



Resilient Global Network to support Research and Education

A/Prof. Francis Bu-Sung Lee

Singapore Advanced Research and Education Network

5th Global Research Platform workshop
16-17 Sept 2024



Global Network Advancement Group



<https://www.gna-g.net/>

Asia-Pacific Backbone Topology



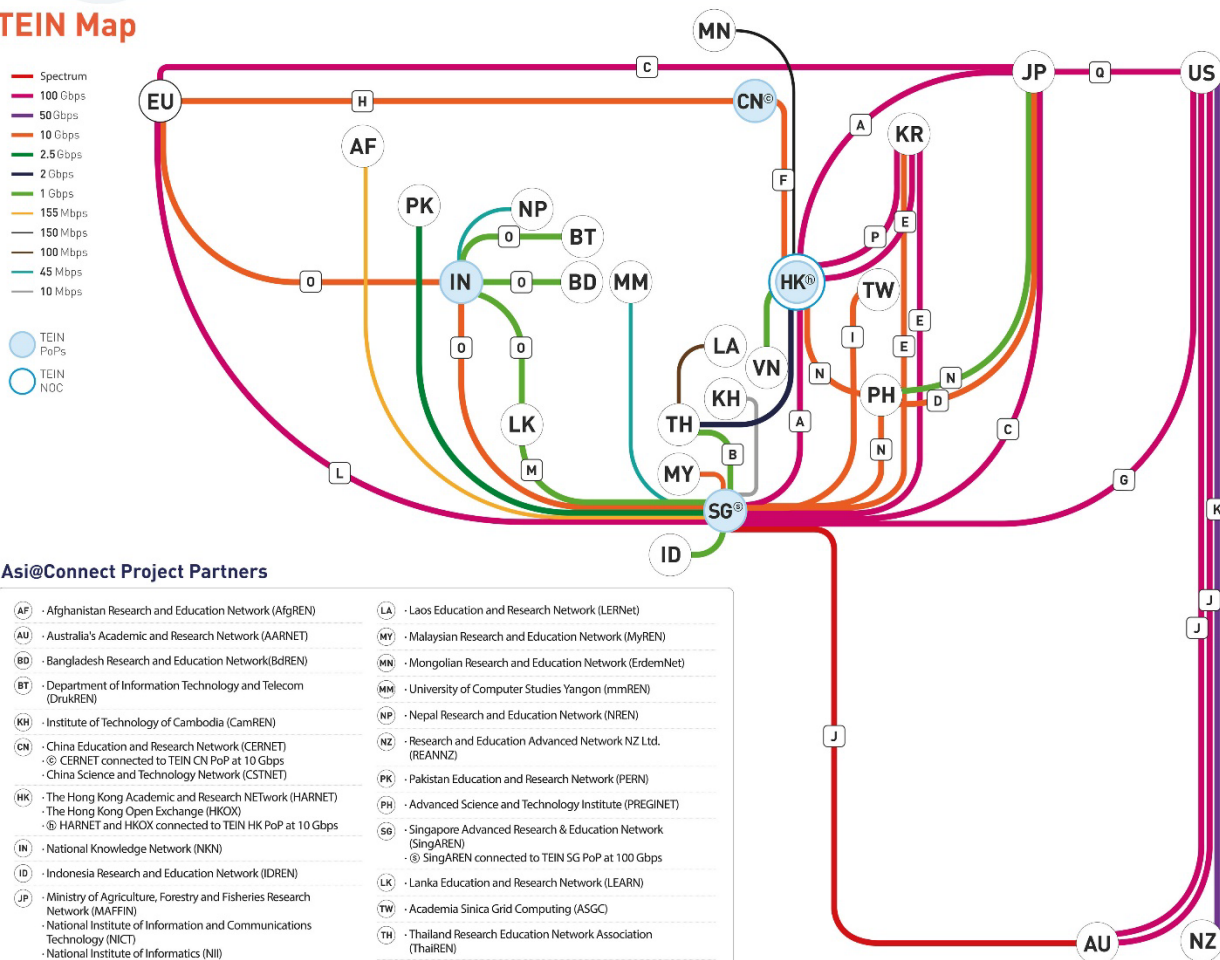
TransPAC/PacificWAVE
SingAREN/NSCC
GEANT
TEIN*CC/Asi@Connect
HARNET/NICT/NSCC/SingAREN
NII/SINET
AARNet/REANNZ
ARENA-PAC
Guam-SG consortium
KREONet2
KAUST
MAFFIN
KOREN
TWAREN
UH
CSTNET
CERNET
ASNet
Others

As of Jul 18th, 2024
Hiroko Osawa
(ops@jp.apan.net)



The EU co-funded Asi@Connect project provides a dedicated regional high capacity and high quality internet network, Trans Eurasia Information Network (TEIN), for Research and Education (R&E) communities across Asia-Pacific and Europe, and leverages e-infrastructures developed for public service projects.

TEIN Map



Asi@Connect Project Partners

AF - Afghanistan Research and Education Network (AfREN)	LA - Laos Education and Research Network (LERNet)
AU - Australia's Academic and Research Network (AARNET)	MY - Malaysian Research and Education Network (MyREN)
BD - Bangladesh Research and Education Network (BdREN)	MN - Mongolian Research and Education Network (ErdemNet)
BT - Department of Information Technology and Telecom (DrukREN)	MM - University of Computer Studies Yangon (mmREN)
KH - Institute of Technology of Cambodia (CamREN)	NP - Nepal Research and Education Network (NREN)
CN - China Education and Research Network (CERNET) - CERNET connected to TEIN CN PoP at 10 Gbps - China Science and Technology Network (CSTNET)	NZ - Research and Education Advanced Network NZ Ltd. (REANNZ)
HK - The Hong Kong Academic and Research Network (HARNET) - The Hong Kong Open Exchange (HKOX) - HARNET and HKOX connected to TEIN HK PoP at 10 Gbps	PK - Pakistan Education and Research Network (PERN)
IN - National Knowledge Network (NKN)	PH - Advanced Science and Technology Institute (PREGINET)
ID - Indonesia Research and Education Network (IDREN)	SG - Singapore Advanced Research & Education Network (SingAREN) - SingAREN connected to TEIN SG PoP at 100 Gbps
JP - Ministry of Agriculture, Forestry and Fisheries Research Network (MAFFIN) - National Institute of Information and Communications Technology (NICT) - National Institute of Informatics (NII)	LK - Lanka Education and Research Network (LEARN)
KR - National Information Society Agency (KOREN) - Korea Institute of Science and Technology Information (KREONET)	TW - Academia Sinica Grid Computing (ASGC)
	TH - Thailand Research Education Network Association (ThaIREN)
	VN - National Agency for Science and Technology Information (VinaREN)

* As of 31 January 2022.

