LHC Computing Grid Project – LCG Version 1

Progress Report – Second Quarter 2003 15 October 2003

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1 General Points

This report covers the period from 1 July to 15 September. The change in reporting period is intended to allow more time to edit the report prior to its delivery to the SC2, taking account of the timing of SC2 meetings at the beginning of each month.

A summary status report covering the past six months (CERN-CRRB-2003-08) has been prepared for the October 2003 meeting of the Computing Resource Review Board (C-RRB). Additional information on resources can be found in other documents prepared for that meeting (see C-RRB home page).

The second Level 1 milestone of the project (*M1.1 - First Global Service - Initial Availability*) was due at the beginning of the quarter. As discussed in the previous report this has suffered a serious delay, finally being made available on September 15, two and a half months late and with reduced functionality. The implications of this delay are discussed in detail below, in the section on Grid Deployment.

The integration of POOL into the experiments applications has been more difficult and has gone more slowly than expected. The POOL project has reorganised its workplan, moving resources to work directly with experiments on integration, and the system has now been integrated in the principal software packages of both ATLAS and CMS. These are important steps towards the integrated use of POOL in the data challenges of the first half of next year.

The Simulation project continued to gain momentum, particularly in the Physics Validation and Generator Services subprojects. With the continuing Geant4 activity, these projects all show good participation by and support from the experiments. The Physics Validation activity also collaborates effectively with the FLUKA team. The Generic Framework activity continues to develop slowly, guided by effective discussion among the experiment simulation leaders.

The LCG Project participated in the LHCC Review of Computing Resources in the LHC experiments. During this review some of the experiments expressed reservations on the current agreed scope of the applications area of the LCG project, in the light of

the resource difficulties that they are experiencing in other areas, in particular their core software programmes. The implications of this will be determined when specific proposals are made in the appropriate LCG committees, and the overall benefits of the common development projects should be one of the factors assessed by the LHCC Comprehensive Review of LCG in November.

The EGEE project proposal (*Enabling Grids for E-Science in Europe*) was approved by the European Union for funding in the 6th framework programme for an initial period of two years. The project, led by CERN, is a wide collaboration of computing centres and scientific institutes, most with strong links to high energy physics, which aims to operate a grid infrastructure for science in Europe. In order to optimise the use of the resources of EGEE and LCG an agreement has been made to have a very close relationship between the managements of the two projects: the EGEE grid will be operated as an extension of the LCG service, managed by the LCG Grid Deployment manager; the manager of the EGEE middleware activity, whose task is to acquire or develop a solid middleware toolkit suitable for HEP and other sciences, will serve as the Middleware manager of the LCG project. EGEE will also fund a small activity for integrating EGEE middleware in the LHC experiments' applications. This work will be coordinated through the Applications Area of the LCG project.

The EGEE project will start in April 2004, but it is anticipated that the middleware activity will begin to operate now using existing expertise and resources. It is anticipated that this will be an important contribution to the workplan developed in response to the ARDA requirements on distributed analysis. Although the ARDA report will not be discussed until the November SC2 meeting, discussions have already started, based on interim reports of the RTAG, on ways of optimising the EGEE and LHC resources available for middleware and distributed analysis development. The concurrence of the ARDA and HEPCAL 2 reports, and the significant resources that may become available through EGEE offers an opportunity for convergence of many of the HEP middleware developments which should not be missed.

A discussion has started on the role and composition of the principal management committees of the project – the Project Execution Board (PEB) and the Software and Computing Committee (SC2). The main motivation is to review the role of the experiment management in the operational management of the project, taking account of the changing focus of the project as the LCG service is opened. A proposal is expected to be brought to the November SC2.

Some progress has been made on the definition of verification milestones, and a number of new milestones are documented in this report. Difficulties have been encountered in developing objective targets for these milestones, and the definition process will continue during the next quarter.

Several changes have been made to the report on human resources in Appendix 2. The staff funded by CERN in EP Division from its base budget are now reported separately according to whether they are assigned to experiments or work in general software support. The only resources reported as funded by the European Union through the DataGrid project are those working on fabric management, where the project is integrated with the IT Division work in this area. The resources for other

activities at CERN in the DataGrid project (grid middleware development, project management, DataGrid integration and testbeds) are no longer reported. In the Fabric Area the report has been synchronised with the IT Division resource planning and reporting database, which has resulted in small changes in the staff levels reported for previous quarters. The Fabric Area also now includes campus and wide-area networking resources attributed to physics support.

The report on LCG Resources (CERN-C-RRB-2003-10) prepared for the Computing Resource Review Board provides details of budget estimates and funding for materials at CERN in Phases 1 and 2 of the project. It is anticipated that sufficient external funding will be committed at the C-RRB meeting to enable the 2004 budget to be agreed. The recently completed re-assessment of the cost of Phase 2 at CERN is within 10% of the current materials budget plan.

The report also includes information on the funding profile for human resources in Phases 1 and 2 of the project. The impact of the effective funding coming from the EGEE project will not be clear for some time. This is the net effort available for the work programme of LCG after deducting the effort required for other EGEE activities and overheads. A long term estimate of the human resource requirements of the LCG project will be made during the next quarter, once the work plans required to respond to the ARDA and HEPCAL 2 requirements have been elaborated, and taking account of the plans of the LHC experiments to participate in the Applications Area. Initial estimates show that there are likely to be insufficient resources from 2005 on.

The C-RRB report also provides information on Regional Centre resources planned to be available for the LHC service next year. This information is incomplete as some Regional Centres have difficulty in estimating the capacity that will be available for LHC. Collecting data for the report on the human resources available for supporting the LHC grid service has been particularly difficult, and indeed the initial experience with deploying LCG-1 suggests that the level of resources available in some Regional Centres is substantially below the level of 2 FTEs set last year by the Grid Deployment Board.

2 Applications Area

Torre Wenaus – Applications Manager

This quarter saw the first important results in integrating applications area software as production software in the experiments. CMS successfully integrated POOL and SEAL and validated it for event storage in their pre-challenge simulation production. At the end of the quarter they had successfully stored ~1M events with POOL. ATLAS successfully integrated POOL and SEAL in their Release 7, an important milestone towards production use of POOL in ATLAS DC2 in 2004. Both experiments found the integration of POOL and SEAL to require more work than they anticipated. Since it is as vital for the project to see prompt and successful take-up of the software in the experiments as it is to develop the software in the first place – "release early and often" only works if complemented by "integrate early and often" – the project must examine how to increase the (already significant) effort employed to

assist the experiments in integration. This will be examined over the next quarter. The next quarter will also see the first integration feedback from LHCb.

Milestone performance was good in most critical path areas (POOL, SEAL) but not so good elsewhere, largely because of insufficient allowance for the holidays – most missed milestones are expected to be completed in October. However, a critical path (for LHCb) milestone is seriously late: the readiness of SPI infrastructure for Windows (cygwin with Visual C++) builds of LCG software. The milestone is late because SCRAM is not yet fully functional in this environment. It is being worked on, but the work would be expedited if CMS SCRAM expertise (recently departed from the project) were applied to its completion.

Project manpower was stable during the quarter. CERN-resident personnel continued to consolidate in building 32 to the great benefit of the project.

A major event of the next quarter will be an internal technical review of the applications area Oct 20-22.

WBS 1.1.1 - Software process and infrastructure (SPI)

Project Leader: Alberto Aimar, CERN IT/DI

This quarter saw the completion of the first version of all SPI services as in the plan presented at the SC2. An updated plan covering the coming quarters was developed (CERN-LCGAPP-2003-13). In new activity during the quarter, standards and tools for automated packaging and distribution of LCG and external software and documentation were implemented and deployed; quality assurance practices and reports were formalized; and a user workbook with greatly improved documentation was put in place. With the completion of the services suite, SPI is approaching a more steady state mode of operation. Manpower is (just) sufficient to sustain the needed services, but only minimal, most urgent improvements to services will be possible at current manpower levels. We continue to estimate 7-8 FTEs as the level required for a fully robust operation. Staffing was ~5.5 FTEs throughout the quarter, but with a changing distribution of people. Substantial effort was spent to document and collect knowledge from the people that moved from SPI to other projects or back to their LHC experiment. Quality assurance activities will be the main focus of the next quarter, as well as better defining uniform policies to be followed by the projects.

The only SPI level 2 milestone for the quarter, support for a Windows binary version of LCG software, is incomplete because SCRAM does not yet work under cygwin. All other aspects of the work are complete. It is being worked on, but the work would be expedited if CMS SCRAM expertise (recently departed from the project) were applied to its completion. It is an important milestone because LHCb requires Windows binary builds in order to do LHCb integration of LCG software.

Highlights from the quarter follow.

Software distribution service: SPI has added a service to allow easy downloading and local installation of the LCG software and all needed external software. From the SPI web any user can select Pool and Seal in the version wanted and the product will be downloaded, as well as all the right versions of the external software used. This greatly simplifies the work of LCG users and developers that are not using the development setup available from the LCG Application Area at CERN. The service

also installs locally the right configuration of Scram, so developers can modify and easily build locally the LCG software.

Policies and quality assurance: QA activities were increased as was the definition of policies and guidelines: for coding and design, for standard CVS structure and for releasing and building software. These policies are now stable. SPI is actively encouraging LCG projects to use the LCG development guidelines and testing practices. SPI is setting up QA infrastructure to verify the quality of the LCG software. The QA framework is under definition and is it being automated in order to collect software metrics and verify adherence to the LCG policies. This activity still suffers from the fact that resources assigned to it have changed due to causes external to SPI, but has been one of the SPI focuses of this quarter. "QA reports" have been written studying the major Pool and Seal releases and will become a regular practice.

LCG workbook: All SPI services have greatly improved their documentation on the web and SPI is now actively maintaining the LCG Workbook web site. This workbook is developing into a comprehensive and complete documentation of all the LCG projects. Each project provides a web section in terms of practical "How To" pages that guides the LCG users and developers in all their activities with LCG software and within LCG projects. In this quarter SPI has provided the first version of its workbook, receiving positive feedback from the users.

Testing framework: SPI has continued the deployment of a testing framework to standardize the way projects perform unit, regression and integration testing. CppUnit and Oval are now effectively used, and PyUnit is supported for testing of Python applications. QMtest was chosen to integrate all the test execution and reporting. It runs all tests of a project via a single script or a web interface.

External software service: The service now provides more than fifty packages in the versions and platforms needed by the LCG projects. SPI has defined a standard procedure to provide these installations and a well documented website for documenting the external software installed. An important achievement was provision of support of the Intel compilers on Linux (icc, 32 bits, ecc 64 bits) and for the Windows operating system (vsc++ 7), which required the installation of all software needed by the LCG projects and experiments for those compilers. Another major improvement is the integration of the service with the Software Download Service.

Savannah portal: This service is now in use by all the LCG projects and by more than fifty projects in the LHC experiments (from thirty in June). In order to benefit from the improvements of the open source project of Savannah by the Gnu Foundation, in this quarter SPI has worked in close collaboration with the open source developers to merge all our changes with the open source and then contribute to, and benefit from, the open source as much as possible. To this end one of the principal GNU Savannah developers is visiting SPI at CERN for the month of September. As the service had reached a stable level and the staff responsible is under change the development is reduced to minimal bug fixing. The effort is focused on convergence with the Savannah open source project. Next quarter there will be major improvements to answer to several user requests.

Scram: In this quarter, as in the previous one, the main task of SPI was to improve Scram performance, work on the port to Windows and help all the LCG projects to

use Scram in their releases. Scram had one bug fix release in order to fulfil requirements specified in the LCG development policies. Scram is also integrated with the Software Download service so that developers can use Scram also on their local computer. As mentioned above, the still incomplete porting of SCRAM to Windows cygwin is a serious missed milestone. A long term strategy for configuration and build management taking into account the experience gained so far with SCRAM usage, development and support will be developed in the next quarter.

Automatic build service: An important new development was the integration in the release cycles of an automatic build system. In this quarter the adaptation and deployment of NICOS for automated POOL and SEAL software builds was completed.

