Getting close to you: MEC@CloudEdge

Mobile Edge Computing (MEC) architecture positions network functions and third-party applications at the network edge, enabling application, content, and network orchestration. Processing services closer to the user also provides users with better-quality services.

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User expectations on service experience have risen in tandem with wireless network speeds. Meeting this higher demand requires a new kind of architecture and service delivery method – one that can deliver more exciting services.

This new architecture is MEC, service solutions for which were demonstrated at MWC 2016. Huawei's MEC@CloudEdge is a 5G-oriented MEC solution.

From flat to edge

Mobile networks have evolved with less service processing nodes and delayered architecture. In the 2G era, users had to pass through the base station, base station controller, SGSN,

and GGSN, before connecting to the Internet, making already sluggish Internet speeds even slower.

By the time mobile networks entered the LTE era, network architecture was largely delayered and Internet access had been simplified into a two-hop system. To access Internet services, a user could connect straight from the base station to the core network gateway, greatly improving experience.

However, we're now in the 5G era of ultra-low latency, ultra-high bandwidth, and large-scale IoT service requirements from different industries, requirements that current network architecture cannot meet.

Low latency at the network edge

Since mobile networks first supported data services, each new generation of mobile technology has aimed to improve network throughput to enhance user experience. As throughput has increased, Internet connection speed is no longer a bottleneck for experience, with latency becoming the key factor affecting user experience.

Research on the application side shows that, for high quality, video services have extremely high latency requirements. For example, augmented reality (AR) and virtual reality (VR) video services require latency of below 20 ms, with latency any higher for the latter causing VR sickness. A service objective tied in with 5G is E2E latency of 1 ms to support the demands of services such as Internet of Vehicles (IoV) and industrial control.

However, current mobile technology can't minimize latency. With LTE, for example, air interface throughput is increased tenfold, but E2E latency is improved only threefold due to sub-optimal network architecture.

Although LTE networks possess two-hop flat architecture, the base station and the core network are often separated by hundreds of kilometers, with multiple aggregation and forwarding devices deployed in between. Add unpredictable congestion and jitter to the mix, and it's impossible to ensure ultra-low latency on LTE networks.

To support services with very strict latency requirements, it's necessary to move network functions and service processing functions to the edge of the network, closer to the user. This reduces the number of intermediate layers, enabling low-latency service processing.

Content localization for ultra-high traffic

Current mobile networks were designed for voice services. Network architecture adopts a tree structure, where services are converged at central nodes to be processed. This allows for frequent service concurrency and transmission efficiency.

But, with MBB services, this kind of network architecture can encounter problems. For example,1,000 users watching a 10 MB viral video would produce 10 GB of network traffic because the content is re-transmitted from the Internet to the mobile network 1,000 times. Therefore, 99.9 percent of the network bandwidth used is wasted. So, caching the video in an edge node close to the access point would save the carrier a huge amount of transmission bandwidth.

As air interface throughput is greatly increased and network traffic continues to grow, network-side inefficiency will increase, making content localization essential.

What verticals need

Mobile broadband networks are becoming the basic platforms for office work and marketing, with companies expecting customized networks to meet their specific needs. Some, for example, want data access to the private cloud to be completed within their enterprise campus networks to ensure mobile office security, meaning that network functions must be deployed on the campus network and support local breakout. Another example

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is the idea of smart billboards proposed by a Korean operator for smart crowd analysis based on network data – the local content changes to increase the advertising conversion rate. This kind of service requires a localized, open network platform.

5G edge cloud with MEC@ CloudEdge

In Huawei's 5G-oriented MEC solution, MEC@CloudEdge, applications, content, and some MBB core network service processing and resource scheduling functions are deployed at the network edge, closer to the access point. This enables both services to be processed closer to the user and also application, content, and network orchestration. As a result, users are provided with reliable, ultimate service experiences.

MEC@CloudEdge: Deployment scenarios

Experience and efficiency must be balanced for deployment. Deploying the solution closer to the base station side requires fewer intermediary nodes, which improves experience. But, it also means there will be fewer users accessing the node, reducing utilization.

