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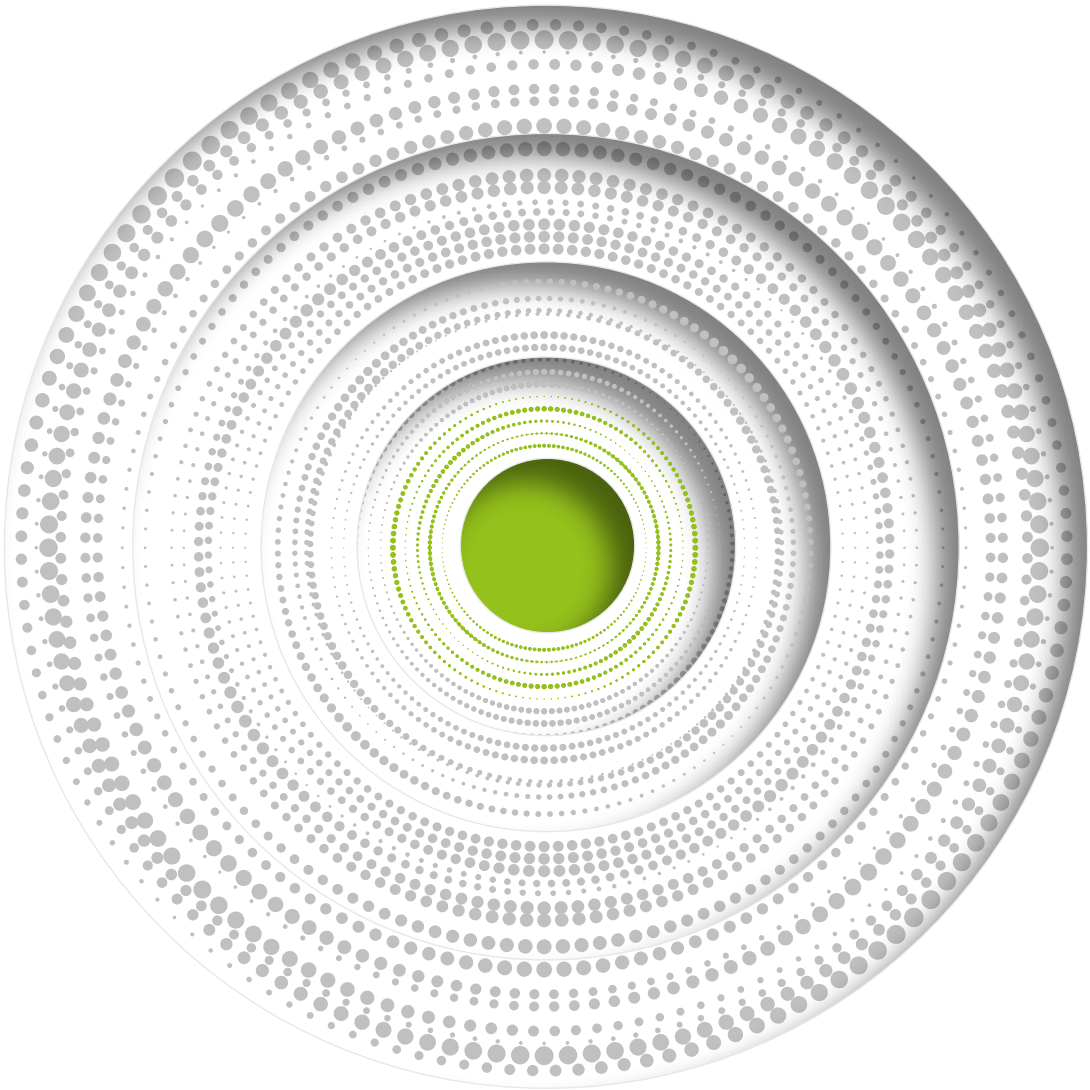


Center for the Long View

Future of Fiber
The need for speed

MAKING AN IMPACT THAT MATTERS since 1845

Introduction

The technical superiority of fiber optics in providing internet services is undisputed, with its availability even considered as an essential future location factor in global competition. Nevertheless, fiber optic expansion varies greatly and numerous areas outside the conurbations remain unserved. How will the future of fiber develop over the next few years? This study explores extreme, yet plausible, scenarios that illustrate how high-speed broadband coverage might evolve, who the major players might be, and how consumer preferences might change as technology progresses.

Technological advances in our professional and private lives have had a tremendous impact on how we communicate, work, and entertain ourselves. Even before the COVID-19 pandemic, working from home had started to flourish and open up remote and more flexible lifestyles. These profound social changes have manifested themselves, increasing the need for a more future-proof bandwidth technology that allows for high-speed connectivity without any delays.

This development comes at a time in which households are already interested in higher bandwidths, anticipating e.g. the use of 4k or even 8k flatscreen TVs, unlimited video-on-demand streaming, virtual and augmented reality, and online gaming. Fiber technology is likely to be the standard technology for meeting these more sophisticated bandwidth demands. Especially in remote areas, where current copper technology is partly limited to download speeds of only 16 mbps, fiber acts as a lifesaver for municipalities that would otherwise risk falling behind.

A recent study by Deloitte shows that many existing networks are already reaching their limits with existing applications. In particular, VR/AR, TV and video applications as well as home working are set to increase even further in consumer demand if higher bandwidths were available to them (see fig. 1).

Alongside entertainment and home office purposes, fiber is becoming essential for more and more economies that must meet well-connected global competition – in rural areas often a make-or-break factor. Fiber connectivity also increases the value of real estate, again particularly in rural municipalities. Furthermore, fiber technology is 'greener' and more sustainable than its copper and cable equivalents, as it requires significantly less electrical power, emits no radiation, and its capacity can be expanded almost indefinitely at very little cost in the future.

