

PRAGMA 27

PRAGMA Experimental Network Testbed (ENT)

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PRAGMA-ENT Goals

- Build a breakable international SDN testbed for use by PRAGMA researchers
 - By no means a production system
 - Complete freedom to access and configure network resources
- Provide access to SDN hardware/software to PRAGMA researchers
- Offer networking support for PRAGMA multi-cloud and user-defined trust envelopes

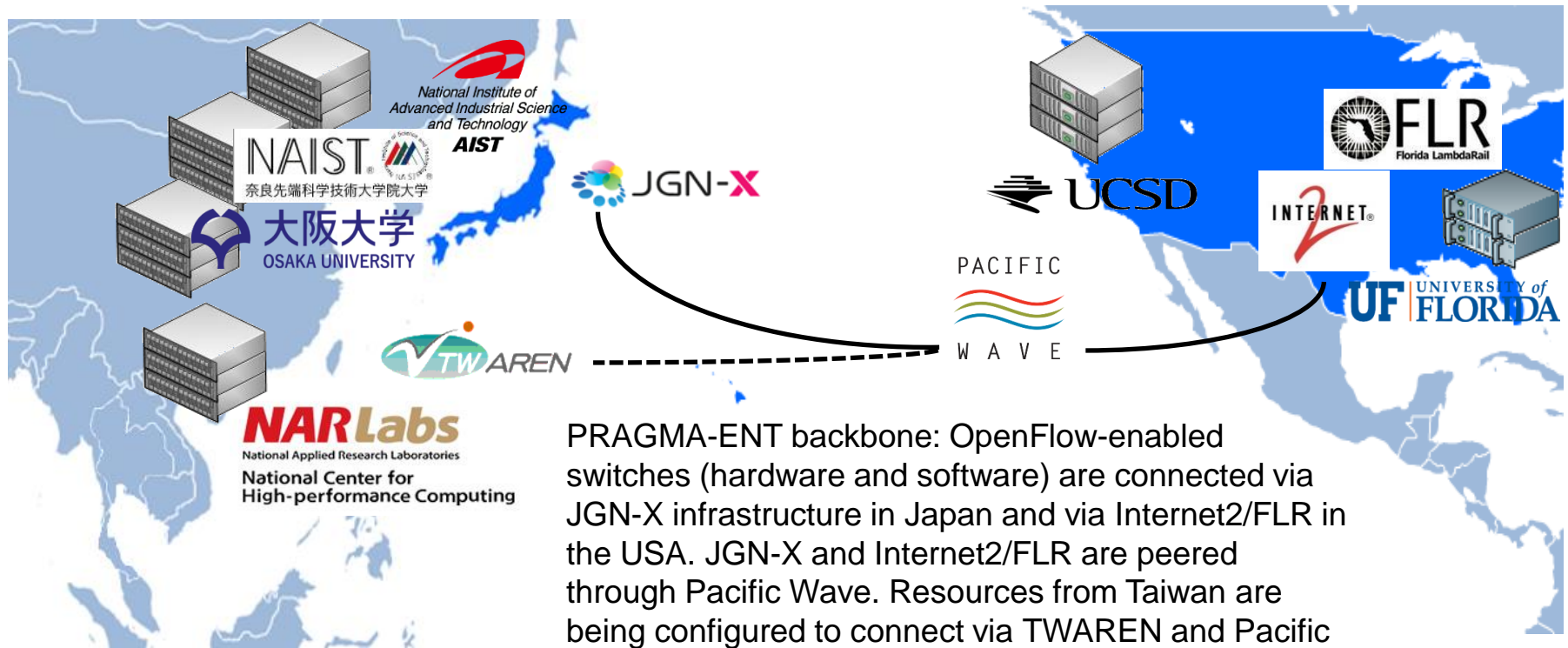
ENT Members

- Established in PRAGMA-25 (Oct-2013)
- Collaboration through pragma-ent@googlegroups.com and PRAGMA-ENT google drive.
 - If interested, please send join requests to tsugawa@acis.ufl.edu
 - 25 participants
 - 12 Institutions
 - Support from Internet2, NICT, FLR, Pacific Wave

