Campus Network Best Practices: RENs Around the World

Dale Smith

Network Startup Resource Center

dsmith@nsrc.org

UNIVERSITY OF OREGON

NSRC
Network Startup Resource Center

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

UNIVERSITY OF OREGON

NSRC
Network Startup Resource Center

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

UNIVERSITY OF OREGON

NSRC
Network Startup Resource Center

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
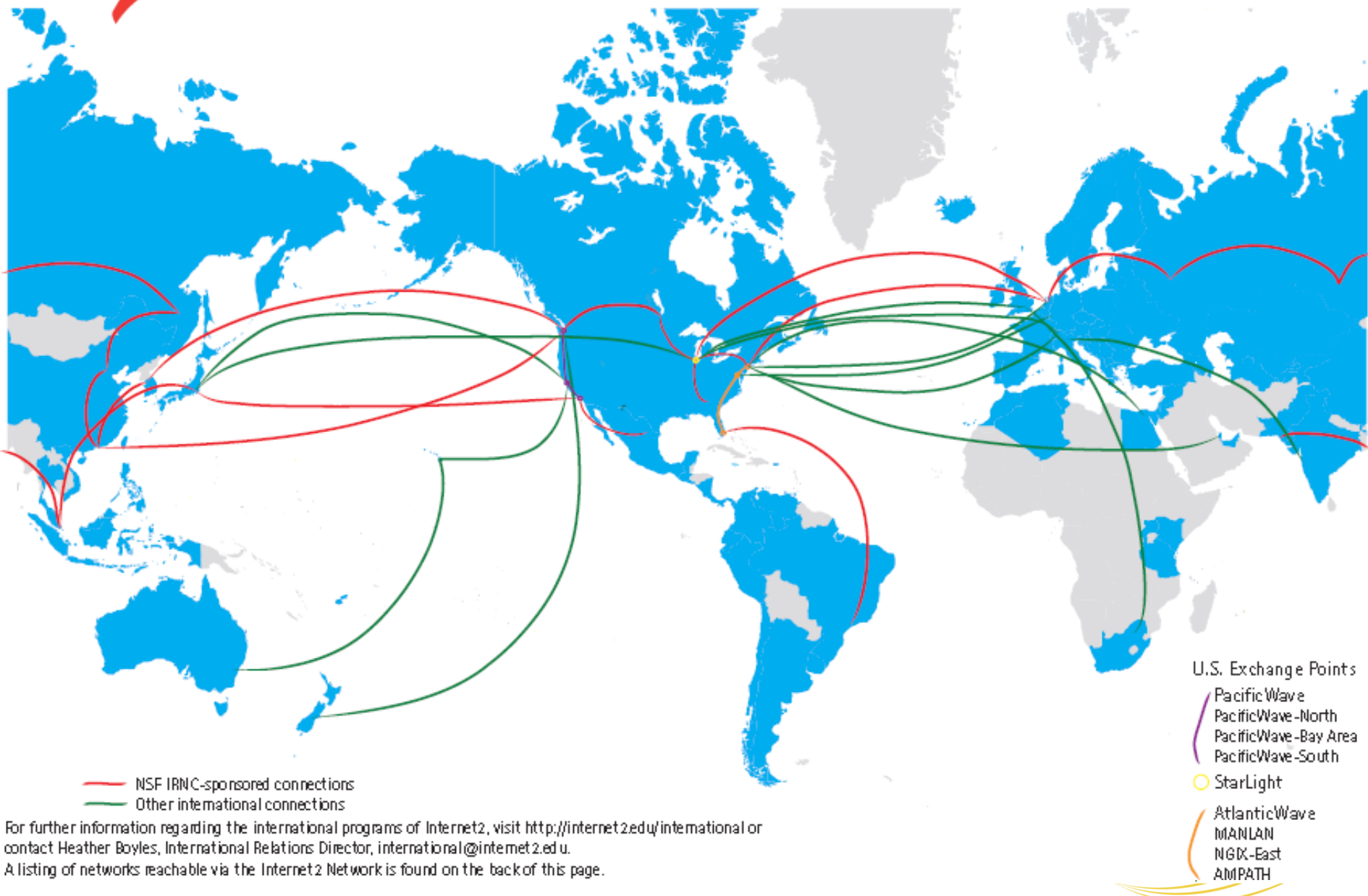
REN Topics

