DELL'ORO GROUP

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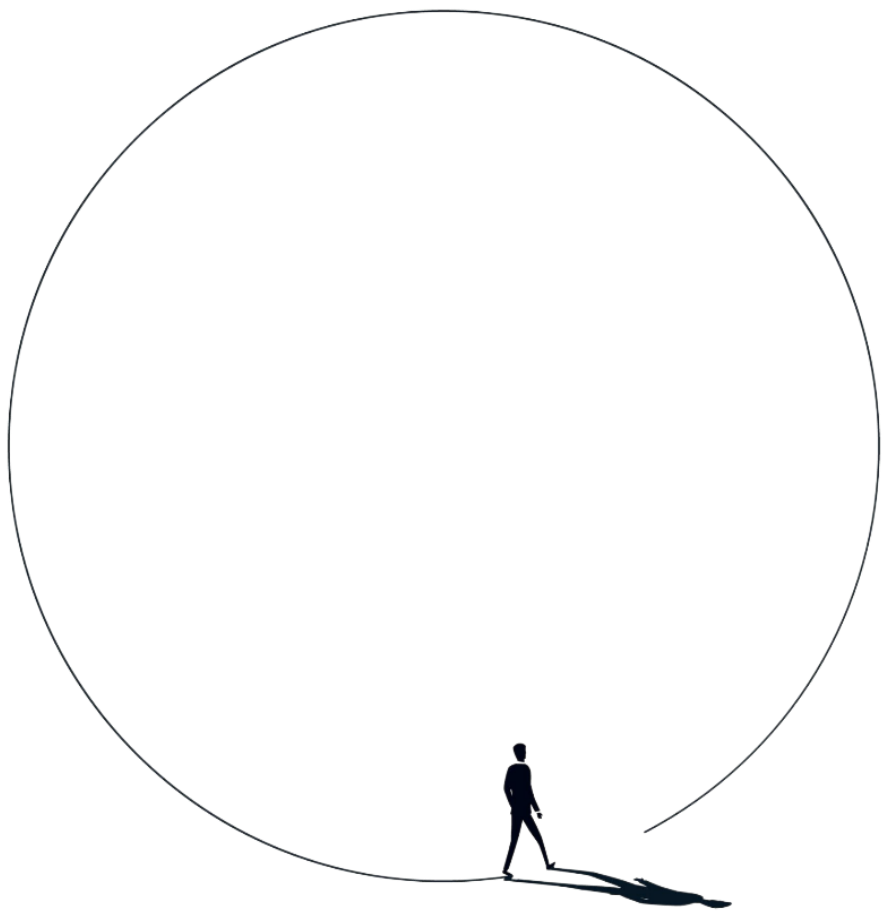
MEC MARKET OPPORTUNITY FOR MNOS

Is it too big to be ignored?

by Dave Bolan, Research Director for Mobile Core Network & Multi-Access Edge Computing

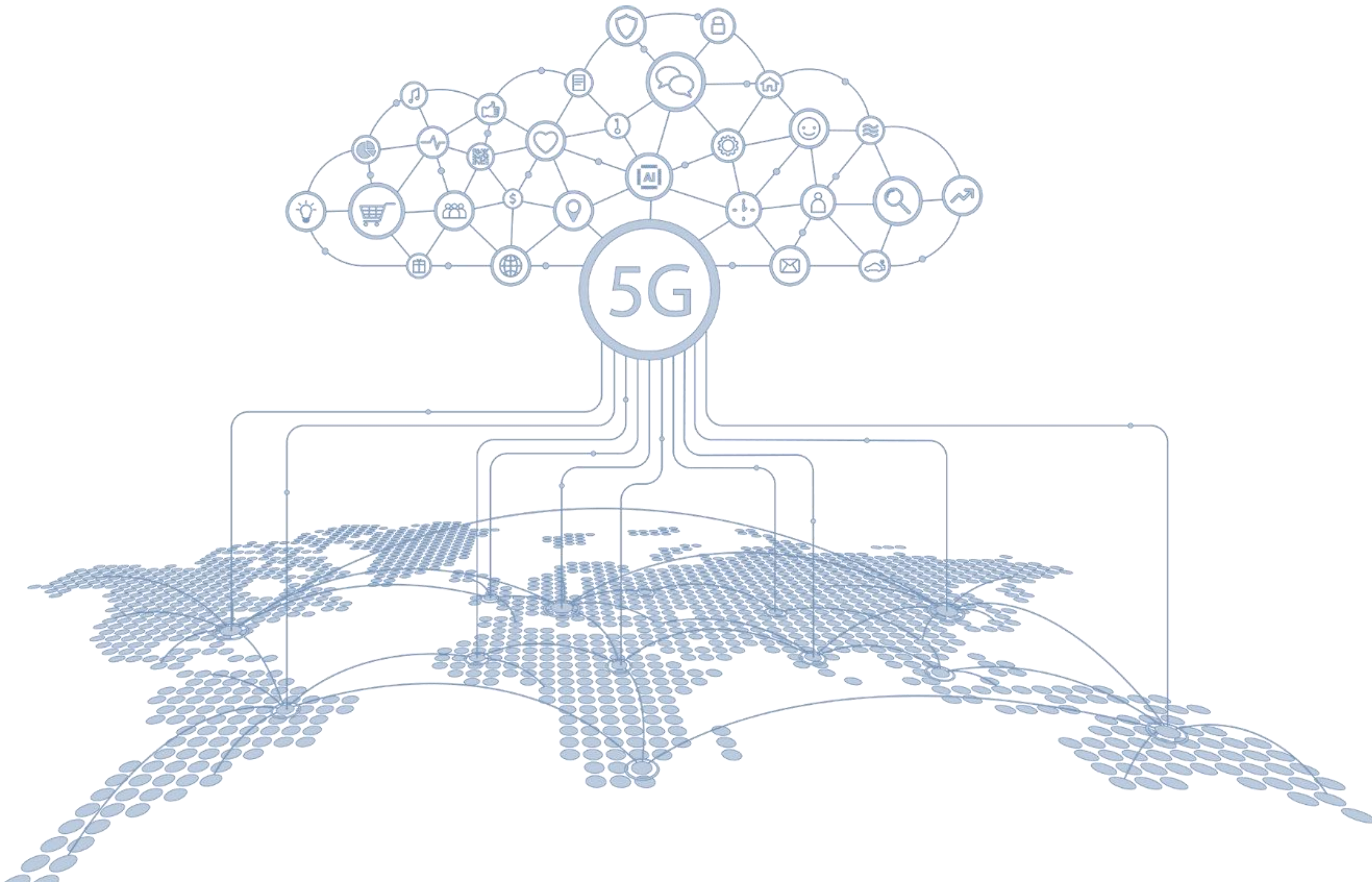


Introduction

Mobile Network Operators (MNOs) began migrating to 5G Standalone (5G SA) networks in July of 2020, which requires the 5G Core (5GC) Service Based Architecture (SBA). These MNOs seek to use a specific 5GC SBA option—Multi-access Edge Computing (MEC)—as a way to monetize their networks. We expect that investments in MEC will accelerate the return-on-investment (ROI) for 5G SA, generating new revenue streams while simultaneously reducing networking costs.

By embracing MEC, MNOs can address new connectivity opportunities in the private wireless market space for industrial enterprises and others, such as Smart Cities, that need real-time or near real-time communications.

This whitepaper defines MEC and explains how it integrates into the 5GC SBA. It outlines the different flavors of MEC, the various options for deploying a MEC network, the realistic market opportunity for MNOs and their suppliers, and the ways in which certain MNOs are already reaping the benefits of implementing MEC.



