

NORDUnet Network Services for Nordic HEP

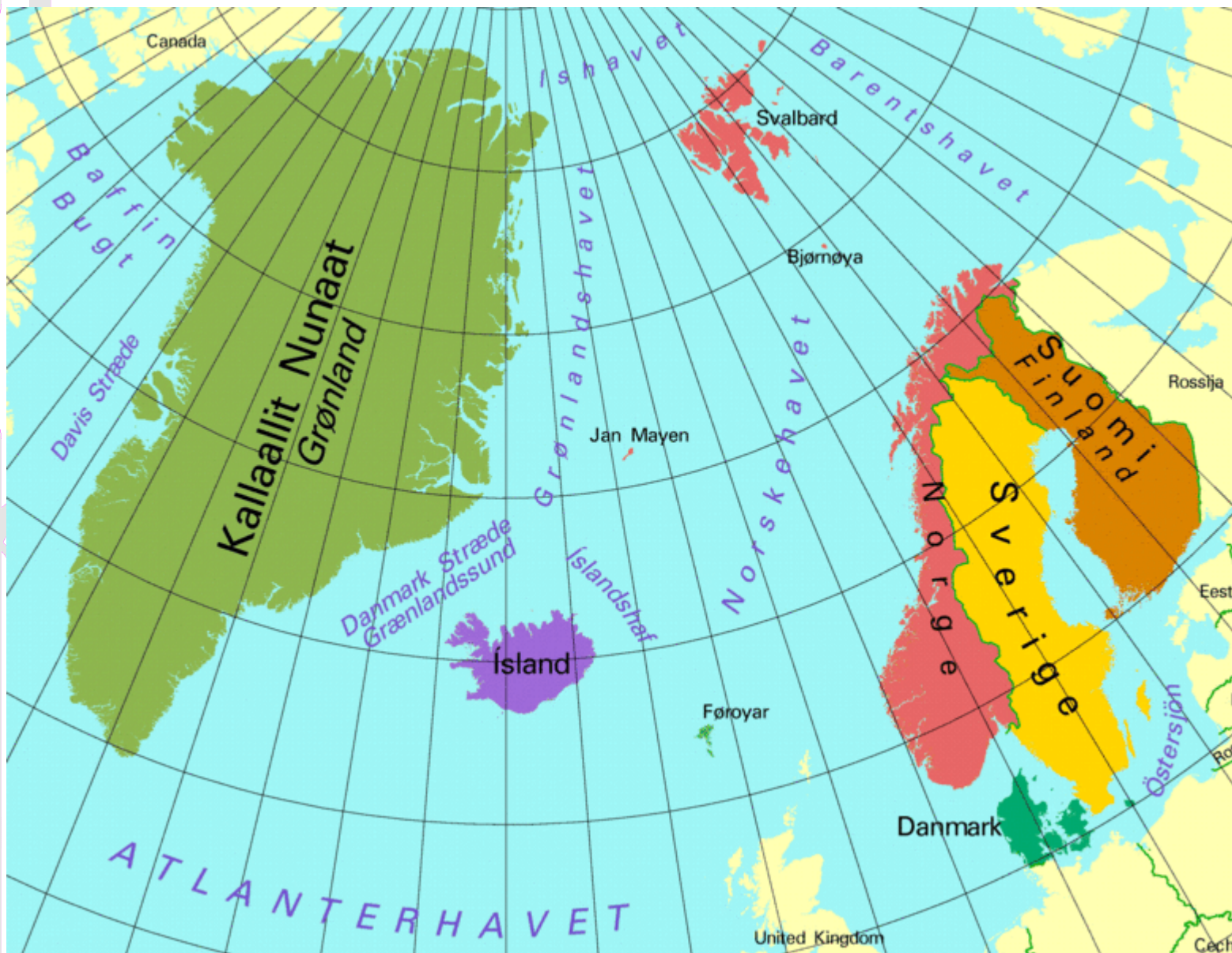
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