21st October 1998

Level-1 Calorimeter Trigger RoIs - Formats,

Hardware and Interfaces

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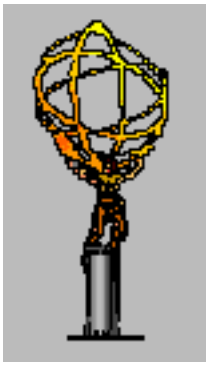
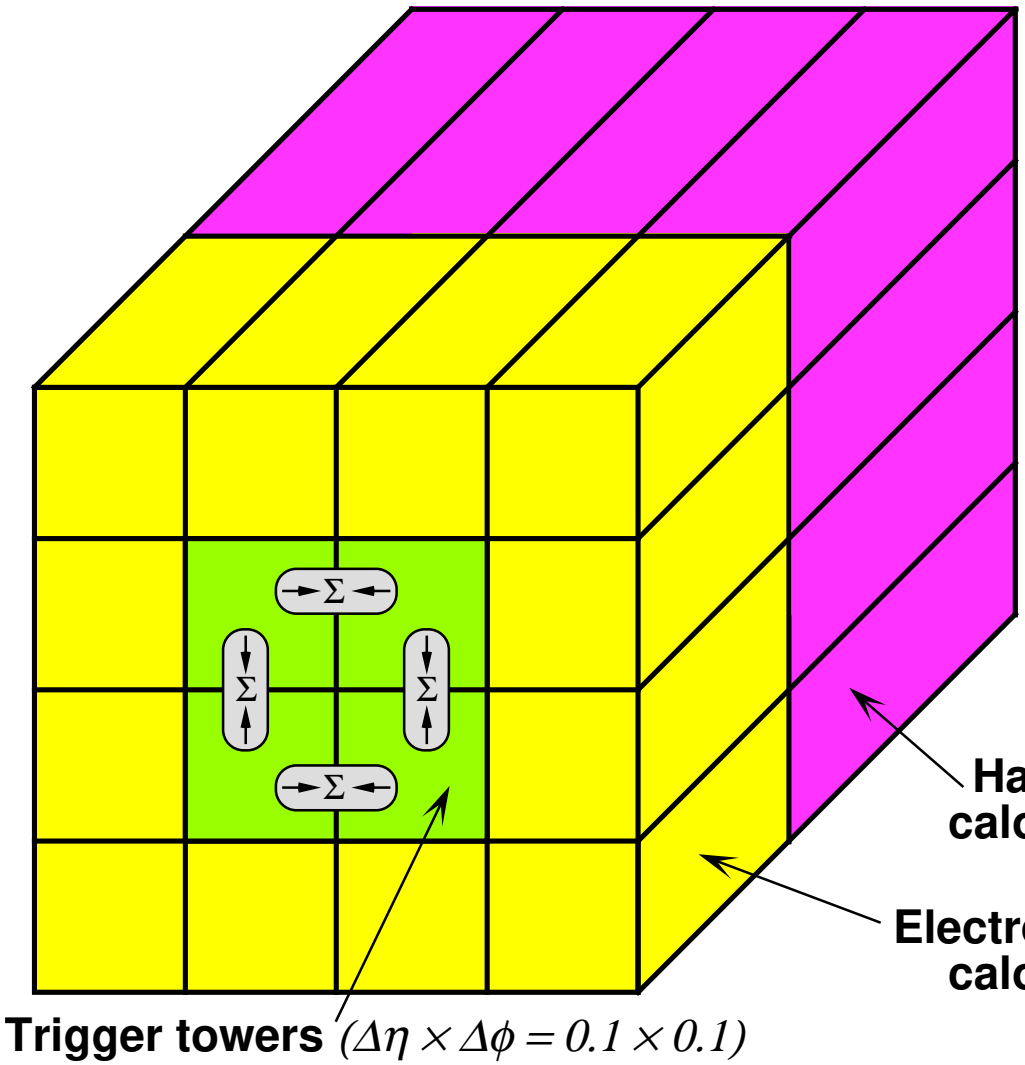


Overview

- **Overview of RoI Formation**
- **RoI Links and Data format on S-LINK**
- **Individual RoI Formats**
- **RoI / DAQ Links & Infrastructure**

Electron/photon trigger algorithm



Vertical Sums

Horizontal Sums

De-cluster/RoI region: local maximum

Electromagnetic isolation < e.m. isolation threshold

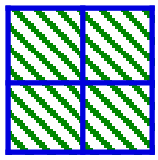
Hadronic isolation < hadronic isolation threshold

- ≥1 vertical or horizontal sum > cluster threshold E_T.
- E.M. and hadronic isolation conditions satisfied.
- Central 0.2 x 0.2 region must be E_T local maximum compared to its 8 overlapping neighbours.
  This does de-clustering and defines RoIs.

