



ESnet

ENERGY SCIENCES NETWORK

ESnet Extension to Europe (EEX)

LHCOPN Meeting
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U.S. DEPARTMENT OF
ENERGY
Office of Science



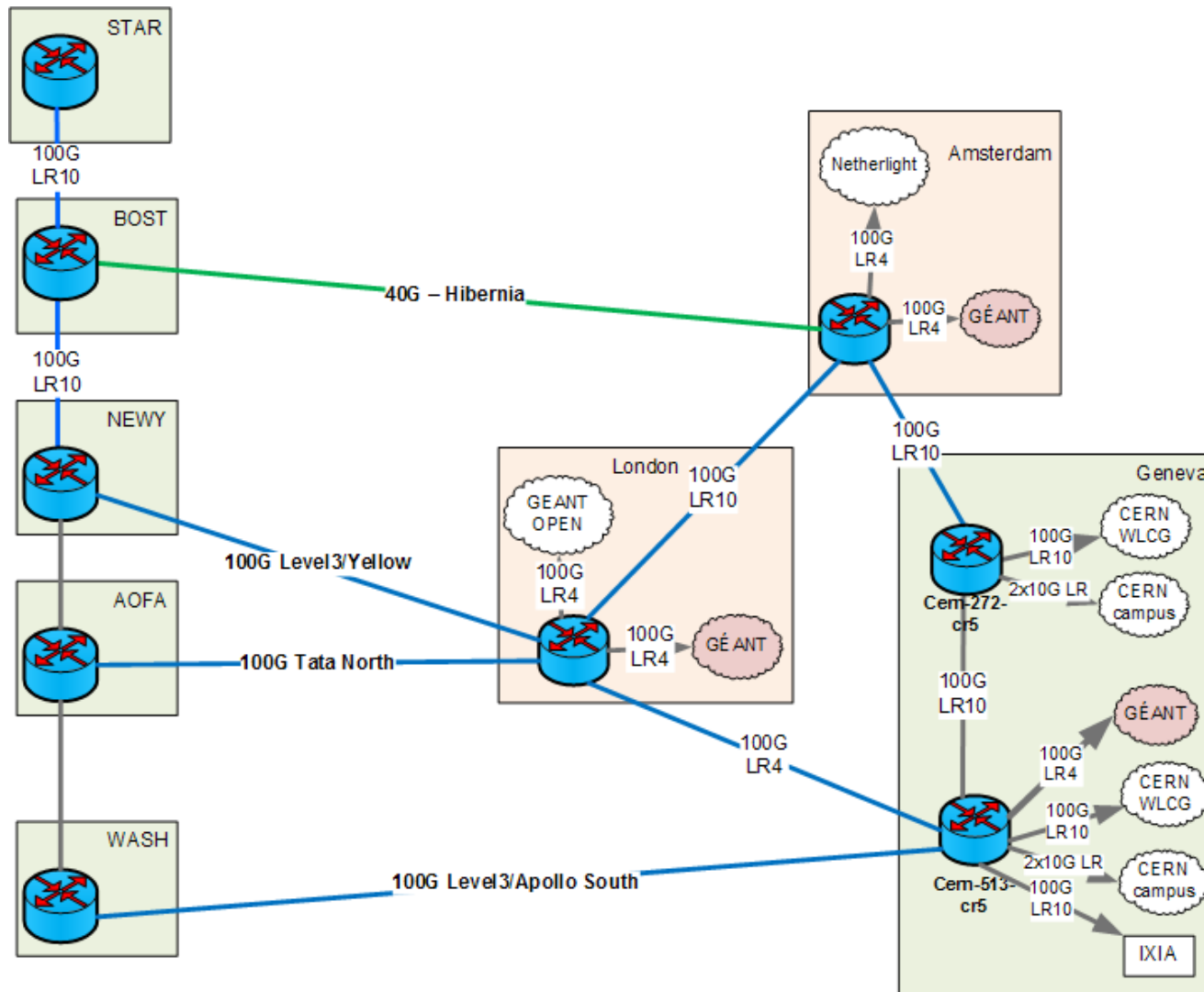
Talk Outline

- EEX Architecture
- EEX Services
- Timeline

EEX - Expansion of the ESnet network into Europe

- Drivers: Improve the quality and quantity of transit for science traffic to Europe for:
 - **All currently supported ESnet programs**
 - US LHC science
- EEX extends ESnet5 architecture to new geography
 - New Hubs
 - London, Amsterdam and 2 at CERN
 - Each contains 1 Rack with ALU, perfSONAR & management infrastructure
 - New Links
 - 100G European Ring - AMS-CERN1, CERN1-CERN2, CERN2-LOND, LOND-AMS
 - 100G Transatlantic - WASH-CERN, AOFA-LOND, NEWY-LOND
 - 40G Transatlantic - BOST-AMS
 - All links will be circuit services from other providers, no ESnet WDM systems.
 - Peering connections to GEANT, Netherlight & London Open.
 - Upgrading Boston: add 100G Router, remove 10G router, cut into Chicago to NYC 100G wave currently expressing through Boston, pull out 40G domestic waves to Boston.

