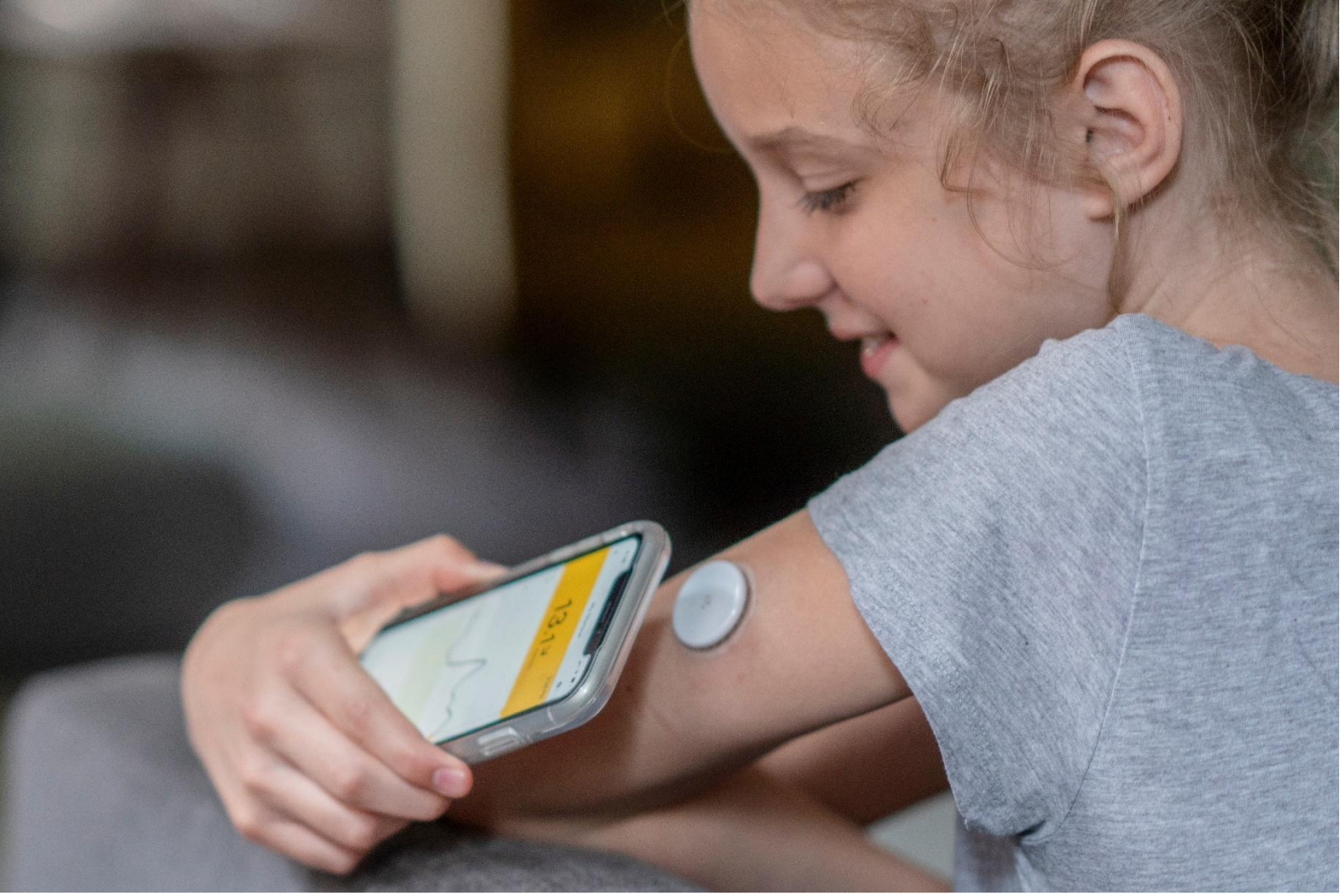

THE MUNICIPAL NETWORK PRINCIPLE IN EUROPE

How local network owners contribute to broadband deployment, competition, and digital resilience across Europe

STADSNÄTS FÖRENINGEN

Sveriges Kommuner och Regioner

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2026-03

Acknowledgements & Disclaimer

This report has been prepared by Arthur D. Little on behalf of The Swedish Local Fibre Alliance (Svenska Stadsnätsföreningen), and in close collaboration with The Swedish Association of Local Authorities and Regions (Sveriges Kommuner och Regioner, SKR), German Association of Local Public Utilities (Verband kommunaler Unternehmen e.V., VKU), and The Association of Public Services and Enterprises Austria (Verband der öffentlichen Wirtschaft und Gemein-wirtschaft Österreichs, VÖWG).

Our conclusions are the result of our best professional judgment, based in part on publicly available data, materials and information provided by The Swedish Local Fibre Alliance, The Swedish Association of Local Authorities and Regions, German Association of Local Public Utilities, and The Association of Public Services and Enterprises Austria and other sources. Any third party using this report is solely responsible for any decisions or non-decisions based on its contents.

Arthur D. Little has been commissioned to contribute to chapters 1–5, together with The Swedish Local Fibre Alliance, The Swedish Association of Local Authorities and Regions, German Association of Local Public Utilities, and The Association of Public Services and Enterprises Austria. Executive summary and Chapter 6 on Recommendations and Policy implications has been written by The Swedish Local Fibre Alliance, The Swedish Association of Local Authorities and Regions, German Association of Local Public Utilities, and The Association of Public Services and Enterprises Austria.

GLOSSARY

Municipal Network – Broadband infrastructure that is owned or governed by a municipality, regional utility, or cooperative. Municipal networks are typically operated on commercial terms and often apply open-access and wholesale principles to ensure competition and community benefit.
Wholesale – The provision of network capacity by an infrastructure owner to retail service providers, who in turn deliver services to end users. Wholesale arrangements enable multiple providers to share a single network.
Open Access – A governance principle requiring network owners to provide access to all service providers on equal, transparent, and non-discriminatory terms. Open access enable competition at the service level rather than through duplicative infrastructure.

EXECUTIVE SUMMARY

A Structural Asset for Europe's Digital Future

High-capacity broadband infrastructure is foundational to Europe's competitiveness, social cohesion and strategic autonomy. Fiber networks underpin essential sectors including healthcare, education, energy systems, transport, public administration and industrial digitalization. As the European Union advances toward its Digital Decade 2030 targets and considers new regulatory initiatives, the structure of Europe's telecom ecosystem will play an important role in shaping long-term deployment, competition and resilience.

This report examines the role of municipal and regionally anchored broadband networks in Europe, with a focus on Sweden, Germany and Austria. It analyses how these actors contribute to network deployment, service-level competition and digital resilience within a broader ecosystem. The findings show that locally anchored network owners function as structural complements within European telecom markets. In several Member States, they have contributed meaningfully to accelerating fiber rollout, expanding retail competition and strengthening long-term infrastructure stewardship.

Accelerating Deployment and Closing Coverage Gaps

Despite significant progress in fiber deployment, geographic disparities remain across Europe, particularly in rural and semi-rural areas where investment conditions are more complex. Fiber rollout is capital-intensive, with civil works representing a large share of total costs and long investment horizons often required. Municipal and utility-based network owners contribute in three structural ways:

- **Long-term investment horizons**, aligned with infrastructure life cycles.
- **Coordination with other infrastructure projects** (energy, district heating, water and roads), enabling cost efficiencies in civil works.
- **Local planning integration**, facilitating permitting processes and targeted deployment in underserved areas.

Country experience illustrates these dynamics:

- **Sweden** has achieved near-universal fiber availability, with municipal networks active in a majority of municipalities and accounting for roughly half of national fiber infrastructure.
- **Germany** has seen increasing engagement from municipal utilities and regional actors, particularly in rural expansion and co-investment arrangements.
- **Austria** combines federal funding with regionally coordinated open-access wholesale platforms to extend high-capacity connectivity to smaller municipalities.

Together, these models broaden the investment base and support rollout in areas where deployment would progress more slowly.

Strengthening Competition Through Open-Access Wholesale Models

A common feature of many municipal networks is the open-access wholesale model. Under this structure, infrastructure is made available to multiple service providers on equal, transparent and non-discriminatory terms. This model contributes to:

- Lower barriers to entry for service providers
- Retail competition and consumer choice
- High infrastructure utilization
- Efficient use of physical network assets

Sweden represents the most mature example, where open-access municipal networks, including the wholesale model pioneered by Stokab in Stockholm, have enabled a large number of service providers to operate on shared infrastructure. Austria requires publicly funded fiber networks under Breitband Austria 2030 to operate on an open-access basis. In Germany, co-investment and reciprocal access arrangements between municipal utilities and private operators illustrate how wholesale-based models can function alongside commercial market structures. These approaches demonstrate that open-access wholesale frameworks can coexist with private investment, supporting competitive retail markets while maintaining efficient infrastructure deployment.

Enhancing Digital Resilience and Long-Term Sustainability

Europe's connectivity agenda is increasingly focused on reliability, resilience and digital sovereignty. Fiber networks now support critical public functions and are subject to strengthened security and operational requirements under frameworks such as NIS2 and the European Electronic

Communications Code. Locally anchored network owners contribute to resilience through:

- **Integration with multi-utility infrastructure**, enabling route diversity and coordinated incident management.
- **Proximity to communities and public institutions**, supporting rapid fault resolution and local coordination.
- **Long-term stewardship models**, where revenues are reinvested in maintenance, redundancy and network upgrades.

Examples from Sweden, Germany and Austria show how municipal and regional operators integrate fiber infrastructure into broader emergency planning and smart-city development strategies. Resilience in this context is both technical and organizational. A structurally diverse ecosystem, comprising national operators, private investors and locally anchored networks, strengthens redundancy and supports continuity across Europe's digital infrastructure landscape.

Policy Implications: A Structural Choice for Europe

The findings of this report lead to a clear conclusion: Europe's telecom policy should safeguard and leverage structural diversity rather than move toward consolidation-driven approaches.

