(Backend) Detector Readout

Steven Alcock, Scott Kolya, Dorothea Pfeiffer, Richard Hall-Wilton (ESS)
Morten Christensen, Martin Shetty, Jonas Nilsson, Tobias Richter (DMSC/ESS)
Harry Walton, John Coughlan, Nauman Iqbal, Meged Sallam(STFC)
Michael Lupberger (CERN)

European Spallation Source ERIC

IKON16
2019-02-12

Overview: Slides recycled

Information

Information on Detector Electronics

- **System design and Integration**
  - Details how the detector electronics is design and integrated into ESS data acquisition chain
  - https://doi.org/10.17199/BRIGHTNESS.D4.1

- **Grounding**
  - Pushed this from a very early stage (Scott) as a key standardisation - very easy to get this very wrong
  - Grounding guidelines and implementation absolutely key to an electronically well-behaving instrument
  - Very please to hear that a dedicated engineer now being hired

- **Details and Status of Implementation**
  - There have been long detector sessions at the past 3 IKONs. Most detailed information is available there:
  - IKON15: https://indico.esss.lu.se/event/1041/timetable/#20180911.detailed
  - IKON14 (satellite): https://indico.esss.lu.se/event/971/
  - IKON13: https://indico.esss.lu.se/event/858/timetable/#20170928.detailed

- **You will need to speak with us**
  - The detail of the integration can only be resolved in person
  - All instruments will be slightly different
  - Expert-expert interaction

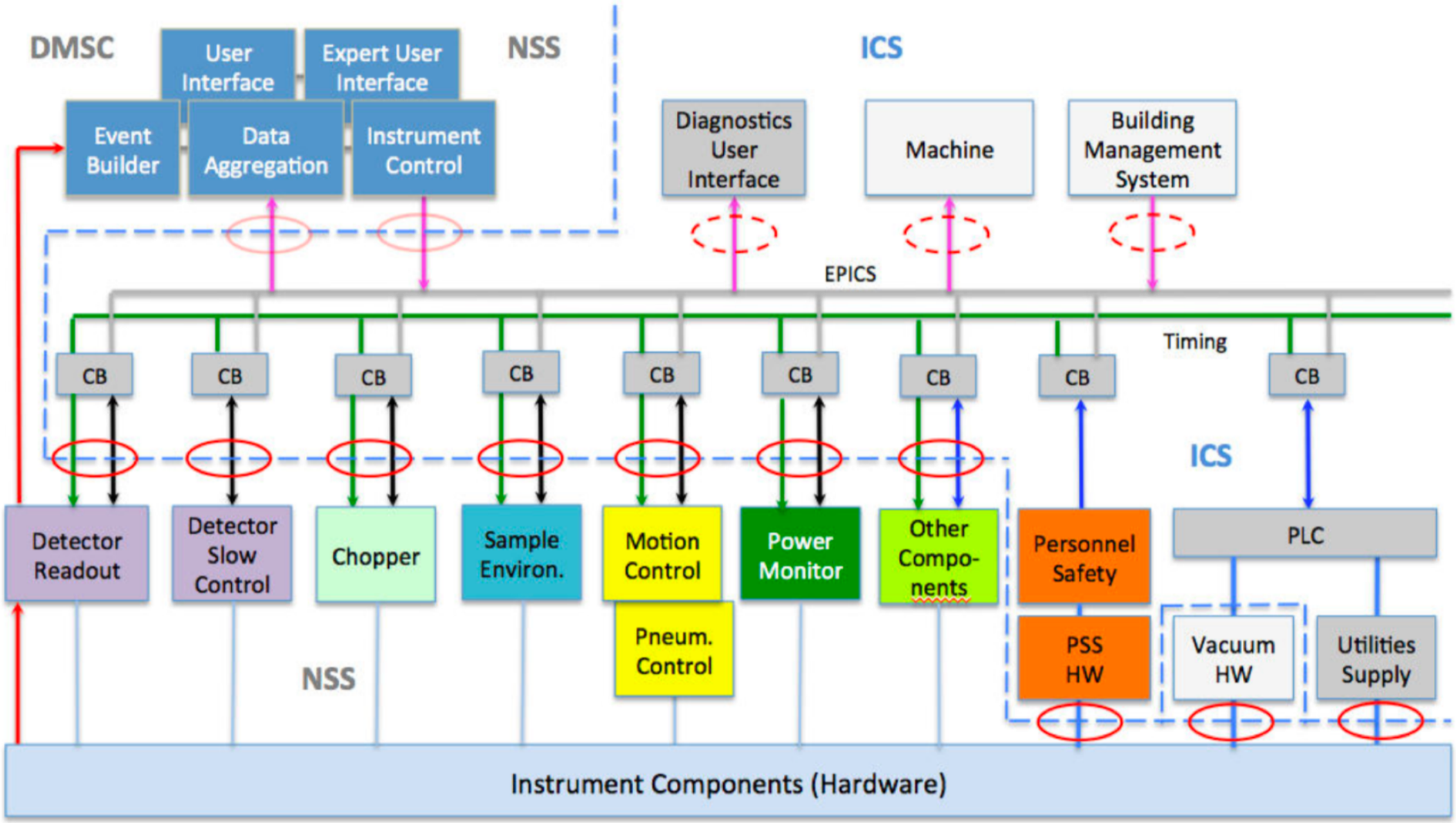
Philosophy

- **Philosophy:**
  - ESS operational model assumes a very high level of efficiency and low level of maintenance
  - Commissioning, Operation and Maintenance must be minimised
  - Therefore common DAQ, common interface to DMSC

