Asian Network Status

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GDB

8 Mar. 2017

Taipei

Outline

- Asian NREN Infrastructure
  - National/Regional R&E network
  - International partners's network
- WLCG Network in Asia
  - Open R&E Exchange Network
- e-Science development in Asia

The Asia Pacific…

- More than half the world's population
  - Rapidly growing proportion of global R&D
  - Rapidly growing population in education at all levels
  - Strong social pressures around food, health
  - Immense diversity

- APAN: Partnership of NRENs
  - 16+ Economies as primary members, 22+ Affiliates, Associates, Liaison and Industry partners
  - Formed 1995, incorporated 2009
    - MoU partnership became APAN Ltd (HK)
  - Independent, self-governing, many investors
  - Started with high speed links of 1-2Mb/s… *within the region*

Asia-Pacific Backbone Topology

0.5Mb/s -> N*10-100Gb/s over the last fifteen years

Asia-Pacific Backbone Topology
by funding source

Asia Pacific
United States
Europe

As of February 8th, 2013

Domestic/international bandwidth

- Domestically: few Mb/s up to 100Gb/s

- Internationally: 10-100Mb/s up to 1-100Gb/s

- Several 100Gb/s international paths emerging
  - TransPAC4 (US/Asia,)
  - Australia, Korea, Japan, Singapore, …
  - Asia/EU still growing, 10Gb/s

NRENs and RRENs

- Benefits of NRENs
  - Enabling infrastructure for Research and Education
  - Value scales exponentially with community size
  - Provide national services to members
  - Provide 'burst' capacity

- Benefits of RRENs
  - Work on common interests/needs across a region
  - Aggregate demand and supply
  - Support cross-border activities
    - Most research and education is becoming internationally collaborative

Challenges for NREN/RRENs

- APAN economies range from >1.2billion to <1 million people, from very-developed to very-developing
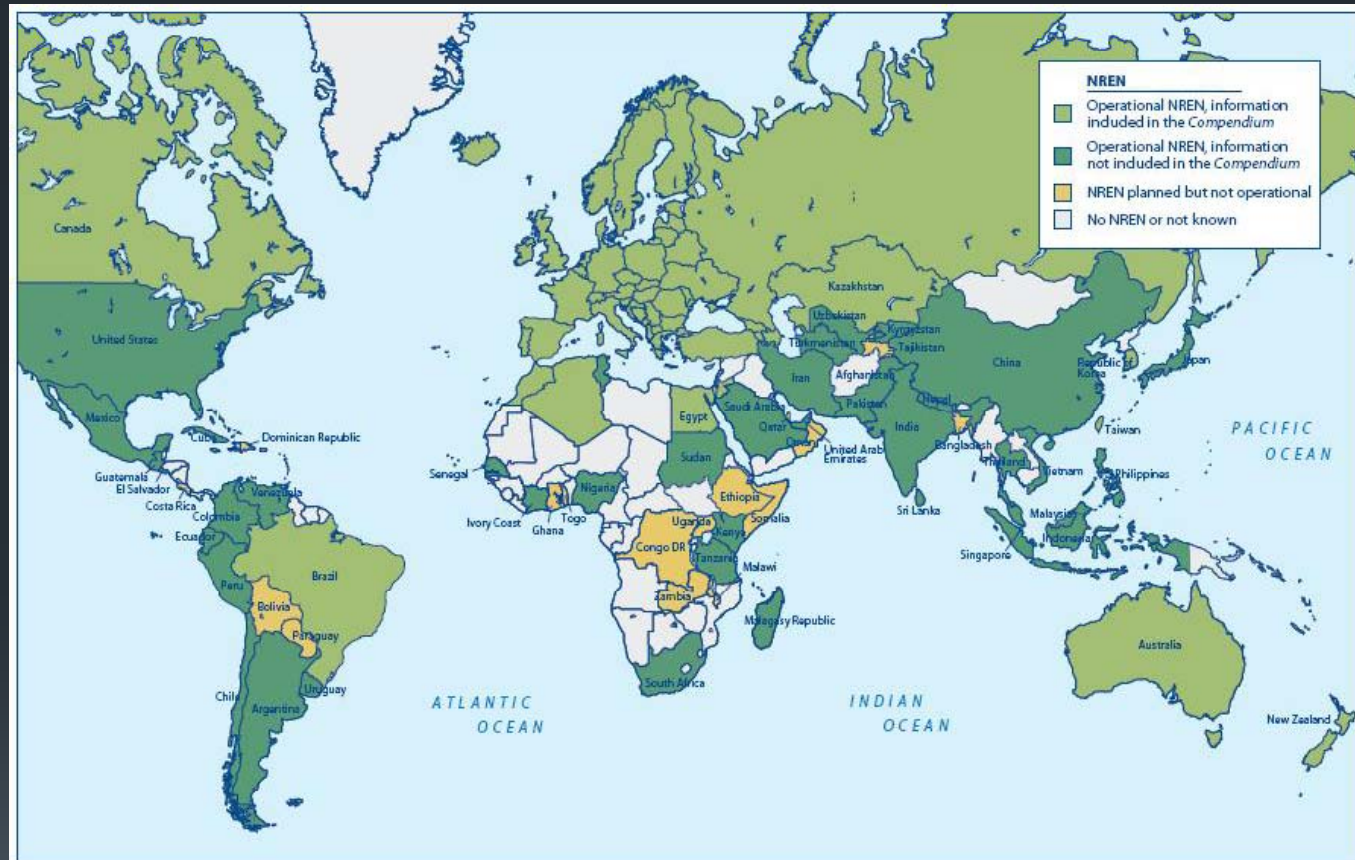
- NRENs have very diverse models – they have to!
  - As companies, partnerships, government agencies, lead entities
  - Funding through subscriptions, project grants, fee-for-service, …
  - Offering service portfolios:
    - Domestic connectivity, international connectivity
    - Computing, storage, collaboration, certificates, identities, data management, training, project support, software development, …
    - Harmonising is hard!
  - CN(CERNET, CSTNET), IN (ERNET, NKN), JP (Sinet, GNX), KR (KOREN, KREONET), TH (UniNet, ThaiSARN), TW (AS, TWAREN), SG, MY, PH, HK, PK, VN, NP, NZ, AU,...

Comparing NRENs

APAN — *Asia-Pacific Advanced Network*

TERENA
NREN
Compendium
2013

NREN
- Operational NREN, information included in the *Compendium*
- Operational NREN, information not included in the *Compendium*
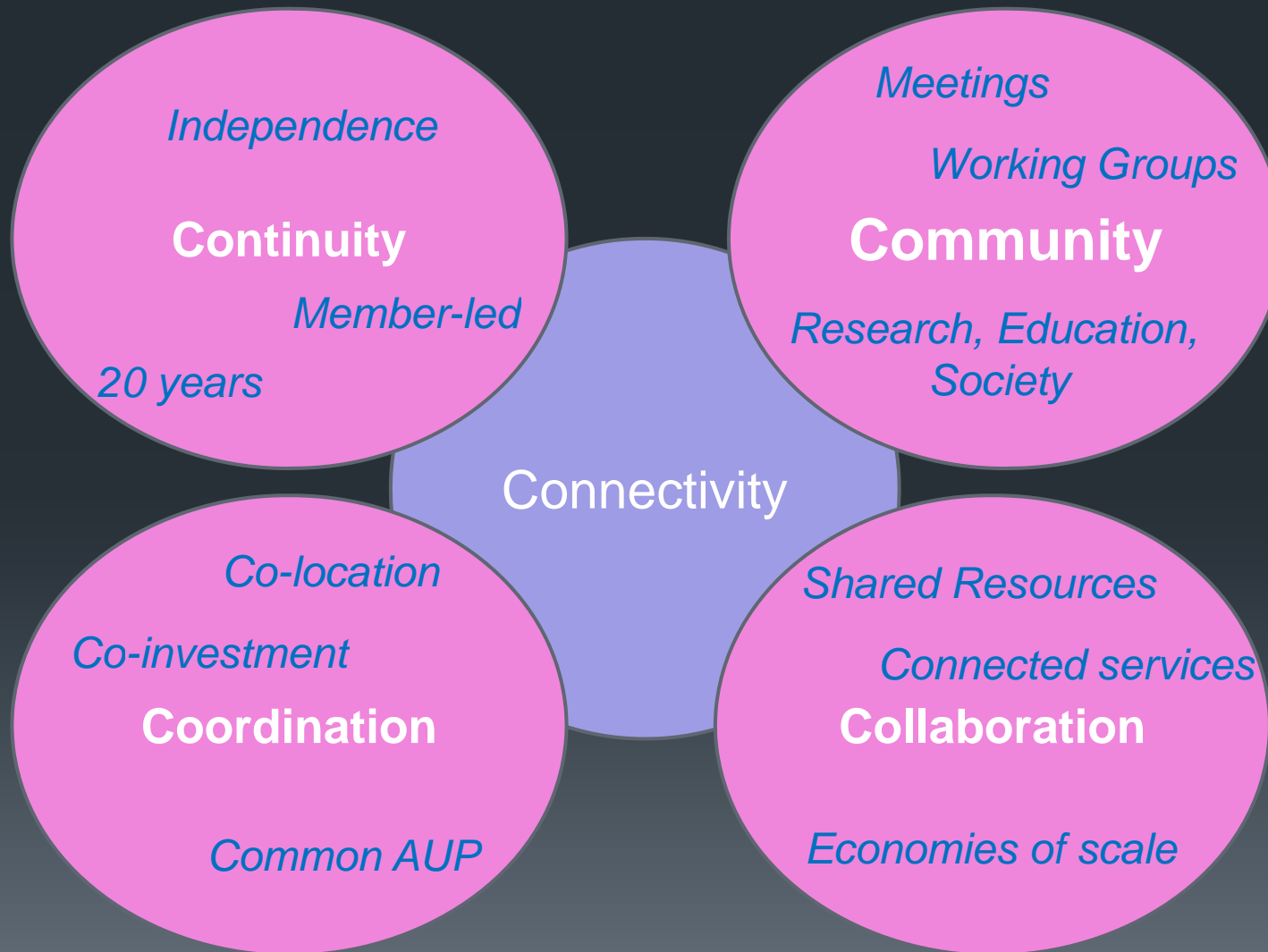- NREN planned but not operational
- No NREN or not known

