

# **SAMGrid Road Map**

**Adam Lyon, 28 February 2006 GDM**

SAMGrid comprises of tools and services used by running experiments for data handling and job management. The ultimate goal of SAMGrid is to make distributed processing of data as simple and transparent to the user as possible while making efficient use of experiment resources.

This document describes a road map for SAM Data Handling and SAM Grid project. The tasks, manpower, and timelines are discussed. This document will follow the SAMGrid FY06 budget plan document from 9/2005. Unless explicitly specified, the terms "SAM" and "SAMGrid" indicate both job management and data handling aspects of the project.

## **1 Tasks**

### **1.1 Continuing activities**

#### **1.1.1 Continue smooth running of SAMGrid for all stake holders**

SAMGrid operations continue to consume effort from the SAM development team, even with front-line shifters at the experiments. Of course one hopes that as we fix more problems and improve our test capabilities, the operations load will decrease. Recent operational problems that needed help from SAM experts were (not including those generated by the DØ refixing effort):

- Autodest problems at CDF
- v7 Autodest at DØ not matching functionality of v5 autodest
- v7 DB Server running out of file descriptors (traced to OmniOrb bug that never closed connections)
- v5 "sam list datasets" command always returning dataset found even for non-existent datasets (traced to FNORB bug exacerbated by the OmniOrb fix on the DB server)
- DØ SAM Framework bug affected file types of stored files
- Various FSS bugs that occurred with high rate of stores and high rate of DB server restarts (the latter addressed with the OmniOrb fix and improved robustness of FSS)

Why does SAM still need so much expert attention (e.g. why do we still find bugs)?

- Our code is still not thoroughly tested. Though are testing capabilities are improving and we run the code through the test suite more often

(something we never did before), it is still difficult to test under production conditions (high rates, many connections, many clients). We hope to somewhat address this issue, but of course it is impossible to guarantee that we release bugless code.

- The move to v6/7 introduced multithreading to the DB server. Our experience with multithreaded coding is limited (but getting better). So we still find mistakes in our multithreaded code. Though we think that the big problems are fixed.
- Monitoring is still limited and is ad hoc. We have no unified monitoring framework. Some of our monitoring code is also very old and no longer functions. We are addressing this problem with MIS.
- Installation and configuration is still an expert task (especially for SAMGrid). We are addressing these issues too.
- The DØ use cases for SAM data handling have been quite stable. But CDF is really just starting to use SAM DH. The usage patterns and load at CDF are different than at DØ and they exercise the code in different ways; finding bugs or "misunderstandings" that DØ does not hit.

I believe that the steady state operations effort from the development team is very slowly decreasing over time. This is evident from the fact that we continue to run well even with the loss of key team members who were heavy into operations support (Sinisa, Lauri, Valeria), and we continue to make progress on our SAM tasks.

The entire team is involved in operations in one form or another. Andrew maintains the station code (including FSS). Steve White maintains the DB server code, but as his fraction on SAM decreases, we are adding Randolph to the DB server maintainers. I expect it will take Randolph at least 6 weeks to get up to speed. Andrew and Parag are the maintainers of the SAMGrid job management code. Steve Sherwood is our primary testing person who designs and runs tests. He is also responsible for a part of the SAM client. Robert Illingworth is the primary operations person for DØ, but he also maintains the SAM client code. Dehong seems to be a primary operations person at CDF, but I want to transition him more into general SAM maintenance and at DØ as well.

The timescale for operations is of course continuous. We may have some measure of relief for maintenance of SAMGrid – DØ is planning to bring a person from the experiment into the SAMGrid team to learn installation and

maintenance of SAMGrid. This person will return to his or her home institution and become a regional expert. It is hoped that more DØ members will take their turn at "SAMGrid Camp" to develop a core group of expertise.

