Multi-tenancy in PRAGMA-ENT using AutoVFlow

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Acknowledgement

- Co-developers of AutoVFlow
  - Eiji Kawai
  - Shuji Ishii
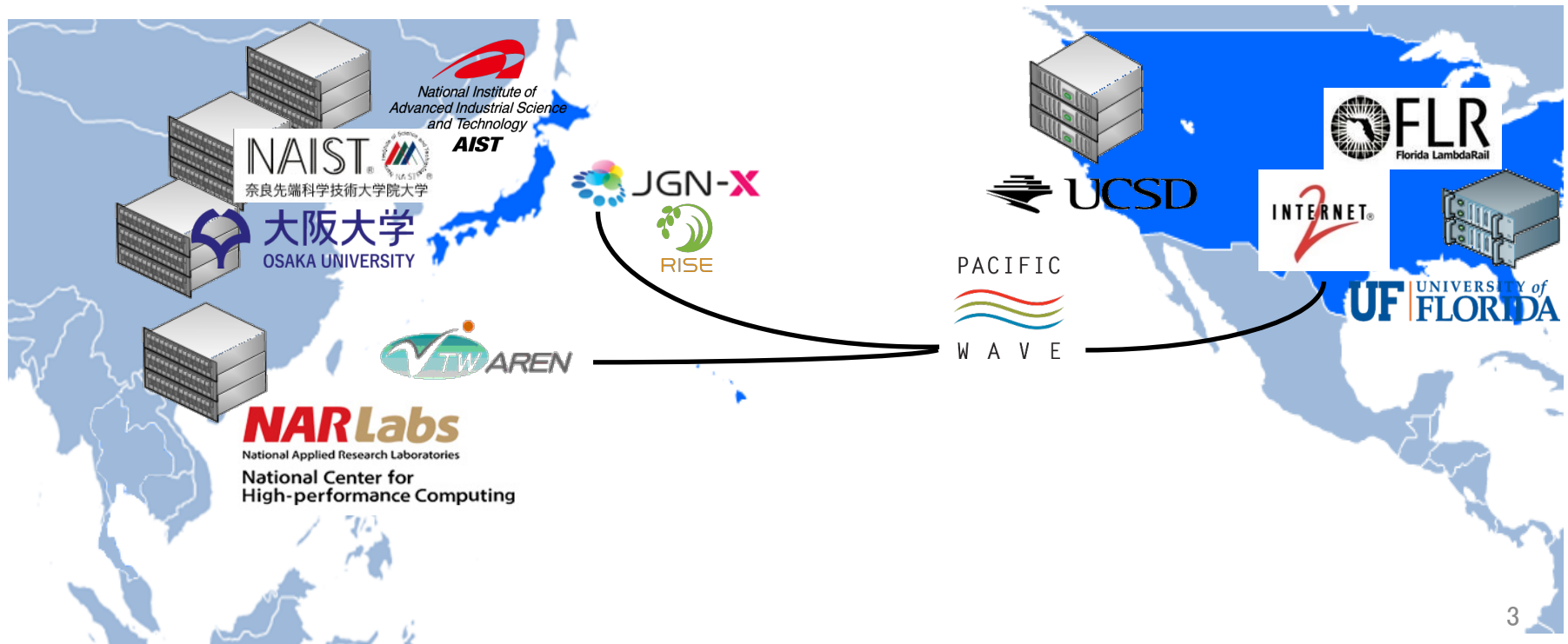 - Shinji Shimojo

- Backbone network providers

- Participants of PRAGMA-ENT

PRAGMA-ENT
(Experimental Network Testbed)

