O3 Project

Network Business Innovation by SDN WAN Technologies

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O3 project (NEC, NTT, NTT Communications, Fujitsu, Hitachi)

Agenda

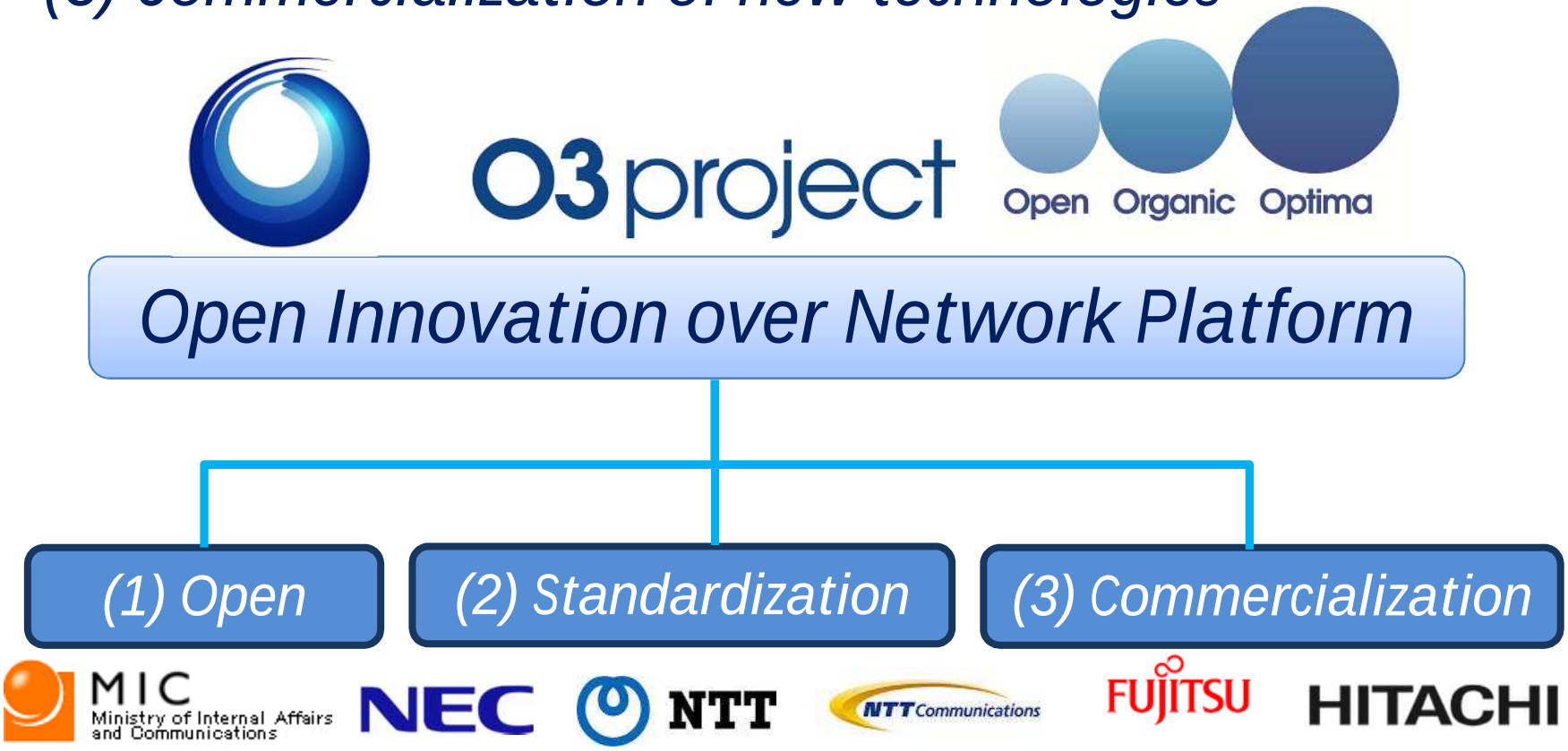
- *Trend on Future Information Networking*
- *Innovation through O3 User-oriented SDN*
- *O3 Technologies for SDN WAN*
- *SDN Use Cases in O3 Project*
- *SDN Ready Open Source Software*
- *Conclusion & Future Work*

O3 project

Innovation through O3 User-oriented SDN

Toward open User-oriented SDN

- 3 Contributions for User-oriented SDN
  - (1) Open development with OSS
  - (2) Standardization of architecture and interface
  - (3) Commercialization of new technologies

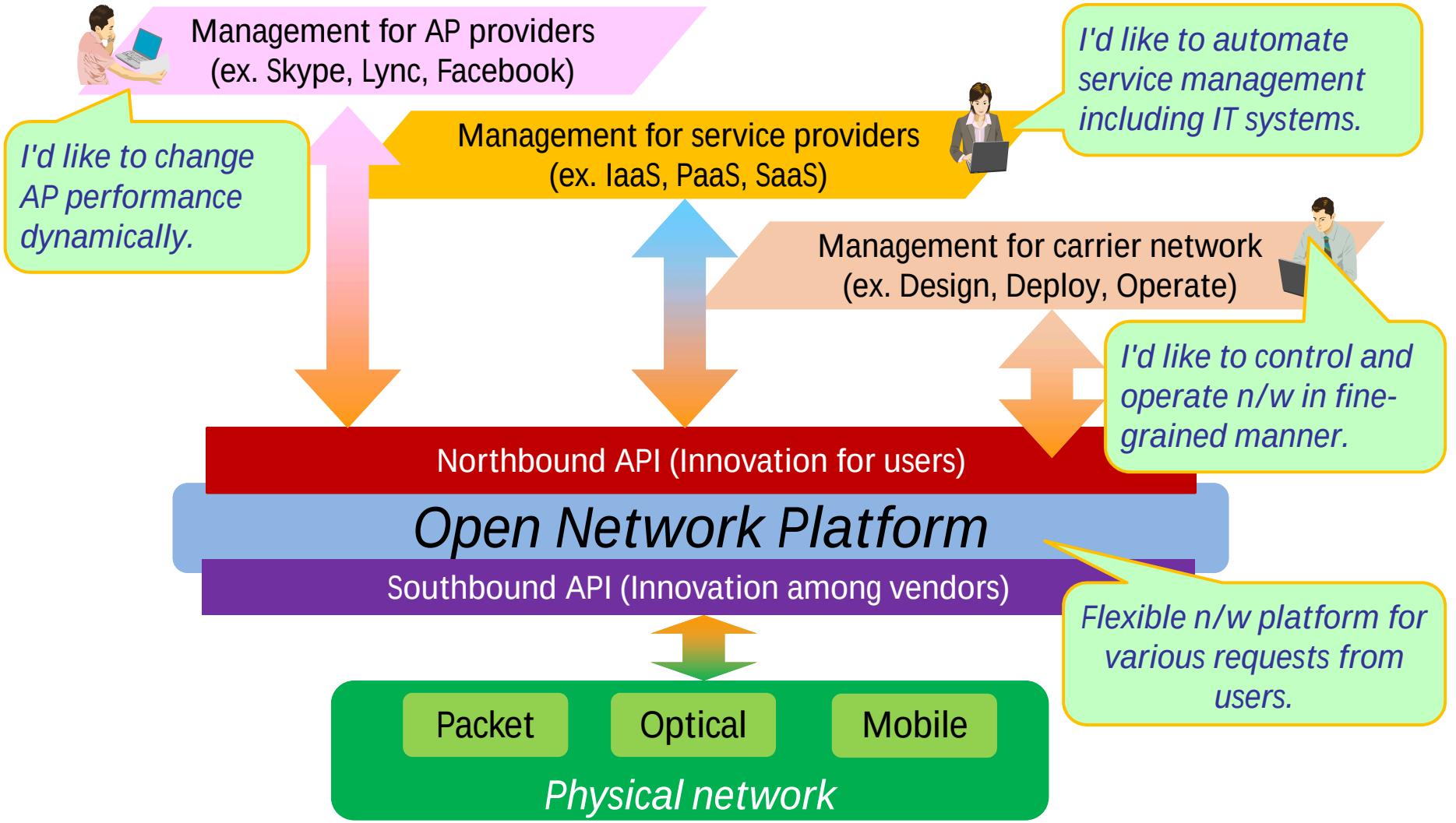


O3 Project Concept, Approach, & Goal

- Open, Organic, Optima
  - Anyone, Anything, Anywhere
  - Neutrality & Efficiency for Resource, Performance, Reliability, ….
  - Multi-Layer, Multi-Provider, Multi-Service
- User-oriented SDN for WAN
  - Softwarization: Unified Tools and Libraries
  - On-demand, Dynamic, Scalable, High-performance
- Features
  - Object-defined Network Framework
  - SDN WAN Open Source Software
  - SDN Design & Operations Guideline
- Accelerates
  - Service Innovation, Re-engineering, Business Eco-System

