

Trends in Network and Service Monitoring

Session Chair: Ivana Golub (PSNC)

Authors: Ivana Golub (PSNC) - Trends in Network and Service Monitoring - Overview

Frédéric LOUI (Renater) - NMaaS

Pavle Vuletić (UoB) - PVM

Antoine Delvaux (PSNC) - perfSONAR, PMP, MDM C&E

Kurt Baumann (SWITCH) - CFM, WiFiMon, eduPERT, SIG-PMV

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Abstract

Constant development of network infrastructure and services requires also continuous development of advanced network monitoring techniques, tools and services. The focus in the network monitoring development and service provisioning has changed from the initial device and technology-oriented solutions towards the service-driven view, keeping at the same time end-to-end, user-centric and multi-domain aspects as key requirements.

The session includes current and future work of development activities in the area of network and service monitoring and performance verification, including those from research institutions and GÉANT4-2: the development of Network Management as a Service, Performance Verification Monitoring, perfSONAR, Performance Measurement Platform, CFM and WiFiMon, and community-oriented initiatives, such as Multi-Domain Monitoring Consultancy and Expertise service, eduPERT and Special Interest Group for Performance Monitoring and Verification.

Network Management as a Service (NMaaS) is a new GN4-2 development initiative that is heading towards the production in Q3-2018. NMaaS offers a portfolio of network management applications that are placed in an 'app store'-like repository, which allows engineers to browse and select the applications they wish to use, launch these applications within a convenient cloud environment, define the entities of interest, and configure the tool(s) to access, monitor, and ultimately manage these entities. NMaaS is suitable for organisations that do not have or do not want to own NMS infrastructure themselves, or who want to outsource network management, as well as for organisations and/or individuals who want to share their software with the community.

Performance Verification Monitoring (PVM) supports service performance monitoring, verification and fault localization for several types of network services: legacy VPNs (all flavours of MPLS VPNs: L2 VPWS and VPLS, single and multi-domain point-to-point and multipoint L3 VPNs), point-to-point virtual circuits using specialised provisioning software (e.g. OpenNSA based), chained service functions and other switching technologies, such as SDN/OpenFlow-based switching, etc. The PVM includes innovative service-aware active and passive monitoring methods on monitoring zone border points and stores the results so that the data can later be inferred for analysis, taking into considerations system scalability and accurate measurement of network service performance parameters, such as those defined in Y.1540, Y.1541 and MEF10.3 specifications. PVM service production service will be available in the second half of 2018.

perfSONAR, a modular open-source suite for active network measurements, helps, for over a decade, network engineers around the world in managing and controlling the performance of

their networks. perfSONAR versions 4.0.x bring new architecture with simplified code base and a new scheduling tool, pScheduler, that provides better control in the measurement process, increased extensibility and integrability. With this new design, perfSONAR opens up to integrations and community contributions and is available for use in virtual environments, such as Multi-Domain Virtual Private Network (MD-VPN) instances. Version 4.1 will be released in spring 2018, with a revamp of the measurement mesh system and support for additional measurement tools, and can be presented to the community at the TNC.

Performance Measurement Platform (PMP) consists of 20 small nodes (low-cost hardware) in Europe and Africa with pre-installed perfSONAR, 5 GÉANT measurement points located in the core of the network towards which the measurements are performed, and central components that manage the platform elements, gather, store and represent the performance data. Small-nodes participants can shape the pre-defined setup and configure additional measurements. This provides the basis for collaboration between all participants, can serve for training purposes, as well as to provide insight and increased transparency of the GÉANT network infrastructure from NRENs' perspective. This platform is now ready to grow with more nodes, covering all NREN of the GÉANT service area, and will evolve with further development of network monitoring and performance measurement tools.

Connectivity Fault Management (CFM) based on IEEE 802.1ag finds its use cases in the project on inter-domain L2 Ethernet service between NRENs, or for extended layer 2 connection crossing domains and borders. Both use cases are of interest for GÉANT, either for the multi-domain cross-border connectivity services, or for test or production networks established in a research collaboration project across separate physical infrastructure segments. Thus the Connectivity Fault Management (CFM) framework and additional belonging functions have been standardised. Further, preliminary tests at DFN showed that CFM has a real potential to address the performance monitoring challenges on Ethernet Services, and in the PERT context to complement the end-to-end performance monitoring and troubleshooting strategies direct on Layer-2. The pilot deployment of CFM is progressed in DFN network, and first discussions with GÉANT are initiated towards its implementation in GÉANT network.

The **WiFiMon** [4], [5] software package enables measuring, recording and exporting statistics regarding the quality of an eduroam enabled WiFi network as experienced by the end-users. The measurements are triggered with JavaScript by users (mobile clients) when they visit WiFiMon-enabled websites and/or WiFiMon-enabled mobile applications. Main goal of WiFiMon is to give the campus network administrators a better overview on how the end-users experience the conditions of the Wi-Fi network. Correlated data-sets will allow performance benchmarking, predictions the user behaviour on the campus. Further, with WiFiMon there is a basis for making decisions on strategic and technical layer.