- Conceived in October 2013
- Goals
  - Build a testbed to explore for use by PRAGMA researchers
  - Facilitate collaborations as demonstrated by use of testbed in papers and presentations
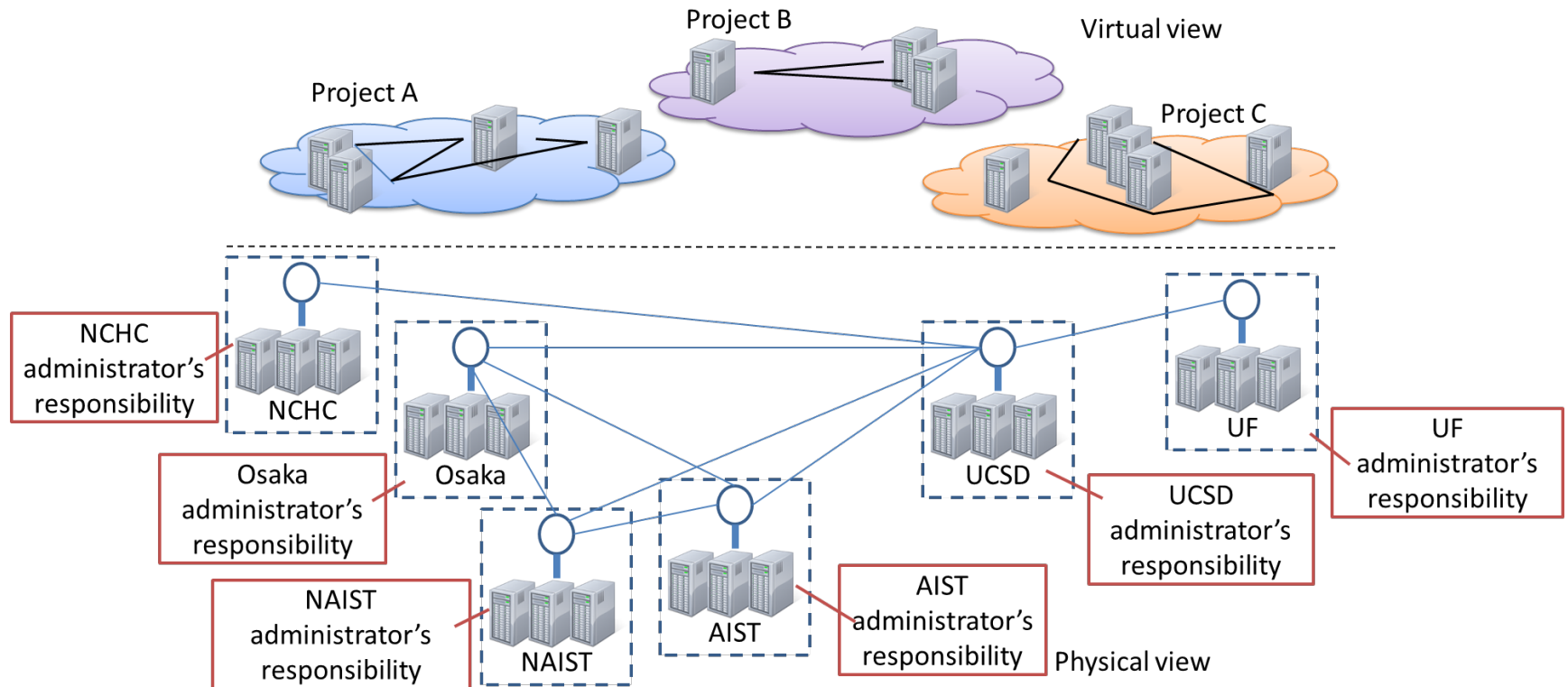
What PRAGMA-ENT provides

- **Multi-site virtual clusters** to experimenters
  - **Virtual machines**
  - **Software Defined Networking (SDN)-enabled network** which you can control as you like using OpenFlow
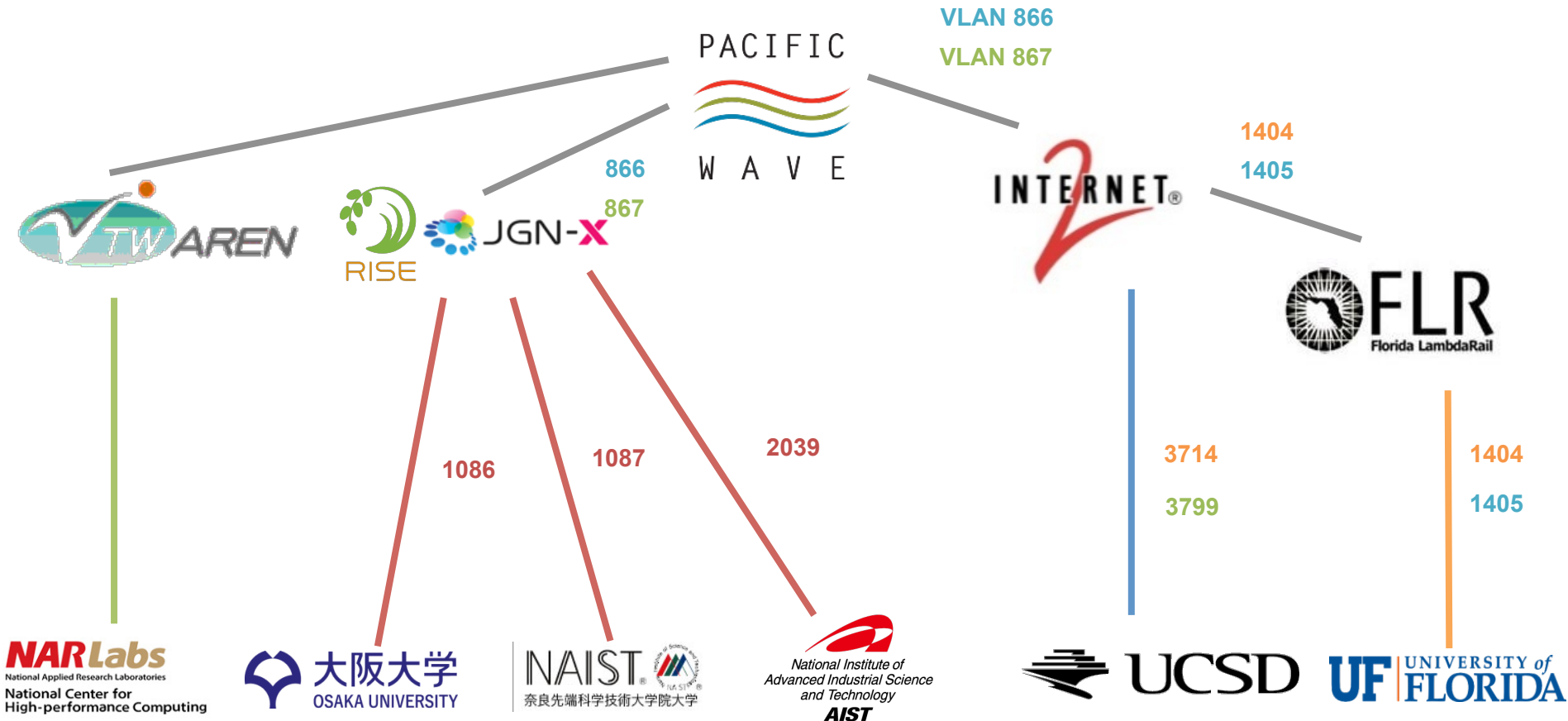

