DRAFT Community Architects' Workshop Report

Executive Summary

On July 16-17, 2019,100 regional, campus and Internet2 staff representatives gathered on the campus of the University of Minnesota in Minneapolis for the Community Architects' Workshop. This workshop provided an important opportunity for presentation and discussion of the Next Generation Infrastructure (NGI) packet and orchestration design plans before Internet2 staff begin procurement and implementation plans of the packet layer. Participants were asked to provide feedback on current infrastructure options, helping to ensure the plans will meet the community's requirements for research, cloud, automation, economies and ecosystem collaboration. The hosts for the workshop including James Deaton, GPN and chair of the NAOPpag NGI Automation Group, Bernie Gulachek, University of Minnesota, Jim Stewart, UETN and chair of the NAOPpag NGI Infrastructure Group and Rob Vietzke, Internet2

The workshop was a mix of presentations by Internet2 staff and large and break-out group discussions by all in attendance. The presentations began with an overview of the NGI project. The overview included five stories that encompass what we have heard from the community that is motivating the creation of NGI including the support for the data-intensive researcher, software-driven infrastructure, cloud for research and administration, ecosystem-wide and resetting the scale economies. The NGI project is composed of the following focus areas: infrastructure including optical and packet, software/automation, service models, and testbed. Presentations were made on each of the project focus areas with emphasis on seeking input on the plans for the packet portion of the infrastructure area.

Recommendations from the workshop included the following:

Services: The community group encouraged Internet2 to design services based on an abundance of capacity.

Optical: Internet2 continues to welcome use cases showing how the community could leverage the optical platform including use cases that don't fit into the traditional alien wave model.

Packet:
The group expressed positive feedback on the designs that were presented by the Internet2 staff. These design plans outlined plans for network node locations, the type of equipment being suggested including a combination of large and small boxes.
Additionally, they had the following recommendations:

- Support for Segment Routing (SR) and EVPN were expressed by the group with the recognition that many questions remain about the implementation and use of SR and EVPN. Subsequent to the workshop, an NTAC Segment Routing/EVPN working group was formed.
- Additional community discussion on MPLS, LDP, protocols and definitions was encouraged.
- When considering support for Big Box/Little Box design, Internet2 staff was encouraged to pay attention to scale numbers and route convergence.
- The overlay security model needs to be considered, particularly as we move overlay into the interdomain model.
- There was a request for the redundancy architecture to be reviewed.
- The group expressed significant interest in testbeds. Ideas for both testbed vendor and community member participants were discussed. There was a recommendation from the group that testbeds be built to recreate current service levels with testing of new protocols and new services to follow.

Software/Automation:

- Based on the interest among the group in investigating streaming telemetry, it was suggested that a Streaming Telemetry working group be formed. Subsequent to the workshop, the Streaming Telemetry working group was formed as a subgroup of the existing NTAC Performance Working Group.

General

- The community requested that regular updates on the project be provided.

Internet2 staff are grateful to the community for their participation in the workshop.

Community Architects' Workshop Report

Introduction and Background

On July 16-17, 2019, 100 regional, campus and Internet2 staff representatives gathered on the campus of the University of Minnesota in Minneapolis for the Community Architects' Workshop. This workshop provided an important opportunity for presentation and discussion of the Next Generation Infrastructure (NGI) packet and orchestration design plans as we finalize plans for the Internet2 infrastructure upgrade. Participants were asked to provide feedback on current packet infrastructure options, helping to ensure the plans will meet the community's requirements for research, cloud, automation, economies and ecosystem collaboration as the next steps of the implementation of the packet infrastructure begins later this year.

Community activities leading up to the workshop
Internet2 staff began the community discussion regarding NGI in 2016. This much planning time for a new network was unprecedented in the proceeding five generations of Internet2 Network Infrastructure. In late 2016, Internet2 issued a call for papers for the Research and Education Community Investment in National-footprint Network Services (RECINNS) workshop held in January of 2017. There were 41 campus, regional, industry and Internet2 staff in attendance at the RECINNS workshop (see Appendix C for a list of attendees) and input from this workshop guided Internet2 planning for the NGI with the following guiding principles for designing the network: an ecosystem approach that focuses on a joint service delivery model including campuses, regionals and Internet2, experimentation that allowed technologies to be tried without impacting current production services, and to target end users with service delivery. (Final RECINNS report found here: https://www.internet2.edu/media/medialibrary/2017/08/11/RECINNS_summary_final.pdf.)

