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Current Trend of Trigger and DAQ Architectures for High Energy Physics Experiments

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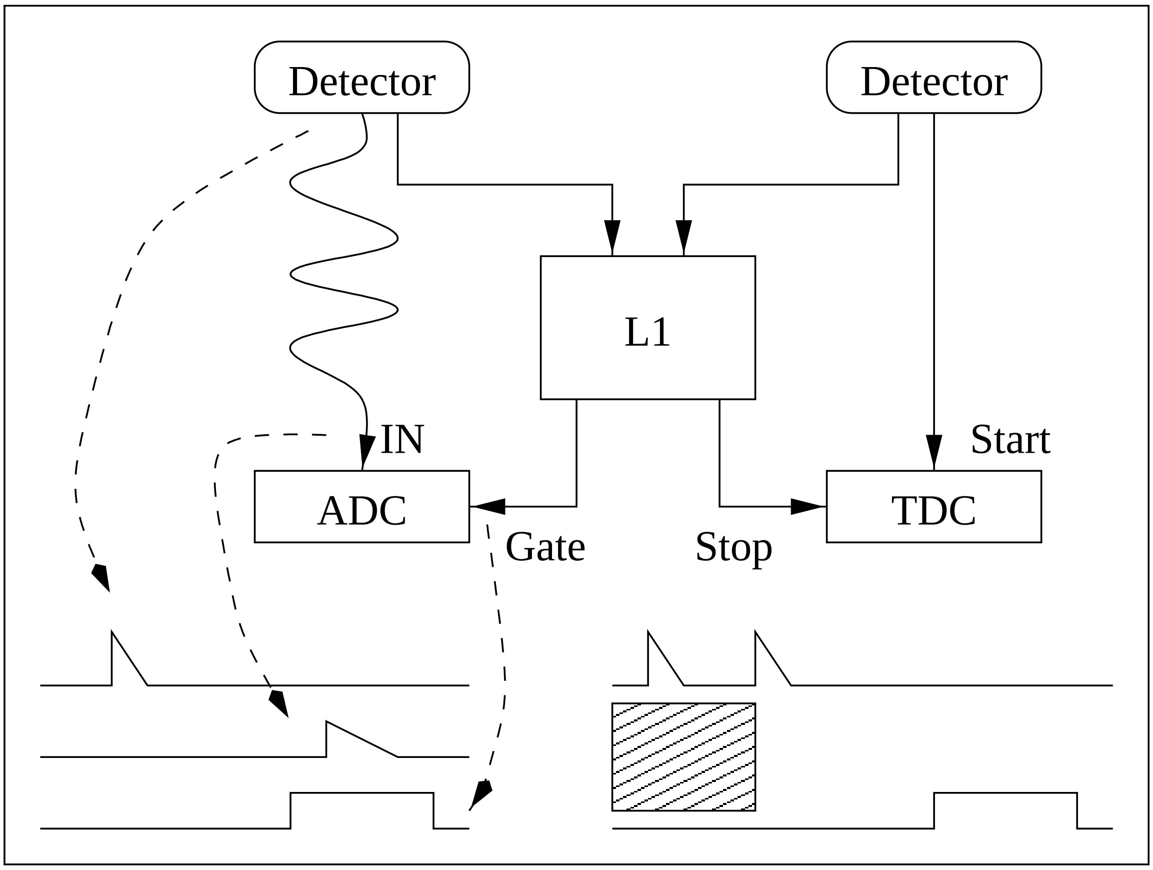
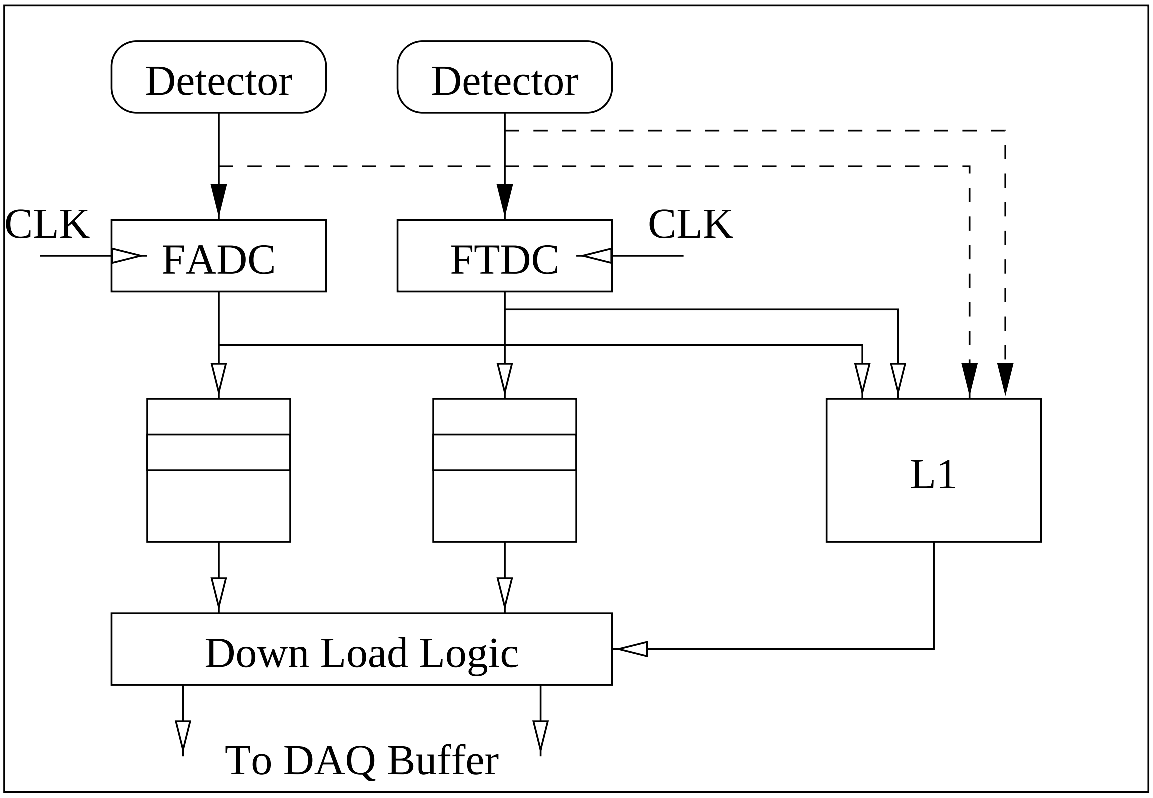
How did we do ADC and TDC?



