# S-Link Data Formats (v 0.6) for Level-2 Pulsar Pre-Processors

## RunIIb L2 Upgrade Bi-Weekly Meeting

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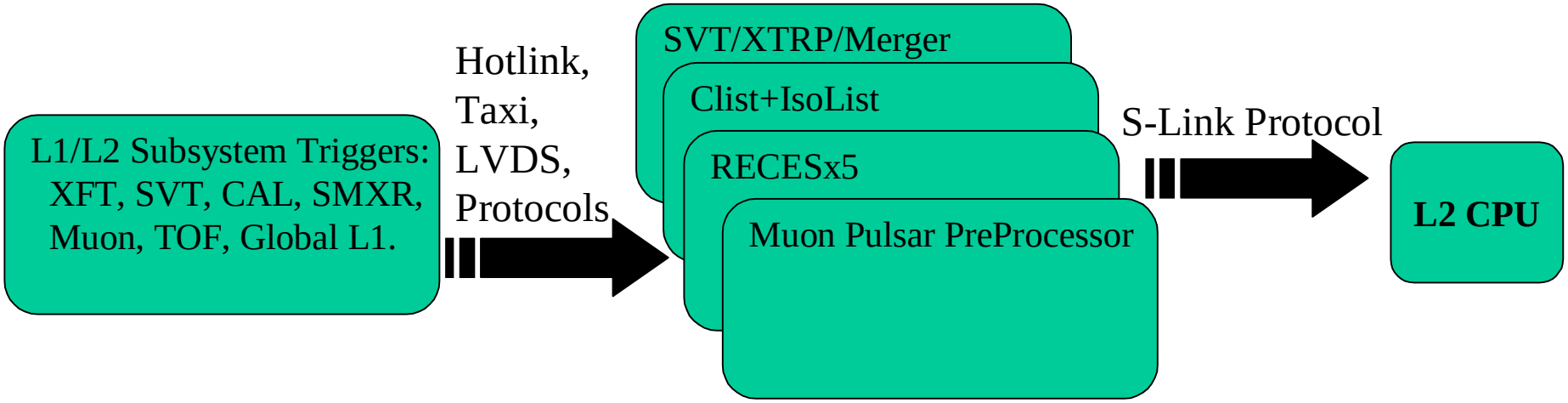
# S-Link Data Formats

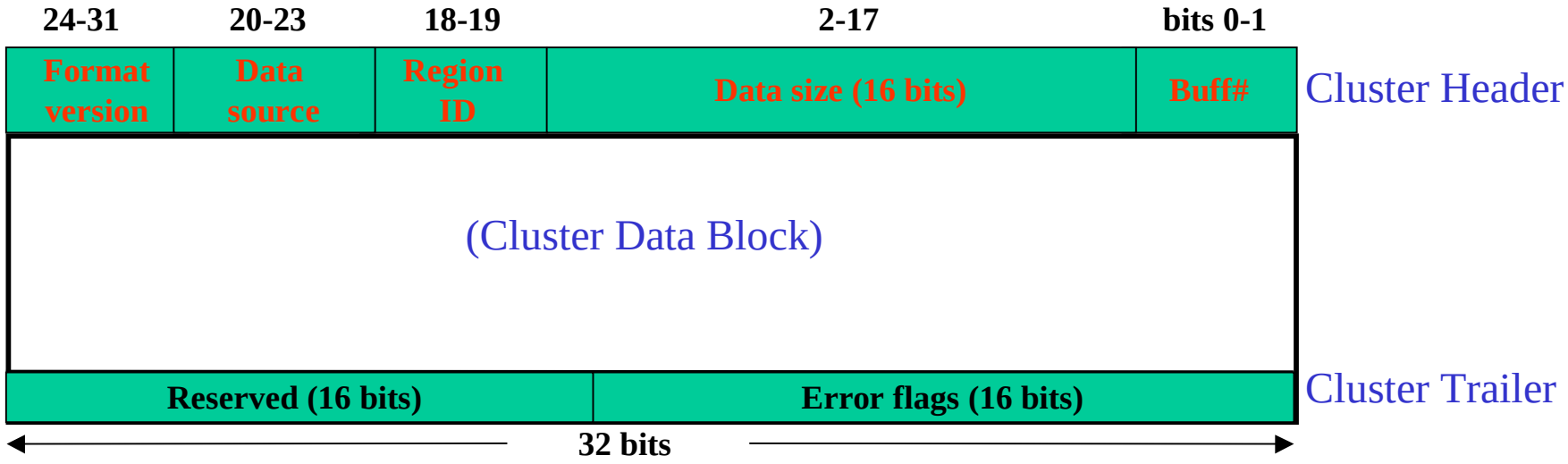



S-Link data contents:

- Muon → sending stub matched XTRP list to L2 CPU with the option of sending the zero suppressed stub data in a separate muon data block,
- RECES → sending cluster matched XTRP list to L2 (initially we will send zero suppressed cluster data to L2),
- Clist, Isolist, SVT and L1→ essentially identical to the current TL2D format,
- XTRP → The existing bit allocation for the XFT data is retained. Additional bits reserved for the stereo information.

# Calorimeter Cluster (CLIST) Path

- For trigger, the EM and Had calorimeters are divided into $24\eta \times 24\phi$ towers.
- For a given seed tower, a clustering algorithm is carried out by the L2CAL boards (DCAS,LOCOS,CLIQUE) and the resulting cluster information is sent to L2 via the interface board (CLIST RunIa, Pulsar RunIIb).
- For a given cluster (and a given threshold pass), we need to send 2 32-bit S-Link words to L2 processor.
- We propose to keep the same format as the one given in the TL2D bank (CdfNote 4152) for the cluster card. However, we will append a different header and trailer for S-Link.



# Cluster S-Link Data Format

Two 32-bit words per cluster:

Word # 1:

| Had Over-flow [31] | Spare [28..30] | Had Energy Sum [16..17] | EM Over-flow [15] | Spare [12..14] | EM Energy Sum [0..11] |
|---|---|---|---|---|---|

- Spare bits can be used later on if we need additional bits for the energy sum.

Word # 2:

| Valid Bit [31] | Spare [24..30] | Pass # [22..23] | L2 Buffer # [20..21] | Cluster η [15..19] | Cluster ϕ [10..14] | Number of towers in cluster [0..9] |
|---|---|---|---|---|---|---|

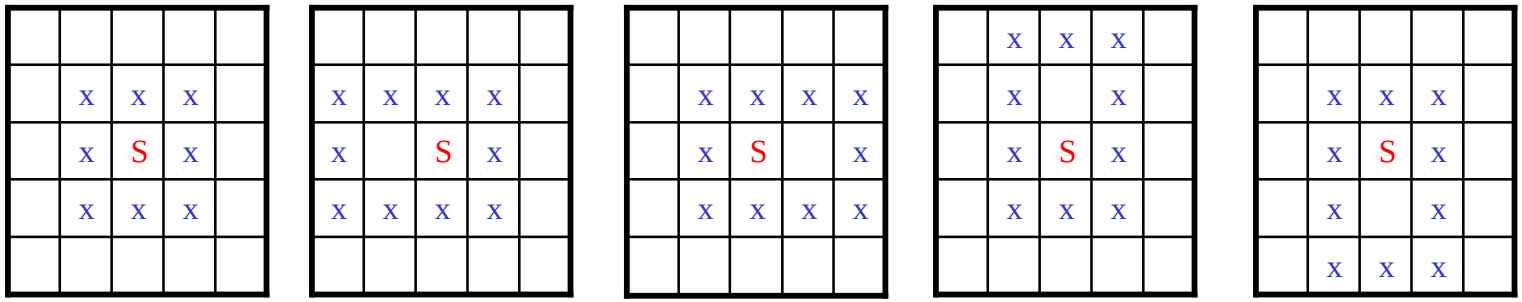
- Cluster ϕ and η are defined for the seed tower,
- Pass # corresponds to the different seed and shoulder thresholds,
- valid bit is set to zero if some hardware condition is found that could cause the crates to report wrong cluster data (eg. Multiple crates reporting the presence of a seed at the same time).

# ISOLATION (ISOLIST) Path

- The isolation trigger uses the same CAL trigger towers ($24\eta \times 24\phi$) and seed tower data as the Cluster trigger.