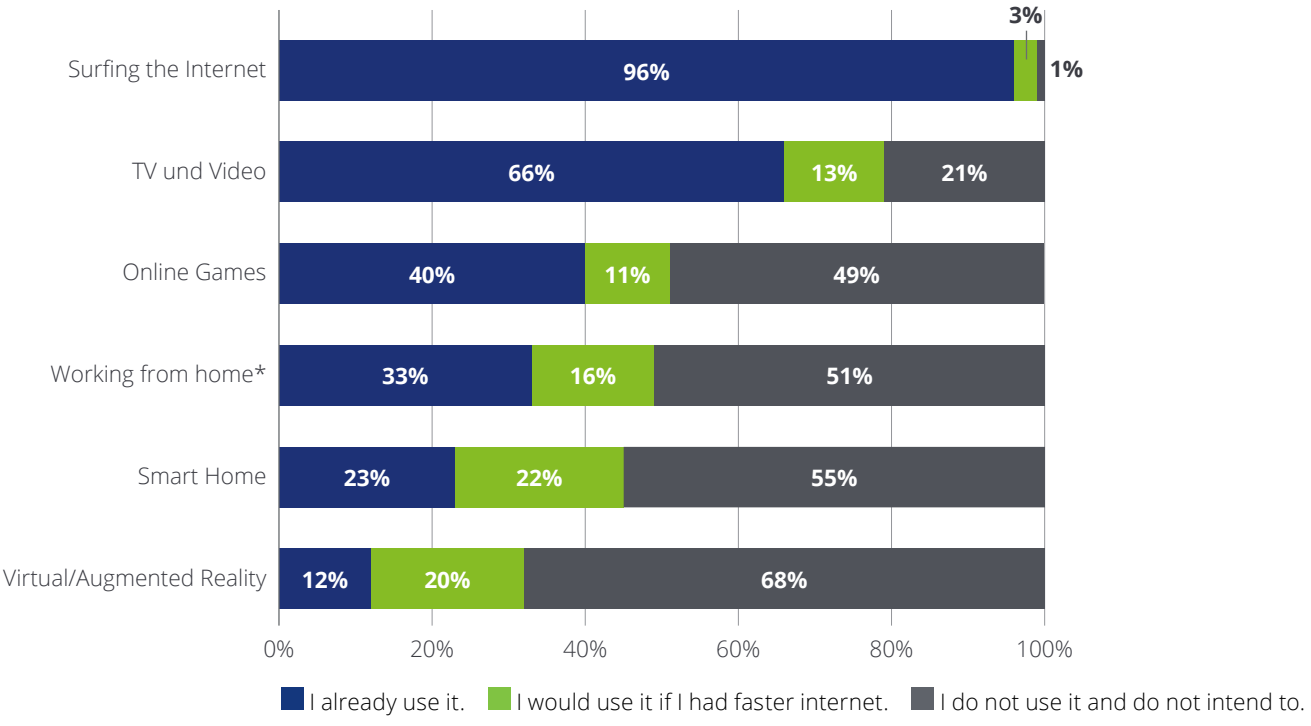
It is therefore no surprise that the incumbents, traditional telecommunication companies with a convergent, i.e. fixed-line and mobile, service offering are increasing their fiber offering, while pure broadband players ('altnets', alternative network operators) partly focus on areas that are underdeveloped with regard to high-speed internet access. Some new players may only focus on infrastructure, i.e. they build fiber networks and sell their capacity to others who then market and provide services to end customers. The former are also called 'NetCos' as they only provide network capacity to other operators, whereas the latter are known as ISPs (internet service providers) or 'ServCos', as they focus on customer acquisition and service provision without their own infrastructure.

Technological progress enables various new ServCos without their own fiber networks to enter this promising field of high-speed internet service provision: mobile network operators and VNOs (virtual network operators) like energy providers that bundle electrictiy, gas, and fixed-line internet or equipment manufacturers that leverage their brand and enhance it with internet services.

Fragmention drives both consolidation and the emergence of aggregators that provide intermediatory interfaces between NetCos and ServCos. The different scenarios in this study will illustrate what visionary endpoints of market developments could look like.

However, at this point in time it is unclear how much consumers are actually willing to pay for upgrading to fiber and whether a critical mass can be reached to make such a business model profitable in areas with low population density or legacy infrastructure. A point of reference is our companion study, "Fiber Consumer Study 2021", in which we explore in detail how satisfied consumers are with their current internet access and what specific factors could facilitate their transition to faster alternatives such as fiber.

Fig. 1 – Which of the following services do you already use in your household, and which would you use if your internet line was faster?



*) incl. video conferencing, VPN.
Source: Deloitte Glasfaser-Studie 2021, https://www2.deloitte.com/de/de/pages/technology-media-and-telecommunications/articles/glasfaser-studie-2021.html

Scenario thinking

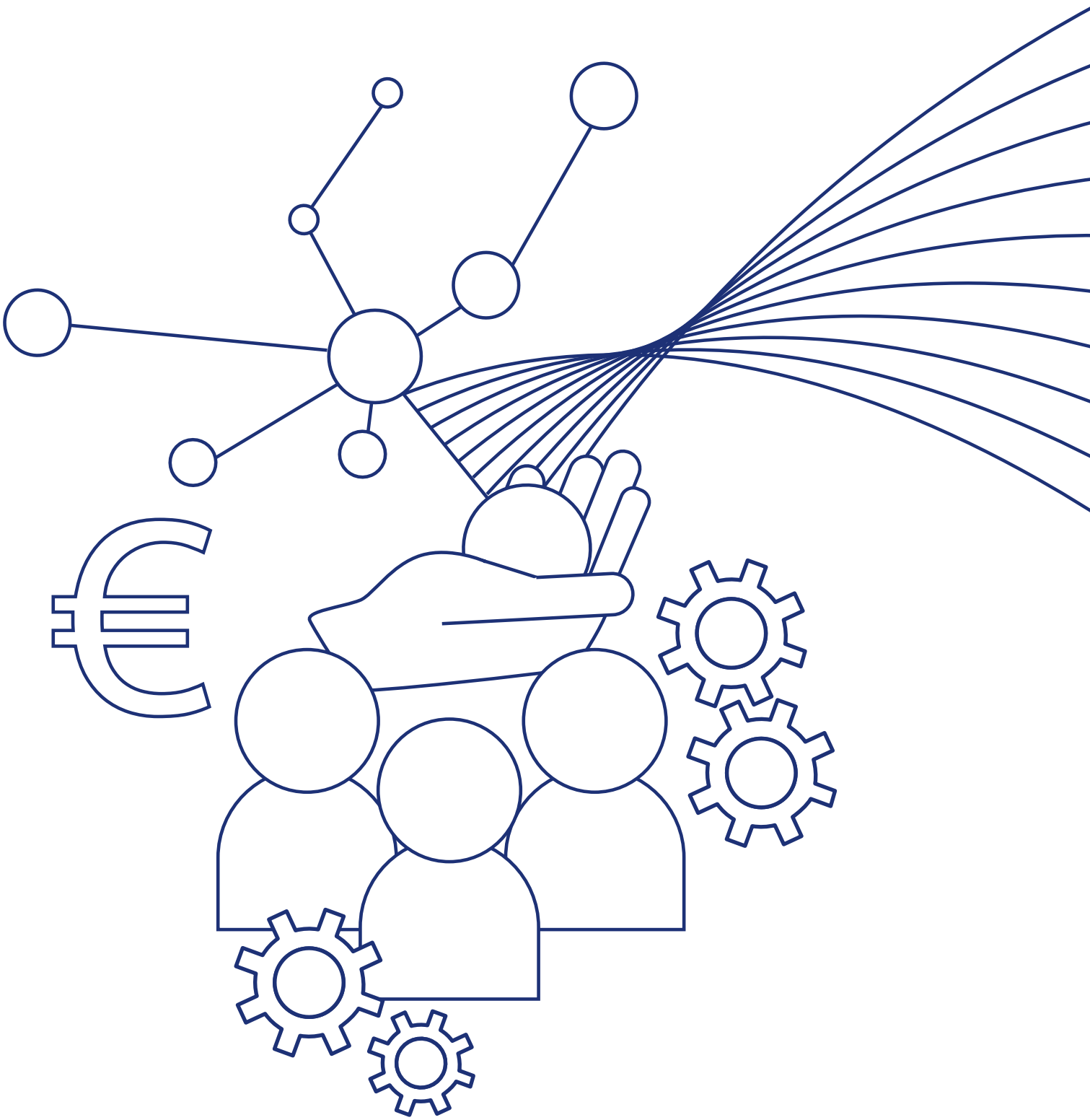
Predicting the exact future of fiber technology is a challenging endeavor. In addition to the usual level of uncertainty, three specific key questions contribute to making a precise prediction difficult:

1. How will the cost per fiber connection and willingness to pay evolve? This affects the profitability of the underlying business model and can attract – or deter – current market players as well as new investors.
2. How will network operators react to the fiber market potential and to new market entrants?
3. Will subsidies become more effective and how will regulators react to accelerating market dynamics?

