

Integration of Micromegas Detectors into the ATLAS Data Acquisition

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On behalf of the MAMMA collaboration

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Motivation

- A 4-layer Micromegas detector will be **installed** on one of the **ATLAS Small Wheels** during the current long shutdown (LS1)
- It allows a test of the **New Small Wheel technology** under original conditions
- Event-by-event **comparison** of Micromegas and Small Wheel muon **track measurements**
- Therefore it is necessary to interface to the ATLAS Data Acquisition Systems:
 - LHC Clock und ATLAS Trigger via **TTC** (Trigger, Timing and Control) network
 - ATLAS data taking infrastructure (Read Out System **ROS**)
 - ATLAS **Run control** network for configuration and slow control
- => Based on successful experience, existing prototype systems, available experts and commercial availability:
Use of the **Scalable Readout System** (SRS) with Scalable Readout Unit (SRU) as ATLAS **Micromegas ReadOut Driver**

SRS ATLAS ROD status

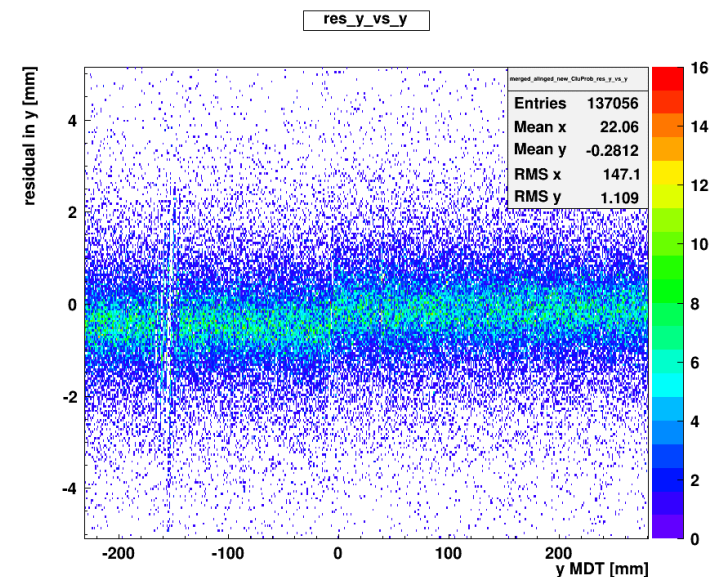
- „Classic“ (non-ATCA) SRS system (with APV25 chips) running in ATLAS-like setup @Garching Cosmic Ray Facility (TTC, ROS available)
- SRU module with ReadOutDriver firmware generating valid ATLAS event fragments
- Comparison of L1 Micromegas chamber track measurements with Reference chamber track prediction
- Analysis of residuals, efficiency and amplification as a function of X and Y coordinates over the full L1 chamber area

... ongoing work

MDT Reference chamber

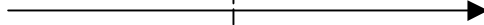
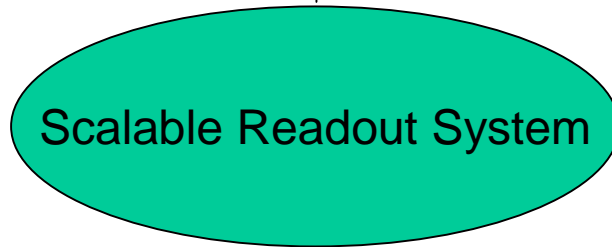
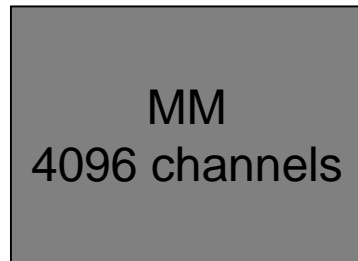
L1 Micromegas

