DIGITAL TELCO 2030

DETECON
CONSULTING

Preface

Dear Readers,

These are not exactly small packages that managers in the telecommunications industry are currently shouldering.

Digitization competition in particular is having a massive impact on the position of telecommunications companies. They have a special role to play because, on the one hand, they themselves have to work intensively to exploit opportunities for themselves, manage risks and take consistent steps in the direction of a "Digital Telco". On the other hand, they provide the infrastructure for nationwide data transmission and data processing and thus form the indispensable basis for the digitization of other industries and entire national economies.

Digital maturity is therefore becoming a central field of action. Digitization as a lever for increasing efficiency is one side of the coin. The other side concerns the optimization of existing business models and the opportunity to tap previously untapped value creation potential. To be able to recognize and implement these opportunities, telecommunications companies must increase their digital maturity. The prerequisite for this is a deep understanding of the dynamics of competition rules in the digital space, but also the ability to build up and expand the resources a company needs to be able to realize opportunities at all.

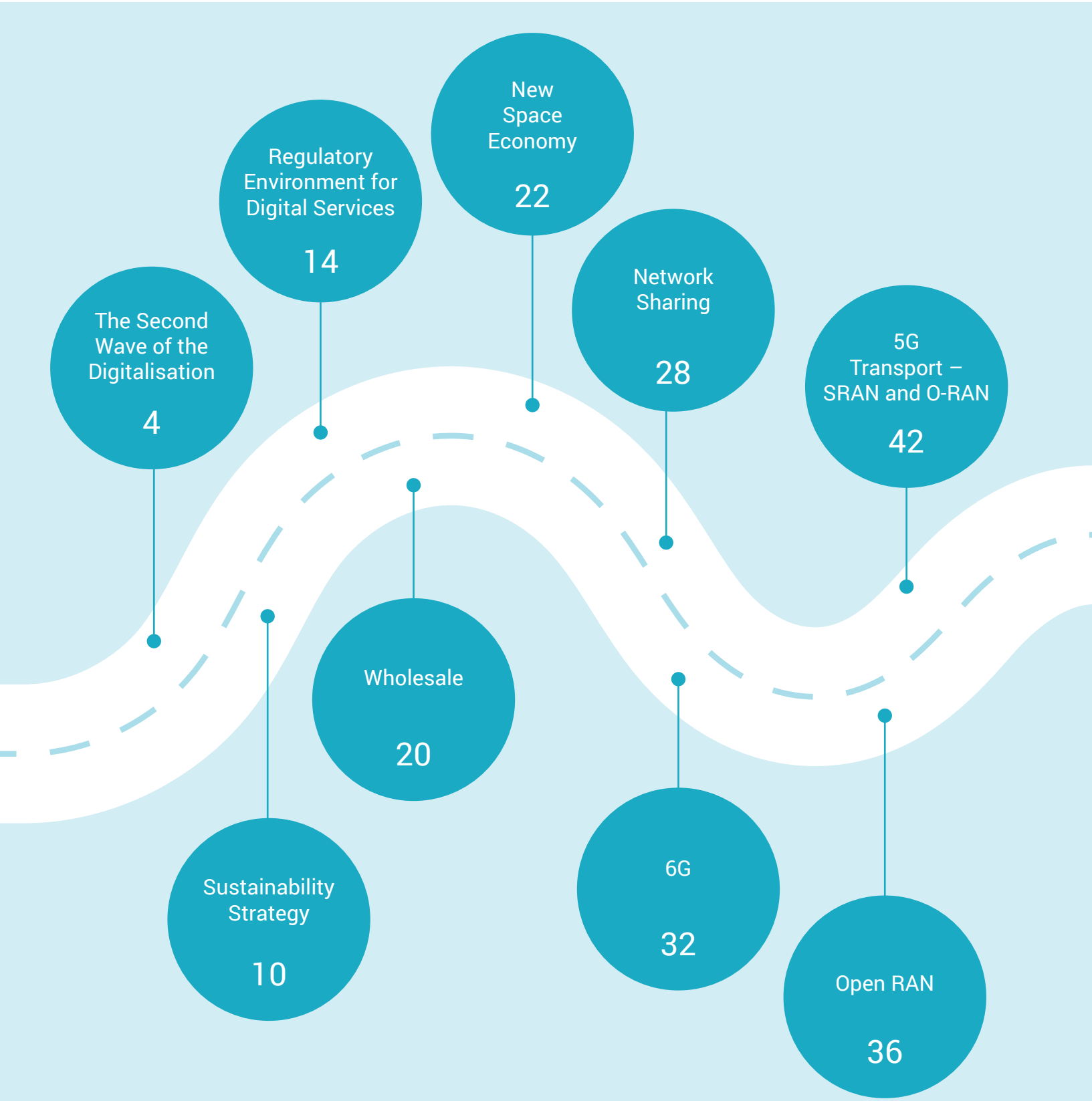
2030 will be a significant milestone on the way to a "Digital Telco". We agree with Immanuel Kant: "Only the aimless suffer their fate; the goal-oriented shape it." In our usual manner, we again take a look at the relevant fields of action for telcos in this publication. These range from the efficient provision of the required network coverage and network capacity, the softwareization and cloudification of the networks, and the options for building partnerships and eco-systems at various stages of the value chain, to examples of a successful product and service portfolio, skills management, and measures for climate protection.

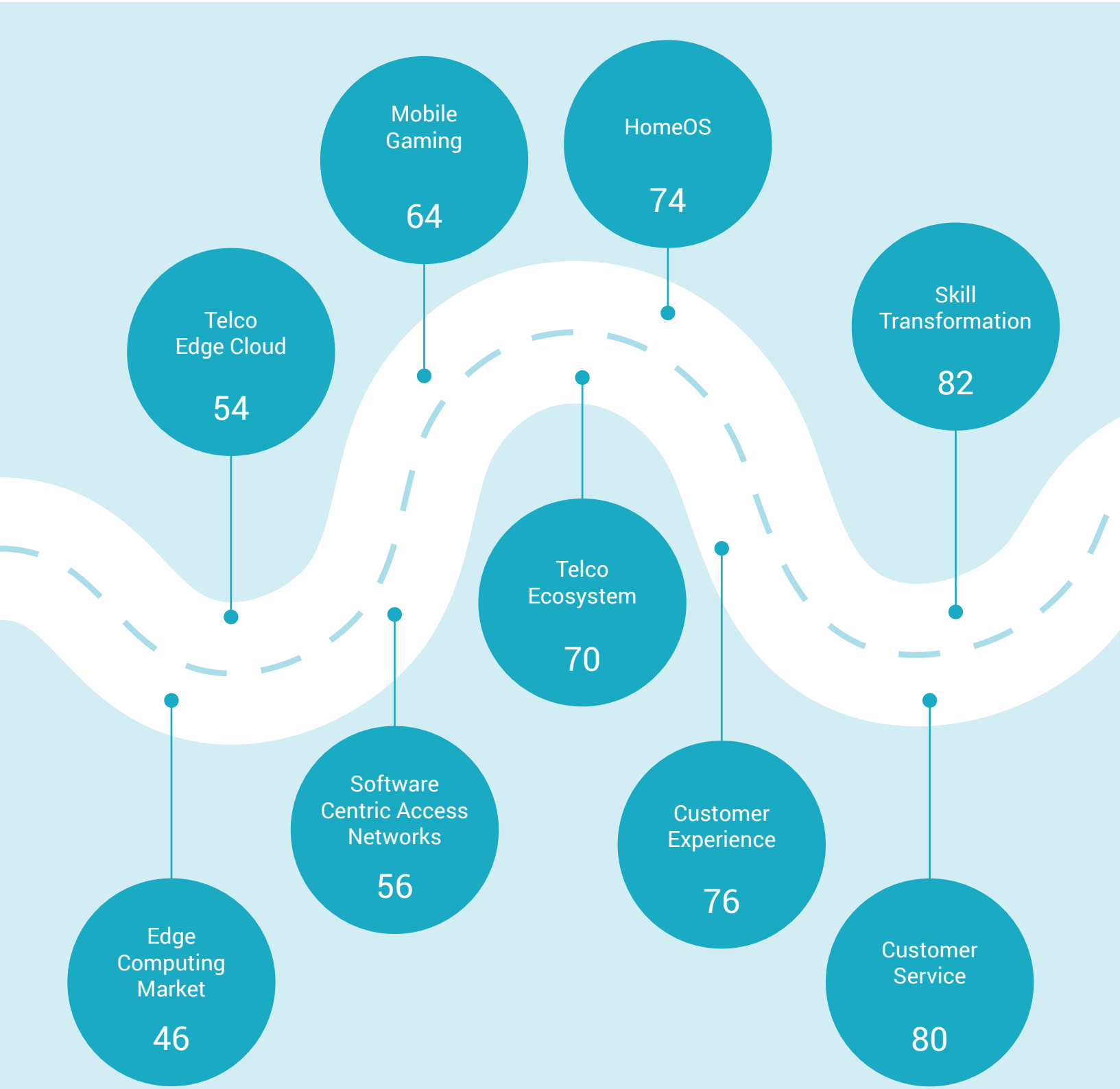
I wish you an equally informative and entertaining read.

Sincerely yours,

Ralf Pichler
CEO Detecon International GmbH

Digital Telco 2030 Roadmap




Mobile Gaming
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HomeOS
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The Second Wave of Digitalization Competition Is Generating Momentum for Telcos

In day-to-day business, focus is mostly on short- to medium-term actions and developments. In all the hustle and bustle, it is easy to lose sight of the extensive market changes in the telecommunications industry. If we step back and view events over the course of time, we see that even seemingly dominating developments such as the enormous market power of many hyperscalers are not immutable.

Change in the competitive framework

The tremendous depth of the penetration of digital services into almost all facets of our lives and business activities over the last decade has had further decisive effects; all of us – whether we use digital services when acting as entrepreneurs, employees, politicians, or business or private users – are becoming increasingly aware of their power and profound structural impact.

The crucial shift in comparison with the past: this realization is gaining broad acceptance across the many classes of social and political stakeholders and influencing concrete political and corporate actions more than ever before. The plethora of various initiatives of the moment at political as well business levels clearly demonstrate this.

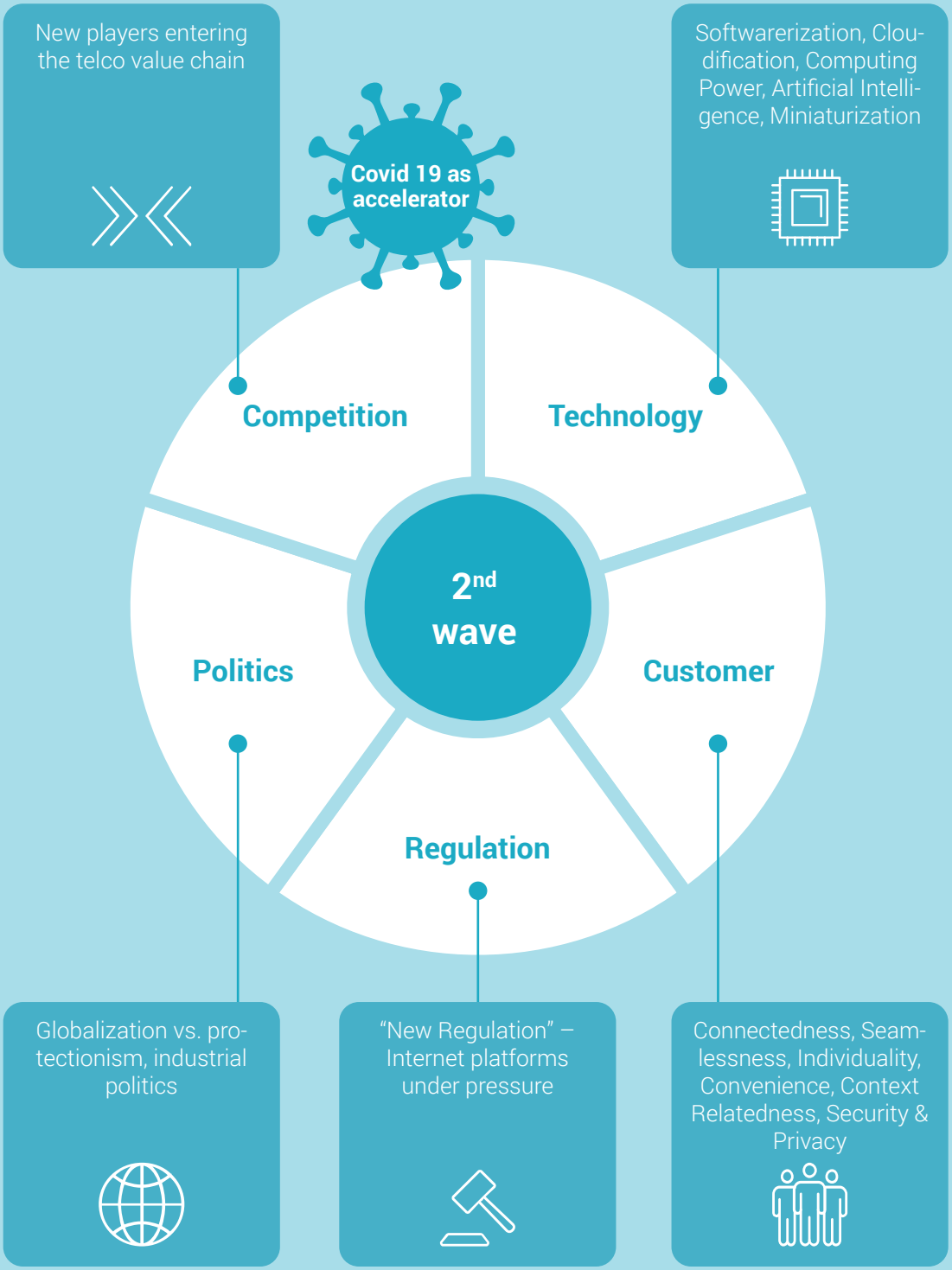
The consequence for telcos is that they will (once again) see profound changes in the competitive framework for all market players.

> Life today is unimaginable without what was unthinkable the day before yesterday – and so we must think ahead to the day after tomorrow.

2nd wave: regulated race for Gigabit Societies

- Successful mastering of chances and risks of digitization and respective technologies decides over welfare of nations
- Technologies and business models become subject of industrial politics
- Security, public control, ethical aspects will gain relevance
- Digital and platform business model will be subject to strict regulation
- New players at the horizon entering the telco value chain
- Covid-19 as accelerator

Six drivers with significant impact on momentum



The drivers behind the 2nd wave of digitization competition

Five theses about the future

Telecommunications companies, like all other sectors of the economy, are subject to digitalization competition. Their role, however, is a special one. To begin with, they must themselves work intensively on exploiting the opportunities associated with digitalization and managing the risks as well as taking determined steps toward becoming a "Digital Telco." Yet they must also provide the indispensable basis for the digitalization of other industries and entire national economies: their infrastructures for full-area coverage of data transmission and data processing.

How do the above-mentioned drivers of digitalization competition affect the position of telcos in the marketplace? Five theses sum up our view of the future.

1. Telcos will undergo a consolidation process over the next several years.

In Europe, where more than 100 network operators are active in an economic area of approximately 500 million inhabitants, there will be a rise in the number of international mergers alongside consolidation measures within the countries. This process will be driven above all by economic constraints. The huge investments in broadband infrastructures that are required while maintaining stability or even a reduction in end-customer prices will place a heavy burden on the earnings position and force network operators to ramp up cooperation or consolidation.

There will be between two and a maximum of three nationwide network operators in each country. Ultimately, a handful of telco groups will be left standing in Europe in the future. The process will start with cooperation agreements in the network sector (for instance, tower sharing, network sharing, joint ventures for network expansion) and end with the joint development and provision of services on the wholesale and/or retail market. Smaller carriers with a weaker market position or late entries will seek their salvation in close cooperation with the hyperscalers, see the example of AWS and Dish in the USA, or merge with other carriers. The possibility that hyperscalers will try to acquire participations in telcos to secure exclusive cooperation positions for themselves cannot be ruled out.

2. Telcos able to realize or maintain a vertically integrated business model for all customer segments will be few and far between.

The process of the disintegration of the traditional telco added-value chain will continue. The field of competition will continue to split into various branches. There will be focused providers who cherry-pick specific components of the added-value chain for themselves.

3. Many telcos will lose their end-customer contact to the hyperscalers and concentrate on a wholesale business model.

The process will extend to the traditional provision of lines service, beginning with the large international corporate customers, campus networks, or in the IoT sector and expanding step by step to engulf the smaller customers as well. Telcos' dependence on hyperscalers will be manageable, however, as new regulatory frameworks, such as DMA and DSA in the EU, demand interoperability, open access, and data portability while blocking lock-in tendencies.

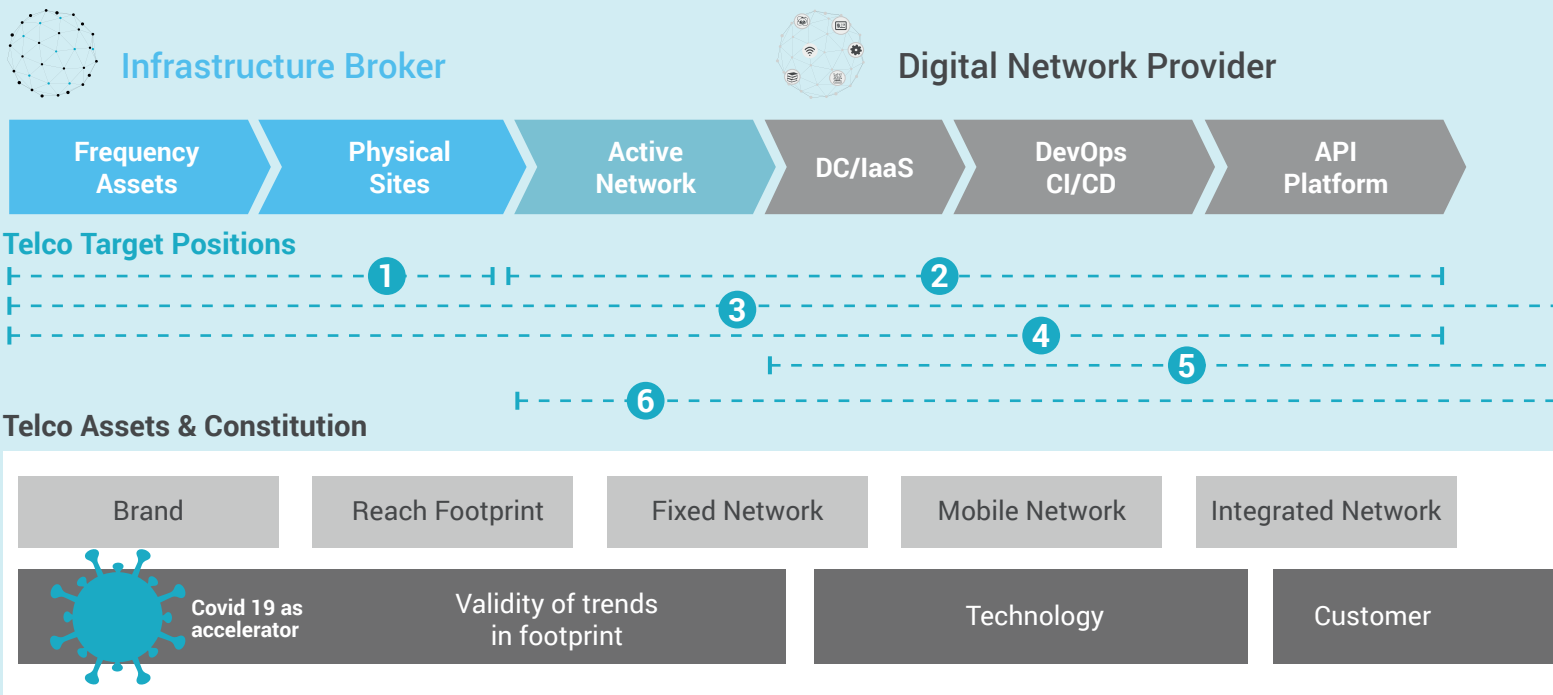
4. A small number of telcos will have a chance to compete on an equal footing with hyperscalers and retain their end-customer contact at the service level.

The prerequisite for their success, however, is that they possess certain assets and capabilities and that they show determination in strengthening and leveraging these qualities in the time remaining to them. These telcos must be able to operate in ecosystems and partnerships at all stages of the added-value chain. Their presence on the end-customer side will be secured by services from a partner ecosystem that includes hyperscalers and by innovative, convergent services they have developed themselves and that, in contrast to the services provided by hyperscalers, have a primarily national or local scale.

In the setting of the drivers outlined above, new opportunities beyond connectivity alone will arise. Security solutions, cloud products, IoT, campus solutions, smart city, e-learning, and collaboration platforms are among the possible candidates. Opportunities for new services or the revitalization of existing services may arise from new regulatory developments or from industrial policy initiatives such as the European GAIA-X. Partnerships and participation in continental and regional ecosystems will create prospects for topline growth and customer retention in these and other sectors. Nevertheless, the necessity for massive efforts to optimize the customer experience across all touchpoints cannot be denied.

5. Telcos must put their trust in greenfield approaches and take radical steps in good time to achieve the required efficiency, automation, and flexibility in internal service delivery.

Incremental further development of existing IT systems, processes, or network architectures takes too long, is too complex, and does not create the essential freedom of action.



Dr. Peter Krüssel I Managing Partner

„The drivers of the second wave of digitization competition are reaching a culmination point that will redefine the rules of the game among the players. Telcos face fundamental decisions regarding their business model."

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Clemens Aumann I Managing Consultant

„Infrastructure is the business essence of telcos – but the huge range and diversity of demand leaves plenty of room to carriers to develop and harvest on (multi-)national business opportunities."

