“Above the Threshold”

EUROPEAN SPALLATION SOURCE

Introduction to the Session and Overview of the Front End Integration

Richard Hall-Wilton
Detector Group Leader
On Behalf of ESS Detector Group and Collaborators

IKON'18

European Spallation Source ERIC
2020-02-26

Welcome to the pre-Dinner session

This IKON Session

Detector Background Sensitivity and Electronics: Overview of Front-End I...	*Richard Hall-Wilton*
Update on Status of the Readout	*Steven Alcock*
Sten Broman, Grand Hotel	15:35 - 15:50
VMM Integration Update	*Dorothea Pfeiffer*
Sten Broman, Grand Hotel	15:50 - 16:05
Downstream of the Readout Master	*Morten Jagd Christensen*
Detector Backrounds: Fast Neutron and Gamma Sensitivity of Helium-3 and B...	*Francesco Piscitelli*
Detector Backgrounds and Timing Resolution	*Alexander Backis*

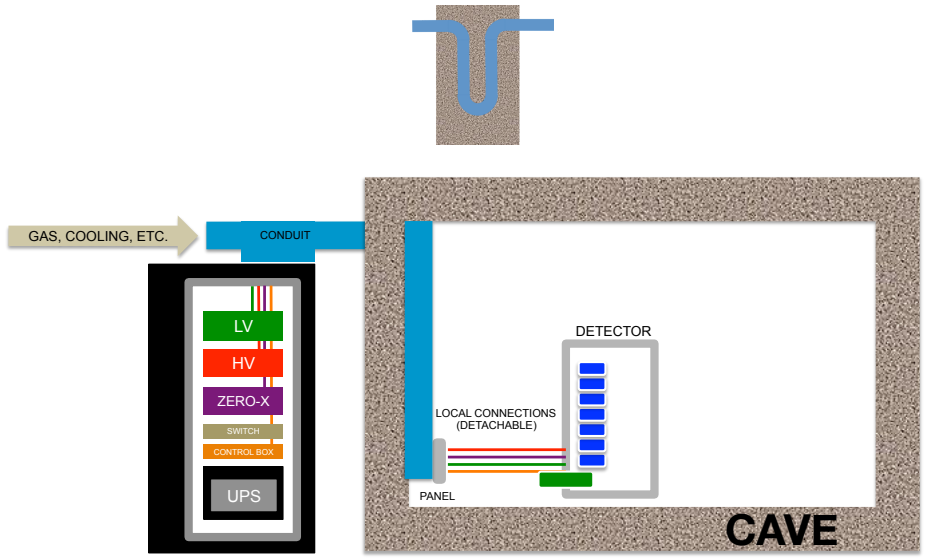
TG3 for Detectors Document

Document Type	Review Report
Document Number	ESS-1546427
Date	Sep 27, 2019
Revision	1 (1)
State	Preliminary
Confidentiality Level	Internal
Page	1 (8)

Chess document: ESS-1546427

Detector Systems Review Process for Instrument Projects at TG3

	Name	Role/Title
Owner	Wen Xiong	Detector Group Administrator
Reviewer	Steven Alcock Richard Hall-Wilton Kalliopi Kanaki Francesco Piscitelli Tobias Richter Oliver Kirstein	Detector Group, FPGA Engineer Detector Group Leader Detector Group, Design Section Leader Detector Group, Detector Scientist Data Management Group Leader Head of Instrument Technologies Division
Approver	Gabor Laszlo	Neutron Instruments Lead Engineer



