Minutes of LHC-CP Link Meeting 12

Subject	:	LHC Controls Project	
Date	:	24th April, 2001	
Place	:	936-Conference Room	
Participating Groups	:	EST-ISS	no representative
		LHC-ACR	Ph. Gayet,
		LHC-ECR	no representative,
		LHC-IAS	no representative,
		LHC-ICP	apologies,
		LHC-MMS	no representative,
		LHC-MTA	L. Walckiers,
		LHC-VAC	R. Gavaggio,
		PS-CO	F. Di Maio,
		SL-AP	E. Wildner,
		SL-BI	J-J. Gras,
		SL-BT	apologies,
		SL-CO	A. Bland,
		SL-HRF	E. Ciapala,
		SL-MR	R. Billen,
		SL-MS	P. Dahlen replacing G. Mugnai,
		SL-OP	apologies,
		SL-PO	Q. King,
		ST-MO	P. Solander.
Others	:	G. Duvoux (SPS 2001 project) M. Jonker (SPS 2001 project) R. Lauckner R. (Chair), M. Vanden Eynden (Core Team), M. Tyrrell (Alarm Sub-Project).	
Distribution	:	Via LHC-CP website: **http://cern.ch/lhc-cp** Notification via: **lhc-cp-info@cern.ch**	
Agenda	:	1. Minutes from previous meeting	
		2. LHC-CP News	R. Lauckner
		3. Report from the Components Working Group	P. Gayet
		4. Review of the Alarm Sub-Project Mandate	M. Tyrrell
		5. Demonstration of the SPS 2001 Vertical Slice	M. Jonker
		6. AOB	

1. Minutes from Previous Meeting

M. Vanden Eynden reported that a meeting is scheduled with R. Saban to clarify the distinction between documentation stored in the EDMS system under the LHC Baseline and that under the LHC-CP Documentation tree. Q. King has supplied documentation to be entered into the system. R. Lauckner asked that other groups and sub-projects contact Marc Vanden Eynden with material to be documented including minutes. (This subject is moved to the long term actions.)

R. Lauckner reported that A. Daneels had conducted the meeting to review technical issues concerning alarms and logging facilities to support the QRL reception tests. Several questions had been raised and notes from the meeting are appended to these minutes. Issues will be followed up by the Alarm sub-project and R. Billen is in the process of defining a database identity to chase these and other issues. Results should be reported to the LHC-CP meetings.

2. LHC-CP News R. Lauckner

J. May has now endorsed the Controls Board SCADA recommendation and all divisions have been informed. Copies of his memorandum to the divisions and the Controls Board document are attached to these minutes.

The 2 day PVSS seminar on 26th and 27th March had been well attended and was an interesting introduction to the product. The Controls Board, that meets again on May 3rd, is now actively pursuing the issues of licensing and support.

The schedule and main topics for the next LHC-CP meetings are:

29/5	Slow Timing, Time Stamping		?
5/6	Database? Post Mortem?		?

3. Report from the Components Working Group P. Gayet

P. Gayet briefly reviewed the sub-project mandate and pointed out that the work had suffered some 3 months of slippage due to his current work load. Only one meeting had been held but nevertheless progress has been made outside of the meetings.

Many groups have made the basic choices of components for their systems. These have all followed the Controls Board recommendations on PLCs and fieldbuses as supported by LHC-IAS. However these recommendations do not cover the protocols that are used within these systems and here there has been a wide divergence. An opportunity now exists to introduce a more systematic approach with the introduction of PVSS. The working group will promote standard protocols for SCADA <> PLC communication.

The major systems to be sub-contracted, (ST-CV. ST-EL, UNICOS) have already passed the tendering phase. Therefore the specification guidelines as requested in the mandate will be too late for the LHC-CP project.

A problem facing several groups concerns time stamping with the appropriate resolution. LHC-IAS are working to identifying solutions for these users.

One group (BT) is also involved in building systems based on custom developments in VMS. They have requested that an initiative similar to this working group should be taken for these systems.

All users face similar needs for the management of configuration data for the PLCs and SCADAs. This must be coherent and a single managed source of this data is required. (*This is perhaps coupled to the versioning requirements for these systems - secretary*).

R. Lauckner pointed out that several teams had yet to embark on development in this area: RF, Warm Magnet Interlock, Magnet Protecton, Quench Detection. He encouraged the working group to continue with the progress already achieved and remarked that the 3 month delay did not appear critical.

M. Tyrrell asked if communication from the Control Room to the PLC layer will systematically go through the SCADA software. P. Gayet considers that SCADA is not robust enough for this task and foresees the needs for parallel command chains from SCADA and from the central control room. This is more complex but is already the preferred solution for BT. P. Sollander pointed out that for the TCR all communication above the PLCs goes through the Smart Socket layer today which would be replaced by PVSS. However the situation is different when PVSS is used as the top layer GUI.

4. Review of the Alarm Sub-Project Mandate M. Tyrrell

M. Tyrrell reported that the Alarm Sub-Project proposed to adopt a new time frame following the announced delay of the Sector Test to March 2004. It seems unnecessary to make the corresponding decisions as early as required by the original schedule. This should favour better technical solutions and users can continue to rely on the present system which will ensure a viable service until the LHC system is operational.

R. Lauckner asked M. Tyrrell to discuss the consequences with the Technical Services and Cryogenic Systems link men before a final decision is made to accept this schedule.

ACTION: P. GAYET, P. SOLANDER, M. TYRRELL

5. Demonstration of the SPS 2001 Vertical Slice M. Jonker

M. Jonker reminded the meeting that the major aims of the SPS 2001 project are to upgrade the SPS Control Room software after over 20 years of operation and to enable rapid changes of supercycle with the necessary level of flexibility to meet operational requirements in the presence of magnetic coupling between the individual cycles.

In his presentation he pointed out that good features of the present architecture, such as the parameter modelling and maintenance will be kept but nevertheless the architecture has to be extended to meet the new requirements.

An important extension is the introduction of the concept of virtual devices to complement the existing physical devices. In the new model a hardware device such as a magnet or a beam stopper would also be a member of the ensemble composing a virtual device such as a beam in a beamline or an access to a geographical area of the machine. The virtual devices have states just as hardware devices but these are composed of sets of the component device states.

M. Jonker went on to outline the communication model for SPS2001. An important feature here is the device contract which is seen as a Java Interface by the control room client. This interface goes beyond the simple get/set interface by starting to introduce some standardisation in the property model of different devices.

The vertical slice implements a generic device state management application from the GUI down to the device layer (hardware is simulated). Device servers build on a server framework developed by the project and independent of the underlying Middleware (DIM in the current implementation) are hosted in the SL Control System environment. The demonstration presented a generic “device explorer” GUI written in Java which discovers, displays and controls the property models published by the underlying virtual devices and their hardware device components.

Q. King asked how many contexts a device would have to maintain (as member of different virtual devices). These all require resources. M. Jonker replied that the equipment group engineer is shielded from this problem by the device framework. (further clarification: the load of the client contexts on the device server is not so high as one might think because the client context that is maintained for one particular client (which should not use more then 200 bytes) is shared by all devices published by a server.)

J. J Gras pointed out that as generic applications are not useful for beam monitoring devices it is not necessary to standardise on their property model.

Q. King remarked that it was his intention to start work involving the software Middleware layer at the end of 2001. By that time he will need clarification concerning the services he should use - CMW or SPS Device Contracts. JJ-Gras remarked that he had discussed this issue with P. Charrue who favoured the use of SPS device contracts for the LHC.

