Technical Board Discussion on Computing Issues

Prompted by LHC Computing Review

J.Harvey

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Outline

- Comparison of manpower needs in LHCb and in ALEPH
- List of products for which we are asking IT for support (FLUKA, ROOT, HTL,…)
- View of LHCb Computing Team on LHC software projects
- Grid computing – what outside labs should do.

Will not discuss

- LHCb opinion on the Tier 0 prototype at CERN
- MOU for Computing

Software Manpower needs in LHCb

Task	Profi	1999	2000	2001	2002	2003	2004	2005	2006
CORE Software									
Subtotal Coordination (FTEs)		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Subtotal Framework - GAUDI (FTEs)		5.5	8.0	9.5	9.0	7.5	5.5	5.5	5.5
Subtotal Software Support (FTEs)		1.5	2.0	2.8	2.8	2.8	2.8	2.8	2.8
Subtotal Computing Facilities (FTEs)		3.0	3.5	4.0	4.0	5.0	5.0	5.0	5.0
Subtotal Simulation Framework FTEs)		1.5	2.0	3.0	3.0	2.5	2.5	2.5	2.5
Subtotal Reconstruction Framework (FTEs)		0.0	1.0	2.5	2.5	2.5	2.5	2.0	2.0
Subtotal Analysis Framework (FTEs)		0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Subtotal Event Display Framework (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**
LHCb subsystems									
Muon	P/E	4.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0
Trackers / Tracking	P/E	4.0	5.0	7.0	7.0	7.0	7.0	7.0	7.0
VELO	P/E	4.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0
L0 Muon Trigger	P/E	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
L0 Calorimeter Trigger	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 / partiicle id	P/E	4.0	4.0	6.0	8.0	8.0	8.0	8.0	8.0
Analysis tools	P	0.5	0.5	1.0	1.0	2.0	3.0	3.0	3.0
Event Generator design (BPACK)	P	0.0	1.5	1.5	2.0	2.0	1.0	1.0	1.0
Subtotal (FTEs) for all subsystems		**27.0**	**29.5**	**45.0**	**47.5**	**50.5**	**50.5**	**50.5**	**50.5**
Grand Total (FTEs) CORE + Subdetector		**39.5**	**48.0**	**69.8**	**71.8**	**73.8**	**72.3**	**71.8**	**71.3**

Software Manpower in ALEPH

Task	1984	1985	1986	1987	1988	1989	1990	1991
Software Infrastructure	4	5	6	7.5	8.5	7.5	7.5	7
Software Support	1	1	1	2	2	2	2	2
Computing Facilities	3	3	5.5	6	6	7	5.5	4.5
Simulation Framework	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Reconstruction Framework	2	2	3	4	4	4	4	4
Analysis Framework	0	0	0	2	2	2	2	2
Event Display	1	1	1	3	4	5	5	4
Total CORE software	**12.5**	**13.5**	**18**	**26**	**28**	**29**	**27.5**	**25**
Subdetector Data Processing Software								
TPC	4	4	7	7	7	7	7	7
ECAL	4	4	7	7	7	7	7	7
HCAL / Muon	4	4	7	7	7	7	7	6
VDET	0	0	0	6	6	6	6	6
ITC	2	2	4	4	4	4	4	4
SCAL	0	0	0	0	0	3	4	4
LCAL	2	2	2	2	2	2	2	2
BCAL	2	2	2	2	2	2	2	2
SAMBA	2	2	2	2	2	2	2	2
Trigger	1	1	1	2	3	3	3	3
Physics Tools	2	2	2	2	3	4	4	4
Total subsystem software	**23**	**23**	**34**	**41**	**43**	**47**	**48**	**47**
GRAND TOTAL	**35.5**	**36.5**	**52**	**67**	**71**	**76**	**75.5**	**72**

LHCb Missing Manpower

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		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trackers / Tracking		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	E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
L0 Calorimeter Trigger	E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
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 / partiicle id		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Analysis tools		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Event Generator design (BPACK)		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**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**	**4.0**

LHCb and ALEPH Online Manpower

WBS	Task	Profi	1999	2000	2001	2002	2003	2004	2005	2006
10	***DAQ System***									
	DAQ manpower (FTEs)		4.0	5.5	7.0	10.5	11.0	10.5	9.5	9.5
	ECS Manpower (FTEs)		1.0	1.5	3.0	3.5	4.0	4.0	4.5	4.5
	Operations Manpower (FTEs)		0.0	0.0	0.0	0.0	1.5	3.0	3.0	3.0
	Grand Total LHCb Online		**5.0**	**7.0**	**10.0**	**14.0**	**16.5**	**17.5**	**17.0**	**17.0**
	LHCb DAQ Manpower Missing (FTEs)		0.5	1.0	0.0	3.5	5.0	5.0	4.0	4.0
	LHCb ECS Manpower Missing (FTEs)		0.5	0.5	1.0	1.5	2.0	2.0	3.5	3.5
	LHCb Operations Manpower Missing (FTEs)		0.0	0.0	0.0	0.0	0.5	1.5	1.5	1.5
	Grand Total missing for LHCb Online		**1.0**	**1.5**	**1.0**	**5.0**	**7.5**	**8.5**	**9.0**	**9.0**

Task	1984	1985	1986	1987	1988	1989	1990	1991
ALEPH DAQ Manpower (FTEs)	8	8	11	14.5	16.5	15.5	13.5	12
ALEPH ECS Manpower (FTEs)	2.5	2.5	3.5	4	5.5	5.5	4.5	4.5
ALEPH Operations Manpower (FTEs)	0.5	0.5	0.5	0.5	2	3	3	3
GRAND TOTAL	**11**	**11**	**15**	**19**	**24**	**24**	**21**	**19.5**

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.
  - ~4 FTEs are missing, largely from the trigger, for which engineering effort is needed for Level1 and physicist effort (2 FTEs) is needed for L2/L3.