** Other regions (Central Asia, Africa and Latin America) can be connected via global R&E networks such as EU(GÉANT) and US[Internet2]

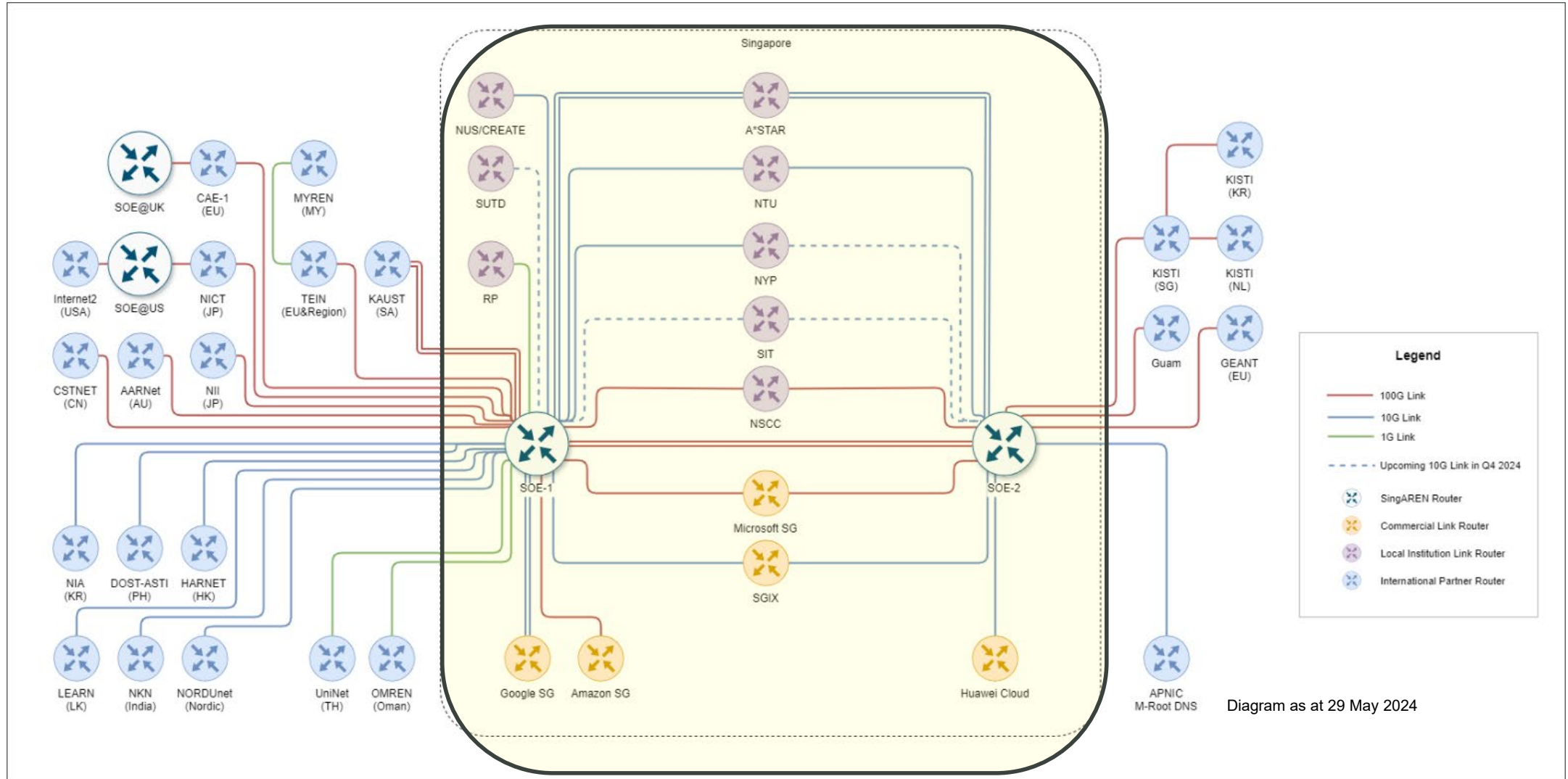
The following links are fully financed/co-financed by the link owners whose support is gratefully acknowledged

NICT	National Institute of Information and Communications Technology
A	National Supercomputing Centre
AREN	Singapore Advanced Research & Education Network
HKAREN	Hong Kong Academic and Research Network
B	National Institute of Information and Communications Technology
	Thailand Research and Education Network
C	National Institute of Informatics
D	Ministry of Agriculture, Forestry and Fisheries Research Network
E	National Information Society Agency
F	China Education and Research Network
	TEIN Cooperation Center
G	Internet2
AREN-PAC	AREN-PAC
TransPAC	TransPAC/Pacific Wave
AARNET	Australia's Academic and Research Network
H	Co-funded by China and EU
I	Academia Sinica Grid Computing
J	Australia's Academic and Research Network
K	Research and Education Advanced Network New Zealand
L	AARNET
GEANT	GEANT
NORDUNET	NORDUNET
AREN	AREN
TEIN	TEIN
M	LEARN
	Lanka Education and Research Network
N	Advanced Science and Technology Institute
O	National Knowledge Network
P	KOREN
	Korea Research Environment Open Network
Q	National Supercomputing Centre
	Singapore Advanced Research & Education Network



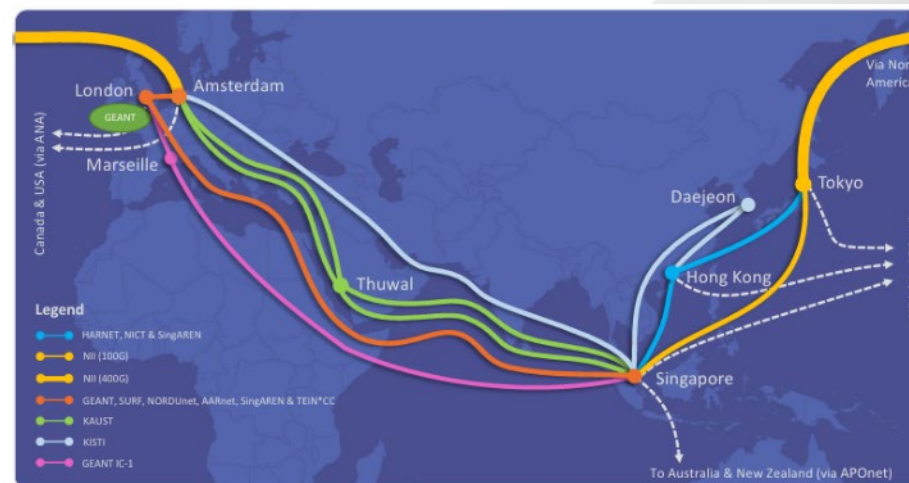
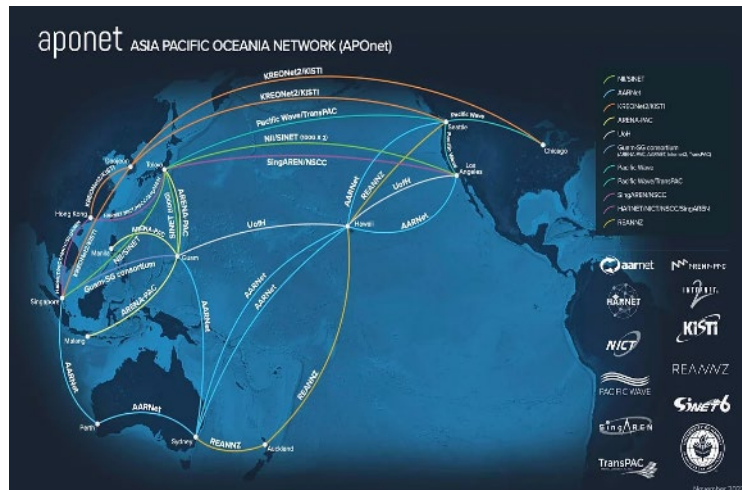
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SingAREN Open Exchange



