Computing This Decade and Next: Our Vehicle to the Endless Frontier.

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Fermilab

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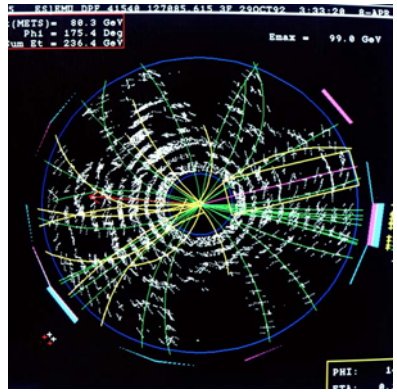
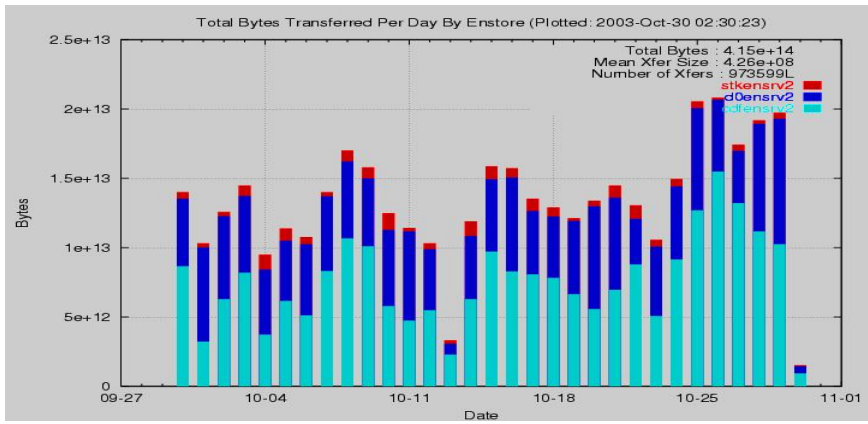
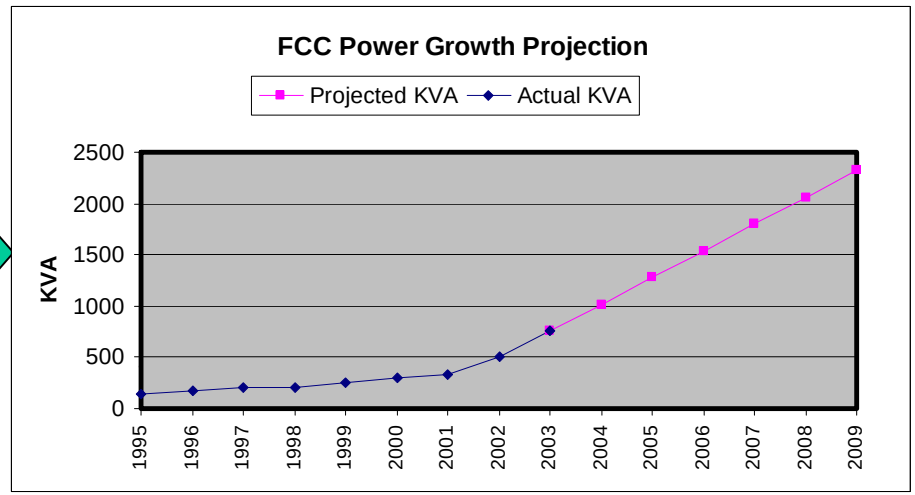
Computing in our Scientific Program Today: Inner Space.



