

## Data Movement between City College of New York and Kyutech University

EPOC Contact Point: Hans Addleman

([addlema@iu.edu](mailto:addlema@iu.edu))

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### ABOUT EPOC

Over the last decade, the scientific community has experienced an unprecedented shift in the way research is performed and how discoveries are made. Highly sophisticated experimental instruments are creating massive datasets for diverse scientific communities and hold the potential for new insights that will have long-lasting impacts on society. However, scientists cannot make effective use of this data if they are unable to move, store, and analyze it. The Engagement and Performance Operations Center was established in 2018 as a collaborative focal point for operational expertise and analysis and is jointly led by Indiana University (IU) and the Energy Sciences Network (ESnet). EPOC provides researchers with a holistic set of tools and services needed to debug performance issues and enable reliable and robust data transfers. By considering the full end-to-end data movement pipeline, EPOC is uniquely able to support collaborative science, allowing researchers to make the most effective use of shared data, computing, and storage resources to accelerate the discovery process.

EPOC supports six main activities:

- *Roadside Assistance and Consultations* via a coordinated Operations Center to resolve network performance problems with end-to-end data transfers;
- *Application Deep Dives* to work more closely with application communities and understand full workflows for diverse research teams in order to evaluate bottlenecks and potential capacity issues;
- *Network Analysis enabled by the NetSage* monitoring suite to proactively discover and resolve performance issues;
- *Data Transfer Testing/ Data Mobility Exhibition* to check transfer times against known good end points;
- *Provision of managed services* via support through the IU GlobalNOC and our Network Partners;
- *Coordinated Training* to ensure effective use of network tools and science support.

### Data Movement between City College of New York and Kyutech University

The JGN (Japan's High speed R&D network testbed) NOC reported packet loss and poor transmission control protocol (TCP) performance from Kyutech Institute in Japan to City College New York (CCNY) across a general router encapsulation (GRE) tunnel. This tunnel is used for a number of joint research

projects, some of which are funded by National Science Foundation (NSF) award #1818884. All of the hosts involved are connected at 1Gbps.

Testing performed by JGN revealed .082% or about 1 in every 1000 packets lost from the host at CCNY to the host at Kyutech, limiting TCP performance to less than 10mbps, while performance in the reverse direction was 6 times higher. Additional tests performed using UDP (User Datagram Protocol) showed good performance in both directions as well.

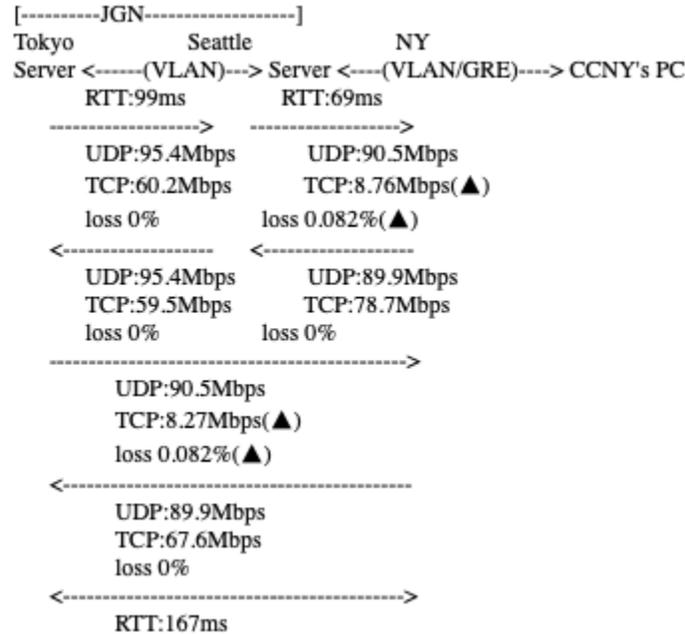


Figure 1: Original testing performed by JGN engineers between CCNY and Kyutech

EPOC engineers performed initial troubleshooting by testing to perfSONAR nodes geographically located along the path of the GRE tunnel, including an APAN node in Japan, the TransPAC node in Seattle, the Internet2 node in Chicago, and the NEAAR node in New York. Testing showed no packet loss and good performance between all nodes. Note that GRE tunnels follow normal routed network paths.

EPOC engineers partnered with staff in the CCNY lab to continue testing through the network to the end host. CCNY staff planned to install perfSONAR on a host in the lab, however, this work was delayed due to the pandemic. EPOC staff consulted with CCNY network engineers during this downtime to better understand the internal network structure and advise which network ports would need to be opened through the campus firewalls to support perfSONAR testing. You can find more information on how perfSONAR can work behind a firewall here: [https://docs.perfsonar.net/manage\\_security.html](https://docs.perfsonar.net/manage_security.html)

EPOC staff engaged the regional network provider, NYSERNet, who provides connectivity to CCNY and has testing points directly connected to the same Router that feeds the CCNY campus R&E connection. A

NYSERNet engineer ran a variety of perfSONAR tests that narrowed the packet loss issue to a point in the CCNY campus network and also revealed packet fragmentation and maximum transmission unit (MTU) problems on the inbound path to CCNY.

CCNY engineers were presented with this testing data, and after some local troubleshooting, found a network security device that was determined to be the cause of the packet loss. They reported that the device was already scheduled for replacement within the month. Once the device was replaced the entire path was retested. No packet loss was detected and performance from CCNY to Kyutech improved by a factor of 10. iPerf testing showed near 100mbps in both directions.

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[2021/03/05]
[-----JGN-----]
NTT-Ote      Seattle      CCNY
Tsv1 <------(VLAN)-----> Ssv1 <-----(VLAN/GRE)----> CCNY
      RTT:99ms           RTT:61ms
----->
UDP:101 Mbps      UDP:90.0 Mbps
TCP:237 Mbps      TCP:79.8 Mbps
loss 0%           loss 0%
<-----
UDP:101 Mbps      UDP:89.0 Mbps
TCP:238 Mbps      TCP:84.7 Mbps
loss 0.0043%      loss 0%
----->
UDP:89.9 Mbps
TCP:39.6 Mbps
loss 0%
<-----
UDP:89.0Mbps
TCP:68.7Mbps
loss 0%
<----->
RTT:159ms

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Figure 2. Testing by JGN engineers after the security device was replaced.

Researchers reported that as a result of the intervention by EPOC and CCNY engineers, the GRE tunnel between Kyutech and CCNY is being used in production with no performance degradation noted.

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