Farming Data for the *HyperCP* Experiment

How a small collaboration farmed a large amount of data.

Timothy Holmstrom

University of Virginia

International Conference on

Computing in High Energy and Nuclear Physics

Beijing, China, September 05, 2001

The *HyperCP* Collaboration

A. Chan, Y.C. Chen, C. Ho, and P.K. Teng
Academia Sinica, Nankang, Taipei 11529, Taiwan, Republic of China

W.S. Choong, Y. Fu, G. Gidal, P. Gu, T. Jones, K.B. Luk, B. Turko, and P. Zyla
Lawrence Berkeley Laboratory and University of California, Berkeley, CA 94720, USA

C. James and J. Volk
Fermilab, Batavia, IL 60510, USA

J. Felix
Universidad de Guanajuato, León, Mexico

R.A. Burnstein, A. Chakravorty, D.M. Kaplan, L.M. Lederman,W. Luebke,
D. Rajaram, H.A. Rubin, N. Solomey, Y. Torun,C.G. White, and S.L. White
Illinois Institute of Technology, Chicago, IL 60616, USA

N. Leros and J.-P. Perroud
Université de Lausanne, Lausanne, Switzerland

H.R. Gustafson, M.J. Longo, F. Lopez, and H. Park
University of Michigan, Ann Arbor, MI 48109, USA

M. Jenkins and K. Clark
University of South Alabama, Mobile, AL 36688, USA

E.C. Dukes, C. Durandet, R. Godang, T. Holmstrom, M. Huang, L.C. Lu, and K.S. Nelson
University of Virginia, Charlottesville, VA 22901, USA

Why do we need a large amount of data?

- We are doing a CP violation measurement of the decays $\Xi \rightarrow \Lambda\pi$, $\Lambda \rightarrow p\pi$, and their anti-matter counterpart.
- The Standard model suggests that an asymmetry could exist at the 10^{-4} level. We hope to make a measurement at the 2×10^{-4} level.

HyperCP Data Acquisition System

- Highest rate (90,000 events/s) DAQ in the world.
- Maximum data rate of 27 MB/s onto 27 Exabyte 8705 tapes.

HyperCP Yields

- In two runs, 1997 and 1999, we took: **231 billion** events, **29,401** tapes, and **119.5 TB** of data.

Triggered Events

Trigger	Beam +	Beam -	Total
Xi	80×10^9	40×10^9	120×10^9
All	157×10^9	74×10^9	231×10^9

Reconstructed Events

Type	Beam +	Beam -	Total
$\Xi \rightarrow \Lambda\pi$	0.46×10^9	2.0×10^9	2.46×10^9
$K \rightarrow \pi\pi\pi$	0.39×10^9	0.16×10^9	0.55×10^9
$\Omega \rightarrow \Lambda K$	5.0×10^6	14×10^6	19×10^6

