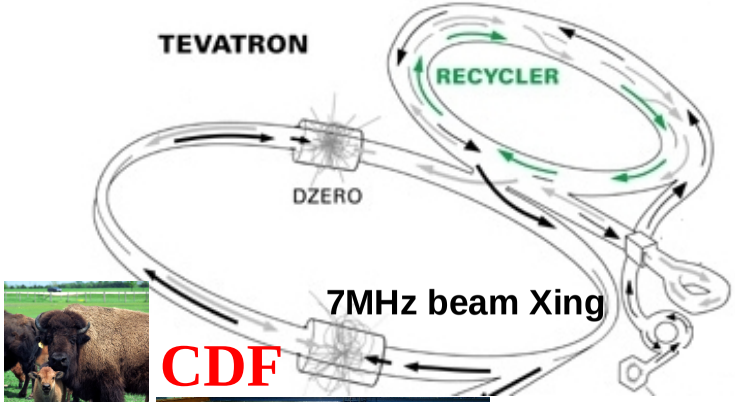
CDF Computing Overview

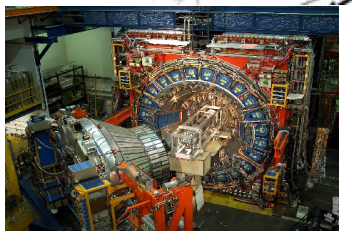
Frank Wurthwein
(UCSD/FNAL-CD)

- Infrastructure Overview
- International Contributions
- CSL upgrade
- Operational Efficiency

CDF DAQ/Analysis Flow



CDF



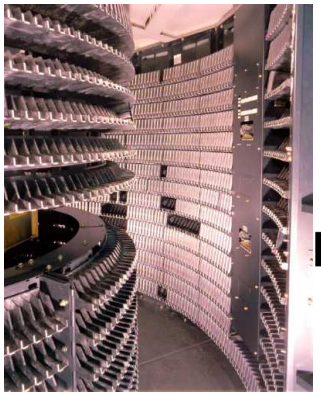
0.75 Million channels

L1
↓
L2
↓
300 Hz

Level 3 Trigger
(~250 duals)

20 MB/s

75 Hz



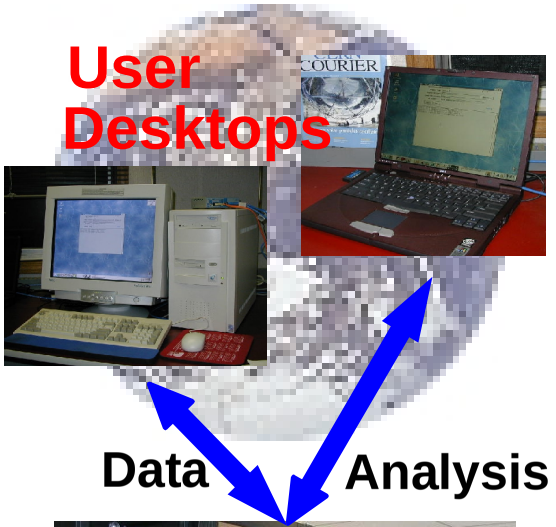
Robotic
Tape Storage

MC Recon

Production Farm
(~150 duals)

