AutoGOLE/SENSE

GNA-G Working Group

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1 Introduction

The Automated GOLE/SENSE Working Group within GNA-G is a worldwide collaboration of open exchange points and R&E networks to deliver network services end-to-end in a fully automated way, wherein connection requests are handled through the Network Service Interface Connection Service (NSI-CS).

An increasing number of networks across the globe are now using NSI to provision and deprovision international network services. This saves a considerable amount of time for NOC engineers facilitating international network service requests. Service creation is done within minutes, instead of multiple days or even weeks, removing manual human effort from the process.

The NSI architecture includes the use of the Open Grid Forum (OGF) Network Markup Language (NML) as the standardized method for network resource descriptions. The Software-defined network for End-to-end Networked Science at Exascale (SENSE) project has developed NML extensions which allows NML to also cover resources which connect to the network such as Data Transfer Nodes (DTNs). This common resource description language provides a starting point for the AutoGOLE and SENSE systems to be utilized together to enable multi-resource, true end-to-end service provisioning.

A key objective of the Automated GOLE/SENSE Working Group is to deploy a global scale persistent infrastructure which combines the AutoGOLE and SENSE functionalities to enable complete end-to-end dynamic network services for domain science and general use within the Research and Education community.

The specific goals of this working group include:

1. Dynamic ANA
Delivering automated network (de)provisioning on the trans-Atlantic ANA fiber system

2. Implementing SENSE
Researching and implementation of SENSE within the AutoGOLE networks, exchanges and end points.

3. Persistent Multi-Resource Infrastructure
Building a persistent infrastructure for science on top of dedicated connectivity, NSI and SENSE.

Additional information is available on the GNA-G AutoGOLE / SENSE Website:

- https://www.gna-g.net/join-working-group/autogole-sense/

2 AutoGOLE Overview

AutoGOLE is a collaboration between multiple Research and Education (R&E) network operators who are using NSI compatible systems for automated network provisioning. The AutoGOLE participating domains use automation systems which comply with the following standard:

Open Grid Forum Grid Forum Document (GFD) GFD-R-P.212 NSI Connection Service v2.0

This deployment of NSI based systems provides the basis for automated, multi-domain provisioning of network services. Some of the key software utilized for the AutoGOLE deployment includes the following:

- Safnari Aggregators
  - https://agg.dlp.surfnet.nl
  - https://nsi-aggr-west.es.net
  - https://nsi-am-sl.northwestern.edu
  - …

- OpenNSA
  - OpenNSA is an implementation of the Network Service Interface (NSI).
  - https://github.com/NORDUnet/opennsa

- Management Environment of Inter-domain Circuits for Advanced Networks
  - Management system and graphical user interface for multi-domain NSI services provisioning.
  - https://wiki.rnp.br/display/secipo/AutoGOLE+MEICAN+Pilot

Additional information regarding the AutoGOLE participating network operators is available here:

- AutoGOLE Service URLs
  - https://wiki.rnp.br/display/secipo/AutoGOLE+Service+URLs

3 SENSE Overview

SENSE is a model-based orchestration system which operates between the SDN layer controlling the individual network regions, and users/applications needing a variety of end-to-end network services. The SENSE system provides a solution to the identified problem and includes a novel set of APIs and methods for interactions with users/applications, as well as with the underlying software-controlled network infrastructure.

The SENSE Orchestrator can interact with multiple network automation systems including NSI based systems. In addition, SENSE has an "End-Site Resource Manager" which allows network connected end-systems such as Data Transfer Nodes (DTNs) to be included in the resource models, topology graphs, and provisioning actions.

The SENSE system defines the mechanisms needed to dynamically build end-to-end deterministic and policy-guided Layer 2/3 network services. An intent-based interface allows applications to express service requirements in a high-level domain science specific context, with mechanisms for interactive and full-service lifecycle coordination with workflow automation systems. Additional information regarding the SENSE system is available here:

- Software-Defined Network for End-to-end Networked Science at the Exascale https://arxiv.org/abs/2004.05953

4 AutoGOLE / SENSE Integration - Work Plan

As mentioned in Section 1, the specific goals and focus areas of this working group are: i) Dynamic ANA, ii) Implementing SENSE, and iii) Persistent Multi-Resource Infrastructure. Additional details regarding these along with a description of the technical plan is provided below.

