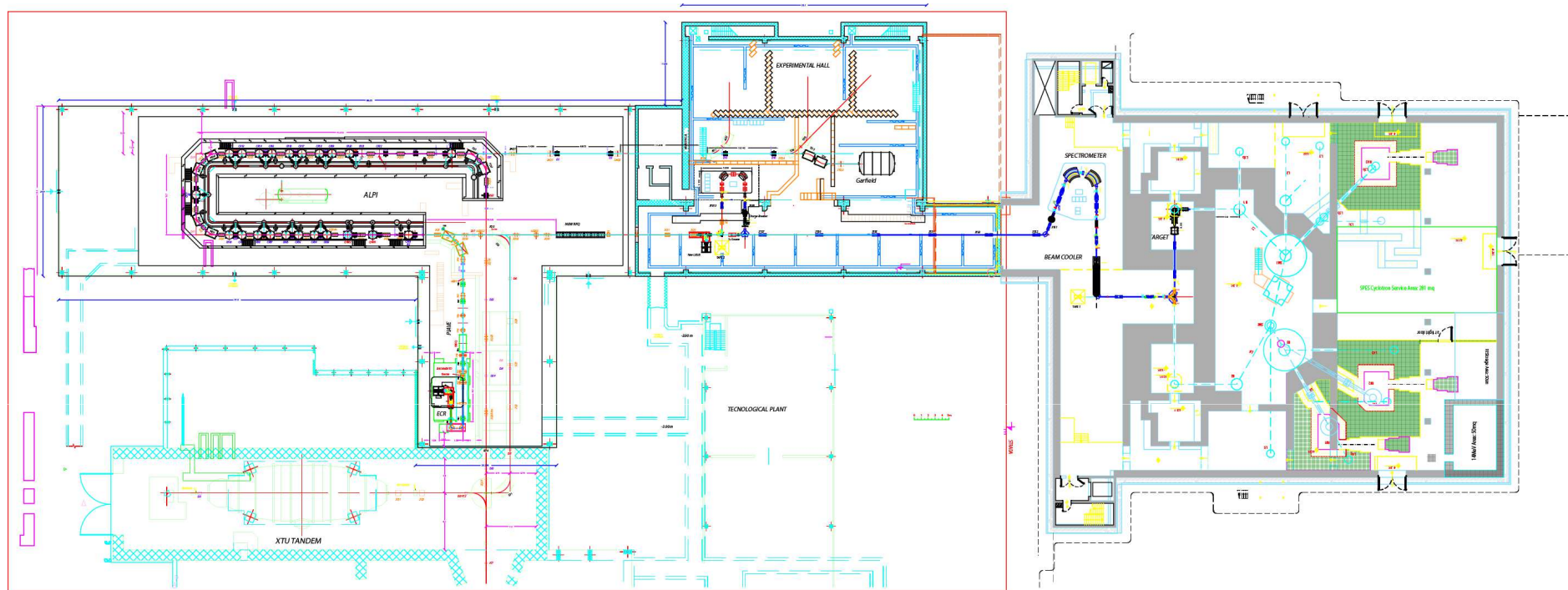


SPES Control System



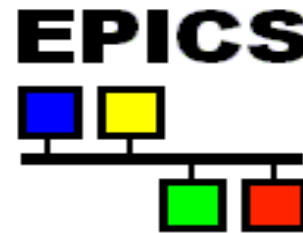
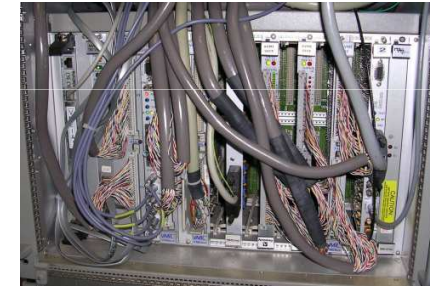
L. Antoniazzi, G. Bassato, A. Battistella, M. Bellato, J. Bermudez, M. Biasotto, D. Bortolato, S. Canella, O. Carletto, M. Contran, S. Fantinel, M. Giacchini, M. Gulmini, R. Isocrate, M. Montis, R. Ponchia, J. Vasquez

Topics

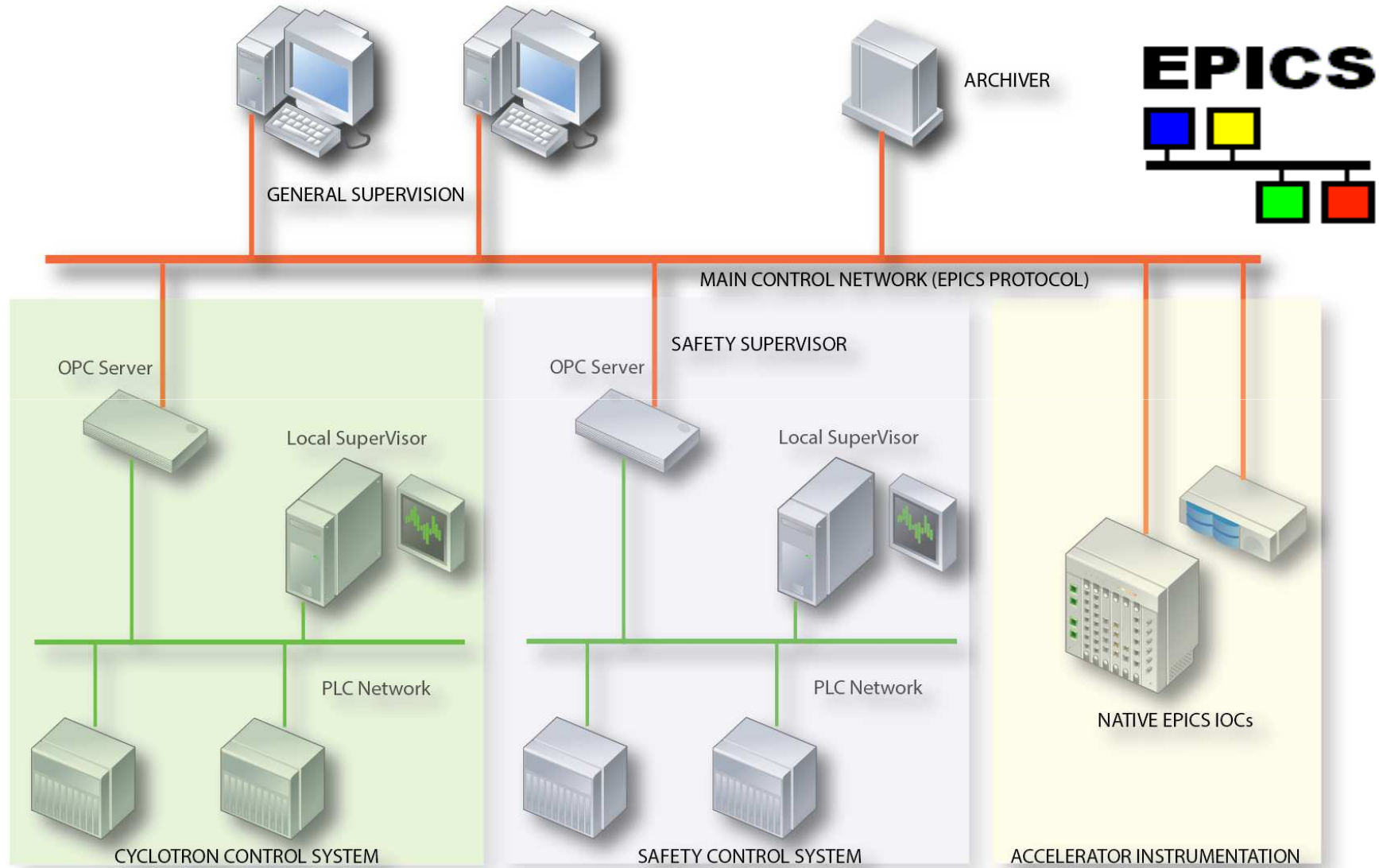
- Architecture
- Infrastructure for controls
- Hardware developments
- Subsystems layout
- Software developments

