



# Transatlantic Connectivity in LHCONE

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# Transatlantic Capacity for LHCONE



- Agreed in Lyon that the prototype implementation will be done using existing resources, made available for that purpose by the partners
- These resources have varying characteristics, and based on that could be used for implementing different LHCONE services
- Challenge: build a system which is meaningful as initial LHCONE, which can be built out to scale without the need to redesign
- These slides try to summarise the current state of discussion on the initial LHCONE deployment across the Atlantic



# INITIAL IMPLEMENTATION

aka Prototype



# 3 Services, Brief Overview



- **(Context: Transatlantic Links)**
- **Static point-to-point**
  - Can be implemented, resources identified
- **Dynamic point-to-point**
  - Future service
  - Several transatlantic links do or will support dynamic allocation
- **Multipoint-to-multipoint**
  - First service to be deployed
  - Main focus of activity



# TRANSATLANTIC PROVIDERS



- **America Connects to Europe**
  - NSF/IRNC funded project, 5 years, starting 2011
  - First links expected in operation in August 2011
  - Continues existing IRNC Chicago-Amsterdam link (Starlight-Netherlight)
  - Partners with GEANT in Europe for reciprocal capacity
- **ACE supports all scientific activity and applications between Europe and North America.**
  - General Purpose, routed capacity
  - Circuit capacity (static and/or dynamic)
- **Currently foreseen links:**
  - 2x10 Gbps for routed connectivity: NYC-Amsterdam & DC-Frankfurt
    - Could contribute best effort capacity
  - 10 Gbps for circuit services: Starlight-Netherlight
    - Available for circuit services (general, LHCONE and other projects)



- **DANTE managed capacity (foreseen):**
  - **2x10 Gbps for routed connectivity: NYC-Amsterdam & DC-Frankfurt**
    - Could contribute best effort capacity
  - **10 Gbps for circuit services: NYC-Paris (current) -> ?-? (foreseen)**
    - Available for circuit services (LHCONE and other projects)
- **Other GEANT collaborators operate other transatlantic links, the use of these resources was not discussed**



