ATCA DEVELOPMENTS FOR THE ATLAS TILE CALORIMETER UPGRADE

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Outline

- Tile Calorimeter Phase II Upgrade
  - Demonstrator project
- Complete ATCA test-bench
- Software tool
  - TileIpmiGui
- sROD demonstrator AMC
  - Hardware design
LHC plans to increase instantaneous luminosity in a factor of 10 by 2022: Phase II Upgrade

Complete redesign of front-end (FE) and back-end (BE) electronics

- Full digital Level-1 trigger, higher reliability and robustness, higher radiation tolerance
- Full digitization of data at 40MHz in FE and transmission to BE

<table>
<thead>
<tr>
<th>Present</th>
<th>Upgrade</th>
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<tbody>
<tr>
<td>Total BW</td>
<td>~ 200 Gbps</td>
</tr>
<tr>
<td>Nb fibers</td>
<td>256</td>
</tr>
<tr>
<td>Fiber BW</td>
<td>800 Mbps</td>
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**Present TileCal readout architecture**

**Phase II Upgrade TileCal readout architecture**
Demonstrator Project

- New FE electronics will be installed in one hybrid drawer during 2014
  - Up to three hybrid drawers more will include the new electronics between the Long Shutdown 1 (LS1, 2013-2014) and LS2 (2018-2019) based on obtained results
  - Hybrid drawers compatible with the present system, providing both analog and digital trigger signals for the present L1Calo

- New BE electronics: super Read Out Driver modules demonstrator (sROD demo)
  - Data reception from the hybrid drawer (48 PMTs)
  - Data processing
  - TTC and Detector Control System (DCS) management and transmission to FE
  - L0/L1Calo functionalities
    - Preprocessor and data transmission
Complete ATCA test-bench in bld. 175 at CERN

RadiSys SYS6006 Platform
- 6 slots chassis
- Dual star topology

RadiSys ATCA-2210
- Switch and shelf management module

RadiSys ATCA 4500
- Computer Processing Module (CPM) with RTM
- Scientific Linux 5 already installed

RadiSys ATCA-1200 Carrier
- 4 single/2 double AMC

RadiSys ATCA-1200 RTM
- Total of 16 SFPs (4 SFP optical modules per AMC)
Software - TileIpmiGui

- TileIpmiGui monitors the ATCA modules through IPMI bus
  - TileIPMI library makes use of the open source OpenIPMI library
- Provides connection to the Shelf Manager through the fabric interface using the CPM
  - Using the name of the IPMI Server from any machine at CERN
  - Version 0: Shows the information of the main boards and FRU detected in the ATCA shelf
    - GLIB AMC (CERN)
- Next steps: include different panels to read and monitor the sensors of the boards

TileIpmiGui – Qt
TileIPMI – C++
OpenIPMI

xTCA Interest Group Meeting - TWEPP 2013 26/09/2013
Selected form factor is a double mid-size AMC
- Plugged in a µTCA platform or in an ATCA carrier
- 180.6 mm x 148.5 mm
- Total power allowed per bay: 80W

Readout architecture for the Demonstrator
**Hardware - sROD Design**

- **FPGAs**
  - Xilinx Virtex 7
    - XC7VX485T-2FFG1558
    - 48 GTX @ 10 Gbps
  - Xilinx Kintex 7
    - XC7K420T-2FFG901
    - 28 GTX @ 10 Gbps

- **Optical Modules**
  - 4 QSFP modules
    - Luxtera – BER < 10^{-18}
    - FE readout and DCS/TTC
  - 1 Avago MiniPOD Tx
    - Transmission to L0/L1 Calo
  - 1 Avago MiniPOD Rx
    - Evaluation purpose

- **SFP + Clock and Data Recovery**
  - Analog Devices ADN2814
  - TTCrx emulation on K7

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*Poster: “A New High-Speed Optical Transceiver For Data Transmission at the LHC Experiments”*

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*sROD demonstrator*
Hardware - sROD Design

- **Memories**
  - 1Gb flash memory
  - 512 MB DDR3

- **Peripherals**
  - 10/100/1000 Ethernet Port
  - FPGA Mezzanine Connector (FMC)

- **MMC mezzanine**
  - Manage the power connection to the carrier (hot-pluggable feature)
  - Provides other functionalities as temperature monitoring and identification
Hardware - sROD Connectivity

- AMC connector
  - Virtex 7 to RTM
    - 4 x SerDes
  - Virtex 7 to Carrier
    - 2 x GbE
    - 1 x PCIe
  - Kintex 7 to Carrier
    - 2 x GbE
- Between V7 and K7
  - 4 x PCIe
- FMC connector
  - 2 x SerDes to V7
  - 2 x SerDes to K7
Hardware - sROD PCB design

- High density of components
  - About 1200
  - Reduced area

- Stack-up
  - 14 layers
    - Power/ Ground: 8 layers
    - Signals: 6 layers
  - NELCO 4000-13 SI
    - Dielectric Constant: 3.2 @ 10GHz
    - Dissipation Factor: 0.008 @ 10 GHz
    - Low moisture absorption
  - Total thickness ~ 1.6 mm (Compliant with AMC Base Specification-PICMG® AMC.0 R2.0)

- First prototypes expected for the end of this year

Poster: “The sROD module for the ATLAS Tile Calorimeter Phase-2 Upgrade Demonstrator”
Summary

- Complete ATCA development test-bench
  - Radisys products

- Software
  - TileLpmiGui
  - ATCA blades and FRU identification

- sROD demonstrator AMC
  - Double mid-size AMC
  - Xilinx Virtex 7 and Kintex 7 FPGAs
  - QSFP and MiniPODs modules
  - First prototypes for the end of this year
THANK YOU