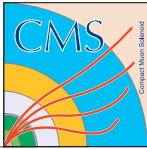


The DAQ column of the CMS Experiment

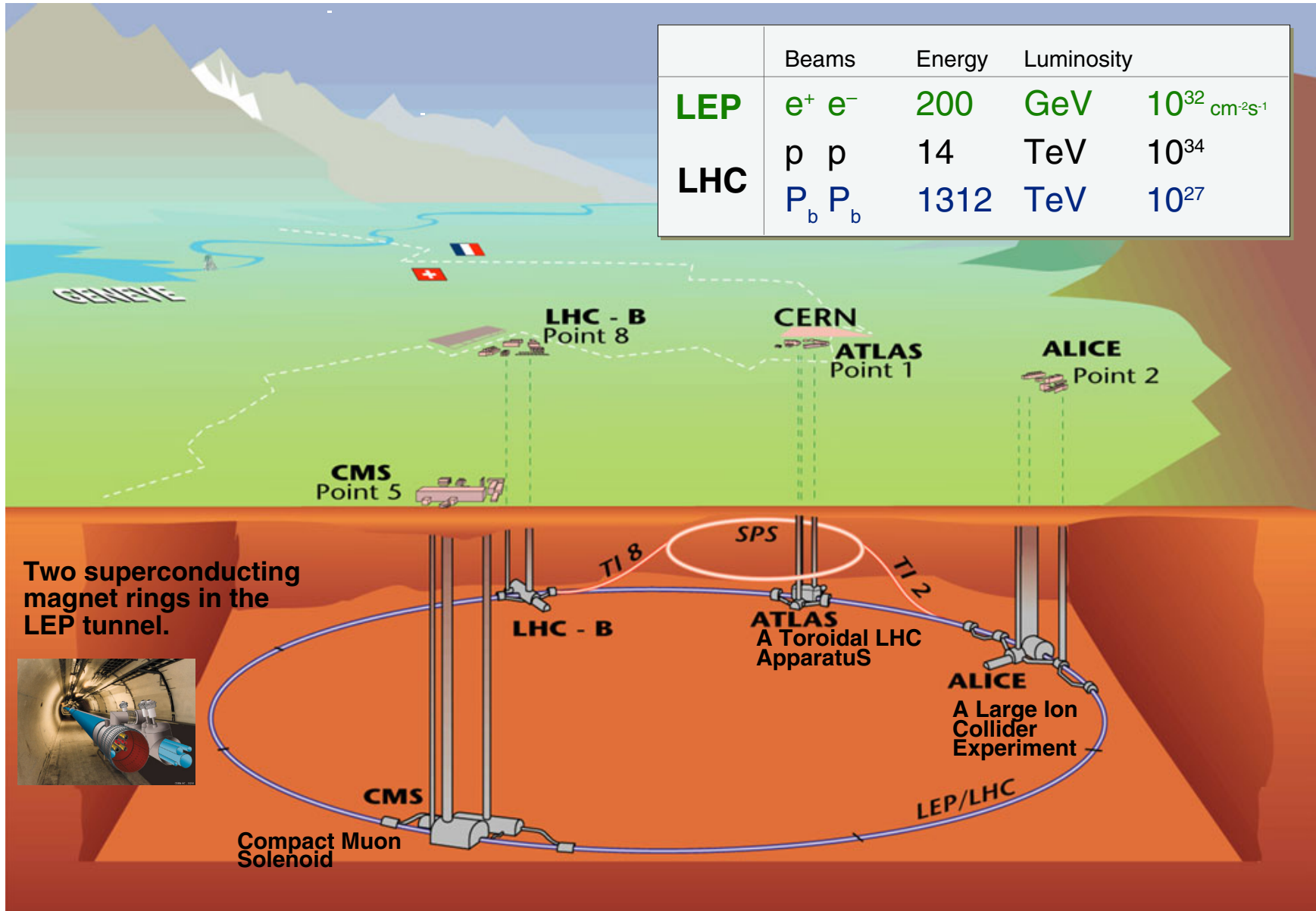


- The Challenge:
LHC and CMS requirements
- The Plan:
The Current Design of the DAQ
- The Way:
Purpose and Status of the DAQ-column
- Summary



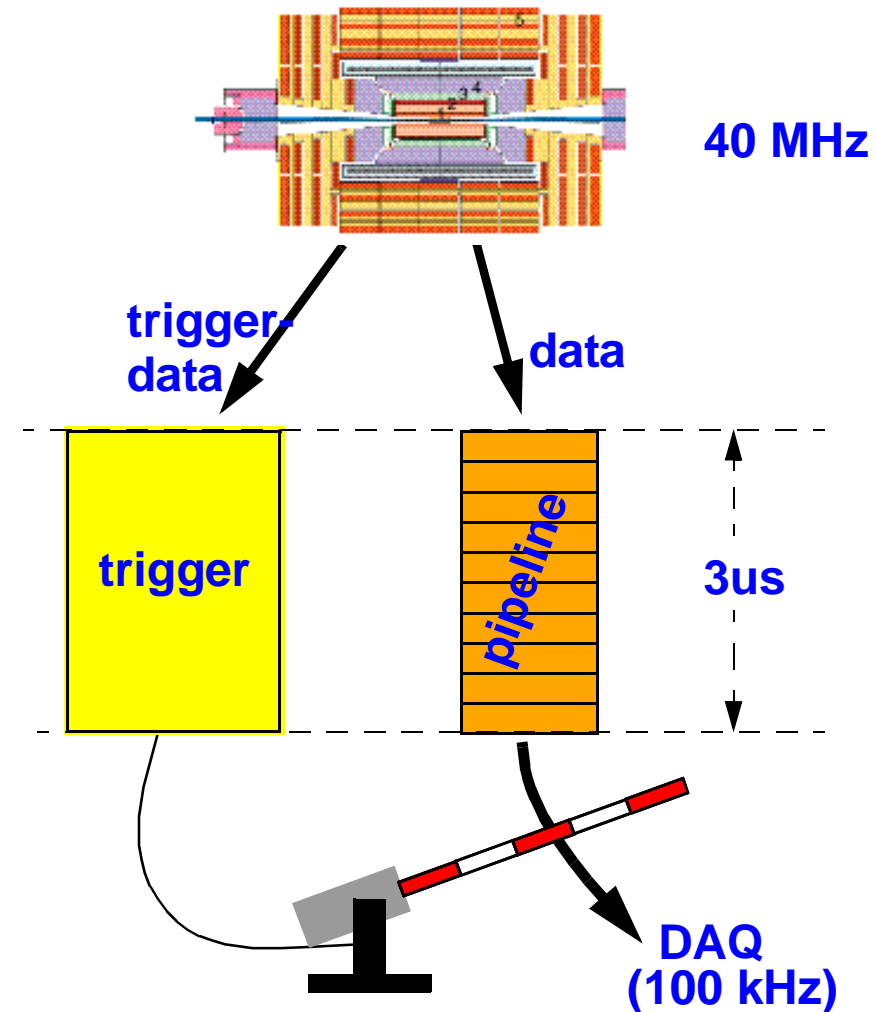
LHC machine and experiments

	Beams	Energy	Luminosity
LEP	$e^+ e^-$	200 GeV	$10^{32} \text{ cm}^{-2}\text{s}^{-1}$
LHC	$p p$	14 TeV	10^{34}
	$P_b P_b$	1312 TeV	10^{27}



