Leveraging General-purpose Technology and Open Community Activities

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Abstract

The NTT laboratories are revolutionizing their development techniques for network systems in order to support a collaboration model and respond flexibly to market changes and technology trends. This article describes our approach to building function groups using open source software and hardware components and introduces our activities in the open community.

Keywords: OSS, open innovation, community activities

1. Environment surrounding network systems

The environment surrounding network systems can be described from three key perspectives: a change in technology trends, a change in trends of Japanese/overseas telecom carriers and vendors, and a change in business structure.

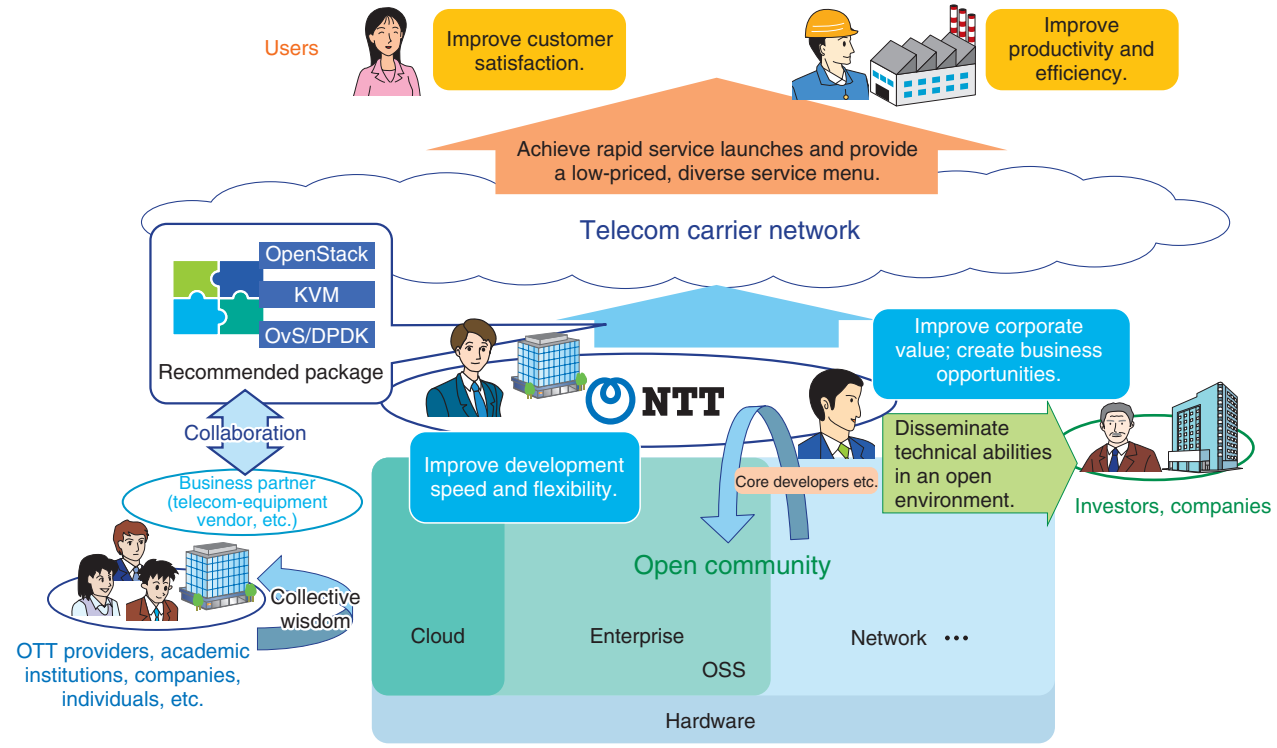
1.1 Change in technology trends (conversion to general-purpose technology)

An examination of hardware technology trends in information and communication technology products reveals that functions heretofore implemented using specialized equipment for telecom carriers are now being achieved using general-purpose devices at an accelerating rate. In particular, high-performance general-purpose processors are enabling functions traditionally processed by hardware to be done by software, and at the same time, hardware and software are becoming increasingly separated through virtualization, enabling functions to be implemented with an even higher degree of freedom. In the datacenter industry, there are many open source software (OSS) packages that can be openly used on a licensing basis. At NTT, we are actively using and contributing to OSS developed within the NTT Group while playing a core role in the global OSS community. The use of OSS makes it possible to achieve reliability and long-term stability through inspection of code in open forums and to achieve a high level of flexibility by responding to diverse user needs. It therefore promotes greater flexibility and speed in software development.