# US LHCNet

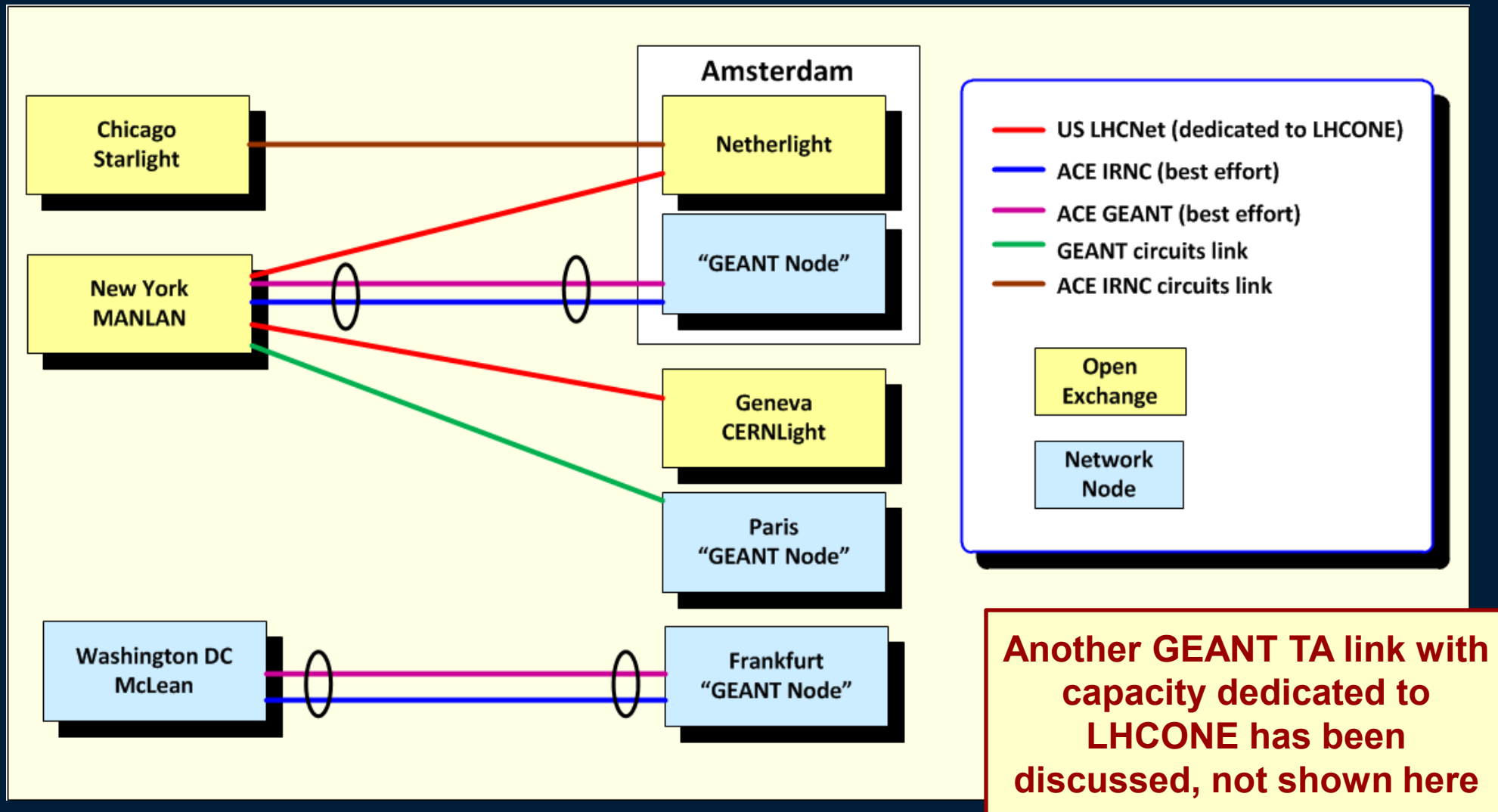


- DOE/OHEP funded program
- **US LHCNet mission is to support US HEP research with focus on the LHC program**
- Provides CERN-BNL and CERN-FNAL links (LHCOPN)
  - In collaboration with ESnet
- Provides capacity for Tier1-Tier2 transatlantic LHC data movement
- **Currently 6 x 10Gbps transatlantic links**
  - Highly resilient configuration (Layer 1 mesh protection)
  - Flexible capacity partitioning
  - 4 x 10 Gbps allocated to Tier0 – Tier1
- **US LHCNet can contribute dedicated capacity, also IDC-managed, to LHCONE**