We address three fundamental MEC issues and their corollaries according to the below Table of Contents:

Contents

Highlights

The 5G MEC market potential is significant and it shows tangible signs of increasing over the next five years:

(1) 25 million potential MEC sites have been identified for deployment;
(2) Dell'Oro Group projects that the MEC market will grow at a 67% CAGR over the next five years;
(3) Learnings from SK Telecom, KT, Verizon, and China Mobile, China Telecom, and China Unicom.

MNOs should reap certain benefits that stem from the above factors:

(1) Increased revenues from a new customer base;
(2) Lower backhaul costs;
(3) Satisfied customers with better user experiences thanks to lower latencies, new applications that increase productivity, and data sovereignty that improves security.

MEC Architecture

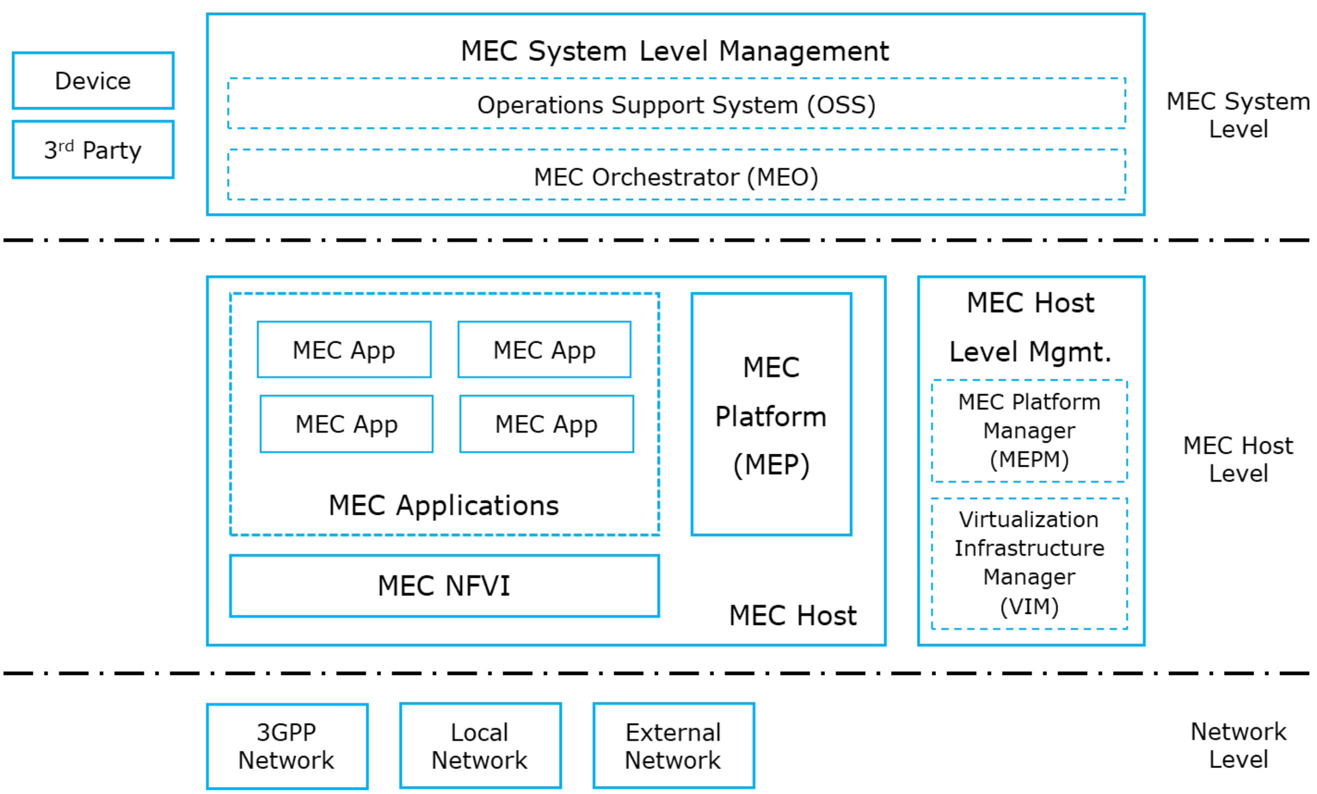
MEC System Architectural Framework

The term MEC (Mobile Edge Computing) was first used in September 2014, when the MEC industry initiative group—which included Huawei, IBM, Intel, Nokia, NTT DOCOMO, and Vodafone—published its introductory white paper. This group had a strong vision of what MEC could accomplish—particularly in terms of providing new services and applications that featured low latency and high bandwidth—if Information Technology (IT) and cloud-computing capabilities within the Radio Access Network (RAN) had access to real-time radio network information (subscriber location, cell load, etc.).

In the ensuing standards process, it became obvious that edge computing applications would extend beyond mobile; therefore, the original terminology ("Mobile Edge Computing") behind the acronym "MEC" was replaced with the more precise terminology "Multi-Access Edge Computing".

The ETSI standards body assumed the responsibility of standardizing MEC that would move computing and storage resources to the edge of the network to allow for the execution of applications in real-time or near real-time (Figure 1).

Figure 1: MEC System architectural framework as defined by ETSI



Source: ETSI Group Specification: GS MEC 003; Framework and Reference Architecture

ETSI Group Specification: GS MEC 003; Framework and Reference Architecture summarizes the main elements:

- MEC enables the implementation of MEC applications as software-only entities that run on top of a Virtualization infrastructure.
- The MEC framework shows the general entities involved. These can be grouped into system level, host level and network levels.
- The multi-access edge system consists of the MEC hosts and the MEC management necessary to run MEC applications within an operator network or a subset of an operator network.
- The MEC host is an entity that contains a MEC platform and a Virtualization infrastructure which provides compute, storage, and network resources, for the purpose of running MEC applications.
- The MEC platform is the collection of essential functionality required to run MEC applications on a particular Virtualization infrastructure and enable them to provide and consume MEC services. The MEC platform can also provide services.
- MEC applications are instantiated on the Virtualization infrastructure of the MEC host based on configuration or requests validated by the MEC management.
- The MEC management comprises the MEC system level management and the MEC host level management.
- The MEC system level management includes the MEC orchestrator as its core component, which has an overview of the complete MEC system.
- The MEC host level management comprises the MEC platform manager and the Virtualization infrastructure manager, and handles the management of the MEC specific functionality of a particular MEC host and the applications running on it.

