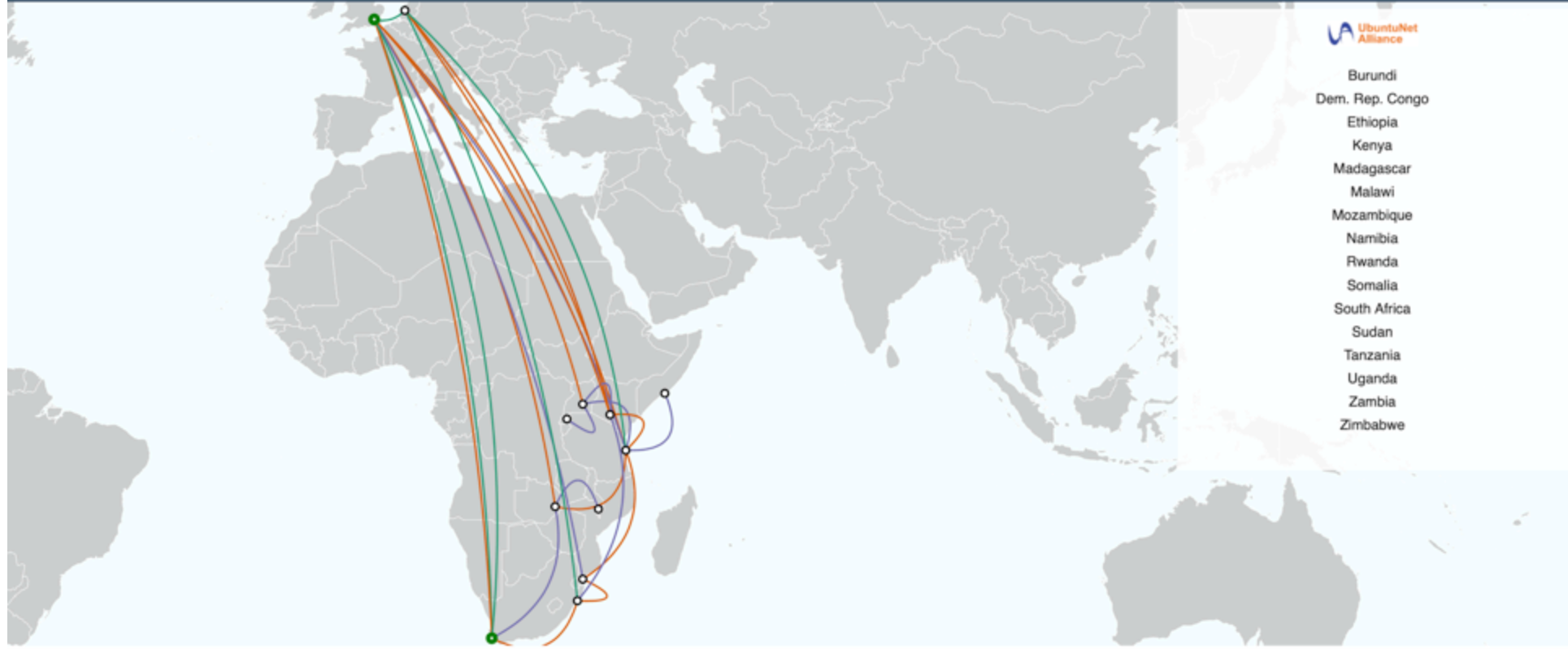


# Research and Education Networking: Introduction, architecture and operations Part2

WACREN Webinar:  
Research and Education Networks:  
Architecture, Routing and Peering

