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Monetizing MEC:

WHAT'S THE VALUE OF THE EDGE?

By Sean Kinney

For operators to effectively monetize 5G, the thinking is that 5G networks need to be coupled with a geographically distributed mobile edge computing (MEC) infrastructure and enterprise-facing applications capable of delivering business outcomes that help a user save money or make money. That logic is fairly straightforward and overlaps with the established notion that the consumer cellular market is stagnant, meaning new service revenues will flow from enterprises to operators on the back of vertically-tailored, internet of things-types solutions.

Taking this paradigm shift from boardroom to a factory floor, a shopping mall, an emergency room or similar environment, however, is highly-variable and involves a much broader ecosystem than operator and enterprise. To some degree, the network is the easiest piece. Augmenting connectivity with decentralized compute and storage capabilities and artificial intelligence (AI) and machine learning (ML) tools, packaged in a manner that's easy for businesses of all sizes to consume, draws in hyperscalers, system integrators, device OEMs, application developers, and others. To capture the opportunity, all these parties need to develop a deep understanding of the specific business problems facing companies working in most all verticals markets; that knowledge then needs to be turned into a solution that impacts the user's top and bottom lines.

In this report, we will explore the ecosystem that's coalescing in pursuit of monetizing MEC, examine how the physical infrastructure is being deployed, discuss how to drive end-to-end solution integration, and look at the developing role of hypsercalers that are pursuing both operator and enterprise business.

Per Kangru, technologist in the CTO Office with Viavi Solutions, framed out the fundamental contours of deploying MEC, building a business case, and monetizing the investment. The early attempts at putting compute at base stations didn't scale because compute costs were based on peak service utilization but revenue was based on the average of the service. This prompted a move to aggregate compute in the radio access network (RAN) to better balance compute cost and service utilization. The current move is into the public cloud for reasons like ease of deployment and cost efficiency of the hardware platform.

"If you have some compute, you have to scale it for peak but revenue will be based on average utilization. That's a very difficult business case to make work if it's an expensive compute resource."
Per Kangru, Technologist, CTO Office, Viavi Solutions

"Monetizing the MEC, there's a number of questions around it," Kangru said. "If you have some compute, you have to scale it for peak but revenue will be based on average utilization. That's a very difficult business case to make work if it's an expensive compute resource. These topologies and aggregation points allow you to get a best in class starting point for a business case. Then it becomes who pays for it."

Telecom edge vs. enterprise edge

Mobile edge, multi-access edge, near edge, far edge, on-device edge... there are a lot of edges and a lot of ways to describe them. Here we'll focus on the distinction between the telecom edge operators use to deliver a variety of consumer and enterprise services as opposed to an enterprise-owned edge infrastructure that's connected to a network.

According to Dell Technologies' Douglas Lieberman, senior director, Global Solutions Co-creation Services, "The interesting part is who is controlling the management, orchestration of the edge—is that a telco or an enterprise? With 5G being the enterprise G, the standards and the way it's being implemented is enabling a much tighter integration between what an enterprise needs and what the telco is delivering...The enterprise has the ability to integrate with the telco backend and provide services in a new way they haven't thought of before."

For operators, the opportunity is to deploy MEC in a way that simultaneously makes the network more efficient by distributing a management and orchestration layer while also supporting enterprise workloads. "They're setting themselves up for success there because they will be able to get a chunk of that revenue through services or partnerships with SIs [system integrators] or directly with the enterprise by hosting higher level services on the same MEC."

The struggle, Lieberman said, is around end-to-end integration and it's a challenge facing the entire telecoms industry. He likened it to the slow and long-underwhelming development of the internet of things (IoT). "For 20 years everything was going to be IoT and companies--telcos, SIs, tech companies--invested billions of dollars building 'build-it-and-they-will-come' frameworks and foundational systems that never really returned monetization. They never really got a one-size-fits-all platform and you could just buy one thing. There's a great deal of momentum in the industry behind the need for MEC. But what everyone is kind of doing at the moment is figuring out how do I bring it together end to end?"

Integration of network, management, security, application, support, and maintenance into MEC-as-an-appliance that can run video surveillance, healthcare diagnostic, or industrial automation workloads on a customer premise is something carriers are delivering with partners today. The next step to monetization is "how do we monetize the base of a cellphone tower or monetize the real estate that we own?" Lieberman said.

He continued: "If the telco really wants to capitalize and maximize the return on that MEC investment, they're going to have to be able to do the same thing every cloud service provider does...work with all these different ISVs to prove or have pre-defined solutions. No one has solved that." But the work is going on in earnest, as shown by a solution led by Lieberman's team at Dell Technologies.

