



### 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

October 19, 2021, 12:00-2:00 p.m. ET

This meeting was held virtually

#### Participants

Shawn Armstrong, University of Alaska  
Todd Butler, NASA/GSFC  
Bobby Cates, NASA/Ames  
Bill Fink, NASA/GSFC  
Ann Keane, NOAA/N-Wave  
Jonah Keough, PNWGP/Pacific Wave  
Padma Krishnaswamy, FCC  
Yatish Kumar, ESnet  
Paul Love, NCO/NITRD

Joe Mambretti, StarLight/MREN  
Linden Mercer, NRL  
Alex Moura, RNP  
Edward Moynihan, Indiana University  
Aruna Muppalla, NASA/GSFC  
Glenn Ricart, US Ignite  
Kevin Thompson, NSF  
George Uhl, NASA/GSFC/ESDIS

**Proceeding:** This meeting was chaired by Kevin Thompson (NSF).

#### **I. Action Items:**

- Internet2 and ESnet updates on their respective new networks.

**II. Review of the Minutes of the September 2021 meeting:** One correction was received and incorporated in the posted final minutes.

#### **III. Update on ESnet's High Touch project – Yatish Kumar**

- A. As a level set, when ESnet was going through the DOE project approval process in 2016 for ESnet6 one of the Mission Needs to be provided was greater flexibility than ESnet5 had. This was to handle the emergence of multi-facility workflows with a large instrument at one location and the compute at another. These superfacility workflows generate the need for near real time analysis of streaming data.
- B. What has resulted is the High Touch (HT) servers. There will be a pair at each of ESnet6's 42 nodes plus ones for development, etc. They are being designed to be usable for the lifetime of ESnet6 – until around 2030 and comprise a Xilinx Alveo U280 FPGA, 2x100G ports, 1.2M logic cells, 32GB DDR4, 8GB HBM2 (with a transfer rate of 3.2Tbps) plus local compute (the best server available when purchased). HTs can look at the network's traffic at line rate and automatically assign unique flow IDs and attached relevant metadata to each flow.
- C. Over the last year HT staffing has grown significantly which has led to the advances that have occurred over the last year.

- D. With HT's ability to do per packet measurement ESnet can get unique insights not possible when measurements are done with a sampling system:
  - a. Flow summaries of all packets entering the network give full visibility without the need for large storage.
  - b. Flows can be dynamically selected for header replication into PCAP files with augmented timestamps that can be sent for further processing & analysis. This selection works network-wide, not on just an individual node. By specifying what flow or packet type is of interest they will be collected from all of ESnet6 – essentially the entire network becomes a large instrument for network analysis.
  - c. These yield:
    - i. Detailed insights into the network's behavior.
    - ii. Profile how flows are performing in the network and take action proactivity.
    - iii. With AI/ML the detailed flow information can be used for traffic engineering, capacity planning and anomaly detection.
- E. Over the last year HT has moved much of the needed steps from separate COTS devices into the FPGA. The first was a DPDK driver that runs at PCIe bus speed. Beyond current needs the driver is expected to have new uses in the. With the addition of the DPDK driver HT could process about 1Mpps. However the needed rate was about 75Mpps so further work in the FPGA moved the data reduction processing, histogram/time series generation, automated flow ID generation, etc. from the software in the exterior server into the FPGA. This met the 75Mpps goal. The remaining software could be run in a laptop. (But the deployed HTs will still include a top end server to be prepared for growth over the life of ESnet6.) The remaining software driven exports are summaries that are on the order of Kpps which can easily be recorded 24/7 and PCAP files for centralized analysis.
- F. There has also been work on a high resolution time service. Not yet in use but it can shadow system time within 100ns. Several areas remain for further development.
- G. HT's timeline is in hand. Two pilot HT servers are in use at Sunnyvale and Starlight. The effort right now is clean up, increasing robustness, etc. and then getting ready for purchasing the equipment needed for deploying the boxes while fitting around the existing supply chain issues. Full deployment is targeted for Q3 2022
- H. ESnet is working towards an Open Source release with the target for the initial release (1.0) in March 2022 and will continue over next two years. SmartNIC (release 1.0) will allow a user to do a P4 program and use it without any FPGA knowledge. ESnet expects to run some workshops, etc. to aid users of this Open Source package.
- I. What else can the HT hardware/FPGA/software tool do beyond ESnet's needs? Two examples:
  - a. At LBNL it's been used to help the processing of data from the Advanced Light Source (an X-Ray beam line) and the Molecular Foundry (an electron microscope). Though very different instruments both had similar needs: take the images, do some DSP work, then identify images (more DSP) and then send on via a DTN to HPC compute/storage. Nothing to do with High Touch or telemetry but the team was able to extend the FPGA development to prototype doing