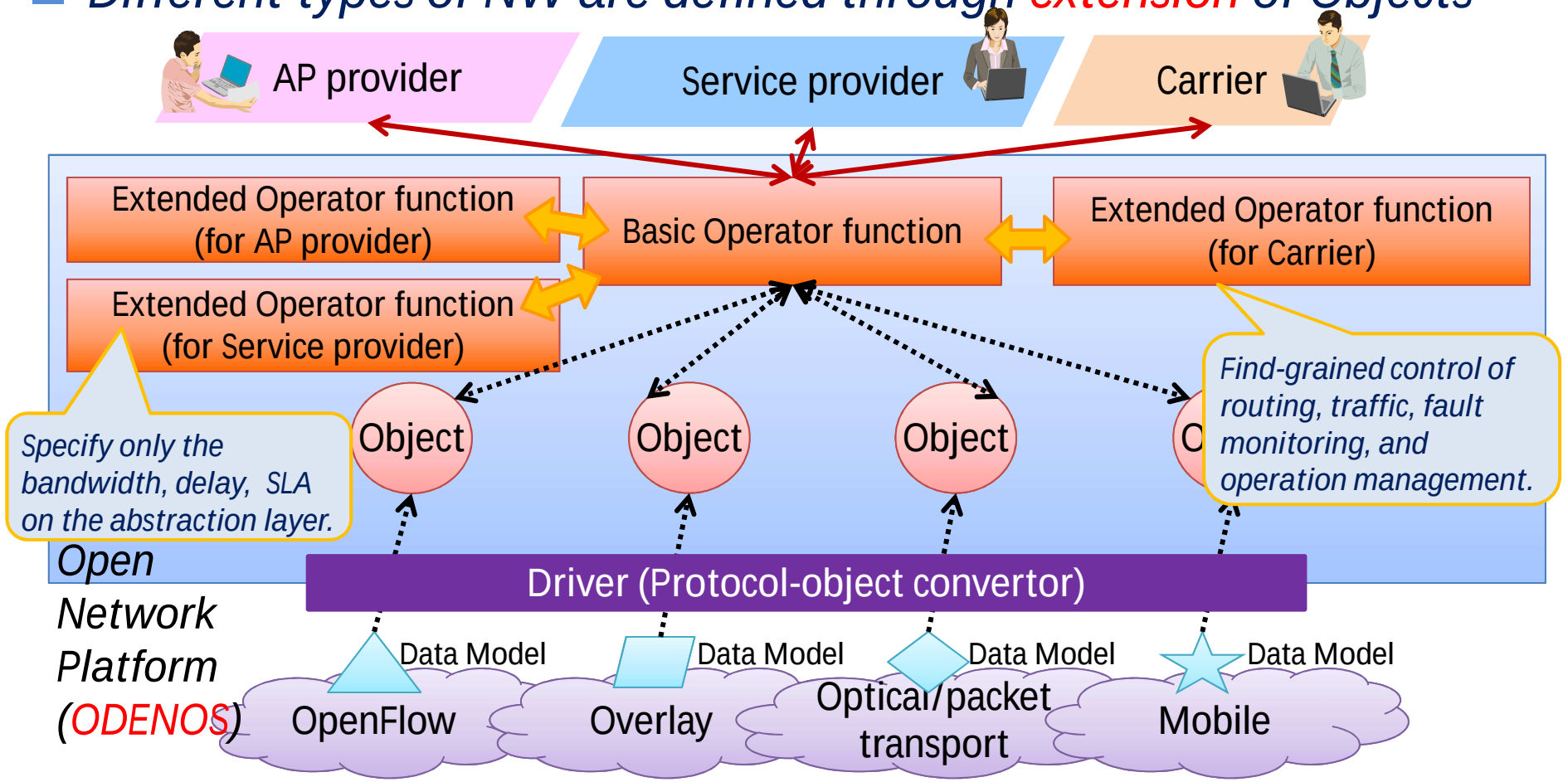
O3 Deliverables: User-oriented SDN

- Provides Orchestration for different user requirements



O3 Object-defined Network Platform

- *Network is abstracted as graph of base Objects*
- *Control functions are the operators for the Objects*
- *Different types of NW are defined through extension of Objects*



O3 Technologies for SDN WAN

SDN Design & Operations Guideline

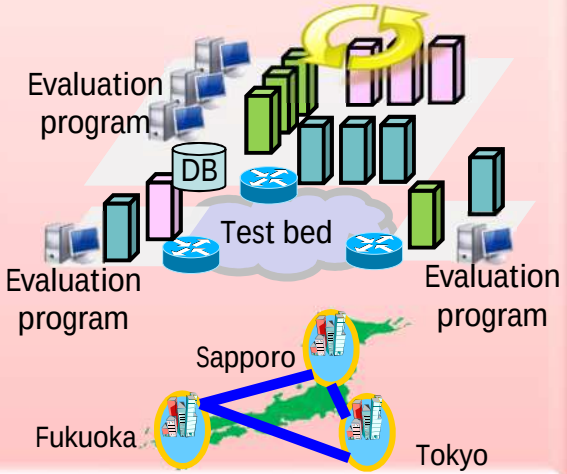
- *Established the SDN guideline for carrier networks which is required to design, deploy and operate the large scale of SDN in the following steps;*

Drafting guideline

Draft includes
- Criteria to select SDN equipment
  - -Capacity
  - -Capability
  - -Reliability etc.
- Criteria for evaluation
  - -Flexibility
  - -Time to deploy SDN etc.
- Evaluation techniques
  - - Design parameters identification
  - - Testing and reporting templates

Testing & analyzing

Evaluation techniques
- Test bed setup
- HW/SW SDN feature evaluation
- Design parameters certification
- Test results analysis

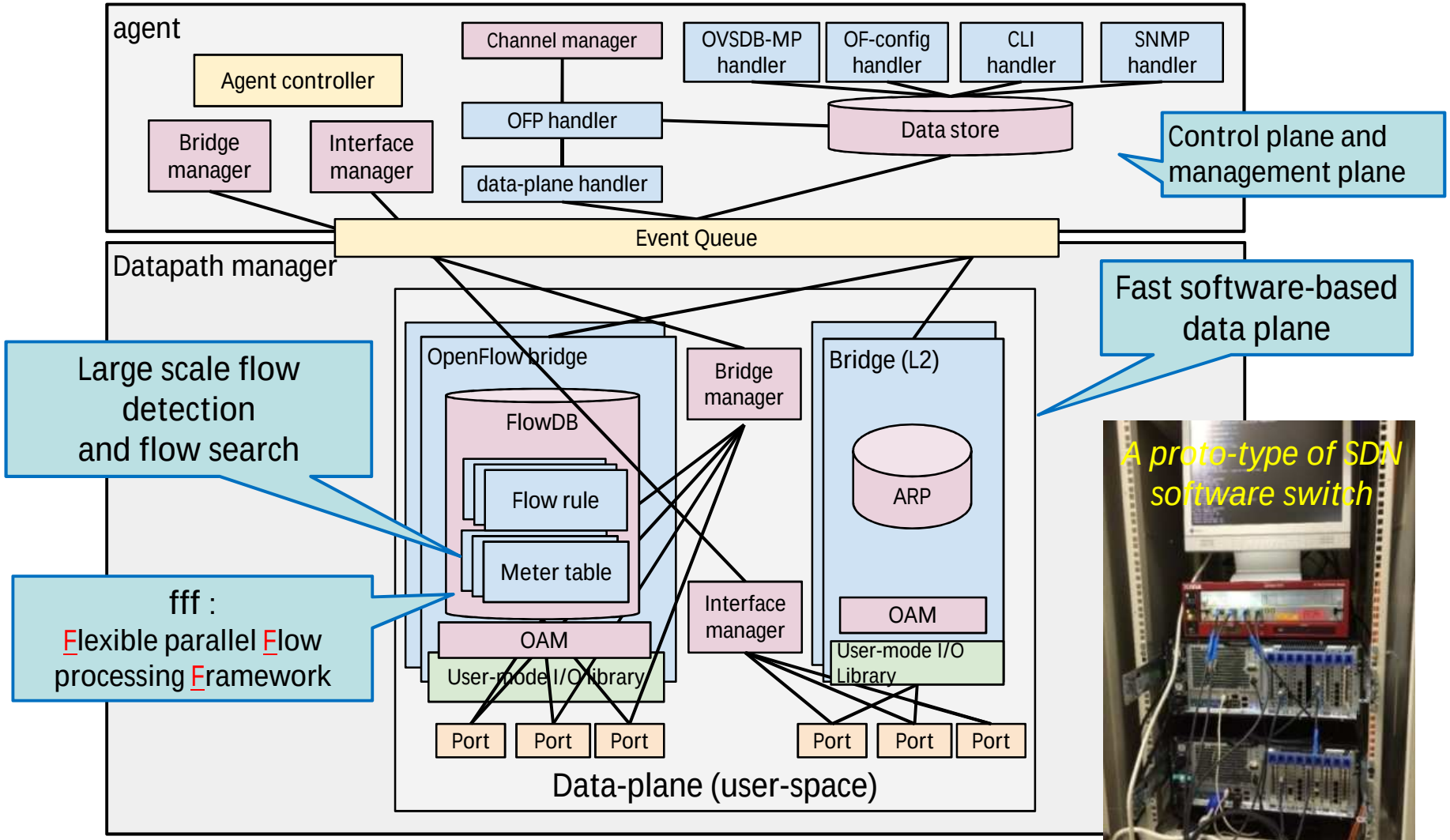


Completed Doc.

