MVNO Solution to Embody Diversifying Market Needs

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An emerging interest in the services provided by mobile virtual network operators (MVNO) focuses on the ways to economize on telecom costs, leveraging budget smartphones and SIM cards. Many magazines and television programs have been eagerly featuring the topic in recent years, and the services are widely recognized, almost by 70% of the Japanese population today. Backed by this growing popularity, the MVNO services are provided not only by telecom carriers and Internet service providers (ISP), but also by players from other industrial fields, such as major logistics companies and content providers. Fujitsu provides these operators, which are considering the possibilities of providing an MVNO service, with a comprehensive solution. A special focus is placed on the development of solutions that address the unique circumstances of Japanese telecom services, coupled with the provision of consulting and integration services. This paper first outlines the MVNO services and their technical factors. It then explains Fujitsu's MVNO solution that facilitates the adaptation to the Japanese version of MNVO services. The paper concludes with descriptions on some hypotheses regarding the future development of the MVNO services, and the directions Fujitsu aims to head in for this.

1. Introduction

Ever since one of the logistics giant AEON Co., Ltd. started marketing budget smartphones in 2014,[note 1)] the media have been eagerly featuring in magazines and TV programs how to leverage budget smartphones and subscriber identification module (SIM) cards in Japan to economize on telecom costs. The mobile virtual network operator (MVNO) services are gaining wider recognition in Japan today, as about 70% of the Japanese population is aware of them, according to a recent survey by the Ministry of Internal Affairs and Communications (MIC).[1)]

This growing popularity is gradually changing the landscape of MVNO service providers. In addition to the telecom carriers and Internet service providers (ISP), there are now players from other industrial fields, such as major logistics companies and content providers.

Also, this is partly backed by government initiatives, led by the MIC, to promote policies to stimulate market competition in the mobile industry in the 2020s, in pursuit of enhanced utility for the nation.[2)] SIM unlock, MNO unbundling, and other deregulations as well as the development of a legal framework are paving the way toward more freedom for MVNOs. As a result, the MIC is pressing for appropriate competition and is initiating the discussion on a reduction in communication expenses in Japan that are said to be remaining at a high level, and seeking market activation for creating new services etc.

Leveraging the expertise gained through developing MNO solutions, Fujitsu began offering a comprehensive solution in 2013 for the operators who aspired to provide MVNO services. These include business planning, system planning, solution development, integration services and support to ensure safe and secure service implementation. A special focus is placed on the development of solutions that address the unique circumstances of Japanese telecom services, coupled with the provision of consulting and integration services.

note 1) Major mobile network operators (MNO) have hitherto been the main players in the mobile network business. But, in 2014, AEON succeeded in launching itself as an MVNO, using MNO's network infrastructure to provide budget smartphone and telecom packages.

Drawing on the experience gained in areas that have advanced MVNO industries—the USA and various nations in Europe—many global vendors offer network node solutions for MVNOs. However, it would be difficult to establish MVNO services in Japan simply by introducing their products into the system. To achieve such services in a meaningful way, there needs to be organic connections between the trunk system (a series of systems such as subscriber management, sales management, fee calculation and collection) and network nodes that control data transmission.

First in this paper, we explain how MVNO services may be realized in Japan, describing technological elements commonly used in relation to network nodes. Second, we illustrate the challenges in adapting them to Japanese MVNO services, and Fujitsu's solution that is designed to resolve them. Finally, the paper presents some hypotheses regarding the future development on the MVNO services, and the directions Fujitsu aims to head in for this.

While MVNO services are diverse, this paper primarily refers to budget smartphones/SIM cards in Japan and similar consumer MVNO services.