Power, Grounding and Detector Connection

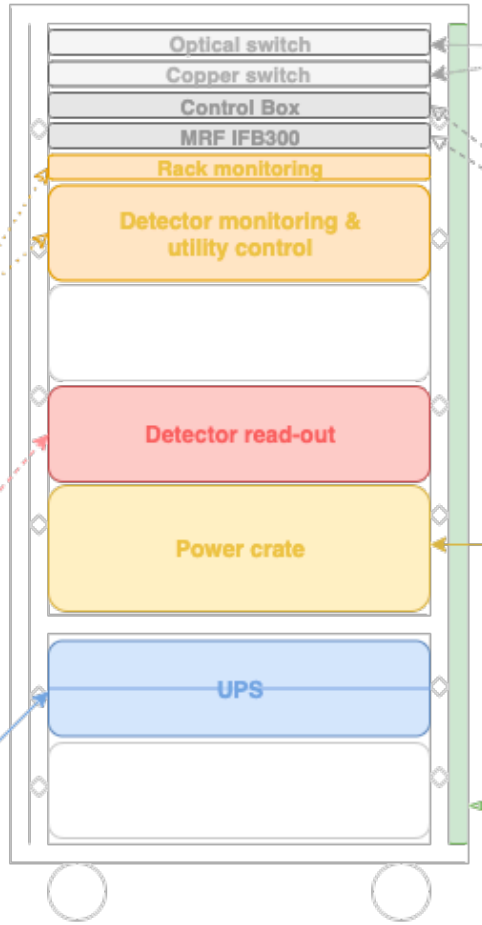
Rack electronics

The standard detector rack is considered part of the readout back-end.

The rack environment will be monitored for e.g. humidity and temperature by use of a commercial-off-the-shelf system. Beckhoff terminals (3U–6U) are used to read and control detector parameters.

The ESS readout back-end provides a common interface for detector front-ends including controls and time distribution.

Six (6) horizontal units of space in the lower frame are reserved for the double-converting Uninterruptable Power Supply (UPS) which will be grounded through the mains input and supply floating ground for all downchain detector electronics.



Switches/patch panels to provide access to networks for timing distribution, event data, and controls. Only routed in via optical fibre.

Server to act as controls interface and to host the PCIe Event Receiver (EVR) and an interface board ("IFB300") to provide timing signal to ESS back-end readout system.

Up to eight (8) horizontal units in the upper frame will host the multichannel Low and High Voltage system, supplying e.g. bias for the detector(s).

A Power Distribution Unit (PDU) will take input from the UPS and feed power to all other detector components.

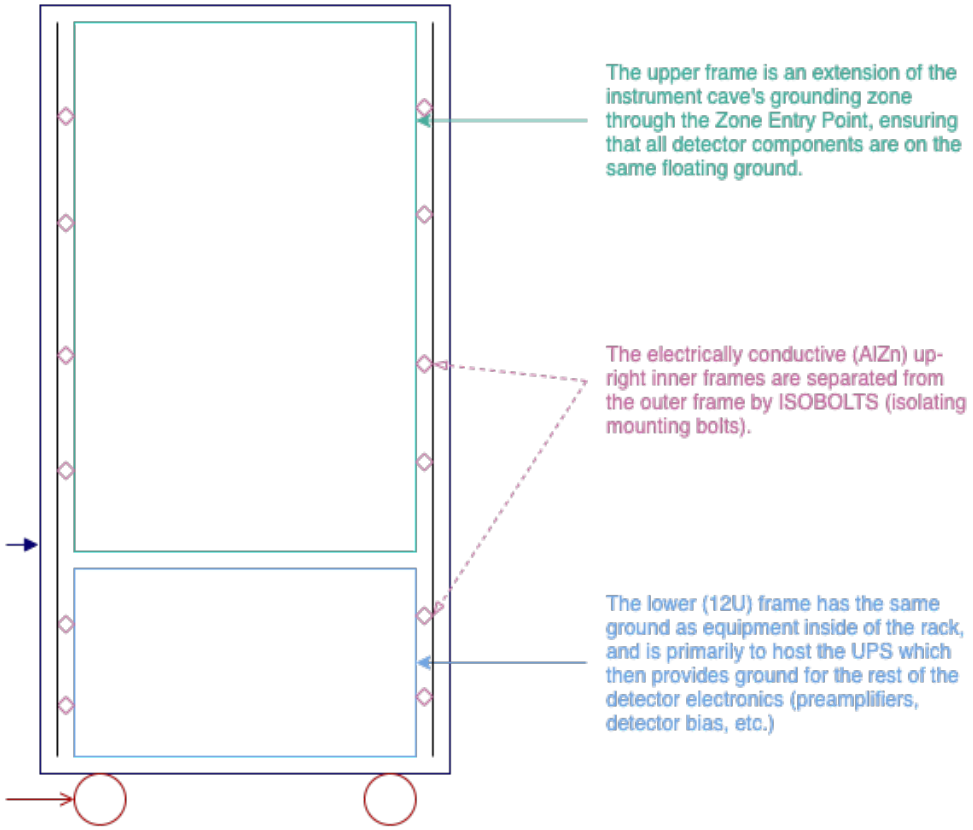
- Draft layout of detector racks done
- Anders Lindh Olsson left in December
- Work will be completed (document) as soon as replacement identified

