

The design of the Alba control system

…software and hardware cost effective

D. Fernández-Carreiras.

on behalf of the Alba's team


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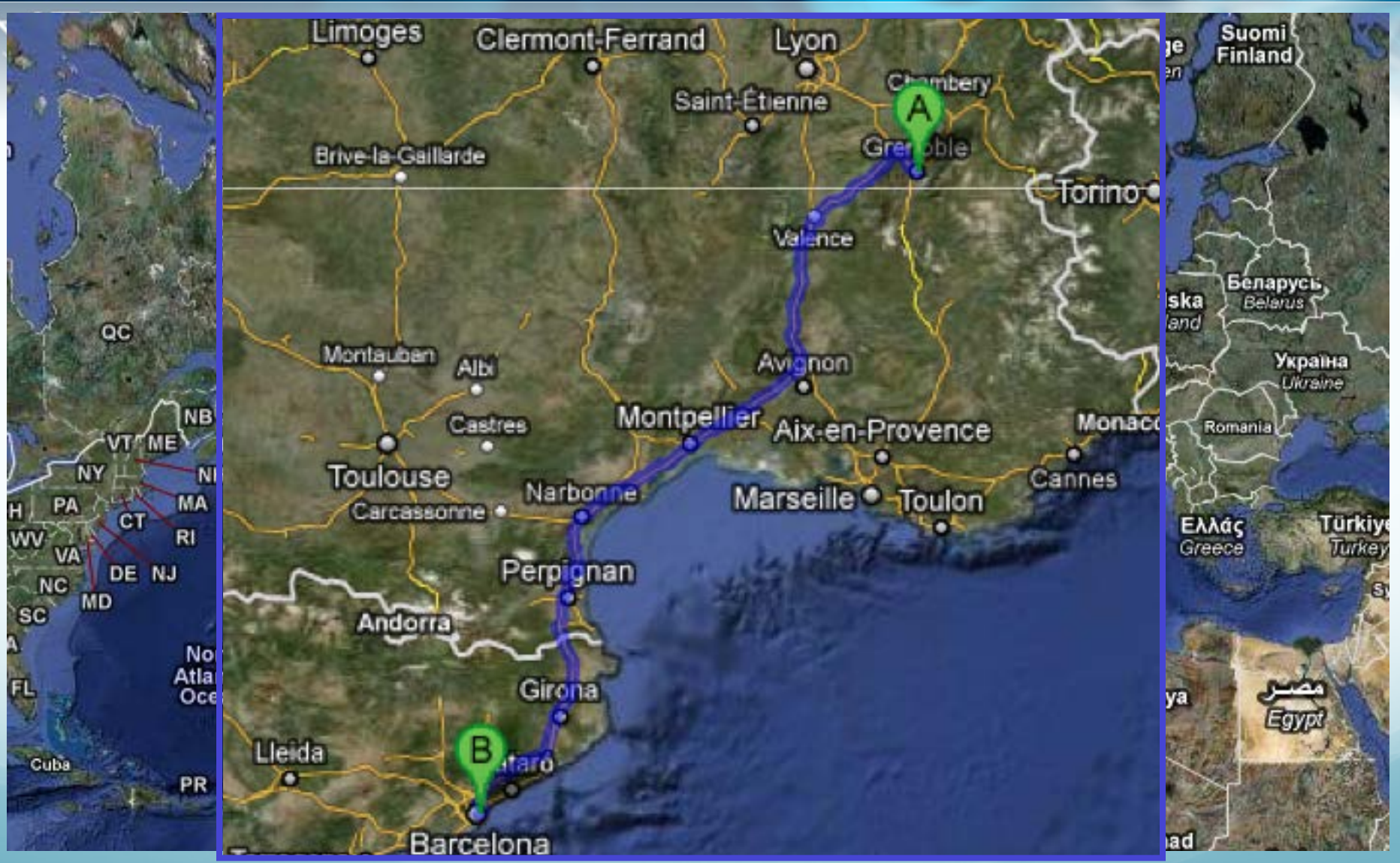
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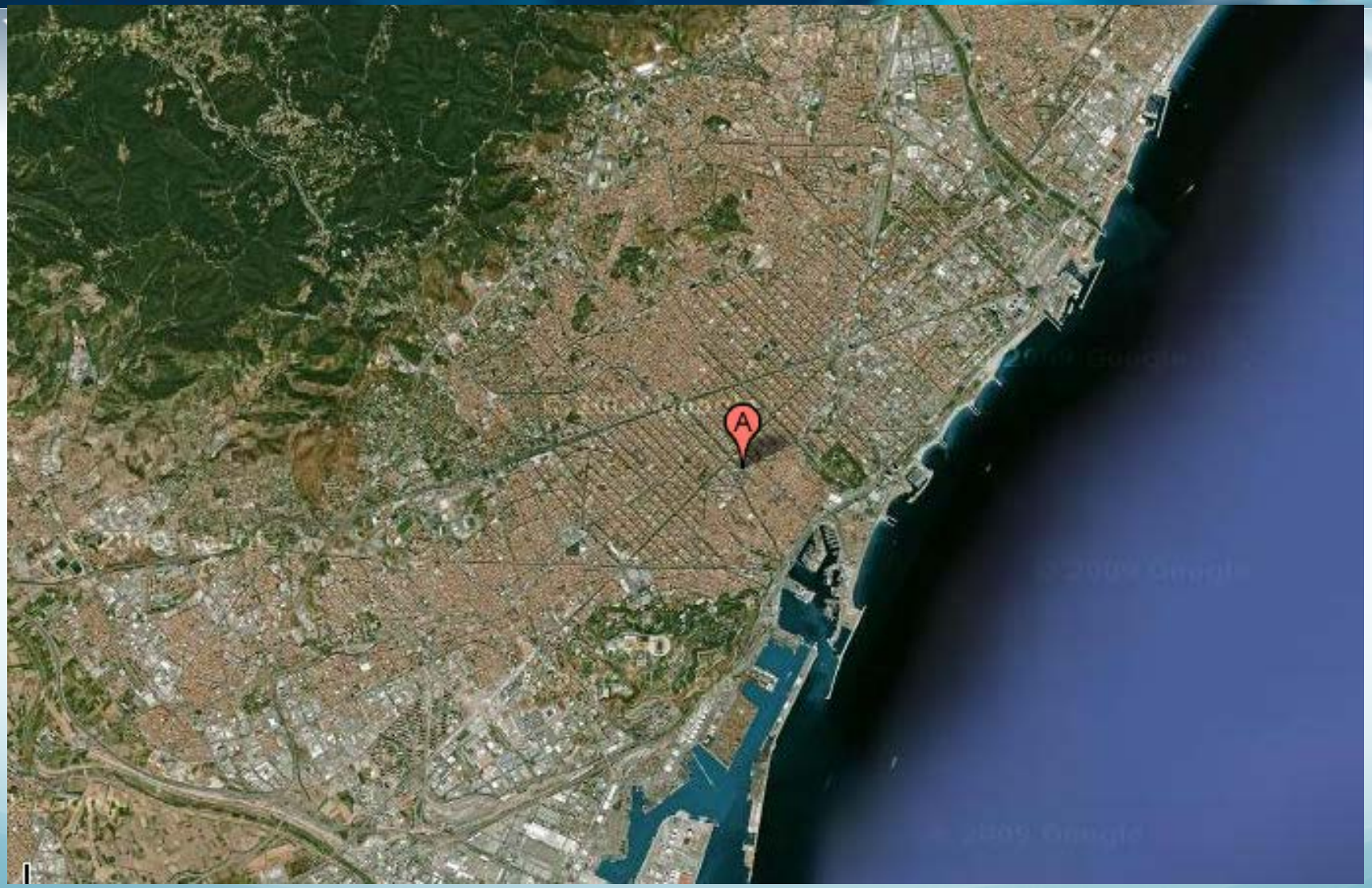