EEX Architecture

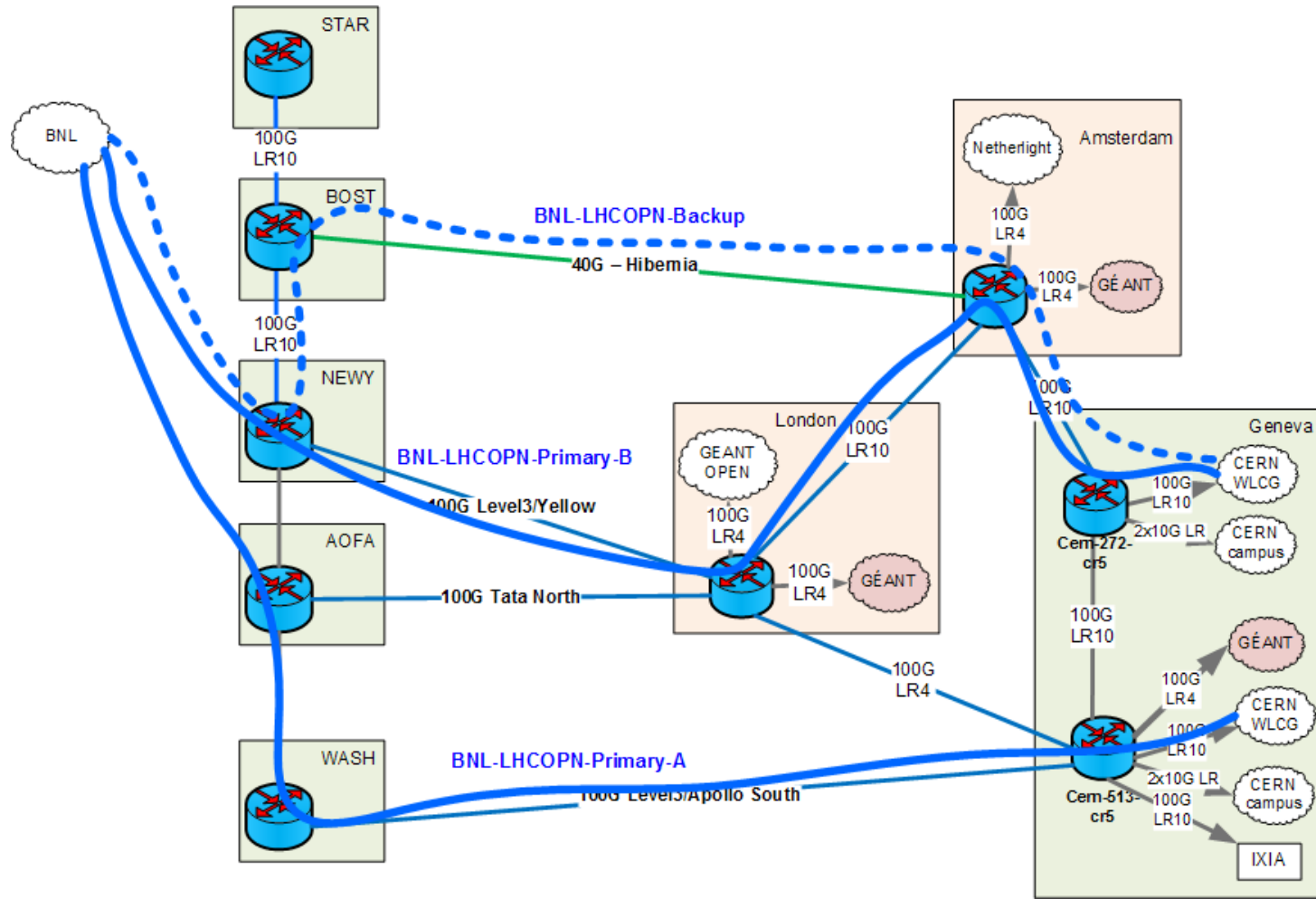


LHCOPN Services

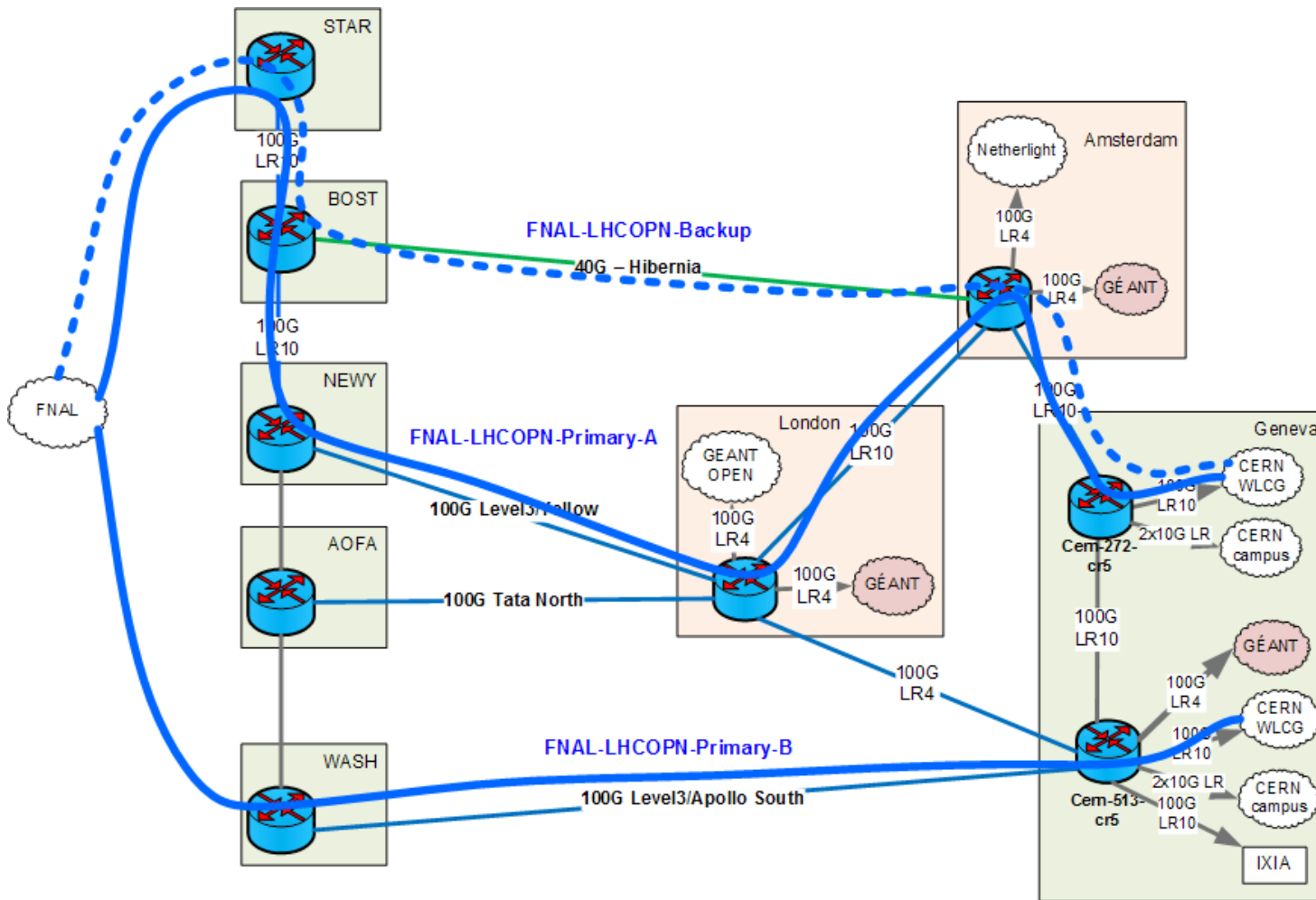
- Interim LHCOPN Services
 - 10G for BNL & FERMI
 - Turned up as soon as some infrastructure is available to provide early access
- LHCOPN-Primary-A & LHCOPN-Primary-B for both BNL and FERMI
 - 20G of reserved capacity per virtual circuit (40G per lab)
 - Paths for each circuit will be explicitly routed, and will not re-route on failure
 - This provides an immediate signal to the end sites if there are any outages.
 - Paths for BNLs virtual circuits will be completely diverse across EEX
 - Paths for FERMI's virtual circuits will be completely diverse across EEX
- BNL-LHCOPN-Backup & FNAL-LHCOPN-Backup
 - 10G of reserved capacity
 - Routed across 40G TA link by default, so no bursting above 40G.
 - Path will automatically re-route across any available link.

