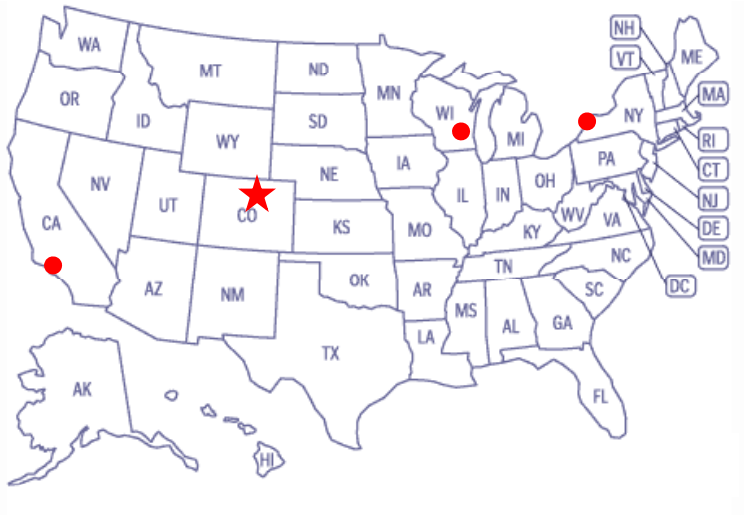
CWS4DB: A Customizable Web Service for Efficient Access to Distributed Nuclear Physics Relational Databases

FY 2008 SBIR Phase II Proposal Award Number: DE-FG02-07ER84757

Mark L. Green, PI

Tech-X Corporation, Buffalo Office
Systems Integration Group



TECH-X CORPORATION

CWS4DB Project

A customizable Web Service for Efficient Access to Distributed Nuclear Physics Relational Databases

DOE NP Phase I and II – Manouchehr Farkhondeh

Tech-X: Mark L. Green (PI), Catherine L. Ruby, Krishna Kantam, Srilakshmi Ramireddy

Need: As the size of NPdata grows and the collaborative nature of HENP experiments increases, the ability to access differently organized relational databases remotely, efficiently, and yet in a user-friendly and interoperable manner is becoming very important.

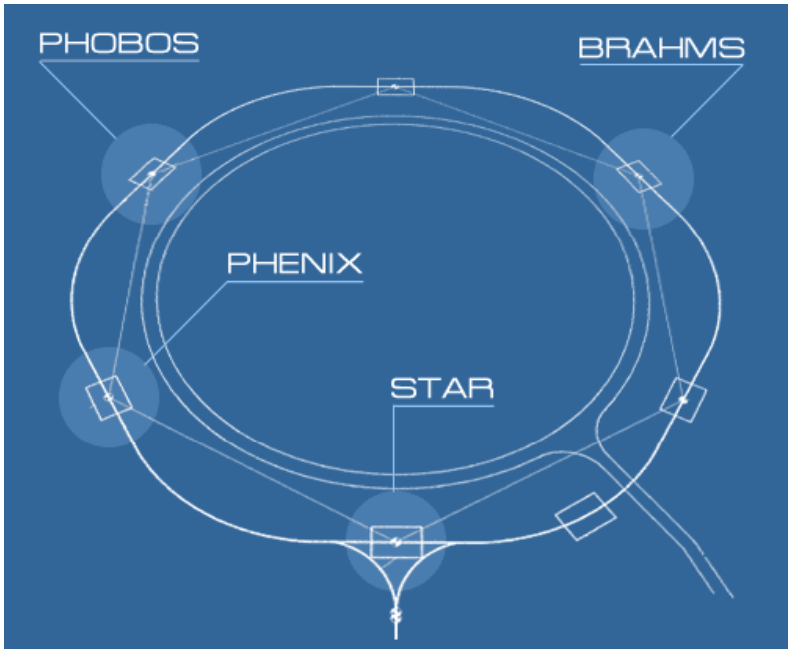
Partners: Jerome Lauret (STAR project at BNL), Kate Keahey (Nimbus project at ANL), Doug Olson (Open Science Grid), Alexandre Vaniachine (ATLAS project ANL/CERN)

DOE Beneficiaries: Nuclear and high energy physics communities, national laboratories, and collaborative projects

Commercial Beneficiaries: Companies requiring efficient web service access to distributed relational databases with high-level database and user APIs

Problem Identification

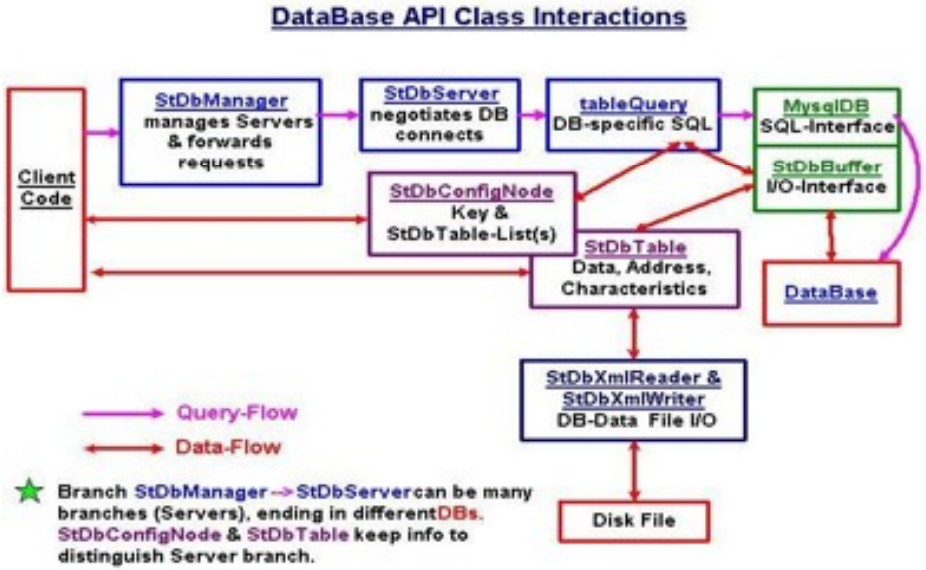
- The importance of this project comes from the fact that a large fraction of the ever-growing data generated by Nuclear Physics (NP) experiments is stored in relational databases. For example:
  - The BNL Relativistic Heavy Ion Collider (RHIC) supports STAR (Solenoidal Tracker at the at the RHIC) which composed of 52 institutions from 12 countries, with a total of 529 collaborators;
  - relational databases (such as Condition databases, Calibration databases, and Geometry databases) are heavily used in the STAR experiment;
  - while accessing data in such databases is convenient and available for local users who are familiar with a particular database, the situation becomes more complicated when the databases are distributed and heterogeneous.



- Tech-X therefore proposes a system to overcome the outlined challenges by bridging relational databases with high-level APIs through Web services.
  - In particular, the distributed and heterogeneous nature of the databases will be addressed by creating Web services in the Orbiter Federation Service Oriented Architecture (SOA), which provides mechanisms coordinating access to diversified data resources through ReST (Representational State Transfer) services, caching, authentication, and authorization.

CWS4DB Technical Objectives

- Tech-X proposes to develop a customizable Web service for efficient access to distributed NP databases. The proposed system will consist of:
  - a generic Web service for accessing arbitrary distributed relational databases,
  - a reference client implemented at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL), for the Solenoidal Tracker at the at the RHIC (STAR) experiment, and
  - a tool for creation of the high-level and domain-specific clients required by particular applications.
- The Phase II objectives include:
  - Take into account what was learned from the research in Phase I and extend the CWS4DB prototype into a production-quality, load-balanced, auto-caching, grid-enabled, fault-tolerant, and on-demand system.
  - Use a flexible work plan involving a separate piece of technical functionality that can be implemented in a way that can be exercised in the STAR computing environment, yet developed in a general way for application's from other NP projects.
  - ***The ultimate goal is to produce a set of software tools and services that can be easily adapted by the NP application developer.***



CWS4DB Tasks

- Task 1: Determine CWS4DB System and Load Balancing Additional Requirements and Properties (Tech-X & BNL) ☆
  - Extend the Phase I developed requirements and properties and continue prototype work with our partners.
- Task 2: Design and Implement Tiered Deployment Capabilities (Tech-X)
  - Develop a tiered deployment based protocol for the CWS4DB system.
- Task 3: Design and Implement Auto-Caching Infrastructure (Tech-X & BNL)
  - Provide a sophisticated auto-caching mechanism in order to increase the effective system performance based on work with our partners.
- Task 4: Enable Multi-Virtual Organization Role-Based Capabilities (Tech-X)
  - Develop the CWS4DB infrastructure required for user-friendly management and caching capabilities.
- Task 5: Develop Dynamic On-Demand Data Resource Access (Tech-X)
  - This on-demand service will provide a STAR MySQL database instance using the Virtual Workspaces infrastructure, Virtual Machine Computing resources, and investigate Grid deployments.

