DIAMOND LIGHT SOURCE CONTROL SYSTEMS RELATIONAL DATABASE

K. Vijayan, S. J. Singleton, M. T. Heron, Diamond Light Source Ltd, Oxfordshire, UK

Abstract

The functionality of the Diamond Light Source Control Systems Relational Database (RDB) is described in this article. An Oracle-based RDB and web-based GUIs allow recording of system configuration and configuration change management. Information about the hardware components that make up each beamline crate is stored in the RDB; for each item of control equipment, the status, location and name of the person responsible for the item are held. The Diamond Control System is based on EPICS [1] and has of the order of 500,000 process variables. The RDB maintains a record of the names of these PVs and validates new names against the Diamond Naming Convention, allowing consistency of naming style to be maintained and avoiding name duplication.

Machine operational details such as alarm logs are stored in the RDB and viewed using a web browser. All process data recorded by the control software are archived using the EPICS Channel Archiver; the archiver configuration for each technical area is maintained in the RDB. A further application using the RDB is the electronic logbook (eLog) which is used to record activities by Diamond Operations and Beamline groups.

INTRODUCTION

Diamond Light Source (DLS) is a 3 GeV third-generation light source with a 561m storage ring (SR), a full-energy booster (BR) and a 100 MeV pre-injector Linac [2]. The photon output is optimised for high brightness from undulators and high flux from multi-pole wigglers. The current operational state includes 19 photon beamlines, with a further three beamlines in an advanced stages of design and construction. A further phase of photon beamlines has now been confirmed; detailed design and construction of these 10 beamlines started earlier this year.

The Diamond Control Systems Relational Database is based on the following software:

- Database: Oracle 11g Standard Edition;
- Entity Relationship Diagram: ER Studio;
- Language: PHP (Hypertext Preprocessor);
- Web server: Apache;
- Operating System: Red Hat Linux Enterprise Edition 5.

Development of the RDB was carried out in parallel with the Diamond Light Source design, so that it was available to be populated during the Diamond construction phase. Since then, it has undergone continuous development to meet new requirements as these arise.

DIAMOND NAMING CONVENTION

The RDB structure for the validation and recording of database names is shown in Figure 1. A device name can consist of up to a maximum of 17 alphanumeric characters. It can be broken down into 4 or 5 sections. The '-'character is used to delimit the sections and is the only non-alphanumeric character allowed.

The format is as follows:

DD[SSS]-TT-CCCCC-NN

Where […] indicates an optional section.

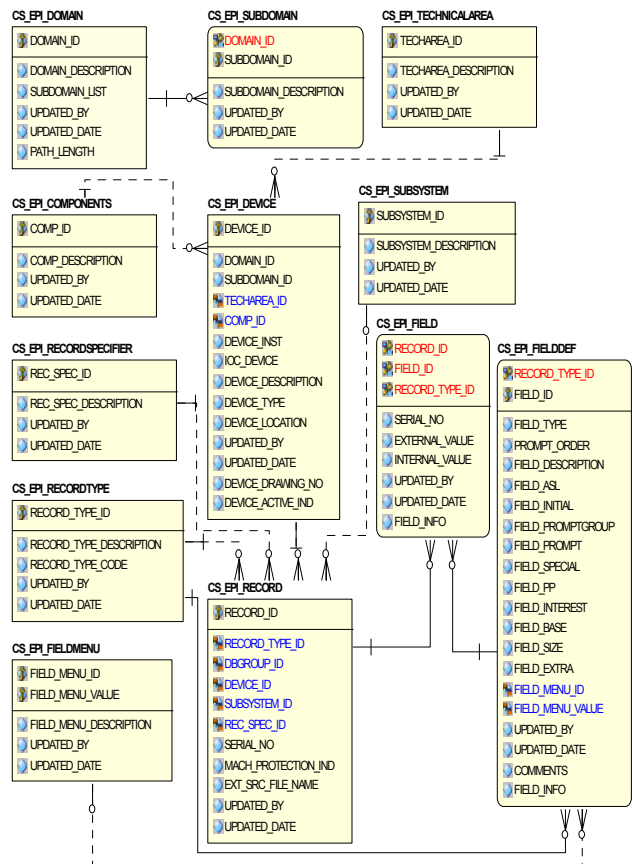|	
DD	Domain
SSS	Sub Domain (Optional)
TT	Technical Area
CCCCC	Component
NN	Identifier

Figure 1: Database design for Naming Convention

The device name DD[SSS]-TT-CCCCC-NN uniquely identifies a device, such as a power supply, a gauge, etc. Properties associated with controlling or monitoring that device are identified by extending the device name with record specifiers. These define the signals associated

with a device and the associated EPICS records carrying out processing and/or calculations.

