100G intercontinental: The Next Network Frontier

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Agenda

Internet2 as an example NREN

Networks for R&E today

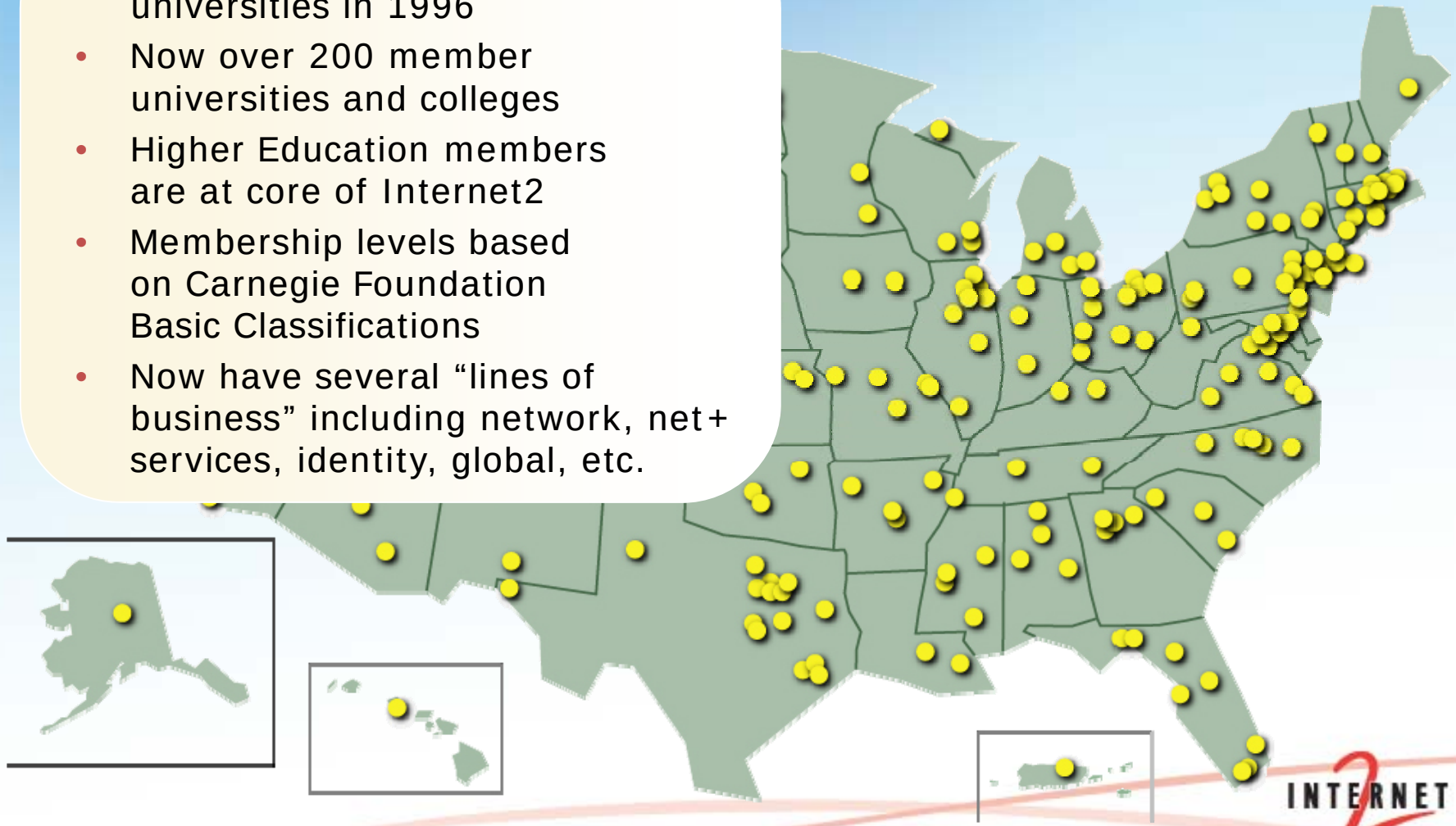
Advanced North Atlantic 100G Pilot