In response to a question from R. Lauckner, M. Jonker said that he considers that the State Management model and software being developed for the SPS would be a useful facility to be re-used for the LHC.

6. AOB

There was no further business.

Long Term Actions	**People**
Establish Real-time sub-project.	R Lauckner
Establish Post Mortem sub-project	R. Lauckner
Attach leaves to EDMS tree	All, M. Vanden Eynden

Reported by R. Lauckner

Notes from a meeting, held 29th March, to discuss ALARM and LOGGING for systems involved with QRL Control

Present:

G. Beetham, R. Billen, J. Casas Cubillos, P. Charrue, A. Daneels, R. Gavaggio, P. Gayet, R. Lauckner, I. Laugier, M. Peryt, P. Ninin, M. Tyrrell, M. Vanden Eynden

Introduction

Controls planning meetings concerning the systems involved in the QRL reception tests have identified a lack of any explicit initiative to prepare the integration of the cryogenic and vacuum systems with the future Alarm and Logging Facilities of the LHC. An LHC-CP sub-project has been mandated to prepare the Alarm Facilities needed for the PCR and the general issue of data management for LHC Control will be examined at the LHC-CP Workshop in April.

This meeting was intended to review the likely integration issues in the light of experience with similar systems in LEP. It was aimed at identifying subjects which should be taken into account within the time frame of preparing for QRL control. This note is a summary of the issues.

Logging

The data management facilities in LEP became progressively more important as LEP Controls moved towards an increasingly data-centric system. Data administration became an increasingly important issue as more systems were integrated. Distributed systems were implemented petitioning being on a high-level functionality basis: alarms, control settings, measurement, logging. The following issues are important for LHC teams involved with logging.

1 To offer the best functionality a global data model needs to be defined for information to be held in the long term archive. This will avoid the unreasonable need to anticipate all possible applications of the data.

2. Logical and physical models of the logging facilities are required to define the partitioning of the implementation. The split of functionality between local control systems and centrally supported systems has to be defined along with the associated interfaces.

Equipment will employ SCADA systems with internal database management. What will be the standard(s) for interfaces towards central systems?

Alarms

The PCR requires alarm reporting from a wide range of systems including LHC machine, technical services, cryogenics, experiments and safety systems. The Technical Control room has similar requirements and other important locations: detector control rooms, cryogenic control rooms have interest in a range of external alarms. The Alarm sub-project of the LHC-CP is prototyping with PVSS and collecting requirements for Alarm Facilities in the LHC era. The following issues concern future controls at the LHC.

1. What are the alarm reduction strategies? Will these be central or distributed and what is the impact on archival and post mortem systems?

2. How will the various alarm acknowledgement requirements be implemented?

3. How will alarm display requirements be met? How will the internal and external alarms be visualised in systems employing SCADA?

4. In order to test the complete alarm chain how will systems that generate alarms report their status?

5. Assuming that SCADA based systems will share alarms with a central alarm facility then how will distributed alarm lists be managed.

6. What level of reliability must be achieved by the central alarm facilities to fulfill the applications of the system?

Finally concerning time stamping both logged information and alarms use time of day as an access key. Time stamps from all systems must have the accuracy and resolution which characterizes the relevant process and must be referred to the same clock.

Follow Up

There are already 2 sub-projects of the LHC-CP working in this area and data management is also under review. R. Lauckner will consult with those concerned to decide on the follow up for these issues and report to the LHC-CP meeting.

R. Lauckner (10/4/01)

DG-DI/JM-np Date: 04 May 2001

MEMORANDUM

To/A	:	M. Buhler-Broglin, J.P. Delahaye, M. Delfino, G. Goggi, D. Güsewell, V. Hatton, K.H. Kissler, P. Lebrun, S. Myers, A. Scaramelli
cc	:	R. Cashmore, C. Détraz, L. Evans K. Hübner, J. van der Boon
	:	Controls Board
From/De	:	J. May
Subject/Objet	:	**SCADA system recommendation**

The Controls Board has evaluated systems for "Supervisory Control and Data Acquisition" (SCADA) and hence recommends the PVSS product for CERN, please see the attached Recommendation for further information.

Could you please bring this recommendation to the attention of people working in the controls field within your division.

EUROPEAN ORGANISATION FOR NUCLEAR RESEARCH

February 2001

Recommendation for SCADA systems at CERN

CERN Controls Board*

Background:

"Supervisory Control and Data Acquisition" (SCADA) systems are in use at CERN for more than ten years. Initially applied only in industrial controls, they are becoming popular in many areas, including large experiments. For historical reasons a number of products are in use today at CERN. The Controls Board has therefore set up a SCADA Working Group with the mandate to produce a proposal to harmonise the products in use, avoid duplication of effort, and provide CERN-wide support.

LHC/IAS has been instrumental in promoting SCADA systems at CERN. After the initial choice of FactoryLink, PCVue was introduced in early 1997. One year later, ST/CV selected Wizcon. The use of other products for new applications is limited.

In May 1997, a SCADA evaluation was started within the Joint Controls Project (JCOP) and endorsed by the Controls Board. The aim was to find out if SCADA systems could be used for the detector control systems of the LHC experiments and, if yes, to select a product common to all experiments. This project is now successfully completed and the tendering has led to the choice of PVSS from ETM, Austria. The Finance Committee approved this selection in September 2000.

Recommendation:

The Controls Board, after consultations with the SCADA working group, and taking into account the present situation at CERN, makes the following recommendation:

- PVSS is the recommended SCADA product at CERN. It can cover applications of all sizes.
- For turnkey systems, companies are encouraged to use PVSS but other products could be accepted if they provide recognised industrial interfaces (such as OPC).
- For economical reason, CERN-wide support should be provided for PVSS and be established within IT with adequate resources. A second level of support should be obtained from the company ETM. For turnkey systems, the supplier shall arrange the support.
- Training should be provided within the framework of the CERN Technical Training Service.
- PCVue32 and Wizcon, as selected respectively by the LHC/IAS and ST/CV groups prior to this recommendation, may continue to be used within the limit of the applications for which they had been chosen. The migration to PVSS shall always be considered.
- Because SCADA products are evolving rapidly, the Controls Board will continue to monitor the evolution of the market.

LCH-CP Industrial Components sub project

Philippe Gayet

Report of Definition meeting

Project Goals

- Define common technical approaches across these system particular in areas such as PLC software and hardware architecture, usage of SCADA, fieldbus configuration, development methods
- Ensure a homogeneous technical interface between these sub-systems and the central control system
- Establish a common support requirements definition for all users and negotiate the implementation of these services with SL/CO and LHC/IAS (and IT)

Involved Team

- Client
  - SL-BT, SL-RF
  - ST-CV
  - LHC-ACR, LHC-ECR, LHC-VAC
- Support/Integration
  - LHC-IAS
  - SL-CO
  - ST-MO
  - (IT-CO)

