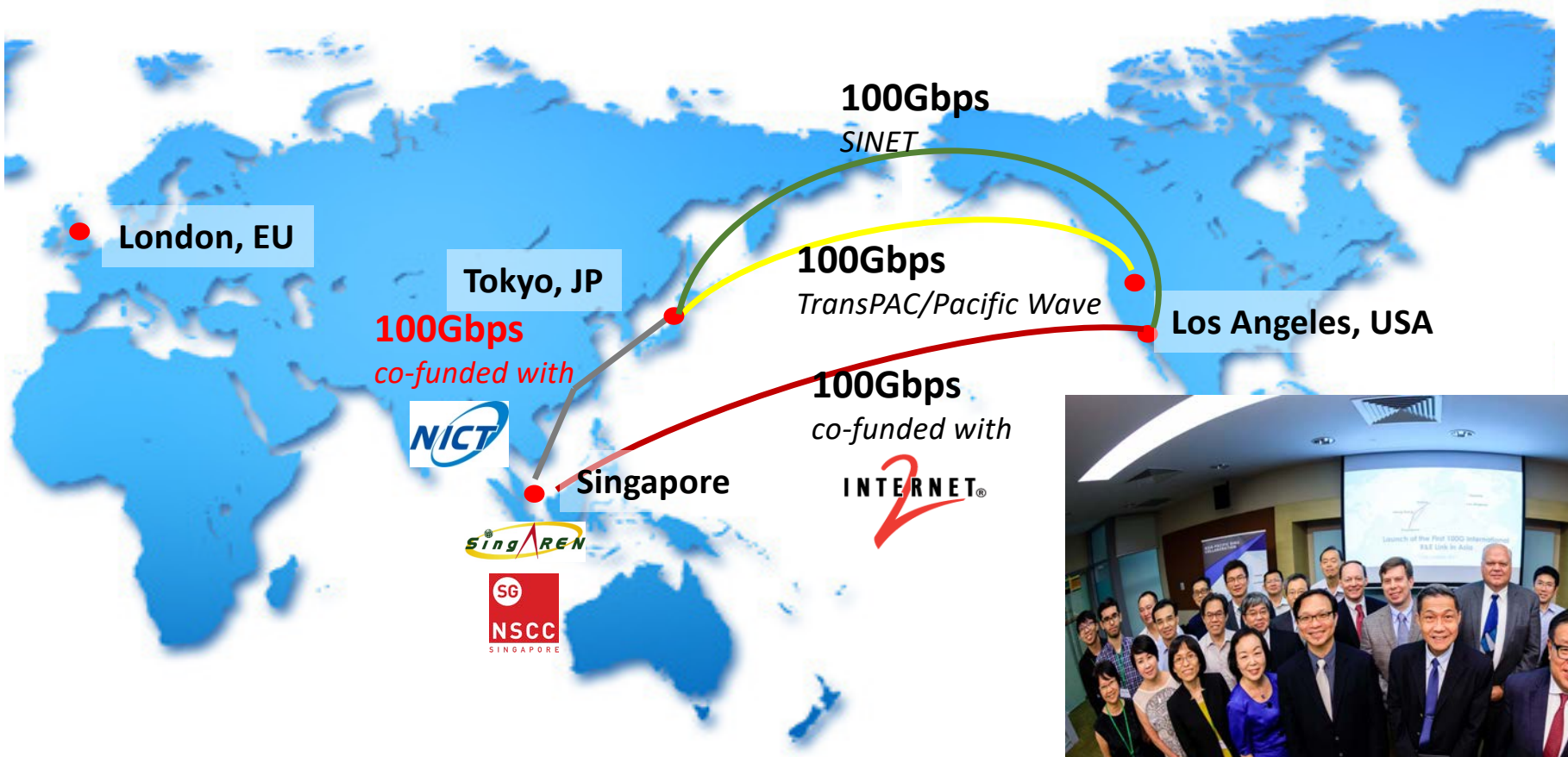
Collaboration between NRENs:APOnet, AER, etc.

By

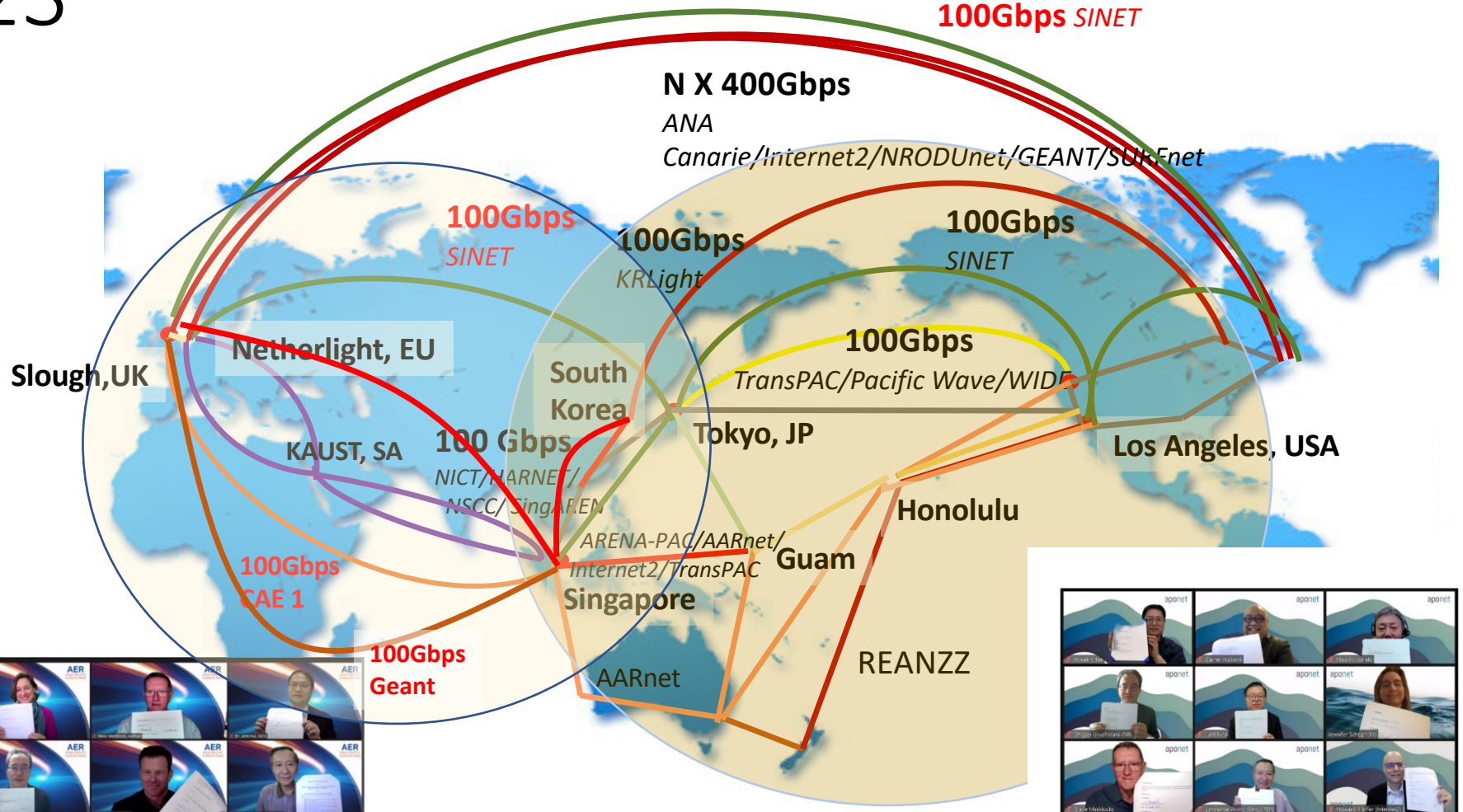
Francis Lee Bu Sung

SingAREN

Asia-Pacific-Ring (Nov 2017)

