Discussion on portable multichannel systems for MPGDs

J. Toledo

Universidad Politécnica de Valencia

jtoledo@eln.upv.es

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Outline

- Introducing my research group

RD-51

- WG 5.4 - The goal
- Design requirements for a portable multichannel DAQ system

My intention is to present my group, share a few ideas and start a discussion on the DAQ

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Introducing my research group

35,000 students

2,500 researchers

Science park

Campus in 3 cities

Digital Systems Design Group

Five motivated engineers with CERN background...

- Angel Sebastiá (DELPHI DAQ)
- Francisco Mora (LHC DAQ)
- Raúl Esteve (ALICE ALTRO)
- José Toledo (LHCb DAQ)
- Jorge Martínez (PET tomography DAQ)
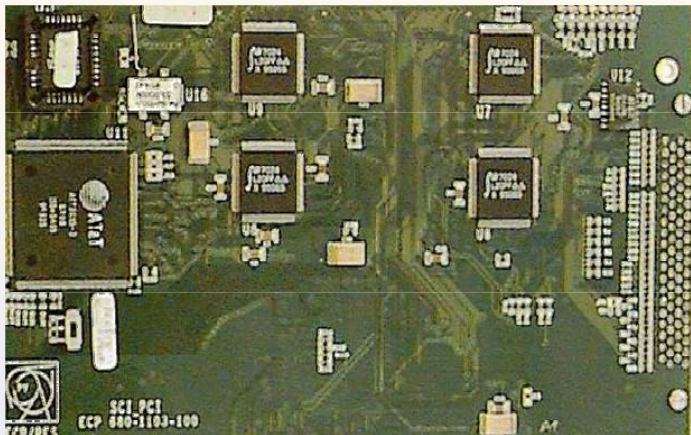
Introducing my research group

What are we good at?

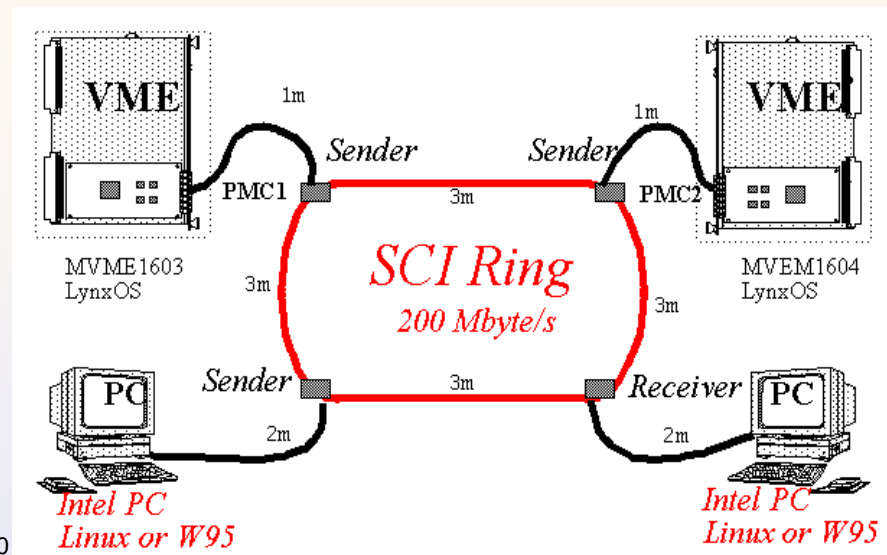   DAQ systems for HEP, Nuclear physics and Nuclear medicine

Some examples of designs from our stage at CERN...(F. Mora PhD thesis)

Study of application of SCI to DAQ at LHC (CERN RD24)