Code documentation service: We improved the automatic system to generate code documentation (Doxygen, LXR and ViewCVS) by also collecting log information on the operations done on the repository (commits, updates, etc) and increasing its configurability by each project. Support for PI and for and for the Simulation projects was added. This service is stable and there will be only minor changes in the coming quarters in order to adapt it to the coming IT CVS service.

WBS 1.1.2 - Persistency framework (POOL)

Project Leader: Dirk Duellmann, CERN IT/DB

The focus of the POOL effort for the quarter was support for the integration and deployment of POOL in CMS and ATLAS as the mechanism for production event storage. Following the release of the first production version of POOL last quarter, the measure of success now shifts to successful integration, validation and deployment of POOL in the experiments, towards which POOL has worked to promptly address the inevitable problems as they are uncovered during integration. The first important validation milestones were met on time with the acceptance and deployment of POOL by CMS for its pre-challenge simulation production. ATLAS also delivered its first integration of POOL into Athena during the quarter. Both ATLAS and CMS found the integration of POOL and SEAL to be more work than they expected; the project will be examining how best to help the experiments further in integration in the future in order to ensure that project software is integrated and validated promptly.

During the quarter POOL produced several releases starting with 1.2.0 which fulfilled new feature requests originating from the experiment integration efforts. POOL 1.2.0 included on the storage manager side for the first time support for the special vector<bool> type and also supported iteration over uncommitted objects already during the originating transaction. Several modifications to the casting and conversion operations provided by POOL Refs which were requested by CMS went into this release. It also supported the ATLAS request for a customisable ownership policy in the POOL cache to allow easier integration into StoreGate.

One of the original release goals was to introduce performance testing for all components. This has been achieved, though a thorough optimisation based on these tests has only happened in some components so far. For the ROOT based collection implementation we were able to show that POOL only imposes very limited overhead on top of vanilla ROOT. Because of the continuing workload on implementing new

features, other work packages have not yet achieved the same level of understanding of their performance.

POOL V1.2.1 was released mainly to pick up the ROOT bug-fix version 3.05.07a. POOL V1.3.0 was targeted mainly to pick up the SEAL 1.1.0 release which came with significant enhancements (and also some API changes) in several of the components used by POOL. In particular the use of the message service had to be adapted in POOL to adjust to the new model. The following releases 1.3.1, 1.3.2 and 1.3.3 were mainly bug-fix releases issued on request from the experiments to remove smaller issues described in (http://pool.cern.ch/relnotes.html).

No significant changes occurred in POOL staffing during the quarter.

WBS 1.1.3 – Core libraries and services (SEAL)

Project Leader: Pere Mato, CERN EP/SFT

During the quarter we released, with only a small delay with respect to the planned date, version 1.0.0 of the SEAL software incorporating a number of essential elements that makes the release ready for use in experiment frameworks. In addition to this release, a number of technical and bug fix versions have also been released (0.3.3, 0.3.4, 1.1.0) in light of user feedback, particularly the integration efforts in the experiments. The quarter saw the initiation of design work for an important pending component foreseen for SEAL, the object whiteboard. Here follow the main highlights for each work package.

- **Foundation libraries**. No new functionality was added to the foundation libraries. Bug fixes and improvements were made in various areas such as the plug-in manager. Some changes were made to better support new platforms.
- **Math Libraries**. Continued the development of the new Minuit package. In particular the development of a tutorial (taken from one of Fred James' lectures), improvements in minimizing the number of function evaluations, and changes in the user interface to configure the number of iterations, the edm-value and adding the possibility for fixing and releasing user parameters. Installation of new versions of math related packages in the SPI external area (CLHEP, GSL, Blas, Lapack).
- **LCG Dictionary**. Apart from bug fixes, several features for the Dictionary work-package have been implemented including support for enums, optional arguments in function calls, the possibility to concatenate calls to ReflectionBuilder functions, and support for the PluginManager. Ready-to-use dictionaries have been created for STL (vector, list for integral types including string), CLHEP (Vector and Random) and the Reflection package itself. The latter makes it possible e.g. to use the dictionary information through the python binding. The STL and CLHEP dictionaries will be extended upon request of users.
- **Basic Framework services**. We have released the first implementation of the SEAL component model. The Framework sub-system is populated with two new packages (SealKernel, SealServices) containing the base classes and services for the model. A first batch of corrections to this young model has already been applied. More work is being done at present towards the building of more SEAL services as DictionaryService to provide on-demand loading of SEAL C++

dictionaries and others. We are eager to receive usability feedback from LCG projects (POOL, PI, Simulation) and from the experiments.

- **Scripting Services**. The report of the evaluation of the existing products for generating Python bindings has been made public. The conclusion is that Boost, Python and SWIG are the leading candidates, by virtue of providing the greatest coverage of features, the most complete documentation, and being under active maintenance and development. Most imaginable features are supported by both, and it seems likely that both systems will continue to improve with time. It is recommended that a more detailed analysis of the issues surrounding interoperability of the two technologies be carried out and this investigation has been started. The PyLCGDict package providing the Python binding to the LCG Dictionary has been released. It allows the user to interact with any C++ class for which the LCG Dictionary has been generated. Optimisation and C-style array support was added to PyROOT.
- **Documentation and Education**. Building on the foundation of the pilot Python course, the course material was developed and adjusted. Three new Python courses were run as part of the CERN technical training program. In liaison with SPI, the SEAL workbook structure and creation procedures were re-designed and streamlined. A variety of new features available in release 1.0.0 were documented in how-tos.
- **Software Process and Infrastructure**. More efforts have been put in the QA activities in the last quarter. Every SEAL package contains a tests sub-directory, with unit tests covering a large amount of code. The existing unit tests in the Foundation subsystem have been converted to use the CppUnit and the new tests in the Framework and Scripting have been also written using CppUnit following the policies proposed by SPI. All SEAL tests have been integrated in QMtest driver, which gives the possibility to easily run the tests and visualize the results. Automatic builds of all the SEAL software are performed every night using the NICOS service. Progress has been made to support builds for new platforms and compilers (icc and windows) but unfortunately this work has not been completed and we have not yet a release including these new platforms.

The milestone to establish a formal decision-making process for the selection of external software, already twice postponed due to its low priority (arising from a lack of perceived need; we have not significantly felt the lack of it), has been demoted to a level 3 milestone because of its low relative importance. We anticipate that important new milestones for SEAL will be defined in the next quarter in areas relating to the object whiteboard and to grid-based services supporting distributed analysis (following ARDA outcomes).

WBS 1.1.4 – Physicist Interface (PI)

Project Leader: Vincenzo Innocente, CERN EP/SFT

During the quarter the work continued to focus on the Analysis Services work package, consistent with the guidelines from SC2 and further guidance arising from a July status report PI presented to the SC2. Priority was given to completing the implementation of all AIDA binned histograms (Histogram1D/2D/3D and Profile1D/2D) as wrappers to their corresponding ROOT objects. This functionality, including the corresponding examples, was released as version 0.3.0 of PI on July 15.

Following feedback from CMS, the functionality of the Proxy_Store component has been improved, now allowing for storing/retrieving groups of histograms using std::vector's or std::map's. Together with some small bug-fixes, and changes in the configuration adapting to new versions of SEAL and ROOT, this was released as version 0.4.0 on Aug. 29. This release was followed by another release (0.4.1) on Sep. 9 where mainly configuration changes (SEAL 1.1.0) and some bug-fixes contributed by LHCb were integrated.

The work on the AIDA evaluation and report is delayed mainly because of slow feedback from users in the experiments (partially due to holiday season, of course). From the feedback we did receive, it is clear that there is interest in using AIDA/PI. We will actively follow the contacts we have now established to collect feedback and estimate to be able to finish the report before end October.

Ongoing work concentrates on updating the PI test suite to full SPI compliance. This is expected to be finished by mid October and will result in the 1.0.0 release. Further planning of the future PI work plan will follow the outcome of the ARDA RTAG.

WBS 1.1.5 – Simulation

Project Leader: T. Wenaus, BNL/CERN EP-SFT

During this quarter the strong activity initiated last quarter in the Physics Validation, Geant4 and Generator Services subprojects continued, with all projects showing good participation by and support from the experiments. The FLUKA team is collaborating effectively with the Physics Validation activity. The Generic Framework activity continues to develop slowly among the experiment simulation leaders. A series of reports on all project activities were presented in applications area meetings in July and August, and the projects were discussed in the following Architects Forum meetings.

The Generic Simulation Framework subproject (A. Dell'Acqua) continues to develop slowly. As a discussion forum among the experiment simulation leaders it is proving to be a very efficient way of exchanging information and profiting from one another's results and experience. A high level service architecture has been laid out, with the "glue" connecting the services to one another and to basic services such as persistency coming from the framework infrastructure (SEAL). Design work on the services is underway, with the starting points being existing applications. Principal future steps are evaluation of the ALICE virtual monte carlo and the implementation of a prototype in close collaboration with the physics validation subproject to provide them with a working infrastructure for comparisons/tests with different engines. Further progress on design and optimal implementation approach is best achieved through hands-on experimentation in the context of the planned prototype; therefore the "Generic framework high level design and implementation approach defined" milestone has been superseded by a milestone for the availability of an initial prototype by the end of the year. The high level design and project status were presented in an applications area meeting in August. The effort level remained as the available time of the experiment simulation leaders during the quarter.

The Geant4 subproject (J. Apostolakis) support activities were the largest part of the efforts during the quarter. Following up release 5.2 in June, the expanding testing

of CMS and LHCb, and feedback from other users, a number of bugs and deficiencies were uncovered. The investigation of problems in geometry and hadronics and the creation of fixes and accompanying testing were significant undertakings. In a series of meetings with SPI, initial areas for cooperative work were identified – the Savannah portal and SPI testing infrastructure. Active collaboration on infrastructure is planned to start in October. The workplan for the subproject (linked from the subproject web page) was updated during the quarter.

In geometry (WP-1), development of a twisted trapezoid solid reached the stage of identifying the candidate solution. A detailed URD traceability matrix is pending. A first implementation of volume divisions for tubs, box, cons has been created. The development of weight-window biasing and its documentation have been achieved ahead of schedule (it was Q4).

Improvements in the presentation of the results of system testing (WP-2) are pending. A first security assessment was made of the vulnerabilities of the testing system, and the most important patches needed were identified.

The testing of the model approach for EM physics (WP-3) has been extended substantially. The identification of the set of tests is pending. Testing results were reported at the Geant4 Workshop September 2nd-6th at Vancouver. An initial statistical test was created from the Atlas FCAL test beam, with the assistance of its team. The development of the error propagation module prototype has made large steps towards its expected first prototype release, scheduled for end September. These were reported at the Geant4 Workshop.

The development of leading particle biasing and X-section biasing in the hadronics (WP-4) has been undertaken. The first physics lists specifically for the simulation of LHC experiments have been published.

Follow-up of new requirements (WP-5) from CMS regarding direct linkage of simulated particle tracks with the primaries from an event generator was undertaken. The resulting developments were done by SLAC-based Geant4 developers and kindly made available very quickly for testing and the creation of a customized release by CMS. A first meeting on performance with experiments took place and identified areas for investigation and improvement of information for performance and memory allocation monitoring.

There are two departures at the end of this quarter. M Dressel reached the end of his fellowship (G Daquino is to take over his developments). P Mendez (LCG Spain) is departing.

There was one arrival, Oliver Link started in July and is working in geometry and field. The effort level in the subproject was ~9 FTEs at the end of the quarter.

The FLUKA Integration subproject (A. Ferrari) continued to be active with the physics validation subproject. Activity in generic framework integration awaits the better definition of that project, with the expectation that work done for ALICE integration can be reused. FLUKA plans and milestones were presented in an applications area talk.