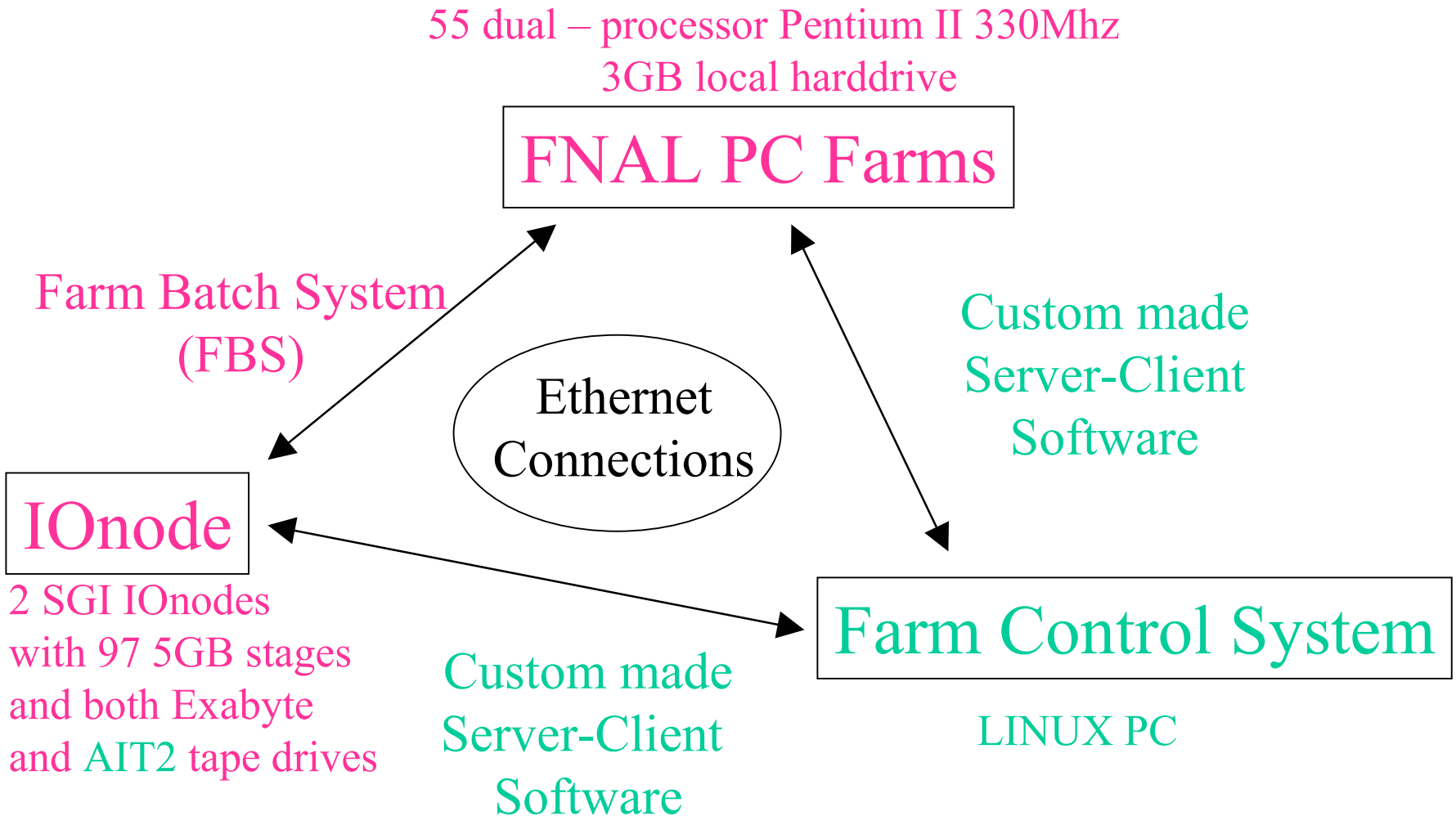
Data Volume of Selected Experiments

Parameters	Aleph	Babar	*HyperCP*	CDF	CMS
Event Size (MB)	0.25	0.05	0.0005	0.25	1.00
Data/yr (TB/yr)	1	100	120	450	2000
Collab.	300	500	42	600	2000

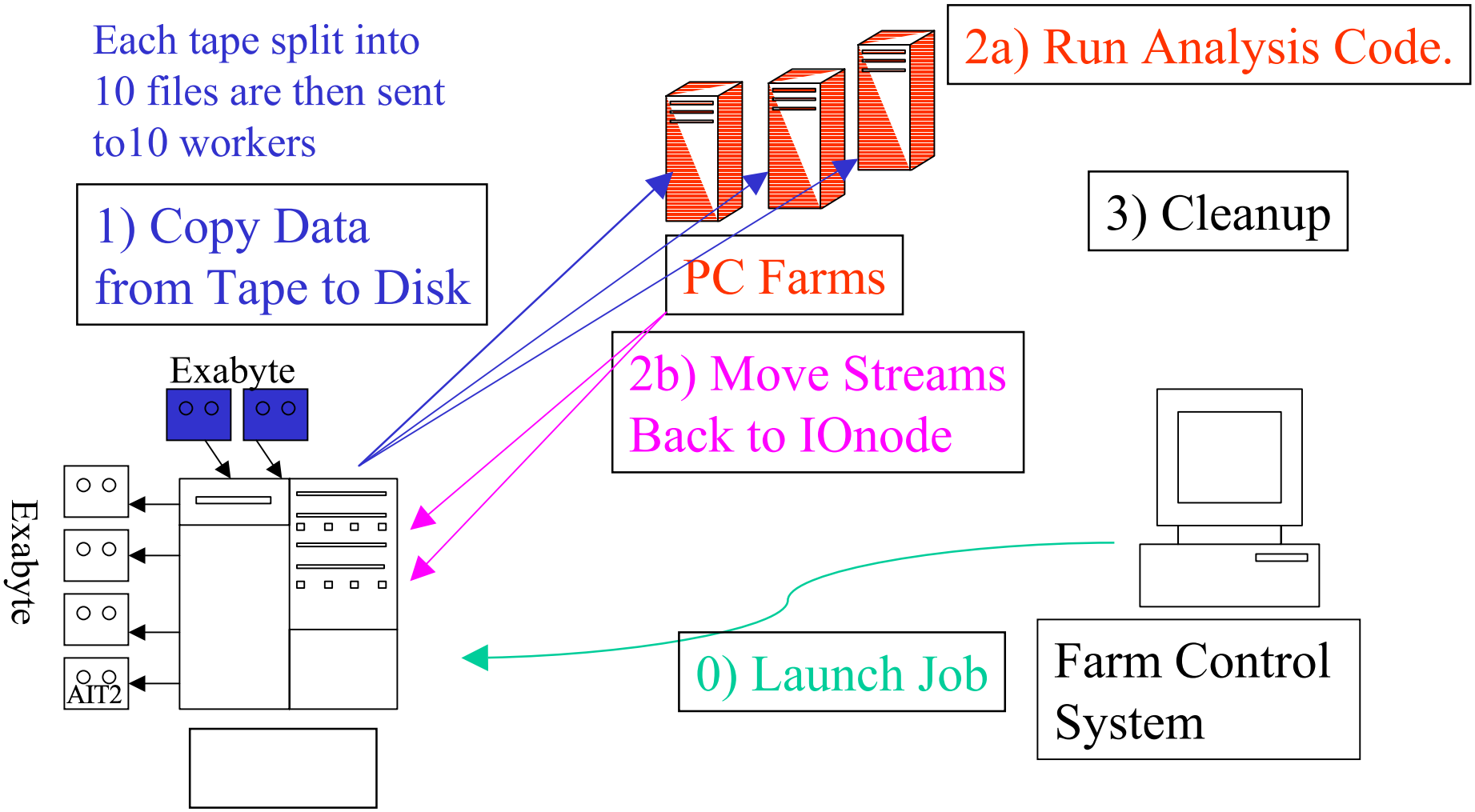
Goal of the *HyperCP* Farming

- Run track reconstruction on data.
- Make loose event selection, so as not to bias CP measurement, for 4 output streams.
- Create DST information, but we didn't remove raw information, so no reduction in event size.
- Monitor data quality – make run and spill level histograms.

