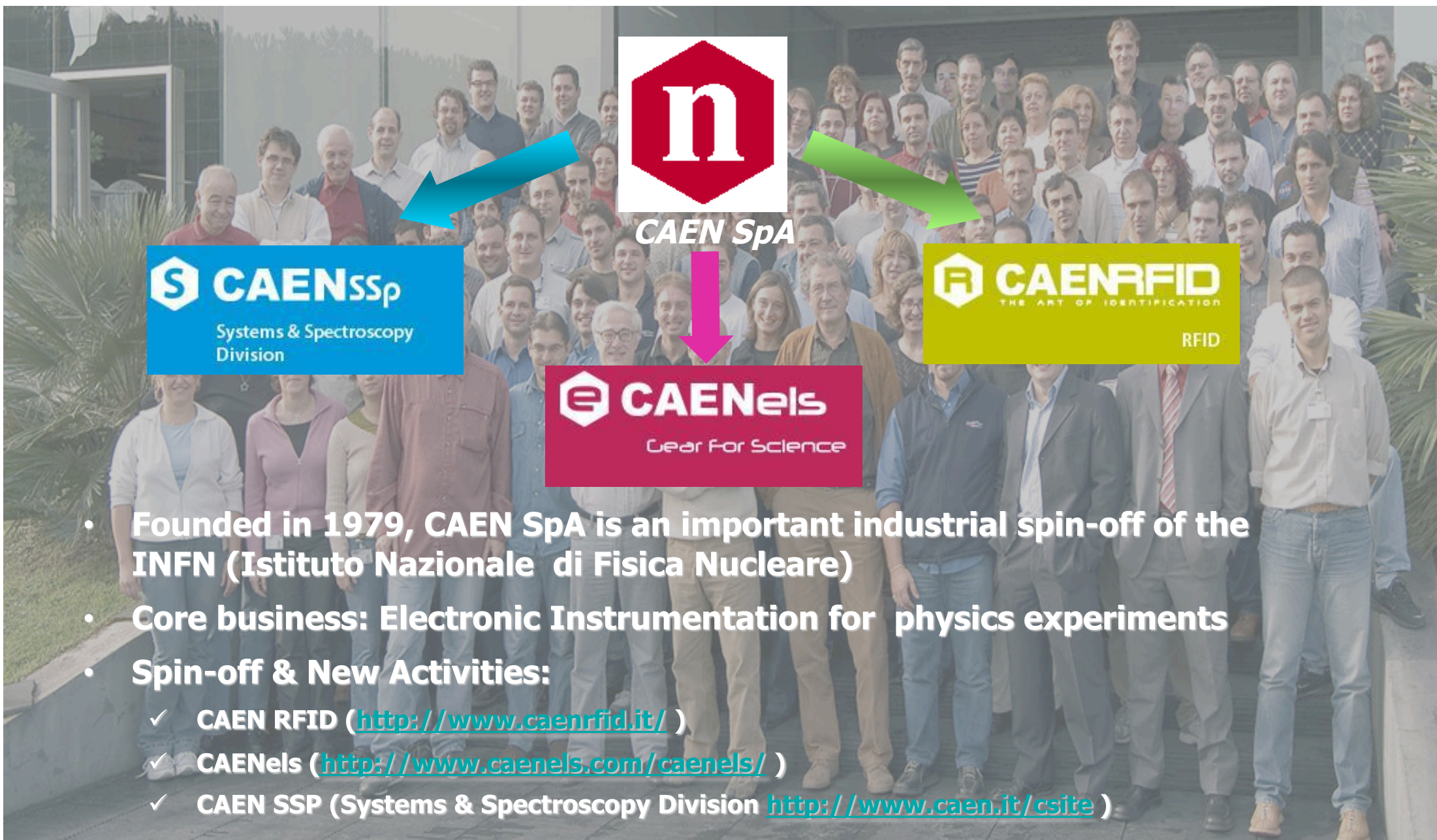




17 April, 2013
Gianni Di Maio (CAEN SpA Maintenance Manager)





CAEN SpA



- Founded in 1979, CAEN SpA is an important industrial spin-off of the INFN (Istituto Nazionale di Fisica Nucleare)
- Core business: Electronic Instrumentation for physics experiments
- Spin-off & New Activities:
 - ✓ CAEN RFID (<http://www.caenrfid.it/>)
 - ✓ CAENels (<http://www.caenels.com/caenels/>)
 - ✓ CAEN SSP (Systems & Spectroscopy Division <http://www.caen.it/csite>)



Quality Certification



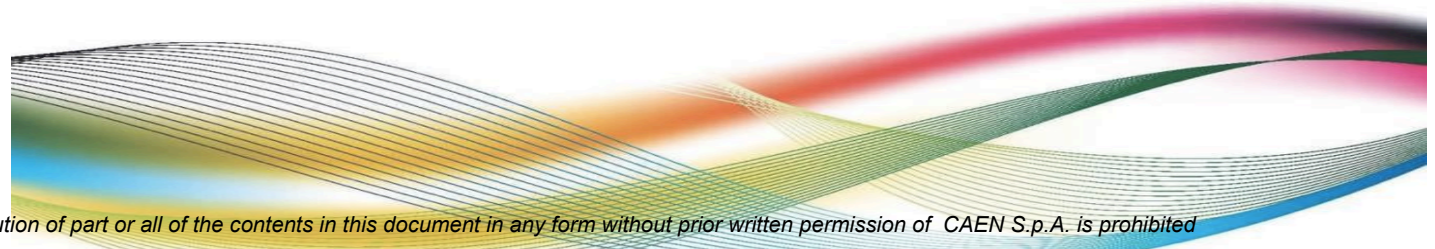
Global coverage

- Worldwide sales network
 - CAEN offices in Italy, Germany, USA,
 - Distributors (Agents & Resellers) in more than 30 countries
- Portfolio: more than 2000 customers
- World leading research centres “Users”
 - Europe: CERN, DESY, INFN, GSI, ESO, ISIS, Ganil, PSI, ...
 - USA: FNAL, SLAC, Los Alamos, BNL, JLab, ...
 - Asia: J-Park, KEK, Riken, IHEP, TIFR, ...
 - Africa: iThemba Labs, ...
 - And private companies GE, Siemens, SAIC, L3, Raytheon, Lockheed