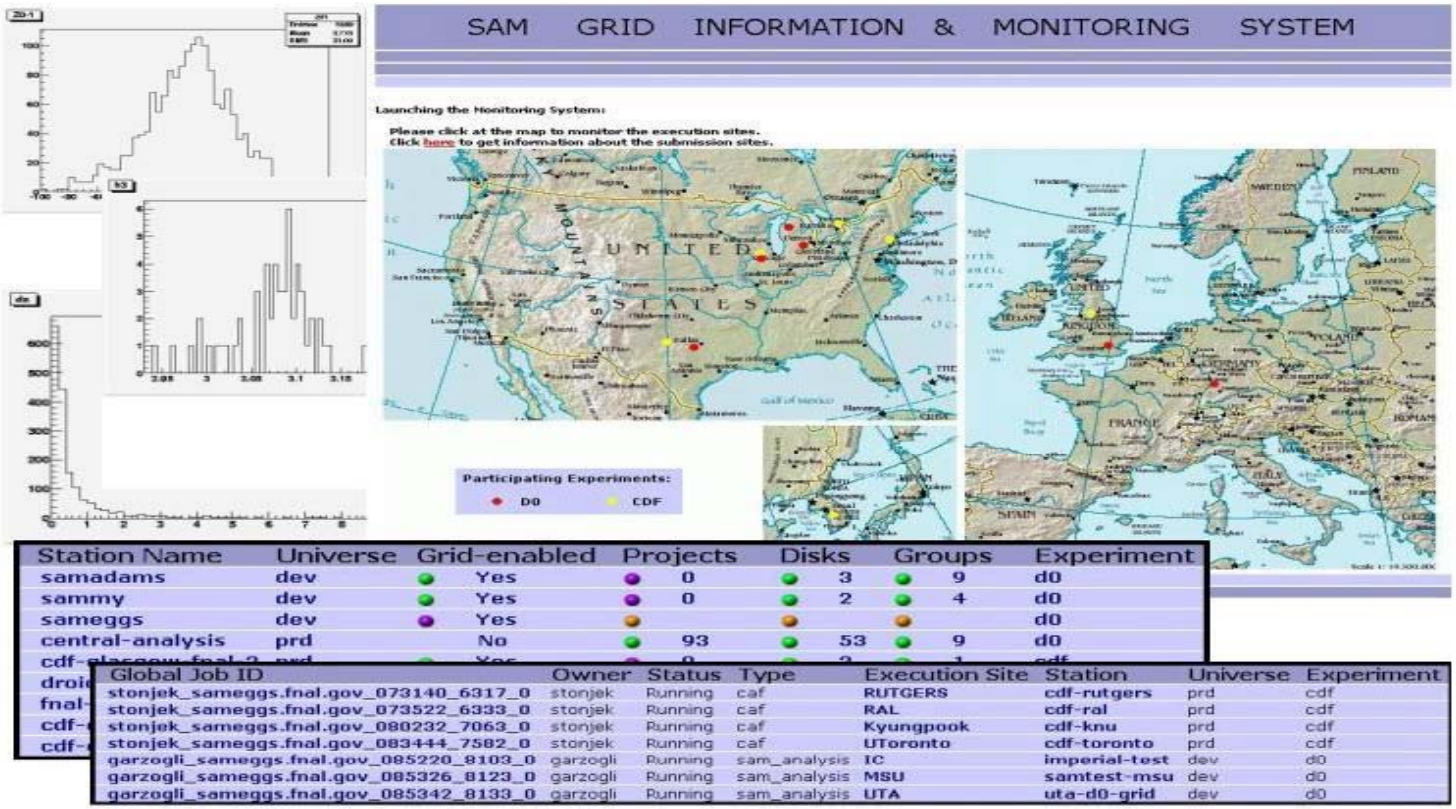
- Petabyte (10^{15} byte) data sets, 20+ Terabytes/day in motion.



- CDF, D0, and CMS CPU farms tapping out FCC power and HVAC.



