BCG

Building the Gigabit Society: An Inclusive Path Toward Its Realization

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Inclusive regulation to unlock the Gigabit Society

Europe has launched a transformation path toward a Gigabit Society, aiming to have each and every European citizen benefit from full digital empowerment by 2025. A Gigabit Society would allow citizens access to new, innovative services and products, ranging from connected cars to e-government and from e-health to the Internet of Things. All of this requires cutting-edge connectivity. The Gigabit Society targets the attainment of network speeds significantly above 100 Mbps for all European consumers and 1 Gbps for public institutions, major transport hubs, and digitally intensive businesses. At ETNO, **we not only welcome this vision but also want to be practical about how we can make it happen**. This is why we commissioned this report by the Boston Consulting Group (BCG).

Our members are Europe's leading providers of digital communications and services; they share this vision and are committed to reaching its concrete objectives. Building on the heritage of all our companies, we strongly aspire to make the high network speeds envisioned by the Gigabit Society available to the citizens of Europe in an inclusive way. We want to make the Gigabit Society a reality for all Europeans as soon as possible.

To realize this vision, **enough resources should be mobilized and all Europeans should be able to tap into the opportunity.** As you will read in the report, we face many tradeoffs in our effort to deliver. The report points to ways in which we can ensure that the investment climate allows a speedy and efficient rollout.

We strongly believe that **the best path toward the Gigabit Society lies in a technology-inclusive approach** supported by a broad range of investment models.

Our priority should be to ensure that no European territory is left behind and that powerful network upgrades empower citizens across the Continent. To this end, operators across Europe should have the flexibility to design their own networks, choosing the best investment model and the most appropriate technologies. These may include fiber to the home (FTTH), G.fast, 5G, cable, or any other technologies that will help Europeans access very-high-speed connectivity.

Regulation should give telcos the leeway to try new paths and be innovative in order to bring high-speed internet to as many citizens as possible in the shortest time and on the smartest investment path. **The higher the inclusiveness and proportionality of the regulatory response, the larger the number of citizens who will be empowered.**

The required flexibility within and across countries also extends to commercial strategies and marketing approaches. Individual operators need to capture diverse consumer needs and face different environments, and thus require a variety of choices in their investment and commercial priorities. But all will share one overarching goal: providing ubiquitous access to the Gigabit Society to all Europeans by 2025.

In order to facilitate the discussions around the Gigabit Society and its realization path, ETNO has asked BCG to prepare this reportwhich presents potential scenarios and estimates the costs of reaching the vision's targets. It describes in more detail what is required from both an investment and a regulatory perspective to bring the Gigabit Society to life. We trust it will help inform the debate and develop high-quality policy choices.

Lise Fuhr, Director General of ETNO

Executive Summary

Although Europe has come a long way in developing its digital economy, there are substantial benefits to gain from further transition toward a true digital society. Forty percent of the economic growth between 2015 and 2020 is expected to be due to a digital society driving job creation and prosperity.

The European Commission has crafted a vision of a Gigabit Society in which all Europeans reap the benefits. This vision is accompanied by an ambitious target to improve Europe's broadband infrastructure.

BCG estimates that this infrastructure upgrade, if delivered exclusively via a fiber-to-the-premises (FTTP) approach, will cost €660 billion, which represents about 25 years of investing at the current pace. Clearly these investments will have to be funded in large part by the private sector. A time frame of 25 years is not in line with the Gigabit Society objectives set by the European Commission. Accelerating the investment pace will be a significant challenge because willingness to pay substantially more for higher broadband speeds is limited and the returns on investments in the telecom industry have been historically low over the past years.

Although the telecom industry has embraced the Gigabit Society, it will need to navigate multiple tradeoffs when charting a practical, inclusive path toward its realization.

As part of this effort, BCG has analyzed the tradeoffs and options the telecom industry is facing. We have concluded that to realize an inclusive, pervasive, and affordable Gigabit Society, Europe will need to embrace a technologically inclusive and market-driven approach.

In this approach, telecom providers would make choices about technology and cooperation models without any regulatory bias, selecting the optimal technology and investment model that best fit local circumstances and benefiting from technological advancements.

Our model suggests that in this way, by use of a more inclusive approach to technology and with an increase in annual investments from €25 billion to €35 billion, the goals of the Gigabit Society and the benefits it promises for all can be attained by 2025.

BCG believes that to realize this pathway Europe needs a thorough update of the regulatory framework for electronic communications[1]:

1. Simplified, streamlined access regulation that is completely technology inclusive, more market-based and focused only where there is lack of effective infrastructure competition in the market
2. A forward-looking spectrum policy to cover accelerated demand
3. A approach to competition policy with more emphasis on dynamic efficiencies

Given Europe's diversity, these guidelines will result in different solutions across the European Union, but the common result will be the achievement of an inclusive Gigabit Society by 2025.

