

5G Campus Networks

An Industry Survey

June 2019



The results of a survey conducted by Detecon International & the University of Regensburg help to understand the 5G Campus Networks market.

WHY 5G Campus Networks?

- Enhanced **flexibility and efficiency** from the application of modern technology are the main drivers.
- 5G is seen as the connectivity part of the **realization of Industry 4.0**.
- **Security and reliability** are critical drivers for own networks.
- Independence to build up **own suited** Campus Networks without **dependency** on third parties is desirable.
- 5G **overcomes current limitations** in legacy network technologies.
- BNetzA provides **frequencies directly** to German industry to realize own Campus Networks.

01

WHY
Motivation & Drivers

WHAT to realize?

- **Most frequently mentioned** use cases are AGV, AR, asset tracking, and modular production automation.
- 5G is at the moment of **little interest** for use in **office communications**.
- The killer feature of 5G technology for industrials is the unmatched level of **reliability** followed by **low latency**.
- Use cases will require **individual solutions** of highly practical applications rather than general solutions.

02

WHAT
Use Cases

HOW to use technology?

- **Initial prototypes in the direction of 5G** are already running.
- Most **current** use cases are still covered by **Wi-Fi & LAN**.
- Many **future** use cases could be realized using 4G/LTE technologies. Several newly developed and future use cases (e.g., AR/VR) will require at least some features of 5G.
- A good **mix of technologies** will be crucial for a successful strategy.
- Companies are on **quite different levels** regarding preparation and approaches.
- Other technologies like **SigFox or LoRa are not seen as robust and reliable** enough for a professional environment.

03

HOW
Technology & Strategy

HOW to partner?

- From **fully make** to **fully buy**, there will be all kinds of combinations to realize Campus Networks, mainly depending on the size of the enterprise. The larger the enterprise, the more it will favor the “make” option.
- The majority of industrials stated that they would rather focus on their core competencies than on building and operating networks, and so **are seeking strong partnerships**.
- **MNOs** are expected to offer **new business models** bundling connectivity with applications.

04

HOW
Ecosystem & Partner

HOW to solve challenges?

- Development of solid and profitable **business cases** is essential.
- Seamless **integration** of new technologies must be realized.
- **Setup** of the future **ecosystem** is needed.
- Role of industrials in the **standardization** process is not adequate.
- **Data Security** – closed shop v. interconnected systems; the right balance must be found.

05

HOW
Challenges & Tackling

Campus Networks are supposed to enable IIoT processes and services, but many questions remain unanswered...

5G Campus Networks as an enabler for the Industrial Internet of Things?

WHY? Motivation & Drivers

- What are the possible motives and drivers for 5G technology and Campus Networks?

WHAT? Use Cases & Features

- What use cases are relevant for Industry 4.0?
- Do they require 5G, or could they be realized with other technologies as well?

HOW? Technology & Strategy

- What is the status of network technology in companies today?
- Which strategy are they following to develop their future networks, and what does their roadmap look like?
- Are Campus Networks generally seen as a solution, and what role do pilot networks play for the industry?

HOW? Ecosystems & Partnerships

- What partnerships will evolve among the different players in the market?
- What does the setup of the future ecosystem look like?

HOW? Challenges and How to Tackle Them

- What kind of challenges are to be noted regarding Campus Networks and 5G technology?
- What are companies' plans for tackling them?

This industry survey by Detecon International and the University of Regensburg is trying to answer those questions.

Framework

- Detecon International conducted this study in cooperation with two students from the University of Regensburg (Chair of Innovation and Technology Management) as part of the “Honors Program”.
- In a total of 15 interviews, industry and technology experts from different companies were surveyed to collect information and opinions from various perspectives:
 - German automobile/automotive manufacturers
 - German technology corporations
 - German machine tool manufacturers
 - Mobile network operators
 - Network equipment suppliers
 - Network infrastructure providers
 - Technology associations

DETECON
CONSULTING



Universität Regensburg

Experts were interviewed, information was collected, and data were processed and compiled for summation of the final results.



An aerial photograph of a large industrial facility. The roof of the main building is dark blue and features the letters 'BOB' in a large, light blue, stylized font. A red truck is visible on a road adjacent to the building. In the foreground, there is a parking lot with several white trucks and cars. A dark blue circular graphic in the top left corner contains the white number '01'. On the right side, a white table of contents overlay is present.

