Network Development in the GÉANT Project

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Public (PU)
GÉANT is the collaboration of European National Research and Education Networks (NRENs) on delivering an information ecosystem of infrastructure and services to advance research, education and innovation on a global scale.
GÉANT Project

Through a long-standing and highly collaborative relationship with the European Union, NRENs and GÉANT provide a stable and innovative environment for research, education, and innovation.

Current project generation: GN5-1

500 contributors from 37 R&E partners

50 million users

9 projects
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Topics

Development

Production Services

Collaboration
Network Development

- Optical Time and Frequency Networks - OTFN
- Quantum Technologies - QT
- Router for Academia, Research and Education - RARE
- GÉANT P4 Lab - GP4L
Optical Time and Frequency Networks - OTFN

Preparing for the forthcoming redefinition of the SI second

Exploring approaches for Time and Frequency (T&F) Services in NREN Networks:
- Building upon already existing T&F infrastructure and services
- T&F Gateway - national signal sources and cross-border transfer
- Monitoring and calibration solutions

https://wiki.geant.org/display/NETDEV/OTFN
Optical Time and Frequency Networks - OTFN

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Design of the Core Time and Frequency Network (C-TFN)

More information in the GÉANT Core Time/Frequency Network (GÉANT C-TFN) Network Development Incubator Report
Quantum Technologies

Exploring Quantum Technologies (QT) for NREN Use cases

Supporting NRENs in their QT deployments and EuroQCI projects
  • Open Quantum Group meetings and infoshares
  • Knowledge hub on the QT wiki

QKD Concepts and Considerations White Paper

QT track in the Network eAcademy

https://wiki.geant.org/display/NETDEV/QT
RARE - Router for Academia, Research and Education

An open source router OS for R&E use cases

Supports six data planes:
- based on UNIX socket
- Libpcap
- DPDK
- BMv2 (P4)
- INTEL TOFINO ASIC (P4)
- XDP, eXpress Data Path

RARE features (not limited to):
- Interior Routing Protocol
- Dataplane forwarding
- External Routing Protocol
- Link local protocol
- Network management

RARE
rare-users@lists.geant.org
rare-dev@lists.geant.org
rare@lists.geant.org
GP4L - GÉANT P4 Lab

**P4 switch-based** lab infrastructure interconnected through the GÉANT network
- 8 switches in Europe: AMS, POZ, FRA, BUD and GNV (4)

**Validation of the RARE/FreeRtr OS routing stack software**

World-wide testbed, offering **experimental dataplane programming facilities to researchers** to perform geographically distributed network experiments:
- With the usage of RARE/FreeRtr NOS
- Using a clean slate environment (i.e without RARE/FreeRtr dataplane & control plane)

A platform for **advancing network operations**:
- New device management
- New experiment reservation
- Digital Twin

Managed and supported using NMaaS as a platform

[https://wiki.geant.org/display/GP4L](https://wiki.geant.org/display/GP4L)
Global P4 Lab

Over 30 locations worldwide

Strong collaboration with the Data Intensive Science and AutoGOLE/SENSE GNA-G Working Groups
Production Services and Software

- NMaaS
- perfSONAR
- Performance Management Platform - PMP
- WiFiMon
- TimeMap
- Argus
- Network eAcademy
NMaaS - Network Management as a Service

A portfolio of network management applications run as dedicated, cloud-based per-user instance

Management of small and medium size networks
- 37 Net management applications available
- Stable, reliable and secure
- Tenants isolation by VPNs, firewall and network configuration
- Simple, efficient procedure for onboarding users
- Technical support of the NMaaS team

Use cases

Virtual Labs for universities and hands-on educational exercises
- Application deployment in the cloud
- No application configuration overhead
- Simple access and management for Lab Managers and Participants

2 Pilot courses
- IT service management
- Network Security

@Ss. Cyril and Methodius University in Skopje, North Macedonia
How to use NMaaS?

Managed service
• Production NMaaS instance: https://nmaas.eu
• Sandbox instance: https://nmaas.geant.org

Self-hosted
• On your own NMaaS instance: https://docs.nmaas.eu/install-guide
• On a local machine: https://docs.nmaas.eu/local-vm
MaaT

The Single Source of Truth for network automation!

