SPARC CONTROL SYSTEM

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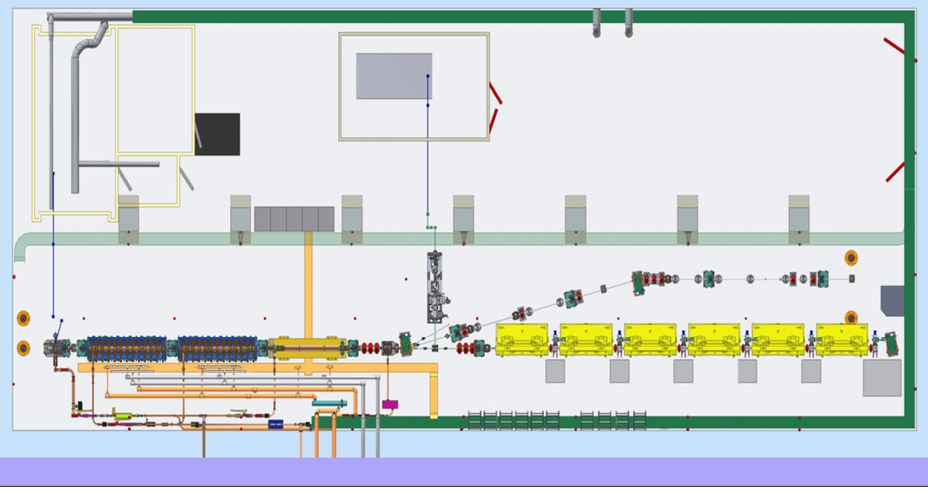
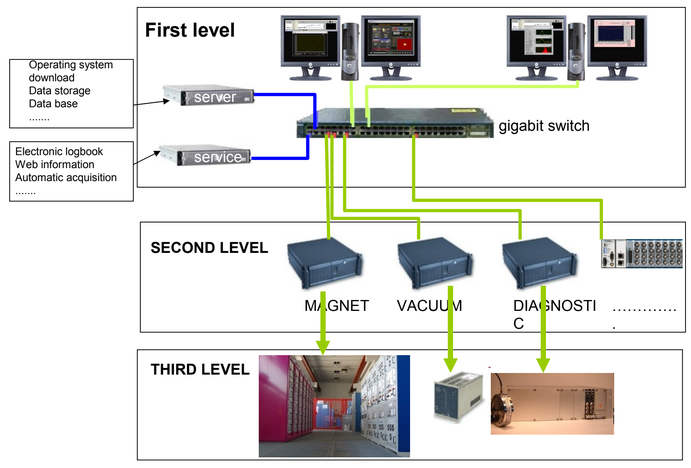
Abstract
We describe the control system operation for the ne injector project built at the Laboratori Nazionali di Frascati INFN (SPARC). The injector started the operation in the autumn of the 2007 and the control systems has been full operating since the start of commissioning and integrate all tools to help the whole machine operation from the gun until the undulator. The SPARC control system must follow all evolution in the machine installation. To allow us a rapid develop of the control system we have made some commercial choices: Labview as developing system; Gigabit Ethernet as interconnection bus with a simple TCP/IP protocol and mainly standard PC as front-end CPU and console. We developed control applications for all machine elements and diagnostic tools. We also developed some tools to help the operation such as an electronic logbook full integrated in the console windows and an automatic process to store all information.

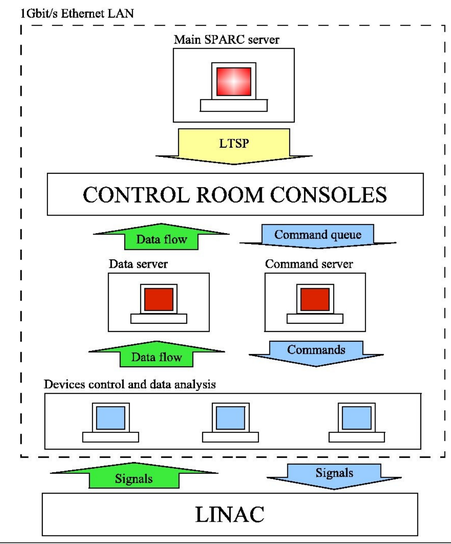


SPARC

The SPARC (Sorgente Pulsata e Amplificata di Radiazione Coerente, Self-Amplified Pulsed Coherent Radiation Source) project is to promote an R&D activity oriented to the development of a high brightness photo injector to drive SASE-FEL experiments at 500 nm and higher harmonics generation. Proposed by the research institutions ENEA, INFN, CNR with collaboration of Universita` di Roma Tor Vergata and INFM-ST, it has been funded in 2003 by the Italian Government with a 3 years time schedule. The machine is under installation at Laboratori Nazionali di Frascati (LNF-INFN). It is composed of an RF gun driven by a Ti:Sa laser to produce 10-ps flat top pulses on the photocathode, injecting into three SLAC accelerating.



