International Committee for Future Accelerators

Standing Committee on Interregional Connectivity

Report to ICFA

October 7, 1999

Matthias Kasemann, FNAL

Related URL's

- ICFA-SCIC Homepage
  - http://www.hep.net/ICFA/index.html

    Cern -> Scientific Committees -> ICFA -> ICFA Standing Committee on International Connectivity

- ICFA-NTF Homepage
  - http:/nicewww.cern.ch/~davidw/icfa/icfa-ntf.html

- ICFA-NTF July'98 Report
  - http://nicewww.cern.ch/~davidw/icfa/July98Report.html

ICFA meeting, Vancouver, 1998

- ICFA received the final report of the
  Networking Task Force (ICFA-NTF).
- Decision:
  create a Standing Committee on Interregional Connectivity (ICFA-SCIC).
- Committee members represent major HEP user communities and laboratories.
- Focus should be on intercontinental connectivity (see charge).

Charge to ICFA-SCIC:

- Make recommendations to ICFA concerning the connectivity between America, Aisia and Europe.
  - As part of the process of developing these recommendations, the committee should
    - monitor traffic,
    - keep track of technology developments,
    - periodically review forecasts of future bandwidth needs, and
    - provide early warning of potential problems.
- Create subcommittees when necessary to meet the charge.
- The chair of the committee should report to ICFA once a year, at its joint meeting with laboratory directors.

ICFA-SCIC membership:

- The **chair** is appointed directly by ICFA. ✓
- Each of the major user **laboratories**, CERN, DESY, FERMILAB, KEK and SLAC, should appoint one member each. ✓
- **ECFA**, **DPF** jointly with **IPP**, and **ACFA**, should appoint two members each. ✓
- ICFA will appoint one member from the **Russian federation** and one member from **South America**. ✓

ICFA-SCIC membership:

- The representatives from the laboratories are:

  Manuel Delfino, (CERN),
  Michael Ernst (DESY),
  Kasemann (Fermi) (chair),
  Yukio Karita (KEK),
  Richard Mount (SLAC).

- The North American user representatives are:

  Harvey Newman (USA),
  Dean Karlen (Canada).

- For Russia:
  Alexei Morozow (ITEP)

- ECFA has nominated:

  Frederico Ruggieri (INFN Frascati),
  Denis Linglin (IN2P3, Lyon).

- ACFA has nominated:

  Prof. Rongsheng Xu
  (Computer Center, IHEP China)

  Prof. HwanBae Park (Korea University)

- For South America:
  Sergio F. Novaes (University de S.Paulo)

ICFA-SCIC meetings:

- April 15. - 16. at FNAL.
  - Main topics:
    - review charge to SCIC,
    - review work of ICFA-NTF
      (a lot of it overlaps with SCIC charge),
    - define priorities and projects,
    - organize work (and subgroups).

- Video Conference on July 6, 1999.
  - Topics:
    - update on status of network connectivity
    - working group plans
    - action items

Recommendations of the ICFA NTF

- Recommendations concerning Inter-continental links:

  - **ICFA should encourage the provision of some considerable extra bandwidth, especially across the Atlantic**
  - **ICFA participants should make concrete proposals, (such as recommendation to increase bandwidth across the Atlantic, approach to QoS , co-operation with other disciplines and agencies, etc.)**
  - **The bandwidth to Japan needs to be upgraded**
  - **Integrated end-to-end connectivity is primary requirement, to be emphasized to continental ISPs, and academic and research networks**

Topics:

- There was a discussion on the reality of QoS today:
  - how to administer it
  - how to take advantage of it for HEP applications
    - bulk data transfer service to be done at low utilization periods,
    - move away from applications that demand low latency such as telnet
  - there is a need for network aware applications for:
    - interactive network connections
    - distinguish bulk data transfer from low latency traffic
    - IP-telephony, Voice over IP
    - collaborative tools

Topics (2):

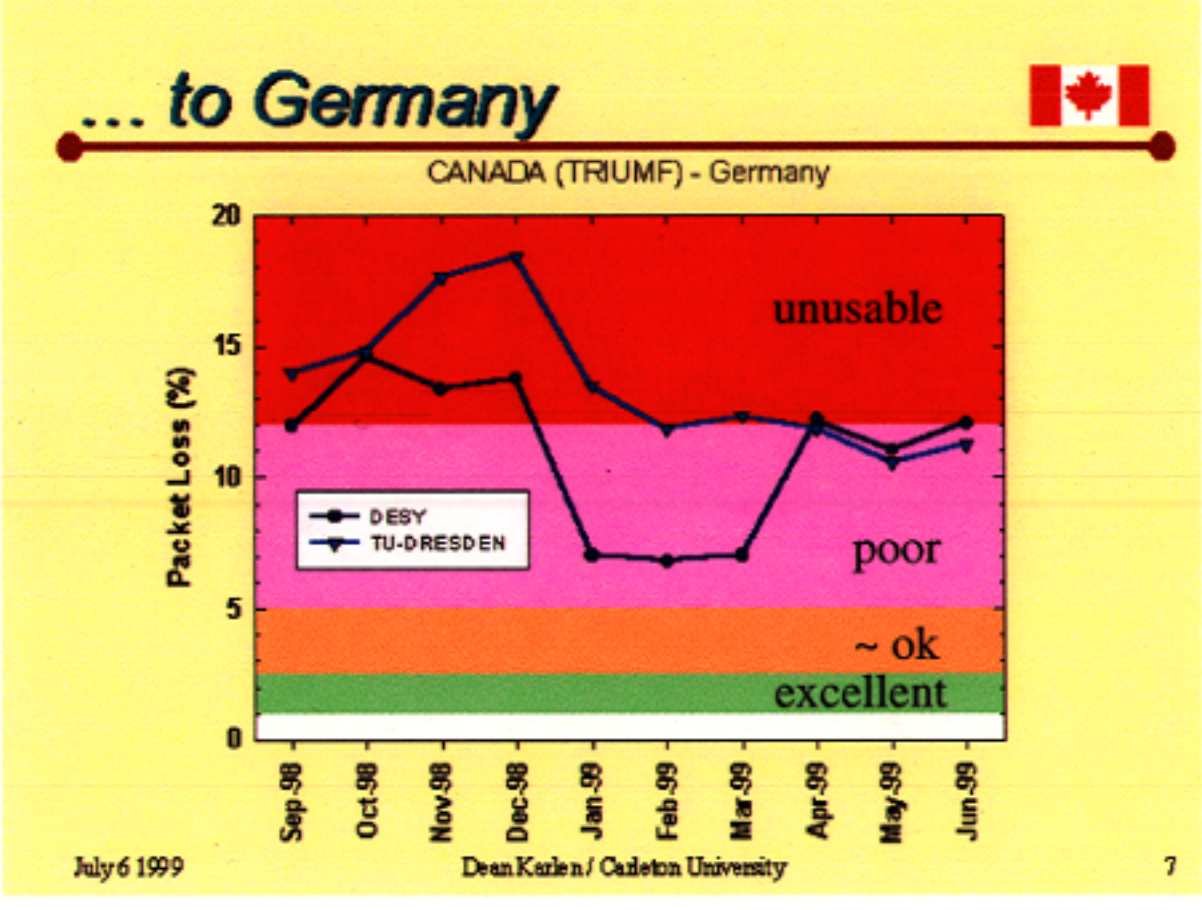
- Status & future directions of US research networks
  - The network environment for HEP research in the US continues to improve in virtually all areas
  - US HEP facilities work well on ESnet
  - University access improving rapidly with emerging I2 networks
  - Acceptable Use Policy (AUP) issues complicate things