MDT Reference chamber



Drawn at: 2013-08-30 17:43:29

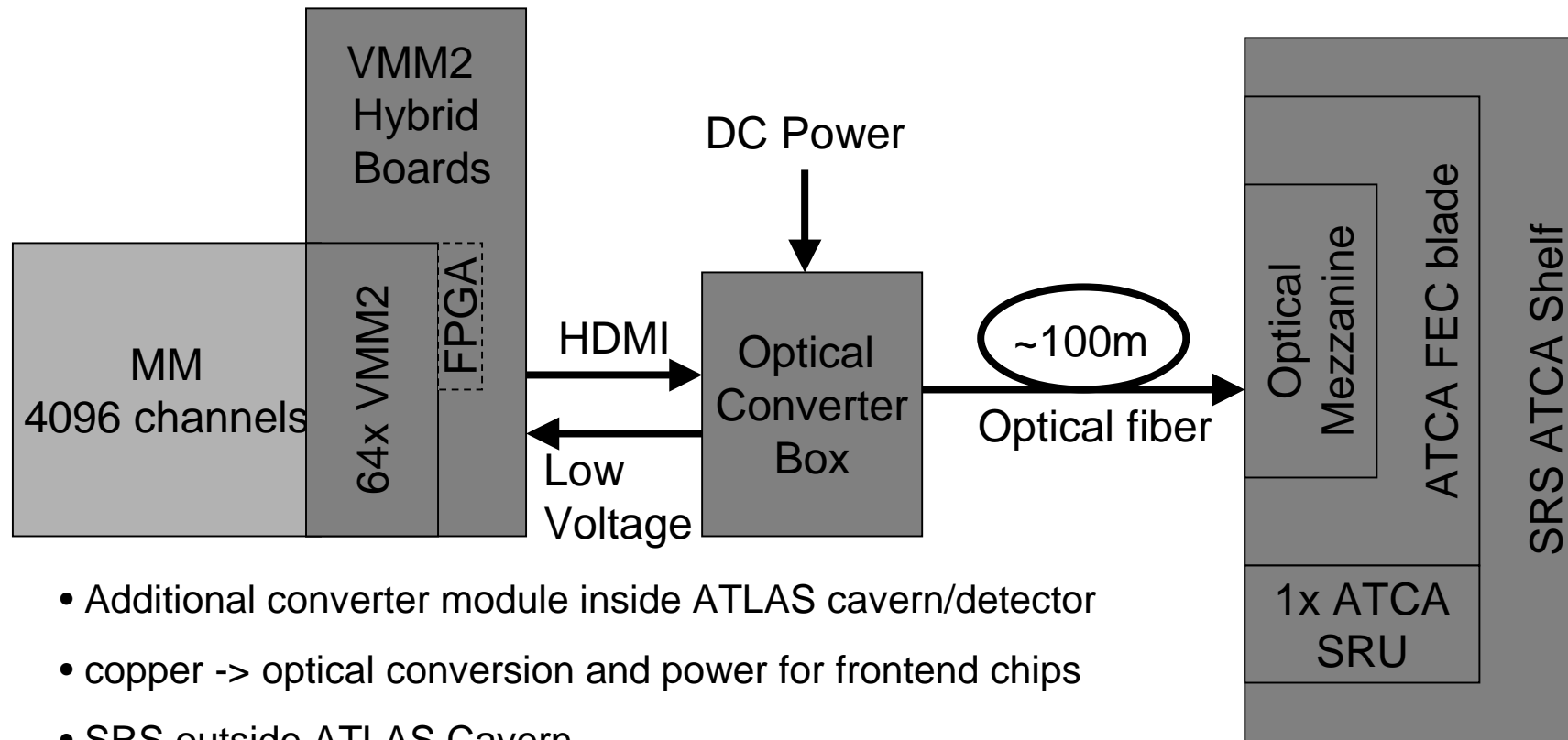
Task:



