

The Business Case for MEC in Retail: A TCO Analysis and its Implications in the 5G Era

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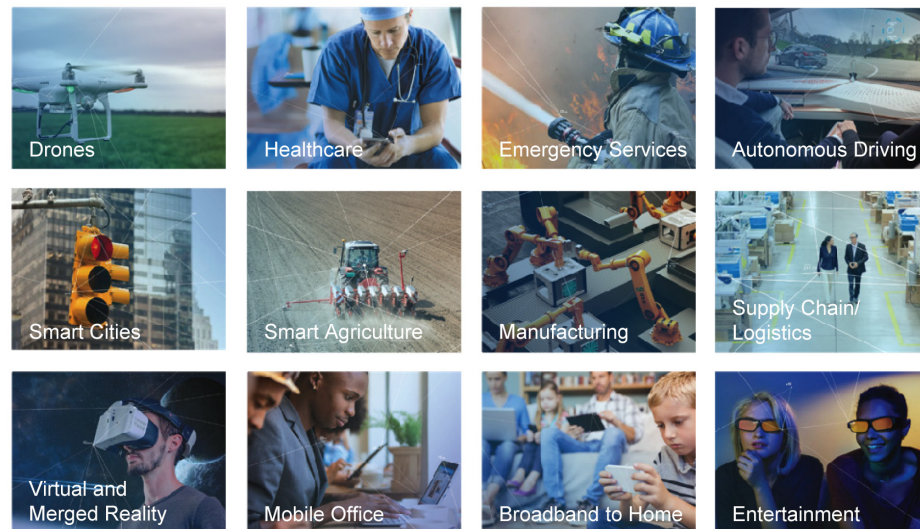
FOR INFORMATION PLEASE CONTACT IAIN GILLOTT (512) 263-5682.

Executive Summary

Mobile networks are quickly evolving to 5G with the first networks expected at the end of the decade. The principle benefits of 5G (lower latencies, higher bandwidth, context aware connections, support for private networks and network slicing) will enable a range of new applications and services to support businesses and enterprises, their employees and their customers. 5G also brings massive machine-to-machine networks, Internet of Things (IoT) and more advanced enterprise networking solutions that will support new services, such as caching which is used in vehicle-to-X for autonomous driving.

Rather than simply an upgrade to the radio access network, in order to meet some of the aggressive 5G performance goals, a complete rethinking of the network architecture is required.¹ Specifically, this means moving processing closer to the edge of network with standards such as Multi-access Edge Computing (MEC) developed by ETSI ISG MEC.^{2,3,4} In order to enable communications and computing that delivers low latency and high-speed access to cloud, the new 5G architecture must make use of a virtualized and software-defined infrastructure to reduce deployment and operating costs compared to previous mobile networks.

Figure 1: 5G will transform EVERYTHING



Source: Intel, 2017

There are many use cases describing how 5G technology and networks could be used. Much of the marketing around 5G has focused on “more bandwidth” and the IoT – but there are many other potential uses for 5G in enterprises including:

- Augmented and virtual reality
- Tactile Internet

- Mobile health and telemedicine
- Connected cars, truck and automotive, including autonomous vehicles
- Mobile video delivery
- Public safety
- Network slicing and private networks

MEC is an important part of making these use cases a reality and in bringing about this 5G network evolution.⁵ In fact, 5G will be unable to meet all its performance goals without edge computing solutions such as MEC. While MEC can be deployed today before the 5G radios are ready, as the “multi-access” name suggests, MEC is not limited to a cellular radio access, but can use other wireless (e.g., Wi-Fi) and wired access technologies.⁶

With its implementation, MEC results in several important network evolutions:

- Provides cloud-computing capabilities and an IT service environment at the edge of the network.
- Transforms access nodes into intelligent service hubs.
- Runs on servers deployed at any of the sites in the operator’s network.
- Deploys on high-volume IT hardware with commercial off-the-shelf components.
- Introduces two new management layers: one at system level (including the orchestrator, and with an overarching view of multiple MEC hosts/platforms), and the other one at host level (including the platform manager and virtualization infrastructure manager).

MEC also enables new services that are not possible with a traditional, core-driven, network architecture and improves the overall performance of applications and services. For example, applications and services that benefit from edge analytics and dynamic radio resource allocation are not feasible with traditional network architectures. An edge computing implementation is required in these cases.

MEC Total Cost of Ownership Benefits

To illustrate and quantify the potential benefits of MEC, iGR conducted a total cost of ownership (TCO) study in a retail environment with a major U.S. retailer. This nationwide retailer has more than 2,000 stores and sells technology products and services. The stores are used for fulfillment, repair, customer support, and distribution, and each store sells multiple types of devices and advanced services.

This study examined three year’s of TCO benefits of the MEC solution (compared to the current Wi-Fi-based network configuration) and the findings were significant:

- **59 percent reduction** during the busy hour WAN traffic over the store connection with the MEC appliance compared to the current deployment. This is accomplished

by caching content locally for video training of employees and device software updates.

- **55.9 percent cost savings over three years** (capital and maintenance) if the stores did not need upgrading from the 100 Mbps circuit.
- If the store has to move to a 1 Gbps connection, then the MEC three-year TCO savings is **54.0 percent**.
- Content caching has the potential to reduce backhaul capacity requirements by up to 35 percent. Local Domain Name System (DNS) caching can reduce web page download time by 20 percent.