Canada - Germany(Desy): poor

There are severe trans-atlantic performance problems which need to be addressed.

They need inter-national cooperation.

ICFA-SCIC (Michael Ernst, DESY) will discuss with DFN.



Canada - Germany(Desy): poor

DESY update...

- The poor CANADA - DESY connection continues to be the biggest problem for networking in the Canadian HEP community
- Have an ISDN - based backup service
- Plan to set up a new backup service that uses the US-CERN link
  - for remote interactive service and modest file transfer

July 6 1999 Dean Karlen / Carleton University 11

S. America / Brazil

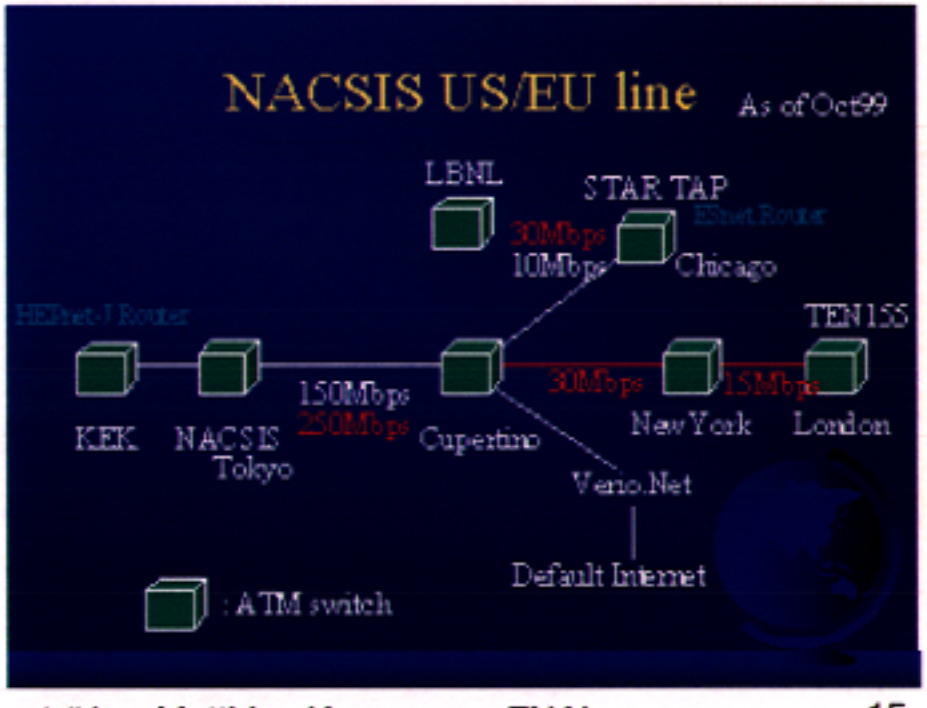
- The needs are to increase bandwidth.
- Need A&R dedicated links, even better if had just HEP links.
- The main HEP partners are CERN & FNAL.
- Unclear how much fiber/infrastructure is being put in place to the US.
  - there are at least 2 international consortia Oxygen, Global Crossing are going into Brazil.
  - Funding is the main problem and limits international connectivity.
- The telecomm industry is being privatized, expect more competition.
- Example of needs:
  - For a D0 farm they need 20kbps/PC or for 30 PC need 600kbps (total available on US link now is 2000kbps).

Germany

- Europe connectivity improved with TEN-155,
- Expect an upgrade of A&R net in Germany next year.
- Problem areas:
  - N. America (2*OC3 won't help much);
  - Russia now & Japan in future.
- **DFN now does ICMP traffic shaping especially at International exchanges.**
- Hoping to be able to use Differentiating Services to provide managed bandwidth for improved performance to HEP sites in N. America.

