Calorimeter DAQ Upgrade for HERA-II

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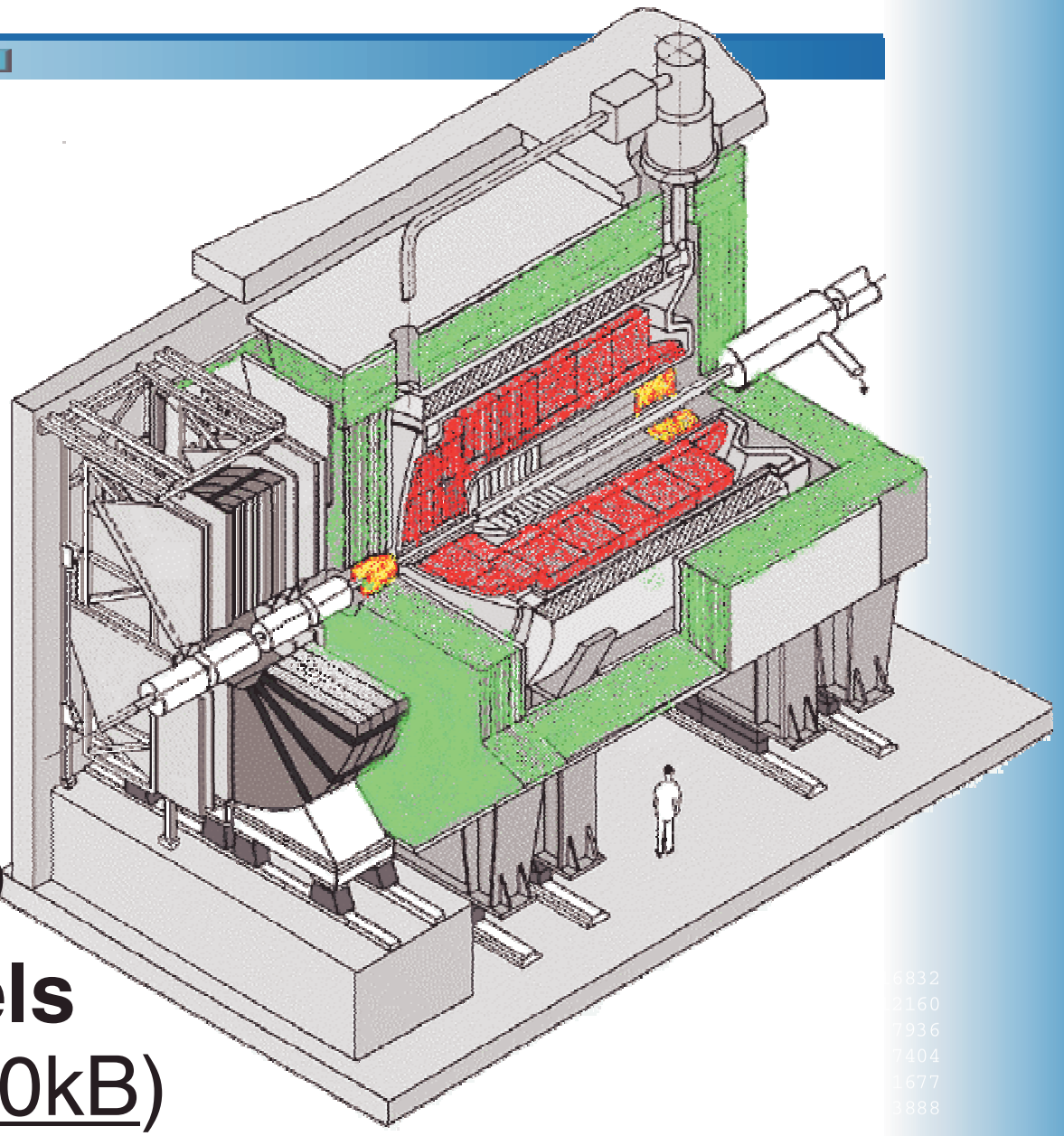
- **Starting point: the HERA-I DAQ system**
- **Conception: Unix and TCP/IP — VME**
- **Implementation:**
  PPC — LynxOS — Java, Perl, C
- **Performance**
- **Outlook and Assessment**