- For a given seed tower, the isolation trigger calculates the EM energy sums for a fixed number of towers around (and excluding) the seed tower. There are 5 energy sums which corresponds to the 5 different combination of shoulder towers around the seed.

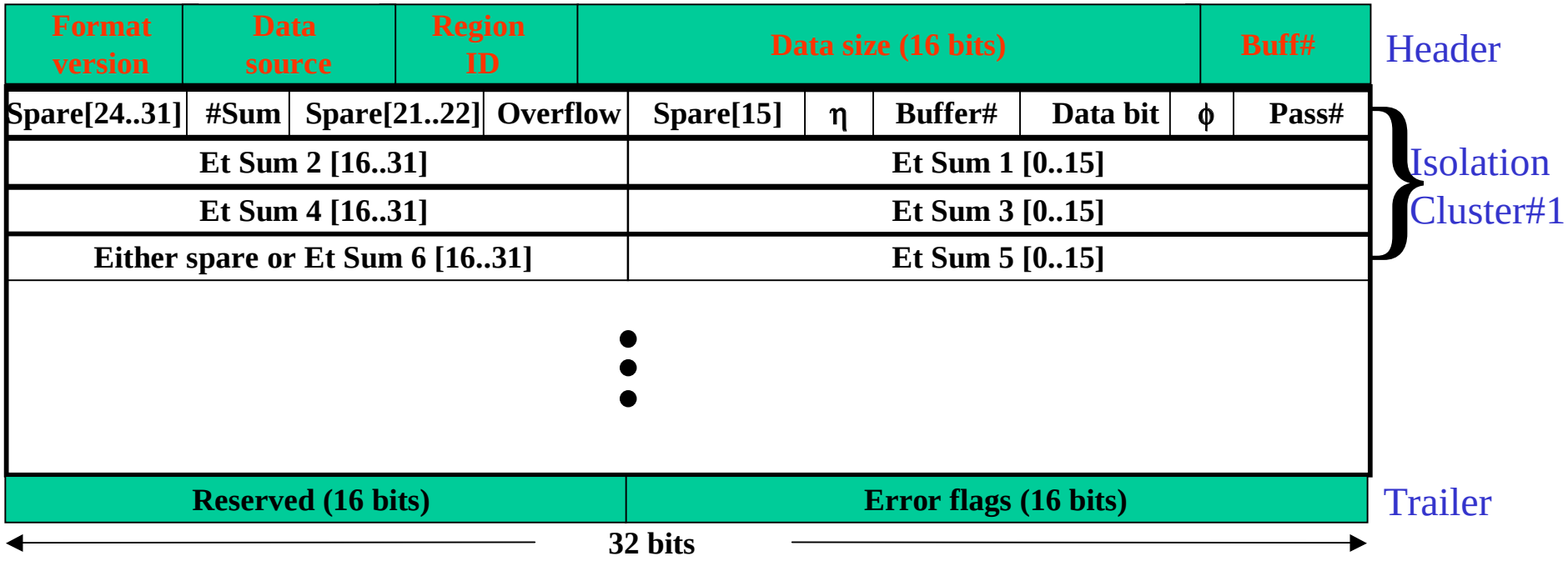
s=seed, x=tower to be summed




- The isolation sums are carried out by the IsoPick and IsoClique boards. The isolation sum outputs are sent to L2 via the interface boards (Isolist RunIa, Pulsar RunIIb).

