Virtualized IMS Solutions for Telecom Carriers

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Abstract

As the telecom sector continues to evolve and innovate, efforts are underway to develop more robust, SDN/NFV-driven solutions that can help reduce OPEX/CAPEX, facilitate disaster resistance and congestion control, and accelerate the development cycle to support even more rapid innovation and deployment of new services. NEC is a leader in the development of SDN and NFV and has already achieved significant results in this area. In this paper, we will introduce the virtualized IMS (vIMS) technology we have developed to provide voice communication services as part of our line of SDN/NFV solutions. We will also review NEC's future plans in this area.

Keywords

network virtualization, ETSI NFV, virtualized IMS (vIMS), IMS, VoLTE, security, IMS-AGW

1. Introduction

Over the past few years, over-the-top (OTT) players have exploded and ramp up their services to meet rapidly growing demand for communications, content, and cloud-based offerings over the Internet. Nevertheless, in spite of the enormous increase in network traffic this has entailed, telecom carriers are now experiencing a situation where average revenues per user (ARPU) have hit the ceiling. And while carriers struggle to maintain revenues, the demand for new technologies continues unabated as new large-scale networks such as 5G and the Internet of Things (IoT) come onstream. To cope with this fast-evolving environment, telecom carriers are increasingly turning to software-defined networking (SDN) and network function virtualization (NFV) to better facilitate prompt, flexible delivery of new services, while at the same time minimizing operating expenses (OPEX) and capital expenditure (CAPEX).

In addition to music, video, data storage, and all the other services embraced by OTT, voice communication itself is becoming more diversified, resulting in best-effort voice services such as Voice over IP (VoIP). Yet even as demand for more diverse services increases and traffic volume expands exponentially, telecom carriers find themselves expected to deliver and assure secure, reliable voice communication services with high disaster-resistant, congestion-control operation capabilities, as well as the ability to support disaster prevention and crime prevention - a situation exacerbated in the wake of major natural disasters and the increasing threat posed by terrorism.

In such an environment, the challenge posed to telecom carriers is daunting. On the one hand, they must find ways to reduce OPEX/CAPEX; on the other, they must be able to rapidly deploy and offer new services. And if all that weren't enough, they are also expected to improve disaster-resistant and congestion control capabilities. As part of its SDN/NFV solution lineup, NEC has developed powerful virtualized IP multimedia subsystem (vIMS) solutions that enable telecom networks not only to be more efficient and flexible, but also to offer more advanced and reliable voice communication services. In this paper, we will take a closer look at the vIMS solutions offered by NEC.

2. Overview of NEC's IMS Products and Features

2.1 Overview of NEC's IMS Products

NEC has developed IP multimedia subsystem (IMS)[1)] products that incorporate IMS applications which are installed on hardware devices built to the Advanced Telecom Computing Architecture (ATCA) standard (the leading hardware standard for telecom carriers), and which form the core networks of mobile phone services. NEC also provides telecom carriers with solutions that help them deliver a wide range of optimized voice services.

NEC's IMS products consist of a Proxy-Call Session Control Function (P-CSCF) and a Serving/Interrogating Call Session Control Function (S/I-CSCF). These are part of a control system that performs call control, a Telephony Application Server (TAS) incorporated in a service delivery system that controls additional mobile phone services, and an IMS Access Gateway (IMS-AGW) that controls packet and relays voice data.

An IMS application sample is shown in **Fig. 1**. As this makes clear, introduction of IMS products to a telecom carrier's core network makes it possible to offer Voice over LTE (VoLTE) service in which voice calls using the LTE communication system are possible. This supports voice calls and video calls with high sound quality, minimal delay, and high stability. Moreover, high-speed data communication can be used even during a call.

2.2 Features of NEC's IMS Products and Technologies

Typically, an IMS system consists of a CSCF that handles call control and a TAS that delivers services. NEC's IMS products, however, are distinguished by the provision of an IMS-AGW that controls voice data. This feature has been added to make the system more robust and secure.

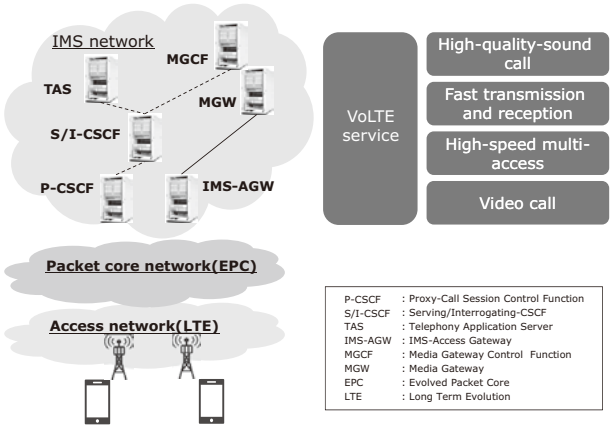

Fig.1 NEC's IMS products and VoLTE service.

