Flexible, User-Managed Network Implementation

Using open architecture-based OpenFlow* controller and Intel® Open Network Platform (Intel® ONP) to make complex network equipment configuration simple and flexible

NTT DATA

Headquartered in Tokyo, with business operations in more than 35 countries, NTT DATA provides professional services from consulting and system development to business IT outsourcing.

Challenges

- Build network using a highly flexible, open architecture
- Build system environment using OpenFlow* switches with high degree of development flexibility

Solutions

- Intel® Open Network Platform (Intel® ONP)
- NTT DATA Virtual Network Controller* Version 2.0

Business Value

- Confirmed performance of communication between Intel ONP switch reference model and Virtual Network Controller Version 2.0 for user use cases.
- Verified OpenFlow 1.0 protocol, with verification of OpenFlow 1.3 protocol currently in progress.

"With demand for the speedy implementation of network infrastructure in accordance with user use cases, testing demonstrated the high degree of freedom and flexibility provided by Intel® ONP."

– Toshihiro Isobe
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SDN and OpenFlow Create a New Generation of Networks

With advances in virtualization technology, a diverse range of servers, storage, and other devices have been virtualized, providing solid momentum behind the shift to the cloud. Meanwhile, the growing complexity of networks is placing an ever-increasing burden on administrators. While a virtualization environment makes it easy to set up and move virtual servers, changing settings on network equipment remains a manual operation that needs to be performed separately for each device. As networks carry a fast-growing and increasingly diverse volume of data, providing reliable services requires optimal data transfer methods based on advanced network design and complex device settings.

To help overcome this bottleneck, interest is growing in architectures that can be implemented in software to free network control from physical constraints. Software-defined networking (SDN) has emerged as way to give users—previously required to use the network controllers built into conventional network hardware—the option of selecting control software from a wide range of options in an environment that also supports user-based development. Benefits of this approach include software-based centralized management, operational automation, and

By combining processors, chipsets, and other components required for network equipment, the open architecture Intel® Open Network Platform is accelerating the shift to open networks.

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the ability to optimize data transmission by software alone.

OpenFlow is one technology for controlling networks via software. The idea is to separate packet transfer (hardware) from decisions on the transmission route (software), functions that in the past were integrated together in each switch, and to place an open interface between the two. OpenFlow is a standardized interface that can be used as required, with network functions implemented by linking OpenFlow switches and OpenFlow controllers (Figure 1).

With OpenFlow's standardized protocol for hardware control, not just the switch vendor, but also other developers, can create their own network functions as required.

Having already contributed to making server hardware more open by supplying components such as processors and chipsets, Intel has now announced Intel ONP, an open architecture that extends this model to network equipment.

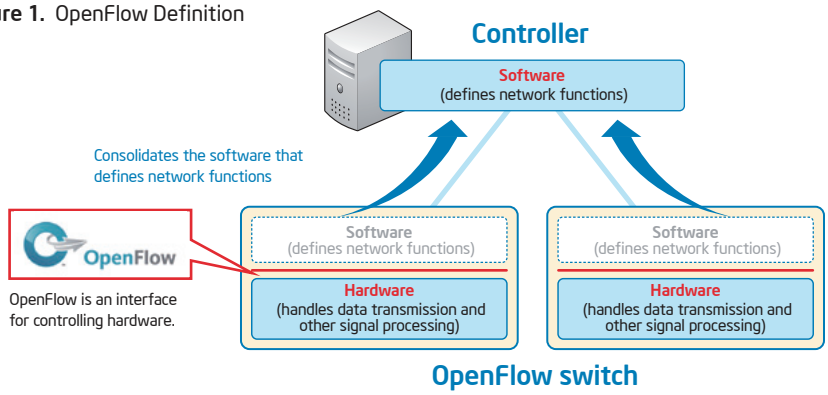
Intel has also started delivering reference models that combine processors, switches, network operating systems, and software as a package. As a result, previously complex network equipment can now be configured flexibly, just like assembling a server. Using standard Intel® architecture-based servers and programmable switches to manage network infrastructure can both cut costs and offer a growing prospect of new network services.