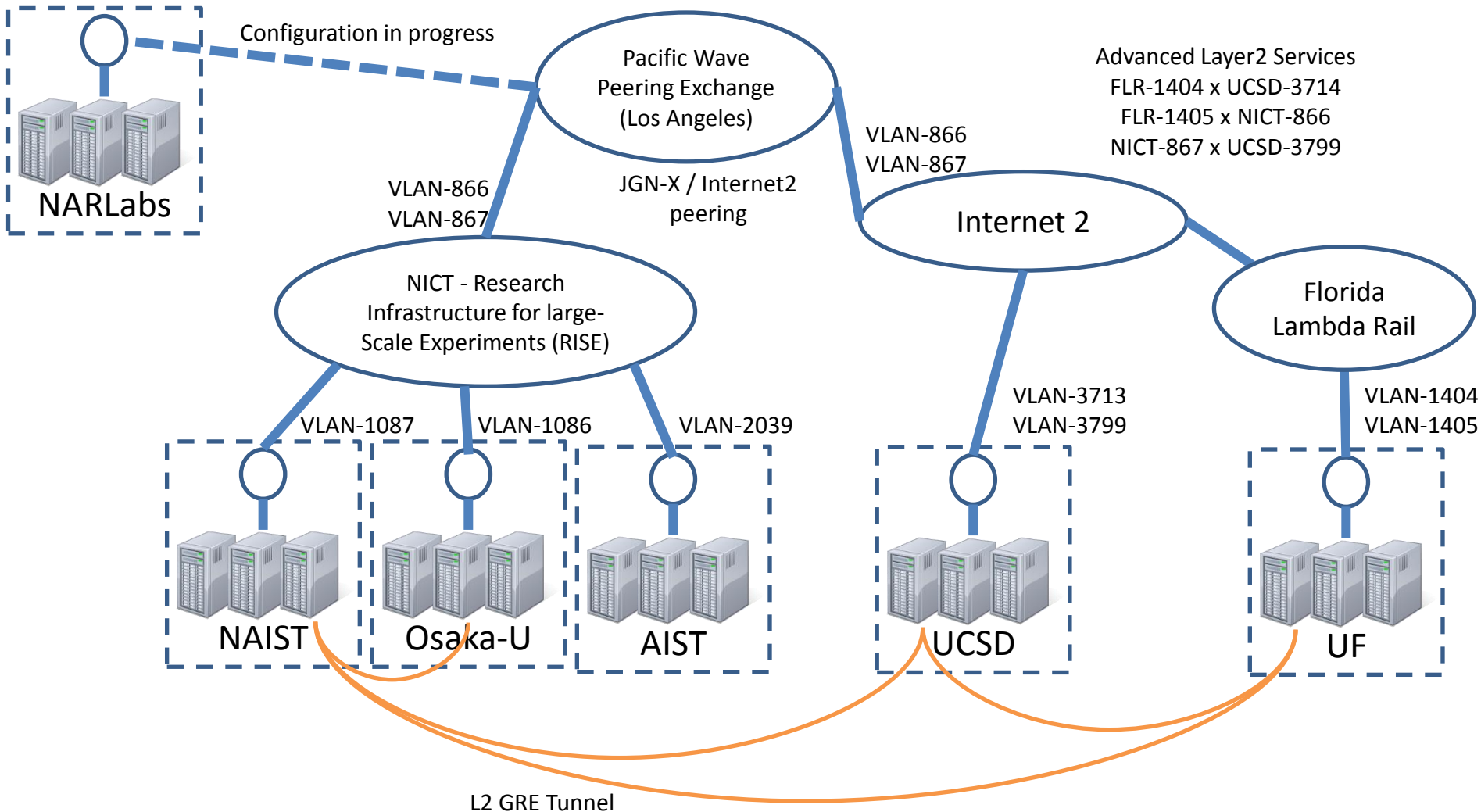
ENT Members

- University of Florida
 - Maurício Tsugawa
- Osaka University
 - Shinji Shimojo
 - Susumu Date
 - Yasuhiro Watashiba
 - Yoshiyuki Kido
- Nara Institute of Science and Tech
 - Kohei Ichikawa
 - Pongsakorn U-chupala
 - Chawanat Nakasan
- University of California, San Diego
 - Phil Papadopoulos
 - Luca Clementi
- Advanced Industrial Science and Tech
 - Atsuko Takefusa
 - Yoshio Tanaka
 - Jason Haga
- Indiana University
 - Jim Williams
 - Jennifer Schopf
- National Institute of Information and Communications Technology
 - Jin Tanaka
 - Hiroaki Yamanaka
- Jilin University
 - Xiaohui Wei
- Computer Network Information Center – Chinese Academy of Sciences
 - Ren Young Mao
 - Kejun Dong
- National Center for High-performance Computing
 - Fang-Pang Lin
 - Te-Lung Liu
 - Li-Chi Ku
- Kasetsart University
 - Putchong Uthayopas

ENT Backbone



ENT Backbone Configuration



ENT Expansion

Site with full hardware support:

