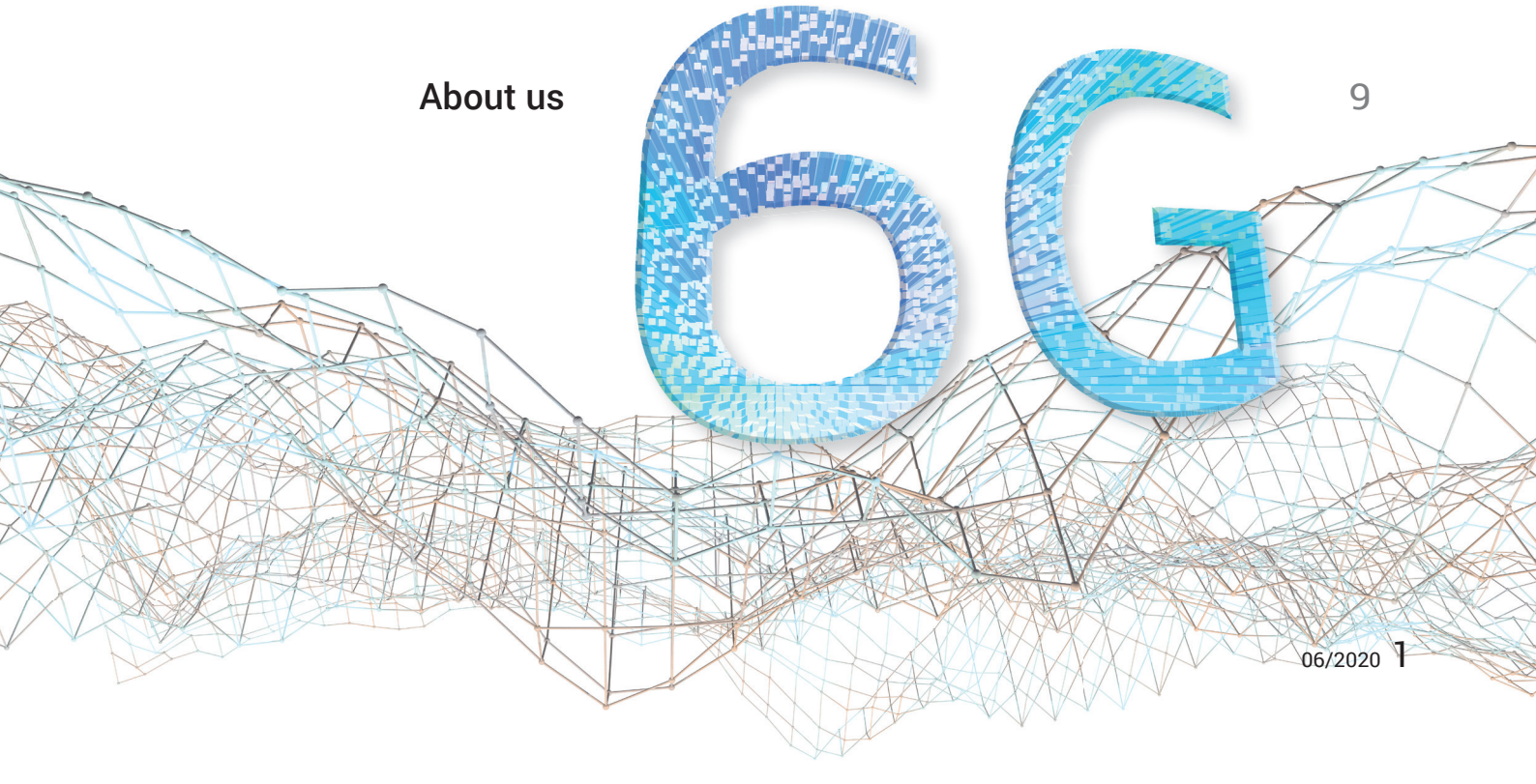
WHITE PAPER

6 Ideas About 6G

DETECON
CONSULTING

Content



Experts are certain: digitalization is here to stay and will even be accelerated by COVID-19

"6G – seriously?" You may well be puzzled to hear that our experts at Detecon are concerned with any "G" right now; after all, the implementation of 5G has barely begun and has yet to claim any significant share of the market.