Driving Concept : Standardization

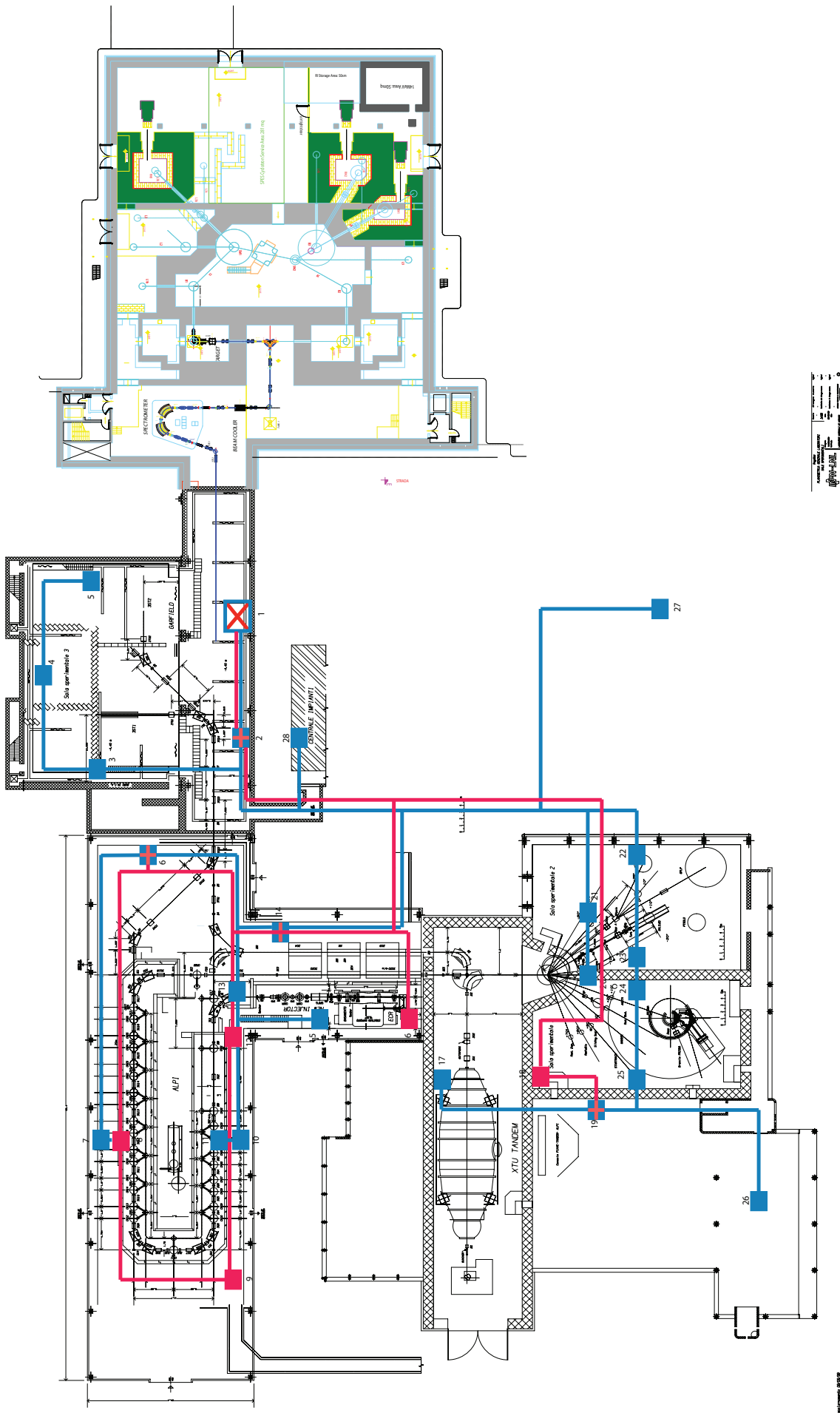
- Mandatory for SPES integration
 - Has forced a revision of existing systems
 - Extended to all accelerating machines and services
- Hardware
 - Field bus, PLC , custom
- Software
 - EPICS on Linux O.S
- Services
 - Archiving, networking, backup



