Redefining manufacturing with private MEC and 5G

By integrating Verizon's On Site 5G and 5G Edge with AWS Outposts, manufacturers can quickly deploy near real-time applications like intelligent logistics, predictive maintenance, robotics, factory automation and more.

There's a reason that cloud adoption among enterprises continues to gain momentum. Actually, there are many reasons. Starting with its ability to provide on-demand computing, storage and networking that extends to a much richer set of innovative services—such as databases, analytics, artificial intelligence (AI) and machine learning (ML), IoT and more. However, there are applications and data that CIOs and IT leaders have not been able to migrate to the cloud. These may have residency or privacy constraints preventing data from leaving the premises, strict latency requirements, a need to connect directly to onsite equipment, or time or bandwidth constraints that make it infeasible to transfer massive amounts of data to the cloud.

These on-premises workloads also face onsite networking challenges. Many applications depend on local wired or Wi-Fi networks to transport enterprise data. Furthermore, while wired networks may provide acceptable performance, they can be expensive to upgrade, reroute and extend, and can be too inflexible to accommodate end device mobility. Enterprise Wi-Fi is a popular alternative due to its simplicity and cost-effectiveness, but it can suffer from coverage, capacity, reliability, security and handoff issues. Addressing these network issues is critical for businesses that want to adopt IoT and industrial IoT (IIoT) as part of Industry 4.0 initiatives, or that want to implement other digital transformation mandates that increase the volume of and dependency on data.

A solution that combines private cellular 5G technologies with mobile edge computing (MEC) could be the answer. The unique combination of Verizon's high-performance On Site 5G network with on-premises cloud computing on AWS Outposts can enable new applications that were previously technically or operationally infeasible.

What is 5G and private 5G?

5G is the next generation of public mobile cellular networking. When leveraging millimeter-wave (mmWave)-based spectrum resources, 5G is capable of supporting gigabit-level data rates with very low latency. Using a new approach to wireless signal construction and processing, it can provide enhanced reliability, service coverage and higher availability.

5G, like the 4G LTE that came before it, is a mobile standard defined by the 3rd Generation Partnership Project (3GPP). Unlike Wi-Fi, 4G and 5G have traditionally been used on public mobile networks. However, recent advances in technology, interest from corporations and enterprise-friendly government spectrum policies worldwide have increased interest in creating private mobile networks.

In particular, the Citizens Broadband Radio Service (CBRS) in the U.S. is a 150 MHz-wide section of the 3.5 GHz band (3,550 MHz to 3,700 MHz) available for commercial use under a three-tier spectrum-sharing arrangement. The arrangement protects U.S. Navy radar use and accommodates a commercial priority access band available through spectrum auctions. The availability of CBRS in the U.S. may be helping to drive increased private 4G and 5G adoption among corporations, educational institutions, public utilities, local governments and municipalities.

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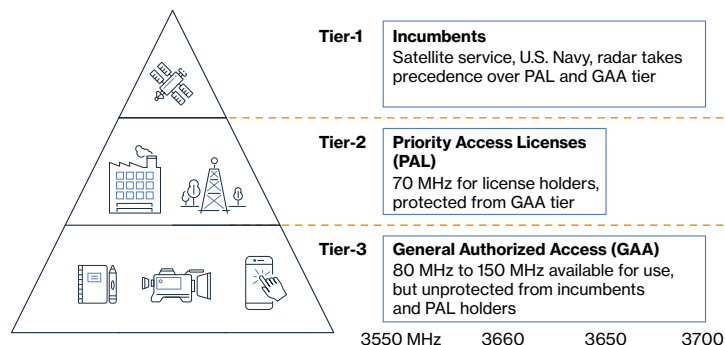
Three-tier CBRS architecture

The cloud continuum

Here's how it works: Wireless base station infrastructure—4G eNodeBs (eNBs) or 5G gNodeBs (gNBs)—is deployed privately in an office, factory or outdoor setting and integrated with a mobile core system, such as a 4G evolved packet core (4G EPC) or a 5G core (5GC). This mobile core system provides the control and data management for mobile traffic, and the system elements can be located onsite.

Like Wi-Fi, these private 4G and 5G networks are isolated from public mobile networks. However, their performance means they can replace wired networks and augment under-performing enterprise Wi-Fi. Today, the majority of installed private networks are based on 4G LTE technology. As the technology matures, however, they will rapidly transition to 5G.

