Data Rates for GRETINA

Mario Cromaz
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Introduction

- Correct rate determinations critical to GRETINA design
  - determine implementation options available
- Complex question:
  - GRETINA will support a variety of experiments
  - Algorithms are under development and continue to improve
  - Computer procurement will begin in 2008
- Detector will be no faster then its slowest component.

Components of GRETINA

Real-time Analysis Programs

- Signal Decomposition
- Tracking

Other Software Components

- Event Building (crystal)
- Event Building (global)
- Sender/Receivers on compute nodes

Communication

- Digitizer crate backplane speed
- Networking, Switch Bandwidth

Data Store, Analysis

- Size of data store, maximum rate

Inputs, Assumptions

1. Average decompositions / gamma
   - 1.5 detectors hit / 1 MeV gamma
2. Segment hits per gamma (net + neighbors)
   - $\frac{2}{3}$ of time - single crystal
     $\longrightarrow$ 13.5 segments
   - $\frac{1}{3}$ of time - two crystals
     $\longrightarrow$ 20 segments
   - average 16 segments/γ read out
3. Segment event size
   - 16 byte header + 2 bytes/sample
   - $\geq$ 100 bytes/segment
4. Decomposition time
   - estimate 4 ms per crystal decomposition
   - probably conservative

Case 1 - 20,000 γ/s

- requirement in PEP
- Computational Requirement:
  - 20,000 γ/s $\rightarrow$ 30,000 decomp/s
  - 30,000 $\times$ 4 ms/decomp = 120 CPU/s
- Data Rates:
  - 20,000 γ/s $\rightarrow$ 320,000 segments/s
  - 320,000 segments/s
    $\rightarrow$ 32 MB/s (for array)
    $\rightarrow$ 3.2 MB/s per crate
  - 4 int / γ $\times$ 20,000 γ/s
    $\rightarrow$ 80,000 int/s
  - 80,000 int/s $\times$ 12 bytes/int = 1.0 MB/s

Case 2 - $M_\gamma = 20$, $f \geq 4$

- high multiplicity, high rate
- Computational Requirement:
  - 190,000 γ/s $\rightarrow$ 285,000 decomp/s
  - 285,000 $\times$ 4 ms/decomp = 1140 CPU/s
- Data Rates:
  - 190,000 γ/s $\rightarrow$ 3 $\times$ 10^6 segments/s
  - 3 $\times$ 10^6 segments/s
    $\rightarrow$ 300 MB/s (for array)
    $\rightarrow$ 30 MB/s per crate
  - 4 int / γ $\times$ 190,000 γ/s
    $\rightarrow$ 760,000 int/s
  - 760,000 int/s $\times$ 12 bytes/int = 9.1 MB/s

Comparison

	PEP	high mult, rate
decomposition nodes	120	1140
tracking nodes	12	114
evt building	1	unknown
aggregate rate	32 MB/s	300 MB/s
backplane rate	3.2 MB/s	30 MB/s
storage rate	1.0 MB/s	9.1 MB/s

- primary bottleneck - decomposition
- secondary bottleneck - tracking
- address by:
  1. improve algorithms
  2. increase number of cluster nodes