Observers are fascinated by the unprecedented pace of exponential growth relating to all aspects of digitalization that is in such stark contrast to the virtual shutdown of public and economic activities around the globe caused by the similarly rapid spread of the COVID-19 pandemic. Even a mature (yet digitally conservative) market such as Germany has seen concepts such as digital schooling, participation in video conferences while working from home, and digital payment gaining momentum across the board. Digital tools have appeared in market sectors where no one would have predicted their use at the turn of the decade.

So why all the interest in 6G?

In view of our preoccupation with current events, we may seem to be getting ahead of ourselves when we peer into our crystal ball and try to determine what innovations await after the turn of the next decade. With everyone feeling now the power of a truly digitalized and location-independent economy, however, we need to define today our vision of the network standard of tomorrow to ensure a smooth and cost-effective transition to 6G. Indeed, Detecon consultants worldwide report that clients are expressing great interest in learning about what will happen next!

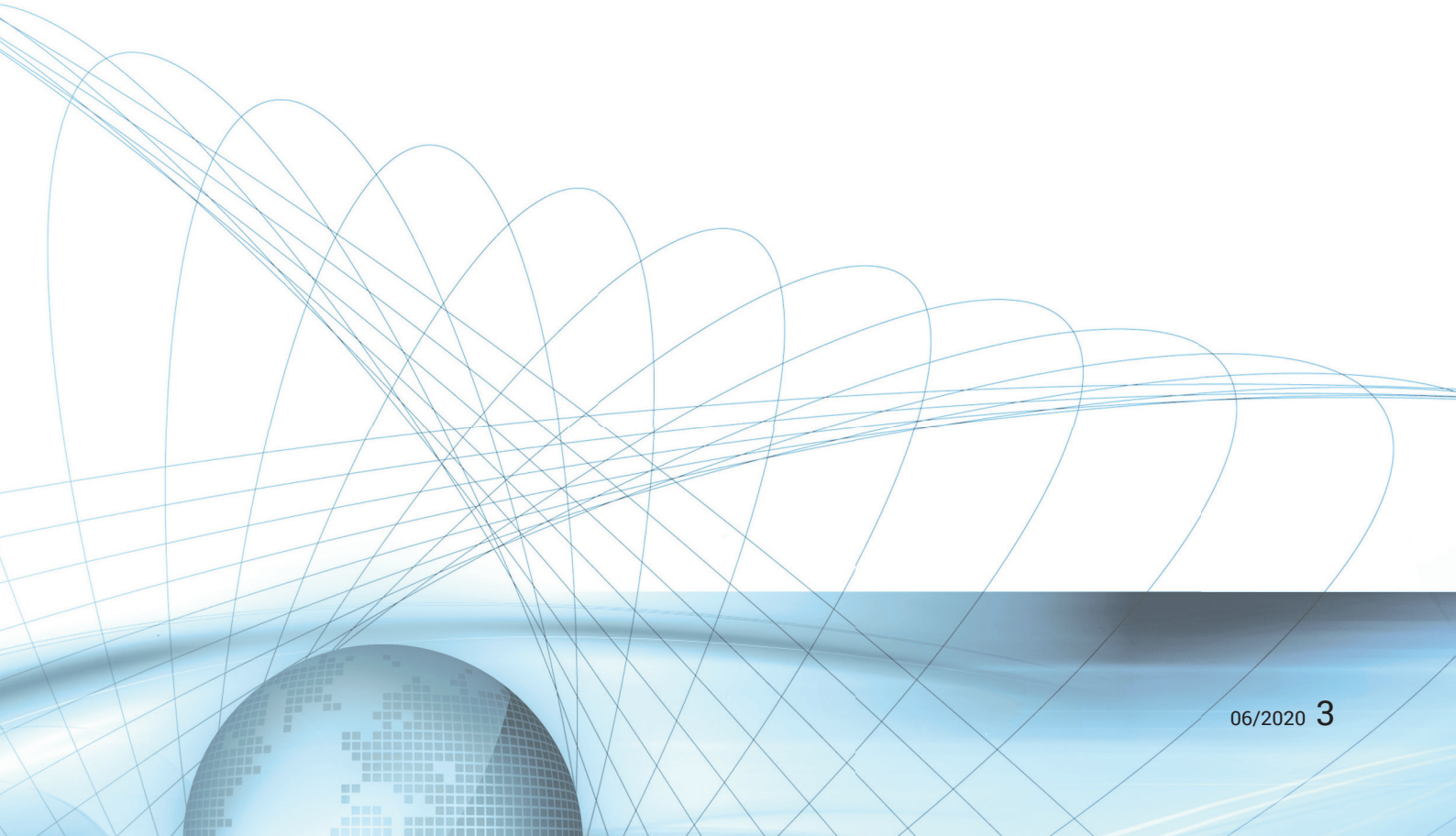
Six statements about 6G to sharpen our focus