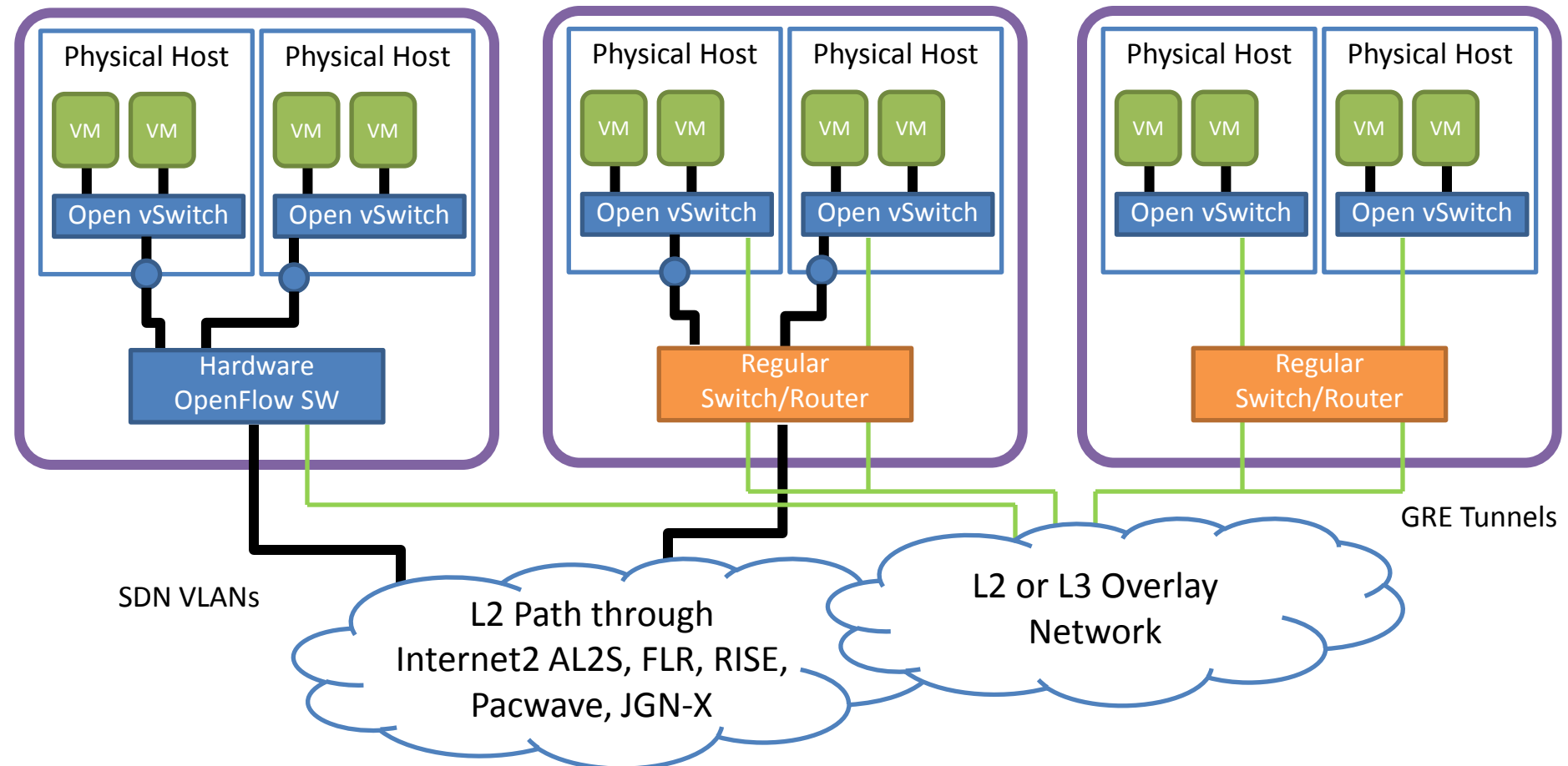
- Link to L2/VLAN
- OpenFlow-enabled switch
- UF, UCSD, NAIST, Osaka-U, AIST

Site with partial hardware support:

- Link to L2/VLAN
- NO OpenFlow-enabled switch

Site without hardware support:

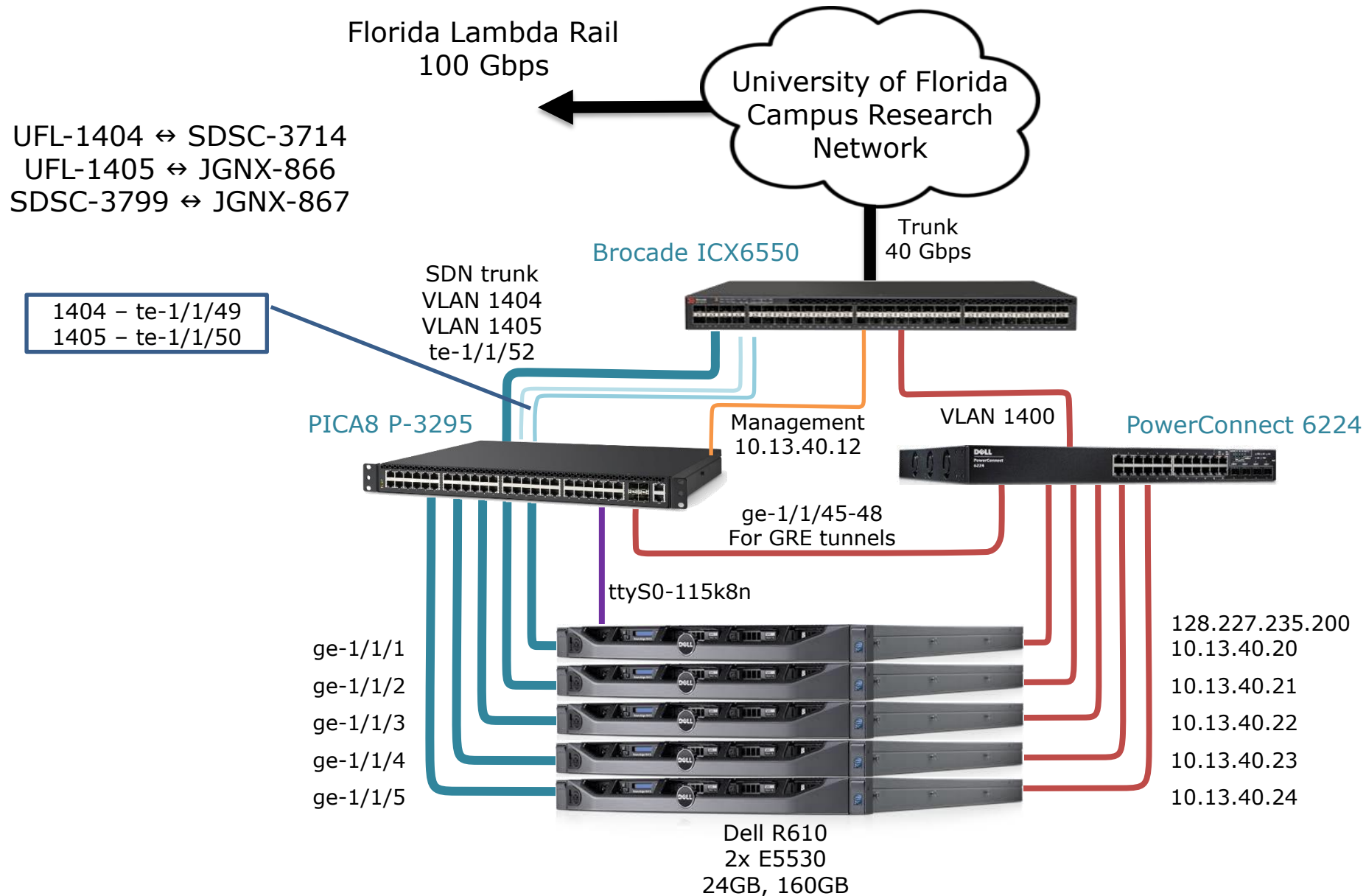
- NO Link to L2/VLAN
- NO OpenFlow-enabled switch