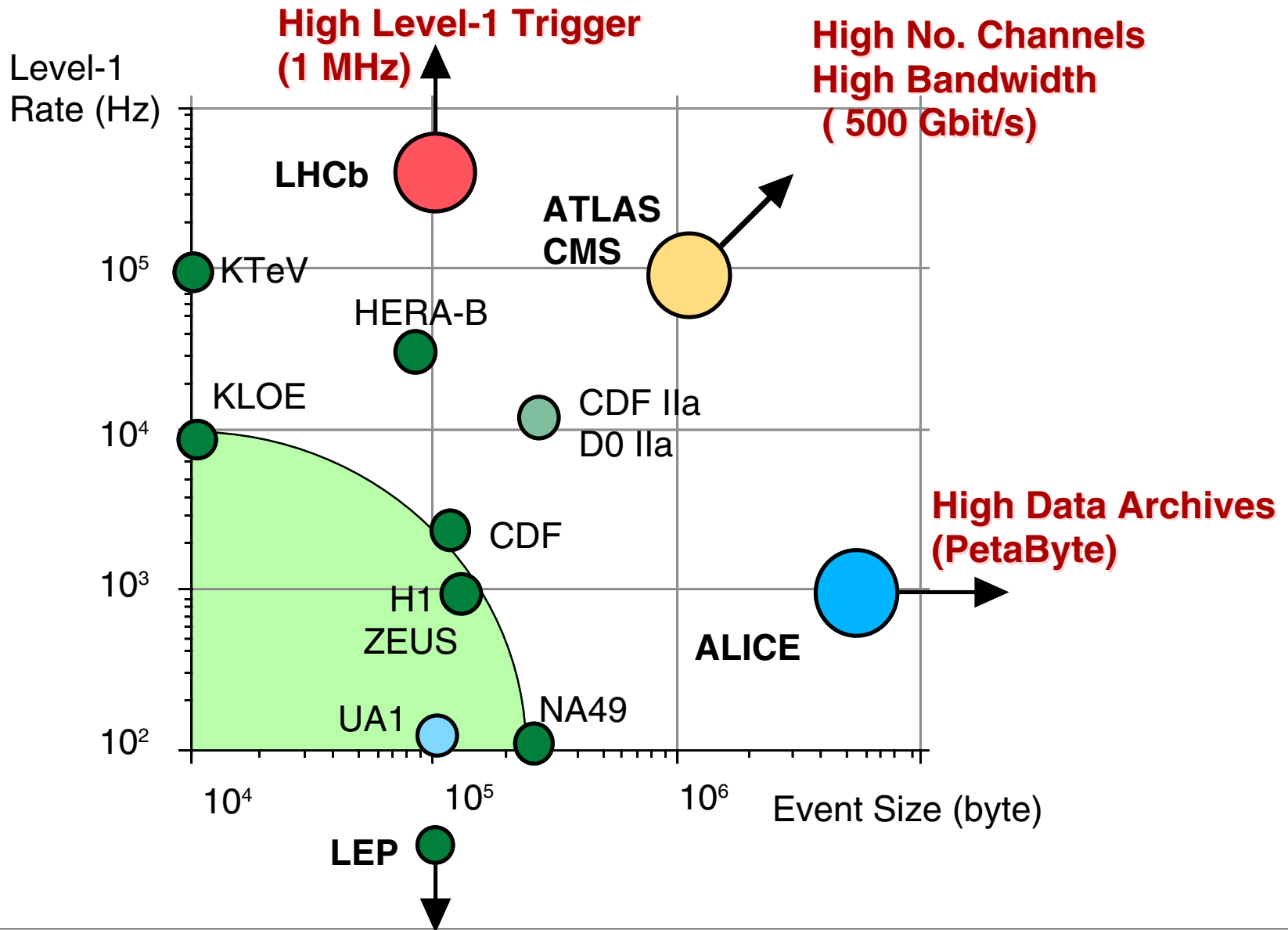
Operating Conditions for LHC & CMS

- Goal Luminosity : 10^{34}
 - bunch crossing every 25 ns ==> 40 MHz operation clock
- proton collision rate : 10^9 Hz (several collisions per bunch crossing)
- select interesting events: Trigger
 - high efficiency for physics events
 - deadtime less
 - Latency : 3 us
 - rate reduction : 40MHz -> **100kHz**
- avg. Event size : **1 MB**
 - DAQ must sustain **100 GB / s** (= 800 Gbit / s)



