program to expand internet access to areas without service, especially rural areas, through partnerships between states, local jurisdictions, and ISPs. The 2021 Bipartisan Infrastructure Law (BIL) also allocated USD 65 billion to promote universal access to reliable, affordable high-speed internet and improve digital literacy and skills through various programmes.³⁰ One such programme is the State Digital Equity Capacity Grant Program, under which states submitted proposals for approval by the National Telecommunications and Information Administration. The programme is aimed at “documenting and promoting availability and affordability of fixed and wireless broadband,” among other things. The law also extended the Tribal Broadband Connectivity Program, which had allocated USD 1.86 billion to 226 tribal entities and connected or lowered internet costs for over 4,500 tribal homes.³¹ The Broadband Equity, Access, and Deployment Program, also under the BIL, is a federal grant programme that has allocated USD 42.45 billion towards high-speed broadband access by funding partnerships to build infrastructure.³²

Several countries have leveraged external funding to reinforce their broadband efforts. Spain, for example, has received support from the EU Recovery and Resilience Facility.³³ Germany has received funding from Multilateral Development Banks, including European Investment Bank and Kreditanstalt für Wiederaufbau, and Finland has received funding from the Nordic Investment Bank.³⁴ Brazil has received a USD 100 million loan from the Inter-American Development Bank to improve digital connectivity and expand fixed broadband coverage.

3.2 Leveraging Policies Promoting Universal Access

Most of the analysed countries have policies and public funding in place to promote universal access to telecommunication services. For example, several countries, including India, have adopted the universal service obligation – a mandate to ensure that access to essential services is available and affordable to all. Policy assessments and evidence suggest that universal service obligation funds (USOFs), often funded through a levy on the revenue earned by telecom operators, have seen mixed progress in achieving universal connectivity, particularly the affordable and high-quality aspects of it. Low and delayed disbursement, misalignment between the fund objectives and implementation, capacity constraints, and lack of legal clarity are some of the barriers identified.³⁵ The experiences of some countries that have made the USOFs a significant part of their broadband strategies are discussed below.

Malaysia is an example of a country that has successfully leveraged its Universal Service Provision Fund (USPF) to implement the National Broadband Initiative, connecting households to broadband and creating community broadband centres. The country has also achieved transparency in financial accounts and investments of its USPF.³⁶

The US has also made considerable progress in boosting connectivity in rural and remote areas. High Cost, the largest of the four programs within the US Universal Service Fund (USF), aims to enable universal access to essential telecom services in rural areas, providing financial support to service providers where market sizes are not large enough

30 Also known as the Infrastructure Investment and Jobs Act.

31 National Telecommunications and Information Administrations. (n.d.). Three years of high-speed internet infrastructure investment. <https://www.ntia.gov/blog/2024/three-years-high-speed-internet-infrastructure-investment>; <https://www.bhfs.com/Templates/media/files/insights/Broadband%20in%20the%20Bipartisan%20Infrastructure%20Package.pdf>

32 NTIA. (n.d.). BEAD Restructuring Policy Notice. <https://www.ntia.gov/funding-programs/high-speed-internet-programs/broadband-equity-access-and-deployment-bead-program>; Brownstein Hyatt Farber Schrek. (2021, August 1). Broadband in the bipartisan infrastructure package. https://broadbandusa.ntia.gov/funding-programs/policies-waivers/BEAD_Restructuring_Policy_Notice?_gl=1*1q5o4fl*ga*Njl3MzY1NDI3LjE3ODEwODAwMDg.*_ga_H50FXLW992*cze3ODEwODAwMDgkbzEkZzEkDE3ODEwODAwMjMkajYwJGwwJGgw*ga_55V70TEFYT*cze3ODEwODAwMTAKbzEkZzEkDE3ODEwODAwMjMkajYwJGwwJGgw

33 European Commission. (2025). Digital connectivity in Spain. [https://digital-strategy.ec.europa.eu/en/policies/digital-connectivity-spain#:~:text=Spain%27s%20Recovery%20and%20Resilience%20Plan,\(TV%20tax\)%20were%20introduced](https://digital-strategy.ec.europa.eu/en/policies/digital-connectivity-spain#:~:text=Spain%27s%20Recovery%20and%20Resilience%20Plan,(TV%20tax)%20were%20introduced).

34 KfW. (2024). Information sheet - KfW's digital infrastructure syndicated loan. [https://www.kfw.de/PDF/Download-Center/F%C3%B6rderprogramme-\(Inlandsf%C3%B6rderung\)/PDF-Dokumente/6000005238_M_854_KK_Digital_InformationSheet.PDF](https://www.kfw.de/PDF/Download-Center/F%C3%B6rderprogramme-(Inlandsf%C3%B6rderung)/PDF-Dokumente/6000005238_M_854_KK_Digital_InformationSheet.PDF); European Commission. (2024). EIB boosts high-speed internet in Germany with €350 million InvestEU-backed loan. https://ec.europa.eu/commission/presscorner/detail/en/ip_24_4766; NIB. (2025). NIB and Valoo to expand high-speed internet access in Finland. <https://www.nib.int/news/nib-and-valoo-to-expand-high-speed-internet-access-in-finland>

35 UNESCAP. (2017). The impact of universal service funds on fixed-broadband deployment and internet adoption in Asia and the Pacific. Asia-Pacific Information Superhighway Working Paper Series. <https://www.unescap.org/sites/default/files/Universal%20Access%20and%20Service%20Funds.pdf>

36 UNESCAP. (2017). The impact of universal service funds on fixed-broadband deployment and internet adoption in Asia and the Pacific. Asia-Pacific Information Superhighway Working Paper Series. <https://www.unescap.org/sites/default/files/Universal%20Access%20and%20Service%20Funds.pdf>

to support network infrastructure costs. In 2012, the program was reformed to the Connect America Fund (CAF), which supports the provision of broadband access to rural areas. The CAF comprises multiple funds with incentive-based models and competitive bidding for service providers that, once selected, must complete deployment over a decided timeline.³⁷ The Rural Health Care Program, also funded through the USF, funds voice and data services through the telecommunications program and broadband services.³⁸ However, challenges remain, including declining revenues compared to payouts, inadequate transparency and coordination between programs, and outdated technologies.³⁹

China's Universal Service Policy forms the basis of its Universal Service Fund, which is financed by contributions from operators and government funding. Various carriers participate in providing universal service, including basic communication services and access to the internet and broadband. Instead of a conventional USF system, China relies on a universal service compensation mechanism, which involves increasing financial input to support network construction in rural and remote areas, promoting greater investment by enterprises in these areas.⁴⁰ While China has achieved significant progress in narrowing interprovincial and urban-rural divides, the penetration rate has lagged behind network expansion. Further, infrastructural investment (i.e., laying more fibre and establishing more towers) is showing diminishing effects on narrowing the divide, possibly requiring a shift towards an end-user-oriented approach.⁴¹

3.3 Connecting Institutions and Leveraging Social Infrastructure

Connecting public institutions widens the reach of the fixed network while generating significant value and promoting important development goals. Conversely, leveraging programmes within various sectors and using social infrastructure can help expand the fixed-line network. Examples with the education and health sector are common. Chile began providing connectivity to schools in 2011 under its national fixed broadband plan in collaboration with the education department, with over 8,800 subsidised public schools provisioned with broadband within a year, enabling access to over 95% of enrolled students.⁴² Brazil's National Strategy for Connected Schools aims to connect all schools to the internet by the end of 2026 and is being implemented in collaboration between the Ministry of Science, Technology, Innovation and Communication and the Ministry of Education.⁴³ Companies that want to obtain spectrum for the commercial operation of mobile 4G services are required to provide free broadband internet access (wired, wireless, or via satellite) to rural schools. Additionally, funds from a 5G frequency auction were used to support this goal.⁴⁴

3.4 Public-Private Partnerships

Private-sector players have been central to fibre deployment. In many cases, the high capital costs, technical complexities, and infrastructural logistics of telecom infrastructure provision have necessitated PPPs. For example, Chile's strong performance is

37 USAC. (n.d.). Get started. <https://www.usac.org/high-cost/get-started/>; USAC. (n.d.). FCC Rural Broadband Accountability Plan. <https://www.usac.org/high-cost/resources/fcc-rural-broadband-accountability-plan/>