There are also intangible benefits of using MEC in the retail stores including improved LTE customer experience while in the store and the ability to quickly and efficiently deploy new applications and services. There are potentially additional revenue opportunities by being able to demonstrate more advanced services and devices in the store, such as augmented reality and virtual reality.

By improving the performance of the in-store systems (especially for device OS upgrades), the retailer has the potential to reduce the time taken to resolve the customer issue. This could result in the ability to process more customer requests in the store in the day or leave additional time for product upsell opportunities, depending on the retailer's priorities. For the customer, this would likely result in lower wait times during busy store hours.

For this nationwide retailer and other large enterprises, 5G and MEC present a wide range of opportunities to solve business problems and challenges. By combining the IT world with mobile networks and edge computing, a host of new applications and services are possible. In fact, as iGR has been discussing 5G and MEC with large businesses and enterprises, it has become clear that the possibilities are limited not by the technology but by the imagination.

Evolving Mobile Networks

As the demands of today's consumers shift toward multimedia content, mobile networks have had to evolve as well. Some would argue that the more advanced capabilities of today's mobile networks (such as higher bandwidth) have driven consumer adoption of multimedia services and applications. Either way, consumers are placing more demands on mobile networks and driving the evolution to the next generation of networks and architectures: 5G.

Other factors are also driving the move to 5G, including the need for massive machine-to-machine networks, IoT and more advanced enterprise networking solutions. But rather than simply requiring an upgrade to the radio access network, 5G is a complete rethinking of the network architecture. This new approach is required in order to meet some of the aggressive 5G performance goals.

Defining 5G

As the world marches toward deploying the first 5G networks, the industry is coming to consensus about exactly what 5G includes. According to the Next Generation Mobile Networks alliance (NGMN),

*"5G is an end-to-end ecosystem to enable a fully mobile and connected society. It empowers value creation toward customers and partners, through existing and emerging use cases delivered with consistent experience and enabled by sustainable business models."*⁷

More specifically, the following appears to be the consensus view of what a "5G Network" should eventually be able to achieve:

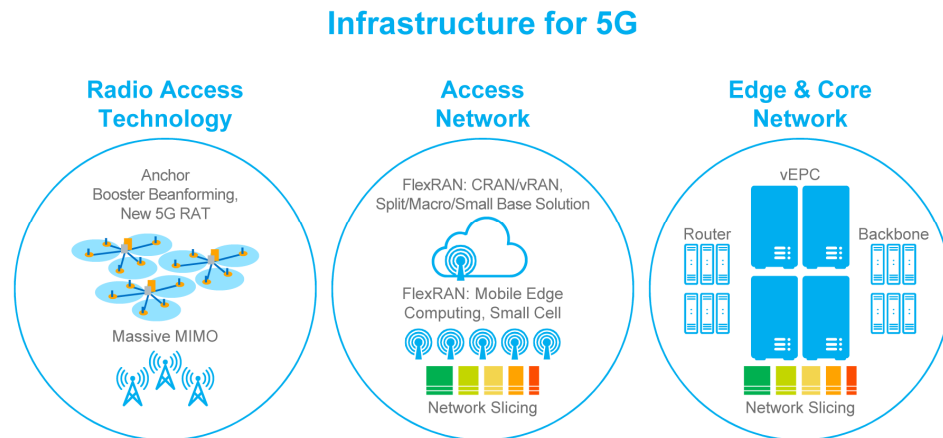
- 1-10Gbps connections to end points in the field (i.e., not theoretical maximum "per cell" throughput, but actual end user speeds)
- 1 millisecond end-to-end round trip delay (latency).

iGR considers the first 5G network technology to be IMT-2020. As the name suggests, this specification is due to be finalized at the end of the decade, with commercial deployments shortly thereafter. While some operators may brand LTE-A networks as "5G" in the next few years, iGR does not consider these networks to be "true 5G."

Unlike previous generational network evolutions, the move from 4G to 5G is not simply about upgrading the radio access network (RAN). For 5G to be successful in meeting its stated performance goals, a new architecture is required. Specifically, this means moving processing closer to the edge of network with standards such as MEC – edge processing is required in order to meet the latency goals of 5G.

Similarly, the new 5G architecture must make use of a virtualized and software-defined infrastructure to reduce deployment and operating costs compared to previous mobile network iterations. The industry simply does not have the capital available to build an entirely new network infrastructure using traditional methods. Figure 2 is a graphical representation of a 5G network.