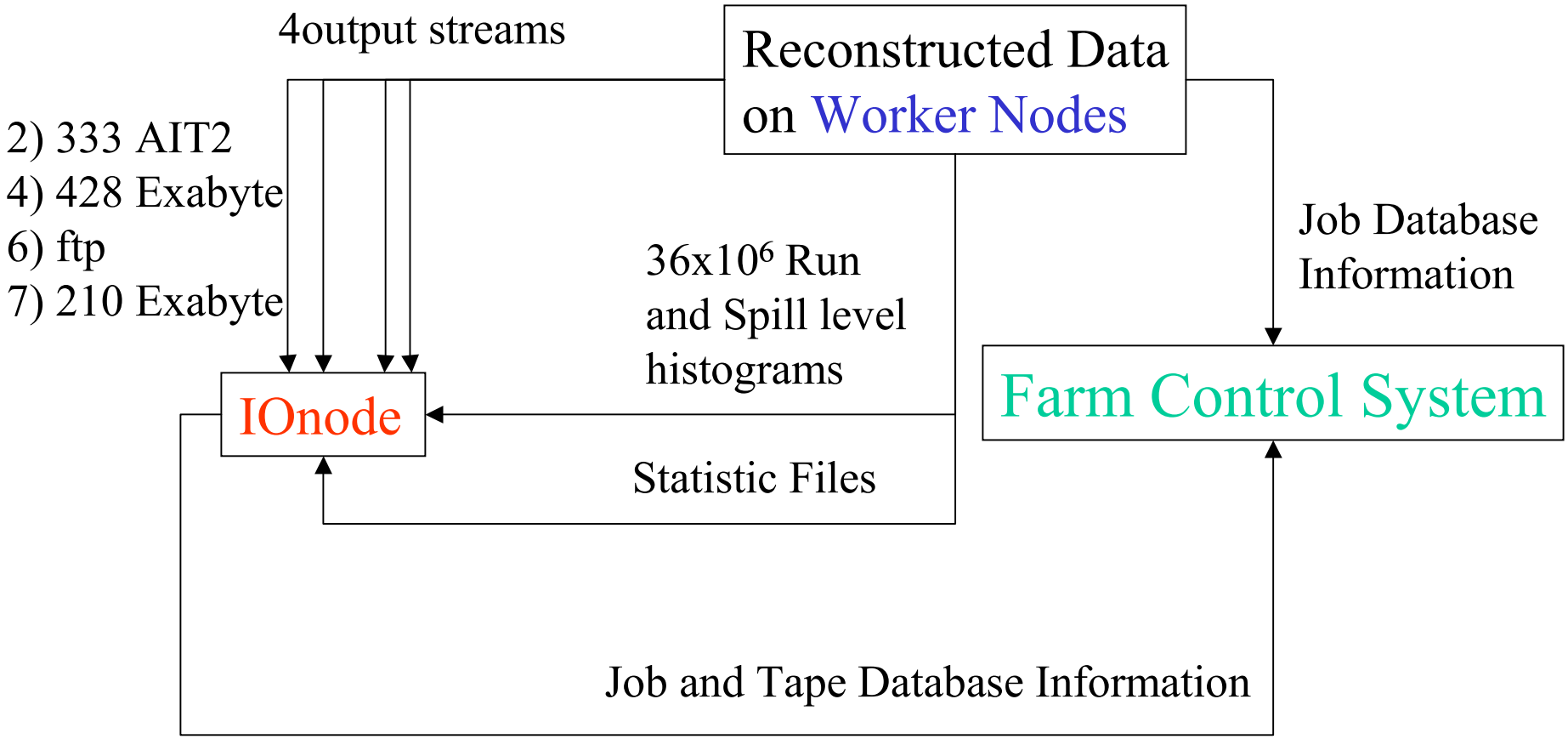
Overview of the *HyperCP* Farm



Job Structure



Farm Outputs



Databases

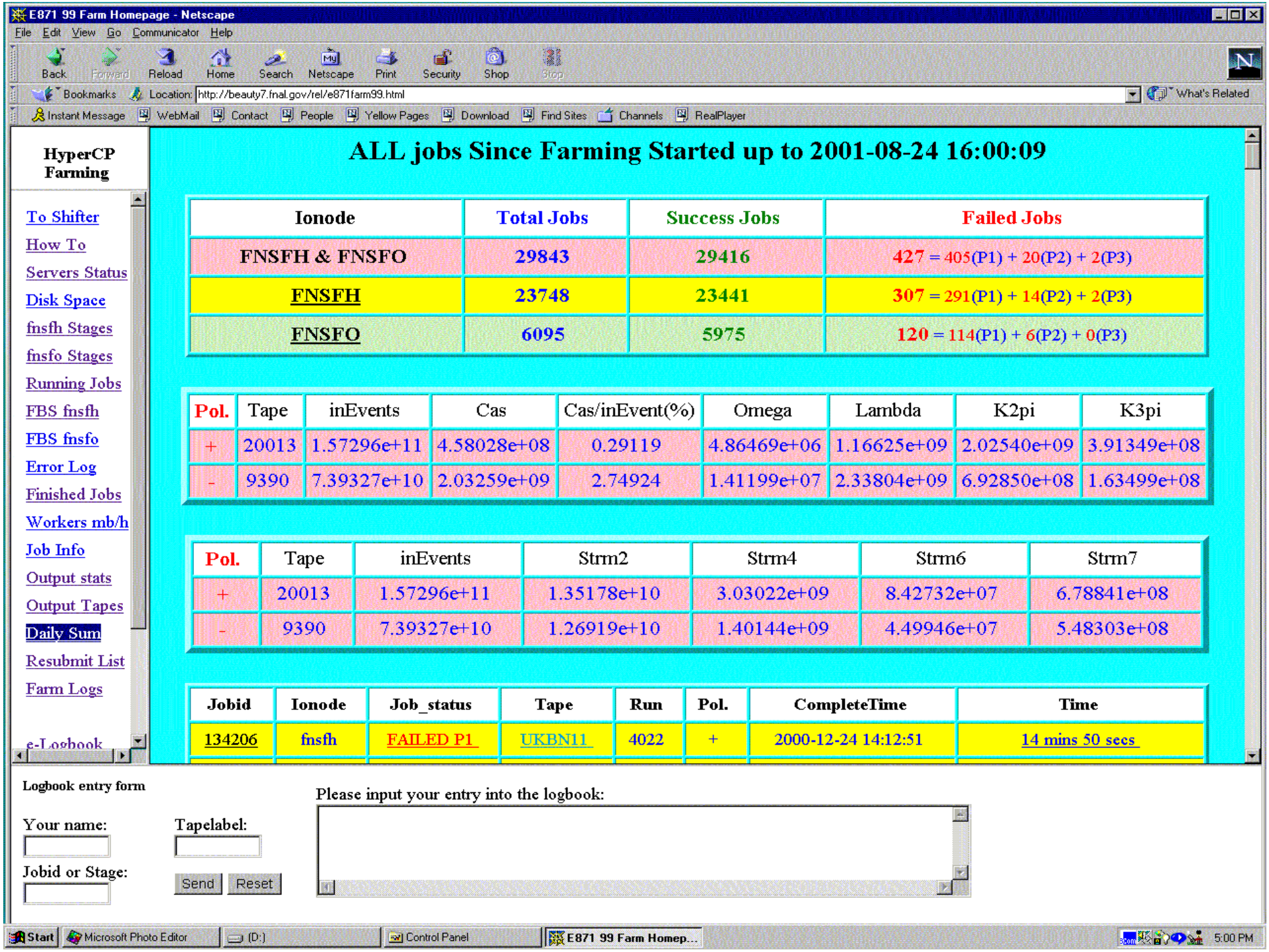
- The database we used was Postgres-SQL.
- Tape Database
  - Information on where input tapes output went.
- Job Database
  - Information on the success and failure of each stage of farming.
- Perl scripts were used to access the database and create our web pages.
- Perl scripts to access histograms and statistics.