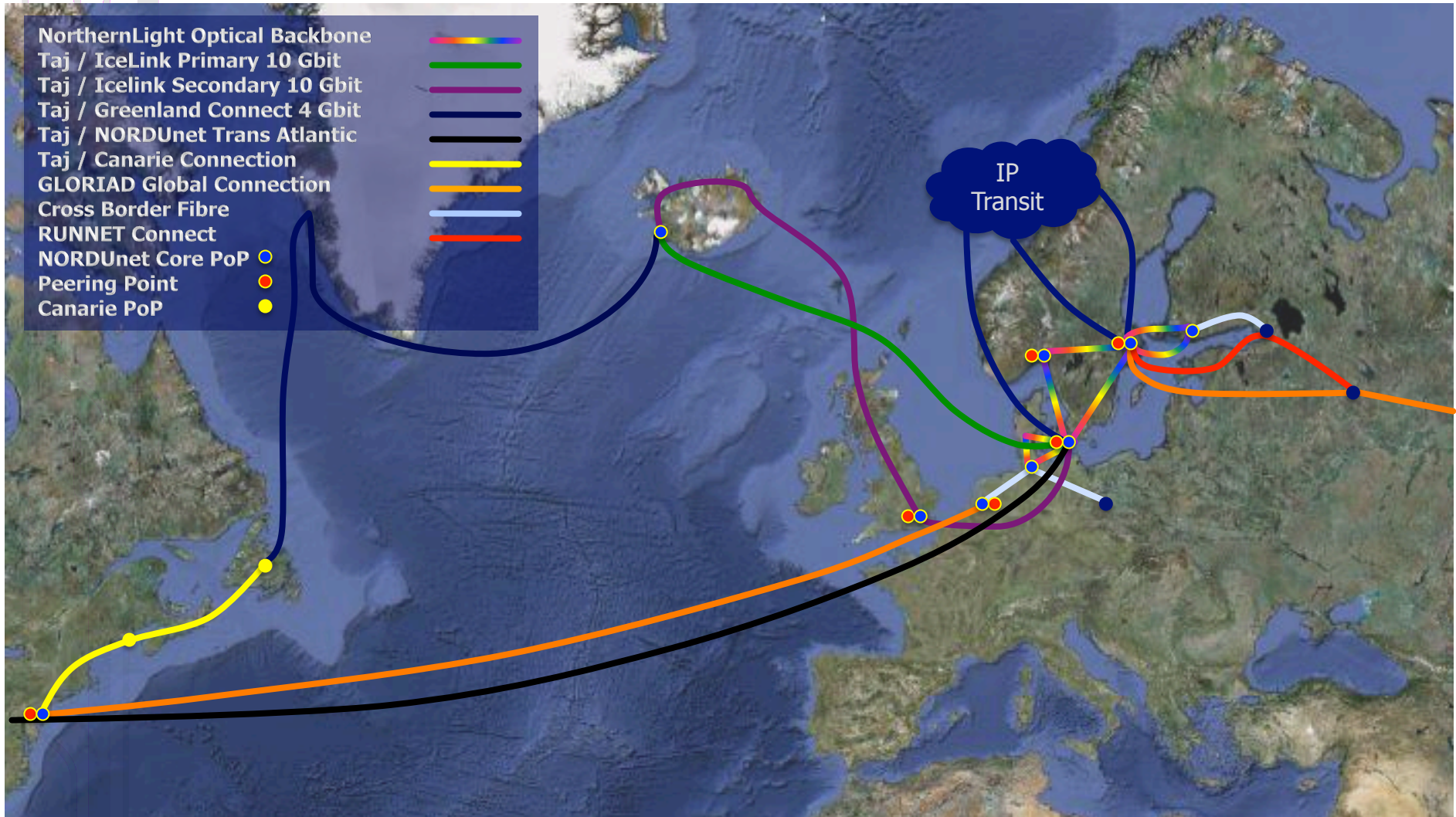
**Workshop on Transatlantic Networking
for the LHC Experiments**

