Digital Transformation via Edge Computing Platform Campus Positioning for Value Creation

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Introduction

Digital transformation (aka digitization) has emerged as a driver of sweeping change in the industrial world. With this, connectivity has shown the potential to empower industry as never before, providing businesses with unparalleled opportunities for value creation and capture. Since the start of the first industrial revolution, manufacturing industries, automotive, oil & gas, logistics and other branches have played a key role in the economic transformation of the world, providing the **"fuel" and the "innovation power" needed for word wide business.**

The **World Economic Forum's study**[1] provided a multi-year projection regarding the anticipated impact of specific digital transformation topics. Four years past publication, we can validate the accuracy of their projection, as we have already observed the "Phase I" impacts in the areas of **Big Data/Analytics**, **IoT**, **Mobile Devices**, and **Cloud**. Looking forward into "Phase II", in the coming 4 years we are projected to see greater shifts towards **Robotics/Drones**, **Artificial Intelligence**, **Wearables**, and **Collaboration**. Phase I technologies are enablers of Phase II and provide the underlying infrastructure for the march towards 2025.

[1] http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-executive-summary-20180510.pdf

Benefits of Industrial IoT

The Industrial Internet of Things (IIoT) has emerged to support the digitization of all elements of production. IIoT encompass the complete gambit -- including software, machines and humans – digitally interconnected, enabling suppliers and manufacturers to rapidly respond to changing requirements, **linking IT to OT**. IIoT enables efficient and cost-effective production by moving data from the customer to the company's systems (IT), and then to individual sections of the production process (OT). With IIoT, new tools and functionalities can be included in the manufacturing process.

Business Benefits of IIoT:

Increased efficiency

The largest benefit of IIoT is that it offers industrial operators the ability to cost effectively automate, and therefore optimize their operating efficiency. Robots and automated machinery can work more efficiently and accurately, increasing productivity and helping plant operators streamline their process functions.

Additionally, physical machinery can be economically connected to software via wired sensors that monitor performance on a constant basis. This offers plant operators better insights into the real-time operational performance of individual pieces of equipment as well as their entire plant. Wireless (**SDLAN, Wi-Fi, 4G/5G**) IIoT-enabled data systems empower operators to improve process efficiencies by:

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- Eliminating manual tasks and functions and implementing automated, digital ones in greater numbers and at a lower cost.
- Switching from "static" to data-driven decisions regarding all manufacturing functions.

In short, a plant operator will be able monitor performance from anywhere, be it on the manufacturing floor or from thousands of miles away.

Reduced Errors

Industrial IoT empowers plant operators to digitize nearly every part of their business. By reducing manual process and entries, operators can reduce the biggest risk associated with manual labor – human error.

Predictive Maintenance

Nothing negatively impacts plant operations more than machine downtime. Traditionally, maintenance in the manufacturing world has been reactive, rather than proactive. Once the machine fails, operators are stuck trying to identify what the issue is, how it can be repaired, and what it will cost. With predictive maintenance powered by industrial IoT solutions, those issues are alleviated.

By consistently monitoring component/machine functions real time, operators can create a baseline. This baseline and the corresponding data empower companies with the information they need to realize any issue before it occurs, thus turning an unscheduled event into a scheduled maintenance window. This delivers the following benefits:

- Having the required parts for the repair on hand
- Understanding the cost of the repairs beforehand
- Moving production to avoid downtime (lost production)
- Operating assets at maximum efficiency

Improved Safety

IIoT in the plant is also helping to bolster workplace safety. "Smart Plant Operations" is turning into "smart security" when all the IIoT sensors work together to monitor workplace and employee safety.

An Integrated Safety System (ISS) is a mesh of sensors protecting workers within the plant. If an accident occurs, everyone in the facility can be alerted, operations can cease, and company leadership can intervene and make sure the accident and incident is resolved appropriately. Additionally, the ISS can help keep tabs on things like employee environmental exposure to surrounding noise levels, helping improve work conditions and potentially improve performance. They can also alert employees when they aren't following proper workplace safety protocols, so they can correct their actions and stay safe on the job.