VME-SCI and PCI-SCI bridges

IEEE TRANSACTIONS ON NUCLEAR SCIENCE, VOL. 47, NO. 2, APRIL 2000

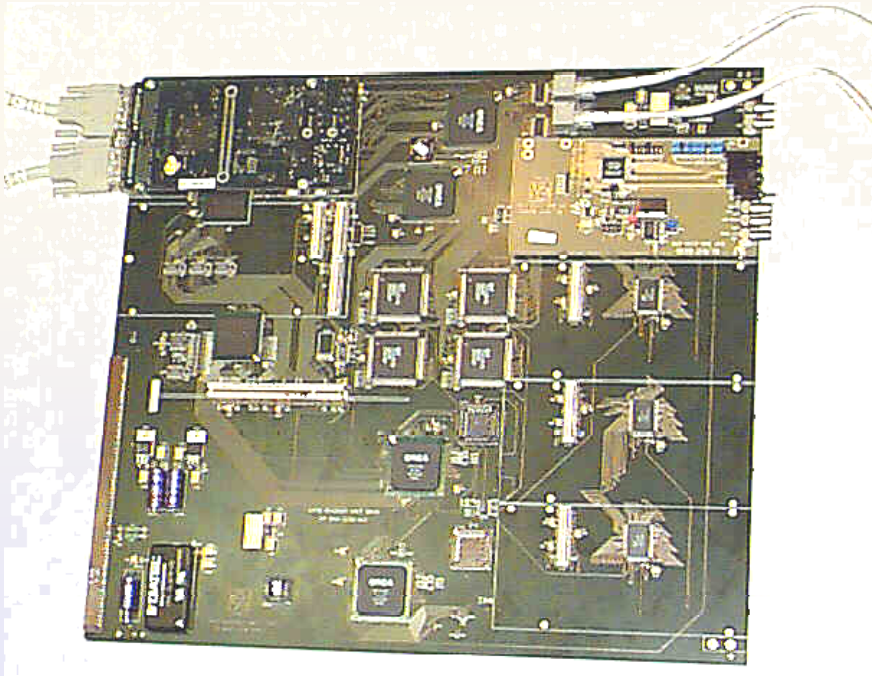UNIVERSIDAD POLITECNICA DE VALENCIA

Introducing my research group

What are we good at?

DAQ systems for HEP, Nuclear physics and Nuclear medicine

Some examples of designs from our stage at CERN...(J. Toledo PhD thesis)

Readout Unit for LHCb DAQ

PCI DAQ card for NA-60 at CERN

IEEE TRANSACTIONS ON NUCLEAR SCIENCE, VOL. 49, NO. 3, JUNE 2002

IEEE TRANSACTIONS ON NUCLEAR SCIENCE, VOL. 49, NO. 2, APRIL 2002

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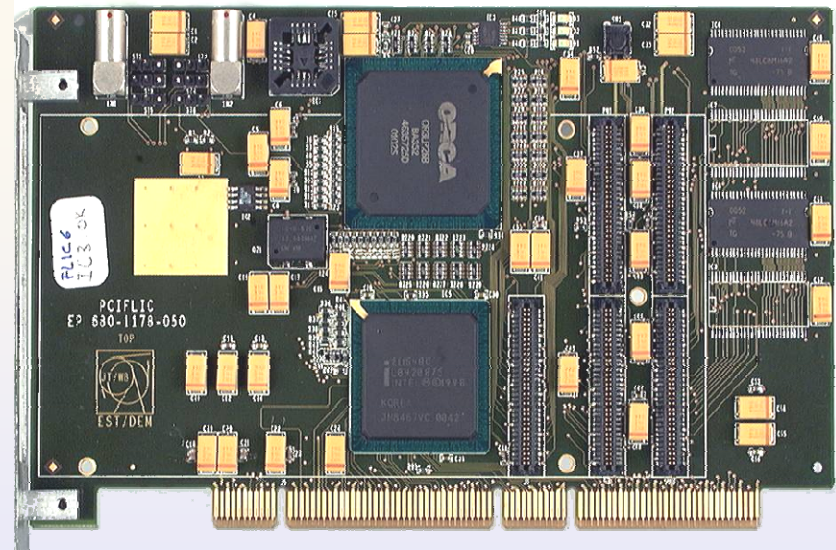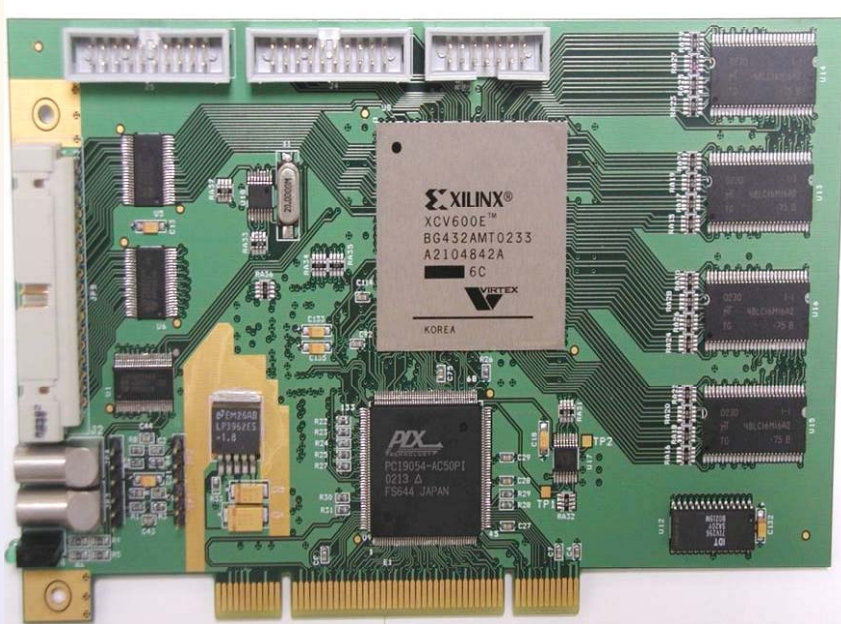
DAQ systems for HEP, Nuclear physics and Nuclear medicine

