LHC Injectors Upgrade

Beam Loss Monitoring & Observation

Status update on the development, installation and commission plans

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12/06/2014

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CERN

Overview

- General
  - Budget
  - Planning
- Installation
  - Crates
  - Detector positions
  - Cables
- Development
  - FPGA
  - FESA Server
  - Expert Application
- Summary

General

Budgetary Requirements

- Updated general cost breakdown up until 2019

LIU-PSB	2011	2012	2013	2014	2015	2016	2017	2018	TOTAL LIU (kCHF)
Ring (L2 position)			90						90
Injection & BI Line					52	49			101
Injection (observation)					110	37			147
Ring (L3 position)				50		123			173
Extraction					80	80			160
TOTAL LIU (kCHF)	0	0	90	50	242	289	0	0	671

- Summary of differences on the updated general cost

PSB	original (kCHF)	updated (kCHF)	Diff	Budget Allocation		
				cables	electronics	Detectors
Ring (L2 position)	90	90	0	LIU	CONS	spares
Injection & BI Line	65	101	36	LIU	CONS	spares
Injection (observation)	77	147	70	LIU	LIU	LIU (Diamond)
Ring (L3 position)	40	173	133	LIU	LIU	LIU (Flat IC)
Extraction	0	160	160	LIU	LIU	spares
TOTAL LIU (kCHF)	272	671	399			

General Planning

Machine/Area		Channels	Documentation	Detectors	Electronics	Installation & Commissioning	Budget	Expected
PSB	Ring (L2 position)	32	Complete	LHC-IC	Pre-series	On-track	Complete	LS1
	Injection & BI Line	18	Complete	LIC	Pre-series	Started	Complete	L4C
	Injection (observ.)	8	Complete	Diamond	OASIS	Started	Complete	L4C
	Ring (L3 position)	32	Complete	FIC	Series	Not started	Complete	LS2
	Extraction	28	Complete	LHC-IC	Series	Not started	Complete	LS2

Plans for LS1 & LINAC4 Connection are clear and agreed

- Update of budget (times and amounts) is on-going.
- Will validate pre-series version of electronics with beam
  - Series production to be received towards the end of 2016
- Development of Firmware and Software will continue after LS1
  - FESA server, Threshold Management, Logging DB, Controls integration
- Additional cables and monitors could be installed during LINAC4 Connection
  - Add electronics in the surface when available.
- Diamond based system's acquisition electronics under study
  - Pursuit more actively after LS1
  - First version will be based on OASIS

Status of the Installation

Detector Supports

- PSB Ring: design complete
  - Prototype constructed by the CERN workshop
  - Production completed on Dec. 2013
  - Installed and checked for conformity

- PSB Injection: started
  - Design started Dec. 2013
  - First versions ready for both LIC and IC detector types
  - Decision/clarification needed which detector type to use

Detector Support – PSB Ring

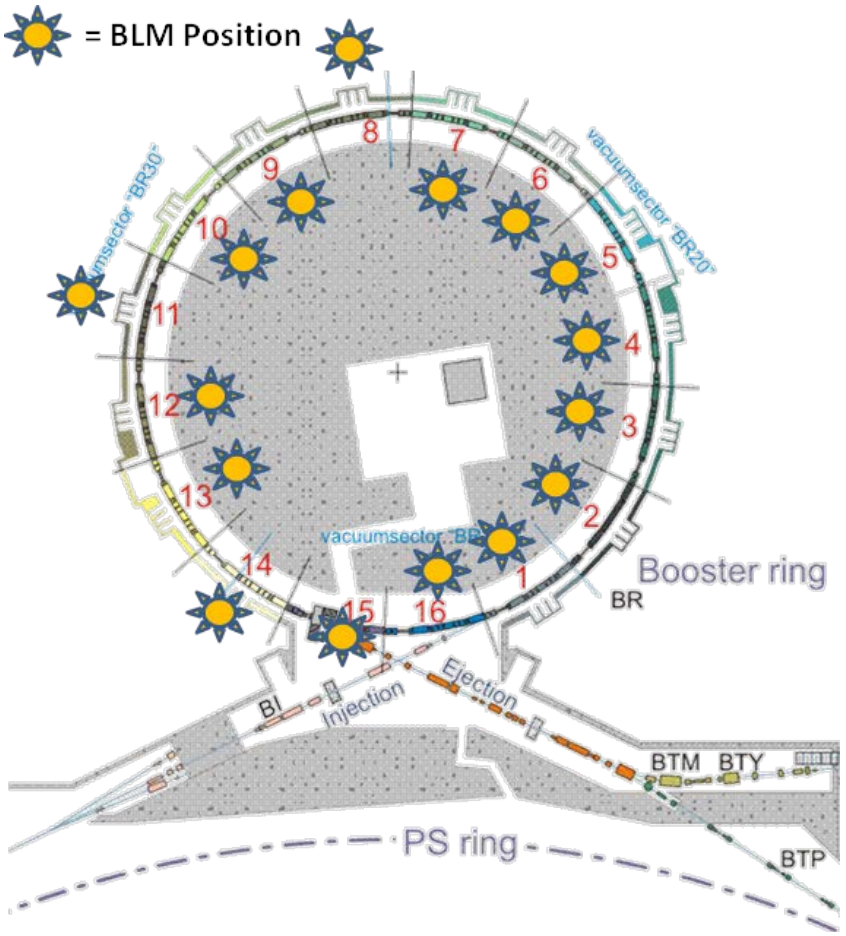
- Very tight integration.
- Verified all locations;
  no interference / obstruction
  to other systems.

Position of the detectors

For periods:

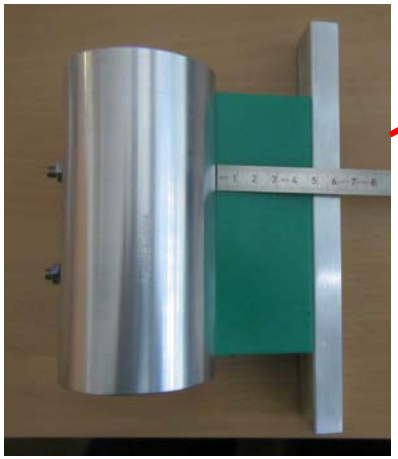
- 8, 11 and 14 on the outside,
- 15 between the ring and the ejection line,
- all others on the inside of the ring.

