Investigating new Services for GÉANT using ONOS

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• **Pan-European** service provider
• Interconnects **38 National Research and Educational Networks** (NRENs)
• 50 million users
• High capacity backbone (up to 8Tbps)
• Different customers and **services**:
  – Connectivity (IP, VPN, P2P, Open)
  – Trust Identity and Security (eduroam, eduGain, ...)
  – Cloud
  – Testbed
  – Management and monitoring

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GÉANT Interconnections

- Extensive connections to:
  - North America
  - Latin America
  - Africa
  - Middle East
  - Asia and Asia-Pacific

- GÉANT receives about 1.5PBytes of data per day on Global and Virtual Private Networks (L3VPN) interfaces

- External peers interconnected through **26 POPs**, located all over Europe, and **2 Open eXchange Points (OXP)**s
Multi-domain Bandwidth on Demand service provisioning
SDN-based Bandwidth on Demand

– SDN BoD creates **L2 services with QoS**
– It runs as **ONOS application**
– Provides **multi-domain BoD** services involving heterogeneous transport technologies
– Through **NSI-CS** protocol, it interacts with the legacy GÉANT BoD service (AutoBAHN)
– Enforces **QoS constraints** such as rate limiting
– Enhances current BoD services with **failure recovery mechanisms** and automated **network topology discovery**
SDN BoD deployment
Benefits for GÉANT

– Automation of service provisioning, reducing the manual configuration and the operational costs
– Optimization of network resources’ utilization, increasing the service request acceptance ratio
– Migration to SDN technologies while keeping the strategic multi-domain connections
– Support for failure recovery mechanisms
Software Defined Internet Exchange Point
– Use SDN in **GÉANT Open eXchange Points** (OXPs) as evolution of the GÉANT Open service.

– GÉANT SDX is a **hybrid environment** that provides both L3 and L2 connectivity services:

  • **SDXL3** ONOS app: provides **IP transit** service via BGP to customers (IXP)

  • **SDXL2** ONOS app: creates **L2 tunnels** between MAC/VLAN endpoints, tagged with VLAN/MPLS
Developed functionalities: SDX – L2

- Abstraction of virtual SDXs
- Implemented as a service that can be called by other subsystems within ONOS
- Monitoring and statistics (IPFIX export)

Tunnel modes

Based on MAC addresses, VLAN encapsulation, MPLS encapsulation (implemented in ONOS core)

SDX L2 app

CLI and GUI implementation

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Developed functionalities: SDX – L3

- Same-subnet BGP peers configuration
- Internal speaker can act as route server
- Direct communication between peers (via modified ProxyARP app)

Dynamic peer administration

SDN-IP improvements

Extended app (SDX L3)
SDX deployment

- **SDXL3** - extends SDN-IP app and enables an SDN network to be operated as the IXP infrastructure

- **SDXL2** – allows automated provisioning of L2 tunnels between SDX customers

- **IP Flow Information Export (IPFIX) protocol** - used for transmitting Traffic Flow information over the network to the Collector process.

- **Pica8 switches** – OpenFlow-enabled switches used for data-plane communication
Benefits for GÉANT

- **Direct control** over packet-processing rules
- Support for **high availability**
- **Vendor agnostic environment**
- **Rapid application development**
- **Custom route selection** process
- **Application-based** peering
Transport SDN
Transport SDN

Packet-optical integration app

- Based on ONOS packet-optical integration
- CORSA switches as L2-L3 devices

Infinera OTSv plugin

New driver to interact with the INFINERA control plane

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Software Defined Transformation of Service Provider Networks

Q&A

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