01/12/2020

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## GÉANT Connectivity Map

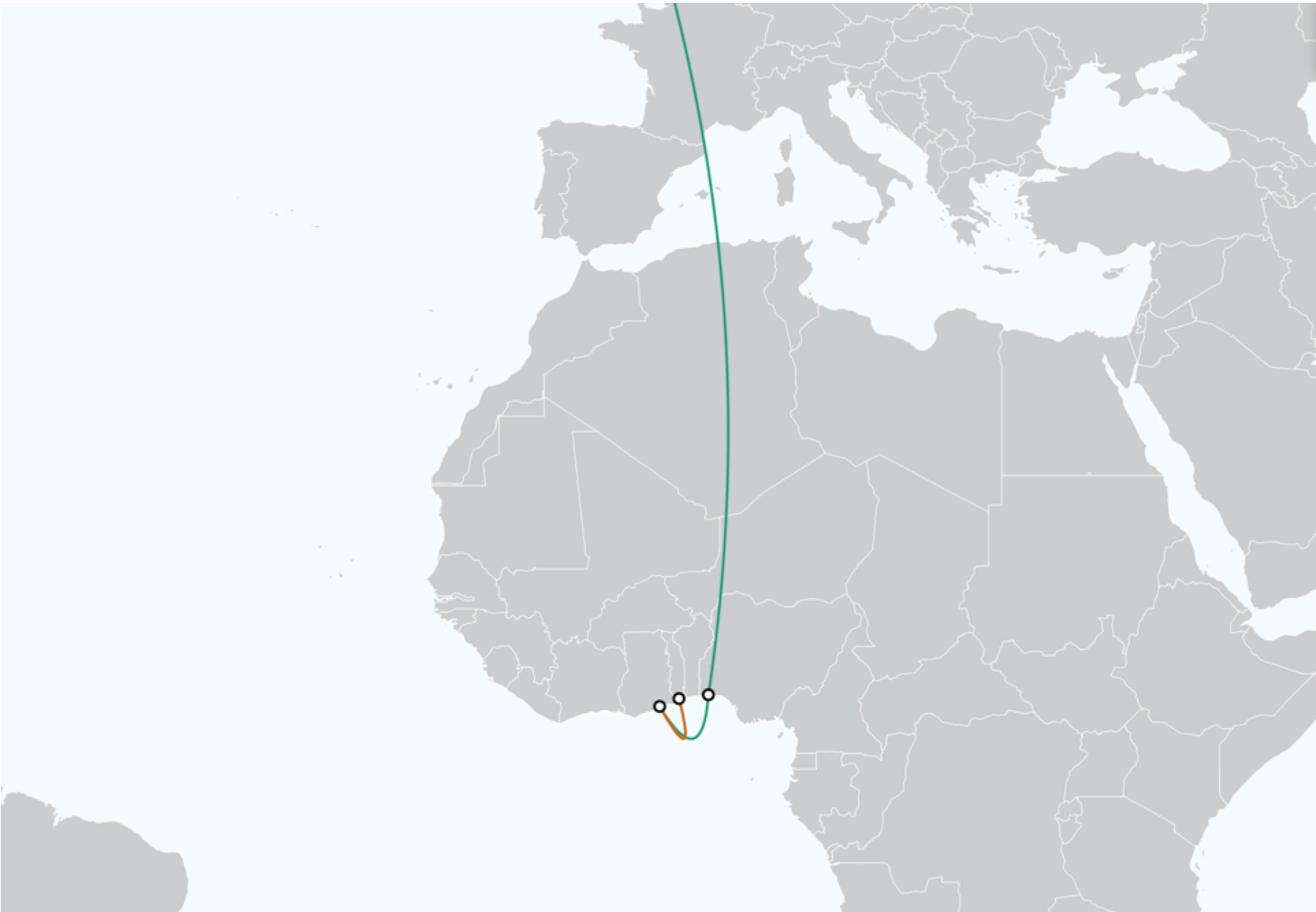
Toggle global links

The global reach of the GÉANT network enables scientists and academics in Europe to exchange data and collaborate with their peers across the world through links to National Research and Education Networks in 65 countries around the world.