01

01 WHY – Motivation & Drivers

02 WHAT – Use Cases & Features

03 HOW – Technology & Strategy

04 HOW – Ecosystem & Partnerships

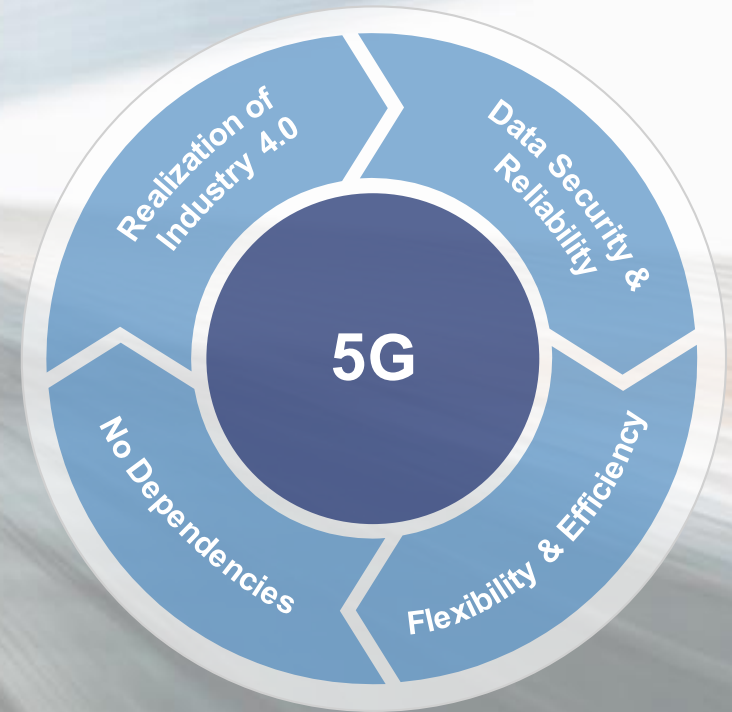
05 HOW – Challenges & How to Tackle Them

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WHY – Motivation & Drivers

We identified several drivers for 5G:

- Enhanced **flexibility and efficiency** from the application of modern technology are the main drivers.
- 5G is seen as the connectivity part of the **realization of Industry 4.0**.
- **Security and reliability** are critical drivers for own networks.
- Independence to build up **own suited** networks without **dependency** on third parties is desirable.
- 5G **overcomes current limitations** in legacy network technologies.
- BNetzA (German Federal Network Agency) provides **frequencies directly** to German industry to realize own Campus Networks.



Although companies mention different motives and drivers, they all share the vision of enhanced production flexibility and efficiency.

Motivation and Drivers for 5G Technology

- 5G is seen as a **key factor** for the realization of **Industry 4.0** by German industry. The early use and implementation of 5G are important for the defense of the **German industry leadership position**.
- There is a demand for a **future-proof technology**. 4G/LTE is already on the market and can cover most of the use cases, but companies want to focus their investment in a future technology with a broad acceptance and the advantages of an international standardization (3GPP).
- **Security and reliability** are the critical drivers for own networks. Company's data must be handled as safely as possible. Production must be realized with the greatest possible reliability to avoid bottlenecks in production from mobile connectivity.
- A strong driver for companies is the wish to build networks that are **independent of third parties** so that they can manage sensitive data and networks critical for the business on their own. In particular, the relationship with MNOs is prejudiced because of disappointments from 4G/LTE (dead spots in coverage). Industrials see a lack of specific client-tailored offers.
- Current **limitations in legacy technologies** (e.g., LAN or Wi-Fi) can be overcome with 5G.
- The current spectrum licensing process in Germany provides **frequencies** for industrial Campus Networks which can be **used directly by the industry** (3.7 to 3.8 GHz).
- **Vendors of network equipment** see 5G Campus development as an opportunity to **address new clients** (ecosystems start to flourish as competitors to MNOs).

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02 WHAT – Use Cases & Features

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WHAT – Use Cases

5G will enable innovative use cases:

- Most frequently mentioned use cases are AGV, AR, asset tracking, and modular production automation.
- 5G is at the moment of little interest for use in office communications.
- The killer feature of 5G technology for industrials is the unmatched level of reliability followed by low latency.
- Use cases will require an individual solution of highly practical applications rather than general solutions.

