Research Infrastructure

- Community-wide infrastructure support
  - HEPnet
  - HEPgrid (Grid Canada)

- Local infrastructure
  - MFA support for detector development
  - Computing infrastructure

Randall Sobie

HEPnet/Canada

Supports and funds wide area networking for SAP

- national links
  - SNO – Laurentian (50%)
- international links
  - now: CERN – Chicago (8% of N.A. cost)
  - in past: Canada – NSFnet, Canada – ESnet
- network monitoring and applications
  - high speed data transfer trials (CERN – Canada)
- dialup service

Randall Sobie

HEPnet/Canada people

- Director – Dean Karlen
- Manager – David Bickle
  - new hire: BSc. (CS), HPCVL & Bell Canada
  - previous manager, Wade Hong, now full time at Carleton University, remains active
- Advisory committee
  - Richard Keeler
  - Renee Poutissou
  - John Martin
- Affiliation with HEPgrid/Canada:
  - Randy Sobie & Bob Kowalewski

CERN – North America link

US - CERN link speed history
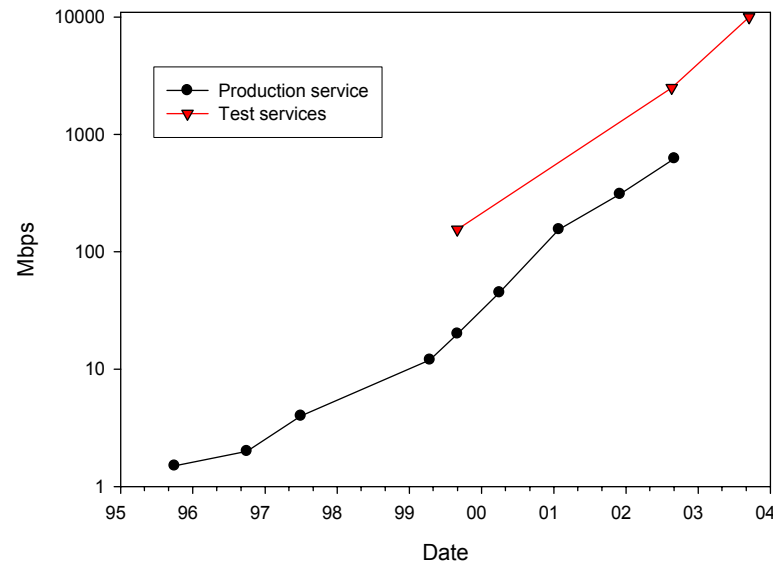
- "US line consortium" active since 1995
- frequent upgrades to reach with LHC requirements by 2007
- HEPnet/Canada support is 8% of N.A. costs

Randall Sobie

Dialup service

- for use by SAPhysicists when travelling
- local dialup access numbers in >1000 cities
- 660 periods reserved in past 7 years:

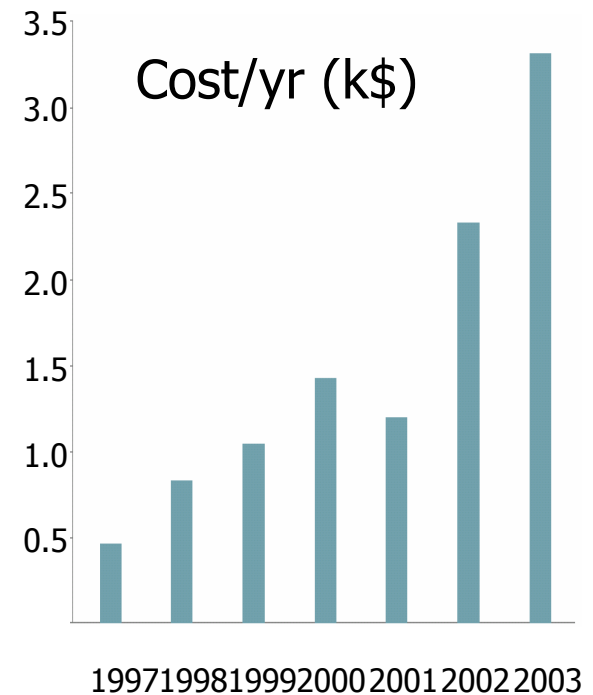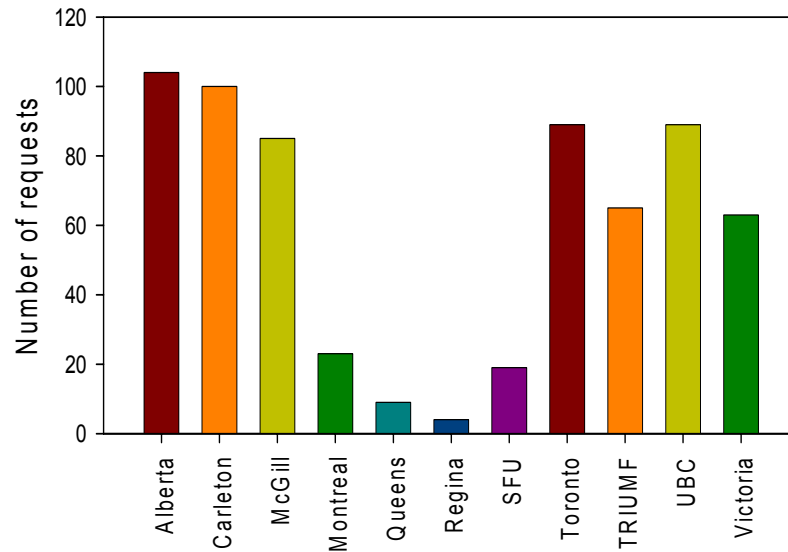HEPnet/Canada Dialup Account Usage (Aug 1996 - Sep 2003)

