Campus Network Best Practices: RENs Around the World

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Research and Education Networks

- Some Terminology
  - Research and Education = R&E
  - Research and Education Networks = REN
  - National REN = NREN
- Globally, the REN connectivity is very complex and very difficult to understand

REN Characteristics

- High bandwidth networks
  - 10G backbones with 40G and 100G coming
  - Research typically needs uncongested networks
    - Which means many RENs are lightly used with lots of unused capacity (we call it headroom)
- Low latency
  - Terrestrial fiber
- Open Networks with no filtering
  - Firewalls can make it hard for ad-hoc activities

REN Ecosystem

- A layered model
  - Global Connectivity
  - Regional RENs
  - National Research and Education Networks
  - All users are connected at the campus network level
    - No scientist is connected directly to a National Network. They are all connected to campus or enterprise networks

REN Topics

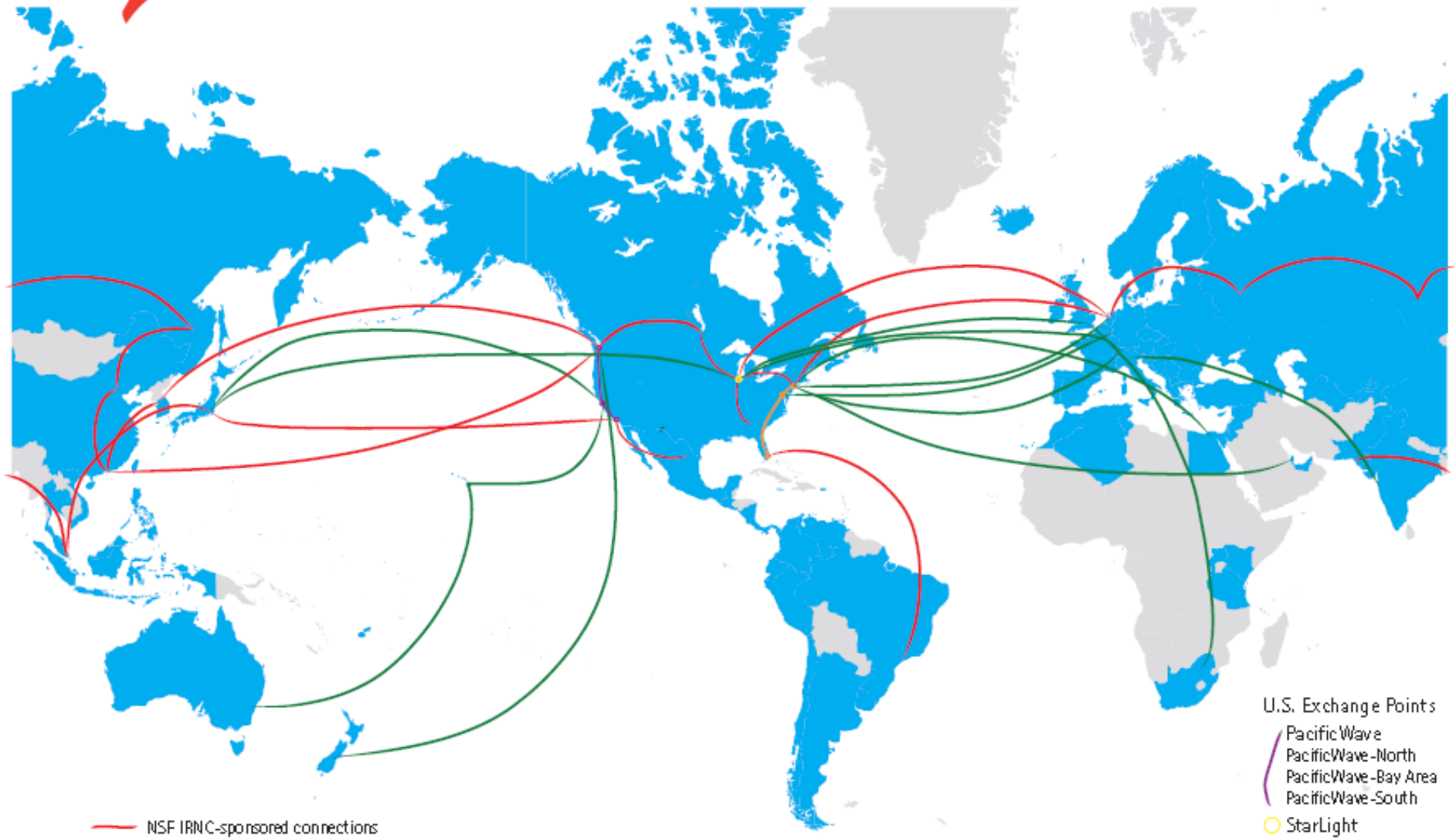
- A look at the Global and Regional REN environment
- A closer look at USA RENs
- How does this relate to South Asia
- NREN IP Transport Models
- Technical Requirements for campus networks and NRENs

