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KDDI Research., Inc.
NTT Communications Corporation
Red Hat K.K.
National Institute of Information and Communications Technology
Fujitsu Limited
Keio University
Infinera
OA Laboratory
ALAXALA Networks Corporation
Keysight Technologies (Former Ixia Communications)
The University of Texas at Dallas (UT Dallas)

iPOP2018 Showcase: Software-Defined Networking and Network Virtualization Technologies for Various Applications

● Introduction

Software-defined networking (SDN) and network virtualization technologies have attracted considerable attention from both academia and industry. Significant efforts have been focused on the efficient use of available network resources that can be achieved via more automation (e.g. SDN) and increased flexibility of the networks (e.g. virtualization) in order to mitigate CAPEX and OPEX in the communication networks. The iPOP2018 showcase presents a number of demonstrations that are based on SDN and network virtualization technologies in support of various applications. Briefly described below there are six network configuration use cases, which include (1) data-analytics-based optical performance monitoring assisted by container technique, (2) dynamic construction and control of virtual network platform utilizing OpenStack, (3) inter-carrier connection technology for critical traffic in the event of a disaster, (4) open and disaggregated transport network, (5) dynamic virtual machine (VM) migration with dynamic multi-layer configuration in support of autonomous driving vehicles (ADVs), and (6) optical slot switching (OSS) technology for future SDN controlled optical data-center networks.

● Showcase network configuration

Figure 1 shows the showcase testbed configuration. The data plane of the testbed is implemented at the National Institute of Information and Communications Technology (NICT) premises in Tokyo, Japan. The testbed consists of a beyond 100-Gb/s-based transport network (Fujitsu) with a client network (ALAXALA

Networks and Keio University and OA Laboratory), 10-Gb/s-based transport multi-domain networks (NICT), an open disaggregated transport network (ODTN) network (NTT Communications and Infinera) and an SDN-based data center network (NICT). The beyond 100-Gb/s-based network comprises two disaggregated WDM nodes and an SDN controller (NTT Communications). Each node is equipped with beyond 100-Gb/s optical transponders and 100-Gb/s Ethernet testers (Keysight Technologies) are connected to the client interfaces of the transponders. In addition, an Ansible Tower (Red Hat) is setup in order to control a Docker container application platform for acquiring sampled data from the beyond 100-Gb/s optical transponder for classification of the incoming optical signal format using convolutional neural networks. The client network comprises two core routers and three edge nodes (servers) with an orchestrator (orchestrating multi-layer (ML) network and VMs), which is located at the premises of University of Texas at Dallas (UT Dallas) in Texas, USA.

