SDN in GÉANT

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SDN conference, 17 June 2014

Agenda

- SDN in European R&E: what's SDN good for?
- SDN research in the GÉANT project
- The NSI protocol: solving the multi-domain problem
- Building a global circuit service based on NSI
- NSI as an SDN building block

“GÉANT” is many faceted…

- A European network backbone operated by DANTE
- A network service area backbone + NRENs
- A consortium (of NRENs, DANTE & TERENA)
- An EC co-funded FP7 project (GN3Plus)

GÉANT: The European internet backbone

25 European POPs

50,000km network infrastructure on 44 routes

12,000km of dark fibre on 18 routes

Diversified footprint

- Serves 40 million users
- 8,000 institutions
- Across 40 European countries

- GÉANT is co-funded by Europe's NRENs and the European Commission (EC) under the Seventh Framework Programme (FP7)
- Project Partners are 38 European NRENs, NORDUnet, TERENA and DANTE as Co-ordinator
- 150 FTEs' annual effort (> 350 individuals) working in GÉANT across Europe

SDN drivers in R&E networks

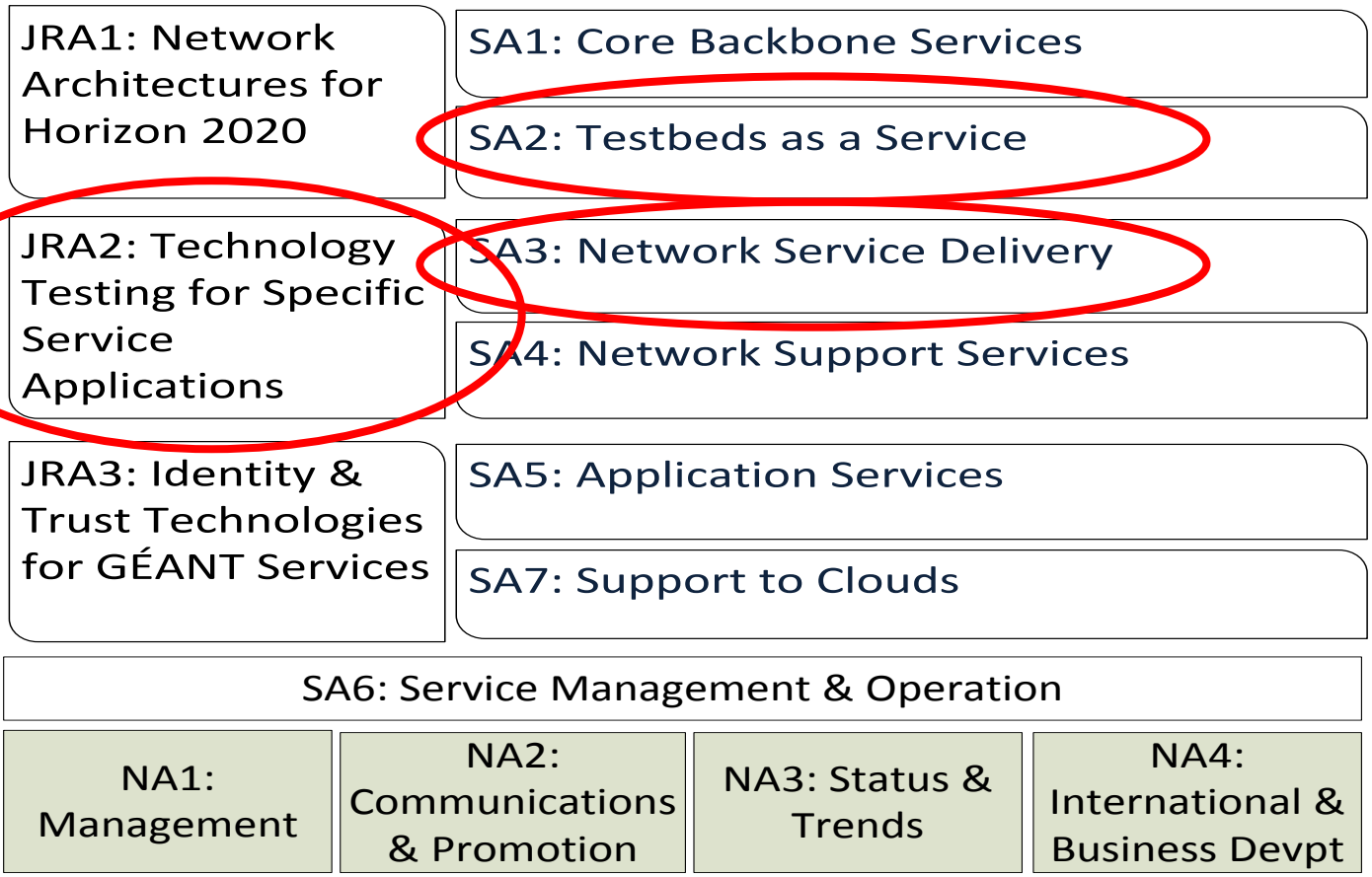
What is of interest in Research Networking?

- End-to-end performance
- Supporting large science flows
- Giving control over the network to researchers
- Solving the multi-domain service challenge

What is NOT interesting?

