Channel hit rate and Salsa bandwidth

Irakli Mandjavidze

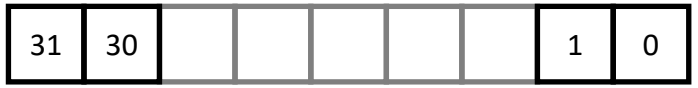
Internal

Feb 2, 2026

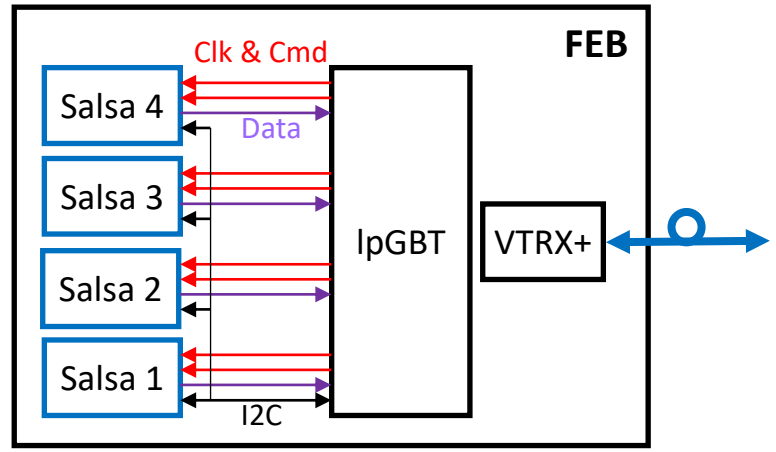
Construction parameters

- Channel data
  - → 12-bit ADC samples
  - → 2 samples per 32-bit word
  - → 3-word channel overhead
    - Header, Trailer, Parity
- 64-channels per ASIC
- Single serial TX data link per ASIC
  - → 1.28 Gbit/s bandwidth
  - → Two 32-bit words of overhead after each packet
    - Idle words

Channel packet



Type: Phy data	Chip ID, Timestamp …	
Flags	Sample 2	Sample 1
…	…	…
Flags	Sample N	Sample N-1
Size	Link ID, Packet num	
Vertical even parity		
Link Idle word		
Link Idle word		



Salsa physics data rate : 40 MHz sampling

- Sampling period : 25 ns

- Signal shape ZS readout
  - → 500 ns readout window when signal is above threshold
    - 200 ns peaking time
  - → 20 samples
  - → 13-word packet + 2-word link overhead

Channel rate kHz	Channel BW Mbit/s	Salsa BW Mbit/s	Link load %	Comment
10	4.6	293	23	Initial value
20	9.2	586	46	Zone of comfort
25	11.4	732	57	
30	13.7	879	69	Uncomfortable
40	18.3	1172	92	Inacceptable

Salsa physics data rate : 50 MHz sampling

- Sampling period : 20 ns

- Signal shape ZS readout
  - → 500 ns readout window when signal is above threshold
    - 200 ns peaking time
  - → 25 samples
  - → 16-word packet + 2-word link overhead

Channel rate kHz	Channel BW Mbit/s	Salsa BW Mbit/s	Link load %	Comment
10	5.5	352	27	Initial value
20	11.0	703	55	Zone of comfort
25	13.7	879	69	Uncomfortable
30	16.5	1055	82	Inacceptable
40	22.0	1406	110	

Summary

- Current MPGD readout architecture implies single 1.28 Gbit/s Tx link per Sala

- Signal shape ZS readout places 20-25 kHz limit at acceptable channel hit rate
  - → Calibration data bandwidth is significantly lower and can be easily accommodated

- To understand if this option is adequate to all MPGD groups
  - → Need to know expected channel hit rates
    - Particle rate, cluster size, charge distribution with the cluster, ZS threshold
  - → Need to know if complete shape has to be read
    - Alternative : few samples on baseline, rising edge, few samples on falling edge
  - → Need to fix sampling rate
    - 40 MHz due to advent of lpGBT, higher to exploit micro-TPC algorithm (if possible), lower

- Sustained channel hit rates can be much higher with Amplitude-Time readout
  - → Not supported in Salsa2
  - → Will require non-negligible modifications in Salsa3
    - Adding of new filtering logic, support for yet another data packet format, probably extra data pipeline…
    - Questionable under existing human resources and tight planning

- Sustained channel hit rates can be much higher using 2 TX data links per Salsa
  - → Significant impact on overall readout architecture :
    - 2 lpGBTs per FEB : not clear if extra lpGBTs available
    - Increase of DAMs : not clear if extra DAMs can be accommodated
    - Alternatively, re-introducing of intermediate RDO subsystem