ATLAS
DCS

# ELMB Full Branch Test

## Outline

- DCS Architecture
- ELMB Full Branch Set-Up
  - Powering
  - I/O functionality
  - Bus Behavior
  - SW Architecture
- Test Procedure
- SCADA Panels
  - Run Control
  - Offline Analysis
- Findings
- *Conclusions**

*** Test currently ongoing. Results are not conclusive yet**

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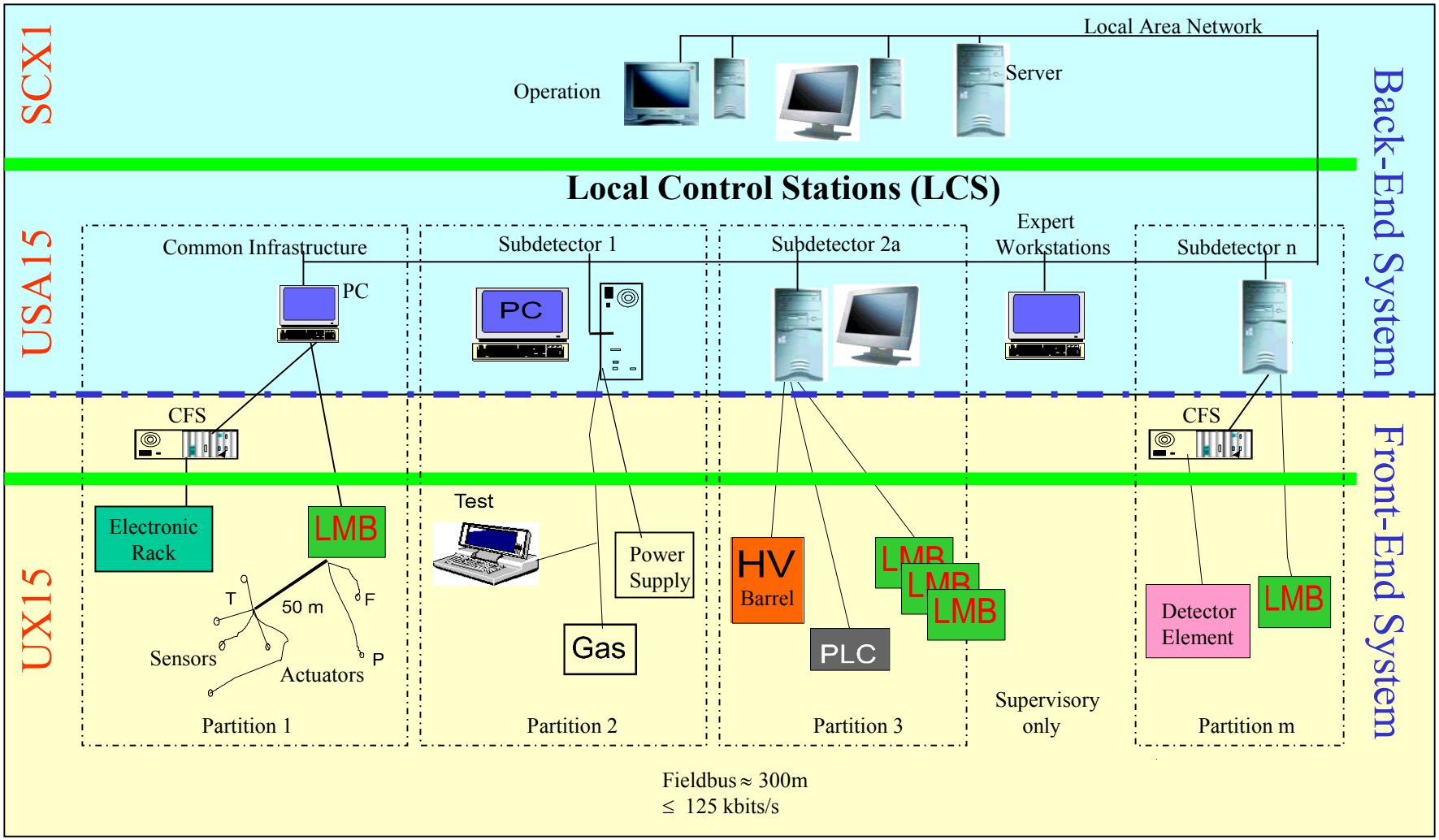
# Architecture of DCS



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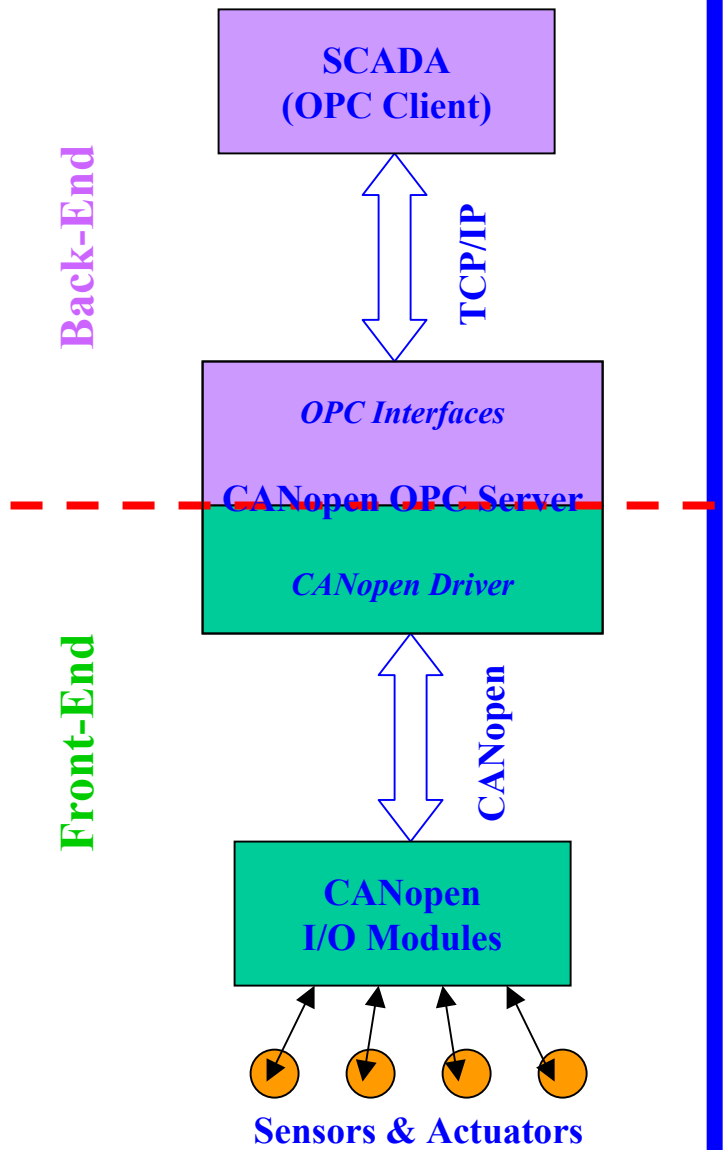
# Communication FE-BE: OPC

