DAQ Requirements Document

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Steve shall present the charge, the committee membership, and a summary of the background material, not to exceed 15 minutes.

Roger shall present a summary of the scope and status of the requirements, with a few specific examples, and the plans for the evolution of the DRD, including open issues that need resolution, not to exceed 15 minutes.

Roger shall lead a discussion of the items he presented.

DAQ Requirements Document Charge and Committee

Committee: R. Dubois, G. Haller, M. Lovellette, S. Ritz,
J. Russell, S. Williams, R. Williamson, K. Wood

The group shall be co-chaired by Roger Williamson and Steve Ritz; in particular, Roger is responsible for seeing that all engineering constraints are identified and included, while Steve is responsible for seeing that all physics inputs are properly reflected. The co-chairs are jointly responsible for seeing that relevant non-DAQ subsystem information is collected and reflected in the draft, and that such inputs are obtained from or with concurrence of the respective **subsystem managers**.

The requirements document shall describe both functional and performance requirements to be placed on the DAQ by:

1. GLAST LAT science objectives
   a. Trigger (level 1,2,3) requirements, b. Throughput (event processing, priorities, counting rate channels, etc.) c. Environmental dependencies
2. Other constraints
   a. Spacecraft interfaces
   b. Ground data processing
   c. Reliability (requirements on system design, rather than parts selection and screening, etc.)
   d. Ground command reconfiguration

Some additional guidelines:

-- Physical constraints, such as weight, power, temperature, vibration, etc, can be postponed.

-- The requirements should be established independent of implementation considerations, such as whether a function is performed in hardware or software. Similarly, ignore presently planned functional and organizational partitions. For example, even though the tracker subsystem captures and stores discriminator triggers for readout by the DAQ, this storage and readout process should be regarded as part of the DAQ functionality. The proper functional interface is at the output of the discriminator, which can be defined in terms of incident flux and analog properties of the detector/amplifier/discriminator signal processing chain. Requirements on individual pieces of the DAQ (hardware or software) will be derived later from the requirements established in this document.

-- Requirements don't depend on cost or effort, so don't set a requirement based on "that's what we can afford," and don't reject a requirement because "it costs too much."

Setup

- Roger Williamson is the editor.
- Haller and Russell are the internal readers/reviewers.
- Inputs by committee members:
  - Subsystem information – subsystem managers Johnson&Johnson&Ormes
  - Housekeeping – Wood
  - Background material, triggers, data rates – Ritz
  - General formulation, commanding, telemetry interfaces – Lovellette

… with earlier work by many others, including Toby Burnett, Sawyer Gillespie, Dan Suson, Jay Norris, Heather Arrighi, …

Updated drafts and supporting material kept at

http://giants.stanford.edu/~roger/docs/drd

Ingredients and results on data volume at L1

Calculation of data volume in two steps:

- number of hits in each subsystem per event per event type
- number of bits per hit in each subsystem

Then, apply the rates for each event type to arrive at full data volume.

Notes on #xtals/event (see full writeup on ftp site):

- chime gives largest # xtals/event (52). This is consistent with earlier studies.
- rates are for orbit average. At orbit max, mean # xtals rises from 25 to 38 in our model.
- albedo proton rate being revisited. Probably pessimistic. Help from our collaborators on AMS!
- effects of noise not included in cal rate. Impact depends on zero suppression scheme. Being worked. Will increase the rate by < factor of 2.
- "hit" means any energy deposition. A readout threshold will reduce the number of crystals by < ~factor of 2. [a (large) threshold of 6 MeV drops #xtals by a factor 2]

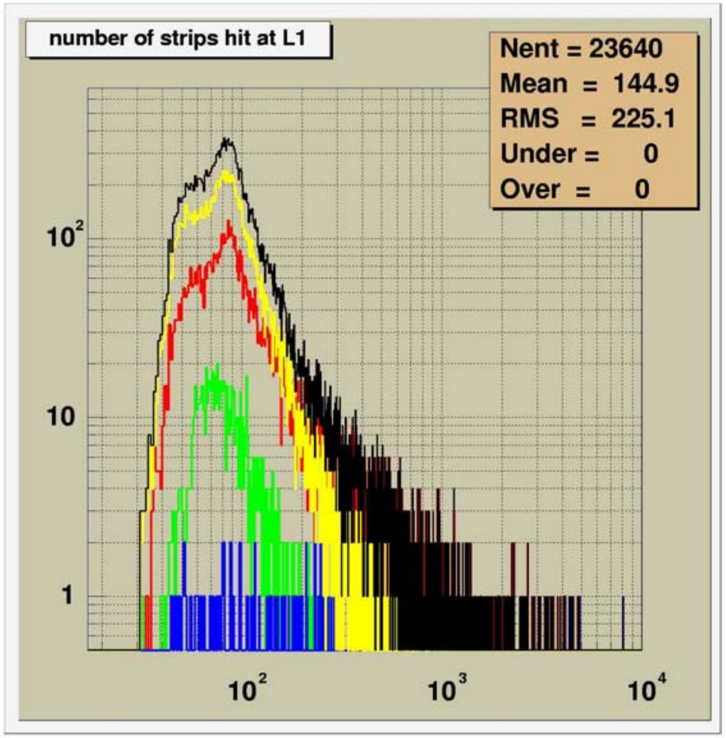
Results are therefore good to better than a factor 2.

