NEC's vMVNO-GW Provides High-Value-Added Businesses for MVNOs

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Abstract

The rapid growth and transformation of mobile communications infrastructure in recent years is accelerating innovation in the telecom sector. Core network devices are now expected to help reduce OPEX/CAPEX, support disaster resistance and congestion control, and have the flexibility to enable rapid innovation and deployment of new services. NEC has been a leader in the development of the two key solutions driving this transition - SDN and NFV - and has already achieved significant results. This paper introduces vMVNO-GW - a product that uses NFV technology for MVNO gateways to provide mobile virtual network operators (MVNOs) with a mobile core network.

Keywords

MVNO, GGSN, P-GW, NFV, APN, DPI, HLR/Open HSS

1. Introduction

Telecom companies today find themselves in an environment that is both fraught with challenge and beckoning with opportunity, an environment where demand for their services is growing at a record pace, while customer expectations are growing even faster.

In Japan, mobile virtual network operators (MVNOs) have responded by improving core capabilities such as service recognition, device procurement, purchasing channels, and support structures, propelling a rapid expansion of the MVNO market. In the space of just a year, the number of contracts for original-type service SIM (subscriber identity module) cards almost doubled, hitting the 3.26 million mark by the end of March 2015.

At the same time, boosted by growing number of tourists and other visitors, sales of prepaid SIM cards (which feature limitations on how long the card can be used and how much data can be transferred) have also been increasing. With Tokyo hosting the Olympics and Paralympics in 2020, demand can only be expected to expand in the years to come.

To help companies keep pace in this fast-evolving mobile environment, NEC has adapted its NFV-based vMVNO-GW mobile gateway technology for commercial use. The service is now being used by three MVNO companies.

In this paper, we will introduce the technology and architecture underlying the vMVNO-GW, which helps increase the efficiency and flexibility of telecom networks, as well as supporting more advanced service offerings. The vMVNO-GW is part of NEC's Software-Defined Networking (SDN) and Network Functions Virtualization (NFV) solutions lineup designed for MVNO services.

2. Overview and Features

2.1 Overview

The system configuration of the vMVNO-GW is shown in **Fig. 1**. In order to start a mobile service, aspiring MVNOs must use a mobile network belonging to a mobile network operator (MNO).

Integrating a GPRS gateway support node (GGSN) and a packet data network gateway (P-GW), this system allows an MVNO to connect via the layer 2 protocol (layer 2 connection and GTP connection) to the serving

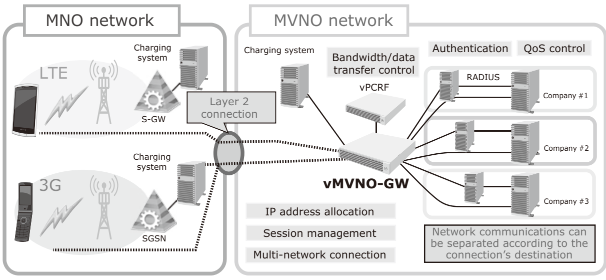

Fig. 1 vMVNO-GW system configuration.

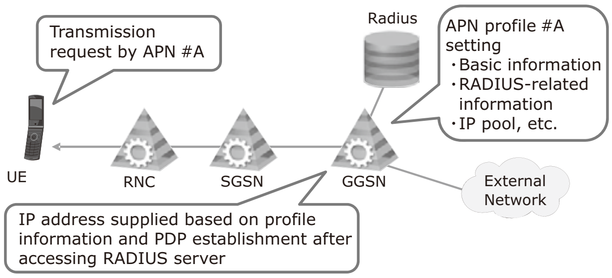

Fig. 2 Concept of APN profile management.

GPRS support node (SGSN) and serving gateway (S-GW) which comprise the MNO's mobile network. It also enables them to manage IP addresses and administer individual networks accordingly, while strengthening their multi-networks and security. MVNOs will also be able to offer various value-added services by linking with the Policy and Charging Rules Function (PCRF).

2.2 Features

2.2.1 NFV Technology

In a conventional MVNO-GW, carrier-grade quality, performance, and capacity are achieved using Advanced Telecom Computing Architecture (ATCA). NFV technology now makes it possible for a vMVNO-GW to deliver a powerful suite of services and ensure carrier-grade quality using only a single general-purpose server. This simple, yet effective configuration dramatically reduces the initial capital investment needed to get an MVNO up and running.

Equally important, the system's processing capacity can be easily expanded by adding virtual machines (VMs) as necessary to meet any increase in traffic. Similarly, all you have to do is update the software to improve functions, enhance performance, and even add new capabilities. You can do all this without upgrading the present system, thus you can actually reduce the operation costs.