Reduced Costs

Information is power, and the information provided to operators via IIoT solutions provides them the tools they need to reduce costs and generate more revenue. Data-driven insights into operations and production (OT) can be translated directly to marketing, sales, and IT to steer business decisions in a profitable direction. These maximized efficiencies will boost profits for operators, making Industrial IoT arguably the most valuable tool for leaders of an industrial company – providing insights from anywhere, anytime.

The Role of 5G in IIoT

Connectivity, foremost 5G, is a driver for digitalization in the German and international markets as it enables digitalization of various use cases that rely on the distribution of massive data and functionality, low latency, communication security, multi-asset IoT, and many more. Edge computing is a core enabler allowing automation of onsite processes by hosting central functionality and / or orchestrating deployment on

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demand. The offering 5G Campus Network represents an open ecosystem, compatible with any kind of connectivity, edge computing, or digital solutions, integrating those e2e with the industry backends to serve their digitalization roadmap.

What is 5G and how does it build on existing LTE?
5G is a moniker assigned to the 5th generation mobile network, a new global wireless standard. 5G enables a new kind of network built upon existing LTE technology that is designed to connect virtually everyone and everything together including machines, objects, and devices. 5G wireless technology is intended to deliver higher multi-Gbps peak data speeds, ultra-low latency, more reliability, massive network capacity, increased availability, and a more uniform user experience to more users. Higher performance and improved efficiency empower new user experiences and connect new industries.

Security in 5G is critical for Industrial Operations (IIoT)
While there are many wireless technologies (e.g. Wi-Fi, Bluetooth, etc.), these are often considered consumer centric. They typically operate in an uncontrolled spectrum and therefore carry with them a higher level of insecurity as well as potential for interruption. For example, the Wi-Fi spectrum which is unlicensed finds use in numerous consumer products from hobby drones and wearables to action cameras.

The overuse of the Wi-Fi spectrum by a vast array of consumer devices clogs the airwaves. The breadth of available devices and rather open standards has enabled numerous “Black Hat” tools to mature, meaning even novice hackers can wreak larger scale damage easily.

Conversely, the LTE spectrum is regulated the world over; it is considered a closed system with a more sophisticated set of protocols. In 5G, added controls include new mutual authentication capabilities, enhanced subscriber identity protection, and additional security mechanisms. 5G offers the industry an unprecedented opportunity to uplift network and service security levels and provides preventative measures to limit the impact of threats.

Rethinking ISA-95 for 5G & IIoT

In the process control space, the ANSI/ISA95 standard is a key tool for digitization. ISA-95 provides the framework, modeling, and vendor independent common information models which can be applied in any manufacturing or process industry production architecture.

Traditionally, ISA95 has been implemented in a 5-layer system architecture, where each level only communicates through adjacent levels. This implementation was built around the technology available at the time it was conceived [circa 1995]. With increases in computing power, wireless networking [i.e.5G], and embedded edge computing, all supported by far more sophisticated and refined software for distributed computing, it is time to re-think this model.

The digitization of manufacturing is leveraging new technologies, including higher bandwidth networking, IIoT communication standards, real-time business enterprise systems, cloud computing, and powerful embedded computing abilities in field devices including sensors, instrumentation, valves, motor controls, and other devices. However, the adoption of new technology for industrial control & automation systems has always lagged behind the technology industry itself. Many industrial automation suppliers initially took the position that these changes were not appropriate for industrial and process automation, preferring to use their proprietary hardware and software.

This attitude has held industry back from achieving its full potential, as it has held a small amount of data “captive” only allowing it to be exchanged transitionally within the stack. OT (Operational Technology) is on its

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own island, separated from IT business functions, making even near real-time exchange not possible.