- FERMI also has a couple of lower-bandwidth virtual circuits that are technically part of LHCOPN, including circuits to DE-KIT, NL-T1. These will be re-routed over the new infrastructure when the appropriate paths are available.

BNL LHCOPN Virtual Circuits



FERMI LHCOPN Virtual Circuits



LHCONE Services

- Current Services
 - BNL, FERMI & SLAC are 'ESnet customers' and are provided transit to all other LHCONE participants domestic and international.
 - Numerous networks and US Universities are 'ESnet peers' and are provided transit only to ESnet customers.
 - PerfSONAR measurement servers deployed in the ESnet LHCONE instance in Chicago and New York.
 - ESnet LHCONE service relies on ACE/GEANT and other providers for all international transit.
- Expanded Services
 - No changes for BNL, FERMI or SLAC.
 - Some US Universities LHC centers will be treated as "ESnet customers". ESnet will provide transit for them to all other LHCONE participants. This includes transit between US Universities.
 - PerfSONAR measurement servers deployed in the ESnet LHCONE instance in Chicago, New York, and Geneva.
 - ESnet LHCONE service will rely on ESnet resources for transit to international partners in Europe.
- Future Services
 - Dynamic Point to Point?

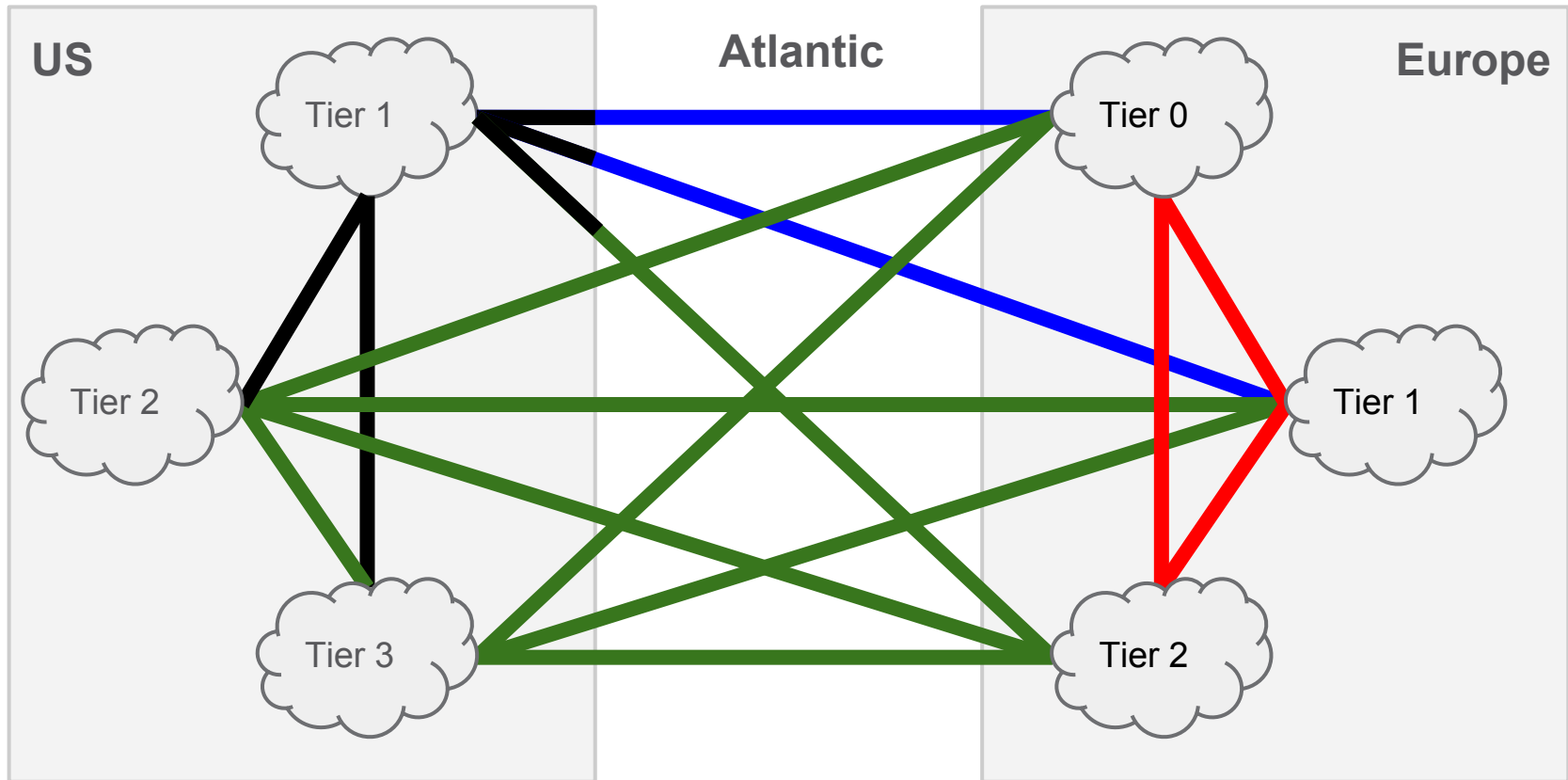
Draft Automatic* Service Levels During Various Worst Case Circuit Outage Scenarios

