Achieving Tbit/s-level Transport Functions with White-box Switching on Virtual Networks—Driving NetroSphere with Network Architecture (MSF) that Maximizes General-purpose Equipment

1. Introduction

NTT has developed transport functions for carrier networks using white-box switches[*1], which are general-purpose communications equipment, and demonstrated the possibility of configuring carrier-provided Tbit/s-level virtual networks using only general-purpose communications equipment. This has been achieved by using software that enables the use of Multi-Protocol Label Switching (MPLS) functions required for virtual networks, which were prepared as hardware for commercial white-box switches but could not be used. NTT has developed the software with completely open source technology so that many equipment vendors and carriers will be able to use this software in the future. As more equipment vendors begin to use this software, the white-box switch market that was once limited to the small-scale networks used in datacenters is expected to expand into the carrier network field. As well as having a much greater range of choices of network equipment, carriers will also have the ability to add functionality with network operating systems (network OS)[*2] themselves. This will make network configuration more flexible and make it easier to provide even faster communication speeds and more customer-oriented services.

These achievements are a big step towards realizing the general-purpose, modularized networks aimed for with the Multi-Service Fabric (MSF), which is an elemental technology of NTT's NetroSphere concept established in 2015 [1, 2]. NTT plans to conduct ongoing studies and engage in experimental operation of its testing environment called NetroSphere PIT [3], which was developed to implement the NetroSphere concept, as well as to participate in wide-ranging collaborations as initiatives for achieving openness at an unprecedented level and expanding the use of this technology by improving its functionality.

2. Background

Server performance and software technologies have improved in recent years, and with this, more and more virtual technologies have been adopted to economically achieve higher scalability and reliability, mainly in datacenters. The adaptation of these technologies for carrier networks by virtualizing computer and hardware resources has been gaining attention.

In line with the NetroSphere concept, NTT aims to provide both virtualization and fast, highly reliable, and even more diverse services to customers and service providers by driving commonization and modularization of network equipment. As part of these efforts, NTT is promoting its MSF initiatives to build

*1 White-box switch: General-purpose communications equipment that runs on equipment vendor hardware, for which software can be freely selected and developed.

*2 Network OS: Control software that runs internally in network equipment such as routers and switches.

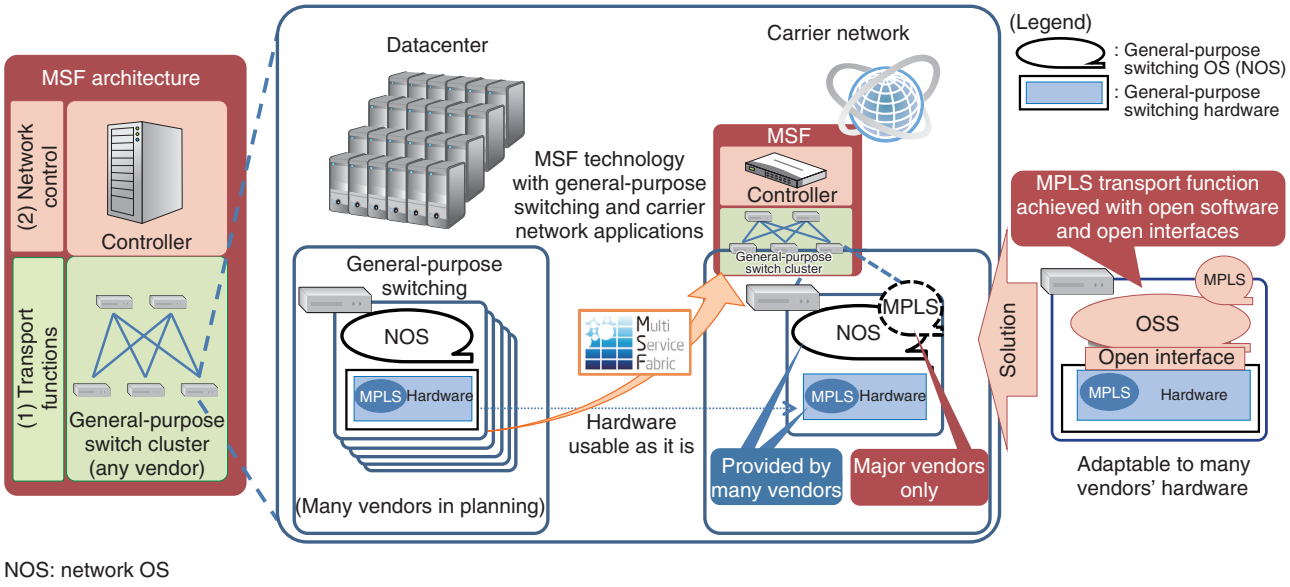

Fig. 1. MSF transfer function problems and solutions.

networks using general-purpose equipment by using general-purpose products with simple functionality instead of specialized equipment with high functionality. Because network functions can be developed independently, MSF provides network architecture in which simplified hardware for transport functions and software for network control can be separated and redefined. This architecture is aimed at achieving transport functions that make maximum use of generic network switches (general-purpose switches) as well as flexible software functionality for network control.