A design for ALBA, Barcelona synchrotron...

HM5 – Histogramming module for MWPC

Used at:
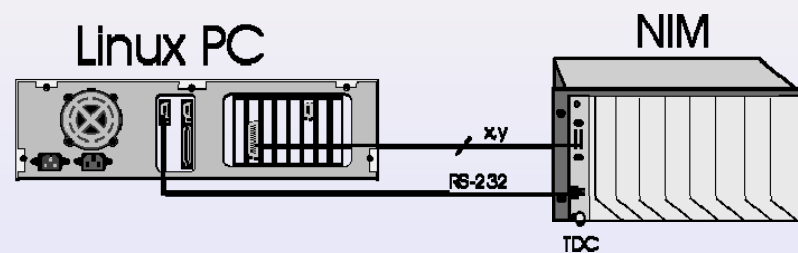
BM16 at ESRF
Adam and Eva at Institute Laue-Langevin
Max Planck Stuttgart
U. Copenhagen Denmark
ALBA Synchrotron Barcelona

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DAQ systems for HEP, Nuclear physics and Nuclear medicine

A nuclear medicine project...(J. Martínez PhD thesis)

Planar Positron Emission Mammography (PEM) Scanners

Coincidence and Processing Module

- Free running sampling approach
- On-board processing and parameters extraction

NUCLEAR INSTRUMENTS AND METHODS A 537 (2005) 335–338
NUCLEAR INSTRUMENTS AND METHODS A 546 (2005) 28–32

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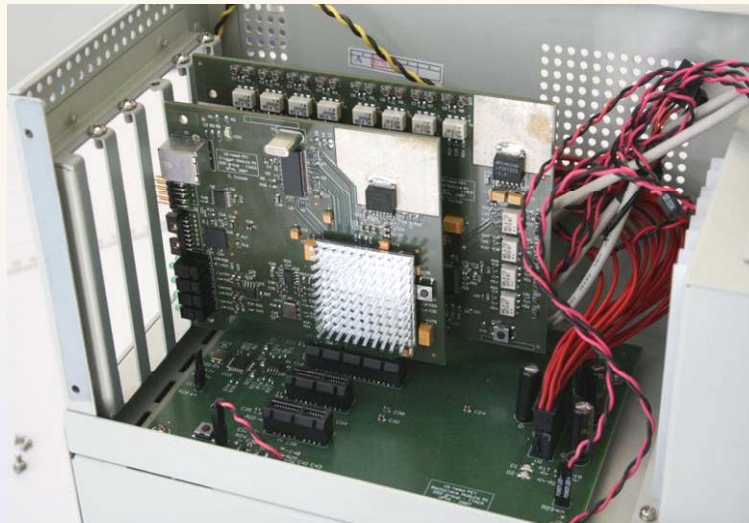
DAQ systems for HEP, Nuclear physics and Nuclear medicine

Two nuclear medicine designs...

