



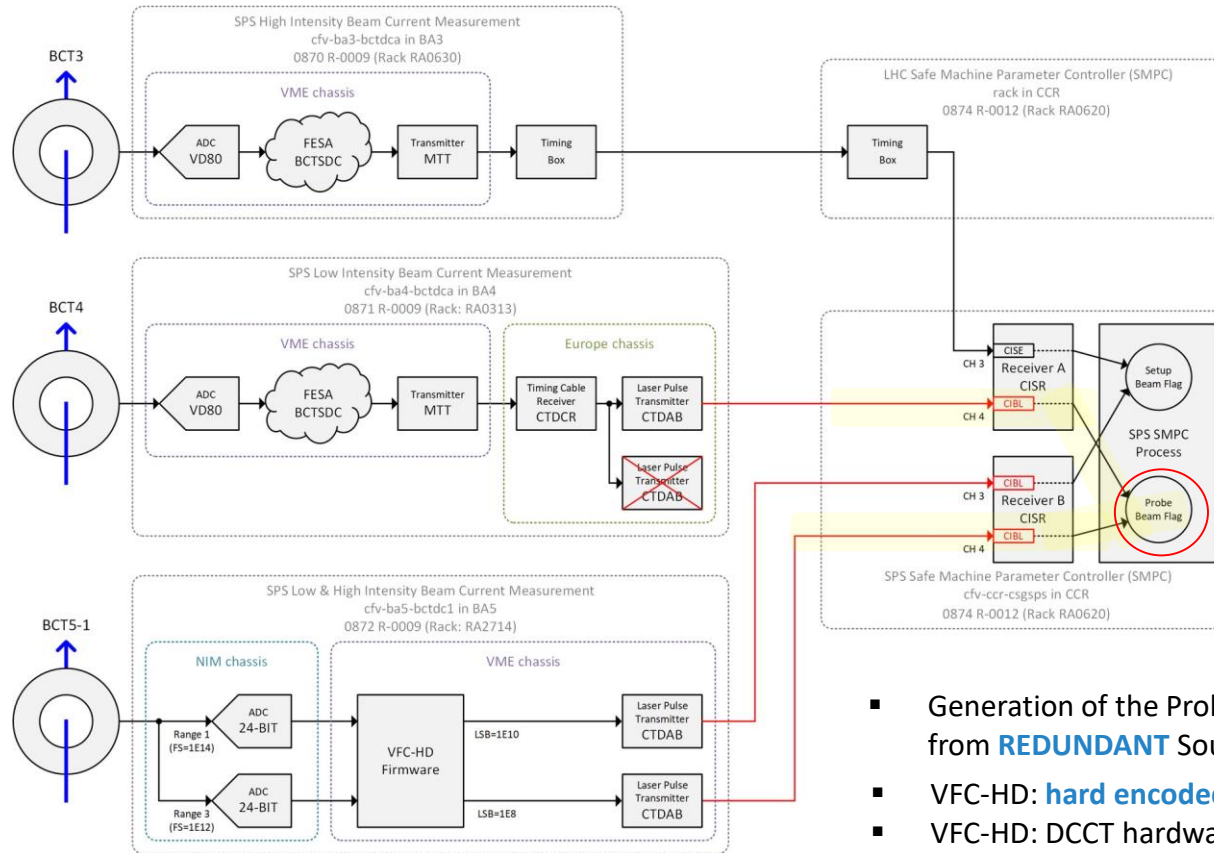
Modifications of the SMP and Implications for the YETS 2022-23

231st Machine Protection Panel Meeting

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on behalf of TE-MPE-MI

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BCT Sources connections to SMP



- Generation of the Probe Beam Flag from **REDUNDANT** Sources
- VFC-HD: **hard encoded**, independent of FESA
- VFC-HD: DCCT hardware ready for **SMPv2** receivers