Market

- **For 30 years CAEN has been providing Scientists and Engineers with the most advanced electronic instrumentation for any particle or radiation detectors**
- **Strong of an extremely close collaboration with the world major research laboratories CAEN is proud to produce the best tools for:**
 - **High Energy Physics**
 - **Astrophysics**
 - **Neutrino Physics**
 - **Dark Matter Investigation**
 - **Nuclear Physics**
 - **Material Science**
 - **Medical Applications**
 - **Homeland Security**
 - **Industrial Applications**





CAEN's Expertise

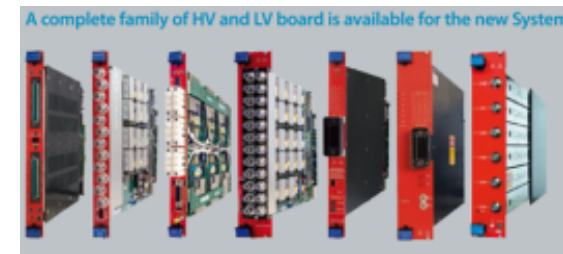
- **HV and LV Power Supplies for particle detectors**
 - **Multichannel CAEN Systems (also for Hostile Area)**
 - **Multichannel NIM std, Desktop and VME std Modules**
 - **"Multichannel VME & NIM" CAEN Systems**
- **Signal Conditioning & Read-out Electronics**
 - **Preamplifiers, Digitizers**
 - **NIM, CAMAC, Desktop and VME (Front-End/Data Acquisition Modules)**
- **Powered Crates and Chassis**
 - **Low Ripple Linear NIM powered Crates**
 - **New Hi-End VME64/VME64x Crates**
- **Custom Developments**
- **Software User Interface**





HV and LV Power Supplies

- **Multichannel CAEN Systems (Standalone and VME & NIM)**
- **Multichannel NIM and VME Modules**



High Voltage boards with completely independent channels: from 6 to 32 channels, from 100 V to 15 kV (A15xx family).

High Voltage Distributor boards up to 48 channels with Independent Current Monitor (A2932/A2935).

Low Voltage boards from 4.5 V to 15 V with Remote Sensing Lines to compensate for the voltage drop over the connection cables.



Signal Conditioning & Read-out Electronics

- Preamplifiers
- NIM, PCIe, USB2.0 and VME Front-End/ Data Acquisition Modules



Digitizers

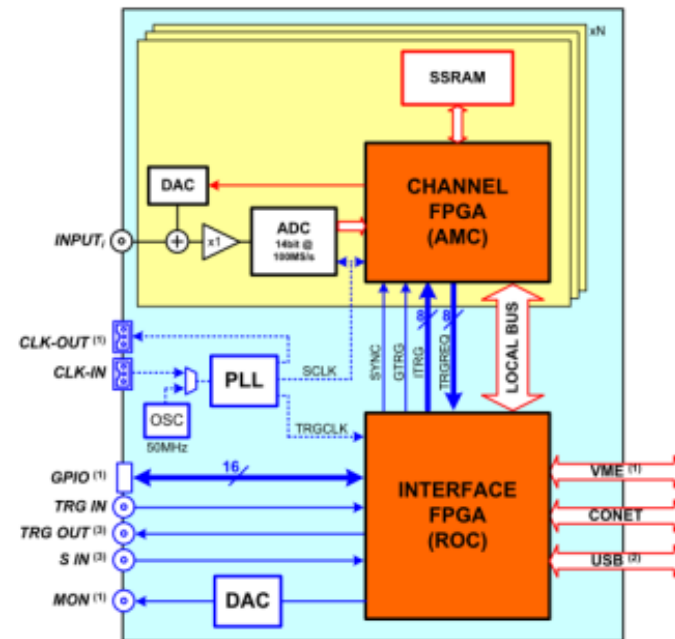
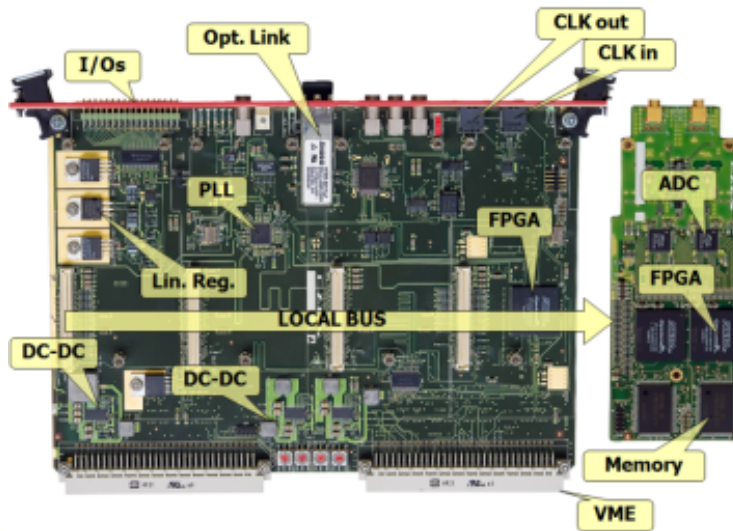
A complete family of digitizers