Standard Detector Racks

- "Standard detector rack" selected based on STFC In-Kind report

Detector rack

The standard detector rack is an nVent Schroff VARISTAR 'EMC' (i.e. RF-shielded) with separate upper and lower inner frames which are galvanically isolated from the enclosure and thus also each other. The inner frames themselves are conductive.



The upper frame is an extension of the instrument cave's grounding zone through the Zone Entry Point, ensuring that all detector components are on the same floating ground.

The electrically conductive (AlZn) up-right inner frames are separated from the outer frame by ISOBOLTS (isolating mounting bolts).

The enclosure itself is of an EMC enhanced version, has roof-mounted lifting eye-bolts and glazed front and back doors.

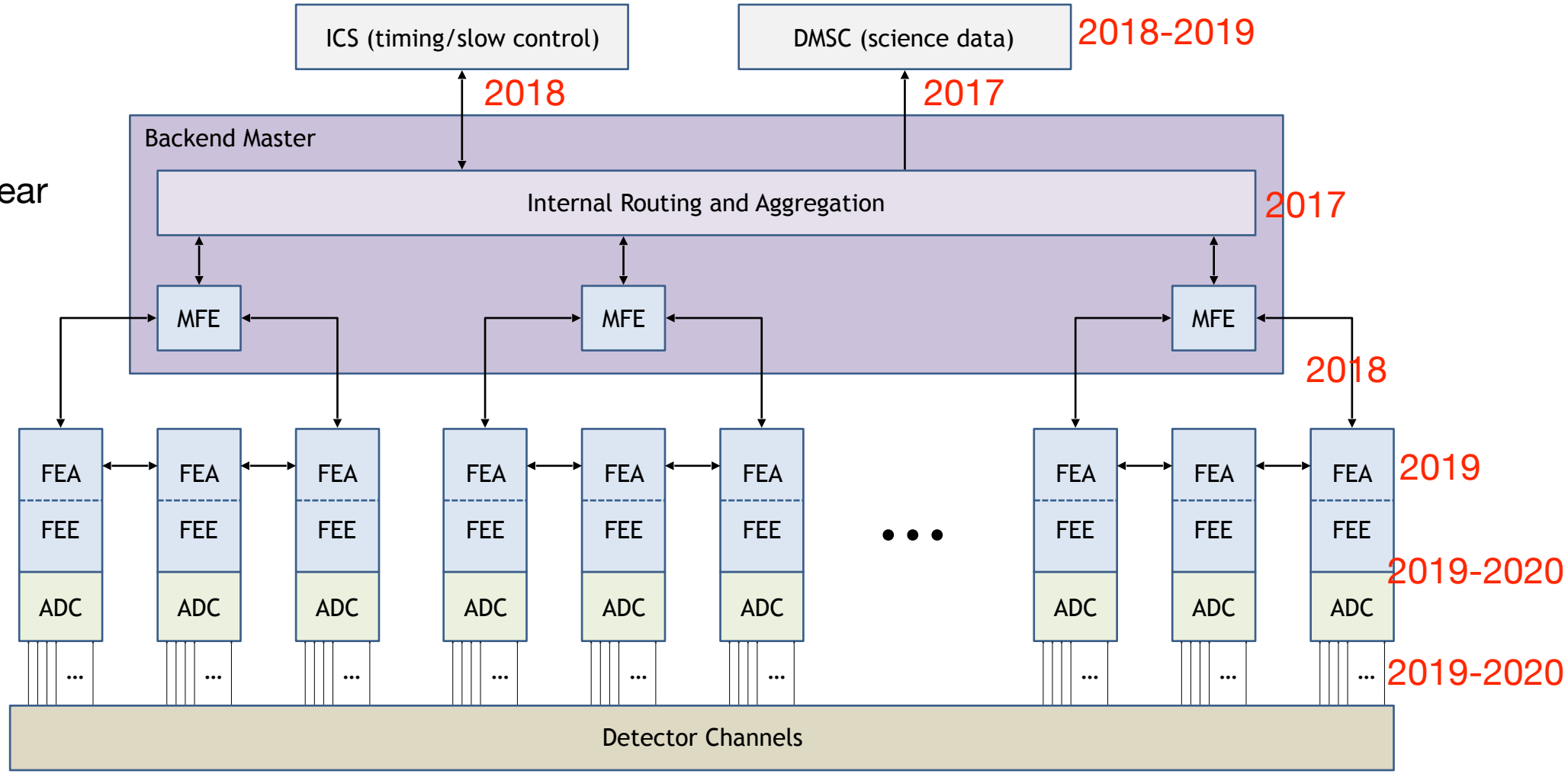
The lower (12U) frame has the same ground as equipment inside of the rack, and is primarily to host the UPS which then provides ground for the rest of the detector electronics (preamplifiers, detector bias, etc.)