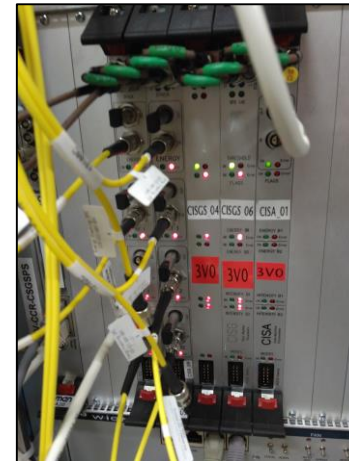
SMP-SPS – BCT Data Transmission

- DATA Transmission format: **8 bit header** and **24 bits payload**

New Headers

- BCT3: **0x4B** not changed
 - BCT4- Low Intensity: **0x2C** → **0x0C** (change for coherency)
 - BCT5- High Intensity: **0x4D** not changed
 - BCT5- Low Intensity: 0x0D**
-
- Modification** implemented in the **critical firmware** of the **SMP-SPS Receivers, CISR, A and B**
 - 2x Fiber pairs available between BA5 and CCR (installed January 2017)
 - SMPv2**: sources shall **modify header values** according to their status to have diagnostics of the source (but keeping only one value accepted as valid)

BCT HEADER FORMAT		
Header Bit	Bit Name	BCT Valid Header (1/0)
7	Not applicable	always zero
6	I10/I8	'1' when the payload is from BCT3 OR BCT5 (nx10 ¹⁰) '0' when the payload is from BCT4 (nx10 ⁵)
5	Redundant/Single source	'1' when the source is redundant (connected to both CISR A and B) '0' when the source is single (connected to only one CISR receiver)
4	Not applicable	always zero
3	Operational / NOT Operational	'1' when the BCT is operational '0' when the BCT is not operational
2	BA bit 2	'011' = BA 3 '100' = BA 4 '101' = BA 5
1	BA bit 1	
0	BA bit 0	



SMP-SPS Receivers - CISR

Safe Machine Parameters in LAB : Detailed Overview

CHALLENGE: Re-programming a Xilinx Spartan 2! (ISE 10.1)

Device Tree

- SMPC
 - SPS
 - RA
 - RB
 - GA
 - GB
 - A
 - LHC
 - RA
 - RB
 - GA
 - GB
 - A
 - C
 - CISV
 - LAB
 - 30.CSGTST.1

Board Info

Board Name : CISX
Variant Name : R
Slot Number : 5

Monitor FPGA Info

Version : 5.2
Revision : 2.0
ISE Version : 11.1.0
Percent used : 95%
UTC : 03-09-12 11:07:50

Control FPGA Info

Version : 0.5
ISE Version : 10.1.0
Percent used : 41%
UTC : 25-01-18 09:51:44

Subscription State

UPDATE : XXXXXXXXXX

SOURCE 1 - NOT RECOGNIZED

Value received : 0x00000000 at time : never received
Polarity : INVERTED Ms received : FALSE
Source Alive : FALSE
Error received : no error at time : never received
Error Count : 0

Value transmitted : 0x00000000 decoded : 0.000 GeV
Mon. Error transmitted : no error
Ctrl. Error transmitted : no error at time : never received
Error Count : 0

SOURCE 2 - NOT RECOGNIZED

Value received : 0x00000000 at time : never received
Polarity : INVERTED Ms received : FALSE
Source Alive : FALSE
Error received : no error at time : never received
Error Count : 0

Value transmitted : 0x00000000 decoded : 0.000 GeV
Mon. Error transmitted : no error
Ctrl. Error transmitted : no error at time : never received
Error Count : 0

SOURCE 3 - SPS/BCTS

Value received : 0x4D00086E at time : 11-11-22 17:23:14
Polarity : NORMAL Ms received : TRUE
Source Alive : TRUE
Error received : no error at time : never received
Error Count : 0

Value transmitted : 0x8800086E decoded : 2.926E13 [p]
Mon. Error transmitted : no error
Ctrl. Error transmitted : no error at time : never received
Error Count : 0

SOURCE 4 - NOT RECOGNIZED

Value received : 0x0D000870 at time : 11-11-22 17:23:14
Polarity : NORMAL Ms received : TRUE
Source Alive : TRUE
Error received : no error at time : never received
Error Count : 0

