



Connecting Global Science: International Networks at Indiana University

Brenna Meade

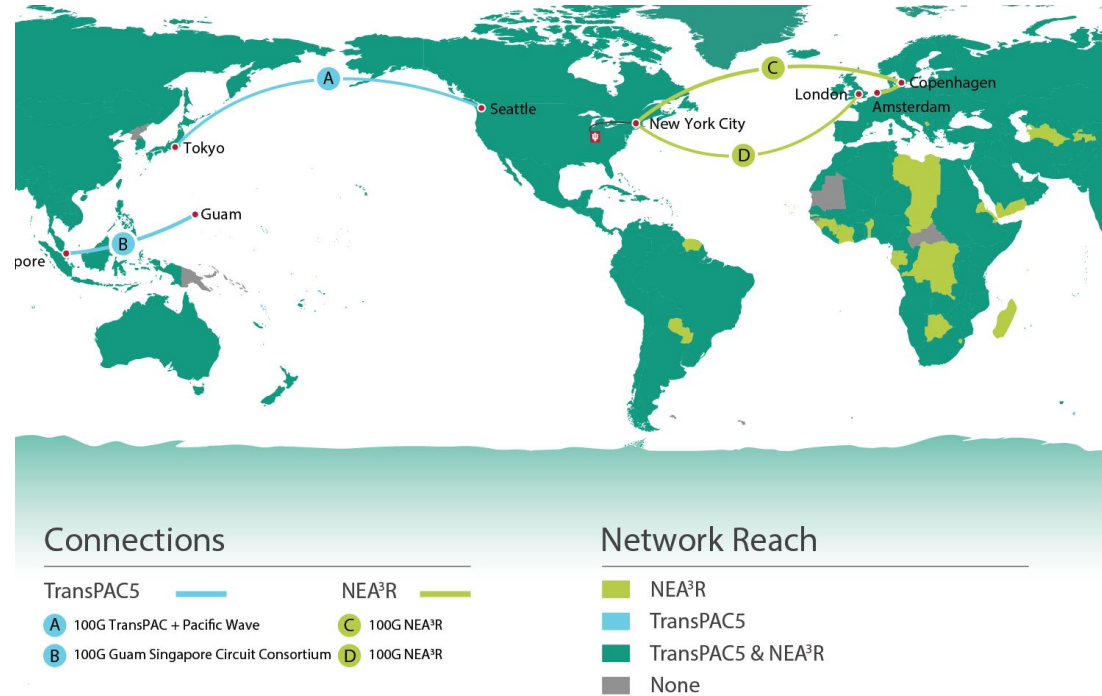
Senior Network Architect



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Networks**
at Indiana University

International Networks @ Indiana University (IN@IU)

- 25 year history of operating international networks and building partnerships
- Currently support 3 100G & 1 400G link with 2 US NSF awards (TransPAC and NEA3R)
- Coordinate globally to ensure US researchers have worldwide access to networking services
- Work with research groups to improve international data flows via engagement and training
- Projects carry traffic data from researchers in 84% of the world



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NEA3R



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- Circuits
 - New York <> London 100G on AEC-1 cable
 - New York <> Amsterdam 400G on AEC-2 cable
 - Part of Advanced North Atlantic (ANA) collaboration
- System of partner provided circuits as named points of collaboration
 - GÉANT 100G New York <> Paris
 - NORDUnet/SURF 100G circuit Copenhagen <> Montreal
 - UbuntuNet Alliance 10G Dar es Salaam <> Amsterdam
- Services
 - NetSage Measurement and Monitoring Framework
 - Performance Improvement via research engagement and training
 - Routing Anomaly detection
 - Support for Network Experimentation



