

## **Minutes of LHC-CP Link Meeting 33 held on 18.02.2003**

### **Present:**

M.E. Angoletta (scientific secretary), L. Arnaudon, V. Baggiolini, R. Billen, A. Butterworth, E. Ciapala, P. Charrue, A. Daneels, S. Deghaye, F. Di Maio, B. Frammery, P. Gayet, P. Gomes, A. Hilaire, M. Lamont, R. Lauckner (chair), I. Laugier, M. Pezzetti, B. Puccio, A. Rijllart, R. Saban, J. Serrano, C-H. Sicard.

### **Agenda**

1. Matters arising from Previous Meetings.
2. LHC-CP News – R. Lauckner
3. GPRS tests – R. Lauckner
4. Status report from signals Working Group – E. Ciapala.
5. Analog signals acquisition: status and plans – J. Serrano
6. AOB.

### **Minutes**

#### **1. MATTERS ARISING FROM PREVIOUS MEETING**

Robin mentioned that several discussions took place in the CO group on how to tackle the issues arisen during the last LHC-CP meeting. Meetings have already been organised for the technical points while a LHC-CP meeting will probably deal with the non-technical issues. Finally, Axel has provided a new scheduling updated with the latest feedback received after the last LHC-CP meeting.

#### **2. LHC-CP NEWS**

No news this time.

#### **3. GPRS TESTS - R. LAUCKNER**

Robin gave a short [presentation](#) concerning the GPRS service, following a couple of meetings with IT/CS. The bandwidth available with the current system is the same as what we have from home, i.e. equivalent to a 56K analogue modem. However, IT/CS will not release the current system as a service at this moment for several reasons. First, its cost as proposed by Swisscom is too high. Second, some data corruption phenomena have been experienced. Third, incoming packets should pass the CERN firewall, therefore the access protocol to the technical network should satisfy CERN safety rules.

It is now mandatory to test the current GPRS system and ascertain if it is really the way to go. IT/CS are ready to collaborate and a test should be scheduled within a couple of weeks.

Philip mentioned two outstanding issues.

First, the cryogenic group asked for “prise portables”, but at the moment none is available.

Second, the cryogenic experiences would like to be connected to the technical network. At the moment, they are under the corresponding experiment’s network and the two networks are completely separated, physically and concerning the budget. The corresponding experiments would have to be notified and agree upon the network change. Philippe underlined that cryogenic systems for experiments and other systems already on the technical network will have to be operated from the same Control Room. As a consequence, using the same network could make the situation simpler. Robin mentioned that both networks can be connected to the control room, in any case, and there is nothing much to gain from that. Finally, Isabelle underlined that the people working on vacuum for experiments have the same type of requests and issues.

#### **4. STATUS REPORT FROM SIGNALS WORKING GROUP (E. CIAPALA)**

Ed started his [presentation](#) by reminding the Analog Signals Working Group (SiWG) mandate. The main points of the mandate are: a) to make a proposal for the next generation signal monitoring systems; b) to review the plans for upgrading the current NAOS system and for making available new signals and facilities; c) to coordinate prototyping work, such as the signal observation for the TT40 extraction line (detailed by Javier in the following presentation).

Ed underlined that PS and SPS users are generally happy with the existing nAos system. There are, however, some problems and limitations that are currently being addressed. For instance, most manufacturers replaced the VXI bus (used in nAos for HP oscilloscopes) with the cPCI one, with the consequence that it is not possible to replace existing HP oscilloscopes. Another example is that the bandwidth available on multiplexers is quite narrow (50 MHz) in comparison to the oscilloscopes bandwidth (250 MHz). The consequence is that high frequency signals have to be connected directly to the oscilloscope, without passing through the multiplexer. Finally, the nAos protocol limits to 500 the number of points that can be transmitted. This was acceptable with old oscilloscopes equipped with non-deep memory, but is not acceptable for new, deep-memory oscilloscopes.

Ed went on by listing the LHC requirements for the analog observation systems. Among others, it must support a post mortem analysis. Ten microsecond is the maximum precision required for triggering, time-stamping or data synchronisation; faster timing triggers (such as the 5 ns) will be provided directly from RF.

Several functionalities will be available in the next generation nAos. For instance, there will be the possibility to have “dual channel” operations, i.e. multiple channels triggered by the same trigger. As Javier mentioned during the short discussion that followed, this option represents a trade-off between functionality and cost. On one side, multi-channel oscilloscopes have a cost-per-channel reduced if compared to oscilloscopes with less numerous channels. On the other side, usually all channels on the same board are triggered by the same trigger, therefore having boards with multiple channels limits the flexibility of the system.