Global REN Connections

- Connect Regional or National networks together
- Tend to be longer, more expensive circuits
- Not always well coordinated
- Routing policies often inconsistent
- Always are peering networks

INTERNET2® www.internet.edu

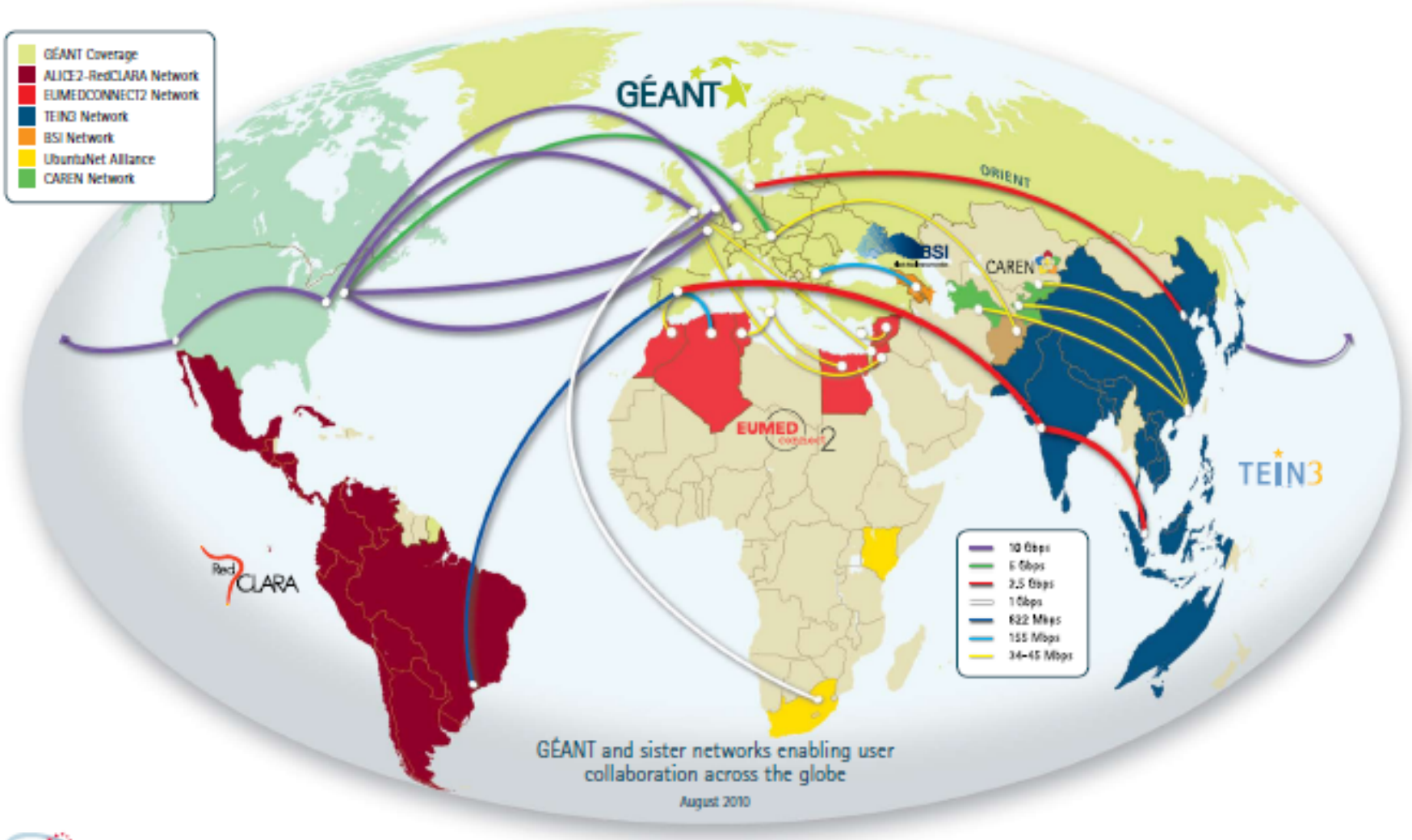
THE INTERNATIONAL REACH OF THE INTERNET2 NETWORK



For further information regarding the international programs of Internet2, visit http://internet2.edu/international or contact Heather Boyles, International Relations Director, international@internet2.edu.

A listing of networks reachable via the Internet2 Network is found on the back of this page.