CERN, 11-12 June 2010





- Regional Network for Nordic countries
 - Denmark, Sweden, Iceland, Norway, Finland (Forskningsnet, SUNET, RHnet, UNINETT, FUNET)
- Services
 - Network Interconnect
 - International Connectivity
 - Coordination, forum for collaboration
 - International projects and relations
- Organization
 - Jointly owned by Nordic NRENs
 - Funded according to GNP





- Nordic NREN interconnect
 - 40G transit, 10G & 40G interconnect
- R&E connectivity
 - GÉANT
 - Direct peering with (some) European NRENs
 - Russian R&E networks
 - North American R&E networks
- IP transit service
 - IX'es: Stockholm, Copenhagen, Oslo, Amsterdam, London, New York City
 - Commercial upstream
 - Peering is 65% of non-REN traffic (with additional local peering by Nordic NRENs)'
- Router POPs in Copenhagen, Stockholm, Amsterdam, London, New York City
 - Transport on NREN-owned and operated dark-fiber & DWDM where possible

- Static Lightpath services
 - Sub-rate 10G, Ethernet and SONET
 - 10G lambda, Ethernet and OC192/STM64
 - 40G lambda, OC768/STM256
 - 100G coming
- Interconnect
 - Nordic NREN lightpath services
 - GÉANT – 10G lambda and GN+ service
 - European CBF interconnect – 40/10G lambda, sub-rate 10G
 - Russia leased-line SONET – 10G, sub-rate 10G
 - GOLE connections
 - Lightpath transit for European, Russian, Global partners
 - Experimental alien wave transit (with SURFnet)

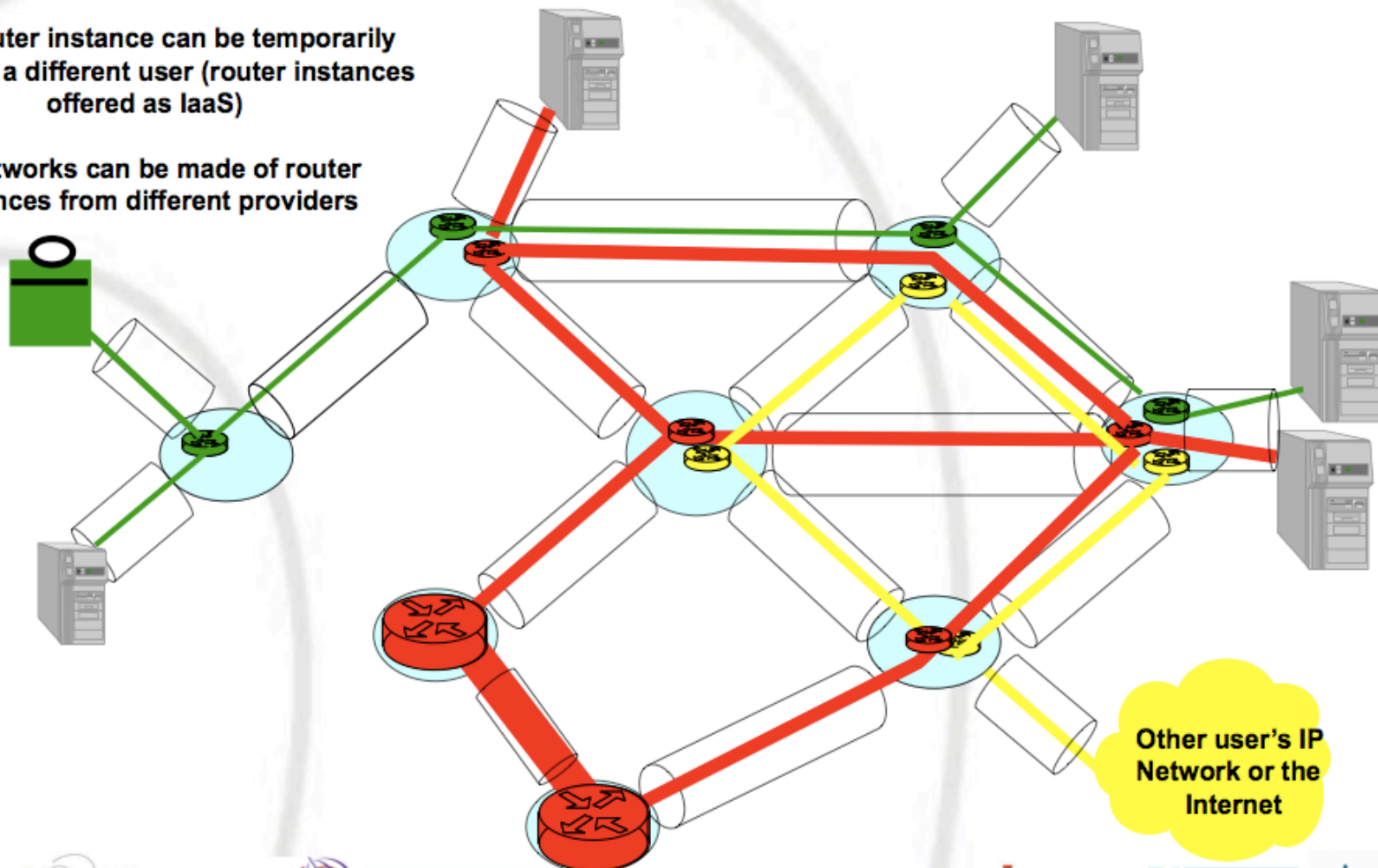
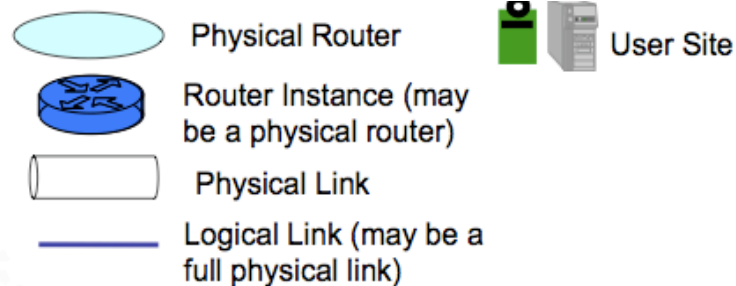
- Dual transport
 - SDH / SONET on top of DWDM backbone, SONET or Ethernet presentation
 - Ethernet over MPLS – over dedicated 10G transport and routers, or over shared IP infrastructure, 40G & 100G coming
- On-demand Service
 - EoMPLS circuit service (OSCARS)
 - SDH / SONET lightpath (AutoBAHN, OSCARS?)
 - Network Virtualization service (MANTICORE)
- Services experimental
 - Revert to manual provisioning and management when required