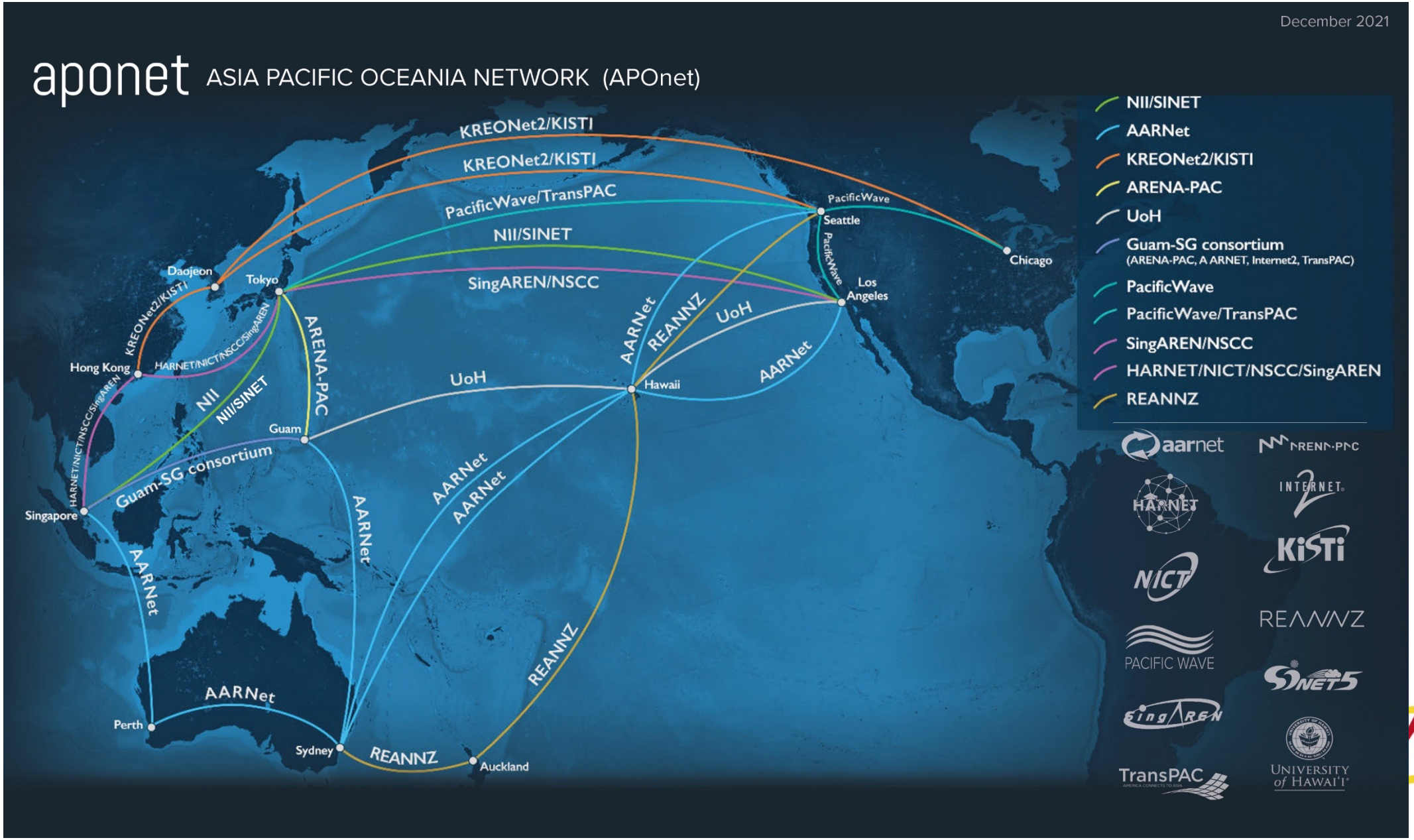


2023



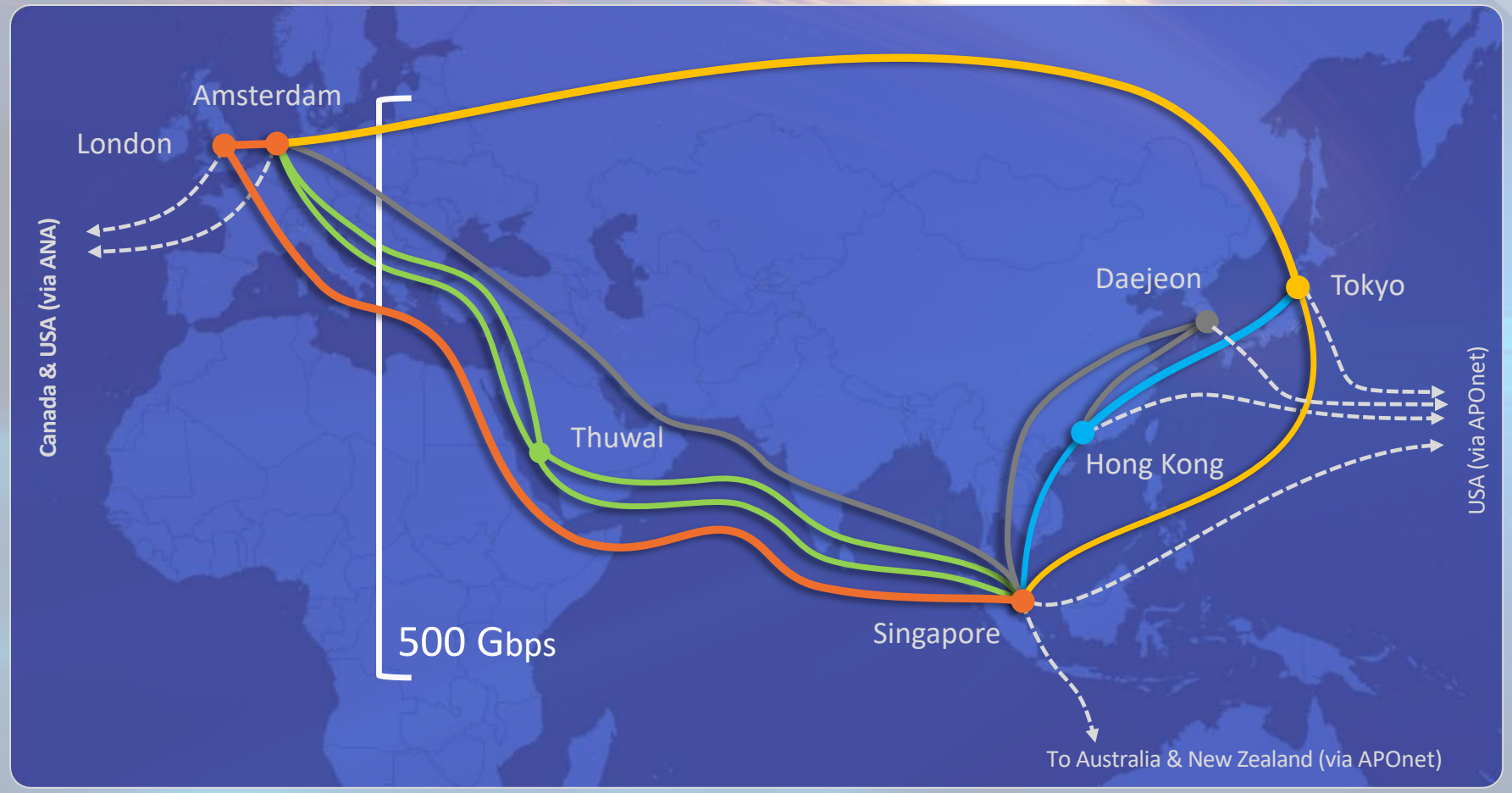
AER (2022)
KISTI joined in 2023

APOnet (2021)
JUCC joined in 2022


December 2021
aponet ASIA PACIFIC OCEANIA NETWORK (APOnet)
KREONet2/KISTI
KREONet2/KISTI
PacificWave/TransPAC
NII/SINET
SingAREN/NSCC
Daojeon
Tokyo
Hong Kong
Singapore
Guam
Hawaii
Seattle
Los Angeles
Chicago
PacificWave
ARENA-PAC
AARNet
REANNZ
UoH
NII
Guam-SG consortium
HARNET/NICT/NSCC/SingAREN
Perth
Sydney
Auckland
NII/SINET
AARNet
KREONet2/KISTI
ARENA-PAC
UoH
Guam-SG consortium
(ARENA-PAC, A ARNET, Internet2, TransPAC)
PacificWave
PacificWave/TransPAC
SingAREN/NSCC
HARNET/NICT/NSCC/SingAREN
REANNZ
aarnet
HARNET
INTERNET2
KiSTi
NICT
REANNZ
PACIFIC WAVE
SINET5
SingAREN
TransPAC
UNIVERSITY of HAWAI'I
AREN