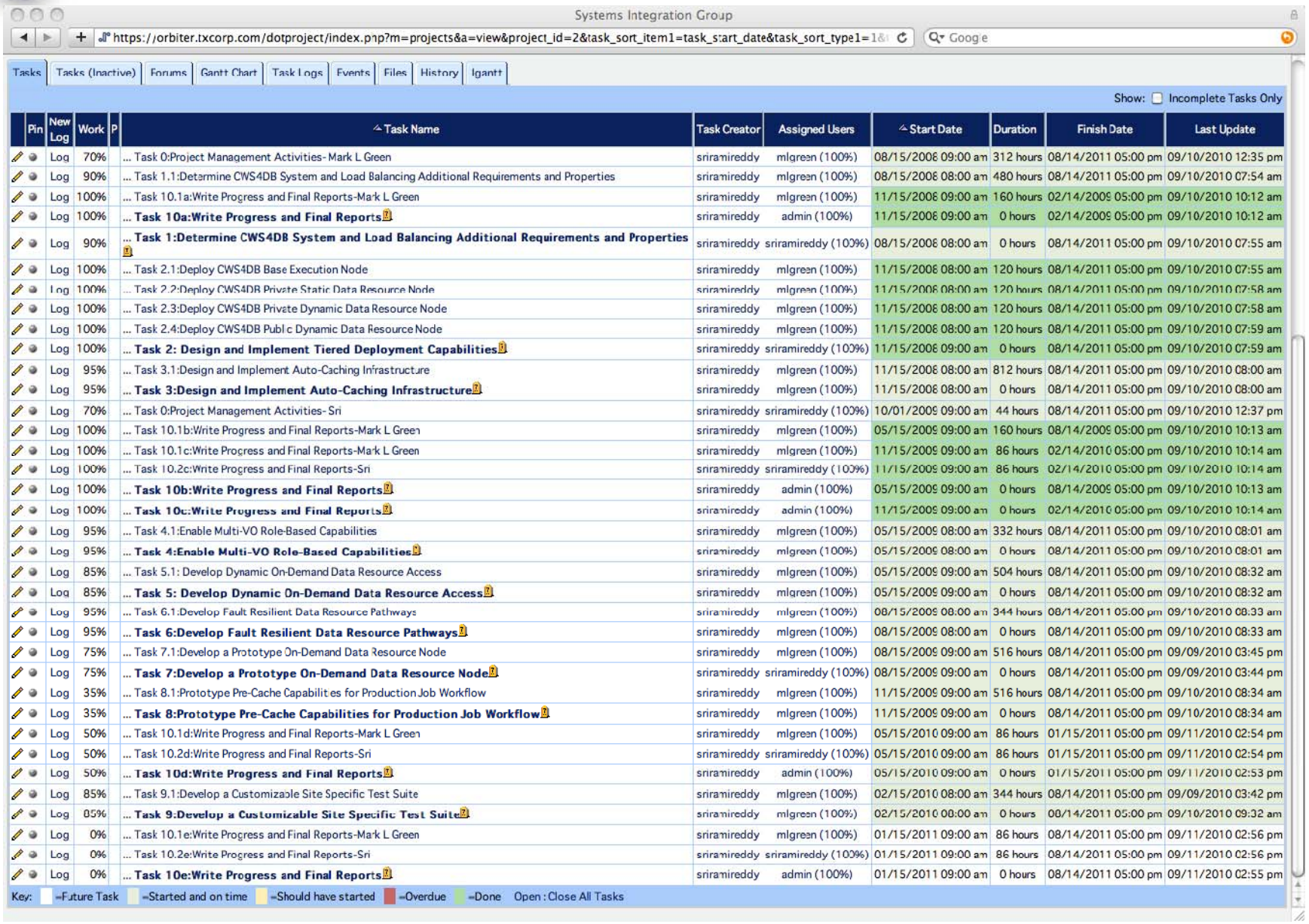
CWS4DB Tasks Continued

- Task 6: Develop Fault Resilient Data Resource Pathways (Tech-X)
  - Investigate eliminating a single point of failure for the STAR C++ API bound codes database query requests.
- Task 7: Develop a Prototype On-Demand Data Resource Node (Tech-X & BNL) ☆
  - Investigate and prototype the deployment of a on-demand data resource node to meet the dynamic data demands of the STAR collaboration.
- Task 8: Prototype Pre-Cache Capabilities for Production Job Workflow (Tech-X & BNL) ☆
  - We will provide a pathway for an authenticated and authorized user upon configuration of the CWS4DB system to execute the customizable site specific test suite for pre-caching production job queries.
- Task 9: Develop a Customizable Site Specific Test Suite (Tech-X) ☆
  - In order to deliver a high quality of service infrastructure a customizable and site specific test suite is required to validate and verify the performance and data delivery capabilities of the CWS4DB system.

Project Management

- Subversion Repositories
  - Multiple readers and committers
- Redmine, Trac, and Wiki Sites
  - Integrates ticketing system, repositories, milestones, and roadmap
- Eclipse Integrated Development Environment
  - Tracks code modifications based on Redmine and Trac tickets
- Zend Studio, Development Server, and Server
  - Commercial PHP development and enterprise level server
- Content Management System (Drupal)
  - Offsite collaborator access to project information
- Knowledgebase Manager
  - Coding best practices, design patterns, systems and integration information
- MacA&D Developer
  - Analysis and Design (A&D) with requirements management and use case development
- dotProject
  - Open source PHP based project management software

Project Status



Tasks | Tasks (Inactive) | Forums | Gantt Chart | Task Logs | Events | Files | History | Igantt

Show: Incomplete Tasks Only

Pin	New Log	Work	P	Task Name	Task Creator	Assigned Users	Start Date	Duration	Finish Date	Last Update
	Log	70%		... Task 0:Project Management Activities- Mark L Green	sriramireddy	mlgreen (100%)	08/15/2008 09:00 am	312 hours	08/14/2011 05:00 pm	09/10/2010 12:35 pm
	Log	90%		... Task 1.1:Determine CWS4DB System and Load Balancing Additional Requirements and Properties	sriramireddy	mlgreen (100%)	08/15/2008 08:00 am	480 hours	08/14/2011 05:00 pm	09/10/2010 07:54 am
	Log	100%		... Task 10.1a:Write Progress and Final Reports-Mark L Green	sriramireddy	mlgreen (100%)	11/15/2008 09:00 am	160 hours	02/14/2009 05:00 pm	09/10/2010 10:12 am
	Log	100%		... **Task 10a:Write Progress and Final Reports**	sriramireddy	admin (100%)	11/15/2008 09:00 am	0 hours	02/14/2009 05:00 pm	09/10/2010 10:12 am
	Log	90%		... **Task 1:Determine CWS4DB System and Load Balancing Additional Requirements and Properties**	sriramireddy	sriramireddy (100%)	08/15/2008 08:00 am	0 hours	08/14/2011 05:00 pm	09/10/2010 07:55 am
	Log	100%		... Task 2.1:Deploy CWS4DB Base Execution Node	sriramireddy	mlgreen (100%)	11/15/2008 08:00 am	120 hours	08/14/2011 05:00 pm	09/10/2010 07:55 am
	Log	100%		... Task 2.2:Deploy CWS4DB Private Static Data Resource Node	sriramireddy	mlgreen (100%)	11/15/2008 08:00 am	120 hours	08/14/2011 05:00 pm	09/10/2010 07:58 am
	Log	100%		... Task 2.3:Deploy CWS4DB Private Dynamic Data Resource Node	sriramireddy	mlgreen (100%)	11/15/2008 08:00 am	120 hours	08/14/2011 05:00 pm	09/10/2010 07:58 am
	Log	100%		... Task 2.4:Deploy CWS4DB Public Dynamic Data Resource Node	sriramireddy	mlgreen (100%)	11/15/2008 08:00 am	120 hours	08/14/2011 05:00 pm	09/10/2010 07:59 am
	Log	100%		... **Task 2: Design and Implement Tiered Deployment Capabilities**	sriramireddy	sriramireddy (100%)	11/15/2008 09:00 am	0 hours	08/14/2011 05:00 pm	09/10/2010 07:59 am
	Log	95%		... Task 3.1:Design and Implement Auto-Caching Infrastructure	sriramireddy	mlgreen (100%)	11/15/2008 08:00 am	812 hours	08/14/2011 05:00 pm	09/10/2010 08:00 am
	Log	95%		... **Task 3:Design and Implement Auto-Caching Infrastructure**	sriramireddy	mlgreen (100%)	11/15/2008 08:00 am	0 hours	08/14/2011 05:00 pm	09/10/2010 08:00 am
	Log	70%		... Task 0:Project Management Activities- Sri	sriramireddy	sriramireddy (100%)	10/01/2009 09:00 am	44 hours	08/14/2011 05:00 pm	09/10/2010 12:37 pm
	Log	100%		... Task 10.1b:Write Progress and Final Reports-Mark L Green	sriramireddy	mlgreen (100%)	05/15/2009 09:00 am	160 hours	08/14/2009 05:00 pm	09/10/2010 10:13 am
	Log	100%		... Task 10.1c:Write Progress and Final Reports-Mark L Green	sriramireddy	mlgreen (100%)	11/15/2009 09:00 am	86 hours	02/14/2010 05:00 pm	09/10/2010 10:14 am
	Log	100%		... Task 10.2c:Write Progress and Final Reports-Sri	sriramireddy	sriramireddy (100%)	11/15/2009 09:00 am	86 hours	02/14/2010 05:00 pm	09/10/2010 10:14 am
	Log	100%		... **Task 10b:Write Progress and Final Reports**	sriramireddy	admin (100%)	05/15/2009 09:00 am	0 hours	08/14/2009 05:00 pm	09/10/2010 10:13 am
	Log	100%		... **Task 10c:Write Progress and Final Reports**	sriramireddy	admin (100%)	11/15/2009 09:00 am	0 hours	02/14/2010 05:00 pm	09/10/2010 10:14 am
	Log	95%		... Task 4.1:Enable Multi-VO Role-Based Capabilities	sriramireddy	mlgreen (100%)	05/15/2009 08:00 am	332 hours	08/14/2011 05:00 pm	09/10/2010 08:01 am
	Log	95%		... **Task 4:Enable Multi-VO Role-Based Capabilities**	sriramireddy	mlgreen (100%)	05/15/2009 08:00 am	0 hours	08/14/2011 05:00 pm	09/10/2010 08:01 am
	Log	85%		... Task 5.1: Develop Dynamic On-Demand Data Resource Access	sriramireddy	mlgreen (100%)	05/15/2009 09:00 am	504 hours	08/14/2011 05:00 pm	09/10/2010 08:32 am
	Log	85%		... **Task 5: Develop Dynamic On-Demand Data Resource Access**	sriramireddy	mlgreen (100%)	05/15/2009 09:00 am	0 hours	08/14/2011 05:00 pm	09/10/2010 08:32 am
	Log	95%		... Task 6.1:Develop Fault Resilient Data Resource Pathways	sriramireddy	mlgreen (100%)	08/15/2009 08:00 am	344 hours	08/14/2011 05:00 pm	09/10/2010 08:33 am
	Log	95%		... **Task 6:Develop Fault Resilient Data Resource Pathways**	sriramireddy	mlgreen (100%)	08/15/2009 08:00 am	0 hours	08/14/2011 05:00 pm	09/10/2010 08:33 am
	Log	75%		... Task 7.1:Develop a Prototype On-Demand Data Resource Node	sriramireddy	mlgreen (100%)	08/15/2009 09:00 am	516 hours	08/14/2011 05:00 pm	09/09/2010 03:45 pm
	Log	75%		... **Task 7:Develop a Prototype On-Demand Data Resource Node**	sriramireddy	sriramireddy (100%)	08/15/2009 09:00 am	0 hours	08/14/2011 05:00 pm	09/09/2010 03:44 pm
	Log	35%		... Task 8.1:Prototype Pre-Cache Capabilities for Production Job Workflow	sriramireddy	mlgreen (100%)	11/15/2009 09:00 am	516 hours	08/14/2011 05:00 pm	09/10/2010 08:34 am
	Log	35%		... **Task 8:Prototype Pre-Cache Capabilities for Production Job Workflow**	sriramireddy	mlgreen (100%)	11/15/2009 09:00 am	0 hours	08/14/2011 05:00 pm	09/10/2010 08:34 am
	Log	50%		... Task 10.1d:Write Progress and Final Reports-Mark L Green	sriramireddy	mlgreen (100%)	05/15/2010 09:00 am	86 hours	01/15/2011 05:00 pm	09/11/2010 02:54 pm
	Log	50%		... Task 10.2d:Write Progress and Final Reports-Sri	sriramireddy	sriramireddy (100%)	05/15/2010 09:00 am	86 hours	01/15/2011 05:00 pm	09/11/2010 02:54 pm
	Log	50%		... **Task 10d:Write Progress and Final Reports**	sriramireddy	admin (100%)	05/15/2010 09:00 am	0 hours	01/15/2011 05:00 pm	09/11/2010 02:53 pm
	Log	85%		... Task 9.1:Develop a Customizable Site Specific Test Suite	sriramireddy	mlgreen (100%)	02/15/2010 08:00 am	344 hours	08/14/2011 05:00 pm	09/09/2010 03:42 pm
	Log	85%		... **Task 9:Develop a Customizable Site Specific Test Suite**	sriramireddy	mlgreen (100%)	02/15/2010 08:00 am	0 hours	08/14/2011 05:00 pm	09/10/2010 09:32 am
	Log	0%		... Task 10.1e:Write Progress and Final Reports-Mark L Green	sriramireddy	mlgreen (100%)	01/15/2011 09:00 am	86 hours	08/14/2011 05:00 pm	09/11/2010 02:56 pm
	Log	0%		... Task 10.2e:Write Progress and Final Reports-Sri	sriramireddy	sriramireddy (100%)	01/15/2011 09:00 am	86 hours	08/14/2011 05:00 pm	09/11/2010 02:56 pm
	Log	0%		... **Task 10e:Write Progress and Final Reports**	sriramireddy	admin (100%)	01/15/2011 09:00 am	0 hours	08/14/2011 05:00 pm	09/11/2010 02:55 pm