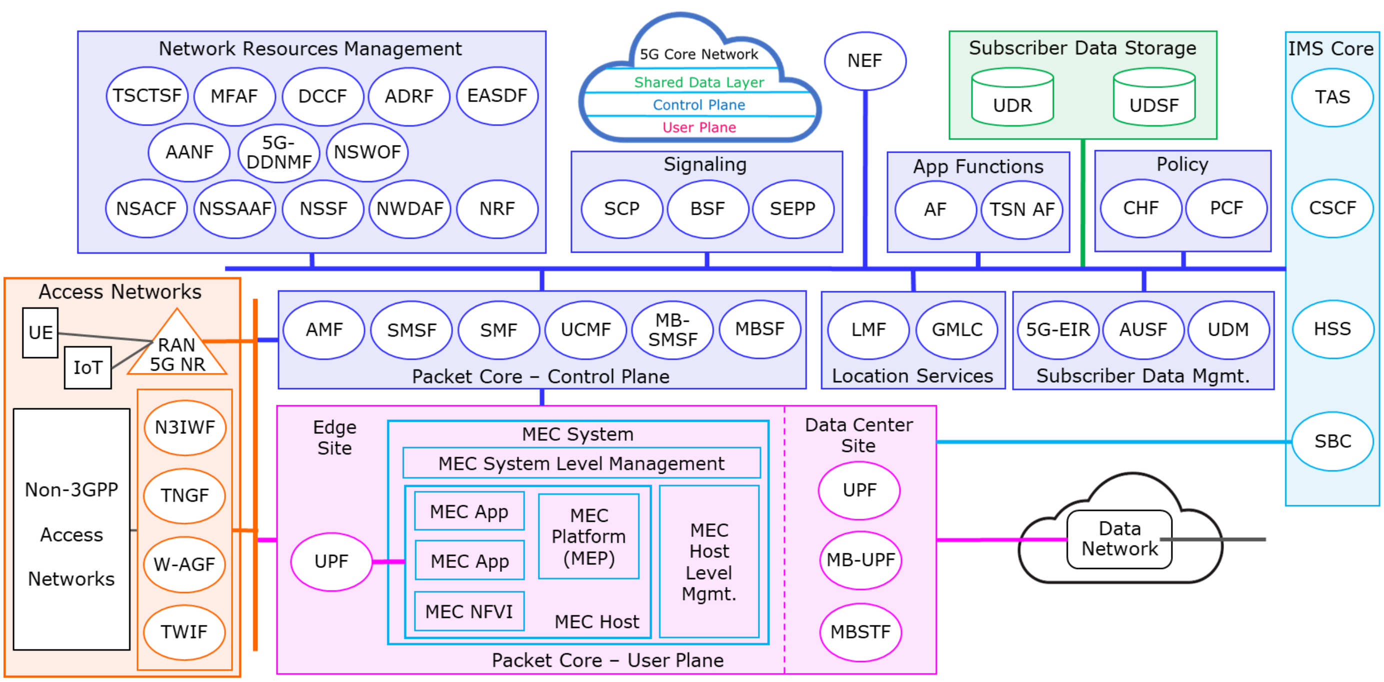
MEC Integrated into the 5G Core

3GPP is the responsible standards body for the 5G System. 3GPP defines how user equipment (UE), the radio access network, and the core all work together as a system. In Release 17 of the standards, 3GPP specified edge computing enhancements, along with measures that enabled certain edge applications in the 5G Core. 3GPP and ETSI have worked together to harmonize the integration of the two standards (5G System and MEC).

The 5G Core was designed as a SBA, in which all network functions have access to all other network functions. MEC sites have access to all 5G Core network functions, including the Policy Control Function (PCF) and the Network Slice Selection Function (NSSF). With the NSSF, the MEC System can meet the needs of the diverse service level agreements (SLAs) that may be required by various clients' subscription plans. Figure 2 illustrates at the block level how the MEC System fits into the 5G Core.

Figure 2: 5G Core Service Based Architecture facilitates MEC

(Please see the Glossary at the end of this document for definitions of the Network Function terminology.)



Source: Dell'Oro Group

Control and User Plane Separation (CUPS) makes it easier to implement MEC in a 5G SBA than networks without CUPS. In 5G, the User Plane Function (UPF) manages the user data for packet networking. The UPF can be distributed around the network to multiple locations. If the user's data is processed close to the user's location, the user's latency is decreased. The need to send user data back and forth between the Data Center (DC) and the end user—locations that could be separated by well over 500 kilometers!—is eliminated, and therefore the MNO's backhaul cost is dramatically reduced. The Control Plane functions do not need to reside at the MEC location; they can be processed at the DC without impacting latency or consuming significant bandwidth.

Public MEC and Private MEC

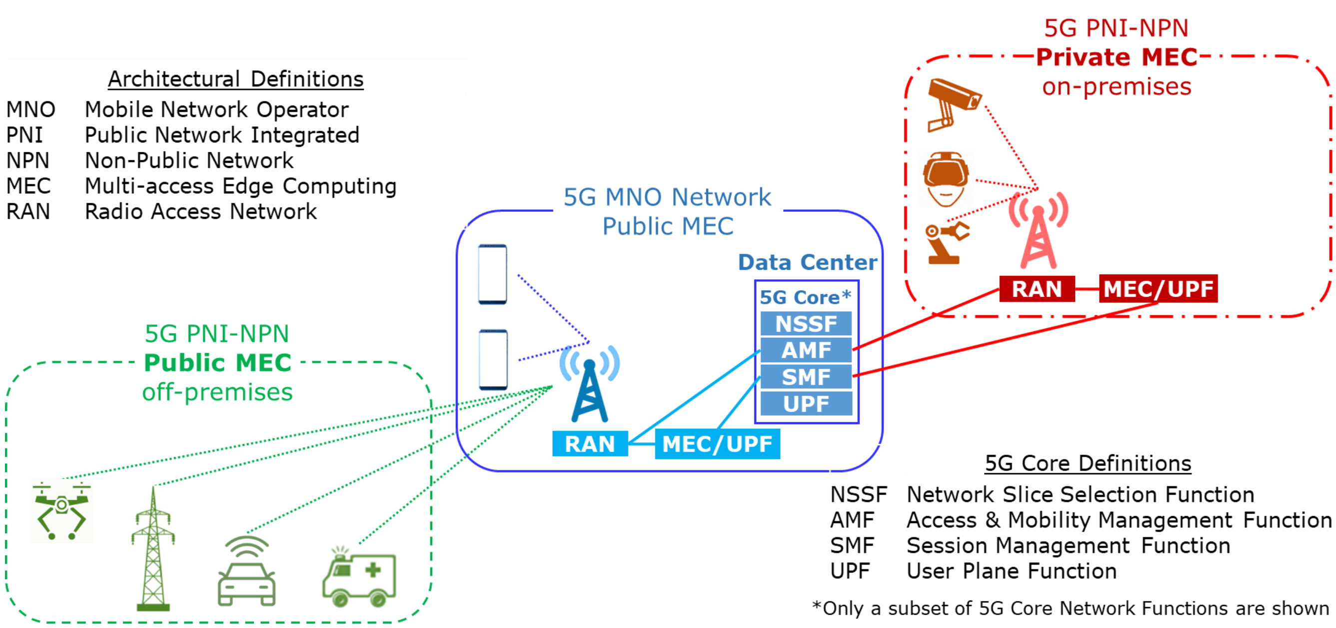
MEC is deployed at the network edge, residing between the central or regional data center and the RAN. There are two flavors of MEC: Public MEC and Private MEC.

Public MEC is part of the outdoor network of the MNO, and capabilities can be shared by everyone that has a subscription to Public MEC services. Enterprises requiring a private wireless network with broad geographic needs can take advantage of Public MEC locations. With Network Slicing, MNOs can guarantee performance with a Service Level Agreement (SLA).

Private MEC is a MEC location that resides on the premises of an enterprise. Enterprises with an on-premises MEC derive certain benefits: (1) low latency; and (2) data sovereignty, because user data remains on site. The spectrum used by the RAN can be part of the MNO's spectrum holdings or utilize the user's private spectrum license/s. The MNO derives the benefit of low backhaul costs.

The formal term used by 3GPP for these private wireless networks is "Public Network Integrated--Non-Public Networks"; the abbreviation is PNI-NPN (Figure 3).