Resource Inventory and Service Inventory implemented as a stand-alone application

- Storage for the information about resources and service instances
  - Use of NoSQL (MongoDB) database
  - Data model can be easily updated/extended and validated
  - In use in GP4L
  - In testing in PSNC/PIONIER
  - Available on NMaaS
Some GÉANT’s recents contributions:
• Lookup Service dashboards
• Microdep integration with perfSONAR
• On-demand perfSONAR Graphical User Interface (psGUI)

Open-source, modular, flexible architecture for IPv4 and IPv6 active network measurement and monitoring

Over 2000 registered hosts in more than 1000 organisations around the world
Performance Measurement Platform - PMP

Exploring the performance of the GÉANT backbone while experiencing perfSONAR on small nodes

- Low-cost hardware nodes with pre-installed perfSONAR software and deployed in GÉANT collaborating organisations in Europe and Africa.
- Central components including a central Measurement Archive (MA) and a Dashboard.
- Measurement points in the GÉANT backbone network

- PMP data analysis for new service report using AI/ML
- In green: Countries with the PMP service coverage in Europe

Dashboard: https://pmp-central.geant.org/maddash-webui/
Contact: perfsonar-smallnodes@lists.geant.org
**TimeMap**

Per-segment latency and jitter monitoring tool

Based on TWAMP (RFC 5357)
Easy and quick modular installation
Initial AI-based anomaly detection implemented

Deployed in the **GÉANT backbone network**

**Documentation**
- TimeMap
- Code and documentation
- TimeMap page
ARGUS

An alarm aggregation and correlation tool

- A single unified dashboard and notification system for aggregated incidents from all monitoring applications
- Based on the CNaaS use case
- In production in Sikt and SUNET
- A production service since Sept 2022

https://wiki.geant.org/display/netdev/argus
WiFiMon is a WiFi network monitoring and performance verification system. It is capable of detecting performance issues, visualizing the achievable throughput of a wireless network for each user, and providing technical information about a WiFi network (e.g., signal strength, link quality, bit rate, etc.). WiFiMon leverages well-known performance verification tools (e.g., Akamai Boomerang and Speedtest) and in addition uses data from the WiFi physical layer in order to gather a comprehensive set of WiFi network performance metrics.

WiFiMon Operation Modes

WiFiMon can operate in two different modes which can be used either separately or together:

- **Software Crowdsourced Measurements**
- **Hardware Probe Measurements**

WiFiMon can be deployed on any WiFi network as it monitors the performance on the network layer. It can also provide additional benefits in 802.11x enabled networks including eduroam in which case users can make various performance analyses per access point, per user, etc.

**Technology and vendor agnostic**

**Easy to deploy**

WiFiMon is a software image (also available as a Docker Image) and can be easily deployed on an NREN/University network on hardware or software probes.

**Active monitoring with low network overhead**

WiFiMon shows the end-user (mobile client) behaviour on a network, its perception about the responsiveness of the network and the speed of web resource downloads, correlation of the performance data with end-user data, and data analysis with an effective query builder.

WiFiMon active measurements are not significantly invasive and do not use any significant bandwidth. One WiFiMon measurement is comparable to one average web-page download (load speed).
Network eAcademy

Powered by:

OAV Training
OAV public wiki
NETDEV wiki
Terminology
Architecture / Mapping
Maturity Model
Quantum Training

ARCHITECTURES

Powered by GLAD

GEANT LEARNING & DEVELOPMENT
Network eAcademy Learning Tracks

- Orchestration, Automation and Virtualisation
- Quantum Technologies
- Optical Time and Frequency Networks
- Artificial Intelligence
- ...to be continued

Network Automation eAcademy

INTRODUCTION TO OAV
OAV ARCHITECTURE
INTRO TO DATA MODELLING, DATA FORMATS AND PROTOCOLS
INTRO TO CI/CD
INTRO TO IOT
INTRO TO AI
INTRO TO VIRTUALISATION
INTRO TO PRODUCTION
INTRO TO AUTOMATION TOOLS
AUTOMATION TOOLS
CONTAINERISED
HYPERVERISOR BASED
PUBLIC/PRIVATE CLOUDS
AWS, AZURE, GOOGLE CLOUD
INTRO TO AUTOMATION
VERSION CONTROL
CONTINUOUS INTEGRATION/CONTINUOUS DELIVERY
AUTOMATED CONFIGURATION MANAGEMENT
CONTAINERISATION
DATA ANALYTICS
BIG DATA STORAGE
ELASTICSEARCH
TOWARDS INTELLIGENT NETWORKS
TOWARDS INTELLIGENT NETWORKS
INTRO TO INTELLIGENCE MANAGEMENT
INTRO TO INTELLIGENCE MANAGEMENT
PARTY MANAGEMENT
CORE COMMERCE MANAGEMENT
INTELLIGENCE MANAGEMENT
DAA REALISATION
USE CASES AND EXAMPLES
ARCHITECTURE

Legend
- Unit
- Document
- Released
- Revised
- Exchange point

You can jump back and forth between this station and all exchange points at any time.