Final document
- test results
- analysis reports

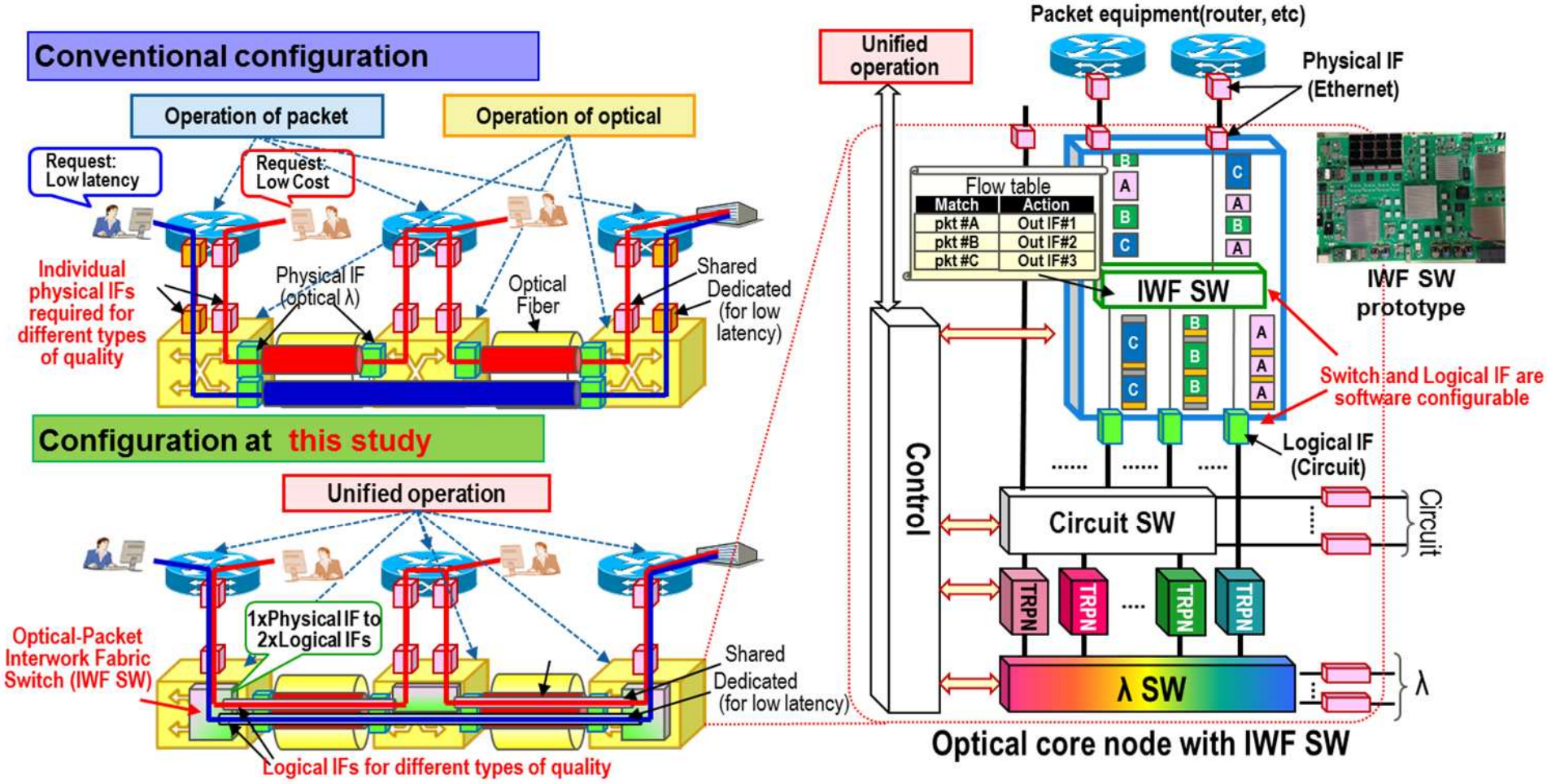
SDN Software Switch: Lagopus

- SDN *10Gbps S/W forwarding* node with 1M flows



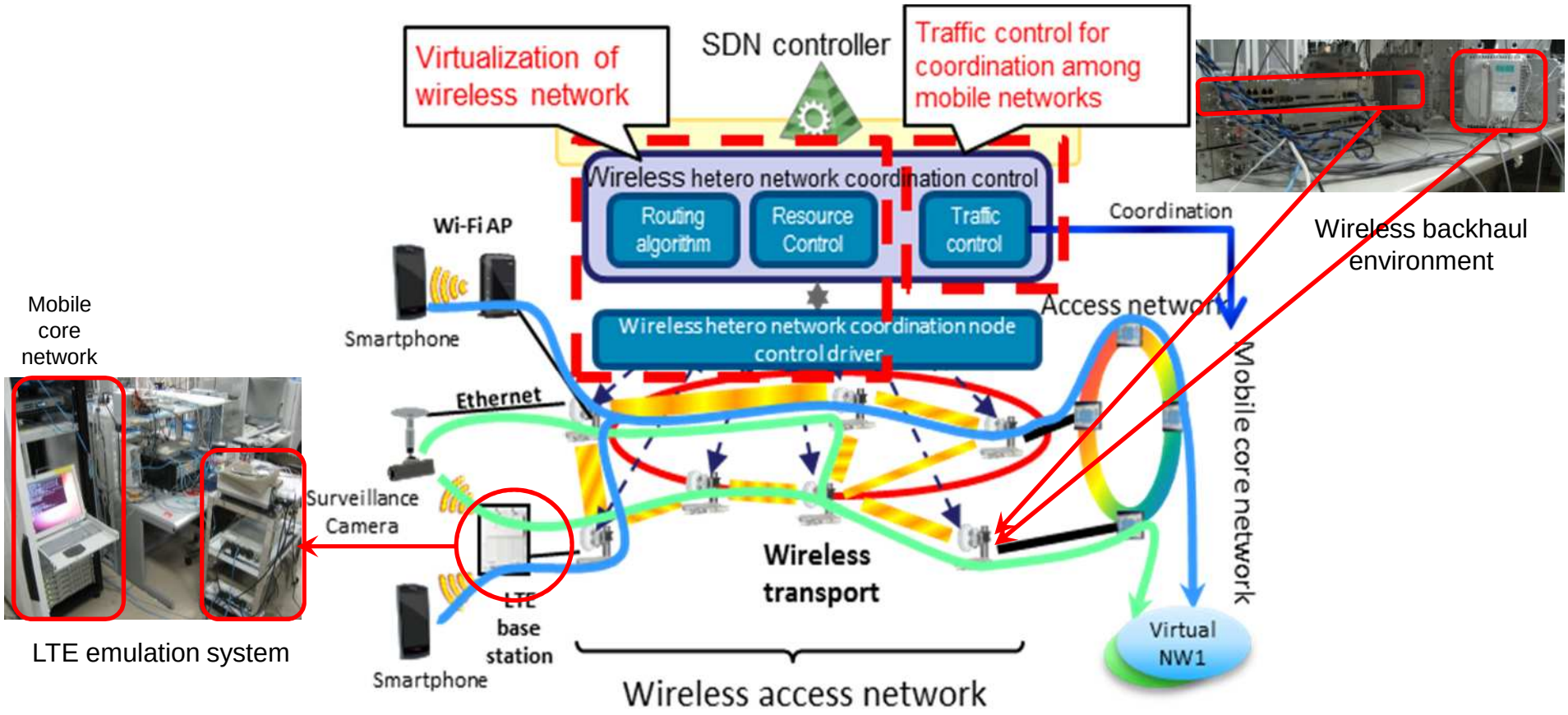
Signal Interwork between Optical & Packet

- *Enables ….*
  a wide variety of service quality & rapid service tune-up



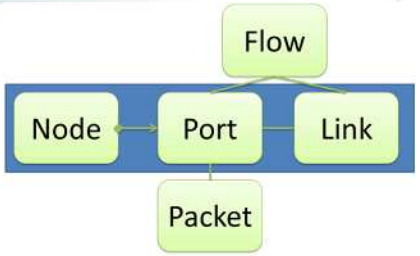
Virtual Wireless Networks

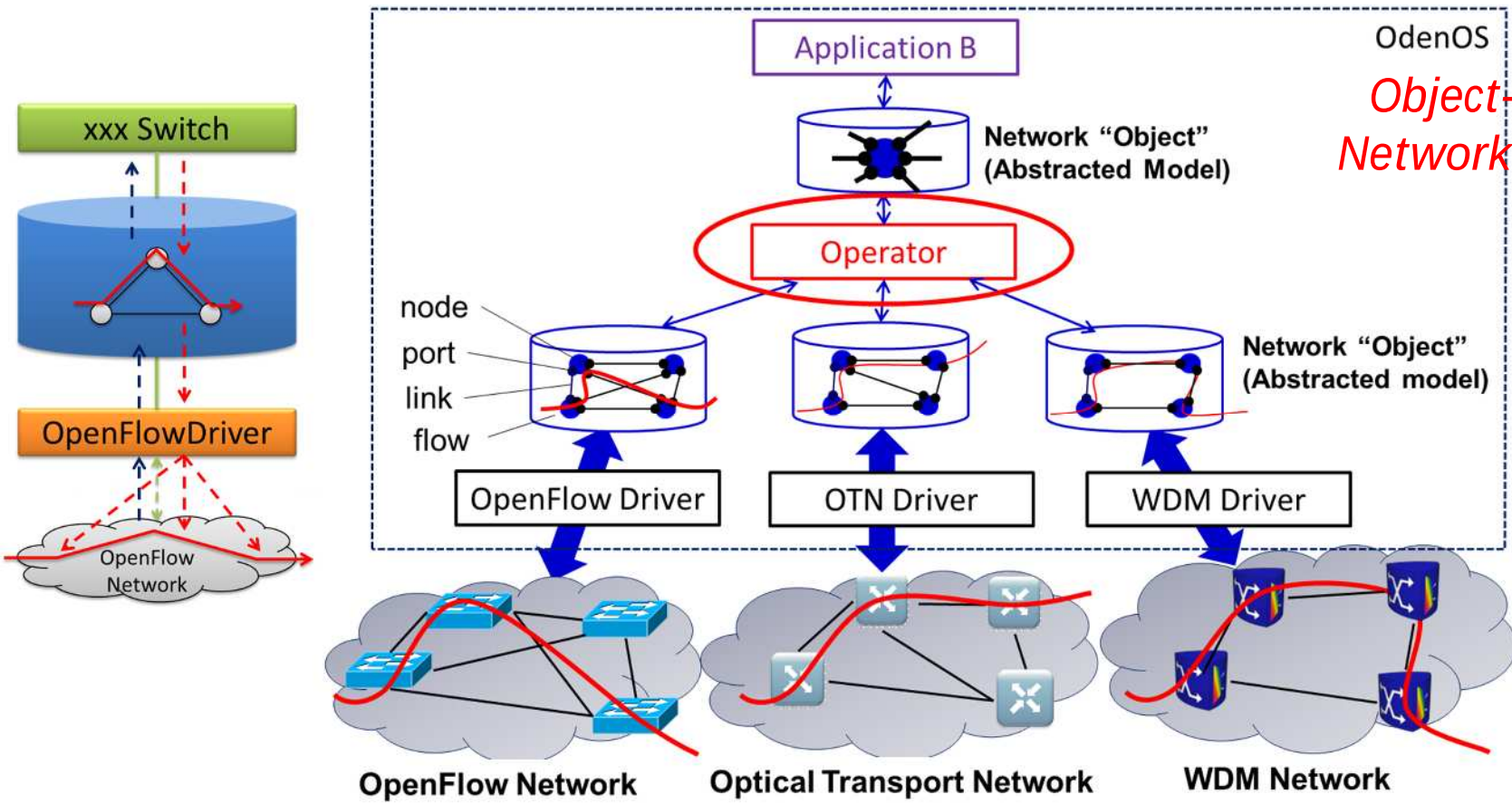
- *Support multiple virtual networks over wireless networks while avoiding degradation of high priority traffic even when traffic demand and data rate of wireless link changes over time*