Key policy directions include:

- Preserving diversified ownership structures, including municipal and regional networks, as a competitive asset.
- Strengthening open-access and wholesale-based competition, ensuring transparent and non-discriminatory access frameworks.
- Ensuring fair migration from copper to fiber, with safeguards against foreclosure risks.
- Maintaining stable public funding frameworks, accessible to smaller and publicly anchored operators.
- Recognizing resilience and operational continuity as core regulatory objectives, linked to governance and market structure.

The most advanced fiber markets in Europe are characterized not by concentration, but by multiple infrastructure owners, effective wholesale frameworks and competitive service layers. There is limited empirical evidence that structural consolidation alone delivers superior outcomes in fiber markets in terms of deployment, innovation or consumer welfare.

Conclusion

Municipal and regionally anchored broadband networks have proven to be effective instruments for accelerating fiber rollout, enabling service-level competition and strengthening digital resilience. They are not substitutes for national or private operators, but complementary pillars within a balanced telecom ecosystem.

As Europe enters a new regulatory phase, the question is not whether local actors should replace existing market structures. The question is whether EU policy will preserve and build upon a diversified, competitive and resilient ecosystem, or risk narrowing it.

The infrastructure deployed today will shape Europe's digital society for generations. Ensuring that this infrastructure rests on open, competitive and structurally diverse foundations is not only compatible with Europe's digital ambitions, it is a prerequisite for achieving them.

CHAPTER 1. INTRODUCTION AND BACKGROUND

1.1 Broadband as Essential Infrastructure

In today's society, broadband connectivity has become essential infrastructure underpinning economic growth, social inclusion and public services. High-capacity networks enable innovation and participation across society, from manufacturing and energy to healthcare, education and government. Fiber networks now form the backbone of Europe's competitiveness, supporting data centers, artificial intelligence, smart cities and other data-driven sectors. They are increasingly recognized as critical infrastructure comparable to electricity grids or transport systems.

1.2 Historical Development and Current Challenges

The emergence of municipal and locally anchored broadband networks can be traced to the liberalization of Europe's telecommunications markets in the 1990s. As national incumbents were separated from state ownership and market-entry barriers were lifted under EU directives, several Member States introduced frameworks that enabled municipalities, cooperatives and utilities to invest in digital infrastructure on commercial terms. In countries such as Sweden, Germany and Austria, the majority of municipal broadband networks are organized within local or regional energy utilities, which also play a central role in local energy markets and often manage other infrastructure assets such as district heating, electricity grids, and waste management.

Northern European countries such as Sweden and Denmark were among the first to seize this opportunity, drawing on local utility traditions and strong municipal autonomy to establish fiber networks during the late 1990s and onwards. In other Member States, comparable initiatives have emerged more gradually, shaped by differing institutional structures, regulatory frameworks and investment capacities. Taken together, these developments illustrate how local and regional ownership models have evolved in multiple forms across Europe, adapting to national conditions while contributing to the shared objective of inclusive, high-capacity connectivity.

Despite rapid expansion of high-capacity broadband networks, significant coverage and performance gaps persist between urban and rural areas. OECD analysis shows that while overall fixed broadband speeds increased substantially between 2019 and 2024, the speed gap between metropolitan and rural regions widened. On average, rural regions recorded speeds 24 percentage points lower than urban areas across the OECD.[1] EU monitoring similarly indicates that rural households continue to lag behind national averages in access to high-speed connectivity, despite rising overall coverage.[2] These patterns reflect enduring structural challenges in extending high-capacity networks to low-density areas, where deployment costs are higher and the economics of rollout are less favorable..

Locally anchored and utility-based networks have emerged as one of several instruments for closing remaining coverage gaps and ensuring full access. When municipalities plan broadband deployment alongside energy, water or road projects, they can reduce duplication, shorten permitting cycles and extend network reach.

1.3 Market landscape

Several Northern European countries have progressed rapidly in fiber deployment, often featuring locally anchored and open-access models among other drivers. Many regions across Europe still face gaps in coverage and investment, particularly in rural and low-density areas where commercial incentives are weaker.

Europe's connectivity landscape combines national incumbents, private alternative operators and locally anchored owners. National incumbents control extensive legacy copper networks and remain major investors in fiber upgrades. Private alternative operators, often backed by infrastructure funds or specialized fiber builders, contribute to market dynamism by expanding competitive pressure and accelerating deployment. Public or community-anchored entities, including municipalities, utilities and cooperatives, also play a significant competitive role. They not only enter where commercial incentives are weaker but also strengthen overall market competition through neutral and transparent infrastructure models and long-term investment strategies. Their ability to coordinate broadband rollout with other infrastructure projects reflects a practical operational advantage, but not an exclusive one. Under the European Electronic Communications Code, Article 44 establishes a legal right for all operators to request coordination of civil

works. This ensures that coordination supports efficient deployment and remains available to all market participants on regulated terms.

Within the European Union's Digital Decade Policy Programme 2030, the Commission identifies persistent investment gaps, especially in rural and semi-urban areas, and calls for complementary public-private mechanisms to close them. Municipal and utility-owned networks are recognized as key contributors to efficient deployment, competition and resilience.

Open-access wholesale has emerged as one of the effective models for promoting competition and efficient network use. It combines the governance principle of open access, which ensures equal and transparent conditions for all service providers, with the wholesale function that allows multiple retail actors to share the same physical network. This structure can aid in supporting competition and efficient resource use, helping to reduce unnecessary duplication and extend high-quality connectivity even in commercially marginal areas.

1.4 The Role of Municipal Networks

Municipal broadband networks generally refer to digital infrastructure that is locally owned or governed, often by a municipality, regional utility or cooperative operating on commercial or cost-recovery terms. Many provide access to multiple service providers on equal, transparent and non-discriminatory terms, following the principle of open access. In practice, most municipal networks operate at the wholesale level, providing capacity to retail service providers, while many also offer limited retail services within vertically integrated organizations. The extent of retail involvement varies between countries, with some, such as Germany, exhibiting a stronger presence of municipal companies at the retail layer.

Municipal and fiber networks follow the same economic logic as other foundational infrastructure systems such as transport networks, electricity grids, or water systems. In each case, a reliable physical layer can support multiple services above it: roads enable logistics providers, grids distribute power from different producers, and fiber networks carry digital services from multiple providers. Applying this infrastructure logic to communications means organizing the physical layer in a way that promotes efficient investment and long-term sustainability, while allowing competition and innovation to take place at the service level. This outcome can be achieved under different ownership models, municipal, private, or incumbent, provided that open-access principles, effective regulation, or structural separation are in place. At the same time, infrastructure-based competition can play an important role in driving innovation and service quality in some markets. The aim is to enable effective resource use, avoid duplication and the extension of high-quality connectivity to less commercially attractive areas.

Municipal and regional network owners contribute with distinctive strengths to Europe's broadband landscape. Their governance models often enable long-term planning, close alignment with public-service priorities and systematic coordination with other local infrastructure projects. These characteristics complement the capabilities of national and private operators, and together they form a balanced ecosystem in which different ownership models can support deployment, competition and digital resilience.

Sweden

Sweden provides the most mature and systemized version of the municipal-network model in Europe. There are about 170 established municipal/city networks operating in approximately 200 of the country's 290 municipalities, of which around 90 percent are municipally owned.[3] Together, these networks account for roughly half of Sweden's broadband infrastructure, illustrating the pivotal role of local actors in achieving near-universal fiber access. Nationwide fiber availability across all operators now places approximately 98 percent of addresses within reach of fiber and 85.4 percent with fiber in the building as of October 2024 (see Figure 1). While the business models vary, almost all municipal/city networks operate as neutral infrastructure owners, leasing fiber or capacity to multiple service providers and enabling competition and consumer choice at the retail layer.

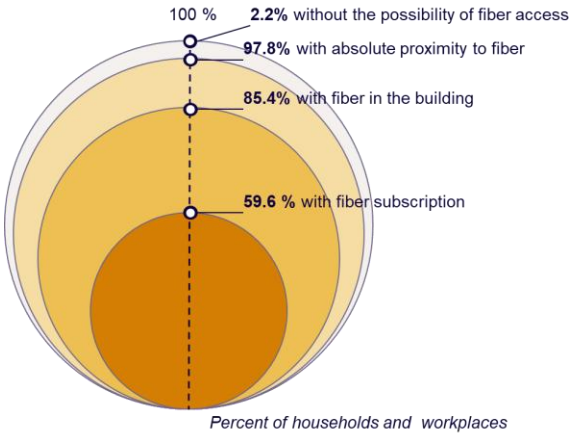

Figure 1: Fiber subscriptions in relation to absolute proximity to fiber infrastructure

Germany

Germany follows a mixed model. A growing number of local fiber actors combine energy-network expertise with broadband rollout, similar to Sweden and Austria. They deploy or co-finance open-access fiber networks that complement national rollouts and fill coverage gaps. The market is characterized to a significant extent by municipal economies, reflecting the scale and maturity of local public utilities in the broadband sector. According to the Federal Ministry for Digital and Public Administration, municipal companies account for at least 21.3 percent of existing fiber coverage, making them the second largest investor group after the incumbent, and the actual share is likely higher since not all relevant companies were classified under the local fiber actor category. The VKU (Verband kommunaler Unternehmen, German Association of Local Public Utilities of municipally determined infrastructure undertakings and economic enterprises) alone has more than 220 member companies active in broadband, out of an estimated 400 telecommunications companies nationwide. Open-access platforms supported by municipal companies are also emerging and becoming established. Stadtwerke Neumünster is currently developing such a platform, and other municipal operators, including WEMAG and Thüga, have also adopted or founded platform-based wholesale models. The Bundesnetzagentur supports voluntary open-access frameworks to promote transparency and interoperability across the market.[4]

They deploy or co-finance open-access fiber networks that complement national rollouts and fill coverage gaps. Open access platforms supported by municipal companies are also emerging and in the process of being established. The Bundesnetzagentur supports voluntary open-access frameworks to ensure transparency and interoperability.