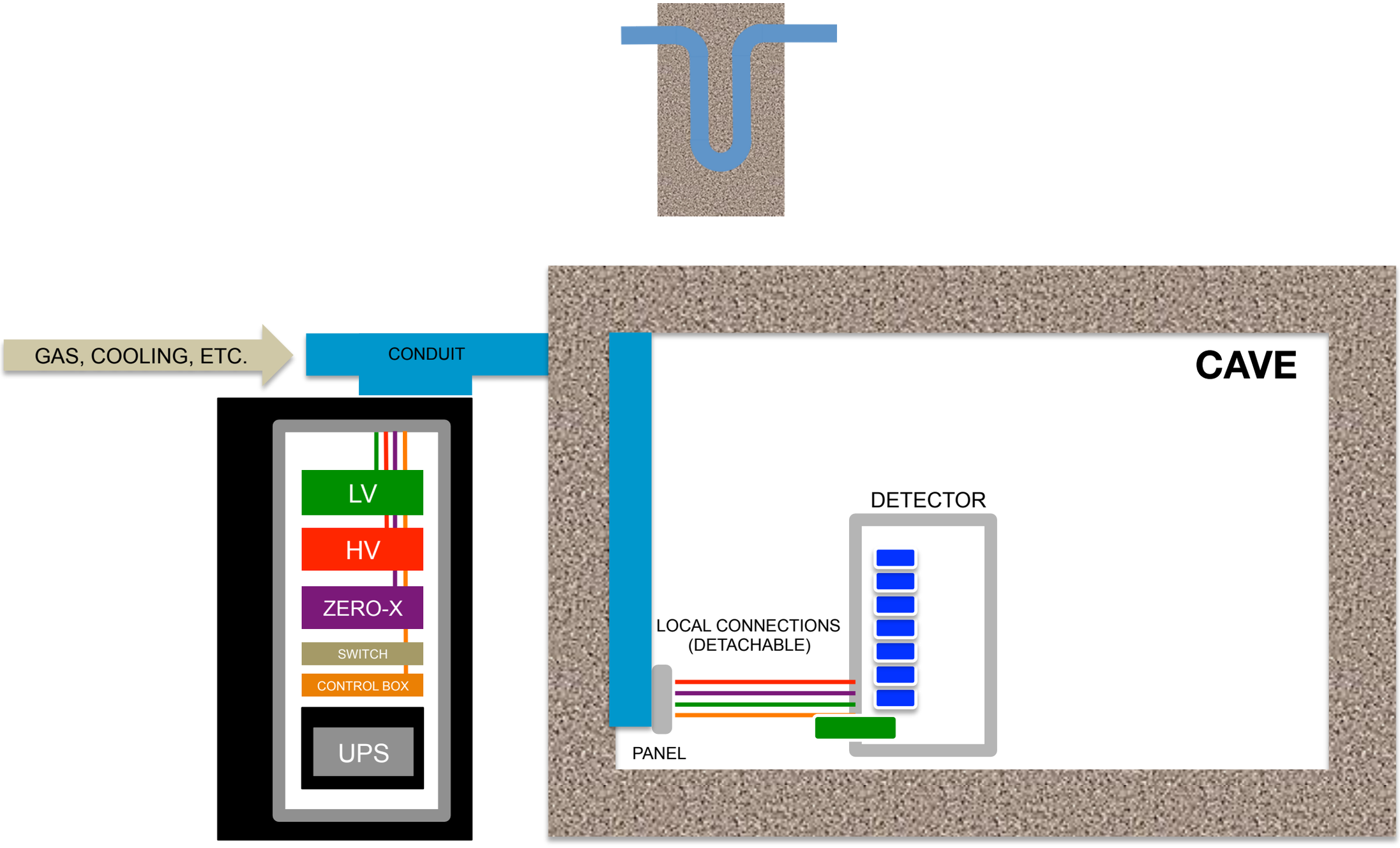
- **Backend Readout**
  - Added to instrument budgets at the scope setting meetings
  - This ensures that a common DAQ, common interface to DMSC is achieved
  - That instrument diversity from detector in-kind partners is standardised at this stage
  - Each instrument will be different in terms of what is needed. Many will need much less than reserved.
  - Rough breakdown:
  - Detector Standard Rack - Rack with separate ground, UPS, Cabling, Testing, etc (ca. 10%)
  - Master Module, etc - Master, Mellanox, Diagnostic and Control, PLC, LV, Tranceivers, fibres, …(ca. 25%)
  - Voltage Provision (ca. 15%)
  - Integration Effort - 2/3rds Front End integration to Assistor, 1/3rd dedicated design (ca. 50%)

- **You will need to speak with us**
  - The detail of the integration can only be resolved in person.
  - Already ongoing with many instruments
  - When you feel you are ready: get in contact with Steven Alcock&Scott Kolya

