Activity of Joint Research with NII

3 FEB 2017

Abstract

The activity was applied for public offer of joint research by National Institute of Informatics

Study for configuration methodology for overlay virtual network

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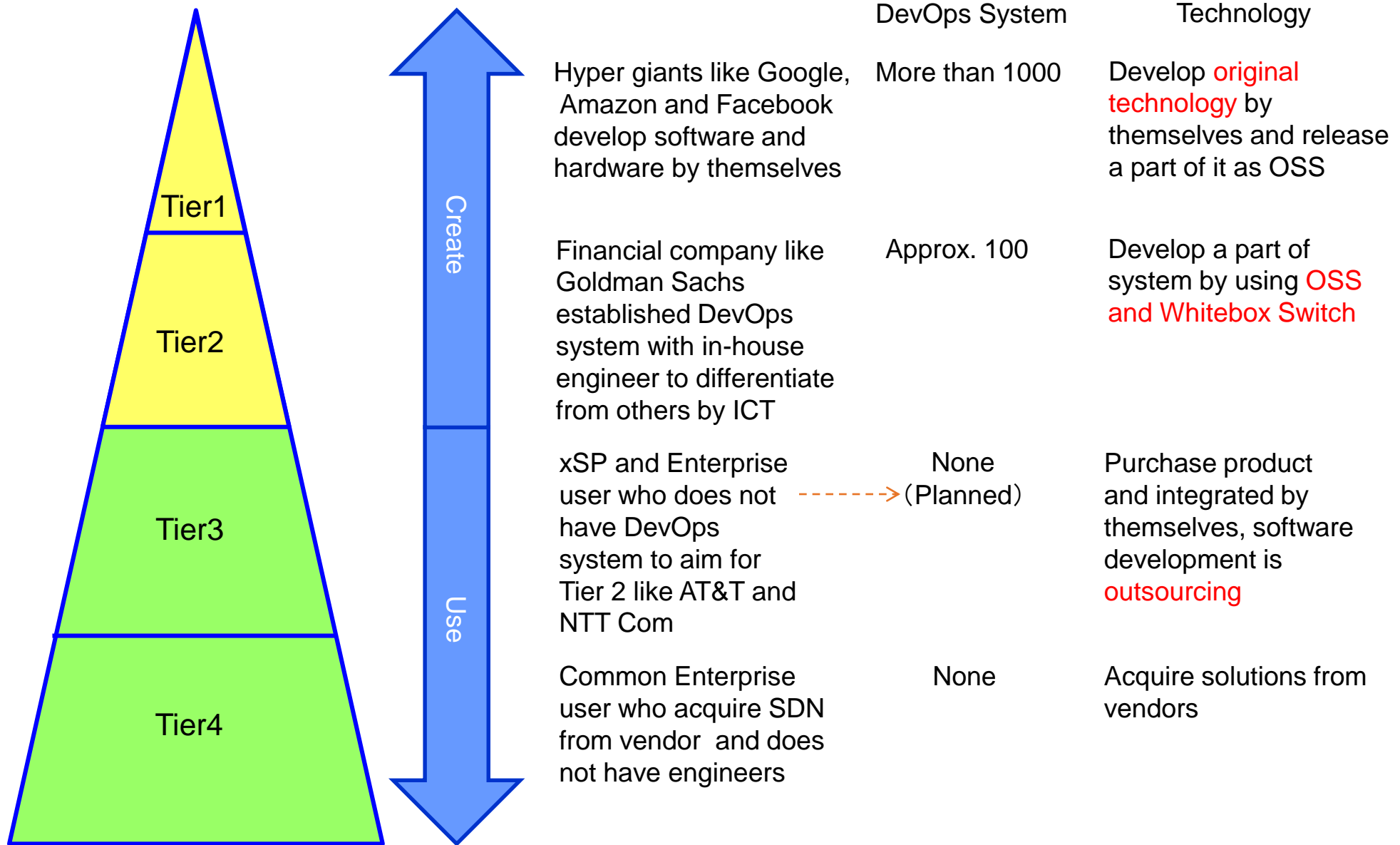Yukinori KISHIMOTO（NTT Com）
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User of SDN/NFV

|	DevOps System	Technology
Tier1 — Hyper giants like Google, Amazon and Facebook develop software and hardware by themselves	More than 1000	Develop original technology by themselves and release a part of it as OSS
Tier2 — Financial company like Goldman Sachs established DevOps system with in-house engineer to differentiate from others by ICT	Approx. 100	Develop a part of system by using OSS and Whitebox Switch
Tier3 — xSP and Enterprise user who does not have DevOps system to aim for Tier 2 like AT&T and NTT Com	None -------> (Planned)	Purchase product and integrated by themselves, software development is outsourcing
Tier4 — Common Enterprise user who acquire SDN from vendor and does not have engineers	None	Acquire solutions from vendors

Create

Use

Usecase for Service Providers

- Replace existing 300 kinds of equipment by Server+WBS（OCP）
- Network functionality and services are realized by software
- Suggest integrated reference model of orchestrator, controller and hardware
- AT&T, Verizon, NTT Com, SK Telecom, China Unicom and Google joined