## **1.2 Upgrade to Python 2.4**

Now that SAM uses a "frozen" client executable, we can package any desired version of Python without affecting the python version used by the experiment (though if experiment code interacts with SAM and wants to use the python API, they must use our SAM python version). We are currently using a very old Python 2.1, a version known to have memory and threading problems. Robert has done much of the work to move to 2.4 and has tested the SAM client. That client is in production at DØ.

The DB Server will not work under Python 2.4 because it uses *dcoracle*, which will not build under Python 2.4 (and *dcoracle* is no longer supported). In principle, one should be able to swap out *dcoracle* with the more modern *cx\_oracle* product (which is interface compatible with *dcoracle*). But this has not been tried. Either Steve White must do this work or Randolph will do it once he has more experience with the DB server. I estimate 2 weeks of work to resolve issues.

The client, however, can still use the new version of Python. Indeed SAMGrid job management may use features specific to python 2.4.

## **1.3 DØ upgrade to v7**

DØ has installed v7 DB servers and clients for the Clued0 and CAB analysis farms, and many users are employing v7 features. v5 is still in use for the online system, MC generation processes, and for much of the file storage activities. SAMGrid job management also relies on v5. DØ had planned to upgrade to v7 by March 1, but this deadline was thwarted by the refixing effort, which consumed several key members of the SAM team (including me). The specific tasks for migration to v7 are below.

### **1.3.1 SAMGrid Job Management Services**

Gabriele had previously sent out a work plan for the transition of JIM from v5 to v7. See the Appendix for the work plan. The plan involves ~70 days of work from Gabriele, Parag and Andrew. This the highest priority task for them with regard to SAM and they have just started. This task is contingent on the success of the RunJob migration to SAM v7 (not performed by the SAMGrid team).

### **1.3.2 Online**

The DØ online system uses a private client that relies on v5 core code. Dehong has been working on a new stripped down client that will use v7 SAM. He has a working system and has performed minimal tests. In the next three weeks, he will be given time on the DØ online system to perform integration and production level tests. I expect this task to be complete in 30 days +/- 10 days.

### **1.3.3 MC Generation Processes**

v7 introduces a new MC request system that unifies the outdated and unmaintainable request systems used by MC and the reconstruction farm. The v7 request system is already in place, but has received little testing by the MC group. Steve Sherwood wrote the client for the request system, and he is following up with its deployment and migration. Steps involve,

- Migrate existing requests in the integration DB [80% done; 1 week]
- Assist MC group with testing within the integration DB [3 weeks]
- Migrate the production DB to support both old and new systems [1 week]
- Assist MC group with use of new system [2 weeks]
- Close out old system [1 week]

Note that the farm request system should be upgraded as well to use this v7 request system. This is at a lower priority and will occur along with or after the MC migration. I expect the time for the MC request system + 3 weeks for the Farm request system migration.

### **1.3.4 Users upgrade to v7**

As more users use v7, we expect an increase in the operational load, especially given that the file storage metadata is different in v7. We will also have to assist remote sites in upgrading to v7. Expect 3 weeks of increased operations load (probably affects Robert the most).

## **1.4 Complete full deployment of SAM Data Handling at CDF**

There are two items still missing for full deployment of SAM data handling.

### **1.4.1 Automated job restart**

The CDF CAF automatically restarts failed job segments. SAM is not compatible with restarting – instead, a recovery project is made. Andrew has already completed work for automated creating of recovery projects and is waiting on the CDF CAF team for testing. I expect two weeks of work to help with tests and then another two weeks to finalize the product. DØ can take advantage of this technology as well. Expect four weeks to implement, test and deploy at DØ.

## **1.4.2 SAM Get Dataset**

CDF wants to transfer datasets to machines that merely run GridFTP. This functionality was in v5 but is not in v7. Furthermore, there is a minor dCache issue involving the directory location of files (a translation step is needed to go from the pnfs directory name to the dCache directory name -- SAM cannot do this translation without lots of very non-generic code). Andrew and Valeria have already written the "sam get dataset" code and we are waiting on dCache to accommodate us (or not) on the translation issue. If they agree to accommodate us, then I expect three weeks of testing and finalization. If they insist that we do the translation, then I expect an additional two weeks of work. Andrew will bring this task to completion.

