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China Telecom: Network as a Service Strategy and development layout Network Economics: Operator Case Study

June 2024

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China Telecom: Network as a Service Strategy and development layout

The case study of "China Telecom: Network as a Service Strategy and development layout" will introduce the blueprint of China Telecom's Network as a Service strategy, some typical API cases including solutions, implementation measures, challenges and results of Network as a Service.

Introduction

Network as a Service (NaaS) has been a hot topic for telecommunication operators for a long time. With the increasingly evident one-stop information service orientation of operators, NaaS plays an important role in the enterprise digital transformation strategy. NaaS provides an open, standardized, application programmable interface (API) for the communications industry, allowing developers to quickly access networks and accelerate the development of digital services and applications enabling on-demand service activation and customer self-service. NaaS enables operators not only to open network programmable capabilities to their own IT teams, but also to external developers and potential enterprise customers, which helps to make new services and business models possible.

In 2023, China Telecom explicitly proposed the value-based capability exposure as one of the key capabilities for China Telecom Cloud and Network Operating System (CNOS). The China Telecom CNOS is customer-demand-oriented, focusing on differentiated network capabilities including connectivity capabilities, network perception and analysis capabilities, network and cloud convergence capabilities, and integrating technologies such as AI and network large language models, in order to provide intent-based service APIs for external simple and flexible invocation. China Telecom will serve as the leading smart provider to open a smart connectivity service capability, as a comprehensive platform provider to ensure safe and flexible capabilities by establishing an integrated capability opening platform to make the content and applications more widely popularized through capability embedding in applications.

Top level design of NaaS

In order to meet the operational requirements of the new type of ICT infrastructure oriented to the integration of cloud and network, China Telecom established a universal operating system - CNOS, to provide the core intelligent brain of the cloud and network infrastructure, so as to drive the leapfrog development of the new type of ICT infrastructure.

The CNOS shields the underlying differences and complexity of the infrastructure, proposes the full-stack multi-core hyper-converged architecture FSCCA, supports the full-stack perception and management of multiple elements (e.g. cloud, network, data, intelligence, and security) as well as the integrated services.

As shown in Figure 1, the architecture of the CNOS includes the orchestration layer, the service layer, and the NaaS layer. The NaaS layer breaks through the barrier between the cloud and network capabilities and the internal and external customer requirements. It realizes the unity of processes, standards, mechanisms, and management, integrating the customers, products, networks, and cloud into a unified process, so that the value-added and standardized products of the cloud and network capabilities can be quickly delivered and put online. In order to meet the needs of internal systems and external developers, the NaaS layer encapsulates specific cloud and network capabilities, empowering customers through various modes such as APIs, SDKs and SaaS, helping customers to realize application innovation and digital transformation.

