N_ToF Experiment DAQ Hardware/Software Upgrade

A. Masi, M. Donze`, A. Hernandez Prieto

Contents

EN-STI Equipments Control & Electronics (ECE) Section takes the responsibility to provide IT & electronics support to n_ToF facility

Section leader: Alessandro Masi

Mandate:

- Design, installation and maintenance of control and acquisition systems on different platforms (PLC,PXI,VME)
- Strong skills in control systems for movable devices (e.g. scrapers, collimators, shielding and target) and positioning control systems in hard radioactive environment at few um accuracy
- Automatic test and measurement benches development
- General Electronics support and development
- Radiation effects on the electronics monitoring and study

1–New technical support organization

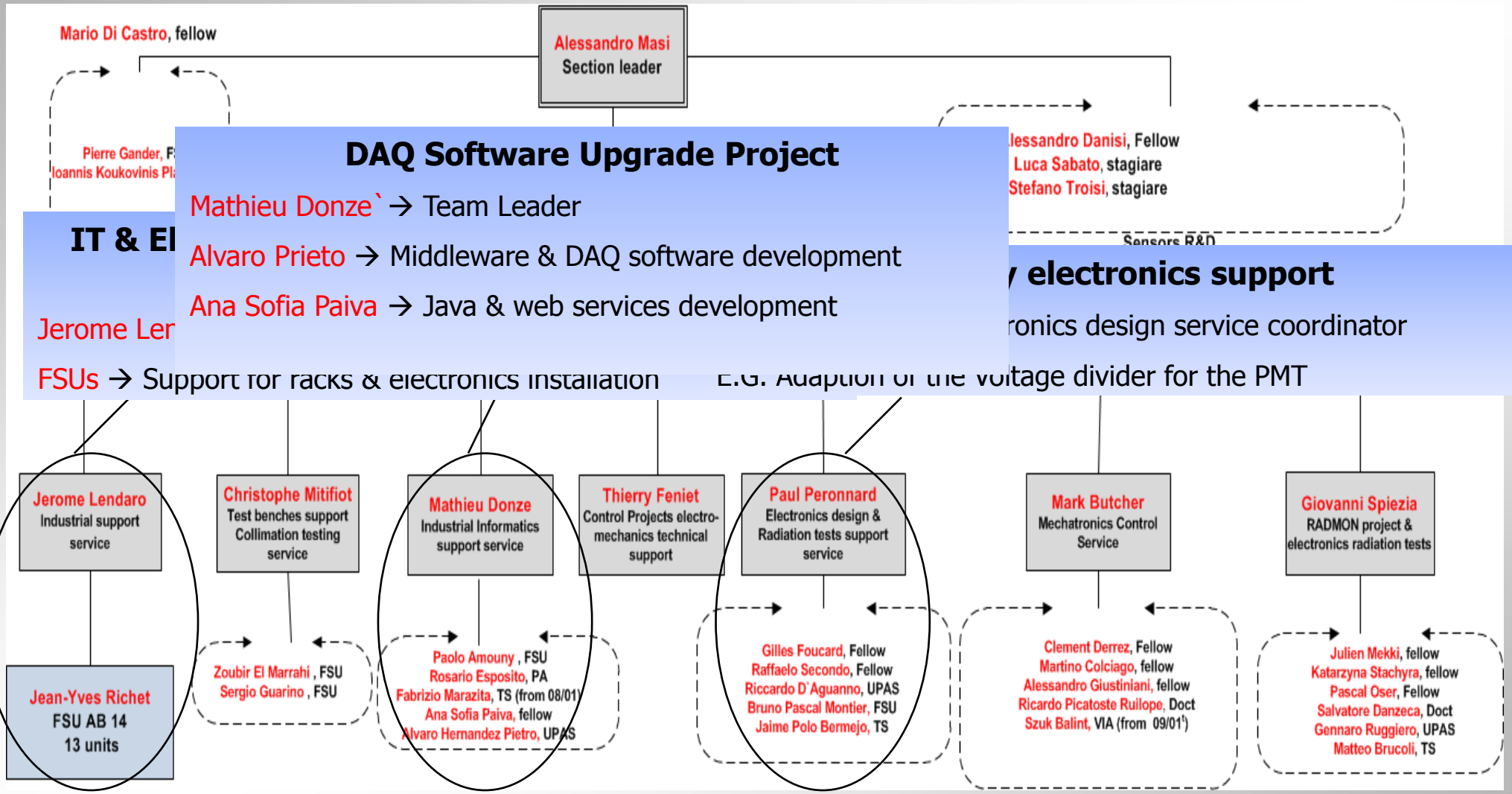
Accelerator	Project	Support for operation	New controls development/ consolidation	R&D
LHC	Collimators phase 1 and phase 2	√	√	√
	TDI in IP2 and IP8	√	√	√
	RADMON, radiation tests on the electronics	√	√	√
SPS	CNGS: target and shutter	√		
	Scraper	√		
	UA9 Crystal Experiment	√	√	√
PS	Beam Stoppers	√	√	
	DUMPs	√	√	
North, East Exp. Area	Movable obstacles, Targets	√	√	√
Linac 2, Linac 3, Leir	SLITs	√		
Isolde/ HIE-Isolde	Front-end FE6, picomotors, slits	√		
Linac 4	Beam stoppers and dumps		√	
AD	Scraper, Target			√
CTF3	Laser control system			√
	Tail Clipper	√		
RILIS	Interlocks System	√	√	
Photo Injector Lab	Monitoring and control	√	√	√
Ntof	Daq system	√	√	√