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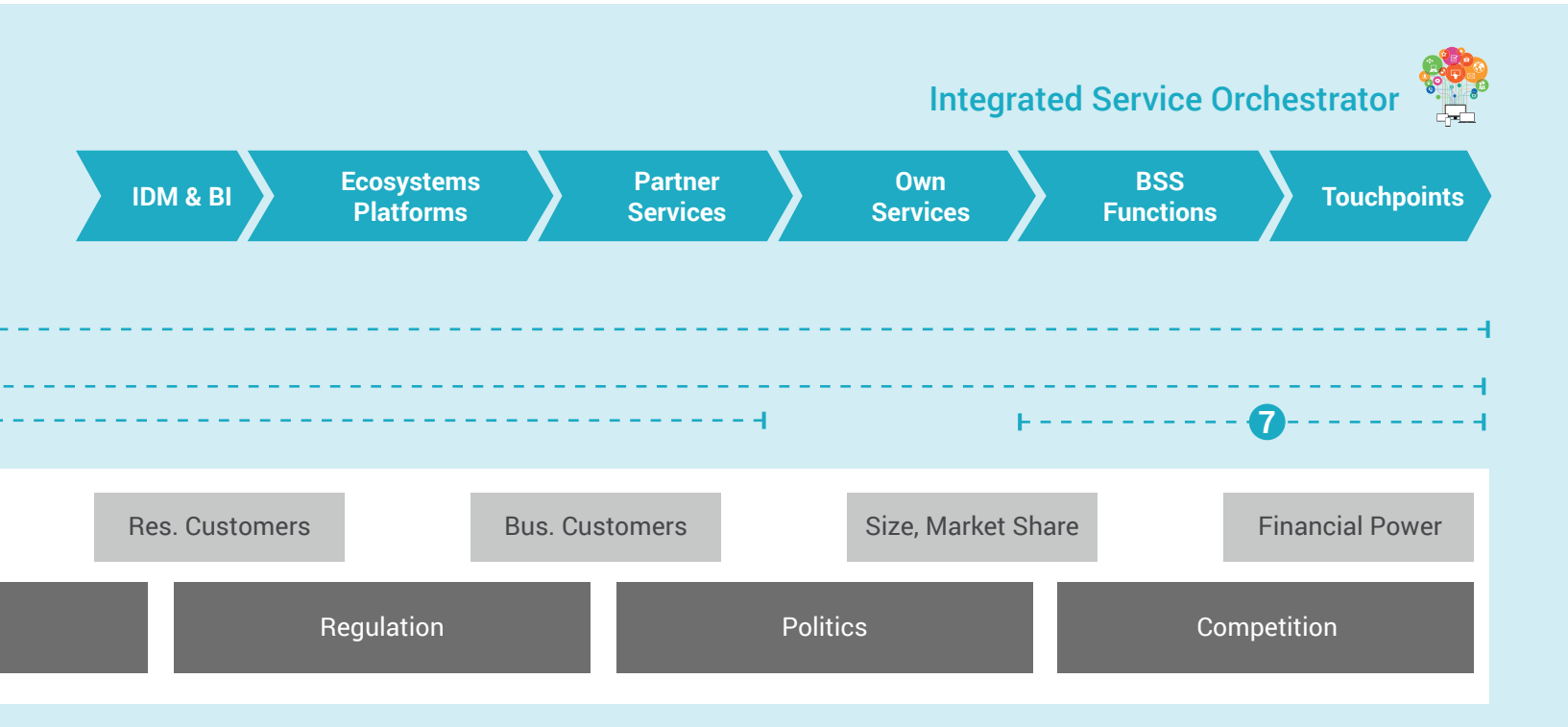
Positioning alternatives

Ultimately, network operators will have two fundamental choices:

- "Infrastructure broker," operations that tend to be oriented more closely to infrastructure
- "Integrated service orchestrator," operating on the basis of a business model that continues to include the service level and end customer contact.

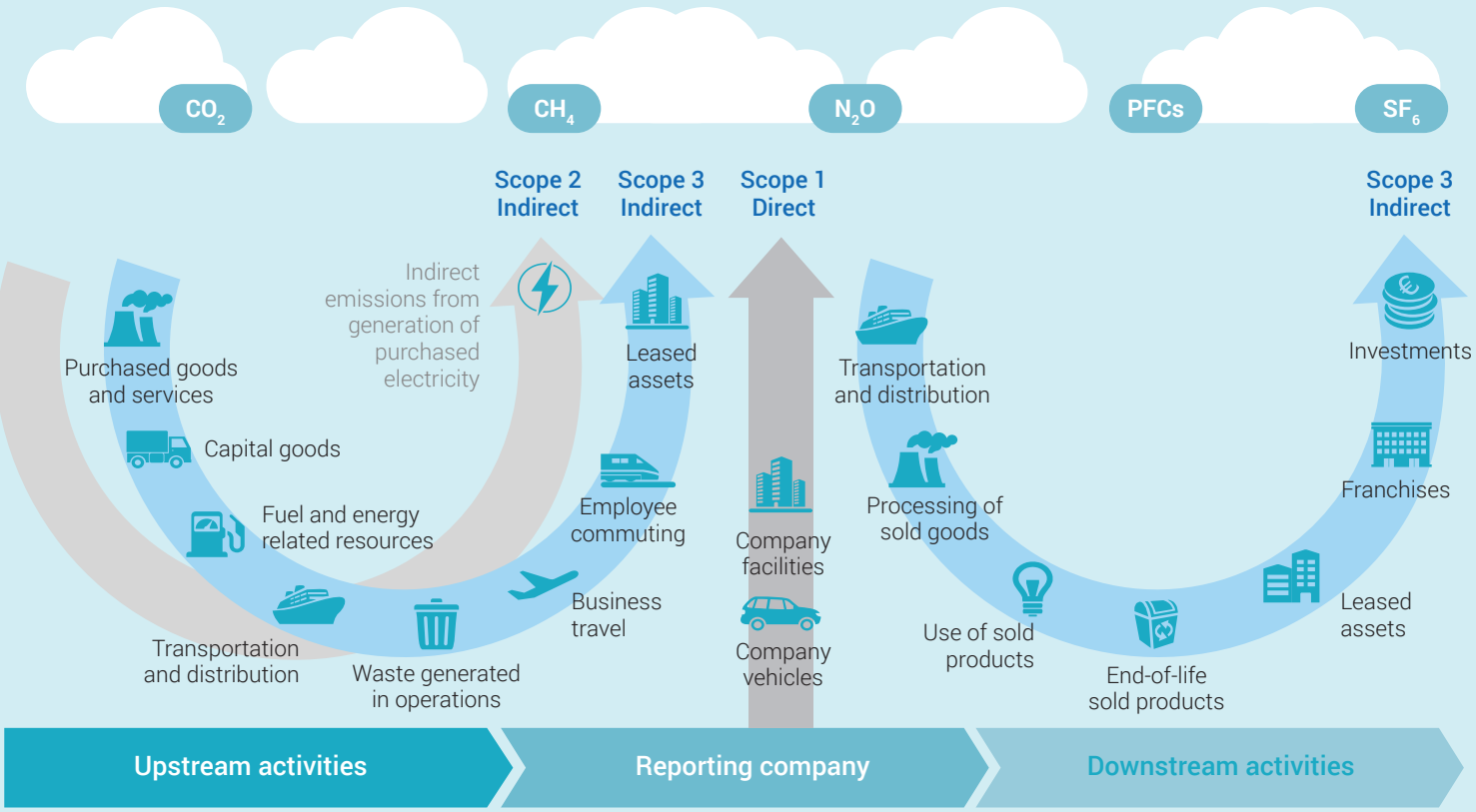
The various positioning options can be mapped along an added-value chain between end points defined as the extremes of these two positioning alternatives. Which of the options – including the possibilities between these two extremes – come into question for individual carriers depends largely on the concrete manifestation and intensity of the above-mentioned drivers on their specific markets as well as the available assets and ambitions of the telcos.



Focus Shifts in Sustainability Strategy

Sustainability has become an important part of every company's strategy in recent years; the first noticeable effects of climate change, the ever-increasing demand for resources, and the rapid acceleration of digitalization are imparting ever greater urgency to the topic even now, and this sense of urgency will continue to grow in the future. Investors, consumers, legislators, and society as a whole are putting increasing pressure on companies to do their part to avert the impending climate crisis. Over the next nine years, the significance of the topic will continue to rise while five shifts in focus will take center stage.

The Greenhouse Gas Protocol (GHG) reporting standards



Source: Greenhouse Gas Protocol

1. Moving from Scopes 1 and 2 to Scope 3 emissions

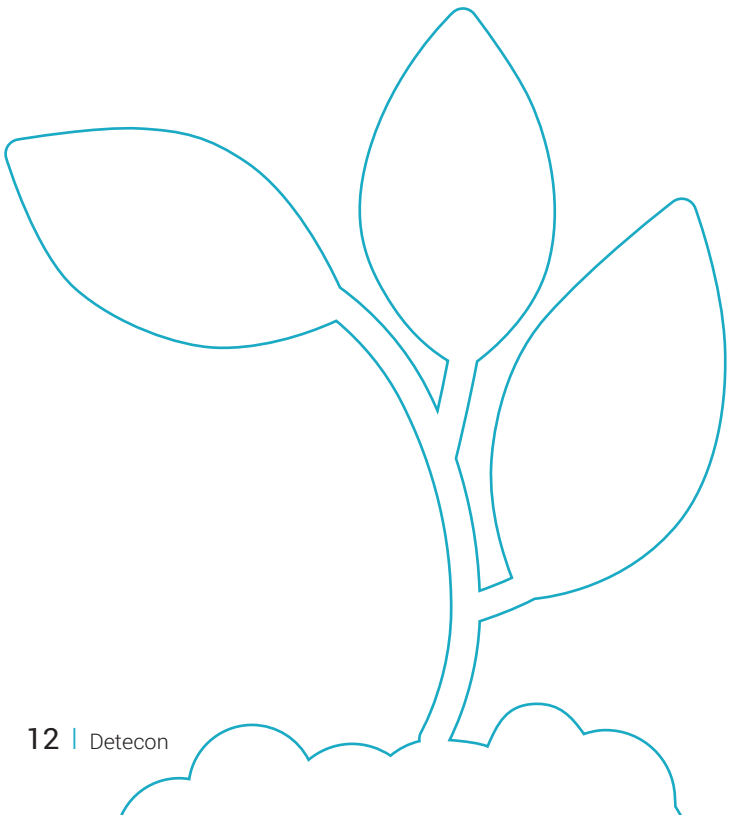
By the end of this decade, most telco companies will have achieved carbon neutrality in their Scopes 1 and 2 emissions. While a lot of telco companies originally set their carbon neutrality goals for 2035 or 2040, these targets have been pulled forward in recent years, and the continuation of this trend will lead to a mostly carbon-neutral industry in 2030.

In consequence, the focus in 2030 will be on Scope 3 emissions. Some operators are already beginning to address the topic by regarding more and more closely the impact of their products at the level of households and industrial clients. The primary questions here should not be limited to the measures required to make products and services energy- and resource-efficient, but encompass as well helping customers to save energy and resources so that they live and work more sustainably.

As the share of renewable energies in the overall energy mix continues to grow and more and more links of the supply chains set a target of 100 percent for the use of renewables, attention is shifting to the CO_2 footprint for the extraction and processing of resources. The use of renewable energy in operational activities will generally be taken for granted and no longer be a major focus of sustainability measures. Instead, the production of all telco-related hardware — from the network architecture to consumer devices — and the full length of its supply chain will concentrate primarily on resource efficiency, circular design, and the recycling of discarded equipment.

2. Energy efficiency indispensable for the energy transition

Although the energy transition will be well underway by 2030 and a lot of companies will be covering almost all their energy requirements from renewable energy sources, total energy demand will continue to rise, putting the worldwide energy transition at risk. Counteracting this risk will demand an increase in energy efficiency of several orders of magnitude. Telco operators have significant energy demands and will have to find ways to become more energy-efficient at every level of their operations. Similar to the issue of emissions, they will need to consider carefully up- and downstream activities. How can routers, access points, consumer devices, and the production and sourcing of these devices be designed to consume the lowest amount of energy possible? As IoT devices and connected devices are implemented in every phase of production and logistics, longevity and energy requirements of these devices must be optimized as well to make sure that they do not negate the sustainability and efficiency gains they promise.



3. Managing an increasing demand for resources

Demand for resources will skyrocket — even if the adoption of IoT devices is not taken into account. Because of the development of 5G (and 6G), the growth in satellite internet services such as Starlink, and the laying of millions of kilometers of new optic fiber cables underground, the demand for resources and their use in the telco industry will increase significantly. Since there will certainly be parallel rises in prices, efficiency in the exploitation of resources and the reusability of employed resources will become even more important. The benefit of a technology and its use cases must be very clear, and the right solution and technology must be chosen for every new access point on the basis of a resource use-benefit analysis and energy consumption and not solely on the criteria of technological feasibility and price.

What is the right solution for each specific situation? Can we really afford to accept the destruction of the low-orbit satellites required solely to provide service to remote areas along with all the resources they contain every five to seven years (the expected lifetime of these satellites), just to give one example? Or would "traditional" mobile access with upgradeable and recyclable access points be the initially more resource-intensive, but more sustainable option? Which 5G and 6G frequency bands offer the best trade-off between the number of antennas that must be installed and the latency and possible traffic for what area and use case? These are only some of the questions that will inevitably confront telcos in 2030.

4. The end of the traditional annual smartphone upgrades

Another important question impacts directly the business model of a typical operator: how to service customers in a world where constant connectivity is expected and most device upgrades and new features will be provided in the form of software rather than hardware. The classic business model of selling consumers a new device every year with incremental upgrades to the hardware is doomed to extinction. Consumers will choose a relatively pricey, resource-intensive hardware device based on their individual requirements (rollable/foldable screen, weight, size adaptability for different tasks) once and expect to be able to use it for several years, perhaps even decades. Repairability, upgradeability, computing power as a service, and other factors will be more important than screen resolution or camera sensor size. New features and improvements will still be expected, but as software rather than hardware updates.

5. Actually realizing development goals

The Sustainable Development Goals (SDGs) of the UN set ambitious targets for the global community intended to improve the world we live in and, among other objectives, eradicate poverty and hunger by 2030. They have been incorporated into sustainability reporting by many companies in recent years. For many companies, the integration of the SDGs into their strategy policies has been little more than lip service. Often enough, previously existing initiatives and social projects have simply been aligned to the more or less matching goals and included in the sustainability report to make a good PR story. The progress in these goals is continuously measured by the UN, and what has actually been achieved will become clear in 2030. As it is likely that not all goals will have been completely reached by then, new revised goals will follow and the importance of companies and their actions in achieving these goals will only increase. Telco operators are uniquely positioned to make major contributions to meeting these targets. The spread of digitalization and the services they provide can facilitate the essential public-private partnerships and can aid in the implementation of tools used to make progress toward almost every goal and subgoal. Telco operators wishing to truly commit to achievement of the goals should measure their actual impact on the SDGs and the latter's potential successors and actively use these impact measurements to develop new solutions that are marketed to the public and private sectors alike.

Jonas Kowalski I Consultant

"Sustainability will become a more integral and more important part of every operator's strategy."

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Pillars of an Enabling Regulatory Environment for Digital Services

Digital regulation refers to legal and regulatory measures to address challenges brought about by digital transformation with the aim of creating an enabling environment for a thriving economy of digital services and products.

Digital services encompass a wide range of economic activities that take place online. Some are completely unrelated to communications. Others consist in transmitting signals over a communication network or in providing access to a communication network.

Regulating the digital sector in 2030 – two major challenges

1. Keep up with the pace of technological development

Regulation generally lags behind technological developments. Be attentive and continuously strive to find the best possible way to create favorable conditions for digital business development, taking into consideration international regulatory trends.

2. Create an enabling regulatory environment

The key lies in finding a healthy balance between promoting innovation and protecting consumers' interests, while allowing also the State to reap sufficient benefit from the technological advances in terms of fiscal resources and administrative opportunities.

Key regulatory issues for a thriving digital economy

Institutional framework for in a digital environment

- A more flexible approach is needed. Reconsider traditional sector-specific or domain-specific institutional setup for regulating activities.
- Where local specificities do not warrant sector-specific structures, dedicated agencies to be considered to respond in a cross-cutting manner to regulatory issues.

Secure a trusted and transparent digital environment

- Define cross-cutting rules that apply to all categories of digital content.
- Establish transparency requirements as well as due diligence obligations.
- Specify conditions for liability of market players with regard to illegal third-party content and obligations to take measures against illegal content online.

Secure a fair and competitive digital environment

- Competition policies must satisfy specific requirements of the digital ecosystem. The advent of converged or unregulated players operating across national borders has challenged traditional solutions.
- M&A assessments need to expand their evaluation of market power to include access to consumer data and the necessary algorithms for data analyze and use.
- Special attention on preventing dominant players from abusing their dominant position against businesses and consumers.
- Government authorities should be given the power to address structural competition problems and to impose behavioral or even structural remedies without the need to make any finding of an infringement of the competition rules.

Promote data-driven businesses

- Create an enabling environment for data sharing and support the development of a trusted data space. This could create new business opportunities for new providers of data sharing services.
- Reconsidering data localization requirements (requirement to store data locally), which very often constitute an obstacle to free movement of data, could be a key.

Secure consumer protection

- Strike a fine balance between the protection of consumers' personal data on the one hand and the facilitation of cross-border data flows, new business models, and new digital services on the other.
- Support the safe expansion of digital services by incorporating relevant provisions on consumer protection, effective procedures for processing complaints, and the heightening of consumer awareness including information and education about consumer-related issues.

Address tax-related issues

- Preference to balanced, harmonized and transparency approaches, integrating national and international tools.
- Avoid excessive burdens on stakeholders and focus on affordability for consumers.
- Promote innovation and effective competition among all sector stakeholders.

Consider cybersecurity

- Keep realistic expectations regarding the capacity for action of the regulatory system.
- Make sure that regulatory frameworks reflect the evolution of cyber threats and encourage security to be integrated into 5G technology to enable effective and safe use of the technology by people and businesses.
- 5G infrastructure must be resilient and completely secure from technical or legal deficiencies.

Consider regulatory challenges relating to IPR protection

- The reproducible nature of digital goods complicates IPR protection.
- IPR approach to consider both qualitative, e.g. intended economic or commercial advantage, and quantitative, e.g. number and scope of breaches involved in the case, aspects.

Good to know — ongoing international initiatives for digital regulation (EU and others)

Regulators around the world (e.g. EU, Germany, UK, USA, Australia and China) are designing answers to challenges of the 4th Industrial Revolution. A look in the EU reveals that ongoing efforts include amongst others these four (4) proposals:

- Digital Services Act (DSA)
- Digital Market Act (DMA)
- New Competition Tool (NCT)
- Data Governance Act (DGA)

Implications for the electronic communications sector ...

Toward a new era of regulation

Through more "collaborative" regulation. Solutions range from minimalist approaches to much more substantial interventions requiring legislative changes. Achieve an appropriate level of international and regional harmonization, integrating best regulatory practices.

Digital services vs. electronic communications services

Besides sector-specific rules for electronic communications services, the regulations on digital (online) services also apply to telcos insofar as they provide digital services.

Institutional regulatory framework

National regulatory authorities (NRAs) need to act as sector facilitator and partner in the promotion of digital markets. Where different national institutions have responsibilities for different aspects, they should interact to avoid ”cannibalization” and hindering of the momentum of innovations.

Market entry (licensing)

Flexibility and dynamism are essential features of any licensing regime. Unified licenses or general authorizations are preferable to service-specific licenses. The need to combine mobile technologies with optical fiber for 5G backhaul rollout demands that eventual exclusivity of incumbent operators be reevaluated at least for cases where the incumbent operator fails to satisfy market demand.

Promote competition

The key lies in the ability of the regulatory framework to protect all economic players “in competition” rather than to protect some of these players “from competition”. As markets is still developing, regulatory caution is required. The most appropriate approach is a case-by-case assessment while taking into account cross-border and inter-sectoral aspects.

Business-supportive spectrum management

Spectrum is a major enabler of growth of the digital economy. Policymakers should work to harmonize the global spectrum framework for 5G. The combined use of licensed, unlicensed spectrum and spectrum sharing can help to create a balanced spectrum ecosystem that would encourage investment and efficient use of spectrum and promotes competition. A clear medium and long-term roadmap is essential to give investors certainty.

Address infrastructure sharing

Sharing of passive or active infrastructure, international sharing (international gateways and submarine cable landing stations), functional separation, and spectrum sharing are some of the options that should be considered in the electronic communications sector.

Ensure universal service and access

The universal service regime can be an appropriate complementary instrument for achieving broadband Internet access for all. Such an approach would require dealing with the scope of access and universal service, the establishment of an access and universal service fund, the means of financing it, obligations relating to access and universal service and the means of enforcing them. For many countries where the ambition of a 5G for all is not realistic in the short and medium term, "3G/4G for all" should be considered.

Facilitate 5G networks

A multidimensional approach that includes regulatory and other measures is required. The main regulatory issues relate to the need for adequate spectrum, deployment of small cells for 5G, constraints to the deployment of the fiber backhaul network, and the facilitating role of political decision-makers and regulatory authorities. In terms of measures beyond the scope of regulation, transitional measures should be considered by NRAs to facilitate the launch of startups with 5G – for example, facilitation of procedures or exemption from certain obligations, e.g., need for licensing or regulatory charges, for a certain period.

Albert Njoume Ekango I Managing Consultant

"While there is no panacea for digital regulation, it conditions the fate of the digital sector. If properly designed, digital regulation is the key enabler for a dynamic, inclusive and secure digital sector."

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Telco as a Platform & Co-opetition

Three questions for Federico Homberg, Deutsche Telekom

The next few years will see a lot of changes on highly competitive markets. If future regulations do not have too great an impact on NB-IoT, LTE-M, or campus networks, these markets have great potential. Detecon Senior Consultant Alexandru Banu asked Frederico Homberg, Deutsche Telekom, three questions about his point of view on the new telco game.

Expected worldwide-aggregated effect of 5G

$

13.1

TRILLION

Enabling a broad set of industries

The growth trajectory of sales enabled by 5G remains virtually unchanged, reaching $13.1T in 2035, despite the downshift in the long term growth trajectory of the overall global economic output caused by the pandemic

Source: qualcomm.com

Federico Homberg is the head of Business Development & Innovation at Deutsche Telekom Global Carrier. In this role, he is in charge of the development and realization of growth opportunities in international wholesale. In addition, he assesses the potential of new technologies revolving around 5G SA, the virtualization of network functions, software-defined networks, XaaS, or the delivery of new wholesale products via APIs. Prior to joining International Mobile Wholesale, Federico worked in multiple positions at Deutsche Telecom, including International Mobile Wholesale, Group Business Development, and Group Strategy. Before joining Deutsche Telekom, Federico worked as a management consultant. Federico holds an MBA from the University of Mannheim.

1

What overall developments do you see happening in wholesale in the coming years?

Wholesale will become increasingly important! There are three primary reasons backing up this statement. Owing to their relatively small footprints in comparison with OTTs, telcos cannot hope to match the scale of these providers at the application/service level, e.g., by buying or even producing their own TV content. The key to their future success will be found in cooperation with other wholesale carriers and OTTS in selected areas, enabling them to offer a global footprint and, more importantly, to offer end-to-end products to customers. The keyword here for carriers is "co-opetition".

2

What form do you expect future wholesale partnerships to take in the light of important topics such as 5G network rollout?

5G is only one element. Other developments such as the virtualization of network elements and softwarization open the door to communications products featuring highly flexible programming that can be delivered to customers via microservices and APIs. This will allow carriers to offer their own connectivity and services as well as to aggregate partner connectivity and services under one roof so that they can act as a platform — just as Amazon is a platform for both its own products and partner products. Carriers become networks of networks.

