

# Open Exchange Points

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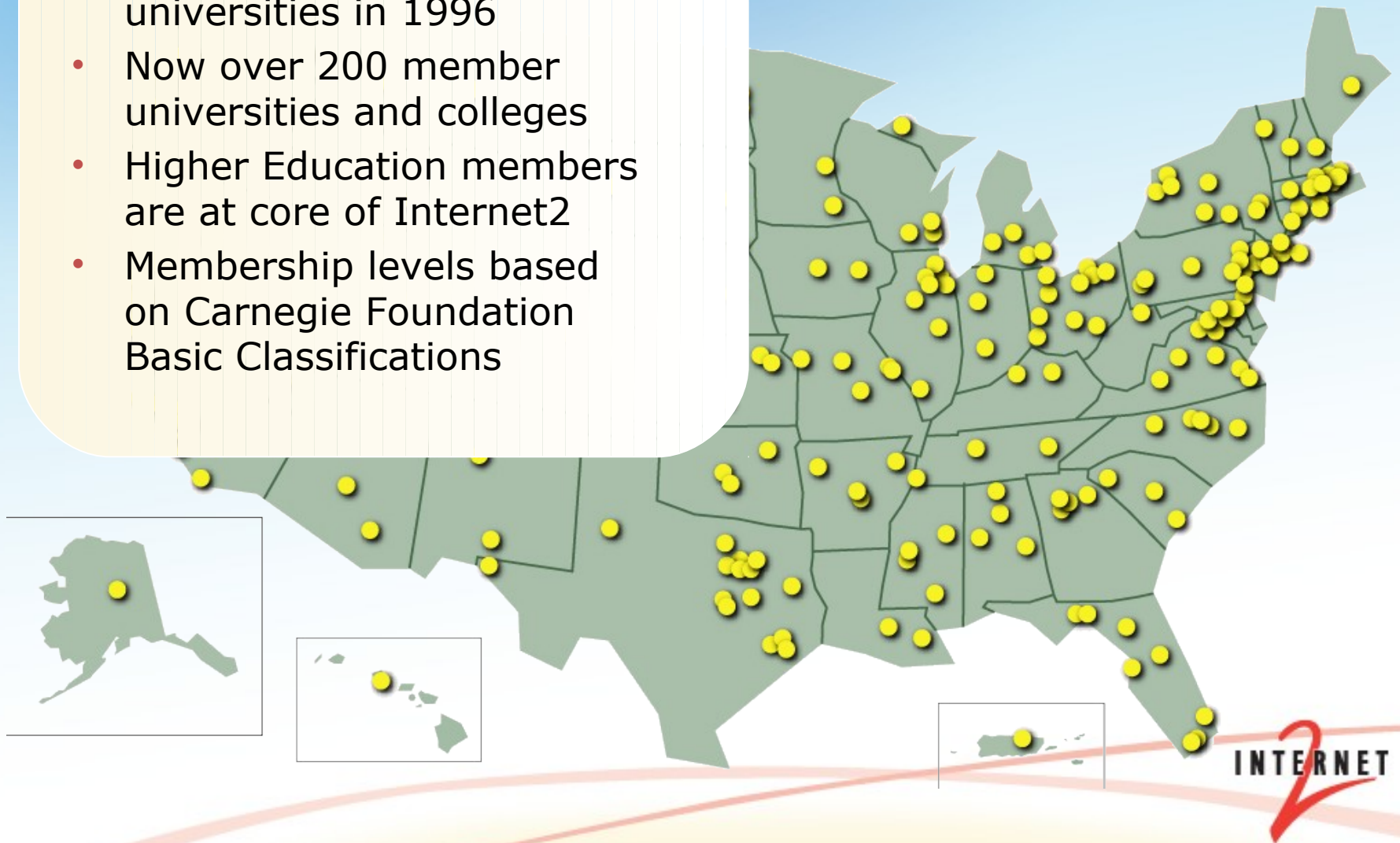


