JET Meeting Minutes
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National Science Foundation
Stafford II, Room 525

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<u>**Action Items**</u>
- Jeff Smith will return for an additional briefing after EIS protest is resolved (carry over)
- Mark Mutz will present on architecture (NOAA security stack architecture and routing); in the meantime he will distribute slide decks
- Linden Mercer and Nick Buraglio will look into speaking on performance barriers in utilizing commercial cloud services

<u>**Proceedings**</u>
This meeting of the JET was chaired by Rich Carlson (DOE/SC) and Kevin Thompson (NSF).

Networks

Andrew Gallo-CAAREN
No updates.

ESnet: Nick Buraglio
Working on renewal for transatlantic connectivity; should finish in next month.
- ESnet6 planning is making good headway.
- Finished annual networking summit.
- Ongoing positive collaboration with Internet 2 on security topics.

Internet2: Chris Wilkinson
Networking update to be addressed in presentation.

Indiana University: Ed Moynihan
TransPAC and near circuit are running smoothly. We will likely have new peerings for TransPAC in the next few months. Africa traffic in Geant is now routed; focusing on application support in Africa.

NRL: Linden Mercer
Currently collaborating with a number of folks about optical wire.

NOAA: Mark Mutz
Completed migration of all offices/program to new TIC 2.0 infrastructure.
To be completed: In-lining of DC metro offices

3ROX: Michael Lambert
Working with Internet 2 to figure out how to transition from current services on AL2S to something more scalable moving forward.

US IGNITE: Glenn Ricart
Summit in Austin, Tx
Working on smart and connected communities research.
Smart gigabyte communities: GENI racks are installed on all of our cities to act as edge computing for cities' smart application. New GENI racks are in Lafayette, LA, Burlington, VT and Richardson,TX. Bringing up local interchange points at smart gigabyte communities to give low latency access to edge computing.
2 trends**:**
- Costs for 10G service to homes have fallen, so new installations are routine; local interest in SDN- particularly municipal systems (services and multicast services)
- Advanced Wireless Research Program (NSF) project office requests communities to propose to be research platforms (research wireless, programmable testbed); 2 will be selected this year. Happy to work with and share facilities with JET member agencies.

Pacific Wave – Dave Reese
Completing year-2 reporting to NSF. Continuing experimentation with PRP and roles of exchanges by adding DTNs in Seattle, Sunnyvale and Los Angeles into Pacific Wave. Will be available to Pacific Wave participants and integrated research platform. May add GPU to

one of the DTNs. Year3 of grant: Will add 100G link between Los Angeles and Sunnyvale; looking forward to getting more capacity

CENIC – Dave Reese
Working on extending IRUs through year 2039 (one is the cyber between Sunnyvale and Nasa AMES). CENIC owns the conduit, but Level 3 trying to claim ownership. 72 strands: goal is to complete by Year 2039. Bobby Cates offered help on Level 3 conduit issue.

Exchange Points

WIX: Dale Finkelson
No significant changes. Amsterdam to NY ANA circuit moved from landing on MAN LAN to new exchange point in Montreal and uses Canarie circuits to get down to MAN LAN about a month ago. Close to having ANA mad dash up. Ongoing discussions with Tom Lehman and Matt Zekauskas and others about whether to revisit how WIX and MAN LAN are structured, services, etc.

MAX: Dave Diller
Doing typical customer augments and upgrades. Addressed uptick in traffic during NOAA upgrades.

StarLight: Joe Mambretti
The StarLight International/National Communications Exchange Facility consortium is planning to stage multiple 100 Gbps WAN demonstrations for the Global LambdaGrid Workshop in Sydney, Australia in September (the annual Global Lambda Integrated Facility - GLIF -meeting).

The StarLight consortium is also planning to stage multiple 100 Gbps and 400 Gbps WAN demonstrations for the SC17 conference in Denver. All demonstration involve components of Software Defined Networking (SDN), including orchestrators for dynamic provisioning, Software Defined Exchange services and technologies (SDXs), and Software Defined Infrastructure (SDI) including integrated high performance data transfer nodes (DTNs).

