

LHC-CP Workshop Architecture session



P. Charrue (SL/CO)

P. Gayet (LHC/IAS/CR)

M. Vanden Eynden (SL/CO/AP)

Report from the session

Outline



- Goal of the session
- Description of the architecture and the services
- 8 typical users
- Lessons learned
- Conclusions

Goal of the session



- To make Controls Specialists meet with their users.
- To listen to the requirements.
- To present our current ideas.
- To describe the services the Controls Architecture is (will) offer.

Goal of the session



- Have a dynamic session with lots of interactions between users and controls specialists.
- Get in the end of the day a better picture of what our users need.
- Publicly announce which services will be made available for the control of LHC.
- Prepare challenging follow-up together.

Structure of the session



- **14h10** : Typical controls user presentation - M.Lamont (SL/OP), K.Sigerud (SL/CO), Q.King (SL/PO), JJ.Gras (SL/BI), E.Carlier (SL/BT), R.Gavaggio (LHC/VAC), P.Gayet (LHC/IAS), P.Sollander (ST/MO)
- **14h50** : Basic Controls Architecture, interfaces and deliverables : "Classic" view - P.Charrue
- **15h10** : Basic Controls Architecture, interfaces and deliverables : "Industrial" view - P. Gayet
- **15h20** : Integration issues - M. vanden Eynden
- **15h25** : Software Production Infrastructure - M. vanden Eynden
- **15h40-15h55** : (small) Coffee break
- **15h55** : Typical controls user integration - (Same speakers as above)
- **16h35** : Discussion - Other participant's presentation and integration.

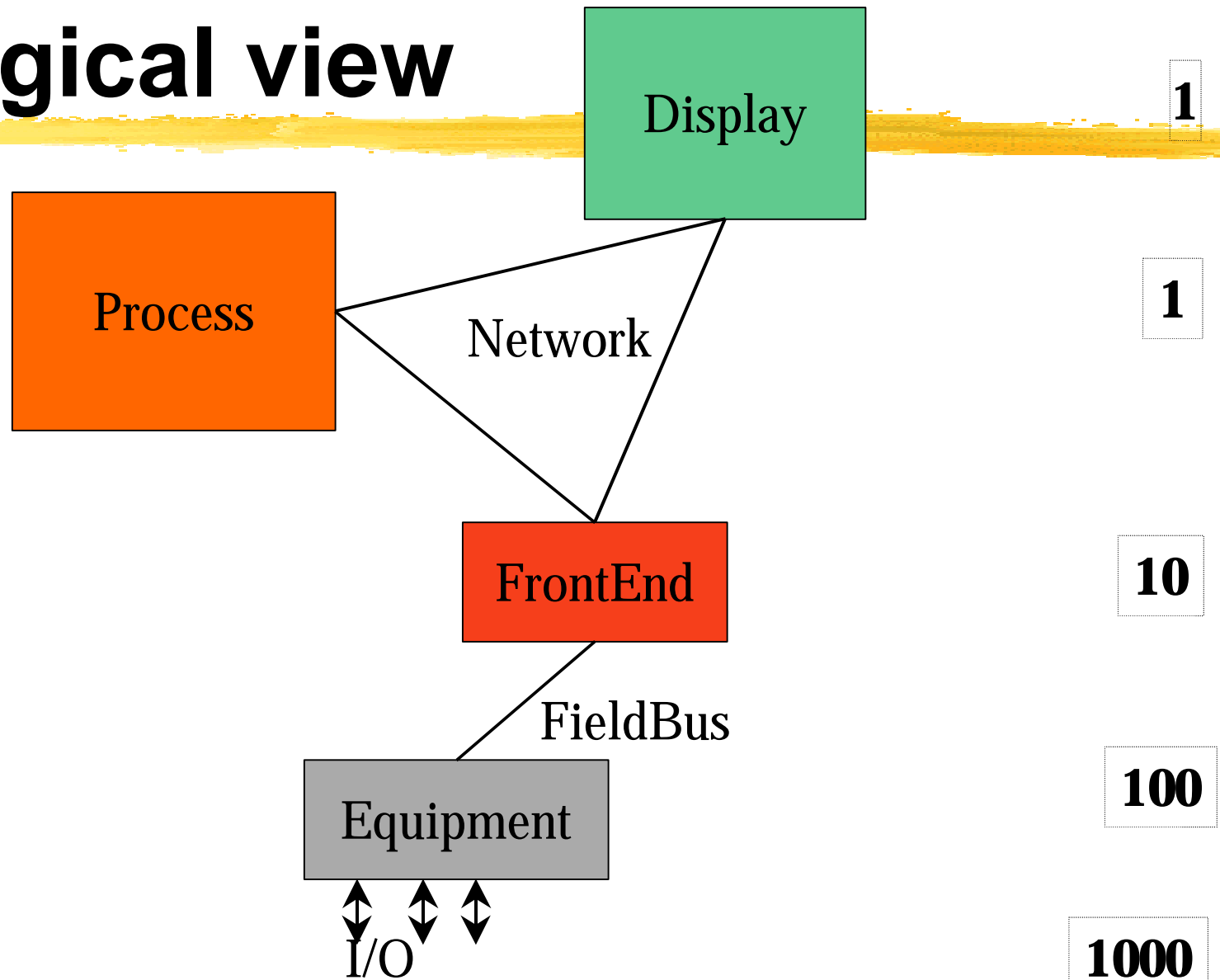
Outline



- Goal of the session
- **Description of the architecture and the services**
- 8 typical users
- Lessons learned
- Conclusions

Basic Control Architecture

Logical view



Basic Controls Architecture



- Fits for home made controls
- Fits for Industrial made controls
- Fits for heterogeneous controls
- **Important remark** : What is relevant today its not **how** the architecture is done but which are the **interfaces** and the **services** proposed, deployed and maintained on this infrastructure
- Our discussions must be based on the requirements of the services needed (e.g. 10Hz feedback or 1 μ s date precision or java support for 2002...)

Services proposed (1/3)

■ Middleware

- client interface (C, C++, JAVA)
- server interface (C, C++, JAVA)
- Specific clients : RAD, Microsoft, SCADA, ...)
- Specific servers : PLC, FrontEnds, ECA, SCADA, ...)
- Tools to configure, retrieve, add, view, etc. NAMES in the namespace

■ Timing HW :

- TG8 (VME, CompactPCI)
- TG3 (G64)
- IRIG-B (PLC)

■ Timing SW

- Machine events (classic)
- Absolute Time of Day synchro (1 us)
- SSM package (5ms)
- MTG support lib to inject events.

■ FrontEnd HW

- VME LynxOS PPC with 1553, GPIB, TG8, etc. boards
- CompactPCI 3U Intel LynxOS or Linux or WNT

■ FrontEnd SW

- Support for all OS and I/O boards
- IRIG-B support library
- PLC support.
- Offer software integration

■ FieldBus

- FrontEnd interface card HW and SW (WorldFip)
- IRIG-B support in WFip
- For Profibus, we could offer a support if needed.