Our task as consultants is to offer to our clients the guidance they require during periods of worldwide disruption and to highlight the elements we consider to be fundamental to the evolution of mobile networks over the course of the next ten years and beyond, so we spoke to our experts and asked for their insights. The excitement generated by consideration of the tremendous potential inherent in the capabilities of 5G when tailored to specific use cases that will be mined in the coming years has inspired us to focus our long-range sights on the start of the next decade and to extrapolate from our findings the driving concepts our experts foresee for 2030 when 6G deployment is expected to start. The following six statements on 6G draw on these concepts and leverage Detecon's 40 years of experience in the world of telecommunications.

The world of 6G rollouts in 2030

Before exploring these six key innovation areas, let us take a moment to consider how the world might have developed in ten years' time. As 2030 draws near, 3GPP releases will have slowly evolved the use case-specific aspects of 5G. Services such as URLLC, unlocked by built-in low latency and reliability concepts, will have reached markets and relevant use cases worldwide. Academics and industry will have collaborated to incorporate high gigahertz and terahertz bands into the standards for niche use cases, e.g., in industry and coverage scenarios. Legacy "Gs" such as UMTS and GSM may have mostly vanished on some markets while LTE will likely be retreating, but still heavily used, in certain areas of the world. Nonetheless, significant ranges of idle spectrum worldwide will be re-farmed to 4G and 5G – the latter now used in stand-alone core network setups (at least on mature markets in Europe, Asia, and the US). Assuming that it has been possible to avoid a "balkanization" of the global standards community in the post-pandemic decade, standardization under the umbrella of 3GPP and its partners may have remedied the drawbacks of 5G and created a practical stage for early 6G deployments.

In this world, ten years from now, six key innovation areas may take center stage in the development of 6G and early deployments will be positioned to leverage the following "extremes."



1. Extreme connectivity everywhere

6G will bring harmonized wireless connectivity across all frequencies and include satellites as well – white spots will become a thing of the past.