# Transatlantic Links Discussed for Initial Deployment

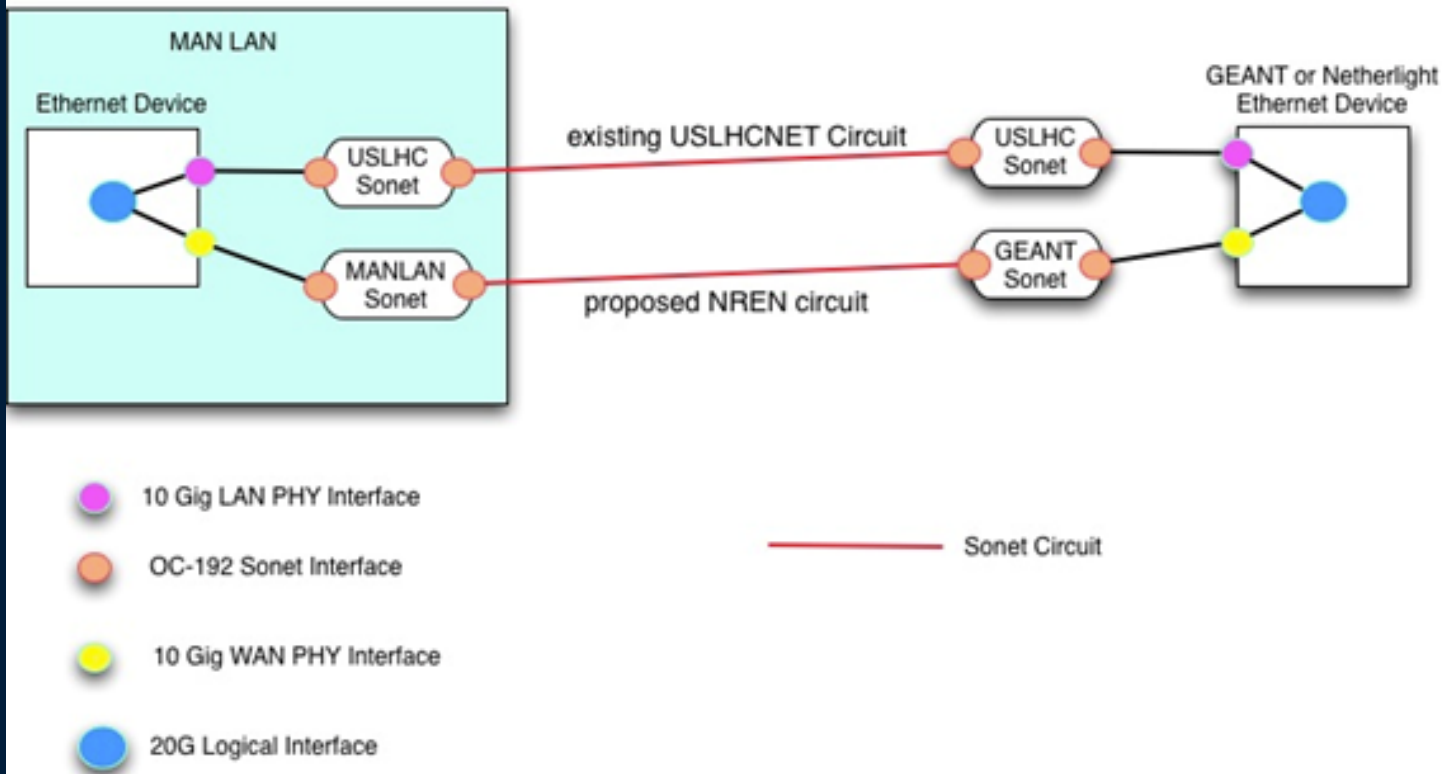




# Multipoint Service with Dedicated Capacity; technical



Using multiple providers of dedicated circuits;  
Ethernet LAG on both ends;  
Assuming NYC-Amsterdam



“Any” number and combination of links and providers as long as they end on same pair of Ethernet devices



# Multipoint Service Challenges



- (not just transatlantic)
- **Spanning Tree**
  - Not good at large scale
  - Constrains topology, and the use of resources
  - -> no STP, design tree topology carefully
    - that's what also PBB-TE does
    - Topology constraints remain
- **Broadcast Storms**
  - Potentially dangerous in large Layer 2 networks
  - But LHCONE does connect routers, not end-hosts