- 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

UNIVERSITY OF OREGON

NSRC
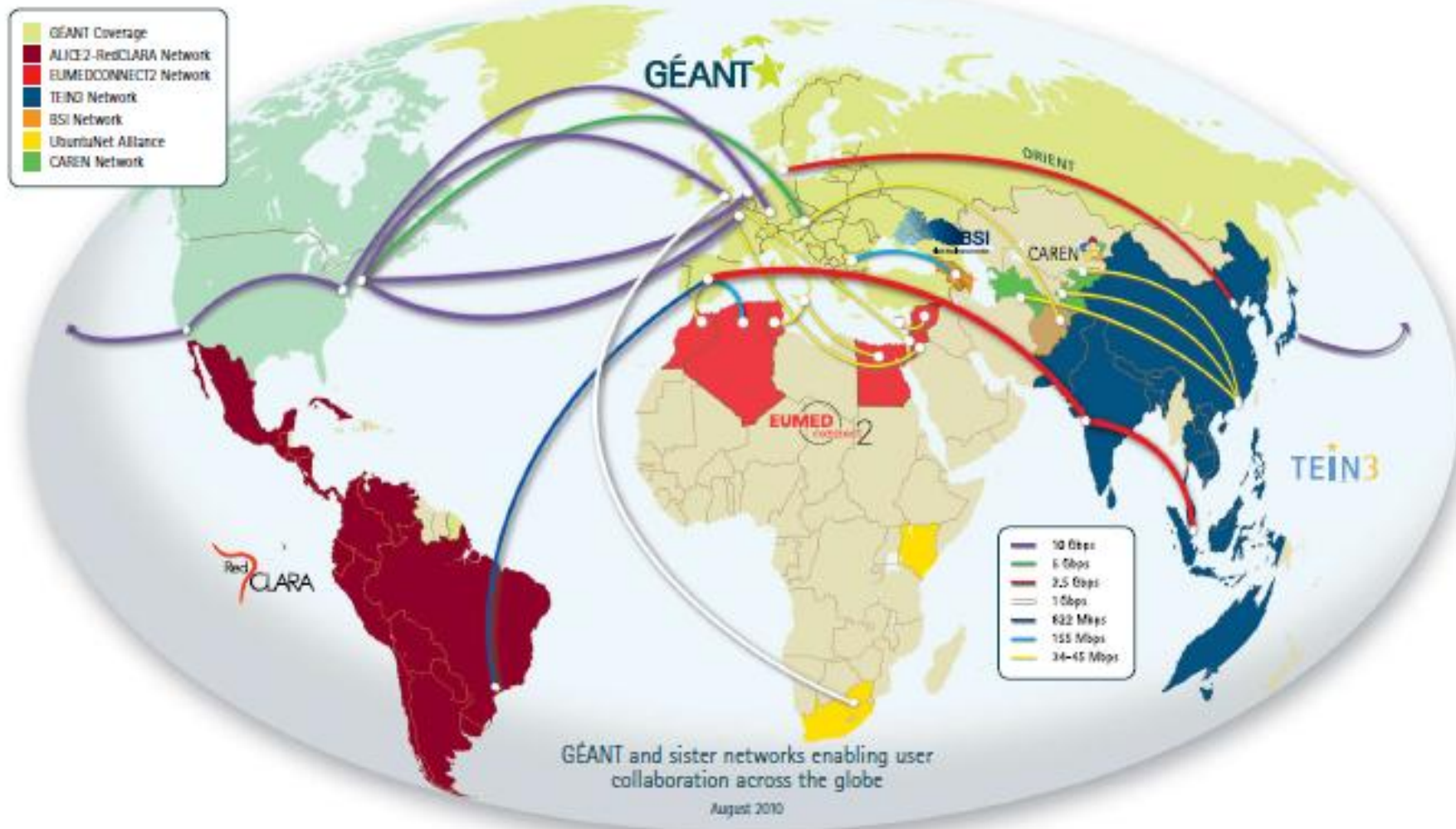Network Startup Resource Center

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

— NSF IRNC-sponsored connections
— Other international connections

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.

U.S. Exchange Points

PacificWave
PacificWave-North
PacificWave-Bay Area
PacificWave-South

StarLight

AtlanticWave
MANLAN
NGIX-East
AMPATH

GÉANT ★ At the Heart of Global Research Networking

GÉANT and sister networks enabling user collaboration across the globe

August 2010

connect • communicate • collaborate

GÉANT is co-funded by the European Commission within its 7th R&D Framework Programme.