[1] See the 2015 BCG report *Five Priorities for Achieving Europe's Digital Single Market*.

1. Europe will benefit from further transformation toward a digital economy

In recent years, Europe has come a long way in developing its digital economy.

- **The digital economy's share of European GDP (e-GDP) has reached €700 billion, or 5% of total GDP** (2014), with 8.4 million people now working in the high-tech sector.
- Network access has risen substantially across the European Union (EU), reaching **97% basic broadband coverage and 71% high-speed, next-generation access (NGA) in 2015.**
- In 2015**, 86% of the population was covered by high-speed Long-Term Evolution (LTE).**
- Subscription to these networks was somewhat lower, with **70% of Europeans in basic broadband, 30% in NGA, and 22% in LTE (2015).**

The projected growth of the digital economy **promises even more potential for the EU**.

- The economy's **digital share is expected to represent 7.5% of total GDP by 2020.**
- **Digital**, in the form of wider coverage and faster speeds, will **become the key driver of overall growth,** contributing **40% to total GDP growth between 2010 and 2020 and increasing 13 times faster than total GDP.**
- This growth will manifest in the labor market, with some **3 million additional jobs in the sector expected by 2020.**

Beyond mere economic growth, Europe is already benefiting from high-speed coverage in a number of **socioeconomic ways.**

- **Telework** is drastically reducing commuting, business travel, and electricity usage.
- **High-speed internet helps elderly and disabled citizens improve their quality of life,** increases participation in society, and reduces the cost of care.
- Substantial gains are expected from e-education, **e-government, and e-health.**
- **Rural areas benefit** as technology allows remote communities to participate more in economic and civic life.
- The ability to lead a modern digital lifestyle in the countryside **reduces migration pressure on metropolitan regions.**

Europe today has the ambition of becoming a leader among its peers.

- Europe intends to catch up in deploying and adopting next-generation networks (NGNs).
- **The EU aims to close the gap with nations like Japan, South Korea, and the US in both coverage and penetration** of technologies such as LTE and especially fiber, although **significant differences clearly exist within the EU, with some countries** (especially in Northern and Western Europe) already **being on par** with these nations.[2]

To reap the advantages of a digital society, close the gap with front-runners, and develop Europe into a digital single market, the European Commission (EC) in 2010 defined a Digital Agenda, the goal of which is to achieve **access to 30 Mbps for every European and to 100**

[2] Ovum, European Commission. For instance, 4G coverage in Europe is at 79%, as opposed to 96% to 99% in the US, Korea, and Japan. Fiber to the building and fiber to the home (FTTB/FTTH) coverage in Europe is 19%, as opposed to 65% in Korea and 92% in Japan.

Mbps for 50% of subscriptions by 2020. BCG has calculated that **an additional €106 billion** will be required to bring this Digital Agenda to life.[3]

2. The EC is laying out an ambitious vision for the Gigabit Society

In September 2016 the EC put forward an **ambitious vision: creating a European Gigabit Society.**[4] At the heart of the vision is the belief that to make the benefits described here available to **not just some but all Europeans** and to achieve the wider objectives of the digital single market, **very-high-capacity (VHC) networks need to be ubiquitous**.

The Gigabit Society is significantly **more ambitious** than the previous policy vision.

- On the basis of developments such as the Internet of Things (IoT), cloud computing, and the prevalence of content streaming, the EC set the objective that **all main socioeconomic drivers (schools, transport hubs, and primary providers of public services, as well as digitally intensive enterprises) should have access to speeds of at least 1 Gbps by 2025** to truly participate in and drive the Gigabit Society.
- The EC is also targeting **ubiquitous connectivity to a VHC network—that is, all households should have access to significantly more than 100 Mbps (downlink, upgradable to gigabit speed) by 2025. This is to ensure cohesion and digital inclusion across the EU.**
- To promote and enable innovation in areas such as automotive, manufacturing, and public services (for instance, next-generation emergency services), **a comprehensive rollout of 5G technology across urban areas as well as major transportation corridors is deemed desirable by 2025.**
- **Connectivity in rural areas should also be improved by 2025** through a **mix of fixed and mobile technologies**, with access to speeds significantly higher than defined in the Digital Agenda so far.

3. Upgrading to the Gigabit Society is to be inclusive and ubiquitous

At its core, the Gigabit Society goes beyond the aspiration to build VHC networks for Europe: its focus is on **universal access and fair participation**. The rollout should be democratic in the sense that no European citizen should be left behind in VHC access simply because he or she lives in a **rural area or in a region that is relatively disadvantaged socioeconomically.** Any upgrade path in line with the Gigabit Society vision must have at its center the goal of connecting everyone by 2025. **Those who have the lowest speeds today should not be the ones who benefit from the Gigabit Society last**.

