US-CMS
User Facilities Project

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Introduction/Disclaimer

In this presentation, I am focusing more on short term plans and "unresolved" issues

Outline

- Milestone Overview
- User Facility Hardware
  - Computing Cost Assumptions
  - Costs focusing on 2001-2003
- User Facility People
  - WBS details
  - WBS in more detail for 2001-2003

Schedule for US-CMS S&C Project

In order to match the proposed funding profile from DOE/NSF more closely as well as the LHC schedule, we have stretched out the CMS Software and Computing Project Schedule.

Now – end FY2003: R&D phase

FY2004-FY2006: Implementation Phase

FY2007 and onwards: Operations Phase

This required a new hardware cost estimate and resource loaded WBS.

CMS Milestones (as pertinent to UF)

CMS is starting from a working OO system and slowly building in complexity. Our goals for the next few years are to fully OO the software chain and implement grid tools.

- **6/01/2000** — **Roughly 1 M events produced for Higher Level Trigger Studies (~0.1% MDC, though not full complexity). Full OO reconstruction + pileup.**
- **12/01/2000** — **~ 5M events produced for HLT Studies, representing ~0.5% MDC. CERN, INFN, FNAL, Caltech and Moscow are participating in deploying grid tools to share simulated data.**
- **12/01/2000** — **Trigger TDR.**
- **01/30/2001** — **create AOD at FNAL for JPG group. For this we have to run over ~2M final jets events. Support re-reconstruction. Needs ~5-6k Si95's for this.**

CMS Milestones (as pertinent to UF)

- **06/01/2001** 1% data challenge. This means ~10M events, or >2M generated in US. 2M at FNAL, 2M at T2? Continue with grid implementation. Non-networked based data movement?
- **12/01/2001** DAQ TDR
- **12/01/2001** 1-2% data challenge. Fully support prototpye Tier 2's. Implement any reconfiguration or design from previous data challenge.
- **12/01/2002** Software and Computing TDR
- **03/01/2003** Tier 1 Regional Center 5% prototype.
- **06/01/2003** 5% Data Challenge. Goals not yet defined.

CMS Milestones (as pertinent to UF)

Longer Term Milestones

- **10/01/2003** Begin Tier 1 implementation phase (FY2004)
- **12/01/2003** Physics TDR
- **12/01/2004** 20% Data Challenge
- **10/01/2005** Pilot LHC run (2-4 weeks at 10^{32})
- **04/01/2006** LHC running (10^{33})

Hardware Plans for FY01-FY03

Wbs 1.2 System and User Support

1.2.2 Collaborative Tools

1.2.2.1	Video Conferencing	2001	2002	2003
	Cost	0	$20,000	$20,000

This is for video conferencing rooms, 1 in 2002 and 1 in 2003. We will make another one in 2005 for a total of 3.

1.2.2.2	Web Servers	2001	2002	2003
		0	$5,000	0

This is for dedicated web servers for CMS software and computing documentation, tutorials, etc.

Hardware Plans for FY01-FY03

Wbs 1.5 Networking

1.5.1 Onsite Networking

	2001	2002	2003
Total Cost	$21,250	$22,500	$56,250

This is to support LAN for our growing central CMS system as well as networking for the CMS desktop cluster.

This breaks down into:

LAN	$20,000	$20,000	$20,000

This is for extra capability in existing Fermilab infrastructure for central CMS computing. This is mainly buying FE/GE cards for an existing switch.

desktops	$1,250	$2,500	$6,250

This is for networking connectivity for the growing number of CMS desktops, priced at $250/box.

Hardware Plans for FY01-FY03

Wbs 1.6 Computing and Software R&D

1.6.1 Distributed Data & Computing testbeds

	2001	2002	2003
Total Cost	$30,000	$50,000	0

This is for dedicated data servers for our analysis cluster and for MONARC measurements. We need some capability in non-interactive or "critical" systems in order to measure database overheads and testing different kinds of configuration and hardware.