**Mother (NIM, Desktop, VME) /
/ Daughter Boards**

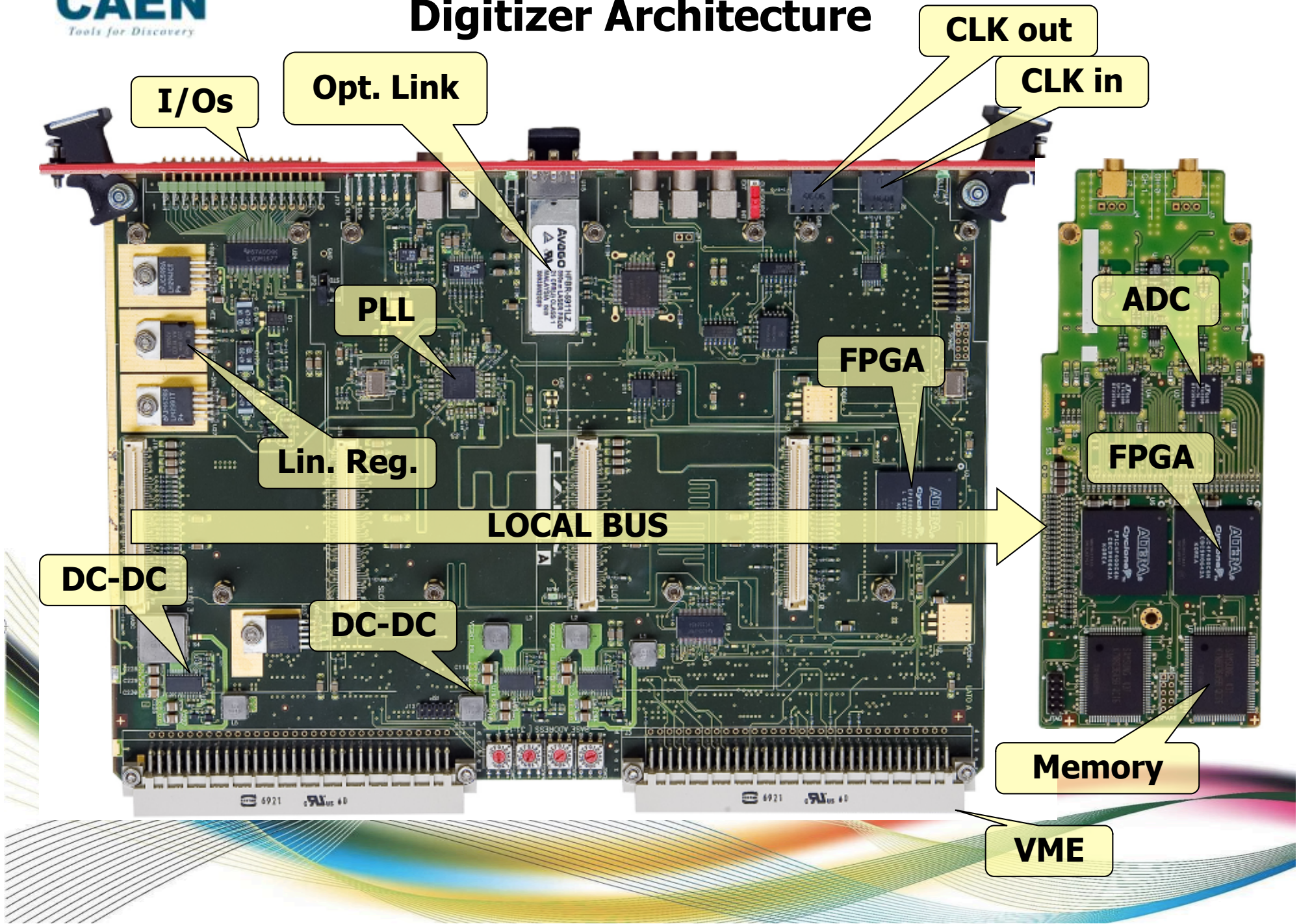
Next .. xTCA boards ?

From 2 to 64 channels
Up to 5 GS/s sampling rate - Up to 14 bit
FPGA firmware for Digital Pulse Processing



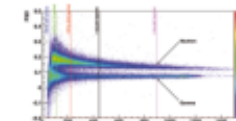
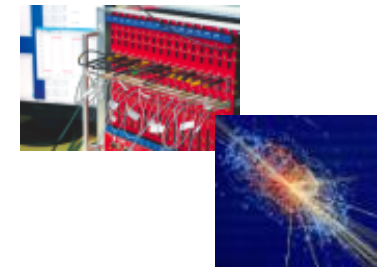
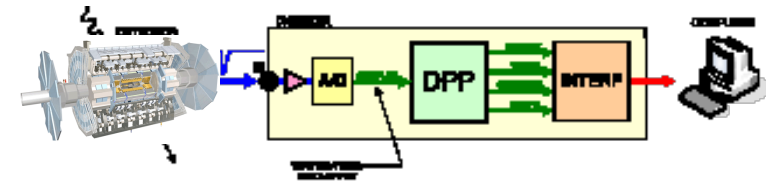
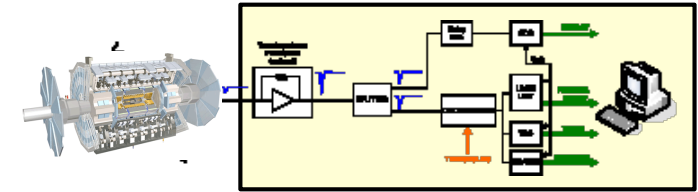
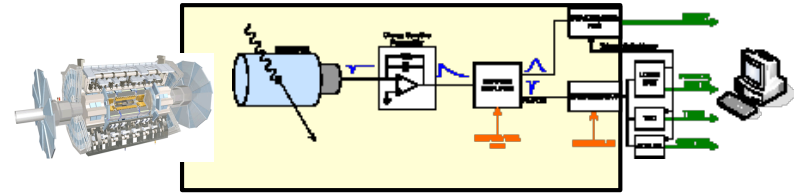
(1) VME boards only
(2) Desktop/NIM boards only
(3) for Desktop/NIM boards, TRG-OUT = GPO, S-IN = GPI

Digitizer Architecture

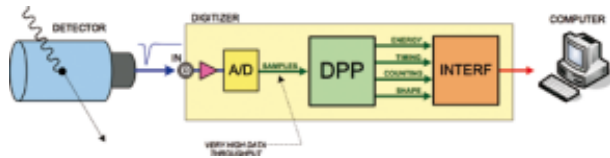


Digitizer Applications

- We can propose digitizers for physics experiments and for research laboratories
- We compete with traditional analog acquisition chains, propose new fully digital approach thanks to on line processing
- We have some interesting DPP algorithms:
 - ✓ Pulse triggering
 - ✓ Zero suppression
 - ✓ Pulse Height Analysis
 - ✓ Charge Integration
 - ✓ Gamma-Neutron discrimination
 - ✓ Time measurement



Starting from the CAEN's Digitizers Platform, with local memory and FPGA , sophisticated algorithms are implemented to make a real-time data processing for spectroscopy for **«high-multiplicity & multi-parameter»** solutions ...



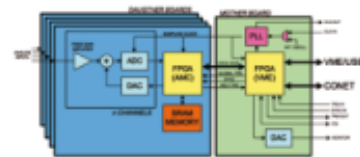
With **CAEN Spectroscopy and System Division Tools** Became *Solution... For Discovery*

CAENSSp Vision

Thanks to **“high density digitizer family”** & **“on line data processing”**,

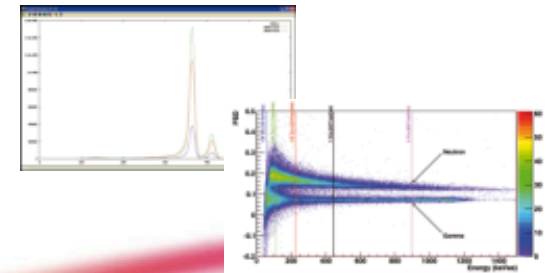
became a leader for ...