Figure 2: The 5G Foundation: Built on the Virtual Network



Source: Intel, 2017

5G Enterprise Use Cases

There are many use cases describing how the 5G technology and networks described in the preceding section could be used. Much of the marketing around 5G has focused on “more bandwidth” and IoT – but there are many other potential uses for 5G in enterprises:

- **Augmented and virtual reality** including for healthcare, education and training. While many companies are offering these types of applications today, IMT-2020 will enable a far richer experience with mobile due to the higher bandwidth, increased reliability and lower latency.
- **Tactile Internet** (The ITU defines this as “extremely low latency in combination with high availability, reliability and security.”) This is essentially the “IoT” with enhancements. These services will likely not all require high bandwidth but will need low latency networks. IoT will also include monitoring of sensor networks and remote control applications, including those for building security and climate control, remote field operations and logistics and inventory control and monitoring.
- **Mobile health and telemedicine** including remote operating theatres (possibly around the world), remote consultations (where a specialist in a major city and the patient in a remote rural area can interact) and patient monitoring. Again, many basic examples of this type of service exist today but with IMT-2020, it is expected that 5G will bring further reach and capability for the provider and the patient.
- **Connected car, truck and automotive**, including, more generally, vehicular internet/infotainment, pre-crash sensing and mitigation, cooperative driving, and inter-vehicle information exchange. But this also includes the ability for the auto and commercial vehicle manufacturers and dealers to connect to and monitor a car or truck. Note, that some of the first autonomous vehicle applications are likely to be seen in commercial vehicles – in particular long haul trucking, fleet management and taxi or rideshare services.

- **Mobile video delivery**, including streaming on demand and support for 4K and 8K HD formats. IMT-2020 may, in some cases, replace or supplement a wired broadband connection to the home or business.
- **Public safety**: mission-critical voice, broadband data (security cameras, drones, wireless sensors/tracking, etc.) are to be enabled.
- **Private networks**, allowing enterprises to use 5G in specific buildings or campuses and control the applications and services used in those specific areas.
- **Network slicing**, although not a use case, this 5G enabled technology is important to mention as it provides tangible benefits to the service provider as they develop new networks. Network slicing will have an impact across a wide array of use cases and industries. It allows the mobile operator to segment bandwidth in the network and dedicate it to a specific application, user base or customer base. For example, a mobile operator could offer network services to a corporation for dedicated use by the corporation's employees. The slicing would be network-wide, not just in specific locations, so that employees could access dedicated bandwidth wherever they were traveling or residing.

Many of these use cases can be supported with LTE-Advanced (3GPP Release 11 and Release 12) and LTE-Advanced Pro (3GPP Release 13 and Release 14). But, the value of 5G is that the end user experience would be much enhanced. In short, while some applications can be supported on LTE, users will notice an impact on performance compared to 5G deployment.

In that vein, the following tables show which 5G applications apply to specific vertical industries and which applications require 5G networks. Note that some applications may have the user experience significantly improved using a 5G architecture.

Table 1: 5G Applications for Specific Vertical Industries

		Manufacturing	Retail Trade	Health Care and Social Assistance	Transportation and Warehousing	5G improved	5G required
AR/VR	Augmented reality	✓	✓	✓	✓	✓	
	Virtual reality		✓	✓		✓	
	Remote surgery			✓			✓
Content delivery	Video optimization (radio aware)	✓	✓	✓	✓	✓	
	Video analytics		✓	✓		✓	
	Content caching		✓	✓		✓	
	Digital signage	✓	✓	✓	✓	✓	
V2V	Vehicular internet/ infotainment				✓	✓	
	Pre-crash sensing and mitigation				✓		✓
	Cooperative vehicles	✓			✓		✓
	Inter-vehicle information exchange	✓			✓		✓
	Autonomous vehicles	✓			✓		✓
	Remote vehicle monitoring	✓			✓	✓	

Table 1: 5G Applications for Specific Vertical Industries (continued)

		Manufacturing	Retail Trade	Health Care and Social Assistance	Transportation and Warehousing	5G improved	5G required
IoT	Remote control	✓		✓	✓		✓
	Asset tracking	✓	✓	✓	✓	✓	
	Location tracking	✓	✓	✓	✓	✓	
	Building security	✓	✓	✓	✓	✓	
	Entry control	✓	✓	✓	✓	✓	
	Climate Control	✓	✓	✓	✓	✓	
	Smart signage	✓	✓	✓	✓	✓	
	Sensor network monitoring and control	✓	✓	✓	✓	✓	
	Drone monitoring and control				✓		✓
	Alert status management	✓		✓	✓	✓	
V2X	Forward collision warning	✓		✓	✓	✓	
	Emergency electronic brake lights	✓		✓	✓	✓	
	Do not pass warning	✓		✓	✓	✓	
	Left/right turn assist	✓		✓	✓	✓	
	Intersection movement assist	✓		✓	✓	✓	
	Blind spot and lane change warning	✓		✓	✓	✓	

Table 1: 5G Applications for Specific Vertical Industries (continued)

		Manufacturing	Retail Trade	Health Care and Social Assistance	Transportation and Warehousing	5G improved	5G required
Private Network	Private network	✓		✓	✓	✓	
	Local corporate intranet	✓		✓	✓	✓	
	Network slicing	✓		✓	✓	✓	
	Patient management	✓		✓	✓	✓	
	Dynamic hospital user	✓		✓	✓	✓	

Source: iGR, 2017

5G Network Benefits

As we have already discussed, 5G involves a wholesale change in the network architecture from 4G and not just an upgrade of the RAN. The principle benefits of 5G are:

- **Low latency** – The aim is for 5G network latency of 1 ms or less. In reality, this is likely to apply to specific applications and services, and in most cases, latency is likely to be around 5 ms. This is still significantly lower than current 4G LTE network latency of 60 – 70 ms. Low latency enables a range of applications from augmented/virtual reality, autonomous vehicles and IoT.
- **Increased bandwidth** – Rather than just increase the amount of bandwidth available within the cell site, 5G will expand the bandwidth to each user. The goal is for 1 Gbps or more per user. Again, this will likely only apply to specific instances but improvements in LTE speeds of 20 to 100 times are expected for 5G.
- **Context awareness** – 5G networks, using edge analytics and other tools, will be aware of what the user is trying to accomplish, the capabilities of the device and the conditions in the network at that location. This means that the 5G network may deliver a different type of connection to a device that is stationary and downloading a new software update, for example, compared to an IoT device connected to a critical piece of manufacturing equipment.
- **Low power device power consumption** – To enable IoT effectively, long battery life (years, not days or weeks) is required. This means that the radio communication between the device and the network must be extremely efficient and optimized to reduce power consumption. 5G will be designed with this in mind from inception, thereby enabling a range of enterprise applications and services.

- **Fast inter-RAT handoff** – Rather than handoff connections between 5G eNodeBs, 5G will allow a connection to be easily and efficiently handed between different types of Radio Access Technologies (RAT). For example, an enterprise user may start on a secure corporate Wi-Fi and then be handed to a secure 5G WAN connection. To the user, this handoff will be imperceptible.
- **Fixed wireless support** to enable high bandwidth services to homes and businesses. This may be offered as a supplement to terrestrial wired data services or in places where a wired connection is not physically or economically possible.

5G network architecture benefits for each application are shown in the following table.

Table 2: 5G Network Architecture Benefits for each Application

		Low Latency	Increased Bandwidth	Context Aware	Low Power Device Power Consumption	Fast Inter-RAT Handoff	Fixed Wireless Support
AR/VR	Augmented reality	✓	✓	✓		✓	
	Virtual reality	✓	✓			✓	
	Remote surgery	✓	✓	✓		✓	
Content delivery	Video optimization (radio aware)		✓				✓
	Video analytics			✓			✓
	Content caching		✓				✓
	Digital signage		✓				✓
V2V	Vehicular internet/ infotainment		✓			✓	
	Pre-crash sensing and mitigation	✓		✓		✓	
	Cooperative vehicles	✓		✓		✓	
	Inter-vehicle information exchange	✓	✓	✓		✓	
	Autonomous vehicles	✓	✓	✓		✓	
	Remote vehicle monitoring		✓	✓		✓	

Table 2: 5G Network Architecture Benefits for each Application (continued)

		Low Latency	Increased Bandwidth	Context Aware	Low Power Device Power Consumption	Fast Inter-RAT Handoff	Fixed Wireless Support
IoT	Remote control	✓	✓	✓		✓	
	Asset tracking			✓	✓		
	Location tracking			✓	✓		
	Building security		✓	✓		✓	✓
	Entry control		✓	✓			✓
	Climate Control			✓			✓
	Smart signage		✓				
	Sensor network monitoring and control	✓	✓	✓	✓	✓	✓
	Drone monitoring and control	✓	✓	✓		✓	
	Alert status management			✓			
V2X	Forward collision warning			✓			
	Emergency electronic brake lights			✓			
	Do not pass warning			✓			
	Left/right turn assist			✓			
	Intersection movement assist			✓			
	Blind spot and lane change warning			✓			

Table 2: 5G Network Architecture Benefits for each Application (continued)

		Low Latency	Increased Bandwidth	Context Aware	Low Power Device Power Consumption	Fast Inter-RAT Handoff	Fixed Wireless Support
Private Network	Private network			✓			
	Local corporate intranet			✓			
	Network slicing			✓			
	Patient monitoring			✓			
	Dynamic hospital user			✓			

Source: iGR, 2017

What is Multi-access Edge Computing?

In September 2014, the founding companies of MEC (which initially stood for Mobile Edge Computing) published a whitepaper which defined it as:

“IT and cloud-computing capabilities within the radio access network in close proximity to mobile subscribers.”

This initiative led to the creation of the standardization body ETSI MEC ISG.² Now, the MEC standard is not limited to mobile networks, but is covering also non-3GPP accesses and fixed networks as well. This increase of scope is reflected in the related acronym meaning (that now is Multi-access Edge Computing). Thus, the new and comprehensive definition is the following:

“MEC offers application developers and content providers cloud-computing capabilities and an IT service environment at the edge of the network.”⁶

For practical deployments, MEC results in several important network evolutions:

- Transforms access nodes into intelligent service hubs that are capable of delivering highly personalized services directly from the very edge of the network while providing the best possible performance in communications networks.
- Runs on servers deployed at any of the sites in the telecom operator’s network: for example, at the LTE or 5G macro base station (eNodeB) or small cell or Cloud-RAN aggregation point. In a cable network, MEC could be at the head end.
- MEC platforms are deployed on high-volume IT hardware with off-the-shelf components.

- Introduces two new management layers: one at system level (including the orchestrator, and with an overarching view of multiple MEC hosts/platforms), and the other one at host level (including the platform manager and virtualization infrastructure manager).
- Offers MEC services, like Radio Network Information (RNI) and location services, at the network edge which the MEC application can leverage to offer enhanced services.

