

5G Campus Networks

An Industry Survey

June 2019



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

WHY 5G Campus Networks?

- Enhanced **flexibility and efficiency** by applying modern technology is the main driver.
- 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** from 3rd parties is wished.
- 5G allows to **overcome 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 mentioned** use cases are AGV, AR, Asset Tracking, and modular production automation.
- **Office communication** is at the moment of **little interest** in usage of 5G.
- 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 high sensible applications rather than overall solutions.

02

WHAT
Use Cases

HOW to use technology?

- **First prototypes towards 5G** are already running.
- Most **current** use case are still covered by **WiFi & 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 an enterprise is, the more they favor the “make” option.
- The majority of industrials stated that they would rather focus on their core competencies instead of building and operating networks, and thus **aspire 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 sufficient.
- **Data Security** – closed shop vs. 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 still 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

- Which 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 do they follow to develop their future networks and what does their roadmap look like?
- Are Campus Networks generally seen as a solution and which role do pilot networks play for the industry?

HOW? Ecosystems & Partnerships:

- What partnerships will evolve between 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 on how tackle 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 tools manufacturers
 - Mobile network operators
 - Network equipment suppliers
 - Network infrastructure providers
 - Technology associations

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Universität Regensburg

To formulate the final findings, experts were interviewed, information was collected and data got processed and summarized.



An aerial photograph of a large, modern industrial building with a dark blue roof. The letters 'BOSS' are printed in large, light blue characters across the roof. A red truck is visible on a road next to the building. In the foreground, there is a parking lot with several cars and a white truck. A dark blue circle with the number '01' in white is overlaid on the left side of the image. On the right side, there is a white table of contents overlay with a dark blue header.

01

01 WHY – Motivation & Drivers

02 WHAT – Use Cases & Features

03 HOW – Technology & Strategy

04 HOW – Ecosystem & Partnerships

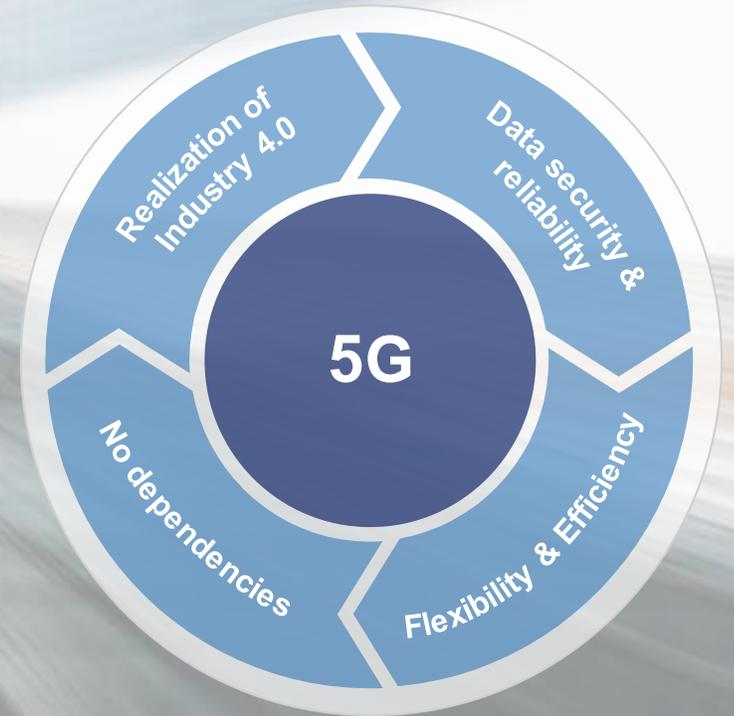
05 HOW – Challenges & How to Tackle Them

06 WHO – is Detecon

WHY – Motivation & Drivers

We identified several drivers for 5G:

- Enhanced **flexibility and efficiency** by applying modern technology is the main driver.
- 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** from 3rd parties is wished.
- 5G allows to **overcome current limitation** in legacy network technologies.
- BNetzA (German Federal Network Agency) provides **frequencies directly** to German industry to realize own Campus Networks.



Although companies quote 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 German industry to realize **Industry 4.0**. The early usage and implementation of 5G is important to defend the **German industry leadership position**.
- There is a demand for a **future-proof technology**: 4G/LTE is already in 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 safe as possible. The production must be realized with a reliability as high as possible to avoid that mobile connectivity will be the bottleneck in production.
- A strong driver for companies is to build networks **independently from 3rd parties** to control sensitive data and business critical networks on their own. In particular the relationship to MNOs is preloaded with disappointments from 4G/LTE (dead spots in coverage). Industrials are missing specific client-tailored offers.
- Current **limitations in legacy technologies** (e.g. LAN or WiFi) 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).