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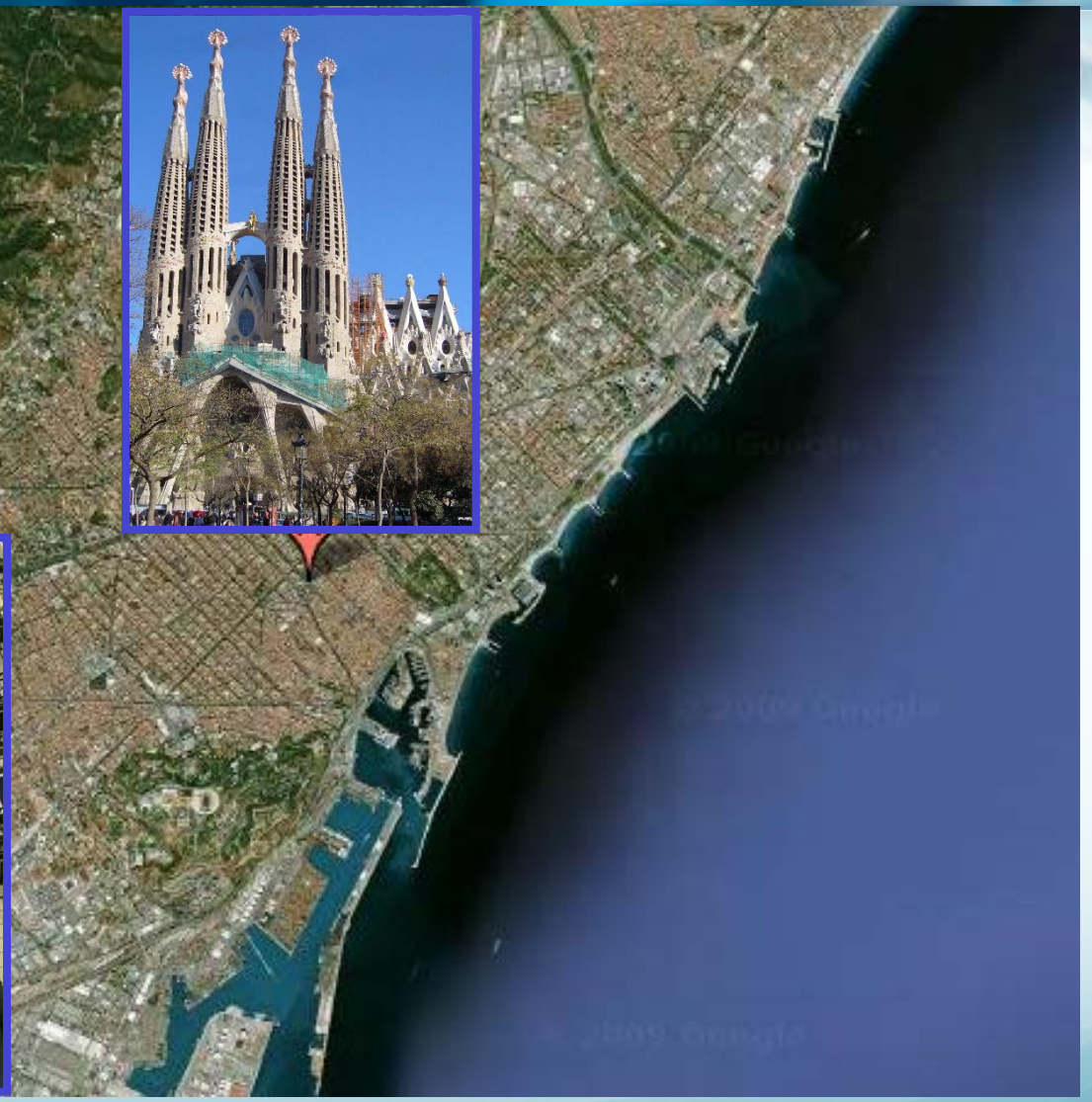
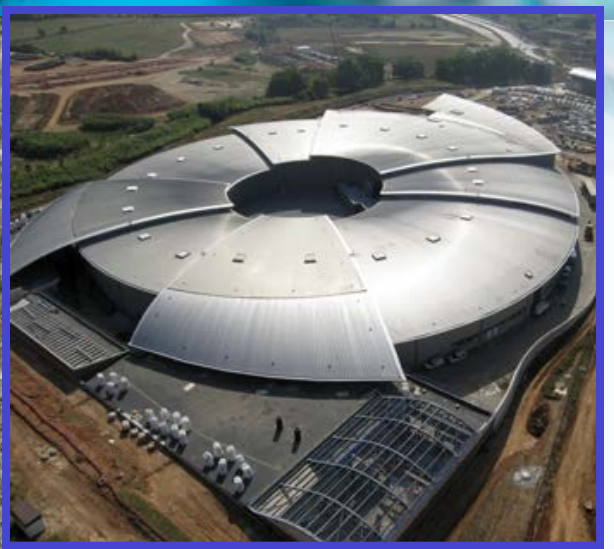


