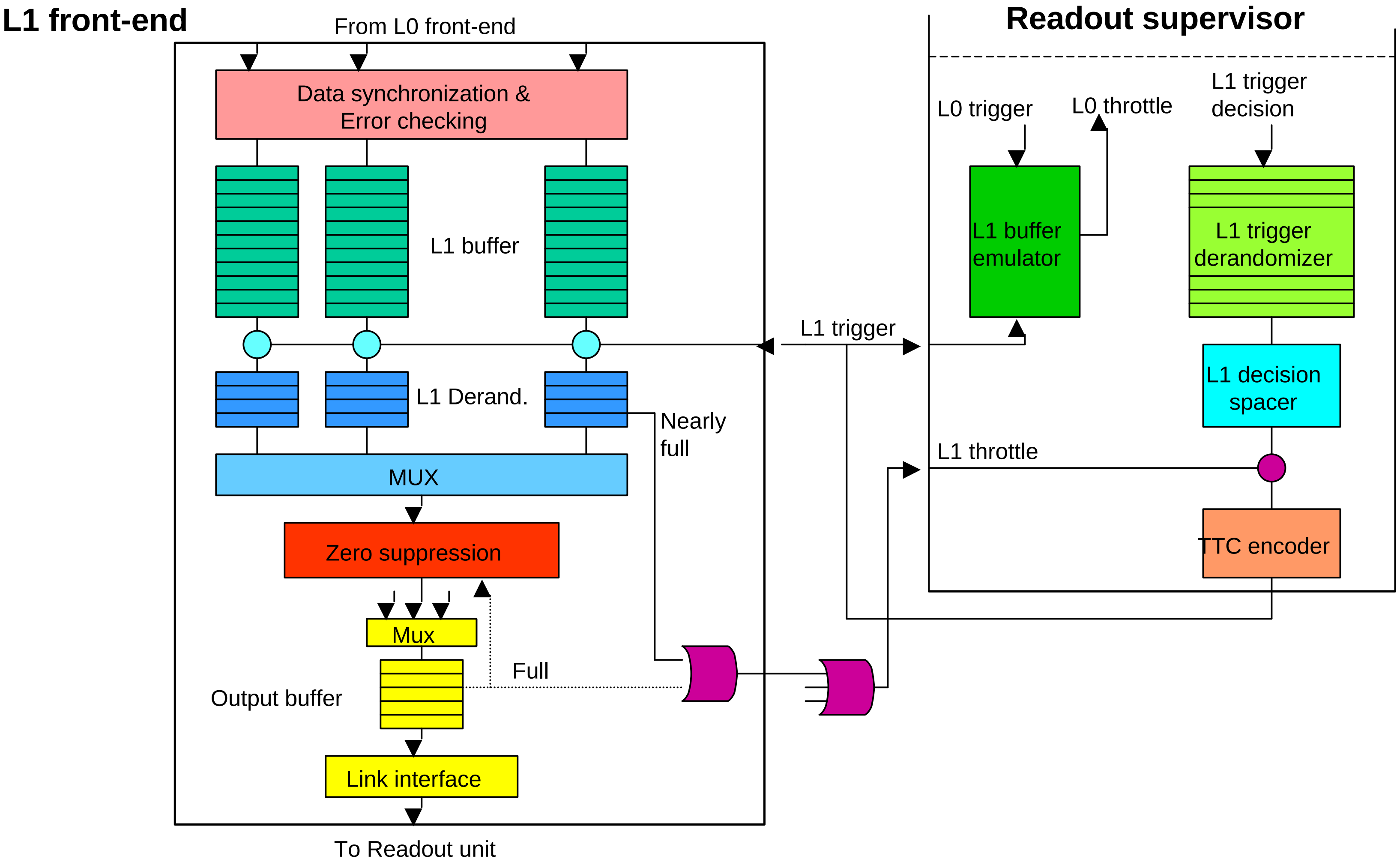
L1 architecture definition and parameters

L1 architecture



Data sync. and Error checking

- Resynchronize data stream after L0 reset.
  - – No data in L0 derandomizer when L0 reset
- Check consistency of input data

  Compare between data sources or

  Compare to known reference
    - B-ID
    - Error flags
    - Event ID
    - Custom
- Compress data tags
  - – Up to 4 data tags allowed in data from L0 derandomizer.
  - – 2 data tags allowed in L1 buffer (32 data + 2 tags)

L1 buffer

- Input rate: Max. one event per 900ns.
- 34 words per event

  32 data + 2 tags

- Output rate: Max. one event per 850ns.