Problems:

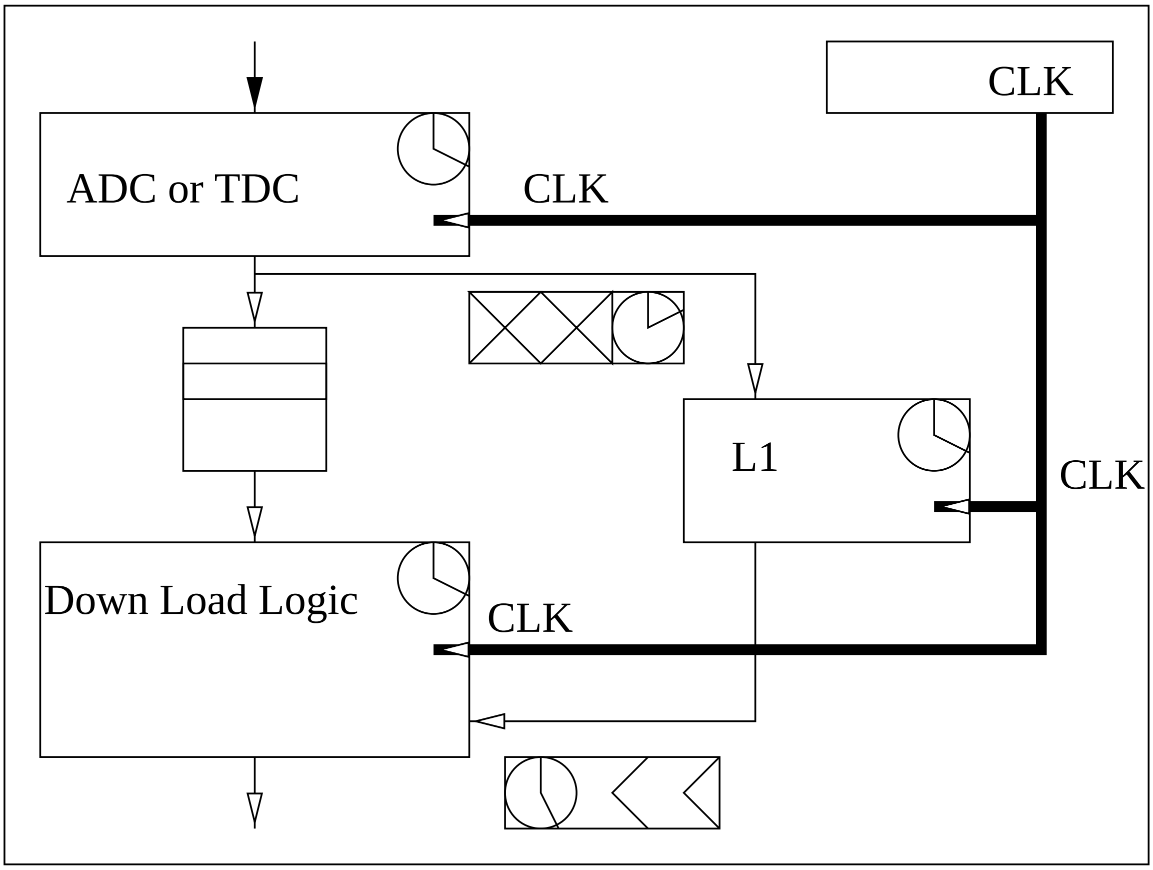
- **High L1 rejection ratio**
- **Trigger with partial detector channels**
- **Long cable delay, time matching pairs**
- **Single digitization ("snap shot")**
- **Dead time, reset/clear**

