The Third Joint Controls Project (JCOP) Workshop – A Summary

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Abstract

The Joint Controls Project (JCOP) is a collaboration between the four LHC experiments and relevant CERN support groups to provide common components for the development of the experiment Detector Control Systems (DCS). A third JCOP workshop took place in June of this year and is summarised in this paper. In particular, the paper concentrates on the deliverables foreseen to be provided by JCOP (supported technologies and components), the status of these and the experience gained with them as reported at the workshop. Finally, it will conclude with an overview of the future direction of JCOP.

I. INTRODUCTION

The Joint Controls Project (JCOP) was set up in 1997 in order to reduce duplication and the overall manpower required to build the control systems of the four LHC experiments. The mandate of JCOP [1] is to develop a common Framework and components for the detector control of the LHC experiments and to define the required long-term support. As part of its work JCOP has organised three workshops and this paper summarises the third of these, which was held in June of this year. All presentations can be found on the JCOP Workshop III web page [2].

A. Purpose of JCOP Workshop III

The project had previously held two workshops (JCOP-I [3], JCOP-II [4]) in June 1998 and September 1999. The goals of JCOP-I were to investigate the best practice in running experiments and those about to go on-line at that time and to obtain input from the LHC experiments on what they saw as critical issues. The goals of JCOP-II were to review the experience gained since JCOP-I and to discuss the future direction of JCOP. In particular, this included the question of whether commercial Supervisory Control and Data Acquisition (SCADA) systems could be used.

A great deal of work had been done since the JCOP-II workshop and in particular many technology choices have been made and are being supported. Furthermore, much development has been based on these technologies and thus many solutions have become available which the experiments can now benefit from, e.g. PVSS and the JCOP Framework.

Thus, it was felt that it was a good time to hold a third workshop, firstly to get an overview of the status of the controls activities in the four LHC experiments and secondly to present the technologies chosen within JCOP and solutions based upon them, as well as the experience already gained with them. As JCOP is a collaboration, each experiment actively participates in all such choices.

B. Content of the JCOP Workshop III

The workshop was held over two days and was comprised of sessions covering the following four main topics:

1) *Reports on the status of controls activities in the LHC experiments*

2) *Reports from other related activities*

3) *Presentations and demonstrations of the JCOP supported technologies and solutions*

4) *Reports on experience gained with the JCOP supported technologies and solutions*

In addition, there was a wrap-up session based on the JCOP Project Leader's proposal for the future direction of project.

II. JCOP ACTIVITIES

Since the four LHC experiment control systems have a lot of similarities, it was decided to have a single presentation covering these aspects rather that having a lot of duplication in the individual experiment presentations. These common aspects also define the scope of JCOP activities and hence this presentation was more a less a summary of JCOP activities.

1) The JCOP Project

First the JCOP project was put in context with other domains and activities, see Figures 1 and 2.

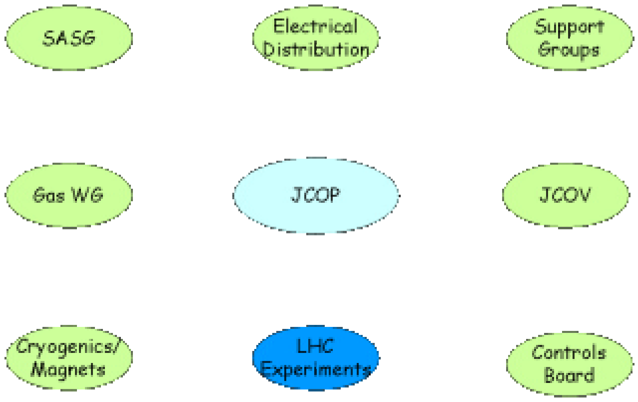


Figure 1: JCOP Interaction with other Domains

It can been seen that JCOP has a lot of interfaces with other domains and activities, as well as technical interfaces both within an experiment as well as with other control systems. It can also be seen that inter-domain interfacing it envisaged to be handled in a common way by all domains; namely via the Data Interchange Protocol (DIP). This will be covered later.

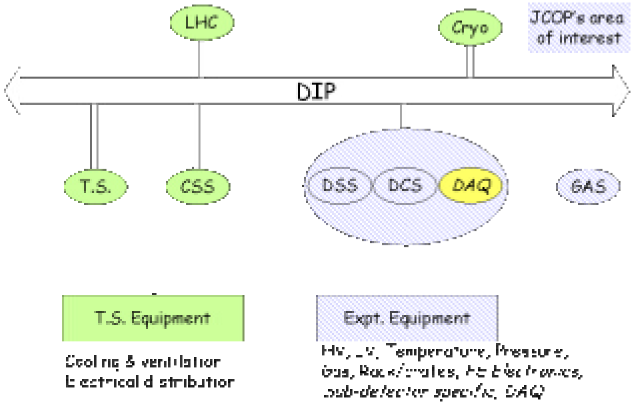


Figure 2: JCOP Area of Interest

JCOP's area of interest is the area with patterned shading.