... **«high-multiplicity & multi-parameter»** solutions



CAENSSp Strategy

Open to cooperate with different **“partners/companies”** to establish business relationships **“for common and mutual benefits”** in the world of spectroscopy applications





Powered Crates and Chassis

- Low Ripple Linear NIM powered Crates
- New Hi-End VME64/VME64x Crates



VME100 series

Enhanced: 21 slot, VME64 or VME64X, removable Power Supply, removable smart Fan Unit, CANBUS, Ethernet, RS232 and USB 2.0 control.



VME200 series

Enhanced: 21 slot, VME64X, removable Power Supply, removable smart Fan Unit, removable Air Filter. Completely free rear side access of VME backplane with optional rear side transition card cage 3U/6U x 80mm, CANBUS, Ethernet, RS232 and USB 2.0 control.



VME010/VME011

Low Cost: 21 slot, VME64, integrated or removable Power Supply, integrated Fan Unit, no remote control and monitor.



VME8002

Mini Crate: 9 slot, VME64, integrated fan unit and removable power supply, CANBUS interface.



VME8004B

Mini Crate: 2U, 4 slot, VME64 / CBLT cycles supported.



VME8001

Mini Crate: 1U, 2 slot, VME64.



NV8020A (Mixed Crate)

Mixed VME/NIM crate: 8 slot VME64, 365 W, 7 slot NIM (5 free) 150 W linear Power supply.



Custom Developments

- Capable of providing custom solutions
- Digital Pulse Processing (DPP)
- Hostile Area projects (LHC and ALMA)



Custom Power Supplies

CAEN and ESO LV Power Supply for ALMA



Air filter cartridge

Air filter cartridge

Design of custom LV Power Supply System for ALMA
8 different voltage channels per System

86 Systems produced

Linear Power Supply

Very low ripple/noise performance

Harsh environmental condition (desert at 5,000 m altitude)

- **high reliability**
- **simplified maintenance**
- **requirements for vibration, shocks, transportation, earthquake, air pressure, dust**

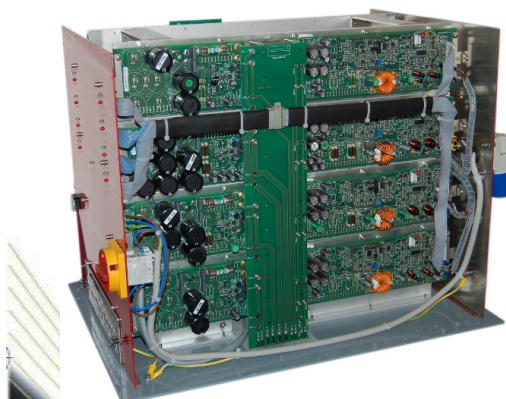




Photo courtesy of ALMA



CAEN and ESO LV Power Supply for ALMA

Tender awarded on May 2009

First prototypes on July 2009

Mass production started on December 2009

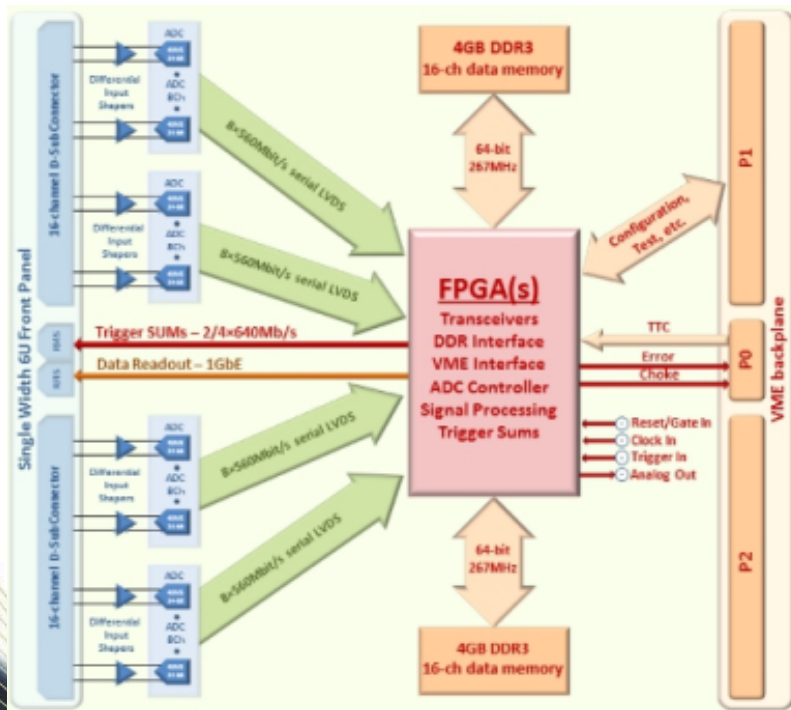
Delivery of 73 Systems completed on August 2010

Additional order of 13 Systems completed in October 2010

"I'm very pleased with the performance of CAEN under this contract." Says Gie Han Tan, ALMA European Front End project manager, "CAEN has delivered state of the art power supplies to our demanding, custom, requirements and according to an aggressive schedule. The technical knowledge and commitment of CAEN staff involved contributed to achieving these objectives and this is greatly appreciated by both ESO and ALMA."