Hardware Plans for FY01-FY03

Wbs 1.6 Computing and Software R&D

1.6.2	R&D in Computing Hardware		
	2001	2002	2003
1.6.2.2.1	Data Intensive Computing		
	This is for chaotic computing needed a very high I/O.		
Total Cost	$50,000	$100,000	$100,000
Si95's	600 Si95's	2k Si95's	3.4 Si95's
1.6.2.2.2	CPU Intensive Computing		
	This is needed for evaluations and to keep up with simulation for Mock Data Challenges and for evaluations.		
Total Cost	0	$50,000	$50,000
Si95's	0	1k Si95's	1.7k Si95
1.6.2.2.3	Data Access and Distribution Servers		
Total Cost	$220,330	$307,600	$163,300
	This is for disk servers. (6 TB/12 TB/6 TB). Mix of commodity and datacenter disk.		

Hardware Plans for FY01-FY03

Wbs 1.6 Computing and Software R&D

1.6.3 Prototype Fully Functional Regional Center

	2001	2002	2003
Total Cost	0	0	$100,000

This is incremental costs to make the individual R&D systems into an ~5% prototype Regional Center. This represents buying ~10 TB MSS cache disk. We will use the R&D pieces which represent the other parts.

1.6.7 Data Import/Export

Total Cost	0	$29,200	0

This is an incremental cost (representing a drive and some tapes) for technology tracking for data import/export. The existing system being used for current activities is assumed to be adequate infrastructure.

Hardware Plans for FY01-FY03

Wbs 1.7 Support for Construction Phase Activities

1.7.1 Computing

Computing for the CMS Detector construction phase is leveraged from FNAL general central systems and from some of the CMS test systems. We do not anticipate buying any general computing specifically for this activity.

1.7.2 Data Storage

	2001	2002	2003
Total Cost	$53,000	$22,000	$21,000
Add'l Storage	0	30 TB	50 TB

These are incremental costs of tapes and tape drives using an existing STK library at Fermilab.

1.7.3 Network Interchange

A large disk pool is necessary for this. We assume reuse of R&D disk systems for this.

1.7.4 Data Import/Export

Total Cost	$82,500	$12,500	$27,500

This is a cost for refitting an existing AML/J library with tape drives and media, and maintenance on the library.

Hardware Plans for FY01-FY03

Wbs 1.8 Support for FNAL Based Computing

		2001	2002	2003
1.8.1	Desktop Support	$10,000	$62,000	$100,000

This is to buy linux host server machines and backup system to host the CMS desktop cluster. The cluster contains about 5 machines now and is expected to go to 40 in FY03.

1.8.2	Remote Control Room	0	0	$20,000

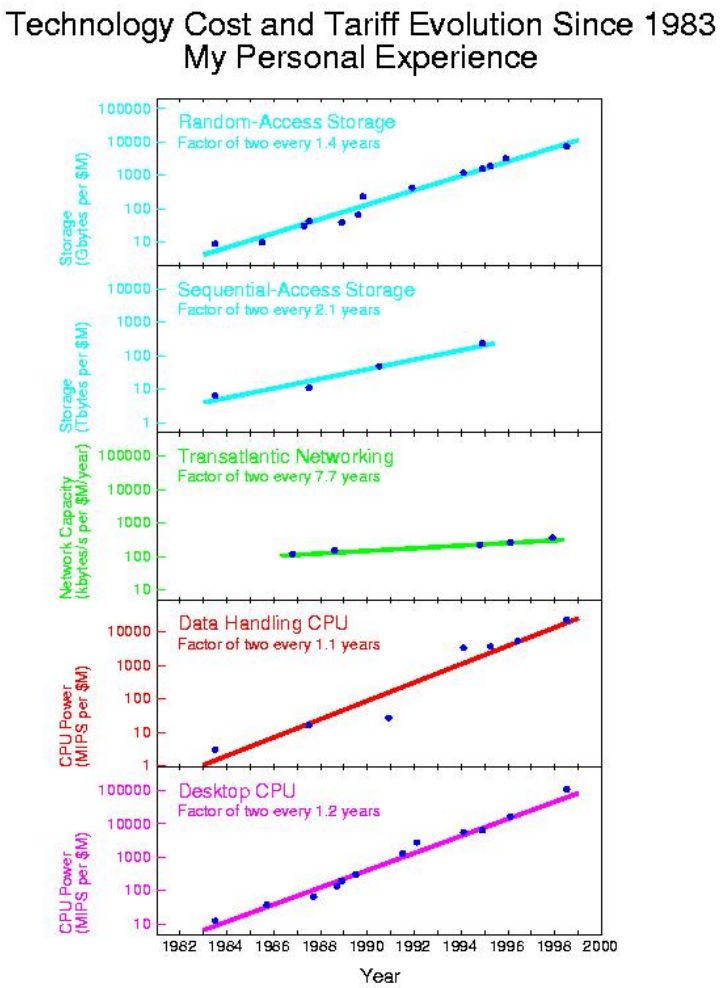
This is to build a remote control room starting in FY03 to support test beam activity at CERN and eventually data taking activities.