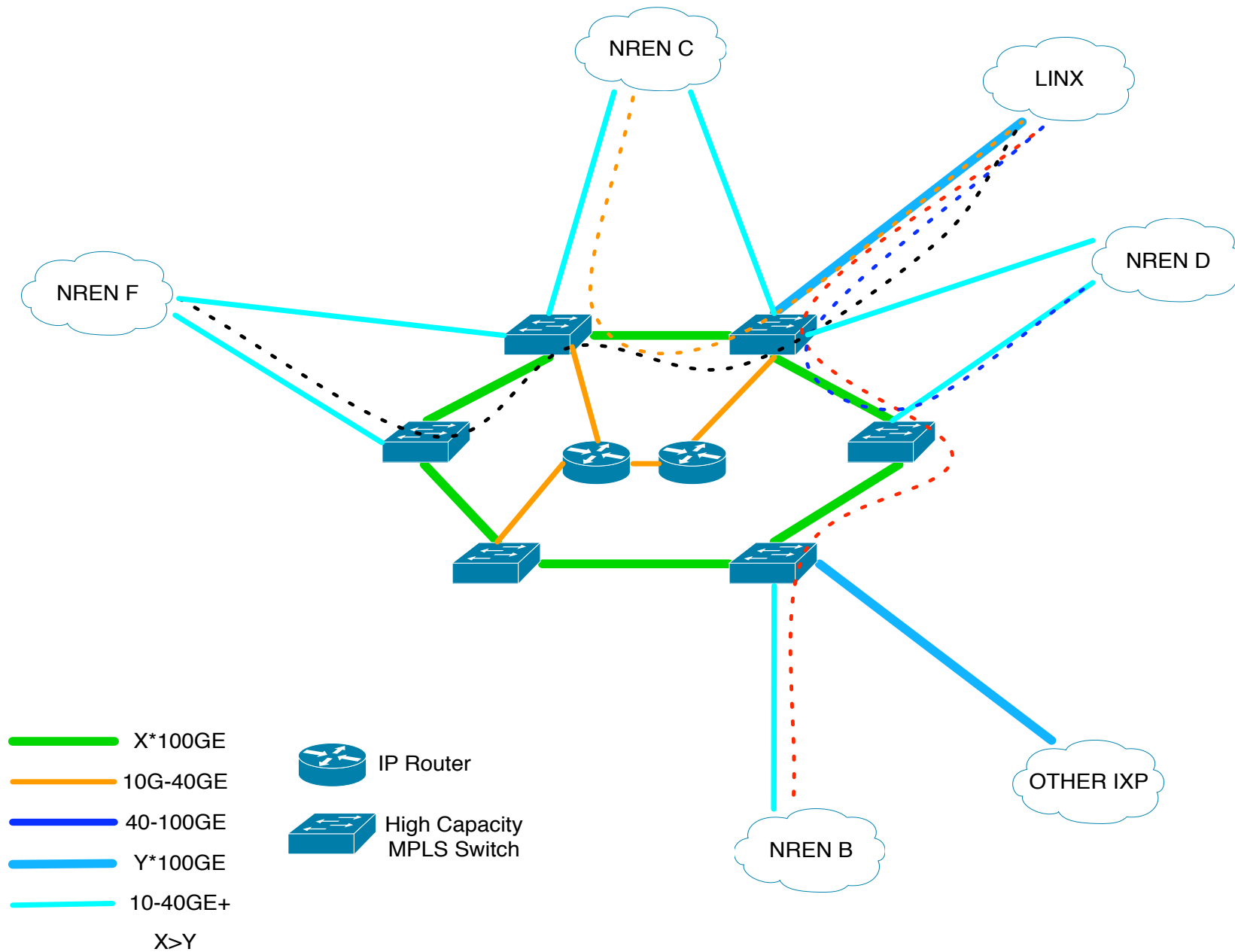
Parallel networks sharing the same substrate