Intralogistics



AGV Transport Systems



Asset Tracking

Factory Floor



Production Automation



Remote Control

Communication



Augmented Maintenance



Safety Monitoring

5G Use Cases

Office



Virtual Conferencing



Wireless Office

Short-term use of 5G technologies focuses on production use cases while office communications (for example) are of medium-term concern only.

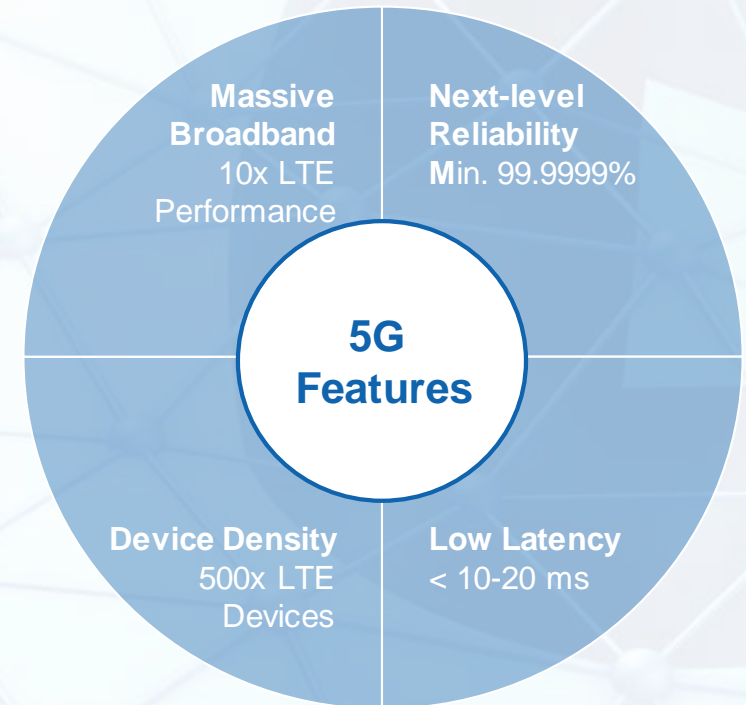
Use Cases of Interest for Industrials

- Main focus on **data connectivity** of machines and M2M communication as well as on **production and factory floor**:
 - Clear benefits in terms of **productivity and cost efficiency** as well
 - Reduction of fixed plugs and cables → high-quality cables can be pricy, fragile, highly complex, and inflexible
- Use cases are still in development, but the following were given as examples:
 - **AGVs** - automated guided vehicles
 - **AI and AR** applications for quality assurance and training
 - **Autonomous robots** for production (e.g., as an enabler for production with minimum lot size 1 on the shop floor)
- 5G in **office communications** is viewed critically, because of **a lack of productivity enhancements** and **high costs** for 5G (at least in the next few years) - legacy technology and their incremental improvements are sufficient to cover office applications (Voice/Data/M2M).
- Goal in production: 5G will **not enable all use cases at once**, but depending on the use case, individual solutions will be necessary.
 - “5G features are comparable to a triangle where you place a circle inside; you can concentrate on one corner, but you will never reach all of them”.
 - “No company will install 5G solely for one single use case. Economic feasibility requires a higher number of use cases.”

The killer feature of 5G technology for industrials is the unmatched level of reliability.

Key Features of 5G

- 5G killer feature is **reliability**. Reason: If highly sensitive networks do not run ultra-reliably, advantages of other features like low latency cannot be realized.
- Existing technologies like Wi-Fi cannot match the new requirements
 - Reliability is inadequate
 - Handover is the problematic key trigger → Connectivity in outdoor areas and between production halls is especially critical
 - Number of connected devices per access point is limited
- For certain use cases, 4G/LTE would be fast enough in terms of latency, but really time-sensitive use cases demand **latencies < 10-20 ms** (AR/VR, autonomous driving).
- **Global availability** is critical for solid business case and handover among the sites.
- Many companies focus specifically on the **high flexibility** of such 5G use cases with mobile operating units.



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HOW – Technology & Strategy

Takeaways from different strategic approaches:

- **Initial prototypes** in the direction of **5G** are already running.
- Most **current** use case are still covered by **Wi-Fi and LAN**.
- Many **future** use cases could be realized using 4G/LTE technologies. Several newly developed and future use cases (e.g., AR/VR) will require at least some features of 5G.
- A good **mix of technologies** will be crucial for a successful connectivity strategy.
- Companies are on **quite different levels** regarding preparation and approaches.
- Other technologies like **SigFox or LoRa** are **not seen as robust and reliable** enough for a professional production environment.