Compared with Wi-Fi, private 5G provides improved security (e.g., default encryption and stronger authentication), better spectrum efficiency and improved handoffs as devices traverse cells. The use of 4G or 5G also provides a path toward public mobility—as devices leave the premises, they can seamlessly connect to public mobile networks.

Note: For the remainder of the solution brief, we will use the term On Site 5G to include both 5G and 4G LTE networks unless we're distinguishing between the two.

What is MEC and private MEC?

Mobile edge computing[1] is often discussed in tandem with 5G, but the two aren't interdependent.

MEC is a network architecture concept that enables cloud computing capabilities and an IT service environment at the edge of any network, effectively extending the cloud to locations closer to where devices and users consume or generate data. Private MEC refers to a service that provides a dedicated on-premises edge compute infrastructure that is then integrated with a private mobile network.
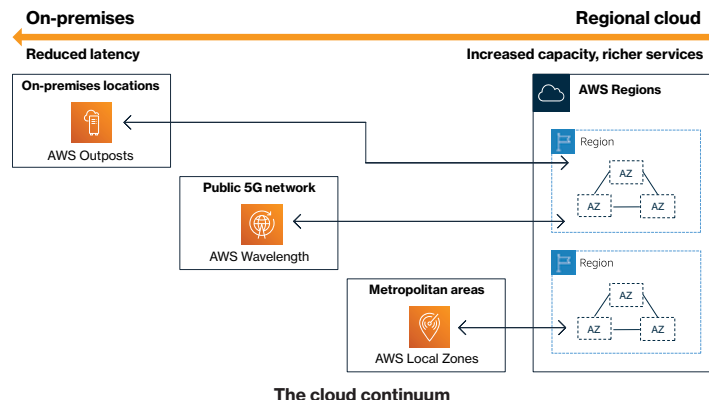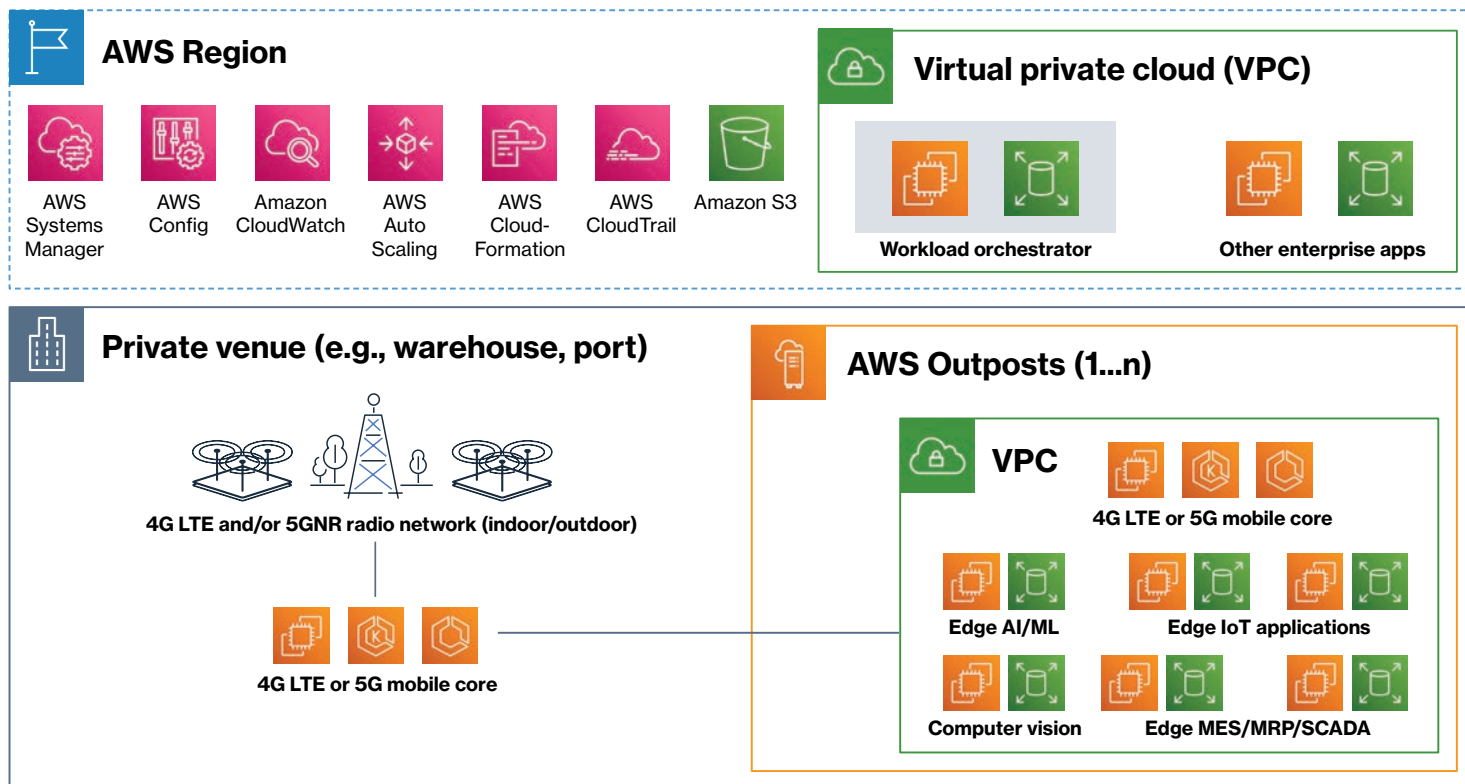
Neither MEC nor private MEC requires a 5G network—but the combination of the two can bring significant value to users.