Read/write

Data



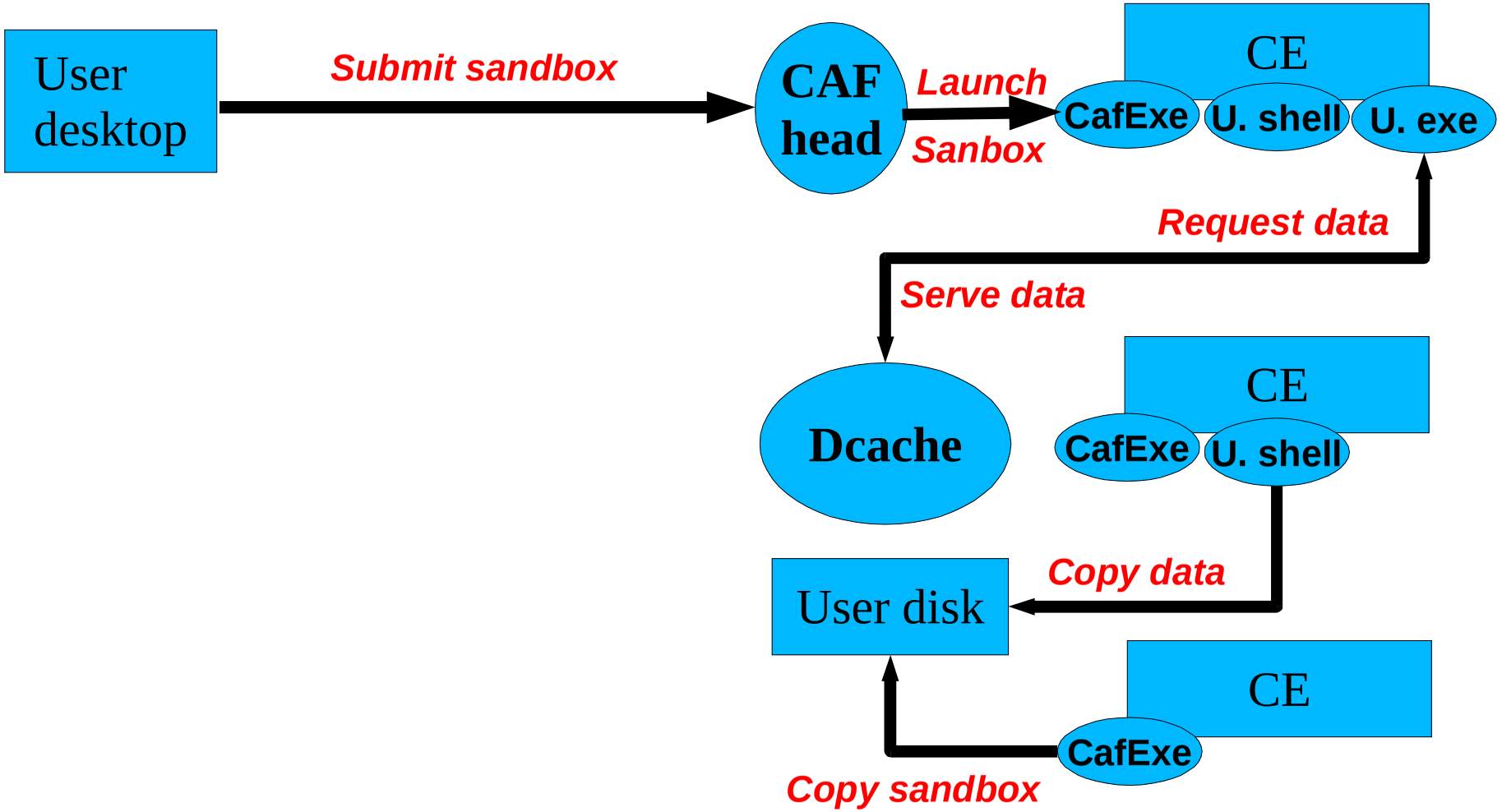
User
Desktops

Data

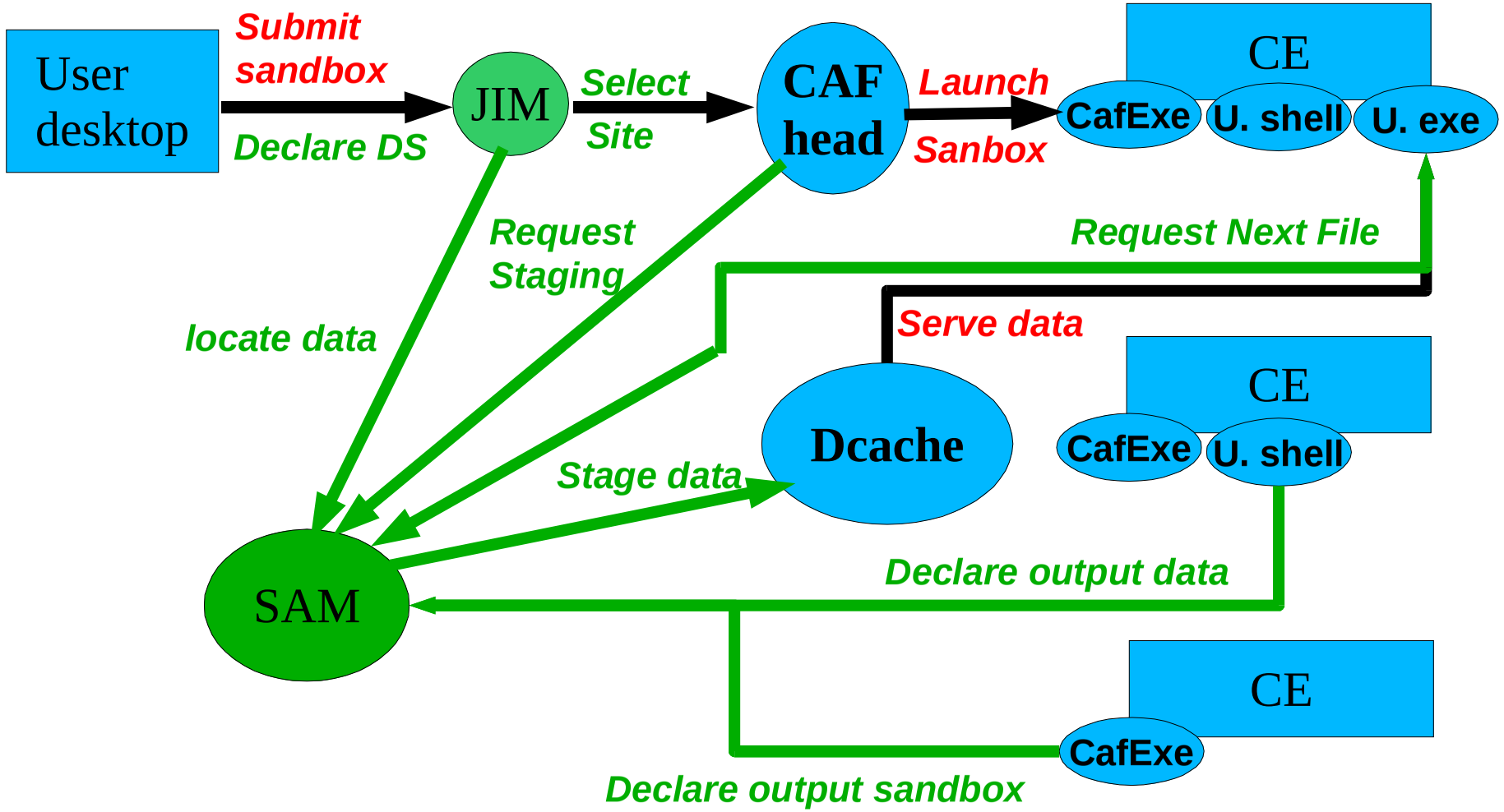
Analysis

Central Analysis Farm
(CAF)
(~300 duals)

CDF Today


User desktop
Submit sandbox
CAF head
Launch
Sanbox
CE
CafExe
U. shell
U. exe
Request data
Serve data
Dcache
CE
CafExe
U. shell
Copy data
User disk
CE
CafExe
Copy sandbox

Future Vision



Technologies & Functions

- **JIM: Inter-site co-scheduling of data and CPU**
- **SAM: Metadata, inter-site data movement, staging prior to execution**
- **Dcache: storage for official & user data**
- **CAF: user interfaces, local site services (based on Condor or FBSNG)**

International Contributions

- CAF contributions & policy
- Offsite MC Production
- Step by step expansion of services

➔ Goal: "virtual center" accounting
based on physics objectives!

CAF Contributions

Roughly 1/3 of CAF CPU & disk space "owned" not by FNAL.

"Service & Useage MOU" signed.