To overcome this, it is necessary to reimagine ISA-95 for era of Industry 4.0 and digitization. The handrails in ISA-95 have served us well for many years and migration away from this standard would be both costly and risky. Reimagining the framework allows us to keep the security we have come to enjoy from ISA-95, yet evolve it at the same time.

This trend is typically referred to as the Left Shifting of IT (information Technology) to OT (Operational Technology). Turning the existing hierarchy on its side transforms it from a monolithic stack to a horizontal scale model, allowing data to flow from Level 1 to all levels, including the business (IT) level, in real time.

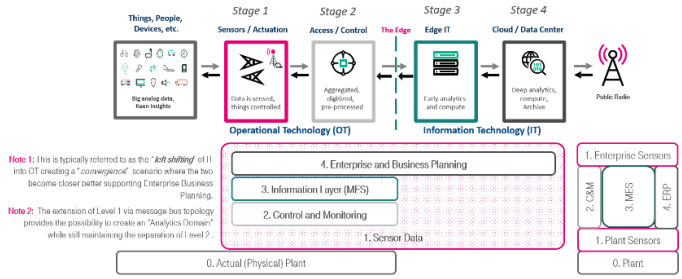

Figure 1 ISA-95 Left-Shifting the OT/IT Model for IIoT Applications

What McKinsey says about Re-Imagining ISA-95:
"Intensifying global competition and increased commoditization are shifting value pools from machinery and products to software and service"[2]

Industry architecture standard ISA-95 addresses the complexity rising out of global production and distributed supply chains but does not address the myriad data and security issues brought on by countless connected devices. Creating solutions here will be no small feat, but successfully addressing these challenges will open the door to use cases that facilitate a massive business opportunity:

Device-management platforms. IIoT platforms support the development and deployment of applications that manage a potentially vast number of connected devices. These platforms simplify the complexity by zeroing in on the common technology needs of a diverse set of applications, devices, and uses.

Industrial automation and shop-floor communication. IIoT technology presents an opportunity for substantial IIoT revenue growth and margin expansion in industrial equipment and machinery. Platforms, software, and app development are the elements of IIoT that are expected to grow, while others, such as device cloud connectivity, have likely plateaued.

An ecosystem of business and technology partners. Working relationships with a wide array of external players and institutions will be a core capability needed. **Companies should begin thinking about which aspects of IIoT platform implementation and monetization they want to "own," as well as which are best addressed through outsourcing, long-term collaboration, or other types of partnerships.** They should then start identifying who those partners might be and engaging them pragmatically.

[2] https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/digital-machinery-how-companies-can-win-the-changing-manufacturing-game#

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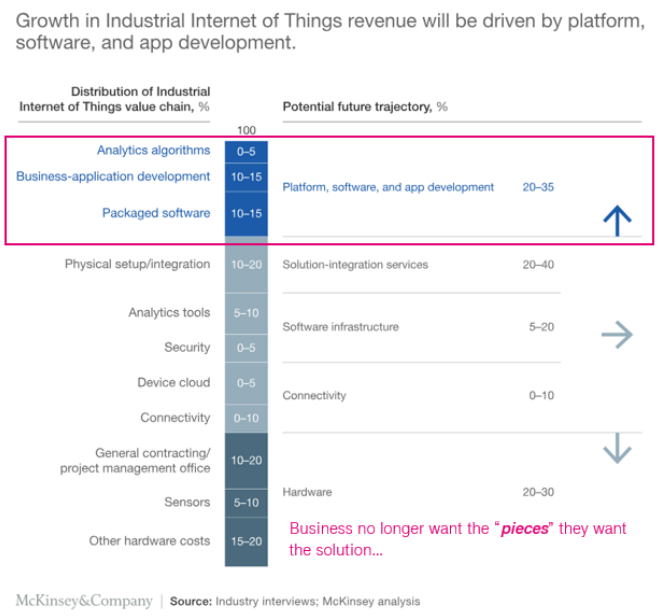

Figure 2 McKinsey's Assessment of IIoT Market / ISA-95[3]

The Role of an Edge Computing Platform

Edge Computing - Power Where you need it.
In the current competitive environment, your company needs to quickly adapt to the fast pace of change. When **IT meets Operational Technology (OT)**, two worlds with completely different requirements face each other. **Time-sensitive networks, real-time data streams, processing and analytics become the new baseline to further** evolve a successful business. The exponential growth of data captured in real-time and the need to analyze and take immediate action, turns Edge Computing into an essential component of your technology landscape.