GÉANT At the Heart of Global Research Networking



DANTE www.dante.net GÉANT www.geant.net

connect • communicate • collaborate

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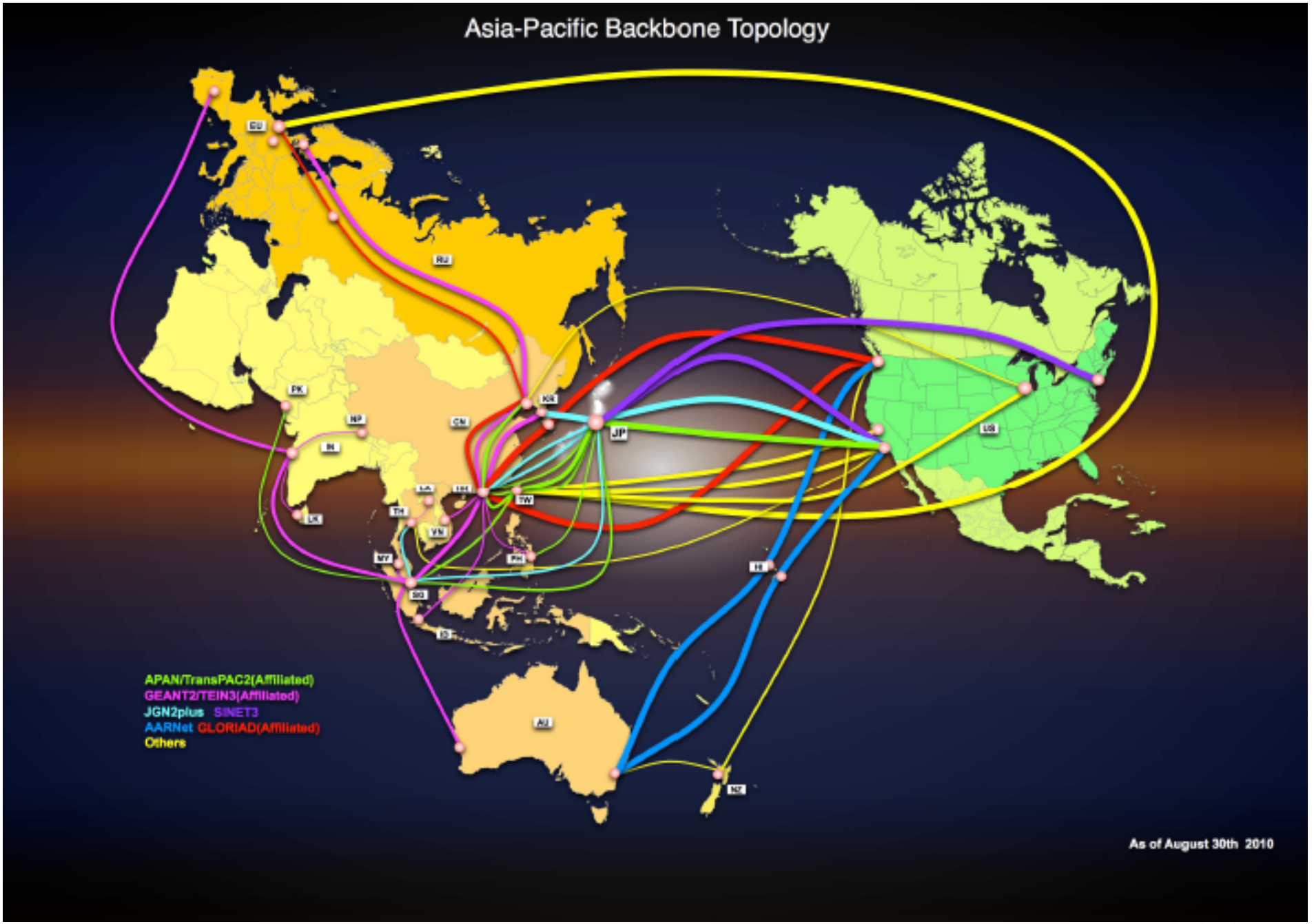
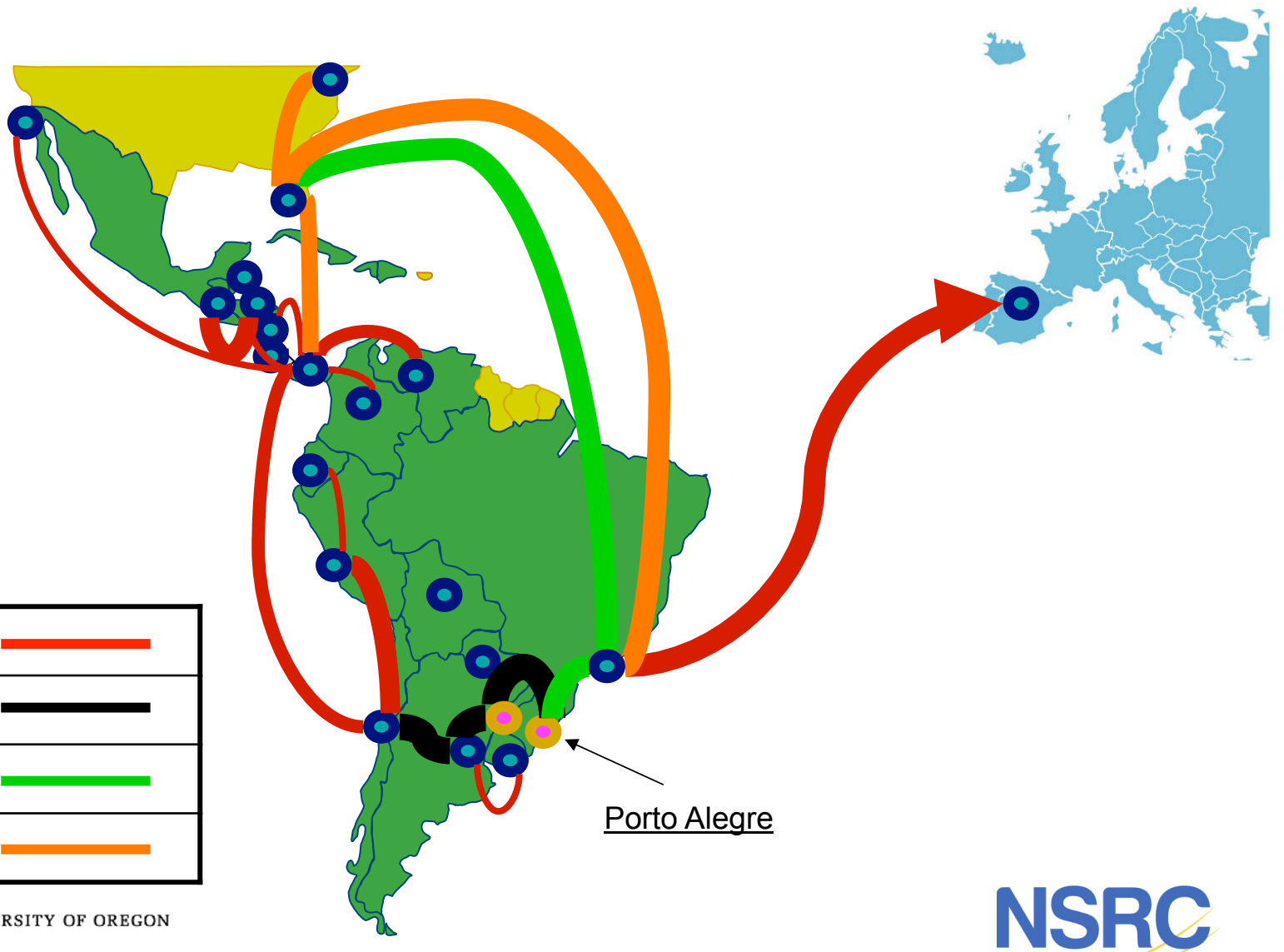

