Towards a Detector Control System for the ATLAS Pixeldetector

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Pixel2002, Carmel September 2002

Overview of the Detector Control System

The Front End System

The Back End System

Experience with the Testbeam Setup

Summary and Outlook

Tasks of the DCS

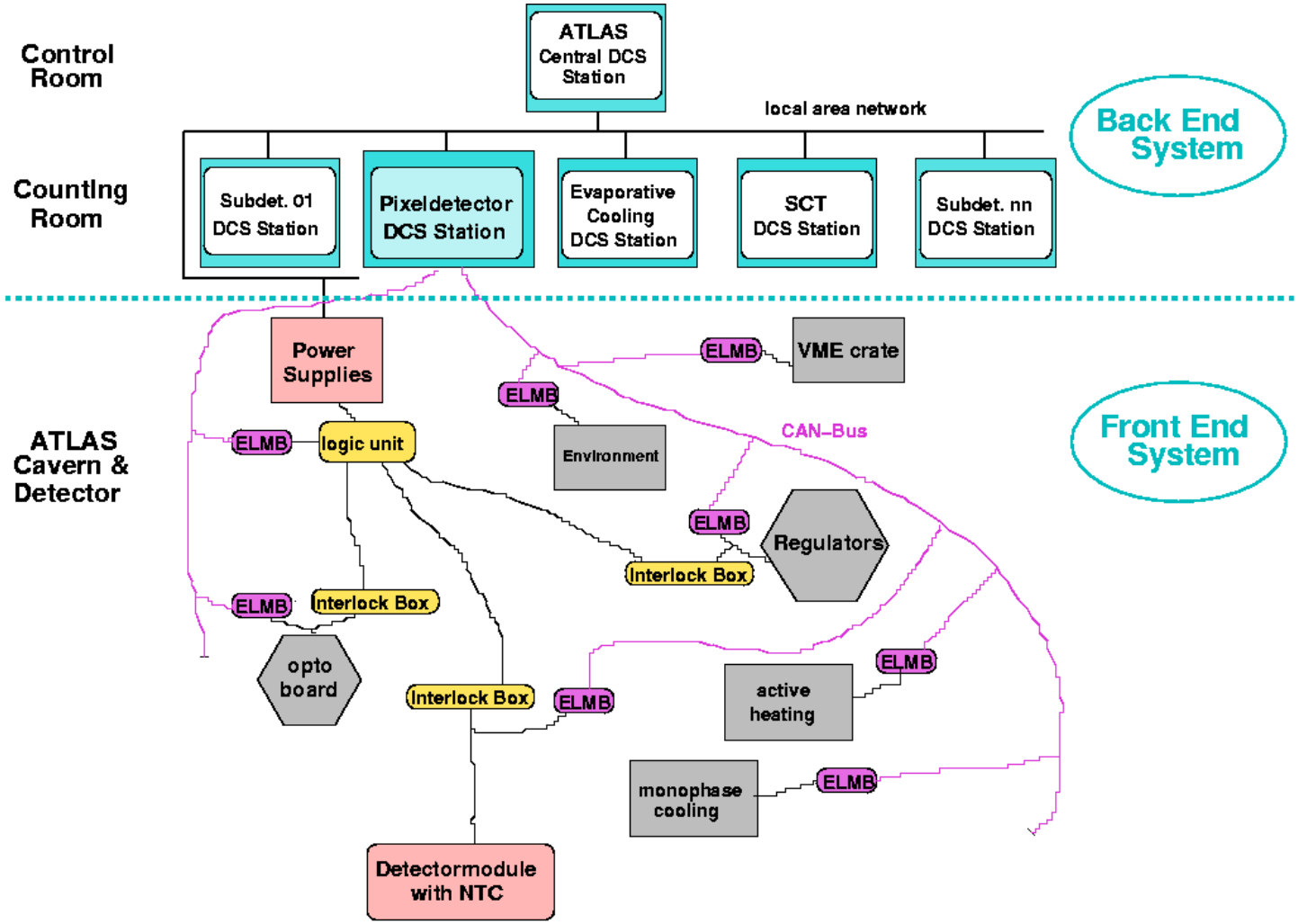
Guarantee reliable data taking + safe operation of the detector

- Monitoring and control of hardware
- User interfaces for experts and shifters
- Reaction to error conditions and error reporting
- Histograms for trend analysis
- Communication to Data Acquisition System .....

+ Our detector specific constraints:

- high power density
- harsh radiation environment
- inaccessibility over long terms

Overview of Pixel-DCS



Front End System

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Power Supplies

- depletion voltage for the sensor
- two low voltages for the front end electronics
- three low voltages for the optolink

Grounding and redundancy considerations → high granularity

ca. 4000 power supply channels

- High level of local intelligence
- Operation of channel groups
- Support interlock system