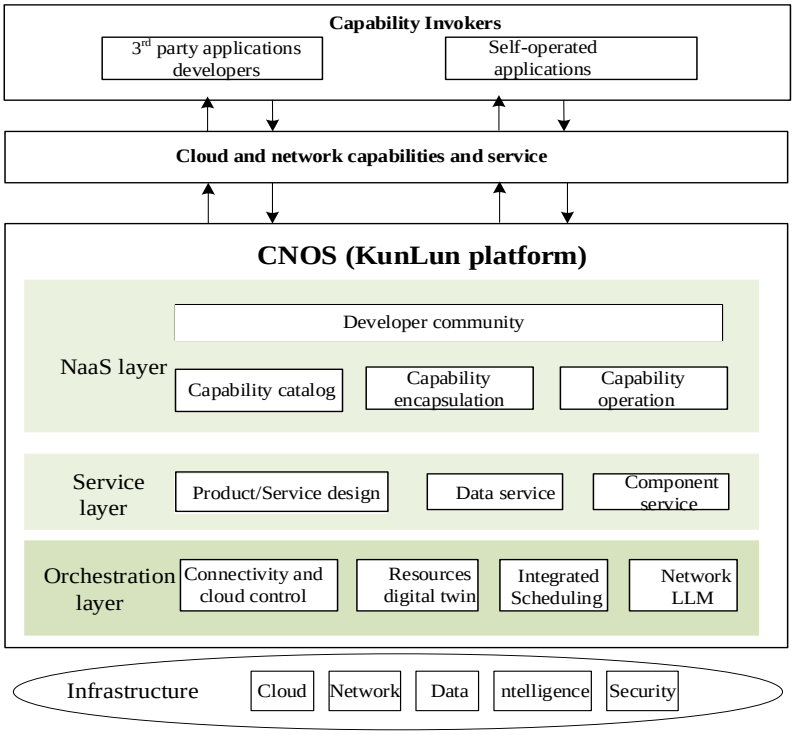

Figure 1 Architecture of China Telecom CNOS and NaaS service

The China Telecom CNOS framework concept is consistent with OPG reference model and the GSMA Open Gateway initiative. The resource layer management inside the operator realizes the support and guarantee of network API capabilities. Through the unified open environment, the north provides simple service calls to application developers, and the east and west supports the capability calls between operators.

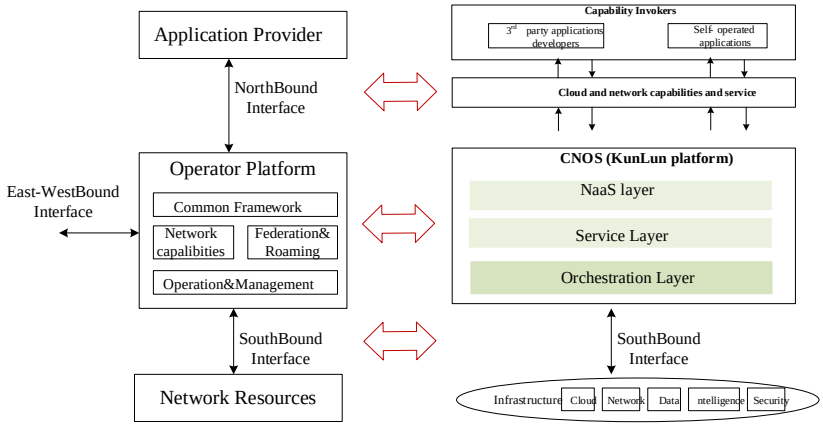

Figure 2 Relationship between OPG reference model and China Telecom CNOS Framework

China Telecom Use case study

China Telecom QoD solution

This section presents examples of how China Telecom implements the QoD API to serve different consumers and enterprises needs.

Background

With the vigorous development of the social media industry and the continuous growth of the mobile game market, the demand of mobile users for specific network quality is also increasing. How to ensure the functional use of various apps under low latency has become an important indicator to improve user satisfaction. Through market research, we discovered the increase of urgent demand of enterprises for mobile network guarantee. In April 2024, China Telecom's 5G users reached 287 million. With the popularization of 5G networks, the demand for QoD API capability has become increasingly evident to provide bandwidth guarantee services for mobile users of various Internet enterprises.

Challenges

The experience with some online gaming applications shows that when the user delay is less than 75ms, the user perceives the experience as satisfactory, otherwise when the delay is greater than or equal to 100ms, the user can obviously feel the application is stuck and has a poor perception. According to the statistics of Tencent Games, 30% of the users' delay is greater than 75ms, 15% of the users' delay is greater than 100ms, of which 86% of the high delay is related to the air interface.

Solution

Through 4G/5G QoD services, users can obtain a network service with the required delay, upstream and downstream network bit rate, packet loss rate, etc. From technology implementation aspect, it is needed to realize flexible parameter configuration, that is to establish the bearer which usually requires multiple parameters to work together, including QCI, ARP, GBR, MBR, and so on. QCI indicates the identifier of QoS service level, ARP indicates the priority of allocation and reservation, and GBR and MBR indicate the minimum guaranteed bandwidth and maximum allowed bandwidth of the network policy. GSMA Open Gateway provides a standardized QoD API, with the benefit of

using standardized QoD definition, we provide a dual-stack solution, which means providing new customers with GSMA Open Gateway QoD API calls while avoiding minimal changes for original customers.