ESS Controls and Readout Architecture

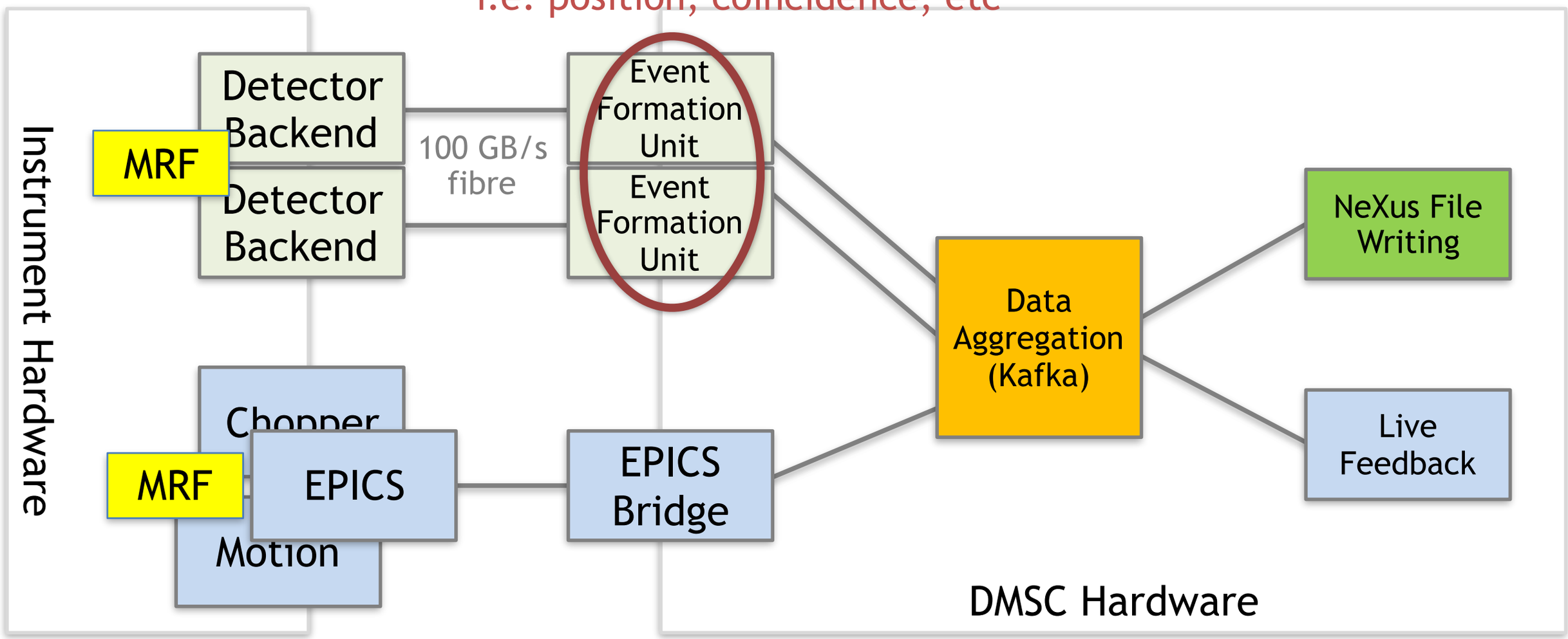


Physical Implementation



Instrument Readout Architecture

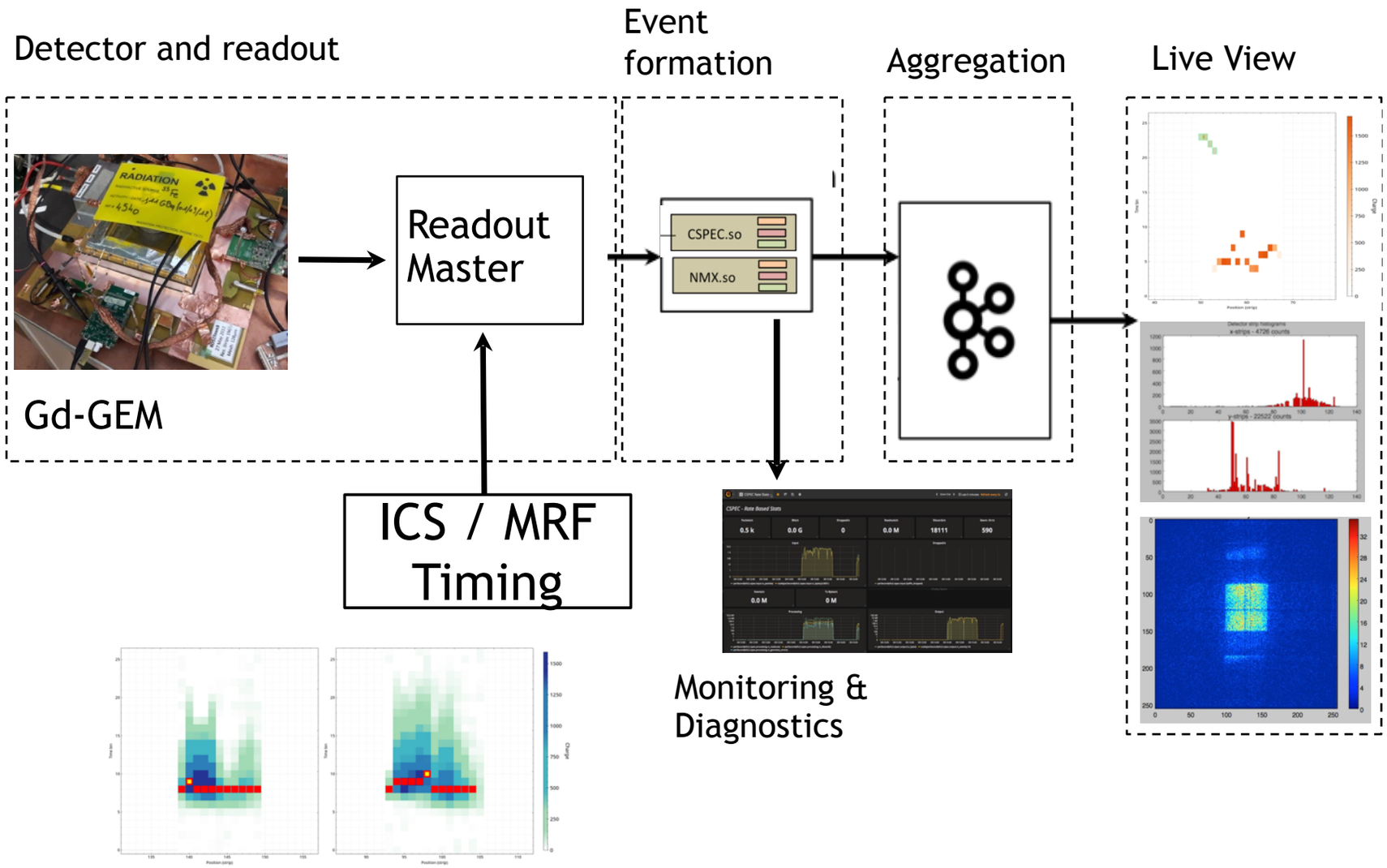
Do calculations here!
i.e. position, coincidence, etc



