Using Public Cloud for 5G Core Networks for Telecom Operators

KANNARI Naoki, KURIHARA Kojiro , NISHIMURA Takeshi , SUZUKI Shunsuke , NANBA Hiroki , ABE Satoki

Abstract

With mobile traffic skyrocketing, telecom operators face the urgent need to scale their networks further while also aiming to curb investment costs and optimize network resource utilization. In this paper, we explore how using the public cloud as a key solution helps telecom operators meet this challenge. We present the essential technologies for maximizing the potential of the public cloud for 5G Core networks and introduce our initiatives to facilitate its implementation.

Keywords

5G, 5G core, public cloud, AWS, telecom operators

1. Introduction

5G is garnering significant attention as a social infrastructure that fosters the creation of innovative services and solutions, and 5G Core Networks (5GC) is the base around which 5G networks are built.

There is a strong expectation for the application of 5G technology across a wide range of vertical industries such as vehicles, transportation, manufacturing, medical care, education, tourism, and public services. This anticipation stems from the desire to diversify the uses of 5G services, both within the offerings of telecom operators and through private 5G (dedicated 5G networks in Japan hosted by entities outside the communication service sector is referred to as private 5G in this paper) networks. Under such circumstances, telecom operators are compelled to strengthen and expand their network equipment to cater to the ever-growing user traffic and the increasing number of devices connecting to 5G networks. Meanwhile, minimizing the power consumption of their expanded network equipment has emerged as a significant concern, given the current focus on achieving carbon neutrality and fostering a greener environment.

To address this challenge, telecom operators are increasingly turning to the utilization of the public cloud as a key solution. By leveraging the public cloud, they can automate the scaling of network resources, ensuring seamless adjustments in response to evolving traffic demands, which leads to substantial cost reductions in network operation, maintenance, as well as the design and building of their network.

NEC 5GC is fully cloud-native, employing a microservice architecture that offers high flexibility and scalability, aligning seamlessly with the characteristics of the public cloud. For example, NEC 5GC aids telecom operators in maintaining service continuity and resilience at an optimal cost by leveraging a hybrid environment that combines their on-premise private cloud and the public cloud, which proves particularly valuable in scenarios involving disasters or unexpected traffic spikes.

In this paper, Section 2 focuses on key technologies and features employed in the process of NEC's successful onboarding of 5GC on the public cloud. Following that, section 3 delves into the benefits and challenges associated with the implementation, and finally, section 4 introduces a range of use cases.

2. Key Technologies and Features

NEC 5GC[1)2)] is an open product that is compliant with the 3rd Generation Partnership Project (3GPP) standards, ensuring compatibility with multi-vendor ecosystems. It is a fully cloud-native solution, leveraging a microservice architecture for rapid time-to-market onboarding and flexible scalability according to specific requirements. This adaptability allows NEC 5GC to cater to a wide range of scales, from small-scale private 5G deployments to large-scale telecom networks. Furthermore, by leveraging virtualization and containerization, the same 5GC software can be seamlessly deployed across both on-premise container platforms and public cloud container platforms.

2.1 Microservice architecture

NEC 5GC adopts a fully virtualized and containerized cloud-native architecture (**Fig. 1**). It enhances the expandability, flexibility and maintainability of the system by utilizing containerized microservices, which are stateless and deployed on a container platform.

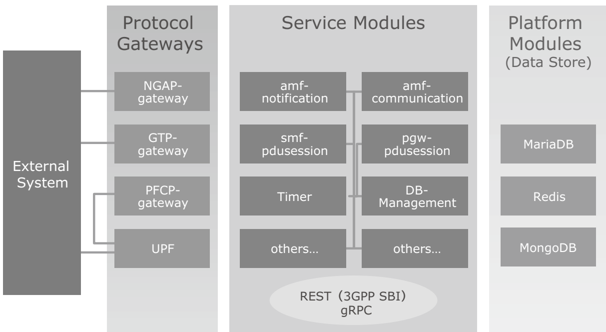

Fig. 1 NEC 5GC microservice architecture.