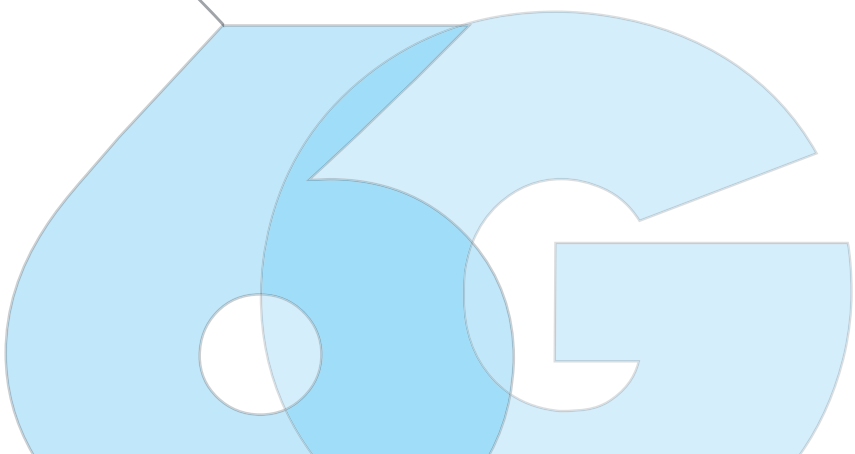
6G will drive wireless coverage and connectivity to a new level known as ubiquitous wireless connectivity. Standard 6G handsets will be able to use satellite systems and any combination of spectrum (licensed and unlicensed, outdoor and indoor). The use of frequencies ranging from a few hundred megahertz to hundreds of gigahertz is expected to solve the problems of patchy indoor coverage as well as the overall area coverage even in rural areas. We will have already seen improvements with 5G networks, especially in the lower frequency range. 6G is expected to take us one step further towards ubiquitous coverage in a technical sense as well as ubiquitous parallel connectivity to multiple operators. Technical coverage may diminish to the point where it is no more than one aspect of many while the evolution of related business models will generate potential for new market players of many types.

In addition, we expect Ethernet as a service of the mobile network to play an even more prominent role beyond 5G local area data network (LADN).

2. Extreme carbon footprint awareness

We expect operators and standardization authorities to integrate carbon footprint awareness into 6G design!

Environmental awareness and movements such as Fridays for Future make it essential for the communications industry to contribute its fair share by implementing measures that will reduce the carbon footprint of their infrastructure and services. While 5G includes functions such as lean carrier and advanced sleep mode as improvements in energy efficiency, an even broader approach is required to achieve climate neutrality. We expect 6G standardization to focus in particular on energy efficiency and carbon footprint awareness. This approach will be supported by artificial intelligence tasked with minimization of the carbon footprint. In a fully virtualized design of networking and cloud, for instance, the placement decisions for computing tasks will always consider and strive for carbon footprint minimization.



3. Extreme and pervasive AI

We foresee that AI will be used in every aspect of 6G, e.g., when bidding for network slice resources.

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. We even expect 6G to leverage AI for "value optimization" in the monetization processes.

Concepts such as network slicing-based value flow automation may be implemented and network slice owners will bid for prioritized access to network resources.

Machine learning will be found in applications on both sides of the transaction: increasing minimum bid prices for resource owners – the network operators –while minimizing bid prices on the part of the slice tenants. The trick is to maximize the bid success rate without violating an SLA for a slice-specific service. The associated value flow automation is expected to be based on an extension of 5G converged charging, easing real-time charging by means of a differentiated resource unit in which a bid time slot-specific identifier of a shared resource is subject to the bidding process.

4. Extreme security

We foresee specialized slices to overcome the inherent vulnerability of IP networking by leveraging concepts such as ETSI NGP RINA within the 6G standard.

Today's networks depend fully on IP connectivity, leveraging the paradigm of "sharing first" whenever public IP addresses have world-wide reachability. This reachability is later restricted via firewall rules to ensure control and security, yet it is still vulnerable as a target of distributed denial-of-service attacks.

However, this concept is not set in stone. ETSI NGP (next generation protocols) has defined a new protocol called RINA that eliminates the risk of such attacks by avoiding the use of IP addresses. RINA reverses the connectivity paradigm to "sharing last" and requires the explicit addition of the sharing partners (instead of weeding out undesirable sharing partners with the aid of firewalls).

As a means of fundamentally increasing the security of 6G over that of 5G, standardization may incorporate concepts such as RINA for specialized network slices. Such slices could provide higher security by virtue of their design while remaining compatible with legacy setups – leveraging interworking mechanisms such as RINA-over-IP as an overlay.

