Status of the control system of Alba

TANGO

Alba: A Tango based Control system. David Fernández Carreiras on Behalf of control groups.
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Introduction

The construction of ALBA, the 3 GeV Synchrotron Light Source near Barcelona (Spain) is proceeding according to schedule. Although the building will be finished on June 2008, the preparation and installation of the components for the Linac is foreseen in November 2007. The 100 MeV Linac is manufactured by Thales Commu-nication as a turnkey system. The 3GeV booster and the storage ring are installed in the same tunnel.

Seven beamlines are being built in the first phase: "XAS: X-ray Absortion Spectroscopy", "PD: High Resolution Powder Diffraction" , "XALOC: Macromolecular Crystallography", "NCD: Non-Crystalline Diffraction", "CIRCE: Photoemission Spectroscopy and Microscopy", "MISTRAL: Soft X-Ray Microscopy". One of them is on a bending magnet. Insertion devices are: a Wiggler (W80), a Super-conducting Wiggler (SCW31), two in-vacuum undulators (IVU21) and two Apple2 (EU71 and EU62).

Picture: September 1st 2007

Picture: July 1st 2007

Model of the building

Tunnel. Picture: October 1st 2007

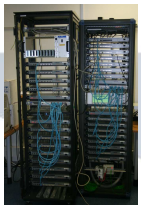
Arquitecture
The architecture of the control system is distributed. Boot servers, Tango [2] databases and archivers run on boxes in the computing room. Tango servers run in IOCs (Input Output Controllers) which are linux boxes, most of them diskless. Compact PCI crates are installed in all those devices where a timing event receiver is needed. The remaining ones are Industrial PCs. Beamlines have industrial PCs with disk
Ethernet is widely used by the control electronics. Power supplies, Liberas, CCD cameras, Oscilloscopes, and of course IOCs are connected by Ethernet. Most IOCs get a dynamic address by Dynamic Host Configuration Protocol (DHCP). Few VLANS (Virtual Local Area Networks) are defined. The main control, EPS, Liberas, power supplies and diagnostics are separated into different VLANS as most communications are between devices of the same group.
The Tango database and databases for archivers (mysql) reside in linux boxes in the computing room whereas fast data loggers for RF and eventually vacuum will store data online.

Vacuum
Main vacuum electronics is Varian Dual Ion Pump controllers. Gauge controllers are decided in the following weeks. They are interfaced by RS232/RS485. An industrial PC per sector (16 in total) is in charge of the vacuum control. This includes serial connections, Tango servers for the different controllers, and connections with the different PLCs.
PLCs manage interlocks of the different devices, as well as temperature readouts. They follow the Alba standard distributed architecture, having a CPU installed in a cabinet in the service area and distributed I/O modules installed inside the tunnel on cable trays.
Boxes to be installed in the tunnel are shielded with 1.5 mm of lead.

Beam dynamics
Storage Ring: 88 **Libera BPM electronics** [5] and 88 correctors in each plane for orbit correction. Corrector magnets are integrated in the sextupoles as extra coils. Data from the Liberas is being distributed among the liberas up to the Compact PCI crate using the **protocol developed at Diamond**. This data transmission meant to be used for the fast orbit correction uses a dedicated fiber optics link. A tango server for every Libera box runs in the Compact PCI crate and is accessible from the control system for the slow orbit correction, displays, archiving etc... This so called slow control goes over the normal Ethernet link.

30 CCD cameras for fluorescence screens are also read by Ethernet, using the E-Giga protocol

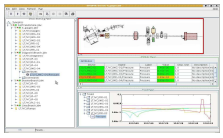
Graphical user interface for Liberas



Liberas installed in the Electronics Lab

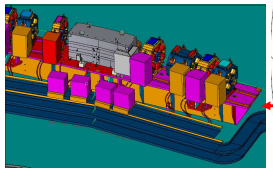
Timing system
It is based on events where an Event Generator (EVG) produces the event stream that is communicated to multiple Event Receivers (EVR). Transmission to all event receivers is multiplexed with fan-out modules and carried out by optic fibers of the same length. This system follows the same philosophy as SLS, Diamond, Soleil and few other institutes and has been manufactured by Microresearch Finland.

