Collaborating through COVID: Challenges, Opportunities, and Lessons from the NEAAR Project

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& AFRICAN RESEARCH

NEAAR Project

- IRNC: Backbone: NEAAR: Networks for European, American, and African Research
- 5 main partners:
  - IU, GÉANT, UbuntuNet Alliance, ASREN, WACREN
- Several national partners:
  - RENU, KENET, ZAMREN, TERNET, TENET, MoRENet
- 100G Circuit to Europe
- perfSONAR support and training
- Science Engagement

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Traditional IN@IU Engagement Efforts

- Partner relationships
- Visibility in science communities
- Education and training
- Targeted outreach to NSF and NIH awardees (mining databases)
- Following leads from partners and other sources (reactive)

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perfSONAR training

- performance Service-Oriented Network monitoring Architecture
- Network measurement toolkit designed to provide federated coverage of paths and to establish end-to-end usage expectations.
- NEAAR funds targeted node deployments
- Training workshops:
  - expand the number of nodes available for testing
  - the number of engineers with expertise in using the perfSONAR toolkit.

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RENU training workshop

- In 2019, we began planning a weeklong hands-on training workshop for RENU's members.
- In December 2019, we finalized plans for RENU to host the workshop in Kampala the week of July 27-31, 2020.
- Unfortunately, in March, the workshop was postponed due to COVID-19 related travel restrictions.
- Throughout 2020, the NEAAR partners worked together to determine if it was possible to re-schedule a hands-on workshop.
- In late 2020, we agreed to design a virtual workshop to be held in February 2021.

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RENU virtual training workshop

- Narrowed down to agenda items that could be done virtually
- Walked through use cases
- Focused on understanding the value perfSONAR deployments can bring to an organization

Lessons:

1. Webinar, not workshop
2. Shipping nodes was problematic
3. Hand's-on aspects are critical
4. Follow-ups are necessary

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Proactive Science Engagement

- Adapting science engagement and end-user outreach efforts to the new realities.
- International data flows between institutions, and data sources related to COVID-19 research.
- Use of NetSage to:
  - Identify top-talkers and science domains
  - Flag changes in volume and rate
  - Detect anomalous routes
- Starting point for End-to-End performance debugging for data transfers
- Improved understanding of how infrastructure is used
- Opportunities for improved performance

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NetSage Use Cases

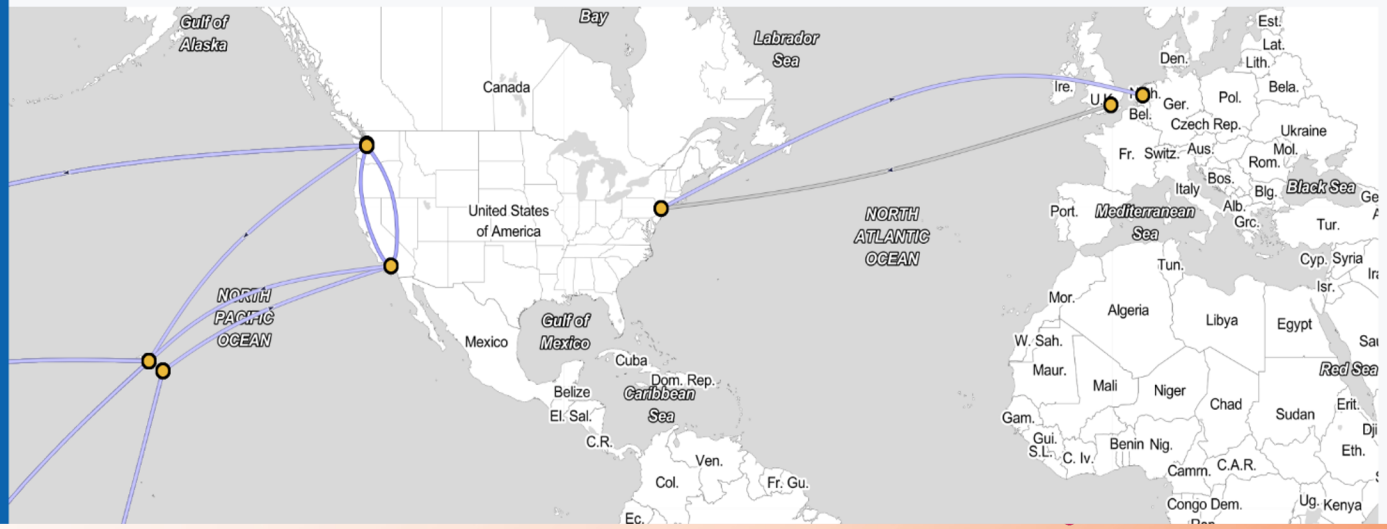
- What is the current state of the network?
- What are the top sources/destinations of flows?
- What are the top flows by organization?
- What do individual flows look like?
- What are the top flows by country?
- What are the flows by science discipline?
- What are the flows by project?
- Who are the top talkers over time?
- What are the patterns in science data transfers in the network?
- What are the bandwidth patterns in the network?
- What are the current flow data summary statistics?
- Advanced Flow Analysis