Digitization Near Detectors



- No long cable delay, min. time matching pairs.
- No deadtime, min. reset/clear
- Possible L1 trigger based on digital information
- Detector history record
- Different DAQ details

Minimum Synchronization

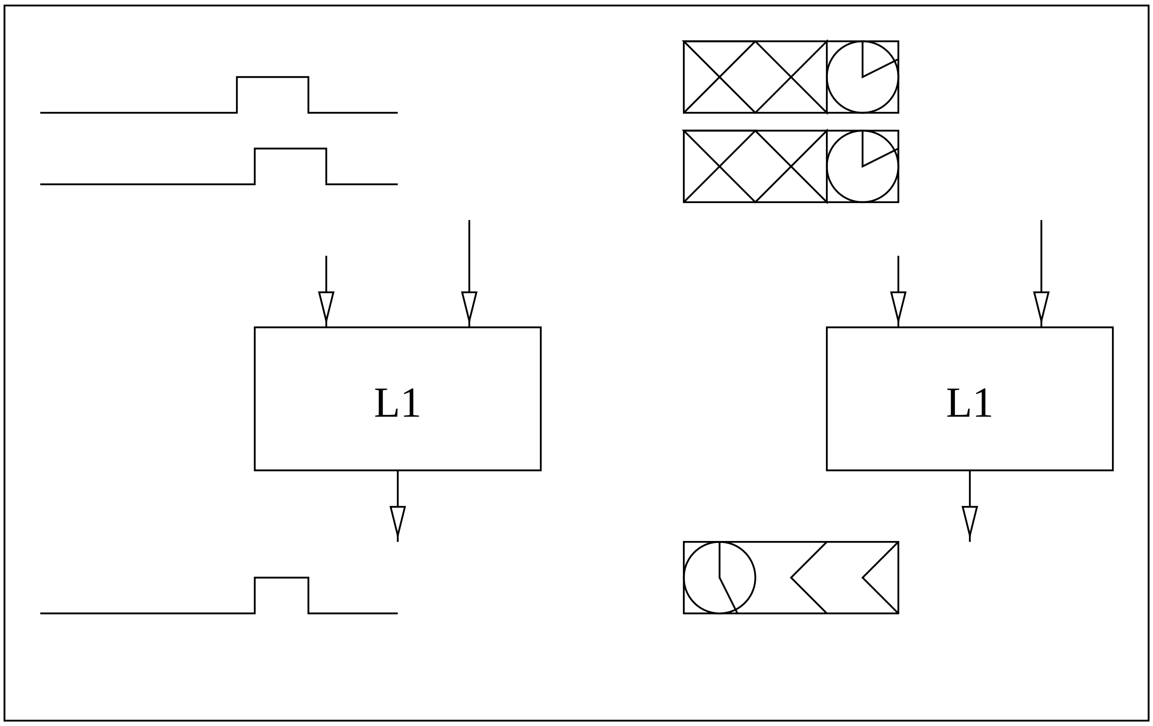


- Synch. clock only / Time stamp kept
- Time stamp trans. with hits and commands
- Commands executed at time specified by time stamp