- Cost reduction
- Billing

GN3Plus Project - activities

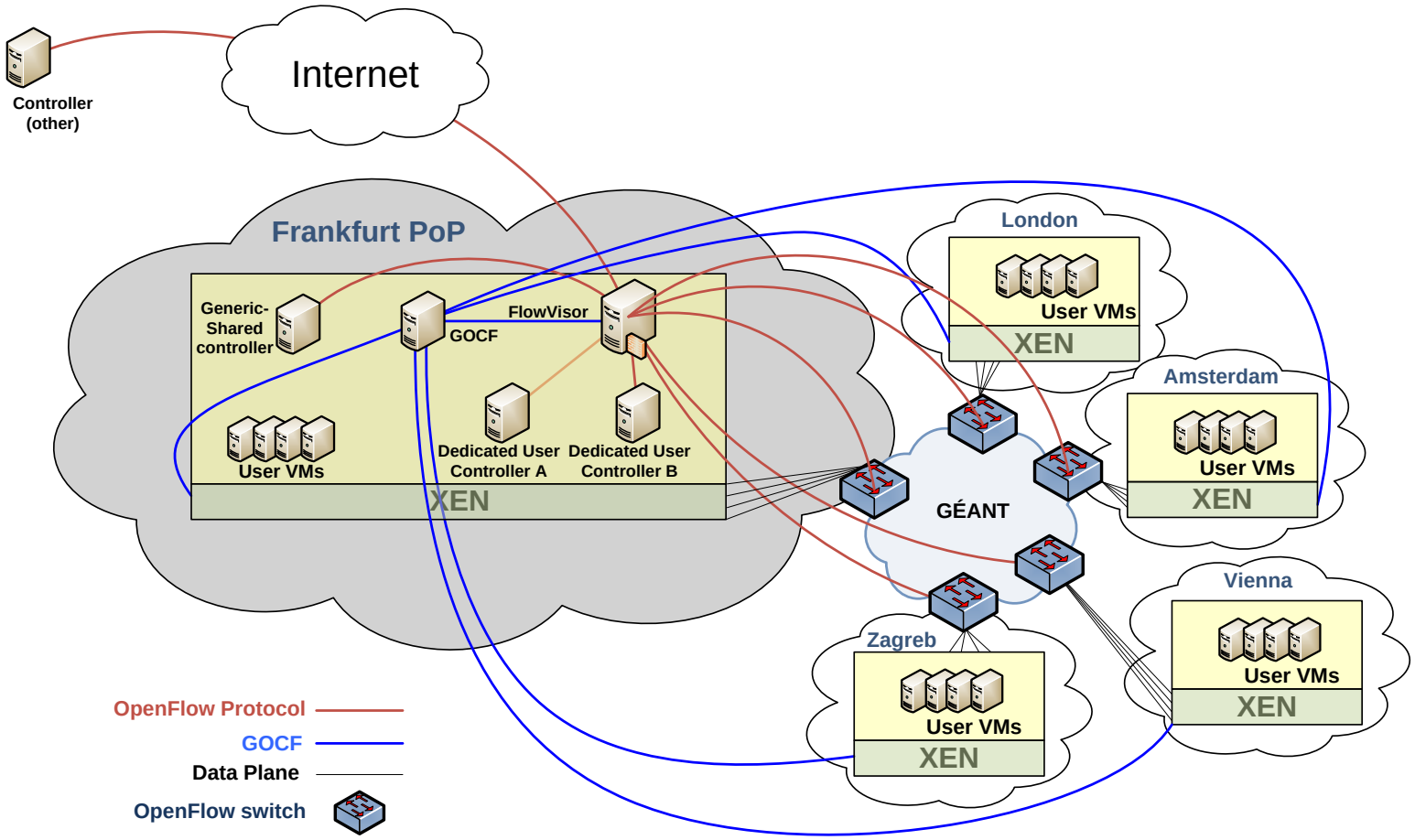


Two generations of SDN testbed

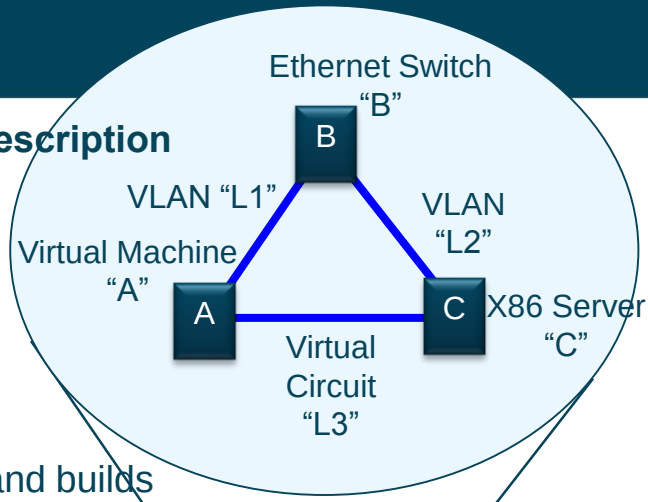
- **Generation 1**
  GÉANT Open Flow Facility
  SDN focused testbed based on Xen hypervisor, a full mesh of Open vSwitches coordinated using the Ofelia Control Framework

- **Generation 2**
  Testbed as a Service
  Low level Testbed resources are allocated via UI. Open Stack is used for the VMs and OF enabled switches are interconnected via NSI enabled BoD service.