what was needed. A lot was learned in the effort which will be incorporate it what comes out in the Open Source.

- b. The Accelerator group needed something to do load balancing into its processing stack. The accelerator has a lot of data acquisition sensors. Their outputs need to be collected together by event (i.e., timestamp) with each event sent to one of many CPU/GPU processors in the stack. The FPGA tools were able to do the load balancing off timestamps with very high data rates (1Tbps). Data compression, link packing and segmentation/reassembly were also required to be done in the FPGAs with all done in P4.
- J. Question: What sort of costs will the deployed servers cost?  
Answer: HT systems can be built for as little as \$2k, allowing 100G perfSONAR solutions, and high end systems based on best in class DTN servers are dominated by the server costs.

**IV. Operational network security roundtable** No updates were received.

#### **V. Network roundtable**

- A. International Networks – Indiana University (Ed Moynihan):
  - a. Overall things have been pretty stable.
  - b. NEA<sup>3</sup>R: There has been seeing some fiber cuts on the NEA<sup>3</sup>R 100G trans-Atlantic circuit which has been down for a couple of weeks. A repair ship is on station with repair expected within another two weeks. This is the AEC-1 cable which also carries one of ESnet's circuits to Europe. ANA has smoothly handled rerouting the traffic from both over the remaining circuits in the consortium.
  - c. TransPAC: There has also been a fiber cut off the coast of Indonesia. This has delayed the new Guam<>Singapore 100G connection. The cut has been repaired and circuit testing is expected to start next week.
- B. NASA GSFC (Bill Fink and George Uhl):
  - a. No network update today.
  - b. Working on getting ready for demos at SC. One server is built with a second underway.
- C. NOAA (Ann Keene):
  - a. N-Wave has finished its deployments in Alaska in support of several offices of the National Marine Fisheries Service (Anchorage, Kodiak, Gibson Cove and two in Juneau).
  - b. N-Wave is in process of installing a POP at NASA/GSFC. It's currently expected to be up in early November.
- D. NRL (Linden Mercer): For its demos at SC21 NRL has installed hardware in the MAX suite in McLean, VA. The needed XCs are on order. There will be dual 400Gs to StarLight (SL) over ESnet through the coordination of the SCinet WAN team. There will also be 400G to NERSC via the ESnet testbed along with shared bandwidth from SL to SC in St. Louis, MO. The connectivity McLean<>SL<>SC will also support the GSFC demos.