ALARM LOG /ARCHIVER

The EPICS Alarm Handler (ALH) is used to log process variable alarms into text files. The contents of these files are automatically imported to the RDB in order to allow them to be viewed using a web browser.

All process data recorded by the control software are archived using the EPICS Channel Archiver. Redundancy is provided by the use of two identical servers which archive data in parallel, though one server is designated the primary archiver and the other as the standby. The archiver configuration for each technical area is maintained in the RDB. This gives users the flexibility to import their individual technical group files to the RDB using a web page (Figure 2). Following an import, a script then restarts the selected archiver process in both archive servers with the updated group file.
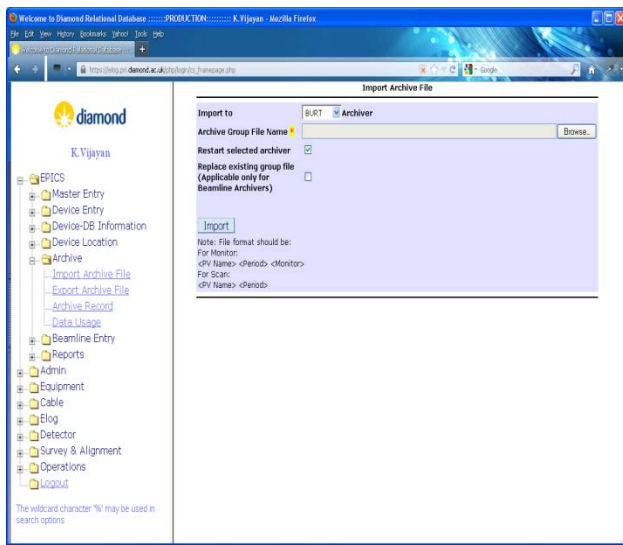

Figure 2: Import Archive File

EQUIPMENT TRACKING DATABASE

The equipment tracking database stores all information about each item of hardware equipment, such as the manufacturer name, the model, the type of the equipment (crate, IP carrier, etc.). Each equipment item is uniquely identified by its equipment ID in the database. For each equipment item, the status, location and name of the person responsible for the item are also held in the database.

This tracking system identifies the present physical location of each item of equipment together with its history of transfer.

If an equipment item becomes faulty, the fault can be registered using the fault registration web page in the database. Once the fault has been corrected, either by the manufacturer or internally within Diamond, the details of the repair can be stored in the database. Thus a full

history record for the equipment item is maintained in the database.

The hardware components that make up each control crate are stored in the RDB. Users can easily modify the crate information using a web browser (e.g. Figure 3). The equipment tracking system has the facility to move all the equipment within one crate to another, for example when a crate is replaced.
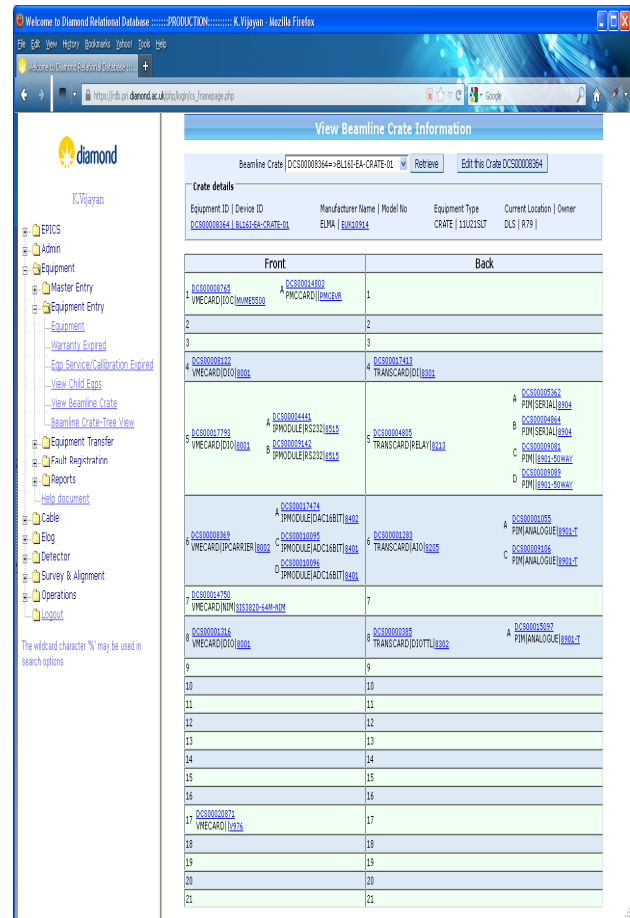

Figure 3: Beamline Crate Information

CABLE DATABASE

The Cable Database maintains information about all cables used in the storage ring and other areas of Diamond. Each cable is uniquely identified in the database by its cable ID. The naming convention for cable IDs is as follows:

V12-3456P

V	Technical Area (Electrical Discipline)
12	CIA Identification (EPICS name)
3456	Cable Number
P	Cable Category

The information stored includes cable type, start location, end location, run length, etc. A history of changes to cable information can be viewed from the database. Also there is a facility to roll back the database to get information on a deleted cable.

