Bringing the World Wide Web to America

Paul F. Kunz

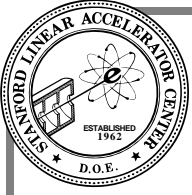*<Paul_Kunz@SLAC.Stanford.edu>*

Stanford Linear Accelerator Center

On Dec. 12, 1991 the first Web server in America was installed, by me, on SLAC's IBM mainframe.

Today, if you don't have access to the Web, you are probably considered disadvantaged

- How did it happen that research in High Energy Physics invented the Web?

- What role did academic research, and HEP in particular, play in developing the ingredients needed for this?

This is the story on how it happened from my perspective

Ingredients

Before we could have the Web, we had to have…

- "free" networking

- common international network for everybody, academic, commercial, and personal use

- open network protocol

- network aware operating systems

- productive software development environments

- Open Source environment and culture

Brief look at the history of how this developed
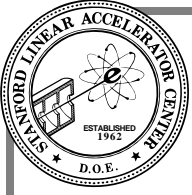
UNIX and the ARPANet

They grew up together in the '70s and early '80s

- Both were computer science research funded by Advanced Projects Research Agency of the DoD

- when academics had needs, they invented new protocols
  - e-mail
  - ftp
  - telnet

- UNIX easily allowed this, or was it that UNIX was made to allow it?

- the Open Source culture developed

- during this time, HEP thought UNIX was a four letter word
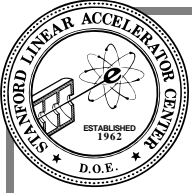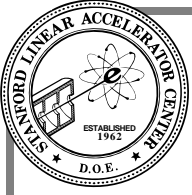
No common network

During much of the '80s, there were separate networks

- ARPANET: computers funded by ARPA
  - mostly UNIX
  - mostly computer science departments
  - but the foundations of the internet were born

- Various DECNets: proprietary network of DEC computers running VMS operating system
  - HEP had one net (started ~1980), NASA another, and who knows how many others there were
  - each funded by one agency and served one research community
  - serious problems were caused when DoE and NASA DECNets crossed paths
  - wasn't scalable, was effectively closed
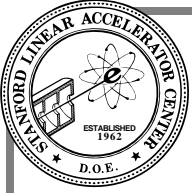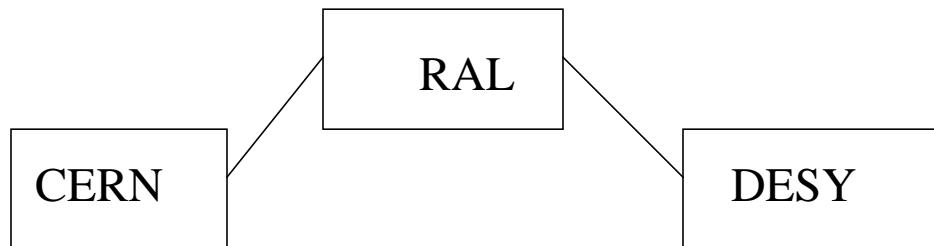
Networks of broader scope

- BITNET: network of academic computing centers using IBM protocols
  - started May 1981 between CUNY and Yale
  - open to entire university including users non-IBM computers (e.g. DEC VMS)
  - SLAC joined in June 1983, 25th site and the rest of HEP followed
  - no central funding agency
  - self governing by volunteers
  - but limited capability compared to ARPANET or DECNet

- EARN: BITNET extension to Europe
  - funded by IBM
  - had significant impact on international networking and HEP played important role
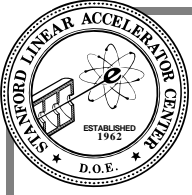
The EARN Story

IBM had plans in 1982…

- IBM proposed linking European research centers and universities together and to BITNET

- CERN would be the major hub

- European PTTs, especially Germany, initially wouldn't allow it

- handling of traffic by a third party was illegal!

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        │  CERN    │            │  DESY    │
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- no traffic between CERN and DESY was allowed

- PTTs said you had to use their OSI X.25 services with which you paid, a lot, by the byte

- you paid even more for bytes crossing borders

- even Washington felt the pressure and ordered all labs to have 5 year plan to convert to OSI X.25

- in Fall of 1984, things looked grim

The PTTs were beaten

Slowly, the PTT's grip on networking was lost…

- US to Italy link got established in February 1984

- Italy to Israel link got established next. Theoretical HEP physicist Haim Harari played crucial role

- links spread to Spain and southern France

- the Swiss, following the German lead, refused to allow CERN to connect

- finally, the German PTT allows temporary links, until their X.25 infrastructure was in place early in '85

- for many months Northern and Southern Europe are connected only by separate links to the States

- the Swiss allows link between CERN and Italy

- the US HEP DECNet links to CERN as well the Italian HEP DECNet; the Swiss PTT allows it after much discussion

- the ARPANET links Scandinavia to the States

- by the time PTTs had X.25 in place, traffic on temporary networks was too high for it to handle
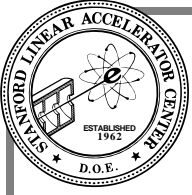
The EARN success

IBM cleverly, or accidently, used academics to break down the PTT power over period of 4-5 years

One can imagine the argument made…

- European nations spend billions on scientific research

- European scientists were at risk of falling behind Americans because of lack of networking

