



Joint Engineering Team (JET) Meeting Minutes

National Coordination Office for Networking and Information Technology R&D (NCO/NITRD)
490 L'Enfant Plaza SW, Suite 8001, Washington, DC 20024
April 20, 2021 12:00-2:00 p.m. ET
This meeting was held virtually

Participants

Shawn Armstrong, University of Alaska	Chris Lowe, USDA/ARS
Joe Breen, UTEN/University of Utah	Joe Mambretti, StarLight/MREN
Nick Buraglio, ESnet	Dave Mauro, NOAA
Rich Carlson, DOE/SC	Alex Moura, RNP
Bobby Cates, NASA/Ames	Edward Moynihan, Indiana University
James Deaton, GPN	Aruna Muppalla, NASA/GSFC
Basil Decina, NRL	Mark Mutz, NOAA
Dave Diller, MAX	Linden Mercer, NRL
Bill Fink, NASA/GSFC	Glenn Ricart, US Ignite
Andrew Gallo, CAAREN/GWU	Mike Simpson, Internet2
Jonah Keough, PNWGP/Pacific Wave	Dan Taylor, Internet2
Kevin Kranacs, NASA/GSFC – EOS	Kevin Thompson, NSF
Michael Lambert, PSC/3ROX	George Uhl, NASA/GSFC
Paul Love, NCO/NITRD	Chris Wilkinson, Internet2

Proceeding: This meeting was chaired by Rich Carlson (DOE/SC) and Kevin Thompson (NSF).

I. Action Items:

- Internet2 and ESnet updates on their respective new networks.

II. Review of the Minutes of the March 2021 meeting: Corrections were received and will be reflected in the posted minutes. (*n.b.*: They were.)

III. An update on automation and telemetry efforts in Internet2's Next Generation Infrastructure initiative – Mike Simpson

- A. Overview of Internet2's (I2) NGI status and completed work.
 - a. Optical: The deployment is nearly done with all planned segments completed by the end of February 2021. A small amount of remediation remains. Other details:
 - i. 80% of the Internet2 IRU fiber had been replaced (through 2042) with new single mode fiber.
 - ii. Infrastructure sharing with four RONS:
 1. CENIC/PNWGP (Pacific Wave)
 2. Florida LambdaRail

3. Wisconsin/Iowa/Minnesota (BORAS and WiscNet).
- b. Packet layer: The gear rollout was completed the end of March 2021:
 - i. Cisco 8200 routes, Dell perfSONAR nodes and a Juniper secure management platform
 - ii. Including remediation there have been 100 site visits to date. Some remediation remains
 - iii. Started bringing up 400G links between the 8200s about two week ago. About 80% the planned 400Gs are now online. The speed was helped by automation.
- B. NGI's Performance Assurance Services (PAS).
- a. Part of the plans for NGI is a complete upgrade and expansion of PAS.
 - b. All 47 code nodes will include a dedicated PASS server with multiple perfSONAR (pS) test points:
 - i. 1x100G for I2's internal testing, monitoring and alerting
 - ii. 2x10G for testing, monitoring and alerting of the internal paths between the pieces constituting the disaggregated node
 - iii. 1x100G for external use to support community ad hoc testing.
 - c. The pS test points will be deployed using Docker containers:
 - i. Internal and external separated to prevent false-positive alerting
 - ii. Using Docker simplifies software deployment & upgrades. Testing has found the overhead of containerization is negligible.
 - d. The PAS servers have capacity for a lot of growth – very lightly loaded by the initial services deployed.
 - e. Status: The basic OS has been deployed on all nodes. Initial turn up of a container pS on each node has also been completed. This is to aid in network turnup testing. A lot of tuning is being done to maintain the multiple 100G long haul flows reliably.
- C. Automation and Orchestration for NGI is divided into five pieces:
- a. Network: The equipment under management; Ciena Waverserver 5s, Cisco 8201/8202s and Cisco IOS XRv. XRv will virtualize one of NGI's router reflectors along with providing a virtualized portion of NGI in the lab. The XRv license is being expanded to permit all, or nearly all, of NGI to be simulated in the lab.
 - b. Assurance: The validation of the network's functionality. This relies on:
 - i. The GlobalNOC's (NOC) tool kit in use for years; NOC's database, AlertMon and the tie ins to the NOC's service desk
 - ii. Containerized pS.
 - c. Orchestration: The structured configuration management – going from what is planned/intended to what is actually in a box. Currently in pre-production rollout:
 - i. Optical layer: Managed by Ciena's BluePlanet MCP. Currently in use on NGI optical gear
 - ii. Packet layer: Managed by Cisco's NSO. Goal: every non-trivial line of configuration will be managed by NSO on all Cisco gear. This is being

done from the start as each new backbone link is being brought up under NSO.