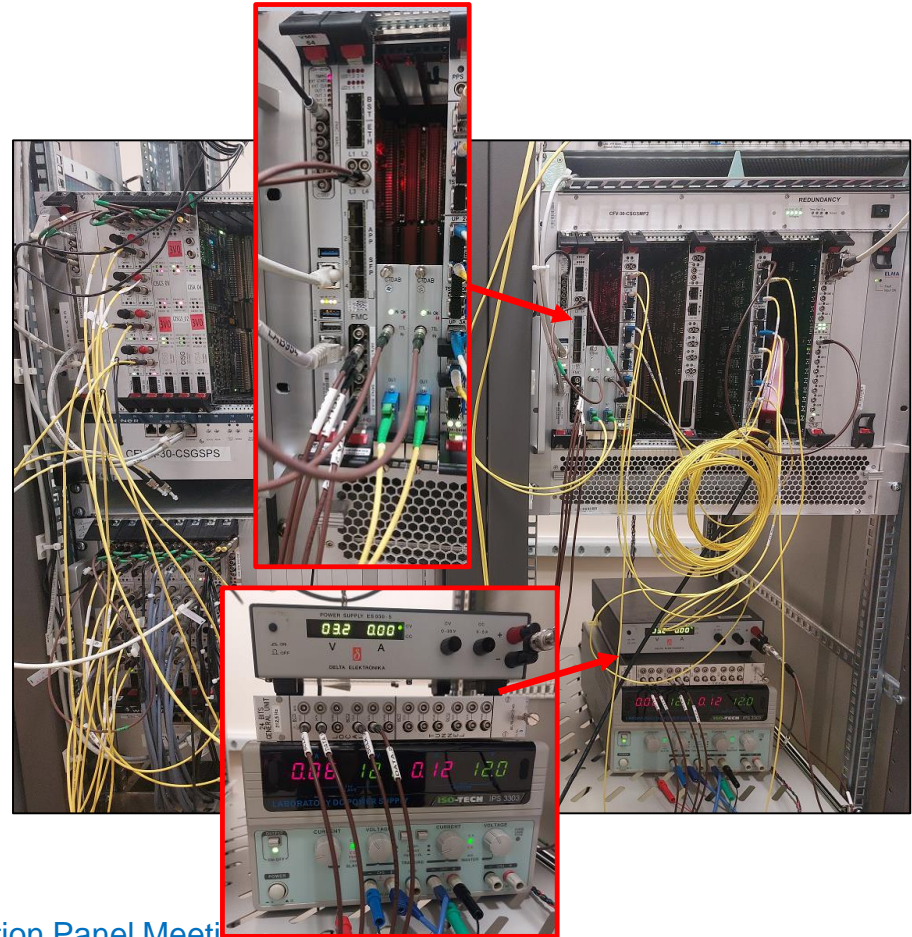
Value transmitted : 0x98000870 decoded : 2.928E11 [p]
Mon. Error transmitted : no error
Ctrl. Error transmitted : no error at time : never received
Error Count : 0

Test Setup in the Lab

- Lab Setup in Bldg. 30:
 - **SMP lab** crate
 - 1x **VFC-HD**
 - 2x **CTDAB**
- **Power supply** connected to an **ADC unit** simulating the BCT5 signal
- **No errors** on the receivers side for **> a week** using two intensities: $1.4e11$, $2.9e11$

SOURCE 3 - SPS/BCTS	
Value received : 0x4D0086E at time : 14-11-22 10:12:38	Value transmitted : 0x9E0086E decoded : 2.926E13 [p]
Polarity : NORMAL Ms received : TRUE	
Source Alive : TRUE	
Error received : no error at time : never received	Mon. Error transmitted : no error at time : never received
Error Count : 0	Ctrl. Error transmitted : no error at time : never received
Error Count : 0	Error Count : 0

SOURCE 4 - NOT RECOGNIZED	
Value received : 0x0D00870 at time : 14-11-22 10:12:38	Value transmitted : 0x9B00870 decoded : 2.928E11 [p]
Polarity : NORMAL Ms received : TRUE	
Source Alive : TRUE	
Error received : no error at time : never received	Mon. Error transmitted : no error at time : never received
Error Count : 0	Ctrl. Error transmitted : no error at time : never received
Error Count : 0	Error Count : 0