Asia-Pacific Backbone Topology
EU
RU
PK
NP
IN
LK
CN
KR
JP
TW
HK
TH
VN
MY
PH
SG
ID
AU
NZ
US
HI
APAN/TransPAC2(Affiliated)
GEANT2/TEIN3(Affiliated)
JGN2plus SINET3
AARNet GLORIAD(Affiliated)
Others
As of August 30th 2010

Regional REN Connections

- Most regional networks have funding from European Union
  - EUMedConnect
  - TEIN/TEIN2/TEIN3
  - GEANT
  - ALICE/ALICE2 – RedCLARA
  - AfricaConnect/Ubuntunet

RedCLARA March 2011



ALICE2	
CLARA	
RNP	
AmLight	

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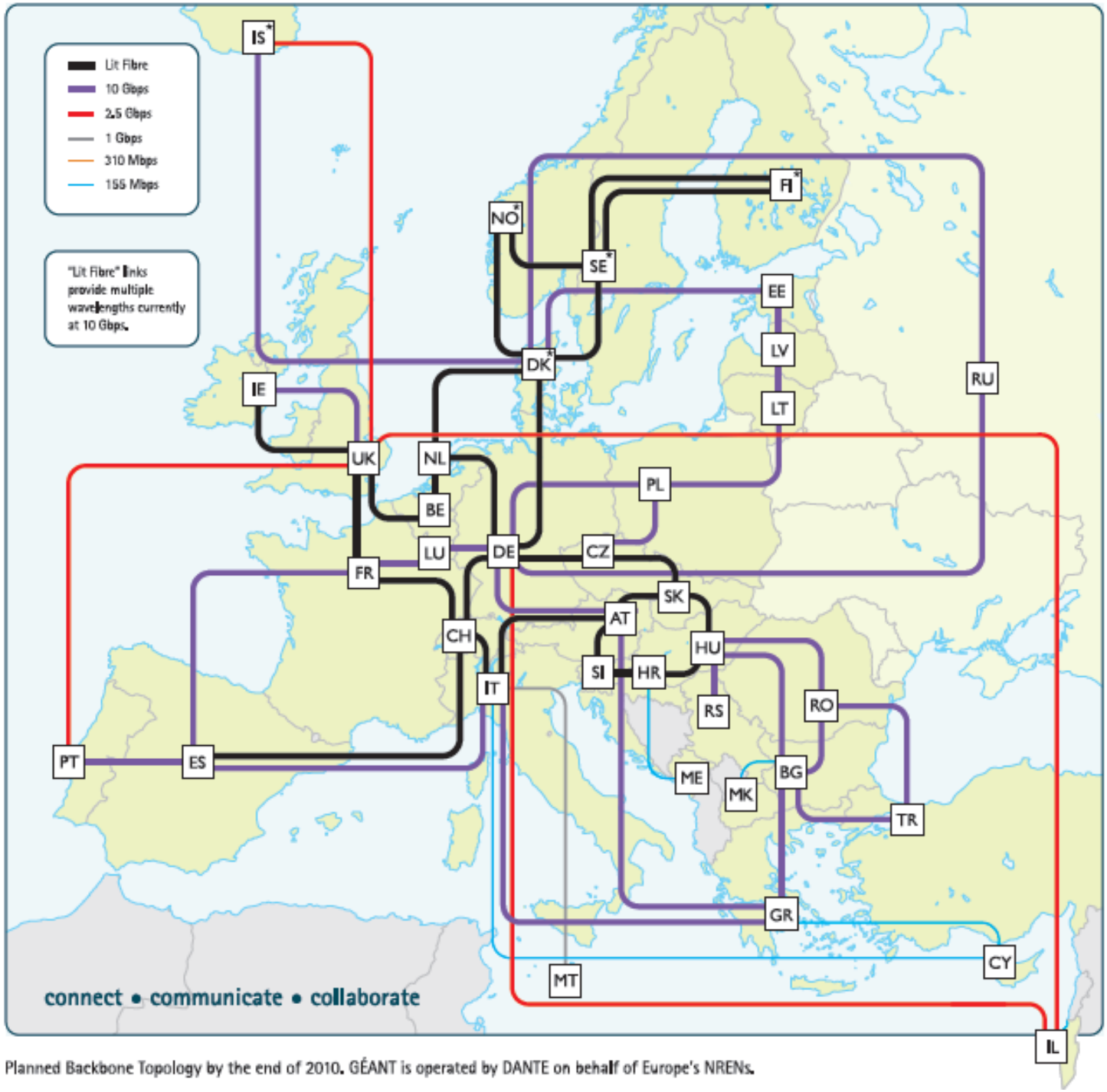
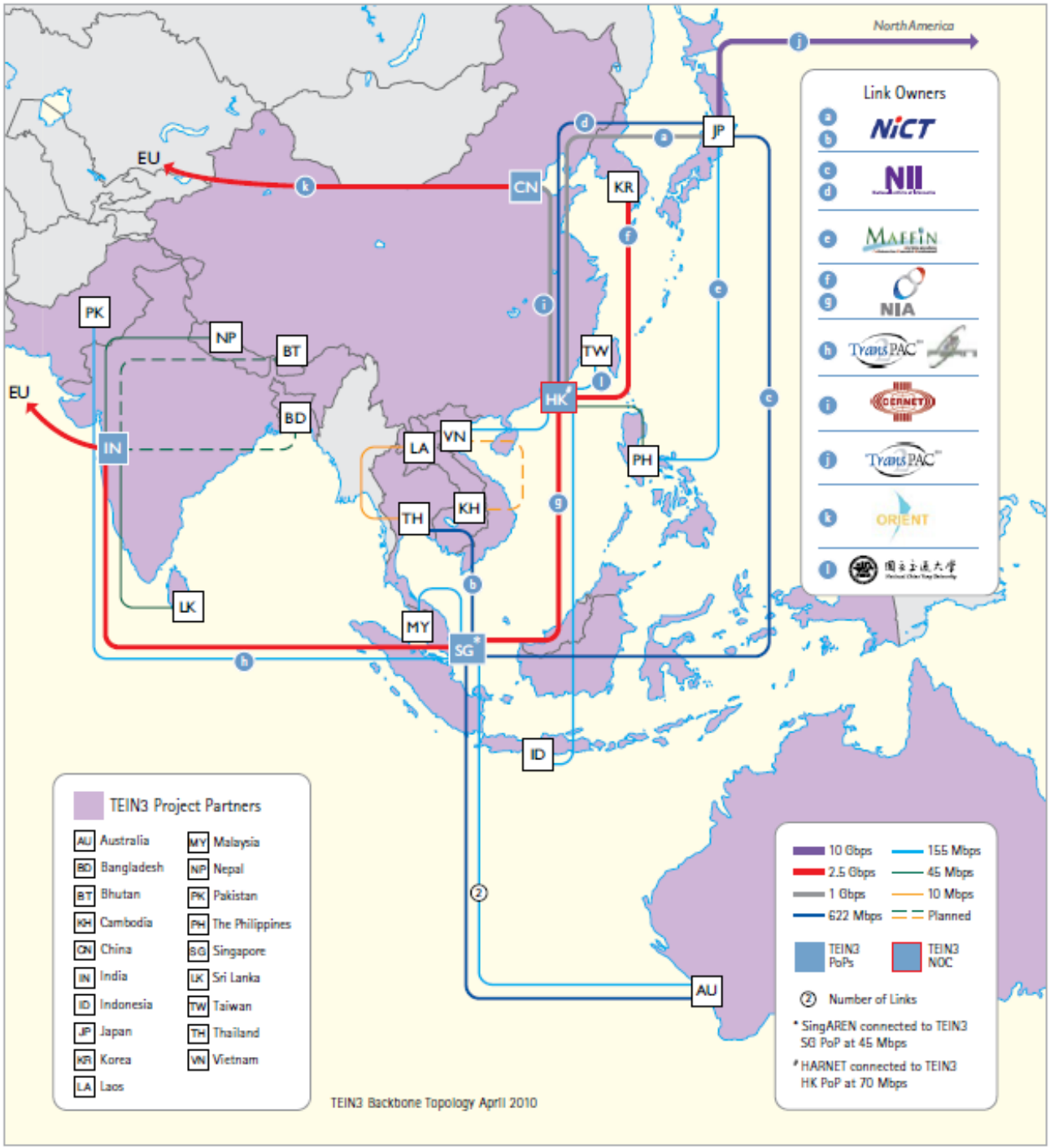
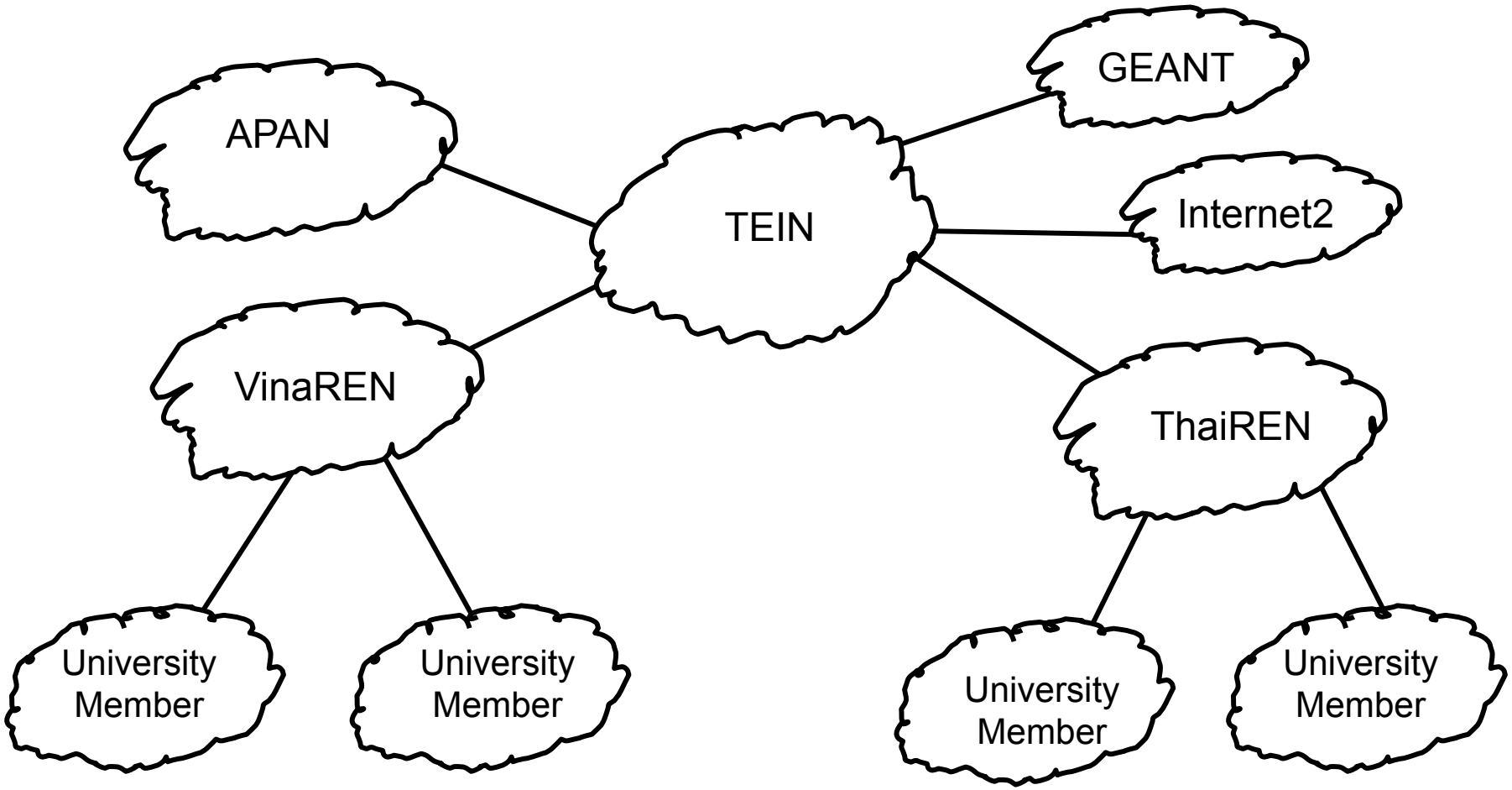