Asia-Pacific Backbone Topology

APAN/TransPAC2(Affiliated)
GEANT2/TEIN3(Affiliated)
JGN2plus SINET3
AARNet GLORIAD(Affiliated)
Others

As of August 30th 2010

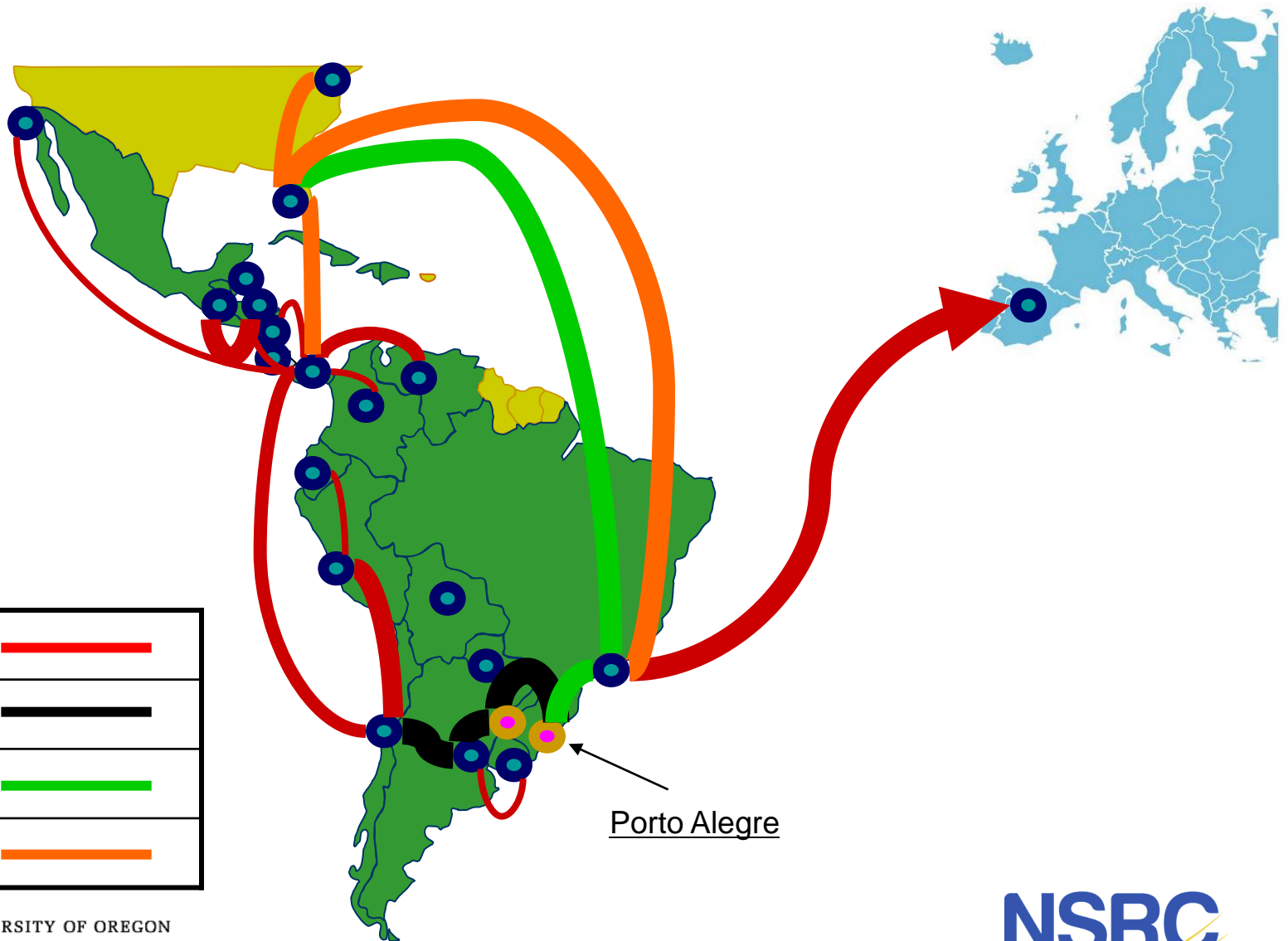Network