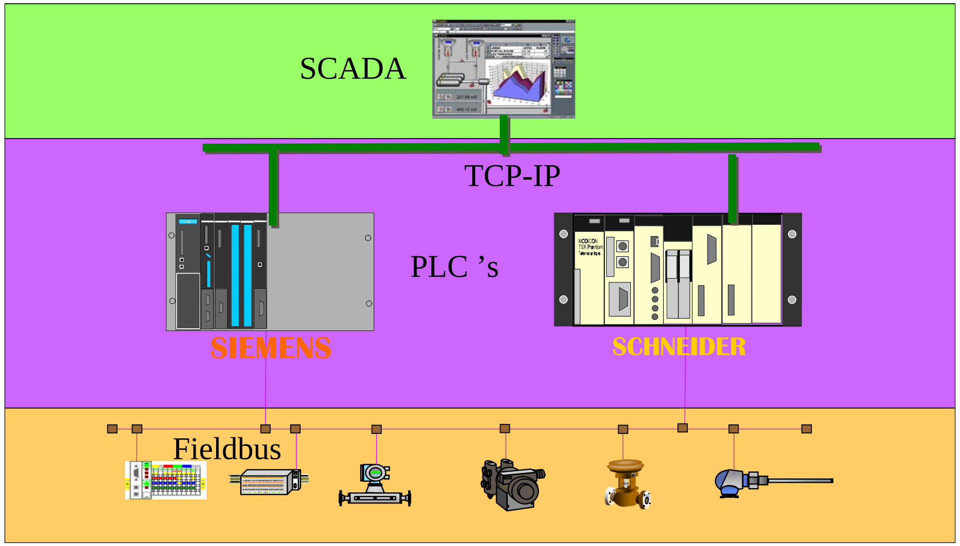
Schedule

- Produce a description of the common support requirements of the groups during the design, development and operational phases of their work for February 2001
- Produce first recommendations on common standards, including the technical infrastructure and configuration management for April 2001
- Final service definition documents for support by June 2001

Architecture

- Review the technical infrastructure currently proposed by each group Involved
- Review any missing components of the infrastructure that must be provided eg timing on Profibus
- Review the user requirements (operational model) for these systems at the local, specialist level.
- Establish a model specification and/or system including
  - a) PLC & Fieldbuses and SCADA requirements/description.
  - b) Architecture models for Hardware and Software

Industrial Basic Control System



Architecture Hardware

- Every body agreed on the model of architecture presented in annex. Then all groups have provided information to fill the boxes.
- It appears that all groups have followed the recommendations of the control's board when they existed. But there is as many solutions as group even for similar type of needs in matter of number of channels repartition of channels type of operation.
- In most of the case the technical choices are settled and changes are not foreseen for the time being. (Is there a real need for specification guidelines???)

Architecture software

- Difficulties to converge to a unique software architecture
  - Different types of application
  - Outsourcing/home made
  - Interaction with middleware
- But some common bricks can be found

Provided Internal Integration Tools 1

- Protocols (Polling/Event driven)
  - PLC/PLC (S7,UniTe,Modbus) on TCP-IP
  - PLC/SCADA (S7,UniTe,Modbus) on TCP-IP
    - Will imply implementation of a communication layer application independant
- Time synchronisation
  - Distribution at all level (PLC, SCADA, Fieldbus)
- Time stamping at origin (functions)
  - PLC, Remote I/O, Fieldbus

Provided Internal Integration Tools 2

- Configuration Databases
  - I/O,PLC, SCADA
- SCADA Framework
  - Alarms/Events
  - Trending
  - Mimics
- Fieldbus configuration tools

Support/Outsourcing

- **Identify the various approaches to procurement and operation of industrial controls systems such as integrated supply, turn-key system, CERN developments**
- **Review the outsourcing policy currently proposed by each group**
- **Review the support needs of each group**
- **Establish a model specification and / or system including Maintenance policy**

SL-BT

- **One project has been outsourced in order to produce the software components and the hardware architecture.**
- **Since, all projects reuse this architecture and the components but in house programmers develop them. The resources involved are 2 men year. The activities on industrial components correspond to 25% of the section activity and it involves software development (PLC, SCADA, integration SL/CO...) and tests, cabling, installation and maintenance of systems in operation.**
- **The group is receiving no support from controls groups for PLC, then it has developed its own competence. But support needs are expressed for firmware components, courses, and configuration management.**
- **The group expresses also the need to see the new hardware solution provided by SIEMENS, SCHNEIDER etc to be evaluated by the controls group to give valuable advice to potential CERN users.**
- **Support needs exist also to integrate the BT control system to the PCR central control System this support is provided by the SL-CO group**

LHC-VAC

- The vacuum group is developing himself the control applications. The group is using the SIEMENS hotline for most of the support needs. Support is needed for time stamping, integration toward PCR/TCR firmware management, new product evaluation.
- A PVSS course will be followed next year to evaluate the possibility to implement the SCADA a unique SCADA interface is foreseen for the vacuum teams and for PCR or TCR.
- The workload is almost 2 men year

SL-RF

- The SL-RF group is a new comer in PLC world, Collaboration with IAS for time stamping and World FIP. Main need is training
- Foreseen workload 2 men year

LHC-ECR/ACR

Grouped together into the UNICOS project in collaboration with LHC-IAS .

- First task was to establish a common hardware and software architecture this will lead in early 2001 in the creation of a library of component for PLC and SCADA (PC-VIEW) this work is subcontracted
- All the development of "User application" using the library foreseen for the accelerator and under ACR control and will be subcontracted.
- ECR is evaluating the method of production of the user application as part of the development is under external institute responsibilities.
- The hardware and software maintenance for the next 10 years are also included in the contract
- Resources: ACR: 2 Men year, ECR: 3 Men year, IAS 4 Men year plus external contract.
- As the project is developed jointly with IAS this group treats the support needs.

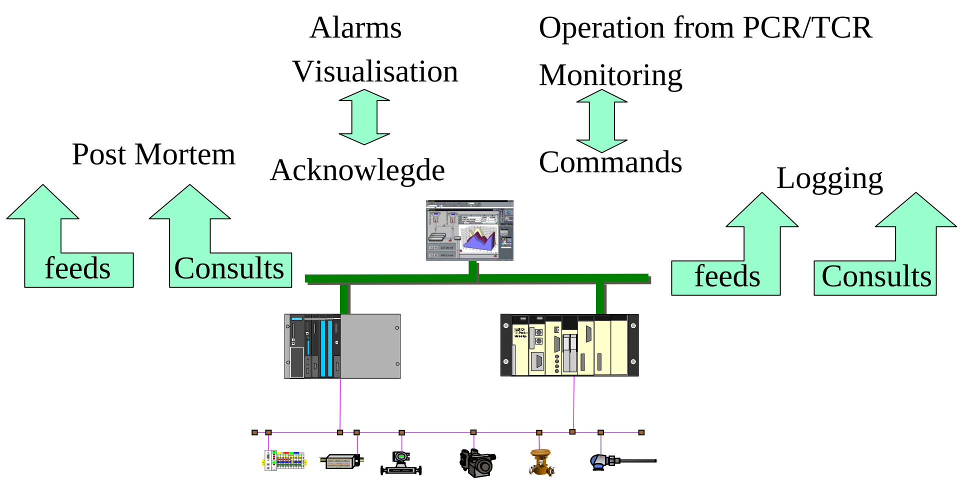
ST-CV

- ST-CV has outsourced the realization of the control application. The control section is involved in project management procedure and contract follow up. The CV control section prepares the technical specification related to the process control. These control specifications are merged either to the global cooling or ventilation specifications in order to prepare and launch the Call for Tenders Procedure
- So at present the control section is heavily implicated in contract follow-up for LHC and SPS works.
- When the cooling and ventilation plants will be in production the CV group should take advantage of the ST-C168 contract for the maintenance software.