Services proposed (2/3)

■ RealTime Communications

- We need to wait for the outcomes from the LHC-CP RT-WG
- But there will be a support for RealTime communications

■ Servers

- Operation File server
- Operation Application server
- Display server
- Development machine support
- user account support
- Operation account support
- 3rd party software support for development and operation
- Support for selected operating system

■ Database support

- In collaboration with SL/MR and IT/DB

■ Alarms

- Archiving - Logging
- Connectivity from anywhere - Accept information from anywhere
- Means to send or retrieve data into/from the ALARM system - Alarm template for alarms providers
- Possible reduction support - Machine mode masking - Control of the information flow
- Display and display management

■ Applications software

- Environment for software development
- Environment for deployment in operation
- Console Manager support

■ Other generic services

- Diagnostic tools for all levels (à la Xcluc for instance)
- Logging and archiving

Services proposed (3/3)

industrial controls



- Protocols (Polling/Event driven)
 - PLC/PLC (S7, UniTe, Modbus) on TCP-IP
 - PLC/SCADA (S7, UniTe, Modbus) on TCP-IP
- Time synchronisation
 - Distribution at all level (PLC, SCADA, Fieldbus)
- Time stamping at origin (functions)
 - PLC, Remote I/O, Fieldbus
- Configuration Databases
 - I/O, PLC, SCADA
- SCADA Framework
 - Alarms/Events, Trending, Mimics
- Fieldbus configuration tools
- Interface to middleware
- Naming Conventions

Integration Issues



■ **Hardwired integration**

- Used for critical and safety information exchange

■ **Software integration** (here start the questions ...)

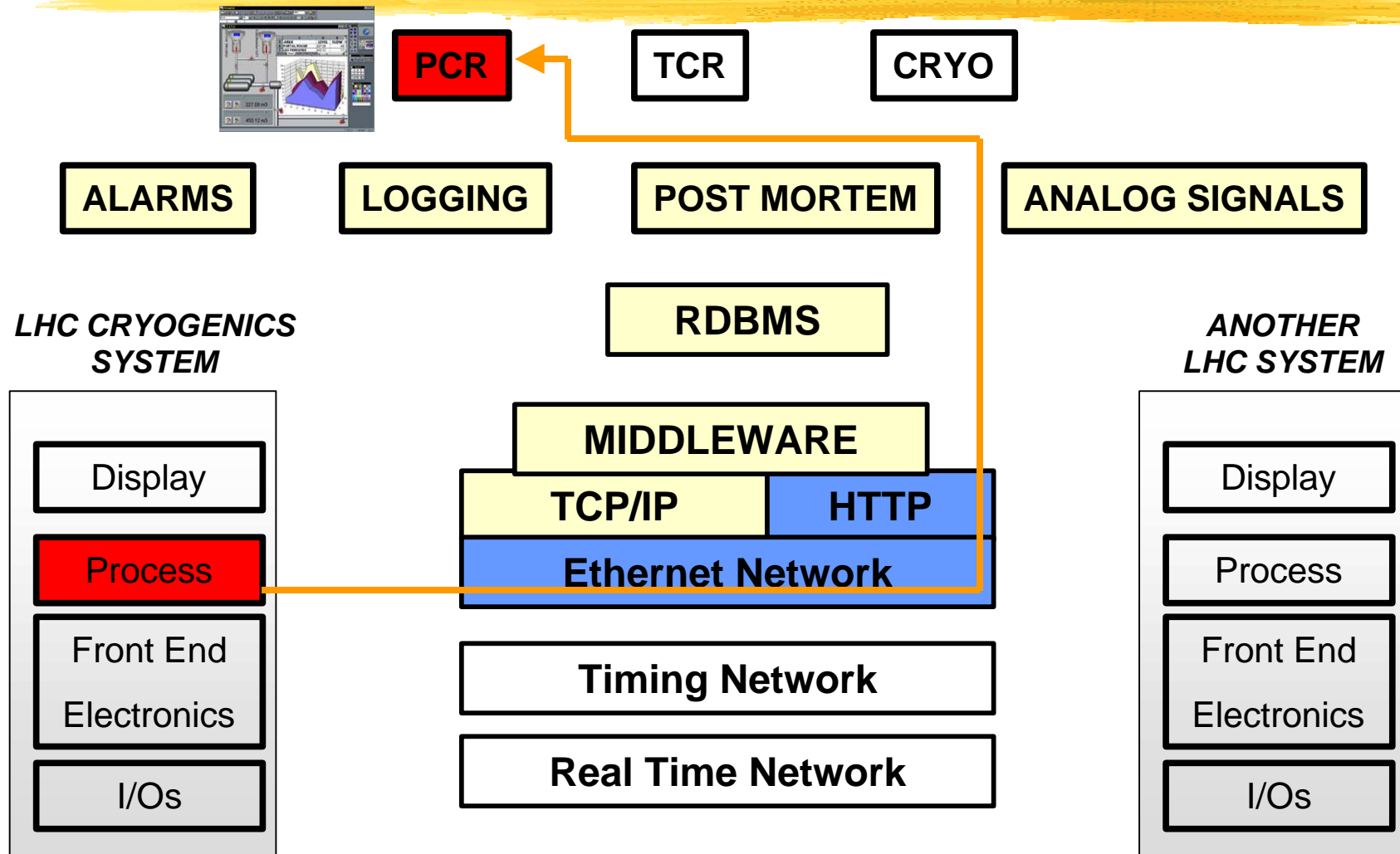
- Allows 2 or more systems to exchange information through software interfaces
- Based on communication protocols and APIs (TCP/IP, MW API, RDBMS API, etc)
- Information exchange only or remote commands ?
- Deterministic or not ?

