NETWORK SERVICES TODAY

George Loftus, John Moore, Paul Howell, Bill Lytle
Internet2 Network Services
Today’s Session

- Network Business Relationship Management, George Loftus, AVP, Network Services
- Network Security, Paul Howell, Chief Cyberinfrastructure Security Officer
- Network Architecture and Planning, John Moore, AVP, Network Architecture and Planning
- Network Operations, Bill Lytle, AVP, Network Operations
- Operations Excellence Community Steering Team, George Loftus, AVP, Network Services
Network Business Relationship Management
Business and Relationship Management

- Work with members and potential members to support their requests for services including contracting, accounting, member support, and program management and service upgrades/augments
- Assure products and services are in line with member and partner requirements, delivering the value that members expect
- Support community engagement activities with regional partners and national anchor tenants
- Manage marketing, communications and member satisfaction within network services
- Develop opportunities to provide services to aligned industries and government agencies
New 100G Connections

- Merit, Inc., Southfield
- Nevada System of Higher Ed, Las Vegas
- Nevada System of Higher Ed, Reno
- Northern Lights Gigapop, Minneapolis
- NOX, Albany
- University of Illinois Urbana-Champaign, Chicago
- University of Pittsburgh, Pittsburgh
Connector Upgrades to 100G

- Indiana GigaPOP, Indianapolis
- KyRON, Louisville
- MAX, Ashburn
- NYSERNet, Buffalo
- Oregon Gigapop, Portland (2)
- OARnet, Cincinnati
Other New Connections

- U.S. Department of Agriculture, 100G, Kansas City
- U.S. Department of Agriculture, 100G, Sunnyvale
- Federal Drug Administration, 100G, McLean
- Syngenta, 10G, Ashburn
Global Services in Support of Research and Education

Internet2 can provide advanced IP services and dedicated VLAN circuits to 71 research and education networking partners in 100+ countries across the globe.
Network Security
Network Security

• Mission
  – Defend the network from attacks

• Approach
  – Enable Internet2 leadership to proactively mitigate security risks that jeopardize the Internet2 network
  – Working together with connectors/regionals and members to collectively protect the National Research and Education Networks
Baseline Security Risk Assessment

- Completed in January 2015
  - Examined Internet2 network and Network Operations Center

- Initial risk assessments often reveal a number of gaps
  - Absence of a planned security program leads to an inconsistent security posture

- Assessment results revealed that the Internet2 network was at considerable risk from a targeted attack

- Work began in May 2015 on improvements to policy, processes, and technical countermeasures with completion slated for end of 2016
Security Risk Assessment Approach

1) Gathered Information
   - NIST SP 800-53 Security & Privacy Controls – Medium (268 questions)
   - Technical interviews of engineers
   - Reviewed logs, policies, configurations, visited COLO and Level3 NOC

2) Identified Threats and Vulnerabilities

3) Analyzed Risks

4) Implemented Corrective Actions
### High Potential Threat

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<thead>
<tr>
<th>Security Assessment and Authorization</th>
<th>Initial</th>
<th>Planned</th>
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<tr>
<td>Security Planning and Privacy Impact</td>
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<td>Audit and Accountability</td>
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<td>Incident Response</td>
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<td>Identification and Authentication</td>
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### Medium Potential Threat

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<th>System, Communications and Availability Protection</th>
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<td>System and Information Integrity</td>
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<td>Access Control</td>
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<td>Awareness and Training</td>
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<td>Physical and Environmental Protection</td>
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### Low Potential Threat

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<td>Contingency Planning</td>
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<td>Maintenance</td>
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<td>Contingency Planning</td>
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<td>Media Protection</td>
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<td>Personnel Security</td>
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<td>System and Services Acquisition</td>
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#### Percent of Controls Implemented

- **100%**: Satisfactory
- **90%**
- **80%**
- **70%**
- **60%**
- **50%**
- **40%**
- **30%**
- **20%**
- **10%**
- **0%**

Ref NIST 800-53
Key Improvements Completed

• Reduced the number of staff from 100 to 28 that have administrative privileges to network systems (routers/switches/controllers)

• Improved user authentication by using two-factor authentication on the network systems (routers/switches/controllers)

• Removed operationally sensitive information (e.g., IP addresses of AuthN servers) from public view

• Designed an out-of-band secure management network

• Dedicated security team formed

• Developed security operations capabilities including security log analysis
Summary

• Leadership of Internet2 are committed to appropriately protecting the network

• Security improvements are a high priority

• Key improvements to the security posture have been completed

• Additional improvements underway are on schedule

• When completed, the network will have a security posture determined by leadership and will have a sustainable security program in place
Internet2 Network Plans
Topics

- Network Upgrade Project: 2016-2017
- Next Stage Network Evolution: 2018-2020
Overarching Goals

- Align network services portfolio with evolving community needs
- Develop deeper partnerships where we can achieve significant mutual benefit
- Provide leadership in the network services landscape
Network upgrade starting in 2016
Current Architecture

• Advanced Layer 2 Service (AL2S) is a key foundational network service
  – Supports all higher layer services (Connector backhaul, R&E IP backbone, Peering)
  – Provides Layer 2 open exchange for direct member collaboration

• AL2S is built using SDN principles, specifically using OpenFlow protocol
  – Deep programmability mainly used by network and systems research community
  – Production use mainly for flexible user provisioning

• We’ve learned a great deal over the last several years about our community’s diverse requirements, and the challenges in serving those needs
Current Issues

• Vendor support for OpenFlow has softened
  – The market is embracing SDN, but is moving away from OpenFlow in the service provider core
  – This has hampered our ability to support the network research community due to lack of features and ability to evolve the service