**1.- Dedicated drivers**

- HW and SW dependent
- Upgrade and Maintenance

**2.- OPC (OLE for Process Control)**

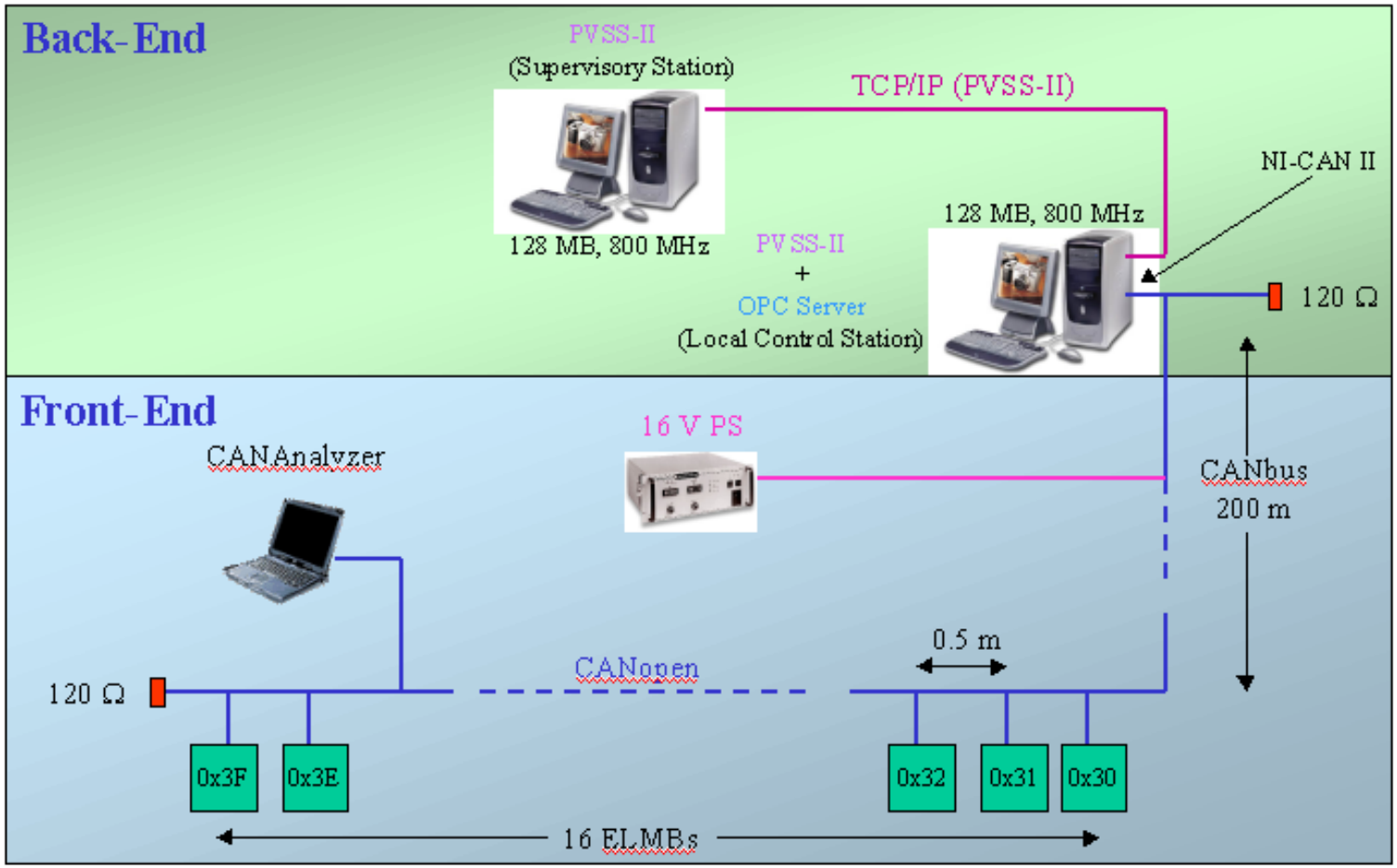
- What's OPC?
  - Set of interfaces designed to facilitate the integration of control equipment into Windows applications.
  - Middle-ware based on Microsoft DCOM technology
  - Multi-client / Multi-server architecture
- Why OPC?
  - Unique and standard mechanism to interface several data sources and software applications
  - SCADA-independent.
  - Almost all SCADA packages provided OPC Client functionality
  - Strong support from industry.
- Drawbacks
  - Only WNT/2000