Novel DAQ system for a PET tomograph

Trigger board

Half-size chassis

TRIG + DAQ in custom backplane
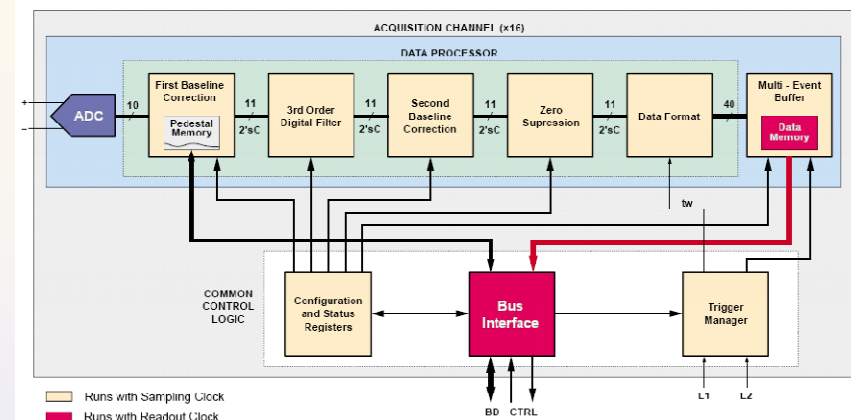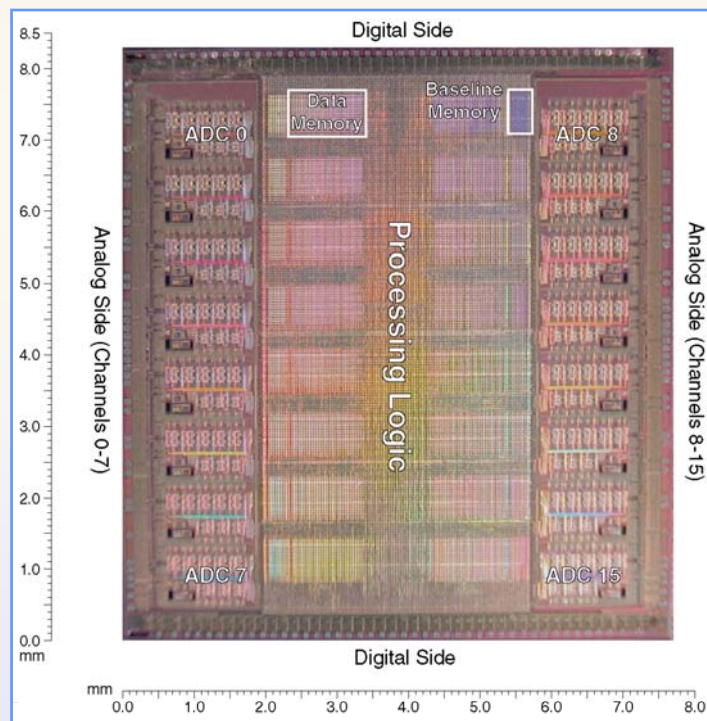
DAQ board

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What are we good at?

ASIC design (R. Esteve PhD thesis)

Major contribution to the design of the ALTRO chip

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Introducing my research group

What are we good at?