- E. Pacific Wave (Jonah Keough):
  - a. In general things are nice and quiet.
  - b. Pacific Wave (PW) will be supporting demos for SC21. These will be virtual supporting among others Harvey Newman at Caltech. PW is turning up 6x100G for these.
  - c. PW is doing some final testing of its router servers.
- F. RNP (Alex Moura):
  - a. RNP is continuing the rollout of its core upgrade to 100G nationwide. Most of the northeast has been completed. Throughout the rest of 2021 and 2022 RNP will be working with the dark fiber providers to upgrade the rest of its backbone.
  - b. A new initiative is in process to build an under-river cable in the Amazon region. It's expected to be ready for first light in one to two years. This will reach underserved areas and support research and education in the North.
  - c. RNP has three large scale research and development projects with funding from now through 2025/2026:
    - i. Programmable Future Internet for Secure Software Architectures is funded for 2021 to 2026.
    - ii. Mentor Red is funded from 2022 to 2025. It uses modeling and experimentation to predict and detect DOS and Zero Day attacks.
    - iii. RNP has SFI which will slice future internet infrastructures. It is funded from 2020 to 2025.
  - d. RNP is supporting CP TECH Center for Weather Forecast and Climate Studies in its participation in the FABRIC Across Borders (FAB) award by getting CP TECH connected. CP TECH is part of Brazil's National Institute for Space Research and will be doing weather research.
  - e. RNP has used the just operational BELLA cable to enable two institutions to more directly move data from LNC. The performance over this link is asymmetric – good for Brazil to Europe but there are some dropped packets from Europe to Brazil. RNP is working with its partner, GÉANT, to resolve.
- G. University of Alaska (Shawn Armstrong): Nice and quiet – no update today.
- H. US Ignite (Glenn Ricart): US Ignite is doing seven communities - exemplars of unconnected communities – funded by the NSF and Schmidt Futures Foundation. They are trying aggressive ways to connect the unconnected.
  - a. The seven communities are:
    - i. Yonkers, New York is taking a look at how they can get youth to do the deployment and training so that that can go with a bigger scale.
    - ii. In Buffalo the University of Buffalo is actually running what is going to be a CBRS network. This will be interesting example as onward connective will be via the university's existing connection with the concomitant filtering.
    - iii. Cleveland has just passed 800 connections to a community network. Cleveland is using the funds generated with the sale its One Community network to a private owner to get a head start on connect the unconnected.

- iv. In Detroit Digital Stewards is running its own fiber cables. Much is aerial but in some places road crossings are being done using epoxy encapsulated fiber that is glued to the street.
  - v. Clinton County Missouri has 143 residents and is trying to connect 34 households of those 143 residents using wireless.
  - vi. Blue River, OR, had its network taken out by one of the California. They are exploring how to stand up a new network with a microwave backbone and CBRS for the connections so that the network is less dependent on fibers as the existing fibers were melted by the fire.
  - vii. Puerto Rico is doing a Community Center based connectivity plan. People will come to a local Community Center and use the Center's internet.
- b. US Ignite is working with these seven communities. We hope each is successful. Each will have a story to tell. These efforts may have some impact on how any Congressional funding for connecting the unconnected may be used in areas where there isn't an incumbent to step in.

## VI. Exchange Points Round Table

- A. PNWGP (Jonah Keough): No update this month.
- B. StarLight (Joe Mambretti):
  - a. Last month Starlight (SL) and its partners organized the 2<sup>nd</sup> Global Research Platform Workshop. The next day the Americas Research Platform Workshop was held. The presentations for both are online at the GRP's website: <https://grpworkshop2021.theglobalresearchplatform.net>.
  - b. SL is working with the SupercomputingAsia conference and helped build the testbed for the conference's Data Mover Challenge. SL and others are now using the testbed in the Challenge's competition.
  - c. SL's planning for SC21 includes:
    - i. SL is working with the SCinet WAN team to design and build a national testbed to support the demonstrations from SC's Network Research Exhibition.
    - ii. This testbed will include 2x400G waves between the Joint Big Data Tasking testbed at McLean, VA, and SL; 2x600G waves between SL and SC21 in St Louis, MO; and 2x100G from the West Coast to SL.
    - iii. The testbed will be used for a collaboration with the Open Science Grid on a 500G demonstration that will show some innovative techniques for High Energy Physics.
    - iv. Another demo will be the Network Optimized for Experimental Data (NOTED) project which will use AI/ML to attempt to predict large flows and provision circuits in anticipation. This is a collaboration of CERN, KIT, CANARIE, TRIUMF and others under CERN's leadership.
    - v. SL is supporting the work by GSFC & NRL on their nationally distributed high performance storage links. These take the techniques used in data centers and extend them across a WAN such that storage across the country can be used as if it were local - at near data rate.

