



### Joint Engineering Team (JET) Meeting Minutes

Internet2 Global Summit 2019  
Mount Vernon Square room, Marriott Marquis Washington, DC  
901 Massachusetts Avenue NW, Washington, DC 20001

March 6, 2019, 7:00am-8:30am ET

#### Participants (\*remote)

|                         |   |                  |   |
|-------------------------|---|------------------|---|
| Celeste Anderson        | Pacific Wave/USC/Los Nettos                 | Paul Love        | NCO   |
| John Chapman            | Internet2                                   | Kate Mace        | ESnet/LBNL                                  |
| Wallace Chase*          | REANNZ                                      | Stein Mkandawire | ZAMREN                                      |
| Bruce Curtis*           | NDSU  | Ed Moynihan*     | International Networks - Indiana University |
| Dave Diller             | MAX   | Bill Owens       | NYSERNet                                    |
| David Farmer            | University of Minnesota/<br>Northern Lights | Jørgen Qvist     | NORDUnet                                    |
| Dale Finkelson          | Internet2                                   | Glenn Ricart     | US Ignite/University of Utah                |
| Brad Fleming            | KanREN                                      | Anne Richeson    | CenturyLink                                 |
| Tom Fryer               | GÉANT                                       | Kevin Sale       | KARST                                       |
| Andrew Gallo            | CAAREN                                      | Paul Schopis     | OARnet                                      |
| Mike Gill*              | NIH   | Jeff Schwab      | Purdue University                           |
| Patty Giuntoli          | ESnet                                       | Robert Sears     | NOAA  |
| Peter Heverin           | MAGPI                                       | Frank Seesink    | WVNET                                       |
| Rommel Hidalgo          | University of Guam                          | David Smith      | ORION                                       |
| Paul Howell             | Internet2                                   | Shannon Spurling | MOREnet/GPN                                 |
| Jonah Keough            | Pacific Wave/PNWGP                          | Jim Stewart      | UETN  |
| Kazunori Konishi        | APAN-JP                                     | David Teach      | University of Oregon/<br>Route Views        |
| Kevin Kranacs*          | NASA – EOS                                  | Kevin Thompson   | NSF   |
| Jim Kyriannis           | NYSERNet                                    | George Uhl*      | NASA - GSFC                                 |
| Charles von Lichtenberg | Boston University                           | David Wilde      | AARNet                                      |
| Len Lotz                | TENET                                       | Chris Wilkinson  | Internet2                                   |

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

#### **Action Items (new):**

- 1) Internet2's Next Generation Network update is rescheduled to April.

#### **Action Items (carry forward):**

- 1) Plans for ESnet6's Optical Core were updated (now to be done as a webinar, date to be announced).
- 2) NORDUnet spectrum sharing (March).

## **Review of the Minutes of the November 2018 meeting**

No corrections to the minutes for the November 2018 were mentioned. It was noted that some were being submitted.

## **Operational network security roundtable**

### **ESnet: Patty Giuntoli**

No comment.

### **Internet2: Paul Howell**

Encouraged everyone to take a close look at what is required to join MANRS (Mutually Agreed Norms for Routing Security). This is a foundational floor that many in the R&E and government networking communities should be striving for. (Note: Please see the minutes from last September's JET meeting for the talk on MANRS given by Michael Sinatra).

### **NASA: Kevin Kranacs**

No comment.

### **NIH: Mike Gill**

No comment.

### **NOAA: Robert Sears**

"We do it, we like it." The most significant item for NOAA has been its perimeter and defense TIC services, which continue to mature and are constantly being broadened. It has been about two years since these services were initially deployed in the five authorized sites (Washington, DC area, Dallas/Ft Worth, Denver, Seattle and Honolulu). They became fully operational during 2018.

### **AARNet: David Wilde**

- It's turning up a SOC. Would like to talk with other NRENs who operate one.
- AARNet is developing a DDOS detection and mitigation service using a Flowmon's DDOS-Defender. Flowmon is a spinoff from the Czech NREN, CESNET.

## **Networks Round Table**

### **CARREN: Andrew Gallo**

No update.

### **ESnet: Patty Giuntoli**

ESnet is very close to finishing the design of ESnet6. The independent final design review is scheduled for May 15-17, 2019.