BrightnESS is funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 676548

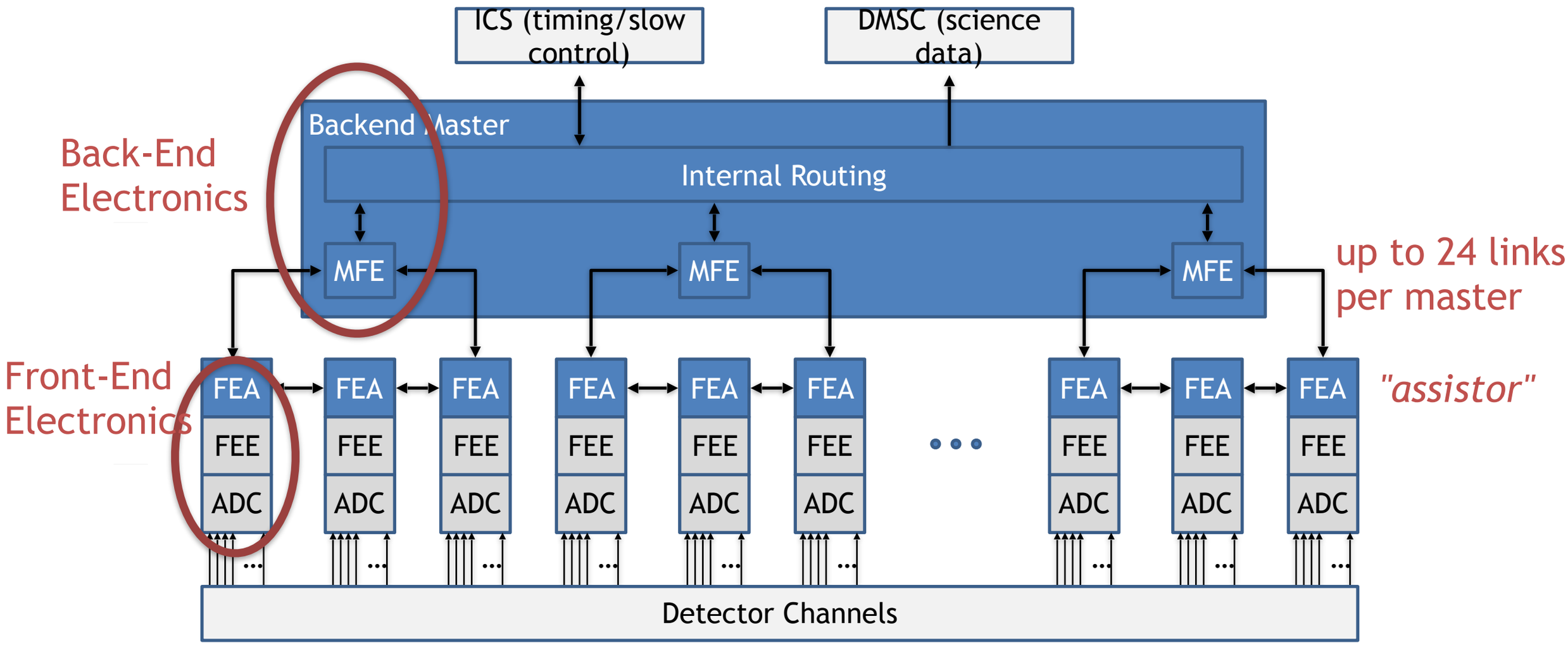
Detector Readout & Event Formation

- Coincidence building and location refinement in software
- Successfully demonstrated for a number of prototypes