Commercial OpenFlow Framework

NTT DATA has worked on research and development of OpenFlow since 2010. This included helping standardize OpenFlow through the Open Networking Foundation (ONF), a non-profit organization established by user companies in 2011 to define OpenFlow standards. OpenFlow controllers that control OpenFlow switches were a particular focus of research and development, with control of multi-vendor switches being trialed successfully in 2011 to automate operation across the entire cloud environment.

"As a software developer, we see our role at NTT DATA as being to supply OpenFlow solutions optimized to work with the standards set by ONF and in a way that suits user requirements," explained Toshihiro Isobe, senior manager of the System Engineering Business Unit, System Platforms Sector, Solutions & Technologies Company. "Before OpenFlow, the only way to proceed was for the integrator to deliver systems by combining the functions of black-box network equipment. Now, OpenFlow has taken away that constraint. Positioned close to the user as we are at NTT DATA, we see OpenFlow as a new way of configuring network systems that match user requirements because it gives

Figure 1. OpenFlow Definition



OpenFlow is a standardized interface for hardware control used to implement SDN. Separation of hardware and software facilitates network control, centralization, and integration with systems.

users the flexibility to select or develop the functions they require."

Based on know-how accumulated through its past activities, NTT DATA released Virtual Network Controller Version 2.0 (VNC 2.0) in February 2013. This new OpenFlow controller is suitable not only for data center networks, but also for applications such as wide-area or internal corporate networks. VNC 2.0 is a commercial software framework that allows OpenFlow controllers to be installed easily to suit different user use cases. It consists of the Virtual Network Controller-Network Operating System* (VNC-NOS*), which handles communications with OpenFlow switches, and the Virtual Network Controller-Application* (VNC-AP*), which provides switching and other network functions. VNC-NOS allows the installation of applications developed by third parties using the VNC-NOS API (network control API) (Figure 2).

"While existing OpenFlow controllers have provided an open source (OSS) framework that is not tied to specific use cases, from our perspective at NTT DATA, we decided to provide a commercial framework designed for specific use cases so that users could be confident about configuring OpenFlow controllers," says Hiroshi Nagasono, manager of the System Engineering Business Unit, System Platforms Sector, Solutions & Technologies Company,

Testing of Intel ONP Switch - VNC 2.0 Communications and Network Performance

NTT DATA has tested OpenFlow switches from a variety of vendors from the prototype stage to confirm that VNC 2.0 can work with many different switches. This testing has now included the Intel ONP switch reference design, an OpenFlow switch that uses the Intel ONP framework.

Isobe explains the motivation for this work: "The history of the shift from black-box switches to open interfaces has followed the same path as the shift from mainframes to open Intel architecture-based servers. Since the processor inside the switch is a key component of OpenFlow, we decided we should be working with Intel with its track record in Intel architecture-based servers."

Similarly, Nagasono commented that, "OpenFlow has let some much-needed air into a networking industry that had ossified. With growing momentum among integrators like us for taking on the existing industry structure, the harmony between our own thinking and Intel's world view of demolishing and rebuilding existing arrangements was another factor behind our teaming up."

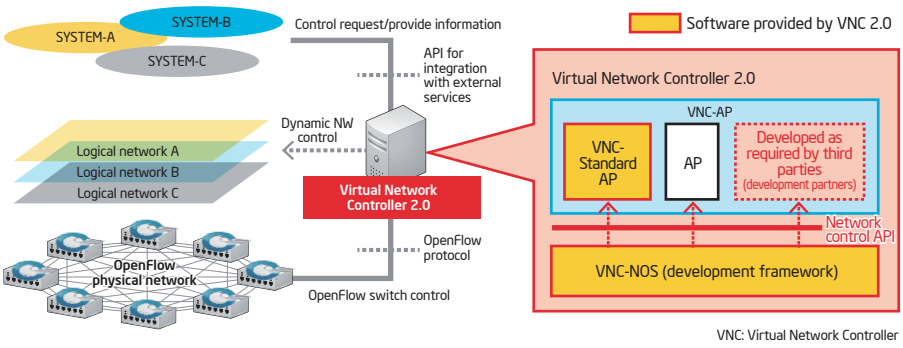
Testing confirmed that VNC 2.0 and the Intel ONP switch reference design complied with the OpenFlow standard and could communicate with each other. The tests also verified that the performance of the overall network, including peripheral equipment, was maintained even under heavy communication loads.