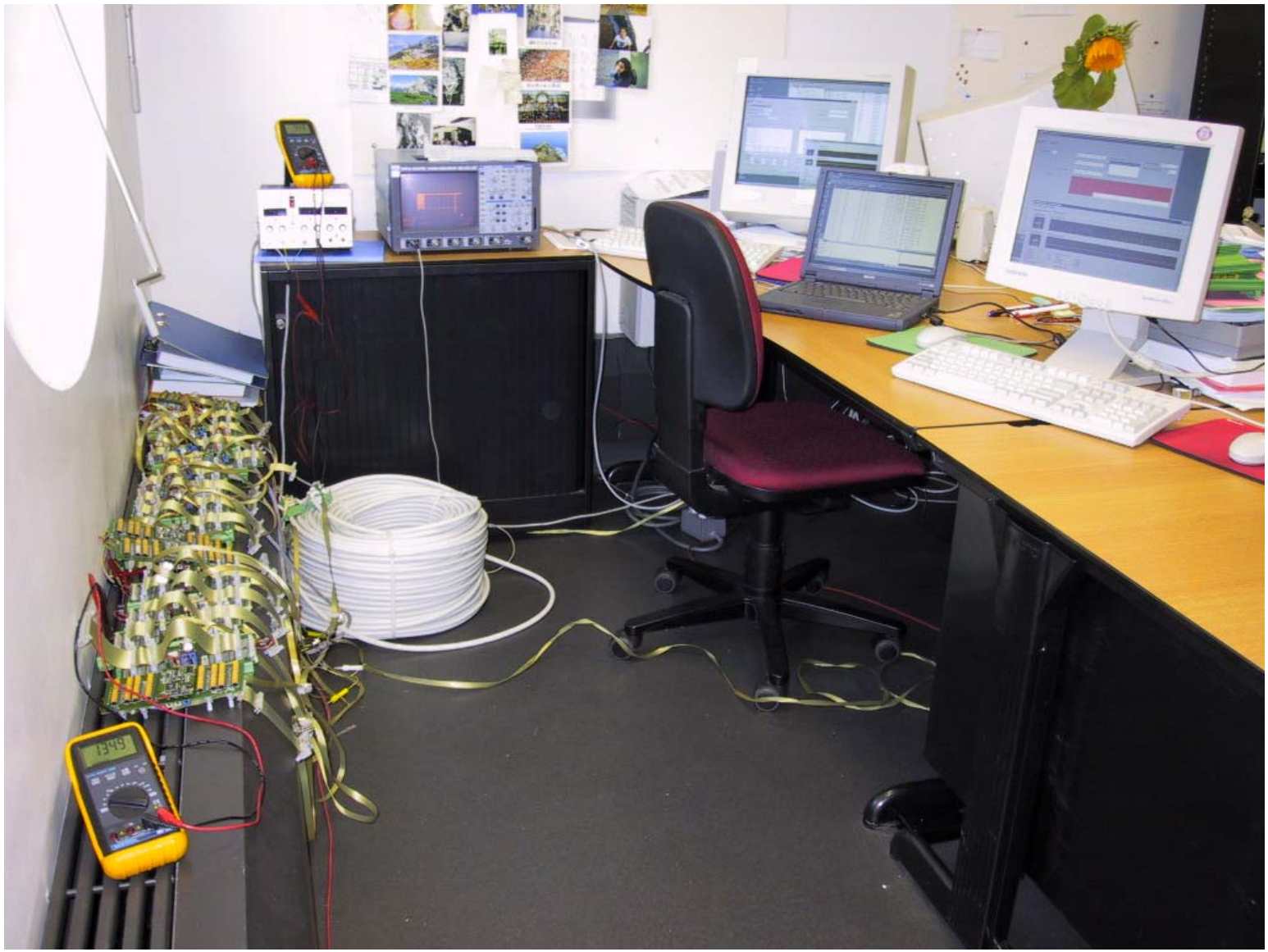
# ELMB Full Branch Test

**Aims:**

- **Powering**
- **Reliability**
  - **robustness**
  - **recovery procedures**
- **Performance**
  - **tuning of parameters**
  - **identifying bottlenecks**



# **ELMB** Full Branch Test



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# **ELMB** Full Branch Test

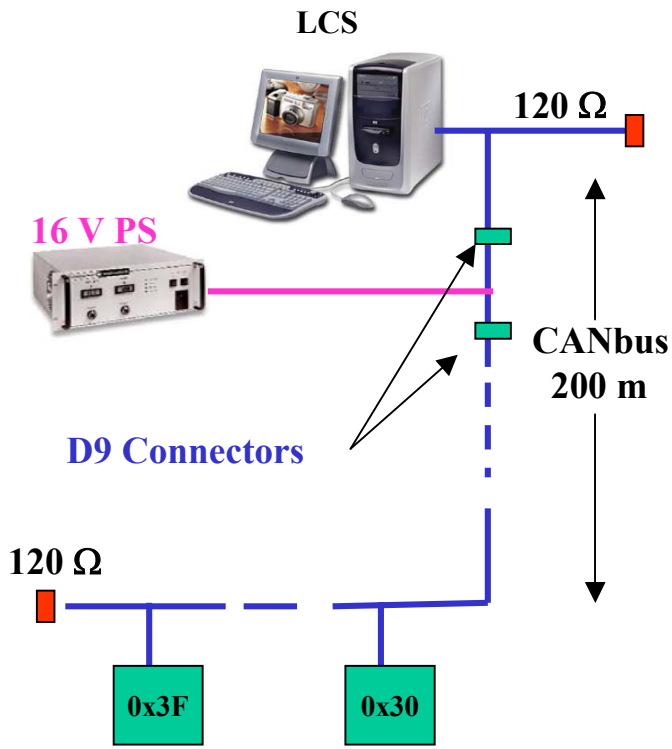
# Set Up

## Powering

- Only one PS used.
- Digital and CAN parts of the ELMB and NI-CAN card powered via the bus.
- Analogue part powered from the digital (Power monitored by a scope).
- Bus and Interface card power lines were de-coupled (Allows for independent reset of both elements).

## I/O Functionality

- 16 x 8 = 128 digital input lines (Sync + Async), 16 x 2 x 8 = 256 digital output lines (Async)
- Input and output lines interconnected
- 16 x 64 = 1024 Analogue channels (Sync)
- ELMBs reprogrammed to bypass filtering in OPC server and ensure maximum data volume transfer to PVSS-II (Worst possible case)

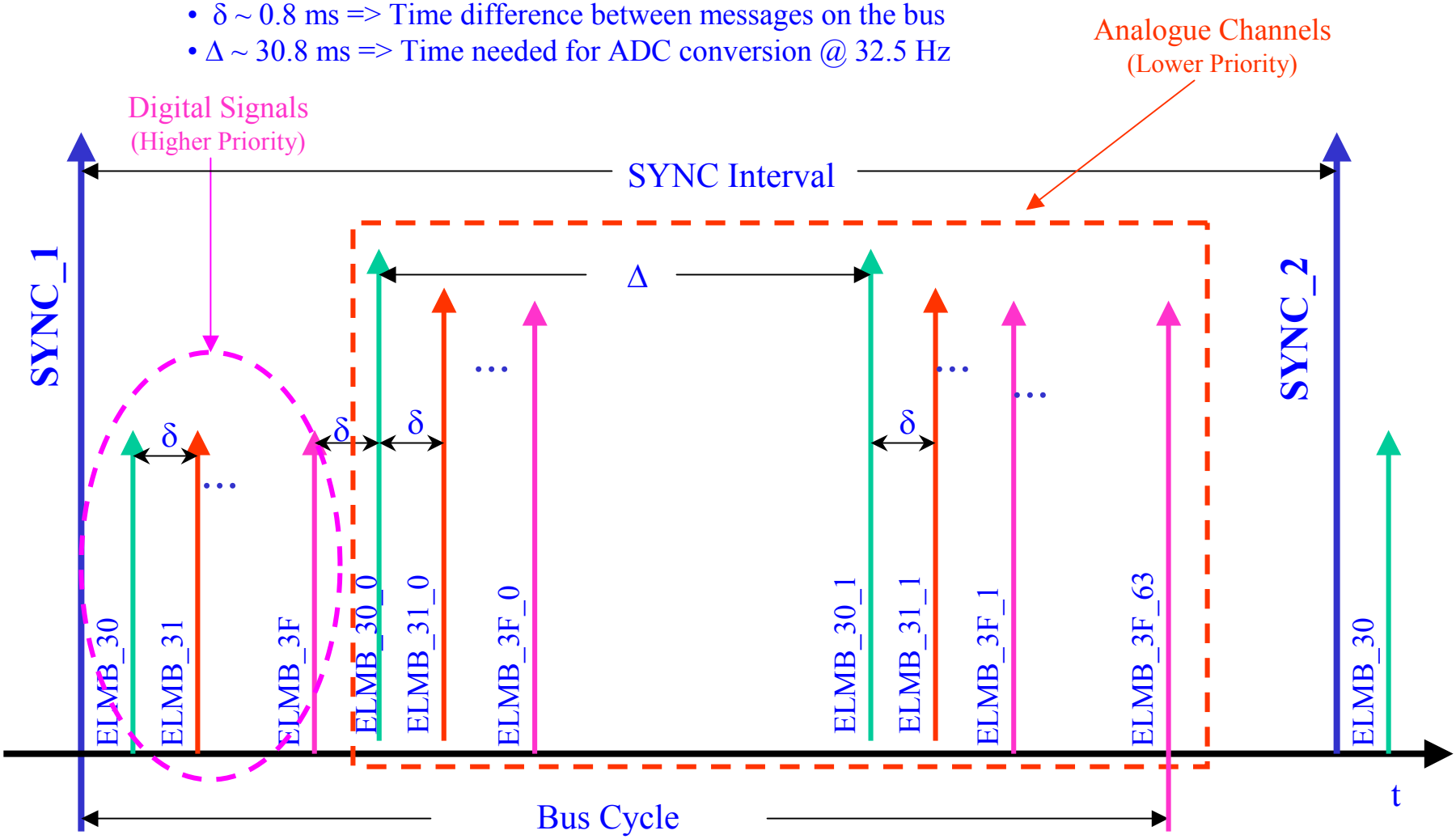


# CANbus Activity, synchronous read

Example

If $\nu_{adc}$ = 32.5 Hz and Bus Speed = 125 kbit/s

- $\delta \sim 0.8$ ms => Time difference between messages on the bus
- $\Delta \sim 30.8$ ms => Time needed for ADC conversion @ 32.5 Hz



