White paper

5G and edge computing for the Public Sector

Unleashing the power of real time

As the world grows more connected, the pace of operations accelerates.

Low latency is becoming increasingly critical for agency operations. Constituents and organizations alike increasingly expect as-it-happens answers, responses and experiences that feel like they are happening in real time.

This emerging era of practically instantaneous information delivery should bring great things, like faster, deeper and more actionable situational intelligence; advanced imaging; smarter vehicles; more efficient operations; better tools for anyone from first responders to artists; and so much more.

It will also leverage new kinds of network architectures. Ones that extend cloud-compute resources to the edge of the mobile network, and even into the premises, and use the powers of 5G and edge computing to bring the real-time enterprise to life.

Cloud computing: What it gave us and where it's going

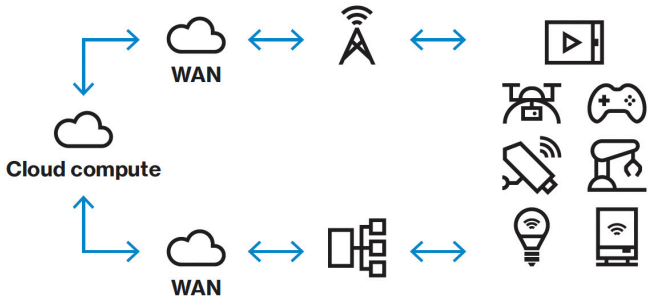
Public cloud enables organizations to outsource infrastructure management and storage. It's also flexible, scalable and cost-effective.

The cloud aids organizations as they expand the capabilities of programs that make use of consolidated data storage; mobile productivity applications; modernized systems such as enterprise resource planning (ERP); and new or reengineered workloads that require flexibility and elasticity.

On an even larger scale, the cloud supports the development of smartphone applications, essentially transforming the way we use mobile devices. These devices can now connect to the next-generation 5G network—and they require next-gen cloud architecture to support new applications.

Still, as more mobile and Internet of Things (IoT) devices come online—and as demand for the ultraresponsive application environments promised by 5G grows—cloud-related latency potentially could become problematic.

Traditional cloud



Latency: Why does it matter?

Round-trip network latency is the time required for a packet of data to make the round trip between two points. More simply, it's the time between a user or device action—opening an app, clicking on a website or sending a video stream—and the response to that action.

Round-trip latency also includes the processing time required within the compute environment. What we are improving in this schema is the network latency. This is done by decreasing the distance between the end user or device and the application at the edge, while also optimizing routing to ensure the shortest route between the end user or device and the edge compute environment—and, critically, the distance between the device making the request and the servers responding to it.

Many data centers are built where land, electricity and water are the least expensive. That means when the typical urban mobile-device user clicks on an application or URL, they are accessing data that may be stored hundreds or even thousands of miles away. Similarly, an IoT device could be sending data and awaiting a response or instructions from that same distant location. Why does that matter? Because latency is directly linked to the end-user experience or application performance. And end users don't like to wait.

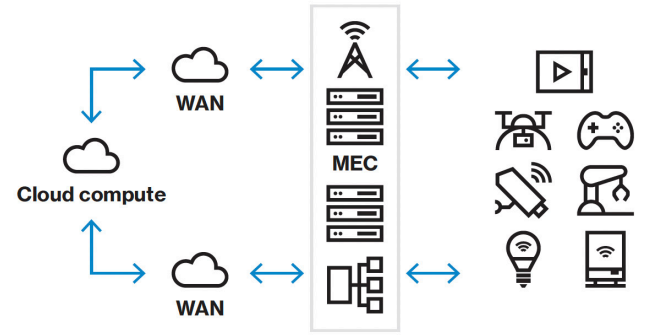
That's especially true if you're wearing virtual-reality goggles that don't quite sync with your movements, operating a facility with autonomous manufacturing equipment or working in public safety, where receiving near real-time intelligence could profoundly impact safety, security and mission success.

That's why distributed computing architectures like edge computing and multi-access edge computing (MEC)—along with 5G—could be essential for supporting functionality that feels like it's happening in real time.