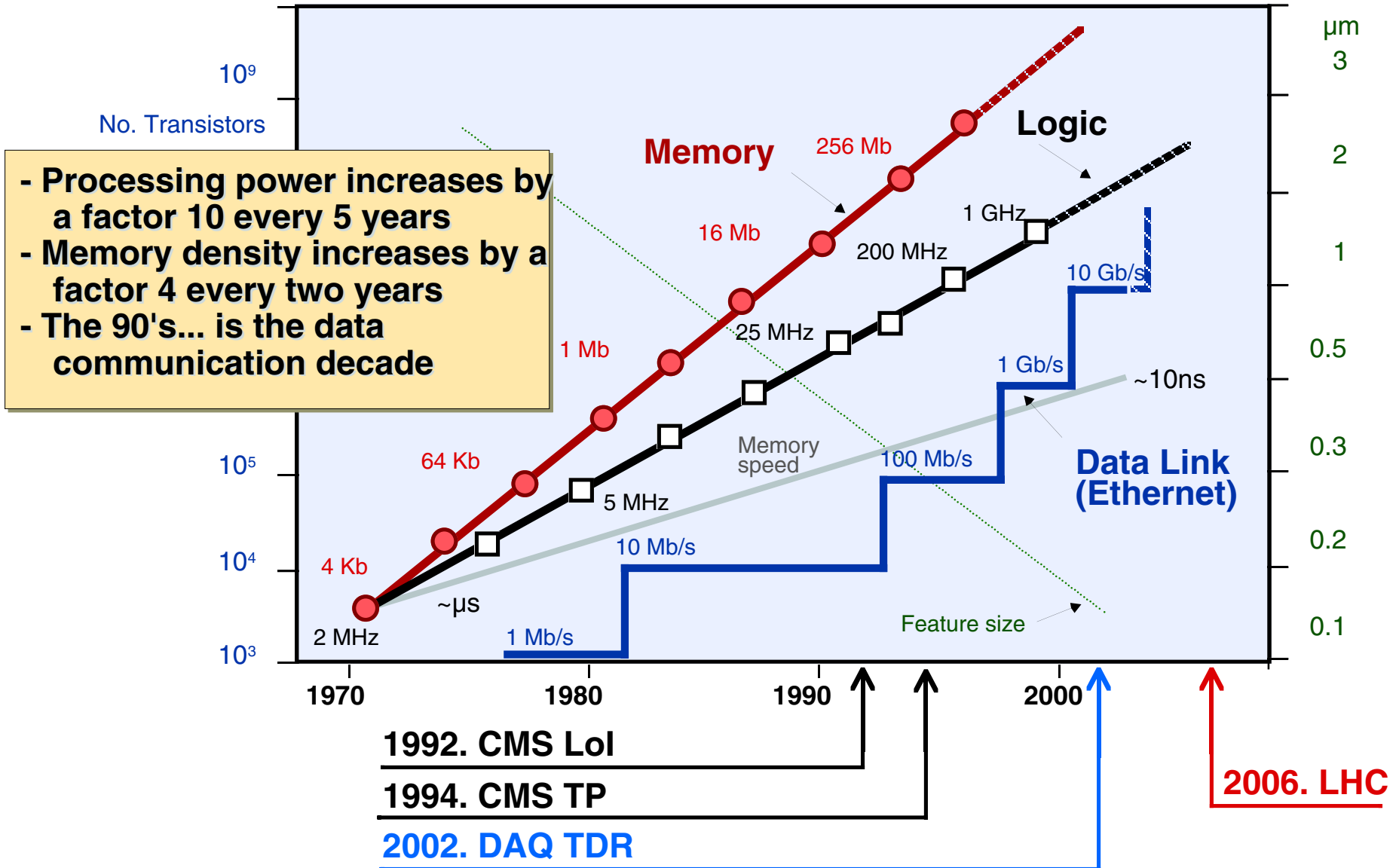


Trigger and data acquisition trends

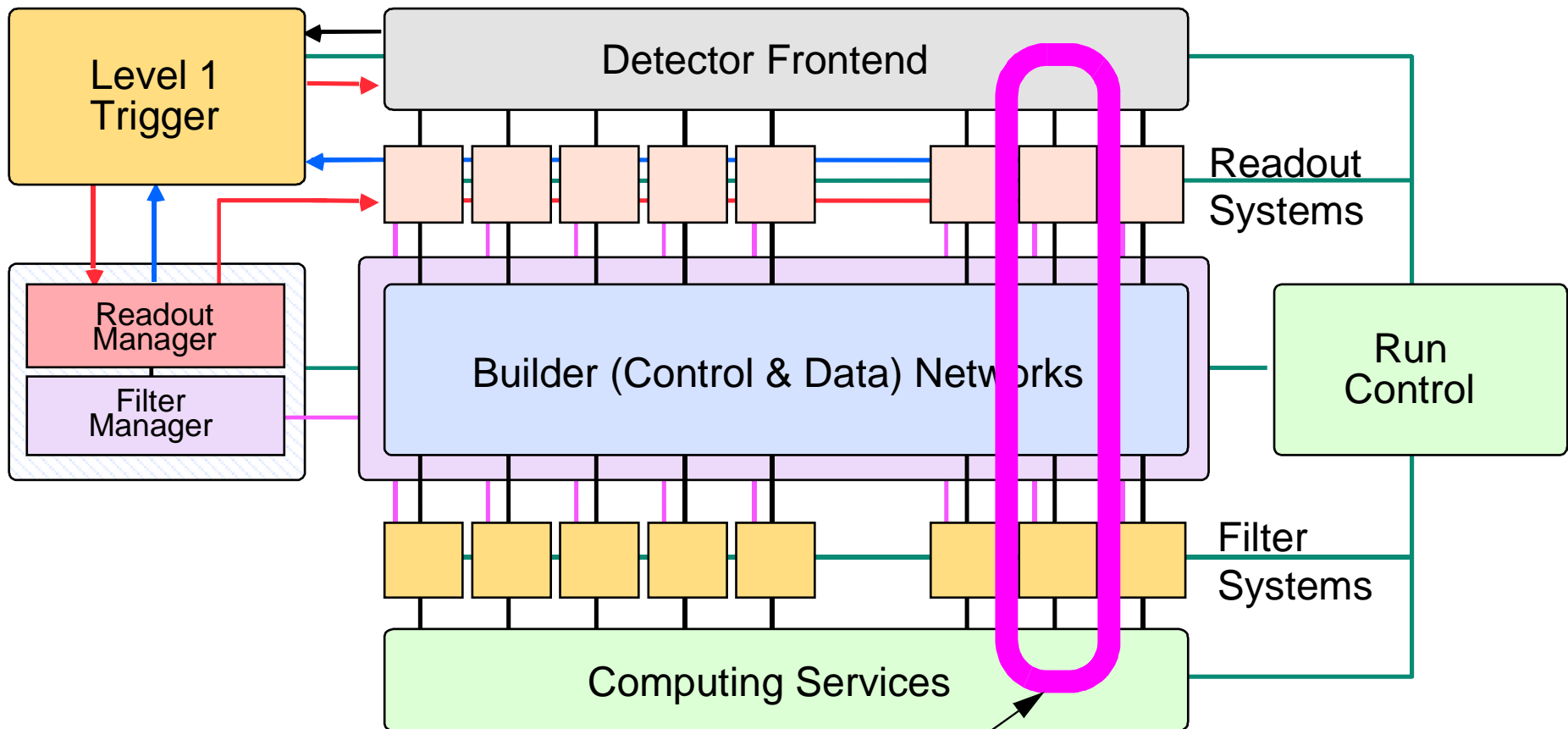




Technology trends (Moore's law)



CMS DAQ system design



DAQ-column : a vertical slice through the DAQ system

CMS DAQ Column

- **FED**

- Detector dependent custom electronics.
- Standard interface to DAQ (SLINK 64)
- optical link to RU