5. Extreme openness

We believe that – for the first time – open source will become a vital dimension of a 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 OpenRAN are making rapid progress.

As of 2020, 24 mobile operators that serve 2.4 billion customers have joined the ORAN alliance, which aims to shift the transformation of the industry in the direction of open, independent, intelligent, and interoperable mobile networks. This would help the mobile networks to accelerate innovation, to reduce costs, and to test and integrate network infrastructure. We believe that this time around open source alliances will be in a position to make a significant contribution to 6G development and become a vital dimension of the new standard.

6. Extreme fixed-mobile convergence with common core enabled by use of common identifiers

We foresee that 6G networks will have a common core for fixed and mobile customers that will enable them to offer a broad range of services and reduce costs and complexity across networks.

While 5G has brought advances in fixed-mobile convergence, the ultimate goal – the use of a common core by both fixed access and mobile access networks – has not yet been fully achieved. Progress that enables the use of the IMSI to authenticate the usage of mobile (VoLTE, VoNR) and fixed services (VoWiFi) has been made; however, fixed access still has its own identifiers that are independent of the IMSI. A converged identifier is required. In cooperation with BBF work area Wireline Wireless Convergence, the latest 3GPP architecture templates have introduced GLI (global line identifier) and GCI (global cable identifier) as additional types of the SUPI (subscription permanent identifiers) –in principle providing the option to extend the SUPI-related procedures from mobile to fixed.

The idea behind extreme convergence is that (when fixed access is involved) the UE is not required to indicate its SUPI to the network during the registration procedure thanks to the execution of a pre-registration procedure at the time of the fixed-line installation. Thinking even further, it may be possible to use an IMSI as SUPI of a fixed line by interpreting the line as an antenna or a very small cell which has the dimensions of the copper or fiber line diameter and serves only one subscriber. This approach would enable the method of federating the cell ID of a single subscriber cell to a single SUPI that is either an IMSI, a GLI, or a GCI. Additional convergence benefits may be in reach when a GLI is used as a cell ID, enabling convergent definition of tracking areas for converged wireline wireless network slicing.

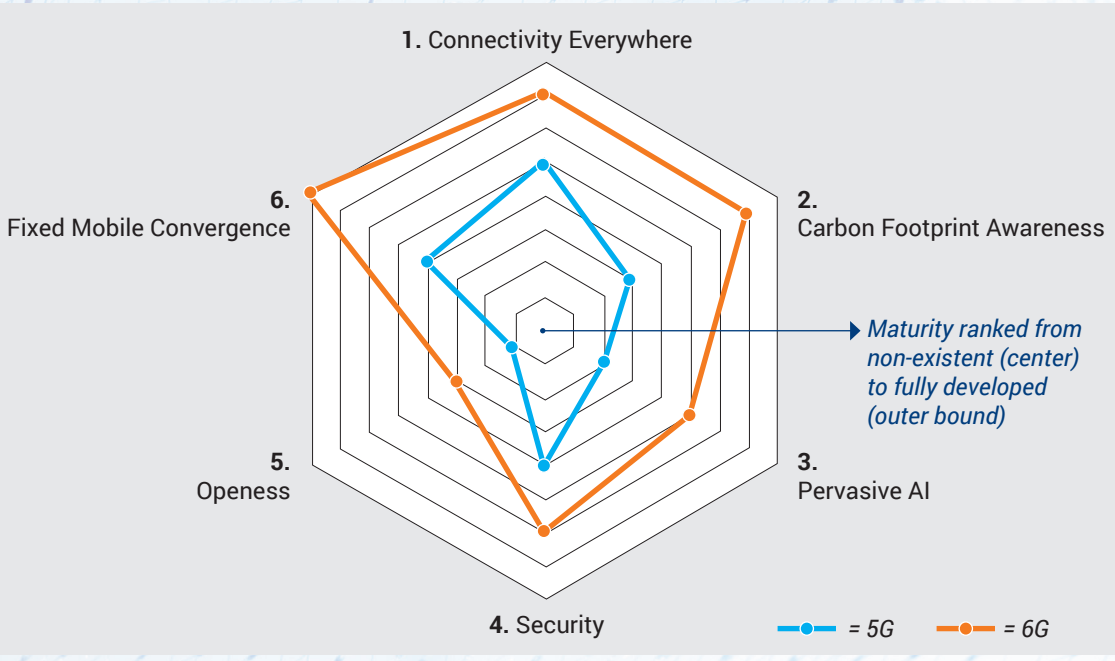
“Prediction is very difficult, especially if it‘s about the future.”