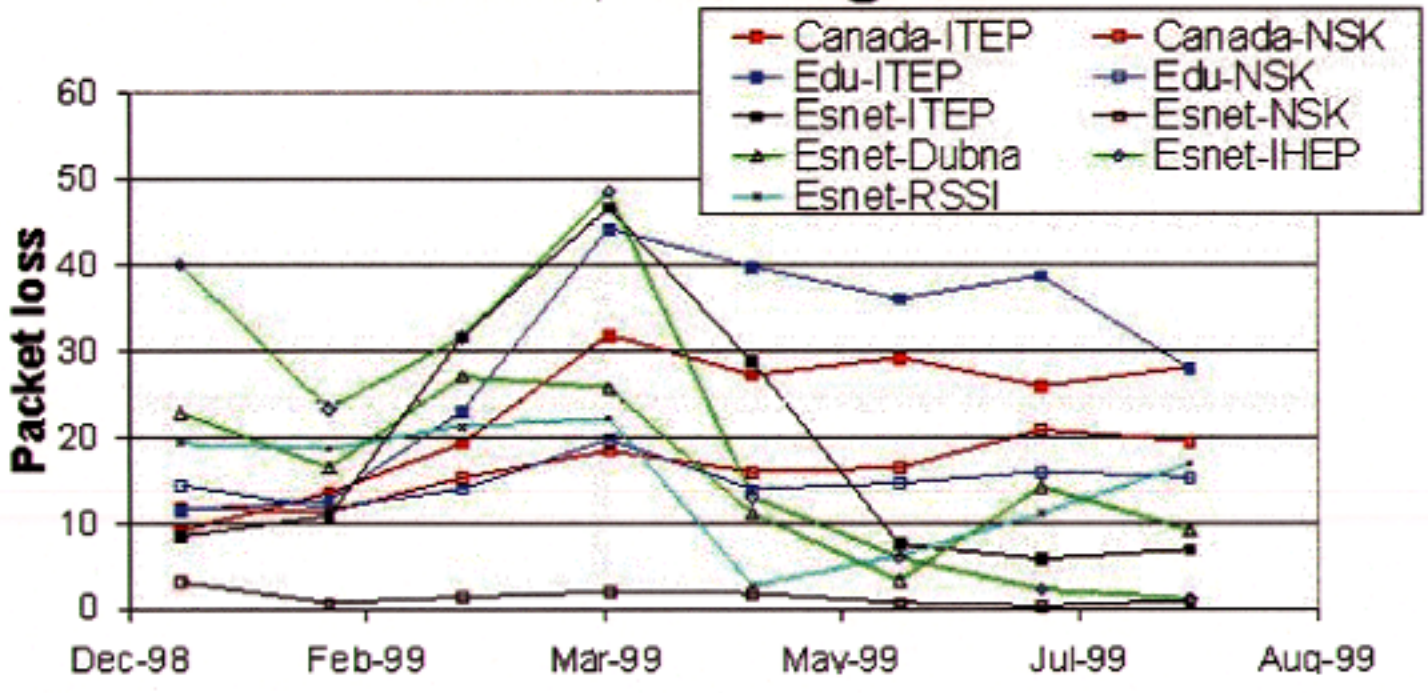
Japan site report - Yukio Karita

- Issues:
  - vBNS is reluctant to peer with Japan HENP at STAR-TAP
  - NACSIS - Europe line is saturated:
    - will be upgraded from 2 Mbps to 30 Mbps in October, 1999.
    - 3-4 Mbps for KEK-CERN ATM PVC will be provided then.
    - Both of this done with Japanese $$'s.
    - European funding can increase the bandwidth.



Russia

Packet loss from N. America to Russia, Jan-Aug 1999



ESnet – NSk good, ESnet – ITEP & IHEP improved with new satellite
Canada & Edu bad all over
DESY, CERN improved to acceptable to ITEP, IHEP, NSK with new satellite, Dubna still v. poor to bad, UK poor to ITEP & NSK
KEK good to NSk, v. poor to ITEP

Recent History of the US-CERN Link

- CERN/US/France/Canada/UN-WHO Consortium
- **October 1996 - August 1997**
  - Upgraded leased digital CERN-US line: 2.048 Mbps
  - Set-up of monitoring tools and traffic control
  - Start Deployment of VRVS a Web-based videoconferencing system
- **September 1997 - April 1999**
  - Upgraded leased CERN-US line to 2 X 2.048 Mbps; Addition of a backup and "overflow" leased line at 2.048 Mbps (total 6 Mbps) to avoid saturation in Fall 1998
  - Production deployment of VRVS software in the US and Europe (to 1000 hosts by 4/99; Now 1300).
  - Set-up of CERN-US consortium rack at Perryman to peer with ESnet and other international nets
  - Test of QoS features using new Cisco software and hardware

Current Dev. for the US-CERN Link

- **October 1998 - September 1999**
  - Market survey and selection of Cable&Wireless as ISP.
  - Began Collaboration in Internet2 applications and network developments.
  - Move to C&W Chicago PoP, to connect to STARTAP.
  - From April 1999, set-up of a 12 Mbps ATM VP/VBRnrt circuit between CERN and C&W PoP
  - 9/99: Transatlantic upgrade to 20 Mbps September, coincident with CERN/IN2P3 link upgrade
  - 7/99: Begin organized file transfer service to "mirror" Babar DST data from SLAC to CCIN2P3/Lyon