TransPAC5



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Services

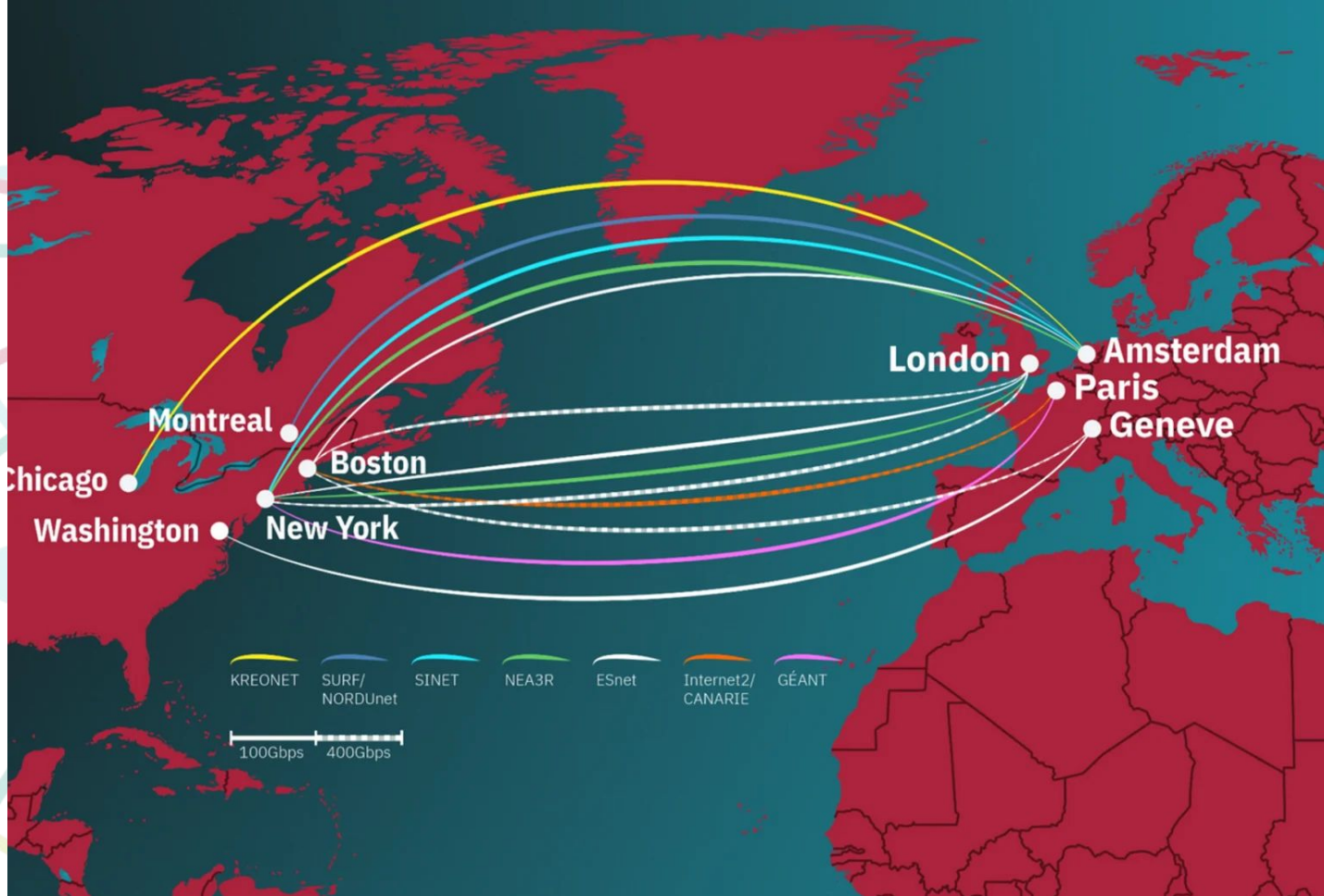
- NetSage Measurement and Monitoring Framework
- TestBed support (FABRIC, SC, DMC)
- Experiment support
- LHCONe Network Service Provider
- End user science support