3

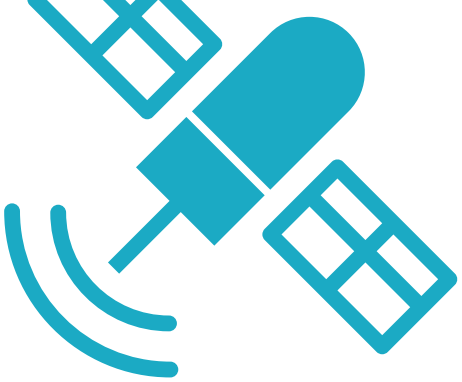
2030 is far away. If, however, you were asked to name the key drivers from the content market that you think may have an impact on the industry nine years from now, what would your response be?

One direction in which carriers are already heading is a shift from dedicated to software-driven carrier solutions. Silo voice, data, and messaging services previously produced in different network stacks will be replaced more and more frequently by IP-based services capable of producing all kinds of services. For instance, previously central firewalls will be replaced by context-aware application security (zero trust network, secure access service edge). While "mobile" is basically best effort today, in the future we will have context-aware QoS enabled by dedicated network slices. This context awareness will generate an entirely new selling proposition for carriers: from selling bandwidth to selling customer experience where every device is served by precisely the connectivity it needs. Dynamic and context-aware, from dumb and passive to smart and active.

INTERVIEW.

New Space Economy – a European Perspective

"A New Space Economy on the Edge of Liftoff" – this is the headline on Morgan Stanley´s web page on the occasion of the first successful messages from NASA´s Mars Rover Perseverance, February 2021. Such spectacular events are – of course – characteristic for the space business not only recently but also in the past decades. But things are now different: a new global transition phase is taking place where the space industry players, roles and methodologies are changing. This is covering all areas of the space business including launch systems, new types of satellites, earth and deep space exploration, navigation and last but not least telecommunication.



"Connecting the unconnected" is a slogan that everybody understands in relation to satellite based communication systems. Many attempts in the past have tried to solve this obvious problem but only recent developments in the frame of the New Space Economy have opened the doors to much more promising approaches – the most spectacular actually is Elon Musk´s Starlink constellation, an assembly of thousands of medium size high capacity satellites in low earth orbits covering the whole earth with broadband low latency Internet.

Global unconstrained Connectivity – the Magic Key in 2030

This does not only address unserved users in 3rd world countries on the earth`s surface but also has created a tremendous response in still underserved areas in developing countries – as we all know, we have too many of them. But even Elon Musk has only made a single step towards an even brighter future.

Whereas Starlink´s user terminals still are quite special and fixed, the true progress and breakthrough will come with constellations designed in such a way that the satellites can be accessed with any mobile device with reasonable performance. Simply spoken, we are talking here about a 5G/6G base station cluster "in the sky", a solution that can be realized with low flying satellites or with stratospheric airplanes (drones) or balloons commonly referred to as "Non Terrestrial Networks". Standardization activities are underway integrating such solutions seamlessly in a 5G/6G environment. The user will not recognize whether he is connected to a terrestrial or spaceborne base station but will experience a much better coverage leveraging on additional signals "from above".

Terrestrial Networks – the Limiting Factors

The key question for a terrestrial network is the maximum possible area coverage. In the past, terrestrial network performance was mainly focusing on increasing the data rates as much as possible for fixed and mobile applications.

But coverage is of at least equal importance particularly for a set of innovative applications. With increasing buildout of networks, the remaining coverage holes are

more and more difficult to close. This has economical and administrative reasons as long as we talk about fiber buildout and is constrained by physical aspects for wireless mobile networks.

Even more: with forthcoming mobile network generations (5G/6G) these limitations will increase due to the extensive utilization of higher frequencies which are counterproductive for a good base station visibility. Consequently, the prediction for the next decade will be that a considerable amount of coverage holes will continue to exist as long as terrestrial coverage only is considered.

Benchmarking Terrestrial and Non Terrestrial Networks

In order to better understand the implications and to derive the right strategies based on these more generic statements, a well known methodology in the consulting business can be applied: Benchmarking. The starting point of any benchmarking process is to define the relevant criteria for evaluation and to associate/evaluate the correct values. Selected criteria should be decorrelated as much as possible. For the comparison of terrestrial and non-terrestrial networks the following 6 have been selected.

Representing the benchmark results in a spider diagram leads to a clear strategic positioning: terrestrial and non-terrestrial (and in particular satellite based) networks are to a high degree complementary. Consequently, they should not so much be considered as competitors but as complements to each other.

This is particularly true for area coverage: non terrestrial networks – and in particular LEO constellations – can be designed in a way that a certain number of satellites is always visible close to the zenith, consequently, a direct LOS (line of sight) channel is available free of obstacles even in dense urban environments.

The number of visible satellites is variable and determines the area capacity. The LOS channel guarantees,

Benchmarking Methodology

KPI	DESCRIPTION	0	Valuation	10
1. Area Coverage	Possible degree of area coverage for fixed and mobile services in % of the total area	< 20%	40-60%	> 90%
2. Area Capacity	Obtainable area capacity under normal operational conditions (Reference is the terrestrial network with 100%)	< 10%	40-60%	> 100%
3. Download Data Rate	Obtainable download data rates @ high QoS requirements (Reference is fiber with 100 %)	<10%	40-60%	> 100%
4. Upload Data Rate	Obtainable upload data rates @ high QoS requirements (Referenz is fiber with 100 %)	<10%	40-60%	> 100%
5. Latency	Realistic average latency for Access and Transport network (incl. long range connections)	< 100 ms	40-60 ms	> 10 ms
6. Network cost for full coverage	Network cost function for full coverage inclusiv feeder network	asymptotic	linear	constant

= Terrestrial network *= Non terrestrial network*

that even higher frequencies can be used without suffering from the limits of NLOS (non line of sight) channels in terrestrial networks with horizontal propagation paths.

A necessary prerequisite is the full integration into terrestrial networks considering the standardization process along mobile network generations (4G/5G/6G). Network latencies can be as low as in 5G and even 6G connections in the access area and even superior to fiber for intercontinental routes. Nevertheless, no NTN network will be able to provide area capacities close to a terrestrial solution, therefore, cooperation is the key, not competition.

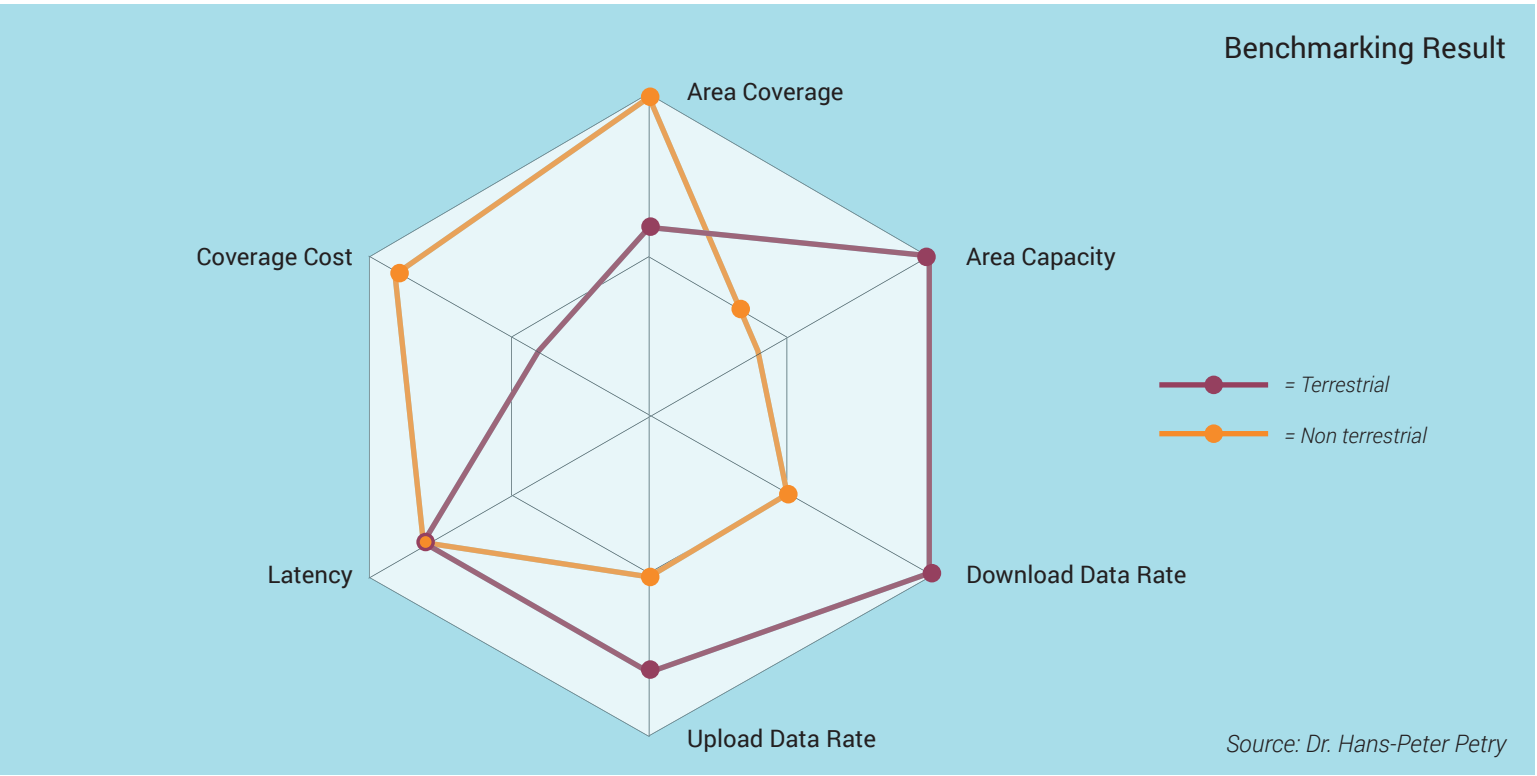
Critical Applications

From the application point of view, such combined networks are finally capable of resolving the coverage problem globally, not only in remote or underserved areas but also in dense areas where terrestrial networks will continue to suffer from coverage holes. Such improvements alone are going to open remarkable additional market segments. It´s therefore not astonishing that all well known OTT players are heavily investing in these technologies. But even more: the global availability of unconstrained coverage is not only a prerequisite but an absolute must for future promising approaches in the area of autonomous traffic systems and IoT.

In particular, autonomous driving systems of the future need to be ultra reliable. The required level of system reliability can not be realized by a single system but needs multi-level (network) redundancy. A potential system solution therefore consists of a combination of local sensors, regional terrestrial mobile networks and global satellite bases networks in order to find the optimum combination of reactive and proactive behavior.

New approaches and new chances

The so-called “New Space Economy” has opened the door to such promising approaches. Associated solutions are much better in time to market and cost perspectives as known from the past. This has not to be proven any more - it´s reality.



This leads us to a very important aspect of future positioning:

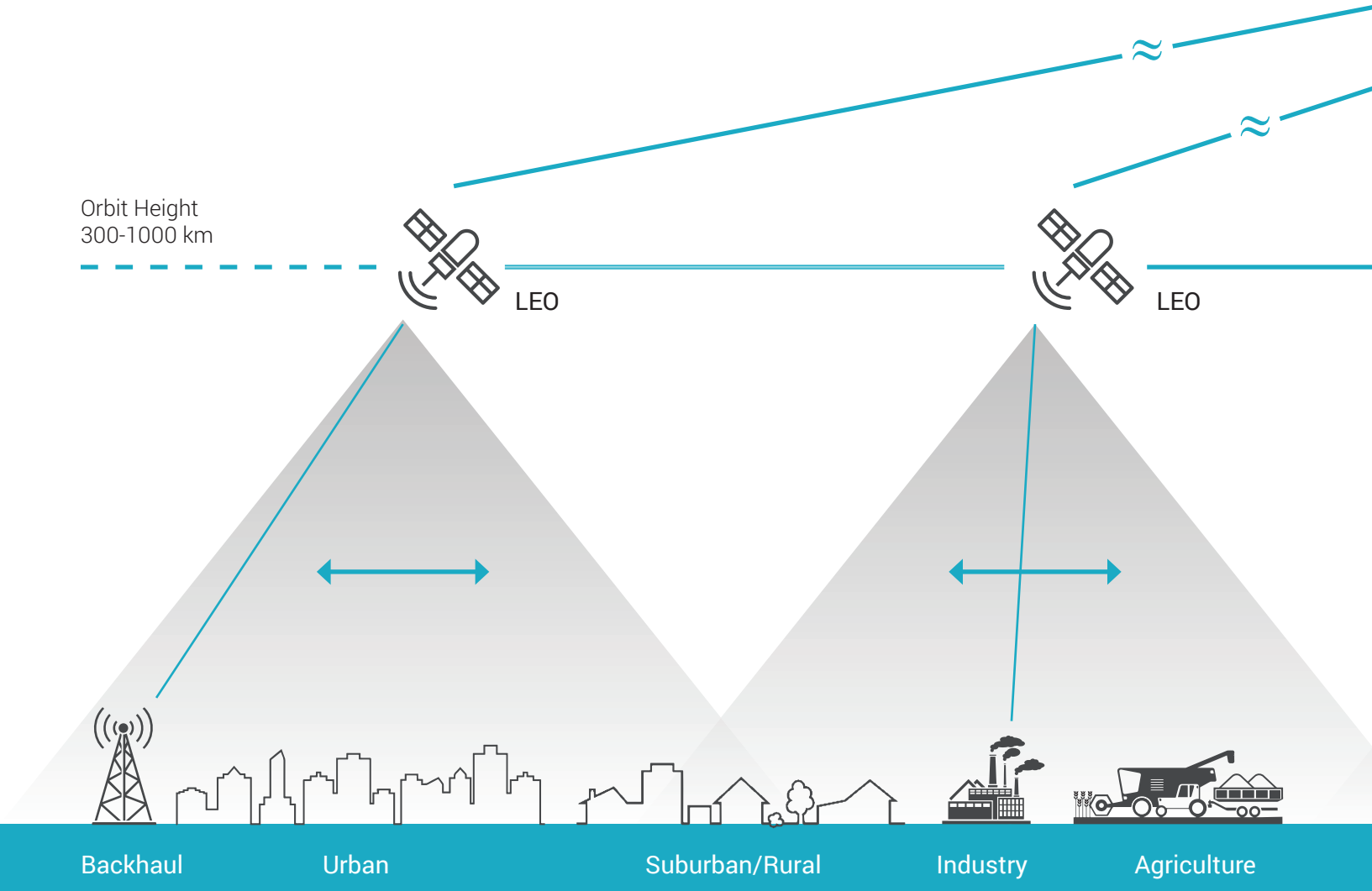
Is it necessary – on a political level – to care for a higher degree of own "digital sovereignty" in particular from a European perspective?

We think, the only answer is "**YES**".

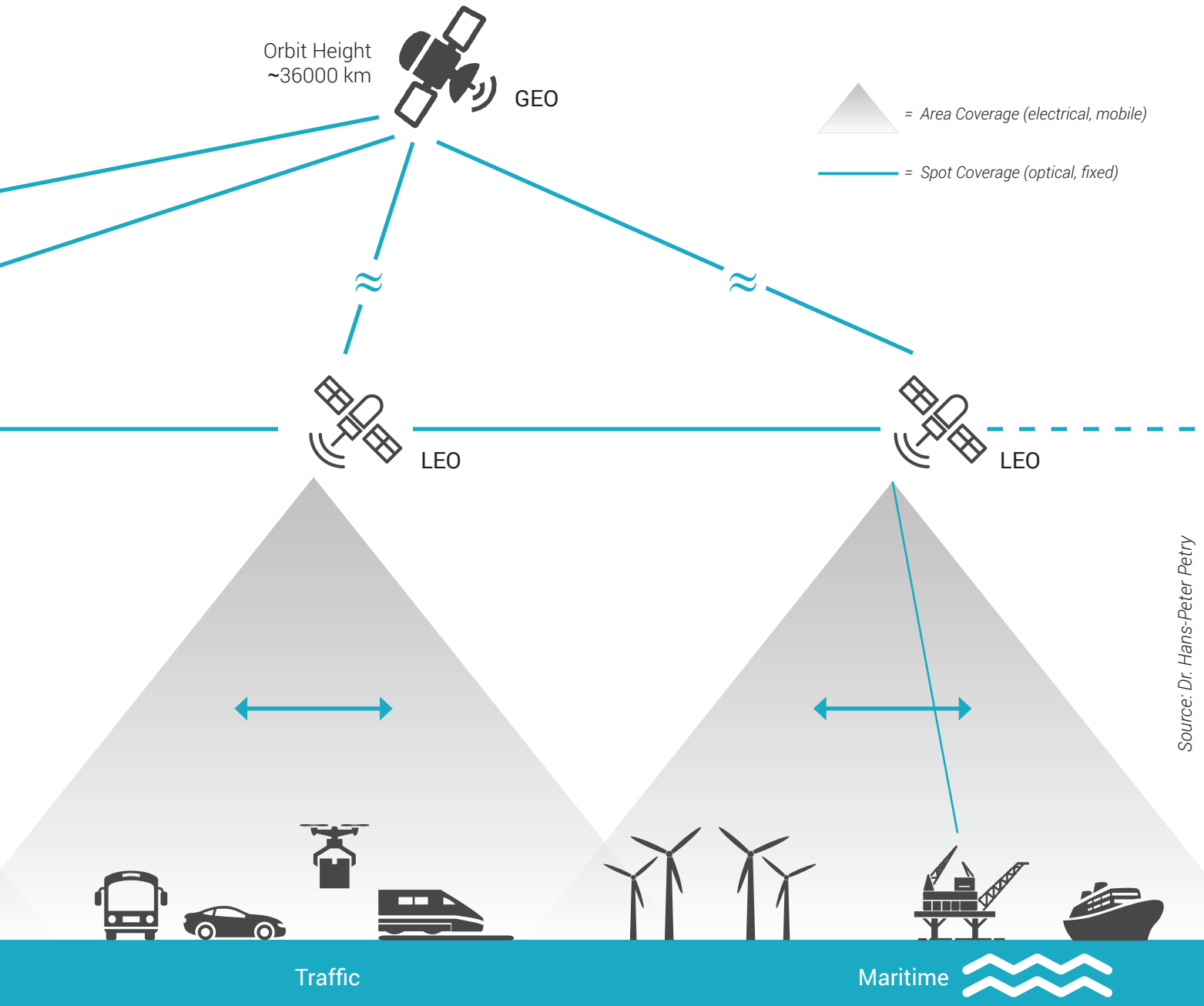
So, what does that mean in detail:

- Opening a new degree of innovation spaces for critical technologies and startups.
- Setting the right boundary conditions for technology and market developments together with a suitable regulation environment.

We think, Europe has all the necessary ingredients on hand, we "only" need to act in a less fragmented way, get a bit faster and adopt risks to a higher extent. This does not only secure a more independent European position in the global competition for system relevant hardware and software but also enables promising solutions requiring more global, highly reliable and secure networks.



Dr. Hans-Peter Petry followed his industrial career at leading manufacturers in the telecommunications industry by working as a Managing Partner at Detecon. Until his retirement, he was the head of the unit Telecommunications Technologies. Since 2018, Dr. Petry has served as Chairman of the Board of Directors of Deutsches Zentrum für Satelliten-Kommunikation e.V. (DeSK).



Source: Dr. Hans-Peter Petry

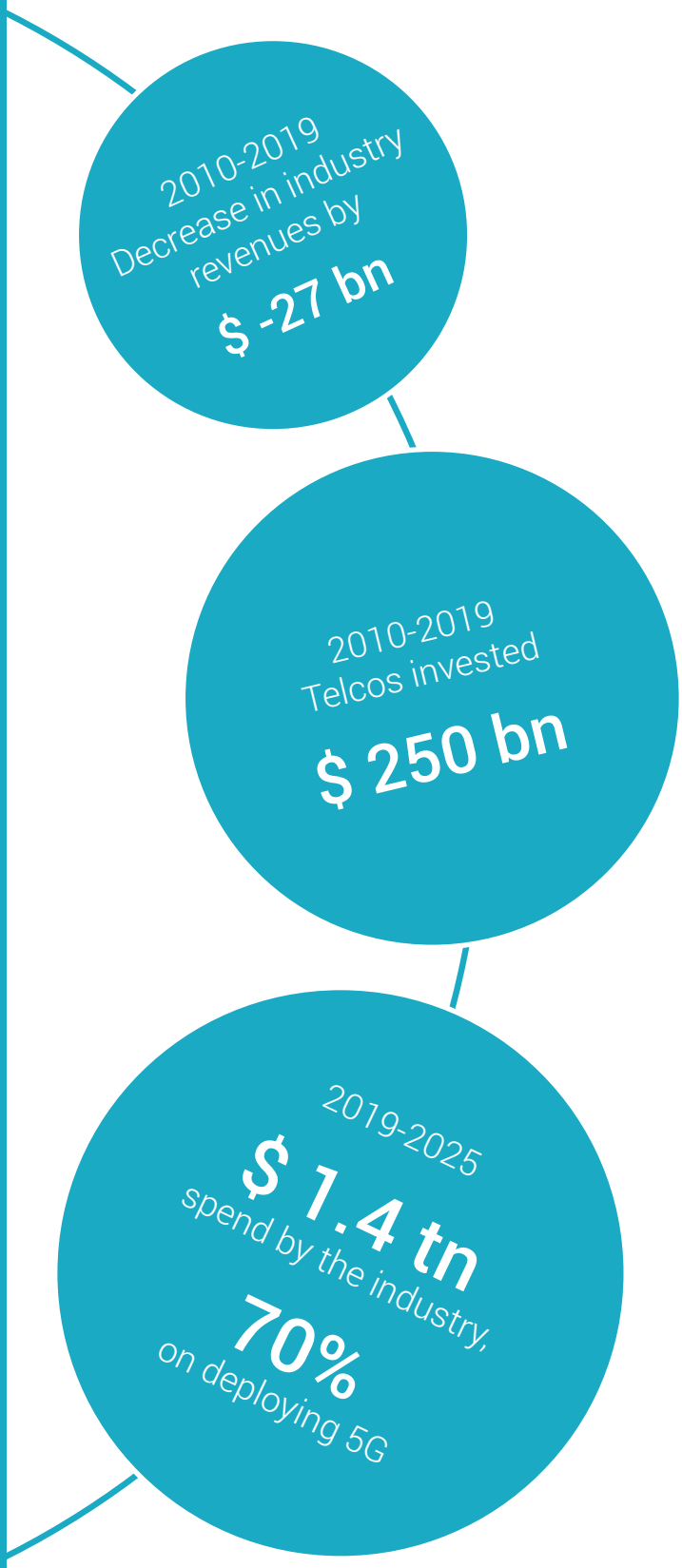
Let's Talk About Network Sharing – Again

Network sharing is not a new topic. However, it may prove to be the most impactful for the coming decade as a contributor to a cost-efficient infrastructure and to the delivery of positive 5G network economies in preparation for 6G commercialization.