Virtual view

Physical view
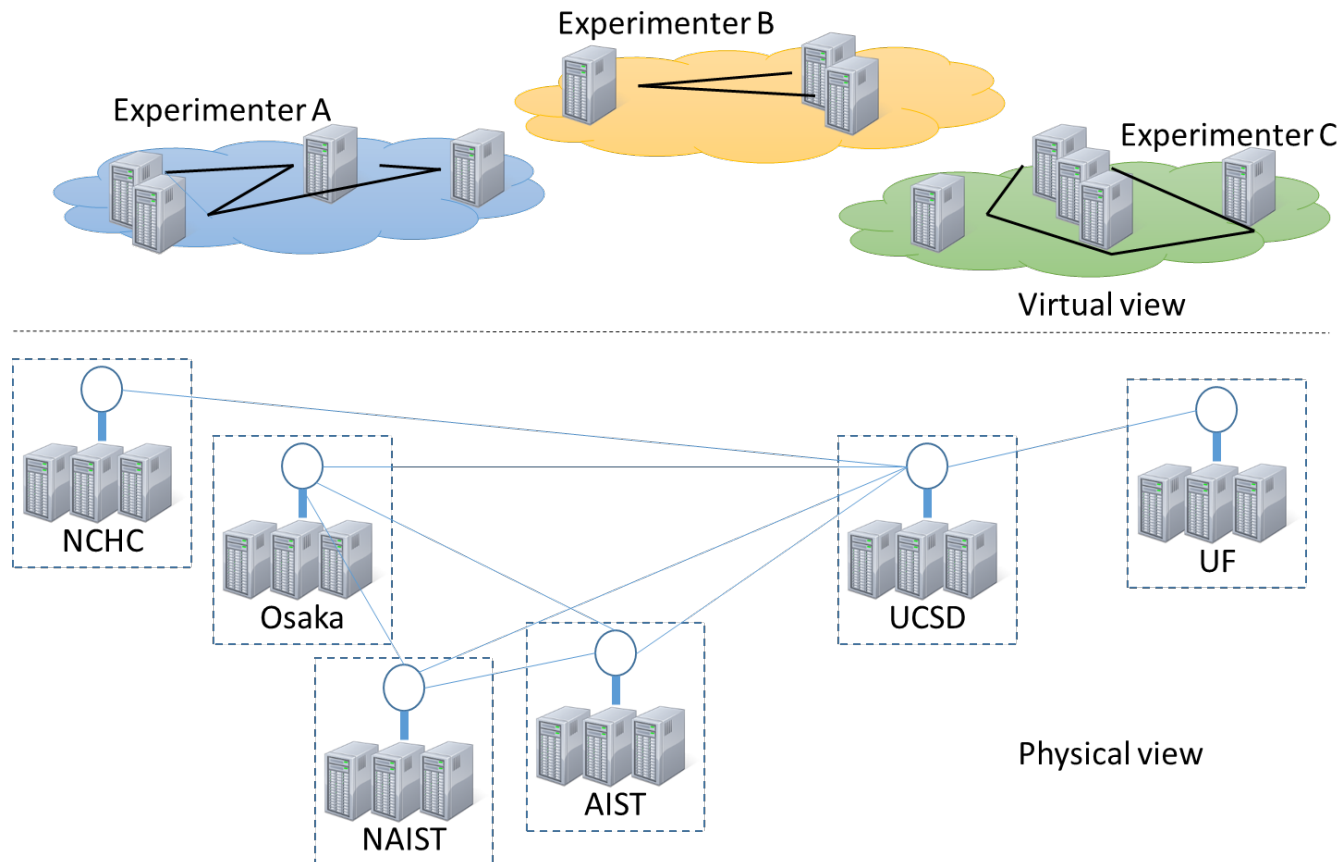
Distributed ENT Management

