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Internet2

SDN – GLIF Implications and Opportunities



FALL 2012
INTERNET2 MEMBER MEETING

Philadelphia, PA
September 30-October 4

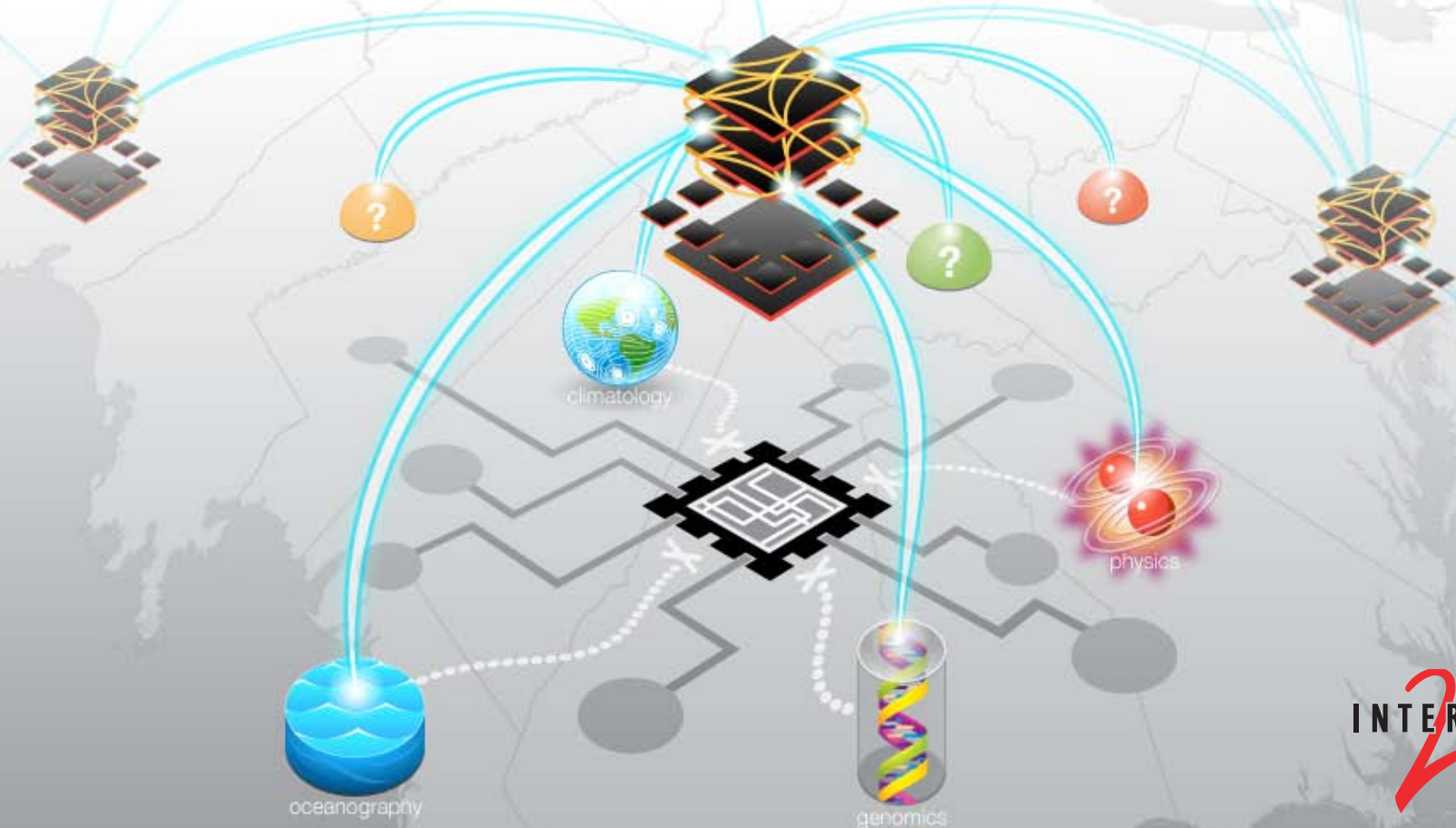
Overview

- Recent Developments at Internet2
- GLIF Context
- Role of GLIF Going Forward
- OpenFlow Session at FMM
- Challenge to GLIF

Components of Internet2 Innovation Program

- 3 components of the Internet2 Innovation Program:
 - Ubiquitous bandwidth and limited aggregation (100G)
 - Open up the network stack (support Software-Defined Networking)
 - Enable data intensive science (support for Science DMZs)
- Matches NSF/Research community call for investment
 - CC-NIE
 - Big Data
- Matches NSF, GPO, OSTP in the application space:
 - GENI RACKS
 - US Ignite