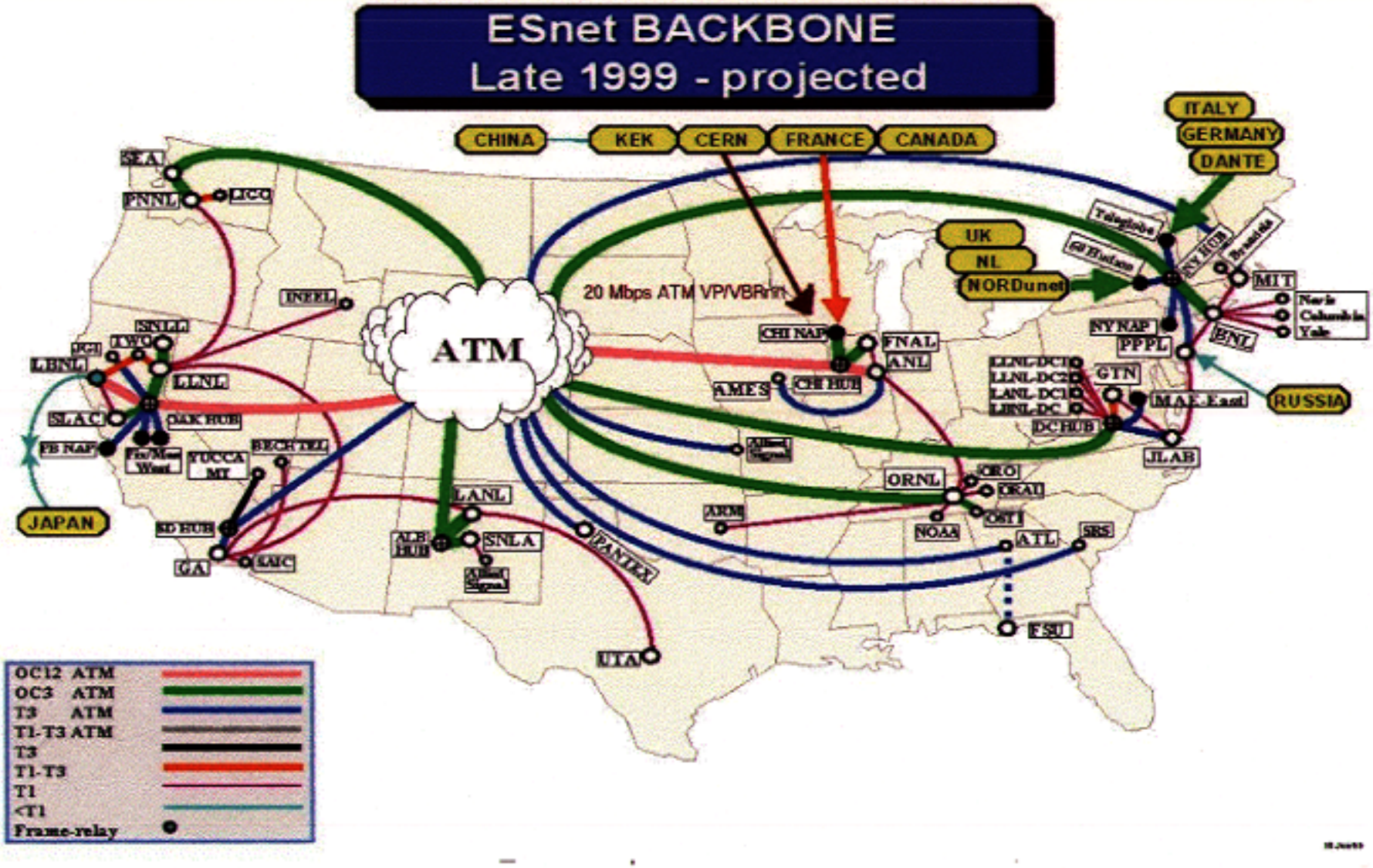
Requirements and Needs for LHC and HEP

Beyond the simple requirement of adequate bandwidth, physicists in all of DoE/DHEP's (and NSF/EPP's) major programs require:

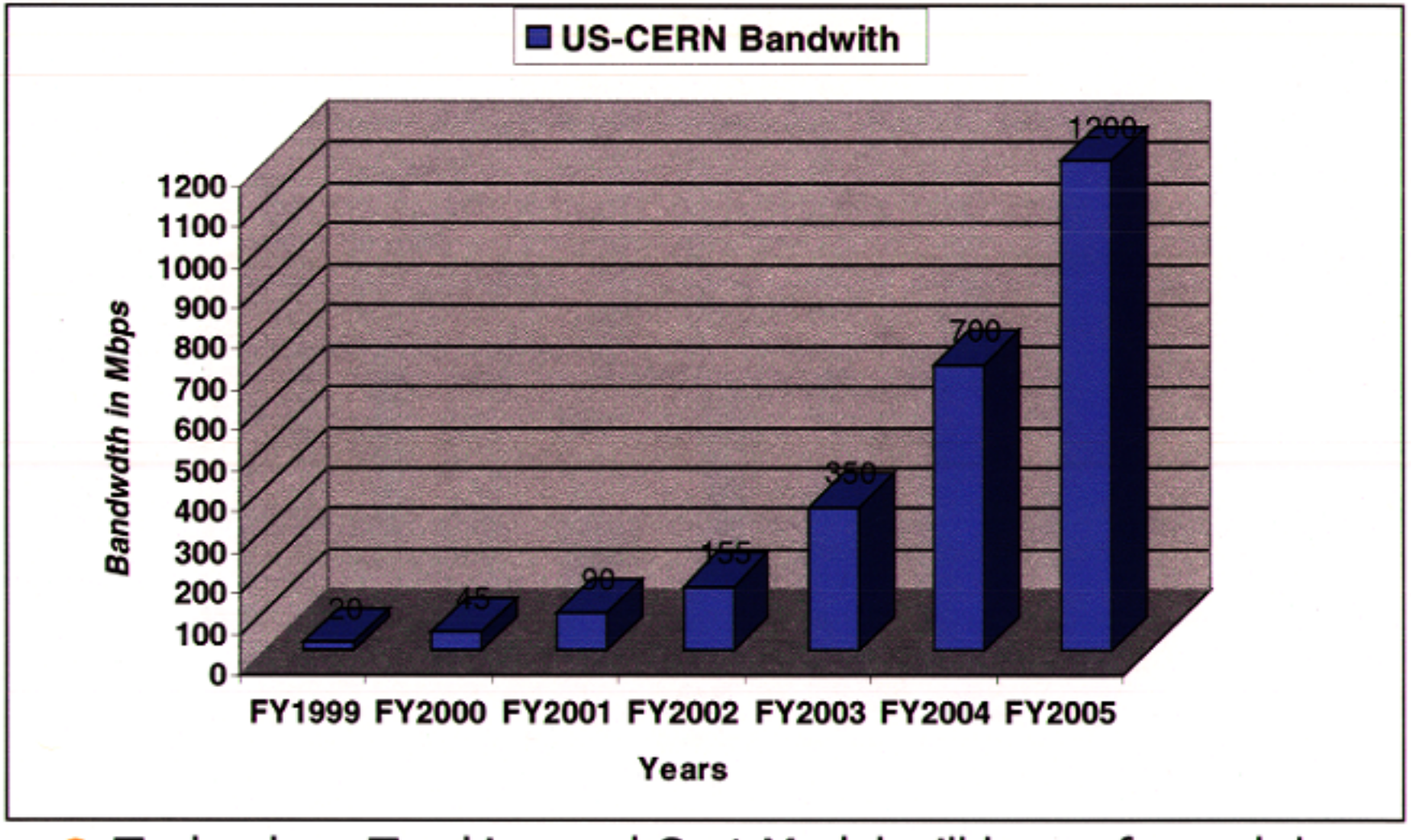
- An integrated set of local, regional, national and international networks able to interoperate seamlessly, without bottlenecks
- Network and user software that will work together to manage the bandwidth effectively
- A suite of videoconference and high-level tools for remote collaboration that will make data analysis from the US (and from other remote sites) effective