Resilient International Connectivity

- **International R&E Network Resilience**
 - **Asia-Pacific-Oceania Network (APOnet):**
 - 12-partner consortium for network resilience
 - **Asia-Pacific-Europe Ring (AER):**
 - 11-partner consortium for network resilience
 - **East Asia Resilient Backbone Network (EARBN)**
 - 6-partner consortium for network resilience



Worst day with multiple cut/maintenance

AER
ASIA-PACIFIC
EUROPE RING



Status



Fiber Cut



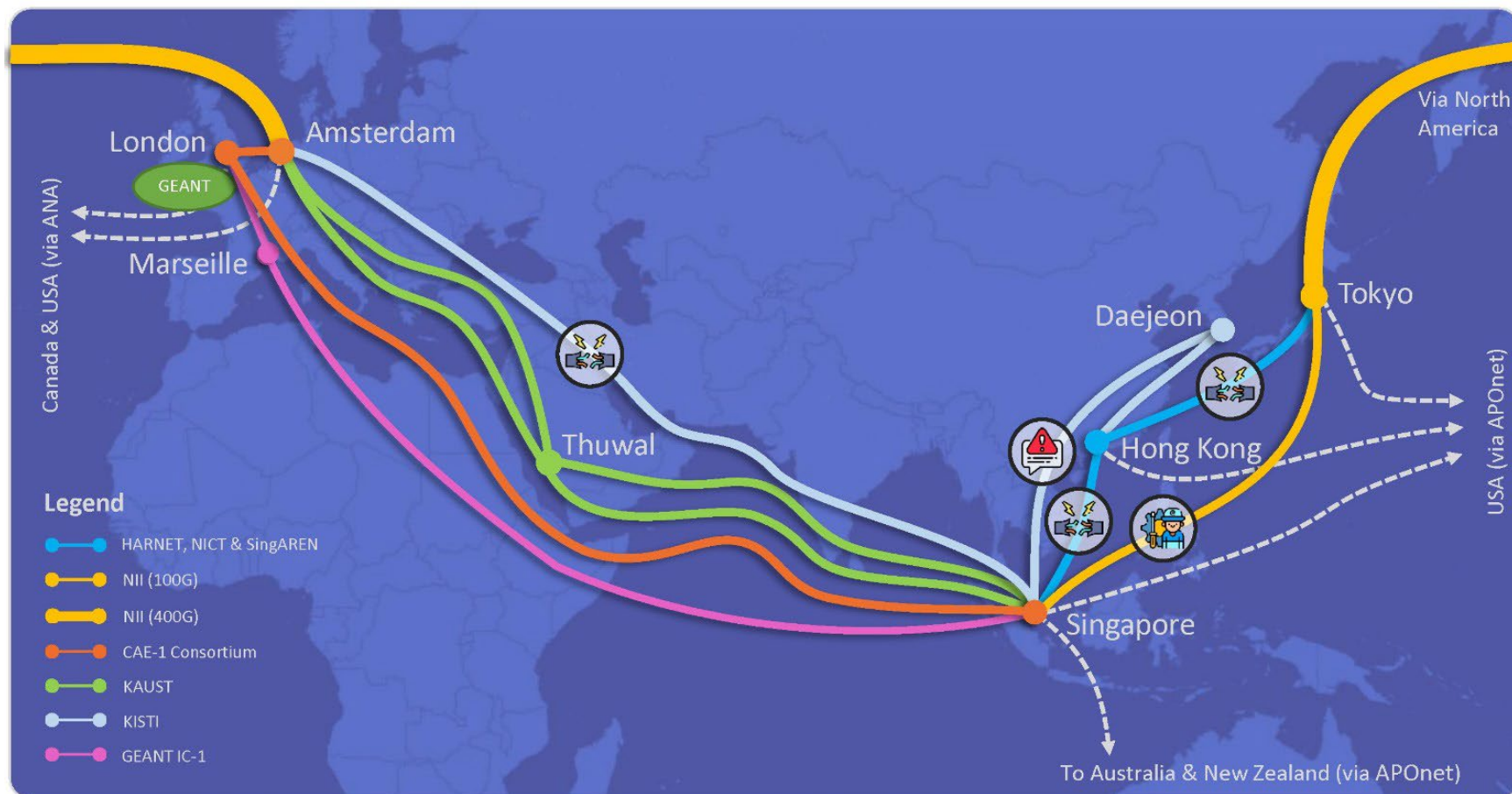
Fault



Planned Maintenance

27 June 2024

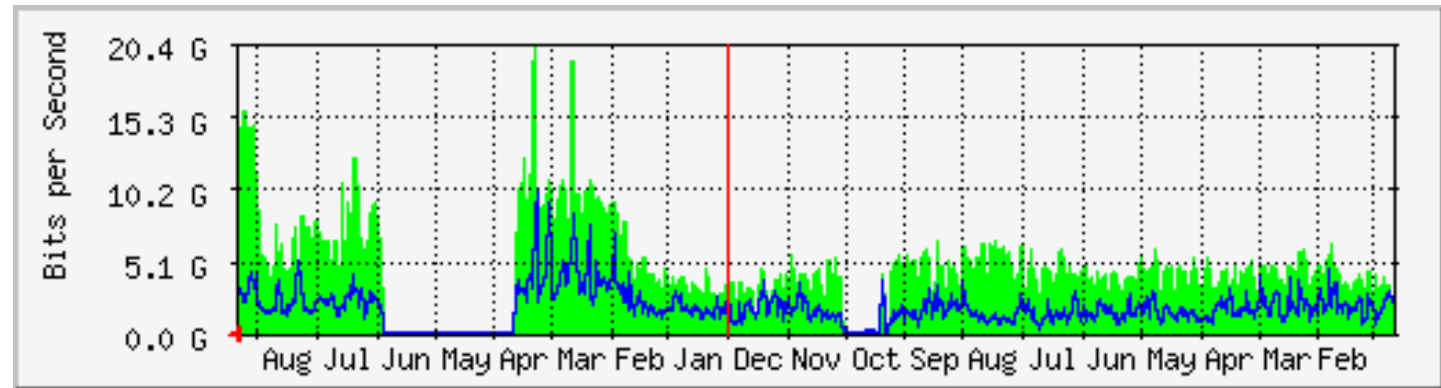




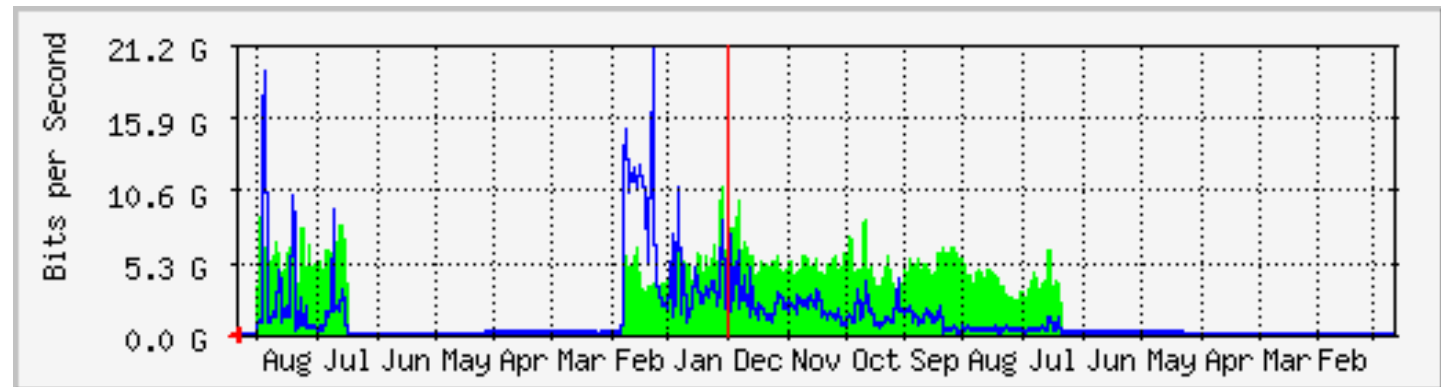
22 July 2024

SG to Europe links

CAE-1 link



Geant-SG



Cable Maintenance Schedule

	Cable Owner	Cable System	A-End	Z-End	Type	Start Date	Expected End Date
	HARNET, NICT & SingAREN	TGN-IA	Hong Kong	Tokyo	Fibre Cut	12 April 2024	23 July 2024
	HARNET, NICT & SingAREN	TGN-IA	Hong Kong	Singapore	Fibre Cut	12 June 2024	23 July 2024
	NII	SJC	Tokyo	Singapore	Planned Maintenance	5 July 2024	23 July 2024
	KISTI	APG	Daejeon	Singapore	Fault	10 March 2024	30 July 2024
	KISTI	AAE-1	Amsterdam	Singapore	Fibre Cut	29 June 2024	30 August 2024
	GEANT IC-1	AAE-1	Marseille	Singapore	Fibre Cut	24 February 2024	30 August 2024
	KAUST	[TBC]	Amsterdam	Singapore	Fibre Cut	24 February 2024	[TBC]