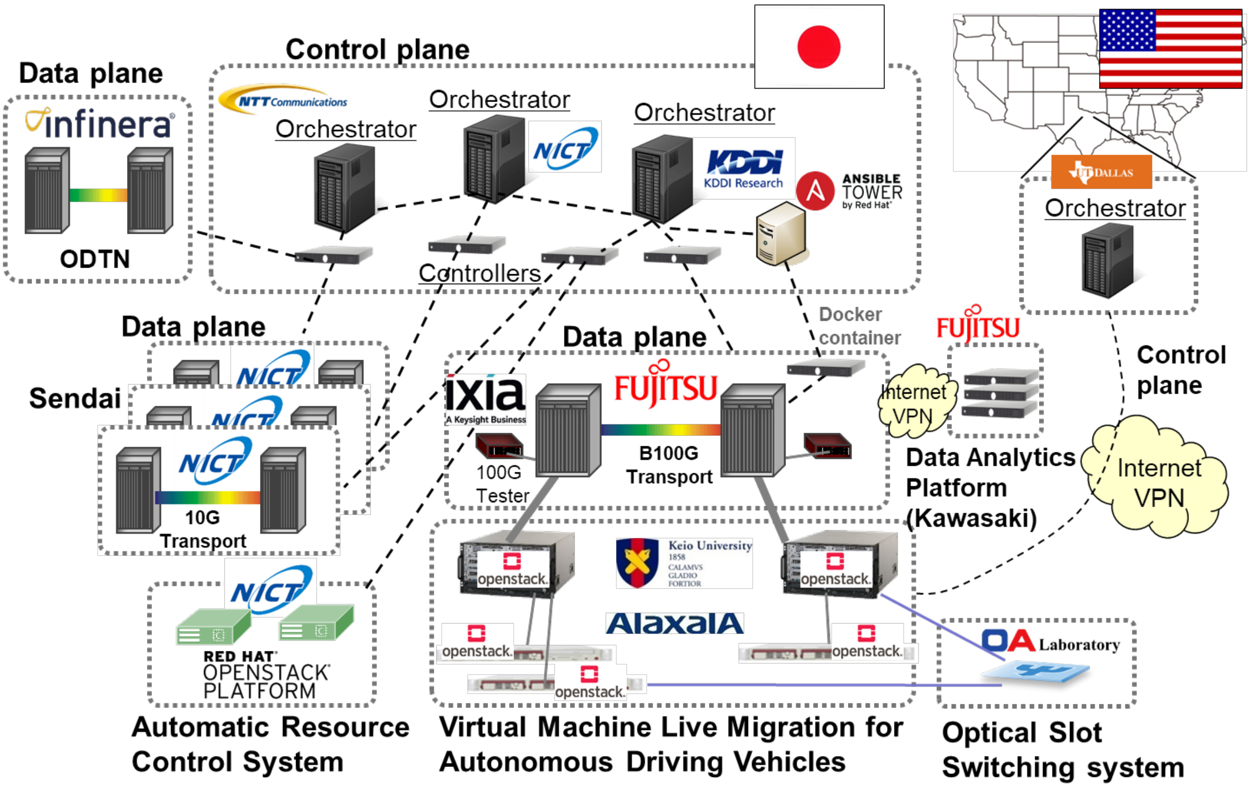


Figure 1 Showcase testbed configuration

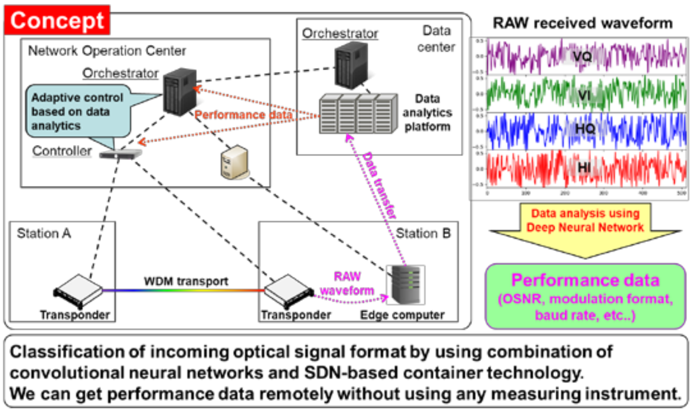
The 10-Gb/s-based transport multi-domain networks comprise three 10Gb/s-based WDM network domains that are located at the premises of NICT in Sendai, Japan and each network is controlled by each SDN controller (KDDI Research, NTT Communications and NICT). The ODTN comprises optical transmission equipment and is controlled by an SDN controller.

The SDN-based data center network consists of servers controlled by an OpenStack controller (NICT and Red Hat), which cooperates with an SDN controller (KDDI Research).

In the control plane, three network orchestrators that are located in Japan (KDDI Research, NTT Communications, and NICT) are connected to the SDN controllers that control the data planes. The ansible master node and one of the orchestrators work together to control the container for acquiring sampled data from the beyond 100-Gb/s transponder. The orchestrator at UT Dallas is connected to the client network in Japan via the Internet VPN in order to control the network and VMs in servers and also routers.