  Having higher output rate than input rate insures that no data saturation effects occur in L1 buffer.

- Buffer size: 64k/34 = 1927 events (2k).

  Limited additional cost compared to 1k buffer

- Central L1 buffer emulation in readout supervisor prevents overflow by throttling L0 trigger when L1 occupancy equals 1927 - 16 - $\delta = \sim 1900$

L1 throttle

- Prevent buffer overflows in front-end and DAQ.
- Buffer occupancies “unpredictable” centrally after zero-suppression.
- Throttle delay: Max 2 us

Throttle network:	100m x 5ns/m =	500ns
Readout supervisor:		100ns
TTC broadcast serialization:	16x25ns =	400ns
TTC cable delay:	100m x 5ns/m =	500ns
TTCrx:		100ns
Front-end:		100ns
TOTAL (conservative):		1700ns = **2 us**

L1 derandomizer

Function: Derandomize rate before zero-suppression and allow delay in L1 throttle network.

No derandomization of L1 trigger decisions needed in front-end as L1 trigger decisions spaced by 850ns in readout supervisor

- Input rate: Max. one event (34 words) per 850ns
- Depth:

  Throttle delay: 2 us / 850 ns = ~3 events (throttle limit)

  Derandomization: 4 - 16 events

  Total: 8 - **16** events
- Readout time:

  Small (8) derandomizer ~25% faster than average rate

  40KHz -> 18us, 60kHz -> 12.5us, 90kHz -> 8us

  Large (16) derandomizer ~10% faster than average rate

  40KHz -> 22us, 60kHz -> 15us, **90kHz -> 10us**

Zero suppression

- Max input rate (words):
  L1 rate x Multiplexing ratio x (32 + 2) x 1.2
- Output rate: data dependant
- Reset recovery time: 0.5 - 1 ms (half L1 latency)
- Processing requirements

Example: Processing: Each word needs to be accessed **4 times @ 40 MHz** (conservative)

Time per event:	L1 multiplexing:
20 us (40kHz)	20us/ (32 x 4 x 25ns) = 6 (192 channels)
13 us (60kHz)	13us/ (32 x 4 x 25ns) = 4 (128 channels)
9 us (90KHz)	9us/ (32 x 4 x 25ns) = 2 (64 channels)

Output buffer

Smoothen data bandwidth to match output link.

Assembly of complete zero suppressed event before output formatting

Can be limited to one event if link bandwidth significantly higher than average bandwidth needed (~factor 2)

Full status can be propagated backwards to zero-suppression and L1 derandomizer.

Link interface

- Output data formatting for link
- Formatting for RU (is this currently fixed and documented ?):
  - – Headers & trailers
  - – Error status
  - – L1 event ID (special L1-ID reset required or use L1 reset ?)
  - – etc.

Summary

- Architecture defined
- L1 input speed: Max. 900ns
- L1 buffer: 64 K words (2k events), 34 words per event
- L1 output speed: Max. 850ns
- L1 throttle delay: Max. 2 us
- L1 derandomizer size:

  15 events (512 words), if zero-suppression 20 % faster 7
  7 events (256 words), if zero-suppression 50% faster
- L1 derandomizer readout output speed:
  40 kHz -> ~22us, 60kHz -> ~15us, **90kHz -> ~10us**
- Output buffer: One to a few events with back propagation.

L1 front-end requirements document under “construction”

Which parameters can we fix today