Evaporative Cooling System

Ca. 20 kW total power dissipation must be removed

minimal extra material in the tracker sensitive volume

using C_3F_8

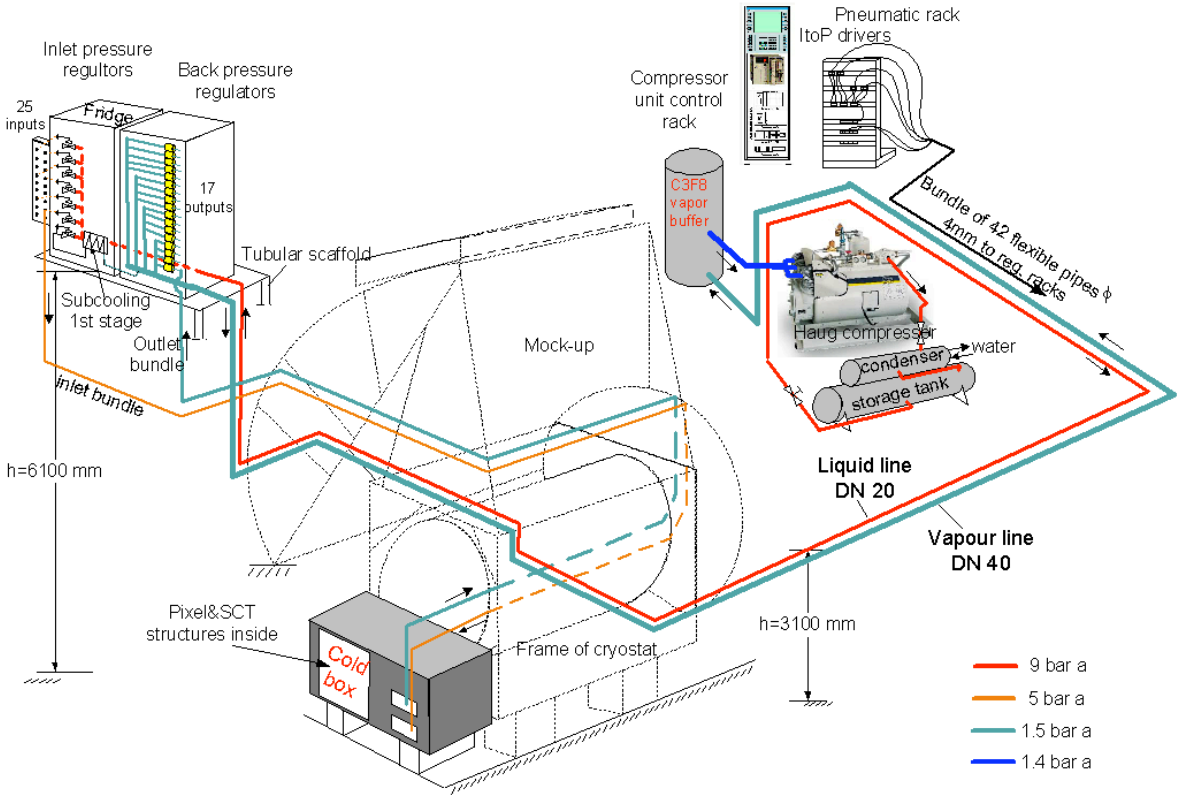
non-flammable

non-conductive

radiation resistant

Detector can be cooled down to –6 °C

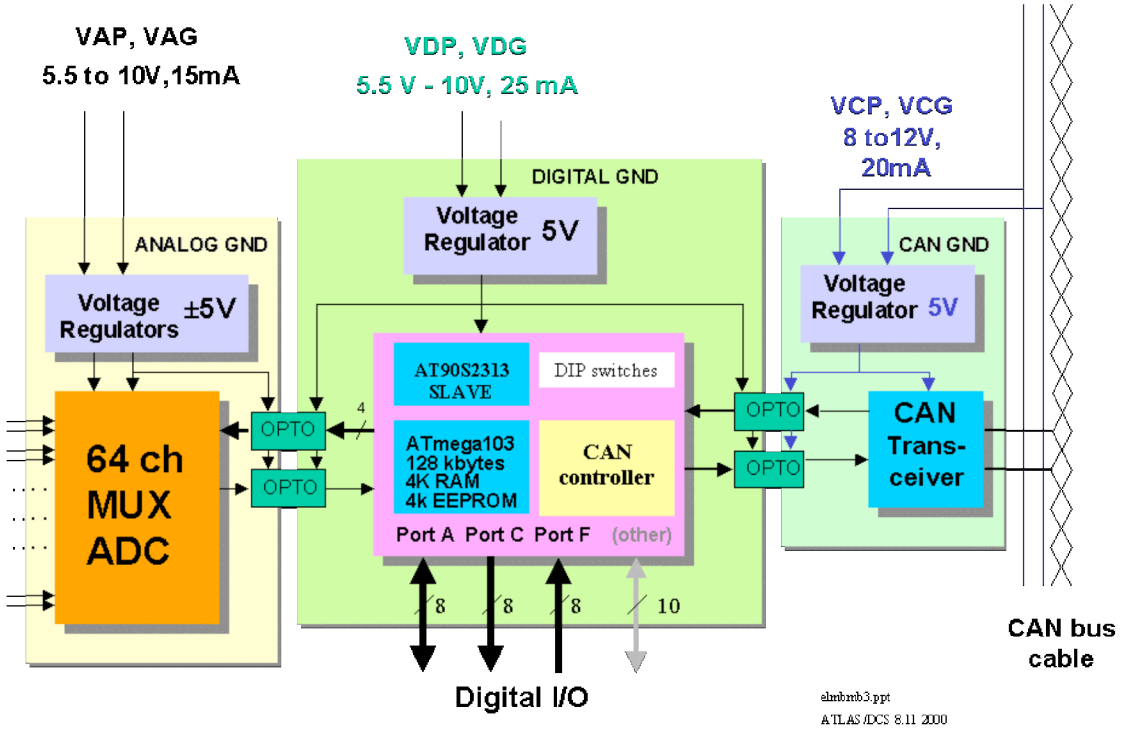
Prototype at CERN:



Embedded Local Monitor Box

General purpose front end IO device developed by ATLAS DCS group

- 64 ADC channels 16 bit
- 34 digital IO lines
- Radiation tolerant
- CAN serial fieldbus
- CANopen protocol



- Pixel: ca. 250 ELMB
- Design of CAN-fieldbus System?

Thermal Interlock System

Aim: protect detector modules against risks associated with

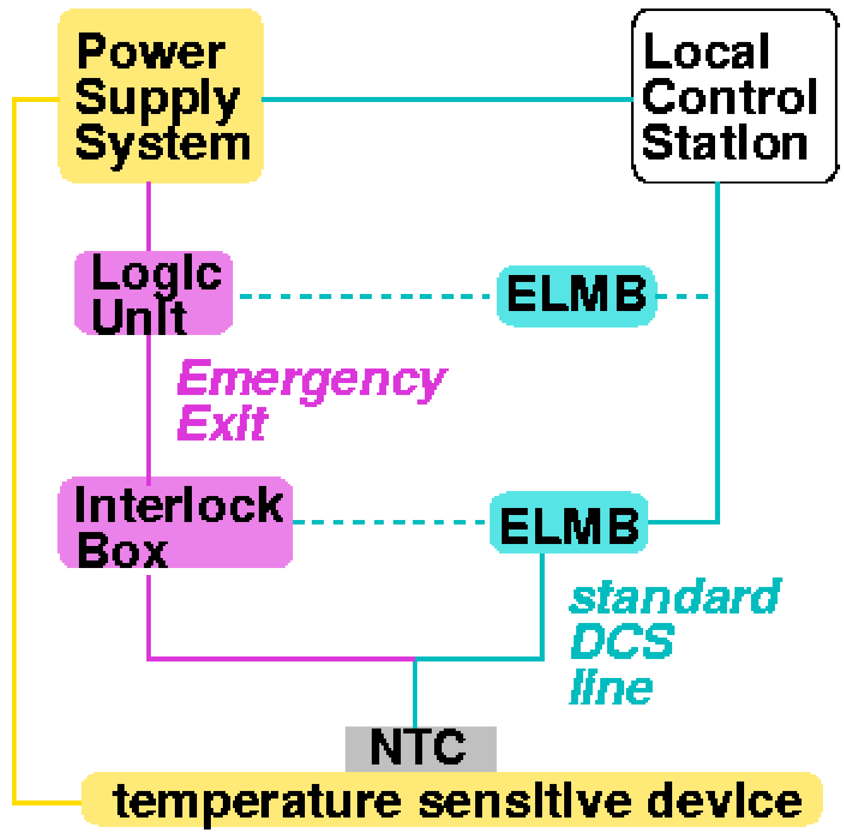
- de-lamination
- latch ups
- failure in cooling system

NTC resistor on each detector

- standard monitoring
- hardwired Interlock-Box

Logic Unit: combine signals

opto couplers, allow pattern monitoring



The Interlock Box

Robust solution! Not relying on any software!