Date:
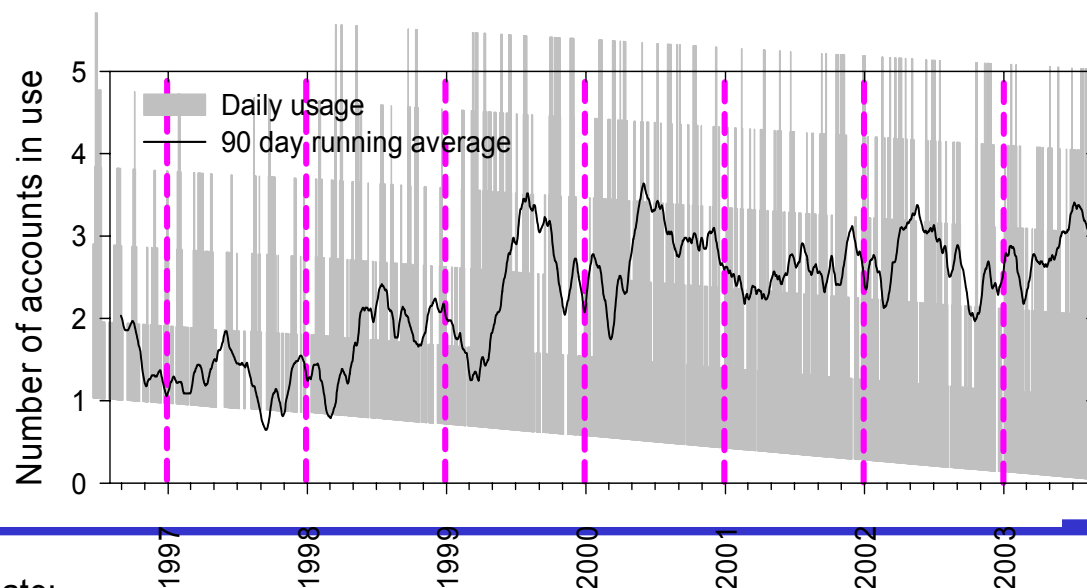
Dialup service

- usage is spread amongst several Universities

- usage fees are increasing…

- new system for requesting accounts in development

Cost/yr (k$)