Interface to central control System

- **Review the user requirements (operational model) for these systems at central, operational level. (LAWG)**
- **Study methods for addressing equipment and variables across these systems in particular so that a common interface can be provided to the central control system.**

Integration To external



Provided External Integration Tools

- Interface to middleware (SL/ST)
  - From/to SCADA (OPC, ODBC,.....)
  - From/to PLC (OPC,
- Configuration Databases
  - (I/O,PLC, SCADA), MW, Top level application
- Naming Conventions

Interfaces

- **Middleware project for integration in central control system**
- **LAWG for operational model and integration in central control system**
- **Fieldbus, SCADA, Guapi component recommendations and support**

LHC-CP Sub-project on Industrial Components

Minutes of Meeting 01

Present: D.Blanc ST-CV, E.Carlier SL-BT, E.Ciappala SL-RF, P.Charrue SL-CO, Ph Gayet LHC-ACR, I.Laugier LHC-VAC, M.Pezetti LHC-ECR,

Excused: U.Epting ST-MO

This first meeting was aimed to take a first contact and to know the participant evaluation of the subproject and its objectives.

After a short presentation, the group has reviewed the different project goals

Architecture topic
Every body agreed on the model of architecture presented in annex. Then all groups have provided information to fill the boxes.
It appears that all groups have followed the recommendations of the control's board when they existed. But there is as many solutions as group even for similar type of needs in matter of number of channels repartition of channels type of operation.
In most of the case the technical choices are settled and changes are not foreseen for the time being.

Then it appears up to now no consensus to converge on the software side.

Support & Outsourcing
All groups have given their first impressions on their needs and outsourcing policy, they are summarized hereafter:

SL-BT
One project has been outsourced in order to produce the software components and the hardware architecture.
Since, all projects reuse this architecture and the components but in house programmers develop them. The resources involved are 2 men year. The activities on industrial components correspond to 25% of the section activity and it involves software development (PLC, SCADA, integration SL/CO...) and tests, cabling, installation and maintenance of systems in operation.

The group is receiving no support from controls groups for PLC, then it has developed its own competence. But support needs are expressed for firmware components, courses, and configuration management.

The group expresses also the need to see the new hardware solution provided by SIEMENS, SCHNEIDER etc to be evaluated by the controls group to give valuable advice to potential CERN users.

Support needs exist also to integrate the BT control system to the PCR central control System this support is provided by the SL-CO group

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ECR is evaluating the method of production of the user application as part of the development is under external institute responsibilities.

The hardware and software maintenance for the next 10 years are also included in the contract
Resources: ACR: 2 Men year, ECR: 3 Men year, IAS 4Men year plus external contract.

As the project is developed jointly with IAS this group treats the support needs.

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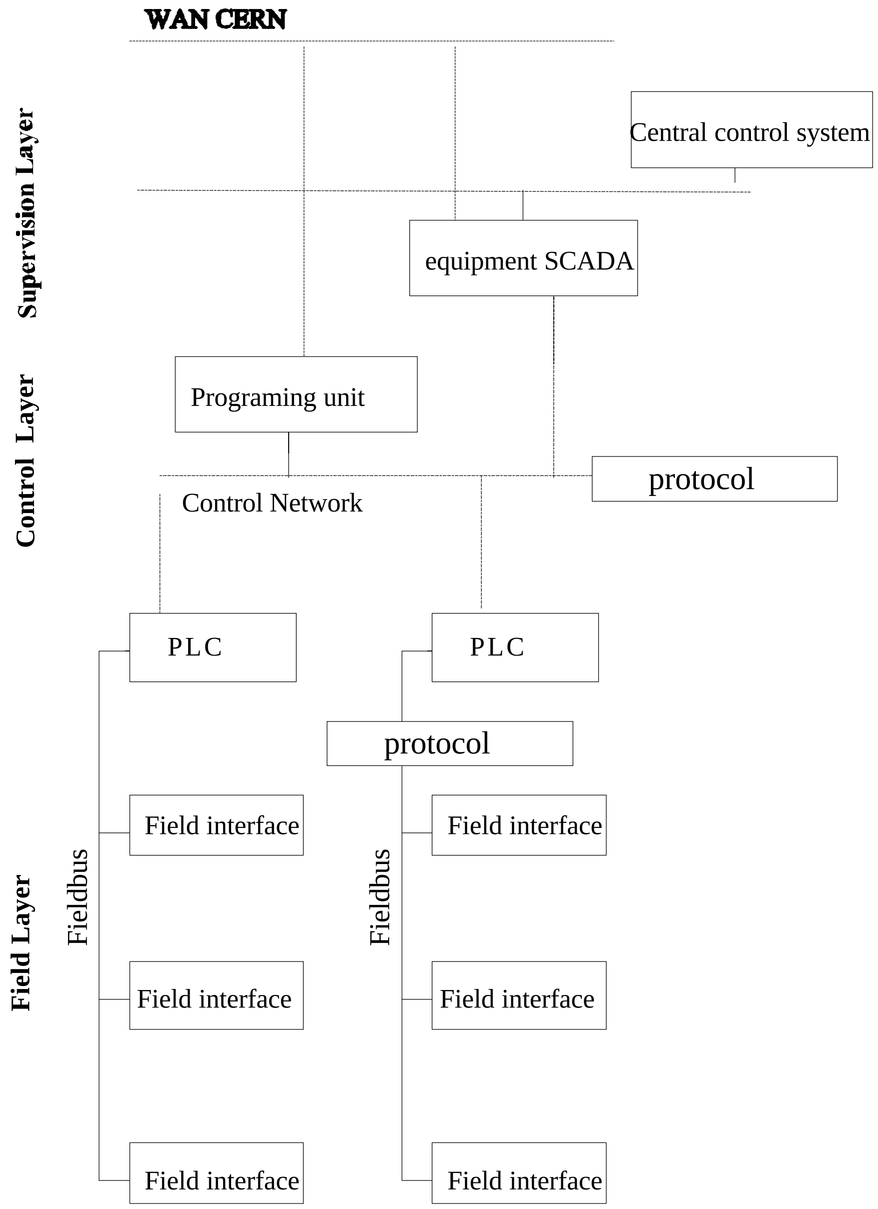
ST-CV has outsourced the realization of the control application. The control section is deeply involved in project management procedure and contract follow up. The CV control section prepares the technical specification related to the process control. These control specifications are merged either to the global cooling or ventilation specifications in order to prepare and launch the Call for Tenders Procedure

So at present the control section is heavily implicated in contract follow-up for LHC and SPS works. When the cooling and ventilation plants will be in production the CV group should take advantage of the ST-C168 contract for the maintenance software.

Follow UP of the meeting

It has been proposed that PHG shall produce more detailed questionnaires on the above topics and including planning inputs. These questionnaires expected for January 01.will be reviewed by the group members and filled in sequence.



SL-BT	ST-CV	LHC-VAC	SL-RF	LHC-ACR/ECR
PCR hp-ux	TCR-TDS	TCR-PCR	PCR	TCR/PCR/ VAC/DCS
	OPC			OPC/ODBC
Scada:WinCC 4000Tags	Scada:Wizcon 8000Tags	????	????	Scada:PCVUE 150000Tags/site
Softnet S7	S7 protocol; Modbus			
TCP-IP S7 protocol	TCP-IP	TCP-IP Web server	TCP-IP Web server??	TCP-IP Modbus protocol event
S7 400 (datation)	S7 400; Quantum Premium; I/O direct	S7 400	Premium	Quantum; Modbus protocol event
Profibus DP	Modbus	Profibus DP	Worldfip	
S7 300 ET200		S7 300 S7 200		Premium Or RIO Quantum
				Worldfip
	Inteligent sensors		Microfip	
				Microfip Ring instruments

April 24th.2001.

