

MVT Read-Out Architecture & MVT / SVT Integration Issues

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- **MVT Readout**
 - Number of Channels
 - Architectural considerations
 - Front End Unit
 - Back End Unit
 - Data Rate Estimations
- **SVT / MVT Integration**
 - Number of SVT and MVT Channels
 - Some comparisons
 - Specific and common readout parts

- Number of MMs

- Barrel X: 3 views x 3 MMs = 9
- Barrel Y: 3 views x 3 MMs = 9
- Forward: 3 stations x 2 views x 6 MMs = 36
- Total: 54

- Number of channels

- Barrel X: ~10 000
- Barrel Y: ~11 000
- Forward: ~25 000
- Total: ~46 000

MVT Read-out Architectural Considerations

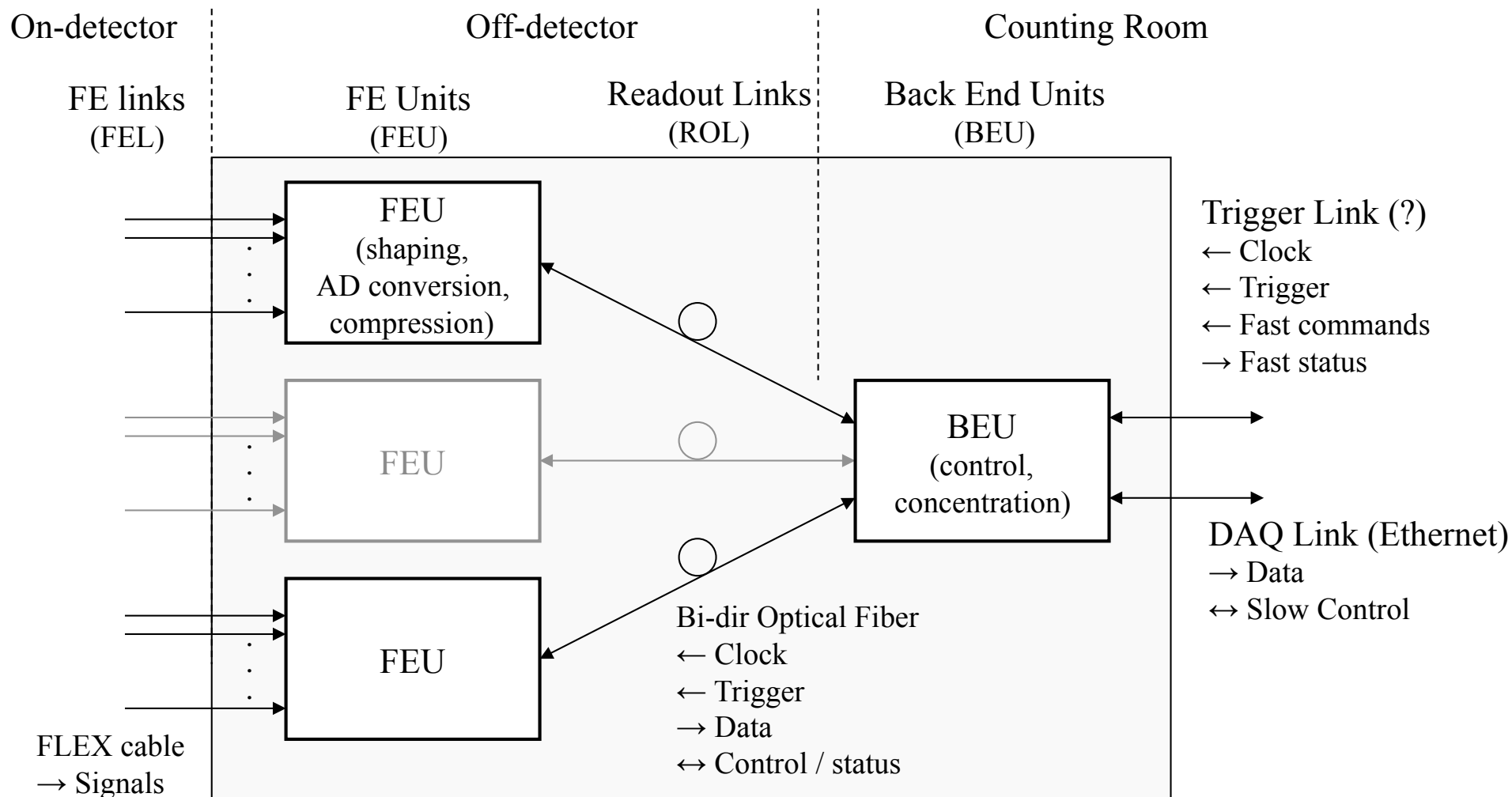
- Minimal number of different hardware to develop and maintain
 - front end cards
 - back end concentrator cards
- Partitioning: DAQ Read-out Unit = View
 - Single communication channel with DAQ per View
 - Concentrate data from all MM in a View before sending to DAQ

