STL PARTNERS

PRIVATE 5G: WHAT IS THE BUSINESS CASE FOR THE MANUFACTURING SECTOR?

Webinar: Questions and answers

Private 5G: What is the business case for the manufacturing sector?

This document outlines the questions and answers received from the STL Partners webinar, ***Private 5G: What is the business case for the manufacturing sector?****, which was hosted on Thursday 10th February 2022.*

In this document, we seek to address the questions raised in the webinar that we were unable to address in the time available.

You can find out more about our Private 5G ROI tool for manufacturing and download an overview here. You can also watch the recording of the session, and also access the slides, using the link here. *We have included the following timestamps for the webinar recording:*

- **05:30** for STL's presentation on "Understanding the private 5G opportunity in manufacturing"
- **13:50** for Fraunhofer IPT's presentation on "Sparking the future of manufacturing with 5G"
- **23:40** for WZL's presentation, with the live demo of the Private 5G ROI tool
- **43:30** for the live Q&A session with:
  - **Yesmean Luk**, Principal Consultant, STL Partners
  - **Dalia Adib**, Director – Consulting, STL Partners
  - **Matt Bamforth**, Consultant, STL Partners
  - **Niels König**, Head of Department, Coordinator 5G-ICE, Fraunhofer IPT
  - **Raphael Kiesel**, Head of Department, WZL of RWTH Aachen

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If you have any questions not addressed in the webinar or this Q&A document, or want to hear more about our research findings or from our speakers, please contact:

- Matt Bamforth, STL Partners – *matt.bamforth@stlpartners.com*
- Niels König, Fraunhofer IPT – Niels.Koenig@ipt.fraunhofer.de
- Raphael Kiesel, WZL of RWTH Aachen - raphael.kiesel@ipt.fraunhofer.de

Webinar questions and answers

The below questions were received from the webinar audience during the live session, this does not include the questions asked to our panellists.

For the Q&A session with our webinar panellists, please refer to the recording of the session here.

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1. **Where is the ROI tool available?**

To find out more about our Private 5G ROI tool, please click the link here: https://stlpartners.com/private-cellular-networks/private-5g-roi-tool-for-manufacturing/

There you will find a video of the tool, an overview of the tool you can download as well as a link to speak to our team to find out more.

2. **What examples of anchor use cases that you've seen? What are some immediate and near-term use cases a private 5G network could provide to a manufacturer?**

STL Partners: Anchor use cases can vary from customer to customer. In some cases, we have found that use cases that are mission critical and can have a direct impact on health and safety aspects or regulatory compliance aspects often become anchor use cases. In this scenario it could be to minimize risk either by removing employees from harms' way (e.g. remote operations for mining and other hazardous environments) or enabling a means to prevent, stop or control incident that may be/is about to happen. This is where security, reliability and resilience are hugely important. Other examples can include use cases like automated guided vehicles (AGVs) or autonomous mobile robots (AMRs) that enable different components to be transported across the shopfloor much more quickly, or other mobile robots that help with various production tasks (e.g. assembly, transport etc.). These use cases require low latency, high reliability, and seamless handover to enable that mobility which private cellular is able to provide much better than Wi-Fi for example.

Fraunhofer IPT: Of course, one of the most prominent use cases is the 5G-connected AGV. This use case can benefit from reliable transmission of data from the different sensors on the AGV, which can be used to generated maps for the simultaneous localization and mapping (SLAM) and fleet management. 5G is especially helpful if you run multiple AGVs at the same time. Another example is process monitoring in critical machining. We have developed wireless sensors for measuring acceleration, temperature, and strain. Having a wireless sensor system enables us to bring the sensing probes closer to the part, which is being machined and needs process monitoring. The process monitoring is on the one hand crucial for detecting critical events like a strong vibration of the part, a temperature elongation, or a critical condition of the cutting tool, e.g., a breakage of the cutting edge

or the complete tool, or even tool wear. 5G enables us to have a robust coverage inside machine tools and an ultra-low latency for immediate reactions on critical incidents We have investigated this sensor approach in the 5-axis milling of jet engine components.