NASA/AMES: Bobby Cates
Today, our connection to Amazon government cloud should be established; DREN will be first up. In a couple months, we should have 10Gs to Amazon AWS (San Jose). We will be using that to test new TIC-compliant connectivity for the AWS site.
- Next month, we hope to provide connectivity between DREN and networks in Sunnyvale. We hope to connect to PacWave and Internet 1 and ESnet.
- Moving USG campus from Menlo Park to Moffat field. TIC access piece is work in progress

LSN Update: Joyce Lee
Larry Peterson, presented on PlanetLab, a global research network that supports the development of new network services.
LSN is continuing to plan a follow on workshop on operationalizing the SDN on September 18-20 in Washington, D.C. KC Wang (Clemson) and Ronald Hutchins (UVA) are the workshop co-chairs.
http://ccit.clemson.edu/research/nsf-nitrd-sdn-workshop/

JET Continuing Tasks FY18 (new additions are in RED)
Deadline for first draft of task: September meeting, as the LSN meeting is Oct 10.
- Continuation of JET Big Data Task to demonstrate BD and SDN applications and technology at SC17 and to plan for SC18 demonstrations
- LSN/JET workshops (see list below)
- Track technologies: SDN/SDX (also, workshop), Science DMZs (also, workshop), TICs, perfSONAR (include performance measurement technologies; e.g., new technologies that allow real-time analysis of network and can change flows in real time to improve performance (MIT), cooperation among JET/GENI/US Ignite, ID mgt, IPv6. Arrange briefings to JET as appropriate
  - TICS- 1 more year as still need to address questions about status of TIC deployment
  - Einstein 3– Next big concern for discussion.
    - Traffic flow requirement- Any requirements for high speed science networks? IF so, how to address?
    - Need to schedule DHS briefings on TIC and Einstein and their impact on science networking (perhaps include OMB)
- Continue to hold JET meetings at conferences appropriate for the JET community (currently Internet2 2018 Global Summit and SC17)
- Request continuing periodic updates from Internet2 & ESnet on their future networks' plans

Potential FY18 Workshops
- DTNs of different flavors: Review the state-of-the-art and inform potential users regarding DTN implementation (DTNs, DMZs and cloud)
  - Performance barriers in utilizing commercial cloud services (Potential speakers: Linden, Nick)
  - Network support for edge computing and security
  - SDN workshop: status of developing SDN capabilities NSF has a continuing interest in SDN and possibly other architectures such as information centric networking (e.g. VDOF's impact on larger networks and exchange points)

Internet 2 : Chris Wilkinson (slide presentation available)
High level updates
- Different iterations of security projects in last month. Tuning netflow infrastructure. Using IP fix instead of legacy protocols and getting better view of what is going on in the internet.
- Rolled off VDOF scrubbing surface. Roll outs are still ongoing.
- Moved NY peering point out of Equinix to Telex.
- OESS- evolving from provisioning layer. Recently upgraded to have MPLS features that will be evolving over time.
- Netflow guidelines: Deploying VNT monitoring on the network that will add another layer of visibility. Hoping for more granularity going forward.
- Restructuring – breaking boundaries between architecture, engineering and operations on the NOX side. Trying to make effort for staff to cross boundaries.
- Thinking of efficiency, improved access to cloud services
- Increasing interconnected bandwidth (especially in edges)
- Moving towards more continuous evolution of a platform; current infrastructure important