■ **Visual integration**

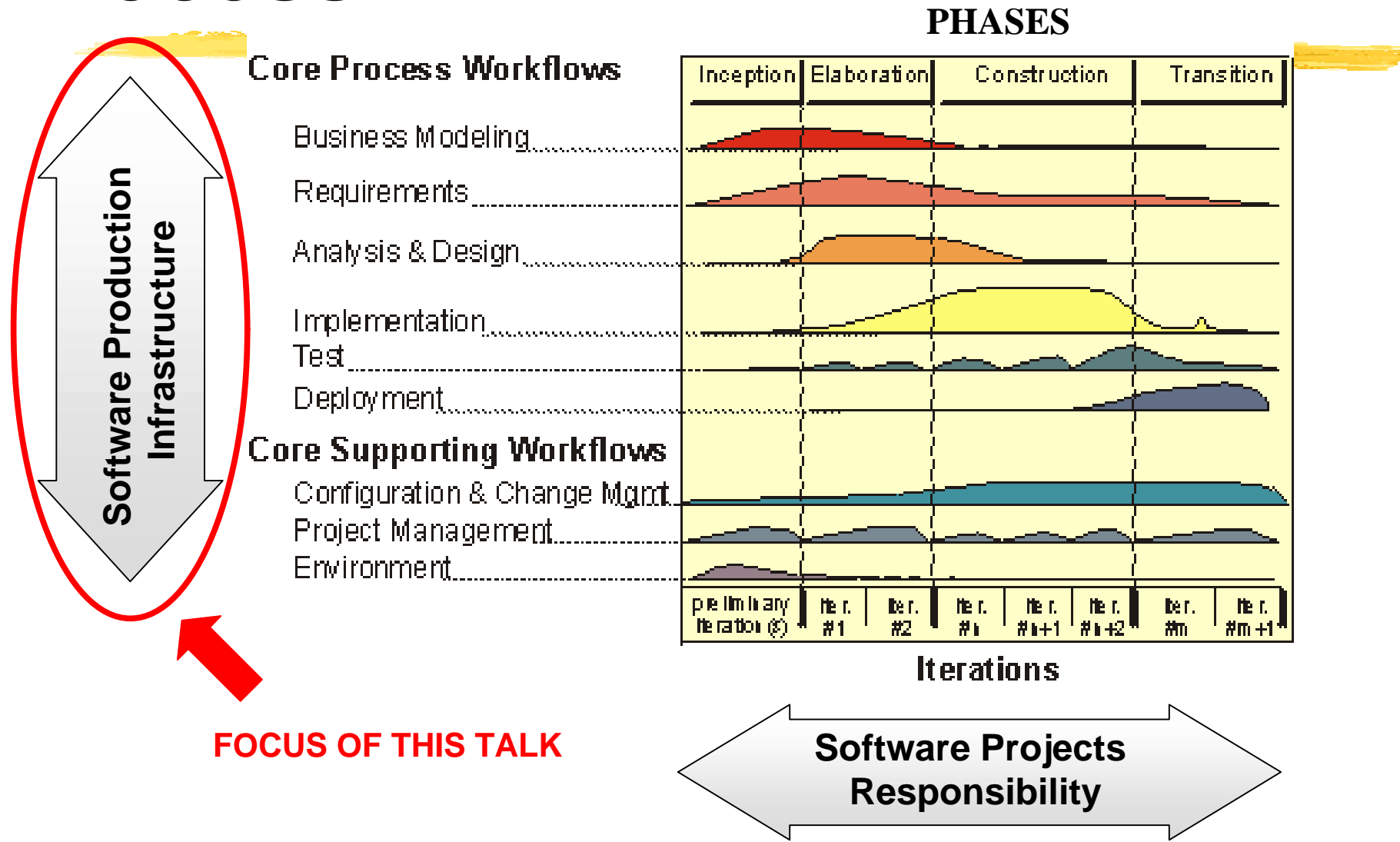
- Allows operator (specialist or PCR, TCR) to visually interact with distributed processes
- Typical examples : Java GUIs, PVSS views, WWW

Integration depends on the NEEDS !

- Examples 2 : *LHC CRYOGENICS information at disposal of PCR operators during magnet quench recovery (visual integration)*



The Software Production Process



Proposed Infrastrucure

Techniques and technology, here we are ...

MACHINE	PLATFORMS	LANGUAGES	GRAPHICS	MIDDELWARE	METHODS TOOLS
SPS (70s)	NORSK Data (Assembler, MAC)	NODAL	NODAL	TITN Network (MTS)	Did they exist ?
	↓	↓	↓	↓	↓
LEP (80s)	APOLLO WS (Domain OS), HP WS (HP-UX 9,10)	NODAL, C	APOLLO DIALOG, X/WINDOW OSF/MOTIF	TCP/IP, RPC CLIENT/SRV MODEL, SL-EQUIP	SASD, IDEs (X/Motif), RDBMS, Early SCaM
	↓	↓	↓	↓	↓
Today	PCs (WIN/NT, W2K, LINUX) HP WS (HP-UX 10.2)	JAVA, C, C++	SWING, JAVA BEANS	TCP/IP, CORBA, JMS (MOM)	OOA/D (USDP), IDEs (Java), Full SCaM, GDPM
2003,4	HP WS (HP-UX 11,...) and/or PCs (WIN/NT, W2K, LINUX) and/or SUN WS (Solaris 7,8,...)				

Outline



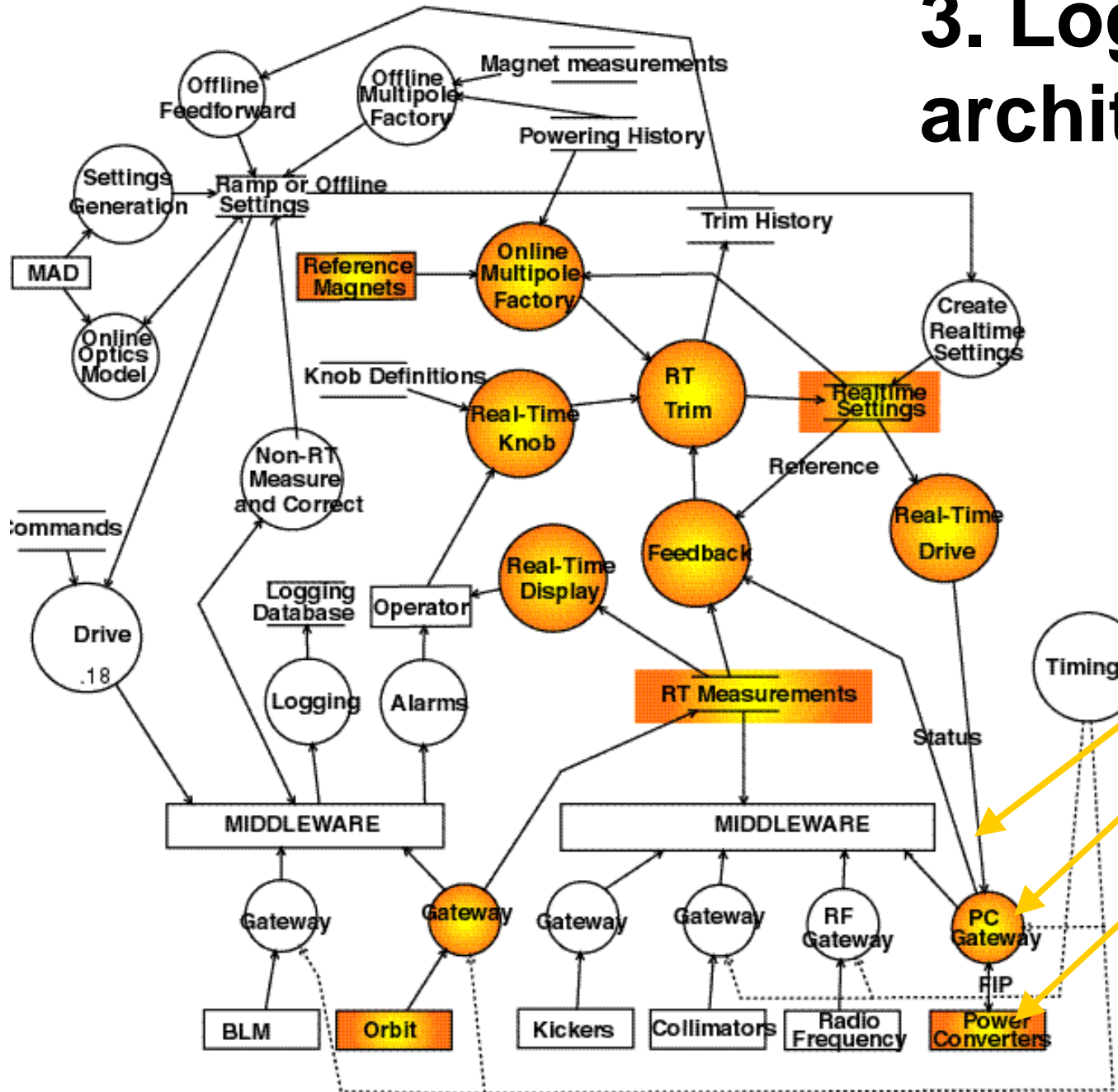
- Goal of the session
- Description of the architecture and the services
- **8 typical users**
- Lessons learned
- Conclusions