<https://aer-network.net/>



Applications



UHCONE VRF domain/aggregator - A provider network.

Connector network – provides, e.g., an L2 path between VRFs.

Provider network PoP router

WLCG sites that are not connected to UHCONE

Exchange point

NREN site router at exchange point

Communication links: 1/10, 20/30/40, and 100Gb/s or N x 100Gb/s

Underlaid link information indicates link provider, not use

Double dash outline indicates distributed site

Future site

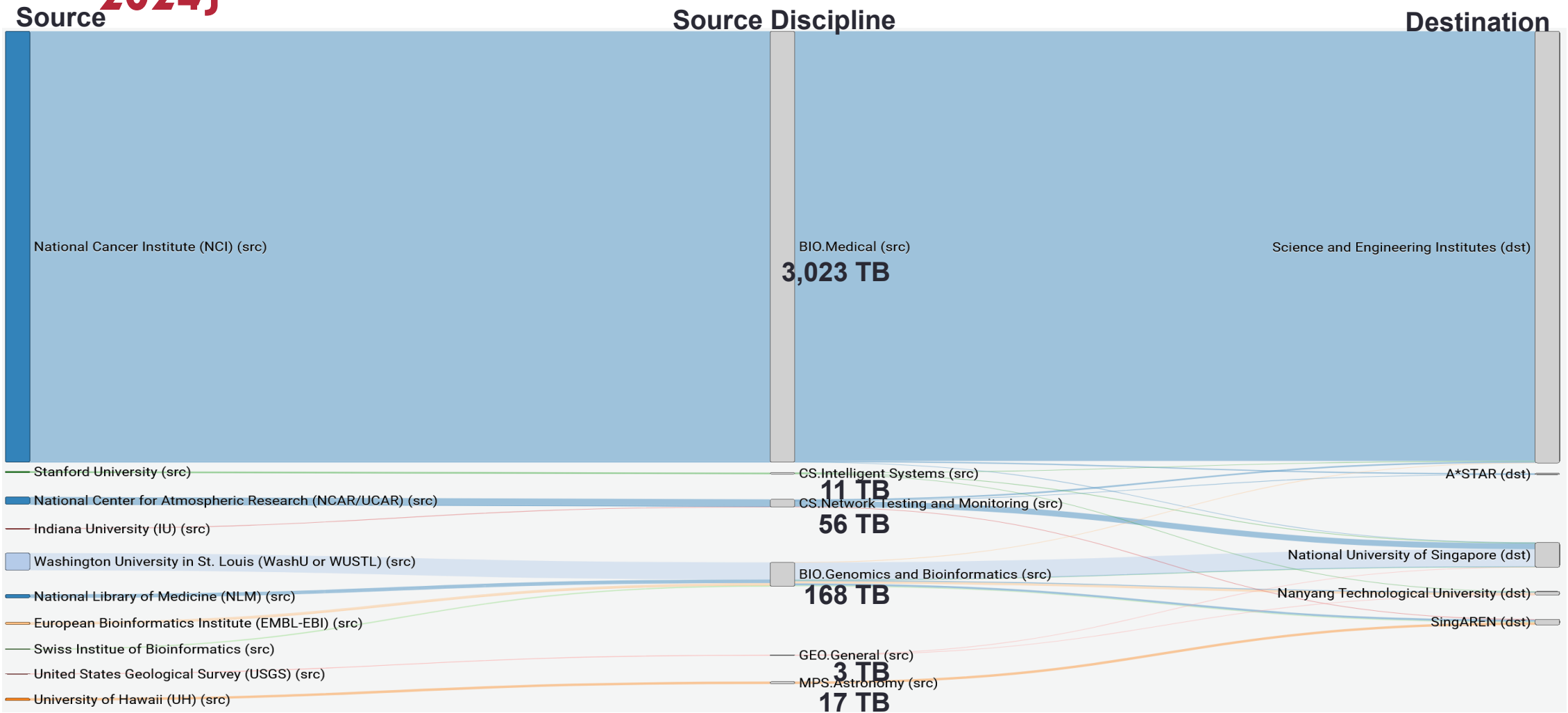
various	SINET
AARNet	NORDUnet
GEANT	KIAX, Russia
SINET, Japan, global ring	KREONet2, Korea
ASGC, Taiwan	BELLA, GEANT, et al
Esnet transatlantic, USA	ReCLARA, et al
NICT/NCC/C/SingAREN	
ANA-300/400 - Various links provided by CANARIE, ESnet, GEANT, Internet2, NORDUnet, SURFnet, SINET, IU/NSF	

UTSM/ CCTVH	LHCb-T2	LHC ALICE or LHCb site	UNL	Sites that are standalone VRFs
	CNAF-T1	LHC Tier 1 ATLAS and CMS		
	UCHI	LHC Tier 2/3 ATLAS and CMS		
	KEK	Belle II Tier 1/2		
	JUNO	JUNO		

NOTES

- 1) ONLY links involved in LHCONF are shown
- 2) LHCONF links are not shown on this diagram
- 3) For map explanation see "Interpreting the LHCONF Map" at <http://www.dropbox.com/sh/padxf583bj1raz/LADb55x8f5?sh=fbf3c4dc2ea76516>
- 4) GANT and CANARIT have shutdown the peering between their VRF and KIAM, as a result of the Ukraine war.