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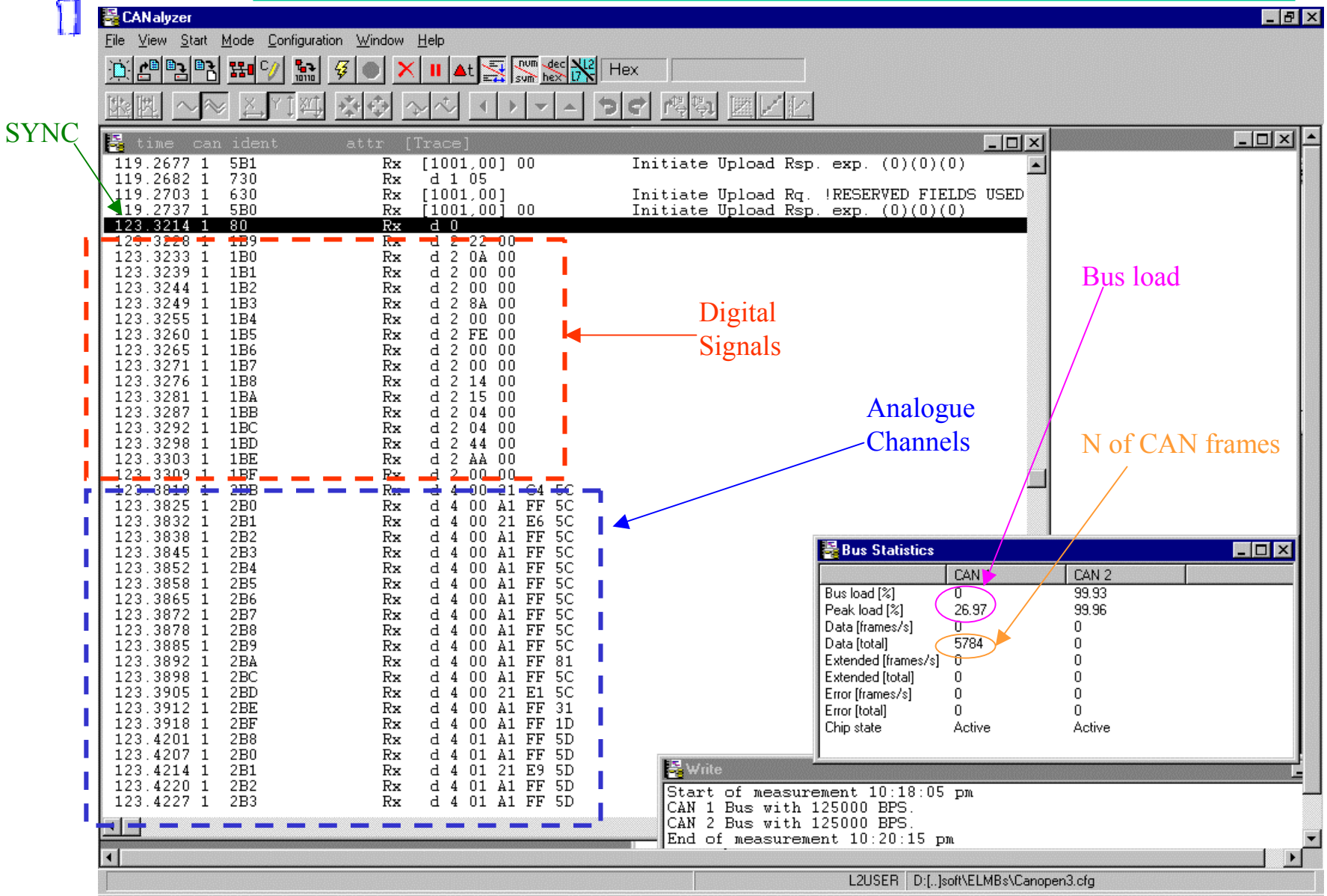
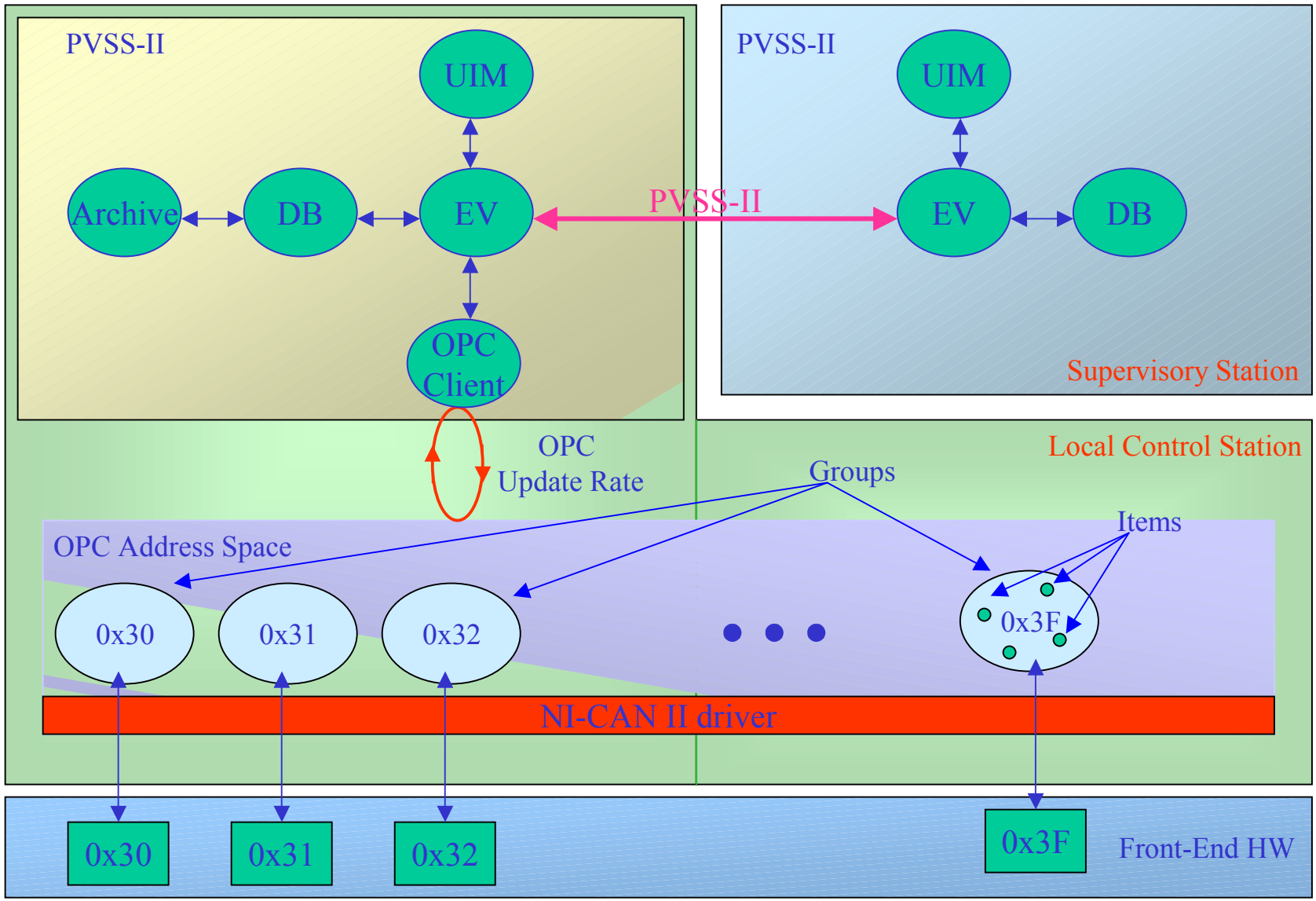
# CAN Analyzer Diagnostic Tool