# A few words on me...

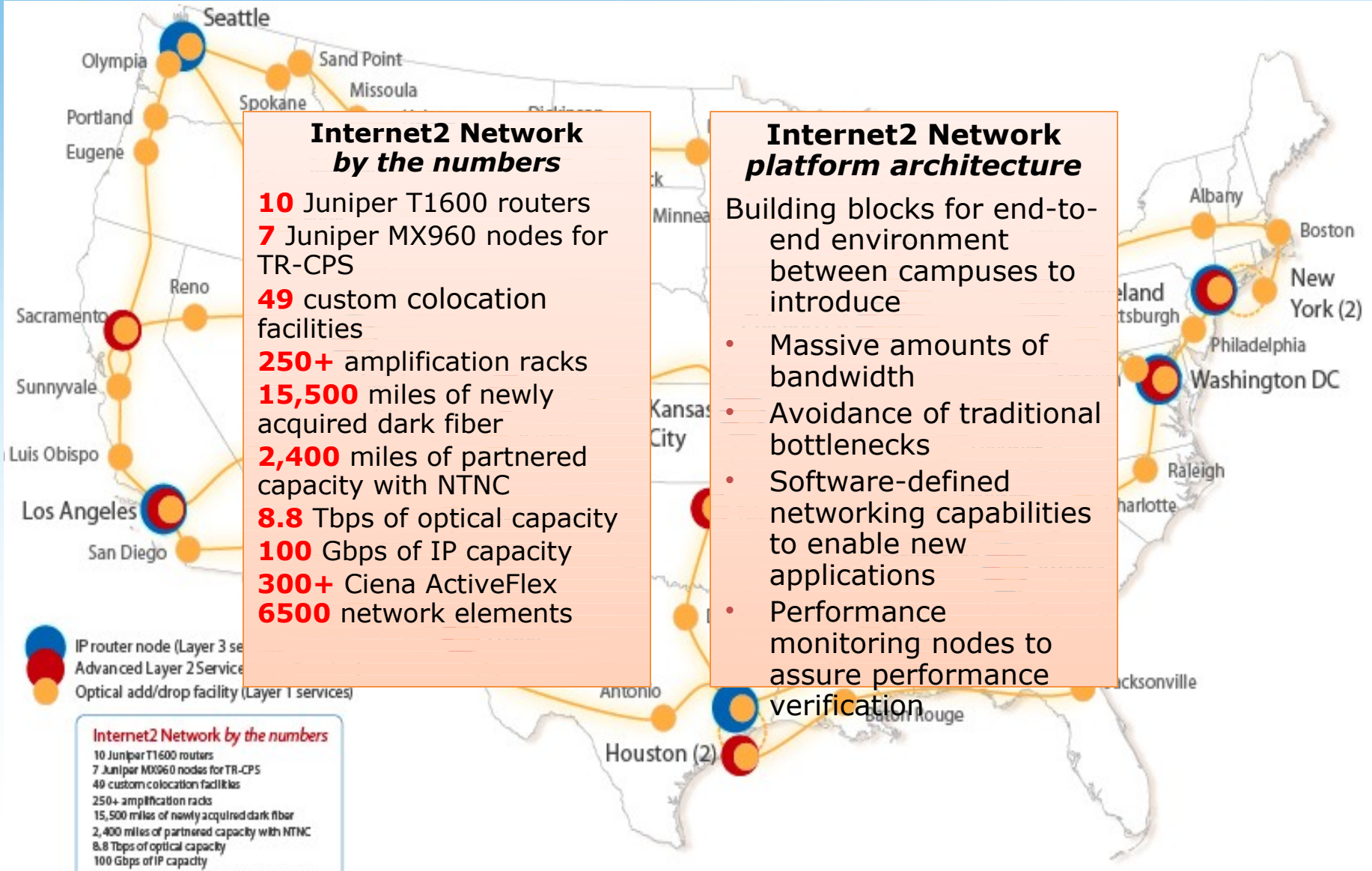
- Worked at SURFnet, the Dutch NREN
  - >23 years (August 1987 - February 2012)
  - Worked on SURFnet[123456]
  - Engineered AMS-IX, NetherLight
- Now working from my own company for:
  - NORDUnet (European Nordics NREN) [2 days/week]
  - Internet2 (USA NREN) [2 days/week]
  - My wife's company (primary healthcare) [1 day/week]

# Higher Education members

- Internet2 was formed by 34 universities in 1996
- Now over 200 member universities and colleges
- Higher Education members are at core of Internet2
- Membership levels based on Carnegie Foundation Basic Classifications



# The New Internet2 Network





## AFRICA IN PERSPECTIVE

People often underestimate quite how large Africa is, so we figured we'd put it in perspective by transposing as many of the world's other countries over it as we could. As you can see, Africa is larger than China, the USA, Western Europe, India, Argentina and the British Isles... combined!

