



# LP-TPC DAQ ans SlowControl

IIHE (Brussels University), CERN, Lund University,  
Bonn University, CEA Saclay, DESY

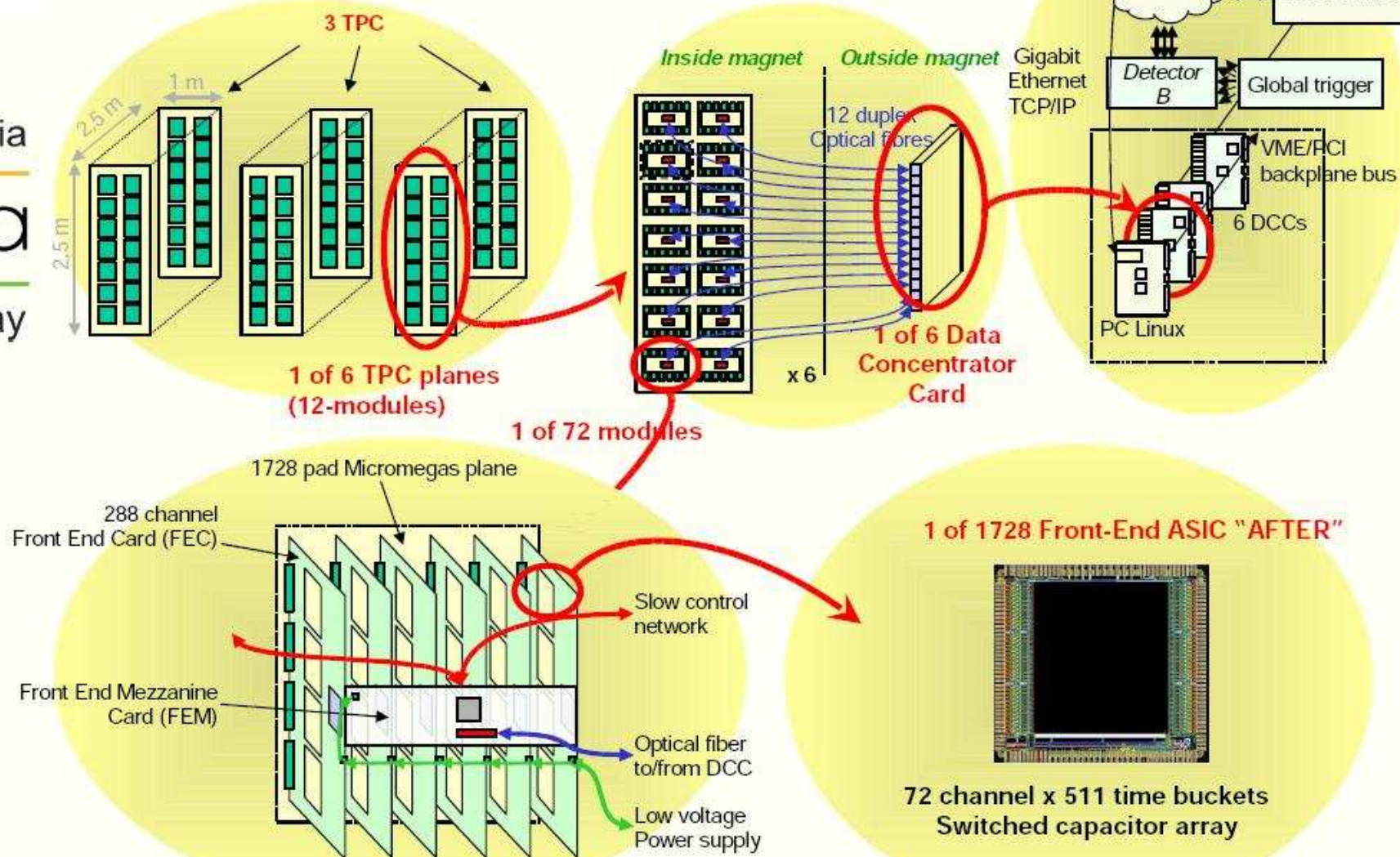
3<sup>rd</sup> EUDET Meeting, NIKHEF, Amsterdam, 6th-8th Oct., 2008