2.2 Multi-platform support

NEC 5GC is designed to be platform-agnostic, capable of running on both on-premise and public cloud environments. The deployment options that are ready to be launched can be categorized into three models (**Fig. 2**). The first model is "container on VM," which combines virtualization and containerization, allowing NEC 5GC containers to work within a virtual machine (VM) environment. The second model is "container on baremetal," where NEC 5GC runs on a purely containerized environment. The third model involves the utilization of Amazon Web Services (AWS) on which NEC 5GC is onboarded. With these various options available, telecom operators can select the deployment model or combination that best suits to their existing infrastructure and network environment.

3. Benefits and Challenges

3.1 Benefits of using the public cloud

The key benefit of using the public cloud is that telecom operators can enjoy significant operation cost reductions by efficiently scaling their network in response to fluctuating traffic demands. Another benefit is the improved time-to-market achieved by using the managed services of the public cloud, which enables the streamlining of the network operation and management, and acceleration of the design, build and operation cycles. This facilitates the rapid generation of new businesses and the prompt delivery of solutions to social issues (**Table**).

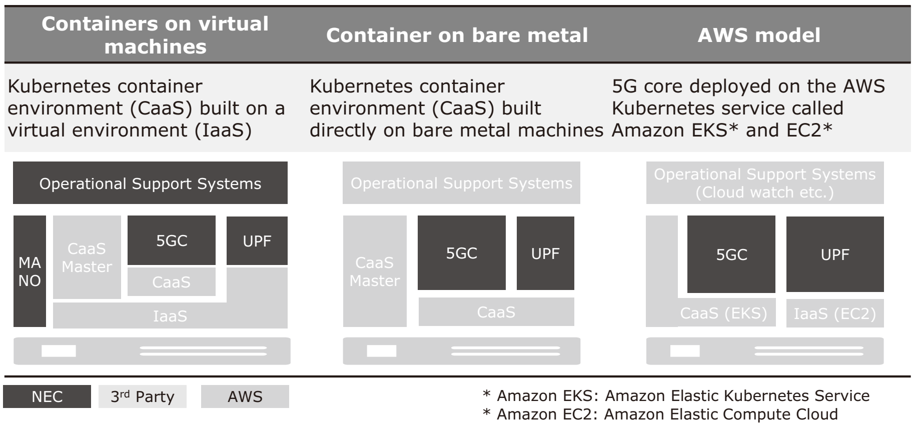

Fig. 2 Multi-platform compatibility.

Table Advantages of public cloud use.

Reduced investments	• Low initial and running costs, enabling for a small start based on the number of subscribers
Scalability	• Area expansion can be handled by adding only base stations
Improved competitiveness	• Eliminates the need to introduce new equipment and shortens delivery lead time
Function scalability	• No need to expand facilities; easy to expand • functionality or upgrades on the cloud
High availability	• Redundancy by software • Highly redundant operations are possible through distributed deployment of sites in the cloud
High security	• User communications are handled at the base station for secure communications

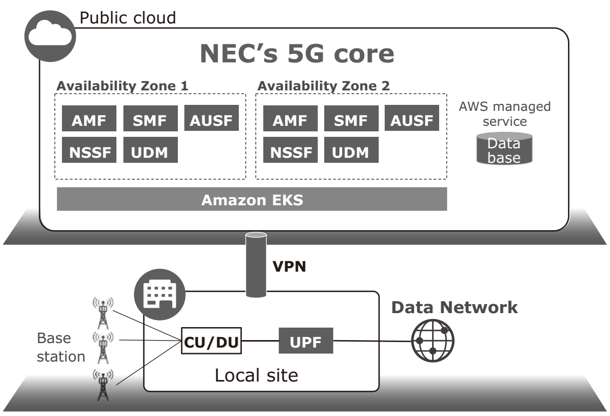

Fig. 3 Example of a 5GC system configuration on AWS.