The enclosure stands on casters with build-in levelling feet.

Readout Architecture

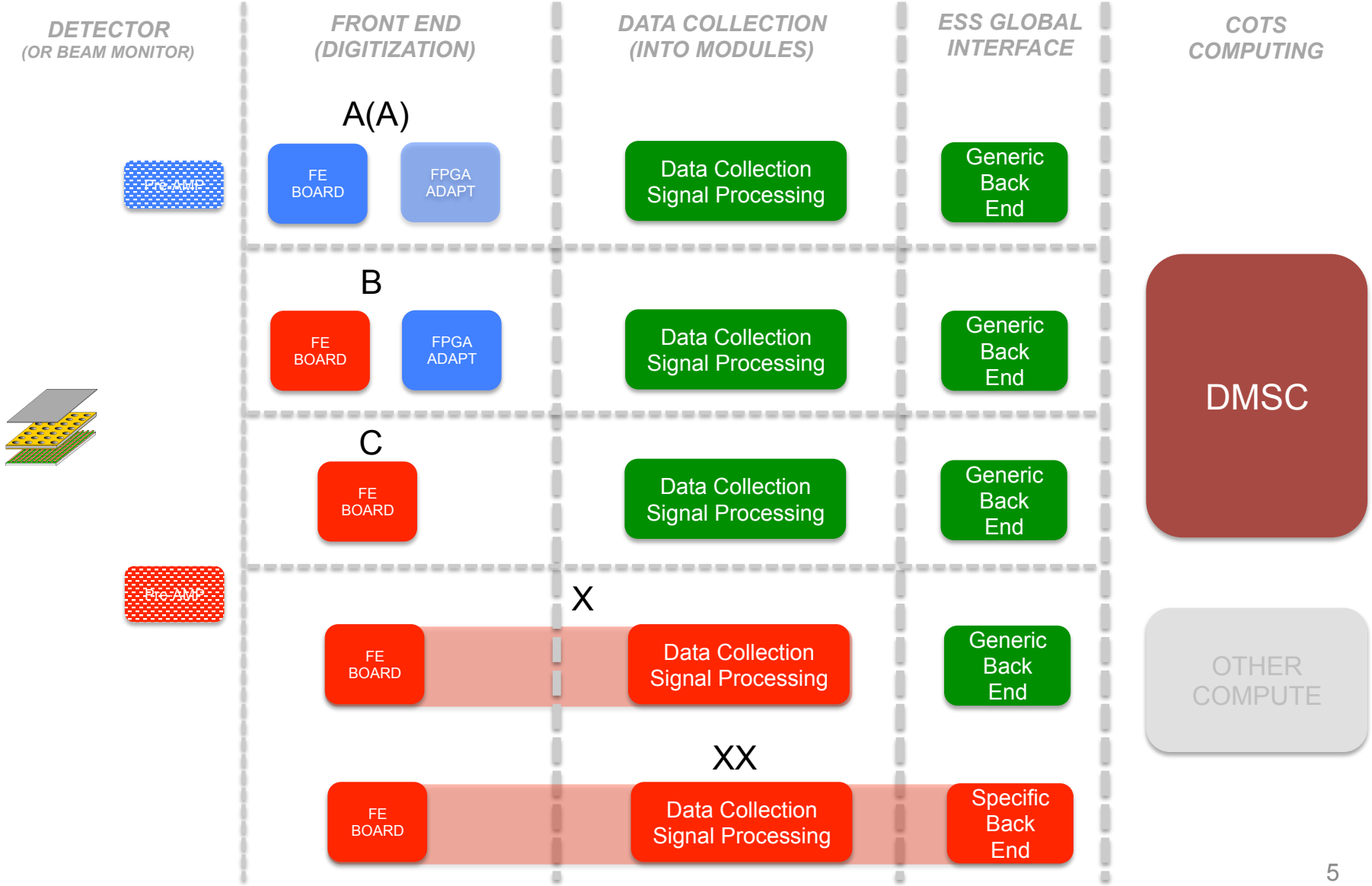
1st end-end DAQ demonstration this year

2020/2021: moving this into a production system