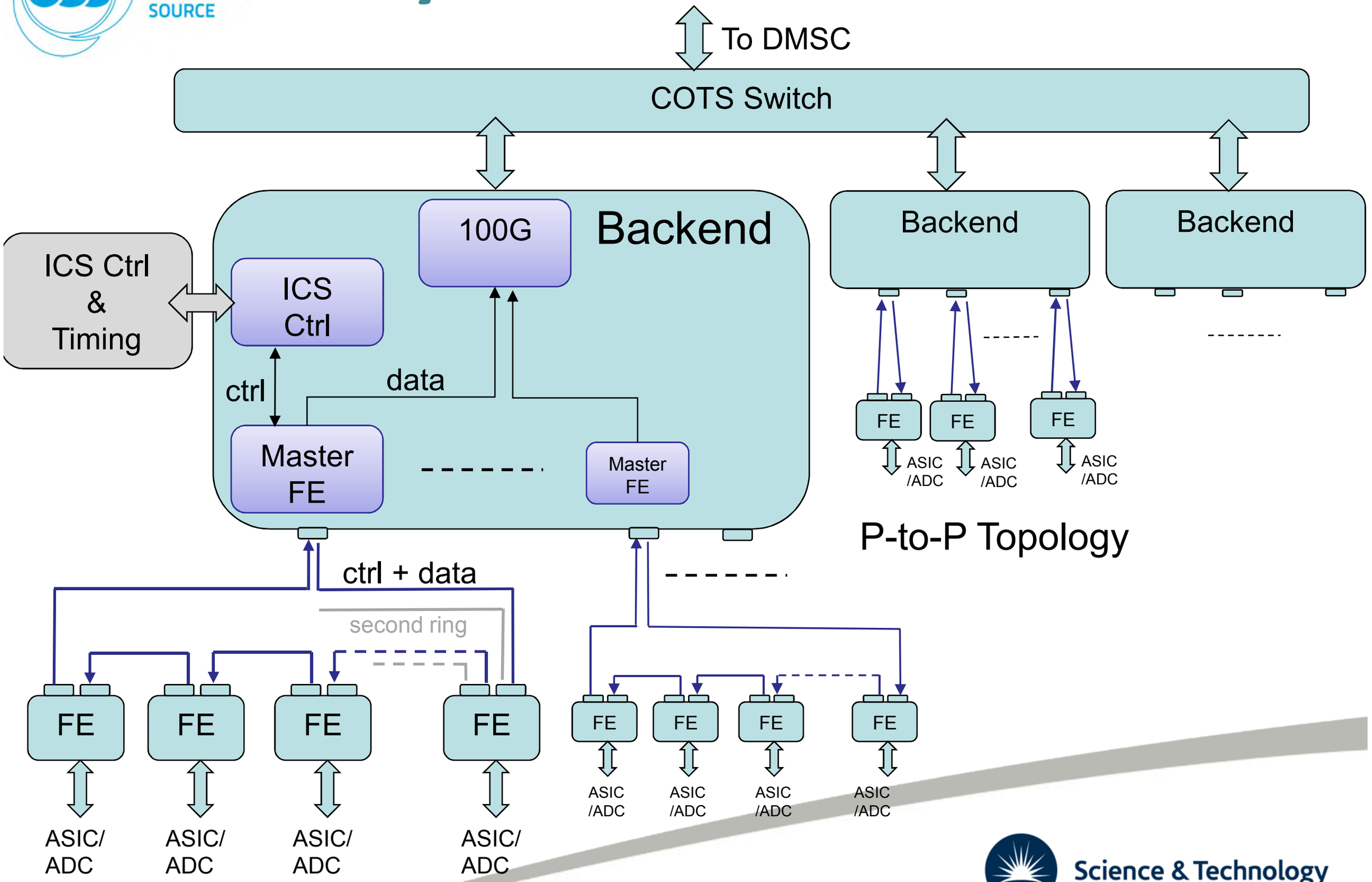


Readout Architecture

EUROPEAN SPALLATION SOURCE



System Architecture



P-to-P Topology

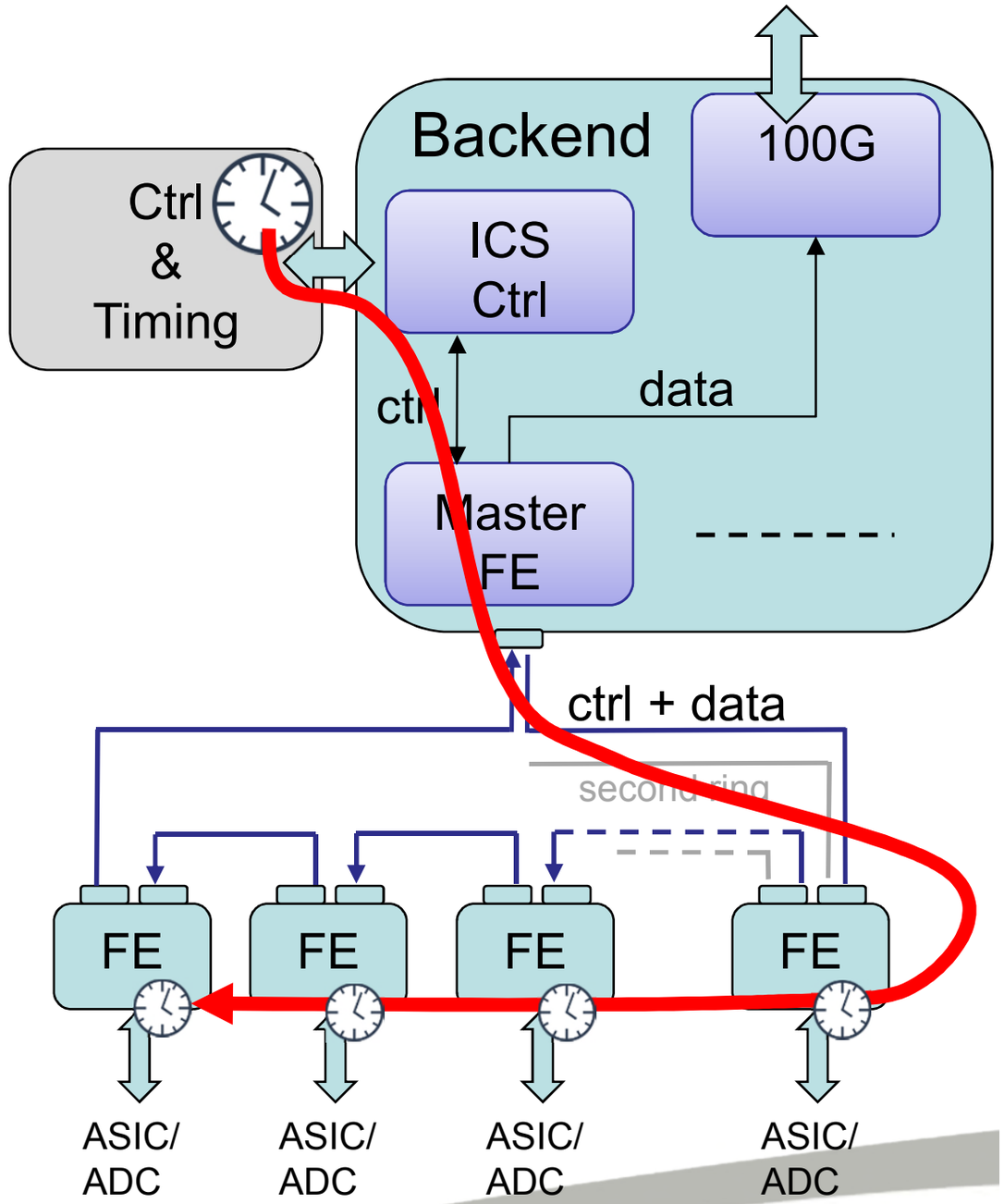
Ring Topology

Front End Functions

- Acquire accurate timestamp.

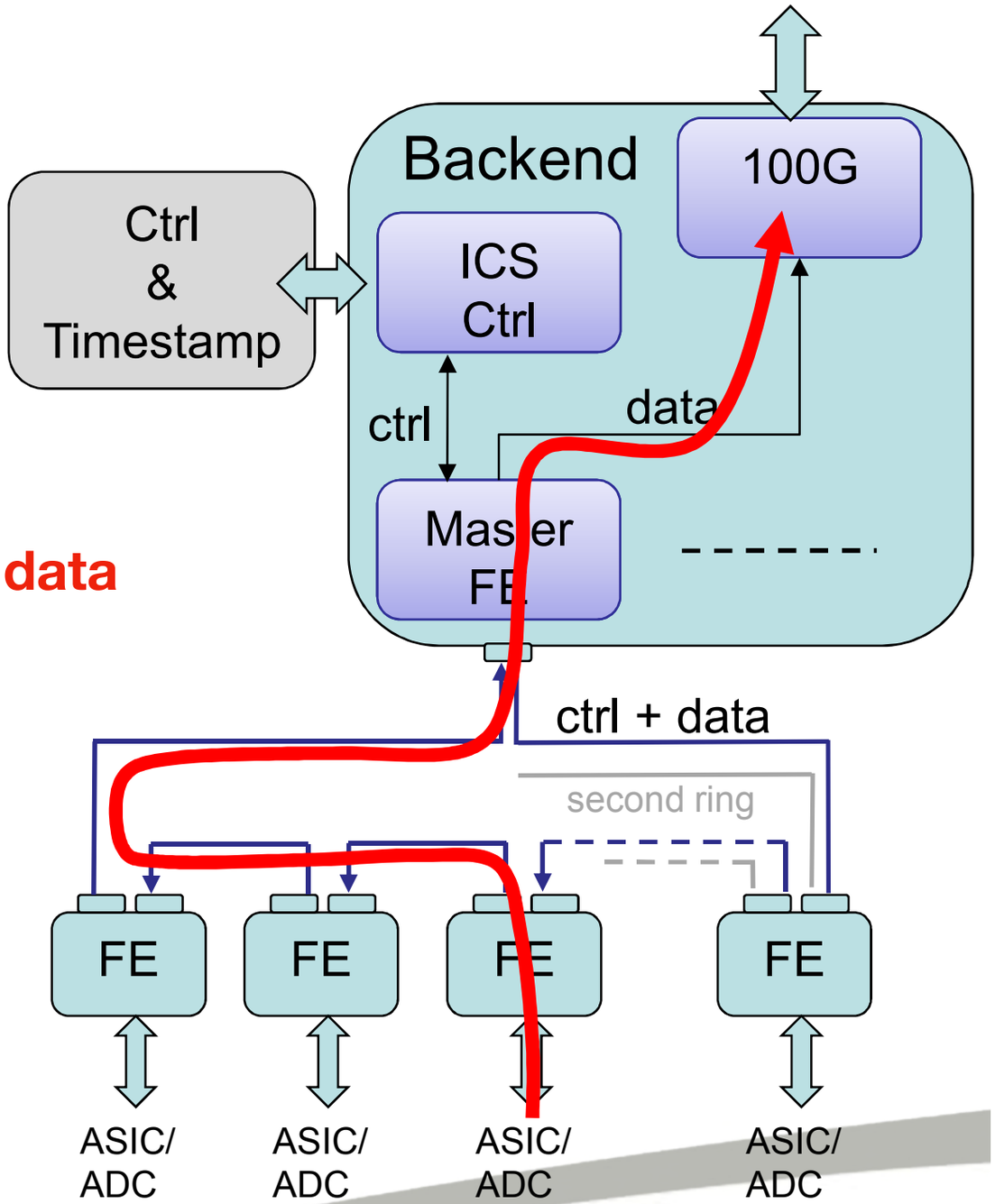
- Collect digitized (timestamped) Bulk data, and downstream it to the BE.