Austria

Austria combines regional coordination with local execution. The nöGIG model in Lower Austria and Open Fiber Austria operate as neutral open-access wholesale platforms financed through long-term public-private partnerships. Regulation by RTR ensures non-discriminatory access and transparent wholesale pricing.

The cases from Sweden, Germany and Austria shows that open-access wholesale frameworks can operate effectively in smaller or rural Member States when supported by clear governance and financing models.

CHAPTER 2: THE ROLE OF LOCAL ACTORS IN CLOSING COVERAGE GAPS

2.1 European Deployment Patterns

Over the past three decades, broadband infrastructure has evolved from a premium technology into a critical societal utility. In the 1990s and early 2000s, connectivity was driven by copper-based technologies such as dial-up and DSL, which provided the first generation of internet access to European households. However, these early solutions were limited in capacity and could not meet the demands of modern digital life. As digitalization deepened, with the rise of cloud computing, video streaming, and data-driven industries, the need for high-speed, reliable broadband became essential to economic and social development.[5,6]

From a broader historical and societal perspective, broadband rollout has mirrored Europe's industrial and social transformation. Access to fast and reliable connectivity now underpins productivity growth, innovation, and competitiveness across all sectors, from advanced manufacturing to agriculture and public services. It also serves as an enabler of inclusion, allowing citizens to participate in digital education, healthcare, and democratic processes. In this sense, broadband has become as fundamental to society as electricity or transport infrastructure.[5,6,7]

The transition from copper networks toward fiber-optic and wireless broadband represents not only a technological leap but also a strategic one. Fiber networks provide very high capacity that can be upgraded with additional investment, forming the backbone of the "gigabit society." Both HFC and 5G enable new applications such as telemedicine, remote learning, smart grids, and connected industries. Moreover, fixed broadband plays a vital and often overlooked role in supporting mobile connectivity. Most 5G base stations rely on fiber backhaul, making the two technologies interdependent rather than substitutable.[8]

Today, Europe's broadband ecosystem is characterized by a mix of technologies. Fiber-to-the-home/building (FTTH/B), hybrid fiber-coaxial (HFC), 5G mobile, satellite and fixed wireless access, each contributing to coverage in different contexts.[5,9]

From a societal and policy standpoint, the importance of broadband is widely recognized. The European Commission and the OECD identify very high-capacity networks as prerequisites for competitiveness, sustainability and territorial cohesion. Ensuring universal access to high-performance digital infrastructures is therefore not only a technological or market challenge, but also a social and political imperative and a foundation for Europe's digital and green transitions. This understanding encompasses multiple technological pathways, recognizing that different forms of high-capacity connectivity, including fiber, cable, wireless and satellite-based solutions, can contribute to meeting long-term societal needs across diverse geographic and economic context[10,11].

Europe's fiber rollout has accelerated significantly in recent years, yet large disparities persist between countries and regions. OECD data show that fiber represented 44.6 percent of all fixed broadband subscriptions in 2024, up from 41 percent the year before.[8] According to the FTTH Council Europe (2024), the EU-27 average for FTTH/B household coverage reached 64 percent, with 48 percent of rural inhabitants reached by full-fiber connectivity. However, the range remains wide, from more than 85 percent in Sweden and Spain to around 42 percent in Germany and 49 percent in Austria. These differences illustrate how national policy frameworks and investment strategies, together with the presence or absence of strong local actors, have contributed, among other factors, to differences in deployment outcomes across Europe.[12]

These disparities reflect differences in geography, market maturity, and the structure of national investment ecosystems. In mature markets such as Sweden, nearly universal fiber coverage has been achieved through a combination of public, cooperative, and private investment. In less mature markets, local and regional actors are now emerging as crucial complements to national rollouts, particularly in rural and semi-rural zones[13].

The OECD has noted that municipal networks can play an important role in promoting infrastructure-based competition, particularly in areas where private investment has been limited.

By introducing an alternative network and separating infrastructure from services, such initiatives can stimulate further private investment and enhance innovation in broadband markets.[14] Reliance on national incumbents alone can leave peripheral communities underserved. By contrast, the entrance of locally anchored, wholesale-oriented networks can help mitigate risk, align planning with community priorities, and speed deployment.

The European Commission's Digital Decade Policy Programme 2030 sets a target for gigabit connectivity for all EU households by 2030. At the same time, the Commission recognizes that significant investment and deployment gaps remain in achieving this objective.[13] Locally owned or managed networks have become one of the key instruments in addressing these gaps, aligning fiber rollout with municipal spatial planning, leveraging public assets, and fostering retail competition in areas where commercial incentives are weakest.

2.2 Mechanisms of Local Impact

In the Swedish context, an evaluation of broadband policy shows that demand is insufficient to justify investment from a purely market perspective in many very-remote regions.[15] High civil-works costs, limited population density and long payback periods can make such projects commercially unattractive under conventional investment models. Municipal and utility-owned entities can operate under different conditions with longer investment horizons, where long-term private infrastructure investors can in some cases

play a similar role. These long-term investment horizons and community-aligned mandates become increasingly important as Europe faces structural challenges such as skills shortages, demographic change and growing demands on digital public services.

Municipal and locally anchored network models have been applied in a range of contexts, reflecting different local objectives rather than a single deployment logic. In some cases, they have been used to extend connectivity in areas where deployment costs are high, while in others they have been designed to support infrastructure sharing and service-level competition in dense urban markets. Stockholm's Stokab network is frequently cited as an example of a wholesale-only, municipally owned fiber network that has facilitated multiple service providers and efficient use of infrastructure in a high-density environment. Across contexts, locally anchored actors tend to tailor their investment and operating models, to local conditions and policy priorities.[16]

In the OECD area, fiber now represents 44.6 % of all fixed broadband connections, with four countries (Iceland ~91 %, Korea ~90 %, Spain ~88 %, Lithuania ~80 %) exceeding an 80 % share for fiber-based connections.[8] According to the FTTH Council Europe, by September 2023 approximately 64 % of European households (EU27+UK) were covered by FTTH/B networks, while 48 % of rural households had access to full-fiber connectivity (up ~7 percentage points year-on-year).[17] In terms of technology choice, fixed wireless access (FWA) is gaining traction in underserved regions: within the OECD area FWA subscriptions rose significantly and in some countries represent a non-negligible portion of fixed broadband. Taken together, these developments indicate that while full-fiber remains the long-term backbone of fixed connectivity, a combination of technologies is increasingly being used to accelerate coverage expansion and close remaining access gaps, particularly in rural and low-density areas.

Civil works represent the largest single cost component in high-speed broadband deployment, sometimes accounting for up to 80 % of overall investment [18]. Cost efficiencies can be achieved where broadband rollout is coordinated with other civil-works projects, such as roads, energy, water, or heating networks, through shared trenching and reduced surface restoration. Access to existing ducts and conduits, together with municipal control of rights-of-way, significantly lowers per-meter costs and shortens permitting cycles[19]. Moreover, the timelines of utility infrastructure upgrades are not always aligned with broadband deployment objectives; where coordination is not carefully managed, reliance on joint civil-works planning can constrain flexibility or delay fiber rollout rather than accelerate it.

Coordinated local planning does not eliminate the possibility of parallel network rollout but can reduce the risk of over-build and redundant civil works. By sequencing broadband rollout with other infrastructure projects, municipalities, other companies and utilities can often reuse ducts, coordinate trenching, and prioritize areas with genuine need. Thereby boosting asset utilization and lowering lifetime costs. An essential prerequisite is that existing coordination formats of municipalities and public utilities are used by market players.

2.3 Country Evidence

Sweden

Sweden is widely regarded as one of Europe's most advanced markets for decentralized, open-access fiber, with municipal city networks in ~200 municipalities. They collectively account for over half of FTTH subscriptions. The model's scalability is evident in its consistency across diverse geographies, both in cities and small rural municipalities. Located in Västerbotten County in northern Sweden, Skellefteå is a municipality characterized by vast rural areas, forests, and long distances between settlements. Despite these geographical challenges, the municipally owned utility Skellefteå Kraft Fibernät has built one of the most extensive open-access fiber networks in the region, a clear example of how local ownership can overcome deployment barriers where commercial incentives are weak.

The company operates a municipal open-access network that today connects roughly 28,000 households and businesses, covering both the town of Skellefteå and surrounding rural communities.[20] Through long-term investment planning and local coordination, the network has achieved coverage for more than 90 percent of households in the municipality.

A key success factor has been the municipality's ability to align fiber rollout with other infrastructure projects and to leverage public broadband support to reach sparsely

populated areas. The Swedish Post and Telecom Authority (PTS), which has the mandate to promote broadband deployment across all parts of the country in line with the government's broadband strategy, has decided to approve Skellefteå Kraft's application for SEK 53 million to carry out network expansion in several areas within Skellefteå Municipality, mainly in rural zones.[21]

As highlighted by Broadband Communities Magazine, Skellefteå Kraft Fibernät is one of several Swedish municipal utilities demonstrating how local ownership, open-access principles, and community reinvestment can sustain fiber expansion in less profitable markets.[22] This model contrasts with purely commercial operators by reinvesting surpluses locally, prioritizing universal coverage, and coordinating deployment through municipal planning processes.[23] The case exemplifies how municipal networks help close coverage gaps and secure digital inclusion across urban and rural Sweden.

Germany

Germany's fiber rollout is transforming a market long organized around Deutsche Telekom's copper network, and, to a significant extent, legacy HFC cable infrastructure. The transition to fiber creates space for stronger infrastructure-based competition. According to BREKO (The German Broadband Association, leading fiber optic association with more than 510 member companies, promoting competition in the German telecommunications market) Market Analysis 2025, competitors to Deutsche Telekom account for 59 % of the 24.3 million fiber lines classified as homes passed, 70 % of the 12.6 million homes connected, and 74 % of the 6.6 million homes activated[24] . The transition to fiber has opened space for infrastructure-based competition, with new actors notably local public fiber/utility companies, emerging as key enablers of broadband expansion, particularly in smaller towns and rural areas.