BCG believes that to reach this target, a **technology-inclusive scenario should be followed**. As the developed model will show, in Europe VHC coverage with a realistic investment volume can best be reached by **giving operators the flexibility to determine their own investment and commercial upgrade paths**. This also allows them to remain open to any **technological innovation** that will occur on the way to 2025. Such a technology-inclusive environment will **enable network operators to play a very strong role in reaching the targets of the Gigabit Society**.

[3] See the 2015 BCG report Five Priorities for Achieving Europe's Digital Single Market.
[4] European Commission, Communication—Connectivity for a Competitive Digital Single Market—Towards a European Gigabit Society.

3.1. A €660 billion investment required to fund the long-term vision

BCG estimates that reaching the required levels of coverage and speed outlined in the Gigabit Society vision **will require** investments of around **€660 billion**, with fiber to the premises (FTTP) used as the long-term technical solution for fixed broadband.

- **€360 billion is to be invested in ultrafast broadband** at home, enabling nearly 100% of European households to access mainly FTTP networks.
- **€200 billion is to be invested in 5G RAN** (**radio access network**), driven by the sevenfold densification required in cities for small cell solutions, fiber backhaul for all base stations to allow for IoT/smart car solutions, and the completion of the 4G rollout.
- **€100 billion is to be invested in low-latency proximity data centers** in existing central office/switch locations.

Most of the investment will have to be **privately funded**. However, the source of that private funding is not certain—on the contrary. Investors have received **relatively poor returns from the EU telecom sector** over the past decade. The average return on capital employed of eight large telecom providers has declined from 15% to 10% in just five years.[5] At the current investment pace, it will take more than 25 years to achieve a Gigabit Society. For this reason, it is essential that **industry and institutions cooperate** to ensure that the required investment volumes are secured. Releasing all the necessary investment is crucial to achieving our common objectives.

[5] BCG ValueScience Center; Reuters.

Estimating the €660 billion investment

a) Ultrafast broadband coverage—€360 billion

According to the EC and Pyramid as of 2014, about 18% of European households were covered by FTTP and 38% by very-high-speed digital subscriber line (VDSL). With the overlap between both technologies taken into account, 62% of households had access only to slow, non-NGA technologies such as asymmetrical digital subscriber line (ADSL).

The starting point for the model is EU-level coverage in eight clusters of population density, which BCG estimates using 2014 country-level coverage data from the EC and representative household densities per cluster in telecom networks. The estimate assumes that all households will eventually be covered by FTTP, with connection prices per household varying according to population density per cluster (from urban and suburban to rural) and technology path. (Building new FTTP is more expensive than upgrading existing VDSL lines, at least in some contexts.)

Approximately 81 million households can be upgraded from VDSL to FTTP at prices between roughly €720 and €1,980 per household, depending on density. This would result in an investment of around **€53 billion**. About 135 million households are covered with new FTTP lines at prices between approximately €740 and €3,150 per household, resulting in roughly a **€307 billion** investment.

b) 5G RAN—€200 billion

Densifying the network in urban areas—€53 billion

Bandwidth requirements in mobile are bound to increase dramatically in the future. The network will have to become denser through construction of new base stations and installation of many small cells, especially in cities. This trend is reinforced by the fact that 5G networks will use additional bands with higher frequencies, again supporting the trend toward denser networks. BCG estimates the density in urban areas will increase sevenfold, adding about 880,000 small cells.

Building last-mile fiber to cells—€94 billion

To deliver the speeds that 5G access networks promise, all cells have to be connected to the fiber backbone. Because a very dense fiber network will already be built for fixed broadband (see the previous paragraph), BCG estimates that only 20 meters of additional fiber need to be deployed per new urban cell. In addition, all cells in rural areas require an improved connection to the backbone. BCG estimates that, on average, 3 kilometers of fiber must be deployed.

Completing 4G rollout—€53 billion

Using EU data, BCG estimates that by late 2014, 21% of the population, predominantly in rural areas, was not covered by 4G mobile networks. This part of the EU is the most expensive to cover, driving the comparably high costs.

c) Proximity data centers—€100 billion

To achieve low latencies, operators will need to invest in data centers close to consumers. BCG estimates that there are about 37,000 central office/switch locations in the EU, where on average three operators will build proximity data centers

Consumers' willingness to pay for higher speeds: Squaring the circle?
Given the **low return on investment (ROI), investing in higher speeds is a challenge**. Clearly, the business case for investments in VHC networks depends also on the **willingness** of consumer and end-users **to pay.**

Yet although the **percentage of fixed broadband connections above 10 Mbps in Europe rose from 56% to 76%** between **2012** and 2015, **the increase did not result in greater revenue per user**. In fact, the **price of 3P bundles**—including high-speed broadband, fixed telephony, and television—**went down by around 25% between 2012 and 2015.**