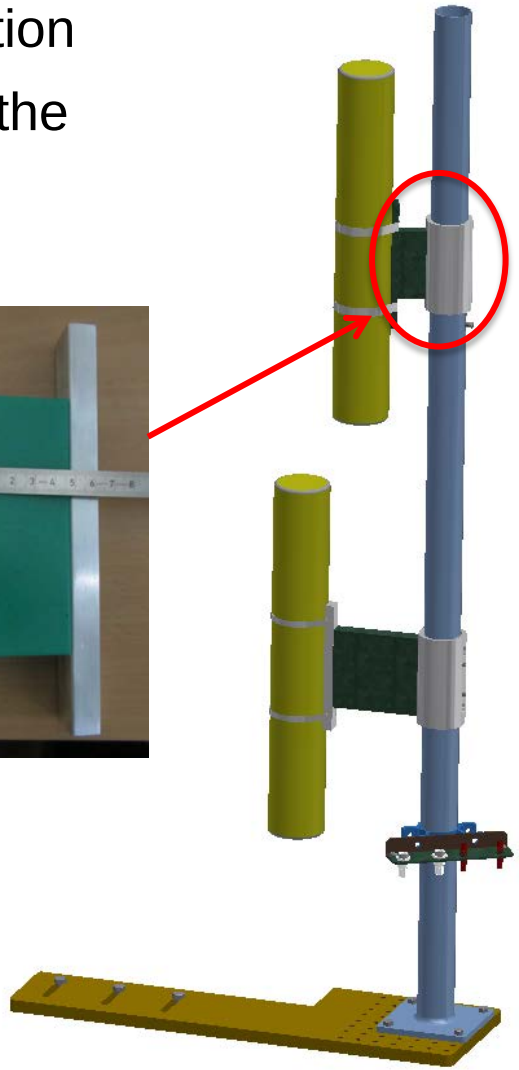
Period	Position	Comment
1	Internal	
2	Internal	
3	Internal	
4	Internal	
5	Internal	
6	Internal	
7	Internal	*BPM pickups*
8	External	custom support
9	Internal	*1230uSv*
10	Internal	
11	External	custom support
12	Internal	
13	Internal	*RF cavity*
14	External	*displaced due to ion pump*
15	External	Ejection custom support
16	Internal	



Modification to the supports

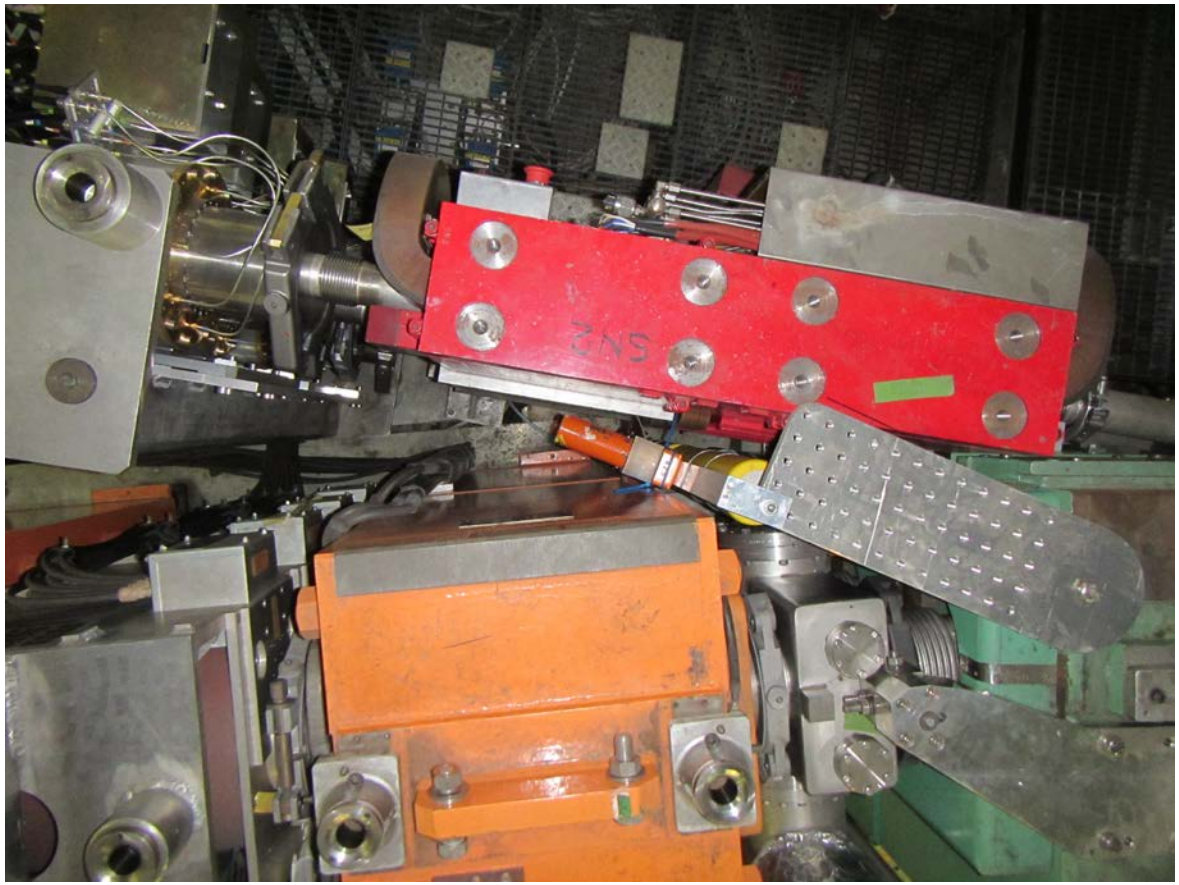
- Ion pumps do not allow standard installation
- Detector is positioned further away from the beam line a few cm.

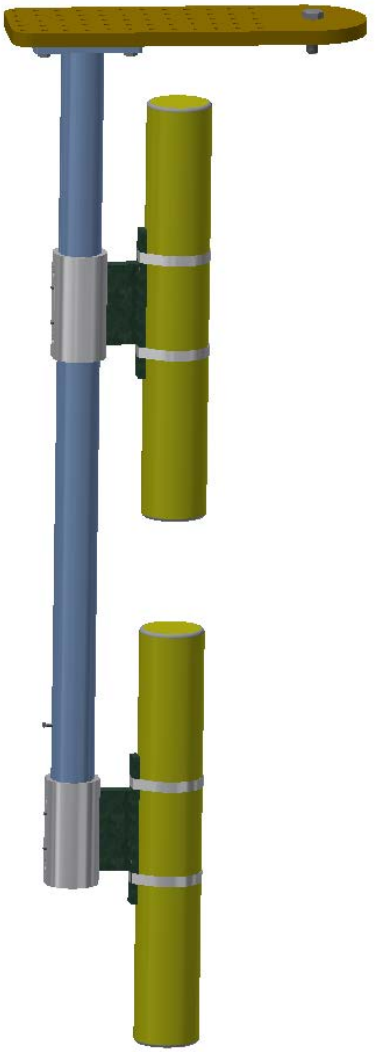




Custom support for period 15

- No space to add the detector on the inside of the ring
- ACEMs mounted on the same plate





BLM Cable installation in PSB

- New cable (CKC50) production run on tight schedule:
  - Modification of the CKB50 specs
  - Completed and delivered on-time
- Re-installation in PSB
  - Conformity measured (developed a test-bench)
  - Completed on-time
- Patch-Cords
  - Several types needed (length and connector type)
  - Completed and tested

Signal and HV Patch-Cords

Signal Cables

HV Cables

Rack Installation

Rear View

Front View

- PSB Ring: completed
  - Floor supports have been designed and installed
  - Rack installed
- PSB Injection & Extraction: on-track
  - Floor supports have been designed and installed
  - Positions defined

Floor Support

Status of Development

PCB Development

- All prototypes verified and functional.
- Pre-Series production will need to cover needs till LS2.
- Tenders for the Acquisition and Mezzanine modules production sent.