Turning data into dollars—milliseconds matter

Whether it's an operator eeking every bit of efficiency out of its network while offering up new services or an enterprise turning data insight into cost-saving/revenue-generating action, time to action corresponds to time to value. In the context of data analysis that can benefit from localized compute and storage, the primary types of data are audio/video feeds or telemetry. 4G has been and is being

OneBox MEC—a single box approach

"Enterprises are expecting the answer to be delivered as an outcome. We're trying to give as much of that as possible."

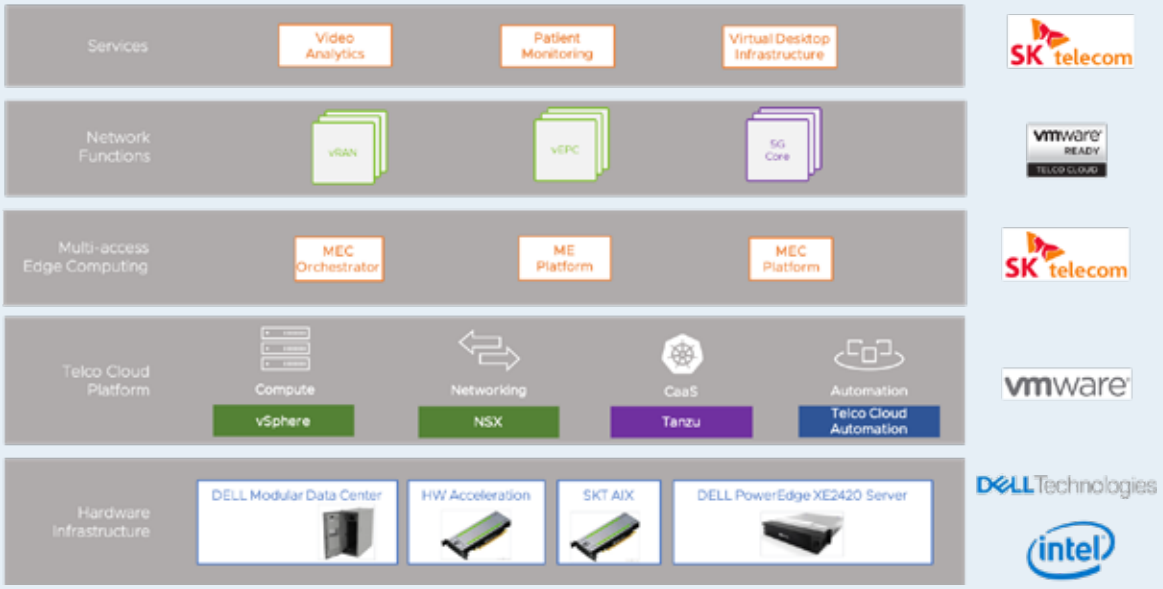
Douglas Lieberman, Senior Director, Global Solutions Co-creation Services, Dell Technologies

OneBox MEC was announced in January, the result of a collaboration between SK Telecom, Dell Technologies and VMware, an enterprise-facing solution that delivers a private 5G network and edge computing platform. SK Telecom has a two-pronged approach to 5G and MEC: a nationwide public edge and an on-site enterprise edge. OneBox MEC incorporates a Dell EMC PowerEdge XE2420 server, VMware's Telco Cloud Platform, and SK Telecom's 5G X MEC Platform.

According to research from STL Partners commissioned by the OneBox MEC consortium, 40% of enterprises surveyed "had issues with the latency of their current networking solutions. The study called out "performance issues" for hospital patient monitoring systems; more than half of architecture engineering and construction companies involved in the study wanted to improve security. OneBox MEC can fix those problems in a manner that's easy for enterprises to consume.

SK Telecom's Head of 5GX MEC Product Lee Dong-kee said in a statement, "With OneBox MEC, our enterprise customers will be able to launch MEC-based services in a speedy manner…We will flawlessly support ultra-low latency sensitive services by combining the strengths of 5G and MEC to accelerate innovations for companies in diverse areas, including healthcare, retail and construction,"

"The idea is to be able to deliver a fully-functional, with services integration, foundation all the way up to the application," Lieberman said. "We're absolutely building that and we think we'll have a lot of success there. If you're an enterprise, great, I'm going to go buy this MEC thing but how do I know it's going to run my Siemens video surveillance software? The piece we're doing with SK Telecom [and VMware] with MEC-in-a-box is critical because it contains the entire layer cake up to the application."



MEC

(Multi-Access Edge Compute)

Enabling new revenue opportunities for Enterprises and Operators

DELL Technologies

intel

used as the connectivity medium for this type of data processing, but the move to 5G makes for a bigger pipe and more responsive network.