    ASIC design

A second example... PESIC: An integrated FE for PET applications

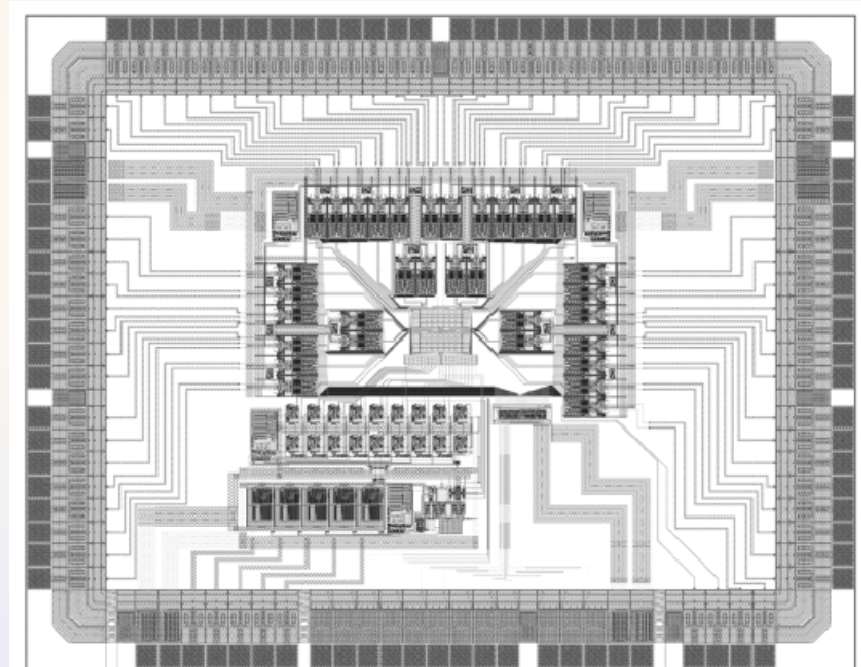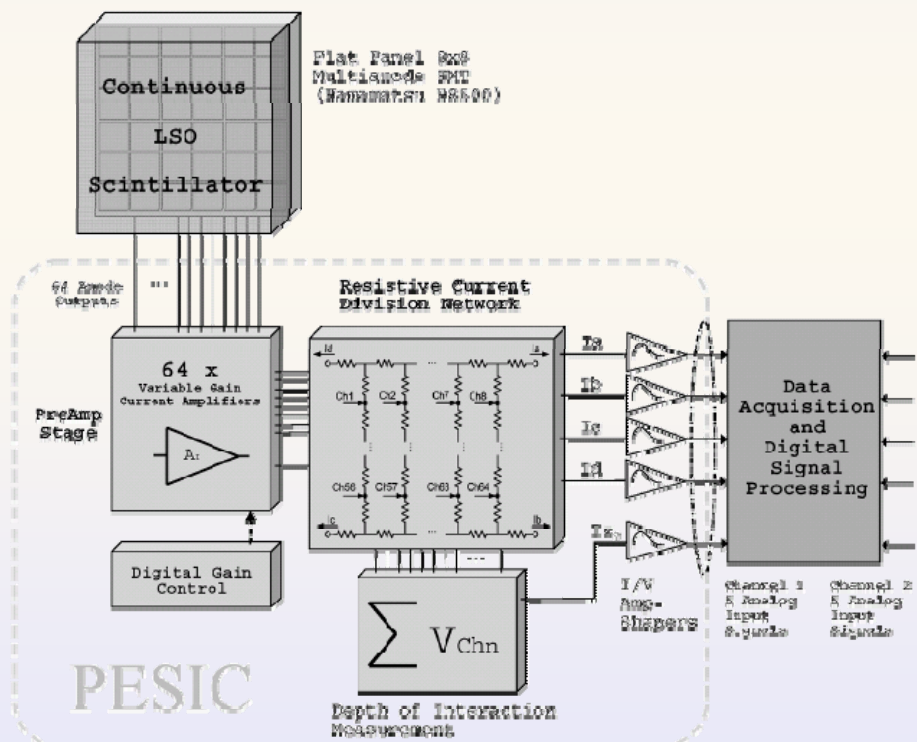Fig. 2. PESIC (64 anodes version). 3.3 mm × 2.8 mm in 0.35 μm technology.

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RD-51

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WG 5.4 - The goal

Scope (from RD51 Proposal)

"For the classical configuration of charge collecting pads or strips an easy-to-use portable readout solution will be developed"

Task and deliverables

- "Design and construction of portable multichannel systems"
- Deliverable: "Prototype system"
- Scheduled for m1/m12 !!
  - WG 5.1 (Definition of FEE requirements) is m6/m12, m12/m36!!

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WG 5.4 - The goal

...so, I understand the goal is to:

1. Design a scalable, flexible and reconfigurable DAQ platform that can work with existing ASICs, trying not to reinvent the wheel

"All DAQ systems are by definition beyond the state of the art. No one designs a new one when an old system can can be adapted or upgraded to do the job"

(...said once a senior scientist from Fermilab)

2. Wait for advances in WG 5.1 and, if required, adapt the DAQ platform to new requierements and/or ASIC

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Design requirements for a portable multichannel DAQ system

From April's meeting:

- TTP card: offered by Paul Aspell in April'08 in Amsterdam
  - Interface for 4 VFAT2 GEM hybrid boards

- We may to extend the TTP concept to a flexible, scalable DAQ that can be used for all ASICs