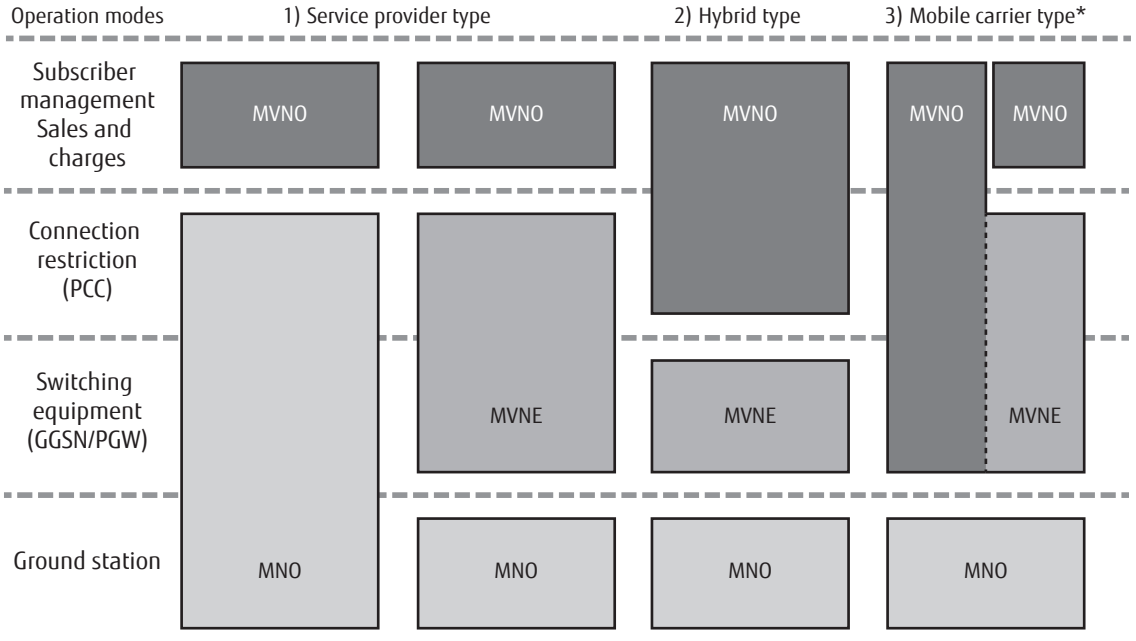
2. Styles of MVNO service provision

In Japan, MVNO services may be provided in one of the following three styles (**Figure 1**).

1) Service provider type

Operators pursue businesses by offering MVNO services that are provided by MNOs and mobile virtual network enablers (MVNE: operators providing support for MVNO). This business mode can be rolled out fast, provided that the operators have the smart devices, SIM cards and sales channels in place. However, the service content and tariffs are dictated by the MNO/MVNE. Therefore, it is difficult to differentiate the operator's own services in many cases. This style is often employed by those operators which anticipate a synergetic effect on their existing services, or enhancement of access channels with their existing customers, rather than those hoping to make a profit from the connection service itself.

It is possible that operators successful in gaining a wider subscriber base will move on to a new business style in the future, to gain more degree of freedom or



*The mobile carrier type operation mode allows an operator not only to become an MVNO but also an MVNE and provide other operators with its platforms for their MVNO services.

PCC: Policy and charging control
GGSN: Gateway GPRS support node
PGW: Packet data network gateway

Figure 1
MVNO service provision styles.

profitability.

2) Hybrid style

Using MVNE's switching equipment to connect to MNO's infrastructure, the operator provides and operates its own infrastructure beyond this point. There are advantages in that the operator does not need to provide the switching equipment, or to negotiate the network connection with MNOs. Conversely, the operator's services may have limited originality depending on how the MVNE's switching equipment is operated (control features of the installed equipment and operational styles of other accommodated MVNOs services).

3) Mobile carrier style

The operator must negotiate with MNOs for network connections, and provide all the infrastructure required for the service provision, including the switching equipment. This gives the operator freedom, in principle, in terms of service content and tariff structure, and thus gives advantages in differentiating them from competing MNOs and MVNO service providers. This style also makes differentiation by line quality possible, and for this reason, many telecom carriers find it a viable option when first entering the market. In this case, operators tend to aspire to deriving benefit from the advantage of scale, a basic principle of the network business. Therefore, they also offer MVNE services in many cases.

The above three styles represent the categories from the MVNO's point of view. They share some component technologies regarding the network nodes in use, while MNOs also employ similar technology.

In the next section, we will explain these component technologies, describing the specific system that realizes flexible service/tariff structures.