Circuits

- TransPAC-Pacific Wave 100G between Seattle and Tokyo.
- Guam-Singapore Connectivity Consortium (GSCC) 100G between GOREX and SingAREN
- Part of APOnet Consortium



ional
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aponet ASIA PACIFIC OCEANIA NETWORK (APOnet)



NA-REX North America Research & Education Exchange Collaboration





2025 and Beyond

- TransPAC will continue to operate into 2028
 - Connecting to new FUJI-XP in Japan
- In partnership with Internet2 NEA3R 100G NY <> LOND will be upgraded to 400G - December 2025
 - Connecting Directly to Internet2's MANLAN Exchange
- Lead Engineering system coordination via APOnet and ANA
- GNA-G Leadership team - Brenna Meade
- Measurement and monitoring dashboards
- Support for Auto Gole / Sense / NSI on all links
- Collaboration with NIH & Starlink in Africa

ANA Engineering Platform WG



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Recommend an automation tool that enables ANA to run as a system, capturing details such as ports, VLANs, bandwidth, requesters, etc.

Ensure the tool provides shared access for all collaborators to maintain full visibility

Contributions from Internet2, IN@IU, SURF, ESnet

Federated NSI Framework for ANA



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- Authoritative Source of Truth – Centralized database & UI with automated L2 provisioning via NSI
- Automated Inventory – Real-time tracking of ports, VLANs, bandwidth, and requests
- Use existing NSI provider agents and federation layer (Aggregator, Distributed Data Store);
- Develop an ANA-specific requester agent.
- Phased Implementation – Initial rollout with NEA3R, Internet2, CANARIE, SURF; expansion to GEANT & ESnet
 - Phase 1: NEA3R NY<> AMS pilot
- Timeline – Q4 2025 pilot → 2026 expansion → Full migration by Q4

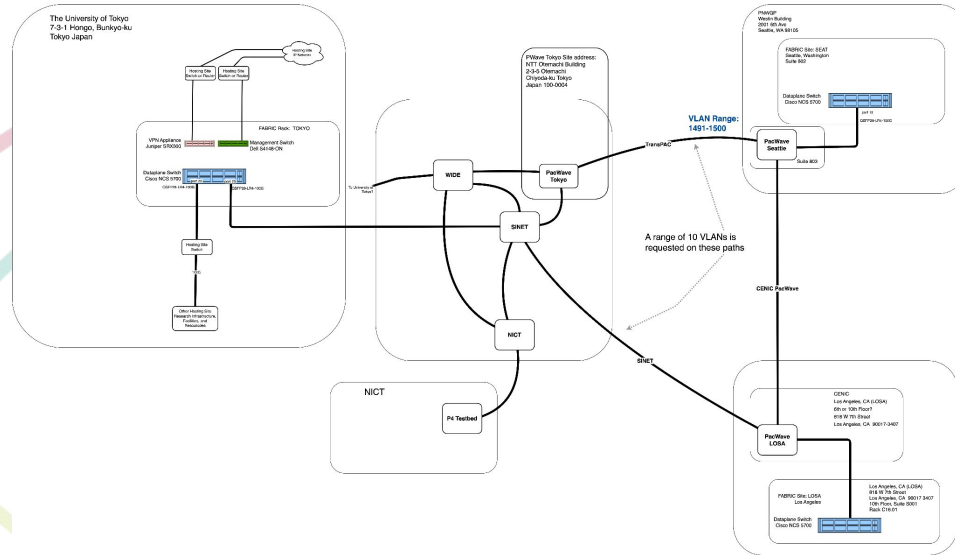
Support Global Research



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- FAB / FABRIC
- EHT
- GNA-G Routing Working Group