In Baden-Württemberg, the municipal utility company Ludwigsburg-Kornwestheim (SWLB) operates an extensive open-access fiber network covering more than 28,000 residential and business units and around 2,000 km of fiber cable. In cooperation with Deutsche Telekom, SWLB is expanding the network to the nearby municipality of Asperg, connecting 7,000 additional households and businesses through a €15 million investment over three years. The partnership follows a "dual-operator" model: the municipal utility builds the passive infrastructure and operates fiber networks so it offers telecommunications services on its own infrastructure. At the same time, Deutsche Telekom leases passive fiber optic infrastructure in order to also offer connections and its digital products besides the utility's ones. Deutsche Telekom also enables other providers to use the Ludwigsburg fiber optic network via wholesale contracts.[25],[26],[27]

This case evidence exemplifies how municipal ownership combined with open-access principles can accelerate deployment.[28] By integrating fiber rollout with local infrastructure planning and using their public-utility status to coordinate civil works, local fiber actors shorten permitting cycles and reduce deployment costs. In parallel, federal gigabit funding supports projects in financially weaker municipalities, further enabling public actors to extend fiber into underserved regions.[29]

The main parts of the fiber networks of the local public utilities are built by their own, but also through such models, local public utilities are even more emerging as pivotal players in Germany's broadband transformation. They combine local presence, infrastructure synergies, and open-access approaches to deliver fast inclusive fiber deployment, embodying the municipal network principle in a German context.

Furthermore, co-investment and reciprocal open access are material features of the market.
Joint ventures plan, build, and operate fiber while offering wholesale products, including Glasfaser Nordwest with EWE AG, Glasfaser Plus with IFM Global Infrastructure Fund, Unsere Grüne Glasfaser with Allianz, and OXG Glasfaser with Altice. Deutsche Telekom has entered 26 partnerships with local public utilities in which the utility builds passive infrastructure and Deutsche Telekom may operate active components. In some cases, the municipal company operates its own active layer in parallel.

Austria

Compared to its Nordic and Western European peers, Austria remains behind in full-fiber deployment. Coverage data from 2024 indicate that the country continues to lag the EU average[30], while take-up rates for fiber subscriptions remain relatively low. The gap is largely explained by Austria's historical reliance on cable and mobile broadband,

both of which have offered high speeds and delayed the business case for nationwide fiber rollout.

In line with the EU Digital Decade 2030 targets and the national Austrian Broadband Strategy 2030, Austria aims to provide gigabit-capable broadband access to all households by the end of the decade. Fiber rollout has accelerated sharply in recent years. By the third quarter of 2024, 2.1 million households were passed by FTTB/H networks, up from less than 30 % in 2021. This progress underlines how Austria's combination of public incentives and local execution has accelerated deployment and expanded coverage.[31]

To accelerate deployment and address persistent coverage gaps in rural and semi-rural areas, Austria launched the Breitband Austria 2030 (BBA 2030) programme. The initiative channels federal and EU funds into gigabit-capable infrastructure in underserved regions, with coordination led by the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) and administration by the Austrian Research Promotion Agency (FFG).[32]

BBA 2030 is structured around several funding tracks, that jointly support broadband expansion, open-access infrastructure, and the connection of socio-economic priority areas. Eligible applicants include municipalities, regional utilities, cooperative networks, and private operators, with grants covering up to 65 percent of capital expenditure where market failure is demonstrated.[32]

Municipalities play a key enabling role in translating national funding into concrete deployment. Local authorities coordinate planning, permitting, and trenching activities and often synchronize broadband construction with roadworks or energy-grid upgrades. According to the European Commission's country profile, BBA 2030 projects now span over 1 500 municipalities, demonstrating that local participation is essential to the program's reach and efficiency.[33]

A leading example is nöGIG in Lower Austria, a regionally owned company that partners with municipalities to deploy open-access fiber in rural communities. The project shows how combining federal funding, regional coordination, and municipal execution enables Austria to expand high-capacity broadband, while preserving local ownership of critical infrastructure.[34]

CHAPTER 3. THE OPEN-ACCESS WHOLESALE MODEL: ENABLING COMPETITION AND EFFICIENT MARKET STRUCTURES

3.1 Definition and Rationale

In many European markets, and particularly in the context of municipal and city networks, open-access wholesale has emerged as a commonly used model for organizing fiber infrastructure in a way that supports both local policy objectives and effective market competition. While not all city networks apply this model, and while open access is also used by private and incumbent operators, it has become a defining reference point for how locally owned fiber infrastructure can be structured to serve multiple stakeholders.

Open-access wholesale describes a market model in which the network owner provides wholesale capacity to multiple service providers on equal, transparent and non-discriminatory terms. It combines the commercial function of wholesale with the governance principle of open access, enabling that competition and innovation can occur at the service layer rather than through duplicative infrastructure. Within this framework, some operators adopt a wholesale-only structure, focusing exclusively on wholesale and foregoing retail activities to guarantee neutrality by design, although open access can also be achieved within vertically integrated organizations provided that transparency and equal treatment are maintained. By separating infrastructure management from retail competition in functional or behavioral terms, open-access wholesale models remove incentives for discrimination and enable a fair and efficient broadband market.

The open-access wholesale model separates infrastructure ownership, network operation, and retail service delivery. Figure 2 illustrates the typical structure and value flows between these layers, showing how neutrality at the wholesale level enables multiple service providers to reach end users through a shared infrastructure.

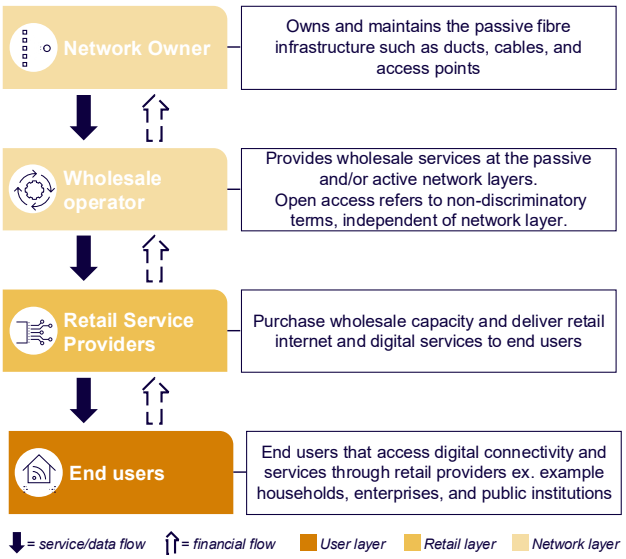

Figure 2: Structure of layers (Network owner and Wholesale operator are sometimes the same provider)

Open-access wholesale networks advance three objectives:

- **Competition** – by ensuring equal access for all service providers;
- **Efficiency** – by reducing redundant parallel builds and maximizing asset utilization; and
- **Sustainability** – by promoting infrastructure sharing and lowering the environmental footprint of rollout.

Given the high capital intensity of network construction, open-access wholesale models enable cost sharing among multiple retail operators, improving efficiency and investment returns while providing consumers with lower prices and broader choice.

The European Electronic Communications Code (EECC) formally acknowledges wholesale-only operators and defines obligations for transparency, non-discrimination, and proportionality[35]. BEREC (the Body of European Regulators for Electronic Communications) has issued detailed guidance on how such networks should provide access to both passive and active elements under equal conditions[36].

3.2 Europe's Experience with open-access wholesale models

Sweden – Pioneering Structural Separation

Sweden is widely regarded as one of Europe's most advanced markets for open-access fiber infrastructure. Local fiber networks have been established in around two thirds of Swedish municipalities and together account for more than half of national fiber coverage. These networks are typically owned by municipalities or local authorities and are typically operated as open-access networks, enabling multiple service providers to offer services over the same infrastructure. This model has supported the entry of hundreds of service providers, expanded customer choice, and contributed to strong competition and high FTTH deployment across the country.[37]

Since its establishment in 1994, Stokab, a company owned by the City of Stockholm, has provided neutral dark-fiber infrastructure to telecom operators, enterprises, and public institutions, forming the model for municipal fiber deployment globally. Stokab builds and manages passive fiber but refrains from offering retail broadband services. This neutrality has enabled more than 100 ISPs and service providers to operate competitively across the Stockholm region, creating one of Europe's densest broadband markets.[38] The Swedish municipal network movement has extended this principle nationwide. Sweden's extensive municipal-network ecosystem now operates mainly on open-access wholesale terms and together accounts for roughly half of the country's fiber lines[39].

Stokab's open-access model has proven both financially sustainable and scalable, with a design based on two dedicated fibers per premise and a network of around 400 access nodes and 600 cross-connection points, allowing providers to interconnect flexibly and maintain redundancy. Benchmarking studies show that Stockholm's dark-fiber and business broadband prices are among the lowest in Europe, reflecting how infrastructure-based competition at the wholesale level disciplines retail pricing.[16]

Germany - Emerging Co-Investment and Access Models

Germany's comparatively slow transition to fiber can be traced to structural and regulatory factors that favored incremental upgrades of copper networks rather than full replacement. For more than a decade, the market has been shaped by a single significant market power (SMP) operator with extensive legacy infrastructure, limiting incentives for alternative builders. Early broadband policies prioritized VDSL vectoring, which extended copper life rather than driving fiber deployment. This path dependency created

regional disparities and delayed rural rollouts. In recent years, the federal government and Bundesnetzagentur have recognized these constraints, promoting open-access partnerships and local utility participation as a means to accelerate deployment and reduce overbuild. Against this backdrop, Germany's emerging local public fiber/utility companies represent a structural correction rather than a new experiment: they align long-term investment with local coordination and complement national operators' efforts.