Each user's IP network is represented by a different color

Each router instance can be temporarily owned by a different user (router instances offered as IaaS)

IP Networks can be made of router instances from different providers





- OSCARS trial
 - Trial installation service towards Nordic NRENs / users
 - Dedicated 10G Nordic transport w/Juniper MX80s
 - Interconnect with partner networks over NORDUnet shared IP
- AutoBAHN trials
 - Trial installation on Alcatel-Lucent TSS
 - Part of GN3 SA2
 - Interconnect with GN3 service area AutoBAHN
 - Support IDC, interconnect with OSCARS platform
- GLIF Dynamic GOLE trial
 - On-Demand GOLE service
 - User trials & demos
- MANTICORE FP7 - Use Case focus

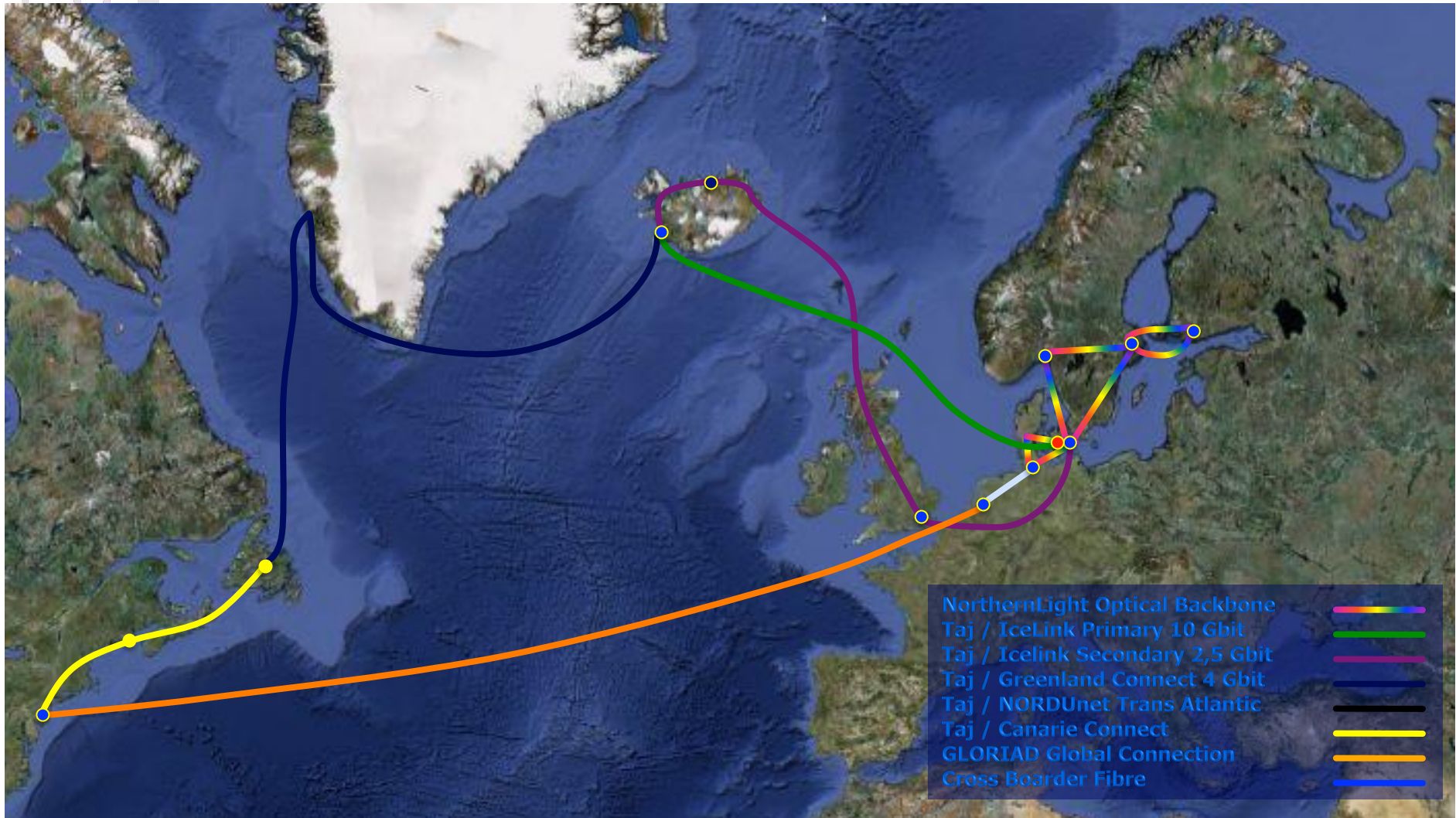
- AutoBAHN
 - Leads GN3 SA2 Task 1 – AutoBAHN service definition
 - AutoBAHN identity management
- OGF NML, NSI groups
 - Network Services Interface definition, topology exchange, path-finding, etc.
- MANTICORE
 - Defining and Deploying IaaS at Layer 3
 - Focus on operations, deployment
- OSCARS (+DRAC)
- GLIF (on-demand) GOLE evolution



- **Iceland:**
 - Local infrastructure – in progress
- **Greenland:**
 - Breakout extremely expensive – politics
 - Local infrastructure
- **Faroe Islands (Føroyar):**
 - Breakout in Negotiation
- **Northern Scandinavia**
 - UNINETT, SUNET, FUNET dark fiber builds
 - Northern interconnect, joint service for remote areas
- **Overall Strategy**
 - Community efforts
 - Federation of resources
 - Virtualization for integration of services

- Bridge the Digital Divide
 - Adequate & Sustainable access to Iceland
 - Option for future Expansion into Greenland
 - Option for future expansion into Faroe Islands
- Link North Atlantic Region
 - Europe, Russia, North America
- Provide alternate route across Atlantic

- Project Partners
 - NORDUnet – Nordic countries
 - National Science Foundation – USA
 - CANARIE – Canada
- Project Cost: 1 M€ / Year
 - Split 3:1:1
- Contributes to
 - GLORIAD / TAJ infrastructure
 - NORDUnet general service infrastructure