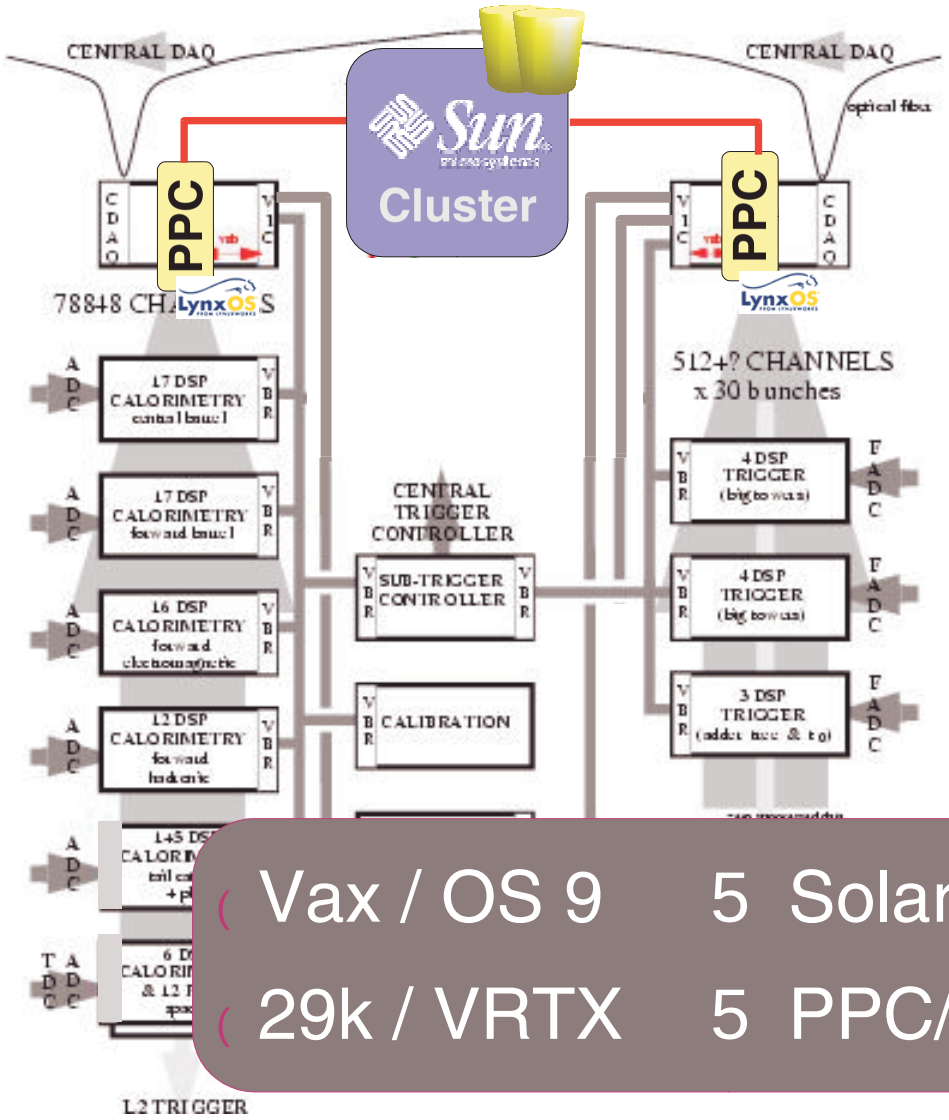
The H1 Calorimeters

- Liquid Argon Calorimeter
- Spaghetti Calorimeter
- PLUG Calori-meter (ADC)
- Tail Catcher (In-strum. Iron, ADC)
- **49897 channels** (180kB raw / 10kB)