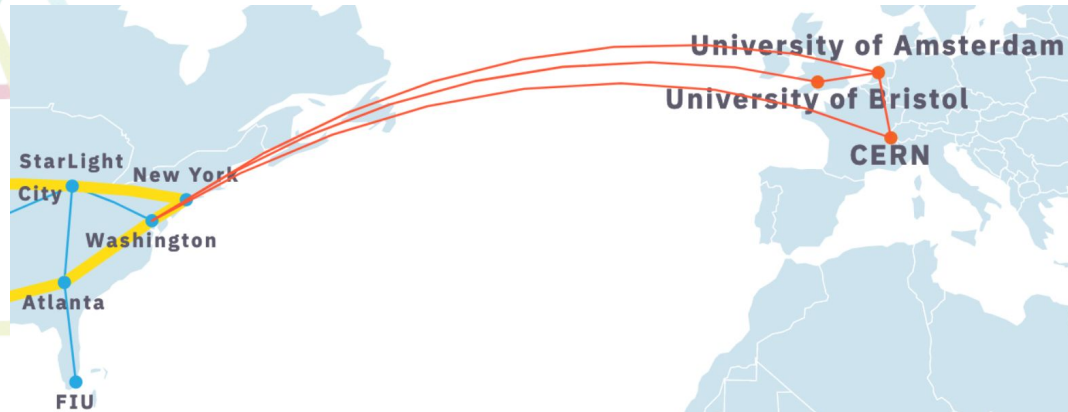
FAB Tokyo - 2024



TransPAC provides connectivity between Seattle and Tokyo for FABRIC nodes at University of Tokyo

FAB - EU

- Provide international connectivity for FAB in the EU
- Supporting nodes at University of Amsterdam, University of Bristol and CERN



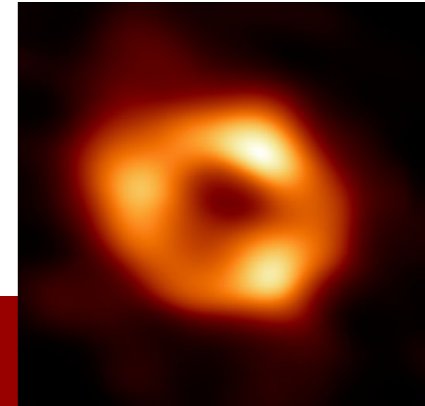
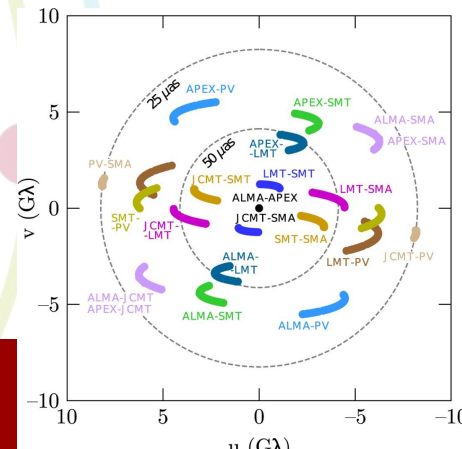
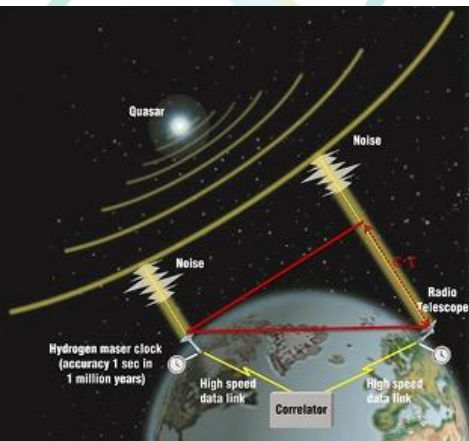
EHT Collaboration



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- The Event Horizon Telescope (<https://eventhorizontelescope.org/>) is an international array of **11** millimeter and sub-millimeter wavelength telescopes using Very Long Baseline Interferometry (VLBI) to image the strong gravitational effects near black holes. The array spans the world creating a telescope with an effective Earth-sized aperture. This capability leads to studies in general relativity, accretion and outflow processes at the edge of a black hole, and other fundamental black hole physics.
- **Currently this data is recorded to disk storage media and shipped to MIT Haystack Observatory in Massachusetts and MPIfR in Bonn, Germany for data correlation/processing.**
- Varying levels of connectivity to their regional, wide area, and international research and education (R&E) networks.