Barcelona

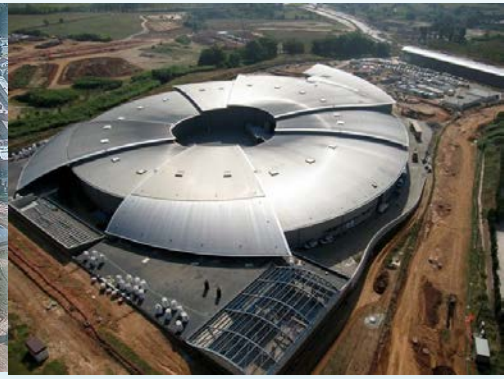


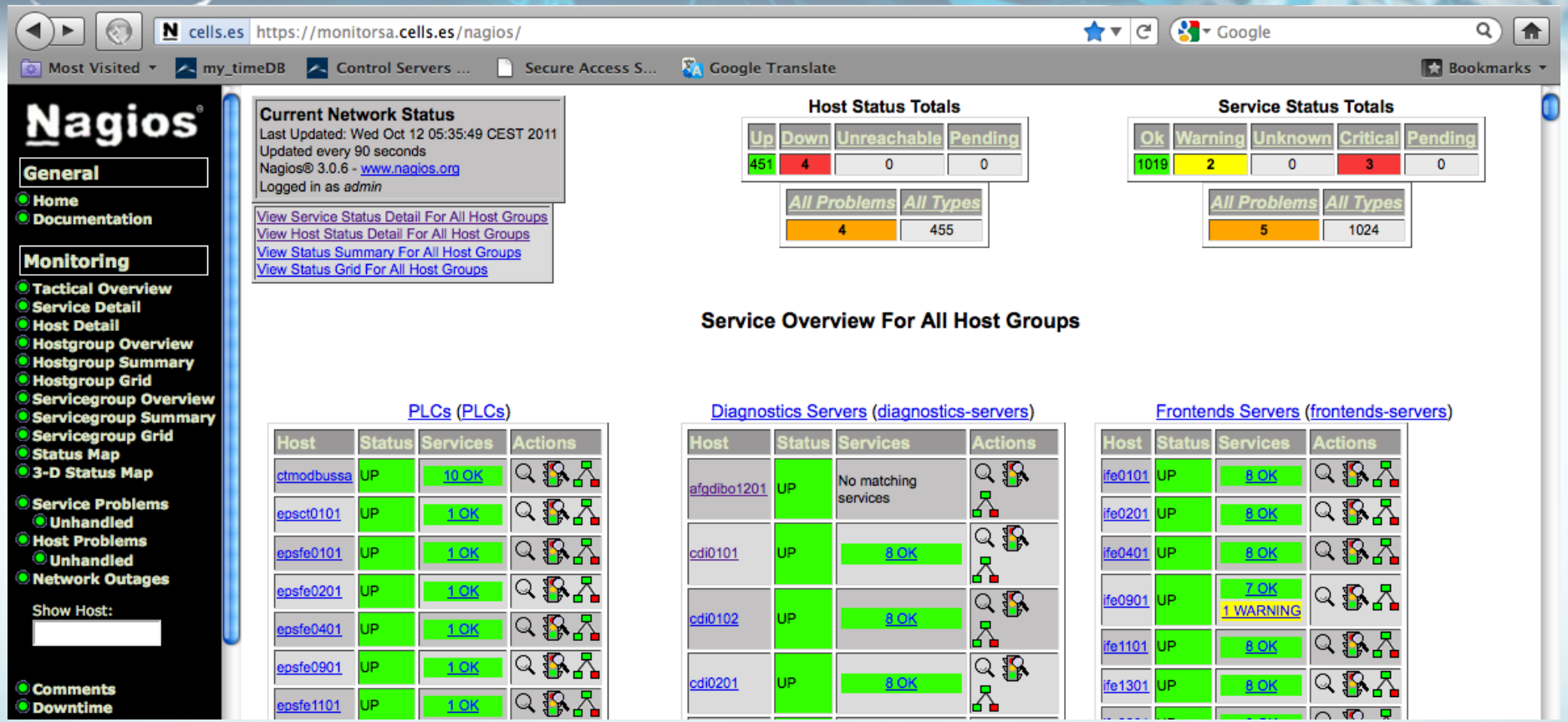
The inaguration

Dec 2006

Oct. 2008

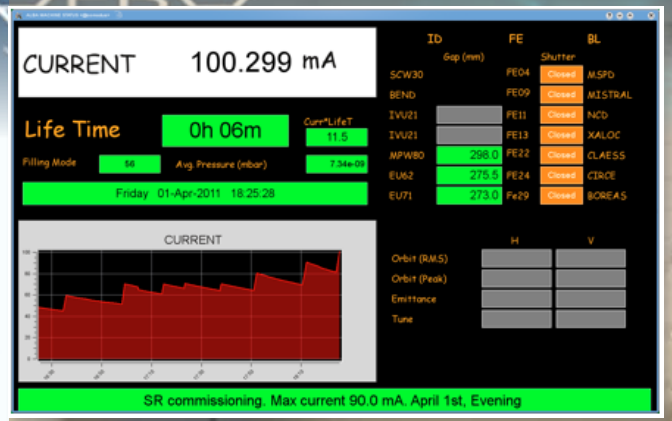


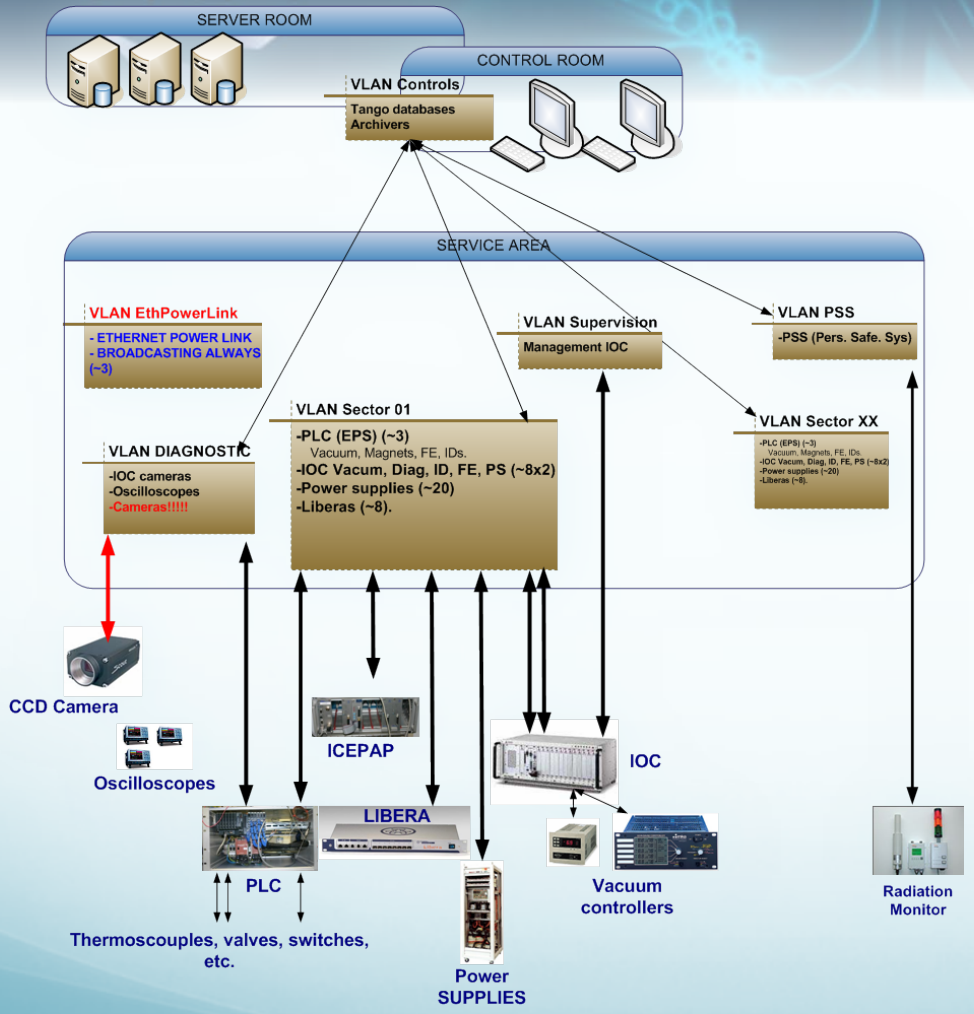

cells.es https://monitorsa.cells.es/nagios/
Most Visited my_timeDB Control Servers ... Secure Access S... Google Translate Bookmarks
Nagios
General
Home
Documentation
Monitoring
Tactical Overview
Service Detail
Host Detail
Hostgroup Overview
Hostgroup Summary
Hostgroup Grid
Servicegroup Overview
Servicegroup Summary
Servicegroup Grid
Status Map
3-D Status Map
Service Problems
Unhandled
Host Problems
Unhandled
Network Outages
Show Host:
Comments
Downtime
Current Network Status
Last Updated: Wed Oct 12 05:35:49 CEST 2011
Updated every 90 seconds
Nagios® 3.0.6 - www.nagios.org
Logged in as admin
View Service Status Detail For All Host Groups
View Host Status Detail For All Host Groups
View Status Summary For All Host Groups
View Status Grid For All Host Groups
Host Status Totals
Up Down Unreachable Pending
451 4 0 0
All Problems All Types
4 455
Service Status Totals
Ok Warning Unknown Critical Pending
1019 2 0 3 0
All Problems All Types
5 1024
Service Overview For All Host Groups
PLCs (PLCs)
Host Status Services Actions
ctmodbussa UP 10 OK
epsct0101 UP 1 OK
epsfe0101 UP 1 OK
epsfe0201 UP 1 OK
epsfe0401 UP 1 OK
epsfe0901 UP 1 OK
epsfe1101 UP 1 OK
Diagnostics Servers (diagnostics-servers)
Host Status Services Actions
afgdibo1201 UP No matching services
cdi0101 UP 8 OK
cdi0102 UP 8 OK
cdi0201 UP 8 OK
Frontends Servers (frontends-servers)
Host Status Services Actions
fe0101 UP 8 OK
fe0201 UP 8 OK
fe0401 UP 8 OK
fe0901 UP 7 OK 1 WARNING
fe1101 UP 8 OK
fe1301 UP 8 OK

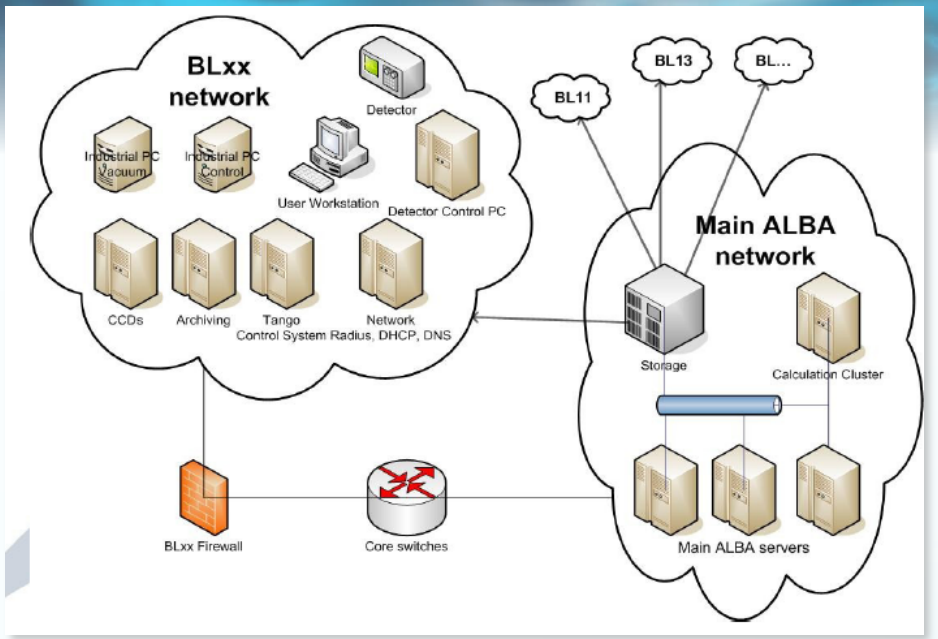
Design choices

- Ethernet As A fieldbus
- cPCI and Industrial PCs (diskless for the accelerators) and with HD for the Beamlines
- Tango as a middleware, Sardana as the SCADA
- Mysql. Central Archiver for the machine handling about 10000 variables
- MRF (Timing),
- PLC based protection systems
- Central repository for the computing and control infrastructure (ccdb)
- Automatic code generation


CURRENT 100.299 mA
ID
FE
BL
Gap (mm)
Shutter
SCW30
BEND
IVU21
IVU21
MPW80
EU62
EU71
FE04 Closed MSPD
FE09 Closed MISTRAL
FE11 Closed NCD
FE13 Closed XALOC
FE22 Closed CLAESS
FE24 Closed CIRCE
Fe29 Closed BOREAS
298.0
275.5
273.0
Life Time
0h 06m
Curr*LifeT
11.5
Filling Mode
Avg. Pressure (mbar)
7.34e-09
Friday 01-Apr-2011 18:25:28
CURRENT
H
V
Orbit (RMS)
Orbit (Peak)
Emittance
Tune
SR commissioning. Max current 90.0 mA. April 1st, Evening