Tracks
- GENERAL INTRODUCTION
- AGILE, DevOps, CI/CD
- DECOUPLING & INTEGRATION
- PRODUCTION
- ENGAGEMENT MANAGEMENT
- PARTY MANAGEMENT
- CORE COMMERCE MANAGEMENT
- INTELLIGENCE MANAGEMENT
- DAA REALISATION
- USE CASES AND EXAMPLES
- ARCHITECTURE

Links to Resources
- https://wiki.geant.org/display/NETDEV/OAV+Training+Portal

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- CC BY-NC-SA license
- eduGAIN access (or social media)
Quantum eAcademy

https://wiki.geant.org/display/NETDEV/OAV+Training+Portal
OAV Terminology

Terminology and Glossary of terms related to:

- Orchestration, Automation and Virtualisation
- Maturity Model
- Artificial Intelligence

Motivation:

- To bridge the terminology gap in the community
- To systematically structure relevant OAV, AI and MM terminology

Published in collaboration with the GNA-G Automation Working Group

OAV Terminology Document
TMForum Open Digital Architecture as a Reference Architecture
NMaaS Architecture

NMaaS-OAV-Architecture-Analysis
Service Provider Architecture

SPA-OAV-Architecture-Analysis
NMaaS and SPA Architectures
NMaaS and SPA Architectures
Digital Architecture Analysis

Mapping NREN & use cases architectures to a common blueprint, the TM Forum Open Digital Architecture (functional architecture).

Align efforts | Find similarities | Collaboration | Interoperability

NREN Architectures
- CARNET
- CYNET
- GÉANT
- GRNET
- HEAnet
- PIONIER
- SURF

NETDEV Architectures
- Argus
- NMaaS
- SPA
- PMP

Other Use Cases
- 5G
- EOSC
- ETSI GANA
- ETSI OSM
- ETSI ZSM
- GVM
- MEF LSO
- Open Baton
- ONAP
- SENSE
- TALENT
Maturity Model for Orchestration, Automation and Virtualisation (OAV)

A self-assessment tool as a digital transformation progress indicator:

- 31 questions
- Data is used for analytical purposes only
- Report is sent to the person defined in survey
- Individual responses not published

https://www.surveymonkey.com/r/SPYDQVB
NETDEV Incubator

A mechanism to include new work during the project
Simple proposal procedure following simple rules

A proposed project MUST be:
• Relevant to the NETDEV project (GN5-1 WP6)
• SMART: Specific, Measurable, Achievable, Resource- and Time-bound
• With evident interest for the results from the community

Incubator projects so far:
• Optical Time and Frequency Networks
• Fibre Sensing
• Workflow Orchestrator Telemetry Module

https://wiki.geant.org/display/NETDEV/NETDEV+Incubator
Collaboration

- Special Interest Groups - SIG-NOC
- Global Network Advancement Group - GNA-G
- Global Research Platform
- MetrANOVA
GÉANT Special Interest Groups - SIGs are established under the auspices of GÉANT in order to create an open forum where experts from its community exchange information, knowledge, ideas and best practices about specific technical or other areas of business relevant to the research and education networking community.
GÉANT SIGs - Network

2 Network-related SIGs:

- Network Operations Centre - **SIG-NOC**
- Next Generation Networks - **SIG-NGN**
SIG-NOC Tools Survey - Report and Matrix

Covers 16 NOC functions

- Monitoring
- Problem Management
- Ticketing
- Reporting and Statistics
- Configuration Management and Backup
- Knowledge Management and Documentation
- Performance Management
- Security Management
- Inventory Management
- Communication, Coordination and Chat
- Out-of-band Access Management
- Resources Management
- Change Management
- DDoS Mitigation
- Data Aggregation, Representation, Visualisation
- Orchestration, Automation and Virtualisation
SIG-NOC Tools Survey: Report and Matrix
SIG-NOC Tools Survey: Monitoring Tools per Methodology

Frequency: daily / few times a week / once a week / once a month / only in case of incident
SIG-NOC Tools Survey: Ticketing Tools
SIG-NOC Tools survey:

- On average, each institution uses 11.5 tools for monitoring.
- Mix of open-source / vendor-based and distributed tools.
- Even if there are many specific tools for resource or inventory management, spreadsheets are commonly used.
- You can find the report, the matrix and the results here:  
  https://wiki.geant.org/display/SIGNOC/SIG-NOC+Tools+Survey+2023
Register
To join us in Helsinki!