Based on feedback from RECINNS, during the May 2018 Internet2 Global Summit, Internet2 released the 2022 Community Infrastructure Services Capabilities and Planning Direction paper (https://internet2.box.com/v/NGI2022) to guide additional planning by outlining a list of requirements for the NGI. In July of 2018, Internet2 had an internal kick-off meeting for the NGI project. Soon after, the Network Architecture, Operation, and Policy Program Advisory Group (NAOPpag), the advisory committee for Rob Vietzke, the VP for Network Services, created an NGI working group to provide guidance to Internet2 Network Services. The NGI working group consists of three subgroups, (a) Infrastructure, (b) Software and Automation, and (c) Community Service Requirements each chaired by a member of the NAOPpag with membership from the broader community.

The infrastructure portion of the project initially focused on the optical infrastructure. An optical infrastructure community group (see Appendix D for a list of members) was convened in late 2018 to review the optical RFP. Responses to the RFP were due in February and the community group reconvened to assist staff in reviewing responses. With the optical infrastructure project well underway, efforts turned to the packet infrastructure project. A community group was convened (see Appendix D for a list of members) and, after review by the group, an RFI to learn more about what was available for packet was released. This was followed by in-person vendor presentations to Internet2 staff and community members. The next step in the planning was to hold the Community Architects' Workshop.

To prepare the attendees for the workshop, three webinars were held to brief the community (both workshop attendees and the broader community were invited) on relevant topics. The webinar topics included:

1. Internet2 staff presented on NGI services, secure management network, and the performance management network
2. Internet2 staff presented on the Optical background and progress

3. University of Minnesota's implementation of Ethernet Virtual Private Network (EVPN) presented by Rich Ingram and Dave Farmer

Workshop Topics and Discussion

Workshop Introduction
The Community Architects' Workshop was kicked off by the four hosts including:

- Bernard Gulachek, Vice President for Information Technology and CIO at the University of Minnesota
- James Deaton, Executive Director of Great Plains Network (GPN) and Chair of the NAOPpag NGI Software and Automation Group
- Jim Stewart, Chief Technology Officer of Utah Education and Telehealth Network (UETN) and Chair of the NAOPpag NGI Infrastructure Group
- Rob Vietzke, Vice President of Internet2 Network Services

Rob Vietzke then introduced the goals for the workshop that had been articulated to attendees prior to the workshop including:

- Revisit why we are talking about community infrastructure upgrades:
    - Supporting research, cloud, automation, ecosystem and efficient opportunities
- Learn about NGI progress
    - new and changed services enabled by new infrastructure
    - roadmap and plans for optical upgrade and refresh
- Provide input into packet architecture
    - understand what the platform enables with respect to cloud, interconnect/peering and R&E Networking
    - debate and advance protocol and service implementation ideas
    - debate and advance topology, resiliency, and capacity planning
    - provide feedback on packet and automation roadmaps
- Advance the community discussion on end-to-end services and infrastructure sharing

The detailed agenda for the workshop is found in Appendix A and the list of attendees is in Appendix B.

NGI Overview
The NGI Overview provided a look back at the community activities that led to the workshop and included the five stories that encompass community input for the creation of NGI including the support for the data-intensive researcher, software-driven infrastructure, cloud for research and administration, ecosystem-wide and resetting the scale economies.

New and Changed Services
Both new and changed Network Services enabled by NGI and the platform fee model for connectors were covered. The platform fee model brings value to the Connectors and their members by utilizing the wide range of new features and capabilities enabled by the NGI Platform. Under the Platform Fee model Connectors would have access to all of the Layer 2 and Layer 3 services shared by the community, including:

- Access to the world-class Research and Education (R&E) network to support data intensive research and the academic enterprise, including international access, updated measurement, telemetry, security and data movement capabilities (examples include NRP, OSG, ERP, etc.).

- Complete R&E routing table and cloud connectivity to support member-to-member and member-to-cloud engagement. (Required)
- Shared access to Cloud Connect Services available via the Cloud Connect Portal to major cloud IaaS providers.
- Shared access to the Internet2 Peer Exchange [I2PX] (formerly TR-CPS).
- Layer 2 connections across the platform.
- Additional capacity available as new solutions become viable (e.g., when 400G is available).

The presentation also described layer 1 services including waves and spectrum. The Wave Service includes a complete solution using Internet2-supplied equipment, with maintenance and support included. Using spectrum gives users the ability to provision dedicated waves on the Internet2 Optical System using the same optical equipment used by Internet2 or another manufacturer's equipment with prior approval.