The effectiveness of U.S. participation in the LHC experimental program is particularly dependent on the speed and reliability of national and international networks

US-CERN line connection to ESnet



Bandwidth Growth Observation/Prediction



- Technology Tracking and Cost Model will be performed by the ICFA SCIC Committee

Bandwidth Requirements for HENP

- Several sources of information have been used to estimate the bandwidth requirements:
  - ICFA NTF Questionnaire on Computing and Networking Needs
  - Computing Technical Proposals and Reports
  - Scaling according to computing and local area network (LAN) speeds
  - Scaling according to the data rate to storage, and to the accumulated data volume
  - Bandwidth available at Homes
  - Bandwidth available on the Mass Market
  - Bandwidth required for Physicists' Tasks (Reconstruction, interactive Analysis, Remote Collaboration,...)
  - Scaling according to the speed of major links common in national and research networks

ICFA Network Task Force Bandwidth Requirements Estimate (Mbps)

Year	1998	2000	2005
BW Utilized Per Physicist (and Peak BW Used)	0.05 - 0.25 (0.5 - 2)	0.2 - 2 (2 - 10)	0.8 - 10 (10 - 100)
BW Utilized by a University Group	0.25 - 10	1.5 - 45	34 - 622
BW to a Home-laboratory or Regional Centre	1.5 - 45	34 - 155	622 - 5000
BW to a Central Laboratory Housing One or More Major Experiments	34 - 155	155 - 622	2500 - 10000
BW on a Transoceanic Link	1.5 - 20	34-155	622 - 5000

See http://l3www.cern.ch/~newman/icfareq98.html

Remote Collaborations: VRVS videoconferencing

- VRVS CERN-Caltech development (1995-
- 21 reflectors Running in U.S. Europe and Asia
  - **Switzerland**: *CERN (2)*
  - **Italy**: *CNAF Bologna*
  - **UK**: *Rutherford Lab*
  - **France**: *IN2P3 Lyon, Marseilles*
  - **Germany**: *Heidelberg Univ.*
  - **Finland**: *FUNET*
  - **Spain**: *IFCA-Univ. Cantabria*
  - **Russia**: *Moscow State Univ., Tver. U.*
  - **U.S**:
    - *Caltech, LBNL, SLAC, FNAL,*
    - ANL, BNL, *Jefferson Lab.*
  - **DoE HQ** Germantown

Asia: ***Academia Sinica.*** Taiwan

South America: ***CeCalcula.*** Venezuela

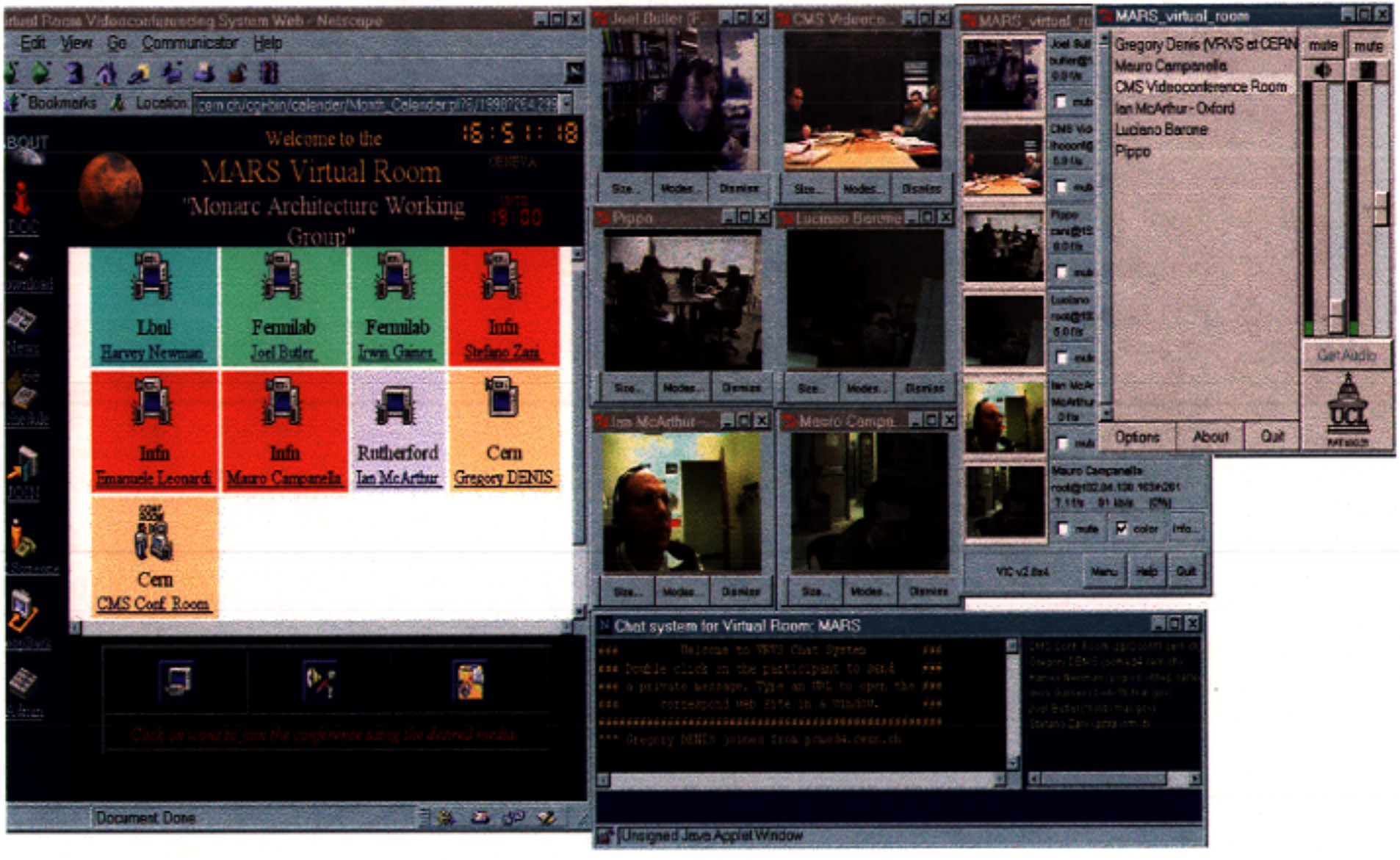
VRVS: Widespread and Strong Support from the Research and Education Communities