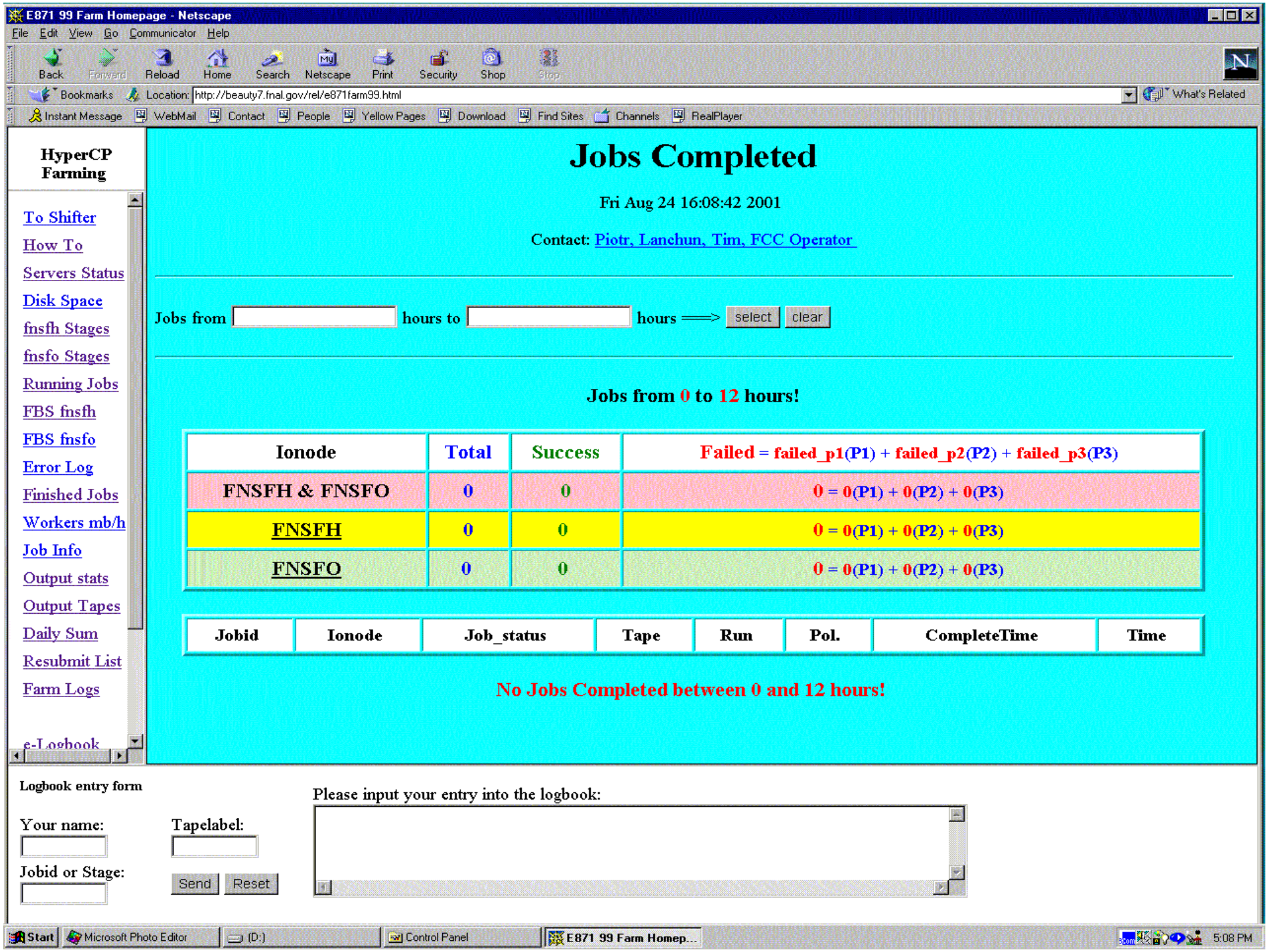
Running the Farms

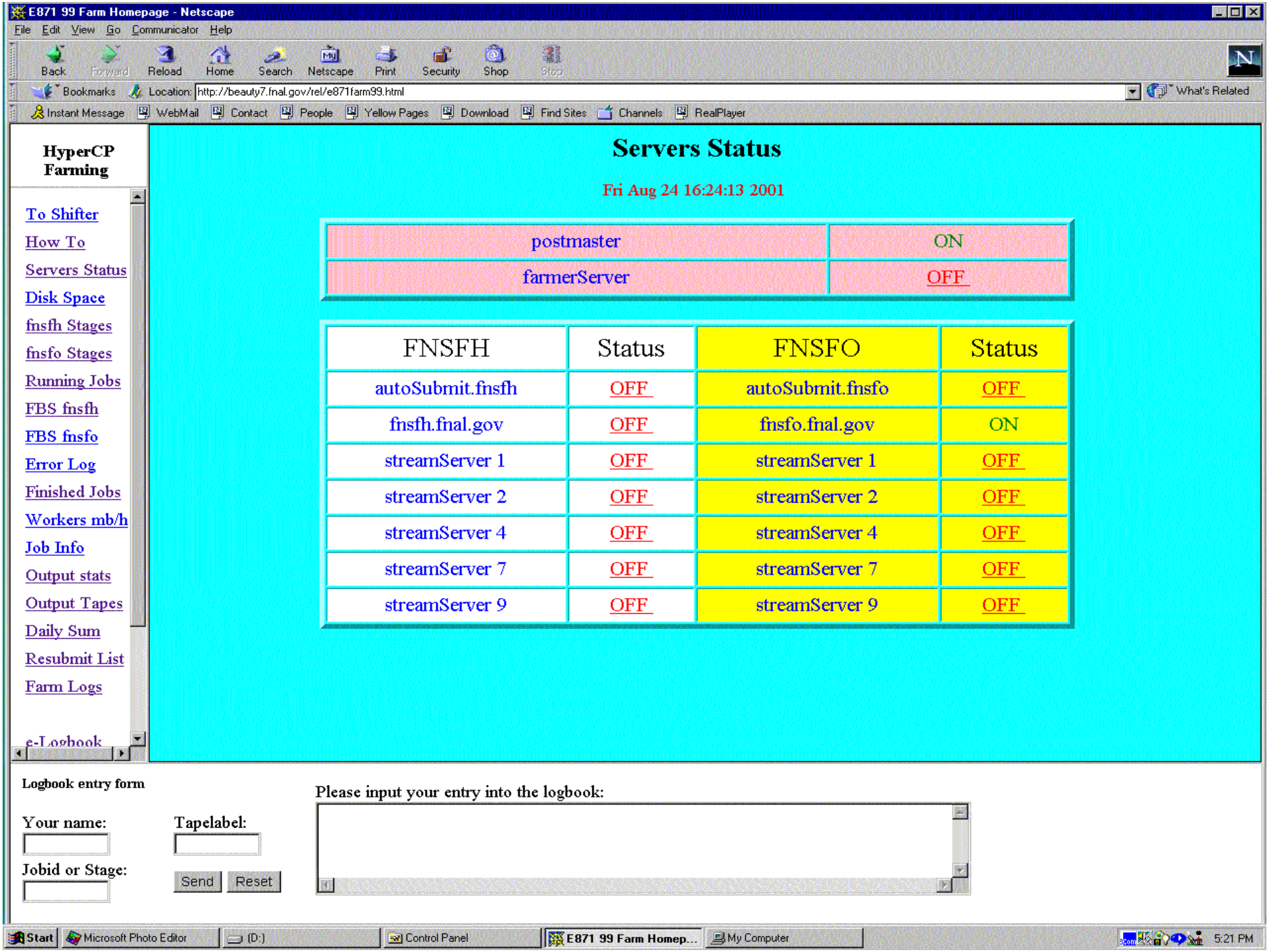
- System was completely automatic. If there was no network or hardware problems, data was processed with only one push of a button.
- Two types of farmers: Shifters and Experts.
- Monitored and run remotely using our custom built dynamic web page.
- Results: 29,401 tapes were successfully processed, with 427 tapes unable to be processed (1.4%), in 11 months of running at a rate of 364 GB/day.