# AFTER r/o: T2K TPC Electronic (CEA-Saclay)



## Read-out Architecture

dapnia  
cea  
saclay

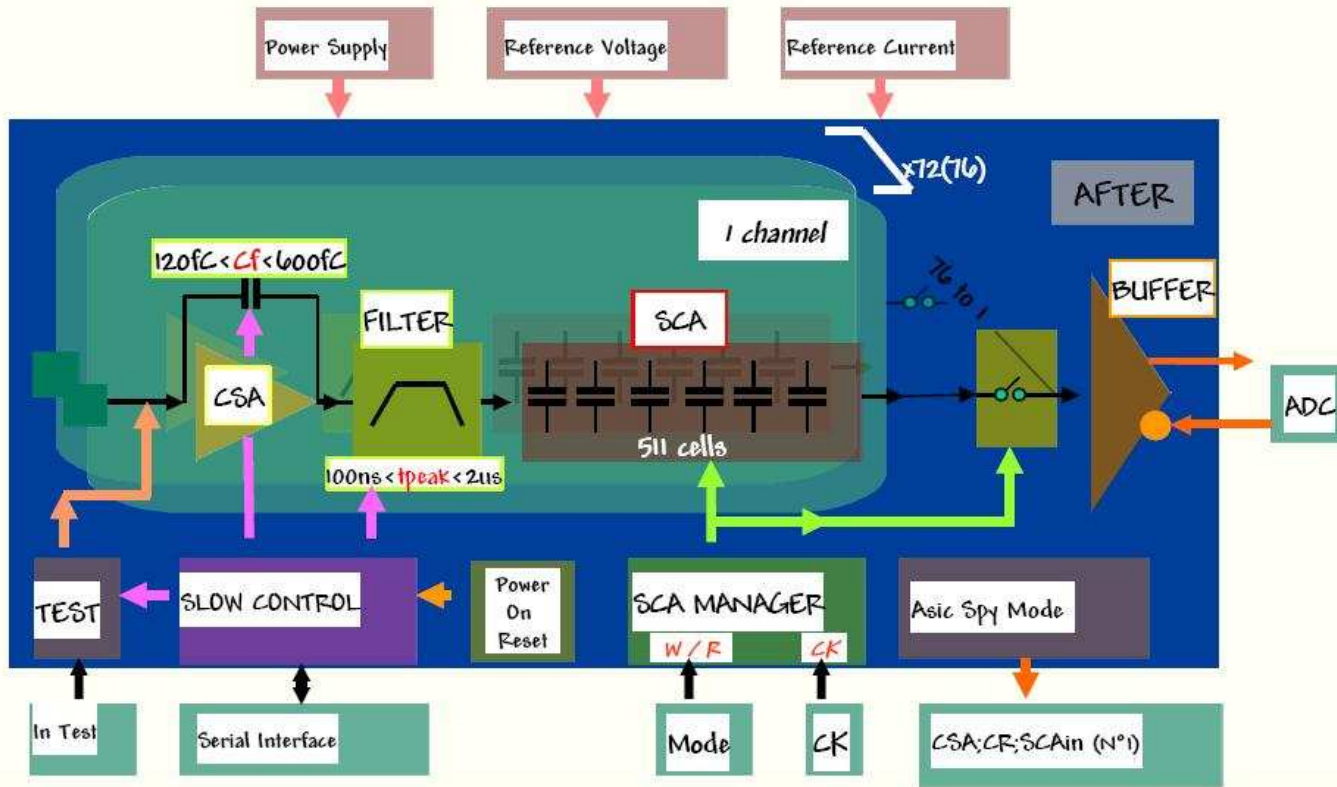


calvet@hep.saclay.cea.fr

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KEK, 18-21 April 2007

# AFTER r/o: T2K TPC Electronic (CEA-Saclay)



## AFTER ASICS:

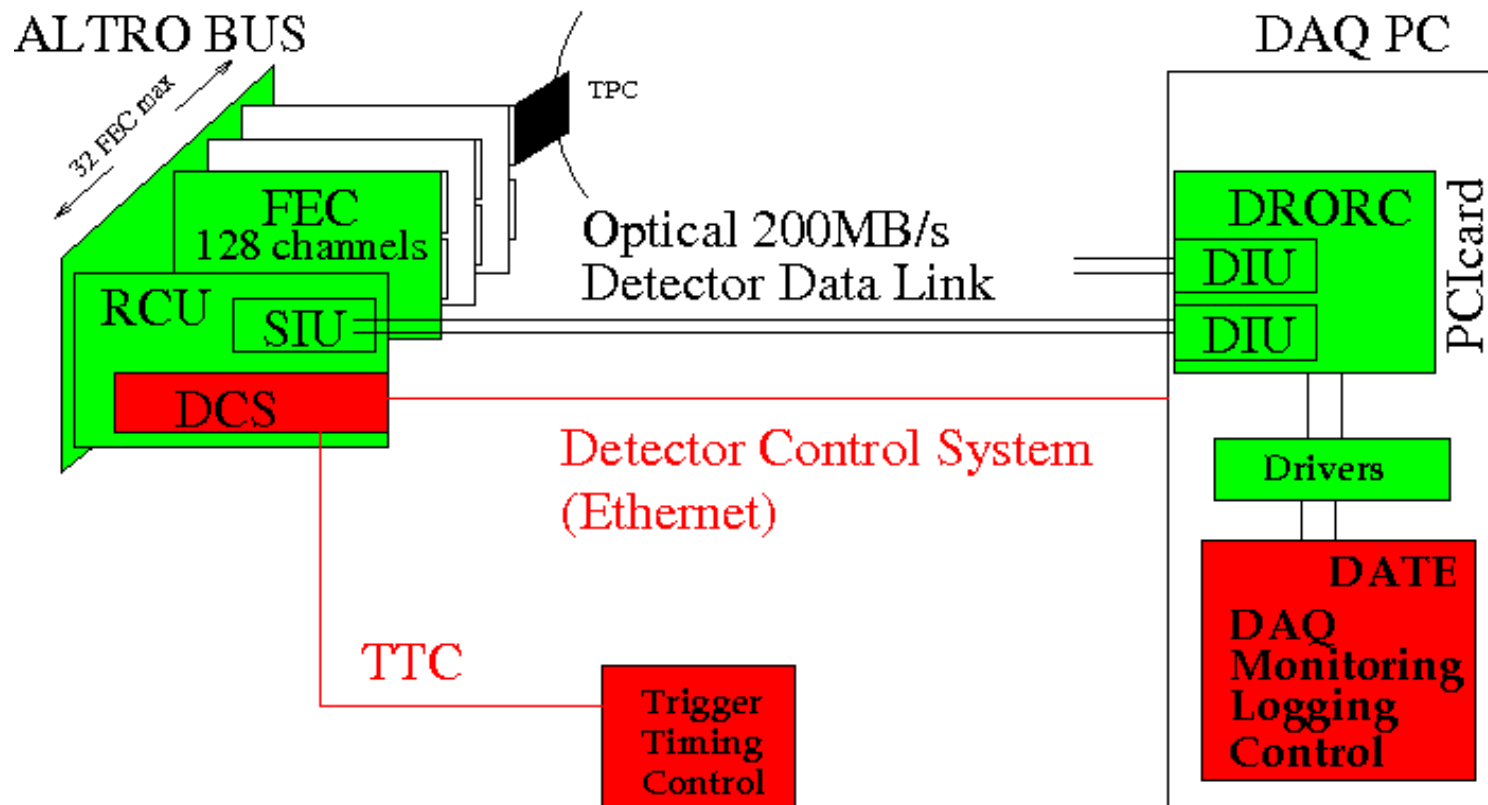
- 72 Analog channels
- 2 input polarities
- 4 gains: 120, 240, 360 and 600 fC
- 16 peaking times: from 100 ns to 2 ps
- 511 analog memory cells / channel



- Analog pipe-line + offline ADC/zero-suppress
- 1 crate tested for LCTPC (1738 channels)
- Mechanic support and shielding builded
  - Tested and delivered to site (DESY)
  - Will be used with Micromegas panels first (week 45 if fieldcage ready)

# ALTRO r/o: ALICE TPC r/o overview

Original ALICE design:

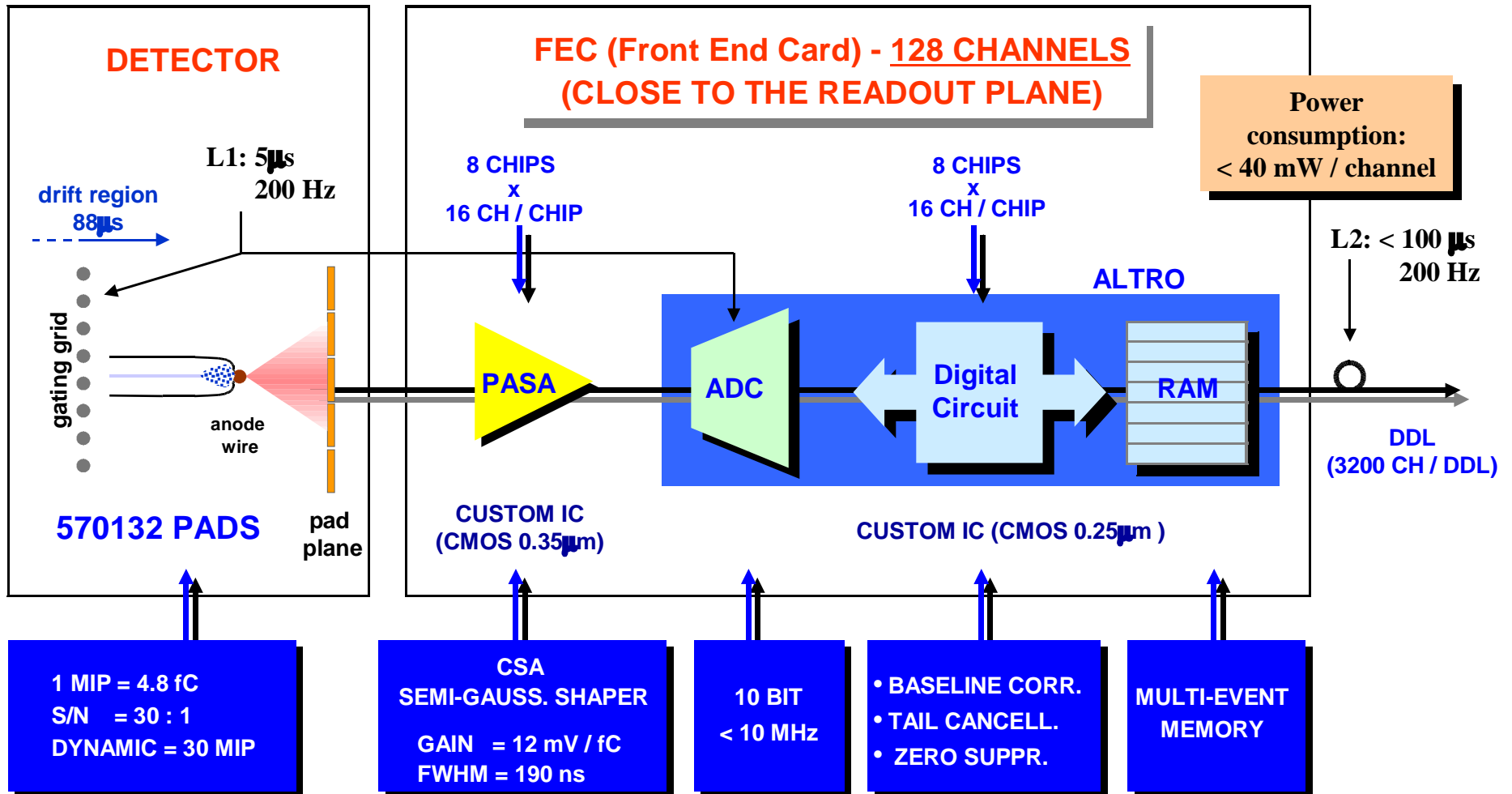


Will not be used for LC-TPC:

- TTC: LHC specific trigger electronics
- DATE r/o software (beyond drivers level)
- DCS

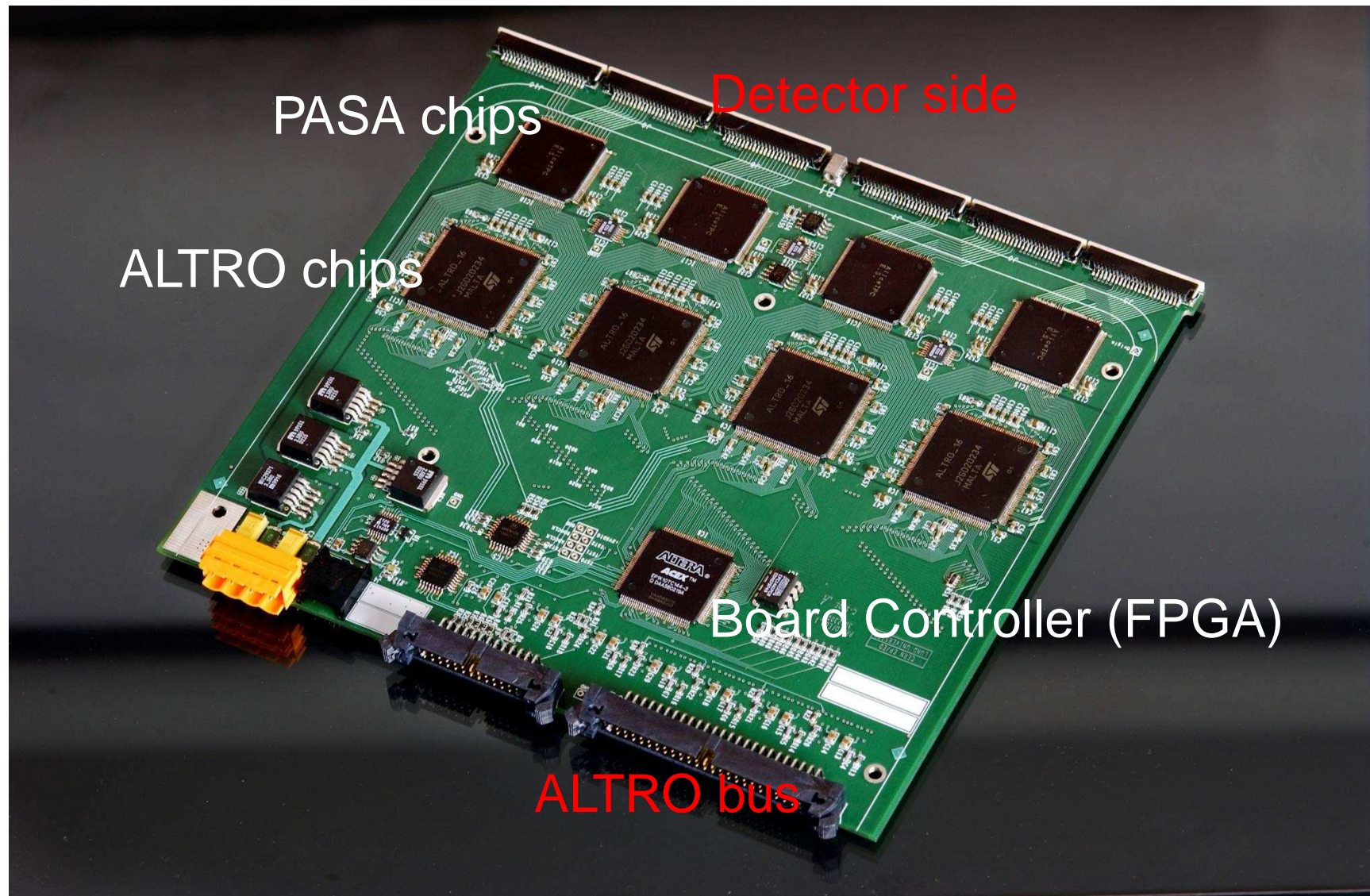


# ALTRO r/o: ALICE Front End Card (1)



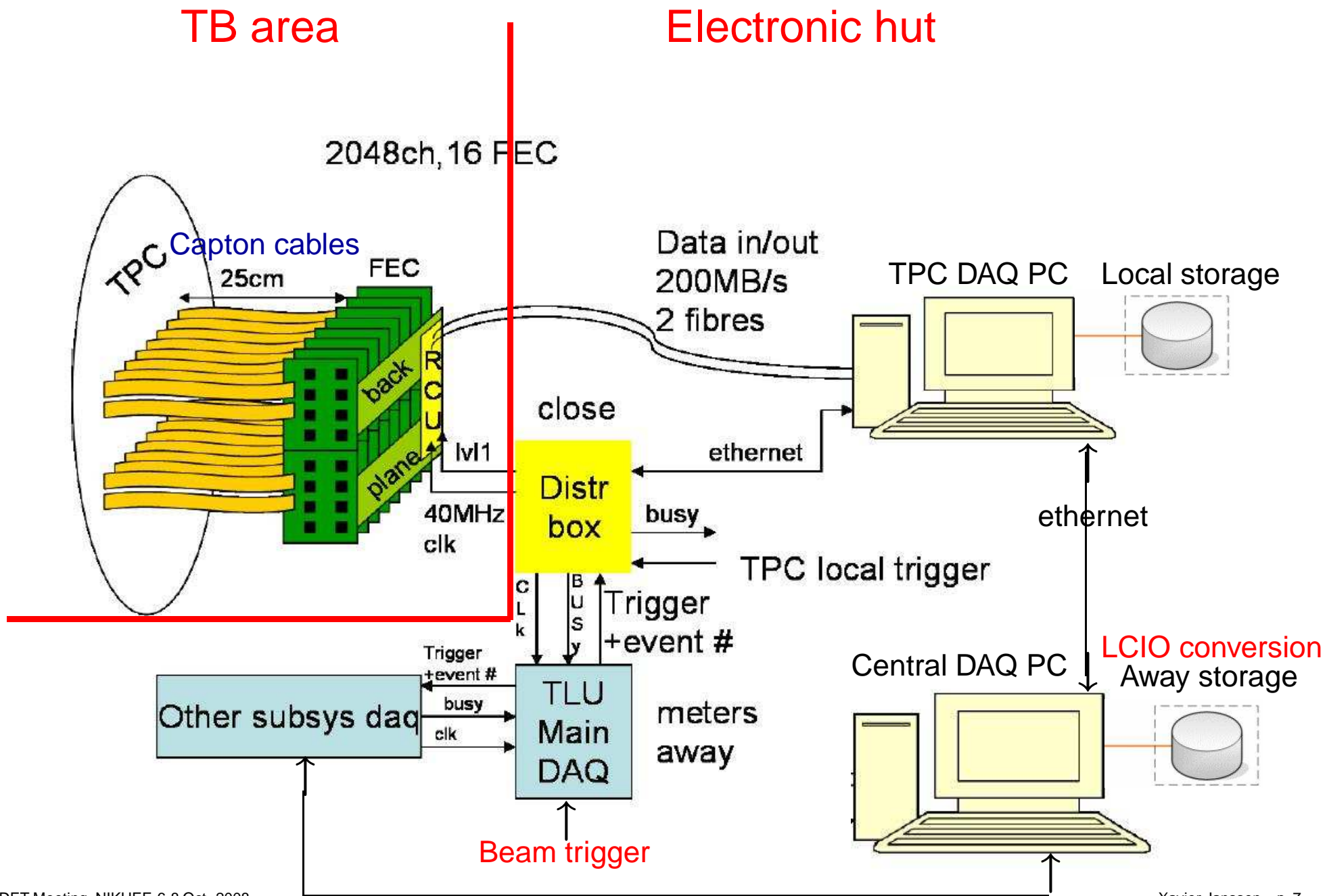
# ALTRO r/o: ALICE Front End Card (2)