Examples:

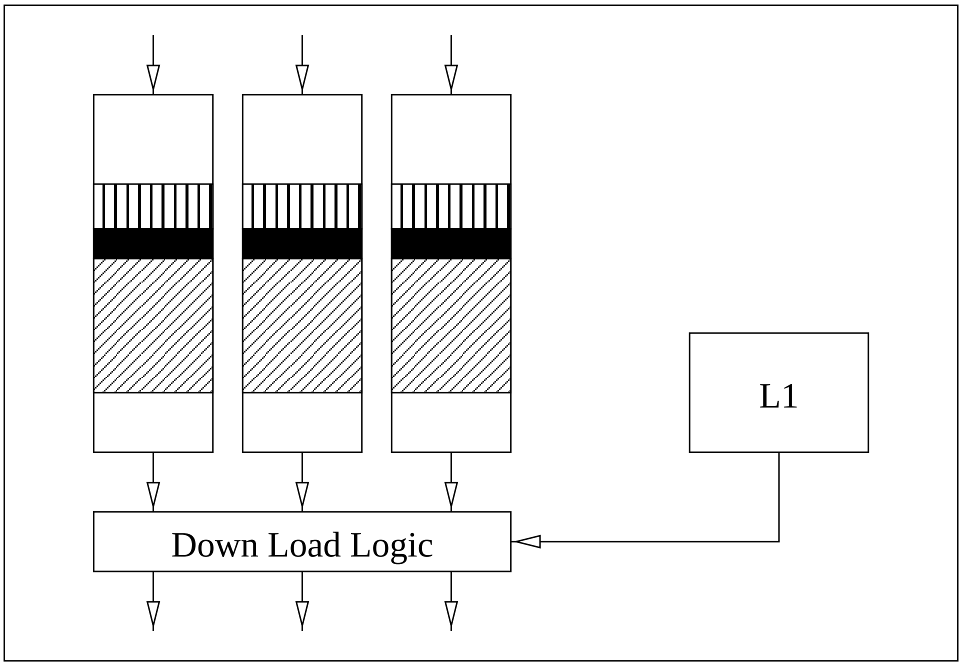
- Channel hit:
  - "I was just hit."
  - "I was hit at XXX ns"
- Trigger Command:
  - "Catch data now."
  - "Catch data at YYY ns."

Digital L1 Trigger

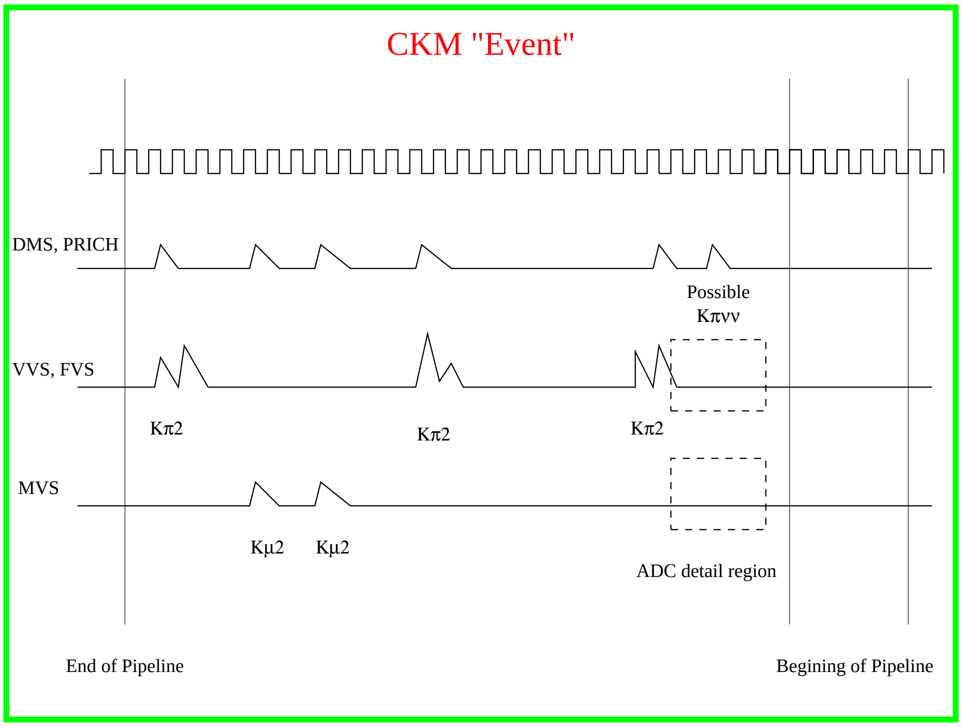


- **Timing/charge info. well preserved**
- **No need of time matching pair**
- **Multiple layer logic and variable latency**