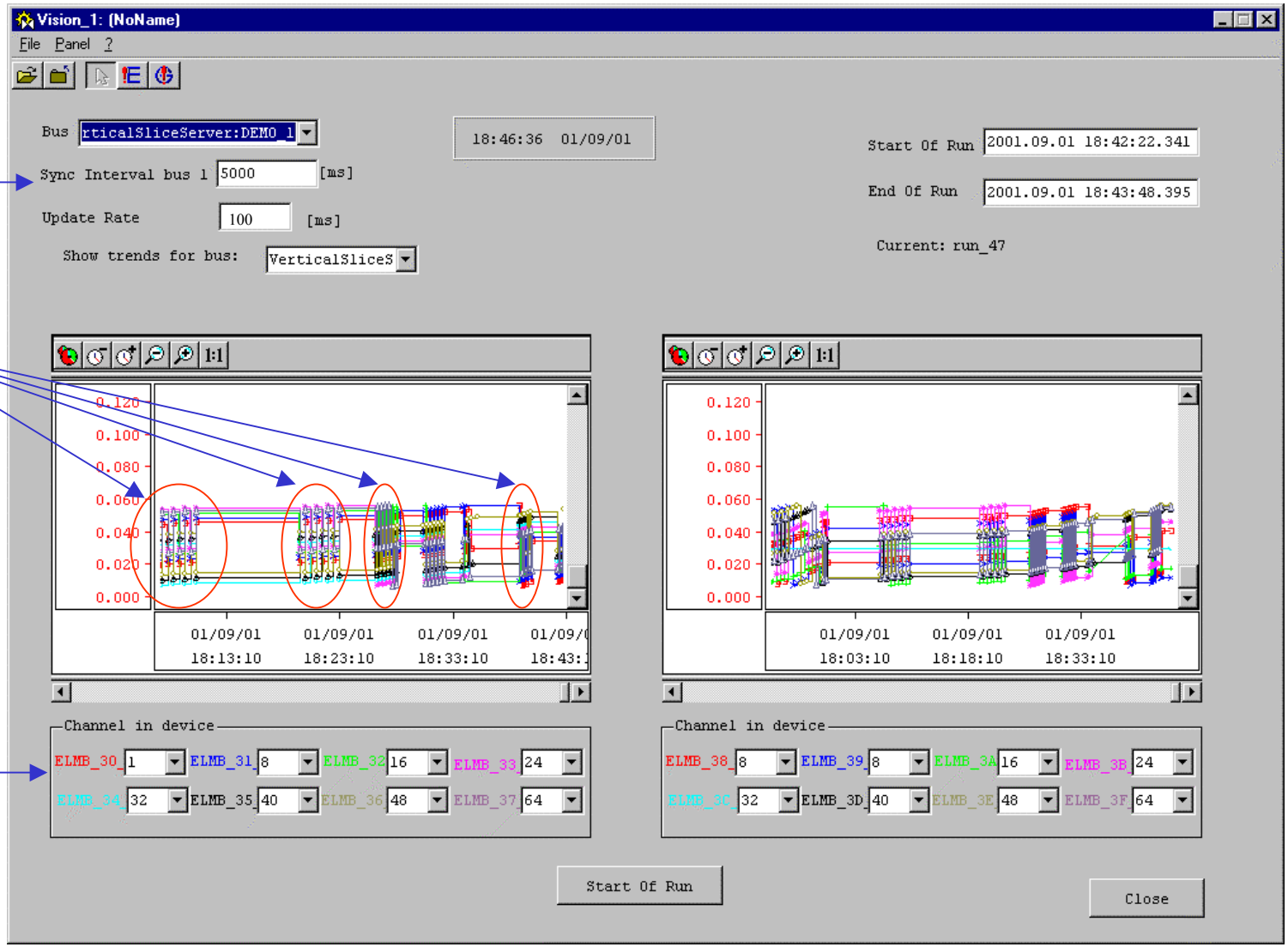


# SW Architecture



# SCADA Supervisor SW

Run Control



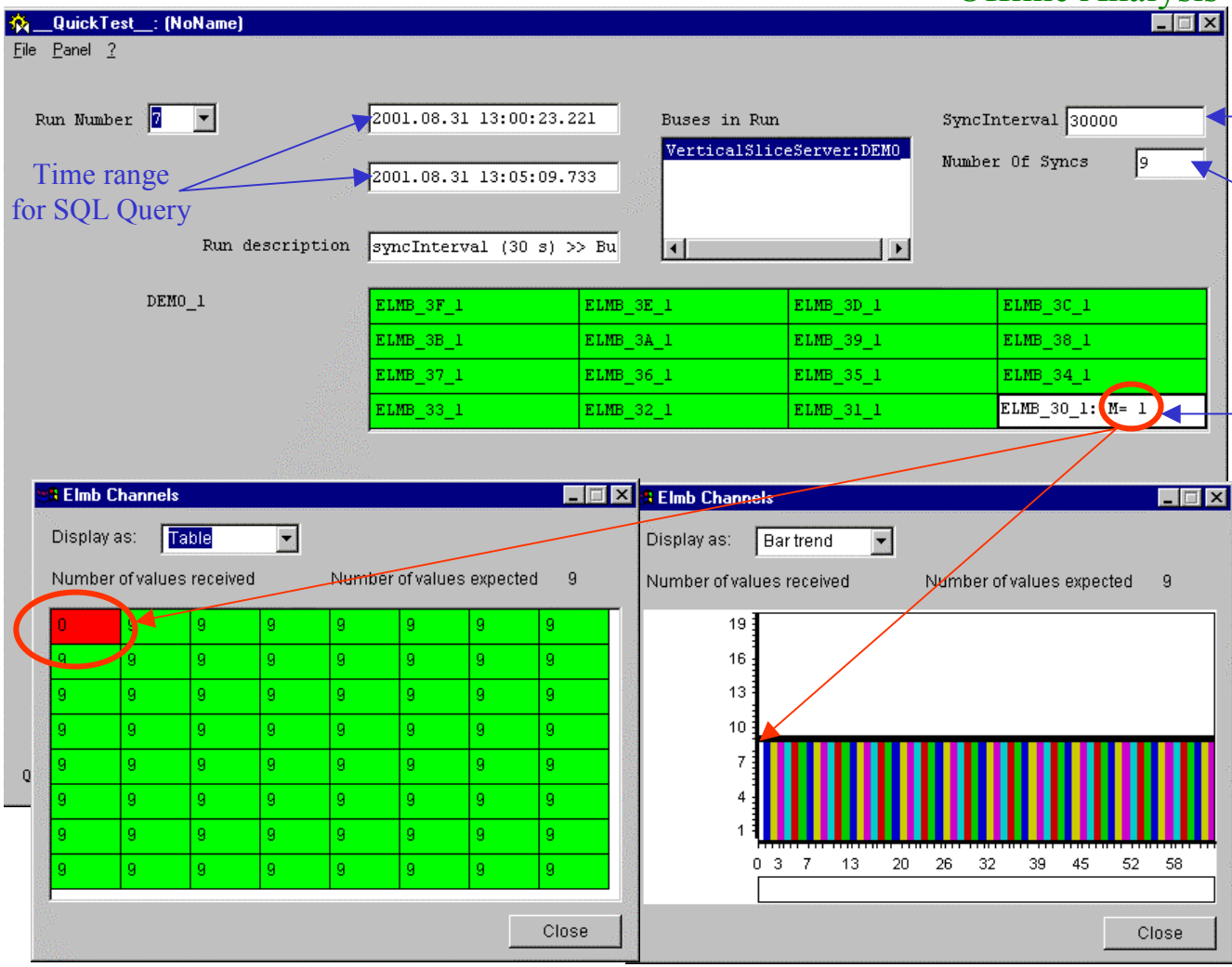

Readout rate for current run

History of Runs at different rates

ELMB Channel displayed

# SCADA Monitor SW

Offline Analysis



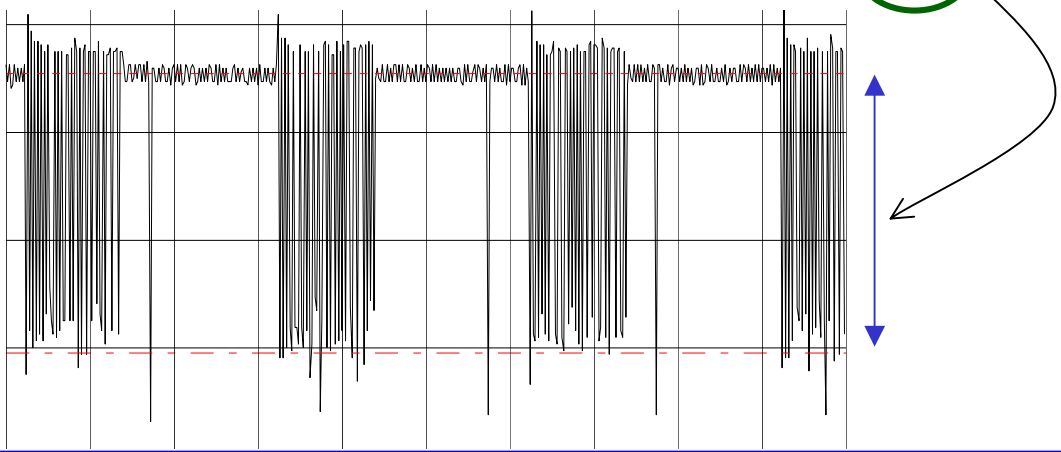
# Findings

## Powering

Problem: Working at $V_{PS\_ANALOGUE}$ = 9 V some ELMBs do not reply to a SYNC (Analyzer files)

Reason: Voltage level of the ADC is too low (< 4.5 V)

| Cable Resistance | 37.5 Ohm / Km | 7.5 Ohm in 200m | | | |
|---|---|---|---|---|---|
| | | | | Voltages | |
| Currents (mA) | | | | VPS_CAN (V) | 16 |
| CAN | 16x20 | 320 | | Velmb_16_CAN (V) | 11.05 |
| ADC | 16x10 | 160 | | VPS_Dig+Ana (V) | 16 |
| CAN | 16x15 | 240 | | Velmb_16_Dig+Ana (V) | 8.26 |
| | | | | | |
| Grounding | | | | | |
| Drop G_CAN (V) | 2.63 | | | Drop DP+AP (V) | 3.88 |