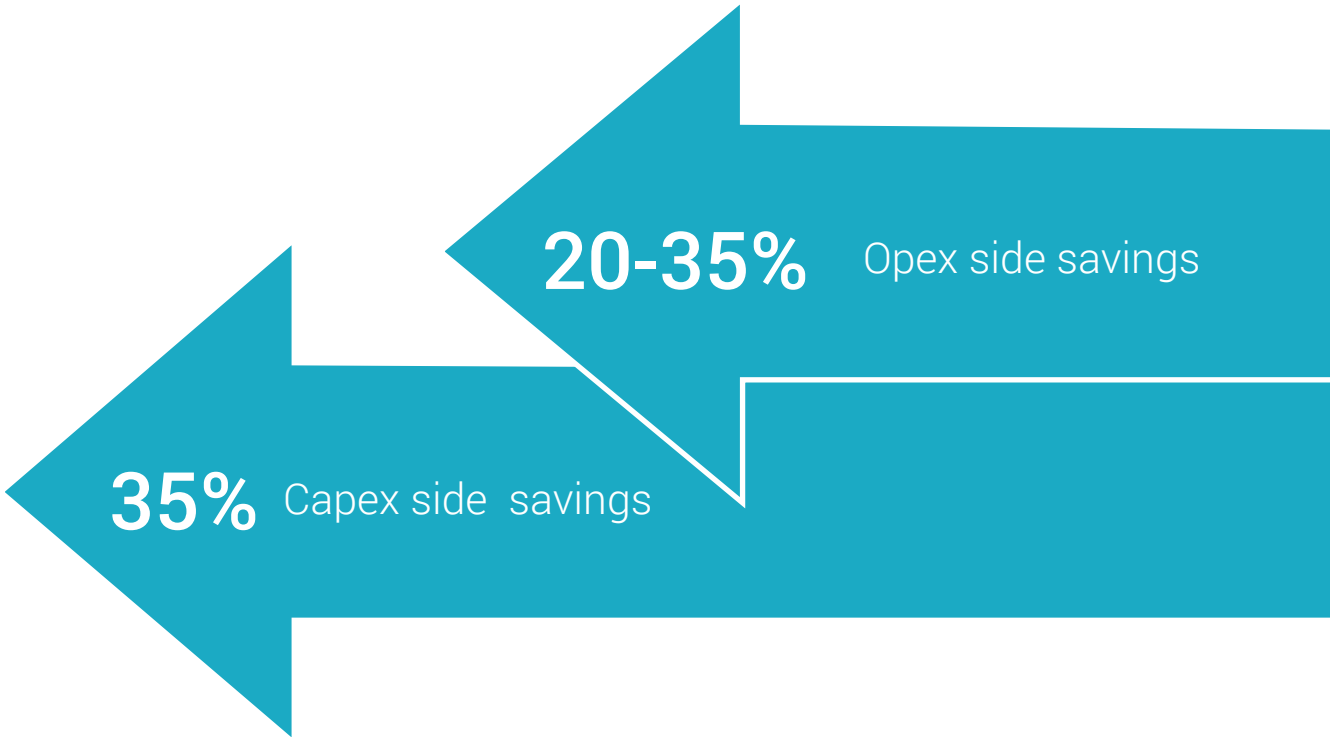
Infrastructure investments will surge

Network sharing is well known in the telco industry. The first deal dates back to 2001, yet it was almost a decade before this option became established as a strategy for coping with 4G network rollout costs. As more and more operators were confronted with the phenomenon labeled "decoupling,"[1] they began to seek network sharing deals in their efforts to sustain ROI and shareholder value.

Today, a decade later, the industry faces a 5G rollout and a massive surge in investments for spectrum, site infrastructure, new active equipment, and fiber backhauling. However, investments in networks still correlate poorly with revenue growth. Industry experts have estimated that between 2010 and 2018 industry revenues declined by $27 billion while telcos invested $250 billion in networks. Between 2019 and 2025, another $1.4 trillion will be spent by the industry, 70 percent of the total for the deployment of 5G.[2] Strict regulation prohibiting consolidation resulted in inefficient spending for overlapping infrastructures of comparable quality. In Europe, 5G licenses were awarded to lateral entrants, making ROI from a network infrastructure even more uncertain.



1 I.e. costs growing faster than revenues
2 www.telecoms.com



Network sharing improves return on investments significantly

To deliver the euphoric promises of 5G operators are examining all their options for the improvement of cost efficiency. Herein lies the appeal of network sharing: it is cheaper and faster to build and operate a joint infrastructure instead of two or more overlapping networks that compete with one another. On the Capex side, savings of up to 35 percent[3] are possible, mainly because of lower spending on network equipment and site infrastructure. On the Opex side, savings from active sharing can be as high as 20 to 35 percent relating to site rent and power reduction as well as to savings in O&M and labor costs.

While most of the synergies stem from a joint greenfield rollout, network sharing can reduce legacy drag, too. Many telcos have managed to switch off one legacy network, either GSM or UMTS, and to refarm freed-up LTE spectrum. Yet regulatory provisions still compel them to keep the remaining layer alive,[4] whether to support emergency services or old devices (feature phones and old M2M modems). Adding legacy to a sharing deal could speed up technology sunset and free up valuable spectrum, particularly in lower spectrum bands that are critical for service coverage.

Network sharing can even turn the emergence of new market players into a business opportunity. Building a competitive greenfield network alone from scratch, even if on a smaller scale (as with industrial networks), requires specific skills and capabilities and not only significant up-front investment. New players will have to look for sharing partners, particularly in the early stages of any rollout, and this is a chance for incumbent players.

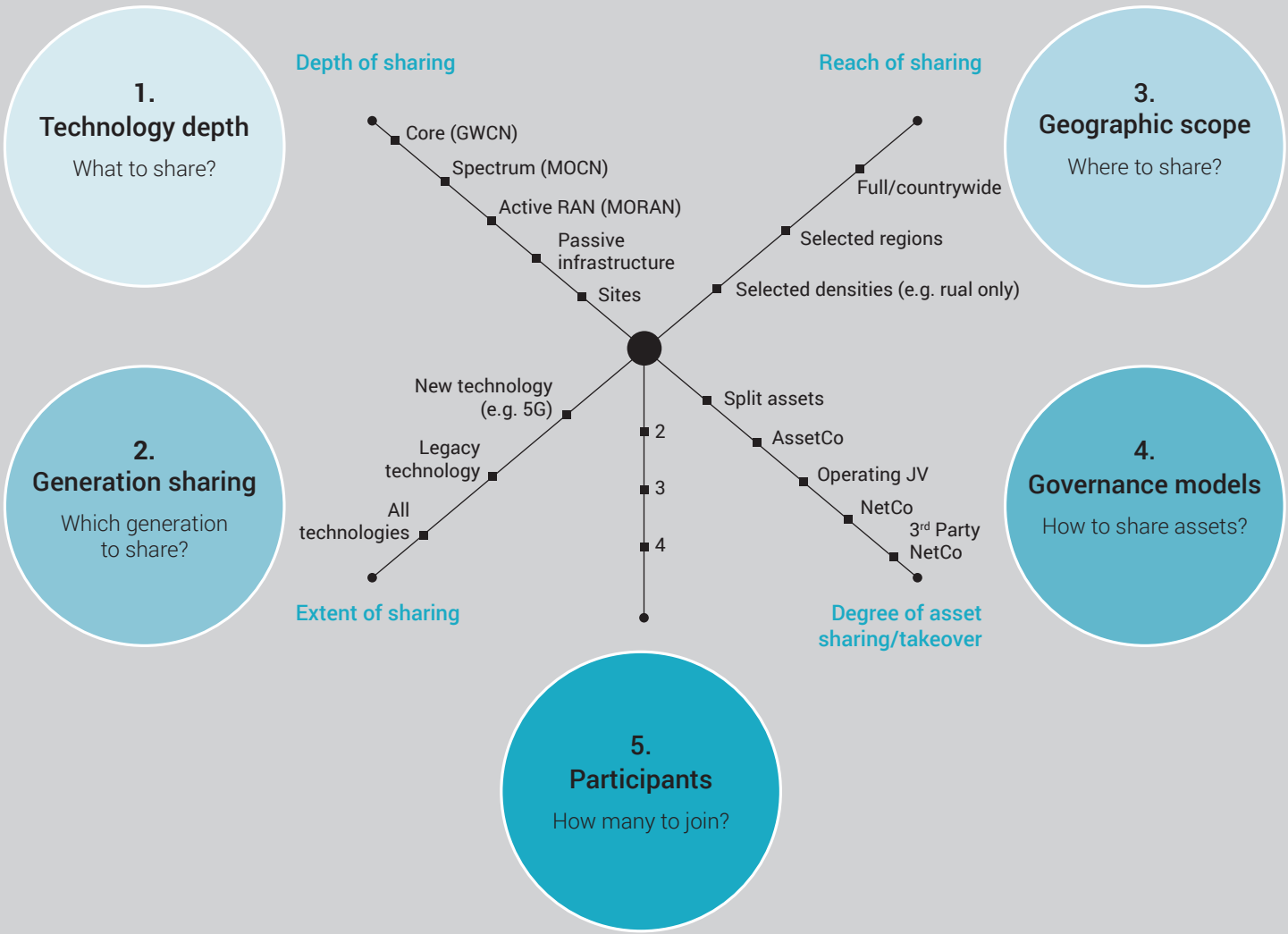
3 Detecon estimates on MOCN all-generation sharing.

4 There is no preferred approach globally (https://www.mobileworldlive.com/blog/intelligence-brief-what-does-2021-hold-for-network-sunsets).

Right-size model and commitment are key to a successful sharing partnership

Network sharing has several design dimensions with a variety of options. There is no one-size-fits-all model: each deal is unique in its strategic intent, scope, and operating model. Active sharing of a complete network generates higher synergies, but is difficult to negotiate, takes longer to implement, and requires more up-front investment in integration. Passive sharing, while easier to establish, may not result in the required cost savings for positive 5G economics, and most savings are generated through equipment sharing.

Design Dimension



Engaging in a sharing partnership has a very long-term impact so the right operating model and governance structure are key to success. A poorly structured deal impairs synergies and creates friction costs. Agreeing on the right model is a delicate balancing act between strategic intent, financial benefits, and business risk considerations.

Negotiating a sharing deal is complex, and two out of three network sharing endeavors do not get past the MoU stage owing to these four factors:

1. Internal resistance, primarily arising from fears of losing a competitive advantage
2. Seemingly incompatible network strategy or operating models
3. Unwillingness to share network control with a business competitor
4. Inability to focus on a perceived win-win solution

Overcoming these challenges requires full endorsement from CEOs and their management teams, a focus on long-term goals, and a cooperative approach to finding a solution. Involvement of a third party, especially at early stage of negotiation, can help to balance out interests and in designing the right model while securing confidentiality.

As interest in 5G network sharing takes off; fewer partnership opportunities will remain

Experience shows that major network sharing agreements are concluded whenever new technology is introduced, and so we expect to see a third wave of sharing deals. New partnerships are being formed and previously concluded deals are being extended to include 5G RAN sharing. Cost efficiency will remain one of the key topics for the next decade (and beyond) as network investment requirements continue to rise.

While we do not preclude the emergence of multi-party sharing models, we strongly believe that bilateral partnerships will continue to represent the lion's share of these deals. In this respect, the window of opportunity is closing; as more partnership agreements are signed, fewer options will remain for stand-alone telcos to secure cost benefits. As a massive 5G rollout will commence within the next two to three years, business leaders cannot dismiss network sharing as a strategic move any.

Evgeny Shibanov I Managing Consultant

"Infrastructure is the backbone to digital economy. Growing customer demand requires higher investments. Network sharing is one of the few options to deliver positive technology economics and securing shareholder returns."

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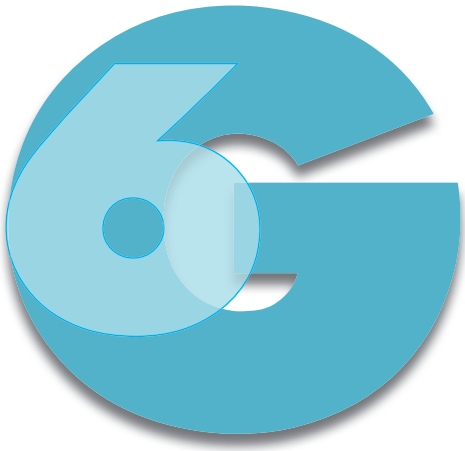
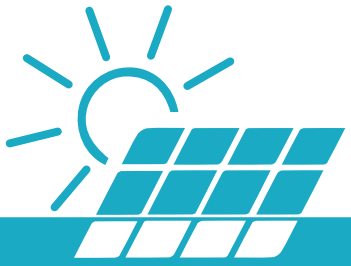


Digitalisation is continuously generating new needs in industries worldwide. Although the 5G network has enormous potential and many capabilities in customised use cases, 6G will go beyond it in several dimensions. From our perspective 6G will be the breakthrough on the road toward more flexible and intelligent network services of the future that enable a greater degree of connectivity in all possible sectors.

What to expect?

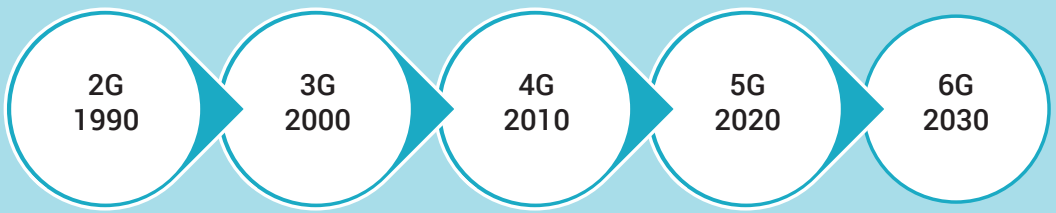


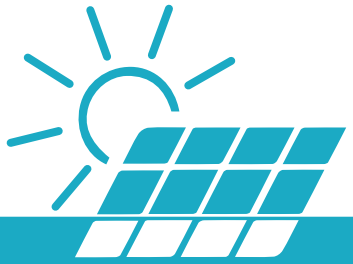
Carbon footprint awareness

- Connectivity everywhere
- Openness
- Artificial Intelligence
- Convergence and cloudification

When to expect?

Approximately every ten years, we have witnessed the next generation of mobile technology. The pandemic has accelerated the push towards digitalization to new heights. "Good to have tech" has become "must-have tech" across all verticals. If not pushed earlier, **we believe 2030 to be the year of 6G**.





Carbon footprint awareness

Across all key areas, carbon footprint awareness will become central to the next generation of mobile networks. Energy consumption has steadily increased over the last few decades. This increase in power consumption is unsustainable in the long run as well as very costly. We envision 6G to leverage AI for optimizing network power consumption to meet the carbon neutrality goals set up by governments and Telco's worldwide. However, AI optimization is only one part of the puzzle to reduce carbon footprint.

Connectivity everywhere

6G will bring harmonized wireless connectivity across all available frequencies and include satellites as well – white spots will become a thing of the past. 6G will drive wireless coverage and connectivity to a new level known as ubiquitous wireless connectivity. Standard 6G handsets will be able to use satellite systems and any combination of the frequency spectrum (licensed and unlicensed, outdoor and indoor). The use of frequencies ranging from a few hundred megahertz to hundreds of gigahertz is expected to solve the connectivity challenges that we face today.

Openness

We believe that – for the first time – open source will become a vital dimension of the mobile standard once 6G has been introduced. Open source is already making inroads into 5G as evidenced by a recent demonstration of an end-to-end 5G network conducted by ONF (Open Network Foundation). Initiatives such as TIP and O-RAN are making rapid progress. New Telco's based on open platforms have already emerged and this trend is likely to continue. This trend, we believe, would make Openness a vital dimension of 6G.

Artificial Intelligence

We foresee that AI will be used in every aspect of 6G, e.g., when bidding for network slice resources or to reduce the carbon footprint of the network. By the time of 6G deployment, the realization of artificial intelligence (AI) may have led to its ubiquitous use, including fixed and mobile terminals, network edge and core, and all kinds of applications. In the same way, network operations will also utilize AI for various purposes – including reliability and network optimization processes. O&M or a rollout of a 6G network will be fundamentally different from a 5G network thanks to AI.

Convergence and cloudification

We foresee that with 6G networks we will see further convergence in technologies and cloudification of services enabling Telco's to offer a broad range of services, reduce costs and complexity across networks. We are already witnessing the shutdown of legacy technologies (non-IP-based / 2G and 3G) and expect the phase-out of LTE by 2030. Cloudification will become part and parcel of a telco network in all network domains including RAN. Due to the cloudification, a 6G network rollout might only be a software upgrade. However, hardware upgrades will be necessary if new frequency bands are added, or lower layer changes are made. For that, a well-thought long term strategy today will be key to fully benefit from the expected convergence and cloudification in 6G.

Abdul Rahman I Consultant

"6G with the help of AI, openness, cloudification, and convergence has the potential to accomplish ubiquitous connectivity while reducing the carbon footprint as well as the costs of a network."

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Felix Kirsten I Senior Consultant

„With 6G, the central concepts of 5G will be brought to maturity: industrial networking, latency, slicing. Much like 4G did in relation to 3G: mobile data for all!"

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Open RAN – Is “Open” the Future of Telcos?

The past decade has seen multiple abbreviations of radio access networks popping up in academia and industry, like C-RAN, S-RAN, or V-RAN. The motivation has always been the desire to create flexible, scalable, and cost- and space-efficient radio access networks. Recently, yet another RAN, this time known as ORAN or Open RAN, appeared.

What is it exactly?
What makes it “open”?

Open RAN aims to benefit from many advances in radio access technologies in the past decade such as virtualization, cloudification, and multi-tech single base stations (4G/5G), and tops everything off with the open interface aspect. There is no vendor lock-in, enabling the use of more than one vendor for RAN and offering flexibility and the freedom to pick and choose. Traditionally, one vendor is responsible for the hardware and software in RAN. The same functionality has now become diversified thanks to the open interfaces in Open RAN; different vendors provide hardware and software components, giving users the opportunity to pick and choose according to different scenarios and approaches in radio access networks, including centralized or distributed cloud, latency tolerance or intolerance, and other properties.

Multiple RAN vendors on the same base station instead of one

General-purpose servers instead of proprietary hardware built for specific purposes

Open interfaces open the radios and baseband processing, can use a radio (RU) from Vendor A with a baseband (CU/DU) from Vendor B

> We believe that “open” is the future of telcos. Time will determine the extent of this “openness“.

Open RAN as an alternative

Open RAN has become increasingly important as it offers an alternative to the limited choice of vendors currently available on the market. The vendor landscape became even more constricted following the ban on Chinese vendors in several countries. These bans generated a tailwind for Open RAN when telco operators started looking for alternatives. The interest is coming from the CSPs as well as from small and midsize vendors who were unable to have a piece of the telco pie because of the vendor lock-in and their limited offerings. Open RAN is also the first RAN technology that has gained the attention of governments worldwide.

Open RAN offers more flexibility, choice, uniformity, and agility in radio access networks

Traditionally, once a vendor is selected for RAN, telco operators have to live with the features they offer. Imagine now having the freedom to choose suitable hardware and software for radio access networks from a number of different vendors. This would make the vendor landscape more vibrant and the overall network experience more uniform because homogeneity of the features can be achieved. Rolling out a new feature from another vendor would become as simple as adding a new software program on a system. In short, Open RAN will offer more flexibility, choice, uniformity, and agility in radio access networks. Some might question how such a "motley" vendor landscape can provide uniformity. It is the result of the deployment of virtualized functions on general purpose hardware using a consistent software platform.

Open RAN drives innovation directly from the startup scene into the heart of telcos

A 5G network, unlike legacy networks, is poised to serve various use cases that go beyond the transmission of high bit rates. A full-fledged 5G network needs more than just coverage and capacity layers, requiring as well the edge and managed latency layers for use cases such as autonomous control, AR-VR applications, and many others. The product and feature requirements are becoming so diversified that it is practically impossible for a single telco vendor to provide them. We see here the first signs of an eco-system like the App Store or Google Play where the software community will fulfill a very important role. Open RAN acts as an enabler for the startup scene to drive innovation directly to the heart of the telco industry without any concerns about hardware, networking, or radio expertise.

New skill sets, platforms required for Open RAN

When a dozen vendors provide software and hardware for RAN, complexity is certain to increase. The motley mix of providers would exponentially increase the integration effort and require input of more resources. Managing Open RAN requires new platforms and skill sets for the required orchestration and automation of the network, which would in turn lead to increased costs, especially in the first cycle of network transformation. These and other questions will be asked. How would fault management be carried out? Would a single integrator or orchestrator take this role? What if this single integrator or orchestrator creates a monopoly? Every challenge is accompanied by an opportunity, however – we are working on concepts that will provide answers to all these questions with the prospect of reducing the complexity of operating a network in the long run.

Are the costs really 30 to 40 percent lower than for traditional networks?

Rakuten, a Japanese telco operating Open RAN, boasted a 40 percent lower CAPEX and 30 percent lower OPEX in comparison with a traditional network and claimed that these savings were among the main reasons for going Open RAN. However, the company did not provide any details on how these cost reductions were achieved or how the comparison was calculated. When we look more deeply at the CAPEX category hardware, the question arises as to how an operator like Rakuten would be able to acquire radio equipment at a much lower price from Open RAN vendors compared to the prices offered by the traditional vendors. Competing with traditional vendors in the hardware sector is quite challenging for smaller vendors as the former benefit from the economies of scale and optimized value chains. As of now, we do not yet see major short-term savings for Open RAN in the TCO of a network. Savings from Open RAN will come from a well-designed, long-term strategy.

In summary, Open RAN ...

... gives telcos the flexibility to select the hardware and software that fits their requirements,

... brings more vendors into the game and boosts competition, brings diversity to the product and feature landscape,

... enables telcos to pursue innovative business models by bringing small software players into the radio access arena.

Major telecommunications operators are joining forces in industry alliances like O-RAN and TIP to drive growth and maturity in the Open RAN ecosystem

Open RAN will generate **$ 3.2 bn**
annual revenues in 2024
> 10% of the 4G/5G market share <

Source: Omdia

However, it remains to be seen whether the benefits of Open RAN can outweigh the incurred costs. We are certain that the winners in the telecommunications industry will be decided on the basis of their RAN strategies that take advantage of the flexibility and innovation coming from Open RAN while managing complexity and overhead costs. Open RAN will be deployed both by greenfield and brownfield operators. While initial large scale rollout will be mostly with new operators, the performance and efficiency achieved at brownfield deployments will be critical for Open RAN to establish itself the solution of choice for CSP's RAN modernization efforts. We believe that "open" is the future of telcos. Time will determine the extent of this "openness."