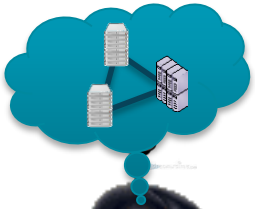
Gen 1: GÉANT OpenFlow Facility



Gen 2: Testbed as a Service

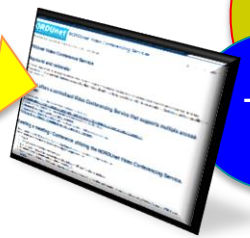


Network testbed concept to test novel idea

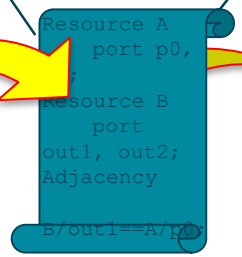


Researcher has a brilliant idea

User logs in, and builds a testbed description via a web GUI frontend to their Testbed Control Agent

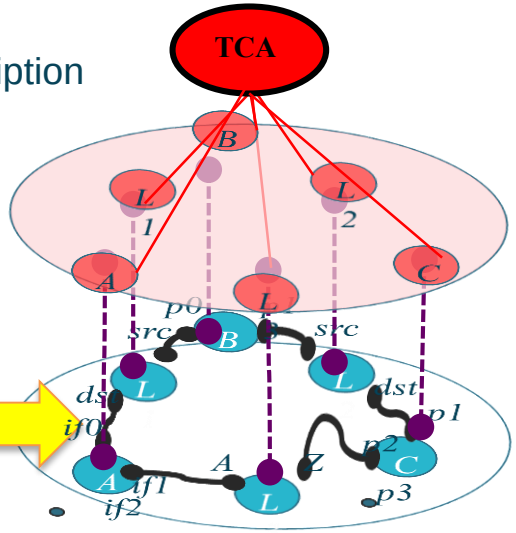


TCA



Testbed Description Doc fed to RM

RM



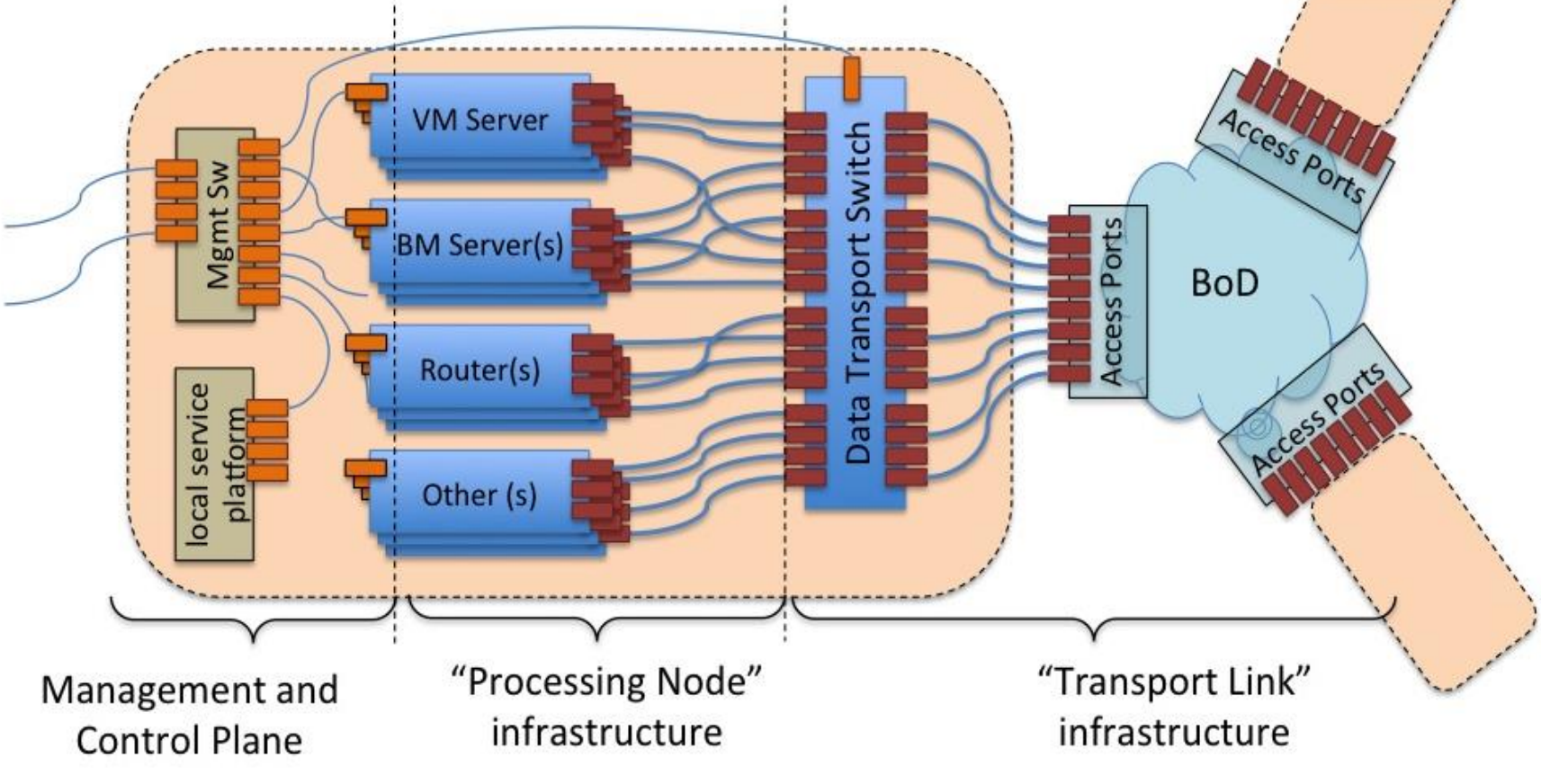
Resource Manager
Allocates resources and sets up the testbed control plane