Edge computing: Extending infrastructure to where it is needed most

The edge is a network architectural model that brings technology resources, including compute and related infrastructure, closer to the end user or device—or to where the data is generated. It's a decentralized cloud-compute extension where data is processed and stored at the edge, with only those workload tasks that are latency tolerant and other bulk or batch processes transmitted back to the centralized cloud for backend services support.

Distributed cloud/edge computing



Edge computing doesn't replace the cloud; it simply puts the parts of the applications that need to be closer to the endpoints where they belong. In a public deployment, that means colocating compute and related resources at the edge of the public wireless network, allowing access by virtually any device that is indirectly or directly cellular enabled and providing coverage over large geographic areas. In a private deployment, a private onsite wireless network is stood up and integrated with the compute resources on premises and designed for use by that customer only, supporting specific devices and providing the lowest possible latency. Both represent a combination of the cloud compute and networking environments in which all data doesn't have to shuttle back and forth between faraway servers, users or devices.

By reducing the distance data must travel, decreasing the number of hops it must make across network equipment and consolidating information, edge computing can reduce round-trip latency, speed up processing and preserve bandwidth on an existing network.

Computing at the edge also enables localization of data for organizations that require data localization for security or privacy reasons. Additionally, it can support business continuity by enabling regional offices or sites to stay up and running when operations are disrupted at the primary site.

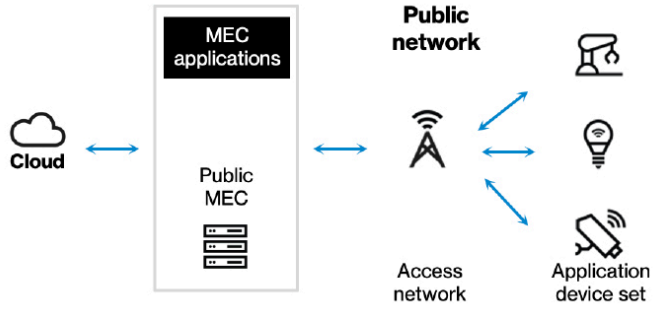
Private deployments provide the highest performance and lowest latency by shortening that last mile even further, colocating network, compute and storage on premises where the data is generated. This provides even greater security and data sovereignty over a public deployment when customer or application needs dictate these levels of performance and security.

Edge computing can enable faster, localized processing. Combine it with 5G and you have the architecture for next-gen solutions that could empower operations essentially in real time.

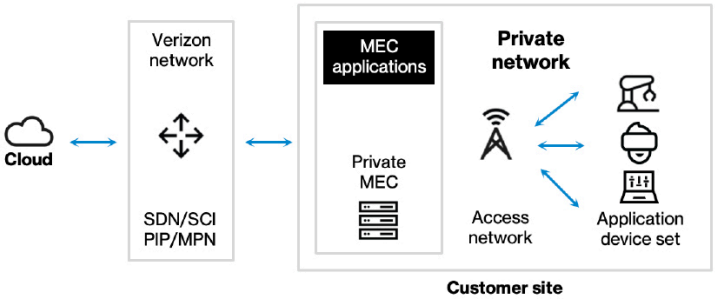
5G + edge = mobile edge computing

5G, the fifth generation of cellular mobile communications, is optimized for services that are latency sensitive, and provide massive bandwidth and fast data transfer rates.

A public MEC can be deployed by placing compute and storage resources at the edge of the public mobile wireless network, close to data generating and consuming 4G LTE/5G-enabled end devices. A complementary technology for 5G, public MEC provides both an IT service environment and cloud-computing capabilities at the edge of the public mobile network, within the radio access network (RAN) and in close proximity to mobile subscribers, devices, enterprises and other organizations—all with a range of networking and computing needs.



Private MEC brings similar compute and storage resources together but colocates them on the customer premises with a private, onsite 5G RAN. Combining the RAN, compute, storage and devices on premises enables support for the most critical and latency-sensitive applications, while also enhancing security and providing for data sovereignty.