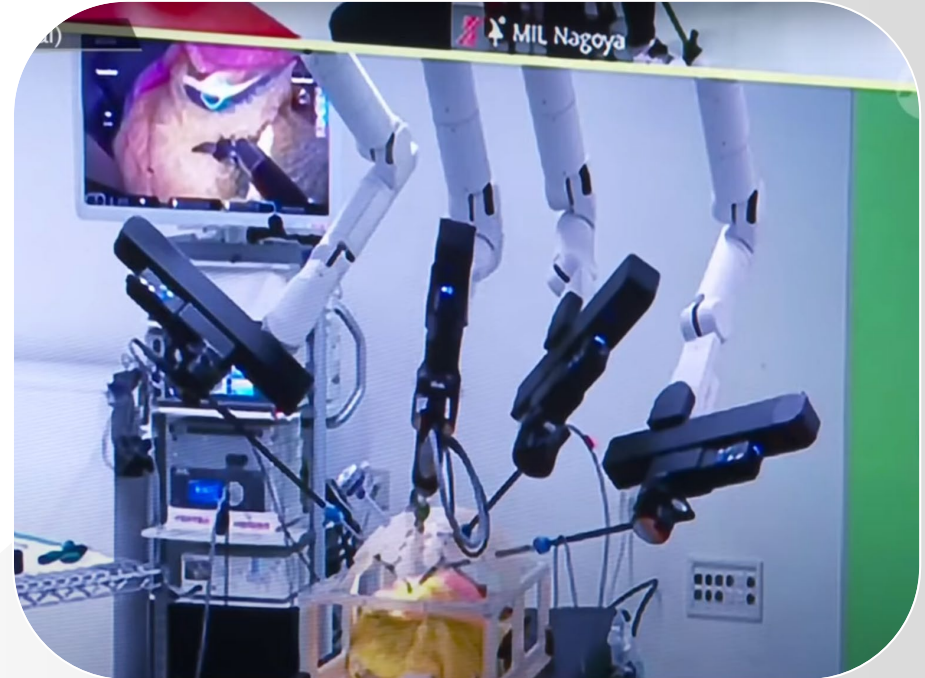
Top Science Talkers – Past 90 days (13 Sep 2024)



Robotic Telesurgery Trial

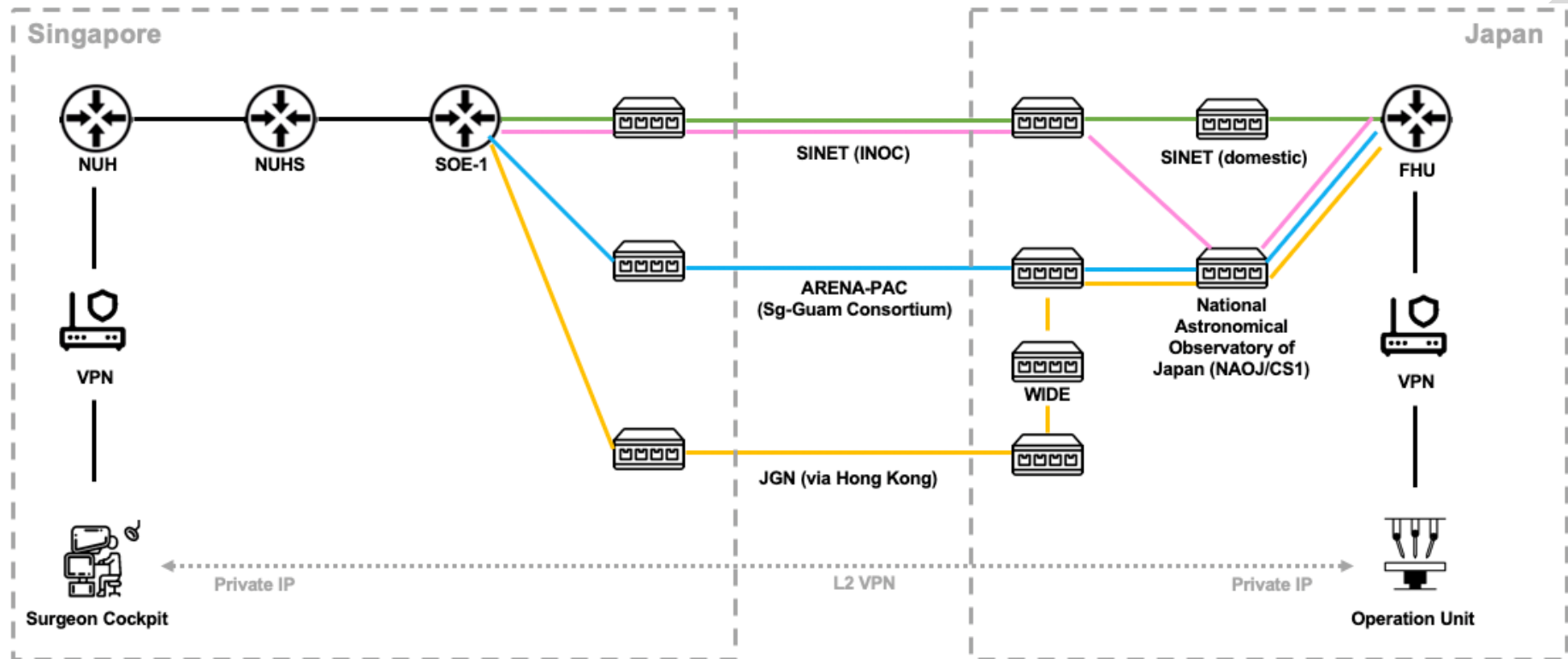
Singapore - Controlling Unit

Singapore and Japan Clinician-Scientists Collaborate on Groundbreaking Telesurgery Trial Spanning over 5,000km in Nov 2023



Japan - Robotic Operation Unit

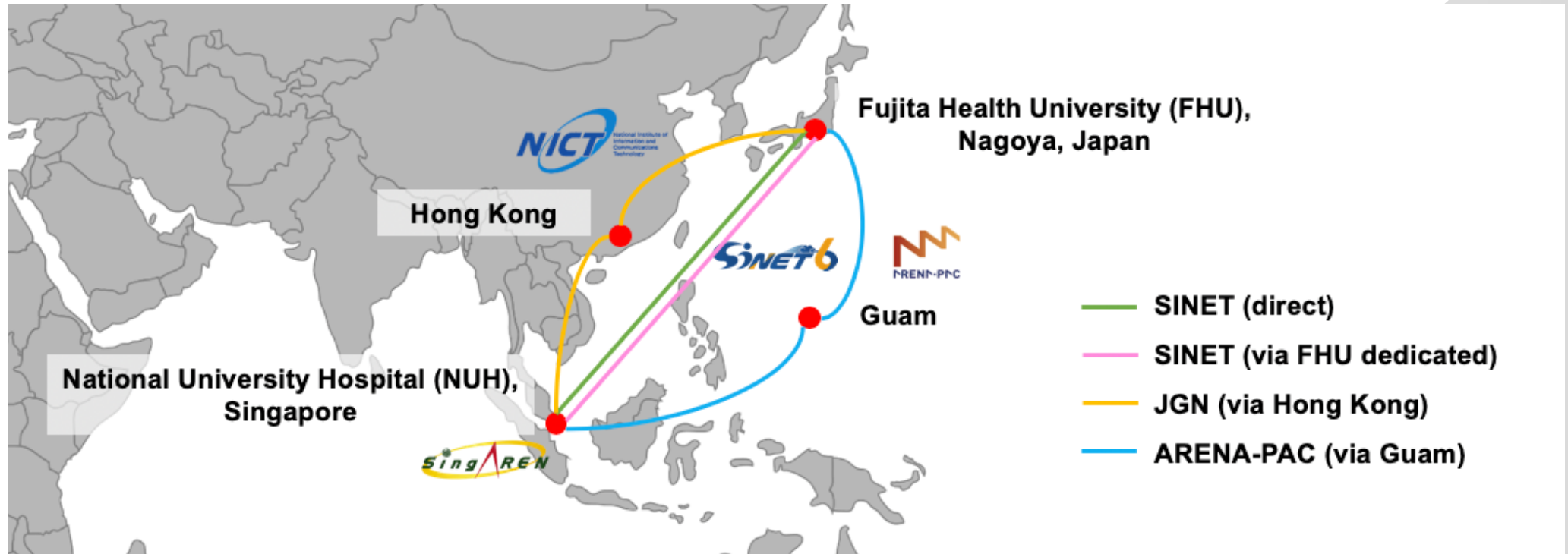
<https://www.youtube.com/watch?v=clm3n3n3n3n>



