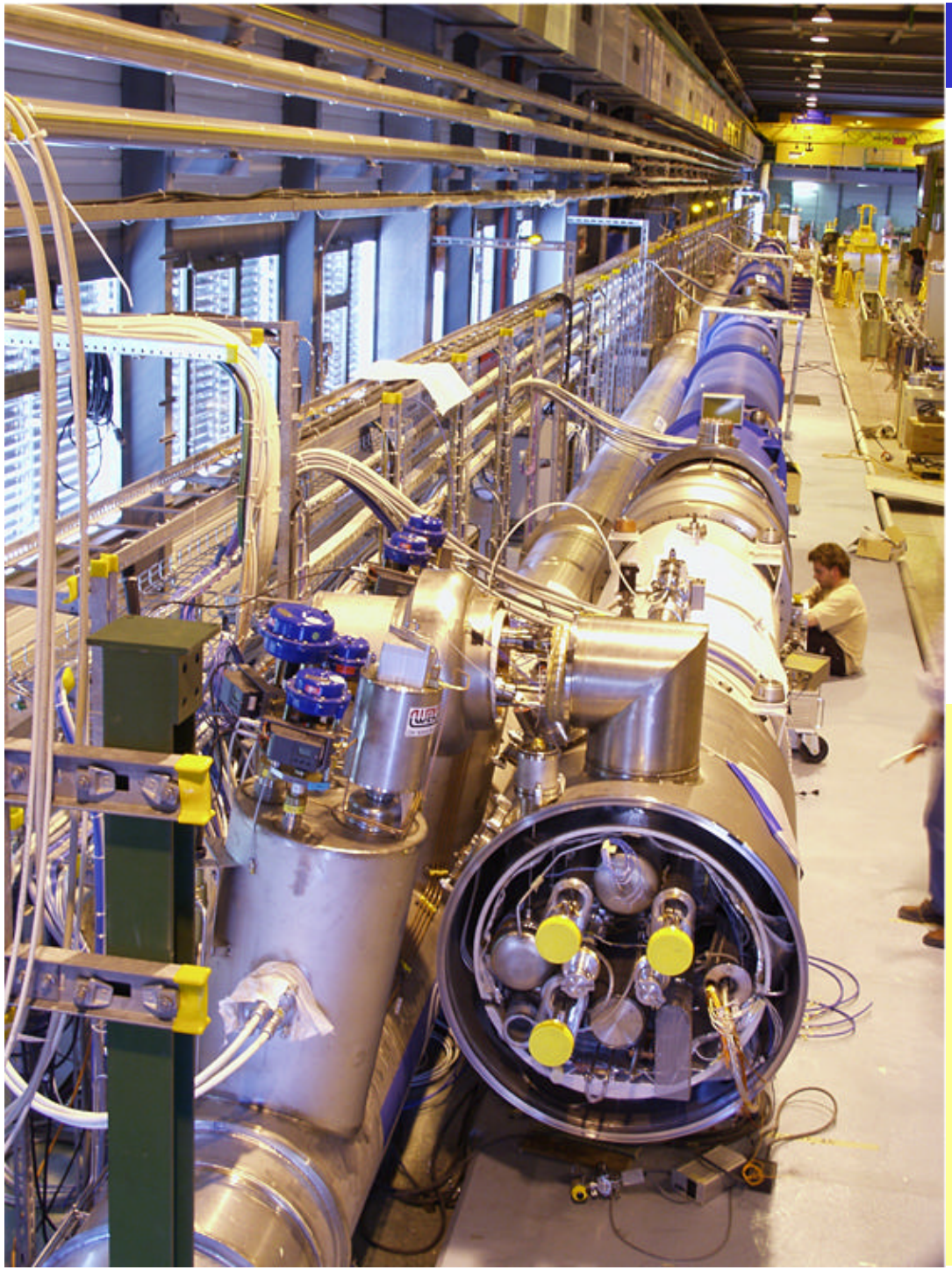


String 2

Why ?

1 to validate
individually the LHC technical systems
the technologies and

2 to investigate their collective behaviour

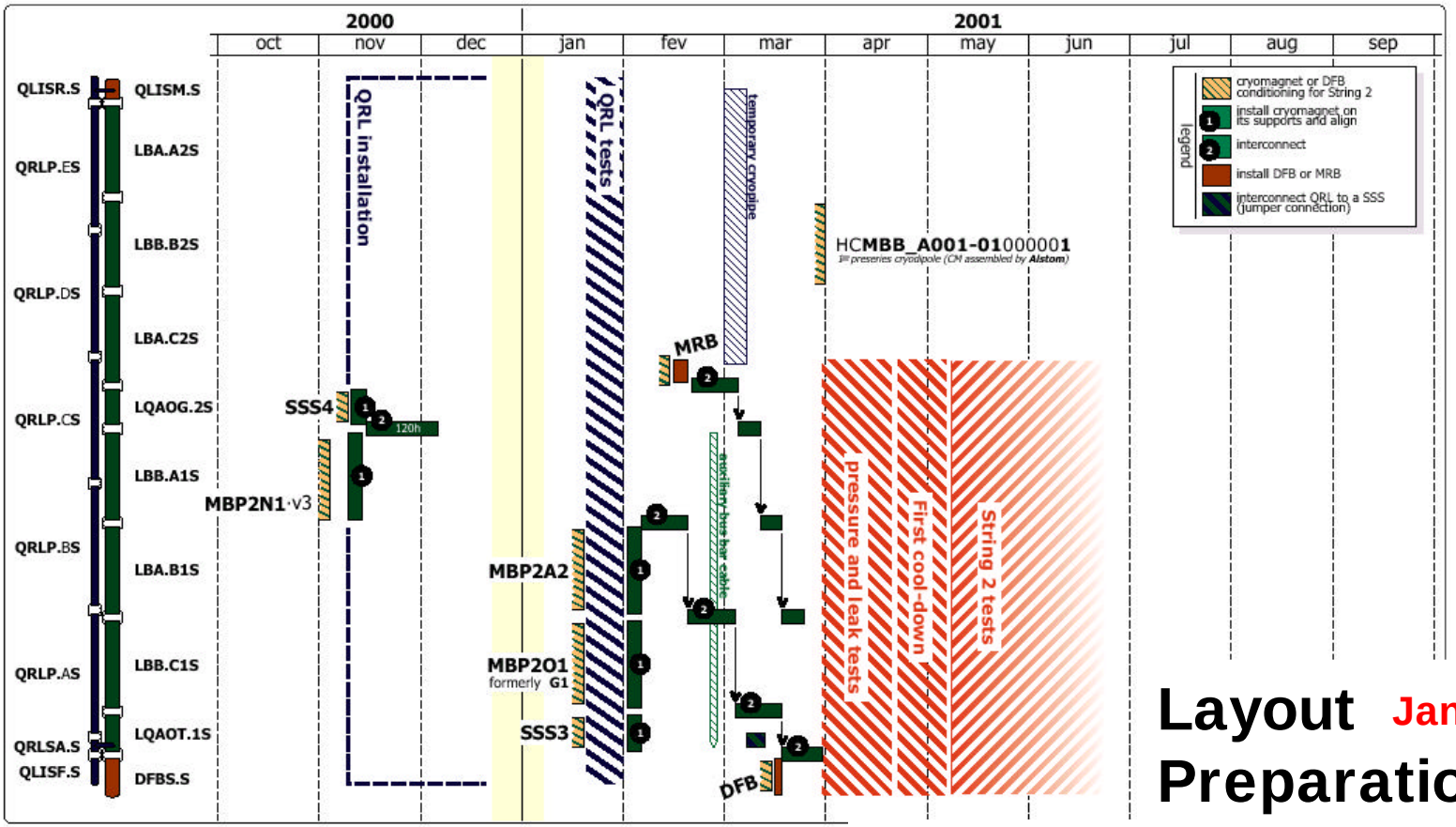
in normal conditions
during transients
during exceptional conditions

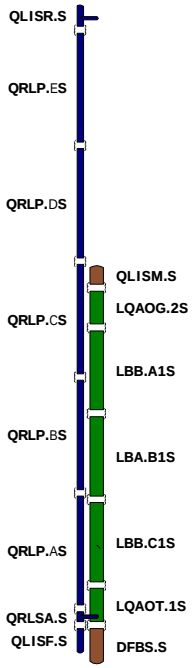
With respect to vacuum, cryogenics, interlocks, protection and powering

String 2 is representative of a full cell in the regular part of an LHC sector

String 2

Schedule





Phase 1

Layout January 2000

Preparation of

- the site
- the cabling
- each component

Assembly

January 2000

June 2000

July 2000

November 2000

April 2001 **Phase 1** one half cell + one quadrupole

February 2002 **Phase 2** one full cell including pre-series dipoles

String 2

Experiments

Assembly
- mechanical design
- assembly procedures
- quality assurance

Cryogenics
- the final superfluid helium cooling loop
- beam screen cooling loop
- thermo-hydraulics and propagation of quenches

Protection
- local and global quench detection
- several circuits
- quench propagation
- HTS current leads
- bus bars