Testbed is activated and user controls it via the TCA

Gen 2: Testbed as a Service

Ethernet Switch "B"

A Service Pod is a self contained set of physical components that is placed as a group at different geographically locations. Pods may be substantially different in terms of number of components, but they all follow the same architectural design below.

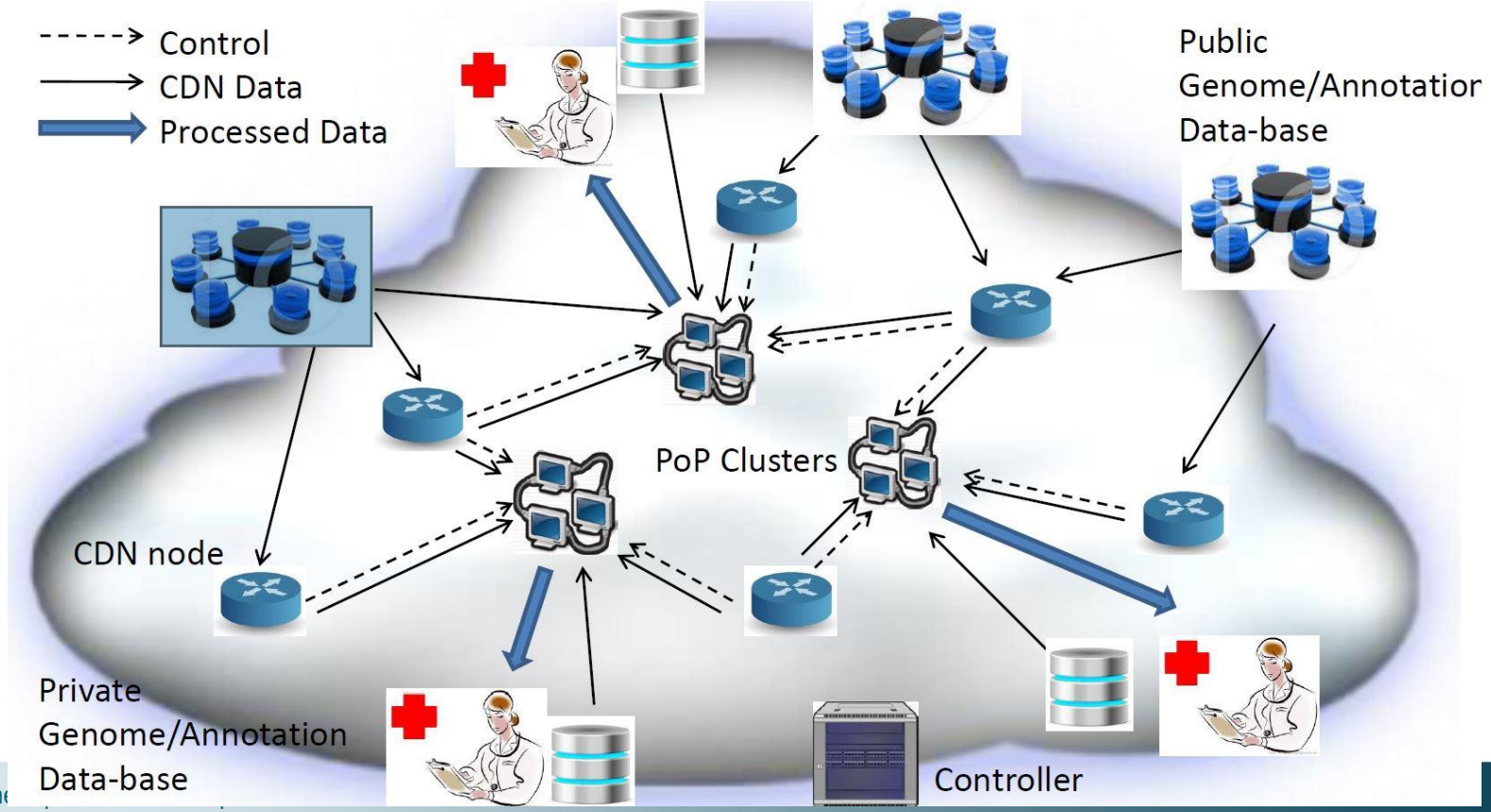


controls it via the TCA

control plane

ARES
Employing cloud techniques to move Genome data

- The ARES project is leveraging cloud services for genome content distribution
- Individual genome sequencing for everyone is imminent, this will result in huge amounts of data - current network architectures won't scale.



