

## THE CONFIGURATION DATABASES FOR THE PSI PROTON ACCELERATOR CONTROL SYSTEMS

*H. Lutz, D. Anicic, A.C. Mezger, M. Gasche, Paul Scherrer Institut, Switzerland*

### ABSTRACT

The configuration database for the PSI Proton Accelerators stores data for the operation of the Low Energy beam lines (72 MeV) and High Energy complex (Injector 2 + Ring cyclotron, 590 MeV). A new facility for biomedical treatment of patients with proton beam, called PROSCAN has been built over the last 2 years. For the corresponding control system part the database and the needed applications have been established. The configuration database is implemented using the latest versions of Oracle database server together with the Oracle's Application Server, both running on a dedicated Linux Server. Oracle Forms applications together with Java Stored Procedures are used for the database entry and distribution. Oracle Reports and JSP interfaces have been developed for documentation purposes on the Intranet.

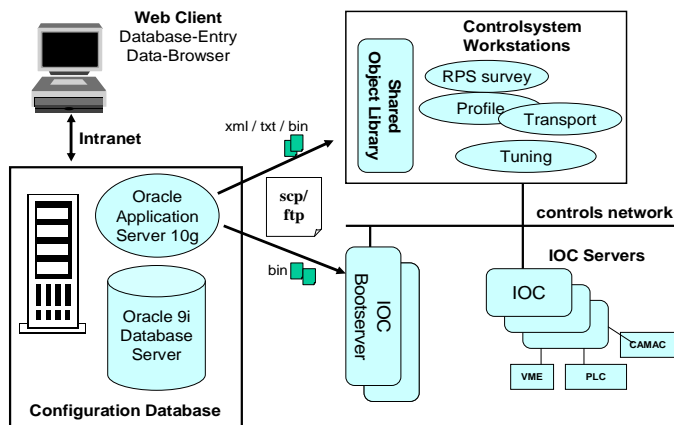
### INTRODUCTION

The configuration database ACSDB for the control system of the PSI Proton Accelerator facility (72 MeV, 590 MeV) is implemented on a dedicated Linux Server (Redhat Enterprise 3) with an Oracle relational database management system. Furthermore on the same platform the software "Oracle Application Server 10g" with Forms and Reports services is running. This part is used for the data-entry and retrieval applications.

For running the MCS control system in the new PROSCAN facility we decided for security reasons (a firewall is used) to use a separate database instance called PRODB, which is running on its own server platform. Both configuration databases PRODB and ACSDB have now the same structure with respect to hardware and software. In order to fulfill new requirements e.g. supporting new hardware components, storing new control system application data, we had to modify the database structure slightly. In addition several new Forms and Reports applications have been developed and introduced in both systems.

### CONTROL SYSTEM CONFIGURATION

The main components of the system with respect to its configuration are shown in Fig 1. The VME based I/O Computers (IOC's) which communicate with TCP/IP based PLC's, bit serial CAMAC-, and VME IO-equipment are fed with configuration files at their boot time via the IOC boot server. Control system workstations use database configuration data for starting their applications or performing a Device IO access through a shared object library. Both the IOC and the workstation configuration files can be generated and deployed via SCP/FTP to the dedicated platforms directly through the web interface



**Fig. 1:** The main components of the control system for ACSDB and PRODB

The following table shows the number of installed hardware components together with the connected “Devices/Attributes” for both systems ACSDB and PRODB. The term Attribute denotes the single access point to read/write the properties of a device (e.g. the current-/setpoint value of a magnets power supply).