SDN – Software-defined network
SCI – Secure Cloud Interconnect
PIP – Private IP
MPN – Mobile private network

5G is expected to be capable of supporting up to a million devices in a square kilometer[1] and spurring a radical increase in the number of connected devices and systems, leading to the Massive IoT (MIoT). By 2025, some 16.44 billion devices are forecast to be connected worldwide, and by 2030 that number is projected to grow to 25.44 billion.[2] Everything from manufacturing equipment and smart-city applications to connected vehicles and wearables will be clamoring for increased bandwidth.

That's why the pairing of 5G and MEC is natural. Together, they could eventually deliver the low latency and gigabits-per-second throughputs that are a precondition for applications that operate practically in real time, such as:[3]

Autonomous and assisted-driving vehicles

A single autonomous test vehicle produces about 30 TB per day, which is 3,000 times the scope of Twitter's daily data.[4] The combination of 5G and MEC might be the key to enabling widespread adoption of autonomous vehicles by enabling constant, near-instantaneous uploading, processing and downloading of massive amounts of data.

Immersive experiences

Augmented, virtual, mixed and extended reality (AR/VR/MR/XR) technologies require extremely high bandwidth and extremely low latency. Anything less creates experiences that are less immersive and more frustrating—or downright nauseating. With MEC and 5G, these technologies could enter the world of government in a big way, potentially powering hyperrealistic training environments, advanced medical imaging, remote repair, immersive meetings, augmented retail and much more.

Situational awareness

Effective Public Safety depends on a clear and common operating picture that provides near real-time situational awareness to leadership. 5G enables HD video surveilance transmission that in combination with AI/ML analysis create a greatly enhanced veiw of the incident that facilitates a quicker and more effective response, potentially saving lives and property.

Digital marketing

Location-based, as-it-happens marketing should become more relevant to individual consumers, and analytics could allow marketers to tweak campaigns on the go. Faster connectivity could also enable higher-resolution and AR ads at the point of purchase (POP); mobile 4K and 8K video streaming; and relevant, omnichannel customer interactions through out-of-home (OOH) networks that feel like they're happening in real time.[5]

Smart public safety

5G is expected to help public safety organizations rapidly ingest, analyze and deliver information gathered from 911 call systems and other data sources to help improve safety and better manage planned and unplanned events. It could also enable hyperrealistic virtualized training for emergency and disaster response, and other paradigm-shifting capabilities to improve first responder safety and awareness.

Massive IoT

Organizations should be able to develop scalable and valuable IoT capabilities known as MIoT. MIoT deployments could generate and harness huge amounts of data to drive advanced analytical and artificial intelligence (AI) programs and provide mission-critical services that require ultrareliable low-latency communication (URLLC) services.

Precision manufacturing

Fully connected and automated factories could detect issues in near real time, potentially reducing error rates, increasing productivity and paving the way for real-time enterprise (RTE) —the holy grail of manufacturing technology.

Data-driven business intelligence

The ability to ingest and process vast amounts of data essentially in real time could empower organizations to rapidly respond to changing markets and demand.

Next-level logistics

5G and MEC could amplify three key technologies that will transform logistics—IoT performance tracking, robotics and distribution automation—to enable just-in-time production and improve tracking, delivery and package movement.

Smart communities

5G and MEC-powered solutions could enable communities to:

- Capture, analyze and distribute video content in near real time
- Provide hyperaccurate area mapping to aid with delivery services and emergency response
- Remotely control miniature robots that may aid in disaster-response
- Citizen engagement (public Wi-Fi access and emergency preparedness)
- Aggregate data from deployed personnel, body-attached or unattended sensors, and autonomous agents to assist in search and rescue or disaster response

5G and MEC could also profoundly impact next-generation hardware by opening the opportunity to rethink mobile devices. Smartphones and other IoT devices could become more battery efficient, with much of the processing moving off the device and to the edge.

Processing and capabilities currently reside on the device, making smartphones and other mobile devices expensive, complex and tough on batteries. Enabling near real-time operations on today's devices would require major improvements in battery life, as well as mobile chipsets for AI/machine learning (ML), computer vision and other complex processes.

Computing at the edge opens the door to low-cost, lightweight mobile devices with wide-ranging capabilities and long battery life. A single device, whether a smartphone, a high-definition camera, goggles, an IoT sensor or a biomedical monitor, could leverage a broad range of advanced capabilities located at the network edge or the on-premises infrastructure.