128 channels ALICE FEC:

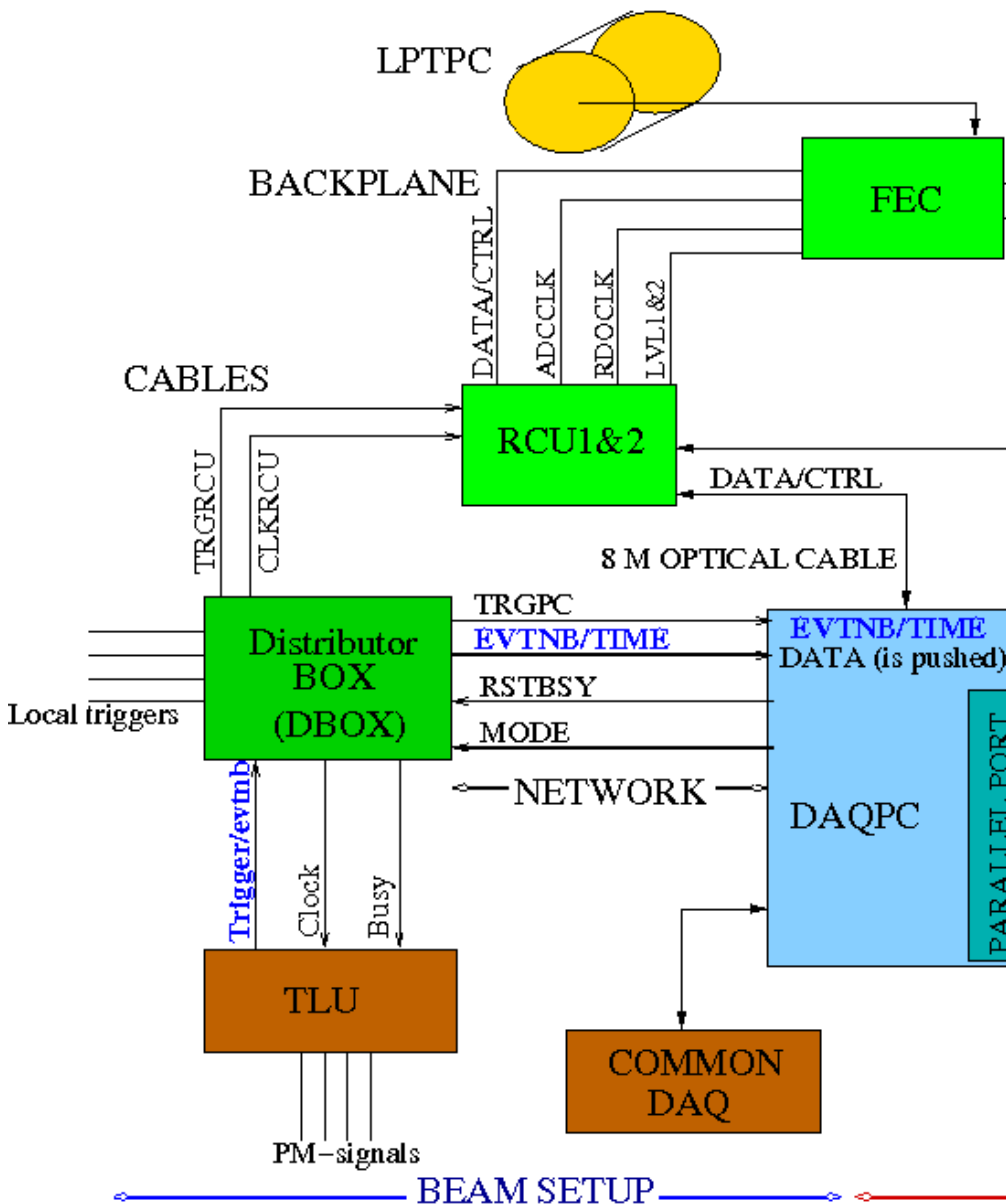


+ 4 PASA chips on rear side

# ALTRO r/o: LC-TPC DAQ overview



# ALTRO r/o: LC-TPC r/o electronic



## Modifications vs ALICE:

- 30 cm capton cables between TPC endplate and FEC's
- New programmable Amplifiers
  - FEC modifications
- Trigger source: EUDET TLU
  - DBOX: interface to TLU
- New DAQ software

## EUDET 2000 channels needs:

- 1 RCU (available)
- 16 modified FECs
  - 2nd prototype tested: **OK**
  - 5 mFEC2 being mounted
- TLU (avail.), DBOX (OK)



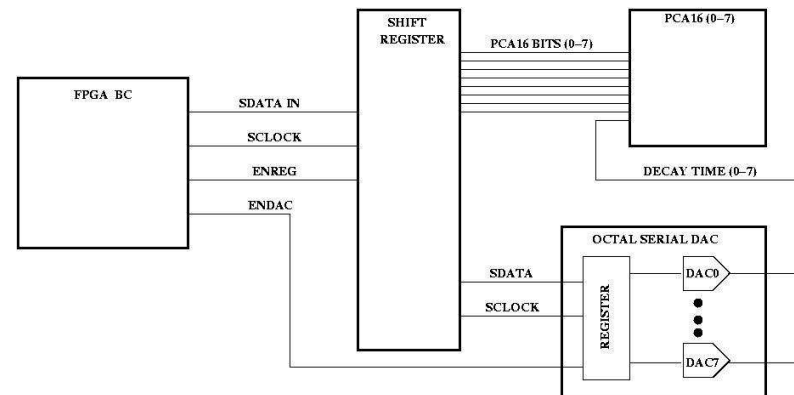
# ALTRO r/o: New Amplifiers

## 16 channels Programmable Charge Amplifier - PCA16 (CERN)

- 1.5 V Supply, power consumption < 8 mW / channel
  - programmable features:
    - Signal polarity
    - Peaking time (30 ns - 120 ns)
    - Decay time (continuously programmable)
    - Power down (wake-up = 1 ms)
    - Gain in 4 steps (12 -27 mV/fC)
- Final version was delivered at end of 2007
- 1000 (200 tested @ Lund) purchased for EUDET test beams