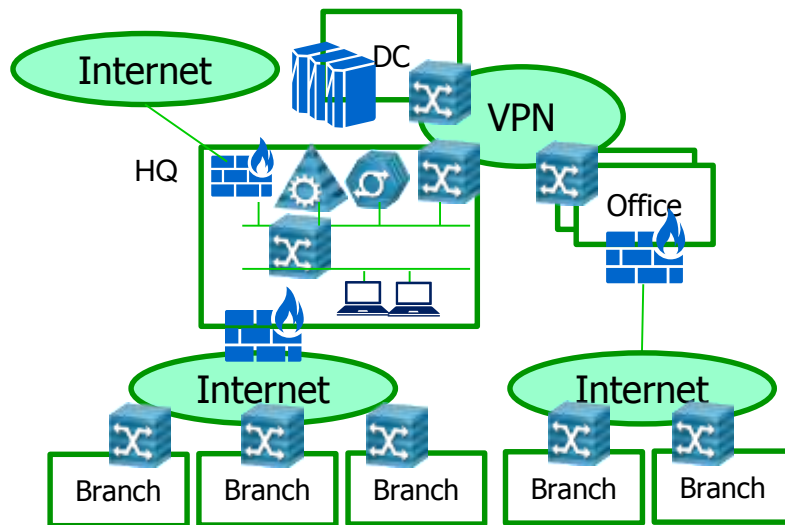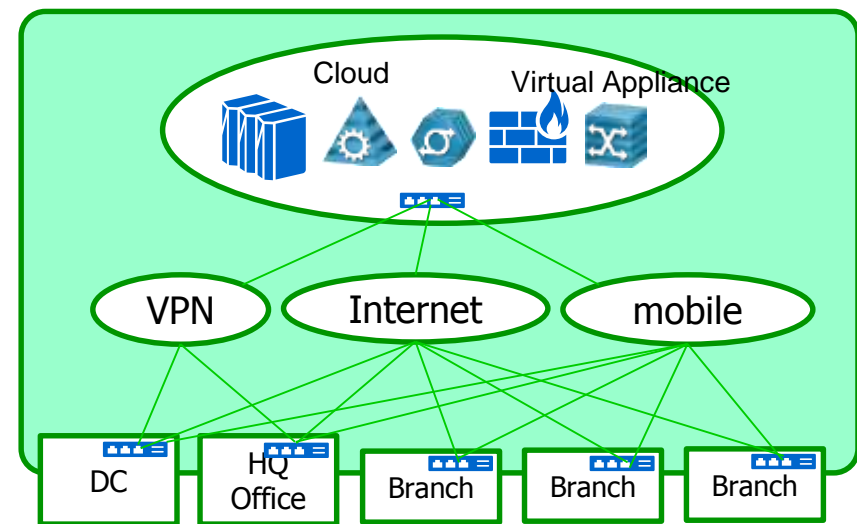http://opencord.org/
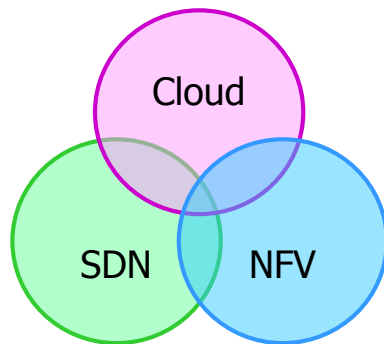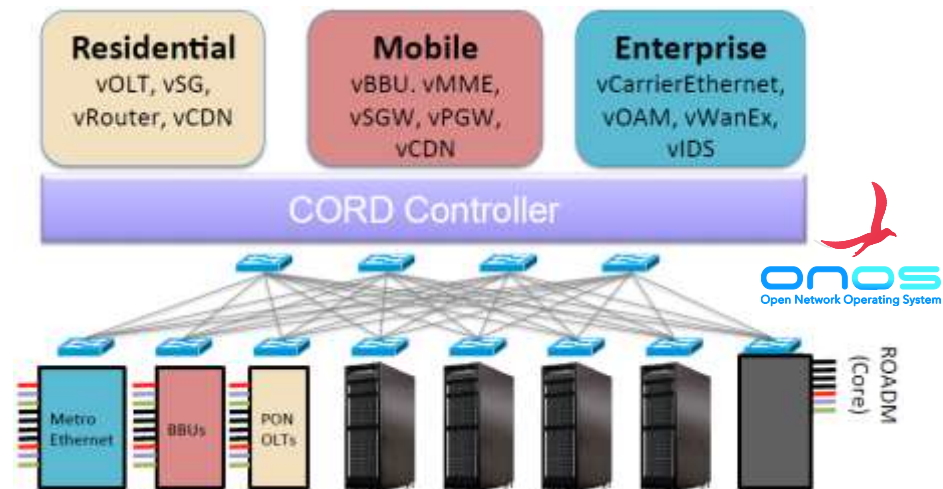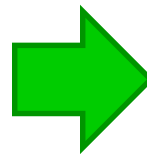
Solution for Enterprise

- Solution for Enterprise （Virtual NW＋NFV＋Central Control）
- Replace NW Function which was SI in past with Cloud (NFV)
- Provider, rather than "Vendor"

Problem to catch up change and new requirement for NW

Provide NW Service + SI by SD-WAN

SD-WAN

Virtual NW with Overlay

- Configure Virtual NW on hybrid Underlay-NW consists of MPLS-VPN, Internet and 4G/5G/WiFi
- Deploy Edge devices on each branch to establish Overlay-Tunnel between Edges

Bandwidth and Quality Control

- Utilize Underlay with ACT-ACT configuration （more bandwidth than ACT-SBY)
- Monitor Utilization/Quality to steer traffic with QoS rules
- Reliability is improved by using physically separated network

Additional Value

- Chaining of VNF （FW, LB, DPI and WAN Acceleration）
- Collaborate with Public cloud

Centralized control, Policy management, Zero-touch provisioning

- Route control for Edge and traffic is controlled in centralized
- Controller configures Edge in remote automatically （Zero-touch provisioning）
- Configuration of FW changed in one time by overwriting Policy

Step by Step installation from existing NW

- Trial → Partial installation → Full installation

Open SD-WAN

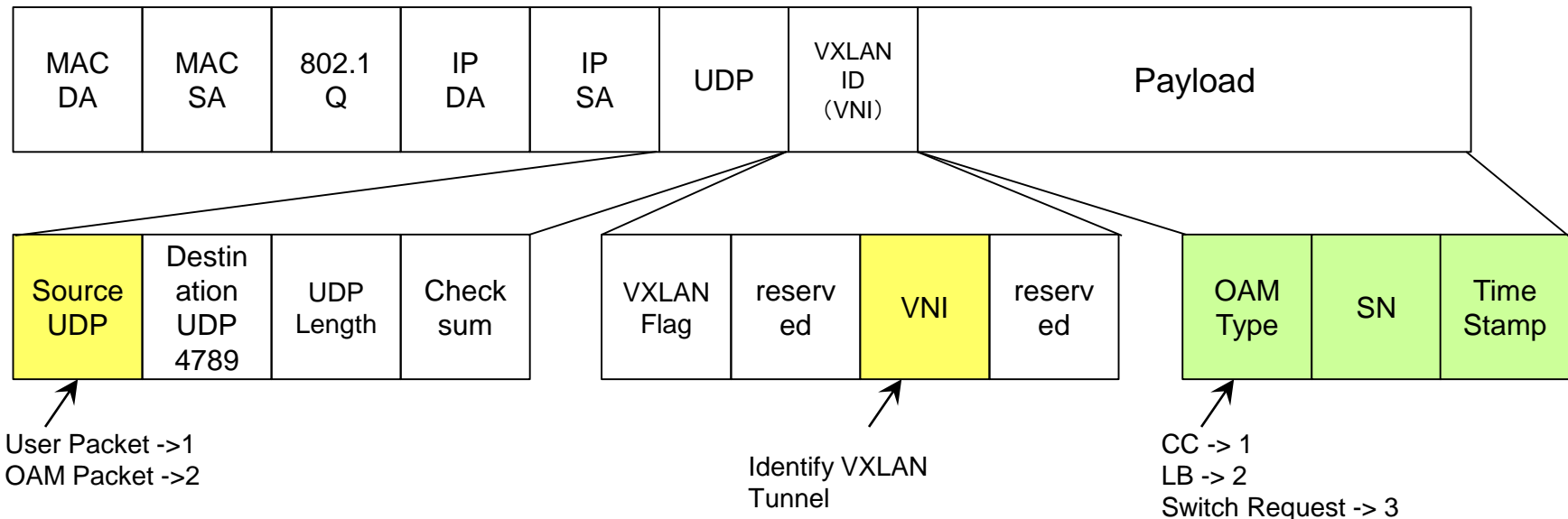SD-WAN integrated with Open Source and general hardware