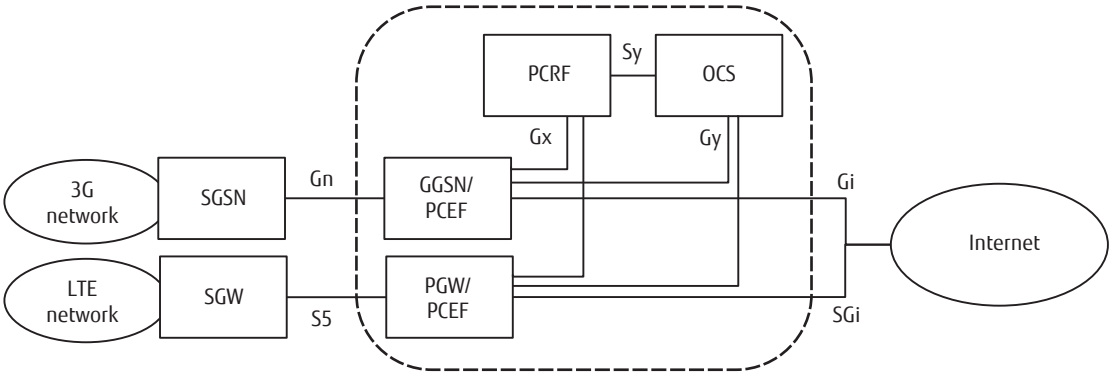
3. Component technologies to realize MVNO services

Components required for mobile services, such as mobility control specifications, are standardized by the Third Generation Partnership Project (3GPP). MNOs in various countries develop their systems based on these standards.

For the MVNO business, the connection fees in proportion to the contract bandwidth by MNO typically account for a large portion of the overall operational cost. For this reason, the operators try to keep the contract bandwidth to a minimum while they employ traffic control to maintain a good user experience. Also, they may need to offer controlled services for certain classes of their clients in order to differentiate their services.

In this regard, policy and charging control (PCC) architecture is an important factor in the standards. Line quality of service (QoS) control and other policy controls are combined with flow-based charging control in the PCC architecture, which is a general-purpose architecture that can be applied to the access network to achieve the IP connection. Presently, the most common connections for MVNO are 3G and LTE, but PCC architecture can also be applied to other types of connections.

The PCC architecture based on the GPRS Tunnelling Protocol (GTP) comprises the following components (**Figure 2**).



SGSN: Serving general packet radio service support node

Figure 2
PCC architecture and interfaces.

1) Policy and charging enforcement function (PCEF)

It performs the QoS and gate controls by each flow according to policy settings. In dynamic policy control, the policy is obtained from PCRF via the Gx interface. It also notifies the online charging system (OCS) via the Gy interface about network use and other information necessary for charging fees. These functions are often covered by GGSN for 3G, and PGW for LTE connection.

2) Policy and charging rules function (PCRF)

It determines the policy for each flow, and sends out the policies to PCEF via the Gx interface. There are two types of policy notifications: pull and push. In the former, a policy is enforced at the point where devices connect to the network, while in the latter, a policy is transmitted at the network's unique timing. PCRF executes push-style control by connecting the user information it manages and the Diameter session established in relation to PCEF.

3) OCS

It controls the charging information based on the connection use by flows, and notifies PCRF via the Sy interface about the events that stipulate changes in policy, such as when the data use exceeds a threshold.

A typical policy enforcement procedure is illustrated below (**Figure 3**) as a basic sequence on LTE connection:

- PGW/PCEF sends out a request for policy acquisition to PCRF, prompted by the session request by serving gateway (SGW),
- PCRF determines the applicable policy based on information, such as the user identifier contained in the policy request, and sets it up on PCEF,
- PGW/PCEF establishes a charged session according to the OCS and the policy,
- It enforces the policy applied to the user data, and forwards the data.