| Drop P_CAN (V) | 2.31 | | | Drop DG+AG (V) | 3.88 |
| Difference (V) | 0.32 | | | Difference (V) | 0 |
| | | | | | |
| Digital + Analogue Voltage drop during ADC activity (V) | | | | | 1.44 |



# Findings

**Parameters:**

- Loop time (Sync interval)
- OPC update rate
- ADC frequency

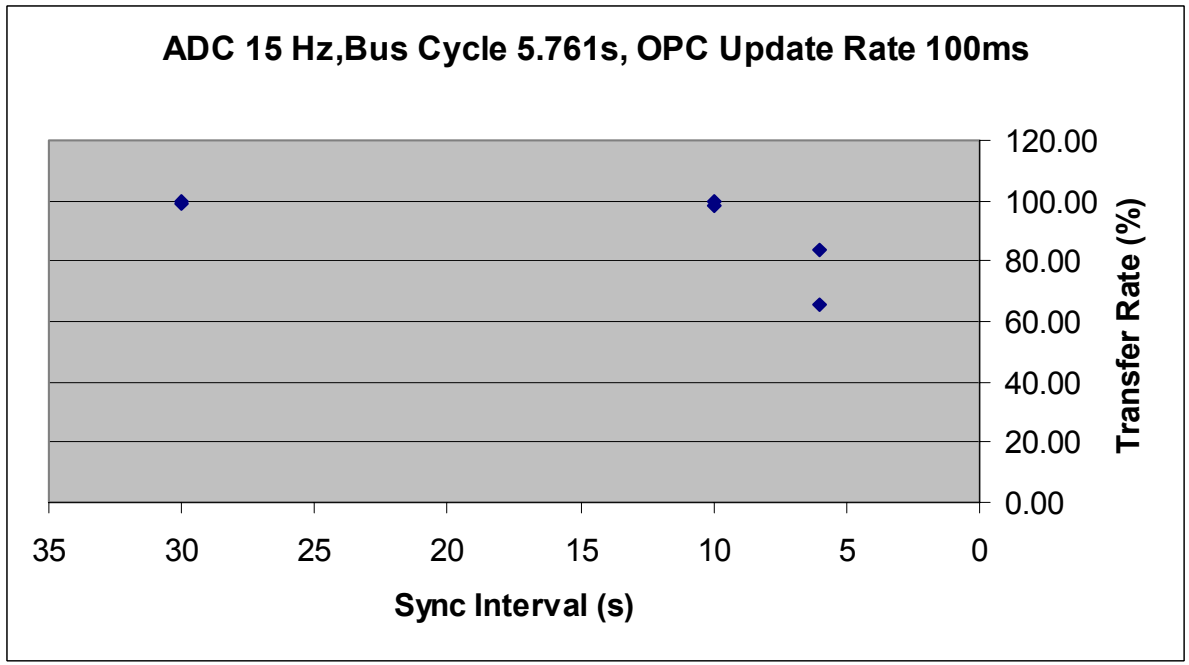
| Sync Interval (s) | OPC Update Rate (ms) | Bus Load (Peak in %) | N. of Syncs | Entries in DB | Expected | Transfer Rate (%) |
|---|---|---|---|---|---|---|
| 30 | 100 | 11.43 | 5 | 5120 | 5120 | 100 |
| 30 | 100 | 11.49 | 6 | 6144 | 6144 | 100 |
| 15 | 100 | 11.75 | 7 | 7168 | 7168 | 100 |
| 15 | 100 | 11.73 | 8 | 8192 | 8192 | 100 |
| 10.5 | 100 | 11.74 | 8 | 8128 | 8192 | 99.22 |
| 10.5 | 100 | 11.48 | 6 | 6144 | 6144 | 100 |
| 10.5 | 100 | 11.03 | 10 | 10240 | 10240 | 100 |
| 10.5 | 100 | 11.56 | 9 | 9126 | 9126 | 100 |