MEC and Virtualization

Virtualization is critical to the concept and implementation of MEC. The MEC hosting infrastructure consists of hardware resources and a virtualization layer. The virtualization manager provides, in brief, an Infrastructure as a Service (IaaS) capability. The IaaS controller provides a security and resource sandbox for the applications and the platform. Virtual-appliance applications run on top of an IaaS and are delivered as packaged operating system Virtual Machine (VM) images.

MEC applications from enterprises, vendors, service providers, and third-parties would be deployed and executed within virtual machines that run on the ME hosts. A single ME host can run multiple VMs. And it should help keep the lease cost down for each individual MEC application provider.

Benefits of MEC

For the enterprise, the benefits of MEC boils down to:

- Providing better services to their customers and employees – **lower latency, higher throughput**, more diverse, localized and personalized services. Application-aware cell performance optimization for each device in real time can improve network efficiency and customer experience. For example, physically closer servers and tight RAN integration can help reduce video stalling and increase browsing throughput.
- **Video caching and edge analytics**, specifically the ability to store video content at the edge of the network, reducing transport costs and improving customer experience. A distributed caching technology can provide backhaul and transport savings and improved QoE. Content caching has the potential to reduce backhaul capacity requirements by up to 35 percent. Local Domain Name System (DNS) caching can reduce web page download time by 20 percent.
- **Support IoT/M2M applications and services**, which tend to transmit small amounts of data but may also include higher-bandwidth applications such as video surveillance.
- **Application virtualization and coordination** between the cloud and the edge opens opportunities to more application designers for over-the-top services and/or virtualized services. For example, an application could dynamically move between the edge processor and the cloud as the needs of the end user dictate. As more and more applications and services are enabled with virtualized solutions, so the role of the MEC architecture becomes critical.

- Ability to support **private/local networks** running apps and services for a specific building, campus or area for certain employees and customers.
- **Mission critical communications** is also enabled by edge computing. For example, in the event of a backhaul communications failure, the local edge computing node could still provide communications and applications support to those devices connected locally to that node.

MEC, as well as improving the overall performance of applications and services that benefit from edge computing, enables new services that are not possible with a traditional core-driven network architecture. For example, applications and services that benefit from edge analytics and dynamic radio resource allocation are not feasible with traditional network architectures. An edge computing implementation is required in these cases.

The following table shows specific MEC benefits and how they apply to each application.

Table 3: MEC Architecture Benefits for each Application

		Low Latency	Caching	Reduced Backhaul	Edge Analytics	App Virtualization between Edge and Cloud	Private/ Local Network
AR/VR	Augmented reality	✓	✓	✓	✓	✓	✓
	Virtual reality	✓	✓	✓	✓	✓	✓
	Remote surgery	✓	✓	✓	✓	✓	✓
Content delivery	Video optimization (radio aware)		✓	✓	✓	✓	✓
	Video analytics				✓		✓
	Content caching		✓	✓			✓
	Digital signage		✓	✓		✓	✓
V2V	Vehicular internet/ infotainment		✓	✓	✓	✓	✓
	Pre-crash sensing and mitigation	✓			✓	✓	✓
	Cooperative vehicles	✓			✓	✓	✓
	Inter-vehicle information exchange	✓			✓	✓	✓
	Autonomous vehicles	✓			✓	✓	✓
	Remote vehicle monitoring		✓	✓	✓	✓	✓

Table 3: MEC Architecture Benefits for each Application (continued)

		Low Latency	Caching	Reduced Backhaul	Edge Analytics	App Virtualization between Edge and Cloud	Private/ Local Network
IoT	Remote control	✓	✓	✓	✓	✓	✓
	Asset tracking				✓	✓	✓
	Location tracking				✓	✓	✓
	Building security		✓	✓	✓		✓
	Entry control		✓	✓	✓		✓
	Climate Control		✓	✓	✓		✓
	Smart signage		✓	✓		✓	✓
	Sensor network monitoring and control	✓	✓	✓	✓		✓
	Drone monitoring and control	✓	✓	✓	✓	✓	✓
	Alert status management				✓	✓	✓
V2X	Forward collision warning				✓	✓	✓
	Emergency electronic brake lights				✓	✓	✓
	Do not pass warning				✓	✓	✓
	Left/right turn assist				✓	✓	✓
	Intersection movement assist				✓	✓	✓
	Blind spot and lane change warning				✓	✓	✓

Table 3: MEC Architecture Benefits for each Application (continued)

		Low Latency	Caching	Reduced Backhaul	Edge Analytics	App Virtualization between Edge and Cloud	Private/ Local Network
Private Network	Private network				✓	✓	✓
	Local corporate intranet				✓	✓	✓
	Network slicing				✓	✓	✓
	Patient management				✓	✓	✓
	Dynamic hospital user				✓	✓	