- Why?
- How?
- What?
- Status

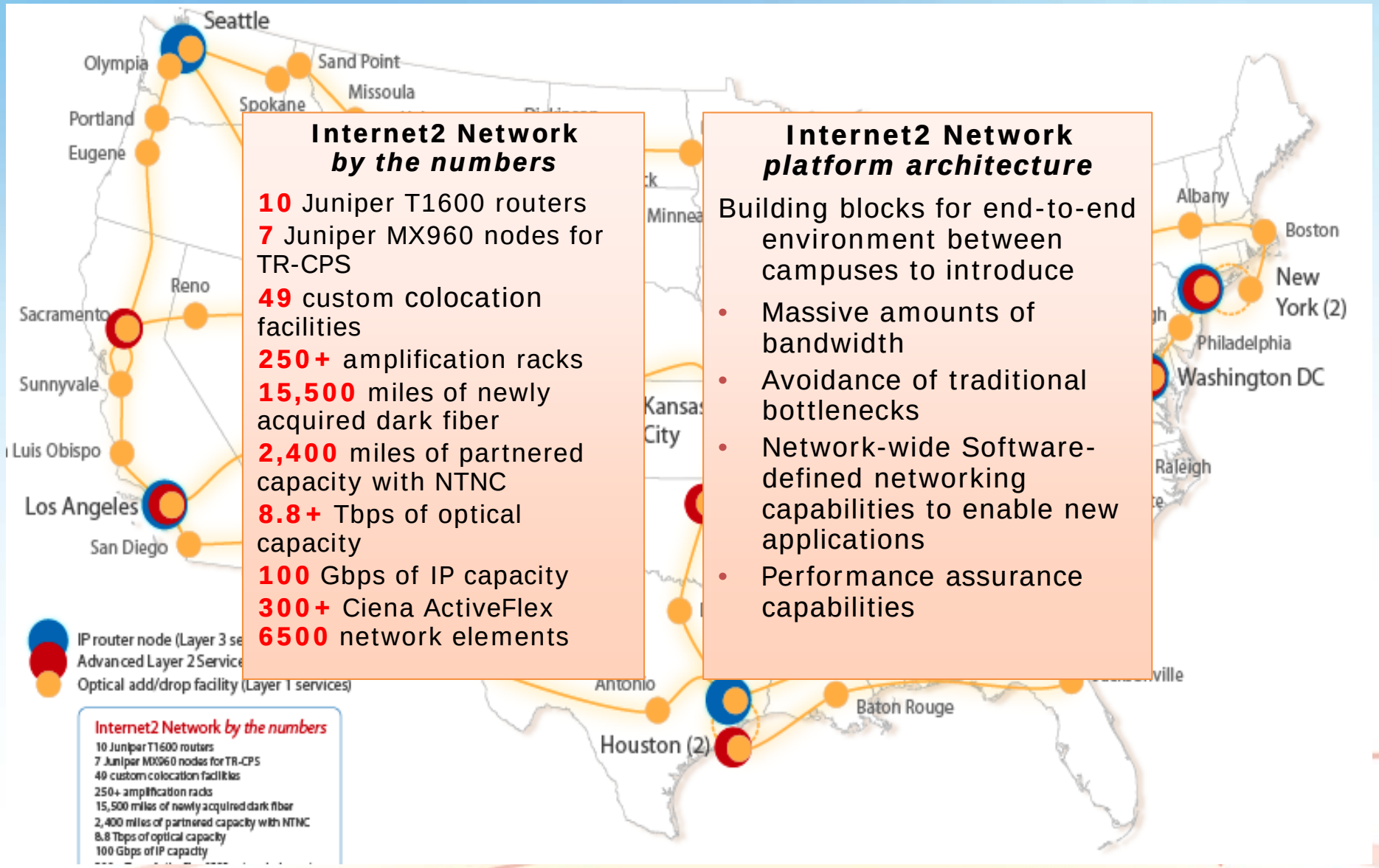
Onwards, post GLIF

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
- Now have several “lines of business” including network, net+ services, identity, global, etc.