SDN Framework: ODENOS

- *Network Abstraction Model: Hierarchical*
  - *Node, Port, Link, Flow, Packet*
- *Enables easy Extension & Customization*

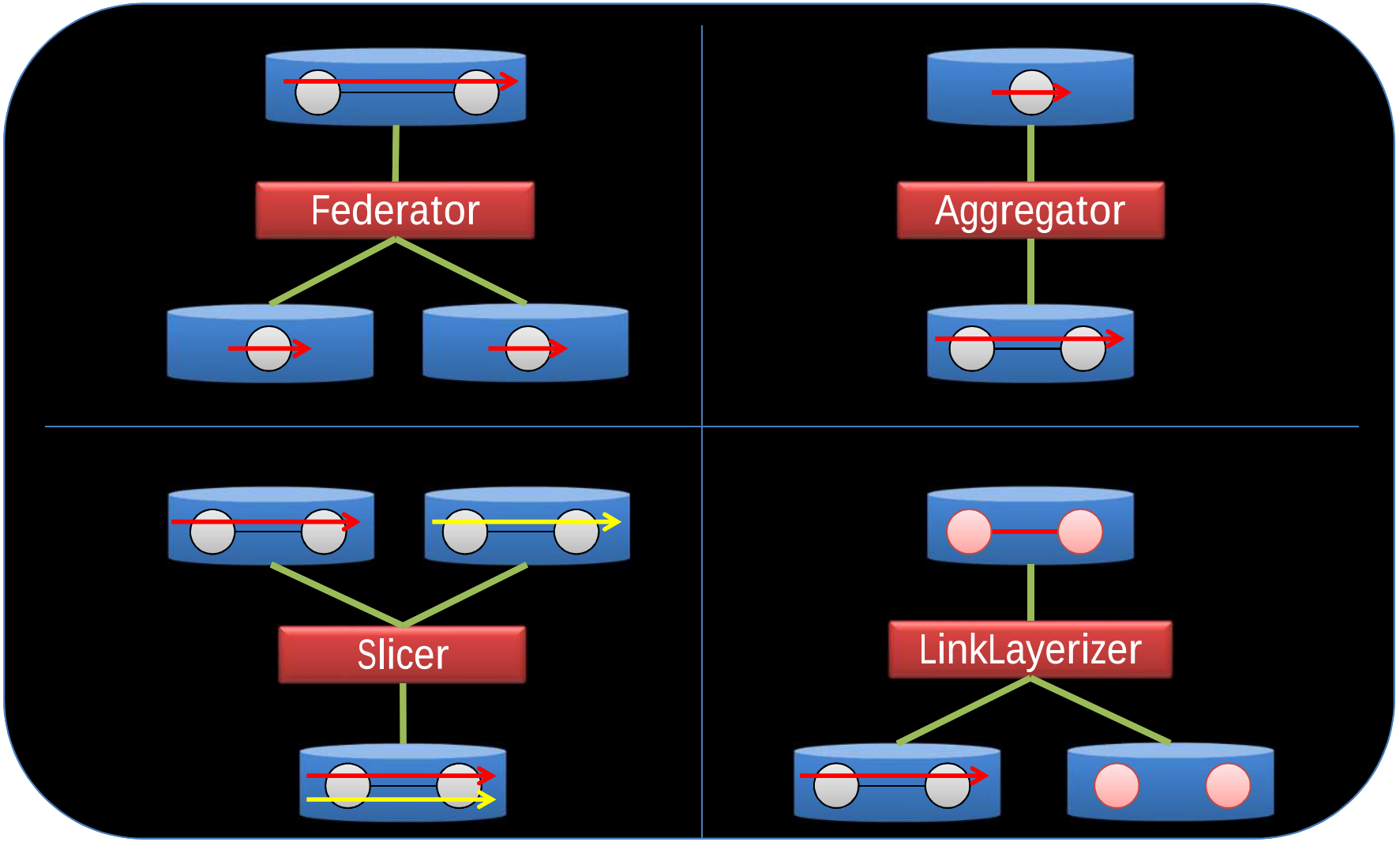




Object-defined Network Platform

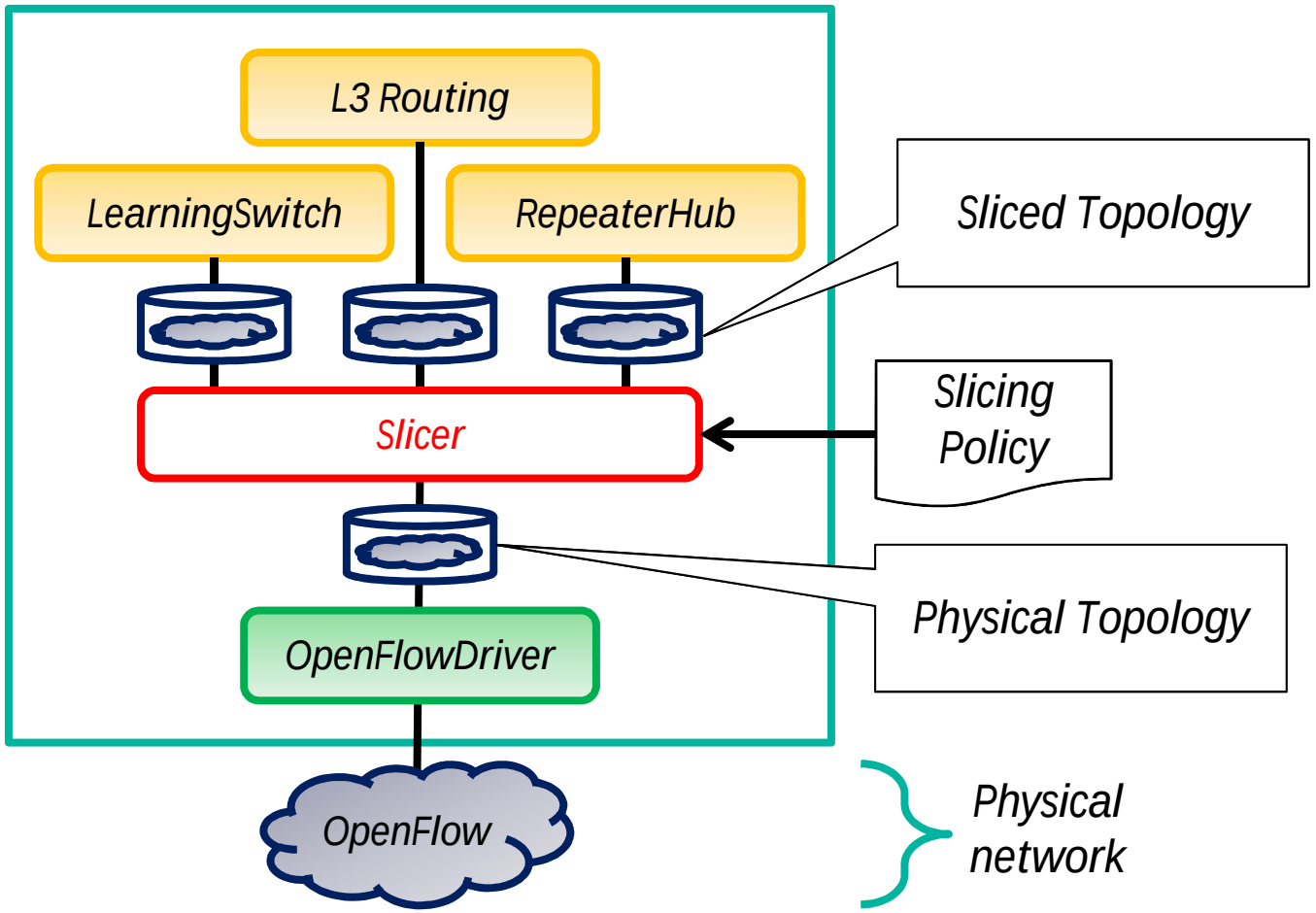
Abstract Network Operators in ODENOS

- *Slicer, Federator, Aggregator, Link-Layerizer*



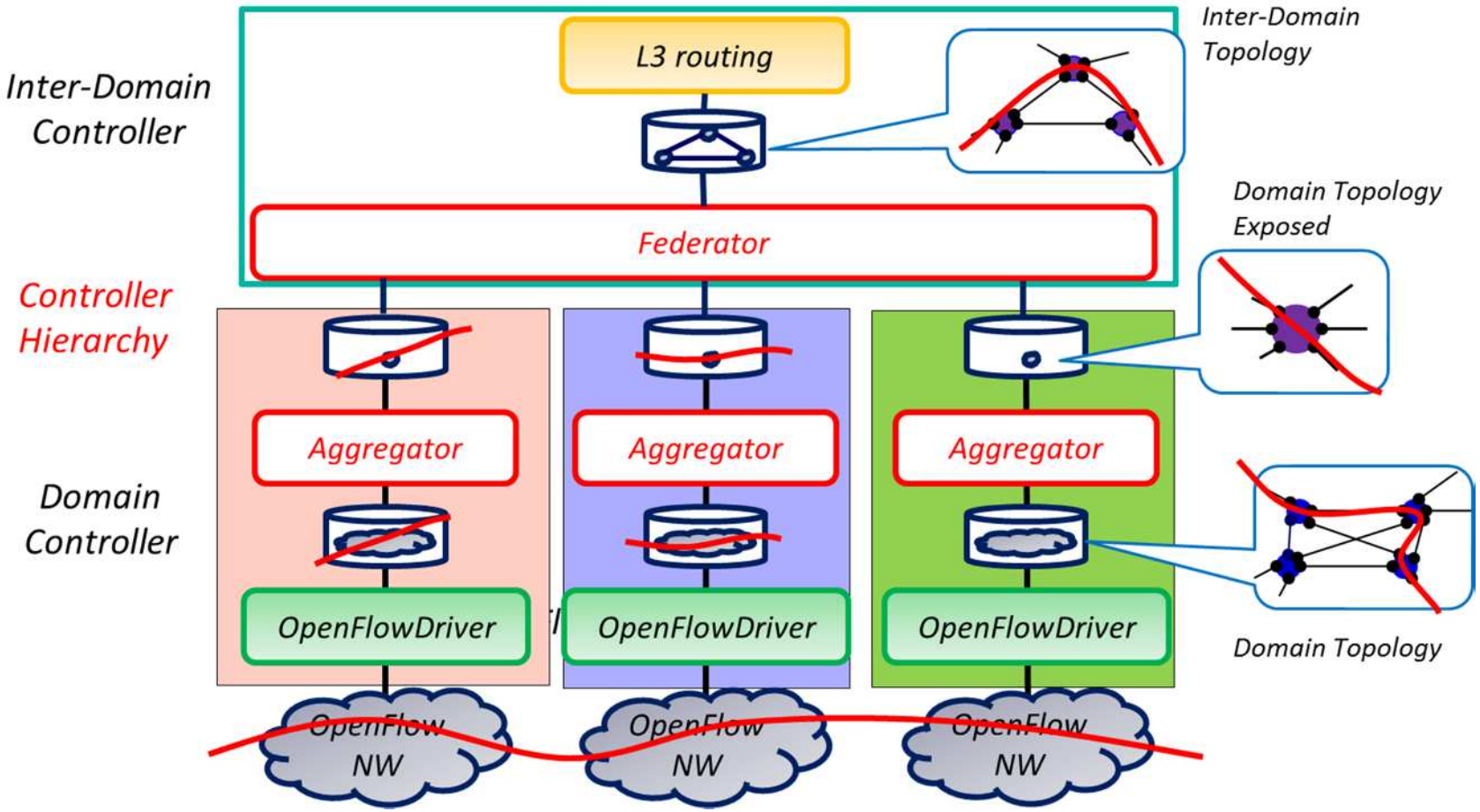
NW Operator: Slicer