This is what we ~~want to be~~ **ARE** able to say: The **100G** testbed of innovation for tomorrow's Internet is available nationwide, right now. **The playground is open.**



Internet2 Service Layers

- Advanced Layer3 Service Network
 - 10 Juniper routers
 - Interconnected via bundles of 10G
- Advanced Layer2 Service Network
 - 14 nodes deployed (growing to ~35)
 - Heterogeneous (Brocade, Juniper, Cisco, ...)
 - Interconnected via 100G
- TR-CPS Network
 - 5 Juniper MX-960 routers
- Interconnects
 - 4x 100GigE and 6x 10GigE between L2 and L3
 - Expect 100G interconnects between L2 and Exchange Points

Advanced Layer 2 Service Policies

- Internet2 is committed to extending a policy-free approach within the Internet2 Advanced Layer 2 Service
- Each individual node should function like an “exchange point” in terms of policy, cost, capabilities
- Internet2 would like to position this service on the forefront of pushing “open” approaches in distributed networks.

Advanced Layer 2 Service Features (Now)

CORE

- 10G & 100G dedicated ports
- Heterogenous
 - Brocade, Juniper (underway)
- 7x24x365 production-quality support
- Robust evolution and regressive lab testing plan

VLAN PROVISIONING

- User (& backup) VLAN provisioning through GUI
- Ability to reach Internet2 Layer 3 Services
- Ability to reach International Exchange Points at 100G
- Interdomain provisioning to IDC Domains

APPLICATION INTERFACE

- IDC API
- OESS API
- Sherpa API

Advanced Layer 2 Service Features (Planned)

CORE

- Heterogenous
 - Juniper (Q1 2013)
 - Cisco (TBD)
 - Dell (DYNES sites, TBD)
- Virtualization via Flowvisor (Q1 2013)
- OpenFlow 1.3 Support (TBD)

VLAN PROVISIONING

- Multipoint VLANs (Q4 2012)
- Interdomain provisioning to NSI Domains (TBD)

APPLICATION INTERFACE

- NSI API (Planned)
- GENI API (Q2 2013)
- User OpenFlow Slice Support (Q2 2013)

INNOVATION TESTING ENVIRONMENT

- InCentre Participant (Q4 2012)
- ONS Participant (TBD)
- SDN Production Test Platform
 - NEC (Q4 2012)

Global context in which GLIF operates is changing very rapidly ...

- In April, 2011, Google announced that SDN was in production between all of its data centers and challenged industry to respond
- Last week, Internet2 launched a production, nationwide 15k+ route-mile OpenFlow-based 100G Advanced Layer 2 Service
 - Network operators and GOLE operators in this room today ... who can commit to doing the equivalent in the next few months?
- Internet2 has committed to supporting the full GENI API by Q2 2013
 - Network operators and GOLE operators in this room today ... who can commit to doing the equivalent in 2013?
- All of the major hardware vendors are implementing OpenFlow 1.0 and aggressively pursuing OpenFlow 1.3
 - They are focused on data centers ...
 - ... R&E community cares about WAN
 - Eric's Estimate: This will be the production “norm” by Summer 2013 ...
 - ... we have 9 months to make an impact while the vendors are still listening