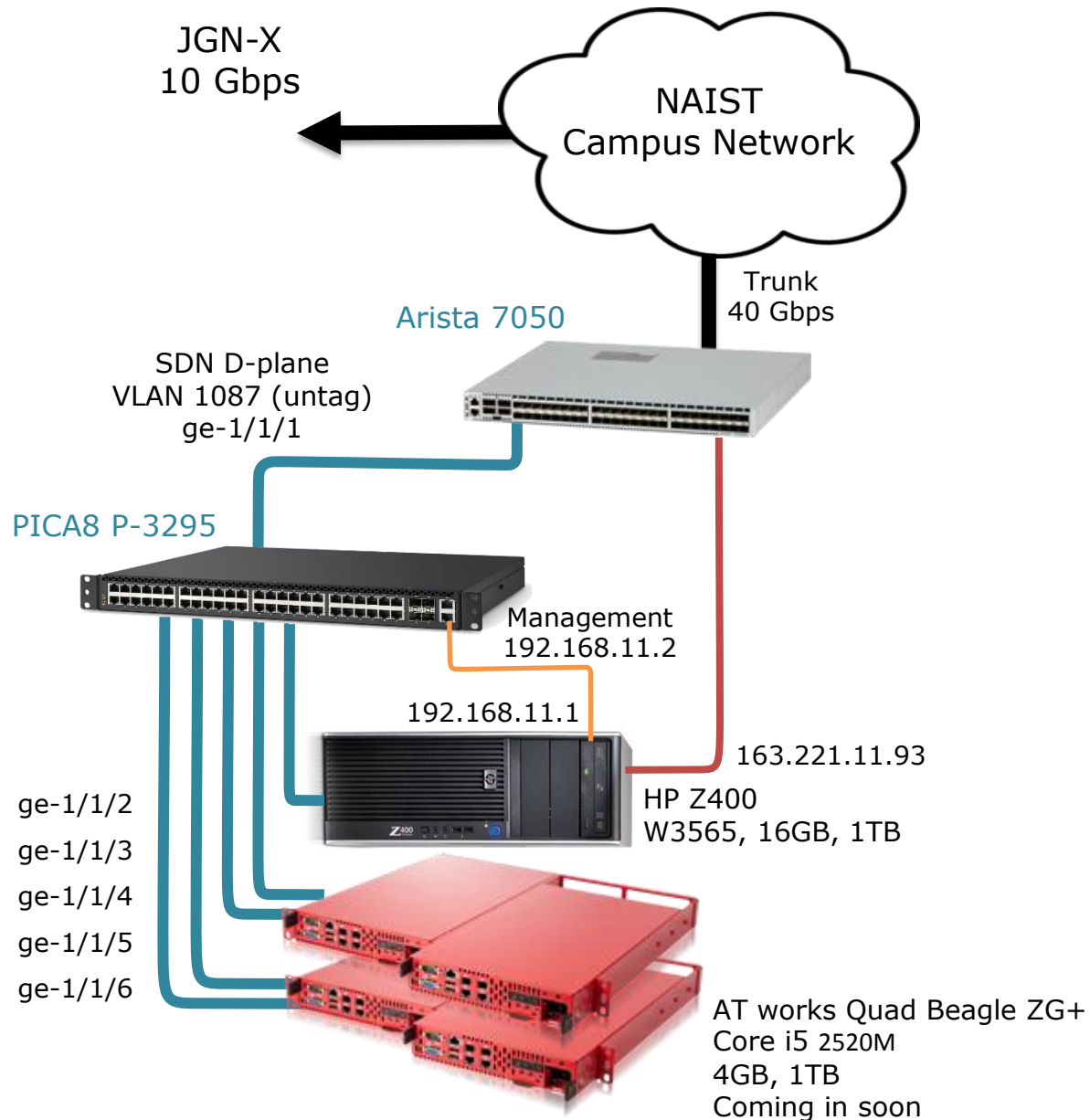
Resources

- L2 paths established through Internet2, FLR, JGN-X and Pacific Wave
 - VLAN-1404 (UF) to VLAN-3714 (UCSD)
 - VLAN-866 (JGN-X) to VLAN-1405 (UF)
 - VLAN-867 (JGN-X) to VLAN-3799 (UCSD)
- L2 paths established through JGN-X
 - VLAN-866, 867 (JGN-X) to the RISE OpenFlow switch in Tokyo
 - VLAN-2039 (AIST) to the RISE OpenFlow switch in Tokyo
 - VLAN-1086 (OsakaU) to the RISE OpenFlow switch in Osaka
 - VLAN-1087 (NAIST) to the RISE OpenFlow switch in Osaka
- OpenFlow-enabled Switches
 - PICA8 switch at UF, UCSD, NAIST, AIST
 - HP switch at Osaka-U
- Servers
 - 5 nodes dedicated to PRAGMA-ENT at UF
 - 8 nodes dedicated to PRAGMA-ENT at UCSD
 - 4 nodes dedicated to PRAGMA-ENT at NAIST
 - 4 nodes dedicated to PRAGMA-ENT at AIST
 - 5 nodes dedicated to PRAGMA-ENT at Osaka-U