Key: =Future Task =Started and on time =Should have started =Overdue =Done Open : Close All Tasks

Task: DB Timings (DONE)

Using sequences of SQL operations that are recorded from actual STAR DB usage, we evaluated database performance under load by timing numerous repetitions of these operations against local and remote databases. The sample SQL sequences are:

Name	# Operations
db-perf-test.txt	6,667
offline.auau200.full.sql	8,911
offline.dau200.full.sql	8,784
offline.pp500.full.sql	6,667

CWS4DB Database Query Caching and Optimization

- Network bandwidth is important and depends on the last mile normally
- Database server load is minimal
- Investigate the database service payload size
- Wrote a custom ReSTful PHP database service with a JSON (JavaScript Object Notation) payload to compare with the XML payload

Timing results for *db-perf-test.txt*:

DB Host	# Repetitions	Avg Time (sec)
dbx.star.bnl.gov	10	921.66
orbiter.txcorp.com	10	3.42
cyber.txcorp.com	10	11.63
dbx.star.bnl.gov	20	922.02
orbiter.txcorp.com	20	3.49
cyber.txcorp.com	20	11.7
dbx.star.bnl.gov	30	898.57
orbiter.txcorp.com	30	3.61
cyber.txcorp.com	30	11.88

Timing results for *offline.auau200.full.sql*:

DB Host	# Repetitions	Avg Time (sec)
orbiter.txcorp.com	5	4.16
dbx.star.bnl.gov	5	1134.09
orbiter.txcorp.com	10	4.14
dbx.star.bnl.gov	10	1090.29
orbiter.txcorp.com	15	4.1
dbx.star.bnl.gov	15	1616.98

Timing results for *offline.dau200.full.sql*:

DB Host	# Repetitions	Avg Time (sec)
orbiter.txcorp.com	5	2.56
dbx.star.bnl.gov	5	993.93
orbiter.txcorp.com	10	2.66
dbx.star.bnl.gov	10	1256.02
orbiter.txcorp.com	15	2.66
dbx.star.bnl.gov	15	999.29

Timing results for *offline.pp500.full.sql*:

DB Host	# Repetitions	Avg Time (sec)
orbiter.txcorp.com	5	4.2
dbx.star.bnl.gov	5	921.82
orbiter.txcorp.com	10	3.52
dbx.star.bnl.gov	10	921.82
orbiter.txcorp.com	15	3.39
dbx.star.bnl.gov	15	907.23

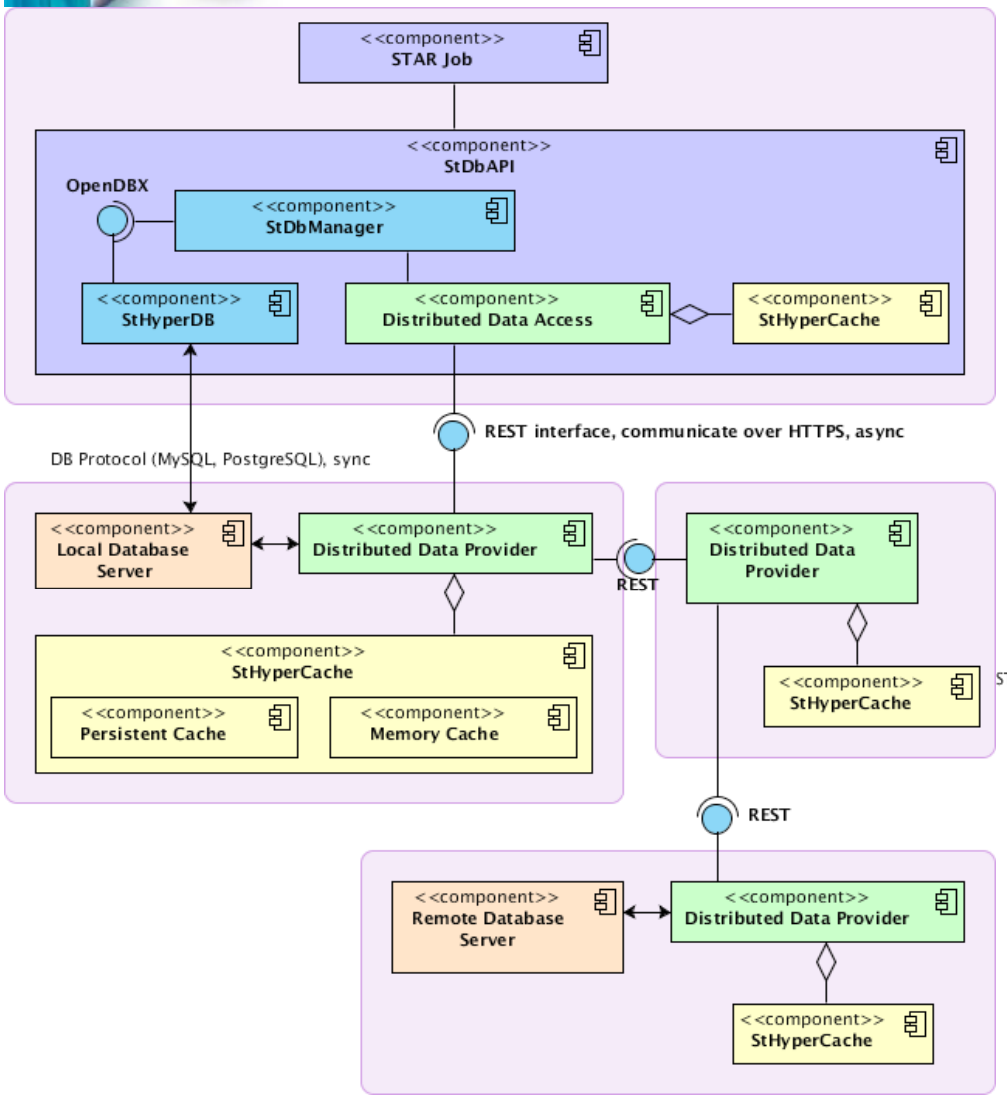
CWS4DB Database Query Caching and Optimization

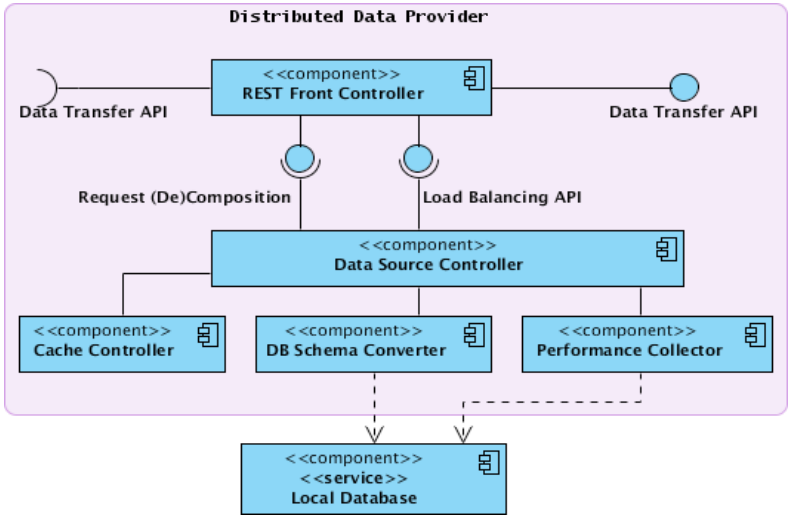
- Log performance data for each SQL operation
- Calculate and log JSON and XML payload size

