Powered by SA: 5G MEC-Based Cloud Game Innovation Practice

China Mobile & ZTE

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5G MEC-Based Cloud Game Innovation Practice

Introduction

This document describes how cloud games are distributed from Public Cloud to the local MEC (Multi-Access Edge Computing) in China Mobile's 5G network. MEC integrates traditional cellular telecom networks with Internet services to reduce end-to-end latency of user service interaction and improve user experience by exposing the capabilities of mobile networks. With respect to cloud games, MEC requires not only communication network capability, but also cloud computing capability. Therefore, MEC is the best model of ICT (Information and Communications Technology) technology integration. In addition, the low-latency slices of a 5G network provide high-bandwidth and low-latency capabilities for cloud games. Cloud games are distributed to the local MEC, the local MEC accelerates the rendering of images and directly sends the rendered media streams to terminals. Thus, MEC achieves traffic offloading, optimizes network bandwidth usage and reduces latency. The game players can enjoy a 4K and 60 frame rate ultra-HD experience without downloading the games. The measured rate is 40Mbps, and the RTT (Round Trip Time) latency is 10-20ms.

Based on the innovative practice of cloud games in 5G MEC, the PaaS (Platform-as-a-Service) capability and IaaS (Infrastructure-as-a-Service) capability exposure function of China Mobile's MEC mobile network can be verified. This could speed up the adoption of edge computing in the deployment of public cloud services, as well as enabling the edge network to transcend from the access pipe to the platform-enabling information service. The progress made in the testing of cloud gaming with high network requirements could facilitate more industrial applications and better serve the enterprise users, thereby stimulating more 5G innovation within vertical industries.

China Mobile

As the leading telecommunications service provider in Mainland China, China Mobile Group provides full communications services in all 31 provinces, autonomous regions and directly-administered municipalities throughout Mainland China and in Hong Kong Special Administrative Region, and boasts a world-class telecommunications operator with the world's largest network and customer base, a leading position in profitability and market value ranking. Its businesses primarily consist of mobile business, wireline broadband and other information and communications services. As of 31 December 2018, the Group had 459,152 employees, 1.633 billion connections and annual revenue of RMB 736.8 billion.

ZTE

ZTE Corporation is a global leader in telecommunications and information technology. Founded in 1985 and listed on both the Hong Kong and Shenzhen Stock Exchanges, the company has been committed to providing integrated end-to-end innovations. The company endeavours to deliver excellence and value to consumers, carriers, businesses and public sector customers from over 160 countries around the world to enable increased connectivity and productivity.

Trend: Services move to the edge, computing converges on the edge.

MEC (Multi-access Edge Computing), an edge cloud platform, provides a new network architecture together with the operator network, with the data plane function as a key focus. It uses the mobile

access network to provide IT services and cloud computing functions for users near the edge, thus creating a carrier-class service environment with high performance, low latency and high bandwidth. With these features, consumers can enjoy a high-quality service experience.

With the growing digital and intelligent computing requirements for terminals, terminal costs are increasing rapidly. Terminal computing is fundamentally limited by power consumption, costs, and space, and moving to the cloud can overcome some of these limitations. On the other hand, cloud computing capabilities cannot meet real-time service requirements, therefore services need to move to the edge. Taking into consideration costs and performance advantages, computing will ultimately converge at the edge.

Typical services include cloud games based on cloud computing. In cloud game operation mode, all games run on the cloud server, and the rendered game images are transferred to users through the network. Compared with traditional game modes, cloud games can greatly reduce user equipment costs. However, the interaction latency of cloud games heavily depends on the network communication latency. The multimedia transmission of cloud games is very sensitive to the network latency. When the network communication quality is poor, players immediately experience high latency between their input and the update of output images, which significantly degrades the quality of experience. The quality of multimedia streams rendered in game scenarios also depends on the network communication bandwidth. It is possible to take advantage of 5G networks, such as low latency, high bandwidth and bearer jitter, in this context. When cloud games are deployed near the user, it is possible to reduce transmission latency and improve the cloud game service experience.

China Mobile's 5G MEC-based cloud game innovation practice

To speed up the commercial implementation of MEC, China Mobile, together with ZTE tested cloud games in the 5G environment, providing a potential applications for 5G MEC.