UX15

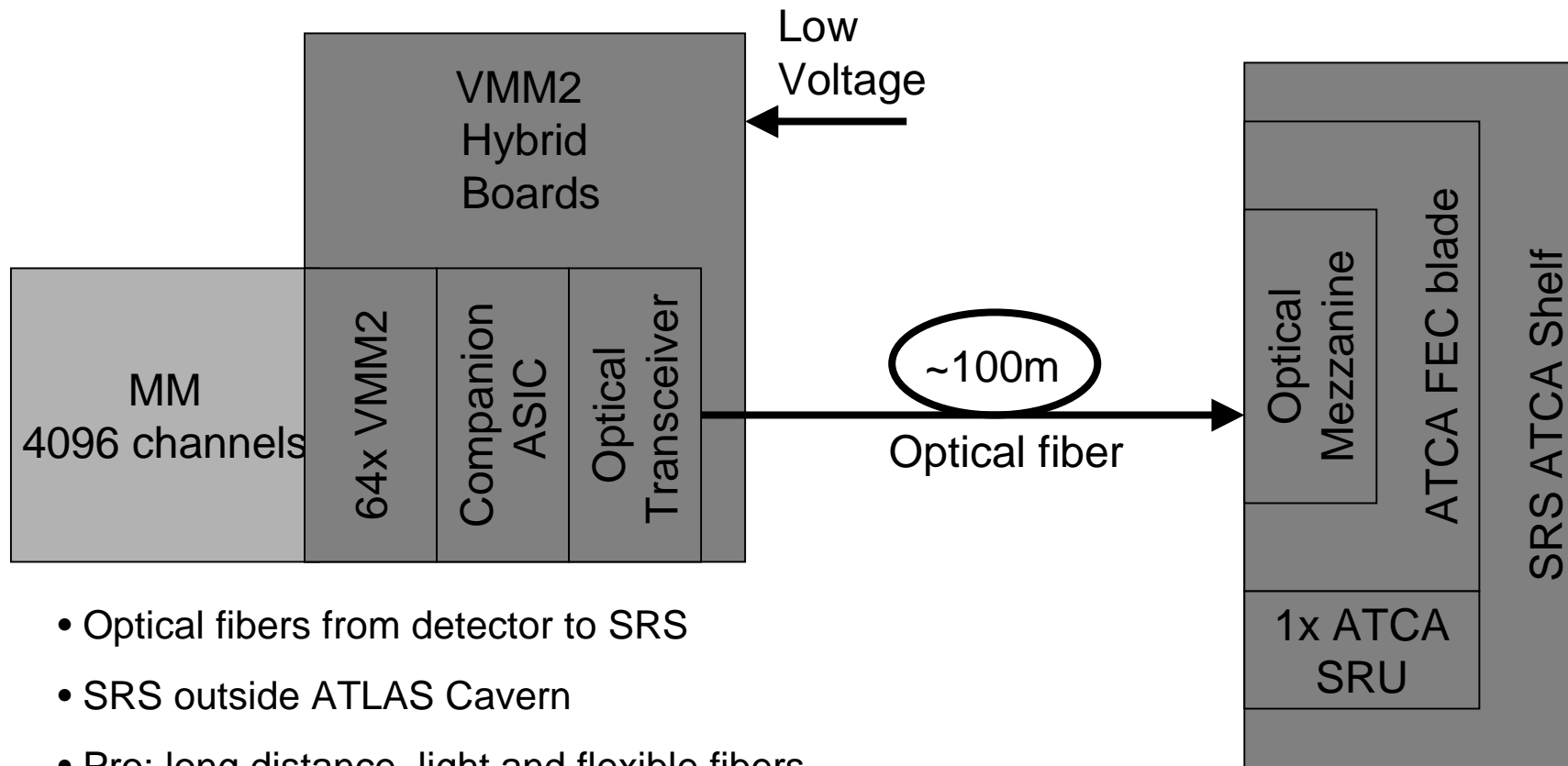
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Frontendchip Option #1a: VMM2



