Integration of Network Services Interface version 2 with the JUNOS Space SDK

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Keywords

NSI, REST, SOAP, Web Services, JUNOS Space SDK, BoD, network provisioning

Abstract

Introduction

The paper presents the concept of integrating OGF NSI-CS v2 (Open Grid Forum Network Services Interface Connection Service version 2)[1] with the Juniper JUNOS Space SDK (framework for building application and services managing networks)[2]. First, the NSI concept is introduced with the explanation what the features are for network providers and end users. Next, a short description on how JUNOS Space SDK can help managing networks is provided. This paper also highlights the most important architectural aspects of NSI v2 application running on JUNOS Space SDK based on the real implementation.

1. NSI-CS concept

The NSI protocol, part of the NSI Framework, is a standardized protocol defined within the Open Grid Forum, that describes communication messaging for heterogeneous resources reservation among multiple domains. The protocol defines Provider and Requester roles as well as reservation, provision and activation state machines, in order to ensure unambiguous behaviour among distributed entities. The NSI-Connection Service (CS) is a service defined within generic NSI framework, allowing dynamic management of end-to-end network connections in multi-domain scale. With the help of NSI-CS, users can request end-to-end connections that fulfil the user's performance, time and authorization requirements.

NSI and NSI-CS are actively developed by OGF community, which involves NRENs and research institutes from Europe, US, and Asia-Pacific region. The efforts put in standard definition are reflected in growing interest of using NSI-CS for global circuits management, involving lightpaths and L2 connections. The multiple demonstrations of NSI-CS of version 1.0, 1.1 and 2.0 were held in the GLIF dependent infrastructures involving deployments in KRLight, KDDI-Labs, JGN-X, AIST, GLORIAD, StarLight, ESnet, US-LHCnet, NetherLight, NORDUnet, CzechLight, GÉANT, UvA, and PIONIER, allowing

dynamic creation of data plane connections between servers distributed geographically around the whole globe. NRENs like NORDUnet, GÉANT, SURFnet, and several GLIF GOLEs are planning to deploy NSI-CS as the production service for management of lightpath in most efficient and scalable way. The success of NSI is a result making the NSI not the provisioning system, but more like a common standardised language, which can be used by existing tools to enable collaboration. The efforts put for years into the development of local scale network provisioning tools, like AutoBAHN, DRAC, OSCARS or G-Lambda, can be still continued, while NSI introduces a novel API to enable inter-domain information exchange. The adoption of NSI is easy and can be done for any existing resources management tool, enabling it to talk to other NSI capable domains.

2. NSI for JUNOS Space SDK

JUNOS Space SDK [2] is a developer toolkit for creating and deploying applications that run on the top of Juniper-based network hardware. The SDK exposes a rich set of RESTful APIs, that abstracts the capabilities of Juniper Networks routers, switches and firewalls. The concept is to provide another layer between user applications and Juniper network hardware, which performs functions of resources discovery, monitoring data collection, unified configuration access, resources abstraction and harmonization. A complex infrastructure built of Juniper hardware can be seen by administrators as simple cloud with particular functionality, simplifying the process of management and administration, and thus simplifying the control tools that are aimed to be used for dynamic resources management.

The combination of the NSI protocol and JUNOS Space SDK provides a complete Bandwidth on Demand solution for providers running Juniper-based networks. The solution will simplify and accelerate the process of device configuration, leading to fully automated network configuration. Networks providers will be equipped with tools to offer new, innovative services. Also unified management interface will decrease financial costs spent on infrastructure maintenance and staff training.