Cloud Connect and Rapid Private Interconnect were also covered. Cloud Connect leverages the regionals' and Internet2's networks to reach the locations where the "direct connect" products of Microsoft, Amazon and Google are available. Rapid Private Interconnect provides dedicated, private, connector-controlled access to any vendor-provided services offered at one or more of the peering exchanges.

During the discussion following the presentation, workshop attendees noted the need for resiliency in connections and interest in alien waves/spectrum as well as cloud-base services and encouraged Internet2 to design services to take advantage of the abundance of NGI.

Optical

The NGI Optical portion of the workshop presented updates on the Request for Proposals (RFP) process for the open line system and 400G transponder platform. Internet2 staff and community volunteers reviewed 13 proposals from 8 equipment manufacturers. Through an extensive evaluation process, Ciena, Cisco, ECI, and Fujitsu were selected as finalists, all of whom provided strong technical proposals which provided clear benefits to the community ecosystem. After an independent scoring process - including a review of hardware features, software features, capital cost, operational cost, and logistical aspects - there was clear community consensus that Internet2 and Ciena renew their long-standing strategic partnership.

Staff then presented details on the proposed Ciena 6500 DWDM platform, which will feature a flexible-grid architecture to enable the Internet2 community to use developing, cutting-edge coherent modulation methods to extend the reach of un-regenerated waves and achieve 400G line rates (and beyond). Additionally, the new system will feature an updated software infrastructure based on BluePlant MCP; combined with internal software tools, this system will provide additional support for the use and monitoring of alien waves for both production and research purposes.

Lastly, an overview of the transition strategy was discussed with a focus on a rolling-migration to keep disruption of services to a minimum. Internet2 also disclosed plans to move on to a new fiber pair as part of the upgrade to improve overall optical characteristics and enhance reach. Hardware deployment planning is proceeding with the goal of having the first of these segments online in late 2019.

We are grateful to the community members, Internet2 staff, and vendors for their diligence and hard work throughout the optical RFP process.

Discussion following the presentation focused on alien waves and optical node placement. Internet2 welcomes use cases for alien waves that don't fit the traditional model.

Packet
Internet2 covered multiple topics in the packet portion of the workshop:

1. NGI Packet Insights
    a. Packet RFI Discoveries
    b. Form Factors: Modular vs Fixed Configuration
    c. ASIC's: Custom vs Merchant Silicon
    d. Buffering Architecture: CIOQ (Combined Input and Output Queued) vs VOQ (Virtual Output Queueing)
2. EVPN and Internet2 Service Delivery
3. Segment Routing as a transport protocol and future capabilities
4. System Architectures and Topology
5. Open items for Testbed / Prototype Network

The NGI Packet Insights portion of the workshop presented updates on the Request for Information (RFI) and Request for Proposals (RFP) process for packet hardware. The team also covered technology disruption learned about during the discovery phase. There are open items questions around much of the disruption and further work will be done by the team as part of the Testbed and Prototype Network to validate and answer the open items. Furthermore, the RFP process will answer some questions around economics of various platforms.

Also presented were two transport technologies, Segment Routing and EVPN. Internet2 sought input on using Segment Routing over MPLS as well as the use of EVPN as an overlay transport technology in support of service delivery. The community feedback was positive and a clear interest was expressed for the support of workshops and tutorials to encourage further learning of these technologies across the community.

Finally, Internet2 presented the system architectures and applied some architectures to the Internet2 backbone for feedback and discussion. These architectures will be further evaluated in the Prototype Network this fall in parallel to the RFP process.

Packet Discussion Groups
Following the presentation, small group breakout groups formed to discuss protocols, testbed and, to review a topology of the NGI, based on geographic areas.

The testbed discussion group reviewed what the community efforts in creating testbeds as well as the Internet2 efforts and how they are shifting with NGI. The group indicated that testbed activity is important to them and several volunteers stepped forward to participate in future efforts. Vendor support for testbed activity was also discussed with ideas for specific vendors mentioned. The group indicated that it is important to design test plans that test both current service levels and some new features/services as well as putting some production traffic on the testbed at the appropriate time as has been done by GENI.