The New Internet2 Network



Internet2 Network
by the numbers

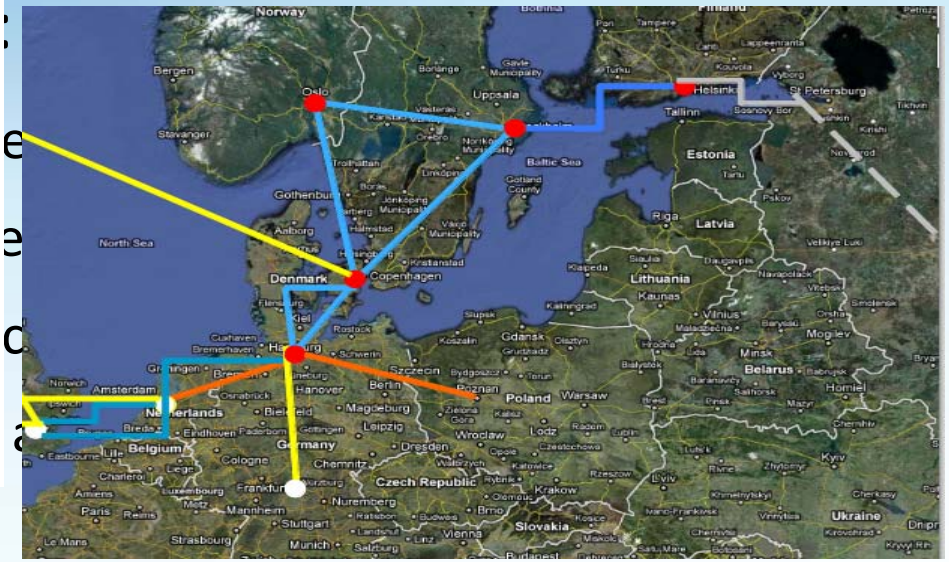
10 Juniper T1600 routers
7 Juniper MX960 nodes for TR-CPS
49 custom colocation facilities
250+ amplification racks
15,500 miles of newly acquired dark fiber
2,400 miles of partnered capacity with NTNC
8.8+ Tbps of optical capacity
100 Gbps of IP capacity
300+ Ciena ActiveFlex
6500 network elements

Internet2 Network
platform architecture

Building blocks for end-to-end environment between campuses to introduce

- Massive amounts of bandwidth
- Avoidance of traditional bottlenecks
- Network-wide Software-defined networking capabilities to enable new applications
- Performance assurance capabilities

Networks for R&E today



Between continents:

- Leased capacity as a service
- Often mission oriented, limited in time
- 10G production as the norm
- Operations are opaque at best

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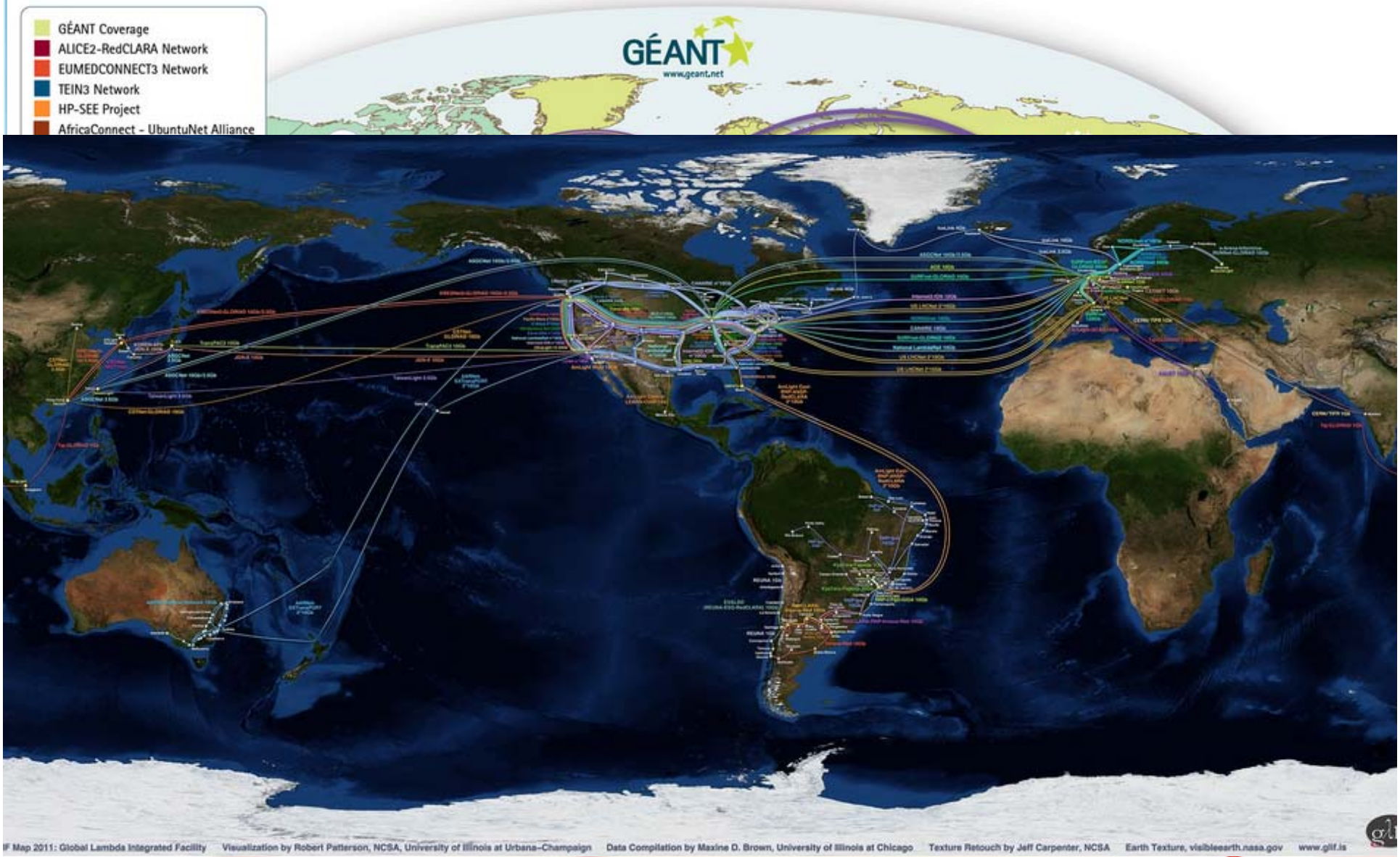
Intercontinental connectivity today