1.2 Change in trends of Japanese/overseas telecom carriers and vendors

Compared to the situation in the datacenter industry, equipment development in the telecom-carrier network field has traditionally been slow, and it has been costly to achieve large-scale, high-reliability, and high-performance networks.

However, OTT (over-the-top) service providers and the so-called *hyper giants* in particular have adopted open product architecture to create an extensive product market whose application scope is rapidly expanding from cloud systems to enterprise and network systems. In line with this movement, telecom-equipment vendors have begun to use such open functions when implementing products. Some telecom carriers in Europe and the United States, moreover, have begun to open up their own products and hold community-based implementation-promotion



DPDK: Data Plane Development Kit
KVM: Kernel-based Virtual Machine
OvS: Open vSwitch

Fig. 1. Revolution in network-system development.

activities with the aim of improving their products and applying them to telecom carrier networks. As a result, it appears that the trend toward system development that assumes the embedding of OSS will accelerate all the more in the field of telecom carrier networks.

In addition, we can expect the proactive participation of telecom carriers in the OSS community through contributions and other activities to speed up the adoption of requirements in the field of telecom carrier networks. Such activities can enhance a telecom carrier's visibility among customers, investors, and business partners, improve corporate value, and create new business opportunities.

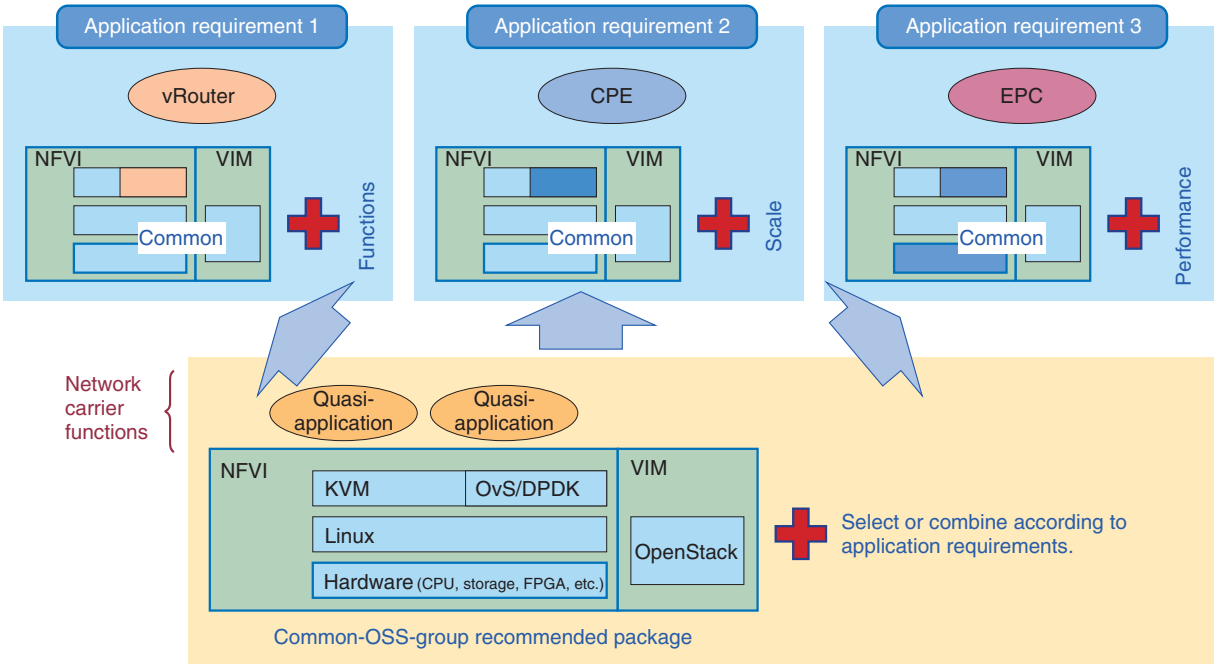
1.3 Change in business structure

At NTT, the transition from a B2C (business-to-consumer) to a B2B2X (business-to-business-to-X) model is accelerating, and as a result, there is a growing need to provide prompt and flexible network functions tailored to the needs of the second *B* (business partners). Consequently, there is also a need in the field of telecom carrier networks to achieve functions that meet the needs of customers in a more flexible, cheaper, and faster manner.

2. Revolutionizing network-system development using OSS

In light of the above changes in the business environment, NTT is revolutionizing its network-system development techniques to accelerate the modularization and combination of network functions. The overall goal is to create a flexible network that can give the service menu more degrees of freedom and facilitate the speedy provision of services. At NTT, we seek to accelerate such modular-type development by making a transition from the conventional in-house development and procurement method to a method that uses OSS and general-purpose hardware components and that works to incorporate telecom-carrier requirements in the open-source community for implementation in OSS (**Fig. 1**).

The following two issues must be addressed in the



CPE: customer premises equipment
CPU: central processing unit
EPC: evolved packet core
FPGA: field-programmable gate array
VIM: virtualized infrastructure manager

Fig. 2. Building function groups.

use of OSS:

(1) Accumulating know-how in building functions consisting of OSS components conforming to standard architecture
(2) Finding methods of dealing immediately with missing OSS functions or software bugs

To resolve these issues, we are building function groups and taking part in open-source community activities as described below.