Abdul Rahman I Consultant

"I believe that the future of telcos is open.General-purpose equipment in place of proprietary solutions will become the norm in all domains of a telco."

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Nicolay Zhelev I Managing Consultant

"The clock is ticking for Open RAN to emerge out of the hype and prove the technology is viable in large, quality demanding deployments."

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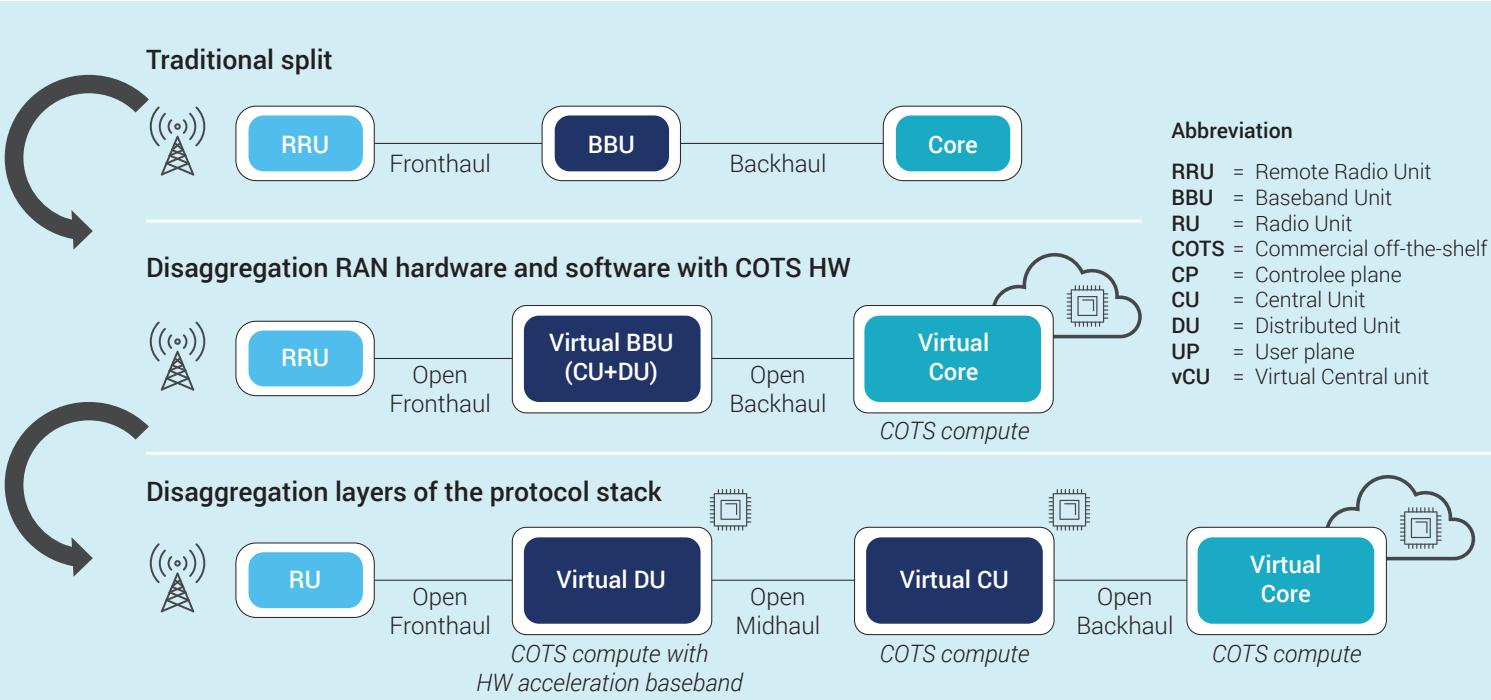
Deep Dive in 5G Transport – SRAN & O-RAN

In light of the ongoing discussions in the industry, the development, and the testing of multivendor O-RAN (Open Radio Access Network) as a possible successor to the SRAN (Single Radio Access Network) that is presently firmly established by the small number of well-known incumbent RAN vendors, the transport networks are about to undergo major changes in their design and capabilities. One of the most important changes is indicated by the word "open": open interfaces, open fronthaul, or open midhaul.

Open RAN means the disaggregation of the different functions from a monolithic base station approach to a distributed approach.

Where does this transport take place?



If an operator needs to interconnect the disaggregated components of the RAN provided by multi-vendors, the interfaces must necessarily be **open, predefined,** and **compatible** and not restricted by proprietary installations of single vendors.

What are the key challenges posed by disaggregation?

- Cell sites can continue to use Remote Radio Unit only insofar as centralization gains are achieved that demand fronthaul connectivity.
- 4G and 5G fronthaul have very high data rates and extremely low latencies (<100 usec).
- Standard Commercially of the shelf servers have drawbacks compared to traditional custom-built Baseband Units with high-density enhanced Common Public Radio Interface ports.
- The transport solution – located at the edge for encompassing all ports between Central Unit/ Distributed Unit (midhaul) and between Distributed Unit and Remote Radio Unit (fronthaul) – requires a substantial upgrade.
- Transporting between sync source, Distributed Unit and Radio Unit is also a specific challenge for Open RAN; traditional SRAN handles it more efficiently.

Standardized protocols must be implemented by all players to guarantee interoperability.

Trends and conclusions in transport caused by introduction of 5G and O-RAN

Mobile access catches up with fixed access in data speed

"Gigabit Society" is one of the most frequently used buzzwords. The industry's promise behind it: being able to deliver "up to" 1 Gbps to the end user at the access layer.

The introduction of 5G enables mobile operators for the first time to provide data speeds comparable to those of fixed-line operators or, under certain circumstances (e.g., when copper-based technologies or older GPON versions are in use), even outperforming them.

The drawback is the need for enormous investments. A much larger number of base stations and huge investments in transport networks, both for capacity and coverage, are required to serve the micro and pico base stations.

(R)evolution of interface bandwidth results in higher demand for number of interfaces at access level/aggregation level

5G and its data capability change the picture dramatically:

- Owing to the aggregation of high bandwidth, more and more physical interfaces become necessary.
- Owing to the disaggregation in O-RAN, more physical interfaces are available.
- Owing to the increase in data speed, interfaces for access and aggregation become more and more expensive – these types of interfaces have previously been seen only in backbones and are really expensive.
- Owing to the limitations in the number of interfaces at switches and routers, the required investments rise.

Major investments in access and aggregation are necessary in the transport network.

(Provider) backbone routers in aggregation

The layers of transport are separated simply by speed classes and feature classes. Access is cheap, aggregation is even cheaper while backbone is expensive, redundant, secure, and feature-rich.

- Backbone: N x 100Gbit/s up to Tbits/s
- Aggregation: N x 1 or 10 Gbit/s
- Access: some 100Mbit/s up to 1 Gbits/s

The choice of the right transport equipment and right boxes ultimately ends in a search for expensive backbone boxes even for aggregation and access layer because only they provide adequate physical interfaces and switching capacity. In a manner of speaking, the "misuse" of backbone boxes will continue until manufactures provide tailored solutions for access and aggregation. In short, one significant cost factor relates to the boxes at the right transport layer.

New data center trend: spine-leaf architecture

When 5G (virtual Distributed Unit, virtual Central Unit) runs on a cloud infrastructure as network function virtualization (NFV), there is a merger of "classic" telecommunications structures and design with well-established "classic" information technology (IT) structures and design familiar from data centers.

The two are combined to provide the desired 5G RAN and core functionalities. But that also leads to a higher number of switches and routers and other network elements and requires investments encompassing "classic" Network Technology and IT design.

Increasing demand for high-speed optical fiber transport

Enabling 5G in most countries means allocating new frequency resources above the frequencies used today. It is simply a matter of radio wave physics: the lower the frequency, the farther the propagation, the better the coverage, and the better the interior penetration as well.

The allocation of higher frequencies reduces the effectiveness of wave propagation and penetration, limiting them to "line of sight"; the corollary is that more base stations are needed to ensure a certain level of coverage. Examples include small inner-city base stations on each power pole, each light pole, at every bus stop, on every advertisement board, or on every traffic light. Since the required bandwidth makes it impossible to serve base stations with more than 10G using microwaves, only one conclusion is possible: optical fiber – and huge investments in excavation – will be required at inner-city power poles, light poles, bus stops, advertisement boards, and traffic lights.

Torsten Soltmann I Managing Consultant

"Networks are deployed to deliver End-to-End valuable services in the best affordable quality to the end customer – humans or even machines. That shall be the major guidance for design and architecture of networks, the service aspect."

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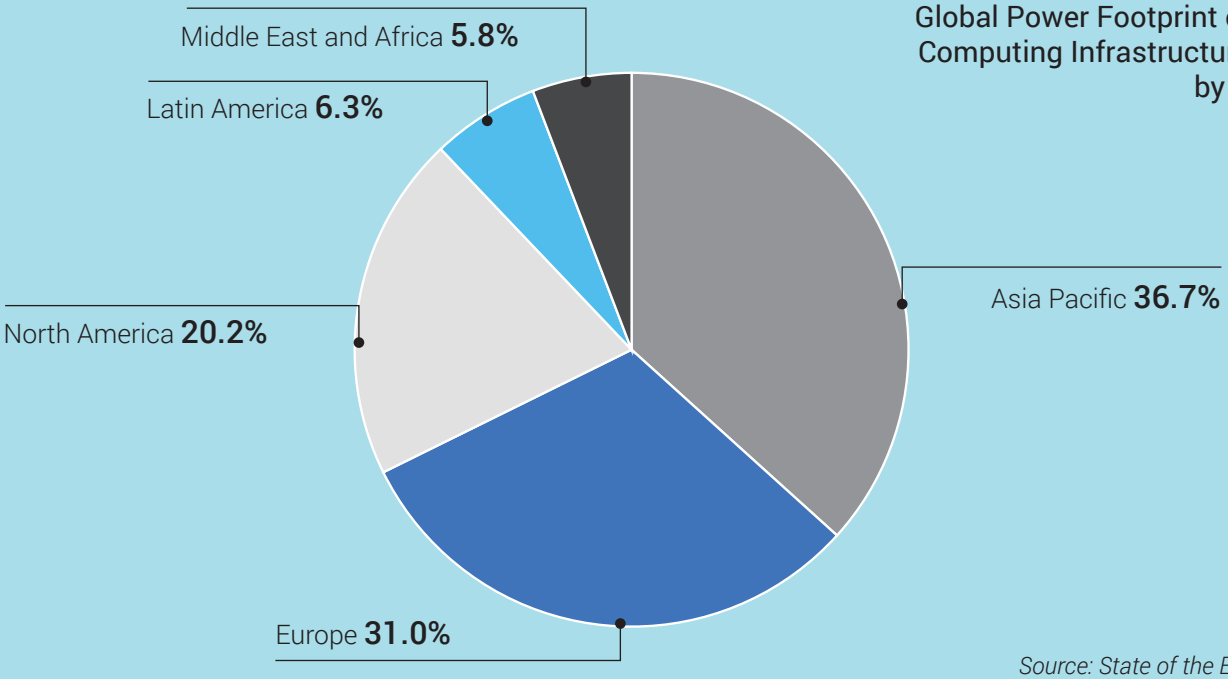
Edge Computing Market – the New Battlefield Between Hyperscalers and Telcos?

The still relatively young market for edge computing represents enormous growth potential and offers opportunities and risks for new and established players. The race is still on to see who will dominate the market in the next few years. However, the course is being set now – and now is the time to act! Telco operators should carefully examine whether and in what form partnerships are expedient for the joint conquest of new markets for edge use cases. Edge computing services are still in the early stages. But massive growth in the edge computing market is foreseen for the coming years as some forecasts predict an increase in revenues to as much as $15.7 billion by Markets & Markets or even $60 billion by Cowen. Let's get down to business!

$60bn

Telcos – where are you headed?



Global Power Footprint of Edge Computing Infrastructure 2028 by Region

Source: State of the Edge 2020

1st step: Check the market situation

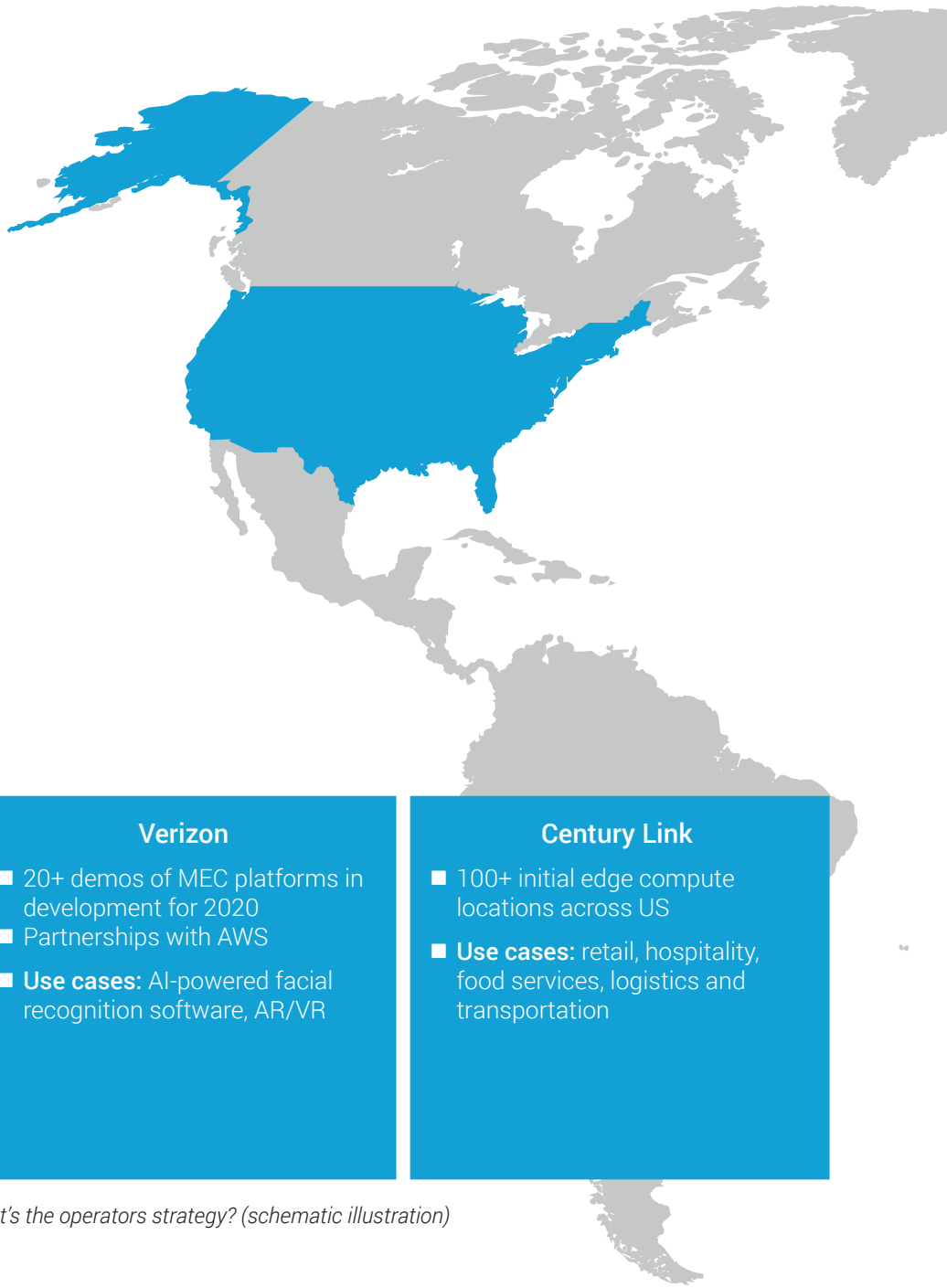
- Edge market still immature, and forecasts vary.
- One third European regional share in 2028.
- Edge computing heavily dependent on 5G use cases with low latencies.

2nd step: Implement measures in strategy

- Establish a strategy to position yourself and defend your right to participate with edge compute in the access and aggregation network.
- Establish network capabilities and open up your network to potential partners. Form partnerships for new products and create a new market approach that can be monetized.
- Decide on your future viable business model:
  - Enabler with dedicated edge hosting.
  - End-to-end service provider developing dedicated solutions for B2B/B2C applications.
  - Doing nothing, which will lead to a dump bit-pipe provider!

Edge Ecosystems

The edge ecosystem is changing. Partnerships that will host edge computing services within the network are being established between hyperscalers and telcos. Some of the Tier 1 operators in the USA (AT&T, Verizon), Europe (Vodafone, DT), and Asia (ST Telecom, KDDI) are in the testing phase or rolling out edge platforms on their markets. But as of this moment, such edge computing availability is still limited to only a few locations.



AT&T

- Began rolling out edge-computing platform in June 2020, partnering with HPE
- Partnerships with Google and Azure
- Plans to roll-out 60k 5G white box routers; requiring MEC to enable low-latency applications
- **Use cases:** AI/ML, video analytics, Enterprise AR

Verizon

- 20+ demos of MEC platforms in development for 2020
- Partnerships with AWS
- **Use cases:** AI-powered facial recognition software, AR/VR

Century Link

- 100+ initial edge compute locations across US
- **Use cases:** retail, hospitality, food services, logistics and transportation

Source: STL Partners, Telco Edge Computing: What's the operators strategy? (schematic illustration)

Telefonica Spain

- Conducted tests with live customers and began the processes of revamping 1,000 central offices to become edge computing hubs
- **Use cases:** automotive (assisted driving), entertainment & media, financial services

Deutsche Telekom

- Testing prototype with partners, with commercial deployment of edge platform expected in 2020
- MoU with SKT to develop MEC to 5G in Korea
- **Use cases:** factory automation, gaming industry

China Mobile

- Deployed its sigma edge computing platform in several provinces across China
- **Use cases:** Partnered with CAS-Vision and Huawei to unveil first commercial 5G MEC cultural tourism project

Vodafone Europe

- 24 sites in Europe planned for 2020
- Partnership with AWS
- **Use cases:** video analytics, real-time asset Inspection. AR, drones, AI-powered media editing

KDDI

- Partnership with AWS to deploy Wavelength at 5G sites
- **Use cases:** AR/VR-sports, entertainment and sightseeing

SK Telecom

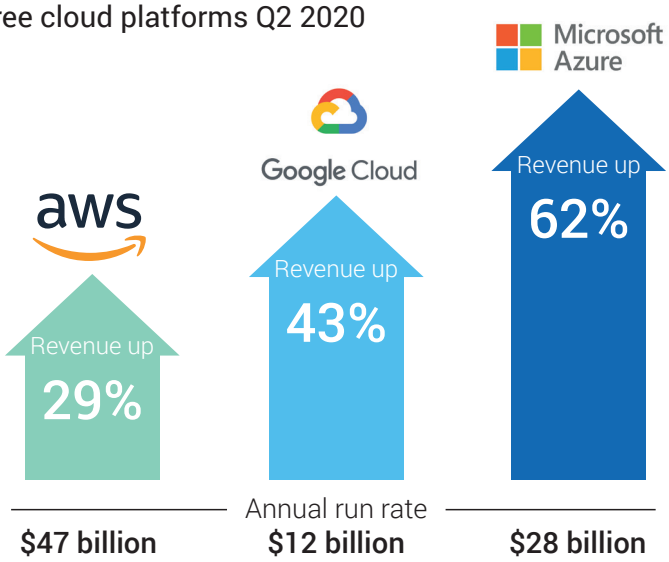
- Plans to build 12 MEC in 5G networks across the nation
- Launched MEC open platform in March to reduce 5G latency by up to 60%
- Partnership with AWS
- **Use cases:** VR/AR and video game streaming, virtual mobile interface

Paradigm shift in telcos ...

Hyperscaler

Hyperscalers are pushing hard to enter the edge computing market with their edge cloud portfolio and are well positioned to become important players in edge computing, especially in the B2B market. They have developed edge computing solutions such as AWS Wavelength and Outposts, Microsoft Azure Edge, or Google Anthos for Telecom to offer cloud services for edge use cases to corporate customers either directly or via newly established partnerships with telcos. They have the money to invest heavily in new cloud platforms and are cost-efficient thanks to their high scalability.

Comparing the Big Three cloud platforms Q2 2020

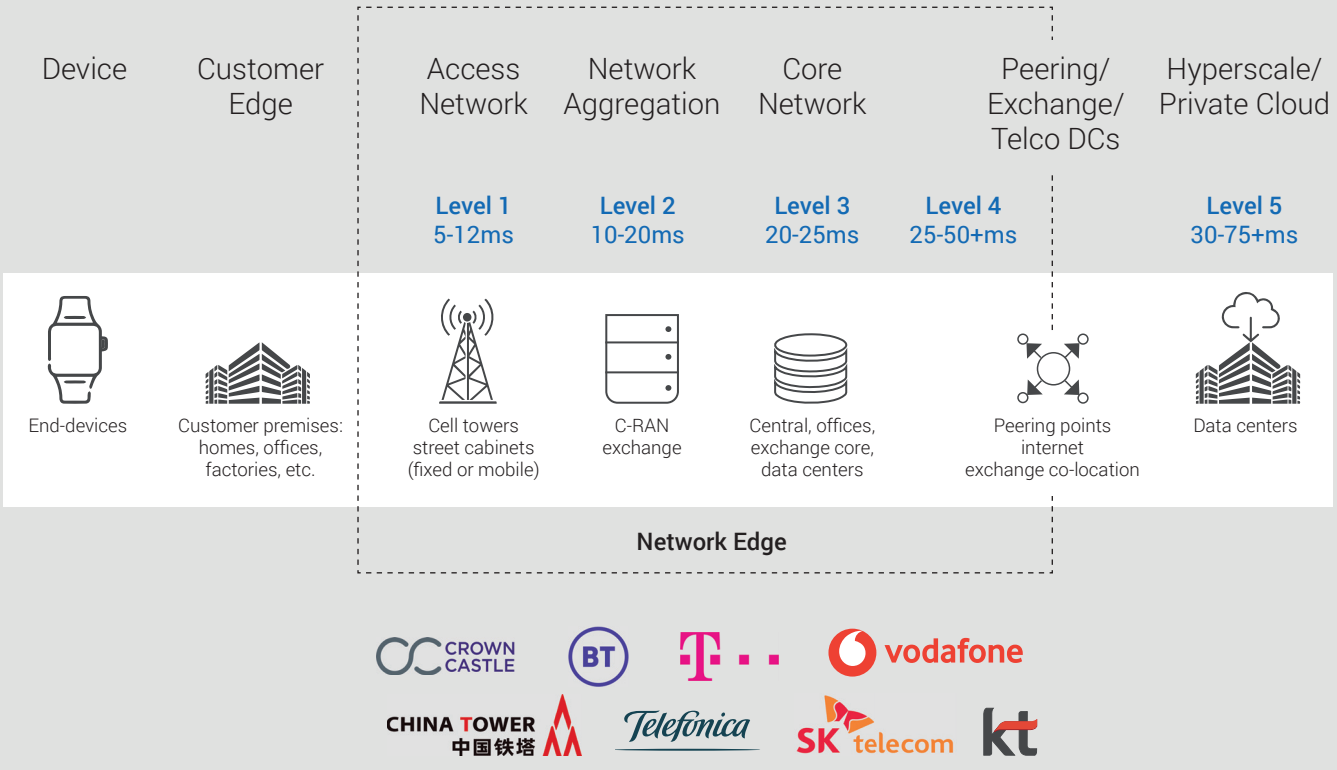


Source: TMForum 2020, How to build and operate at the edge

> Microsoft is not the only internet giant on the telecom prowl. Both Amazon (through AWS) and Google have been stalking the CSP neighborhood, luring operators into cloudy partnerships.
>
> Light Reading India, September 29, 2020

Telcos, on the other hand, need to define an edge strategy and defend their position in their access and aggregation networks where edge computing will be located. Network and IT technologies are converging driven by cloudification and softwarization becoming more dominant in their networks. This trend has triggered a paradigm shift in telcos. In the meantime, they see more clearly the need to cooperate with hyperscalers and establish partnerships on a peer level if they want to achieve success.