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 cars and a white truck. A semi-transparent white table of contents is overlaid on the right side of the image. A dark blue circle with the number '02' in white is positioned in the upper left corner.

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02 WHAT – Use Cases & Features

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WHAT – Use Cases

5G will enable innovative use cases:

- **Most mentioned** use cases are AGV, AR, Asset Tracking, and modular production automation.
- **Office communication** is at the moment of **little interest** in usage of 5G.
- 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 high sensible applications rather than overall 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

The short term usage of 5G technologies focuses on production use cases, whereas e.g. office communication will only come in the medium term.

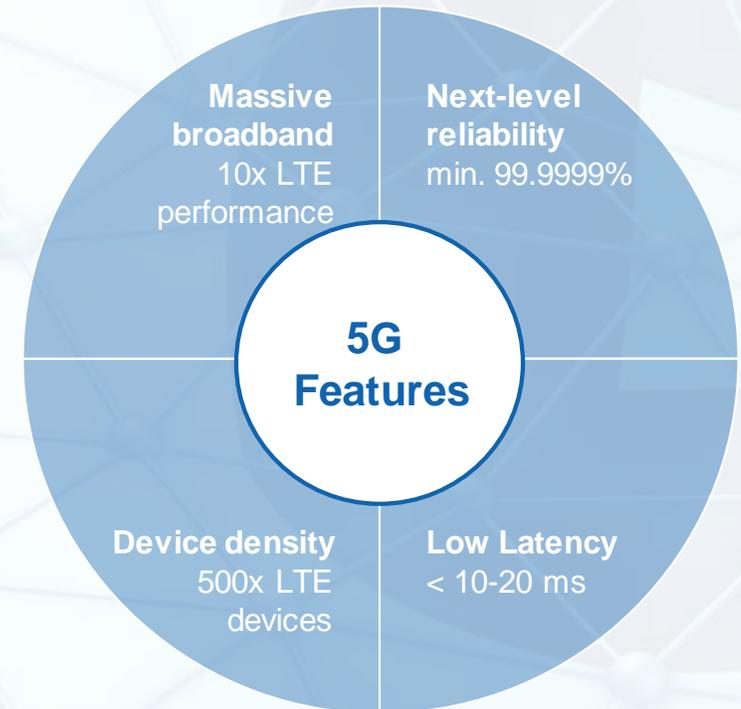
Use Cases of Interest for Industrials

- 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 named 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 communication** is viewed critically, because of **missing productivity enhancements** and **high costs** for 5G (at least in the next 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 exclusively for one single use case. For economic feasibility a higher number of use cases is required.”

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 WiFi can not deliver on the new requirements
 - Reliability is not sufficient
 - 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 between 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:

- **First prototypes towards 5G** are already running.
- Most **current** use case are still covered by **WiFi 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

First pilots and proofs of concept

3

Implementation of technological standards of 5G

4

First roll outs 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

- Across different industries most companies base their networks on **WiFi and LAN today**, which supports 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 also distinguished approaches regarding the deployment and operation of 5G technologies. None of them was able to disclose a detailed roadmap.
- Most of the companies want to run **WiFi parallel to 5G**; e.g. office communication with WiFi 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 is already prepared. Once the spectrum is 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 first years of the next decade. Only afterwards 5G technology will gain broader usage.”*

*“The **currently used technologies are sufficient in many cases** and will still be used in future but they will be complimented by 5G. WiFi is not sufficient for OEMs and their use cases, but right now they do not really have a strategy / roadmap since **everything is dependent on the BNetzA.**”*

*“**5G and WiFi 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 WiFi.”*

*“As the new standard, 5G will push away other technologies like **SigFox, Lora and NB-IoT.** WiFi will not be sufficient 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 **directly** make the next step towards 5G without any technology between. Quite big differences in the approaches and the development of 5G.
 - Some companies: No steps in-between with other technologies like LTE, 5G as stand-alone.
 - Other companies: Definitely one intermediate technology, but they do not know which one.
- When the **currently missing business cases** are finally developed, productivity and cost efficiency will decide which 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.
- **WLAN 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 retentive about the roadmap for their network development.

