# Title

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# Keywords

# Abstract

Network Service Interface (NSI) was created as a result of brainstorming in the community of network and application engineers. The objective was to deliver the missing piece of solution to integrate services with network infrastructures and provide it as integrated product to the end users, often lacking a technical knowledge. The first step was to make a protocol which enable automated creation of multi-domain heterogeneous network circuits and offer it as a “*Connection Service”* at global scale.

The concept was put into a protocol specification by August 2011 under the umbrella of Open Grid Forum (OGF) NSI-WG. In three following months the interoperability of six implementations of NSI protocol were able to negotiate resources and provision circuits across twelve domains at global scale. The demonstrations tool place in Rio de Janerio (Brasil) in September at GLIF Technical meeting, in Poznan (Poland) in October at Future Internet Week, and in Seattle (WA, USA) in November at SuperComputing’11 event. The current list of tools for network provisioning which are capable of using the NSI protocol includes AutoBAHN (GÉANT), DRAC (CESNET, NetherLight, UvA), DynamicKL (KISTI), G-Lambda (AIST, JGN-X, KDDI), OpenNSA (NORDUnet, SURFnet), OSCARS (ESnet). The protocol is now prototyped only, however there are plans for future operational deployment.

The NSI relies on basic assumption to hide network complexity by creation of additional Network Service Plane (NSP) and give users and applications a simple way to request resources. The NSP relies on Network Service Agents, which can use NSI to communicate and create entities of threefold nature – Requestor, Provider, and Requestor-Provider agents. The Requestor Agent (RA) can request network resources, while Provider Agent (PA) is responsible to deliver the service to the RA. That functions can be merged, as the same agent can behave as RA or PA for different requests depending on configuration and particular request cases.

The NSI is not just a protocol, but rather a framework for service protocols development, a defined set of principles and relations that form the basis of the protocols, which can be used to build variety of architectures and services. The first prototyped service is the Connection Service delivering end-to-end provisioning features, which was a scope of recent demonstrations, but more services are in scope of the research, including support for topology exchange, performance verification, fault localization and remediation, or provisioning of general IT resources. The NSI-WG is very open-minded and groups people of various expertise assuring the NSI framework to be developed in multi-dimension environment.

The currently prototyped NSI CS is well defined and stable, which makes it easy to migrate to production service and deployment over production environment around the globe. It has a defined reservation state machine which is assuring that processing is performed correctly according to NSI rules and system policies. Current state machine has eleven states and defines permitted transition between them, which can be initiated by events or message occurrences. The state machine supports the operations of accepting a request, reserving resources, provisioning a connection, releasing a connection after pre-defined time, and cancelling a reservation at any time. Reservations can be requested to be configured immediately or scheduled for the future, according to internal resources calendars available at particular provisioning systems.

As the NSI CS by itself is not a provisioning system, but rather a stateful protocol for resources scheduling and provisioning, it relies on independent provisioning tools deployed over network infrastructures. The tools functionality is extensively used by NSI protocol for verification of local resources availability, global and local pathfinding, booking and provisioning of resources, while the NSI support offers an opportunity to deliver inter-domain services and extend service coverage to global dimension. The service range is constantly growing, by involving more and more deployments in addition to recent demonstration partners. Despite the fact that this environment is not an operational one and was built for demonstration purposes only as a proof of concept, it shows the potential and interest in unified network services delivered at largest possible scale.

The OGF NSI-WG activity is now using the critical mass to continue the work even more intense than before. The demonstrations have shown the usability of the protocol and acts as a proof of concept for global network services development and the actions now are focused to release a new stable version of NSI protocol which will be base for operational deployment. Most of engaged NRENs and organizations expressed an interest in providing NSI peering for their infrastructures, providing approximate timescale and resource commitment. The year 2012 then, is expected to be a series of NSI coming out events and enlarging NSI cloud in order to reach more and more infrastructures and end users.

Since the NSI protocol readiness for operational activities was proved, there are still some missing puzzles required to deliver the highest quality and reliability of the service. The NSI-WG has created a list of features which are subject of investigations for further protocol releases. The list involves items learned by experience from the three past demonstrations of the NSI protocol, and also requirements issued by NSI contributors and potential users. The most crucial ones are AAI and Topology exchange functionality. Since security is one of the most important matters in opened infrastructures, the systems must be resistant to potential intruder attacks, control take over, or resources abuse. Therefore an authentication and authorization mechanism must be included in the further protocol definition as a requirement for safe service providing and guarantees of constant service delivery to the end users. Lack of AAI support in the current protocol version is a critical factor which may prevent the protocol to be widely adopted by NRENs and network providers. Another functionality needed in short time scale is topology exchange, which will provide mechanisms for dynamic network management at global scale. Currently a statically downloaded topology file is used by NSI implementations, which obstacles adoption to network changes in the sense of topology and resources available. As the NSI is designed to dynamic network management it must have access to accurate and up to date network information with possible predictive behavior for advance reservation features. Having both AAI and Topology distribution problems solved, the protocol will become a fully functional proposition for all kind of deployment in either research or commercial environments. The list of future features however is not limited to this two issues and assures that the NSI-WG will require lot of efforts to work on e.g. monitoring, accounting, service reliability and robustness, etc.

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# References

# Author Biographies