CASE STUDY

Communications Service Providers
Multi-access Edge Computing (MEC)

NearbyComputing* Orchestrator Powers Large Scale MEC Services

Multi-access edge computing (MEC) reduces latency, which enables next-generation services, but adds significant management complexity. The NearbyComputing Orchestrator is developed to enable remote lifecycle management of Intel®-powered MEC deployments. The orchestrator has been successful in a proof of concept with Barcelona municipal police.

At a Glance

Guardia Urbana de Barcelona protects and serves a city of 1.61 million people in 10 districts and 73 neighborhoods

- 2,992 police personnel (as of 2018)
- 2012 computers first introduced into patrol cars
- 500 patrol car fleet (300 of which are hybrid or electric)

Multi-access edge computing (MEC) has the potential to enable new and advanced real-time services in today's networks. From autonomous cars to augmented reality, the low latency of MEC servers offers a new cloud computing paradigm for carriers, enterprises, and government agencies. But mass deployment of servers with complex configurations and ongoing data security needs can create a management nightmare without the proper orchestration. This was the case for the Guardia Urbana de Barcelona, which conducted a successful proof of concept that better integrated video and data services into their squad cars and smart city video cameras spread throughout the city. Intel® Network Builders ecosystem partner NearbyComputing* has developed its Nearby Orchestrator* specifically for the challenges of MEC-based services and leverages Intel® hardware to help ensure high performance of the overall solution.

The Challenge: Managing Thousands of Edge Servers

MEC servers are designed to host applications locally, reducing the internet transport travel time and latency involved in data services. MEC is a perfect fit for 5G networks, which will feature reduced latency compared to 4G services on the wireless link from the user equipment to the base station. Ultra-low-latency services, requiring sub-5 millisecond response times, such as virtual reality, augmented reality, real-time streaming media, autonomous vehicles, and others are suited to deployment on edge servers.

These services across an entire city can take hundreds to thousands of servers, depending on the city size and the services deployed. While the capital expense required for these deployments can be calculated, the operating expenses are hard to determine and could be potentially high. Beyond the physical installation costs, there are ongoing security updates, multitenancy issues, service assurance requirements, performance management, and remote deployment of virtual network functions (VNFs) that contribute to the operational expenses of the networks.

These issues make orchestration an important element of the entire solution. MEC orchestration software automates the management of a MEC server and its VNFs through the full lifecycle of a service. Once an edge server is turned on and connected to the internet, a MEC orchestrator can download, install, and configure the operating environment, install the VNFs, deploy the service, and then monitor and manage the service until it is time for it to be terminated.

NearbyComputing has taken on the challenge of developing a MEC orchestrator that features an open, API-driven platform that conforms with the MEC standard from the European Telecommunications Standards Institute (ETSI).*

NearbyComputing Orchestrator

The NearbyComputing Orchestrator allows the unified management of wireless and wired compute environments including cloud, MEC, fog, edge, and internet (see Figure 1). The software allows simplified deployment processes and life-cycle management of complex and ambitious MEC applications. The platform is deployed on Intel® processor-based servers on a customer premises or in the cloud.

Components of the Nearby Orchestrator platform include:

- **Nearby Control Plane:** Comprises a unified control and management plane for easy integration. The control plane operates deployed services, controls the lifecycle of software and hardware, and provides service assurance.
- **Nearby Blocks:** All managed entities are abstracted and managed as Nearby Blocks, utilizing standard NETCONF/YANG northbound interfaces.
- **Managed Entities:** Third-party VNFs and other resources managed as Nearby Blocks and operated by the control plane, including operating environments (bare metal, virtual machines, software-defined entities), virtualization infrastructure (Kubernetes,* OpenStack,* other third-party solutions), and network devices (vRouters, vSwitches, physical equipment).