Jet algorithms

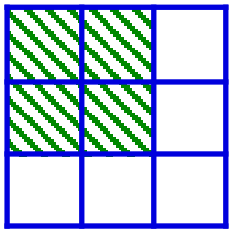
Separate Programmable Choice per Threshold

Window 0.4 x 0.4
Jet element/Slide 0.2 x 0.2
De-cluster/RoI 0.4 x 0.4, overlapping



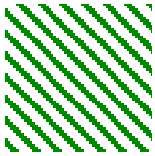
> Jet Threshold

Window 0.6 x 0.6
Jet element/Slide 0.2 x 0.2
De-cluster/RoI 0.4 x 0.4, overlapping



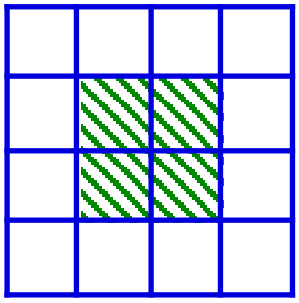
> Jet Threshold

De-cluster/RoI can be in 4 possible positions



Note: De-cluster/RoI region is defined to be a local maximum in E_T

Window 0.8 x 0.8
Jet element/Slide 0.2 x 0.2
De-cluster/RoI 0.4 x 0.4, overlapping

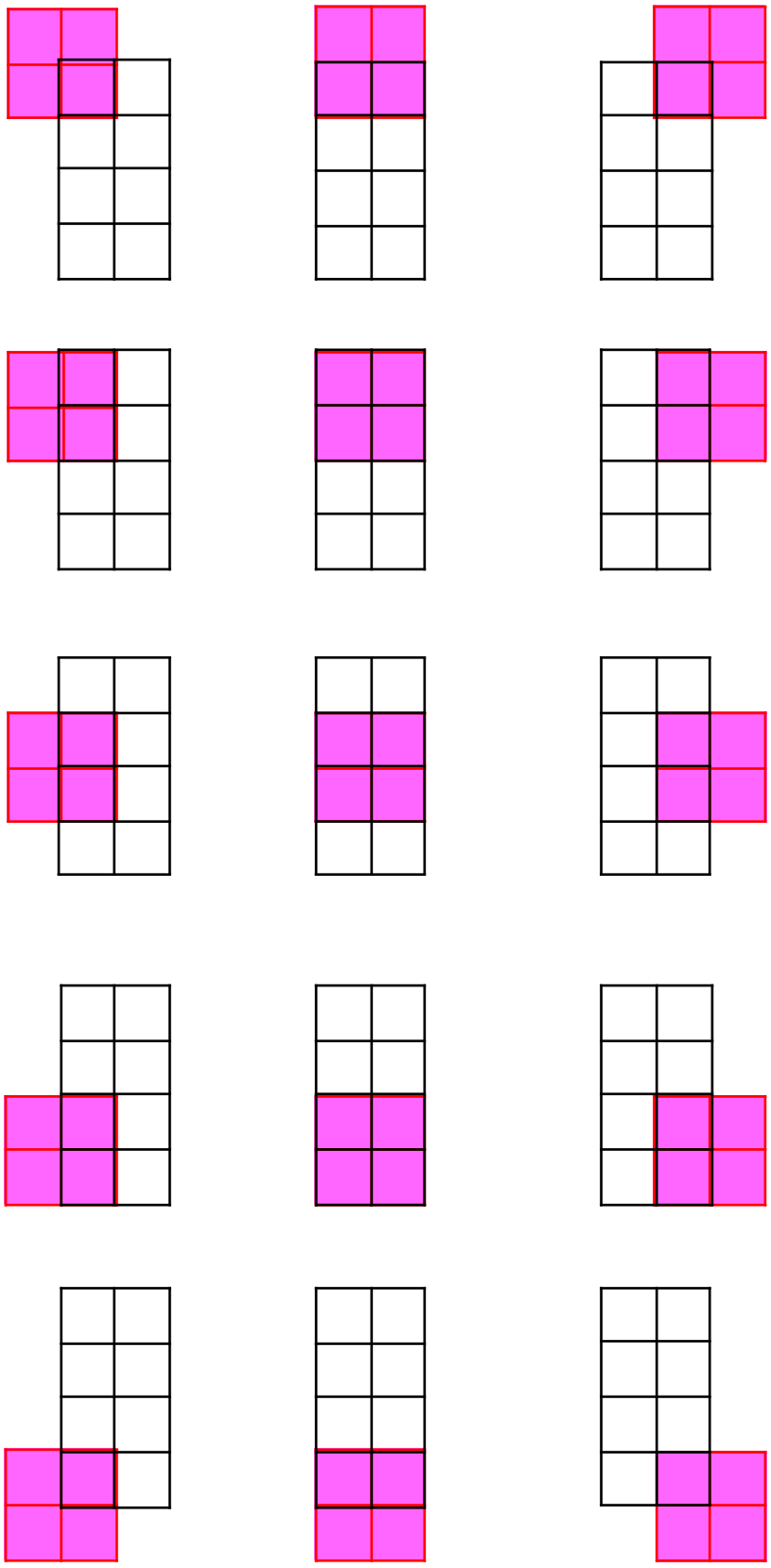


> Jet Threshold

De-cluster/RoI must be in centre position (to avoid 6x6, and 2 jets/window)

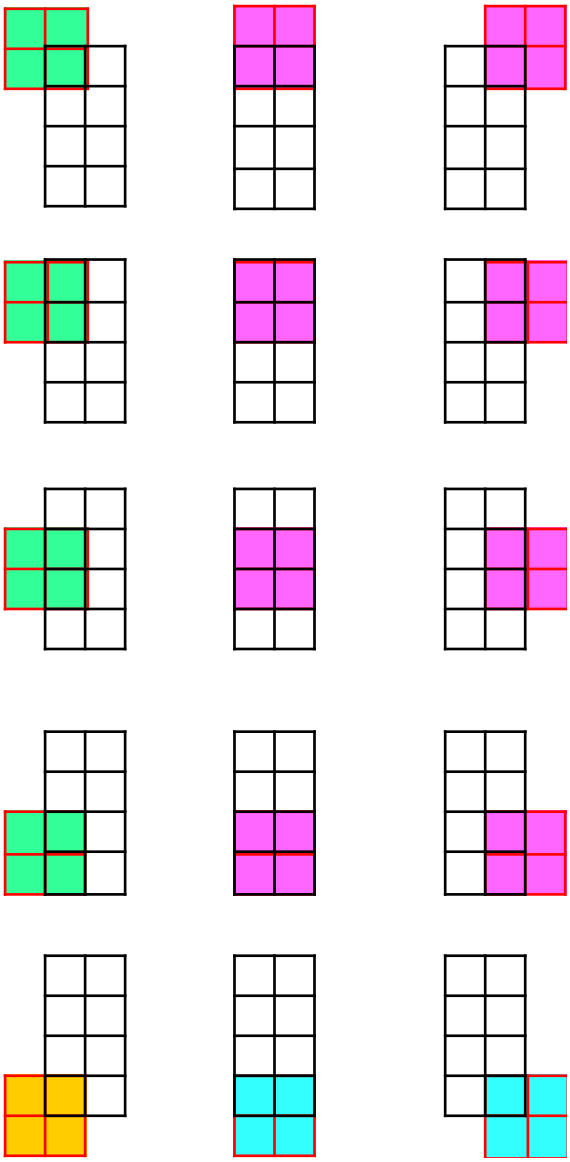
Positions of RoIs

A 2 * 4 calorimeter region can generate up to 15 possible RoIs:



Sequence of RoIs

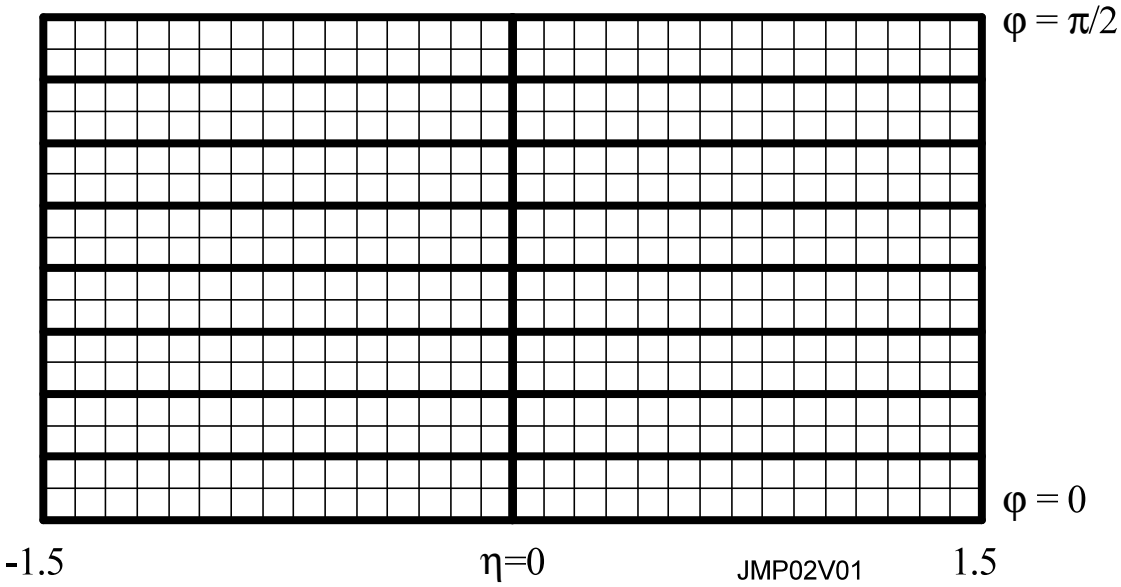
The e/γ ASICs cover a 2*4 calorimeter window region.
RoIs from one ASIC are read out together.

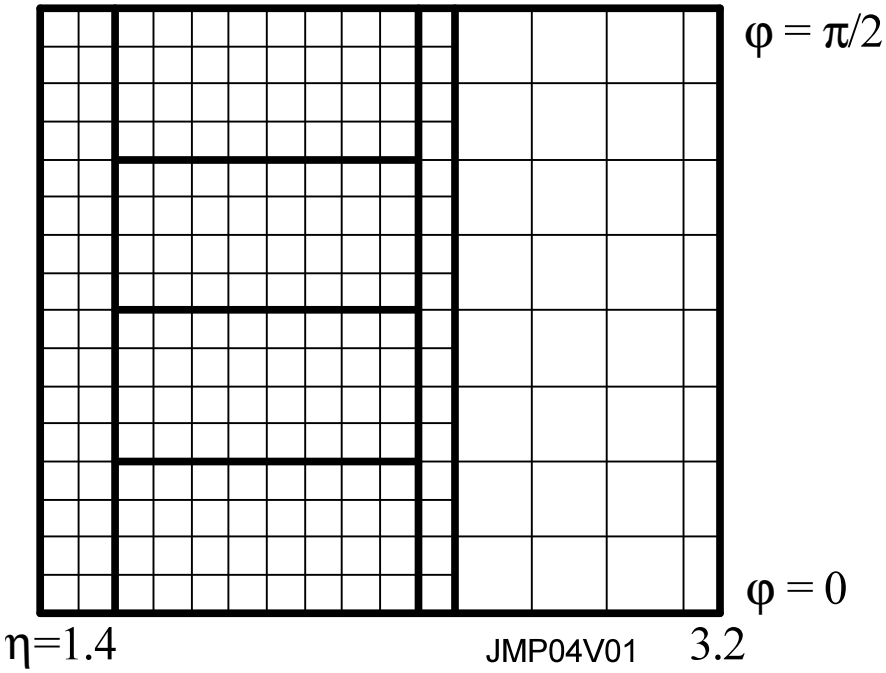


_The order of readout is not monotonically increasing…
All RoIs per ASIC (η-φ array);
All ASICs per Cluster Module (η-φ array);
All 13 Cluster Modules per crate (increasing η);
Crates are read out to different RODs(increasing φ);
Similarly for Jet processor.

