Future Networks (FuN): Transport

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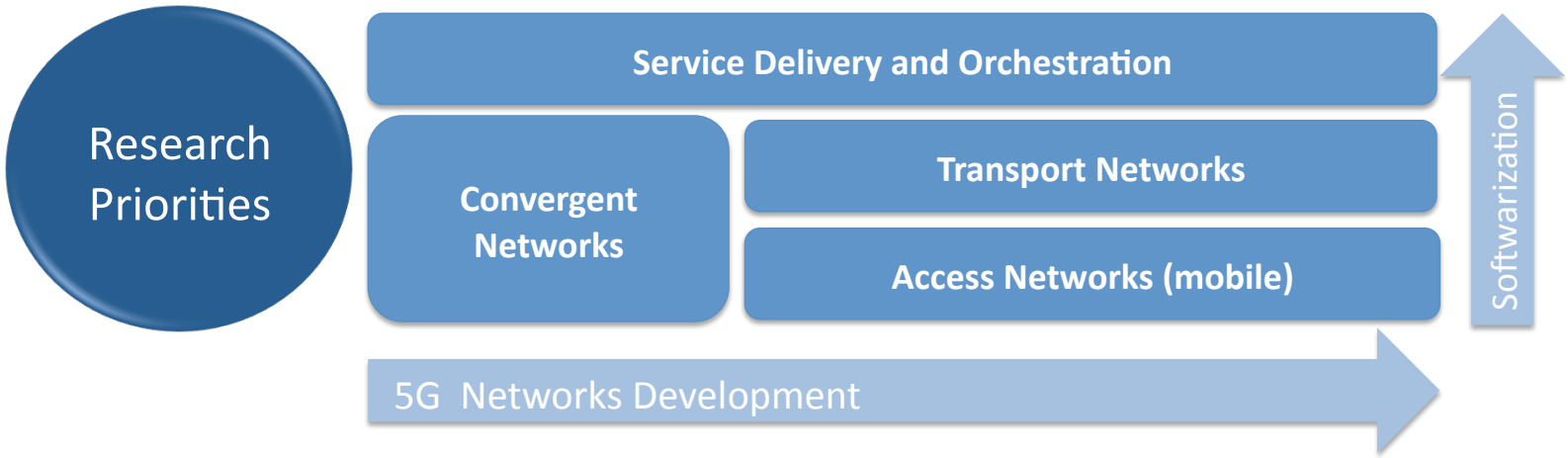
10 years 2003-2013 CREATE-NET

Future Networks Research Priorities

Objective: novel contributions to the development of converged & flexible software-defined network and broadband communication infrastructures



http://create-net.fbk.eu/fun/

@future_networks

Objective and technical activities

Objective: develop the architecture and the infrastructure of tomorrow's applications and services using a system research approach

- R&D&I topics
  - Software-Defined Networking (SDN) and Network Function Virtualization (NFV)
  - Control and virtualization of transport networks (from L3 to L0)
  - Application-centric networking
  - Segment routing
- Methods and instruments
  - Design and validation of control plane architectures
  - Development of optimisation algorithms
  - Analytical and simulation studies (simulation tool based on Omnet++)
  - Experimental validation
    - SDN Controller for Optical Networks: Yamato
    - SDN-based network orchestrator for packet-optical networks: NetStratos
  - Support on integration and experimental activities
  - Strong academic record