Multi-Domain Monitoring Consultancy and Expertise (MDM C&E) service is offered to the GÉANT community to help integrating existing network monitoring tools and establishing a network monitoring platform for an organisation, taking into consideration requirements of individual use-cases. Initially started as perfSONAR Consultancy and Expertise service, it has focused on the implementation of perfSONAR in GÉANT NRENs, as a single or multi-domain solution to support NREN NOCs work, or as a measurement platform for the researchers in the area of network and performance monitoring. The support provided includes analysis and suggestions for improvements in specific network monitoring and management use cases as well as trainings about tools and technologies.

eduPERT [6] is a community group that supports PERTs with network performance monitoring and verification expertise (see WiFiMon and CFM), including the tools and services developed and provided primarily, but not limiting to the GÉANT project, such as WCSPMV or perfSONAR. In the future, eduPERT will act as a skills-pool provider organising trainings and having a Knowledge Data Base (KDB) in place as a compendium on PMV issues for PERTs,

research and outreach organisations. Together with SIG-PMV it can span the umbrella on a wide PMV scope on localised scenarios addressing research, academic ICTs and the Industry.

The GÉANT **Special Interest Group for Performance Monitoring and Verification** (SIG-PMV) [7] is focusing on performance monitoring verification scenarios from a research and also operational perspective. As a logical consequence SIG-PMV is intended to act as an umbrella for eduPERT, thus located scenarios presented by the new SIG shows PERT relevant approaches that if a use case is presented at SIG-PMV, eduPERT will support solutions for given, figured out scenarios in a single, or multi domain and/or vice versa. All presented developments and services are aimed for the research and education community. Users are coming from specific groups such as Network Operations Center (NOC) engineers, researchers or end-users in search for tools and techniques for single- or multi-domain network monitoring and management, as well as assistance for more efficient performance verification and fault localisation.

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Ivana Golub received her BSc, MSc and PhD in Electrical Engineering from Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture, University of Split and is working as a senior researcher for Poznań Supercomputing and Networking Center. Her areas of expertise include and are not limited to network and services lifecycle management and performance monitoring. Dr. Golub is actively involved in GÉANT4-2 project where she takes the roles of Network Services Development Co-Activity Leader, Trust & Identity and Multi-Domain Services Deputy Activity Leader and Multi-Domain Monitoring Task Leader.

Frederic LOUI, M.Sc.Eng. in Computer Science and Automation from Pierre & Marie Curie University, is a senior network engineer with almost 20 years of experience. He began as GroupWare professional services in 1998 and started his career in the Telecom industry in 2000 at Sita-Equant company, mainly as an IP/MPLS Network Architect dedicated to the Airlines industry. In 2006 in joined RENATER and integrated the Network Core Backbone team where he actively participated to RENATER-4 and 5 implementations roll-out. He now leads Innovation activities within RENATER in addition to his Peering Manager activities for the AS2200. He is active within GEANT activities since 2007 (GN2) and now leads NMaaS service development.

Pavle Vuletić obtained his BSc, MSc and PhD in Computer Systems and Network Architecture from University of Belgrade, School of Electrical Engineering. He used to work at the University of Belgrade, Computer Centre as a senior network engineer while Computer Centre was responsible for the development of Serbian Research and Education Network (AMRES), and later as a deputy director of AMRES. He is currently assistant professor at the University of Belgrade, School of Electrical Engineering at the Department of Computer Engineering and Information Theory, teaching Advanced Computer Networks and Software Defined Networks courses. His research interests span from network security to network performance, monitoring and modern network management principles. Dr. Vuletic was

involved in several EC projects in the area of research and education networking. He was a leader of research tasks exploring multi-domain control and management principles and network service performance in four GÉANT projects.

Antoine Delvaux, M.Sc.Eng. in Computer Science from the University of Liège, Belgium (1999), is working for PSNC, the Poznań Supercomputing and Networking Center, and is perfSONAR Service Manager in the GÉANT project. He has participated in different network and services monitoring activities, both on the operational and the software development sides, for many years and for various (N)REN (Belnet, Dante, PSNC, WACREN). He is involved in the perfSONAR project since 2008.

Kurt Baumann MSc UZH – System Engineer at SWITCH. He holds a Master degree in mathematics of the University Zurich (2001). After IBM he joined SWITCH in 2005 in a position of a Project leader SWITCHconnect. Today he is member of the Network Department and represents SWITCH's interests in various tasks in GÉANT, currently as a task leader SA3T5 "eduPERT" and SC member of SIG-PMV. Further he is a founder of the SDN Switzerland Meet Up Workshop focusing research, academic ICTs and Industry.