Discussion on Software Agreements and Computing MoUs

Prompted by LHC Computing Review

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Goal of meeting is to address these questions

- How do we intend to ensure that we have enough resources to develop our software and maintain it over the lifetime of the experiment?
- What place is there for formal agreements describing institutional responsibilities for software?
- What implications are there for the way software production is organised in LHCb?
- What computing infrastructure is needed, how will it evolve between now and 2005 and how will responsibility (i.e. manpower and costs) for developing and maintaining it be shared within the collaboration?

Milestones for the Computing MoU

- The following is based on current indications from ongoing discussions in the Computing Review
  - We should aim to provide by 2003 a practical demonstration of the viability of the software and a realistic prototype of the computing infrastructure
  - By end 2000 we should produce an Interim MoU describing sharing of work to achieve these goals in 2003
  - The proper MoU for producing the final system is expected sometime in 2003 i.e. after the Computing TDR has been submitted
- Details are still to be fixed.

Outline of this presentation

- Software Issues
  - Work Breakdown Structure (WBS) of software tasks
  - Manpower requirements; available and missing
  - Model for providing missing manpower
  - Responsibilities and organisation - 'Software agreements'
  - Discussion

Coffee Break

- Computing Infrastructure Issues
  - LHCb Computing requirements - update
  - Baseline Computing Model - identification of centres
  - Prototype for 2003 - goals, share of responsibilities
  - Discussion

Scope of software

- ❑ CORE software
  - ➢ General services and libraries, data management
  - ➢ Frameworks for all data processing applications
  - ➢ Support for development and computing infrastructure
- ❑ Subdetector software
  - ➢ Configuration and calibration
  - ➢ Descriptions of geometry and event data
  - ➢ Reconstruction and simulation algorithms
- ❑ Physics software
  - ➢ Production analysis code
  - ➢ Private analysis code

Software WBS - Manpower Needs

WBS	Task	Profi	1999	2000	2001	2002	2003	2004	2005	2006
1	***Computing Steering***									
1.1	LHCb Computing Coordination	E	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Subtotal (FTEs)		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
2	***Software Framework GAUDI***									
2.1	GAUDI Project Coordination/ Architect	E	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
2.2	General Framework Services	E	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0
2.3	Generic Event Model	E	1.0	1.0	0.5	0.5	0.25	0.25	0.25	0.25
2.4	Detector Description (structure, geometry)	E	0.5	1.0	1.0	0.5	0.25	0.25	0.25	0.25
2.5	Detector Conditions (calibration, slow control)	E	0.0	0.5	1.0	1.0	1.0	0.25	0.25	0.25
2.6	User interaction, GUI, scripting visualisation	E	0.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0
2.7	Data Management (persistency/mass storage)	E	1.0	1.0	2.0	2.0	1.0	1.0	1.0	1.0
2.8	Data Management (bookkeeping)	E	0.0	1.0	1.0	1.0	1.0	0.25	0.25	0.25
2.9	Distributed data access / grid software	E	0.0	0.0	1.0	1.0	1.0	0.5	0.5	0.5
	Subtotal (FTEs)		**5.5**	**8.0**	**9.5**	**9.0**	**7.5**	**5.5**	**5.5**	**5.5**
3	***Software Engineering Support***									
3.1	Code management and distribution	E	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3.2	Documentation management	E	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
3.3	Software test, quality, performance manager	E	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5
3.4	Collaboration Tools	E	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
3.5	Training	E	0.0	0.0	0.25	0.25	0.25	0.25	0.25	0.25
	Subtotal (FTEs)		**1.5**	**2.0**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**