NA62 @ CERN

CAEN awarded contract for the design and production of the Calorimeter REAdout Module (CREAM) for the NA62 Liquid Krypton Calorimeter (LKr)



455 CREAM modules (13,249 read-out channels)

CREAM Features:

VME 6U form factor

32 channel

14 bit 50 MS/s ADC

2 Vpp input dynamics (differential)

14-bit programmable DC offset adjustment ($\pm 1V$)

Memory buffer:

26 MB circular buffer,

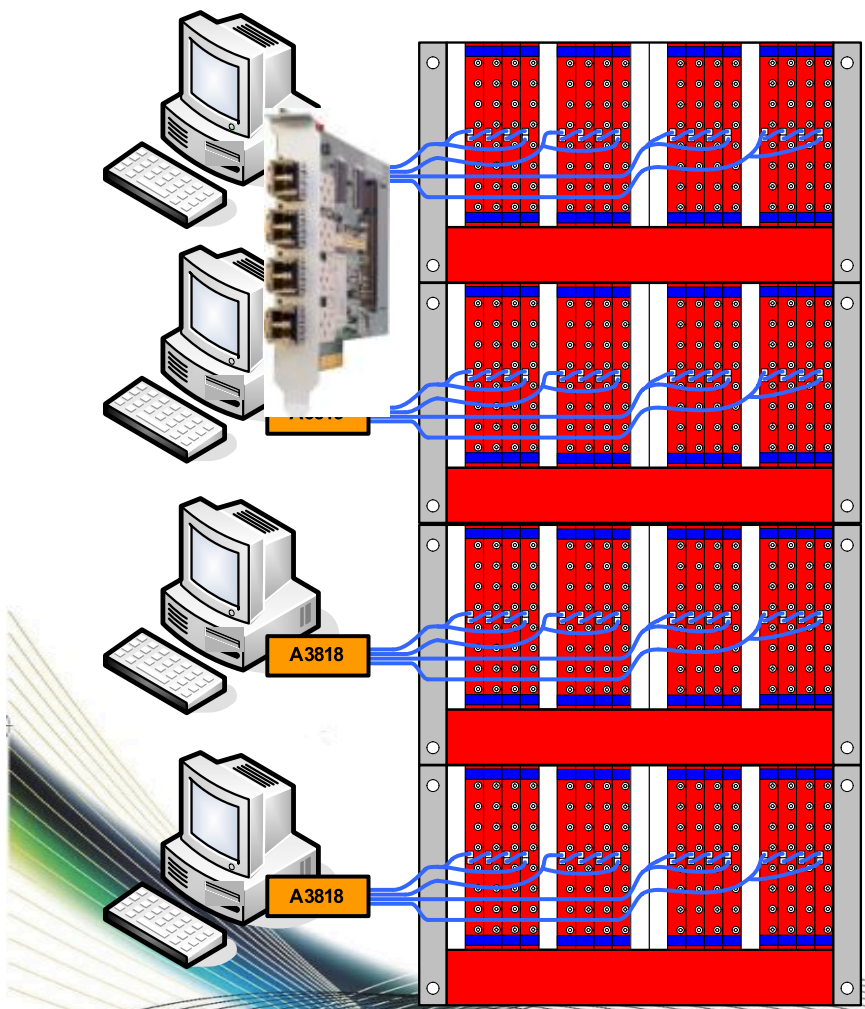
5.2 GB event buffer

Gbit Ethernet port for data readout

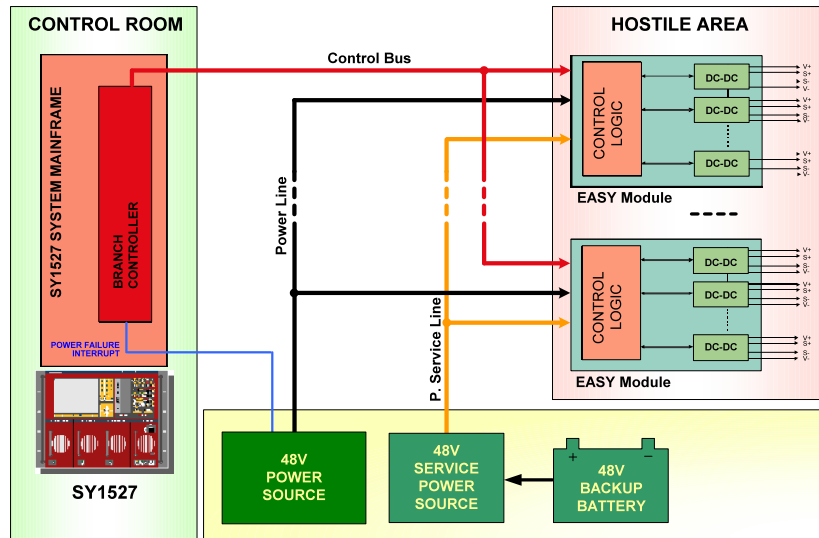
VME64X compliant interface

XMass @ Kamioka, Japan

- 64 V1751 modules in 4 VME crates
- 512 channels (10 bit @ 1GHz)
- 4 A3818s 4 link PCIe cards
- 16 parallel CONET links
- 4 digitizers daisy chained
- Readout Bandwidth = ~ 2 MB/s/ch
- Total aggregate throughput = ~ 1 GB/s