‘Alarm Mandate’ Date Changes.

Due to the fact that the LHC schedule has changed, in that the LHC Sector Tests have moved from:

2003 to 1/3/2004 – 30/9/2004

The ‘Alarm Services’ schedule has been changed accordingly.

‘Alarm Mandate’ Date Changes.

- A presentation of this proposal and a preliminary review of the system requirements by Q2 2001 (Q1 2001)

- LHC alarm component requirements by Q3 2001 (Q2 2001)

- A first functional specification of the LHC alarm component for Q4 2001 (Q3 2001)

- A first specification of the LHC alarm component interfaces for Q1 2002 (Q3-4 2001)

- A first prototype to be running Q3 2002 (Q1 2002)

- Operational use of the prototype system for the LHC QRL installation and testing in 2003 (2002)

- Operational system for the LHC Sector Test in 2004 (2003)

Demonstration of the SPS2001 Vertical Slice

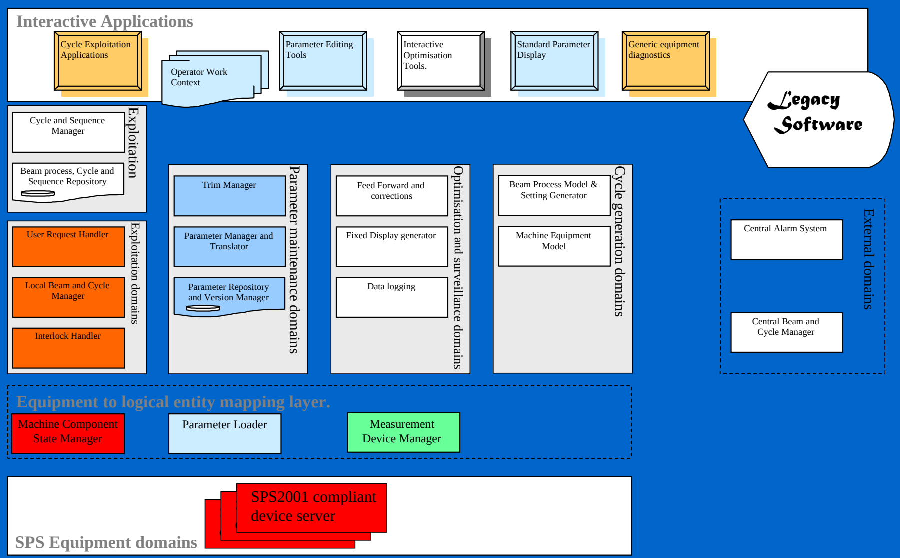
Presented for the LHC-CP forum.

M.Jonker, K.Sigerud, G.Duvoux,
S.Chtcherbakov, M.Jorda-Garcia

Outline

- What is the SPS2001 Vertical Slice ?
  – A slice from top to bottom through the **SPS2001 architecture**.
- Why this talk ?
  – Demonstration of **new concepts** in the SPS2001 architecture
- The Demo
  – The demo was given before for the PCR software meeting. Here I will not go through all scenarios.

SPS2001 Architecture

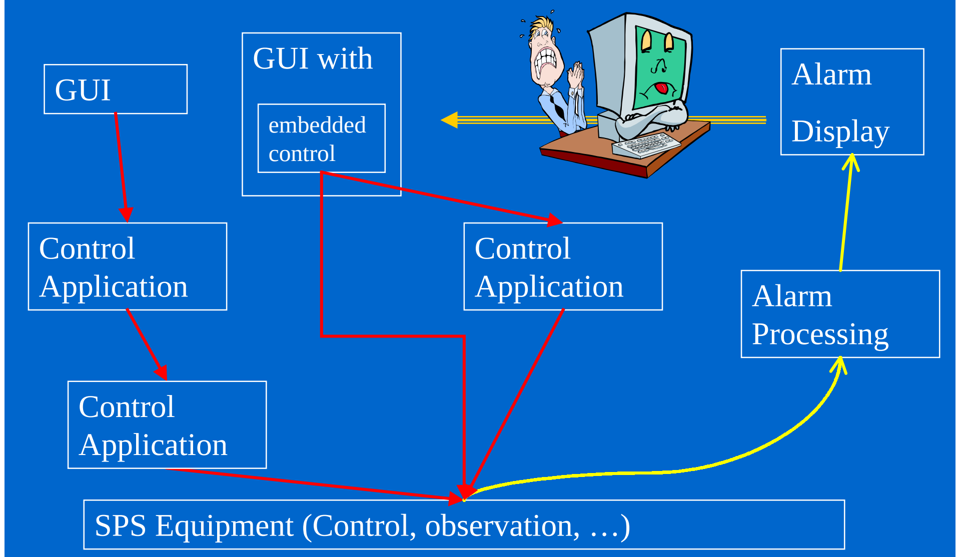


SPS2001 Architecture

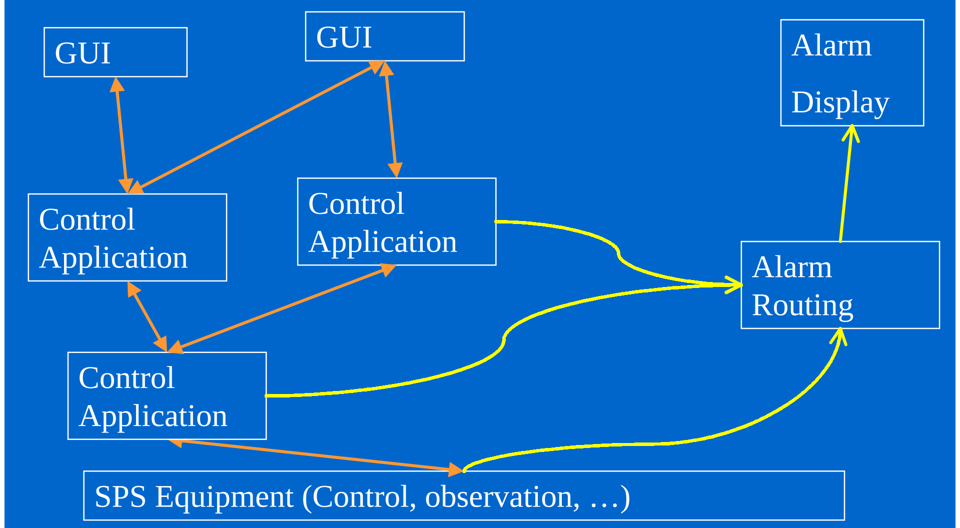
Layered software
  – with as many tiers as it takes

- No business logic in GUI layer
  – E.g. no device parameter evaluation and loading
- Business layer contains applications with well defined responsibilities in **both** directions!
- Avoid duplication of responsibilities
  – Minimize internal coupling
- Database used for archival, not for communication.
- Minimize external coupling