- *Slicer: creates copies of the network object based on the given policy: Edge ports, TCP/UDP port number (i.e., application)*
- *Enables multi-tenancy, multiple applications*



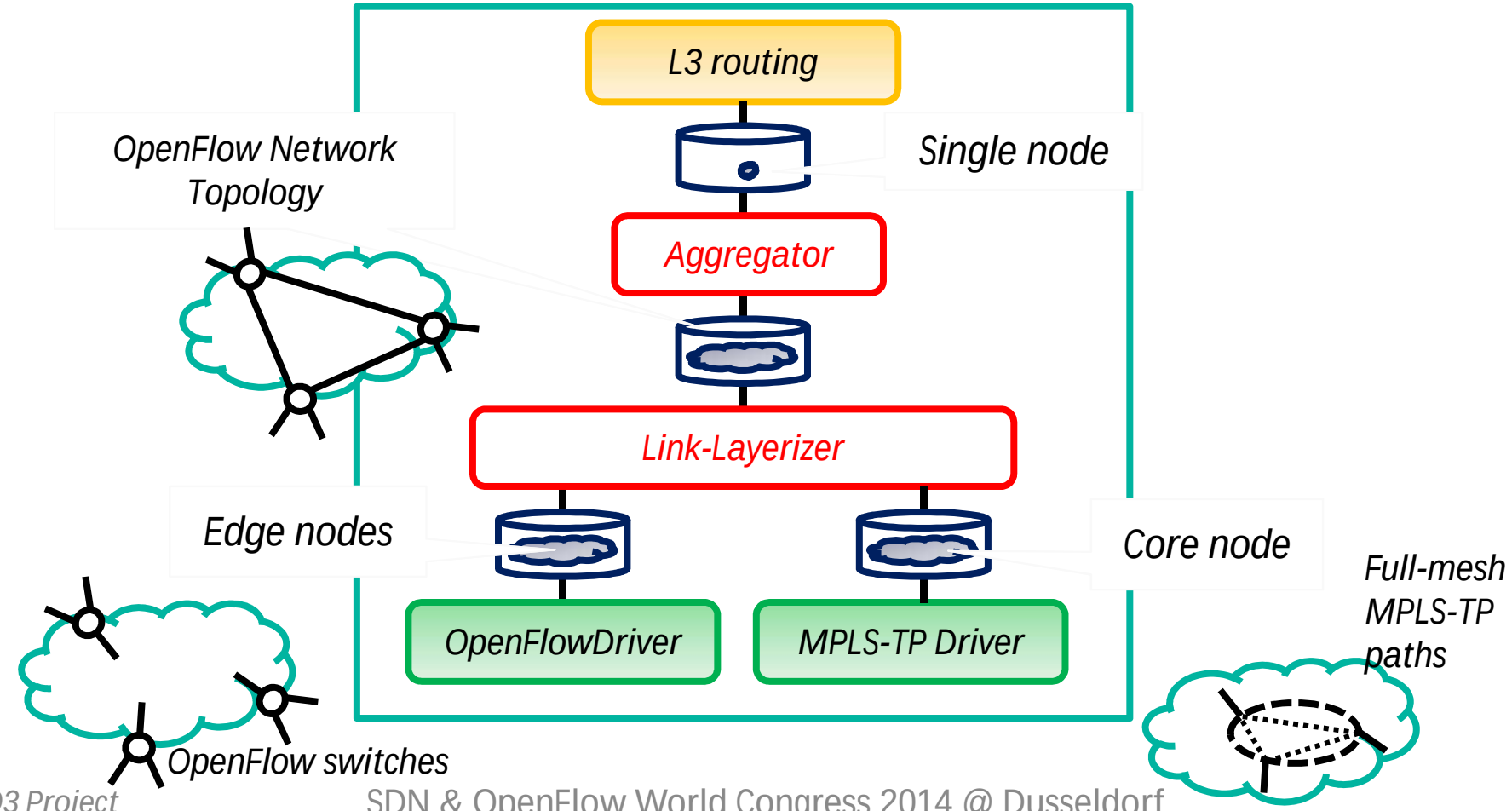
NW Operator: Aggregator & Federator

- *Aggregator: Creates single big-switch abstraction*
- *Federator: Connects multiple networks*
- *Use Case: Multi-domain controller (with controller hierarchy)*