Typical use cases

Tencent Games

For online multiplayer games, such as Honor of Kings, players may often experience network latency and stuttering issues in the following scenarios.

Scenario: Player A is located in Jiangsu province, while the server is located in Guangdong province. Due to network latency and bandwidth limitations, communication between Player A and the server may be affected. In a game, this can be in the form of a delay in character movement, a delay in skill release, or screen stuttering.

— Character action delay: When player A clicks to move or release a skill, the action is not immediately responded to, which reduces the playability and leads to frustration and disappointment for the player.
— Game screen stutters: The game screen stutters on Player A's screen, causing the character's movement to appear inconsistent, which reduces the fluency of the game experience and can cause the player to miss key actions or be easily defeated by enemy players.
— Sensitivity: A player's sensitivity to a stutters varies from person to person, but in general, most players will be unhappy if the stutters are so severe that it interferes with the core gameplay of the game, such as not being able to dodge enemy skills effectively or not being able to fight back accurately. In addition, frequent delays can reduce the gameplay, affect the user experience, and may even cause some players to abandon the game.

Figure 3 Quality of experience of game players

Solution: QoD is a good solution to handle the pain points in games by adapting the network configuration to meet the requirements of games and thereby reducing network latency and stutters. For example, QoS policies can be configured on the network devices to ensure real-time and fluency for players in the game. QoD services enable Tencent Games customers to select different policies based on actual service requirements and achieve the expected effect through API calling

by flexibly configuring different parameters. Especially, in crowded environments, using QoD service by assigning appropriate bandwidth, delay, jitter and other parameters enables the performance of the games applications and user experience.

After applying QoD, Players may experience reduced network delay and stutters, and a smoother gaming experience. Measurements shows that the rate of network stutters decreased by 10%-20% with QoD, thus the character operation response is more timely, the screen stuttering phenomenon is reduced, and the player can enjoy the game better.

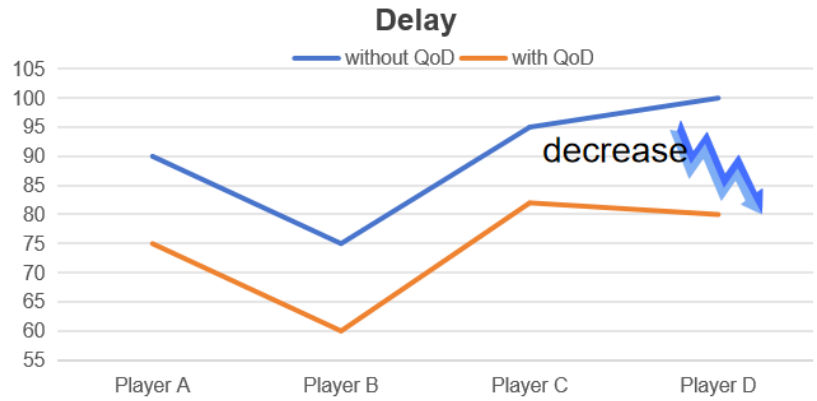

Figure 4 Delay decrease of game with QoD and without QoD

The application of QoD API in Tencent "King of Glory" Games shows that the acceleration effect of the national players is obvious, and the average proportion of no stutters increases by 42%; After QoS optimization, for the users with air interface delay of 200-300ms, the proportion of no stutters improved by 29%- 56% while the proportion of serious congestion decreased by 39%- 43%.