38 FCC. (n.d.). Rural Health Care Program. <https://www.fcc.gov/general/rural-health-care-program>

39 Glass, V., & Tardiff, T. (2021). Reforming funding of universal access to telecommunications and broadband services: Approaches for the new decade. *Telecommunications Policy*, 45(2), 102037. <https://doi.org/10.1016/j.telpol.2020.102037>; Small Company Coalition. (2025, September 15). Congressional Universal Service Fund (USF) Working Group. [https://itif.org/publications/2025/09/15/how-universal-service-fund-can-better-serve-consumers-while-spending-less/](https://www.smallcompanycoalition.com/post/congressional-universal-service-fund-usf-working-group#:~:text=With%20respect%20to%20the%20High,feasible%20through%20the%20USF%20program.&text=With%20respect%20to%20the%20Lifeline,required%20by%20the%201996%20Act; Scherer, E., & K., Joe. (2025). How the universal service fund can better serve consumers while spending less. <a href=); Lyons, D.A. (2023). Assessing the state of the Universal Service Fund. American Enterprise Institute. <https://www.commerce.senate.gov/wp-content/uploads/media/doc/Lyons%20Senate%20Commerce%20Testimony%20re%20Universal%20Service.pdf#:~:text=Contribution%20Reform%20Finally%2C%20any%20review.any%20questions%20you%20may%20have.>

40 ITU-D Study Group 1. (2024). Challenges and opportunities for using universal service funds to bridge the digital divide. https://www.itu.int/dms_pub/itu-d/opb/stg/D-STG-SG01.04.05-2024-PDF-E.pdf

41 Wang, L., & Liu, C. (2021). Critical evaluation of China's universal service policy: Toward a harmonious online nation. *The Information Society*, 37(3), 177–189. <https://doi.org/10.1080/01972243.2021.1897912>

42 Puig Gabarró, P., García Zaballos, A., Iglesias Rodríguez, E., Sepúlveda, A., Wong, A., & Yoo, C. (2021). Strategies and Business Models for Improving Broadband Connectivity in Latin America and the Caribbean: Guidelines for the Planning, Investment, and Rollout of Broadband Networks. <https://doi.org/10.18235/0003263>

43 OECD. (2018). Digital government review of Brazil: Towards the digital transformation of the public sector. OECD Digital Government Studies. <https://doi.org/10.1787/9789264307636-en>; Vanoli, C. (2023, November 22). Brazil's new strategy aims for Internet in all schools. ITU. <https://www.itu.int/hub/2023/11/brazils-new-strategy-aims-for-internet-in-all-schools-2/>

44 OECD. (2017). OECD Digital Economy Outlook 2017. <http://dx.doi.org/10.1787/9789264276284-en>; Giga Global. (2022, November 10). Case study: Mobilizing capital for school connectivity in Brazil. <https://giga.global/case-study-mobilizing-capital-for-school-connectivity-in-brazil/>

in part attributed to PPPs, such as the Fibra Óptica Nacional (FON), a 10,000 km wholesale fibre backbone initiative with a subsidy of about USD 120 million.⁴⁵ The Fibra Óptica Austral (FOA), another PPP aimed at reducing the digital divide, links to the FON and aims to connect over 500,000 users in the southern regions of the country. The subsidy was especially important in the region given the higher costs and lower returns on investment. As per the Undersecretary of Telecommunications, the last phase of the four-phase FOA project required redesigning tenders to be more attractive and competitive.⁴⁶ The FOA project also gave Chile a boost in both penetration and quality of fixed broadband in the country, which had already been leading within Latin America.^{47, 48, 49, 50, 51, 52}

South Korea also used a PPP model to enhance connectivity in rural areas where private investments alone can be challenging due to the terrain and low population density. A 2020-22 programme targeted about 1,300 villages, bringing together central and local governments and major ISPs. A study by the country's Technology Policy Research Division suggested that the PPP approach allowed service providers to establish fibre broadband at costs comparable to or lower than the universal service model. However, in some areas, the PPP approach was less efficient due to geographical and logistical challenges.⁵³

The Singapore government set up the Next Generation Nationwide Broadband Network (NBN), a PPP, to provide competitively priced high-speed broadband to consumers and businesses. A competitive bidding process was used to select a company to provide the passive infrastructure (e.g., fibre optic cable) as well as to select the active infrastructure (e.g., routers, switchers, and other equipment). Both companies received some financial support from the government and had to cooperate to design, build, and operate the fixed wireline network. The NBN now connects over 85% of residential homes to services of at least 1 Gbps.⁵⁴ The network was also able to meet high demand during periods such as the COVID-19 pandemic. The programme's success was driven by the government's ability to hold a transparent and competitive procurement process, learn from other countries, consult with private-sector stakeholders in a timely manner, and provide appropriate incentives to the industry.^{55, 56}

3.5 Upgrading Existing Fixed-Line Networks

Alongside expanding networks, most countries doing well on fixed broadband within their portfolio have also been simultaneously upgrading older established infrastructure, such as direct subscriber line (DSL) and cable. There is also an increasing focus on upgrading last-mile infrastructure in addition to strengthening the backbone. Full-fibre broadband provides

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- 45 BNAmericas. (2021). Spotlight: The 'crown jewels' of Chile's fiber projects. <https://www.bnamerica.com/en/features/spotlight-the-crown-jewels-of-chiles-fiber-projects>
- 46 Subsecretaría de Telecomunicaciones de Chile. (2022, March 9). Gobierno completa el despliegue de la totalidad de la Fibra Óptica Austral: Beneficiará a más de 536 mil usuarios de 15 comunas de la zona austral de Chile. <https://www.subtel.gob.cl/gobierno-completa-el-despliegue-de-la-totalidad-de-la-fibra-optica-austral-beneficiara-a-mas-de-536-mil-usuarios-de-15-comunas-de-la-zona-austral-de-chile/>
- 47 Chile had around 4.37 million fixed internet connections by April 2022, of which nearly 60% were fibre, around 34% used hybrid fibre coaxial technology, and 2.5% used Asymmetric Digital Subscriber Line (ADSL). Fibre optics grew by about 40% between mid-2021 and mid-2022. Goovaerts, D. (2023, January 4). Chile leads, US sixth as fixed broadband speeds jump 28% YoY – Ookla. Fierce Network. <https://www.fierce-network.com/broadband/chile-leads-us-sixth-fixed-broadband-speeds-jump-28-yoy-ookla-0>
- 48 Ookla. (2023). Chile fixed broadband performance. <https://www.ookla.com/articles/chile-fixed-broadband-performance-2023>
- 49 GSMA. (2024). Chile writes the blueprint for fixed network improvement in Latin America. https://www.gsma.com/get-involved/gsma-membership/gsma_resources/chile-writes-the-blueprint-for-fixed-network-improvement-in-latin-america/#:~:text=Hyper%2Dcompetitive%20fixed%20broadband%20market,growing%20technology%20within%20the%20market
- 50 Srikanth. (2024). Movistar Chile announces 1.5 million 5G customer milestone and fibre migration plan. TelecomTalkInfo. <https://telecomtalk.info/movistar-chile-announces-fibre-migration-5g-customers/922779/#:~:text=Rollout%20in%20Chile-,Fibre%20Optic%20Migration,in%20rural%20and%20remote%20areas>
- 51 InfraPPP. (2016). Chile releases tender for fibre optic concession. <https://www.infrappworld.com/news/chile-releases-tender-for-fiber-optic-concession#:~:text=The%20Government%20of%20Chile%20has,read%20the%20tender%20document%20here>
- 52 Subsecretaría de Telecomunicaciones de Chile. (2022, July 5). Radiografía de las telecomunicaciones en Chile: inéditas cifras revelan crecimiento de 996% en conexiones 5G durante primer cuatrimestre del año. <https://www.subtel.gob.cl/radiografia-de-las-telecomunicaciones-en-chile-ineditas-cifras-revelan-crecimiento-de-996-en-conexiones-5g-durante-primer-cuatrimstre-del-ano/>
- 53 Telecom Review. (2025, May 9). South Korea's binary broadband push: Bridging the digital divide, one village at a time. <https://www.telecomreviewasia.com/news/featured-articles/13330-south-koreas-binary-broadband-push-bridging-the-digital-divide-one-village-at-a-time/>; Lee, H., & Jeong, S., & Lee, K. (2023). The South Korean case of deploying rural broadband via fibre networks by implementing universal service obligation and public-private partnership based project. Telecommunications Policy, 47(3). <https://ideas.repec.org/a/eee/telpol/v47y2023i3s0308596123000174.html>
- 54 SG Press Centre. (2024, February 21). Singapore is investing ahead in 10G Nationwide Broadband Network [Press release]. https://www.sgpc.gov.sg/detail?url=/media-releases/imda/press_release/P-20240221-1&page=/detail&HomePage=home
- 55 World Bank Group. (n.d.). Next Generation Nationwide Broadband Network, Singapore. <https://ppp.worldbank.org/telecom-and-ict/next-generation-nationwide-broadband-network-singapore>; ITU. (n.d.). Building Singapore's Next Generation Nationwide Broadband Network. https://www.itu.int/net/wsis/stocktaking/docs/activities/1291981845/Towards%20a%20Next%20Generation%20Connected%20Nation_Singapore.pdf
- 56 The Infocomm Media Development Authority announced investments of up to USD 100 million for upgrading the NBN between 2024 and 2026, with more than half a million households in 2028 expected to receive higher speeds (up to 10 Gbps). IMDA. (2024). Singapore is investing ahead in 10G Nationwide Broadband Network (NBN). <https://www.imda.gov.sg/resources/press-releases-factsheets-and-speeches/press-releases/2024/sg-investing-ahead-for-nbn-to-be-future-ready>

higher speeds, greater reliability, and a better user experience through upgraded network components, including last-mile cables to homes. In the US and Canada, cable was still the most prevalent in 2024, but its use is declining in the share of subscriptions as fibre uptake accelerated. Fibre overtook DSL within Europe's fixed broadband market around 2022, reaching over 50% of subscriptions by 2024.⁵⁷ In the UK, Ofcom reported that 69% of households had access to full-fibre broadband in 2024 compared to 57% in September 2023.⁵⁸ In India, despite a delayed and more limited adoption of fixed wireline, the share of fibre is already quite high, at over 85% as of 2024, with more than 39 million out of 45 million fixed broadband subscriptions using fibre.⁵⁹