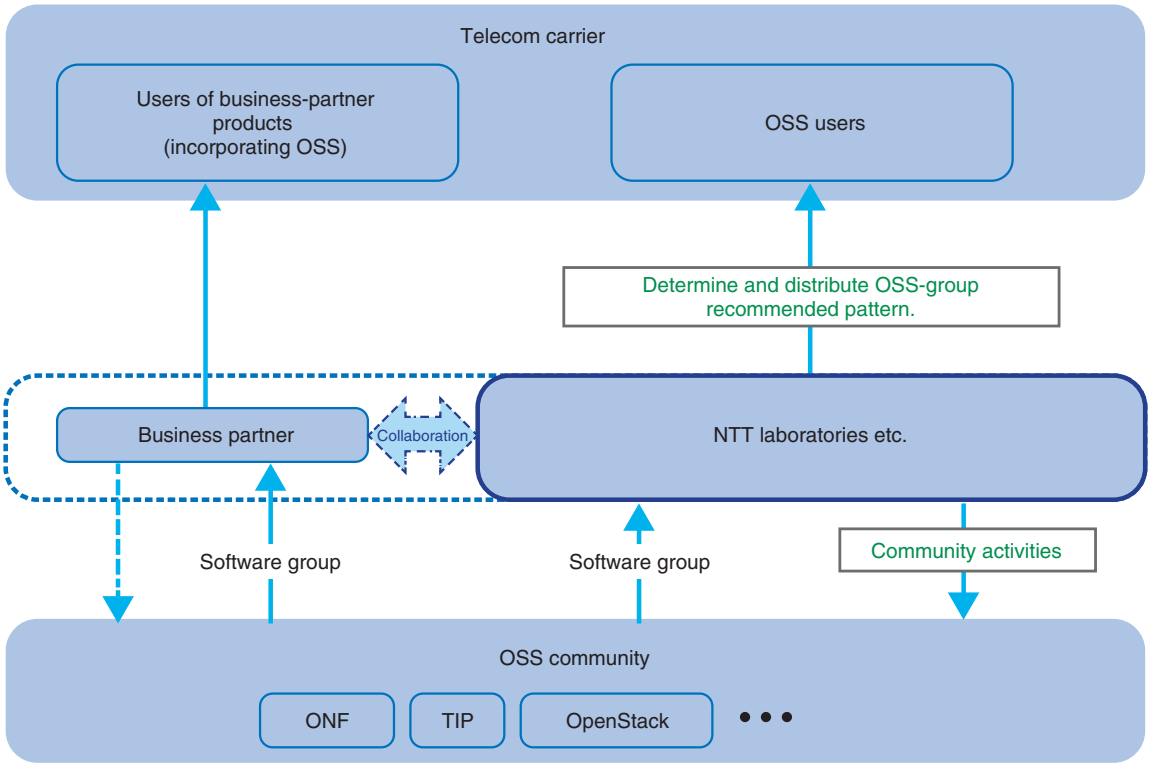
2.1 Building of function groups

System implementation in the case of a telecom carrier network requires the provision of functions that combine a wide variety of hardware and software, products from various companies, and OSS as well as those in many variations including different software versions. A telecom carrier network, in particular, requires that an optimal combination of functions be selected to satisfy its functional and nonfunctional requirements. As a means of meeting this need, we are providing a common-OSS-group recommended package that compiles functions that can be used in common while having a business partner such as a vendor decide on a recommended pattern according to application requirements and provide the associated software.

We consider, for example, cases of building function groups conforming to network functions virtualization (NFV) architecture now being standardized at the European Telecommunications Standards Institute (ETSI) [1]. Here, a virtual network function (VNF) consisting of diverse network functions runs above the network functions virtualization infrastructure (NFVI) and management and orchestration (MANO) sections. However, while NFVI and MANO are affected by VNF requirements, they are not dependent on specific network functions, so they can be assembled as common functions (**Fig. 2**).

The main features of this common function group composed of OSS are listed below.

- A platform that satisfies diverse VNF requirements
- Proactive use of OSS and general-purpose hardware
- An architecture that partially uses required functions
- Use of tools from the datacenter field
- Application of knowledge and know-how related



ONF: Open Networking Foundation
TIP: Telecom Infra Project

Fig. 3. Function-group building cycle.

to quality/maintenance management cultivated at NTT laboratories
- Guarantee of connectivity to equipment from diverse vendors