- Best view of all NRENs
- Includes historical data
- Measures on many dimensions
- Services, costs, business

- *Needs more participation*
- *Global effort to collect data*
- *Trying to make it more valuable*
- *Trying to make it much easier*

APAN's role

APAN — Asia-Pacific Advanced Network

Independence

Continuity

Member-led

20 years

Meetings

Working Groups

Community

Research, Education, Society

Connectivity

Co-location

Co-investment

Coordination

Common AUP

Shared Resources

Connected services

Collaboration

Economies of scale

Community: focus on users

- *Enhance opportunities, access, and adoption of resources*
- Research, Education and Societal Benefits
  - Applications: Agriculture, Earth Systems and Sensing, Culture and Arts, Astronomy, HEP, Bioinformatics, Medicine, Education, Disaster Management (natural, medical, etc.), …
  - Tech: UC, IPv6, HDTV, Future Int., SDN, IdP Fed., Grid, Cloud, …

- Two major meetings each year, 300+ attendees
  - APAN-42: Hong Kong, 43: New Delhi, …
- Participation and engagement with many community events
  - Within the region, and globally

Coordination

- Many funding sources, many needs, many bilateral links

- Coordinate planning to maximise benefits
  - Connect and share backbone links
  - Attract and direct investments for new links
  - Demonstrate demand for capacity in emerging areas
  - Co-location and peering points – internet exchanges
  - …

- International peering and planning
  - Coherent AUPs simplify peering and routing
  - Any user on any NREN globally can reach any APAN institution

Collaboration

- With large partnerships come economies of scale

- Sharing infrastructure connected to the network
  - Collaboration systems, videoconferencing – unified communications, MCUs, directories, …
  - High-performance computing, grid and cloud technologies
  - Data hosting and movement, …
  - Identity federations, eduroam, …
  - People, support, operations, skills, …
  - Standards, best practices, …
  - …

Continuity

- *More than 20 years of meetings now*
- A member-owned partnership
  - Governance by the interested parties
- No single project dependency
  - Funding is independent, flexible, and largely recurrent
- No single government dependency
  - Politics can be reduced…

- Ongoing evolution & demonstration of value to the community
  - It's more than "just" connectivity

Learnings from nearly 20 years

- Plan for sustainability, growth and change.
- Focus on the users
  - Foster the communities
  - Make it easy for ordinary users
  - Support advanced technologies for advanced users
- Plan & build collaboratively, to maximise the benefits

- Look to the Asia-Pacific region as well, where more than half the world is looking to collaborate and share with you!

TEIN

Connecting Asia and Europe's Research and Education Communities

www.tein.asia

TEIN Project Partners

AF Afghanistan	ID Indonesia	NZ New Zealand
AU Australia	JP Japan	PK Pakistan
BD Bangladesh	KR Korea	PH Philippines
BT Bhutan	LA Laos	SG Singapore
KH Cambodia	MM Myanmar	LK Sri Lanka
CN China	MN Mongolia	TH Thailand
HK Hong Kong	MY Malaysia	TW Taiwan
IN India	NP Nepal	VN Vietnam

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

a — NICT — National Institute of Information and Communications, Japan

b — NICT — National Institute of Information and Communications, Japan / Thailand Research and Education Network, Thailand

c — NII — National Institute of Informatics, Japan

d — MAFFIN — Ministry of Agriculture, Forestry and Fisheries Research Network, Japan

e/f — NIA — National Information Society Agency, South Korea

g — CERNET — China Education and Research Network, China / China Science & Technology Network, China

h — TransPAC — co-funded by Japan and the USA

i — ORIENT plus — co-funded by China and EU

j — ASGC — Academia Sinica Grid Computing, Republic of Chinese Taipei

k — aarnet — Australia, Academic and Research Network, Australia

l — REANNZ — Research and Education Advanced Network New Zealand

m — National Supercomputing Centre, Singapore

n — LEARN — Lanka Education and Research Network, Sri Lanka

o — Advanced Science and Technology Institute, Philippines
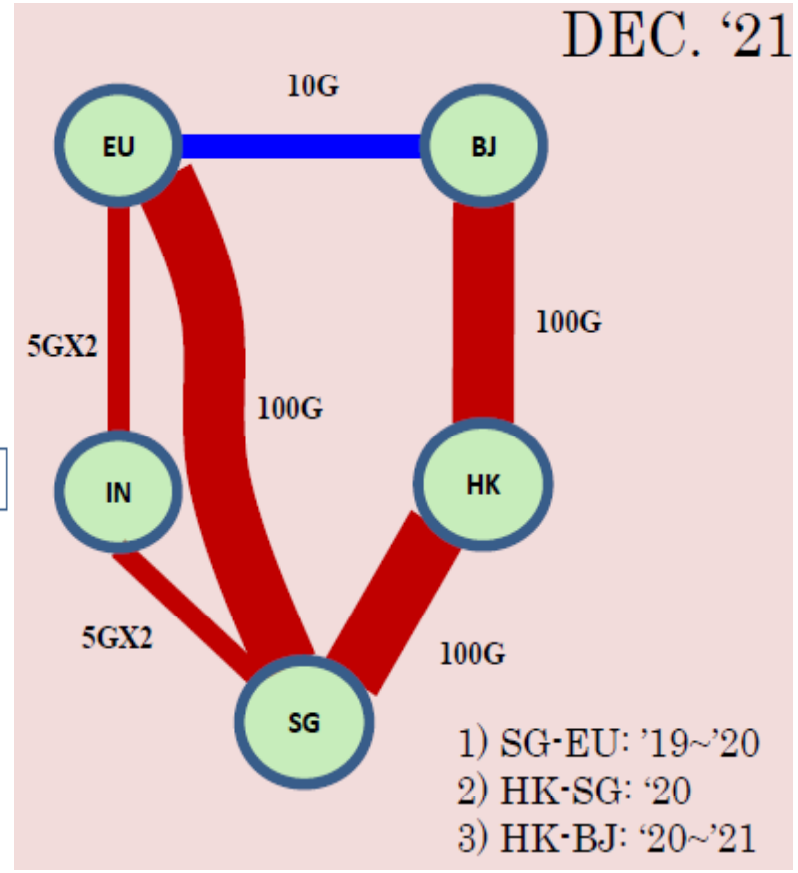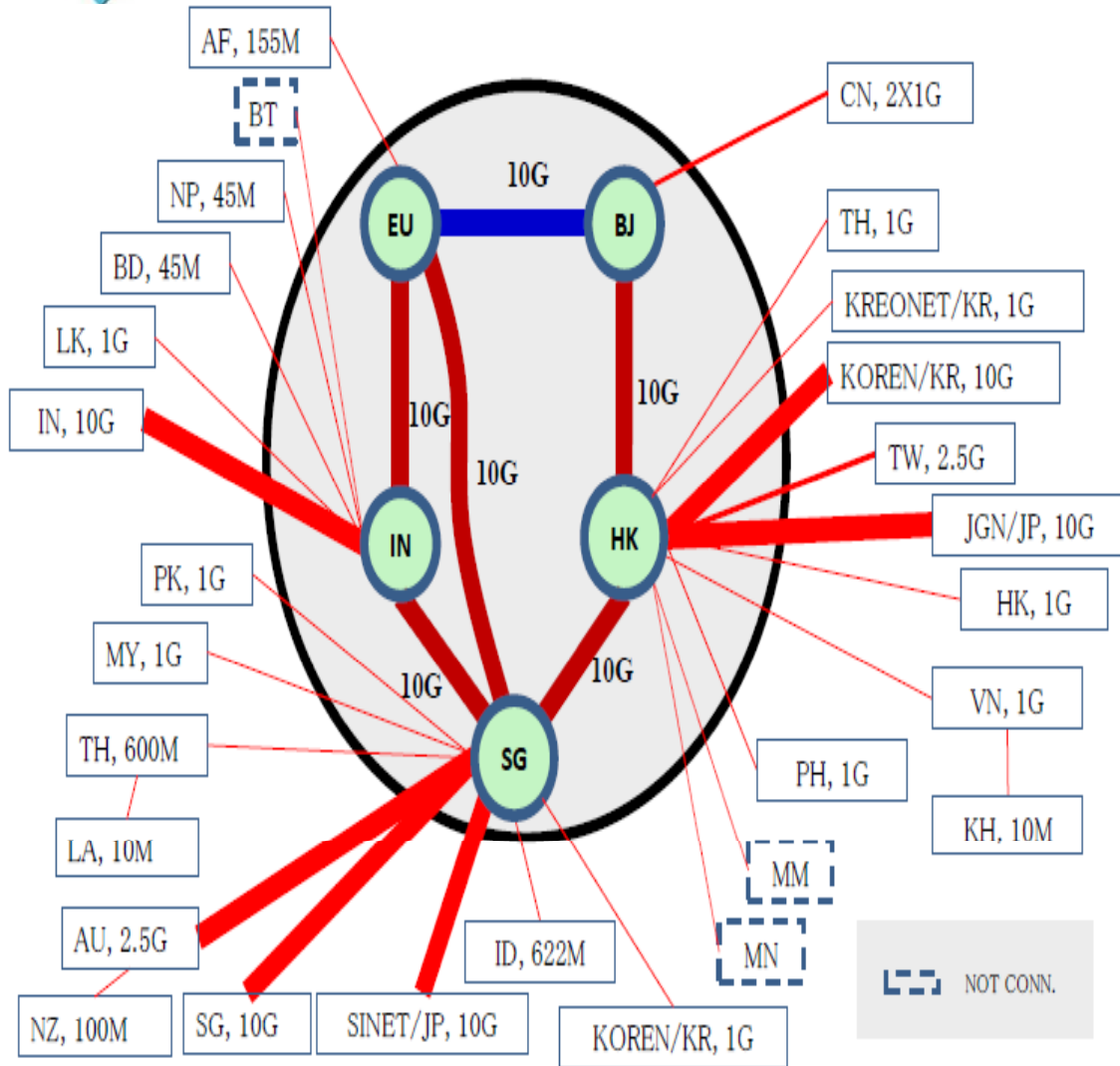
As of December 2016