- vi. Other demonstrations will include AutoGOLE/SENSE, P4 techniques, the integration of the Chameleon testbed with FABRIC, software defined XPs, DTN as a Service, and Named Data networking (in collaboration with Northeastern University and Caltech).

VII. Discussion of possible tasking to the JET for CY2022

Potential tasking was discussed (see below for what was the starting point). After a review of the process and the starting point tasking discussion ensued. It was suggested that connecting the unconnected - in general, not just the underrepresented and disadvantaged - would be an All Hands on Deck effort and the JET participants could help. After discussion this will be added to the tasking proposed to the LSN for its Annual Planning Meeting next month.

Starting Point for CY2022 tasking

Ongoing JET Tasks

- Assist in the planning of technology and application demonstrations of SDN & Big Data at SC22.
- Technology tracking: perfSONAR, SDN/SDX/SDI, Science DMZs, and network automation & orchestration.
- Hold two meetings collocated with R&E networking community conferences:
  - Internet2 Global Summit (22-25 May)
  - SC22 (November)
- Continue to schedule meeting round tables of updates on members’ networks, operational network security, exchange points and meetings of interest to the community
- Track Segment Routing.
- Continue coordinating the development of tools to monitor cross-domain workflows and automate the detection of transport issues. Additionally facilitate the sharing of measurement data between networks - anonymized as needed.

New JET tasking

- Encourage participation from diverse communities, including those from disadvantaged and underrepresented groups. This has the goal of creating awareness and opportunities for equal access and the benefits of science and technology. This would be done by a combination suggested contacts from the JET’s participants, by utilizing NITRD’s Minority Serving Institutions (MSIs) data base and Women in IT Networking at SC (WINS) participants.
- Track members’ steps on transitioning to IPv6-only over the next 4 years.

Potential JET Workshop: TBD

**Meetings of Interest 2020**

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

- Oct 19-20            [ARIN 48](#), virtual meeting
- Oct 19-21            [ESCC](#), virtual meeting
- Oct 28                [ARIN 48](#), virtual meeting

Nov 1-3	<a href="#">NANOG 83</a> , Minneapolis, MN, hybrid meeting
Nov 4	<a href="#">ARIN 48</a> , Minneapolis, MN, hybrid meeting
Nov 6-12	<a href="#">IETF 112</a> , in person cancelled, moved to a virtual meeting
Nov 14-19	<a href="#">SC21</a> , St. Louis, MO, hybrid meeting
Jan 16-19, 2022	<a href="#">PTC'22</a> , Honolulu, HI
Jan, TBA	Hawaiian Intranet Consortium
Feb 9-10	<a href="#">The Quilt Winter Meeting</a> , virtual
Feb 14-16	<a href="#">NANOG 84</a> , Austin, TX
Mar 1-3	<a href="#">SupercomputingAsia 2022</a> , Singapore
Mar 7-11	<a href="#">APAN53</a> , Bangladesh
Mar 19-25	<a href="#">IETF 113</a> , Bangkok, Thailand
Apr 24-27	<a href="#">ARIN 49</a> , Nashville, TN
May 22-25	<a href="#">Internet2 Global Summit</a> - tentative
Jun 6-8	<a href="#">NANOG 84</a> , Montréal, Québec, Canada
Jun 13-17	<a href="#">TNC22</a> , Trieste, Italy

#### **Next JET meetings**

*Note: It is anticipated that JET meetings will remain virtual for the foreseeable future*

Nov 16, 2021, 12-2 p.m. ET

Dec 21, 2021, 12-2 p.m. ET *n.b. Will be held only if needed*

Jan 18, 2022, 12-2 p.m. ET