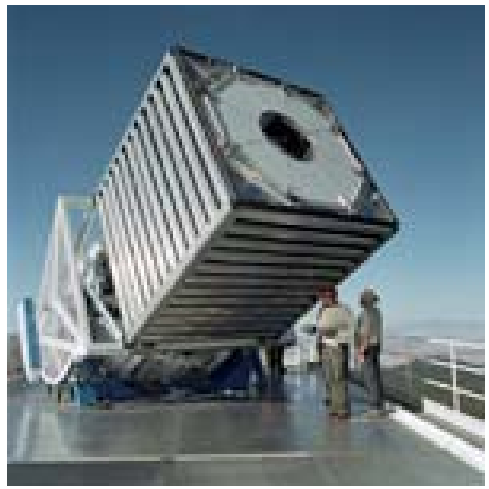
RunII never sleeps…



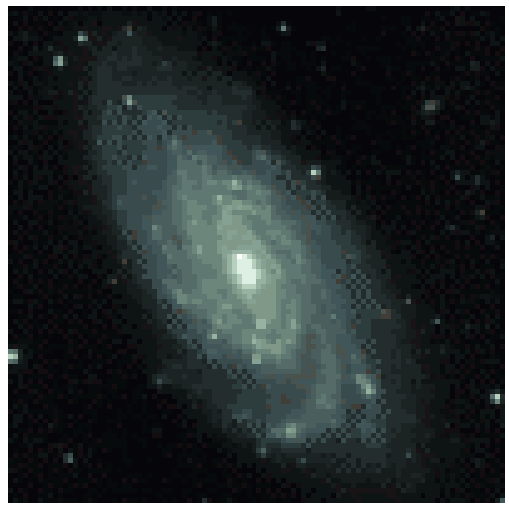
And CMS is here…today!

Computing in our Scientific Program Today: Outer Space.

The Sloan Digital Sky Survey is a successful data-intensive experiment that has an off-site detector (and accelerator!).



Fermilab plays a big role in this science by (*and while*) being a central data handling center.



Computing in our Scientific Program Tomorrow…

- "The Open Science Grid".
- Enabling Excellence,

  One can sensibly imagine:

  "The Fermilab Center for Network Research."

  "The Fermilab Center for Realtime Applications."

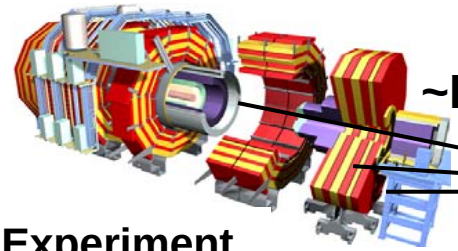
  "The Fermilab Center for Cyber Security."

Steps to the GRID: Distributed Computing

Example:

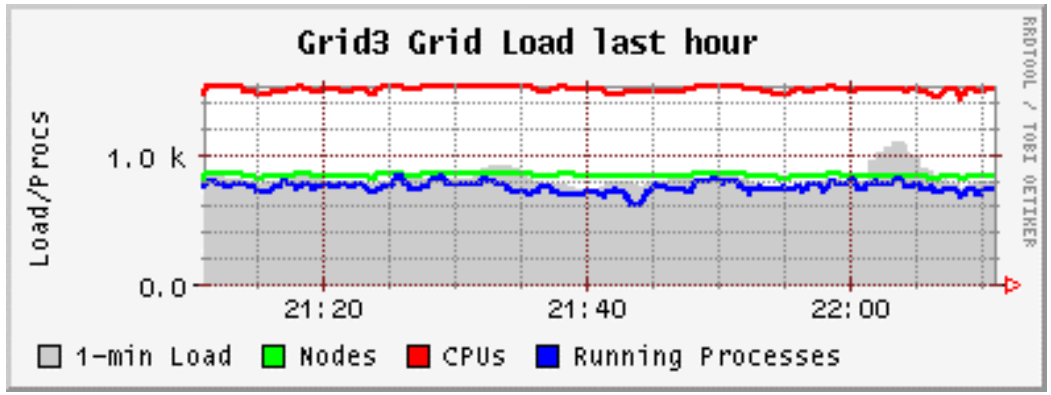
- Snippets of radio telescope frequency data are distributed to a vast network of participants that run a screen-saver application that analyzes that snippet for periodic signatures (ET calling).
- Currently 470,000 participants, 1100 CPU years/clock-hour.
- Static configuration, relatively easy to manage, *not* GRID yet.