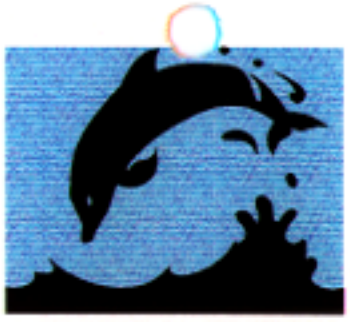
- HENP Community. Hosts registered from: *CMS, Atlas, Alice, Lhc-b, Aleph, NA48, NA49, NA50, AMS, Aleph, Babar, RHIC, CDF, Ceres/NA45, Chorus, Delphi, DESY/ZDV, H1, CEBAF, KLOE, KTeV, L3, Minos, Soudan2, OPAL, PHENIX, STAR, SpEcTrE, WA95, WA98, ZEUS, etc ...*

- Strong interest from others Research Communities
  - Internet2/UCAID *(University Corporation for Advance Internet Development)*
    - Ted Hans, Director, Application Development Internet2:

- *"..The Internet2 Community sees VRVS as the model for providing a highly functional video-enabled collaboration service for research and education..."*
  - I2-DV (Internet2 Digital Video) Initiative recognized that VRVS is a uniquely suitable foundation for development and deployment of its applications. (*http://i2dv.nwu.icair.org*)
  - P. Galvez is a member of the I2-DV (Internet2 Digital Video) steering committee

Example: 9 Participants, CERN(2), Caltech, FNAL(2), Bologna (IT), Roma (IT), Milan (IT), Rutherford(UK)





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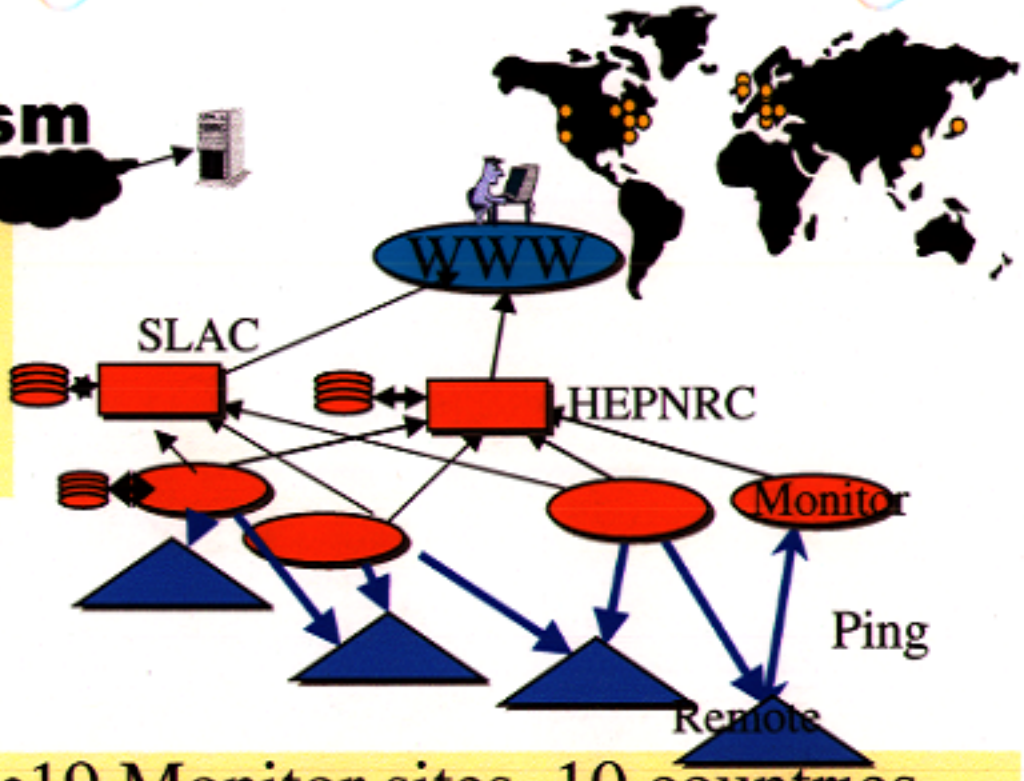
Standing Committee on International Connectivity

SCIC monitoring WG
Active Internet Monitoring Activities

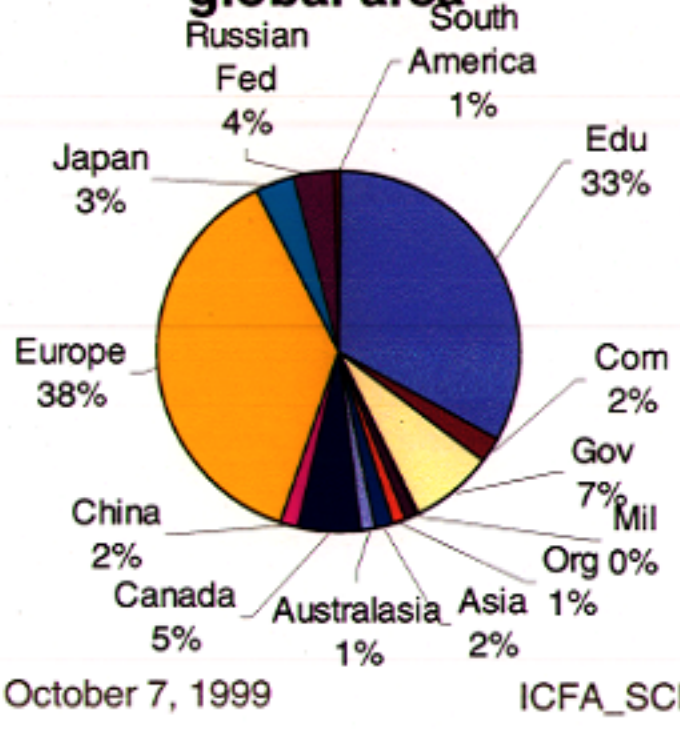
Les Cottrell – SLAC
For the SCIC-WG

Overview of Mechanism

Treats Internet as black box
Uses existing infrastructure (ping)
Low cost, well understood