3.6 Fixed Wireless as a Hybrid Option

Fixed wireless is an in-between option that provides broadband access to a specific location, such as a home or enterprise premises, through radio signals from a tower, removing the need for last-mile wireline connections. Fixed wireless technologies are capable of delivering higher speeds and lower latency than mobile internet when supported by 5G technologies, at a cost lower than fixed-line internet.⁶⁰ It is particularly advantageous in providing higher quality connectivity in more remote locations and difficult terrains. Fixed wireless is also a cheaper and easier alternative to upgrading older forms of fixed wireless, such as xDSL, into fibre. Including fixed wireless as part of a mix along with mobile and fixed line can help better serve the individuals and businesses whose needs lie in between the quality and affordability levels of mobile and fixed line. Fixed wireline remains the fastest and most reliable option for heavy use in areas with higher density which provide a sufficient base to justify last mile connections.

An appropriately balanced mix of technologies can help countries achieve the widest coverage of internet access at a quality adequate to promote its productive use. One recommended way to arrive at the appropriate mix is to ensure that public funding and programmes adhere to the principle of technological neutrality, alongside criteria such as minimum network quality parameters. Instead of promoting a predetermined preference for a certain distribution of network technologies, the programmes should be designed to allow market forces to allocate technologies based on demand patterns and supply constraints in an area while staying consistent with larger national goals.⁶¹

Despite being a mature broadband market, the US has seen significant increases in fixed wireless since 2021, with more than 600,000 additional net subscribers per quarter.⁶² 5G fixed wireless has created an opportunity for providers to compete for fixed broadband subscribers with smaller investments and highly competitive pricing, especially to existing mobile customers. Notably, despite the rise in the number of fixed wireless subscriptions, mobile internet quality has stayed consistent, supported by sufficient acquisition of mid-band spectrum.

While fixed wireless has largely been seen as a way to reach remote areas, where other types of fixed broadband would not be commercially viable, the US provides an interesting case study of success in well-saturated urban markets. Younger customers are more likely to adopt newer technologies and be comfortable with the self-installation process that involves picking up a router and setting up the network through an app. The ability to easily relocate routers also makes the technology more appealing.

57 Bell, P. (2025, March 6). The rise of fiber. TeleGeography. <https://blog.telegeography.com/the-rise-of-fibre>

58 Ofcom. (2024, 5 December). Full-fibre broadband reaches nearly 7 in 10 homes. <https://www.ofcom.org.uk/phones-and-broadband/coverage-and-speeds/full-fibre-broadband-reaches-nearly-7-in-10-homes>

59 Bell, P. (2025, March 6). The rise of fiber. TeleGeography. <https://blog.telegeography.com/the-rise-of-fibre>; Weissberger, A. (2025, October 29). Point Topic: Global broadband subscribers in Q2 2025: 5G FWA, DSL, satellite and FTTP. IEEE ComSoc Technology Blog. <https://techblog.comsoc.org/2025/10/29/point-topic-global-broadband-subscribers-in-q2-2025-5g-fwa-dsl-satellite-and-ftp/>

60 Ericsson. (n.d.). Fixed wireless access. <https://www.ericsson.com/en/fixed-wireless-access>

61 Briglauer, W., & Grajek, M. (2024). Effectiveness and efficiency of state aid for new broadband networks: evidence from OECD member states. *Economics of Innovation and New Technology*, 33(5), 672-700. <https://doi.org/10.1080/10438599.2023.2222265>

62 Wyrzykowski, R. (2024, June 6). 5G fixed wireless access (FWA) success in the US: A roadmap for broadband success elsewhere? Opensignal. <https://insights.opensignal.com/2024/06/06/5g-fixed-wireless-access-fwa-success-in-the-us-a-roadmap-for-broadband-success-elsewhere>

63 Comms8. (2024, May 21). South Korea's digital leap: How local apps are shaping the future in 2024. <https://www.comms8.com/blog/south-korea-digital-leap-social-media-local-apps-2024>; Kaczmarek, M. (2025, June 9). The state of internet access in Denmark: From fiber to satellite in 2025. TechStock. <https://ts2.tech/en/the-state-of-internet-access-in-denmark-from-fiber-to-satellite-in-2025/>

The US experience of fixed wireless is also the result of a unique balance between competitive pricing against wireline services and leveraging the large existing mobile-internet subscriber base. Various other countries have launched 5G services, but the adoption and trajectories of 5G fixed wireless (as opposed to 5G mobile) varies significantly. In Saudi Arabia, the operator Zain rapidly scaled fixed wireless services by leveraging its large mobile subscriber base and launched its national 5G fixed wireless network early, almost simultaneously with its 5G mobile network services. Zain has achieved a very high 5G fixed wireless market penetration and ratio of fixed wireless to mobile subscribers. However, unlike the US, Saudi Arabia has been experiencing a declining quality for both fixed wireless and mobile services in areas with higher fixed wireless penetration. Zain has announced plans to invest over USD 400 million to address these challenges and support continued growth.

3.7 Demand-Side Subsidies

Besides improving the ecosystem around the provision of fixed broadband, several countries are also making efforts to prepare the consumer ecosystem and boost demand.⁶³ A study on OECD countries between 1995 and 2010 showed that demand-side policies tend to have more substantial effects when broadband networks are more developed.⁶⁴ In this study, data from 2010 showed that, on average, subscribers used only 33% of all available new broadband network connections. At this point, supply-side measures are likely to have limited impact, and demand-side measures are likely to be more effective in realising welfare gains, especially in areas with higher coverage. Consumers with lower willingness to pay for more expensive upgraded fixed wireline connections can be nudged through public support, such as vouchers or tax reliefs. The 2022 broadband state aid guidelines of the European Commission also outlined demand-

side measures such as vouchers to help address low adoption.⁶⁵

The UK was among the first to use voucher programmes. The Gigabit Broadband Voucher Scheme, launched in 2018, provided vouchers to cover the installation costs for connecting homes and businesses in specific areas.⁶⁶ A report evaluating the BDUK Vouchers found that the vouchers significantly improved the availability of ultrafast broadband in 2020, but not much in 2019⁶⁷. The UK has also been using “social tariffs,” which offer lower priced broadband packages to low-income customers who receive universal credit or other government financial support. Apart from boosting affordability and expanding access, it also helps existing low-income customers continue having access. For example, 1.9 million households with fixed broadband in the UK are estimated to be struggling to afford the service.⁶⁸ Ofcom, the government-approved regulatory and competition authority for the broadcasting, internet, telecommunications and postal services, has been raising awareness of the scheme as well as the broader range of social tariff options. Despite an increase in the number of customers using the tariff – which rose by 125,000 customers (33%) from September 2023 to reach 506,000 in June 2024 – less than 10% of all eligible customers are covered, highlighting the need for greater awareness.

3.8 Fair Competition in the Fixed-Line and Telecom Markets

Ensuring fair competition within and across the multiple interconnected layers in the telecom infrastructure is a common and important aspect of many countries’ efforts to promote affordable and high-quality broadband networks. Vertical unbundling or functional separation is a common approach that is used to promote fair access and competition in the sector. Studies have suggested

64 Belloc, F., A. Nicita, and M. A. Rossi. 2012. “Whither Policy Design for Broadband Adoption? Evidence from 30 OECD Countries.” *Telecommunications Policy* 36 (5): 382–398. <https://doi.org/10.1016/j.telpol.2011.11.023>

65 Briglauer, W., & Grajek, M. (2024). Effectiveness and efficiency of state aid for new broadband networks: evidence from OECD member states. *Economics of Innovation and New Technology*, 33(5), 672–700. <https://doi.org/10.1080/10438599.2023.2222265>

66 Department for Digital, Culture, Media & Sport. (2021, April 20). Government launches new £5bn ‘Project Gigabit’. GOV.UK. <https://www.gov.uk/government/news/government-launches-new-5bn-project-gigabit>

67 Hatch, Belmana and Winning Moves. 2023. BDUK Vouchers Evaluation: Impacts and Value for Money Assessment. Summary Report. https://assets.publishing.service.gov.uk/media/650986e7a41cc3000d5613f5/BDUK_Vouchers_Evaluation_Impacts_and_Value_for_Money_Assessment_-_Summary_Report.pdf

68 Ofcom. (2024, December 12). Ultrafast broadband and landline bundles see biggest price drop in 2024. <https://www.ofcom.org.uk/phones-and-broadband/bills-and-charges/ultrafast-broadband-and-landline-bundles-see-biggest-price-drop-in-2024>; Beckett, M. (2026, February 9). Broadband social tariff deals: How to get low income broadband on universal credit. Uswitch. <https://www.uswitch.com/broadband/guides/broadband-deals-for-low-income-families/>

that functional separation and non-discrimination in access to infrastructure can help India ensure fair competition, reduce prices, and improve network quality. A cross-country analysis found that a higher degree of functional separation has more positive impacts on the fixed broadband market.⁶⁹ However, in many regulated sectors with high capital investments and economies of scale, vertical integration is permitted, and even promoted, if it can create more efficient, affordable, and higher quality outcomes. Regulatory, licensing, and system design decisions thus need to balance both these considerations, alongside the interests of operators who invest in the infrastructure (often incumbent) and operators providing last-mile services (often a mix of incumbents and new entrants).