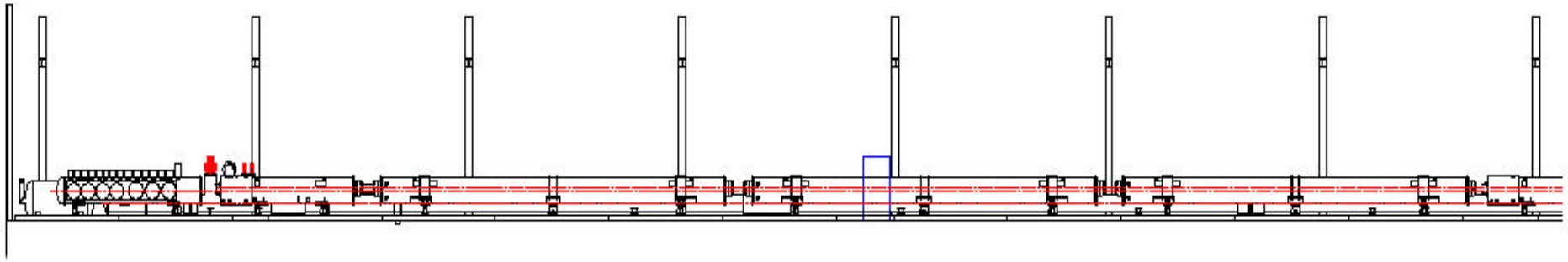
Vacuum
- mechanical design
- procedures for assembly and testing
- behaviour of the vacuum systems
- beam screens beam induced heating, quench induced deformations and currents

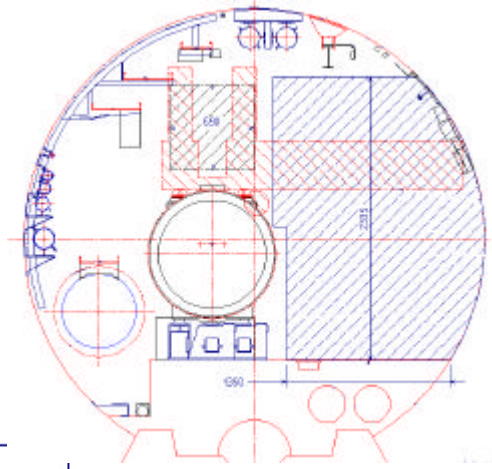
Powering
- final design converters
- 15 independent circuits
- high precision DCCTs
- dipole circuit topology
- digital regulation
- tracking
- EMC

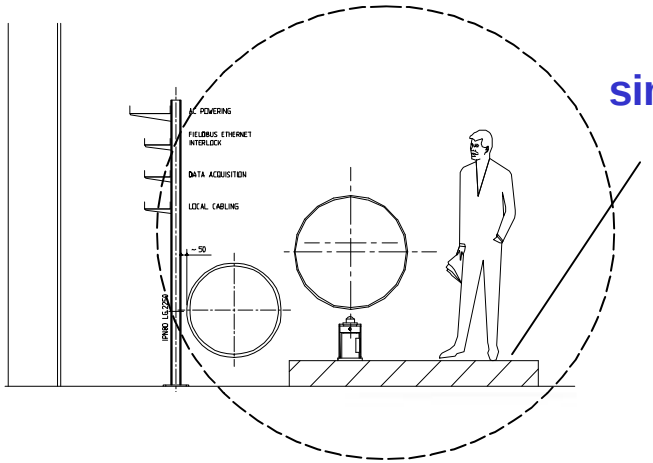
… but provides, in some cases, only partial validations or no information