Architecture

The JUNOS Space SDK delivers a complete API, which is used for interaction with the Juniper network domain. All interaction between user tools and applications is performed via REST based interface, providing indirect access to the infrastructure features. The objective of the developed NSI based BoD tool was the following:

1. To extract the network topology of a domain
2. To gain access to the monitoring data of switches and domains
3. To control resources (i.e. capacity) of the network and implemented connections
4. To set up and tear down the dynamic end-to-end connection inside Juniper based domain
5. To enable extension of local connection beyond current domain

The created management tool was designed as a proof of concept, and therefore was aimed to be simple and have the minimal required functionality. Objectives 1-4 are achieved using JUNOS Space SDK API, while objective 5, which is inter-domain feature, is achieved via NSI v2.0 protocol. The choose of the NSI protocol was not accidental, is it is widely used in testbeds, and is planned to be operational among multiple NRENs and network communities. This gives the newly developed tool a

potential to be widely used and thus promote both NSI standard and Juniper solutions in the form of JUNOS Space SDK.

The Figure 1 shows the architecture of NSI and JUNOS Space SDK integration:

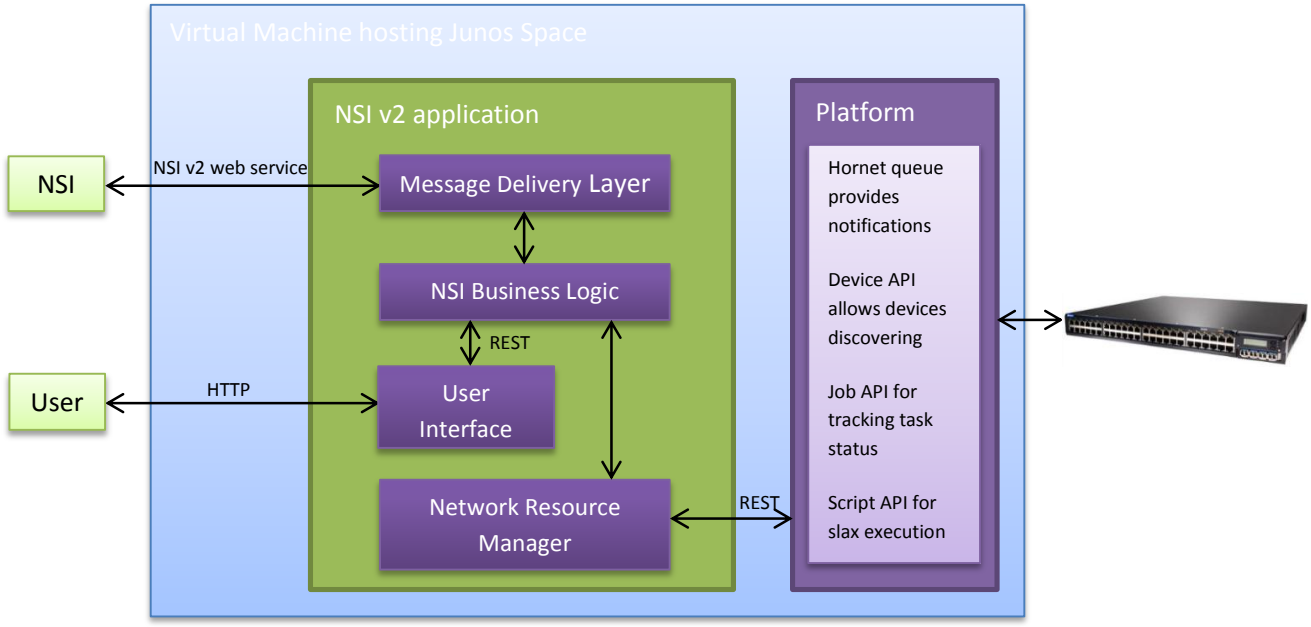

Figure 1. Integration of NSI v2 application with JUNOS Space SDK

The NSI application consist of the following functional components:

- **Message Delivery Layer** – implements the NSI v2 interfaces (WSDLs available at NSI-WG web site[1]) and deploys them on the JBOSS service. Responsible for SOAP message handling and dispatching.
- **NSI Business Logic** – the core logic of the application is contained in this module (EJB component). It ensures validation and proper processing of incoming reservation requests, manages internal resources pool, reservation state machines and delegates tasks to Network Resource Manager. Also exposes its REST API to be used be the User Interface module.
- **User Interface** – web application intended for network administrators and users. Offers management panel for NSI v2 application as well as monitors current network utilization. Users with less privileges can only request new circuits.
- **Network Resource Manager** – acts as a domain manager, its main jobs are: discovering network elements, reacting to topology changes, intra-domain path computation and booking resources for specified time period in the future. This module directly interacts with JUNOS Space SDK.
- **Platform** – module provided by Juniper offers abstraction layer for network management through a set of RESTful APIs.
- **NSI –** Requester Agent, typically a host, middleware or network provider who submits reservation requests to NSI v2 application.
- **User** – network operator that supervises NSI v2 application, also can be authorized user who wants to provision a circuit.