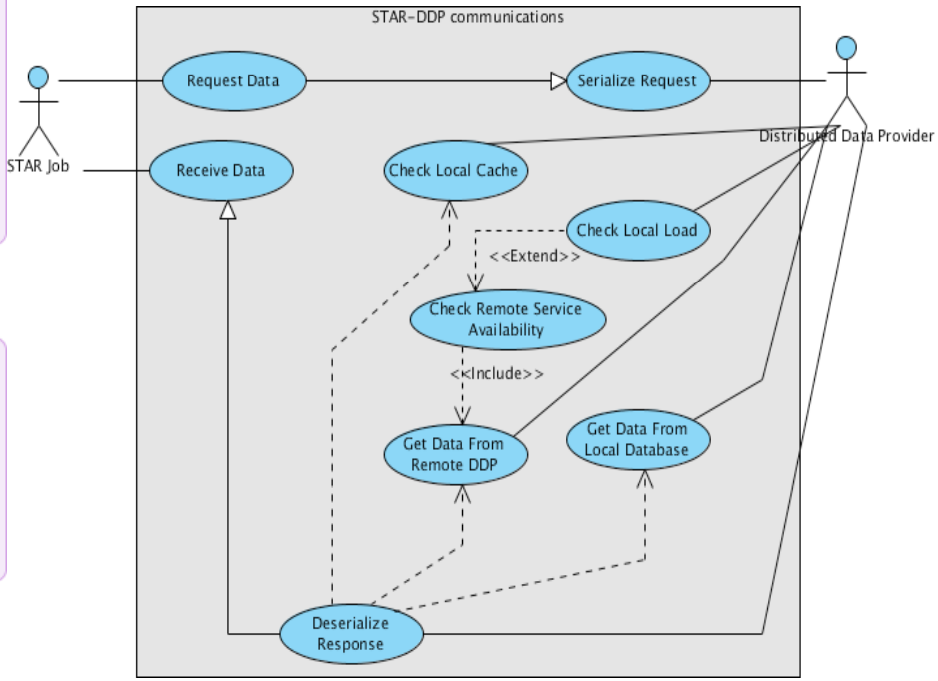
- On average over a dataset the equivalent JSON payload is 8.8 – 10.1 times smaller
- In general an order of magnitude lower bandwidth loading is required with the JSON PHP service

←T→	entry_id	query_id	json_size	xml_size	duration	timestamp
	44880	5757	97	273	0.00026798248291016	2009-08-11 14:46:58
	44881	5758	396	996	0.00047802925109863	2009-08-11 14:46:58
	44882	5759	99	275	0.00019717216491699	2009-08-11 14:46:58
	44883	5758	467	1205	0.00057792663574219	2009-08-11 14:46:58
	44884	5760	94	270	0.00020289421081543	2009-08-11 14:46:58
	44885	5761	3310	7498	0.0028619766235352	2009-08-11 14:46:58
	44886	5762	62	190	0.00020694732666016	2009-08-11 14:46:58
	44887	5763	102	278	0.00020194053649902	2009-08-11 14:46:58
	44888	5764	126	312	0.00022315979003906	2009-08-11 14:46:58
	44889	5765	7	63	0.00011920928955078	2009-08-11 14:46:58
	44890	5766	102	278	0.00022387504577637	2009-08-11 14:46:58
	44891	5767	126	312	0.00022315979003906	2009-08-11 14:46:58
	44892	5768	7	63	0.00012707710266113	2009-08-11 14:46:58
	44893	5769	102	278	0.00021219253540039	2009-08-11 14:46:58
	44894	5770	127	313	0.00026917457580566	2009-08-11 14:46:58
	44895	5771	7	63	0.00011920928955078	2009-08-11 14:46:58
	44896	5772	103	279	0.0002291202545166	2009-08-11 14:46:58
	44897	5773	127	313	0.00023388862609863	2009-08-11 14:46:58
	44898	5774	7	63	0.00012397766113281	2009-08-11 14:46:58
	44899	5775	103	279	0.00020599365234375	2009-08-11 14:46:58
	44900	5776	127	313	0.00024199485778809	2009-08-11 14:46:58
	44901	5777	7	63	0.00016498565673828	2009-08-11 14:46:58
	44902	5778	103	279	0.0002598762512207	2009-08-11 14:46:58
	44903	5779	127	313	0.00022602081298828	2009-08-11 14:46:58
	44904	5780	7	63	0.00013303756713867	2009-08-11 14:46:58
	44905	5781	103	279	0.00022983551025391	2009-08-11 14:46:58
	44906	5782	127	313	0.00027108192443848	2009-08-11 14:46:58
	44907	5783	7	63	0.00012493133544922	2009-08-11 14:46:58
	44908	5784	103	279	0.00025486946105957	2009-08-11 14:46:58
	44909	5785	127	313	0.00022006034851074	2009-08-11 14:46:58

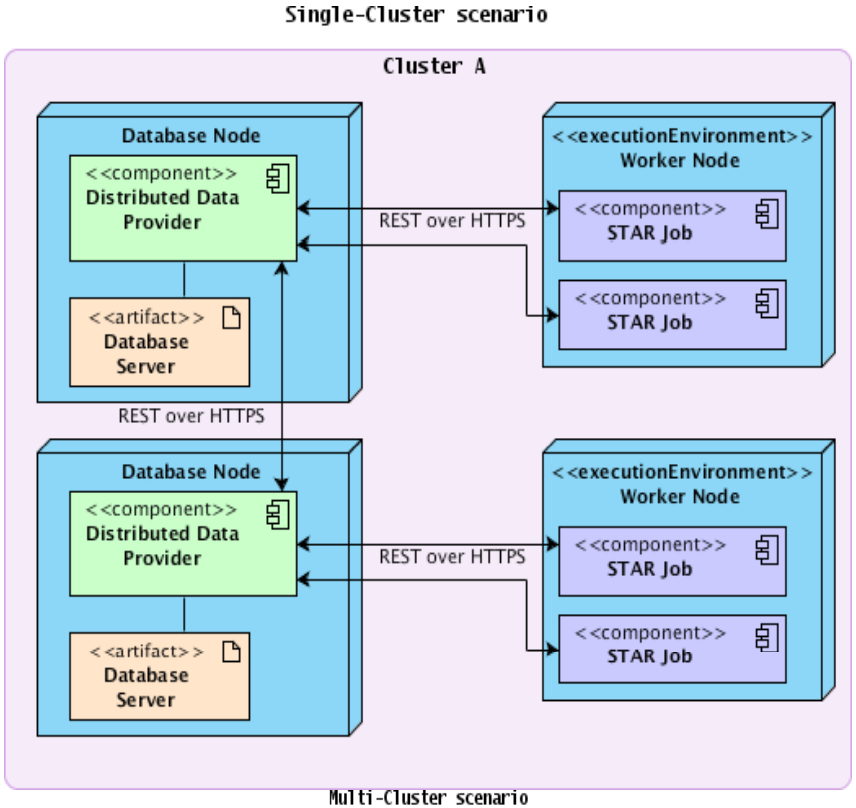
CWS4DB Load Balancing Design

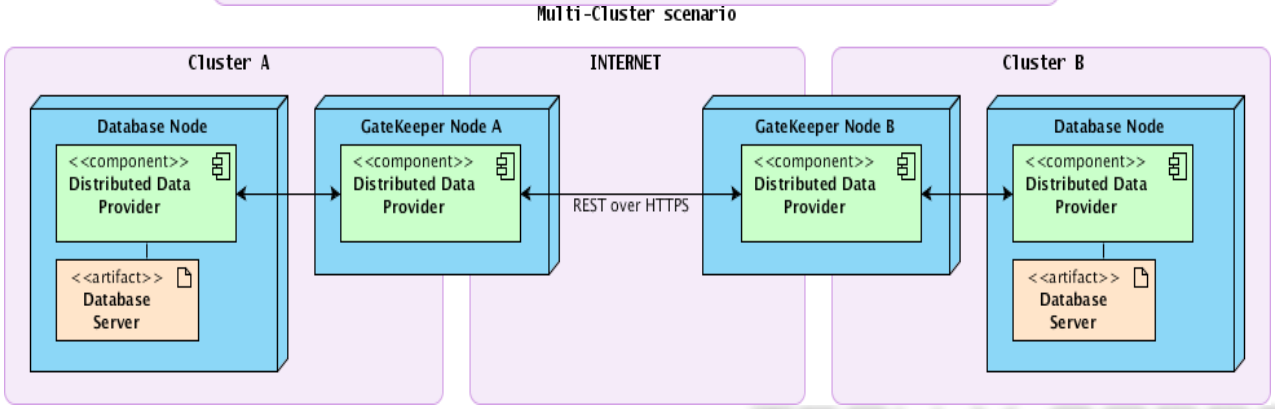






CWS4DB Proxy Implementation

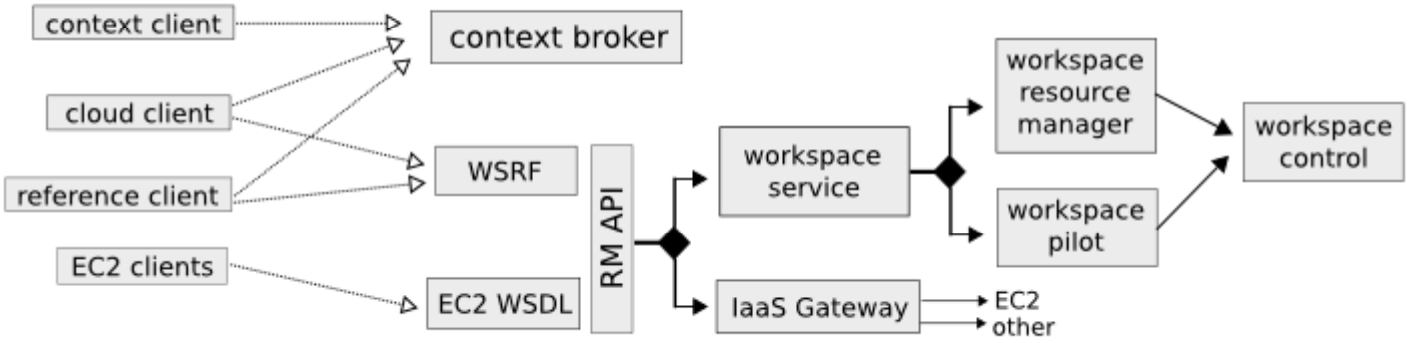




CWS4DB Cloud On-Demand Resources

- Tech-X has installed Nimbus and utilized the Nimbus client with the available science clouds in support of the STAR on-demand database service.
  - The Nimbus infrastructure provided limited upload/download bandwidth consistently.
  - The required STAR image is relatively large due to the size of the MySQL database.
  - We investigated several ways of populating the STAR database and tested query performance with our ReSTful PHP JSON database service successfully.
  - The Open Grid Services Architecture - Database Access and Integration (OGSA-DAI) XML database services could not be loaded on the Nimbus science cloud due to memory constraints.
  - We are still investigating utilizing Eucalyptus and the cloud enabled MySQL database Drizzle