The protocol discussion group expressed support for Segment Routing and EVPN with some caveats. The group encouraged further investigation of EVPN and VXLAN vs MPLS and noted that this dovetails with prototyping. Other areas for additional investigation include understanding whether to use policies to steer traffic when using Segment Routing or steer traffic using Segment Routing policies and whether this will differ based on vendor. Further, the group noted that when supporting network whether to use overlays or segment routing is an important question. The group discussed low-delay paths and engineering high delay paths with the notion that this could be a single label specific path, recognizing that this may be vendor dependent. When prototyping, it is important to understand control plane security focusing on EVPN and determining if it is secure, scalable, and not unintentionally DOS network. The group asked if it is possible to obtain RSVP-like stats on Label Switched Paths with Segment Routing. The group

encouraged investigation of services across the ecosystem to understand how that will work as well as having a broken network as a service.

Three topology groups formed representing the western, central and eastern regions of the US. Each group was given a drawing depicting the possible topology for NGI. These groups had lively discussions and articulated the questions that they had about the diagram. They asked what will determine a single node vs a double node in any given city, how the two types of boxes shown in the known will be split functionally. The group asked if the diagram allows for a multi-vendor solution. Another question that they had is how Internet2 and the regionals will work together to ensure uniform edge to edge services are delivered to the schools. There were questions about scale and traffic flow with the boxes implemented on NGI. The group encouraged Internet2 staff to take these questions into consideration as vendors offer solutions and to have a list of criteria for making final node decisions as solutions are offered.

Software, Automation, Orchestration

Internet2 spent some time presenting recent progress focused on internal configuration automation efforts. Those workflows will be abstracted and shared with the community.

There were two active discussions focusing on streaming telemetry and multi-domain orchestration; both of which address edge to edge provisioning and performance monitoring. A streaming telemetry working group was formed and will explore how the community can share and leverage streaming telemetry for performance monitoring and troubleshooting with a focus on services that cross multiple organizations. There was interest in pursuing multi-domain service orchestration especially in support of cloud connect. Efforts should result in workflows to provision services (e.g., layer 2 or 3 VPNs) across multiple organizations (e.g., campus to connector to Internet2 to cloud).

The Key Take-aways from the discussion on Software, Automation and Orchestration included ensuring that working services aren't broken when access to devices that have connections to the network is allowed. Security on and availability of the network are critical. The group encouraged a community understanding of the definition of edge—is it the campus border or something else? Other important considerations are encryption automation for cloud, API definition and OESS integration in automation and orchestration efforts.

Lightning Talks

Several lightning talks were presented and this was a popular part of the workshop. The lightning talks included
George Loftus-cars, lemonade stands
Howard Pfeffer-bass guitars
Jim Stewart-soldering irons
Dave Teach-route views

Recommendations Summary

The following recommendations were made by the workshop attendees:

Services: The community group encouraged Internet2 to design services based on an abundance of capacity.

Optical: Internet2 continues to welcome use cases showing how the community could leverage the optical platform including use cases that don't fit into traditional alien wave model.

Packet:

The group expressed positive feedback on the designs that were presented by the Internet2 staff. These design plans outlined plans for network node locations, the type of equipment being suggested including a combination of large and small boxes.
Additionally, they had the following recommendations:

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- Additional community discussion on MPLS, LDP, protocols and definitions was encouraged.
- When considering support for Big Box/Little Box design, Internet2 staff was encouraged to pay attention to scale numbers and route convergence.
- The overlay security model needs to be considered, particularly as we move overlay into the interdomain model.
- There was a request for the redundancy architecture to be reviewed.
- The group expressed significant interest in testbeds. Ideas for both testbed vendor and community member participants were discussed. There was a recommendation from the group that testbeds be built to recreate current service levels with testing of new protocols and new services to follow.

Software/Automation:

- Based on the interest among the group in investigating streaming telemetry, it was suggested that a Streaming Telemetry working group be formed. Subsequent to the workshop, the Streaming Telemetry working group was formed as subgroup of the existing NTAC Performance Working Group

General

- The community requested that regular updates through blogs, newsletters and webinars on the project be provided. Webinars including the following are planned between now and the end of 2019: NGI project, cloud connect and some security topics.

Internet2 staff thank the Community Architects' Workshop attendees for their participation in the workshop and welcomes additional community feedback as the project progresses.