1

Elimination of uncertainty of 5G auction

2

Initial pilots and proofs of concept

3

Implementation of technological standards of 5G

4

Initial rollouts of 5G networks

1

2

3

4

A good mix of technologies will be crucial for a successful network strategy. The levels of preparation for the future differ greatly.

Setup of Current Networks & Strategies

- Regardless of the industry, most companies base their networks on **Wi-Fi and LAN today**, which support most of the current use cases.
- **Many use cases** could already be realized by using **4G/LTE** technologies.
- Several newly developed and future use cases (e.g., AR/VR) will require **at least some features of 5G** (i.e. lower latency, higher bandwidths, etc.).
- The interviewed companies show **very different levels of preparation** and varying approaches regarding the deployment and operation of 5G technologies. None of them were able to disclose a detailed road map.
- Most of the companies want to run **Wi-Fi parallel to 5G**; e.g., office communications with Wi-Fi and factory floor with 5G.

*“Although 80% of the use cases could be realized by private LTE networks, they are **pushing hard for 5G technologies** and everything has been prepared. Once the spectrum has been auctioned, the implementation will be delivered with full speed.”*

*“There is **not really a harmonized strategy** for wireless technologies, but **LTE will be the main technology** during the early years of the next decade. Only later will 5G technology gain broader use.”*

*“The **technologies currently in use are adequate in many cases** and will still be used in future, but they will be complemented by 5G. Wi-Fi is inadequate for OEMs and their use cases, but right now they do not really have a strategy/road map since **everything is dependent on the BNetzA.**”*

*“**5G and Wi-Fi will be used in parallel.** While all cases of industrial/machine communication will be facilitated by 5G, all cases of office/person-to-person communication will be carried out over Wi-Fi.”*

*“As the new standard, 5G will displace other technologies like **SigFox, Lora, and NB-IoT.** Wi-Fi will not be adequate for future industrial use cases while **private LTE** might be well suited to support most of the industrial use cases.”*

5G technology is seen as key technology and major enabler for competitive advantage.

Future Technologies

- Many companies plan to move **directly** to 5G without any intermediate technologies. Quite big differences in the approaches and the development of 5G.
 - Some companies: No intermediate steps with other technologies like LTE, 5G as stand-alone.
 - Other companies: Definitely one intermediate technology, but they do not know which one.
- When the **business cases that are currently lacking** are finally developed, productivity and cost efficiency will decide what technology will be used in the end.
- Other technologies like **SigFox** or **LoRa** are **not seen as robust and reliable** enough for a professional production environment.
- **Wi-Fi 6** is **not really useful** for specific use cases. Interferences in the non-licensed spectrum are a challenge.

Companies do not have a harmonized strategy and are very reticent about the road map for their network development.

5G Strategies

- Initial **pilots** are **already running** on 5G. Car manufacturers especially plan to deploy 5G (e.g., for autonomous driving).
- Most of the companies do **not** want to **wait** for technical **standardization**, so they will run their initial pilots on their own → technical standardization is expected in 3GPP Rel. 16 and later.
- After initial tests and trials, one automobile manufacturer plans to **implement 5G** for its **worldwide** business as early as **2022**.
- Some companies plan to launch their first industry-ready **products with 5G** capability **as early as 2021**.
- **Huawei, Ericsson, and Nokia**, the three biggest vendors, launched their first products for **stand-alone implementation** at *Hannover Messe 2019* or earlier.



Companies deploy pilots to test the different elements of a Campus Network, but spectrum and devices are limiting the possibilities.

Pilot Networks

- **Pilot networks** play an extremely important role in **testing the devices, processes, and partners** for industrials, telecoms, and vendors.
- Several interview partners have planned the deployment/are already in the process of deploying **pilot Campus Networks on Wi-Fi or 4G/LTE basis**.
- Key **limiting factors** of piloting Campus Networks with 5G technology are the **lack of spectrum and devices**.
- Although **spectrum** will be available in the 2nd half of this year, the **application process** is still **completely obscure**.
- Vendors are seeking to **enable their products** for industry applications of 5G within the **next 2 years**.