- No super-administrator
- How to federate multi-domain networks
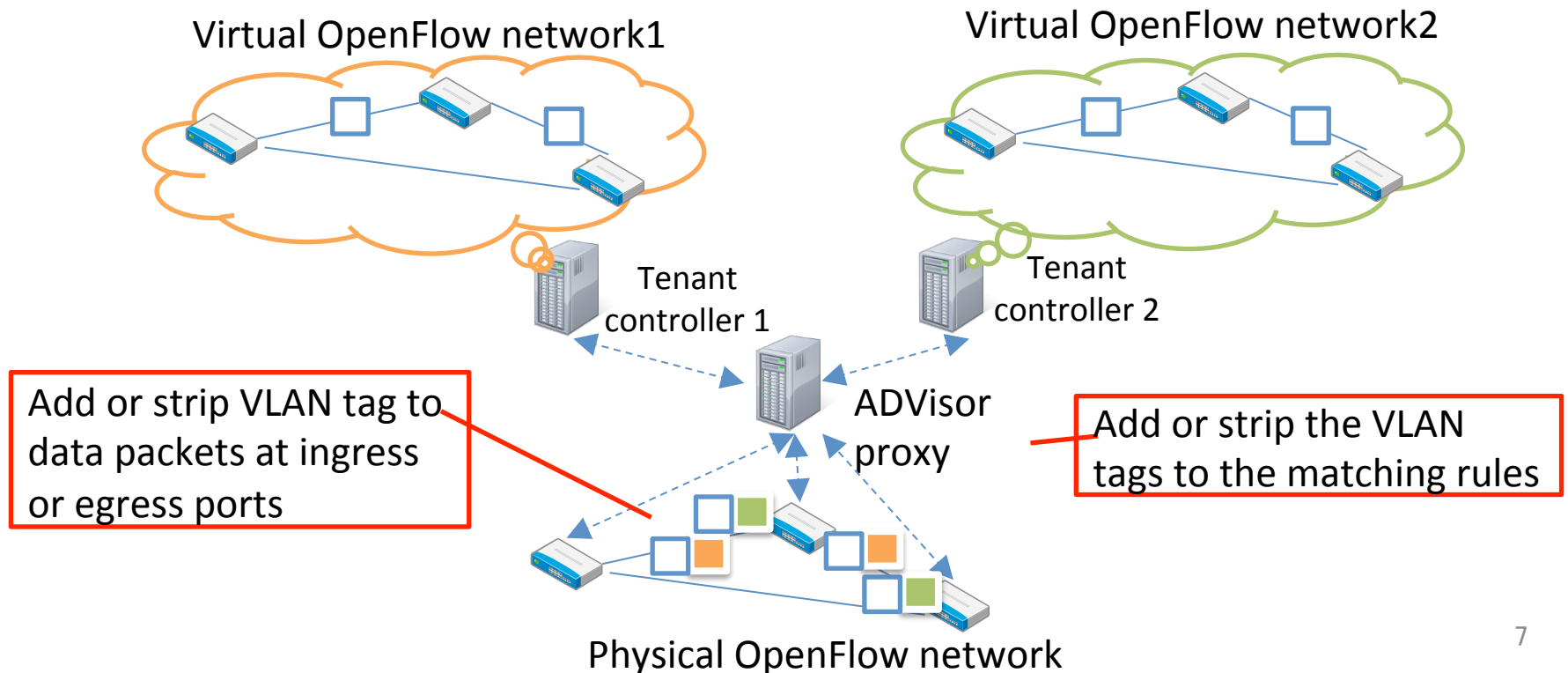
PRAGMA-ENT L2 backbone

- How to realize network virtualization without many VLAN configurations
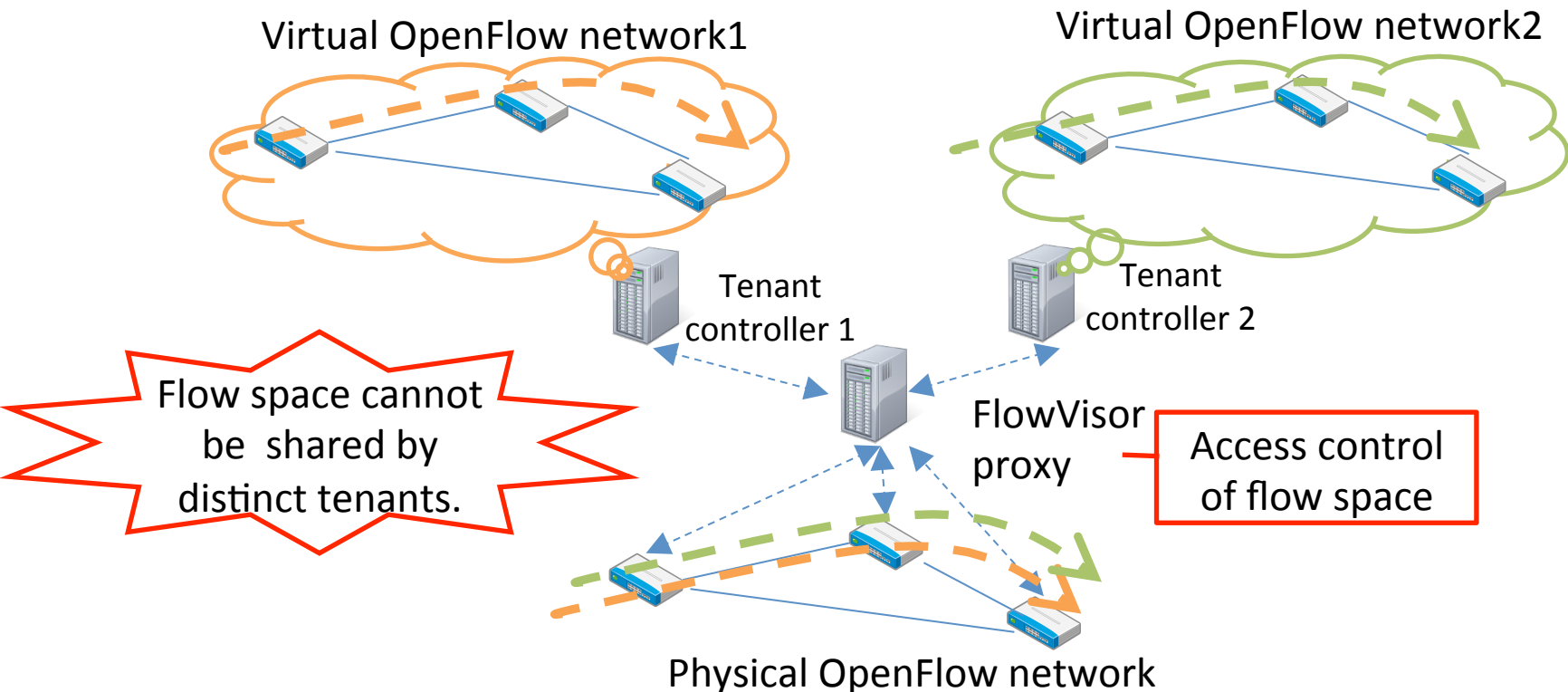
FlowSpace Firewall