"Our core strength is being able to take data as soon as it is created and as fast as it can get devolved to reduce time to get the data into the intelligent platform," according to VoltDB Chief Product Officer Dheeraj Remella. Volt's platform stores and aggregates data, aligns it to KPI parameters and invokes a notification. Rather than do this with disparate systems, Remella noted that an integrated approach "has realized a 10x reduction in footprint for our customers. The footprint reduction becomes important when you look at edge data centers. When you move to edge environments, the available hardware by nature is much smaller. What we do is done by bringing multiple technologies together."

To demonstrate that milliseconds do matter, Remella gave the example of customer cross-sell/upsell opportunities. He said the total window for subscriber engagement is around 250 milliseconds and that promotions need to be pushed in less than 10 milliseconds from the time of a triggering event. "The common point is acting on the moment of engagement."

To give another example of how time delays equate to lost business opportunities, Inseego is part of a real-time video analytics solution geared toward the retail sector. For a retailer, an empty shelf or otherwise sub-optimal inventory management equates to lost sales. AI-based vision systems running on a 5G network and with access to edge computing can let retailers know exactly when a shelf is empty or stock is below a defined threshold; from there, an action can be initiated and profits are protected.

Inseego worked with IoT system integrator Net4 on a pilot also involving Vodafone Business and Amazon Web Services's Wavelength edge nodes. The pilot involved an Inseego 5G fixed wireless access CPE transferring data from video cameras and Vodafone's network and MEC infrastructure. To the role of edge, Inseego's Yogesh Rami, product marketing principal, Cloud Services, said intelligence has to move out of the data center to enable real-time capabilities. "Most of the processing we can now do on the edge. It eliminates the need to go back to the data center. You keep the data as local as possible and on the edge."

Inseego's Simon Rayne, SVP and managing director in the U.K., EMEA and APAC, said the pilot project can show retailers and other industries how "to capitalize on the power of 5G and MEC, Inseego brings out the best in mobile networks by providing fast, reliable, secure 5G connections that make this type of seamless solution possible."

'There is no easy button' for delivering MEC-based business outcomes

There's an animating tension as it relates to service provider monetization of MEC for enterprises. Businesses want to buy solutions that are easy to use,

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where the complexity is essentially hidden. But hiding complexity is difficult, particularly in the context of building new infrastructure, connecting it to a network, working with partners to build impactful applications, packaging it as a solution, then mustering the sales know-how to reach deep into a variety of verticals that all have different needs. Hanging over all of this is the descriptor of carrier as a "dumb pipe." To fully capitalize on 5G and MEC, carriers can't repeat what happened with LTE where third-parties who didn't spend a cent on building the network were able to monetize the services that ride on top of it.

"When you look at CSPs," Remella said, "all they can do unless they invest in industry verticals is they can provide connectivity and connectivity as a service. How far down the line they can bring that connectivity is the edge equation... CSPs don't do it themselves. They'll partner. If they don't do that, they're basically looking at network slicing as the answer to everything."

Inseego's Amit Marathe, director of AI/ML, rightly points out that buyers want to buy outcomes. "They like to see the technology for sure... but it all pivots back to what's the business outcome, what insights can I drive out of this, what can my customers get out of this and at what cost?" His colleague Rami tied it all back to "what's the TCO for me if I do this for two years, three years, five years? And they also want to know what's the ROI? It's up to companies like us to show what the TCO and ROI can be if you invest into a 5G infrastructure."

For telcos, "There's not an easy button," Dell's Lieberman said. That calls for a robust ecosystem play involving carriers, hyperscalers, consultancies, system integrators, ISVs, enterprises and others. "Ultimately we want to build that ecosystem." Regarding MEC-based services, "The math comes down to shared risk and capex vs. opex and who's responsible for maintaining it and running it. The reason why anyone moves to a cloud model is beyond just that it's cheaper. You're buying a risk model. Ultimately they make sure it's running and they do software updates and patch updates. On my books, I can pay opex, not capex. It also enables, from an enterprise perspective, elasticity. We all know...there's a financial model somewhere that accounts for elasticity." He gave the example of factory automation: 100 devices with defined service level parameters could cost $100 per month all in. "That substantially changes the business model and the execution for the enterprise. This is why the telcos need to do more than say, 'Here's connectivity, here's a SIM card.'"

He continued: "I truly believe that MEC is something that will evolve to provide value for the telcos. The takeaway is, there's no easy button. We're not going to walk out tomorrow and it's just gonna be there. That ecosystem is going to be critical. That is going to be as much of a battle as the technology is."