The problem statement

New links so far are incremental additions, with limited scope, purpose and/or timeline

Hard (if not impossible) to coordinate routing → suboptimal use

Big science applications generate flows >10G and (soon) >40G

Market for 100G or above is immature at best

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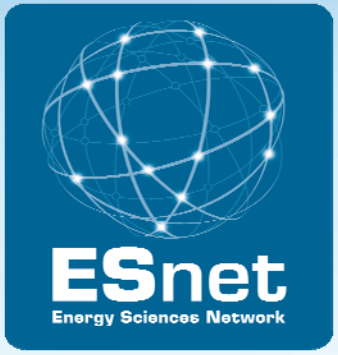
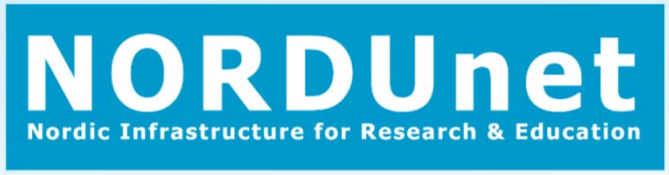
Introducing ANA-100G

Collaboration between six R&E Networks

Announced on April 24, 2013





ANA-100G aims to test...

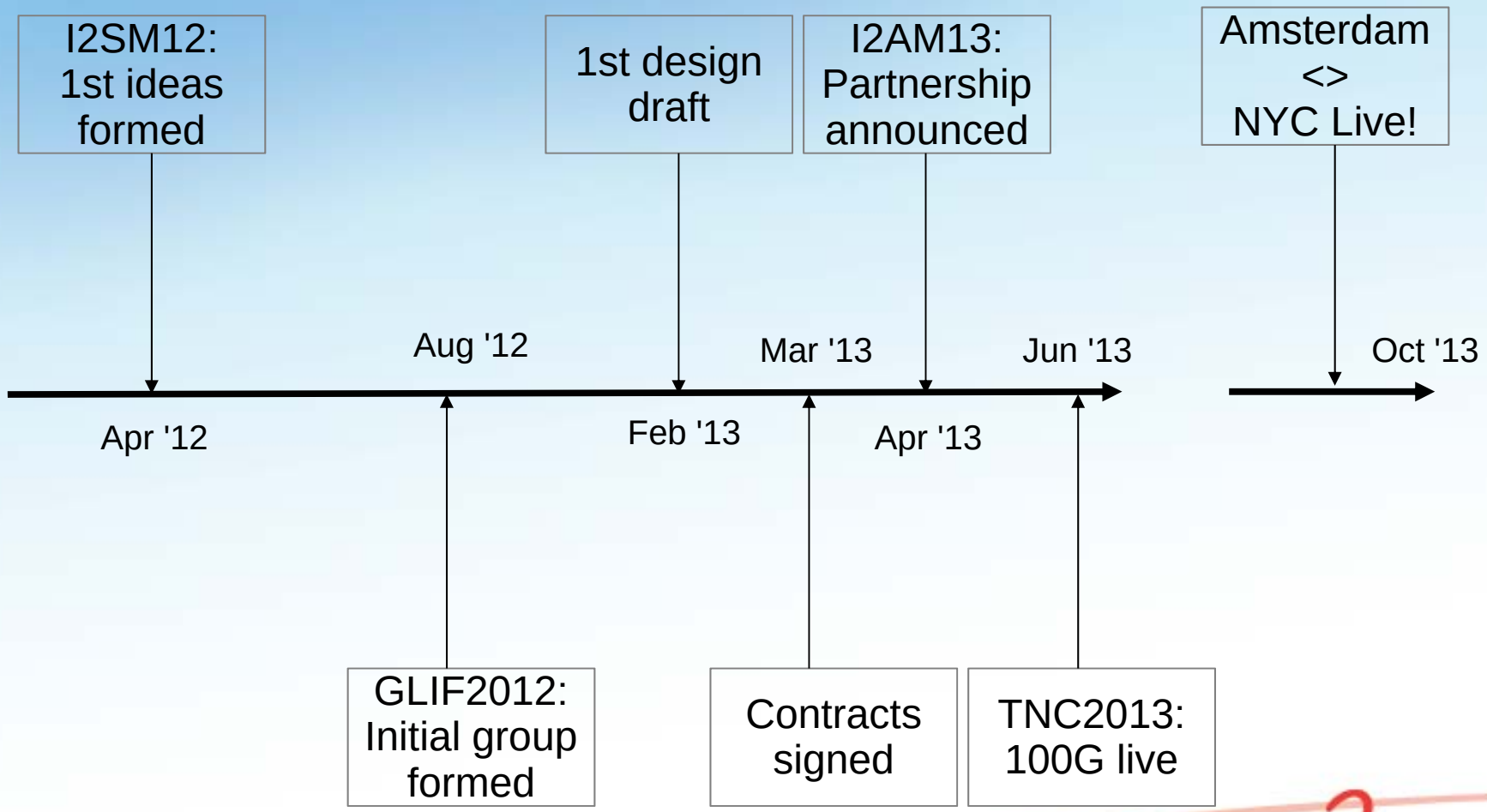
New models for collaboration

New governance

New technologies

In public-private partnership with Industry

ANA-100G Time Line through TNC



Collaboration & Governance

Lightweight Memorandum of Understanding

Steering Group and Project Group

Subgroups on PR, demos, operations

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Technology

Historic: Leased spectrum capacity

Today: Dark fiber nationally/regionally & leased capacity spectrum between continents

Future: Owned spectrum IRU's & open exchanges & rings around the world?

ANA-100G is path finder, today using:

- Spectrum
- Open Exchanges

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ANA-100G and TNC2013

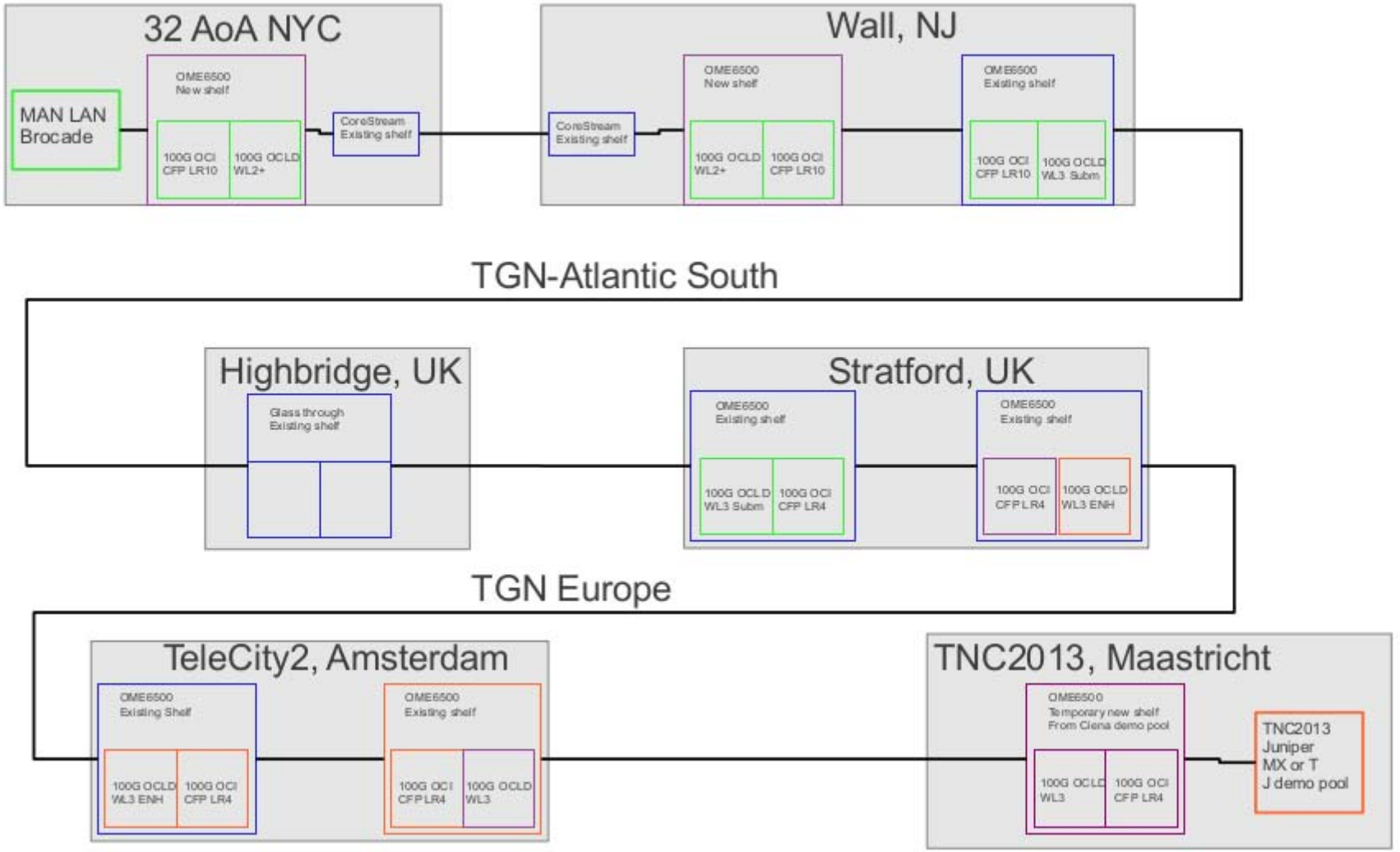
TNC2013 provided focus for ANA-100G

Ambitious deadline:

“get a first 100G operational for pilot purposes before June 3, 2013”

See also Erik Huizer's blog “Pushing the limits by Innovating Together” at: https://blog.surfnet.nl/?p=1952

ANA-100G TNC2013 implementation