NW Operator: Link-Layerizer

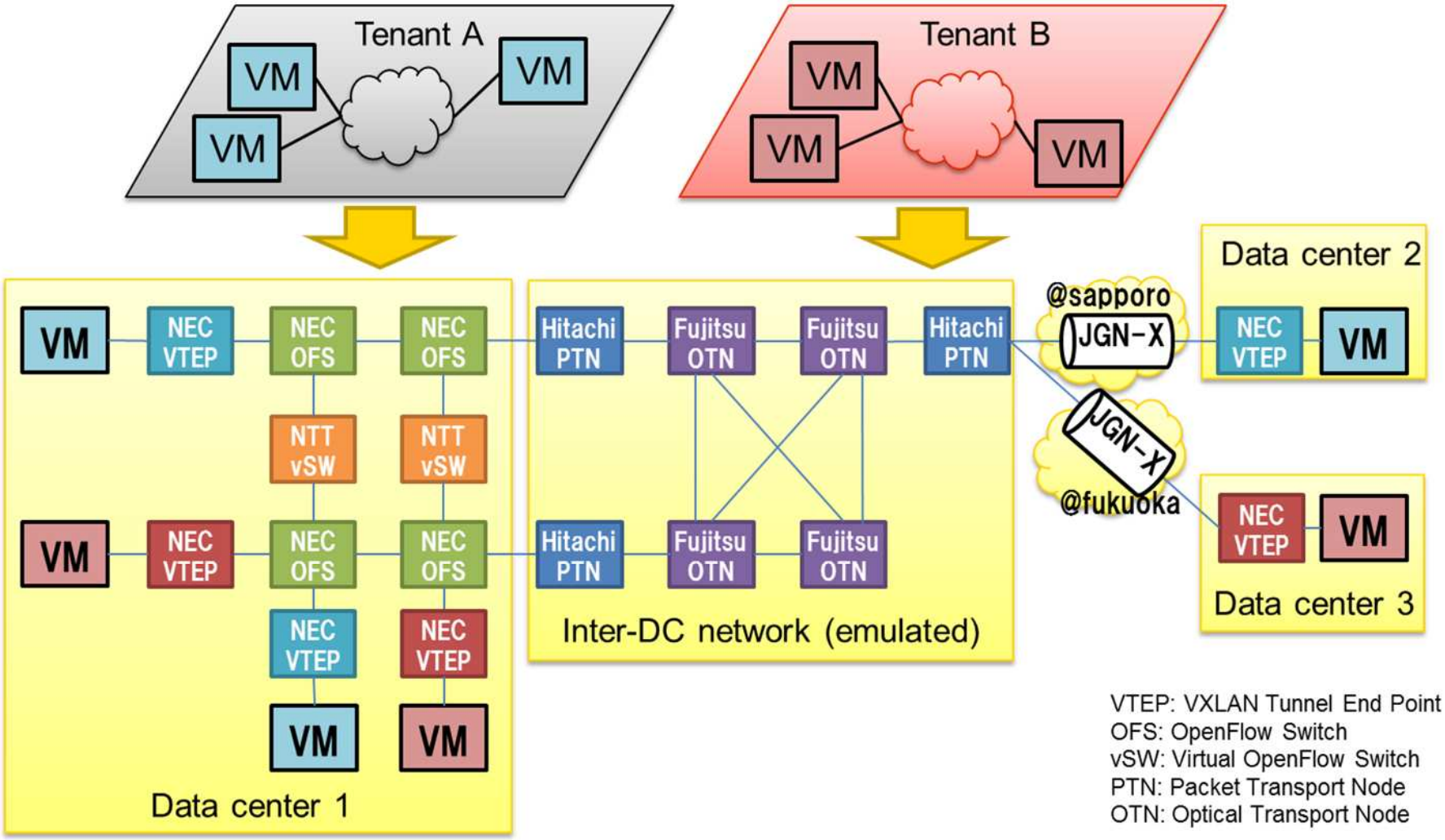
- *Link-Layerizer: Creates a network from the upper-layer nodes and lower-layer "paths" (flows)*
- *Use Case: Unified Control of Multi-layer Networks*



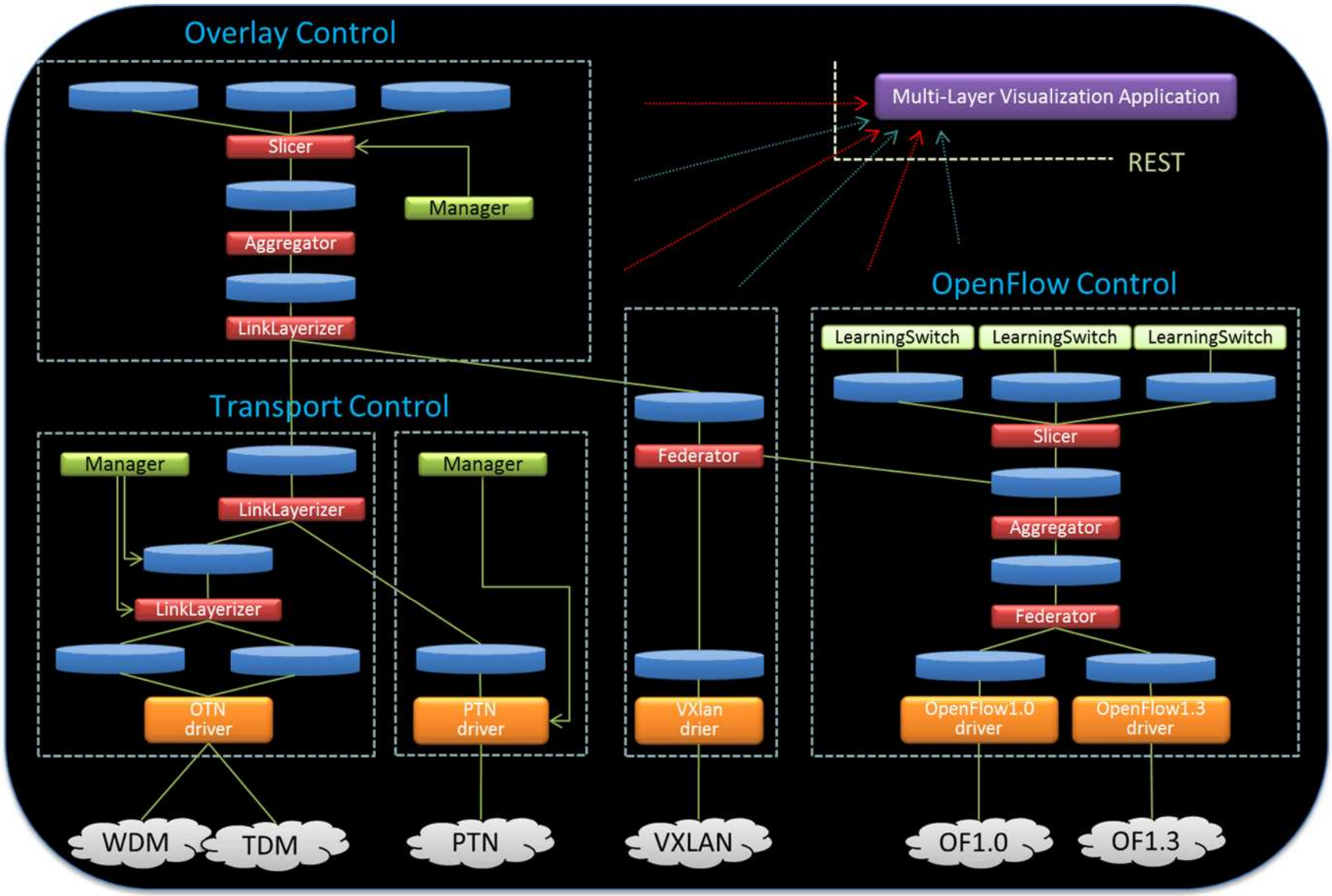
SDN Use Cases in O3 Project

Proof-of-Concept: Physical Configuration

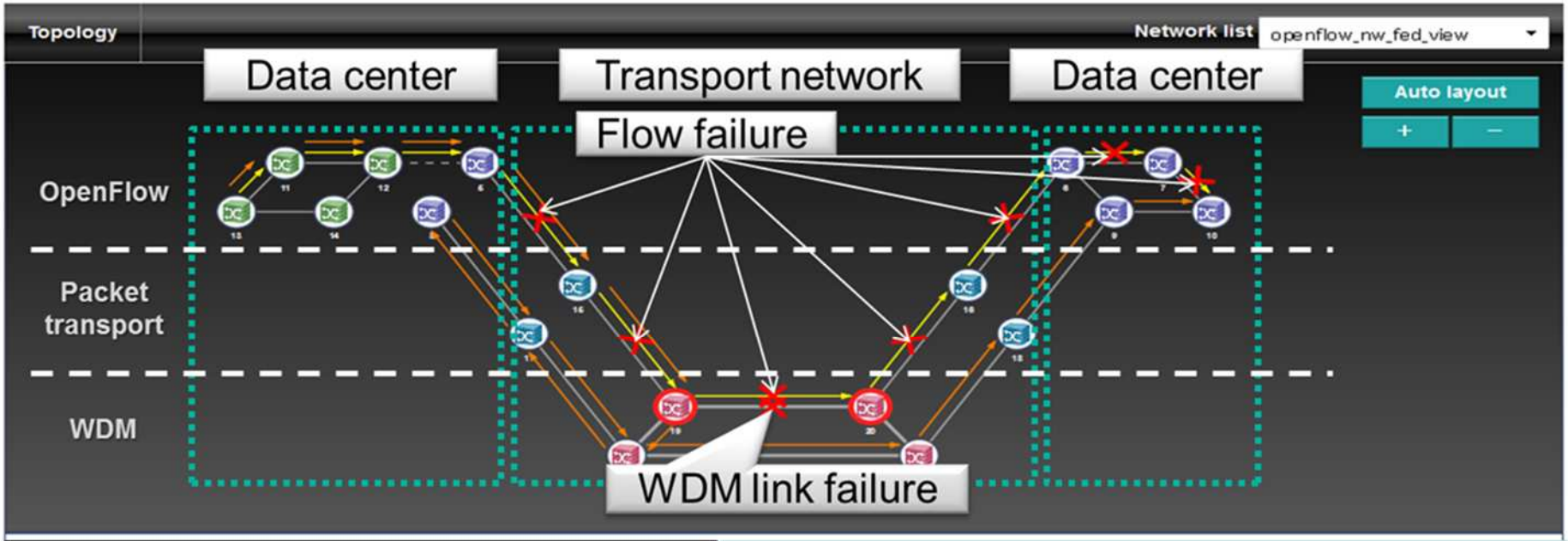
- *WAN experiments with Multi-vendor Equipment*