Number of	ACSDB	PRODB
VME IOC 's	15	8
CAMAC crates	116	1
CAMAC controlled Devices / Attributes	2458 / 11383	21 / 716
VME controlled Devices / Attributes	53 / 1283	96 / 2219
PLC controlled Devices / Attributes	92 / 411	254 / 867

Table 1: Device/ Attribute statistic for PRODB and ACSDB

In the Proscan configuration (PRODB), 8 new IOC’s are used to control currently 371 physical devices. Most of them (254) belong to the ACCEL PLC section driving the COMET accelerator. In total 96 physical Devices belongs to the already installed beam line devices like magnets, monitors, foils etc. . These are interfaced through new standard VME-based hardware components. (e.g. Industry Pack (IP) carrier board from Hytec Electronics). The ACSDB configuration is still dominated by the CAMAC based control. 94% of totally 2604 accelerator devices are controlled through 116 CAMAC crates. 15 IOC’s are currently in use. The replacement of CAMAC hardware towards standard VME components is an ongoing process.

### MODIFICATIONS

The content of the configuration data which is physically implemented in relational database tables can be split into the categories “Device Control, Equipment, Application Data and Global”:

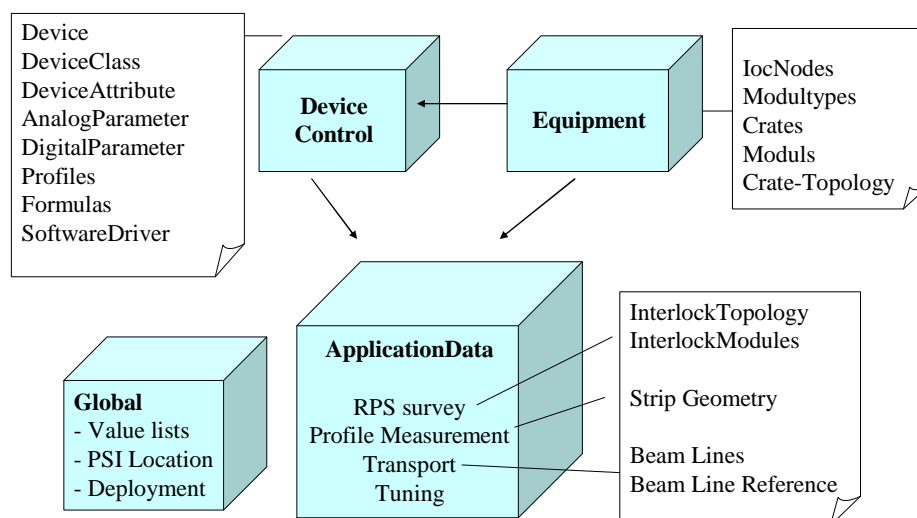


Fig. 2: Different categories of information in the Configuration Database

The major modifications have been done in the following fields:

### *Global*

A system wide “PSI-Location” table has been introduced. This table defines all locations in terms of acronyms for buildings, rooms and racks. It is used for assigning installed components (a device, a piece of hardware) to its current location at PSI.

### *Device Control*

Several data-entry applications have been improved in order to facilitate the definition and modification of whole data sets. For example, the definition of a device control object can be done by copying the associated database records from an existing device.

### *Application Data, RPS survey*

The Run Permit System described in /1/ contains data tables for description of our interlock modules. The modules are organized into a tree structure with areas, groups and sections. Each module is mapped to a hardware slot identified by ioc, crate, slot and subslot address. The hardware addressing scheme has been changed in order to support new VME hardware using IP modules and old CAMAC modules as well. The corresponding transition module description has been added to each IP module installation. When extracting the RPS configuration data an XML type output is generated and converted into two binary files; one is responsible for the RPS survey monitor application and the other one for the “RPS-configuration” of the IOC-server software.

### *Application Data, Profile measurement*

New diagnostic elements have been introduced for the PROSCAN facility. These consist of multi strip profile monitors, current monitors, ionisation chambers and halo monitors. In order to specify the multi-strip-geometry for the new profile monitor devices, two database tables were added. A multi strip measurement is organized into n channels and m groups. Each strip has a position, and thickness. Each group can be mapped to a single measurement. A Strip Pattern Editor has been developed for predefining the data sets and mapping it to the dedicated measurements.