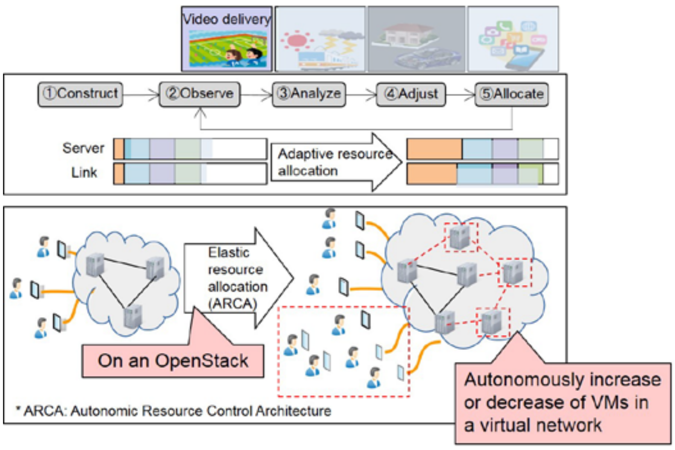
Demonstrations

(1) Data-Analytics-based Optical Performance Monitoring Assisted by Container Technique



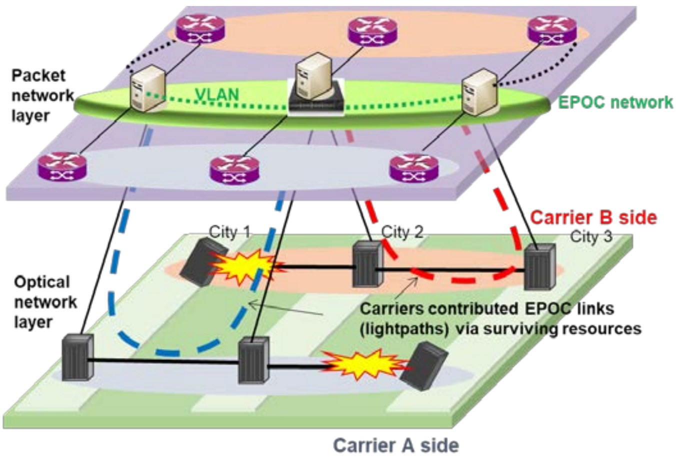
Data-analytics-based technology has recently been intensively studied. Using this technology for operating and optimizing networks is gradually coming to be regarded as an effective solution for large and complex network environments. We demonstrate classification of an incoming optical modulation format by a combination of convolutional neural networks and SDN-based container technology.

(2) Dynamic Construction and Control of Virtual Network Platform Utilizing OpenStack



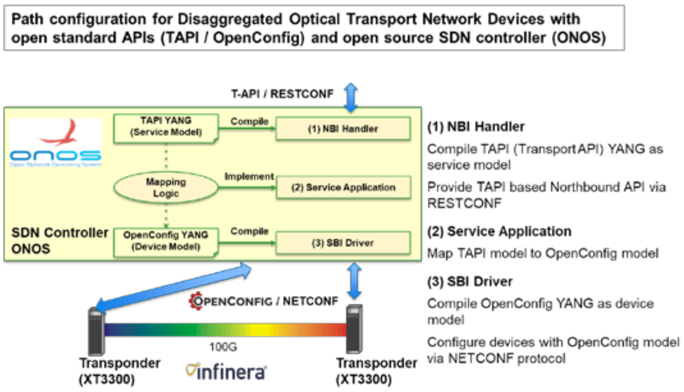
In order to achieve automatic adjustment of VM resources in a virtual network responding to some external events, NICT has been designing and implementing autonomic resource control architecture (ARCA), which has been installed on a Red Hat OpenStack*1 Platform. In this showcase, we demonstrate a video service that must be adapted dynamically (increase or decrease resources) by means of a virtual resource control request from KDDI Research's orchestrator after some external event occurs.

