SESAME'S CONTROL SYSTEM

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Workshop: PLC Based Control Systems : SA1E

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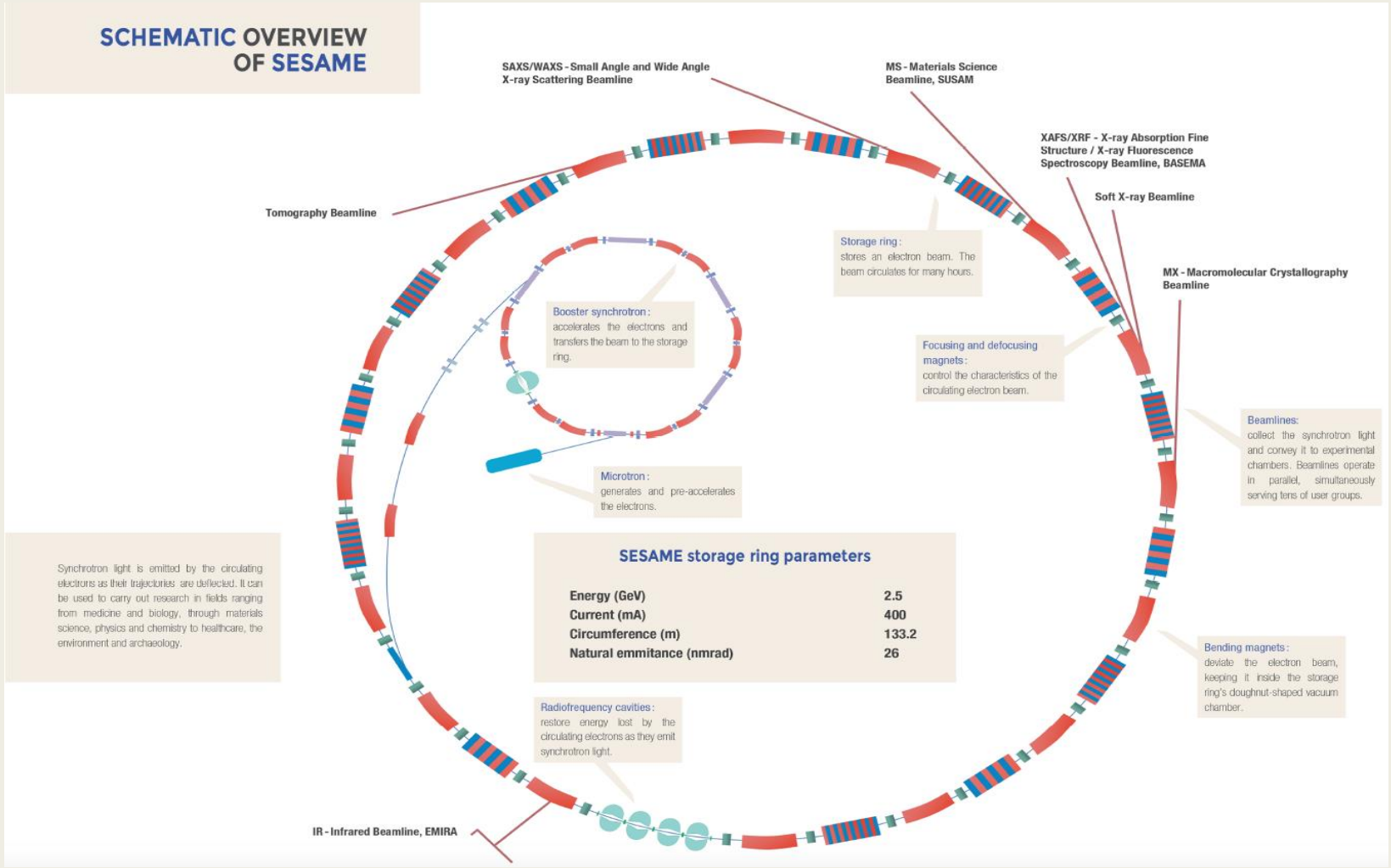
What is SESAME?

- SESAME (**S**ynchrotron-light for **E**xperimental **S**cience and **A**pplications in the **M**iddle **E**ast)
- **Location:** Allan, Jordan
- A “third-generation” synchrotron light source that was officially opened on 16 May 2017
- It is expected to become operational in late 2017. Storage ring is currently under commissioning.
- It is the Middle East's first major international research centre
- The current Members of SESAME are Cyprus, Egypt, Iran ,Israel, Jordan, Pakistan, Palestine and Turkey.

What is SESAME?

SESAME Information



Energy; *2.5 GeV*

Circumference; *133m*

Emittance; *26 nm-rad*

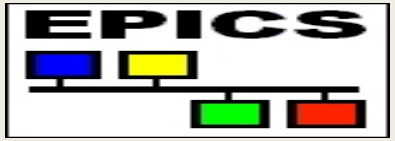
Space for future full energy inject
the storage ring tunnel

Day One Beamlines:

- XAFS/XRF
- Infrared

Control System Overview

- Control system implementation uses (EPICS) base 3.14.12



- Development and administration platforms use Scientific Linux 6.4

- Siemens S7-300 PLCs are used for the Machine Protection System (MPS)

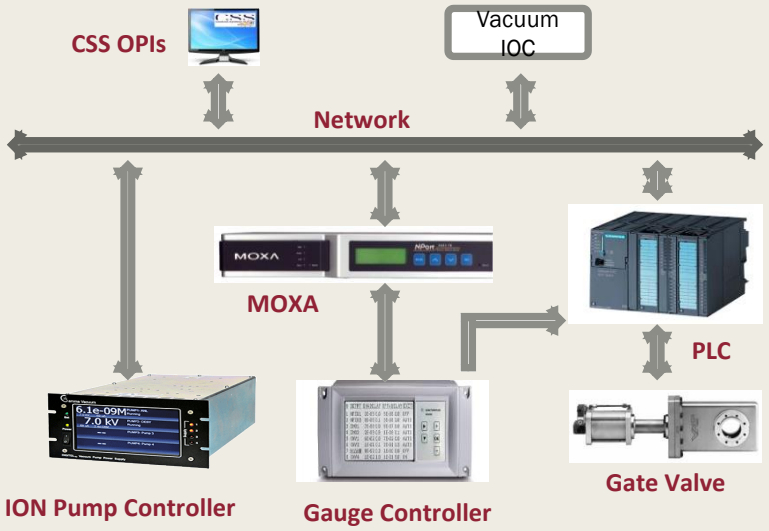
- Clients implementation uses Control System Studio (CSS) based on V.3.16