2.2.2 APN Function

This system is also provided with a virtual Access Point Name (APN) function, allowing you to map multiple real APNs from the virtual APN. Connections can also be made using only the real APN, rather than the virtual APN function. APN settings can be managed in the APN profile using maintenance commands. The concept of APN profile management when the GGSN function is in operation is shown in **Fig. 2**.

Real APN profile is retained as packet data network (PDN) connection information. The real APN profile includes information such as the Gi/SGi interface, user authentication, and an IP address pool to assign to user equipment (UE). The virtual APN profile is also retained, and the matching information between the virtual APN and real APN is included as well.

The virtual APN function determines the network to be accessed by using the user name (login@domain) which was set in the Protocol Configuration Options (PCO) when a session establishment request for a specific virtual APN was received.

2.2.3 Total Volume Control Function

This system is provided with a function that controls bandwidth according to the originator's number or the numbers of a group of multiple originators. As soon as the volume of data transferred reaches a specified amount, the bandwidth control function kicks in, operating in accordance with the policy conditions (QoS - quality of service) defined for each APN, group, and user.

As for the removal timing of communication restrictions, this can be specified on different conditions such as cross-monthly basis or by any number of days after the allowed volume has been exceeded. Policy conditions and schedules are managed and controlled on the PCRF side, and bandwidth control is performed when a QoS directive is received from the PCRF. **Fig. 3** shows how total volume control processing works.

2.2.4 DPI Function

This system incorporates a Deep Packet Inspection (DPI) function, eliminating the need for an external DPI device. This reduces the number of nodes that will be needed and assures excellent cost performance. When Policy Charging Control (PCC) and Application Detection and Control (ADC) are used in combination, packet analysis, traffic control, and traffic detection can be performed from layer 3 to layer 7. **Fig. 4** shows how the DPI function works.

Thanks to the DPI function, this system can connect

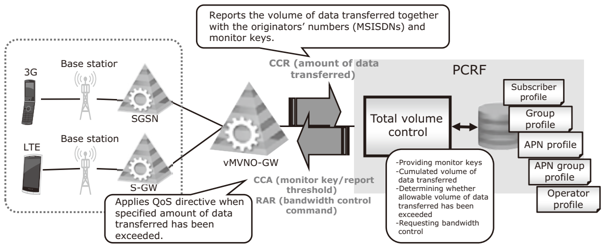

Fig. 3 Concept of total volume control processing.

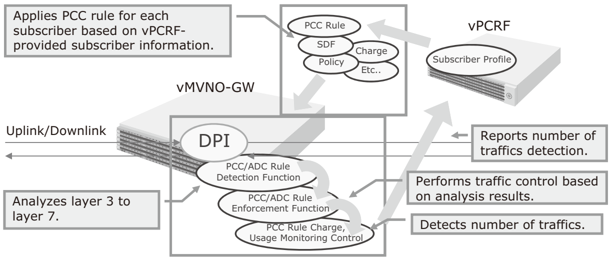

Fig. 4 How the DPI function works.

to specific sites and track usage of applications and protocols (with control over what should be included or excluded), as well control traffic (bandwidth control and gate control). HTTP redirection to portal sites and other sites is also available for connections to specific sites.

3. Virtualization Environment

3.1 Logical Network Configuration

Fig. 5 shows the logical network configuration of this system. This system is composed of a service resource controller (SRC) server and physical machine (PM) server.

As a virtualization platform, the SRC server facilitates integrated management of intrasystem resources including the PM server to improve usage effectiveness. An agent MiddleWare (aMW) installed in the PM server that links with the SRC server. The PM server also includes a maintenance function section (FS), call processing section (GWP), and user data section (GWU), to achieve the P-GW/GGSN function.

The SRC server has a maintenance interface and can be connected with the maintenance terminal via the network. The PM server is provided with P-GW/GGSN interface reference points and interfaces for maintenance and connected to opposing nodes.

3.2 SRC

The SRC monitors and manages resources in the servers and networks on the virtualized system. Equipped with a maintenance function that works in conjunction with the aMW to detect problems in a PM, it provides surveillance and notification capabilities comparable to those available with the aTCA platform.

The SRC's design assumes that it will be used in a small-scale virtualized system. The SRC and VM implemented with the MVNO-GW application can be implemented on the same server as long as the vMVNO-GW is set up using the minimum configuration - helping to reduce initial investment in equipment. Migration is possible in conjunction with the MANO when the system is scaled up and platforms are shared with other systems.