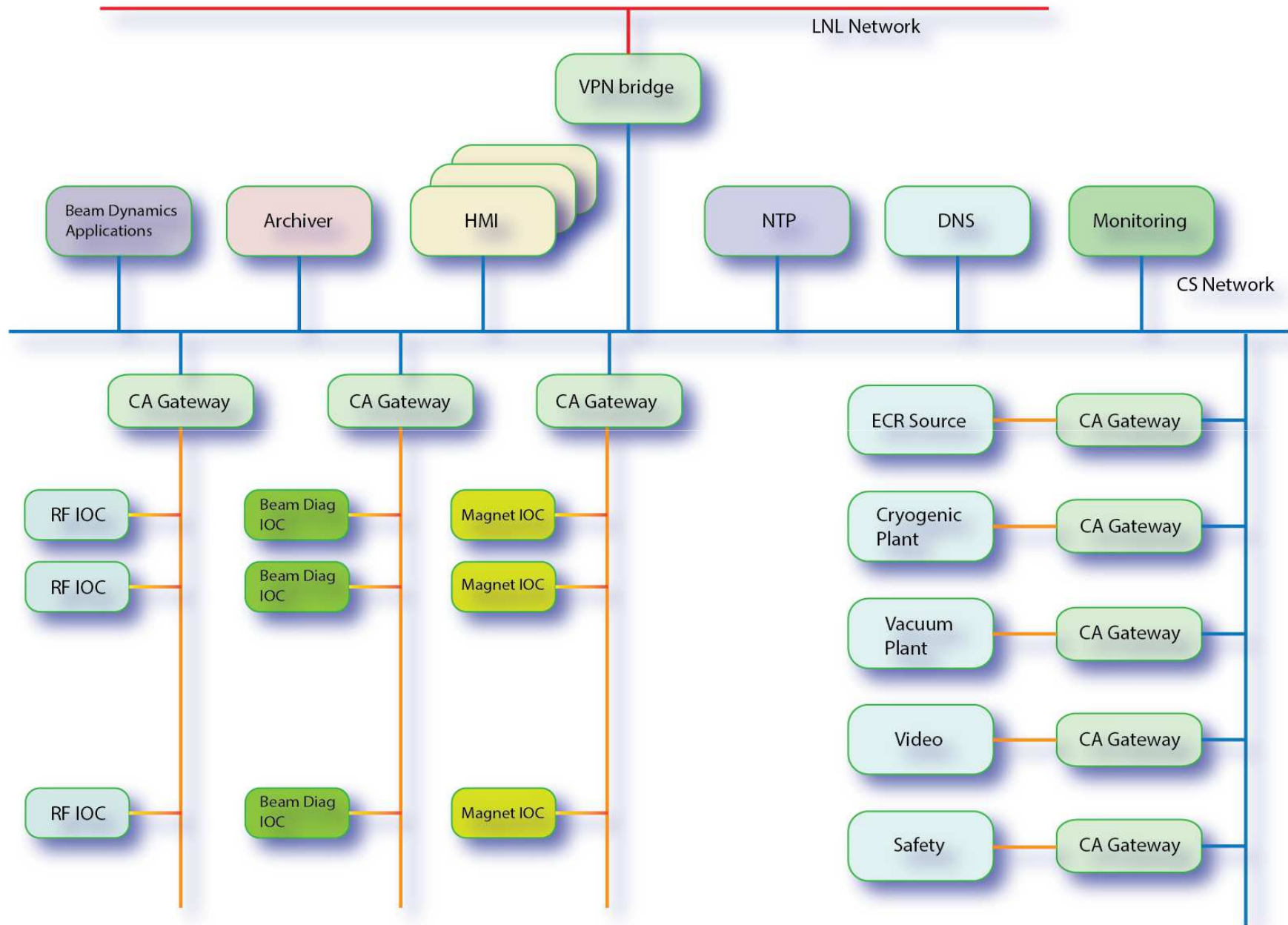
General Architecture



Control network layout

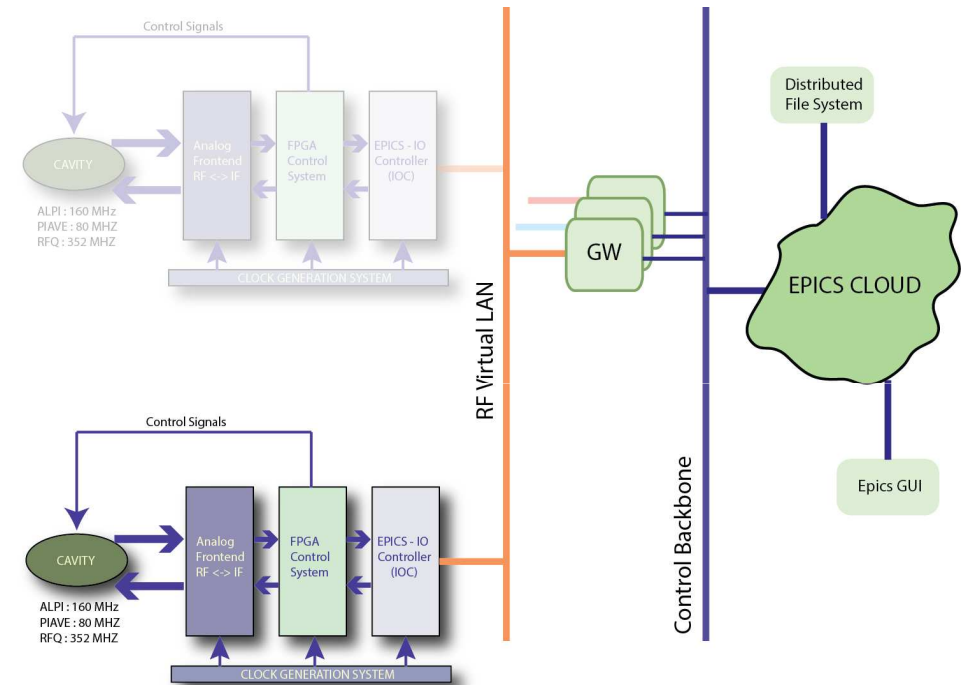


Network Architecture



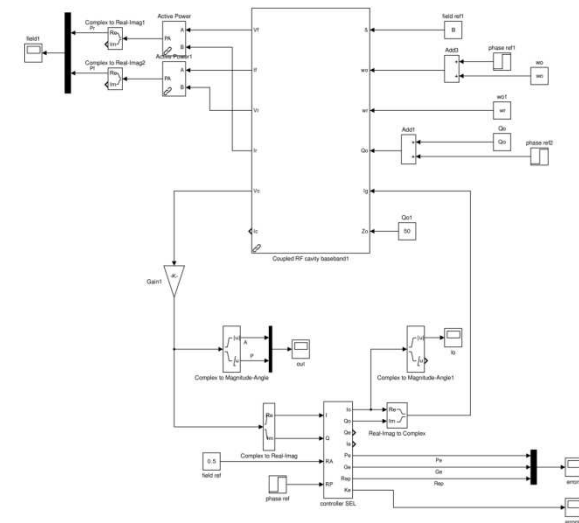
LLRF Developments

- LLRF for RFQ/LINAC cavities control
- Existing analog controllers have maintainability problems
- Need for higher resolution phase control
- New controller based on HF sampling/ digital control
 - More versatile, adapts easily to 40 MHz, 80 MHz, 160 MHz and 352 MHz cavities
 - An EPICS IOC is embedded in each LLRF controller