Edge compute locations in the network



Source: STL Partners, Telco Edge Computing: What's the operators strategy?

How can a coopetition be developed over the next decade?

For hyperscalers

- Obtain access to new customer segments in markets such as Europe or Asia
- Partner with telcos to establish a new go-to market approach and defend against protective measures taken by regulators or governments

For telcos

- Maximize the share of wallet and win a reasonable market share on the B2B market, e.g. campus networks
- Develop and successfully market new products based on the edge cloud in the B2B2C and B2C markets

Degree of overlap

Potential partners should complement each other in market and technology areas as much as possible:

- Market: agree on customer approach per country/region, e.g., Partner A addresses customer segment B2B, Partner B segment B2C
- Technology: Partner A provides edge platform on IaaS/PaaS layers, Partner B provides on-top service and application layers

What are the stumbling blocks along the road?

For both sides

- Protectionism and regulator issues (politics)
- Cultural clash: new world (open, innovative) vs. old world (closed, legacy)

For telcos

- Money (Capex and Opex): Limitations to investments in new technology and people
- Technology issues:
  - Open-source development is rather new and still in its infancy
  - New Technologies
  - Lack of access to developer community

Win-win situation within sight

The winners in this race have not yet been decided, but there are certainly elements that can help any service provider to secure an advantage in edge computing services.

Reliability
Trust
Flexibility

Strong operators who possess dense, close-meshed, and powerful networks, have deep understanding of national markets, and represent established brand names are the best possible counterpart for agile, innovative hyperscalers. At this stage, a win-win situation is created when the two sides benefit in a partnership of equals.

Georg Karl Kopf I Managing Consultant

"In the field of edge computing, players from various business sectors will be coming together on the market where they will be forced to reconcile their differing interests through partnerships and other means. Customers will ultimately benefit solely if this process is successful."

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Hyperscalers vs. Carriers: Telco Edge Cloud's New Role Model

Three questions for Juan Carlos Garcia Lopez, Telefónica

1 To what extent is the Telco Edge Cloud leading the way for the development of relationships among telcos and hyperscalers?

The Telco Edge Cloud is one of the elements in the computing continuum that has been created from the ground up and extends all the way to the central clouds. As with the Central Public Cloud (cloud regions), the edge is becoming a hybrid multicloud environment. The Telco Edge Cloud is one of the components of that multicloud/multi-edge environment, and it will be combined with the other hyperscalers' edge alternatives to provide the best value proposition to our customers, who will benefit from the best of each option. It will be possible to take advantage of the operational scale, a marketplace rich in solutions, the huge ecosystem of developers, and the broad market acceptance that hyperscalers enjoy while having options to adapt more flexibly to specific customers' requirements and demands such as greater proximity, data residency, lower jitter, and latencies closer to 1 ms, all in conjunction with a solution that is open and standard.

Juan Carlos Garcia Lopez is SVP Technology Innovation and Ecosystem at Telefonica Group where he leads technical projects in edge computing, private networks, or network slicing. He heads the Technology Innovation Plan and oversees Telefónica's participation in standardization bodies and industry forums (O-RAN, ETSI, 3GPP, etc.). He represents Telefónica in the GSMA Technology Group and on the Telecom Infra Project Board and chairs GSMA Telco Edge Cloud Forum and 5TONIC Steering Board (Telefónica's 5G ecosystem lab). He has held other VP positions at Telefónica GCTIO units over the years – Technology and Architecture, Radio and Fixed Access, Transport, Operations, Architecture and Planning – and has worked in various companies during his 30 years at Telefónica.

INTERVIEW

2 **Are any initial implementations in place, and what are the results?**

Telefónica has been offering an edge computing service in four major cities in Spain since May 2020 (Madrid, Barcelona, Sevilla, and Bilbao) and plans to extend it to other cities as demand evolves. The number of customers is growing steadily, and we are already working with the main industry sectors.

Telefónica is currently cooperating with other operators at the GSMA and at the Telco Edge Cloud Forum to develop and deploy a solution federating the operators' edge infrastructures with the objective of providing a global, telco-based edge computing service. We have conducted multiple trials with Tier 1 operators such as Deutsche Telekom, BT, Telstra, KT, or China Unicom in the last two years that demonstrate the feasibility of the concept and have confirmed its readiness for edge use cases such as V2X, drone swarm management, holographic videoconferencing, Industry 4.0, ports/airports, or logistics.

3 **How does Telefónica define the role of telcos in the future?**

The telecom operators can play a role as ICT service providers, offering to their existing B2B customer base complete solutions combining connectivity (fiber, 5G, Wi-Fi), computing (IaaS, PaaS) and solutions on top (big data, analytics, IA/ML, cybersecurity, IOT, sector-specific solutions, SaaS). They will need a complete cloud/edge value proposition, a specialized sales force, and technical/operational skills and tools to realize this position, much like the situation at Telefónica, which has a subsidiary — Telefónica Tech — created specifically to address this business opportunity.

Some telcos own facilities like central offices, aggregation nodes, or cell sites that can host computing infrastructure. Partnering with cloud providers for housing and connectivity and/or deploying their own edge infrastructure and services that will ensure the best experience with the public and private edge and cloud for their customers can be an additional opportunity for these facility-based operators.

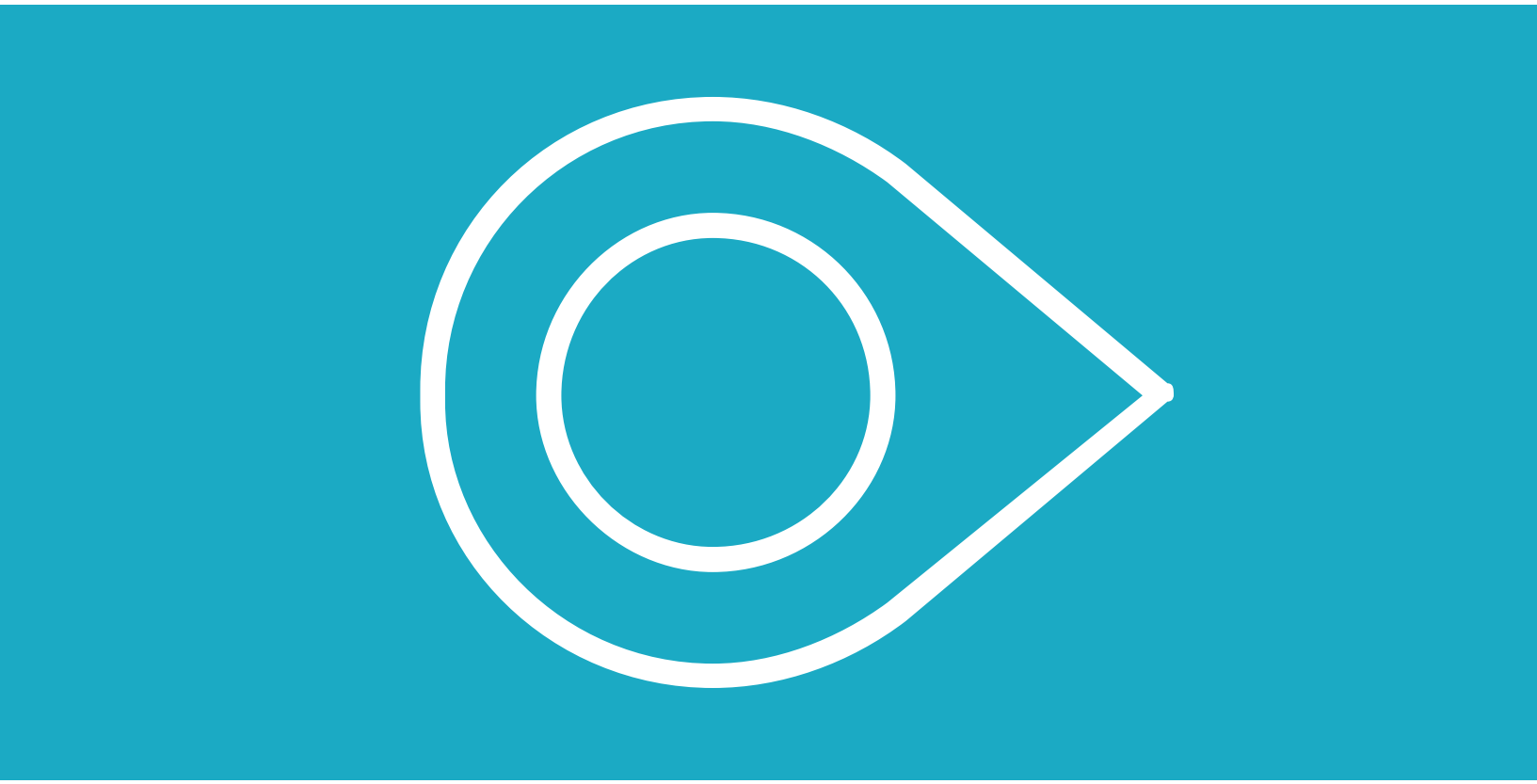
Software Centric Access Networks

2030

The (R)Evolution of Fixed Access Networks

The demand for connectivity services towards 2030 include an expected annual bandwidth increase growth of ~20-30% CAGR[1], low latency requirements and innovation speed. To satisfy this demand without risking profitability, a fundamental change to the architecture will be required. The shift to a software centric access architecture will enable operators to meet demand with a technically and economically viable approach.

1 Telegeography, Detecon Analysis



TECHNICAL

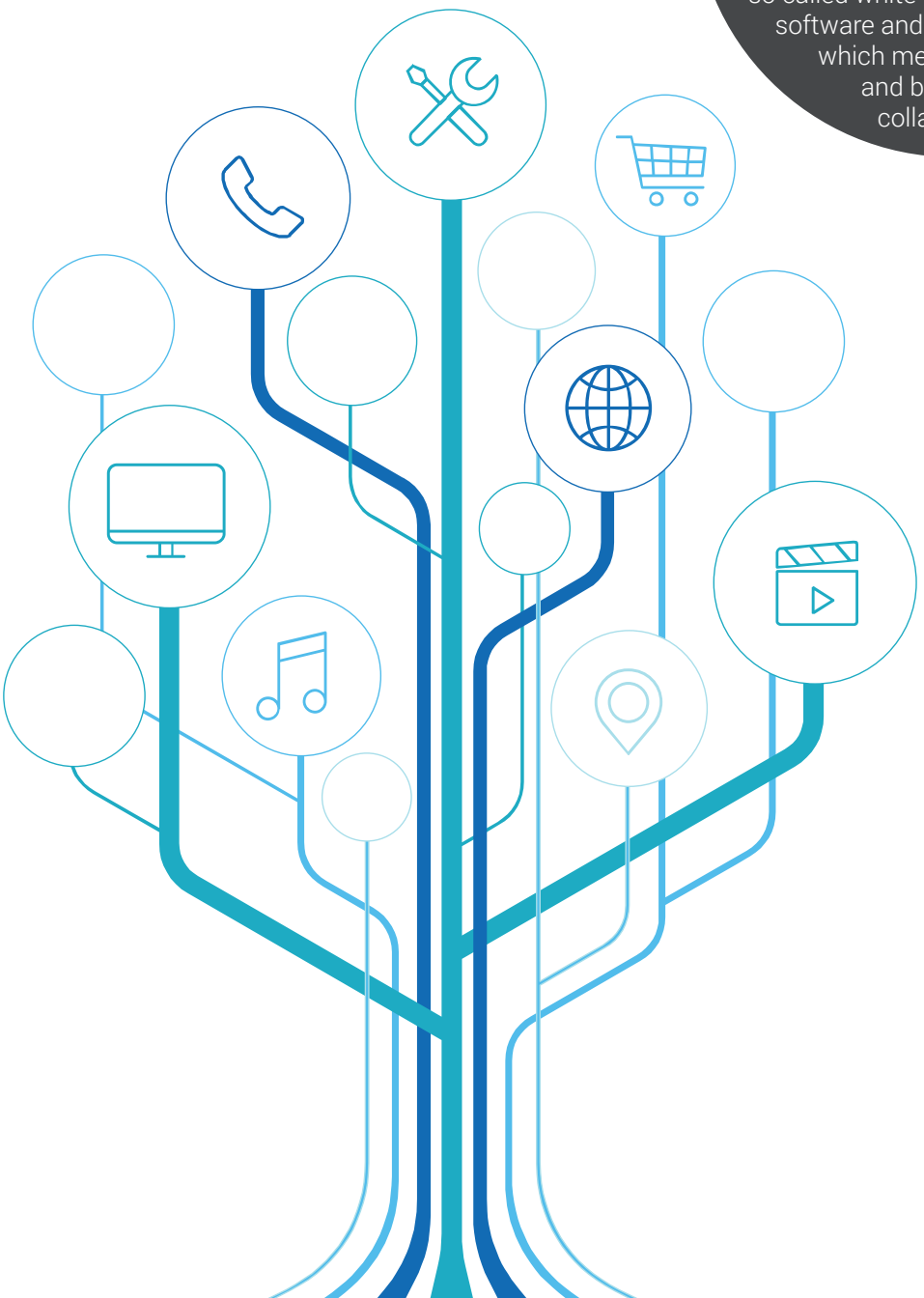
Bringing content and services more flexible to the end user.

Restructuring the central office to become an IT Datacenter supporting flexible and scalable service introduction with a rapid time to market.

ECONOMICS

Disaggregating active network elements to increase energy efficiency and reduce cost with white label network elements.

Cost reduction drivers with focus on energy and data center technology using merchant silicon based HW so called white box HW, open source software and community work - which means contribute and benefit from collaboration.



The most promising trend for a new generation of fixed access networks is the software-centric network modernization based on SDN principles.

Disaggregation of todays complex fixed access network appliances in modular hardware and software components will address the most challenging expectations to an access network service provider.

> ‘Software-ising’ the network promises to transform its cost base, but major challenges need to be overcome before operators can benefit from cost efficiency and faster innovation.[2]

2 Network ‘software-isation’ is an IEEE/5G term referring to the introduction of NFV/SDN; Analyst Reports, Analysys Mason, Detecon analysis; Survey: Heavy Reading Open and Disaggregated Network Survey 2020, Detecon analysis.

SDN based networks for cloud-centric services, the (r)evolution paths includes

Challenge: Telco fixed access network modernization

- New demand and technical requirements driven by cloud based AI, AR/VR and automation use cases.
- Consistent increments of fiber coverage ready to deliver Gigabit services.
- To keep networking expenditures under control to remain profitable.

Disaggregation

To enhance customer experience a more flexible service offering with drastical reduction of time to market is needed.

Green Strategy

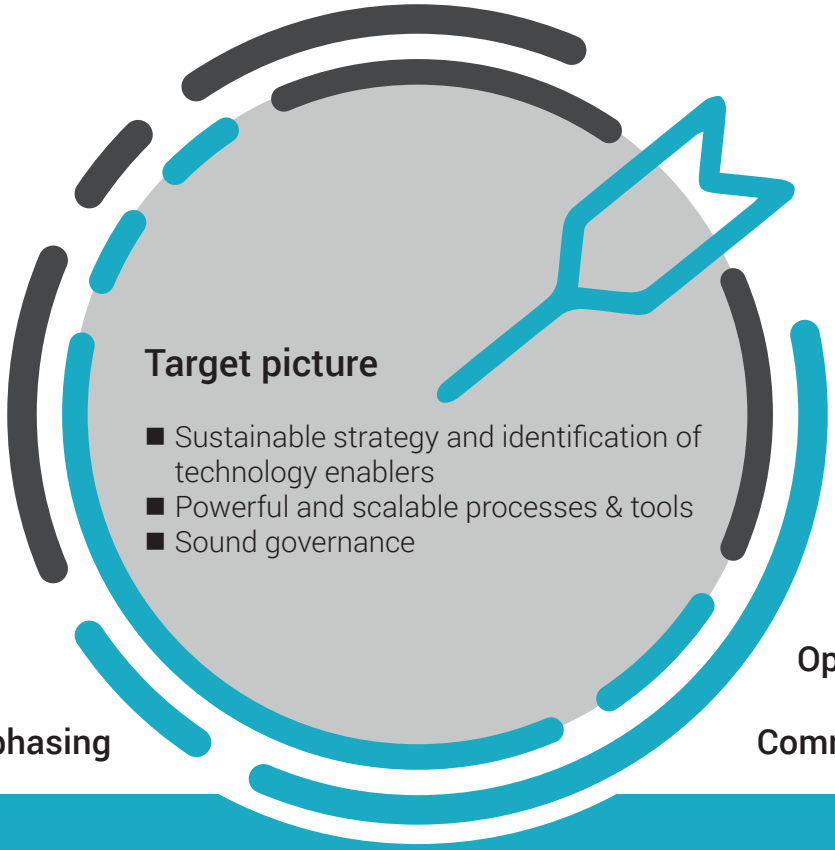
Future proof investments on access networks with a green strategy that include architecture, energy and legacy network retirement 'at the right time' and with the minimum impact.

TCO Reductions

Create a new eco system with new and more vendors for white boxes and open source software components and maximized automation.

A future proof software centric access network

- Adapted **Datacenter Design** for Central Office space put HW and SW in different domains offering scalability options in different dimensions – bandwidth, # of access lines, # comput power/storage.
- **White boxes** reduce capex, secure business continuity because of increased number of market players and due to competition innovation speed will be high.
- **Community work** is one of the most enabling factors for developing new features. Cooperation and exchange of standard components let the operator focus on real core business of service delivery.
- Besides common baseline SW and HW of the shelf differentiation to competition and rapid feature evolution is enabled by having **own control** over value generating service development. This requires skill and knowledge in SW design and Orchestration of the services.



Fibre Everywhere
Copper/HFC Outphasing

E2E Automation
Open Interface & API
Software
Common Infrastructure

Passive Network

- What are your main services and roadmap objectives 2030?
- What are the risks to your operation?
- What is the impact to your TCO?
- With whom should you partner?

Active Network

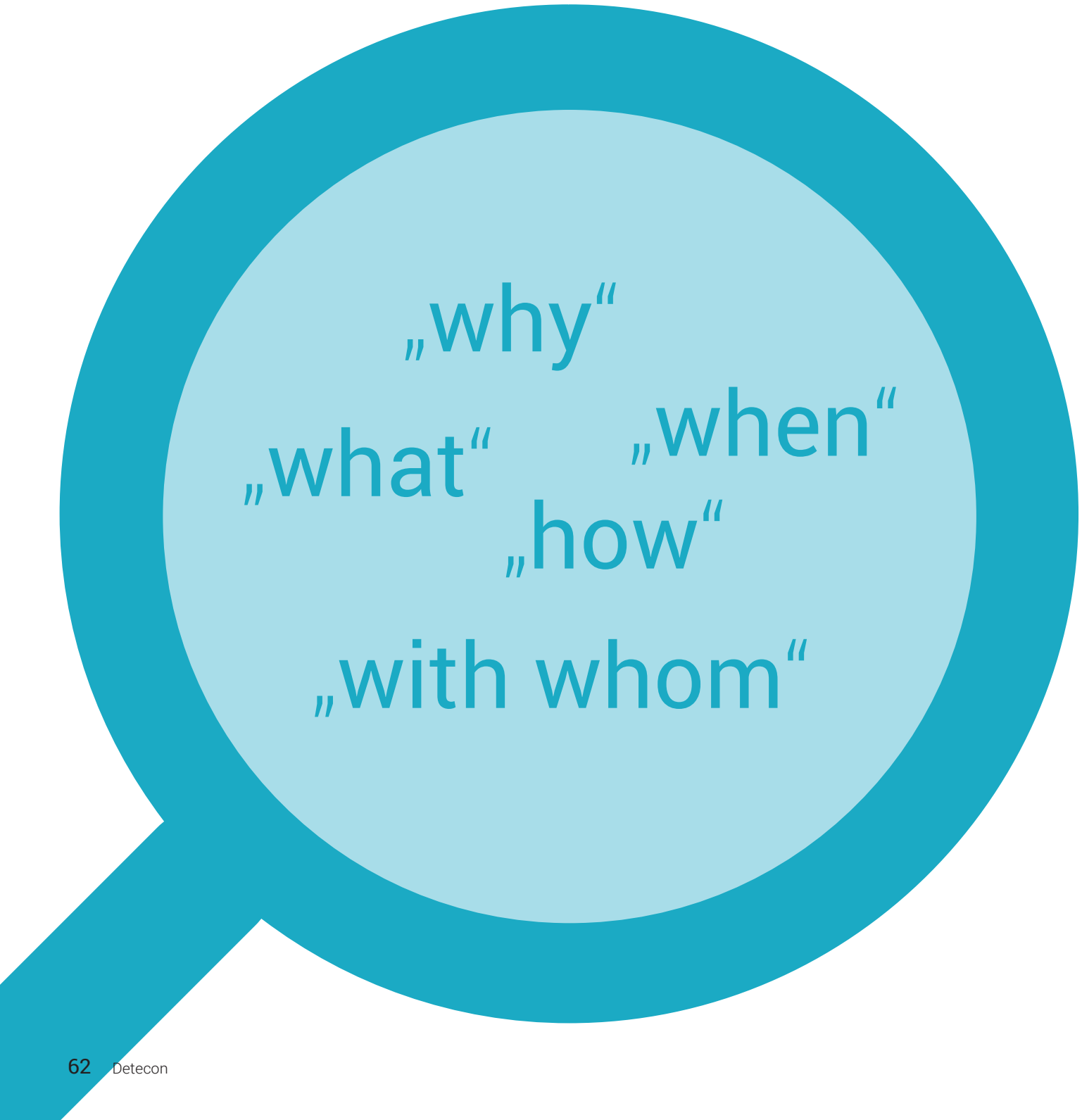
- How can you bring agility, automation in a multicloud environment?
- How can you provide secure access for all users?
- How can you improve user experience?
- What does the right mix of public and private cloud looks like?
- How to keep your costs under control?