Especially in those highly uncertain environments, conventional strategic analysis methods tend not to result in true or sustainable insights. However, approaching the landscape through the lens of scenario design gives perspectives beyond conventional three- to five-year strategy planning horizons.

Scenarios illustrate relevant but opposing forces rather than specific events in the future. In other words, they are narratives set in alternative future environments that are impacted by today's decisions. In demonstrating the underlying drivers, scenarios help planners model their strategies and adapt them according to their potential impact.

Scenario design cannot predict the future per se, but it can view the risks and opportunities of specific strategic options in detail. From there, we can develop responses that are robust enough to generate realistic outcomes in different potential futures. As a next step, we generate a set of scenarios that describe plausible futures which differ significantly from each other and provide a sense of context and practical application.



The underlying drivers and how we derive them

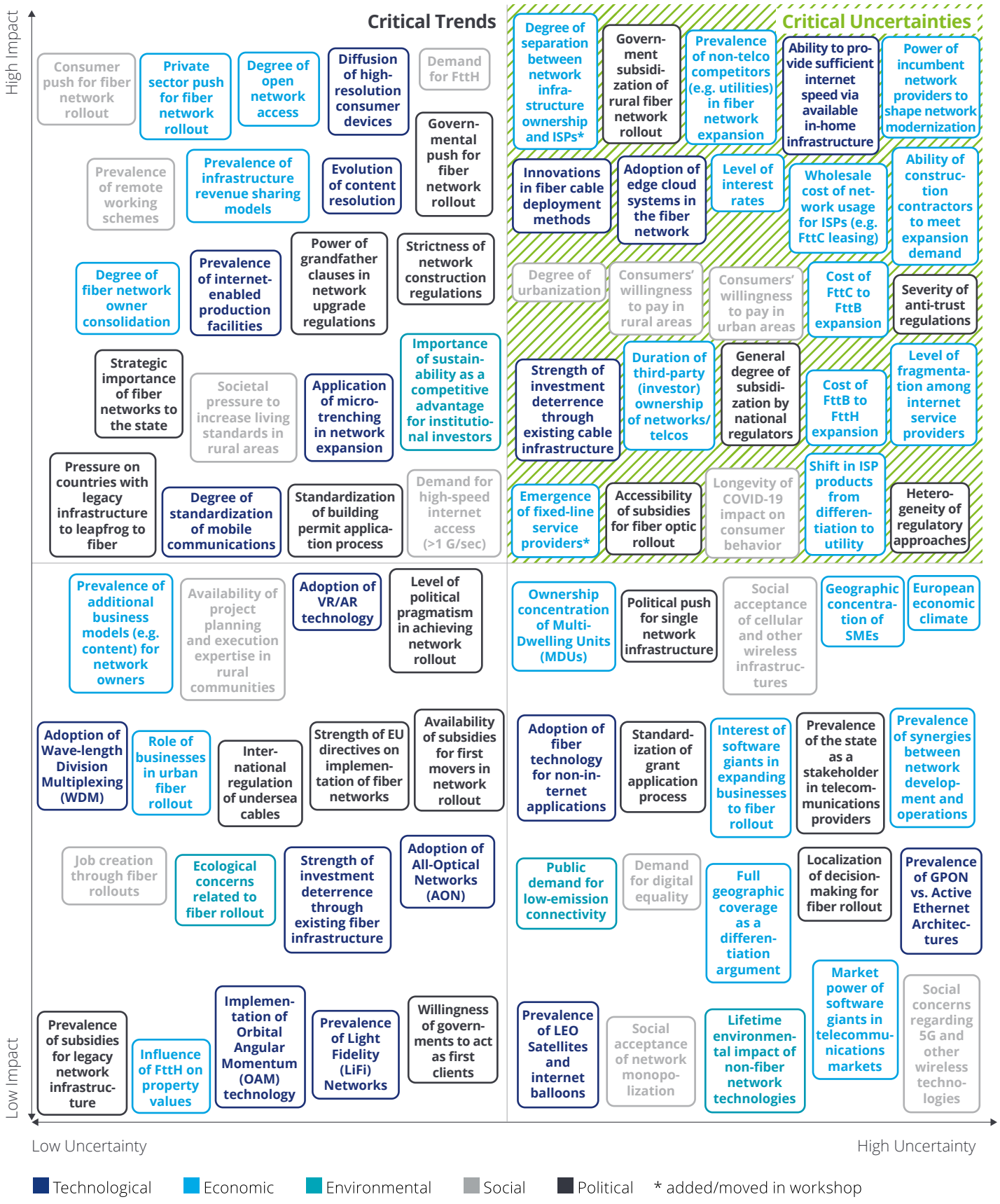
We develop our scenarios from a comprehensive set of underlying drivers that will plausibly shape the future of fiber. These drivers stem originally from both expert interviews and utilizing our unique external environment analysis, which is based on Natural Language Processing algorithms. Applying social, technological, economic, environmental, and political (STEEP) factors allows us to cluster our set of 84 driving forces and rate them according to their relative uncertainty and their respective predicted impact on the future (see fig. 2).

We identified two types of relevant driving forces for our scenarios:

- Drivers with high impact and predictable evolution or critical certainties, i.e. critical trends
- Drivers with high uncertainty and high impact on the future of fiber or critical uncertainties

We will highlight the most relevant trends below before guiding you through the selection of critical uncertainties that led us to the development of our final scenarios.

Fig. 2 – Driving forces regarding the future of fiber: Evaluation by degree of impact and uncertainty



Note: Overlapping data points have been rearranged to increase readability; survey was conducted between 12 May 2020 and 11 June 2020 with 14 participants.

What our experts are certain about

The ‘critical trends’ shown above in figure 2 are highly relevant to the future of fiber and our experts are able to estimate their development relatively well. Four of these critical trends are particularly important and play a role in all of the scenarios presented below.