The operating application was demonstrated during SuperComputing 2012 event in Salt Lake City, US. Several Juniper EX3200 and 4200 switches were deployed with a single server attached as an end-point, JUNOS Space SDK Platform component, and NSI v2 application. The application can successfully retrieve the network topology and retrieve the status of the resources and monitoring data through JUNOS Space SDK environment. The local end-to-end connections were realised via JUNOS Space SDK configuration request, successfully creating L2 circuits, i.e. VLANs between indicated end-points in topology. Since the application was a proof of concept, the management of resources was limited and no capacity control was introduced to the NSI Business Logic mechanism. However, this functionality is planned for further releases. The testbed infrastructure was connected to the PIONIER AutoBAHN domain, which is NSI-enabled and participate in the global Automated GOLE demonstration of NSI capabilities, as depicted on Figure 2.

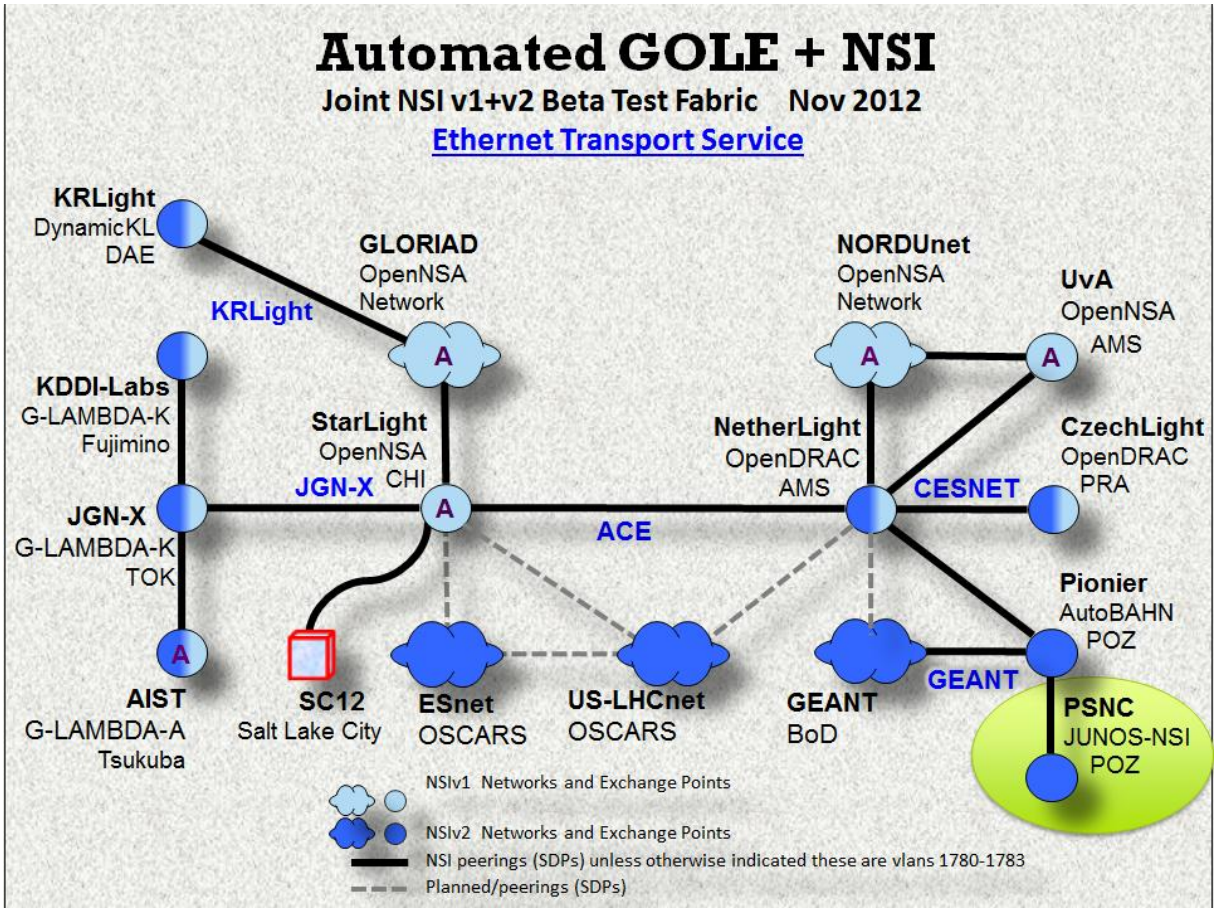

Figure 2. Automated GOLE and NSI demonstration with JUNOS Space SDK enabled NSIv2.0 application at PSNC

The SuperComputing'12 deployment proved that NSIv2 application can work in collaboration with JUNOS Space SDK and native Juniper domains. The connections and capacity management can be then extended at global level, using standardized NSI interface. The interoperability of the NSI clouds, i.e. including Juniper-PSNC one, states that all 5 objectives were fulfilled, providing required functionality.

3. Summary and further work

Though NSI v2 application is still in early development phase of it life. The results gained so far indicate that ambitious goal of complete Bandwidth On Demand solution running on Juniper network, can be done with one click needed to deploy the application. It is clear that with Network Resource Manager component enhancements, NSI v2 application can adapt to any Juniper based network, regardless of its scale. Also worth to note that both NSI Framework and JUNOS Space SDK continuously evolve to leverage current and future infrastructure facilities and services.

4. References

[1] NSI, https://forge.ogf.org/sf/projects/nsi-wg