This common function group can now be provided with software from a business partner who has determined a recommended pattern according to application requirements. This makes it possible to provide an operability-confirmed recommended package that extends as far as the application itself. This can simplify troubleshooting in the event of a problem and thereby reduce any system downtime (**Fig. 3**). Going forward, we will continue our efforts in resolving technical issues and easing requirements with the aim of expanding the use of this common function group.

2.2 Community activities

In system applications to a telecom carrier network, there will be times when an immediate response is needed in order to deal with missing OSS functions or software bugs. We can therefore envision cases in which missing functions are temporarily created, but continuing to respond in this manner can result in a dramatic increase in individual functions. Within the OSS community, however, publically released OSS may be objectively used and tested by engineers in various companies who may then point out software bugs or functional deficiencies. We can therefore expect software functions and quality corresponding to common requirements of telecom carriers to improve via the OSS community.

With this in mind, we are promoting community activities from the viewpoints of opening up NTT research and development products and conveying requirements to the OSS community. Here, we are examining existing OSS in terms of compatibility with telecom-carrier development strategies, degree of community activity, degree of software completion, and application fields and talking to specific communities that have a high affinity with our own products and a high OSS usage effect. Additionally, with respect to functions that we judge to be insufficient, we are conveying telecom-carrier requirements to the OSS community. The communities that we are