## **1.5 MIS**

MIS is our new monitoring system that has been in the works for a long time. We are inching our way closer to deployment. Much of the work is already in place. We have a SAMTV that works with the MIS database. We already have SAM station, project master and FSS code that can send events to the MIS server. We have performed functional testing with one station feeding events to the MIS server. We must now perform the more realistic test of multiple stations and also determine a MIS DB retention policy (e.g. how long do we keep monitoring data, do we summarize it and store it elsewhere?). I expect two weeks to do the testing. One week to determine the retention policy. Two weeks to implement it. Two weeks for deployment at DØ into production. Two weeks for deployment at CDF. Once MIS is in place, then we can imagine improved metrics and monitoring. Steve Sherwood is the primary person on MIS.

## **1.6 SQLBuilder**

The dimensions parser currently in use at DØ and CDF is old, unmaintainable, very inefficient, and buggy. There are currently some queries that should work, but do not because of dimensions parser bugs. We do not have the time to dissect the code to make fixes. Furthermore, we would like to add functionality to broaden the scope of queries that can be performed (e.g. child\_of, parent\_of). Many such queries are needed by production efforts and must currently be done very inefficiently or with direct SQL.

Randolph Herber has been tasked with rewriting the SQLBuilder using modern parsing techniques. He has the new dimensions language defined (and it is compatible with the old language). Steps he must follow are...

- Write the parser grammar [60% done]
- Code up the back end (take the parsed tokens and turn it into SQL) [3 months]

- Test ALL old queries at CDF and DØ and make fixes to his code [2 months]
- Migrate DB storage of old queries to new improved and more efficient storage schema [1 month]
- Test new functions of the language [1 month]
- Migrate into the DB server [2 weeks]
- Full testing in integration and fix bugs [3 weeks]
- Write documentation [somewhat concurrent 1 month]
- Deploy [1 week]
- Assist users, fix documentation [1 month]

### **1.7 Improve testing capabilities**

Steve Sherwood is our main testing person for SAM. He maintains the test harness and runs it on new releases as needed. Right now, the test harness exercises code in the DB server by calling the DB server proxies directly. Those tests are good for confidently releasing DB server code and client code in as far as the client does little extra than the DB server. But in some cases, the client does go beyond the DB server and processes the data returned before giving a result to the user. These functions are not tested. We also have no tests for the autodes and only old tests for the SAM station. We would like to improve our testing to include

- Specific client tests (e.g. test every SAM command to ensure the same output is obtained) [3 weeks]
- Autodes tests (involves a test pnfs area and null movers) [2 weeks]
- SAM station tests – revive old tests [2 weeks] and improve [2 weeks]

### **1.8 Testing for upgrade to Oracle 10g**

The database group is upgrading all DB installations to 10g (we are currently running version 9i at CDF and DØ. MINOS is running 10g). We have confidence from MINOS that SAM will function with 10g, but the MINOS installation is too small to be sure that there are no performance problems. When Oracle was upgraded from 8 to 9i, the performance of many queries suffered. We must ensure the upgrade to 10g does not cause problems. The plan is to determine a sample of DB queries logged by the DB servers and compare timings with the CDF and DØ integration databases at 9i and then at 10g. If we see no performance degradations, then we will allow the production DB to go to 10g. Steve Sherwood is leading the effort with help from Randolph Herber. Estimate one week to gather the queries and another week to do the testing.

## **2 Future tasks**

These are tasks that we have not seriously started. Time estimates are thus more fuzzy.