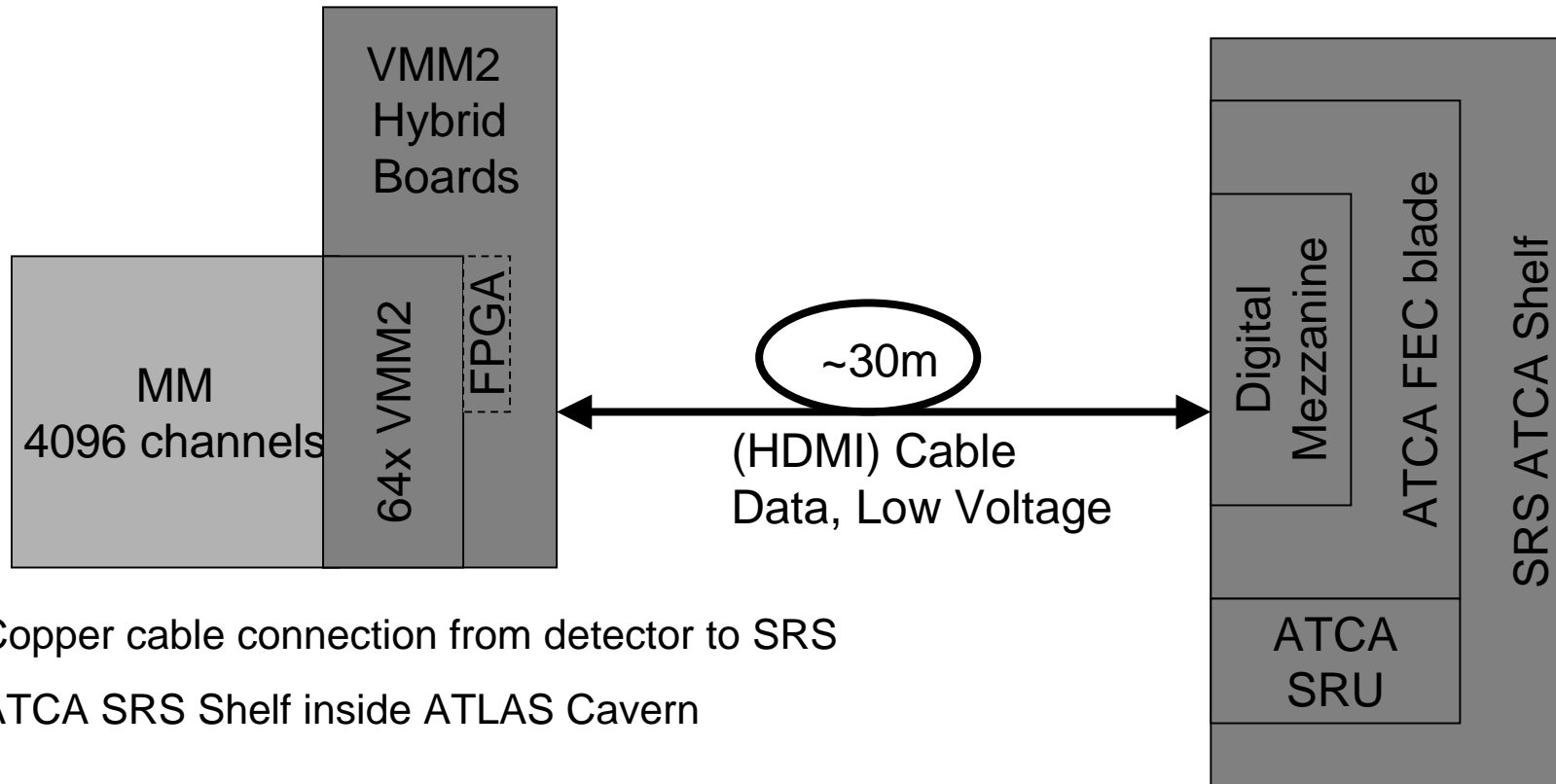
- Additional converter module inside ATLAS cavern/detector
- copper -> optical conversion and power for frontend chips
- SRS outside ATLAS Cavern
- Pro: long distance, light and flexible fibers, radiation issues for optical fibers migrated, minimal cost for hybrid board
- Con: needs independent powering for VMM2, however available inside OC box