2) *JCOP Approach*

As a collaboration between many parties, the general JCOP approach is to work by consensus and to involve the experiments as much as possible in all activities. Where possible commercial solutions are chosen to reduce the manpower required to build the systems and to ease the long-term maintenance. The JCOP solutions are normally general-purpose solutions which are chosen for global optimisation. As such, they might not always provide the best possible solution in all areas. Nonetheless they should be sufficient and flexible enough to meet the needs of the experiments. The experiments can then choose which solutions to take and for which use they put them.

Figure 3 below gives an overview of the various technologies being employed by JCOP. Many of these are discussed in more detail in the following sections,

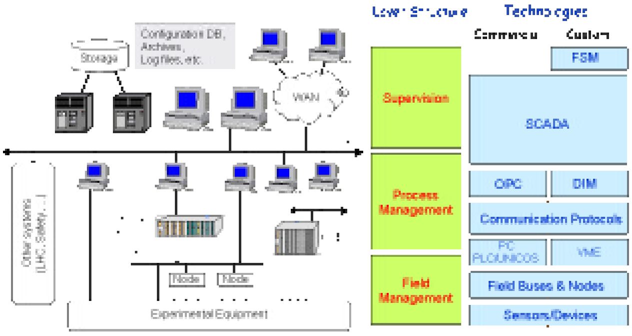
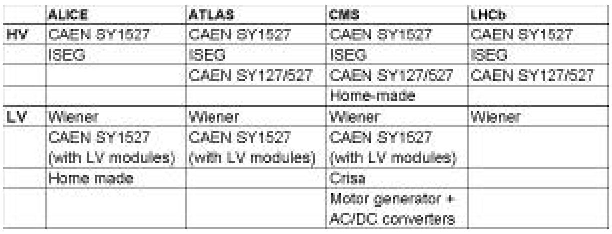


Figure 3: Controls Technologies

3) *High and Low Voltage Control*

High and low voltage power supplies will be used extensively in all experiments. Due to the different needs of the various sub-detectors equipment from many different manufacturers is being considered. Table 1 below gives the current status of the high and low voltage solutions likely to be employed by the experiments.



	ALICE	ATLAS	CMS	LHCb
HV	CAEN SY1527	CAEN SY1527	CAEN SY1527	CAEN SY1527
	ISEG	ISEG	ISEG	ISEG
		CAEN SY127/527	CAEN SY127/527	CAEN SY127/527
			Home-made	
LV	Wiener	Wiener	Wiener	Wiener
	CAEN SY1527 (with LV modules)	CAEN SY1527 (with LV modules)	CAEN SY1527 (with LV modules)	
	Home made		Crisa	
			Motor generator + AC/DC converters	

Table 1: Potential High and Low Voltage Suppliers

As can be seen from the table there are three manufactures' equipment that are common to all experiments. As such, common control solutions are being developed and these are being integrated into the JCOP Framework. For CAEN, a connection is available via its OLE for Process Control (OPC) server and this has already been integrated as a component in the FW. (OPC is a widely used industrial standard). For Wiener, the OPC server is being developed but is not yet available. As an interim solution an IT-CO developed implementation is available and has been integrated as a component in the FW. For ISEG, a first release of its OPC server was received recently and a FW component being developed for this by a member of the ALICE Central DCS Team.

4) *Other Front-Ends*

In terms of other front-ends, the CERN chosen and supported PLCs, Siemens and Schneider, have OPC servers available, and these are integrated with the FW. However, there is no further consensus on the use of common FEs between the experiments. Several different FE solutions exist in the experiments, including Embedded Local Monitoring Box (ATLAS), CCU (CMS), Credit Card PC (LHCb). Although not supporting any of these directly, JCOP offers a number of interface possibilities for easy integration within the FW. These are OPC, the standard PVSS Communication (API/Driver) mechanism, DIP and the Distributed Information Management (DIM) protocol, which was already used in one of the LEP experiments.

5) *SCADA*

Following the previous JCOP workshop a decision was taken by the four LHC experiments to employ Supervisory Control And Data Acquisition (SCADA) technology. After a full CERN tender, the product Prozeßvisualisierungs- und Steuerungs-system (PVSS) from the Austrian company ETM was selected. Among the main reasons for its selection were:

Openness – PVSS is a very open product. All its internal data is accessible via its API, its supports many industrial standards such as OPC and ActiveX Data Objects (ADO), it is possible to export/import its configuration data in ASCII format and its graphics are also stored in ASCII format, allowing a possible automated generation of these.

Architecture – PVSS is event-driven and consists of a number of collaborating software processes, called Managers, which communicate via TCP/IP and can therefore run on independent CPUs. See Figure 4 below. These can run on either Windows or Linux platforms and it is possible to mix both operating systems in a single PVSS system distributed over many CPUs. The PVSS data structuring is device-oriented whereby all the data for a single device if grouped together in a so-called data point. Furthermore, it is possible to define data point classes (data point types) from which instances can be derived and which inherit the structure of the data point type. This provides significant advantages over the traditional Tag-based SCADA systems in which data for a device is stored in independent variables. As with any user-developed application, most of the PVSS tools are built using standard PVSS panels with associated data stored in internal data points, which means that even the standard PVSS tools can be customised/enhanced if needed.