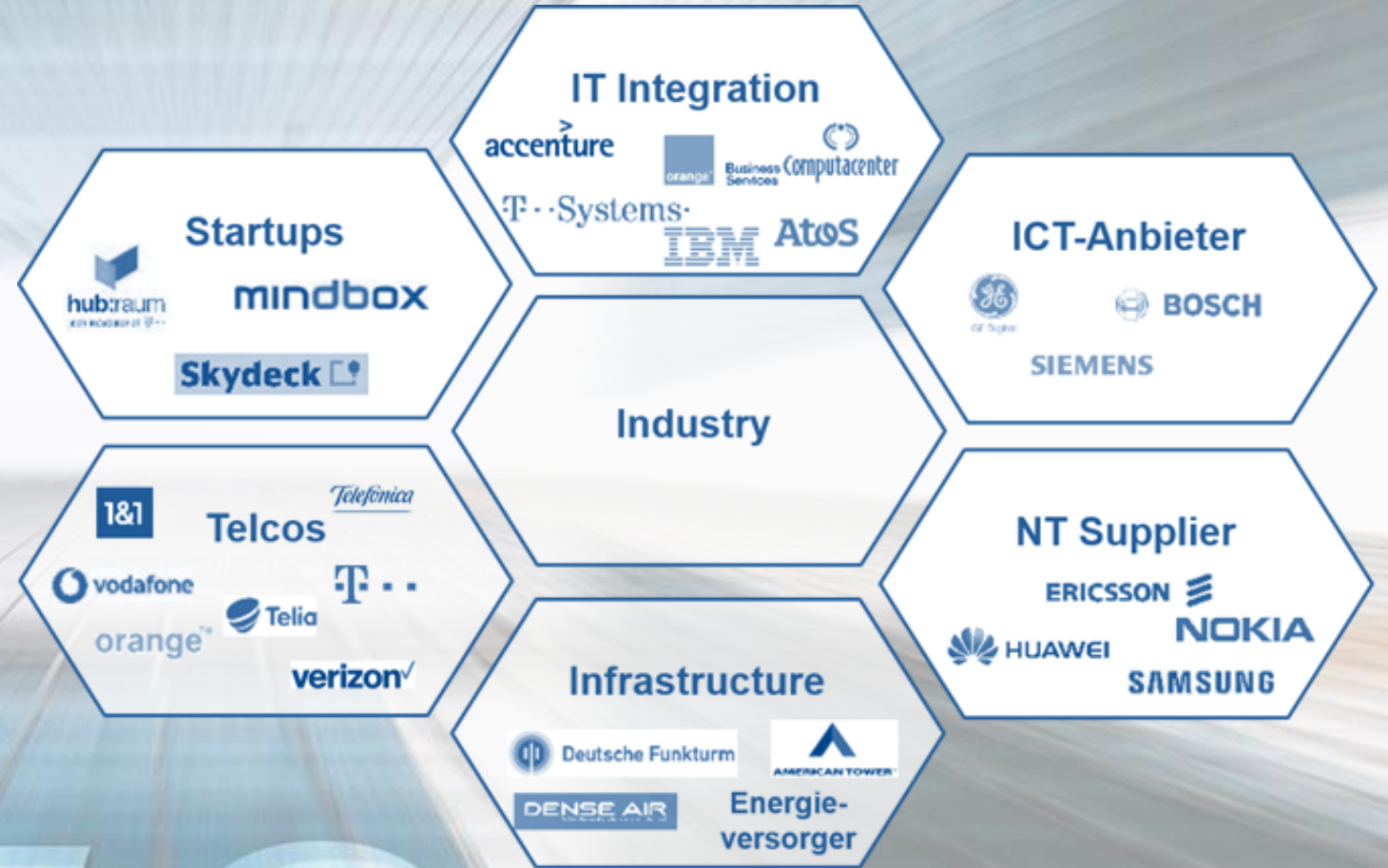


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HOW – Ecosystems & Partnerships

- From **fully make** to **fully buy**, there will be all kinds of combinations to realize Campus Networks, mainly depending on the size of the enterprise. The larger an enterprise, the more it will favor the “make” option.
- The majority of industrials stated that they would rather focus on their core competencies than on building and operating networks and so are **seeking strong partnerships**.
- **MNO** are expected to offer **new business models** bundling connectivity with applications.



Industrials want more control over the deployment and operation of their networks. MNOs have to adapt their service.

