DESIGN AND IMPLEMENTATION OF SESAME'S STORAGE RING CONTROL SYSTEM

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Abstract

SESAME is a synchrotron light source located in Allan, Jordan. It is expected to become operational in late 2017. Storage ring is currently under commissioning. SESAME's control systems are based on EPICS used for developing both soft and hard IOCs. Control System Studio (CSS) is used to build the graphical user interfaces. PLCs are used in machine protection and personal safety systems. VME crates are used in timing and power supplies control systems. This paper presents progress made in design and development of the Storage ring's control systems including: vacuum, power supplies, RF, diagnostics, cooling, MPS, PSS and timing systems.

Overview

- Control system implementation uses (EPICS) base 3.14.12
- Clients implementation uses Control System Studio (CSS) based on V.3.16
- Development and administration platforms use Scientific Linux 6.4
- Git version Control System is used to track development & documentation
- Siemens S7 PLCs are used for the machine protection system
- Allen Bradley PLC is used for the Personal Safety System (PSS)

Vacuum Control System

Device	Qty.	Manufacturer
Ion Pump Controller	32	Gamma Vacuum - QPC
Ion Pump	106	Gamma Vacuum
Gauge Controller	8	Agilent – XGS600
IMG Gauge	27	Agilent
Serial Terminal Server	4	3onedata
PLC	1	SIEMENS – S7 300

Table 1: Vacuum Subsystem Devices

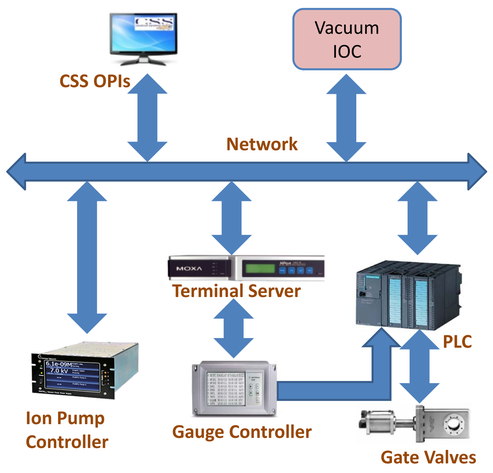

Figure 1: Vacuum Control Architecture

Power Supplies Control System

Device	Qty.	Manufacturer
Bending magnet PS	1	EEI
Quadrupole PS	64	TDK-lambda
Sextupole PS	4	TDK-lambda
Corrector PS	64	PSI
Skew Quad PS	8	TDK-lambda
Power Supplies Controller (PSC)	93	PSI
Gateway	6	IOXOS Technologies
Injection Septum PS	1	Delta-SM400
Injection Kicker PS	1	FUG-HCP35

Table 2: Power Supplies Subsystem Devices

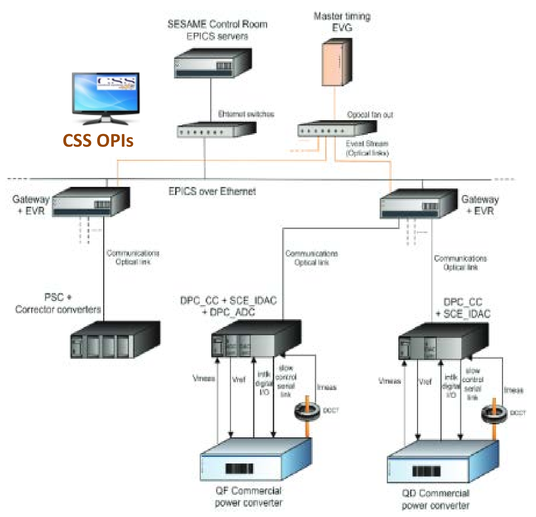

Figure 2: Power Supplies Control Architecture

Radio Frequency (RF) Control System

Device	Qty.	Manufacturer
Cavity	4	ELETTRA
Cooling Rack	4	ELETTRA
Solid States Amplifiers (SSA)	4	SOLEIL & SIGMAPHI
D-LLRF	2	DIMTEL
Signal Generator	1	Work Microwave
Motion Controller	1	Galil
PLC	1	SIEMENS – S7 300