Countries analysed in this study have adopted varied stances and approaches on the issue of competition in fixed-line and telecom markets. Competition amongst ISPs has been identified as one of the primary drivers of Chile's strong performance in fixed wireline provision.⁷⁰ The competition promoted high investments in fixed line infrastructure, with a focus on migrating customers from cable to fibre. Additionally, neutral networks such as On*Net Fibra offer wholesale fibre to ISPs, helping catalyse the process of migration to fibre.

Singapore's Infocomm Development Authority (IDA) recognised early that smooth delivery to end users through the Next Gen NBN market would require a system that can adapt to its multi-layered structure. The IDA imposed structural separation

(i.e., separation between active and passive infrastructure provision) to ensure competitive access to downstream operators and to enable the most cost-effective dark fibre prices at the wholesale and retail levels. Downstream operators, however, could be shareholders in the active infrastructure as long as they are operationally separated from the active network providers, ensuring that all downstream operators receive equal and competitive treatment.⁷¹ The UK also functionally separated its fixed line network starting 2006.⁷² While this did lead to lower prices in the short term,⁷³ the long-term impacts on quality and investment have been debated.⁷⁴ A more recent push to upgrade the network to fibre and support universal access through subsidies have, however, boosted performance.

Brazil reported an increase in fixed broadband connections by about 43% from the end of 2020 to 2024. Its fixed broadband market is competitive and fragmented, with smaller providers estimated to hold more than half the market, and particularly active in mid-size cities that are traditionally underserved by larger national providers. While price regulation for wholesale access in some areas and lower regulatory burden have supported smaller players, recent changes, such as a lower threshold for licence requirements, are likely to create challenges. Ensuring wholesale neutral host networks has been crucial in sustaining this landscape. While these networks were built as joint ventures, there has been increased consolidation with ISPs showing an interest in regaining majority ownership.⁷⁵

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- 69 Prasad, R., Sridhar, V., & Kedia, M. (2025). Functional Separation and a Restructured Licensing Framework for Indian Telecommunications. *Vikalpa: The Journal for Decision Makers*, 50(4), 295-309. <https://doi.org/10.1177/02560909251330750> (Original work published 2025); Han, S., & Pei, D. (2021). Is functional separation the right policy remedy to break telecommunications monopoly and improve performance? *The Frontiers of Society, Science and Technology*, 3(1), 56-73. <https://doi.org/10.25236/FSST.2021.030110>
- 70 Ookla. (2023). Chile fixed broadband performance. <https://www.ookla.com/articles/chile-fixed-broadband-performance-2023>
- 71 ITU. (n.d.). Building Singapore's Next Generation Nationwide Broadband Network. https://www.itu.int/net/wsis/stocktaking/docs/activities/1291981845/Towards%20a%20Next%20Generation%20Connected%20Nation_Singapore.pdf; IMDA. (2011, January 21). Guidelines for service provisioning over the Next Generation Nationwide Broadband Network. <https://www.imda.gov.sg/regulations-and-licensing-listing/guidelines-for-service-provisioning-over-the-next-generation-nationwide-broadband-network>
- 72 Tropina, T., Whalley, J., & Curwen, P. (2010). Functional separation within the European Union: Debates and challenges. *Telematics and Informatics*, 27(1), 56-66; Prasad, R., Sridhar, V., & Kedia, M. (2025). Functional Separation and a Restructured Licensing Framework for Indian Telecommunications.
- 73 The price of a 5GB fixed broadband basket was estimated at 2.5% of monthly GNI per capita in 2025. as per ITU statistics from <https://www.itu.int/en/ITU-D/Statistics/Pages/ICTprices/default.aspx>
- 74 Sidak, J. G., & Vassallo, A. P. (2015). Did separating Openreach from British Telecom benefit consumers? *World Competition*, 38(1), 31-76. <https://www.criterioneconomics.com/docs/did-separating-openreach-from-british-telecom-benefit-consumers.pdf>
- 75 Opensignal. (2025). Fixed broadband experience. Brazil. <https://insights.opensignal.com/reports/2025/10/brazil/fixed-broadband-experience>; Carro, R. (2025). Broadband pushes telecoms revenue growth in Brazil. *Valor International*. <https://valorinternational.globo.com/business/news/2025/06/10/broadband-pushes-telecoms-revenue-growth-in-brazil.ghmtl>

3.9 Licensing, Regulation, and Incentives

The design and implementation of licensing regimes, regulatory compliance, and spectrum allocation mechanisms affect the time and cost of infrastructure projects and the operational complexities of service provision. Licensing and regulation also play an important role in establishing a market structure and ecosystem that promotes the best long-term economic and social outcomes for customers, businesses, and the country, as discussed in the previous subsection.

Brazil's regulator Anatel simplified the process to obtain licences for providing broadband services, and recent reforms to Brazil's General Telecommunications Law allowed licence holders for fixed-line services to migrate from a public regime to a more flexible private regime. It also recently extended authorisations for offering telecom services to cooperatives in order to promote the expansion of digital infrastructure and the democratisation of telecom services. An amendment to the General Telecommunications Law opened the possibility of cooperatives to provide services of collective interest, such as fixed broadband, with the rights of a service provider, including access to financing sources such as the FUST (Universal Telecommunications Service Fund). Efforts to unify the rules and processes of different municipalities are also underway.⁷⁶

China's efforts to align residential and building standards with requirements for fibre deployment is another example of creating conducive regulatory ecosystems.⁷⁷ Spain has also leveraged improvements in the urban planning process to smoothen the layout of fibre network infrastructure.

3.10 Technological Innovations and Systems Improvements

Innovations such as fibre aggregation and wavelength division multiplexing⁷⁸ can help improve infrastructure and increase network capacity at manageable costs. More broadly, promoting an ecosystem that nurtures and fosters innovation is also important. Additionally, improved coordination between the entities that hold various responsibilities related to the fixed wireline system is crucial. Another requirement is capacity development through local and international partnerships to address the lack of skilled practitioners necessary for the rollout of fibre technology. Belgium is a notable example, with its strong emphasis on innovative civil works partnerships,⁷⁹ highlighting the importance of coordination between agencies for the effective delivery of fibre rollout. Belgium also provides a sound example of supporting buildings and other infrastructure to become "fiber-ready" for smooth roll out across the country.⁸⁰

4 Recommendations

Mapping India's past and current initiatives (Section II) against other countries (Section III) highlights certain measures that can improve the balance of fixed broadband in the mix of technologies to attain wider access to better quality internet.

4.1 Leveraging Policies Promoting Universal Access and Boosting Public Funding

While India has various funding mechanisms to promote universal access, their implementation can be improved. The USOF, for example, has

76 Ministério das Comunicações. (2026, January 7). Governo do Brasil libera cooperativas para oferecer internet e telefonia e amplia conectividade no país. Gov.br. <https://www.gov.br/mcom/pt-br/noticias/2026/janeiro/governo-do-brasil-libera-cooperativas-para-oferecer-internet-e-telefonia-e-amplia-conectividade-no-pais>; GSM Association. (2019, October 9). The industry welcomes Brazil's reform of General Telecommunications Law. <https://www.gsma.com/about-us/regions/latin-america-and-the-caribbean/the-industry-welcomes-brazils-reform-of-general-telecommunications-law/>; Instituto Federal de Telecomunicaciones. (n.d.). White paper F5G Mexico. <https://despliegueinfra.ift.org.mx/docs/WP%20F5G%20MEXICO%20vEN.pdf>

77 Instituto Federal de Telecomunicaciones. (n.d.). White paper F5G Mexico. <https://despliegueinfra.ift.org.mx/docs/WP%20F5G%20MEXICO%20vEN.pdf>

78 Fibre aggregation can allow cables to be spliced together, reducing cable needed for long-distance transmission. Wavelength division multiplexing can increase the capacity of the cable by allowing the transmission of multiple signals at different wavelengths.