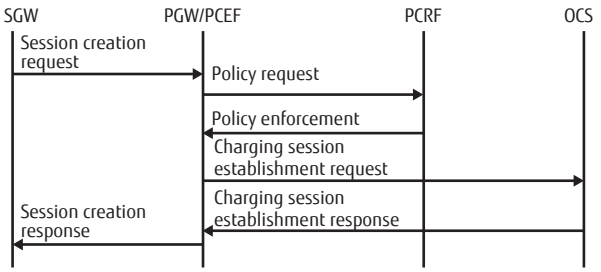


Figure 3
Basic sequence.

As described above, a tariff structure is kept flexible through effective use of lines by virtue of the standardized mobile technology. Flexibility extends to services; for example, certain types of data access are not charged.

4. Challenges and solutions towards realizing Japanese MVNO services

We anticipate that MVNO services will attract companies from diverse industries beyond the boundary of the telecom industry to serve as operators. We consider that these new players may need to overcome the following challenges before starting their MVNO services:

- Setting up work unique to MVNO,
- Establishing use cases unique to the Japanese market.

The tasks unique to MVNO services include registering subscribers' user data on SIM cards and activating them, and performing online charging and real-time verification of packet usage. These tasks require expert knowledge on network nodes for activating service orders and configuring service plans for network nodes. For new operators from other industries, this requirement would be very difficult to meet.

Regarding the use cases unique to the Japanese market, we present an example of the heavy-user restriction. In Japan, it is often the case that, if a user consumes about 3 GB of data transmission within three consecutive days, a restriction is imposed on this user's connection speed for a certain period of time from the following day. This rule is unique to Japan, and such a use case is not recognized in products by global vendors. In order to enforce this heavy-user restriction, the system must have the dedicated features stated above built in.

To provide a solution to these challenges, Fujitsu offers a network node set for global vendor products and mediation servers that cater to MVNO-specific work processes, as well as the use cases unique to the Japanese market. By combining these features, our solution helps operators to quickly launch MVNO services in Japan (**Figure 4**).

The mediation server offers a package that covers the tasks unique to the provision of MVNO services, bridging between the operator's existing trunk system and MVNO network nodes. It also helps to scale up