### *Application Data, Transport*

In order to specify input information for the calculation of beam envelopes using the Transport code /3/ some new database tables were introduced. A Beamline Reference Editor is used to fill the data sets from scratch. Each entry consists of a predefined Transport type code, driftspace and an optional value string, together with a 4 char Transport Label. Depending on the type code the required drift space is automatically filled in.

### *Application Data, Tuning*

For Proscan’s MCS (Machine Control System) a Tune manager software has been developed. This application is described in /2/ and needs XML type Tune files as input. The specification of such a file has been included into our configuration database. Each particular Tune file contains data for a specific Beam setting with certain energy, intensity, emittance, gantry angle and other parameters. The corresponding device information for each setting can be inserted in a so called “Tune Reference File editor”.

## **DATABASE ENTRY**

All of the data can be entered by Oracle Web forms which are accessible through the Intranet. A home-made template system together with a shared PLSQL library which implements generic functionality makes it easy to build new user-friendly screens. Template Forms can be customized in order to build new user screens with the same functionality. The development is done on a Windows

NT platform by using the Oracle Developer Suite 10g software package. After testing a new or modified application the Forms code, stored in the oracle-specific FMB/MMB-format is copied and compiled into the Applications Servers repository. The main features of our web forms are as follows:

- Oracle Forms allows manipulation of multi-record blocks. This brings a lot of information to a user screen. Master detail forms are often used to manipulate objects like a device and their parameter records.
- Most of our forms are based on database views (instead of pure tables). This allows to display information from more than one table simultaneously. The collection is done on the database server itself. Other forms maintaining hierarchical tree structures are based on Stored Procedures.
- Tab Pages are used in order to handle several tables/views on the same screen, or to present buttons for executing special functions like “copy complex objects”, “execute special queries”, “perform validation routines”.

## DATABASE DEPLOYMENT

A generic web form is used to generate data into a file and deploy it to the relevant destinations. The user can first select the destination(s) (host computers) and proceed with the following actions:

1. Generate: Execute a ProC\* application or Java Code on the database server machine. The relevant data tables are queried and written into a text or XML type configuration file. If necessary, the configuration file is converted into a binary application dependent file.
2. Deploy: The configuration file is copied via scp/ftp to the selected destination(s).

In both steps Oracle Forms triggers a Java Stored Procedure to execute the relevant runtime process on the database server machine (e.g. a shell script for a post copy installation).

## DATABASE REPORTS

Oracles Reports Builder allows building reports either for a Paper Layout or a Web Layout. Paper Layout reports present the content in PDF/HTML or XML format. Web Layout reports implement Java Server Pages (JSP) as the underlying technology. Hyperlinks can be dynamically filled in for navigation to another Web/Reports Page. Before executing a report, Parameter Forms can be activated letting the user enter a “where condition” for the underlying database. Report examples are:

- Device Browser , a html/pdf report where the user enters some query conditions and gets afterwards the device control information (e.g. attributes, analog/digital parameter settings)
- Modified Device Attributes, a pdf report for a list of all recently modified Devices
- Machine Topology (a clickable map) , a jsp report where the click on a machine section and retrieve the underlying device information.

## CONCLUSION

A configuration database, implemented with a relational Database, is a necessary component of any modern control system. In our case, the Oracle configuration database has been upgraded to be used for the control system of the PROSCAN facility. The Oracle tools “Forms and Reports” were used to build/upgrade the necessary database applications.

## REFERENCES

- [1] G.Dzieglewski Other, “Protection mechanisms for a high power accelerator”, ICALEPCS’2005, Geneva, Switzerland, October 2005.
- [2] D. Anicic Other, “Proscan Control System Status Report” ICALEPCS’2005, Geneva, Switzerland, October 2005.
- [3] [http://people.web.psi.ch/rohrer\\_u/trans.htm](http://people.web.psi.ch/rohrer_u/trans.htm)