Manufacturers are always interested in acquiring live data to understand the health status of their entire shopfloor. Of course, wireless devices are easier to integrate than wired devices. So, for us it became clear that wireless sensors needed to be developed for the first use cases. As a next step, 5G should be used to provide connectivity to mobile production equipment like mobile robots for assembly or AGVs for logistics, though these approaches have not been widely implemented in factories yet. In future, 5G features like localization and sidelink communication might provide another boost for 5G in industries because then more capabilities come with 5G – for free.

3. **How much data is typically produced in a production environment?**

Fraunhofer IPT: We have carried out a study in 2019 on exactly this question. The study was carried out as part of the International Center for Networked, Adaptive Production (ICNAP) and we have collected input from various manufacturing companies. In total we defined more than 20 use cases and estimated how many 'copies' (or implementations) of the use cases we can find on a future shopfloor of 10.000 sqm size. It became clear that from approx. 900 devices in total, 208 devices are used for latency-critical use cases, where the latency must be less than 20 ms. These 208 devices produce a constant upstream of more than 600 mbit/s in total. It is clear that the QoS to these 208 devices can only be delivered by 5G.

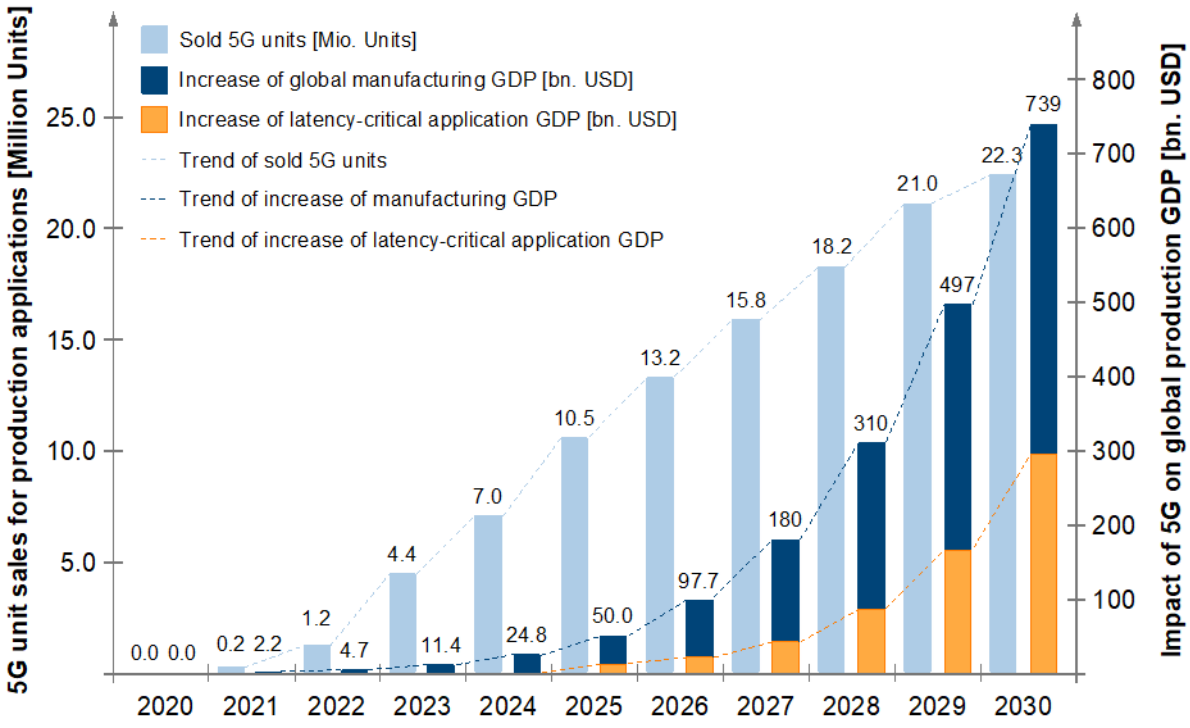
4. **Has your tool been evaluated by AMR/AGV companies? As I am aware, today most of the AMR/AGV companies have mechanisms in the vehicles to ensure they are not dependent on the wireless network.**