Figure 3: Two types of MEC-enabled Private Wireless Networks Public MEC and Private MEC

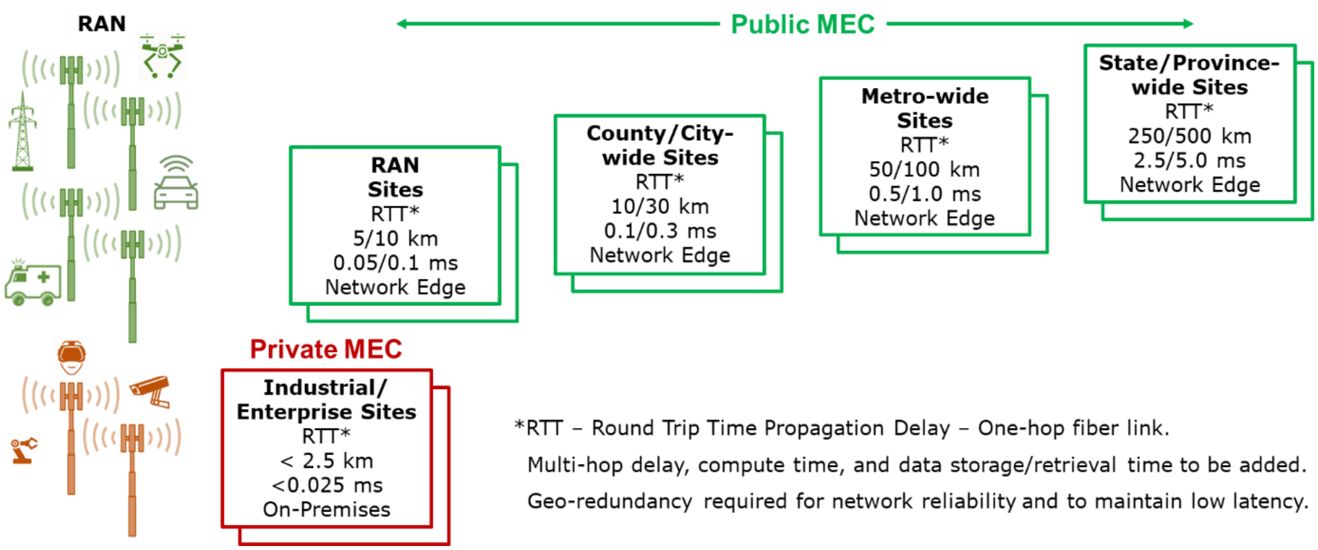


Source: Dell'Oro Group

MEC Network Topology

MEC Network Topology can have MEC sites in various locations between the DC and the RAN. Some MNOs have deployed MEC sites at the state or province level, at the municipal or county wide level, or at RAN sites. Placing an MEC site at the RAN site provides the lowest possible latency; this is the typical use-case scenario for on-premises Private MEC applications (Figure 4).

Figure 4: Moving MEC closer to the RAN site lowers latency and reduces backhaul costs



Source: Dell'Oro Group

MEC networks must include geo-redundant MEC backup sites to ensure network reliability and maintain the same low latency as the primary MEC site.

For real-time and near real-time applications, MEC sites must be located near the RAN to achieve the lowest latency possible. Some smart grid applications already require such low latency performance. In the future, other applications—such as Vehicle to Everything (V2X) and certain mission critical communications for public safety—will also require the lowest latency possible.

MNO Telco Cloud Network Architecture

The 3GPP standards body has defined the 5G Core for 5G SA networks for modern web-scale cloud deployments for the Telco Cloud, similar to the definition for a Public Cloud. This allows the 5G Core to scale capacity up or down based on a given MNO's network requirements. The primary features required to enable cloud-based deployment at the web scale level are:

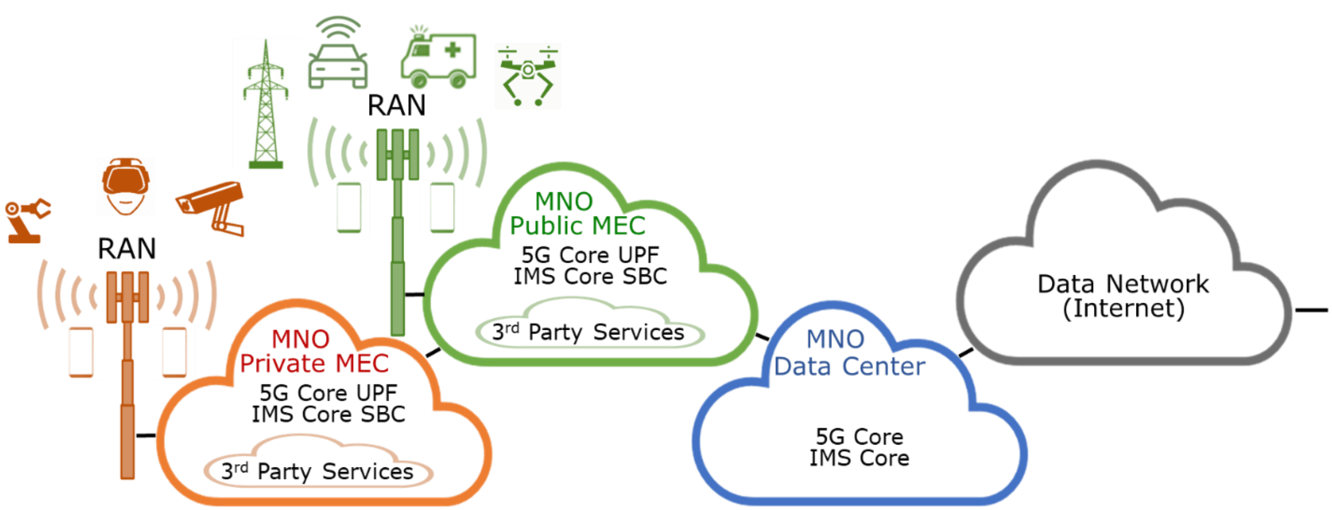
- The SBA of 5G Core network functions, which exposes a network function's capabilities to all other network functions.
- Network functions designed to be cloud-native with a separate shared data layer, control plane, and user plane (Figure 5).

In addition, more services can be delivered than previously in 4G or 3G networks. Today, 5G Core network functions are container-based, enabling microservices that can be delivered faster than ever before to certain user groups, theoretically as small as one. These network functions are known as Containerized Network Functions (CNFs).

Enterprises contract services from a wide variety of enterprise solution suppliers, including hyperscalers, to run their IT workloads. Many of these solution suppliers recognize that they can extend some existing and new services for Operational Technology (OT) workloads that require 5G connectivity.

As a result, many enterprise solution suppliers have begun to forge relationships with 5G MNOs, integrating their services into the Edge of the 5G Network space. This allows enterprise solution suppliers to bring certain services—such as Artificial Intelligence/Machine Learning (AI/ML) computing power—to the Edge, which in turn allows industries to make real-time decisions using data and video analytics that are delivered with Edge (maximum) speed and (minimal) latency. This is a win-win for both entities: 5G MNOs can offer additional applications at the Edge, and the enterprise solution suppliers can extend their services to support new, latency-sensitive applications (Figure 5).

Figure 5: MNOs Telco Cloud Networks can offer Enterprises numerous 3rd party services



Source: Dell'Oro Group

Seeking to maximize the revenue potential of the Enterprise market, several 5G MNOs are already well down the path of integrating the services that enterprise solution suppliers are pushing to the Edge into their Telco Cloud.

For their part, Enterprises may already be using enterprise solution supplier "X" for their IT workloads, and they may wish to extend their OT workloads to the same enterprise solution supplier. An MNO Telco Cloud solution would allow an MNO to provide such enterprise preferences that were previously unavailable.

MEC Market Opportunity

The 5G Core SBA in 5G SA networks brings new connectivity capabilities to the market, allowing MNOs to address new enterprise and industrial applications to generate more revenues. These capabilities include:

- Higher density of devices – 1 million IoT devices per square km for smart cities and buildings
- Edge Computing – decreasing latency for real-time and near real-time performance
- Network Slicing – customized SLAs for guaranteed performance
- New partnerships – with these new capabilities, MNOs may attract new partners that want to extend their services to 5G-connected devices to enterprise customers.