An **Edge Computing Platform** enables a more efficient **distribution of computing resources (outside the Cloud or central Datacenters)**, to meet the needs of the most demanding scenarios "near" to where the action is taking place (e. g. devices, machines, robots, etc.). Ultra-low-latency (< 10 MS) Use Cases like indoor or outdoor Automated Guided Vehicles (AGVs), Augmented and Virtual Reality (AR / VR) use Simultaneous Localization and Mapping (SLAM) algorithms which are only possible with Edge Computing. In scenarios where you need to deploy this kind of applications you need to **focus on the business rather than on IaaS and PaaS management**.

Edge computing helps you bring the domains of IT and OT (Operational Technology) closer together.

Our Solution is based on:

- High performance, industry grade compute units and an
- IaaS / PaaS service layer to provide a platform for Edge application
- development and productive deployments at the Edge
- Edge Analytics and Big Data capabilities
- A best-in-class technology ecosystem
- A vendor agnostic strategy
- T-Shirt sized blueprints that we can customize to your specific requirements also including specialized hardware (e. g. GPU, FPGA) if required:
  Simplex / one compute node
  Duplex / two compute nodes
  Advanced / eight or more compute nodes

Fully Managed Services

Let us take care of the platform, so you can take care of your business. Our offering includes operating (monitoring, maintaining, patching, upgrading, etc.), securing and connecting your Edge Computing and Edge Analytics environment.

Value proposition

[3] McKinsey&Company; Industry Interviews; McKinsey analysis

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- All necessary Edge-Computing Components for multiple Edge Sites from one single hand: T-Systems
- Edge Analytics: Code-to-Data principle
- High performance and Ultra low latency (up to < 10 ms)
- Customer specific and aligned Edge-Use Cases
- Integration of T-Systems Edge Computing in Public Clouds
- Vendor agnostic Edge Computing Service
- Edge Computing Services integrated in 5G Campus Network of Deutsche Telekom based on highly secure communications

Easy Platform Management

T-Systems is your End-to-End partner. We help you from the Blueprint definition, through the implementation and further operation and maintenance of the complete Edge Computing environment. We provide you the best and most secure networking services, hardware infrastructure, a completely managed platform as a service, consulting and developer on-boarding.

Your Benefits

- Secure the ROI of your Edge Computing initiatives
- Focus on the business logic of your Use Cases
- Leverage the End-to-End coverage of T-Systems and Deutsche Telekom
- Enable innovation with 5G technology

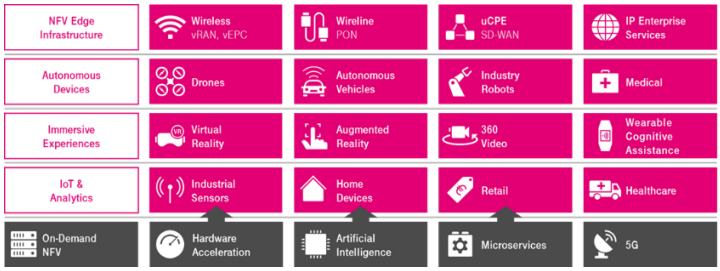

Figure 3 Use Cases for Edge Computing powered by an Edge Computing Platform - Wherever Latency, Bandwidth, Security or Connectivity counts

The Role of Campus Positioning

The industries and their partners are operating sites world-wide and need to manage a large number of processes along the value chain. There is an emerging demand for positioning and localization services resulting from IoT services and digitalization ambitions of industries. The automated identification and localization of objects in indoor- and outdoor campus areas is the key enabler for more process transparency, optimizations and future and extended use cases like automated guided vehicles or others. Existing positioning solutions are designed for specific use-cases like GPS for out-doors and individualized technologies for indoor but cannot fulfil the industry requirements in the context of connectivity, precision, flexibility, cost and standardization. Often several systems, solutions and specialists are needed for different use cases.