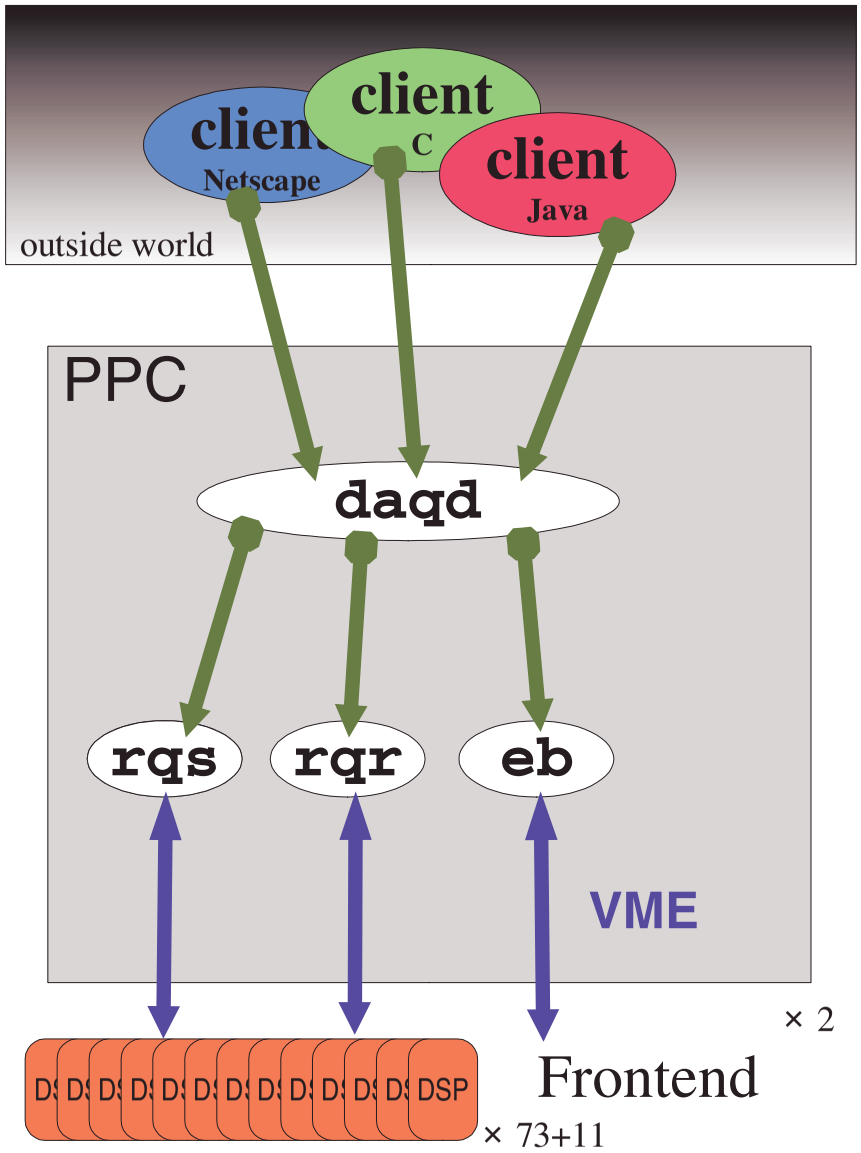
Starting point:
H1 Calorimeter DAQ for HERA-I

- ADC branch: **Energy**
  - 73 DSPs (56k)
- Trigger branch: **Time**
  - 11 DSPs (56k)
- VME/VICbus tree