Ethernet as a fieldbus



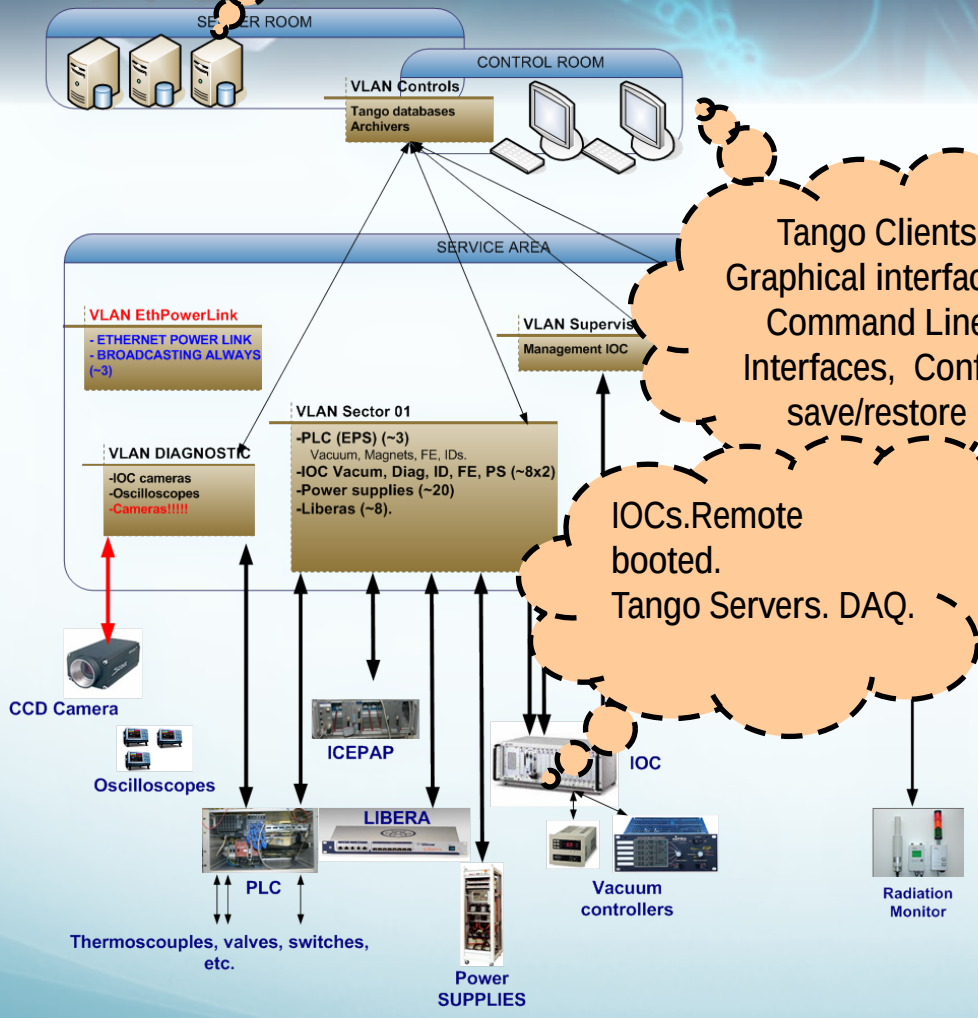


- Homogeneous installation
  - Reasonable Installation costs
  - Easy to maintain

IOCs, PLCs, Diagnostics Basler GigE ccd cameras, Power supplies, Oscilloscopes, Motor controllers, Electrometers (J. Lidon WEPMS02)… Application-specific hardware HVSpliters (J. Jamroz, WEPMS024)

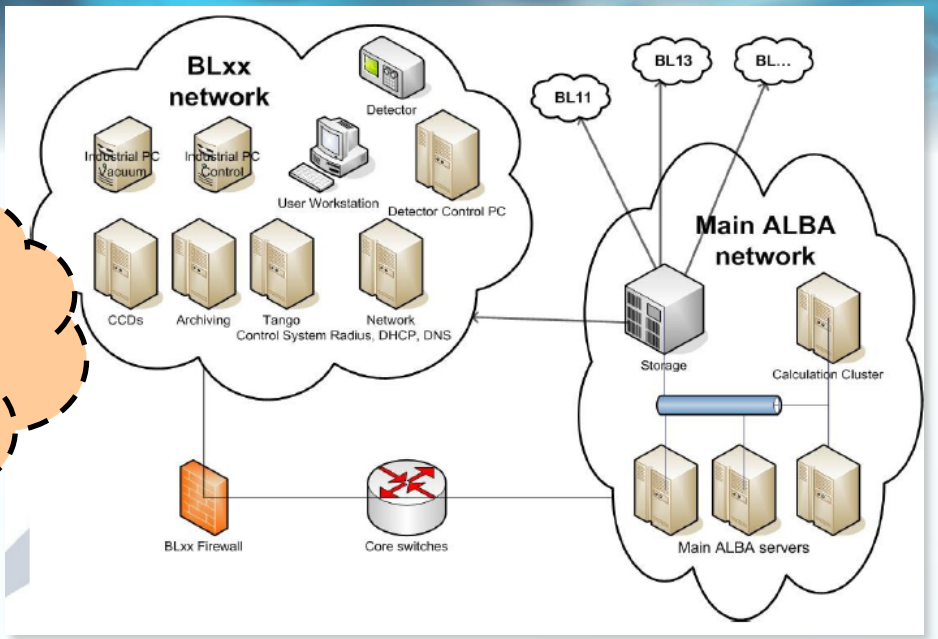
Ethernet as a fieldbus

TangoDB. Boot servers, Archivers, CCD servers. Network services Storage



Tango Clients
Graphical interfaces, Command Line Interfaces, Config save/restore

IOCs.Remote booted.
Tango Servers. DAQ.



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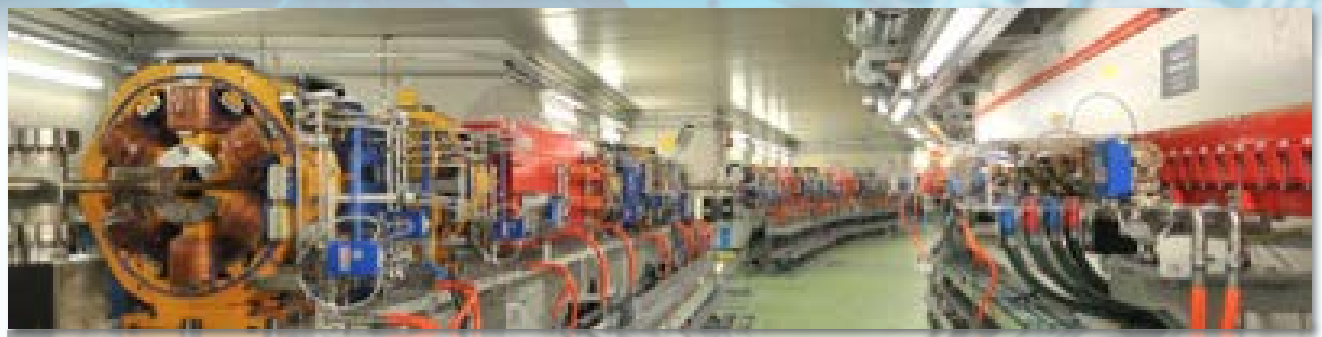
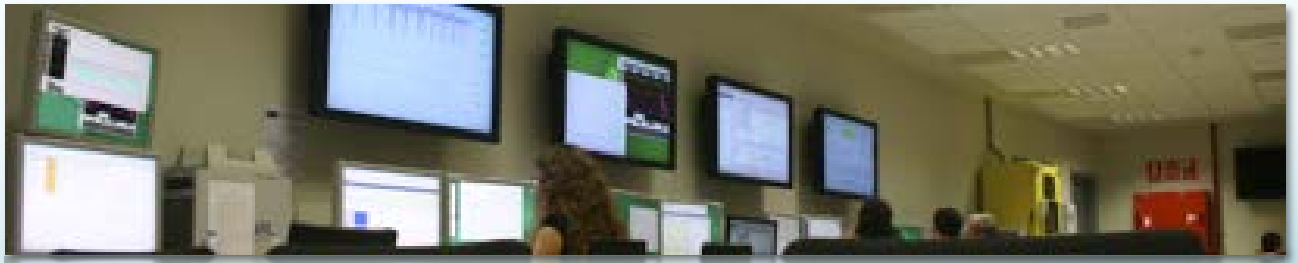
Tango as a middleware