Verizon takes on public and private MEC with partners

Verizon is all in on both public and private MEC and has a range of partnerships in place with the likes of AWS and Microsoft Azure as well as companies focused on applications. But its MEC infrastructure, live in 13 metro areas in its public form and on customers' premises for private use, is part of a larger solution set, including its 5G network, both sub-6 GHz and mmWave, its private networks business, IoT devices and platform, and managed services.

MEC is key to bringing 5G into vertical industries

5G is a powerful technology but the notion of 5G manufacturing—using 5G to drive digital transformation within a manufacturing enterprise—includes more than just the network. To drive efficiency gains in manufacturing and other important verticals, 5G needs to be coupled with mobile edge computing (MEC) infrastructure, artificial intelligence (AI), machine learning (ML), and internet of things (IoT) sensors.

"5G is not the end," according to Intel's Caroline Chan. "It's a means to an end." Chan, vice president of the Network and Edge Group and general manager of the Network Business Incubator Division, called out the capacity and latency gains 5G brings to the table, but said high-impact use cases like machine vision or autonomous guided vehicles (AGVs), also require localized compute, AI and connected cameras used as sensors.

5G, she said, "provides a very convenient intersection of all this different technology especially for the industrial side." Beyond bringing telecom systems into a manufacturing environment, meaningful enterprise adoption also requires a new degree of alignment between information technology (IT) and operational technology (OT) functional groups. "That's no small feat," Chan said.

Intel worked with TIM, JMA Wireless and manufacturer EXOR International to build a smart factory in Verona, Italy. The Industry 4.0 showcase combines 5G, AI, MEC and other technologies to "demonstrate that digitalization can happen at any scale,"

EXOR CTO Claudio Ambra said, "This is increasingly important for small and mid-size manufacturers who are looking to stay innovative and competitive in the market. We can't wait to share what is now possible for manufacturers of all sizes with Industry 4.0 solutions."

Image courtesy of Intel

Whether the goal is 5G manufacturing process enablement, or bringing 5G into any vertical industry really, "We've noticed that even non-technology companies...have to become technology companies in order to advance," Jillian Kaplan, Dell Technologies lead of Telecom and 5G Thought Leadership, said. "Manufacturing is no exception to this rule and investing in technology can enable applications potentially to reduce cost and time."

Target applications, Kaplan said, include more refined workflow scheduling, digital twins, more flexible and efficient production lines, predictive machine maintenance, design customization, augment and virtual reality, production waste reduction, and worker safety.

Another important dynamic playing out in the market revolves around delineation of duties through the build and run bit of an enterprise network lifecycle. Specifically, who does what in an era when regulators are making spectrum available to businesses, hardware is being commoditized, and network functions are moving into the cloud. This new paradigm means enterprises could face a decision between buying a network and managed services from an operator, building and running their own network, or something in the middle.

Kaplan made the point that operators' businesses revolve around running networks and that construct should extend into the enterprise space. "All of these applications need a network. That's what [operators] do." Dell's role, she said, is "to help communications service providers monetize their investments in 5G with these enterprise [verticals] like manufacturing. And making sure these manufacturers can save money, save time, save lives...We can build these custom solutions to solve these enterprise challenges."

Partnerships are key in Verizon's larger strategy of delivering 5G-enabled enterprise solutions. In an interview ahead of Mobile World Congress Los Angeles, Verizon Business Chief Revenue Officer Sampath Sowmyanarayan said, "5G is all about the ecosystem. You cannot do it yourself. That's been our focus on anything 5G-related."

This partner-based approach has accelerated Verizon's sales cycle, Sowmyanarayan said, explaining that depending on the customer, Verizon may take the lead, AWS may take the lead, etc**…**"It actually helps because we're able to get to the right decision makers really fast. We can actually short circuit what would typically be a four- to six-month process."