20th SIG-NOC meeting - Helsinki, Finland
7&8 May 2024
Going Global

- GNA-G - Global Network Advancement Group
- Global Research Platform

Image source: https://www.gna-g.net/
GNA-G = Global Network Advancement Group

A community of network professionals from the R&E networking organisations worldwide

The GNA-G goal
Work together to better align resources and make the continent-to-continent interconnections more efficient for global science collaborations and transnational education

The GNA-G Vision
The international collaboration of national R&E networks on more effective use of resources and interconnection of R&E networks for science and future development of these networks

The GNA-G Mission
Ensure the technologies, infrastructures and investments of the partners and participants are utilised for interconnecting R&E networks on a global scale.
GNA-G ModusOperandi

- The work is taking place within Working Groups
  - Regular meetings - weekly, bi-weekly, monthly
  - Work per objectives and expected outcomes
- Working groups
  - Proposed through a charter
  - Established and closed by the Leadership Team
- Community meetings
  - Working group results report
  - Presentations on a specific topic from several organisations / regions
- Each community meeting organised in two sessions, e.g.:
  - 6am - 8am UTC, suits Asia, Australia, New Zealand, Africa, and Europe
  - 8pm - 10pm UTC, suits North America, Latin America, Africa, and Europe

Communicate, Contribute, Collaborate
GNA-G Working Groups

Established:
- AutoGOLE/SENSE
- Data Intensive Science
- GREN Map
- Network Automation
- GNA-G Routing WG
- GREN Engineering Advancement
- Security Bootcamps
- NomCom - Nomination Committee

Next meetings:
Q2 Community VC, tbd

@TNC24, 10.6.2024
GNA-G Network Automation WG Meeting, 09:00 - 12:30
GNA-G Community Meeting, 14:00 - 17:30

More info: https://www.gna-g.net/meeting/
GRP = The Global Research Platform

An international scientific collaboration led by:

The International Center for Advanced Internet Research (iCAIR) at Northwestern University,

The Electronic Visualization Laboratory (EVL) at the University of Illinois Chicago,

The Qualcomm Institute–Calit2 at UC San Diego,

and

its partners worldwide.

https://www.theglobalresearchplatform.net/
GRP = The Global Research Platform Objectives

- Create one-of-a-kind advanced ubiquitous services that integrate resources around the globe at speeds of gigabits and terabits per second.
- Focus on design, implementation, and operation strategies for
  - Next-generation distributed services and infrastructure
  - High-performance data gathering, analytics, transport, computing, and storage, at 100 Gbps or higher.
- Global partnering for distributed cyberinfrastructure to support data-intensive scientific workflows

https://www.theglobalresearchplatform.net/
GRP Meetings and Topics

Often collocated with some other event (IEEE, SC, SCA…)

Topics:

- Large-Scale Global Science
- Next-Generation Research Platforms
- Orchestration Among Multiple Domains
- Large-Scale Data WAN Transport
- High-Fidelity Data Flow Monitoring
- Visualization, Analytics, Diagnostic Algorithms,
- Event Correlation AI/ML/DL
New Consortium MetrANOVA to Create a Measurement and Analysis Toolbox for Research and Education Networks Worldwide

Please fill in the MetrANOVA Survey
Forthcoming Events

March
  • 21 March, WiFiMon InfoShare, online

April
  • 18 April, OAV Architecture Workshop (Brussels, Belgium)

May
  • 7-8 May, 20th SIG-NOC Meeting (Helsinki, Finland)
  • 14-16 May, 4th European perfSONAR User Workshop (Trondheim, Norway)

June
  • 10-14 June, TNC24 (Rennes, France)
    • NETDEV, perfSONAR, RARE, nmaas, GP4L,
    • GNA-G, MetrANOVA
    • … and more
Thank You!

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