Last 24 hours

Bandwidth Dashboard

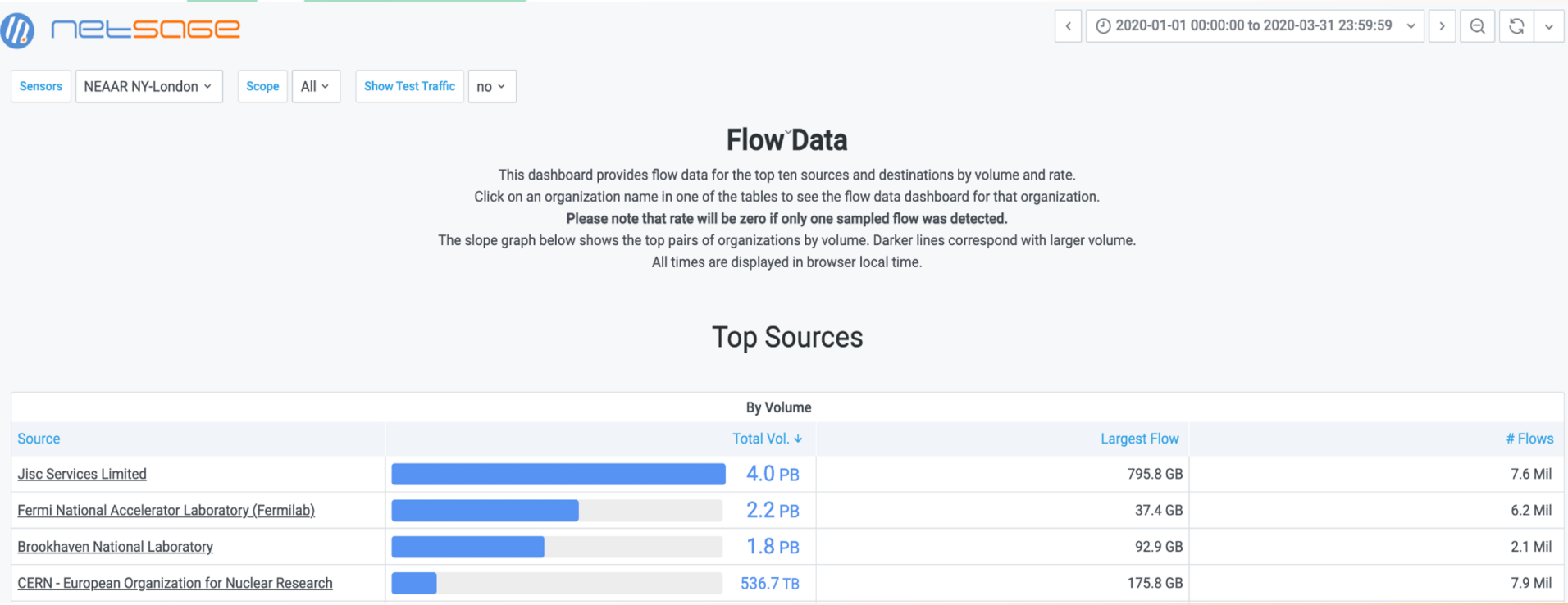
the minimum, maximum, and average bandwidth utilization of the circuits and exchange points over the selected time period.
he rows below the map show each of the links in more detail, including traffic rate and total volume transferred.
A combined view of the average and maximum bandwidth utilization is shown at the bottom of the page.
All times are displayed in browser local time