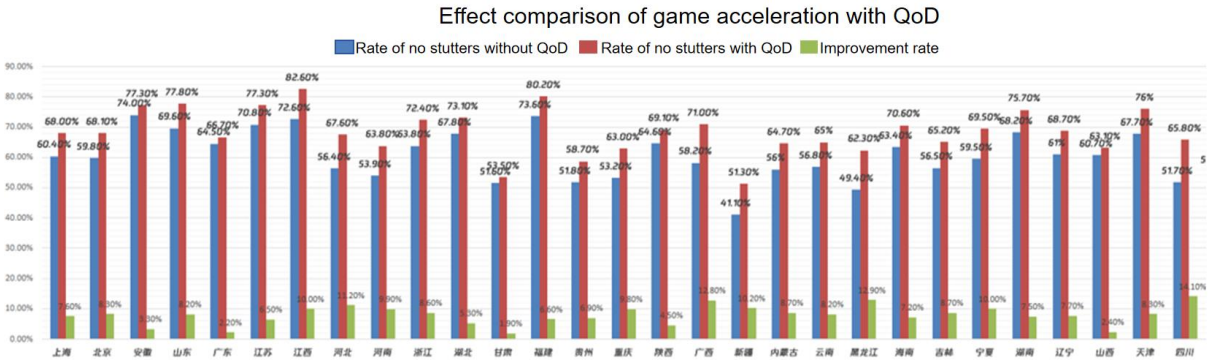

Figure 5 Effect comparison of Tencent Games with QoD API and without QoD API

Live streaming - Kuaishou/Quick Hand

Before discussing QoD solutions in live streaming services, let's first understand the common pain points in live streaming services without QoD API. Take a typical live streaming platform as an example, such as Kuaishou Live.

Scenario: Suppose there is a popular live game show playing, the host uses a server located in Sichuan province to do a live broadcast, and the audience comes from all over the country, including Anhui province, Fujian province, Liaoning province etc. Without using QoD API, viewers may often encounter the following problems:

— Stuttering and degraded picture quality: Due to network delay and bandwidth constraints between viewers and live hosts, live streams may experience stuttering, blurred or distorted images. This can lead to a decline in the viewing experience and even affect the viewability and understandability of live content.
— Long buffer time: Viewers may encounter long buffer times when watching live broadcast, live broadcast picture pause or slow loading speed, resulting in increased waiting time for viewers, reducing the continuity and fluency of live broadcast viewing.
— Sound and picture out of sync: Due to network delay, viewers may experience situations where sound and picture are out of sync, which can lead to the disruption of the viewing experience and make it difficult for viewers to understand the live content.
— Audience loss and user experience reduction: Due to the existence of the above problems, viewers may choose to quit live streaming.

Without the use of QoD API, these problems may affect the user experience of the live streaming platform and the viewing desire of the audience.

Solution: Aiming at the above pain points, QoD API can provide a solution to adapt the network configuration to the requirements of a transmission of live stream data, so as to improve the viewing experience of live viewers. For example, a live broadcast platform can configure QoS policies on its servers to better accommodate live stream packets, reduce network latency and improve bandwidth utilization.

After applying QoD, viewers may experience the following improvements:
— Smooth viewing experience: The problems of stalling and declining picture quality in live streams are alleviated, and viewers can watch live content more smoothly, improving the coherence and clarity of the viewing experience.
— Reduced buffer time: Due to a more adapted network configuration, the buffer time of live streams is reduced, viewers can load live content faster, reduce waiting time, and improve the fluency and immediacy of the viewing experience.
— Sound and picture synchronization: Problem of sound and picture synchronization is reduced, so that the audience can more accurately understand the live content, improve the integrity and understandability of the viewing experience.
— Improve user satisfaction and retention: By improving the viewing experience of live viewers, QoS technology can improve the user satisfaction and retention rate of live streaming platforms

QoD application market and benefit

QoD application market

In 4G/5G networks, the network configuration can be dynamically adjusted according to factors such as service types, user needs, and network conditions to achieve more efficient resource utilization and better user experience. Through the QoD, 4G/5G networks can achieve lower latency, higher bandwidth, and more reliable connections, thereby supporting more kinds of application scenarios, such as augmented reality, virtual reality, autonomous driving, large-scale online conferences, and etc. QoD services can provide network support for the realization of functions in more industries, and a low-latency, high-bandwidth network environment is also the