Challenges GLIF Tech could tackle

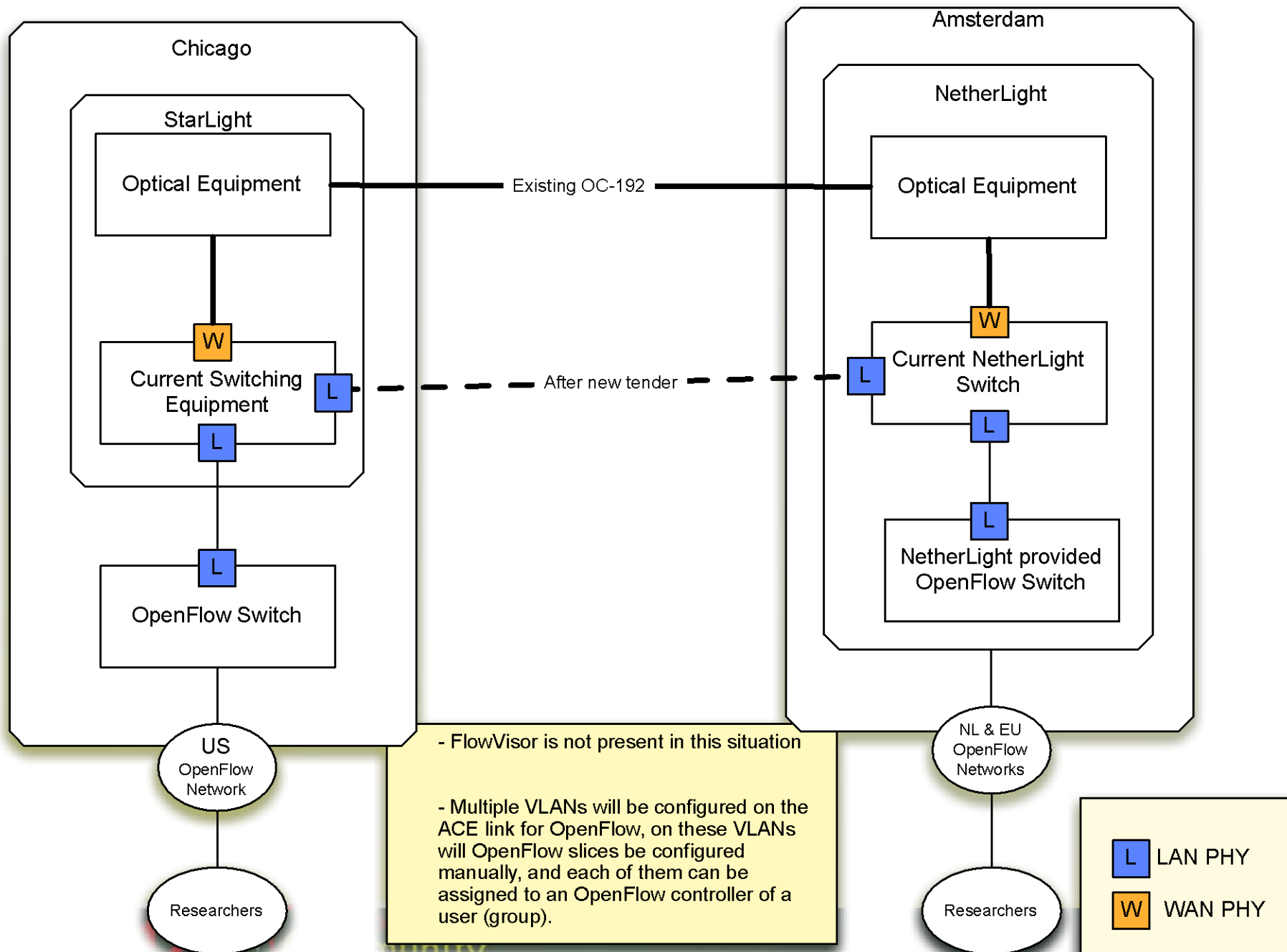
- Today: We can connect OpenFlow “islands” with Layer 2 VLANs ...
- Tomorrow: What does it mean to “peer” OpenFlow domains?
 - Start with the use case, then worry about what protocol to share the data
 - e.g., different domains have different flow mod rules ... what would you do differently if you knew your peer network’s controller state?
- Today: We know how to create a “network research service” within a single domain
- Tomorrow: What does a multi-domain “network research service” look like?
 - Difference between allocated BW and allowing researchers to rewrite the forwarding tables on the switch
 - GPO: “Slice around the world” ... implement “peering” between OpenFlow domains across GLIF (no VLANs in between)
 - Network virtualization in a multidomain context?
- What else?