- **Owner has first pick at CPU.**
- **50% of disk space dedicated to CDF group of owners choice.**
- **3 year MOU with FNAL service in FCC.**

MC Production Offsite

Within FY03 migrated from onsite to offsite MC production.

- 110 Million evts produced (60% Canada,30% UK).
- MOU for mcProd coordination (Canada)
- UK lead CDF SAM effort.

Within FY04 provide "DCAF" for MC.

- M IT, UCSD, Rutgers, Korea, INFN, ...
- Negotiations for general access ongoing!
- "Test case" for user level grid computing.

Expansion of Services

- **FY03: coordinated MC offsite.**
- **FY04: user level MC offsite.**
- **FY05: general user analysis offsite.**
- **FY06: "Virtual Center accounting"**

Physics Centers

Centers based on "Physics"
rather than "Region"

- ➔ **Dataset & CPU co-located at center**
- ➔ **Assumes negotiation success ...**
- ➔ **... optimistic given experience with CAF.**

Offline Bandwidth Upgrade

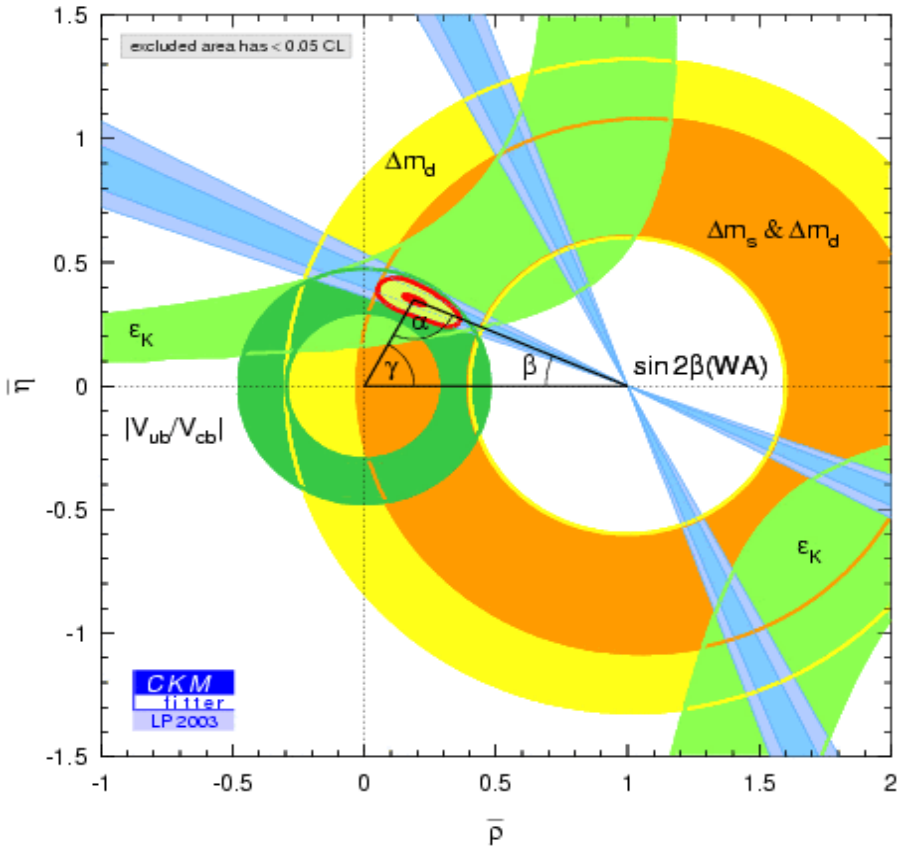
Fiscal year	02	03	04	05	06
CSL rate (MB/sec)	20	20	20	40	60
Raw data compression	No	No	Yes	Yes	Yes
Implied peak event rate (Hz)	80	80	120	240	360
CPU in $M	0.4	0.3	0.8	1.2	1.0

Maximize Physics Output independent of Luminosity.

Saturate bandwidth with low pT physics.

Physics Justification

Largest error due to unknown Bs mixing.