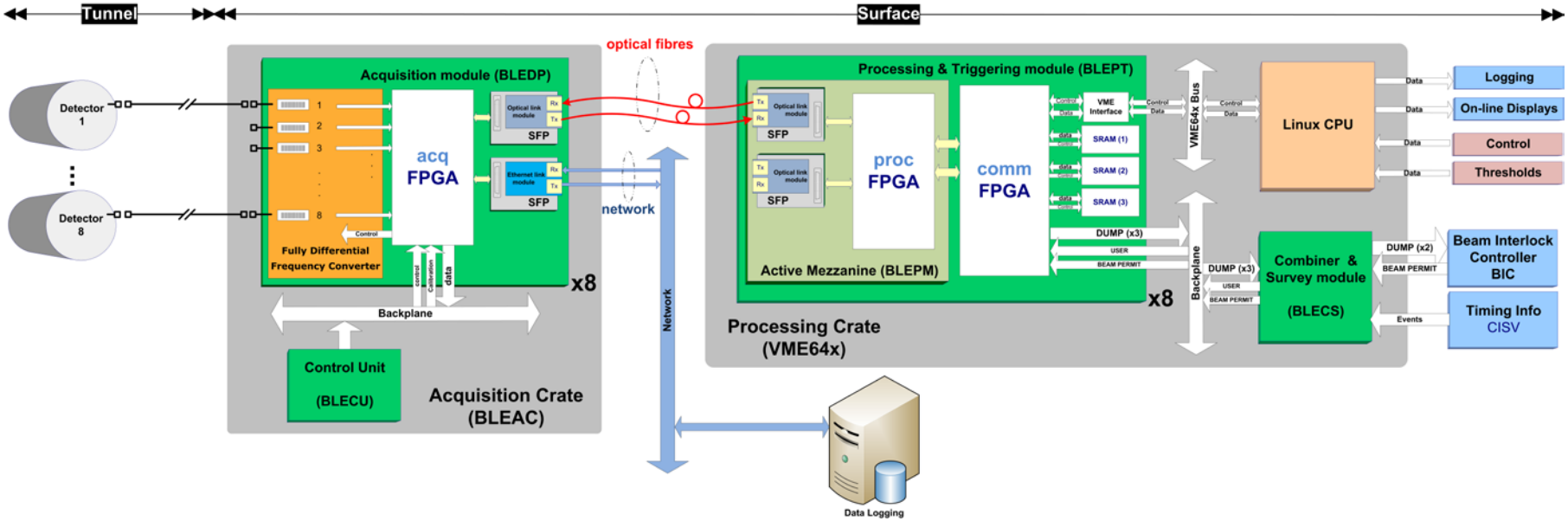
Name	Acronym	Number of Components	2010	2011	2012	2013	2014	2016/7
			Prototype Development			Pre-Series		Series
Acquisition Module	BLEDP	1934	First Prototype (1 piece)	**V1.0** (2 pieces)	**V2.0 & V2.1** (3 pieces)	-	Production **V3.0** (20 pieces)	Production **V3.x** (60-100 pieces)
Acquisition Backplane	BLEBP	1173	-	V1.0 (2 pieces)	**V2.0** (1 piece)	Production **V3.0** (7 pieces)	-	Production **V3.0** (10-15 pieces)
Processing Mezzanine	BLEPM	210	-	V1.0 (1 pieces)	-	-	Production **V2.0** (20 pieces)	Production **V2.x** (60-100 pieces)
Crate Main Panel	BLEMP	52	-	First Prototype (2 pieces)	**V1.0** (2 pieces)	Production **V2.0** (7 pieces)	-	Production **V2.0** (10-15 pieces)
Crate Control Unit	BLECU	180	-	First Prototype (1 pieces)	Second Prototype (1 pieces)	Production **V1.0** (7 pieces)	-	Production **V1.0** (10-15 pieces)
Acquisition Crate	BLEAC	200	-	First Prototype (1 pieces)	**V1.0** (2 pieces)	Production **V2.0** (7 pieces)	-	Production **V2.0** (10-15 pieces)
Crate Programmer	BLEJP	160	-	-	First Prototype (1 pieces)	Production **V1.0** (7 pieces)	-	Production **V1.0** (10-15 pieces)
High Voltage Distribution	BLEHV	100	-	-	-	Production **V1.0** (7 pieces)	-	Production **V1.0** (10-15 pieces)

PCB Production

- Production of the Acquisition (BLEDP) and Mezzanine (BLEPM) modules.
- Tenders for the Acquisition and Mezzanine modules production sent.
- Costs: BLEDP: ~60 KCHF, BLEPM: ~30 KCHF

15/04/2014	Send Tenders
	4 weeks
20/05/2014	Deadline for offers
01/06/2014	Send order
	(production of pre-series) 9 weeks
15/08/2014	Reception of pre-series
	(verification of production quality) 2 weeks
01/09/2014	Give OK/FAIL
	(production of series) 7 weeks
01/11/2014	Reception of series

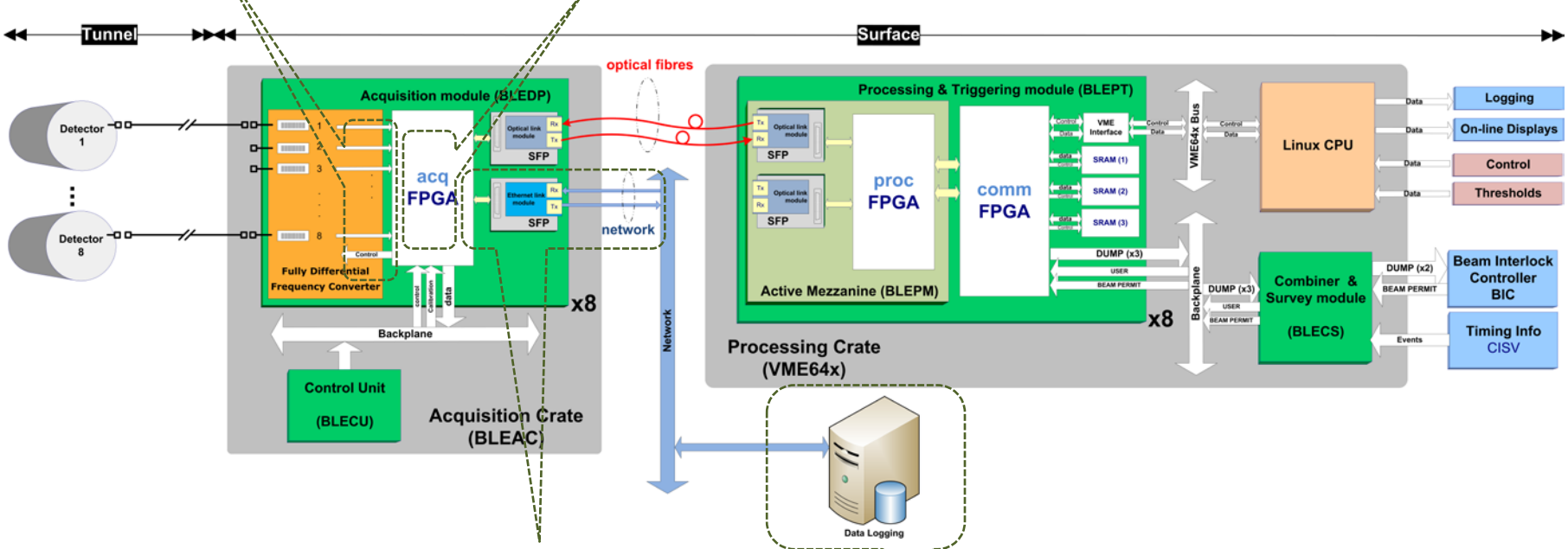
System Overview



FPGA Development (1/4)