Another functionality available in the next generation nAos will be the presence of wideband multiplexers. In addition, the number of points retrievable from a digitizer will be increased. Concerning the triggers, a wider choice of triggering modes will be available.

Concerning data treatment, both data and acquisition settings will be stored in a common database. The new nAos will be compatible with the post-mortem; it should be noted that the post-mortem data format in the database has not yet been decided, although J. Wenninger (PMWG) has already made a proposal.

Ed concluded his talk with a few functionalities that haven't been required (yet?), such as the setting switching from cycle to cycle and the 1 ns precision in slow timing trigger.

Robin remarked that for TT40 an important functionality would be shot-by-shot logging.

## **5. ANALOG SIGNALS ACQUISITION: STATUS AND PLANS (J. SERRANO)**

Javier started his [talk](#) by giving an overview of the current nAos system. There are two types of crates involved: VXI crates and timing crates. VXI crates digitize the analog signals and send digitized data to virtual oscilloscopes applications over the LAN. Timing crates deliver triggers to the other crates, and are setup from the application through the LAN.

Robin asked if there had been any market surveys before putting together the current system, to ascertain the availability of commercial applications capable of satisfying our needs. Bertrand answered that there were no commercial solutions capable of supporting pulse-to-pulse modulation (ppm).

Javier continued by listing the hardware choices for the new nAos system. The new bus of choice is the cPCI, since the vast majority of hardware manufacturer are now supporting it. Acqiris fast digitizers will be the standard digitization hardware, together with Concurrent Technologies Pentium-based CPU boards equipped with an in-house developed PMC timing card.

The software architecture will be three-tiered and Linux will run in the cPCI crates. Pierre Charrue asked which Linux version is the one used. The answer was that so far a special version had been prepared by Nicolas; that was necessary because standard releases present problems with the diskless boot.

The current status of the development is very encouraging. The Concurrent Technologies CPUs and different versions of Acqiris digitizers have been tested. A backup VXI solution is already available for the TT40 tests.

The choices made for TT40 tests include Linux as OS, Acqiris fast digitizers and Concurrent Technologies CPU. The SPS mountain range is being developed in Labview, and will be ported later on to the architecture chosen for TT40. Appropriate equipment modules for Acqiris digitizers and multiplexers are currently being defined.

Bertrand commented that so far the triggering part was the most difficult part of the analog observation systems. It is very convenient not to have to worry about it for the TT40 tests; it will of course come, for future systems.

Robin underlined again that it would be important to provide TT40 with a shot-by-shot logging, as opposed to logging at every cycle.

Frank di Maio asked about the development of a new GUI to be used with the new nAos system. Javier underlined that the cPCI oscilloscopes can already be seen as traditional nAos oscilloscopes, since the software running on VXI has already been ported to cPCI. However, there is the need to overcome the limitation on the number of points that can be transferred, limitation linked to the protocol used by the old nAos system. Delphine Jacquet will probably develop such new GUI application, but this has not yet been officially agreed upon.

Robin asked when the SiWG will provide a time planning for the TT40 development. When Javier answered that this will happen very soon, Robin suggested to present it at the next LHC-CP meeting.

Finally, Bertrand asked Maria Elena how she intends to proceed with the different systems based on Acqiris digitizers in the BDI group. I answered that I'm already in contact with Stephane Deghaye and Javier for jointly specifying the EM relative to the Acqiris fast digitizers family, so to have a common interface to a common hardware.

Reported by M. E. Angoletta

# GPRS Service



- Leaky feeder in sector 7-8 is installed and operational
- Useful bandwidth of current system equivalent to 56K analogue modem
- Current Swisscom offer is at unrealistic cost and data corruption has been experienced
- Mobile telephony service contract being renewed. Outstanding technical issues still to be addressed through tender and later discussions
- Incoming packets must pass CERN firewall, a production VPN service exists but proposed access to the technical network is against current rules (<http://cern.ch/vpn>)
- IT/CS ready to collaborate with LHC-CP for a limited test

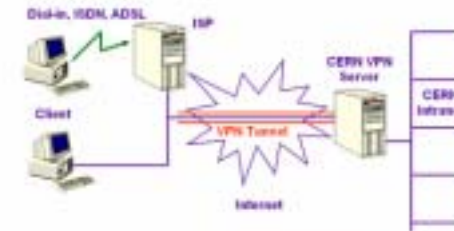
*L. Guerrero and R. Lauckner, 18.02.2003*



## CERN VPN Service

[Home](#) [Documentation](#) [Registration](#) [Security](#) [Status](#) [Troubleshooting](#) [Internal](#)

### Welcome to the CERN Virtual Private Network Service



User must agree to the [VPN Security requirements](#) before registering the service.