ATLAS Canada Lightpath trial
TRIUMF CERN

CANARIE
2xGbE
circuits

StarLight

NetherLight

SURFnet
2xGbE
circuits
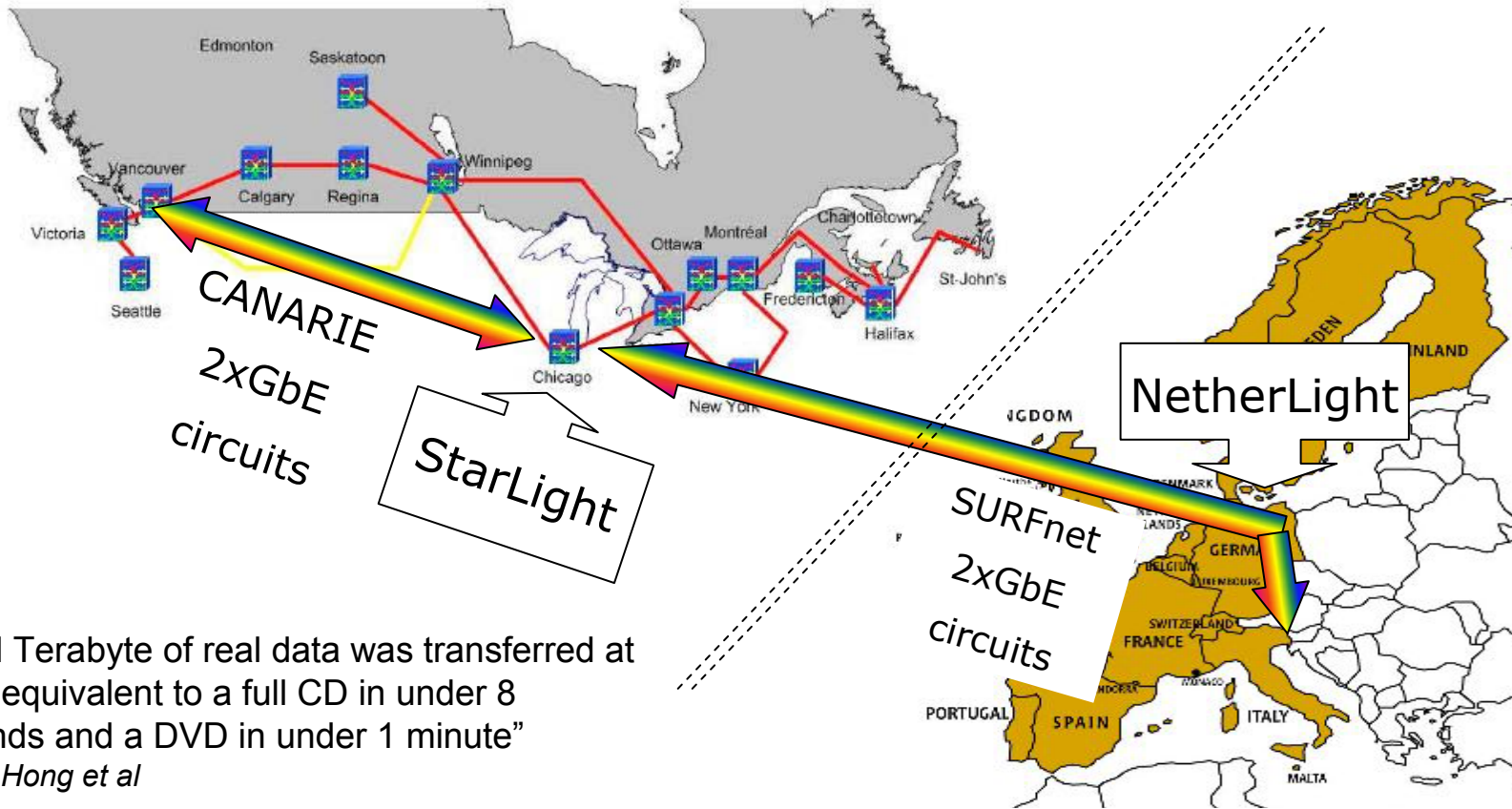
"A full Terabyte of real data was transferred at rates equivalent to a full CD in under 8 seconds and a DVD in under 1 minute"
Wade Hong et al

Randall Sobie

High bandwidth tests

- A new demonstration/test is in preparation, in association with Telecom 2003 (Oct 12-18).
  - 10 Gbps line between CERN & Carleton U.
  - packet generators/ iPerf memory transfers / disk to disk transfers (up to several Gbps)
  - will be very useful tests of equipment/software to be used in the LHC era

- A Canada-wide testbed for high bandwidth testing is being proposed, to be funded by Canarie
  - led by Wade Hong
  - primarily to benefit HEP

HEPnet Summary

- High performance networking is a very dynamic field
- Our field will benefit from the close ties developed with CANARIE
- Available manpower is increasing
  - support from Wade Hong
  - new full time manager, David Bickle
- Expanded role:
  - merge network and grid support activies
  - single MFA for HEPnet and HEPgrid in the future…