Need ~3.2 fb-1 to "cover" Standard Model allowed range @ 5 std. dev. level.

Key to Success

Maximize Bs to Ds pi yield !

Yield depends on Lumi & L1,L2,CSL bw.

➔ **Fill total bandwidth by nominal plus dynamically prescaled low pt trigger.**

➔ **Up to 66% increase in yield seen.**

Status & Plan

After evt. Size reduction:
25% headroom @ 4e31

➔ L2 now limiting factor!

Pursuing 4 complementary strategies to increase L2 bandwidth by ~x2 within ~6m.

➔ Commission x2 CSL capability in FY04 to keep up with L2,L1.

Operational Efficiency

- Availability of uptodate reconstr. output.
- Coordination of MC production
- Coordination of disk caches.
- Code speed.
- Software ease of use.
- ntuple/micro-DST support.

→ Each one of these can have a significant impact on the average CPU per event & total CPU required.

Setting the Scale

1/15 evts/sec for MC

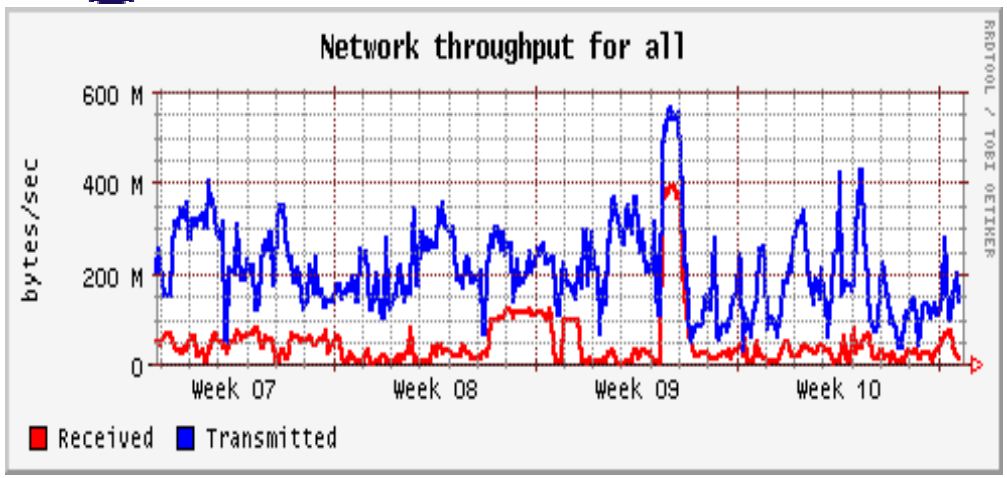
1/3 evts/sec for reconstruction

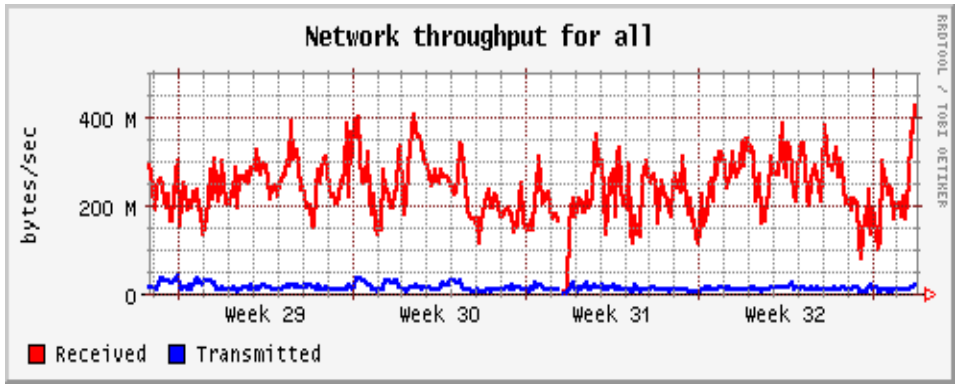
~5 evts/sec for "typical" user analysis

~300 evts/sec for complex ntuple analysis

➔ Organizational issues can have large impact on CPU power needed, or quality of service perceived by user.