To use the VPN Service, you must register your account and configure your computer according to the documentation. You can access the registration page and the documentation from the toolbar at the top of this page.

## Analog Signals Working Group SiWG

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Status Report:

### Part 1. (E. Ciapala)

- Introduction: Mandate, SiWG and activities
- Current systems and new requirements

### Part 2. (J. Serrano)

- Progress so far - Status and plans
  - System hardware and software developments
  - Tests and Pilot projects
- Realization of application software
- Goals and milestones for TT40 extraction tests

## SiWG Mandate - Phase 1 Objectives

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- **Produce accelerator wide proposal for next generation of signal monitoring system**  
Functional requirements, Scope, Technical proposal,  
Ensure maximum compatibility with other systems, e.g. alarms, logging, post-mortem.  
Cost/manpower estimates and timescales, work packages and responsibilities  
Maintenance plan, strategy for further evolution
- **Review and understand current plans to:**  
Upgrade PS/SPS NAOS  
Provide signals for SL kickers, LHC damper and RF systems  
Provide facilities and support for LHC post-mortem
- **Coordinate prototyping work: (Pilot Projects)**  
PS NAOS replacement  
TT40 extraction  
RF fast mountain range display, Triggering hardware
- **Deliverables for May 2003:**  
The accelerator wide proposal  
Working system for TT40 extraction hardware commissioning & beam tests, expected August 2003.  
Working system for LEIR, preferably using a common solution.

## SiWG Members

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- *Groups involved:*
  - PS-CO, PS-OP, SL-BT, SL-CO, SL-HRF, SL-OP.
- *Members:*  
Stephane Deghaye (CO); Luca Arnaudon (RF); Javier Serrano (CO);  
Gabriel Metral (OP); Etienne Carlier (BT); Erich Bracke (RF);  
Edmond Ciapala (RF); Delphine Jacquet (OP); Adriaan Rijllart (CO)  
  
Part time: Thijs Wijnands (CO)
- *Documentation*
  - Minutes of meetings, reports on LHC CP web site  
<http://project-lhc-cp-siwg.web.cern.ch/project-lhc-cp-siwg/>

## SiWG Meetings

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### **9 meetings held since May 2002:**

1. Mandate & organization
2. nAos in PS (Javier), SPS mountain range (Luca), SPS extraction kicker requirements (Etienne)
3. LHC requirements (M. Lamont)
4. LSS4 extraction & proposal (Etienne), DACQ hardware survey
5. nAos in SPS (Bernard Desforges), hardware & software developments
6. Hardware (multiplexers) and dacq crate software
7. MMS systems (Adriaan), LF acquisition systems (Erik), nAos protocol
8. GUI solutions (Eugenia) => "Business Layer"
9. Review of first report on findings, requirements and the way forward...

## Review of Existing Acquisition Systems - nAos

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- 30 VXI crates containing HP oscilloscopes, multiplexers
- Local software in crate VxWorks/LynxOS
- 1500 Analog signals connected
- Dedicated VXI trigger source crate
- User application C/Motif under Linux
- 100 mS 'Self imposed' limit on acquisition to display time

PS and SPS users generally very happy

### Positive features:

- Crates close to equipment
- Convenient user interface
- User reservation of equipment, priority allocation
- Pre/post trigger data acquired
- Data identified with cycle type
- Data stored in database

## nAos – Present Limitations

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- VXI dropped by major manufacturers of fast digital oscilloscopes, have moved to Compact PCI
- Present multiplexers only have 50 MHz bandwidth, scopes have 250 MHz Critical HF signals connected directly to 'scopes
- Upgrade of system and accommodation of new requirements are difficult:
  - Workstation application program has had many modifications and is difficult to maintain.
  - The system is not open, making it difficult to build a new application easily  
Communication between the crates and the applications is not AB-CO standard.  
Data format is non-standard
- Currently two databases holding configuration information - PS & SPS
- SPS / PS triggering schemes are different (SPS non-standard)
- Limitation on number of points to 500, due to transmission of data in a single UDP packet
- Additional requirements asked for:
  - Different triggering modes,
  - Increase in the number of points per curve
  - Analysis facilities such as peak detection