- VLAN-based OpenFlow network virtualization
  - VLAN configurations per tenant in L2 backbone networks are required.

Virtual OpenFlow network1

Virtual OpenFlow network2

Tenant controller 1

Tenant controller 2

ADVisor proxy

Add or strip VLAN tag to data packets at ingress or egress ports

Add or strip the VLAN tags to the matching rules
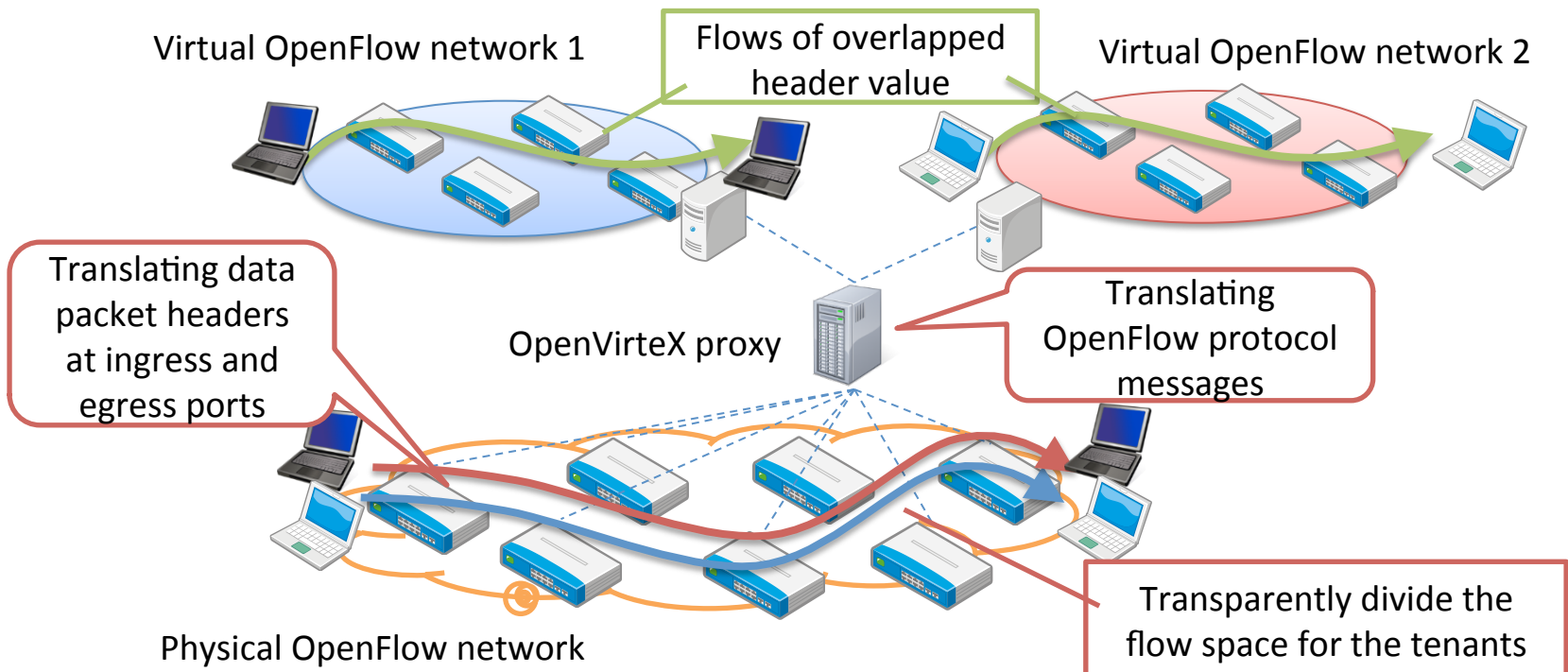
Physical OpenFlow network