Source: iGR, 2017

The 5G and MEC Opportunity

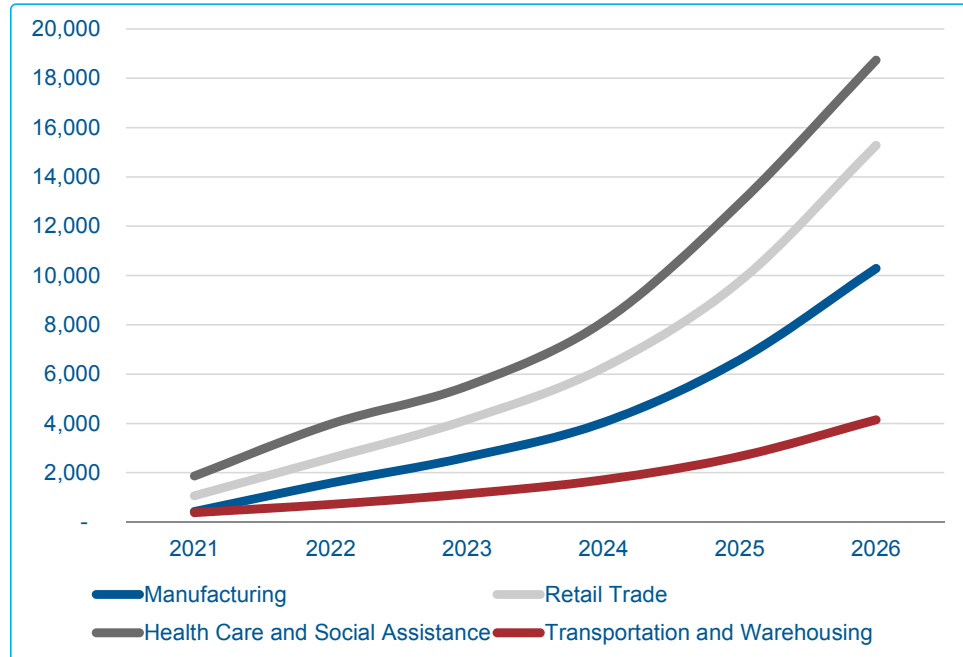
As part of the preparation for this white paper, iGR modeled the opportunity and forecasted adoption of 5G connections and MEC installations across four vertical industries in the U.S. and Western Europe. The four industries examined include retail, manufacturing, healthcare and transportation/warehousing. In addition, the model looked at those applications and services that would be enabled by 5G and MEC installations within the mobile networks.

5G Opportunity

The figures below show the forecasted number of 5G connections in the U.S. and Western European markets from 2021 to 2026. Note that, in each case, the model assumes that networks will be built in late 2019 and 2020 and commercial services will be launched early in 2021.

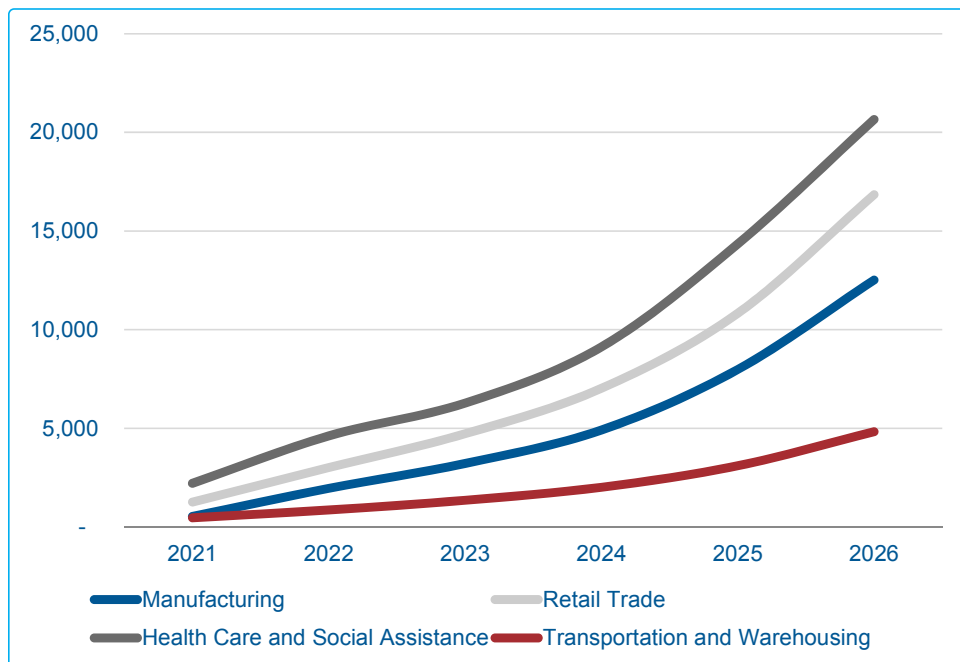
These forecasts are based on the number of employees in each industry and within each market and the assumed deployment schedule for 5G networks. Note that the penetration rate of 5G into each vertical varies according to the applications they are likely to use. For example, penetration in transportation and warehousing is lower since applications in this vertical will require more extensive network coverage which will take some time to build.

Figure 3: U.S. 5G Enterprise Connections by Industry (000s)



Source: iGR, 2017

Figure 4: Western Europe 5G Enterprise Connections by Industry (000s)



Source: iGR, 2017

As the two charts above show, there are forecast to be a total of 48.4 million 5G connections in the four industries in the U.S. by 2026 (accounting for 37 percent of all mobile connections). For Western Europe, the total is forecast to be 54.7 million 5G connections by 2026 (equivalent to 28 percent of all mobile connections).