# Isolation S-Link Data Format

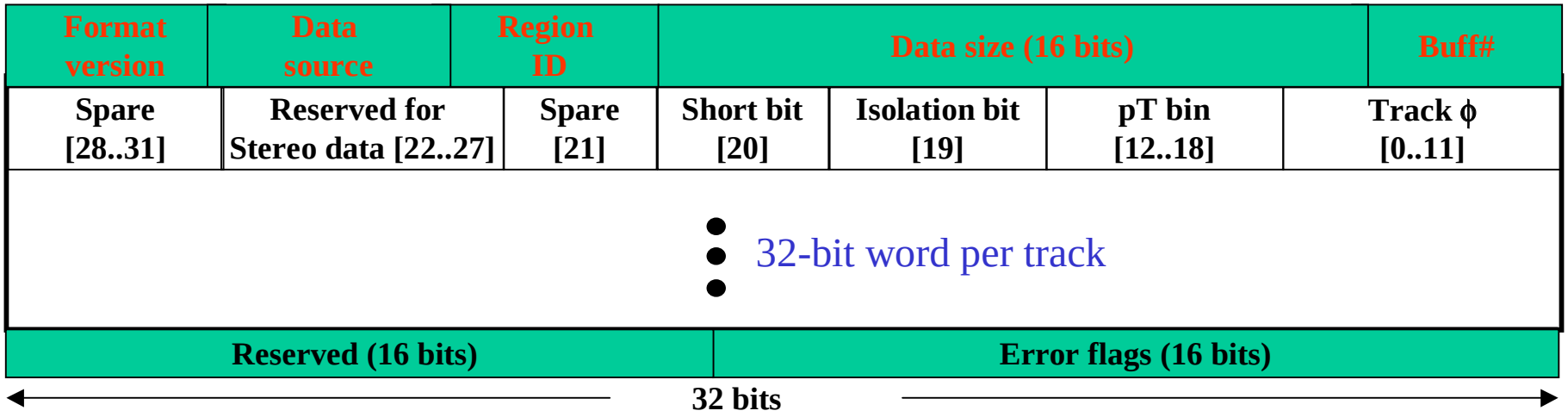
- Minimum of 4 32-bit words are needed for each isolation cluster.




- Pass # [0..1]→ same as CAL Cluster data. Isolation trigger only uses pass 0 and 1,
- ϕ [2..6] and η [10..14] are defined for the seed tower,
- Data bit [7] → 1=diagnostic, 0=real data,
- Buffer# [8..9] → Level 2 buffer #,
- Overflow[16..20] → overflow bits for the 5 Et sums (bit 16 is for Et Sum 1),
- #Sum [23] → 0= 5 Et Sums, 1= more than 5 Et sums.

# XFT/XTRP Path

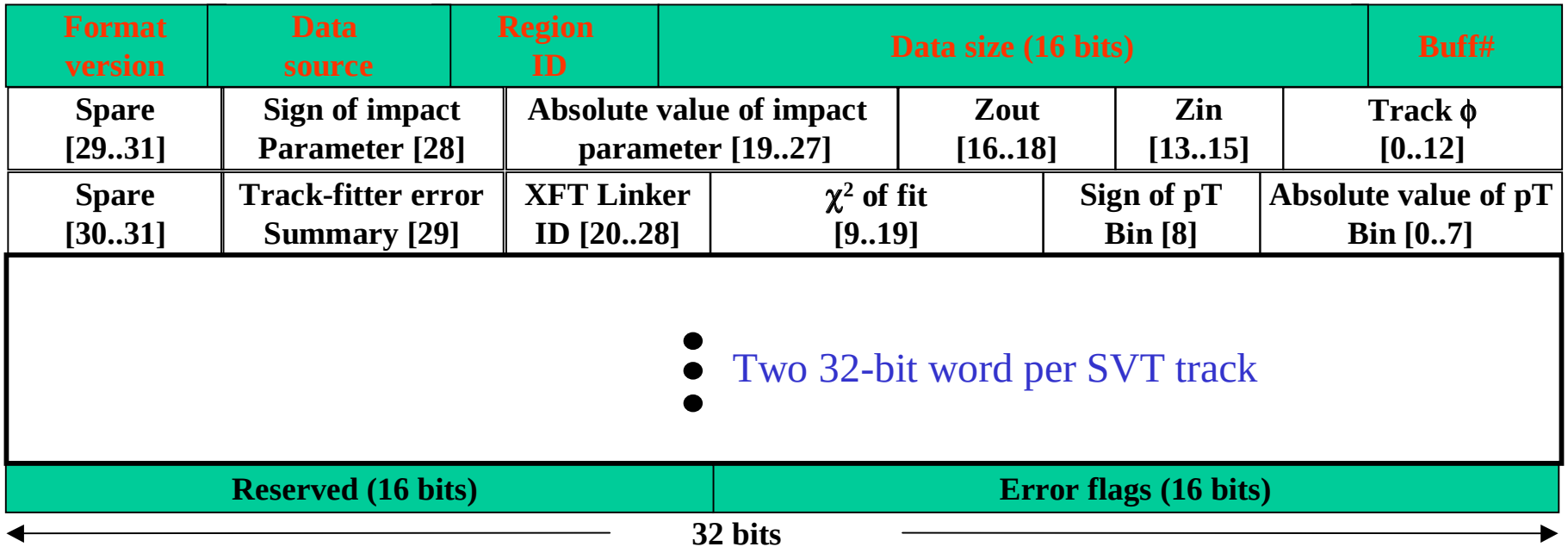
- The XFT track data format is similar to the current TL2D format. Some additional bits are reserved for the stereo information.
- Unlike TL2D, the muon and RECES matched information will not be appended in the XTRP S-Link stream. They are sent via the Muon and RECES stream.