ARES: Advanced Networking for EU Genomic Research

- A range of CDN services need to be supported, such as:
  - Minimum delay CDN services for handling urgent situations.
  - Short delay CDN services for handling less urgent situations.
  - Balanced network load CDN services for handling all other situations.
- Management of virtualization services using NetServ (NSF funded programmable router architecture).
- NSIS signalled caching allows data to be accessed via a cloud-like interface
- Virtualization through OpenStack based IaaS allows aggregation of computing resources and storage.
- Use of NSIS NSLP protocol for discovering bottlenecks & disjoint paths

Research by University of Perugia and Polo GGB and funded by GÉANT Open Calls

Autonomic OpenFlow (AUTOFLOW)

- AUTOFLOW is applies autonomic network management (ANM) to the SDN environment. Uses ANM Control Loops (ACLs).
- Focus of work is on *self-configuration and self-healing properties of ANM*, in order to recover from network failures and optimize network performance
- Goal is to steer the network's operation according to operator's policies (energy efficiency, load balancing, service performance etc)
- Employment of *reinforcement learning* and an agent system per physical network that is responsible for customizing its resources
- SDN enables the centralization of the routing - *inter-AS optimization* and allows *load balancing* algorithms to be applied
- *Congestion prediction*, based on the past experience of the network.
- learning scheme uses *Self-Organizing Map* (SOM) which is a artificial neural network

Research by University of Perugia and Polo GGB and funded by GÉANT Open Calls

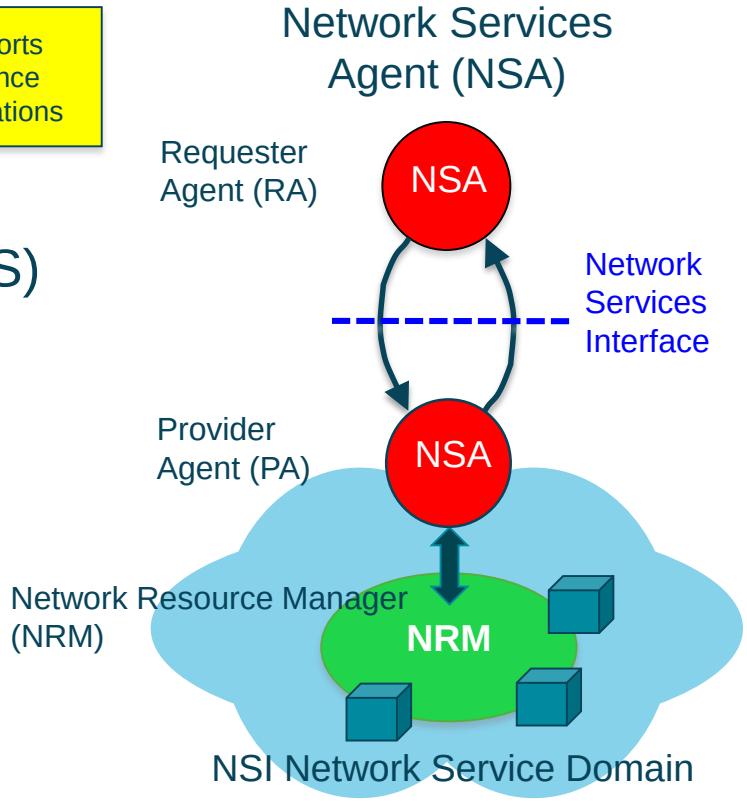
NSI Fundamental Design Principles (1/3)

1. **“Network Service Interface” is a framework for inter-domain service coordination**

Examples:

- Connection Service (NSI-CS)
- Document Distribution Service (NSI-DDS)
- *Monitoring Service*
- *Protection Service*
- *Verification Service*
- *Etc.*

Supports advance reservations

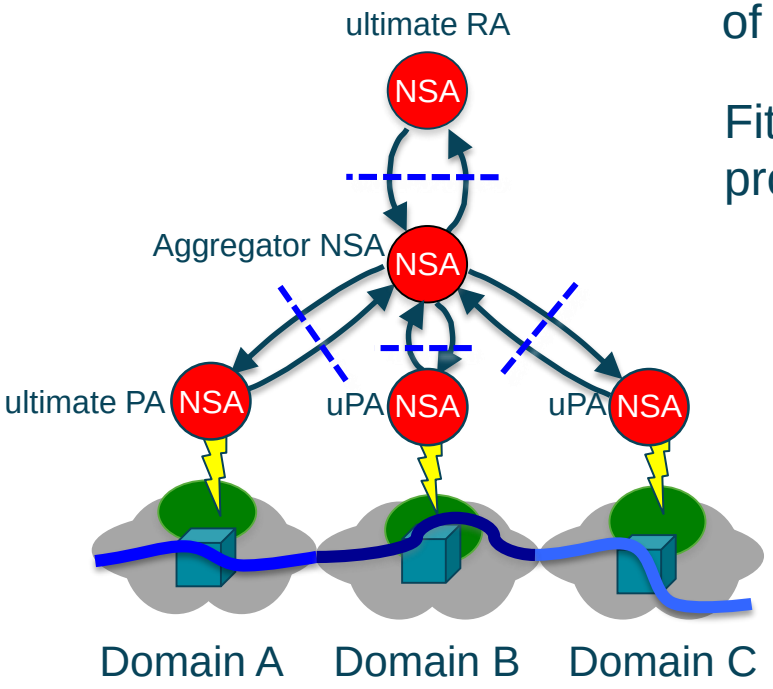


NSI Fundamental Design Principles (2/3)