Source: *The Times Atlas*

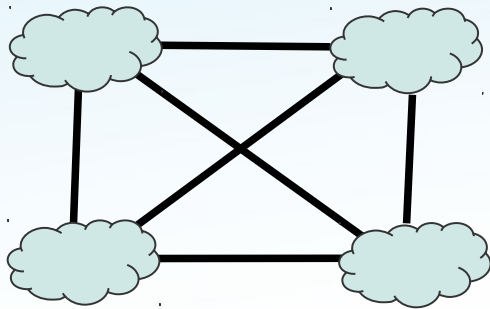
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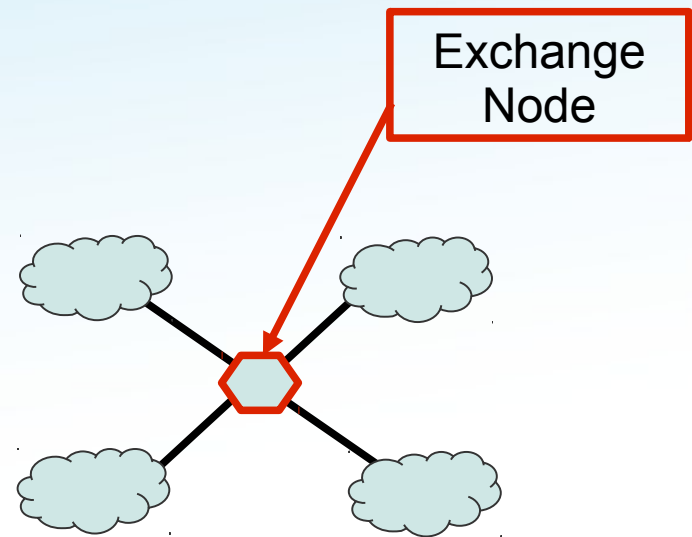
# History of Open Exchanges

- Early '90s: US (ATM) and Europe (Eth)
- Economic way of interconnecting

In stead of:



Mesh Model



IX Model

# Function of an Open Exchange

- Front and center:
  - Provide a stable and up to speed peering fabric
  - Keep local traffic local (cost saving & RTT improvement)
- Concentration of ISP → concentration of fiber
- For ISP: Elegant way of interconnecting with peers
- For city or country: Market place for connectivity