トンネル

Edge Device

Edge Device

Edge Device

IP-VPN

Internet
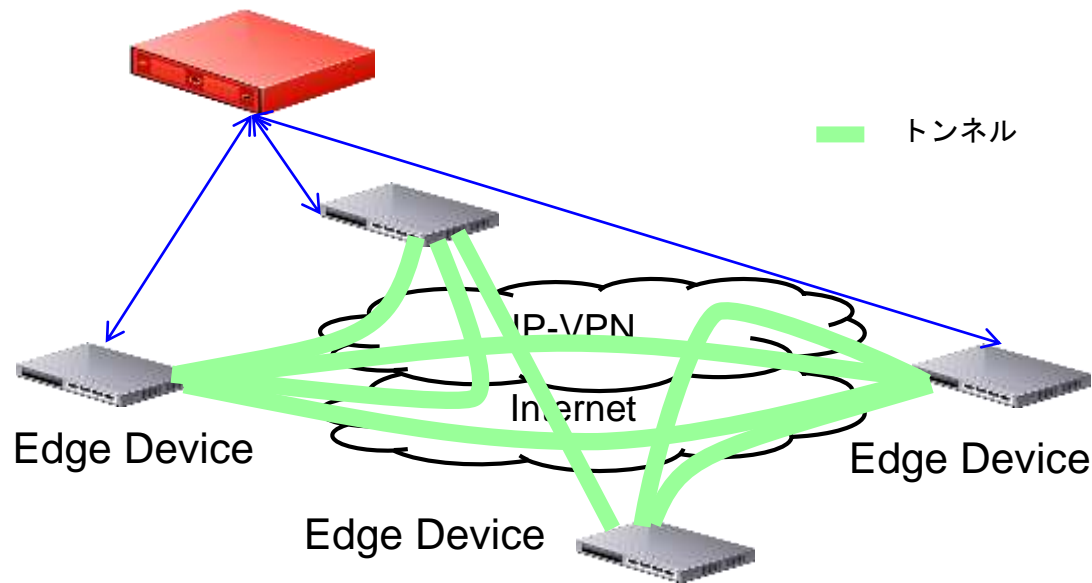
Joint research focused on "How to realize overlay virtual network"
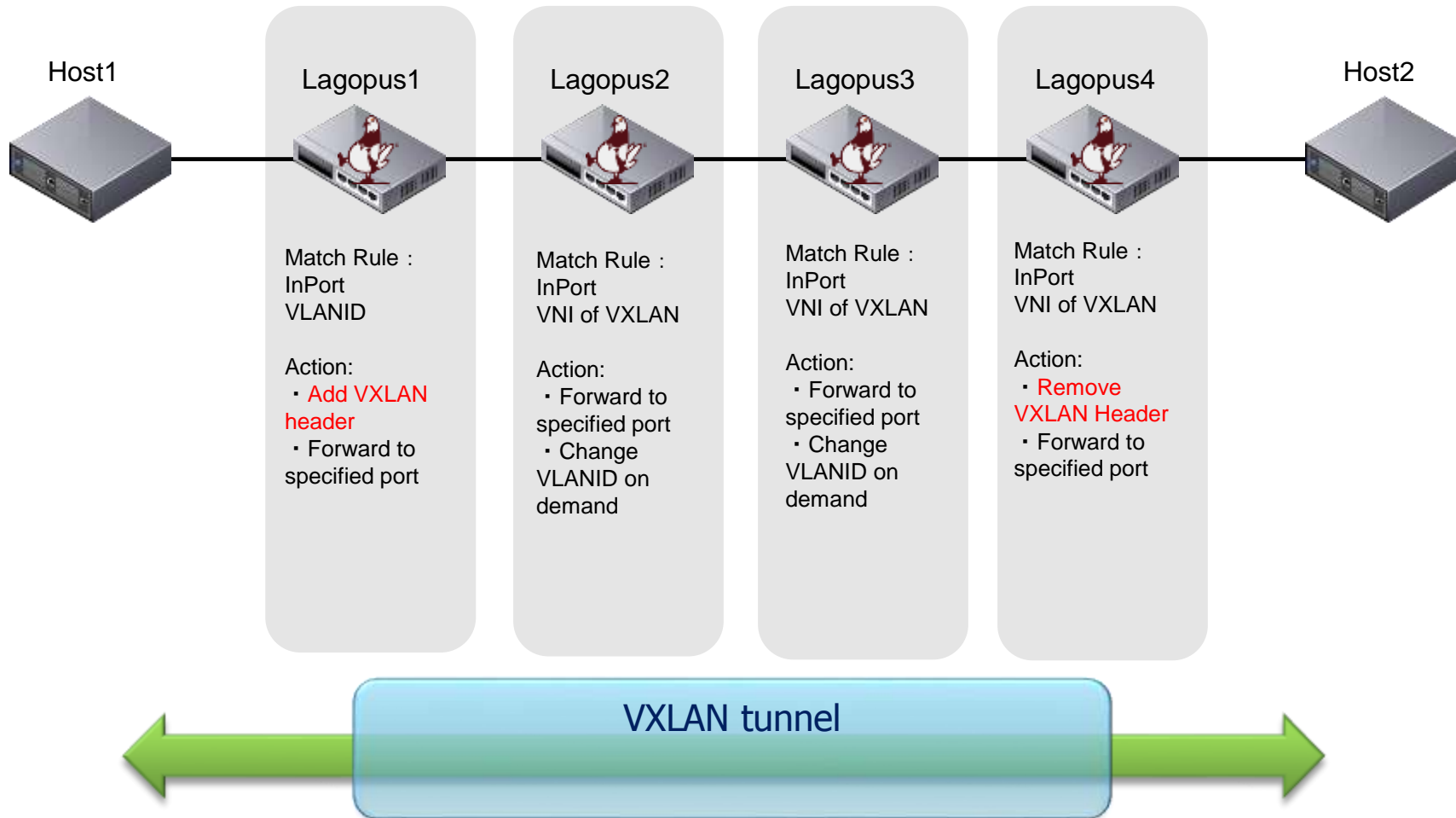
Research overview

・ Technology for Virtual Network Configuration
  Method to realize Virtual NW with VXLAN Tunnel

・ OAM Functionality
  CC ： Down Detection, Loss detection of CC packet and
        Delay Measurement
  LB ： Connectivity check

