Esnet4 - The Next Generation ESnet

ESnet has just announced a major expansion of its network, which is the 4th generation of ESnet since its inception in 1986. Esnet4 is being built on a national optical infrastructure that is the result of a partnership with Internet2, which has contracted with Level3 Communications for a dedicated fiber footprint that covers most of the US.

ESnet and Internet2 have signed a Memorandum of Understanding that expresses the shared goal of building a large-scale and robust US R&E network infrastructure, and provides for joint development of circuit based services. A secondary goal will be to explore the mutual backup of each other's network operations for disaster recovery purposes. ESnet will have a certain number of dedicated, 10Gb/s optical circuits on the Internet2 Network and ESnet will use these circuits to interconnect its routing and switching equipment in order to build the ESnet IP network and the new ESnet circuit-oriented Science Data Network.

This expansion and partnership is to facilitate ESnet's primary mission of serving the science programs of DOE's Office of Science (SC). ESnet also continues, as part of its overall mission, to provide network services to all of the other large DOE Labs. There are about 10 large scale science programs that ESnet has characterized so far that will result in major amounts of network traffic – of order petabytes per year. The LHC is one of those projects, and is a bit ahead of the others, but there are several others that are expected to generate comparable amounts of network traffic within the next several years. It is such science projects that provide the primary motivation for ESnet4.

The job of ESnet is to connect the DOE Labs and facilities to the collaborating science community. ESnet is an intra-US network which provides direct connections to DOE Labs and facilities on one end, and, for the most part, to R&E network peering points on the other. One of ESnet's roles in the research and education (R&E) networks that it connects to, especially the ones that carry large amounts of Office of Science (SC) traffic, has been to encourage those networks to provide redundant connections at diverse locations, and then to ensure that ESnet has a high-speed presence at those locations. Most recently, ESnet built out its previous generation 10Gb/s infrastructure to Washington, DC in order to connect to the second GÉANT 10Gb/s US connection. (GÉANT, which is the network that serves the European R&E community, is currently ESnet's largest general science peering partner in terms of traffic volume.) ESnet4 provides multiple 10Gb/s connections to all current US R&E peering points, as well as to several other locations in the US that may be used in the future.

In the spirit of maximizing the R&E connectivity for DOE sites, ESnet will generally connect to, and/or peer with, any network that is of direct interest to DOE. For example, as indicated in the attached roll-out plan, ESnet has planned the connectivity for the US LHC Tier1 Centers (both of which are DOE/SC sites) to correspond with the roll-out plan of USLHCNet, which provides a very high-speed, ring-structured, network connecting the LHC at CERN, MAN LAN in New York, and Starlight in Chicago. (USLHCNet is a project of Caltech and the DOE/SC High Energy Physics Program.) If there are other USLHCNet connections that are needed, including Layer 3 peerings, ESnet will facilitate those as well. ESnet is also working with the LHC OPN (network planning) group in looking at various tertiary fall-back paths for LHC traffic.

Within the US, ESnet has multiple high-speed connections to Internet2's Abilene network, and will have even more to the new Internet2 Network in order to ensure the best possible connectivity of DOE sites to the US university community. ESnet has also established direct connections to some US RONs (Regional Optical Networks), and a few individual campus sub-nets, in order to address specific

requirements such as the LHC T1-T2 traffic patterns and the experiment sites of the DOE/SC Magnetic Fusion Energy program. Internet2 also recognizes these needs and is working with the RONs and universities to ensure optimal high-speed connectivity for the LHC and other large-scale science projects.

As noted, while SC is the major stakeholder in ESnet, all of the large DOE/NNSA labs and several other DOE labs (INL/INEEL, NREL, etc.) are also important ESnet stakeholders. As can be seen in the current roll-out plan, these sites have been taken into account in ESnet4, with the same sort of redundant connectivity (or the potential for future redundant connectivity) as the SC Labs.

Attached is the Esnet4 roll-out plan as it currently stands. This is based on a spending profile that is driven by the Office of Science's current budget estimates for ESnet. This plan will be presented at the LHC OPN meeting in mid-Sept., 2006, and will be posted on the ESnet Web site.

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ESnet is a DOE Office of Science facility operated by the University of California's Lawrence Berkeley National Laboratory.