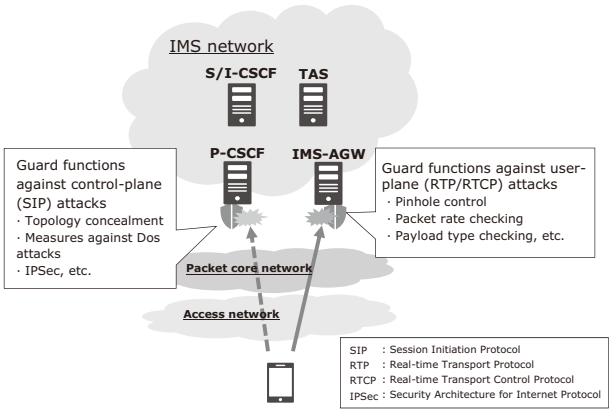

Fig.2 Security measures using NEC's IMS products.

In an IMS system - especially VoLTE - terminals and the IMS core network are directly connected via IP. While this increases the openness and flexibility of the technology, it leaves open the possibility that malicious terminals can be used to engineer advanced security attacks on the IMS core network. Making their systems robust enough to withstand these kinds of security threats is of paramount importance for telecom carriers. One of the most common solutions is to install dedicated security gateway devices in front of the IMS core network to protect against attacks. However, this means that installation of security products other than IMS is necessary, introducing additional levels of complexity to operation and management, as well as increasing costs because of the need to incorporate additional equipment.

By equipping the IMS products themselves with the necessary security functions, NEC now offers solutions that enable telecom carriers to easily protect against attacks on their IMS core networks. Specifically, as shown in **Fig. 2**, we provide functions that protect the back S/I-CSCF and TAS against attacks using SIP protocols for call control signals to the P-CSCF, which is the main entry point into an IMS core network. Moreover, when a service that handles voice media within a core network is offered, the IMS-AGW, which controls the RTP/RTCP protocols used for voice media, is installed at the entry point to the IMS core network, making the network even more robust.

3. Application of NFV Technology to NEC's IMS Products

3.1 NEC's vIMS Solutions

NEC is currently developing vIMS solutions - that is, we are incorporating NFV technology in the IMS products that operate on the ATCA described above. The main advantages of NFV technology are that it allows utilization

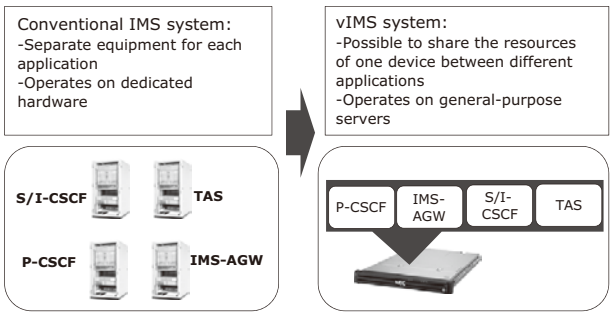

Fig.3 Reduction of initial introduction cost.

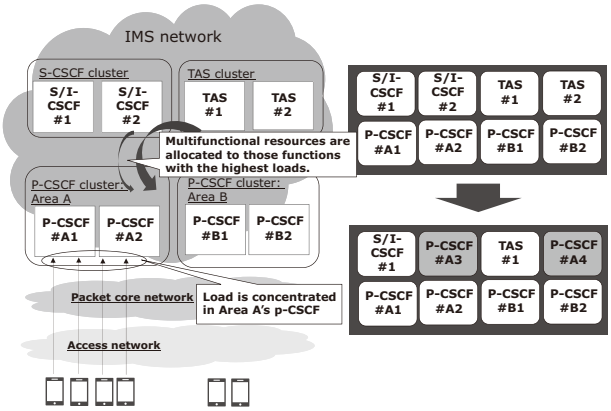

Fig.4 Improvement of network scalability.

of general-purpose servers based on open technology and fast, flexible introduction of new services. The application of NFV technology to IMS systems enables us to solve the problems listed below.

(1) Reduction of initial introduction cost

In conventional IMSs that run on dedicated hardware, incorporation of multiple applications such as P-CSCF, S/I-CSCF, TAS, and IMS-AGW requires the telecom carrier to invest in multiple hardware devices in order to launch an IMS service. As a result, initial investment in equipment and facilities is too much of a burden for telecom carriers who want to build a small-scale IMS service.

However, the application of NFV technology makes it possible for the same resource to share and deliver multiple applications. Consequently, it is now possible to easily build a small vIMS system capable of operating multiple IMS applications on the same device (as shown in **Fig. 3**). This dramatically reduces initial introduction costs and allows the small-scale IMS services to be introduced quickly and easily.