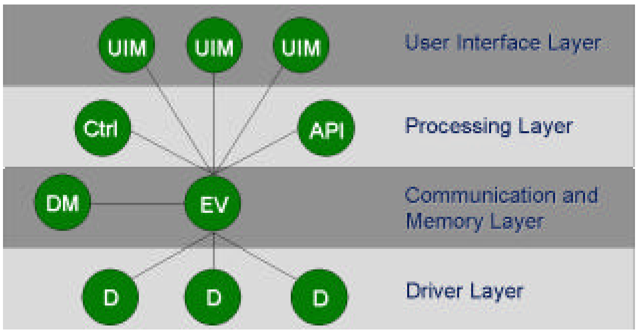


Figure 4: PVSS Software Architecture

Scalability – as stated above PVSS's Managers may run on independent CPUs which means that a single PVSS system, consisting of one kernel (Event Manager and Database Manager) and one or many of the other Managers, may be distributed over many CPUs to spread the load. This gives the first level of scalability. A second level is achieve through the fact that it is possible to build a federation of collaborating PVSS systems, as seen in Figure 5 below.

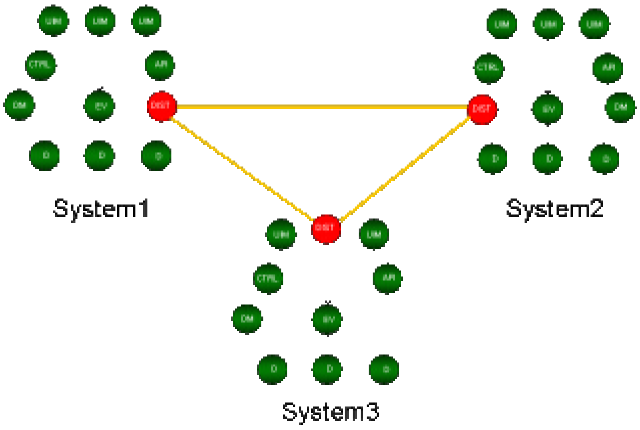


Figure 5: Distributed PVSS System

In this case the data in one PVSS system is visible from any other connected system. In the example shown in Figure 5, from any User Interface Manager (UI) in System 1 it would be possible to view any data originating from either System 2 or 3 as well as the data from System 1 itself.

Flexibility – due to its openness, its powerful scripting language (~Ansi C with many SCADA specific extensions) and the fact that all external and internal data is stored in data points, PVSS supports full on-line modification as well as the possibility for PVSS to be used to configure itself.

However, despite the strengths summarised above, PVSS, like any S/W product, is not perfect. PVSS is now being widely used in the LHC experiments, as well as elsewhere at CERN, and as a result of the experienced gained with it a number of required improvements have been identified. These have been discussed in regular meetings with ETM and the company has been very open to such enhancement requests. In fact, some have already been implemented and many others are planned for future releases. Nonetheless, some required improvements remain open and discussions continue with ETM. These include improved archiving and retrieval, remote access and security and some aspects of performance.

Up to now the collaboration with ETM has been close and very good and as such there is a every chance that these, and other enhancements, will indeed be implemented.

6) *System Modelling*

Experiment control systems are typically modelled as a hierarchy of Finite State Machines (FSM). However, since PVSS does not have specific tools for modelling abstract behaviour, JCOP has selected and integrated a FSM toolkit into PVSS to be able to reproduce this system modelling. This is a more general approach than the use of PVS scripting. This has been done in such a way as to use the features of these two tools in a very complementary way and hence to benefit from the strengths of both tools.

Figure 6 below gives an example of a hierarchy built of two types of devices, termed Device Units (DU) and Control Units (CU).

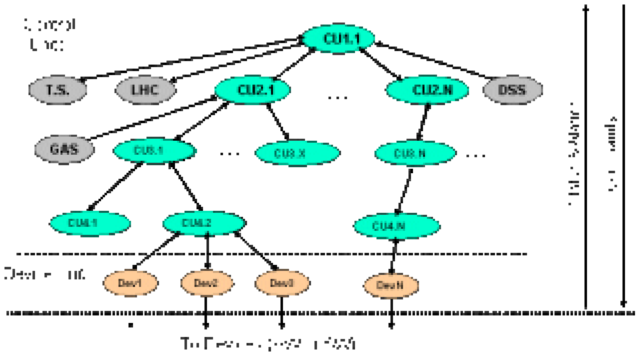


Figure 6: Example DCS System Modelling

Typically, a DU is a software representation of a real world device, e.g. a HV supply, whereas a CU is an abstract device, e.g. Muon sub-detector. The State of a DU is derived from hardware input parameters, whereas the State of a CU is derived from the States of its children. Similarly, a Command sent to a CU will usually result in Commands being sent to its children, whereas a Command sent to a DU would be converted to a hardware output signal. Furthermore, a CU implements fully the partitioning rules defined by the Architecture Working Group (AWG) [6], see the description below, and hence can be partitioned out of the running system and even run independently. A DU cannot be partition out as such.