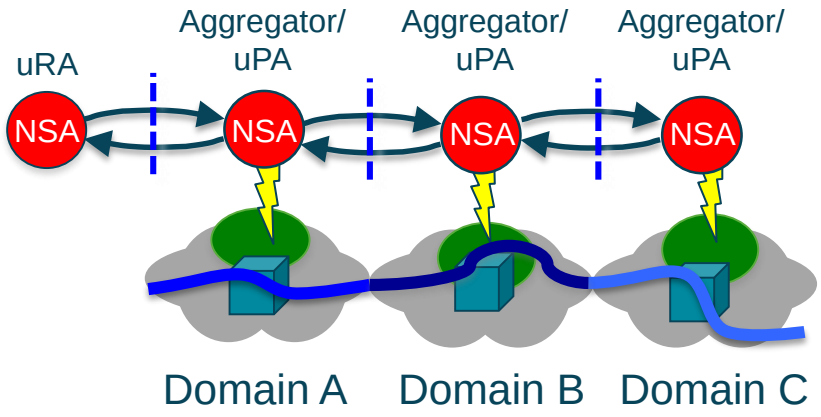
2. Designed for flexible, multi-domain, service chaining

Supports **Tree** and **Chain** model of service chaining

Fits in well with Cloud/Compute model of provisioning as well as Network/GMPLS model