Remark about η=0

All calorimeter triggers are based on Trigger Towers built from raw calorimeter cells thus:





Trigger Towers do not span η=0.

Overview of RoI Formation

RoIs are calculated at 40 MHz as part of the e/γ and τ/h, jet, Missing- and Sum-E_T trigger formation

Following a level-1 Accept, RoI candidates are…
- **Copied synchronously to FIFOs in ASICs/FPGAs;**
- **Transported by dedicated G-links to RODs. Time for readout to RODs < 1μs;**

In the RODs…
- **Bunch counter fields are checked;**
- **Error conditions are handled;**
- **Empty RoIs are discarded;**

Surviving RoIs are reformatted and injected into S-links to level-2. The same RoI data in the same format is also sent from RODs to ROBs and ultimately into the event data stream.

Number of RoIs sent per event:
The Average number of trigger RoIs sent per event is <~5.
Non-trigger (low threshold) RoIs are also sent.
Traffic in the RoI S-links is dominated by the event fragment overhead - 13 32-bit words.

Discussion is starting on the need for an upper limit (perhaps ~ 30) to the maximum number of RoIs sent for an event. Details to be discussed within L1 and L2 communities.

The current RoI data format is different from that described in the L1 TDR. It is still subject to modification but must be frozen soon (next 1-2 months).

Data format on S-Link

The same format must be used for RoIs and DAQ (since the same data goes to both places).
The ATLAS S-Link Data format version 1.1 (McLaren, Boyle, new DAQ note 50 coming) is suitable.
It can also be used with data for L1 internal monitoring.

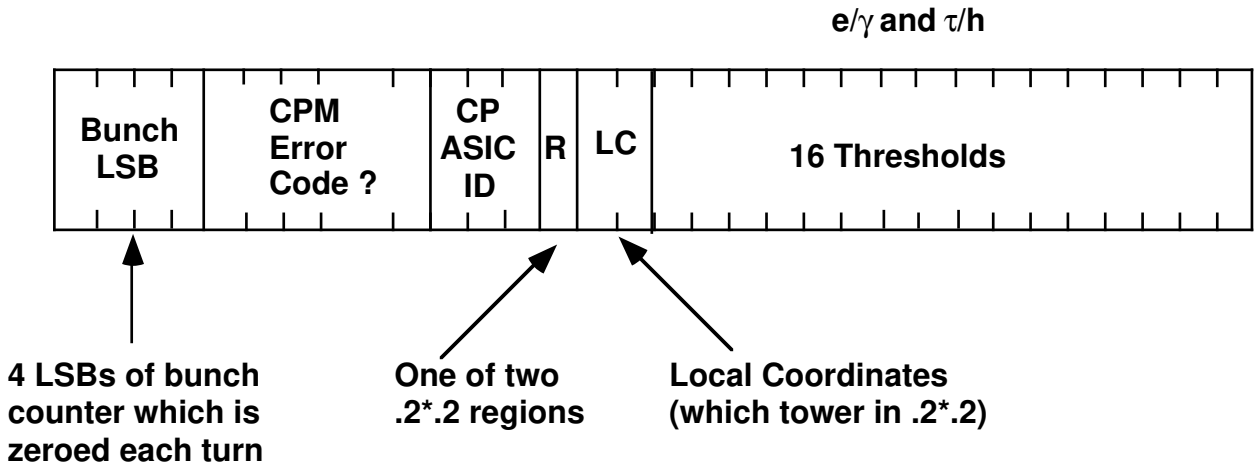
Word	Content	Type
0	Beginning of Fragment (B0F00000)	Control
1	Start of header marker (EEEEEEEE)	Data
2	Header Size in 32-bit words.	Data
3	Format Version No.	Data
4	Source identifier (ROD #)	Data
5	Level 1 ID (24-bit ROD_L1ID)	Data
6	Bunch crossing ID (12-bit ROD_BCID)	Data
7	Level 1 trigger type (from TTC)	Data
8	Detector event type (leave at 0)	Data
9	Data or Status elements	Data
	(List of M RoIs)	Data
	:	Data
9+M	Status or Data elements	Data
	(List of N status words)	Data
	:	Data
9+M+N	Number of status elements	Data
10+M+N	Number of data elements	Data
11+M+N	Data/Status first flag	Data
	End of Block (E0F00000)	Control

We need to use data compression for Preprocessor readout when running at high rates. Are there some ATLAS standards for compression? How is this handled by the event format?