ACINO

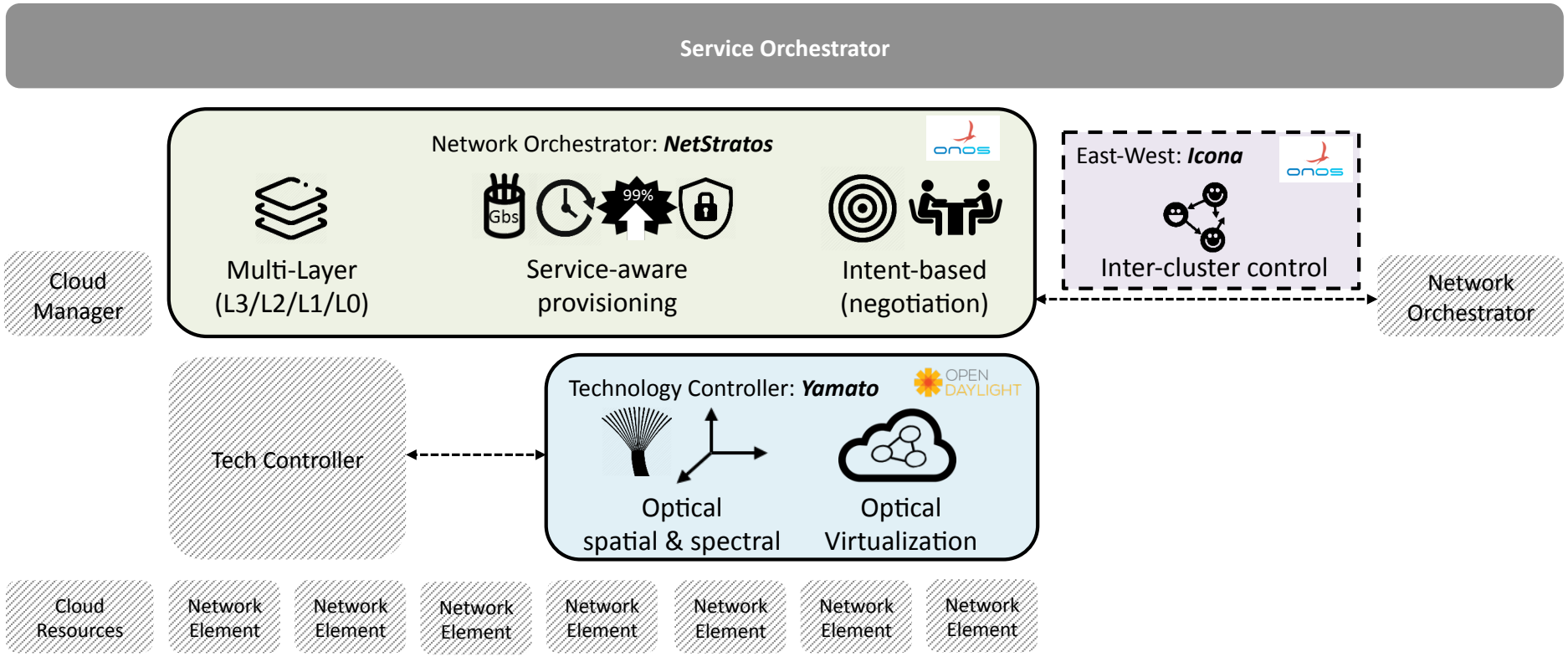
INSPACE

5GXCrosshaul
the integrated fronthaul/backhaul

GÉANT
connect • communicate • collaborate

NetIDE

Transport network: our positioning



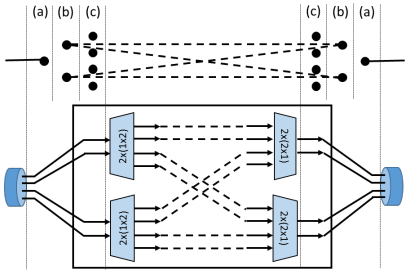
Optical network control and virtualization: Yamato

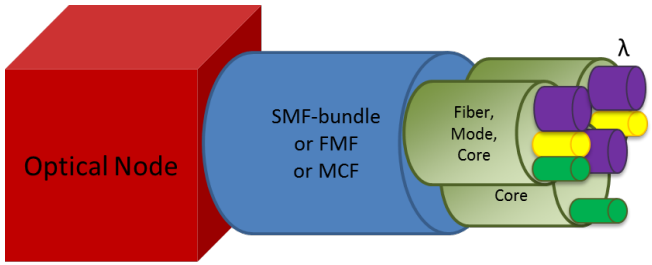
- Yamato
  - Hierarchical network model for spatially-spectrally flexible optical networks
  - Management of virtual network instances
  - Based on OpenDaylight (ODL)
- Next Steps
  - Research: RSSA algorithms, heuristics for virtual network embedding
  - Innovation: monitoring and sub-lambda support
- Use-cases and impact
  - SDM features to be demonstrated with vendor equipment (Finisar)