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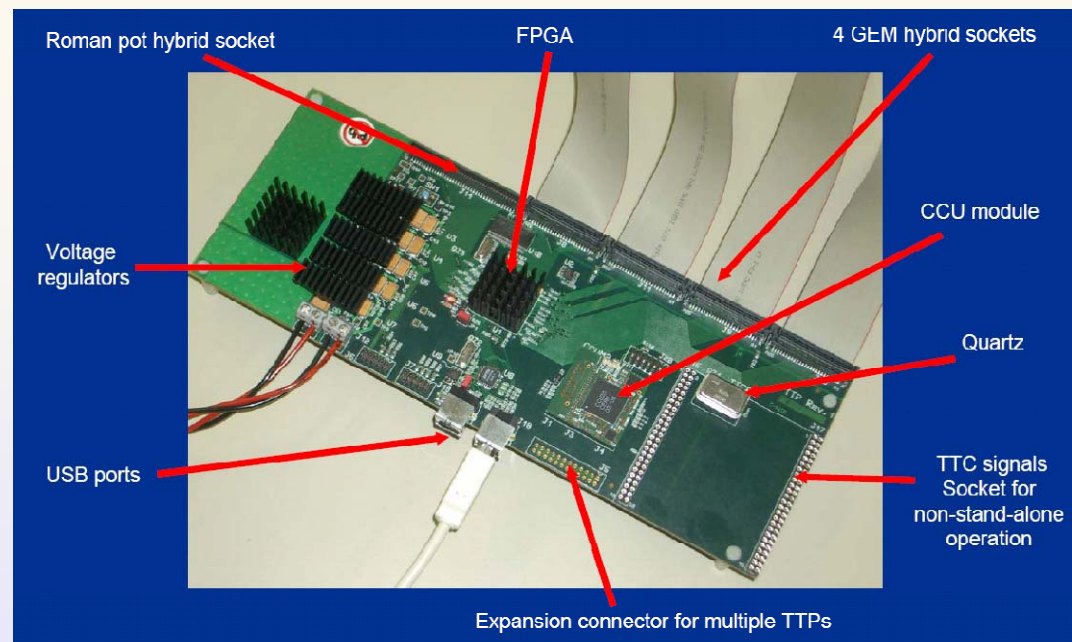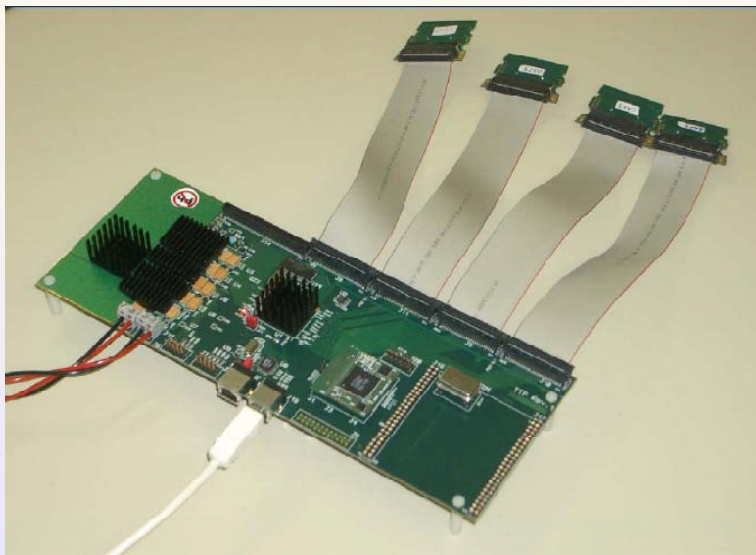
Design requirements for a portable multichannel DAQ system

Binary readout

  CARIOCA (8 ch)
  ASDQ (8 ch)   ~ easy or direct interface to digital logic (LVDS)
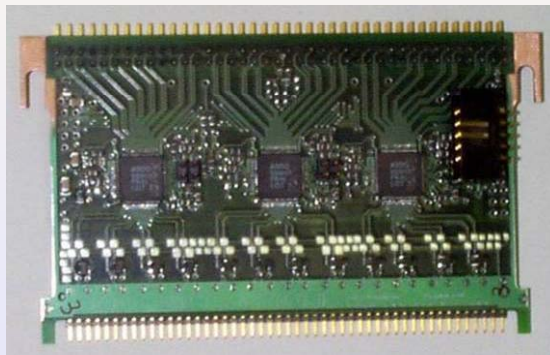 VFAT2 (128 ch)

Digital readout
  ALTRO (16 ch)   ~ direct interface to digital logic

Analogue readout
  APV25 (128 ch)   Requieres external ADC

We could use existing FE cards and cabling for these ASICs and design a flexible DAQ to control them

3 ASDQ on a board

2 ASDQ + TDC on a board

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Design requirements for a portable multichannel DAQ system

- N * ASICs on existing (?) FE cards close to the detector
- Existing power modules for FE cards