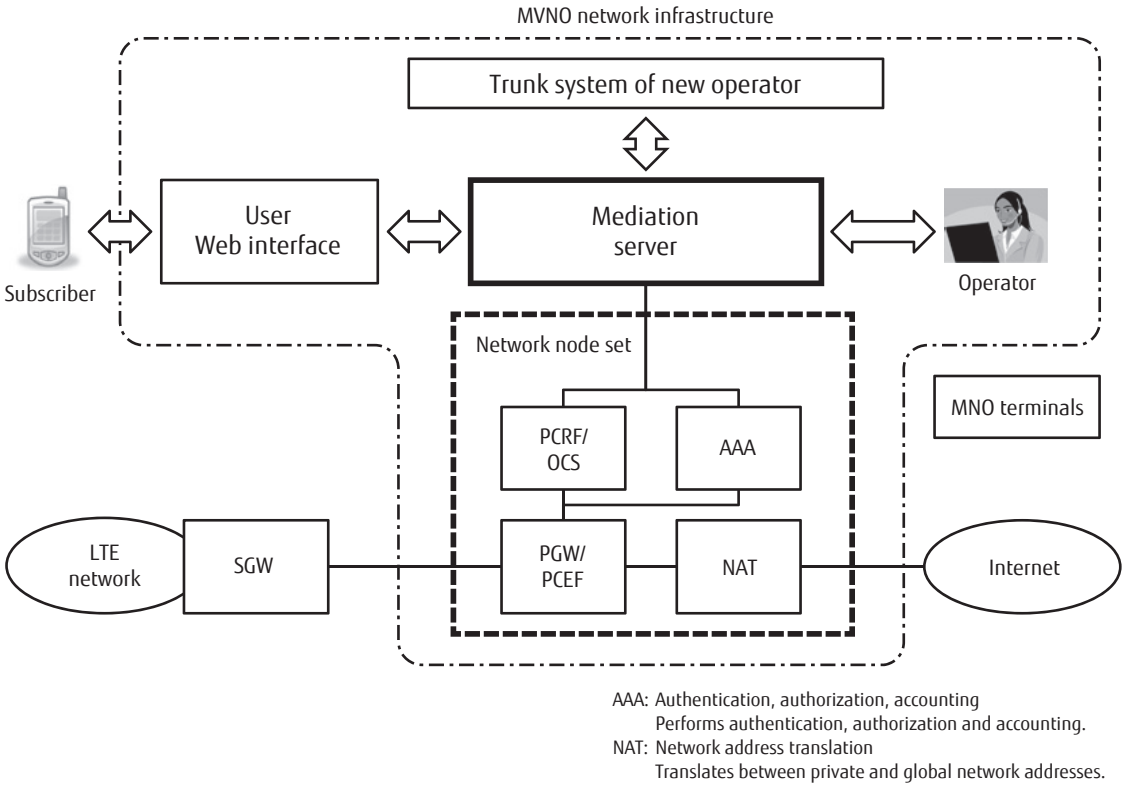


Figure 4
Fujitsu MVNO solution (outline).

services to account for use cases with which global vendor products are not compatible. The mediation server allows new MVNOs to swiftly launch their MVNO business while keeping the impact on their existing trunk system to a minimum.

The mediation server is equipped with the Web portal API, operator Web interface, interface for existing trunk system, and network node control feature. It is capable of performing MVNO-specific tasks in one package, including subscriber registration, SIM registration and activation management, registering subscriber information on network nodes, real-time online charging and service diversification (e.g., heavy-user restriction) (**Figure 5**).

The server seamlessly integrates the operator's existing customers into MVNO services, for which it offers an interface, enabling data sharing with the operator's existing subscriber management system, mailing system and charge management system. This bridging feature allows subscribers to use their account information to subscribe to MVNO services, without having to create additional user accounts or re-register credit card details.

Furthermore, several MVNOs can be carried on the same server to share one network node set. This feature caters to an MVNE business. Individual systems that need to be operated separately as MVNO businesses (user Web interface, subscriber management system, etc.) can be managed independently by respective MVNOs under this system. As for the configuration of service plans, which require expert knowledge on network nodes, MVNOs can simply chose a preferred service plan from preset ones provided by the MVNE, which operates the mediation server. This allows the MVNOs to provide their customers with MVNO services quickly without necessarily possessing the network-node-related knowledge.

The MVNO market is still developing, and thus Fujitsu will be expanding its MVNO solution in tandem with the market development. This should include the enhancement of features such as in-store sales support for mobile number portability (MNP) and other policy-handling processes, as well as adaptation to the hybrid MVNO.