・ Path Switching Functionality
  Switch ACT-SBY
  Switch to Third Route

VXLAN Header

・ Use Source UDP to identify Packet
  ->Distinguish packet sent from user and packet used in NW management
・ Add OAM field on payload to identify OAM type
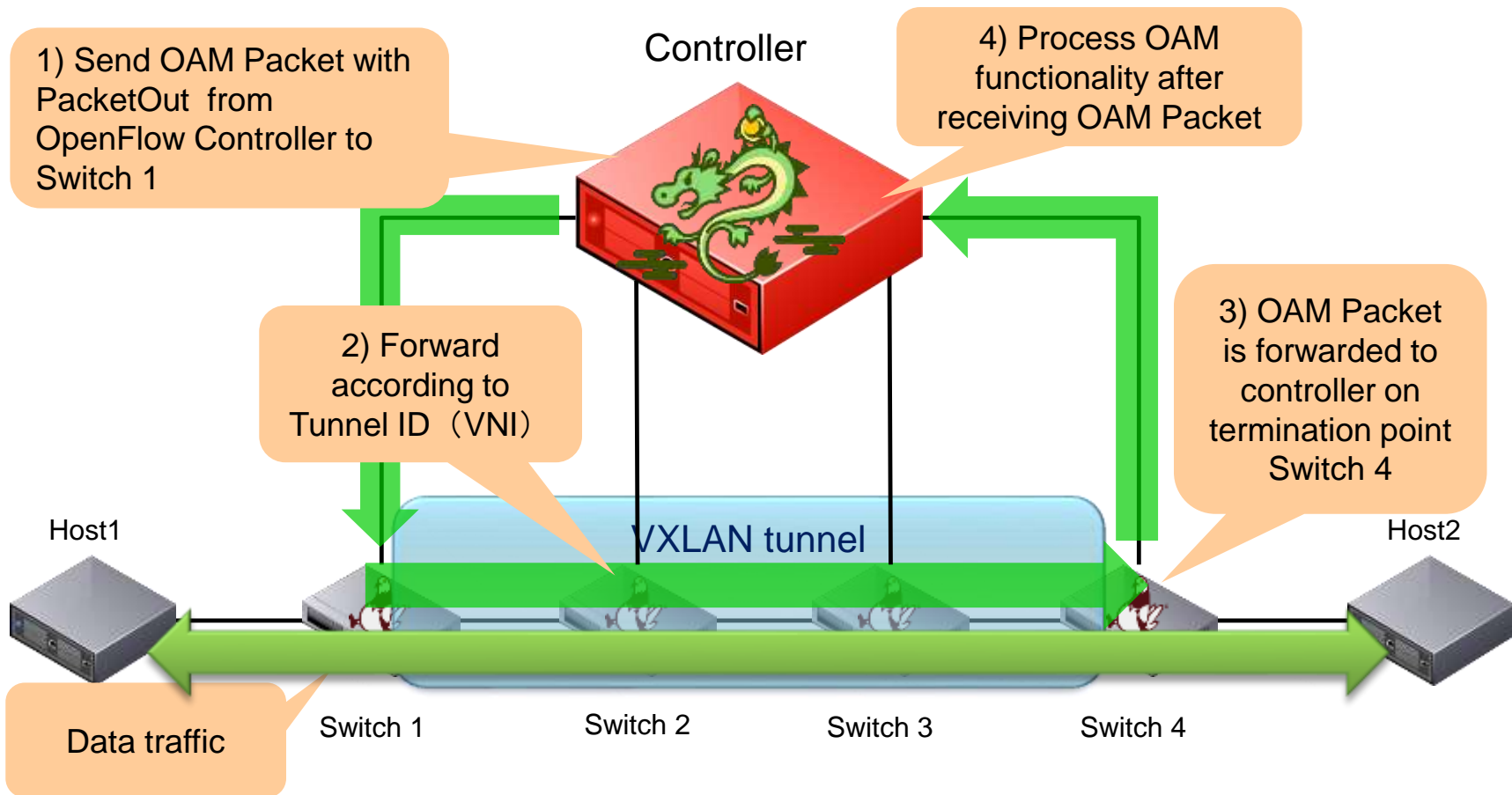・ Identify Tunnel with VNI
  ->Forwarding rule is decided by VNI

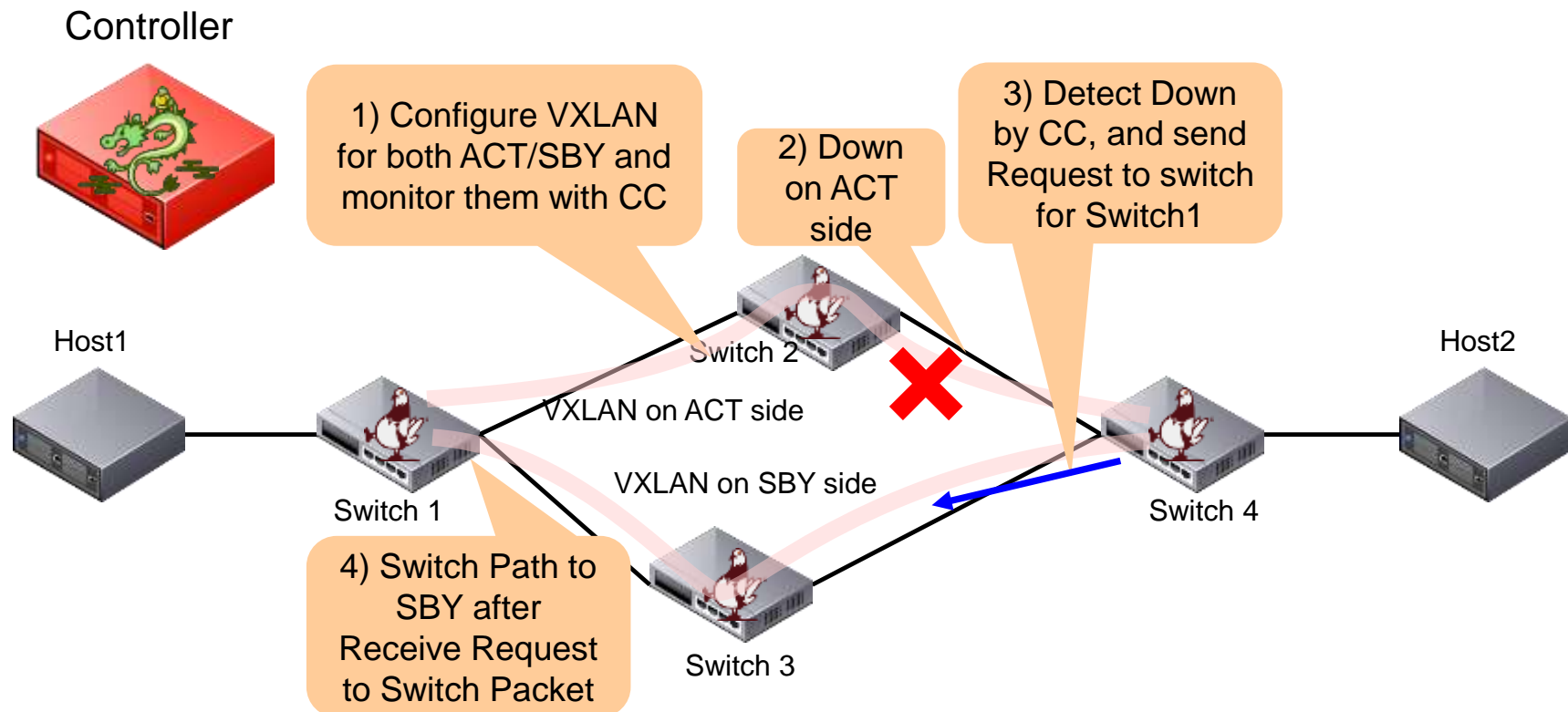| MAC DA	MAC SA	802.1 Q	IP DA	IP SA	UDP	VXLAN ID （VNI）	Payload