String 2

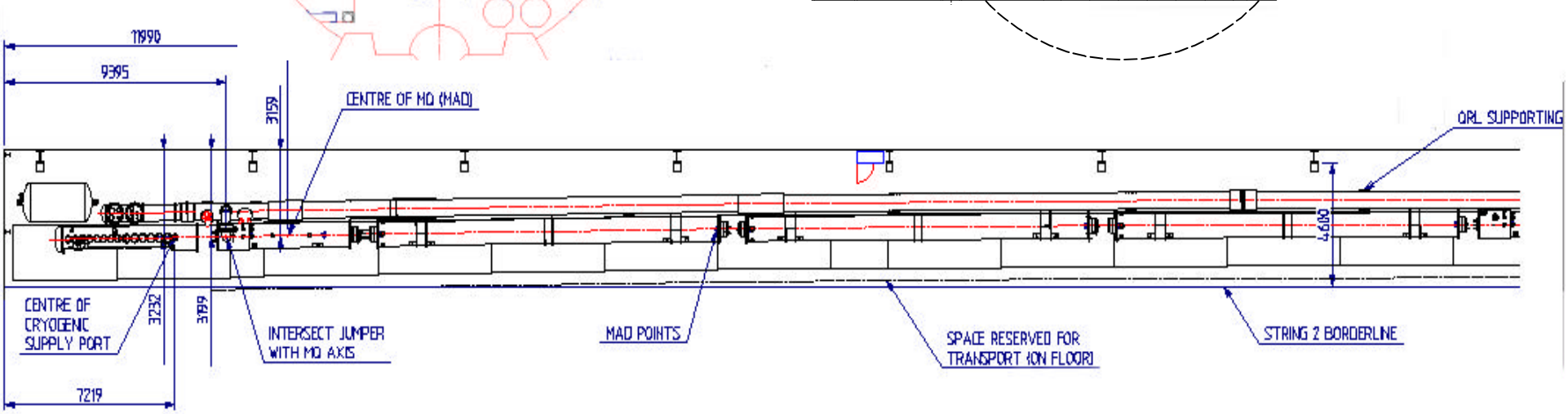
Layout







Slabs to simulate the trench



String 2

Preparation of the site

Infrastructure: Racks & Cabling

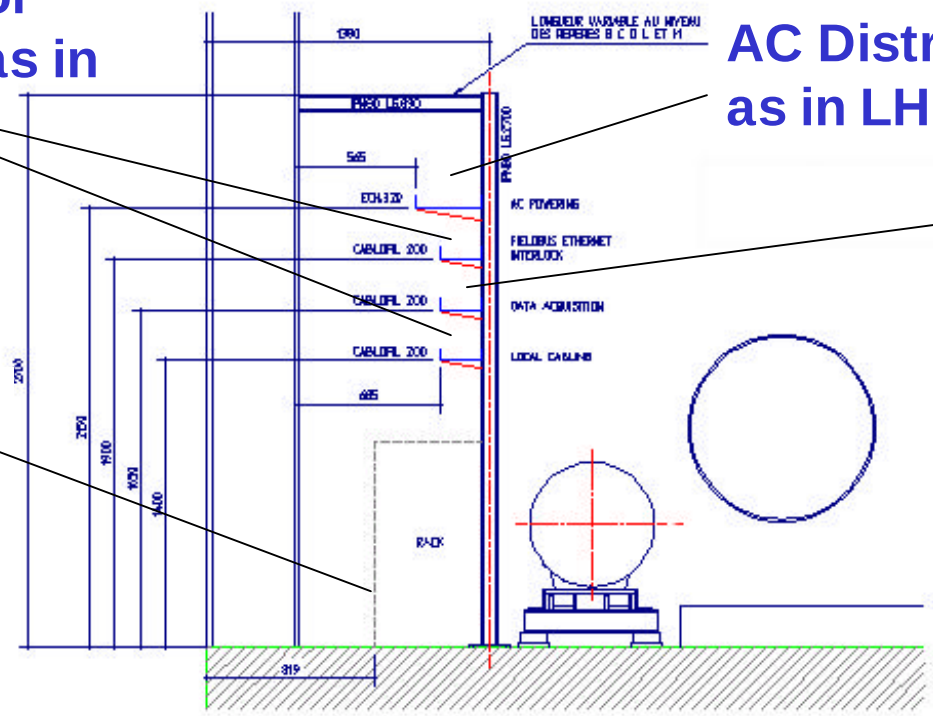
Cabling for controls as in LHC

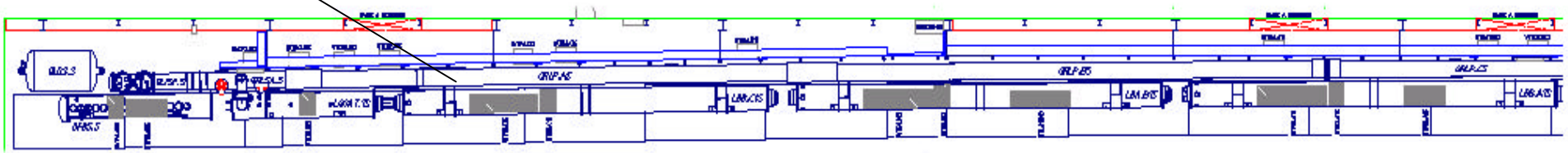
AC Distribution as in LHC

String specific cabling for Data Acquisition and Controls

String specific racks behind the cryoline

Racks under the magnets as in LHC



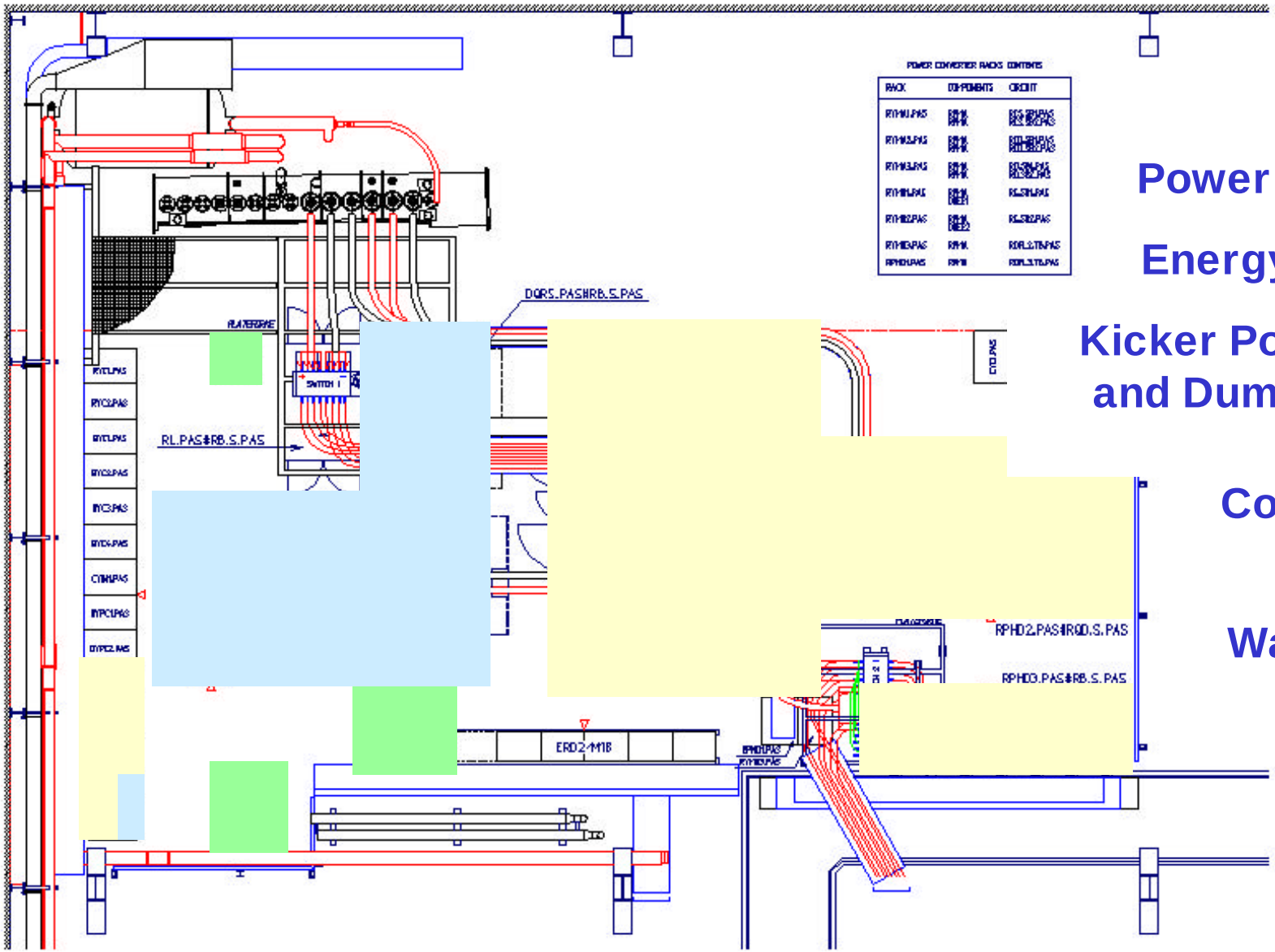


JC.Guillaume, R.Rausch

String 2

Preparation of the site

Powering Area



- Power Converters
- Energy Extraction
- Kicker Power Supply and Dummy for EMC Studies
- Control Racks
- DC Cabling
- Water cooling
- Switches