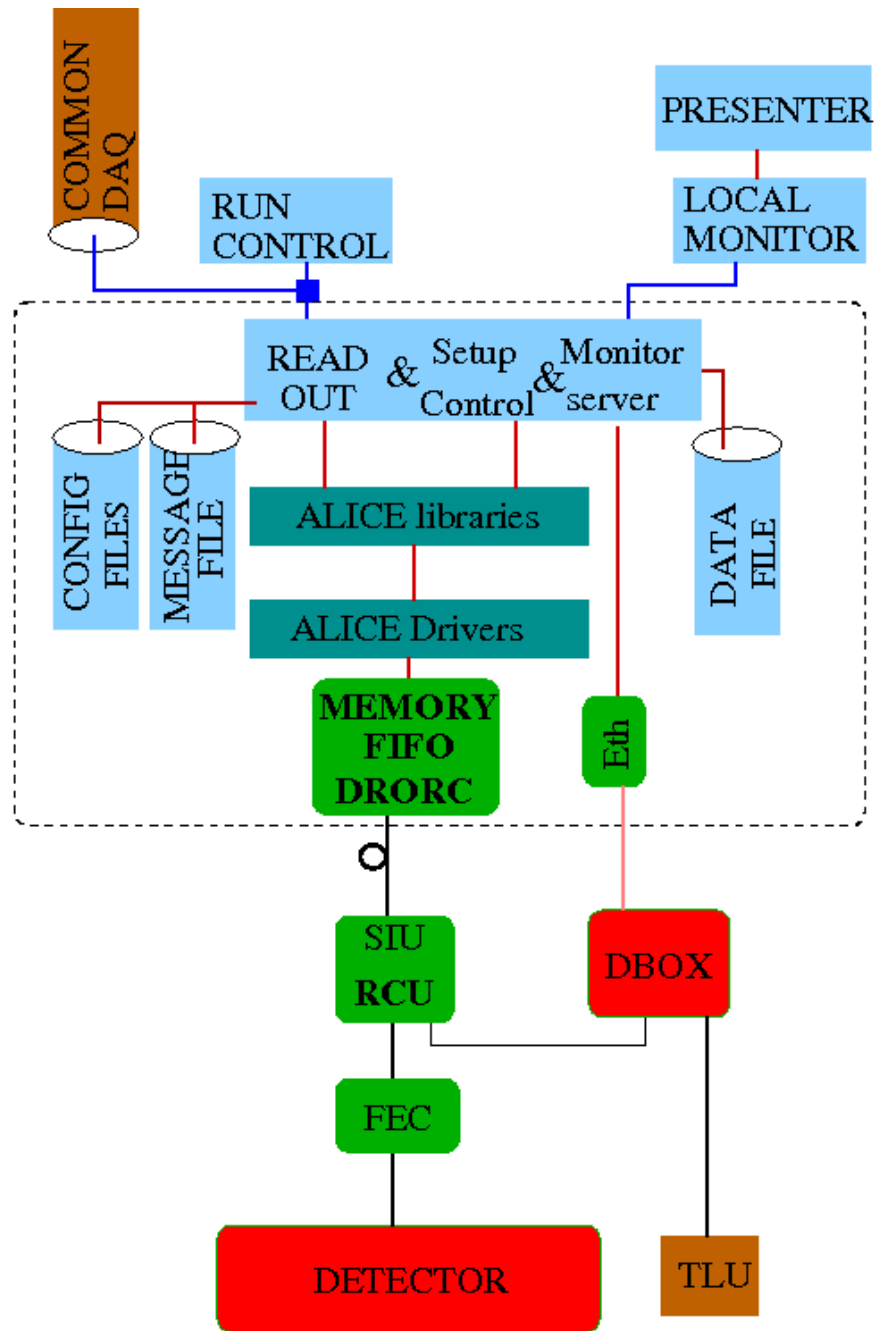
## PCA16 control:

- FEC modified to add a DAC and a shift register (Lund)
- Reprogram FEC's FPGA to control them (Brussels)



→ Tested successfully with 1st prototype of modified FEC

# ALTRO r/o: DAQ Software



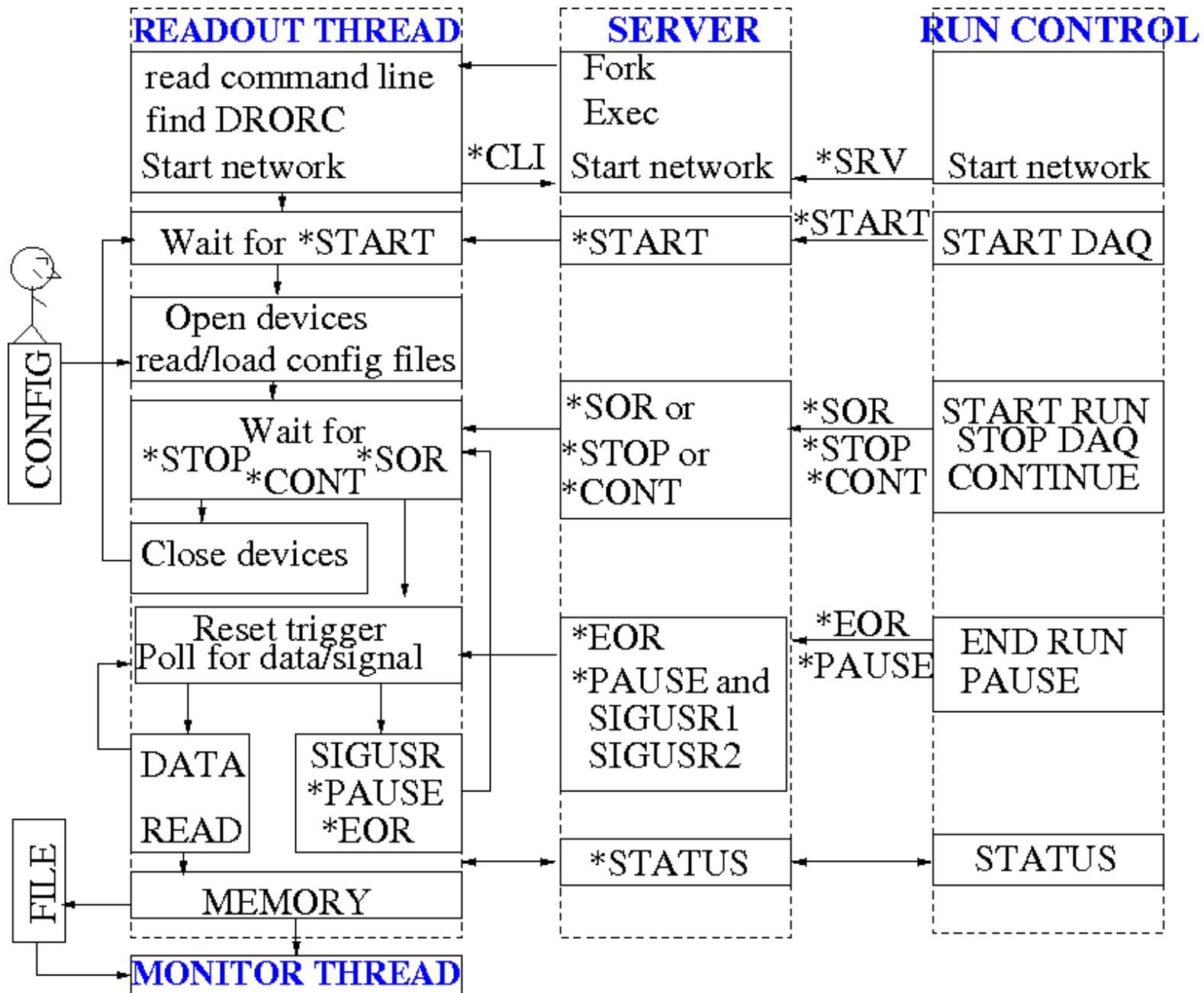
## Local Readout Software (Lund)

- Use ALICE drivers and libraries
- Direct memory access for RCU
- Configuration: ASCII files
- Local data: binary files
- TCP/IP server for data transfer
- TCP/IP server for run control
- Local monitor (TCP/IP): Histos
- Message files: ASCII files
- DBOX interface: TCP/IP client