Startup Resource Center

Regional REN Connections

- Connects RENs of individual countries within a geographic region
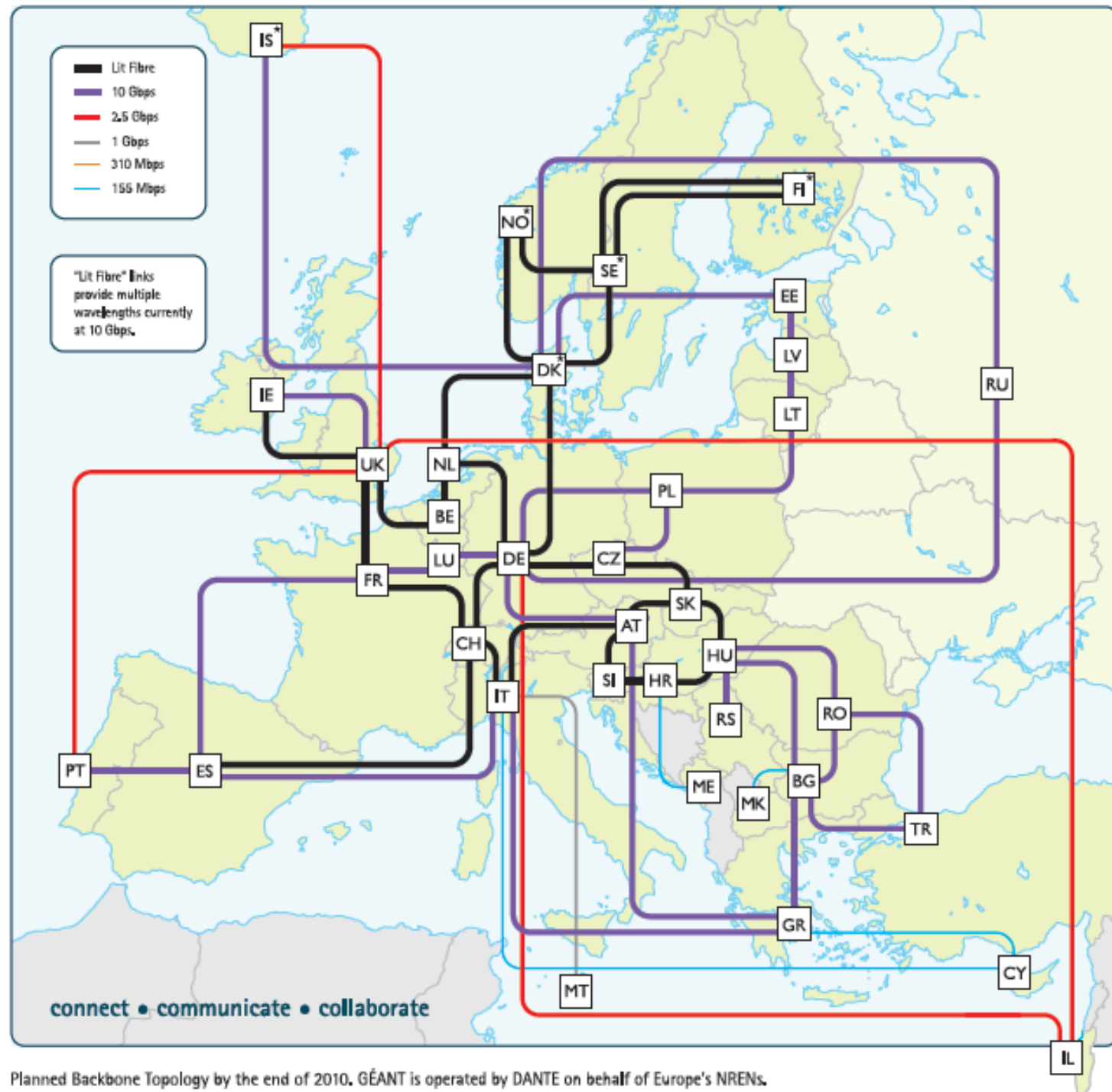 - TEIN is a good example

