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FEATURE

5G edge as an operations transformation platform

How a 5G edge platform can help leaders across industries transform operations

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THE DELOITTE CENTER FOR TECHNOLOGY, MEDIA & TELECOMMUNICATIONS

The combination of 5G and edge computing can supercharge data collection, analysis, and action—and potentially provide a platform to transform business operations.

Introduction

Most executives understand that 5G means far more than faster downloads and better smartphone connections. This latest generation of wireless technology offers enterprises a powerful connectivity fabric to capture and transmit vast amounts of data from a tremendous number of devices. And when paired with its edge computing counterpart, 5G further empowers organizations to act on these rich datasets in real time, offering unprecedented visibility, insights, and control over assets, products, and services.[1]

5G edge's true value lies in its role as a transformation-enabling platform and innovation engine for the applications that run on top of it.

Business leaders generally grasp the potential transformational impact enabled by what we call the *5G edge* and its potential to unleash the next wave of organizational growth.[2] And there are already real-world examples of implementing 5G edge platforms to transform business operations:

- Port operators are using 5G edge infrastructures to support massive IoT deployments and enable greater efficiency, lower labor costs, and improve security and worker safety.[3]
- Automakers have begun introducing 5G edge systems as part of their Industry 4.0 initiatives to transport massive amounts of data from connected production equipment and machinery. This allows the plant to track movement of individual parts and to monitor machines as well as quality in real time.[4]
- The retail industry is experimenting with the 5G edge to power new services for customers as well as to drive operational optimization—for instance, shelf scanning for out-of-stock inventory or prevent shoplifting.[5]

That's not to suggest that implementing and orchestrating such large and complex initiatives isn't daunting. Notwithstanding an unexpected acceleration in enterprise deployments of private 5G edge networks,[6] many executives remain unclear where to start, how to approach deployment, and how to obtain widespread organizational buy-in for what can seem a complicated and costly undertaking.[7]

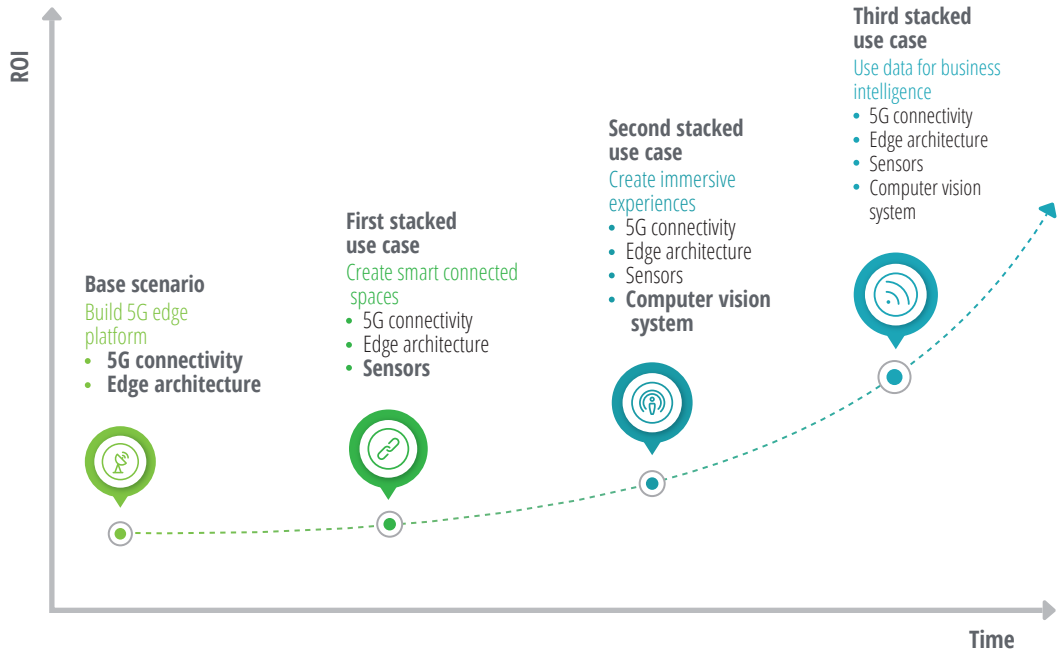
Investing in the 5G edge as a transformation-enabling platform