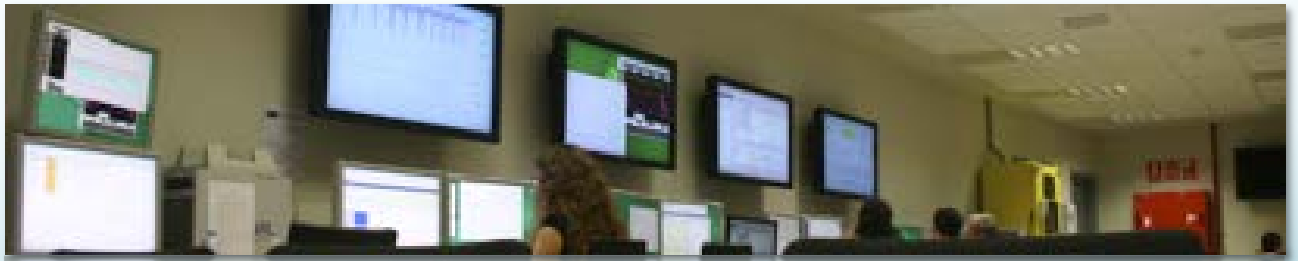
EPICS

PVSS II

TANGO



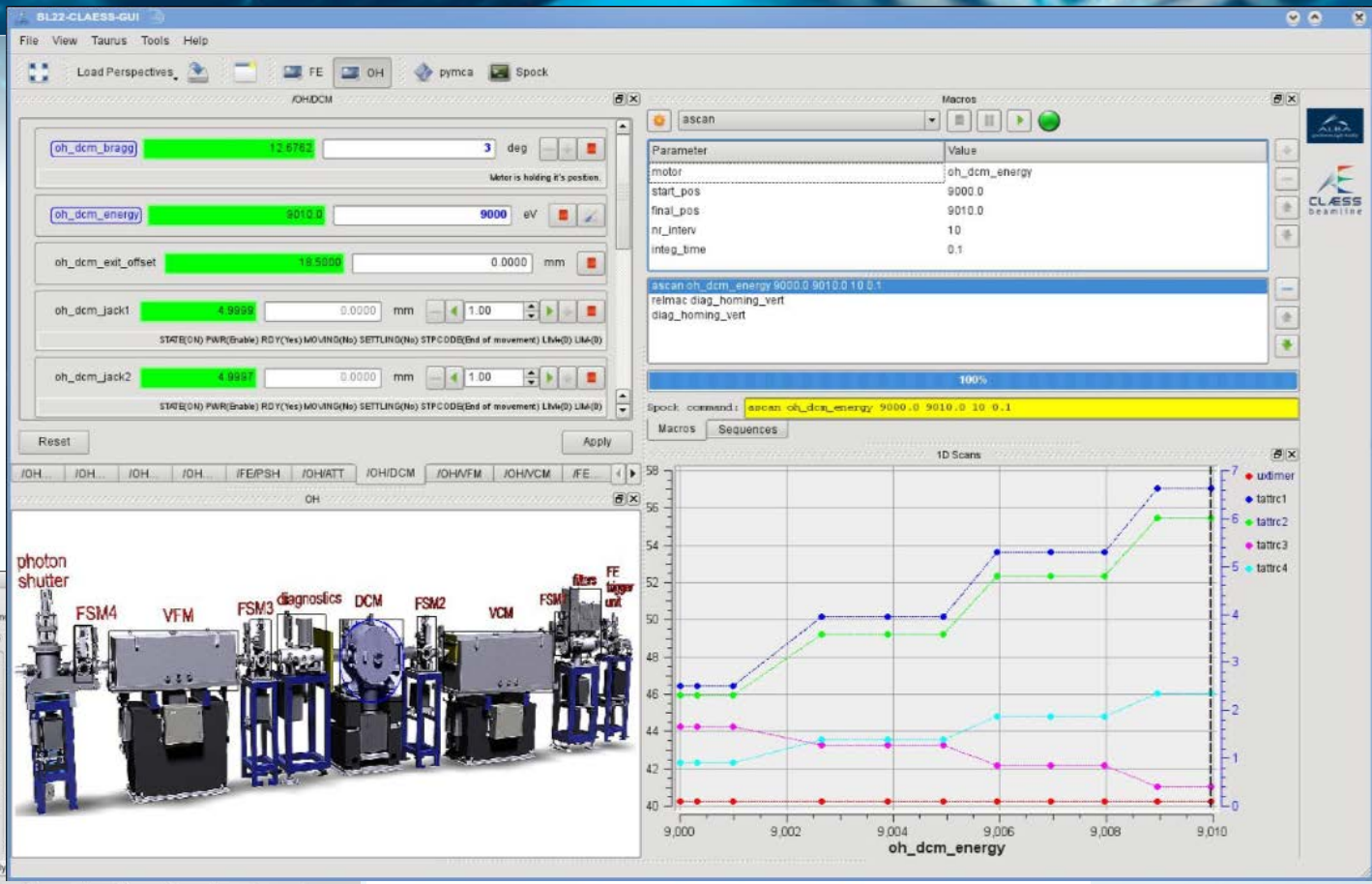
Tango as a middleware

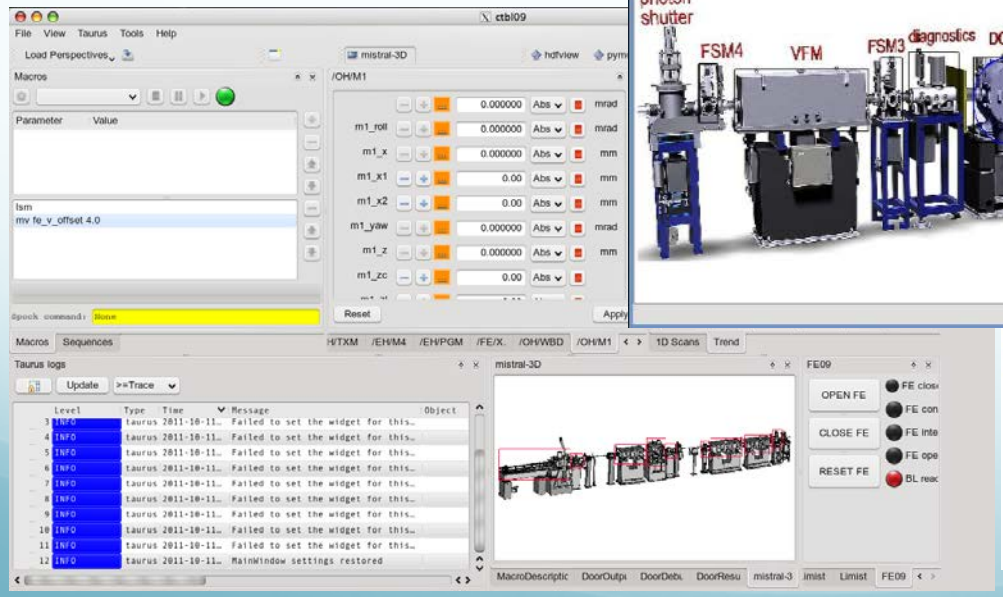


Sardana as the SCADA

WEAAUST01. T. Coutinho.

http://www.tango-controls.org/static/sardana/latest/doc/html/users/introduction.html#sardana-introduction





http://www.tango-controls.org/static/taurus/latest/doc/html/index.html

Real Time Hw, non deterministic Sw

- Timing System implemented on MRF hardware (O. Matilla WEPMS023, J. Moldes, MOPMU023)
  - cPCI form factor
  - About 100 EVR
  - Upgrade to implement fast interlocks (4 us) using the bidirectional fibers