Software WBS - Manpower Needs

WBS Task		Profi	1999	2000	2001	2002	2003	2004	2005	2006
4	***Computing Facilities***									
4.1	Computing Model Project Coordination	E	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
4.2	Event Filter CPU farm	E	0.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0
4.3	LAN Infrastructure at pit + CDR	E	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0
4.4	OS system management	E	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
4.5	OS system administration	E	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Subtotal (FTEs)		**3.0**	**3.5**	**4.0**	**4.0**	**5.0**	**5.0**	**5.0**	**5.0**
5	***Simulation Project***									
5.1	Simulation coordination	P	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5
5.2	SICb coordination (GEANT3 based)	P	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0
5.3	GEANT4 framework	P	0.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0
5.4	Data Production Management	E	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Subtotal (FTEs)		**1.5**	**2.0**	**3.0**	**3.0**	**2.5**	**2.5**	**2.5**	**2.5**
6	***Reconstruction Project BRUNEL***									
6.1	Reconstruction Project coordination	P	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
6.2	BRUNEL framework design	E	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
6.3	High level trigger framework	P	0.0	0.0	1.0	1.0	1.0	1.0	0.5	0.5
6.4	Software and data quality monitoring	P	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5
	Subtotal (FTEs)		**0.0**	**1.0**	**2.5**	**2.5**	**2.5**	**2.5**	**2.0**	**2.0**

Software WBS - Manpower Needs

WBS	Task	Profi	1999	2000	2001	2002	2003	2004	2005	2006
7	***Analysis Project DAVINCI***									
7.1	Analysis Project coordination	P	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
7.2	Analysis framework design	E	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	Subtotal (FTEs)		**0.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
8	***Event Display MONET***									
8.1	Offline Event Display	E	0.0	0.0	1.0	1.0	0.5	0.5	0.5	0.5
8.2	Online Event Display	E	0.0	0.0	0.0	0.0	0.5	1.0	1.0	0.5
	Subtotal (FTEs)		**0.0**	**0.0**	**1.0**	**1.0**	**1.0**	**1.5**	**1.5**	**1.0**
	Subtotal (FTEs) for core Computing		**12.5**	**18.5**	**24.8**	**24.3**	**23.3**	**21.8**	**21.3**	**20.8**

Software WBS - Manpower Needs

WBS	Task	Profi	1999	2000	2001	2002	2003	2004	2005	2006
9	***Subdetector Data Processing Software***									
9.1	Subdetector software coordination	P	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
9.2	Subdetector structure and geometry	E	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
9.3	Subdetector Event Model	E	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
9.4	Subdetector simulation algorithms	P	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
9.5	Pattern recognition algorithms	P	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
9.6	Subdetector alignment and calibration	P	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0
9.7	Testbeam software	P	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	Subtotal (FTEs)/ generic subdetector		**5.5**	**5.5**	**6.5**	**6.5**	**7.5**	**7.5**	**7.5**	**7.5**
	Muon Software (Rio, Rome)	P/E	4.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0
	Tracking (NIKHEF)	P/E	4.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0
	VELO	P/E	4.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0
	L0 Muon Trigger software (Marseille)	P/E	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
	L0 Cal Trigger Software (Orsay/Bologna)	P/E	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
	L1 Trigger	P/E	2.5	2.5	3.5	3.5	3.5	3.5	3.5	3.5
	L2/L3 Trigger	P/E	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0
	Calorimeter (ECAL,HCAL,PreShower)	P/E	6.0	6.0	8.0	8.0	10.0	10.0	10.0	10.0
	RICH	P/E	4.0	4.0	6.0	8.0	8.0	8.0	8.0	8.0
	Subtotal (FTEs) for all detectors		**26.5**	**27.5**	**41.5**	**43.5**	**45.5**	**45.5**	**45.5**	**45.5**
	Grand Total (FTEs) CORE + Subdetector		**39.0**	**46.0**	**66.3**	**67.8**	**68.8**	**67.3**	**66.8**	**66.3**