ELOG

Electronic logbooks are used by the members of the Diamond Operations team and several Beamline groups to record their activities in the storage ring or beamlines. Each group has its own logbook, the structure of which is shown in Figure 4. eLog messages have a title, a message body and a category. The content of the message body is based on HTML, and so can include normal text, images and URL links. An eLog entry can be made in many ways: using the eLog web client, via Microsoft Outlook Email, by means of Blog editors or by setting up automated entries.

The eLog web client allows users to save their logs as draft and preview their draft entries before publishing. Using AJAX (Asynchronous JavaScript and XML) the content is saved automatically every minute without user intervention.

Once published, an eLog entry cannot be modified or deleted. A facility is provided to allow a user to replace an incorrect entry; the replacement entry is then marked as such and provides the means to view the original entry.

Web log (Blog) editors such as Windows Live Writer (WLW) or Classic ScribeFire can also be used to make entries to a logbook.
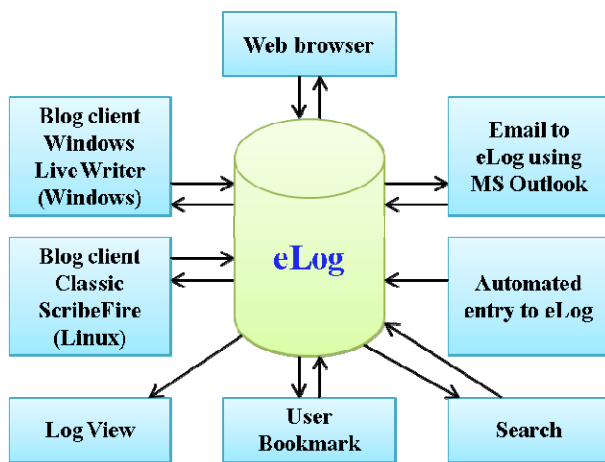

Figure 4: Logical diagram of eLog interface

By using the ink Blog add-on to Windows Live Writer (Figure 5) users can import handwritten pages and incorporate them in entries to the logbook.

Possible future developments of eLog include:

- A facility to drag and drop images from file explorer to the eLog entry compose page.
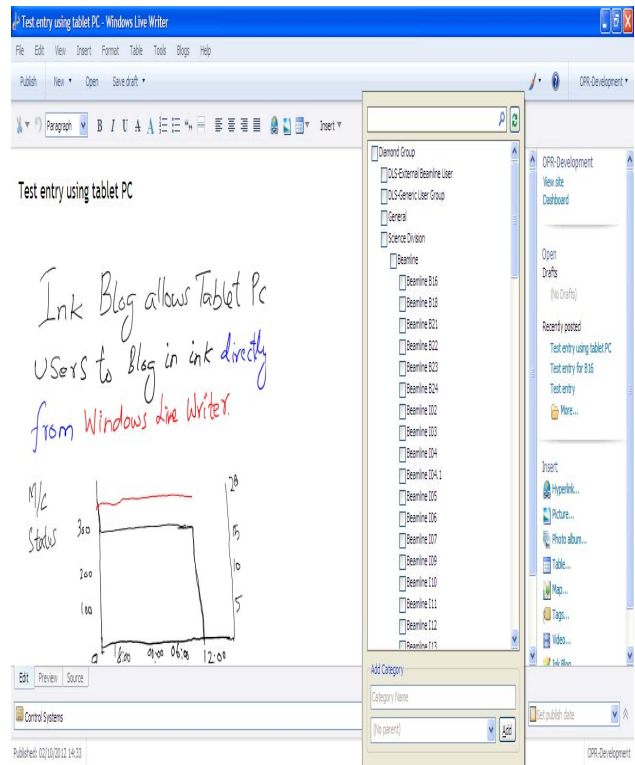- An eLog app to view a logbook and to create new entries for Android devices.

Figure 5: Handwritten entry to eLog using Windows Live Writer

CONCLUSION

The Diamond Control System RDB played a significant role in the successful construction of Diamond, and continues to provide valuable support to Operations and maintenance staff, and those responsible for the development of new beamlines.

By using this Control System RDB, system engineers can easily archive their EPICS PVs, create device names that comply with the Diamond Naming Convention and uniquely identify and track system hardware equipment. Using eLog all users are able to record their work and to view and search the logbook for entries containing information relevant to them.

REFERENCES

[1] Experimental Physics and Industrial Control System; http://www.aps.anl.gov/epics

[2] R. P. Walker, "Commissioning and Status of The Diamond Storage Ring", APAC 2007, Indore, India.