## Common DAQ (Bonn)

- TCP/IP connection to local DAQ
- Should ensure LCIO conversion

# ALTRO r/o: DAQ Software

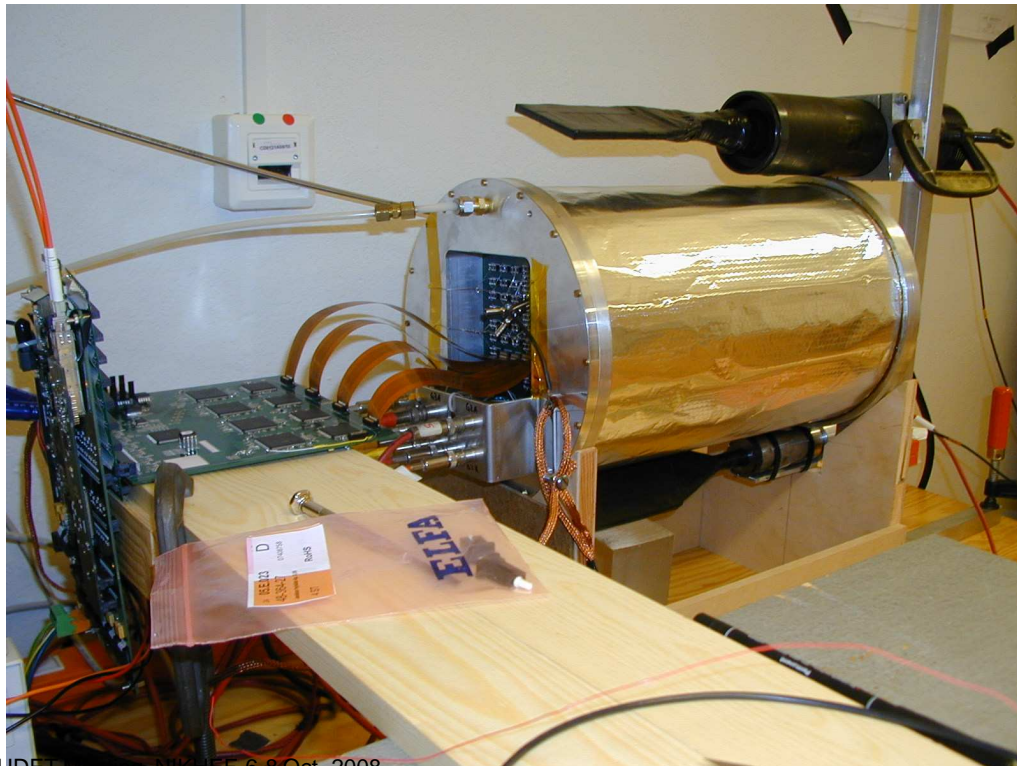
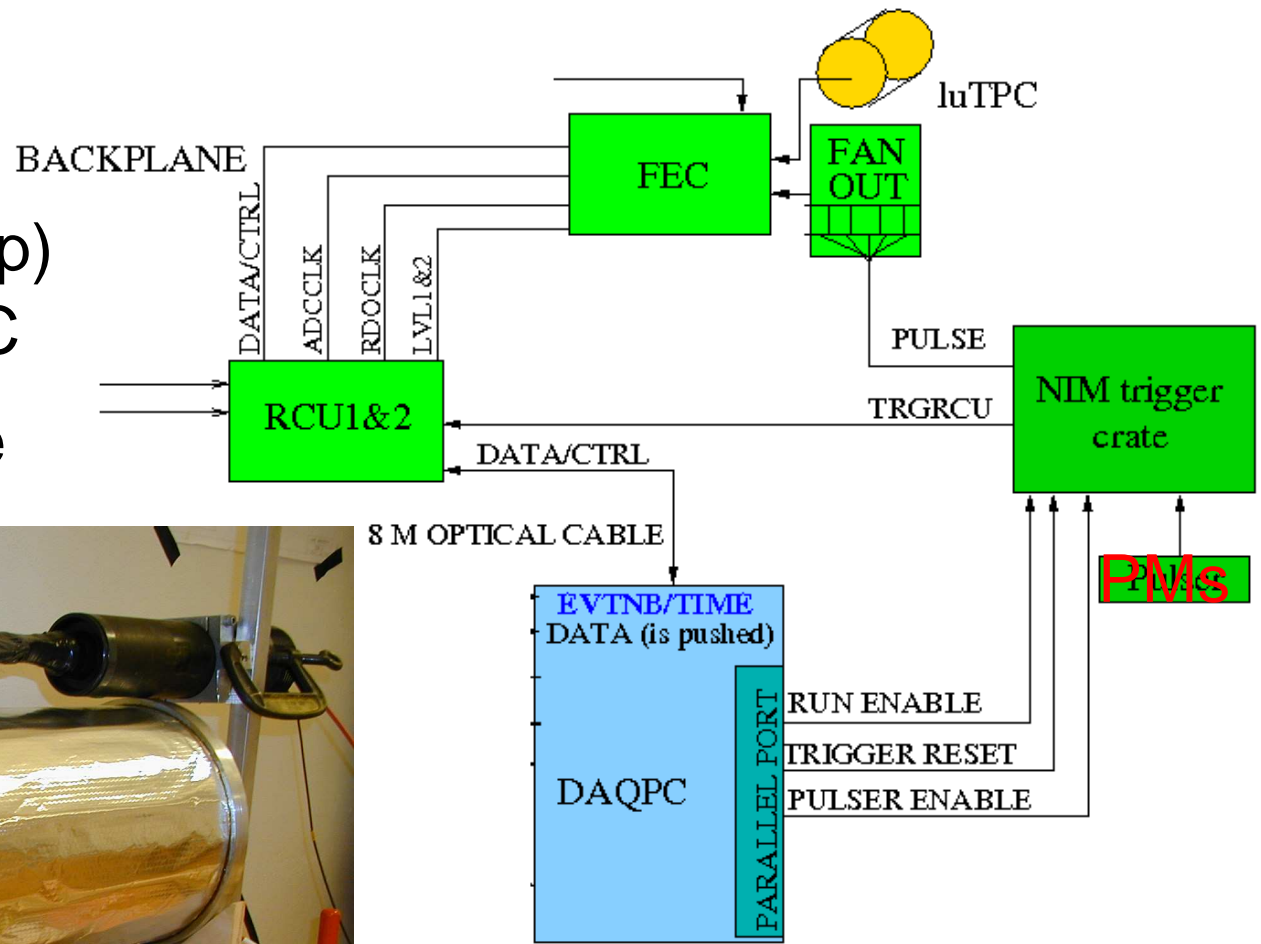