Private MEC with Verizon On Site 5G—a potent combination

To bring private MEC to our customers, we've expanded our 5G collaboration with Amazon Web Services (AWS) for a private MEC solution that will fully integrate our Verizon On Site 5G and 5G Edge with AWS Outposts. 5G Edge with AWS Outposts delivers a fully managed AWS® infrastructure, native AWS services, application programming interfaces (APIs) and tools to virtually any customer on their premises. AWS Outposts enables applications that need to run on the premises due to requirements of low latency, local data processing or local data storage needs, while removing the heavy lifting required to procure, manage and upgrade onsite infrastructure. Powered by Verizon's On Site 5G network connectivity, edge applications can take advantage of private 5G benefits, including performance, control, reliability and density for demanding enterprise workloads such as Industry 4.0, as well as future 5G network slicing capabilities for improved quality of service.

By offering a continuum of consistent cloud services, Verizon and AWS customers no longer have to choose between running workloads in the region or the edge. Developers can simultaneously deploy components at more than one edge location. Latency-sensitive portions of applications can be run on edge locations, while the remainder can stay in AWS Regions. By deploying applications and workloads to the right edge location, enterprises and organizations can ensure the best application performance experience for end users while optimizing costs.

AWS Region

AWS Systems Manager	AWS Config	Amazon CloudWatch	AWS Auto Scaling	AWS Cloud-Formation	AWS CloudTrail	Amazon S3

Virtual private cloud (VPC)

Workload orchestrator **Other enterprise apps**

Private venue (e.g., warehouse, port)

4G LTE and/or 5GNR radio network (indoor/outdoor)

4G LTE or 5G mobile core

AWS Outposts (1...n)

VPC

4G LTE or 5G mobile core

Edge AI/ML   **Edge IoT applications**

Computer vision   **Edge MES/MRP/SCADA**

AWS Outposts as private MEC

Ushering in Industry 4.0

Industry 4.0 is an initiative to apply digitization, industrial IoT, closed-loop automation, smart production technologies and agile techniques to evolve existing industrial processes. Verizon's On Site 5G and 5G Edge with AWS Outposts addresses many Industry 4.0 initiatives, providing a high-performance, low-latency edge service that can address industrial control and automation use cases, power computer vision for video surveillance and safety, and drive innovative applications of augmented reality and virtual reality (AR/VR) to improve productivity. For example, AR/VR applications are data and graphics intensive, especially for use cases requiring visualization of large 3D data sets, such as computer-aided design (CAD) models, point clouds or digital twins. To support lightweight mobile devices (e.g., wireless headsets, tablets and smart phones), 3D data processing can be offloaded from these devices to high-performance private MEC, such as EC2 GPU instances on AWS Outposts. The remotely rendered output can be streamed via the On Site 5G over a variety of AR/VR/3D streaming protocols.

AWS Outposts, in addition to hosting enterprise workloads, can be used to host the mobile core and/or cell-site network functions. Whether a 4G EPC or a 5GC is deployed as EC2 instances or as containers with ECS or EKS, Outposts provides an onsite, high-performance platform for network functions. Additional functions for security, communications and analytics can be run on Outposts as well. The mobile core can be coupled with 4G and/or 5G radios, enabling a self-contained on-premises 5G Edge and On Site 4G/5G network.