TEIN CC COOPERATION CENTER
www.teincc.org

TEIN is co-funded by the European Commission through the Directorate-General for Development and Cooperation-EuropeAid

Legend

— 10Gbps	— 100 Mbps
— 2.5 Gbps	— 45 Mbps
— 1 Gbps	— 10Mbps
— 622 Mbps	= = Planned
— 155 Mbps	

TFIN PoPs

TFIN NOC

* SingAREN connected to TEIN SG PoP at 10 Gbps

\# HARNET connected to TEIN HK PoP at 1 Gbps

~ NKN connected to TEIN IN PoP at 10 Gbps

§ CERNET connected to TEIN CN PoP at 2 x 1 Gbps

% ThaiREN Connected to TEIN SG PoP at 600 Mbps

% GLORIAD-KR connected to TEIN HK PoP at 1 Gbps

% Internet2 connected to TEIN SG PoP at 1 Gbps

North America

EU

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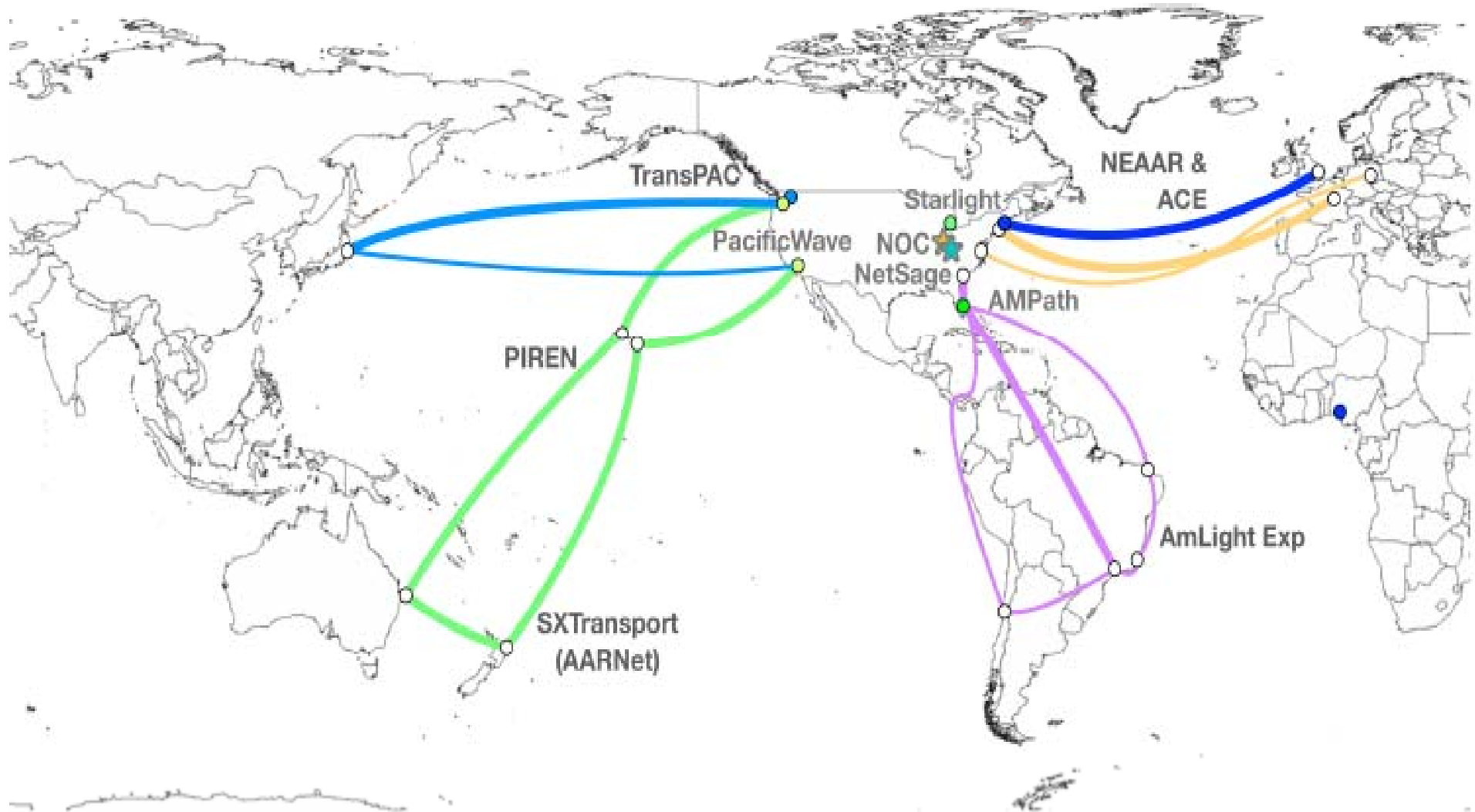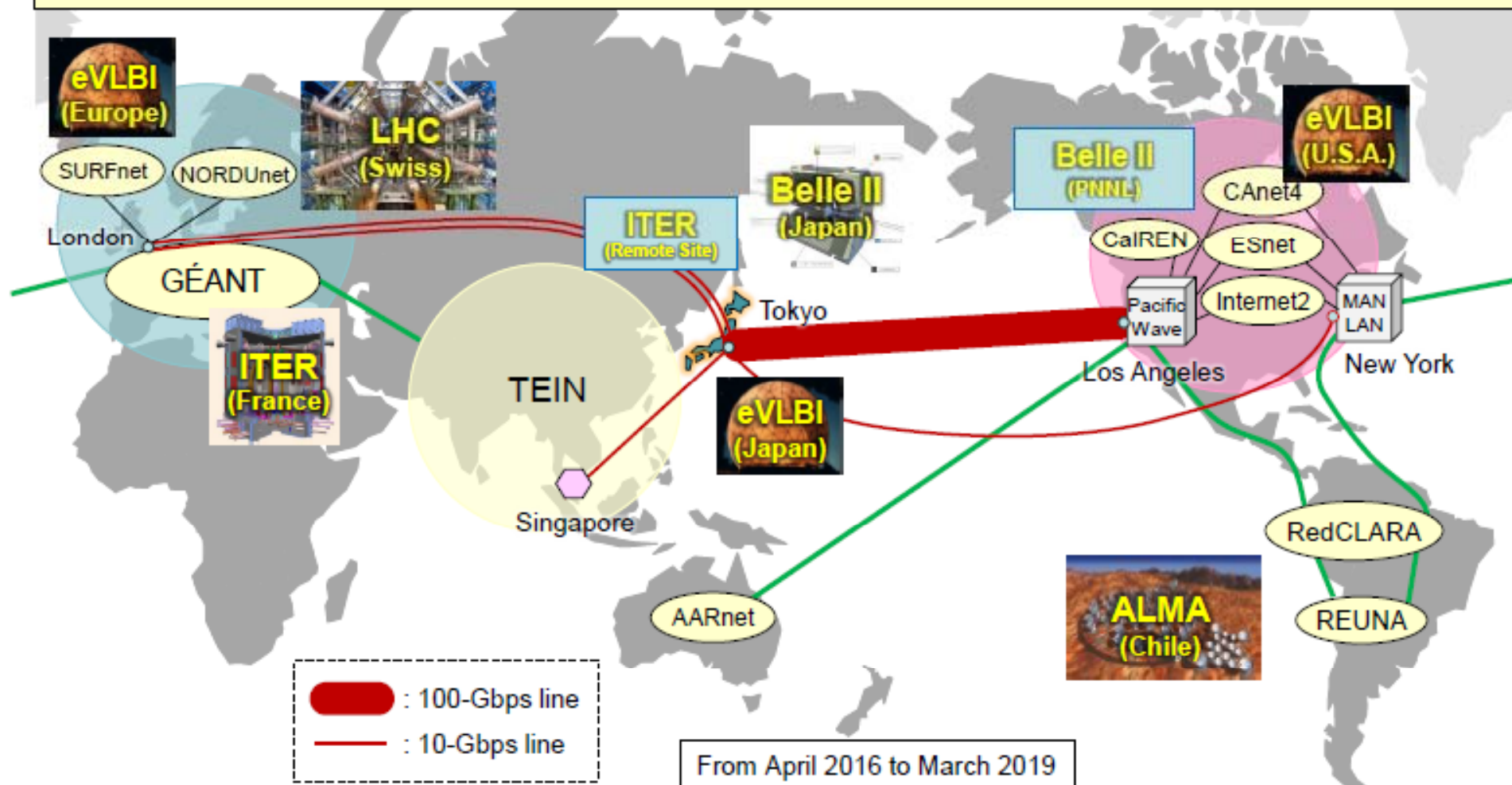
Map country labels: Mongolia, Japan, Korea, China, Afghanistan, Pakistan, Nepal, Bhutan, Bangladesh, Hong Kong, Myanmar, Laos, India, Vietnam, Thailand, Philippines, Cambodia, Sri Lanka, Singapore, Malaysia, Indonesia, Australia, New Zealand