3.2 Example of 5GC configuration on AWS

By leveraging the aforementioned benefits, we provide an illustrative example of a 5GC configuration on AWS as a model case (**Fig. 3**).

Given that NEC 5GC is cloud-native and built on a microservice architecture, it can be seamlessly onboarded and operated on Amazon EKS. Data processing and storage within the 5GC software is clearly separated. This design allows for the optimized utilization of AWS managed service when using the database tools to handle the data storage of 5GC software.

3.3 Challenges telecom operators face when building 5G networks using the public cloud

Trials and commercial deployments of 5GC using the public cloud are currently underway across various regions, with many focusing on smaller-scale implementations such as private 5G networks.

To further drive the advancement and widespread adoption of 5G, collaboration between private cloud and public cloud is crucial. NEC is actively collaborating with telecom operators to build an innovative mobile core through a proof of concept (PoC) that aims to harness the benefits of both private cloud and public cloud technologies, specifically by achieving carrier-grade quality and flexible resource management in the cloud simultaneously.

There are many challenges associated with using the public cloud while maintaining carrier-grade quality, such as ensuring large scalability to accommodate millions of subscribers, implementing automatic scale-out capabilities in the event of disasters or sudden traffic spikes, and performing software upgrades without service interruption, among others.

NEC is committed to tackling these challenges and continuously working towards finding solutions for the next-generation core network, based on our extensive insight and expertise gained through our longstanding development of mobile core products for telecom operators.

4. Use Cases

In chapter 4, we present two use cases as part of NEC's initiatives to expand 5G. The first showcases a telecom operator's successful reduction in power consumption, and the second highlights the application of a private 5G solution for an enterprise customer.

4.1 NEC reduces power consumption for 5GC using AWS

NEC is committed to contributing to the creation of a sustainable society by delivering environmentally friendly and energy-efficient mobile infrastructure. One way NEC aims to achieve this is by onboarding NEC 5GC on AWS Graviton2 processors, which provide a substantial performance boost and contribute to reducing the carbon footprint of IT workloads. With this technology, NEC has demonstrated around 70% reduction in power consumption compared to the incumbent CPU.

In the demonstration, we ran the NEC 5GC C-Plane software on the Graviton2 processor at AWS, made measurements of the power related metrics, and calculated the impact to the environment. For the demonstration, we used EC2 instances on the Graviton2 processor (Graviton2 environment) and Amazon Elastic Compute Cloud (Amazon EC2) instances on the fifth generation x86 processor (x86 environment). Both environments exclusively hosted 5GC software, and we injected traffic loads into each environment to measure the power consumption when the load was on and off. As a result, we successfully confirmed that the power consumption

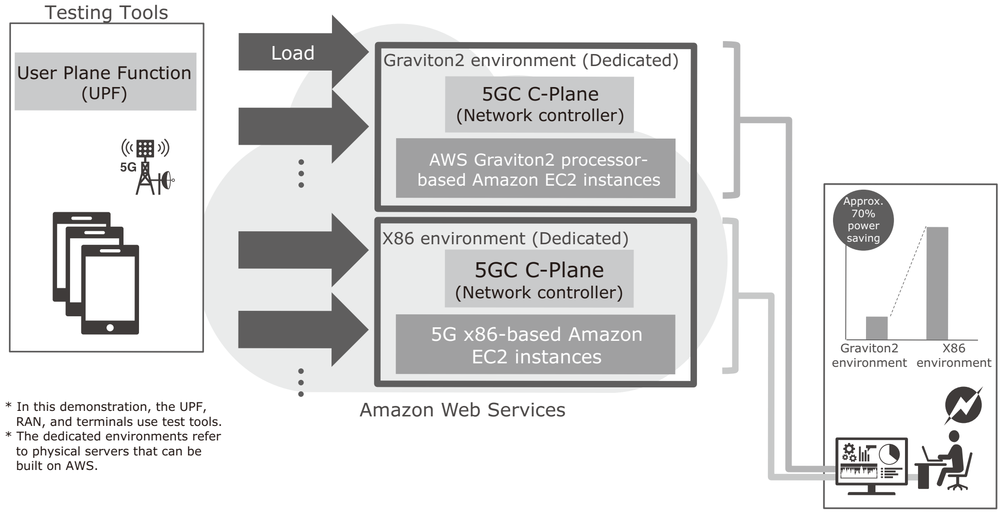

Fig. 4 Verification of power saving capability of 5GC using AWS Graviton2.