UF Deployment

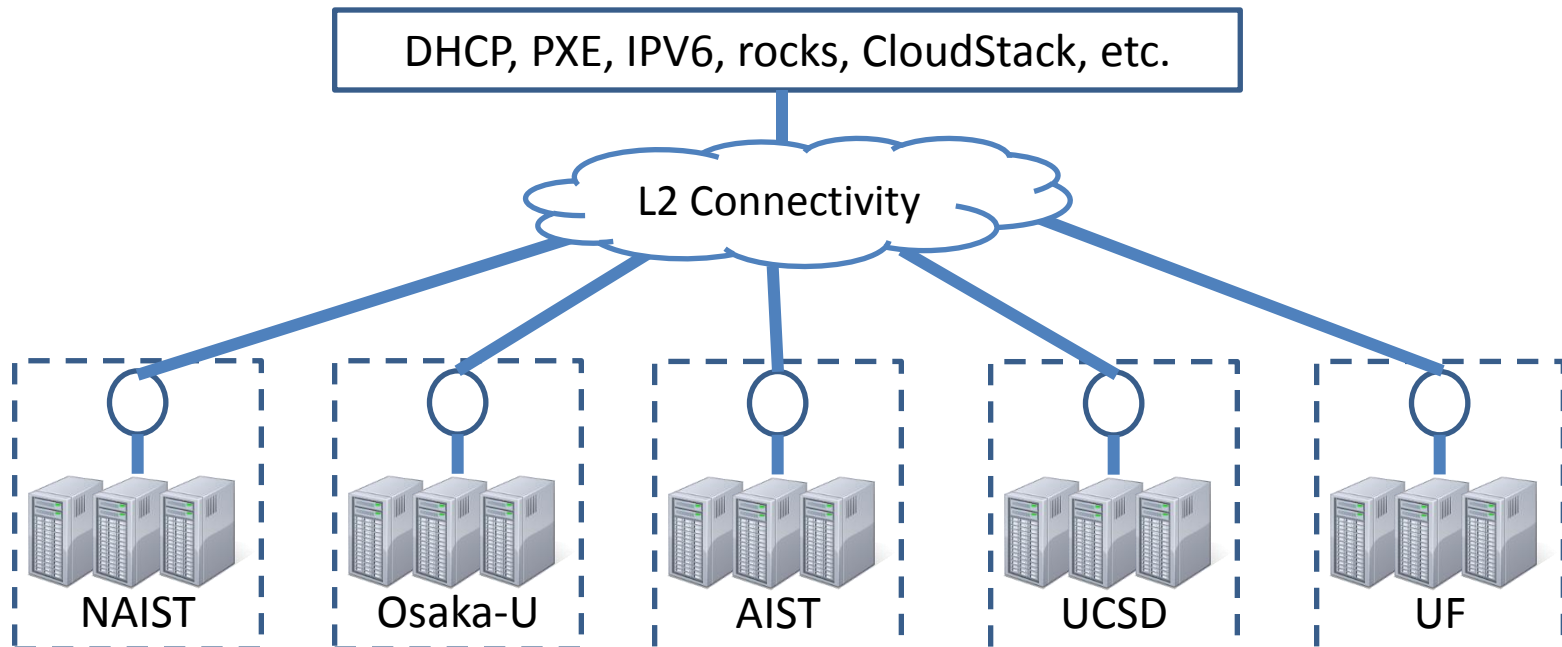


NAIST Deployment



Applications (1/4)

- Centralized control of multi-site resources
 - (Virtual) Cluster management (rocks front-end at UCSD successfully provisioned a VM at UF)
 - Cloud software (Cloud Stack, Open Stack, etc.)

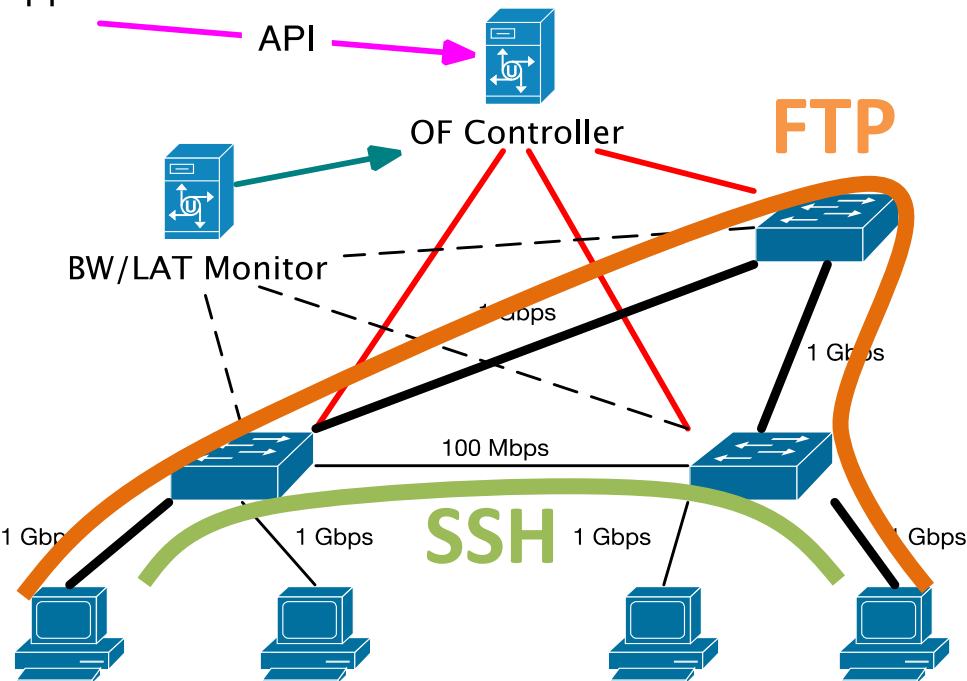


Applications (2/4)