# ALTRO r/o: Cosmics with Lund TPC

## LuTPC:

- GEM detector
- 1x6 mm pads
- 2 rows (1mm side up) connected to 1 FEC

→ Test DAQ in real life

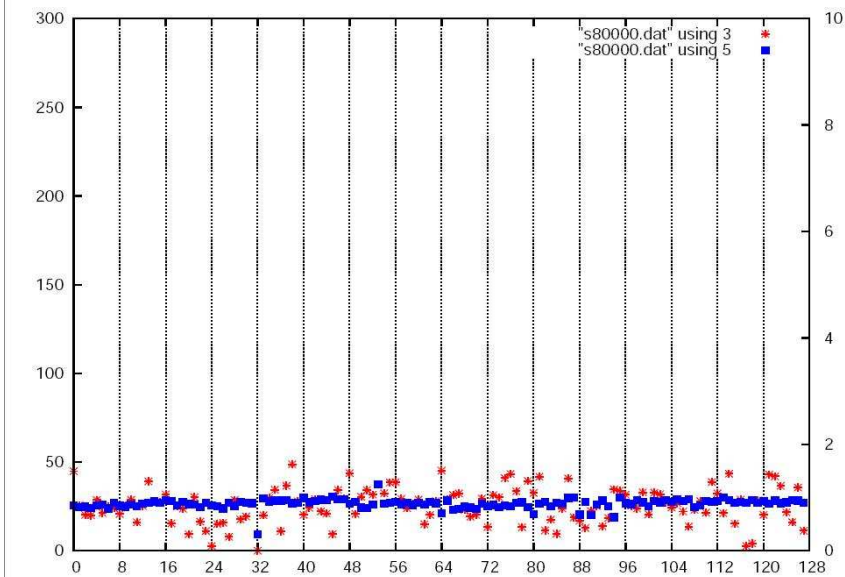


TEST SETUP

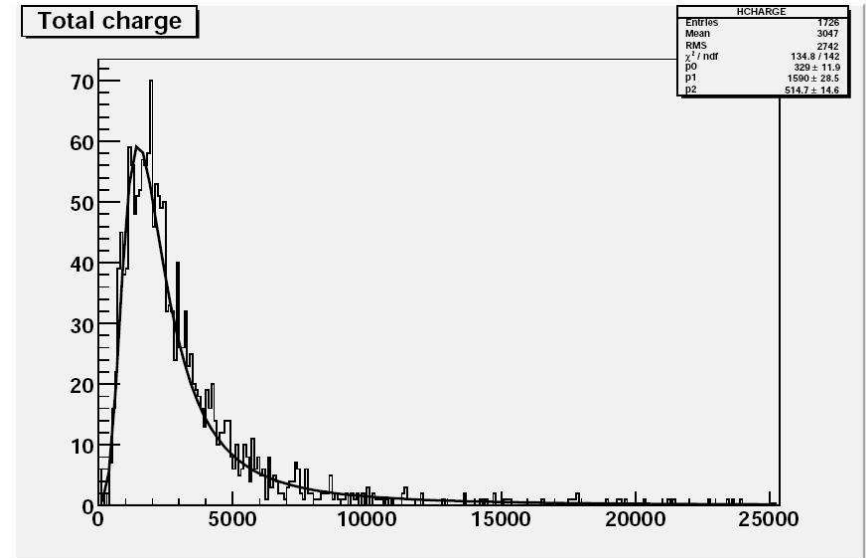


# ALTR0 r/o: Cosmics with Lund TPC

## Pedestals:



## Total charge vs time:



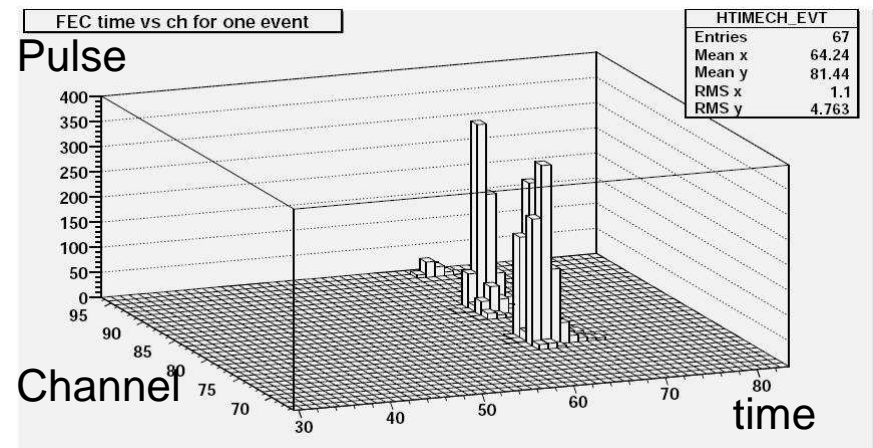
## Pedestal run:

Low noise after FEC modification

## Cosmic run:

DAQ seems to work

## Single event:



# ***ALTRO r/o: Schedule and remaining tasks***

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## Remaining (open) tasks:

- Test new RCU firmware (sampling at 10 and 20 MHz) (CERN/Lund)
- Modify RCU's to receive clock from DBOX (and not TTL) (CERN/BXL)
- Test a system with 2 RCUs and/or more than 1 FEC (Lund)

## Schedule:

- Test remaining 800 PCA16: October
  - Receive more mounted mFEC2: 6.10
  - Test new mFEC2: 6.10 - 13.10
  
  - Receive Kapton cables: 17.10
  - Connectors mounted on Kapton cables: 3.11
  
  - Receive extra RCU and DCS: 10.10
  - Test all new units (RCU, DCS, SIU, DRORC): 13.10-17.10
- ⇒ Ready for GEM testbeam on week 48: 24.11

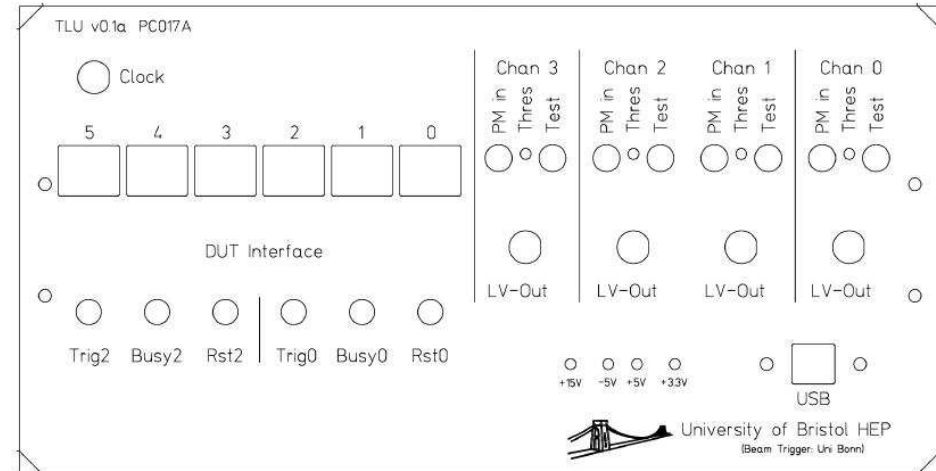
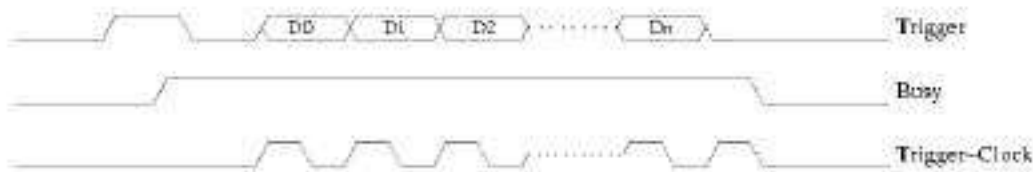
# EUDET Trigger Logic Unit

## TLU inputs:

- 4 comparators with level between  $\pm 800$  mV (LEMO connectots)
  - Cosmic trigger will send NIM signal to TLU
  - beam trigger
- **BUSY** signal from TPC ( + other detectors: Si ) in LVDS format
  - None of r/o electronic provide such a signal (see later)

## TLU outputs:

- Reset (LVDS)
- Trigger signal (LVDS)
- Event number (LVDS) pulled out by a data clock (LVDS)



# **Distributor Box** (Brussels)

- ALTRO/AFTER needs a 3.3 V Trigger signal and a clock (ALTRO)
- ALTRO/AFTER do not provide BUSY → Fixed timeout or ethernet
- Synchronisation (timestamp/event#) via special trigger count



Use commercial ALTERA Cyclone 3 board + few custom electronic board for LVDS (TLU) interface