- d. Provisioning: Designing workflows for the creation and maintenance of the configuration. This is in active development:
 - i. Training on NSO's CLI
 - ii. Retrofitting existing tools to use NSO (OESS, CloudConnect)
 - iii. Creation of new tools, a web-based API and services.
- e. Supervision: Will provide a high level, "single pane of glass", overview of the other 4 pieces - currently in early prototyping:
 - i. Initially a dashboard to provide packet backbone provisioning and management. A starting point for other functions
 - ii. Session services providing a unified single sign on SSO and authentication via I2's Collaboration Platform
 - iii. Eventually the only access will be via the dashboard and the SSO.
- D. Modeling with NSO
 - a. I2 is moving from large, complex models to simpler ones for a layered approach. The layers are combined to create the larger model. Some models are for a single router, some models affect several or most devices in the network.
 - b. Management and configuration of the entire network rather than the constituent pieces. A service is specified and NSO then determines what changes are needed to accomplish that.
 - c. Model deployment is transactional and atomic; the needed changes to all devices succeed or all are rolled back as a transaction. When all are correct then the modeled changes are rolled out on the network.
- E. Quick summary of what remains to be done with NGI's deployment.
 - a. Some of the bumps NGI has hit:
 - i. COVID – impact on field teams, no staff travel, supply chain delays, ...
 - ii. Partnership and contracting: Contracts now require more rigor than in the past so longer lead times. Scope-of-Work always require debate also lengthening lead times.
 - iii. New platforms, new technologies, new colocation sites, and their unexpected discoveries
 - 1. Incompatibility between fixed-grid and flex-grid Ciena systems...
 - 2. Many rack types - did the correct ears get sent? Maybe...
 - 3. DACs and AOCs - are they fully plugged in? Maybe...
 - 4. Move to fully embrace third party optics - is the programming correct? Maybe...
 - 5. Certain features for IOS-XR on 8200s are pending or have challenges translating design into operations (Cisco has been very helpful in resolving I2's issues):
 - a. Multicast in VRFs
 - b. L2 shaping
 - c. Route leaking for VRFs

- b. For the next month I2 will be doing NGI testing at scale: outages of all types, latency, throughput, QoS issues, bandwidth step downs (400G->100G, 400G->10G), packet loss detection.
 - c. Next phases:
 - i. Shimming: Ciscos are placed in the path between connectors and the existing/old Juniper routers. The Ciscos are transparent to the traffic.
 - ii. Migrate services (to be done over summer): Service by service traffic is peeled off the Juniper network and starts traveling over the new network. (*n.b.*: there are 1200 to 1500 services to be migrated.)
 - iii. Deactivate Junipers: When all services have been migrated the Junipers will be removed.
 - d. Current target dates:
 - i. Bases platform testing: May 10
 - ii. Complete network “shimming”: July 12
 - iii. Complete migration (MXs to 8200s): September 30
 - iv. Power down of all legacy optical and packet H/W: October 15
 - v. Legacy H/W removal: December 15
- F. Q&A:
- a. Lesions learned: What would you have done differently a year ago if you had but known:
 - i. If I2 could have created a bubble with the key people together would have been a huge help (though terribly hard on families).
 - ii. Mike Simpson: Otherwise went pretty smoothly. Especially since the Mike’s team didn’t exist before March 2020 when he joined I2.
 - iii. Chris Wilkinson: Because of all the new technology and the needed timing of contracts not all gear/features could be tested beforehand.
 - b. IOS XR issues:
 - i. XR is very mature. Issues are which features are implemented on which platforms. For example the 8200s, which are brand new, are great for power, space and port density. They are extremely capable boxes, but I2 is certainly leading the way on deploying them as a service provider on a nation-wide network. Example: multicast is implemented in XR on other platforms, but not so much on the 8200s.
 - ii. I2 is migrating from a mixed configuration of having somethings in the base instance, some in VRFs to everything in VRFs. New for I2 and learning how Cisco does this. Again, very good support from Cisco.
 - c. How is the IPv6 support? At the IGP level all seems fine. It also seems fine at the VRF level (*n.b.*: no one the call had firsthand knowledge of this). (It was noted that IPv6 doesn’t exist in Cisco’s data center offerings at this time.)
 - d. Do your various tools allow you to do traffic and outage modeling? I2 has a license for ROA from Ciena. Not had a chance to make use of it yet due to the complexity of NGI and a limited number of engineers. Disaggregation implies two to four devices per node that NSO ties together to act as a single large router. Larger nodes are interconnected with multiple 400G circuits between pairs

providing redundant paths. Just not enough engineers to do concurrently with the rollout.

