Table of content

1 Award Number and Recipient

DE-FG02-07ER84853

EPIC Consulting

2 Title

Device OrientedProcess Controller

3 Date of Report and Period Covered

June 24, 2009
October 1, 2008 – May 31, 2009

4 Comparison of Actual Accomplishments to Goals

4.1 Task 1 – record definition is complete. Implementation is being done by a different engineer to provide review and to train a second engineer. The implementation is behind. The first two records are complete. Momentum is building and this should accelerate.

4.2 Task 2 – record definition is well under way. The implementation occurs after task 1.

4.3 Task 3 – record definition for beam line control is not being done. Instead we are following interest from accelerator model based control. Definition of the records needed to complete this is under way. This is being provided by NSLS II. We will use SBIR funding to implement them.

4.4 Task 4 –The demand for accelerator device record set is not clear. We have redirected this effort to implement state records to expand the capability of the process database

4.5 Task 5 – The configuration tool is being based on VDCT and is on schedule.

4.6 Task 6 –The communication protocol is on schedule. Evaluations were done early and set the direction to use ICE. After finding unsuitable performance, efforts were redirected to expand Channel Access to support PVData. We are on schedule in spite of this set back.

4.7 Task 7 – bench mark process database has not yet started. The initial prototype was bench marked and met our goals. The record processing was 20% slower using this grammar.

4.8 Task 8 – time measurements of the communication protocol have not started.

4.9 Task 9 – was added to provide connectivity from this new grammar process database to physical I/O. This is 50% complete.

5 Discussion of what was accomplished

5.1 Task 1. Define Existing EPICS Record Set

The record definition for the existing EPICS record set has had one iteration. This task is behind schedule but the budget has not been spent to complete it. The major delay was in transferring the understanding of how to create EPICS records in this new grammar. Several basic functions were added. The primary addition is in the ability to set multiple alarm conditions. This approach is now documented for beginners. The productivity should increate quickly.

5.2 Task 2. Define Industrial Process Control Record Set

The record definition is well under way. The implementation follows 4.1. The implementation is behind schedule. However, this should come along at a reasonable pace now that the grammar is understood..

5.3 Task 3. Define Beam Line Control Record Set

There has been little support or interest from the beam line community. In place of this, we have started to define the record set needed for high level physics applications. This provides the possibility of a client/server architecture for accelerator modeling codes.

5.4 Task 4. Define an Accelerator Device Set

This task has been redirected to design a state record to expand the functionality of the process database. The first implementation to use this feature is a 2 bit control, 2 bit read back valve that has the concept of state, travel time, redirect while in process, and faulting.

5.5 Task 5. Configuration Tool

The Visual Database Configuration Tool is being modified to support the creation of database records using this grammar. There was a test set of records completed in Phase 1 that is being used to develop this tool. The fundamental structure, PVData, is being implemented in the VDCT tool.

5.6 Task 6. Communication Protocol

Evaluations were done on many different protocols including ICE, DDS, TINE (from DESY), and Channel Access. Initially, ICE was chosen. The first several steps of implementation proved to be disappointing in the performance and application. A hybrid approach is now underway with the Phase II grant implementing Channel Access support for PVData. The NSLS II project also started to implement a DDS Application Programming Interface layer for Channel Access version 3 that supports the serialization and deserialization of PVData structures. This allows early adoption of the PVData and DDS API. When the version 4 Channel Access support PVData, it will replace this.

5.7 Task 7. Database Benchmarks and Development of version 2

The benchmarks have not started..

5.8 Task 8. Benchmark Communication Protocol

The benchmarks have not started.

5.9 Task 9. Asynchronous Driver Support

A new task was added to include a driver layer to communicate with hardware. This layer was added so that a practical working version could be released. A driver that supports interfaces to this new process database and provides synchronous and asynchronous device interfaces is being developed. It is based on the ASYN driver that exists in version 3 of EPICS. This has added some significant scope. We expect laboratories that have recently shown interest in these developments will help to support these developments and offset the addition of this scope..

6 Costs

6.1 $306,025.35 of an initial allotment of $551,160.00 has been expended. The total budget for this phase II grant is: $724,200.00

6.2 No cost sharing was required. However, there has been some support from projects that are interested in the technology. This helped in the communication protocol evaluation and the develop of record types for accelerator model based control.

7 Schedule

7.1 Task 1 was scheduled to complete in February. It will complete in December. Resources and a slow start put these first 4 tasks behind schedule. We expect to complete them within the budget, but late.