**Table 3, ADC conversion rate 7.51 Hz, Bus cycle 10.019 s.**

| Sync Interval (s) | OPC Update Rate (ms) | Bus Load (Peak in %) | N. of Syncs | Entries in DB | Expected | Transfer Rate (%) |
|---|---|---|---|---|---|---|
| 60 | 30000 | 6.77 | 4 | 4096 | 4096 | 100 |
| 60 | 30000 | 6.63 | 4 | 4068 | 4096 | 99.32 |
| 40 | 30000 | 6.55 | 3 | 3072 | 3072 | 100 |
| 40 | 30000 | 6.55 | 4 | 4096 | 4096 | 100 |
| 36 | 30000 | 6.56 | 5 | 5120 | 5120 | 100 |
| 36 | 30000 | 6.48 | 3 | 3072 | 3072 | 100 |

**Table 3, ADC conversion rate 1.88 Hz, Bus cycle 35.571 s.**

# Findings



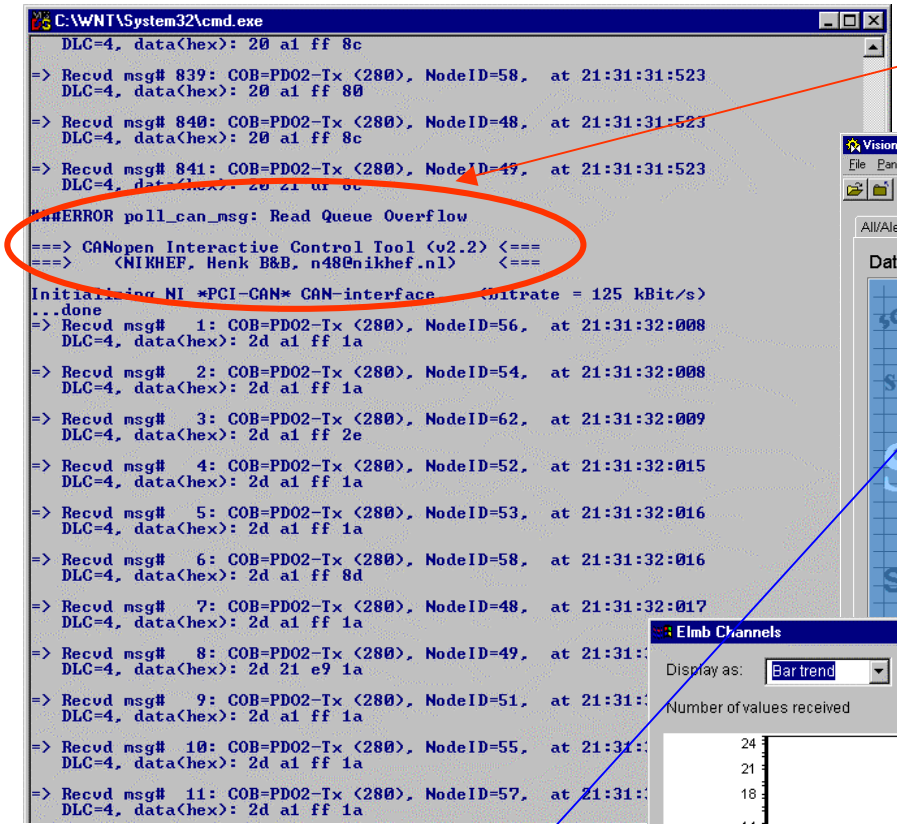

**Data get lost at higher data rates when SYNC Interval -> bus cycle**

**Bottlenecks:**

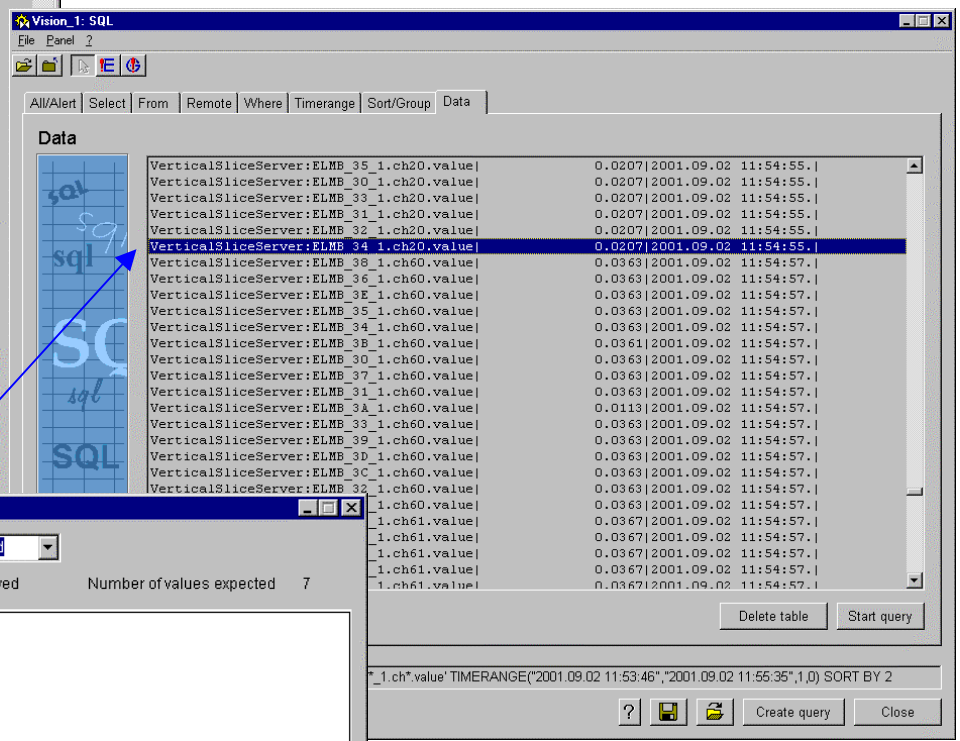
- **NI CAN interface card (buffer overflow) ??? => Need for a new interface (cost and characteristics).**
- **PVSS archiving (CPU consumption) => Better distribution of the tasks performed by SCADA.**