Nimbus components (Keahey, ANL)



CWS4DB Summary

File Name : star.pp500.full.sql

https://cyber.txcorp.com/orbiter/service/star/OrbiterStarSimulatorService.php
/cache/off/
/format/XML/
/host/local/
/file//tmp/testfiles/star.pp500.full.sql/
/address/http://64.240.154.24/orbiter/service/star/

Result:

Number of trials averaged: 1
Total number of queries: 6549
Total size of queries: 38,926,201 bytes
Total query time: 76.9 seconds
Total query rate: 85.1 query/second.

CWS4DB Summary

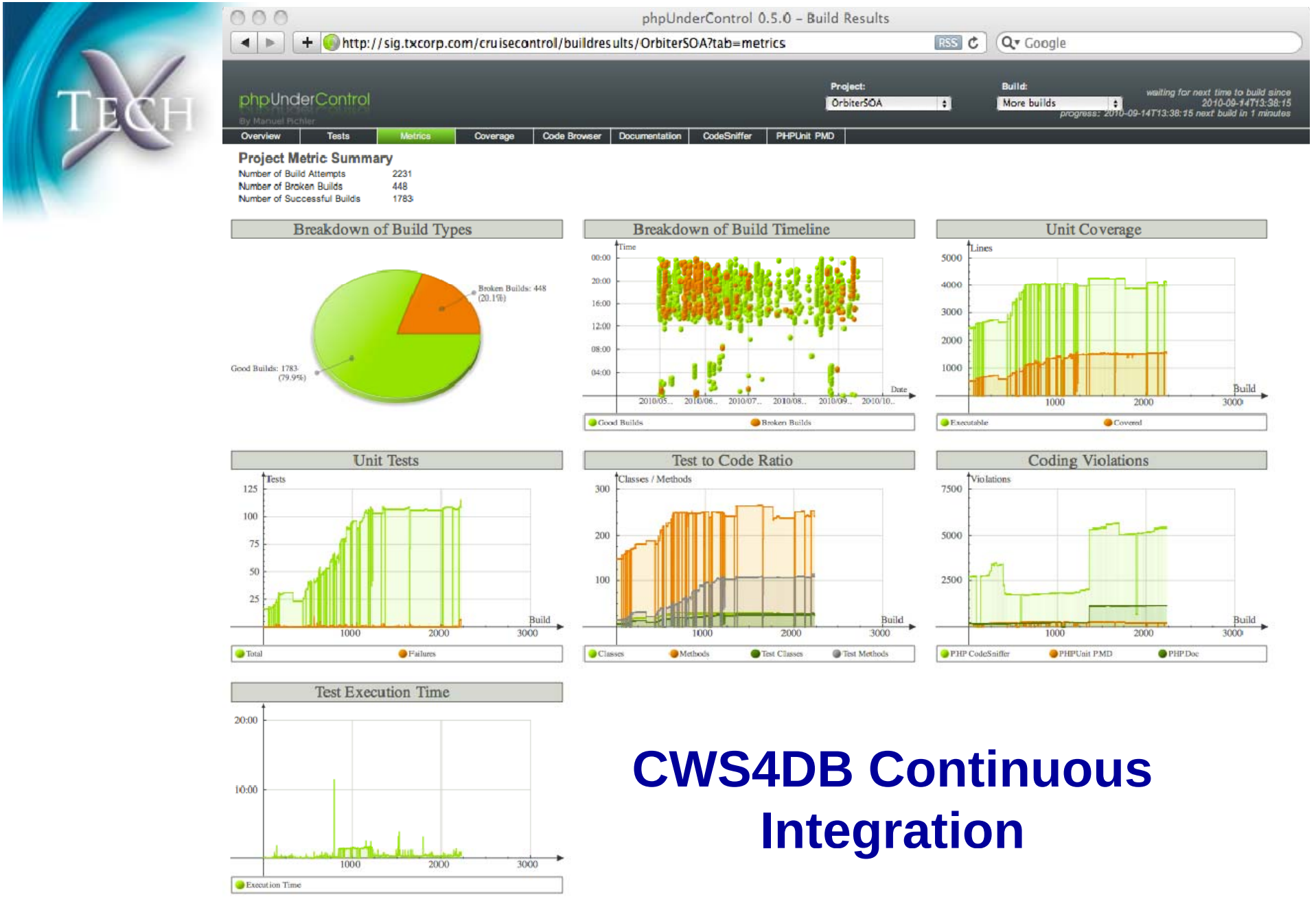
New class files and services developed to accomplish the above tasks:

-- orbiterAutoLoader.php (150)
-- OrbiterAttributeParser.class.php (147)
-- OrbiterCacheFileService.php (723)
-- OrbiterCacheManager.class.php (236)
-- OrbiterDatabaseConnection.class.php (212)
-- OrbiterErrorHandler.class.php (509)
-- OrbiterErrorHandlerMessageService.class.php (526)
-- OrbiterMailer.class.php (187)
-- OrbiterMasterSlaveDatabaseValidationService.class.php (439)
-- OrbiterQueryDbConnectionStringStarService.class.php (467)
-- OrbiterQueryDbLoadBalancerStarService.class.php (399)
-- OrbiterRestAuth.class.php (655)
-- OrbiterServiceAttributes.class.php (132)
-- OrbiterServiceLogger.class.php (234)
-- OrbiterStarQueryService.class.php (530)
-- OrbiterStarSimulatorService.php (489)

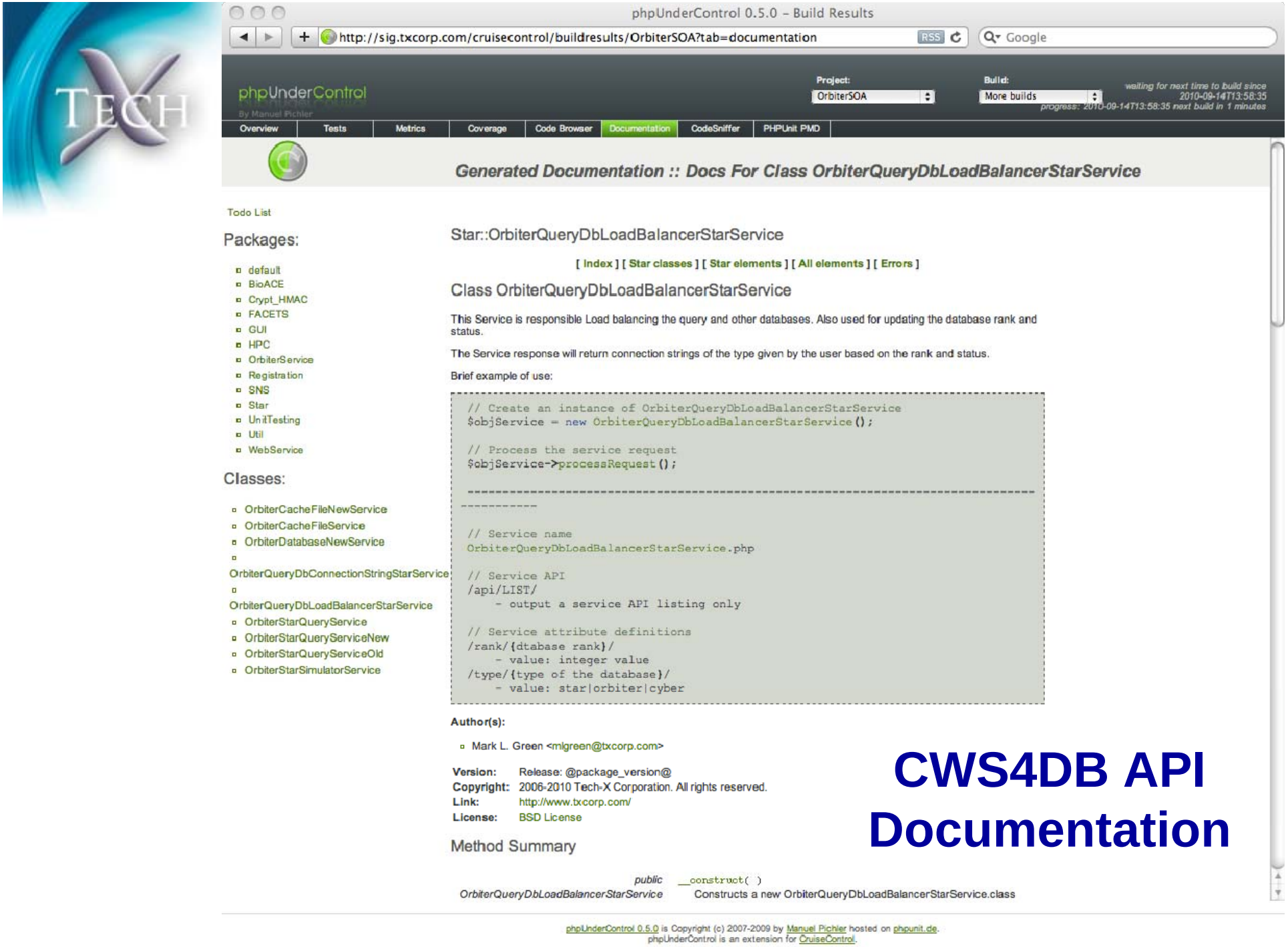
Services developed:
-- OrbiterCacheFileService.php
-- OrbiterQueryDbConnectionStringStarService.php
-- OrbiterQueryDbLoadBalancerStarService.php
-- OrbiterQueryDBService.php
-- OrbiterStarQueryService.php
-- OrbiterStarSimulatorService.php