How to get there?

- Assessment of current fixed access network and develop a viable business strategy
- Define a strategy to alliance with key players and stakeholders
- Set up scheme for contracts, governance, delivery framework, service architecture

Building a new ecosystem for Software Centric Access

There are multiple pathways that operators could follow for the implementation of access networks modernization. Implementing a successful software centric access network ecosystem requires deep knowledge.



Success Factors

1

Define a clear target picture

What is the target access network architecture for 2025?

What are the services your clients want in 2025?

What will make your access network standout your clients by 2025?

What partners are needed to build a SW centric access network ecosystem?

2

Identify the drivers of change enabling the target picture

Why should I change to a SW centric access network?

Why should you upgrade your passive network?

Why disaggregate your active network?

Why start thinking now about SW centric access networks?

3

Plan your legacy access network retirement

Legacy networks will influence your decisions significantly to define when is the right time to start the implementation of a software centric access network, other factors may include technology maturity and the impact to your market(s) of operations.

4

Get ready for increased complexity

Software centric access networks has to deal with more vendors and a larger community.

Building-up a large and new ecosystem has the potential to bring significant benefits, however if this new ecosystem is not managed properly, it may only bring delays.

5

Software centric culture

To build a new successful ecosystem will require not only the best partners and community, it will also require a culture where people are open to adapt to a new ecosystem that allow you to build and operate the telecommunication access network of tomorrow.

Klaus Hilbers I Managing Consultant

"The controlled and supervised orchestration of modularized and softwarized access networks will be the key challenge for a successful Central Office transformation."

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Carlos Castaneda I Senior Consultant

"Access Networks are moving towards a disaggregated digital network and operations platform, that will look like a system, but act as a platform with open and extensible properties, bringing significant cost-efficiencies within a new ecosystem."

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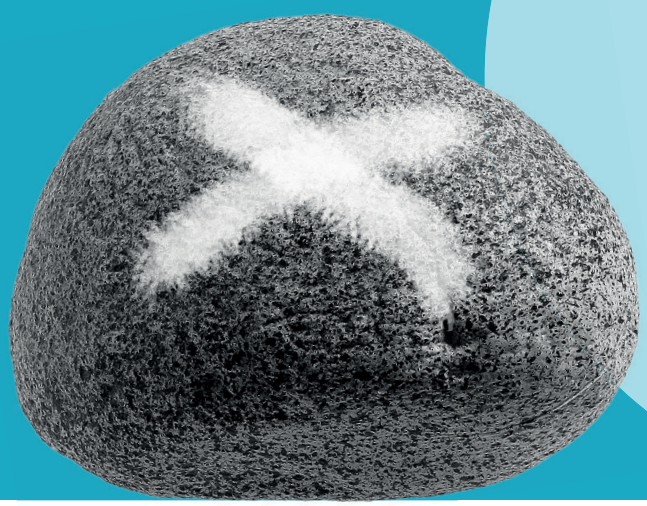
From Stones to Clouds

The gaming market is a rapidly growing entertainment market that is larger than the video or audio streaming services industries.

Cloud gaming as a disruptive game changer is currently growing at a low rate compared to mobile or console gaming, but the technology is expected to grow steadily and strongly in the near future, provided the data center and network fundamentals are optimized for the gaming experience.

Gamers expect a console-like gaming experience, which means that stability and real-time performance are must-haves for potential cloud gaming services.

In addition, cloud gaming providers must ensure an appealing games offering in the service, as it turned out that this is the key driver to grow the customer base constantly.



Play everywhere

Gamers will be able to play on any device while at home or mobile on the go with seamless gaming experience.

Play with anything

Gamers won't require expensive gaming hardware to experience best quality and performance of gaming.

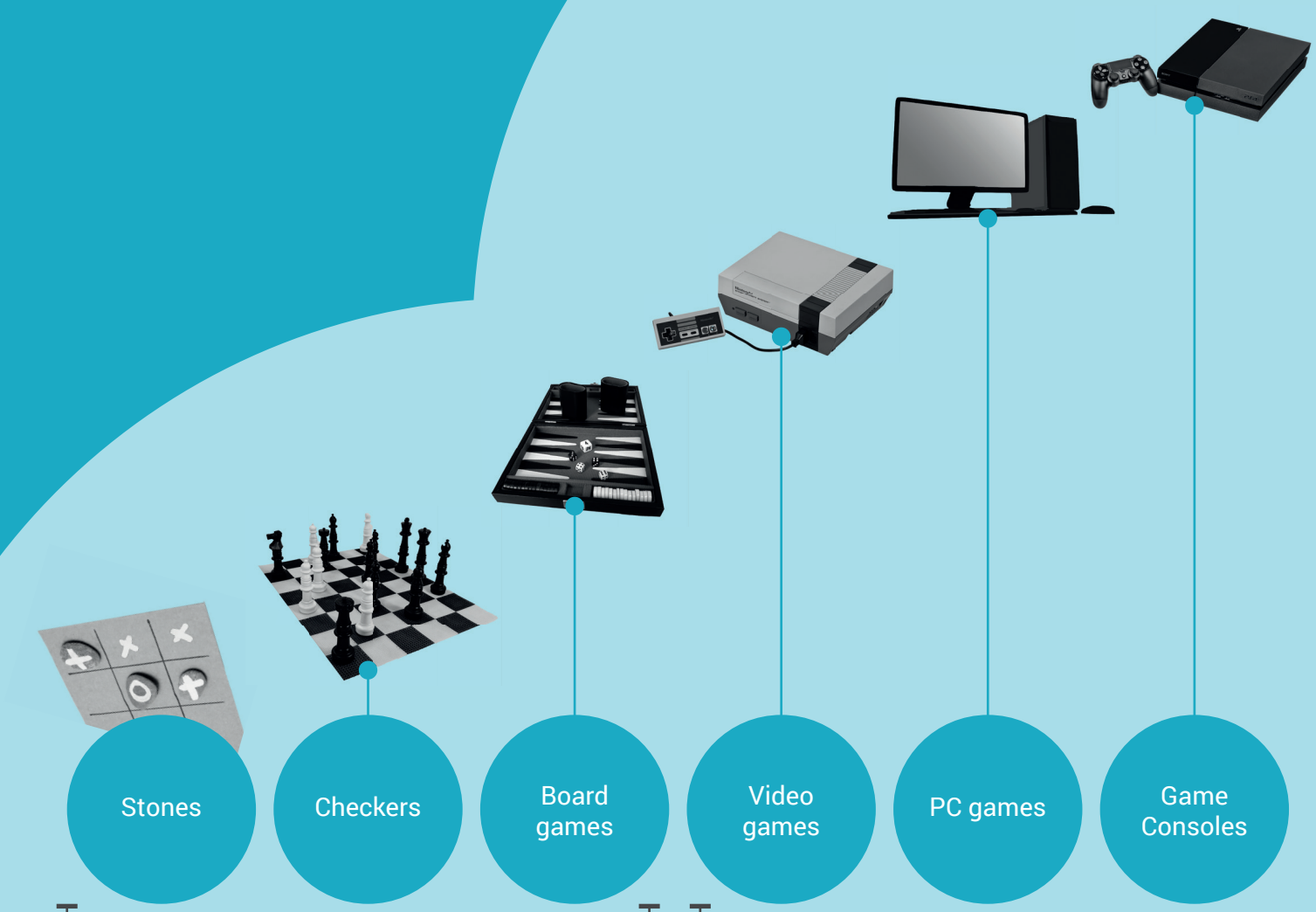
What really makes the difference for customer traction in cloud gaming

The challenge for the cloud gaming innovation is to convince the adult gaming market of the benefits of the gaming cloud.

A bigger argument than the use of different devices for gaming is the availability of high-end gaming hardware at a low price in the cloud. Providers must ensure that not only good titles are playable, but that they also work with the best possible performance and graphics. This is the unique advantage for customers to switch use from expensive gaming devices.

Telcos can make a decisive contribution to the value chain with the establishment and partnerships for strong data center capabilities and network optimization and be an enabler for the future of game streaming.

The Evolution of Gaming



Start: solo player

Moore's Law:
Technology complexity doubles every 2 years

8000 BC | 700 AD | 1910 AD | 1970 | 1995 | 2000

Portable games

Mobile & tablet games

VR games

AR games

Spectating games eSports

Multi device gaming

... gaming hardware

Digital game experience with bandwidth

Present: millions of players

Zuckerberg's Law:
Era of Sharing – online collaboration and data consumption grows exponentially

2006 2010 2014 2016 2020 2025

Challenges and chances for telcos

Challenges

Massive increase in data traffic and data offerings.

Necessary optimization of network for latency and jitter and traffic prioritization.

Chances

Real 5G/XG B2C use case for selling mobile data offerings.

Utilization of network capabilities designed for high performance in industry – broaden the capabilities to B2C customer market and reduce costs at scale.

Refresh customer segments and introduce to a sound product portfolio in the area of home entertainment.

How can a telco successfully approach cloud gaming?

Product

Strengthen capabilities for network and data center optimization.

Ensure integration and strong collaboration between cloud gaming and home entertainment and data/communication product portfolio.

Development

Ensure flexible development based on strong customer-oriented requirements.

Focus on customers using the service and improve for retention and organic growth.

Game content

Establish strong partnerships with developers, publishers and potential competitors in the market is key.

Offer low entry barriers for new customers and serve premium offerings like "Bring your Own Game" for first movers like upper core and hardcore gamers.

Gaming 2030

VR/AR, In-Car, massive multiplayer online, multiple devices for one game, graphic like real, Free2Play content

Cloud gaming

Customers

- Play everywhere
- Play with any device
- No specific gaming hardware but best graphics

Developers/Publishers

- New opportunity to offer games
- Completely new types of games based on strong cloud hardware capabilities never affordable for gamers

Felix Sprenger I Senior Consultant

"To compete for a slice of the gaming market, telcos should focus on fostering a smart ecosystem of partners and utilize core assets to create a superb gaming experience for their customers."

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Christian Nover I Senior Consultant

"Multi Device Gaming is the next evolution of gaming. Edge Cloud technology and a capable network will be the enablers for a new era of powerful games and embody key cornerstones for Telcos to enrich their product offerings and refresh their customer base."

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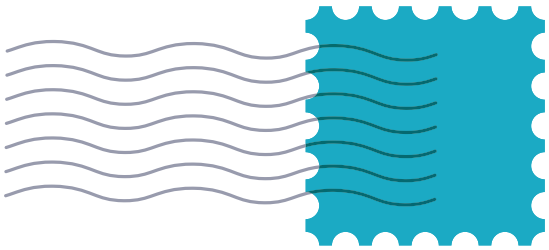
Anatomy of a Telco Ecosystem in 2030

A short note on the ecosystem hype and a look ahead at the future role of the chief ecosystem officer. Sparked by the success of the hyperscalers, the terms "ecosystem play" and "platform play" have become key buzzwords for strategists and consultants. Misused by some, misunderstood by others, and adopted by first movers to disrupt industries, ecosystem play has become firmly established. Telcos, who have operated as a networked industry throughout their history, have for many years sought ways to participate in the modern form of "over the top" ecosystem play. The growing number of failures and successful strategies now becoming visible have prompted Detecon to launch its telecommunications ecosystem index research in 2021, a project for the analysis of more than 145 telco ecosystems. We will use the results to guide our partners into the next ecosystem design revolution.

In the following discussion, we will present Detecon's perspective along with some of the early findings from our research as well as take a look into the future and describe the form telco ecosystems will have in 2030.

We discovered that by 2030 ecosystem design will have changed competitive paradigms, shifting from work activities taking place in silos to co-evolution, from the management of tiered partnerships to fluid value streams, from having one business model to pursuing multidimensional ones. The anatomy of an ecosystem in 2030 has the following characteristics:

- **Hyper customer centricity**
- **Seamless macro-orchestration capabilities**
- **Things and agents as customers**
- **Cognitive operating models**
- **Automated stakeholder management capabilities**



Postcard from the future

Wanting to find out what the future holds for us, we stepped into our time machine and traveled to the year 2030 for a discussion with Dan Wright, Chief Ecosystem Officer at Telecom X.

Dan Wright, Chief Ecosystem Officer at Telecom X

Dan, when did you assume the position of chief ecosystem officer and what was the first thing you realized in your new job?

I started back in 2021 when we carried out a benchmark study on six competitors to assess their ecosystem strategy at the time. The benchmarks that came out of our work revealed that most competitors in the telecommunication industry were already in the process of integrating multiple ecosystems in various verticals and working with highly complex partner networks. My first and most important realization was that Telecom X was lagging far behind and that we needed to adapt if we wanted to stay competitive, by riding the wave of disruption that was headed our way. Momentum was key.

Did you manage to catch the wave at the right point? And how?

We certainly did. First, by changing every possible paradigm; second, by mastering crowd co-creation and crowd co-evolution within several complex networks; and third, with our scaling strategy, once we got the basics right.

So what is the anatomy of your ecosystems at this exact moment on June 13, 2030?

We interact in a group of ecosystems (currently a total of 87); the company pursues what we call the "ecosystem of ecosystems strategy" that has constant business innovation at its core and that serves advanced customer segments from the digital society. Our current anatomy can be summarized succinctly like this:

- Telecom X co-creates with 87 ecosystems. Each ecosystem is given its own design elements that include basic topology, hierarchy of roles and participants, links and synapses, information/data exchange, virtual transactions and physical assets, and distribution.
- Each ecosystem has partners who are specialists in fundamental areas (on average, 80 partners per ecosystem).
- In most of our ecosystems, the stakeholder 2.0 approach considers other systems, organizations, value chains, cognitive systems, and machines as ecosystems users, too.
- Data drives everything. Just like nutrients and water in a biological ecosystem, data and information exchange are the basis for growth. FRAND (Fair, Reasonable and Non-Discriminatory) access to data has proven to be a key principle driving growth in many of our ecosystems.
- All our ecosystems are cross-industry. There are no clear provider/consumer roles anymore. Everyone consumes resources and services from the ecosystem, everyone contributes to it.

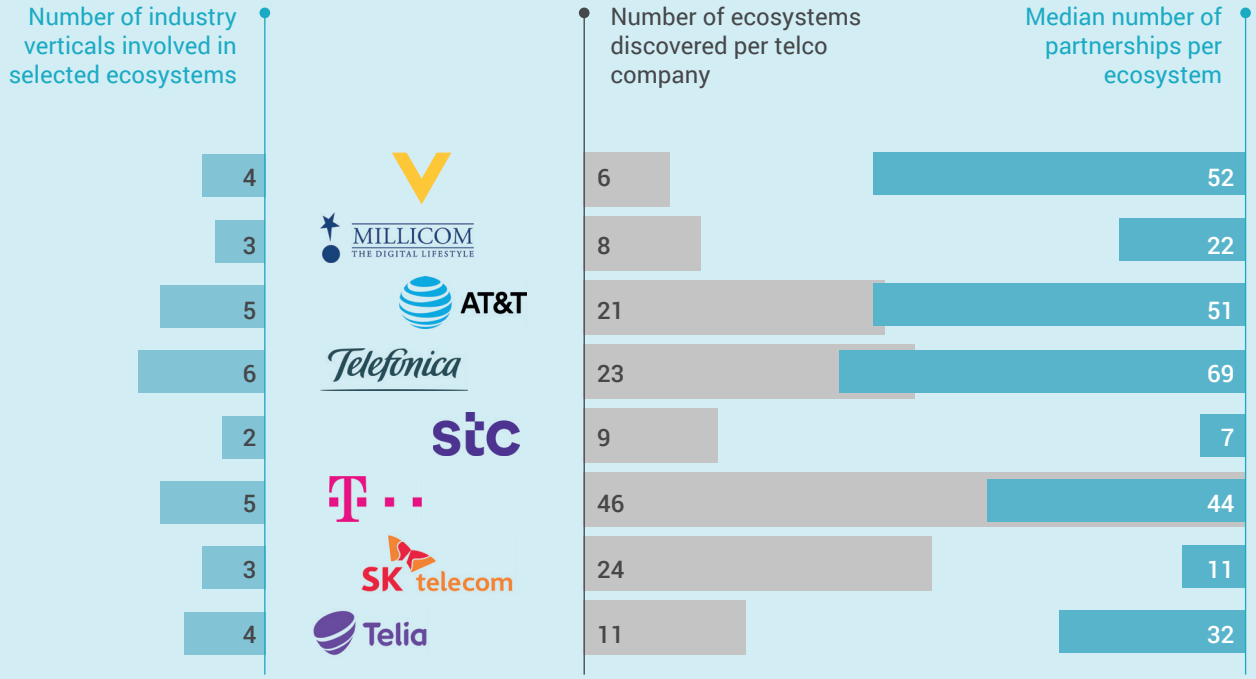
What are three key lessons learned from your ecosystem experience?

- Successful ecosystems will continue to grow in numbers, size, and complexity. Stakeholders, interrelationships, and data will not stop evolving. Mechanisms need to evolve simultaneously to keep pace with these developments.
- Ecosystems are dynamic macro- and micro-structures, and the ability to adapt will be crucial for long-term survival.
- Trust is the secret sauce for any ecosystem. It took many, many years to build trust and create mechanisms for sharing and conferring trust. In a few cases, regulation actually helped.

Ecosystems in the telecommunications industry today

Our latest research from the present clearly indicates that the future has already arrived: telcos have started embracing ecosystems! Leading global players already participate in 20 or more ecosystems. Telecoms have realized that without partners from other industries they cannot deliver the end-to-end value their customers require, and so they are reaching out to join and to integrate into other verticals. A typical ecosystem involves players from five other verticals. And the ecosystems are "healthy," populated by a broad variety of "species." The median number of players is in most cases in double digits and exceeds the threshold of 50.

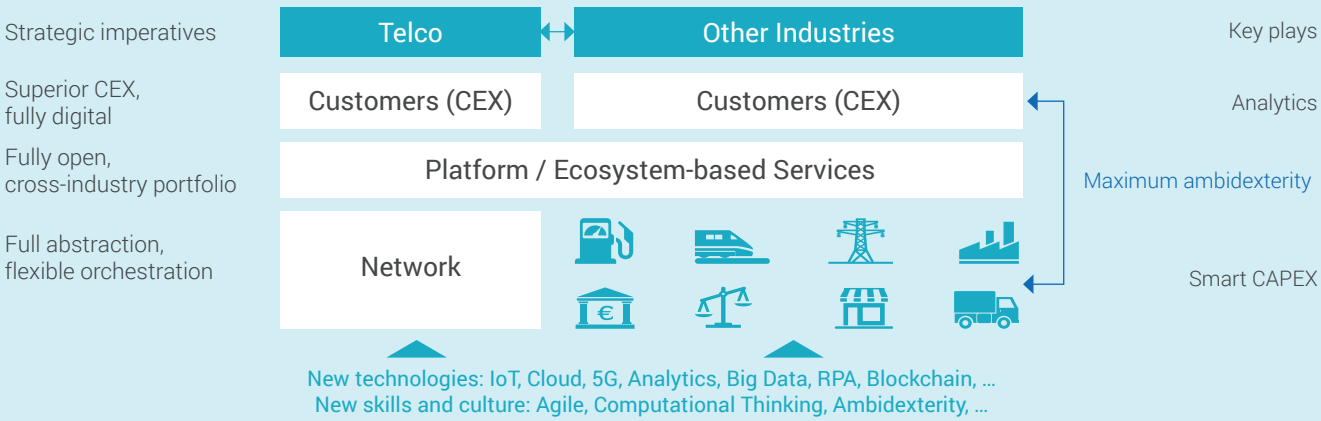
Telecommunication Ecosystem Index findings



Ecosystems are cross-industry and link customers with infrastructure assets

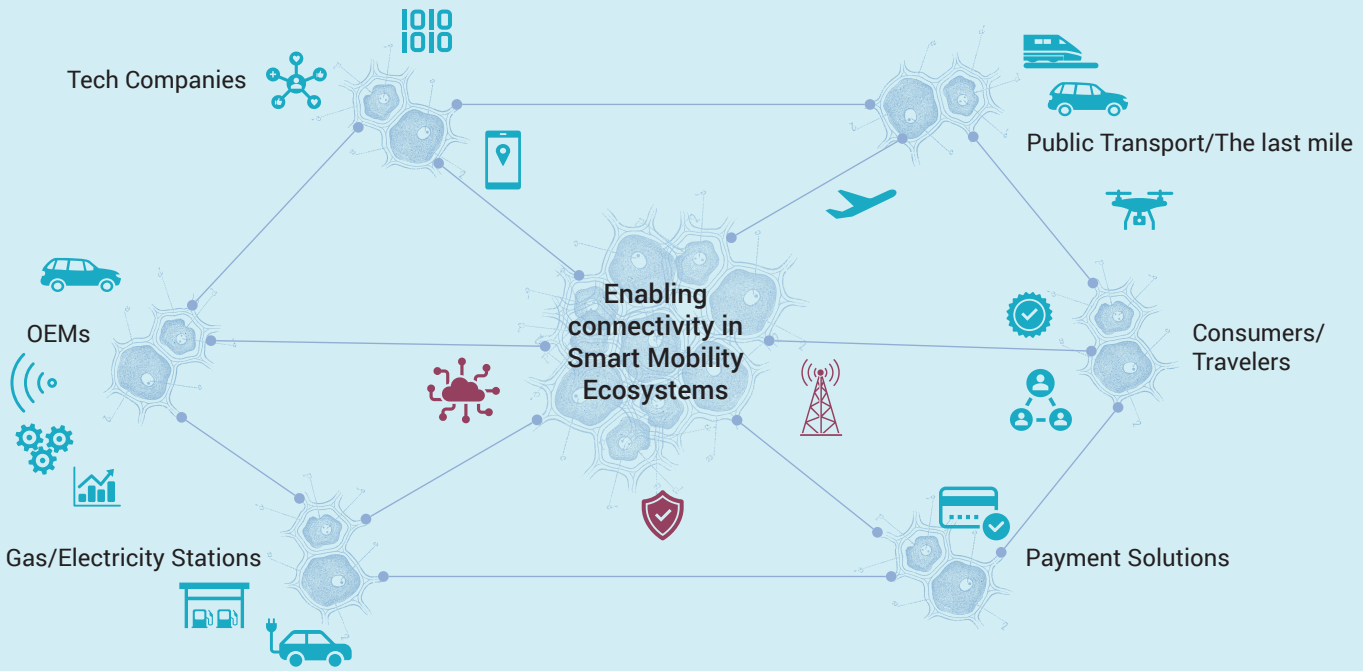
Telcos' biggest assets are their customer base and their infrastructure and they must be protected in any ecosystem play. This is also true for other industries, whether energy, retail trade, banking, transportation, or anything else. Ecosystems generate their value primarily at the services layer.

