Rostelecom Transport SDN successful Interoperability Proof of Concept with Huawei, NEC/Netcracker and Nokia

Contents

1 Executive Summary

Service providers are looking towards software-defined networking (SDN) to enable automation and programmability of their transport optical networks in order to quickly deploy new revenue-generating network services, such as bandwidth on demand, and reduce costs related to service provisioning, maintenance and restoration. In turn, this is driving a need for open systems/software that can interoperate without significant integration costs.

However, Transport SDN (T-SDN) deployments today are mainly limited to single domains because interoperability between different vendors is complex. A new hierarchical networking approach is needed that provides complete end-to-end control and visibility, automating the operations across separate optical multi-vendor domains.

In this paper, we discuss the Transport SDN proof of concept by Rostelecom, together with Huawei, NEC/Netcracker and Nokia and key results. This was the first multi-vendor Transport SDN demonstration in the Russian Federation and uses NEC/Netcracker's umbrella Multilayer SDN Controller managing three optical network domain controllers including Huawei's Agile Controller-Transport, NEC's Optical T-SDN Controller and Nokia's Network Services Platform (NSP).

2 Transport SDN Interoperability Test Overview

The test was organized in Rostelecom's lab. The vendors included Huawei Technologies, NEC/Netcracker and Nokia.

Figure 1. Transport SDN Interoperability Test Participants

For this interoperability demonstration, the network infrastructure was designed to mirror one that comprises multiple domains across different geographies, vendors and technologies. The infrastructure also reflected the ability for services to cross domain boundaries.

The vendors' equipment came not only with traditional NMS systems for basic OAM functions but also with SDN controllers for advanced service control. The implementation of the SDN use cases was based on a hierarchical combination of the SDN controllers for the different network domains with an end-to-end controller from NEC/Netcracker.

DWDM Equipment

Optical transport equipment was used in each vendor's domain for this test. The following DWDM systems were provided by vendors:

- Huawei Intelligent Optical Transport Platform OptiX OSN 9800
- NEC Converged Packet Optical Transport System SpectralWave DW7000
- Nokia 1830 Photonic Service Switch (PSS)

Transport SDN Domain Controllers

Each optical network domain includes a domain controller that controls the services in the respective domain. Controllers are separated to manage the vendor-specific equipment in the optical network domains. The following SDN controllers were used:

- Huawei Agile Controller-Transport
- NEC Optical T-SDN Controller
- Nokia Network Services Platform (Nokia NSP)

End-to-end Transport SDN Controller

The end-to-end T-SDN controller was provided by NEC/Netcracker:

- NEC/Netcracker Multilayer SDN Controller

This is a hierarchical controller that combines information from the domain focused controllers for an end-to-end service view. Thus it simplifies and automates the network operation in a multi-vendor and multi-domain environment. It enables rapid service delivery by automatically configuring services via the different domain controllers across all domains from a single instance. Moreover, the end-to-end T-SDN controller optimizes the utilization of network resources by employing a centralized network view.