ANA-100G TNC2013 demos

Big data transfers with multipathing, OpenFlow and MPTCP

Visualize 100G traffic

How many modern servers can fill a 100Gbps Transatlantic Circuit?

First European ExoGENI at Work

Up and down North Atlantic @ 100G

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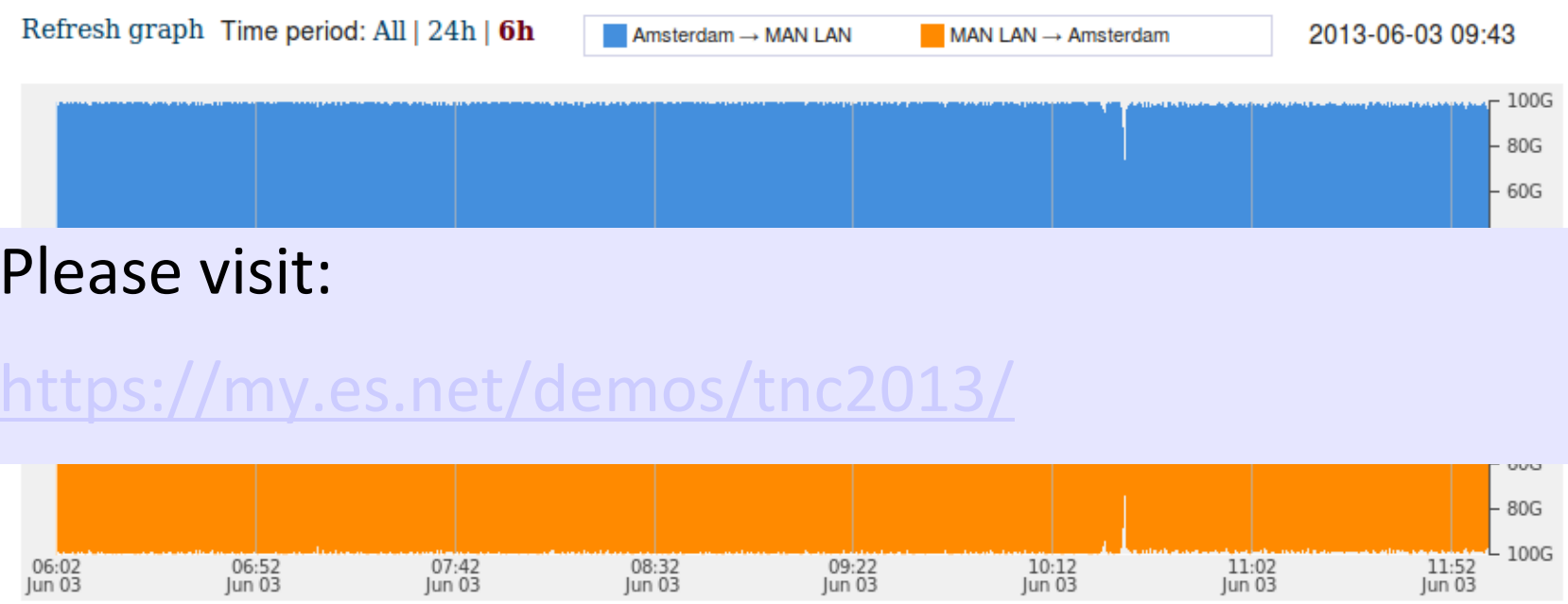
100G Visualization Demo (ESnet)

Data will refresh in 1 seconds.