Winter vs Summer 03





Winter 03
~200MB/sec for 630GHz

Summer 03
~250MB/sec for 940GHz

➔ In both cases CPU consumption/IO is roughly x2 higher than expected while IO is roughly ok.

Possible Explanations

Users redo part of reconstruction:

e.g. Beamlines & track refitting

-> get (more) useful reco output

Users generate their own private MC's

-> extend offsite MC production capability

Code Speed

Run2 software x10 slower than Run1

common across experiments

CDF doing x10 better on reco,

x2 worse on user anal (no thumbnails)

With code close to mature

and convergence on gcc

-> Good time to expend coherent effort

on code speed improvements.

Software ease of use

"Being able to retain the best young students is one of the most important challenges in our field. The CDF software is sufficiently complex, and frustrating that it's very hard to motivate young students. Students leave HEP to work on something that has quicker entry into physics, and is thus more rewarding."

Henry Frisch & Tony Liss

What to do about it?

- **Better tool support (incl. education):**

  profiler, mem.checker, debugger, code browser
- **Improved ntuple/micro-DST support**
- **Improved documentation.**
- **More coherent interfaces/standards.**
- **Lower threshhold for first time users.**

➔ This is a multi-year collaborative effort of CDF & CD.

Ntuple/micro-DST support

Today: no official support beyond AC++.

- Computing model: ntuple analysis on desktop & remote.
- DH support focused on AC++ only.
- Production farm output not supporting ntuples.
- Code base and production a volunteer effort.

Task force this Fall:

- Understand needs of CDF.
- Understand infrastructure issues.
- Understand support issues.
- Make proposal for actions.

→ Improve service @ reduced cost

→Carrot & Stick approach?

Stick

CSL upgrade affordable only with reduced service.

- **High pT physics: 1 day turn around, 200users.**
- **Low pT physics: 25 days turn around, 15 users.**

➔ Assume users to organize somewhat.

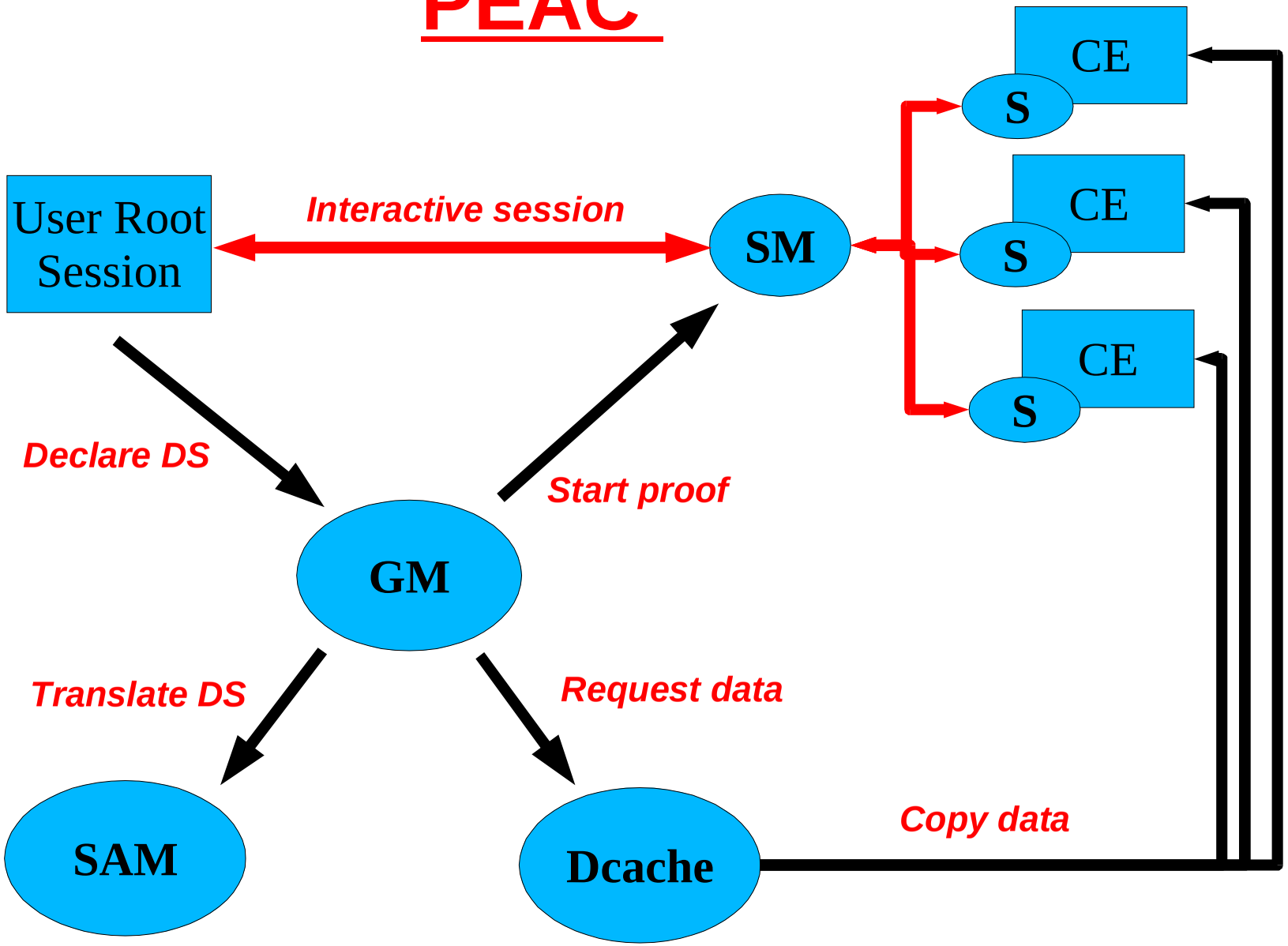
➔Few people create "standard" ntuple.