Maintenance & long term support/ support to the operation & stand-by service

DAQ software & experiment controls architecture upgrade- Electronics & IT support

Test & development of new DAQ cards for EAR2 and EAR 1 upgrade

1–New technical support organization



The ECE section will ensure in best effort the:

- Electronics & IT support on the construction of the EAR2
- Upgrade of the DAQ software and experiment management software architecture
- General electronics support
- Maintenance and support during the operation (i.e. piquet service)

In order to do that:

- A new "standard" experiment data interchange middleware is being developed
- The installation of new detectors, software and/or hardware modifications should be coordinated by the ECE section
- S. Montesano will collect the collaboration requests

Detectors Specifications review

Detector	Rise Time (ns)	Signal BWD (MHz)	Sampling rate required (GS/s)	Signal Range (V)	Required Noise Level (V)
TAC	2	175	1.75	0 ÷ -0.2	0.0008
MGAS	10-20	35	0.35	0 ÷ -0.5/0 ÷ -5	0.004
MGAS2	10-20	35	0.35	0 ÷ 0.5/0 ÷ 5	0.01
SIMON	100	3.5	0.035	0 ÷ -5	0.06
C6D6	2	175	1.75	0 ÷ -2	0.004
K6D6	4	87.5	0.875	0 ÷ -0.5	0.001
PPAN	4	87.5	0.875	0 ÷ -0.2	0.0015
PPAC	20	17.5	0.175	0 ÷ -0.1	0.0015
DIAMON1	0.8	437.5	4.375	0 ÷ 0.05	0.0025
DIAMON2	80	4.375	0.04375	0 ÷ 0.5/ 0 ÷ 1	0.003
FIC	20-30	17.5	0.5	0 ÷ 1	0.005

DAQ Cards Specifications Review

- **Dynamic range:** 10 bit for all the channels with proper frontend or 12 bit with only few input gains
- **Full Scale Range:** +/- 2.5 V with offset regulation (10 bit version) or +/- 5 V without offset regulation on 12 bit
- **Bandwidth:** > 500 MHz < 1 GHz- 800 MHz ok for all the detectors
- **Coupling:** DC with adjustable BIAS (+/- 2.5 V)
- **Sampling Frequency:** > 1 GS/s- Selectable from 1 GS/s up to likely more than 4 GS/s
- **Operational mode:** Burst mode. 100 ms time window should be acquired and stored locally. Acquisition repetition rate: 1 Hz. The data should be transferred to the Host in less than 1.2 s
- **Triggering:** External trigger
- **Synchronization:** synchronization between channels better than 1 sample
- **Quantity:** 32 channels at 1 GS/s and 8 channels at more than 3 GS/s