Digital LLRF controller status

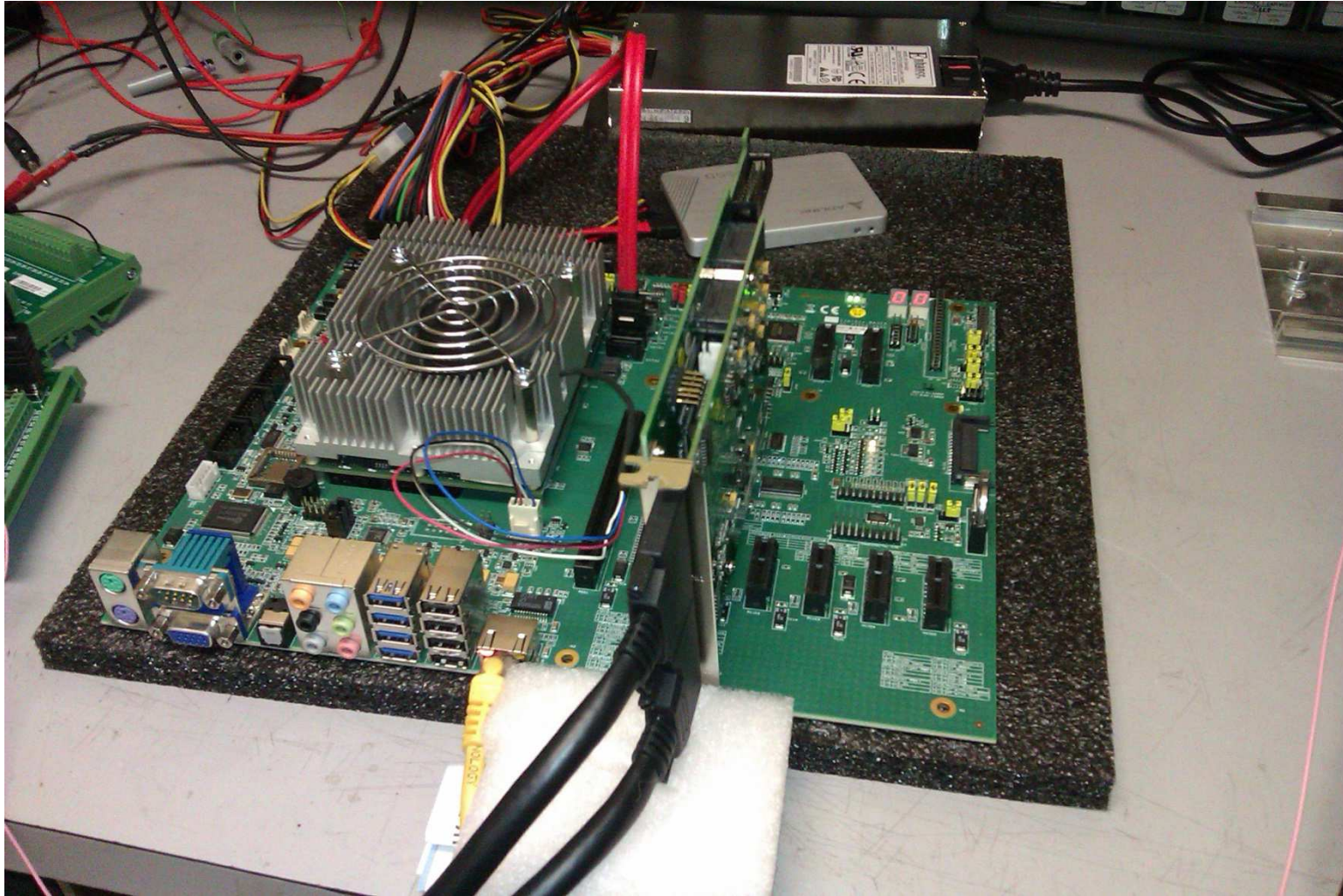
- R&D started in October 2012
- Mockup working with warm 160MHz cavity on March 2013
- Start of EPICS software on May 2013
- Test on cold 80MHz and 160 MHz cavities – June 2013
- Schematics completed on Nov. 2013
- PCB layout of RF part started on Dec. 2013
- Test on RFQ at low power on Jan. 2014
- Pre-production prototype expected on Q2 2014
- Collaboration with LLRF group @ ISOLDE