It may prove useful to consider 5G and edge computing as core components of a broader enabling infrastructure or platform that positions the organization for whatever comes next. Having a robust and flexible digital infrastructure in place allows companies to adopt a systematic and modular approach in rolling out new applications. Given that a 5G network is also highly modular in

FIGURE 1

Stackable use cases

As additional applications and use cases come online, the overall return on investment and total cost of owning the transformation platform improves considerably.



Source: Deloitte analysis.

terms of both design and how it can be rolled out, enterprises can phase their 5G investments based on business needs.

As innovative and advanced use cases materialize, companies can rapidly deploy them on top of the existing platform, with no need to build a whole new network infrastructure for each use case. As defined by Metcalfe's law, with more solutions and devices deployed on the 5G edge platform, the ROI and total cost of ownership improve considerably.[8] Thus, the true value of the 5G edge lies in its role as a transformation-enabling platform and innovation engine for the solutions that run on top of it.

"Stackable use cases" and the path to positive ROI

Through experience, everyone knows not to deploy technology for technology's sake. But as organizations begin to examine their business issues and the existing and emerging technology tools to solve them, 5G and edge computing will likely increasingly become part of the solution for many. With that in mind, it is essential to architect a network infrastructure with the capabilities and flexibility to meet the organization's future needs.

By developing a strategic road map for their infrastructure investments, organizations can lay a strong foundation to take advantage of future opportunities. Specifically, a 5G edge platform architecture can provide an enterprise with a reusable, multipurpose transformation platform to layer or stack new technologies and applications without having to build additional, specialized platforms. And each additional initiative stacked on the base infrastructure considerably improves the overall ROI.

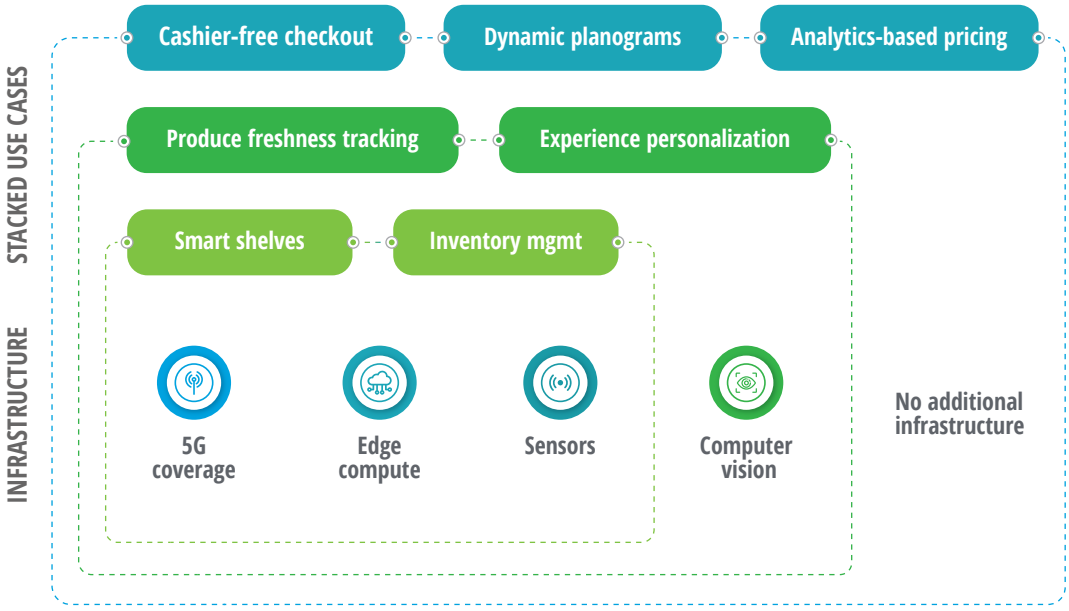
As figure 1 illustrates, establishing a base 5G edge architecture enables a more phased and modular rollout of applications and use cases. This is in contrast with traditional technology infrastructure investments that require a high upfront capital commitment—for example, data center build-out. The modular nature of 5G edge allows enterprises to introduce only the baseline platform and gradually introduce new infrastructure elements as the need arises. The 5G edge particularly advances those applications requiring device-centric and data-intensive operations, such as camera analytics and machine learning, that will increasingly define the future competitive landscape.