➔3-5 users 5-8 days?

Carrot

- Priority access to CPU for ntuple creation.
- "Full" DH support.
- MOU/service work recognition of code support.
- PEAC: Proof Enabled Analysis Center
  - "initiate session" in minute(s).
  - "querry" in tens of seconds.
  - Project being formed by UCSD, INFN, MIT, (FNAL, Condor).
  - Future goal: multi-experiment, non-HEP grid.

PEAC


User Root Session
Interactive session
SM
CE
S
CE
S
CE
S
Declare DS
Start proof
GM
Translate DS
Request data
SAM
Dcache
Copy data

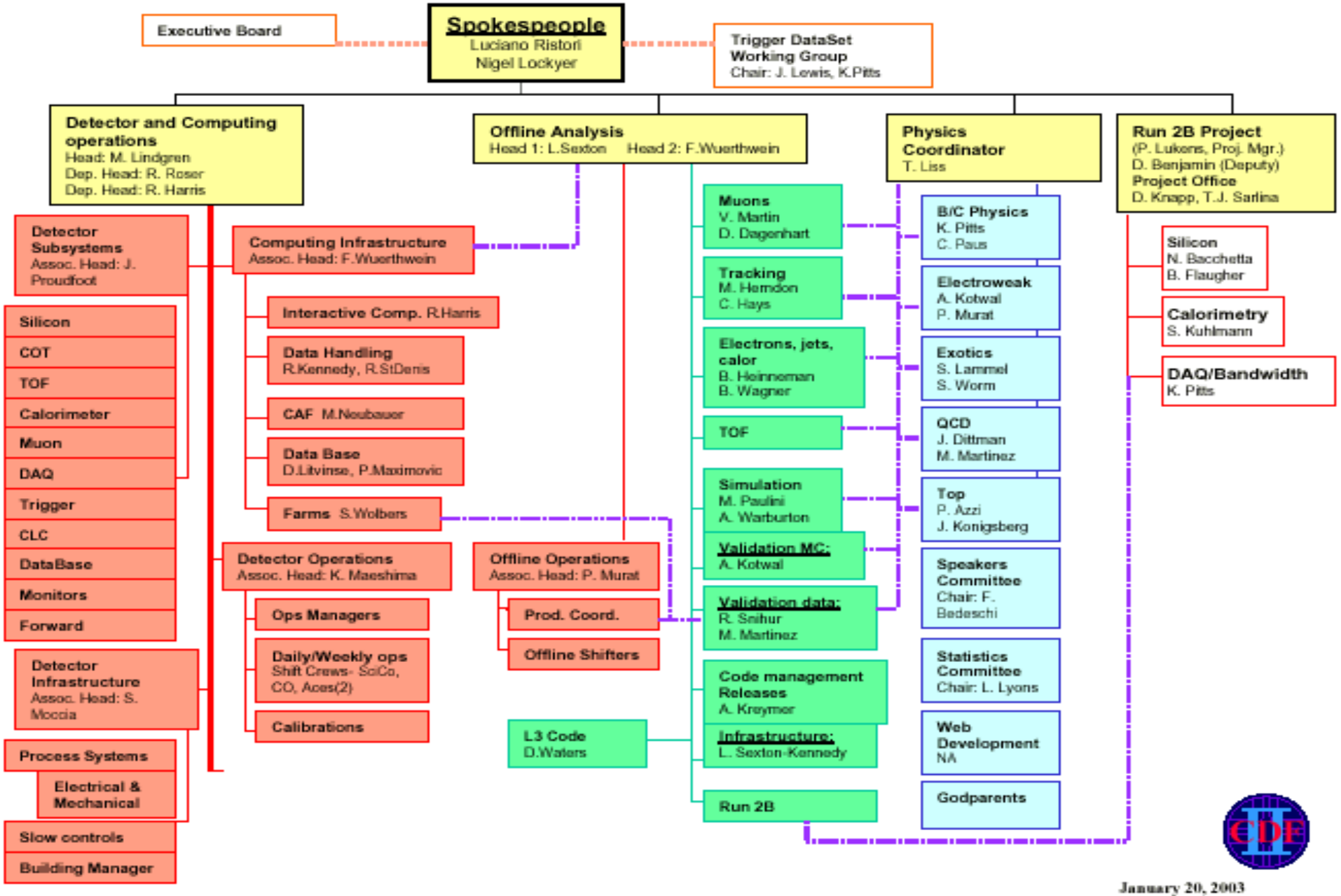
Summary & Conclusion

Core Central Services (almost) complete.

Focus on Offsite integration.

Software (largely) mature.

Focus on "operational efficiency".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Nigel Lockyer
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Dep. Head: R. Roser
Dep. Head: R. Harris
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T. Liss
Run 2B Project
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CDF
January 20, 2003

