Service-partner-oriented Network Slicing

Takuya Sato, Tomohiro Okada, Shunsuke Homma, and Hidetaka Nishihara

Abstract

In the coming 5G (fifth-generation mobile communications) era, it will be necessary to create diverse services using networks with high-performance characteristics such as large-capacity broadband, massive session connectivity, and ultralow-latency and high-quality communications. This article introduces network slicing technology for rapidly constructing and providing virtual networks corresponding to such diverse service requirements, and slice gateway technology for achieving end-to-end slices that can maintain a fixed level of communications quality on an end-to-end basis.

Keywords: network slicing, 5G, end-to-end slice

1. Introduction

In the fifth-generation mobile communications (5G) era, it is expected that various new services will be created by taking advantage of the features of 5G such as high-capacity broadband, massive session connectivity, and ultralow-latency and high-quality communications. To realize these new services, a variety of networks will be required to meet various service requirements. The challenge is to provide networks quickly and flexibly in response to such demands.

2. Network slicing technology

Network slicing technology enables the simultaneous construction and operation of multiple virtual networks called *slices* having different requirements on a common physical infrastructure. Physical facilities are managed as resources that can be virtually partitioned, and these resources can be freely combined to create the virtual network needed. Conventional communications networks use expensive specialized equipment that takes time to build. In contrast, with slices, various services can be promptly provided by switching settings using general purpose equipment that is relatively inexpensive. This technology is expected to support networks of the 5G era. At NTT, our aim is to use this technology to quickly provide our service partners with the networks they need.

3. Slice gateway technology

The provision of networks for service partners with diverse requirements requires end-to-end slices, each of which can maintain a fixed level of communications quality on an end-to-end basis. One problem here is the construction and operation of end-to-end slices that straddle multiple provider networks managed under various rules. To solve this problem, NTT is proposing an architecture that deploys slice gateways (SLGs) at connection points between provider networks (**Fig. 1**). An SLG provides functions needed on a slice data plane such as protocol conversion, traffic allocation, and inter-slice isolation. The SLG deployed at the connection point between the networks can operate the slice across multiple networks with different specifications by performing appropriate conversion according to the specifications of each network.

We are currently installing SLGs using open source software (OSS) on the NetroSpherePIT [1] test platform and conducting trials. A slice can be constructed