OpenFlow session at FMM

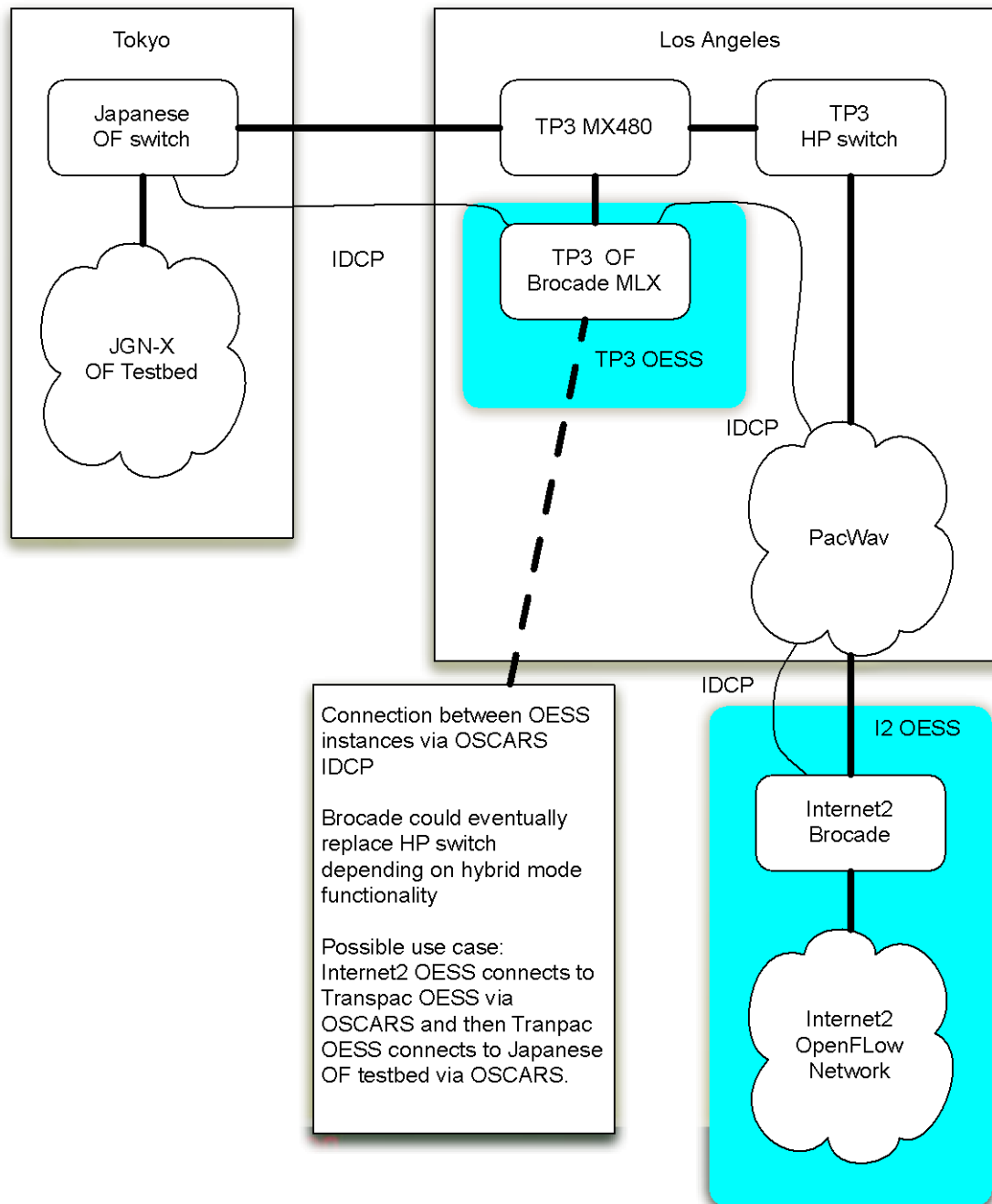
- Discussion at FMM:
 - Topic: Equipping ACE and TP3 circuits to support OpenFlow.
 - Organized by Jim Williams
 - Participants:
 - Providers
 - Researchers
- Goal: Provide a facility allowing testing of any techniques for allowing distinct Open Flow Aggregates/Domains to interact:
 - Build interdomain slices?
- Very enthusiastic response.
 - Very interested in using FlowVisor over these links.

Interdomain OpenFlow

- Plan:
 - Start with using OESS to interconnect.
 - Interconnects using VLANs.
Still a need to protect production traffic on the link.
 - Recognizing the limitations of the current circuit
Currently SONET
Retender the circuit as a LAN PHY
 - Move as quickly as is feasible to using FlowVisor (Q1 2013)
- Timeline
 - October, 2012: Initial OESS connectivity
 - Late 2012 / Early 2013: Retender
 - Q1 2013: Move to FlowVisor based system



Phase 1
Possible solution using OESS



Challenge to GLIF community

- Today
 - 100G Interconnects
 - Production SDN
- Tomorrow
 - Network research service on production networks/GOLEs
 - Today's network research environment is tomorrow's application development environment
- Open Questions
 - What does it mean to “peer” OpenFlow domains?
 - Start with “what would we share” and “why”
 - Worry about the protocol (extension? new?) later
 - What does a multi-domain “network research service” look like?
 - What does it mean to “peer” Flowvisor instances?
 - ?
- Suggestions
 - Commit to doing what we know how to do on a global scale
 - Put together a SDN-focused Task Force to define / answer open questions

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