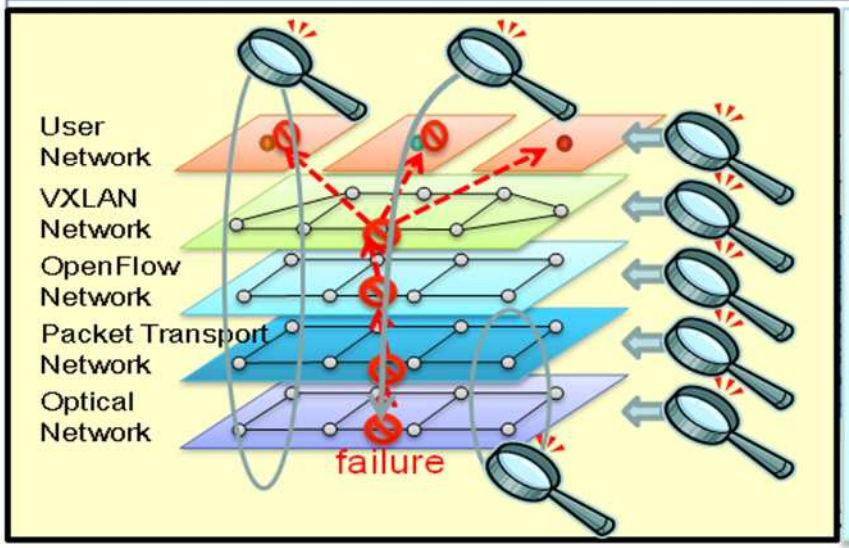


PoC on Multi-Layer & Domain Control



PoC on Network Visualization

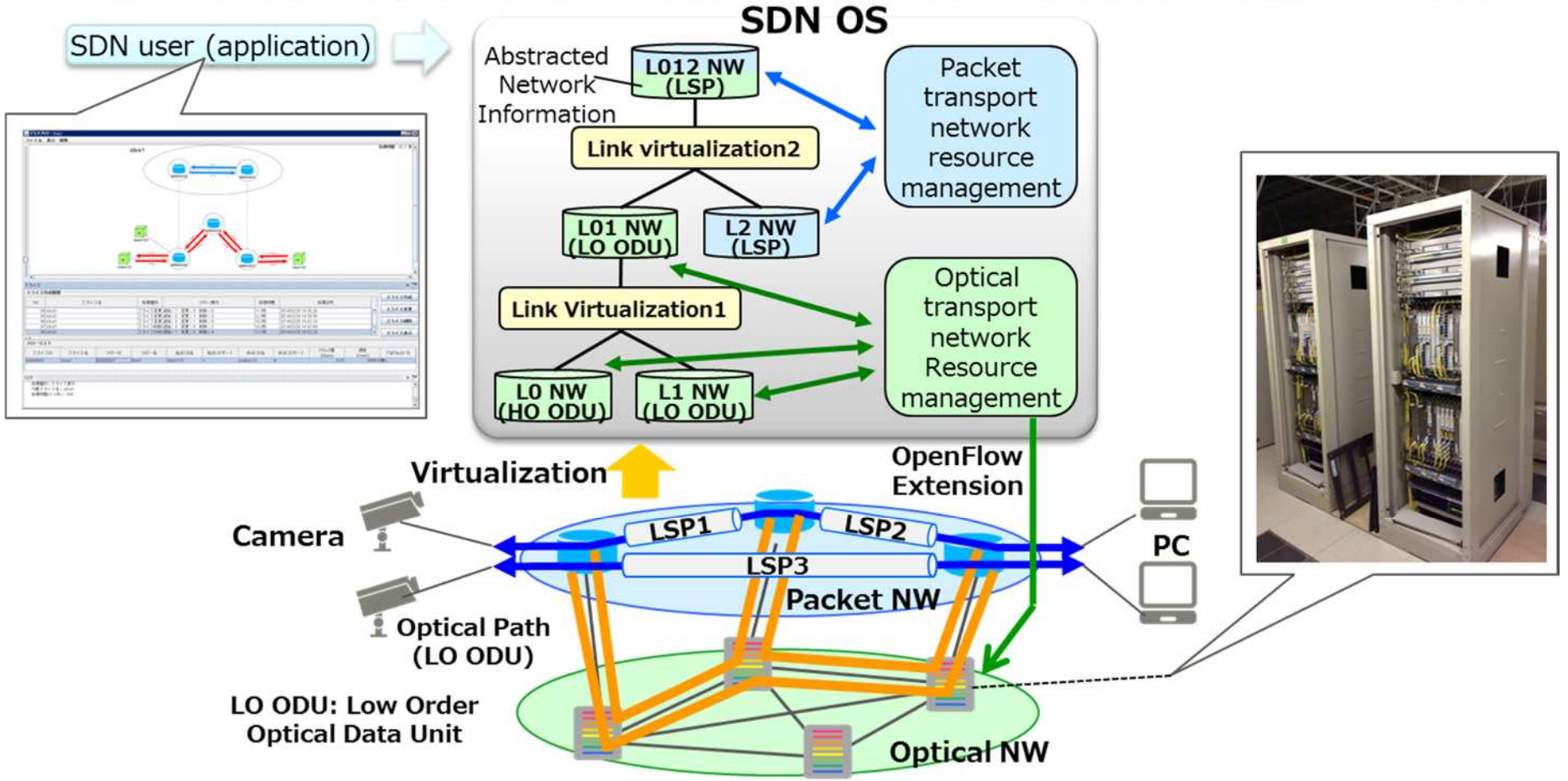




- Multi-layer topology visualization from logical network instances
- Inter-layer correlation mapping through operators
- Trouble shooting, failure analysis, etc.

PoC on Packet & Optical Integrated Mgmt

- *Control of transport network based on simple requirements from users such as transmission speed and response time*
- *Flexible multilayer resource utilization to meet user requirements*

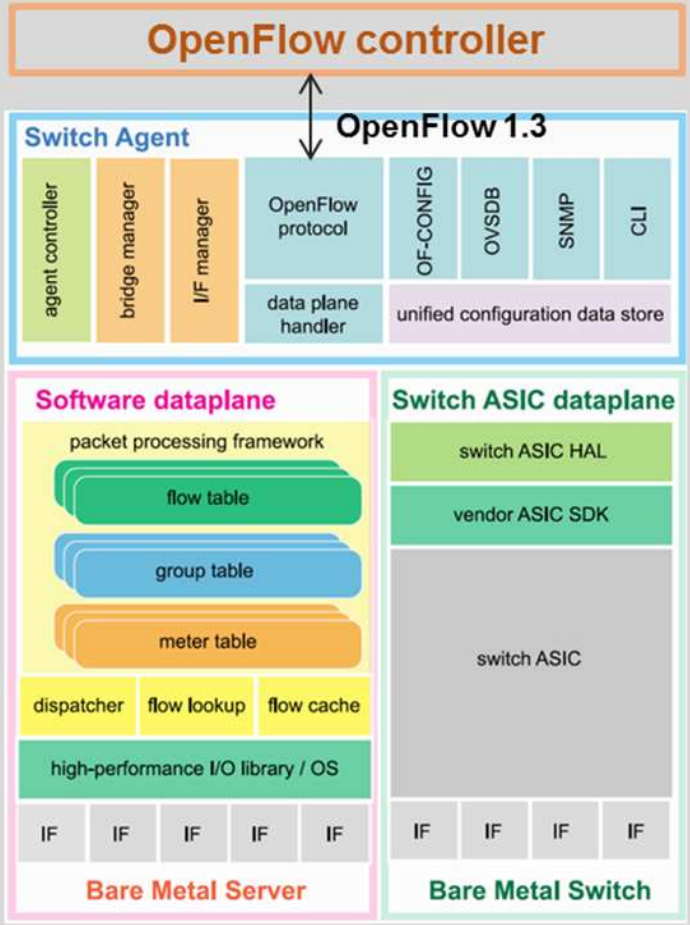


SDN Ready Open Source Software

SDN Software Switch: Lagopus

"Lagopus" features and targets

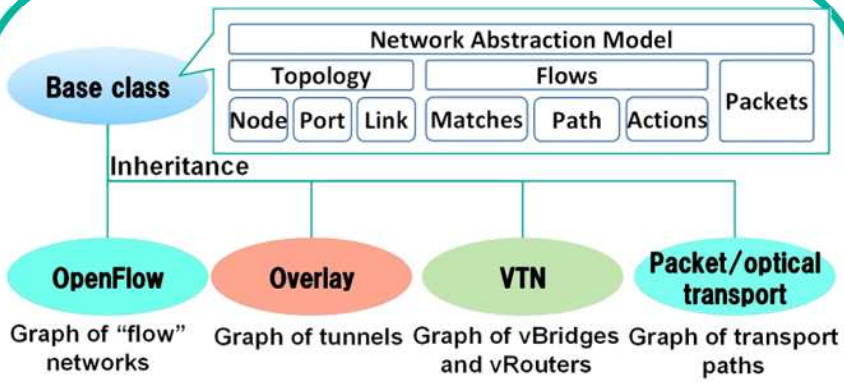
- **High-performance packet processing**
  - Support for 1M flow control rules
  - Forwarding performance over 10 Gbps
- **Support for various protocols**
  - Extensive support for latest stable specification OpenFLow 1.3.4 (including MPLS, PBB, and QinQ in wide area networks)
    - Top score in "Ryu certification tests" http://osrg.github.io/ryu/certification.html
- **Support for various config/mgmt interfaces**
  - OF-CONFIG, OVSDB, CLI, SNMP, and Ethernet OAM (including features under development)
- **Modular architecture**
  - New protocol modules or management interface modules easily deployed on "unified configuration data store" basis.
- **Support for multiple data planes**
  - General-purpose servers (IA servers)
    - Parallelized and multi-threaded packet processing
    - I/O acceleration by leveraging Intel DPDK
  - Bare metal switches (under development)
    - For general-purpose hardware switches



- **Open source**
  - Released as open source software at http://lagopus.github.io/