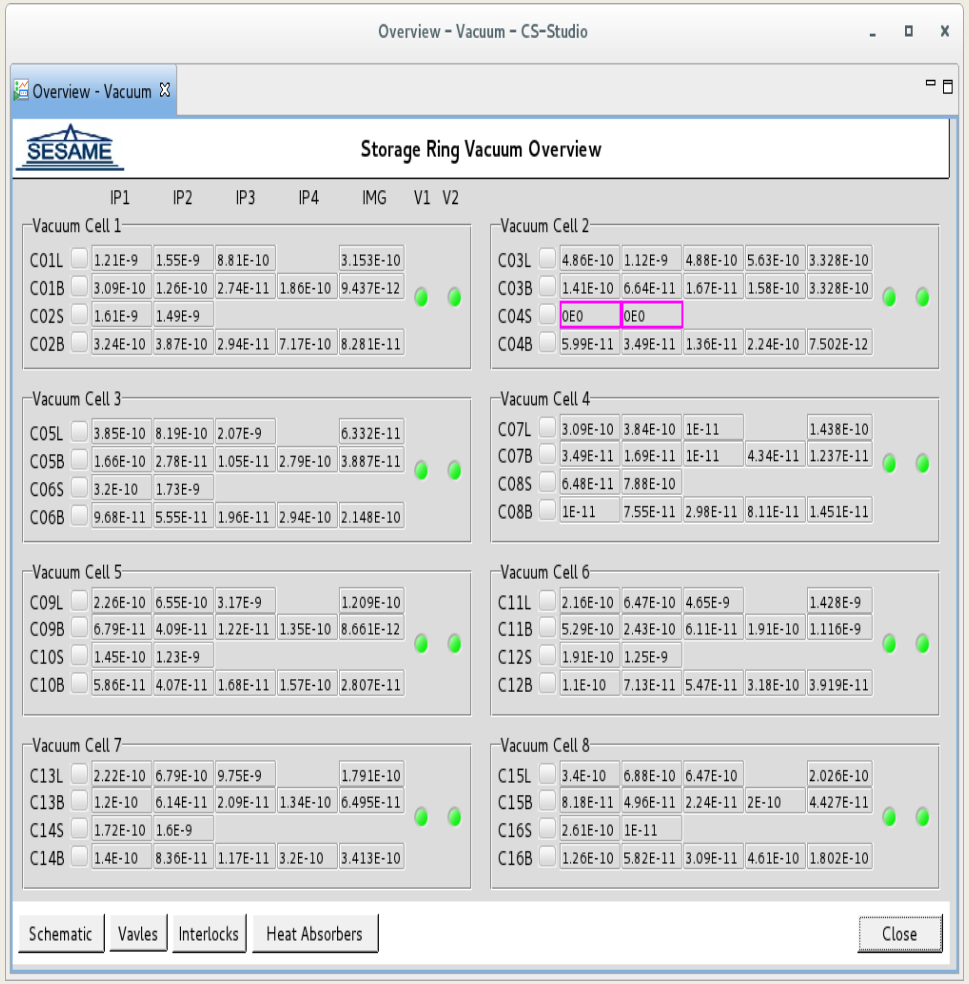
- Git version Control System is used to track development & documentation

- Allen Bradley PLC is used for the Personal Safety System (PSS).