- **RU**

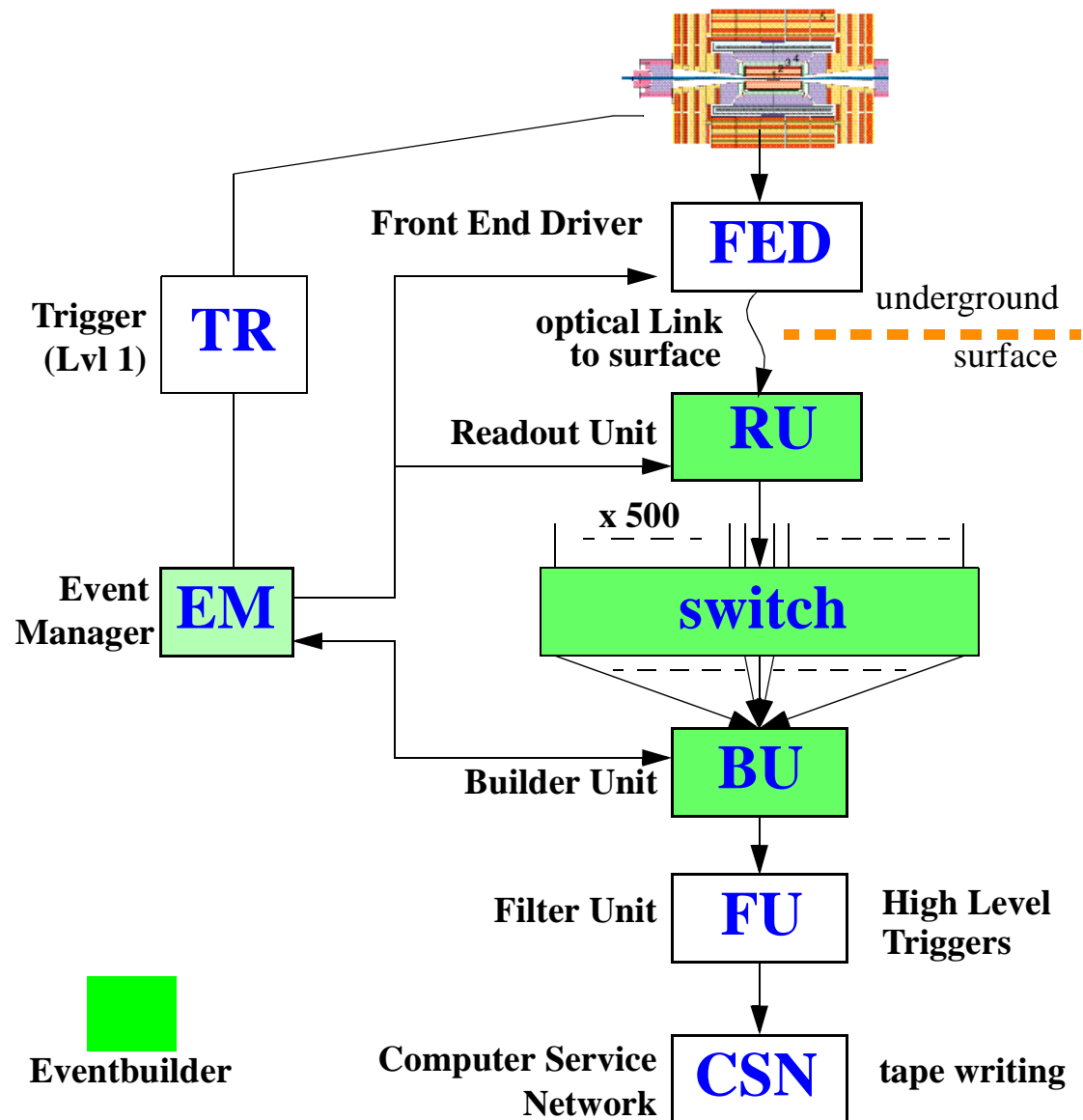
- Buffer Memory for data.
- associates event with ID from EM
- sends fragment to BU on request