Linac
The 100 MeV Linac manufactured by Thales Communication. The control system is based on PLCs with 2 interfaces based on a common library. One of the interfaces is for local control, intended to be used for commissioning.



Graphical user Interface for vacuum

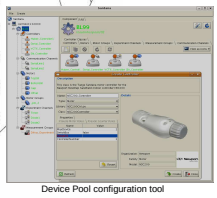
B&R PLC of the Equipment Protection system



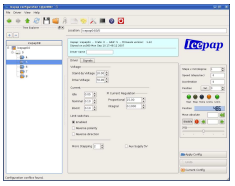
3D model of the elements installed in the girder. The boxes for Equipment protection system are Installed on the cable tray.

Power Converters
All power converters have an Ethernet interface complemented with an external trigger input. Corrector magnets of the storage ring will have a fast link for the fast orbit feedback [6]. They are interlocked with the corresponding magnet flow-switches and thermo-switches by the EPS, and each of them having the corresponding Tango server (implementing the power supply interface) for slow control and data acquisition.

Beamlines:
A project for writing a generic tool for beamline control has been started at Alba, and now the European Synchrotron Radiation Facility (ESRF) [8] is collaborating in the development. This "device pool" provides a common way of acquiring data, moving motors, scanning and in general interfacing any device. It is based on Tango, written in C++ and Python. This is very appropriate for beamline controls, diffractometers, detectors, motors, counters, etc. but also for some applications in the accelerator controls.



Device Pool configuration tool



Icepap configuration and test tool

The Icepap electronics is a development of the ESRF.. It is fully configurable by software and accessed by Ethernet or serial lines.

Icepap crate.

RF
Storage Ring: six radio frequency plants with a power of 160 kW (two transmitters of 80 kW each).
Booster one plant of 80 kW.
Pulses in the electron gun are chopped at 499.654 MHz.
A transmitter including a high voltage power supply (HVPS) and an Inductive Output Tube (IOT) has been already installed in the Radiofrequency lab.
The control system for the transmitter is based on Siemens Programmable Logic Controllers (PLCs) and delivered by Thomson.
The interlock system follows the same philosophy as the general Equipment Protection System (EPS) and uses B&R PLCs with CPUs installed in cabinets outside the tunnel and distributed I/O modules inside the tunnel. Both are interconnected through an X20 bus. Graphical interfaces are written in Python [3] and Qt4 [4]

PSS
The system is based on **Safety PLCs from Pilz**, following the golden rule of **redundancy and diversity**. All inputs and outputs like door switches, radiation monitors, emergency stops, shutter limit switches; have redundant cabling, actuators and contacts. The PSS interlocks every RF transmitter (out of 13) in two different ways as well as both klystrons of the Linac and the electron gun.

Pilz PLC installed on the cabinet of the PSS of the RF lab

Conclusion

Major choices like Ethernet as field bus, PCI and cPCI, Libera, Icepap, Linux and evidently **Tango** have been taken. Prototypes have already been implemented mostly for the RF lab which needs an RF control, EPS, Vacuum control, Archivers, Save/Restore, and even a PSS. Choices up to now demonstrated to fulfill all the needs and expectations. However, large scale systems need still to be tested, in particular for the archiver and tango databases

Acknowledgments
Many developers are working or have worked in this project. Besides the computing division at Alba, I would like to thank specially E. Taurel, A. Homs, M. Guijarro, and V. Rey from the ESRF. Also special thanks to the Tango collaborators who have written most of the standard Tango Applications and Tools available for the community: **ESRF, Soleil and Elettra**. Recently **Hasylab** has also joined the community.

References.

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[4] http://trolltech.com [5] http://www.i-tech.si
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