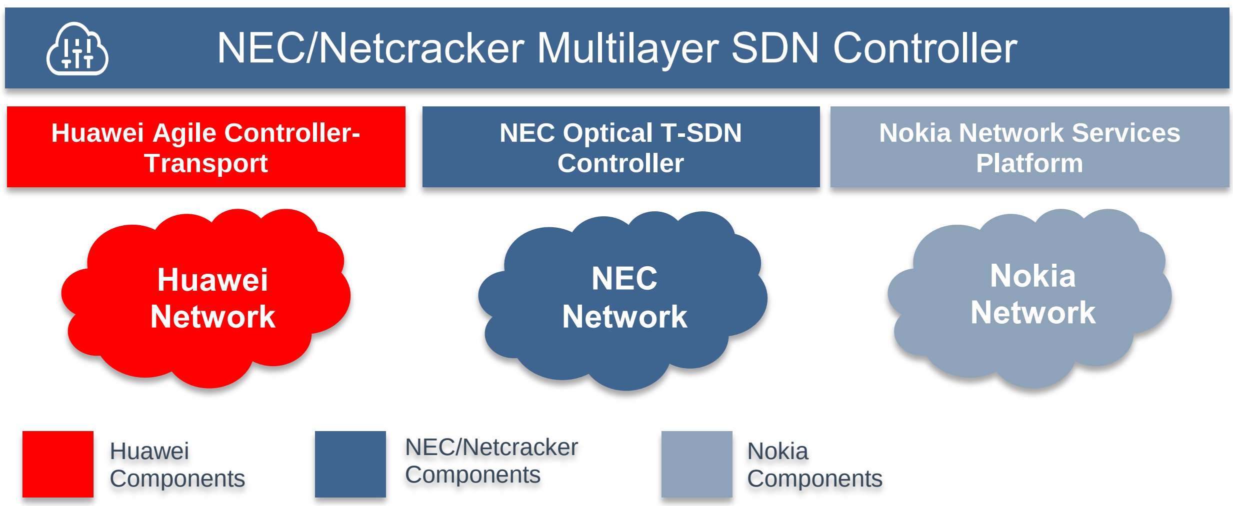

Figure 2. Products included in the test set up

The tests carried out were to validate the hardware-software combination of the DWDM systems and T-SDN controllers in the laboratory of Rostelecom and were aimed at demonstrating the following capabilities:

1) Automatic discovery of the topology and resources of the optical multi-domain network;

2) Automatic creation of services using the resources of an optical multi-domain network;

3) Multilevel traffic restoration with proactive recovery of backup routes.

3 Five Transport SDN Interoperability Tests Performed

3.1 Multivendor network Topology Discovery and Visualization

In the first test case, NEC/Netcracker's Multilayer SDN Controller queries domain controllers for topology using REST. The solution visualizes the complete multi-domain topology with:

- Up to date information about network topology is received from Vendors' Domain Controllers.
- GUI representing multivendor multi-domain network topology.
- Existing services are shown in table view by UI.
- Logical service topology is shown over physical topology by GUI