- e. Any plans to use the ROA's PC functionality? Not at this point.
- f. How are the [disaggregated] devices in a node tied together? There are a pair of core routers at each site. Core 1 at a site ties to Core 1 at an adjacent site, Core 2 to Core 2. Internally there are three 400Gs between the pair. In the one instance where there are multiple, parallel circuits between adjacent sites the configuration is still to be finalized. Most likely the parallel links will be bonded. In the three large sites with cloud access (Ashburn, VA, Chicago, IL, and San Jose, CA) where there are also a pair of aggregation routers for cloud access there are 4x400G interconnects.
- g. What determined which sites received 8201s vs 8202s? All peering sites have 8202s.
- h. How much bandwidth does I2 expect to have in and out of the cloud? Each cloud router will have 800G into the core so 1.6 Tbits facing the cloud. The major CSPs are starting to have 100G connections. I2 is also seeing some 100G connections at the major IXPs. There are issues with some CSPs providing multiple 100G connections. (*n.b.*: Other JET participants are having the same issues.) I2 noted that some of its peers have resisted going to a 100G connection for years.

IV. Discussion of the JET's tasking on tools to help with inter-domain issues – Joe Breen, James Deaton, all

- A. Prototype/pilot: The various pilots continue to progress. Work continues to get basic measurement data from different universities and RONS.
 - a. James organized getting talks underway with MERIT for a sharing of its data.
 - b. The project is working through some ACLs and logistics with RedCLARA to make its data available.
 - c. Dan Dole is leading the effort to make TENET's data available.
 - d. Dan, James and Joe met with Jen Leasure of The Quilt to build a live, augmented Quilt map. Conversations are being held with The Quilt members who have shared data with The Quilt to also share their data for this project.
- B. Background on efforts lead by Eric Boyd, Joe Breen, James Deaton, Dan Doyle, and Karl Newell:
 - a. The project gets basic SNMP metrics from groups around the country that are willing to share for trouble shooting and research. Metrics include link utilization, discards and errors. These are collected hop by hop as the path crosses multiple domains.
 - b. Several prototypes are going along with the drafting a basic letter of intent for those wishing to participate.
 - c. Tools: Telegraf container as an option for local collection. Nearly ready for production use.
 - d. Tracking sheet of networks willing to share data. Please update your network's entry. See:

https://docs.google.com/spreadsheets/d/1pMW_PNVpeT42nAxa3bW4QostMxcHTXkWSPbZOplFwE/edit#gid=0

The spreadsheet also has an embedded link to measurement templates for campus, regional and national networks setting out what data is desired. See:

<https://drive.google.com/drive/folders/1l-LRyrl6u4AvBeY6NlvYYalNRpjByA>

- e. The Internet2 Performance Working Group Community Measurement, Metrics, and Telemetry project holds meetings on the second Tuesday for those participating or interested. If you are interested, please contact Joe:

[Joe Breen <Joe.Breen@utah.edu>](mailto:Joe.Breen@utah.edu)

- f. General information about this project can be found at:

<https://spaces.at.internet2.edu/display/PerformanceWG/Internet2+Community+Measurement%2C+Metrics+and+Telemetry+Project>

- g. While NASA polices preclude EOS from sharing this data, EOS has an internal perfSONAR (pS) mesh. They are happy to open their firewalls to permit pS testing by prior arrangement. Contact George at:

["Uhl, George D." <george.d.uhl@nasa.gov>](mailto:Uhl,George.D.<george.d.uhl@nasa.gov>)

V. Operational network security roundtable No updates received.

VI. Network roundtable

- A. CAAREN (Andrew Gallo): No updates today.
- B. ESnet (Nick Buraglio):
 - a. ESnet 6:
 - i. Deployment of the Nokia SR-2 routers is progressing
 - ii. Training with Nokia begins next week.
 - b. The DOE IPv6 only task force is moving quickly. A data call is anticipated by month's end to enable the building the implementation plan. OMB has provided clarifications on what the implementation needs to look like.
- C. GPN (James Deaton): GPN is overhauling its perfSONAR infrastructure and conducting a performance assessment. GPN is also assisting in the encouragement and development of non-primary exchanges.
- D. International Networks – Indiana University (Ed Moynihan):
 - a. No major operational or engineering changes.
 - b. Both new Transatlantic circuits are up, traffic has been shifted and they are working to complete their integration into ANA.
 - c. In the Pacific Indiana University continues to work with the new consortium procuring the 100G Guam<>Singapore circuit. Currently anticipated to be up in early May 2021.
- E. NASA EOS (Kevin Kranacs via telephone): No update today.
- F. NASA GSFC (George Uhl): No update today.
- G. NOAA (Mark Mutz):
 - a. NOAA continues to work on its core router upgrade.
 - b. NOAA's network expansion in Alaska is continuing.