Figures 7 and 8 highlight the different implementations of a CU and DU. In addition to the standard SCADA facilities of logging & archiving and alarm handling, a DU includes a Command/State interface. Although the present implementation foresees the use of PVSS scripting to perform the conversion of input/output values to/from Commands/States, it is conceivable that these conversions be performed outside of PVSS, e.g. in a PLC or other FE, with only the Command/State reflected within PVSS.

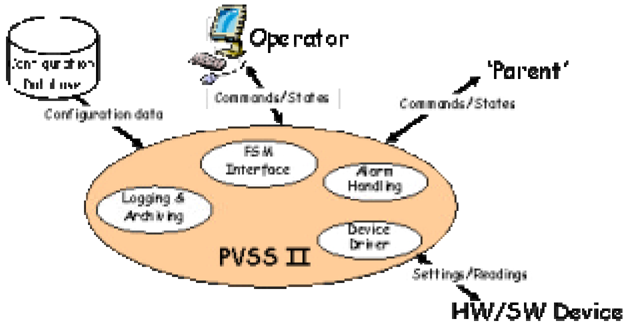


Figure 7: Modelling of DU

A CU implements the behaviour, which is specific to that device, using the FSM toolkit. In addition, it implements the fixed partitioning rules, which are common to all CUs, again using the FSM toolkit. PVSS is used to store the current State of the devices as well as the Commands sent to it.

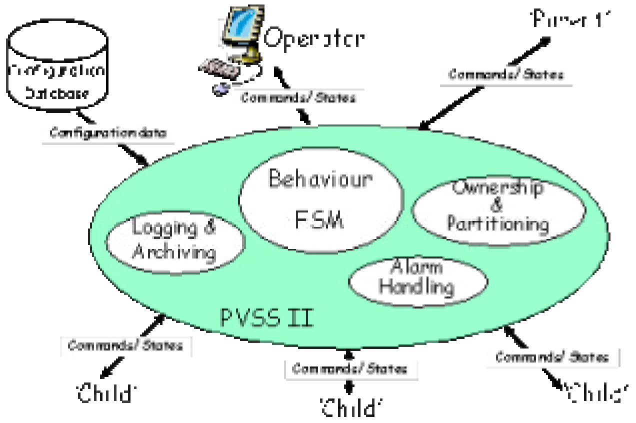


Figure 8: Modelling of CU

7) *Partitioning*

Following on from the system modelling, and benefiting from the FSM toolkit, a number of partitioning possibilities have been provided as standard behaviour of a CU which is inherited by any device declared as a CU. Partitioning is necessary to support the different running modes, e.g. physics, calibration, test, and to allow independent and concurrent activities. The partitioning implementation foreseen is for the DCS, but obviously a close and well co-ordinated interaction with the Trigger / Data Acquisition (TDAQ) control system is also required but this is not considered to be within the scope of JCOP.

8) *The JCOP Framework*

In the preceding sections a number of JCOP-selected and supported tools have been discussed. In order to provide these in a directly usable fashion for the sub-detector teams building their part of the DCS, a JCOP Framework is being developed. The FW is an integrated set of guidelines and tools that ease the development of control system applications. The FW will include, as far as possible, all templates, standard elements and functions required to achieve a homogeneous control system and to reduce the development effort as much as possible. Furthermore, the FW will hide the complexities of the underlying tools to reduce the knowledge required by a typical developer of the controls application.

Figure 9 below gives an overview of the JCOP Framework. As can be seen, the FW in principle covers all levels down to the connection to the hardware. However, as there is only agreement on the use of certain hardware and front-ends, the majority of the FW is provided at the supervisory level. However, connection of other front-ends, and integration with the FW, is possible via one of a number of communications interfaces (OPC, PVSS Communications, DIM or DIP).

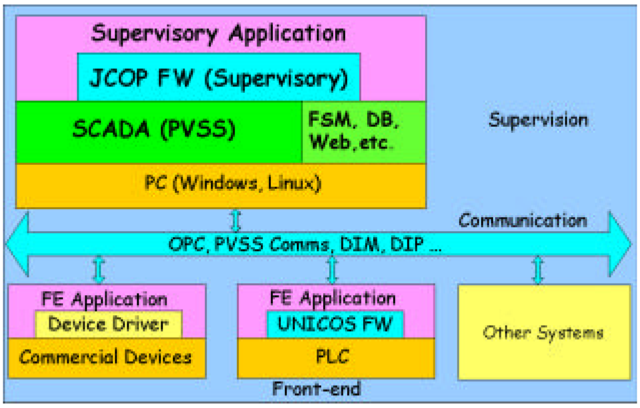


Figure 9: JCOP Framework

The FW provides a number of components which can be divided into two main categories; Devices and Tools. In terms of devices there are already a number of standard HEP items provided, including CAEN and ISEG High Voltage Power Supplies, Wiener Low Voltage Power Supplies, ELMB, PS and SPS data servers. In addition, there are a set of standard configuration panels and standard script libraries. In the category of tools, there is the integration of the Finite State Machine, an external alarm server, an additional driver (DIM), the hierarchical modelling tool, a mass configuration tool and an exception handling mechanism. Other devices and tools will be added as and when necessary.

