



TRD Upgrades

TDR Status

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EB TDR Chapter Concept

Content suggested by editorial board

- Sub system specifications
 - Consequences of overall specifications ok
- Implementation architecture
 - Segmentation and data rates ok
 - Front-end board ok
 - Read-out board; Interface to back-end/DAQ ok
 - Trigger & busy handling discussed above
- Schedule, funding and institutes

In addition for TRD:

- Detector capability
- New data format: content, offline performance

TDR Concept

- **Detector Rate Capability**
 - expected currents in Run3: extrapolation from existing data (PbPb, pPb, pp)
 - feasibility of HW: HV supplies,...
- **Aging of HW components**

shortly summarize some of the following aspects:

 - Compile information on HV problems: when appear in which chambers; conclusions on reasons
 - Feedback from investigations of Sec17 chambers if suitable
 - (statistics of FEE issues)
- **FEE Readout Rate Capability**
 - FEE readout rate limits
 - Power consumption and rate limits
- **Modified Readout Data Format(s)**
 - Description of alternative formats:
 - (extended) tracklets
 - (full raw data for electron candidates only)
 - Achievable rates
 - **Offline performance**
 - Tracking
 - dEdx, PID
 - Approaches for calibration, alignment,..
- **Readout – CRU**
 - TRD-specific interface and CRU;
 - Basic functionality similar to readout path of existing GTU (without L1 downscaling)
 - Discuss also trigger and busy

Rate Capability

- To which extent is TDR standalone or should refer to Lol?
- Rates: focus on specifications instead of max. rates
- distinguish: interaction vs readout rate

LV Limitations

- Measured (rate dependent) D18 currents vs rate in various scenarios
 - Tracklet only readout (PT- L0 sequences) with variable amount of tracklets
 - Raw data readout with various L1 rejection (PT – L0 – nn% L1)
- First conclusion (detailed analysis will follow)
 - ~ 60A / 100 kHz rate (PT, L0); 62A / 100kHz with 2% L1a
 - 85A in CONFIGURED → current <150A up to >100kHz readout rate

CRU

- Interface: FEE optical – “standard” CRU
- Input (per sector): 60 x 2Gb/s with low duty cycle
- FEE readout
 - Accept data at 60x 2Gb/s
 - Accept tracklet only, no tracklet, tracklet+full raw data
 - robust handling of FEE data transfer (format errors)
 - Buffer depth: static or dynamic event buffer size?

Questions:

- CRU: number of input links (15 x 1Gb/s?)
- Trigger distribution: latency, format
 - As current scheme: from CTP to FEE and in parallel to readout board
- Busy: from CRUs
- N_DDL / CRU: 1 or more
- TRD (L1) trigger in Run3?

Backup Slides

Readout Upgrade – ALICE CRU

	Reduced Raw Data	Tracklet Data
FEE event readout time [$\mu\text{s}/\text{event}$]	19.5	7
FEE readout rate at 100% deadtime [kHz]	51.2	<143 100 (*)
Readout data throughput at maximal FEE readout rate [GB/s]	33.4	<38.2 26.7 (*)
Readout rate at 50 kHz interaction rate [kHz]	25.3	37
Corresponding readout data throughput [GB/s]	16.5	9.7
Corresponding deadtime [%]	49	26