2 bit logic:

temperature too high,

temp too low,

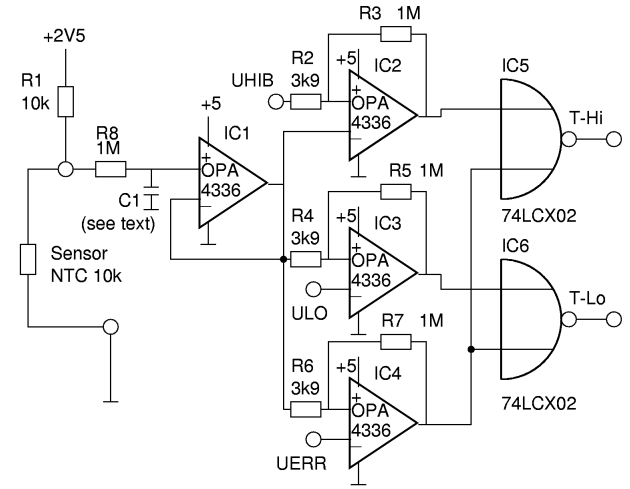
broken cable, short circuit

Overall max. error: 1K

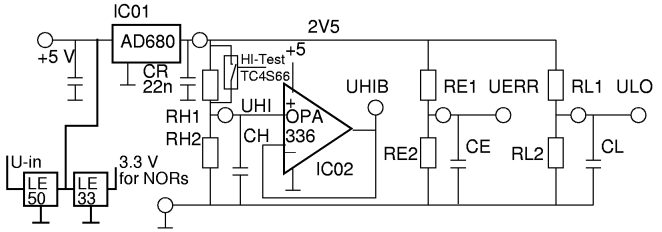
Operation in radiation environment:

5×10^{11} n/cm^2

93 Gy



Discriminator section, one for each channel

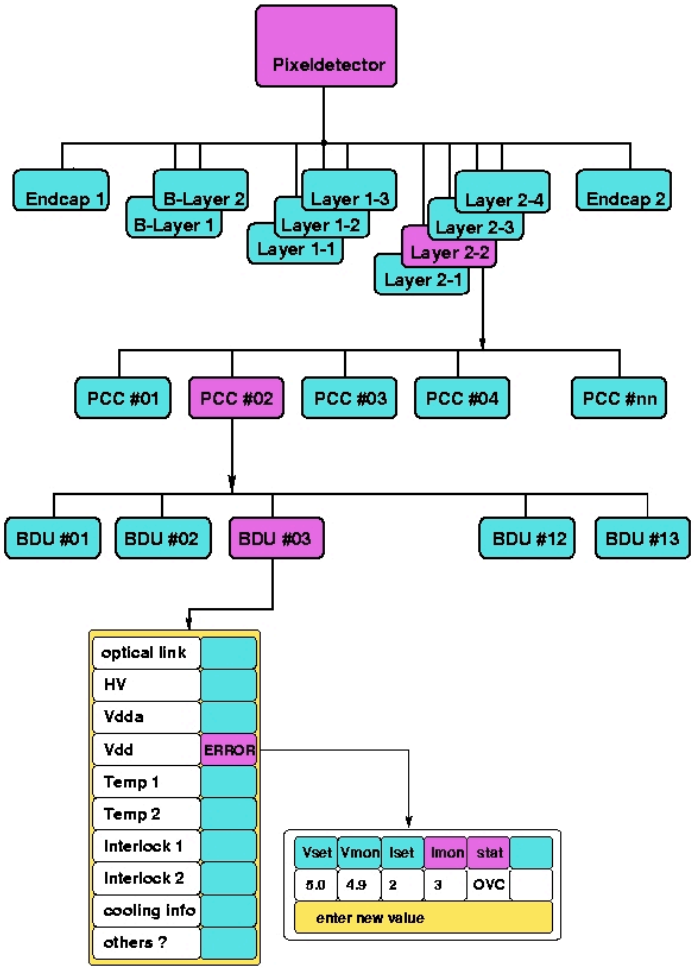


Reference section, common for all channels

NTC I-Box circuit P. Kind 5.2002 Uni Wuppertal

Mapping between Hardware components and Software

Motivation: graphical surface,
make problems evident,
easy problem tracing



Geographically oriented tree structure

- Level 1: pixeldetector
- Level 2: shells and disks
- Level 3: parallel cooling circuits
- Level 4: Base Detector Unit

Back End System

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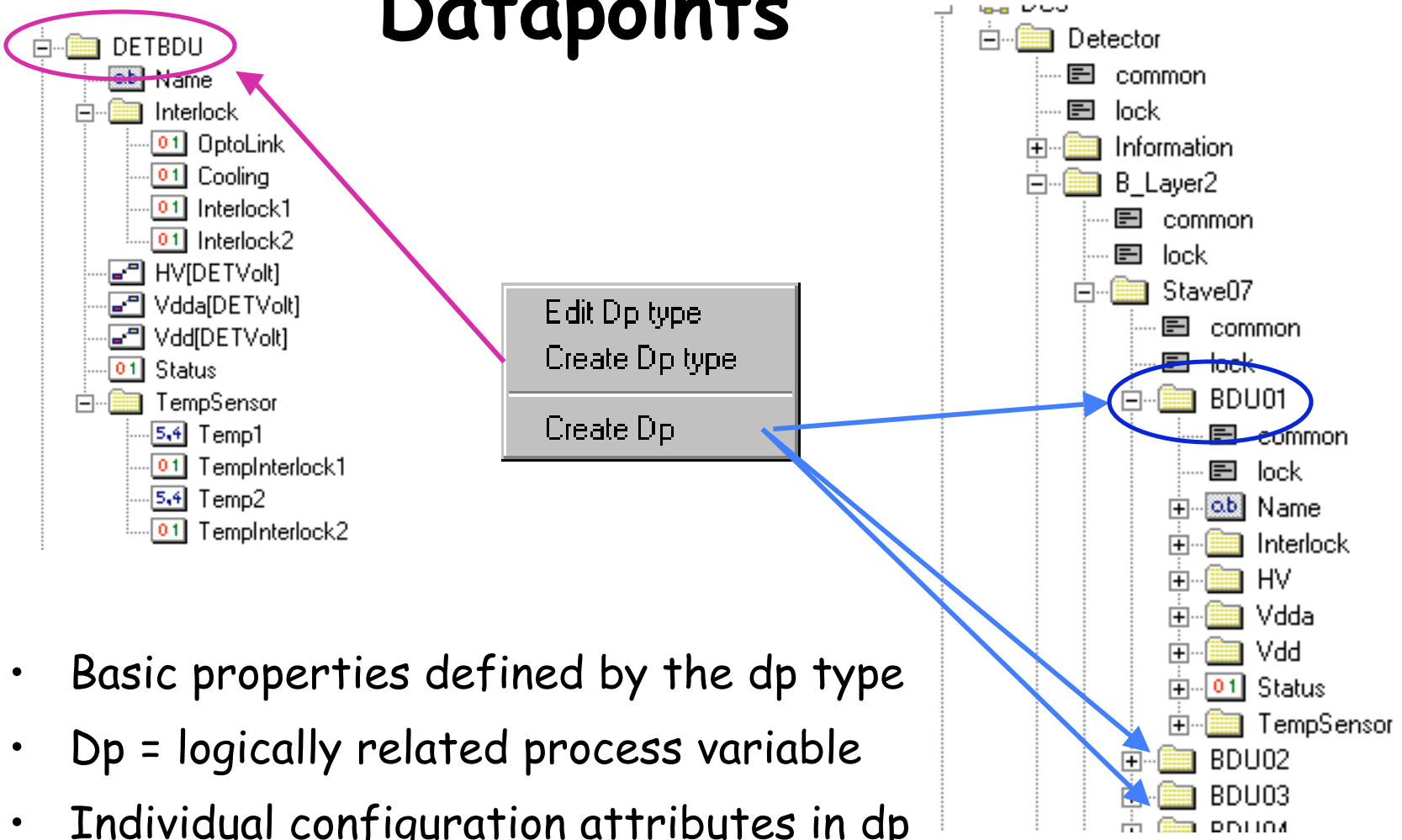
Supervisory Control And Data Acquisition System: PVSS