MVT Read-out Architectural Considerations

CLAS12

A DAQ Readout Unit

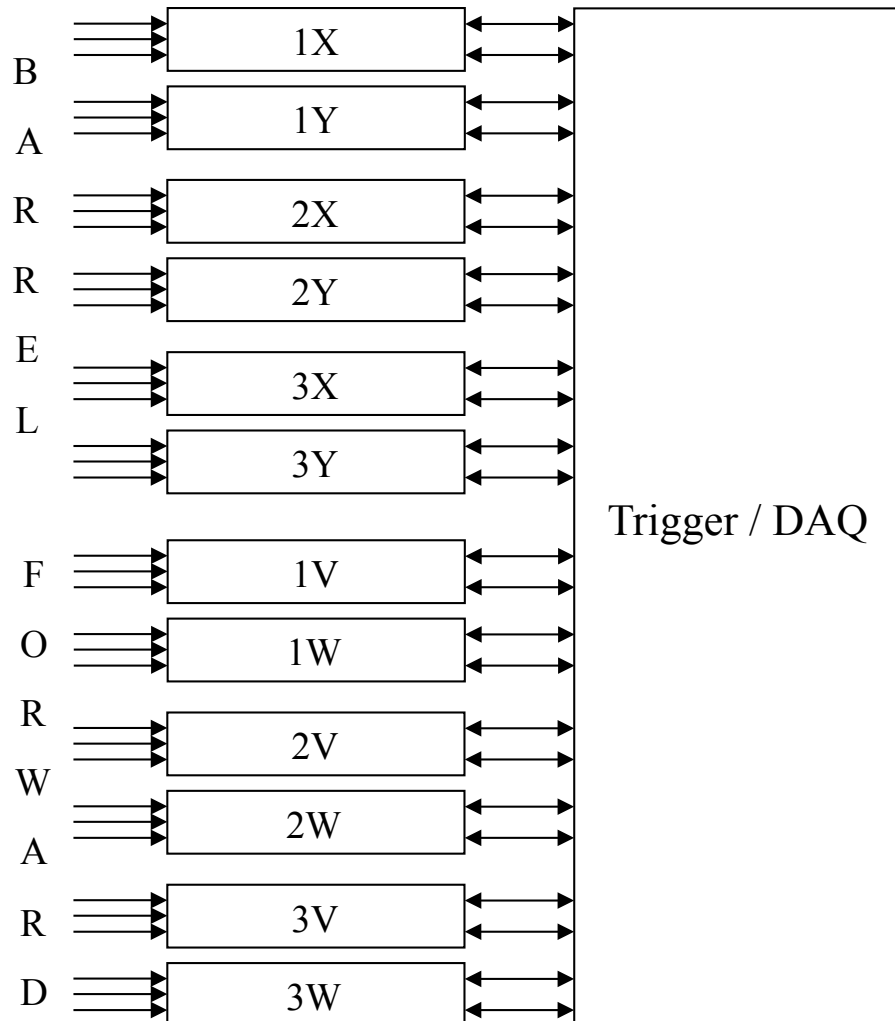
- One read-out unit per view



MVT Read-out Architectural Considerations: CLAS12

Partitioning

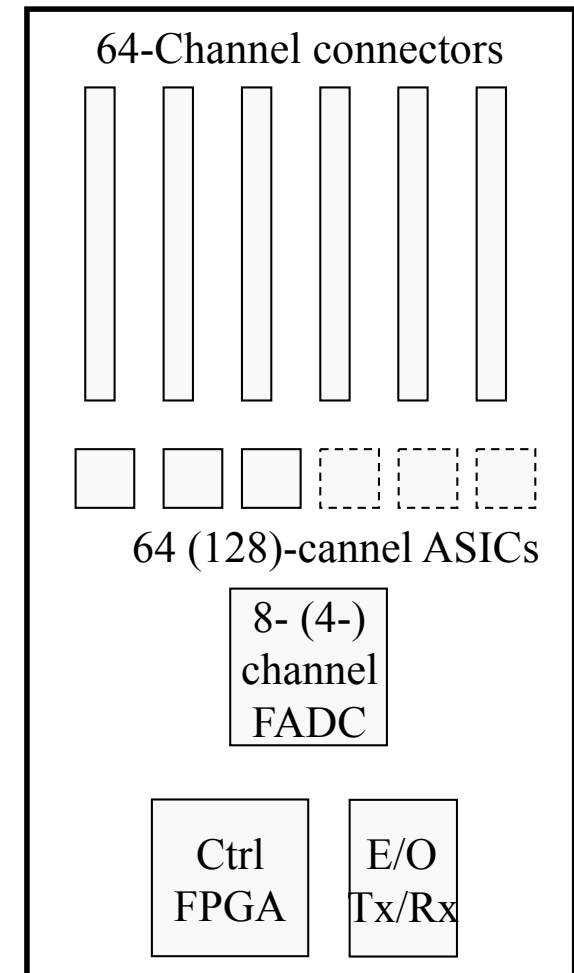
- 12 MVT partitions



Read-out Architecture Considerations: CLAS12

Front End Unit (FEU)

- 64 channels per FLEX
- 64- or 128-channel FE ASIC
- FEU6 option:
 - 6 64-channel FLEXes
 - 384 channels
 - 6 or 3 ASICs
 - an 8- or 4-channel FADC
 - a controller FPGA
 - an optical link towards a concentrator card



Read-out Architecture Considerations: CLAS12

FE Granularity

- Barrel X with 3 MM / view

→ D1X:	6 FEU	(2 FEU / MM)
→ D2X:	9 FEU	(3 FEU / MM)
→ D3X:	12 FEU	(4 FEU / MM)

- Barrel Y with 3 MM / view

→ D1Y:	6 FEU	(2 FEU / MM)
→ D2Y:	9 FEU	(3 FEU / MM)
→ D3Y:	12 FEU	(4 FEU / MM)

- Forward with 6 MM / view

→ Disk:	12 FEU	(2 FEU / MM)
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- Total number of FEUs: 126

- 756 64-channel ASICs or 378 128-channel ASICs
- 756 64-channel FLEXes

Read-out Granularity: Back End Unit (BEU)