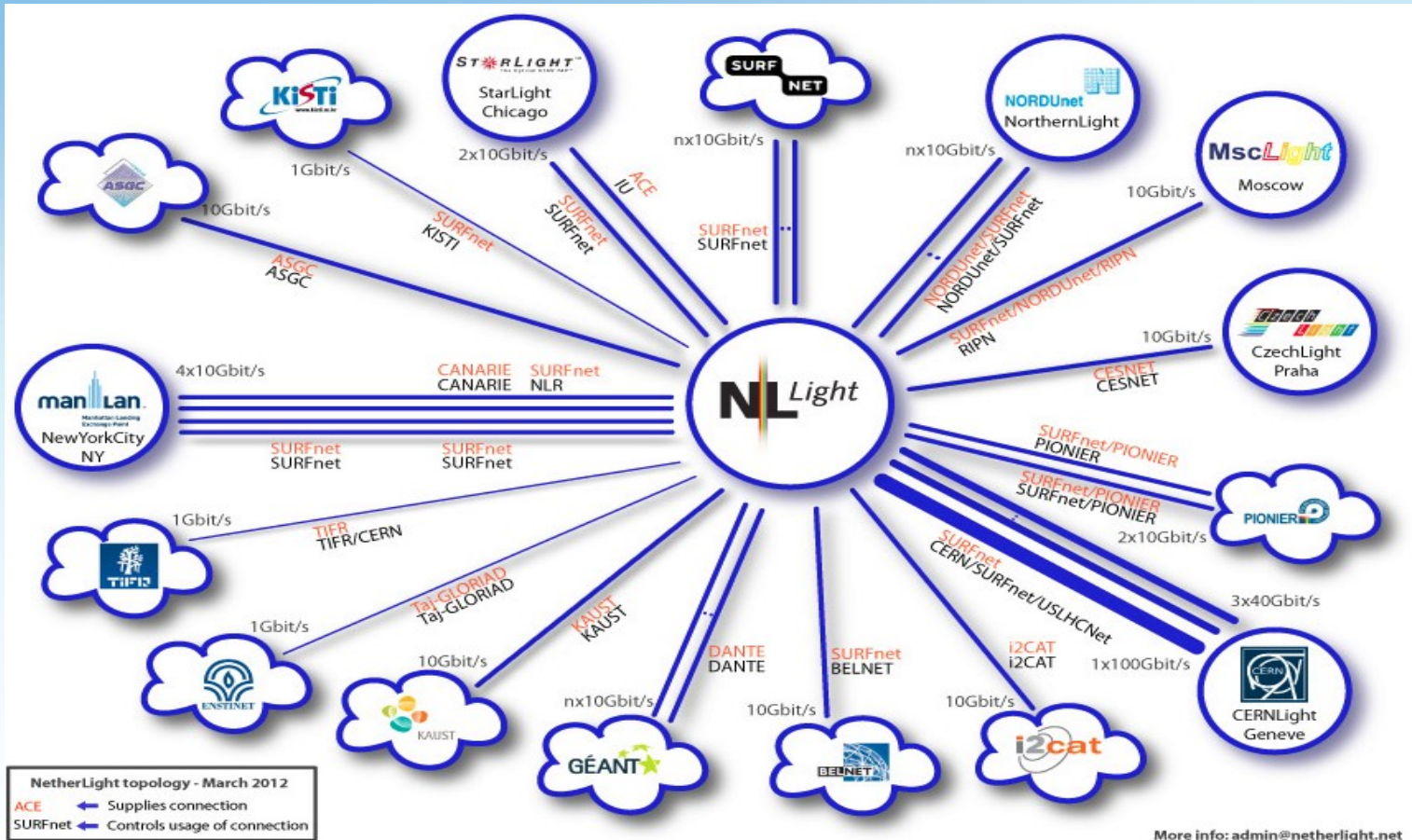
# The Major Exchanges of the World

- Beginning: They came and went
- Hundreds of them now
  - In Europe: Euro-IX
- A few very big ones:
  - North America: Equinix, NOTA
  - Europe: AMS-IX, LINX, BNIX, VIX, DE-CIX
- Many started or still run by an NREN

# Open Lightpath Exchanges

- “Route at home, switch at \*Light”
- Supporting the concept of lightpath networking
- Modelled after Internet Exchanges