Asi@Conncet

NSF IRNC: TransPAC

America Connects to Asia
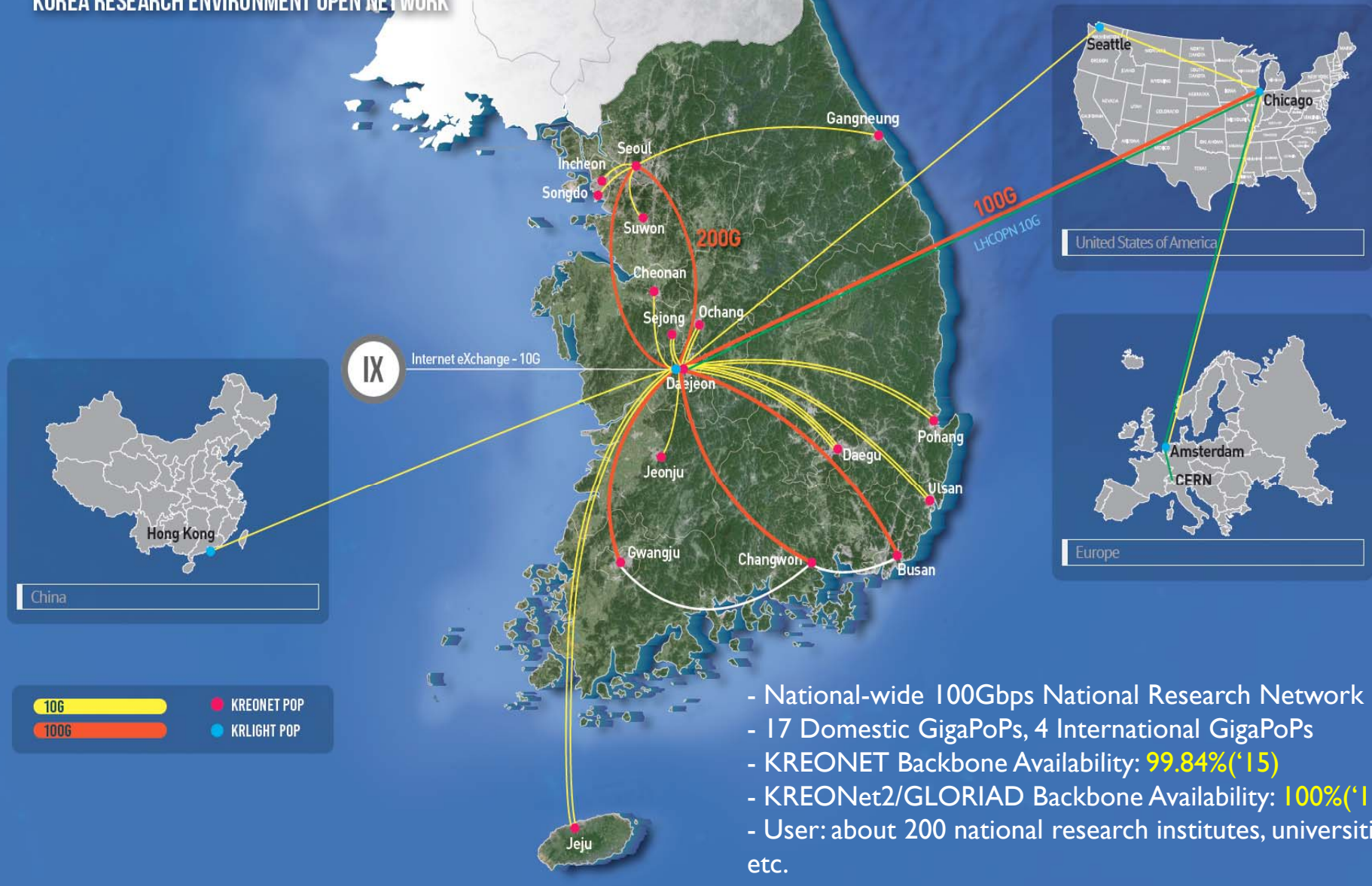
International Lines of SINET5

◆ **SINET5 has direct international lines to USA, Europe, and Asia.**

- USA: 100-Gbps line to Los Angeles, 10-Gbps line to New York
- Europe: Two 10-Gbps lines to London for small latency
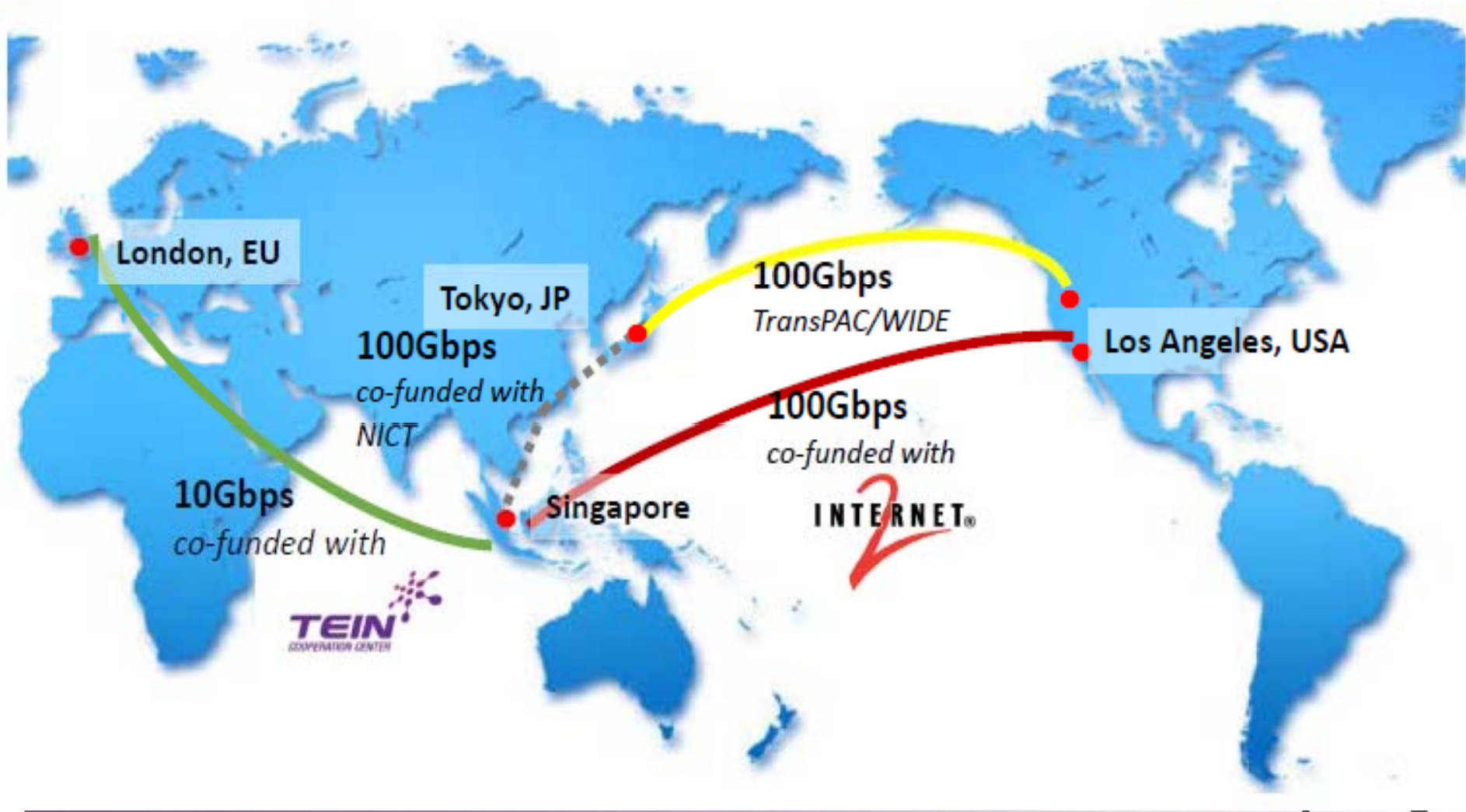- Asia: 10-Gbps line to Singapore

Legend:
- : 100-Gbps line
- : 10-Gbps line

From April 2016 to March 2019

MAP OF KREONET 2016

KOREA RESEARCH ENVIRONMENT OPEN NETWORK

Seattle
Chicago
United States of America

100G
LHCOPN 10G

Gangneung
Seoul
Incheon
Songdo
Suwon
200G
Cheonan
Sejong
Ochang

Internet eXchange - 10G
IX
Daejeon

Pohang
Daegu
Jeonju
Ulsan

Hong Kong
China

Amsterdam
CERN
Europe

Gwangju
Changwon
Busan

Jeju

10G — KREONET POP
100G — KRLIGHT POP

- National-wide 100Gbps National Research Network
- 17 Domestic GigaPoPs, 4 International GigaPoPs
- KREONET Backbone Availability: 99.84%('15)
- KREONet2/GLORIAD Backbone Availability: 100%('15)
- User: about 200 national research institutes, universities etc.