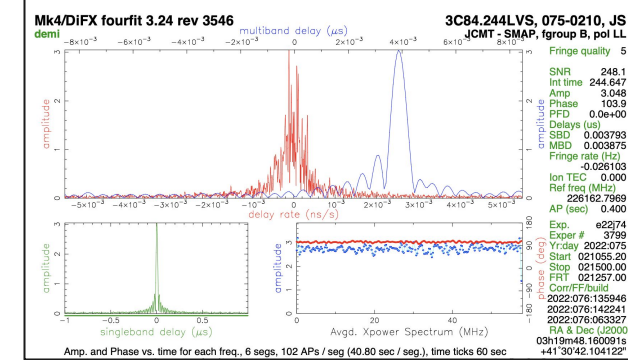
Pre Check Demonstration at SC24 and TPRE

- Why a Precheck Process?

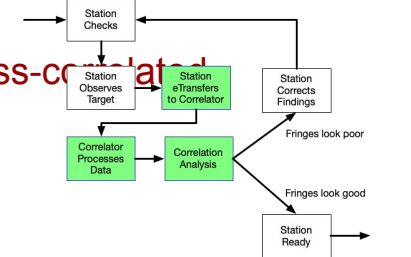
- Nanosecond timing check between site critical
- Quantify the network between station and correlator.
- Check current performance (perfSonar)
- Transfer actual observation data over the R&E networks live
- Prepare the data on the correlator for processing
- Kick-off correlation - Correlation will produce fringe plot and statistics of the cross-correlated data between at least 2 stations
- Analysis of the fringe plot, identifying any issues
- Relay information to the stations for correction or START Campaign

● DEMONSTRATION between Hawaii and Haystack

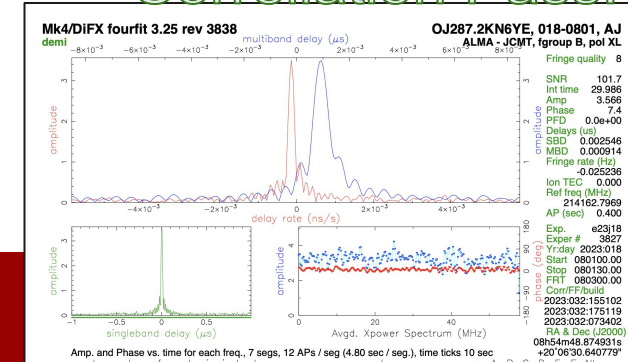
- 30 seconds of data sent from Hawaii to Haystack in ~3 minutes
- Precheck correlation took ~3 minutes.
- Allows correlation check in minutes not months!
- **Much faster time to science!**



Correlation Fail



Correlation Pass!



EHT issues and next steps identified

EHT Site issues

- People Issues
 - Lack of dedicated IT staff at sites
 - Funding and Hiring issues
 - Staff are overworked and spread thin
 - Not a priority since “Shipping disks” just works
- Last Mile connectivity issues
- Connections to regional networks
- Internal Site Networking Issues
- scheduling time is a challenge
- **Socialize with EHT consortium (and others) that use of available R&E networks will reduce cost (of shipping disks) and accelerate time to science!**

Next Steps

- Work with each station to:
 - Document current issues network or otherwise
 - Diagram network path at station to both correlators.
 - Network testing to correlators
- Write report on the findings overall
- Put together a team to tackle the issues found.



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Routing Working Group

Goals:

- Work on international routing issues TOGETHER to improve performance.
- Engage network owners and NRENs to address ineffective routes
- Proactively identify issues and create best practices

25 solved cases

170 members on the email list from over 25 different countries

Active Slack channel - APAN #Routing

(https://join.slack.com/t/apan-network/shared_invite/zt-2gdzd58zp-r8Vzry_SAVplwIXFJJyDgg)

THANK YOU!

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