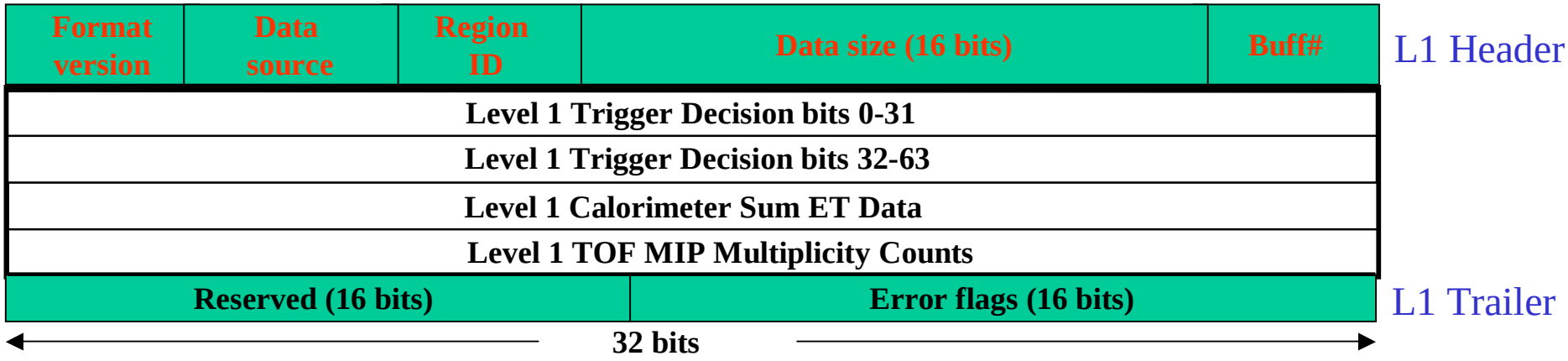

- Track ϕ → bits [3..11] gives the XFT Linker ID,
- Isolation bit not used at the moment,
- Short bit → 0= 4 segment track, 1= 3 segment track (first 3 inner axial layers),
- Stereo data → track dip angle info.

# SVT Path

- The SVT data format is identical to the current TL2D format.
- For each SVT track, we need to send two 32-bit words:



# L1 Trigger Card S-Link Data Format




- Calorimeter Sum ET Data:
  - $\Sigma(E_T)$ → bits [0..10],
  - $\Sigma(E_T)_x$ → bits [11..20],
  - $\Sigma(E_T)_y$ → bits [21..30],
  - spare → bit 31.

- TOF MIP multiplity bits: to be defined.

# MISCELLANEOUS DATA PATH INFORMATION

# HotLink Input Data Format For CLIST

- The L2 CAL clustering is performed by 72 DCAS boards under the control of 6 LOCOS boards and a CLIQUE board,
- Each LOCOS board oversees $24\eta \times 4\phi$ trigger towers,
- For a given seed and threshold pass, all 6 LOCOS boards send partial energy sum and cluster data to the CLIST board via hotlink fibers (one fiber per LOCOS board). If a seed is outside the jurisdiction of a LOCOS board, that particular board will send zero for partial energy sum,
- When all clusters have been found, CLIQUE sends a DONE signal to CLIST via an LVDS cable.