String 2

Communication Infrastructure

Hub

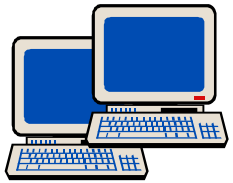
FO link

Media converter

Solaris System

PCs on public Network

Printer



PCs on public network

SCADA System

Hub

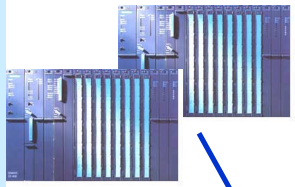
10 Mbit Public Network

PLC

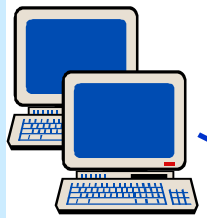
Power hub

FDDI backbone Control network

PLCs



LynxOS Systems



SCADA System

Hub

FO link

Media converter

X-terminal

Unshielded Twisted Pairs

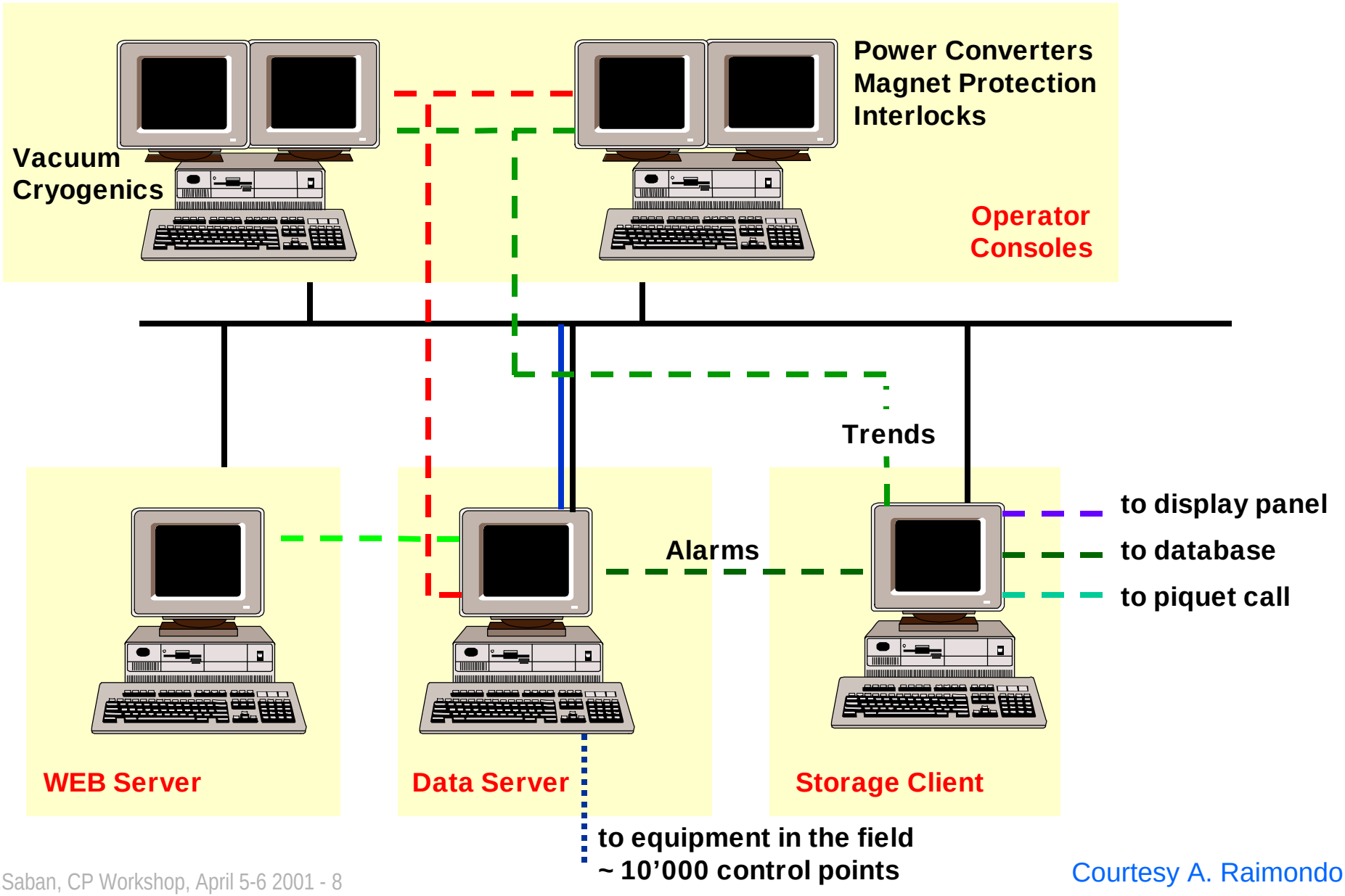
Powering Area or String

String Control Room

Courtesy A. Francano

String 2

Supervision



Courtesy A. Raimondo

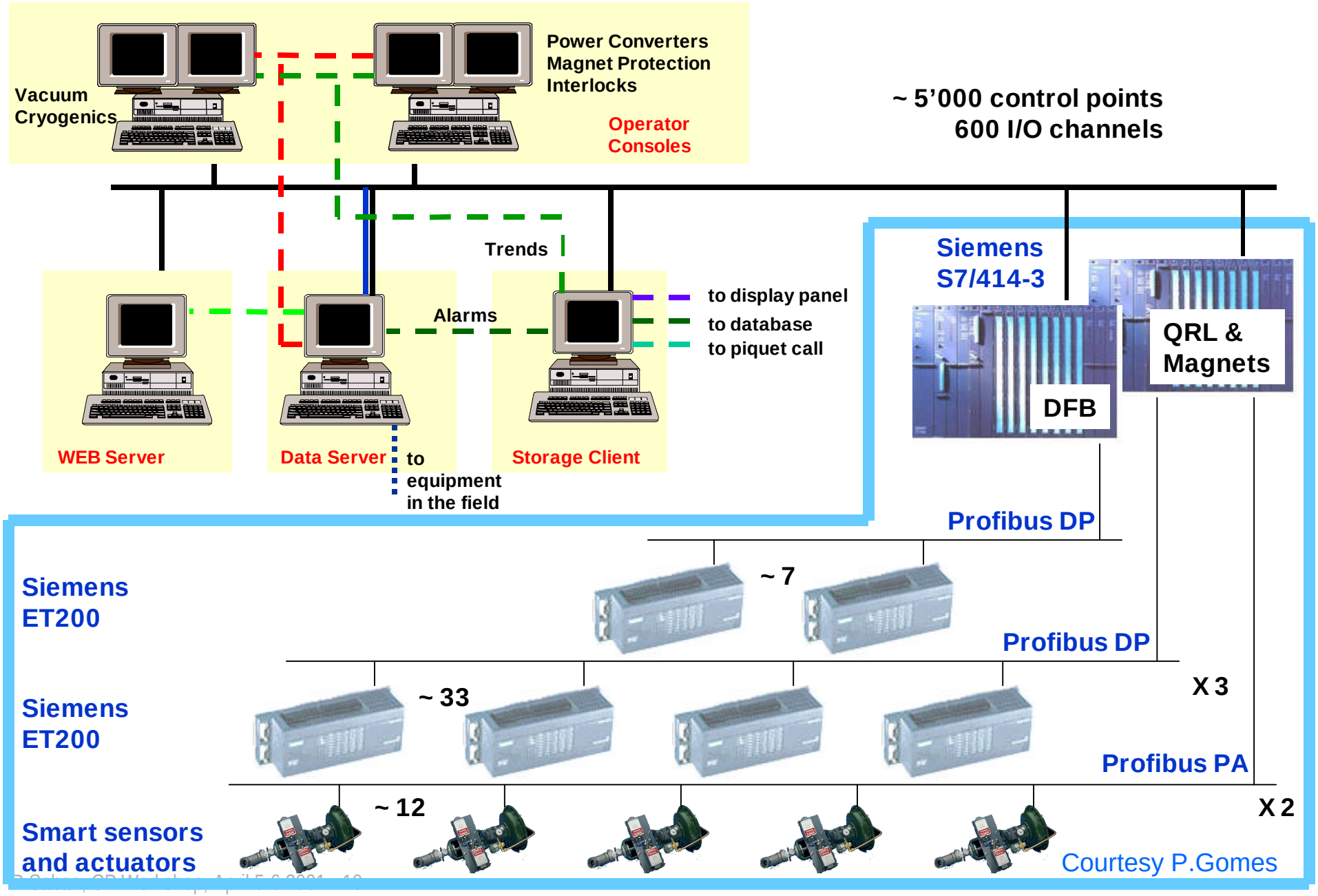
String 2