79 Analysis Mason. (2020). Full-fibre access as strategic infrastructure: strengthening public policy for Europe.

80 TelecomLead. (2022, June 28). Proximus fiber broadband reaches 1 mn homes and businesses. <https://telecomlead.com/broadband/proximus-fiber-broadband-reaches-1-mn-homes-and-businesses-105345>

remained grossly underutilised.⁸¹ The Digital Bharat Nidhi (DBN) replaced the USOF under the Telecommunication Act, 2023, bringing a more targeted focus to underserved areas and marginalised groups. Although a total of INR 92,652 crore has been disbursed under various schemes of the DBN as of October 2025, an estimated balance of over INR 1 lakh crores remains unutilised in the consolidated fund as of March 2026.⁸²

India's USOF represents a case that successfully mobilised public money but failed to convert it into connectivity outcomes. The problem is not one of resources but of programmatic design, accountability architecture, and the assumption that supply automatically generates demand. Unless the DBN addresses these design flaws, it risks repeating the same pattern.

The most fundamental structural flaw of the USOF is that the 5% levy collected from operators flows into the Consolidated Fund of India and is then subject to budgetary appropriation before reaching the DBN. This creates a gap between collection and disbursement, with the money being diverted to other government uses. The DBN's revised framework, while improving the administrator's autonomy, does not conclusively resolve this transfer problem. A direct ringfenced crediting mechanism, bypassing the Consolidated Fund or, at minimum, establishing a mandatory and time-bound transfer

obligation backed by legislation, is the foundational reform required before any other interventions can work effectively.

Some have argued that replacing universal levies with incentives for the private sector can help meet universal connectivity objectives more efficiently⁸³. Other ideas to utilise public funding more effectively include introducing demand-side support to end users for both service provision and device access.⁸⁴

The effective utilisation of the various sources of public funding will be essential to achieve National Broadband Mission 2.0, including the 2030 target of operational optical fibre cable connectivity in 2.7 lakh villages.⁸⁵ While budget allocations for the telecom sector have increased in the last five years (with a total outlay of INR 73,990.94 crores in FY 2026-27)⁸⁶ and have continued to prioritise BharatNet expansion,⁸⁷ the effective utilisation of these funds requires significant improvements in implementation. Some recommendations for this include adopting a programmatic approach that focuses on more coordinated and holistically planned infrastructure layout and network utilisation; fostering flexible implementation models backed by financial support; strengthening monitoring and accountability mechanisms; and customising interventions in areas with particularly low reach, such as India's North East.⁸⁸

81 Lanka, Shravani Nag and Medha Garg. 2025 Budget and Digital Rights: Artificial Intelligence Takes Centre Stage. Internet Freedom Foundation. <https://internetfreedom.in/2025-budget-and-digital-rights-artificial-intelligence-takes-centre-stage/>; Maheshwari, D., & Sharma, B. (2025). Governing Digital India: A Report on Institutions and Instruments. New Delhi: Centre for Social and Economic Progress. <https://csep.org/wp-content/uploads/2025/10/GOVERNING-DIGITAL-INDIA.pdf>; Das, Bhargavee & Krithika Ramnath. 2024. The Evolution of BharatNet: Lessons from India's Largest Rural Broadband Project. In ViCT (ICRIER and Vodafone Idea Centre for Telecom). <https://icrier.org/pdf/pb-BharatNet.pdf>

82 Universal Service Obligation Fund. (n.d.). Fund status. Ministry of Communications, Government of India. <https://usof.gov.in/en/fund-status>

83 Das, Bhargavee & Krithika Ramnath. 2024. The Evolution of BharatNet: Lessons from India's Largest Rural Broadband Project. In ViCT (ICRIER and Vodafone Idea Centre for Telecom). <https://icrier.org/pdf/pb-BharatNet.pdf>

84 Maheshwari, D., & Sharma, B. (2025). Governing Digital India: A Report on Institutions and Instruments. New Delhi: Centre for Social and Economic Progress. <https://csep.org/wp-content/uploads/2025/10/GOVERNING-DIGITAL-INDIA.pdf>

85 Department of Telecommunications. (2025). National Broadband Mission 2.0: 2025-30. <https://www.dot.gov.in/static/uploads/2025/07/c7c060d6fec6ac6bb73230c65f134909.pdf>

86 While this represents an 8.65% decrease in budgeted expenditure from FY 2025-26, it is a ~39% increase compared to the real expenditure.

87 The budgeted expenditure for FY 2025-26 was at INR 22,000 crores but only 25% (INR 5,500 crores) was utilised. The budgeted expenditure for FY 2026-27 was still set at INR 20,000 crores. Internet Freedom Foundation. (2025, February 4). Analysis of the 2026-2027 budget. <https://internetfreedom.in/analysis-of-the-2025-2026-budget/>

88 Das, Bhargavee & Krithika Ramnath. 2024. The Evolution of BharatNet: Lessons from India's Largest Rural Broadband Project. In ViCT (ICRIER and Vodafone Idea Centre for Telecom). <https://icrier.org/pdf/pb-BharatNet.pdf>

4.2 Connecting Institutions and Leveraging Social Infrastructure

The effective inclusion of rural populations into increasingly digitalised systems, particularly in sectors with high potential for social impact, such as healthcare and education, depends on broadband connectivity for last-mile institutions, such as public health clinics, health and wellness centres, schools, colleges, and gram panchayats.⁸⁹ NBM 2.0 aims to extend broadband connectivity to 90% of anchor institutions (primary health centres, schools, anganwadi centres, and panchayat offices) by 2030. The 2025-26 budget announcement to extend broadband connectivity to government-run secondary schools and primary health centres in rural areas through BharatNet is well aligned with this target.⁹⁰

Conversely, social and private infrastructure can be leveraged to extend connectivity, particularly for individuals who do not have other means to access the internet. For example, the PM-WANI scheme aims to proliferate broadband access through public Wi-Fi hotspots at public or private entities such as schools, hospitals, and shops (called public data offices, PDOs). However, progress has been slow. A little over four lakh PM-Wani Wi-Fi hotspots were operational as of February 2026,⁹¹ compared to a target of one crore by December 2022 as per the National Digital Communications Policy, 2018. One of the reasons identified for this is the high cost of obtaining the internet leased line connection required to support the hotspot. Telecom service providers have tended to charge higher rates for these connections than the rates for fibre-to-home connections. Given that data utilisation in most of

these connections remains low, TRAI recommended that a retail broadband connection would suffice and, accordingly, PDOs should be charged lower tariffs.⁹²

4.3 Demand-Side Initiatives

Demand-side factors such as affordability, awareness, digital skills, and lack of technical expertise in institutions also limit adoption and utilisation. Creative ways of leveraging public funding to help address some of these demand-side factors can help bridge the gap in demand where supply exists as well as help induce demand to which supply can respond.

4.4 Upgrading Existing Fixed-Line Networks and Leveraging Public-Private Partnerships

Converting BSNL and MTNL's legacy copper-based landline and DSL network to fibre is the most obvious upgrade. BSNL and MTNL remain the backbone fixed-line operator, with 8.96 lakh route km of OFC combined with an additional 6.89 lakh km laid under BharatNet giving it the largest fibre footprint of any single entity in India.⁹³ A combined public-sector fiber footprint under BSNL/MTNL+BharatNet of approximately 15.85 lakh route km, which is quite robust to begin.⁹⁴ BSNL alone accounts for roughly 37-38% of the country's entire fibre footprint.⁹⁵ Yet, much of its last-mile delivery still runs over ageing copper, capping broadband speeds and reliability. India's tower fiberization rate stands at approximately 36% (IBEF/TAIPA, 2024-25),⁹⁶ against a DoT target of 70% by 2024. In contrast, over 70% of cellular sites in North America have fiber backhaul (GSMA), and South Korea and Japan — where fiber broadband penetration exceeds 84-88% — have far deeper fiber integration across their mobile infrastructure.