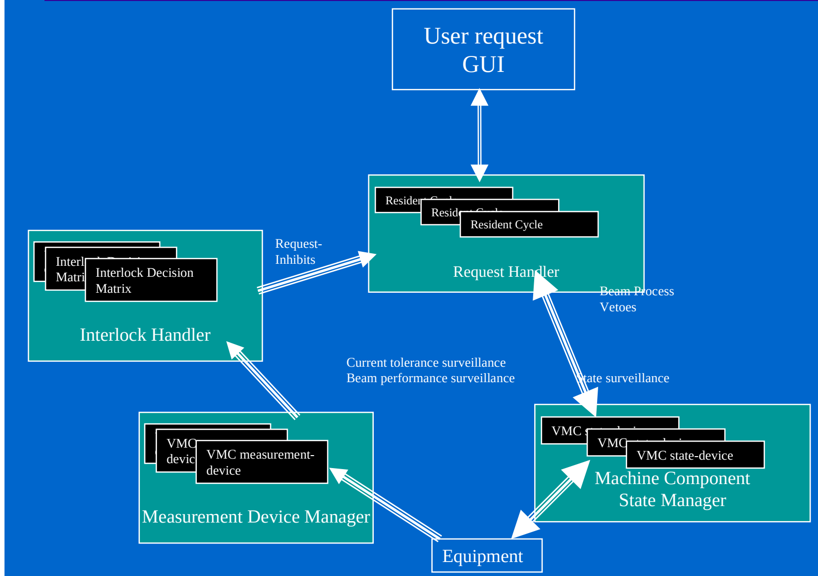
i.e. NOT this:



but this:

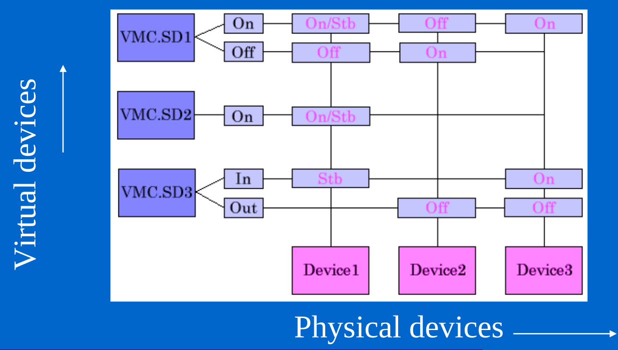


SPS2001 exploitation: the road up

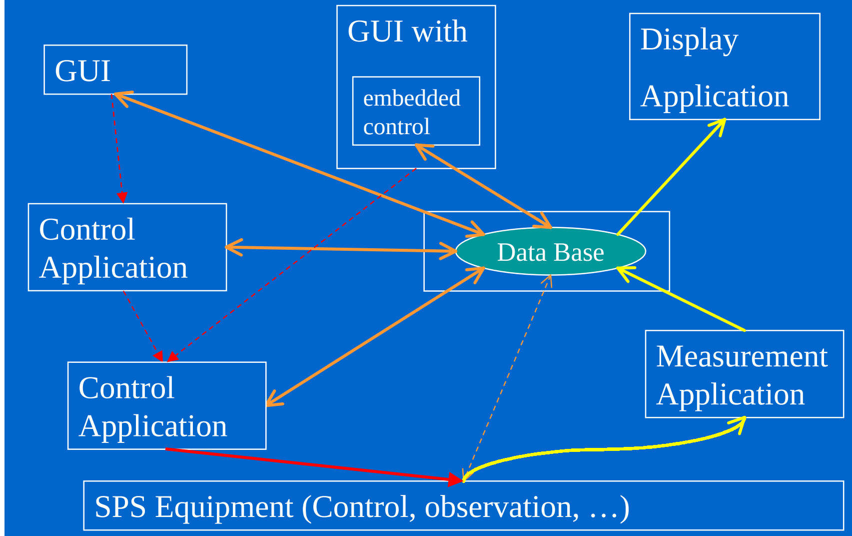


Example

- A Virtual Machine Component State Device
  - Associates physical devices and their wanted states to Virtual Devices
  - Translates State Requests on Virtual devices into State Requests on Physical Devices
  - Translates Actual States of Physical Devices into Actual States of Virtual Devices



i.e. NOT this:



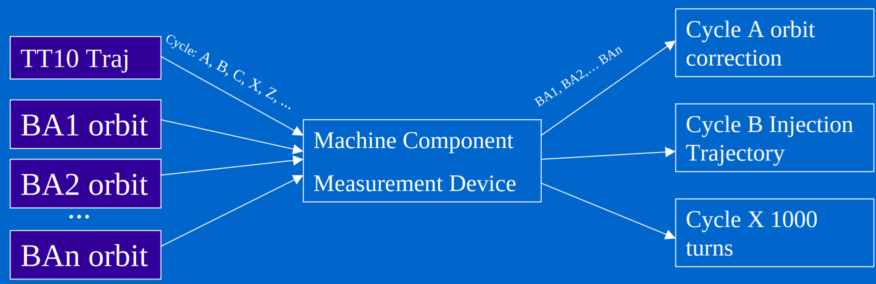
SPS2001 mapping layer

Maps physical equipment
onto logical machine components

- Equipment understands *equipment* oriented states and data
- Controls software needs *machine component* oriented states and data

Example:

Measurement Device Manager (MDM)



SPS2001 Architecture: Philosophy

- Create a set of independent components with well defined interfaces.
- Components communicate through a middleware and may be deployed anywhere.
- Coupling with other products should be minimal:
  through a well defined layer (equipment contracts)
  - persistent data storage in a limited set of components / classes.
- Furthermore:
  - SPS2001 software should be available without imposing a specific commercial/in house developed software package.
  - The SPS2001 software will not provide a '*do it all*' accelerator-control software-suite, but tools from which we will create an integrated accelerator control environment for the SPS.
  - All effort should be made to keep the specification "non SPS specific", such that they can be reused in other environments. Example: Although the SPS2001 software is intended for a multi cycling machine, a careful organisation of the equipment service contracts will make large part of the developed components directly reusable for LHC control system.

Communication in SPS2001

Communication with the devices is organized in contracts.

- Contracts can be represented by Java Interfaces
- Contracts can also be used by virtual devices.
- Java framework provided for Client and Servers
- C framework provided for Servers
- Contracts hide the middleware from the user!

Communication in SPS2001

- A client does not need to know:
  - what the devices can do. (I.e. which contracts are implemented)
  - which Device Server publishes a given device.
  - on which host a Device Server is running.
- (The underlying middleware does not need to know this either)
- A server does not need to know:
  - where it is supposed to run.
  - what devices it should create (he may read the info from a private configuration file, or get this information from a configuration manager on the middleware.
- All information is provided by the server:
  - When it starts up
  - When it creates a device dynamically

Implementation Philosophy

Device Properties are organised in **Contracts**

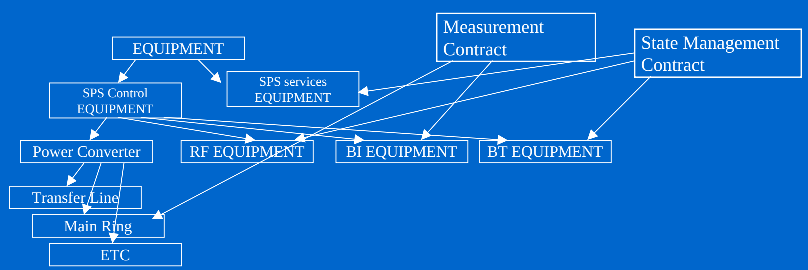
- Standardisation on communication and a get-/set- "property" device model itself is not enough.
- We need also standardisation on the property model.
- Device properties (a.k.a. data items) are organised in contracts:
  - Identification Contracts
  - State management contracts
  - DeviceData, SettingsData, MeasurementData Catalogue contracts
  - Cycle Management contracts

⇒A device server "implements" contracts according to its needs.