- H. NRL (Linden Mercer): NRL is optimistic about SC this year despite the remaining uncertainty. NRL has been having some conversations with cloud providers and has identified a TB data movement in less than 1 minute as an interesting target. This requires more than a single 100G connection and would be a good demo/target for St. Louis in November. The demo would be between storage outside the cloud into or out of the cloud and across distance. (It was noted that Igor Sfiligoi from SDSC did some great tests last year between SDSC & University of Wisconsin moving data into and out of the cloud but not using any cloud storage.)
- I. Pacific Wave (Jonah Keough): No significant updates. Pacific Wave (PW) is doing some software work on its new IGROK monitoring nodes. These will be deployed at its core nodes. PW may have some route server options in the fall.
- J. 3ROX (Michael Lambert): No updates this month.
- K. University of Alaska (Shawn Armstrong): University of Alaska, Fairbanks is installing generators in its data center next month.
- L. USDA/ARS (Chris Lowe): ARS is planning roll out 26 new research sites this year.

VII. Exchange Points Round Table

- A. MAX (Dave Diller): As part of its network refresh MAX is still evaluating 400G options.
- B. StarLight (Joe Mambretti):
 - a. StarLight (SL) is optimistic for SC21 in St. Louis, MO. SL is working with NRL and GSFC on a testbed with 400G between DC, SL & SC. They're exploring options to extend the circuit to UCSD. SL is working on the needed hardware and exhibits to make use of the 400G testbed.
 - b. SL is helping to design the Data Mover Challenge testbed that will be used in the runup to next year's Supercomputing Asia (March 1-3, 2022).
 - c. The integration of SL's p4 testbed with GÉANT's is almost done – some maintenance in Europe has delayed the completion which is now moving again forward.
 - d. SL continues to work with the international AutoGOLE/SENSE (AG/S) consortium to develop a global multi-point testbed. Gerben van Malenstein, who has led this project for several years, has left SURFnet. His successor has not yet been selected. The impact of this remains unclear.
 - e. SL continues working with CERN on the NOTED project. NOTED's goal is using ML to anticipate large flows and do just-in-time circuit provisioning.
 - f. SL continues to work on FNAL's ROBIN project. ROBIN is an integration of the Rucio data manager, FNAL's Big Data Express and DOE's SENSE data orchestrator.
 - g. SL continues to work on several provisioning efforts: Internet2, ESnet6, Michigan State University, Academia Sinica and FABRIC. The FABRIC rack is now powered up and ready for use. FABRIC's recent Experimenter Workshop had several experimenters describing the fascinating work they plan to do over FABRIC.
- C. PNWGP (Jonah Keough): No updates today.

Meetings of Interest 2020

Note: Meetings cancelled since the April JET have been removed from this list. Those moved to a virtual format have been updated.

Jun 14-16 [NANOG 82](#), virtual meeting
Jun 21-25 [TNC21](#), virtual meeting
Jul 24-30 [IETF 111](#), In person cancelled, moved to a virtual meeting
Aug 2-6 [APAN52](#), In person cancelled, moved to a virtual meeting
Sep 20-21 [The 2nd Global Research Platform \(2GRP\) Workshop](#), In person cancelled,
moved to a virtual meeting

Nov 1-3 [NANOG 83](#), Minneapolis, MN
Nov 4-5 [ARIN 48](#), Minneapolis, MN
Nov 6-12 [IETF 112](#), Madrid, Spain
Nov 14-19 [SC21](#), St. Louis, MO. Anticipated to be a hybrid meeting

Next JET meetings

Note: It is anticipated that the JET's meetings in CY2021 will be virtual due to COVID-19 guidelines. The possible exception will be the November meeting if SC21 remains a hybrid conference.

May 18, 2021 12-2 p.m. ET
Jun 15, 2021 12-2 p.m. ET
Jul 20, 2021 12-2 p.m. ET