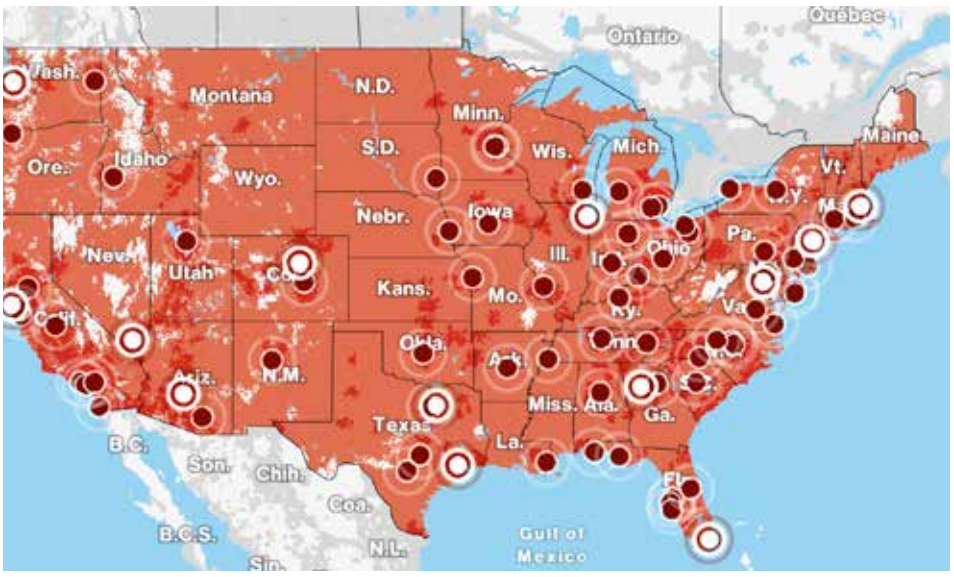
One example of how Verizon is using its MEC capabilities is to deliver near-real-time driver notifications to enhance road safety using sensor data. Working with Nissan North America's Research and Advanced Engineering team, the companies demonstrated how sensor data from vehicles and surrounding infrastructure can be processed at the edge of Verizon's wireless network and communicated back to the driver in near real time.

The research was aimed at creating "a multi-viewpoint picture of safety hazards" that might be lurking beyond the vehicle and the driver's line-of-sight. This was accomplished by testing a variety of vehicle-based and infrastructure-based sensor configurations. Then, sensor data gathered from Nissan vehicles and surrounding infrastructure was processed at the edge of Verizon's network using the carrier's 5G Edge with AWS Wavelength. Once processed, insights are communicated back via the cellular network to vehicles in near-real-time, prompting Nissan's Intelligent Shared World platform to initiate driver notifications.

During the trials, drivers were notified of several different safety scenarios, such as pedestrians entering roadways from behind other cars, or of oncoming vehicles obscured behind larger vehicles.

The private, on-prem MEC solution is being used by logistics and supply chain specialist Ice Mobility

Sampath Sowmyanarayan, Verizon



The white concentric circles indicate metro areas where Verizon's 5G Edge is available

Image courtesy of Verizon

300 ms
the blink of a human eye

185 ms
full rotation of a helicopter rotor

35 ms
maximum latency for most autonomous vehicle needs

20 ms
maximum latency for AR without inducing dizziness

5 ms
maximum latency for remote tactical control

1 ms
duration of a camera flash

Why every millisecond matters.

You've heard all about blazing-fast 5G download speeds. But what's even more exciting are the ultra *low latency response times* 5G delivers. By reducing the delay between an event and a response, 5G opens the door to an endless array of new edge computing possibilities, from autonomous vehicles to augmented reality, from industrial robotics to remote surgery and countless other mission-critical applications that haven't been imagined yet.

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The IMT-2020 technical requirement for Ultra Reliable Low Latency Communications (URLLC) is 1 millisecond.

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for computer vision-assisted product packing. This flavor of MEC combines Verizon's network with the Microsoft Azure Stack Edge. "Business innovation demands powerful technology solutions and central to this is the intersection between the network and edge" said Yousef Khalidi, corporate vice president Azure for Operators at Microsoft. "Through our partnership with Verizon, we are providing customers with powerful compute and storage service capabilities at the edge of customers' networks, enabling robust application experiences with increased security."

While Verizon's 5G network is currently in Non Standalone mode of operation, the carrier will ultimately migrate to Standalone 5G; in terms of combining Standalone 5G and MEC, Verizon is already testing in the lab with IBM with an eye on 5G for Industry 4.0 applications.

This latest development in the IBM and Verizon partnership will allow enterprise customers to use the lab, which provides a pre-commercial, Standalone 5G and MEC environment, to develop and test use cases like robotics, guided vehicles, manufacturing process automation, visual quality inspection and data analytics.

Hans Vestberg, Verizon

"This lab demonstrates the power of optimizing solutions for a new era of hybrid cloud that leverages the growing relationship between 'connectivity + compute' to create new value. The lab will provide hands-on experience for enterprises as they seek ways to leverage the new 5G capabilities - reduced latency, increased bandwidth, network slicing and edge — by trialing new use cases and highly automated deployment and management approaches," wrote Steve Canepa, global GM & managing director, IBM Communications Sector in a blog post.

In an October earnings call, Verizon CEO Hans Vestberg said MEC will be a part of the company's long-term growth. "When it comes to edge compute, we are the mobile edge compute leader, both in public and private." In addition to public and private MEC, Vestberg also linked it to delivering private networks. Of those three big use cases, "All of them are in execution right now," he said. "We're working with customers."