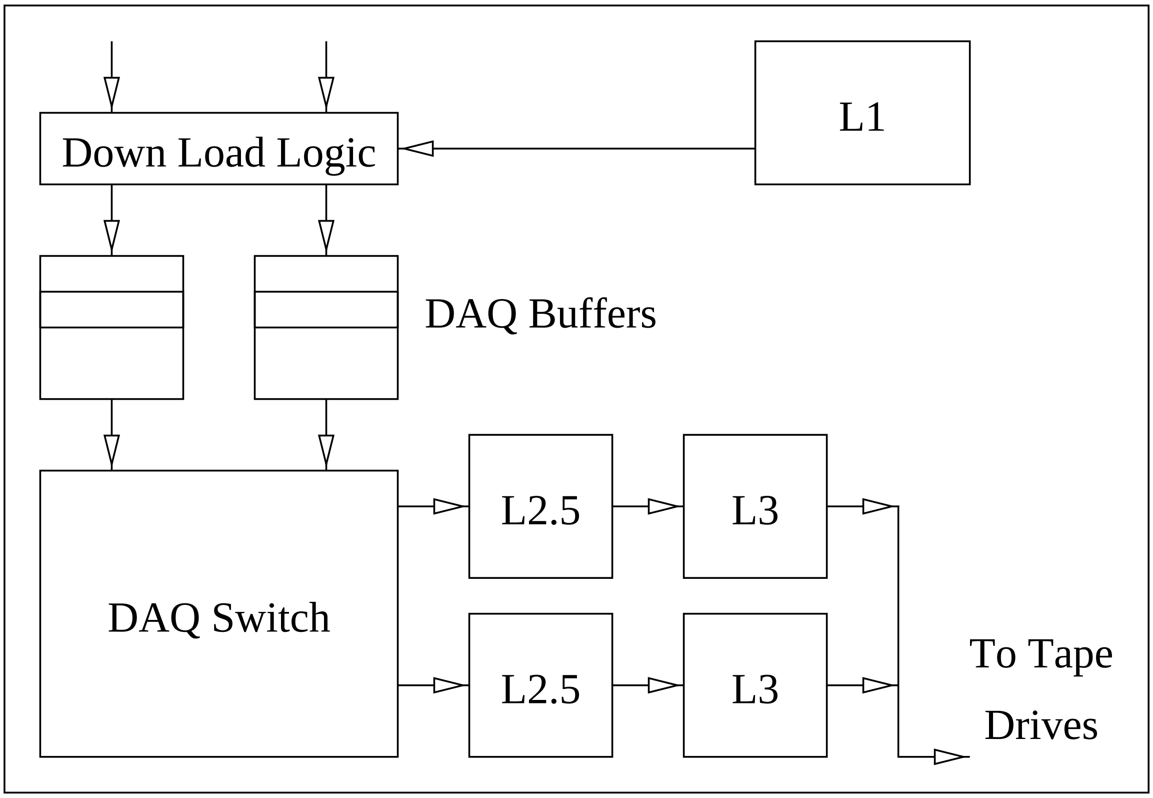
DAQ Records



- Chronicle records
- Different levels of detail
- e.g. ADC 0-supp. or not



Trigger in DAQ Stream (L2.5 and L3)



- **Trigger based on full detector data**
- **Summary of rejected event – not "throw out"**
- **Easy logic improvement (RAM based FPGA), e.g., in an arbitrary detector:**

Trigger Conditions	**Detector needed**	**L2.5**	**L2**
1 high p_T track	**chamber**	**OK**	**OK**
2 high p_T tracks	**chamber + chamber**	**OK**	**ok**
high p_T, $\pi^{\pm}$	**chambers + cal.**	**OK**	**??**
high p_T, $\pi^{\pm}$, no μ	**chambers + cal.+ μ**	**OK**	**!!**
...	**...**	**OK**	**:-(**