FlowVisor

- Flow space (header address) division-based OpenFlow network virtualization
  - No VLAN configurations for each tenant
- Necessary to intermediate of the flow space division when tenants want to use same header address (e.g., dst TCP 80)
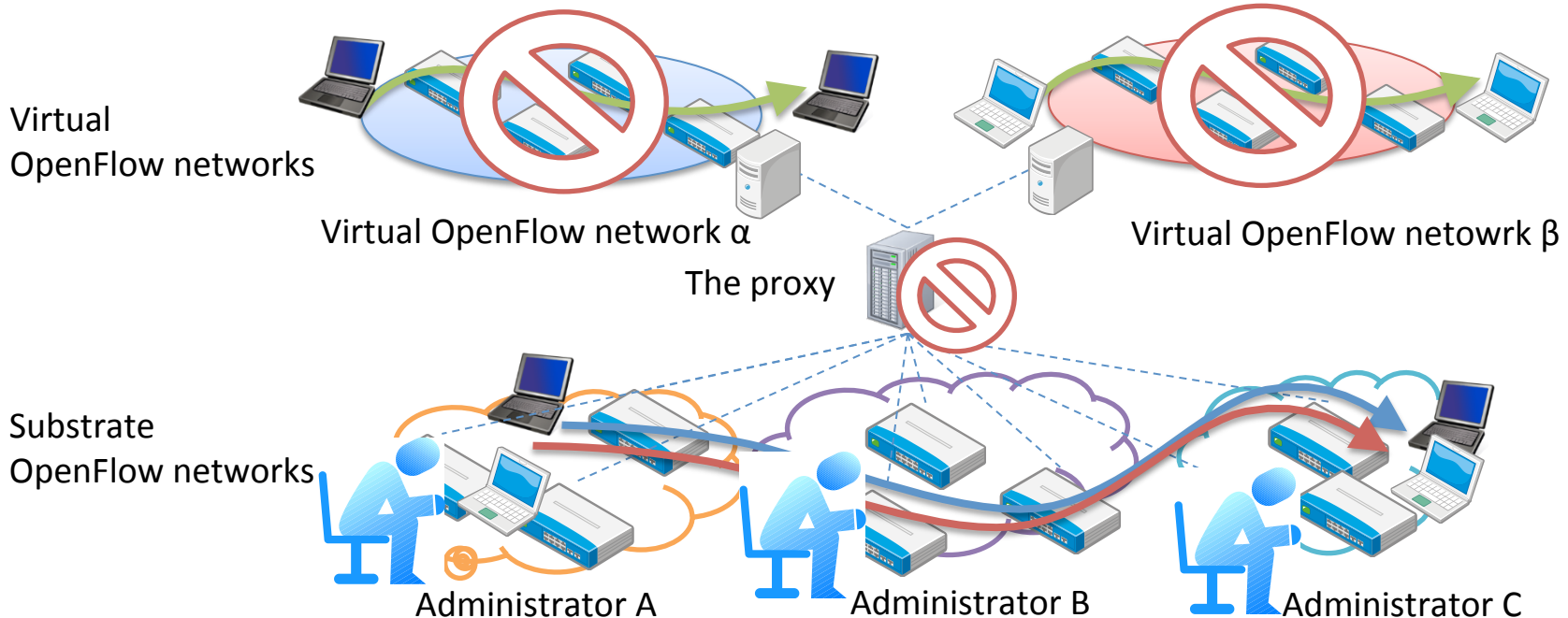
Virtual OpenFlow network1

Virtual OpenFlow network2

Tenant controller 1

Tenant controller 2

FlowVisor proxy

Flow space cannot be shared by distinct tenants.

Access control of flow space

Physical OpenFlow network

OpenVirteX

- OpenFlow network virtualization with flow space virtualization
  - Enabling to use overlapped header values in all virtual OpenFlow networks
- No need of mediation for the flow space division among tenants

Virtual OpenFlow network 1

Flows of overlapped header value

Virtual OpenFlow network 2

Translating data packet headers at ingress and egress ports

OpenVirteX proxy

Translating OpenFlow protocol messages

Physical OpenFlow network

Transparently divide the flow space for the tenants

Virtualization over Multi-domain Networks

- The single proxy architecture
  - Most of the existing techniques
- The single proxy has huge responsibility for all virtual networks
  - When the proxy is failure, it affects all virtual networks.