Bringing together the best of Google at the edge

At the recent Google Cloud Next event, the company took the wraps off Google Distributed Cloud, a new product portfolio that extends Google infrastructure to the edge and on-premise using qualified hardware. The products can operate on any of Google's 140 global network edge locations and can also be set up at customer locations, depending on the need. At launch, Google has announced support from vendors including Cisco, Dell, HPE and NetApp.

"Now more than ever, organizations are looking to accelerate their cloud adoption. They want easier development, faster innovation, and efficient scale, all while simultaneously reducing their technology risk. However, some of their workloads cannot move to the public cloud entirely or right away, due to factors

such as industry or region-specific compliance and data sovereignty needs, low latency or local data-processing requirements, or because they need to run close to other services," said Sachin Gupta, Google GM and VP of Product for IaaS, in a blog post.

Google's distribution for these new cloud products include its own worldwide edge network, on CSP edge networks, on customer-owned edge or remote locations and in customer-owned data centers and colocation facilities.

"Google Distributed Cloud taps into our planet-scale infrastructure that delivers the highest levels of performance, availability, and security, while Anthos running on Google-managed hardware at the customer or edge location provides a services platform on which to run applications securely and remotely," said Gupta.

Google Distributed Cloud was made using Anthos, a cornerstone of Google's Global Mobile Edge Cloud (GMEC) strategy. Anthos is Google's fully managed hybrid cloud platform that works on premises, edge and in multiple public clouds, all through a Google Cloud-backed control plane. Anthos uses the Google-developed Kubernetes engine as the basis for its container orchestration management.

Anthos is built on Google Kubernetes Engine (GKE); Anthos Config Management, a policy and security automation engine; Anthos Service Mesh, which manages traffic and telemetry; and Anthos Migrate, which manages Virtual Machine (VM) to GKE migration. Also announced at Google Cloud Next were a preview launch of Anthos for Virtual Machines and Anthos Multi-Cloud API to help its customers manage Kubernetes clusters on AWS and Azure cloud environments.

In an interview with RCR Wireless News, Google Cloud Director of Product Management for Telecom and Edge Gabriele Di Piazza expanded on the monetization of MEC beyond delivering latency-sensitive apps. "There's much more to the story than latency. As

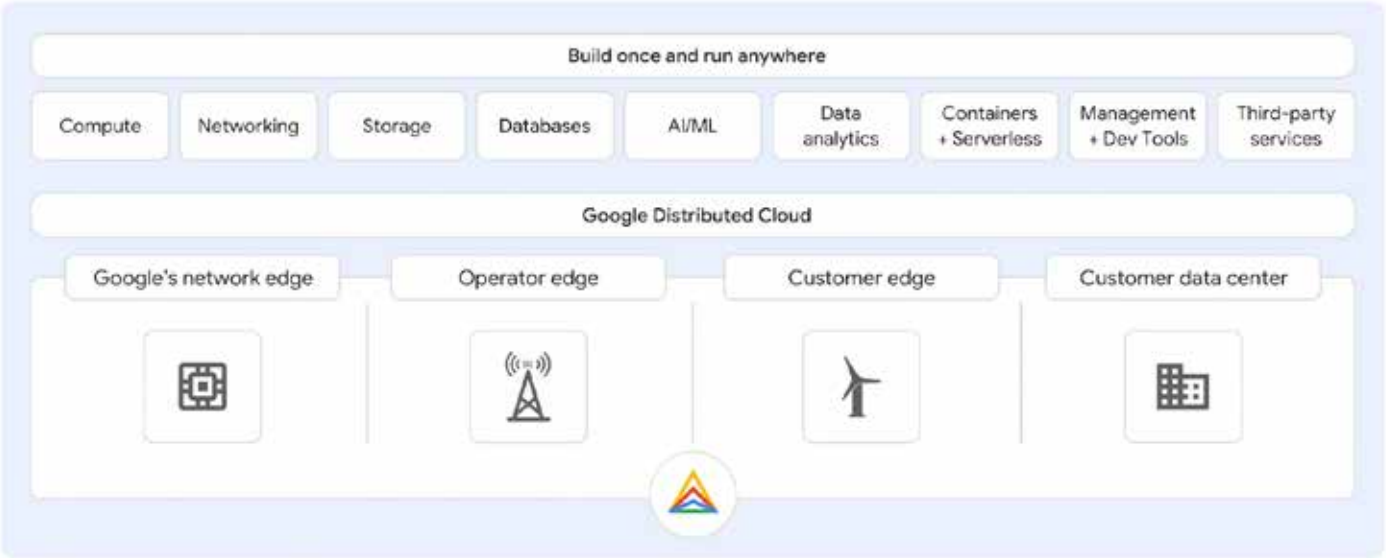
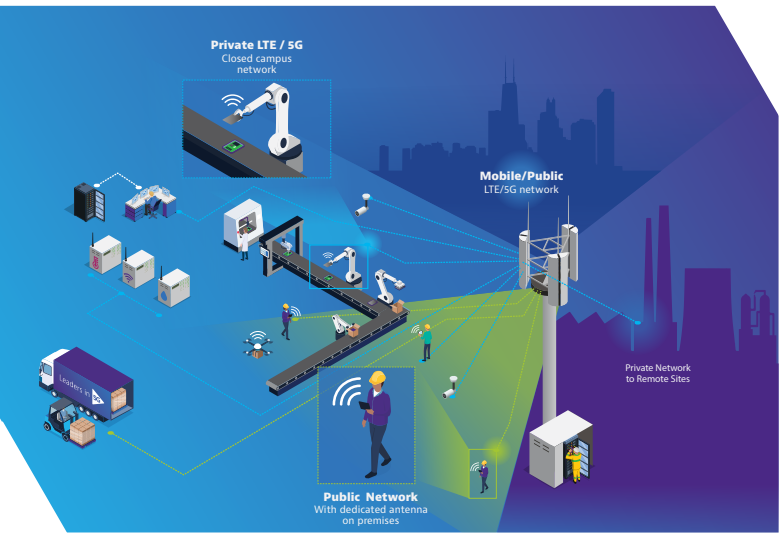