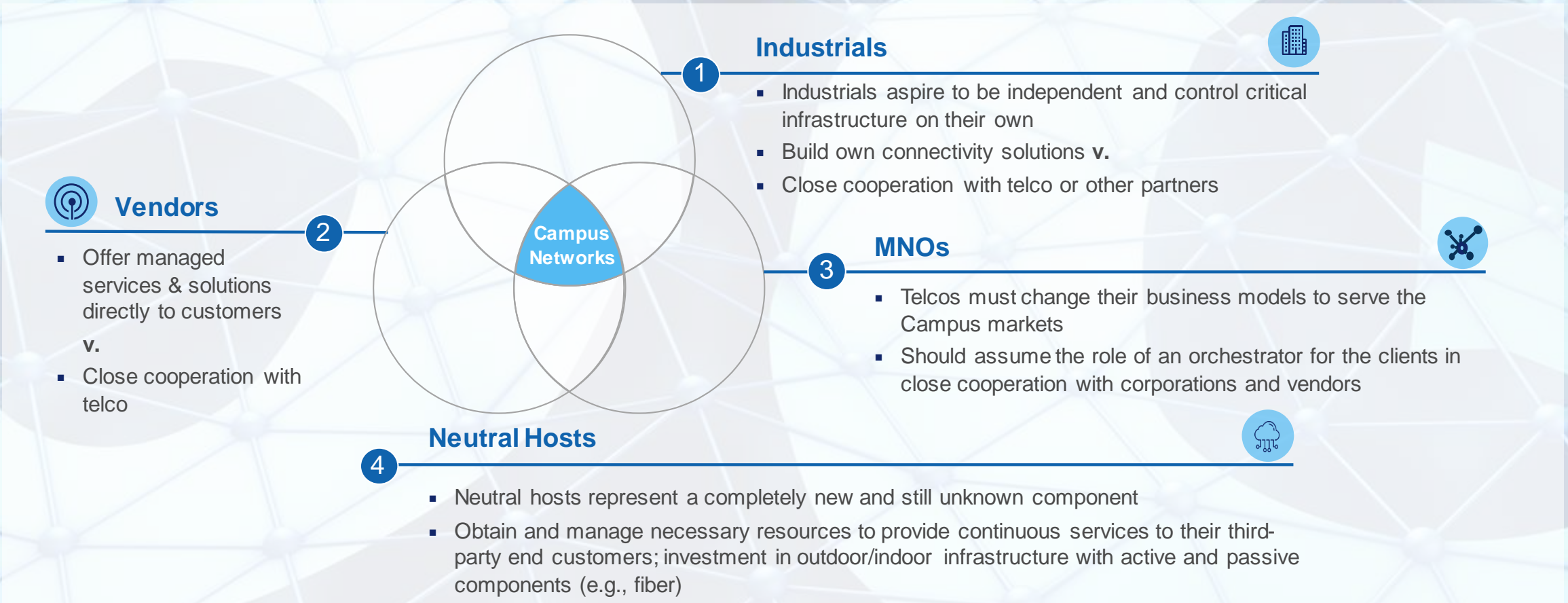
Make or Buy and the ...

- In the opinion of the interviewed vendors, there will be **all kinds of combinations** from fully make to fully buy, mainly depending on the size of the enterprise.
 - **SMEs** will need the support of the different players while forming **strategic alliances** – especially in the early stage.
 - **Large** corporations are more likely to build and operate their **own Campus Networks**.
- During the interviews, however, the majority of industrials stated that they would rather **focus** on their **core competencies** than on building and operating networks and are **seeking strong partnerships**.
- Reasons are...
 - ... the unpredictably high costs and risks of self-realization
 - ... the acknowledgement of MNOs' experience and its lack within their own organization

... Role of MNOs in this Process

- As a result, **MNOs** are definitely **possible partners** in the deployment and operation of Campus Networks for their industrial customers.
- One interviewee explicitly stated that he would appreciate it **if MNOs** would proactively offer managed services and show **more engagement**.
- In this vein, a change in the mindset of some industrials in the course of this study is to be noted; from “we are going to build Campus Networks all on our own“ to a search **for partnerships and ecosystem** solutions.
- Nevertheless, according to vendors and industrials, radical change and comprehensive actions within MNOs will be required regarding...
 - ... **new business models**
 - ... **the restoration of trust**

Four different kinds of players are competing for a stake in the newly formed ecosystem.