Commercial product PVSSII from ETM, Austria

LHC wide decision

- Can be distributed over many stations
- Flexible and open architecture
- Basic functions for automatisation
- Standardized interface to the hardware
- Application programming interfaces

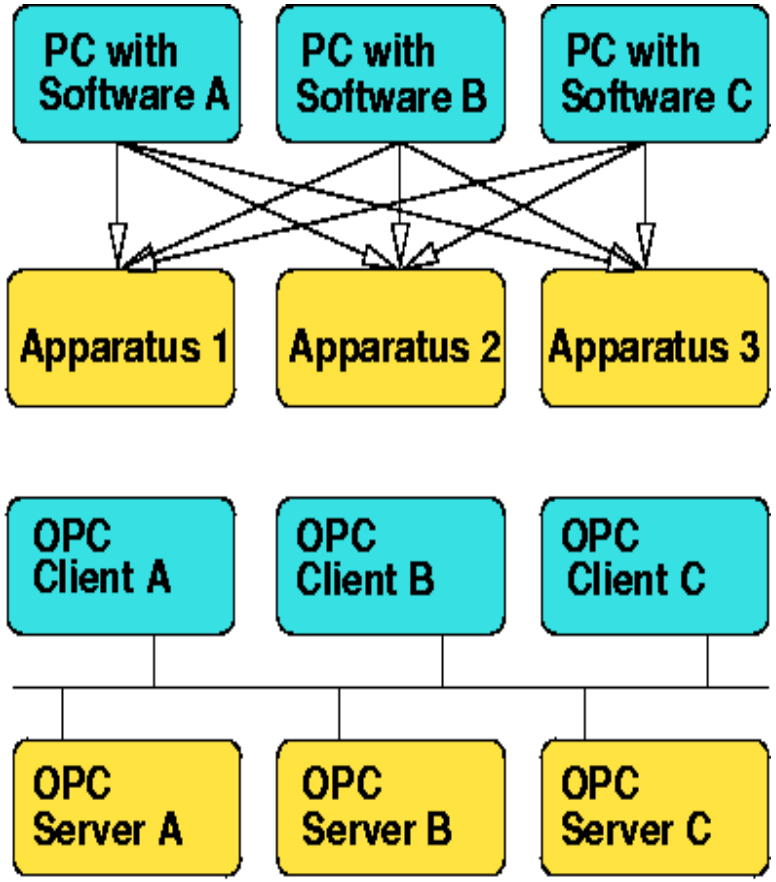
Datapoints



- Basic properties defined by the dp type
- Dp = logically related process variable
- Individual configuration attributes in dp
- configuration, reaction, GUI via scripts

OPC server

- Connection between PVSS and CAN nodes via OPC server
- OLE for Process Control
- Based on Microsoft object
- Model DCOM/ COM
- Industrial standard interface
- No specific driver for each client



Testbeam Setup

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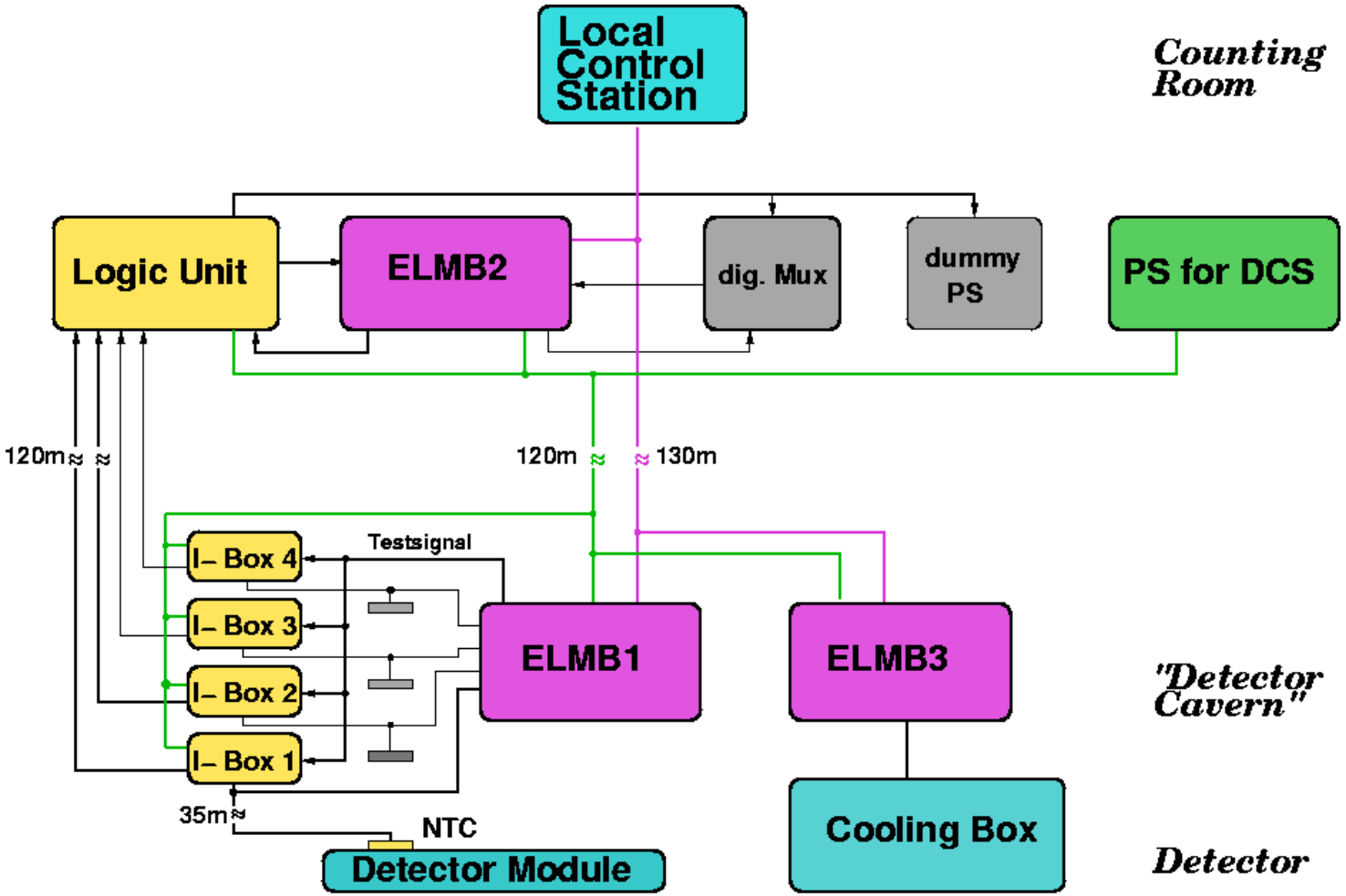
Aims and Questions