The 5G edge transformation-enabling platform in action

5G edge platforms can support a wide variety of use cases and applications and even other connectivity technologies such as Wi-Fi or LPWAN. While the edge platform can simultaneously support other connectivity options, our focus in this section is on the value driven from combining the edge with 5G. Here we look at two scenarios,

FIGURE 2

The 5G edge in retail



Source: Deloitte analysis.

highlighting the platform's transformative potential in the retailing and manufacturing sectors. In each scenario, the 5G edge platform offers the retailer or manufacturer the optionality and flexibility to add or stack new applications on the platform as needed without implementing a whole new enabling infrastructure.

STACKABLE USE CASES IN THE RETAILING SECTOR

Base scenario: Establishing the 5G edge enabling platform. In our example, we follow a large retailer's journey through its digital transformation using a 5G edge platform to support multiple initiatives that can improve overall efficiency and customer engagement of the brick-and-mortar shopping experience.

Some organizations opt for building private 5G edge networks, but leaders at our retailer decide to contract and collaborate with a third-party service provider for its 5G connectivity and edge computing needs.

Stacked use case in retail: Smart shelves and inventory management. With a 5G edge platform in place, our retailer begins to outfit its stores with wireless video cameras and sensors to monitor store shelves and track inventory. The system monitors incoming data to proactively alerts store associates to replenish the shelves, identify misplaced items, and keep inventory levels up to date.[9]

Of course, companies are already using IoT and existing wireless technologies to implement some of these systems.[10] In this use case, the retailer taps 5G's low power consumption, precision location detection, and ability to support high device density on a single network to deploy thousands of low-power IoT devices that bring to life a smart shelf system.

Stacked use case in retail: Freshness tracking and experience personalization. With the smart shelf and inventory management systems in place, leaders recognize that the retailer needs a better understanding of customer traffic patterns and deeper insights into fast-moving inventory. In its produce department, the store adds AI-driven algorithms to the existing camera-vision system to track freshness and dynamically adjust pricing on digital signage to encourage demand, optimize sales, and minimize waste.[11] Again, the retailer can build on the same 5G edge platform and camera surveillance system that supports the smart shelves application to detect aging fruit and vegetables.

The problem with computer vision systems has been that they generate massive amounts of data that can stress any network. But 5G's high up- and downlink throughput capacity, when combined with powerful edge computing resources, provides the immediate analysis and response needed to bring real-time vision systems from concept to reality.

Stacked use case in retail: Personal and immersive interactive experiences. Our retailer is also exploring opportunities to use data to drive more personal experiences and higher customer engagement levels. Retailers such as Ikea and ASOS are also exploring the use of virtual reality to create more engaging and fun shopping experiences, using 3D representations and magic mirrors that superimpose products on customer images.[12]

Granted, over the years, many retailers' IoT-led personalization initiatives have failed or, at the least, underwhelmed. Often, the reason has been the underlying network's inability to keep pace with technological development, resulting in inconsistent and unreliable customer experiences.[13] Many of the problems associated with old networks—primarily, erratic and jittery connectivity—are mitigated by 5G, which was designed to handle these types of device-centric and data-intensive use cases.