PingER pair distribution by global area



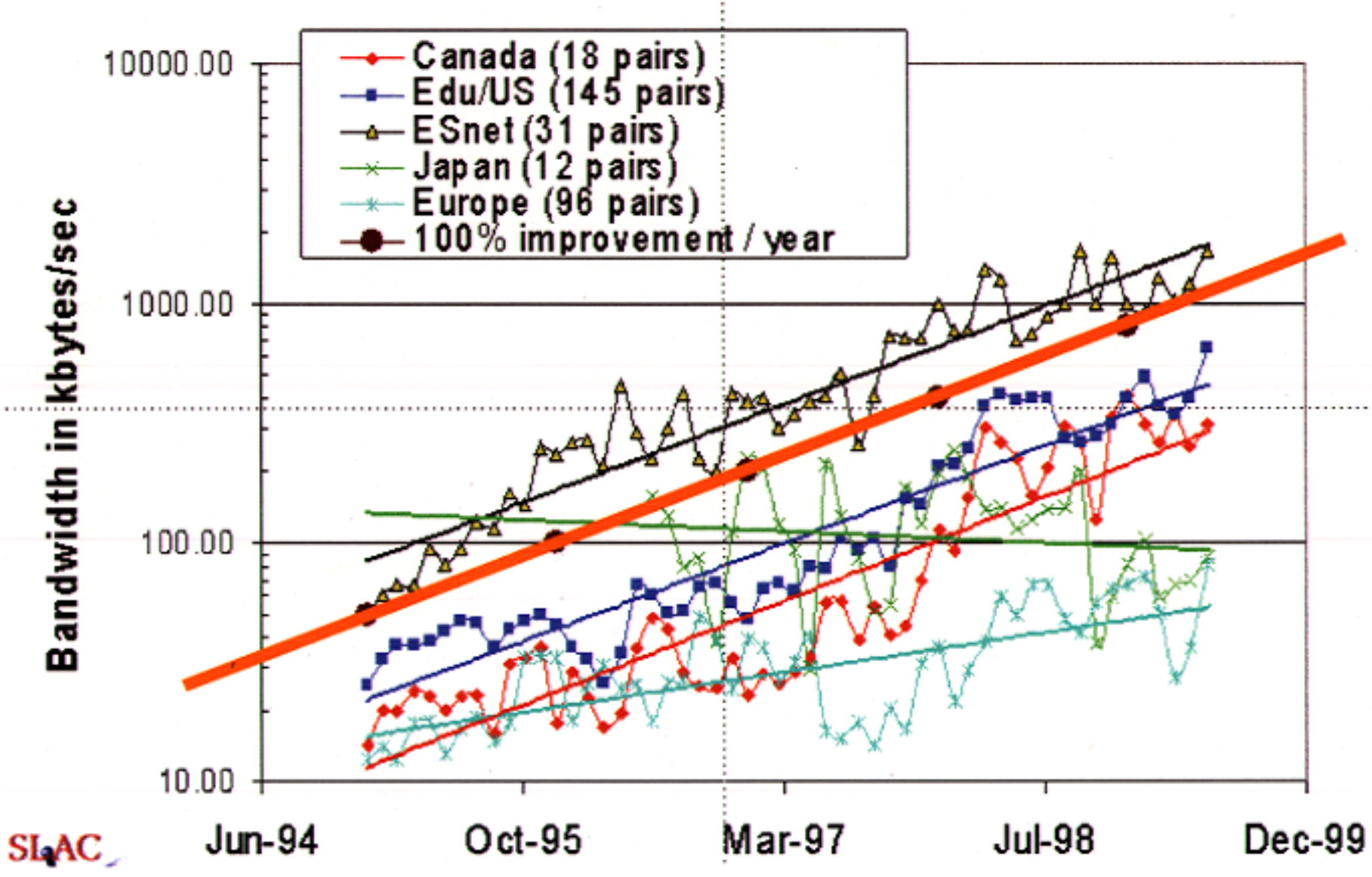
- 19 Monitor sites, 10 countries
- 1300 monitor-remote-site pairs
- 379 unique hosts, 27 countries
- Measure response, jitter, loss, reachability
- Data goes back > 4 years
- 1 Million probes of Internet/day

Deployment in HEP

- Over 50% of HEP collaborator sites are explicitly monitored as remote sites by PingER
  - Atlas (37%), **BaBar(68%)**, Belle(23%), **CDF(73%)**, CMS (31%), **D0(60%)**, Zeus (35%), Aleph, Delphi, Opal, L3 (43%)
  - Created focussed PingER pages for **BaBar, CDF, D0, RHIC**
- Remainder represented by beacon sites
  - Selected to represent countries/R&E nets
  - About 50 beacon sites in 27 countries

Performance Trends

Bandwidth $_{TCP}$ < 1460/(RTT * sqrt(loss))