With 5G RAN with the right spectrum can address higher speed data links – addressing high-speed data intensive applications.

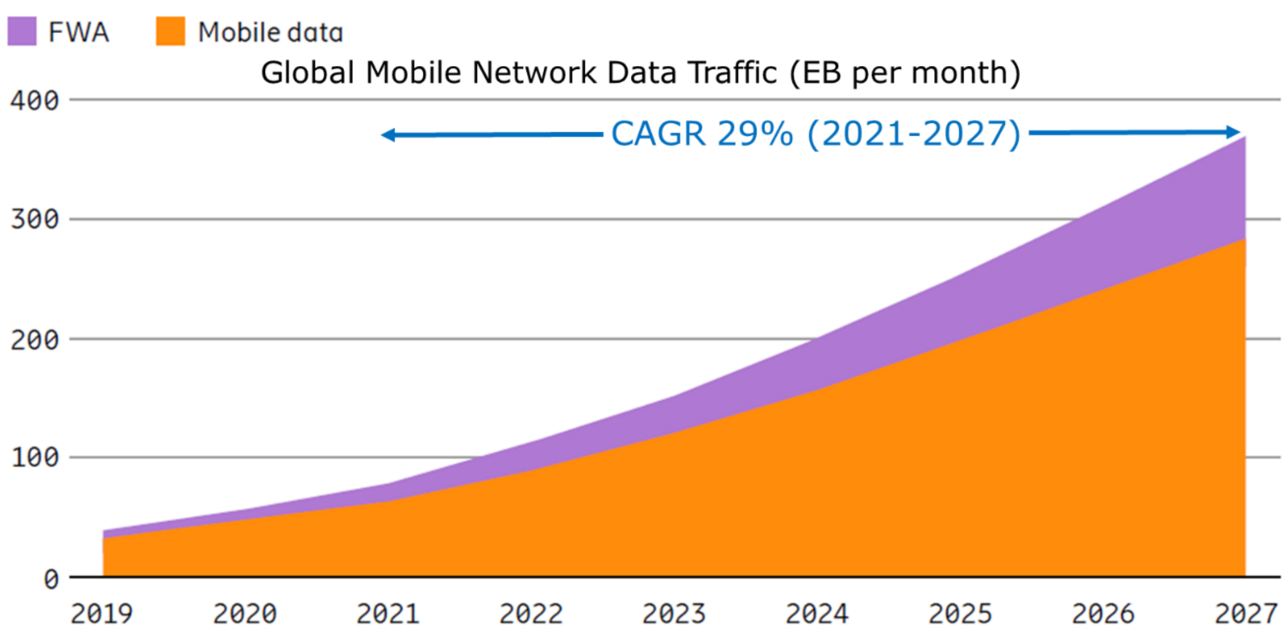
To recap from the previous section, for MNOs, MEC enables:

- Lower backhaul costs – i.e., reducing Operating Costs (Opex)
- Increased revenues – by providing new services to Enterprises with new enterprise solution supplier partners
- Reduced network latency – supporting enterprise need for deterministic communications
- Added data sovereignty – provisioning on-premises MEC sites to keep enterprises data secure.

We note again that deploying Private MEC, an on-premises solution for Enterprises, is a win-win-win scenario for all parties concerned – MNOs, Enterprises, and enterprise solution suppliers.

- MNOs may increase revenues by (1) providing new services to Enterprises, and (2) leveraging the access they gain from Enterprise solution supplier partners to Enterprises that have 5G connectivity. In addition, MNOs can lower their back-haul costs—this savings feature may become a non-negotiable necessity, given the current forecasts predicting continued substantial increases in data traffic (Figure 6).
- Enterprises benefit from lower latency communication protocols that enable new applications, data sovereignty, and access to favored supplier solutions/services for 5G applications.
- Enterprise solution suppliers will generate more revenue for enterprise solutions that offer 5G access.

Figure 6: MEC can minimize backhaul cost as data traffic increases

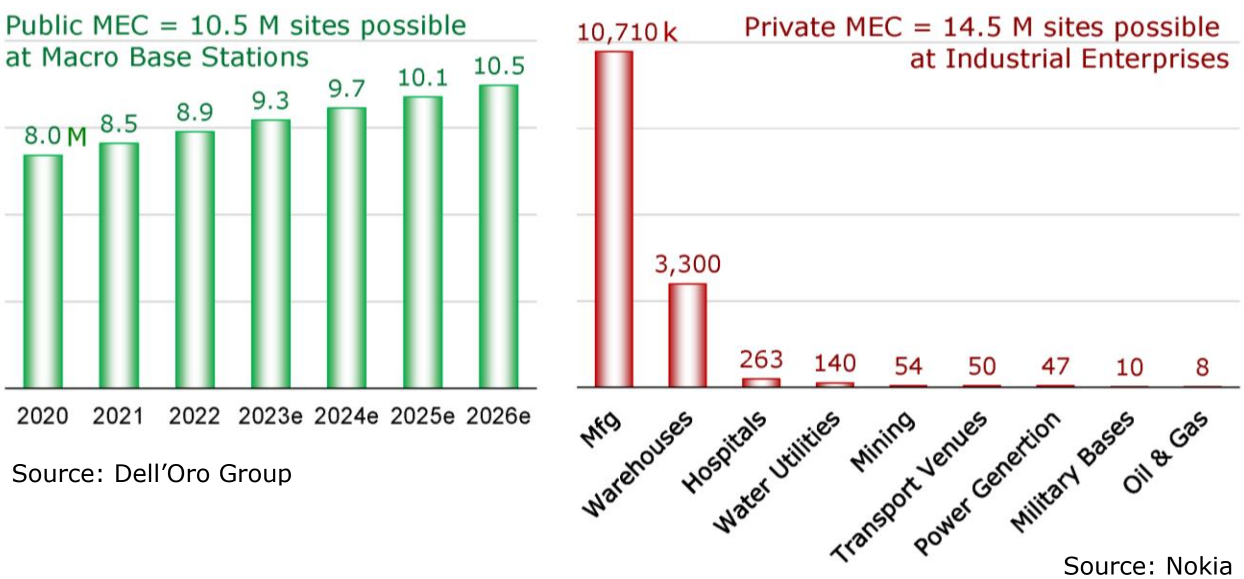


Source: Ericsson Mobility Report, June 2022

Public MEC Opportunity

To achieve the lowest latency possible, the MEC System must be located next to the Base Station. In the case of Public MEC, this would mean planting an MEC System next to every macro-Base Station site, representing a potential 10.5 million systems by 2026. This scenario would generate the maximum back-haul cost savings an MNO could realize, dramatically reducing back-haul user data traffic to and from the DC. As noted above, the market will eventually mature to this point for applications that require geographic coverage, including V2X and mission critical communications for public safety, among others (Figure 7).

Figure 7: MEC-enabled Private Wireless Networks could extend to 25 M+ likely locations



Once Public MEC Systems are widely deployed, MNOs can offer low-latency consumer applications. Many believe the on-line multi-player cloud gaming is the largest near-term opportunity. Gamers have already demonstrated their willingness to pay for better service in broadband networks.