There have already been three releases of the FW, each with increasing functionality. The contents of each release are discussed and agreed at the FW Working Group meetings, which include representatives from each of the experiments. Further releases of the FW with ever increasing functionality are planned over the next few years. For more information on this project please see [8].

9) *Rack Control*

A common rack project was set up with the controls aspects of it under the co-ordination of JCOP [8]. Originally, the Rack Control System (RCS) was intended to provide temperature and humidity monitoring, power control (sub-rack level) and implement a safety chain. This was foreseen for all racks, including in the cavern and hence it was necessary for the system to be able to operate in a magnetic and radiation environment. This implied that standard commercial systems would be not be suitable and that an extensive evaluation of components would be necessary. However, in the light of the problems discussed above, as well as the flexibility offered by ST-EL (see Section IV-D below), it has been decided to reduce the scope of the RCS. The control over the rack power will be ensured by equipment provided by ST-EL, but under the control of the DCS. Similarly, although the safety chain will be implemented as part of the RCS, the output will go as an interlock to the ST-EL provided equipment. This greatly simplifies the RCS and removes the need for extensive evaluation of components as the monitoring function can be handled by connecting the sensors to an ELMB, which has been validated for use in the cavern environment. From the ELMB the connection to the DCS is via the OPC server.

10) *LHC Data Interchange Working Group (LDIWG)*

The LDIWG was formed to define a common data exchange mechanism for all ‘players’ in the LHC era; LHC machine, Cooling & Ventilation, Electrical Distribution, Magnet and Cryogenics, CERN Safety System (CSS) and the experiments. The data exchange will be based on a common protocol called the Data Interchange Protocol (DIP). The project was defined in two phases. The first phase, which has been completed, was to define the requirements for this data exchange mechanism. The second phase, which is about to begin, should define an appropriate implementation, which should, if possible, be based on a product which is already in use at CERN. Once a suitable product has been selected this will be integrated into JCOP FW as described above.

III. EXPERIMENT SPECIFIC PRESENTATIONS

Following the presentation of common aspects there were individual presentations by each experiment. These gave a general overview of the control activities in these experiments and then went on to describe the specific aspects of controls in each case. The key points are briefly summarised below.

A. *ALICE*

Firstly, the way of working of the ALICE DCS community was described. Led by the central DCS team of 5 persons, the approach is very much a bottom up one. That is to say that the focus is first on the process and field layers with the aim of producing standard building blocks. In parallel, the sub-detector teams have been asked to produce User Requirements Documents (URD) which are being used as the basis for identifying common needs. The collaboration with JCOP has been very good and ALICE is relying heavily on the solution being produced by JCOP. However, where JCOP solutions are not foreseen, prototypes are developed and tested within two sub-detectors for applicability. An important aim of this approach is to foster the development of a homogeneous system.

Another important aspect of ALICE controls, which was presented, was that of the Experiment Control System (ECS) which sits above the DCS, Trigger and DAQ system. This is shown pictorially in Figure 10 below. The ECS is responsible for the experiment configuration and partitioning, to provide the global experiment status and to pass information between systems to synchronize them. Its goal is to automate the operational procedures. The ECS will also use the JCOP-selected FSM toolkit.

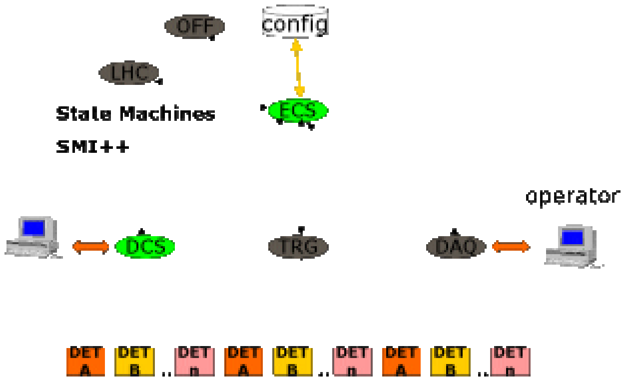


Figure 10: ALICE Experiment Control System (ECS)

B. *ATLAS*

There were two important items described during this presentation. The first was the interaction between the DCS and DAQ. In ATLAS, the DAQ and DCS will be operationally independent with separate data paths. However, there will be a bi-directional connection between the two via a dedicated interface. The DCS will pass ‘messages’ (events, state changes) to the DAQ and the DAQ will pass commands to the DCS. This interface gives the DCS access to the ATLAS S/W environment, e.g. to the configuration and conditions databases. A prototype implementation of this exists and is being evaluated.