Software WBS - Manpower Missing

Task	Profi	1999	2000	2001	2002	2003	2004	2005	2006
Subtotal (FTEs) missing coordination		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal (FTEs) missing framework GAUDI	E	1.5	2.5	3.0	2.5	2.0	0.8	0.8	0.8
Subtotal (FTEs) missing support	E	0.0	0.5	1.3	1.3	1.3	1.3	1.3	1.3
Subtotal (FTEs) missing facilities	E	0.0	0.5	1.0	1.5	2.5	2.5	2.5	2.5
Subtotal (FTEs) missing simulation	P	0.5	0.5	1.5	1.5	1.5	1.5	1.5	1.5
Subtotal (FTEs) missing reconstruction	P	0.0	0.5	1.5	1.5	1.5	1.5	1.0	1.0
Subtotal (FTEs) missing analysis	P	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Subtotal (FTEs) missing event display	E	0.0	0.0	1.0	1.0	1.0	1.5	1.5	1.0
Total (FTEs) missing for core Computing		**2.0**	**5.0**	**9.8**	**9.8**	**10.3**	**9.5**	**9.0**	**8.5**
Muon Software (Rio, Rome)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tracking (NIKHEF)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VELO	E	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0
L0 Muon Trigger software (Marseilles)	E	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5
L0 Cal Trigger Software (Orsay/Bologna)	E	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5
L1 Trigger	E	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0
L2/L3 Trigger	P	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0
Calorimeter (ECAL,HCAL,PreShower)		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RICH		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal (FTEs) missing for all detectors		**0.0**	**0.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**

Profile of missing manpower for software

- Core computing has ~10 FTEs missing
  - ~4 FTEs have physicist profile for coordination of simulation and analysis, high level trigger algorithms and data quality monitoring
  - ~6 FTEs have engineering profile for producing software frameworks, support of development and facilities
- Resources for subdetector software are expected to come from within the existing teams.
  - ~5 FTEs are missing, largely from the trigger, for which engineering effort (2 FTEs) is needed for Level0 and Level1 and physicist effort (2 FTEs) is needed for L2/L3.

Model for providing missing manpower

- tasks will be eventually resourced from within the collaboration
- Assumed that effort for 'core computing' activities will be more difficult to find
  - We are expected to explain how we intend to solve problem
  - Other experiments have missing manpower of a similar profile and on a similar scale
- Model has been proposed by Panel 3 (Calvetti) that missing engineering effort (~10 FTEs) should be provided from within the collaboration along reasonable lines
  - -2 FTEs
  - this effort must work within the core software team
  - the manpower does not need to be resident at CERN

Software Agreements

- CERN management is asking for an explanation of how LHCb software will be maintained in the long-term
- It is being discussed to what extent formal agreements should be made assigning responsibility on an institutional basis for core software packages
- We are also expected to describe how management and maintenance of LHCb software will be organised.
- The agreements and description of the organisation will form part of the Computing MoU.

Assignment of responsibility

- Coverage of responsibility for all tasks described in WBS needs to be defined. Three scenarios can be envisaged:
  - An agreement can be made with one or many institutes
    -
    -
  - Granularity of responsibility may be more precise
    - CORE / Visualisation : Orsay
    - Muon / L0 trigger : Marseille
    - Too inflexible? – does not easily allow change with time
  - Contact persons with technical responsibility may be defined
    - CORE / Visualisation : Orsay (contact : Guy Barrand)

Assignment of responsibility

- Whole collaboration must be guaranteed access to source code required for all physics studies
- Leads to an Open Source Model for software impacting physics
  - Institute(s) commit to manage a particular package
  - Everyone can access source, and submit improvements
- Detector specific software (calibration etc) managed by institutes responsible for the detector
- No formal agreements possible for private physics analysis software i.e. all non-production code

