**U.S. CMS**

**Compact Muon Solenoid**

**Operations Program**

**Quarterly Report**

**for the**

**Period Ending March 31, 2015**



# Report of U.S. LHCNet on Transatlantic Networking

1. **Phase I: Decommissioning and transition of the transatlantic production network services to ESnet EEX**

This report provides an update on the migration of the US LHCNet provided transatlantic production services to ESnet EEX project. This includes an update on the equipment decommissioning process at the various points of presence and the migration of services for the future collaboration and projects.

During December 2014, US LHCNet team worked with ESnet and the CERN network operations center (NOC) for the circuit migration and failover testing of the LHCOPN circuits between CERN and Fermilab, and CERN and BNL. This process involved shutting down the transatlantic circuits one by one within the US LHCNet domain and shifting the services over to the ESnet network. The testing process went smoothly, with no apparent issues or outages. On December 8th, all the paths carrying LHC traffic were switched over to ESnet. The LHCONE service between Internet2 and CERN through Amsterdam was decommissioned close to the end of December.

The US LHCNet team is currently involved in the process of coordinating, decommissioning and shipping the equipment installed at various remote Co-location sites. The decommissioning schedule as of this writing is as below:

1. Amsterdam January 8-9 (completed)
2. New York January 20-21
3. Chicago January 22-23

The Amsterdam PoP has been cleared and all the equipment is in the process of being shipped to Caltech. The equipment from New York and Chicago will be shipped back to Caltech as per the schedule. The rack locations in remaining two PoPs will be cleared to avoid any further charges.

As mentioned in the relevant statement of work, during the 4-month period of service migration, the US LHCNet group at Caltech is working on the following deliverables and/or effort to the Operations Programs:

1. Transition completion from US LHCNet to ESnet EEX production services, including teardown of the final circuit on January 22nd.
2. Meeting the contractual obligations with Level3 followed with plans to decommission the US LHCNet optical multiplexers and other equipment that is no longer needed at the CERN, Amsterdam, New York and Chicago points of presence, shipping or storing the equipment as needed.
3. Transitioning to a development oriented configuration leveraging the Brocade, Pronto and Dell/Force10 switches at these PoPs as well as Caltech. The team will perform the reconfiguration of the equipment and network routes for the follow-on phase of the Caltech network team working together with ESnet, other R&E networks, university teams and lab teams at Fermilab and Brookhaven. The latter is to support future ongoing technical developments of software-defined networking, dynamic circuits, and state of the art high throughput data transfer methods in partnership with ESnet.

This decommissioning work will close out the US LHCNet project and there will be no further cost to the Operations Programs related to US LHCNet transatlantic production services past April 30, 2015.

1. Phase II: Joint R&D and developments for the LHC experiments

The Caltech team and ESnet are continuing joint research projects in the context of ANSE (Advanced Network Services for Experiments) and LHCONE, as well as new initiatives on the future Internet architectures in the context of future evolution of the LHC Computing Models. A talk on the ANSE project, its integration with PhEDEx to provide network aware point to point services to the experiments is scheduled for the LHCONE conference in February 2015.

In association with the foreseen program, arrangements are underway for a modest allocation of continued rack space for servers and software defined network switches at CERN, and Starlight in Chicago. We are also discussing an allocation in Amsterdam and the SURFnet/SARA PoP. In all cases, there will be no co-location costs. We will of course use the equipment and 100 Gbps link at Caltech, funded by the NSF CHOPIN project together with support from the California regional network CENIC.

Several of the following areas of work will be closely coordinated with ESnet to ensure a smooth transition, and to define the joint development program for Phase II from May 1 2015 onward, together with the LHC experiments, and Fermilab, CERN and BNL in particular.

* Continuing the work on the use of dynamic circuits, monitoring and software-defined network control. This includes, in the near term, bringing the use of PhEDEx with OSCARS dynamic circuits into pre-production use among a limited set of sites, and adapting the use of the circuit mechanisms and some of the code in PhEDEx to PanDA for ATLAS.
* The application-side (PhEDEx, PANDA) work for this is supported mostly by the NSF ANSE project, but the network configuration, operation and testing work will be done in the context of the Caltech Network Development program.
* Continued work to develop point-to-point circuits in the context of LHCONE. This will build on the PhEDEx and PanDA work cited above, in order to provide improve data transfer performance, and more predictable time to completion for dataset transfers.
* Continued software-defined network development in the context of Open Daylight. This is targeted at the selection of optimal paths across the complex networks used by the LHC experiments for sets of flows, taking into account other traffic in progress and other pending requests. This will result in better load balancing, especially during periods of intensive network use.
* Another aspect of this is to couple these control mechanisms with comprehensive monitoring, to moderate the aggregate use by the LHC experiments, so as not to saturate the available network infrastructure or overly impede other network traffic.

Several of the above Phase II items have been demonstrated successfully at the Supercomputing 2014 conference last November. The work areas will serve to bring these to a pre-production state this year, followed by the development of production services on an increasing scale during LHC Run2.

A complementary line of ongoing development is focused on state of the art systems for high throughput data transfers at moderate cost, adapting to the rapid progress in both networks and network interfaces, as well as server architectures matched to the current generation of 100 Gbit/sec links.

Further specification and definition of the work areas and deliverables of the Phase II Caltech network development plan, in close coordination with ESNet and the LHC experiments.