Regional REN Connections

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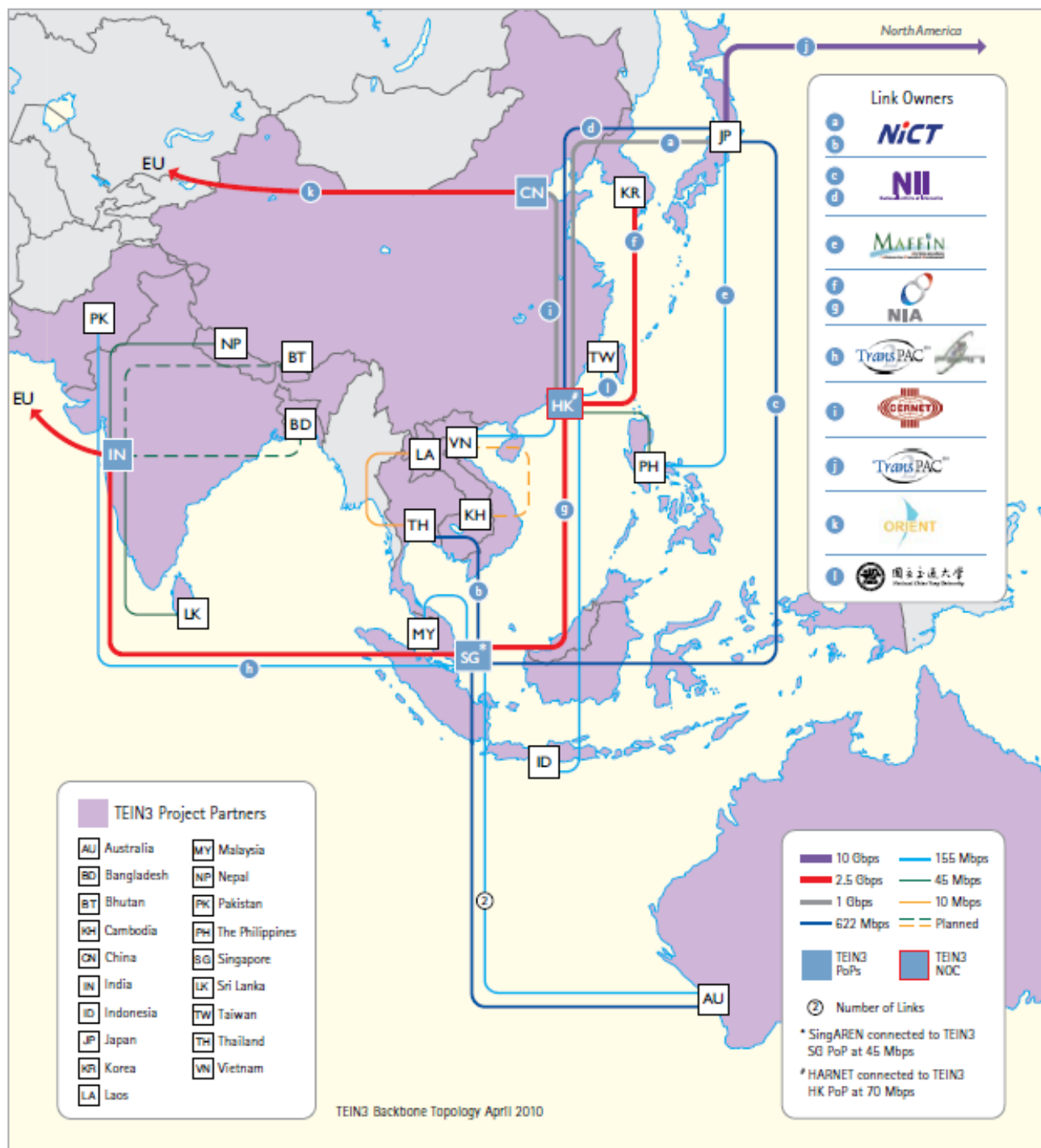 - ALICE/ALICE2 – RedCLARA
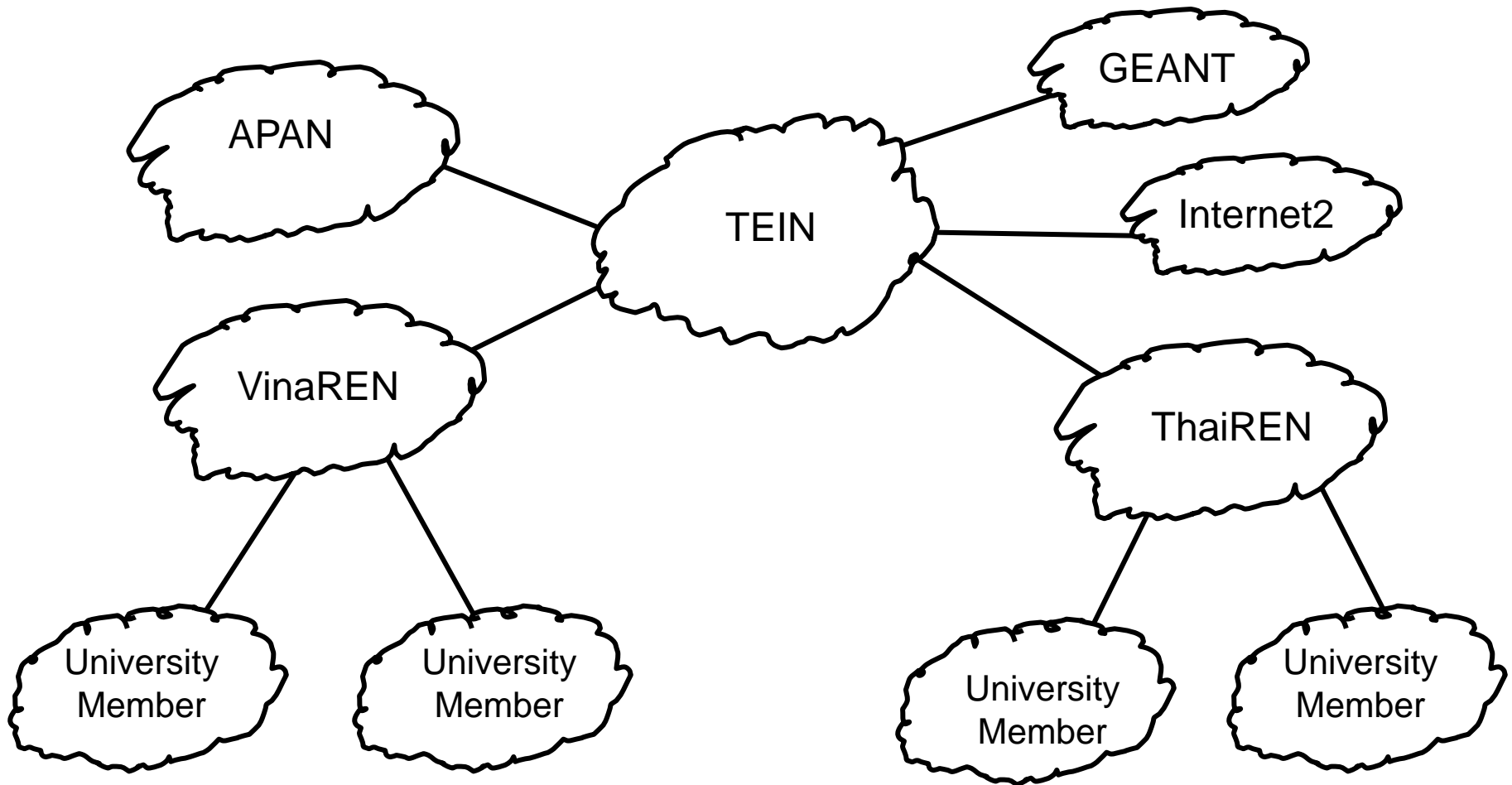 - AfricaConnect/Ubuntunet