### **Internet2: Chris Wilkinson**

Internet2 is deep into its Next Gen refresh

- Chris for questions in general and about optical
- Scott Taylor is running the process for packet

- George Loftus is running the process for services

**NASA EOS: Kevin Kranacs**

- The network is in a constant state right now
- EOS has its science TICAP in place; it is keeping up with new requirements from DHS

**NIH/NLM: Mike Gill**

No update today.

**NOAA: Rob Sears**

- N-Wave's 100gbps backbone upgrade that utilizes Internet2 is progressing
- It is also upgrading its DC metro DWDM ring to 400gbps using new Ciena Ai equipment. This will support many of NOAA's DC area facilities including the National Weather Service's College Park, MD, facility that disseminates all the life and property data to the public. The latter's backup location is in Boulder, CO, supported by the backbone upgrade.

**Pacific Wave: Jonah Keough**

No update today.

**NYSERNet: Bill Owens**

NYSERNet is nearing completion of a statewide network upgrade.

- NYSERNet has developed a new path between the network's extreme – Buffalo and New York City (NYC) – thereby establishing redundancy to the network that's been running for the last 14 years.
- It will have ADVA gear – flexible grid, colorless DWDM.
- NYSERNet has started a project that would use Internet2 alien waves to reach from NYC to Ashburn, VA, and back to Buffalo. The completion of this project is estimated to occur in June.

**GÉANT: Tom Fryer**

- GÉANT currently has two types of connections: fiber (14 countries), with leased circuits for the rest (primarily multiple 10gbps circuits).
- GEANT has just started a new project, funded by the EU, to go from shorter term arrangements to longer term IRUs.
  - Spectrum sharing will be used where it's appropriate
  - 24 countries will be on fiber
  - Seven countries will remain on leased circuits. Minimum will remain 10gbps, with that rising to 100gbps by the end of the project
  - Initial segments are expected to go live in 2020-2021; completion in 2020.
- GÉANT's global connectivity is expanding.
  - It now has 2x10gbps circuits to China
  - It is working with NII and SInet to bring in 100gbps as part of their round-the-world 100gbps deployment

- WACREN has recently connected to GÉANT's open exchange in London at 10gbps (as are many other R&E networks, including several from other parts of Africa).

### **REANNZ: Wallace Chase**

- REANNZ has upgraded its core routes to 100gbps across both islands; other segments are also being upgraded to 100gbps
- REANNZ has enhanced its peering and increased in-country cashing.
- REANNZ has upgraded its monitoring capabilities.
- REANNZ has also done a lot of RPKI work and is working towards a MANRS certification.
- REANNZ works on the Faucet controller, which is used in parts of the REANNZ network.
- The biggest item over the last year was the New Zealand owned Hawaiki cable system. It connects New Zealand to Hawaii and the US mainland, with a run across the Tasman Sea to Australia.
- REANNZ initially has 20gbps with the ability to increase to 2tbps over the 25-year contract.
- Hawaiki has a branching unit into American Samoa ( it has others not yet in use).
- REANNZ is working with the University of Hawaii and the University of Guam to breakout at the cable's Hawaii landing. This will give better access to western Pacific islands and Asia.
- REANNZ is looking for redundancy, perhaps to Asia, for when its contract with Southern Cross ends in May.

### **University of Guam/GOREX: Rommel Hidalgo**

- Guam has become a strategic communications hub with many submarine cables landing on it.
- The university via GOREX has:
  - 100gbps to Hawaii through the University of Hawaii.
  - 10gbps to Hong Kong through TransPAC.
- GOREX:
  - Goals:
    - Leverage the strategic location of Guam
    - Establish an open R&E exchange
    - Improve Pacific-wide transport diversity and resilience
    - Promote increased growth and the effectiveness of data, as well as intensive and collaborative R&E in the Asia-Pacific region and with the global R&E community at large
  - GOREX went live in January 2018.
  - It provides local, hands-on training and works with Network Startup Resource Center (NSRC) to help with training elsewhere.

### **International networking at Indiana University: Ed Moynihan**

- TransPAC: All stable.
- NEAAR: Established the peering with WACREN in London about a month ago.