There is **little public data** available on the degree to which operators actually succeed in selling higher speeds, but **NBN in Australia does report these figures and finds that only 14% of subscribers are paying approximately 30% more** to move from the standard 25 Mbps offer to 100 Mbps. Moreover, the percentage of consumers opting for 100 Mbps has **actually fallen from roughly 30% in 2013.**

Willingness to pay for incremental speeds is a **key driver of investment in VHC networks.** In the future, the investment needs will require **a new balance of revenues and ROI.**

One of the reasons for limited willingness to pay might be that **customers today do not consider higher speeds valuable. Packages that are priced according to penetration and that also cover the significant switching cost**—a large impediment to upgrading for many consumers—could be a way to tackle the issue by providing consumers with high-speed access at the price of their current, lower-speed plan for a trial period. This could help consumers appreciate the value of higher speeds and ultimately increase their willingness to pay when prices transparently rise again after a few months.

Finally, a **closer, segmented look at willingness to pay** might be required. Studies of US consumers suggest that **willingness to pay for higher speeds is above average in rural regions as well as among high-income households**. Leveraging this willingness to deploy **differentiated prices** could raise some of the funds needed for network investment.

These considerations become very sensitive in the context of policy decisions. The ideal situation would see speedy rollout of superfast networks at no price increase. Can the EU square the circle and win this challenge? In section 3.3 we propose a possible way ahead.

3.2. Key tradeoffs confronting network operators

Europe's telecom industry has stated that it is **committed to investing in the vision of the Gigabit Society**. In determining the right pathway for the coming decade or more, it faces a number of tradeoffs that will determine how many Europeans can benefit from the Gigabit Society—and when.

Realizing a profitable business case versus affordability

- Consumers clearly value the benefits a digital society brings them. BCG research indicates that most **consumers would rather give up beer than internet access**. The consumer surplus of broadband access—**the delta between the actual value for the customer and the price paid—**is estimated at €1,275 on an annual basis.[6] In an ideal world, consumers would be willing to pay for **part of the increased value of higher bandwidth to help the operator finance the investments**. However, as the sidebar shows, this is not universally the case—in fact, the value of speed is not yet recognized by most consumers.
  Thus, to fund the investments, **telcos must make difficult choices on both investment and pricing policies in retail and wholesale** to ensure that the investment can be funded from incremental revenues and that affordability is not threatened. The outcome of this tradeoff depends on many local circumstances, including a town or village's demographics, the competition, existing network assets, and so on. Obviously, **in some situations FTTP will emerge as the optimal choice, whereas in others it could be investments in G.fast or fiber to the distribution point (FTTdp).** Upgrades of the cable network will also play an important role. In a few rural areas, **some of the emerging wireless technologies may be the best choice.**
- **Upgrading networks in a big-bang versus a step-by-step approach**
  Although **the most capable technology in the long term is clearly FTTP everywhere** and fiber to each mobile antenna, **many options exist for a step-by-step investment in addition to a big-bang upgrade.** Recent years have seen substantial improvement in technologies that deliver superfast speeds via copper networks (for example, G.fast, XG.FAST, and bonding), hybrid fiber coaxial (HFC) networks (DOCSIS 3.1, fiber to the last node), 4.5G and 5G, and microwave (for instance, e-band). **These technologies all offer the potential of speed over 250 Mbps (and in many cases significantly higher) with lower CAPEX than a full FTTP rollout.** Moreover, all the technologies bring fiber closer to the home—that is, they offer a significant contribution to full FTTP set-up coverage for the longer term. Financial analysis by BCG has shown that in some cases a big-bang approach (investing directly in FTTP) is cheapest but that in other cases the cost of upgrading to such an intermediate technology first and to FTTP as and when required is lower than a big-bang upgrade. **Telcos are well advised to understand their specific situation clearly and to act accordingly.**
- **Rollout speed versus investing with a 20-year time frame**
  Another tradeoff that is not typically addressed in the political debate is the **speed of deployment**. Some technologies are inherently faster to roll out—they can be built for more people in the same period. The differences lie in the amount of work they entail, **especially the necessary civil works, required building permits, practical difficulties in accessing buildings, and so forth**. BCG

[6] From the 2012 BCG report *The Internet Economy in the G-20: The $4.2 Trillion Growth Opportunity,* using an exchange rate of 1.12 US dollars per euro.

experience indicates that, across the board, **FTTP is a relatively slow technology to build**, whereas upgrades to the copper or HFC network can on average be carried out two to four times as quickly. To reach all Europeans with VHC networks in the fastest possible way, **a combination of FTTP and technologies requiring less effort to roll out would thus be optimal.**

Practicality of a full FTTP rollout

In many EU countries, a **further deployment of high-speed internet that is focused exclusively on FTTP is almost impossible, for a number of reasons:**