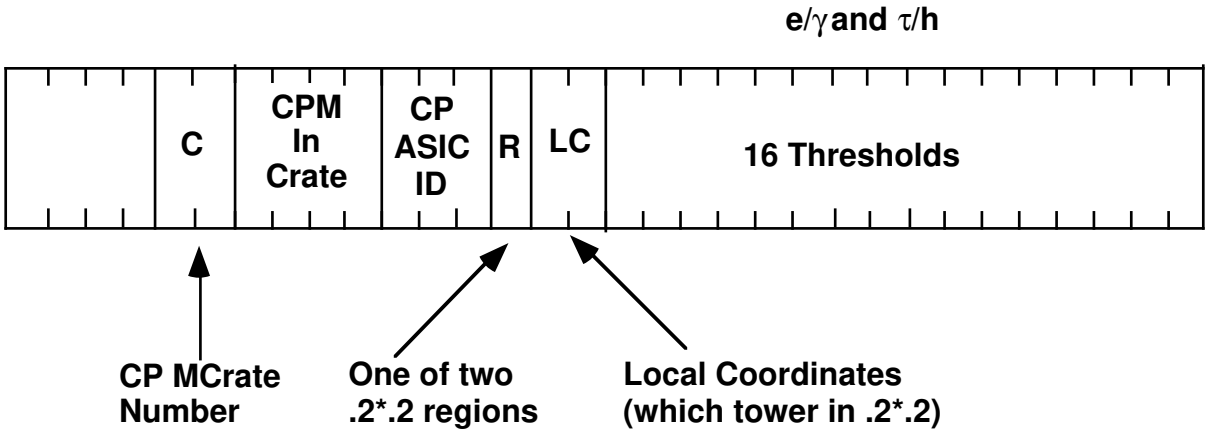
Individual RoI Formats

Electron/Photon RoIs

as read from CPMs to ROD



as sent on S-Link

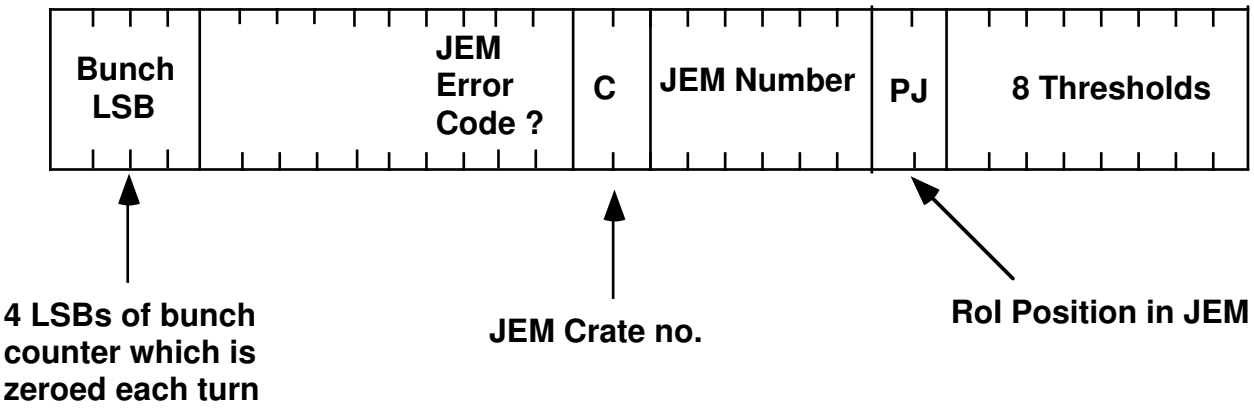


Change since TDR: thresholds may be programmed to find e/γ or τ/h trigger;
Number of Threshold bits might possibly increase?
Handling of error conditions is not decided;
Format is NOT FIXED.