Image courtesy of Google

Multi-Access Edge Computing and Private 5G: **Checks and Balances Required**



Multi-access edge computing (MEC) is a significant development in network functionality where data is processed locally, literally at the edge of the network—close to users and devices—to circumvent congestion. A key benefit is reduced latency. To grasp how edge computing can complement priva te 5G network infrastructure, let's look at the mechanisms of MEC.

Two main components of MEC are edge servers and edge devices. Edge servers are IT equipment built to compute workloads. These could be industrial PCs or half racks with four to eight blades. Similarly, edge devices are equipment with processing capacity for another purpose, e.g., robots, cars, manufacturing machines, conveyor belts, etc.

A practical example is an Industry 4.0 factory employing ultra-reliable low latency communication (URLLC) where application servers are on premises. Here you find connected machinery and cameras communicating with a server to provide geolocation information, monitor production processes and quality, and analyze data for continuous productivity improvement.

MEC and 5G share a common goal: to minimize latency and increase connectivity speed

Cloud computing, the predecessor of MEC, required these factory machines to send data off premises for computation. Like a warehouse, the cloud computes data from countless sources, leading to a higher level of latency.

Further, cloud computing requires continuous Internet access, making it less-than-ideal for remote use cases. MEC, powered by private 5G, removes these limitations and introduces the potential for unprecedented productivity and efficiency.

MEC and Private 5G: A Balance of Reward and Risk

MEC and 5G share a common goal: to minimize latency and increase connectivity speed. In practical terms, MEC allows data to be processed as close as possible to Private 5G antennas, which will reduce the time and distance required for data transmission and increase the connection speed.

With up to 50x faster connectivity, MEC incentivizes 5G implementation for enterprise use cases and beyond—surgeries, unmanned vehicles, robotic deliveries, and many more. 5G MEC's lower latency and faster connectivity simply bring huge advances for machines performing in the highest-risk scenarios.

Further, as the data processed from connected devices is not safely contained within an IT data center, the risk of data breaches increases. An example here is a cyberattack on an edge server through the injection of unauthorized software and hardware components potentially infecting multiple different devices connected to it.

Node replication, the act of inserting a malicious node into the edge network and assigning it with an identical ID number of an existing node, can work as an undetected spy stealing valuable data or intelligence. Hardware trojans are also security threats, giving attackers complete control over a node's integrated circuits, and thus their data and software.

Getting to the Mecca of MEC and 5G

To reap the potential rewards of MEC and 5G, enterprises face a number of challenges including embracing and mastering a deployment model where the IT team manages, or partners with a provider to manage cellular infrastructure and also acquires the expertise to manage, secure, and optimize many different types of connected devices with different loading models. A strong test and measurement strategy is essential in the journey to mastering and monetizing 5G enabled MEC.

Enterprises, like service providers and network equipment manufacturers worldwide, can rely on expertise and test, measurement, security, and optimization solutions from VIAVI—for public and private 5G applications. VIAVI Solutions has been an early driver in 5G adoption and we continue to deliver innovative and cost-effective 5G testing tools to meet the full range of 5G and MEC testing needs.

an example, controlling cost of operations. Edge apps reduce backhaul, transport, network capex spend." Operators can also leverage localized compute and automation for service differentiation to drive new business models and attendant revenue streams. Data security, compliance, privacy and sovereignty are another benefit enabled by MEC.