Private MEC Industrial Enterprise Opportunity

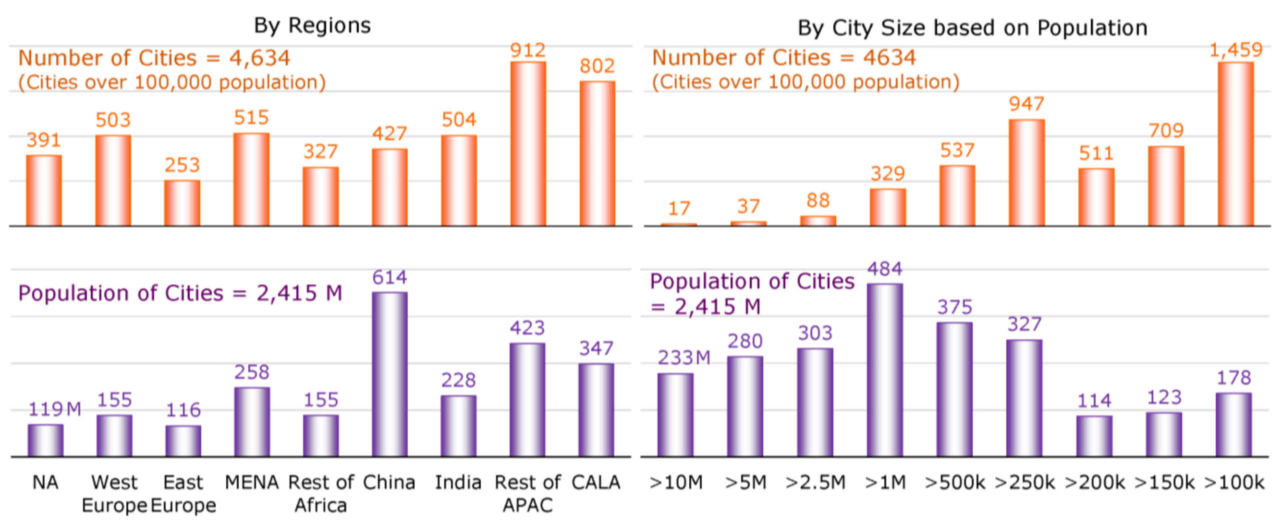
The extraordinarily robust market for supplying infrastructure and software to the MNO market is readily demonstrated—nearly 9 million installed macro-based stations are expected by the end of 2022. However, when we look at the industrial enterprise market, we see over 14 million more locations that are identified as having the potential for 5G connectivity. Any one of these could be addressed with Private MEC. Industry suppliers are laser-focused on this space, because they recognize that 5GC with MEC can meet the needs of this segment.

Smart City MEC Opportunity

Smart Cities have been identified as an opportunity that will require 5GC and MEC capabilities for many of the applications that require geographic coverage. Options to provide such capabilities will include Public MEC, some venue specific coverage will require Private MEC. Each region, state, and city is unique. Factors such as geographic size, population density, topography, climate, and even politics may affect the introduction of 5GC and MEC, which may be introduced at a different pace in one region/state/city than in another.

The data below is presented to give the reader an approximation of representative demographics. The actual number of cities in the world is greater than what we show below; current population data is not available for all areas of the world. Below, we represent a sample of 4,634 cities with a population over 100,000; the total population of these cities is 2.4 billion. We present the data by Regions and by City Size based on population (Figure 8).

Figure 8: Smart City market estimated at 4,600+ prospective cities for MEC-enabled Private Wireless Networks



Source: Dell'Oro Group

Smart Retail MEC Opportunity

Smart Retail is another important market. Retailers want to provide real-time information to customers as they shop in their stores, making suggested purchase options and pointing the customer toward the location of sale items on the shelves. Shopping malls represent an important market opportunity, with over 1,500 malls in the US, and 600 each in Germany and the UK.

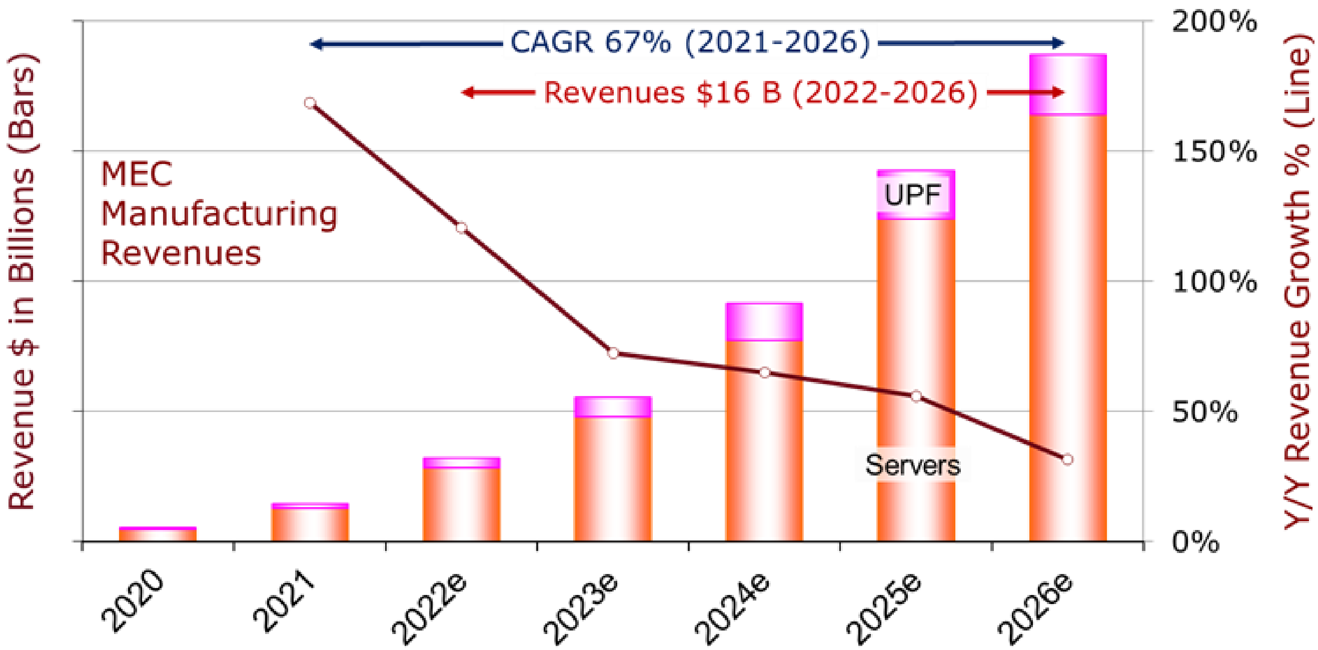
Grocery stores or supermarkets would be especially fertile ground needing some of the same applications.

Estimating the Growth Rate of the MEC Market

Dell'Oro Group has two reports that projects the growth rate of the MEC industry, and that is the forecast for UPF and Servers employed at the edge of MNOs networks. These revenues represent the investments MNOs are making in the 5G ecosystem from their respective 5G vendors. Even though this is not the total size of the market with respect of all of the elements for MEC, such as the orchestration and management software and applications services, it is an indicator of the growth rate for the entire ecosystem.

The estimated 5-year CAGR for the MEC market is 67%. As with any new technology that is just being introduced, the early years have high Y/Y growth rates, but we predict that even five years after introduction, MEC will still be growing at a healthy pace of 31% Y/Y in 2026 (Figure 9).

Figure 9: MEC market estimated to develop at a 67% CAGR



Source: Dell'Oro Group

The growth rate after 2026 also looks promising. The market is still in the early stages, and standards are still evolving. This will encourage more applications; however, such efforts will not be fully realized until after 2026.

Enthusiasm for MEC across the 5G ecosystem is high, because of the large market opportunity outlined above. MNOs, 5G vendors, enterprise solution suppliers, and application developers are all working together to bring new services to enterprises and regular consumers.

Many MNOs have created 5G Innovation Labs to demonstrate what they (the MNOs) have to offer, and to fuel an environment in which 5G vendors, application developers, and Enterprises can collaborate on solution requirements and test them in the lab.