Additionally, because MEC architecture can support deployment on RAN sites at the farthest edge of the network or physically on premises, 5G and MEC can deliver localized compute services specific to an environment or industry, such as oil and mining operations, manufacturing plants, warehouses, hospitals, universities, public safety and other government facilities, sports arenas, and business campuses.

Verizon 5G Edge is designed to help enable the development of large-scale, latency-sensitive applications.

Verizon 5G Edge: The right edge computing platform

MEC is an essential aspect of Verizon's network strategy. It is one of the four key elements—along with massive fiber resources, small-cell deployment and Verizon's spectrum holdings—that help make the Verizon 5G network a powerful tool for transformation.

In fact, Verizon has built MEC right at the edge of its 5G network to help enable the development of large-scale, latency-sensitive applications. For the most critical and most latency-sensitive applications, Verizon will be able to deploy a private onsite 5G network and the MEC infrastructure nearly anywhere, even if there is no public wireless coverage. This flexibility allows Verizon to support nearly any need or application an organization might require.

It's important to note, too, that 5G and MEC could bring additional benefit beyond low latency. In addition, government agencies could greatly benefit from the increases in speed,

bandwidth, throughput, agility, scalability, privacy and security that these two technologies can deliver.

Piloting new possibilities: What will real time do for you?

"Transformative" is a term that's thrown around frequently in the technology and business sectors, and it can be difficult to differentiate the wheat from the chaff—the truly transformative technologies from those that sound impressive but fail to deliver actual benefits.

We believe that 5G and MEC are the key to enabling the real-time era. By extending infrastructure to where it is needed most, these technologies could radically transform the way operations are accomplished. That's why we're building the power of the cloud right at the edge of the Verizon 5G network, or even your network.

And we invite you—whatever your agency size—to imagine how 5G and MEC could help you do more, offer more, and work smarter or safer. Dream about all the new capabilities that gigabits-per-second throughputs and low latencies could bring to your organization. Visualize what real time could do for you.

And then, when you're ready to partner with a company that knows how to turn big ideas into powerful realities, let us know.

We can help you develop a pilot project that harnesses Verizon 5G Edge to transform your organization.

Be sure to dream big.

Getting on the path to real-time operations

As with any major technology evolution, the better—and sooner—you prepare for 5G and MEC, the smoother the transition should go. And the quicker you could be able to take advantage of the benefits they'll bring. Following are steps you should take now:

- Assess and baseline your environment, so you can develop an executable transformation plan
- Begin transitioning from traditional operating environments to programmable, on-demand, software-defined ones
- Deploy application-visibility solutions to gain insights into the performance of your applications
- Identify the operational processes and applications that would most benefit from real-time responsiveness and low latency
- Partner with a company that can deliver hybrid connectivity—the right mix of private WAN, public WAN and wireless access
- Create a pilot project to appraise the value of 5G and MEC to your organization

Learn more:

To learn more about private MEC, contact your Verizon Government Account Manager or call 844.825.8389

verizon business

5G edge

1 "Connection density of 4G, 5G and 6G mobile broadband technologies (in millions of devices per kilomter)," Statista, 2021. https://www.statista.com/statistics/1183690/mobile-broadband-connection-density/

2 "Number of Internet of Things (IoT) connected devices worldwide from 2019 to 2030," Statista, 2020. https://www.statista.com/statistics/1183457/iot-connected-devices-worldwide/

3 These use cases reflect potential uses of MEC, ranging from applications available near-term that use current technologies, to more advanced uses that leverage the expected full benefits of future 5G- and MEC-critical capabilities. They should not be seen as current or committed solutions—there is no guarantee that Verizon nor anyone else will develop and launch these solutions.

4 "Storage Almost Full: Driverless Cars Create Data Crunch," Wards Auto, January 18, 2018. https://www.wardsauto.com/technology/storage-almost-full-driverless-cars-create-data-crunch

5 "How 5G Will Transform the Business of Media and Entertainment," Ovem and Intel, October 2018. https://newsroom.intel.com/wp-content/uploads/sites/11/2018/10/ovum–intel–5g–ebook.pdf