



Laboratoire d'Annecy-le-Vieux
de Physique des Particules

Readout Systems

LAPP ITK group meeting
09.03.2015

A. Rummler

Readout systems for FE-I4b at LAPP

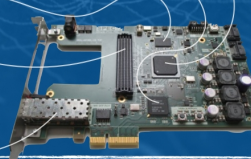
- Testing and qualification of single modules
 - Maximum 4 FE-I4Bs at a time
 - No data rate restrictions
 - USBpix commonly used for this purpose
- Testing and qualification of stavelets and the full L2 stave prototype
 - 56 FE-I4Bs to be read simultaneously
 - Data speed is important as the connective part (flex) is also under test
 - The whole system has to demonstrate its performance
 - Large scale system → RCE et co.

« Exotics » : YARR, SEABAS + another one to rule them all

ATLAS EXPERIMENT

Hardware

- Simple PCI Express Carrier (SPEC) Board
- Developed by CERN under the Open Hardware License: <http://www.ohwr.org/projects/spec/wiki>
- Produced by multiple commercial suppliers for 600€
- Xilinx Spartan 6 LX45T
- Gennum GN4124 4-lane PCIe I.I bus bridge
- 256MB DDR3
- FMC-LPC compatible
- Multiple clocking resources
- SFP plugin



Timon Heim 3 IT's Week

- Not available
- Not fully developed
- Not really popular

Introduction of the SEABAS2 board

- SEABAS2 : General purpose readout board with SiTCP.
 - ➔ SiTCP : network processor to communicate with PC. Maximum data rate : 1 Gbps.
 - ➔ FPGA for each user application.
 - ➔ Four NIM_IN, two NIM_OUT (trigger, busy etc...).

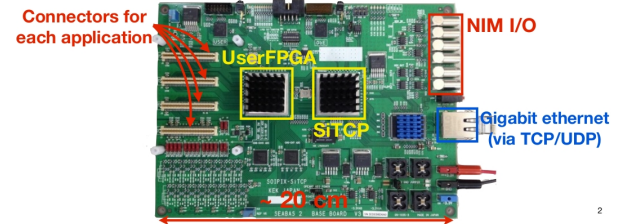
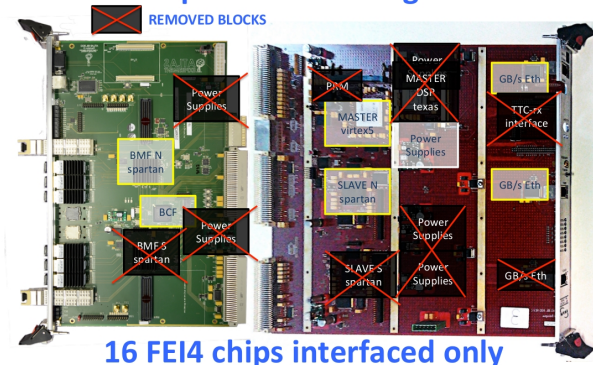


Table Top BOC ROD Merged Card



25 Feb 15

A. Gabrielli - Table top ROD BOC prototype

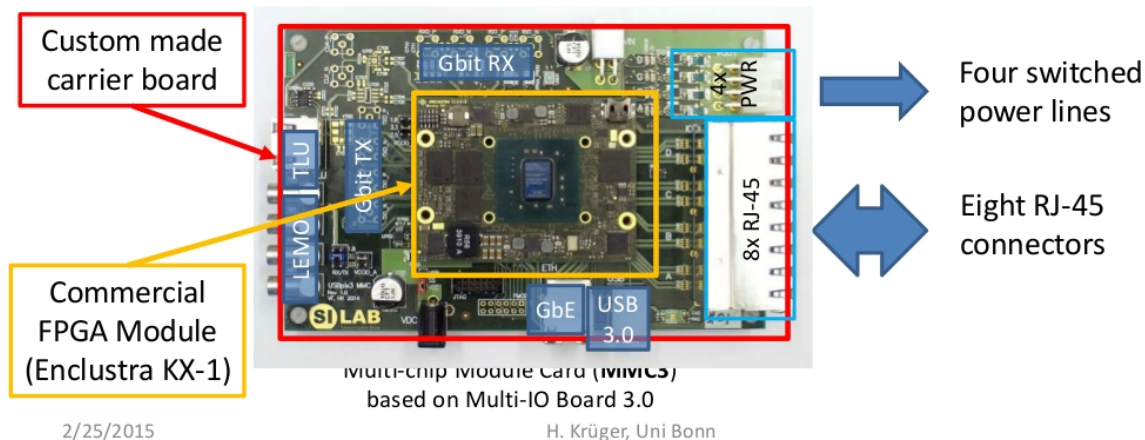
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USBpix3