Randall Sobie

Grid Computing

- The Grid is the solution for ATLAS computing
  - ATLAS-Canada model has TRIUMF as the link into the LHC Grid with the University sites forming a Canadian Grid
- The Grid has the potential to open up resources (manpower and hardware) not normally available to HEP
- UVictoria group active in Grid Computing since 2001
  - R.Sobie, R.Kowalewski, A.Agarwal + coop students
  - HEPgrid MFA 2 year funding for coop student support
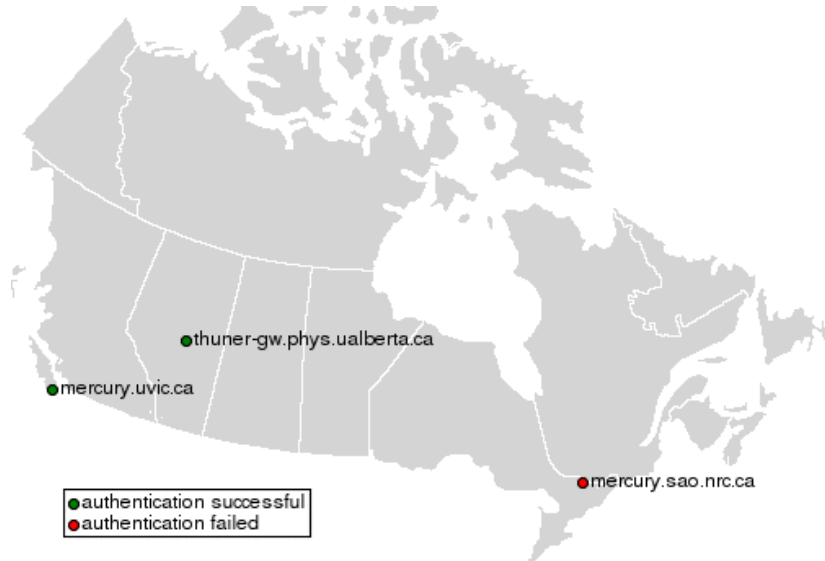
Grid Canada

- Collaboration with NRC Institute for Information Technology (Ottawa), CANARIE, Alberta, Pacific Forestry Centre

- GC is responsible for Canadian Certificate Authority

- Established a Grid Testbed (2001-2003) using ~50 computers at 12 sites across Canada
  - Ran BaBar MC simulation and ATLAS DC
  - Results presented at the CHEP Conference (2003)

Randall Sobie

Canada-wide Grid

- Creating a Grid using "production" facilities at Victoria (Mercury), Alberta and NRC (~300 CPUs)

thuner-gw.phys.ualberta.ca

mercury.uvic.ca

mercury.sao.nrc.ca

authentication successful
authentication failed

Operational Oct 2003

Large scale test using ATLAS DC software prior to CANARIE meeting

Randall Sobie

GC Status

- Grid enabled 3 clusters (globus)
  - Involves sys admins who are not part of GC
  - Common accounts, gc-production queue
  - Site monitoring (ganglia)
  - "gcsub" batch submission and resource broker
- Short term goal
  - Working Grid by Oct 22 CANARIE WORKSHOP
  - Running ATLAS DC
- Longer term
  - Add additional sites
  - Apply to NSERC Strategic Grant (NRC, Eng, Forestry)

Randall Sobie

Training of HQP

- Tremendous interest in learning about the Grid from students
  - 40 applications per term from outstanding students in physics, engineering physics, computer and electrical engineering from SFU, UBC and Victoria

- Physics and Engineer departments at the University of Victoria are jointly supervising students on Grid projects

- 2003 IEEE Gold Medal – D.Vanderster
  - Computer Engineering
  - MSc on Grid Computing

Randall Sobie

UVic MFA

- MFA to the University of Victoria group

- Support Detector Development
  - ATLAS and Linear Collider

- Software Engineering Support
  - All experiments
  - Application-specific software and data installation and maintenance

Randall Sobie

Detector technologist: Poffenberger

- *Paul Poffenberger*
  - many years of experience in providing technical support to the experimental groups at the University of Victoria
  - FY2003 50/50 (ATLAS MIG), FY2004 100% on MFA
- Current activities
  - ATLAS feedthrough project:
    - managed day to day activities in laboratory
    - successful completion of project on time & on budget
    - now overseeing installation of completed feedthroughs at CERN

Detector technologist: Poffenberger

- Current activities (cont.)
  - Linear collider TPC project:
    - detector modifications
    - data acquisition system development
    - setup and operations of TPC at TRIUMF and DESY
- Future activities
  - Linear collider TPC project:
    - micromegas detector and test beam preparations
  - JPARC-SK long baseline neutrino program:
    - "near detector" design studies
    - detector construction activities