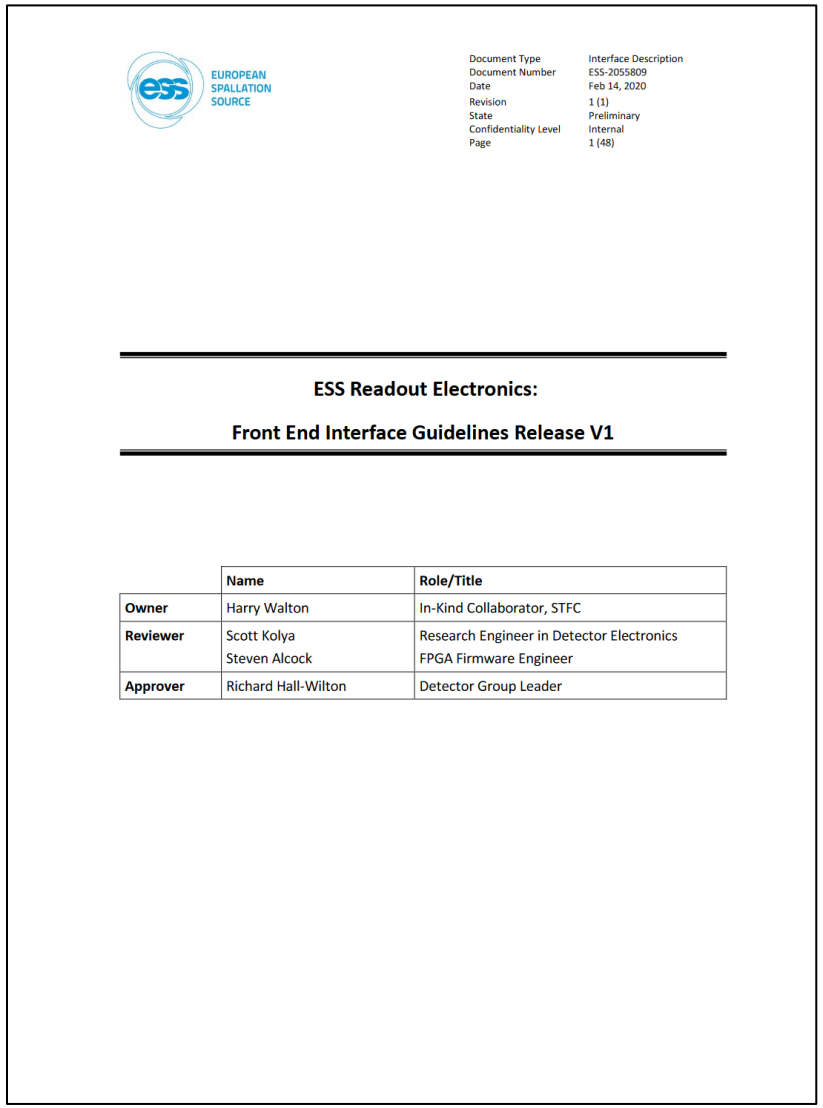
Detector Electronics Integration Models

EUROPEAN SPALLATION SOURCE



Assister Specification Document

Chess document: ESS-2055809



EUROPEAN SPALLATION SOURCE