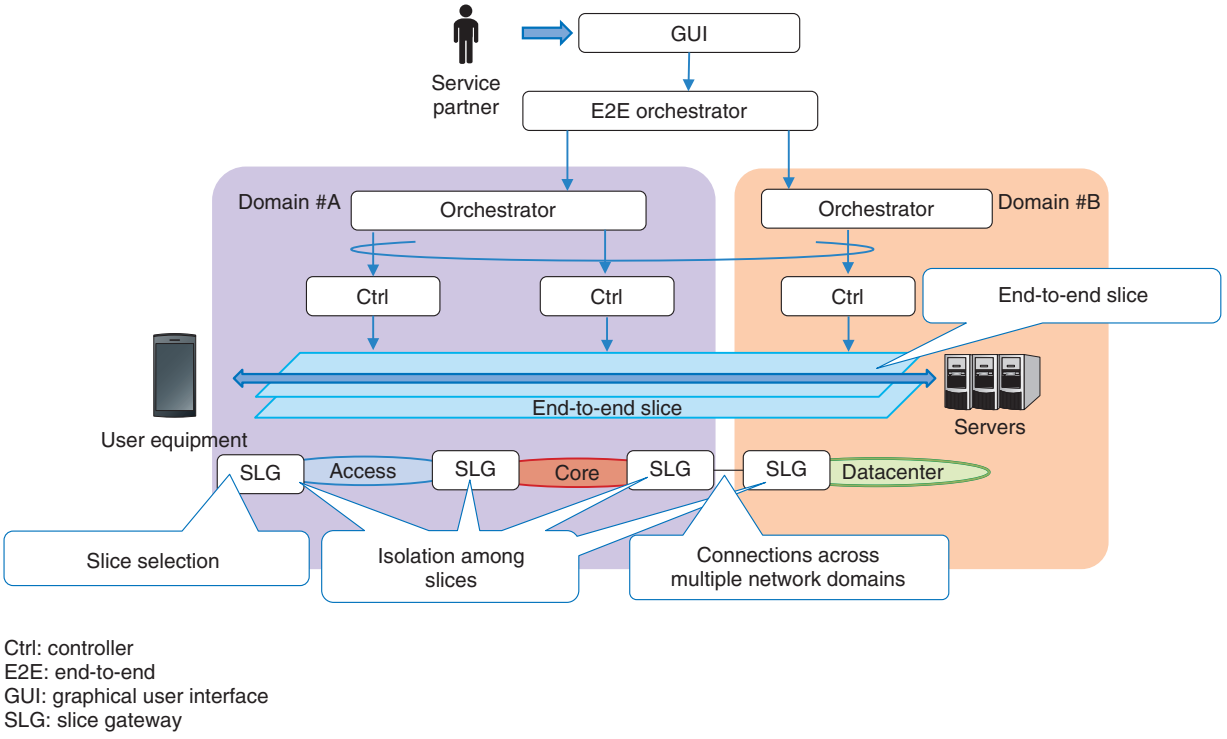


Fig. 1. Overview of proposed architecture.

using any protocol compatible with the specifications of the infrastructure network. We are investigating the construction of slices using the new technology SRv6 (Segment Routing Internet Protocol version 6). We are also constructing and evaluating end-to-end slices with latency guarantee [2] as an added function with the aim of providing an even better user experience. Finally, we have also developed a prototype GUI (graphical user interface) for constructing and switching slices and displaying slice operation status through telemetry technology. The research and development (R&D) results described above were presented at NTT R&D Forum 2018 Autumn held in November 2018. At this exhibit, service partners were able to experience slice control for themselves.

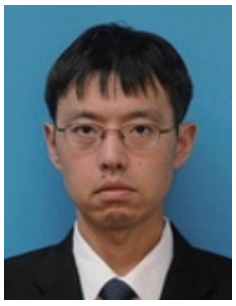
4. Future outlook

NTT is moving forward on refining network slicing and SLG technologies through test bed trials with an eye to commercialization. We are currently promoting global standardization with the aim of including these technologies in commercial products and de facto OSS.

References

[1] 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

[2] T. Fukui, Y. Sakaue, and K. Minami, "Guaranteed Transmission within Maximum Allowable Network Latency for Enhanced User Experience in Two-way Communication Applications," NTT Technical Review, Vol. 17, No. 6, pp. 20–22, 2019. https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr201906fa6.html



Takuya Sato

Researcher, Transport Service Platform Innovation Project, NTT Network Service Systems Laboratories.

He received a B.E. and M.E. in computer science from Tohoku University, Miyagi, in 2003 and 2005. He joined NTT EAST in 2005 and worked on the operation of communications networks. From 2007 to 2009, he wrote standard operating procedures for telecommunications equipment. From 2009 to 2018, he worked on configuring network termination equipment, which is network equipment that connects NTT's Next Generation Network to the networks of Internet service providers. He is currently studying network slicing.

Tomohiro Okada

Senior Research Engineer, Transport Service Platform Innovation Project, NTT Network Service Systems Laboratories.

He received a B.E. and M.E. in electrical engineering from Shizuoka University in 1991 and 1994. He joined NTT in 1994 and worked on the development of enterprise asynchronous transfer mode switches (BA-3000 Series). He was with NTT Communications from 1999 to 2012, developing the OCN broadband Internet service. He has also researched the application of distributed databases to network functions. He is currently studying network slicing.

Shunsuke Homma

Researcher, Transport Service Platform Innovation Project, NTT Network Service Systems Laboratories.

He received a B.E. in chemistry from Tokyo Institute of Technology in 2010 and an M.E. in basic science from the University of Tokyo in 2012. Since joining NTT in 2012, he has been engaged in research on network virtualization and development of service edge routers. He is also involved in the standardization processes for network functions virtualization and service function chaining. He is a member of the Institute of Electronics, Information and Communication Engineers.

Hidetaka Nishihara

Researcher, Transport Service Platform Innovation Project, NTT Network Service Systems Laboratories.

He received a B.S. from Kyoto University in 2011 and an M.S. in physics from the University of Tokyo in 2013. He joined NTT EAST in 2013. He has been with NTT Network Service Systems Laboratories since 2015, where he is studying policy control technology to achieve flexible traffic control by identifying applications from traffic. He is currently engaged in R&D of 5G transport with network slicing.