The Campus Positioning of T-Systems and its components focus on combining different localization technologies like mobile cellular technology and complementary technology like UWB, BLE, RFID, GPS, WIFI… to one solution serving all process steps planned and digitalized in different indoor- and outdoor zones of the campus in scope. It provides connectors to existing common real-time-localization systems and uses the state-of-the art real-time 5G capabilities to automatically localize moving and non-moving objects in in order to

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serve the following not exclusive use cases within various industries:

- Geofencing in order to trigger area of interests (zones) entries and leaving events,
- Track and Trace for automatically capturing of object movements,
- Gates Recognition for automatically capturing of passing events,
- Presence Monitoring for automatically detection if area of interests is occupied or not,
- Utilization and KPIs calculation for campus area of interests,
- Generation of alarms and notifications based on predefined rulesets,
- Widgets for visualization of assets and asset movements in real-time,
- Widgets for visualization of asset tracks and results of motion analysis.

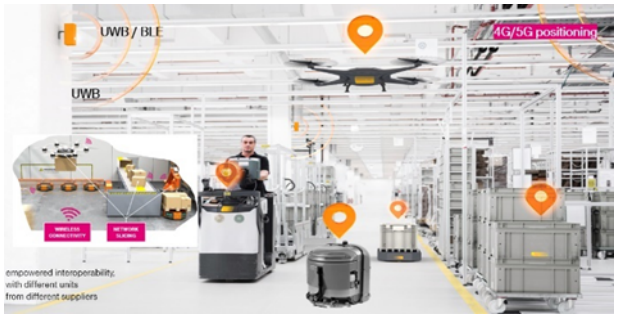

Figure 4 Industry Use Cases

A key component of the Asset is the Positioning Service supporting different kind of localization precisions up to 10 cm. It provides standardized APIs for the simplified integration of industry business applications and can be configured for any kind of process where equipment, assets or per-sons needs to be localized in order to proactively manage, control and optimize processes along the chain. The product is considering the campus areas and supports the seamless integration of IoT Devices monitoring the transport ways between different campus areas.

The Campus positioning follows a modular approach. This approach enables the industry to use the product with the biggest flexibility in the market and allows to integrate existing infra-structures (i.e., Real-Time-Location system, RFID based system) but provides also the possibility to introduce new localization infrastructures (i.e. BLE based High Accuracy Indoor Positioning) to your campus if use-cases demanding for it. Furthermore, the product enables the industry to use the high sophisticated localization capabilities of cellular networks (i.e. 5G Networks) without investing in additional localization infrastructures. So fully automated and paperless processes can be realized.

The Positioning Service is fully compatible to OMLOX, the new industry standard for Industry 4.0 Location-based Services defining the interfaces between the movable assets, the localization infra-structure, the coordinates and the consuming business applications. **The product 5G Campus positioning provides different modules, connectors and optional plugins** to enable the one solution approach for the industry. The product is a central service of the T-Systems product family 5G Campus Networks.

