DO Requirements and Budget

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Shank Review

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Computing Contributions

Use the FNAL equipment budget to provide very basic level of functionality

- Databases, networking and other infrastructure
- Primary Reconstruction
- Robotic storage and tape drives
- Disk cache and basic analysis computing
- Support for data access to enable offsite computing

Estimate costs based on experience or need for replacements

Remote Contributions

- Monte Carlo production takes place at remote centers
- Reprocessing (or primary processing)
- Analysis at home institutions
- Contributions at FNAL to project disk and to CLuED0
- Collaboration-wide analysis

Virtual Center

- For the value basis, determine the cost of the full computing system at FNAL costs, purchased in the yearly currency
  - Disk and servers and CPU for FNAL analysis
  - Production activities such as MC generation, processing and reprocessing.
  - Mass storage, cache machines and drives to support extensive data export
- Assign fractional value for remote contributions
  - Merit based assignment of value
  - Assigning equipment purchase cost as value ("Babar Model") doesn't take into account life cycle of equipment nor system efficiency or use.
  - While shown as a predictor, most useful after the fact
- Not included as part of the value estimate yet
  - Wide Area Networking, Infrastructure, desktop computing, analysis

Tools for projections

- Over time, DO has developed a set of spreadsheets used for making projections and calculating value.
  - Original version—Chip Brock in 2002 for first Bird Review
  - Without them, couldn't have developed concepts for Virtual Center
- Typically use either data rate or total number of events collected as underlying quantity.
- Use past year to predict hardware futures
- Infrastructure usually budgeted on a replacement cycle, except for networking, which has a component that scales.
- Spreadsheets are available
  - Gives some indication of how the assumptions influence the outcome
  - Typically some differences between final documentation and this presentation—we often tweak the assumptions
  - Typically differences between budget request and actual purchase request
  - Typically differences in schedules
  - Use the spreadsheets to guide decisions through the year
  - If you find any mistakes, let me know! Constant program of improving them

What's Changed?

- Changed to a 4 year retirement cycle for equipment. Assume 20% attrition when off warrenty
  - Minor wrinkle in '06 due to LCC construction
- Assume higher data collection rate for higher luminosity years.
- Assume major infrastructure is in place
- Costing model for hardware, assume 25% increase in capacity per year.
- Planning to continue with LTO II drives and AML2—saves equipment costs.

Accumulation Estimates

	2006	2007	2008
peak event rate	100	100	100
average event rate	34.48276	34.48276	34.48276
weekly average	50	50	50
raw data rate			
Geant MC rate	3.45	3.45	3.45

data samples (events)			
Current	**2006**	**2007**	**2008**
events collected	1.09E+09	1.09E+09	1.09E+09
total events	2.90E+09	3.99E+09	5.08E+09
Geant events	1.09E+08	1.09E+08	1.09E+08
PMCS events	1.09E+08	1.09E+08	1.09E+08
TAPE data accumulation (TB)			
Yearly storage (TB)	**888**	**1,102**	**1,308**
total storage (TB)	**2,248**	**3,349**	**4,658**
disk data accumulation (TB)			
total storage (TB)	**186**	**186**	**186**

Purchases in 2006 provide capacity for 2007

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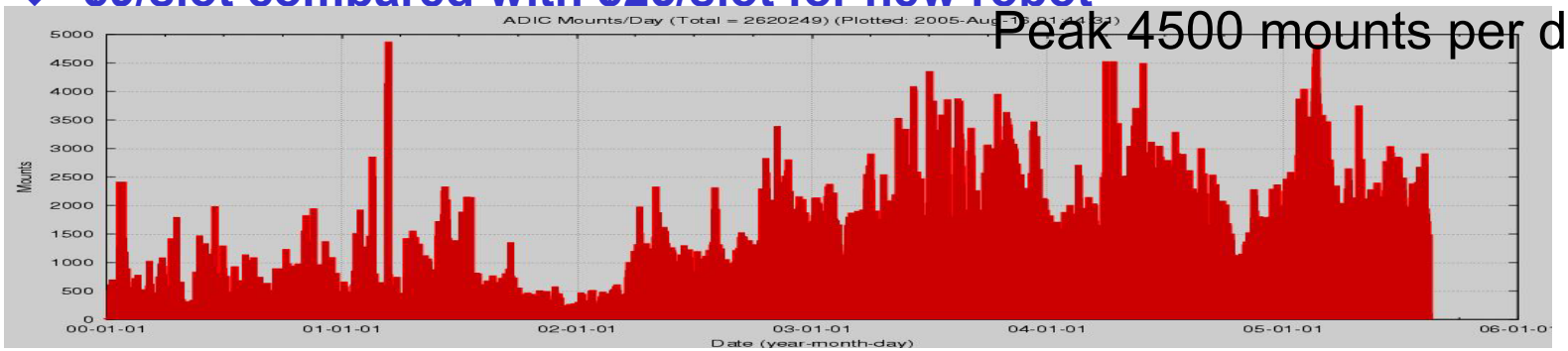
Mass storage

- DO uses STK powerhorn silos and an ADIC AML/2
- Have 16 9940b drives, 14 (+4) LTOII drives
- 1/3 of files consumed for analysis can be transferred from tape (compare 2/3 at peak in 2004)
  - Activated the second arm in the AML/2
- In 2005 "traded" 9940b drives for 4 LTOII drives, have 3500 STK Slots. Use for D0 raw data, accommodate CDF need
- Plan to remain with AML2 and LTO II, will have to activate the third quadrotower
  - Currently sharing the AML/2 with SDSS
  - $9/slot compared with $25/slot for new robot



Peak 4500 mounts per day

Mounts per day in AML/2, past 5 years.