Acquisition & Control
complete

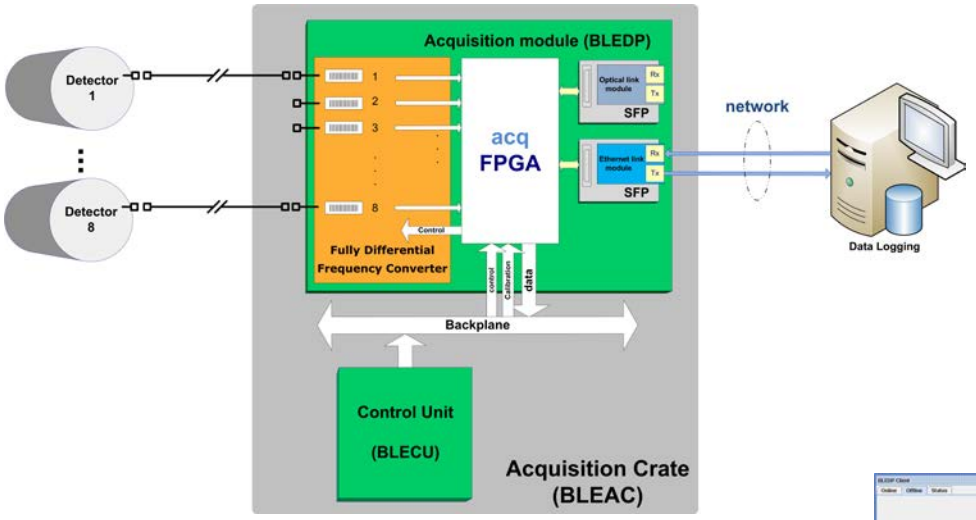
Data Processing
complete



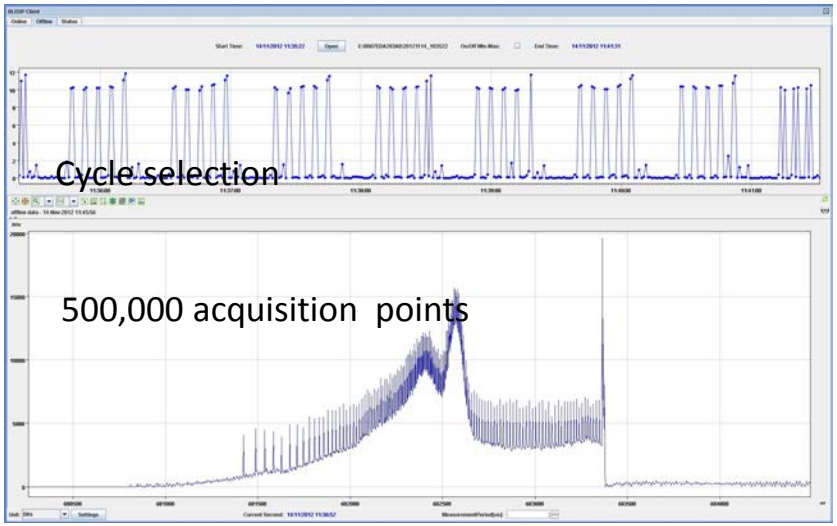
Gigabit Ethernet Link
complete

Stand-alone Application
complete

Stand-alone/Ethernet version



- Ethernet-based version of the system ready
- Very powerful for
  - verification,
  - commissioning and
  - fine observations

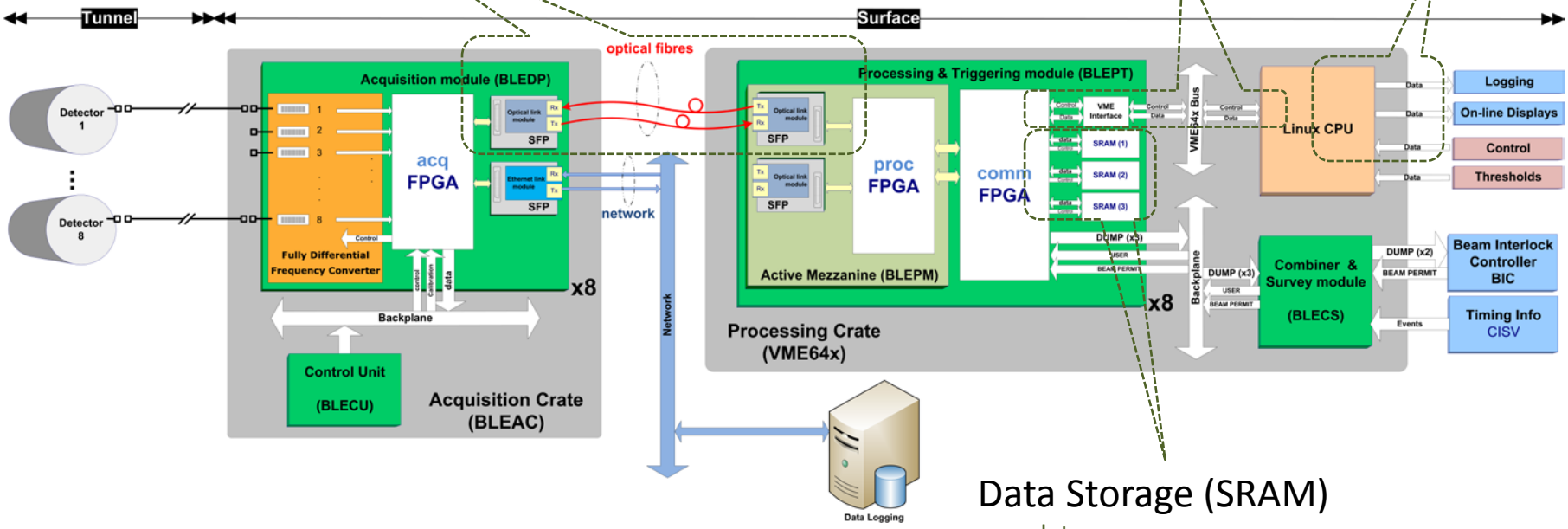


FPGA Development (2/4)