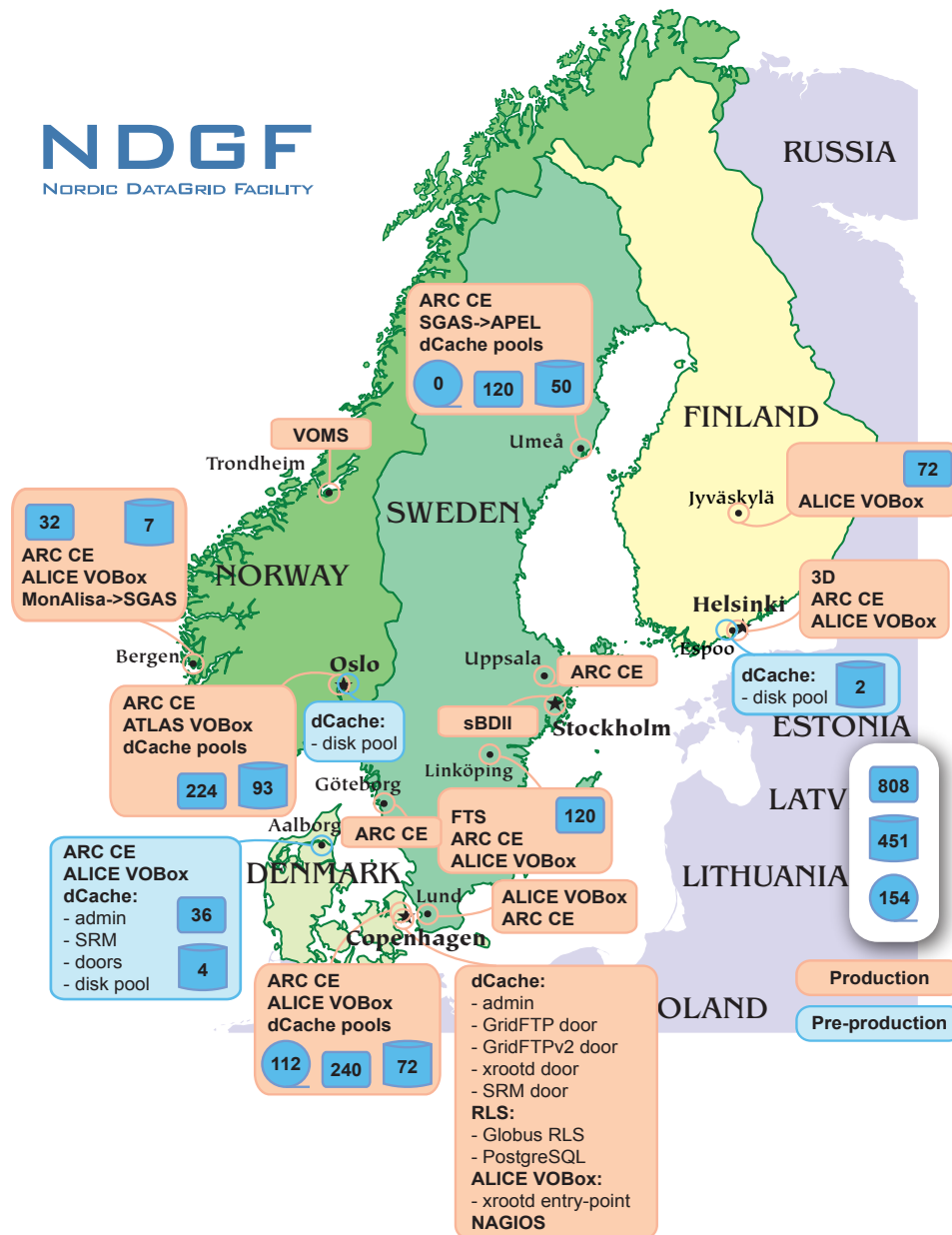


- Dual-route trans-Atlantic connection
 - Currently 10G + 4G – more to come
- Services
 - Shared IP
 - EoMPLS
 - 1G Ethernet over SONET
- NORDUnet router in New York City
 - Shared IP peering
 - Interconnect with North American E2E service providers