Supervision

- collaboration with BARC-Bombay
- specifications by users
  - database
  - screens
  - functions (custom developments, trends, alarms, etc.)
- developments following IAS defined standards
- stays at CERN for initial debugging and commissioning
- 10 man • months for the development
- ~30 screens

String 2

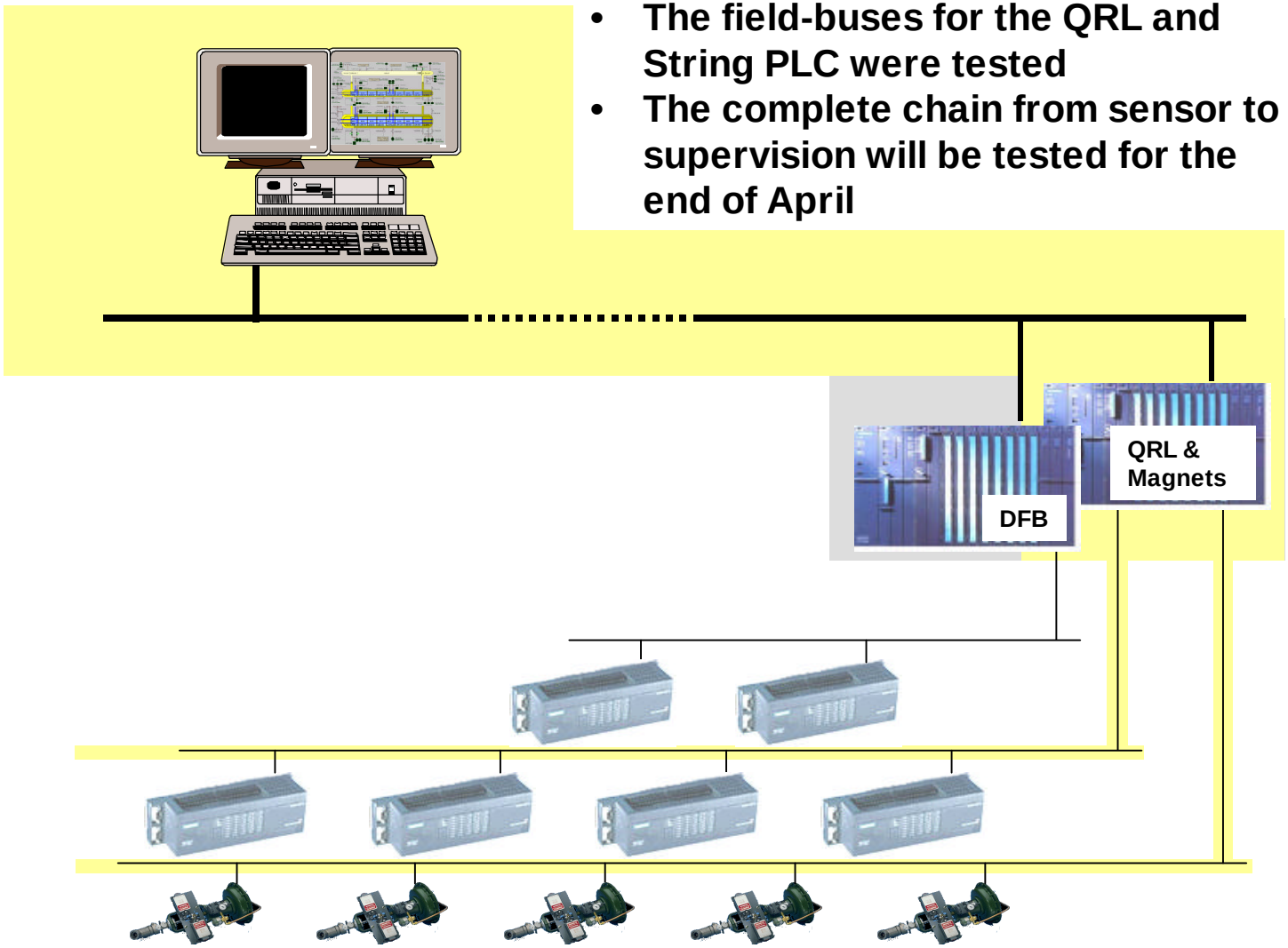
Controls for Cryogenics



String 2

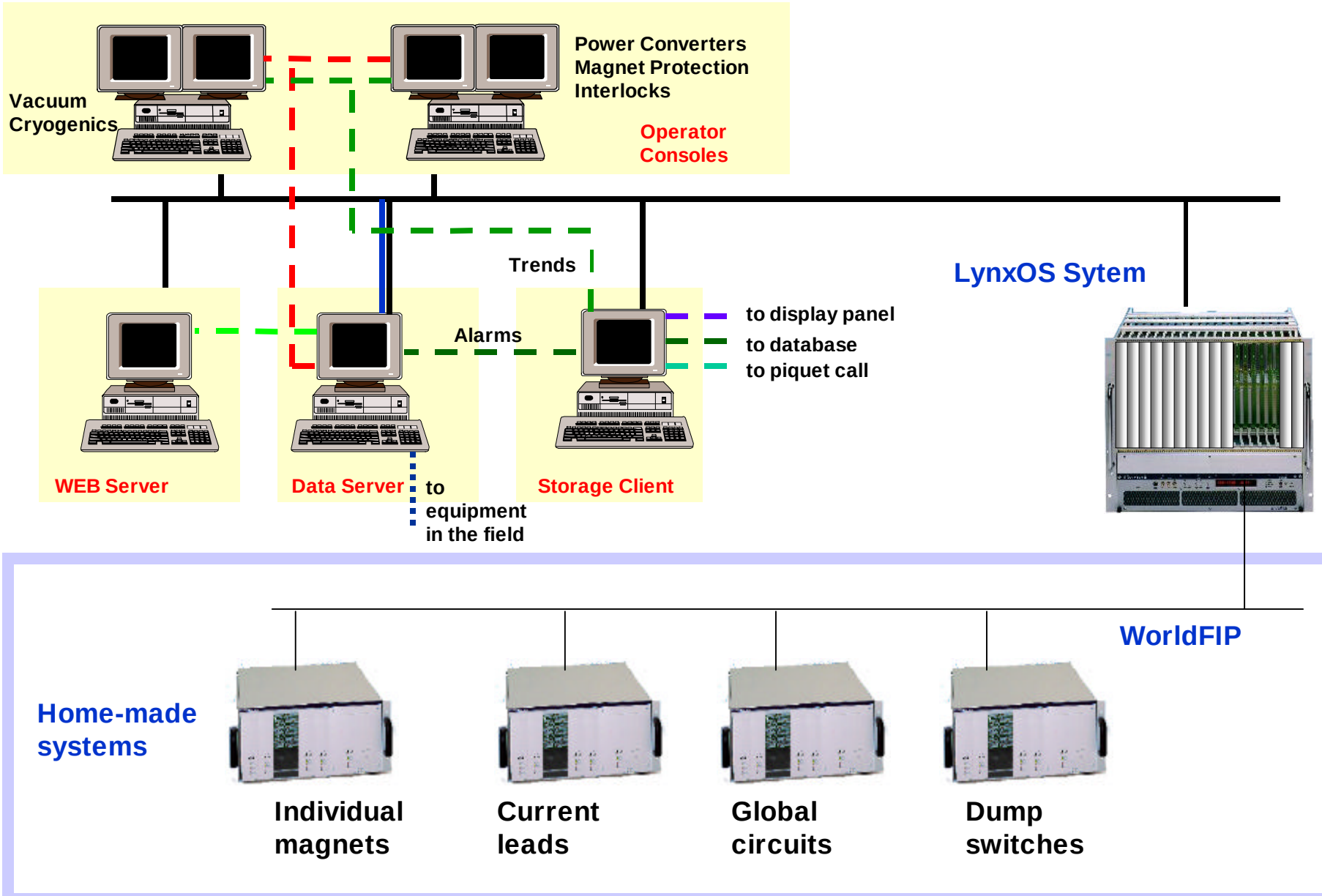
Cryogenics Status

- Version 1 of the supervision application is in production.
- The field-buses for the QRL and String PLC were tested
- The complete chain from sensor to supervision will be tested for the end of April