Single Link Max Z-A	Average Across All Links	Total Transferred
20.6 Gb/s	5.88 Gb/s	953 TB



Identifying Performance Issues - EBI Covid data

Jan - March 2020 we saw an increase in data transfers between JISC and US Sites



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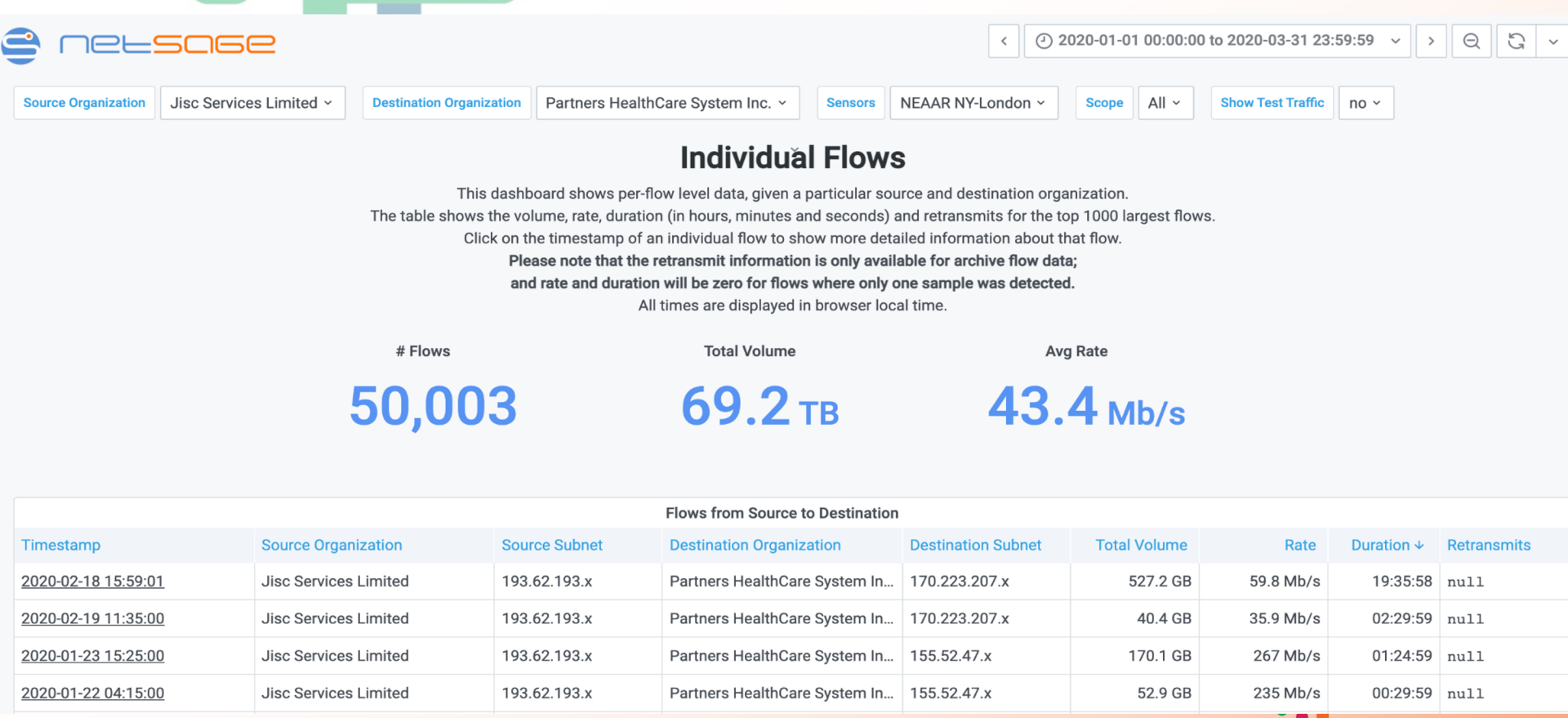
Identifying Performance Issues - EBI Covid data