The control system should guarantee and simplify machine operation. In general the main operations in an accelerator control system are: data taking, display of information, analysis, command execution and storage.
The simplest and functional control system has distributed processors on a classic three levels architecture.
***First level*: at this level we find the console with its human interface to allow the operator to control the machine, a logbook to share information within the collaboration, a database to store all information coming from the machine and a web tools to help the management of the control system and to share some information outside the collaboration;**
***Second level* at this level we find the front-end CPU that executes commands and handle all the information about the status of the machine available at the first level. Meanwhile it automatically saves data from its various elements in two ways: on value changes and/or at fixed time intervals;**
***Third level* is the acquisition hardware where we find an appropriate acquisition board or the secondary field bus to acquire data from the real element.**
The interconnection bus between the levels is a Gigabit Ethernet LAN.

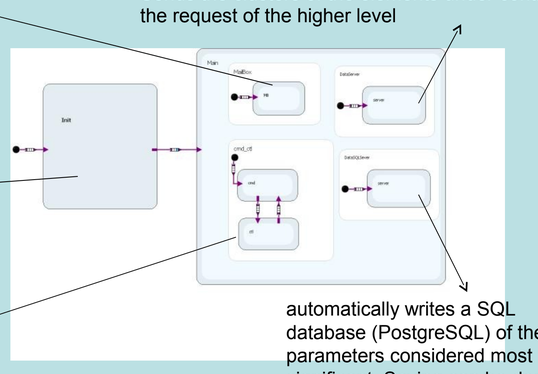


Front-end

acquires any commands from a console or from another computer puts them in a queue for execution.

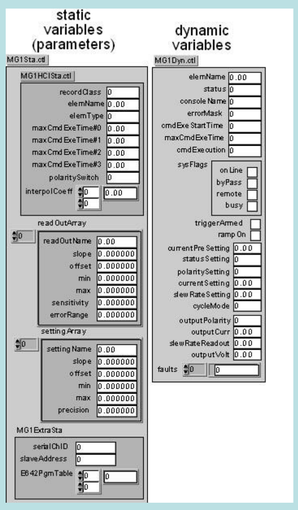
Sends the clusters of the elements under control at the request of the higher level

Initializes all the variables for data communication and acquires information about the elements under controlled and perform any hardware initialization



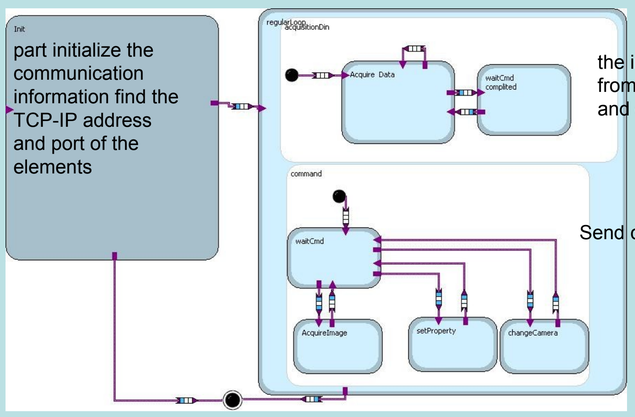
automatically writes a SQL database (PostgreSQL) of the parameters considered most significant. Saving can be done either periodically or upon significant change

execute the command if present in the command queue. The second operation is the control operation.



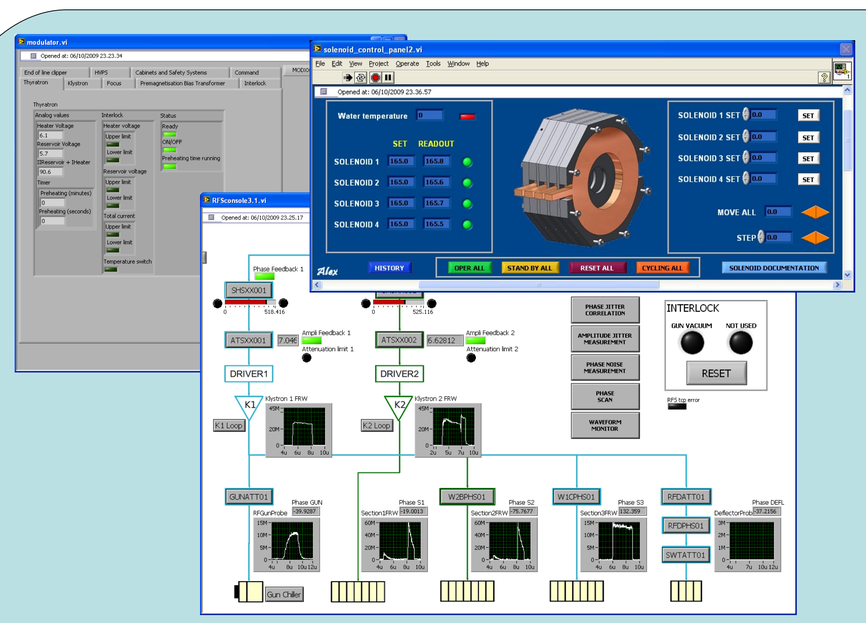
Console

Init
part initialize the communication information find the TCP-IP address and port of the elements