Frontendchip Option #1b: VMM2



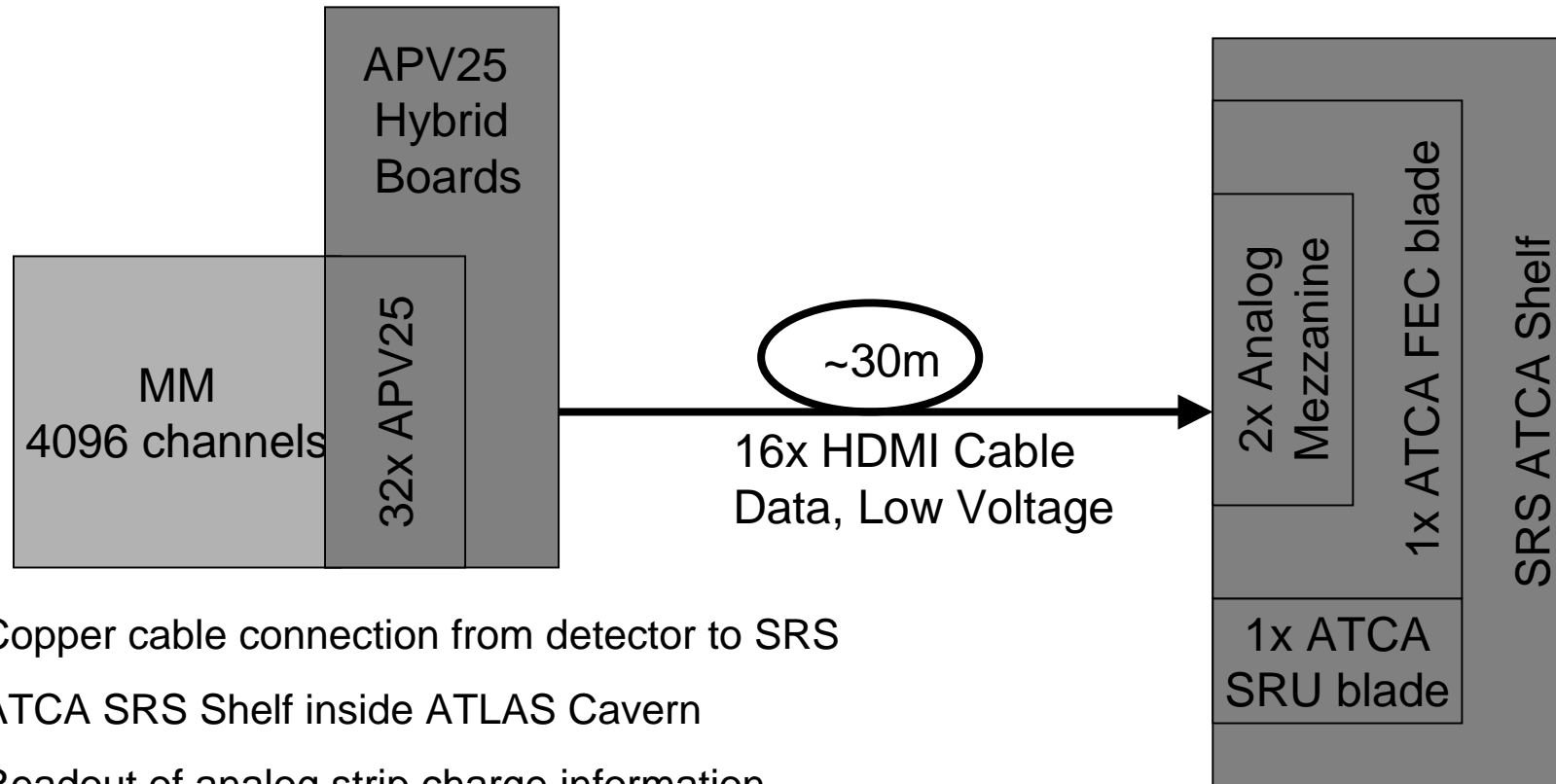
- Optical fibers from detector to SRS
- SRS outside ATLAS Cavern
- Pro: long distance, light and flexible fibers
- Con: needs independent powering for VMM2, needs special companion ASIC on Hybrid board, possible radiation issue for optical transceiver