The Physics Validation subproject (F. Gianotti) continued to be very active in the last quarter. The project continues a regular program of monthly meetings gathering

participants from all the LHC experiments and simulation projects. Activity during the quarter covered the following areas:

- Simple benchmarks. The study of double differential cross-sections for (p, xn) at various energies and angles has been completed. FLUKA and G4 have been compared with many experimental measurements performed at Los Alamos. A note summarising the results is being written. The next benchmark to be addressed is pion absorption.
- Physics requirements of the various experiments are being revisited. The ATLAS part is completed. We anticipate this to be completed for all experiments by the end of the year.
- Radiation background studies in the LHCb experiment, aiming at comparing G4/FLUKA/GCALOR, have started.
- Physics validation of FLUKA using ATLAS Tilecal test beam data has started.
- Validation of EM physics is essentially completed, although new test beam data and studies are available and are regularly reported to our meetings. In particular, results on shower shapes in the ATLAS EM calorimeter have recently been obtained.
- Comparisons of test beam data with G4 to validate the hadronic physics are going on. They are based on the calorimeters of both ATLAS and CMS as well as special data collected with the ATLAS pixel detector.

Effort level was stable through the quarter at ~3 FTEs.

The Generator Services subproject (P. Bartalini) continued to be very active in the quarter. Dedicated subproject meetings are held monthly. The manpower level was stable during the quarter at 1.3 FTEs. MC4LHC (which oversees the activities of the project) issued series of recommendations that will be taken into account in future planning:

- The organization and goals of the subproject, the defined milestones, the current GENSER structure and the plans for its future evolution have been approved.
- The LCG participation in the MC4LHC workshop has been appreciated. LCG Generator is contributing to advertise the new MC projects and is providing a forum for discussions on the generator related software.
- It is recommended to improve the collaboration with the MC authors, identifying contact persons to monitor inclusion of packages in the LCG environment.
- The turnover and the possible loss of well trained people (for instance the librarian) can represent a big problem as all the experiments will soon rely on GENSER. Long term support to LCG Generator members has to be guaranteed by LCG.
-

Highlights during the quarter follow.

Generator library (WP1): The beta version of GENSER containing the top priority packages (HERWIG, HIJING, ISAJET and PYTHIA) was prepared during the quarter. Contact persons for these MC projects have been identified. Package versions

pursued for inclusion have been indicated by the contact persons in MC projects and/or by the volunteered beta testers in the LHC experiments. GENSER beta will be released on schedule at the end of September. A pre-release was produced in August. CMS and ATLAS have reported very positive feedback to the September monthly meeting. The use of the Simulation Savannah portal for bug report and task assignment will be strongly encouraged from now on.

Following the suggestions from the contact persons in LHC experiments and MC projects, three milestones relevant to WP1 are being defined:

1) The inclusion of the first C++ generator (end of 2003). Sherpa is the identified candidate (contact person F.Krauss). Sherpa has been already successfully installed as external package in the LCG environment.
2) The inclusion of LHAPDF (end of January 2004). LHAPDF is considered to have the highest priority among the remaining mandated packages.
3) The inclusion of COMPHEP, ALPGEN and EVTGEN (end of March 2004).

Dedicated LCG resources corresponding to 1.0 FTE for 0.5 years would be needed to take on these tasks.

Storage, event interfaces and particle services (WP2): The CLHEP split is complete and the LHC experiments are currently performing its evaluation. It may be necessary to support a dedicated LHC version of HepMC but it is currently premature to take a decision. An agreement on the persistency for the generator output would be necessary to organize the work. Different solutions are currently being discussed in LCG generator meetings. A specific proposal will be produced end of November 2003. Dedicated LCG resources corresponding to 0.5 FTE for 1.0 years may be necessary to coordinate the standardization of HepMC.

Common event files, event database (WP3): MCDB will be the tool for centrally providing common event generator files. MCDB has a web interface providing simple access to event files, and a programming interface. The impact of the choice for the common event format on MCDB will have to be carefully evaluated. Technical support for bookkeeping and for the storage and management of large files will be needed from LCG.

Tuning and validation of event generators (WP4): progress has been made in the context of the MC4LHC workshop held this summer at CERN. However setting up a dedicated project in LCG does require the generator library to be in place. A specific proposal for the integration of existing tools in the LCG environment will be made in 2004. The JetWeb project [hep-ph/0210404] should constitute a good starting point for this work package. JetWeb is a Database of data, MC and comparisons with fitting and tuning tools. An enquiry is currently being made to verify if the JetWeb authors are interested to use GENSER and/or to develop their project in LCG. It is anticipated that dedicated LCG resources will be requested in 2004.

WBS 1.1.6 - ROOT participation

The LCG applications area contributes effort to the ROOT project. The LCG-contributed effort to mainstream ROOT development areas liberates the core

members of the ROOT team to devote greater time to the specialized developments in ROOT I/O and elsewhere that are required by LCG software. Ilka Antcheva and Valeriy Onouchine are LCG-supported personnel contributing to GUI development, documentation, and a new implementation of ROOT on Windows using Win32GDK. During the quarter the ROOT team continued to collaborate with POOL participants and experiment integrators to respond to integration feedback and bug reports. The ROOT team also began an examination of how POOL uses ROOT I/O in its streaming layer in order to identify any shortcomings and recommend improvements. In addition, Gerardo Ganis (working with ALICE and ROOT) continued work on the integration of Grid-based authentication into ROOT, now officially documented and released (http://root.cern.ch/root/Auth.html).

WBS 1.1.7,1.18 – Core/Grid Interface & Experiment Integration

Through this activity the Applications Area provides direct assistance to the experiments at the interface between core software and the grid, and supports the adaptation of physics applications to the grid environment. Oxana Smirnova continued work with ATLAS on the integration and deployment of ATLAS simulation and reconstruction production on the grid, with the focus now moving to the LCG-1 service. She also continued to play an active role in the GAG HEPCAL activities. Gerardo Ganis works with ALICE and the ROOT team on different aspects of Grid-enabling ROOT as discussed earlier.

Milestone performance during the quarter

WBS 1.1.1 - SPI:

- SPI support for Windows binary version of LCG software (Aug)
  - Incomplete due to ongoing SCRAM difficulties (non-SCRAM aspects are done). Anticipate October.

WBS 1.1.2 - POOL:

- CMS POOL integration: POOL persistency of CMS event (Jul)
  - Completed
- Initial POOL deployment on LCG-1 (Jul)
  - Incomplete due to late availability of LCG-1. In progress.
- ATLAS POOL integration: POOL persistency in Release 7 (Aug)
  - Completed

WBS 1.1.3 - SEAL:

- First set of GSL enhancements available (Sep)
  - GSL enhancements were delivered but statement on GSL and NAG usage still required. New milestone (Oct) added for this; this one closed.
- SEAL V1.0 release (Jul)
  - Completed
- Nightly builds deployed in SEAL (Jul)
  - Completed
- Establish external software decision process (Sep)
  - Postponed due to higher priorities and demoted to level 3
- Math library workplan in place (Jul)
  - Incomplete. Promised for ~end Sep.

- SEAL support for Windows binaries (Sep)
  - Incomplete pending SPI milestone completion. Anticipate October.

WBS 1.1.4 - PI:

- AIDA interface review (users) completed (Sep)
  - Incomplete due to slow feedback. Anticipate completion in October.

WBS 1.1.5 - Simulation:

- Generic framework high level design and implementation approach defined (Jul)
  - Superseded by an initial prototype milestone for Dec
- Simulation physics requirements revisited (Jul)
  - Completed for ATLAS; should be complete for all experiments by end of year

Upcoming milestones (to level 2)

WBS 1.1.1 - SPI:

- SPI support for Windows binary version of LCG software (Oct)
- SPI infrastructure operational on IT CVS service (Nov)

WBS 1.1.2 - POOL:

- POOL RDBMS independence layer in beta (Sep)
- POOL support for Windows binaries (Oct)
- Initial POOL deployment on LCG-1 (Nov)

WBS 1.1.3 - SEAL:

- Math library workplan in place (Oct)
- Statement on GSL and NAG usage for math library (Oct)
- SEAL support for Windows binaries (Oct)

WBS 1.1.4 - PI:

- Report from AIDA interface review (Oct)

WBS 1.1.5 - Simulation:

- SPI-G4 collaborative infrastructure pilot in place (Nov)
- Initial generic simulation prototype supporting Geant4 and FLUKA (Dec)
- Simulation physics requirements revisited for all experiments (Dec)

3 Fabric Area

Bernd Panzer-Steindel – Fabric Manager

A detailed status report was presented to the SC2 on the 12th of September (see **presentation**).

The CERN management has decided that the cost of tape media for the LHC experiments at CERN will be funded from the IT and EP budgets in 2004 and 2005. The estimated cost of this is 600 KCHF in 2004, 1000 KCHF in 2005. The IT contribution for this will have to come from the budget foreseen for

processors and disk storage for the LHC experiments. A proposal has been made to cover part of the costs by recuperating existing media, copying data from low to higher density format. When the request has been refereed by COCOTIME, and the funding available in EP established, a proposal for next year's acquisition of tape media, processors and disk will be brought to the PEB.

The Linux distributor, RedHat, has lately changed again its strategy towards the support of their free Linux distribution. They reduced the lifetime of the distribution from 12 to 6-8 months, while at the same time emphasizing the superiority of their enterprise versions in terms of stability and support. Currently a single node license for the enterprise version costs ~500 CHF per year. The Linux certification team (including representatives of IT, LHC and non-LHC experiments, the LCG Applications Area, and the Accelerator Sector) is discussing the options for the future. This will also be discussed more widely within the HEP community at the next HEPIX meeting at the end of October.

The new CASTOR architecture and design has been presented in several meetings (user meeting on 24th June, PEB on 12th August PEB, SC2 on 12th September) and a paper has been distributed to key people for feedback.

The order for 440 CPU nodes has been made with the aim of installing them in November.

Milestones in Q3 2003

Fabric Management

QUATTOR is a system administration toolkit being designed and implemented by the EDG WP4 group and the IT/FIO group. It has different components which are/will be used to administer the CERN T0/T1 center.

- The Software Package Management Agent (SPMA)
- The Node Configuration Manager (NCM) subsystem
- The Automated Installation Infrastructure (AII)
- The Configuration Database (CDB)
- The Fault Tolerant System (FT)

Initial components (SPMA, CDB) are already deployed on 1200 systems in the computer center and have been used 2 weeks ago to upgrade 800 batch nodes to LSF 5.1 fully automatically (no LSF interruption, no user noticed….).

Milestone 1.2.2.1 due 01-Aug-2003 - SPMA – full production
→ was completed on 1200 nodes on 18th August 2003

Milestone 1.2.2.7 due 01-Sep-2003 - FT – development started
→ started 01.09.2003

Computer Centre Upgrade

To host the expected amount of equipment in 2007 the space, cooling and electricity infrastructure in the computer center has to be upgraded. Today we have a maximum capacity of about 600 KW, and we are already using ~ 450 KW. The goal is to refurbish the infrastructure to deliver 2.5 MW for powering computer equipment, with a similar capacity for peak cooling and other infrastructure needs.

Milestone 1.2.3.3 due 01-Sep-2003 – Sub-station civil engineering starts

→ work started on the 18th of August

Milestone 1.2.3.2 due 01-Aug-2003 – Right half of m/c room migrated to vault

→ finished on the 15th of August

Grid Integration

With LCG-1 now stabilizing, the coordination work between the LCG-1 grid deployment team and the Fabric service teams has restarted (installation procedures, security, network access, LSF issues,etc.)

Milestone 1.2.4.2.1 due 01-Aug-2003 - 10 LXBATCH nodes integrated in LCG-1 (isolated from main LXBATCH)
→ delayed until November due to the late deployment of LCG-1

Expected Milestones in Q4 2003

Mass Storage

Milestone 1.2.1.1.1 due 01-Oct-2003 - Concept of pluggable scheduler and high rate request handling demonstrated (CASTOR)

Milestone 1.2.1.2.1 due 01-Oct-2003 - ALICE DC5 (300 MB/sec)

→ due to late installation of the upgraded prototype this milestone will move by about 1 month (November)

Fabric Automation

Milestone 1.2.2.2 due 03-11-2003 - NCM – full production

Milestone 1.2.2.3 due 01-Oct-2003 - SMS – initial system

Milestone 1.2.2.5 due 01-Oct-2003 - Monitoring – Systems monitor displays operational

Milestone 1.2.2.10 due 01-Oct-2003 - HSM ops display – development started

Milestone 1.2.2.11 due 01-Dect-2003 - HSM ops display – system complete

Fabric-Grid Interface

Milestone 1.2.4.2.2 due 01-Oct-2003 - 100 LXBATCH nodes integrated in LCG-1 (isolated from main LXBATCH)

→ we will not be able to reach this goal and have to postpone this to November, probably merging the two milestones (1.2.4.2.1 + 1.2.4.2.2) into one.