Demand for high-speed internet access

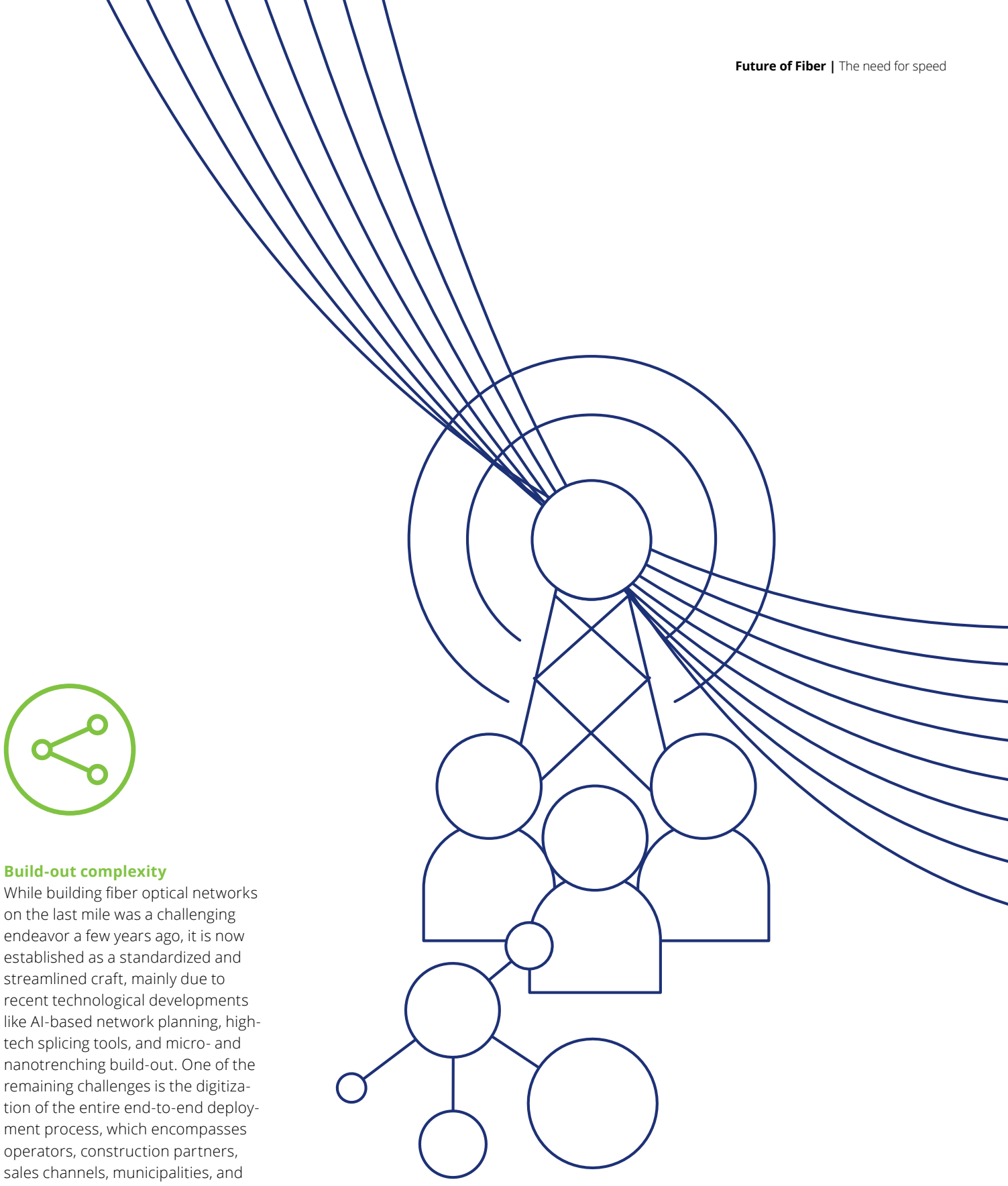
High-bandwidth applications like 4K/8K, AR (augmented reality) and cloud-based apps, combined with increased use of home working and a rising need for mobile antenna connectivity, fuel the necessity for high-speed internet access lines that are strong both down- and upstream. Only optical fiber networks can deliver this.

Digital divide between urban and rural areas

The societal distance tends to grow if rural infrastructure falls behind, which becomes especially obvious when considering the diverging quality of internet access, i.e. the ‘digital divide’. Optical fiber networks are state-of-the-art for closing this gap.

Open access

While open access was a threat a few years ago, this has now reversed and becomes a trend, since it increases marketing and sales power per infra-structure, and thus utilization, at equal cost base. In addition, without an infra-structure access monopoly, overbuilding existing networks becomes less attractive, although complexity increases and must be managed.



Build-out complexity

While building fiber optical networks on the last mile was a challenging endeavor a few years ago, it is now established as a standardized and streamlined craft, mainly due to recent technological developments like AI-based network planning, high-tech splicing tools, and micro- and nanotrenching build-out. One of the remaining challenges is the digitization of the entire end-to-end deployment process, which encompasses operators, construction partners, sales channels, municipalities, and end customers. The seamless integration of all parties onto one digital platform will further accelerate the fiber build-out.

Our critical uncertainties

Critical uncertainties focus on drivers that are both highly uncertain and highly relevant. Our study takes 84 driving forces into consideration for subsequent analysis (see fig. 2).

After testing the drivers by measuring their interdependence with and relevance to each other, we subsequently grouped them according to their degree of relatedness. Finally, we created a matrix by choosing those critical uncertainties that generate the most challenging, divergent, and relevant scenarios. Clustering these leads us to two critical impact dimensions with high degree of uncertainty:

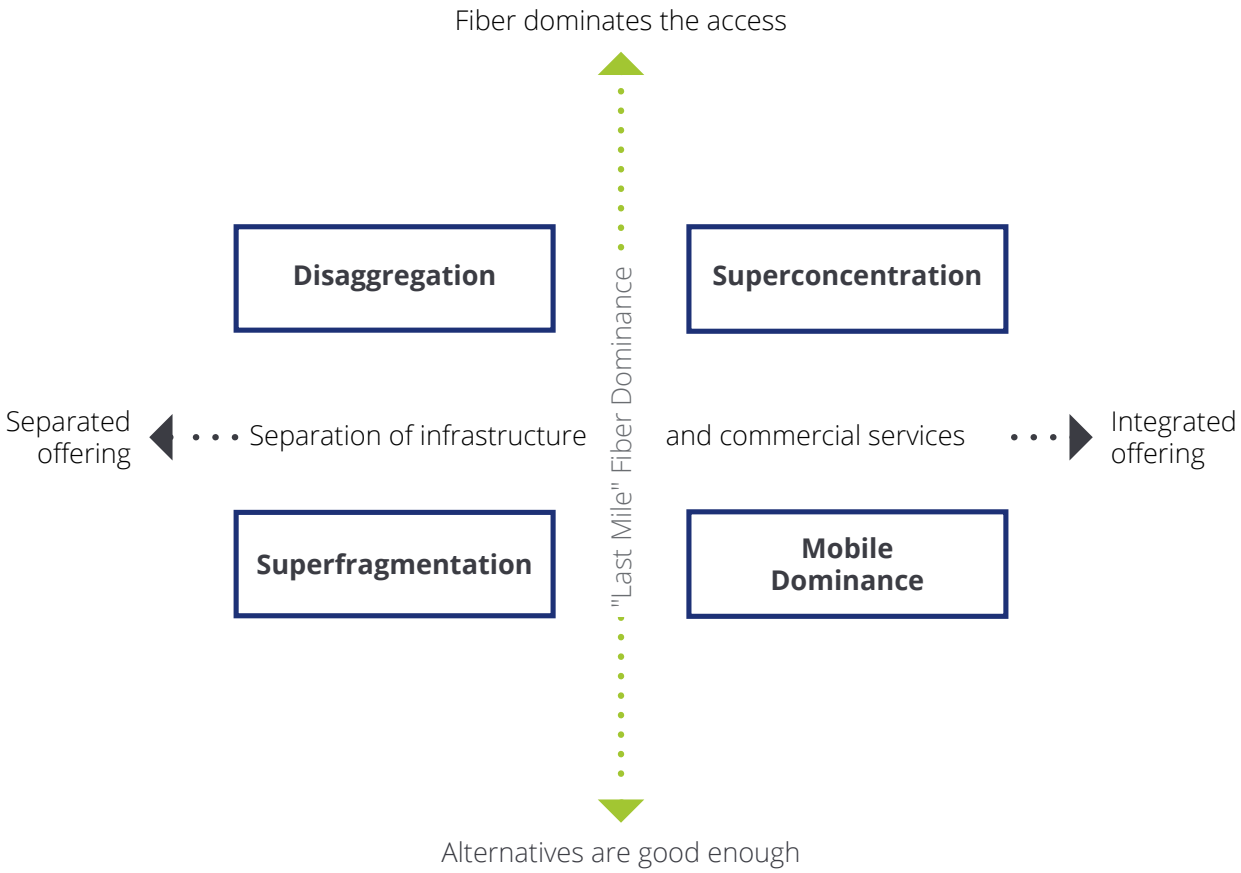
The first one is uncertainty regarding the separation between physical network ownership and the provision of digital services. Will traditional telco providers continue to pursue both by keeping their communication networks and serving end customers? Or will third-party investors fuel the rise of pure infrastructure firms that sell open access to their networks to a multitude of existing and emerging service providers?