Tasks for Shifters

- Monitored the status of all jobs through the web page 3 times a day.
- Initial debugging of failed jobs.
- Checked status of farm servers.
- Checked status of IOnode stages.
- Looked for performance problems on worker nodes.
- Made sure outputs were reasonable.


E871 99 Farm Homepage - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Shop Stop
Bookmarks Location: http://beauty7.fnal.gov/rel/e871farm99.html
What's Related
Instant Message WebMail Contact People Yellow Pages Download Find Sites Channels RealPlayer
HyperCP Farming
To Shifter
How To
Servers Status
Disk Space
fnsfh Stages
fnsfo Stages
Running Jobs
FBS fnsfh
FBS fnsfo
Error Log
Finished Jobs
Workers mb/h
Job Info
Output stats
Output Tapes
Daily Sum
Resubmit List
Farm Logs
e-Logbook
ALL jobs Since Farming Started up to 2001-08-24 16:00:09
Ionode | Total Jobs | Success Jobs | Failed Jobs
FNSFH & FNSFO | 29843 | 29416 | 427 = 405(P1) + 20(P2) + 2(P3)
FNSFH | 23748 | 23441 | 307 = 291(P1) + 14(P2) + 2(P3)
FNSFO | 6095 | 5975 | 120 = 114(P1) + 6(P2) + 0(P3)
Pol. | Tape | inEvents | Cas | Cas/inEvent(%) | Omega | Lambda | K2pi | K3pi
+ | 20013 | 1.57296e+11 | 4.58028e+08 | 0.29119 | 4.86469e+06 | 1.16625e+09 | 2.02540e+09 | 3.91349e+08
- | 9390 | 7.39327e+10 | 2.03259e+09 | 2.74924 | 1.41199e+07 | 2.33804e+09 | 6.92850e+08 | 1.63499e+08
Pol. | Tape | inEvents | Strm2 | Strm4 | Strm6 | Strm7
+ | 20013 | 1.57296e+11 | 1.35178e+10 | 3.03022e+09 | 8.42732e+07 | 6.78841e+08
- | 9390 | 7.39327e+10 | 1.26919e+10 | 1.40144e+09 | 4.49946e+07 | 5.48303e+08
Jobid | Ionode | Job_status | Tape | Run | Pol. | CompleteTime | Time
134206 | fnsfh | FAILED P1 | UKBN11 | 4022 | + | 2000-12-24 14:12:51 | 14 mins 50 secs
Logbook entry form
Your name:
Tapelabel:
Jobid or Stage:
Send Reset
Please input your entry into the logbook:
Start Microsoft Photo Editor (D:) Control Panel E871 99 Farm Homep... 5:00 PM


E871 99 Farm Homepage - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Shop Stop
Bookmarks Location: http://beauty7.fnal.gov/rel/e871farm99.html
What's Related
Instant Message WebMail Contact People Yellow Pages Download Find Sites Channels RealPlayer
HyperCP Farming
To Shifter
How To
Servers Status
Disk Space
fnsfh Stages
fnsfo Stages
Running Jobs
FBS fnsfh
FBS fnsfo
Error Log
Finished Jobs
Workers mb/h
Job Info
Output stats
Output Tapes
Daily Sum
Resubmit List
Farm Logs
e-Logbook
Jobs Completed
Fri Aug 24 16:08:42 2001
Contact: Piotr, Lanchun, Tim, FCC Operator
Jobs from hours to hours ==> select clear
Jobs from 0 to 12 hours!
Ionode | Total | Success | Failed = failed_p1(P1) + failed_p2(P2) + failed_p3(P3)
FNSFH & FNSFO | 0 | 0 | 0 = 0(P1) + 0(P2) + 0(P3)
FNSFH | 0 | 0 | 0 = 0(P1) + 0(P2) + 0(P3)
FNSFO | 0 | 0 | 0 = 0(P1) + 0(P2) + 0(P3)
Jobid | Ionode | Job_status | Tape | Run | Pol. | CompleteTime | Time
No Jobs Completed between 0 and 12 hours!
Logbook entry form
Your name:
Tapelabel:
Jobid or Stage:
Send Reset
Please input your entry into the logbook:
Start Microsoft Photo Editor (D:) Control Panel E871 99 Farm Homep... 5:08 PM