(2) Improved scalability on networks

In cases where user transmissions in a particular area suddenly increase - for example, if there is a natural disaster or other major event, IMS core networks may have difficulty in making and maintaining connections due to the congestion caused by the increased traffic load on the P-CSCF entry point. With a conventional IMS system running on dedicated hardware, additional backup systems will be required in order to handle the increased load in times of crisis. All of this means more costs and more time will be required to build networks that are sufficiently robust and flexible.

NFV eliminates these problems, making it possible to share the same resources between multiple IMS applications. When the load on the IMS core network increases as shown in **Fig. 4**, resources - such as P-CSCF, as well as S/I/CSCR and TAS - can be flexibly allocated from areas with relatively low loads and high margins - to the P-CSCF in areas with higher loads. This allows the telecom carrier to promptly and efficiently scale up its network as required.

3.2 Problems to be Solved

In order to apply NFV to conventional ACTA-based IMS products, a technical contrivance must be built to operate the IMS-AGW, which is the primary feature of NEC's IMS products. In a conventional ATCA, the IMS-AGW depends on intrinsic processing performed by dedicated hardware in order to perform transfer processing of voice data packets.

To apply NFV, it is necessary to turn the intrinsic processing performed by dedicated hardware into software and to achieve processing performance equivalent to dedicated hardware even on general-purpose servers. Nevertheless, a transmission system device for voice packets is more difficult to build than a TAS in a service system or a CSCF in a control system device because transfer delay and fluctuation can cause deterioration of voice quality. The biggest problem, then, is how to achieve processing performance equivalent to dedicated hardware on a general-purpose server.

3.3 Technology Solutions

In order to solve this problem, we decided to apply the open technologies shown below to the IMS-AGW. These technologies have also been adopted in our virtualized Evolved Packet Core (vEPC) which we used to apply NFV to packet transmission system devices.

- **Data Plane Development Kit (DPDK)**
  This is a toolkit to achieve high-speed processing of packets without using kernels.

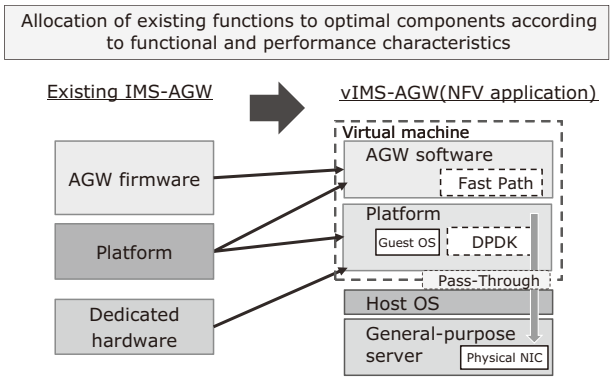

Fig.5 Conceptual diagram of NFV technology to IMS-AGW.

- **Pass-through**
  This is a technology that enables virtual machines to directly refer to and control the host's PCI devices.

Also, as shown in **Fig. 5**, after integrating these open technologies, we develop devices to optimally allocate functions. For example, among the functions provided by existing IMS-AGW devices, functions that need high-speed processing such as packet transfer and mode control are allocated to the fast path, while functions that can be processed at relatively lower speeds such as RTCP terminal control are allocated to the slow path.

4. Future Commitment

NEC conducted a verification test for the VoLTE service by linking VoLTE technology with the vIMS technology discussed above. The results demonstrated that the voice data relay processing performance matched that of conventional ATCA devices.

In the future, by combining our new vIMS solution with the vEPC solutions we already offer, we will be able to help telecom carriers operate voice services and data communication services on the same virtualized platform. We are also committed to facilitating the rapid introduction of new services simply by adding network function virtualized software to the same platform.

Beyond this, we plan to introduce software codec technology for use when NFV is applied to IMS-specific functions such as voice codec terminal processing and encryption, which are currently handled by dedicated hardware. We will also introduce hardware accelerator technology that efficiently optimizes hardware processing performance to complement function characteristics.

5. Conclusion

In this paper, we have looked at the technologies and involved in the development of the vIMS solutions we are currently working on. vIMS is part of our SDN/NFV solutions lineup and is specifically designed to help telecom carriers solve a variety of problems they now face such as the need to improve network scalability and reduce OPEX/CAPEX.

We are aiming for commercial introduction of vIMS for telecom carriers in fiscal 2016 and intend to continue refining and deploying these technologies, thereby adding value for telecom carriers and end users.

* LTE is a registered trademark of European Telecommunications Standards Institute (ETSI).

Reference

1) 3GPP TS23.228 – Technical Specification Group Services and System Aspects; IP Multimedia Subsystem(IMS); Stage2

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Vol.10 No.3
July 2016

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