Source UDP	Destin ation UDP 4789	UDP Length	Check sum

User Packet ->1
OAM Packet ->2

VXLAN Flag	reserv ed	VNI	reserv ed

Identify VXLAN Tunnel

OAM Type	SN	Time Stamp

CC -> 1
LB -> 2
Switch Request -> 3

Virtual NW with VXLAN

Host1

Lagopus1

Match Rule：
InPort
VLANID

Action:
・Add VXLAN
header
・Forward to
specified port

Lagopus2

Match Rule：
InPort
VNI of VXLAN

Action:
・Forward to
specified port
・Change
VLANID on
demand

Lagopus3

Match Rule：
InPort
VNI of VXLAN

Action:
・Forward to
specified port
・Change
VLANID on
demand

Lagopus4

Match Rule：
InPort
VNI of VXLAN

Action:
・Remove
VXLAN Header
・Forward to
specified port

Host2

VXLAN tunnel

Process of OAM

- Generate and Terminate OAM Packet on Controller
- OAM Functionality is realized by application on Controller

1) Send OAM Packet with PacketOut from OpenFlow Controller to Switch 1

4) Process OAM functionality after receiving OAM Packet

Controller

2) Forward according to Tunnel ID（VNI）

3) OAM Packet is forwarded to controller on termination point Switch 4

Host1

Host2

VXLAN tunnel

Data traffic

Switch 1   Switch 2   Switch 3   Switch 4

Process of Path Switching

・ Down detection and switching process triggered by detection are processed by Controller