MEC Opportunity

Starting with the number of enterprises in each vertical and the number of commercial buildings, the model forecasts the expected number of MEC appliances required for each vertical. The demand model was driven by the adoption of specific applications into each vertical. For the mobile network MEC installations, the model assumed the penetration of specific applications that would require network-wide edge processing, such as autonomous vehicles.

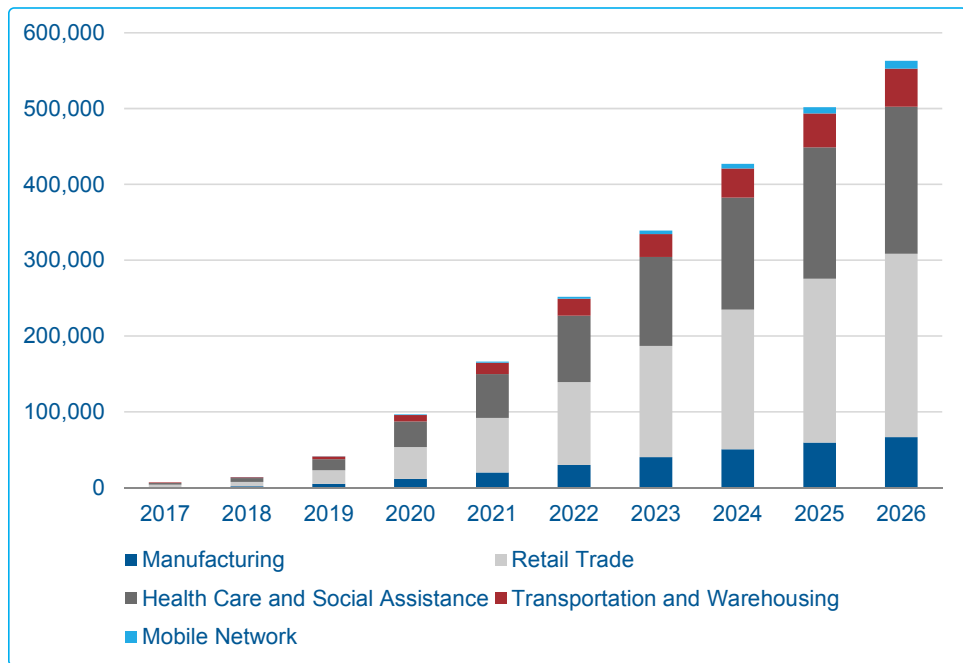
The figure below shows the number of MEC appliances installed for the U.S. from 2017 to 2026, with the same data for the Western Europe region in the chart below that. Note that MEC installations start in 2017, some four years before the first anticipated 5G commercial services. MEC does not require a 5G network to be deployed (the converse is not true: 5G will require edge computing architectures to meet all its performance goals).

The largest number of MEC appliances are expected to be in the retail industry simply because of the number of potential locations. For example, a national retailer may have 2,000 locations each with a small MEC appliance. But one manufacturing plant (which may employ the same number of people as in 2,000 retail locations), could be

supported with a single, large MEC installation. The forecast, therefore, shows the number of locations with MEC installed, not the relative size of each MEC appliance.

As the figure below shows, the number of U.S. MEC installations is expected to reach 166,000 by 2021 (when 5G is commercially launched) and just over 563,000 by 2026. The largest number of installations are expected in retail and health care and social assistance industries.

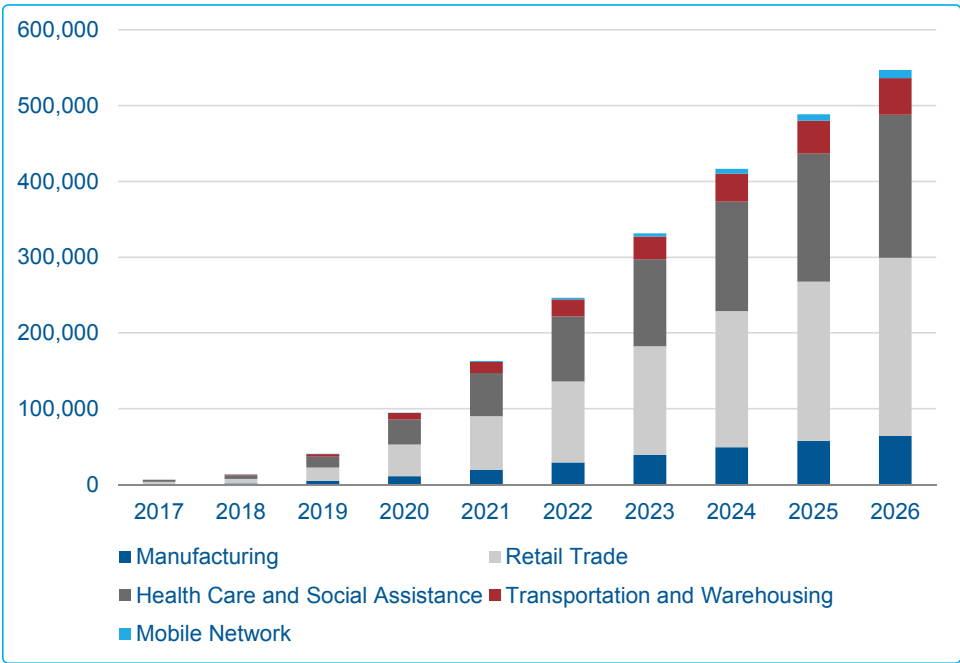
Figure 5: U.S. MEC Installations



Source: iGR, 2017

For Western Europe, the picture is similar: The largest number of installations will be for retail and health care and social assistance. Growth is relatively low from 2017 to 2021 (when there are forecast to be 163,000 MEC installations in Western Europe) but then strengthens as the market reaches 563,000 installations in 2026.