5G Strategies

- First **pilots** are **already running** on 5G. Especially car manufacturers plan to deploy 5G (e.g. for autonomous driving).
- Most of the companies do **not** want to **wait** on the technical **standardization**, so they will run their first pilots on their own → technical standardization is expected in 3GPP Rel. 16 and following.
- After first tests and trials one automobile manufacturer plans to **implement 5G** for its **worldwide** business already **for 2022**.
- Some firms plan to launch their first industry ready **products with 5G** capability **already in 2021**.
- With **Huawei, Ericsson and Nokia** the three biggest vendors have already 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 WiFi 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**.

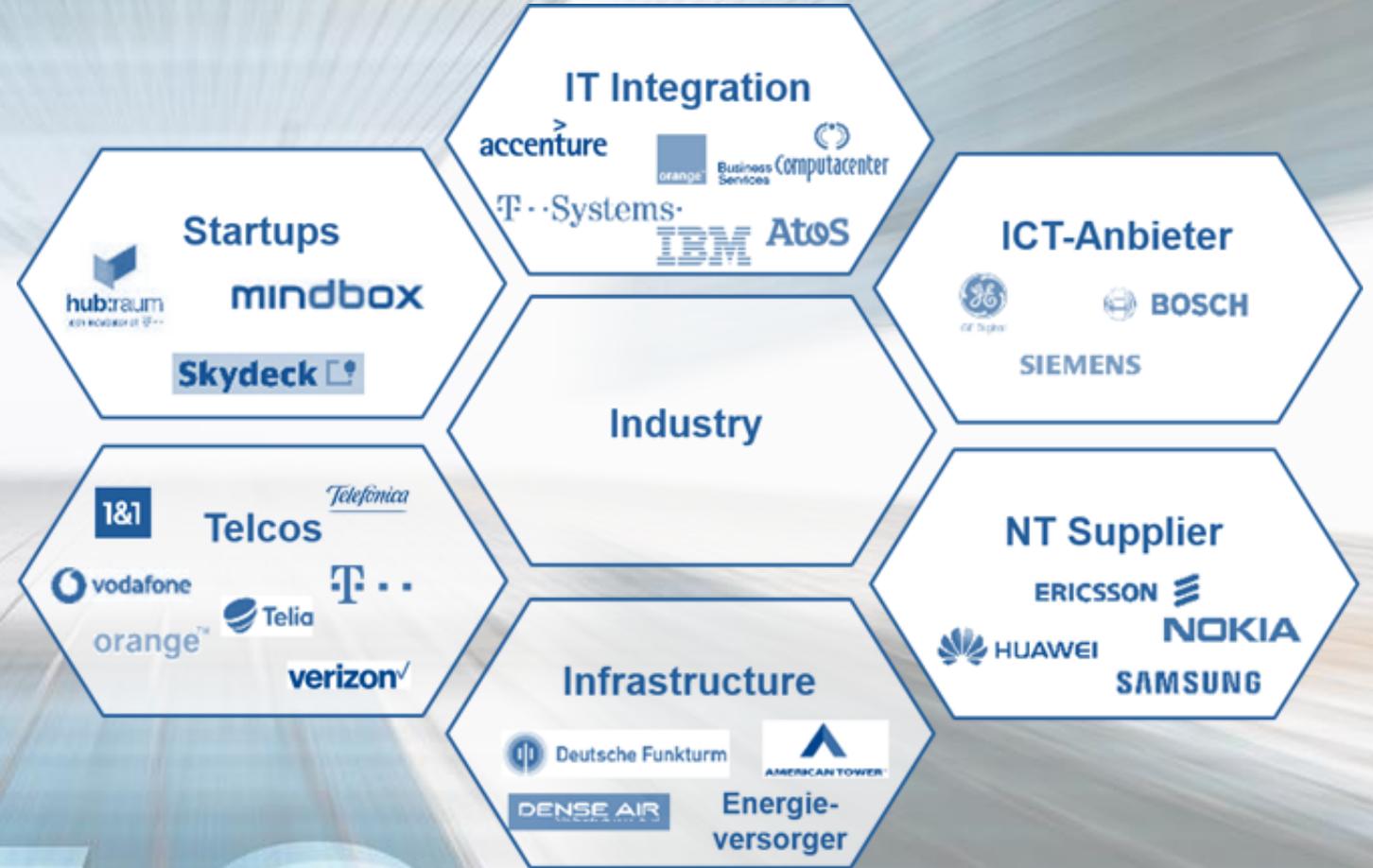


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HOW – Ecosystems & Partnerships

- 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 is, the more they favor the “make” option.
- The majority of industrials stated that they would rather focus on their core competencies instead of building and operating networks, and thus **aspire strong partnerships**.
- **MNO** are expected to offer **new business models** bundling connectivity with applications.