Deployment location needs to consider scenario-based service requirements. For example, some enterprises want private cloud data access to be completed within their enterprise campus networks, requiring the solution to be deployed within their campus network. For sports stadiums that provide live playback, interaction services, online purchasing, and location services for match-goers, the solution would need to be deployed in the stadium.

Based on service requirements and resource efficiency, these demands mean that MEC@ CloudEdge should be deployed between the edge of the metropolitan area network (MAN) and the base station. This might include central offices (CO) and a number of specific venues and campuses.

MEC@CloudEdge: Main functions

To meet service requirements, MEC@ CloudEdge offers the following main functions:

End of the user plane: runs core network functions such as billing and policy, and meets requirements for billing, monitoring, mobility, and O&M.

Local Breakout (LBO) for services: uses LBO functionality to support localized content and application processing, so the user can directly access local content via MEC without routing to the central core network gateway.

Third-party application registration and management: supports third-party application integration, including registration, discovery, and unified management on tasks like resource scheduling and health checks. This allows network functions to be expanded and third-party services to be customized, as well as service traffic and content awareness and orchestration, so services can be optimized to improve experience.

Network function sharing: provides an open platform for services to be customized for verticals and enables flexible third-party service deployment. With an open platform, internal network capabilities are shared, making seamless integration with third-party services possible.

MEC@CloudEdge: Solution structure

MEC@CloudEdge is based on Huawei's CloudEdge platform. It can be deployed on the same hardware, with third-party applications based on general servers. The solution can share network functions to support new service innovation for operators, and enable on-demand modular deployment on the control, user, enabling, and management planes.

MEC@CloudEdge: Key technologies

MEC tech used to be constrained by platform sharing technologies and commercial factors before actual deployment. But now, the maturity and application of NFV technology has prompted the industry to develop standards for MEC and carry out R&D on MEC solutions.

MEC@CloudEdge's main enabling technologies include:

NFV and cloud technology to support multi-tenancy: NFV technology supports multiple tenants on the MEC@CloudEdge. It also enables co-platform deployment and unified resource management on gateway functions and third-party applications. However, as the deployment location is lower using NFV, node capacity is relatively small. This means using NFV alone cannot ensure the reliability and performance provided by large-scale DCs.

Therefore, it’s necessary to introduce cloudified software architecture on top of NFV, so software functions can be decoupled and deployed as layers based on the properties of the different capabilities. This enables high reliability, high flexibility, and high performance when resources are limited.

CU separation for flexible deployment of network functions: When MEC@CloudEdge is deployed close to the access point, core network gateway functions are distributed at the edge of the network. This creates a large amount of interface configuration, connection, and commissioning. Thus, the core network’s control plane and user plane must be separated to allow the gateways to be flexibly deployed and to simplify the network.

Separating the Gateway CU strips away the complex control logic of the gateway. Gateway functions are retained on the traditional central gateway or integrated into an integrated control plane, lowering deployment costs and resolving problems with circuitous signaling routes and the burden on the interface.

Gateway CU separation first requires making the functions lightweight and stripping away complex control logic functions. Next, the basic core functions that are retained are modeled, and the common forwarding plane models and object-oriented interfaces defined. The forwarding plane is then programmable with excellent scalability. Once the complex service functions are stripped away, lightweight configuration is implemented to support one-click deployment.

Service awareness and smart orchestration: To enhance user experience, MEC@CloudEdge supports real-time service awareness and intelligent experience optimization. When, for example, wireless network quality degrades, MEC@CloudEdge can sense the user's video bit rate and send the traffic to a video optimization module, where the video stream is re-encoded, ensuring smooth video for the user.

As MEC is deployed on mobile networks, a number of exciting new functions for work and leisure will emerge. These include MCDN-based HD video experiences; AR/VR-based mobile games; LBS marketing; and secure, reliable LBO-based enterprise mobile office; smart stadiums based on MCDN and open platforms; and traffic assistance systems for IoV. These new technologies will transform life in ways we cannot yet imagine.