Table 3: RF Subsystem Devices

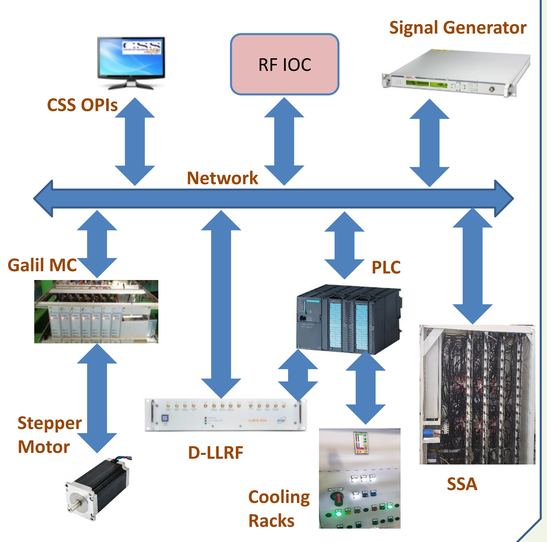

Figure 3: RF Control Architecture

Diagnostics Control System

Device	Qty.	Manufacturer
BPM	64	FMB, kyocera
Libera Brilliance Plus	12	Instrumentation Tech.
Florescent Screens	3	VAB
Scrappers	2	VAB
FCT	1	Bergoz
DCCT	1	Bergoz
Shaker	1	In-house
SRM	1	NA
BLM	1	Instrumentation Tech
Motion Controller	1	Galil
PLC	1	SIEMENS – S7 300

Table 4: Diagnostics Subsystem Devices

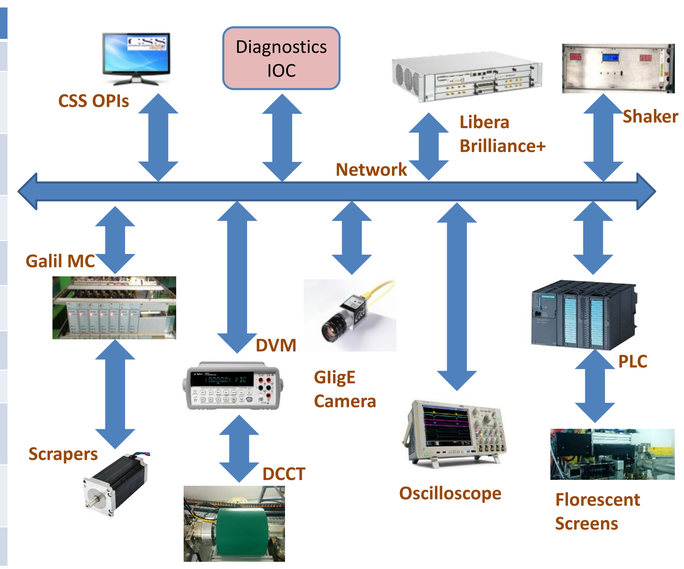

Figure 4: Diagnostics Control Architecture

Cooling Control System

Device	Qty.	Manufacturer
Security Box	16	In-house
PLC	1	SIEMENS – S7 300

Table 5: Cooling Subsystem Devices

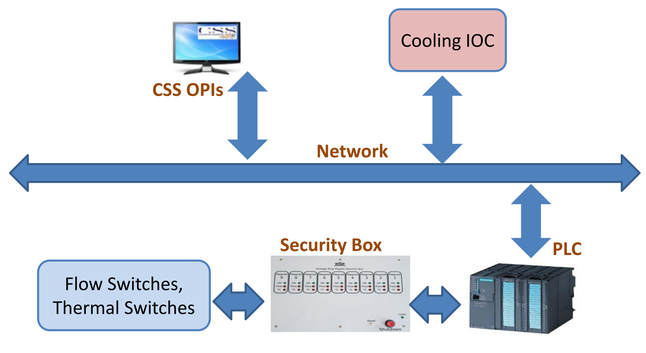

Figure 5: Cooling Control Architecture

Machine Protection System (MPS)

The machine protection subsystem for the Storage Ring consists of three main Siemens S7-300 PLCs. Each PLC has a CPU module, communication module and signal modules. Each PLC is responsible to protect its connected subsystem as follows:
Vacuum/Diagnostics PLC (CPU 314)
Cooling/Power Supplies PLC (CPU 314)
RF PLC (CPU 315-2dp)

The storage ring is divided into 16 cells, each 4 cells makes one quadrant. It is difficult to connect the subsystem's devices to the PLC modules in one place because that requires using very long cables which is not recommended. For that reason a PROFINET communication has been used between the CPU and the remote I/O modules which are distributed in the four storage ring quadrants racks as shown in Figure 6.