- Nigeria and Ghana are currently connected.
- Togo will connect in the near future.
- Ivory Coast, Mali and Burkina Faso are investigating connections.

### **Zambia Research and Education Network (ZAMREN): Stein Mkandawire**

- ZAMREN was founded in 2012, covers all ten provinces of Zambia, and has 126-member institutions
- Its bandwidth has grown from 155mbps to 2.5gbps; concomitantly the cost has dropped from ~\$6k/mbps to \$8/mbps
- For international connectivity, ZAMREN has:
  - Dual, diverse paths to Cape Town, South Africa, (2.5gbps and 1.8gbps)
  - 2.5gbps to Dar es Salaam, Tanzania
  - 620mbps to Blantyre, Malawi
  - From Dar es Salaam the UbuntuNet Alliance connects to the Netherlands
  - From Cape Town connections reach London, UK, and the UbuntuNet Alliance in both Dar es Salaam and Nairobi, Kenya
- ZAMREN is helped in reaching its members by the electric company (ZESCO), the telephone authority (ZICTA), and the telephone company (Liquid Telco). These provide long haul and local loop services at little or no cost.
- ZAMREN's international partners are key to its progress: the NSRC, Indiana University, Astrial Learning, Center for High Performance Computing (in South Africa), and the UbuntuNet Alliance.
- ZAMREN is working with to increase their staffs' knowledge on a variety of issues including IT, network operations, and cyber security.

### **AARNet: David Wilde**

AARNet is a consortium partner in two submarine cable projects:

- INDIGO: Sydney to Perth and Perth to Singapore
- JGA (Japan-Guam-Australia): AARNet is a partner on the southern portion: Sydney to Guam (GOREX) for both connections to other R&E networks at GOREX and to reach onward to Asia. AARNet will probably acquire a GOREX to the Hong Kong circuit and perhaps a circuit to Japan.

### **ARIN: Dave Farmer**

Earlier this year, the University of Pennsylvania Law School published a paper titled "Lowering Legal Barriers to RPKI Adoption". This paper was funded by the NSF. It analyzes the legal issues in North American that surround RPKI. ARIN is reviewing the article and will probably have comments at its next meeting (7-10 April). The paper can be found at:

[https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3308619](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3308619)

### **Exchange Points Round Table**

#### **PNWGP: Jonah Keough**

No update today.

**MAX: Dave Diller**

- MAX has reworked their fiber plant in Northern Virginia to get rid of some old fiber and simplify the infrastructure going forward.
- MAX has started to look into and use alien waves; it has utilized a Fujitsu DWDM system for several years with 100gbps; more modern hardware is significantly less expensive, so it is testing Ciena Waveservers and comparing it with the existing system

**WIX and MAN LAN: Dale Finkelson**

- Internet2 is planning hardware upgrades at both locations. The existing equipment is several years old and is getting dated. At MAN LAN, the gear is also near capacity. The date for these upgrades has not been set.
- MAN LAN has just completed upgrading SInet's connection to 2x100gbps as part of SInet's round-the-world 100gbps circuit.

**US Ignite: Glenn Ricart**

- There are currently 27 Smart Gigabit Communities. US Ignite has been working in these communities to develop gigabit capable local exchange points to remove bottlenecks between the gigabit networks in a Community.
- US Ignite has started to deploy some edge computing for Smart Communities.
- US Ignite is helping turn up a Digital Town Square in the greater Las Vegas, NV, area. In addition to the gigabit interconnect and edge computing, as a Digital Town Square it will have a data serving node (DSN). The DSN looks much like a DTN.

**NORDUnet's spectrum sharing – Jørgen Qvist**

- The current NORDUnet (NDN) architecture was designed a decade ago. While it was a good fit then, NRENs need to support much different needs and services now. Modern technology provided the opportunities to meet these expanded needs.
- NDN's new network will use 100gbps coherent light and disaggregation: Open Line System (OLS) with Data Center Interconnect transponders.
- It has used cross boarder fiber and alien waves for several years. Since NDN operates on a federated operations model (as does ANA – the Advanced North Atlantic collaboration), the operation of shared resources presents no problems to NDN and its member NRENs.
- Spectrum allocations between NRENs and NDN have been agreed upon, with the spectrum allocated in 50 GHz slots. Initially, each Nordic NREN provided NDN 4x50 GHz. NDN will cover the incremental cost of getting access to the spectrum.
- Before NDN started this network upgrade design in 2016, it was agreed by its members that infrastructure would be shared. Due to the spectrum sharing, NDN would not operate any fibers within the Nordic countries: "Don't ask what NORDUnet can do for you, ask yourselves what you can do for NORDUnet."