String 2

Controls for Magnet Protection

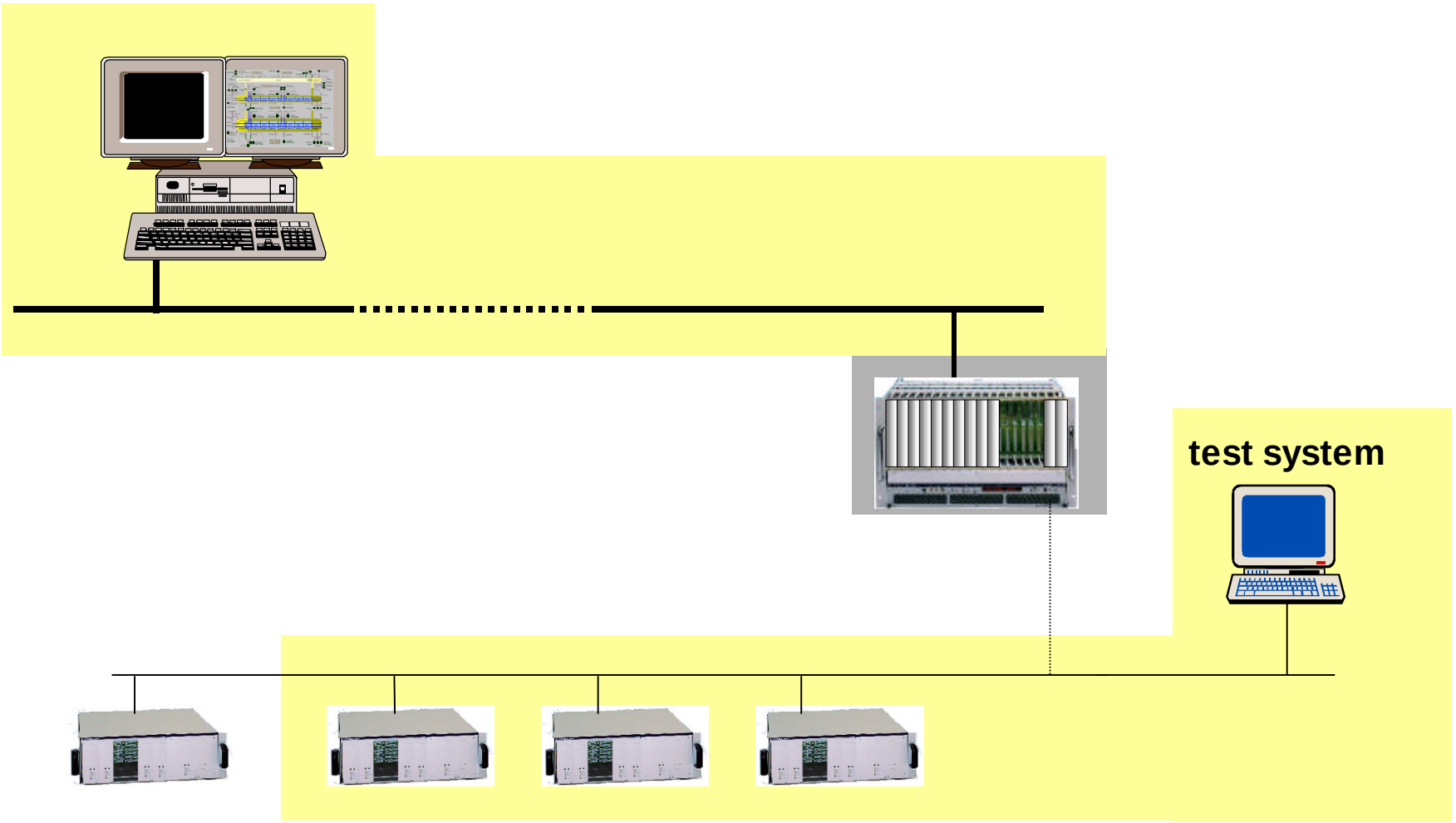


Courtesy R.Denz

String 2

Magnet Protection

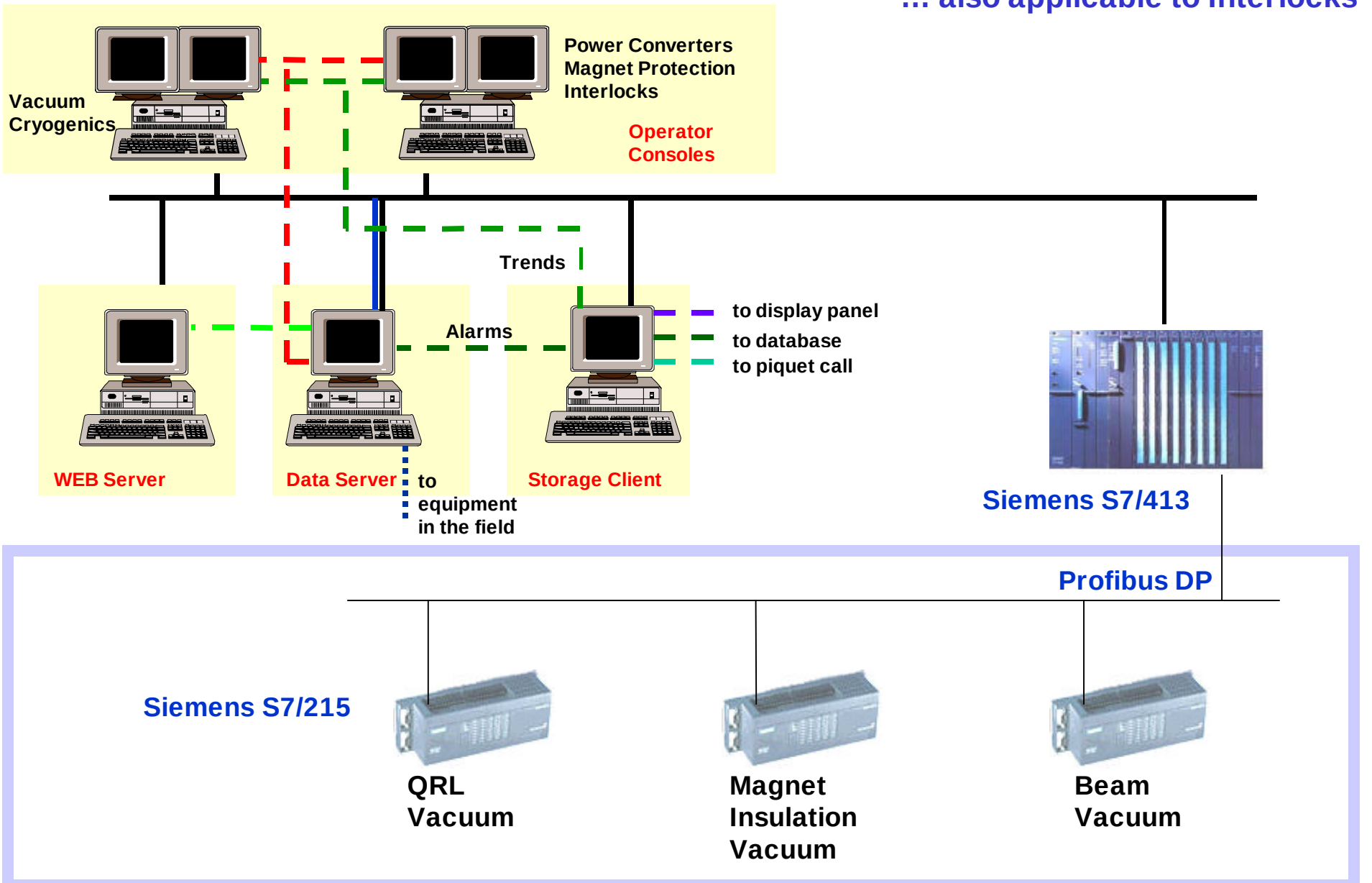
Status



String 2

Controls for Vacuum

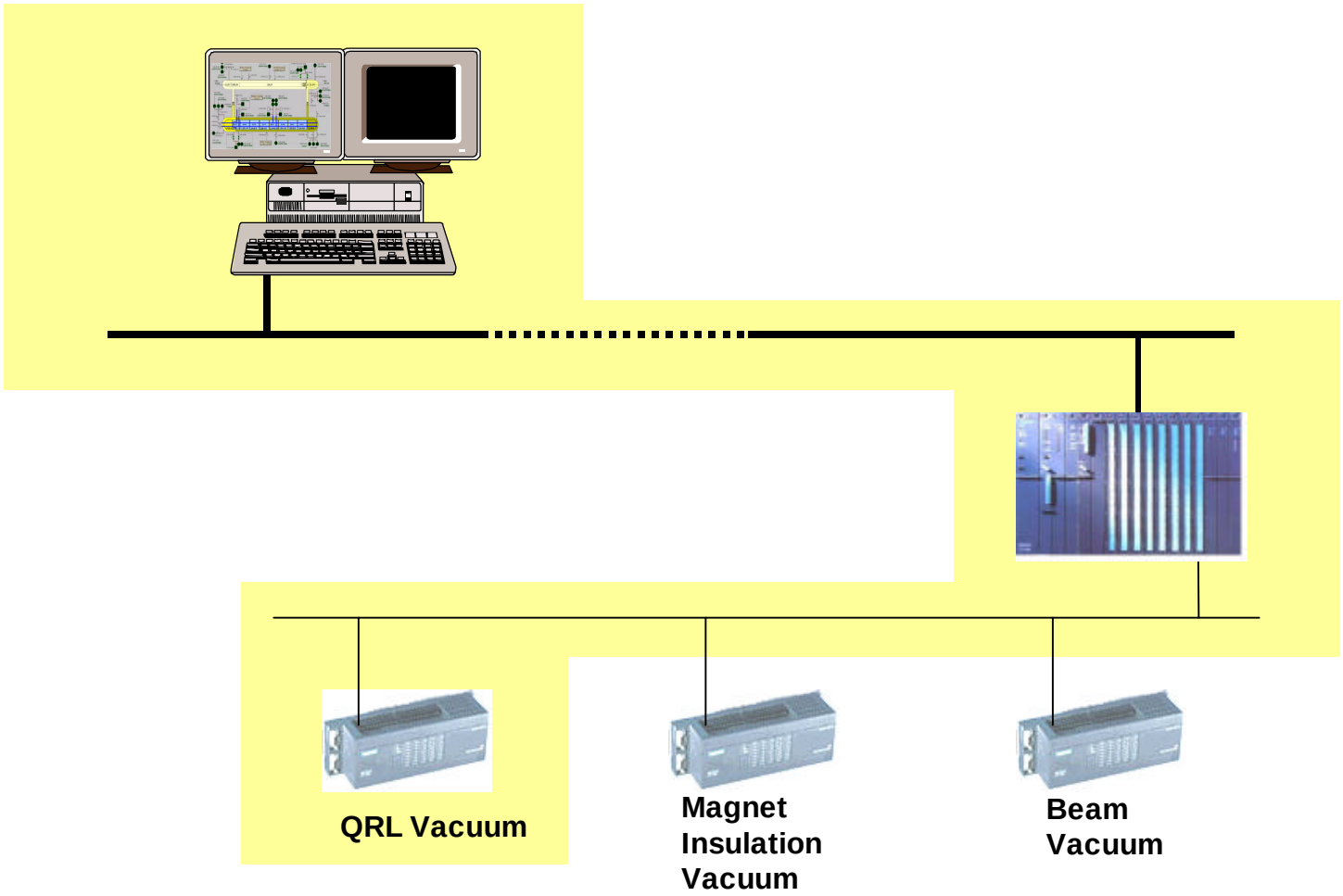
… also applicable to Interlocks



Courtesy R.Gavaggio

String 2

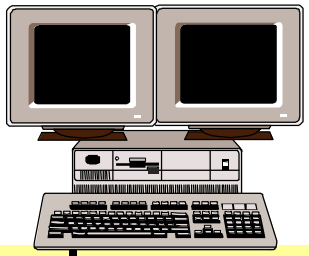
Vacuum Status



Both PLCs have been tested in the lab. They are being installed as the gauges are activated.

String 2

Interlocks Status



- The supervision application is being prepared
- The PLC data base is known

- The continuity test of the 55 I/O channels is progressing as the systems become available (converters, magnet protection, dump switches)

interlock matrix

quench detection

power converters

dump switches

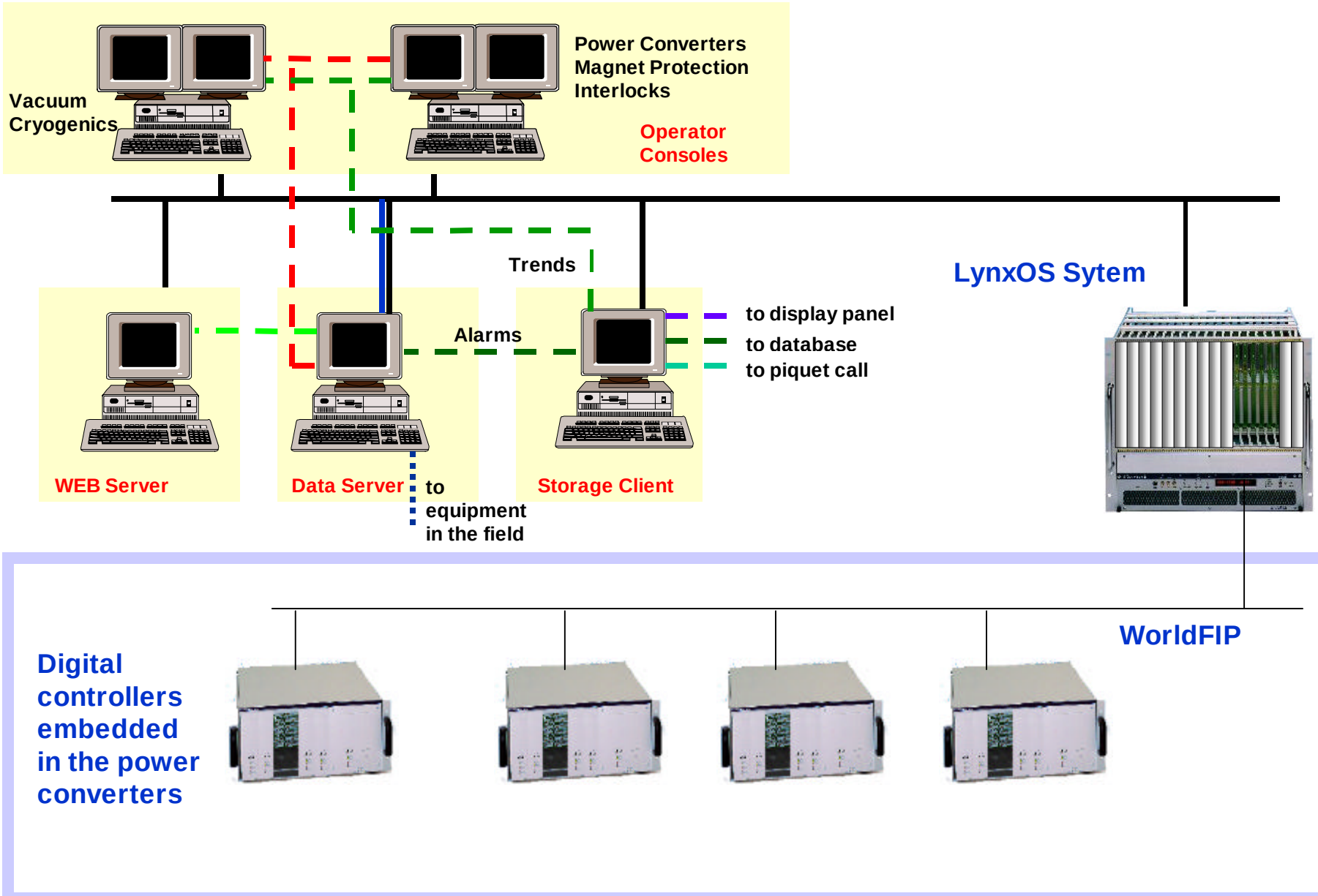
cooling water

...