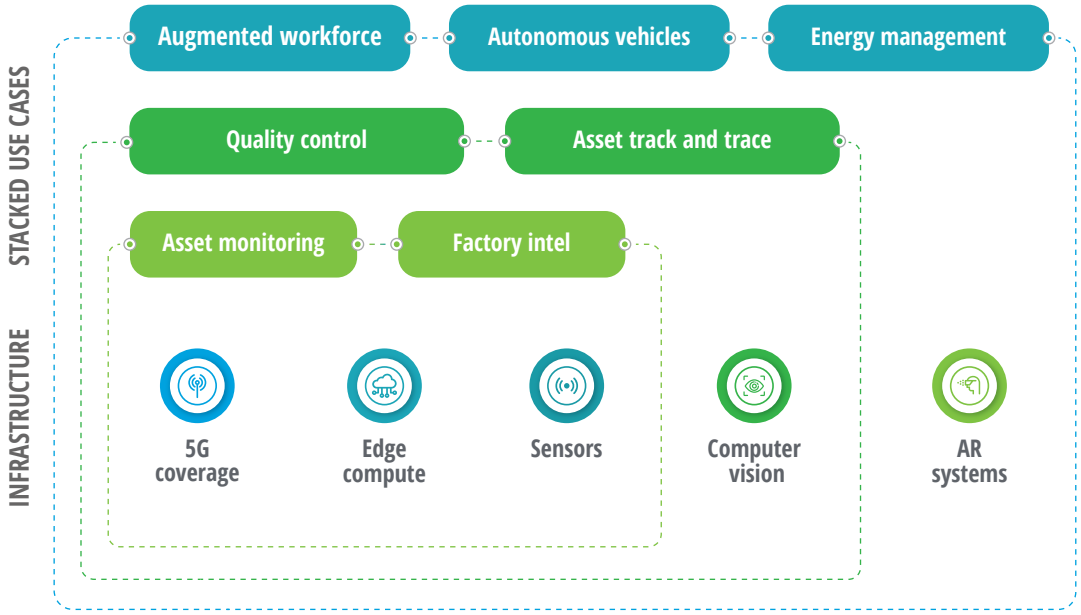
Stacked use case in retail: Advanced data analytics. There are many secondary and tertiary benefits. The 5G edge transformation platform supports in-store analytics applicable to almost every phase of the retail process.

As our retailer rolls out smart shelves to monitor inventories across all locations, leaders envision pulling real-time data to understand demand conditions at each store. The system can then use the data to automatically alter pricing on electronic signage, automate store reordering, and optimize overall system stock levels. It can also use data on consumer purchasing patterns and behaviors to predict retail trends, forecast product demand, design shelf/floor layouts, and optimize merchandising strategies.[14]

The 5G edge platform enables the massive collection and processing of vast amounts of data across the network ecosystem. But the key is to get the right data to the right person to make the right

FIGURE 3

The 5G edge in manufacturing



Source: Deloitte analysis.

decisions. AI-driven applications on top of the 5G edge transformation platform can help turn this data into valuable and actionable insights.

STACKABLE USE CASES IN THE MANUFACTURING SECTOR

Manufacturing is poised to become one of 5G's biggest beneficiaries,[15] with the technology knocking down many of the barriers that have prevented IoT from achieving its full potential in smart factories. Many manufacturers are looking to 5G to unleash a new wave of productivity gains as they max out the capabilities of existing wireless options.

Base scenario: Building the 5G enabling platform. Leaders at our manufacturer decide to build a private 5G edge network to support current and anticipated mission-critical factory operations. Indeed, many large organizations are taking steps toward building networks—enabling owner control over connectivity, performance, and security[16]—to advance smart factory and Industry 4.0 ambitions. Private networks are not new, but the addition of a 5G edge can unleash a wave of automation and operational efficiency gains. Some companies, such as John Deere, are going as far as acquiring their own spectrum;[17] in Germany, the government allocated private spectrum to automotive OEMs such as Audi and Mercedes-Benz.[18]