- SINET (direct)
- SINET (via FHU dedicated)
- JGN (via Hong Kong)
- ARENA-PAC (via Guam)
- Routers
- Switches
- Network Hub

- NUH National University Hospital
- NUHS National University Health System
- SOE-1 SingAREN Open Exchange
- FHU Fujita Health University

Resilient paths

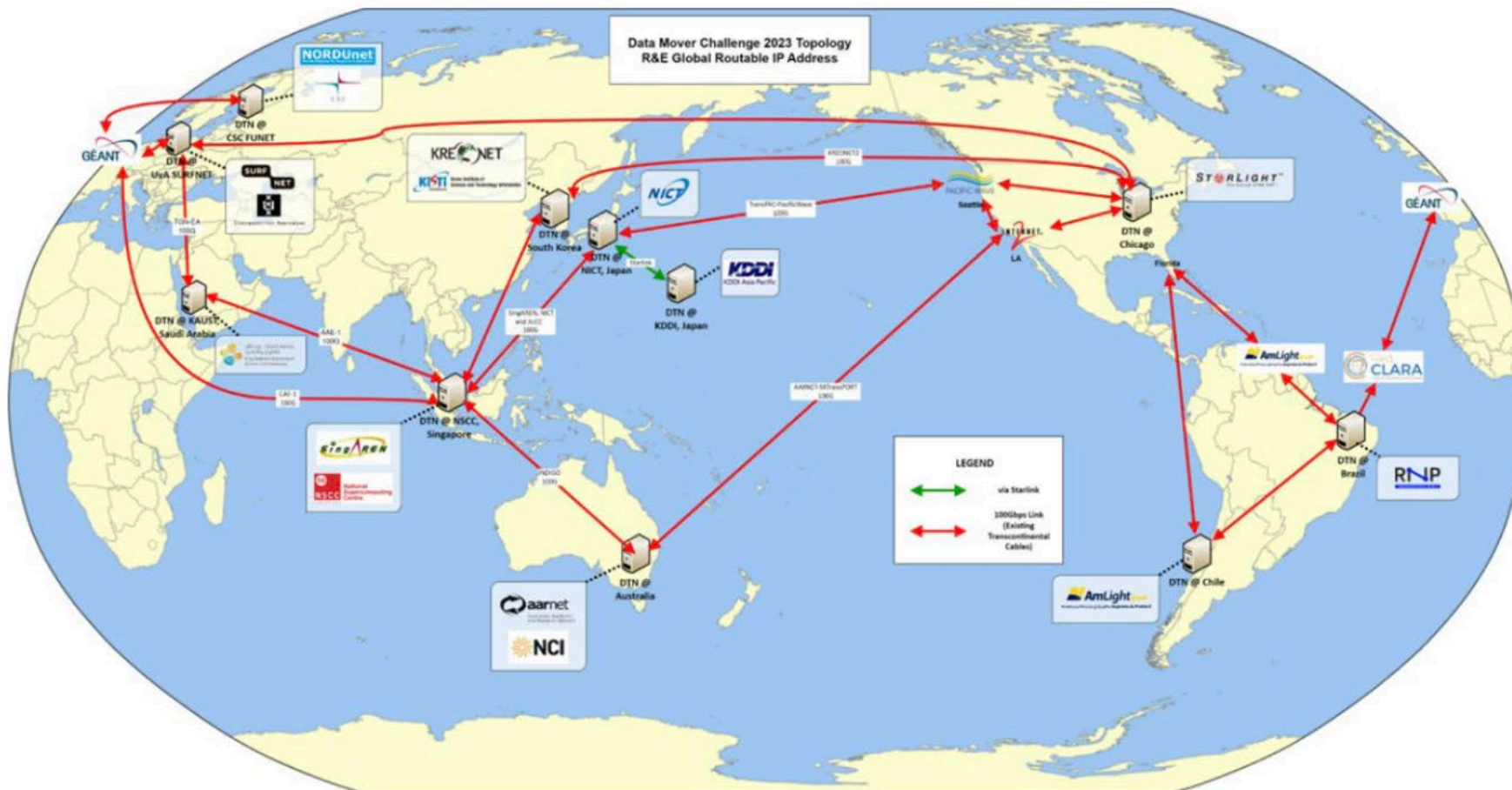




Data Mover Challenge 2023

REPORT

2023 DMC Network



DMC'23

- 5 continents
 - Welcome South America
- Modelling two data transfer scenarios:
 - 100G R&E production networks
 - Starlink for field based data acquisition

DMC23 Network Partners



DMC23 DTN Partners

STARLIGHT™



ICT Solutions for Brilliant Minds



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Judging Panel

- **Andrew Howard - NCI (Australia) – Chief**
- Prof Francis Lee - SingAREN and NTU (Singapore)
- Prof Paolo Grosso - University of Amsterdam (UVA Amsterdam)
- Hirotaka Sato - APAN-JP and KDDI (Japan)
- Ikeda-san - APAN-JP and KDDI (Japan)
- Marcos Felipe Schwarz - RNP (Brazil)
- Tim Chown - JISC (UK)

DMC23 Teams

- Team Falcon
- Team CiTEO
- Team Livewire
- Team Musashino
- Team Just SSH
- Team Raysync x Robust HPC Alliance

DMC'23 Results

- Overall Winner – Team Falcon
- Most novel approach – Team CiTEO
- Most complete architecture – Livewire
- Best performing in impaired networks – Team Musashino
- Most innovative for HPC uses – Just SSH