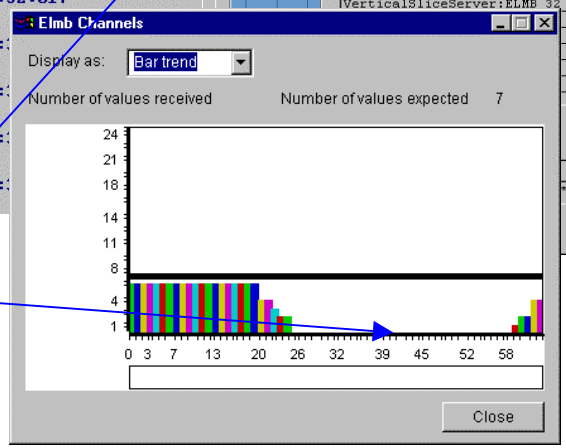
# ELMB Full Branch Test: Example of Overflow

$\nu_{adc}$ = 32.5 Hz




Overflow in read buffer of the NI-CAN II interface




Hole in DataBase

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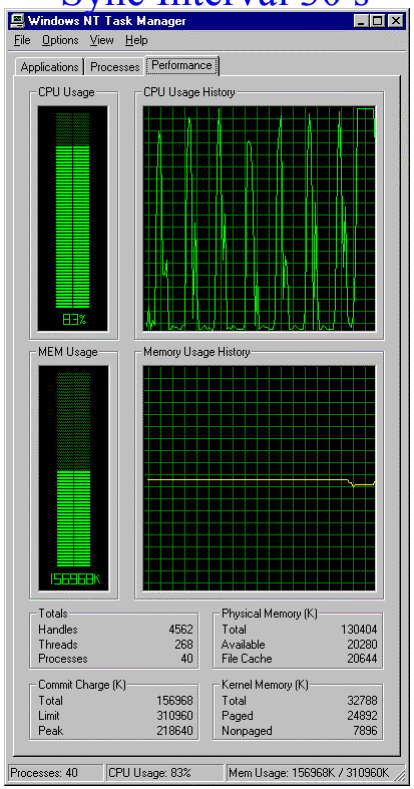
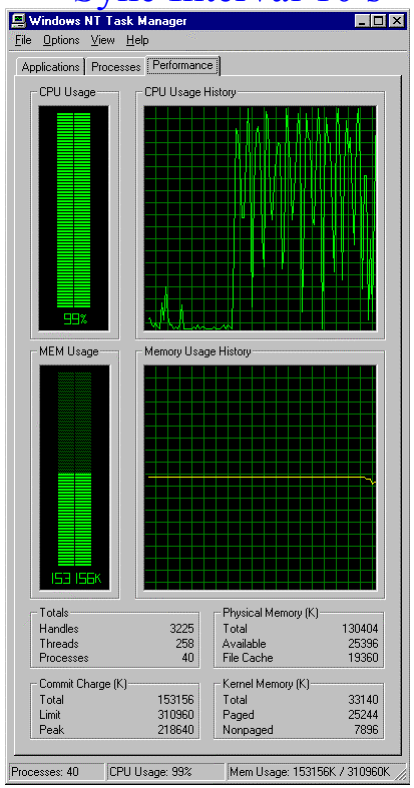
# CPU Behavior

## ADC Conversion Rate 32.5 Hz

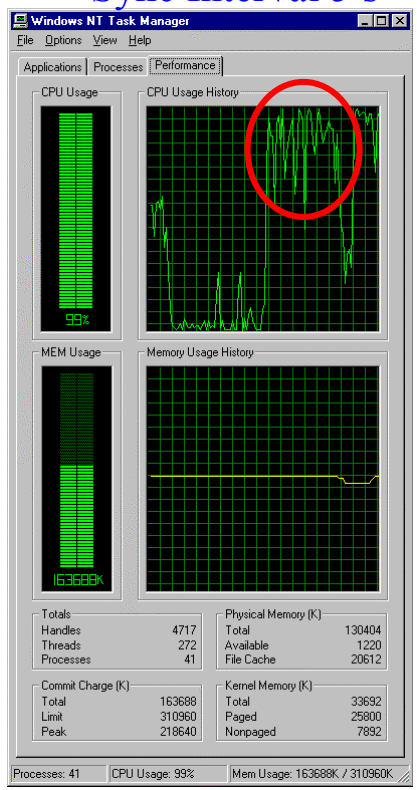
### Sync Interval 30 s



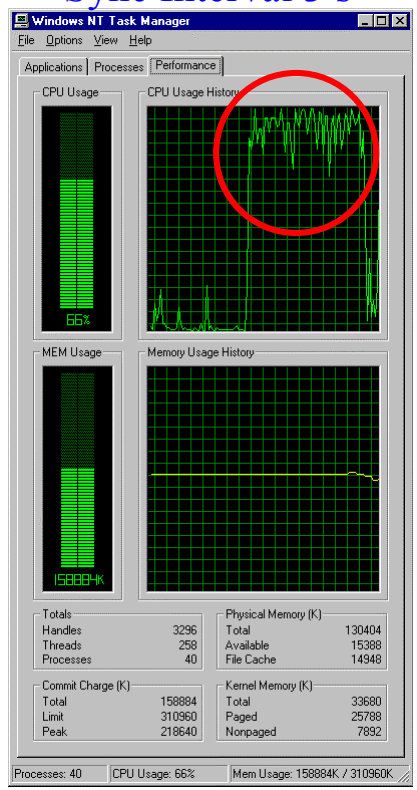

### Sync Interval 10 s




### Sync Interval 5 s




### Sync Interval 3 s




Most of the CPU time is consumed by the PVSS archiving manager.
OPC takes about 60 % during the avalanche of analogue channels.

# Conclusions

- Full ELMB Branch successfully operated.
- I/O channels of the order of magnitude of some subdetectors in ATLAS
- Preliminary studies of the powering has been carried out.
- The test tried to reproduce the "worst possible case" => All ELMBs transmitting at the same time.
- The system has shown excellent performance for $\nu_{adc} < 15.1$ Hz :Transfer rate of 100% for
  - messages on the bus different priorities on the bus
  - and different transmission types.
- Several issues were identified at higher $\nu_{adcw}$ when SYNC $\rightarrow$ Bus Cycle
  - Overflows in the read buffer of the NI-CAN interface
  - High CPU consumption by the PVSS archiving manager

    => Input for new tests with a better design -> Results can be improved!!!

Final results of this test, together with the obtained in radiation tests, will define the bus behavior, CANopen network topology in ATLAS and the distribution of tasks between the different elements of the Vertical Slice.