3. Software that maximizes the use of white-box switching

MSF uses generic switches mainly used in datacenters and is aimed at achieving carrier network virtualization (to configure network slices), although this requires transport functions that use MPLS technologies. To date, however, MPLS transport functions have only been provided with software (network OS) by some router vendors, even though hardware is equipped with many general-purpose switches.

Hence, NTT has created a software product that is equivalent to a network OS. The product can be mounted on white-box switches to achieve MPLS transport functionality by making full use of hardware performance (**Fig. 1**).

4. Software overview and effects

The software uses two techniques to achieve MPLS transport. It generates optimal pathways by exchanging network path data with other MPLS routers, and it writes the generated paths to hardware through an interface that supports MPLS transport (**Fig. 2**). The software functions are configured using only commercially available open source technologies such as open source software (OSS), so white-boxing is possible even in internal software configurations. At the same time, using architecture that maximizes hardware performance enables high-capacity, carrier-grade transport with white-box switching (1 Tbit/s/tens of thousands of paths).

These achievements mean that it is possible to apply general-purpose switches to carrier networks, and consequently, equipment vendors will be able to pioneer new markets (for general-purpose switches for carrier networks), which should bring down prices for general-purpose switches as well as lead to additional functionality through competition among vendors. Moreover, carriers will have a greater selection of equipment with which to build networks, and they will be able to modify network OS software by themselves.

These developments are driving the NetroSphere concept and MSF objectives of network commonization and modularization and will make it easier to

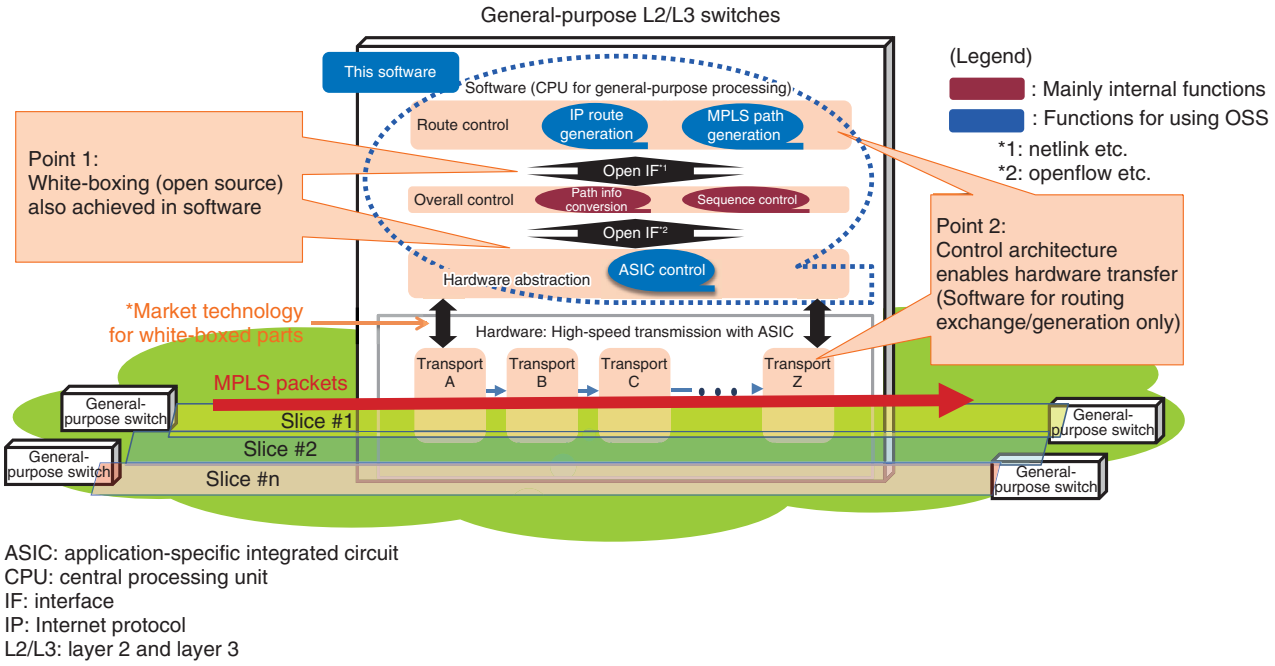

Fig. 2. Technical overview (software for white-box switches).

meet customer requirements with even faster communication speeds.

5. Future outlook

Beginning with NetroSpherePIT, NTT plans to carry out studies on experimental operations and further expansion of functionality in order to establish this technology, and to engage in even greater levels of openness by forming wide-ranging partnerships with various organizations.

References

[1] Press release issued by NTT on February 19, 2015. http://www.ntt.co.jp/news2015/1502e/150219a.html

[2] K. Takahashi, H. Yoshioka, K. Ono, and T. Iwai, "Promoting the MSF Architecture for Flexible Networks," NTT Technical Review, Vol. 14, No. 10, 2016. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201610fa6.html

[3] T. Okutani, A. Kawabata, T. Kotani, T. Yamada, and M. Maruyama, "NetroSpherePIT: Demonstrations to Accelerate the Adoption of NetroSphere," NTT Technical Review, Vol. 14, No. 10, 2016. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201610fa2.html

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