- **switch, BU, EM**

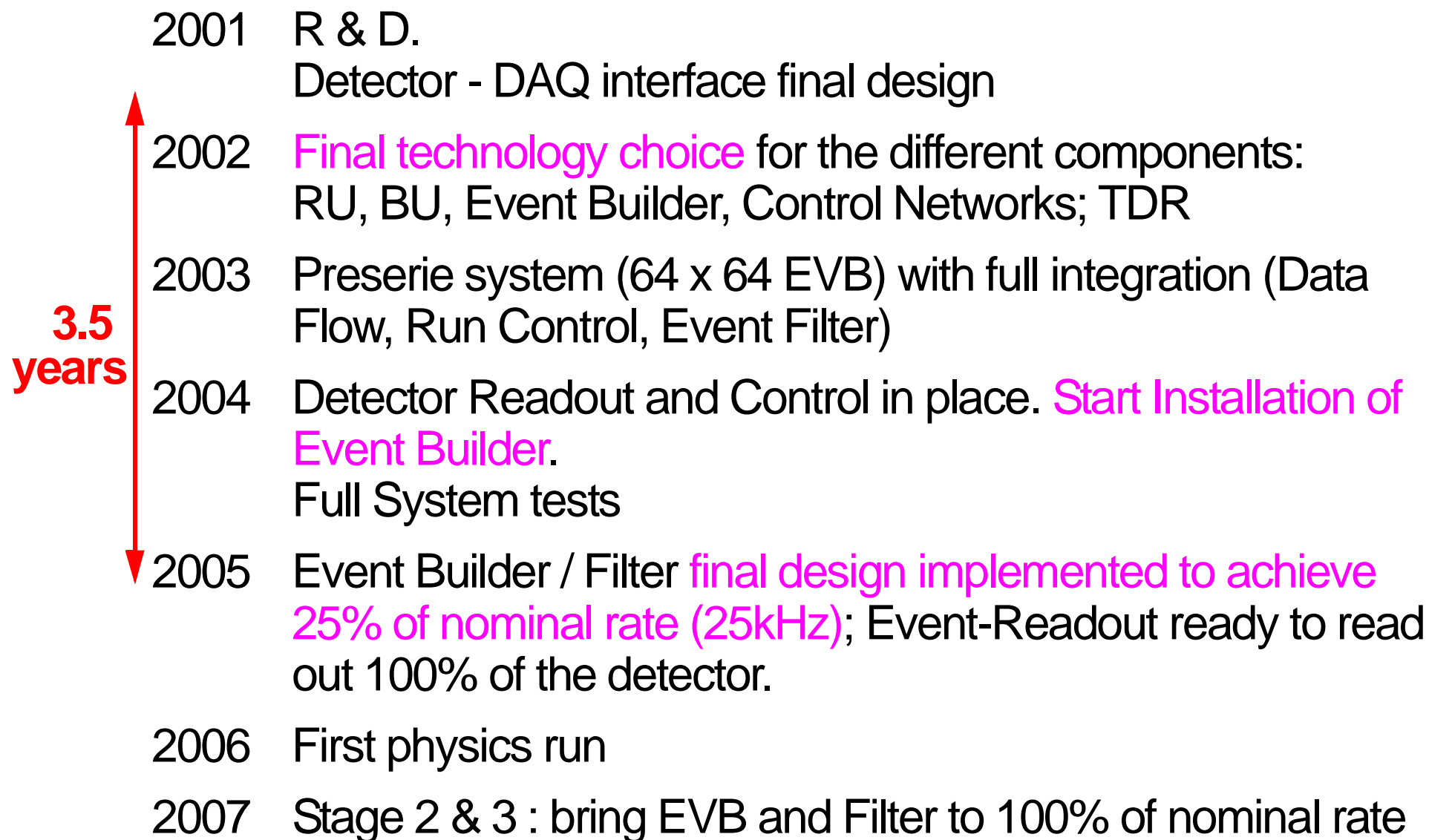
- form the event builder

- **FU**

- Implements High Level Triggers

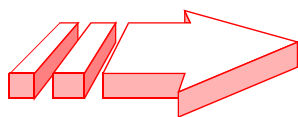
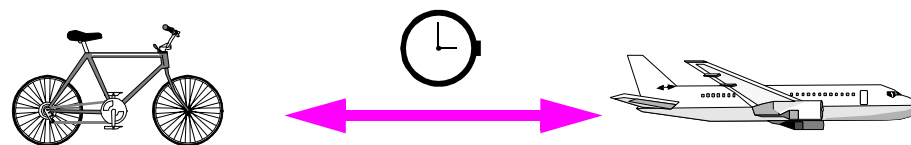
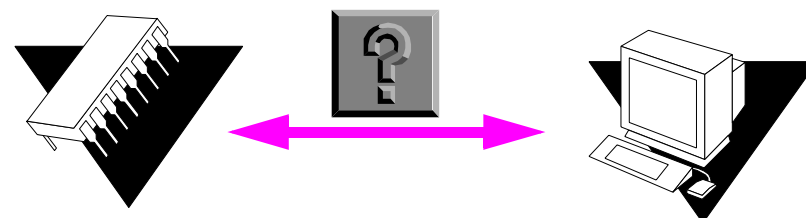


DAQ schedule



Goals of the Column Prototype

- Need a test-bench to finalize R & D
- Prove the feasibility of the chosen design
 - test **interfaces** between different units
 - test **protocols**
- Try out different implementation options for final design
 - test bench for various **technologies**
 - find the border line between **custom hardware** <---> **PC + software**
- Measure performance