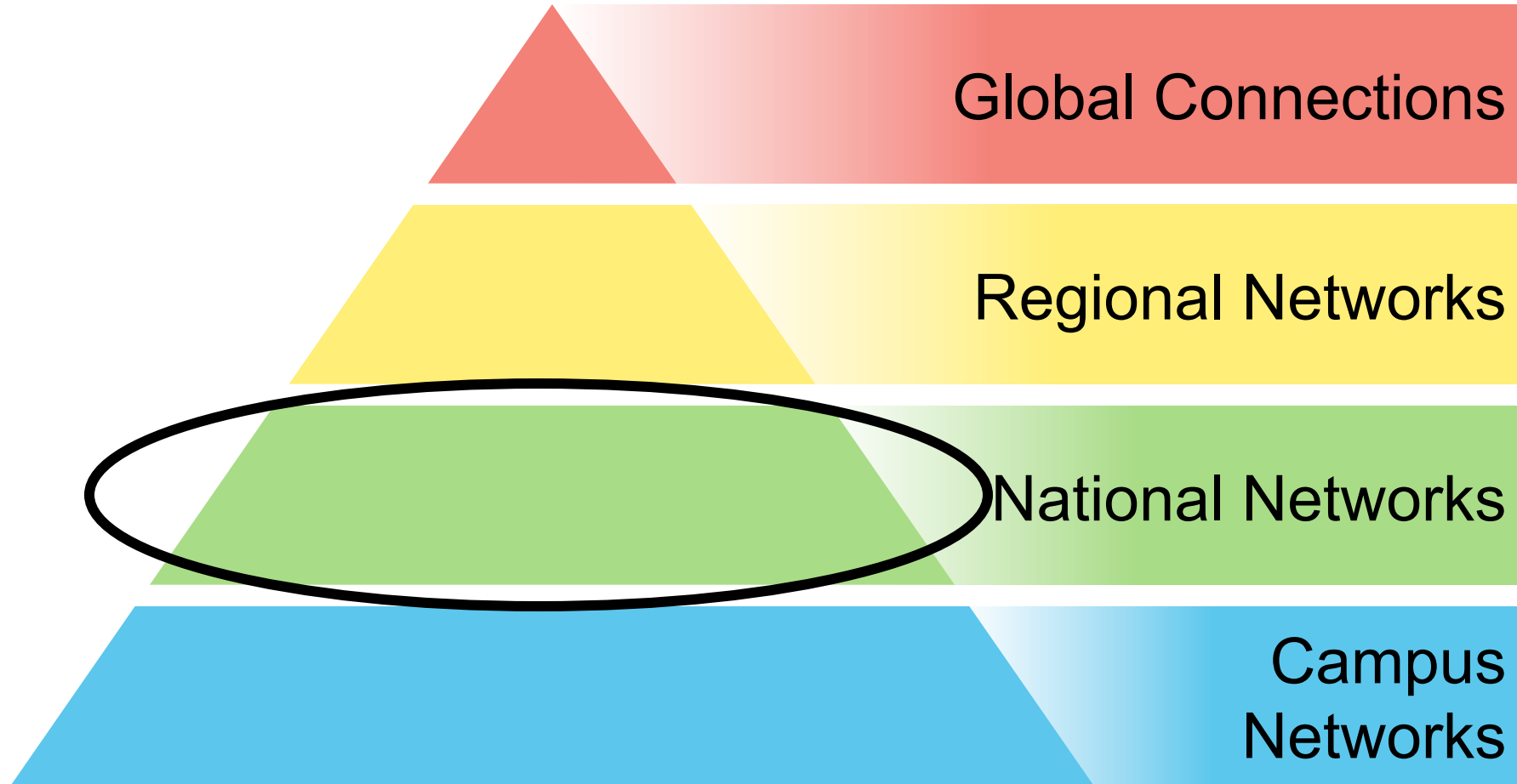
To learn more about connectivity to and within the different world regions reached by GÉANT, click on the links above.



This map is produced as part of the GÉANT Specific Grant Agreement GN4-2 (No. 731122), that has received funding from the European Union's 2020 research and innovation programme under the GÉANT2020 Framework Partnership Agreement (No. 653996). In addition to GN4-2, the following projects mentioned have received funding from the European Union: AfricaConnect2, CAREN3, and AsiaConnect (DG DE/CO).