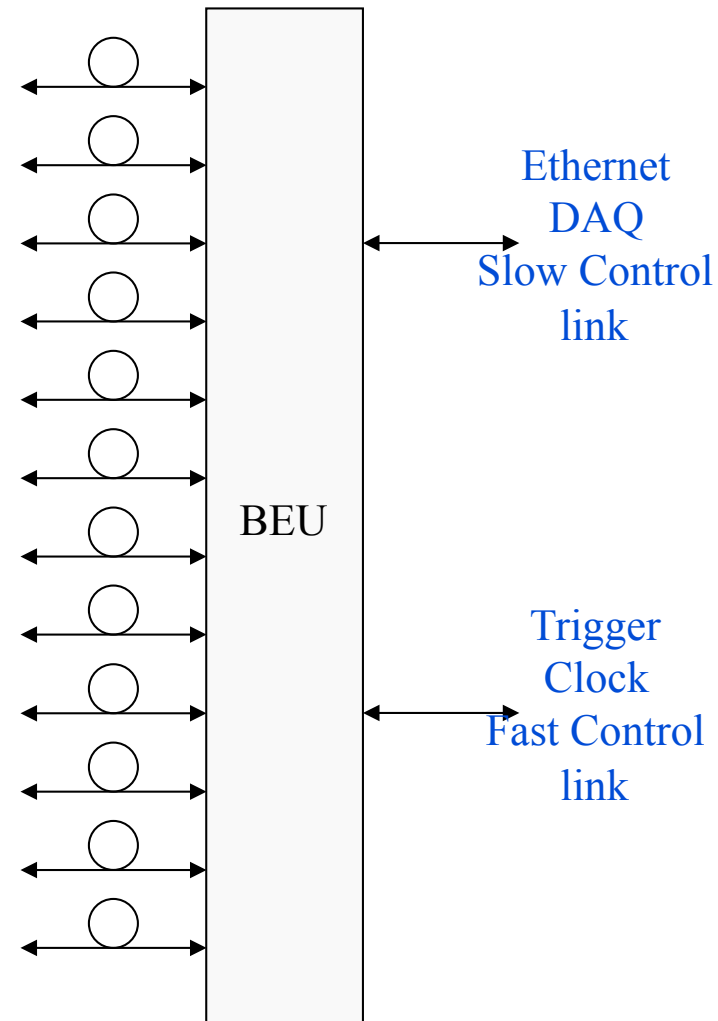
● Functionality

- Receives CLAS12 clock, trigger and control flow & distributes it to all FEUs of a view