LHC Operator (M.Lamont)



- Need to define how the LHC beam will be controlled and later (2007?) control it!
- Request for software development environment and all support for equipment access, support for complex operation package (like trim, logging, parameter translation, ...), real-time support.


3. Logical architecture



Mixture of logical and physical which reflects reality

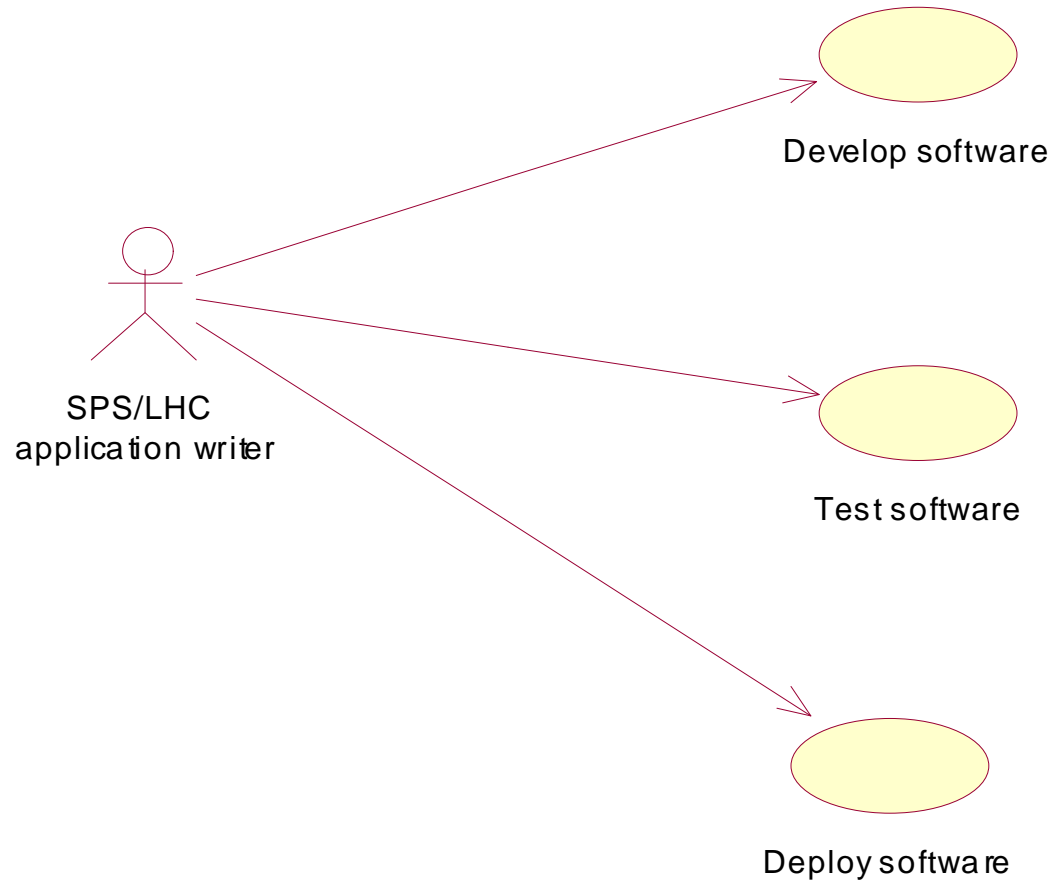
Power converters, for example: Digital controllers connected to VME by world FIP, IRIG-B/TG8 presumably Gigabit Ethernet to high level

LHC application writer (K. Sigerud)



- Need to develop, test, deploy, maintain operational software
- But what is an application?

How to develop software

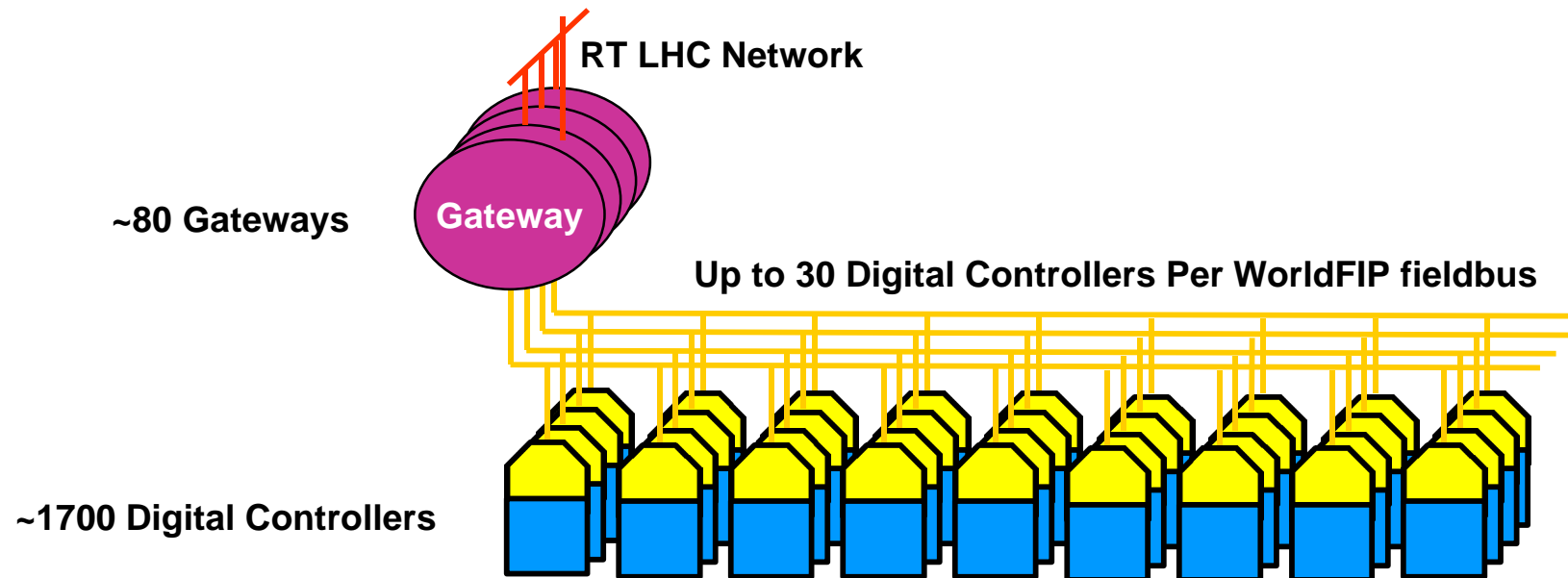


Equipment owner I (Q. King SL/PO)