Alternative USBpix3 Hardware for Multi-chip Modules/Stave Tests

MIO3 card with **integrated multi chip support** → **MMC3**

- Same connectivity as MIO3 (including MGT for future RD53 chips)
- KEL connector replaced with eight RJ-45 connectors (optional ac-coupling)
- Additional four power channels (power switch + current sense/limit)
- Direct connection of up to 4, 8, or more FE-I4 modules (depending on CLK and CMD line sharing)



USBpix3

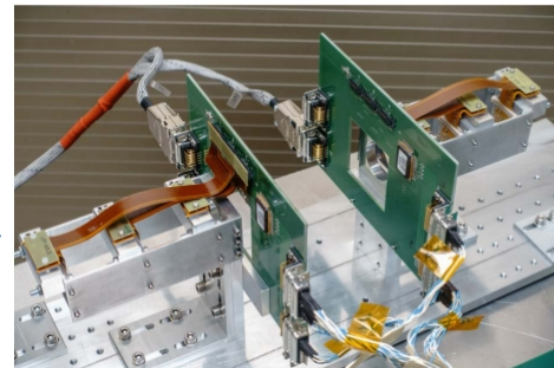
Max. bandwidth determined by
computer port: 200 MB/s USB3
or 100 MB/s UDP (Ethernet)

MMC3 Use Cases

- Stave testing (LVDS lines can be ac-coupled to allow for serial powering)
 - Four Quad modules (16 FE chips)
 - Two RJ-45 connectors per module → CMD, CLK, 4x DATA, no multiplexing required
 - Eight Quad modules (32 FE chips)
 - One RJ-45 connectors per module → CMD, CLK, 1x DATA, with data multiplexing on module
- Combined Telescope and DUT R/O
 - Eight channels → for example six FE-I4 planes + two FE-I4 based DUT
 - Example: AIDA SBM FE-I4 telescope (under investigation)



2/25/2015



H. Krüger, Uni Bonn

USBpix3

HW Status & Component Availability

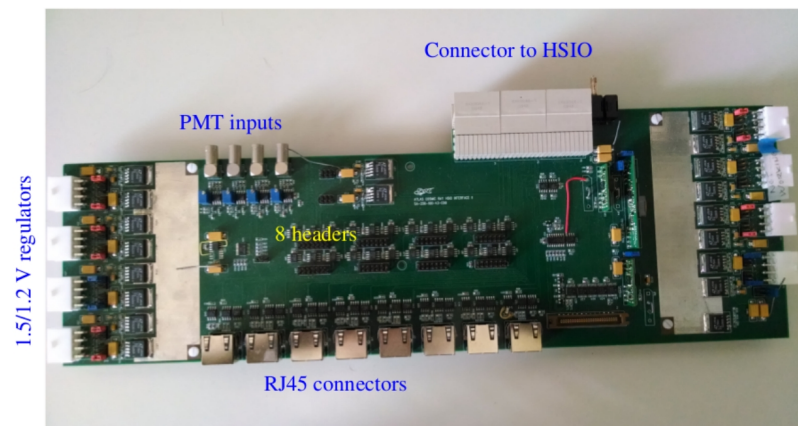
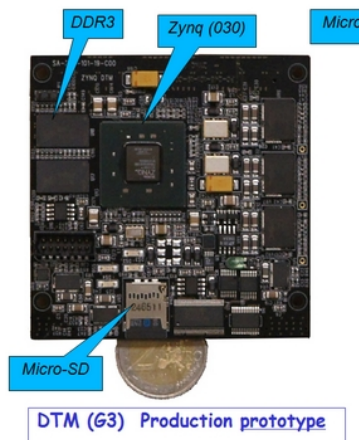
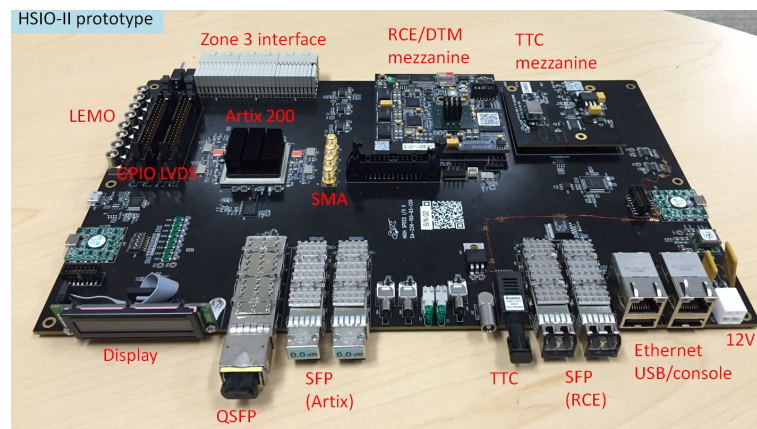
- **GPAC**: new production ready, 30 pcs. available immediately
- **MIO3** and **MMC3**: prototype tested → production to be started
- **GPAC** (850€), **MIO3**, and **MMC3** (price tbd.) will be distributed by Bonn via CERN TID or invoice (contact Fabian)
Oral estimation: >~800€ for MMC3
- New boards available ~Mar 2015
- Only very few **BIC** left
- No more FE-I4 adapter cards
- No more **MIO** boards
- Please contact Fabian or me to indicate your interest in
 - MIO3 boards
 - MMC3 boards
 - GPAC boards**LAPP has interest in 1-2 systems, will tell them**