SingaREN/Internet2/NICT/Asi@Connect
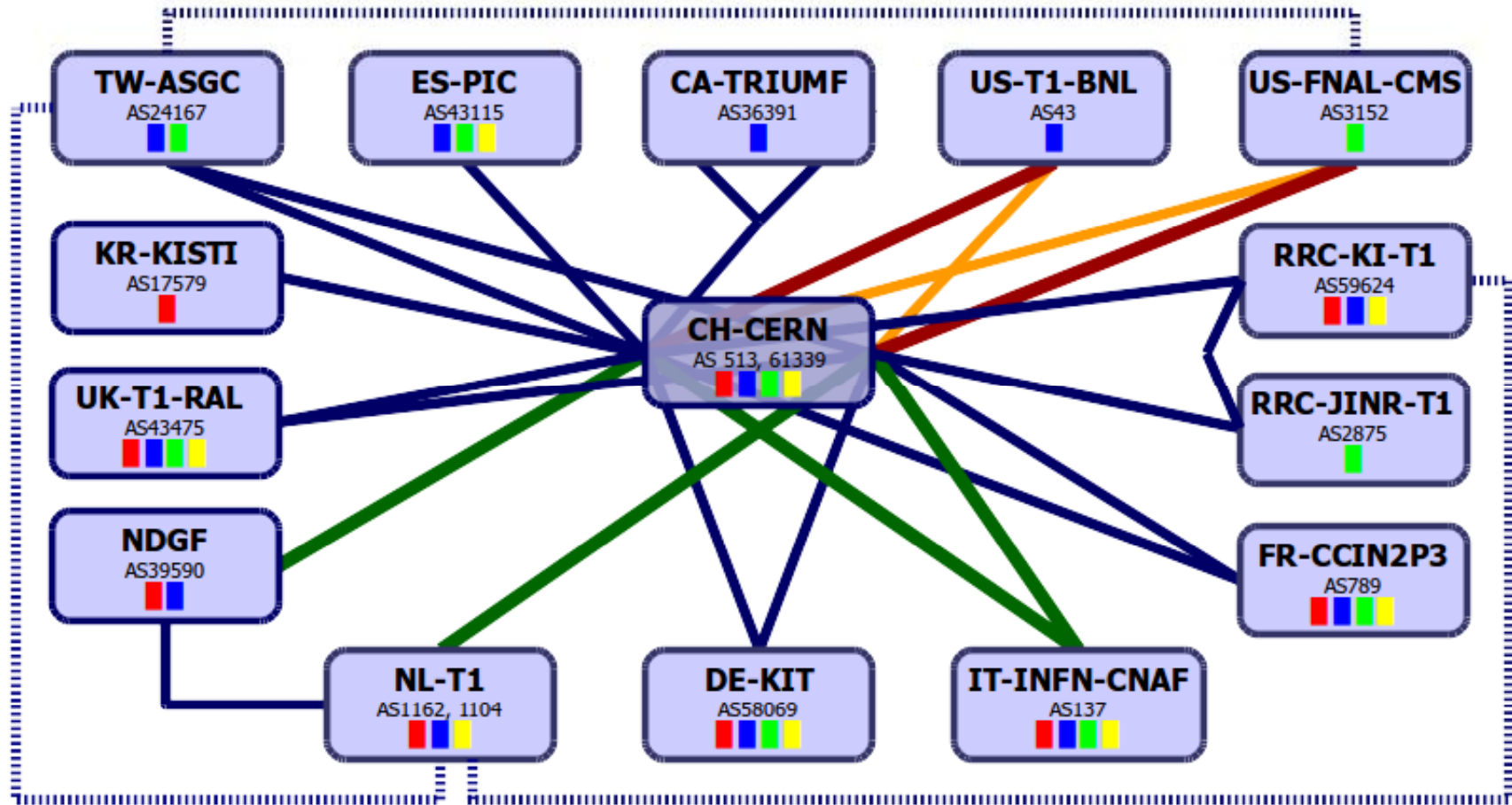
L3VPN Current topology

LHCONE L3VPN: A global infrastructure for High Energy Physics data analysis (LHC, Belle II, Pierre Auger Observatory, NOVA)

Asia

North America

Europe

South America
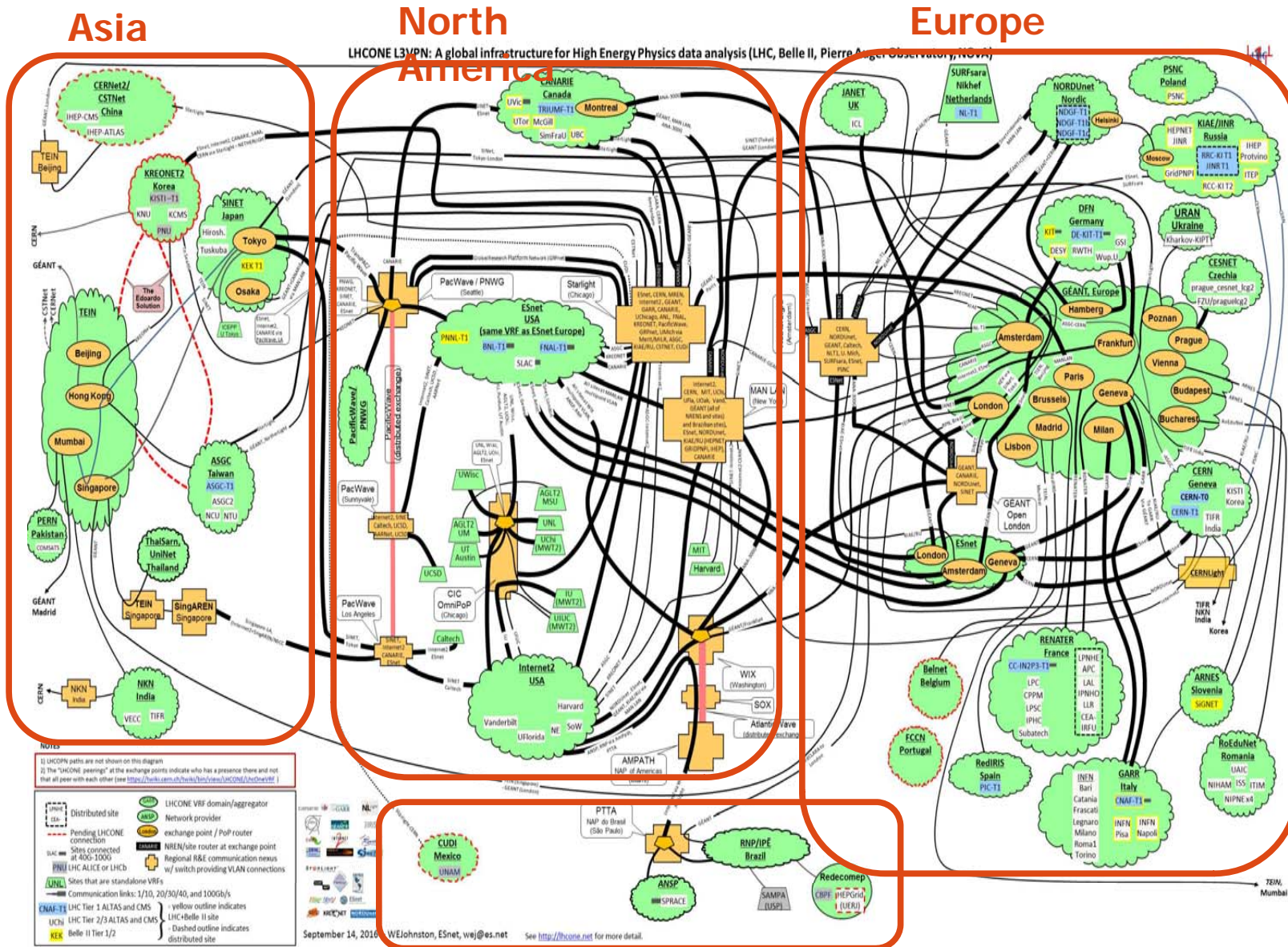
LHCONE Asia VRF Open Exchange Point

Missing connections

Esnet AS293

ThaiREN AS24475

CERNlight AS20641

SINET AS2907

ASGCNet AS24167

TEIN AS24490

KREONET AS17579

ERnet AS2697

GEANT AS20965

International

National

LHCONE peering in place

Only physical connection in place

Missing LHCONE peering

Information Technology Department

26
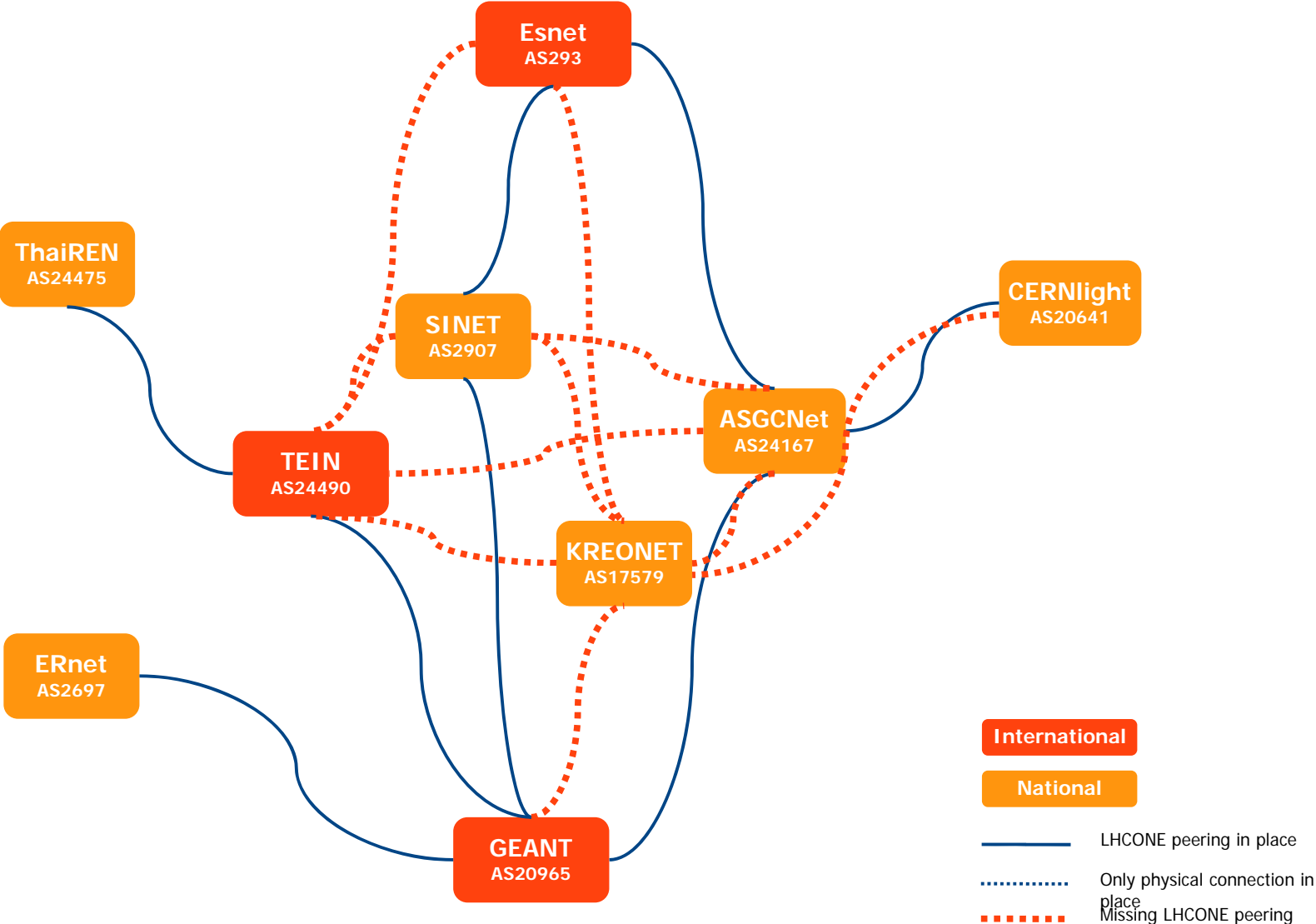
TAIWAN Global R&E Network

Legend:
- ASGCNet (red)
- ASNet (purple)
- TWAREN (blue)
- TANet (dark)