cornerstone for the realization of many industries and product functions. Therefore, QoD solutions have a wide industry market:
(1) Real-time interactive entertainment APPs: 5G QoD provides low latency and high bandwidth that can support real-time interactive entertainment applications, such as online multiplayer games and real-time live broadcasting. This real-time interactive experience can make the player or viewer feel a more authentic and connected social and entertainment experience.
(2) Augmented Reality (AR) and virtual reality (VR) : 5G QoD provides more space for AR and VR experiences, capable of supporting higher quality content delivery and more complex scene presentation. With 5G QoD, users can enjoy a more realistic and immersive virtual world experience, such as virtual reality games and virtual tours.
(3) High-definition video streaming: 5G QoD enables high-definition video streaming more smooth and high-quality. Users can easily enjoy high-definition or even ultra-high-definition video content, such as movies, TV dramas, sports events and so on.
(4) Cloud games and game streaming media: 5G QoD provides an ideal network environment for cloud games and game streaming services, so that players can enjoy a high-quality game experience without downloading large game files. This service not only reduces the requirements of the game device, but also provides users with a more convenient and flexible way to play.

QoD In 2023, China Telecom's 5G QOD API calls reached 570 million times, with 18.03 million active users and an average success rate of 98.8%, and has generated tens of millions of revenue.

QoD application benefit
QoD has potential impact benefits and broad future implications for all industries, the following are some of the main aspects:

(1) Increase revenue sources: By providing higher quality and more reliable services, 5G QoD can attract more users or customers, thereby increasing revenue sources. For example, a certain game company or live streaming company can attract more users by providing high-quality video streaming services or cloud gaming services, and on this basis increase revenue.
(2) Create new business models: 4G/5G QoD can promote innovative business models and services. For example, in the field of smart cities, a variety of services can be launched based on QoD, such as location-based services and intelligent traffic management systems, etc., providing new business opportunities for city managers and enterprises.
(3) Improve user experience: 4G/5G QoD can provide users with a better experience, such as faster download speed and smoother video playback. This will increase user satisfaction and increase user loyalty, which in turn will lead to more stable and sustainable revenue.
(4) Driving digital transformation: 4G/5G QoD is one of the key drivers of digital transformation. With the high-bit rate connectivity and low latency provided by 5G networks, enterprises can more easily adopt advanced technologies such as cloud computing, big data analytics and artificial intelligence, thereby enhancing business efficiency and innovation capabilities.

QoD evolution
The next evolution stage of 5G QoD service is the research of 5G network slicing to provide guaranteed SLA. 5G network slicing can not only meet the needs of users in personalized services such as live broadcasting, video, games, and cloud mobile phones, but also can be applied in a

variety of industry application scenarios such as V2X, intelligent manufacturing, smart medical care, and smart policing, to achieve the rapid development of 5G in vertical industries. For large enterprises, dedicated & customized network with static slicing is a good choice to these complex service scenarios demanding deterministic latency, deterministic bandwidth, and security isolation.

For massive B2B2C/2C oriented SME, dynamic network slicing may be a good choice to these flexible service scenarios demanding self-service provisioning, flexible subscription and flexible billing. For vertical industries, since 2018, operators, equipment manufacturers and industry partners have repeatedly carried out research and pilot on 5G network slicing and obtained significant phased results. Not only highlights the important position of industry slicing in 5G, but also opens the door to the intelligent network of the whole industry, and promotes the landing and development of 5G in thousands of industries.

Conclusion

From these API solutions, it can be seen that relying on the CNOS, China Telecom will realize the revenue growth through NaaS, as well as better serve customers. China Telecom will grasp the trend of industrial development, take the integration of communication capabilities and Internet capabilities, and the combination of internal capabilities and external capabilities as the core method, form a series of communication and Internet cooperative innovation products, jointly carry out product service expansion and promotion with capability users.

China Telecom will adhere to the concept of ecological win-win cooperation, and jointly create cloud and network capability products with internal transformation developers, external industry developers, manufacturer developers, standardization and solution participants, and explore the value of cloud and network capabilities, and fully help to improve the operating efficiency of the economy and society.