Identified main source of increase as European Bioinformatics Institute (EBI) and destination Partners Healthcare Systems (PHS)



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NetSage can show us:

- 1TB total between EBI and PHS in 2019
- January 2020 - March 2020 70TB transferred
- Transfers were averaging <50Mbps, with significant variance ~400Mbps and others only ~5Mbps
- Very low for standard downloads on what we believed to be at least a 10G path end-to-end.

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Improving Performance - a Global Effort

- Outreach to partners at GEANT and JISC
- JISC contacted EBI and put us in touch with a technical contact
- Reached out to NOX and MIT
- In March 2020, IN@IU staff brought together engineers from both institutions to examine traffic routing and to test the end-to-end network path
- Hand over to engineers for resolution

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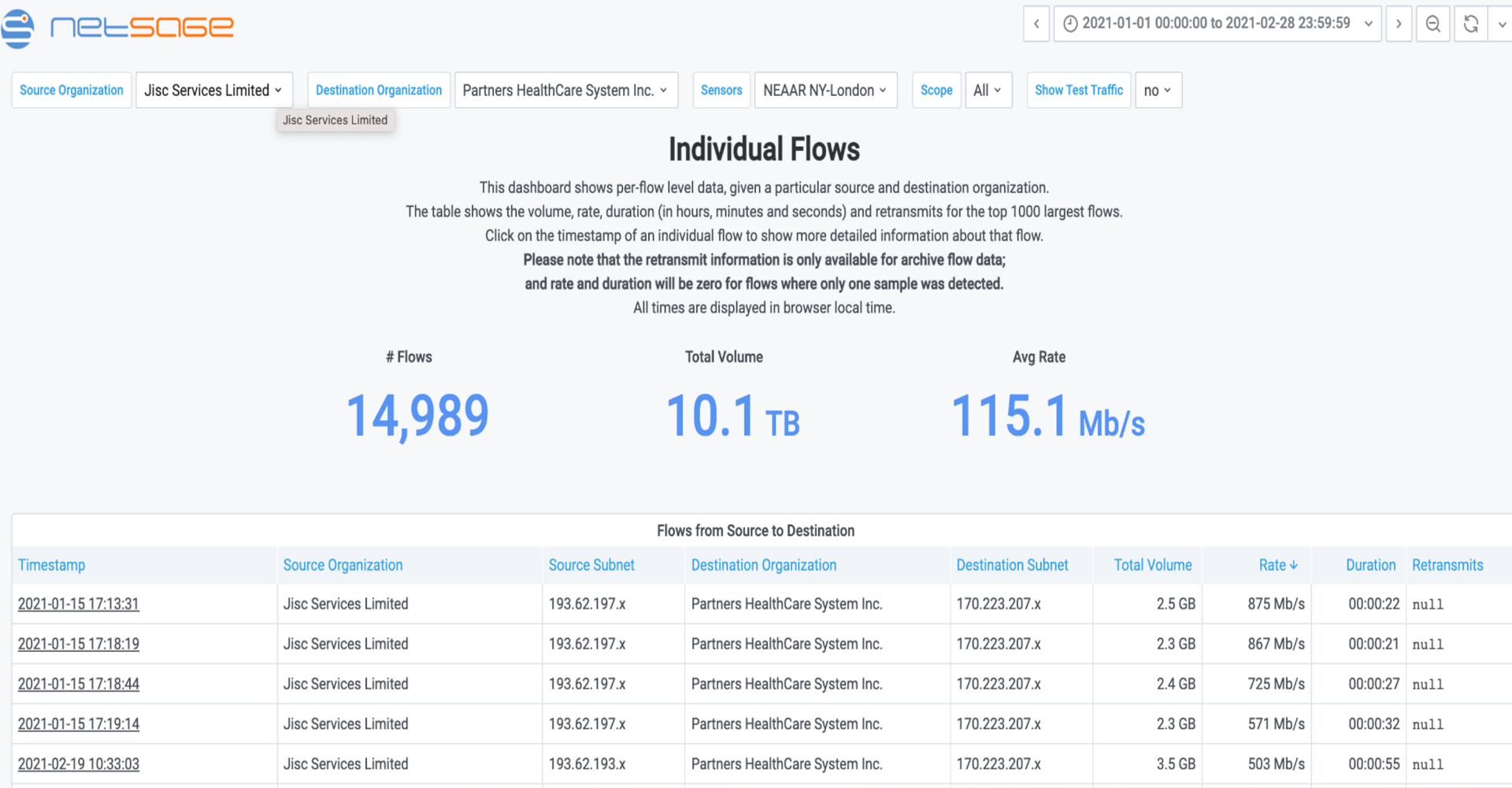
Improved Performance