[2] JUNOS Space SDK, https://developer.juniper.net/content/jdn/en/develop-overview/JUNOS-space-sdk/getting-started.html

Biographies

Radosław Krzywania received the M.Sc. degree in Computer Science – Software Engineering from the Poznan University of Technology in 2003. He is working in Poznan Supercomputing and Networking Centre as a senior network engineer. He participated in several FP6 IST projects: 6NET (IST-2001-32063), PHOSPHORUS (IST034115) and GN2 (IST511082). He also participated in a number of national initiatives funded by Polish Ministry of Science and Higher Education (e.g. Clusterix). Currently he is involved in the national project "Engineering of Future Internet" and FP7 project GN3 (Project no. 238875). The main experience is Bandwidth on Demand services, network control planes, and network management. He is author or co-author of papers in professional journals and conference proceedings.

Michał Balcerkiewicz received the M. Sc. degree in Automatic Control Engineering and Robotics from Poznan University of Technology in 2003 and joined the Network Division of Poznan Supercomputing and Networking Center as a Networking Systems Analyst. In the past he participated in GN2 and national projects. Currently he is involved in GN3, where he participates in SA2T5 and JRA2T2 activities, where his main focus is on building Bandwidth on Demand systems, including Autobahn, Idcp and Nsi protocols. His main interests are in advanced networking technologies, Software Defined Networking, network protocols and services.

Bartosz Belter received the M.Sc. degree in Computer Science from the Poznan University of Technology in 2002. He works in Poznan Supercomputing and Networking Center as a Senior Network Engineer. He participated in several FP6 IST projects: 6NET (IST-2001-32063), PHOSPHORUS (IST034115) and GN2 (IST511082). He also participated in a number of national initiatives funded by Polish Ministry of Science and Higher Education (Clusterix, Polish LDAP and others). Currently he is involved in several EU funded projects. His main research activities concern the architectural aspects of Control and Management Planes in optical networks and Quality of Service in next generation packet networks. He is author or co-author of papers in professional journals and conference proceedings.