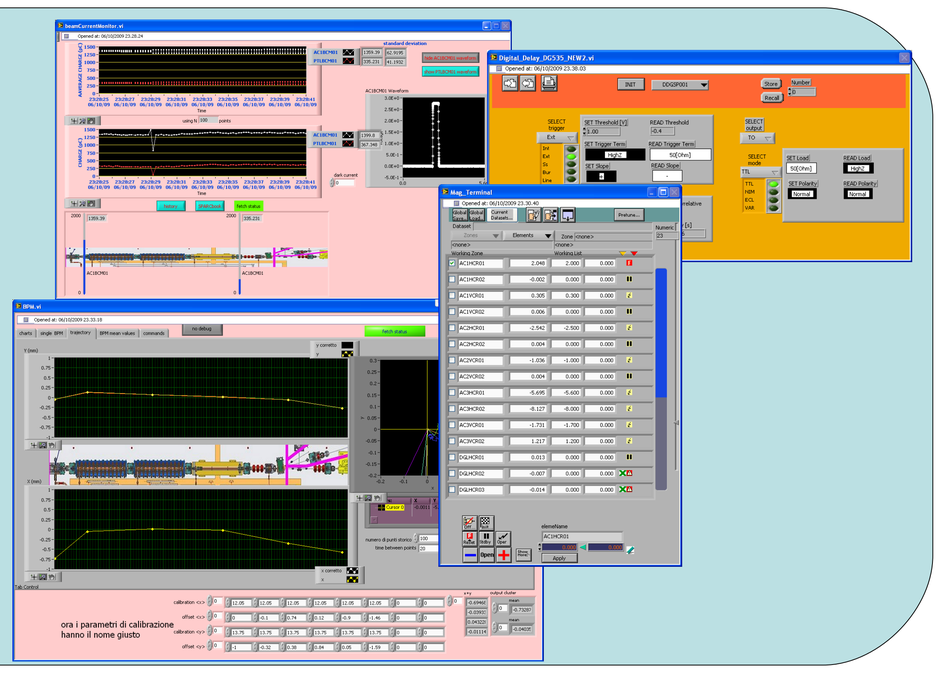


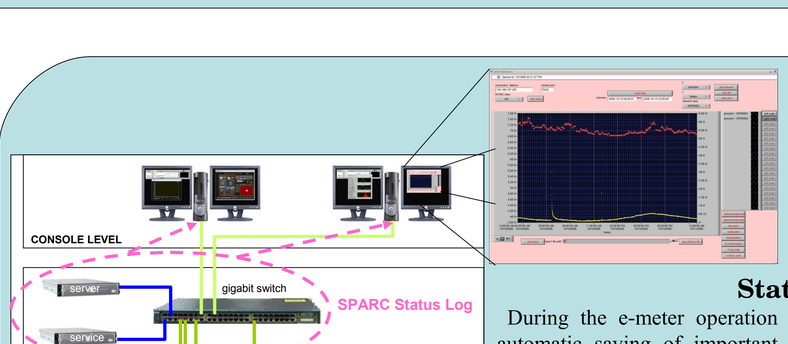
the information from the front-end and display

Send command



Element	Number	Interface
RF Modulator	2	TCP/IP
RF Low Level	1	PXI Digitizer
Vacuum Pump	30	DAC, ADC, IO, Serial
Vacuumetr	12	Serial
MagnetPS	50	Serial, ModBus
Flag	24	Serial Motor
Camera	24	IEE1384, GigaEth
BP M	12	Bergoz ADC
BCM	2	Bergoz DVM
Faraday Cup	1	High speed digitizer
Laser Photodiode	1	High Speed Digitizer
Filter wheel	3	Serial motor





Status log machine

During the e-meter operation we started to study the possibility to have an automatic saving of important data: this mechanism could be useful in the maintenance of the machine and in the offline analysis.

We developed a data acquisition system based on a database with a possibility to communicate via TCP/IP. We choose the PostgreSQL database.

Each front-end processor runs programs that send periodically all data of the controlled elements. We have developed some different interfaces program that can correlate the information

The system has been used during the e-meter measurement and demonstrated it is a powerful instrument.