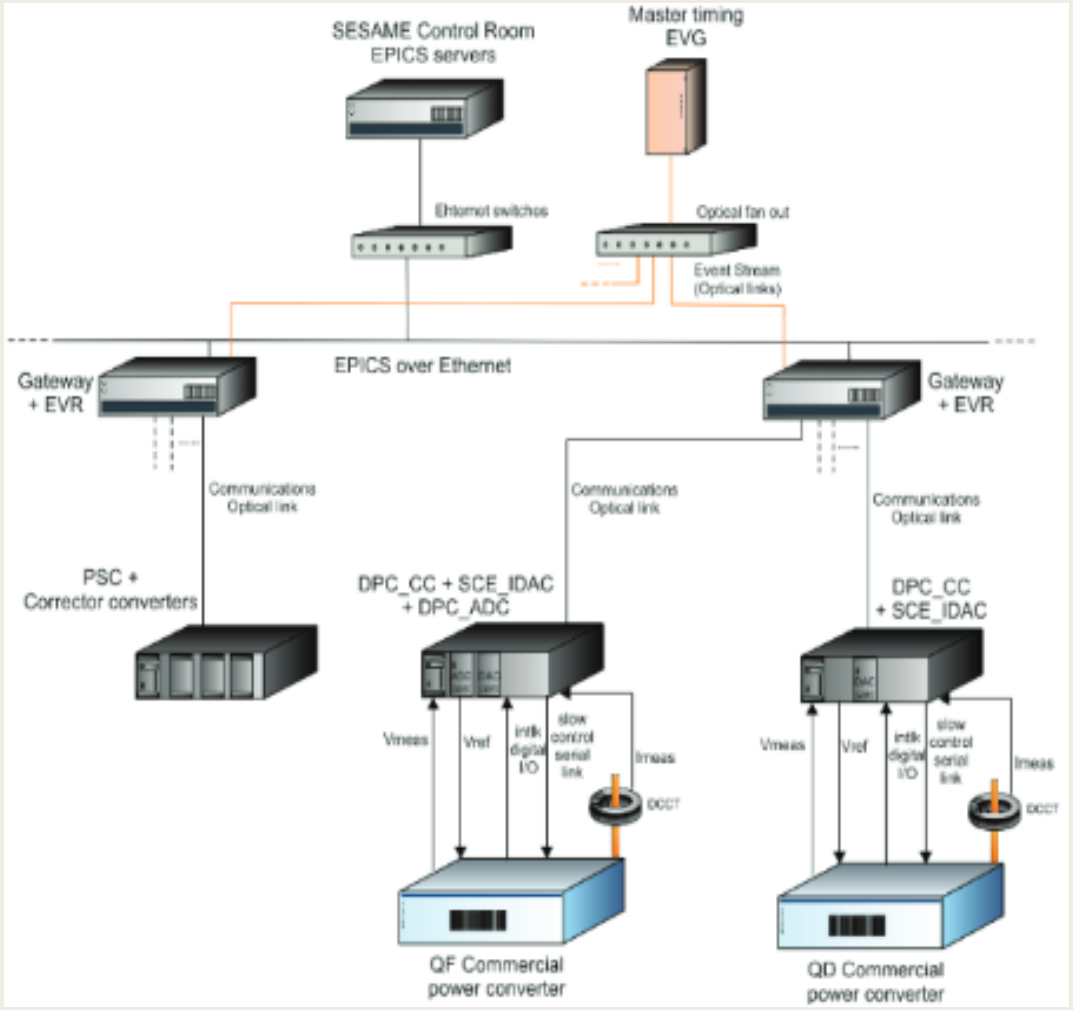
Vacuum Control System

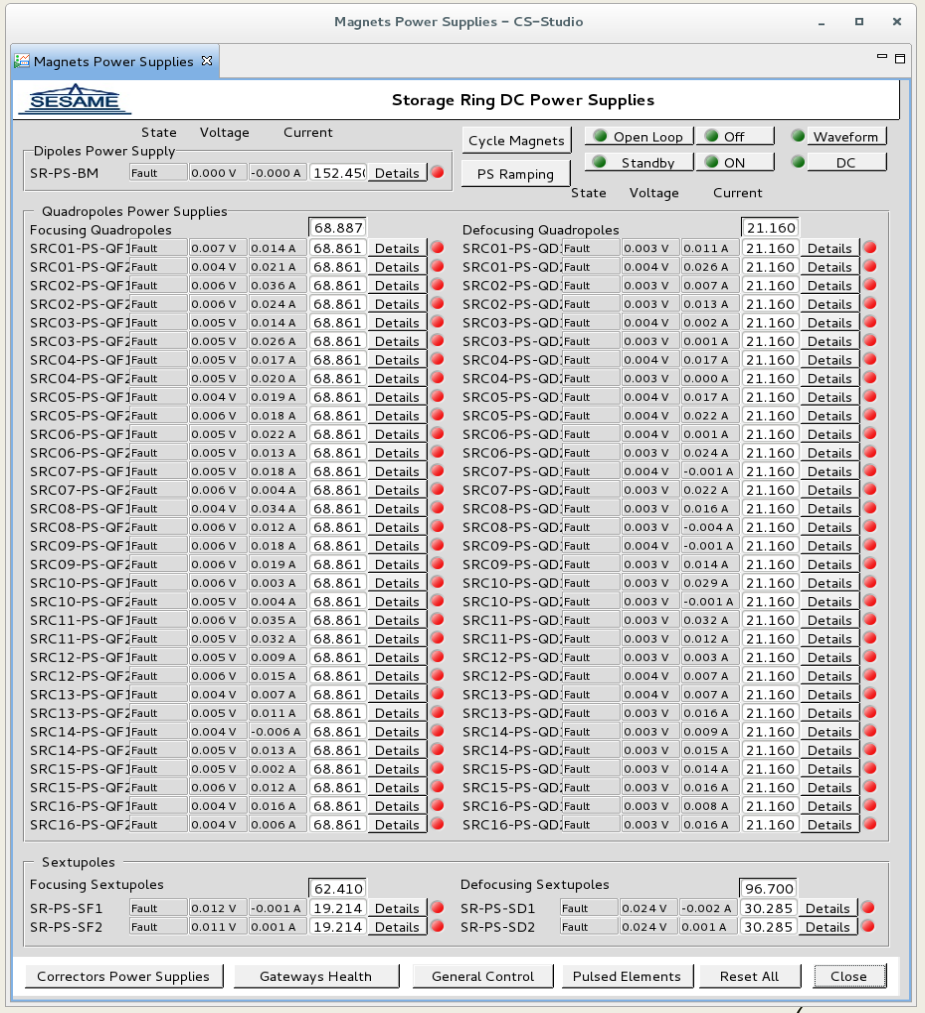
Device	Brand	Control Interface
ION Pump Controller	Digital QPC (Gamma Vacuum)	Ethernet
Gauge Controller	XGS-600 (Agilent)	RS232, I/O
Gate Valve	VAT	I/O