Virtual
OpenFlow networks

Virtual OpenFlow network α

The proxy

Virtual OpenFlow netowrk β

Substrate
OpenFlow networks

Administrator A

Administrator B

Administrator C

AutoVFlow Approach

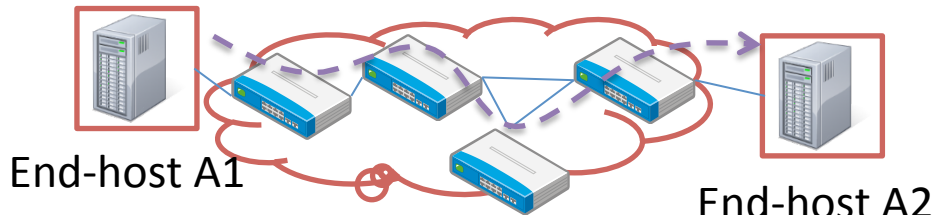- AutoVFlow: Autonomous Virtualization of OpenFlow networks
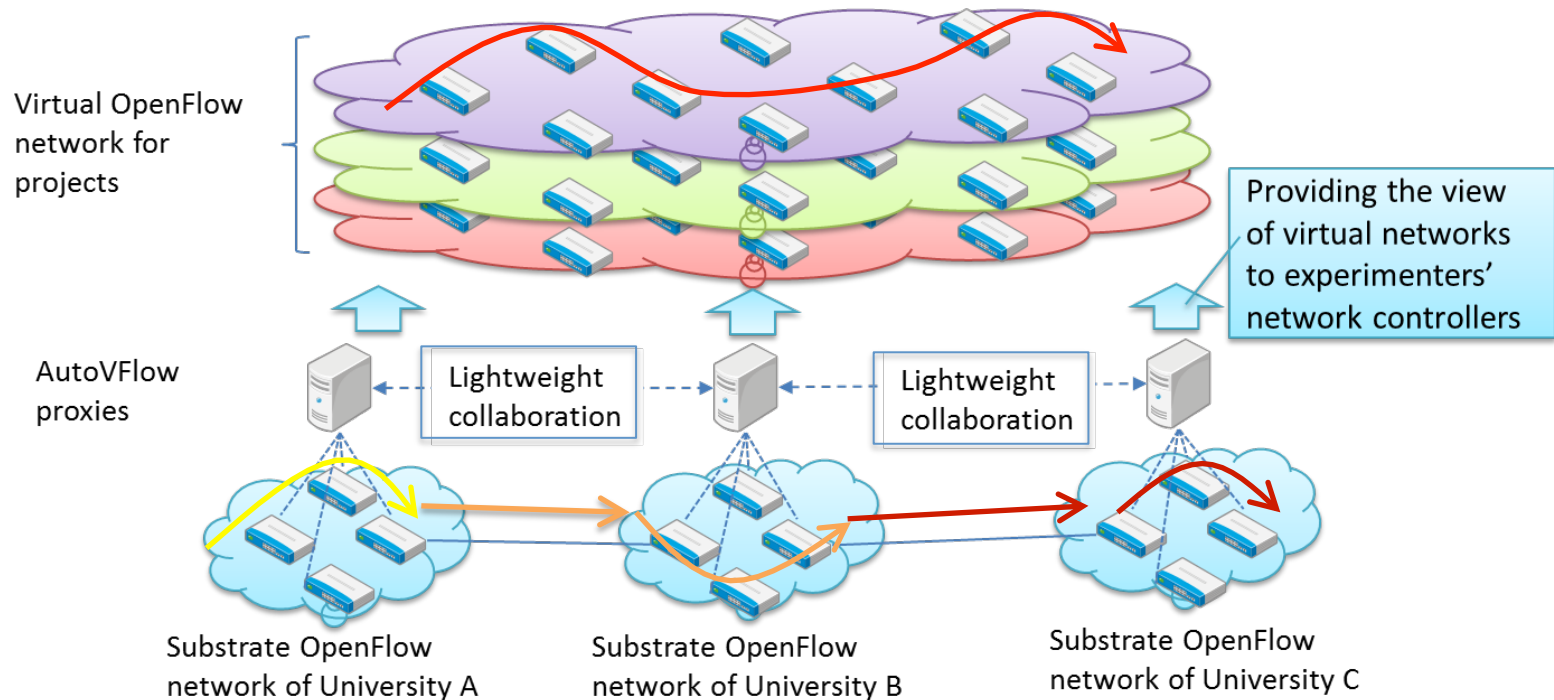
- Features:
  - Flow space virtualization
  - Autonomous federation of multi-domain physical OpenFlow networks
    - Information exchange between domains for header address virtualization
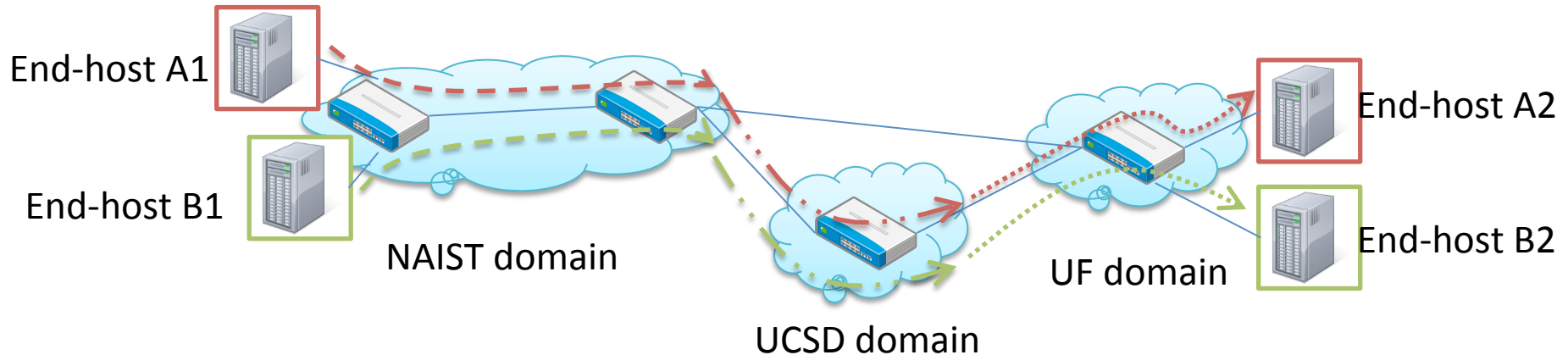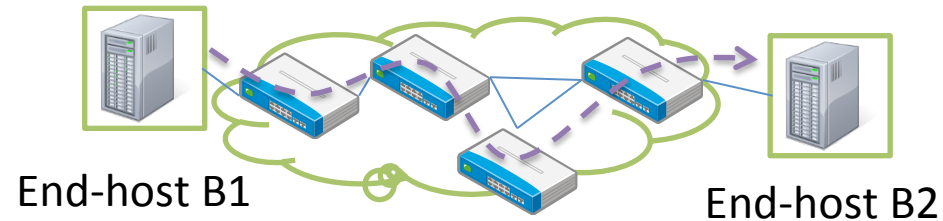
Demonstration 1