Appendix A
Community Architects' Workshop Agenda

Tuesday, July 16

Time	Session
9:00 - 9:30am	Welcome & Introductions
9:30 - 10:25am	Topic #1: Next Generation Infrastructure (NGI) Overview & New and Changed Services
10:25 - 10:55am	Discussion #1
10:55 - 11:15am	Break
11:15 - 12:00pm	Topic #2: Optical Selection & Deployment Roadmap
12:00 - 12:45pm	Lunch and Collaboration Time
12:45 - 1:00pm	Lightning Talks
1:00 - 2:30pm	Topic #3: Packet Introduction -- RFI Process and Protocols
2:30 - 2:55pm	Discussion #2: Working Break (Grab a snack and join the discussion)
2:55 - 4:00pm	Topic #4: Packet -- System Design, Topology
4:00 - 4:45pm	Discussion #3: Break-out Groups
4:45 - 5:15pm	Summary, Wrap-Up and a Look Ahead to Tomorrow
5:30 - 6:30pm	Reception

Wednesday, July 17

Time	Session
8:30 - 9:00am	Thoughts from Day 1
9:00 - 10:00am	Topic #5: Software and Automation
10:00 - 10:30am	Discussion #4: Break-out Groups
10:30 - 10:45am	Break
10:45 - 11:00am	Break-out Group Reports
11:00 - 12:00pm	Discussion: Checking Community Expectations on Delivering Edge to Edge Services
12:00 - 1:00pm	Lunch
1:00 - 2:00pm	Bringing it all Together, Follow Up Steps and How to Report to Community

Appendix B

Community Architects' Workshop Roster

Sara Aly	Internet2
Jeff Ambern	Indiana University
Nicholas Amento	Harvard University
Jeff Bartig	Internet2
Jason Boryk	University of South Carolina - Columbia
Jesse Bowling	Duke University
Eric Boyd	University of Michigan - Ann Arbor
Joseph Breen	University of Utah
Anthony Brock	Oregon State University
William Brockelsby	Duke University
Eric Brown	Virginia Polytechnic Institute and State University
Grover Browning	Indiana University
Dana Brunson	Internet2
Eric Buckhalt	Georgia Institute of Technology
Dennis Cagampan	CENIC
Pat Christian	University of Wisconsin - Madison
James Conrad	MCNC
Dennis Cook	PNWGP (Pacific Northwest GigaPOP)
Camille Davis-Alfs	Internet2
James Deaton	GPN (Great Plains Network)
David Diller	MAX (Mid-Atlantic Crossroads)
Jon Domen	OSHEAN. Inc.
Kent Eitzmann	University of Nebraska System
Andrew Elble	Rochester Institute of Technology
David Farmer	University of Minnesota - Twin Cities
Alison Ferreira	Internet2
Dale Finkelson	Internet2
Brad Fleming	KanREN (Kansas Research and Education Network)
Jaroslav Flidr	George Washington University, The
Stephen Fromm	University of Oregon
Mark Fullmer	OARnet (Ohio Academic Resources Network)
Jeremy Geelen	MCNC
Joshua Gorton	WiscNet
Chris Griffin	FLR (Florida LambdaRail, LLC)
Greg Grimes	Mississippi State University
Bernard S. Gulachek	University of Minnesota - Twin Cities
Louis Hammond	University of Minnesota - Twin Cities
Ryan Harden	University of Chicago
James Harr	University of Nebraska System
Carl Harris	Virginia Polytechnic Institute and State University
John Hernandez	UCAR / NCAR
Jon-Paul Herron	Indiana University
John Hicks	Internet2
Troy Holder	North Carolina State University
Paul Howell	Internet2
Alex Hsia	NOAA (National Oceanic & Atmospheric Administration)
William Johnson	Indiana GigaPoP