WZL: Yes, it hast been evaluated on a testbed in Aachen together with an AGV company. The results have also been published here: https://doi.org/10.3390/electronics11020192

5. **Do you think that the introduction of Release 17 will accelerate the adoption of 5G for Industry 4.0 and make some use cases become even more economically viable? For example, indoor positioning with 5G with Release 17 could be used in AGVs.**

WZL: Yes, the improvements of 5G will accelerate the adoption. This gets clear by both, discussions with potential users as well as by looking at studies. An example is shown in below figure, focussing on the prospected improvements due to decreased latency within Release 18. The figures show both prospected sales and revenues shows. To forecast the sales, McKinsey & Company analysed over 150 potential 5G use cases, focusing on the business-to-business (B2B) market. The study of STL Partners forecasts the overall impact of 5G on global production GDP to $739 billion,

representing a 4% GDP uplift. Thereby, the trends of both sales and impact match: The unit sales follow a saturation curve, whereas the impact has an exponential growth. A strong rise in 5G unit sales in 2023 is noticeable. This effect is associated with the latency-critical applications and the improvements of URLLC within release 18 in 2023, which explains the observed trigger in that year. Equal improvements are expected by release 17 for the positioning.



6. Do you think that open RAN can accelerate the adoption of 5G for industry 4.0? Are there any benefits compared to traditional architectures?

STL Partners: Most deployments of private 5G (or LTE for that matter) still use traditional architectures, i.e. virtualised but still proprietary, not cloud-native or disaggregated. It is still early days for deployments of open RAN even by telecoms operators, with few proof points of performance, cost savings and other factors, and the interest from enterprises is still nascent. One early example of an open RAN-based private network deployment is at the Moray Wind Farm with Vilicom, recently acquired by BAI Communications. This deployment claims to be the UK's first open RAN-based private network.

7. Is the tool able to differentiate the benefits between 5G non-standalone (NSA) and 5G standalone (SA)?

WZL: Assuming that SA has better performance than NSA, the values for, e.g., availability, reliability and latency can be adapted within the tool to test, whether a higher performance of one or the other deployment option might lead to a benefit from an application point of view.

8. How is 5G helping in the area of knowledge retention i.e. capturing decades of experience gathered by retiring works and enabling new entrants to quickly become productive?

STL Partners: 5G can enable some key use cases that help enterprises capture, take advantage and pass on knowledge, expertise and experience. These use cases are focused on remote operations or remote assistance (enabled by AR/VR/MR for example). Remote operations use cases refer to the ability to connect an asset (e.g. vehicle, drone, machine tool) and have that remotely controlled by an expert from a central location. This means you can also remove employees from potentially hazardous environments (e.g. a chemical production facility). The other use case on remote assistance can involve using smart AR glasses (e.g. Microsoft HoloLens) to provide a visual overlay to enable different types of use cases e.g. for remote expert assistance, training, assisted maintenance and repairs etc. We elaborate on such use cases in more detail in our How 5G and edge computing will transform AR/VR use cases article.