- Receive & Return Memory Mapped Slow Control data (e.g. ADC-register W/R's)



Front End Functions

- Acquire accurate timestamp.
- Collect digitized (timestamped) Bulk **data** , and downstream it to the BE.
- Receive & Return Slow Control data (e.g. ADC-register W/R's)

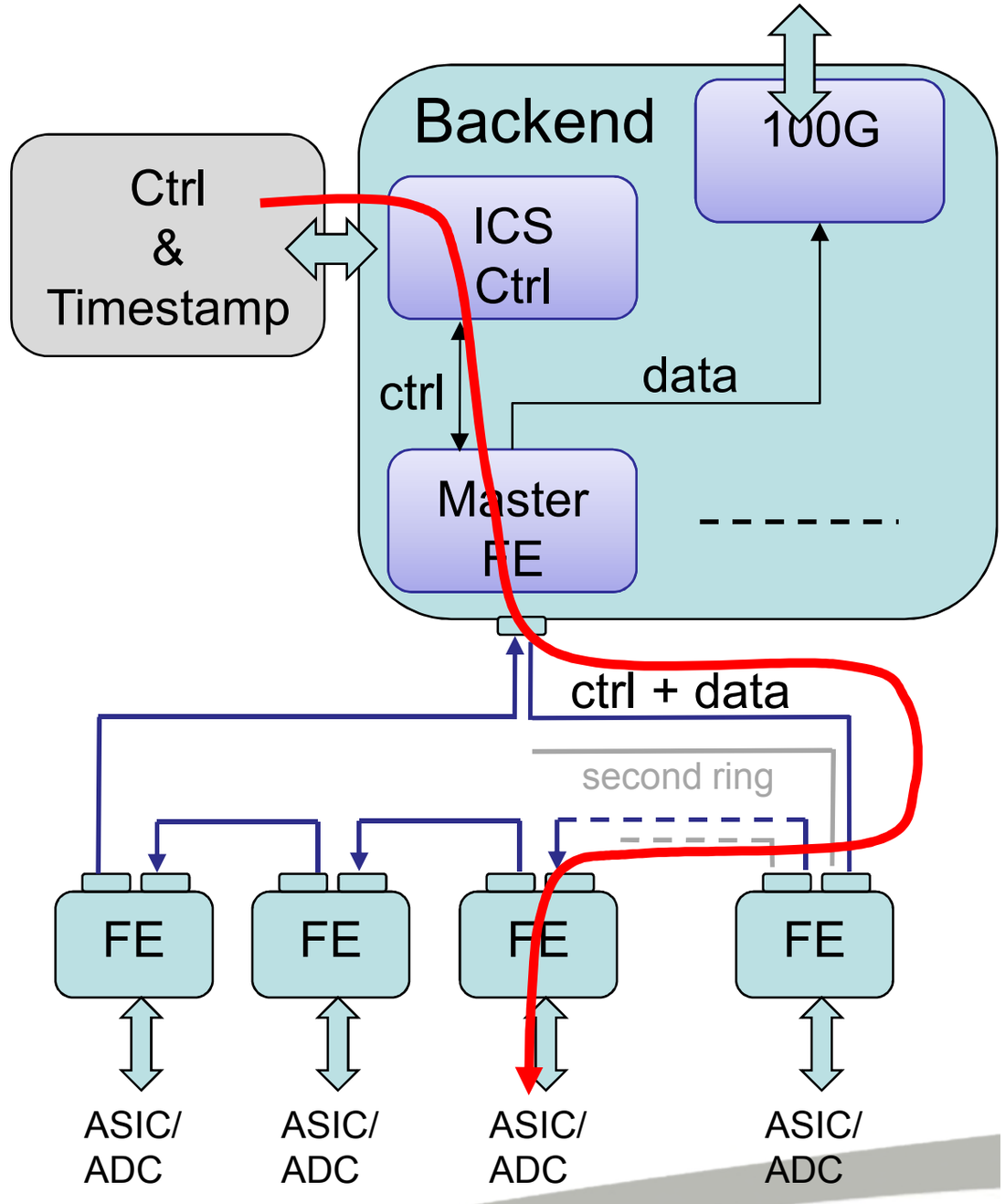