"In order to ensure true monetization," Di Piazza continued, "we're actually trying to bring together the best of Google," including its global network, hybrid/multi-cloud solutions, AI and analytics, commitment to open source, and partner ecosystem. He identified AI-based audio and video processing as a "key common factor" between multiple edge use cases.

"Edge is de facto creating a new set of applications…But obviously this is not monetization that goes zero to 100. It's progressive. It's predicated on enterprise adoption."

Gabriele Di Piazza, Director of Product Management, Telco & Edge, Google Cloud

More on the ecosystem point, Di Piazza reiterated that an ecosystem-based approach is central to fully harnessing the power of edge computing. That means contributing to the development of developer communities and working together with Independent Software Vendors (ISVs). He laid out a three pillar strategy: an edge solutions portfolio, an open platform, and edge infrastructure spanning Google assets, the telco edge, customer edge, and third-party edge.

"Edge is de facto creating a new set of applications…But obviously this is not monetization that goes zero to 100. It's progressive. It's predicated on enterprise adoption. Our approach is to partner with [operators] in a revenue share approach. I think it will gradually pick up during 2022 and 2023."

The ultimate edge–on-device AI and processing

A major strategic MEC concern is around the cost of backhauling data to where it's processed—it's reductive thinking but the farther the data has to go to be processed, the more it costs. In addition to not wasting the latency gains 5G brings to the table, this is a key argument for MEC; it's cheaper to process data closer to where it's created versus piping it to a centralized data center somewhere. This can be extended further when you pull edge devices into the equation. What if on-device software is the first stop for data processing in that some decisions can be made before the applicable data set even hits the MEC node.

"The whole point about moving to the edge is we want to do more and more processing on the edge to take away that latency," Rami said. "Where Inseego is coming from is we cover…5G intelligent devices on the edge." Security is another driver here, particular in the context of sensitive, proprietary data. If it can be processed without leaving the figurative four walls of a facility, it's easier to ensure security, sovereignty and compliance.

Back to the example of edge-enabled retail effectively using a camera as a sensor. Inseego's Marathe noted that on-site there would be a camera and a device being used to connect the camera to the cellular network and to the MEC node. Inseego puts intelligence on its CPE device. In that paradigm, the retailer can have "cheap, dumb cameras that pass video through our device which has a layer built in to run AI models at the edge. Can I count people? Can I see where the people are? Those analytics can be done on the edge. Then we could engage the MEC for higher-level AI stuff that is either expensive or not possible to do on the edge [device]. We want to keep the costs down." As it relates to the centralized cloud residing in a data center somewhere, "We can then look at the metadata and send maybe some short clips to the cloud. Let's say I want to recognize my frequent visitor or understand who is an employee. I send those clips to the MEC, run that intelligence at the MEC layer and aggregate what the edge [device] is seeing vs. what the MEC is seeing. That's one narrow example."

For operators, there needs to be a two-pronged approach to MEC: new MEC-enabled services need to be balanced with accompanying MEC-enabled network optimizations, both of which outcomes are a function of making the highest and best use of data. Viavi's Kangru gave the example of sending out software updates to millions of vehicles. "You have 10 million cars out there...Each of them now needs a software update which is 1 GB in size. How do I deliver that to these units without driving up an enormous transport cost and blowing our capacity on the radio side? That's the type of optimization challenge" Viavi is focused on helping solve. It involves knowing the location of vehicles, the statistical probability the vehicle will be parked overnight, available network capacity, and other variables. That knowledge can be turned into a business offering. "This now becomes a MEC software delivery application. You don't want to download that 1 GB file 500 times over the same transport network. You want to download it once, cache it at the MEC, then push it to the vehicles."

The idea of increasingly localized AI processing was a key theme of Qualcomm's recent Investor Day event. Qualcomm has long developed on-device AI solutions for smartphones but now, as the company embarks on a major growth strategy that hinges on applying core mobile technologies to other areas, the connected intelligent edge will be key, according to Qualcomm CTO Jim Thompson.

"The gravity of AI processing is moving towards the edge," he told investors at an event in New York City. "Cloud is super important for that but I think it's moving towards the edge now. As we go through this digital transformation where there are sensors that are basically measuring everything about the world...that's generating an incredible amount of data. You cannot just send the amount of data that is being generated all back to the cloud--just can't do it. Some of that has to be processed at the edge."

Editor's note: RCR Wireless News editors Peter Cohen and Catherine Sbeglia contributed to this report.

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