Locations and links:
- Hong Kong — 2.5G, 2.5G, 5G, 10G
- Tokyo
- TAIWAN
- Palo Alto — 10G
- Chicago — 1G
- New York — 1G
- LA — 10G + 10G
- Amsterdam — 10G
- Geneva — 10G
- 10G links across Pacific and Atlantic
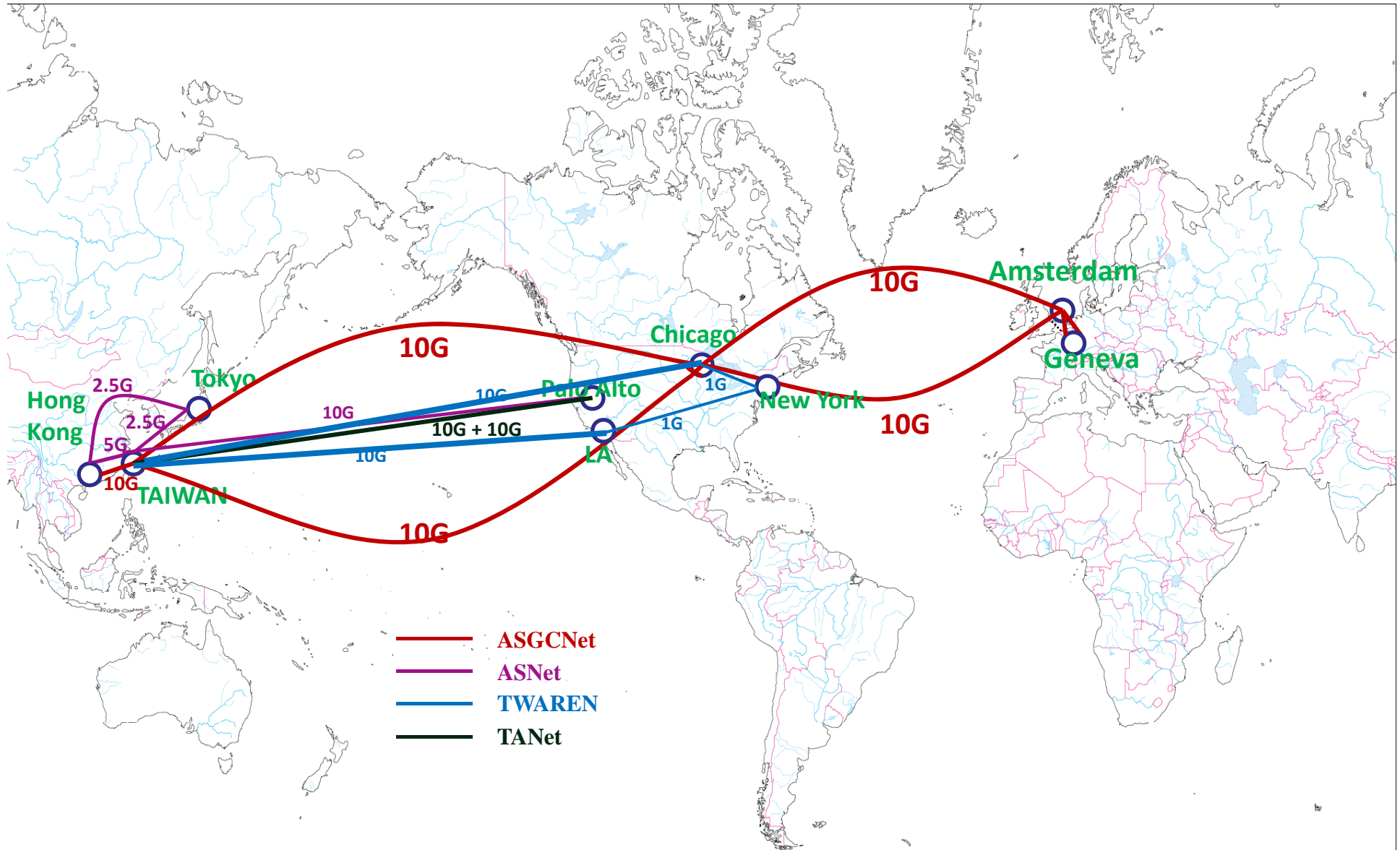
ASGCNet International Network Plan
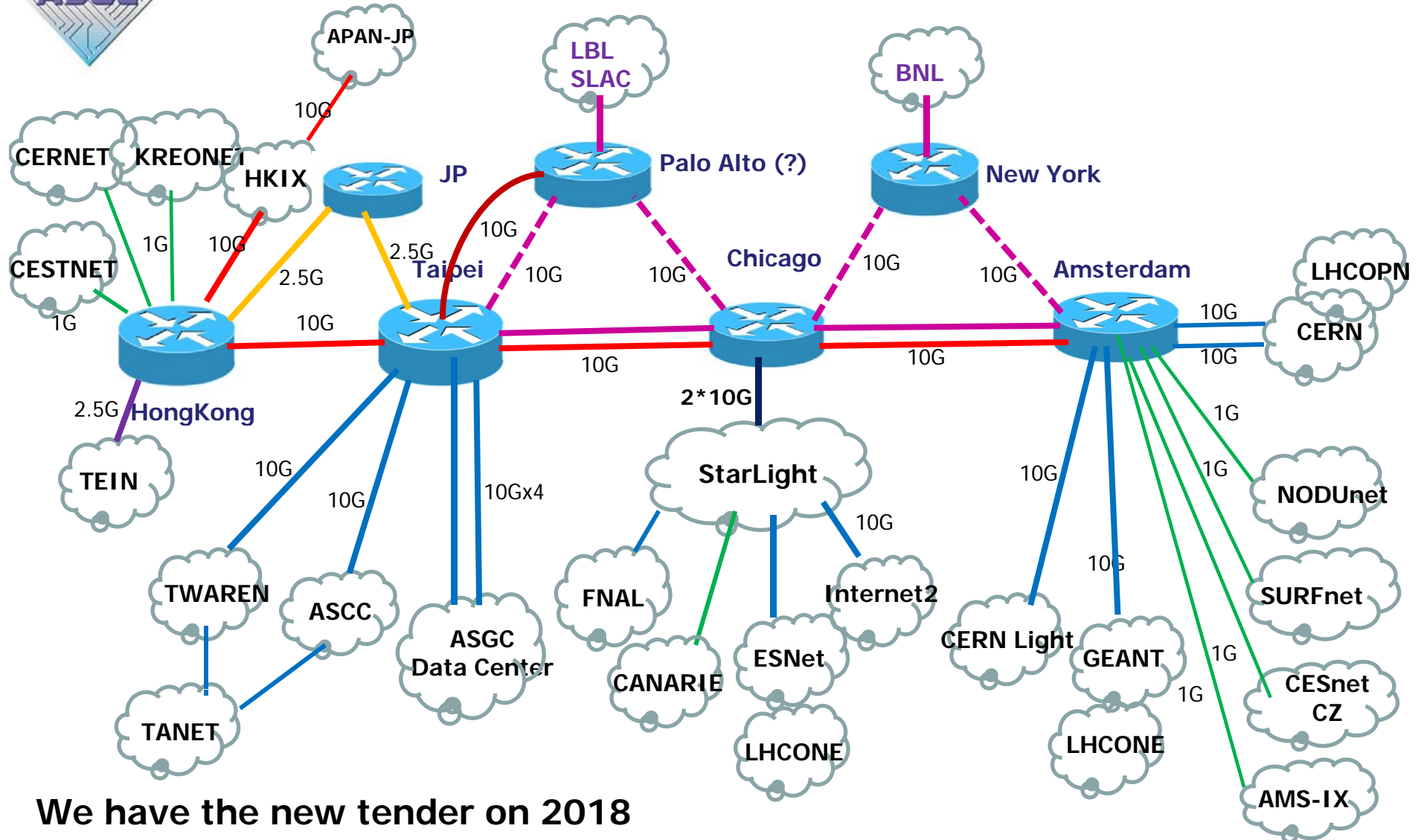
We have the new tender on 2018
ASCC provide the Link:
Plan to Recolocate 10G Link :