7.2 Task 2 was scheduled to complete July 2009. Completion is not expected until December 2009.

7.3 Task 3 was scheduled to complete July 2009. Completion is not expected until December 2009.

7.4 Task 4 was scheduled to complete July 2009. Completion is not expected until March 2010. This is no longer beam line record types, but accelerator model data types.

7.5 Task 5 is scheduled to complete in March 2010. It is expected to complete December 2009.

7.6 Task 6 first portion is scheduled to complete June 2009. It should complete August 2009. The second portion, introspection, was expected to start in June 2009. The design has started in parallel with the first portion. It is expected to complete on time in December 2009.

7.7 Task 7 has started with benchmarks completed on prototype records. Final benchmarks will be done at the end of each of tasks 1-4.

7.8 Task 8 is scheduled to start December of 2009. The benchmarks for the communication protocol are expected to start on time.

7.9 Task 9 was added and started in January, 2009. It is expected to complete by September of 2009.

8 Changes to the Approach or Aims

Two notable changes occurred. First the interface from the new process database to physical I/O was added as it became apparent that without a demonstration of how to integrate hardware, the prototype would have significant functionality missing. Second was the change of focus from beam line support to physics model based control. The interest for people in this application to contribute some effort and become invested in the technology for possible use in the NSLS II high level physics applications, made this change a practical shift. This greatly improves the chance of moving this development into the field.

9 Problems or Delays

The most significant problem was the start of record implementation by a different engineer. This has improved our overall support, understanding, and design of the new grammar. It set this effort back some. We expect to make up the time with external support in record definition and an improvement in availability of the engineer.

10 Changes of Key Personnel

Key personnel have been available and engaged. The one exception is the early availability of the engineer to implement these new records. Full time funding did not exist for him. His availability is improving and we should be able to come in on time.

11 Technology Transfer

The key efforts here have been to publish these developments to the physics and business communities. We have serious interest from accelerators for a client/server architecture for model based control Currently model based control is done by very large monolithic codes. This architecture is being employed to provide modular systems that support multiple models and independent development of thin clients to act as operator interfaces. This collaboration has resulted in some early work on existing communication protocols to prototype the use of DDS and help define the process records required for implementation. In addition, this is being introduced to ITER for possible use in the fusion community.

11.1 Presentations

EPICS Collaboration Meeting, Legnaro, Italy, "Version 4 Phase II development plan", Bob Dalesio, BNL, October 13-17, 2008.
EPICS Collaboration Meeting, Legnaro, Italy, "Java IOC - Generic Record Support", Marty Kraimer, October 13-17, 2008.
EPICS Collaboration Meeting, Legnaro, Italy, "Java IOC Calc Record", Marty Kraimer, October 13-17, 2008.
EPICS Collaboration Meeting, Vancouver, Canada, "EPICS-DDS", Nikolay Malitsky BNL, April 30-May 2, 2009.
EPICS Collaboration Meeting, Vancouver, Canada, "Propsal For Introspection in EPICS", Bob Dalesio BNL, April 30-May 2, 2009.
EPICS Collaboration Meeting, Vancouver, Canada, "Java IOC Status", Marty Kraimer, April 30-May 2, 2009.

11.2 Websites

Presentations:
http://isacwserv.triumf.ca/epics09/meeting.pl
http://agenda.infn.it/conferenceDisplay.py?confId=715
Development site:
http://sourceforge.net/projects/epics-pvdata/

11.3 Networks or collaborations fostered

The work here is being actively included in the efforts at NSLS II to create a client/server architecture for high level physics applications. It incorporates the work of the SDDS tools that were developed at Argonne National Lab and the Matlab Middle Layer Toolkit (with AT model control) that was developed at LBL and SLAC and is in use at light sources around the world.

11.4 Technologies/Techniques

One interesting aspect of this approach is that we are developing a real time, high performance communication protocol that can be used in the DDS open-source project. The initial developers released a CORBA based communication protocol in the open source. It was far too slow for most practical applications. The initial developers made more efficient proprietary protocols and now sell them. With our use of DDS as the API and an open-source Channel Access as the protocol layer, this community may take notice and find a high performance, open-source protocol. Tech-X has been exploring ways to incorporate this technology in their proposals.

11.5 Inventions or patents

This is an open-source development.

11.6 Other Porducts

None.