The "whole" ecosystem for 5G vendors includes IMS Core vendors. The best way to implement Voice over 5G (Vo5G) may be to do so at the Edge. Also, standards bodies and device manufacturers are making their devices Edge aware; the tower companies are prepping sites for Edge connectivity; and the router vendors preparing for higher speed optical transport and microwave back-haul for connectivity to the Edge to address the MEC market opportunity.

There are too many MEC applications developers to list here. The applications garnering immediate attention are those that leverage AI/ML for data and video analytics; for AR/VR/MR/XR (augmented, virtual, mixed, extended reality); for autonomous driving automobiles and trucks; for security; and for Time Sensitive Networking (TSN). These applications will drive the development of industry specific solutions, including: Smart Manufacturing, Smart Cities, Smart Retail, Smart Buildings, Smart Health, Smart Education, Smart Transportation, Smart Utilities, Smart Mining, and Smart Ports.

MNOs That Are Already Utilizing MEC

MEC in South Korea

KT launched its 5G network along with eight Public MEC Systems, introducing new VR games alongside the roll-out of a 5G network. KT also plans to use MEC centers actively for the deployment of its own autonomous cars, smart factory, augmented reality, and virtual reality services.

SK Telecom (SKT) launched its 5G network with eleven Public MEC Systems. This put every user within 100 km of an MEC System. The targeted audience was the online multi-player cloud gaming community, which is a large market in South Korea. Since launching, SKT has been integrating third-party enterprise solution supplier services from Hyperscale Cloud Provider (HCP) Amazon Web Services (AWS).

MEC in US

Verizon has launched Public MEC Systems in 19 major cities, putting 75% of the US population within 240 km of a MEC System. In addition, the company has integrated AWS into all of these Edge sites, extending AWS services to 5G devices. For Private MEC, Verizon offers on-premises capability and can make AWS, Microsoft Azure, or Google Cloud services available, per the Enterprise preference.

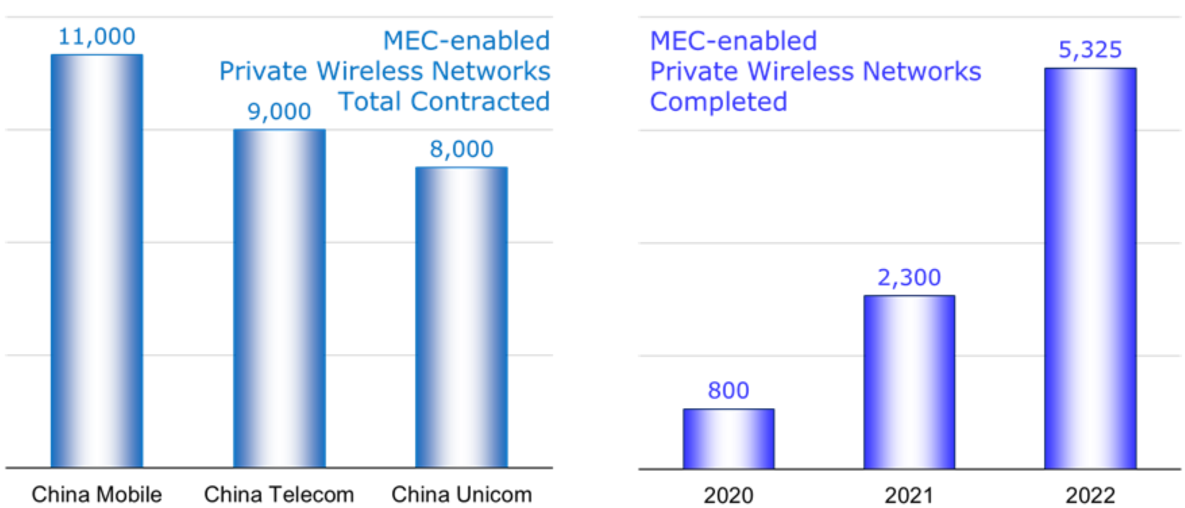
Highlighted Private MEC cases with HCPs are:

- Corning, with one of the world's largest fiber-optic cable plants, is currently experimenting with high-speed, high-volume data collection on the factory floor. Corning is also actively exploring how to apply machine learning to quality assurance and on-premises inference applications.
- Ice Mobility, a logistics and supply chain solutions company, is leveraging the benefits of on-premises MEC performance to help with computer vision-assisted product packing to improve on-site quality assurance.
- Ericsson is employing the advantages of Private MEC at its own factory in Texas. This is a proof-of-concept enterprise at its USA 5G Smart Factory. The first trial use case involves Verizon's Sensor Intelligence solution, which attaches a camera to an autonomous mobile robot that will scan packages to maintain an accurate inventory (including the location) of indirect materials in the factory's warehouse. Using computer vision, the robot will communicate the bar code and shipping label data via 5G and mobile edge, communicating with the inventory management system and providing real-time analytics to improve logistics.

MEC in China

China has aggressively deployed MEC-enabled Private Wireless Networks with Public and Private MEC locations. Collectively, 28,000 MEC contracts in various phases of deployment are being handled by one of the three Chinese MNOs, China Mobile, China Telecom, and China Unicom. Of those contracts, 5,325 were completed by June of 2022 (Figure 10).

Figure 10: MEC-enabled Private Wireless Network Trends in China



Source: China Mobile, China Telecom, China Unicom, 1H22 Interim Reports

Source: Communication Industry Network, June 2022

China Mobile

China Mobile began aggressively building a MEC network with the launch of its 5G SA network in 2020. The Company deployed Public MEC sites in all 31 Chinese provinces and, shortly thereafter, in 295 major Chinese cities, announcing the strategic objective of lowering backhaul costs and offering lower latency services. China Mobile then began to focus on Private MEC market opportunities and achieving early successes in certain market segments, in this rank order: manufacturing, mining, government, energy, ports, health, and entertainment.

China Mobile highlighted its 5G SA Private Wireless Strategy and momentum in its 1H22 Interim Financial Report. The below provides a snapshot of that report:

- Partnered with leading enterprises across various industries to create model cases
- Accelerated the transition of 5G dedicated networks from a customized to a standardized model.
- Achieved the commercialization of solutions and promoted the launch of packaged products.
- Continued the mass replication of solutions that have reinforced position the company's position as the leading 5G services provider
- Launched 300 leading 5G showcases
- Signed over 11,000 cumulative agreements for 5G commercial projects
- Started mass replicating projects across a wide range of industries:
  - 1200 Smart Factories
  - 260 Smart Mines
  - Top 10 Smart Ports
  - 1100 Smart Parks
  - 230 Smart Grids
  - 1300 Smart Hospital Partnerships
- Generated revenues for 5G dedicated networks up 223% (assuming Y/Y)

China Telecom

China Telecom highlighted its momentum in their 1H22 Interim Financial Report:

- >1,300 new contracts signed in 1H22
- New contract values grew greater than 80% Y/Y
- ≈ 9,000 cumulative projects signed
- Focusing on 15 industries, some of which are Industrial Internet, Healthcare, Smart City, Transportation, Logistics, and Education
- Focus on 5G Vision: Industrial Vision, Production Monitoring, Remote Control, Smart Factory Logistics
- Scale replication of >200 5G+smart hospital projects in aggregate
- Served >50 customers in steel industry in aggregate
- A 5G Crane application improved working conditions, efficiency 15%, and revenues 67% first Phase
- 5G+smart aircraft maintenance for an airline company:
  - PRC's first 5G application for aviation industry covering 14 provinces
  - Supports tens of thousands of maintenance workers,
  - >2,000 flights, inspection, and maintenance – efficiency up 20%
  - Project revenue up 6 times after combining with 5G customized network

China Unicom

Highlights from the China Unicom 1H22 Interim Financial Report:

- 5G industry contracts signed amounted to RMB 3.9 B
- Number of customers served by 5G virtual private networks reached 2,014
- Cumulative virtual projects re over 8,000
- Benchmark projects highlighted:
    - Textile Manufacturing
        - Applications are data collection, AI quality inspection, energy management
        - Reduced production costs 15%
        - Increased quality inspection efficiency by 20%
- Internet of Vehicles
    - Applications include vehicle road coordination, autonomous driving, and remote driving
    - An island business case increased tourist by 10% and reduced Opex costs 15%
- Smart Medical Care
    - Applications are pre-admission first aid, 5G remote medical consultation, 5G remote surgery demonstration and teaching
    - One project covered 80 facilities, increased medical consultation efficiency by 30%, and personnel covered by doctor training increased by 40%

Summary

MNOs that adopt a 5G SA Telco Cloud approach with MEC to address the private wireless market will greatly increase their revenues and drastically reduce their backhaul costs. MNOs should consider addressing MEC from day one as they plan their 5G Core strategies, so that they can capture the market opportunity that we describe above, which is projected to have a 67% CAGR over the next five years.