Funding Request for 2001-2003

WBS Item	2001	2002	2003
1.1 Tier 1 Regional Center	0	0	0
1.2 System and User Support	0	29,000	23,200
1.5 Networking	24,650	26,100	65,250
1.6 Computing R&D	348,400	622,750	479,500
1.7 Detector Construction Phase Computing	157,180	40,020	56,260
1.8 Host Lab Based Computing Support	11,600	71,920	139,200
Total	**541,830**	**789,790**	**763,410**

(This is the total with FNAL added overhead)

Hardware Costing Projections: CPU



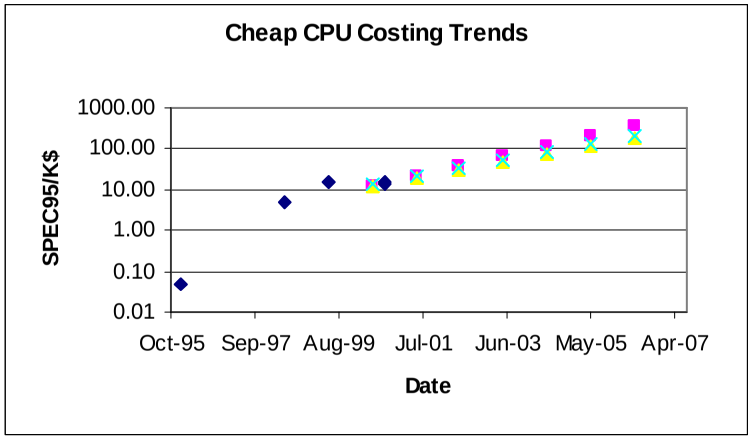
CPU Costs

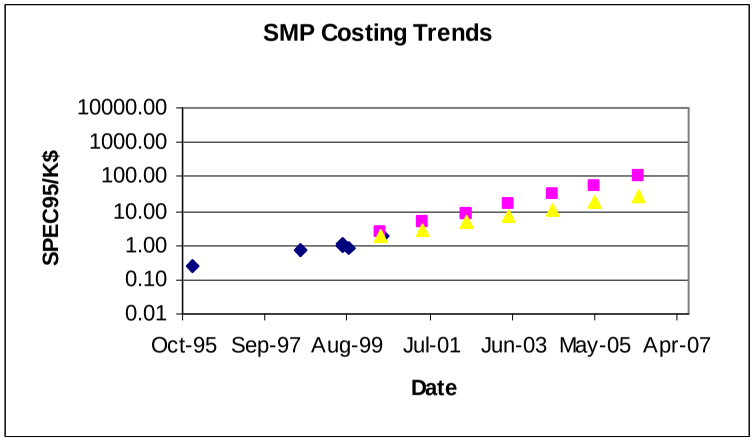
We are using an extrapoloation from a review of prices over 15 years.