The New DAQ cards evaluation criteria

- **Performances:** Dynamic range and bandwidth are the most important but a possible relaxation should be discussed case by case (e.g. DC coupling)
- **Experimental results:** General recommendation is do not believe to the datasheets. An accurate characterization campaign should be performed on sample units. The characterization to be useful requires specific instrumentations and a full compliance of the standards (i.e. IEEE 1241)
- **Long term support:** The cards, drivers, bus type must be supported by our section for the entire life time of the project. Standard solutions supported by BE/CO are strongly recommended
- **Price:** The lower the better

1. **Definition and setting up of a an Experiment Middleware : DIM**
2. **Upgrade the DAQ software to make it modular and compatible with new DAQ cards**
3. **Replacement of the trigger management box with a standard BE/CO solution based on timing cards**
4. **Build up n_TOF Control Center Applications**
5. **New Experiment Configuration Management**
6. **Logging system upgrade**
7. **Webservices renovation**

Advantages:

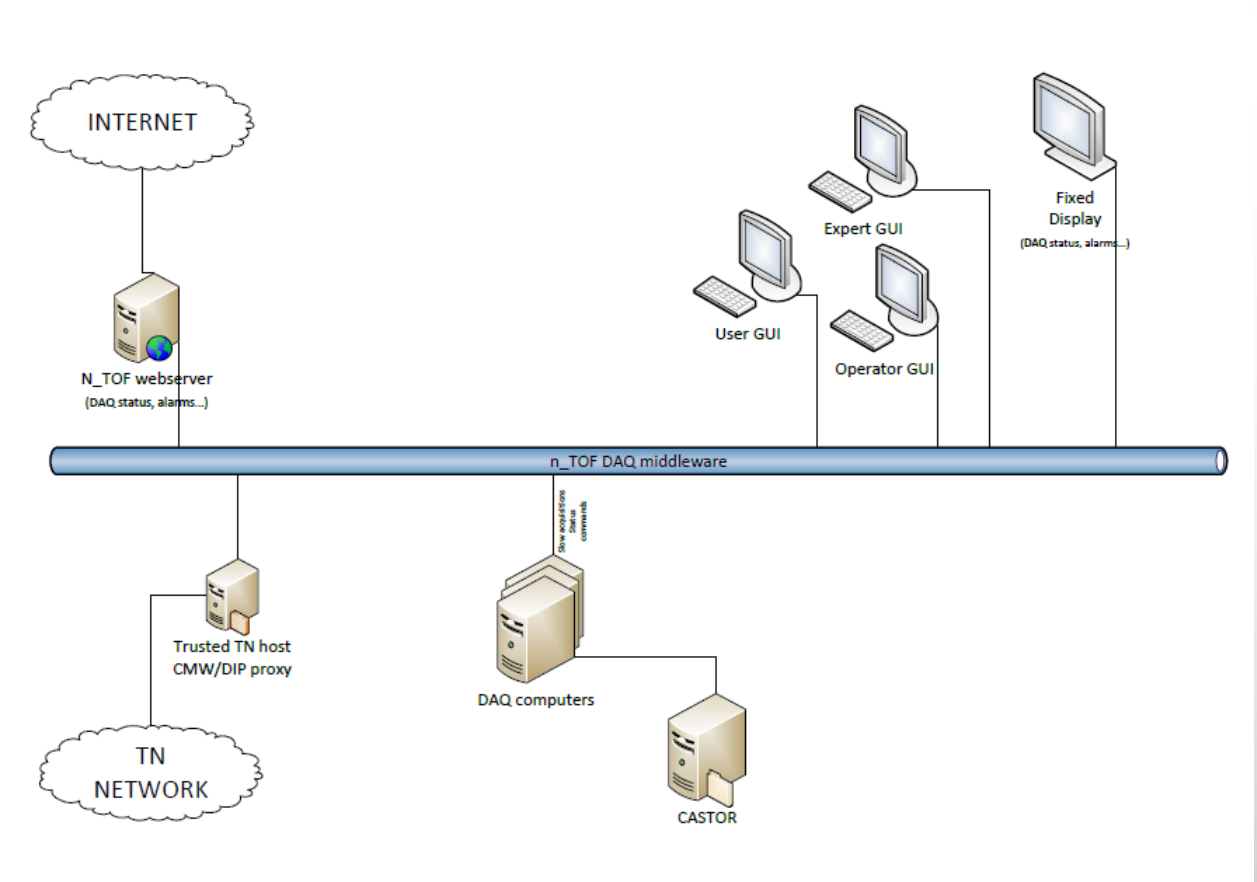
- Make easier the experiment data distribution (i.e. slow parameters, settings, commands) among different clients/webservices
- Make easier the integration of new DAQ cards/detectors/instruments
- Improve the data synchronization
- Allow Data Clients multiplatform