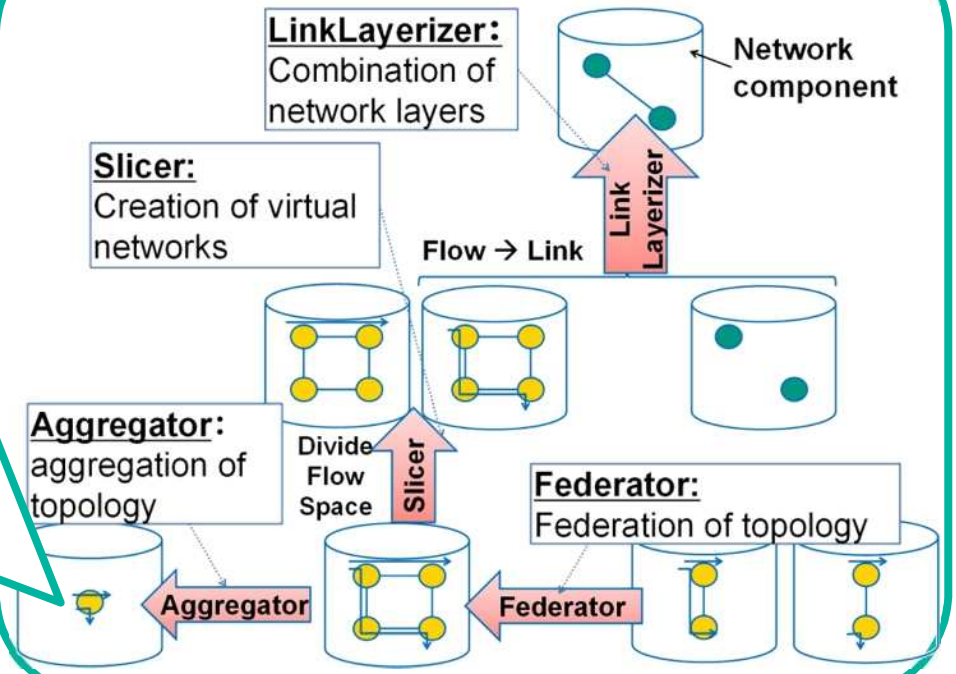
SDN Framework: ODENOS

Network abstraction model



Topology: graph-based representation of network structure and statistics
Flow: point/multipoint-to-point/multipoint communications (OpenFlow path, MPLS / optical paths, and overlay tunnels)
Packet: OpenFlow packet_in/out.

Network control structure model



Instance of various logical network

Operators for network instances

Design a SDN controller as an arbitral combination of logical network and operators

Conclusion & Future Work

Conclusion & Future Work

- O3 project provides SDN ready environment
  - SDN Design, Deployment & Operations Guideline
  - SDN Framework: Object-defined Network Platform
    - Network Abstractions and Programming Model
  - SDN-enabled WAN nodes
    - SDN Software Forwarding and Control
    - Optical, Packet and Wireless Network Control

Jump-start with O3 Open Source Software !!

- Future plan

Achievement	2014	2015
O3 Website	Released	Expansion, Customization & Maintenance
SDN guideline	Plan to release by 3/E	
Common control FW (OSS)	Plan to release Dec/E	
SDN-enabled WAN nodes (OSS) Lagopus---	Lagopus: Released; Others:by 3/E	

Thank you for your attention!

O3 project

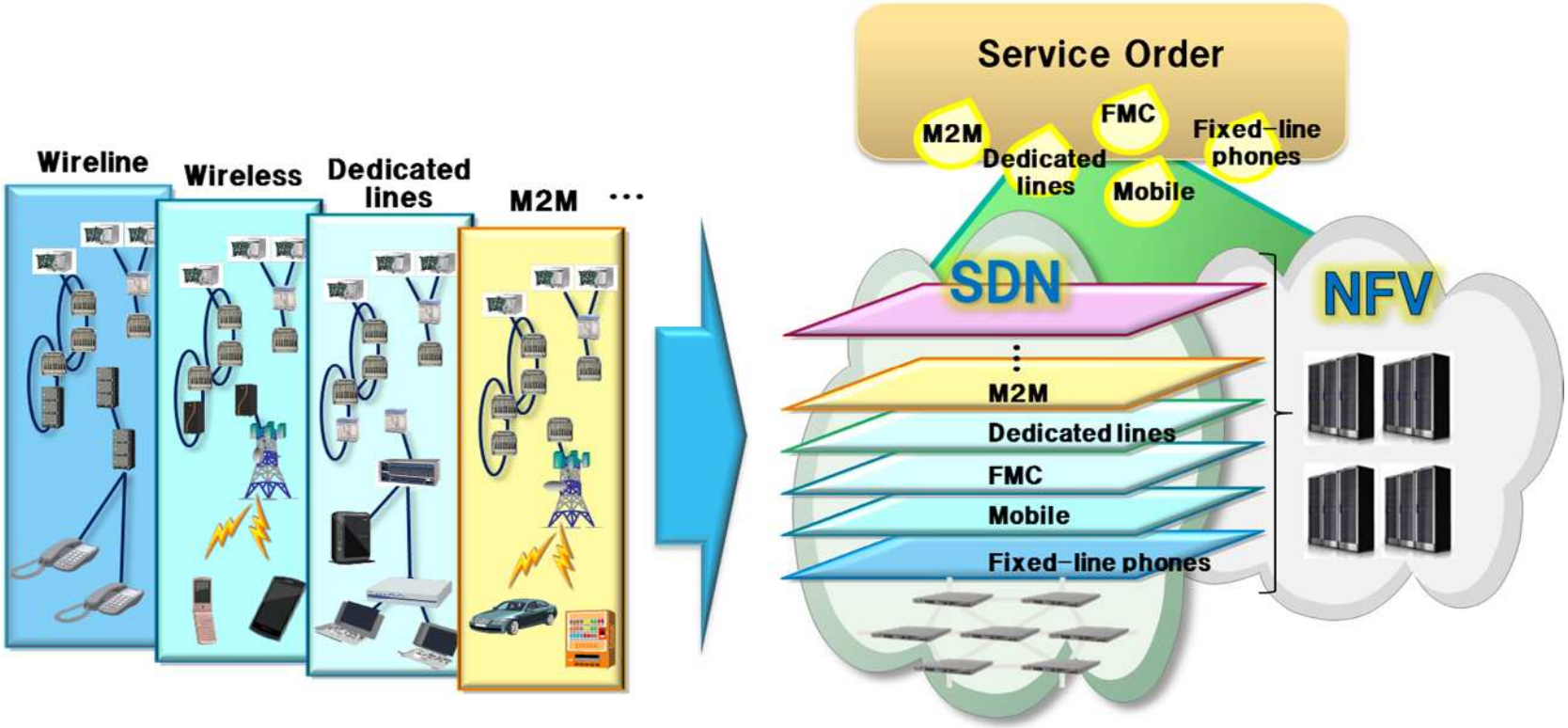
www.o3project.org/en/

This research is executed under a part of a "Research and Development of Network Virtualization Technology" program commissioned by the Ministry of Internal Affairs and Communications.

Trend on
Future Information Networking

Software-Defined Networking (SDN)

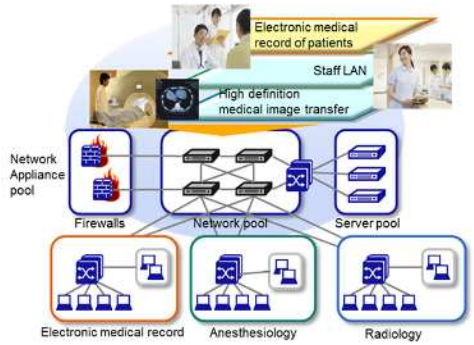
- SDN is a technology to innovate new services and to accelerate businesses
- Network will be designed, deployed and operated by business application and orchestration system



SDN/NFV Future Direction

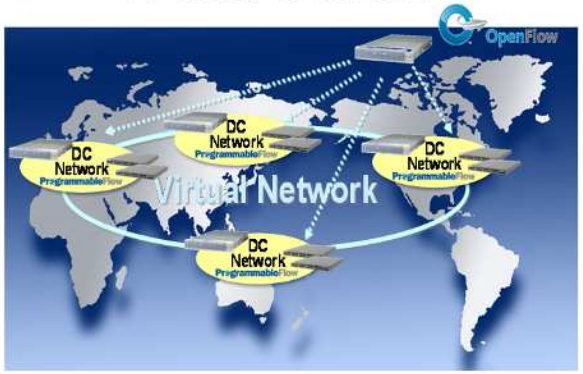
- *Commercial SDN technologies are mainly applied to "closed domain networks", such as enterprise, datacenter, and mobile core*

Enterprise



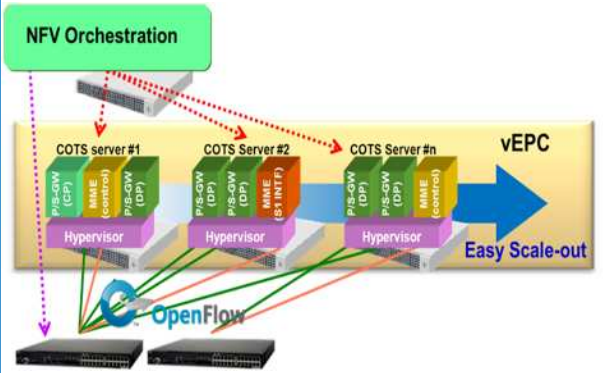
Secure virtual network infra.

Data center



Global multiple distributed DCs

Mobile core



Load-based flexible resource allocation

Open & Agile end-to-end service deployments and operations to satisfy service SLA/QoS for various users