### ***2.1 Improved monitoring***

Once MIS is in place, a whole new range of monitoring options become open to us. One area that needs drastic improvement is cache metrics. I expect 1.5 month to write a cache monitor using MIS information (includes user interface). Steve Sherwood would be the primary person for that task.

### ***2.2 Improve SAMGrid performance, deployment, and stability***

The DØ refixing effort propelled the use of LCG and OSG resources for production. DØ is putting effort into keeping the use of LCG and OSG going while the SAM developers work on the v7 upgrade. When that upgrade is complete, Parag and the UTA students will work on this task. The details and priorities will need to be worked out with DØ software management. I estimate 2-4 months depending on the actual goals.

### ***2.3 SRM interface***

A SRM interface for SAM is essential, especially now that the dCache implementation is quite functional and well defined. An SRM interface to dCache would be beneficial for CDF as a replacement to the ad-hoc dCache station as well as useful for the CAF glide-in. An SRM interface is necessary for SAMGrid to utilize LCG and OSG storage elements, eliminating the need for our own SAM stations with cache to support our jobs on those grids. When the SAMGrid v7 upgrade enters testing phase, Andrew will start design discussions. When v7 upgrade is complete, he will shift to designing and implementing an SRM interface full time, in consultation with dCache personnel. I estimate 1-2 months to design (depends on v7 upgrade), another month to implement, and about a month to test and deployment to production.

### ***2.4 SAMGrid for analysis***

SAMGrid so far has been used for production purposes, where the use cases and application requirements are well defined. SAMGrid for analysis involves running user applications under a variety of conditions and use cases.

Furthermore, for production jobs there are no considerations of fairness in job priority (all jobs are equal). For user jobs, all of the complicated problems of fair use of a batch system are extrapolated to the Grid. For FY06, expect this task to be mostly research and demonstrations.

## **2.5 Breakup SAM into Services**

The ultimate goal for the future of SAM is to break the monolithic system into individual independent services. That way, for example, one could use the SAM metadata catalog without added baggage. Or that added baggage (say the station's efficient file transfer mechanisms) could be used with a different metadata catalog. This task is farther in the future when SAM at CDF and DØ are almost completely in operations mode only.

## **3 Priorities**

The SAMGrid project has the following priorities.

- Continue to meet the current needs of the running experiments
- Eliminate SAM v5 so that we have one version of SAM to support
- Continue to bring SAMGrid into the future by interfacing to Grid services

Therefore, the tasks are ranked as follows...

Priority 1 (highest): Operations support as needed [SAMGrid as a project fails if we do not investigate and correct problems and bugs]

Priority 2: Upgrade to Python 2.4, upgrade to Oracle 10g [SAMGrid must keep up with the up to date underlying tools]

Priority 2.5: DØ v7 upgrade; Improved testing and documentation [SAMGrid can continue to function without these tasks, but our operations support level will remain high and the experiments will suffer]

Priority 3: Automated job restart, SAM Get Dataset, MIS, SQL Builder [SAMGrid can continue to function without these tasks, but at a compromised level]

-- Future tasks --

Priority 4: Improved monitoring, SAMGrid performance/deployment/stability [SAMGrid can continue to function, but at a higher operations level]

Priority 5: SRM [SAM can work without an SRM interface, but we will fall behind in the Grid world and experiments will need to develop a SAM replacement]

Priority 6: SAMGrid for analysis [DØ will need to find an alternate to SAM for running user jobs on the grid]

Priority 7: Breakup SAM into Services

## 4 Risks

Clearly, this roadmap is ambitious even if effort on the project were not slowly declining. Additional projects popping up would seriously delay or even derail the tasks defined here. Such unplanned requests should be presented to the GDM for evaluation.

Clearly, there are also lots of places where things can go wrong in this plan, and it is difficult to anticipate where problems will lie. There is a well defined priority of tasks, however, and effort can be pulled from lower priority tasks to help.