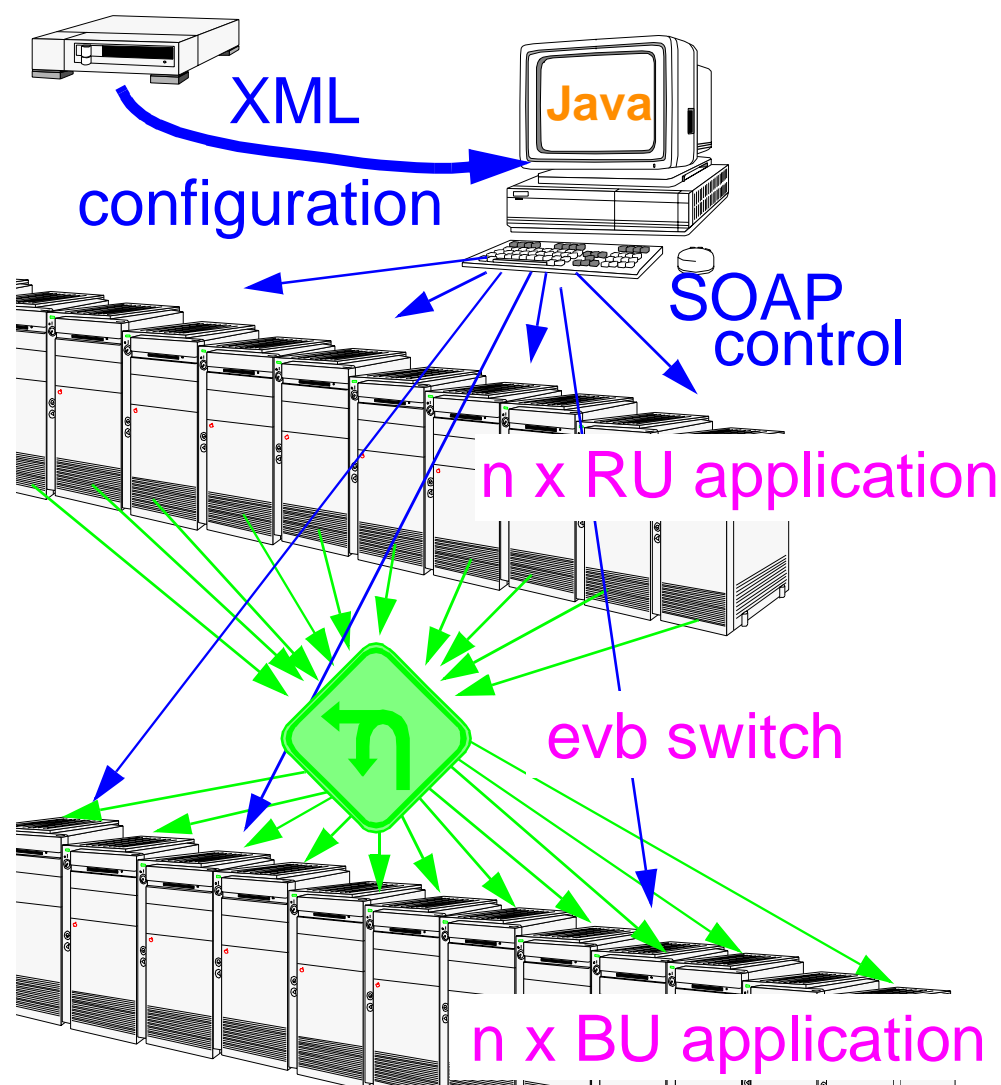


freeze the design + implementation in first half of 2003

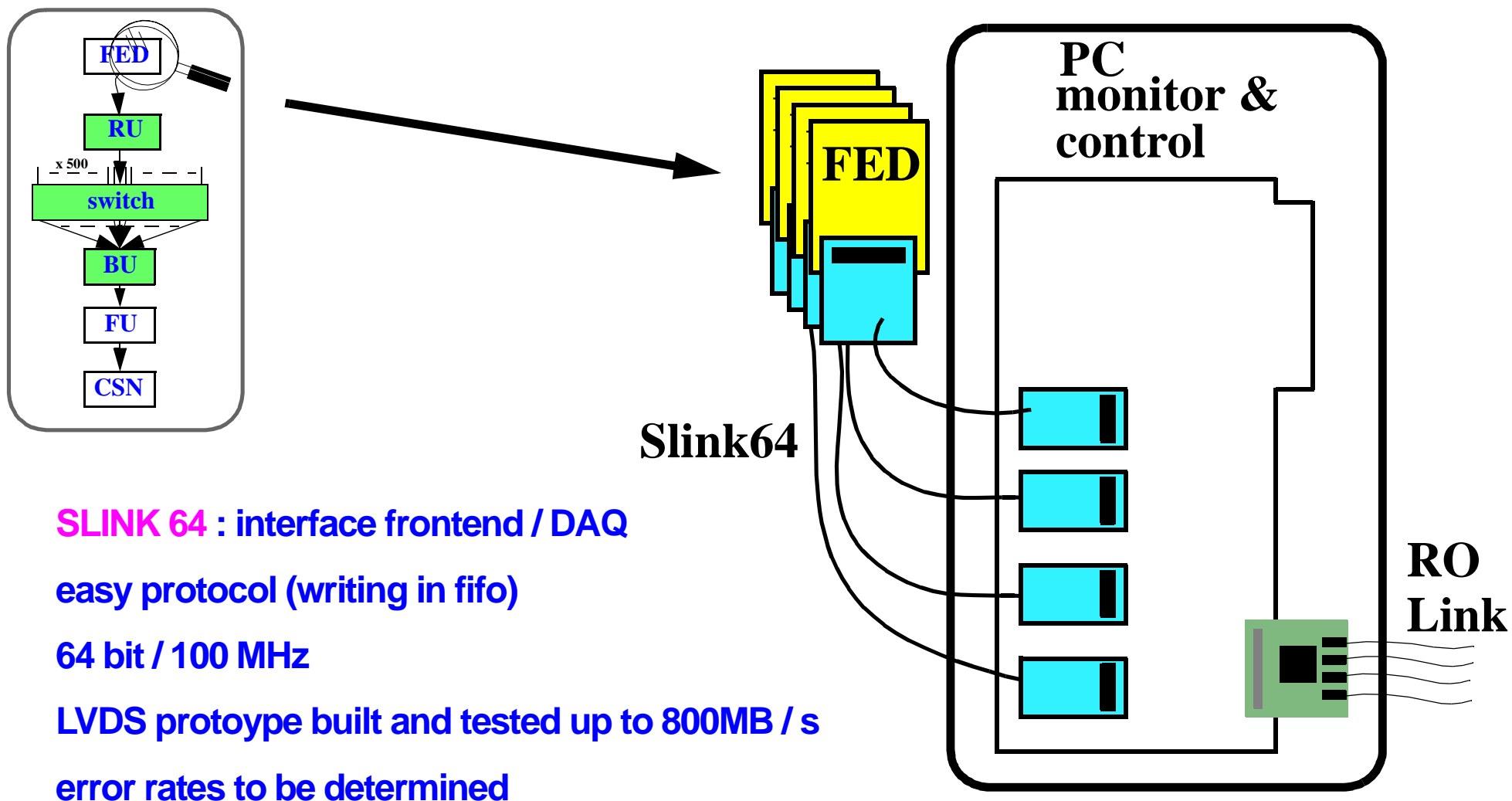
DAQ Column implementation : Software

- XDAQ: A framework for a distributed Data-Aquisition system

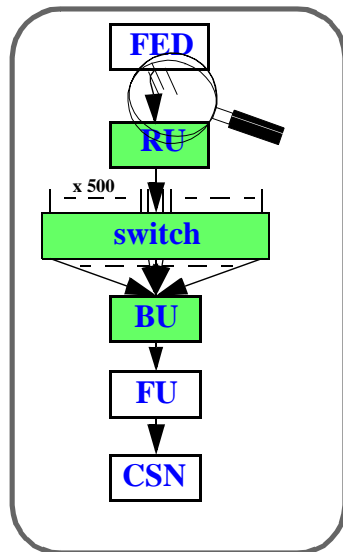
- execution **framework** for specific DAQ applications
- defines and implements interfaces for **inter-application communication** (compare: CORBA, RMI)
- DAQ-system-**configuration** driven by **XML** descriptions