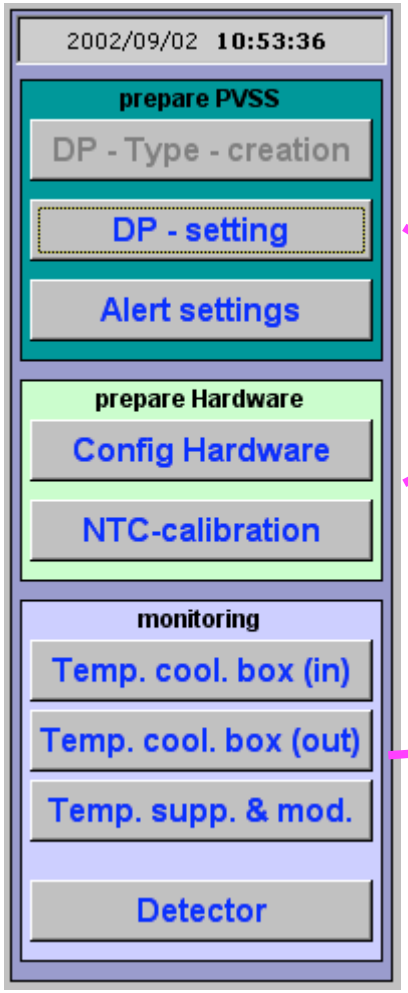
- Support shifter with information
- Experience with PVSS, are our needs covered by the program
- Temperature behaviour of detector module
- System test for thermal interlock system
- DCS and DAQ together

- Build a system which can be used for performance tests (operating parameters ..)
- Build a system which can easily be expanded
- create basis for hierarchical structure - BDU

Testbeam DCS Setup



PVSS Startpanel



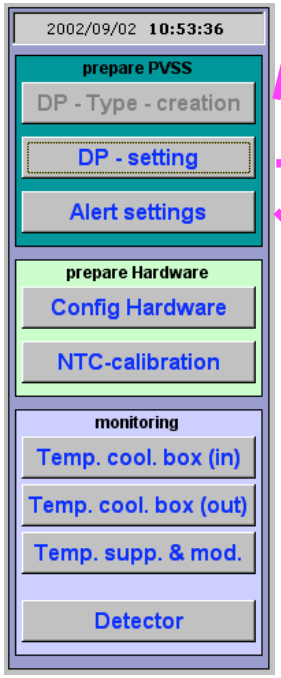
For DCS Operator

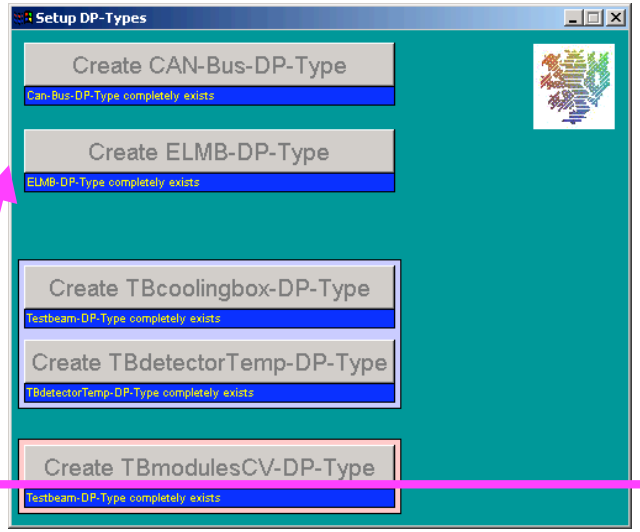
- apparatus oriented -

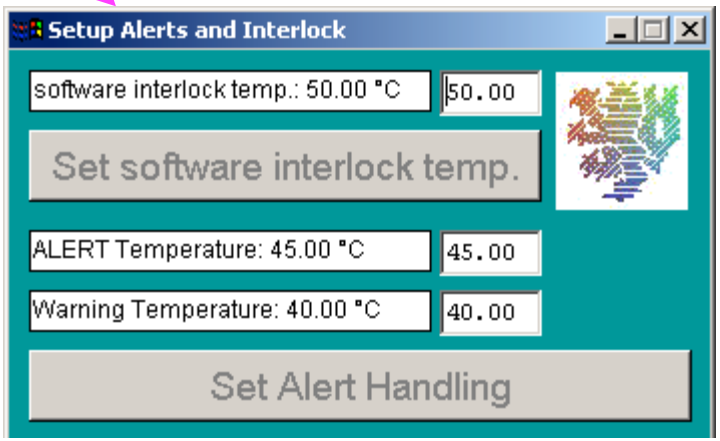
For Shifter

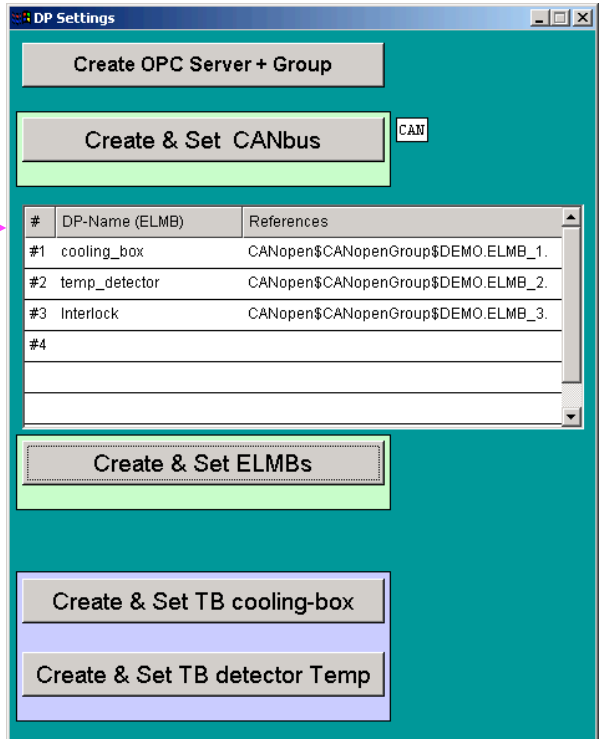
- geographical or application oriented -

