



Particle Physics Data Grid Collaboratory Pilot PPDG

<http://www.ppdg.net>

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Executive Summary September 2001

Vision:

The Particle Physics Data Grid collaboration brings together as collaborating peers 6 experiments at different phases of their lifecycle and the recognized Grid middleware teams of Globus, Condor, SRB, and LBL-STACS. PPDG will develop, evaluate and deliver vitally needed Grid-enabled tools for data-intensive collaboration in particle and nuclear physics. Novel mechanisms and policies will be vertically integrated with Grid middleware and experiment specific applications and computing resources to form effective end-to-end capabilities. Our goals and plans are guided by the immediate, medium-term and longer-term needs and perspectives of the LHC experiments ATLAS and CMS that will run for at least a decade from late 2005 and by the research and development agenda of other Grid-oriented efforts. We exploit the immediate needs of running experiments - BaBar, D0, STAR and Jlab experiments - to stress-test both concepts and software in return for significant medium-term benefits. For these "mid-life" experiments the new Grid services must be introduced and deployed without destabilizing the existing data handling systems. While this imposes constraints on our developments, it also ensures rapid programmatic testing under real production conditions.

Major Goals and Technical Challenges:

The challenge of creating the vertically integrated technology and software needed to drive a data intensive collaboratory for particle and nuclear physics is daunting. The PPDG team will focus on providing a practical set of Grid-enabled tools that meet the deployment schedule of the HENP experiments. It will make use of existing technologies and tools to the maximum extent, developing, on the CS side, those technologies needed to deliver vertically integrated services to the end user. Areas of concentration for PPDG will be the sharing of analysis activities, the standardization of emerging Grid software components, status monitoring, distributed data management among major computing facilities and Web-based user tools for large-scale distributed data exploration and analysis.

The PPDG work plan will focus on several distinct areas as follows:

- 1) Deployment, and where necessary enhancement or development of distributed data management tools:
 - Distributed file catalog and web browser-based file and database exploration toolset
 - Data transfer tools and services
 - Storage management tools
 - Resource discovery and management utilities
- 2) Instrumentation needed to diagnose and correct performance and reliability problems.
- 3) Deployment of distributed data services (based on the above components) for a limited number of key sites per physics collaboration:
 - Near-production services between already established centers over 'normal' networks (currently OC12 or less);
 - Close collaboration with projects developing "Envelope-pushing" services over high-speed research testbeds (currently OC48 or more).
- 4) Exploratory work with limited deployment for advanced (i.e. difficult) services
 - Data signature definition (information necessary to re-create derived data) and catalog
 - Transparent (location and medium independent) file access

- Distributed authorization in environments with varied local requirements and policies
- Cost estimation for replication and transfer
- Automated resource management and optimization

The above work breakdown reflects the viewpoint of physicists. From a CS viewpoint, the research and development agenda of this effort will map principally on to issues related to the Grid fabric layer and within or close to the application layer. The principal CS work areas, forming an integral part of the above breakdown are

- Obtaining, collecting and managing status information on resources and applications, (managing these data will be closely linked to work on the replica catalog)
- Storage management services in a Grid environment
- Reliable, efficient and fault-tolerant data movement
- Job description languages and reliable job control infrastructure for Grid resources.

Tools provided by the CS team are being adapted to meet local/specific requirements and will be deployed by members of the Physics team. Each experiment is responsible for its applications and resources and will operate a largely independent, vertically integrated Grid, using as far as possible standardized components and often sharing network infrastructures. The schedule and deliverables of the CS team are being coordinated with the "milestones" of the experiments.

Results and deliverables will be produced in three areas:

- Data-intensive collaborative tools and services of lasting value to particle and nuclear physics experiments. Support responsibilities for this technology will be transferred to the experiments and to a dedicated US support team for which funding has been requested within the DOE High-Energy Physics program.
- Advances in computer science and software technology specifically needed to meet the demanding needs of a data-intensive collaborative. The validation and hardening of ideas currently embodied in early Grid services and proof-of-concept prototypes is considered a most important component of these advances.
- Advances in the understanding of the infrastructure and architectural options for long-term development of data-intensive Grid and collaborative services. The involvement of key scientists from long-term Grid projects will ensure that practical experience gained from this collaborative pilot can become an integral part of forward-looking architectural planning.