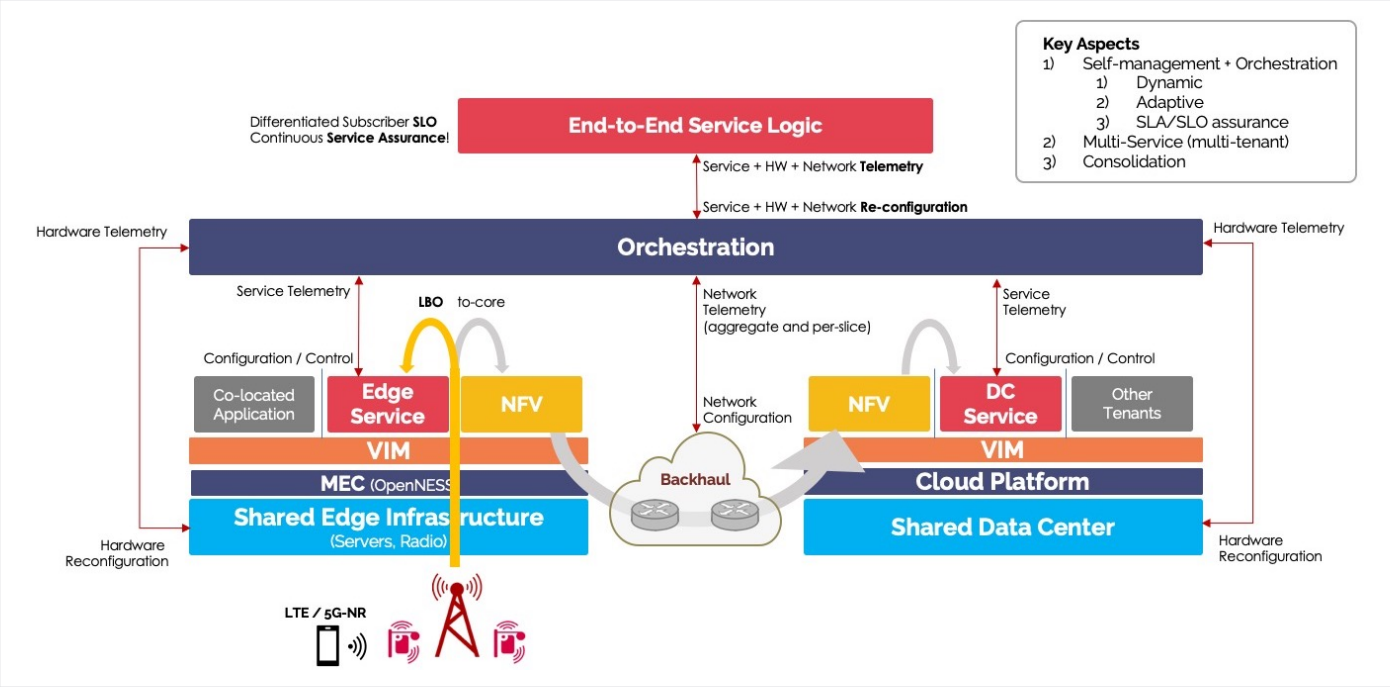

Figure 1. Block diagram of functionality of the Nearby Orchestrator.[1]

The Nearby Orchestrator infrastructural management features start by creating an inventory of network devices throughout the network edge and assigning roles to them. This can be done as new devices are deployed or the inventory can be bulk imported into the system. Next, the orchestrator can remotely boot the systems and provision their virtual infrastructure, setting up the containers and virtual machines needed to host services. Operational status is provided on an ongoing basis covering both hardware and software with the ability to re-provision services after a failure.

Once the MEC infrastructure is registered and deployed, then services automation features are able to work. First the Nearby Block is onboarded and configured, and the service deployed using AI-assisted service logic. An authentication, authorization, and accounting (AAA) server is part of the solution and provides the authentication needed to allow different tenants using the server to share data and resources securely.

There are a number of use cases where capacity varies and there's a need to automatically launch new services to meet the increased workload. The orchestrator has event user logic that lets the mobile network operator (MNO) define traffic triggers that will automatically launch the deployment of new services, or terminate service if traffic levels decrease. The orchestrator also features configuration capability for the connectors on each Nearby Block to ensure interoperability.

All of this functionality is monitored by a separate management function that provides accountability and can connect with a billing support system (BSS) for processing by the billing system.

The system is based on OpenNESS,* an Intel-developed open source edge services manager. OpenNESS offers cloud and internet of things (IoT) developers an easy-to-use toolkit that abstracts complex networking technology and exposes standards-based APIs, enabling the development and deployment of applications at the network edge.

In the NearbyComputing application, OpenNESS communicates with the orchestration engine in order to instantiate VNFs and add them to the registry. This is an important feature for the NearbyComputing product as it simplifies both hardware abstraction of an Intel® processor-server as well as providing the MEC management services.

Nearby Computing has made use of the ability to integrate other functionality into OpenNESS by integrating the OpenVINO™ toolkit of video analytics software into the solution as this supports a popular edge network application.

Smart Policing Proof of Concept

One significant proof of concept for the Nearby Orchestrator was a smart policing trial that was conducted in Barcelona, Spain, with the Guardia Urbana de Barcelona, the city's municipal police force.

The police department had a vision for improving police services by adding a server to each police car to provide access to data and to provide a variety of services, including processing video data from an onboard license plate recognition camera and from a camera in the backseat that was focused on people being held in custody.