Why the DIM choice ??

- DIM (Distributed Information Management System) is a communication system for distributed / mixed environments, it provides a network transparent inter-process communication layer

  http://dim.web.cern.ch/dim/
- DIM is open source, multi-platforms and supported at CERN
- DIM has been successfully used as middleware in the LHCb experiment, the LHC Collimators low level communication layer and the UA9 experiment
- DIM has proven to be reliable and easy to integrate both on machines on GPN and TN

3.1–Definition and setting up of a an Experiment Middleware : DIM

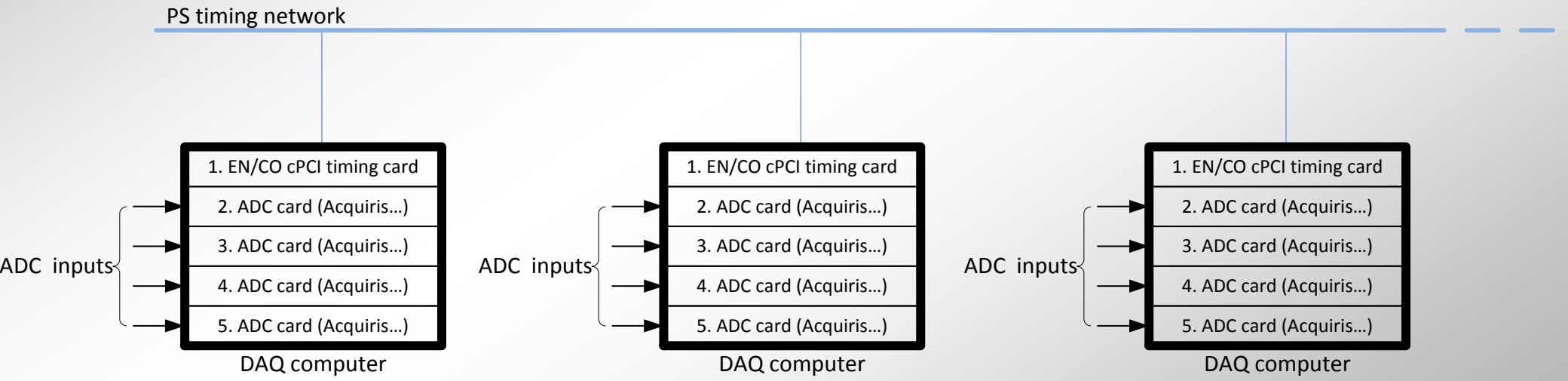


- **Advantages:**
  - Modularity
  - Easiness to add new DAQ systems/cards without touching the software
  - Easier maintainability
  - Possibility to mix different DAQ cards ensuring the compatibility of the raw data format
  - Possible migration to Linux 64 bit