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Tape Costs

- Tape costs are part of the operating budget
- Choice to stick with LTOIIs is motivated by large savings in equipment costs
- Tape costs grow slightly each year, with constant data rate to accommodate reprocessing
- Savings due to recycling tapes are not included.

		2005	2006	2007	2008
Data Volume		629	888	1,102	1,308
# to retire		0	0	0	0
Tape Cost		$ 157,250	$ 177,680	$192,815	$229,005

Primary Production

	Primary Reconstruction Cost Estimate			
Year		2006	2007	2008
Average Rate		34.48275862	34.48275862	34.48275862
efficiency		80%	80%	80%
contingency		20%	20%	20%
Reco time		85	100	100
Required CPU		2092759	2462069	2462069
Existing system		902761	1704485	2025993
Nodes to purchase		208	106	49
Node Cost		$666,665	$339,534	$156,352

Rate increase planned as part of the upgrade
Calculation uses SpecInts
Opening up to Fermigrid
Analysis CPU calculated in the same way using the observation that the weekly analysis is approximately the total data set collected.

Estimated Disk Costs

Fileservers:

	2006	2007	2008
Data Volume (TB)	186	186	186
Project Volume	31	31	31
total volume	217	217	217
contingency	40%	40%	40%
years volume (# servers)	17	16	15
Cost	$ 348,500	$ 328,000	$ 307,500

Do not have good model for cache space, size for disk resident samples, assume 40% contingency as in the past.

Some replacement costs start in 2007.

May need more cache as years go by as some analyses will be several versions behind

Infrastructure Costs

- FY-2005 Replace aging components
  - Retired Domino-> replace with login pool
    - Budgeted $100K, cost $30K
  - Home areas SGI D02ka -> Network appliance
    - Budgeted $100K, cost $63K
  - Purchased new db machines for luminosity db, added disk
    - Budgeted $100K, cost $70K
  - Networking-buying dual core worker nodes and running cables from FCC1 to FCC2
    - Budgeted $225K->cost $130K
  - We worked aggressively to bring the costs down.
  - Budget $100K per year—reuse networking

FY-2005 Actual

	2004		2005	
	Projected	Purchased	Projected	Purchased
FNAL Analysis CPU	$339,000	$277,000	$420,000	$400,000
FNAL Reconstruction	$83,000	$370,000	$450,000	$400,000
File Servers/disk	$490,000	$350,000	$360,000	$325,000
Mass Storage	$230,000	$254,700	$40,000	$20,000
Infrastructure	$290,000	$140,000	$500,000	$276,171
FNAL Total	$1,432,000	$1,391,700	$1,770,000	$1,421,171

DO tends to purchase worker nodes to preserve rate to tape

Cost Estimate-Sept 2005

	Purchase 2006	Purchase 2007	Purchase 2008
CPU	$449,308	$475,835	$404,720
Reconstruction	$666,665	$339,534	$156,352
File Servers/disk	$ 348,500	$328,000	$307,500
Mass Storage	$57,000	$97,500	$97,500
Infrastructure	$100,000	$100,000	$100,000
FNAL Total	$1,621,473	$1,340,869	$1,066,072

We take the guidance to be $1.5M in equipment money for 2006

Reprocessing & MC

- Resources to reprocess needed will vary as a function of amount of data to process, how quickly it needs to done, and speed of Reco
- Reprocessing is constrained by release cycle, analysis timescales and availability of remote resources
- Usually considered not to be a steady state event, but something that we plan for.
- MC production is steady state.
  - Try to estimate MC needs as a fraction of the data collection rate.
  - Using a fast parameterized MC in production has always been part of the plan.
  - Geant based simulation has been tuned and corrected to better model the data.
  - We do overlay zero-bias events over the geant simulation, which adds a data handling component, beyond the simple store.

Value Estimate-Sept 2004

	Value 2005	Value 2006	Value 2007	Value 2008	Value 2009
FNAL Based CPU	$2,192,370	$2,073,155	$2,285,221	$2,752,547	$2,429,034
File Servers/disk	$369,000	$758,500	$984,000	$1,209,500	$1,271,000
Mass Storage	$800,000	$800,000	$800,000	$800,000	$800,000
Reprocessing	$4,013,039	$4,187,340	$4,208,316	$6,526,760	$5,438,967
MC	$436,484	$219,458	$234,089	$187,271	$149,817
Center Total	$7,810,893	$8,038,454	$8,511,625	$11,476,078	$10,088,818

This reflects the full value of doing all DO computing in one year
In current year dollars—legacy systems are worth what it would cost to replace them.
Refinements continue—Infrastructure currently valued at $0, assigning fixed value to Mass Storage
We no longer calculate yearly “cost” for remote centers—not a relevant concept for many places.

Conclusions

- The DO computing model is successful
  - We have developed tools to enable us to target computing spending at FNAL
  - We use metrics from SAM and system monitoring to provide estimators.
- Use Virtual Center Concept to calculate the "value" that remote computing brings to the collaboration.
- DO continues to pursue a global vision for the best use of resources by moving towards interoperability with LCG and OSG
- DO computing remains effort limited—a few more skilled people would make a huge difference.
- Short budgets and continued construction projects is a cause for concern