## Existing Acquisition Systems – Quench recording (A. Rijllart)

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- Magnet test benches in SM18, 500 channels/system. Three systems installed and three more to come. One system for the LHC string 2, 1000 channels.
- VME crates with medium-frequency range digitizers. No local operating system involved. A LabVIEW application controls the settings and data is transferred over MXI to local workstations (Sun running Solaris).
- Data is both sent to an NFS file server and to an Oracle server.
- Operators in the Bench Control Room can display and analyse the data using display consoles (Sun).
- Some continuously recorded signals can be monitored from any user's office using a web viewer.
- Use of LabVIEW for signal treatment
- **Some features of the system:**
  - Event triggering is an important feature => configurable levels
  - Data time-stamping is using UNIX time from the workstations
  - Configuration data, i.e. channels, sampling rates, trigger conditions, for different types of measurements stored in files
  - Large amounts of data acquired –up to 200 Mbytes per trigger
  - Sampling speeds range from a few ks/s to 10 Ms/s in diode test bench
  - Cost is around 300 CHF per channel

## LHC Requirements (SiWG + M. Lamont)

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- Many LHC systems will have their own inbuilt monitoring and Post-Mortem facilities.(e.g. quench protection, power converter, beam loss ..)
- Raw analog signals will be provided mainly by RF and BT systems.
  - Roughly 400 signals for the injection kickers and dump kickers, in the frequency range DC to 50 MHz, with a few signals up to 200 MHz.
  - For the RF and transverse damper systems ~ 200 signals in the 0 to 40 MHz range, with 20 or so RF signals in 1 GHz range.
- PM Mode of operation
- Need to correlate data with that from systems with inbuilt monitoring
- Fast timing triggers are directly supplied where needed to RF and kicker equipment
- Otherwise no requirement for better than 10us precision for triggering, time-stamping or synchronization of data



## TT40 Test Requirements

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- LHC injection requirements will be similar to the SPS extraction requirements.  
The TT40 project: Monitoring of the synchronization between circulating beam and control and monitoring of the extraction kicker pulse (MKE)..
- Eight signals to be monitored with three independent triggers. Pulses are of the order of 10us, with triggers arriving around 20us in advance  
Some specific requirements are:
  - Software compensation of cable delays, beam time of flight, HV generator delay in order to display a true measure. Implies signal and trigger delays known to system.
  - Simultaneous view & comparison of different acquisitions
  - Acquisition trigger/generator synchronization better than 5 ns. The trigger is derived from RF synchronization.
  - Cycle dependent triggering
  - Predefined settings (gain, timebase) via menus for each measurement
- Different modes of operation:
  - Wide time base + zoom facility for finding the pulses inside a large time interval during hardware setup
  - Fine time resolution for control and synchronization with beam.

## Functionality in ‘next generation’ nAos (1)

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- System and layout:
  - New crate and module system based on modern, standard, open supplier hardware and software.
  - Dual channels (where possible)
  - Wide band signal multiplexing.
  - Case by case system configuration “standard” modules (acquisition and multiplexers)
  - Acquisition crates optimally installed close to signal sources
- General:
  - Extension of the number of points per acquisition to appropriate maxima
  - Maintain the 100 ms acquisition and display time
- Triggering:
  - Wider choice of triggering modes, e.g. internal ‘event’ trigger
  - Pre-acquisition compensation of signal and ToF delays
  - RF bucket selection and trigger with various modes (e.g.  $f_{rev}$  interval train)
  - Pre/post trigger memorization of data.
  - Post Mortem trigger (LHC)

## Functionality in ‘next generation’ nAos (2)

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- Data treatment:
  - Acquisitions and acquisition settings stored in single database \*
  - Standard data formats: format to be agreed! (PMWG proposal)
  - Post Mortem compatibility
  - Data identified with cycle type *and* cycle number where appropriate
  - Time-stamping of data acquisition (UTC)
  - Post-acquisition synchronization of data acquisitions
  - Zoom facility in acquisitions with large numbers of data points
  - Analysis facilities such as peak detection, envelope check/comparison.
  - Buffer storing of data from given acquisition systems, readable by many clients \*

## Functionality in ‘next generation’ nAos (3)

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- Operational:
  - Convenient user interface for control of all functionality and data display
  - Standard setup menus for different applications
  - User reservation of acquisition equipment, user priority allocation/re-allocation of equipment. (as present nAos) \*
  - ‘Integration’ of measurements from other systems
  - Maximum compatibility with Post-Mortem and other systems having equivalent functionality
- Replacement of present stand-alone facilities:
  - Pure data acquisition LabVIEW applications e.g. SPS ASOS?

## Functionality in 'next generation' nAos (4)

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- Some other possible functional requirements, not specified
  - Export trigger i.e. sending of internal trigger on one system to others (Case by Case basis)
  - Real time switching of settings from cycle to cycle
  - 1 ns precision (maximum jitter) in slow timing trigger

These have substantial hardware & software implications!