- Portable DAQ system

  - **Scalable**: modular system, single or multi chassis

  - **Flexible**: Input connectors, buffers, level conversion, etc. can be installed on application-specific mezzanines

  - **Reconfigurable**: FPGAs for FE control and readout, clock and trigger generation

- Common DAQ software

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Design requirements for a portable multichannel DAQ system

Adapter cards (application specific)
- Adapts connectors
- Digital readout (buffers, level conversion)
- Binary readout (buffers, level conversion)
- Analogue readout (+ ADC)

DAQ cards
- FE readout and control
- Data formatting
- FPGAs for flexibility
- p-p links to TRIG card
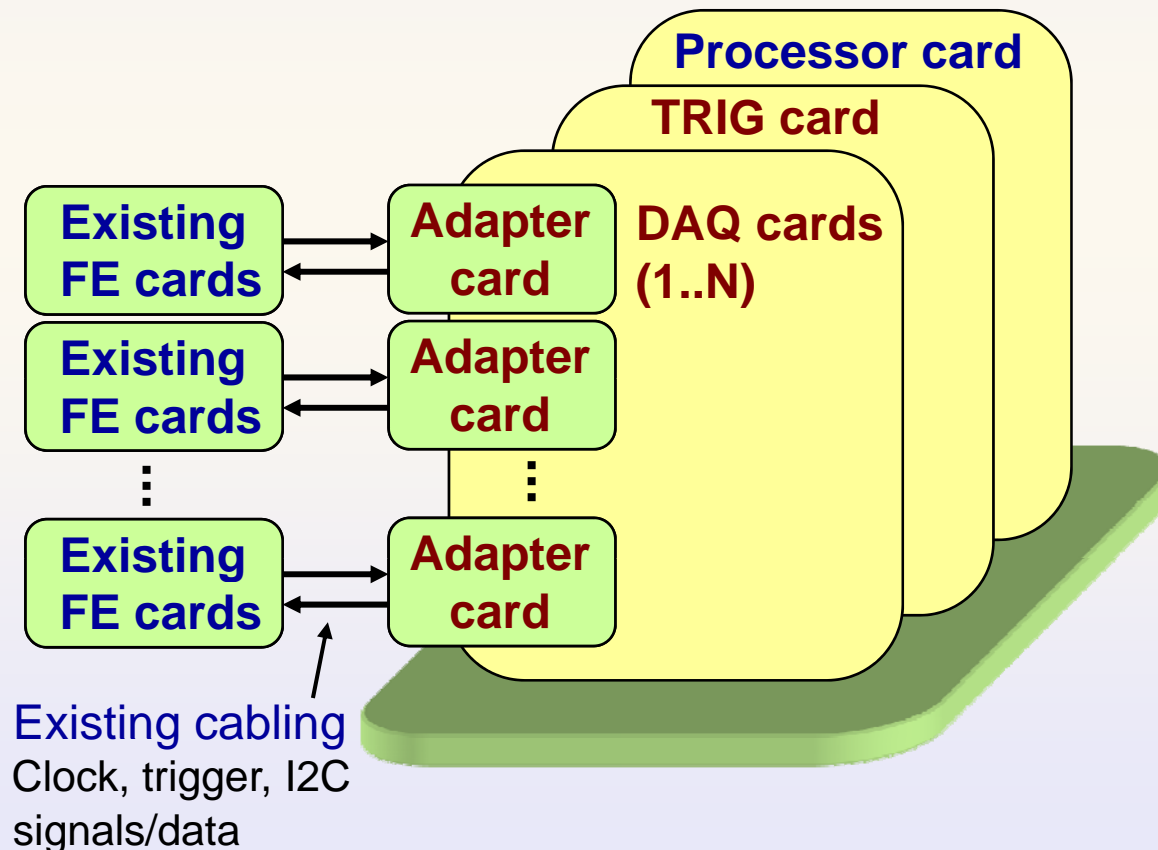- Optional data input from other chassis

TRIG card
- Clock and trigger generation and distribution via p-p to DAQ cards and/from other chassis

COTS processor card
- Network interface
- Runs **DAQ Software**
- Reconfigures FPGAs

COTS chassis and backplane
- Power
- Backplane
- Mechanics

Processor card

TRIG card

DAQ cards (1..N)

Existing FE cards

Adapter card

Existing FE cards

Adapter card

Existing FE cards

Adapter card

Existing cabling
Clock, trigger, I2C signals/data

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Design requirements for a portable multichannel DAQ system

Only for large systems...