- The **total annual investment needed to roll out FTTP by 2025 is about €70 billion from 2020 onward.** This represents more than three times the current investment levels. According to current funding models, this **cannot be sustained by the telecom industry as it is today.**
- In most countries, **expanding FTTP requires significant civil works.** According to most experts, the third parties (including municipalities and administrations) that are needed for obtaining permissions, conducting the requisite planning, and executing the work **do not have the capacities required for this short-term boost in activity**. As experience in Australia shows, such a **step-up is far from guaranteed and will at a minimum result in a substantial increase in costs** given the massive market demand.
- To make such a rollout commercially viable at all, **the initial deployment would have to focus on urban areas with the highest population density**. This would imply that suburban and rural areas, which are most in need of increased access to high-speed internet, **would benefit from the Gigabit Society only later**.

- **Synergies between technologies and operators**
  With the emergence of fast mobile broadband technologies like 4G and 5G, **formerly distinct networks are now becoming increasingly intertwined**. Fiber is an important backbone for the fiber to the X (FTTX), HFC, and mobile networks. The **network rollout can thus be made more efficient by using the same fiber pathways for all technologies and multiple operators**.
  But **there are substantial practical barriers to leveraging these potential synergies**, especially as they can be fully captured only in a world of perfect foresight and information. Especially in the fast-moving area of telecommunications, such a world is an illusion. **Telecom players—and also national and local governments—will have to accept that such rollouts can be coordinated only to a certain extent** and that attempts to force close cooperation are likely to slow progress.

3.3. An inclusive, practical pathway for universal access to the Gigabit Society

As laid out in the previous section, telecom providers must make important tradeoff decisions in their effort to bring the benefits of the Gigabit Society to all Europeans by 2025. BCG has modeled some potential pathways involving technology mix, consumer prices, and investment volume.

Using this modeling, **BCG asserts that connecting all households to a VHC network by 2025 should be possible in combination with substantial 5G coverage by the same year.** One conceivable pathway is closest to squaring the circle, as it ensures future-oriented investments, maximizes the speed of rollout, and reduces impact on consumer prices. It comprises the following pieces:

- A rollout of VHC fixed broadband with 250 Mbps speed to all Europeans by 2025, using a **mix of FTTP and investments** in advanced copper-based technologies as determined by the local circumstances
- **A rollout of 5G**—especially in urban areas—facilitated by the deep fiber network required for VHC
- Depending on local circumstances, **further upgrades to FTTP or then-available technologies for even higher speeds—**well possible after 2025 without risking write-offs of these investments
- An increase from **€25 billion** to **€35 billion** in annual investments in the access layer, **financed, in part, by an improved ROI** and, to a smaller extent, by governments through both demand stimulation and subsidies for the most challenging areas

In this **technology-inclusive regulatory context, operators should determine the most economical investment in FTTP, cable networks, or advanced hybrid fiber technologies.** This will likely be determined on the basis of the **existing infrastructure and its upgrade potential,** as well as the **market environment**, including the potential to sell additional services. Such a determination will ensure that **the available capital is used most efficiently in the rollout**—that is, customized for the specific context in a given EU country. This efficiency and flexibility will raise the likelihood that all Europeans can be part of the Gigabit Society by 2025 at the latest.

We have also modeled **alternative scenarios rolling out FTTP almost exclusively, based on it being the preferred "end-state" technology**. We realize that full FTTP coverage by 2025 in Europe **would require more than double the industry's annual investments**, and that this would be possible only with massive increases in consumer prices across the board (including those for legacy technologies). We also realize it would require **a massive scale-up of Europe's rollout capacity and capability**, which is unlikely to go smoothly, as the Australian experience has shown. Clearly, however, this scenario can change in light of national circumstance. **For some countries, because of specific local factors**—as with Portugal and Spain, for instance—**FTTP-only could be the most attractive pathway.**