# REN EcoSystem



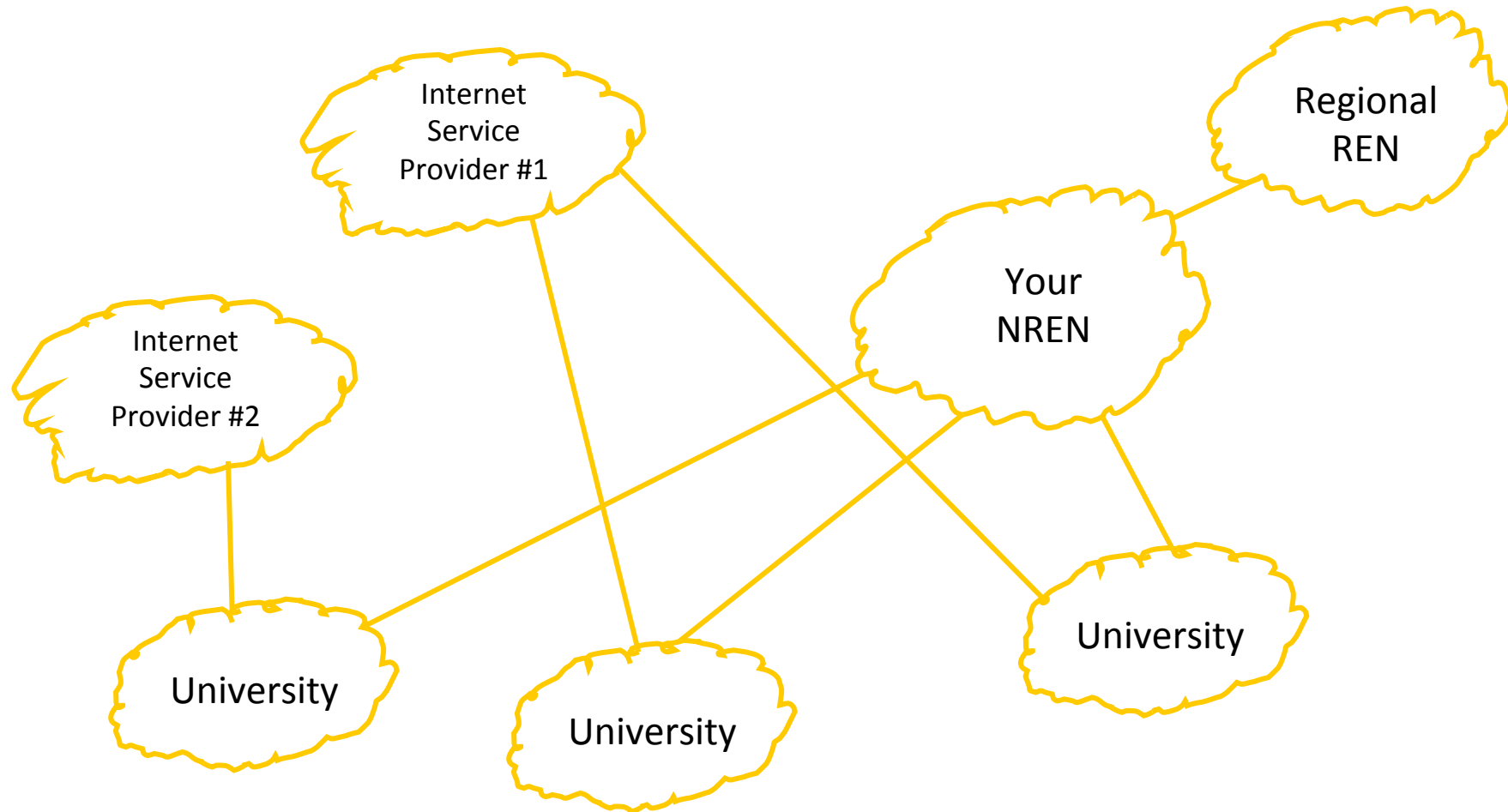
# National RENs (NRENs)

- Provides service to Universities, Colleges, research labs, and others in an entire country
- Often hosted and operated by a prestigious university in the country
- Often provides “value add” services to members
  - Video conferencing, VoIP, e-learning, web hosting, data center space for disaster recovery, etc.