2023

AER
ASIA-PACIFIC
EUROPE RING



HARNET, NICT & SingAREN
NII
GEANT, SURF, NORDUnet, AARnet, SingAREN & TEIN*CC
KAUST
KISTI

EARBN

East Asia Resilient Backbone Network (22 Aug 2023)

China Science & Technology Network

NII

KiSTi

HARNET

NICT

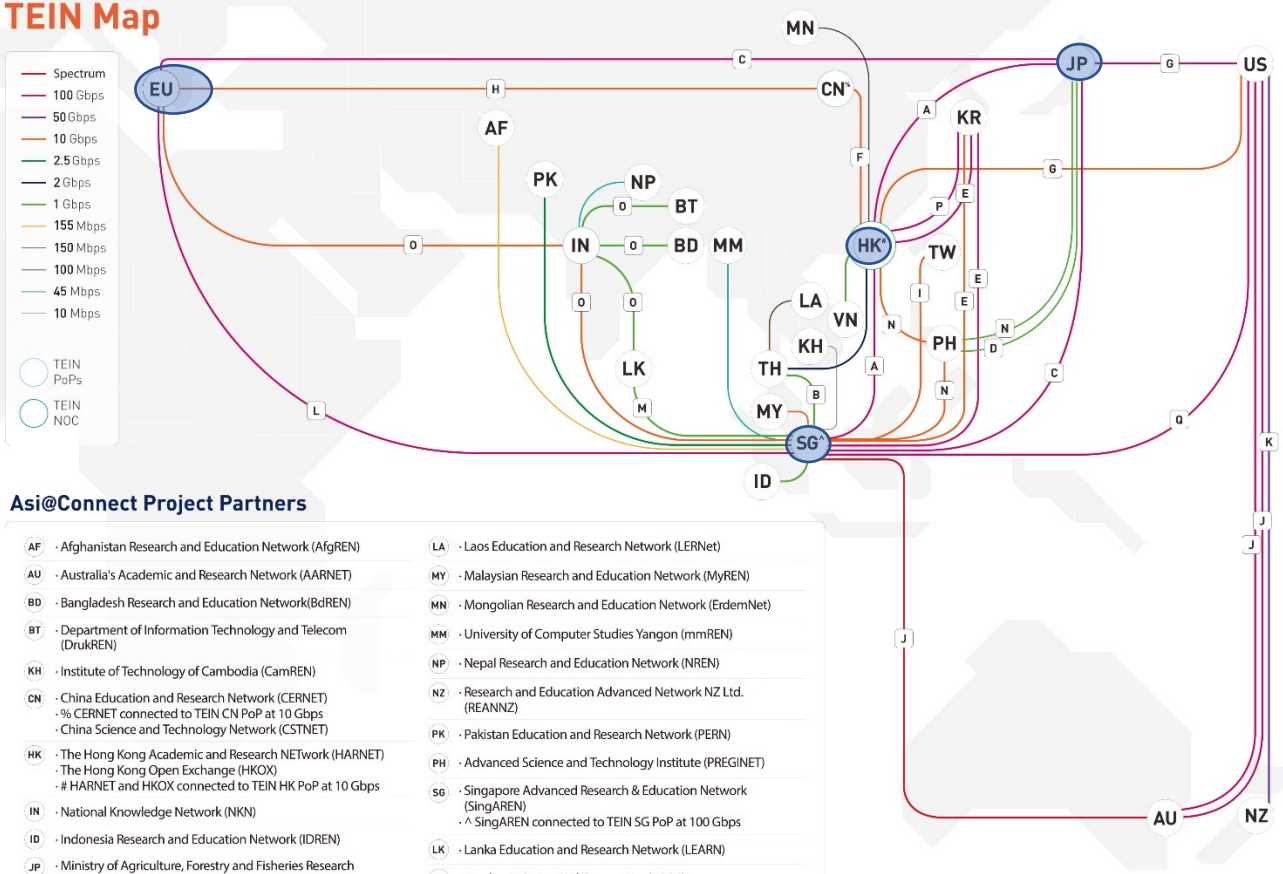
SingAREN

SingAREN

Asi@Connect

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

* As of December 2020.
** 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

- A · National Institute of Information and Communications Technology; National Supercomputing Centre; Singapore Advanced Research & Education 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 · TransPAC/Pacific Wave
- 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 · GÉANT; NORDUnet; SingAREN; SURFnet; TEIN
- M · Lanka Education and Research Network
- N · Advanced Science and Technology Institute
- O · National Knowledge Network
- P · Korea Research Environment Open NETwork
- Q · National Supercomputing Centre; Internet2; Singapore Advanced Research & Education Network

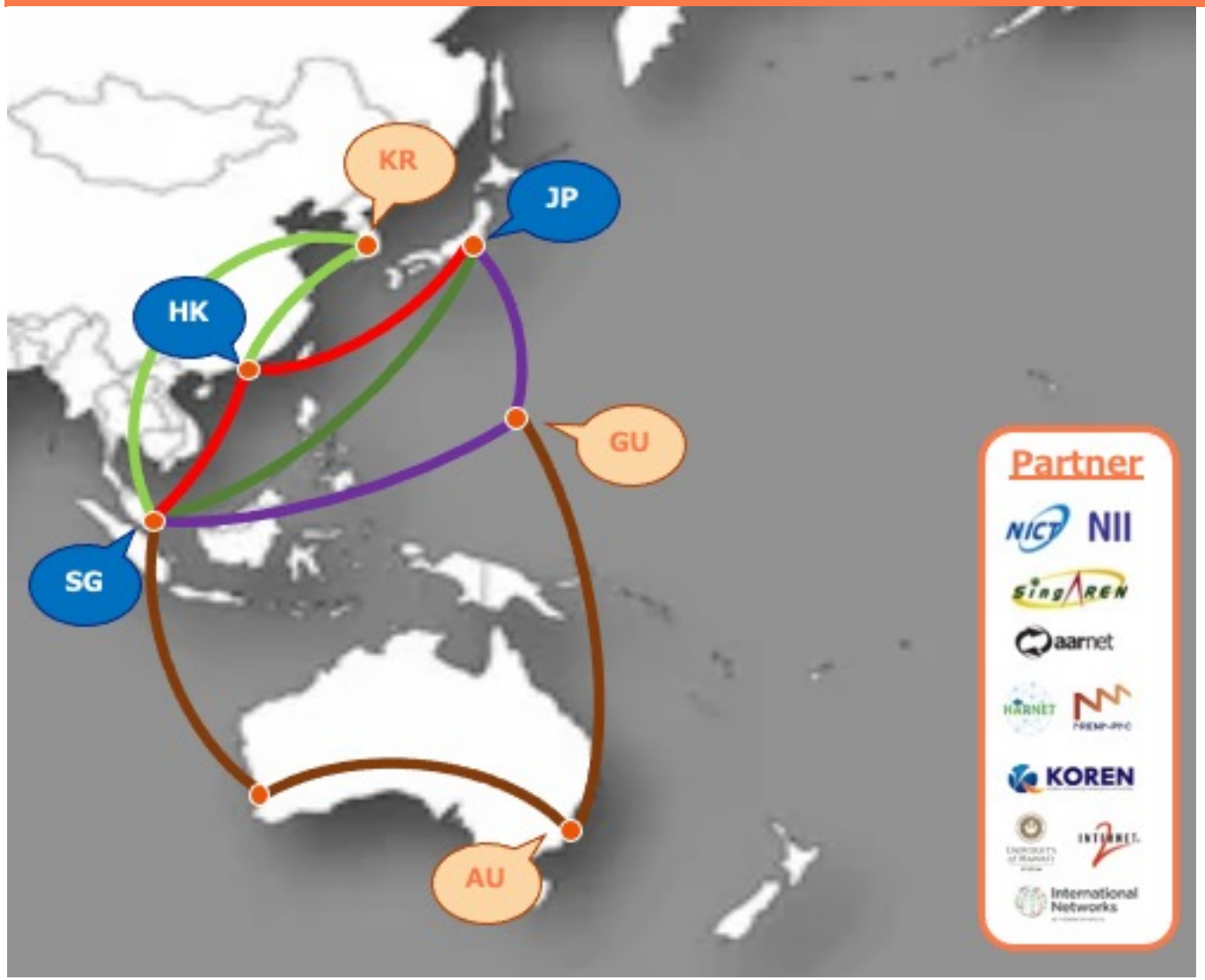
- Telemedicine
- Earth Observation
- Food Security
- e-Science
- e-learning
- e-Culture
- Advanced ICT Technology
- Capacity Building Programs

Possibilities with **Asi@Connect**

This publication has been produced with co-funding of the European Union for the Asi@Connect project under Grant contract ACA2016-376-562. The contents of this document are the sole responsibility of TEIN*CC and can under no circumstances be regarded as reflecting the position of the European Union.