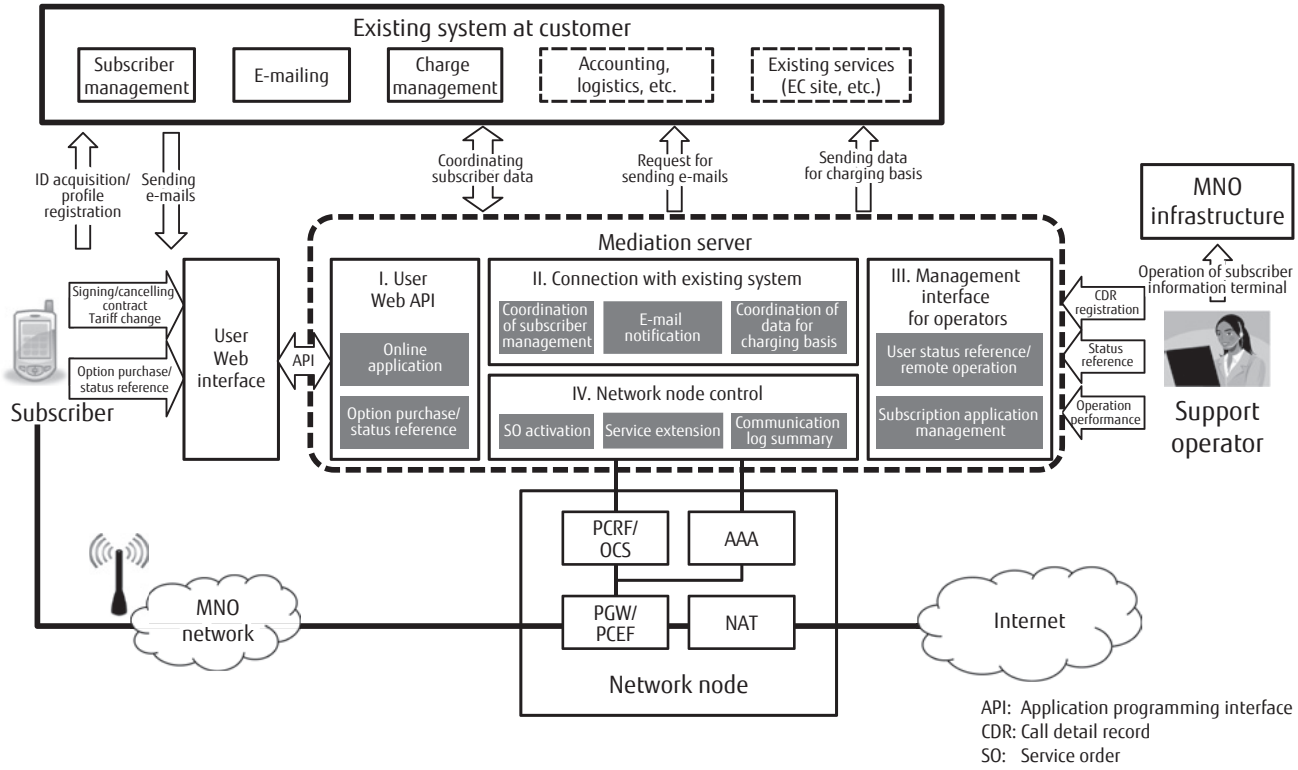


Figure 5
Mediation server (outline).

5. MVNO evolution and the direction for Fujitsu solutions

Lastly, we will describe the MVNO solution which we are trying to achieve.

1) Low-price platforms through technology innovations

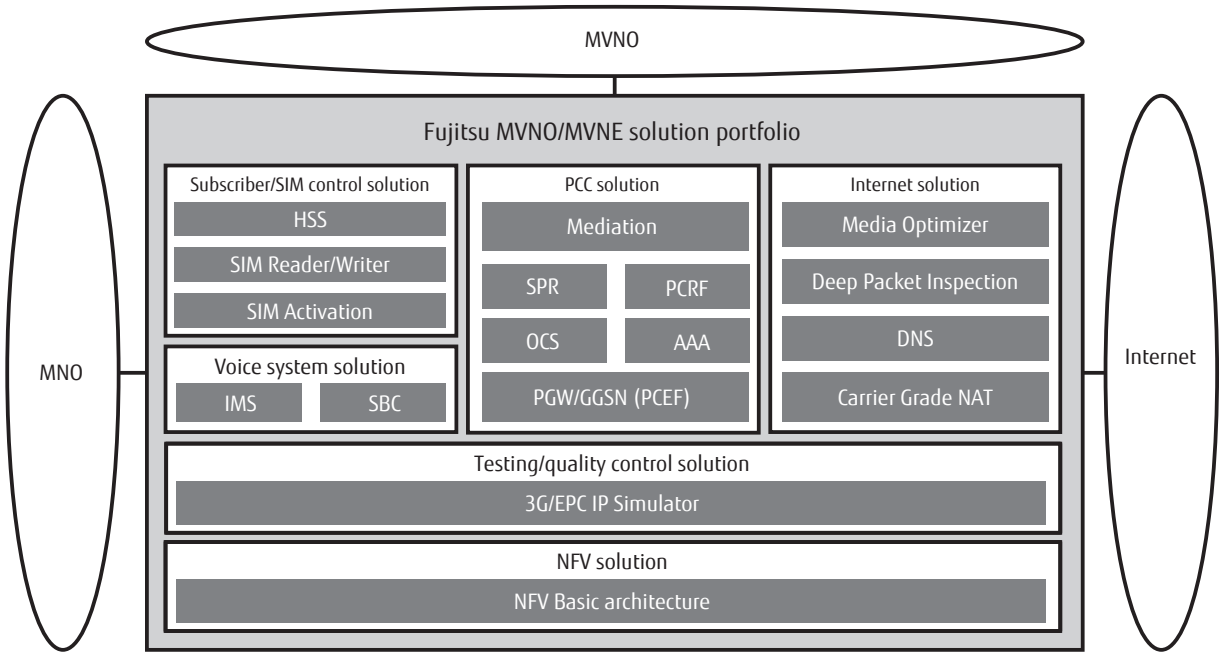
For a mobile-carrier-type MVNO to gain more footage, cost reduction on infrastructure investment and operation/maintenance cost is one important factor, to be achieved through innovative technologies.