9. What are the key low latency use cases where 5G can make a difference compared to other technologies like Wi-Fi 6?

Fraunhofer IPT: Our first results of comparing Wi-Fi 6 with 5G show a clear advantage, e.g., with a moderate upstream for image processing and subsequent gesture recognition, where 5G shows a much more fluent user experience. When adding more devices at the same time, the situation is getting worse for Wi-Fi 6. Generally, use cases where transmitted data are used for closed-loop applications are ideally suited for 5G. One example is our process monitoring use cases with wireless sensors already mentioned. I have to add, that for unleashing the full potential of 5G, we see an on-premise edge-cloud as a must-have. Therefore, we are very much looking at latency between application end points, i.e. from the physical events via the 5G sensor, the edge-cloud processing pipeline and the feedback to the end point, e.g. the machine. Here we already could show end-to-end latency of down to 10 ms. Another example is the tool monitoring using 5G-based acoustic emission sensor systems, where you need immediate reaction for example as soon as for a tool is broken.

10. What is going on with the intersection of Private 5G and Wi-Fi? Do you see a need for convergence of the tools to deploy and manage the two technologies?

STL Partners: We recently published a report looking at the topic of convergence: 'Convergence, coexistence or competition: How will 5G and Wi-Fi 6 interact?'. Our key finding was that convergence of these technologies is still immature on both the demand and the supply side as 5G is yet to become a genuine alternative. Private 5G of course has many benefits over just the public 5G network, and the

need for private 5G over Wi-Fi will depend on the applications needed by the enterprises. If use cases require coverage outside or mobility within a site, then private 5G has distinct advantages over Wi-Fi. Use cases requiring high reliability, high bandwidth, or low latency can also be enabled by private 5G. This is not to say that enterprises adopting private 5G will completely phase out Wi-Fi, as we believe the future of enterprise connectivity will be a hybrid of both wired and wireless technologies. There will still also be many applications needing connectivity not requiring the capabilities of private 5G (e.g. office functions, personal mobile phones, etc.).

11. Do you expect the smaller and midsize manufacturers in Germany to have the required skillset to manage a full private 5G network?

Fraunhofer IPT: Right now, I do not see the point yet, where SME are prepared for operating a private 5G network on their own. The 5G systems on the market right now are too complex and require expert knowledge. Besides that, a private 5G may also not be affordable for a single SME. So, I see the task more for system integrators or MNO. But it requires special deployment and operator models, e.g., for industry parks. I would also add that SMEs also need support in defining their use cases. Fraunhofer IPT offers special consultancy products for this purpose.

12. If outdoor coverage of the 4G/5G network in Germany were not as poor as it is now, but was 99.8% coverage, would you still expect manufacturers to choose private 5G above the public 5G offering?

Fraunhofer IPT: It is clear that certain quality of service conditions simply require dedicated network resources which is not possible with public 4G/5G networks. All use cases relying on ultra-reliable low-latency communication (URLLC) cannot be served within a public network. Furthermore, the configurability of the network performance and the ability to tailor the network to the use case requirements is limited in public networks: most industrial 5G use cases are more uplink heavy, while the default network is downlink friendly. If we talk about industrial communication and especially hard-real time requirements, then you need features like TSN-over-5G, which is another indication for a private 5G network. Nevertheless, there may be cases, where a simple synchronization with soft-real-time requirements may be of help. In a European project, we are investigating how to accurately generate UTC timestamps with high accuracy based on the CellTime approach of u-blox. Accurate timestamps can be used to 'heal' the fact that in public networks the latency fluctuates. In these cases, the timestamp delivers information about when data have been sent regardless how long it takes to receive them.

13. Do you think that ultimately the public operators will provide private 5G networks or will there be a whole new set of players entering the private 5G market as new operators?

STL Partners: We have seen an emergence of new types of players in the private networking ecosystem, in addition to the public mobile network operators, which has made the ecosystem incredibly dynamic. We have noted some examples below but elaborate on this in our report 'Private networks: Lessons so far and what next' in more detail who these new stakeholders are, their strengths and capabilities, and how they are approaching the private cellular market.

14. What is the value in deploying a private 5G network over a dedicated slice from a public operator?

WZL: The table below summarizes the characteristics of the four deployment options. The highest benefits of the private network are – besides higher performance – the flexibility, security, and availability of the network.