Private MEC and 5G Edge manufacturing use cases

For manufacturers, Industry 4.0 powered by Verizon On Site 5G and 5G Edge with AWS Outposts provides the opportunity to use data analytics, near real-time controls and AI/ML to reduce costs; help improve quality, efficiency and safety; increase scale; and more. Here are just a few examples of potential innovations that are poised to transform the industry:

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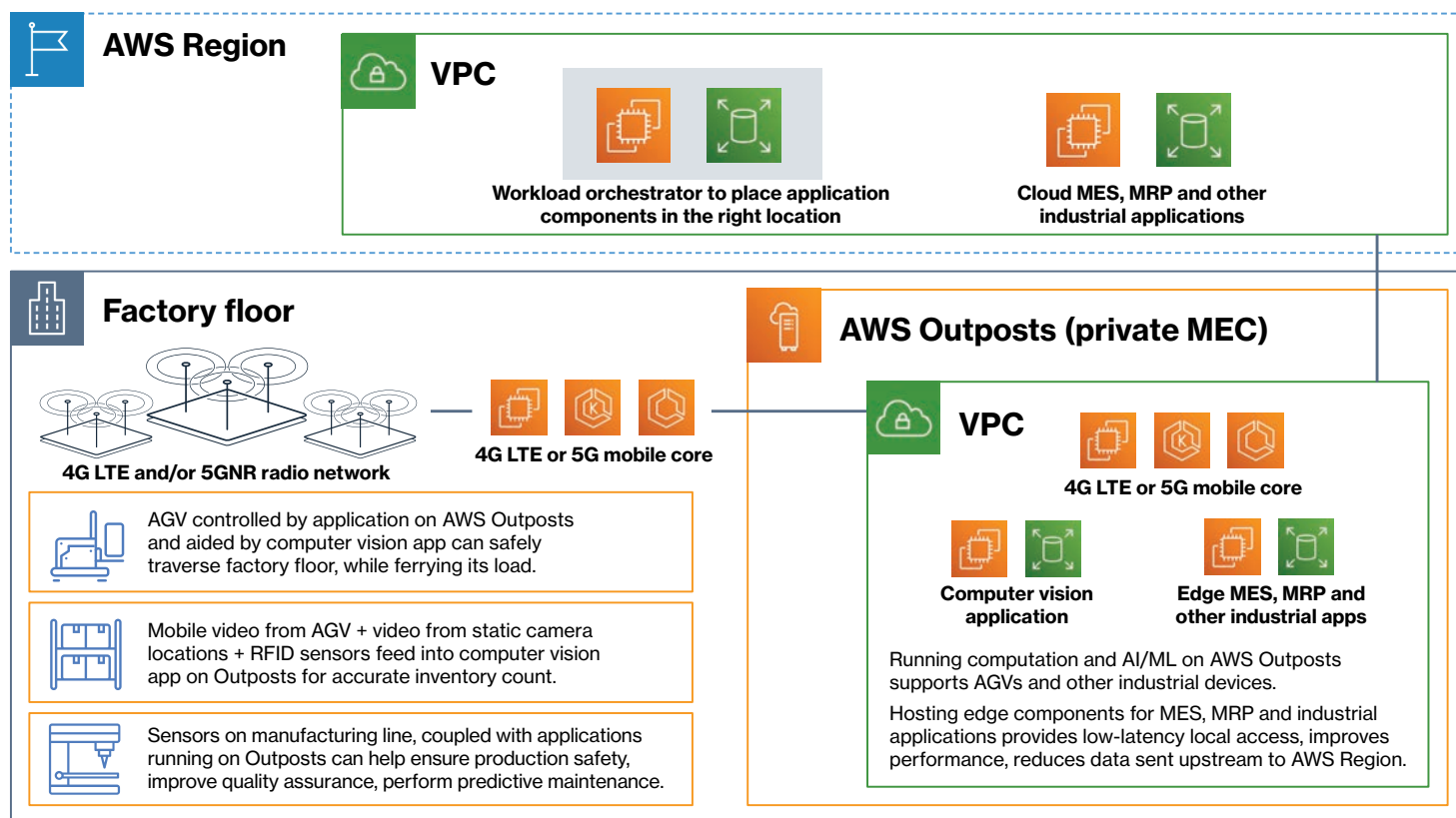
Real-world manufacturing example

Production

When it comes to production, Verizon On Site 5G and 5G Edge with AWS Outposts facilitates predictable, low-latency connectivity between factory floor programmable logic controller (PLC) systems, computer numerical control (CNC) machines, supervisory control and data acquisition (SCADA) devices and the AWS cloud to enable deeper integration between IT and operational technology (OT) systems. Manufacturing execution systems (MES) and materials requirements planning (MRP), maintenance and quality assurance systems can have on-premises application components, which is key to supporting advanced use cases like predictive maintenance and predictive quality.