Stacked use case in manufacturing: Asset monitoring. As part of the 5G edge implementation, our manufacturer outfits its factory with wireless sensors connected to the 5G edge platform, which collects, monitors, and analyzes factory asset performance. In this respect, 5G offers huge benefits over other forms of connectivity. It not only supports a vast number and wide variety of devices—it provides 24/7 ubiquitous and deep coverage to reach difficult locations in challenging environments. Moreover, since 5G offers the same if not better speed, latency, and throughput as wired ethernet connections, 5G untethers our manufacturer from its web of wired cabling, enabling more flexible and rapid production setups and teardowns.[19]

The data flows from these devices provide a clear line of sight into asset health and performance and generate insights that help optimize and improve the overall manufacturing process. For example, the system sends alerts to maintenance technicians if machines breach set tolerance levels, indicating imminent failure. It provides the plant engineer with the information needed to adjust sensitive production processes to reflect changing environmental conditions such as humidity. And it keeps the plant supervisor up to date with real-time visibility into production uptime.

Our manufacturer adopts a deliberate approach, rolling out targeted applications and tracking performance metrics to validate positive outcomes. Early success inspires our manufacturer to experiment with new applications. Specifically, with everything on the same network, leaders realize that it will be relatively easy to interconnect existing applications to autonomously communicate, synchronize, and self-optimize processes within the manufacturing environment.[20]

Stacked use case in manufacturing: Quality sensing. The manufacturer adds a visual quality inspection system to the 5G edge platform to enable continuous product inspection, defect detection, and predictive quality analysis. Here, 4K cameras rely on 5G's high capacity and data rates to feed high-resolution images to machine learning inference algorithms at the edge, where they are analyzed and acted upon instantly. Real-time quality detection reduces the need for manual inspections throughout the process and dramatically reduces scrap.

The sensors, machines, and applications that form the heart of the IoT generate massive amounts of data, a flow that can tax most networks. IoT devices will generate terabytes of structured and unstructured data.[21] The 5G edge platform is explicitly engineered to handle the rising number of connected devices and the exponential growth in data traffic they will generate. And instead of sending all this data back and forth to the cloud for analysis, the 5G edge platform processes data locally, reducing transmission costs, latency, and complexity.[22]

Stacked use case in manufacturing: Augmented reality. With the COVID-19 pandemic curtailing air travel, our manufacturer learns that several large Chinese manufacturers have adopted augmented reality (AR) solutions for remote service and maintenance support on their imported equipment. The AR glasses enable experts in Germany and Austria to provide remote technical support for their purchased manufacturing equipment.[23] In partnership with its local communications service provider, Schneider Electric is also trialing AR in maintenance technician activities and implementing a telepresence robot for remote visits.[24] Inspired by these applications, our manufacturer begins exploring opportunities to utilize AR solutions to connect offsite engineers with its maintenance workers using real-time 3D visualization to triage and repair its complex bespoke machinery.

AR remote and robotic applications in particular require ultra-reliable, low-latency connectivity to provide a satisfactory user experience.[25] 5G's super-fast, high two-way data rates and low latency wireless connections reduce video applications' jitter and lag, making them more natural and enjoyable to use. 5G, combined with local edge processing, makes these time-sensitive applications possible.[26]

Moreover, 5G enables multiple networks to exist on the same platform. The network operator can tailor each network's characteristics to meet specific applications' quality-of-service requirements.[27] This practice, also known as network slicing, allows the manufacturer to provision a separate low-latency network for mission-critical, time-sensitive applications such as AR or precision robotics while maintaining separate networks for nontime-sensitive applications.[28]

Stacked use case in manufacturing: Advanced data analytics. The secondary and tertiary benefits from the 5G edge transformation platform and stackable use cases derive from the collected data and analytics. Manufacturers can use data insights to optimize operational activities in and across all production facilities at almost every manufacturing process phase. In one case, analysis of production line data across multiple plants suggested that the manufacturer could reduce furnace temperatures and cure times without affecting product quality, dramatically improving energy management and overhead costs.[29]

The above scenarios illustrate how companies in very different industries can deploy the 5G edge as a foundation to harness powerful new technologies and innovate purposefully at scale. The retailer uses the platform to enhance its brick-and-mortar customer experience; the manufacturer uses it to drive greater efficiency, automation, and insights.