2016-17 Target areas

- Core Network: Single vender platform based on MPLS; large capacity augments
  - 2016- Focused on hardware/maintenance; node replacement nationwide (May-Oct); expanded MPLS footprint (end of 2016)
  - 2017- currently focused on OESS and AL2S MPLS migration
    - TRCP migrated into full VRF and recently distributed to every node nationwide; pull some connectors back to local nodes so available regionally
      - remediating and migrating 10G backbones supplying interconnect services between nodes; merging onto backbone, so backbone traffic increasing.
    - Summer 2017- Addressing key software dependencies:
      - upgrade Sienna platform to support 200G channels
      - PGA re-starts pending
      - AL2 migration to MPLS so can migrate to Junos 151 and get off OpenFlow; important because slot limited in some cities
- Optical audit and other optical platform focus areas
  - Augments: 2017- 23 channels to be added (mix of 200 and 100, mostly 100 across country). Expect many augments between nodes in the next 6 months/coming year.
  - Determine roadmap for optical system beyond fixed grid and 16QAM with 100 G encoding (18-24 mo. timeframe)
    - Want to support on shorter span; distance-limited, so not possible on longer span
  - No set plans but looking to where makes sense to evolve platform for high capacity/gridless scenarios in future
  - Trying to get system in best performance characteristics
  - Goal: 200G capability and capacity on most of east coast and east of Mississippi
    - upgrading sites on CBC corridor; crunch points (e.g., Chicago)
    - ongoing changes on optical platform (replace amplifiers on key segments; in next 6 months, 12-18 Raman amps likely on footprint to improve Q factor on some segments)

ESnet6 Update- Chin Guok (slide presentation available)
Potential hybrid architecture pulling from the best of 3 architectures (packet optical integration, traditional routed, and SDN).

Mission Need
- Capacity: more cost effective solution to increase capacity because of traffic growth
- Reliability: equipment reaching end of life and increased need for cyber resiliency of the network in context of more complex workflows
- Flexibility: from all layers of network needed to support complex workflows

Hollow Core design –Low cost capacity model to add needed bandwidth at minimum cost.
- Core: Prefer dynamic provisioning at optical or packet layer with centralized intelligence
  - Optical component – exploring open line system. Prefer:
    - flexible grid (to accommodate 100g, 400G waves)
    - colorless and directionless (not fully contention-less due to cost)
    - transponders: in router switch platforms or dedicated transponder shelves
    - *Biggest issue*: need integrated management system; if looking at dynamic provisioning, need full control between transponders

- Packet core- Need (1) deep buffers- potentially 50-100 ms; (2) QOS and (3) traffic engineering functions (exploring MPLS and segment routing)
- Service edges: highly programmable devices that includes data plane configurations; standard protocols because of interaction with external community. Prefer:
  - Set of compute nodes at every location (exploring how to virtualize perfSONAR hosts)
  - APIs that can make configuration changes

Deployment Considerations
- Can put service edge and core packet functions into a single chassis (still cost effective)
- Programmability at the edge:
  - Edge devices- generally off the shelf, but limited to chipset's capabilities
  - In addition to control plane programmability, prefer data plane programmability for program encapsulation (e.g., high granular telemetry, security)
  - Different components in service edge node depend on functions at each location; thus, homogeneity may not be possible across entire service edge

BIG ISSUE: Viewing automation through an orchestration platform. Continue supporting testbed for research (external) and direction purposes.

Design implementation: Exploring combination of single vendor, disaggregated or open platform solutions, custom; May need vendor for specific functions (e.g., open line system)

Software and Research -Network intelligence depends on software. Moving towards this because:
1) Network scale growing and will outpace manual configuration
2) To meet capacity requirements, need something more proactive and able to dynamically configure
3) Security has become a bigger issue and important design consideration; as connectivity increases, network may become first line of defense.

Big picture – As part of ESnet6's upgrade, in addition to looking at new network designs and architecture and operations, we need to revamp how we do software, development cycles.

Meetings of Interest

Aug. 7-8	National Research Platform Workshop, Bozeman, Montana
Aug. 26 – Sept. 1	APAN44, Dalian, China
Sept. 18-20	NSF-NITRD Workshop on Operationalizing SDN, Washington, D.C.
Sept. 25-27	GLIF, Sydney, Australia
Oct. 2-4	NANOG71, San Jose, CA
Oct. 2-5	ESCC, NSF PIs, & Quilt, Albuquerque, NM
Oct. 5-6	ARIN 40, San Jose, CA
Oct. 15-18	Internet2 Technology Exchange, San Francisco, CA
Oct. 23-26	CANS2017, Kunshan, China
Nov. 12-17	SC17, Denver, CO

Next JET Meetings:
September 19, 12-2 p.m. Eastern (remote)
October 17, 12-2 p.m. (Eastern)
Nov 14, 1:30-3:30p.m. (Mountain) Room 507, Colorado Convention Center, Denver, CO