Milestone 1.2.4.2.3 due 01-12-2003 - Full integration of LXBATCH worker nodes in LCG-1 completed

→ this will probably be delayed to beginning of January

Fabric Infrastructure

Milestone 1.2.6.1 due 01-12-2003 - Decisions on the equipment selection criteria made

Milestone 1.2.6.2 due 01-12-2003 - Agreement with SPL on acquisition

4 Grid Technology

David Foster – Chief Technology Officer

The period July through 15th September was dedicated mainly to the OGSA engineering activities that were created in order to understand the capabilities of the released GT3 toolkit from Globus on July 1st.

One milestone addresses this, which was the report on GT3 due 1st September. Due to the vacation period this milestone was fulfilled by the LCG seminar held on the 24th September.

http://agenda.cern.ch/fullAgenda.php?ida=a035448

The work that was executed involved setting up a small testbed and working with the GT3 toolkit. Additional software components were created and used to understand the issues in creating new grid services. Finally many discussions were held concerning the integration of existing software, in particular AliEn, into a GT3 framework.

Work continued on the modelling activities and in particular understanding the requirements of the experiments for the 2004 data challenges. Much time was spent in understanding the Monarc toolkit and its capabilities. As of the current date this activity can only still be described as exploratory as defining the interesting problems to be investigated have not yet been finalised and many issues remain with Monarc. Nevertheless the current work and plan has been published on the GTA web pages:

http://lcg.web.cern.ch/LCG/peb/GTA/LCG_GTA_Modeling.htm

The current plan is ambitious but the intention is to focus on investigating some definable aspects useful to the 2004 data challenges by the end of the year. Close collaboration with the experiments will be continued and the models refined as the requirements become clearer.

The EGEE senior management team was established and the negotiations with the EU continue. The focus of attention has been on creating the technical annexe for the EU. It is anticipated that technical design team will be established by the EGEE middleware manager (Frederic Hemmer), who takes up the job on 1 October. In the interim, the LCG engineering activity will continue to investigate relevant technical issues around a service based architecture expected to be adopted by EGEE. The preliminary report of RTAG 11 (ARDA) also indicates that this is an appropriate strategy to adopt for middleware development.

It was agreed in September that the GTA area would be reorganised. The provision of middleware becomes the responsibility of the new Middleware Area, which is identical with the EGEE Middleware Activity. The existing resources and some activities will continue to function as part of the LCG-CTO role that will continue to be fulfilled by David Foster for the time being. In particular, the CTO retains responsibility for the overall strategy and long-term policy for middleware.

Milestones

The Q3 milestones are summarised below:

1.3.2			System Modeling	
1.3.2.2	3.337	2	Modeling plan for work during 2003 created	15-07-2003
1.3.4			LCG Technology Evolution	
1.3.4.2	3.344	2	Report on GT3 capabilities ready	01-09-2003
			LCG - EGEE Coordination	
1.3.4.1	3.501	2	EGEE senior management appointed	15-07-2003
1.3.4.2	3.502	2	Technical design team established	01-09-2003

All milestones were met apart from 1.3.4.2, which is the responsibility of the EGEE Middleware manager (see the discussion of the next quarter's milestones below).

The Q4 milestones foreseen are:

1.3.1			Technology Review	
1.3.1.3	3.496	2	Report on the Review of Grid Technologies 2003 ready	06-10-2003

This milestone has largely been completed leveraging on an extensive report done earlier in the year by Tony Hey and Geoffrey Fox. A summary is being prepared and will be available on the LCG GTA web pages:

http://lcg.web.cern.ch/LCG/peb/GTA/LCG_GTA_ES.htm

			LCG - EGEE Coordination	
1.3.4.3	3.503	2	2004 "blueprint" architecture published	01-10-2003
1.3.4.4	3.504	2	Work packages definition published	03-11-2003
1.3.4.5	3.505	2	Implementation teams, allocations to work packages, team management and job descriptions identified	03-11-2003
1.3.4.6	3.506	2	2004 work plan and system performance goals for 2004 by trimester published	01-12-2003
1.3.4.7	3.507	2	Work plan formally agreed	15-12-2003

The first of these milestones, 3.503, corresponds to the publishing of the ARDA report (and assumed the prior publication of the HEPCAL 2 report). The other milestones, along with 3.502, are the responsibility of the joint LCG/EGEE Middleware activity. They have still to be confirmed with the Middleware Manager, who begins work on 1 October, but are all dependent on the ARDA recommendations. This includes the establishment of the technical design team, which should include participation of all of the teams that will be involved in later implementation. It is however already clear that the current milestone schedule will not be met.

Resources

The foreseen continuing resources for 2003 attached to the Grid Technology Area for the above work at present are 50% of the area leader, one person from the FZK, one CERN employee and one person from the EDG project. The 2 persons from Moscow State University left and one new person arrived. In addition one from the Academia Sinica in Taipei are working as part of the team although due to leave soon.

5 Grid Deployment

Ian Bird – Deployment Manager

Milestone Status

1.4.1.1 (L2) Initial middleware for LCG-1 delivered (30 April 2003)

This milestone was met on 31 July (3 months late). The middleware expected from EDG at the end of April had many problems. LCG took a reasonably stable sub-set of middleware and worked for several weeks on the LCG certification test-bed to find major problems, and to address and solve these together with VDT/Globus and the EDG developers. By the end of August we had a set of middleware that we considered stable enough to deploy.

1.4.1.4 (L2) Deploy LCG-1 m/w to agreed 10 Tier 1 sites (15 July 2003)

This milestone was late but was achieved on September 15. The lateness was due to the delayed availability of the EDG middleware components. The middleware is now deployed to 11 sites (1 US, 2 Asia, 8 Europe), with 3 more in the process of installation. A pre-release version was available for deployment at the beginning of July, and was installed at 5 sites within 2 weeks. The other 5 Tier 1 sites originally identified as initial deployment sites had problems with available effort during this period. The certified LCG-1 release was available for installation on 1 September. Within 24 hours the upgrade of the first 5 sites was achieved, with several others following within a week. Barcelona, Budapest joined during this period. Of the original 10 Tier 1 sites Brookhaven and Lyon have still not managed to install the distribution. BNL have been using the "lite" installation that allows middleware installation over an existing OS installation, and this procedure is still being debugged during this process. The delay at Lyon is apparently due to a lack of available effort. Presently (15 September) the following sites are up and participating in LCG-1: CERN, CNAF, RAL, FZK, Moscow, Taipei, Tokyo, FNAL, Barcelona, Budapest, Poland; with BNL, Lyon, and Prague still working on the installation.

M1.1 (L1) First global service initial availability (1 July 2003)

This milestone was late but was met on September 15 with the satisfaction of the L2 milestone (1.4.1.4) having the middleware deployed to 10 sites. The middleware release for LCG-1 was tagged on 1 September. The time from initial availability of the middleware to the milestone was very close to the original estimates. It took this long to really work through all the problems and approach something reasonably stable. This is not a process that can short-cut and experience during the past few months demonstrates that we must really allow enough time to debug and stabilise middleware before deployment.

1.4.1.6 (L2) LCG-1 Certified and Commissioned (1 August 2003)

This milestone was delayed but is now met (29 September). The intention was to run the certification tests and the Loose Cannon tests on the deployed system to meet this goal. Due to the delays in deploying the system and lack of staffing in the regional centres during the summer this has been reduced to running by the Loose Cannons'. The experiments are now beginning their tests on LCG-1. These are being carefully scheduled and monitored to allow debugging and understanding of problems.

1.4.2.2 (L2) LCG-1 Performance goals defined (1 September 2003)

This milestone was a request for the experiments to define what goals should be reached by LCG-1 and was addressed by them in their presentations to GDB meetings over the past 2 quarters. The milestone was met on September 9 with the final presentation from LHCb.

Milestones Next Quarter

The next quarter is focused on moving from the initial system to one that will be capable of handling the needs of the data challenges in 2004. This culminates at the end of November in a Level 1 milestone for having LCG-1 fully operational. This has been referred to as LCG-2 (i.e. LCG-2 is the fully operational version of LCG-1).

1.4.1.7 (L2 external) Experiment Verification (1 October 2003)

This is a requirement on the experiments to perform a basic level of acceptance testing of the LCG-1 service. Since this is obviously dependent on the deployment of the middleware the milestone will be delayed. It was anticipated that the experiments would be able to start this testing during August, and the activity began in the first week of September with the EDG Loose Cannons running their tests on the certification test-bed, and then moving to the deployed system. The experiments are now scheduling time to make first evaluations on LCG-1; ALICE has already started, CMS and Atlas will follow quickly. Feedback is anticipated during October/November.

1.4.2.4 (L2) Middleware functionality complete (1 October 2003)

Although the integration, testing and release of a set of middleware for use in LCG-2 in the 2004 data challenges will not be complete before the end of November (the target date is November 20), it is now well defined what that set of middleware will be. The delays in producing and integrating the middleware coming from EDG have somewhat reduced the anticipated functionality that will be available, however, the functionality will be sufficient for the data challenges to succeed. The expected developments are:

- Re-alignment of the LCG release with EDG version 2.1 – this will provide the move to the gcc3.2 compiler needed by the experiments,
- Upgrade of VDT/Globus to Globus version 2.4.x which will be supported during 2004. Testing of this is well in hand.

- Deployment of the VOMS service to provide role-based authorization and authentication; initially for access to compute services, later for access to storage,
- The integration of the grid file access library (GFAL) with RLS and SRM to provide storage element functionality. The components have been tested independently and are currently being tested on the certification test-bed. The GFAL has been tested against Castor at CERN and Enstore at FNAL which have working SRM interfaces.
- The deployment of the RLI part of the RLS will be delayed until this has been demonstrated to work in the EDG test-beds. We will focus on a longer term goal of moving towards interoperation of the two different RLS implementations which currently do not interoperate. This is already a problem for the experiments and must be resolved. There is a plan to achieve this by June 2004 agreed between the CERN RLS developers, LCG, and Globus. In the interim, for the data challenges, the solution will be to continue with a central RLS service, and tools for the cross population of RLS catalogs. In batch production it is understood that the major use case is bulk updates of a catalog, rather than individual updates from each job. This model can be supported with the current set of services.
- It was originally anticipated that R-GMA would supercede MDS as the information system. Unfortunately, R-GMA has yet to be demonstrated to be stable in a production environment. This fact, coupled with the reality that LCG must inter-operate with other grid infrastructures using MDS, means that it is unlikely that R-GMA will be part of the main LCG installation in the next few months. However, once it is stable it is intended that LCG will make a comparison between the two systems on the production infrastructure.

1.4.2.5 (L2) Job Execution Model Defined (30 September 2003)

This is a documented technical description, based on the middleware available, of the functionality and mode of use of the LCG service. Since this is highly dependent on the middleware available within LCG, the complete description will not be available until there is a full understanding of exactly which components have been integrated and demonstrated to work in the production environment. Particularly important is to understand and specify the possible data management and storage access models.

1.4.2.3 (L2) Tier 2 centres included (31 October 2003)

This milestone will be met. At the GDB in July a proposed schedule for Tier 2's joining LCG-1 was requested from the members. Although there was limited response to that request, several sites have expressed willingness to join the LCG-1 service on this timescale. Currently active Tier 2 sites are Budapest and Cracow, with the 4 Italian Tier 2's ready to deploy now.

1.4.2.6 (L2) Second prototype operations centre and user support operational (30 October 2003)

Since LCG-1 is late in being deployed, the time between the initial implementation of the operations centre and user support service is very short. However, by the end of October there should be sufficient operational experience with LCG-1 to verify the usefulness of these services and to determine where further effort should be directed.