Solving Missing Manpower Problem

- Identify subsystem and get an institute to take it on as a formal responsibility
  - e.g. Event Filter Farm/CDR and high level trigger (5 FTEs)
  - ALEPH FALCON facility done by Barcelona / Florida
- Get institutes to agree to supply some defined level of effort in FTEs which can be assigned to common tasks e.g. in ALEPH :
  - ORSAY and RAL (3 – 4 FTEs each)
  - Annecy, Bari,Ecol Poly, MPI Munich, Heidelberg, RHBC, Saclay, (1-2 FTEs each)

List of software products LHCb needs

- Foundation Libraries – STL, CLHEP, NAG C
- GEANT4 - PYTHIA, QQ, STDHEP, …
- FLUKA – "centralised geometry description for use with Fluka and GEANT4 strongly requested"
- ROOT – "used in LHCb testbeam, should be supported as it is the only OO analysis tool in widespread use today. We also rely on ROOT as the IO package within GAUDI."
- Objectivity – currently requested for conditions database (calibration). We requested an open debate on future of Objectivity for event storage.
- Support for development tools (design, XML, code checking,……) welcome and appropriate for IT.

List of IT products others are asking for

- CMS – Objectivity, LHC++, Qt, HEPVIS, GEANT4, FLUKA (private source – no IT support needed), ROOT ("No request for IT support although physicists are free to use it.")
- ATLAS – Objectivity, LHC++, FLUKA (essential - reproduces calorimeter testbeam data), ROOT (as a replacement for PAW, not integral to experiment's software – support issue should be soluble)
- ALICE – ROOT (request 2 IT jobs for support), FLUKA, MSS ; they do NOT ask for LHC++, Objectivity,NAG C, etc ….

LHC software projects - CMS

- Put main emphasis on the data store
- Rely completely on a single solution for persistency and the features of an ODBMS – Objectivity
  - creates problems for people wanting to make private analysis on small data samples – you need Objectivity on every PC
  - CMS online people are skeptical that all communication between software components is done through a persistent store
  - Possibility of having to change is a nightmare (>1 year of work)
- They have >50 physicists actively working developing OO algorithms – claims ~zero FORTRAN development
- Close ties to IT division (Objectivity, Physics Analysis)

LHC software projects - ALICE

- Framework (AliROOT) is based exclusively on ROOT
- ROOT I/O for event store coupled with an RDBMS (e.g. MySQL) for run catalogue
- Restrict features of C++ - don't allow NAG library, STL, clhep, namespaces, etc restricts use of 3rd party software
- Big emphasis on mass storage – series of MDCs
- They do not rely upon CERN/IT software – Objectivity, LHC++ (data presentation)
- They did a fast migration to C++ (~overnight)
- Concerns are ROOT, FLUKA, G4 physics, HSM, GRID
- No use of software management tools (CMT)

LHC software projects - ATLAS

- Big effort on FORTRAN software for Physics TDR studies – baseline for any comparison with new software
- Had a software revolution
  - New organisation – not yet detailed plans i.e. milestones, WBS, ..
  - Started by thinking about architecture and framework
  - In May delivered a new software framework based on GAUDI
- Reconstruction code low risk (they have experience)
- Data handling, Objectivity, scalability are high risk
- Need to forge an effective partnership with IT

LHC software projects – IT division

- Act as catalyst for common solutions (share work)
- Started a new approach for data analysis
  - AIDA to specify abstract interfaces
  - LIZARD – replacement for PAW (with CMS)
- Objectivity and GEANT4 strategic products
- Tool support – no manpower for this (G. Kellner)
- NAGLIB replacement for MATHLIB
- Conditions database – based on Objectivity
- Working model – work with one experiment at a time
- See ROOT, FLUKA,.. as competitors to their own in-house developments

Grid computing – what outside labs should do.

- Now : Forming GRID technical working group with reps from regional facilities
  - Liverpool(1), RAL(2), CERN(1), IN2P3(?), INFN(?), …
- June 2000 : define simulation samples needed in coming years
- July 2000 : Install Globus software in LHCb regional centres and integrate with LHCb production tools
- End 2000 : define grid services for farm production
- June 2001 : implementation of grid services provided by EU Grid project
- Dec 2001 : MDC 1 - small production for test of software implementation (GEANT4)
- June 2002 : MDC 2 - large production of signal/background sample for tests of world-wide analysis model
- June 2003 : MDC 3 - stress/scalability test on large scale Tier 0 facility, tests of Event Filter Farm, Farm control/management, data throughput tests.