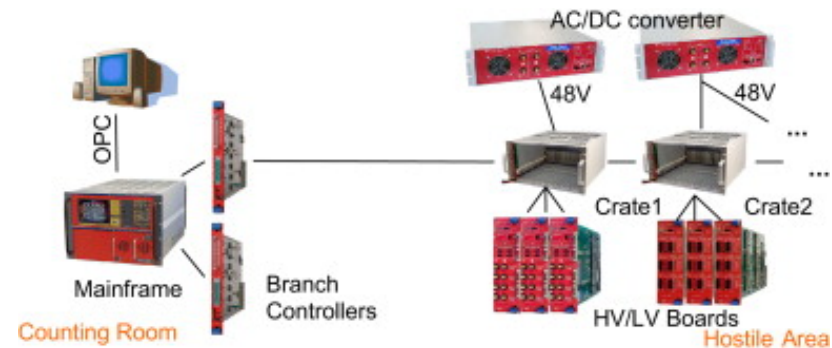
Electronics in Hostile Environments



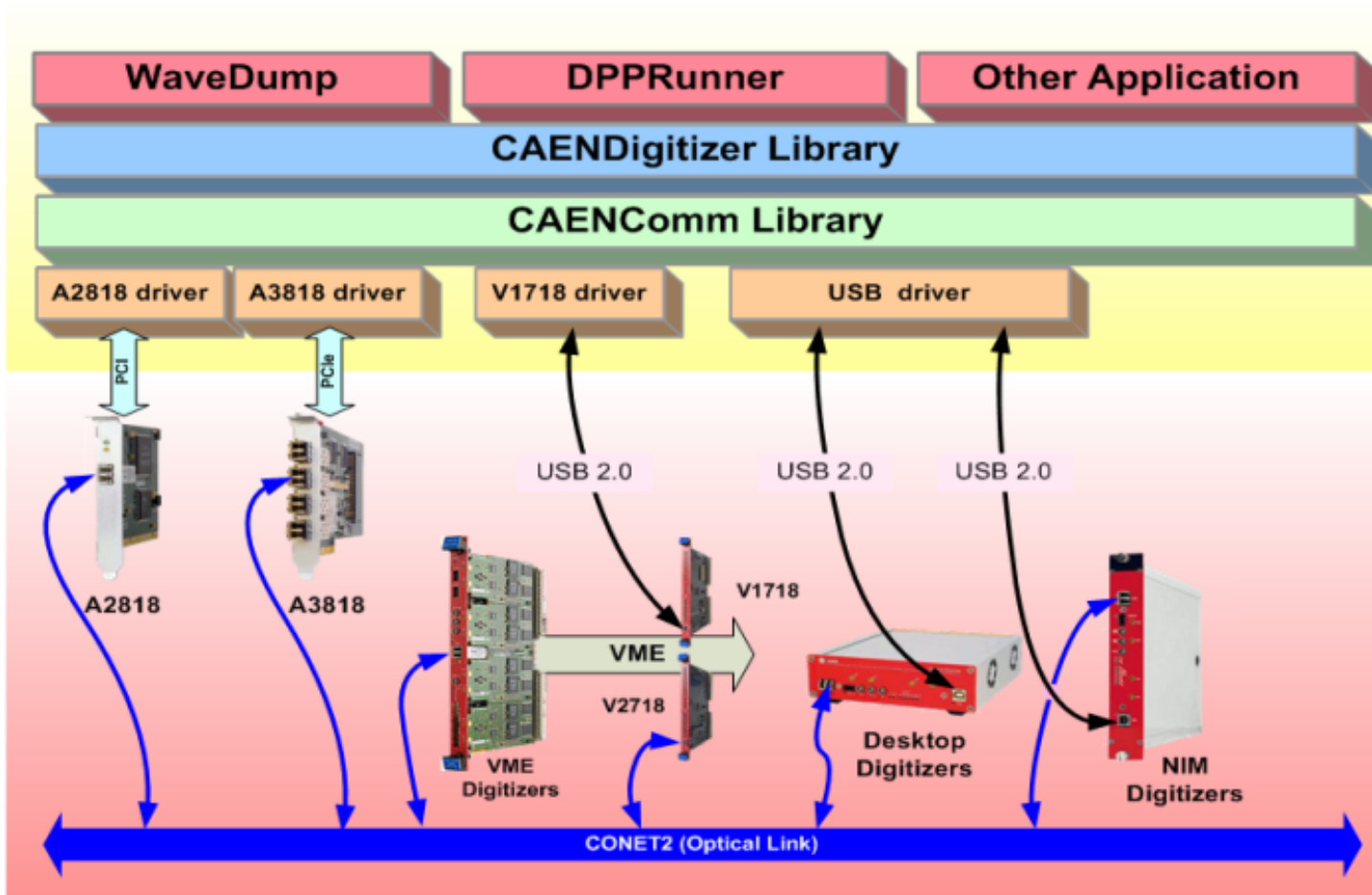
“EASY” System - CERN/LHC Embedded Assembly System

for “hostile” areas with COTS components

- 7 kGauss magnetic field
- $1 \cdot 10^{11}$ p/cm² TD - 15 kRad TID
- $2 \cdot 10^{12}$ n/cm² TD



Control Software philosophy for Digitizers



Control Software philosophy for Power supply



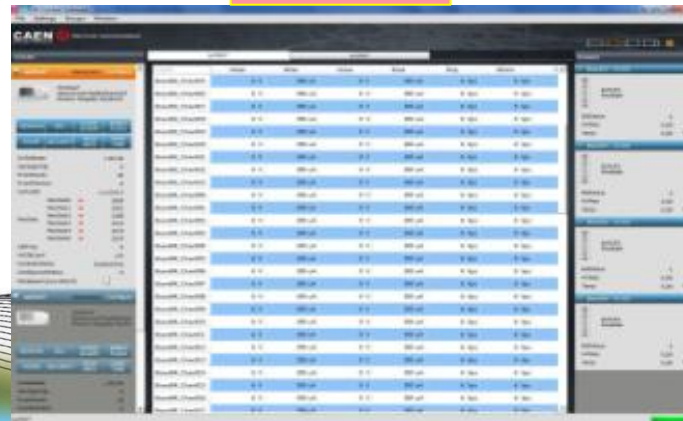
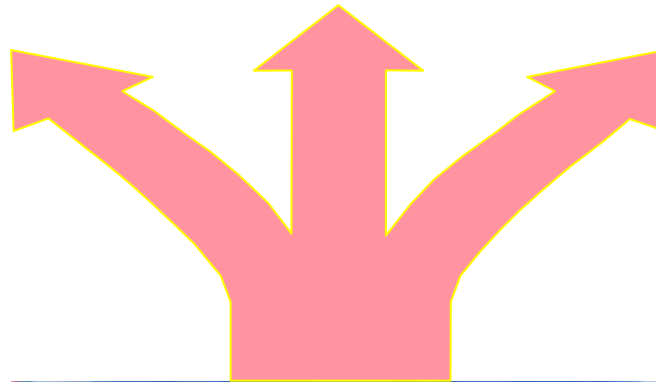
**Touchscreen,
external keyboard**