LNL IOC development

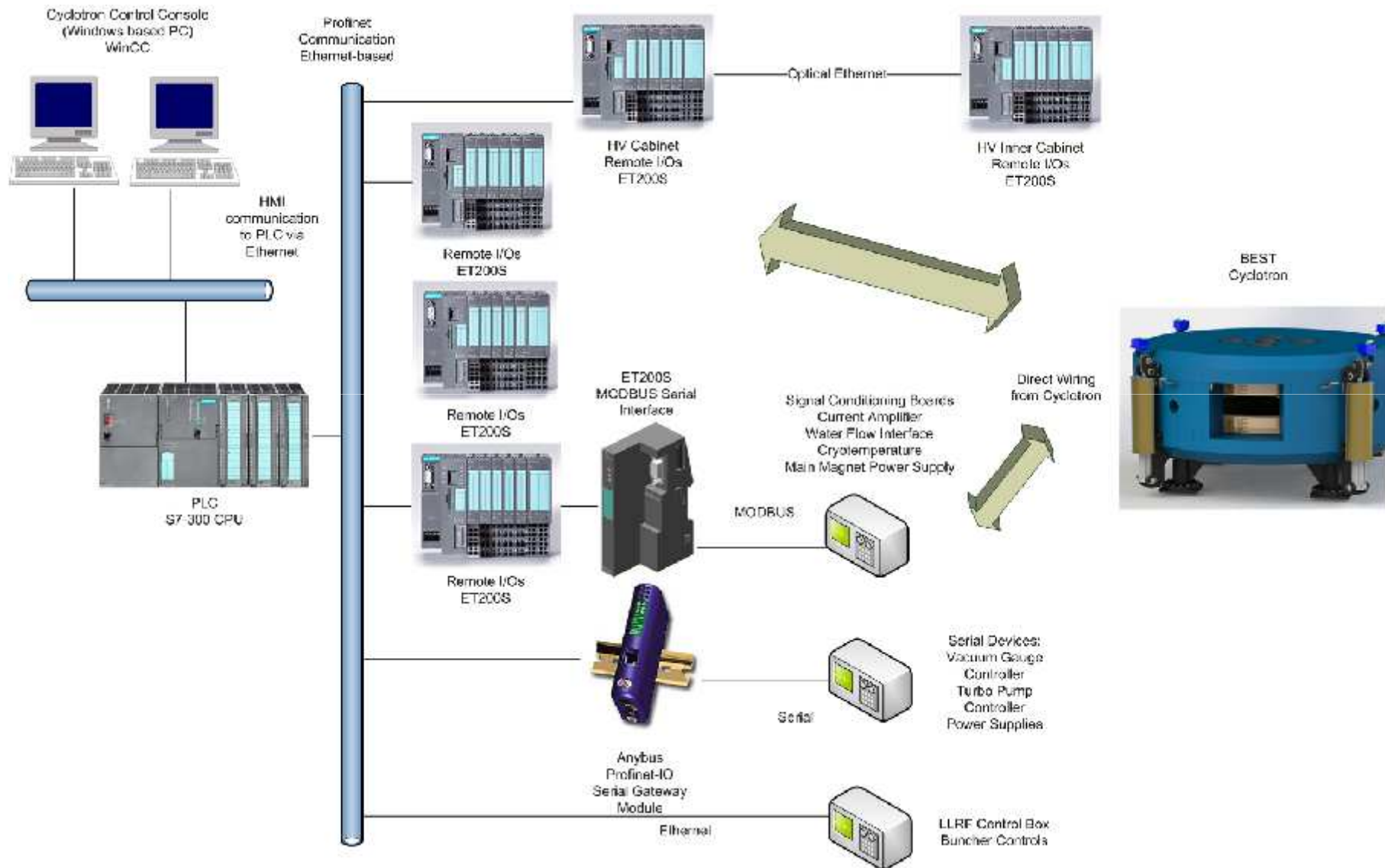
- Rationale:
 - Build once, use it everywhere
 - Reliable and easy to maintain
 - Affordable(< 400E target), low power
 - Runs standard X86 code
 - Core CPU is a COM-EXPRESS industry standard
 - Fits the needs of : Magnets & Lenses PS, BPM, Tape Sys, EM, FC, etc
- Design is starting on Q1 2014