An aerial photograph of a large industrial facility. The roof of the main building is dark blue and features the word 'BOSS' in large, light blue, stylized letters. A red truck is visible on a road adjacent to the building. In the foreground, there is a parking lot with several white trucks and cars. The background shows a residential area with houses and green fields under a clear sky.

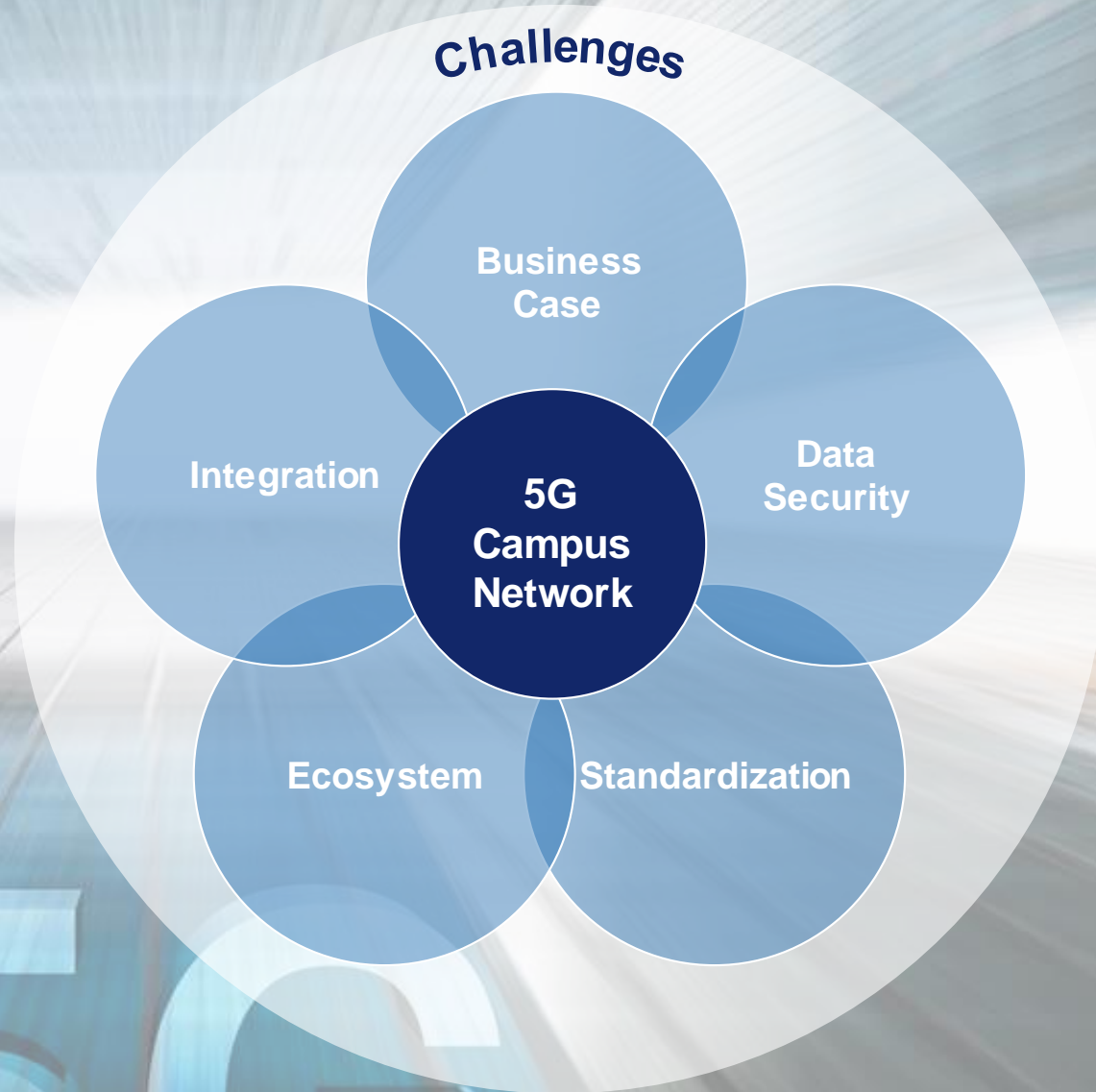
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HOW – Challenges & How to Tackle Them

All players on the market face the same challenges:

- Development of solid and profitable **business cases** is essential.
- Seamless **integration** of new technologies must be realized.
- **Structure** of the future **ecosystem** is needed.
- Role of industrials in the **standardization** process is not adequate.
- **Data Security** – closed shop v. interconnected systems; the right balance must be found.