1.4.2.8 (L2) Upgraded middleware deployed (15 October 2003)

This milestone will be delayed. The current plan is to have the upgraded middleware fully integrated and tested on the certification test-bed and ready for deployment by November 20. The full deployment will take place immediately after that and should be expected to be deployed by mid-December.

1.4.2.9 (L2) Security procedures in place for 2004 (1 December 2003)

The security group is working on a full security policy for LCG. This will cover many of the aspects that had been put aside to get LCG-1 initially deployed. It is anticipated that this milestone will be met.

1.4.2.11 (L2) Service review complete (24 November 2003)

This milestone was proposed before it was clear that there would be an LHCC review and an LCG internal project review in November. Those reviews will replace this milestone, but should provide the same level of validation of the service, albeit with a shorter length of experience with LCG-1 than was anticipated.

M1.4 (L1) LCG-1 Fully operational (28 November 2003)

This milestone marks the deployment of the set of middleware that will be integrated into LCG this quarter, and deployed to the participating sites. Owing to the delays described above, it is anticipated that the integration will be done by November 20, with the deployment being carried out over the month following. The service will be fully operational in January 2004.

Resources

Now the initial deployment of the service has been done, many tasks now are of an operational nature and should be done by collaborations between the regional centres and the deployment team. Here we must focus some effort to find people to work on some of these tasks. This has not been easy to find so far, but will become crucial in making LCG a sustainable service.

The INFN recruitment round was finished in the last quarter, with 6 Fellows being recruited for Grid Deployment. Three of these will work in experiment integration, the others will join the certification and deployment teams. However, due to administrative delays we only expect to have these staff begin work in October (4

fellows) and November (1 fellow). The sixth candidate turned down the position and the alternate was also no longer available.

A good candidate for the FZK post has been found, and is expected to start work at CERN in mid-October. He will join the infrastructure support group who are supporting the actual deployment.

A Portuguese trainee system administrator also joined the group in August.

6 Milestone management

Jürgen Knobloch – Planning Officer

Verification milestones. We have started to introduce verification milestones where for certain products or services the LHC experiments have agreed to carry out verification tasks to ensure that the delivery fulfils their requirements. The verification milestones are assigned to the individual experiments who have also determined the milestone dates:

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.1		0		**Applications**	20-06-2003	1.1
1.1.2				**Physics data management**		1.1.2
1.1.2.1				**POOL Persistency Framework**		1.1.2.1
1.1.2.1	1.176	2	V_CMS	CMS POOL integration: POOL persistency of CMS event	31-07-2003	1.1.2.1
1.1.2.1	1.177	2	V_Atlas	ATLAS POOL integration: POOL persistency in Release 7	10-09-2003	1.1.2.1
1.1.2.1		2	V_LHCb	Gaudi persistency mechanism replaced by POOL (Win version also)	19-12-2003	1.1.2.1
1.1.2.1		2	V_Atlas	ATLAS POOL validation with complete Event Data Model	31-03-2004	1.1.2.1
1.1.2.1	1.179	2	V_Atlas	ATLAS POOL validation with DC1 data	31-10-2003	1.1.2.1
1.1.2.1	1.18	2	V_CMS	CMS POOL validation with PCP data	31-10-2003	1.1.2.1
1.1.2.1		2	V_Atlas	ATLAS POOL Metadata/EventCollection validation	31-01-2004	1.1.2.1
1.1.2.2				**Conditions database**		1.1.2.2
1.1.2.2		2	V_Atlas	ATLAS validation of POOL beta Conditions DB	31-12-2003	1.1.2.2
1.1.3				Core libraries and services (SEAL)		1.1.3
1.1.3		2	V_Atlas	SEAL Integration into Athena	31-12-2003	1.1.3
1.1.3		2	V_LHCb	SEAL plugin manager integrated in Gaudi (Win version also)	19-12-2003	1.1.3
1.1.4				Physicist Interface (PI)		1.1.4
1.1.4		2	V_Atlas	ROOT implementation of AIDA histograms in Athena	30-11-2003	1.1.4
1.1.5				**Simulation**		1.1.5
1.1.5.1				Generic simulation framework		1.1.5.1
1.1.5.1		2	V_Atlas	ATLAS evaluation of generic simulation framework	30-04-2004	1.1.5.1
1.2				**Fabrics**		1.2
1.2.1				**Repositories and Managed Storage**		1.2.1
1.2.1.1				**Castor**		1.2.1.1
1.2.1.1.5	2.1167	2	V_Atlas	Full CASTOR support for ATLAS DC3 (2nd half 2005)	30-06-2005	1.2.1.1.5

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.2.1.2				**Data Recording Challenges**		1.2.1.2
1.2.1.2.2	2.1170	2	V_Alice	ALICE Verification of target performance for ADC V	15-11-2003	
1.2.1.2.4	2.1172	2	V_Alice	ALICE Verification of target performance for ADC VI	15-11-2004	
1.2.1.2.6	2.1173	2	V_Alice	ALICE Verification of target performance for ADC VII	15-11-2005	

By the next quarterly report we will add further verification milestones for CMS and for the analysis domain after a workplan following RTAG-11 (ARDA) has been defined.

Three other new milestones have been introduced this time in the applications area:

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.1.1	1.188	2		SPI tools operational on IT CVS service	30-11-2003	
1.1.3.8	1.124	2		Statement on GSL and NAG usage for math library	30-09-2003	
1.1.5.6	1.189	2		SPI-G4 collaborative infrastructure pilot	15-11-2003	

Four milestones have changed the "due date" relative to the previous baseline:

WBS	ID_Unique	Level	Extern	Name	New Date	Old date
1.1.2.1	1.179	2	V_Atlas	ATLAS POOL validation with DC1 data	31-10-2003	21-08-2003
1.1.2.1	1.114	2		Initial POOL deployment on LCG-1	15-11-2003	31-07-2003
1.1.5.4	1.14	2		Simulation physics requirements revisited	31-12-2003	31-07-2003
1.2.2.11	2.528	2		HSM ops display – system complete	01-12-2004	01-12-2003

The first one has been changed by Atlas in the course of the definition of verification milestones. The second one is delayed because of the LCG-1 delay. The third one has been fulfilled for Atlas and will be complete for the other experiments by the end of the year. The last one corrects a typing error.

There are two milestones that no longer appear in the list:

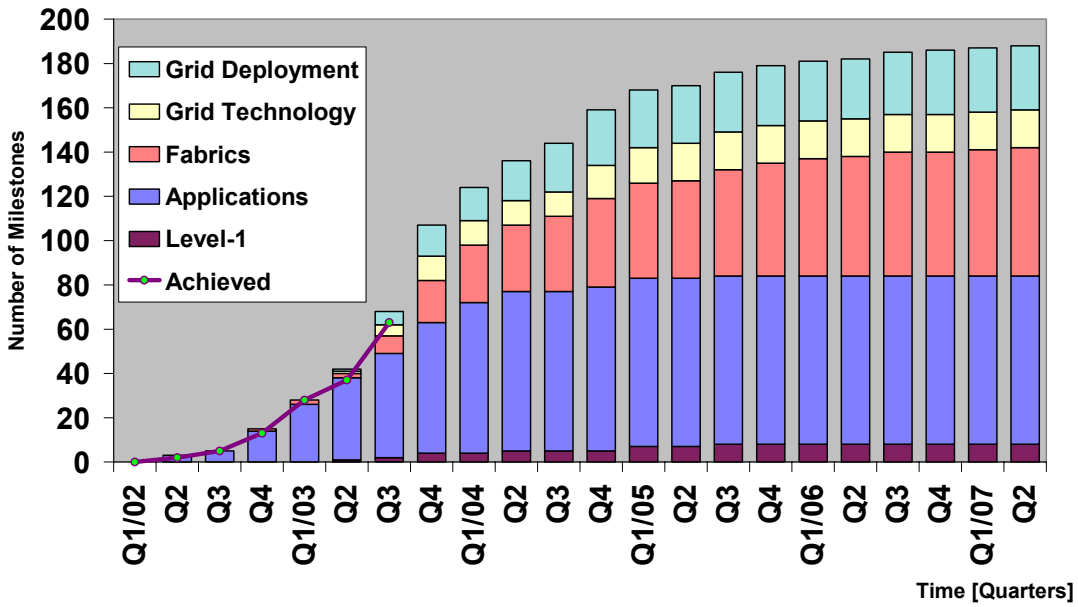
WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.1.3	1.124	2		Establish external software decision process	15-09-2003	
1.1.5.1	1.139	2		Generic framework high level design and implementation approach defined	31-07-2003	

The first one is demoted to level-3 because of relative unimportance and the second one is superseded by another new milestone:

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.1.5.1	1.144	2		Generic simulation framework prototype available (G4 and FLUKA)	31-12-2003	

The time distribution of milestones and the current achievement is shown in Chart 1.

Chart 1: Number of LCG Level 1&2 Milestones (cumulative)



The number of milestones in the different areas and milestone levels is given in Table1 – the corresponding numbers of milestones that were available at the previous quarterly report are given in brackets. The increase is mainly due to the addition of verification milestones.

	Level 1	Level 2
Applications	2	76 (65)
Fabrics		58 (55)
Grid Technology	6	17 (15)
Grid Deployment		29 (18)

Table 1: Number of milestones

The level 1 Milestones have remained unchanged since their publication on 22 November 2002. It should be noted, though, that two milestones (M1.3 and M1.5) are still suspended. New milestone definitions and dates will follow the conclusion of the RTAG on distributed analysis (RTAG 11-ARDA) that will deliver a final report by October 2003.

Out of the level 2 Milestones due by 15 September 2003, six have not yet been achieved:

WBS	ID_Unique	Name	Date due
1.1.1	1.17	SPI support for Windows binary version of LCG software	15-08-2003
1.1.3	1.184	Math library workplan in place	31-07-2003
1.1.3	1.187	SEAL support for Windows binaries	15-09-2003

WBS	ID_Unique	Name	Date due
1.1.4	**1.171**	**AIDA interface review (users) completed**	**15**
1.2.4.2.1	2.**562**	10 LXBATCH nodes integrated in LCG-1 (isolated from main LXBATCH)	01-08-2003
1.3.4.2	3.502	Technical design team established	01-09-2003

Details are given in the individual area reports.

A summary of all currently defined milestones is given in Appendix 1. The tables are is also available from the Web providing links to a more detailed description of milestones. These descriptions will be further completed. The web address of the milestones table is:

http://lcg.web.cern.ch/LCG/PEB/Planning/MilestonesOct2003/

APPENDIX 1 - Milestone Tables

1.1.1 Applications Area Milestones

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1				**LHC Computing Grid Project**		
1.1				**Applications**	20-06-2003	
1.1.1				**Software Process and Infrastructure (SPI)**		
1.1.1	1.156	2		Initial process and infrastructure team in place	15-04-2002	14-07-2002
1.1.1	1.158	2		Basic LCG code development and repository services in place	01-05-2002	02-05-2002
1.1.1	1.159	2		Software process workplan to SC2	11-10-2002	11-10-2002
1.1.1	1.16	2		All infrastructure tools and services in beta	31-12-2002	09-02-2003
1.1.1	1.161	2		All infrastructure tools and services released (SPI V1.0)	28-02-2003	28-02-2003
1.1.1	1.162	2		2003 SPI workplan complete	30-05-2003	29-06-2003
1.1.1	1.163	2		Software library complete	31-05-2003	01-05-2003
1.1.1	1.164	2		Savannah based portal complete	31-05-2003	22-12-2002
1.1.1	1.17	2		SPI support for Windows binary version of LCG software	15-08-2003	
1.1.1	1.188	2		SPI tools operational on IT CVS service	30-11-2003	
1.1.2				**Physics data management**		
1.1.2	1.103	2		Persistency framework workplan to SC2	12-07-2002	02-08-2002
1.1.2	1.109	2		2003 persistency framework workplan complete	24-02-2003	05-03-2003
1.1.2	1.2	2		General release of POOL hybrid data store	15-06-2003	30-06-2003
1.1.2	1.117	2		2004-2005 persistency framework workplan complete	15-12-2003	
1.1.2	1.7	2		Full function release of persistency framework	01-03-2005	
1.1.2.1				**POOL Persistency Framework**		
1.1.2.1	1.101	2		Hybrid event store workshop	05-06-2002	05-06-2002
1.1.2.1	1.102	2		Persistency framework status report	18-06-2002	18-06-2002
1.1.2.1	1.104	2		V0.1 POOL internal release	30-09-2002	02-10-2002
1.1.2.1	1.105	2		V0.2 POOL internal release	31-10-2002	15-11-2002
1.1.2.1	1.106	2		First prototype (V0.3) release of POOL hybrid data store	15-12-2002	18-12-2002
1.1.2.1	1.108	2		SPI compliance of POOL	28-02-2003	07-03-2003
1.1.2.1	1.11	2		POOL V0.4 'interface-complete' release	28-02-2003	07-03-2003
1.1.2.1	1.111	2		Define feature set of first general release of POOL	01-03-2003	05-03-2003
1.1.2.1	1.112	2		POOL V1.0 pre-production release	30-04-2003	13-05-2003
1.1.2.1	1.113	2		Nightly builds deployed in POOL	30-05-2003	29-06-2003
1.1.2.1	1.176	2	V_CMS	CMS POOL integration: POOL persistency of CMS event	31-07-2003	31-07-2003
1.1.2.1	1.177	2	V_Atlas	ATLAS POOL integration: POOL persistency in Release 7	10-09-2003	11-09-2003
1.1.2.1		2	V_LHCb	Gaudi persistency mechanism replaced by POOL (Win version also)	19-12-2003	
1.1.2.1		2	V_Atlas	ATLAS POOL validation with complete Event Data Model	31-03-2004	
1.1.2.1	1.116	2		POOL RDBMS independence layer in beta	30-09-2003	
1.1.2.1	1.181	2		POOL support for Windows binaries	30-09-2003	
1.1.2.1	1.179	2	V_Atlas	ATLAS POOL validation with DC1 data	31-10-2003	
1.1.2.1	1.18	2	V_CMS	CMS POOL validation with PCP data	31-10-2003	
1.1.2.1	1.114	2		Initial POOL deployment on LCG-1	15-11-2003	
1.1.2.1	1.121	2		POOL hierarchical cataloging production release	15-03-2004	
1.1.2.1		2	V_Atlas	ATLAS POOL Metadata/EventCollection validation	31-01-2004	
1.1.2.1	1.12	2		Release of POOL implementation of conditions DB	31-03-2004	
1.1.2.1	1.122	2		POOL meets scalability requirements	31-10-2004	

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.1.2.2				**Conditions database**		
1.1.2.2	1.115	2		POOL implementation of conditions DB - beta	01-11-2003	
1.1.2.2		2	V_Atlas	ATLAS validation of POOL beta Conditions DB	31-12-2003	
1.1.3				**Core libraries and services (SEAL)**		
1.1.3	1.123	2		Establish core libraries and services (SEAL) project	30-10-2002	30-10-2002
1.1.3	1.125	2		Define the V1 SEAL software suite	30-11-2002	30-11-2002
1.1.3	1.107	2		Prototype object dictionary service released	01-12-2002	18-12-2002
1.1.3	1.126	2		Present the initial SEAL workplan to SC2	10-01-2003	10-01-2003
1.1.3	1.127	2		SEAL V1 essentials in alpha	31-03-2003	07-04-2003
1.1.3	1.129	2		SEAL V0.3 internal release	16-05-2003	24-05-2003
1.1.3	1.128	2		Nightly builds deployed in SEAL	30-06-2003	10-07-2003
1.1.3	1.13	2		SEAL V1 release	30-06-2003	18-07-2003
1.1.3	1.184	2		Math library workplan in place	31-07-2003	
1.1.3		2	V_Atlas	SEAL Integration into Athena	31-12-2003	
1.1.3		2	V_LHCb	SEAL plugin manager integrated in Gaudi (Win version also)	19-12-2003	
1.1.3	1.187	2		SEAL support for Windows binaries	15-09-2003	
1.1.3.8				**Mathematical libraries**		
1.1.3.8	1.167	2		Delivery of first round of GSL enhancements	30-05-2003	30-05-2003
1.1.3.8	1.124	2		Statement on GSL and NAG usage for math library	30-09-2003	
1.1.4				**Physicist Interface (PI)**		
1.1.4	1.149	2		Establish physicist interface project	19-11-2002	25-11-2002
1.1.4	1.15	2		Report on PI experiment consultations	20-01-2003	20-01-2003
1.1.4	1.151	2		Initial PI plan presented to SC2	29-01-2003	07-02-2003
1.1.4	1.152	2		AIDA interface review (developers) completed	30-05-2003	30-05-2003
1.1.4	1.153	2		Physicist interface (PI) workplan completed	01-07-2003	04-07-2003
1.1.4	1.171	2		AIDA interface review (users) completed	15-09-2003	
1.1.4		2	V_Atlas	ROOT implementation of AIDA histograms in Athena	30-11-2003	
1.1.5				**Simulation**		
1.1.5	1.131	2		SC2 mandate for simulation project	07-12-2002	07-12-2002
1.1.5	1.132	2		Simulation project structure defined	28-01-2003	28-01-2003
1.1.5	1.133	2		Simulation project draft workplan	28-02-2003	28-02-2003
1.1.5	1.134	2		Simulation project initial workplan approved	14-03-2003	19-03-2003
1.1.5.1				**Generic simulation framework**		
1.1.5.1	1.144	2		Generic simulation framework prototype available (G4 and FLUKA)	31-12-2003	
1.1.5.1		2	V_Atlas	ATLAS evaluation of generic simulation framework	30-04-2004	
1.1.5.1	1.147	2		First generic simulation framework production release	01-10-2004	
1.1.5.4				**Physics validation**		
1.1.5.4	1.136	2		Test beam setup of the four experiments available in G4	31-05-2003	31-05-2003
1.1.5.4	1.143	2		First cycle of EM physics validation complete	30-09-2003	30-09-2003
1.1.5.4	1.14	2		Simulation physics requirements revisited	31-12-2003	
1.1.5.4	1.145	2		First cycle of hadronic physics validation complete	31-01-2004	
1.1.5.4	1.146	2		Simulation test and benchmark suite available	31-03-2004	
1.1.5.4	1.148	2		Final physics validation document complete	31-12-2004	
1.1.5.6				**Generator services**		
1.1.5.6	1.138	2		Generator librarian and alpha version of support infrastructure in place	30-06-2003	30-06-2003
1.1.5.6	1.189	2		SPI-G4 collaborative infrastructure pilot	15-11-2003	

1.1.2 Fabrics Area Milestones

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.2				**Fabrics**		
1.2.1				**Repositories and Managed Storage**		
1.2.1.1				**Castor**		
1.2.1.1.1	2.521	2		Concept of pluggable scheduler and high rate request handling demonstrated	01-10-2003	
1.2.1.1.2	2.520	2		Integrated prototype of the whole system	02-02-2004	
1.2.1.1.3	2.519	2		Production system ready for deployment	01-04-2004	
1.2.1.1.4	2.518	2		Full functional CASTOR release available	01-03-2005	
1.2.1.1.5	2.1167	2	V_Atlas	Full CASTOR support for ATLAS DC3 (2nd half 2005)	30-06-2005	
1.2.1.2				**Data Recording Challenges**		
1.2.1.2.1	2.516	2		ALICE DC5 (300 MB/sec)	01-10-2003	
1.2.1.2.2	2.1170	2	V_Alice	ALICE Verification of target performance for ADC V	15-11-2003	
1.2.1.2.3	2.515	2		ALICE DC6 (450 MB/sec)	01-10-2004	
1.2.1.2.4	2.1172	2	V_Alice	ALICE Verification of target performance for ADC VI	15-11-2004	
1.2.1.2.5	2.514	2		ALICE DC7 (750 MB/sec)	03-10-2005	
1.2.1.2.6	2.1173	2	V_Alice	ALICE Verification of target performance for ADC VII	15-11-2005	
1.2.1.3				**Evaluation of new tape hardware**		
1.2.1.3.1	2.526	2		Report on LTO evaluation delivered	01-03-2004	
1.2.1.3.2	2.525	2		Report on high-end tape drive evaluation delivered	01-12-2004	
1.2.1.3.3	2.524	2		Proposal on storage architecture and implementation of disk storage system for Phase 2 made	01-06-2004	
1.2.2				**Fabric Management**		
1.2.2.1	2.538	2		SPMA – full production	01-08-2003	18-08-2003
1.2.2.2	2.537	2		NCM – full production	03-11-2003	
1.2.2.3	2.536	2		SMS – initial system	01-10-2003	
1.2.2.4	2.535	2		SMS – full production	07-01-2004	
1.2.2.5	2.534	2		Monitoring – Systems monitor displays operational	01-10-2003	
1.2.2.6	2.533	2		Monitoring – No further need for private (experiment) monitoring	01-03-2004	
1.2.2.7	2.532	2		FT – development started	01-09-2003	01-09-2003
1.2.2.8	2.531	2		FT – Initial system available	01-03-2004	
1.2.2.9	2.530	2		FT – Deployment complete	01-09-2004	
1.2.2.10	2.529	2		HSM ops display – development started	01-10-2003	
1.2.2.11	2.528	2		HSM ops display – system complete	01-12-2004	
1.2.3				**Computer Centre Upgrade**		
1.2.3.1	2.553	2		Vault converted to machine room	01-11-2002	01-11-2002
1.2.3.2	2.552	2		Right half of m/c room migrated to vault	01-08-2003	15-08-2003
1.2.3.3	2.551	2		Sub-station civil engineering starts	01-09-2003	18-08-2003
1.2.3.4	2.550	2		Sub-station civil engineering finishes	01-03-2004	
1.2.3.5	2.549	2		Sub-station electrical installation starts	01-04-2004	
1.2.3.6	2.548	2		Sub-station commissioned	07-01-2005	
1.2.3.7	2.547	2		Electrical distribution on right side of m/c room upgraded	02-02-2004	
1.2.3.8	2.546	2		Left half of m/c room emptied	02-08-2004	
1.2.3.9	2.545	2		Electrical distribution on left side of m/c room upgraded	01-06-2005	
1.2.3.10	2.544	2		Machine room HVAC upgraded	01-03-2005	
1.2.3.11	2.543	2		New 800KW UPS for physics installed	03-04-2006	

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.2.3.12	**2.542**	**2**		**Current UPS area re-modelled**	**01-01-2007**	
1.2.3.13	2.541	2		2nd 800 KW UPS added	02-04-2007	
1.2.3.14	2.540	2		3rd 800 KW UPS added	01-04-2008	
1.2.4				**Batch Computing**		
1.2.4.1	2.564	2		Baseline plan for Phase 2 agreed (architecture + technology)	01-06-2004	
1.2.4.2				Grid Integration		
1.2.4.2.1	2.562	2		10 LXBATCH nodes integrated in LCG-1 (isolated from main LXBATCH)	01-08-2003	
1.2.4.2.2	2.561	2		100 LXBATCH nodes integrated in LCG-1 (isolated from main LXBATCH)	01-10-2003	
1.2.4.2.3	2.560	2		Full integration of LXBATCH worker nodes in LCG-1 completed	01-12-2003	
1.2.4.3				Batch Scheduling		
1.2.4.3.1	2.557	2		Decision on Phase 2 Batch Scheduling System made	01-12-2004	
1.2.5				**Installation Schedule (short term)**		
1.2.5.9				Networking infrastructure		
1.2.5.9.3	2.580	2		Integration of 10 Gbit equipment into the Prototype done	01-07-2003	01-07-2003
1.2.5.9.5	2.582	2		First phase of backbone replacement by 10 Gbit equipment	01-07-2004	
1.2.5.9.6	2.583	2		Backbone fully upgraded to 10 Gbit	01-07-2005	
1.2.6				**Phase 2 Acquisition Process**		
1.2.6.1	2.591	2		Decisions on the equipment selection criteria made	01-12-2003	
1.2.6.2	2.590	2		Agreement with SPL on acquisition strategy ready	01-12-2003	
1.2.6.3	2.589	2		Market survey issued for cpu and disk	01-07-2004	
1.2.6.4	2.588	2		Market survey issued for tape system	01-12-2004	
1.2.6.5	2.587	2		Phase 2 TDR ready	01-07-2005	
1.2.6.6	2.586	2		Finance Committee for cpu & disk vendor selection passed	01-09-2005	
1.2.6.7	2.585	2		Finance Committee for tape system selection passed	01-12-2005	
1.2.6.8	2.584	2		All orders placed for 2006 equipment	01-03-2006	
1.2.6.9	2.575	2		Order placed for tape system	09-01-2006	
1.2.6.10	2.574	2		2006 system installation and commissioning complete	01-08-2006	
1.2.6.11	2.573	2		Phase 2 service in production	01-09-2006	
1.2.7				**Milestones prior to June 2003**		
1.2.7.1	2.599	2		L2M Production Pilot I starts	15-01-2003	06-01-2003