Unit Test scripts developed:

-- OrbiterAttributeParserStubTest.php
-- OrbiterAttributeParserTest.php
-- OrbiterServiceTestSuite.php
-- OrbiterAutoLoaderTest.php
-- OrbiterCacheManagerFileTest.php
-- OrbiterCacheManagerTest.php
-- OrbiterDatabaseConnectionMasterTest.php
-- OrbiterDatabaseConnectionSlaveTest.php
-- OrbiterDatabaseConnectionTest.php
-- OrbiterDataProcessManagerTest.php
-- OrbiterErrorHandlerEmailTest.php
-- OrbiterErrorHandlerErrorDetailedTest.php
-- OrbiterErrorHandlerLogTest.php
-- OrbiterErrorHandlerNotifyTest.php
-- OrbiterErrorHandlerSampleTest.php
-- OrbiterErrorHandlerShowContentsOutputTest.php
-- OrbiterMailerTest.php
-- OrbiterQueryDbLoadBalancerStarServiceTest.php
-- OrbiterRestAuthTest.php
-- Services_JSONTest.php

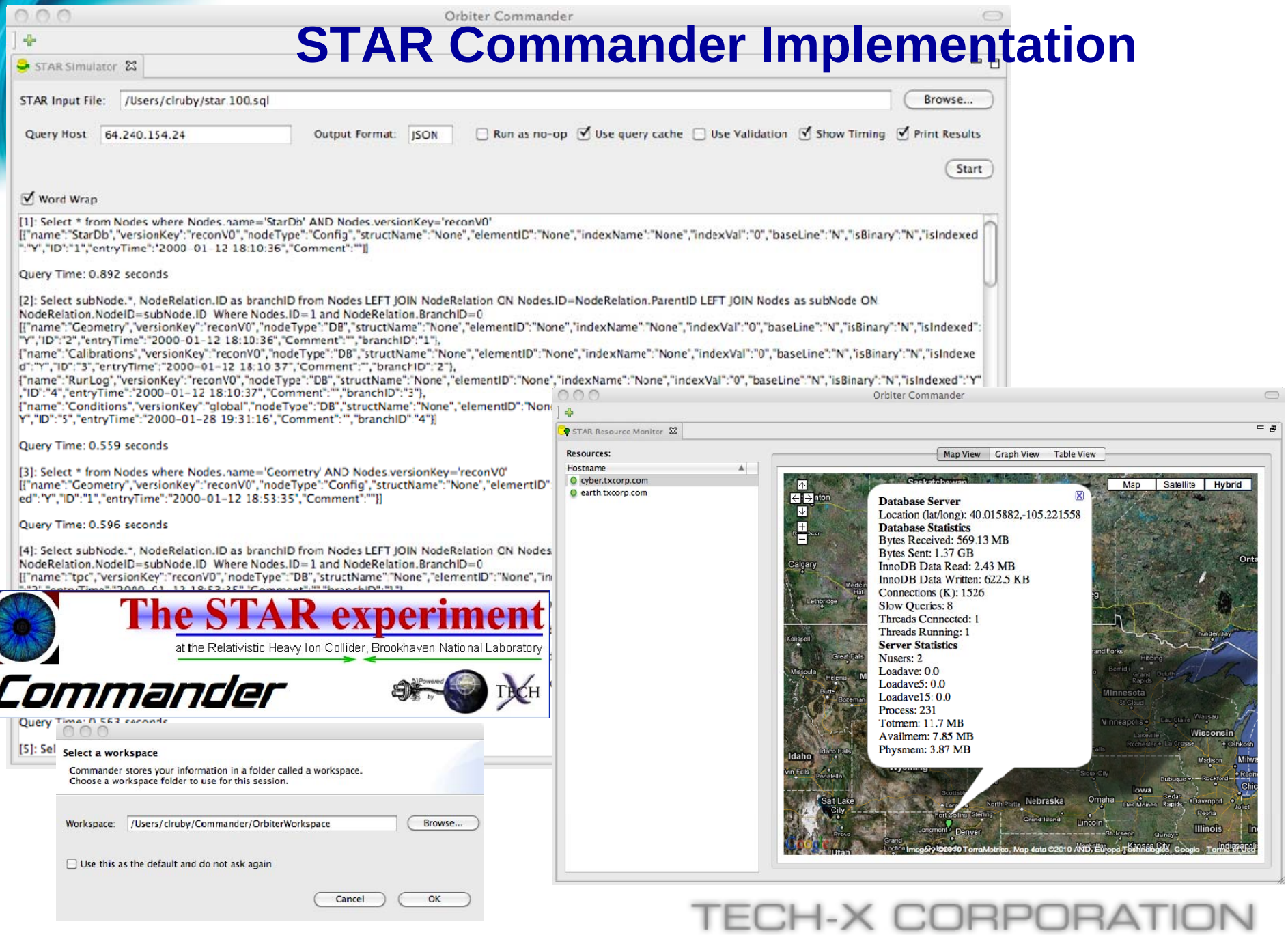


CWS4DB Continuous Integration



CWS4DB API Documentation

STAR Commander Implementation



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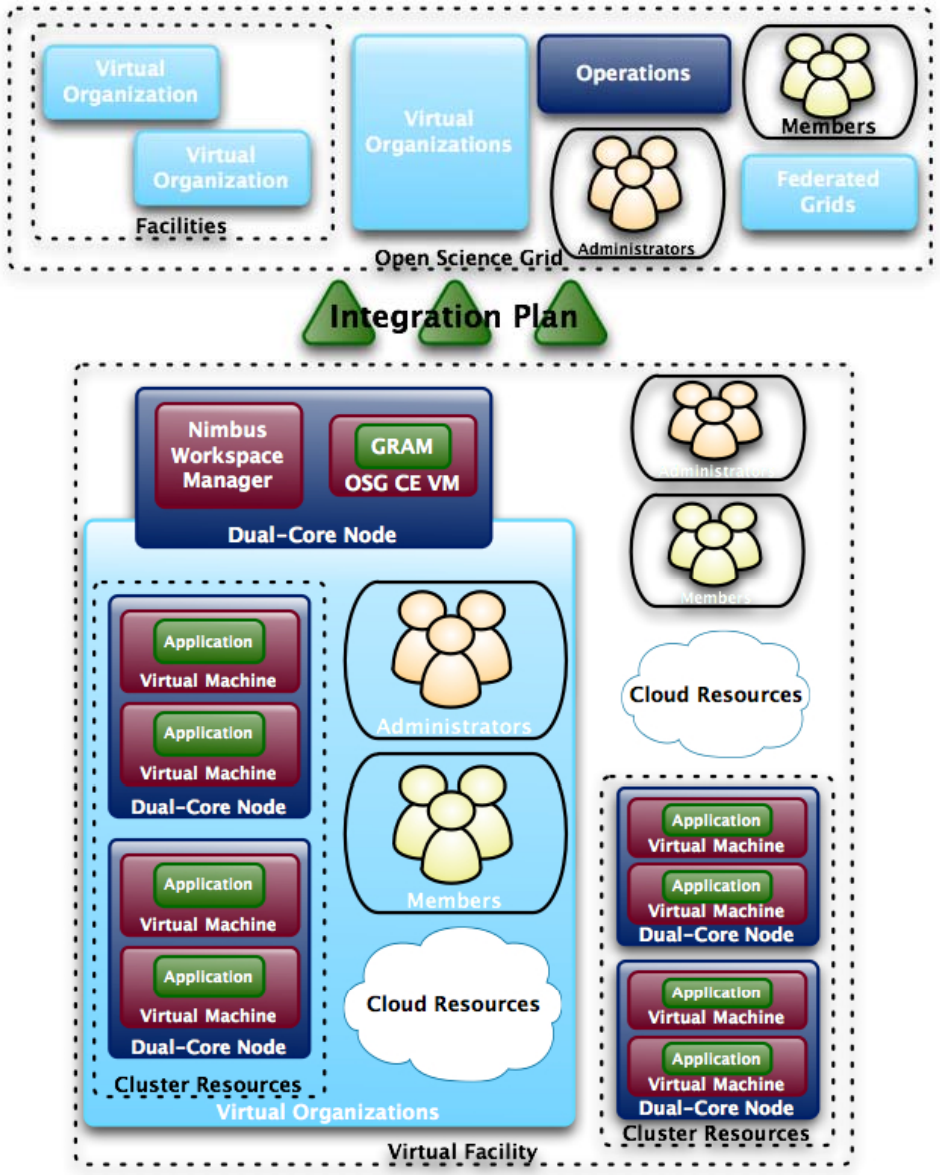
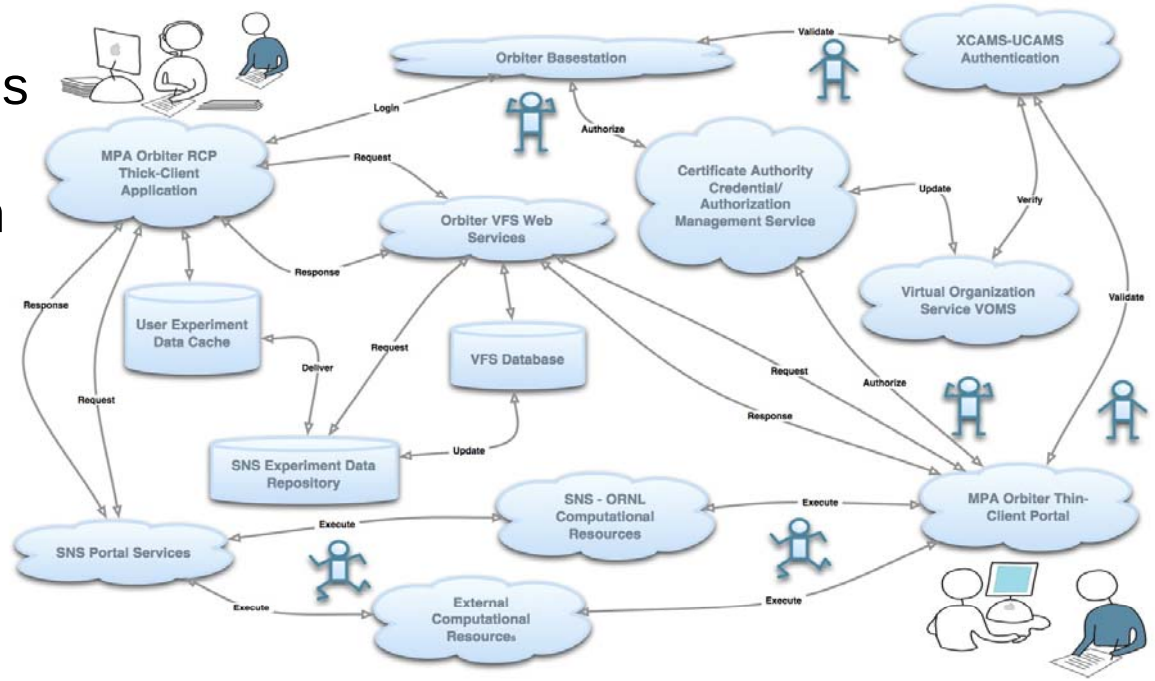
Future Directions