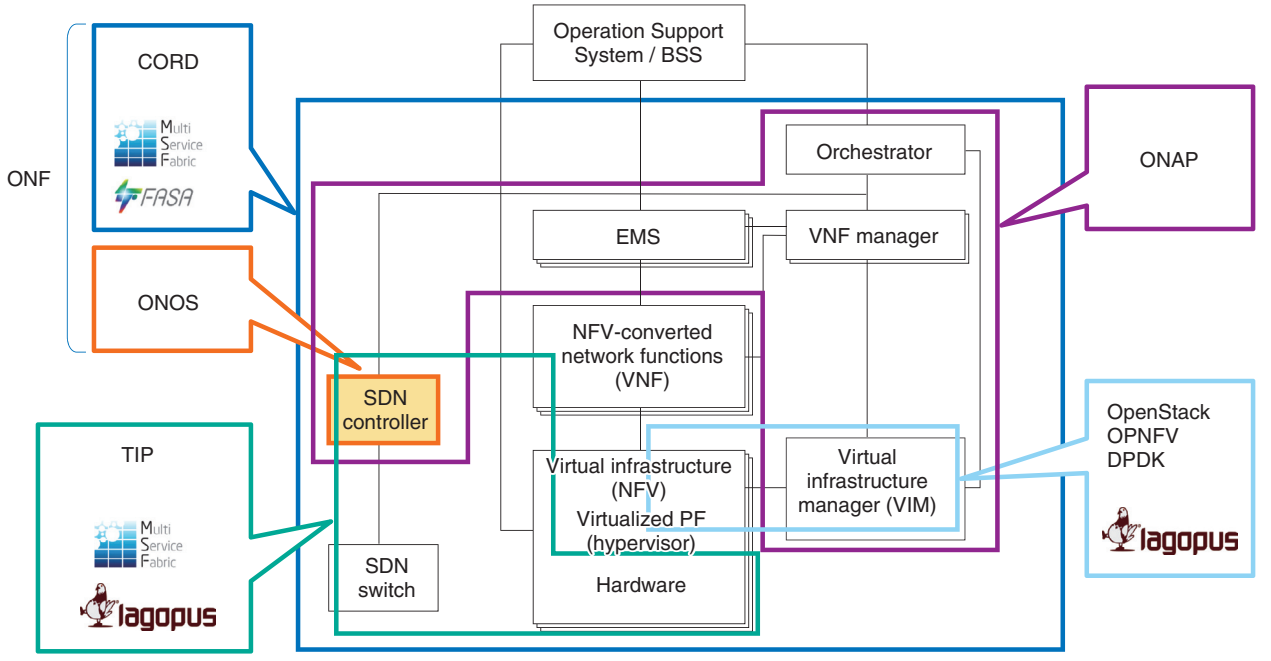


Fig. 4. Targeted communities.

currently targeting based on this policy are shown in **Fig. 4**.

In the area of software-defined networking (SDN) switches and controllers, we are promoting Multi-Service Fabric (MSF) [2] technology developed by the NTT laboratories as part of our activities in the Telecom Infra Project (TIP) [3], which aims to standardize the next-generation SDN controller satisfying telecom carrier requirements. Similarly, with the aim of popularizing the Lagopus [4] switch developed by NTT laboratories within TIP, we are working toward a proof of concept demonstration. In Open Networking Foundation (ONF) activities [5], our contributions include feeding back to the community the results of an evaluation conducted by the NTT laboratories on CORD (Central Office Re-architected as a Datacenter)-3.0 from the viewpoint of a telecom carrier. Additionally, in the area of virtual infrastructure and virtual infrastructure management, we are making contributions to OpenStack [6], Open Platform for NFV (OPNFV) [7], and the Data Plane Development Kit (DPDK) [8]. At OPNFV, we are following up our activities in resource reservation technology in the Promise project with upstream activities in the OpenStack Blazar project.

References

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[5] ONF, https://www.opennetworking.org/
[6] OpenStack, https://www.openstack.org/
[7] OPNFV, https://www.opnfv.org/
[8] DPDK, http://dpdk.org/

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