- application-**control** by **SOAP** remote method invocation
- contains **applications** with the functionalities of the CMS DAQ-components: RU, BU, RM, BM,... These applications handle the data transfer.
- can use **different transport layers**: Myrinet, Gigabit Ethernet and TCP/IP
- runs on **different platforms** (SUN, Linux, VXWORKS)



DAQ Column implementation : FED Interface

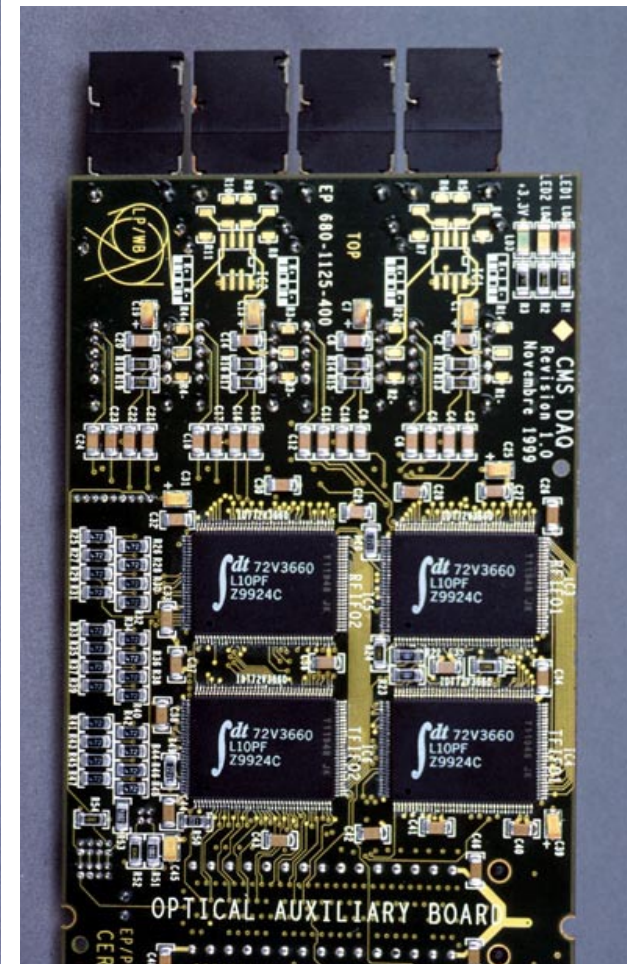
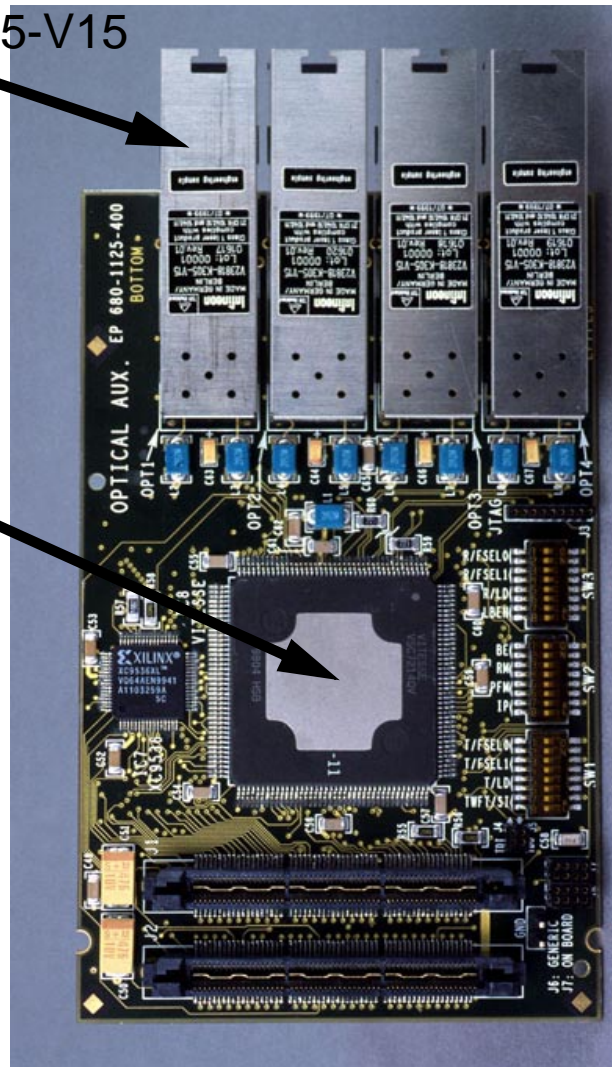