Load balancer and firewall overload at EBI; Internal adjustments: <50Mbps to 100Mbps+



Other examples: Identifying Routing Issues

NetSage can also provide insight into how R and E traffic is routed

Top Pairs

Top Pairs

Source	Destination	Total Vol. ↓	Largest Flow	# Flows	Avg Rate	Peak Rate
WIDE Project	RWTH Aachen University	15.1 GB	2.8 GB	7.0	5.6 Mb/s	5.7 Mb/s
Federal State Institution Russian Scientific Center Kurchatovsky institute	Office of Info.Tech. Admin. for Educational Development	14.6 GB	946.4 MB	86.0	13.0 Mb/s	68.6 Mb/s
Australian Academic and Research Network (AARNet)	Academia Sinica	14.4 GB	1.8 GB	104.0	24.4 Mb/s	143.4 Mb/s
China Education and Research Network Center	King Abdullah University of Science and Technology	14.2 GB	2.4 GB	199.0	11.9 Mb/s	180.4 Mb/s
Academia Sinica	Renater	13.6 GB	1.6 GB	79.0	76.5 Mb/s	114.0 Mb/s
King Abdullah University of Science and Technology	King Abdul Aziz City for Science and Technology	13.5 GB	4.7 GB	7.0	5.2 Mb/s	5.8 Mb/s
National Taiwan University	Jisc Services Limited	13.4 GB	8.4 GB	55.0	5.0 Mb/s	54.7 Mb/s
Academia Sinica	Jisc Services Limited	12.8 GB	2.8 GB	51.0	26.5 Mb/s	249.0 Mb/s
Auckland University of Technology	CERNET2 IX at Northeast University	11.9 GB	101.3 MB	154.0	2.0 Mb/s	2.8 Mb/s

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GNA-G International Routing Working Group

Established to create a community to work on international routing issues to improve R&E performance. The goal is to engage network owners and NRENs to not only reactively discuss and address ineffective routes, but will work proactively across the community to systematically create policies to prevent them from occurring.

- **Co Chairs:**
  - **Brenna Meade , Indiana University**
  - **Warrick Mitchell, AARNET**
  - **Hans Addleman, Indiana University**