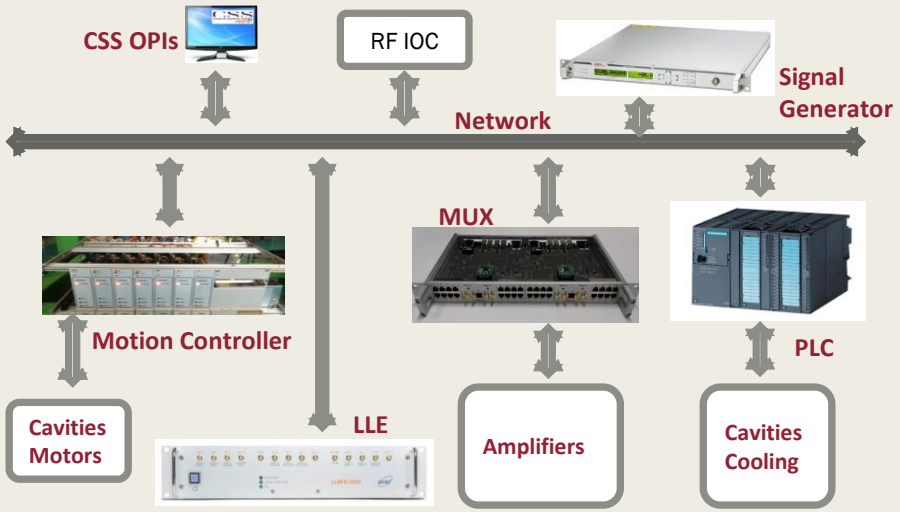
Power Supplies Control System

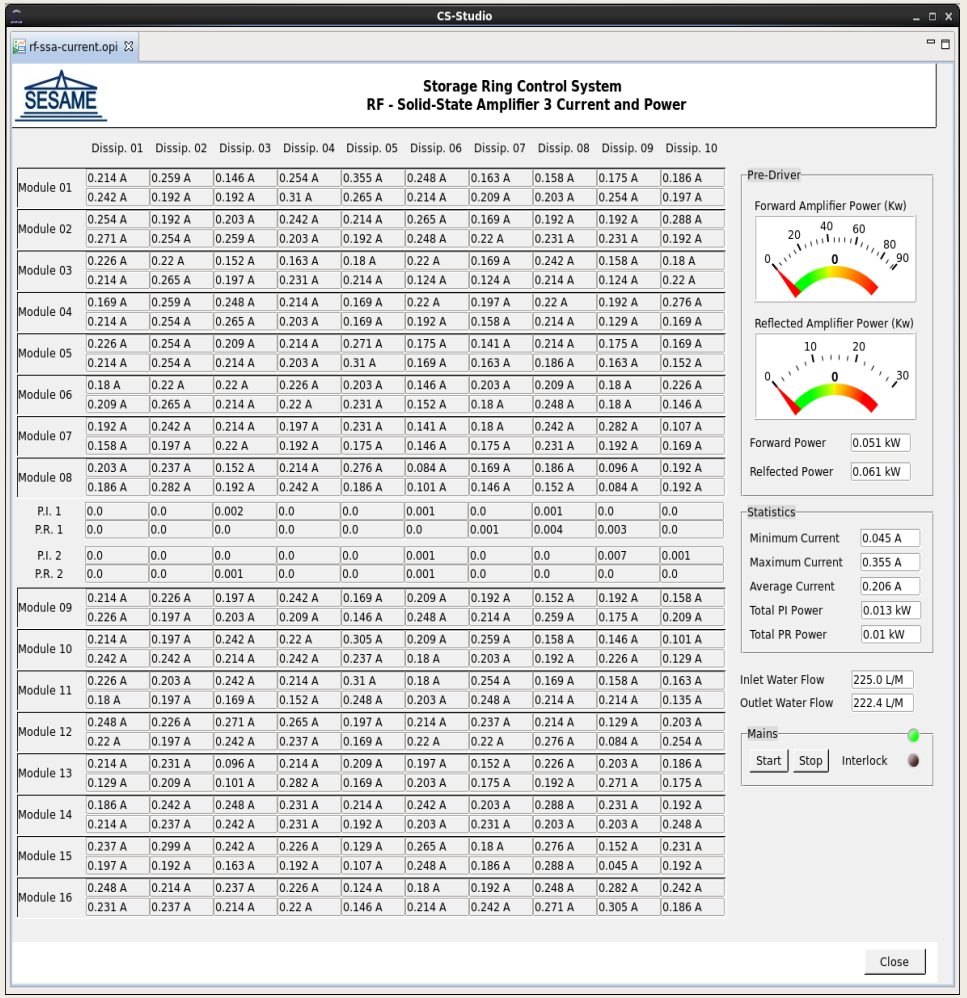




RF Control System

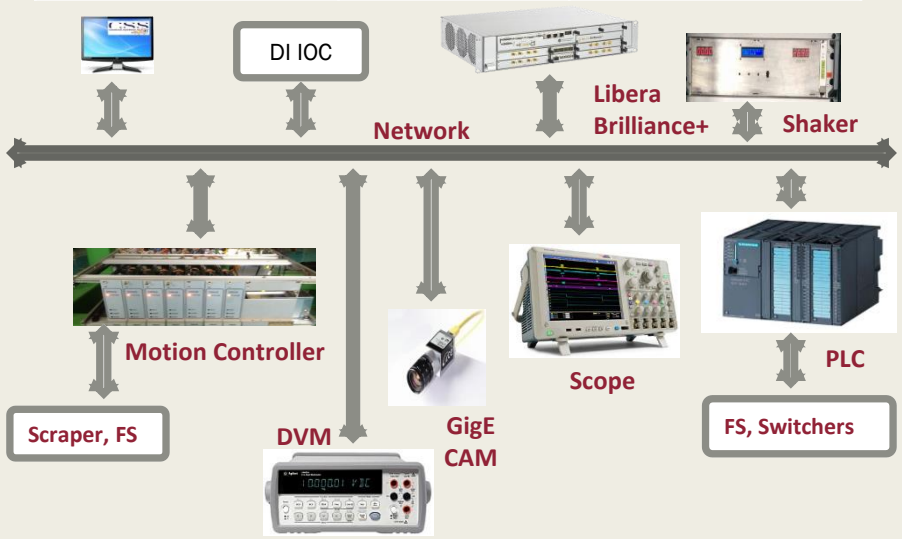
Device	Brand	Control Interface
LLE	Dimtel	Ethernet
Cavities	ELETTRA	I/O
Amplifiers	SEGMA-Phi	Ethernet (MUX Board)
Motion Controller	Galil	Ethernet
Signal Generator	Work Microwave	Ethernet

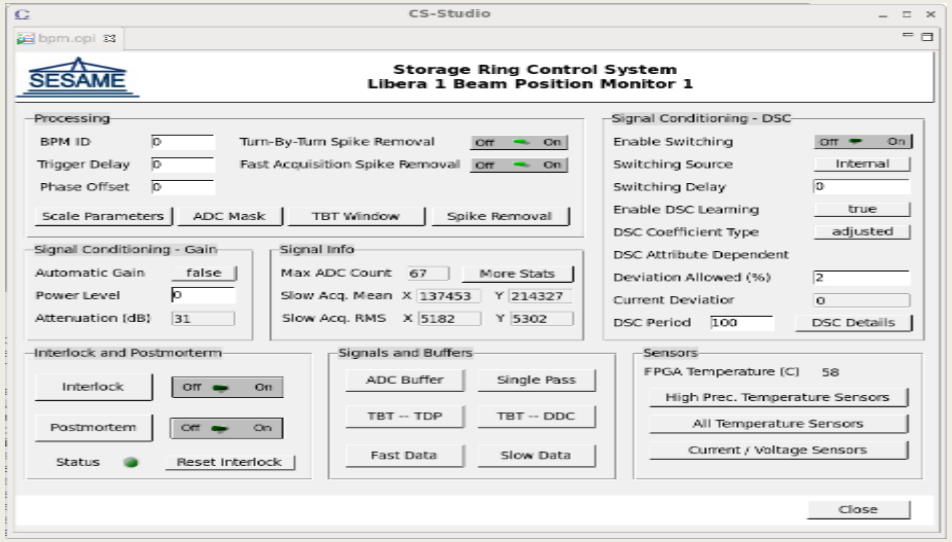


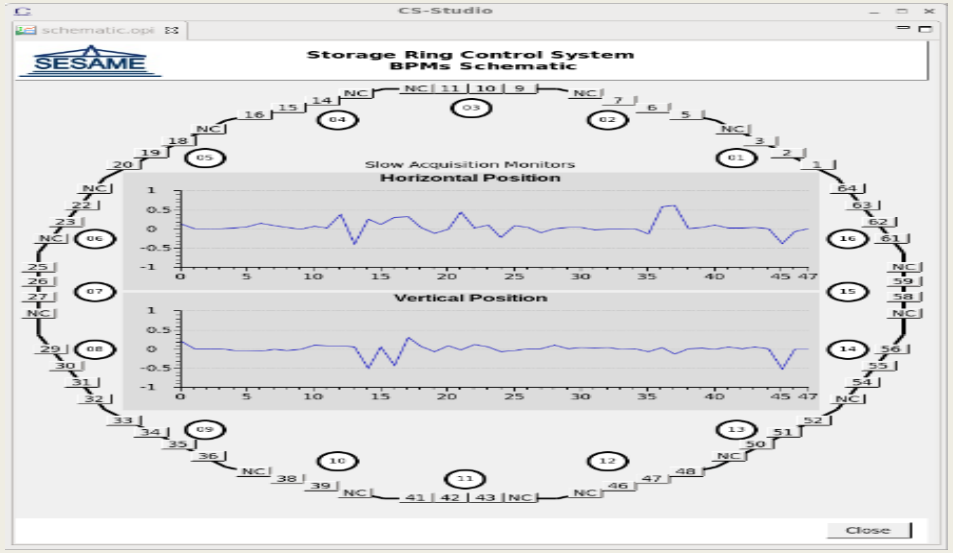


Diagnostics Control System

Device	Brand	Control Interface
Libera Brilliance+	I-tech	Ethernet
Florescent Screens	VAb	I/O
Shaker	In-house	RS232, I /O
Function Generator	Tektronix	Ethernet
Oscilloscope	Tektronix	Ethernet
Motion Controller	Galil	Ethernet
Camera	Basler	Ethernet
Digital Voltmeter	Agilent	Ethernet
RF Switchers	NA	I/O