Controller

1) Configure VXLAN for both ACT/SBY and monitor them with CC

2) Down on ACT side

3) Detect Down by CC, and send Request to switch for Switch1

Host1

Switch 2

VXLAN on ACT side

VXLAN on SBY side

Switch 1

Host2

Switch 4

4) Switch Path to SBY after Receive Request to Switch Packet

Switch 3

Test Configuration

・D-Plane
 Hybrid WAN configuration with L2VPN on SINET and the Internet
 Lagopus is deployed at each site to establish VXLAN Tunnel
・C-Plane
 Controller is connected to Lagopus with L2VPN on SINET
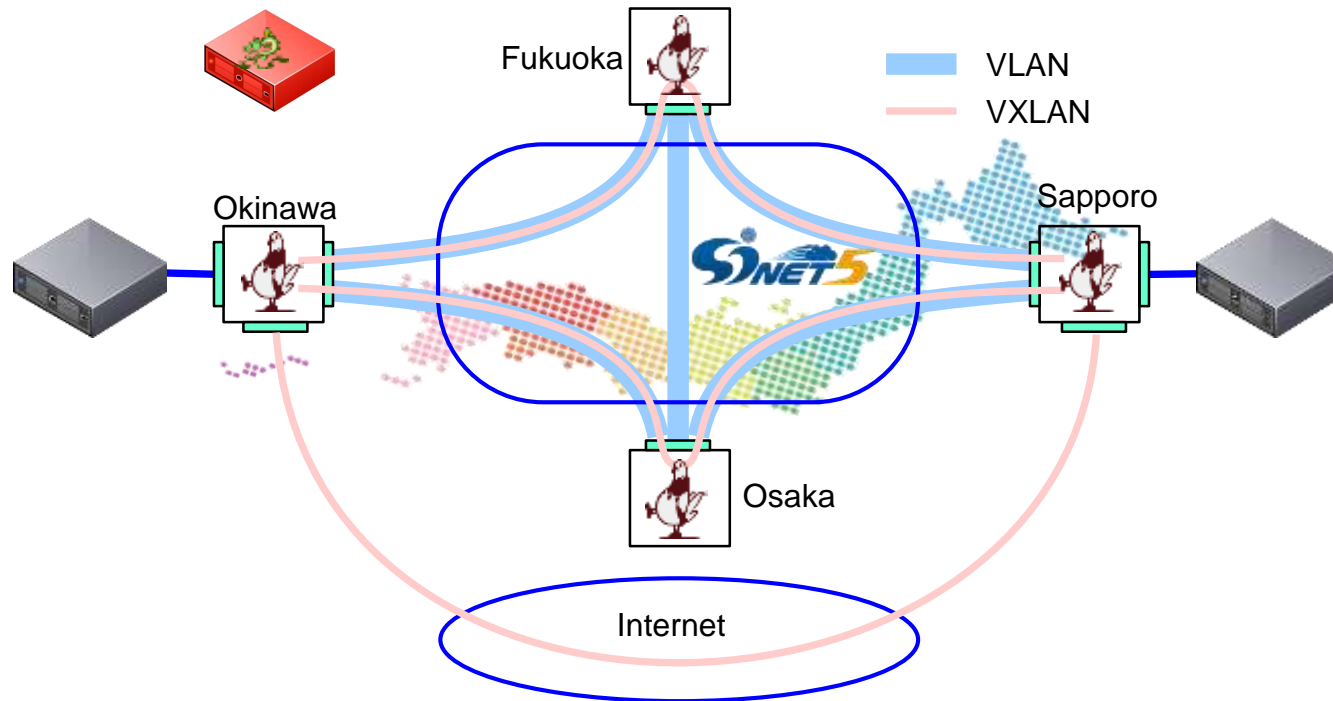
Path was provisioned by L2VPN, and path trail was selected to avoid route duplication
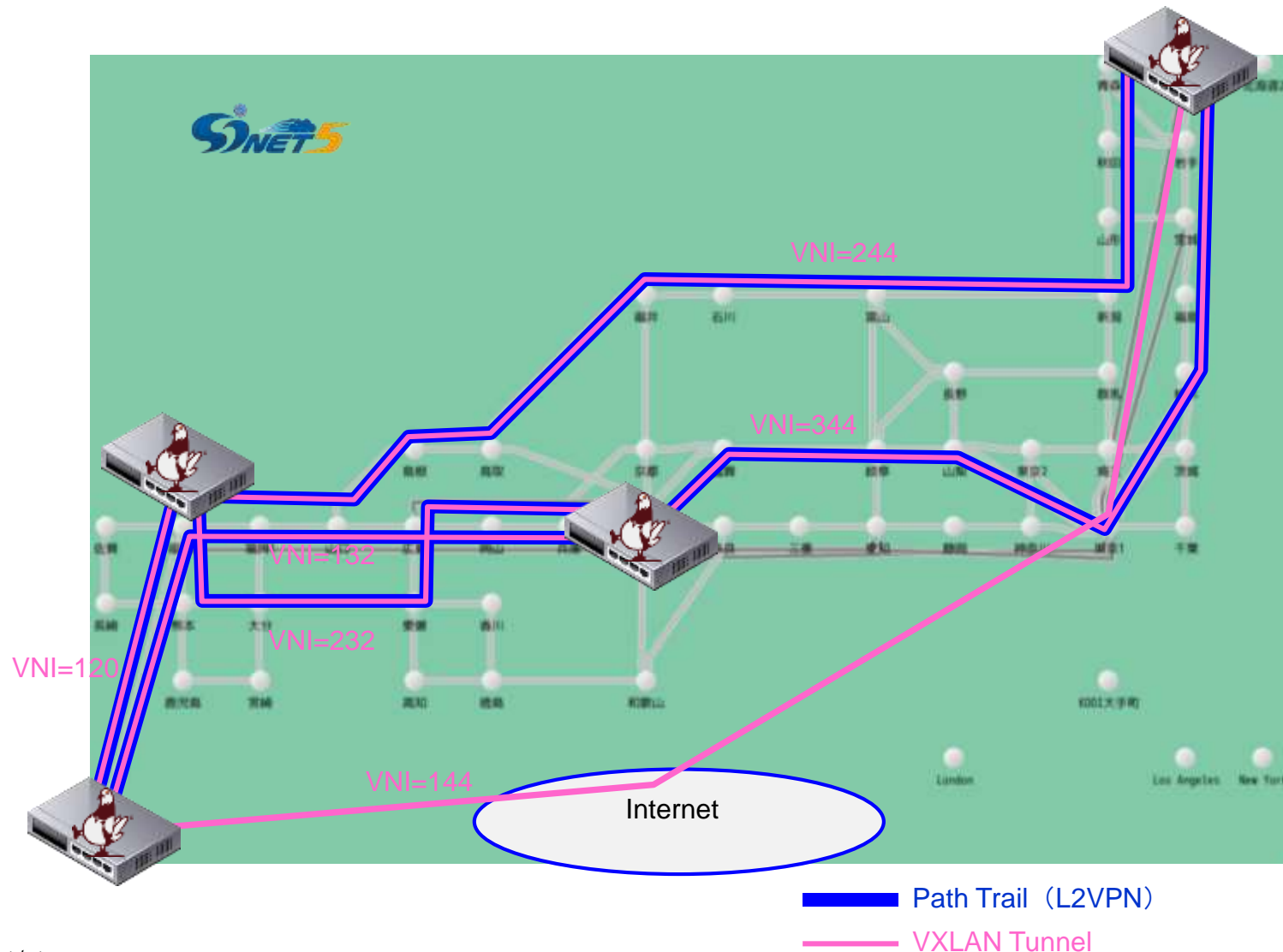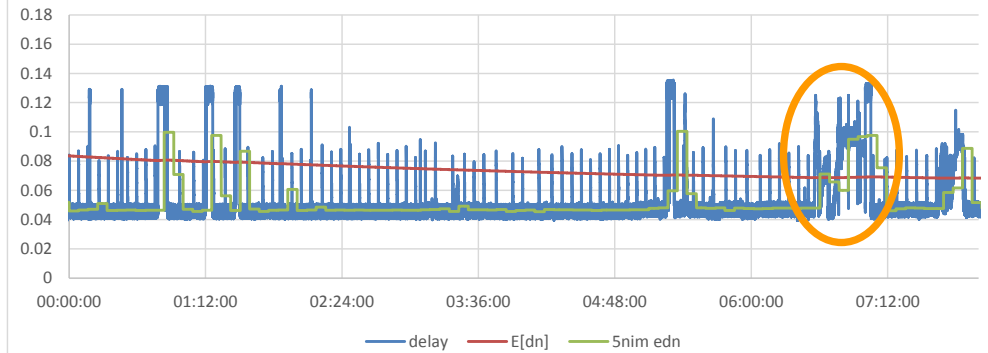
Latency measurement result with CC
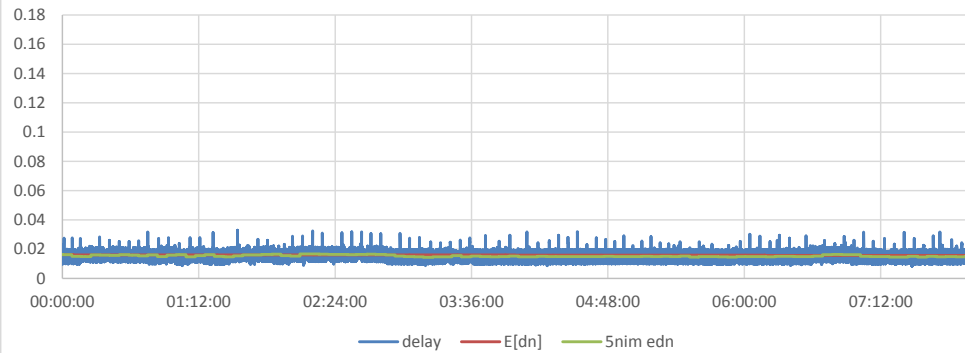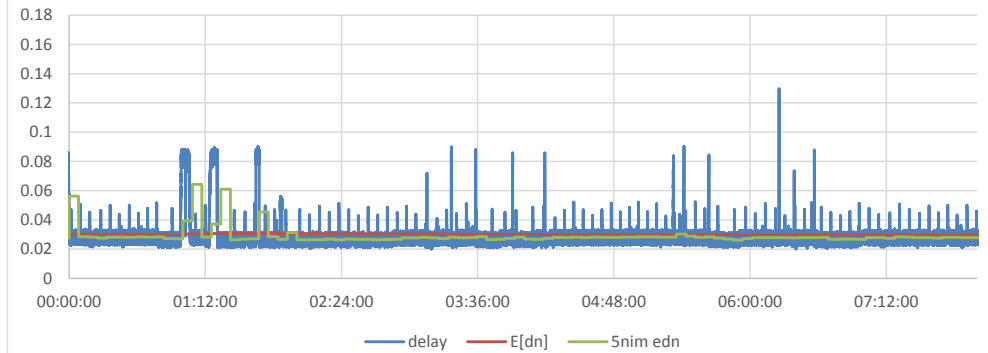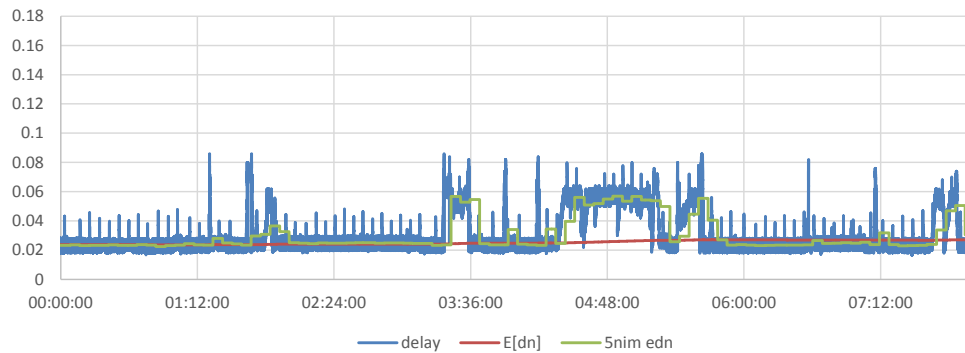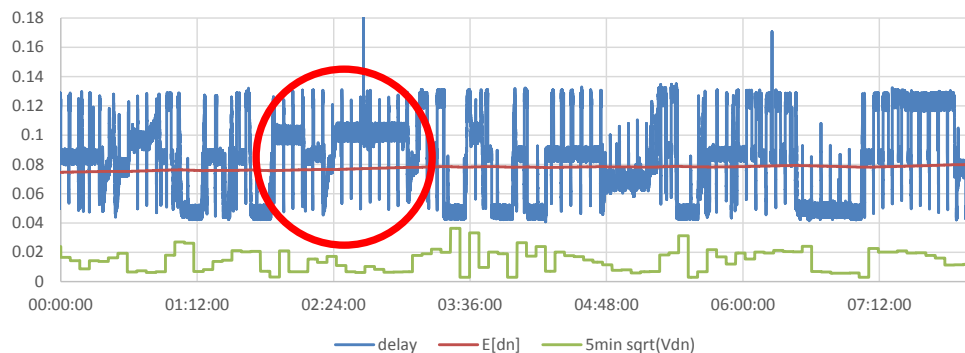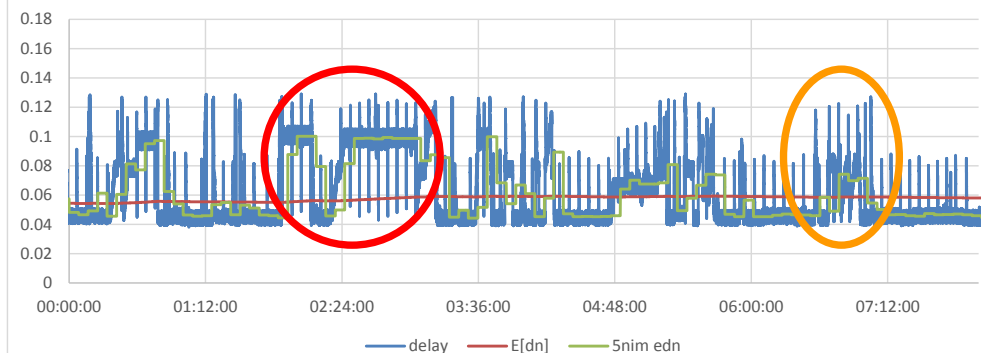
Confirmation of Path Switching
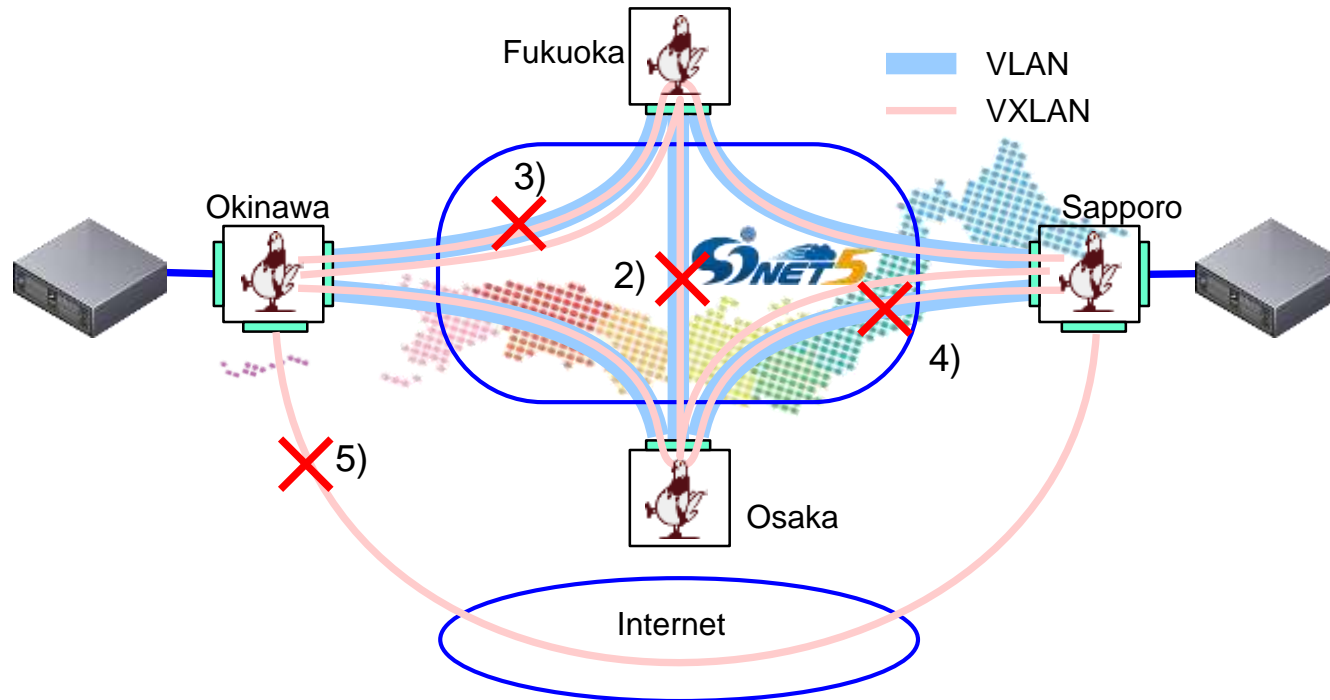