RedCLARA March 2011

ALICE2	——
CLARA	——
RNP	——
AmLight	——

Porto Alegre

UNIVERSITY OF OREGON

NSRC
Network Startup Resource Center

Legend:
- Lit Fibre
- 10 Gbps
- 2.5 Gbps
- 1 Gbps
- 310 Mbps
- 155 Mbps

"Lit Fibre" links provide multiple wavelengths currently at 10 Gbps.

connect • communicate • collaborate

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

Link Owners

- a NiCT
- b NiCT
- c NII
- d NII
- e MAFFIN
- f NIA
- g NIA
- h TransPAC
- i CERNET
- j TransPAC
- k ORIENT
- l 國立交通大學 National Chiao Tung University

TEIN3 Project Partners

AU Australia	MY Malaysia
BD Bangladesh	NP Nepal
BT Bhutan	PK Pakistan
KH Cambodia	PH The Philippines
CN China	SG Singapore
IN India	LK Sri Lanka
ID Indonesia	TW Taiwan
JP Japan	TH Thailand
KR Korea	VN Vietnam
LA Laos	

Legend:
- 10 Gbps (purple)
- 2.5 Gbps (red)
- 1 Gbps (grey)
- 622 Mbps (dark blue)
- 155 Mbps (light blue)
- 45 Mbps (green)
- 10 Mbps (orange)
- Planned (dashed orange)

TEIN3 PoPs
TEIN3 NOC

② Number of Links

* SingAREN connected to TEIN3 SG PoP at 45 Mbps
# HARNET connected to TEIN3 HK PoP at 70 Mbps

TEIN3 Backbone Topology April 2010

North America

EU

UNIV...