Portugal case study

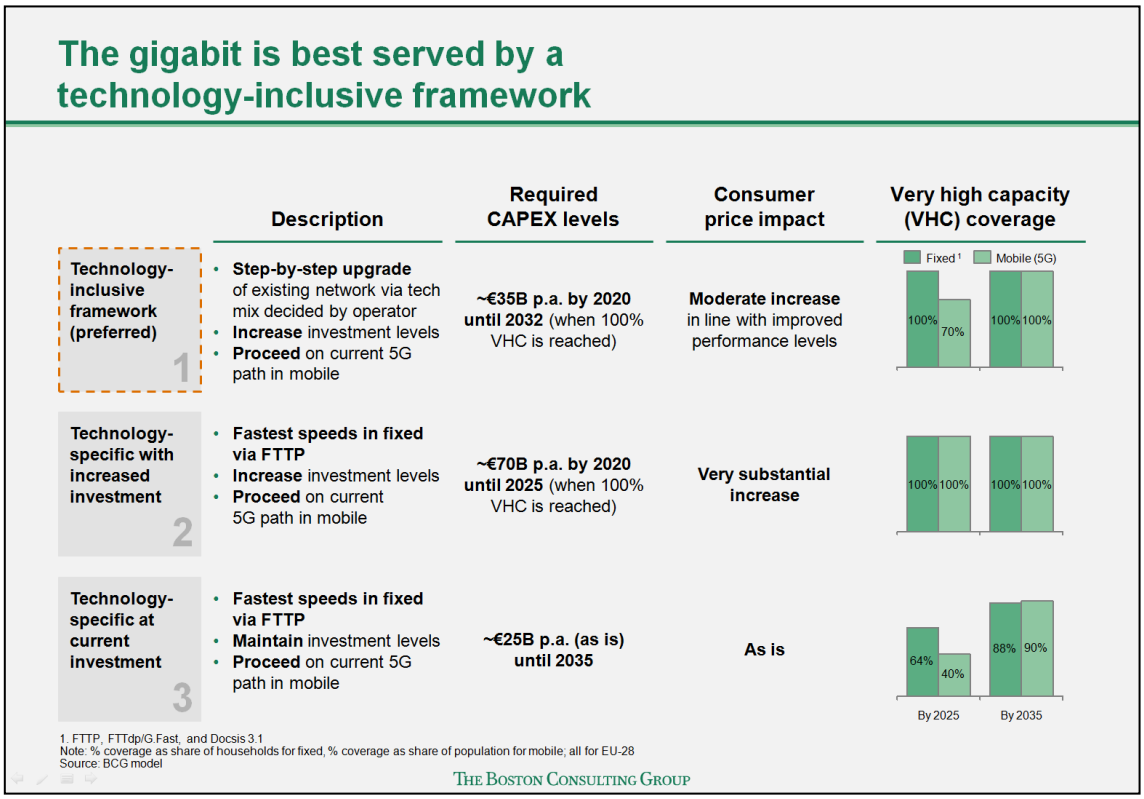
When it comes to fiber rollout, **Portugal can be considered an exceptional case.** As early as 2014, over **65% of households were covered by fiber to the home** (**FTTH**), more than in any EU nation outside of the Baltics.

The rapid rollout of fiber in Portugal has been spurred by **a good starting point combined with favorable regulation**. Four drivers in particular stand out:

1. Competition was characterized by **fierce rivalry with cable**, with full migration to DOCSIS 3.0 already by 2009 and co-investment by several operators to **share the CAPEX burden.**
2. **The rollout costs were lower than in many other EU nations** for a number of reasons. An extensive and clean duct system could be leveraged to significantly drive down civil engineering costs, a large share of the population live in dense apartment buildings, and labor costs are comparatively low.
3. As early as 2008 the **government initiated a process to financially support the rollout of NGNs in rural areas through subsidies and easier-to-obtain credit**.
4. A clear, **investment-friendly regulatory and legal regime was already established in 2009**, ensuring symmetrical access to ducts and poles and mandating fiber in newly built housing. The implementation of a centralized information system was also imposed by law to coordinate civil works.

Alternatively, **we modeled a scenario in which the annual investment stays at the current level but is fully directed to an FTTP rollout.** In that case, **full VHC coverage cannot be expected before 2035 to 2040.** Moreover, the regions with the poorest broadband are most likely to receive the upgraded networks last. This would imply that **some areas would remain in a broadband "Stone Age" of less than 10 Mbps for at least another 15 years.**

The exhibit highlights the technology-inclusive and the two FTTP-only scenarios.



4. Regulatory adaptations are needed to support VHC network rollout

BCG believes the aforementioned gigabit network rollout is possible, but that it is dependent on, among other things, **a change in regulation** to make the European telecom industry once again **attractive for investing and investors**. Moreover, **regulatory intervention that favors one solution or technology over another invariably has unintended and unforeseen effects** that are detrimental to universal coverage.

The **transition to high-speed networks can be hampered or accelerated by the set of regulatory policies**. The EU points to the many benefits of the digital single market, but it **continues to regulate according to a system based on national markets as well as market definitions that no longer apply**.

Therefore, a **thorough update of European regulation in fixed and mobile** technologies is required, one that **supports a technology-inclusive scenario:**

- Simplified, streamlined fixed-**access regulation**
- A **forward-looking spectrum policy** to cover accelerated demand
- A policy with more emphasis on **dynamic efficiencies in competition**

4.1. Simplified, streamlined fixed-access regulation

Given the variety of telecom technologies in high-speed access that are based on legacy decisions and consumer preferences in EU member states, a **simpler, technology-inclusive,**

more market-based approach is needed. This market-based approach should be **grounded on solid insight** into what spurs investors and investment.