If resources are lost, then clearly some tasks will not be completed. If a choice has to be made to sacrifice a task in the short term, then the ones with lesser impact on the future would be the most vulnerable. There has been considerable effort already put into MIS and we are close to deployment. But that task could be delayed, or delayed indefinitely if necessary. We could find ad hoc ways gain extra monitoring for the experiments, though if that effort were put into MIS, we would gain more monitoring. The SQLBuilder is another vulnerable task, since it will be awhile before it is deployed, and will probably be delayed if we need Randolph to help more with the DB server. I hesitate to eliminate that task, because we do need improved dimensions parsing and the current system is truly unworkable. Without SQLBuilder, we would have to resort to direct SQL, which would increase our support load (because we would have to write the SQL queries for each case).

The future of SAMGrid is also vulnerable. I believe that an SRM interface is essential for DØ and CDF to fully utilize the Grid. Whether SAMGrid should be used for analysis can be up for debate. The ultimate goal of breaking of SAMGrid into services also depends how far we want to take the SAMGrid project.

## 5 APPENDIX

\* JIM migration from sam v5 to sam v7

Gabriele Garzoglio

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The following is the WBS of the project and a time estimate for its completion.

Using the PERT Multi-point estimate rule, the total estimated FTE days for the project is (43 +- 3).

2 FTE can work in parallel during the development phase.

Essentially no parallelization is achievable during the integration phase.

Considering the 15-15 rule for working efficiency and week ends (holidays are not considered), the total

estimated calendar days to complete the project is (60 +- 4). This estimate can extend to (72 +- 5) days

if the porting of jim to python 2.4 fails and the contingency plan is enacted (see "contingency" section

in the "Integrate system" item of the WBS).

#### NOTES:

Assumptions are noted next to the relevant activity in the WBS.

All time estimates are expressed in FTE days and are rolled up using the PERT Multi-point estimate rule.

- Port jim software suite to python 2.4.

-- Perform show-stoppers tests (critical porting).

Time: (3.0 +- 0.7) (min 1, max 5, most-likely 3)

--- xmldb\_client (uses XMLRPC libraries)

--- xml\_meta\_configurator (uses pyxml intesively)

-- Perform tests of the complete suite.

Time: (3.2 +- 0.5) (min 2, max 5, most-likely 3)

- Implement required commands to sam v7

-- Port "sam get dataset" command from sam v5.

Time: (2.0 +- 0.3) (min 1, max 3, most-likely 2)

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--- Lightweight consumer in poll mode

--- Lightweight consumer in call-back mode (IS THIS NEEDED?)

-- Add "poll"-mode to the station v6 routing interface (for LCG).
    Time: (4.8 +- 0.8) (min 2, max 7, most-likely 5)

- Port execution site software suite to sam v7.

-- run_grid_job.py and plug in (jim_job_managers).
    Time: (2.0 +- 0.3) (min 1, max 3, most-likely 2)

-- wrappers (jim_job_managers): check the use of the sam command line
commands.
    Time: (1.2 +- 0.2) (min 1, max 2, most-likely 1)

- Port cliet site software suite to sam v7.
    Time: (3.0 +- 0.3) (min 2, max 4, most-likely 3)

-- Port "check job consistency" modules (interaction with db server)

-Integrate system

-- Integrate JIM (new sam_client software distribution).
    Time: (1.2 +- 0.2) (min 1, max 2, most-likely 1)

-- [ Contingency: What if we cannot port JIM to python v2.4?
    Distribute different python versions for JIM and Runjob to the
worker node.
    Time: (min 4, max 10, most-likely 6)
]

-- Integrate Runjob.
    Time: (14.5 +- 2.2) (min 7, max 20, most-likely 15)

(ASSUMES:
    o Runjob integrated with SAM for data storing and MC request
system
    o Runjob developers presence
)

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-- Integration tests.

Time: (8.5 +- 0.8) (min 5, max 10, most-likely 9)