Concept of contract

- A contract is a list of device properties that are implemented by the device server.
  - Each contract is defined by Java Interfaces.
- Provides a common interface for a heterogeneous group of SPS2001 devices.

It introduces horizontal structuring in a hierarchical class organisation.
An application can mix devices of different classes as long as they implement the same contract.



Identification Contract

A mandatory contract which specifies:

- What a device can do (i.e. which contracts it implement)
- Where the device is running (server, host)
- The names of its associated devices.
  - Useful for the creation of device trees.

An identification contract

- allows localisation of the other contracts implemented
- is itself located using the device name.

StateManagement Contract

A contract for all state oriented devices:

- Does not impose a state model.
  - The client can inquire the state model of a device.
- Has Major States and minor states
  - Minor states are useful for expert diagnostics
- Can be implemented by different classes of physical and virtual devices.

DataCatalogue Contracts

- DeviceData Catalogue
  - Expert
  - Not cycle aware
- SettingsData Catalogue
  - SPS2001 business
  - Cycle aware
  - Settings commit operation
- MeasurmentData Catalogue
  - SPS2001 business
  - Cycle aware
  - ReadOnly

Cycle Management Contract

- A device that implements the Cycle Management becomes cycle aware.
- Used by Clients to maintain its cycle context
  - (i.e. which cycles are affected by the cycle aware operations.
- Makes other contracts cycle independent
  - Other contracts are also usable in non cycling environments.

Implementation Philosophy

The contracts specification is driven by the requirements of the SPS2001 project:

- provide the high level of **device independence** required by SPS2001.
- provide large **flexibility** to tailor for specific equipment requirements:
  - device services contracts (predefined groups of properties i.e. “data items”)
  - optional extensions, to add open functionality:
    - equipment specific device state model
    - equipment specific sub states and sub components (optional)
    - expert actions and diagnostics (optional)

  extensions are part of the API. Not all optional extensions will be fully exploited by the SPS2001 core applications.
- all effort is made to keep the specification “non SPS specific”, such that they can be reused in other environments.

Implementation Philosophy

Hide all middleware details from the user:

Define the API on client and server side for:

- Physical Equipment Device Server (for usage by the equipment groups)
- Virtual Equipment Device Server (for SPS2001 project: VMC-SD, VMC-MD, …)
- Client applications
- Java Beans for GUI building

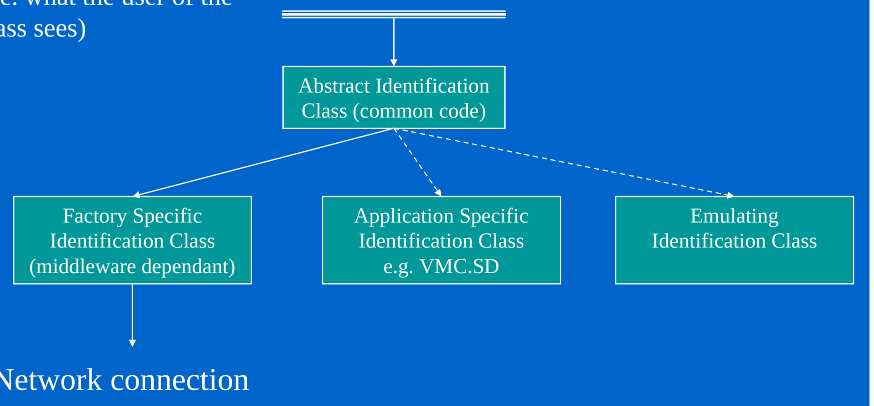
Advantage: User code becomes independent from the actual middleware solution.

Possible to replace brand-X with brand-Y without involving the users.

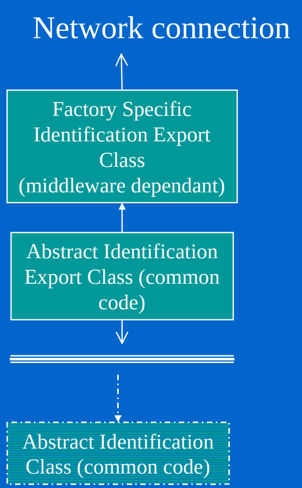
Allows redeployment of the SPS2001 software components elsewhere without imposing our choice of the middleware software. (With the option of a free middleware brand-x).

Client Implementation

Identification Interface:
(I.e. what the user of the class sees)

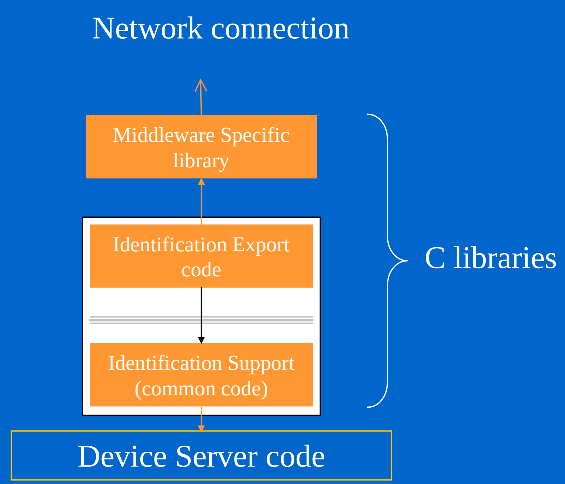


Server Implementation Java



Identification Interface:
(I.e. what the device server has to provide for exporting a device)

Server Implementation C



What you will get and what you will see:

What you will get (and are expected to adapt)

A template for a device server that can be adapted to your needs

- template_device_server.c
- template_device_server.h

What you will see (and what you will use but what you should not touch)

The SPS2001 server API (.c version)

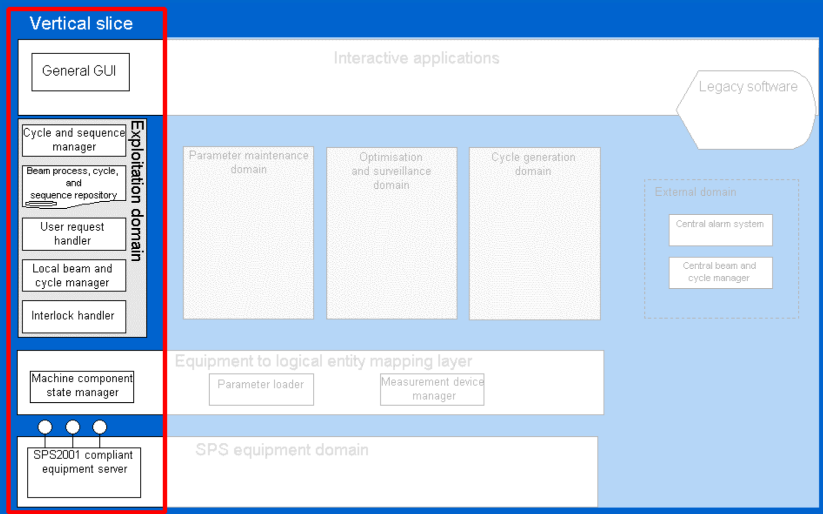
- SPS2001_device_server.h
  defines prototypes of public functions.
  declarations of constants
  convenience macros
  type declarations for common property structures

- SPS2001_device_server.o based on:
  SPS2001_device_server.c, SPS2001_device_server_private.h, SPS2001_device_server.h, SPS2001_device_server_def.h,
  contains the SPS2001 server API functions for creating a device server.