1.1.3 Grid Technology Area Milestones

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.3				**Grid Technology Area**		
1.3.1				**Technology Review**		
1.3.1.3	3.496	2		Report on the Review of Grid Technologies 2003 ready	06-10-2003	
1.3.1.5	3.498	2		Report on the Review of Grid Technologies 2004 ready	02-11-2004	
1.3.2				**System Modeling**		
1.3.2.2	3.337	2		Modeling plan for work during 2003 created	15-07-2003	15-07-2003
1.3.3				**LCG Technology Evolution**		
1.3.3.2	3.344	2		Report on GT3 capabilities ready	01-09-2003	01-09-2003
1.3.4				**LCG – EGEE Coordination**		
1.3.4.1	3.501	2		EGEE senior management appointed	15-07-2003	15-07-2003
1.3.4.2	3.502	2		Technical design team established	01-09-2003	
1.3.4.3	3.503	2		2004 “blueprint” architecture published	01-10-2003	

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.3.4.4	3.504	2		Work packages definition published	03-11-2003	
1.3.4.5	3.505	2		Implementation teams, allocations to work packages, team management and job descriptions identified	03-11-2003	
1.3.4.6	3.506	2		2004 work plan and system performance goals for 2004 by trimester published	01-12-2003	
1.3.4.7	3.507	2		Work plan formally agreed	15-12-2003	
1.3.5				**TDR Planning**		
1.3.5.2	3.347	2		Plan and outline for the TDR available	01-10-2004	
1.3.5.3	3.348	2		Proposal for review created	01-03-2005	
1.3.6.4	3.1188	2	V_LHCb	Computing model chapter of LHCb computing TDR available	01-12-2004	
1.3.5.4	3.349	2		LCG TDR completed	01-06-2005	
1.3.7				**Milestones prior to June 03**		
1.3.7.3		0		Deliver initial software packages		
1.3.7.3.2	3.494	2		Initial software packages delivered	30-05-2003	30-05-2003
1.3.7.3.3	3.1174	2	V_Alice	ALICE AliEn analysis interface to LCG-1 performance evaluation	15-10-2004	

1.1.4 Grid Deployment Area Milestones

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.4				**Grid Deployment**		
1.4.1				**First Global Service Initial Availability**		
1.4.1.1	4.353	2		Initial middleware for LCG-1 delivered	30-04-2003	31-07-2003
1.4.1.2	4.354	2		LCG-1 security model implemented	30-06-2003	30-06-2003
1.4.1.3	4.355	2		First prototype operations & user support service in place	30-06-2003	30-06-2003
1.4.1.4	4.356	2		LCG-1 m/w to agreed 10 Tier 1 sites deployed	15-07-2003	15-09-2003
1.4.1.6	4.956	2		LCG-1 certified and commissioned	01-08-2003	29-09-2003
1.4.1.7	4.1175	2	V_Alice	ALICE AliEn production interface to LCG-1 readiness review (prototype design and functionality)	14-11-2003	
1.4.1.8	4.1176	2	V_Alice	ALICE AliEn analysis interface to LCG-1 readiness review (prototype design and functionality)	15-04-2004	
1.4.1.9	4.1177	2	V_Alice	ALICE AliEn production interface to LCG-1 performance evaluation	15-07-2004	
1.4.1.10	4.1178	2	V_Alice	ALICE LCG-1 PDC3 production environment verification	15-07-2004	
1.4.1.11	4.1179	2	V_Alice	ALICE LCG-1 PDC3 analysis environment verification	15-10-2004	
1.4.1.12	4.358	2	V_Atlas	ATLAS validation of LCG-1	15-10-2004	
1.4.1.13	4.1169	2	V_Atlas	ATLAS production on LCG-1	29-02-2004	
1.4.1.14	4.1186	2	V_LHCb	DIRAC deployed in LCG1	28-11-2003	
1.4.1.15	4.1185	2	V_LHCb	50% of LHCb DC04 production executing in LCG1	01-06-2004	
1.4.1.16	4.1187	2	V_LHCb	LHCb analysis environment (GANGA) deployed in LCG1	01-07-2004	
1.4.2				**Full Operational LCG-1 Service**		
1.4.2.2	4.957	2		LCG-1 performance goals defined	01-09-2003	09-09-2003
1.4.2.3				**Expand Service to include Tier2 centres**		
1.4.2.3.1	4.958	2		Tier2 centres included in service	18-10-2004	
1.4.2.4				**Middleware functionality complete**		
1.4.2.4.6	4.965	2		Middleware functionality complete	01-10-2003	
1.4.2.5	4.369	2		Job Execution model defined	30-09-2003	
1.4.2.6	4.370	2		Second prototype Operations and User Support Service	30-10-2003	

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
				operational		
1.4.2.8	4.963	2		Deployed to agreed sites	15-10-2003	
1.4.2.9				**Security Procedures for 2004 in place**		
1.4.2.9.3	4.969	2		Security Procedures for 2004 in place	30-11-2003	
1.4.2.11	4.966	2		Service Review completed	24-11-2003	
1.4.3				**Fully Operational LCG-3 Service**		
1.4.3.2	4.961	2		LCG-3 functionality defined	31-03-2004	
1.4.3.3	4.378	2		LCG-3 Pilot system available	01-07-2004	
1.4.3.5	4.962	2		LCG-2 upgraded to LCG-3	17-01-2005	
1.4.3.7	4.1180	2	V_Alice	ALICE LCG-1 PDC4 production environment verification	15-07-2006	
1.4.3.8	4.1181	2	V_Alice	ALICE LCG-1 PDC4 analysis environment verification	15-10-2006	
1.4.4				**Completion of Computing Service TDR**		
1.4.4.2	4.382	2		Experience with LCG-2 reviewed	01-07-2005	

1.1.5 Global Level-1 Milestones

WBS	ID_Unique	Level	Extern	Name	Date MS	MS_Done
1.5				**Global Milestones/Goals/Targets**		
M1.1				**First Global Service - Initial Availability**		
M1.1	M1.1	1		First Global Service (LCG-1) - Initial Availability	01-07-2003	15-09-2003
M1.2	M1.2	1		General release of POOL hybrid data store	02-06-2003	30-06-2003
M1.3	M1.3	1		Distributed production environment using grid services	03-11-2003	
M1.4				Fully Operational LCG-1 Service		
M1.4	M1.4	1		Fully operational LCG-1 Service	28-11-2003	
M1.5	M1.5	1		Distributed end-user analysis from a Tier-3 Regional Centre	03-05-2004	
M1.6				Fully Operational LCG-3 Service		
1.5.6.1	5.401	0		Define LCG-3	02-02-2004	
1.5.6.2	5.402	0		LCG-3 pilot system available	01-07-2004	
1.5.6.3	5.403	0		Decision on new batch system software (CERN)	31-12-2004	
M1.6	M1.6	1		Fully operational LCG-3 Service	28-01-2005	
M1.7	M1.7	1		Full function release of persistency framework	01-03-2005	
M1.8				Completion of the Computing Service TDR		
M1.8	M1.8	1		Completion of Computing Service TDR	30-06-2005	

1.1.6 Level 1 Milestones Detailed Description

Ref.	Milestone description	Target date
M1.1	**First Global Service (LCG-1) – Initial Availability** This comprises the construction and commissioning of the first LHC Computing service suitable for physics usage. The service must offer reliable 24x7 availability to all four LHC experiments and include some ten Regional Centers from Europe, North America and Asia. The milestone includes delivery of the associated Technical Design, containing description of the architecture and functionality and quantified technical specifications of performance (capacity, throughput, reliability, availability). It must also include middleware specifications, agreed as a common toolkit by Europe and US. The service must prove functional, providing a batch service for event production and analysis of the simulated data set. For the milestone to be met, operation must be sustained reliably during a 7 day period; stress tests and user productions will be executed, with a failure rate below 1%. **The milestone was met with 2.5 months delay on September 15, 2003.**	**July 2003**
M1.2	**General release of POOL hybrid data store** The first public, production-capable release of the persistency framework. This will be a release offering basic hybrid persistency services, documented and packaged using the SPI-defined templates and tools, for general use by the experiments in production environments. The release should support production usages with O(1M) file counts, O(50TB) data volumes, distributed operation at O(10) sites, and with O(10k) populating jobs. Previous releases were internal releases targeted at developers and experts; this is the first public release with the robustness, documentation, packaging and support requirements inherent in a public release. Specific feature set for this release defined by a milestone four months earlier. **The milestone was met on June 30, 2003**.	**June 2003**

Ref.	Milestone description	Target date
M1.3	**Distributed production environment using grid services** A distributed production environment integrating experiment specific software with common software components and services, grid portal services and grid middleware. The deliverables of this milestone will be elaborated when a Physics Interfaces work plan is developed following the conclusion of the analysis RTAG. **This Milestone is currently suspended.**	**Nov 2003**
M1.4	**Fully operational LCG-1 Service** This comprises the availability of LCG-1 as a fully operational and performant 24x7 production service. Operation must be sustained for a period of one month. This service would be used for the "5% data challenges" of the LHC experiments. LCG-1 will be operated continuously, evolving in terms of capacity, performance and functionality. It includes the addition of Regional Centres as they come on-line as defined in GDB Working Group 2. It includes the delivery of the technical service specifications and user documentation, and deployment/consolidation of an appropriate user support infrastructure. It also includes incremental releases of middleware to improve reliability, robustness and performance **The service level must be as required for the 2004 data challenges. The determination and acceptance of the milestone should be done with a formal review of the service by representatives of the experiments, regional centres and LCG.**	**Nov 2003**
M1.5	**Distributed end-user interactive analysis from a Tier 3 Regional Centre** Extension of the distributed production environment integrating experiment specific software with common software components and services, grid portal services and grid middleware. This extension will support the analysis environment, enabling distributed end-user interactive analysis down to Tier 3 in the LHC grid. A related level-2 milestone, 6 months before the due date, will provide a full specification of what this milestone includes. **This Milestone is currently suspended.**	**May 2004**

Ref.	Milestone description	Target date
M1.6	**Fully operational LCG-3 Service** **This comprises the construction and commissioning of a fully operational full-size prototype (LCG-3) of what it will be the initial LHC Computing production service. Operation must be sustained 24x7 reliably for a period of one month for the milestone to be met.** LCG-3 will be used as a proof that the LHC computing model will work, including Tier 0, 1, 2 and 3 Regional Centres, providing practical backup for the computing service TDR. LCG-3 will use the LHC Grid Toolkit, will have 50% of the components required for the 2007 production service for CMS or ATLAS, and will be used for the "20% milestones" of the experiments.	**January 2005**
M1.7	**Full function release of persistency framework** Completion of the fully functional POOL persistency framework. Deliverables in terms of feature set, performance and scalability for this milestone will be finalized as an outcome of the Computing TDRs of the experiments in 2004.	**March 2005**
M1.8	**Completion of the Computing Service TDR** The Computing Service TDR will specify the requirements for the Grid that will be used for the first production services for the four LHC experiments. It will include details of the architecture, functionality, capacity, performance, throughput and availability. It will include the Regional Centre plans that will have been developed to meet these requirements, and will provide cost estimates and an overall installation and verification schedule. It is assumed that the TDR will be approved by the LHCC within three months following its availability, and may be used to provide data for the Memorandum of Understanding for Phase 2 of the project. The full process from acquisition to service verification is expected to take 12-18 months (according to the administrative procedures of the Regional Centres). The initial service must be in full production by September 2006 (6 months before data taking). The TDR will therefore be approved after the acquisition procedures have started, but before orders are placed.	**June 2005**