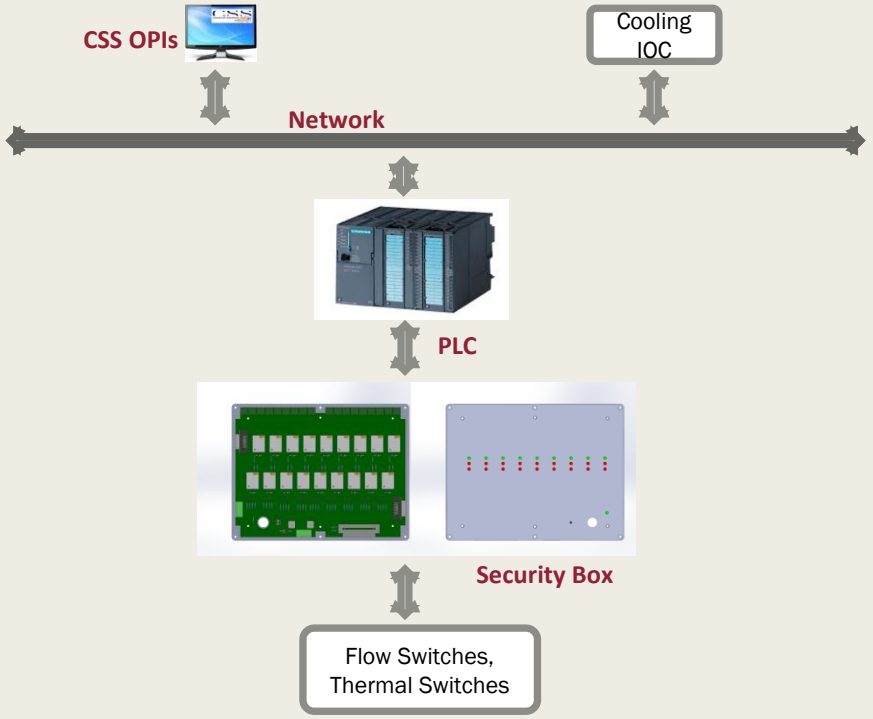


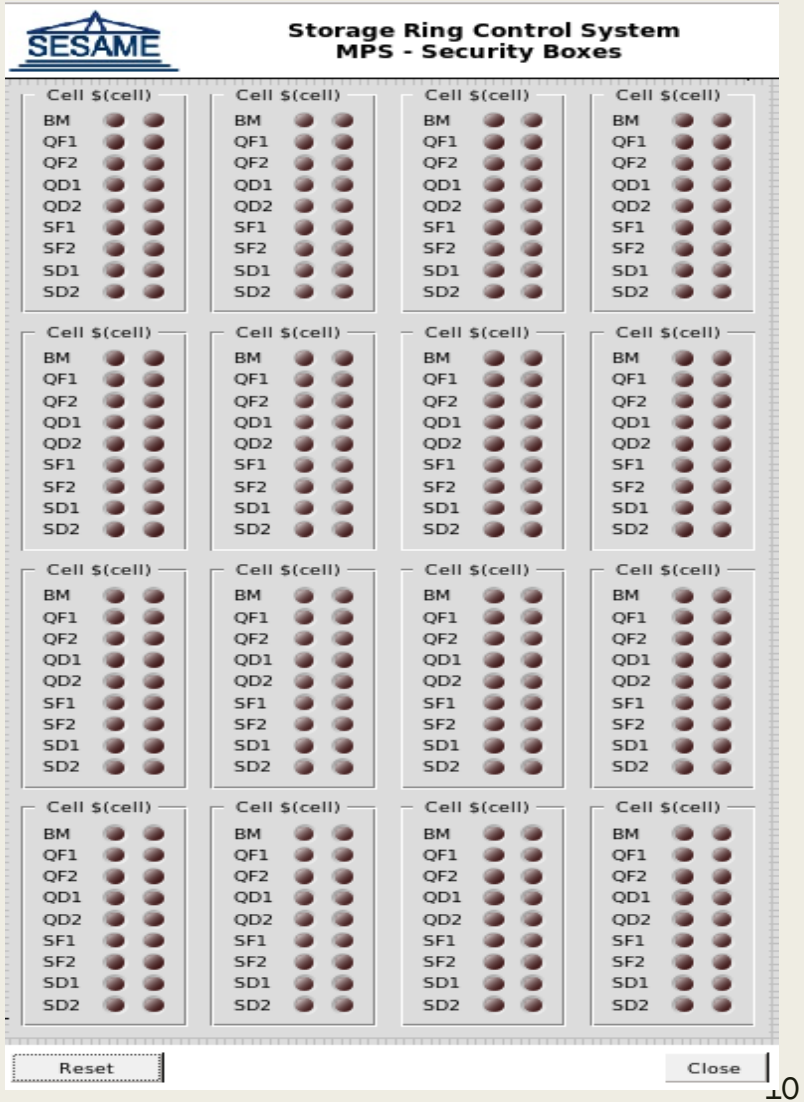




Cooling Control System

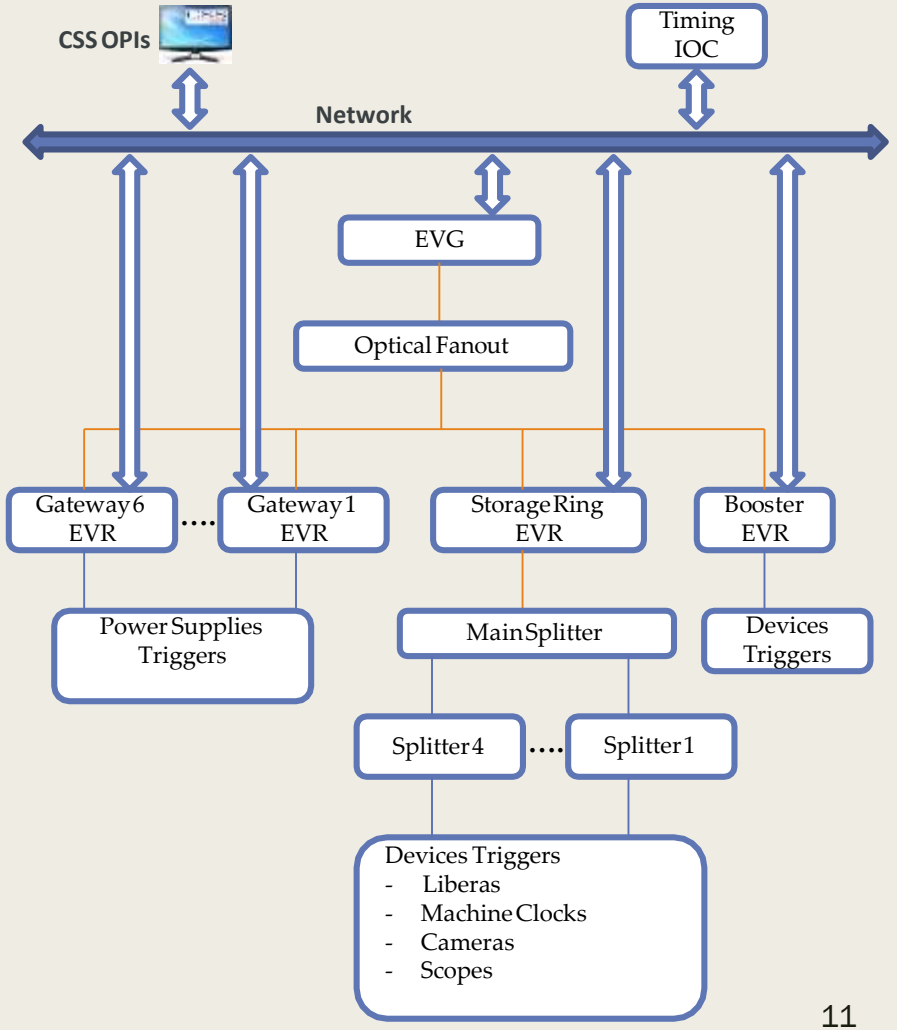
Device	Brand	Control Interface
Security Box	In-House	I/O