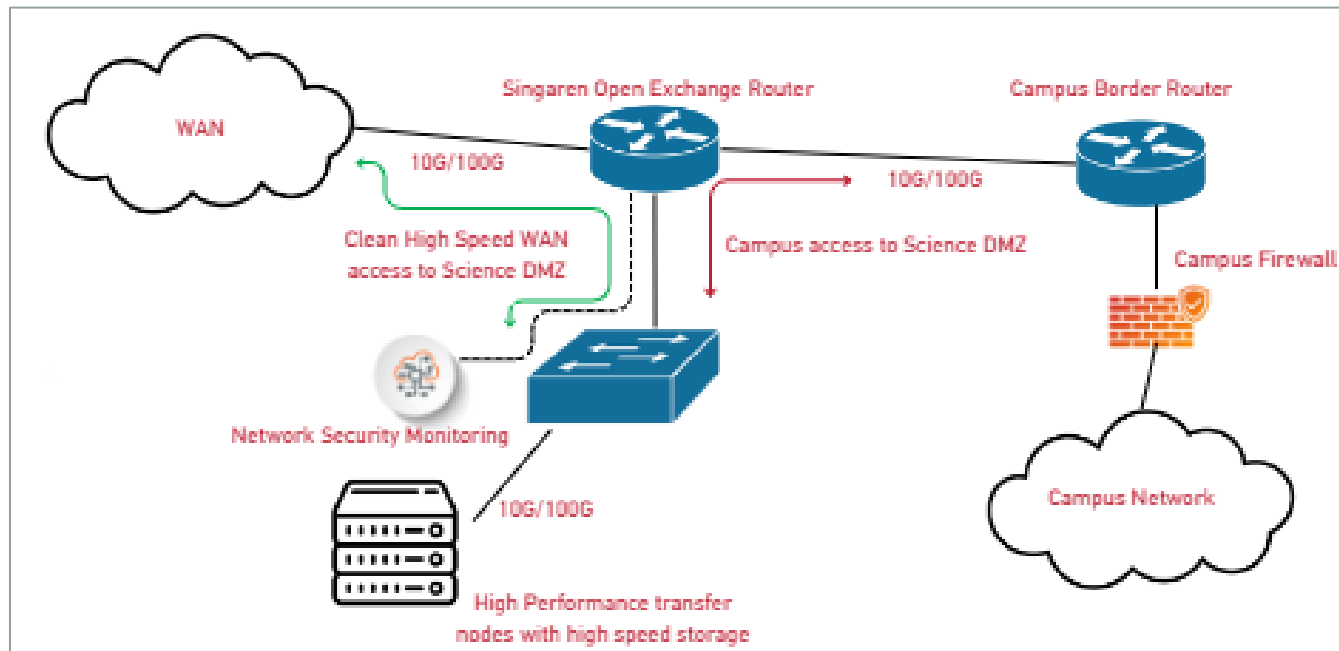
Overall winner





PoCs and experiments

Science DMZ POC Testing – NTU HPCC



- SingAREN has set up a **Science DMZ as proof-of-concept with NTU HPCC** to facilitate faster connectivity and a secure zone for HPCC users who are currently limited by the network policies in place.

Science DMZ POC Testing – NTU HPCC

Test Scenario	Avenues	Download Speed	Benefit
Download of 2 GiB Bioinformatic dataset from SingAREN Database Mirroring Service	Data download via NTU campus network	0.128 Gbps (115 sec)	<u>17 x increase</u> in download speed via Science DMZ versus the NTU campus network
	Data download via Science DMZ	2.232 Gbps (7.9 sec)	

MoU: San Diego Supercomputer Center (SDSC) and SingAREN



Deployment of **Open Science Data Federation** and **Protein databank cache server**

- SDSC contributes a high-performance server that is hosted at the SingAREN Open Exchange, located at Equinix SG3.
- SingAREN provides the high-speed international connectivity for the server in the region.

Deployment of Open Science Data Federation and Protein Databank cache server



Image credit: SDSC

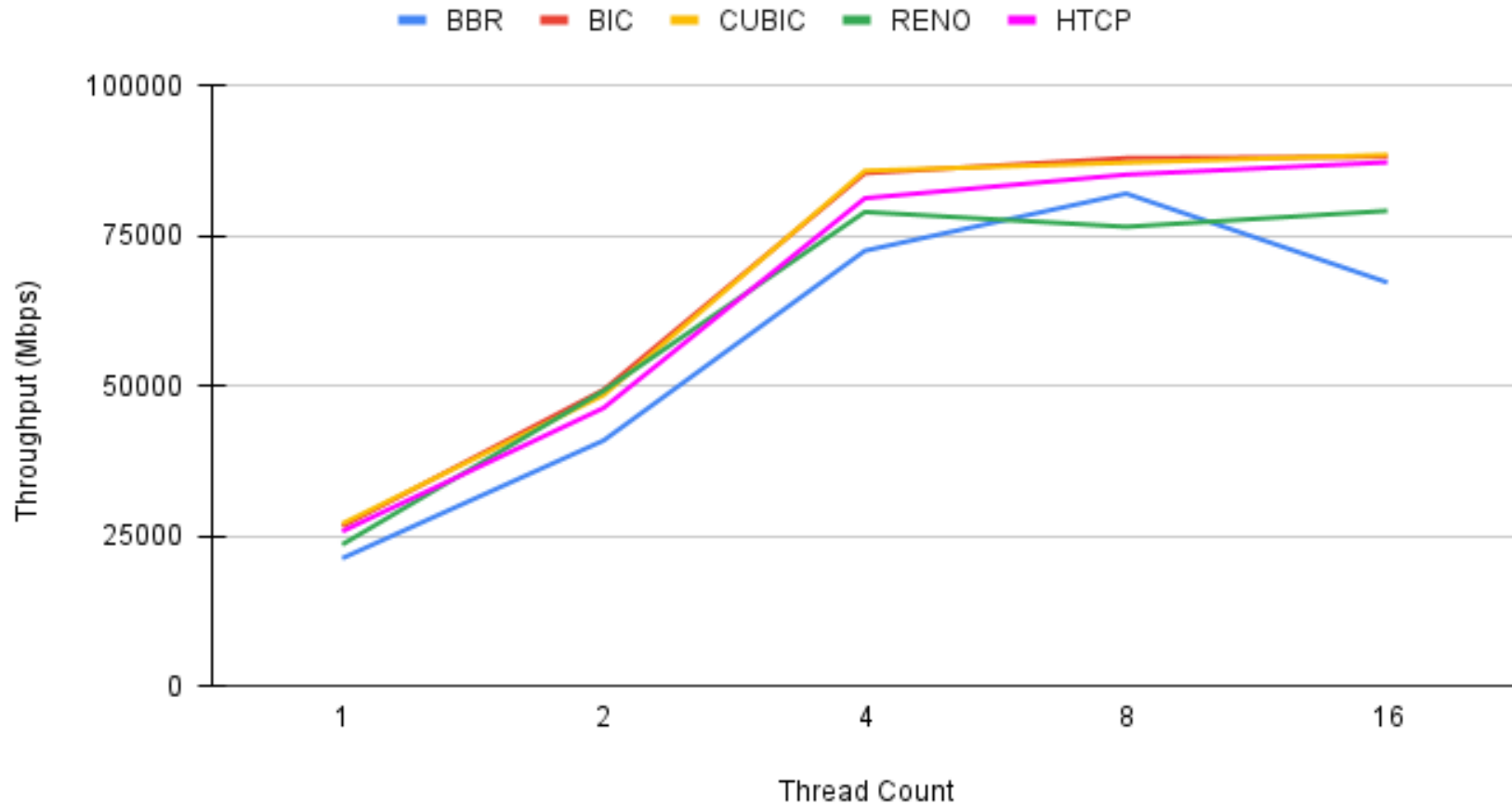
- Collaboration between San Diego Supercomputer Center and SingAREN
- The Protein Databank cache server is successfully deployed in Singapore on 20 Sep 2023.
- SingAREN shall promote the availability of the resource to the community.