In Germany, the open-access wholesale model is gaining momentum through co-investment and open-access agreements between regional fiber/utilities actors and private fiber specialists. Examples include *NetCologne* and *M-net* partnering with Deutsche Glasfaser to provide reciprocal wholesale access. The Bundesnetzagentur promotes regulatory frameworks that encourage investment, accelerate rollout, and prevent inefficient overbuild. Analysis shows that deployment has advanced fastest in regions with active local fiber actors involvement and open-access or co-investment models, highlighting the effectiveness of local cooperation in Germany's fiber market. The industry association VATM has advocated expanding the open-access wholesale logic nationwide. [40]

Austria – Regulated Open-Access Frameworks
Austria now represents one of the EU's most advanced regulatory environments for open-access wholesale broadband. Since 2022, all networks receiving funding under the Breitband Austria 2030 (BBA 2030) program must operate on an open-access wholesale basis. The OpenNet guidelines issued by the Federal Ministry for Climate Action (BMK) prohibit exclusive retail use and require non-discriminatory wholesale access to both dark fiber and active capacity.[41]

Regulatory oversight by the Austrian regulator RTR ensures transparent pricing, standardized wholesale offers, and consistent service-level agreements. According to RTR, open-access networks now cover a substantial share of national FTTH connections, and the number of Internet service providers active on these networks continues to increase.[42,43]

A leading regional example is nöGIG in Lower Austria, which builds and owns a neutral, publicly financed open-access wholesale. Multiple retail providers lease capacity under transparent terms, allowing small municipalities to reach gigabit coverage without vertical integration.[34] The combination of federal funding, regional governance, and municipal coordination has proven effective in extending coverage and sustaining competition. Austria's approach demonstrates that tying public investment to wholesale-obligations can create scalable, neutral fiber infrastructure nationwide.

3.3 Benefits and Measured Outcomes

Competition and Service Innovation
Open-access wholesale networks can lower entry barriers for ISPs and expand consumer choice. Experience from Sweden, Austria, and Germany illustrates that open-access environments host more active retail providers and achieve higher network utilization than vertically integrated systems as long as the willingness of other telecommunications companies to purchase wholesale services is given .

In Austria, the regulator RTR reports a rising number of ISPs on open-access networks and a slight decline in average retail broadband prices, signs of stronger competition and greater service differentiation.[31] In Germany, the VATM-commissioned SBR-net Consulting (2023) study found that cooperative and open-access fiber models significantly improve network utilization and end-user choice, concluding that "open networks are the key to Germany's fiber success."[44]

In Sweden, most municipal networks operate on a wholesale level, offering neutral access to multiple ISPs. As mentioned earlier, over 100 providers use the Stokab network in Stockholm alone, while municipal networks nationwide account for roughly half of all FTTH connections.[16] This decentralized ecosystem has created one of Europe's most competitive broadband markets, with high fiber take-up and relatively uniform pricing for gigabit services.

By decoupling physical infrastructure from service provision, the open-access wholesale model seeks to shift competition away from network ownership toward the retail layer. While this can lower entry barriers for service providers and support price competition, outcomes in terms of service quality, innovation, and customer experience are not guaranteed and depend on market structure, coordination between actors, and operational execution, considerations

that are relevant in the context of the EU's Single Digital Market objectives.[45]

Efficiency and Sustainability

Structural separation also improves deployment efficiency and reduces environmental impact. By enabling a single open-access fiber network to support multiple service providers within a given area, infrastructure sharing reduces duplicative network build-out and increases utilization of existing ducts and physical infrastructure. Empirical analysis from Germany shows that coordinated civil works, such as joint trenching of fiber together with electricity networks, can reduce fiber-related civil-works costs by around 30 percent and lower total investment per access line by more than 20 percent.[46] Infrastructure sharing and coordination of civil works are also identified by BEREC as key levers to reduce duplication of physical infrastructure, lower material use and energy consumption, and improve both cost efficiency and environmental sustainability in electronic communications network deployment.[47]

Market Structure

The open-access wholesale model reduces barriers to entry, which in turn benefit consumers through lower prices and potential broader service choice. Sweden's broadband market, with its extensive municipal networks and dozens of competing ISPs, exemplifies this dynamic. RTR notes similar patterns in Austria's open-access regions, where wholesale neutrality has maintained competition even in smaller markets.

Studies by WIK-Consult and BEREC further show that structurally separated networks reduce entry barriers for ISPs and stimulate product innovation. In Sweden, price dispersion for gigabit services is among the lowest in Europe, reflecting stable, transparent wholesale terms. These outcomes illustrate that structural separation is not merely a regulatory safeguard but a structural catalyst for competitive, consumer-oriented broadband markets.

Collectively, these national experiences confirm that the wholesale-only model can deliver measurable benefits: faster and more efficient deployment, stronger competition, and improved consumer welfare. The examples of Sweden, Austria, and Germany show how structural open access can translate into tangible market outcomes.

3.4 Challenges, Success Factors and Enabling Conditions

Fragmented regulation and a lack of common standards within national markets can create uncertainty for investors, particularly where local or regional networks apply differing wholesale terms, technical interfaces, or onboarding processes for service providers. In parallel, limited coordination on demand stimulation at the local level may slow retail take-up on newly built networks, even where infrastructure is available. These challenges are not structural barriers, but they underline that open-access wholesale models benefit from nationally aligned governance frameworks, harmonized wholesale conditions, and coordinated demand-side initiatives, enabling service providers to scale efficiently across multiple local and regional networks within the same country and thereby realize the full potential of the model.[46, 48]

The effectiveness of the open-access wholesale model depends on several institutional and financial enablers:

1. **Transparent, non-discriminatory, or fair, market-negotiated access** - Cost-oriented wholesale tariffs, published access conditions and predictable SLAs are foundational to trust and uptake on open-access platforms. Efficient mechanisms to ensure fair, market-negotiated access can be an alternative.[49] [50]
2. **Regulatory Recognition** – Formal status for open-access wholesale operators under the European Electronic Communications Code (EECC) and national frameworks ensures consistent oversight and proportional obligations.[35]
3. **Financial Sustainability and Investor Appeal** – OECD analysis on *Financing Broadband Networks of the Future* highlights that predictable wholesale revenues and stable governance are key determinants of private investment.[51]
4. **Infrastructure Sharing Across Sectors** – Integration of fixed broadband and mobile backhaul planning enhances efficiency and sustainability, as highlighted by GSMA and BEREC.

The open-access wholesale model is a cornerstone of Europe's effort to balance investment efficiency, competition, and environmental sustainability. Where examples from Sweden, Austria, Germany and co-investment models

confirm that this approach can complement private initiatives and speed rollout.

3.6 The Owner Perspective: Governance, Accountability, and Long-Term Value

Municipalities, regional utilities, and cooperatives typically act from a dual rationale: ensuring digital inclusion and maintaining control over critical local infrastructure, while operating on commercial and financially sustainable terms. This "public–commercial" hybrid model allows for longer investment horizons and the generation of stable, often regulated returns on invested capital, which are typically reinvested into network maintenance, capacity upgrades, and broader local development.

Public owners typically operate under mandates that prioritize long-term service continuity, digital inclusion and support for local welfare, education and economic development. These incentives differ from those of many commercial actors, not in opposition but in emphasis. Municipal networks therefore complement private-sector investment by ensuring that critical digital infrastructure remains closely aligned with community needs and long-term stewardship objectives.

Owners of municipality operators emphasize neutrality, transparency, and predictability as core values in their governance models. Many establish separate limited-liability entities for network operations to maintain structural separation and financial accountability. The governance approach often mirrors that of other essential local utilities such as energy or district heating.

Interviews with municipal operators in Sweden and Germany highlight a shared perspective: ownership is not about competing with private providers but about ensuring that open infrastructure exists as a platform for competition and innovation.

Owners describe their primary value creation not in terms of short-term profit but in regional competitiveness, service reliability, and public trust. This stewardship logic differentiates municipal networks from purely private infrastructure.

CHAPTER 4. MAINTAINING AND FUTURE-PROOFING DIGITAL INFRASTRUCTURE

4.1 Evolving Requirements

As mentioned in Chapter 1, Europe's connectivity agenda is shifting from rollout and coverage toward reliability (the ability of networks to deliver consistent performance and service quality over time), resilience (the capacity of networks to withstand, adapt to, and rapidly recover from disruptions such as cyberattacks, physical damage, or extreme events), and preparedness (the extent to which governance, redundancy, and contingency planning are in place to manage crises and ensure continuity of critical services). As broadband networks underpin critical sectors such as health, energy, transport, and public administration, network resilience and digital sovereignty have become central to Europe's strategic autonomy. They are increasingly treated as essential infrastructure comparable to power grids and water systems.

As societal and economic reliance on digital networks has increased, cyber resilience and continuity of service have become explicit policy priorities at both EU and national level. This is reflected in initiatives such as the NIS2 Directive, which extends cybersecurity and operational-resilience obligations to all essential and important entities, including public and private network operators.[52] Under NIS2, operators are required to implement risk management measures, continuity planning, and incident reporting processes to ensure that communications infrastructure remains operational during disruptions. Local and regional network owners are often well positioned to meet these requirements, as they are embedded in municipal emergency frameworks and maintain close operational links with public institutions and providers of essential services. This proximity facilitates coordination during incidents and supports the practical implementation of resilience and continuity obligations at the local level

Furthermore, ENISA and BEREC have issued guidance at a regulatory and policy level outlining considerations for network operators, including municipality owned operators, related to supplier dependencies, network architecture, and resilience, including incident preparedness and response.[49] [53] For open-access wholesale networks, which interconnect

multiple service providers, these guidelines help define responsibilities at the infrastructure layer and establish consistent service-level baselines that all retail operators can rely on.