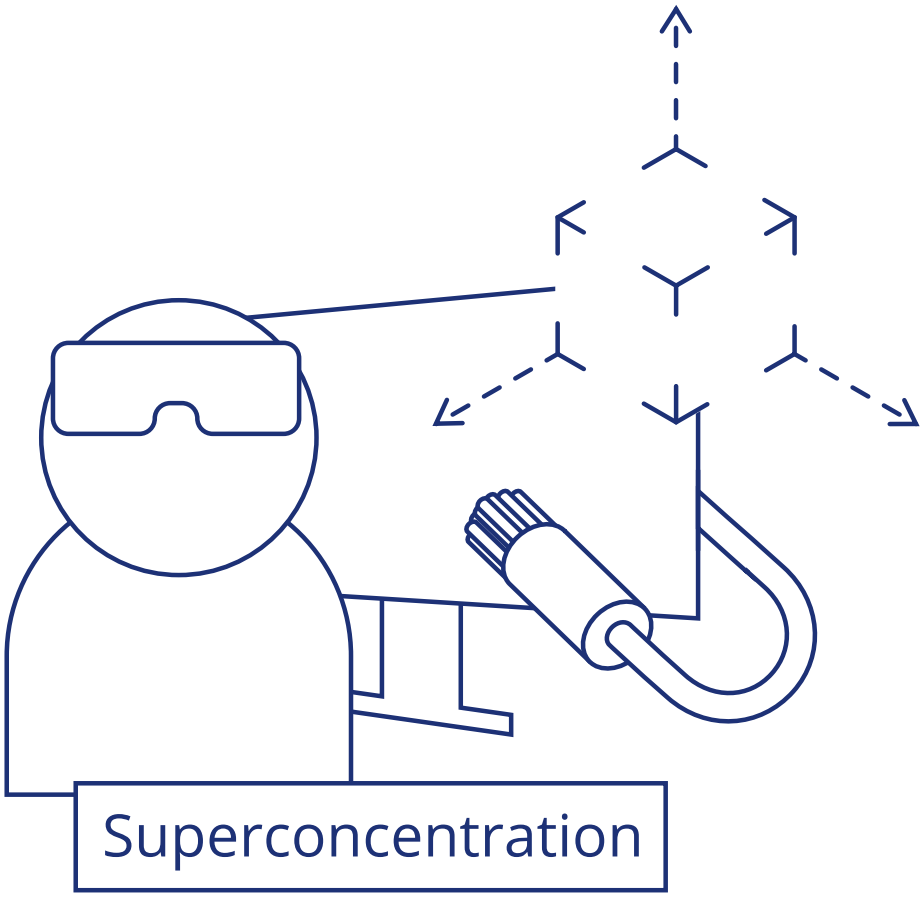
The second critical uncertainty revolves around the evolution of last-mile connectivity. Will fiber be the dominant solution and fiber-to-the-home connections the new industry standard? Or will technologies such as 5G and existing, successively upgraded infrastructures suffice to cover the demand for high-speed internet connectivity in this decade?

Based on our scenario methodology, we have developed four extreme yet plausible scenarios for how the future of the fiber network ecosystem may develop in the coming years, as seen in figure 3.

Let's now take a glimpse into these possible futures.

Fig. 3 – Scenario overview for the future of fiber





Our four scenarios

Scenario 1: Superconcentration

In our first scenario, fiber-to-the-home connections are the only acceptable answer to the ever-increasing demand for high-speed internet access, the widespread implementation of remote working schemes and the rapid adoption of virtual and augmented reality and 4k/8K TV.

Here, the incumbents use their existing copper and cable infrastructure as a cash cow to fund its replacement by fiber and to limit new market entrants to unattractive areas.

Emergent services that require deep infrastructure integration, such as edge-cloud capabilities, enjoy acceptance and enable telecommunication firms to maintain sustainable differentiation by combining network ownership and service provision.

Having sensed these developments early, incumbents have swiftly accelerated their own fiber investments and actively consolidated independent fiber deployments of altnets, which have mushroomed predominantly across rural areas. In other underserved areas, telcos lease capacity from local NetCos and thereby gain nationwide high-speed fiber coverage.

Consequently, incumbents' control of infrastructure ownership and service provision allows for the creation of differentiated service bundles and distinct offerings for all B2C and B2B segments, including the direct integration of major OTT offerings. Coupled with their ability to place cost pressure on competing service providers, incumbents can attract most of the growing market revenues. Mobile operators and altnets profit only little and the digital divide between urban and rural areas increases.

Scenario 2: Mobile Dominance

In the world of Mobile Dominance, innovations in 5G+ technology and the development of new communication standards have significantly improved the quality, usage rates, and deployment costs of mobile networks. Consequently, connectivity issues are a thing of the past, with 5G/6G as a suitable complement to fill gaps and strengthen existing connections. Mobile connectivity can even substitute fixed-line access lines and provide all the applications in demand, such as 4k TV and enhanced/virtual reality, thereby strengthening all operators with their own mobile networks.

