Title:
Innovation and Evolution: The GEANT Backbone Network

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Presentations and discussion

Abstract
This session will inform the audience about recent tests conducted by the GÉANT Association and its two strategic suppliers (Juniper and Infinera) on the GÉANT backbone network and using the GÉANT Network and Operational Verification Capability (GNOVC – a router and switch test lab facility collocated with the GÉANT Operations Centre). It will also elaborate on the plans of how to capitalise on their results and explore further features and technologies.

The GÉANT backbone network exists to serve a select, small number of European network operators – the NRENs – many of whom take an active interest in the evolution of this network, both because of the services of theirs it supports, and by way of a benchmark for their own networks. It is expected that many of these NRENs will be represented in the audience and they will be encouraged to contribute their thoughts and preferences for the future development of the GÉANT network.

The GÉANT backbone network is made up of Juniper MX Universal Edge Routers and Infinera's DTN-X multi-terabit packet optical platform. Already capable of switching packets at 100Gbps, Infinera have developed a prototype 1Tbps tributary card, and we will present the results of their first field trial of a single-chip Terabit scale super-channel, which was conducted between Bratislava and Budapest using the GÉANT network.

As is typical of other European R&E networks, GÉANT's MPLS overlay network is currently implemented at the router layer, with layer-2 point-to-point and multipoint services then built on this MPLS "substrate". We will present a proposal to use MPLS-TP on DWDM equipment to enhance performance and reduce the cost of transporting layer-2 services.

In the current Large Hadron Collider Optical Private Network (LHCOPN) architecture, most of the traffic transits CERN. This network would benefit from an MPLS-TP based EVP-LAN service which would allow them to send traffic between T1 sites without having to go through CERN, while still benefiting from guaranteed/dedicated bandwidth and automatic path restoration.

Overlay networks such as LHCONE which carry large traffic loads and are running as an overlay on IP networks can be moved down a layer to reduce the cost of the interfaces. The LHCONE overlay can be deployed on DWDM/OTN equipment, which supports MPLS-TP, to provide additional benefits such as bandwidth guarantees that are not currently offered on IP overlay.

Many of GÉANT's advanced services rely on one or more specialist applications, often running on servers collocated in GÉANT PoPs. High availability techniques typically require multiple devices

(running the same application) to be connected to the same LAN, and these are susceptible to site-wide incidents (power or ventilation issues, etc). In this part of the session we will describe how Juniper's new 'Ethernet VPN' (EVPN) technology will create a LAN across geographically diverse sites, whilst Virtual Machine Traffic Optimisation will ensure that traffic to individual devices takes the best possible route over the WAN.

Before being deployed in the GÉANT network, these new Juniper features will be rigorously tested using the GNOVC mentioned above. This will become a key part of a new pre-deployment testing process for GÉANT that is being developed by Axians (formerly ImtechICT), who re-sell Juniper systems to the GÉANT Association. This will also be described in the session.

Whilst there is much interest in ground-breaking technologies such as 1Tbps, of equal importance in the future will be the ability to provide cost efficient and versatile network systems and service support substrates. One approach to this is the use of high speed but simple layer-2 switches controlled by external network controllers using OpenFlow as has been explored in GÉANT joint research activities and some of the Open Call projects. We will present our plans, and findings to date (making use of the GNOVC) of using OpenFlow with such switches and controllers.

Proposed speakers:
Guy Roberts, Mian Usman, Mark Johnston, Michael Enrico

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I would like to acknowledge the contribution to this work by all those in Infinera, Juniper and Axians who work on the GEANT Association account.

Vitae:
Guy Roberts received his BEng degree from RMIT University in Australia in 1991 and his PhD in photonics from the University of Cambridge in 2006. He began his career in Australia, working for Telstra network then moved to Fujitsu Australia in 1995. In 1999 he relocated to the UK to perform system integration and testing on Fujitsu's DSL platform the FDX. In 2006 Guy joined DANTE and he is now the Senior Transport Network Architect in the office of the CTO of what is now the GÉANT Association. He is also research coordinator for the GN3plus project and co-chair of the Network Service Interface working group in the Open Grid Forum.

Michael Enrico received his BSc and PhD degrees in Physics from Lancaster University. He moved into telecommunications when joining what was then BT Labs, where he worked on novel access network architectures and highly scalable IP network transport solutions for broadband services. In 2001, he joined the former DANTE's Network Engineering and Planning team. In 2012 he was appointed CTO and is now responsible for developing network-related technology strategies in the GÉANT Association. He is also a technical coordinator in the GÉANT project and regularly represents the GÉANT Association and project on the international R&E networking and telecommunications industry stages.

Mian Usman received his BSc in Network Management and Design from University of Portsmouth in 2007. He worked as a network engineer for a commercial ISP before joining DANTE (now part of the GEANT Association) as a NOC engineer in 2008. He joined the Operations team in January 2010 then became the IP Network Architect in the Office of CTO in 2012. Mian led the team responsible for designing and deploying GÉANT's new IP/MPLS platform and the migration of GÉANT Plus service from EoSDH to EoMPLS. Now focused on GÉANT network architecture and design, he is the task leader of 'Backbone Network development' in the GN3Plus project and also chair of the Technology and Topology working group in the Global Network Architecture (GNA) initiative.

Mark Johnston became Chief Network Operations Officer in 2013 and has responsibility for the delivery and operation of the GÉANT network and its services. He was previously leading the 500Gbps GÉANT Network Migration Project, having joined DANTE in 2012. Mark has over 20 years of telecommunications experience in managing operational teams to design, plan, build and operate network infrastructure and network-centric services; and in driving continual improvements of operational processes and workflows. Mark has an Electrical and Electronic engineering undergraduate degree and a Masters in Business Administration.