Academia Sinica Grid Computing

2009 SUBMARINE CABLE MAP
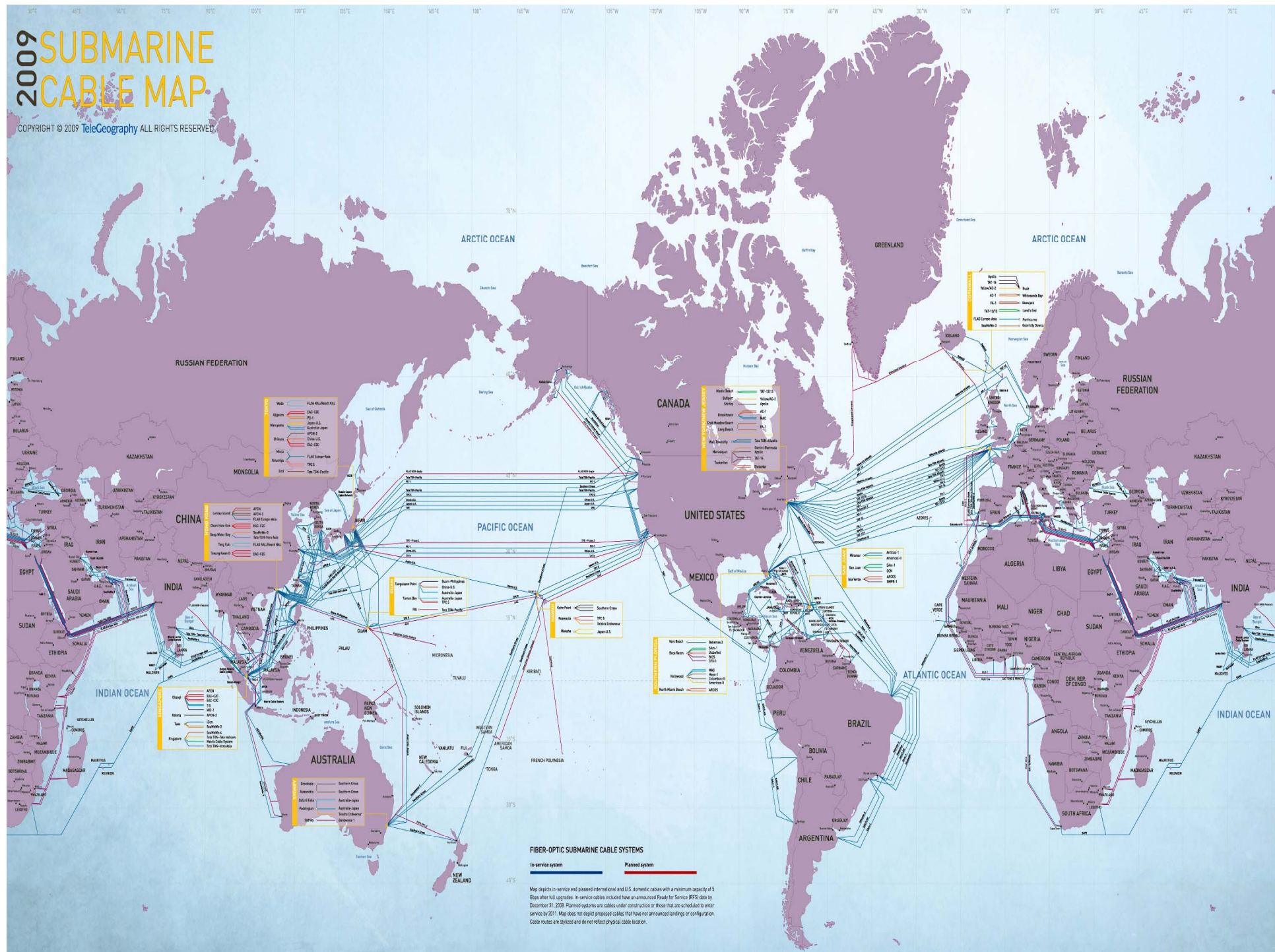
FIBER-OPTIC SUBMARINE CABLE SYSTEMS

In-service system

Planned system

Map depicts in-service and planned international and U.S. domestic cables with a minimum capacity of 5 Gbps after full upgrades. In-service cables included have an announced Ready for Service (RFS) date by December 31, 2008. Planned systems are cables under construction or those that are scheduled to enter service by 2011. Map does not depict proposed cables that have not announced landings or configuration. Cable routes are stylized and do not reflect physical cable location.

Plenty of terabit action in AsiaPac

Proposed cables 2016-18

SEAMEWE-5 launched dec 2016
APG launched nov 2016
AAE-1 : Q1 2017
SEA-US: Q2 2017

Momentous impact to be expected on
bandwidth pricing if sufficient
liberalization of telecomm market
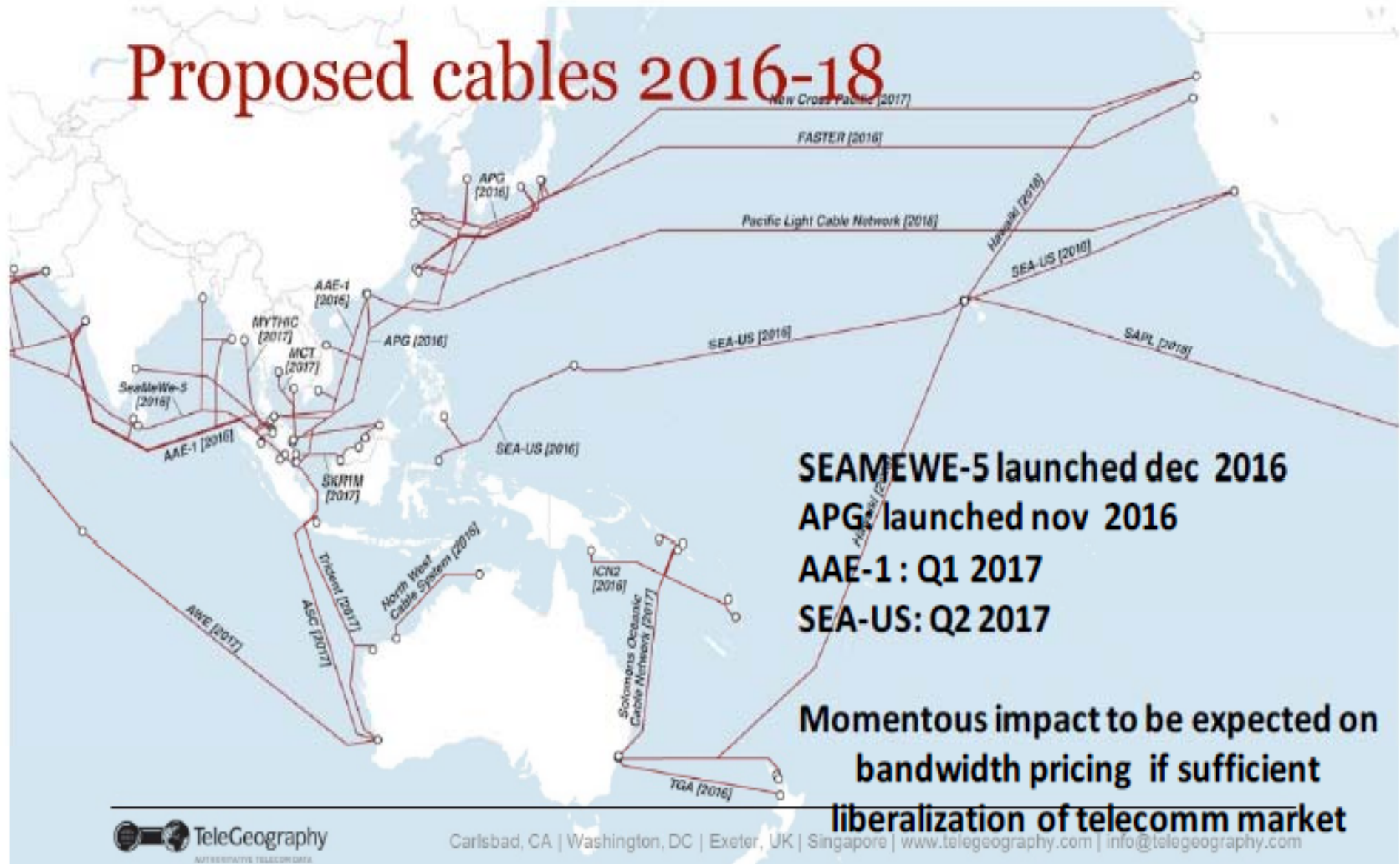
Development of the 100G Network in Asia

- Diversity & Redundancy
- Collaboration and Co-operation in Asia
  - Open policy to the communities
  - Open eXchange Point
- HEP and Bio are the major science activities
- Taiwan Deploy the 100G in Asia/US?

e-Science in Asia

Regional Distributed Computing Infrastructure Is Available

Taking advantage of EC funded e-Science flagship program (EGI and WLCG), Asia Pacific regional e-Science infrastructure, application and collaboration environment has been growing since 2005

- ## Partner Institutes

AU: U. Melbourne

CN: iHEP, CAS

HK: HKU

ID: ITB

IN: VECC, TIFR

IR: IPM

JP: KEK, U. Tokyo

KR: KISTI, KNU, UOS

MY: UM, UPM,

USM

NZ: UOA

PH: ASTI, ATENEO

PK: CIIT, NCP

SG:

TH: NSTDA, SUT, CHULA, NECTEC

TW: ASGC, NCU, NTU, NCHC

VN: IOIT, IFI

- ASGC (TW) is the regional coordinator
- Collaboration Model
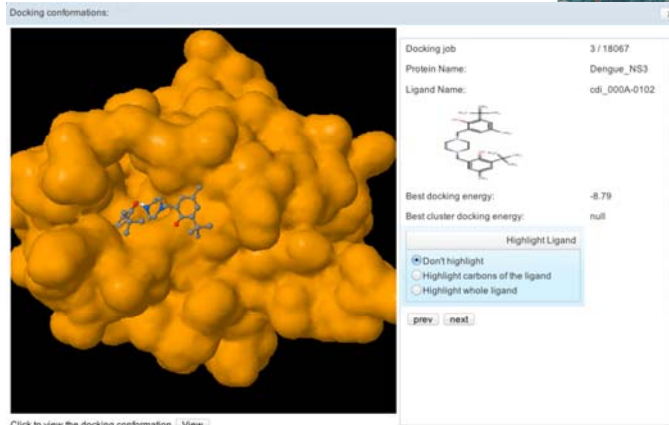 - Site installation; Application implementation; Trust Framework; Operation Consult; User Community Engagement
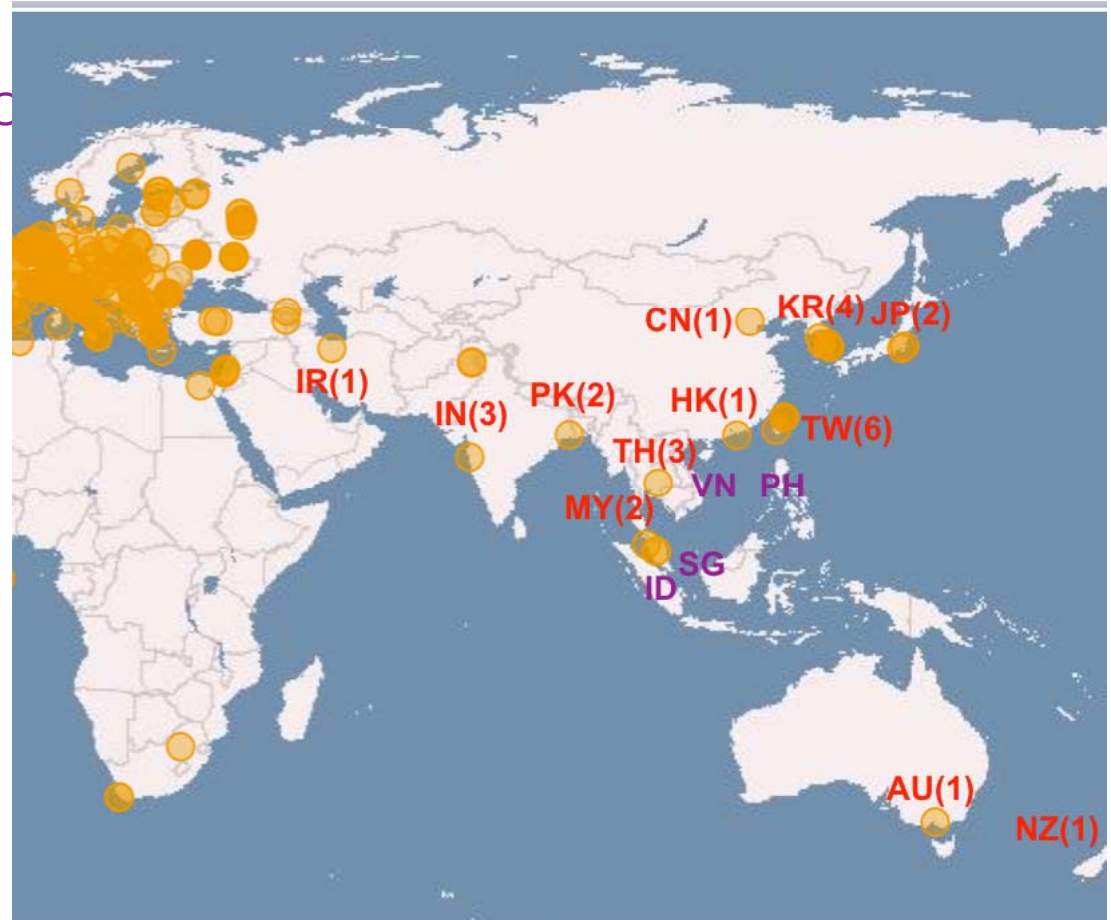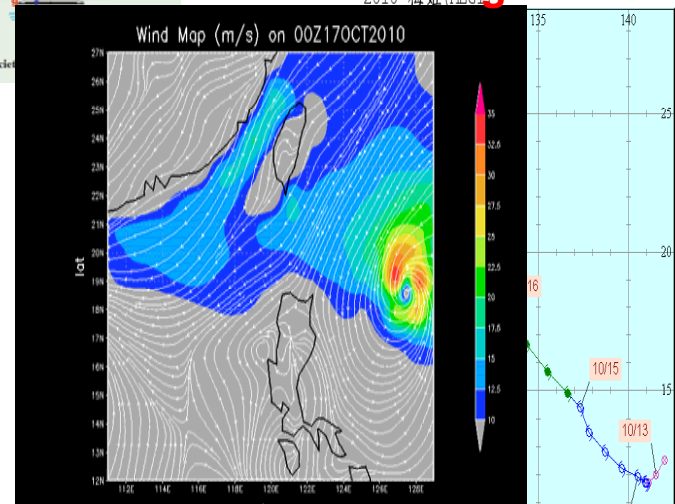
Higgs Search at ATLAS
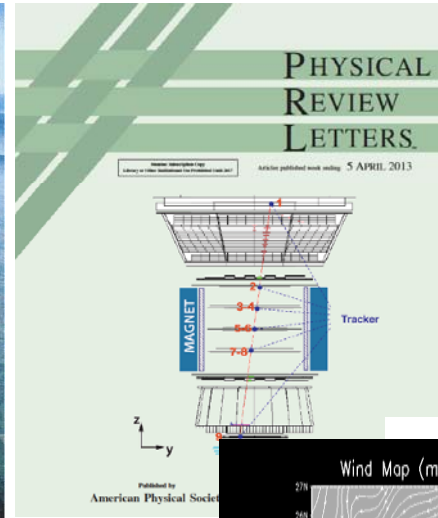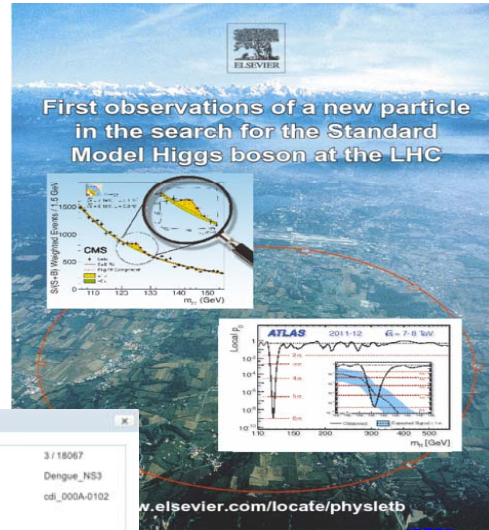
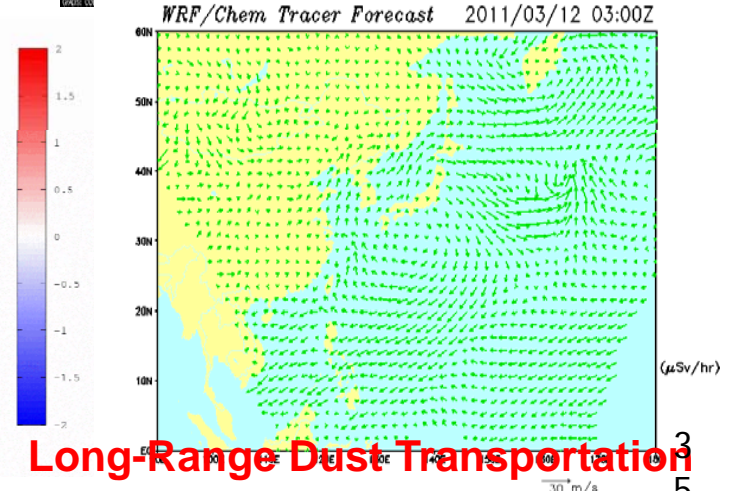**Alpha Magnetic Spectrometer**
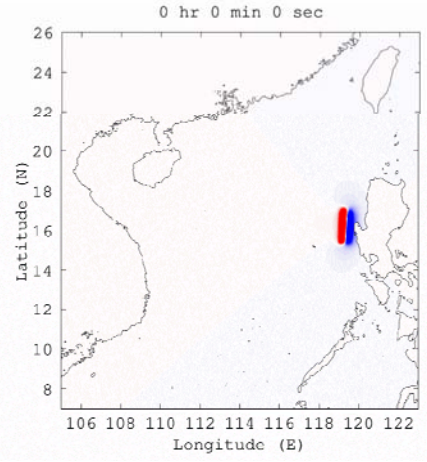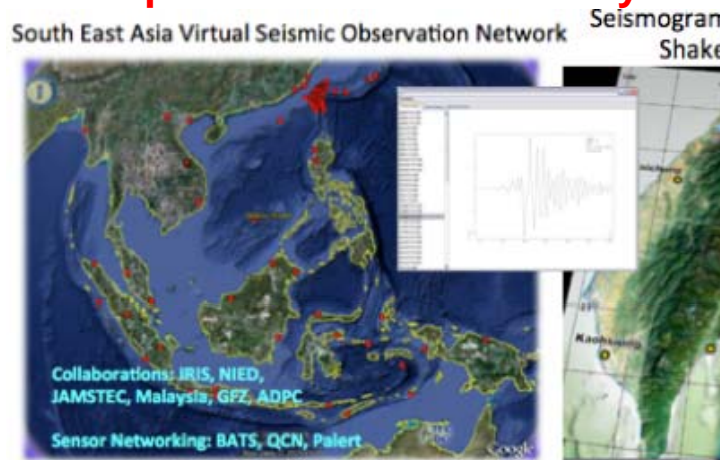
Weather/ Climate Changes

Distributed Computing Infrastructure (HW, SW, Networking)

Drug Discovery Application Portal

Earthquake and Tsunami Early Warning

Long-Range Dust Transportation

Conclusion

- Big Science lead the infrastructure development
  - LHC, Belle, SKA, Bio, ...etc
- e-Science for the masses evolve the global collaboration within the user communities
  - EGEE, EUAsiaGrid, DMCC,... etc

Thanks!

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ASGC e-Science Global Network

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