Industrials desire more control over the deployment and operation of their networks. MNOs have to adopt their offer.

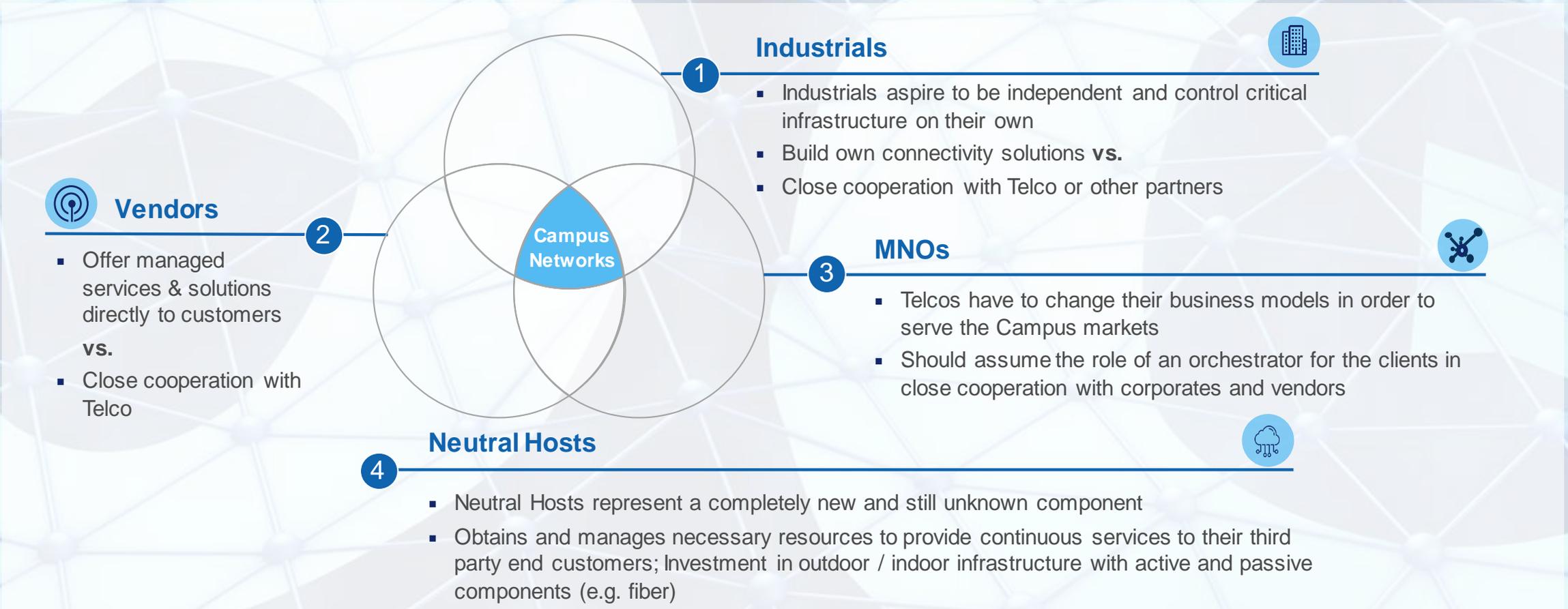
Make or Buy and the ...

- 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 an early stage.
 - **Large** corporations are more likely to build and operate their **own Campus Networks**.
- However, in the conducted interviews the majority of industrials stated that they would rather **focus** on their **core competencies** instead of building and operating networks, and thus **aspire strong partnerships**.
- Reasons therefore are...
 - ... the unpredictably high costs and risks of self-realization.
 - ... the acknowledgement of MNOs' experience and lack thereof within the own organization.

... Role of MNOs in this Process

- As a result **MNOs** thoroughly represent a **possible partner** in the deployment and operation of Campus Networks for their industrial customers.
- One interviewee explicitly stated that they would appreciate **if MNOs** proactively offered managed services and showed **more engagement**.
- Regarding this, a change in the mindset of some industrials in the course of this study has to be noted: Coming from “we are going to build Campus Networks all on our own“ they are now looking **for partnerships and ecosystem** solutions.
- Nevertheless, according to vendors and industrials radical change and strong actions within MNOs will be required regarding...
 - ... **new business models**
 - ... **the restoration of trust**