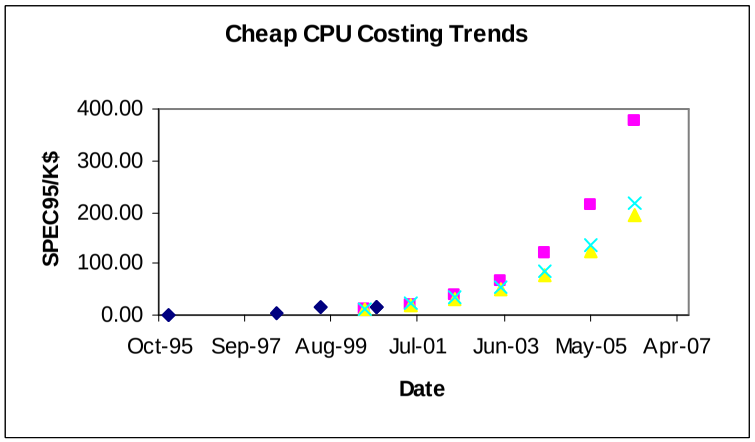
In order to blend in packaging costs, many use a less aggressive extrapolation (doubling time every 1.5 years)

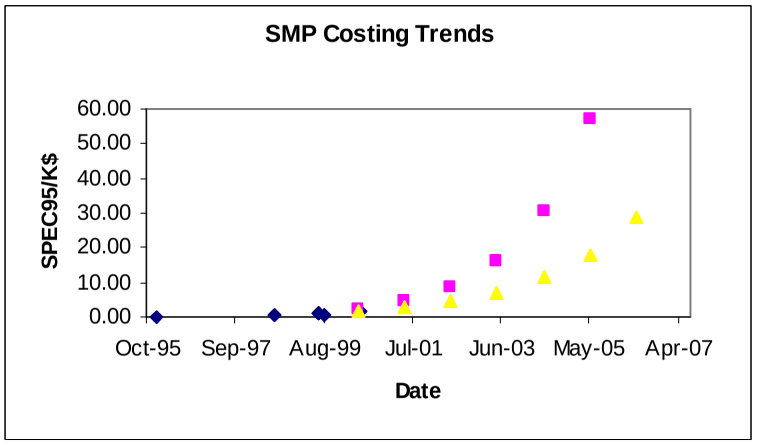
There are *large uncertainties* (~50-100%) in these extrapolations – we should continue to monitor prices and continually update these extrapolations.

Costing Uncertainties









Costing Uncertainties

Using 1.1/1.2 year doubling time

Year	2001	2002	2003	2004	2005	2006
Com	$85	$48	$27	$15	$8.4	$4.7
SMP	$410	$218	$116	$62	$33	$18

Using 1.5 year doubling time

Year	2001	2002	2003	2004	2005	2006
Com	$85	$54	$34	$21	$13	$8.4
SMP	$410	$258	$163	$103	$65	$41

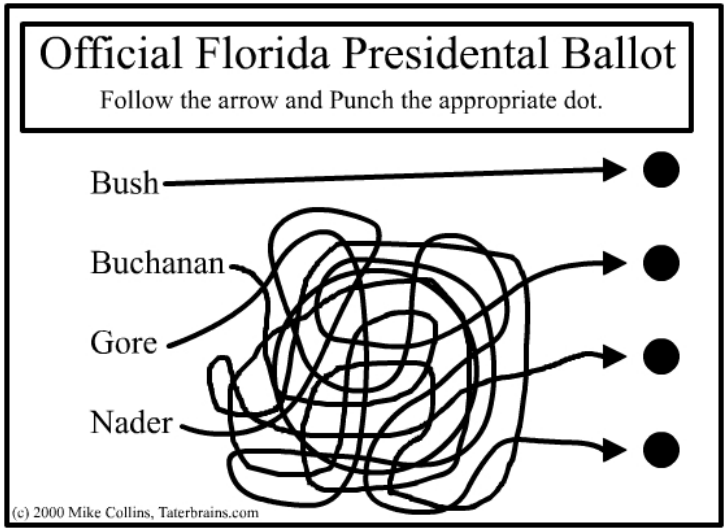
Costing Uncertainties

So the method of calculating costs has considerable uncertainties.