(3) Inter-Carrier Connection for Vital Traffic in the Event of a Disaster



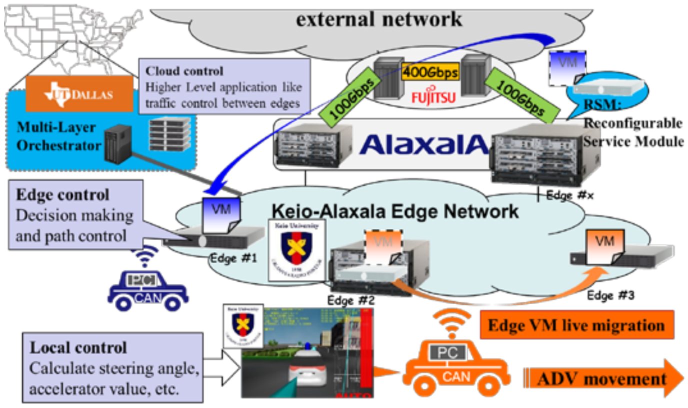
In order to achieve rapid and low-cost recovery in the event of a huge disaster, NICT, KDDI Research and NTT Communications are working together and investigating the technology for enabling the inter-carrier collaboration in the post-disaster recovery phase. In this showcase, we experimentally demonstrate the rapid creation and control of an emergency shareable exchange network (ESEN) between network carriers to convey the highest priority traffic, i.e., vital traffic for victim relief after a disaster.

(4) Open and Disaggregated Transport Network (ODTN)



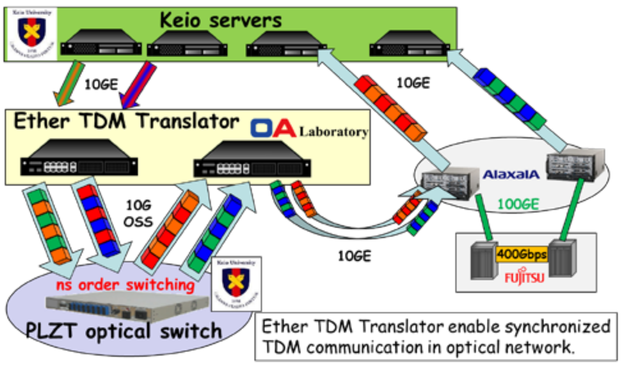
Open and Disaggregated Transport Network (ODTN) is an open project for designing the reference open architecture and the open source solution where available open components are integrated and tested for disaggregated transport networks. It aims to help world-wide service providers to use disaggregated devices and open models/controllers for their services. In this showcase, we demonstrate the latest architecture and solution using Transport API (Northbound Interface [NBI]), Open Networking Operating System (ONOS) (SDN Controller), OpenConfig (Southbound Interface [SBI]) and open transport devices provided by Infinera.

(5) Dynamic VM migration with dynamic ML-network configuration for ADV



A network-controlled autonomous driving vehicle (ADV) with high mobility is one of the relevant applications for smart communications. Close coordination of Cloud, edge, and local computer resources is required. For example, a 10-ms response time between the ADV's board computer and edge servers is required, which includes both communication and processing time. To meet this tight requirement, a dynamic edge processing system with VM live migration is proposed. The ADV has three agents running in the edge servers, which provide service redundancy. As the ADV moves on the road one of the three agents at a time is live-migrated to another edge location in order to satisfy the 10-ms response time requirement. This migration is realized by a dynamically reconfiguring the ML-network that interconnects the edge locations. Keio University provides the ADV control application and the OpenStack-based VM environment. ALAXALA Networks provides the reconfigurable router, which includes a reconfigurable service module board with VM hypervisor capability. UT Dallas provides the resource orchestrator which has ML-network reconfiguration and OpenStack VM management capabilities combined.

(6) Optical Slot Switching System using Ether TDM Translator



Optical data-center networks are attractive for achieving energy efficient data-centers. The optical slot switching (OSS) technology has been paid attention. OA Laboratory and Keio University are members of the HOLST (high-speed optical layer 1 switch system for time slot switching-based optical data center networks) projects. In this demonstration, recently developed 10 Gbps Ethernet to OSS converter (Eth_TDM translator) is presented. The server provides mixed flows to 2 destinations, the Eth_TDM translator provides OSS slots for each destination, and the PLZT (Plomb Lanthanum Zirconate Titanate) optical switching system distributes incoming OSS slots to destination ports.

Acknowledgments

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*1. OpenStack:
OpenStack is an open source body and software that is widely used to manage and control server and cloud environments.

[iPOP2018 Overview]
Date: May 31 -June 1, 2018
Venue: Koganei Headquarter, NICT, Koganei Tokyo, Japan
More details: https://www.pilab.jp/ipop2018/