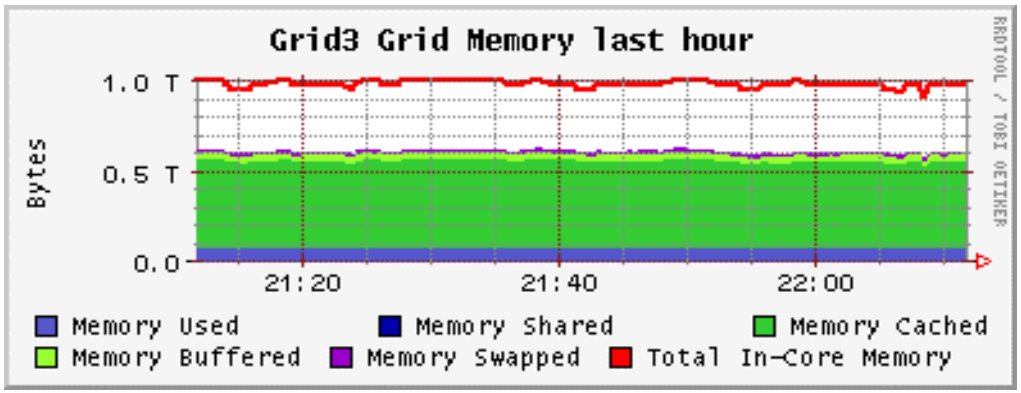
A GRID We Need…



There is Real Progress on the Dynamic Resource Sharing…

Grid3: 1500 processors dynamically federated.





Why is realizing a High Performance GRID Difficult?

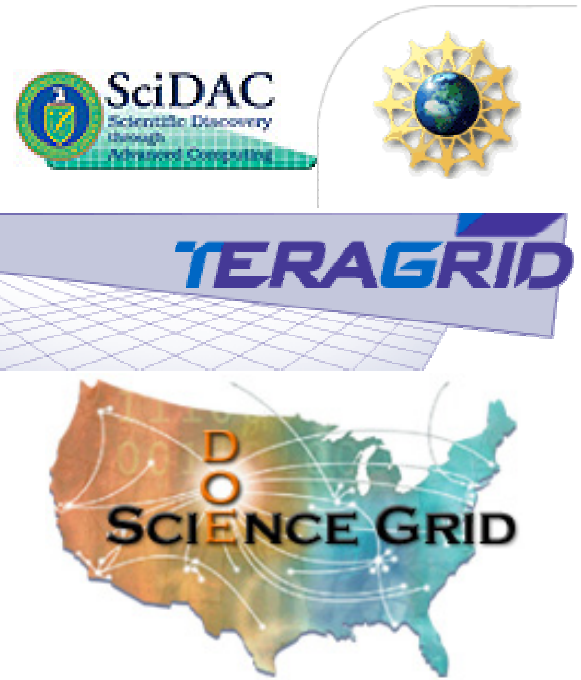
- Resource Brokering: Data to the Application, Application to the Data?
- Security Issues:
  - Inviting a virus.
  - Free access among peers with a spectrum of security concerns.
- Networking: Big networks are expensive.

- Interaction with Real-time applications.

“The Open Science Grid*”

The “Open Science Grid” initiative largely originated at Fermilab. The vision is to employ a federation of high data volume experiments to trigger the formation of a coherent dynamic resource pool that can enable a broad sweep of science and education.