- To maximize the total funding flowing into the market, **regulation should not favor one investor type or investor model over another**. **Having the market determine the best ROI** will ultimately result in the most funding.
- It should be ensured that **any regulation to stimulate investment in VHC networks applies to all technologies that can drive meaningful improvements over today's broadband experience, and that it takes into account the associated risks for the investor** as well as the very different starting points.
- The previous point implies **recognition that HFC-cable networks are as capable as the telecom networks of being upgraded to VHC capabilities. Regulation should take this into consideration and acknowledge that in the presence of effective infrastructure competition, this kind of upgrade can be sustained without the need of ex-ante regulation.**

To ensure that returns on network investments are **predictably attractive**, three associated principles are key to this altered approach:

- **Segmenting markets according to current competitive dynamics** (leaving competitive markets to ex-post competition control)
- **Making light-touch ex-post regulation the rule and ex-ante regulation the exception, enabling operators to** (1) introduce **differentiated, segment-specific pricing** for customer segments that are more willing to pay for higher speeds, and (2) **cover switching cost** and design **trial offers for penetration pricing** during upgrade periods to **acquaint consumers with the value of higher speeds** before charging for them
- **Relying on commercial agreements** for access provisions and **more flexibility in wholesale pricing** by moving away from cost orientation

4.2. A forward-looking spectrum policy to cover accelerated demand

5G should play an important role in the development of the gigabit society. Given the substantially different architecture of the foreseen 5G network (up to ten times more cells than the current network), **creating the right regulatory environment is essential**.

- Policymakers need to **allocate more spectrum for mobile wherever possible in order** to limit the need for ever more cells and to make the network more efficient.
- Several **spectrum-sharing models** offer the potential to increase utilization. This is especially important given the massive densification effort.
- **Licenses with longer terms – or indefinite terms will stimulate more investments and spectrum release planning**—including national spectrum plans—should make spectrum **auctions and expenses more predictable.**
- **When and where possible, spectrum assignment should be coordinated**. In short, new regulation should carefully consider allowing more spectrum and network sharing models in a more predictable framework.

4.3. A policy with more emphasis on dynamic efficiencies in competition

- Regulators should shift from **price as the dominant regulatory objective to a more comprehensive and balanced assessment** that also includes investment, technical progress, quality of service, and innovation.
- Analysis of mergers should include how they **yield investment boosts in networks.**

NBN–Australia case study

In 2007 the Australian government decided to attempt **one of the most ambitious FTTP deployments ever, aiming for 98% coverage in a country with one of the lowest population densities worldwide.**

The National Broadband Network (NBN) was founded in 2009 to implement this plan and achieve target **coverage by 2021.**

Unfortunately, **NBN was not able to deliver as planned**. After five years, **less than 5% of the target had been achieved, about 80% less than intended.** What prevented the rollout?

- **Higher-than-expected costs**, particularly from third-party vendors
- **Availability of resources for specialist activities** (splicing) and civil work
- **Accessibility of aging infrastructure**, especially ducts

In 2013 a strategic analysis of the plan's technical and commercial aspects, as well as of actual customer needs, was conducted. As a result, a **dramatic shift in strategy for NBN was recommended**.

The new goal is to offer a **minimum of 25 Mbps to all households and at least 50 Mbps to 50% of households**. This is to be achieved through a **mix of technologies—FTTP, fiber to the node (FTTN), HFC, and wireless**. As a result, **full population coverage is expected not only six to eight years earlier** than would have been feasible with the old FTTP-only plan, but also **at massively reduced costs (35% to 40% lower)**.

5. Government involvement in subsidizing and steering the VHC network rollout must be tailored to the needs of individual countries

Government involvement in high-speed network rollout **typically encompasses subsidies to provide incentives and steer the rollout in a jurisdiction—**for example, toward rural regions that would otherwise not be covered.

Within the EU, France and Germany may serve as prototypes for the role of government. France tends toward a centrally steered network-upgrade plan backed by significant subsidies, whereas Germany influences competitive dynamics by enabling municipalities and other local governments to apply for rollout funding and has an overall lower level of subsidies.

France steers its rollout centrally and from the top down, providing **direct subsidies for rural areas** that would otherwise not be served. Germany relies on a **bottom-up approach. Germany's goal is to engage network providers in a competitive game,** wherever possible, that ensures maximum private-sector involvement in high-speed network rollout.

Both countries build on their respective starting points and diverging technological legacies. Germany, with its **federal, decentralized structure**, encourages competition on the local level and reacts with subsidies only where this competition does not lead to high-speed rollout. France uses its top-down model to determine where government funds will be allocated.