Status of Reconstruction

- **Quality of reconstruction exceeds Run 1 in (almost) all areas.**
- **Likely causes for future reprocessing:**
  - **Silicon standalone tracking (high eta b-tagging).**
  - **L00 alignment improvements (Bs mixing).**
  - **Further refinements in drift chamber alignment.**
  - **High eta muon coverage.**

Formal MOUs:
Calorimetry Reconstruction: Argonne,Rockefeller,Toronto
Tracking: Duke,Harvard,JHU.Karlsruhe,LBL,Liverpool
Simulation: CMU,LBL,Glasgow,Duke,Rockefeller,NM,
OSU, Tufts, Florida
DH: Rutgers
Production Farm: Taiwan
Offline Support/Operations: Brandeis
ToF: Cantabria, MIT, Rome
Muon Reconstruction: NW, Wisconsin, Texas A&M
Codegen: LBL
Event Display: ITEP
L3filter: Rochester, Oxford
Data Quality Monitoring (DQM): Barcelona

Informal commitments:
CAF: UCSD, Frascati, Trieste, Finnland
SAM: Glasgow, Oxford
mcProd: Liverpool, Glasgow, McGill, Toronto, MIT, UCSD
Calorimeter Reconstruction: Liverpool
L3filter: UCL
Offline Calibration & DQM: UCL
Calibration DB: JHU