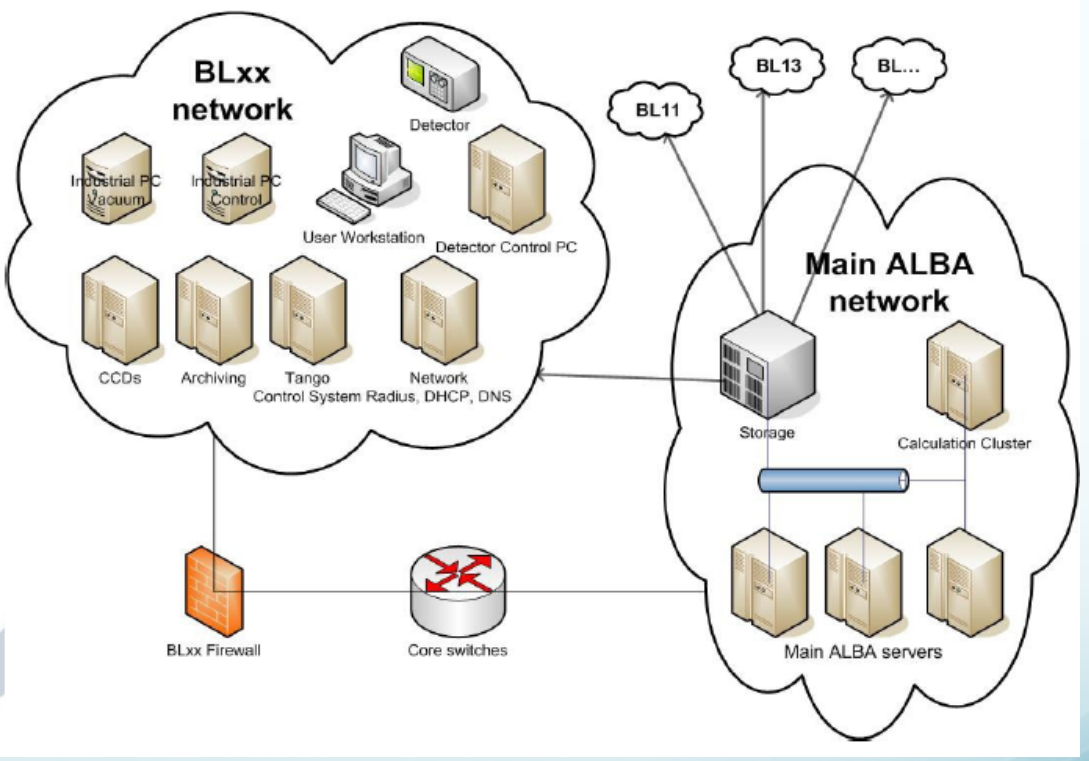
- Independent PLC installation (Pilz, SIL3,) for the PSS interlocks
  - SafetyBus

- Equipment Protection System Implemented with B&R PLCs (WEPMS023)
  - Ethernet PowerLink

- Other applications like LLRF implemented with specific FPGAs (A. Salom and the diagnostics group)

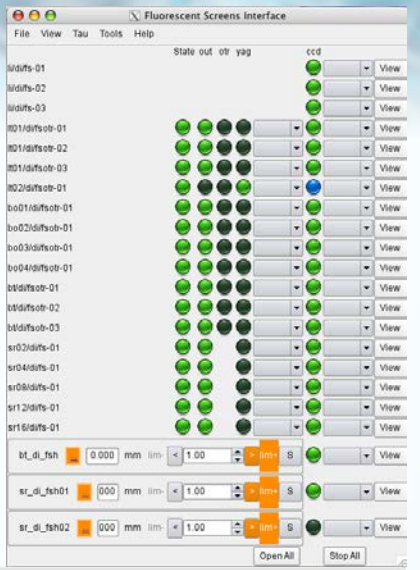
- IOCs run openSUSE11.1 (few windows XP) standard distribution.

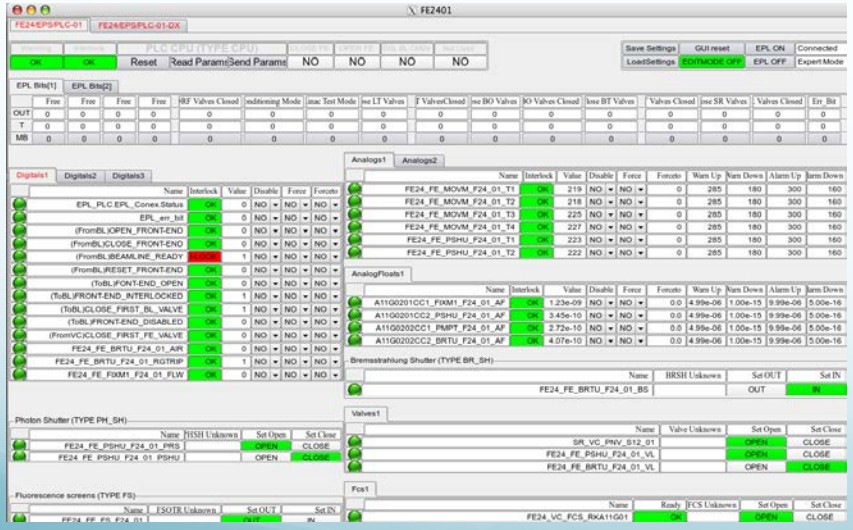
Ethernet, VLANS and firewalls

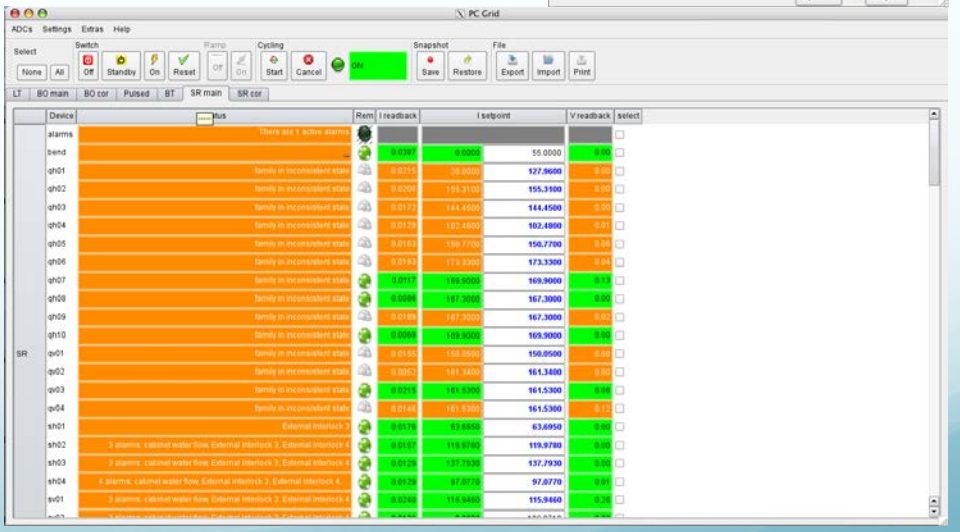


Automatic code generation

- Great advantages!!. Easier to develop, easier to maintain
- But, a big effort is needed to keep the central repository consistent.
  - Although still a lot of coding has been needed!!
    - SVN, sourceforge, RPM (blissinstaller)







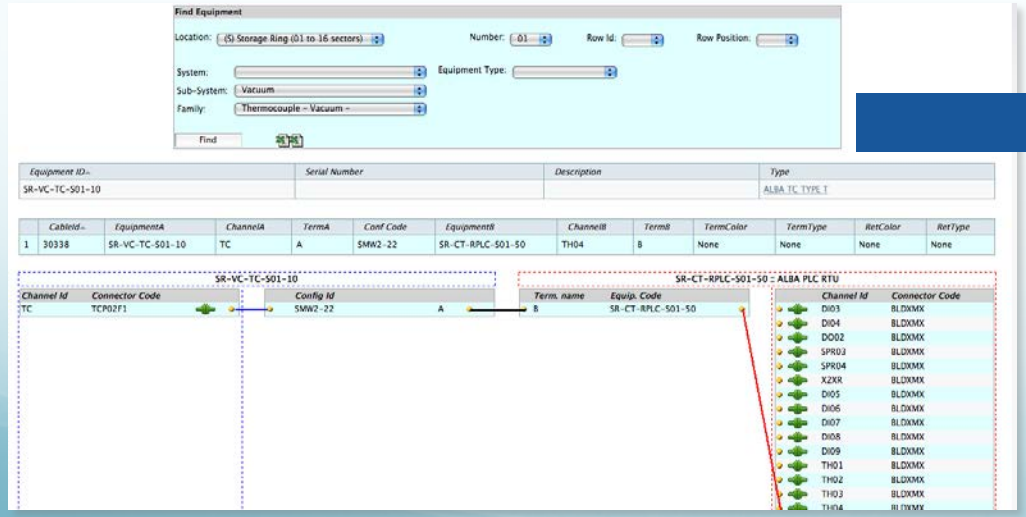
Central Repository

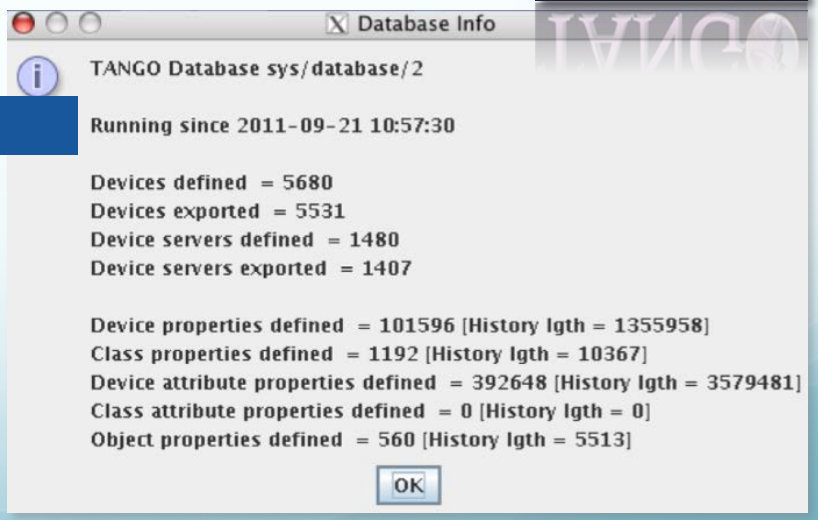
ccdb:

- Equipments, connectors and cable types,
- Instances of equipments and cables (naming conventions)
- Documentation files
- Installation logs
- Source for automatic code generation and creation of Tango devices

Next:

- Inventory. Manage serial numbers and integrate maintenance data





ccdb: The computing and cabling DB

- Web (in Plone at the moment) interfaced to a RDBMS mysql

Find Equipment Network Info

Location: (A) Technical/Service Area (1 | Number: 01 | Row Id: | Row Position:

System: | Equipment Type:

Sub-System:

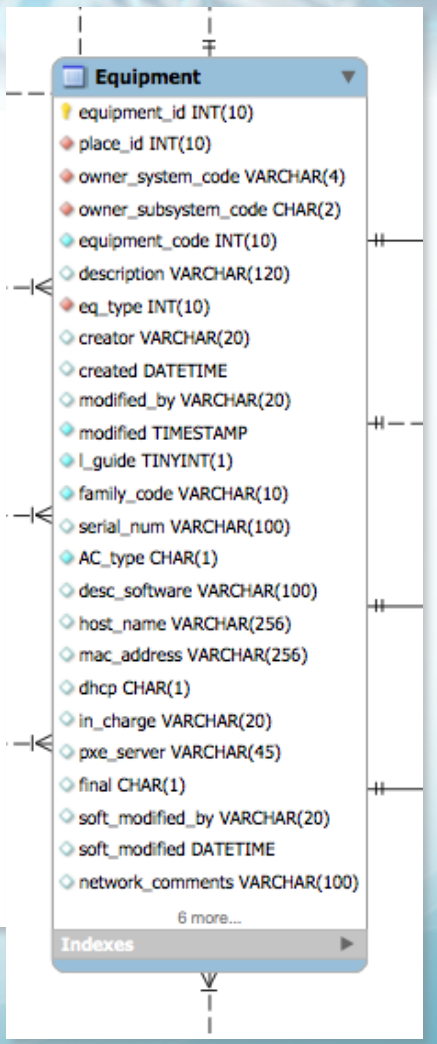
Family: | Responsible: ALL

DHCP: ALL | Boot Server: ALL

Final Position: ALL | Hostname:

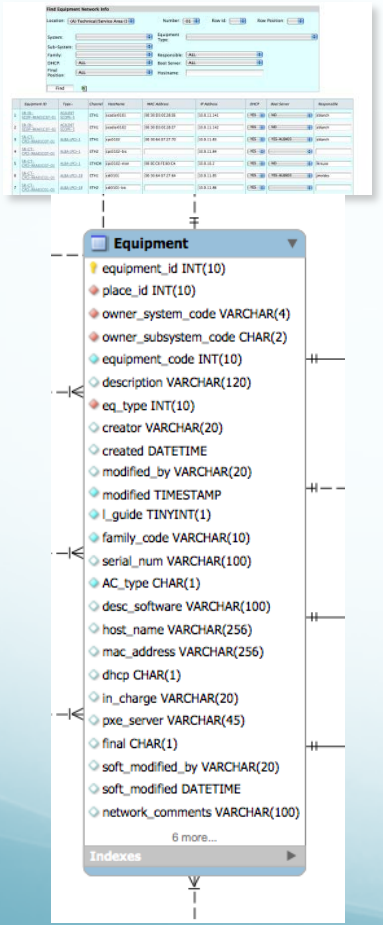
Find

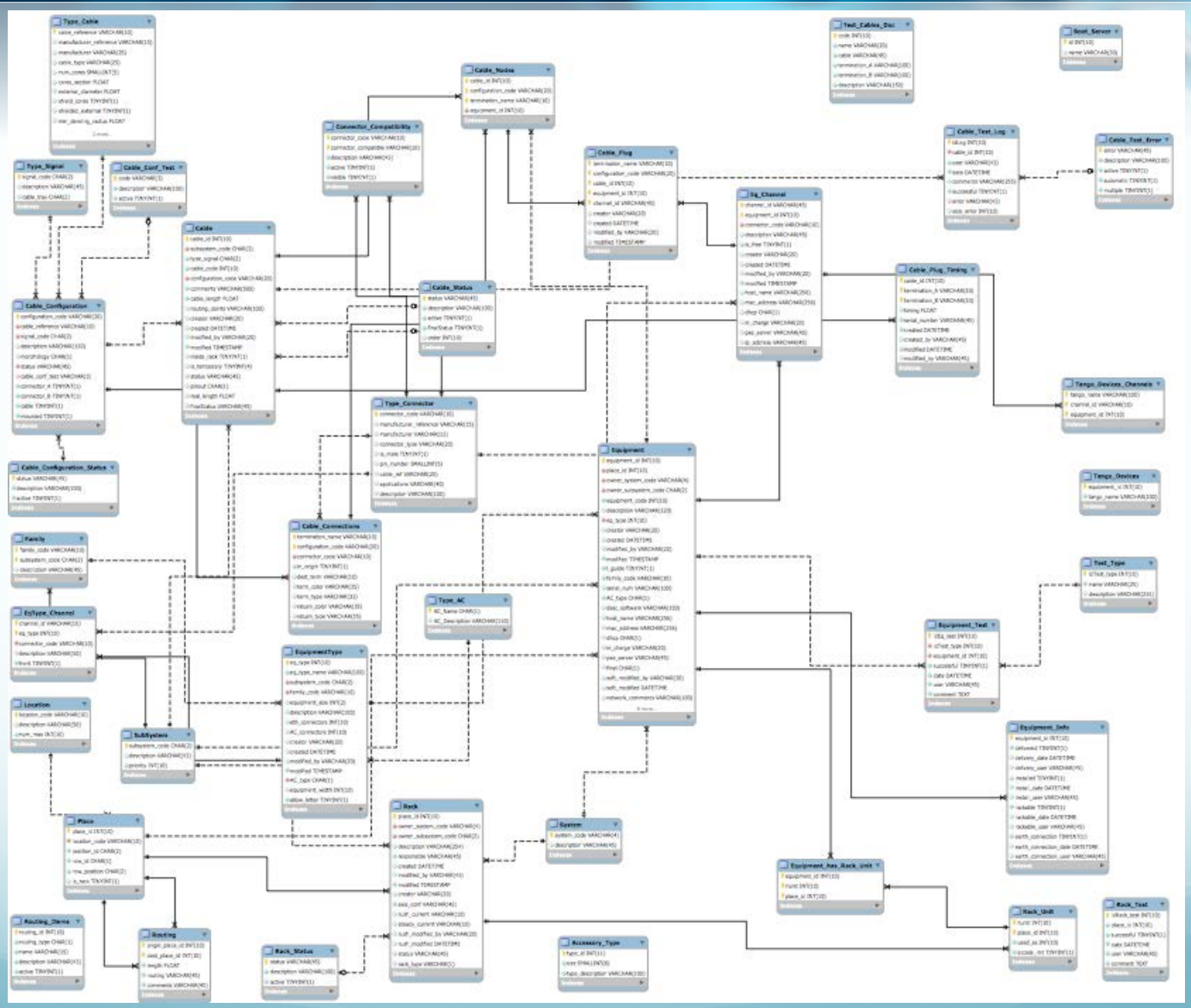
	Equipment ID	Type	Channel	HostName	MAC Address	IP Address	DHCP	Boot Server	Responsible
1	SR-DI-SCOP-RKA01C07-01	AGILENT SCOPE-5	ETH1	scodisr0101	00:30:D3:0E:28:E6	10.0.11.141	YES	NO	sblanch
2	SR-DI-SCOP-RKA01C07-02	AGILENT SCOPE-5	ETH1	scodisr0102	00:30:D3:0E:28:E7	10.0.11.142	YES	NO	sblanch
3	SR-CT-CPCI-RKA01C07-01	ALBA cPCI-1	ETH1	cpc0102	00:30:64:07:27:70	10.0.11.83	YES	YES-ALBA03	sblanch
4	SR-CT-CPCI-RKA01C07-01	ALBA cPCI-1	ETH2	cpc0102-bis		10.0.11.84	YES		
5	SR-CT-CPCI-RKA01C07-01	ALBA cPCI-1	ETHCM	cpc0102-mon	00:0E:C6:FE:60:CA	10.0.10.2	YES	NO	lkrause
6	SR-CT-CPCI-RKA01C01-01	ALBA cPCI-1B	ETH1	cdi0101	00:30:64:07:27:64	10.0.11.85	YES	YES-ALBA03	jmoldes
7	SR-CT-CPCI-RKA01C01-01	ALBA cPCI-1B	ETH2	cdi0101-bis		10.0.11.86	YES		