- Using 'home-made' equipment
- VME LynxOS, WorldFIP, RealTime, postmortem, UTC date distribution, ...
- Support for simple scripting languages (Tcl/Tk, Perl, Python, ...) ?
- System in operation on SM18

SL/PO architecture

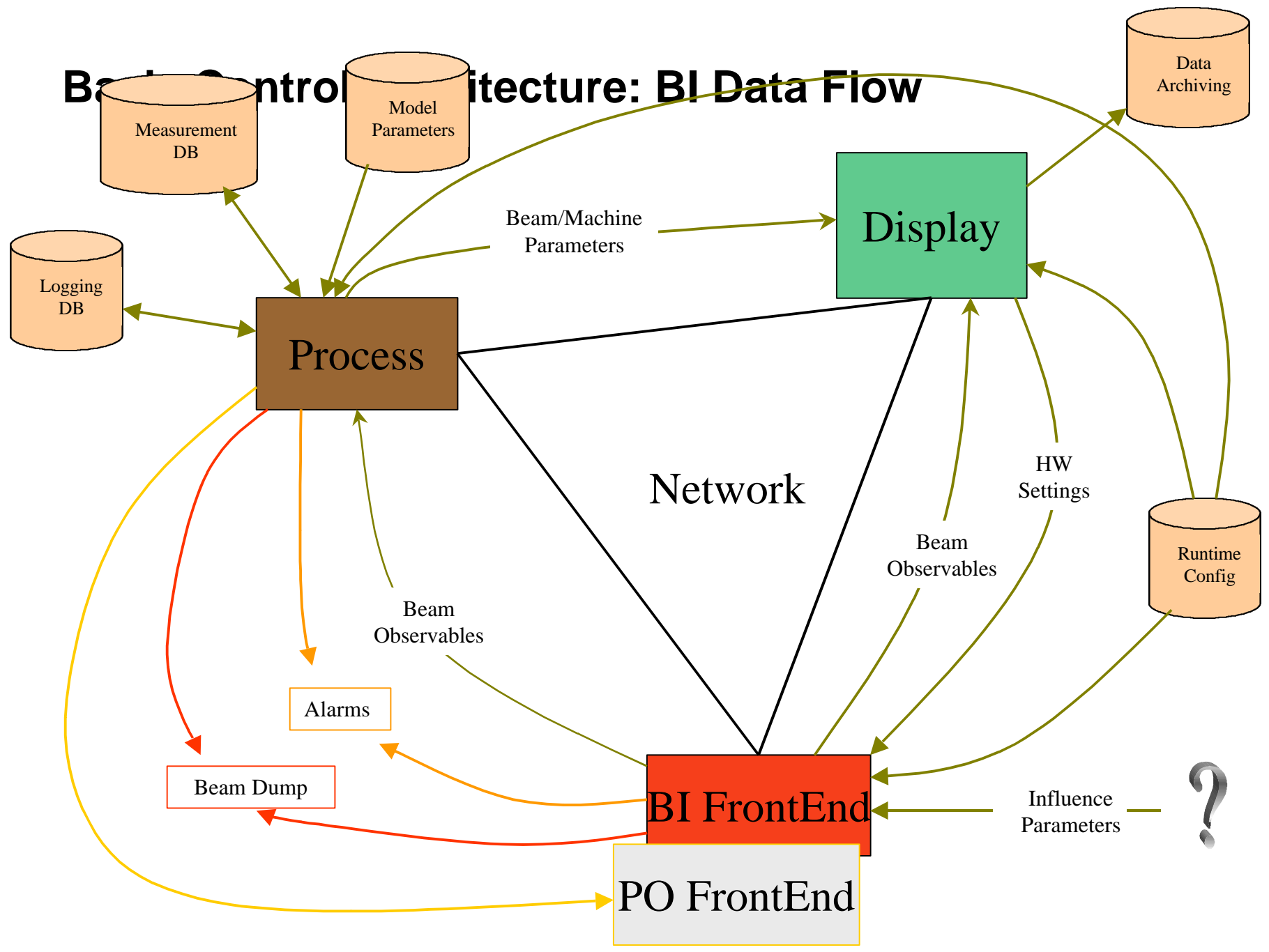


Equipment owner II (JJ.Gras SL/BI)



- Using 'home made' equipment
- Many different equipment but with the same controls infrastructure and philosophy
- BI Policy:
 - Use within our mandate the standard solutions provided by SL/CO whenever possible.
 - When no standard solution is available, check with SL/CO if one could be provided on time.
 - If no standard solution can be provided within the timescale, develop one.