- Vax / OS 9 — 5 Solaris/Linux
- 29k / VRTX — 5 PPC/LynxOS

Processes and Agents



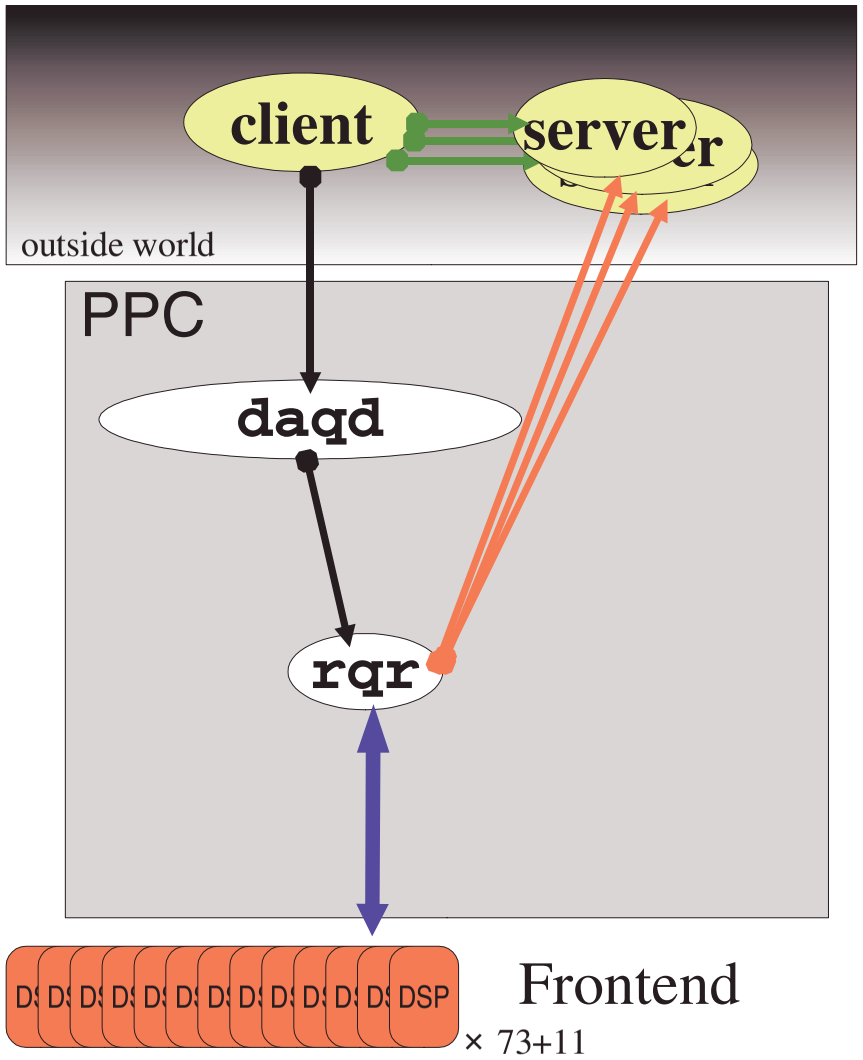
- DAQ « user »:
  calibration, setup, online (H1)
- DAQ « daemon » (server):
  for control and arbitration, launches:
  - ReQuest Setup
  - ReQuest Run
  - EventBuilder
  - others (Trigload, private, debug)
- IPCOMM: **text format**

Software Requirements and Solutions

- **Clients:** 
  - high degree of flexibility
- **Server (DAQ daemon):**
  - parser/interpreter function
  - arbitration
  - subprocess control
- **Hardware access:** 
  - performance, upto realtime needs
  - VME access in a complex VICbus tree

- « your choice »
  recommendation: Java
- Perl *a compiled scripting language*
  - slow startup, performant runtime
  - very convenient regex syntax, short design-to-product time, reduced error probability
- C language *a comfortable assembler*
  - best performance
  - careful design, testing and de-bugging