Chad Julius	South Dakota State University
Michael Lambert	3ROX (Three Rivers Optical Exchange)
Pete Lambertz	North Dakota State University - Main Campus
Andrew Laubach	OneNet
Andrew Lee	Indiana University
George Loftus	Internet2
Jason Lomonaco	Internet2
Derek Masseth	University of Arizona
James McCabe	Arizona State University
Ronald Milford	Internet2
Anne Milkovich	Nevada System of Higher Education - System Office
Ben Miller	KINBER
Kenneth Miller	Penn State (Pennsylvania State University, The)
Michael Milliken	Merit Network, Inc.
Marie Modrell	Internet2
Don Moskiewski	Duquesne University
Matthew Mullins	Internet2
Gary Mumphrey	Louisiana Board of Regents / LONI
Colin Murphy	University of Minnesota - Twin Cities
Karl Newell	Internet2
Chris O'Brien	NoX (Northern Crossroads)
William Owens	NYSERNet, Inc.
Garry Peirce	University of Maine
Howard Pfeffer	Internet2
Robert Placencia	Sun Corridor Network (Arizona)
Yul Pyun	University of Southern California
Kevin Quire	University of Utah
Andrew Ragusa	Indiana University
Bob Richman	University of Notre Dame
Chris Robb	Internet2
Mike Robbins	Internet2
Linda Roos	Internet2
Szajih Saniatan	Georgia State University
James Stewart	UETN (Utah Education Telehealth Network)
Roger Stoen	University of Minnesota - Twin Cities
Donna Tatro	Princeton University
Scott Taylor	Internet2
David Teach	University of Oregon
Dereje Tekola	George Washington University, The
Christian Todorov	Internet2
Rick Tuthill	University of Massachusetts - Amherst
Matthew Valenzisi	MCNC
Francesca Vargas	Texas A&M University
Robert Vietzke	Internet2
Barr von Oehsen	Rutgers, The State University of New Jersey
Steven Wallace	Internet2
Christopher Wilkinson	Internet2
Phillip Winans	University of Illinois - Urbana-Champaign
Chris Zane	University of Hawaii - Manoa
Adam Zangerle	SUNY University At Buffalo
Matthew Zekauskas	Internet2

Appendix C
RECINNS Workshop Participants

Stephen Alexander	Ciena Corporation
Jeffrey Bartig	Internet2
Joe Breen	University of Utah
Eric Brown	Virginia Tech University
Douglas Carlson	New York University
Russell Clark	SoX
James Deaton	OneNet
William Deigaard	Rice University
John Dundas	CENIC
Chin Guok	ESnet
Jon-Paul Herron	Indiana University
Paul Howell	Internet2
Gwendolyn Huntoon	KINBER
Julio Ibarra	Florida International University
Mark Johnson	MCNC
Ronald Johnson	PNWGP
Akbar Kara	LEARN
Kathleen Kay	Internet2
Raj Kettimuthu	Argonne National Laboratory
Kireeti Kompella	Juniper Networks
Michael Kowal	Cisco Systems
Michael Lambert	3ROX
George Loftus	Internet2
Joe Mambretti	Northwestern University
John Moore	Internet2
Kevin Morooney	Internet2
John Murphy	Brocade
Karl Newell	Internet2
Leonid Reznik	Rochester Institute of Technology
Robert Ricci	University of Utah
Matt Riley	University of Montana
Linda Roos	Internet2
Paul Schopis	OARnet
Tracy Schroeder	Boston University
Christopher Sedore	NYSERNet, Inc.
Tripti Sinha	MAX
Jerry Sobieski	NORDUnet
Rick Tuthill	University of Massachusetts-Amherst
Timothy Upthegrove	GENI Project Office
Robert Vietzke	Internet2
Steven Wallace	Indiana University
Christopher Wilkinson	Internet2

Appendix D

NAOPpag Next Generation Infrastructure (NGI) Project Committee

Service Model

- Dee Childs, Chair, Texas A&M University
- Cort Buffington, KanREN
- Steve Kankus, NYSERNet
- George Loftus, Internet2
- Matt Riley, University of Oregon
- Linda Roos, Internet2
- Paul Schopis, OARnet
- Marc Wallman, North Dakota State University

Software and Automation

- James Deaton, Chair, Great Plains Network
- Eric Boyd, University of Michigan
- William Deigaard, Texas A&M University
- Greg Grimes, Mississippi State University
- Ryan Harden, University of Chicago
- James McCabe, Arizona State University
- Karl Newell, Internet2
- Linda Roos, Internet2

Infrastructure (Optical)

- Jim Stewart, Chair, UETN
- Sana Bellamine, CENIC
- Dennis Cook, PNWGP
- Dave Diller, MAX
- Josh Gorton. WiscNet
- Bill Jensen, University of Wisconsin Madison
- Tom Johnson, iLight
- Bill Owens, NYSERNet
- Garry Peirce, University of Maine System
- Yul Pyun, USC
- Chris Wilkinson, Internet2

Infrastructure (Packet)

- Jim Stewart, Chair, UETN
- David Farmer, University of Minnesota
- Stephen Fromm, NERO
- Andrew Gallo, George Washington University
- Chris Griffin, FLR
- Richard Hicks, NERO
- Derrick Masseth, University of Arizona
- Brian Miller, Clemson University
- Scott Taylor, Internet2