## Distributor box should:

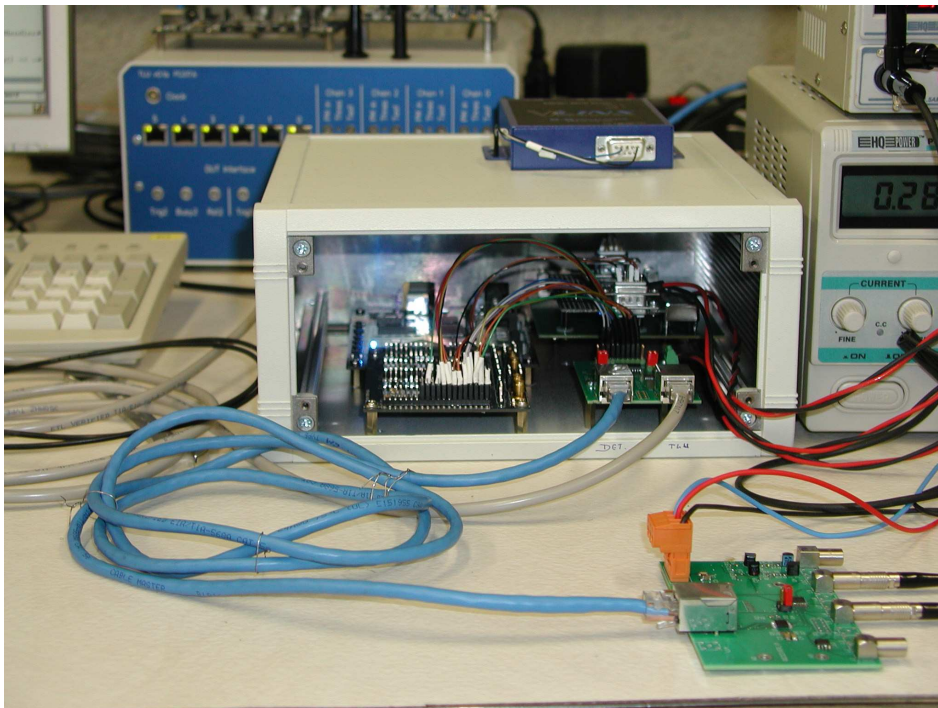
- Translate trigger level
- Get event# from TLU
- Tag event with time
- Send event # + time to DAQ computer
- Assert BUSY for a fixed time: waiting for DAQ pc end of r/o
- provide soft trig / reset
- provide common clock



# Distributor Box status

## DBOX separated in 2 pieces:

- 1 logic unit:
  - LVDS Com to TLU (trigger, event#, BUSY handle)
  - eth Com to ALTRO, T2K and Si: config and event#
  - 40Mhz clock for all ALTRO: oscillator or external
    - 1 PLL with phase shift possible
  - Standalone mode: 5 NIM, random or eth triggers
    - No need for TLU in this mode

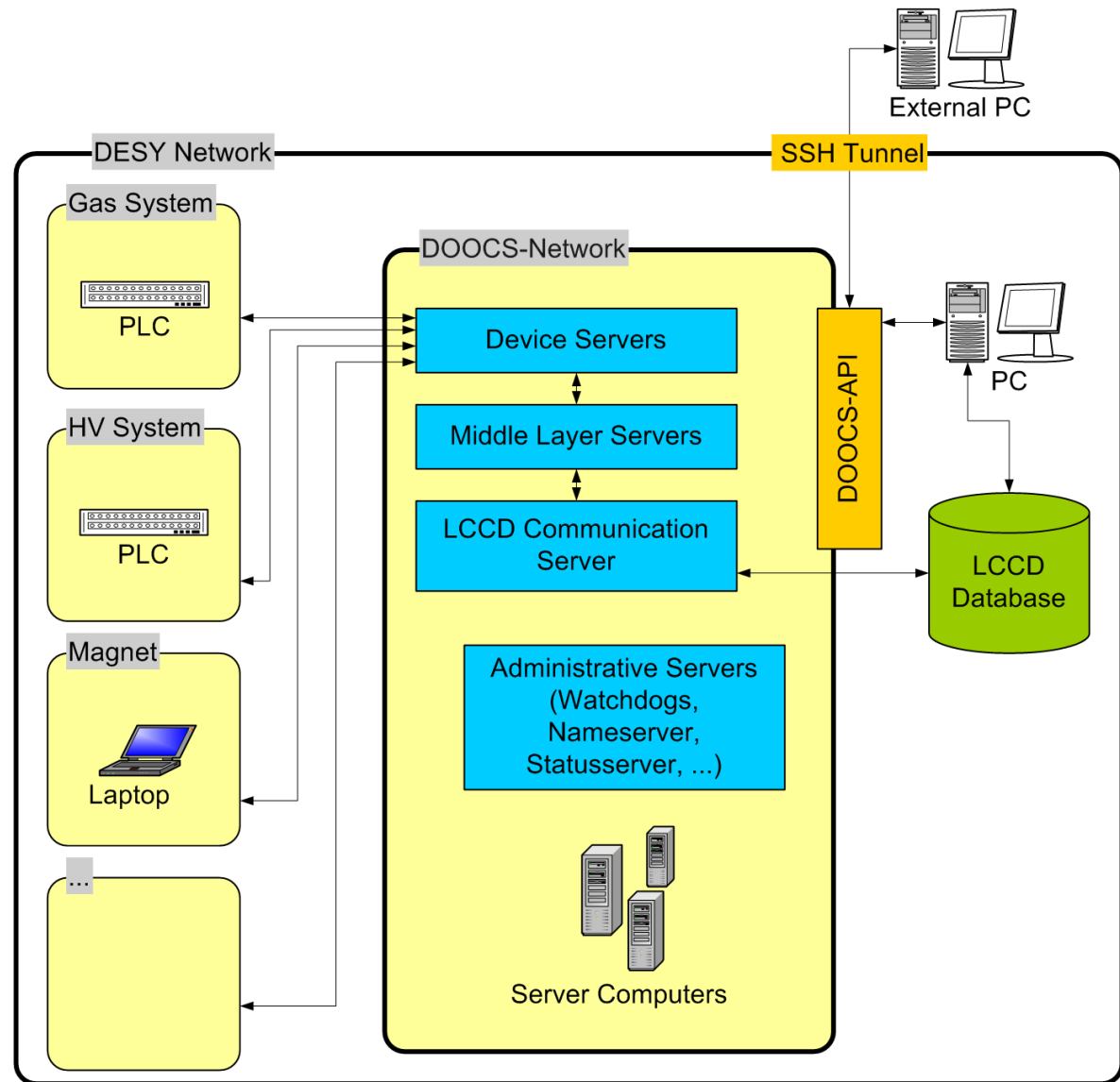


- 1 fanout card:
  - Non magnetisable (close to det)
  - LVDS connection to logic box
  - Fanout triggers to RCU or T2K
  - 1 NIM trigger output (U2F/Bonn)
  - Fanout with PLL 40 MHz Clock

1 DBOX ready and tested,  
second one being mounted.

# LPTPC Slow Control General Layout (DESY)

- Based on **D**istributed **O**bject **O**riented **C**ontrol **S**ystem (dev. by DESY)
- Hardware communication by C++ server programs
- Internal communication via DOOCS address system
- API for access to this address system
- DOOCS provides broad set of tools for control tasks



⇒ <http://doocs.desy.de>

# SUMMARY

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## ALTRO r/o electronic:

- First DAQ prototype tested successfully with cosmics
- Second FEC prototype tested → final production next week(s)
- 1 Trigger Distributor ready (also for AFTER), 2nd being builded
- Goal is to deliver (at least) a 2000 channels r/o by november  
→ Use for GEM detectors and mixed Si/GEM detectors

## AFTER r/o electronic:

- T2K r/o tested successfully and installed at DESY  
→ First test beams with  $\mu$ Megas by end october

## Remaining steps:

- Integration within the common (EUDAQ) DAQ software
- Slow control