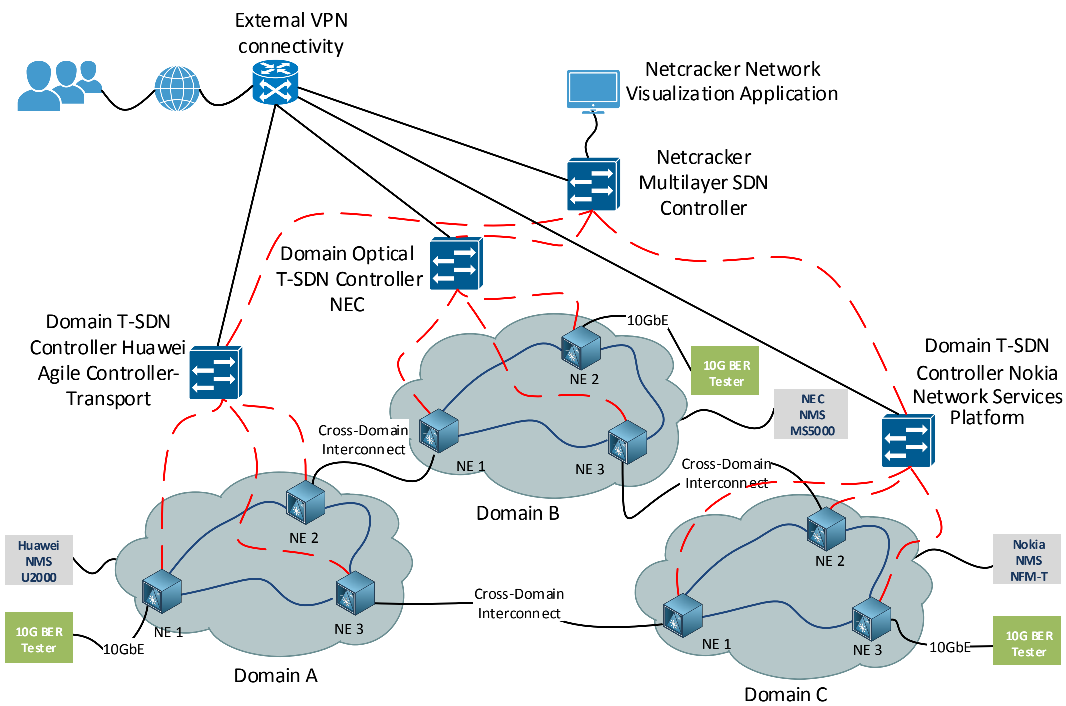

Figure 3. Multivendor network Topology Discovery and Visualization

3.2 Computation and Provisioning of Multi-Domain Service Without Restoration

In the second test case, NEC/Netcracker's Multilayer SDN Controller computes the multi-domain path across the network domains using a built-in path computation engine. This process is outlined in the steps below:

1. User requests optical network service provisioning via UI.
2. Multilayer SDN Controller makes an API call to Huawei Agile Controller-Transport, NEC Optical T-SDN Controller and Nokia NSP domain controllers requesting connectivity between optical ports.
3. Uses received information as input data for PCE and calculates E2E connectivity.
4. Provisions E2E service.
5. Displays the overall end-to-end connectivity.

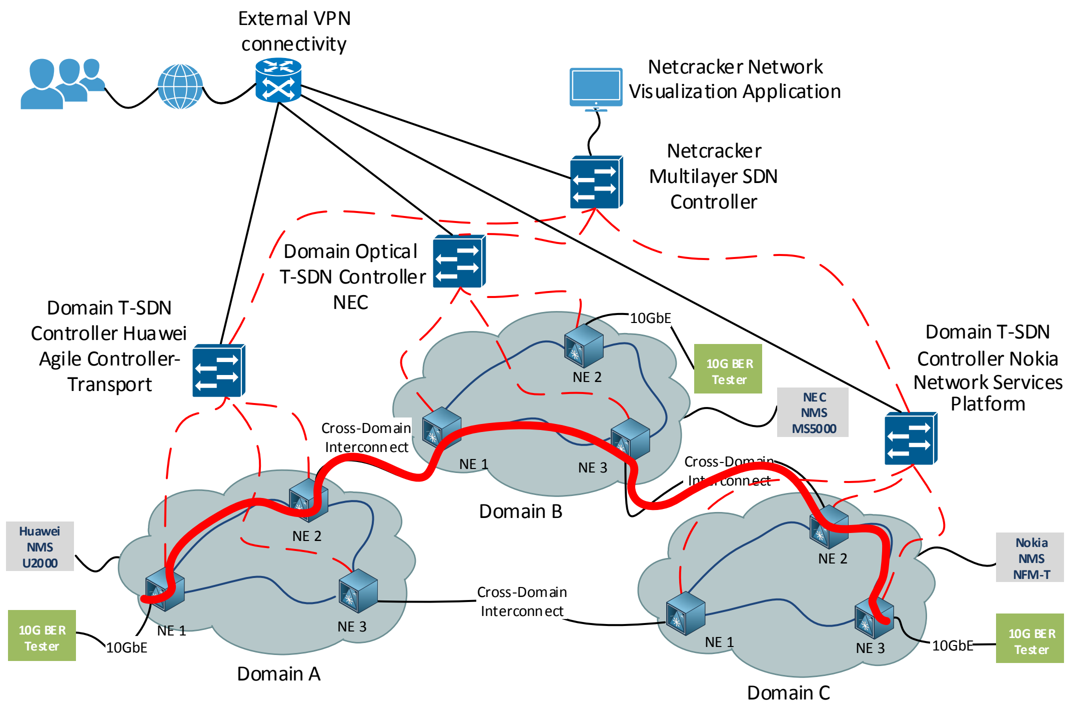

Figure 4. Computation and Provisioning of Multi-Domain Service without Restoration