Timing System Control Status

Device	Brand	Control Interface
Event Generator	MRF	Ethernet
Event Reciever	MRF	Ethernet



PLC Systems at SESAME

- **Purpose:** Machine protection for each sub-system
- **PLC:** SIEMENS S7-300
- **Software:** STEP7, TIA PORTAL
- **Programming Language:** Ladder Logic
- **CPUs:** CPU314, CPU315-2DP
- **I/O Modules:** DI32, DO32, AI8, A08, TC8
- **Communication Modules:** CP-343-1, CP342-5
- **Communication Protocols:** PROFIBUS, PROFINET
- **Distributed I/O Modules:** ET200M (IM153-4)

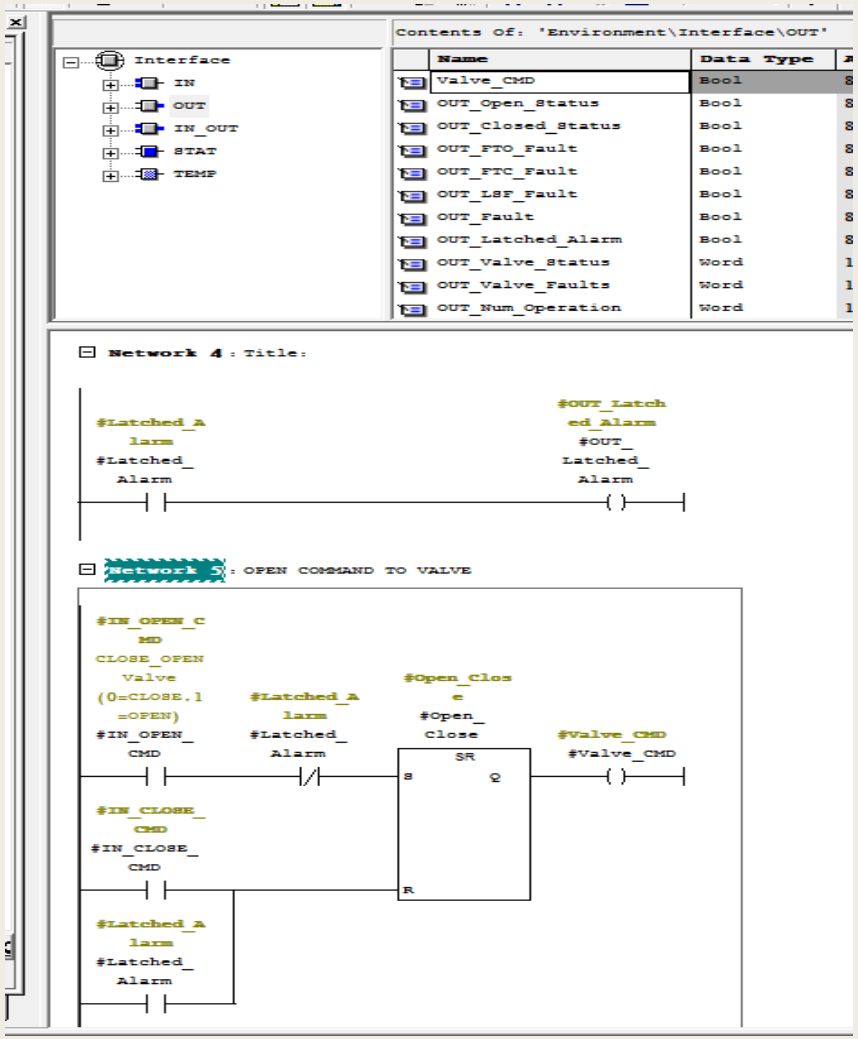
PLC Systems at SESAME

- Nine CPUs and set of I/O modules are used for the following sub-systems:
  - Microtron (CPU315-2DP)
  - Transfer Line 1 (CPU315-2DP)
  - Booster Vacuum & Diagnostics (CPU315-2DP)
  - Booster Cooling & Power Supplies (CPU315-2DP)
  - Booster RF (CPU314)
  - Transfer Line 2 (CPU314)
  - Storage Ring Vacuum & Diagnostics (CPU314)
  - Storage Ring Cooling & Power Supplies (CPU314)
  - Storage Ring RF (CPU315-2DP)