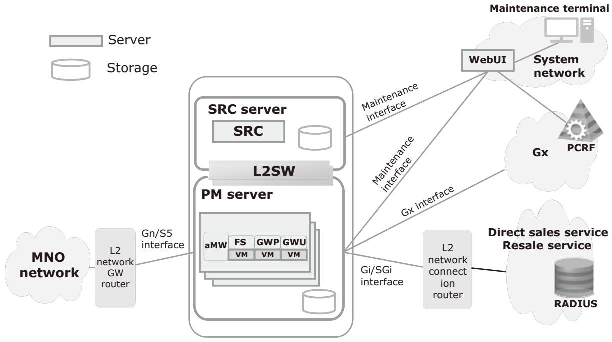

Fig. 5 Logical network configuration.

3.3 WebUI

Provided with operation functions such as station establishment and maintenance of the vMVNO-GW applications available in the virtualized environment, the WebUI features user-friendly interfaces that maintenance personnel and vendor support representatives can easily use, making it possible to further reduce system support costs.

With the WebUI, you can select which node types to use by changing the database settings when it is installed. The system is configured on the basis that it will be used by MVNOs, so it is also compatible with small-scale systems, allowing users to take advantage of web-based maintenance and operation functions that do not require a large-scale EMS.

When linked with the SRC, the WebUI makes it easy to set up a virtualized environment with functions such as an automatic installation function, manual VM add/remove function, and auto-healing function.

The automatic installation function allows maintenance personnel to run the VM installation procedure from the WebUI's GUI screen.

The manual VM add/remove function lets maintenance personnel add or remove virtual machines from the

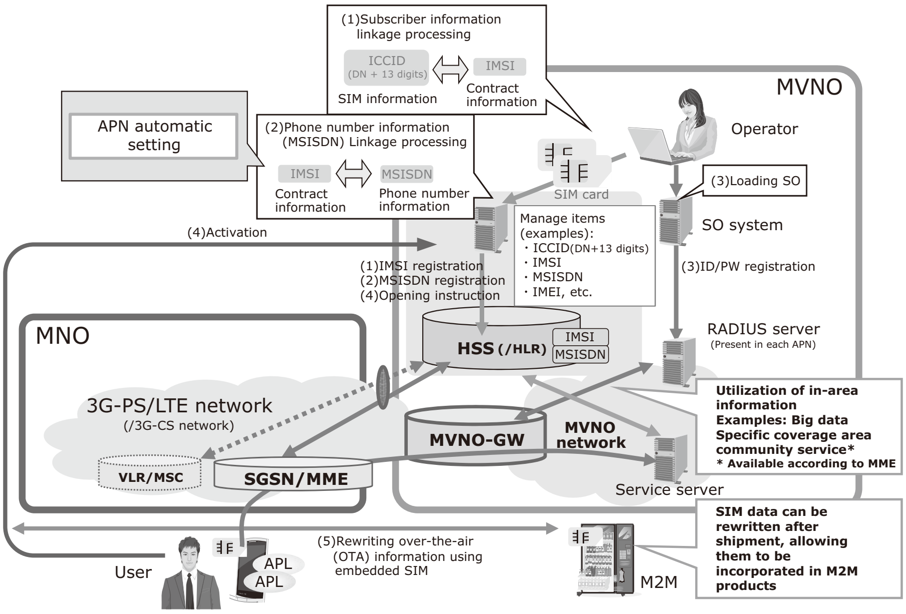

Fig. 6 Additional services made possible by HLR/HSS.

WebUI's GUI screen.

When adding VMs, maintenance personnel can also set the SRC, start up the VMs, and idle away newly added VMs.

When a failure occurs, the auto-healing function rebuilds the VM on a pool server prepared separately by linking with the SRC - separating it from the server where the failure occurred.

4. Future Plans

Currently, it is examined that Home Location Register (HLR) and Home Subscriber Server (HSS) should be opened to MVNOs.

By allowing MVNOs to own their own HSS, this would make it possible for them to issue and manage original SIMs and give them more flexible control over SIM activation. It would also allow them to leverage in-area user data to offer additional services tailored to user needs. Fig. 6 shows how an HLR/HSS can facilitate delivery of additional services.

As the number of subscribers continues to increase, so too does the number of MVNOs, exposing each operator to ever more intense competition in the area of service delivery.

Our goal is to provide MVNOs with the tools they need to expand their service offerings, streamline their operations, and grow their businesses. These include compatibility with an open HLR/HSS, linkage with traffic management solutions, and improvement in voice services.

5. Conclusion

In this paper we have discussed our vMVNO-GW system built around NFV technology - a system that we see as the core of future businesses and one which we intend to continue to develop and refine.

Finally, we would like to express our deepest gratitude to those who have been helpful in this commitment and also those who gave advice to and cooperated with us when writing this paper.

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