# Data Transfer from LOCOS to CLIST (via Hotlink)

Hotlink Protocol for a LOCOS board (6 8-bit words per cluster, 50ns strobe rate):

| strobe# | I | II | III | IV | V | VI |
|---|---|---|---|---|---|---|
| bit_0 | 1 | em(5) | 1 | had(5) | 1 | crate_sel |
| bit_1 | L2 Buffer# (0) | em(6) | Pass#(0) | had(6) | phi(0) | ntow(0) |
| bit_2 | L2 Buffer# (1) | em(7) | Pass#(1) | had(7) | phi(1) | ntow(1) |
| bit_3 | em(0) | em(8) | had(0) | had(8) | eta(0) | ntow(2) |
| bit_4 | em(1) | em(9) | had(1) | had(9) | eta(1) | ntow(3) |
| bit_5 | em(2) | em(10) | had(2) | had(10) | eta(2) | ntow(4) |
| bit_6 | em(3) | em(11) | had(3) | had(11) | eta(3) | ntow(5) |
| bit_7 | em(4) | em(12) | had(4) | had(12) | eta(4) | ntow(6) |

- 2 bits for L2 buffer #,
- em(0) to em(11) are the partial energy sum of EM towers, em(12) is overflow bit,
- Pass#(0) and Pass#(1) are the two bits to define the threshold pass #,
- had(0) to had(11) are the partial energy sum of Had towers, had(12) is overflow bit,
- crate_sel is asserted if LOCOS has the cluster-boss authority,
- ntow(0) to ntow(6) gives the total number of of partial towers in the cluster.

# Data Transfer from CLIQUE to CLIST

After all seeds have been processed, CLIQUE sends a done signal to CLIST via an LVDS cable. The LVDS signals are driven by a 16.7nsec clock.

LVDS cable pin assignments:

| | | |
|---|---|---|
| pin 1 | BUF_DONE(0)+ | } Buffer # |
| pin 2 | BUF_DONE(0)- | |
| pin 3 | BUF_DONE(1)+ | |
| pin 4 | BUF_DONE(1)- | |
| pin 5 | ignore | |
| pin 6 | ignore | |
| pin 7 | EVENT_DONE*+ | } Done signal |
| pin 8 | EVENT_DONE*- | |
| pin 9 | unused | |
| pin 10 | unused | |

# Overview of the ISOLATION Trigger Flow

- There are 6 ISOPICK board that perform the partial isolation energy sums. Each ISOPICK board oversees $24\eta \times 4\phi$ trigger tower data from DCAS,
- The clustering starts when ISOCLIQUE receives a seed from the CLIQUE backplane. ISOCLIQUE fans out the seed to the six ISOPICK boards to begin incrementing the partial sums,
- When a ISOPICK finishes computing the partial sums, the partial isolation cluster data is sent to ISOLIST,
- The clustering process repeats until all the seeds have been used. At that point, ISOCLIQUE sends an end-of-buffer word to ISOLIST.

# Taxi Input Data Format From ISOCLIQUE to ISOLIST

- When a seed the received by ISOCLIQUE, ISOCLIQUE sends two 8-bit words to ISOLIST that contains the seed tower location, pass#, and L2 buffer #.

| strobe# | I | II |
|---|---|---|
| bit_0 | phi(0) | pass#(0) |
| bit_1 | phi(1) | pass#(1) |
| bit_2 | eta(0) | L2 buffer #(0) |
| bit_3 | eta(1) | L2 buffer #(1) |
| bit_4 | eta(2) | crate(0) |
| bit_5 | eta(3) | crate(1) |
| bit_6 | eta(4) | crate(2) |
| bit_7 | Diagnostic bit | Done bit |

- phi(0) and phi(1) are the local phi bits. The global phi is given by 5 bits in following order: crate(2) crate(1) crate(0) phi(1) phi(0). (Note: phi(0) is the least significant bit),
- Done bit is set to 0 for all valid seeds. If no more seed is available, ISOCLIQUE sends a dummy seed data with Done bit set to 1.