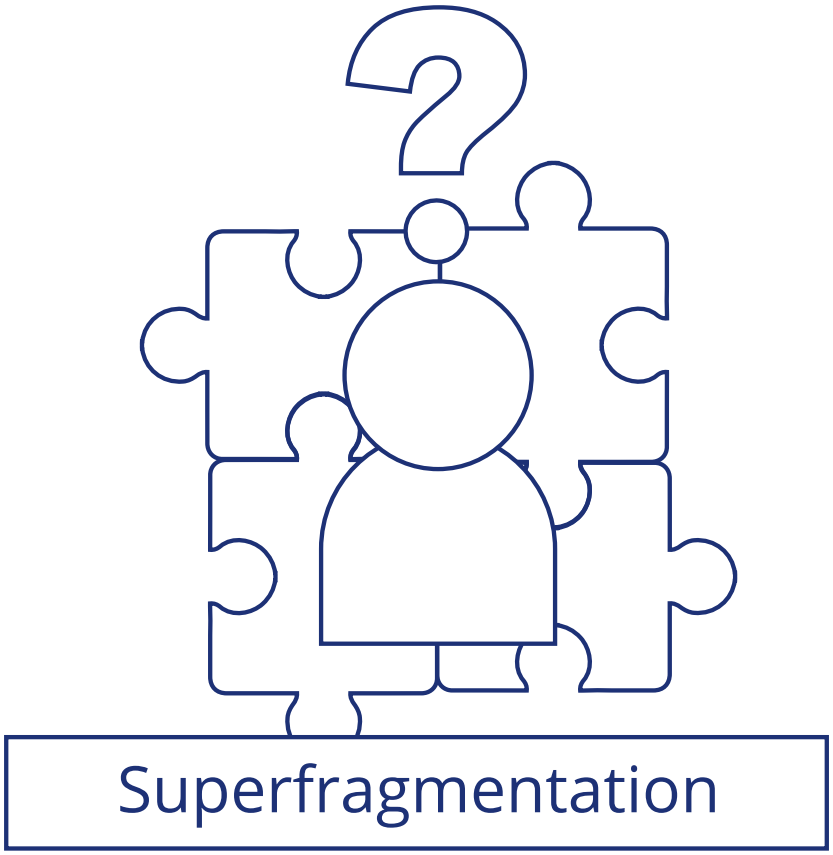
Customers can use mobile services even for in-house connectivity or a seamless combination of mobile and fixed-line connectivity, where the fixed-line part is based on legacy infrastructure that experienced substantial fiber upgrades.

Fueled by cash flow from their existing countrywide homogenous infrastructure, incumbents are able to invest boldly into a dual fixed-line/mobile network strategy. Combined with integrated services, comprehensive OTT offerings, and a strong brand, this development leads to a strong competitive positioning with 'full customer experience' at substantial price premiums, dominating over pure infrastructure-centric FTTH offerings.

Since optical fiber networks are most important for transporting data traffic to and from mobile 5G/6G antennas, so-called front- and backhaul networks, they are essential in this scenario, shifting profits to mobile operators and specialised front- and backhaul NetCos.

Other players have a hard time combating the competitive advantage of incumbents and mobile operators. Alternative network providers are constrained to building fiber networks in underserved areas, and other market entrants sidestep to alternatives such as LEO satellite broadband services, which so far have failed to gain traction. However, market aggregators, who source multiple infrastructures to increase compatibility and provide simplified wholesale and end-consumer access, represent a growing threat.

Regulators are looking to shift subsidization towards mobile and optimal technology mixes, further boosting telcos' power while doing little to bridge the digital divide.



Scenario 3: Superfragmentation

In this world, the market does not reward tighter integration of network infrastructure with services. Instead, service providers have access to heterogeneous network infrastructures thanks to open standards, regulatory pressure, and a trend towards open access, which increases utilization at the same cost levels and keeps overbuild at bay. As a result, alongside the incumbents, a variety of new players have emerged in the field, such as virtual network operators, for example hardware manufacturers, digital platform companies, or energy suppliers.

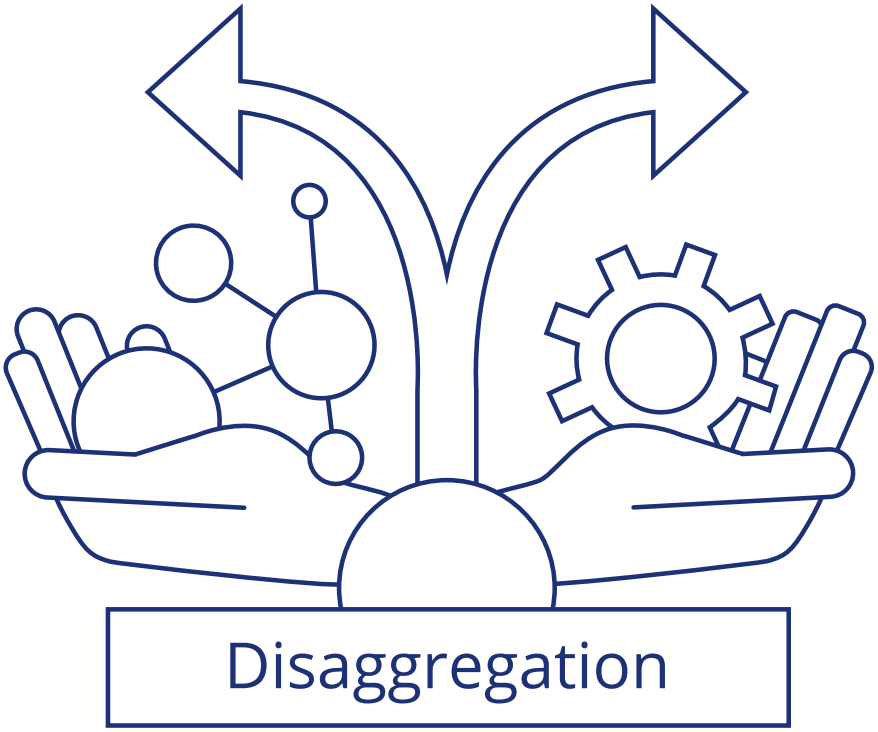
Attracted by stable returns from telco infrastructures, investors are pushing to break up traditional telcos into infrastructure and service companies, i.e. NetCos and ServCos, and to build new fiber networks in the underserved countryside.

Consequently, fiber-to-the-home is on a par with competing infrastructures such as 5G or cable. This development leads to highly fragmented markets on both the infrastructure and the service provisioning sides, which makes navigating the field increasingly difficult for consumers.

However, fragmentation also fosters the emergence of consolidators and aggregators. Wholesale aggregators bring scale and structure back into this highly competitive market with nationwide offerings that are based on fragmented networks across the country. On the other hand, investors, AltNet, and incumbents compete to consolidates network islands to extend their coverage and fill in the gaps.

As a result, different infrastructures co-exist and end consumers benefit from widespread coverage and low prices. Aggregators profit from fragmentation and distribute revenues downstream, i.e. to those that maintain the customer relationship. Failed governmental expansion policies have resulted in a high concentration of fiber connections only in densely populated cities or in rural niches, a situation that threatens to increase the digital divide.

Scenario 4: Disaggregation



As in the Superfragmentation scenario, institutional investors are attracted by stable returns from network infrastructure and push the segregation of network operators into NetCos and ServCos.

However, in this world, fiber-to-the-home is clearly perceived as the best technology. Consumers as well as businesses demand ever-increasing bandwidths that mobile-only cannot deliver. Operators that have not invested heavily into fiber are eventually pushed out of the infrastructure business, leading to a complete reshuffle of the sector. Fiber is not only being laid in currently underserved rural areas, but also in cities where copper and cable networks have reached their capacity limits.