Gigabit Optical Link
complete

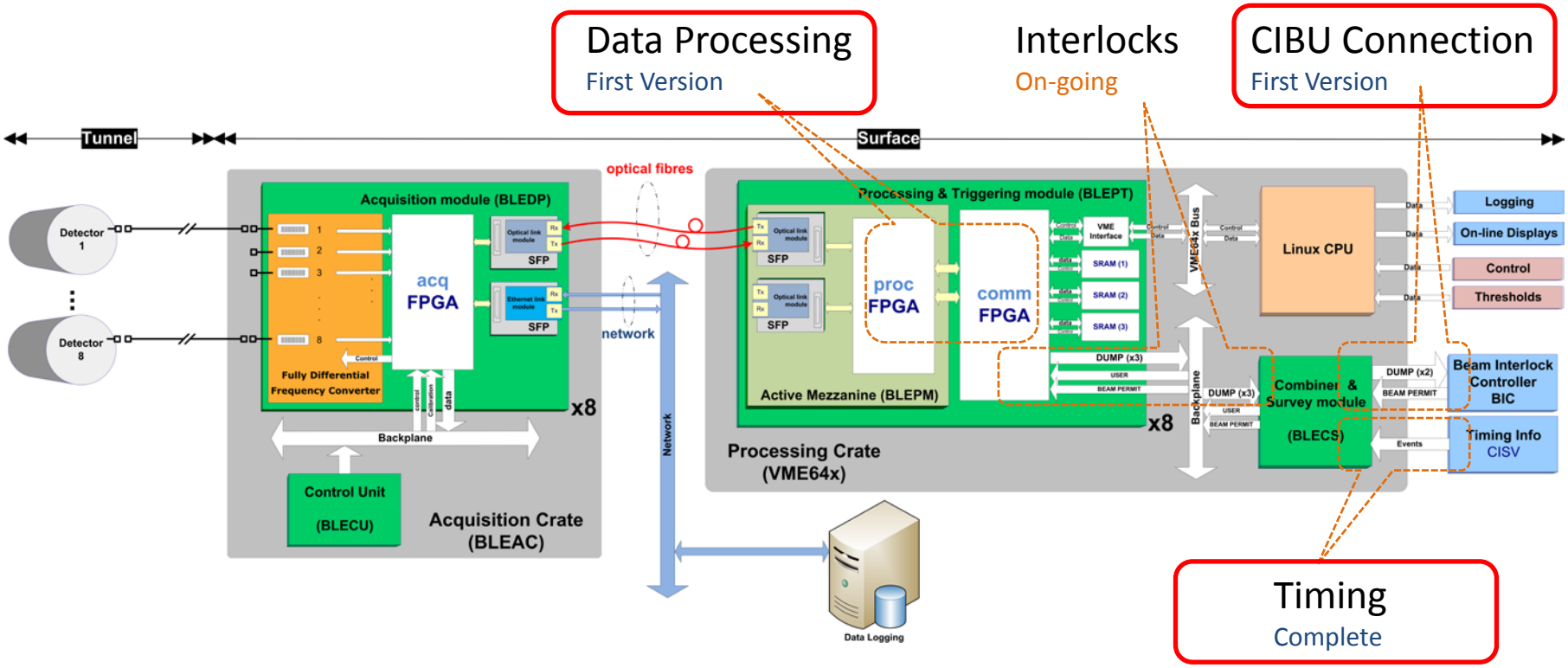
VME Comm.
complete

FESA Class API
complete

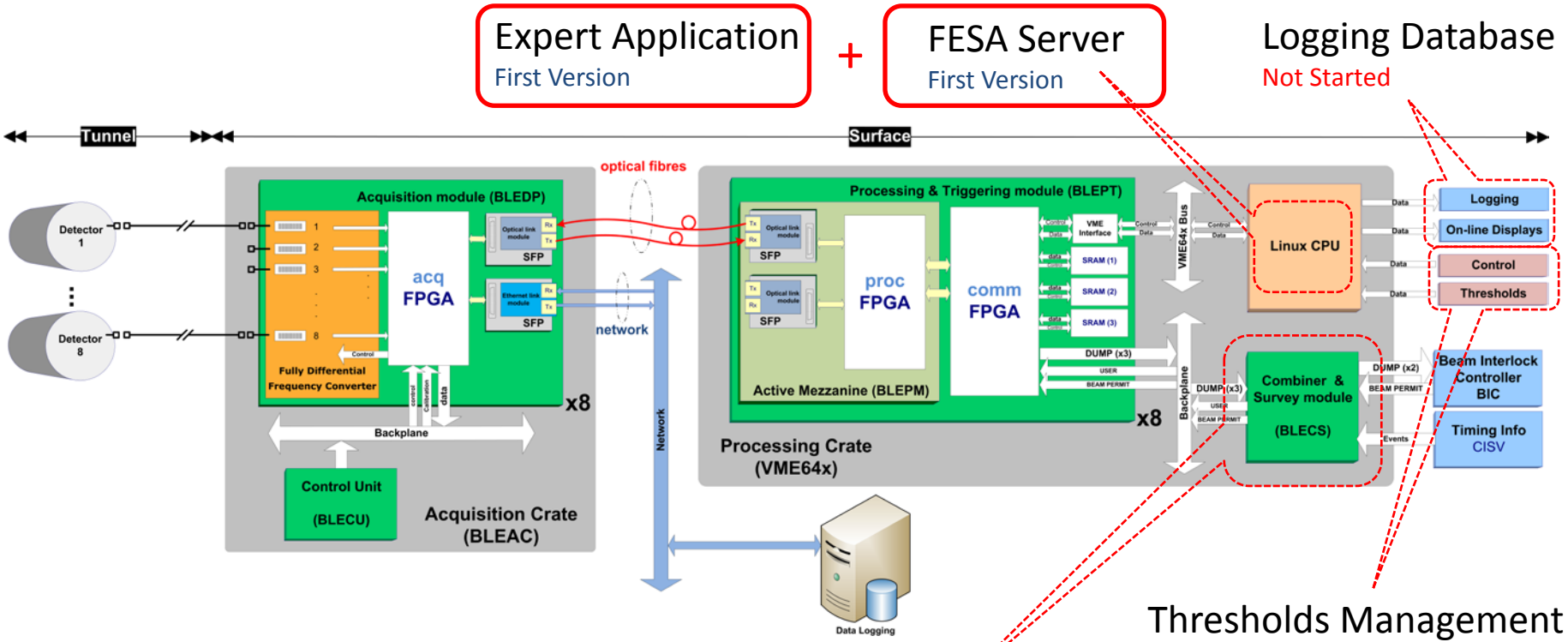


