# Network Service Interface

# gateway for future network services

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# Abstract

The Network Service Interface (NSI) [1] was created as a result of collaborative development by network and application engineers primarily associated with the Research and Education (R&E) community. The objective was to deliver network infrastructures as a service to both novice and expert end users. The first step was to design a protocol which could enable the automated creation of multi-domain heterogeneous network circuits and offer it as a “*Connection Service”* at global scale.

The NSI Connection Services (NSI-CS) [2] concept was formalized into a protocol specification in August 2011 under the umbrella of the Open Grid Forum (OGF) NSI-WG. Within three months, seven distinct implementations of the NSI protocol demonstrated interoperability at a global scale by negotiating resources and provisioning circuits across twelve domains. The first protocol interoperability demonstration took place at the GLIF Technical meeting in September 2011 in Rio de Janerio (Brazil) followed by provisioned circuits over a global topology at the Future Internet Week in October 2011 in Poznan (Poland), and at the SuperComputing’11 event in November 2011 in Seattle (WA, USA). The current list of tools for network provisioning which are capable of using the NSI protocol includes AutoBAHN (GÉANT), OpenDRAC (CESNET, SURFnet, UvA), DynamicKL (KISTI), G-Lambda (AIST, NICT, KDDI Labs), OpenNSA (NORDUnet, UvA, CANARIE/Northwestern University), OSCARS (ESnet, Internet2, RNP). These protocol implementations are currently a prototypes based on draft-standard documents, however there are plans for future operational deployment once the final standard is published.

The goal of the NSI is to hide network complexity from the end user. This is accomplished by the creation of the Network Service Plane (NSP) which provides a simple way for a user or application to request for network resources. The NSP is composed of Network Service Agents (NSA) which can assume one of three roles; a Requestor, a Provider, or a Requestor-Provider.. The Requestor Agent (RA) can request network resources, while the Provider Agent (PA) is responsible for delivering the service to the RA. A Requestor-Provider agent can behave both as an RA or PA depending on its configuration and the specific request.

The NSI is not just a protocol, but also rather a framework for service protocol development. It consists of a defined set of principles and relations that form the basis of the protocols, which can be used to build a variety of architectures and services. The first specified service was the Connection Service that delivers end-to-end provisioning features. Other services are being explored, including topology exchange, performance verification, fault localization and remediation, and provisioning of general IT resources. The NSI-WG is comprised of a well-rounded group of contributors with various applicable skillsets. This ensures that the NSI framework is developed within a multi-dimension environment.

As currently defined, the draft-standard veriosn of NSI CS is stable and functional, making it easy to migrate into a production deployment over networkinginfrastructures around the globe. It has a well-specified reservation state machine that assures that processing is performed consistently and correctly according to the NSI-CS rules and system policies. The current state machine has eleven states and defines the necessary events or messages needed to transition between them. The state machine supports the following operations; i) accepting a request, ii) reserving resources, iii) provisioning a connection, iv) releasing a connection after a pre-defined time, and v) terminating a reservation at any time. Reservations can be requested to begin immediately or to be scheduled for a future time, nased on availability of network resources from the requested provisioning systems. Once confirmed, these reserved resources are made available for end users use at the appointed time.

As the NSI CS by itself is not a provisioning system, but rather a stateful protocol for resource scheduling and provisioning, it relies on independent provisioning tools that are deployed over network infrastructures. Thers the tools are extensively used by the NSI protocol for verification of local resource availability, global and local path-finding, and reserving and provisioning of resources., The NSI protocol augments this support to provide the ability to deliver inter-domain services and extend service coverage to a global dimension. By involving more and more deployments in addition to recent demonstration partners, the reach of the NSI is continually growing. Despite the fact that the current environment was built for a proof of concept, there are already end users developing against the offered service, showing the potential and interest in unified network services delivered at the largest possible scale.

The OGF NSI-WG activity is leveraging the critical mass to push the work forward more intensely than before. The demonstrations have shown the usability of the protocol as a proof of concept for global network services development. Moving forward, the NSI-WG is now focused on releasing a new stable version of the NSI CS protocol that will be the base for operational deployment. Most of the engaged NRENs and organizations have expressed interests in providing a NSI CS capable peering for their infrastructures that support approximate timescale and resource commitments. In 2012, it is expected that there will be a series of NSI showcase events to expand the NSI cloud in order to reach more infrastructures and end users.

The NSI CS protocol’s readiness for operational activities has been proven. However, there are still some missing functionality required to deliver the highest reliability and level of the service. The NSI-WG has created a list of features which are subject to investigations for further protocol releases. The list involves issues learned from the past three demonstrations of the NSI protocol, as well as from experiences and requirements of the NSI contributors and potential users. The two most crucial issues are the Authentication Authorization Infrastructure (AAI) and Topology exchange functionality. Since security is one of the most important matters in open infrastructures, the service must be resistant to potential intruder attacks, unauthorized control, and resource abuse. Therefore an authentication and authorization mechanism must be integral to the future protocol definition as a requirement for production service deployment. The lack of AAI support in the current protocol version is a critical factor that may prevent wide adoption by NRENs and other network providers. Another urgently needed functionality is topology exchange, which will provide mechanisms to support dynamic network management at global scale. Currently, the statically downloaded topology files used by NSI implementations cannot reflect dynamic network changes such as topology and resources availability. As the NSI is designed for dynamic network management, it must have access to accurate and up to date network information with possible predictive behavior for advance reservation features. Once both the AAI and Topology distribution problems have been solved, the protocol will become a fully functional proposition for all kinds of deployment in either research or production environments. The list of future features are not limited to these two issues, but include monitoring, accounting, service reliability and robustness to name a few. Developing all these functionalities will not be trivial but it provides a systematic roadmap for the NSI-WG .

# Acknowledgements

# References

[1] NSI Architecture document

[2] NSI CS protocol specification

# Author 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 Center as a network engineer. He is responsible for research task of GÉANT3 for develop new functionality of AutoBAHN Bandwidth on Demand system, and is an activity leader for network infrastructure in FEDERICA project. He is also interested in resources virtualization, efficient network utilization an management, as well as running, diving, and harp playing

**Chin Guok** joined ESnet in 1997 as a network engineer, focusing primarily on network statistics. He was a core engineer in the testing and production deployment of MPLS and QoS (Scavenger Service) within ESnet. He is the technical lead of the ESnet On-Demand Secure Circuits and Advanced Reservation System (OSCARS) project, which enables end users to provision guaranteed bandwidth virtual circuits within ESnet. He also serves as a co-chair of the Open Grid Forum On-Demand Infrastructure Service Provisioning Working Group.