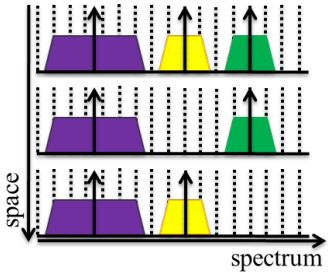
Yamato

Yamato
SDN controller for optical networks
Spectral (fixed grid and flexi-grid WDM)
Spatial (SDM with independent/Fractional-Joint/Joint Swicthing)

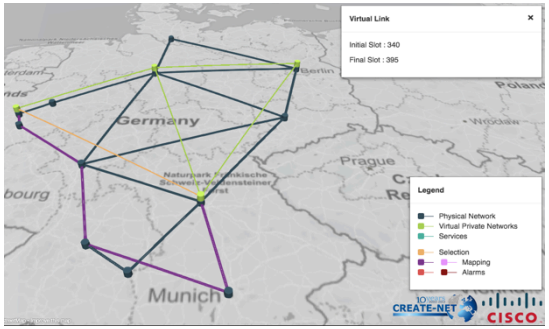
Abstraction







Optical Virtual Private Network



- Customized Yamato implementation
  - Support for GMPLS instantiation and resilience
  - Management of Optical Virtual Private Networks
  - Optimal (ILP) and heuristic solutions for Virtual Network Embedding
  - GUI
- Extended GMPLS cisco stack
  - Custom TLVs in RSVP-TE and OSPF-TE to manage OVPNs (links, interfaces, services)
- Demonstrated at CISCO Packet Optical Networking Conference 2016, Cisco Live 2017 in Berlin and OFC 2017
- Will be presented at Cisco Live 2017 in Las Vegas