DAQ Column implementation : Readout Link



4 x Infineon
V23818-K305-V15

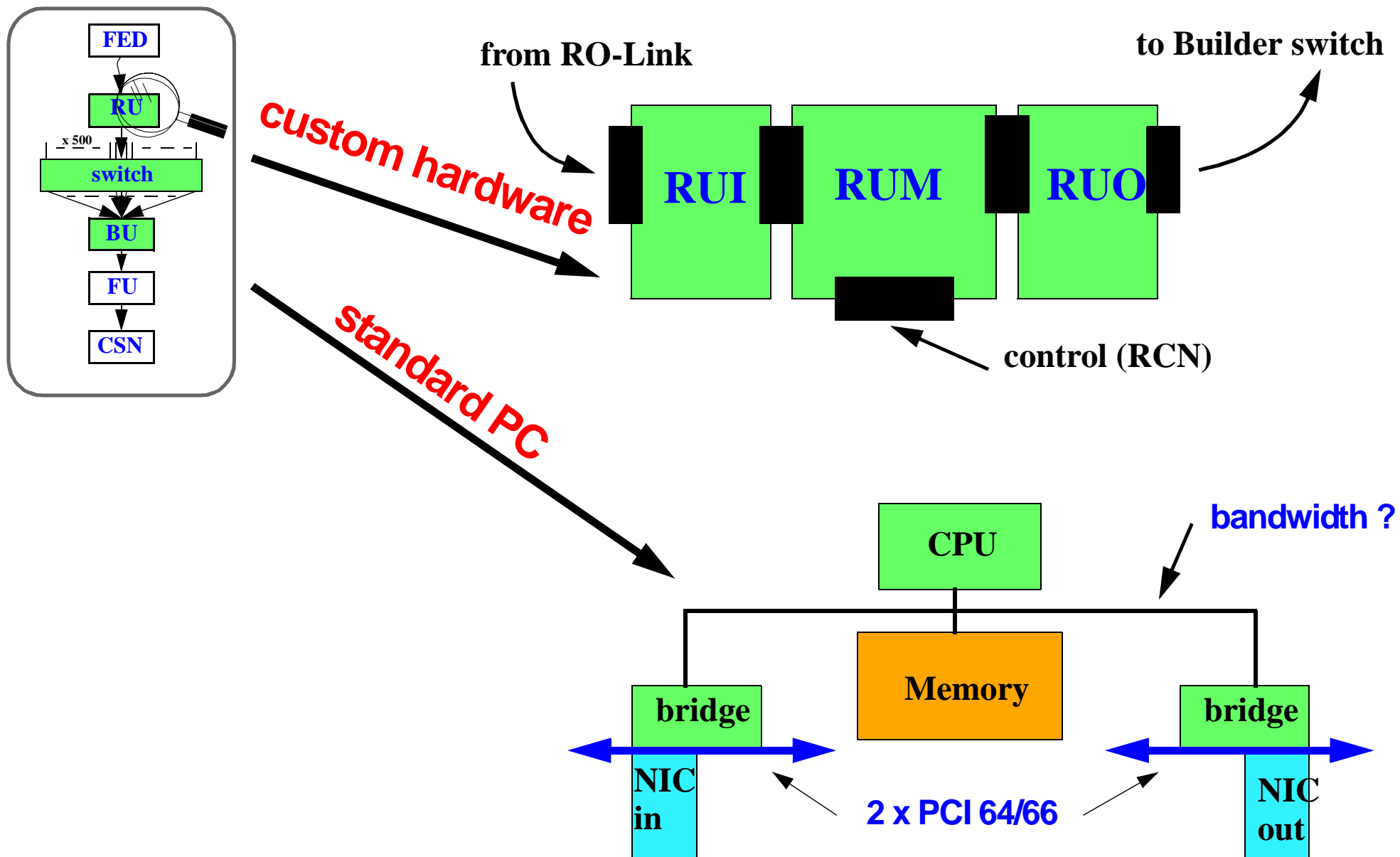
Vitesse
VSC7214



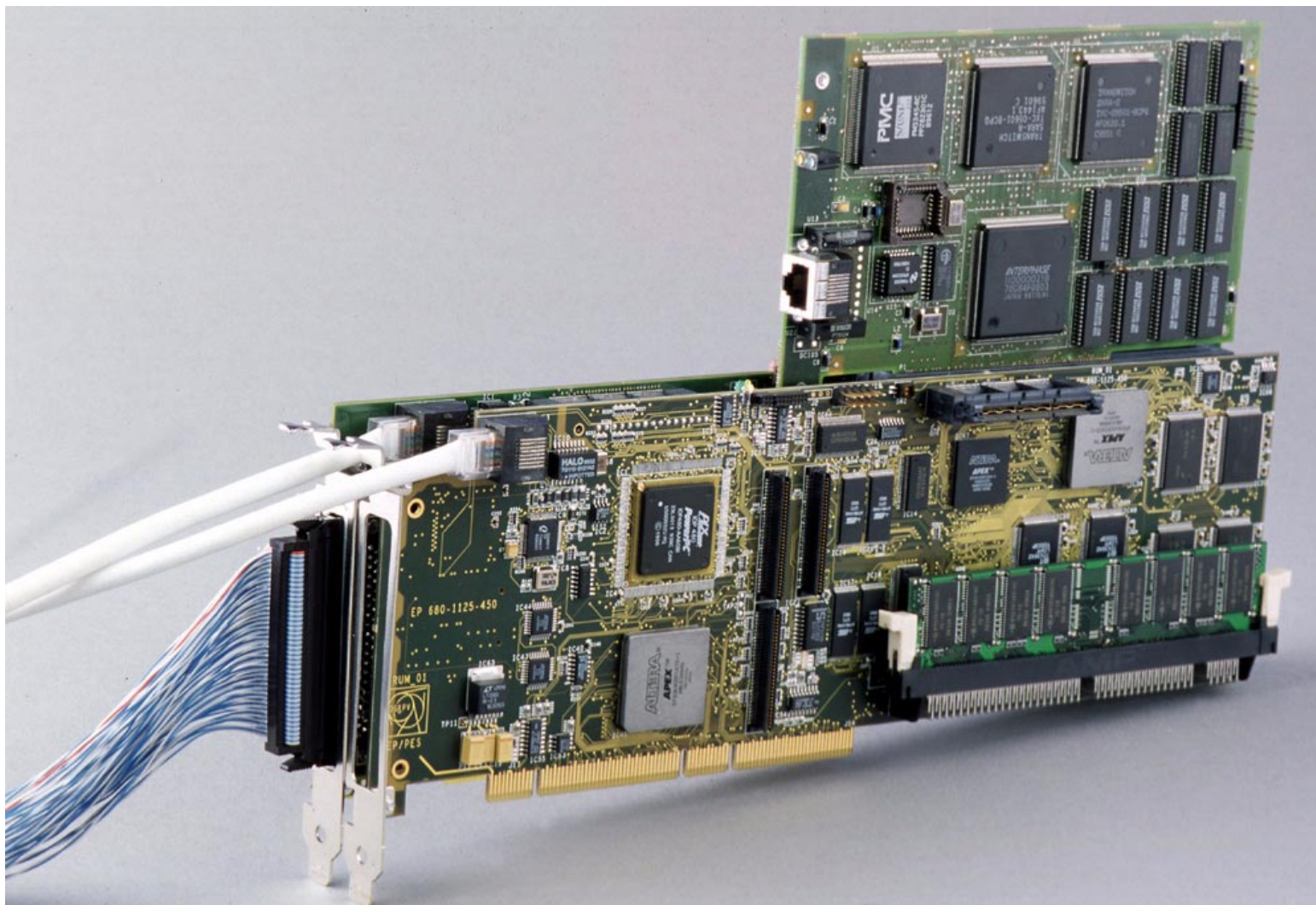
Readout Link :
full duplex
32bit / 100 MHz -> 400 MB / s
prototype built and being tested

Alternative : Commercial Link
(Myrinet; to be tested)

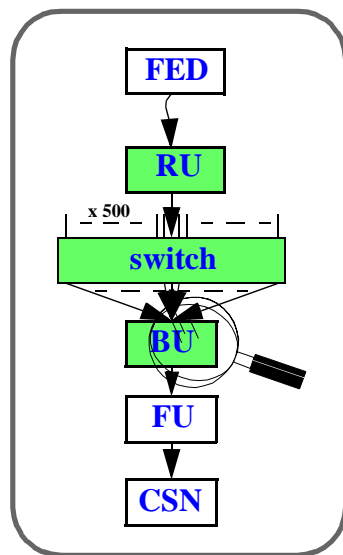
DAQ Column implementation : Readout Unit



The RU - Memory prototype



The BU



Features:

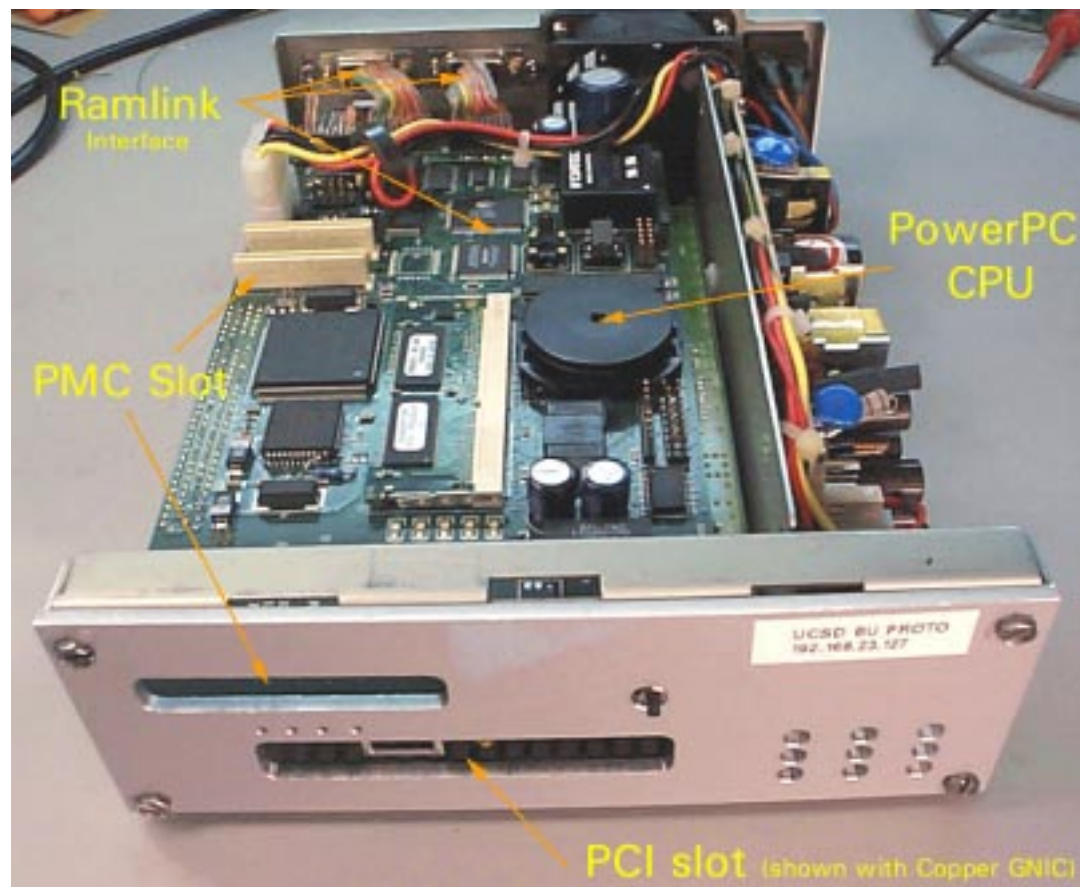
low cost PPC board

custom high speed link

2 units can form one BU

Alternative :

standard PC (see RUM)



Conclusions

- The **CMS-DAQ column** prototype is a vertical slice containing **all components** of the DAQ system.
- Prototypes for all functional components are existing or are being built.
- In the DAQ column these components will be **integrated**
- The Column is a **test bed** for alternative applications
- The column will help to decide the final implementation choice of various components:
 - different technologies**
 - custom hardware or PC with software**