The onboard computer—an industrial PC powered by an Intel® Core™ i7 processor communicates with smart city servers managing security cameras mounted on the streets. This would allow police personnel that are en route to a reported crime to take control of visual infrastructure in the street near their destination and see what is happening. This includes having direct control of the camera with zoom or pan functionality so they can have a complete understanding of the circumstances and environment before they arrive.

To support these compute and connectivity needs at scale requires virtualized services, and the Nearby PoC featured virtualized telemetry, cloud services routing, and camera processing software all managed by the Nearby Orchestrator.

The mission-critical nature of the system meant that remote reboot capabilities were considered critical. Going into the PoC, when an onboard computer needed repair, it resulted in the host police car being in the repair shop a day to diagnose and a day to repair. But with the Nearby Orchestrator, the computer and the apps could be rebooted quickly, sometimes without the officer knowing that it was underway.

With computers in each car and more than 3,000 street boxes required, this remote management aspect of the Nearby Orchestrator helped to reduce officer downtime, but also minimized the number of technicians needed to maintain the system—a big concern for police management. The PoC was a success and the city council is working to include this new specification into public procurement processes.

Hardware Platform

NearbyComputing Orchestrator was developed with a perspective that MEC requires resources at the edge and in the network core. The orchestrator must bridge both domains. Optimizing for Intel® technologies enables seamless deployment on a wide range of CPUs that might be used in differing locations.

In the data center and at large edge locations, Intel® Xeon® Scalable processors deliver data center processing performance. These processors feature an open architecture that scales and adapts with ease to handle the demands of emerging applications. The platform provides a future-ready foundation for agile networks that can operate with cloud economics, be highly automated and responsive, and support rapid and more secure delivery of new and enhanced services.

At the edge, Nearby often prefers servers featuring Intel Xeon D processors because they offer a good balance of performance and power efficiency. These innovative, system-on-a-chip (SoC) processors support high-density, single-socket network, storage, and cloud edge computing solutions with virtualization support and a range of integrated security, network and acceleration capabilities. The low power draw has helped the company to experiment with utilizing solar and wind in some outdoor locations.

Intel® Rack Scale Design

Nearby is able to extend its orchestration to interface with Intel® Rack Scale Design (Intel® RSD)-based servers. Intel RSD specifies the rack, compute modules, hard disk storage modules, FPGA modules, networking modules, and other resource modules that can be logically assembled as a composed node. The resources in the composed node are connected to each other within the rack using high speed, low latency interconnects, such 100 Gbps Ethernet. Each resource can be scaled up or down to meet the need of the service, offering significant flexibility compared to servers with fixed resources. The Nearby Orchestrator utilizes NETCONF/YANG to abstract an Intel RSD node, accessing the resources in that node and configuring them for use in a service. This can be a convenient way for a CommSP to deploy a compute-heavy application such as accelerated video analytics that make use of Intel® Arria® 10 FPGA-based programmable acceleration cards.

Vision processing is another use case where the Nearby orchestrator can access Intel resources, specifically Intel® Movidius™ Vision Processing Units (VPUs), which are specialized processors for computer vision applications that combine highly parallel programmable compute with workload-specific hardware acceleration.

Conclusion

From smart city services to new mobile gaming apps, MEC is an enabling technology for services that will have a big impact. But as seen with the complexity of the Guardia Urbana PoC, orchestration provides the ability for MEC to operate smoothly and with minimal operational resources. The NearbyComputing Orchestrator, utilizing Intel® technology, offers the orchestration functionality required for these applications.

About NearbyComputing

NearbyComputing aims at developing advanced end-to-end orchestration services that expand all the way from the cloud to the edge of the network. These services allow for both companies and public institutions the automation of computing processing in the edge for the IoT and 5G networks. It provides personalized services for different MEC (Multi-access Edge Computing) and Fog Computing scenarios, computer technologies which will be key to the future development of 5G and IoT. The solutions will combine different products of commercial software and the integration of hardware and software components. More information is available at https://www.nearbycomputing.com.

About Intel® Network Builders

Intel® Network Builders is an ecosystem of infrastructure, software, and technology vendors coming together with communications service providers and end users to accelerate the adoption of solutions based on network functions virtualization (NFV) and software defined networking (SDN) in telecommunications and data center networks. The Intel® Network Builders Edge Ecosystem is a new initiative gathering ecosystem partners with a focus on accelerating network edge solutions. As an integral part of the broader Intel Network Builders program, this initiative aims to facilitate partners' access to tested and optimized solutions for network edge and cloud environments. Learn more at https://networkbuilders.intel.com/networkedgeecosystem.

[1] Image provided courtesy of NearbyComputing.