LNL IOC development

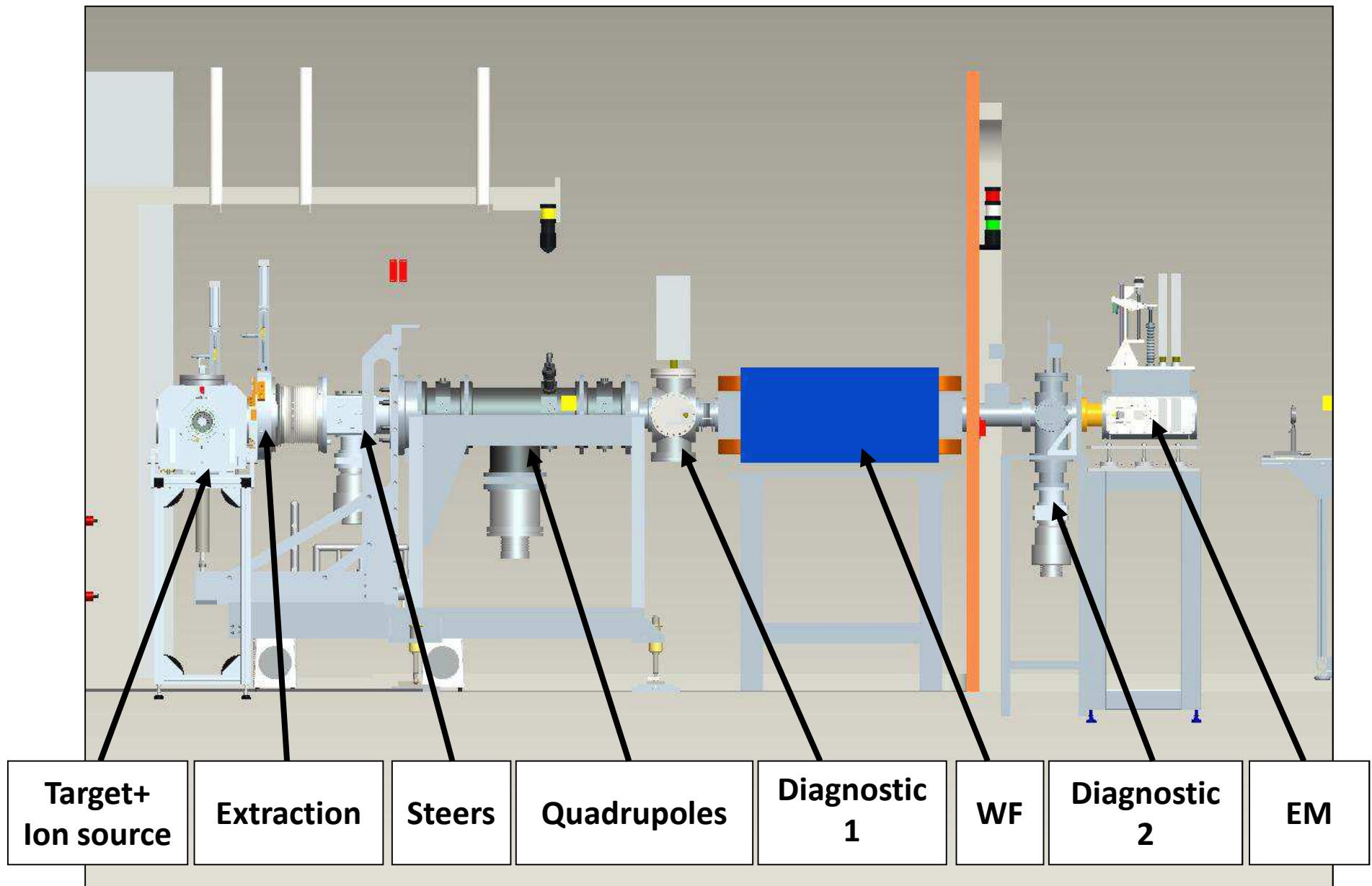


SPES - TAC meeting 22-23 Jan 2014

Cyclotron Control



Target & Ion Beam Source Control



Target & Ion Beam Source Control

The screenshot displays the CSS BeamDiagnostic.opi control interface. The window title is "CSS" and the menu bar includes "File", "Edit", "Search", "CSS", "Window", and "Help". The toolbar shows various icons for file operations and zooming. The main interface is divided into several sections:

- Diagnostic Menu:** A vertical list of buttons for "Beam diagnostic", "Mass separator", "Beam emittance", "Efficiency measurement", and "FE webcam".
- Detector Positions:** A section with buttons for "Faraday Cup 1" (OUTSIDE), "Faraday Cup 2", "Beam Profiler 1" (OUTSIDE), and "Beam Profiler 2" (OUTSIDE).
- System Time:** Displays "2013/07/25 09:45:38".
- Beam Profiler:** Contains two sub-sections: "Vertical Profile" and "Horizontal profile". Both show a graph of "Current (nA)" on a logarithmic scale (0.1 to 1) versus "Channel" (0 to 40). The graphs are currently blank.
- Faraday Cup:** Shows "FC2 Current" as **211.24 nA**. Below this is a graph of "Primary Y Axis (f)" versus "Primary X Axis (0)" with a time range from 20:53:47 to 20:54:09. The graph shows a noisy signal fluctuating between approximately 209.82 and 211.72.
- Control Panels:** Two "Open Advanced Control Panel" sections. The first has "Position Status" (OUTSIDE) and "Command" (IN, OUT) buttons. The second has "Position Status" (OUTSIDE) and "Command" (IN, OUT) buttons.
- Server Control:** Two red buttons at the bottom right: "Reboot server" and "Shutdown server".

Target & Ion Beam Source Control

The screenshot displays the 'MassSeparator.opi' control interface. It is divided into several sections:

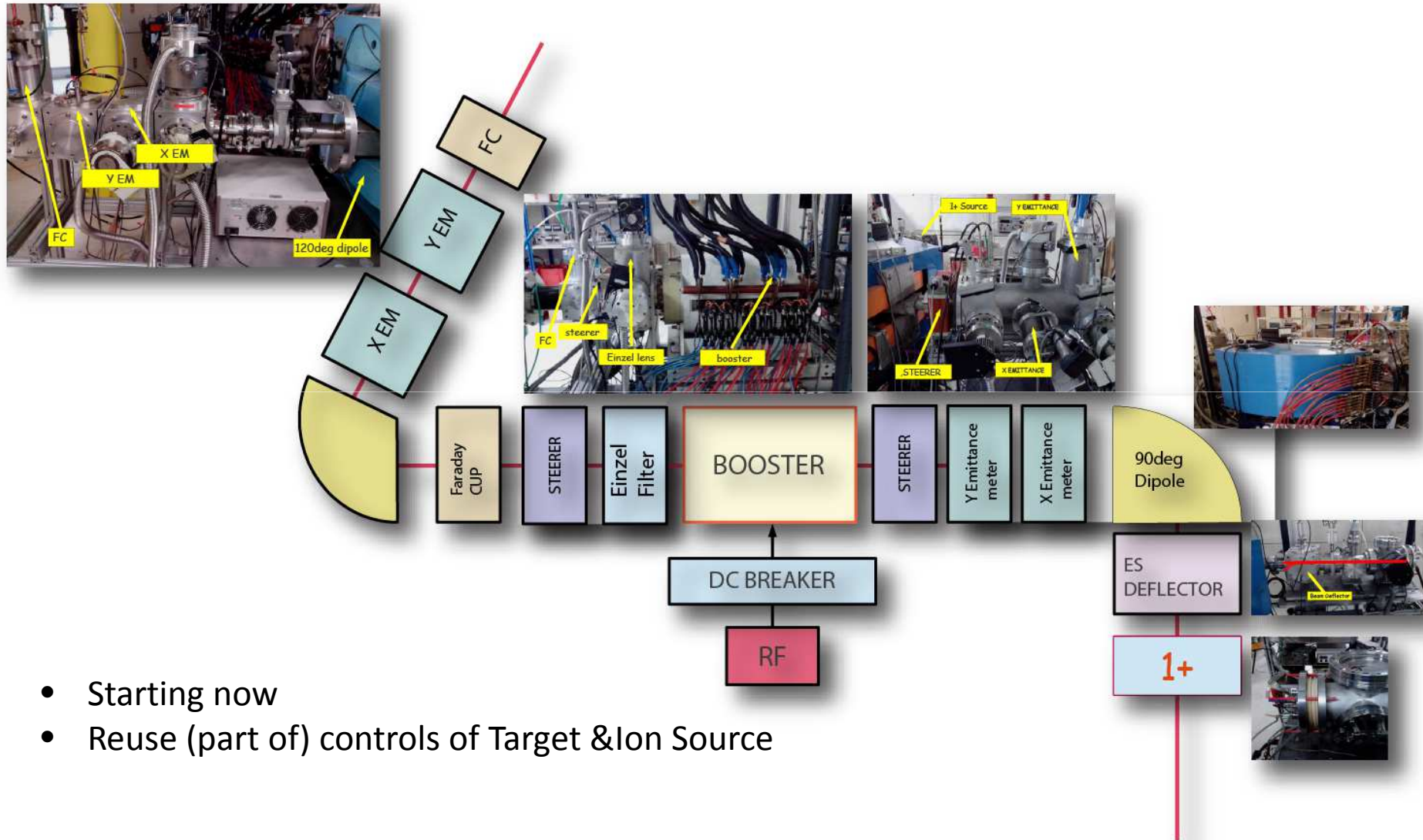
- Positive High Voltage Power Supply:** Includes a power switch (OFF), voltage setting (0 V), current setting (2 mA), and measurement fields for voltage (0.00 V) and current (0.00 mA). It also shows fault status (Normal) and control mode (Voltage).
- Negative High Voltage Power Supply:** Similar to the positive supply, with power (OFF), voltage (0 V), and current (0 mA) settings.
- Current Power Supply:** Features a power switch (OFF), current setting (0 A), voltage (0.00 V), and power (0.000 W) settings. It also displays a magnetic field of 0.0024924 T.
- Power Supply Status:** A table showing various operational parameters:

PS interlock status	Normal
Power supply door status	Closed
PS water flow status	Normal
PS temperature status	Normal
PS water flow read	18.2 L/min
PS water input temperature	20.1 C
PS water output temperature	20.3 C
- Coil Status:** Displays temperatures for coil (19.1 C), coil water flow (Disconnected), coil water input (19.5 C), and coil water output (18.9 C).
- Electric Field Operation:** Offers radio buttons for Simetric Operation and Manual Operation.
- Slit:** Controls for Motor 1 (left) and Motor 2 (right), including position and speed settings, and status indicators.

Power Supply Settings

Temperature readings

Charge Breeder Control



- Starting now
- Reuse (part of) controls of Target & Ion Source

Tape System Control

- Prototype built with Labview
- Now migrating to EPICS
- New HW based on LNL IOC

DAQ for Ge Detectors under physicist control



New Network Architecture

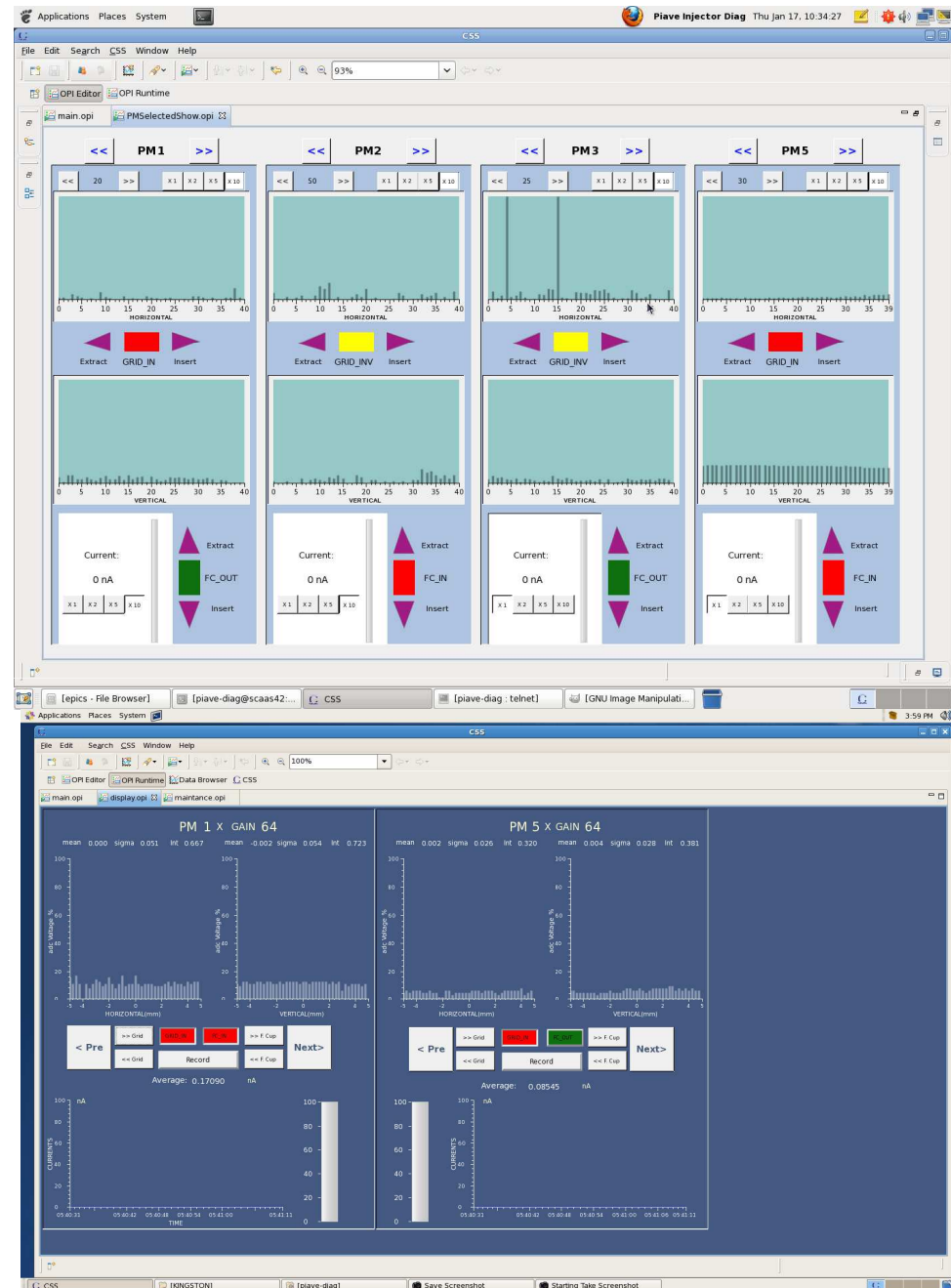
- Homogeneous layout for all accelerating machines
- Private network integrated with Lab network
- Vital services(timing, domain name server , ...) centrally managed
- Laboratory-wide IT service key for implementation and maintenance
- Executive project completed
- Cabling starts in Feb./March 2014
- Extension to SPES building due for Q1 2015 (depending on building availability)

Archiving

- Common Archive for every subsystem (RF, vacuum, diagnostics, magnets P.S, etc...)
 - Accessible from every EPICS endpoint
 - Centrally managed
- Pilot implementation based on Postgres DB
 - Tested at a max rate of 1.000 process variables/sec
 - Up-time of 3 months at full rate
- Prototype Archiver scheduled to be online on Q2 2014