Dynamic ANA

The Advanced North Atlantic (ANA) is a consortium consisting of SURFnet, NORDUnet, CANARIE, and Internet2 which operates several transatlantic links connecting multiple exchange points located in Europe, United Kingdom, Canada, and the United States. This includes connections in Amsterdam, London, New York, Washington D.C., and Montreal. These links are utilized by multiple domain science research projects including the Large Hadron Collider (LHC) based experiments conducted at CERN.

There is interest in developing mechanisms to enhance the real time usage awareness and dynamic management. This includes the development of technologies to enable per flow Quality of Service, deterministic end-to-end quality of experience, and automated troubleshooting.

The focus of this working group activity area will be to evaluate how the NSI, AutoGOLE, and SENSE technologies can be leveraged to provide solutions in these areas as applied specifically to the ANA links and connected end-site resources.

Implementing SENSE

The objective of this activity is to integrate the SENSE services with the AutoGOLE infrastructure. These SENSE services include deployment of a Data Transfer Node (DTN) Resource Manager at end-sites which are connected to the AutoGOLE managed networks. This will provide the basis for true end-to-end services provisioning which includes the AutoGOLE NSI based network services and coordinated DTN based provisioning. A SENSE Orchestrator deployment will provide an API for domain science application workflow agents to initiate synchronized end-system and network service provisioning.

Persistent Multi-Resource Infrastructure & Operationalizing the AutoGOLE

The objective of this activity is to deploy an persistent multiresource infrastructure based upon the AutoGOLE deployments with integrated SENSE functionality. The intent is for this persistent infrastructure to be continuously running and available, with systems in place for monitoring, automated problem isolation/notification, with established upgrade mechanisms/procedures. The expectation is that deployment of a persistent testbed infrastructure will provide a resource for advanced network services development, testing, and application workflow agent integration.

The following AutoGOLE Network and attached End Sites are expected to be part of the initial persistent multiresource infrastructure deployment (completed in 2020):

- Starlight Exchange (Network)
- Starlight DTN (EndSite)
- MOXY Exchange (Network)
- NetherLight Exchange (Network)
- CERN DTN1 (EndSite)
- CERN DTN2 (EndSite)
- CENIC Network (Network)
- PacificWave (Network)
- PacificWave-Los Angeles (EndSite)
- PacificWave-Sunnyvale (EndSite)
- PacificWave-Seattle (EndSite)
- UCSD (EndSite)
- Caltech (EndSite)

In addition the following sites are identified for possible future addition to this persistent testbed infrastructure.

- RNP, KISTI, AARNET, Amlight/AMPATH, DE-KIT, KAUST, TIFR

5 AutoGOLE / SENSE Working Group Deliverables and Schedule

The following tasks and schedules are noted for each of the key activity areas.

5.1 Implementing SENSE

- ✓ End-to-End Testing Complete - Q4 2020
- ✓ SENSE Services Integrated with AutoGOLE Infrastructure - Q4 2020
- ✓ Communicating to the wider community (SC'20, GNA-G)

Communicating to the wider community through showcases/functionality validation - 2021

5.2 Persistent Multi-Resource Infrastructure

Adding new sites (new; e.g. SKA, Scandinavia, KAUST, Singapore, Guam and Hawaii) - 2021
Design of monitoring system complete - Q1 2021

- Monitoring of control plane and circuit metadata as first sub deliverable
- Monitoring of circuit data plane (in-band)
- Split up normalizing operations & decision support
- Have a look at PRP/IGROK

Deployment monitoring system complete - Q3 2021 (was: 2021Q2)
Development of automated regular testing system - Q2 2021
Deployment of automated regular testing system - Q3 2021
Domain Science Application Workflow Agent Integration and Testing - 2020 Q3 and ongoing, via DIS WG

5.3 Dynamic ANA

Design and Implementation Options Defined, including what parts – Q1 2021 (was: 2020Q4)
Implementation Option Selection and Schedule – Q3 2021 (was: 2021Q2)

5.4 Generic points, tbd in upcoming meetings

- Security
- Relationship between PRP and AutoGOLE/SENSE
- More defined software stack to easily deploy code and new sites