Keeping this quote from Niels Bohr in mind, our experts have in this article taken up the challenge of identifying key innovation areas during evolvement toward 6G networks. Significant uncertainties lay ahead, be it in the context of business models that leverage those innovation areas or of political ramifications and economic downturns that may affect both standardization as well as the acceptance of the envisioned services by users all over the world. Moreover, even though 5G is here to stay and will evolve parallel to the design and standardization of 6G, we believe that some dimensions of 6G will go well beyond 5G.

Outlook on the maturity of key innovation areas in 6G

Before we draw our final conclusions about the above statements and determine where we believe 6G will represent a giant leap rather an incremental step forward, let us examine the diagram shown below. It clearly reveals that the pervasive application of AI and an overall carbon-footprint awareness are both regarded as areas of tremendous improvement. On the other hand, incremental steps relating to coverage and security may be of value to customers, but it is not likely that they will be of such as scope as to be potentially experienced as revolutionary. Moreover, it appears there is a long way to go from today’s low assessment of openness in 5G, but 6G increments in this domain may bring the needed breakthrough on the road towards flexible network services. Bolstered by a truly mature converged architecture, 6G is expected to become so elastic and intelligent that it will be able to handle any demands made on the networks of the future by use cases that as of today have not even been conceived.

Outlook on the maturity of key innovation areas in 6G compared to 5G



Source: Detecon

Authors

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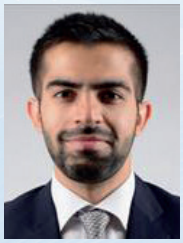

Abdul Rahman is Consultant at Detecon and has been working for the company since 2018. Following his graduation with a bachelor's degree in electronic engineering, he started his career as a radio frequency planning and optimization engineer at Huawei. After working for more than two years, he moved to Germany to pursue a master's degree in information and communication systems. While working toward his master's, he undertook research projects in Japan and Germany; he joined Detecon as a Business Analyst after graduation. Thanks to his involvement in numerous projects, he has acquired profound knowledge of network architectures of 5G, LTE, UMTS, GSM, and Wi-Fi and IP networks. He has in-depth experience in vendor management, network strategy, data analytics, IoT technologies, and rollouts.

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Lothar Reith is Senior Consultant at Detecon and has been working for the company since 2005. After graduating with a degree in computer science from the University of Darmstadt in 1983, he started his career as programmer for AEG in a telecoms project and subsequently held various positions at Nortel Networks ranging from technical support to product management and marketing, gaining broad experience in data and voice services and technologies. From 2005, he worked on various fixed and mobile network projects both nationally and abroad, including BNG and VoLTE introduction, covering network technologies and OSS topics, and related end-to-end testing. Lothar has been a regular presenter and panelist at SDN/NFV world conferences.