# Taxi Input Data Format From ISOPICK to ISOLIST

- After a ISOPICK completes a partial isolation sum, it sends, via a TAXI fiber to ISOLIST an 8-bit header word followed by ten 8-bit data words.

| strobe# | I | II | III | IV | V | VI | VII | VIII | IX | X | XI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| bit_0 | eta(0) | Et1(0) | Et1(8) | Et2(0) | Et2(8) | Et3(0) | Et3(8) | Et4(0) | Et4(8) | Et5(0) | Et5(8) |
| bit_1 | eta(1) | Et1(1) | Et1(9) | Et2(1) | Et2(9) | Et3(1) | Et3(9) | Et4(1) | Et4(9) | Et5(1) | Et5(9) |
| bit_2 | eta(2) | Et1(2) | Et1(10) | Et2(2) | Et2(10) | Et3(2) | Et3(10) | Et4(2) | Et4(10) | Et5(2) | Et5(10) |
| bit_3 | eta(3) | Et1(3) | Et1(11) | Et2(3) | Et2(11) | Et3(3) | Et3(11) | Et4(3) | Et4(11) | Et5(3) | Et5(11) |
| bit_4 | eta(4) | Et1(4) | Et1(12) | Et2(4) | Et2(12) | Et3(4) | Et3(12) | Et4(4) | Et4(12) | Et5(4) | Et5(12) |
| bit_5 | L2 buffer(0) | Et1(5) | Et1(13) | Et2(5) | Et2(13) | Et3(5) | Et3(13) | Et4(5) | Et4(13) | Et5(5) | Et5(13) |
| bit_6 | L2 buffer(1) | Et1(6) | Et1(14) | Et2(6) | Et2(14) | Et3(6) | Et3(14) | Et4(6) | Et4(14) | Et5(6) | Et5(14) |
| bit_7 | Diagnostic | Et1(7) | Et1(15) | Et2(7) | Et2(15) | Et3(7) | Et3(15) | Et4(7) | Et4(15) | Et5(7) | Et5(15) |

# Muon S-Link Format

## Muon TrkList:

- For each track with a muon stub match, we send the following S-Link word

| Reserved [22..31] | TOF HIP[21] | BMUF E/W $p_T$ [18..20] | CMP+CSP E/W, $p_T$ [15..17] | CMX+CSX E/W, $p_T$ [12..14] | CMU E/W, $p_T$ [9..11] | Linker ID [0..8] |
|---|---|---|---|---|---|---|

- CMU, CMX, CMP, BMUF have 3 bits, 1 for east/west and 2 bits for high, medium and low stub $p_T$ thresholds.

## Muon stub data:

- For each S-Link word, we can send up to 2 muon stubs,

| East/West [31] | Stub pT [29..30] | Wedge/Stack ID [20..28] | System ID [16..19] | East/West [15] | Stub $p_T$ [13..14] | Wedge/Stack ID [4..12] | System ID [0..3] |
|---|---|---|---|---|---|---|---|

- System ID:

  0=no data, 1=CMU, 2=CMX+CSX, 3=CMP+CSP, 4=BMU+BSUF+(HAD), 5=BMU+BSUR+TSU+(HAD), 6=HAD+CMU, 7=TOF HIP,

- For CMP+CSP stub, the stub $p_T$ bits are used to address the stacks.

# RECES S-Link Format

We have re-arragement the order of threhold, eta, and e/w bits in this version#0.6 (old version # 0.5 was discussed in the bi-weekly meeting on Apr 11, 2003)

RECES TrkList:

- For each track with a match to a RECES cluster, we send an S-Link word

| Reserved [17..31] | RECES threshold [16] | East/West [15] | Hi/Low Eta [14] | Wedge [9..13] | Linker ID [0..8] |
|---|---|---|---|---|---|

RECES cluster data:

- For each S-Link word, we can send up to 2 RECES clusters,

| | Threshold [28] | E/W [27] | Eta [26] | Wedge/cluster ID [17..25] | Data [16] | | Threshold [12] | E/W [11] | Eta [10] | Wedge/cluster ID [1..9] | Data [0] |
|---|---|---|---|---|---|---|---|---|---|---|---|

- Bit 0 and 16 indicate whether or not the 16 bit block contains cluster data,
- Bits [13..15] and [29..31] are reserved for future use,
- If high threshold bit is set, the low threshold bit is also set → only send the high threshold bit,
- The RECES cluster data will be dropped after the RECES-XTRP matching firmware is implemented in the Pulsar pre-processor.