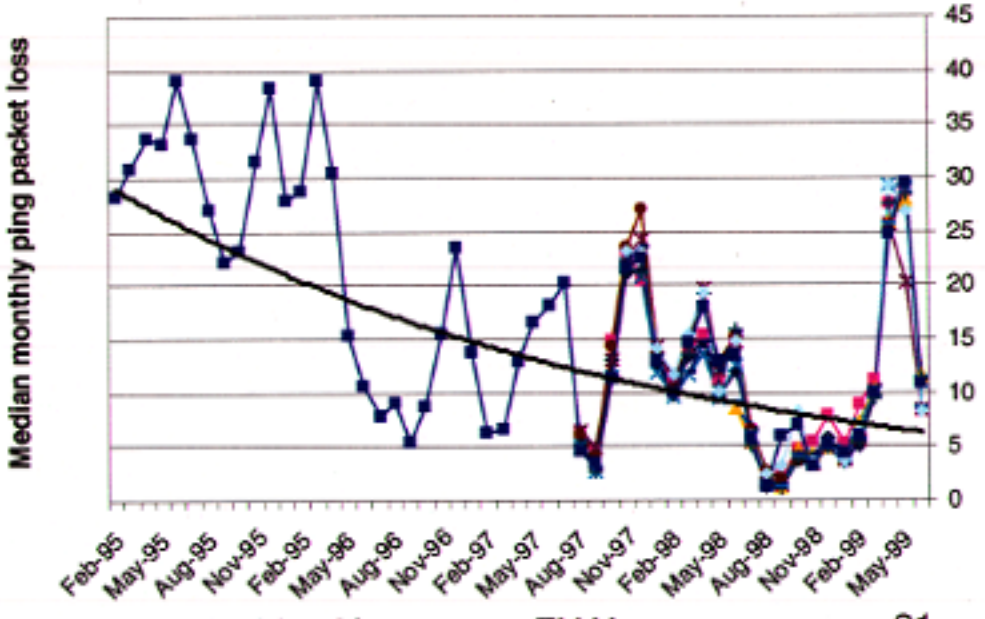
Problem areas

Germany bad with Canada & .edu
yet good with ESnet
Russia (W) bad to everywhere
yet good with Esnet
China poor with most

WORLD	uk	edu	ca	de	net	jp
uk	0.20		5.97	0.72		2.80
edu		0.16		14.13	0.17	
ca	5.61				0.15	
de	0.69	3.11		0.30		3.03
net	4.45		5.16		3.77	
jp		0.53	2.98		0.30	0.51

Peering is critical, avoid congestion points, reduce number of NSPs, reliance on your NSP

UK varies with time, bandwidth increased by factor of ~80 in 4 years



Overview & Future directions of Internet Monitoring in HEP

- Action Items:
  - Need to add India to the Beacon sites. ✓
  - Calibrate the formula ✓

    TCP BW < (MSS/RTT)* (1/sqrt(loss))

    with measurements within the HEP community, e.g. CERN-SLAC, SLAC-LBNL etc.
  - HEPNRC will redouble its efforts to get more heavily involved with PingER once again.
  - Increase efforts to gather and archive traceroutes between major sites
- Recently added 3 more PingER monitoring sites:
  - at RAIKEN (a fusion site in Japan)
  - at KAIST a site in Korea (center for the Asia Pacific Advanced Network)
  - ANSP in Sao Paolo Brazil
  - We are currently working to get a site up at ITEP in Moscow.

Network monitoring conclusions

- Performance is getting better
- ESnet is well provisioned
- Within R&E networks things are good
- Transoceanic, needs special care
- Peering is critical
- Monitoring bare network
  - If one wants to go beyond ping to start to understand network aware applications and understand the barriers to higher throughput it will need to involve the applications people. This would be less global than PingER, i.e. more focussed on point-to-point particular links and applications. This is not part of the monitoring group's responsibilities.
  - Report on Survey & tracking of HEP network aware applications, QoS, prototyping work in the area of:
    - distributed databases, data transfer, collaborative tools

SCIC Summary: Working Groups

- Requirements Analysis Working Group
  (Harvey Newman & Matthias Kasemann)
  - Proposed action
    - compare expected requirements for 2000 to reality
    - comment on "network aware" applications, R&D prototyping effort
    - Report to ICFA in Spring 2000
- Technology, status, cost & development/expectations for HEP
  (Richard Mount, Michael Ernst, David Williams)
  - Keep track of technology trends:
    - review networking activities and initiatives,
    - report on pilot projects,
    - have active participation of ICFA-SCIC members in projects

SCIC Summary

- Need small focussed task force to address particularly bad performance areas:
  - Japan-US, Japan - Europe: some relief on the horizon
  - Canada-Germany (getting Germany to STARTAP)

- Document Status of Remote regions
  - get reports from India, Pakistan
  - UK - N. America: invite UK person to report on connectivity.

SCIC Summary

- Reports to ICFA planed:
  - Summer 1999:
    monitoring results, short report on activity, report on short term bottlenecks
  - Spring 2000 / 2002 / ... every 2 years:
    monitoring results, recommendations for long term situation
  - Spring 2001 / 2003 / ... every 2 years:
    monitoring results, update report on requirements
  - First report to ICFA on Feb 10,11 2000,
    (report ready by October, 1999)
  - 3rd Meeting: November 13, 1999 CERN at which we derive recommendations for the ICFA report.

Discussion Topics

- General academic & research networks often provide national service only. How to improve international connectivity?
  - Rely on available peering of national A&R networks?
  - HE(N)P funded solutions (need agreement between peers)?
  - Who are partners: Laboratories, Collaborating Institutes, Funding Agencies?
  -
  -
  -

Discussion Topics

- In which areas can networking and the availability of network aware applications improve the efficiency of a world wide distributed HE(N)P collaboration?
  - Communication
  - experiment control and monitoring
  - data access and analysis
  - reducing travel load = increasing work efficiency
  -
  -
  -
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Discussion Topics

- Which applications and technology needs are HEP specific, so we have to invest in R&D to find novel solutions?
- Which technologies will be driven by commercial interests (we can sit back and use what is available)?
  - Communication
  - collaboration over distance (virtual presence, ...)
  - data distribution
  - network aware applications
  - distributed data analysis
  -
  -

Discussion Topics

- How much improvement on data analysis techniques can we expect from R&D on simulating the analysis needs and the impact on networks?
  - Investigate data models
  - investigate data flow
  - geographical distribution of resources (CPU and storage)
  - 'virtual' presence of world wide distributed scientist
  -
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  -