It has been customary to connect with the MNO's network using the dedicated switching equipment approved by the MNO or its equivalent. This practice has been observed in the Japanese mobile network market due to the emphasis placed on the cultural value of safe, secure and credible connection services.

However, many vendors, including venture companies that challenge legacy vendors, offer software-based, low-cost products that meet the aforementioned requirements. Many of these products can be run on PC servers. Also, they have been developed not simply for performing the switching function, but for being able to carry out network functions virtualization (NFV) in order to perform other network functions virtually. As the NFV-based solutions gain recognition and are put to successful application in Europe, the U.S. and Asia, the Japanese market may potentially take to it not only for MVNOs, but also to replace a part of MNOs' core networks. Fujitsu also is working hard on NFV products, in terms of technology development, evaluation and testing. We already have several products that, in our opinion, can meet the stringent requirements of the Japanese market. We hope to further drive the mobile market in Japan by proactively introducing and promoting these products in the Japanese market.

2) Unbundling MNO functions

The MIC is driving a debate about unbundling the functions that have hitherto been under MNOs' monopoly, aiming to stimulate vigorous competition between MNOs and MVNOs. The deregulation of home subscriber server (HSS) and home location register (HLR), which form the subscriber database for managing SIM



DNS: Domain name system
EPC: Evolved packet core
SBC: Session border controller
SPR: Subscriber profile repository

Figure 6
MVNO/MVNE solution portfolio.

data and location[note 2)], is of particular interest. If MVNOs possess this function, they will be equipped with the prerequisite functions to start providing services such as issuing SIMs, managing the in-zone information, and handling voice calls.

If this is deregulated, MNOs will need to develop new open connection points and prepare their operation rules. The cost incurred through these efforts is likely to be recuperated partly through the charges on MVNOs that use these features. It is also possible that only a few of the major MNVOs will succeed in securing most users if the connection fees remain high—a situation similar to when the reciprocal connection through the Layer 2 was introduced between MNO and MVNO. Furthermore, there are still technological and financial obstacles, apart from the deregulation debate, related to the IP multimedia subsystem (IMS), as this requires the installation of self-owned infrastructure for operating SIM card writers, SIM activation and voice calls.

Also, deregulations may invite global giants such as Apple and Google into the Japanese MVNO market. Therefore, there is a need to consider the possible impact on the Japanese mobile market as such giant companies might succeed in monopolizing it. We expect to see the system develop to promote sound competition and diversification, leading to the enhancement of user convenience.

At Fujitsu, we continue to follow these developments, and aim to establish a rich portfolio of solutions that cater to various use cases, and drive the MVNO business development. We must strive to develop such products that allow a group of 10,000 to 10,000,000 subscribers to use services safely and securely, at reasonable prices (**Figure 6**).

6. Conclusion

At the beginning of the 2000s, countries in Europe and the U.S. pursued the deregulation of mobile network businesses, and succeeded in stimulating the market by bringing in new MVNOs. The prosperity of the market in Japan today is following the same pattern, and hence it is fairly easy to forecast market

note 2) Information conveying the presence of designated devices within a certain network range.

growth through deregulation.

However, we consider that this trend will take a turn in the future, due to some unique aspects of the Japanese market, such as the predominant post-paid tariff structure and possibilities for combo-discount offers in tandem with the deregulations of public utilities such as gas and electricity.

Fujitsu will work with its customers and continue striving to create use cases that do not exist in advanced Western cases so that it can present solutions Japan can proudly offer to the world. In this way, we will make a contribution to the progress of the MVNO market both inside and outside Japan.

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