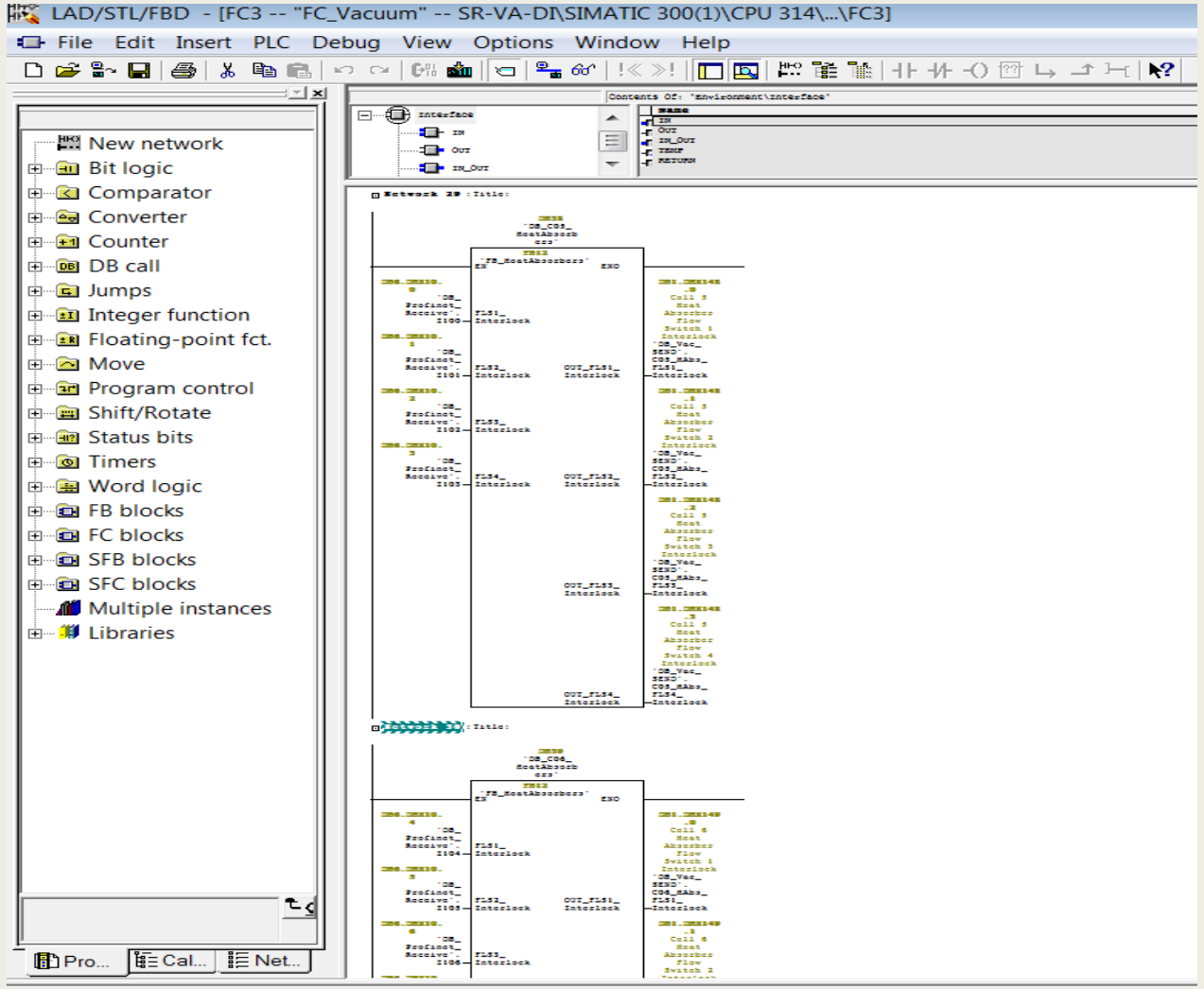
PLC Programming - Strategy

- Building the programming in an organized way
- Make it easy to be modified
- Make it easy for troubleshooting
- Assign One Function Block (FB) for each device which will have the main logic for that device.
- Assign number of instance Data Blocks (DB) depends on the number of devices for each sub-system.
- Calling all FBs inside one Function (FC) or more
- Calling all the Functions (FCs) inside the main Organization Block (OB)