Beam Diagnostics

- New Control SW
 - EPICS based
- Prototype actually working on PIAVE injector
 - In commissioning since April 2013
- Installation on ALPI Linac started on Oct 2013
 - Ready for deployment in Feb. 2014
- New HW IOC integrating EPICS controls under investigation



Magnets & Lenses PS Control

The screenshot displays a control interface for a power supply system. It features two main control panels for different devices, each with a 'REMOTE' and 'LOCAL' mode selector and a '#####' status indicator. Each panel includes 'Interlocks' (with a 'RESET' button) and 'Power' (with 'OFF' and 'ON' buttons) status indicators. Below these are 'I Set [%]' and 'I Act [%]' fields, a 'Ready' indicator, and a slider for current adjustment from 0 to 100%. Further down are buttons for '- z', '+ s', and 'Sensibilità' with '- Δ' and '+ V' buttons. At the bottom of each panel is an 'Interlocks List' with 14 items, each with a status indicator (grey, red, or green).

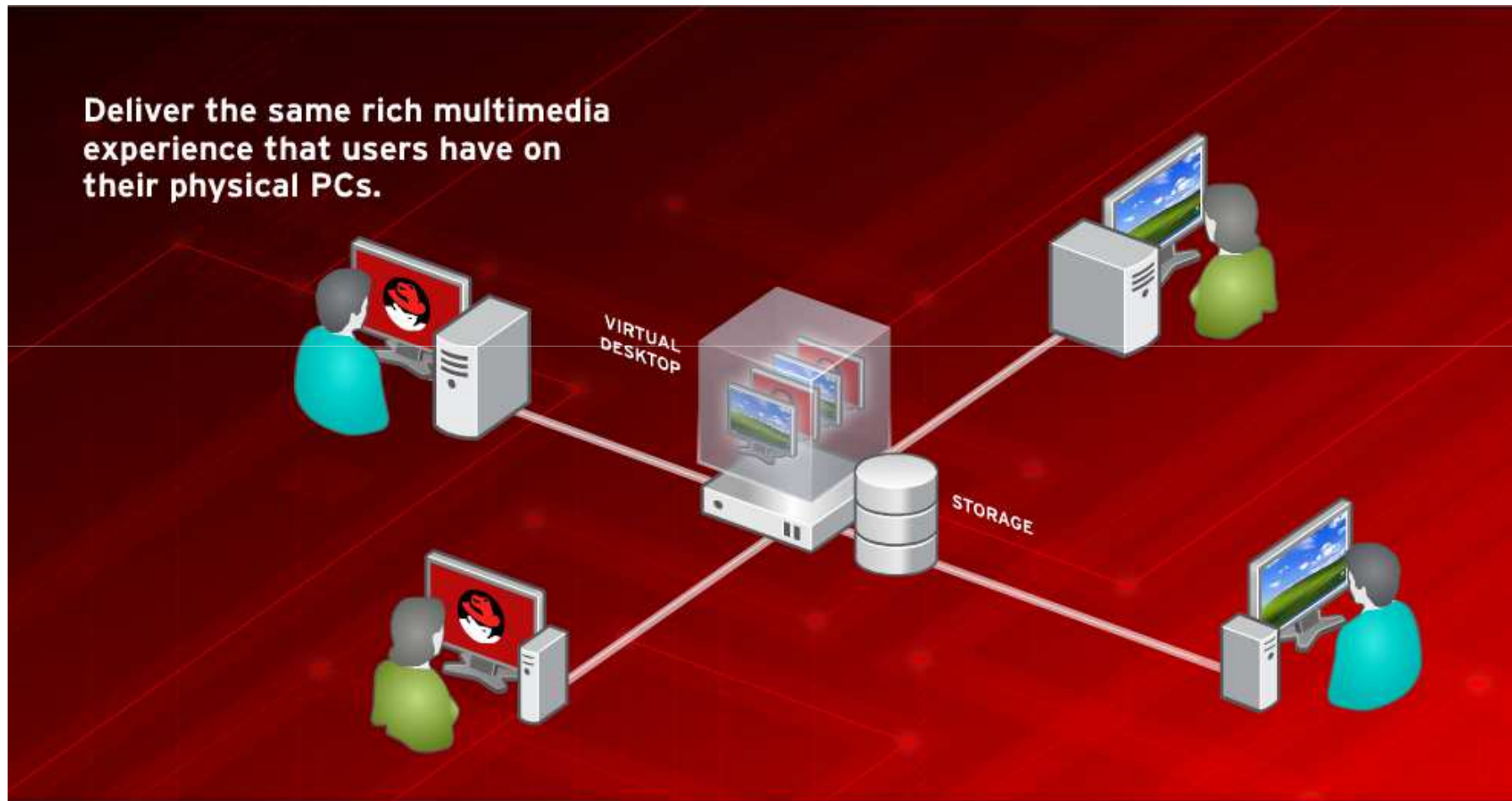
The right-hand sidebar contains a 'Status' section with readouts for Current (#####), Voltage (#####), Power (green dot), and Interlocks (green dot). Below this is a 'Control' section with 'OutputCurrent' input, 'Power' (ON/OFF buttons), and a 'Reset' button (green dot). The 'Misc' section includes 'Auxiliary 1' and 'Auxiliary 2' (green dots), 'Polarity' (green dot and square), and a 'Command Line' input (#####). At the bottom of the sidebar are 'ADC', 'DAC', and 'Status' buttons, and a large empty input field.

- SW control for PS of magnets, quadrupoles, steerers, etc
- EPICS based
- Prototype in commissioning since Nov. 2013
 - Daisy chain of six Danfysik PS + one steerer
- Deployment foreseen on June 2014
- New HW
 - Micro-IOC w/ EPICS in each PS

Beam Transport Automation

- Leverage EPICS and XAL to model RF cavities and beam optics (by experts)
- Interact with accelerator field controls
 - BPMs, LLRF controllers, lenses, etc
- Deliver a procedure to (at least partially) automate beam transport
- Investigation has started (post-doc position dedicated to the task)

Operator Interface



Summary

- No conclusions : *work in progress* !
 - Many tasks started in parallel
- Progress is constrained by “normal” maintenance & operation of existing accelerators
- Skilled manpower is crucial because training time on controls is remarkable (*obvious but true*)