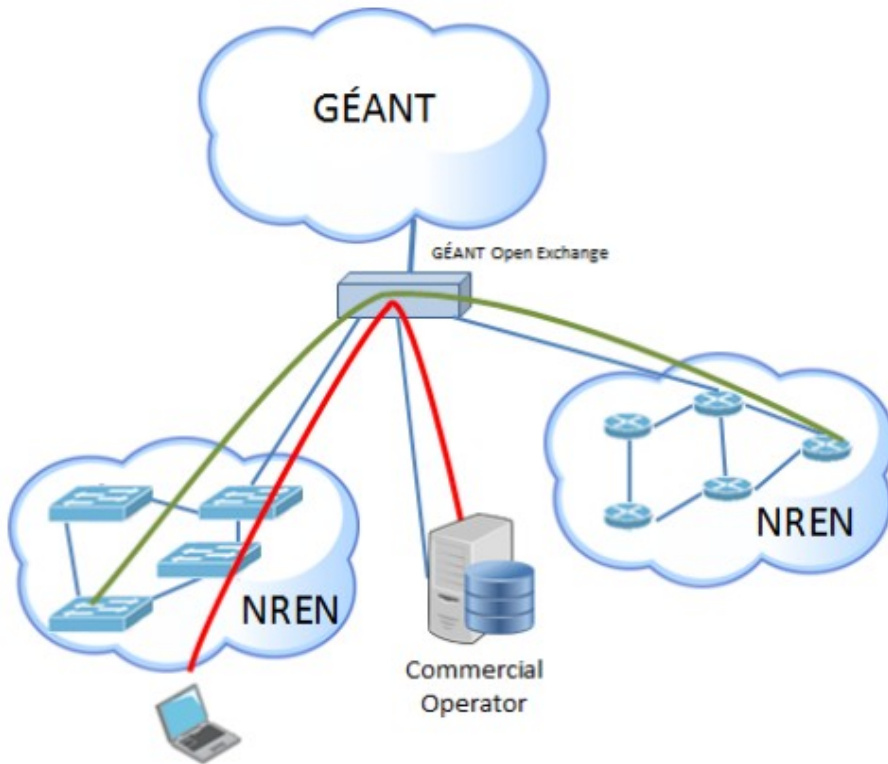
# Examples OLE #1: NetherLight



# Examples OLE #2: GÉANT Open (London OLE)

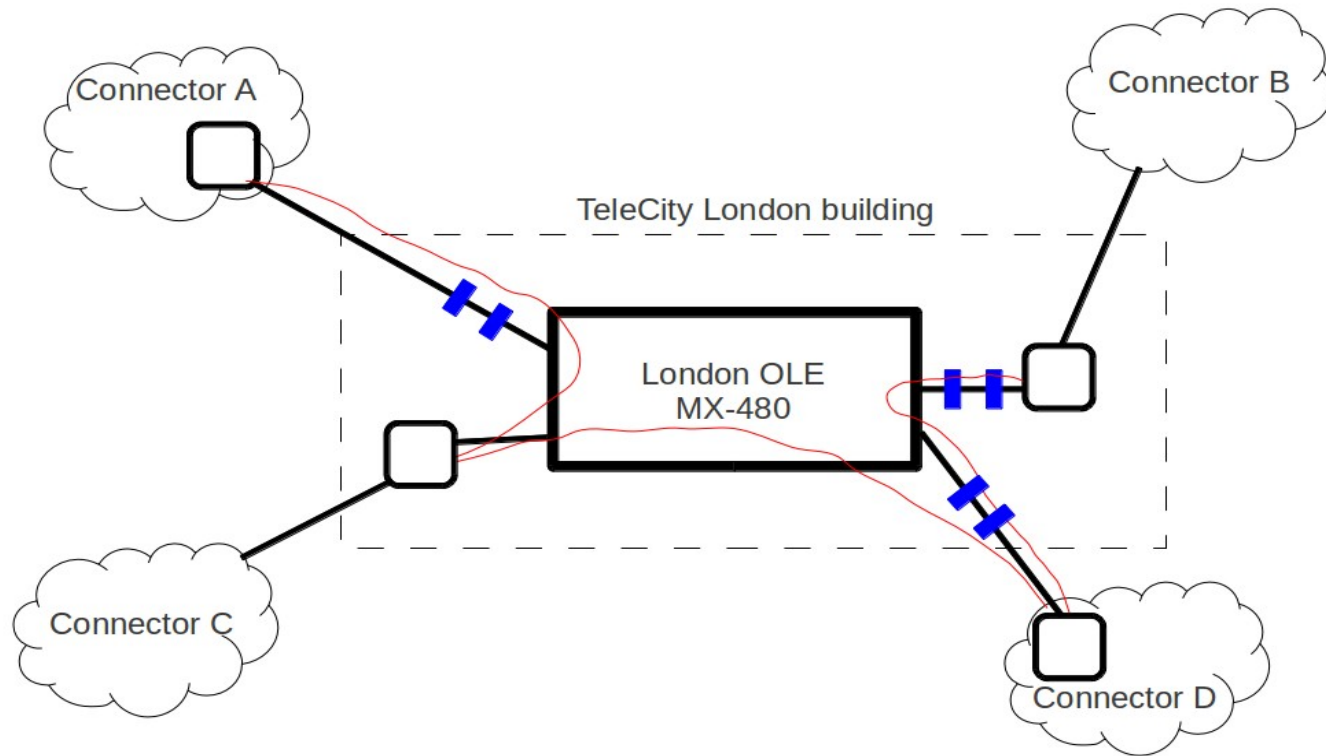
## Background

- Initial 1 year pilot to test “Open Exchange” concept within GÉANT
- Based in London at a major telehouse
- Facilitates interconnections of Research & Education users
- Enables interregional connections + other connections to GÉANT domain