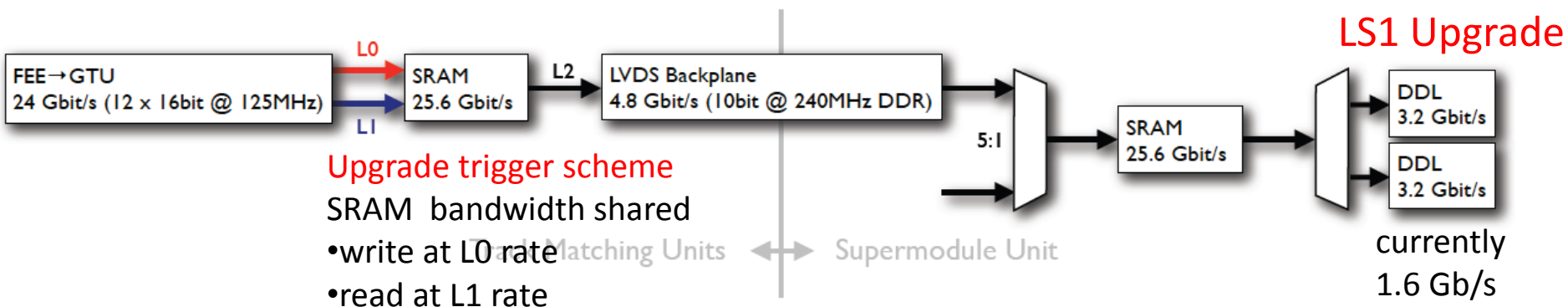
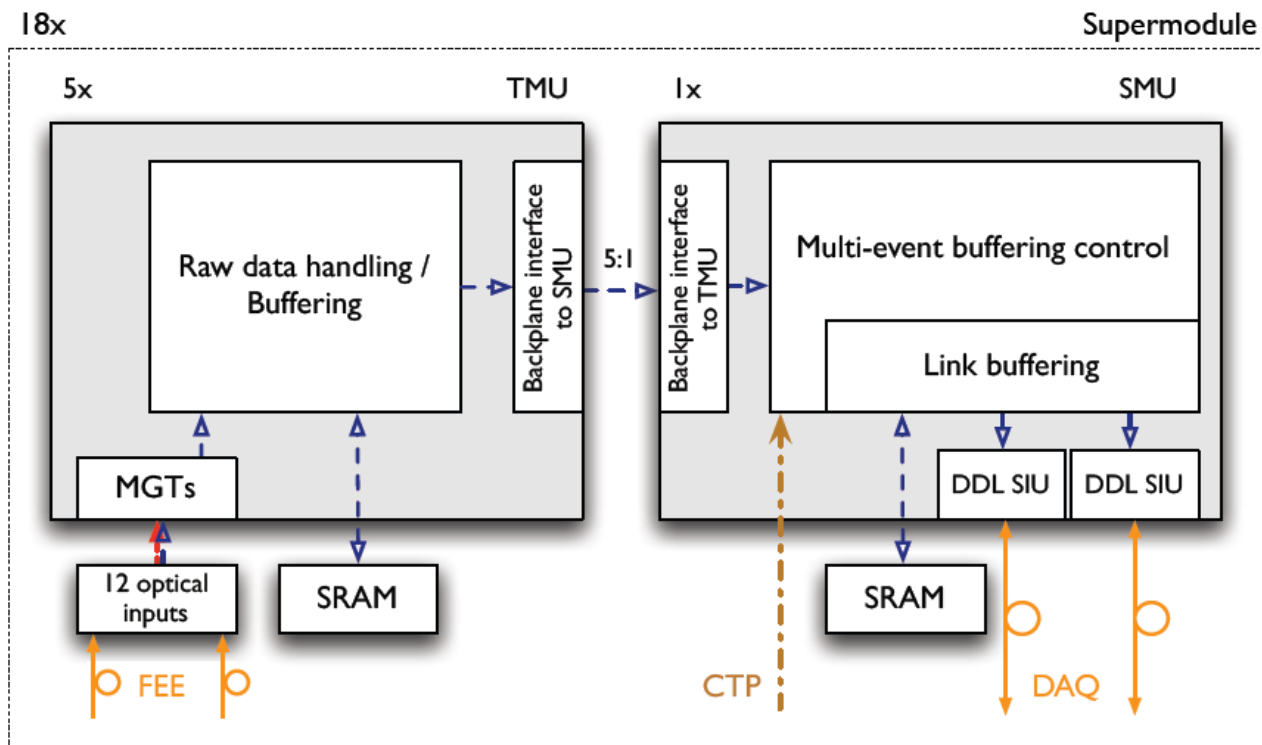
R_int kHz	R_read kHz	Deadtime fraction	FEE_rd duty cycle	N_links	Data vol. Gb/s/sect	Data vol. Gb/s/link
50	37	26	4	5	4.3	0.08
100	59	41	6	8	6.9	0.12
50	37	26	8	10	8.6	0.15
100	59	41	12	15	13.8	0.23

Note:

- Deadtime/event: 7 μs
- N_links assumes 1Gb/s links

GTU - Data Transfer Bandwidth

S. Kirsch



TRD FEE Readout Upgrades - Concept

ALICE after LS2

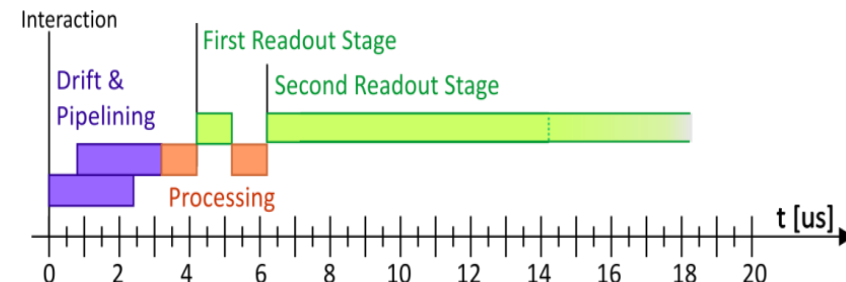
- continuous readout (ITS, TPC) or high rate readout of MB triggered data: up to 50kHz PbPb

TRD FEE

- single event buffer → FEE event sequence imposes rate limits: drift - processing – tracklet readout – full raw data readout
- no hardware upgrade conceivable

FEE readout modifications

- basic idea: no ADC raw data readout; use FEE (TRAP) processing capability to reduce amount of data
- readout of reduced raw data
 - variable amount of processed information such as tracklet fit parameters, charge sums and other PID-related variables
- modified tracklet readout
 - severe restriction in data volume: four 32bit words / MCM/event



TRD FEE Readout Upgrades - Rates

Rates

- rate limits and data volumes

	Zero Suppr. ADC Data	Reduced Raw Data	Tracklet Data
FEE event readout time [μs /event]	36.5	19.5	7
FEE readout rate at 100% deadtime [kHz]	27.4	51.2	<143 100 (*)
Readout data throughput at maximal FEE readout rate [GB/s]	81.5	33.4	<38.2 26.7 (*)
Readout rate at 50 kHz interaction rate [kHz]	17.7	25.3	37
Corresponding readout data throughput [GB/s]	52.4	16.5	9.7
Corresponding deadtime [%]	65	49	26

(*) further rate limitation coming from the low voltage system, shown are alternative numbers for 100 kHz max. rate

- very preliminary numbers for data volume and event readout time with the new readout modes