	All Circuits Up		1 Circuit Down		2 Circuits Down		3 Circuits Down	
Service	Reserved BW	Peak BW	Reserved BW	Peak BW	Reserved BW	Peak BW	Reserved BW	Peak BW
LHCOPN BNL	40	200	20	100	20	40	10	40
LHCOPN FERMI	40	200	20	100	20	40	10	40
LHCONE	120	200	60	100	50	100	10	40
ESnet IP	100	100	100	100	50	100	10	40
Circuits A: 40G BOST-AMS B: 100G NEWY-LOND C: 100G AOFA-LOND D: 100G WASH-CERN	A: Other B: LHCOPN/LHCONE C: ESnet IP D: LHCOPN/LHCONE		Similar if B or D fail A: Other B: Down C: ESnet IP D: LHCOPN/LHCONE		Both B&D Fail A: LHCOPN B: Down C: ESnet IP & LHCONE D: Down		B, C & D Fail A: All Services B: Down C: Down D: Down	

* Service levels during extended outages will be monitored and manually adjusted if necessary.



Expanding ESnet to Support US LHC Science



BLACK = Historical ESnet Scope

RED = Out of Scope

BLUE = Now in Scope via EEX LHCOPN

GREEN = Now in Scope via EEX LHCONC



Expanding the ESnet User Base

ESnet will provide connectivity directly to CERN with the following limitations

- ESnet will provide transit from CERN to the US R&E community, including US Universities
- ESnet will not provide transit from CERN to the European R&E community
- ESnet will not provide transit from CERN to the commodity Internet

US Universities

- ESnet will carry LHC traffic between some US Universities
- ESnet will carry LHC traffic between some US Universities and Europe
- This will be implemented by connecting Universities to ESnet's LHCONE VRF

General Process for University LHCONE Connections

- Universities will have to meet ESnet at an existing 100G ESnet Hub
- Universities will have to agree to comply with DOE, ESnet & LHCONE policies & best practices for traffic exchanged with ESnet
- Implementation Order
 - US LHC Management will generate a list considering science impact
 - ESnet will evaluate the list for ease of implementation
 - Final order will take both criteria into account
- ESnet will control the rate, timing, and number of connections
 - Constrained by ESnet staff workload and network capacity
- Implementation will not start until the EEX physical build is mostly done.



EEX Anticipated Timeline

- May - August 2014
 - Procurements
 - Equipment
 - European Ring & Colocation Space
 - Transatlantic Circuits
 - Ship ALU Router, Ixia & misc hub equipment to CERN
 - Relocated 1 engineer to CERN
- September - October
 - Ship remaining equipment to CERN, London & Amsterdam
 - Install all 4 POPs (First CERN POP done!)
 - Start turning up circuits
- October - December
 - Turn up service to BNL, FERMI & CERN
 - Finish turning up circuits
- Starting in January 2015
 - Turn up LHCONE services to Universities