The effectiveness of these frameworks ultimately depends on governance structures capable of integrating resilience into daily operations. Municipal and regional network owners can be well positioned for this task, their proximity to communities and integration with other utilities enable effective redundancy and emergency coordination.

BEREC defines resilience as a core attribute in assessing very high-capacity networks; it also expects wholesale reference offers to include SLAs covering availability and repair times.[49] BEREC's resilience workshop further highlights operational practices such as redundancy, failover and recovery planning.[54] Taken together, these sources support aligning wholesale products and service levels with resilience standards typically expected of critical communications infrastructure.

4.2 Local Ownership and Operational Resilience

Integration with Multi-Utility Infrastructure

Municipal networks in Germany are often operated by local public fiber/utility companies that also manage electricity, water, or transport infrastructure. This integrated structure enables joint planning of fiber, power, and transport corridors, providing route diversity, backup power, and coordinated outage management. The VKU notes that such cross-sector integration strengthens reliability and recovery capacity during multi-infrastructure incidents.[55]

Local ownership brings an operational advantage in terms of proximity. Technicians, planners and decision-makers are based within the community, enabling faster incident response and direct coordination with local emergency services, healthcare providers and municipal administrations. These locally anchored capabilities do not replace national or private networks but complement them, contributing to a broader multilayered resilience framework.

In Sweden, energy utilities such as Umeå Energi (UmeNet) (see Section 4.4) and Öresundskraft exemplify one approach to multi-utility integration. Fiber is deployed alongside district-heating and energy infrastructure, enabling common access points, shared ducts, and close operational coordination.[56] Similar resilience and restoration capabilities can also be achieved through partnership agreements or joint field-force arrangements, meaning that network operators do not need to be utility-owned to benefit from rapid cross-sector coordination. During local disruptions, such arrangements can enable traffic rerouting and connectivity restoration within hours through proximity to operational staff and direct coordination with emergency services

Governance and Compliance Alignment

Local ownership can embed resilience at the level of governance, depending on the institutional and regulatory framework in which networks operate. In open-access models, infrastructure owners such as municipal networks, are structurally separated from retail competition and derive revenues primarily from long-term wholesale utilization rather than short-term customer capture. This design can shift incentives toward network availability, reliability, and predictable service quality, although it does not eliminate the risk of underinvestment or monopoly behavior. Where combined with regulatory oversight and public-interest mandates, such separation may also reduce operational complexity in meeting EECC and NIS2 requirements, as responsibilities for infrastructure security and service provision are more clearly delineated.[57]

National regulators such as PTS (Sweden) and RTR (Austria) provide guidance on robust fiber design, covering site hardening, route diversity, escalation paths, and periodic exercises with authorities.[58] [59] In principle, these measures can be applied regardless of ownership model, including in areas with overlapping networks or in vertically integrated, privately owned networks. However, open-access infrastructure models tend to facilitate more uniform implementation, as resilience requirements are addressed once at the infrastructure layer and subsequently benefit all retail providers relying on the same physical network, reducing coordination needs and potential duplication.

Because these networks often connect schools, hospitals, and public utilities, they can, where they hold a significant local footprint, act as intermediaries between national security authorities and retail providers in matters related to critical information infrastructure. This role is not unique to municipally owned networks and may also arise in privately owned or monopolistic network settings, or shift over time in

the presence of overbuild and increased competition. As such, any contribution to the protection of critical information infrastructure at the community level depends on local market structure, governance arrangements, and regulatory frameworks rather than ownership per se

4.3 The Societal Role of Future-Proof Connectivity

Europe's next phase of digitalization will depend on high-capacity, reliable broadband infrastructure that can support essential public and private services. Fiber networks are no longer only communication assets, they are becoming critical enablers of health, education, energy and local governance.

The European Commission identify fiber-based very-high-capacity networks (VHCNs) as the foundation for future societal and economic resilience.[60] They underline that applications such as remote healthcare, cloud-based education, digital public services, and smart-energy systems require symmetric fiber connectivity to every home and business. Without such capacity, citizens cannot fully benefit from "hospital-at-home" solutions, tele-rehabilitation, distance learning or AI-based municipal services, making broadband a prerequisite for a future-proof Europe.

The OECD Digital Economy Outlook 2024 likewise highlights that very high speed connectivity is essential for equal participation in digital health, education, and work, noting that regional disparities in high-speed access risk deepening social inequality and economic divides.[61] Fiber networks that reach rural and semi-rural areas therefore represent a key social-inclusion policy.

Municipal and regional fiber networks are today not only instruments of connectivity but pillars of Europe's future welfare systems. They enable smart hospitals, digital classrooms, and energy-efficient cities. They balance regional development, and they help safeguard Europe's capacity to deliver inclusive, secure, and sustainable digital services for decades to come.

4.4 Resilient and Sustainable Broadband through Local and Regional Governance

Sweden – Karlstads Energi / Karlstads Stadsnät
Karlstads Stadsnät is operated through the municipal multi-utility Karlstads Energi and forms part of the wider Karlstad Stadshus AB group. The network is embedded in a coordinated governance structure where municipal companies and departments align infrastructure, digitalization and crisis-preparedness planning. This integration ensures that the fiber network is treated as essential local infrastructure rather than as an isolated commercial activity.

Local ownership gives the municipality long-term control over a critical asset and enables reinvestment, operational continuity and close coordination with other municipal services. The network supports both public-sector IT and emerging digital solutions in welfare, healthcare and smart-city development. Interviewees emphasize that this collaboration would be far more difficult with national operators, since Karlstad requires a partner that can engage directly in municipal digitalization and IoT initiatives.

At the same time, Karlstads Stadsnät operates as a wholesale provider, offering open and non-discriminatory access to multiple retail service providers. This dual role allows the municipality to address its own digitalization needs while simultaneously enabling competition and service diversity in the local telecom market

Karlstad benefits from local operational capacity, with on-site technical staff familiar with local conditions. This is important across both urban districts and rural areas, where rapid fault handling and close cooperation with welfare and emergency services are essential. The municipality also participates in regional collaborations such as MittNät and Nodena, which strengthen resilience and allow knowledge sharing across municipal networks.

Karlstad's experience illustrates how a city network embedded in municipal governance can combine resilient infrastructure, long-term planning and strong local accountability. The model supports digital public services, healthcare at home, smart-city functions and crisis preparedness, demonstrating the broader societal role that locally owned fiber networks can play.

Sweden – Umeå Energi / UmeNet
UmeNet, operated by the municipal multi-utility Umeå Energi, illustrate how local ownership and technical governance create robust, future-proof broadband infrastructure. Umeå Energi delivers electricity, district

heating, and fiber within a single organization, enabling joint planning and co-laying of energy and fiber ducts, which may reduces excavation, costs, and environmental impact.[56] Under its robust broadband, Umeå Energi builds ring-structured, redundant networks, with the purpose of withstand disturbances and can quickly be restored if something happens. Local technicians stationed in Umeå can act quickly if disruptions occur, ensuring rapid restoration and continuity.[62]

Beyond technical robustness, Umeå Energi integrates broadband into smart city initiatives, where fiber serves as the nervous system of the smart city. The network supports smart-city applications in transport, energy efficiency, and data-driven municipal services, linking connectivity with environmental and social sustainability.[62]

Together, these practices show how multi-utility integration, local operational capacity, and smart-city collaboration can enable a municipal network that is resilient, sustainable, and adaptable to future digital-infrastructure demands.

Sweden – Stokab / City of Stockholm

Stockholm's municipally owned network operator Stokab complements this picture by showing how neutral, large-scale fiber infrastructure can underpin both digital resilience and innovation. Stokab's redundant, point-to-point architecture allows rapid rerouting and restoration in case of failure. The network's reliability has made it a backbone for critical public services, from healthcare and emergency communications to traffic-management systems. It also supports advanced applications such as quantum-secure data transmission and high-performance computing, demonstrating how open municipal infrastructure can adapt to emerging security and capacity demands. By combining public ownership, open access, and technical redundancy, Stokab illustrates how long-term, neutral network planning contributes to a resilient and future-proof digital foundation for cities.[16]

Germany - WOBCOM (Stadtwerke Wolfsburg) and Deutsche Glasfaser

In Wolfsburg, the municipal operator WOBCOM and Deutsche Glasfaser have established a reciprocal open-access partnership that enhances network resilience and efficiency. WOBCOM provides wholesale access within city limits, while Deutsche Glasfaser supplies bitstream capacity for surrounding rural areas, each gaining reach without redundant build-out.[63]

This reciprocity creates path diversity for backhaul, reduces single-point dependencies, and aligns incident-response procedures between networks. Coordinated change windows, shared restoration targets, and transparent escalation channels ensure consistent service levels for enterprises and public institutions. The model shows how public–private interoperability can strengthen reliability and operational resilience while maintaining open-access principles.

Germany - Stadtwerke Münster

Stadtwerke Münster, a municipal utility with decades of energy and transport experience, applies similar governance principles to its fiber operations. The company finances and builds the passive network layer and, where appropriate, contracts active management to specialized partners while retaining strategic oversight. This structure maintains structural separation, ensures accountability for resilience measures such as site hardening, backup power, and capacity planning, and facilitates transparent coordination during maintenance or emergencies.[64]

Documented priority-restoration procedures for hospitals, emergency services, and other critical users are integrated with municipal emergency planning. The model demonstrates how municipal utilities can combine patient capital with operational discipline to provide high-reliability connectivity that meets the same continuity standards as other critical local infrastructure.[64]

Austria – Regional Resilience through Open-Access Governance (nöGIG and Vienna)

Austria's regional networks illustrate how the Open-access wholesale described earlier translate into day-to-day operational resilience and coordinated maintenance. The publicly owned company nöGIG in Lower Austria manages a three-layer wholesale architecture that separates passive infrastructure, active network management, and retail service provision. This structure ensures neutrality, scalability, and clear accountability across all levels.

nöGIG coordinates fiber deployment across multiple municipalities, pooling civil-works planning and procurement to reduce costs and avoid duplication. The network connects

smaller communities that would otherwise remain below commercial thresholds for private rollout. Wholesale access is offered on equal terms to all qualified ISPs, and revenues are reinvested into expansion and maintenance. The company operates under RTR-approved reference offers that specify transparent pricing, service-level commitments, and performance indicators.