"While many network device vendors promote SDN," Isobe said, "in terms of achieving a level of openness that does not depend on specific vendor functions, it is important that switches be designed to work faithfully in accordance with the OpenFlow standard. Since our test environment was created according to the use case of some real user, I cannot talk about the details of it. The testing focused on verifying that the basic set of functions worked correctly."

With testing of the OpenFlow 1.0 protocol completed, the plan was to move on to testing the new OpenFlow 1.3 protocol.

"As our primary focus shifts to testing the OpenFlow 1.3 protocol," Nagasono said, "the greater number of specifications defined in version 1.3 compared to version 1.0 means that we need to use higher-spec hardware. Despite concerns that the processors used in existing network equipment might be inadequate for maintaining performance while also supporting version 1.3, this obstacle has already been overcome by Intel ONP, which provides extremely extensive coverage of the 1.3 specification. Our plan for the future is to continue testing based on use cases with an implementation of version 1.3 that we share with Intel."

Figure 2. Virtual Network Controller 2.0



Architecture of Virtual Network Controller 2.0

Intel ONP Expands the Potential of OpenFlow

Considering the testing in its entirety, NTT DATA was particularly impressed by the flexibility of Intel ONP. As Isobe noted, "Intel ONP is a reference architecture that supports SDN over a wide scope, extending from switches to servers and network cards. With SDN being used to expand the potential of cloud-based ICT systems, Intel ONP's ability to operate switches using only Intel architecture-based servers indicates that switching can be implemented using only a desktop PC. Since this architecture can open up such possibilities, it means that the arrival of Intel ONP in the marketplace is a very significant event."

Nagasono added, "Since Intel ONP is a growing platform, we anticipate its development will be fast enough to keep pace with the evolution of SDN."

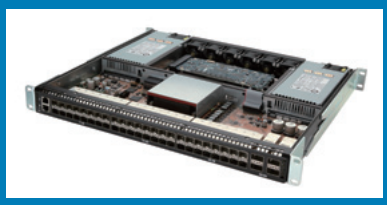
NTT DATA implemented a virtual network combining Intel ONP switches with VNC 2.0 in a Tier 1 class user environment and has plans to extend this to Tier 2 and 3 users.

"Because both OpenFlow and Intel ONP are global-scale technologies," Isobe said, "we plan to deploy them not only in Japan, but also in other parts of the world. In addition to further technical testing of OpenFlow with a view on its use in overseas market segments, we will continue working towards the adoption of open architectures throughout ICT systems, including the network. This includes participating as a steering committee member in the Open Data Center Alliance (ODCA), a user organization promoting the standardization of cloud computing and data centers, and also strengthening our partnership with Intel, a technical advisor to ODCA."

Intel ONP looks set to continue contributing to NTT DATA's business as it seeks to realize the ideal network and create new value.

Intel® Open Network Platform Switch Features

- Intel architecture-based processor for switch control and Intel® FM6764 Ethernet Switch silicon, a 10G/40G switch processor with low latency
- Open Network Software (network operating system)
- Open and modular control plane API
- SDN protocol support: VxLAN*, NVGRE*, and OpenFlow
- Server load balancing function, line-rate Advanced NAT function



For more information on Intel® Open Network Platform, visit
http://www.intel.com/content/www/us/en/switch-silicon/open-network-platform.html

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