Customers do not honor the benefits of tight network infrastructure and service integration. Open standards foster the emergence of a new type of VNOs (virtual network operators) without their own infrastructure. Consequently, fierce competition between ServCos leads to decreasing connectivity prices for end customers.

The power of regionally monopolistic altnets and NetCos to set wholesale connectivity prices is regulated by price-setting auctions in which ISPs bid for network access. This puts pressure on ServCos' profit margins, which is only partly alleviated by lower Capex requirements in an asset-light business. Aggregators emerge and position themselves as gatekeepers to local network capacity, with only a few nationwide ISPs and outstanding global device manufacturers enabled as anchor tenants in their guarded networks. Overall, market revenues are increasingly pushed upstream to network owners.

In the end, service providers offer cutting-edge products to consumers and businesses that are based on a virtualized crowd of fragmented high-speed fiber networks, whose capacity is distributed by wholesale aggregators.

The societal demand for equal quality of life in rural and urban areas is influenced by urban flight as a consequence of the rising cost of housing and improved working flexibility. The positively trending population density in rural areas has improved the business case for expansion and increased the push for rural expansion subsidies. All in all, the digital divide has closed to a significant extent.

Taking a closer look: Recommendations

The future development of fiber networks is impacted by a variety of trends, such as increasing demand for high bandwidth, a higher degree of collaboration between telecommunication companies, and faster build-out speeds at lower cost.

However, critical uncertainties largely determine what the infrastructure and operator landscape will look like in the future. Two of the most interesting and mutually independent uncertainties are the NetCo/ServCo separation that can be observed in some markets, as well as the question of how much of the last-mile networks will be either substituted or amended by fiber.

This leads us to four extreme, yet plausible scenarios along these two dimensions, which we have developed in this study: Superconcentration, Mobile Dominance, Superfragmentation and Disaggregation.

In the Superconcentration scenario, the incumbent telco bets on fiber, wins it all, and leaves the other players behind. In the Mobile Dominance scenario, telcos play the mobile game, fostered by high-performance fiber backbones and high demand for applications that require tight integration of services and infrastructure. In the Superfragmentation scenario, aggregators dominate by selling network capacity to a fragmented crowd of ServCos in a complex landscape of hybrid infrastructures. In the Disaggregation scenario, fiber is king and monopolistic network island capacity is distributed by aggregators to a variety of ServCos, leading to decreasing end customer prices and a reduction in the digital divide between rural and urban areas.

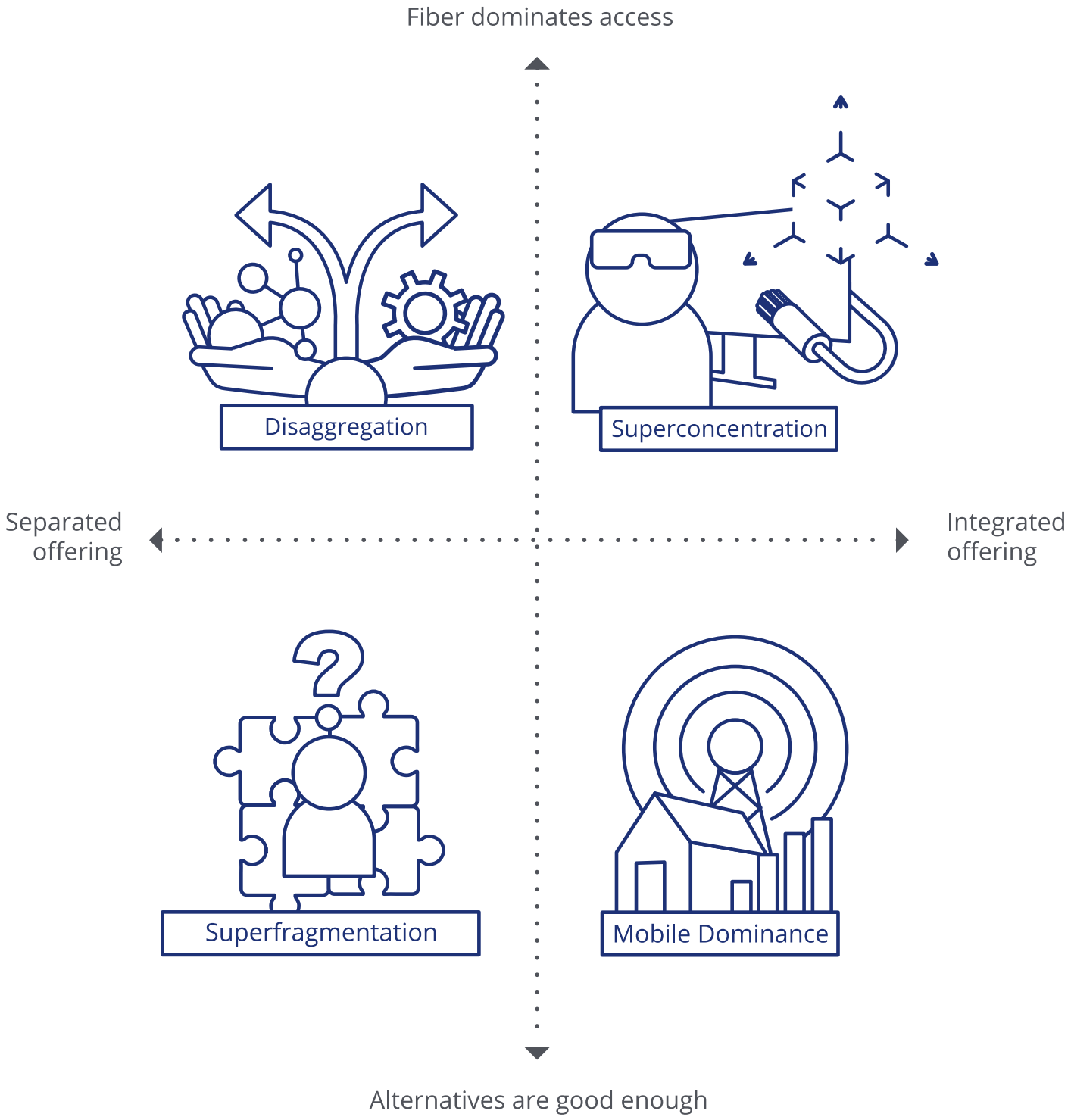
Each of these scenarios is possible but requires a certain set of assumptions to become true. To actively shape the infrastructure landscape of tomorrow, the key trigger points of each scenario have to be understood perfectly. This will be essential in order to react as early as possible, if not drive the change and proactively shape the market.

For all players in this exciting but complex market, the stability of their own strategy with regard to the scenarios developed can be tested and adjusted, if necessary, by answering some key questions:

- Do we want to incrementally upgrade our network, substitute it with fiber, or leave it to a new player?
- Are cooperation agreements part of our asset strategy? Should we extend our coverage to other players' infrastructure, or should we increase the utilization of our infrastructure, or both? Is our infrastructure ready to react flexibly to open access?
- Do we leverage our customer base, brand, and USPs well enough to fend off competitors' strategic moves?
- Are our marketing and sales strategies and processes suitable to allow for a setting where multiple ISPs perform customer acquisition on one underlying infrastructure?