89 Inampudi, S., Rajkumar, E., Gopi, A., Mol, K. S. V., & Sruthi, K. S. (2024). Barriers to implementation of digital transformation in the Indian health sector: A systematic review. *Humanities and Social Sciences Communications*, 11, Article 632. <https://doi.org/10.1057/s41599-024-03081-7>

90 BharatNet. (2025). Union Budget 2025 News: Broadband connectivity announced in rural areas under BharatNet scheme. <https://bharatnet.in/broadband-connectivity-to-schools-healthcare-centres-in-rural-areas-under-bharatnet-scheme/>

91 Ministry of Communications, Government of India. (2026, April 2). PM-WANI scheme accelerates public Wi-Fi expansion across India with over 4 lakh hotspots. <https://www.pib.gov.in/PressReleasePage.aspx?PRID=2248538®=3&lang=1>

92 Telecom Regulatory Authority of India. (2021, August 31). Recommendations on roadmap to promote broadband connectivity and enhanced broadband speed. https://www.trai.gov.in/sites/default/files/2024-09/Recommendations_31082021.pdf; Bhargava, Y. (2024). Why PM-WANI is falling behind targets & how govt plans to fix the public Wi-Fi hotspots scheme. *The Print*. <https://theprint.in/theprint-essential/why-pm-wani-is-falling-behind-targets-how-govt-plans-to-fix-the-public-wi-fi-hotspots-scheme/2239166/>

93 Ministry of Communication. 2024. Lok Sabha Unstarred Question No. 310. https://sansad.in/getFile/loksabhaquestions/annex/182/AU310_F34kVO.pdf?source=pqals

94 TelecomTalk.info, 2024. Available at: <https://telecomtalk.info/bsnl-had-provided-38-93-lakh-fth-connections-by-april-30-2024/979500/>

95 Minister of State for Communications' written reply to Lok Sabha (2024) and the DoT Year-End Review (December 2025)

96 India Brand Equity Foundation (IBEF). Telecom Industry in India: Market Size, Growth & Future. New Delhi: IBEF (Ministry of Commerce & Industry, Government of India). Available at: <https://www.ibef.org/industry/telecommunications>

The copper conversion programme needs to be accelerated nationally rather than being rolled out circle by circle. Several steps would support this: first, ring-fencing capital from BSNL's INR 1.64 lakh crore government revival package specifically for last-mile fiberisation; second, setting measurable annual targets for copper retirement by exchange area with independent monitoring; and third, decommissioning copper exchanges on a defined schedule to prevent the dual-network maintenance cost that has historically drained BSNL's operational budget.

India also has an extensive network of millions of kilometres of coaxial and legacy cable TV infrastructure laid by local cable operators that could theoretically be upgraded to hybrid-fibre-coaxial or full fibre networks at lower cost than greenfield deployment. However, the regulatory framework does not integrate cable TV operators smoothly into the broadband licensing regime.

On PPP, India's track record in telecom points to several structural conditions that have repeatedly undermined concession viability that discourages private-sector participation. RoW reform remains the most acute bottleneck. The Telecommunications (Right of Way) Rules 2024 simplified the framework, but ground-level implementation, particularly at the municipal and panchayat levels, is lagging. Addressing this bottleneck is as important as designing individual PPP structures.

Additionally, demand risk allocation has been a notable failure in BharatNet PPP bidding. Commercial operators are reluctant to bear the full demand risk due to low affordability in rural areas. In this context, international models offer three proven instruments India could adopt:

- Viability gap funding calibrated to take-up rate rather than construction milestones (i.e., viability gap funding paid per active subscriber, not per connected Gram Panchayat)
- Anchor tenant commitments where the government guarantees a minimum revenue by pre-purchasing broadband connectivity for anchor institutions (schools, primary healthcare centres, panchayats) under the DBN/NBM 2.0 frameworks, providing a demand floor for private concessionaires

- Reverse auction with minimum service price, where the operator who bids the lowest government subsidy while committing to defined service levels wins. This model was used successfully in Chile's and Peru's rural connectivity programmes.

4.5 Competition, Regulation, and Licensing

While state support for a capital-intensive exercise is crucial for fiberisation to rebalance the fixed-to-mobile-network ratio, some regulatory solutions can also alter private incentives. The Indian telecom sector has gravitated towards a duopoly, with the two largest players capturing 75% of the market share. With limited competitive pressure, there is no incentive to fiberise areas beyond immediate commercial interest, therefore limiting it to dense urban and peri-urban markets. Second, India lacks a significant market power (SMP) regulatory regime analogous to the EU's framework, under which dominant operators have mandatory wholesale access obligations, price controls, and non-discrimination requirements. Without SMP-equivalent obligations, market power in fibre infrastructure is largely unregulated.

Though wholesale access to fibre is permitted under unified licence conditions, where operators may share dark fibre and duct space, it is not mandated. As a result, each large operator builds its own proprietary last-mile fibre network, duplicating capex in profitable urban areas while leaving unprofitable areas unserved. TRAI's April 2024 recommendations advocated active infrastructure sharing, but this remains voluntary for private operators. Digital connectivity infrastructure provider (DCIP) authorisation creates a neutral-host category but does not impose mandatory access obligations on existing fibre owners. Moreover, IP-1 licensing to DCIP transition uncertainty is chilling fibre infrastructure investment by independent/neutral providers.

Publicly funded backbone fibre is nominally open access, but the absence of a standard reference interconnection offer, transparent regulated pricing, and an independent dispute resolution mechanism means that only large Telecom Service Providers can access the fibre while smaller ISPs face commercial and administrative barriers. Moreover, the compliance and fee burden of ISP licensing, which includes hefty security deposits, fees linked to Adjusted Gross Revenue (AGR), and reporting obligations, is disproportionately heavy for small

operators, and the forthcoming authorisation regime under the Telecommunications Act 2023 has not clarified whether these burdens will be meaningfully rationalised for smaller entities.

Finally, an AGR-based levy disincentivises investment. Therefore, we recommend a levy offset for rural fibre capex – a mechanism that is used in several Latin American universal service regimes. Without structural separation or equivalent behavioural remedies such as non-exclusivity with last-mile providers and vertical integration between fibre infrastructure and retail services, the current duopoly model will disadvantage competing operators.

4.6 Balancing Fixed Wireline with Fixed Wireless as a Hybrid Option

India has also been investing in fixed wireless infrastructure, with around 14.6 million subscriptions by December 2025.⁹⁷ Approximately a third of these are from rural areas, where Jio has the largest market share (close to 80% in May 2025). The majority of Jio's fixed wireless connections are from rural areas and Tier 3 and Tier 4 cities. Airtel has been growing its subscriptions as well. Fixed wireless is also being deployed in urban areas, with challenges related to RoW.⁹⁸ Both players have been targeting their existing mobile subscriber base as well as new customers in smaller towns. However, introducing new FWA customers can potentially lower the network experience for both mobile and fixed wireless users, requiring careful planning, load balancing, and traffic routing. Sufficient spectrum is

also required to maintain capacity. Starlink has also announced packages for satellite broadband in India, which will contribute to the country's mix of mobile, fixed wireline, and fixed wireless broadband internet connectivity.

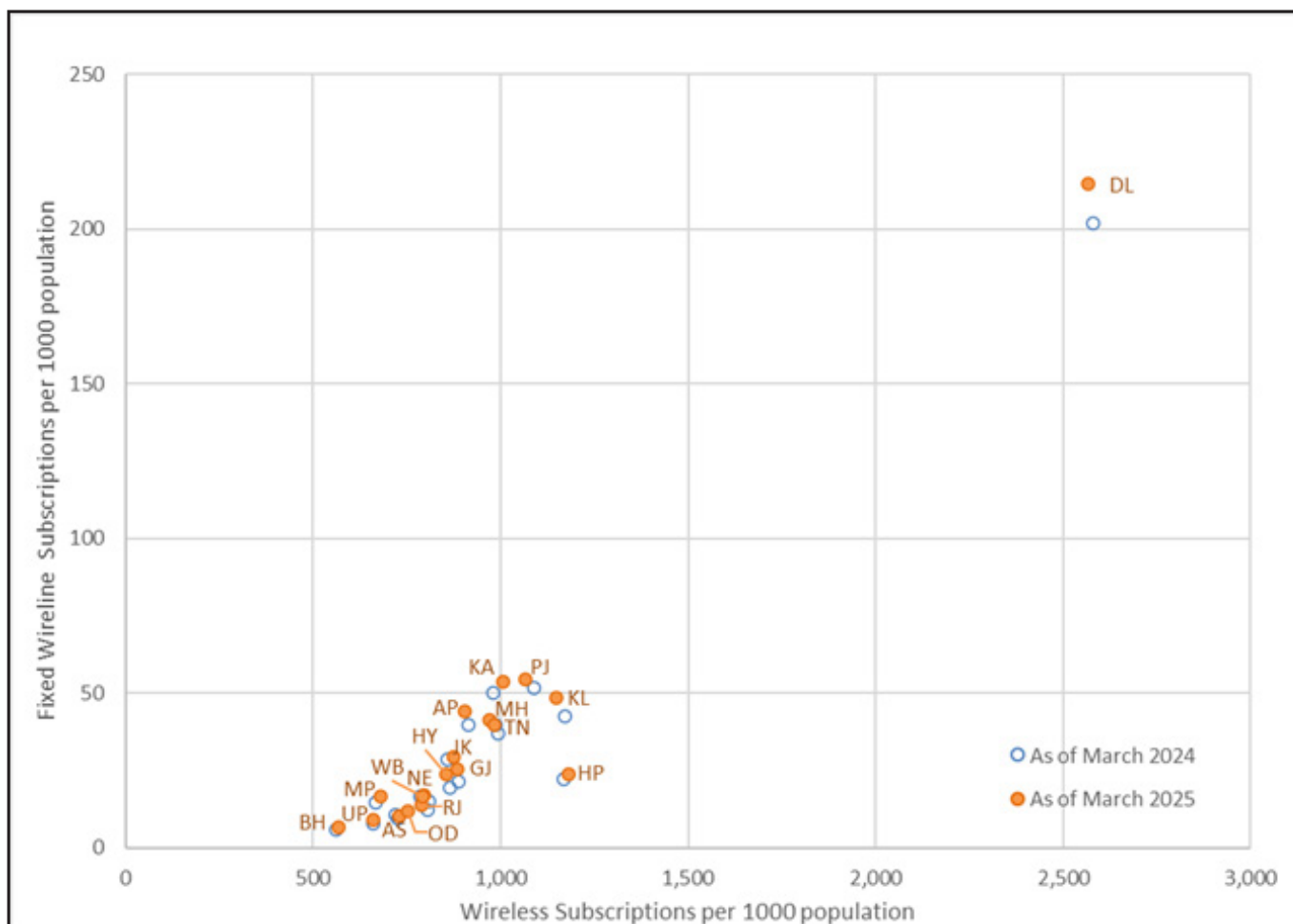
4.7 Harmonising Planning and Implementation at the State and Central Levels Based on an Understanding of the Subnational Distribution of the Network Mix