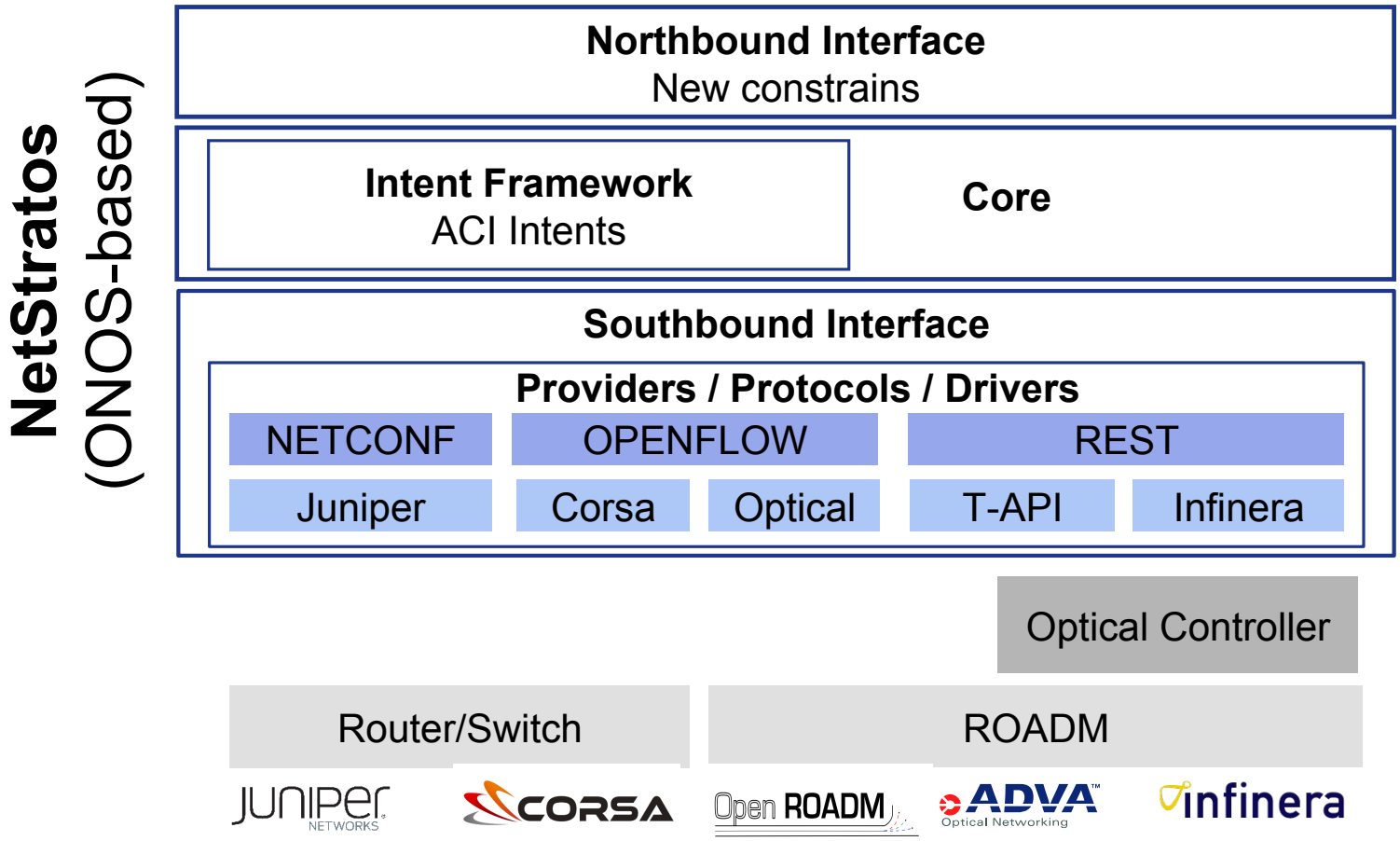
Transport Network Orchestration

- Split-layer architecture for multi-layer/multi-technology/multi-vendor networks
  - Manually coordinated operations (even most basic ones such as network discovery)
  - Layer-by-layer pre-engineered constructs
  - Difficult to meet global service requirements (e.g. costly yet ineffective network resiliency)
- Joint coordination of transport layers (from L3 to L0) to increase network efficiency, ease operations and reduce cost
- Objectives
  - Define a multi-layer network model (starting from IP/Optical)
  - Create an open-source network orchestrator
  - Enable application-centric optimization
- Started developing idea in 2015: no state of the art multi-layer controller
  - Sedona Systems (SME) and NEC (vendor) have developed their multi-layer control solutions

Transport Network Orchestration: NetStratos

- NetStratos
  - Intent-based enabling definition of app requirements
  - Abstracts and configures three layers
    - L3/IP (Juniper)
    - L2/Switches (vendor-indep, OpenFlow (e.g. Corsa))
    - L1/L0/ROADMs (ADVA, Infinera, OpenROADM)
  - Algorithms for application-centric provisioning and resiliency
  - Based on the Open Networking Operating System (ONOS)
- Next steps
  - Research: novel algorithms, negotiation, interface with service orchestrator
  - Innovation: include standard API (ONF T-API), MPLS, support further technologies (Xhaul)
- Use-cases and impact
  - Demonstrated NetStratos for intent-based restoration and secure service creation
  - Plan for interop demonstration with other vendors
  - Discussions with operators and global vendor

NetStratos


NetStratos
(ONOS-based)
Northbound Interface
New constrains
Intent Framework
ACI Intents
Core
Southbound Interface
Providers / Protocols / Drivers
NETCONF
OPENFLOW
REST
Juniper
Corsa
Optical
T-API
Infinera
Optical Controller
Router/Switch
ROADM
JUNIPER NETWORKS
CORSA
Open ROADM
ADVA Optical Networking
infinera

Optical network control and virtualization

- Future (5G) services will need for high-bandwidth, low latency, high reliability
  - Optical networks: effective yet expensive solution
- Issues
  - Complexity of the media
  - Need to increase capacity while containing costs
  - Dangerous ossification if compared to required investments
  - Early-stage distributed control plane solutions are vendor-specific
- Objectives
  - Propose a centralized SDN control plane capable of interoperating with distributed solutions
  - Investigate Space Division Multiplexing (SDM) paradigm
  - Introduce network virtualization
- Most of the current control plane implementations for optical networks is based on GMPLS

Thanks!! Questions?

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