Planned Backbone Topology by the end of 2010. GÉANT is operated by DANTE on behalf of Europe's NRENs.



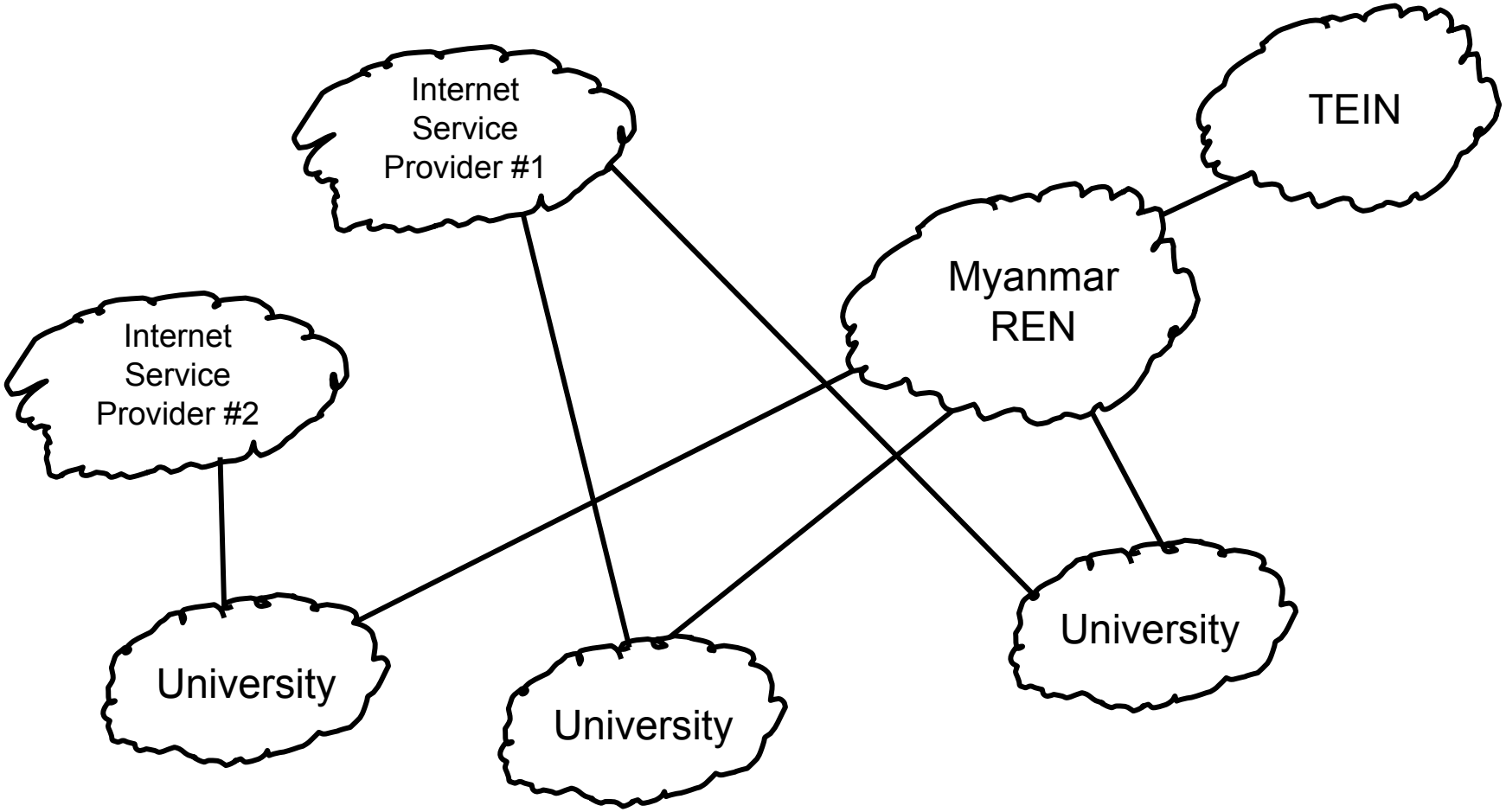
The South Asia REN Picture



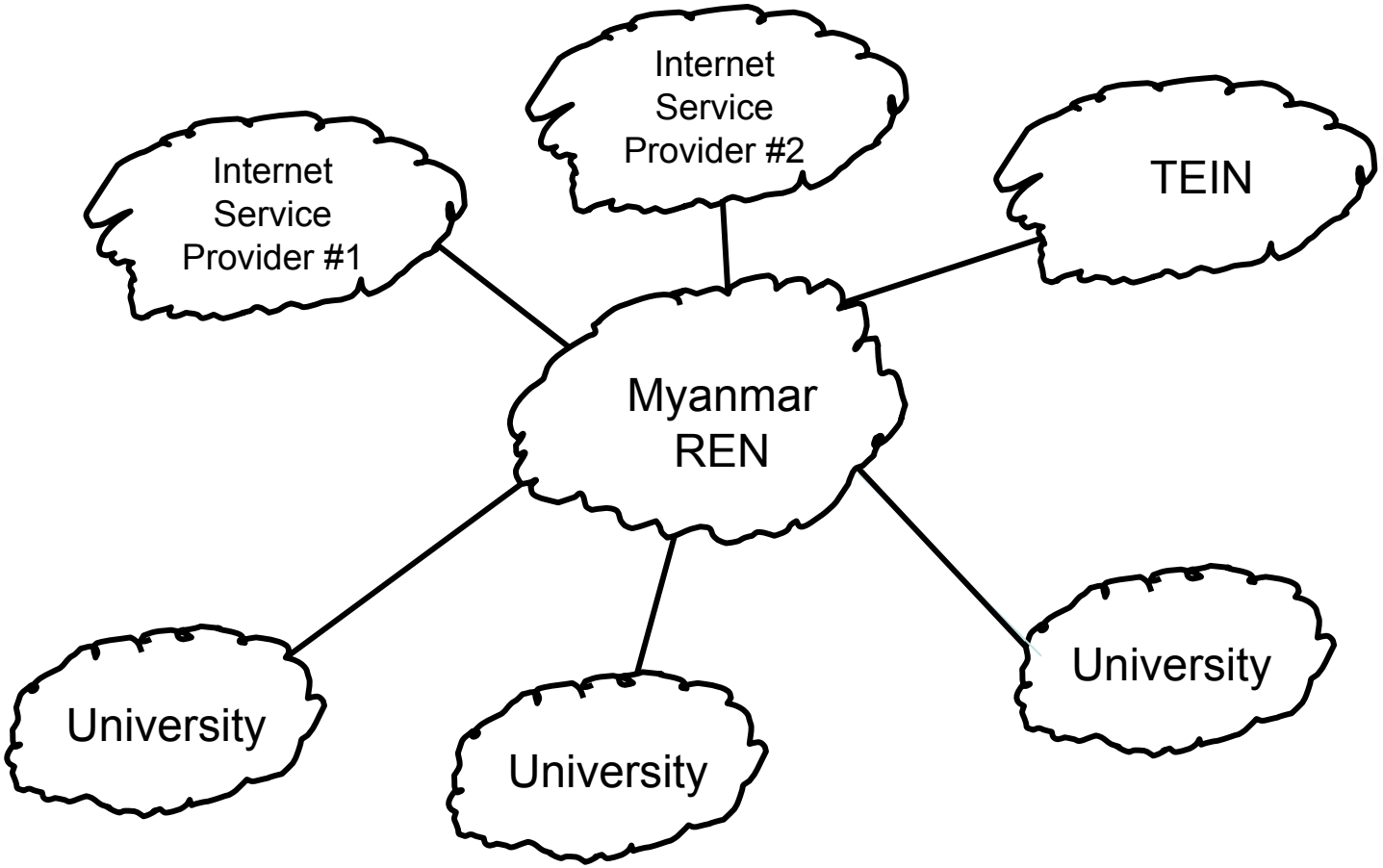
NREN Models of Service

- Two basic models:
  1. Peering network
     - Exchange traffic between members
     - Provide international connections (GEANT, etc)
     - Can peer with a local commercial exchange (Google, local ISPs, etc)
  2. REN provides all Internet connectivity
     - REN is the ISP
     - In this case, REN also provides peering network

NREN as Peering Network



NREN as ISP


Internet
Service
Provider #2
Internet
Service
Provider #1
TEIN
Myanmar
REN
University
University
University

Implications for Universities

- If NREN is a Peering Network
  - Each University still has their own ISP
  - Each University connects to NREN
  - The two connections are hard to manage
- If NREN provides all Internet connectivity
  - Simplest for campus members
  - Treats NREN as Internet Service Provider
  - Only one connection to manage

NREN as a Peering Network

- Easiest to implement from a political perspective.
  - The Internet Service Providers like this approach because they keep many customers
  - Often the legal and regulatory environment allows this use without licensing and/or the license is easier to get
- However, there are problems with this approach

NREN as a Peering Network

- Universities now have two connections
  - How do they decide which one to use?
- Three approaches:
  1. Get provider independent IP address, autonomous system number, and run BGP
  2. Get routes from NREN and run special software and configuration on a NAT box
  3. Split campus network into NREN and Internet
- What do we find around the world?

NRENs Around the World

- Most NRENs act as the Internet Service Provider
- For those that do Peering Only
  - Advanced regions: they do the right thing and have Provider Independent IP addresses, ASN, and run BGP. This works fine.
  - Less advanced regions: they split their campus and the NREN becomes a video conferencing network.
- What kind of network will you build here?

What to do in Myanmar?

- MPT will need to be involved with the International connection to TEIN
- Will REN serve Universities from all Ministries?
- Will the REN be operated by MPT or by Universities?
  - If Universities, which University or Ministry should lead?
- NSRC can provide training on building NREN

Questions/Discussion?