3.3 Traffic restoration in case of intra-domain link failure

In the third use case, the vendor's domain controller makes traffic restoration of the service when a fault inside one of the domains occurs. This process is outlined in the steps below:

1. User requests optical network service with restoration path provisioning via UI.
2. Multilayer SDN Controller makes an API call to Huawei Agile Controller-Transport, NEC Optical T-SDN Controller and Nokia NSP domain controllers requesting connectivity between optical ports.
3. Uses received information as input data for PCE and calculates E2E connectivity.
4. Provisions E2E service.
5. Displays the overall end-to-end connectivity as in 2nd case.
6. After the fault occurs, GUI shows the fault.
7. Vendor's domain controller restores the service.
8. GUI displays the restored overall end-to-end connectivity.

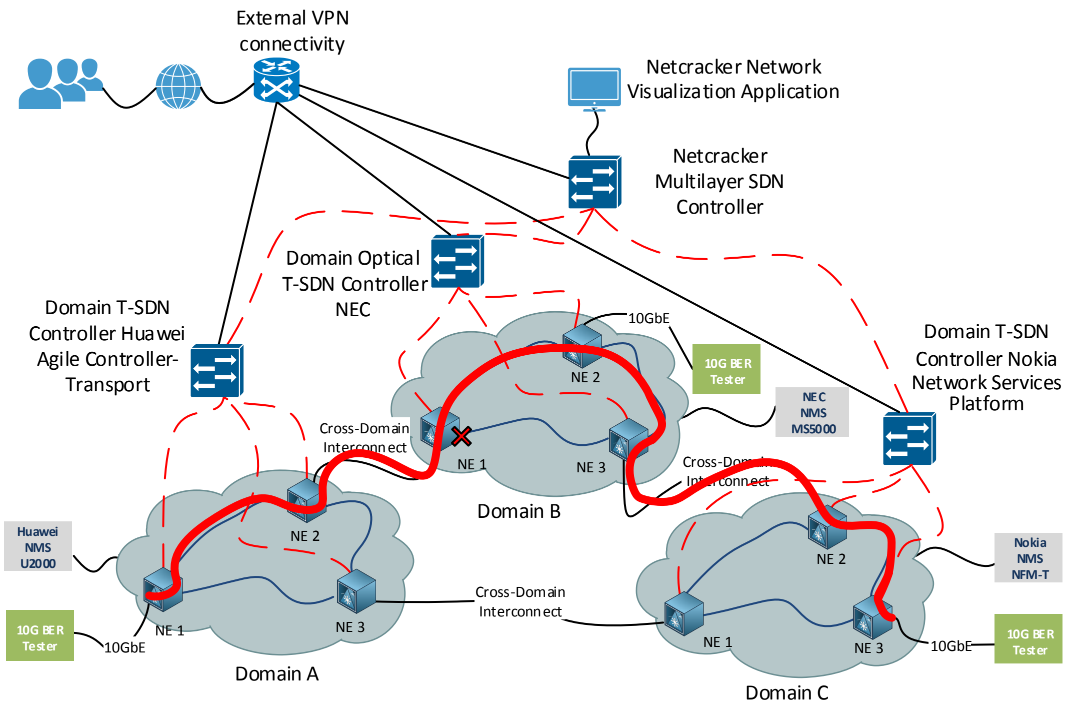

Figure 5. Traffic restoration in case of intra-domain link failure

3.4 Transport circuit E2E Re-optimization

In the fourth test case, NEC/Netcracker's Multilayer SDN Controller makes E2E re-optimization of the service after the 3rd case took place. This process is outlined in the steps below:

1. User requests optical network service re-optimization via UI.
2. Multilayer SDN Controller makes an API call to Huawei Agile Controller-Transport, NEC Optical T-SDN Controller and Nokia NSP domain controllers requesting connectivity between optical ports.
3. Uses received information as input data for PCE and calculates E2E optimized connectivity.
4. Provisions E2E service.
5. Displays the overall end-to-end connectivity.