The second item was the ATLAS-developed Embedded Local Monitor Board (ELMB) which can be seen in Figure 11 below. This was developed to provide a low cost, general-purpose readout unit that could operate in the hostile cavern environment. It provides 64 analogue (input) and 24 digital (input/output) channels and has an optional add-on DAC providing 16-64 channels. It is radiation tolerant for usage in the cavern outside of the calorimeter (0.5 Gy and $3*10^{10}$ neutrons per year) and will operate in a field of 1.5 Tesla. It provides remote diagnostics, S/W loading and Single Event Error (SEE) detection and recovery facilities. The cost per unit is about $100.

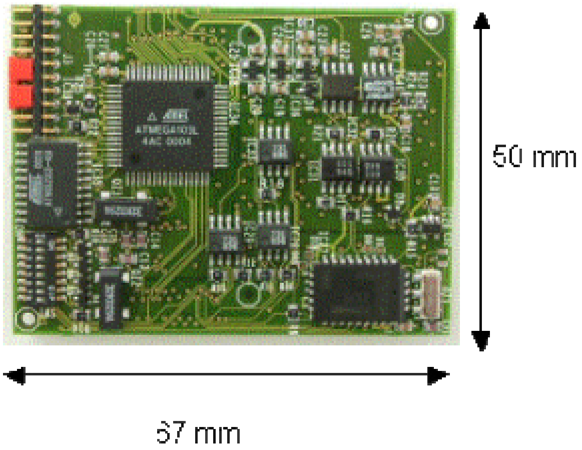


Figure 11: Embedded Local Monitor Board (ELMB)

A full branch test with 16 ELMBs on a 200m CAN cable connected via the ELMB custom OPC server to PVSS has been performed. This showed that in the worst case all data could be read-out and archived in PVSS in 4 seconds.

C. CMS

This presentation gave a clear summary of the role of the DCS with respect to the other on-line systems, see Figure 12 below. For CMS, the DCS covers only the classical slow controls domain and will be based on industrial components and JCOP tools. That is to say, it will be responsible for the supervision and control of the power of racks/crates, HV/LV power supplies, cooling and environmental systems, and gas and fluid systems. It will provide central supervision, manage alarms, provide a history database and communicate with external systems. In addition, the DCS with be used to set-up and monitor the detector and its environment as well as to monitor and protect the detector equipment.

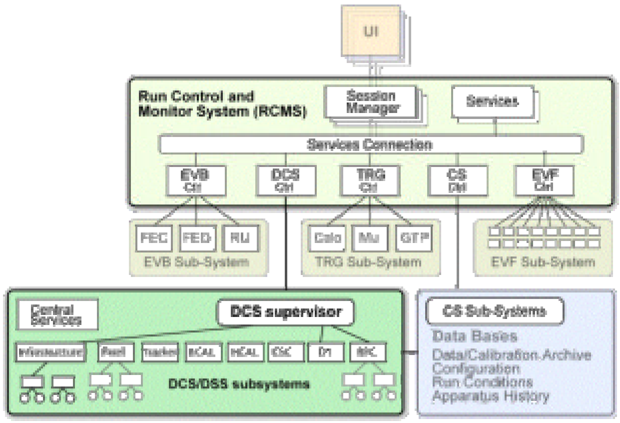


Figure 12: DCS in the context of CMS

The other on-line systems, Run Control and DAQ, will be based on the CMS on-line S/W framework and commercial products (DBs, SOAP, XML, e-tools etc.). These are responsible for the overall run control and monitoring, the local and global DAQ systems, the configuration of the front-end and read-out electronics, and the monitoring and control of the PC clusters and their applications. In addition, they provide local and remote data archives as well as the conditions and configuration databases.

D. LHCb

The emphasis of this presentation was on the common approach being taken to the design and implementation of tools and components for all aspects of control for LHCb. That is to say that the same tools and components, many of which will come from JCOP, will be used for all control domains, not only DCS (classical slow controls) but also the monitoring and control of Trigger, DAQ, Infrastructure, PC Farms, etc, as can be seen in Figure 13.

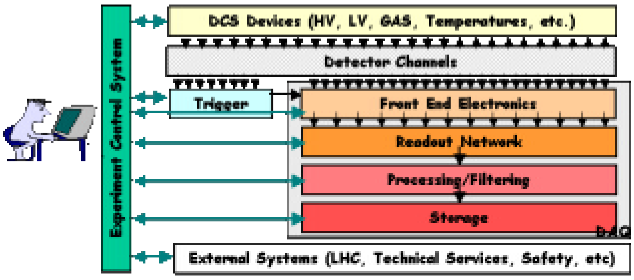


Figure 13: LHCb Experiment Control System (ECS)

The overall control system for LHCb, called the Experiment Control System (ECS), is built in a hierarchical manner and incorporates the DCS, Trigger and DAQ controls. This is based on the use of the FW tools, PVSS and the FSM. Particular emphasis was placed on the support of partitioning. In addition, LHCb will be using commercial technologies for the control of its front-end electronics. For instance, a credit card sized PC, shown in Figure 14 below, will be used for the control of electronics in non-radiation areas.