Organisation Issues

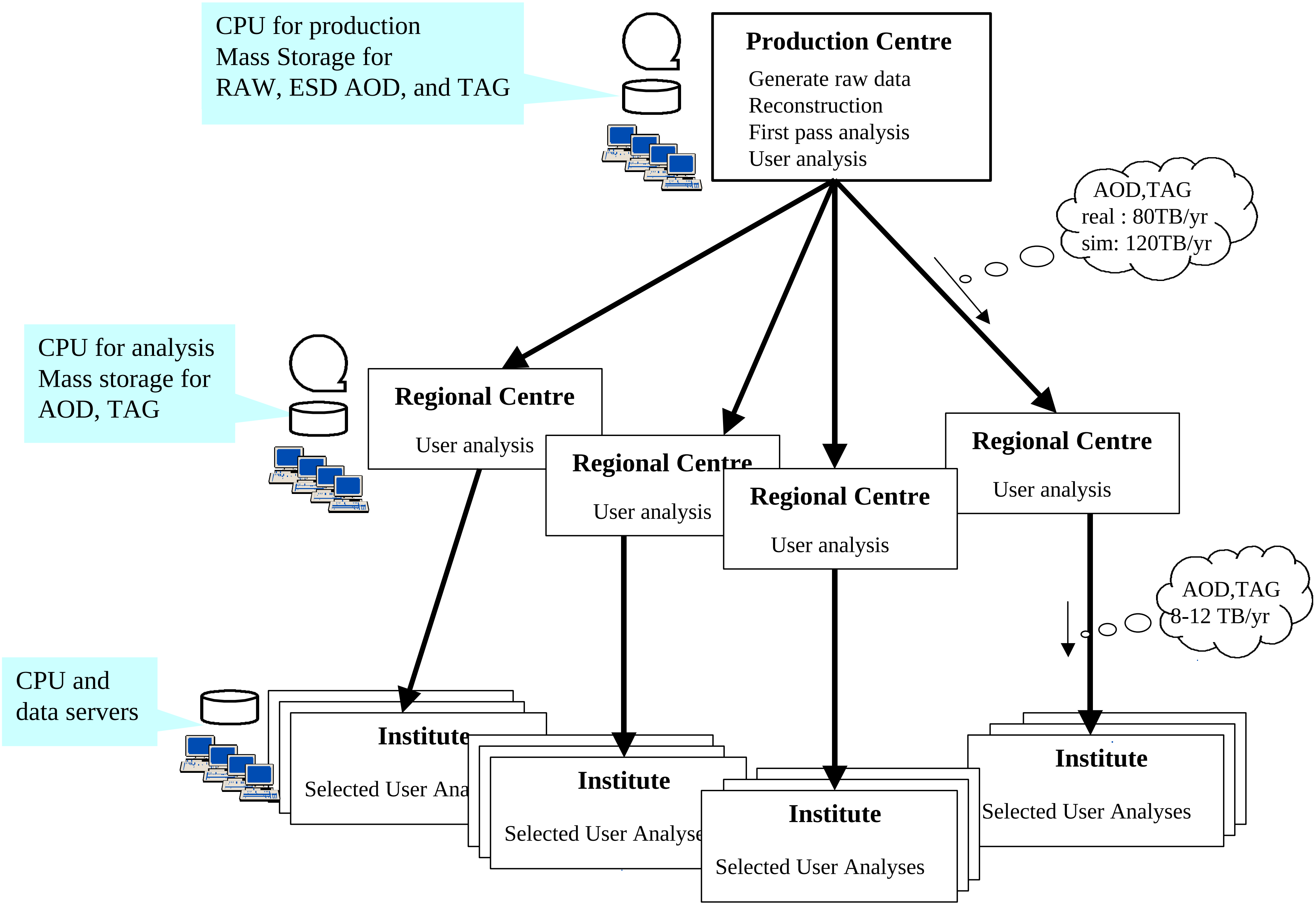
- Management of code repository and roles of package coordinators
- Quality control procedures and rules for following them
- Description of maintenance tasks
  - Platform support
  - Help and consultancy to the collaboration
- Estimate of effort involved
- Identification of contact person within institute
- Schedule for decisions and for producing deliverables