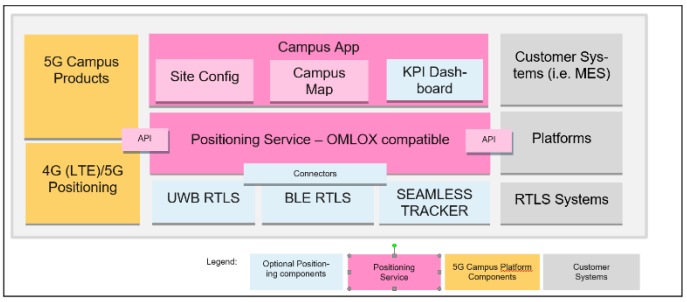

Figure 5 Overview of modules

The Campus App is a web application that provides functions for the administration of the positioning service. This includes the registration of different positioning providers (i.e., UWB RTLS or 5G based positioning) and as well the registration of trackable. A trackable is a registered object/asset paired with at least one or more tags (i.e. UWB Tag, BLE Beacon) supported by the positioning providers. Additionally, the Campus

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App provides functions related to the real-time tracking of as-sets/ trackable. This includes a specific view of a predefined Area of Interest for a user. In particular the specific Area (of interest) and the respective KPIs.

The overall functionality can be summarized as:

- Site Config – Component to configure the Positioning Service
- Campus Map – Component for viewing the current positions in the map
- KPI Dashboard – An optional component

The Positioning Service is the main component of the product Campus Positioning providing functions and connectors for the integration of different localization technologies. Furthermore, it pro-vides a standardized API for the integrating of customer systems and 5G campus components.

The connectors and API are based on OMLOX, the first open and independent industry standard for localization services. OMLOX is an open and interoperable standard that is revolutionizing real-time locating. Driven by an industry consortium of mayor players, OMLOX ensures seamless positioning services across multiple established or even upcoming technologies (ex. UWB, Wi-Fi, GPS, 5G, RFID, and BLE). All location-based use-cases are being supported. The OMLOX compatible ser-vice basically is built upon two core elements, an open infrastructure and a lightweight software middleware, supporting a unified access to positioning data from various sources and various technologies. OMLOX is ready to support multiple transmission technologies like UWB and 5G at the same time right out of the box. The middleware, called HUB, is the central component managing the different campus localization zones using various positioning technologies (i.e. BLE, UWB, 5G) at the same time. It is able to transform all incoming position data into global geocoordinates thus being able to e. g. calculate potential collision between vehicles, load carriers and other assets. Seamless fencing across multiple data sources becomes reality.

The main functions of the Positioning Service can be grouped as following:

- Positioning Engine
- Interfaces (API)

The Positioning service provides an engine as central component provides OMLOX compatible APIs, connectors and positioning functions like geofencing, tracking and tracing and seamless positioning. Following functions are provided:

The service supports different positioning and localization technologies.

- LTE based localization technology with a precision up to 5 m.
- UWB as localization method with a precision up to 10 cm
- GPS based localization method with a precision up to 10 m
- BLE proximity-based localization with a precision up to 10 m

With the OMLOX compatible interfaces the Positioning Service provides standardized APIs for the simplified, quick and cost-efficient integration of business application and the integration of real-time localization systems (i.e. BLE, UWB) and cellular-based localization systems (i.e. LTE, 5G).

- Integration of LTE, 5G based infrastructure
- Integration of RTLS systems based on UWB (later also BLE)
- Integration of GPS tracking devices

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Conclusion

While wireless connectivity is at the heart of all industrial IoT solutions, there is not a single digital ecosystem.

Digitalization is not only coming down to the application of digital technologies and solutions to automate processes (AI in Prediction, Computer Vision in QS, Robotics in Transportation). It requires adequate platform infrastructure that forms the backbone of digital use cases.

Each unique digital ecosystem is an interdependent group of actors, including enterprises, customers, IoT devices, and other stakeholders. They share standardized digital platforms to achieve mutual benefit. A “best fit” ecosystem will ultimately become the competitive unit, yet there are complex undertakings which require many interconnected factors to be balanced by a seasoned integrator.

A platform ecosystem empowers IoT and its integration into customer backend, enables synergies though shared services and simplifies management of technology stack. Edge Platforms bring powerful ecosystems to where it is needed, and connectivity is key in secure and low-latency data transmition.

Editorial
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