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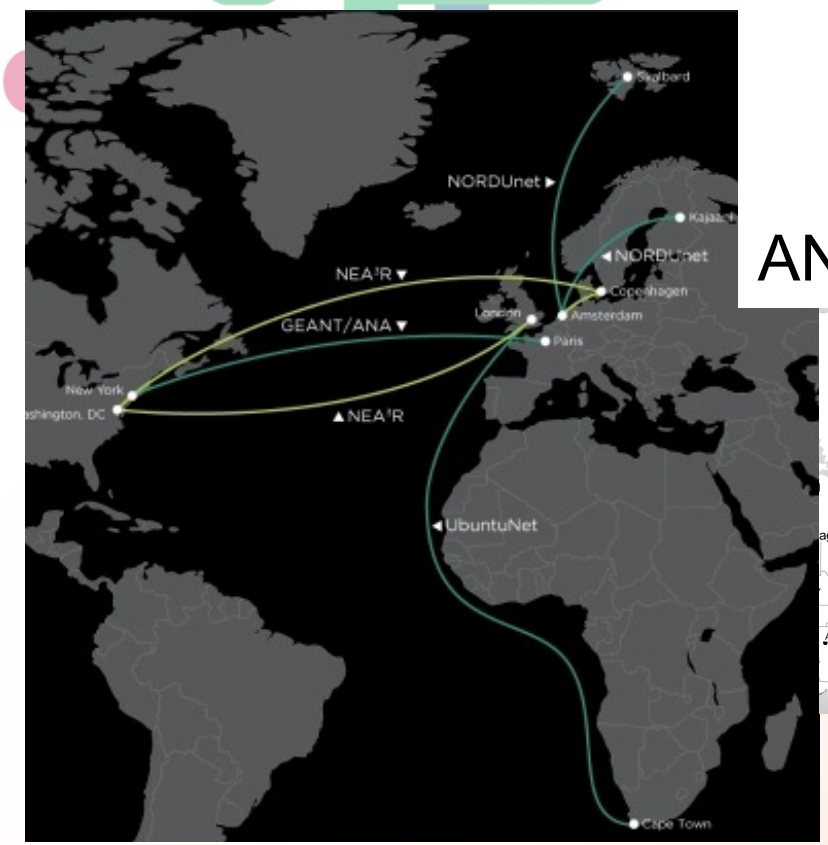
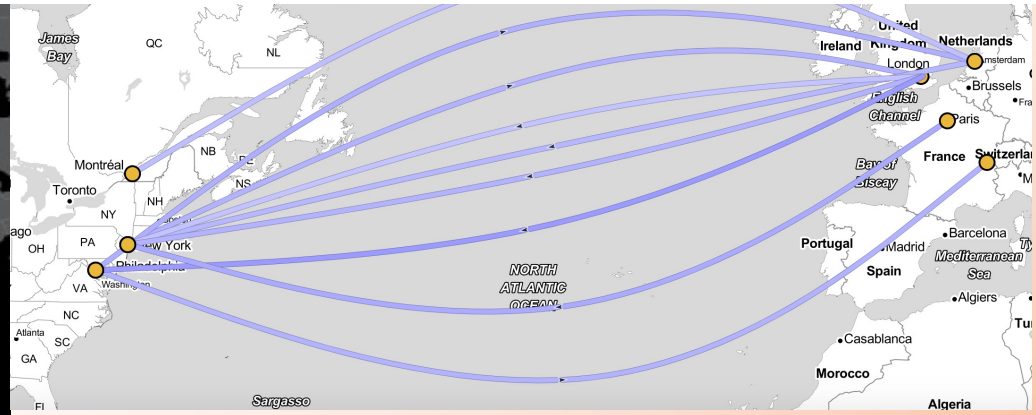
Networks for European, American, African, and Arctic Research (NEA³R) and the Advanced North Atlantic (ANA) Consortium

NSF funds:

- 100G NY-London
- 100G NY-Copenhagen-Amsterdam

ANA connectivity – 9x100G US-EU





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NEA^{3}R Network-Related Formal Partners

- coPI Tom Fryer: GÉANT – European RREN
- coPI Rene Buch: NORDUnet Nordic RREN
- coPI Matthews Mtumbuka: UbuntuNet Alliance – South and East African RREN
- Advanced North Atlantic Network Consortium
  - GEANT, NORDUnet
  - Internet2 – US R&E
  - SURF – Dutch NREN
  - CANARIE – Canadian NREN
  - ESnet – US DOE NREN
- FABRIC –US TestBed

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Higher Level Services for NEA^{3}R

- Use of NetSage to share SNMP and de-identified flow data
  - http://portal.netsage.global
- End-to-End performance debugging for data transfers
- One-on-one direct work with applications to support international collaboration
- Anomalous route detection and resolution
- Testbed Support

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