Frontendchip Option #1c: VMM2



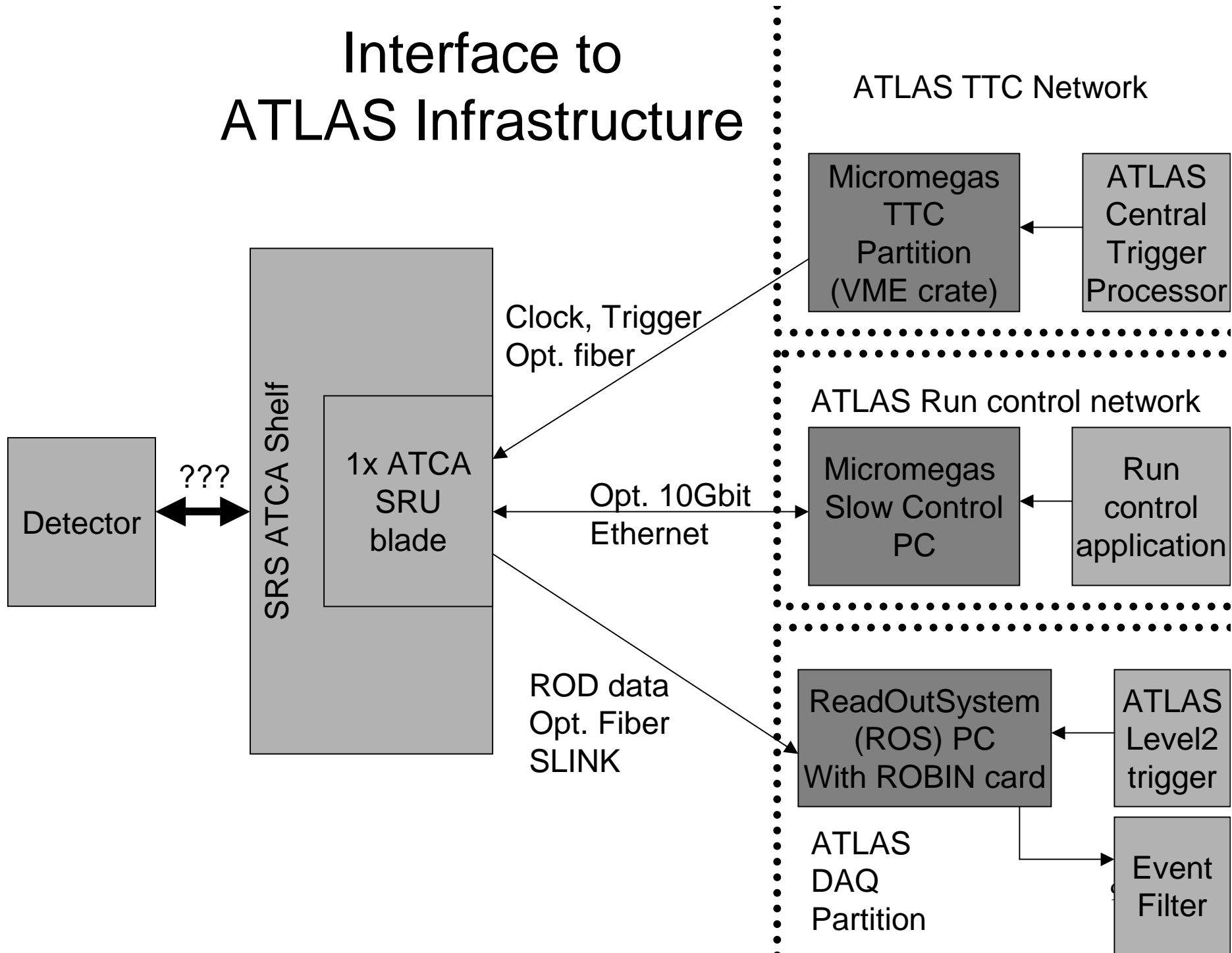
- Copper cable connection from detector to SRS
- ATCA SRS Shelf inside ATLAS Cavern
- Pro: power for VMM2 provided by ATCA shelf, minimal cost for hybrid board
- Con: Cable weight and maximum distance of 30m

Frontendchip Option #2: APV25



- Copper cable connection from detector to SRS
- ATCA SRS Shelf inside ATLAS Cavern
- Readout of analog strip charge information
- Pro: hybrid boards off-the-shelf from CERN store, low channel cost, no radiation issues up to ~50 kRad
- Con: APV25 rate limitation, Cable weight and maximum distance of 30m

Interface to ATLAS Infrastructure



Summary

Necessary **ATLAS Infrastructure**:

- Micromegas **TTC partition** allowing dedicated calibration, configuration, etc.)
- Micromegas **ROS PC** with ROBIN card, configured within **ATLAS DAQ partition**, incl. L2 triggers
- Integration of Micromegas specific configuration into **ATLAS run control** state machines
- Dedicated Micromegas **Detector ID**

Possible Frontend chip and SRS interface scenarios:

- **#1a:** 64x **VMM2** on Hybrids, **converter boxes** in detector proximity, ATCA SRS with optical Mezzanine, SRS located in counting room
 - **#1b:** 64x VMM2 on Hybrids with **onboard conversion** to optical, ATCA SRS with optical Mezzanine, SRS located in counting room
 - **#1c:** 64x VMM2 on Hybrid boards, **cable connection**, ATCA SRS with digital Mezzanine cards, SRS located in ATLAS cavern
 - **#2:** 32x **APV25** Hybrids (16x Master/Slave), ATCA SRS with Analog Mezzanine, SRS located in ATLAS cavern
- Preferred solution →

Scalable Readout System hardware:

- ATCA SRS components **commercially available** from EicSys Company (Germany)
- Either **ATCA SRU** blade or „classic“, ATCA compatible SRU in 19“ 1HE case
- SRU based system in use or planned for several LHC experiments (ALICE Calorimeter upgrade, TOTEM, ...)