Deployment category	**Isolated network**	**Conjuction with PLMN**		
Deployment option		**Shared RAN**	**Shared RAN & control plane**	**Hosted by PLMN**
Characteristic	All NPN functionalities are on-premises; fully separate physical network	NPN and PLMN share part of RAN, while other network functions stay segregated	NPN and PLMN share RAN; network control tasks performed in PLMN	NPN completely offpremises, but treated differently by virtualization of functions
Required licence	Campus Licence	Campus Licence optional	Non	Non
Contractual requirements	Non	MNO Service Level Agreement	MNO Service Level Agreement	MNO Service Level Agreement
Setup cost (↓)	++	o	-	--
Required competence (↓)	++	-	o	--
Data sou-vereignty (↑)	++	+	+	o
Network security (↑)	++	++	++	++
Architecture flexibility (↑)	++	o	o	-
Robustness (↑) (in- & extern)	+	o	o	+
Network availability (↑)	++	o	+	o
Enabling low Latencies (↑)	++	+	++	o

++ high **↑ the higher the better**

o neutral **↓ the lower the better**

-- low

15. 5G lives together with many other technologies and evolutions: Open RAN, AI, IoT. How do you think these technologies can support one another, and in what way? Is 5G the key lever?

STL Partners: There are many different routes and means of finding synergies across different technologies, whether it be 5G, edge computing, open RAN, AI/ML or IoT (the list goes on). For example:

- 5G and edge are two inextricably linked technologies where edge computing can be an important means to reduce network latency (more detail here)
- 5G is an important foundation for IoT by providing high bandwidth, low latency, and the ability to support a much greater device density to enhance existing IoT use cases and enable new ones that weren't possible before.

5G is not necessarily always the key lever as some of these technologies can be enabled by other means (e.g. AI/ML) but can be an important one particularly as enterprises look to reduce the level of complexity they have in the number of interfaces and fragmentation they have to manage (e.g. having multiple different forms of connectivity, multiple point solutions etc.). However, all of these technologies play a significant role in enabling enterprises to move towards being much more automated and policy-driven in the way they operate.

16. Do you see 5G making a meaningful impact in predictive maintenance? Has that ROI been tested?

Fraunhofer IPT: We plan to use our 5G multi-sensor platform not only for process monitoring, but also for condition monitoring. Accelerometers or microphones connected via 5G can easily be retrofitted and can help our customers to monitor the health condition of their machines, e.g., if the drives of a machine 'sound' different than the other day or different to another machine. We also know of cases, in which this approach is attractive because you can use the 5G wireless sensor in areas hard to reach. One example is the health monitoring of drives and bearings, e.g., in the steel industry. Applying models for the prediction is then another story, but that should be rather straight forward once you collect data. We have not yet investigated the ROI here.

17. Why should the manufacturing and automotive sector care about the connectivity offered by a better frequency spectrum instead of the main problem of their industry such as autonomous driving, electrification, zero carbon etc? Don't you think they have bigger challenges in front of them than 5G?

STL Partners: This is an important question - our main point is that 5G is not a challenge but a potential solution that can enable the manufacturing and automotive sectors to address these challenges around sustainability, productivity, flexibility in a much better way. We forecasted that the unique benefits of 5G can help the manufacturing industry unlock $740bn of value in 2030 through different types of use cases that enable manufacturers operate in a much more efficiently and effectively. This is mapped to direct impact on OEE metrics (Overall Equipment Effectiveness). We argue that this is also not just about money but also about the socio-economic benefits.

In more detail in our report here: 5G's impact on manufacturing: $740Bn of benefits in 2030

We have covered the potential impact of 5G in other areas too including:

- How telcos can make the world a safer place
- How telcos can provide a tonic for transport
- How 5G can cut 1.7 billion tonnes of CO2 emissions by 2030

For more information, please see our 5G research here: https://stlpartners.com/5g-research/

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