## Conclusions (Part 1)

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- ✓ Existing systems studied
- ✓ User requirements collected:
  - Analog monitoring system is a fundamental facility for operation
  - For the large part it can and should make maximum use of standard facilities of the control system; database, timing, middleware & communications, GUI ..
- ! Ongoing task of following up LHC requirements – MPWG, LCC, PM studies

### Progress on

- Hardware and software platforms
- Prototyping and tests in progress
- Realization of overall software structure

in second part of presentation ...



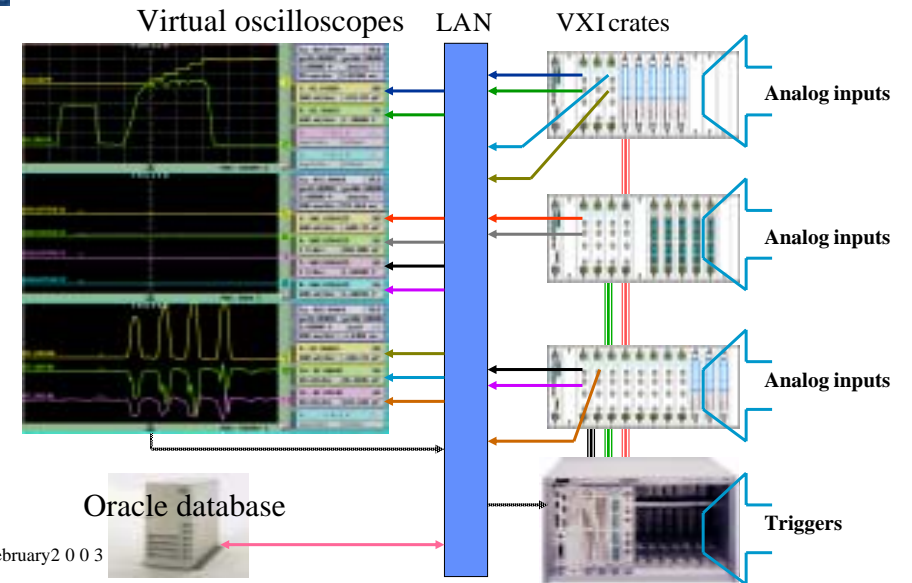
## Anal o signal acquisition: status and plans

Javier Serrano AB-CO  
On behalf of the SiWG

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## The current system



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## Hardware choices for the future system

- ◆ CompactPCI form factor.
- ◆ Concurrent Technologies Pentium-based CPU board.
- ◆ Acquisition digitizer modules.
- ◆ Pickering analog matrix and multiplexer modules.
- ◆ General Machine Timing via PMC (PCI Mezzanine Card), available for the end of 2003.
- ◆ RF bucket timing card in PMC, to be developed.

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## Software choices for the future system

- ◆ The retired architecture.
- ◆ Linux OS running in the CompactPCI crates. A real-time alternative will be explored if needed.
- ◆ Use of AB-CO standard components:
  - Front end uses Equipment Modules.
  - Communication between front end and middle tier through Control Middleware.
  - Middle tier will use services provided by AB-CO.
  - GUI based on the GUI Platform (GP).

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## Status of tests and development

- ◆ Current Technology GPU board tested (bugs found and fixed by manufacturer).
- ◆ Acqiris 1 Gs/ s modul tested under Linux
- ◆ Acqiris 2 Gs/ s modul tested under Lab view/ Windows with SPS beam.
- ◆ Multiple external modules for TT4 tests selected and procured Linux driver will be available shortly from AB-CO-FC.
- ◆ Low frequency multi channel board with Linux support purchased for evaluation.
- ◆ Backup AOS solution prepared for TT40.

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## The way forward(1)

- ◆ Choice of TT4 tests: Linux, 1 Gs/ s Acqiris modules picking multiple external Current Technology GPU.
- ◆ SPS mountain range being developed in Lab view. Will be reported later to the architecture chosen for TT40.
- ◆ Front end: Equipment Modules and other digitizers and the multiple external.

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## The way forward(2)

- ◆ Middle tier: close collaboration between AB-CO-FC and AB-CO-AP.
- ◆ GUI AB-OP involved in development with support from the GP team.
- ◆ For both middle tier and GUI an analysis has to be done based on our requirements.
- ◆ The goal is to have a full working prototype satisfying the requirements for the TT4 tests by the end of August.

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## Conclusions

- Basic decisions made on hardware and software platforms.
- Prototyping and tests in progress.
- Overall software structure now has to be defined in detail.
  - Implementation and ready validation of parts of the LHC control system.
  - Support should be given high priority.
- Focus now on TT4 test.
- Ongoing task of following LHC requirements – MPWG, LCC, PM studies.

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