# Multipath



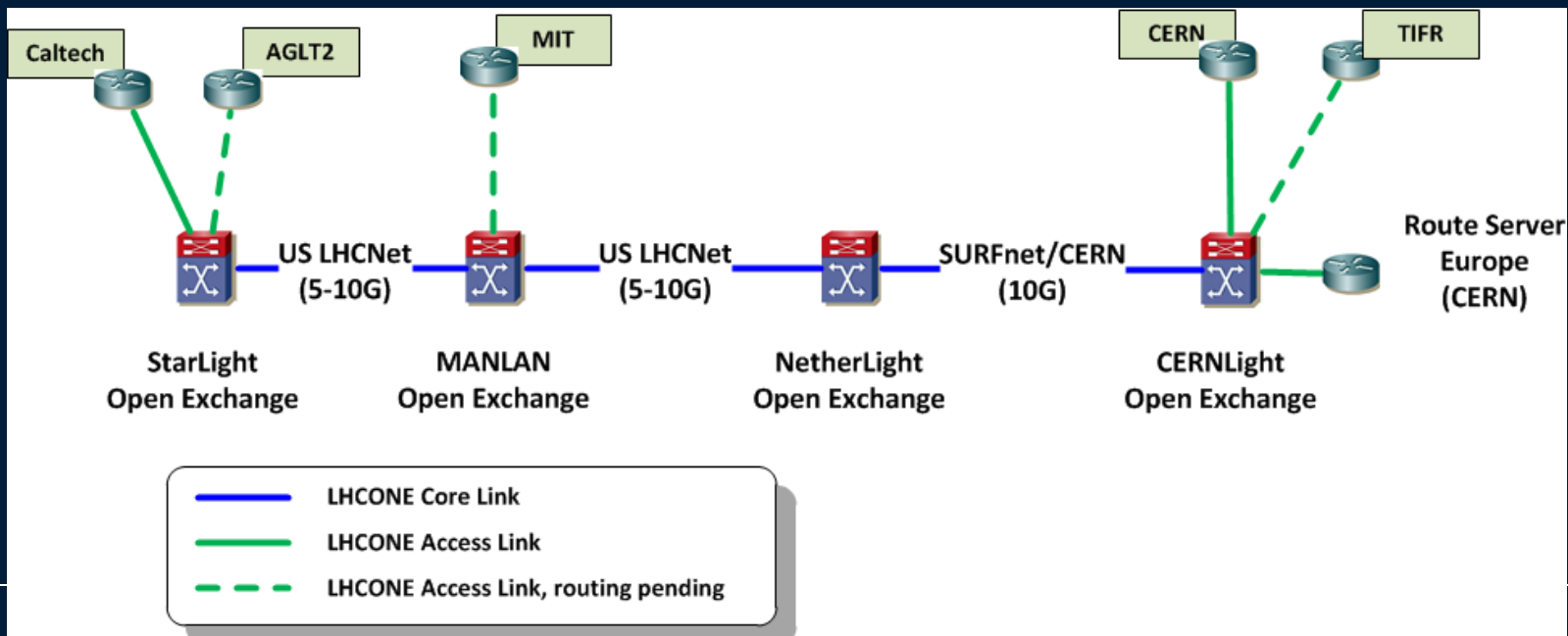
- **The constraint of a tree topology will have to be overcome**
  - Scalability
  - Resilience
- **Two standards in working, both have support in industry:**
  - SPB (IEEE 802.1aq)
  - TRILL (IETF)
- **But will need to be also deployed at the Open Exchange Points**
  - Time scale?



# Multipoint: What we have running today



- **Interconnected CERN and Caltech**
  - CERNLight – NetherLight – MANLAN – StarLight
  - SURFnet: 10 Gbps GVA-AMS
  - USLHCNet: 5 Gbps AMS-NYC
  - USLHCNet: 5 Gbps NYC-CHI (temporary, see previous presentation)
- **AGLT2, MIT have vlan 3000 extended, waiting for green light to enable routing**





# Summary



- **Point-to-point services**
  - Static p2p: OK
  - Dynamic p2p: will be available in the future, dependency on terrestrial deployment
    - USLHCNet: ready (OSCARS based system deployed)
    - ACE: will be available in the future
- **Multipoint service**
  - Work in progress, mainly on aggregation of circuits from USLHCNet and ACE
- **In the meantime, multipoint service across the Atlantic is provided by US LHCNet**
  - With SURFnet/CERN in Europe



# QUESTIONS AND DISCUSSION...

<http://lhcone.net>

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