Randall Sobie

Software Engineer: Agarwal

- *Ashok Agarwal*
  - several years of software support to the Babar group
  - FY 2003 – FY 2004, 50 / 50 (Babar operating)
- Current activities:
  - Babar experiment:
    - MC production, data management and software support
  - ATLAS experiment:
    - Grid Computing, Data Challenge, cluster software support for test beam and Monte Carlo studies
  - Linear Collider project:
    - Cluster software support for cosmic ray and MC studies

Randall Sobie

Local Resources

- Desktop
  - Linux/Windows workstations and laptops

- Muse Linux Cluster
  - Commodity Intel processors and inexpensive disk

- Mercury Linux Cluster (470th in TOP500)
  - IBM Intel processors connected to SCSI disks via FC

- Storage Facility
  - 200 TB disk/tape system designed for moving data fast

Randall Sobie

Muse Cluster

- ## Commodity Intel cluster (Linux)
  - Funded by Startup Funds, CFI and NSERC Eqpt grants
  - Interactive users from all experiments
  - BaBar MC production

- ## Very successful - 3rd stage of "renewal"
  - Well managed by Jan van Uytven

- ## Manpower intensive and I/O limitations
  - Trading low-priced hardware for manpower
  - I/O limited - BaBar NTUPLE analysis

Randall Sobie

CFI Funded Resources

- UVictoria Research Computing Facility
  - 1999 $2M CFI/BC for a parallel processor (N.Dimopoulos)
  - 2002 $6M CFI/BC for storage facility (R.Sobie)

- Multi-discipline facility
  - Biology, Earth and Atmospheric Sciences, Engineering and Physical Sciences
  - NRC Herzberg Institute for Astrophysics and Canadian Forest Service Pacific Forestry Centre

CASS

- Managed by UVictoria Computing Centre (CASS)
  - UVictoria allocated $1M of its CFI IOF to the project

- 2 CASS FTE's dedicated to Research Computing
  - Colin Leavett-Brown (25 years HPC experience)
  - Drew Leske (UVic BSc with 5 years experience)
  - Access to pool of experts in Networking, Storage Management, Facilities

- Strong University support
  - VP Research and CASS

Randall Sobie

IBM

- Excellent relationship with IBM Corporation
  - IBM has provided hardware and support for many years

- IBM has been generous in its support
  - 1999 $840K IBM SUR grant (R.Sobie)
  - Mercury Linux Cluster was donated to UVictoria

- In response UVictoria has worked with IBM
  - IBM Beta Test for LTO2 Tape library (1/2 in Canada)
  - Working with their Storage Software team (Tivoli)

Randall Sobie

Year 1 Layout

1st of 4 Year Project

Fully Operational

- 12 TB disk

- 220 LTO2 tape library

- 8-way Storage Server

- Storage Area Network with 2 Gigabit/s Fibre Channel

- 108 2.4 GHz Xeon CPU's

- 128 CPU IBM SP

- 2 Gigabit/s Ethernet to BCNET/CANARIE

Current Status

- Hardware delivered January-April 2003

- Operational May 2003 and Grid-enabled Sept 2003

- Integrating large storage users
  - Particle Physics, NRC HIA and Pacific Forestry
  - 10 TB data on the system

- Mercury Linux Cluster
  - 470th fastest computer in the world (100% utilized)

- We are demanding users
  - Hardware is excellent; software is not meant for Research

Randall Sobie

Challenges

- HEP software no longer operating system, compiler or software independent

    – Impediment for making a Grid

- IBM/Tivoli Storage Manager struggling with millions of files

    – Astronomers putting in data faster than the SM can cope

    – Inject some intelligence into the SM like tarring common files or keeping frequently used NTUPLES disk resident

    – Working with IBM to help speed it up (an ls of the Astronomy disk takes 9 hours)

Randall Sobie

Randall Sobie

Future plans

- ## Fall 2003
  - Disk from 12 TB to 24 TB
  - 28 dual Xeons using BaBar NSERC Eqpt Grant
  - Link Muse cluster into the Storage Facility (2 Gbit/s ETH)
  - Social Science CFI Project (TAPOR)

- ## 2004, 2005 and 2006
  - Double storage and processing capacity per year?
  - CFI for new parallel processor and extension to Storage
  - MFA for system support?

Randall Sobie