- Virtualization over multi-domain physical OpenFlow networks
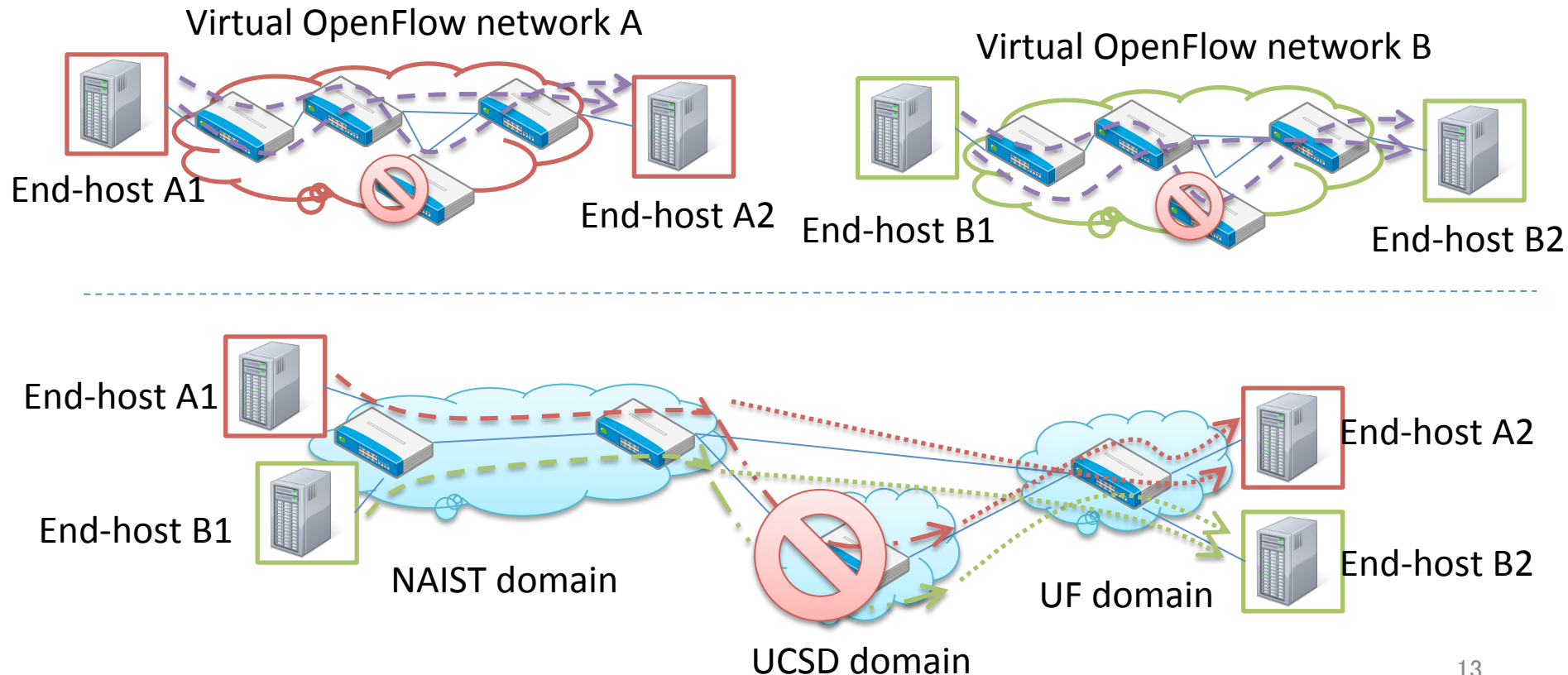
Virtual OpenFlow network A

Virtual OpenFlow network B

End-host A1

End-host A2

End-host B1

End-host B2

End-host A1

End-host B1

End-host A2

End-host B2

NAIST domain

UCSD domain

UF domain

Demonstration 2

- Autonomous federation of multi-domain physical OpenFlow networks

Virtual OpenFlow network A

End-host A1

End-host A2

Virtual OpenFlow network B

End-host B1

End-host B2

End-host A1

End-host B1

NAIST domain

UCSD domain

UF domain

End-host A2

End-host B2

Conclusion

- OpenFlow network virtualization in PRAGMA-ENT
  - No VLAN configurations per tenant
  - No super administrator for all resources
- AutoVFlow is suitable for PRAGMA-ENT.
  - Autonomous federation and virtualization of multi-domain physical OpenFlow networks
- Demonstration
  - Virtual OpenFlow networks over multi-domain physical OpenFlow networks
  - Autonomy of virtualization