GENI and Internet2
Supporting the Network Research Community across the Internet2 Network
Eric Boyd, Internet2
Overview

• Internet2 Innovation Program
• Internet2 Advanced Layer 2 Service
• Recent Improvements to Internet2 support of GENI
• Internet2 and GENI – Moving Forward Together
Partnership leads to innovation

Internet2
Community & Staff

Community

NSF

Indiana University

ONRC Research

geni: Exploring Networks of the Future
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 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
  - 5 node advanced test network (NEC)
- Advanced Layer1 Service Network
  - Only 10/40/100G capable Layer 1 Service in the US
  - 88 channels of 100G capability
  - 56 Add/drop and flexibility to add more
- 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
Long-term Architectural Aspiration

Software Defined Networking

- R&E IP
- TR-CPS
- Layer 3 IP Network
- Static Layer 2
- Dynamic Layer 2
- GENI Experiments
- GENI
- ???

- Traditional Services
- Innovation Services

- Software Defined Networking Substrate

- Optical System

- Dark Fiber
Software Stack —

Today
Software Stack — Q1 2013
Software Stack — Future
Software Stack — Not fully baked
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)
Current GENI Mesoscale infrastructure
Current GENI Mesoscale infrastructure

GENI interconnectivity in a representative city, for example, Washington, D.C.
Current GENI Mesoscale infrastructure

- 5 existing 1 Gig connection to the IP network
- 4 New 10G interconnects in multiple cities.
- Open Flow AL2S network
- Multiple interconnects between the 2 infrastructures
- Peering

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Today, the campus/regional/national backbone is used *to get to* the GENI infrastructure.
Internet2 and GENI Tomorrow

Tomorrow, the campus/regional/national backbone implements the GENI infrastructure
Internet2 and GENI

- GENI environment implemented on the Internet2 backbone
  - **Today**: The campus/regional/national backbone is used *to get to* the GENI infrastructure
  - **Tomorrow**: The campus/regional/national backbone *implements* the GENI infrastructure

- Software and operational environment of GENI is supported in a production environment
  - **Tomorrow**: Aggregate manager API, dynamic stitching, instrumentation and measurement API
  - **Next Day**: GENI environment continues to evolve to meet needs of network research community
GENI AND INTERNET2
SUPPORTING THE NETWORK RESEARCH COMMUNITY ACROSS THE INTERNET2 NETWORK

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Eric Boyd, Internet2