- Integrate On-Demand Application Resources (O-DAR) within the Open Science Grid.
- This is a new type of OSG virtual facility that can be used for cycle scavenging usage on hardware that is idle or migrated out of a production environment and might not even have OSG stack installed.
- It can represent a lightweight method of deploying OSG worker nodes and building more capacity for scientific application usage.
- Will support NP, HEP, Neutron Science, etc.

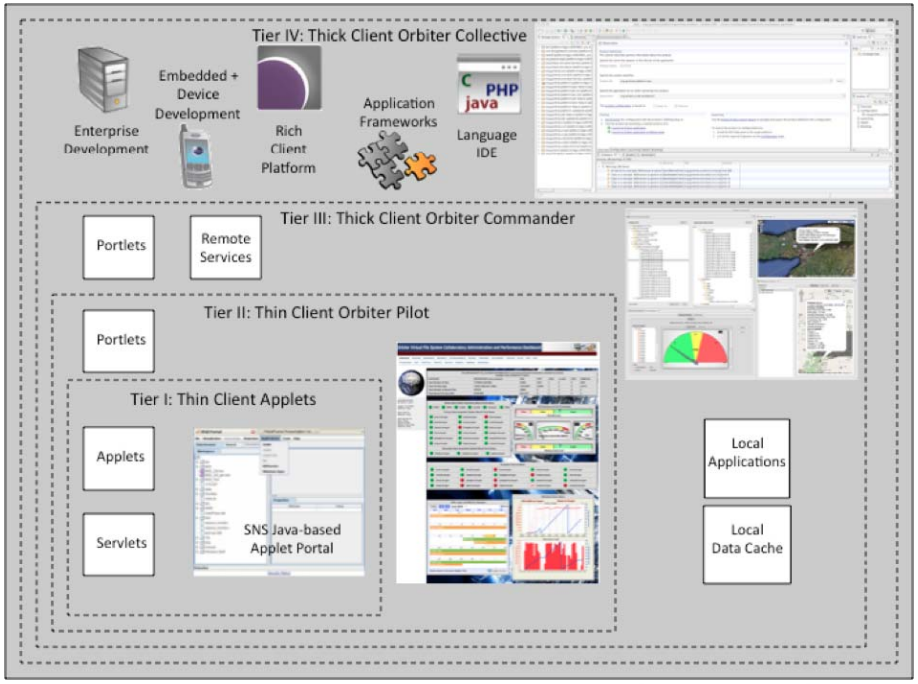
Orbiter Federation SOA via ReSTful Services

- Orbiter Infrastructure serves capabilities via ReSTful web services
- Services are standards-based and are scalable, reusable, and extensible
- Robust security standards using access keys and private-key authentication
- Reusable to ensure consistent and reliable Quality of Service



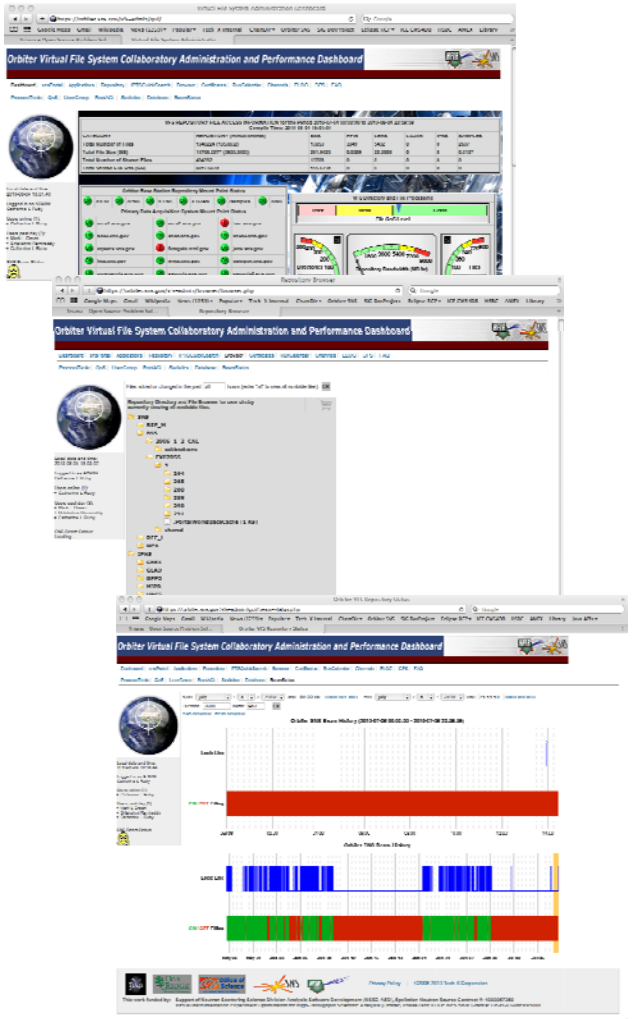
Orbiter Multitier Portal Architecture (MPA)

- Framework for delivering capabilities to thin- and thick-clients using the Orbiter Federation ReSTful SOA
- Flexible and re-usable architecture for developing capabilities for thin web clients and thick local clients
- Comprised of four tiers:
  - Orbiter Federation SOA
    - Thin-Client Applets
  - Orbiter Pilot
    - Thin-Client Portlets
  - Orbiter Commander
    - Thick-Client Applications
  - Orbiter Collective
    - Thick-Client Eclipse IDE



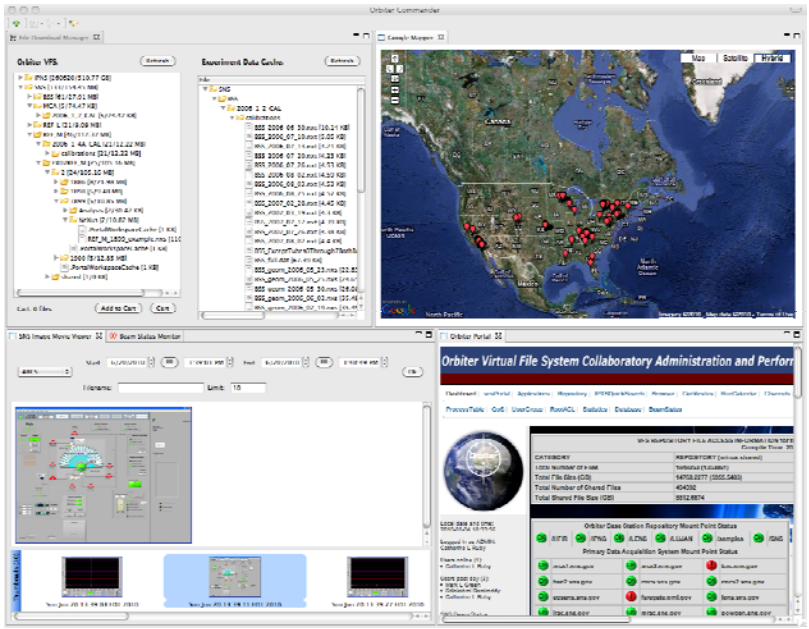
Orbiter Pilot – Thin Client

- Built on top of the Orbiter Federation SOA
- Tier II of the Orbiter Multitier Portal Architecture
- Accessible to users with accounts and internet access (via a web browser)
- Build upon the services provided by the Orbiter SOA infrastructure
- Capabilities are seamlessly integrated using these well-defined ReSTful web services