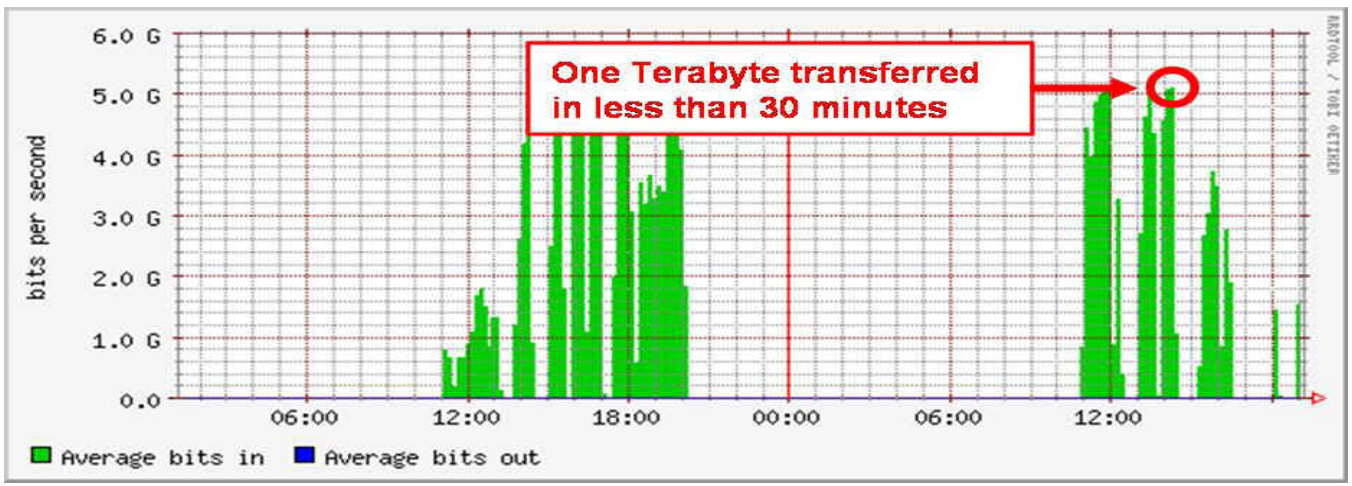
*(http://opensciencegrid.org)



“The Fermilab Center for Network Research”

- Commodity network equipment is now used as core elements in Data Acquisition, Lattice-QCD engines, and the backbone of scientific Grids. The performance/dollar is increasing even faster than Moore’s law.

Speed Record set Last Month: 1TB in 30 minutes from CERN to Chicago!



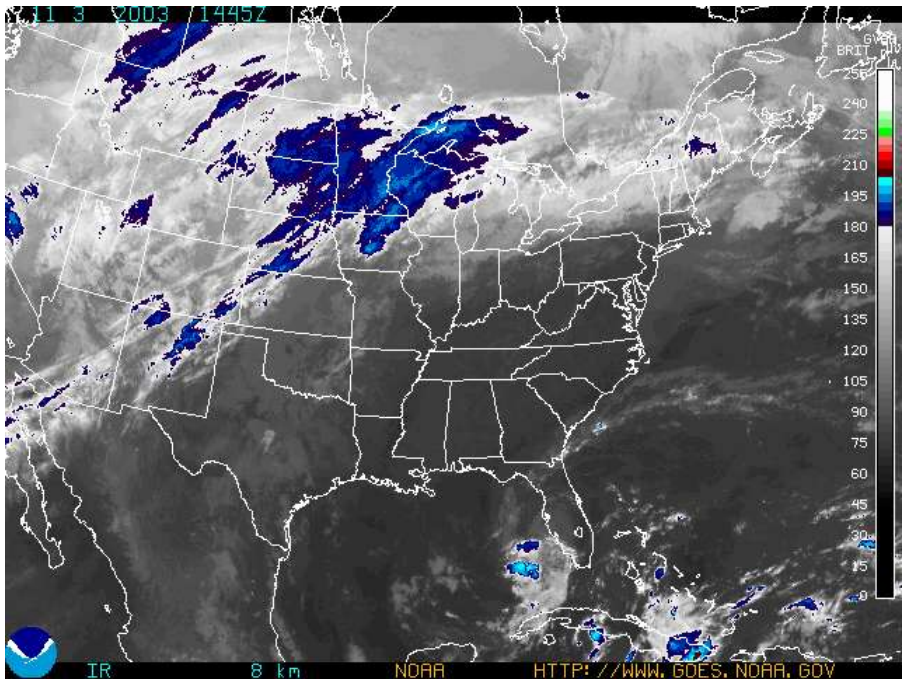
Center of Network Research: Many Fortuitous Circumstances…