Major Milestones and Activities:

Project Activity	Experiments	Yr1	Yr2	Yr3
CS-1 Job Description Language – definition of job processing requirements and policies, file placement & replication in distributed system.				
P1-1 Job Description Formal Language	D0, CMS, JLAB	X		
P1-2 Deployment of Job and Production Computing Control	CMS	X		
P1-3 Deployment of Job and Production Computing Control	ATLAS, BaBar, STAR		X	
P1-4 Extensions to support object collections, event level access etc.	All			X
CS-2 Job Scheduling and Management - job processing, data placement, resources discover and optimization over the Grid				
P2-1 Pre-production work on distributed job management and job placement optimization techniques	BaBar, CMS, D0	X		
P2-2 Remote job submission and management of production computing activities	ATLAS, CMS, STAR, Jlab		X	
P2-3 Production tests of network resource discovery and scheduling	BaBar		X	
P2-4 Distributed data management and enhanced resource discovery and optimization	ATLAS, BaBar			X

P2-5 Support for object collections and event level data access. Enhanced data re-clustering and re-streaming services	CMS, D0			X
CS-3 Monitoring and Status Reporting				
P3-1 Monitoring and status reporting for initial production deployment	ATLAS	X		
P3-2 Monitoring and status reporting – including resource availability, quotas, priorities, cost estimation etc	CMS, D0, JLab	X	X	
P3-3 Fully integrated monitoring and availability of information to job control and management.	All		X	X
CS-4 Storage resource management				
P4-1 HRM extensions and integration for local storage system.	ATLAS, JLab, STAR	X		
P4-2 HRM integration with HPSS, Enstore, Castor using GDMP	CMS	X		
P4-2 Storage resource discovery and scheduling	BaBar, CMS		X	
P4-3 Enhanced resource discovery and scheduling	All			X
CS-5 Reliable replica management services				
P5-1 Deploy Globus Replica Catalog services in production	BaBar	X		
P5-2 Distributed file and replica catalogs between a few sites	ATLAS, CMS, STAR, JLab	X		
P5-3 Enhanced replication services including cache management	ATLAS, CMS, JLAB		X	
CS-6 File transfer services				
P6-1 Reliable file transfer	ATLAS , BaBar, CMS, STAR, JLab	X		
P6-2 Enhanced data transfer and replication services	ATLAS, BaBar, CMS, STAR, JLab		X	
CS-7 Collect and document current experiment practices and potential generalizations	All	X	X	X

Current Connections with Other SciDAC Projects:

- DOE Science Grid: Enabling and Deploying the SciDAC Collaboratory Software Environment”, Bill Johnston, LBNL - Discussing centrally supported Certificate Authority for use by PPDG collaborators.
- ““Middleware Technology to Support Science Portals”, Indiana Univ., (Dennis Gannon) – ATLAS collaboration working with experiment participants at Indiana Univ.
- “A High Performance Data Grid Toolkit: Enabling Technology for Wide Area Data-Intensive Applications,” Ian Foster, ANL – Planning to use toolkit developed for PPDG Data Grid applications.
- “CoG Kits: Enabling Middleware for Designing Science Applications, Web Portals and Problem Solving Environments”, G. von Laszewski, ANL – PPDG JLAB applications developing web services and portals are discussing ideas and common technologies with the project.
- “Storage Resource Management for Data Grid Applications”, LBNL (A. Shoshani) – PPDG application interface to storage resources will use the interfaces developed by this project.
- “Scalable Systems Software ISIC” – for manipulating the billion HENP event/data objects of a typical PPDG experiment over the lifetime of the project.
- “Data Management ISIC” - PPDG SDSC members are collaborating with JLAB on issues directly related to the work of the Data Management ISIC.