Figure 14: Credit Card PC (CCPC)

IV. REPORTS FROM RELATED ACTIVITIES

There was a series of reports from related activities and these are briefly summarised in the following sections.

A. *Detector Safety System (DSS)*

This activity was initiated as a result of a realisation that there was a certain amount of the functionality that had been provided by the General Safety System (GSS) in LEP times, that hadn't been foreseen in either the CERN Safety Alarm Monitoring (CSAM) system nor the experiment DCSs. The presentation described the role of this new system, DSS [9], which is essentially to safeguard experiment equipment, as well as the status of the project. Although this started out as a project independent of JCOP for the requirement definition phase, it has since been incorporated into JCOP for the implementation phase.

The DSS is intended to be a simple and robust system with a relatively small number of input and output channels. The system will be based on a PLC front-end and a PVSS supervisory layer. To ensure a high reliability, all safety actions will be performed by the front-end, without the intervention of the supervisory layer, based only on hardwired inputs.

B. *Gas Control System*

This activity is a close collaboration between JCOP and the Gas Group in EP/TA1 [10]. The presentation gave the current status of the project, which aims to build generic components from which each of the 23 gas control systems will be built. The control systems will use extensively industrial components and will be based on the UNICOS framework (see below).

As some of the gas distribution racks will be in the cavern in a hostile radiation and magnetic environment, a readout unit capable of withstanding these conditions will be required for gas flow measurement. The current design is based on the ELMB. However, this requires some special S/W to be written and the gas group expressed its concerns regarding the long-term maintenance of this solution.

C. *UNified Industrial COntrol System (UNICOS)*

This presentation gave an overview of the UNCIOS framework and its status. UNICOS is a framework that is being developed in the scope of the LHC cryogenics control system. It includes an object-oriented PLC library and an associated set of supervisory level components. As the supervisory layer will also be based on PVSS, there is scope for this framework to be used for parts of the experiment DCSs which are using PLCs. As stated above, the gas control systems will use this framework extensively. In addition, there is a close collaboration between the UNICOS and JCOP framework teams regarding PVSS developments.

The PLC libraries are available and the PVSS-based supervisory components are currently being developed.

D. *Electrical Distribution Control*

This presentation gave an overview of the electrical distribution system foreseen for the LHC experiments. In particular, it gave an insight into the level of control that will be possible from the experiments' DCSs. In principle, it is foreseen for the experiments to have full control over the power distribution to the racks as well as being able to send interlock signals to switch off the power in the event of a problem detected by the DCS, DSS or RCS systems.

The power distribution foreseen for the two larger experiments is different from that foreseen for the two smaller ones. Whereas LHCb and ALICE will have traditional power distribution, i.e. via the Hazemyer switchboards and cables as in LEP times, ATLAS and CMS will required a new system which is based on power distribution bars. This is due to the high power requirements and very limited space available for cables. This new power distribution system and the associated costs are being discussed with the experiments.

E. *Magnet Control*

This presentation summarised the magnet control system, which is comprised of two main elements; the Magnet Supervisor (MS), responsible for the overall monitoring and control of the magnets, and a Magnet Safety System (MSS), responsible for ensuring the protection of the magnet and for personnel safety around the magnet. The MS is based on the UNICOS Framework, described above, and is being developed in close co-operation with the LHC Cryogenics group. The MSS is a dedicated hardwired system. The MS will be capable of exchanging information with the DCS, but currently it is assumed that this will be mainly towards the DCS.

F. *Cooling and Ventilation Control*

This presentation reported on the status of the cooling and ventilation control and the interaction with the experiment DCSs. The Joint Cooling and Ventilation Project (JCOV) had been set up to look at cooling and ventilation issues in common for all LHC experiments.

The presentation highlighted that although the responsibility for the control of the primary cooling and the sub-detector specific cooling are well understood, there is still a grey area in between. This area will need further discussion between the experiments and the JCOV project.

Whereas the LHC cryogenics, vacuum and magnet control systems will use PVSS as a supervisory level, the cooling and ventilation supervision is based on another SCADA system. The impact of this is not yet fully understood and will depend, to some extent, on the outcome of the discussions regarding the grey area.

V. SUPPORTED TECHNOLOGIES

In this session there were a series of presentations and demonstrations giving more details on the JCOP supported technologies and solutions introduced in the presentation on common aspects of the experiment control systems. The first gave a general overview of DCS technology and trends. The second gave an overview of the JCOP FW philosophy and the current status. This was followed by a detailed description of FW devices with a demonstration of the configuration and operation one of these – the CAEN SY1527. There were then three demonstrations of FW tools. The first was on the device editor/navigator, which is a central tool in the FW, used to configuration and operate FW devices. The second showed the use of the controls hierarchy which implements the system modelling and partitioning described previously. The final demonstration was on the advanced trending tool which enhances the functionality provided by the PVSS trending tool.