Prepare PVSS









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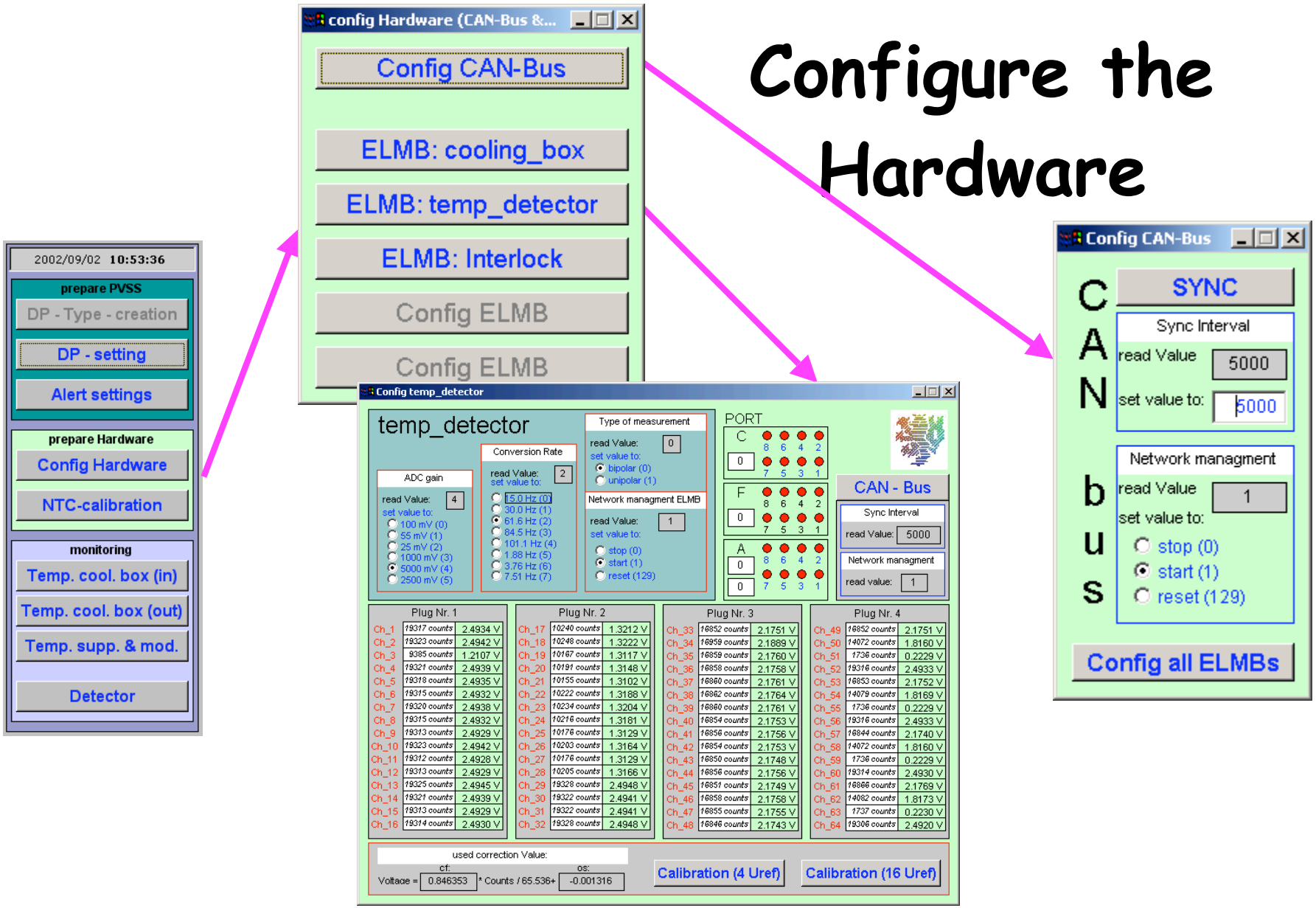
Configure the Hardware



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Operation Parameters for ADC and CAN-Bus

No operation close to the limits!

max. noise of ADC

→ Conversion rate:

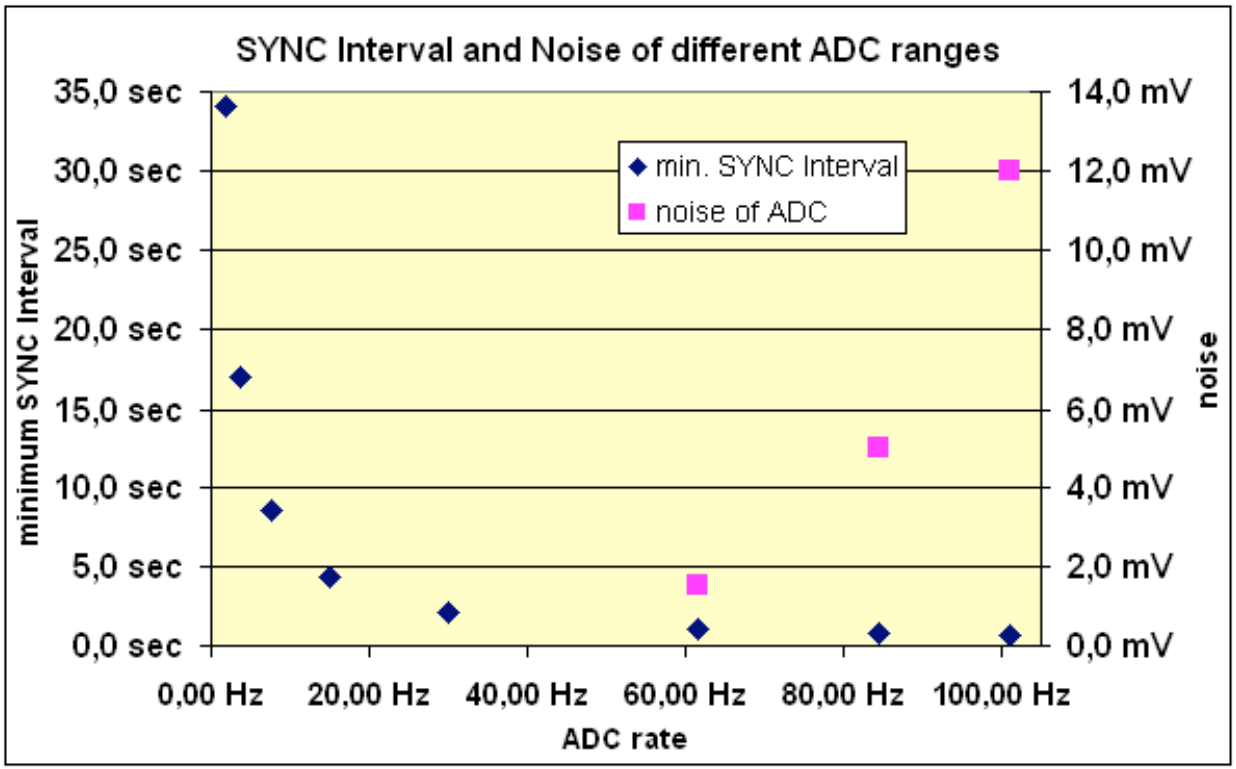
61.6 Hz

→ Synch Interval:

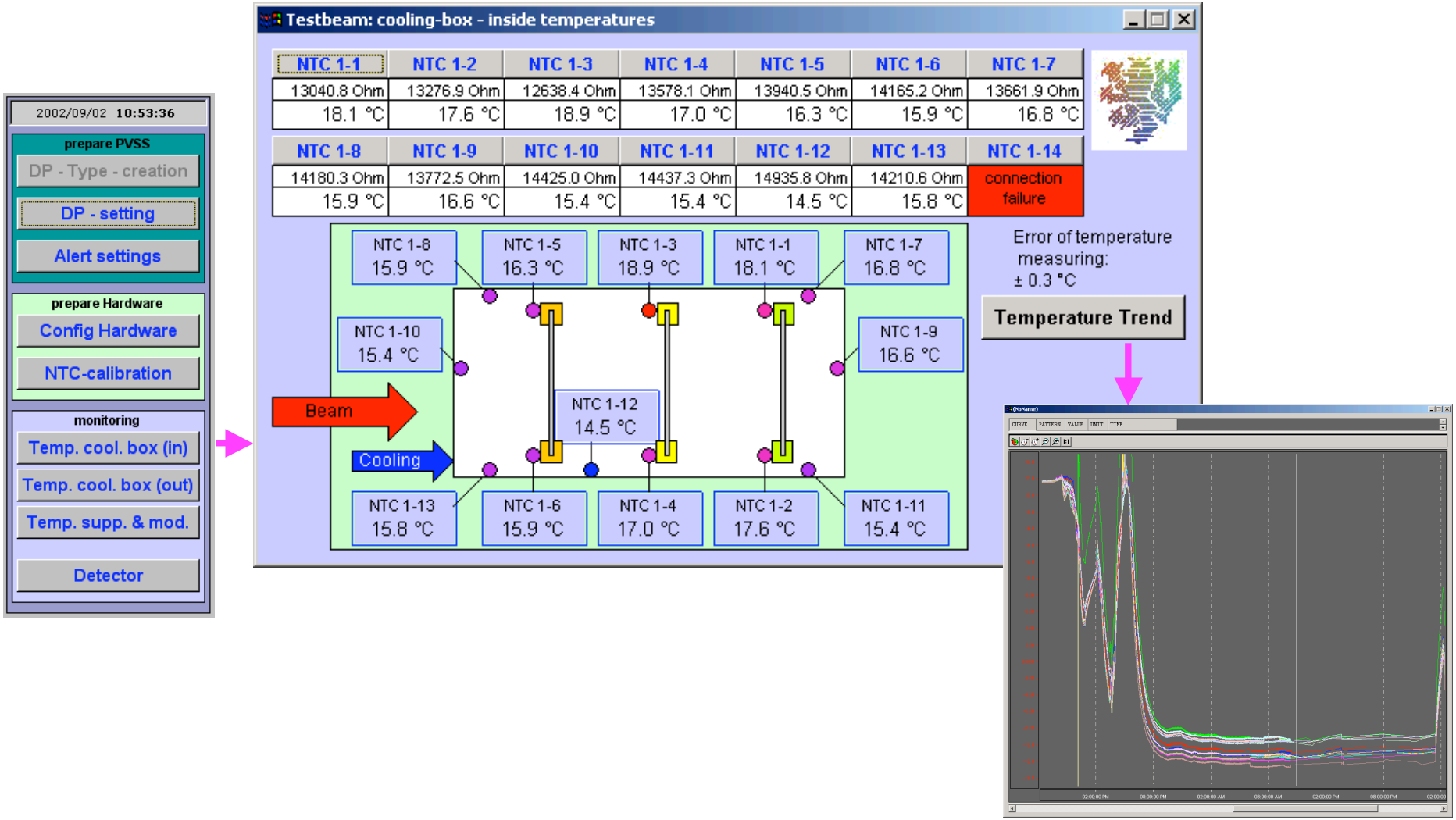
5 sec

→ Bus speed:

125 kBit/sec



Monitoring: Cooling Box



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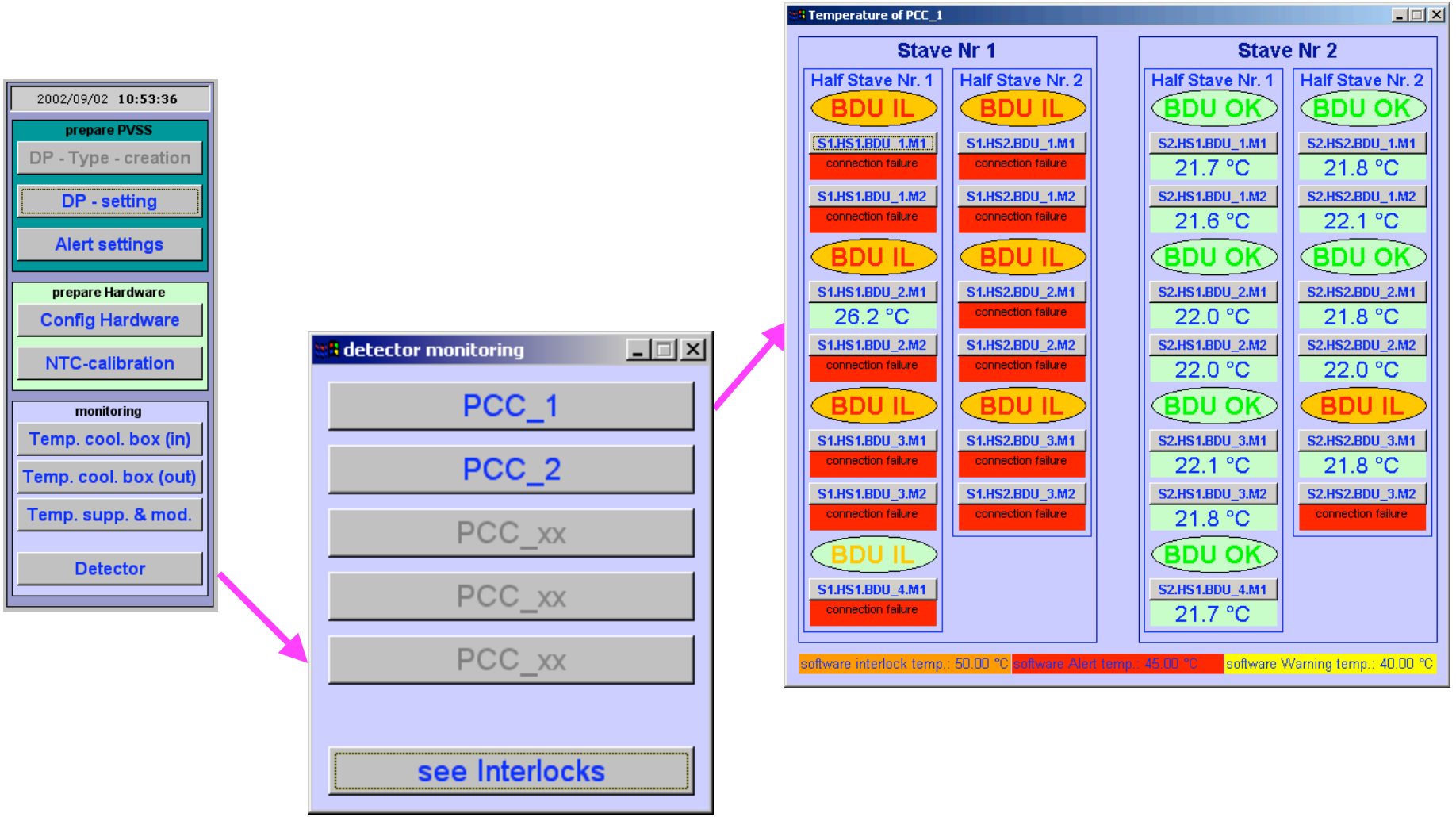
Monitoring: Base Detector Unit



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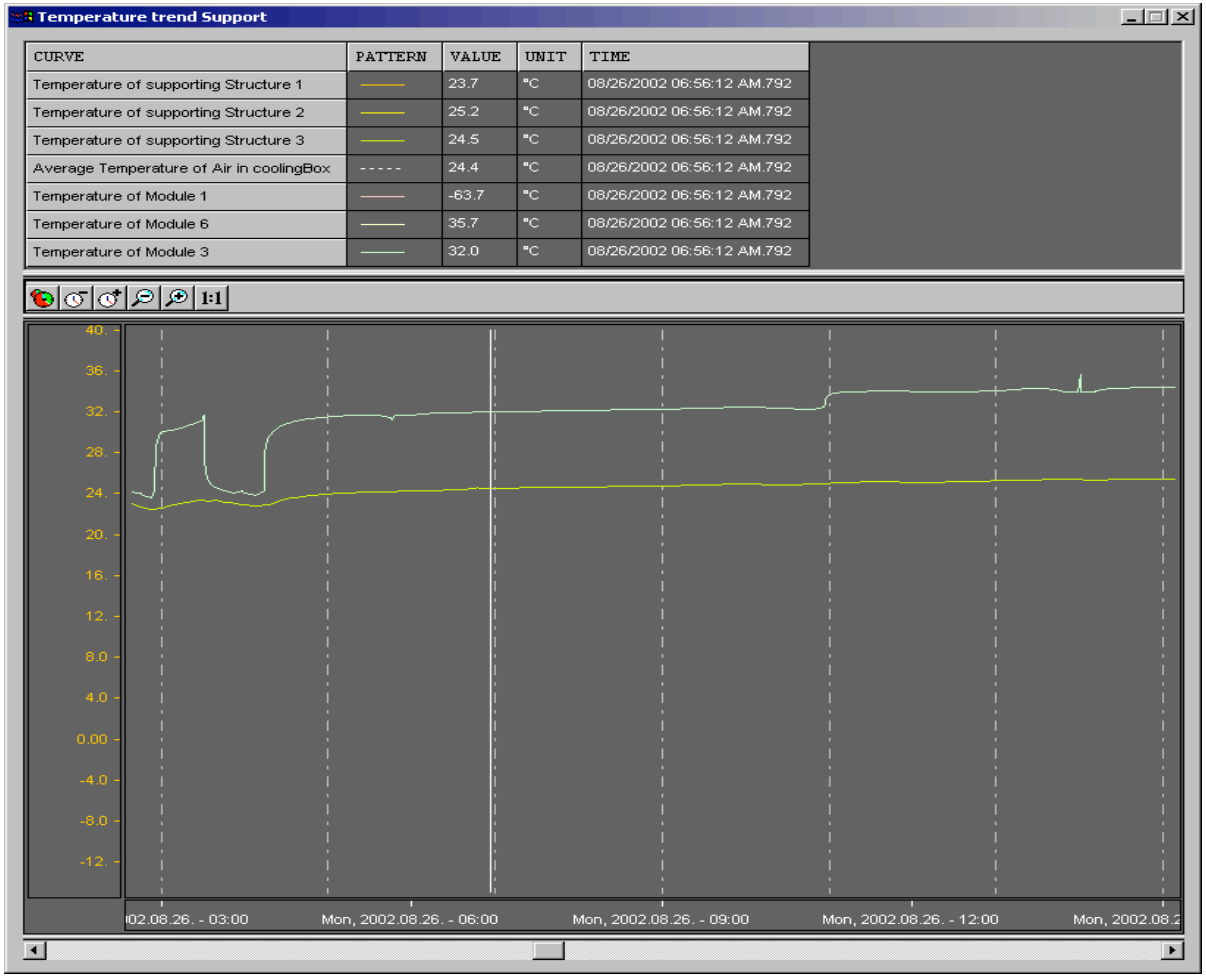
Temperature Behaviour of a Detector Module

@ Environ.Temp of 24 °C

□T □ 8 K

with an active front end electronics



Summary and Outlook

- Complete chain for thermal interlock system
- Long cable no problem, no cross talk DAQ – DCS

- PVSS covers our needs
- Vision manager instable
- trending pure → seperate tool for histograming

We now have a system

- for further DCS system studies (several CAN Busses, ...)
- where further quantities (LV, HV..) can easily be added
- which can be used for the control of larger detector parts