SRC Startup Resource Center
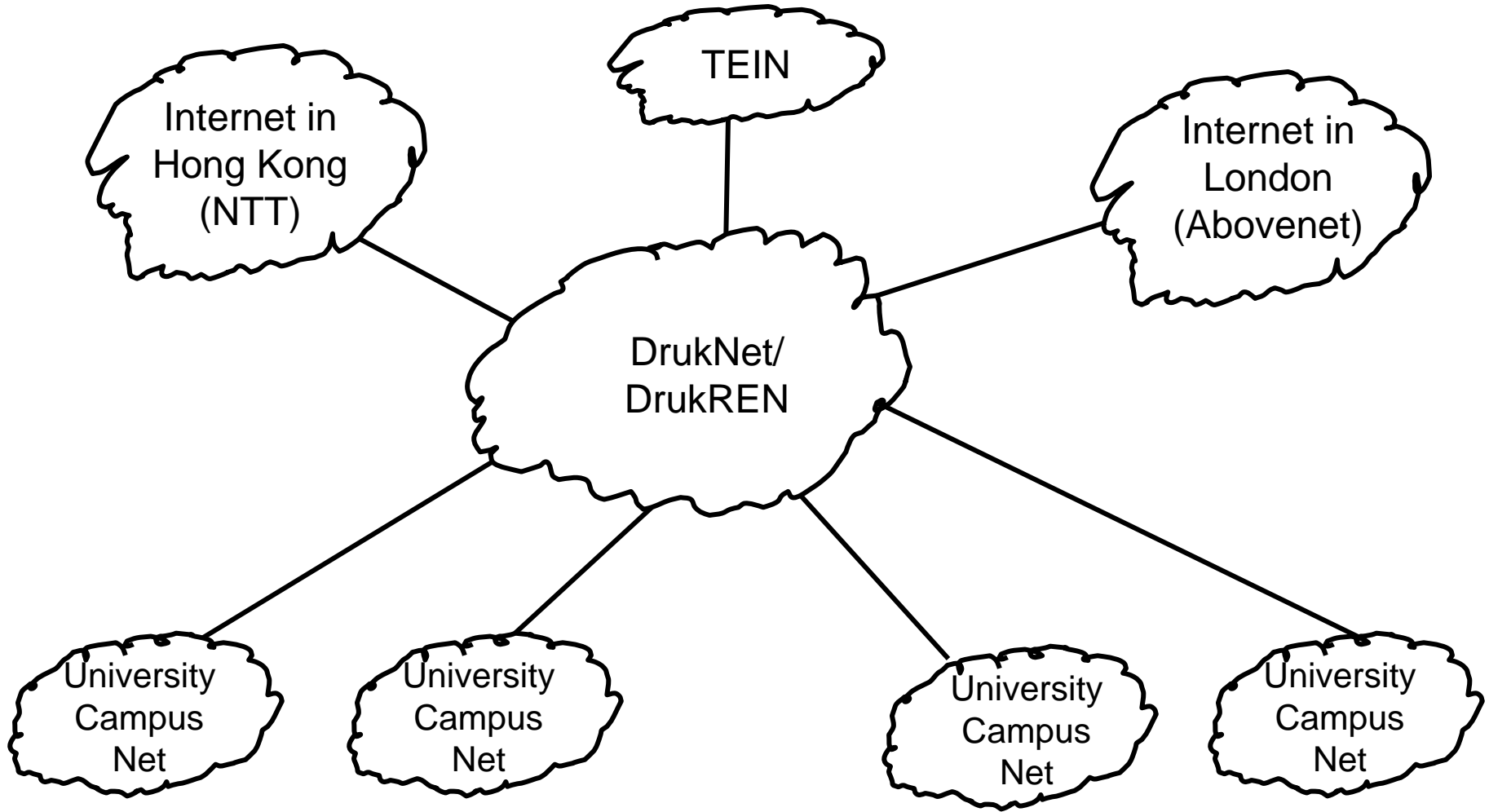
The South Asia REN Picture