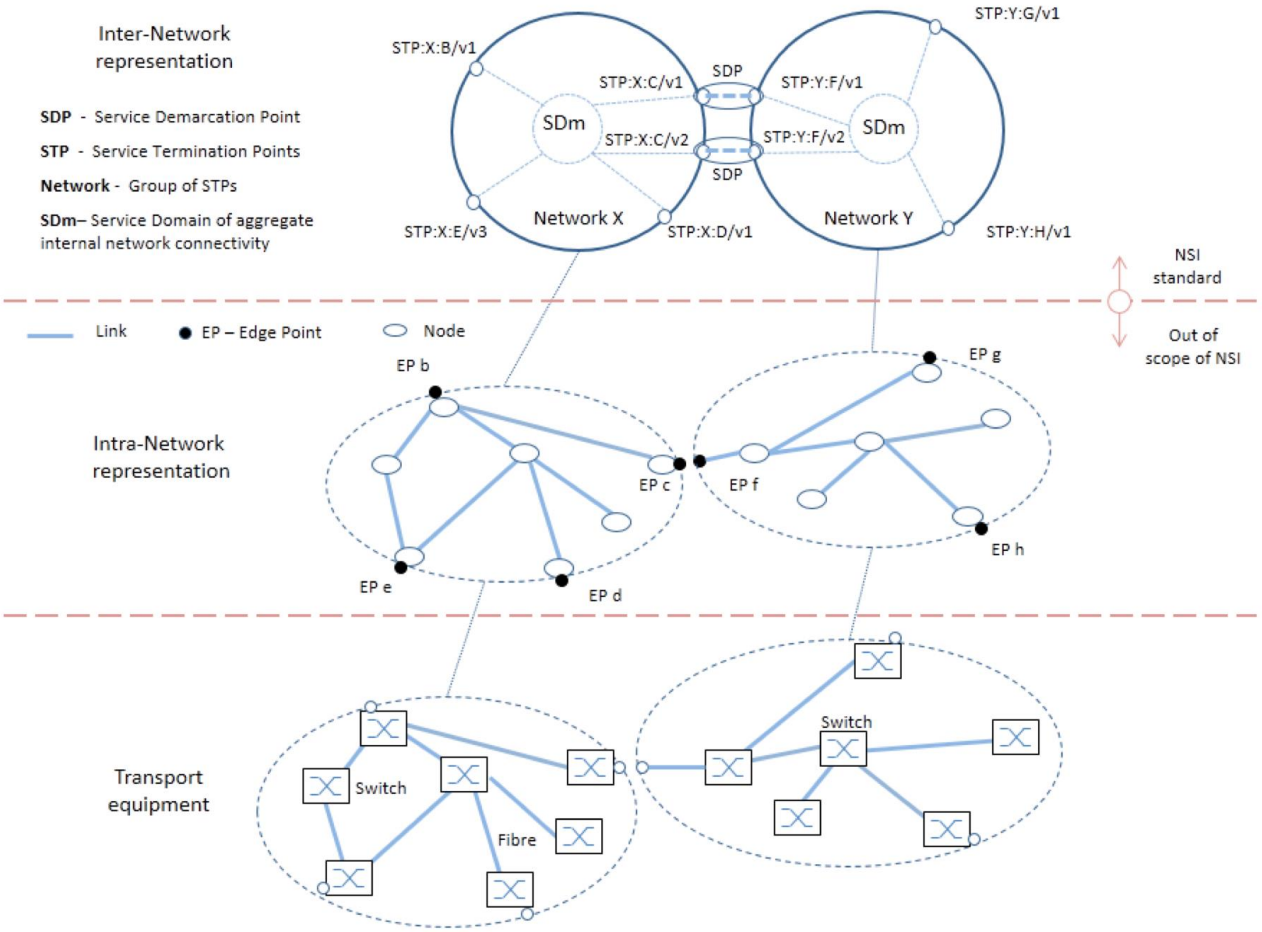
Tree NSI Topology



Chain NSI Topology

NSI Fundamental Design Principles (3/3)

3. Principles of Abstraction applied – to network layers, technologies and domains



Service Termination Points (STPs)

Service Demarcation Points (SDPs)

Are both abstract and technology independent

NSI compliant dynamic circuit implementations

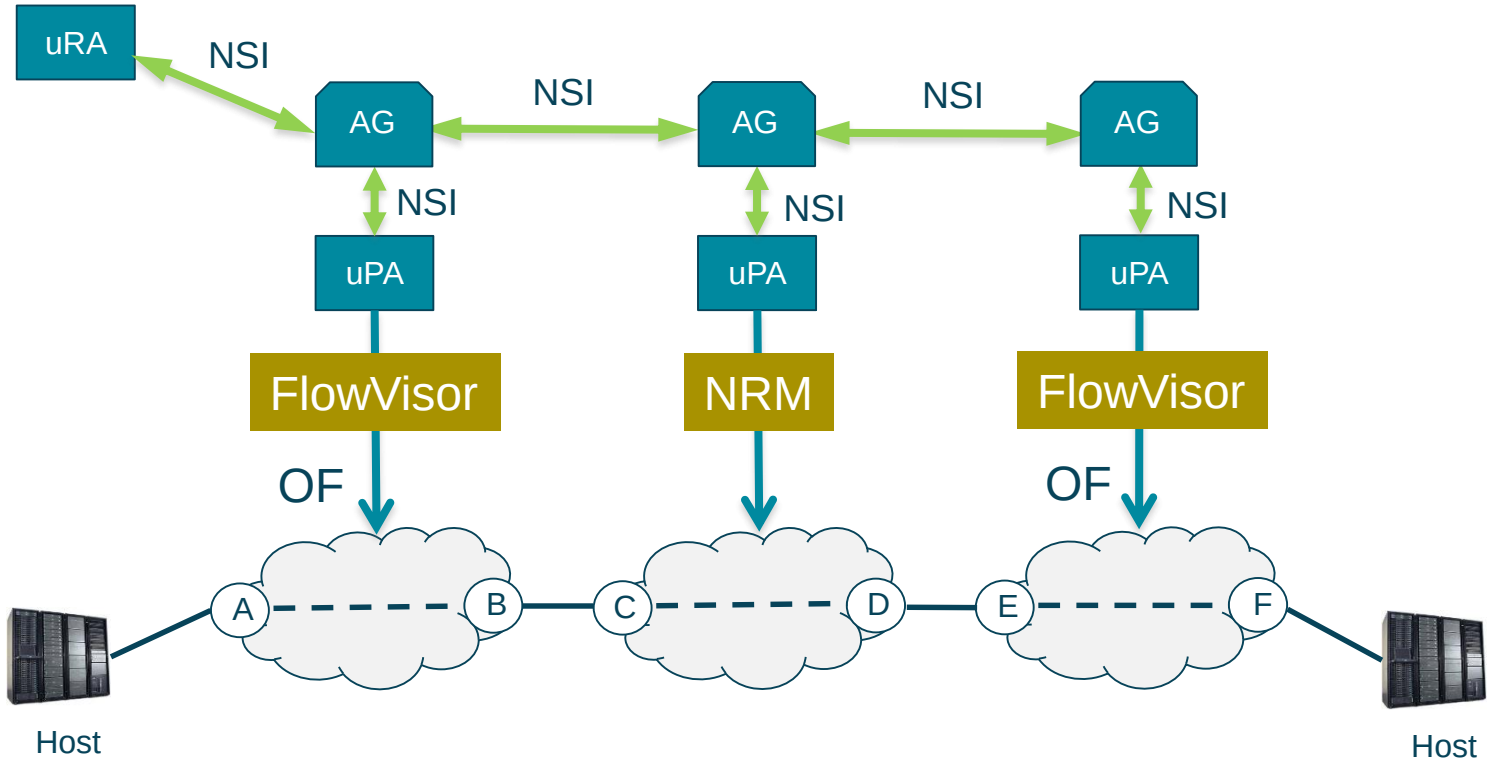
- ***AutoBAHN*** – GÉANT (Poznan, PL)
- ***BoD*** - SURFnet (Amsterdam, NL)
- ***DynamicKL*** – KISTI (Daejeon, KR)
- ***G-LAMBDA-A*** - AIST (Tsukuba, JP)
- ***G-LAMBDA-K*** – KDDI Labs (Fujimino, JP)
- ***OpenNSA*** – NORDUnet (Copenhagen, DK)
- ***OSCARS*** – ESnet (Berkeley, US)