Beam Control Architecture: BI Data Flow

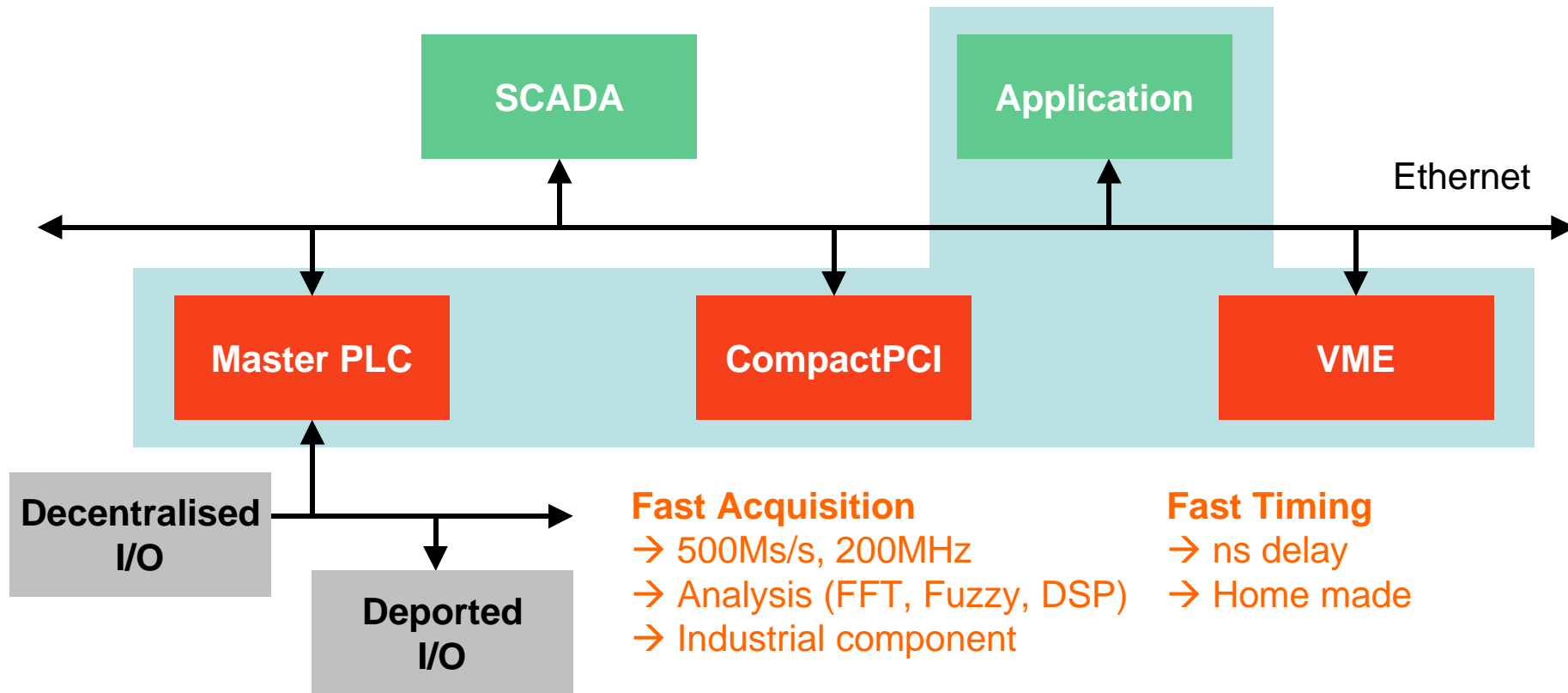


Equipment owner III (E. Carlier SL/BT)



- Mixing home made with industrial equipment
- Need for mixed solution support (VME-LynxOS, PXI acquisition, Siemens PLCs)
- Horizontal integration with other equipment

SL/BT Architecture



Fast Acquisition
 → 500Ms/s, 200MHz
 → Analysis (FFT, Fuzzy, DSP)
 → Industrial component

Fast Timing
 → ns delay
 → Home made

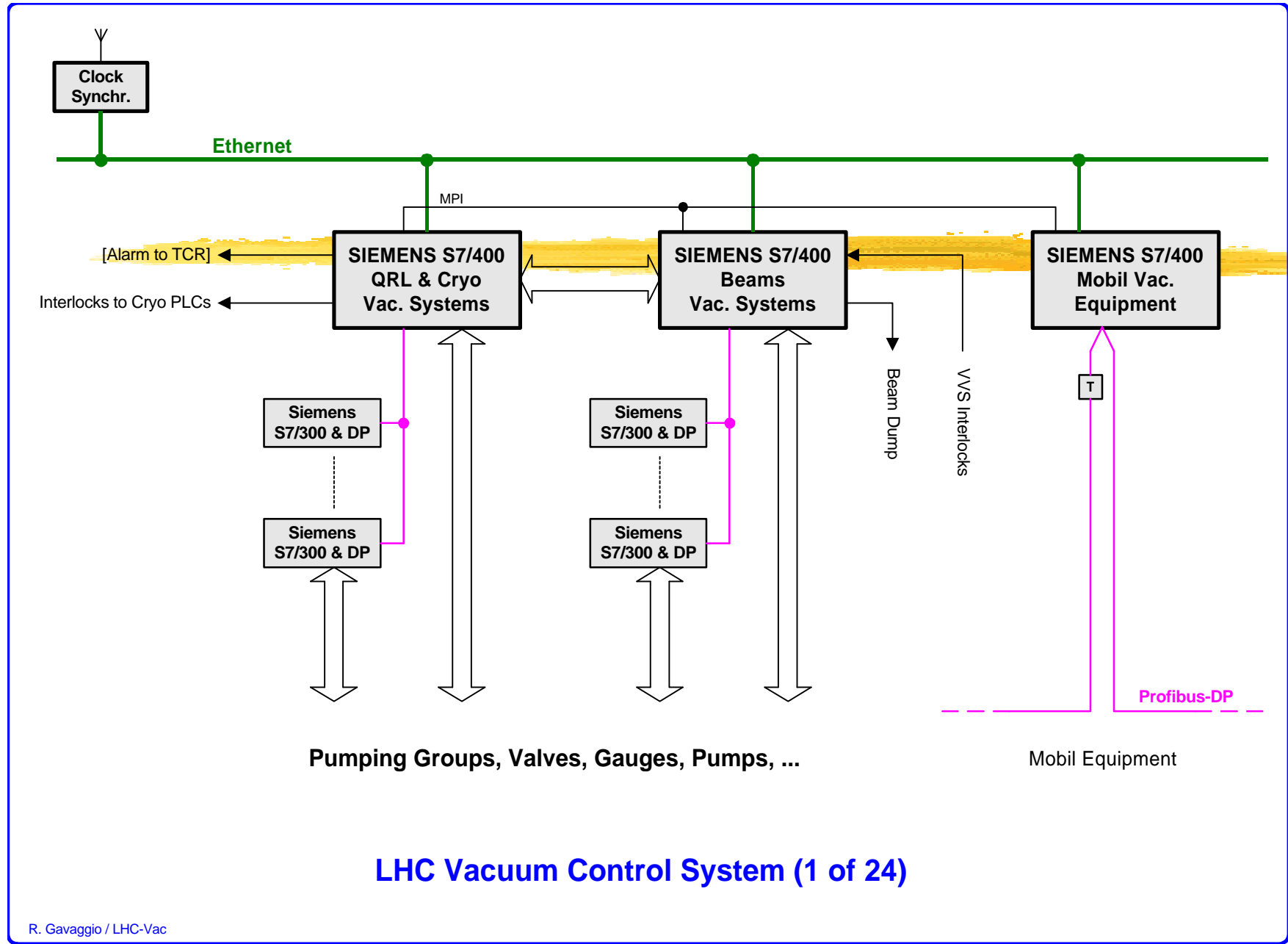
Slow control
 → Equipment state control
 → Industrial Control