This innovative cloud game practice was demonstrated in the 5G pilot network deployed in Guangzhou, by China Mobile's Guangdong Branch, with ZTE's commercial 5G end-to-end system solution encompassing 5G base stations, 5G core networks, MEC platforms, and test terminals. The cloud game providers provided Edge Cloud Game Connector to enable cloud games to be moved to the edge. The architecture for 5G MEC-based cloud game solution is as follows:

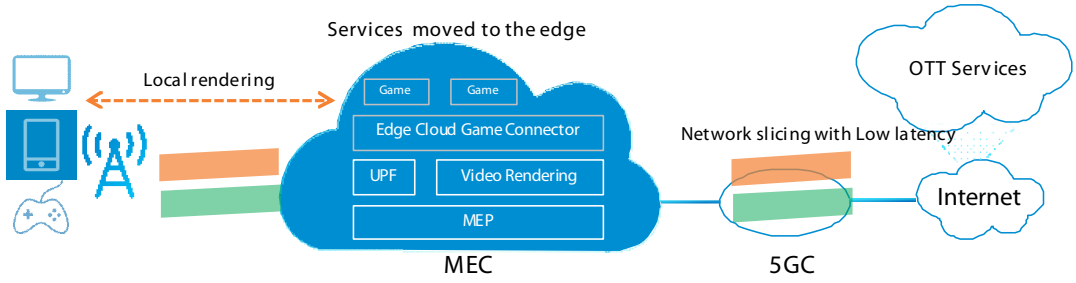

Figure 1. 5G MEC-Based Cloud Game Architecture

MEC capability exposure

5G Core UPF (User Plane Function) is moved to the local MEC in order to implement traffic offloading of cloud games. The MEP (Multi-access Edge Platform) provides network capability exposure for cloud games, and RAN awareness capability exposure, including RNIS (radio network information service), TCPO (TCP Optimization) service, and VO (Video Optimization) service. It also provides network layer PaaS capability exposure for optimization of cloud games. In addition, the lightweight edge cloud provides cloud games with VM (Virtual Machine), containers, bare metal resources and acceleration capabilities. It dynamically allocates resources in accordance with game loads, and schedules resources on demand to implement resources sharing and fully exploit valuable edge resources.

Low latency slicing

Combined with the Slicing Channel bearer technology developed by ZTE, it is able to customize bearer bandwidth, latency, isolation and guarantee level on demand. Through priority scheduling and channel self-adaptive coding control, the uplink and downlink rate and latency requirements of slices are guaranteed, and network slices with high bandwidth and low latency are provided for cloud games to further reduce cloud game latency.

Cloud-edge coordination

The cloud game providers provide Edge Cloud Game Connector in the MEP PaaS to realize seamless coordination with edge network and cloud services, enabling on-demand distribution of cloud games from cloud to the edge. The cloud game accelerates image rendering on the MEC, which directly sends the rendered media streams from terminals. By implementing local MEC offloading, network bandwidth usage and latency can also be reduced.

Economic Benefits

Cloud games based on 5G MEC and low-latency slicing operate smoothly. The game players can enjoy a 4K and 60 frame rate ultra-HD experience without downloading the games. The test result is 40Mbps rate and RTT latency 10-20ms.

The advantages of this solution are as follows:

Reduced latency: Cloud game services are deployed on the edge of the submerged network with local rendering and short transmission distance. Combined with low latency slices, the transmission guarantee for low latency is possible. The RTT latency is reduced from 120ms to less than 20ms, which significantly improves the user experience.

Saving transmission cost: The cloud game needs to render the video at the cloud and then send the rendered video to the game terminal. Each game terminal occupies up to 30M transmission resources. With MEC deployment at the edge, a cloud game only needs to send a game control instruction from the cloud to the MEC, rendering the video on the MEC and sending the video stream to the terminal. It takes only a few thousand transmission resources. The MEC-based cloud game solution can greatly save the transmission resources from MEC to 5GC, and the bandwidth can occupy less than 1/1000.

Lowering entry barriers for players: Video rendering of MEC-based cloud gaming is implemented at the MEC edge, greatly reducing the requirements of cloud games for terminal performance as only encoding/decoding is done by the terminal. A player can play games directly on existing devices without paying for better performance terminals, significantly reducing the cost of game promotion and customer acquisition. In the 5G era, a large number of services that can currently only operate on a PC (Personal Computer) can be migrated to mobile phones.

Figure 2. Economic Benefits

Summary

MEC is both a resource computing platform and a mobile network capability platform. By integrating the mobile access network with Internet services, it not only improves user experience and saves bandwidth resources, but also supports the deployment of computing capabilities in the network edge to integrate a third party's applications, enabling service innovation at the mobile edge.

The cloud game test proves that public cloud services such as OTT (Over-the-top) implemented in MEC at the edge significantly reduces latency, improves user experience and reduces transmission costs. However, it not only requires a large amount of investment, but also burdens maintenance difficulties for Internet enterprises to build a large number of edge data centers. China Mobile already has a large number of edge data centers all over the nation. China Mobile can directly expose PaaS capabilities of infrastructure and mobile networks to third parties, accelerating service innovation in the 5G vertical industry and avoiding duplication of investment.

The key capabilities of China Mobile are the network connection of the MEC platform, the computing power, and network capability and its exposure. Through the MEC platform, services are deployed in the edge of mobile networks, and China Mobile is able to transform itself from being an access pipe provider to being the information service enabler.

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