What to do in Bhutan

- Bhutan has a small population
- TEIN will only provide one connection per country
- Where will that connection go?
- DrukNet could be reconfigured to provide a dedicated network for Research and Education
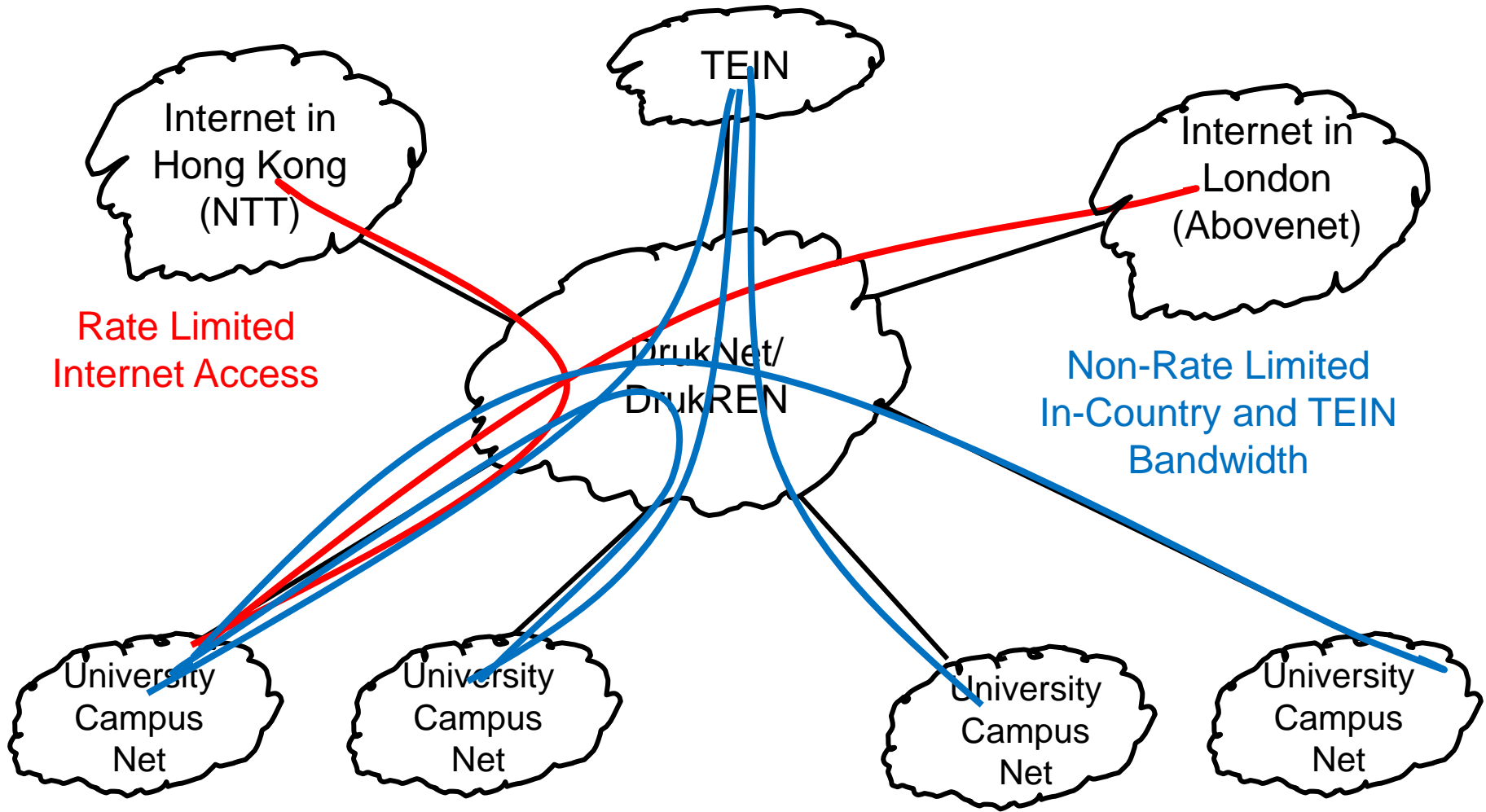 - Then, TEIN could connect to DrukNET

DrukNet as DrukREN

DrukNet as DrukREN

- I don't normally recommend using an ISP to provision a REN, but in this case, it may be a good choice.

- I suggest that DrukNet make changes to accommodate REN activities:
  - Run link from University to POP at maximum data rate
  - Make in-country bandwidth free
  - Only rate limit International Internet access

Suggested DrukNet Changes

Questions/Discussion?

UNIVERSITY OF OREGON

NSRC
Network Startup Resource Center