Front End (FE) Functions

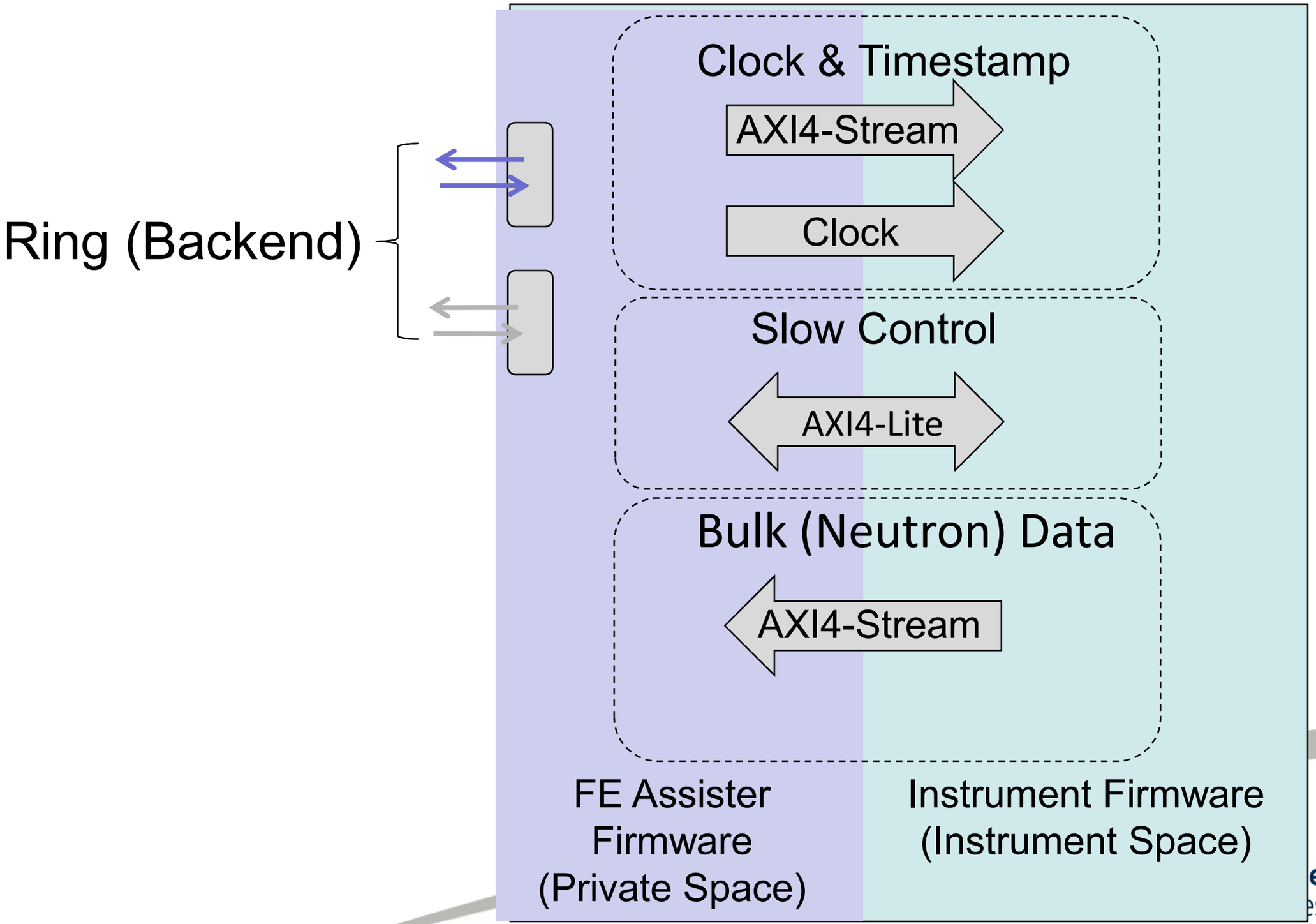
- Acquire accurate timestamp.

- Collect digitized (timestamped) Bulk data, and downstream it to the BE.

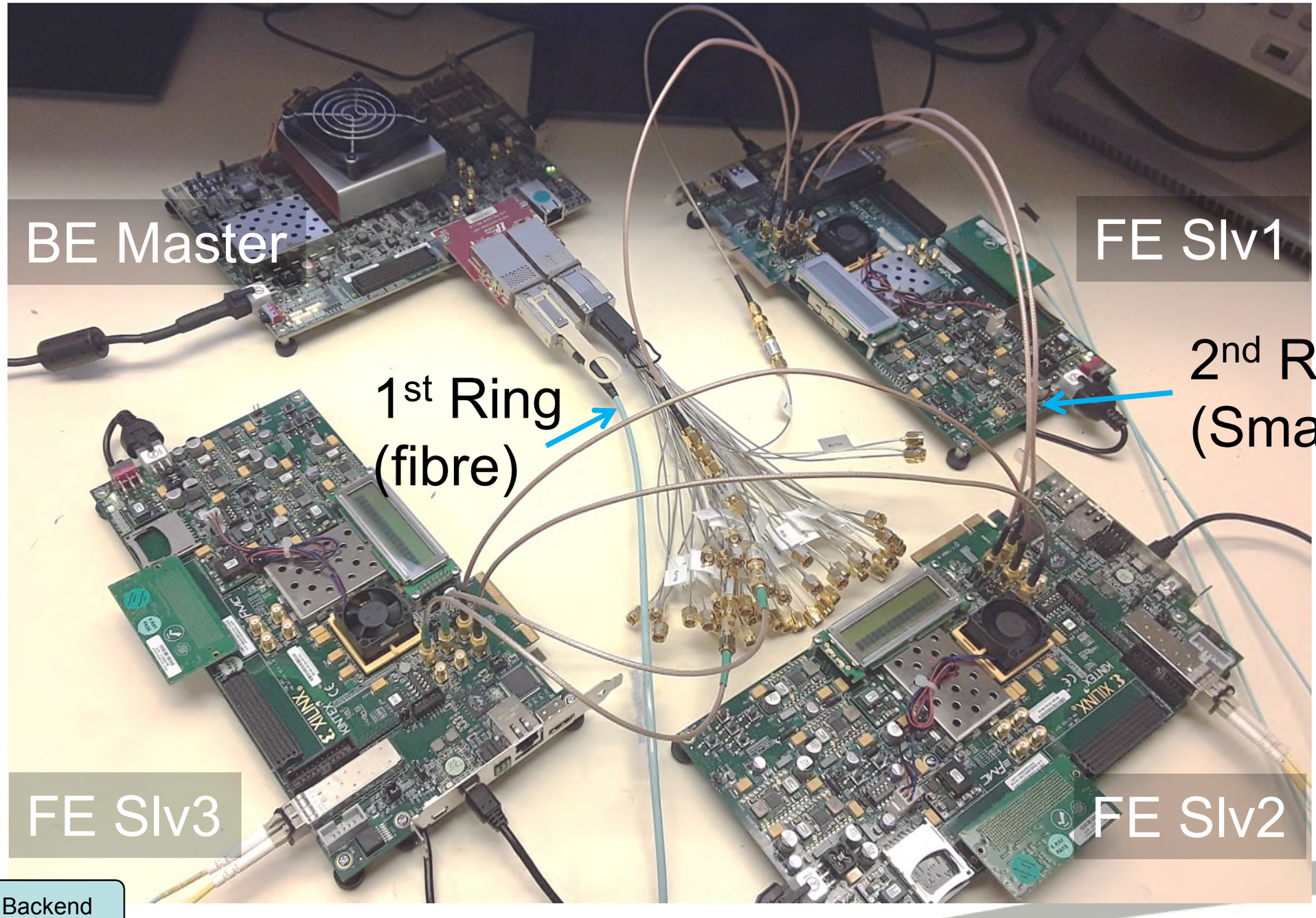
- Receive & Return Memory Mapped Slow Control data (e.g. ADC-register W/R's)