- Concentrates data from the FEUs & sends them to DAQ

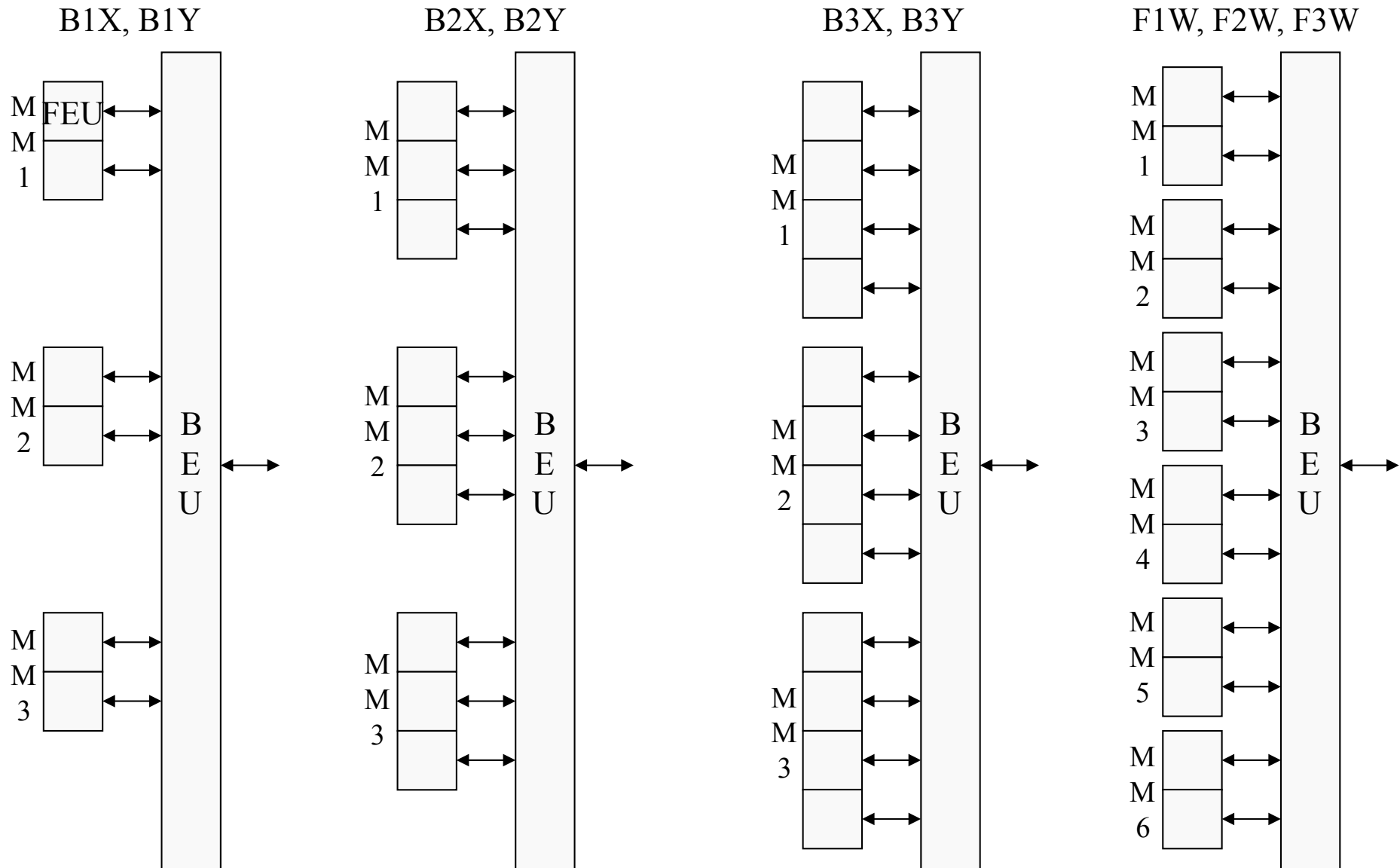
● BEU12 option:

- 12 optical FEU links
- Ethernet DAQ – Slow Control link
- Trigger – Clock – Fast Control link
 - whatever standard
- Form factor?

● Total of 12 BEUs needed



Read-out Granularity: Barrel X,Y and Forward V, W Units



- Hypothesis

- 10 MHz Barrel background (safety factor ~2)
- 20 MHz Forward background (safety factor ~1.4)
- 20 kHz L1 rate (safety factor 2)
- Multiplicity: barrel 4, forward 1.2
- 20 MHz sampling rate
- 4 samples / channel read-out

- Full readout: 7400 Mbyte/s

- Event size 380 Kbyte

- Zero suppression: 75 Mbyte/s

- Subtract common noise, apply threshold
- Event size 3.8 Kbyte

- Data reduction factor of ~100

Number of SVT Channels Speculations

- 3 Regions
 - 2 views per region
- Regions composed of 256-channel modules
 - Region 1: 8 modules
 - Region 2: 12 modules
 - Region 3: 16 modules
- Number of channels
 - Region 1: 4096
 - Region 2: 6144
 - Region 3: 8192
 - Total: ~18 000
 - ~140 additional 128-channel ASICs

Current Ideas: SVT

- On-detector front-end electronics
 - relatively stringent space & power constraints
- Space
 - ASIC
 - wire-bonded
 - minimal number of external components
 - as complete read-out system as possible
 - higher channel count
 - cooling extends up to detector
- Power
 - minimize mW / channel ratio
 - special attention to low voltage distribution