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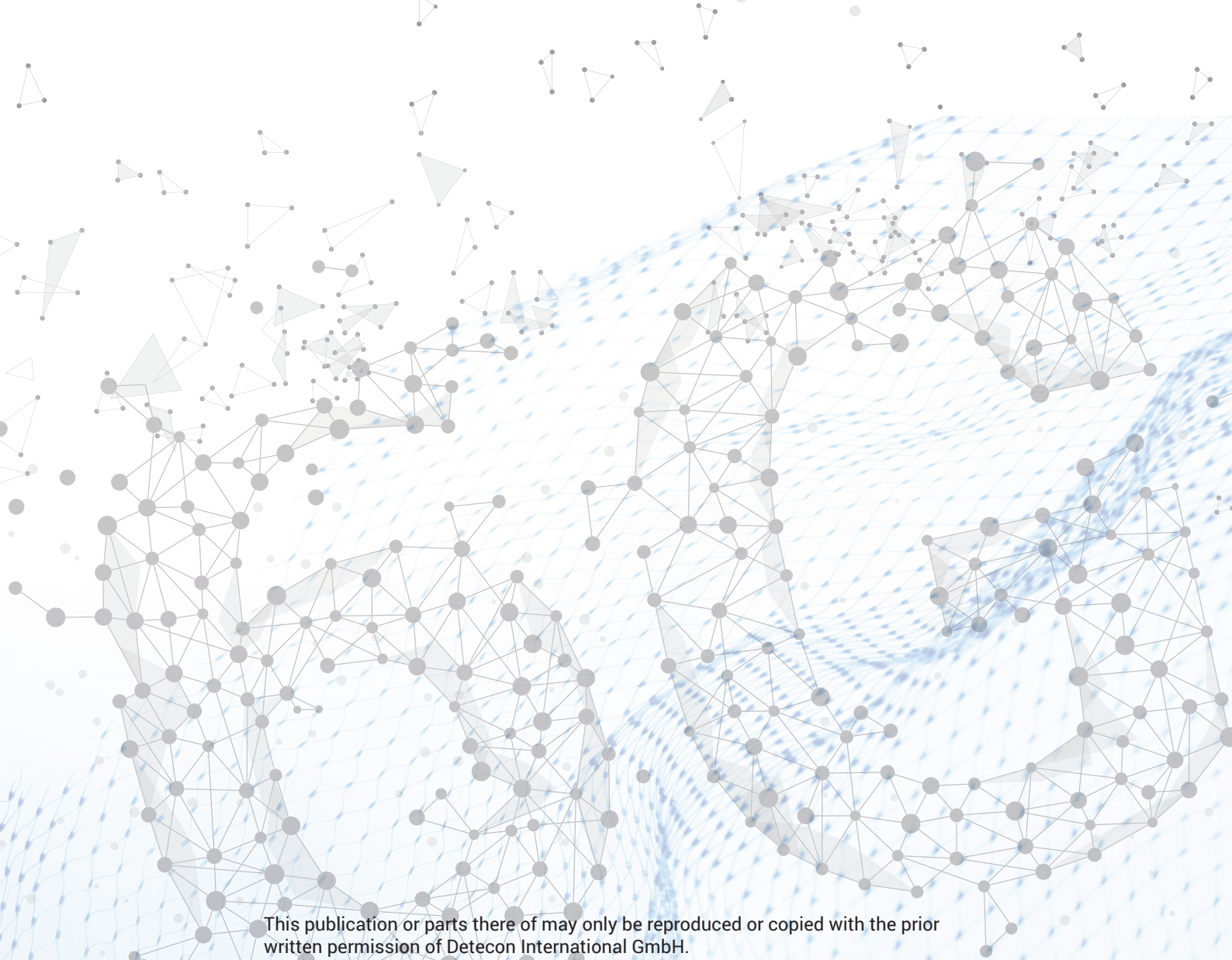
About us

Detecon is the leading, globally operating technology management consulting company with headquarters in Germany, which has been combining classic management consulting with high technological competence for over 40 years. The focus of its activities is on digital transformation: Detecon supports companies from all areas of business to adapt their business models and operational processes to the competitive conditions and customer requirements of the digitalized, globalized economy with state-of-the-art communication and information technology. Detecon's expertise bundles the knowledge from the successful conclusion of management and ICT consulting projects in over 160 countries. It is a company of Deutsche Telekom.



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