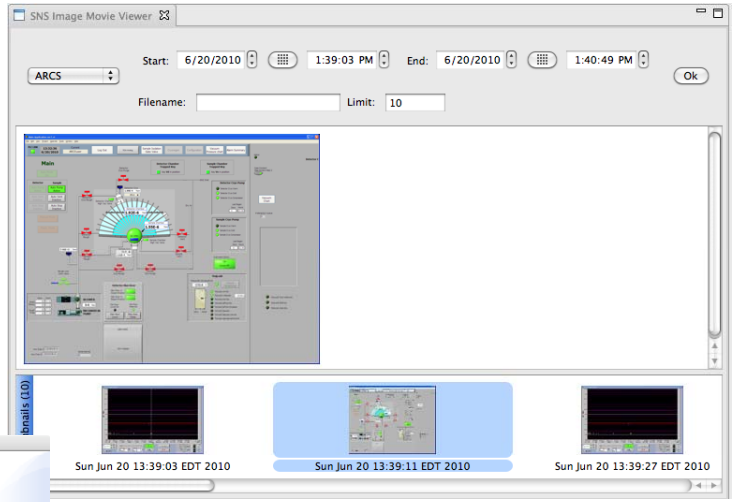
Orbiter Commander – Thick Client

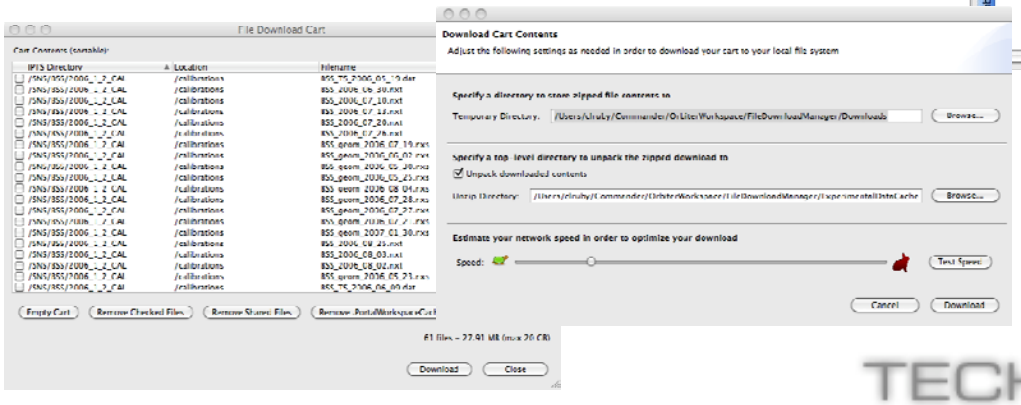
- Built on top of the Orbiter Federation SOA
- Integrates Orbiter Pilot
- Tier III of the Orbiter Multitier Portal Architecture
- Run locally on user work stations or personal computers
- Uses Eclipse RCP (Rich Client Platform) to deliver a robust and powerful GUI to the end user, also allows Commander to integrate with other local resources like e-mail, the file system, and local applications.
- Build upon the services provided by the Orbiter Federation SOA infrastructure
- Allows users to run complex simulations or computationally-intensive tasks on their local machines, relieving Quality of Service concerns on web service providers



Orbiter Commander – Thick Client (continued)

- Atomic capabilities are provided as *modules* that can be installed as needed from a central module repository
- The Orbiter Federation ReSTful SOA provides robust access to diverse capabilities, such as:
  - Multi-threaded streaming downloads of repository files
  - Live status monitoring of the beam
  - Slideshows of instrument application screenshots
  - Organization of modules into "*Suites*"





Orbiter Collective (future capabilities)

- Modules will be continuously added to Commander to provide new capabilities, including:
  - A *collaboratory* providing live chat and data sharing capabilities
  - Opportunistic file slicing to support the retrieval and management of very large data sets
  - Real-time and offline scientific data visualization capabilities
  - Integration with other open-source tools such as data analysis and workflow management for computational, data movement, and visualization jobs
  - Support for 3rd party module contributions as well as user integrated applications (MPA Tier IV Orbiter Collective)

Orbiter Federation SOA: Python Client Service Access Example

```
#!/usr/bin/python
import os, sys, base64, hmac, commands, time
from hashlib import sha1 as sha
from urllib import urlencode
from urllib import urlopen
from urllib import quote_plus

myhome = os.environ.get('HOME')
os.environ['TZ']='GMT'
time.tzset()

idfile = open(myhome + "/.orbiter/my.id")
ACCESS_KEY = idfile.read().strip()
idfile.close()
keyfile = open(myhome + "/.orbiter/user.key")
PRIVATE_KEY = keyfile.read()
keyfile.close()

URI = sys.argv[1]
EXPIRES = str(int(time.mktime(time.localtime(time.time()+60))))
str = URI + '/OrbiterAccessKeyId/' + ACCESS_KEY + '/Expires/' + EXPIRES
SIGNATURE = base64.b64encode(hmac.new(PRIVATE_KEY, str, sha).digest()).strip()
print urlopen(str + '/Signature/' + SIGNATURE, params).read()
```

Related Publications

- Lynch, V. E., Cobb, J. W., Green, M. L., Kohl, J. A., Miller, S. D., Ren, S., Smith, B., Vazhkudai, S. S.; “Experience with Remote Job Execution”, NOBUGS 2008 Conference, Australian Nuclear Science and Technology Organization (ANSTO), Sydney, Australia, 3-5 November 2008 in proceedings.

- Green, Mark L.; Alexander, David A.; Pundaleeka, Roopa; Matykiewicz, James. "Automatic Certificate Based Account Generation and Secure AJAX Calls in a Grid Portal", Grid Computing Environments Workshop, 2008. GCE’08 Volume , Issue , 12-16 Nov. 2008 Page(s):1 - 8 DOI 10.1109/GCE.2008.4738444

- Green, Mark L, Miller, Stephen D, Vazhkudai, Sudharshan S, Trater, James R; “Doing Your Science While You’re in Orbit”, International Conference on Neutron Scattering 2009, Knoxville, TN, 3-7 May 2009. Submitted to Journal of Physics Conference Series.

- Miller, Stephen D., Herwig, Kenneth W., Ren, Shelly, Vazhkudai, Sudharshan S., Jemian, Pete, Luitz, Steffen, Salnikov, Andrei A., Gaponenko, Igor, Proffen, Thomas, Lewis, Paul, Green, Mark L.; “Data Management and Science at DOE BES User Facilities - Past, Present, and Future”, SciDAC 2009, San Diego, CA, 14-18 June 2009.

- Green, Mark L. and Miller, Stephen D. (2007) “Multitier Portal Architecture for Thin- and Thick-client Neutron Scattering Experiment Support.” Grid Computing Environments (GCE) workshop, Nov. 11-12, 2007, Reno, NV, http://casci.rit.edu/proceedings/gce2007 .

- Green, Mark L., Alexander, David, Pundaleeka, Roopa, and Matykiewicz, James (2008) “Automatic Certificate Based Account Generation and Secure AJAX Calls in a Grid Portal.” Grid Computing Environments Workshop, 2008. GCE '08, Nov. 12-16, 2008, pages 1 – 8, Austin, TX

Related Posters

- Green, Mark L., Miller, Stephen D., Ren, Shelly X., Peterson, Peter F.; “Scalable Web Services for Experiment Repository Virtual File System Access”, NOBUGS 2008 Conference, Australian Nuclear Science and Technology Organisation (ANSTO), Sydney, Australia, 3-5 November 2008.

- Green, Mark L., Miller, Stephen D., Cobb, John W., Trater, Jim R.; “Enlightened Cybersecurity to Enable Collaborative Research Using Virtual Organizations”, NOBUGS 2008 Conference, Australian Nuclear Science and Technology Organisation (ANSTO), Sydney, Australia, 3-5 November 2008.

- Lynch, V. E., Cobb, J. W., Green, M. L., Kohl, J. A., Miller, S. D., Ren, S., Smith, B., Vazhkudai, S. S.; “Experience with Remote Job Execution”, NOBUGS 2008 Conference, Australian Nuclear Science and Technology Organisation (ANSTO), Sydney, Australia, 3-5 November 2008.

- Miller, S.D., Kohl, J.A., Vazhkudai, S.S., Green, M.L.; “NSSD Neutron Science Portal architecture”, NOBUGS 2008 Conference, Australian Nuclear Science and Technology Organisation (ANSTO), Sydney, Australia, 3-5 November 2008.

- Green, Mark L, Miller, Stephen D, Vazhkudai, Sudharshan S, Trater, James R; “Doing Your Science While You’re in Orbit”, International Conference on Neutron Scattering 2009 (ICNS 2009), Knoxville, TN, 3-7 May 2009.

- Miller, Stephen D., Herwig, Kenneth W., Ren, Shelly, Vazhkudai, Sudharshan S., Jemian, Pete, Luitz, Steffen, Salnikov, Andrei A., Gaponenko, Igor, Proffen, Thomas, Lewis, Paul, Green, Mark L.; “Data Management and Science at DOE BES User Facilities - Past, Present, and Future”, SciDAC 2009, San Diego, CA, 14-18 June 2009.

Related Presentations

- Green, Mark L. and Miller, Stephen D.; “Orbiter Service Oriented Architecture at SNS”, DANSE Developer Meeting, CalTech, Pasadena, CA, 24-27 August 2008.
- Green, Mark L; “A Multi-tiered Portal Architecture Overview: Emphasizing the Orbiter Thick-client Tier”, NOBUGS 2008 Conference, Australian Nuclear Science and Technology Organisation (ANSTO), Sydney, Australia, 3-5 November 2008.
- Green, Mark L.; “A Service Oriented Architecture for the SNS”, DANSE Developer Meeting, CalTech, Pasadena, CA, 15 December 2008.
- Green, Mark L. and Miller, Stephen D.; “Demonstration of the Orbiter Service Oriented Architecture at SNS”, DANSE Developer Meeting, CalTech, Pasadena, CA, 25-29 January 2009.
- Miller, S.D. and Green, Mark L.; “Toward Federated Services and Infrastructure for SNS Researchers”, Composing Collaboratories Meeting, Chicago, IL, 24-26 February 2009.
- Green, Mark L.and Lauret, Jerome; “STAR & Virtualization, looking beyond: Integrating Scientific, Grid, and Cloud Computing Infrastructures”, Open Science Grid All Hands Meeting, Virtual Technology Workshop, LIGO Livingston Observatory, Louisiana, 2-5 March 2009.
- Miller, S.D. and Green, Mark L.; “Current and Future Data Intensive Computing at DOE BES User Facilities”, Workshop on Enabling Data-Intensive Computing: from Systems to Applications, Pittsburgh, PA, 30-31 July 2009.

Sponsored Workshop

- Green, Mark L.; “Orbiter Workshop for DANSE Project Integration with SNS”, Oak Ridge National Laboratory, Spallation Neutron Source, JICS Auditorium, Oak Ridge, TN, 30 April 2009 – 1 May 2009.

For More Information

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