APAN-JP Backbone

Improved the resiliency with the addition of backup links



APAN-JP Backbone

PoP of APAN-JP

PoP of other R&E organizations

Main Path:

APAN-JP (NICT JP-HK,HK-SG)

Backup Path:

NII JP-SG

ARENA-PAC, Guam-SG Consortium

ARENA-PAC, AARNet

KOREN

2023/3/15~7/14:

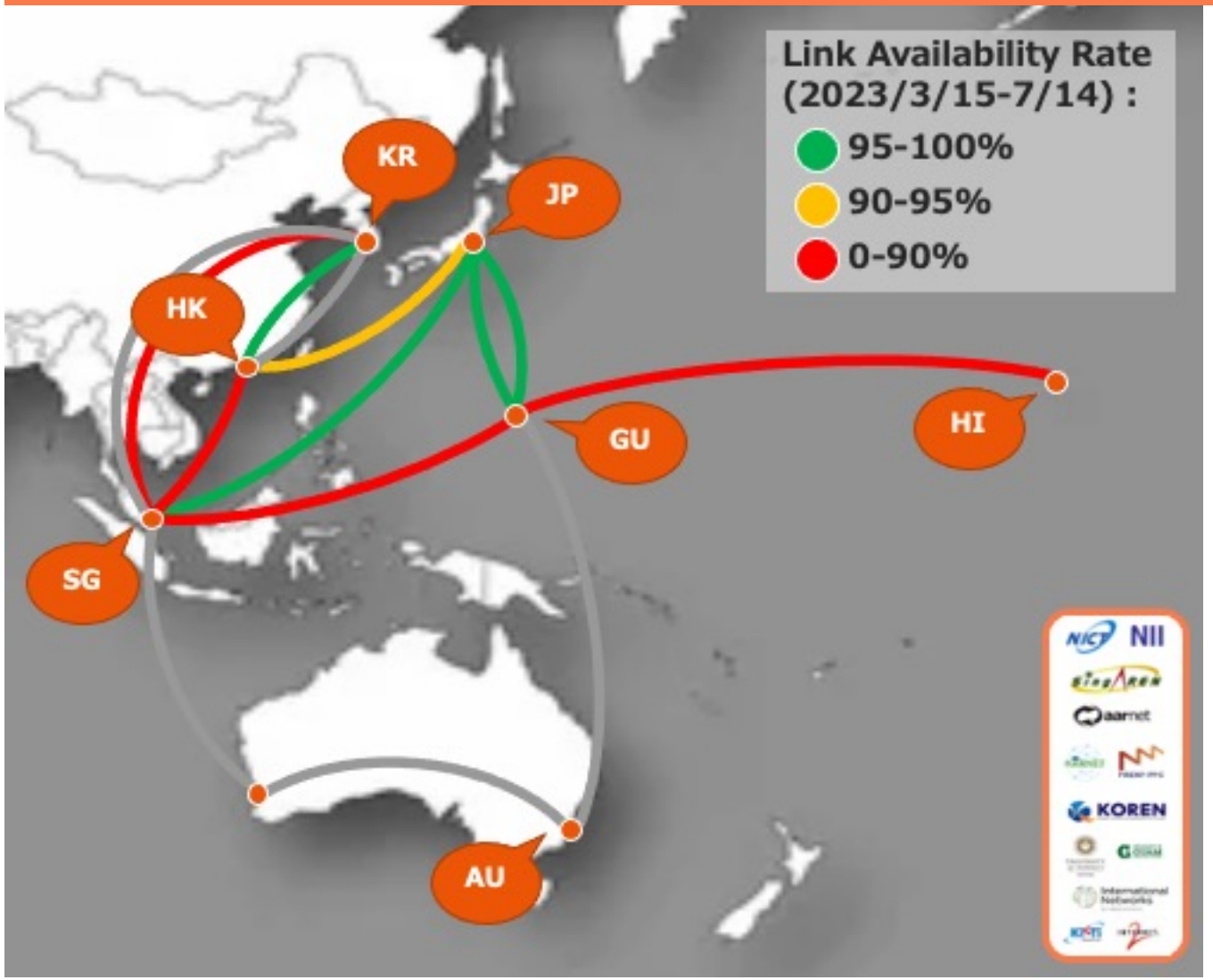
Although the APAN-JP main path link failed for a long time

Availability of APAN-JP Backbone >99.9%

- **Thank you very much!**

Interconnection of R&E International Circuits

Link Availability Rate



Submarine Cables:

- 99% of international communication is achieved by submarine cables
- more than 400 submarine cables in the world, over 100 cable breaks are reported each year

Causes of Interruption:

- Earthquake, Landslides caused by typhoons
- Fishing gear or ship anchors

Outage Characteristics:

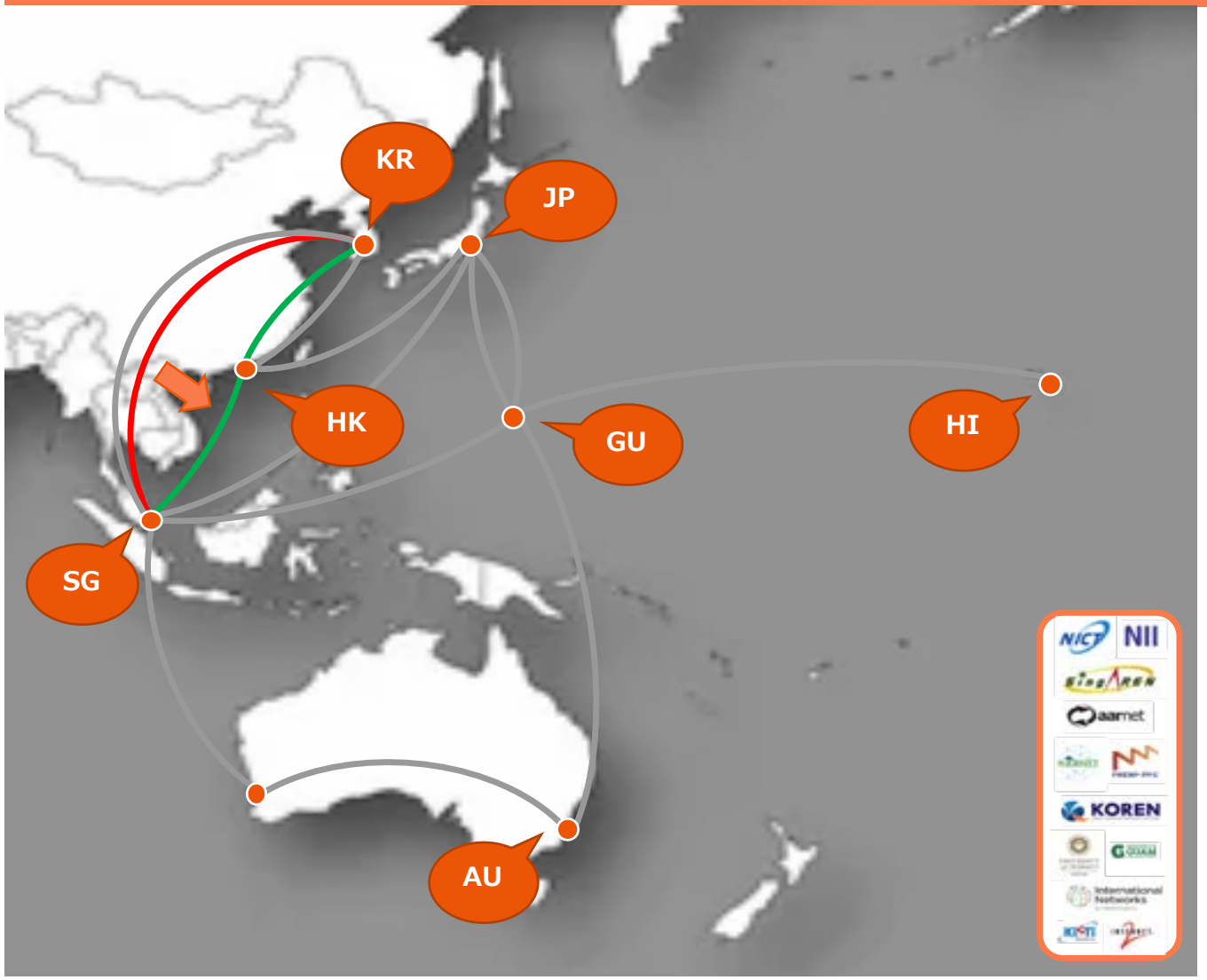
- Fewer outages than land links
- Once interrupted, recovery takes time