Transatlantic Traffic



Please visit:

https://my.es.net/demos/tnc2013/

Special thanks to Inder Monga and Team

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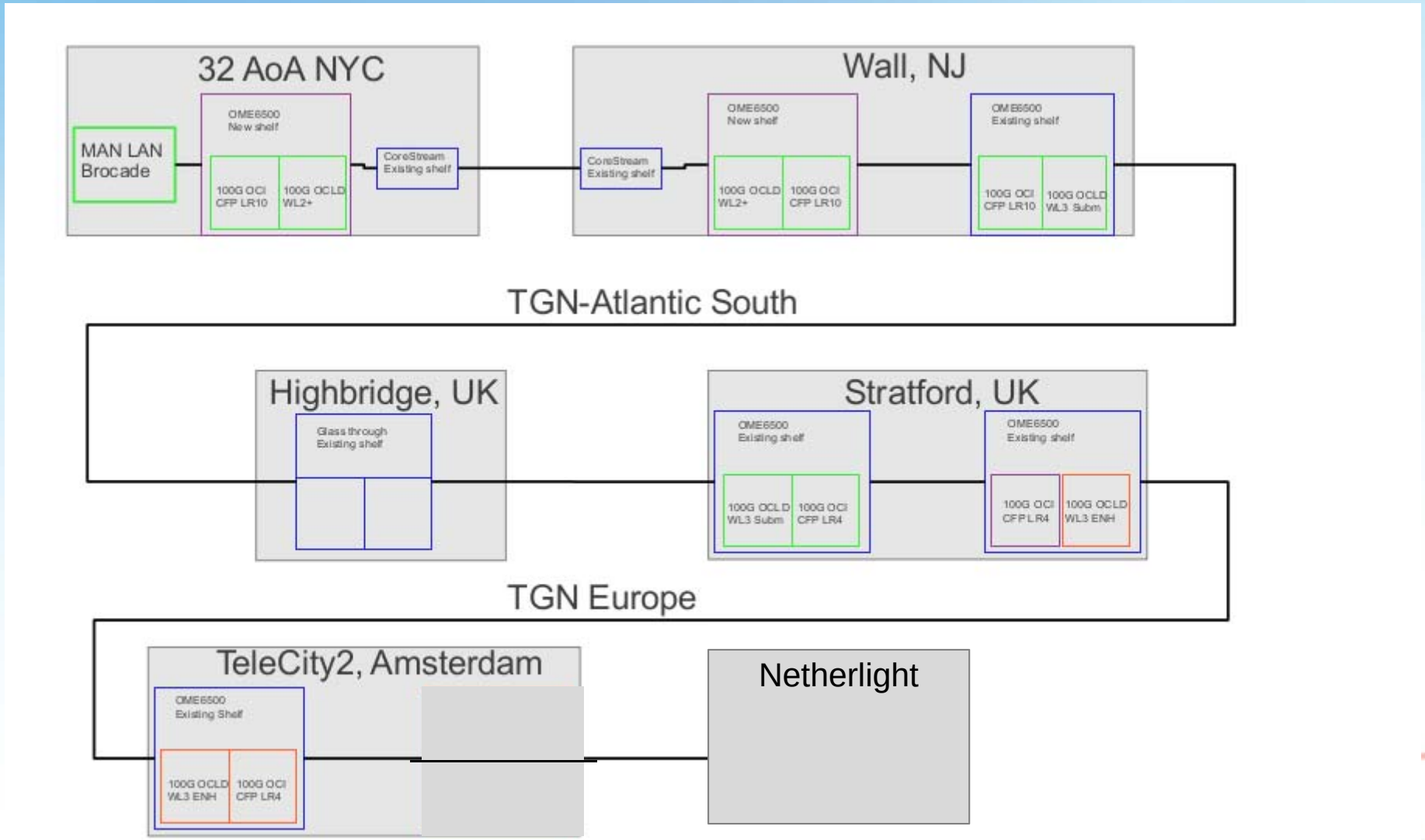
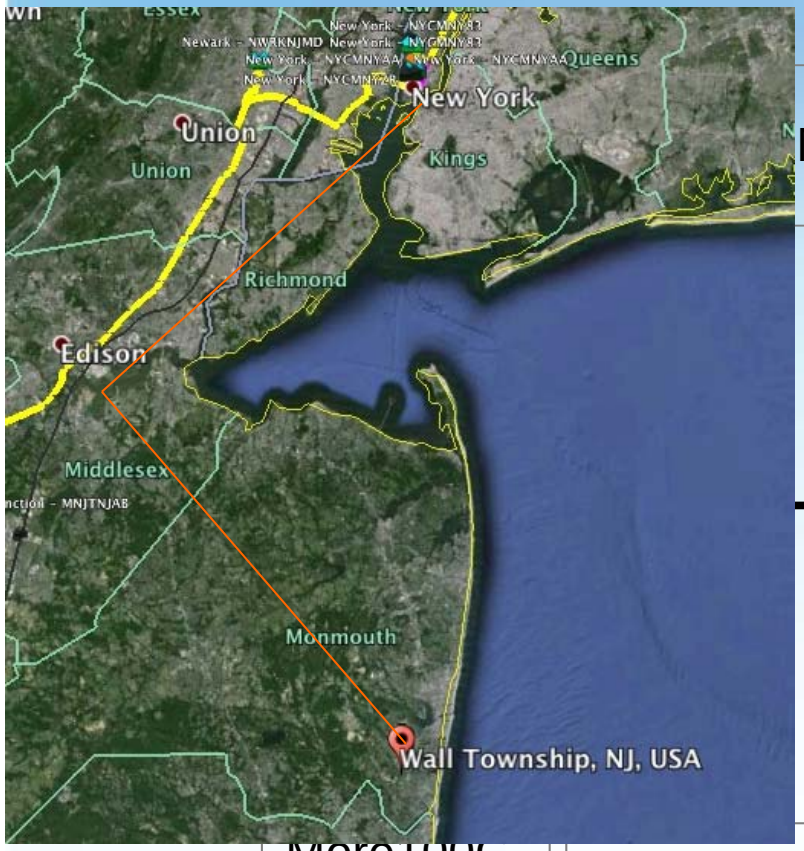
ANA-100G post TNC2013 →