Data Storage (SRAM)
complete

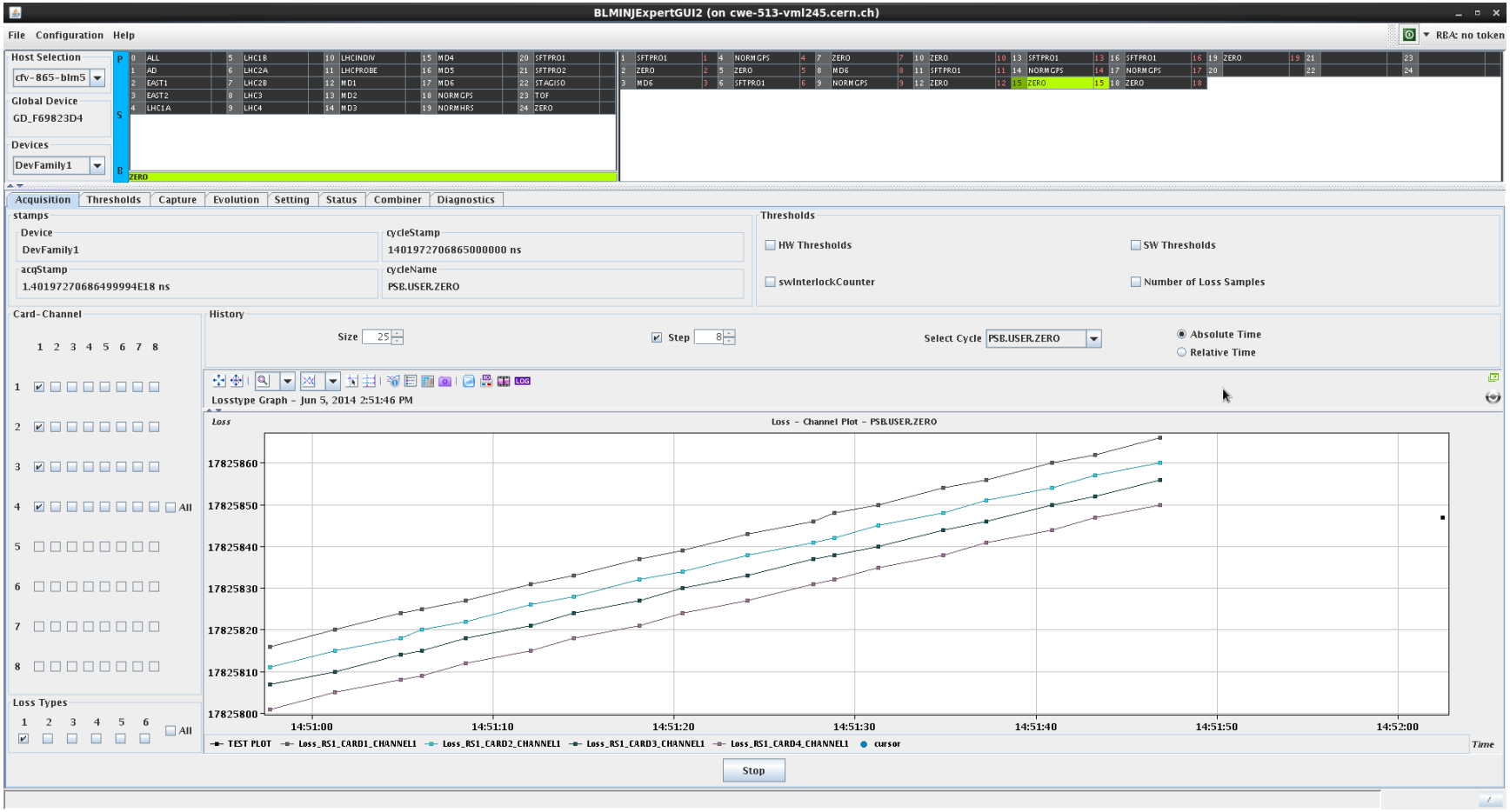
FPGA Development (3/4)



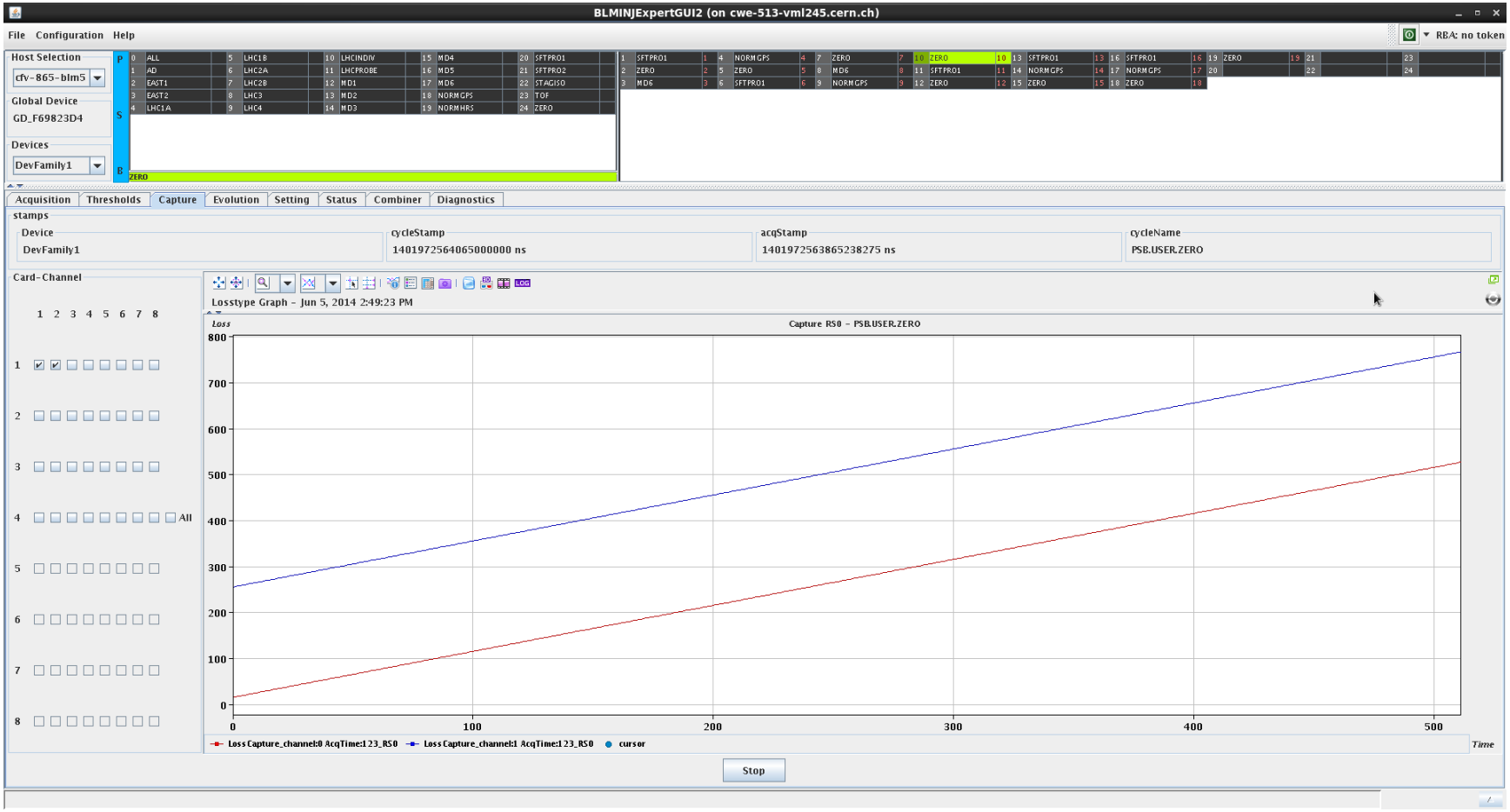
FPGA Development (4/4)