Difficult to maintain link availability above 95%

Mutual cooperation between organizations is very important

Interconnection of R&E International Circuits

Traffic detour case ①

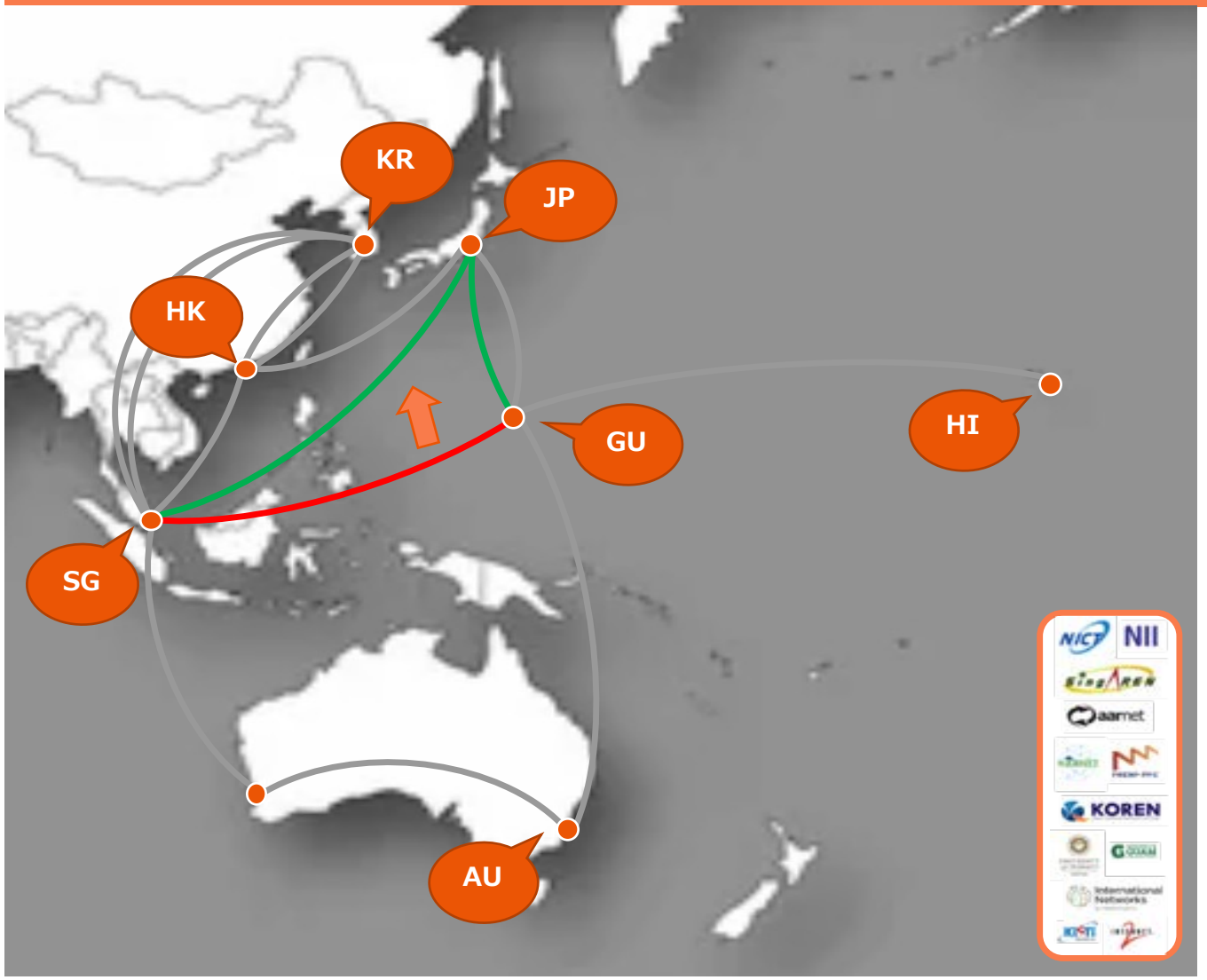


Fault circuit:
KOREN KR-SG link down in April

Detour route：
KOREN KR-HK link
NICT/SingAREN/JUCC HK-SG link

Interconnection of R&E International Circuits

Traffic detour case ②



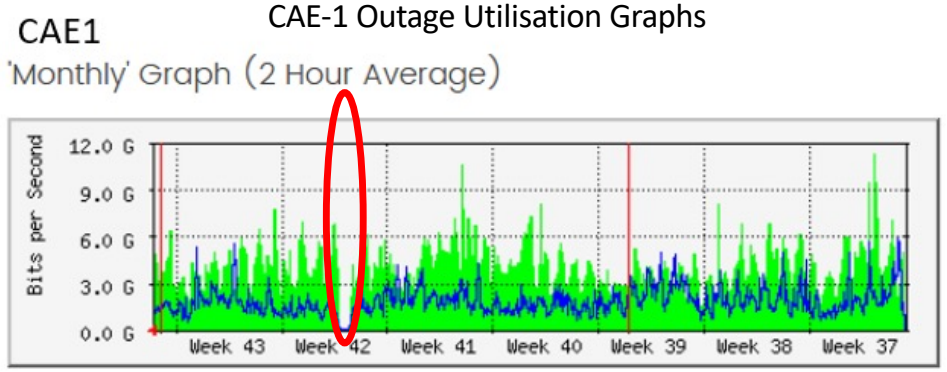
Fault circuit:
Guam-SG Consortium link down in May

Detour route：
NII JP-SG link
NII JP-GU link

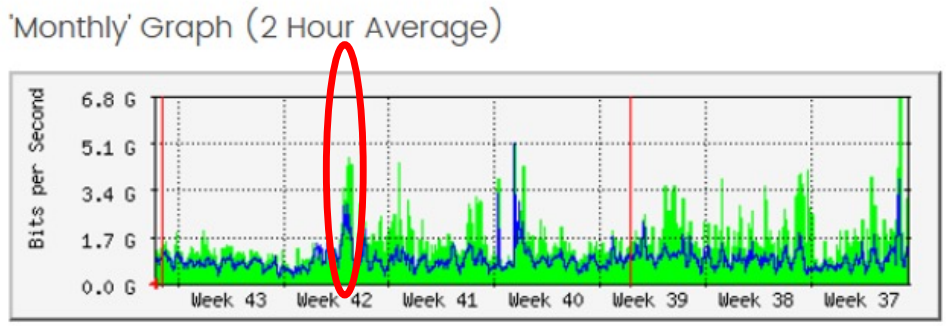
Network Outages

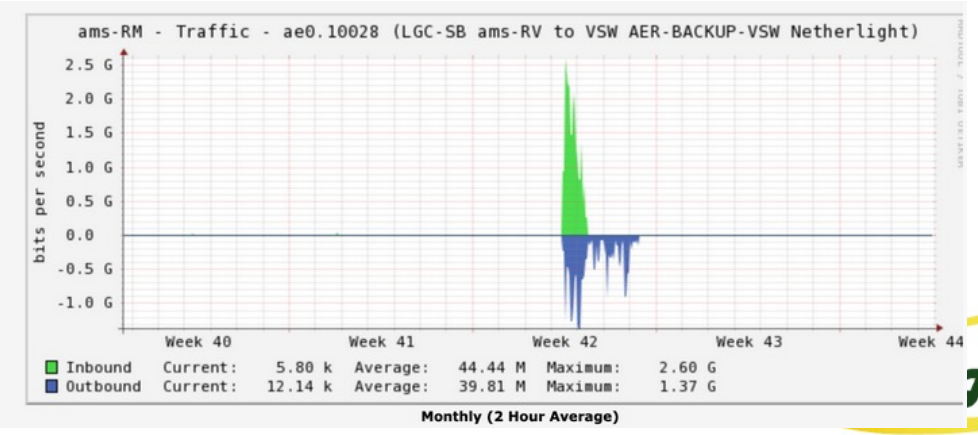
- SG-Guam 100G
  - Outage from 29th Jun to 5th Aug 2022 (36 days) due to undersea cable break
- CAE-1 100G
  - Outage due to multi-link break at Marseille from 18th to 20th Oct 2022
    - No traffic was impacted due to backup links in place over the SG-HK-JP & SINET Trans-Siberian links
      - Bottom graph is from the SINET Netherlight Interface of the Trans-Siberian SINET link