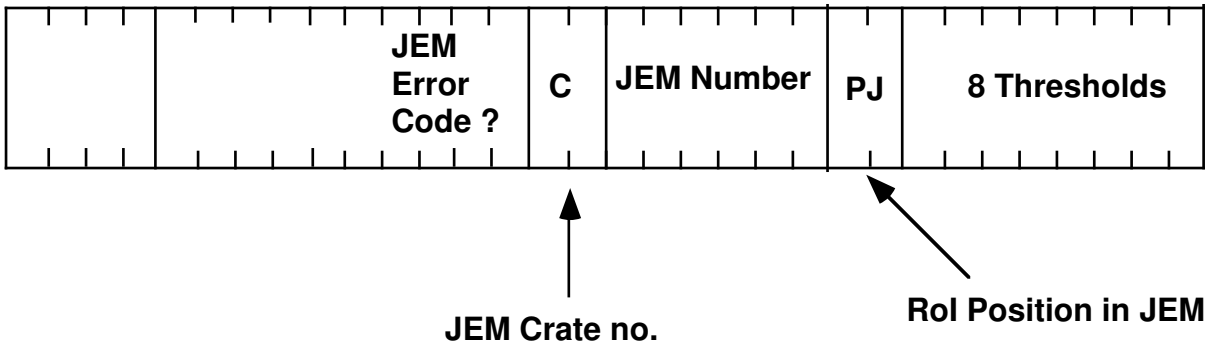
Individual RoI Formats

Jet RoIs

as read from JEMs to ROD



as sent on S-link

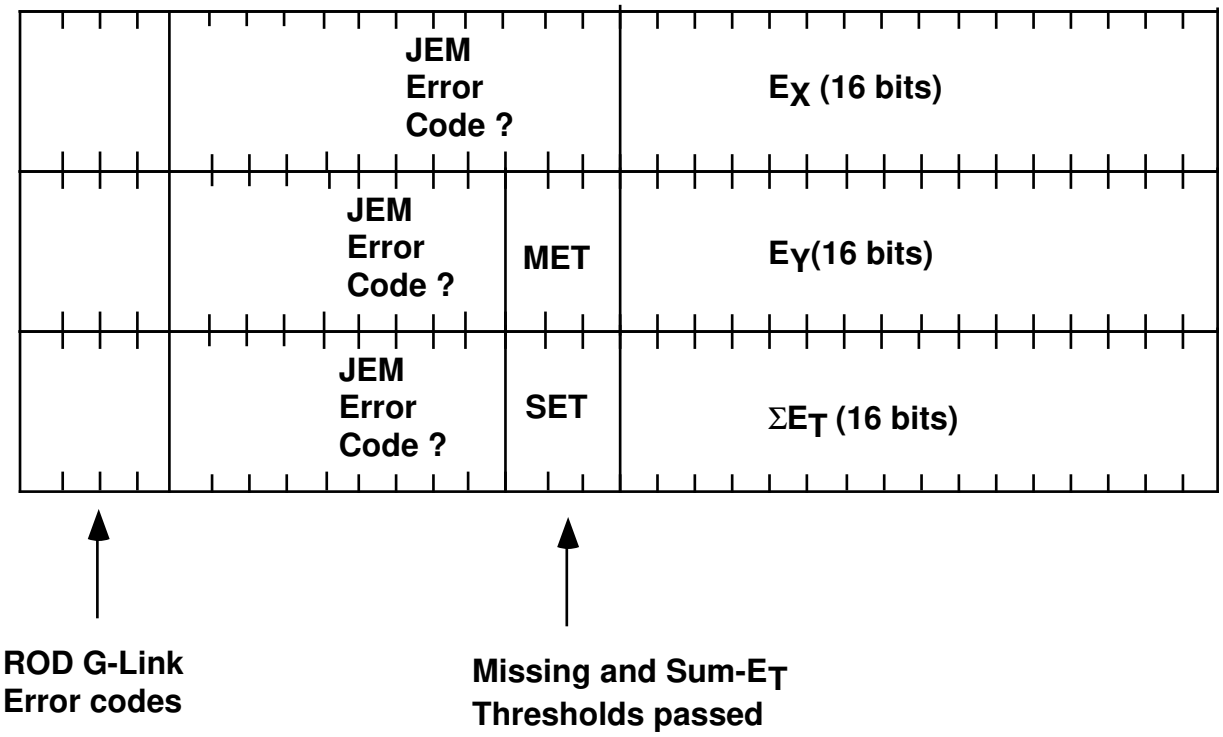


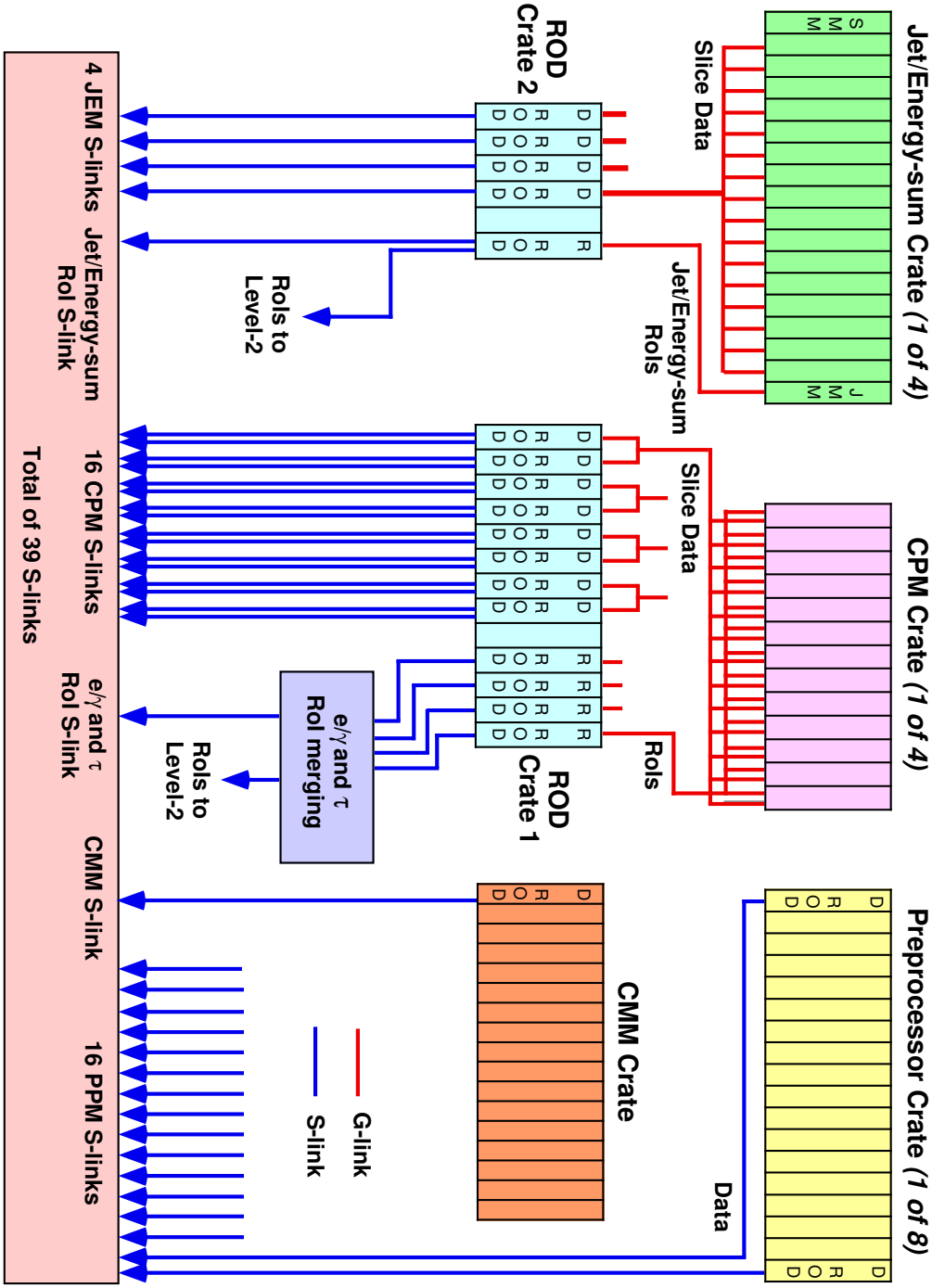
Number of Threshold bits might possibly increase?
Handling of error conditions is not decided;
Format is NOT FIXED.

Individual RoI Formats

Energy Sums

16-bit fields, plus threshold bits passed.



Number of Threshold bits might possibly increase?
Handling of error conditions is not decided;
Extra information might be added;
Format is NOT FIXED.

RoI Link Layout