SMP-SPS Generators - CISG

- Probe Beam Flag Generator logic is **1oo2: the first VALID**
- Proposal with two redundant sources: **1oo2 the HIGHEST**

Safe Machine Parameters in LAB : Detailed Overview

Device Tree

- SMPC
 - SPS
 - RA
 - RB
 - GA
 - GB
 - A
 - LHC
 - RA
 - RB
 - GA
 - GB
 - A
 - C
 - CISV
 - LAB
 - 30.CSGTST.1

Board Info

Board Name : CISX
Variant Name : GS
Slot Number : 7

From Sources

BCT4/40S Intensity A: 0.0E0 [p]
BCT4/40S Intensity B: 2.928E11 [p]

Generation

1 out of 2 : Select A then B

BCT4/40S Intensity: 2.928E11 [p]

Operator Probe Beam Limit: 1.4E9 [p]

Probe Beam Limit: 1.0E11 [p]

To Arbitrer & Extraction BIS

SPS Probe Beam Flag: FALSE

BCT3/30S Intensity A: 0.0E0 [p]
BCT5/50S Intensity B: 2.926E13 [p]

1 out of 2 : Select A then B

BCT3/BCT5 Intensity: 2.926E13 [p]

Setup Beam Limit: 5.0E11 [p]
TED Beam Limit: 3.5E13 [p]

SPS Setup Beam Flag: FALSE
TED Beam Flag: TRUE

SMP GUI Updates

The screenshot displays the 'Safe Machine Parameters in LAB : Detailed Overview' window. On the left, a 'Device Tree' shows the hierarchy from SPS to LAB. Below it, 'Board Info' lists details for board CISX, variant GS, slot 7, and monitor FPGA info. The main area contains a logic diagram with several sections:

- From Sources:** BCT4-LI Intensity A (0.0E0 [p]), BCT5-LI Intensity B (5.388E11 [p]).
- Generation:** A logic block '1 out of 2 : The highest' receives inputs from BCT4/BCT5 LI Intensity and outputs to 'Probe Beam Limit' (1.6777215E15 [p]).
- Operator Probe Beam Limit:** A logic block '1 out of 2 : The highest' receives inputs from 'Operator Probe Beam Limit' (2.4E9 [p]) and 'Probe Beam Limit' (1.0E11 [p]).
- BCT3-HI Intensity:** BCT3-HI Intensity A (0.0E0 [p]), BCT5-HI Intensity B (5.387E13 [p]).
- Setup Beam Limit:** A logic block '1 out of 2 : The highest' receives inputs from BCT3/BCT5 HI Intensity and outputs to 'Setup Beam Limit' (5.0E11 [p]).
- TED Beam Limit:** A logic block '1 out of 2 : The highest' receives inputs from 'Setup Beam Limit' (3.5E13 [p]) and 'TED Beam Limit' (3.5E13 [p]).
- BEM4 Energy Link:** BEM4 Energy Link A (0.000 GeV), BEM4 Energy Link B (0.000 GeV).
- Machine Energy:** A logic block '1 out of 4 : Select BEM4 A then BEM4 B then BEM4 C then BEM4 D' receives inputs from BEM4 Energy Link A and B.
- Flags:** SPS Probe Beam Flag (FALSE), SPS Setup Beam Flag (FALSE), TED Beam Flag (FALSE), Energy AWAKE (FALSE), Energy HiRadMat (FALSE), Energy LHC (FALSE).

A yellow banner at the bottom of the screenshot contains the text: **CHALLENGE: Re-programming a Xilinx Spartan 2! (ISE 10.1)**

SMP-SPS

- New **BCT5** connection to replace the previous BCT4-B
- SMP **CISR** and **CISG** requires reprogramming
 - New Header values
 - Generator logic changed to “**1002 the highest**”
- FPGAs **hard to reprogram**

SMP-LHC

- Changes on the sources side are **transparent to SMP-LHC**
(no modifications to data format and protocol)
- No modifications of the critical logic