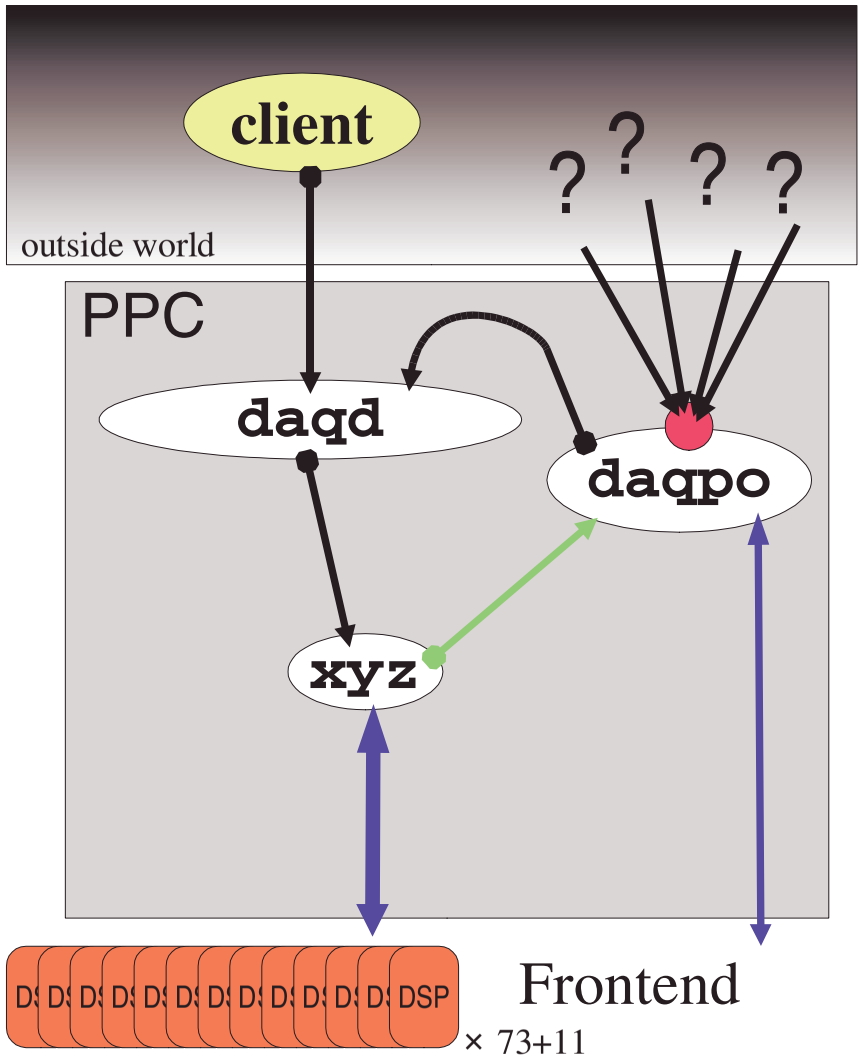
Dataflow 1: Calibration



- from the hardware, back to the client
- subserver launch, similar to FTP

- IPCOMM: **binary format** (H1 BOS banks)

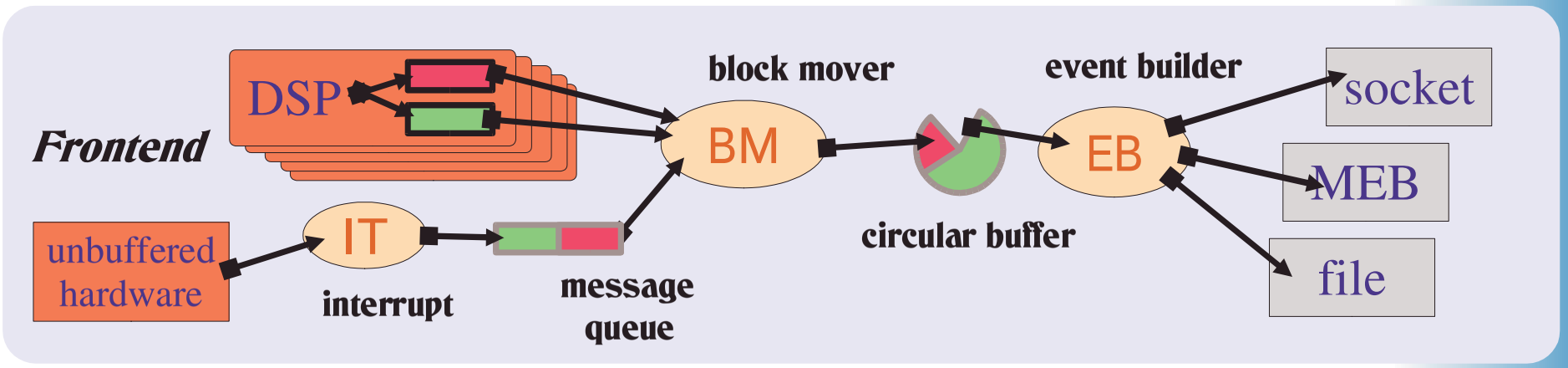
Dataflow 2: Messaging / Errors



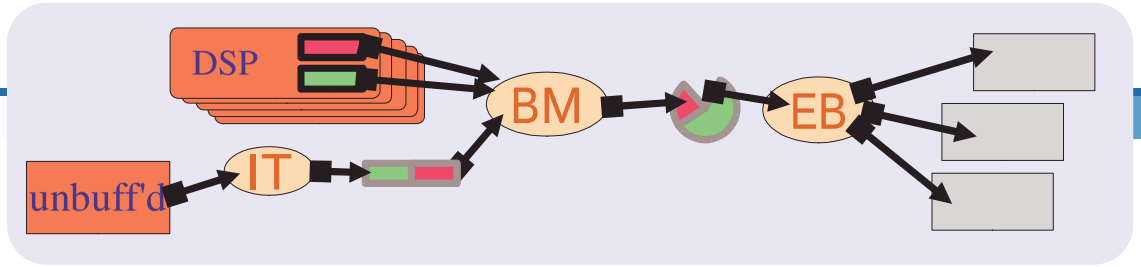
- DAQ **P**ost **O**ffice:
  - asynchronous communication manager
  - error message reception and distribution
  - “H1 client” / representative of Central DAQ
  - low priority task