PLC Programming - Strategy

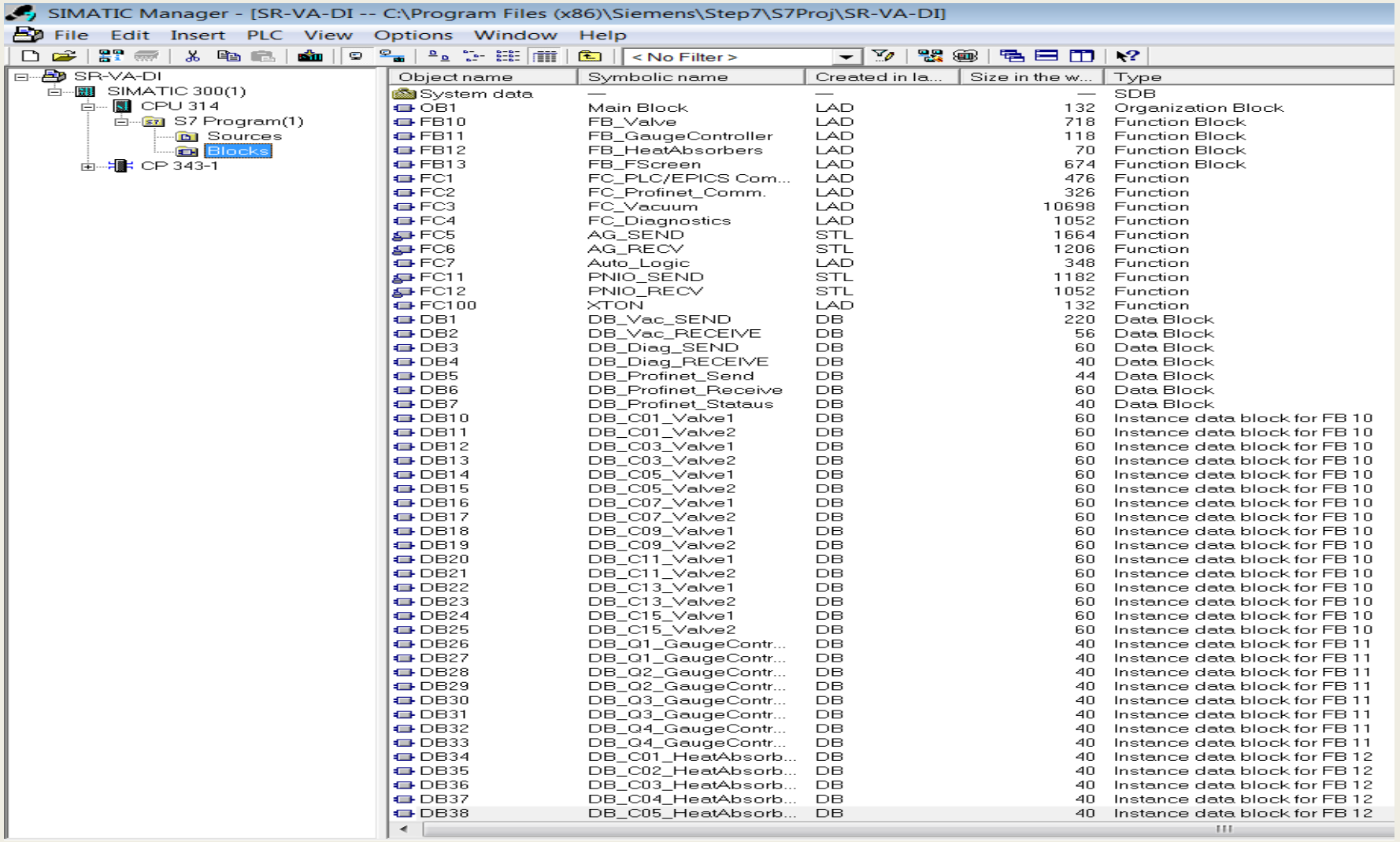


FB



FC

PLC Programming - Strategy

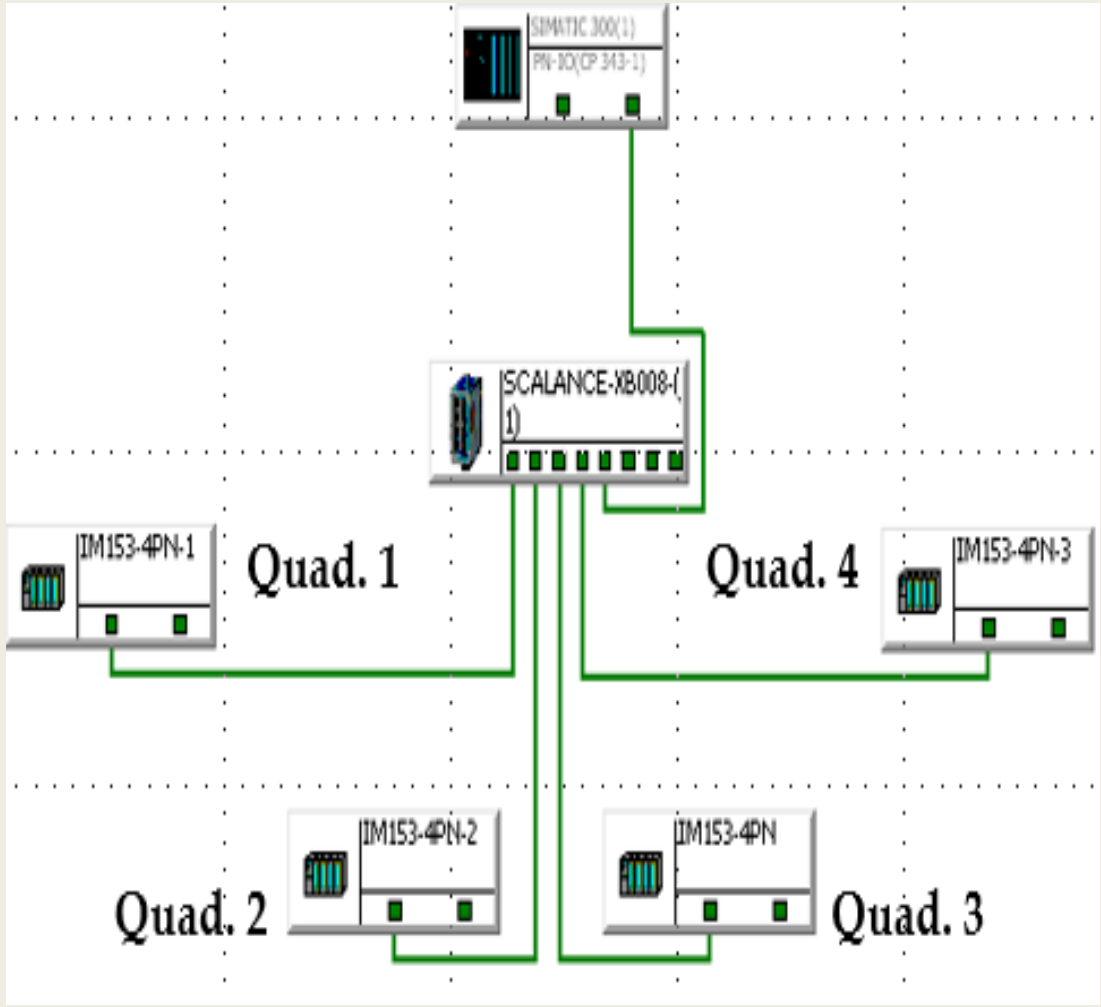


Object name	Symbolic name	Created in la...	Size in the w...	Type
System data	—	—	—	SDB
OB1	Main Block	LAD	132	Organization Block
FB10	FB_Valve	LAD	718	Function Block
FB11	FB_GaugeController	LAD	118	Function Block
FB12	FB_HeatAbsorbers	LAD	70	Function Block
FB13	FB_FScreen	LAD	674	Function Block
FC1	FC_PLC/EPICS Com...	LAD	476	Function
FC2	FC_Profinet_Comm.	LAD	326	Function
FC3	FC_Vacuum	LAD	10698	Function
FC4	FC_Diagnostics	LAD	1052	Function
FC5	AG_SEND	STL	1664	Function
FC6	AG_RECV	STL	1206	Function
FC7	Auto_Logic	LAD	348	Function
FC11	PNIO_SEND	STL	1182	Function
FC12	PNIO_RECV	STL	1052	Function
FC100	XTON	LAD	132	Function
DB1	DB_Vac_SEND	DB	220	Data Block
DB2	DB_Vac_RECEIVE	DB	56	Data Block
DB3	DB_Diag_SEND	DB	60	Data Block
DB4	DB_Diag_RECEIVE	DB	40	Data Block
DB5	DB_Profinet_Send	DB	44	Data Block
DB6	DB_Profinet_Receive	DB	60	Data Block
DB7	DB_Profinet_Stataus	DB	40	Data Block
DB10	DB_C01_Valve1	DB	60	Instance data block for FB 10
DB11	DB_C01_Valve2	DB	60	Instance data block for FB 10
DB12	DB_C03_Valve1	DB	60	Instance data block for FB 10
DB13	DB_C03_Valve2	DB	60	Instance data block for FB 10
DB14	DB_C05_Valve1	DB	60	Instance data block for FB 10
DB15	DB_C05_Valve2	DB	60	Instance data block for FB 10
DB16	DB_C07_Valve1	DB	60	Instance data block for FB 10
DB17	DB_C07_Valve2	DB	60	Instance data block for FB 10
DB18	DB_C09_Valve1	DB	60	Instance data block for FB 10
DB19	DB_C09_Valve2	DB	60	Instance data block for FB 10
DB20	DB_C11_Valve1	DB	60	Instance data block for FB 10
DB21	DB_C11_Valve2	DB	60	Instance data block for FB 10
DB22	DB_C13_Valve1	DB	60	Instance data block for FB 10
DB23	DB_C13_Valve2	DB	60	Instance data block for FB 10
DB24	DB_C15_Valve1	DB	60	Instance data block for FB 10
DB25	DB_C15_Valve2	DB	60	Instance data block for FB 10
DB26	DB_Q1_GaugeContr...	DB	40	Instance data block for FB 11
DB27	DB_Q1_GaugeContr...	DB	40	Instance data block for FB 11
DB28	DB_Q2_GaugeContr...	DB	40	Instance data block for FB 11
DB29	DB_Q2_GaugeContr...	DB	40	Instance data block for FB 11
DB30	DB_Q3_GaugeContr...	DB	40	Instance data block for FB 11
DB31	DB_Q3_GaugeContr...	DB	40	Instance data block for FB 11
DB32	DB_Q4_GaugeContr...	DB	40	Instance data block for FB 11
DB33	DB_Q4_GaugeContr...	DB	40	Instance data block for FB 11
DB34	DB_C01_HeatAbsorb...	DB	40	Instance data block for FB 12
DB35	DB_C02_HeatAbsorb...	DB	40	Instance data block for FB 12
DB36	DB_C03_HeatAbsorb...	DB	40	Instance data block for FB 12
DB37	DB_C04_HeatAbsorb...	DB	40	Instance data block for FB 12
DB38	DB_C05_HeatAbsorb...	DB	40	Instance data block for FB 12

Main Blocks

Distributed I/O modules

- Storage Ring signals are distributed into 16 cells and 4 quadrants.
- Putting the PLC modules in one place will not be possible because of cabling.
- Using distributed I/O modules ET200M (IM153-4) based on Profinet communication was the solution.



PLC Hardware and Cabling

- Organize the PLC modules inside the racks
- Organize cables inside the trunks
- Installing Terminal Blocks

  (Simatic Top Connect, ABB)
- Labeling is important
- Adding space for future use

Thank You