3 poss. RCE based systems

- Data speed poses (mostly) no problem
- 4 HSIO-II
 - Potentially the most straightforward ?
 - 2.2 GB/s from 14 channels into 1 PGP channel by Artix
 - Output by DTM, downlink limited by 1 GBit Ethernet if only one link used → on board processing
- Single COB with e-RTM
 - Needs developement of special RTM
 - No data speed limit
- Single COB with GBT
 - Needs development of special GMTx and GBLT based end of stave card
 - Not yet available
 - Depends completely on GBT → introduces additional complexity
 - Each GBTx aggregates 3.2 GB/s, 4 optical links, each of the two RCEs on the single DPM processes $2 * 3.2$ GB/s
- Participation in common production run requires answer until 16.3.2015 (but might negotiable) → MOU signing and TID payment

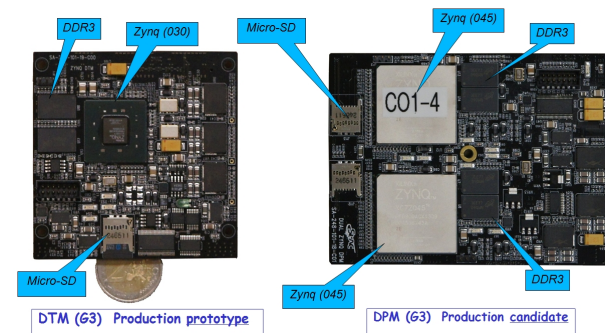
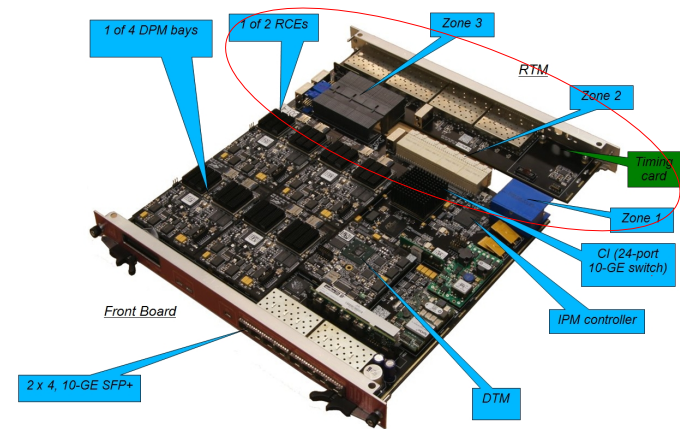
4 HSIO-II system