- NDN and its members agreed on a cost sharing model where all realized the savings from the new design, but each member was compensated for the work it did as part of the new NDN.
- With continued growth services such as the cloud and centralization, a network must be designed for 100% availability: “Redundancy to support ‘100% availability’ starts with the number 3.”
- NDN’s existing OLS (Ciena 6500) has several more years where it can adequately support the new network’s spectrum sharing, so it will be kept on lowering the initial investment required.
- NDN’s NEXTgen Network Objectives:
  - Accommodate ladder architecture – new paths that provide connections between the existing NDN members thereby enhancing resiliency.
  - Add redundancy out of Norway as per the Norwegian Communications Authority report’s recommendations.
  - As part of NDN’s target for 100% availability as some members have experienced cyber issues and attacks it has:
    - Adding redundancy – N+3 (sometimes N+4).
    - Have topology to protect against major city or regional infrastructure outages.
    - Have one link from each NREN to Europe that does not touch any other Nordic NREN.
  - Use NREN spectrum where technically possible.
  - Use NDN fiber only where necessary.
  - Take into account the requirements for any known major infrastructure projects in the Nordics, i.e.:
    - ESS - European Spallation Source located in Lund, Sweden, and Copenhagen, Denmark. Operation targeted to start 2019-2020 with full capacity reached in 2022.
    - EISCAT\_3D - Incoherent Scatter Radar facility which will be located in the far north of Finland, Norway and Sweden. Targeted for 2022.
  - Create sufficient redundancy to lower the operational cost by:
    - Minimizing the need for 24/7 support in the classic sense.
    - Lowering the on-site support levels and making spare parts only need to be available on the Next Business Day.
    - Establishing a federated operations model.
- Ensure that NEXTgen is AUP free with an EU footprint that still makes NDN an attractive partner for NREN’s and commercial operators.
- The new NDN plans to have these international connections:
  - Amsterdam – London
  - London – Frankfurt
  - Frankfurt – Berlin
  - And at least one route out of Scandinavia not touching Hamburg.
- Completion is targeted for the end of 2021.

- Questions:
  - Are there issues when traversing different vendors' hardware over the members' networks? Not with modern OLS equipment using coherent light. There is a measure of trust that the underlying owner will not do anything disruptive. At least in the NDN/Nordic NRENs case, something like this would do more damage to the owner than to NDN.
  - Are you planning any OEO? Only where the distance involved requires it.
  - What are your plans for bandwidths above 100gbps with their shorter distances? NDN is looking at 200gbps at distances up to about 1200-1400km using 50 GHz. 400gbps would require 67.5 GHz to reach 800-1000km.

### **Meetings of Interest**

|            |   |
|------------|---|
| April 7-10 | <a href="#">ARIN 43</a> , Bridgetown, Barbados      |
| June 10-12 | <a href="#">NANOG76</a> , Washington, DC            |
| June 16-20 | <a href="#">TNC19</a> , Tallinn, Estonia            |
| July 20-26 | <a href="#">IETF 105</a> , Montreal, Quebec, Canada |
| July 22-26 | <a href="#">APAN 48</a> , Kuala Lumpur, Malaysia    |
| Sep 17     | GLIF Americas Workshop, San Diego, CA               |
| Sep 17-18  | Global Research Platform Workshop, San Diego, CA    |
| Sep 19-20  | GLIF community/GNA meeting, San Diego, CA           |
| Sep 24-25  | National Research Platform, Minneapolis, MN         |

### **Next meeting**

April 16, 2019 12-2 p.m. ET, NCO/NITRD, Washington, DC  
 This will be the 3rd DC area Face-to-Face meeting of the JET. The room will be available 11:30-2:30.