A better understanding of the balance of fixed wireless and wireless networks at a subnational level, mapped onto a more nuanced understanding of the varying needs, demands, and supply-side constraints of these areas, can be a strategic way to improve the national balance. Figure 3 shows that all states have a significantly higher density of wireless subscriptions compared to wireline, but this imbalance is particularly high in states like Assam, Odisha, and Rajasthan. Whether this imbalance is due to geographical constraints, affordability, lower need, or supply-side bottlenecks needs to be better assessed. Himachal Pradesh also has a relatively high imbalance (i.e., ratio of fixed wireline to wireless subscriptions per capita), but the number of fixed wireline subscriptions per capita is not as low and remains above average. In the context of states like Bihar and Uttar Pradesh that are relatively low on both wireless and wireline, there is a need to examine factors such as affordability, lower demand, state capacity, and other disincentives for service providers, which affect the broader provision and use of the internet regardless of technology type.

97 Telecom Regulatory Authority of India. (2026). The Indian Telecom Services Performance Indicators: October–December 2025. https://www.trai.gov.in/sites/default/files/2026-03/QPIR_03032026_0.pdf

98 Opensignal. (2025). Fixed broadband experience. India. <https://insights.opensignal.com/reports/2025/08/india/fixed-broadband-experience>

**Figure 3: Subnational distribution:
Service area-wise fixed wireline vs. wireless subscription density**



Source: Telecom Regulatory Authority of India (TRAI). *The Indian Telecom Services Yearly Performance Indicators 2024-2025*.

Note: The telecom circles are as follows: Andhra Pradesh includes Telangana; Bihar includes Jharkhand; Madhya Pradesh includes Chhatisgarh; Maharashtra includes Goa; North-East includes Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland & Tripura States; Punjab includes Chandigarh; Uttar Pradesh includes Uttarakhand; West Bengal includes Sikkim and A&N Islands. Labels are as follows: AP: Andhra Pradesh Combined; AS: Assam; BH: Bihar Combined; DL: Delhi; GJ: Gujarat; HY: Haryana; HP: Himachal Pradesh; JK: Jammu & Kashmir; KA: Karnataka; KL: Kerala; MP: Madhya Pradesh Combined; MH: Maharashtra Combined; NE: North East Combined; OD: Odisha; PJ: Punjab; RJ: Rajasthan; TN: Tamil Nadu; UP: Uttar Pradesh Combined; WB: West Bengal Combined.

4.8 Technological Innovations and Systems Improvements

Both technological and systems improvements are required to broaden the reach of the fixed wireline network and ensure it remains efficient and resilient. For example, National Broadband Mission 2.0 mentions leveraging assets like the optical ground wire of the power sector to improve broadband

connectivity, particularly in hilly and remote areas, and to improve resilience during disasters.⁹⁹ Ensuring that telecom infrastructure is resilient to an increasing threat of natural hazards and cybercrime will be crucial for ensuring a robust digital economy. This, in turn, requires effective needs assessments, vulnerability and criticality analyses of fibre networks, and coordination between multiple agencies.

⁹⁹ Department of Telecommunications, Ministry of Communications. 2025. National Broadband Mission 2.0 2025-30. https://eservices.dot.gov.in/sites/default/files/user-manual/NBM%202-0%20Vision%20Document_Final_RoW-compressed.pdf

Annexures

Annexure 1: Country Policy Actions and/or Incentives

Country	Policy Action/Incentive									
	National Plans and Strategies	Access to Public Funds	Subsidies	Tax Benefits	Regulation	Support from MDBs	Private-Sector Engagement	Performance Management	Compliance	Promoting an Innovative Ecosystem
Canada	Connectivity Strategy (High-Speed Access for All) National Broadband Map	Universal Broadband Fund			Canadian Radio-Television and Telecommunication Commission (CRTC) permits wholesale access to fibre networks			CRTC evaluates service delivery of funding recipients	CRTC's monitoring of services provided meeting universal service objective-level standards	Small businesses are encouraged to develop competitive pricing fibre optic sensing tech
Chile	Zero Digital Divide Plan 2022-2025; improving DPI, including fibre	Fondo de Desarrollo de las Telecomunicaciones (FDT) – supports competitive bidding for national subsidies, with an annual programme of projects for requests	Fibra Óptica Nacional – Public Subsidy Fibra Óptica Austral: Significant subsidy Fibra Óptica Tarapacá		Wholesale open access Subsecretaría de Telecomunicaciones (Subtel): Inclusive access to telecommunications infrastructure Internet Access as a Public Service Law (April 2024) Auctions for Spectrum – Steering indirect demand for fibre		Strong competition Copper to fibre migration Demand for international connectivity, a hub for LAC, submarine connection			
Denmark	Digital Strategy 2022-2025 and 2024-2027 National Broadband Goals (2025 Targets) Broadband mapping	Bredbåndspuljen (Broadband Pool) EU Recovery and Resilience Facility			Wholesale access and open networks Technology-neutral regulation Implementing the EU Electronic Communications Code		Major involvement by energy utility companies High demand and supply for high-speed broadband			High adoption of fibre, initiating innovation
Germany	Digital Strategy for Germany (Digitalstrategie), 2022 Gigabit Strategy for Germany (Gigabitstrategie), 2022	Federal Funding Programme for Broadband Expansion (Bundesförderprogramm zum Breitbandausbau / Gigabitförderung) Grey Spots Funding (Graue Flecken Förderung) and White Spots Funding Federal government covers around 50-70% of gigabit rollout costs			Telecommunications Act (TKG) Amendment (2021) Wholesale access Support for copper to fibre migration	KfW's Digital Infrastructure Investment Loan and the KfW Digital Infrastructure Syndicated Loan Support from EIB				
Spain	España Digital 2026 (Digital Spain 2026)	UNICO-Banda Ancha (UNICO-Broadband) for white and grey areas EU Recovery and Resilience Facility (NextGenerationEU funds)		Reduction of tax options	Implementation of General Telecommunications Law (TKG) 2022, in line with the EU Electronic Communications Code Comisión Nacional de los Mercados y la Competencia (national regulator) – wholesale access Improving ease of investing in Spain through faster permits, expedited urban planning, and an obligation for universal service		Telefónica's high ambition is steering fibre rollout High competition			