Cross-industry Ecosystem Architecture



As the business logic for a customer-centric organization differs greatly from that of an infrastructure player, end-to-end business models require the greatest organizational stretch – from steering logic to culture and mindset. For telcos and incumbents from other industries, breaking up into separate entities that tap into the service ecosystem might become viable options as we approach 2030. "Over-the-top" players in any industry, whether telco, travel, or transport of financial services, follow exactly this approach.

Exemplary Ecosystem (Mobility Sector)



Dr. Daniela Drube I Managing Consultant

"The future success of ecosystems is based on a well-designed governance model that allows all participants - including customers - to innovate together and dynamically adapt to changing market demands."

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Riem Jalajel I Senior Consultant

"Successful ecosystem play is one of the key enablers for Telcos to develop innovative customer services. What is left to decide is the role Telcos will play in those ecosystems."

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Gabriela Wiest I Senior Consultant

"Ecosystem-strategy-design is the key to manage & leverage complexity in the industries of tomorrow."

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HomeOS: Delightful In-House Experience

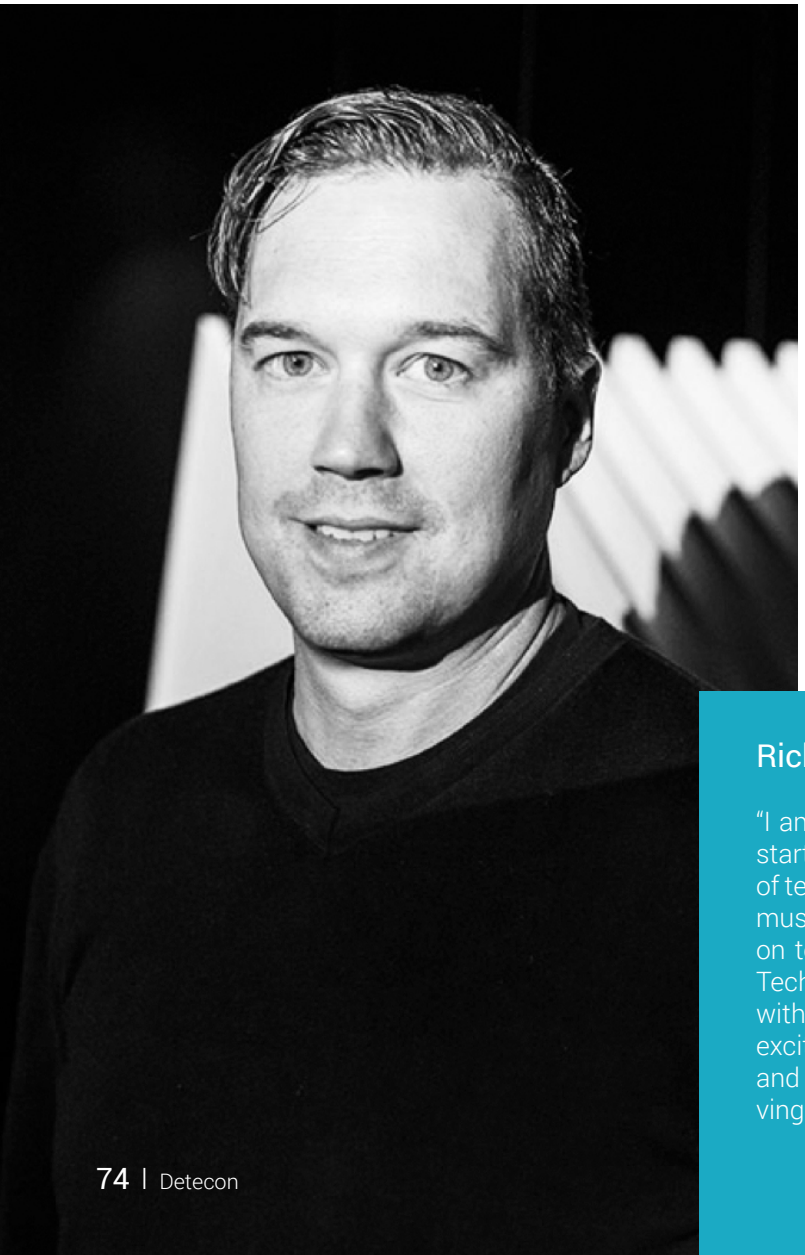
Three questions about the future for Rickard Damm, Deutsche Telekom AG

1 What is HomeOS about?

HomeOS addresses a major white spot on the image of most telcos: the seamless interplay among different service domains for the creation of truly converged experiences.

HomeOS is built around the concept that customers will expect us to deliver a much more fluid and integrated user experience in the future if we want to compete against the hyperscalers who themselves want to muscle in on our core domains of entertainment, communications, and connectivity. It is easy to imagine a scenario in which future customers will find, compare, and buy a service based on how well it fits into their own technology ecosystems at home rather than on price alone. We see this happening even today in the mobile sector when customers enter one of the dominant ecosystems and get "stuck" there.

Our objective in providing HomeOS is to offer an open ecosystem encompassing the technology in people's homes based on cloud APIs, where cross-domain use cases come to life. It may comprise obvious services such as asking the voice assistant to create a guest network on the fly and display the access credentials on your TV or more advanced use cases such as having your house act as a family member in your chat reminding you of tasks or recommending new items that complement well the products you have already installed.



Rickard Damm, Vice President, Deutsche Telekom AG

"I am Swedish, and my career in the telecommunications industry started at Ericsson, where I spent ten years working with a broad set of technologies and products such as mobile advertising, streaming music, and core network features. After leaving Ericsson, I moved on to the Telia Group where, among other activities, I headed the Technology Innovation department and the innovation partnership with Spotify. At Deutsche Telekom, I am in charge of "HomeOS", an exciting service that will soon be available in millions of households and create a clearly differentiated and delightful experience involving our products."

2 What will the "connected home" look like in 2030?

The appetite and demand for ever-increasing bandwidth and lower latency will not stop. Deutsche Telekom´s commitment to building fiber optic networks and 5G is crucial and will secure our leading position for the next 10 to 20 years. I am convinced that there will be no need to find "killer applications" for these technologies; the killer apps will emerge naturally when there is a crucial mass of users. This is what happened with Spotify, for instance. The story of its creation is that Daniel Ek, after having high-speed internet installed, quickly became bored with bad download experiences and decided to do something about it. The same thing will happen with 5G and higher-speed fiber optic internet. We already see this occurring in places such as Sweden where houses without fiber optic connectivity are less attractive for the market. Families like mine who have teenage children simply cannot imagine going "back in time" after growing accustomed to the new world.

As far as new technologies inside the home environment are concerned, I would like to think that very few households will be completely without smart devices. Many households are becoming smart homes without the awareness of the people living in them when, for example, families upgrade to a new vacuum cleaner or buy connected lightbulbs from IKEA. My prediction is that an average family will have hundreds of connected devices on their home network without ever having thought about creating an elaborate "Smart Home."

Another big trend I attribute to the years of the pandemic is the future of communication and togetherness among widely separated family members and loved ones. I would not be at all surprised to see super-high-definition video communications and content sharing from the living room, possibly even with 3-D capability, turn into a substantial driver for higher bandwidth and edge cloud services.

3 Are there any technologies or products you find especially exciting for the future?

I am always excited about technologies that significantly enhance the user experience and technologies that dramatically increase performance. One area where I think that we have only just started to see huge innovations emerging is in the field of cameras in combination with other sensors and GPU/tensor chipsets on cellphones, tablets, and other devices. The supporting AI chipsets required for advanced processing in real time are coming down in cost and size. We will quite soon see things that previously required large cloud capacity now able to run on individual devices. One example of this is Facebook Portal and the Apple Center Stage feature where an AI "cameraman" follows you around the room and zooms in where appropriate. These types of functions require very advanced AI models to run and would not have been possible only a few years ago.

Customer Experience for Digital Rookies — Success Factor for Telco Services for an Aging Population

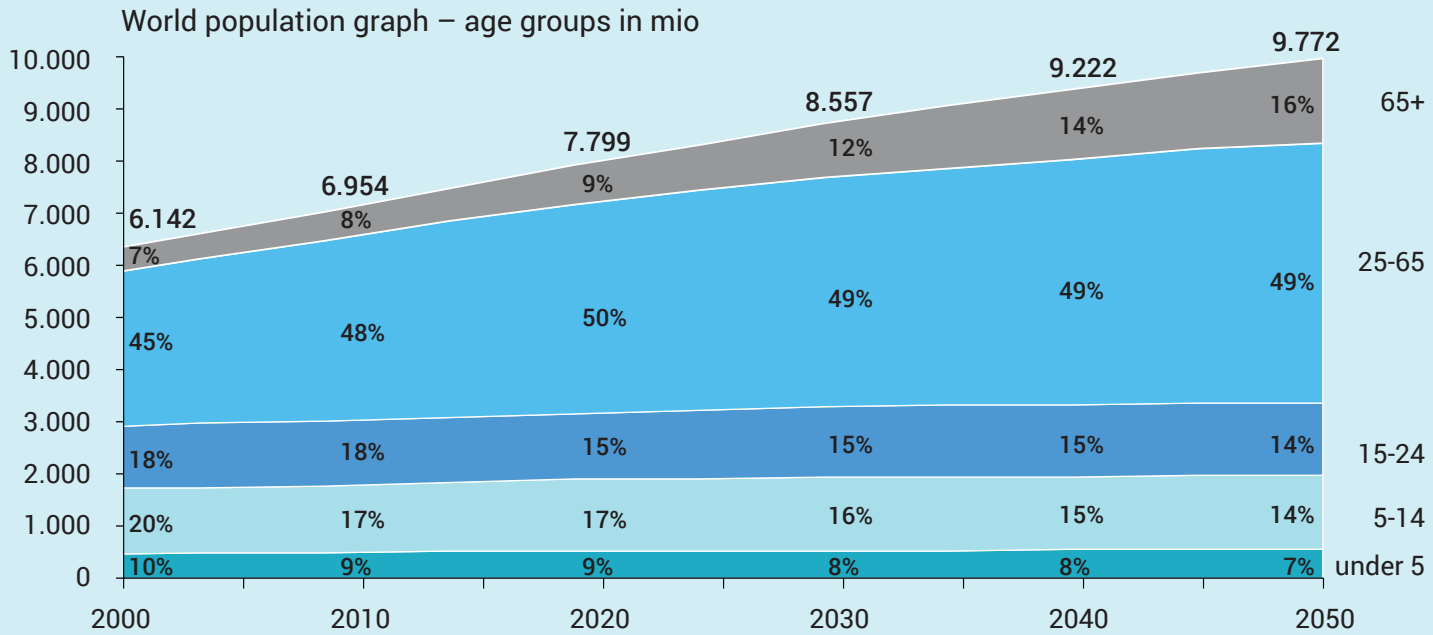
Smart home and smart health use cases for an aging population are a foreseeable megatrend in the consumer ICT business and a major opportunity for telcos to succeed in product categories beyond simple connectivity. Realizing a convincing customer experience (CX) for this specific target group is indispensable, if the telcos really want to put points on the board.

We are talking about a very specific, yet fast-growing and highly interesting market. The age group of 65+ has nearly doubled since 2000 and will be the most rapidly-growing age group within the total world population until 2040, expecting double-digit percentage increases every five years.[1]

Coping with the challenges of an aging population is quickly becoming an issue that is not limited to countries in Europe or North America; it has international relevance as well for many other countries (in Asia, for example). This topic has various socio-economic aspects besides merely the sheer numbers of people involved. Increasing mobility renders the possibility to care for relatives several times a week burdening (if not impossible) for a growing part of the population. Digital tools in the smart home and digital health field can be a highly beneficial means of support enabling elderly citizens to remain independent and in their own homes as long as possible (ageing in place).[2]

Securing widespread acceptance and usage in this target group especially, comprising as it does digital immigrants and even downright digital evaders, will be a monumental task.

Recent experience during the pandemic has demonstrated that the relatively simple digital registration and scheduling procedures during the vaccination process for the prioritized elderly citizens represented a huge challenge for this specific target group. This became a source of considerable discord in some countries, e.g., Germany, because it sometimes seemed impossible to obtain a vaccination slot without considerable support from relatives or other persons more adept at navigating the digital world.



Source: ourworldindata

This highlights how critical and challenging the customer and user experience is for this specific target group. Smart home applications and use cases are not the exclusive domain of pioneers and tech nerds anymore, but smart home customers are of course predominately digital enthusiasts or at least digital natives. Customer journeys, support channels, devices, and user interfaces have until now been designed with these target groups in mind. This attitude will need to change as in our opinion elderly citizens who have very specific demands will be a key target group for future smart homes.

1 *Own calculation based on United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision*
2 *STL Partners "Coordinating the care of the elderly" (2020)*

Key factors for a convincing CX for the elderly

1. Key requirement: RELIABILITY

Surprise outages will be inacceptable, especially for use cases relevant for health care and monitoring. Cast-iron connectivity is a must, but is feasibly achievable solely by using redundant connectivity technologies (broadband and 5G) with proactive monitoring.

The perception of reliability, however, will be dependent on the user experience as well because elderly users' own insecurities in operating devices will strongly impact their perception of reliability; "foolproof" management of devices and settings is essential.

2. Multirole setup

Along with the elderly users themselves, there are several other roles that might be relevant as elements of the solution. Tracking or monitoring messages or alarms might be sent to children, day care services, or the next-door neighbor, depending on the individual setup. There is of course a constant tug of war between independence, self-determination and, ultimately, human dignity on the one hand and the safeguarding of the intended protection function on the other.

3. Layered user experience

Ease of use, convenience, and status transparency are always crucial CX elements, but they are extraordinarily critical when it comes to this target group. The user experience (UX) must be mindful of the low digital maturity and users' insecurity about settings and required actions while giving due consideration to the needs of other roles (configurators, care, persons of trust) at the same time.

4. Personalization and capability profile

Personalization will have to address the needs and competence profile of specific users precisely. Compensation for multiple frailties might be required, whether sensual limitations (poor hearing, vision, etc.) or other factors (e.g., users with onsetting dementia might need reminders at a frequency level that would annoy and frustrate users whose mental awareness has not been impaired).

5. User perception mirroring

Artificial intelligence (AI) support for sensors simplifies the handling of functions and communication activities for the elderly. Owing to daily interaction with users and machine learning, AI can create an objective user perception status and recognize unusual behavior of the users or the slow degradation of sensory, communicative, or intellectual skills. Furthermore, it can recognize otherwise unmonitored actions and act appropriately, e.g., by initiating an emergency call.

Telcos have a competitive edge on this challenging, although highly promising, market. Convincing people who grew up without the internet to value and trust technology with their private health care data and their personal health is genuinely challenging. Security is one key factor for smart home products.[3] Telcos benefit in this respect from a more positive reputation concerning security than other competitors. On a local level, telcos already have access to many homes, facilitating their entry in comparison with other third parties. This advantage is further enhanced by the decentral services from telcos that can render support when needed. New technologies such as Wi-Fi motion sensing that can be integrated directly into telco routers and mesh devices create further opportunities.

Some telcos are already addressing the demands of this market. KPN, for instance, supports digital transformation because the health-care sector is still heavily dependent on legacy ICT and closed systems (B2B2C). Tele2 is cooperating with the startup Cuviva (B2C) and using a home computer with connected sensors to measure and report patient parameters automatically. SK Telecom has even launched its AI-based speaker for senior care service (B2C).

But regardless of the concrete business model, the time to act is now. Patient empowerment is already the largest investment focus in the health care startup sector that is the subject of so much hype at present.

Healthcare startup investments in tools by area of focus 2019 in billion $

Source: StartUp Health Insights, 2019

3 *Omdia "Telco Smart Home Strategies 2021: Key market trends and challenges" (2021)*

Mona Bschaden I Consultant

"For the growing market of smart home & smart health applications CX is absolutely crucial. It has to deliver ease of use and convenience combined with trust and security to foster adoption and usage."

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Joachim Hauk I Managing Consultant

"In these use cases, the needs of elderly users, relatives and professional support must be taken into account. Especially for the elderly it has to deliver an experience allowing lacking of digital skills, sensory and other limitations, but still ensures the functionality, privacy and dignity of the users!"

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Bots in Customer Service 2030

Three questions to Gereon Hammel, Deutsche Telekom Service

Bots are the 1st level assistant in customer service 2030. Detecon Consultant Andreas Penkert asked Gereon Hammel, Vice President Business Development at Deutsche Telekom Service, how the interaction between machine and human will work in customer dialogue.

1 **What will the dialogue with telecommunications providers in 2030 look like from the customer's point of view?**

The first contact for most issues and customer groups will be in digital form, be it through messaging, chat or voice bots, apps, or intelligent, self-service features based on need and offering diagnostics, FAQs, and explanatory videos. This means that customers will solve the vast majority of their service queries themselves without any human interaction. The development towards extensive automation and digitalization is clearly visible even today. In ten years, it will be taken for granted in all areas where customers can help themselves. We can already see how young customers in particular take advantage of these services. If we look at China, we determine that our projections for 2030 are already reality in large parts of the country.

Gereon Hammel leads business development at Deutsche Telekom Service GmbH. He has had almost 30 years of experience in the areas of governance, marketing, and innovation in the FMCG and telco industries.

INTERVIEW

2 **What role do digital assistants ("bots") play?**

Bots, the service assistants of the future (especially at the first-response level), will accept customer queries, solve the issues immediately, or, if necessary, pass them on to service agents silently and without waiting. The agents will then take charge of the query seamlessly, i.e., they will have all the information showing what the customers have already tried to do themselves and can continue there. All in all, service staff and digital assistants will work side by side on an almost equal footing and will collaborate harmoniously to achieve an excellent customer experience. And although we believe that bots will become smarter and smarter, better and better at providing assistance and will one day become more empathetic, we also believe that our employees can make the difference, especially with particularly complex issues. That's why we are currently investing massively in both professionalism and technology.

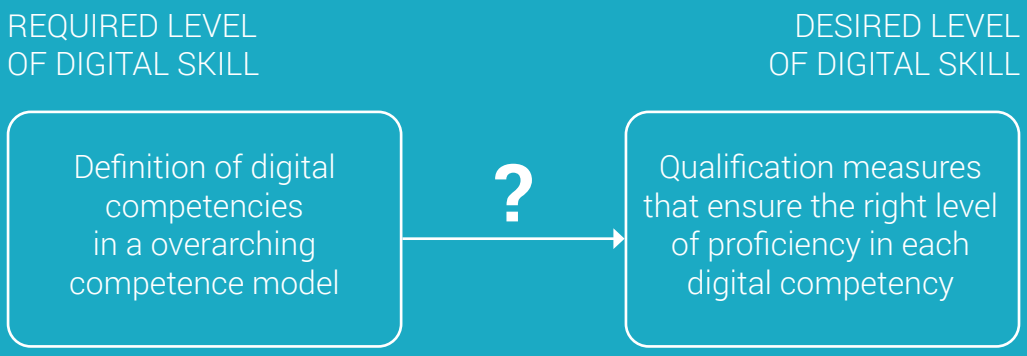
3 **Is it conceivable that end customers, not only companies, will use bots and have them work for them?**

Definitely! This scenario is already being discussed as a very concrete trend. In this sense, we speak of bot-to-bot interaction, i.e., a direct exchange between digital assistants on the company side and bots used by customers, which independently handle requests of various kinds. This development is clearly foreseeable today. Customers are already using chatbots like Amazon Alexa, Apple Siri, etc., to obtain weather forecasts, to calculate the travel time to their workplace, or even book tables at restaurants; my voice assistant connects with the booking system of my favorite restaurant to make the reservation. Even in the future, however, one system will not be able to cover all topics and tasks. Customers will assemble a team of specialized bots, e.g., for mobility, finance, or telecommunications, to handle all their requirements. The bots will be able to communicate with one another so that customers have the feeling that they are interacting with one single bot. The basic customer needs for simplicity and speed must still be realized effectively in the future.

Strategic Skill Transformation: Future-oriented Learning Approaches for Companies

The changing skill requirements due to digital transformation and the new normal are forcing companies to strategically focus on digital skills development. Companies frequently lack a framework to link strategic competence requirements with future-oriented qualification programs.

Required and desired level of digital skill



Skills and strategy must be aligned

Skills have a short half-life

The half-life of many professional skills is no more than 2.5 to 5 years.

New channels

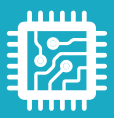
Employees access information differently than they did just a few years ago. Most are looking to new channels, e.g., online courses, forums.

Little time for learning

Employees can generally carve out no more than 1 percent of a typical workweek (that's 24 minutes per week) for training and development.

14% of the workforce **does not understand** their **company's strategy**

Less than **65%** of all organizations **do not successfully implement their strategy**



Digitalization is changing jobs

New technologies and rapid disruptions demand agility and the development of new competencies at the individual (and organizational) level.

Securing employability

Enable employees to prepare for tasks that are not yet precisely known.

The complexity of the work environment is on the rise

More than 80 percent of companies assess their business as "highly complex" or "complex" for employees.

Source: Detecon Future Learning Studie

Strategic skill transformation and organizational learning are levers for business strategy execution and success

Our Learning Journey approach provides a standardized & proven framework helping employees reach the desired proficiency levels. We see four major areas for action.

Strategic skill transformation

With the help of capability maps and an AI-based market analysis, we derive the skills needed to achieve the strategy. The skills are mapped with the capabilities and adjusted if necessary.

Learning architecture design

After deriving the strategic skills and identifying needed and existing skills, we develop the learning architecture that closes gaps between existing and needed skills.

Development of a learning portfolio

The learning architecture is enriched with a learning portfolio of sustainable learning journeys. Here we rely on our learning approach of the magic triangle: personal development, diversity and didactics, networking and exchange.

Building a learning culture

A portfolio is not enough to anchor learning sustainably. A learning culture based on community building serves as a lever for continuous learning and organizational development.

Dr. Volker Rieger I Managing Partner

"Telcos are particularly affected by the changing competency needs. Competing for talents with hyperscalers and startups requires new approaches for reskilling the existing workforce. Strategic skill transformation is the answer."

volker.rieger@detecon.com

Sophie Müller I Senior Consultant

"We need to step away from "stockpiling of knowledge" to learning cultures in which everyone feels motivated to renew and broaden his own skillset. Creating learning experiences will be a differentiating factor in the war for talents."

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