Host PC



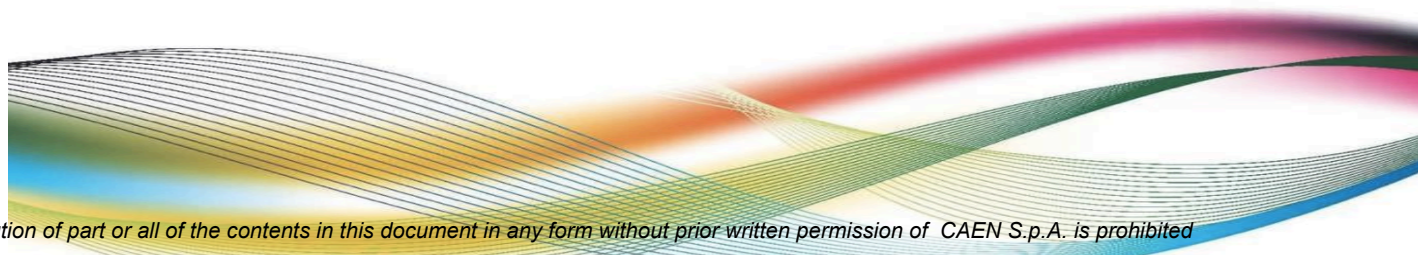
Tablet





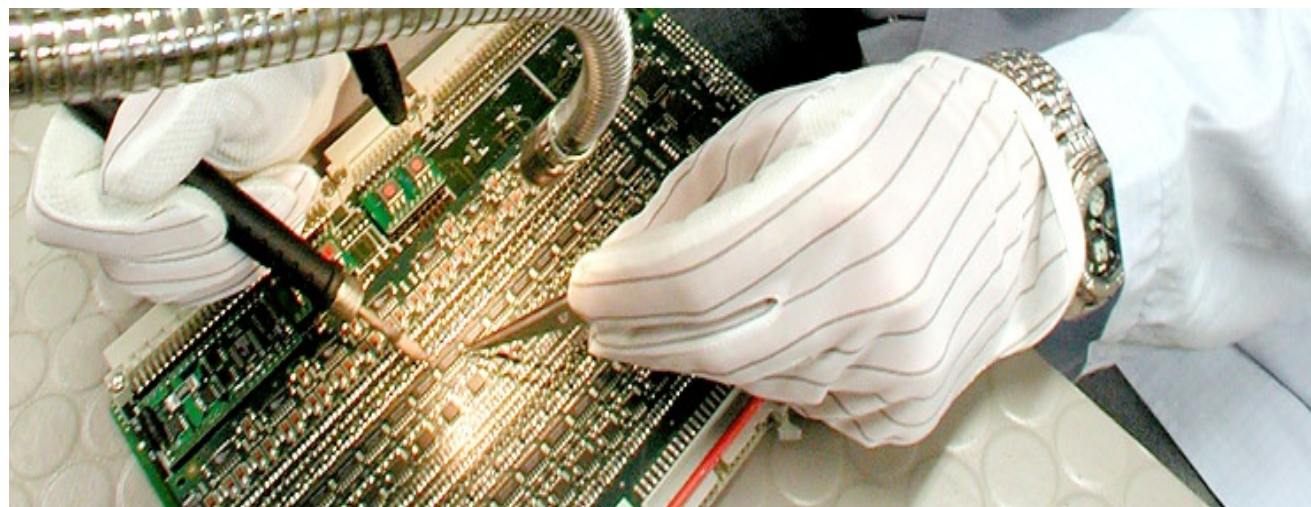
Key Strengths

- **R&D**
- **TEST**
- **MAINTENANCE**
- **SPIN-OFF**



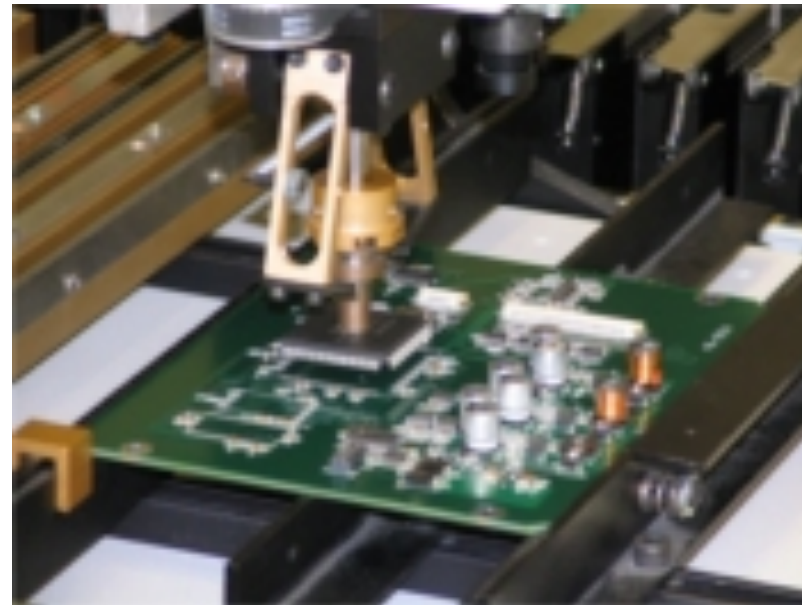
R&D

- **R&D Division at the forefront of technology (26 designers)**
- **Ongoing collaborations with important institutes (Elettra, IN2P3 (LAL,IRES..), PSI, INFN..)**



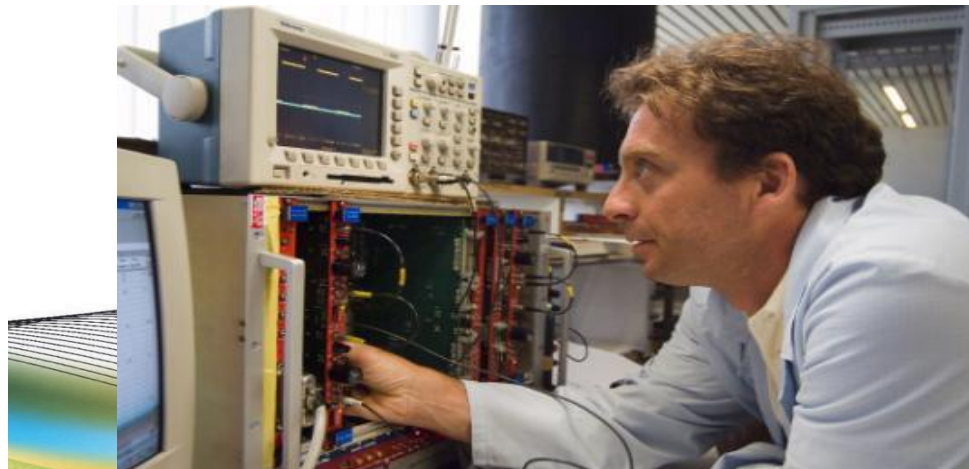
TEST

- **Assembly Outsourced**
- **In-House Calibration and Test with a Staff of 26 people**