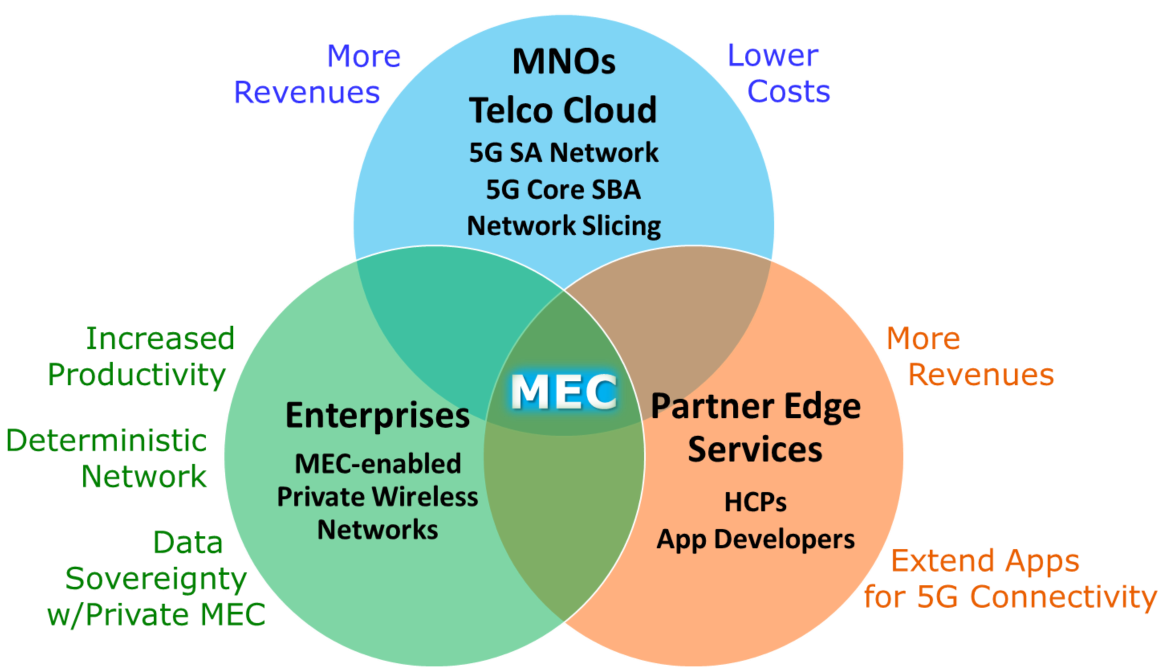
Benefits to the MNO:

1. Rising revenues from a new customer base
2. Lower backhaul costs
3. Satisfied enterprise customers

Enterprise customers are satisfied due to increased productivity, because they will have gained 5G connectivity via MEC that provides a better user experience thanks to (1) lower latencies, (2) choice of preferred solution suppliers, (3) new applications, and (4) data sovereignty for security in Private MEC deployments.

Likewise, partner edge solution suppliers increase their revenues, extending their applications for 5G connectivity uses cases. This will result in a win-win-win scenario in the MEC-enabled Private Wireless Network market for all of the players involved (Figure 11).

Figure 11: A Win-Win-Win Scenario for all Players in MEC-enabled Private Wireless Networks



Source: Dell'Oro Group

Glossary of Terms

5G DDNMF – 5G Direct Discovery Name Management Function

5G-EIR – 5G-Equipment Identity Register

AAnF – AKMA Anchor Function

ADRF – Analytics Data Repository Function

AF – Application Function

AI – Artificial Intelligence

AMF – Access and Mobility Management Function

AR/VR/MR/XR – Augmented, Virtual, Mixed, Extended Reality

AUSF – Authentication Server Function

BSF – Binding Support Function

CHF – Charging Function

CUPS – Control and User Plane Separation

CNFs – Containerized Network Functions

DC – Data Center

DCCF – Data Collection Coordination Function

EASDF – Edge Application Server Discovery Function

GMLC – Gateway Mobile Location Centre

LMF – Location Management Function

HCP – Hyperscale Cloud Provider

IIoT – Industrial Internet of Things

IoT – Internet of Things

IT – Information Technology

MBSF – Multicast/Broadcast Service Function

MB-SMF – Multicast/Broadcast Session Management Function

MBSTF – Multicast/Broadcast Service Transport Function

MB-UPF – Multicast/Broadcast User Plane Function

MEC – Multi-access Edge Computing

MEO – MEC Orchestrator

MEP – MEC Platform

MEPM – MEC Platform Manager

MFAF – Messaging Framework Adaptor Function

ML – Machine Learning

MNO – Mobile Network Operator

N3IWF – Non-3GPP Interworking Function

NEF – Network Exposure Function

NFVI – Network Function Virtualization Infrastructure

NRF – Network Repository Function

NSACF – Network Slice Admission Control Function

NSSAAF – Network Slice-specific and SNPN Authentication and Authorization Function

NSSF – Network Slice Selection Function

NSWOF – Non-Seamless WLAN Offload Function

NWDAF – Network Data Analytics Function

OSS – Operations Support System

OT – Operational Technology

PCF – Policy Control Function

PNI-NPN – Public Network Integrated - Non-Public Network

SBA – Service Based Architecture

SBC – Session Border Controller

SCP – Service Communication Proxy

SEPP – Security Edge Protection Proxy

SLA – Service Level Agreement

SMF – Session Management Function

SMSF – Short Message Service Function

TNGF – Trusted Non-3GPP Gateway Function

TSCTSF – Time Sensitive Communication and Time Synchronization Function

TSN– Time Sensitive Networking

TSN AF – Time Sensitive Networking Application Function

TWIF – Trusted WLAN Interworking Function

UCMF – UE radio Capability Management Function

UDM – Unified Data Management

UDR – Unified Data Repository

UDSF – Unstructured Data Storage Function

UF – User plane Function

V2X – Vehicle to Everything

VIM – Virtualization Infrastructure Manager

W-AGF – Wireline Access Gateway Function

About Author

Dave Bolan joined Dell'Oro Group in 2017 and is currently responsible for the Mobile Core Network (MCN) and Multi-Access Edge Computing (MEC) market research, as well as Advanced Research Report 5G Workload Moving to the Public Cloud. While at the firm, Mr. Bolan has expanded the MCN research to ensure the program is evolving to address NFV, 5G core architectures, IMS core, and edge computing. Mr. Bolan has written articles and white papers and has been widely cited in leading trade and business publications. Mr. Bolan is a frequent speaker at industry conferences and events.

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