Financing relies on public-private partnerships combining state grants from the BBA 2030 program with long-term capital from institutional investors such as Allianz Capital Partners and other infrastructure funds. This mix provides patient capital while maintaining public control of core infrastructure. The model has inspired replication in other Austrian regions and is recognized by RTR as a benchmark for transparent wholesale operation.

In Vienna, open-access principles are integrated into the city's broader digitalization and smart-city agenda. Municipal coordination ensures that fiber deployment supports public services, energy-efficiency projects, and data-platform initiatives. Vienna illustrates how a metropolitan authority can align broadband policy with sustainability and resilience goals, complementing the regional wholesale model represented by nöGIG.

Together, these cases show how Austria links regulatory design with operational practice. The combination of neutral wholesale governance, regional coordination, and blended financing demonstrates that open access can deliver both efficient infrastructure deployment and long-term resilience without relying on direct municipal ownership.

CHAPTER 5. SUMMARY

Across Europe, municipal and regional broadband initiatives have played a central role in closing coverage gaps and fostering inclusive digital development. Sweden's long-established municipal-network ecosystem demonstrates how coordinated local ownership, aligned with national broadband strategies, can deliver near-universal fiber availability across both urban and rural areas. Similar approaches in Germany and Austria, through the engagement of local fiber actors, municipal utilities and regional programs, have accelerated deployment in communities where commercial incentives are limited or where coordinated infrastructure planning creates clear advantages. These experiences show that locally anchored actors can complement national operators by expanding coverage, reducing civil-works costs and ensuring long-term stewardship of essential infrastructure.

The open-access wholesale model, widely adopted within these municipal networks, provides an institutional framework that supports competition, efficient investment and sustainable market structures. This structure can increase network utilization, strengthen consumer choice and reduce unnecessary duplication of physical networks. Sweden's extensive experience with wholesale-based fiber networks, including Stokab in Stockholm, demonstrates that neutrality and transparent access conditions can support both vigorous competition and stable long-term investment. Austria's national requirement for publicly funded networks to operate on an open-access basis, and Germany's growing practice of co-investment and reciprocal access agreements among local utilities and national operators, further illustrate how open-access principles can scale across diverse market environments.

Europe's broadband agenda is now shifting from a focus on deployment and coverage toward resilience, long-term reliability and digital sovereignty. Fiber networks increasingly underpin essential societal functions, including health and homecare, education, energy management, public administration and emergency services. As a result, they are recognized as core components of Europe's critical infrastructure. Locally owned and open-access networks can contribute to this resilience by coordinating broadband deployment with other municipal utilities, integrating redundancy into network architecture and ensuring compliance with national and European standards for security and continuity.

Taken together, the evidence from Sweden, Germany and Austria demonstrates that municipal and regionally anchored broadband networks are not merely gap-fillers in the market. They are strategic complements to national initiatives, capable of enhancing competition, promoting efficient infrastructure development and supporting Europe's long-term digital resilience. As the demands on digital infrastructure continue to expand, these governance models offer valuable insights into how local ownership, open-access principles and coordinated planning can contribute to

a robust, inclusive and future-proof digital ecosystem across Europe.

CHAPTER 6. RECOMMENDATIONS & POLICY IMPLICATIONS

6.1 "Building for the future – not just for tomorrow."

This report shows that locally and regionally anchored fiber networks, operating on open-access and wholesale principles, have made a measurable contribution to broadband deployment, competition and digital resilience in several European markets. The experiences from Sweden, Germany and Austria demonstrate that diversified ownership structures, strong local governance and open infrastructure models can deliver high-capacity connectivity efficiently and at scale, benefitting consumers across Europe.

These findings are especially pertinent in light of the recently proposed Digital Networks Act (DNA).

Preserve diversity of ownership and market structures
EU digital infrastructure policy should promote diverse ownership structures, including municipal and regional networks. Experience from Germany, Sweden and Austria shows that such diversity strengthens competition and extends coverage where commercial incentives are weak. Locally anchored networks tend to reinvest in their communities and contribute to redundancy and operational continuity.

Policy frameworks that primarily favor large, vertically integrated operators risk weakening these dynamics. A broad ecosystem of actors – public and private, large and small – is better suited to sustain long-term competitiveness and digital resilience than a concentrated market structure.

EU policy should therefore avoid measures that, directly or indirectly, favor market concentration over sustainable competition and long-term public value.

Locally and Regionally Anchored Actors Strengthen Europe's Telecom Ecosystem
A telecom landscape characterized by structural diversity enhances – rather than dilutes – competitiveness. A broad ecosystem of actors expands the sector's investment base, accelerates deployment and reinforces long-term resilience.

A significant share of locally and regionally anchored telecom operators are publicly owned or part of municipal and regional energy groups. These entities combine commercial telecom activities with mandates rooted in essential public services. Their governance structures are typically shaped by long-term infrastructure planning, regional development objectives and public accountability.

This ownership model brings distinctive capabilities to the telecom sector:

- Long-term investment horizons aligned with infrastructure life cycles
- Proven expertise in managing critical infrastructure under security and crisis conditions
- Integrated sustainability strategies embedded across energy and network operations
- Strong local presence that facilitates rapid deployment and stakeholder coordination

Beyond their direct market contribution, these actors introduce complementary institutional and operational perspectives into the telecom ecosystem. Their experience in essential-service governance, infrastructure redundancy, security preparedness and sustainability integration can inform broader sectoral practices.

As telecom networks are increasingly recognized as critical infrastructure, cross-sector learning between energy and telecom becomes particularly relevant. Approaches to resilience planning, risk management and long-term asset stewardship developed within energy systems may serve as valuable reference points for the wider telecom sector.

Importantly, these locally and regionally anchored operators function fully within competitive market frameworks. Their presence strengthens competitive dynamics by diversifying capital sources, broadening deployment models and lowering structural barriers to entry.

Structural diversity in this sense is not fragmentation; it is a competitive and strategic asset that enhances Europe's collective capacity to meet connectivity targets while strengthening infrastructure security and sustainability.

Avoid consolidation-driven policy approaches

Although consolidation is often suggested as a response to Europe's investment needs, there is limited evidence that it delivers clear benefits for consumers, innovation or resilience in fiber markets. The most advanced European fiber markets are characterized by multiple infrastructure owners and functioning wholesale competition.

Strengthening competition and improving regulatory frameworks align more closely with Europe's positive market experiences than promoting structural concentration. Even where policy debates have moved away from explicit consolidation, safeguards remain necessary to ensure that the future policy action do not unintentionally favor market concentration over competitive dynamics.

EU policy should therefore prioritize competition-enhancing measures and include safeguards preventing regulatory or financial incentives from favoring consolidation.

Strengthen open-access and wholesale-based competition

A well-functioning wholesale market is essential to ensure that infrastructure investment translates into service-level competition. EU policy should guarantee transparent and non-discriminatory wholesale access to both fixed and mobile networks. This requires enforceable access obligations, effective tools to prevent anti-competitive practices such as strategic overbuild, and a regulatory environment that enables new and smaller actors to enter the market.

Preserving the independence and authority of national regulatory bodies is crucial to ensure that they can intervene where competition is restricted or market dynamics are distorted. Inclusive wholesale frameworks are particularly important for locally anchored networks and smaller service providers.

EU policy should therefore support open-access wholesale frameworks and empower national regulators to ensure effective and fair access to infrastructure across the Union.

Ensure non-discriminatory migration from copper to fiber

The transition from copper to fiber networks must not reinforce existing market dominance. Migration processes should be objective, transparent and subject to effective regulatory oversight. Technical interoperability and open access should form the baseline of migration frameworks. Exclusive arrangements that limit choice for households or restrict access for alternative operators require careful assessment. Technological transition should enhance competition in next-generation networks rather than consolidate it.

EU policy should therefore establish clear safeguards and empower national regulators to ensure fair and non-discriminatory migration processes across Member States.

Promote interoperable and transparent wholesale products

Clearly defined and interoperable wholesale products are essential for service providers and new entrants to operate efficiently across markets. EU policy should encourage open and transparent wholesale platforms while respecting national systems and market structures. Standardization should facilitate access and cooperation without imposing rigid harmonization that undermines well-functioning national models.

EU policy should therefore support interoperable interfaces and access procedures that lower entry barriers while allowing Member States to maintain effective national frameworks.

Maintain stable and predictable public funding frameworks

Public funding remains necessary in rural and high-cost areas where market-driven investment alone is insufficient. Support schemes should be predictable, long-term and accessible to smaller and publicly owned operators on equal terms. Funding should complement market-based investment rather than crowd it out and, where appropriate, be linked to open-access obligations to maximize public value and competitive impact.

EU policy should therefore ensure stable funding frameworks and equal accessibility for all types of infrastructure operators.

Link resilience and security to local and national anchoring

Digital infrastructure underpins essential public services, crisis preparedness and societal resilience. Ownership

structures therefore matter. Locally and regionally anchored operators, often closely integrated with municipal governance and emergency planning, contribute to accountability, operational continuity and reduced systemic risk. Strengthening local responsibility and diversified ownership can provide a more robust foundation for resilience than structural concentration.

EU policy should therefore recognize resilience and operational continuity as core regulatory objectives and avoid approaches that increase systemic dependency on a limited number of operators.