E871 99 Farm Homepage - Netscape
File Edit View Go Communicator Help
Back Forward Reload Home Search Netscape Print Security Shop Stop
Bookmarks Location: http://beauty7.fnal.gov/rel/e871farm99.html
What's Related
Instant Message WebMail Contact People Yellow Pages Download Find Sites Channels RealPlayer
HyperCP Farming
To Shifter
How To
Servers Status
Disk Space
fnsfh Stages
fnsfo Stages
Running Jobs
FBS fnsfh
FBS fnsfo
Error Log
Finished Jobs
Workers mb/h
Job Info
Output stats
Output Tapes
Daily Sum
Resubmit List
Farm Logs
e-Logbook
Servers Status
Fri Aug 24 16:24:13 2001
postmaster ON
farmerServer OFF
FNSFH Status FNSFO Status
autoSubmit.fnsfh OFF autoSubmit.fnsfo OFF
fnsfh.fnal.gov OFF fnsfo.fnal.gov ON
streamServer 1 OFF streamServer 1 OFF
streamServer 2 OFF streamServer 2 OFF
streamServer 4 OFF streamServer 4 OFF
streamServer 7 OFF streamServer 7 OFF
streamServer 9 OFF streamServer 9 OFF
Logbook entry form
Your name:
Tapelabel:
Jobid or Stage:
Send Reset
Please input your entry into the logbook:
Start Microsoft Photo Editor (D:) Control Panel E871 99 Farm Homep... My Computer 5:21 PM