ccdb: The computing and cabling DB

ccdb: mysql





ccdb: The computing and cabling DB

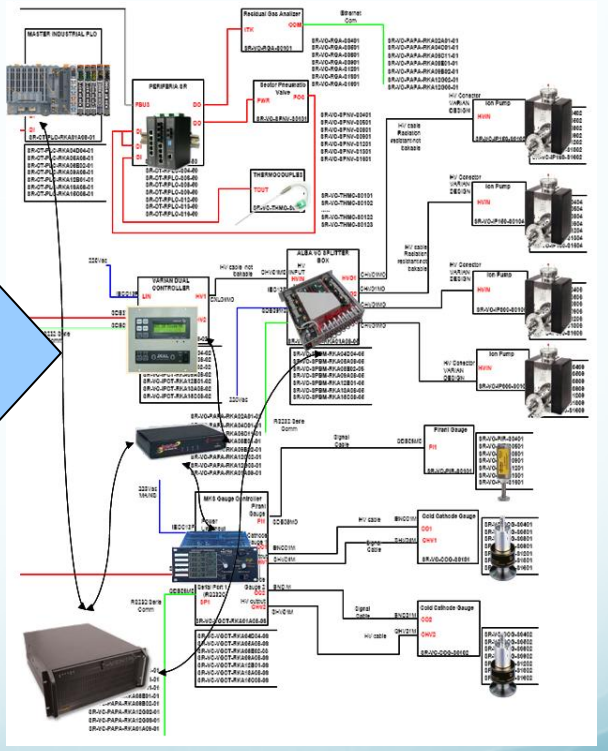
- Automatic code generation. Tango devices and attribute names

MOPMN003 S. Rubio-Manrique

http://www.cells.es/Intranet/MISApps/ccdb/find_equip_network_info

Getting Started Latest Headlines BLISS Talks — ESRF

1481	LI-DI-LIB-RKA04A04-01	Instrumentation Technologies LIBERA Electron	ETH1						
1482	LI-DI-LIB-RKA04A04-01	Instrumentation Technologies LIBERA Electron	ETH3						
1483	LT-CT-CPCI-RKA04A03-01	ALBA cPCI-30	ETH1	cdi0403	00:30:64:06:E9:BC	84.89.238.2	YES	YES-ALBA02	rsune
1484	LT-CT-CPCI-RKA04A03-01	ALBA cPCI-30	ETHCM						
1485	LT-CT-CPCI-RKA04A03-01	ALBA cPCI-30	ETH2						
1486	LT-CT-CPCI-RKA04A04-01	ALBA cPCI-9B	ETH1	cdi0404	00:30:64:06:E9:DA	84.89.238.3	YES	YES-ALBA0	rsune
1487	LT-CT-CPCI-RKA04A04-01	ALBA cPCI-9B	ETHCM						
1488	LT-CT-CPCI-RKA04A04-01	ALBA cPCI-9B	ETH2						
1489	LT-CT-IPAP-RKA04A07-01	ESRF IcePAP MASTER-1	ETH	icedi0401	00:0C:C6:76:01:C7	84.89.238.81	YES	NO	gcuni
1490	LT-DI-FSOTR-T01-01	ALBA DI FSOTR	ETH1	dccd0401		84.89.235.21	YES	NO	sblanch
1491	LT-DI-FSOTR-T01-02	ALBA DI FSOTR	ETH1						
1492	LT-DI-FSOTR-T01-03	ALBA DI FSOTR	ETH1						
1493	LT-DI-FSOTR-T02-01	ALBA DI FSOTR	ETH1	dccd0402		84.89.235.22	YES	NO	sblanch
1494	LT-DI-LIB-RKA04A04-01	Instrumentation Technologies LIBERA Electron	ETH2						
1495	LT-DI-LIB-RKA04A04-01	Instrumentation Technologies LIBERA Electron	ETH1						
1496	LT-DI-LIB-RKA04A04-01	Instrumentation Technologies	ETH3						



Automatic code generation (PLC)

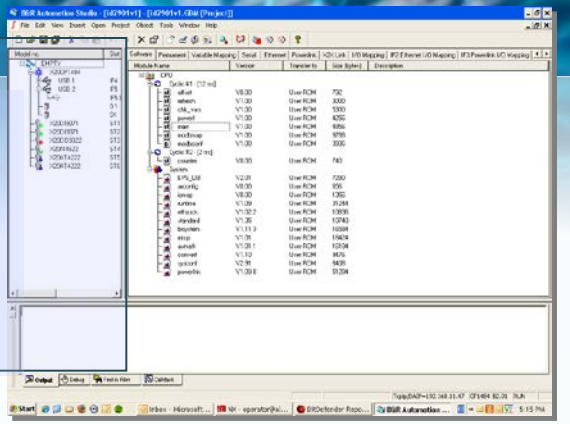
ALBA ccdb DB

MySQL

APJ

APJ file

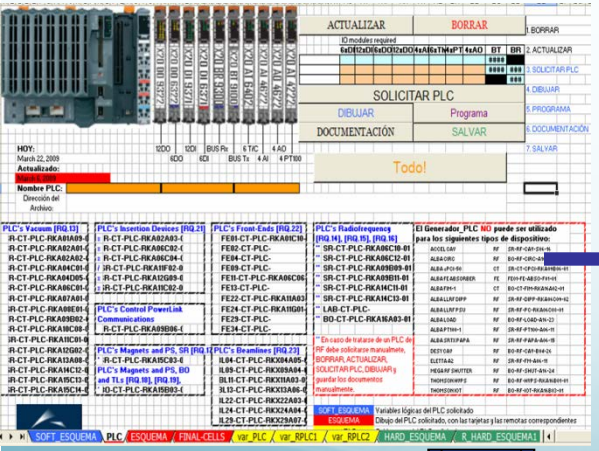
PLC Common INIT file:
- Coms. Libraries (Modbus, EPL)
- Data structures
- Common variables
- Common SW tasks



PLC Programming SW
(B&R Automation Studio)

Programmer Inputs

Modbus/TCP



XLS – VBasic script

VBasic

XLS

XLS files

PLC documentation: I/F with devices, I/O channels assignation, etc.

PLC code generation:

PLC variables declaration

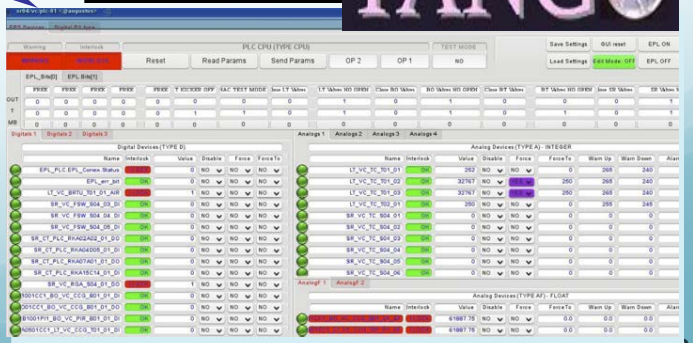
PLC Modbus mapping and variables allocation.

PLC standard services: disable and force variables, alarm/warning thresholds checking, permanent memory storage, etc.

Modbus Device Server

AlbaPLC Device Server

TANGO



Lessons learned and Conclusions

- Ethernet as a fieldbus, provides, homogeneity and longevity.
  - Finding a balance between functionality and security is tough (firewalls)

- Tango worked well as a middleware. The notification system (about to be replaced) was the biggest source of problems. Nagios helped out to keep it stable.

- ccdb: A central repository for the installation is crucial and has to be given priority from the beginning.
  - A considerable effort is needed to keep it up-to-date.

- Automatic code generation reduces errors, make subsystems easier to maintain

- Using standard distributions (openSUSE, Ubuntu..) and diskless when possible makes the maintenance easy.

- In most cases, deterministic requirements are successfully implemented by hardware (FPGA, PLCs., dedicated Communication).

Thank you

Ack: ESRF, E. Taurel, A. Homs, V. Rey, E. Detona, L. Claustre, J.M. Chaize, J. Meyer, A. Götz, the Bliss group, Soleil Synchrotron, N. Leclercq, P. Betinelli, A. Buteau. M.Ounsy., Elettra, C. Scafuri, M. Lonza, and the whole Tango collaboration, PSI, T. Korhonen, A. Luedeke, B. Kalantari Diamond, M. Heron, and many others..