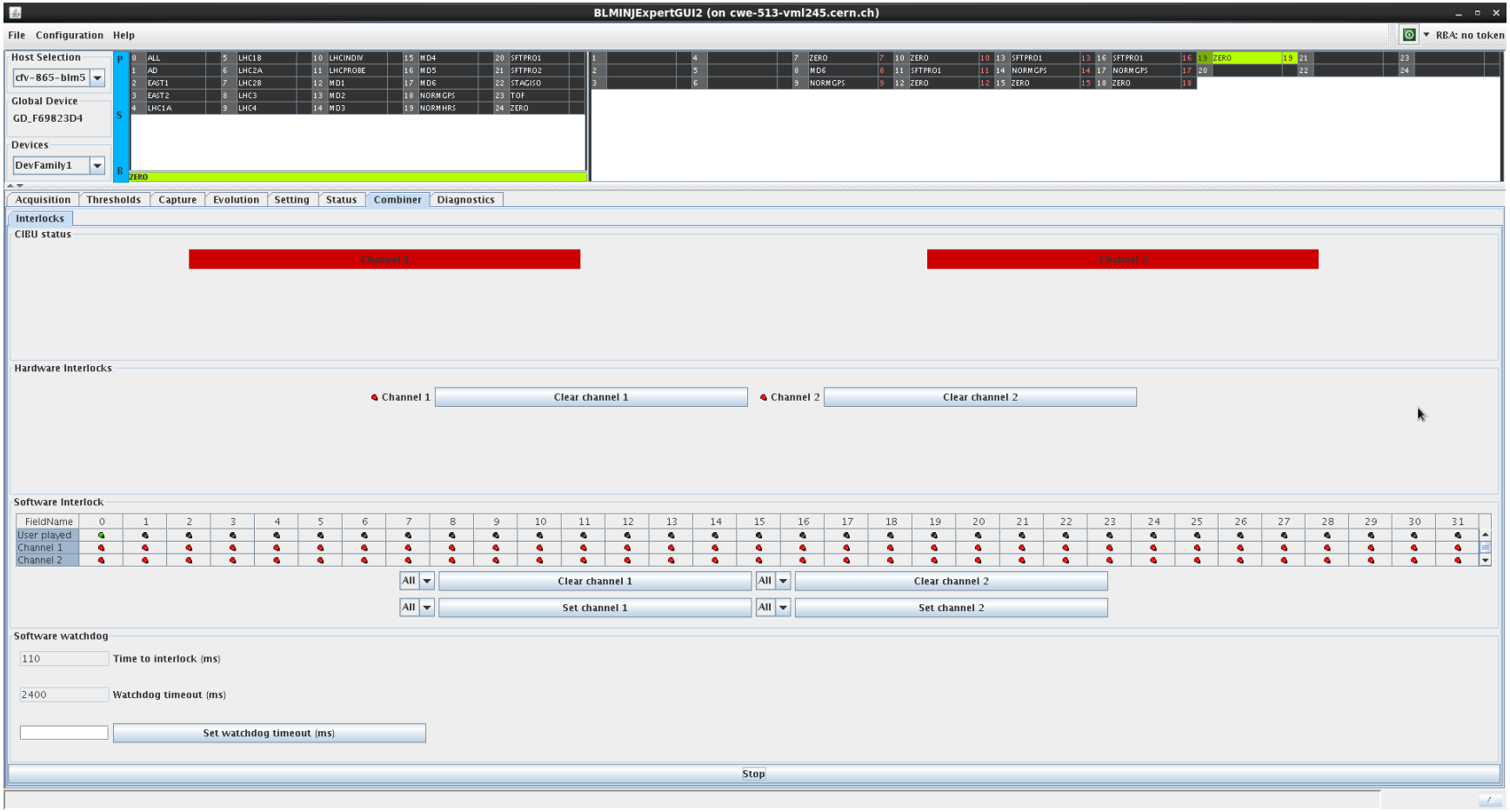
Expert Application – Integrals



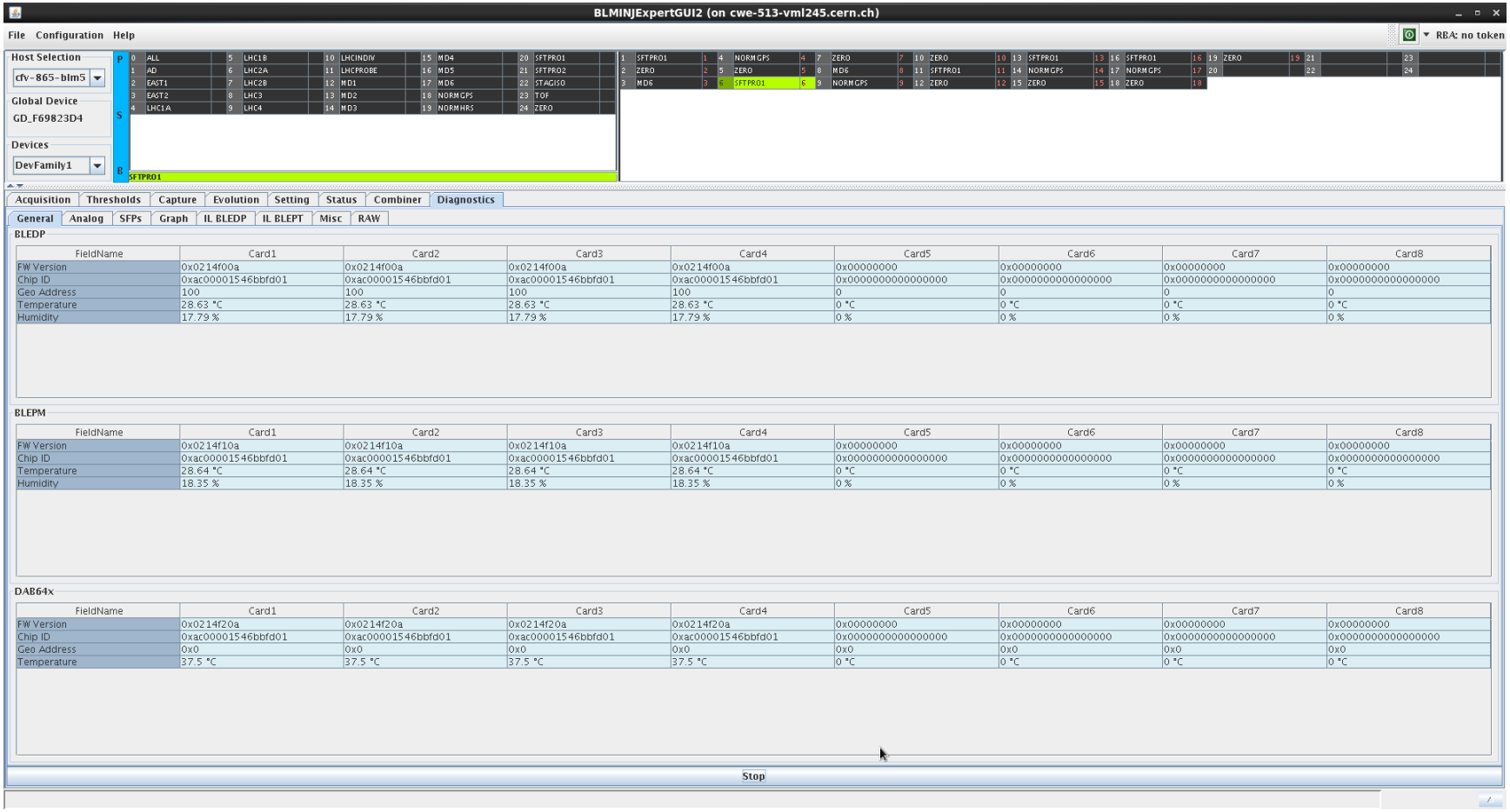
Expert Application – Capture



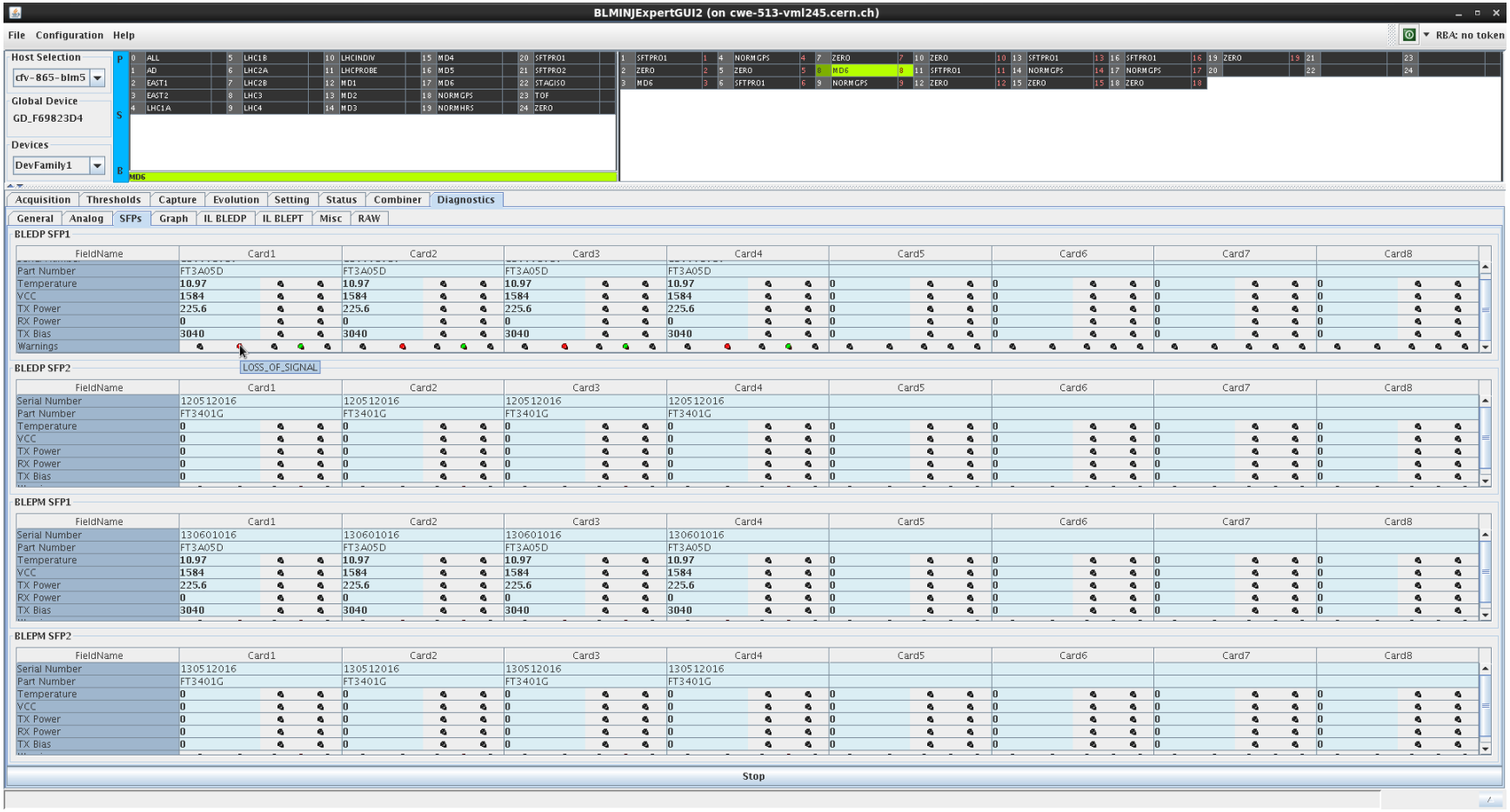
Expert Application – Interlocks



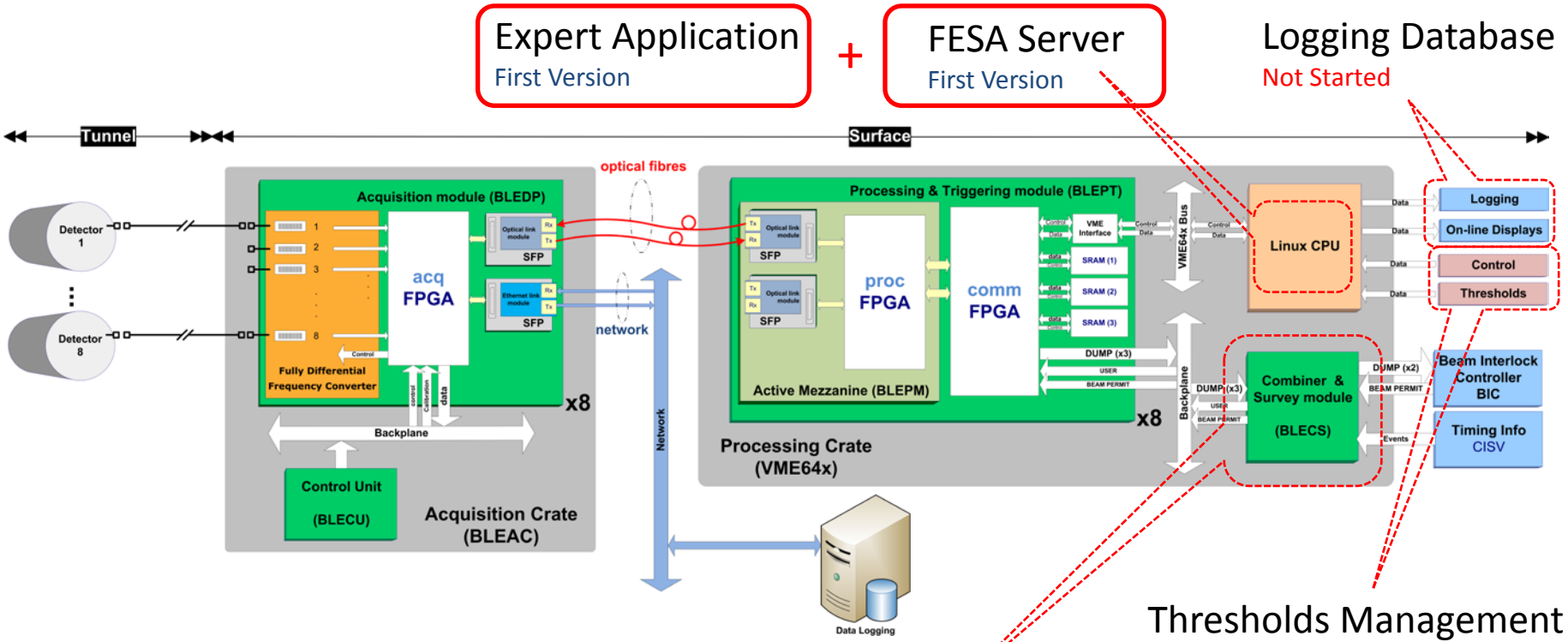
Expert Application – Diagnostics 1/2



Expert Application – Diagnostics 1/2



FPGA Development (4/4)



Summary

- First part of PSB Ring system is complete
  - All detectors are installed
  - All cables and connections have been verified
- PCB production is on schedule
  - Pre-series to be delivered on Nov14
  - Series to be produced in 2016
- FPGA & FESA development advanced
  - Major functions in firmware and software available
  - Now testing complete measurement line (i.e. from acquisition to data publish)
  - Several functions to be developed (e.g. self-diagnostic, statuses, interlock)
- Next steps:
  - Logging database
  - Threshold management
  - Operational applications