Journey to 5G and edge-enabled transformation

Leaders should consider the following framework to enable a 5G edge-driven transformation:

ALIGNING THE ENTERPRISE AROUND THE 5G EDGE

Project success depends on the involvement of players and partners both within and outside the organization. Each brings a unique perspective that can help identify the enterprise's most pressing strategic and business challenges—and help maximize the technology's potential to solve those challenges.

Pulling together, coordinating, and aligning stakeholders require a significant orchestration effort. Strategy officers have a tremendous opportunity to act as a conduit within their organizations to unlock, execute, and deliver on the 5G edge as a strategic enabler of competitive advantage.[30] But whoever takes the orchestrator role will need to collaborate and cultivate commitment from critical stakeholders across four key dimensions:

Business

Line managers bring different perspectives on how the platform can help overcome the enterprise's most critical pain points. Some leaders will focus on incremental opportunities to reduce costs and improve efficiency; others will explore its broader potential to create new business and revenue models.

Finance

Finance executives will require financial justification and a clear path to positive ROI. This requires evaluating the investment based not on any single project but on the infrastructure's role in rapidly implementing and scaling a portfolio of immediate and anticipated applications.

Cyber risk

While 5G and hybrid cloud architectures' intrinsic characteristics can improve security and data privacy, the exponential rise in data and the number of connected devices increase a company's attack surface and governance challenges as well as the potential points of failure in the organization's supply chain. Early involvement of risk stakeholders presents opportunities to shape more robust technical architectures and compliance and governance frameworks to minimize and manage organizational risk.

Technology

IT executives and network engineers should design and build the intelligent edge network for a broad portfolio of current and future use cases. As a transformation platform, the network should be designed to reuse core assets to support multiple opportunities with the flexibility to experiment and add new services as technologies evolve and innovative use cases materialize.

- **Education and buy-in.** Educate business leaders in different roles and their teams on 5G and edge computing and what capabilities it enables. Secure buy-in on both immediate and future opportunities for 5G to accelerate external and internal priorities for which they are responsible.

- **Use case identification and prioritization.** Identify the initial and future set of use cases based on value creation and technology readiness; base ROI/total cost decisions on the basket of use cases, considering both immediate and anticipated opportunities.

- **Platform design and operationalization.** Detail and design a flexible transformation platform architecture that can accommodate identified use cases and applications' diverse network requirements. Identify and coordinate with external partners and vendors to augment the current workforce or jump-start capabilities with semibuilt solutions. Be conscious of retaining critical tasks and developing in-house talent. Implement and operationalize prioritized use cases while maintaining a healthy pipeline to further the transformation vision.

- **Vision and tracking.** Ground the journey for 5G edge transformation in the enterprise's vision for the future, considering both internal operational efficiencies and external opportunities to create a competitive advantage. Establish a standard model to compute and track benefits emerging from the 5G edge transformation platform, including incremental external revenue and internal cost-saving opportunities.

- **Organization and change management.** Set up the organization for success by assessing the fundamental changes regarding personnel, processes, and technology that come with adopting new solutions. Leadership should drive a sense of urgency, alignment, and collaboration among critical stakeholders. Address what activities, timelines, owners, dependencies, and outcomes are needed to bring the vision to life.

Conclusion

As enterprise transformation ambitions become bigger and bolder, a well-conceived 5G networking and edge computing architecture can help future-proof an organization to take advantage of whatever comes next. The 5G edge provides a versatile and reusable platform to layer multiple technologies and applications as needed and serves as a force multiplier and innovation engine in their rapid deployment and scaling. Together, 5G and edge computing can help enterprises unleash a new wave of efficiency gains and immersive customer experiences that set them up for future success.

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