Courtesy B.Puccio

String 2

Controls for Power Converters

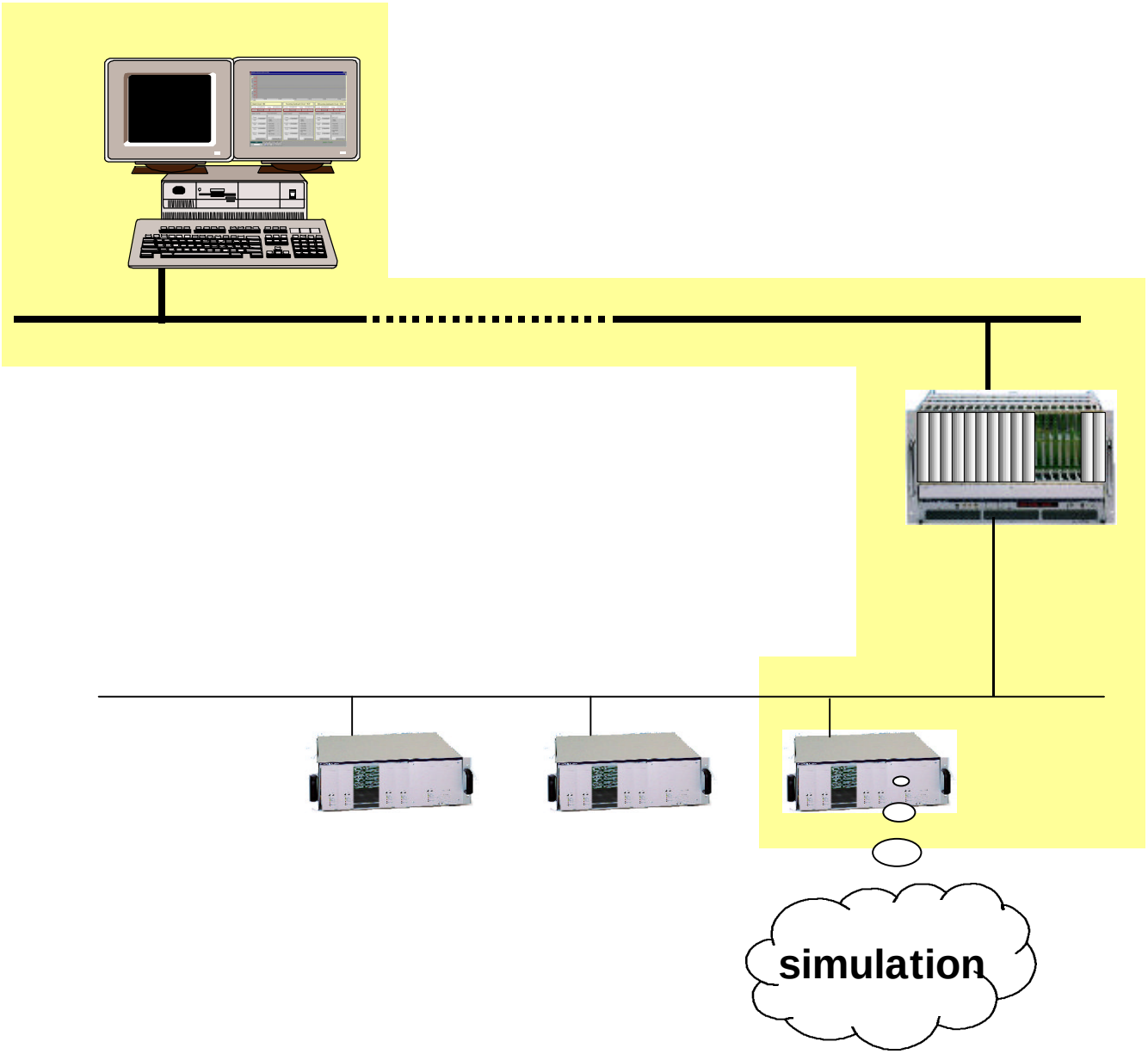


Courtesy R.Denz

String 2

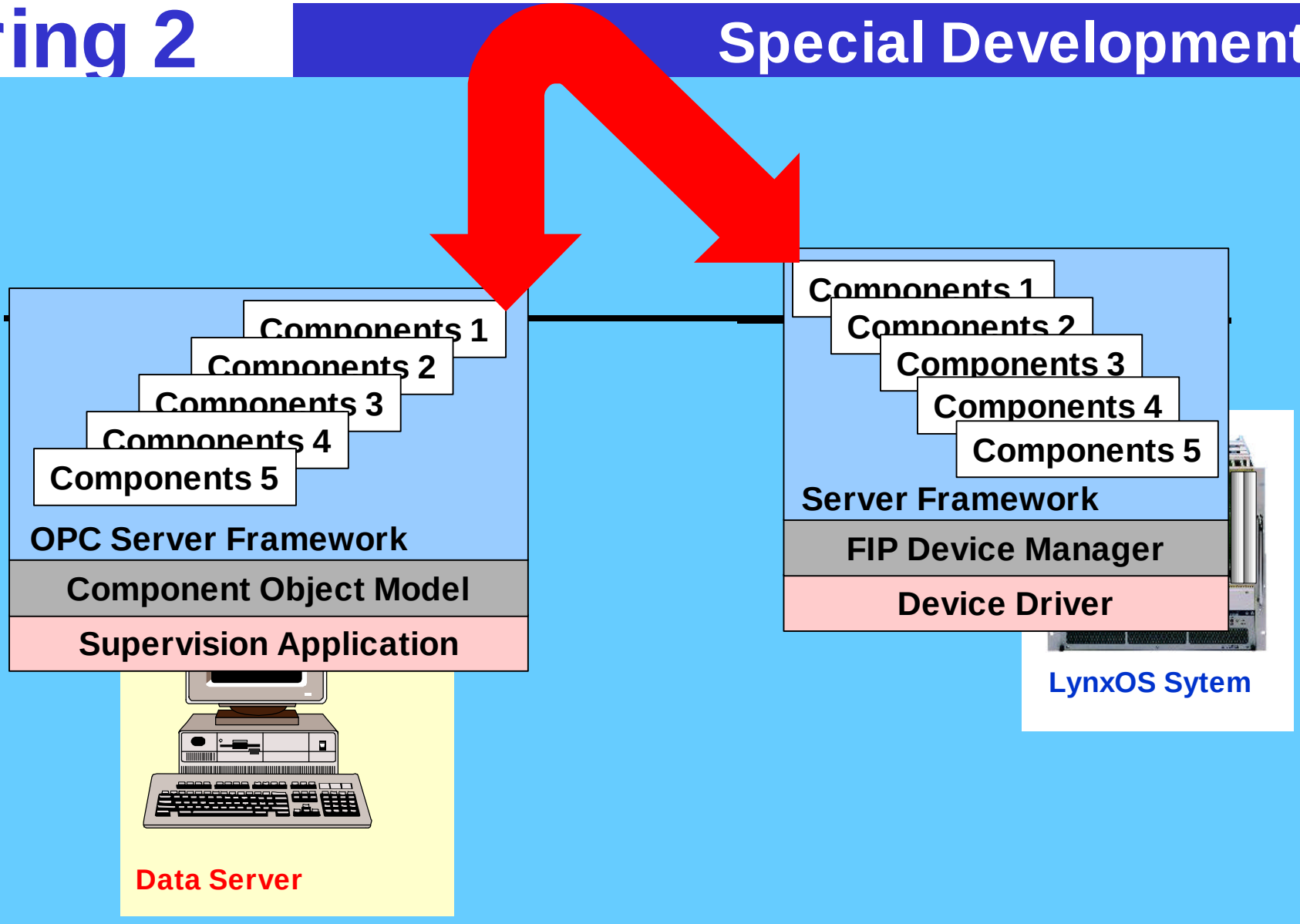
Power Converters

Status



String 2

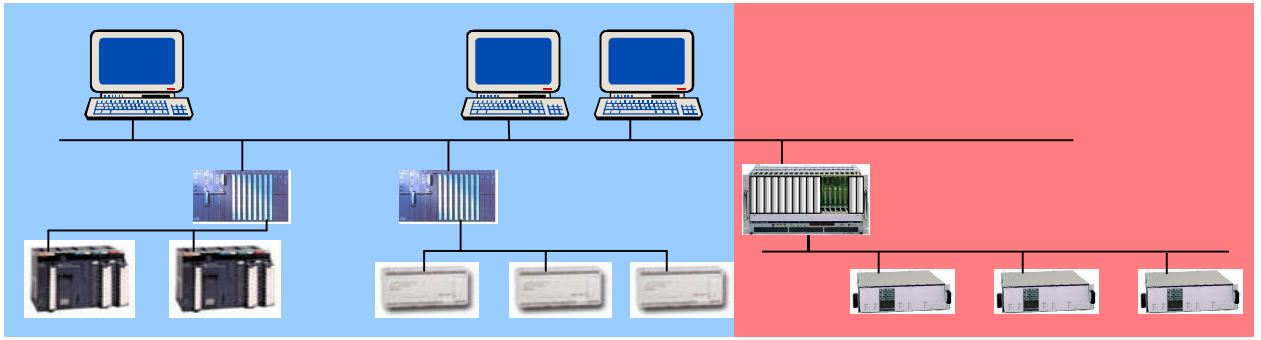
Special Developments



Courtesy P.Ribeiro

String 2

Conservative LEGO-like approach



Wherever possible, it is based on readily available industrial components

Cryogenics
Interlocks
Vacuum

Profibus

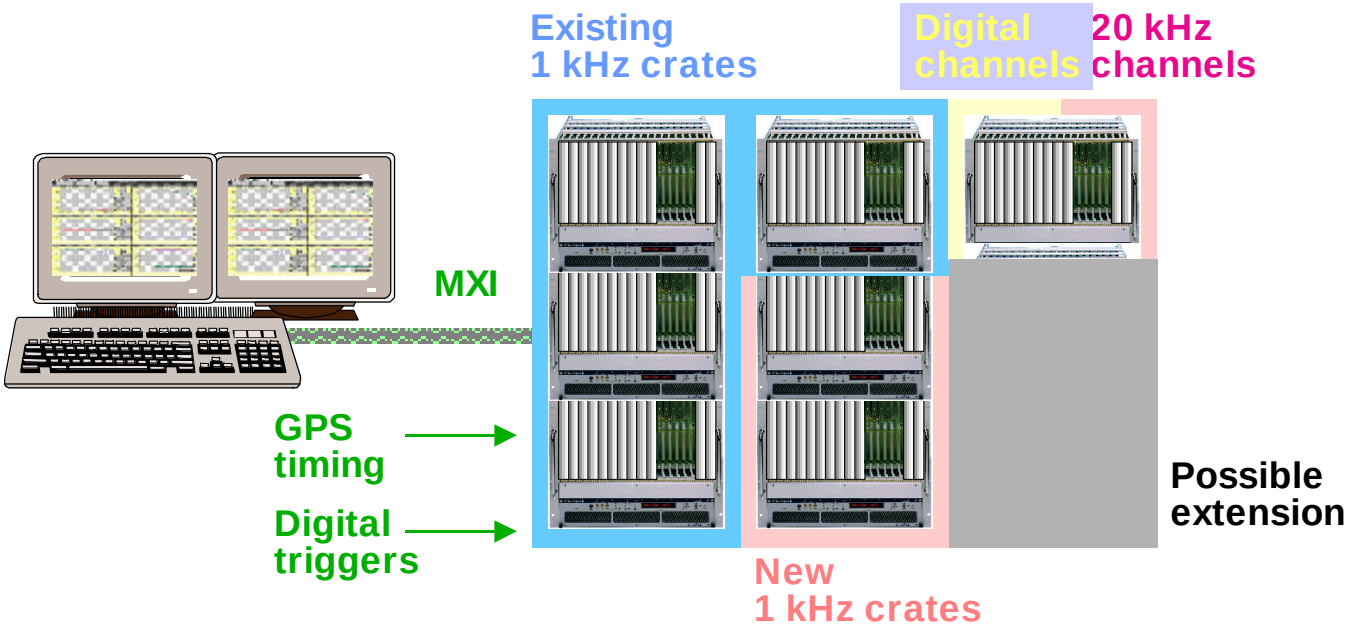
Howevere, there are some inevitable (?) special home/industry made developments

