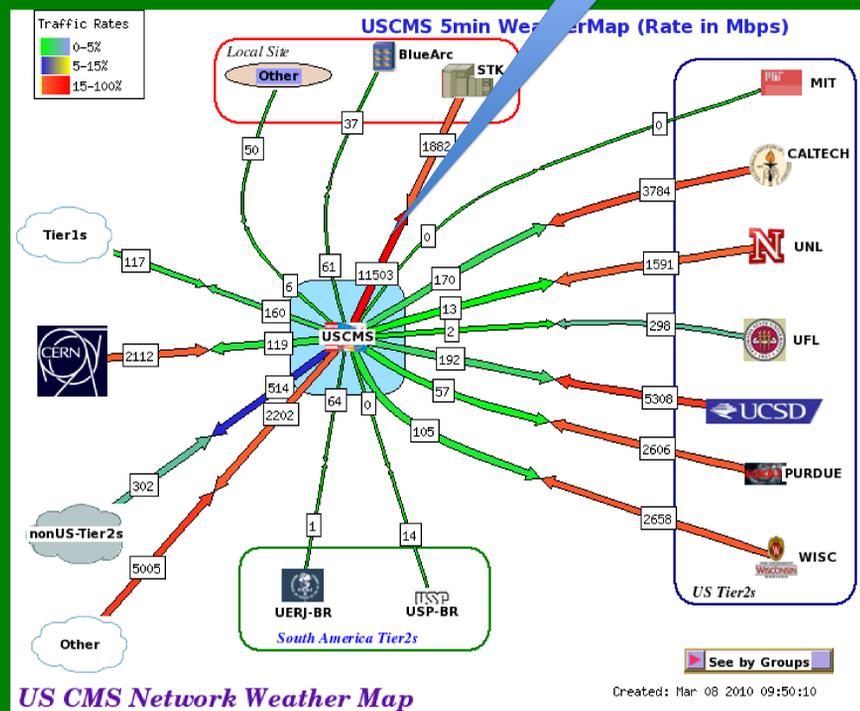


Networks For Petabyte Data Movement

Wide Area Network: from/to CERN (Tier-0), Fermilab(Tier-1) & the Universities (Tier-2 and Tier-3) for the CMS experiment

Data I/O Rates in Mb/Sec.
Links that are Red are reaching Saturation.
Monitoring can be automatically linked to alarm systems,

Writing data to tape at 11 Gigabits/sec



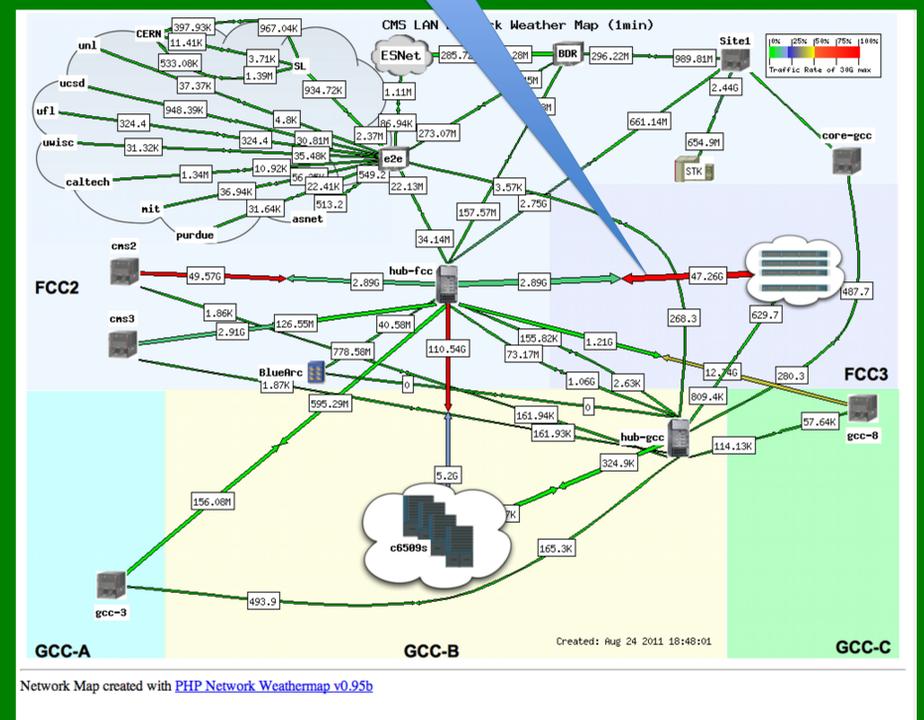
The Fermilab network infrastructure supports round-the-clock science data movement of more than 1/2 Petabyte a day onsite and to/from offsite.

The site is connected to ESNET via 8 10Gigabit links

Monitoring is essential to ensure timely response to problems and to diagnose problems.

Local Area Networks: Internal to the Fermilab and University Sites

47 Gigabits/sec written back from the production systems



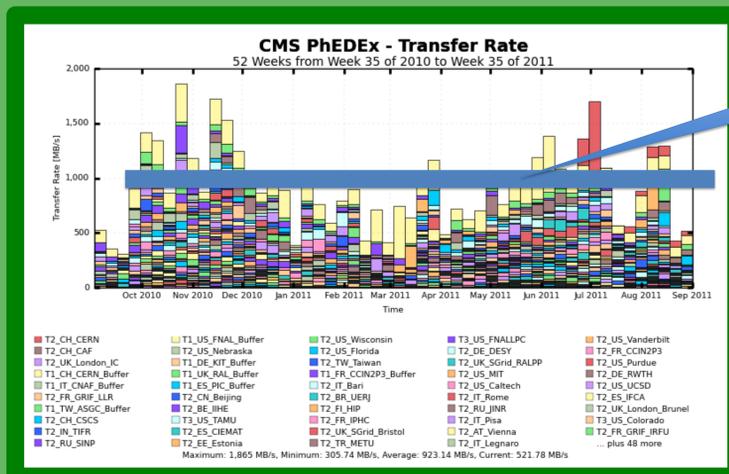
LHCNet Driving International Network Bandwidths.

Year	Production	Experimental	Remarks
2001	0.155	0.622-2.5	SONET/SDH
2002	0.622	2.5	SONET/SDH DWDM; GigE Integ.
2003	2.5	10-20	DWDM; 1 + 10 GigE Integration
2005-6	10-20	2-10 X 10	λ Switching; λ Provisioning
2007-8	3-4 X 10	~10 X 10; 100 Gbps	1 st Gen. λ Grids
2009-10	6-8 X 10	~20 X 10 or ~2 X 100	100 Gbps λ Switching
2011-12	~20 X 10 or 2 X 100	~10 X 100	2 nd Gen λ Grids Terabit Networks
2013-5	~Terabit	~MultiTbps	~Fill One Fiber Paralleled by ESnet Roadmap for Data Intensive Sciences

Worldwide CMS Data Movement



Fermilab connects to the ESNET production networks through the Chicago Metropolitan Area Network (MAN); ANL/FNAL provide ESnet with 10 gigabit channels; ESnet provides ANL and FNAL enhanced Layer 2 services.



Each color is different site (Lab or Universities)
Data is distributed 365 days 24x7
Each link is commissioned and checked for quality continuously..

Gigabyte/Second



Fermilab is a member of Internet2 collaborating in the support of data movement monitoring for US and offshore universities.