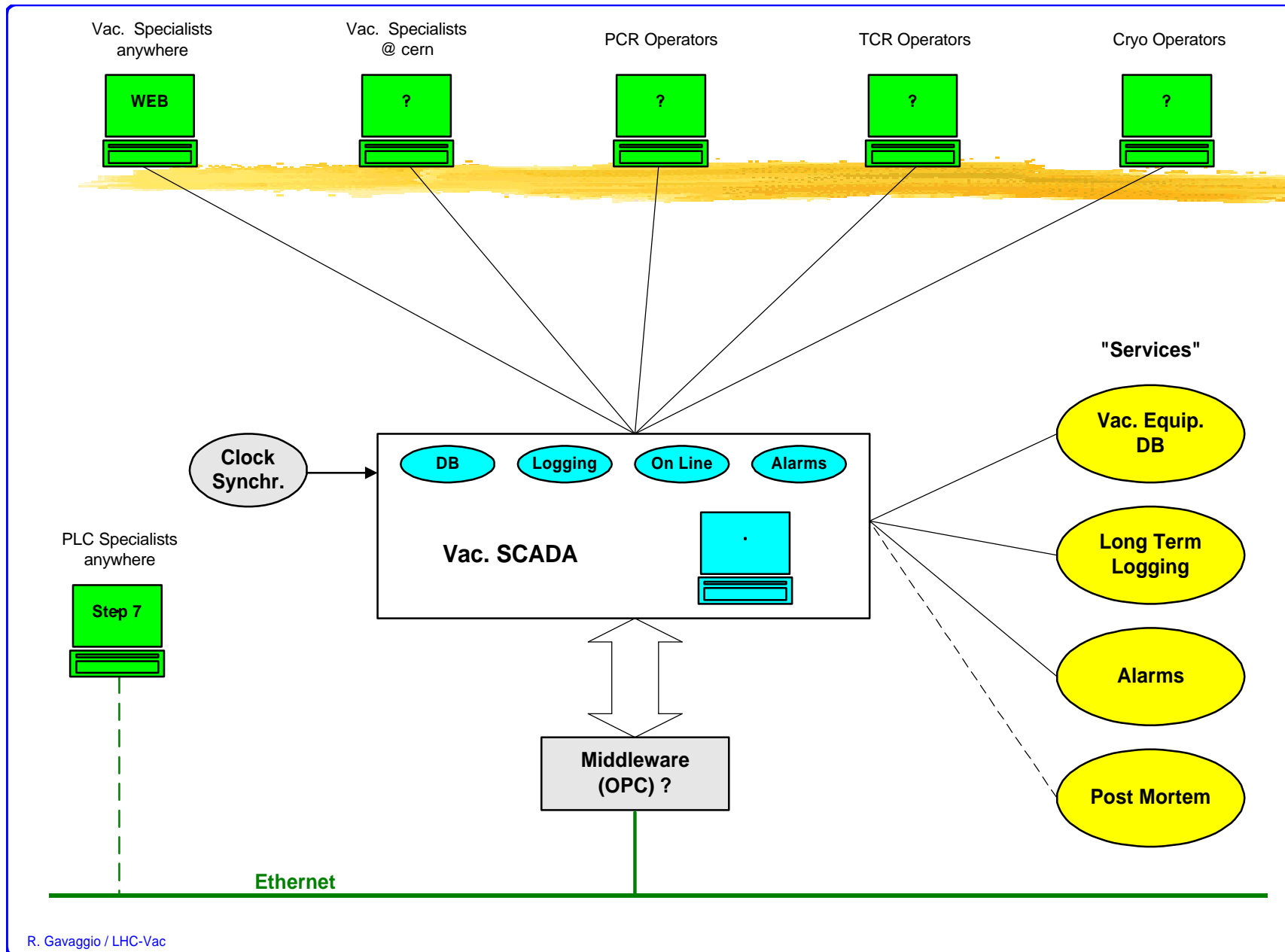
LHC Vacuum

(R. Gavaggio LHC/VAC)



- Integration of industrial equipment
- Siemens and Profibus infrastructure
- SCADA for control
- 1ms datation for postmortem
- Stand alone installation for end 2002
- Direct connection with Cryo
- Need close integration with PCR, TCR, Cryo, PS/CO.





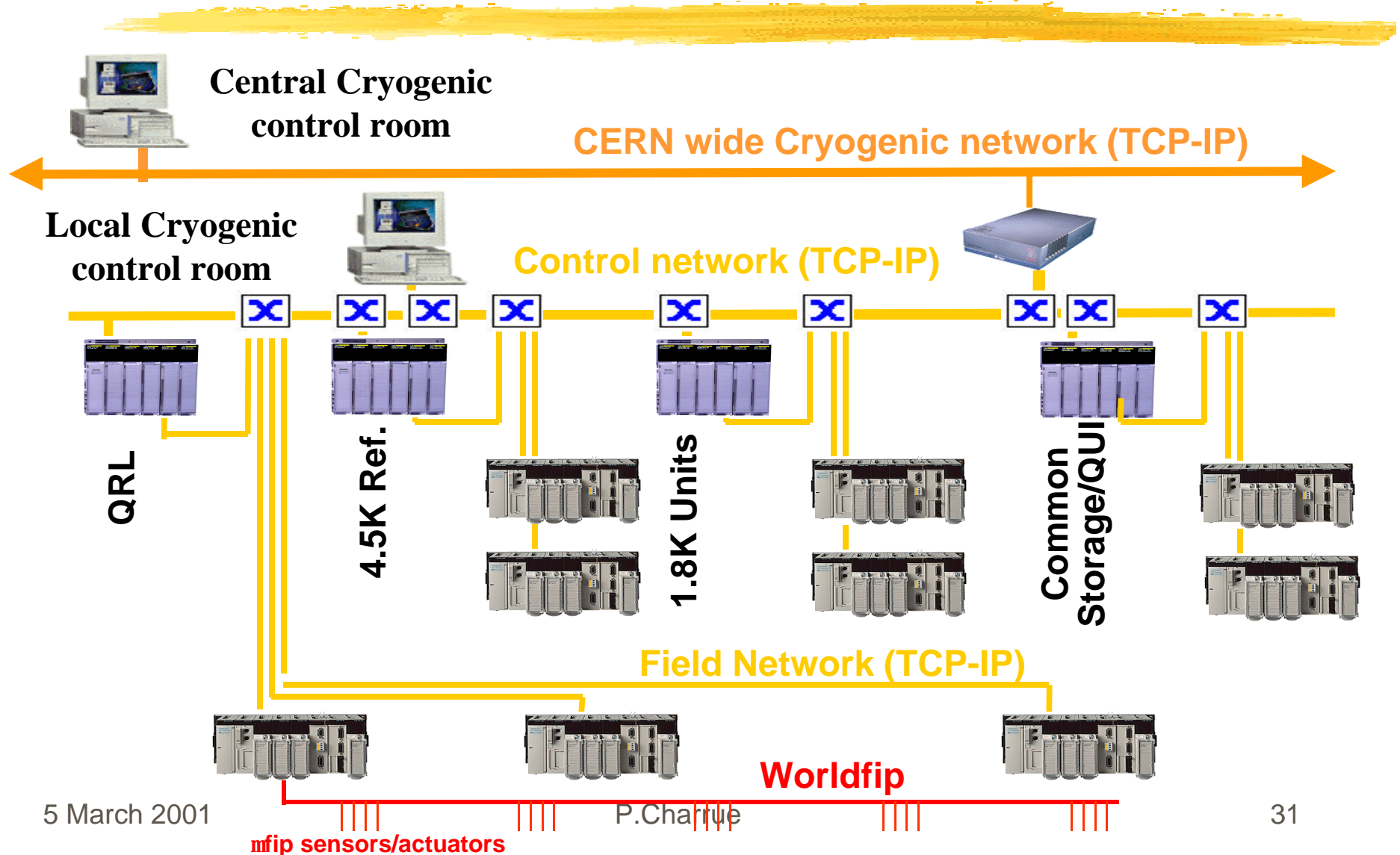
R. Gavaggio / LHC-Vac

Cryogenic system (P.Gayet LHC/IAS)



- Complete industrial system based on PLC and SCADA developed outside CERN
- Need information from PCR
- HW interlock with vacuum
- Integration needs to PCR, TCR, ...