Maintenance

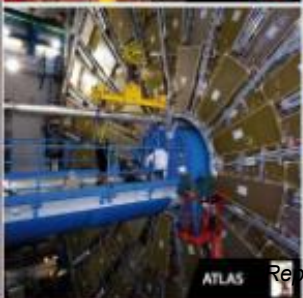
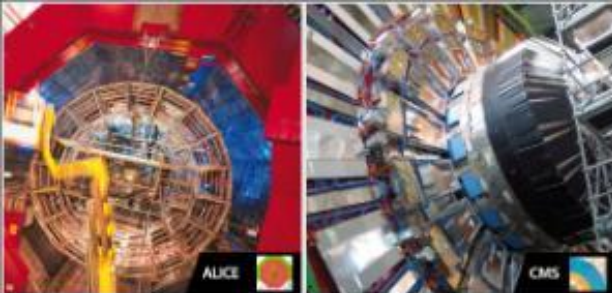
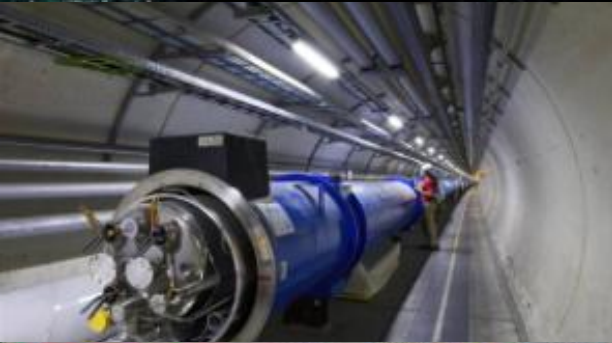
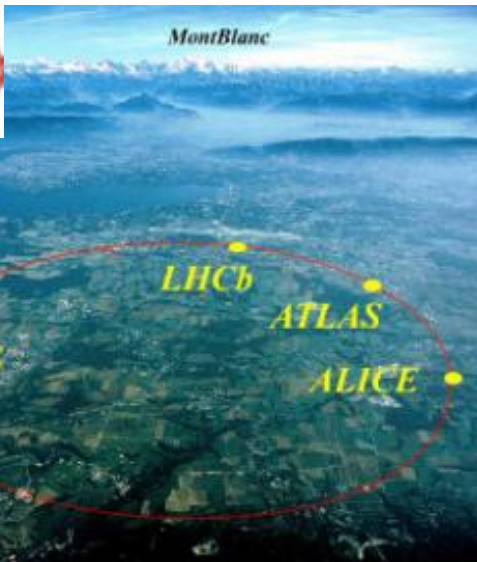
- **Excellent pre- and post-sales support: Maintenance division**
- **Staff: 10 specialized senior technicians**
- **Maintenance on site**
- **Training for on site technicians**



Spin-off

- **Flexibility and capability of facing new markets and new products & company (Spin-offs)**
- **CAENSSp** <http://www.caen.it/>
- **CAENels** <http://www.caenels.com/caenels/>
- **CAEN RFID** <http://www.caenrfid.it/>
- **NEW - CAENqS (quantum Security)**





CAEN & LHC Experiments

1998 – 2008

SYNERGY for SUCCESS

10 years of joint efforts to achieve top performances

- **6.500 electronic units delivered**
 - 190.000 sub-boards
- **Designed for Hostile Environments**
 - Magnetic Field resistant (up to 5000 Gauss)
 - Radiation tolerant

CAEN & LHC Experiments



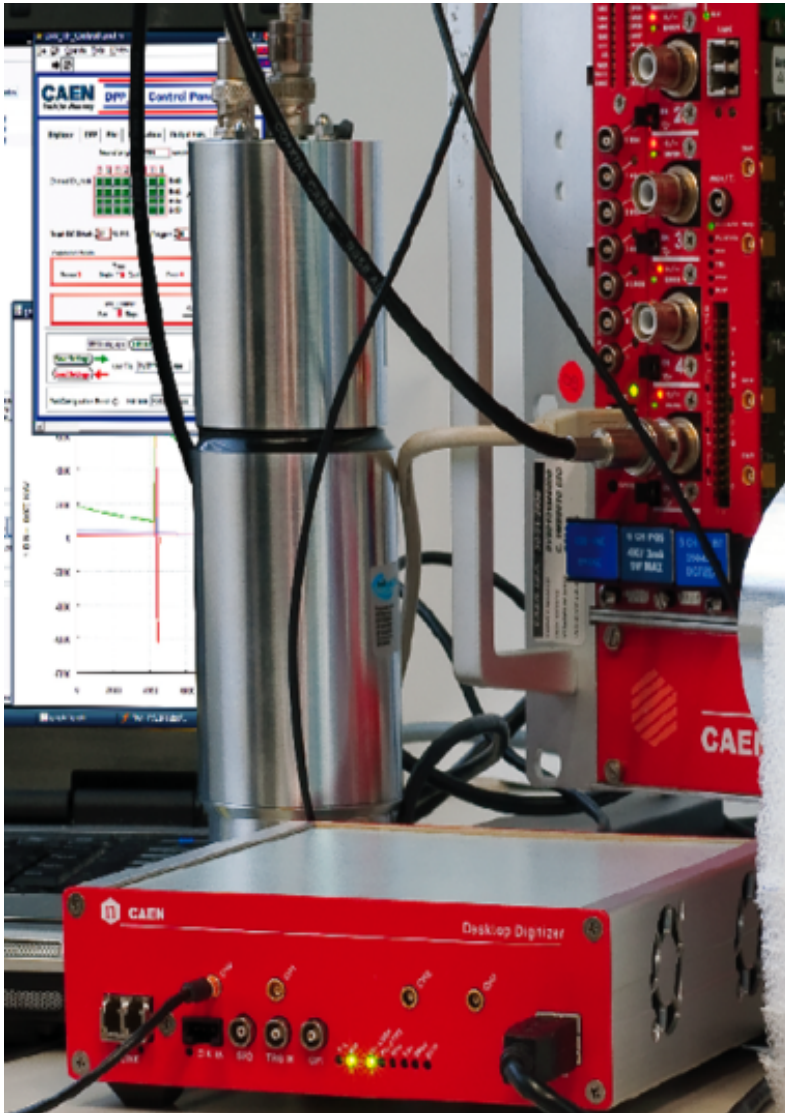
1998 – 2008

SYNERGY for SUCCESS

CAEN has received the **"CMS Crystal Award of the year 2009"** for the development and production of the power system for the CMS Tracker.

- **Detector subdivided into 1994 Power groups**
- **HV (0÷600V) for silicon strip detector**
- **LV (1.25V - 2.5V) for FE electronics**
- **Itot > 15 kA**
- **139 crates / 29 racks / 1200 Power Supply Units**

CAEN and its Partners/Customers: Winning Synergies



- **CAEN is always open to cooperate and talk about new projects and partnerships**

CAEN

Tools for Discovery



Gianni Di Maio
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