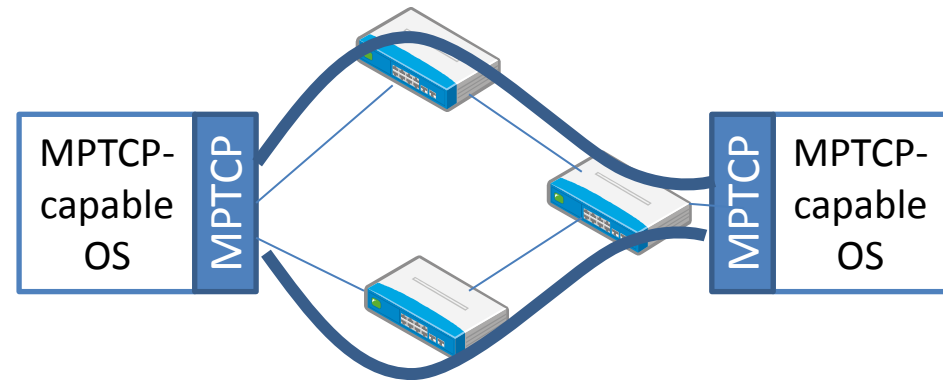
- L2 routing and optimizations
 - Bandwidth and latency-aware routing (demo on Fri.)
 - Multipath routing (demo on Fri.)

routing and optimizations

Applications



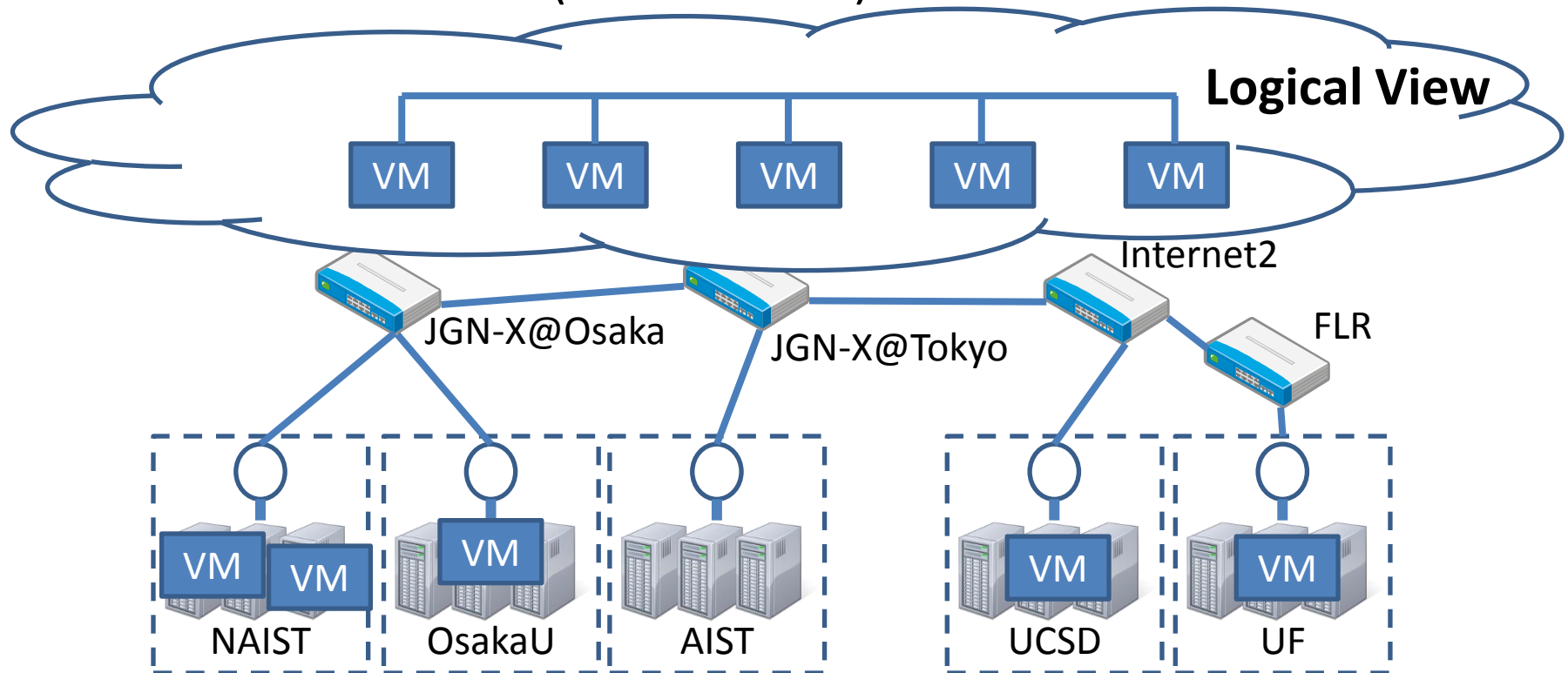
Multipath routing



Applications (3/4)