HEP, space science, and other big science projects were played an important role

- they had large and obvious need

- the large international laboratories were visible to government officials

- the laboratories had experience dealing with high government officials

The success allowed the rapidly growing US internet expand internationally

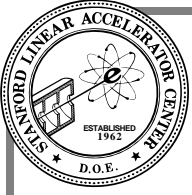HEP also funded networking to Russia and China
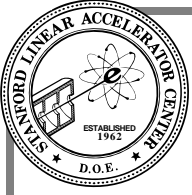
The Internet becomes dominant

The National Science Foundation made it happen…

- Al Gore, Jr. *did* play a role

- Congress mandated that the NSF build supercomputer centers for American researchers

- NSF solicited proposals for region networks

    – use ARPANET technology
    – self governing
    – must be available to the entire university research community, like BITNET
    – NSF supplied backbone as network of networks, thus the word *internet*

- NSFNet saturates and was upgraded to 1.544Mbps

- still academic network, except for companies with joint research projects with academics

- HP asks NSF if it can support customers via the net

- NSF stops funding of backbone, internet becomes self supporting commercial network

- The use of backbone remains free and ARPANET culture persists

The last ingredient

The role of NeXTStep…

- from Steve Job's NeXT computer company

- sold as the next great thing for desktop publishing, then dominated by the Macintosh

- underlying system was UNIX, so had all the well known software development tools including all the internet suite of software.

- applications were very much easier to develop than any prior platform because…

    – foundation was object oriented
    – GUI building tools were part of the system

The greatness of the NeXTStep can be measured by the large number of quality applications produced by a very small community.

A mere mortal with a good idea, could program an application in a reasonable amount of time to try them out and show it off to others.
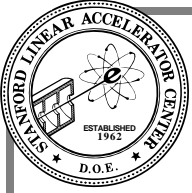
The Web is Invented

The ingredients are in place…

- international, free and open internet

- excellent application development environment geared to desktop publishing

Tim Berners-Lee, working at CERN, was trying to solve a problem…

- easy document creation and viewing

- document cross reference via hyper links

- world wide document distribution

What were his solutions…

- buy a NeXT computer (Sept. 1990)

- write a hypertext application

- extend hypertext to remote computers by adding a new protocol to the internet: HTTP

He had a demonstrable application by Christmas
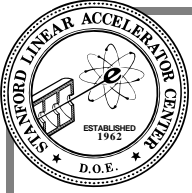
Where I come in

A complete accident…

- bought a NeXT, Feb. 1989, to write a much easier to use physics analysis system.

- saw announcement about WWW, Aug. 20th, 1991 on internet news group

  - shrugged: "*what are these crazy CERN people up to now?*"
  - did not even fetch the free software to try it out

- CERN visit Sept. 9-13, 1991

  - busy week, scheduled to meet with many people, but not Tim Berners-Lee
  - Tim catches up with me and insists I come see him, I couldn't refuse

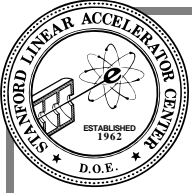- Friday the 13th, I visit Tim late in the afternoon, my last meeting
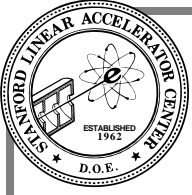
My first view of the Web

What Tim and I did in his office…

- Tim demonstrates Web browser on his NeXT which was the first web server as well

- *Oh hum, I didn't really care about documentation systems*

- Tim demonstrates the Web interface to CERN's IBM mainframe by sending a query to the help system database

- *Now that is interesting, and I immediately had an application in mind. but will it work across the Internet?*

- We upload my NeXT at SLAC with browser software and ran it there with windows sent back to CERN.

- *Worked well, remarkably well*

I told Tim I was going to put SLAC's SPIRES database on the Web, as soon as I got home.
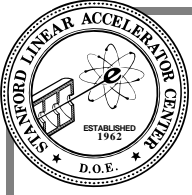
The Web comes to America

On my return from CERN…

- I demonstrate the Web browser to Louise Addis, SLAC librarian, and others by connecting to CERN servers

- Would you like me to start a server connected to the library's SPIRES database, I ask?

- **YES**, by all means

- I give the job to someone else, then forget about it. I was too busy with my more important project.

- Nothing much happens for three months

- prompted by the Louise and Tim, I finished the job

- on Dec. 12, 1991, I sent e-mail to Tim asking him to try out our newly installed Web server

SLAC was the within the first dozen sites in the world and the first outside of Europe to have a Web server

Tim Berners-Lee was very excited abut the SLAC Web server, and used it frequently in public demonstrations

What happened after that

The SPIRES-Web application at SLAC was the killer app for the Web…

- The SLAC SPIRES database had 200,000 records that physicists really wanted to search; 1000s of users in 40 countries

- Before the Web, it was hard to access and had an awkward command line interface

- The Web interface was easy to use and could be accessed from any computer on the internet

- enthusiasm for the Web within HEP grew enormously, even at CERN, because of SLAC server

- growing use of the Web by HEP was seen by other academic centers such as NCSA where Marc Andressen developed the Mosaic browser
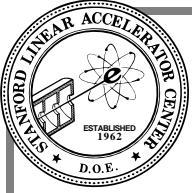
Conclusions

We all understand academic research directed towards producing tangible benefits, for example

- ARPA funded network development

- medical research

Less well understood is how academic research in fields like high energy physics also leads to developments for the public good

The internet and the World Wide Web are a dramatic demonstrations of the results from an open, academic research environment