CAE-1 Outage Utilisation Graphs



SG-HK-JP





Re: [aponet-l] SEA-US restored

GY

aponet-l-request@list.iu.edu on behalf of Garret Yoshimi <gyoshimi@h

To Chris Zane

Cc piren-l@lists.hawaii.edu; aponet-eng-l@list.iu.edu; aponet-l@list.iu.edu

[Alert: Non-NTU Email] Be cautious before clicking any link or attachment.

Adding my thanks to REANNZ for supporting us through this challenging time! This very much demonstrates the high value of our long standing cooperation with all of our APONet partners!

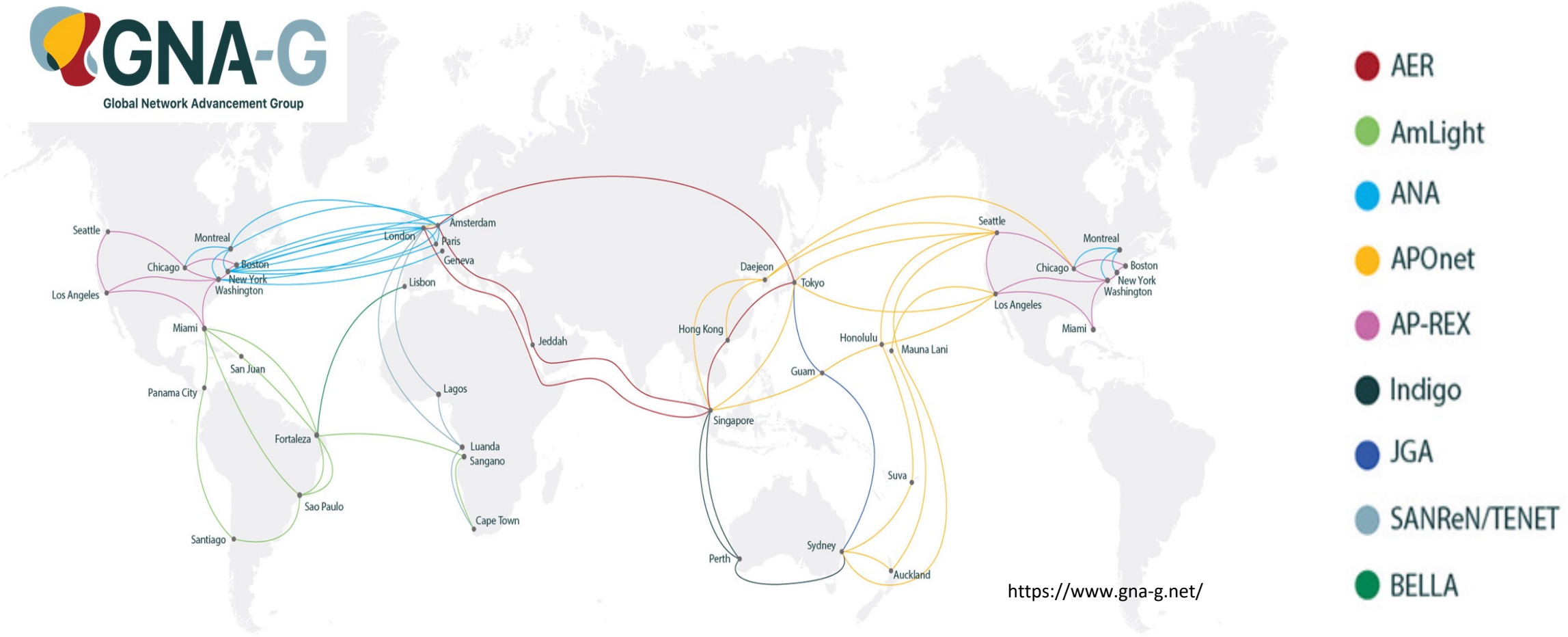
Best.
g

Garret T. Yoshimi
VP IT & CIO
University of Hawaii

On Sat, Aug 12, 2023, 6:43 AM Chris Zane <czane@hawaii.edu> wrote:

> Hi All
>
> SEA-US is back up and running and provider has reported all repairs have been completed. Peering and VLANs that were not moved have been restored between the US West Coast - Hawaii - Guam. We plan to let this sit for a day or so and will begin migrating vlans that were moved back to their original paths.
>
> Many many thanks to REANNZ for carrying traffic between Hawaii and GOREX during the prolonged outage.
>
> Thanks!
>
> ##