In addition to these presentations and demonstrations, a number of hands-on activities were organised outside of the workshop. There was a PVSS tutorial with exercises based on the material produced for the CERN School of Computing, a FW tutorial with exercises aimed at showing how to build a controls application using the FW tools and a tutorial on the use and integration of field buses and PLCs. These were well attended and the material used is available in an IT-CO laboratory for self-tuition.

Requests to use this self-tuition material can be made to ITControls.Support@cern.ch.

VI. EXPERIENCE WITH SUPPORTED TECHNOLOGIES

In this session there were a number of presentations reporting back on the experience already gained with the use of the technologies and solutions presented above. These reported on the use of these technologies in many divers projects; the DESY H1 and NA60 DCSs, multiple ATLAS activities including TileCal calibration, ELMB radiation and branch tests and the MDT cooling test, the LHCb Timing and Fast Control system and the Computer Centre Supervision project. In addition, there was a report from ALICE on the integration of the ISEG High Voltage system into the JCOP Framework.

Although there were some problems raised, e.g. with the use of the PVSS archiving, as well as some areas of missing functionality, on the whole the experience reported had been positive.

In addition to other LHC experiment sub-detectors and the projects given above, the technologies and solutions presented in this workshop are already heavily in use in two other fixed target experiments; COMPASS and HARP. Despite some initial teething problems the technologies, due largely to the immature nature of the solutions at the time, are being used successfully in the controls systems of thee experiments.

VII. DIRECTIONS AND ROADMAP

The JCOP Project Leader presented his view of the role of JCOP and the direction it should take. He first highlighted that in the current situation, where resources, both financial and manpower, are continuing to decline that common projects must play an important role. JCOP aims to reduce the overall development effort required by the experiments by providing commonly developed components from which all experiments can benefit. However, common projects imply some level of compromise and JCOP has in the past, and will continue in the future, to work via consensus on activities which are requested by the majority of the experiments. The project will continue in its approach to use commercial solutions where possible, as these reduce the effort required both for development and long-term maintenance. However, where custom solutions are required, these will be developed and a support and maintenance concept agreed, so long as resources can be found.

JCOP will continue to work with projects in other domains to benefit from the work being done there. Examples being the LHC cryogenics group for the UNICOS Framework and the CERN-wide SCADA Application Support Group (SASG) for PVSS developments. Other possible domains of interest, which will be monitored for applicability, are the LHC Controls Project (LHC-CP) and the Computer Centre Supervision project.

Over the coming years JCOP will continue to execute its agreed program of work to deliver the common components required by the experiments as well as to define a maintenance strategy for these. In addition, the project will continue to clarify and agree the interaction with external systems. Where possible, the interaction with active sub-detector teams will be intensified in order to refine the requirements on the components required from JCOP and to get feedback on the solutions being provided. In this way the solutions provided can be better tailored to the needs of the experiments.

JCOP will be open to new common activities. In cases where these are identified and approved by the JCOP Executive Board, and where the necessary resources exist, new JCOP sub-projects may be started. Possible new activities might include:

1) *Interfacing to the experiment configuration and conditions databases*

2) *Definition of a strategy for the configuration, operation and maintenance of large PVSS distributed systems*

3) *Security issues, particularly those related to remote access of the control system*

4) *Work with commercial providers to enhance their products, e.g. ETM for PVSS, CAEN, ISEG and Wiener.*

From the discussion that followed a number of important points are worth reflecting here. Firstly, all four experiments agreed on the current JCOP scope of work. However, there was some concerned about taking on additional activities, even if these were required by all four experiments, due to the limited resources available to the project. In fact, the issue of resources was the only issue which led to an animated discussion. The Project Leader noted that although some developments had been made by the experiments, which could be integrated into the FW and hence shared by all experiments, no experiment resources had been explicitly allocated to JCOP activities. Furthermore, in response to his suggestion that the experiments could perhaps perform developments in a way which would allow them to be used by all experiments, some people from the experiments felt that all resources for common developments should be supplied by the service groups. The CERN Management considered that the experiments also had a responsibility to find people for such activities.

VIII. CONCLUSION

Although there were less people present than hoped for, the JCOP Workshop was considered to have been a useful forum for the exchange of information. The presentations were on the whole very good and the information presented of general interest.

JCOP has made significant progress since the previous workshop and a number of solutions are already available with more on the way. Although the experiments intend to use these solutions to varying degrees, it could be seen that the experiments rely heavily on them. Importantly, the experiments agreed on the scope and activities of JCOP and re-iterated their commitment to it.

Whilst clearly there is room for improvement, the experience gained with the currently supported technologies and solutions has been on the whole very positive.

In conclusion, it can be considered that the workshop was a success and JCOP continues to be an important project and a good example of collaboration between the experiments.

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