APPENDIX 2 - Human Resources

LCG Project - Human Resources

Experience-weighted FTEs

Funding source: EP, IT - funded from CERN base budget as a CERN support activity; ***LCG*** - funded at CERN by special contributions; ***EDG*** - EU funding from DataGrid used for LCG project work; ***Experiments***: funding allocated through experiments - ***CERN*** - funded in EP from CERN base budget, ***Insts.*** -funded by an external institute

Experience-weighting factors: trainee, student **0.5**; fellow, junior staff to 2 yrs experience 0.85; staff, associates 1.0; experienced staff, associates (>5 years) **1.2**

	Experience-weighted FTEs in October-03 *funding source*								Resources used (FTE-years)				
			CERN			Experiments							
Applications	*EP*	*IT*	*Support*	*LCG*	*EDG*	*CERN*	*Insts.*	*Total*	*2002*	*1Q03*	*2Q03*	*3Q03*	*Total*
Software Process Infrastructure	*1.4*	*2.7*	4.2	3.2		1.0	0.1	8.5	4.8	2.5	2.7	2.1	12.0
Object Persistency (POOL)		*2.9*	2.9	4.0		0.9	4.9	12.7	8.7	2.8	3.0	3.0	17.5
(SEAL)	*2.0*		2.0	1.0		0.5	2.2	5.6	5.8	1.5	1.5	1.5	10.2
Physics Interfaces (PI)	*1.0*		1.0	2.5		1.7		5.1	0.6	0.4	0.8	0.9	2.6
Simulation	*11.0*		11.0	3.9		1.6	0.2	16.8	11.4	3.7	4.8	4.9	24.8
GRID interfacing				4.6				4.6	1.3	0.8	0.8	1.1	4.0
Architecture						0.2		0.2		0.0	0.1	0.1	0.1
Management	*1.0*	*0.1*	1.1	0.6		0.2	0.1	2.1	0.8	0.3	0.5	0.5	2.2
Total	*16.3*	*5.7*	**22.1**	**19.8**		**6.2**	**7.5**	**55.6**	**33.3**	**12.0**	**14.0**	**14.1**	**73.4**
ROOT	*2.4*		2.4	2.0		0.8	1.0	6.2	4.5	1.4	1.6	1.6	8.9
CERN Fabric													
System Management & Operations		*8.7*	8.7	1.0				9.7	5.8	2.7	2.8	2.7	13.9
Development (e.g. Monitoring)		*3.5*	3.5	4.2				7.7	7.1	2.2	2.2	2.3	13.8
Data Storage Management		*6.3*	6.3	1.5				7.8	5.2	1.7	1.7	2.0	10.6
Grid Security		*1.0*	1.0	2.7				3.7	2.1	0.7	0.7	0.8	4.3
Grid-Fabric Interface		*4.0*	4.0	1.2	3.0			8.2	8.7	2.4	2.1	2.1	15.1
Internal Networking for Physics		*1.1*	1.1					1.1	1.1	0.3	0.3	0.3	2.0
External Networking for Physics		*0.7*	0.7					0.7	0.7	0.2	0.2	0.2	1.2
Management		*1.5*	1.5					1.5	1.5	0.4	0.4	0.4	2.6
Total		*26.8*	**26.8**	**10.6**	**3.0**			**40.4**	**32.2**	**10.4**	**10.3**	**10.7**	**63.5**
Project Technology													
Grid Technology, modelling, evaluations		*1.7*	1.7	3.0				4.7	1.2	0.3	0.8	1.4	3.6
Total		*1.7*	**1.7**	**3.0**				**4.7**	**1.2**	**0.3**	**0.8**	**1.4**	**3.6**
Grid Deployment													
Integration and Certification				14.1				14.1	2.1	2.0	2.3	2.5	8.8
Grid Infrastructure, Operations and User Support		*3.4*	3.4	7.0				10.4	5.4	2.2	2.3	2.3	12.3
Total		3.4	**3.4**	**21.1**				**24.5**	**7.5**	**4.1**	**4.6**	**4.9**	**21.1**
LCG Management		*3.9*	**3.9**	**1.8**				**5.7**	**5.9**	**1.8**	**1.7**	**1.6**	**11.0**
LCG Project Total (inc.Root)	*18.7*	*41.5*	**60.2**	**58.3**	**3.0**	**7.0**	**8.5**	**137.0**	**84.5**	**29.9**	**33.0**	**34.2**	**181.6**

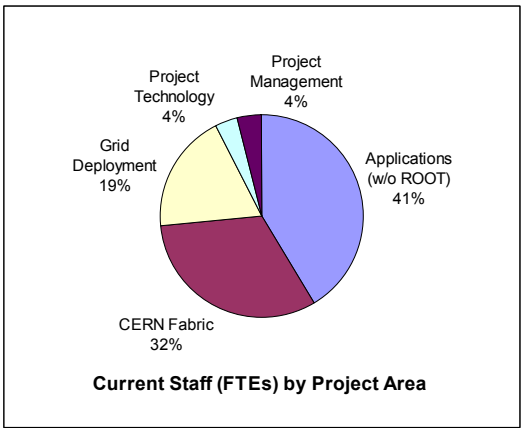
LCG Project - Human Resources

Unweighted FTEs

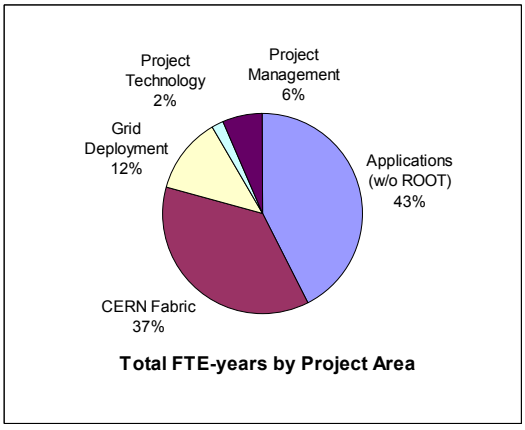
Funding source: EP, IT- funded from CERN base budget as a CERN support activity; ***LCG-*** funded at CERN by special contributions; ***EDG-*** EU funding from DataGrid used for LCG project work; ***Experiments:*** funding allocated through experiments - ***CERN -*** funded in EP from CERN base budget, **Insts.**-funded by an external institute

Unweighted FTEs in October-03

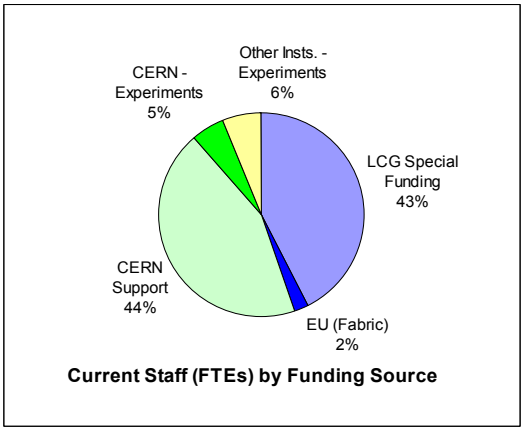
	funding source							
			CERN			*Experiments*		
Applications	*EP*	*IT*	***Support***	***LCG***	***EDG***	***CERN***	***Institutes***	***Total***
Software Process Infrastructure	*1.2*	*2.6*	3.8	3.9		1.0	0.1	8.7
Object Persistency (POOL)		*2.7*	2.7	4.1		1.0	4.5	12.3
Core Libraries and Services (SEAL)	*2.0*		2.0	1.1		0.4	1.9	5.4
Physics Interfaces (PI)	*0.9*		0.9	2.5		1.7		5.1
Simulation	*10.2*		10.2	4.0		1.6	0.2	16.0
GRID interfacing				4.2				4.2
Architecture						0.2		0.2
Management	*0.8*	*0.1*	0.9	0.5		0.2	0.1	1.7
Total	*15.1*	*5.4*	**20.5**	**20.4**		**6.1**	**6.8**	**53.7**
ROOT	*2.0*		2.0	2.0		0.7	1.0	5.7
CERN Fabric								
System Management & Operations		*9.4*	9.4	1.0				10.4
Development (e.g. Monitoring)		*3.6*	3.6	5.0				8.6
Data Storage Management		*5.5*	5.5	2.0				7.5
Grid Security		*1.0*	1.0	3.0				4.0
Grid-Fabric Interface		*4.0*	4.0	1.0	3.0			8.0
Internal Networking for Physics		*1.0*	1.0					1.0
External Networking for Physics		*0.6*	0.6					0.6
Management		*1.3*	1.3					1.3
Total		*26.3*	**26.3**	**12.0**	**3.0**			**41.3**
Project Technology								
Grid Technology, modelling, evaluations		*2.0*	2.0	3.0				5.0
Total	*0.0*	*2.0*	**2.0**	**3.0**				**5.0**
Grid Deployment								
Integration and Certification				14.5				14.5
Grid Infrastructure, Operations and User Support		*3.0*	3.0	7.0				10.0
Total	*0.0*	*3.0*	**3.0**	**21.5**				**24.5**
LCG Management	*0.0*	*3.4*	**3.4**	**1.5**				**4.9**
LCG Project Total (inc.Root)	*17.1*	*40.0*	**57.1**	**60.4**	**3.0**	**6.8**	**7.8**	**135.0**



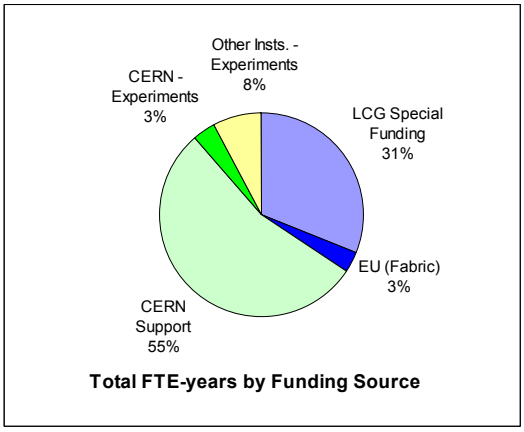
Current Staff (FTEs) by Project Area



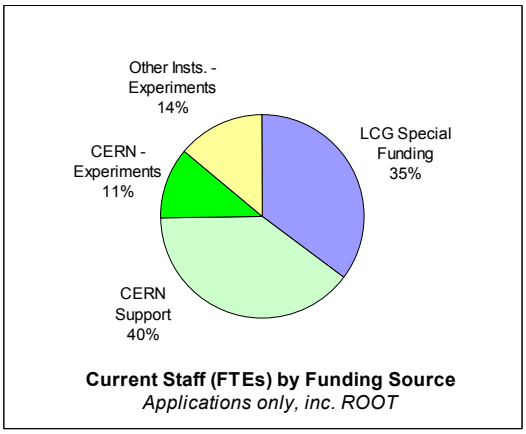
Total FTE-years by Project Area



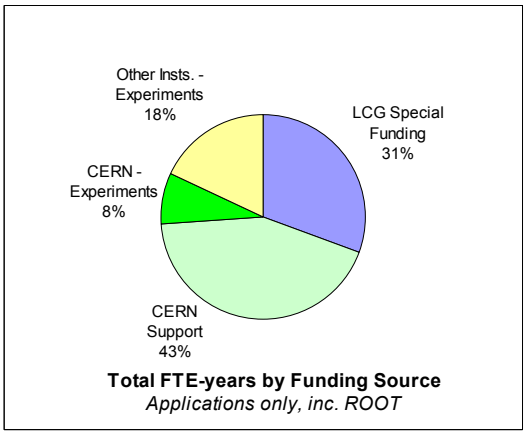
Current Staff (FTEs) by Funding Source



Total FTE-years by Funding Source



Current Staff (FTEs) by Funding Source
Applications only, inc. ROOT



Total FTE-years by Funding Source
Applications only, inc. ROOT