- **Metropolitan Chicago is a center for network R&D**
  - Starlight is an example, a major international high-speed optical network connection point.
  - Operated by NU, UIC, ANL
  - ~100 km from FNAL by fiber, working to connect this year. Expect throughput increase of **x10** current capacity.
  - Connections to relevant peers: CERN, NIKHEF, Caltech, UK…
- **Network research community is increasingly interested in systems research.**


“The Fermilab Center for Real-Time Applications.”

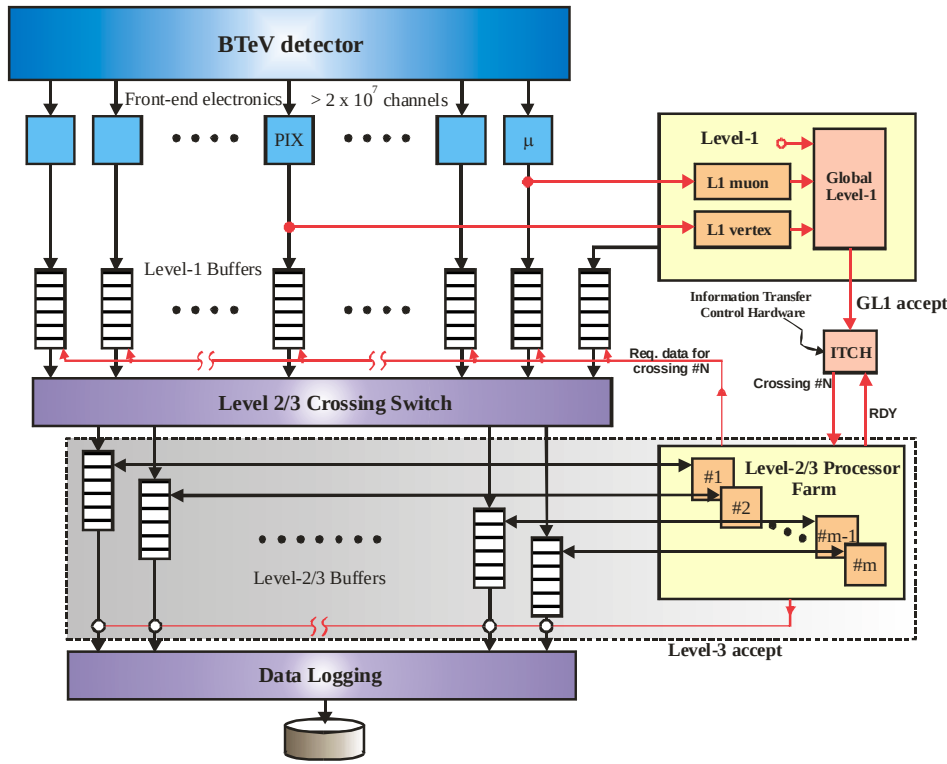
- Fermilab has a long and distinguished history in Realtime computing.
- The LHC experiments and BTeV provide fantastic laboratories for Realtime fault-tolerance issues.
- Broad applications ranging from space-flight to medicine.

A Couple of Hard Realtime Computing Applications



November in Illinois

The BTeV Trigger & DAQ



Fault Tolerance in Complex Systems.

- Failure Happens. The challenge is to remain tolerant.
- BTeV is collaborating with IT scientists in a “Real Time Embedded Systems” NSF funded project.
- Fermilab can make leading contributions to fault tolerance in large computing systems. Clear synergy with GRID concerns.

Summary

- Our scientific computing center now employs thousands of processors analyzing petabyte data sets.
- The opportunity ahead of us to synthesize our expertise in software, networks, and hardware into high performance GRIDs and Real-Time systems is exciting…and achievable.
- The problems are hard, but the interest in solutions within and outside of HEP make this frontier truly endless.