Real Data Processing Requirements

Length of period	120 days	10^7 secs	
LHC duty cycle	50%		
Event rate stored	200 Hz	10^7 per day	10^9 per year
RAW data size	100 kB/event	1 TB/day	100 TB/yr
ESD data size	100 kB/event	1 TB/day	100 TB/yr
AOD data size	20 kB/event	0.2 TB/day	20 TB/yr
TAG data size	1 kB/event	0.01 TB/day	1 TB/yr
L2 trigger CPU	0.25 SI95sec/event	@40 kHz	10,000 SI95
L3 trigger CPU	5 SI95sec/event	@5 kHz	25,000 SI95
Reconstruction CPU	250 SI95sec/event	@200 Hz	50,000 SI95
First Pass Analysis	5 SI95/event	2.10^8 in 2 days	5000 SI95
User analysis at RC	20 SI95sec/event		10,000 SI95
User analysis CERN	20 SI95sec/event		20,000 SI95

Simulation Requirements

RAWmc data size	200 kB/event	200 TB/10^9 events
Generator data size	12 kB/event	12 TB/10^9 events
ESD data size	100 kB	100 TB/10^9 events
AOD data size	20 kB/event	20TB/10^9 events
TAG data size	1 kB/event	1 TB/10^9 events
CPU power	~100,000 SI95 signal events	~400,000 SI95 background events