Taking into consideration the different starting points in EU member states, as in France and Germany, it is clear that **no one-size-fits-all solution will suit the EU as a whole**. Rather, **overarching principles must be shaped on the European level** while national regulators are given **leeway to steer high-speed rollout in line with their national technology and regulatory legacy** as well as operator and consumer preferences.

Moreover, BCG recommends that both the EU and its member states consider the potential of **demand stimulation in providing sufficient incentives for investments**.

- Such stimulation could **involve minimum performance standards for the internet at schools, vouchers for speed upgrades for key socioeconomic actors, and so forth.**
- To determine the right package, **each member state should ensure that it truly understands what is required to further increase private investment** in the sector, given its specific circumstances.

6. Summary—What is required now?

Although Europe has already achieved much, there is a **clear need to accelerate the efforts toward a Gigabit Society, providing ubiquitous high-speed connectivity to consumers and businesses across the EU.**

Reaching the maximum speeds within the shortest possible time frame requires a **smart investment path.** BCG advocates a **technology-inclusive approach.**

- Operators should be given the flexibility to decide on their preferred **network upgrade and marketing path independently.**
- The technology-inclusive approach includes a **40% increase in investment** (**to €35 billion per year**) in VHC networks, plus a **revised regulatory framework** focusing on s**impler access regulation, a forward-looking spectrum policy**, a competition policy **aimed at optimum investment** and growth, and a system enabling segment-specific and penetration pricing.

No one-size-fits-all approach will do the trick. Given the diverse technologies in EU member states and the differences in labor costs, infrastructure, and market structures, **EU policy should set overall guidelines** for regulation that pushes forward VHC network rollout. **National regulators should** then, in a second step, **translate these guidelines into the optimum setup for their respective member state**.

Modeling logic for calculating a ramp-up of CAPEX allocation coverage

Penetration and CAPEX allocation as crucial model outputs

The model's key output is the penetration for **four prototypical technology choices** (FTTdp, FTTP, 4G, and 5G) for each year. The most important input parameter is the **overall CAPEX available for access networks each year**, for which different values are assumed in the various scenarios. Because 5G will be a critical topic in the future, BCG assumes that **the fixed/mobile split will gradually move from around 70/30 for fixed/mobile toward a more even distribution of around 50/50**.

The logic for fixed coverage

CAPEX is distributed in **five simple steps** for each year. CAPEX that is not invested in one step is spent in the next. At each step, population densities are of fundamental importance. **Once coverage in one density area reaches 100%, CAPEX is invested in the next area**—proceeding from urban to rural.

- Step 1: Continue FTTP expansion at current rates.
  In some locations, FTTP expansion is already under way. The model assigns a certain amount of CAPEX to continue this trajectory, leading to slightly rising FTTP penetration.
- **Step 2: Set aside dedicated CAPEX for rural areas.**
- Many governments encourage and provide incentives to telcos to connect rural areas to high-speed internet. A certain amount of CAPEX is reserved for this purpose and assigned to the two out of eight modeled density clusters that are least dense. The upgrade path assumed here is FTTdp, given the lower cost per household than an all-out FTTP connection path.
- **Step 3: Use remaining CAPEX for VDSL to FTTdp, starting in urban areas.**
- Telcos will invest where they expect the highest ROI, be it through increased revenues or the safeguarding of current revenues by keeping up with competition. Hence, areas that already have NGA connectivity in the form of VDSL are upgraded to the next speed tier in the form of FTTdp. As in step 1, upgrades occur first in the densest areas and proceed to less densely populated ones.
- **Step 4: Use remaining CAPEX for regions without telecom NGA, starting in urban areas.**
- Next, telcos would begin upgrading regions where heavier investment is required. Adding new FTTdp coverage to a region that was previously not covered by VDSL is more expensive.
- **Step 5: Use remaining CAPEX for FTTP, starting in urban areas.**
- As a final step, the remaining CAPEX is spent on upgrading the remaining FTTdp to FTTP.

The logic for mobile coverage

The investment model for mobile is somewhat simpler. First, 4G will be rolled out to the currently uncovered population. Next, 5G will be rolled out, starting again in the densest areas. Key parameters that could change the outcome for mobile are the **number and cost of both small cells and proximity data centers**. Plus, the model **does not include any cost for additional spectrum rights.**

The role of cable

The model is based on a view of ultrafast broadband access that is driven by fiber technology. In reality, operators in **some European countries may opt to upgrade their existing cable (HFC) networks instead of building an alternative technology**. However, BCG recognizes that cable upgrades to fiber to the last amplifier (FTTLA) have cost profiles similar to those of telecom upgrades to FTTdp. The model's conclusions are thus broadly applicable.

Model input changes for the technology-specific scenario

For the technology-specific scenario, the **path toward FTTdp is replaced by a direct upgrade path to FTTP**. Because the **connection cost per household is higher**, coverage with ultrafast broadband requires significantly higher investments.

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