Experts see challenges ranging from business case development to integration to the structure of the future ecosystem.

Main Challenges for Vendors, Verticals, and MNOs

Business Case

- Several crucial factors for the development of business cases are lacking (in particular, the cost of network equipment, devices and the cost of spectrum).
- The final business case must be solid and profitable.

Standardization

- Currently, vendors and MNOs are determining the development of standards in 3GPP.
- Industrials feel the need to be more involved in the development of standards.

Ecosystem

- The structure of the future ecosystems is still unsettled.
- All players are seeking to stake out a share of the market and in part competing for the same roles.

Integration

- A seamless integration of the processes, data models, and machine standards will be crucial for a functioning 5G Campus Network.
- Transition of legacy systems to new ecosystems and their interconnection will be hard to achieve.

Data Security

- Key determinant: How strictly do companies want to separate their networks from the outside world?
- Both closed shops and interconnected systems have advantages and disadvantages.

An aerial photograph of a large industrial facility. The roof of the main building is dark blue and features the letters 'BOB' in a large, light blue, stylized font. A semi-truck is parked on the roof. In the foreground, there is a parking lot with several cars and a semi-truck. A dark blue circular graphic in the top left corner contains the number '06' in white. On the right side, a semi-transparent white box contains a table of contents with six items, where the sixth item is highlighted in a dark blue background.

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Detecon is the leading consulting company that unites management with profound digital technology expertise.



Detecon offers expertise and experience in telco and IT across industry sectors and unbiased advice regarding Campus Network implementation.

We are Telco

- We have comprehensive technology expertise in networks and IT.
- We are at the forefront of edge computing and 5G.
- We turn IoT use cases into proofs of concept and service implementation.

We are Digital

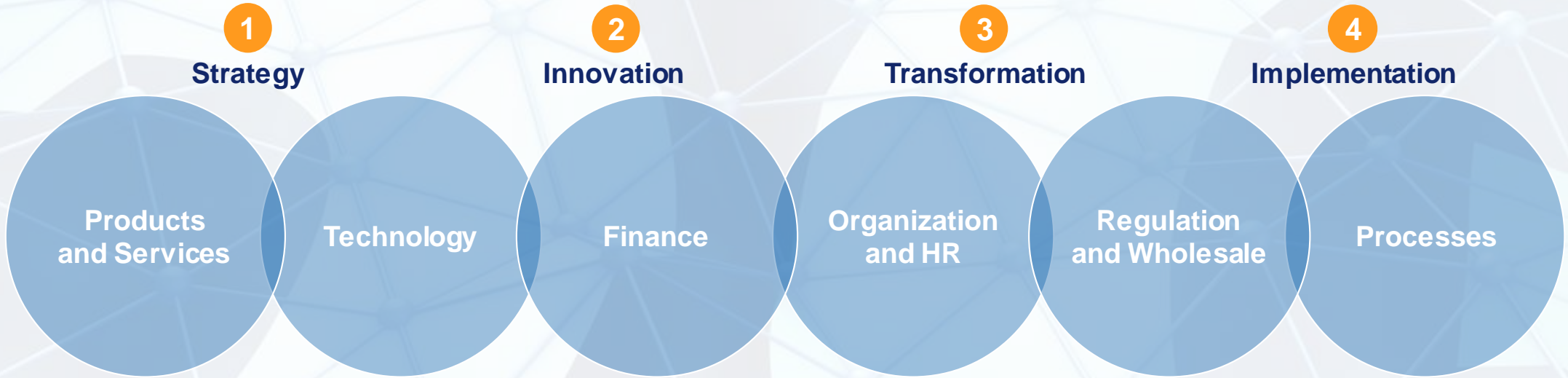
- We support digital transformation.
- We are IoT partner of industry players.
- We leverage our network across industries and markets.

We are Unbiased

- We are independent and impartial.
- We focus on the client perspective.
- We avoid vendor and operator lock-in.
- We bring the right players together and accelerate the delivery of results.

**Our experts have been successfully building ICT networks for more than 40 years.
From network to IT, from telco to industry.**

Our experience across the value chain and the combination of strategy & hands-on skills has been leveraged in many digitalization projects.



Cross-Industry Strategy and Digital Transformation



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