International R&E networks

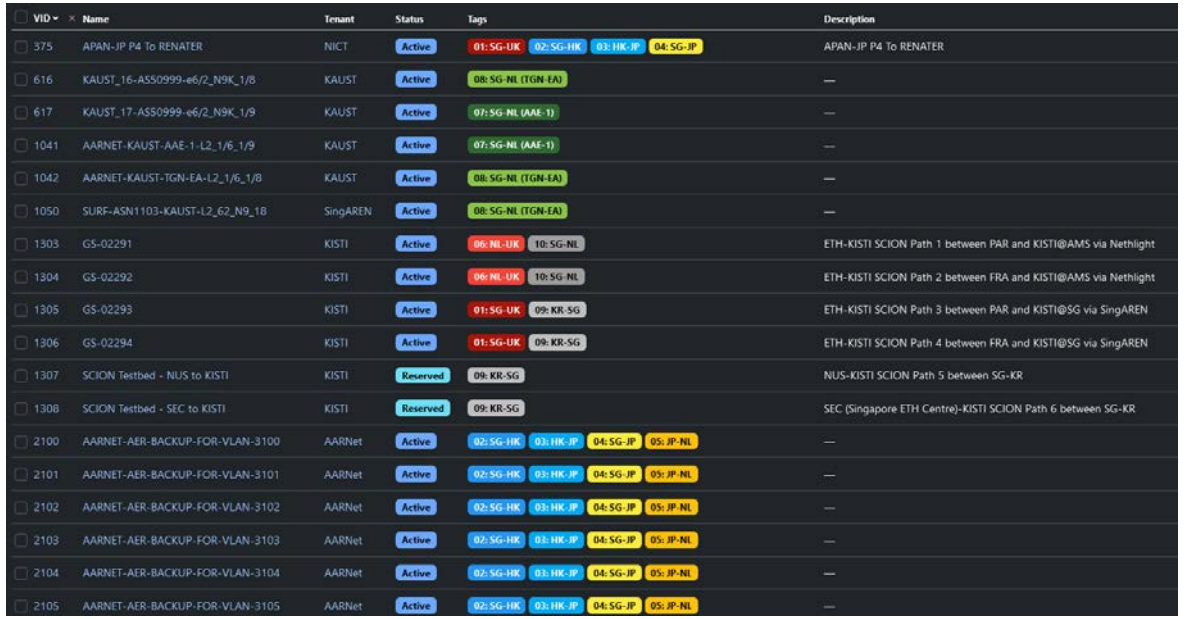


https://www.gna-g.net/

Engineering collaboration

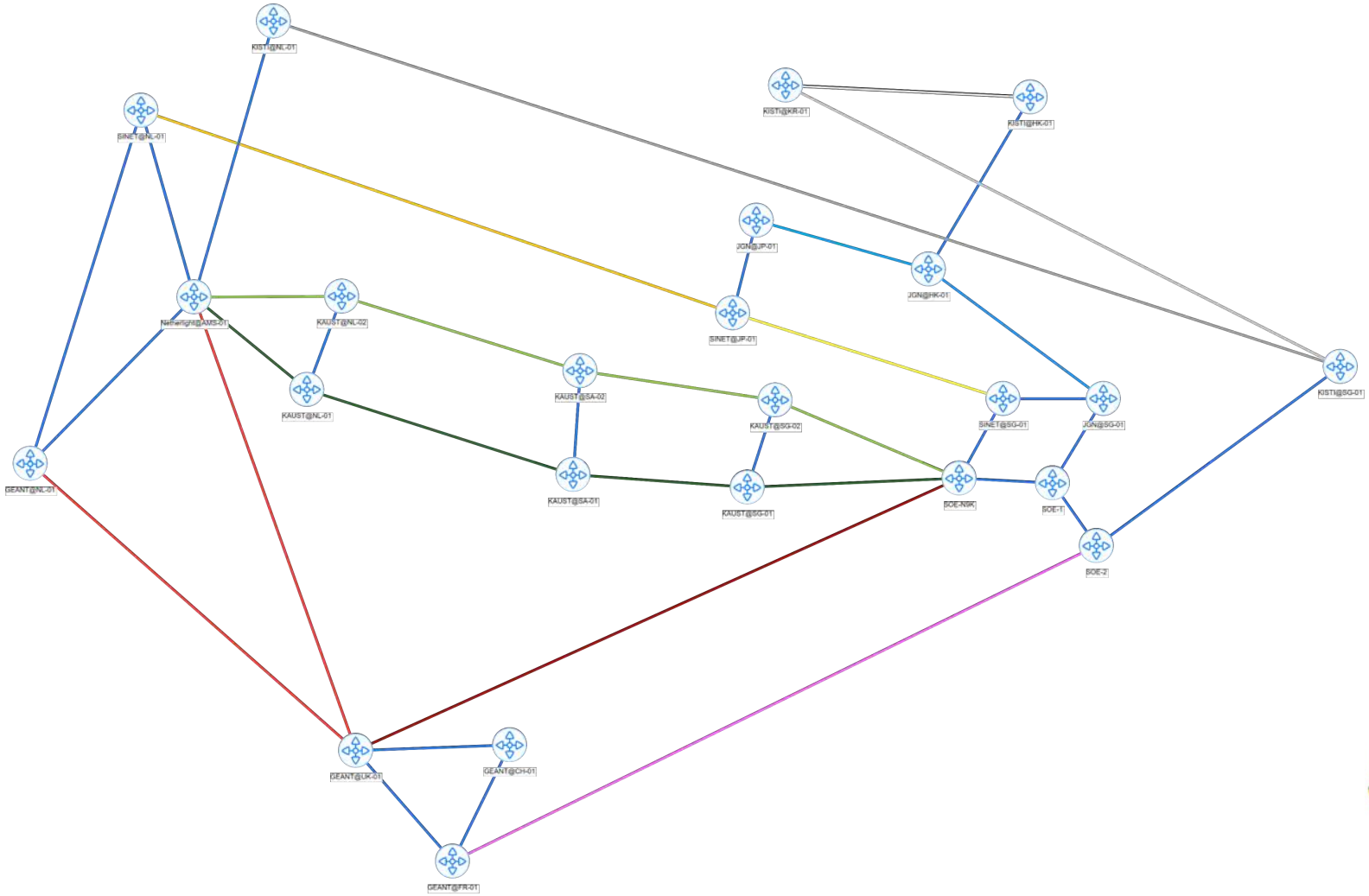
AER VLAN Management environment

- VLANs are setup based on partners requests. They sometimes goes beyond regional domains.
- Netbox used for
  - inventory management of circuits, e.g. owner, status, service provider, termination point,etc.
  - Inventory management of devices
  - Autogeneration of topology



VID	Name	Tenant	Status	Tags	Description
375	APAN-JP P4 To RENATER	NICT	Active	01: SG-UK, 02: SG-HK, 03: HK-JP, 04: SG-JP	APAN-JP P4 To RENATER
616	KAUST_16-AS50999-e6/2_N9K_1/8	KAUST	Active	08: SG-NL (TGN-EA)	—
617	KAUST_17-AS50999-e6/2_N9K_1/9	KAUST	Active	07: SG-NL (AAE-1)	—
1041	AARNET-KAUST-AAE-1-L2_1/6_1/9	KAUST	Active	07: SG-NL (AAE-1)	—
1042	AARNET-KAUST-TGN-EA-L2_1/6_1/8	KAUST	Active	08: SG-NL (TGN-EA)	—
1050	SURF-ASN1103-KAUST-L2_62_N9_18	SingAREN	Active	08: SG-NL (TGN-EA)	—
1303	GS-02291	KISTI	Active	06: NL-UK, 10: SG-NL	ETH-KISTI SCION Path 1 between PAR and KISTI@AMS via Nethlight
1304	GS-02292	KISTI	Active	06: NL-UK, 10: SG-NL	ETH-KISTI SCION Path 2 between FRA and KISTI@AMS via Nethlight
1305	GS-02293	KISTI	Active	01: SG-UK, 09: KR-SG	ETH-KISTI SCION Path 3 between PAR and KISTI@SG via SingAREN
1306	GS-02294	KISTI	Active	01: SG-UK, 09: KR-SG	ETH-KISTI SCION Path 4 between FRA and KISTI@SG via SingAREN
1307	SCION Testbed - NUS to KISTI	KISTI	Reserved	09: KR-SG	NUS-KISTI SCION Path 5 between SG-KR
1308	SCION Testbed - SEC to KISTI	KISTI	Reserved	09: KR-SG	SEC (Singapore ETH Centre)-KISTI SCION Path 6 between SG-KR
2100	AARNET-AER-BACKUP-FOR-VLAN-3100	AARNet	Active	02: SG-HK, 03: HK-JP, 04: SG-JP, 05: JP-NL	—
2101	AARNET-AER-BACKUP-FOR-VLAN-3101	AARNet	Active	02: SG-HK, 03: HK-JP, 04: SG-JP, 05: JP-NL	—
2102	AARNET-AER-BACKUP-FOR-VLAN-3102	AARNet	Active	02: SG-HK, 03: HK-JP, 04: SG-JP, 05: JP-NL	—
2103	AARNET-AER-BACKUP-FOR-VLAN-3103	AARNet	Active	02: SG-HK, 03: HK-JP, 04: SG-JP, 05: JP-NL	—
2104	AARNET-AER-BACKUP-FOR-VLAN-3104	AARNet	Active	02: SG-HK, 03: HK-JP, 04: SG-JP, 05: JP-NL	—
2105	AARNET-AER-BACKUP-FOR-VLAN-3105	AARNet	Active	02: SG-HK, 03: HK-JP, 04: SG-JP, 05: JP-NL	—