Magnet Protection
Power Converter Control

WorldFIP

String 2

Data Acquisition



- commercial VME/LabView/SUN-based solution
- independent from the control system but synchronized
- 1000 channels 16-bit 1 kHz
- 64 channels 16-bit 20 kHz
- all the String 1 hardware re-used

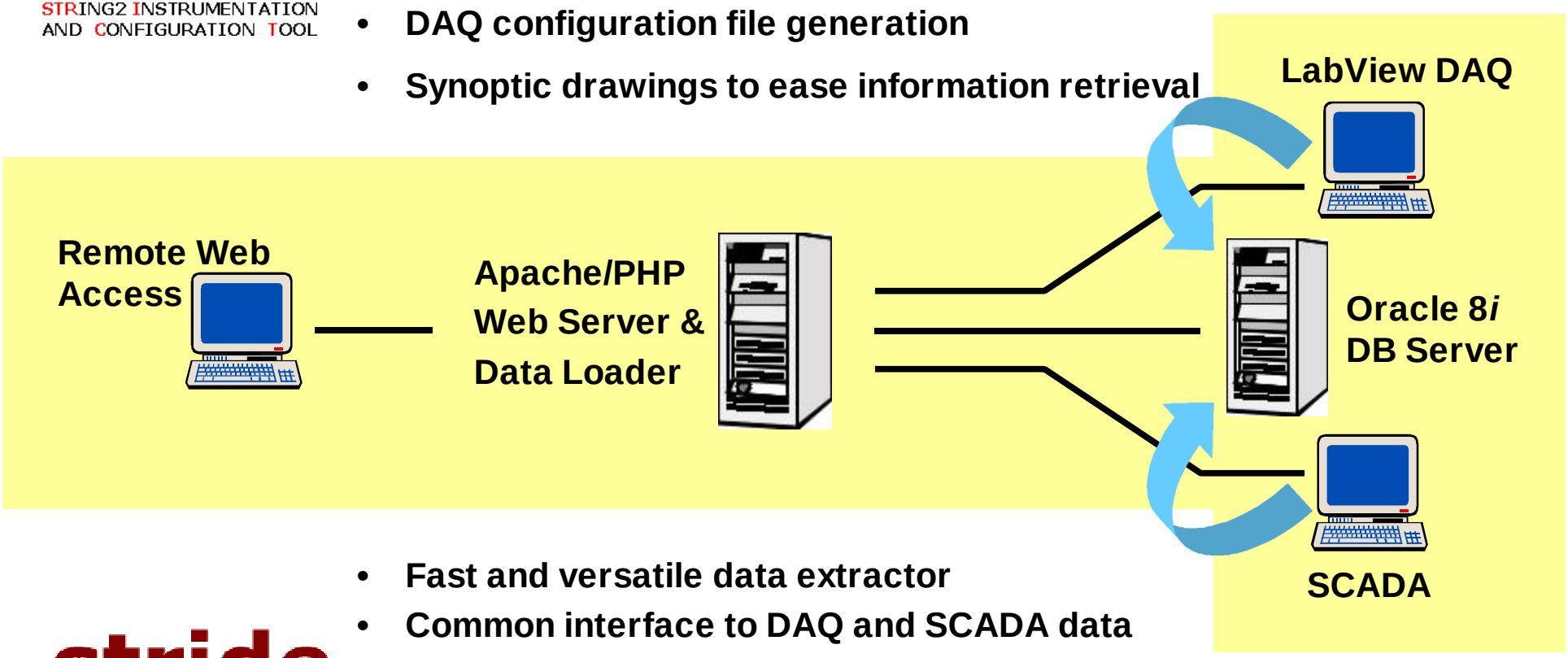
Courtesy A.Rijllart

String 2

Database Services

strict
STRING2 INSTRUMENTATION AND CONFIGURATION TOOL

- Instrumentation repository
- Grouping signals into classes prior to assigning triggers and configuration parameters
- DAQ configuration file generation
- Synoptic drawings to ease information retrieval

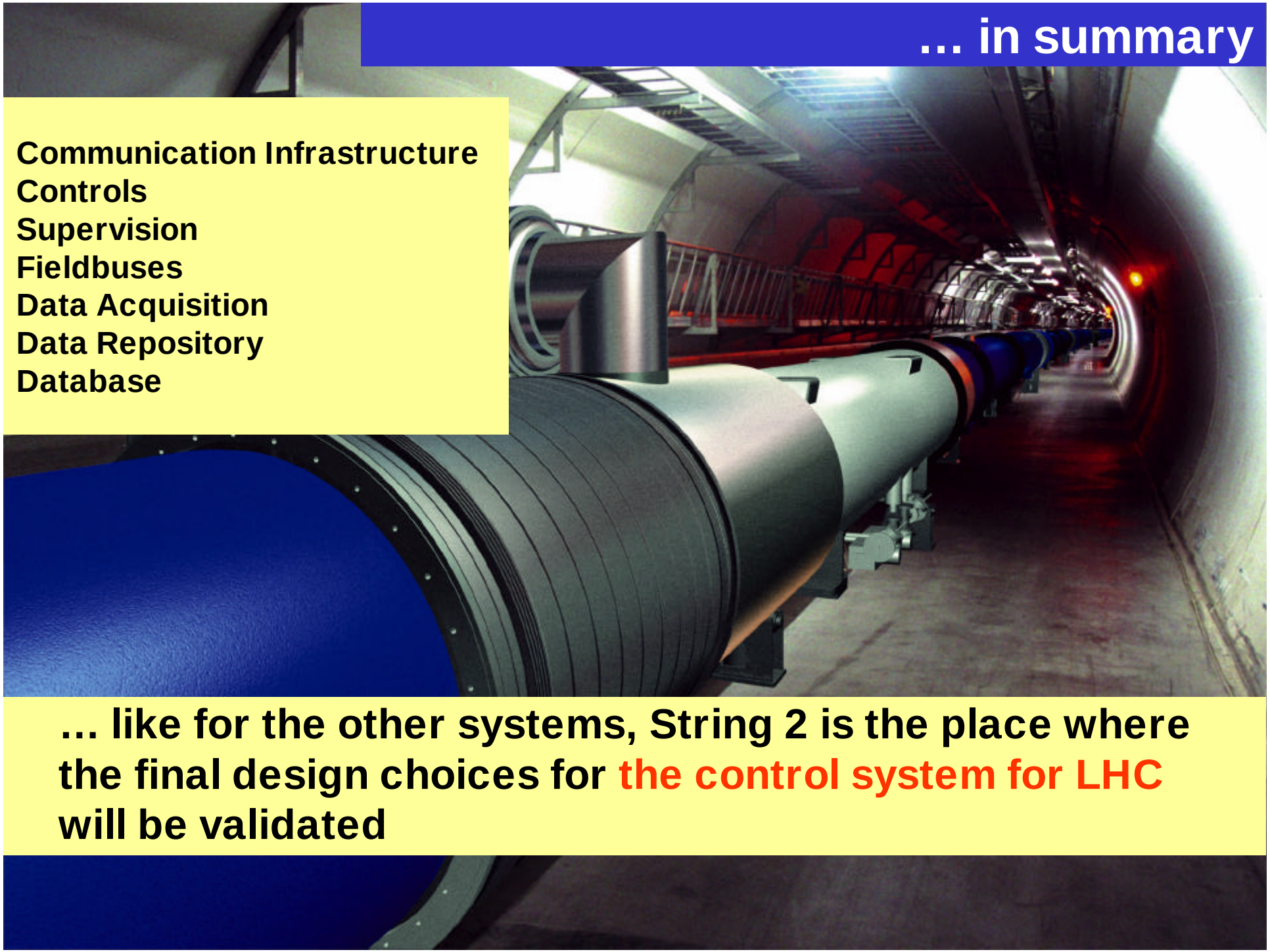


stride
STRING2 DATA EXTRACTOR

- Fast and versatile data extractor
- Common interface to DAQ and SCADA data
- Historical configuration browser
- Not an analysis tool, but simple visualization capabilities provided

Courtesy T.Ladzinski, M.Peryt

… in summary



Communication Infrastructure
Controls
Supervision
Fieldbuses
Data Acquisition
Data Repository
Database

… like for the other systems, String 2 is the place where the final design choices for the control system for LHC will be validated