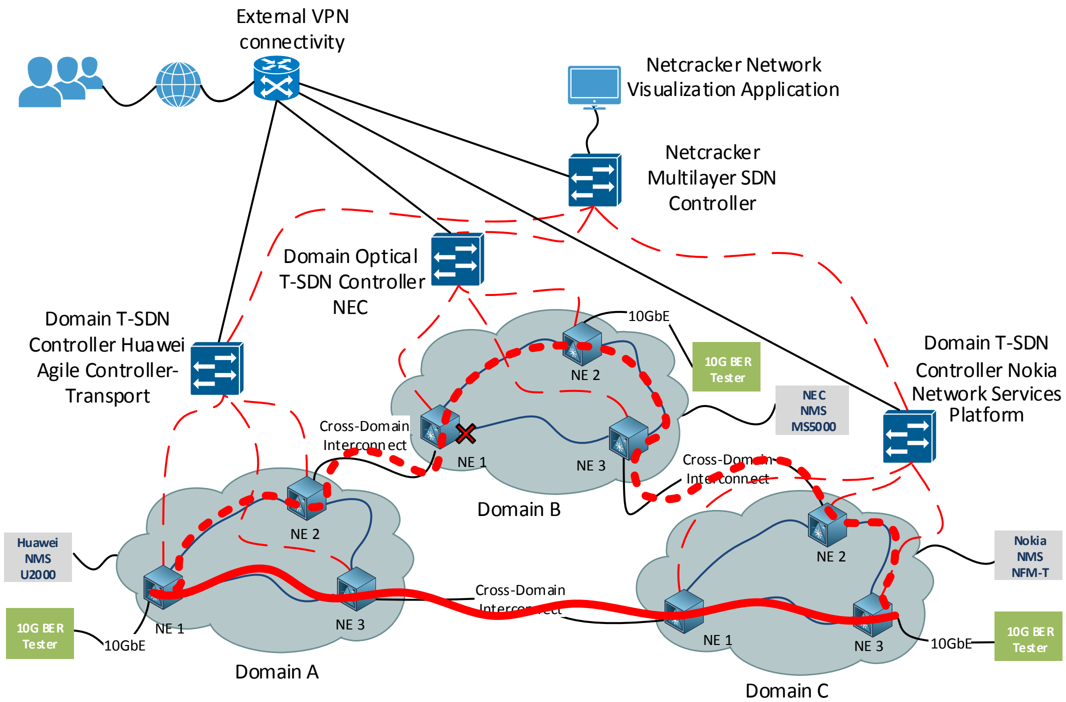

Figure 6. Transport circuit E2E Re-optimization

3.5 Traffic restoration in case of Cross-Domain link Failure

In the fifth and final test case, NEC/Netcracker's Multilayer SDN Controller makes service restoration of the service inter-domain link failure. This process is outlined in the steps below:

1. User requests optical network service with pre-calculated restoration path via UI.
2. Multilayer SDN Controller makes an API call to Huawei Agile Controller-Transport, NEC Optical T-SDN Controller and Nokia NSP domain controllers requesting connectivity between optical ports.
3. Uses received information as input data for PCE and calculates E2E connectivity.
4. Provisions E2E service.
5. Displays the overall end-to-end connectivity.
6. After the fault occurs, GUI shows the fault.
7. Multilayer SDN Controller provisions restoration of the service.
8. Displays the overall end-to-end connectivity.