4	HSIO-II	\$ 3500
4	DTM	\$ 1200
4	Pixel interface board	\$ 1500
Total		\$ 24800



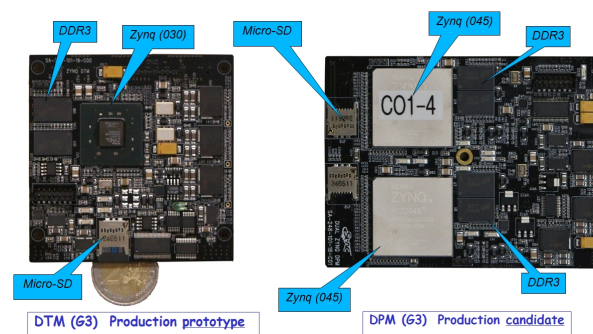
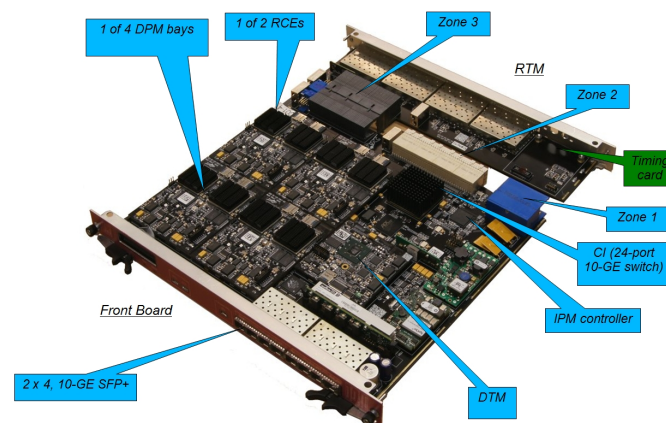
Single COB with e-RTM

1	COB	\$ 6200
1	DTM	\$ 1200
2	DPM	\$ 3700
1	RTM tbd.	~>\$ 1800
Total		\$ 16600
1	ATCA chassis	\$ 2000
1	ATCA shield manager	\$ 1200
1	ATCA power supply	\$ 500
Total		\$ 20300



Single COB with GBT

1	COB	\$ 6200
1	DTM	\$ 1200
1	DPM	\$ 3700
1	RTM	\$ 1800
Total		\$ 12900
1	ATCA chassis	\$ 2000
1	ATCA shield manager	\$ 1200
1	ATCA power supply	\$ 500
Total		\$ 16600
1	GBT EOS tbd.	???
1	Optical transceivers	???



BACKUP

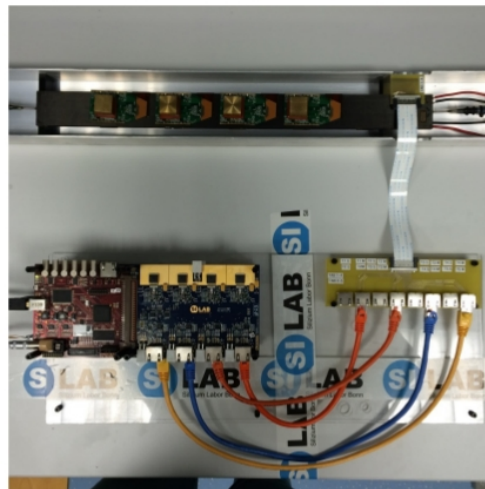


Serial Powering Test Stave Bonn and Göttingen

Serial power stave prototype



- **Dummy modules** (i.e. flex with resistive loads) loaded on one side of the stave
- Tested **cooling**, **current distribution** and **electrical connectivity**
 - Cooling done with a mix of water and ethanol works very well
 - One TAB not useable due to shorts or open lines
 - One TAB has one DO line open, can still readout two FEs



monitoring configuration

☒ turn off in reverse order ☒ no update during scan ☐ continuously refresh status

Item name	Status	Enabled?	Voltage (V)	Current (A)	Temp. (C)
▾ SILAB25	DCS				
▾ USB-regulators_209	OK	ALL OFF			
CH1	OK	OFF	0.003681	0.001196	19.0
CH2	OK	OFF	0.004353	0.001892	19.1
CH3	OK	OFF	0.003598	0.003487	19.0
CH4	OK	OFF	0.004982	0.002116	19.2

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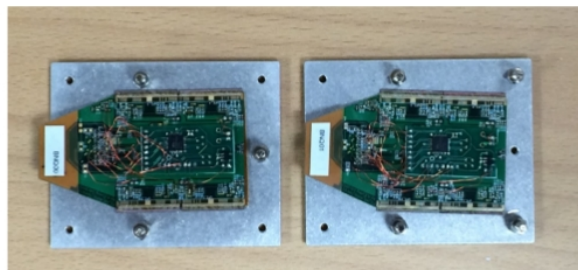
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Quad flex modules

Quad modules for SP stave

- Three quad modules available for stave prototype
 - BNQ00: digital module
 - BNQ01: pseudo quad, n-in-p sensor
 - BNQ02: pseudo quad, n-in-n sensor
- Two more modules are assembled this week

BNQ00 and BNQ01
pseudo flex and LBNL MUX PCB



BNQ02
MUX-DCS flex