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





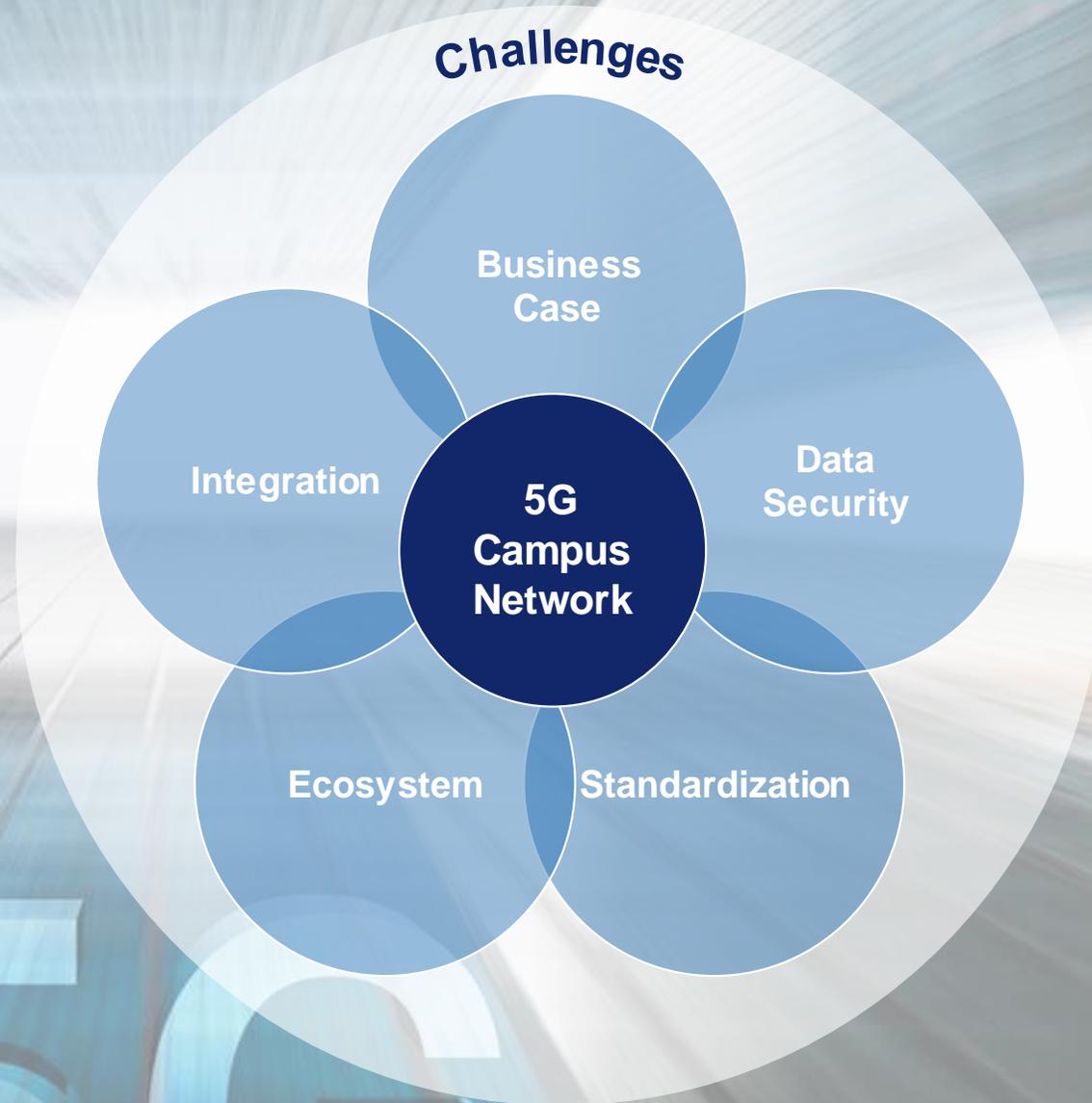
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HOW – Challenges & How to Tackle Them

All players in the market face the same 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 sufficient.
- **Data Security** – closed shop vs. interconnected systems; the right balance must be found.



Experts see challenges reaching from business case development, over integration to the setup of the future ecosystem.

Main challenges for vendors, verticals and MNOs

Business Case

- To develop business cases several determinants are missing in particular the cost of network equipment, devices and the cost of spectrum.
- The final business case needs to 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 setup of the future ecosystems is still questionable.
- All players are looking for their stake in the market and partially 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 into new ecosystems and their interconnection will be hard to achieve.

Data Security

- Key determinant: How strongly 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 word 'BOSS' in large, light blue, stylized letters. A red truck is visible on a road adjacent to the building. In the background, there are other industrial buildings and a residential area. A dark blue circle with the number '06' in white is overlaid on the left side of the image. A semi-transparent white box on the right side contains a table of contents with six items, where the sixth item is highlighted in a dark blue background.

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