Figure 6: Western Europe MEC Installations



Source: iGR, 2017

The Business Case for MEC in Retail

To illustrate and quantify the potential benefits of MEC in the retail environment, iGR conducted a total cost of ownership (TCO) study with a major U.S. retailer. This nationwide retailer has more than 2,000 stores and sells technology products and services. The stores are used for fulfillment, repair, customer support, and distribution, and each store sells multiple types of devices and advanced services. In order to expand distribution and customer support, the company is opening new stores every year.

Rather than look at the costs associated with a single store, iGR studied the TCO for 25 new greenfield stores for the retailer. The TCO examines three years and compares a MEC appliance installation with the current Wi-Fi configuration used in each store. No depreciation is included in the model – the formula is a simple TCO.

Current Technical Environment in Store

Each of the retailer's current stores use Wi-Fi infrastructure and video servers to support in-store employees, devices, demonstrations and digital signage. A range of point-of-sale devices, printers, PCs and other devices are connected to the Wi-Fi network.

Each store has a minimum 100 Mbps dedicated circuit connection, while larger stores are having to upgrade to 1 Gbps dedicated circuits to deal with busy-hour traffic load. As a result of the additional load on the stores, Wi-Fi controllers, load balancing and policy engines are having to be upgraded in the WAN.

There are several significant challenges presented by the current store IT environment:

- WAN connection (100 Mbps) is overloaded due to the number of software update downloads and video downloads. This results in slow customer service in peak hours – in simple terms, the network cannot handle the volume of network traffic.
- The current Wi-Fi network is challenged by the need to support employees, customers, demo devices, point-of-sale, etc. And some stores use outdated Wi-Fi access points that need replacing. In addition, the Wi-Fi traffic load means implementation of load balancing in the WAN.
- Policy management for employee devices, demonstration devices, etc. requires implementation in the WAN.
- The company is planning new in-store capabilities (including augmented reality and virtual reality) that would require significant new server and Wi-Fi infrastructure in each store.
- Improve customer experience by reducing their turnaround time in store.

MEC Environment

The proposed MEC appliance configuration for each store is:

- One MEC appliance per store that provides LTE coverage throughout the store.
- Applications and services for the retailer will be virtualized and orchestrated across the network and appliances.
- Two of the current Wi-Fi access points will be retained per store and connected to the MEC to provide Wi-Fi connectivity for store customers as needed.
- MEC will be connected to the company's WAN via a 100 Mbps dedicated circuit connection.
- No load balancing, Wi-Fi controllers or policy engines will be required in the WAN for the Wi-Fi, since the MEC provides policy support through the LTE protocol.
- The existing wiring in the store for digital signage, point-of-sale devices, etc will be retained.

TCO Benefits of MEC

The three-year TCO benefits of the MEC solution are significant:

- **55.9 percent cost savings over three years** (capital and maintenance) if the stores do not need upgrading from the 100 Mbps circuit
- If store has to move to a 1 Gbps connection, then the MEC three-year TCO savings are **54.0 percent**
- The busy hour WAN traffic over the store connection is **reduced 59 percent** with the MEC appliance compared to the current deployment. This is accomplished by caching content locally:
 - Software updates are cached on the MEC server locally in the store and updated once per day (at night). This means that each request for a device software update (usually performed before trying to diagnose other customer device issues) is processed locally rather than using the store WAN connection.
 - Training videos and demonstration videos are cached on MEC server locally in the store and, again, updated once per day (at night).

There are also intangible benefits of using MEC in the retail stores. For example, since LTE coverage is provided throughout the store, the load on the external macro site is reduced and the customer experience in the store is improved – while this can be quantified, it is difficult to argue to there is a significant fiscal benefit since the macro site is highly unlikely to be decommissioned as a result. For example, to deploy augmented reality or virtual reality in the stores, the AR/VR software is added to the MEC remotely (just as you would on any other cloud platform), and provided the MEC

appliance has sufficient processing and storage capacity, AR/VR can be easily deployed without additional servers or infrastructure.

Finally, by improving the performance of the in-store systems (especially for device OS upgrades), the retailer has the potential to reduce the time taken to resolve the customer issue. This could result in the ability to process more customer requests in the store in the day or leave additional time for product upsell opportunities, depending on the retailer's priorities. For the customer, this would likely result in lower wait times during store busy hours.

Conclusion

As stated at the beginning of this report, there are many use cases describing how the 5G technology achievements and networks could be used and MEC is an important part of bringing about the 5G network to enable those use cases. MEC provides a platform to meet the latencies requirements for 5G critical communications uses that can't be realized with today's network architecture and it is key to many use cases that are enhanced by deploying services closer to the network edge.

MEC provides an opportunity for both the service provider and the enterprise to embrace new models and reduce costs – all while improving cost, speed and capability.

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