The Vertical Slice

A piece of the MACSy cake

The vertical slice



Why a vertical slice?

- To demonstrate that what we want to accomplish is possible
- To validate the architecture
- To decide on the communication between the subsystems
- To present the development process for the project

Device server in vertical slice

- State-management contract
- Emulated equipment access
- Configuration manager
- Operational on LynxOS

MCSM in vertical slice

- Core functionality implemented
  - create a VMC.SD
  - handle a physical device state change
  - handle an external state change request for a VMC.SD
- Fixed configuration file
  - dynamic creation/destruction not yet possible

Examples of VMC.SD

- MD_VMCSD/TT10_Optic_GLA_FZ_TEST
- System_VMCSD/SPS_Orbit
- Access_VMCSD/Ring
- Access_VMCSD/North
- BP_VMCSD/TT10_proton
- BP_VMCSD/Proton_Acceleration

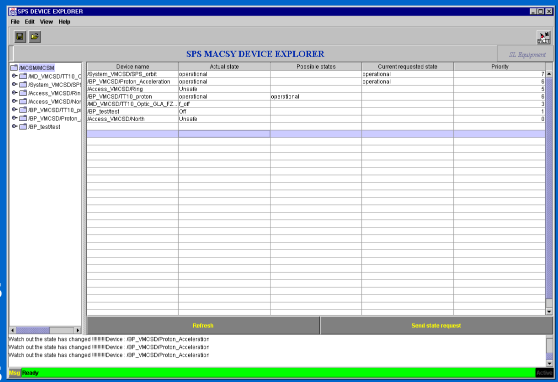
BP_VMCSD/Proton_Acceleration

State:OPERATIONAL	
MPS/SMB	ON
MPS/QD	ON
MPS/QF1	ON
MPS/QF2	ON
RFcavity/TWCAV1	ON
RFcavity/TWCAV2	ON
RFcavity/TWCAV3	ON
RFcavity/TWCAV4	ON
PowerSupply/LSFC	ON
PowerSupply/LSDB	ON
PowerSupply/LSFA	ON
PowerSupply/LQSA	ON
PowerSupply/LSFB	ON
PowerSupply/LSDA	ON
PowerSupply/LSFB	ON
System_VMCSD/SPS_orbit	OPERATIONAL

State: BEAM SAFE	
MPS/SMB	ON
MPS/QD	ON
MPS/QF1	ON
MPS/QF2	ON
PowerSupply/LSFC	ON
PowerSupply/LSDB	ON
PowerSupply/LSFA	ON
PowerSupply/LQSA	ON
PowerSupply/LSFB	ON
PowerSupply/LSDA	ON
PowerSupply/LSFB	ON
System_VMCSD/SPS_orbit	BEAM_SAFE

IA in vertical slice

- Collaboration with StOpMI project
- The Device Explorer
  - created VMC.SD's
  - associated physical devices
  - the states of the physical devices



Test configuration

[illegible]

It informs a client when a late server becomes available.

The configuration does not include the list of devices.

Server	machine	groups (number of devices)
VStest_DevServZS	hpslz22	ZS (2)
VStest_DevServKICK	hpslz22	Kicker (5)
VStest_DevServMPS	hpslz22	MPS (4)
VStest_wesba6	hpslz22	Stopper (1)
VStest_nesba2	hpslz22	Stopper (2)
VStest_m1sbb3	m1sbb3	PowerSupply (13)
VStest_m1sba1	m1sba1	PowerSupply (16)
VStest_m2sba2	m2sba2	PowerSupply (20)
VStest_m3sba3	**hpslz22**	PowerSupply (0), RFcavity (4), RFtransmitter (8)
VStest_m2sba4	m2sba4	PowerSupply (14)
VStest_m1sba6	m1sba6	PowerSupply (13)
VStest_m2sba6	m2sba6	PowerSupply (12)
VStest_m3sba6	m3sba6	PowerSupply (13)
VStest_m4sba6	m4sba6	PowerSupply (4)
VStest_m1sb80	m1sb80	PowerSupply (16)
VStest_CnfgServer	hpslz22	Configuration manager for 15 device servers
dns	hpslz22	device name registry
mcsm_server	Java/winnt	BP_vmcsd (5), MD_vmcsd (1), ACCESS_vmcsd (3), PLANT_vmcsd (3), SYSTEM_vmd(1)
device explorer	Java/winnt	

MACSy Configuration Manager

What it does

Finds, extracts and sends configuration information for servers. If server publishes a property /configuration= and is found in the configuration file it will be configured automatically when it starts.

Information available (from cfg manager)

List of all servers, that found in configuration file
Full path to the configuration file, which is currently in use
List of servers configuration times

Commands available

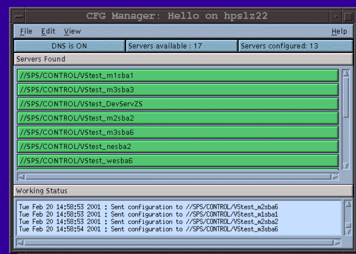
Reload configuration file
Change configuration file

Command line

`prompt> cfg [CONFIGURATION_FILE_NAME]`

Interface

Two versions of `cfg` manager are available: with GUI and GUI-less.



Configuration file format

The first line of the configuration file always contains configuration manager name. The name should be unique.
Format is:

#<!CFG_MANAGER_NAME>

Comments:

symbol # used as a comment symbol.

Key words:

Server: - server name
Class: - class name
Device: - device name

MACSy Configuration Information Display

What it does

Collects information from **all** `cfg` managers, that are available and displays it.
Helps to control configuration process.

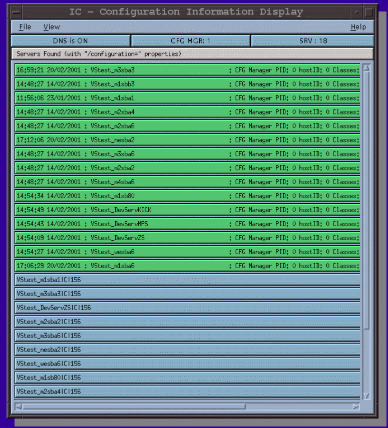
Information available

Complete list of all configured servers.
Information can be sorted (filtered)

Command line

`prompt> ic`

Interface



Configuration file FORMAT

```
#<!CFG_MANAGER_NAME>
#
# this is the comment line
#
Server:  SERVER_NAME_1
{
        Class: CLASS_NAME_1
        {
            Device : DEVICE_NAME_1
            {
              DEVICE_DATA (string)
            }
            Device: DEVICE_NAME_2
            {
              DEVICE_DATA
            }
            …….
        }
        Class : CLASS_NAME_2
        {
        }
        …
}
Server : SERVER_NAME_2
{
        Class: CLASS_NAME_1
        {
            Device : DEVICE_NAME_1
            {
              DEVICE_DATA (string)
            }
            Device: DEVICE_NAME_2
            {
              DEVICE_DATA
            }
        }
}
…
```

It is possible to start a lot of configuration managers, depends on needs, but all of them should have different configuration files (to configure different servers):

I.e: **RF_CnfgMgr**

Rocks_CnfgMgr

and so on...