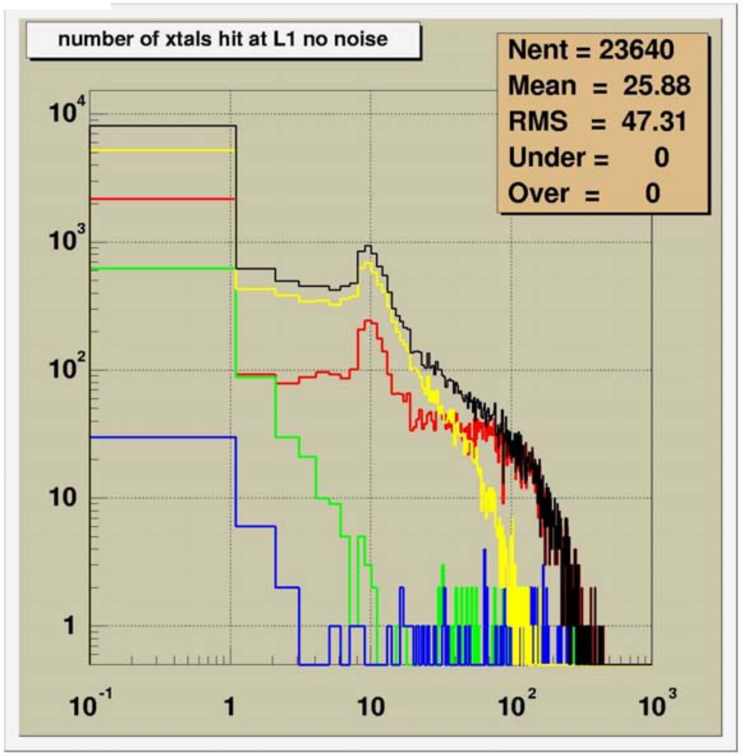
Further work on internal data volume

Current calculations of data volume for TKR and CAL at L1T

source	mean #strips	frac total TKR data
chime	213	0.54
gamma albedo	105	0.03
electron	657	0.03
albedo p	100	0.41
TOTAL	145.0	

source	frac total rate	rate [Hz]	mean #xtals	frac total CAL data
chime	0.37	2019	52.3	0.75
gamma albedo	0.04	196	4.2	0.01
electron	0.01	30	86	0.02
albedo p	0.59	3224	10.1	0.23
TOTAL		5470	25.9	





all background
p albedo
Chime
γ albedo
electrons

Orbit-average
(many details, caveats)

This is not the science telemetry!!

Ingredients and results on data volume at L1

Notes on #strips/event:

- TKR occupancy is $5x10^{-5}$ in simulations. Thus, of the 145 strips hit orbit-average, on average 93 are real and 52 are noise. At $1x10^{-4}$ occupancy, mean number of strips rises to 196.
- At orbit max, with $1x10^{-4}$ occupancy, number of strips/event is 226.

DATA VOLUME AT L1

- **CAL:** Assuming 40 bits/log => 6 Mbps orbit-average, 15 Mbps orbit-max
- **TKR:** Assuming 45 bits/hit (see writeup) and $1x10^{-4}$ occupancy,
  => 48 Mbps orbit-average, 102 Mbps orbit-max
- **ACD:** 6 Mbps of discriminator info + 35 Mbps of PHA (can trim!)
- **Trigger and Ancillary:** 20 Mbps (educated WAG)

Grand total of 178 Mbps orbit-max out of L1

Revisiting onboard CPU requirements

Next step is to continue the data flow through onboard processing.

Requires:

- scrub of realism of data, formats, etc.
- revisit of L2 and L3 -- principles proven, now details matter!