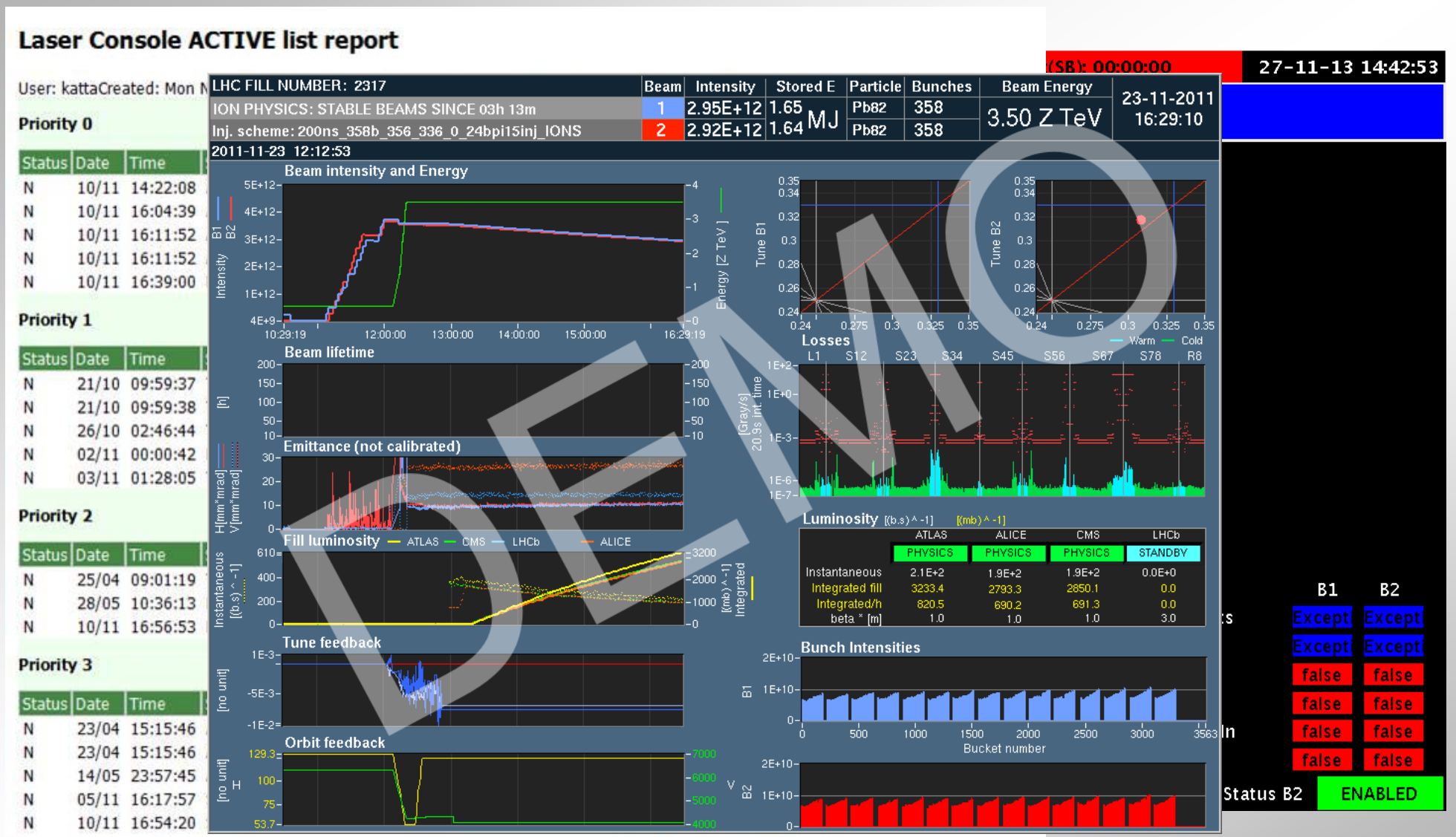
Advantages:

- Modularity
- Timing synchronization between different systems at ns level
- Cabling simplification

Layout:

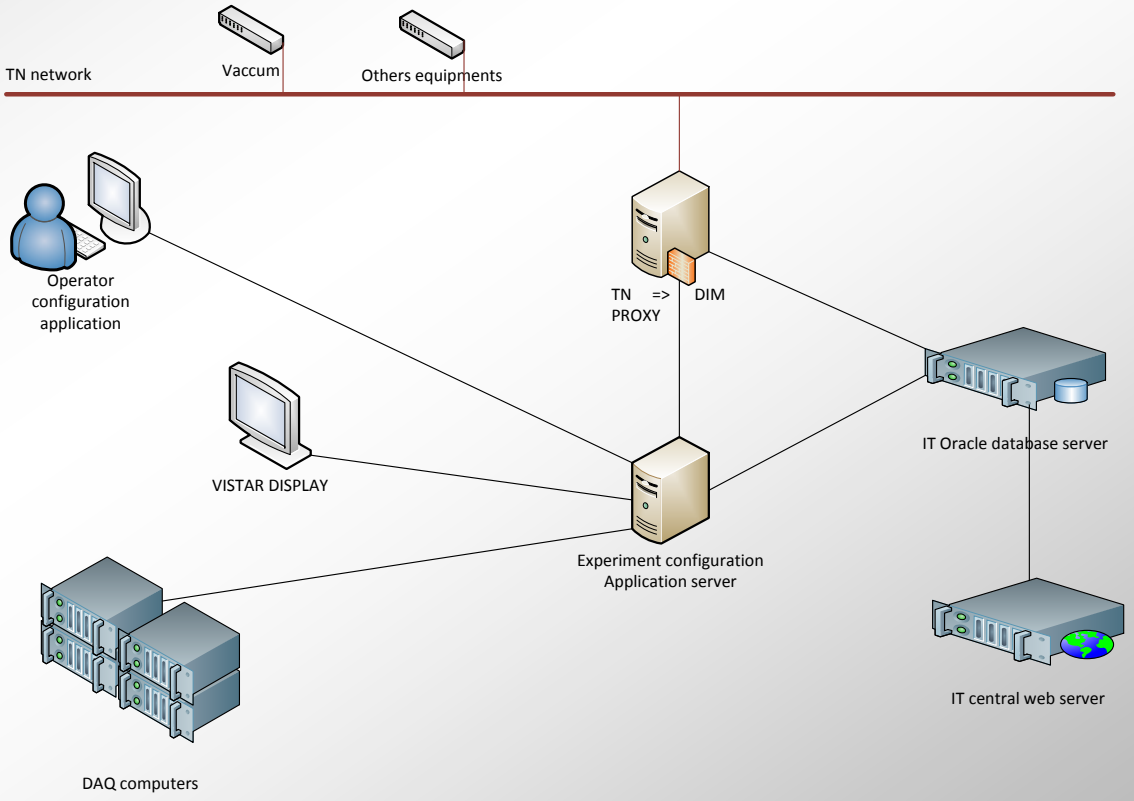


3.4–Build up n_TOF Control Center Applications



- **Advantages:**
  - Modularity
  - Easier tracking and changes history
  - Easier configuration info distribution
  - Storage of configuration parameters in a Oracle Database (Standard IT service)

- **Layout:**



- **Advantages:**
  - Use Oracle standard IT services
  - Slow parameters stored in the Database at each run
  - Configuration file stored in the Database at each run
  - Target slow parameters will be stored in the LHC standard logging system

- **To be decided storage files organization**

  Possible options:
  - Keep the slow parameters file as it is now
  - Add slow parameters in each DAQ logging file
  - Leave just the slow parameters in the Database

Advantages:

- Standard IT service to host the website
- Vistar as webpage
- Logbook

4–Timeline

Dec 2012

- Definition of the modifications/upgrades and preparation of the functional and technical specs

Oct 2013

- Definition and setting up of DIM as Experiment Middleware

Nov 2014

- Upgrade the DAQ software to make it modular and compatible with the new DAQ cards

Dec 2014

- Replacement of the trigger management box with a standard BE/CO solution based on timing cards

4–Timeline

Feb 2014
- Setting up of a new Experiment Configuration Management

March 2014
- Logging system upgrade

April 2014
- Build up n_TOF Control Center Applications/ Webservices renovation

May 2014
- Commissioning

5–Conclusions

- **The proposed software and hardware upgrades are under development. They should be completed by next May 2014**
- **The increased modularity will allow an easy setting up of the DAQ system for the EAR2**
- **The new acquisition cards should be bought by the Q2 2014**
- **The more visible advantages of the DAQ upgrade will be an experiment operation control software LHC like (i.e. more friendly and effective) and a professional support to the operation**