How do we deal with this?

- **Adopt a "Build to Cost" philosophy**
  - **This is the Run 2 attitude**
- **Keep tracking technology at FNAL and at Tier 2 sites and update costing assumptions**
  - **Manual recounts several times a year..**
- **10% management reserve – small compared to hardware costing uncertainties but gives us a buffer in case of dramatic changes.**

User Facility Work Breakdown Structure



User Facility WBS

	2001	2002	2003	2004	2005	2006	2007
1.1 Tier 1 Regional Center				13	17	20	18
1.2 System and User Support	1.3	2.25	3	3	5	4.5	4.5
1.3 Operations and Infrastructure	1	1.25	1.25	3	5	4.5	4.5
1.4 Tier 2 RCs	2.5	3.5	4	5	6.5	7.5	7.5
1.5 Networking	0.5	1	2	2.5	3	3	3
1.6 Computing and Software R&D	3	4	4.5	1.4	0.6	0.6	0.6
1.7 Construction Phase Computing	2	2	2	0.25			
1.8 Support of FNAL based Computing	0.4	1.4	1	2.6	2.25	2	2
User Facilities (total)	10	15	18	30	37	43	41
(Without T2 Personnel)	7.5	11.5	14	25	30	36	34

Full time staff working on User Facilities tasks: (technicians, support staff, computing professionals)

User Facility WBS from 2001-2003

	2001	2002	2003
1 User Facility Project	**10**	**15.0625**	**18**
1.1 Tier 1 Regional Center	0	0	0
1.2 System and User Support	1.3125	2.25	3
1.3 Operations and Infrastructure	0.625	1.25	1.25
1.4 Tier 2 Regional Centers	2.5	3.5	4
1.5 Networking	0.5	1	2
1.6 Computing and Software R&D	2.6875	3.8125	4.5
1.7 Detector Construction Phase	2	1.875	1.875
1.8 Support for host lab computin	0.375	1.375	1.375

User Facility WBS from 2001-2003

	2001	2002	2003
1.2 System and User Support	**1.313**	**2.25**	**3**
1.2.1 Documentation	0.125	0.25	0.5
1.2.2 Collaborative Tools	0.125	0.125	0.25
1.2.3 Development Environment	0.125	0.25	0.5
1.2.4 Administration, Monitoring + Problem	0.188	0.625	0.5
1.2.5 User Help Desk	0.125	0.25	0.25
1.2.6 Training Office	0.25	0.25	0.25
1.2.7 Support for Tier 2 Centers	0.25	0.25	0.25
1.2.8 Computer Security	0.125	0.25	0.5

User Facility WBS from 2001-2003

	2001	2002	2003
1.6 Computing and Software R&D	**2.688**	**3.813**	**4.5**
1.6.1 Distributed Data and Computing Tes	0.5	0.5	0.5
1.6.2 R&D in Computing Hardware for T1	1.438	2	1.625
1.6.3 Prototype Fully Functional Regional	0.125	0.688	1.75
1.6.4 Simulation Software	0.5	0.5	0.5
1.6.5 System Administration	0.125	0.125	0.125

User Facility WBS

For more details of the WBS, see

"US-CMS User Facilities Subproject"

and/or we can spend some time now browsing the WBS.

Summary

We have a detailed costing model for the Research and Development and the Implementation Phase(*)

- **There are uncertainties in this model that become very large in 2006**
- **We need to remain flexible**
- **We have adopted a "Build to Cost" philosophy**
- **Keep tracking technology at FNAL and at Tier 2 sites and update costing assumptions**
  - **Manual recounts several times a year..**

A completed Work Breakdown Structure

- **We have formulated a detailed bottom-up Work Breakdown Structure(**)**

(*) See "User Facility Sub-Project Hardware and Material Costs"

(**) See "US-CMS User Facilities Subproject WBS"