- NSI Documents: https://redmine.ogf.org/dmsf/nsi-wg?folder_id=6526

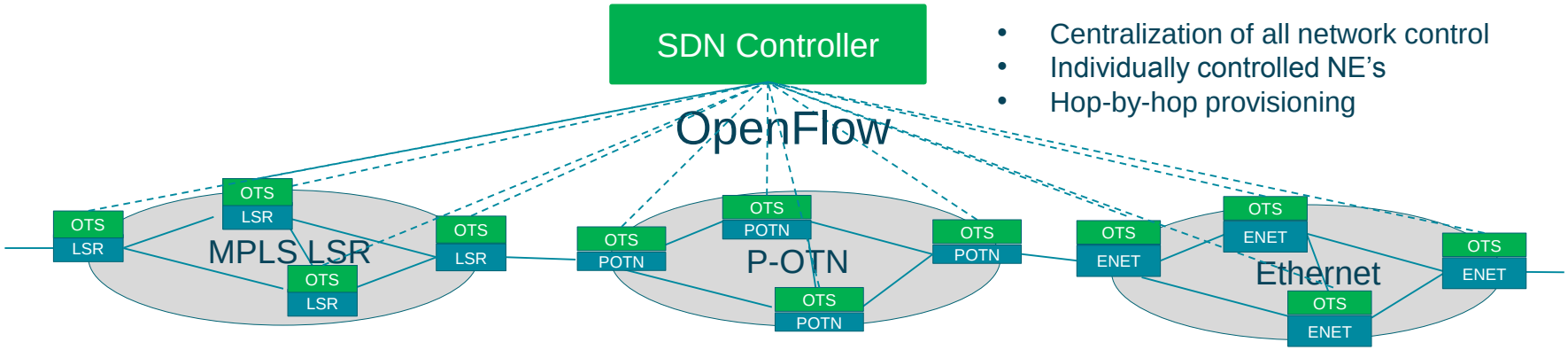
- NSI Co-Chairs
  Guy Roberts <guy.roberts@dante.net>
  Chin Guok <chin@es.net>
  Tomohiro Kudoh <t.kudoh@aist.go.jp>

How does NSI fit into SDN?

NSI for multi-domain path negotiation

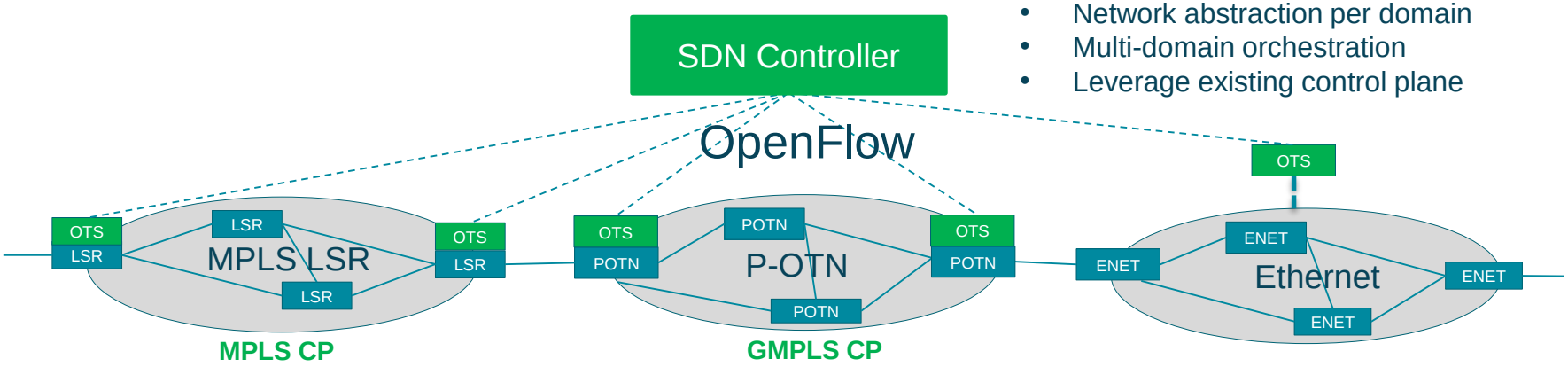


Infinera's Transport SDN Models



- Centralization of all network control
- Individually controlled NE's
- Hop-by-hop provisioning

Explicit (Direct) Model



- Network abstraction per domain
- Multi-domain orchestration
- Leverage existing control plane

Implicit (Indirect) Model

SDN and NSI integration

- GÉANT sees the NSI protocol as a key component in delivering multi-domain SDN services in the R&E networks.
- Work is ongoing in the MOTE GÉANT Open Call to integrate NSI into the SDN environment.
- Aims to add Open Flow constructs to the NML topology description.
- This will bridge the intra-domain operations of OpenFlow with the inter-domain provisioning in the NSI.

Thank you!

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