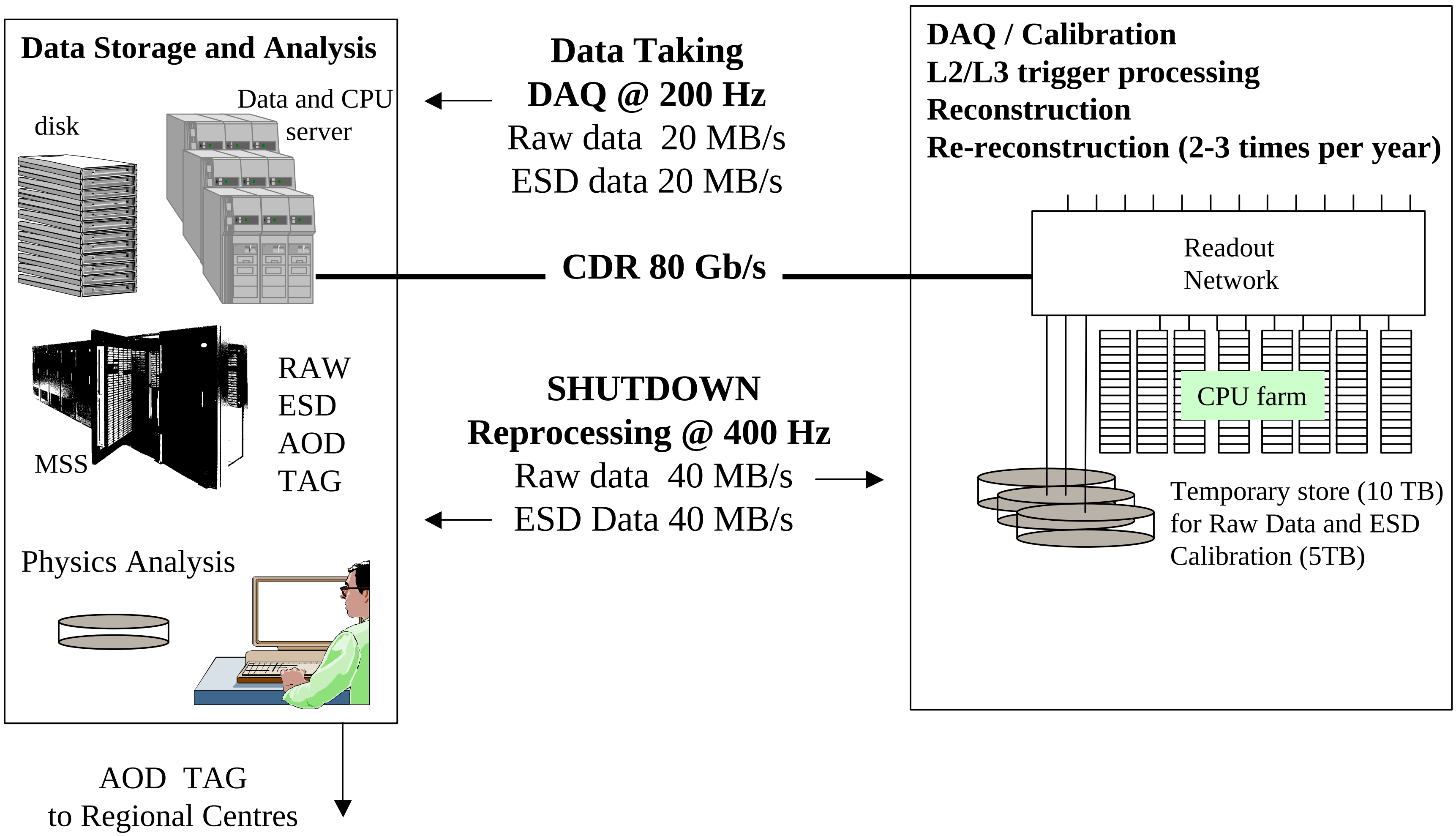

CPU for production
Mass Storage for
RAW, ESD AOD, and TAG
Production Centre
Generate raw data
Reconstruction
First pass analysis
User analysis
AOD,TAG
real : 80TB/yr
sim: 120TB/yr
CPU for analysis
Mass storage for
AOD, TAG
Regional Centre
User analysis
Regional Centre
User analysis
Regional Centre
User analysis
Regional Centre
User analysis
AOD,TAG
8-12 TB/yr
CPU and
data servers
Institute
Institute
Selected User Analyses
Institute
Selected User Analyses
Institute
Selected User Analyses

	Real Data	Simulated Data
Production Centre (x1)	CERN Data collection Triggering Reconstruction Final State Reconstruction User Analysis	e.g. RAL Event Generation GEANT tracking Reconstruction Final State Reconstruction User Analysis
	Output to each RC: *AOD and TAG datasets* *20TB x 4 times/yr= 80TB/yr*	***Output to each RC:*** *AOD, Generator and TAG datasets* *30TB x 4 times/yr= 120TB/yr*
Regional Centre (~x5)	RAL , Lyon, ... User Analysis	CERN, Lyon, …. User Analysis
	Output to each Institute: *AOD and TAG for samples* *1TB x 10 times/yr= 10TB/yr*	***Output to each institute:*** *AOD and TAG for samples* *3TB x 10 times/yr= 30TB/yr*
Institute (~x50)	Selected User Analysis	Selected User Analysis