Autogeneration of topology



Beyond connectivity

Singapore Upgrades HPC Infrastructure to Support Future Research Demands

❑ Upgrading Infrastructure

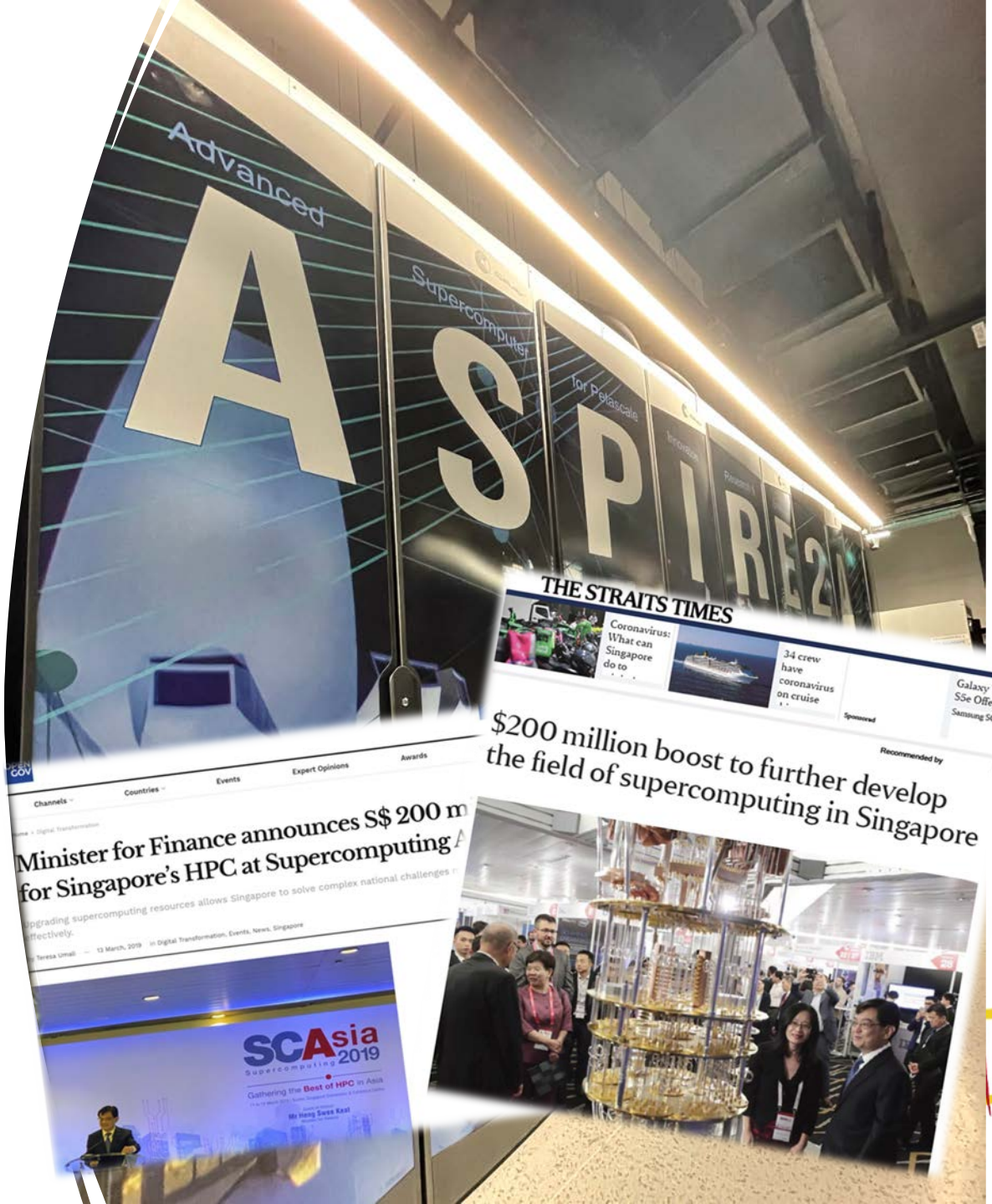
- From ASPIRE 1, AI Platform@NSCC, HTC1000 to ASPIRE 2A, and the benefits for Singapore R&D

❑ Connecting Singapore Research with the World

- Our links and connectivity in partnership with SingAREN

❑ Growing Local HPC Community & Int'l Collaboration

- e.g. Edge Supercomputing @ Singapore Hospitals and collaborations with overseas partners

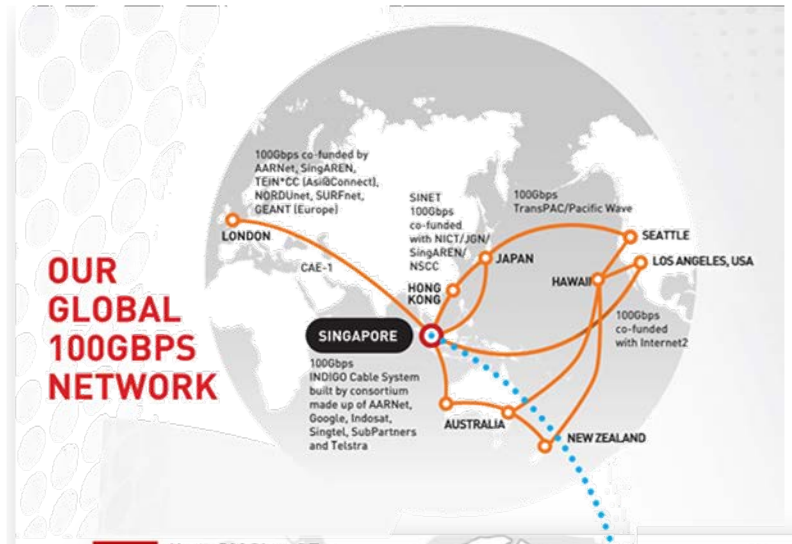


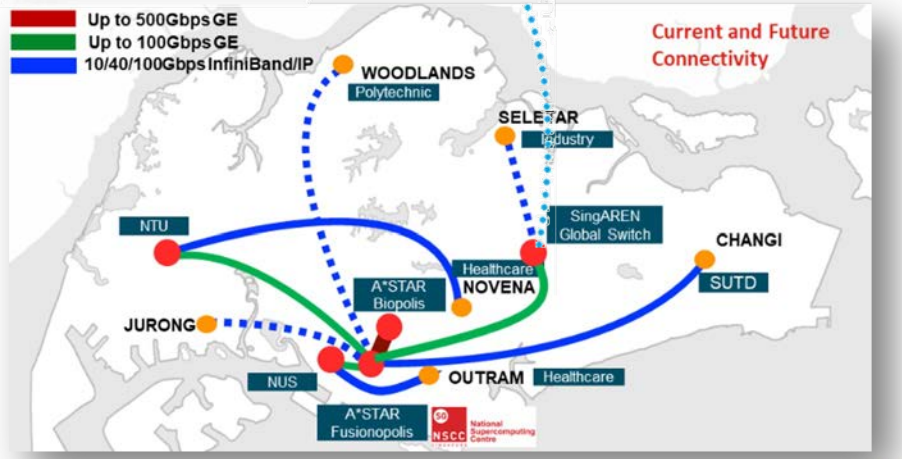
Superconnected – Locally and Globally

LOCALLY

Ultra High-speed InfiniBand for Data Transfers

Leveraging long-haul InfiniBand switches, NSCC is able to deliver high-bandwidth and low-latency between different geographic locations in Singapore. Our connections are done in collaboration with the *Singapore Advanced Research and Education Network (SingAREN)* and *SingAREN-Lightwave Internet Exchange (SLIX)*. Researchers using ASPIRE1 at locations islandwide experience the same connectivity and speed as if they were at NSCC itself!





GLOBALLY
Linking Singapore and the region with the rest of the world

Singapore as Strategic HPC and Advanced Networking Hub for the region.

To connect Singapore to Global Research and Top HPC Centres worldwide.

Key connections:

- **Agency for Science, Technology and Research (A*STAR)**
- **National University of Singapore (NUS)**
- **Nanyang Technological University (NTU)**
- **Singapore University of Technology and Design (SUTD)**

Leveraging International HPC Partnerships

Ongoing

RIKEN-CCS
- R-CCS-NSCC-ThaiSC – EU-ASEAN-Japan / HPC School collaborations
- R-CCS-NSCC-RIST – Call to Fugaku Projects (2nd run)
- SCA event co-organiser

ThaiSC
- EU-ASEAN-Japan - Thai HPC School
- ThaiSC-NSCC – ASEAN HPC Taskforce members
- ThaiSC-NSCC MOU (2023)

SDSC & PSNC
- Discussions between SDSC-SingAREN-NSCC on Cloudbank collaboration
- Potential for linkup with GNA-G for PSNC, SDSC and NSCC / SingAREN.

CSC
- Finland-Singapore MOU (Mar 21)
- Finland-Singapore QKD Workshop (Jun 21)
- CSC-Pawsey MOU (Oct 21)
- CSC-A*STAR-IQM-VTT MOU (Sep 22)
- Green DC / HPC resource discussions

Pawsey
- NSCC-Pawsey MOU (2018)
- New MOU in the works
- SCA event co-organiser

NCI
- NCI-NSCC MOU (Mar 2022)
- NCI-NSCC joint MPI training workshop
- NSCC project with NCI on HPC resources support

SingAREN

Other support

- Supercomputing Demonstration
- Data Mover Challenge since 2019
- Remote Robot surgery between Japan and Singapore.

Q&A

Thank You