ANA-100G TNC to Today



Maintenance

Amsterdam
<>
NYC Live!

Oct '13

Nov

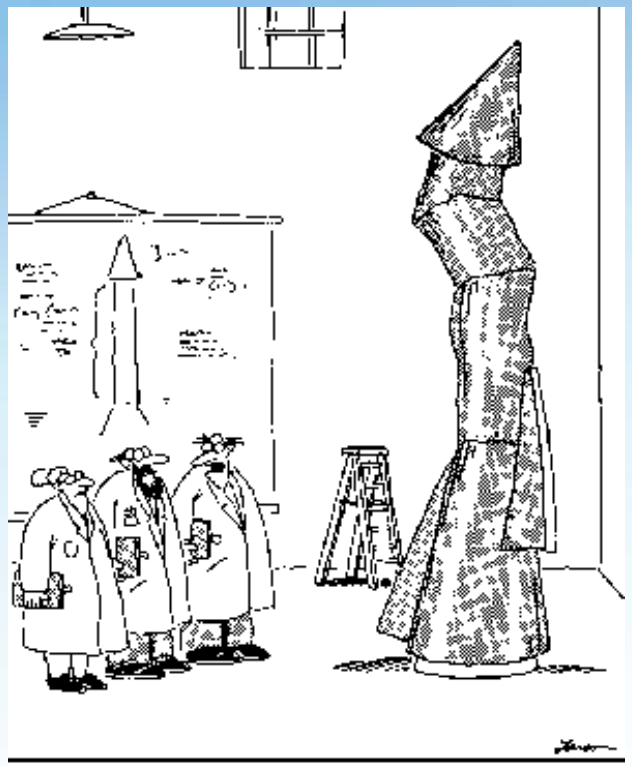
Oct '13

Sept '

More100G
added at
Netherlight

Error!

Rocket science?



"It's time we face reality, my friends. ...We're not exactly rocket scientists."

- Technology is awesome, but GA
- Planning is important
- Creativity, dedication & teamwork are king

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Future plans post-GLIF

The 100G will remain for at least 12 more months:

- Looking into service delivery
- Enabling and supporting applications development

Research for a second 100G link:

- Fully resilient
- Using more Open Exchange Points
- Potentially a full ring between US and Europe @ 100G+

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Acknowledgements

ANA-100G Collaborators

Ciena

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