Document Type	Interface Description
Document Number	ESS-2055809
Date	Feb 14, 2020
Revision	1 (1)
State	Preliminary
Confidentiality Level	Internal
Page	1 (48)

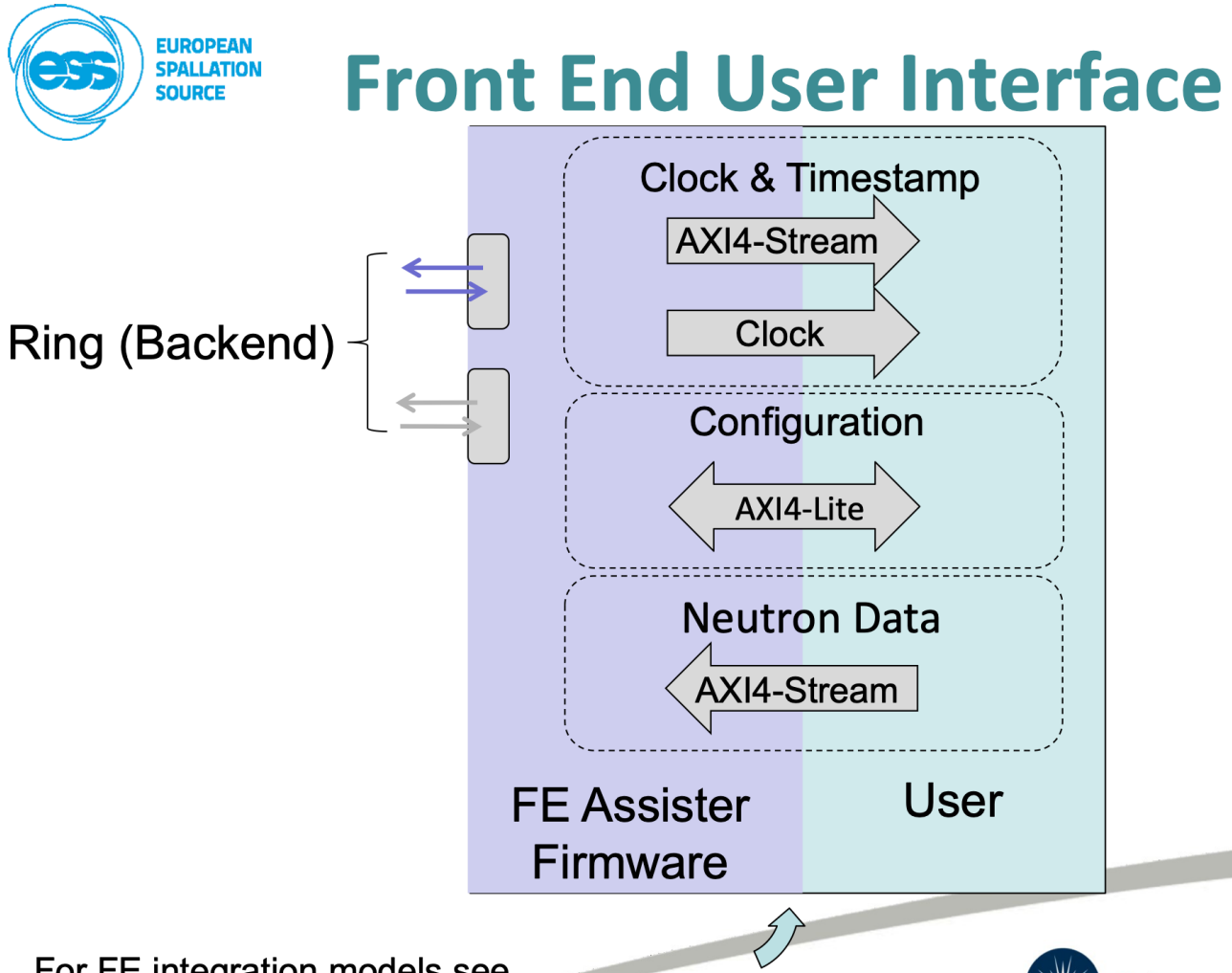
ESS Readout Electronics:

Front End Interface Guidelines Release V1

	Name	Role/Title
Owner	Harry Walton	In-Kind Collaborator, STFC
Reviewer	Scott Kolya Steven Alcock	Research Engineer in Detector Electronics FPGA Firmware Engineer
Approver	Richard Hall-Wilton	Detector Group Leader

FE user interface

- FEA (front end assister) firmware communicates with the ring/backend
- FEE (front end user firmware) communicates with frontend ASIC like VMM3a or ADC
- FEA and FEE part of firmware communicate via AXI4 streams



For FE integration models see BrightnESS Deliverable Report: D4.1 – *Integration Plan for Detector Readout*. Scott Kolva et.al. 2017

Front-End to Back-End Integration Status

Instrument	Front-End	Integration Agreed?	Integration Model	Integration Started?	Estimate for Integration Demonstration
CSPEC	VMM	Yes	A	Yes: Nov19	May 2020
TREX	VMM	Yes	A	Yes: Nov19	May 2020
ESTIA	VMM	Yes	A	Yes: Nov19	May 2020
FREIA	VMM	Yes	A	Yes: Nov19	May 2020
NMX	VMM	Yes	A	Yes: Nov19	May 2020
DREAM	CIPIX	Yes	C	Yes: Oct19	Apr 2020
MAGIC	CIPIX	Yes	C	Yes: Oct19	Apr 2020
HEIMDAL	CIPIX	Yes	C	Yes: Oct19	Apr 2020
LOKI	ISIS PREAMP/CAEN R5560	Yes	C	Yes: Jun19	Mar 2020
BIFROST	ILL PREAMP / CAEN R5560	Yes	C	No: Mar20	Jun 20
VESPA	*PREAMP / CAEN R5560 (TBC)*	No	C (tbc)	No	tbd
MIRACLES	*PREAMP / CAEN R5560 (TBC)*	No	C (tbc)	No	tbd
SKADI	IDEAS	Yes	X	Partially: Aug19/Jan20	May 2020
ODIN	Custom Camera+EPICS & TIMEPIX 3	Partially	XX & C (tbc)	No	tbd
BEER	Delay Line + Custom FPGA	No	C (tbc)	No	tbd
Beam Monitors	PREAMP / PINK BOX	Yes	B	Yes	Complete
TestBeam Line	Custom	No	tbd.	No	No

After Integration Demonstration?

- Full DAQ chain needs to be challenged with data to iron out features …
- … and to understand data , geometry and how to commission …
- ESS Detectors systems are complicated compared to most existing neutron detectors

- Full system needs to be documented

Enjoy the Session