Analyzing the resilience and competitiveness of your strategy with regard to the four scenarios will be crucial to profit from tomorrow's uncertainties.

Fig. 4 – Scenario overview for the future of fibre



Methodology

The methodology of this study is based on the proven scenario approach first employed by Shell and perfected by Monitor Deloitte. A seven-step scenario development approach applies the guiding scientific principles of objectivity, reliability, and validity. The study is the outcome of a series of interviews, questionnaires, and workshops involving TMT experts from the Deloitte Global network and industry professionals as well as experienced scenario practitioners from Deloitte's Center for the Long View (CLV).

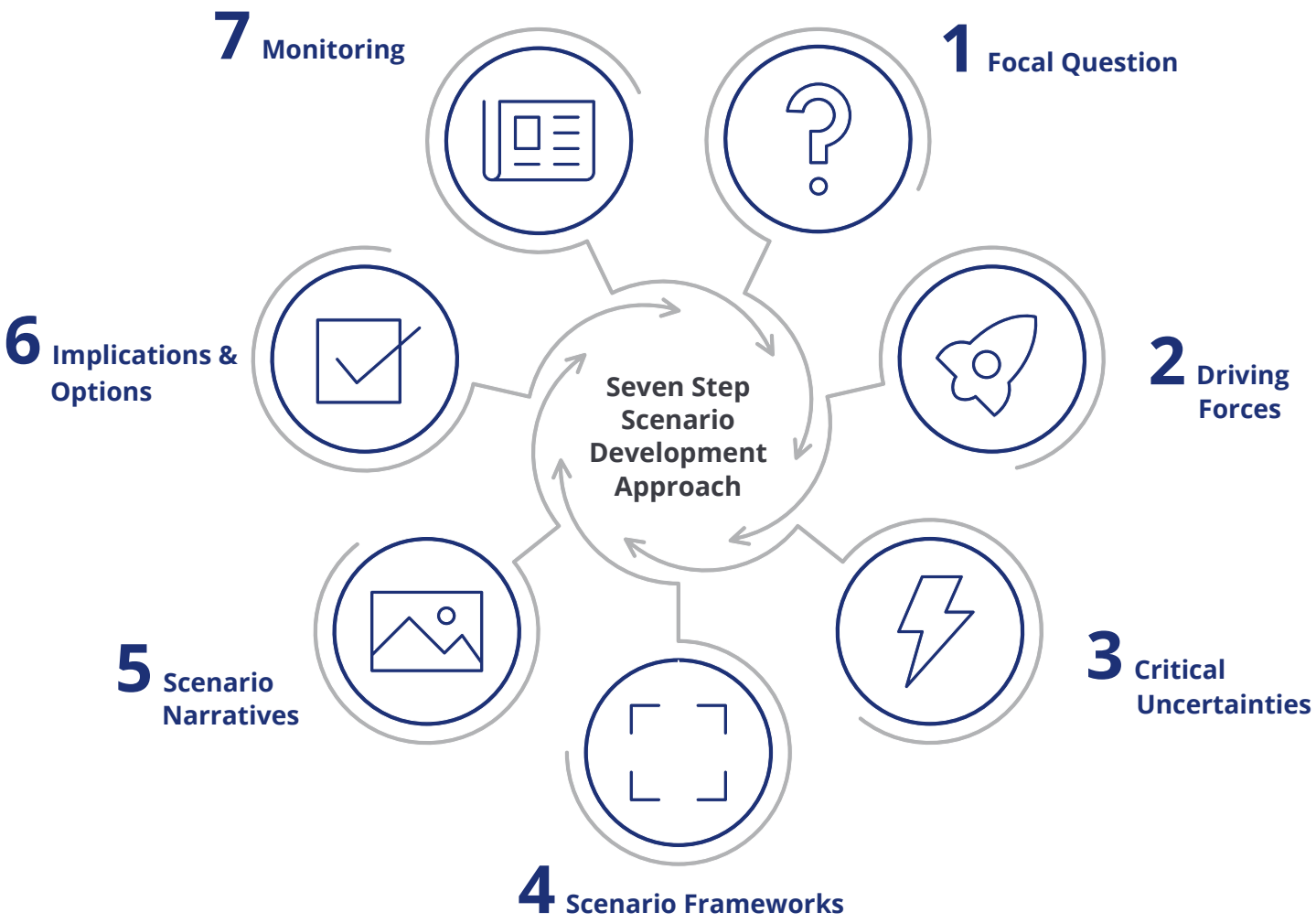
Scenario design starts by identifying the focal question of the underlying issue. Since we could tell an infinite number of different stories about the future of fiber, we first had to agree on the issue or strategic challenge we wanted to address. This enabled us to appropriately support decision-making for our clients. Scenarios are tools for shedding light on the strategic challenge, while the focal question sets the scope of the scenarios. In the present case, we focused on the question, "What will the future of fiber look like in 2030?"

Scenarios are a way of understanding the dynamics that shape the future. Therefore, in a second step, we pinpointed the forces that drive the focal question. Driving forces are fundamental sources of future change. They shape the course of events and history and dramatically enhance our ability to imagine future scenarios. These drivers can be grouped into five categories known as STEEP, as they consist of Social, Technological, Economical, Environmental, and Political factors. Since most issues involve more than one of these categories, they are only handles. In order to derive our driver list, we also conducted expert workshops using Deep View, an Artificial Intelligence (AI-) based trend-sensing and analysis machine. Deep View helps to avoid the bias of the traditional approach, which often has a built-in tendency based on the character, mood, or preferences of the scenarists.

As a part of the workshop series, in a third step we identified the critical uncertainties for the focal question. Not all driving forces are uncertain, some may be predetermined. These are the trends already in the pipeline, unlikely to vary significantly in any of the scenarios. Critical uncertainties are driving forces with the potential to tip the future in one direction or another. They have two fundamental characteristics: They have an unusually high impact and are uncommonly uncertain or volatile. Initially, all uncertainties appear unique, but by stepping back, we can reduce uncertainties to clusters that serve as the building blocks for creating our scenario sets.

The scenario framework was developed in the fourth step by focusing the entire list of related uncertainties into two orthogonal axes. We then defined a matrix consisting of crossing and independent axes that allowed us to define four very different quadrants of uncertainty. In the underlying study, we used the relevance of "fiber dominance in the last mile" and "separation of infrastructure and services" as critical uncertainties and developed four distinct, yet plausible future scenarios.

The CLV scenario approach includes two further steps that help enterprises make use of the defined scenarios: Developing strategic options and monitoring the scenarios. We use the scenarios to derive consequences for market stakeholders, in this case creative agencies and media companies, for example. Existing strategies are tested against each scenario and adjusted where necessary. Here, we apply proven Monitor Deloitte methodologies to identify, dissect, and analyze businesses' strategies. At the same time, new strategic options are formulated that are suitable for all or for individual scenarios. As it is important to provide long-term scenario monitoring in order to ensure the validity of defined strategic options, we have developed CLV Gnosis. This is an AI-based modular tool that tracks movements toward individual scenarios in real time and indicates where the future is heading.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3 Critical Uncertainties
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