Dataflow 3: Online Datataking

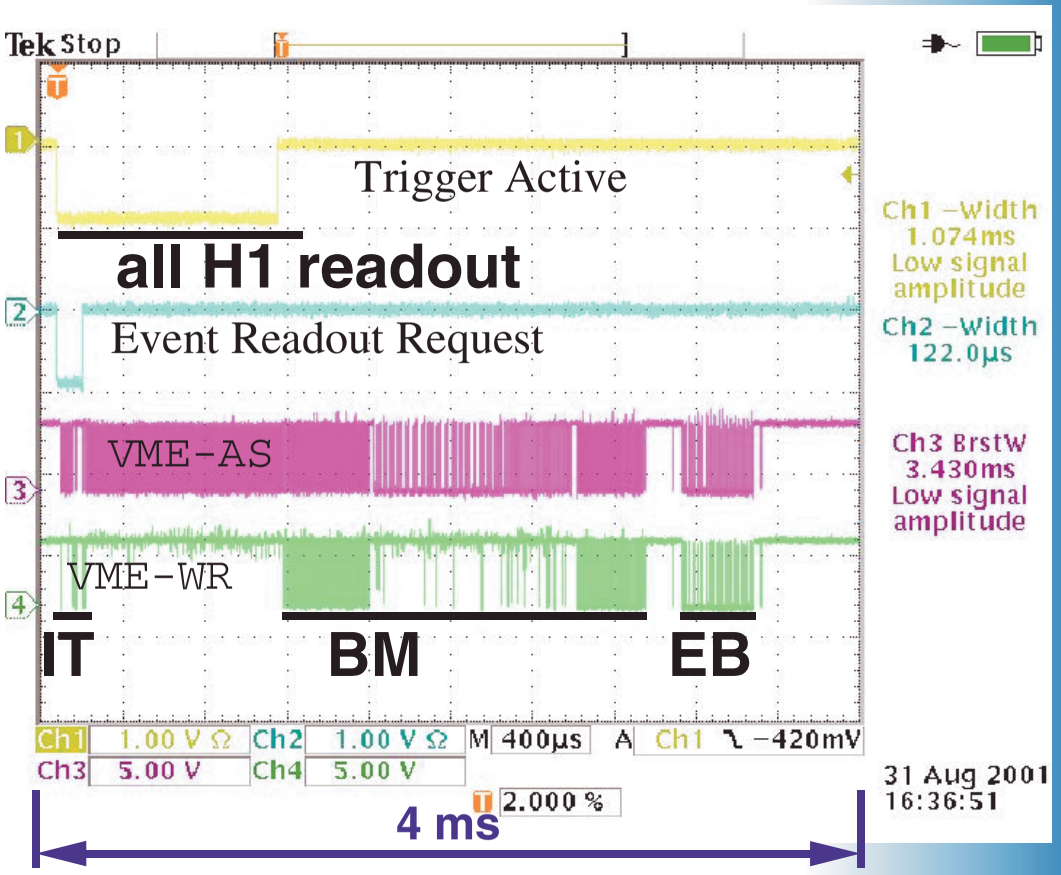
- Severe Requirements: 800µs frontend deadtime
- Threaded EventBuilder Process
  - three main POSIX threads:
    Interrupt (**IT**), Block Mover (**BM**), EventBuilder (**EB**)
  - POSIX message queues for communication
  - Unix sockets for control and monitoring



Online Performance



- 1st order D.T. 122 µs
  - for readout of unbuffered hardware
  - preempted by DSPs
- 2nd order/latency 2.4 ms Ø 425 Hz



- sufficient margin / factor > 2 improvement

User Interface

- Standard Shiftcrew / Expert Interface
  - using Java 1.3 (Swing)
  - Java Analysis Studio (JAS) 2.2.1

- Integration of formerly independent partitions in progress

Summary

- Principal outcome of DAQ Upgrade:
  - Improvement in second order reactivity
  - Standard Environment
    - Extension for new components (like the Jet Trigger)
    - Ease of maintenance for another decade or more
- Good experience with hybrid software solution
  - in a real time OS environment
  - with TCP/Internet Protocol data transfer
- **Ready for future upgrades and new applications**