Czech Republic	<u>National Plan for the Development of Very High Capacity Networks (VHCN), in line with Innovation Strategy for 2019-2030.</u> <u>Czech Republic's digital transformation efforts in line with the EU's Digital Decade Policy Programme 2030</u>	<u>Ministry of Industry and Trade's Broadband Competence Office provides long-term support for the development of high-speed networks</u>	<u>Subsidies</u>		<u>Implementing the EU Electronic Communications Code</u> <u>Encouraging fair competition</u> <u>Mapping of infrastructure assets</u> <u>Ease of releasing permits</u>		<u>Ease of investments promoted (ongoing)</u> <u>Uncertainty of investments proposed to be alleviated as the Czech Republic is currently lagging behind OECD countries in fibre rollout penetration rate</u>			
Belgium	<u>National Digital Strategy: Digital Belgium & Connectivity Plan: National Plan for Fixed and Mobile Connectivity (2022-2024)</u>	<u>EUR 41 million funded for rollout of fixed digital connectivity in white areas</u> <u>EU Recovery and Resilience Facility</u>			<u>Implementing the EU Electronic Communications Code</u> <u>Infrastructure wholesale access</u> <u>Router freedom</u>		<u>Increasing competition and ambitions of incumbent operators</u>	<u>Supporting buildings and other infrastructure to become "fibre-ready"</u>		<u>Reduction of administration costs through Federal Acts</u>
Italy	<u>Italian Strategy for Ultra Broadband "Towards the Gigabit Society" (2021, updated 2023)</u>	<u>EU Recovery and Resilience Facility</u> <u>Connected schools and health plans</u> <u>Voucher plan</u> <u>Fondo per lo sviluppo del settore delle telecomunicazioni (Broadband Development Fund)</u>			<u>Implementing the EU Electronic Communications Code</u> <u>Infrastructure wholesale access</u> <u>Infrastructure mapping</u>		<u>Increasing competition and ambitions of incumbent operators</u>			
Finland	<u>Digital Infrastructure Strategy 2025</u> <u>Finland Digital Compass in line with the EU Digital Compass</u>	<u>Valokuitua Kotiin - Fibre to the Home (Broadband Aid Programme)</u> <u>EU Recovery and Resilience Facility</u> <u>National State Aid Scheme for Sparsely Populated Areas</u>			<u>Encouraging fair competition</u> <u>Wholesale access</u>	<u>Nordic Investment Bank</u> <u>InvestEU Program</u>	<u>Fibre cooperatives</u> <u>Role of Nokia as key player in promoting fibre</u>			<u>Traficom's Tieto.</u> <u>Traficom portal data bank for sharing insights on underserved areas</u>
Ireland	<u>National Broadband Plan (NBP) – wholesale only network, connected large number of schools through Broadband Connection Points (BCPs)</u> <u>Digital Connectivity Strategy (2022)</u> <u>Harnessing Digital – The Digital Ireland Framework (2022)</u>	<u>Under NBP</u> <u>RISE Community Fund (supported by National Broadband Ireland)</u>			<u>Commission for Communications Regulation promotes competition</u> <u>Wholesale access</u> <u>Copper to fibre migration</u>		<u>Fibre-to-the-home network involvement by private sector</u> <u>For example, SIRO, a joint venture between Vodafone and ESB (Ireland's electricity supply board) delivering to commercial businesses and homes</u> <u>PPP through National Broadband Ireland</u>			
South Korea	<u>Framework Act on Informatization Promotion (1987)</u> <u>Korean Information</u>	<u>Direct Capital Support: National "informatization fund" (contributions from government and private capital).</u>		<u>Tax relief (partial remission): high-tech companies investing in broadband</u>	<u>Obligation for universal service</u> <u>Anti-monopoly law</u>		<u>PPPs for rural broadband</u>			<u>"Broadband Buildings" certification programme</u> <u>Digital literacy promotion</u>

	Infrastructure (KII) Initiative (1994) Cyber Korea 21 (1999) , e-Korea Vision 2006 (2002) , IT Korea Vision 2007 (2003) , Broadband Convergence Network (BcN) , IT 839 initiatives (2004) K-Network 2030 Strategy (launched 2023)	dedicated IT budgets Low-interest loans		communications infrastructure					
Japan	Digital Garden City Nation Concept (ongoing till end-2027) e-Japan Plan (2001) , e-Japan Strategy II (2003) Ubiquitous-net Japan (U-Japan) Strategy (2004) IT New Reform Strategy (2006)	Program for the Complete Dissolution of Geographical Divide Areas (Broadband Zero Areas Elimination Project): Grants supporting subsidies Universal Service Fund system	Maintenance and management subsidies Support for 5G-compatible upgrades, starting FY2020, subsidising private carriers that receive publicly installed facilities for upgrading them in line with 5G and other advanced technologies		Prevention of anti-competitive practices Wholesale access Optical fibre categorised as “Category I Designated Telecommunications Facilities” as per the Telecommunications Business Act: Fair and equitable renting of facilities for carriers		Increased competition High ambition by major private players High adoption due to weakening use of traditional telecommunication infrastructure		
Australia	National Broadband Network (NBN) and its Upgrade Program – government-owned wholesale network (NBN Co)				Wholesale access Special Access Undertaking (SAU) – Government policy project notice		Australian Competition and Consumer Commission – Measuring Broadband Australia (for quality and speed)	Statutory Infrastructure Provider Regime Fibre-ready requirements	Demand-led initiatives, such as School Student Broadband Initiative
Russia	Digital Economy National Program (Launched 2017) Sovereign Internet Initiative (2019) Dominance of State-Owned Operators – Rostelecom Arctic Circle Submarine Cables In light of sanctions, import substitutions, and shift to domestic technology	Universal Communication Services (Universal Service Obligation – USO), funded by Universal Service Fund			Federal Law “On Communications” Interconnection Rules: Publicly available telecom networks operators required to connect to other operators				
UK	Project Gigabit (GBP 5 billion program for last-mile users) – Gigabit Broadband Voucher Scheme and GigaHubs		Under Project Gigabit	Between 2017 and 2022, significant tax relief for businesses for deploying new full-fibre infrastructure	Ofcom – Wholesale access to Openreach’s infrastructure, with pricing rules to protect competition Ofcom supports copper to fibre migration Ofcom provides ease of investments beyond 2031 Implementing the European Electronic Communications Code				Improving ease of planning regulations for infrastructure deployment

Please note: The above mapping is not exhaustive.

Annexure 2: National Broadband Programmes in OECD Countries till 2018

The below table from Briglauer & Grajek (2024)¹⁰⁰ provides an overview of National Broadband Programmes in OECD countries till 2018.

State	National broadband/NBN program names ^a	National NBN targets ^b	National NBN funds ^c	(%/Focus) Rural areas ^d
European OECD states				
AUT	ICT Master Plan – 2007; Breitband 2013	2020: 99% of households with 100 Mbit/s	Yes	100%
BEL	Digital Belgium	2020: 100% of households with 30 Mbit/s	No	–
CHE	Digital strategy	2020: 100% of municipalities with 30 Mbit/s	No	–
CZE	Digital Czech Republic; National Plan for Develop. of NGN	2020: 100% of population with 30 Mbit/s population and a coverage of at least 100 Mbit/s for 50% of households	Yes	Yes
GER	IKT 2020; Digitale Agenda	2018: 100% of households with 50 Mbit/s	Yes	94.3%
DNK	Better broadband coverage	2020: 100% of households and businesses with 100 Mbit/s	Yes	100%
ESP	Broadband strategy; Digital Agenda	2020: 100% of population with 30 Mbit/s population and a coverage of at least 100 Mbit/s for 50% of households	Yes	60%
EST	Information Society Development Plan; EstWin Project	2020: 100% of households with 30 Mbit/s	Yes	100%
FIN	Broadband implement. Plan; ubiquitous information society	2015: 99% of households, businesses and public offices with 100 Mbit/s	Yes	100%
FRA	Digital France 2012; France très haut débit	2022: 100% of households, businesses and public offices with 30 Mbit/s	Yes	100%
GRC	National Broadband Plan Next Generation	2020: 100% of households with 30 Mbit/s	Yes	75%
HUN	Digital Literacy Action Plan; National Infocommunication Strategy	2018: 100% of households with 30 Mbit/s 2020: 50% household penetration with 100 Mbit/s	Yes	71.4%
IRL	Next Generation Broadband; national broadband strategy	2020: 100% of households with 30 Mbit/s	Yes	100%
ISL	e-nation	2020: 99.9% of households and businesses with 100 Mbit/s	No	–
ITA	Broadband Internet for all; Strategy for next gen. access network	2020: 100% of households with 30 Mbit/s; 100% of businesses and 85% of population with 100 Mbit/s	Yes	75%
LUX	National Strategy for superfast broadband	2020: 100% of households, businesses and public offices with 1 Gbps/500 Mbit/s	Yes	No
NLD	Broadband policies; Digital Agenda	2020: 100% of households with 30 Mbit/s	Yes	100%
NOR	Digital Agenda; Information Society	2020: 90% of households with 100 Mbit/s	Yes	Yes
POL	National broadband plan; Development of the Information Society	2020: 100% of households and businesses with 30 Mbit/s and 50% of households with at least 100 Mbit/s	Yes	75%
PRT	Agenda Digital; connecting Portugal	2020: 100% of population with 30 Mbit/s population and a coverage of at least 100 Mbit/s for 50% of households	Yes	100%
SVK	Digital growth & next gen. infrastructure; Information Society Strategy	2020: 100% of households with 30 Mbit/s	Yes	Yes
SVN	Next gen. broadband networks; Broadband Network Development Strategy	2020: 96% of households with 100 Mbit/s and the remaining 4% with 30 Mbit/s	Yes	Yes
SWE	Completely Connected Sweden; Rural areas program	2025: 98% of households and businesses with 1 Gbit/s	Yes	100%
GBR	NGN Deployment Plan; Superfast Broadband Future	2020: 95% of households and businesses with 25 Mbit/s	Yes	100%
Non-European countries				

100 Briglauer, W., & Grajek, M. (2024). Effectiveness and efficiency of state aid for new broadband networks: evidence from OECD member states. *Economics of Innovation and New Technology*, 33(5), 672-700. <https://doi.org/10.1080/10438599.2023.2222265>



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