6.2 Overall Strategic Direction – A Structural Choice for the European Commission

The evidence presented in this report points to a clear policy direction for European digital infrastructure policy. The strategic implications are unambiguous:

- Competition over consolidation
- Open access networks over vertical integration
- Local and national anchoring over structural concentration
- Resilience and security as integral objectives of digital policy

Europe's digital future should not be shaped by consolidation-driven assumptions. A policy trajectory prioritizing structural concentration risks weakening competition, reducing innovation capacity and undermining long-term resilience.

The European Commission now faces a structural choice. By safeguarding ownership diversity and preserving varied market structures, the Commission can strengthen Europe's telecom ecosystem in a sustainable and future-oriented manner. A telecom market that promotes not only large pan-European operators, but also locally and regionally anchored actors, enhances innovation, operational resilience and secure infrastructure deployment.

Open-access fiber networks and non-discriminatory wholesale frameworks remain essential to ensure a fair and efficient migration from copper to fiber. They enable sustainable competition, maximize the value of both public and private investment, and prevent foreclosure risks during technological transition.

The infrastructure being deployed today will form the backbone of Europe's digital society for decades to come. It will shape economic competitiveness, societal resilience and technological sovereignty, not only for the present generation, but for the next.

For this reason, EU regulation must extend beyond short-term rollout objectives. It must actively foster a diverse and competitive market landscape in which municipal networks, regional operators, national providers and cross-border players each contribute their unique competencies.

The decision at hand is therefore not merely technical. It is structural and generational.

A competitive, open and resilient telecom ecosystem is not only compatible with Europe's digital ambitions, it is a prerequisite for achieving them.

[1] https://www.oecd.org/en/data/insights/statistical-releases/2025/07/digital-connectivity-expands-across-the-oecd-but-rural-areas-are-falling-further-behind.html
[2] https://www.oecd.org/content/dam/oecd/en/publications/reports/2025/05/closing-broadband-connectivity-divides-for-all_17ee89fa/d5ea99b2-en.pdf
[3] https://www.ssnf.org/globalassets/nyheter/uppkopplat---en-tidning-om-sveriges-stadsnat-2023-03-09.pdf
[4] https://bmds.bund.de/fileadmin/BMDS/Dokumente/Bericht-Glasfaserausbau-V10-SCREEN-BF-Maps-highres.pdf
[5] https://www.itu.int/en/ITU-D/Statistics/Pages/facts/default.aspx
[6] https://www.worldbank.org/en/topic/digitaldevelopment/publication/broadband-for-all
[7] https://digital-strategy.ec.europa.eu/en/policies/desi
[8] https://www.oecd.org/en/data/insights/statistical-releases/2025/05/fibre-and-5g-continue-to-expand-their-footprint-while-fixed-wireless-access-gains-ground-in-oecd-countries.html
[9] https://www.ftthcouncil.eu/committees/market-intelligence/2154/2024-ftth-market-panorama-report-by-country
[10] https://www.oecd.org/content/dam/oecd/en/publications/reports/2021/12/promoting-high-quality-broadband-networks-in-g20-countries_379417ef/cf0093dc-en.pdf
[11] https://digital-strategy.ec.europa.eu/en/policies/europes-digital-decade
[12]https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Marktregulierung/Massstaebe_Methoden/FttH_FttB_Ausbau/Deutsche_Telekom_Stellungnahme_FTTH_Regulierung.pdf?__blob=publicationFile&v=1
[13] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022D2481
[14] https://www.oecd.org/content/dam/oecd/en/publications/reports/2015/11/development-of-high-speed-networks-and-the-role-of-municipal-networks_g17a2728/5jrqdl7rvns3-en.pdf
[15] https://rural-interfaces.eu/wp-content/uploads/2022/11/MAP_PP-SW_final_v3.pdf
[16]https://stokab.se/download/18.4e63bdf518e5799b1da147/1712591992160/Stokab_Neutral%20fibre%20as%20platform%20for%20innovation.pdf
[17] https://www.ftthcouncil.eu/resources/all-publications-and-assets/2045/ftth-b-in-rural-areas-2024
[18]https://www.berec.europa.eu/sites/default/files/files/document_register_store/2021/3/BoR_%2821%29_30_BEREC_opinion_on_the_revision_of_the_BCRD.pdf
[19] https://stadsnatsforeningen.se/globalassets/press-och-asikter/remisser/2024/response-to-the-european-commissions-white-paper---stadsnatsforeningen-slutversion.pdf
[20] https://www.skekraft.se/om-oss/verksamhet/bredbandsnatet/
[21] https://www.infrastrukturnyheter.se/20221118/27020/skelleftea-kraft-beviljas-bredbandsstod-glesbygd
[22] https://bbcmag.com/municipal-fiber-in-sweden-4/
[23] https://www.stadsnatsforeningen.se/globalassets/in-english/facts-and-statistics/local-fibre-networks-in-sweden.pdf
[24] https://brekoverband.de/wp-content/uploads/2025/08/BREKO_Marktanalyse_2025_.pdf
[25] https://www.swlb.de/de/SWLB-Navigation/Presse/Pressemeldungen-2022-2023/SWLB-Ueber-die-Haelfte-Ludwigsburgs-mit-Glasfaser-ausgebaut-2023-02-03.html
[26] https://www.ludwigsburg24.com/15-millionen-euro-offensive-stadtwerke-ludwigsburg-kornwestheim-bringen-schnelles-internet-nach-asperg/
[27] https://www.die-bbh-gruppe.de/en/newsroom/news/unique-project-in-germany-bbh-provides-assistance-in-cooperation-project-of-stadtwerke-ludwigsburg-kornwestheim-and-deutsche-telekom-in-the-fibre-optic-expansion
[28] https://www.vatm.de/offene-netze-als-schluessel-fuer-den-glasfaserausbau-vatm-sbr-studie-vorgestellt/
[29] https://fiber-products.com/gigabit-strategy-2025/
[30] FTTH Council Europe - FTTH/B Market Panorama in Europe September 2024
[31] https://www.rtr.at/rtr/publikationen/Kommunikationsbericht/RTR_Kommunikationsbericht_24_EngWeb_Final.pdf
[32] https://www.ffg.at/Breitband2030/Foerderuebersicht
[33] https://digital-strategy.ec.europa.eu/en/policies/digital-connectivity-austria
[34] https://www.noegig.at/ueber-noegig/
[35] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L1972
[36] https://www.berec.europa.eu/sites/default/files/files/document_register_store/2020/12/BoR_%2820%29_232_BEREC_Guidelines_Art76_%28Clean%29_%28Publication%29.pdf
[37] https://www.ssnf.org/globalassets/in-english/facts-and-statistics/local-fibre-networks-in-sweden.pdf
[38] https://stokab.se/en/stokab
[39] https://www.stadsnatsforeningen.se/globalassets/in-english/facts-and-statistics/ssnf_thestory_hres.pdf
[40] https://www.vatm.de/wp-content/uploads/2025/09/2025-09-08_SBR_VATM-Studie_Netznutzungsmodelle_Open-Access.pdf
[41] https://www.bmwkms.gv.at/themen/telekommunikation-post/breitband/breitbandfoerderung/breitbandaustria2030/opennet.html
[42] https://www.rtr.at/TKP/aktuelles/publikationen/publikationen/Open_Access_Netze_Oesterreich.pdf
[43] https://www.rtr.at/TKP/aktuelles/publikationen/publikationen/Open_Access_Netze_Oesterreich_update2024.pdf
[44] https://www.vatm.de/studie-zeigt-kooperationen-und-open-access-sind-schluessel-fuer-den-glasfaser-erfolg-in-deutschland/
[45] https://digital-strategy.ec.europa.eu/en/policies/2024-state-digital-decade-package
[46] https://www.wik.org/fileadmin/files/_migrated/news_files/WIK_Diskussionsbeitrag_Nr_390.pdf
[47] https://www.berec.europa.eu/system/files/2025-06/BoR%20%2825%29%2068%20BEREC%20Report%20on%20Infrastructure%20Sharing_0.pdf
[48] https://broadbandnow.com/research/open-access-networks
[49] https://www.berec.europa.eu/sites/default/files/files/document_register_store/2020/10/BoR_%2820%29_165_BEREC_Guidelines_VHCN.pdf
[50] https://www.oecd.org/content/dam/oecd/en/publications/reports/2013/03/broadband-networks-and-open-access_g17a2259/5k49qgz7crmr-en.pdf
[51] https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/06/financing-broadband-networks-of-the-future_812ce667/eafc728b-en.pdf
[52] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022L2555
[53] https://www.enisa.europa.eu/publications/5g-security-controls-matrix

[54] https://www.berec.europa.eu/system/files/2025-03/BoR%20%2825%29%2036%20Report_Workshop%20on%20Network%20Resilience.pdf
[55] https://www.vku.de/themen/digitalisierung/
[56] https://a.storyblok.com/f/162274/x/d4a04d5e9b/umea-energi-ars-och-hallbarhetsredovisning-2024.pdf
[57] https://eur-lex.europa.eu/EN/legal-content/summary/european-electronic-communications-code.html
[58] https://pts.se/contentassets/29b19e7d2bfd4c588b1fb4b2e420e39a/anvisningar-och-forutsattningar-for-pts-bredbandsstod-2024.pdf
[59] https://www.rtr.at/rtr/publikationen/Kommunikationsbericht/RTR_Kommunikationsbericht_23_Engl.pdf
[60] https://eur-lex.europa.eu/resource.html?uri=cellar:03b1958e-b362-11ed-8912-01aa75ed71a1.0001.02/DOC_1&format=PDF
[61] https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/11/oecd-digital-economy-outlook-2024-volume-2_9b2801fc/3adf705b-en.pdf
[62] https://www.umeaenergi.se/om-oss/robust-bredband
[63] https://www.stadtwerke-wolfsburg.de/aktuelles/pressemitteilungen/detail/mehr-glasfaserangebote-fuer-haushalte-in-und-um-wolfsburg-deutsche-glasfaser-und-wobcom-kooperieren
[64] https://www.glasfaser-muenster.de/glasfaser-kooperation