Cryo Hardware Architecture



5 March 2001

mfiip sensors/actuators

P.Charrue

Worldfip

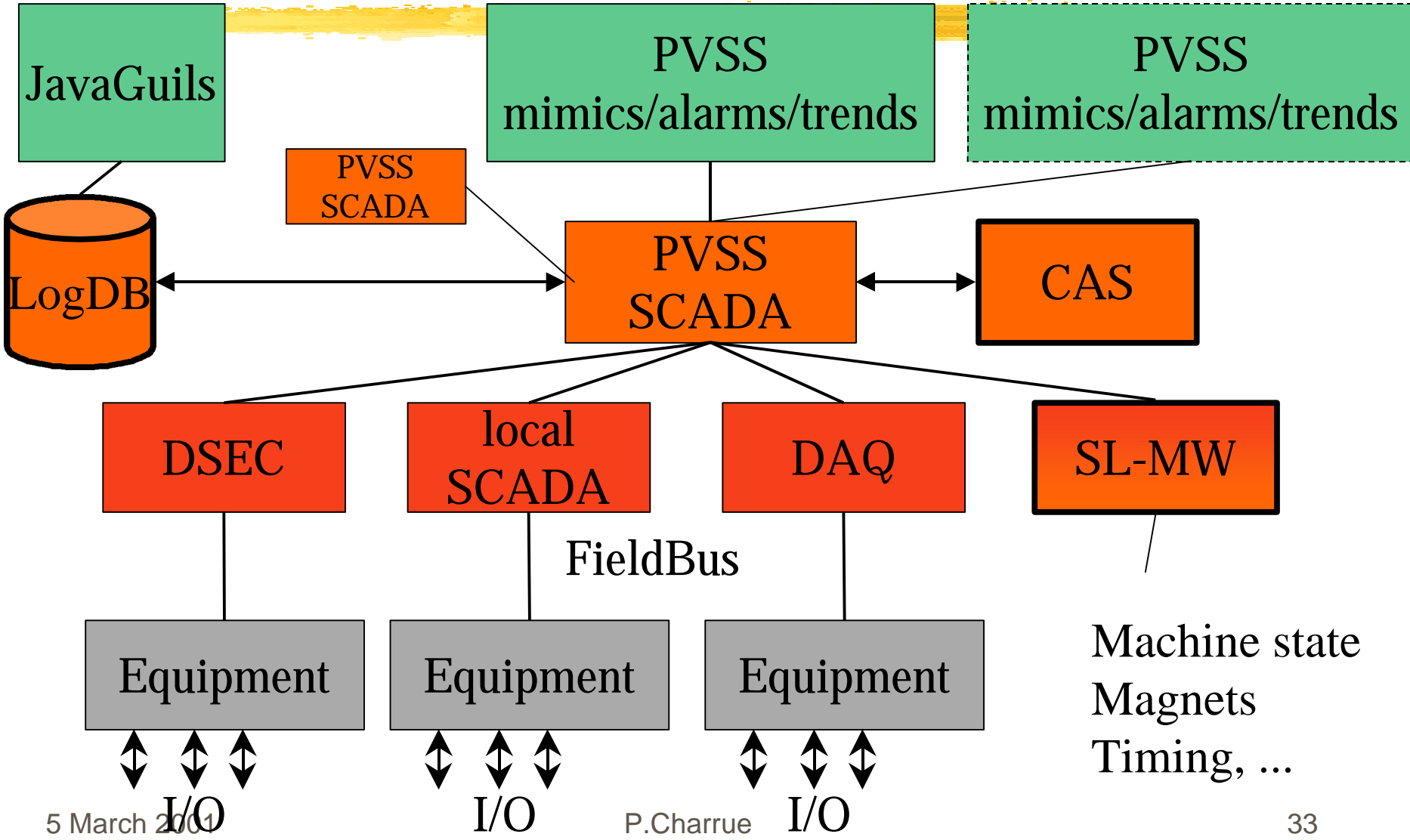
31

TCR Operator (P.Sollander ST/MO)



- Current system being migrated to PVSS-II
- Need generic tools like CAS, logging, JavaGUILS
- But also SCADA to CMW interface

TCR Architecture



Outline



- Goal of the session
- Description of the architecture and the services
- 8 typical users
- **Lessons learned**
- Conclusions

Requests - Comments (1/2)



- Request for a good testing environment.
- Need to define what is an application and who will write them.
- We have to know the integration needs
- What is the analogue signal support (e.g. oscilloscope with Ethernet connection?)
- Why SCADA is not a good solution for controls architecture? Aren't we re-inventing the wheel?

Requests - Comments (2/2)



- Software development architecture must be there for 2003.
- Will there be a support for simple scripting tools (e.g tcl/tk or Perl or Python)?
- Need for equipment to equipment horizontal communication.
- Request for a standard interface CMW to/from SCADA.

Outline



- Goal of the session
- Description of the architecture and the services
- 8 typical users
- Lessons learned
- **Conclusions**

Conclusion (1/3)



- The future LHC controls architecture is not yet defined.
- But we have currently several projects running to study and implement parts of the architecture (e.g. middleware, HELIX, SCAMS, RAD, Alarms, FFEWG, SPS-2001, CESAR, ...)
- And we will continue our discussions with our users to get their inputs and find suitable solutions.

Conclusion (2/3)



- Some important questions still remain to be clarified regarding
 - Development environment
 - Integration **needs**
 - SCADA to CMW
 - Etc.
- Action : SL/CO, LHC-CP, LAWG
- String-2 must be used to deploy the LHC architecture controls solutions

Conclusion (3/3)



- **Reminder** : What is relevant today its not **how** the architecture is done but which are the **interfaces** and the **services** proposed, deployed and maintained on this infrastructure
- We have to continue our excellent collaboration within controls groups and with our users.
- But R&D is now over and requirement must now be crystallized into real implementations.
 - Action : SL/CO & LHC-CP & LAWG