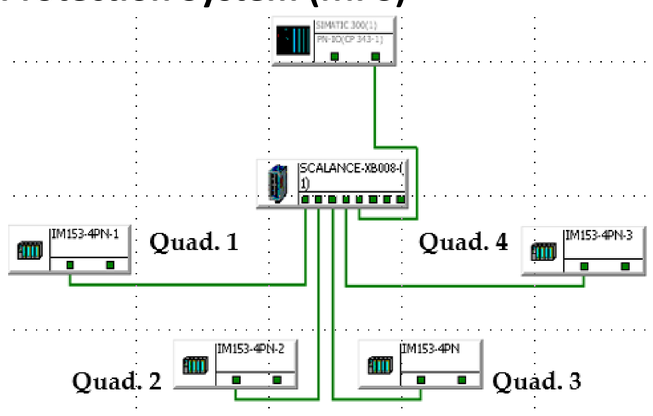

Figure 6: MPS PROFINET Architecture

Personal Safety System (PSS)

The personal safety subsystem for the Storage Ring consists of a PLC based control system which provides an easy tool to implement the PSS sequences and procedures in a protected programming tool where all changes are recorded. PSS has been designed and selected to meet the requirements of SIL3. The safety PLC (Allen Bradley Guard -Logix L72s) monitors a set of conditions connected to its input modules and as result of the programmed logic safety PLC will send the permissions to allow the operation of the interlocked system as Microtron, Booster RF, Storage Ring RF, Injection from booster to Storage Ring and beam shutters, each system has some conditions to be verified, if one or more conditions lost, the PLC will disable the related system [6]. Figure 4 shows the layout of personal safety system PLCs.

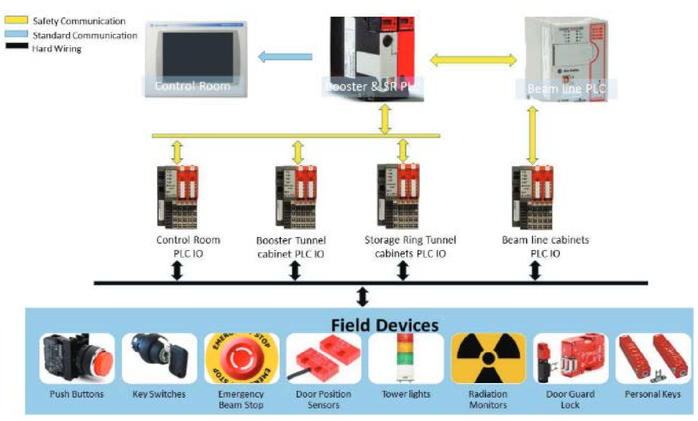

Figure 7: PSS Layout

Timing Control System

Device	Qty.	Manufacturer
Event Generator	1	MRF
Event Receiver	8	MRF
Optical Fan-out	1	MRF
Signal Splitter	5	CAEN

Table 6: Timing Subsystem Devices

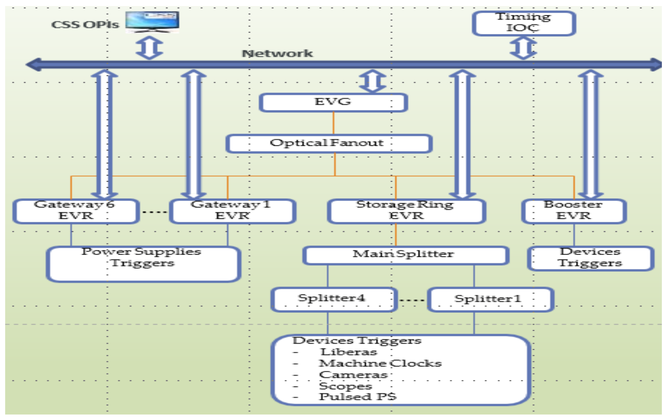

Figure 8: Timing Control System