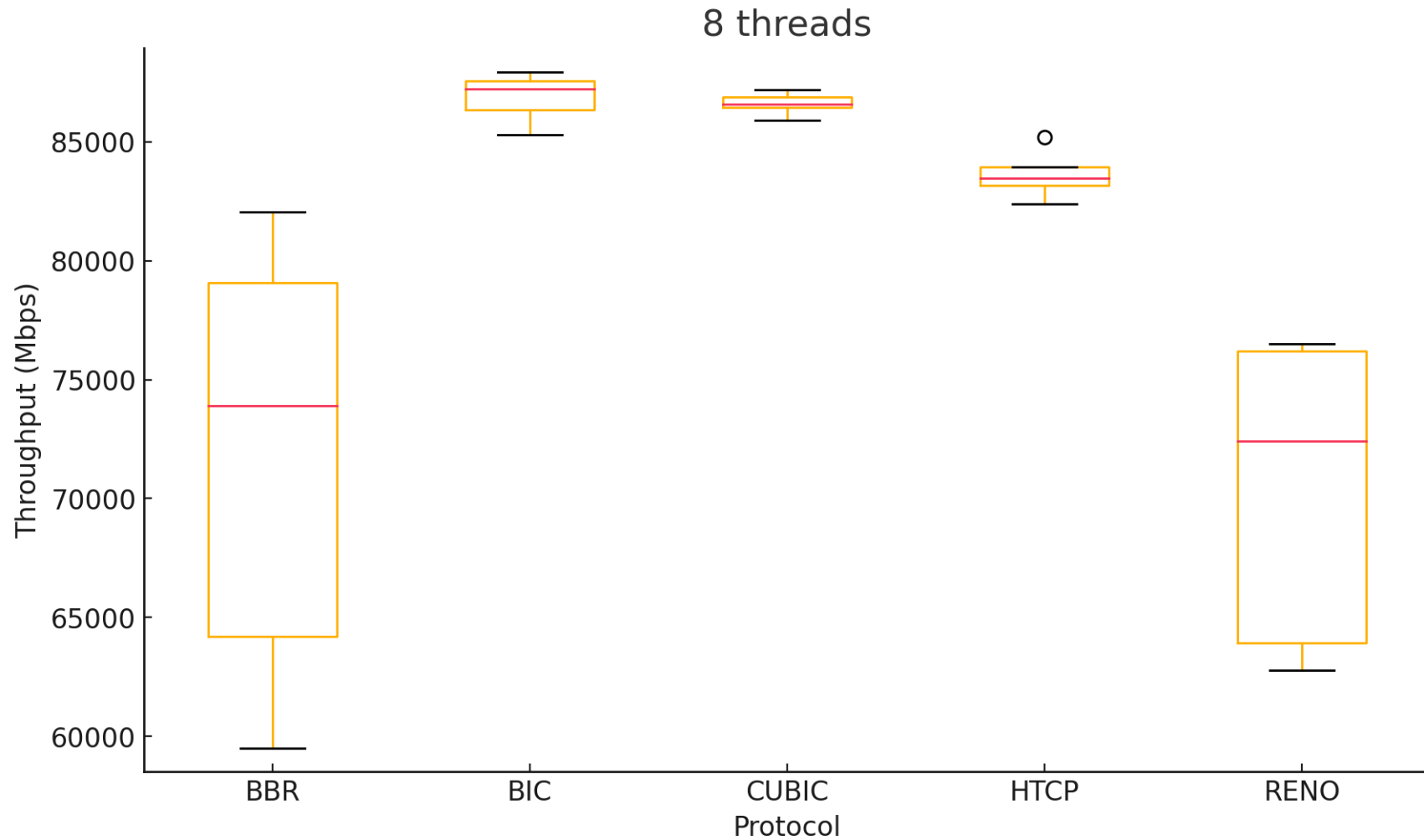
Experiment testing of Congestion Control

Experiment results of congestion control algo.

Iperf3 93ms Finland to Saudi Arabia



8 threads



Conclusion

- More activities across the NREN network.
- It is high bandwidth, low-latency and less congested.
- It is resilient.

SCA 2025

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Tutorials

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Abstract Submissions Due:
8 Nov 2024

Paper Submissions Due:
11 Nov 2024

Notice of Acceptance:
17 Jan 2025

Camera-ready Paper Due:
24 Jan 2025

[Submit here](#)



SCA25
Call For Papers

[SupercomputingAsia 2025 \(SCA25\)](#) is an annual international conference that encompasses an umbrella of notable supercomputing events with the key objective of promoting a vibrant and relevant HPC ecosystem in Asia. Co-organised by HPC centres from Australia, Japan, Thailand and Singapore, the SCA25 will be held from 10 to 13 March 2025 in Singapore.



Workshop & Tutorial Proposal Submission Due:
11 Oct 2024 (AoE)

Workshop & Tutorial Notice of Acceptance:
11 Nov 2024 (AoE)

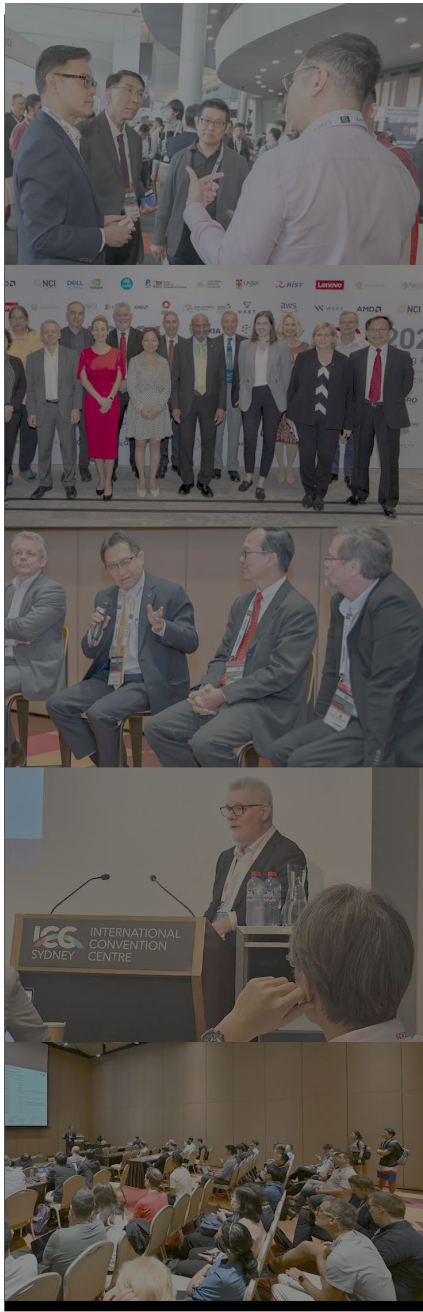
Workshop Day:
10 Mar 2025 (SGT)

[Find Out More](#)



SCA25
Call for
Workshops &
Tutorials

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THANK YOU

SingAREN



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