Operations

On the factory floor, manufacturers can benefit from optimizing factory operations, including productivity, machine availability and product quality. On Site 5G and 5G Edge with AWS Outposts enables new use cases that include using computer vision for accurate inventory tracking, as well as helping to increase safety, quality and uptime on production lines.

Autonomous guided vehicles

Transporting items across the factory floor can become easier and more efficient when using autonomous guided vehicles (AGVs) directed by computer vision software that leverages AI and ML. Running this software on Verizon On Site 5G and 5G Edge with AWS Outposts can help AGVs move safely and speedily through the factory, avoiding people and obstacles while ferrying loads from point to point.

The use of 5G mmWave, with its high capacity and low latency, enables ongoing streaming of high-resolution videos for AI/ML inferencing and remote human operators. Operators can observe AGVs in near real time and intervene when necessary. At the same time, Verizon's On Site 5G network helps provide reliable transmission of rich sensor data (lidar, vibration, temperature, audio) from these AGVs and other industrial devices located throughout the factory.

Inventory tracking

The same computer vision application used by the AGVs for navigation and safety can be used to detect and inventory raw material and finished goods. Mobile video streams from AGVs can be combined with feeds from cameras installed in the factory and onsite sensor input and RFID for accurate counting and tracking. Integration with MES running on Outposts enables near real-time monitoring, automation and optimization. Private 5G provides a reliable backbone to carry sensor feeds and control channels with the necessary level of latency and throughput. 5G product-tagging technologies could allow a seamless transition from a private network to a public 5G network (U.S. only) for ongoing tracking.

Quality control and safety

AI/ML processing of video streams in the manufacturing process can be used for quality control and to spot safety concerns. Computer vision apps can help ensure that the output from different manufacturing stages conforms to appropriate quality metrics. Automation allows for higher-quality products with less human intervention. At the same time, manufacturing safety records can be improved through the use of video feeds to spot potential safety violations and help ensure that precautions are taken.

The On Site private 5G network's low latency and reliability help ensure the necessary data associated with quality and safety initiatives reach the private MEC system promptly and that the control signals are transmitted with reliability to the robots on the manufacturing line.

Further, by using private MEC to crunch the large amounts of data from sensors, manufacturers can detect potential failures and perform predictive maintenance and servicing of onsite machinery. AI/ML-driven proactive maintenance can be achieved without the need for specialized onsite hardware or the need to ship massive amounts of sensor data over network links into the cloud.

This is just the beginning.

For a manufacturing company, Verizon On Site 5G and 5G Edge with AWS Outposts can help transform it to a digital factory transformation to a digital factory and evolution to Industry 4.0. The unique combination of a high-performance private network with on-premises cloud computing can improve safety, quality and productivity, and unlock new applications driven by onsite analytics and AI. Likewise, the centralization of computation for robots and AGVs reduces operational expenses and decreases the cost of these devices, allowing for a lower TCO.

And these types of innovations aren't limited to manufacturing; similar significant outcomes may be achievable in other verticals thanks to the powerful combination of On Site 5G and 5g Edge with AWS Outposts. Examples of those vertical innovations may include:

- **Events and venues:** Offer enhanced experiences with AR/VR; live information overlays; multicamera, multiple angle views; and personalized instant replays

- **Shipping ports and airports:** Integrate near real-time processing of manifests, luggage and container processing, and deploy automation that supports predictive maintenance, AR-enabled connected workers, AGV control, passenger security, safety monitoring, passenger temperature screening, social distancing enforcement and more

- **Warehouses:** Improve operations with AR-enabled connected workers, wayfinding, AGV control, and automated inventory monitoring and updating

- **Schools and universities:** Offer virtual desktops and private networks to students in rural regions or areas of inadequate coverage

- **Smart cities:** Deploy near real-time sensor-driven automation, safety monitoring, climate controls and energy-saving technologies (U.S. only)

Learn more:

For more information on private MEC and our ongoing 5G collaboration with AWS, visit verizon.com/business/resources/lp/5g-edge-manufacturing/