*This slide courtesy of Michael Enrico, DANTE CTO*

# GÉANT Open (London OLE) schematic



# Basis of AMS-IX success as of Day 1 (Jan 1994)

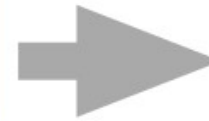
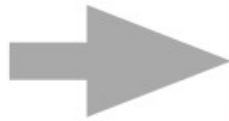


- Neutral, Impartial and Independent:
  - All participants have equal rights/vote/pricing etc
  - AMS-IX is not dependent on any of the participating (rival) companies
- Not for profit
- Very limited rule-set to connect:
  - Be legal entity
  - Have AS number

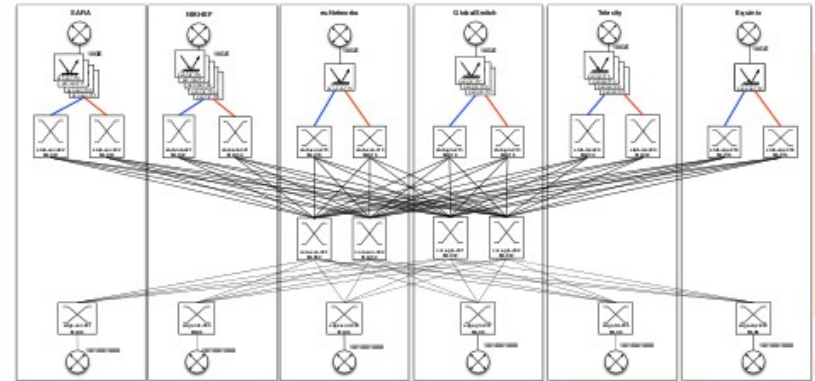
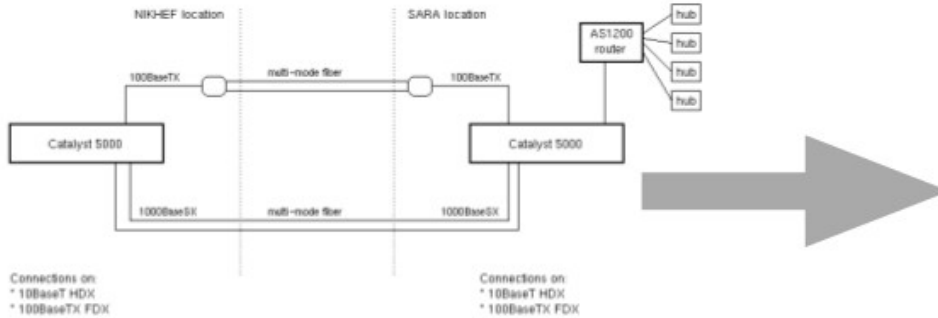
*This slide courtesy of Henk Steenman, AMS-IX CTO*



# AMS-IX Evolution



AMS-IX Topology Map



*This slide courtesy of Henk Steenman, AMS-IX CTO*

# How to start an Open Exchange? (1)

- Important ingredients:
  - A number of ISPs willing to flock together and peer
  - A neutral co-lo facility/carrier hotel
  - A GE/10GE switch and an IPv4 and an IPv6 prefix
  - A dedicated individual wanting to make this fly
- Things to do:
  - Create a lightweight connection agreement: connectors
  - Make sure the initiative is well-known
  - Make sure the admission is open to all
  - Keep it simple



# How to start an Open Exchange? (2)

- Things not to do:
  - Make it cumbersome to connect (technically & organizationally)
  - Interfere with the peering policy between connectors
  - Over-engineer the switch / peering fabric
- A word on Peering:
  - Every connector at IX can peer with every other one
  - Usually settlement-free (but of no concern to the IX)
  - No obligation to peer

# Conclusions

- A well functioning Internet Exchange Point adds to the ISP ecosystem in a region, in a country and/or in a city
- When the ISP ecosystem gets a boost, Internet prices drop and availability increases
- When these effects happen, the country's knowledge economy gets a boost

# Thank you! Questions?

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