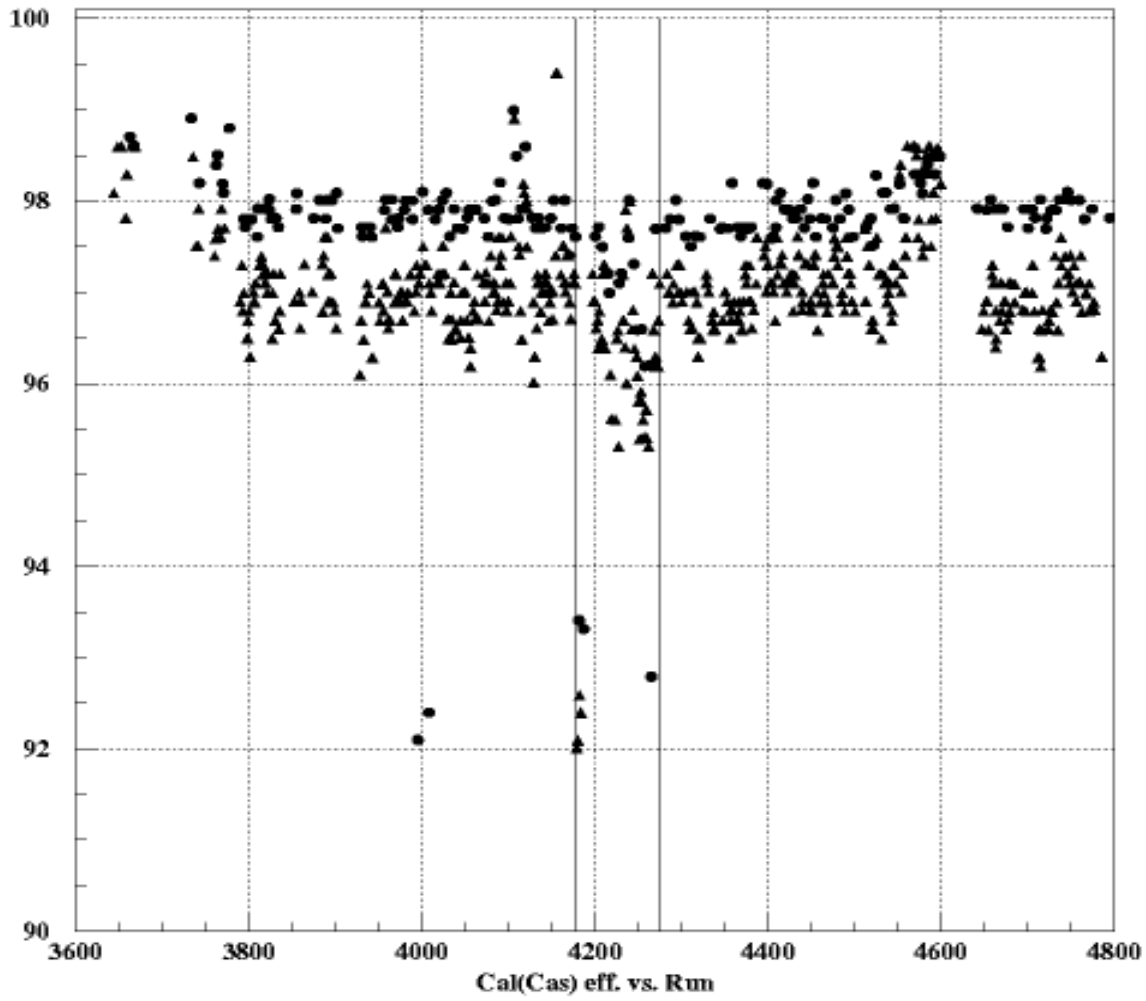
Farming Errors and Recovery

- Tape drive not ready.
  - Tape resubmitted.
- Mislabeled Tape.
  - Tape label corrected and then resubmitted.
- Damaged Tape.
  - Unrecoverable Error
- Farm Crash.
  - Stopped streamers, cleaned up databases, reset farms, and restarted. (Only happened twice during 11 months.)

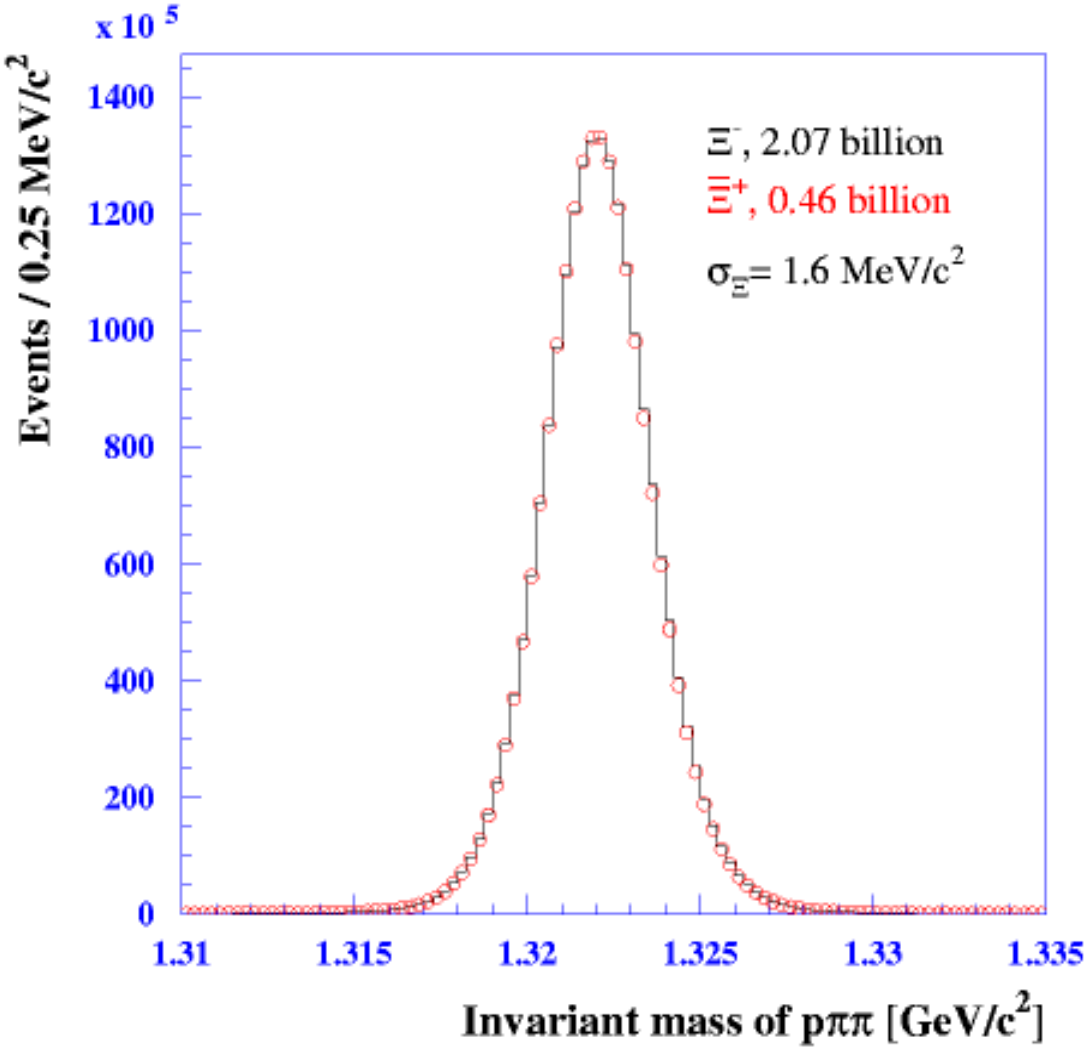
Tasks for Experts

- Debugged failed jobs that shifters couldn't handle.
- Checked that the data on the output tapes was consistent with the database.
- Answered shifters questions.

Typical Statistic File Output



Merged Run Level Histogram



Conclusions

- A small team of physicists using the FNAL farms has successfully farmed a 120TB data set of 231 billion events, on 29,401 tapes.
- A custom-designed web-based interface was crucial in enabling us to run the farms remotely, and allowed more collaborators to contribute to the farming effort.
- Integration of a database in the farming architecture was crucial in both tracking the progress of the farming as well as monitoring the quality of the data.
- The reconstructed DST data and 36 million histograms are now ready for the CP-violation study as well as other physics analysis.