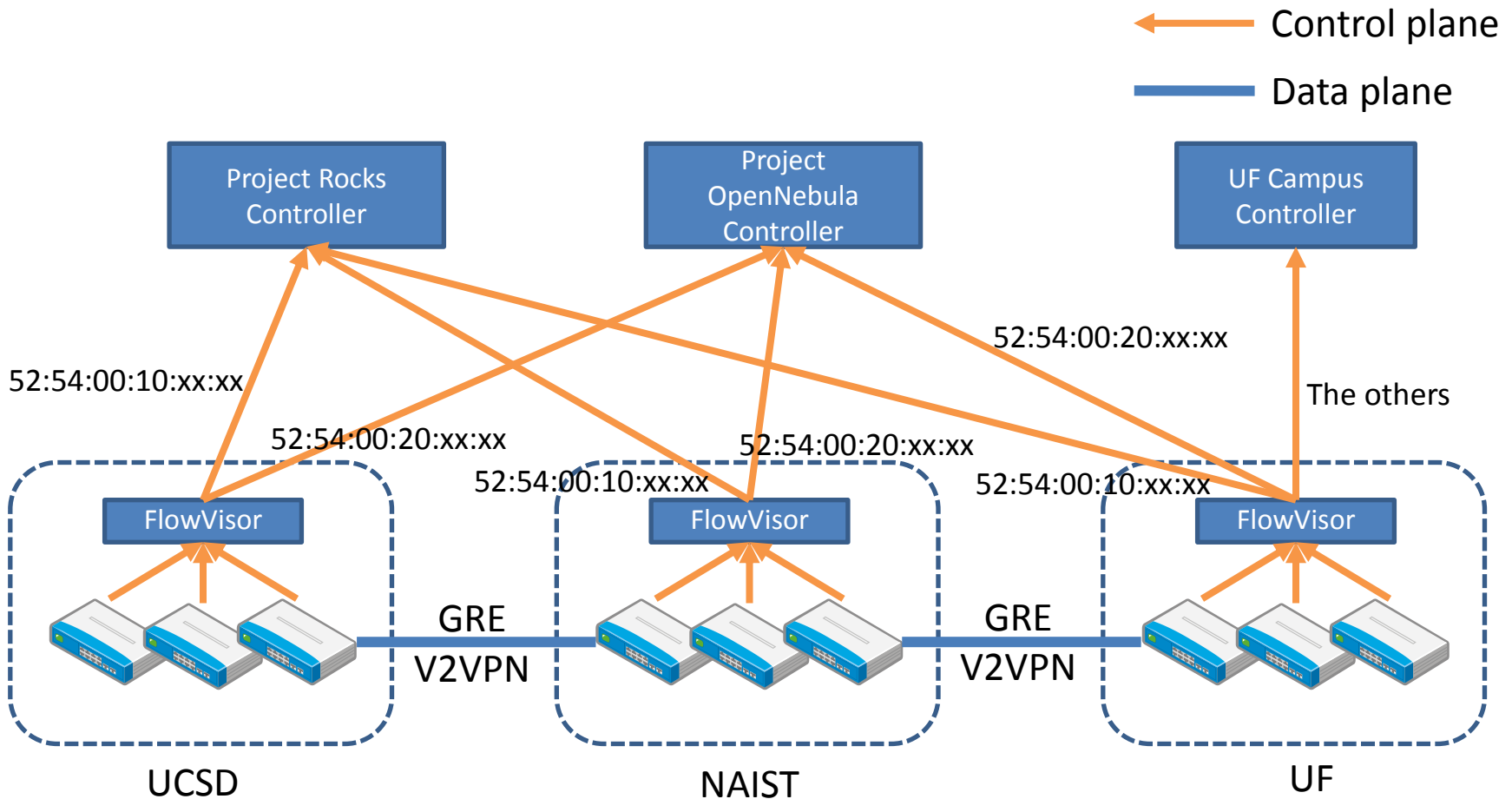
- Application using multisite resources
 - Pragma-ENT allows to provide a single L2 flat network for applications. This makes it easy for application users to use multisite resources simultaneously.

Dock simulation on ENT (demo on Fri.)



Applications (4/4)

- Network slicing (Multi-tenant/project network)
 - Slicing a network into multiple tenants using FlowVisor/FlowSpace Firewall/AutoVFlow



Future Directions

- Expand PRAGMA-ENT L2 connectivity
- Deploy overlay networks to manage GRE tunnels
 - Sites without L2 network reach will be able to join
 - Sites without OF switches will be able to join
- Applications/use cases