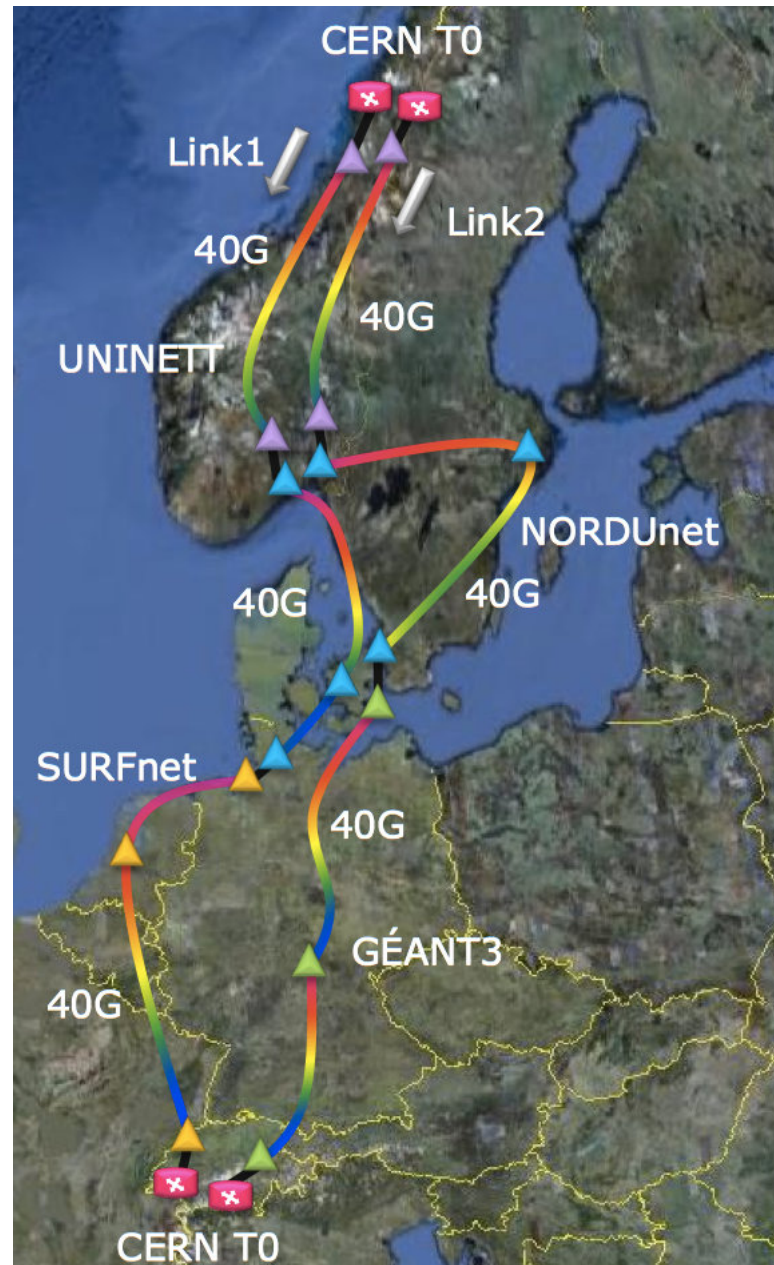
- Distributed Tier-1
 - An HPC centre with longer Ethernet cables
 - A federated HPC centre – resources from 5 countries, many local HPC centres
 - Managed and operated by Nordic Data Grid Facility
 - Distributed, Federated operations team
- Networking by NORDUnet and Nordic NRENs
 - 10GE star network, centered in Copenhagen
 - LHCOPN connection to T0 (CERN) and NL-T1 (Amsterdam)

NDGF

NORDIC DATAGRID FACILITY



- European T1-T1 and T1-T2 trial
 - Based on AutoBAHN
 - NDGF, DE-KIT, NORDUnet, DFN, DANTE...
- Trans-Atlantic T1-T2 traffic trials
 - Based on OSCARS
 - Possibly with GLIF Dynamic GOLE trial
- NORDUnet can facilitate trans-Atlantic E2E on-demand
 - Between NORDUnet router POPs



- Federate where possible
 - Inter-Nordic CBF
 - Partner with neighbors
 - Use NREN owned and operated transport
 - Virtualize for management of multi-domain services
- Extended footprint routed network
 - Cost – maximize peering
 - E2E interconnect, Participate in E2E trials
 - Shared IP quality
- Extended footprint transport network?
 - E2E services

- State-of-the-Art regional network
 - OPN and Virtualization capability
 - Dynamic E2E service capability
- High-performance
 - Optical Core
 - E2E and IP service layers
 - MPLS core overlay, pushing intelligence to the edge
- Interconnect – IP and E2E services
 - Region
 - Europe – GÉANT
 - Trans-Atlantic & North-Atlantic infrastructure
 - Global partnerships

NORDUnet

Nordic Infrastructure for Research & Education

NORDUnet

<http://www.nordu.net>

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