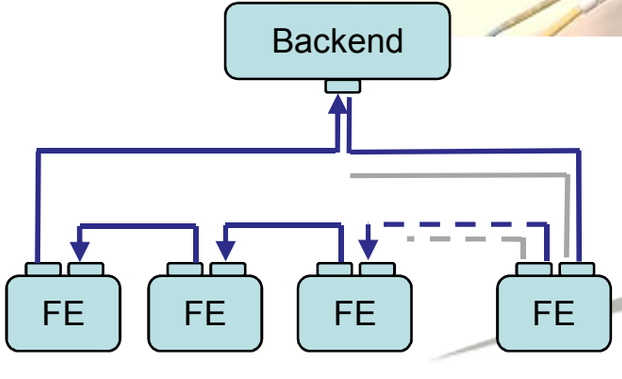


Front End User Interface



Previously (IKON 2018)





Science & Technology Facilities Council

Readout Architecture

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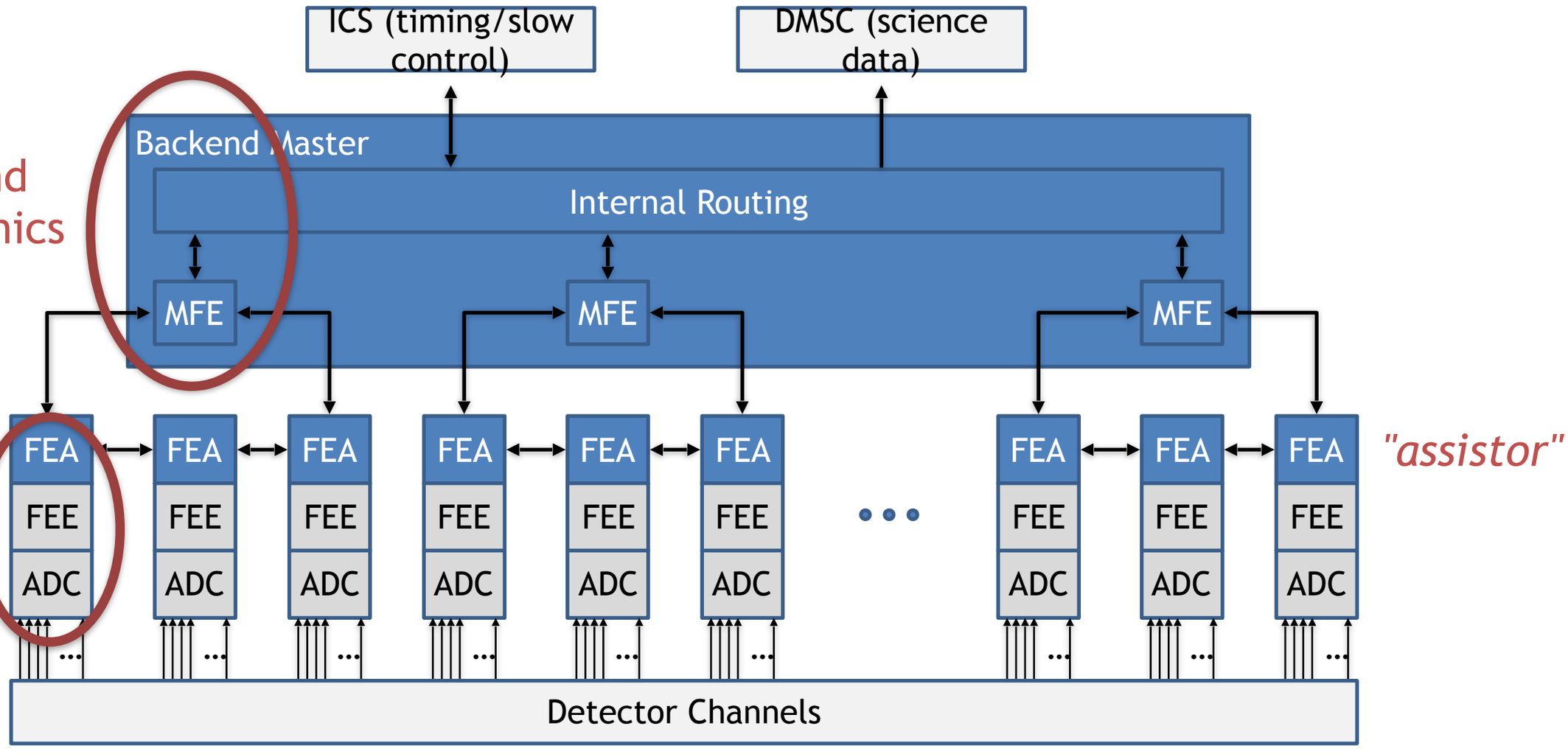
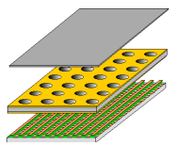
Back-End Electronics

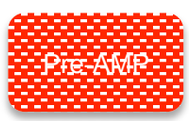
Front-End Electronics



Detector Electronics Integration Models

EUROPEAN SPALLATION SOURCE





DETECTOR (OR BEAM MONITOR)	FRONT END (DIGITIZATION)	DATA COLLECTION (INTO MODULES)	ESS GLOBAL INTERFACE	COTS COMPUTING
	A(A): FE BOARD + FPGA ADAPT	Data Collection Signal Processing	Generic Back End	DMSC
	B: FE BOARD + FPGA ADAPT	Data Collection Signal Processing	Generic Back End	
	C: FE BOARD	Data Collection Signal Processing	Generic Back End	
	X: FE BOARD	Data Collection Signal Processing	Generic Back End	OTHER COMPUTE
	XX: FE BOARD	Data Collection Signal Processing	Specific Back End	

Thank you for your attention