Current Ideas: MVT

- Off-detector front-end electronics

- looser space & power constraints

- Space

- ASIC

- packaged

- more complex read-out circuitry possible

- external digitization, zero suppression

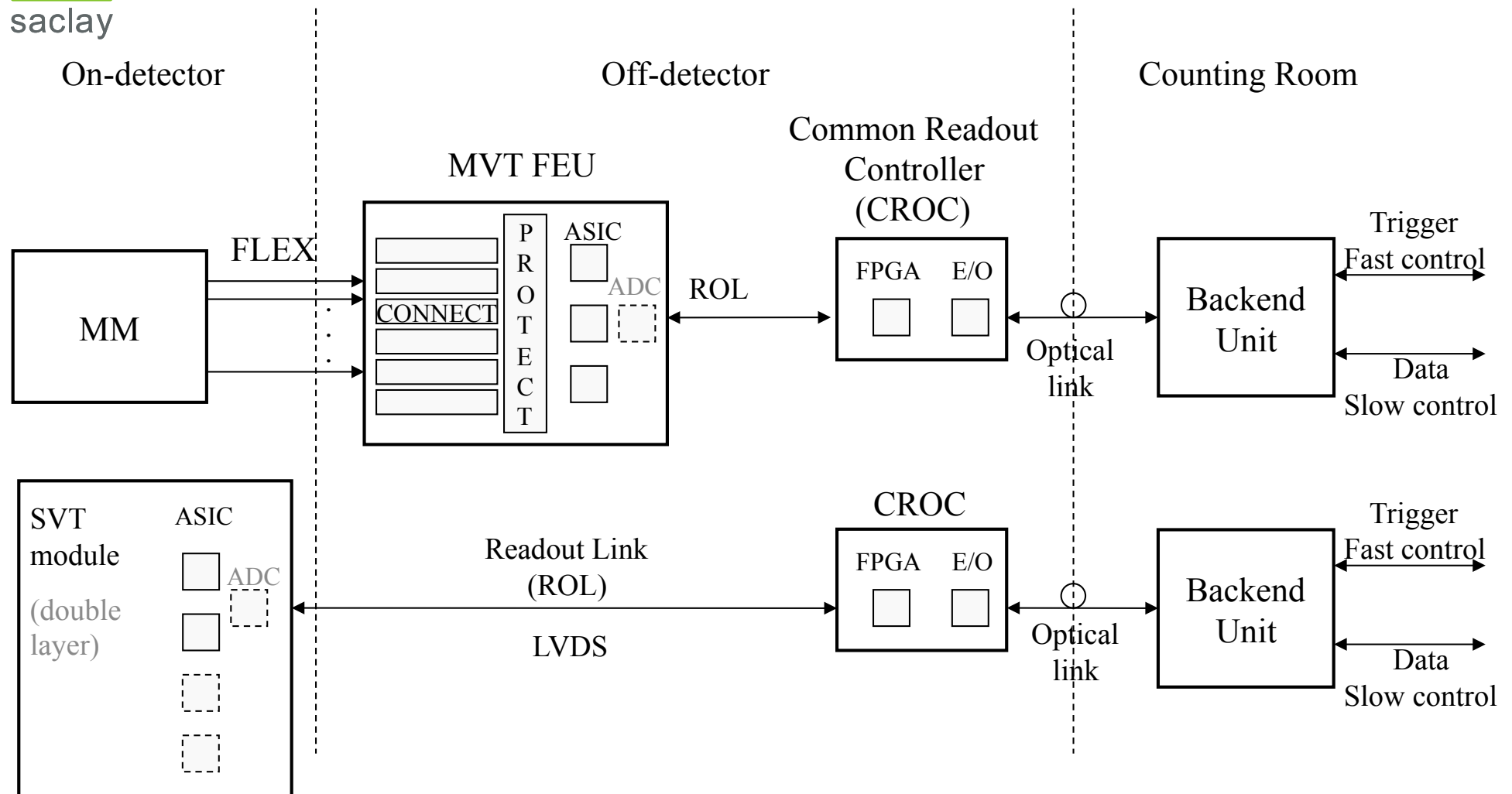
- lower channel count

- cooling system does not extend to detector

- Power

- can permit somewhat higher mW / channel ratio

- low voltage is not distributed to detector



- An external FADC: additional 1 mW / channel (at least)

Data Rate Estimations: SVT Speculations

- Hypothesis

- 30 MHz background (safety factor ~?)
- 20 kHz L1 rate (safety factor 2)
- Multiplicity: 1.2 (?)
- 20 MHz sampling rate
- 4 samples / channel read-out

- Full readout: 2800 Mbyte/s

- Event size 144 Kbyte

- Zero suppression: 19 Mbyte/s

- Subtract common noise, apply threshold
- Event size 1 Kbyte

- Data reduction factor > 100

Discussions

- MVT participation in L1 Trigger is not envisaged
- What is the control interface?
 - clock and trigger distribution
- Current FE electronics volume estimates: 0.12 m^3
 - a cube of 50 cm!
 - central SVT / MVT Tracker – 0.1 m^3
- What are the space constraints?
 - how do the SVT and MVT on-detector infrastructures cohabitate?
 - how do they cohabitate with other central detectors?
 - power, cables, channel protections, electronics, cooling
- What can be common?
 - ASIC?
 - read-out controller & back-end concentrator?
- What if the SVT electronics could be off-detector?

The most optimal read-out granularity and partitioning will be defined accordingly