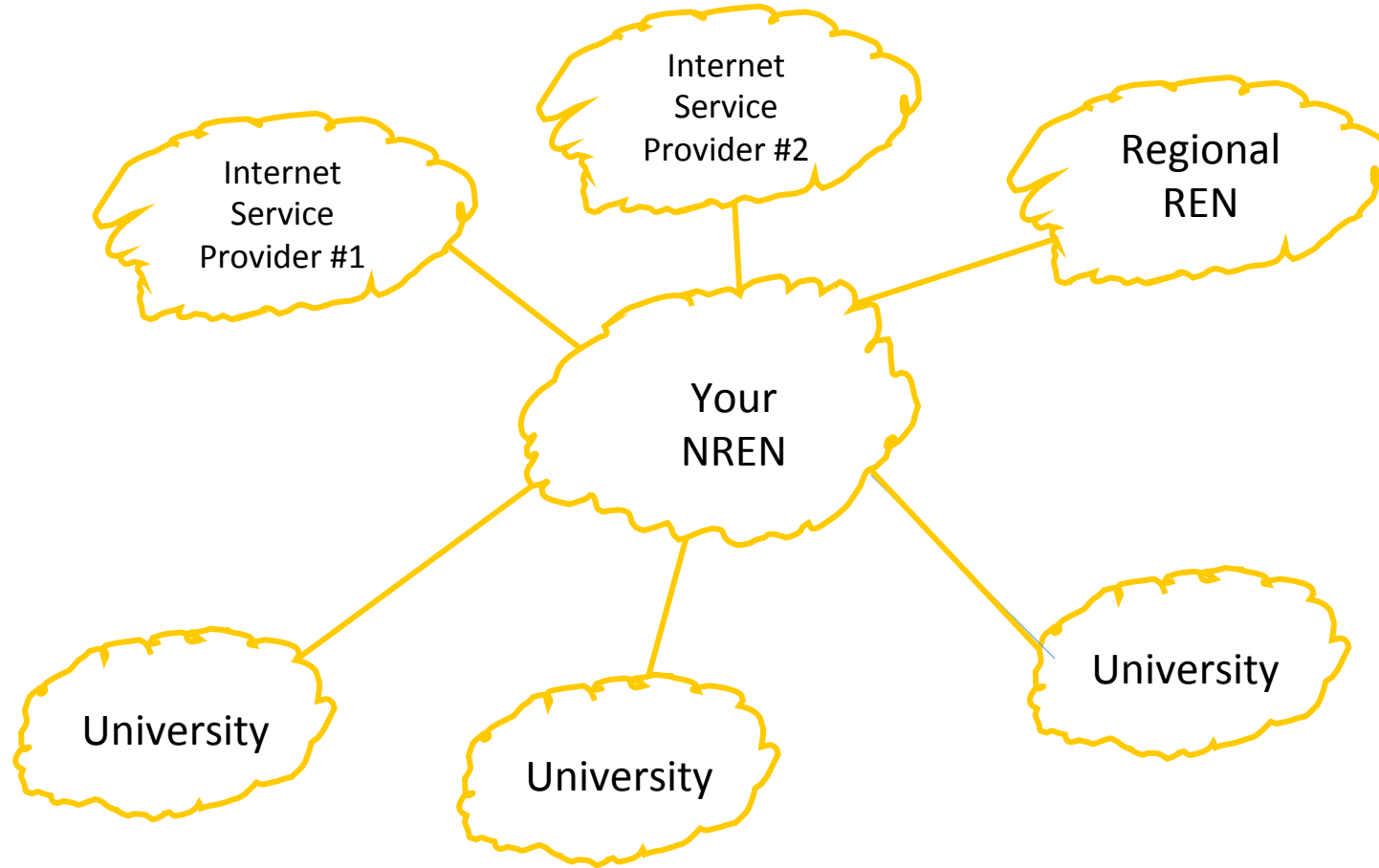
# REN Models of Service

- 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

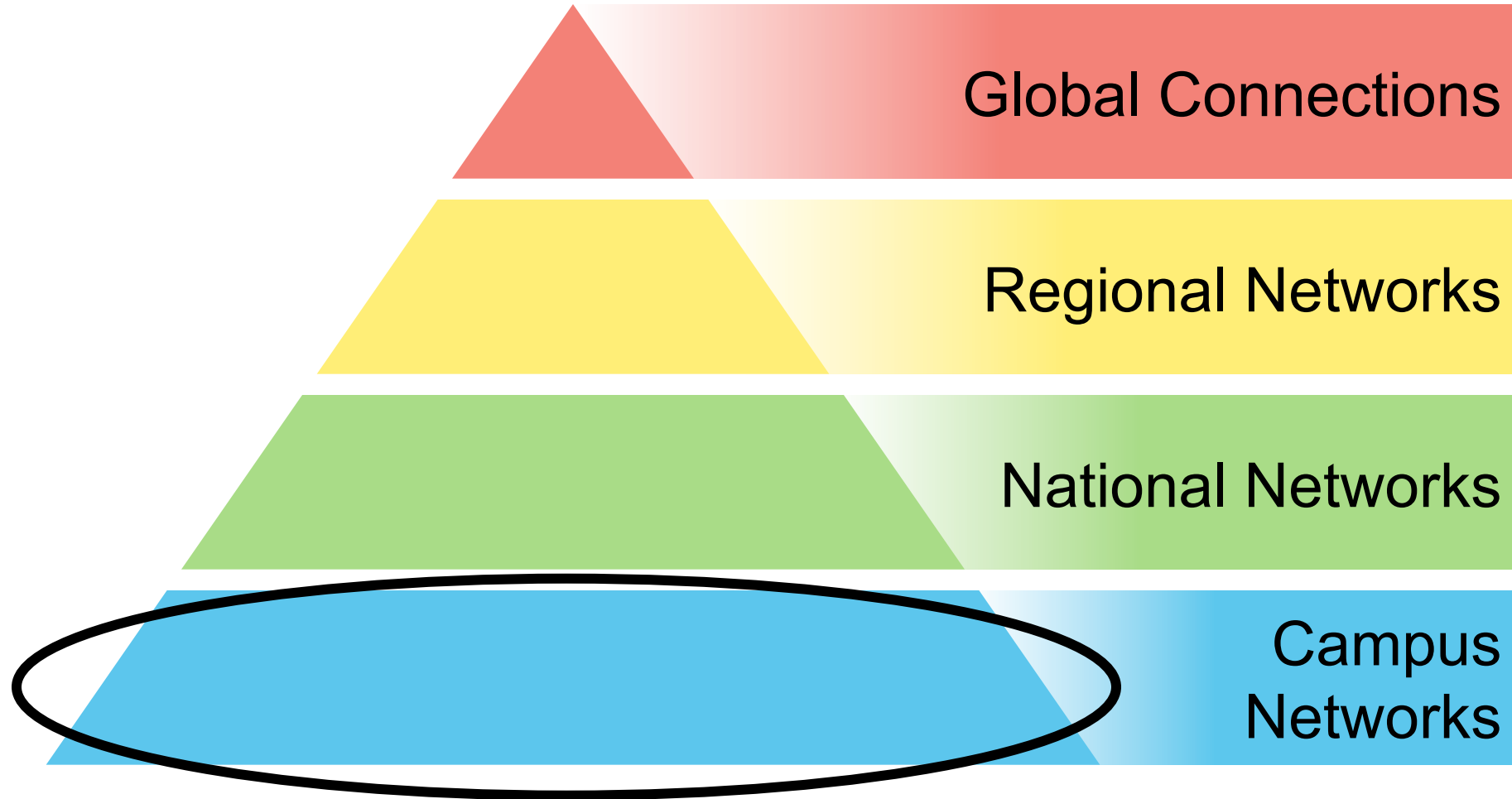




# Implications for Universities

- If NREN is a Peering Network
  - Each University still has their own ISP
  - Each University connects to NREN as well
  - 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

# REN EcoSystem



# Campus Network Role

- No student, researcher, or faculty member is connected directly to a Global, National, or Regional Network.
  - They are all connected to a campus network
- Without a good campus network, the entire ecosystem is affected
  - You can have a 100-gigabit connection to your National Network with a 100-gigabit to the regional network, but if the users have a poor connections on campus, the entire investment is wasted
- The campus network is the foundation that the entire REN ecosystem is built upon

# Foundation Failures



# Campus Network Challenges

- Many campus networks are not structured properly and can't effectively utilize high bandwidth connections
- Many make heavy use of NAT and firewalls that limit performance
- Many are built with unmanaged network equipment that provide no ability for monitoring or tuning the network

# Challenges

- Emerging regions need to develop National Networks
  - Some countries have problems getting funding and the political will to build an NREN
- Campus networks often perform poorly
  - Local expertise is often lacking

Questions?