Compute Facilities at CERN

CERN Computer Centre

Experiment - LHC Pit 8

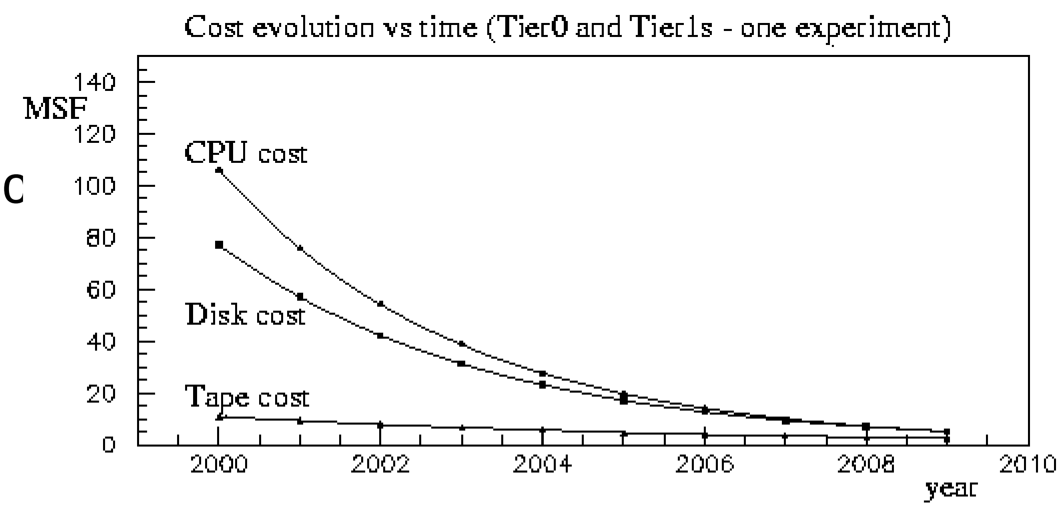


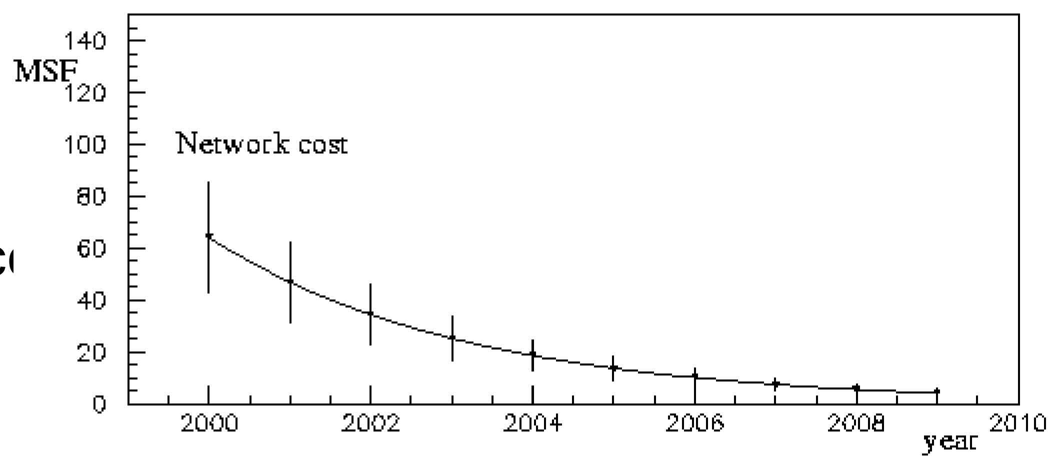
LHCb Computing Infrastructure

- The choice of the production and regional centres for LHCb must be described.
  -
- The cost and manpower needed to build and operate the infrastructure must be estimated
- The access to common resources by all institutes in the collaboration must be understood

Cost of CPU, disk and tape

- Law evolution with time for cost of CPU and storage. Scale in MSFr is fc a facility sized to ATLAS requirements (> 3 x LHCb)
- cost for LHCb (CERN and regional centres) would be ~60 MSFr
- In 2004 the cost would be ~10 - 20 MSFr
- After 2005 the maintenanc cost is ~ 5 MSFr /year





Prototype Computing Infrastructure

- Aim to build a prototype production facility at CERN in 2003
- Scale of prototype limited by what is affordable - ~0.5 of the number of components of ATLAS system
  - Cost ~20 MSFr
  - Joint project between the four experiments
  - Access to facility for tests to be shared
- Need to develop a distributed network of resources involving other regional centres and deploy data production software over the infrastructure for tests in 2003
- Results of this prototype deployment used as basis for Computing MoU

Need to study

- The design of the various centres and plans for their evolution over the coming years
- Goals of the prototype
  - Satisfy simulation needs (2003 and 2004)
  - Tests of farm management
  - Mock Data Challenges to measure performance and identify bottlenecks (hardware and software)
  - Middleware for security, resource management (EU grid proposal)
- Share of responsibilities and costs for building and operating the infrastructure
  - need input from experts in the regional centres