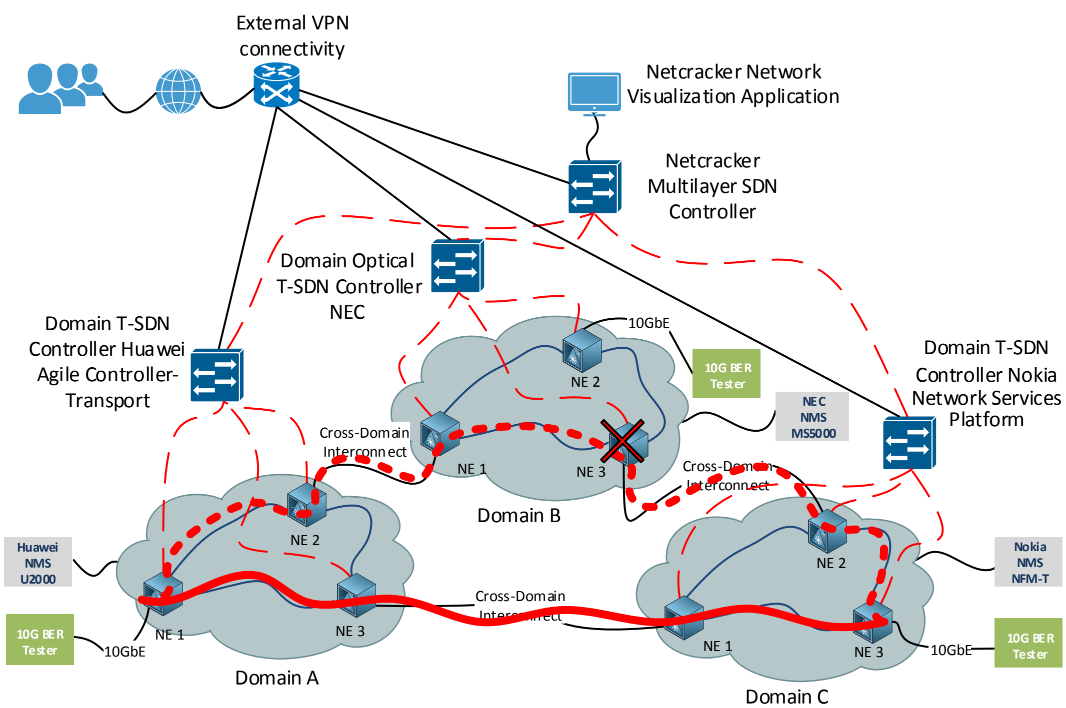

Figure 7. Traffic restoration in case of Cross-Domain link Failure

4 Results and Benefits

Successful completion of all test cases

Rostelecom chose three hardware companies (Huawei, NEC and Nokia) and one software company (Netcracker) to show their achievements in the Transport SDN area and prove successful interoperability. The test cases, lab equipment and the role of each vendor were agreed and in June 2017 all equipment was already in Rostelecom's lab. Software integration began and it took less than two months to successfully complete all five tests. This was a significant achievement with strong collaboration across all companies. It also showed the benefits of using standard protocols for integration making it easy for potential new vendors to be added.

Resulting benefits for service providers

The joint Rostelecom, Huawei, NEC/Netcracker and Nokia demonstration illustrates efficient service provisioning from a single GUI over several vendor domains, as well as rapid network service restoration in a single domain or over multiple domains. This will lead to much faster troubleshooting, service provisioning, and restoration for Rostelecom compared to performing the same actions via traditional network management systems.

With these elements in place, network users can self-select new, on-demand transport services that are provisioned automatically and optimized dynamically according to bandwidth and network performance requirements. An integrated network with centralized multi-vendor service provisioning will drive service agility and allow operators to create innovative, vendor-specific applications to speed up network innovation and new services for its end-users.

Significant cost savings can also be achieved. Hierarchical control of multi-vendor networks can reduce OPEX as it enables much faster service deployment and rerouting times. The order management process time will be reduced, going from months to just hours, with a simpler configuration process. Service restoration, after a fault, can drop to an average of just several minutes. CapEx savings can also be achieved by allowing other departments in the operator organization to share the network, creating a true multi-purpose network.

By leveraging multi-vendor SDN control, operators will be able to avoid vendor lock-in through support of multiple T-SDN controllers working over different vendors' infrastructure. The innovative demonstration prompted a greater understanding of the business value of SDN-enabled network control that will help to drive the implementation of SDN architectures in optical networks.