• Conflicting goals between production and network research use
  – Network research community demands agile support for experiments
  – Community business and discipline research needs require us to evolve to follow standard IT Service Management processes
Current Issues

- Traffic volumes have increased
  - Nice problem to have. However….
  - AL2S as the foundation of other services creates complexity between the service layers that hampers our ability to manage growing demand
  - After some reflection, we see an opportunity to make adjustments with an aim towards simplification
Upgrade Goals for 2016-17

- Modify the core of the network
  - Remove dependency on OpenFlow in the core
  - Build a rock-solid, production, single vendor, MPLS-based core - *use Juniper*
  - Maintain existing customer service view: *feature parity*
- Provide a more agile platform for the network and distributed systems research community in an “overlay”
  - Support SDN capability, including OpenFlow
- Simplify architecture and increase visibility for planning purposes
  - Strive to cut maintenance, power and co-lo costs
- *Position us to be more innovative and responsive to community needs as we plan for 2018-2020*
Overlay for network experimentation

- Build partnerships to allow us to provide the community a platform for network experimentation
  - OpenFlow 1.0 to start, OpenFlow 1.3 soon to support GENI and other uses
  - Sync with the goals of the network and distributed systems research community

- Evolve Internet2 software components – both core and overlay
  - Customer portal (OESS) and virtualization (Flow Space Firewall)
  - Support network experimentation in the overlay much as we do today
  - Support some degree of user provisioning in the core
Transition Planning for 2016-2017

- Process
  - Phase 1: Swap hardware with existing functionality
    - Consolidate to achieve higher efficiency
    - Targeted to be complete by end of Q3 2016
  - Phase 2: Bring up new MPLS core and migrate
    - Bring up SDN overlay platform
    - Implement critical path software changes
    - Targeted to be complete by end of Q4 2016
  - Phase 3: Cleanup Tasks
    - Complete by Q2 2017
- Budget: ~$5-7M in capital for core and research support platforms
  - Key planning metric is to keep opex within reasonable margins
Community Input

- Internet2 Network Technical Advisory Committee (NTAC)
- MPLS Working Group
  - Leverage community experience with MPLS
  - Chaired by Brad Fleming (KanREN)
- Programmability Working Group
  - Leverage community experience with using the OESS portal
  - What services are needed on the core network?
  - Chaired by Michael Lambert (3ROX)
What comes next?
2018-2020: Network Refresh Planning

• The Opportunity
  – The Internet Board of Trustees has given us spending authority to plan for a network refresh in 2018
  – This planning horizon gives us the time to engage the community in a deep conversation about what they want and need from the Internet2 network

• Broad outreach conversation with the community
  – Managed through Network Architecture, Operations and Planning advisory group
  – Understand community priorities:
    – Be in sync, lead in key areas where it makes sense
  – Experiment with better ways to work together
    – “National Network Architecture”
    – Deeper vendor partnerships
What we’re hearing so far.....

- Network value proposition
  - Distinct from the Internet2 value proposition
- Research support
  - People, tools
- Segmented networks
  - By community (HEP, HCLS, etc.)
- Cloud services
  - Optimize access
- Peering
  - Expand to better support cloud services
Network Operations
Network Operations

• Mission
  – Responsible for the 24 x 7 x 365 Internet2 Network Operations located at Indiana University

• Network Operations Responsibilities
  – Service Desk
  – NOC
  – Engineering
  – Service Delivery
  – Software & Systems
  – Business Operations
Network Operations Today

• Tools
  – NMS- Nagios & Alertmon
  – Incident Management- Footprints
  – Change Management- Footprints
  – Configuration Management

• Metrics (over 25 measured monthly)
  – TTR by Service, Customer
  – Availability by Service
  – Bandwidth Utilization
  – Customer Satisfaction
2015 Review

- Review and Enhance key ops partnerships (ESNET, GEANT, CERNET)
- Begin Collecting Comprehensive Metrics & Reporting
- Improve Vendor Relationships & Measurement
- Improve Service Delivery Process
- Implement Better Process for Projects & Initiatives
- Start IT Service Management Program
2016 Initiatives

- Integrated Change Management
- IT Service Management
- Begin Transition to Service Now
- Community input on Service Level Offerings
- Reporting on Demand / Updated Reporting
- Begin Predictive Analytics
Operations Excellence
Community Steering Team
Charge to the Operations Excellence Community Steering Team

The community steering team has been asked to provide guidance on the development of requirements, execution of process and veracity of analysis as review of Internet2’s important network operating contracts proceeds. They will provide input and advice to the staff and, ultimately, be the community's window into the process and analysis used to assure the community at large that requirements and objectives are reasonable and that a fair process that best meets community requirements is being used.
Operations Excellence Community Steering Team Members

- Dave Swartz – American University (Co-chair)
- Kelli Trosvig – University of Washington (Co-chair)
- Steve Corbato – Oregon Health and Science University
- James Deaton – OneNet
- William Deigaard – Rice University
- Steve Fleagle – University of Iowa (Internet2 Board Member)
- Kathy Gates – University of Mississippi
- Patty Giuntoli – BerkleyLab/Esnet
- John Krogman – University of Wisconsin
- David Lois – WiscNet
- Charlie McMahon – Tulane University
- Michele Norin – Rutgers University
- Pankaj Shah – LEARN (Internet2 Board Member)
Operations Excellence Community Steering Team

- The Steering Team has a community mailing list [Ops-Excellence-discussion@internet2.edu](mailto:Ops-Excellence-discussion@internet2.edu)
- Community is invited to an open meeting with the Operations Excellence Community Steering Team during the Internet2 Global Summit in Chicago on Tuesday, May 17, 3:00-4:00 p.m.