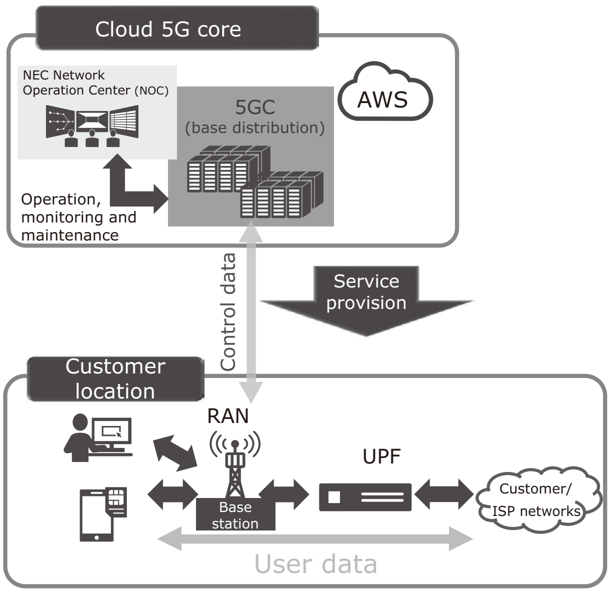

Fig. 5 Usage examples of private 5G.

of the Gravtion2 environment was approximately 70% lower compared to the x86 environment (**Fig. 4**)[3].

4.2 Use in the private 5G domain

NEC has established itself as a leader in the private 5G domain by providing the NEC 5GC as a comprehensive managed service on AWS that includes operation, monitoring and maintenance. In fact, several private 5G operators follow this business model (for instance, to offer 5GC as managed service), and use it to provide private 5G services to a diverse range of vertical industries (**Fig. 5**).

Deploying 5GC on AWS offers the advantage of starting small with minimal initial costs and then scaling out as needed. Additionally, user data traffic can be processed locally at the edge location where User Plane Function (UPF) is deployed so that only control plane signaling is transmitted to and from the public cloud. By implementing this approach, the costs associated with transmitting large volumes of user data across the backhaul network can be significantly minimized. This approach also helps mitigate potential security risks by keeping user data traffic localized at the customer's site.

Currently, there is significant momentum in the experimental demonstrations and trial launches of private 5G networks across a wide range of vertical industries including manufacturing, airports, factories, hospitals, and railways.

5. Conclusion

The adoption of the public cloud is gaining traction as an integral part of the social infrastructure, and NEC has demonstrated its commitment through the successful onboarding of 5G Core (5GC) on the public cloud. This achievement is of utmost importance as the need for agile and on-demand delivery of multiple services continues to grow, with the use of the public cloud serving as a key solution. NEC has positioned itself at the forefront of the industry, collaborating closely with telecom operators to pioneer the development of a cutting-edge 5G network. Drawing on our extensive expertise and technologies gained through the commercial deployment of 5GC, we are fully committed to tackling new challenges and driving advancements in the field.

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Authors' Profiles

KANNARI Naoki
Senior Professional
Mobile Core Department

KURIHARA Kojiro
Director
Mobile Core Department

NISHIMURA Takeshi
Professional
Mobile Core Department

SUZUKI Shunsuke
Assistant Manager
Mobile Core Department

NANBA Hiroki
Assistant Manager
Mobile Core Department

ABE Satoki
Assistant Manager
Mobile Core Department

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