1) Connect via Okinawa - Fukuoka – Osaka – Sapporo   Downtime(sec)

2) Shutdown VLAN Fukuoka – Osaka → Switch to Okinawa – Fukuoka - Sapporo   4.87

3) Shutdown VLAN Okinawa – Fukuoka → Switch to Okinawa – Osaka – Sapporo   5.50

4) Shutdown VLAN Osaka – Sapporo → Switch to route on the Internet   5.20

5) Recover VLAN Okinawa – Fukuoka and Shutdown VLAN for the Internet   5.08
   → Switch to Okinawa – Fukuoka – Sapporo

Path Switching triggered by Latency

Path Switching occurred after 5 minutes from delay was increased by NW Emulator
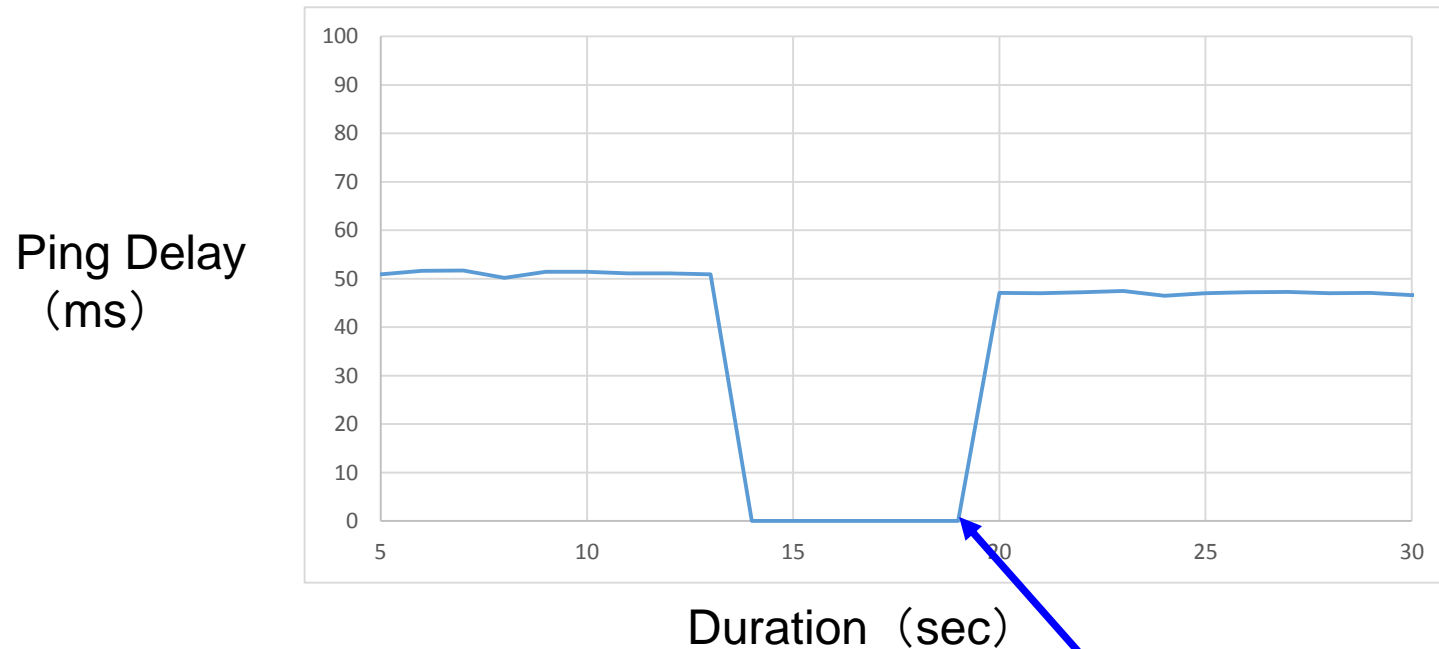Downtime for switching is almost 1 second

Ping Delay
（ms）
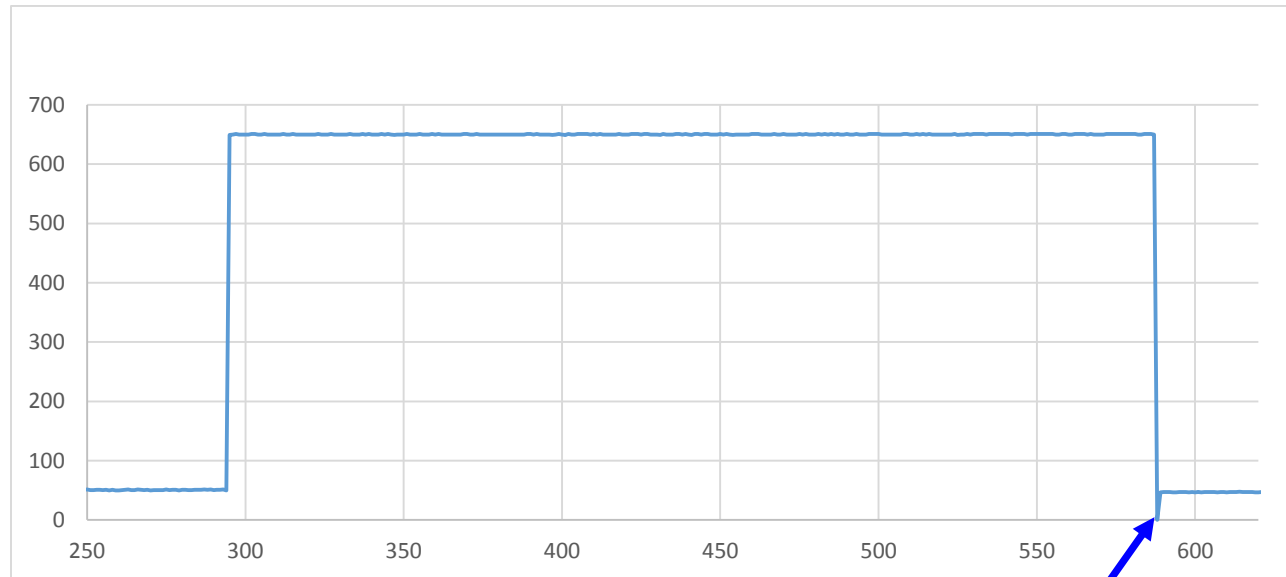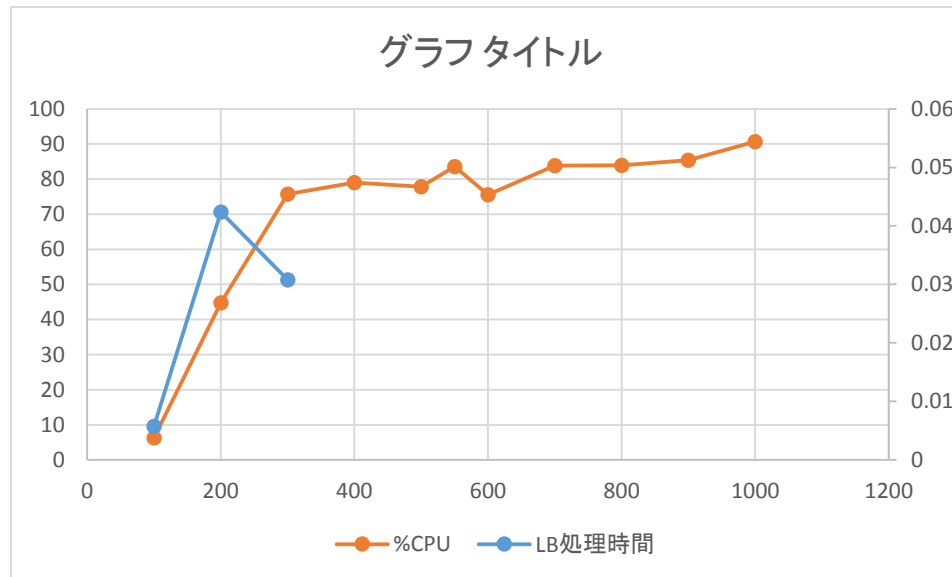
Duration（Sec）

Path Switching Occurred (Lost only 1 ping)）

Path Switching occurred after Packet Loss rate was raised by NW Emulator
Downtime is 6 seconds

Ping Delay
（ms）

Duration（sec）

Path Switching Occurred(Lost 6 ping）

Scalability of CC

グラフ タイトル

%CPU   LB処理時間

Summary

- Realization of Open SD-WAN
  Researched and Developed technology to configure overlay
  virtual Network with Open Source Software and General small server

- Implementation of OAM Functionality
    Monitor status of WAN line by CC and,
    Trouble shooting by LB
  were enabled

- PoC on SINET5
    OAM Functionality
    Path Protection Switch Functionality
  were confirmed that they were effective

- Further Research
    Improvement of Scalability
    Prediction of Path Status

Acknowledgement

Highly appreciated to Nissho-Electronics for contribution of instrument at PoC on SINET

END