Processor card

TRIG card

DAQ cards (1..N)

Processor card

TRIG card

DAQ cards (1..N)

Processor card

TRIG card

DAQ cards (1..N)

Clock + Trigger

Network
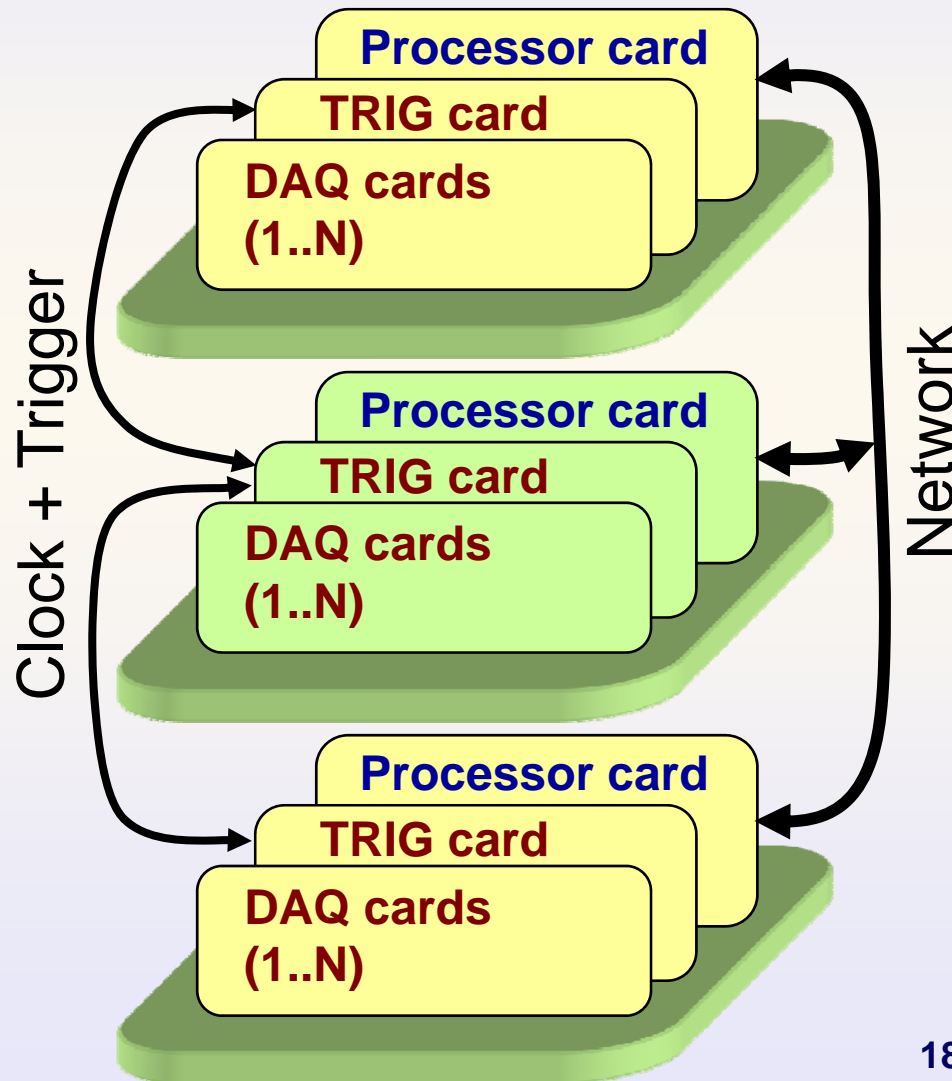
"Any path that narrows future possibilities may become a lethal trap" from the novel Children of Dune

Multi-chassis systems

- No special HW is needed
- One Master chassis
- CLK, TRIG distributed from TRIG Master to TRIG slaves
- DATA to Master via:
  - Network, or
  - one DAQ card per Slave send data to DAQ card in Master

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Design requirements for a portable multichannel DAQ system

- Re-use of existing FE cards and cabling

- There must be out there some existing DAQ HW we can adapt

- There must be out there some existing DAQ SW we can adapt

The concept is flexible, scalable and reconfigurable and aims at reusing existing developments

WG 5.4 scheduled for m1/m12

Discussion and feedback is needed

Thank you for your attention !

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