RF Backplane For MTCA.4 Based Control System

Krzysztof Czuba
Warsaw University of Technology
Institute of Electronic Systems
For the DESY LLRF Team
krzysztof.czuba@desy.de

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Internal LLRF System RF Signal Distribution in Fully Equipped MTCA Crate

Controller

AMC Cards (front)

uRTM Cards (back)

Vector Modulator

ADC

ADC

ADC

ADC

10-CH DWC

10-CH ADC

1.3 GHz RF signals

9x 1.3 GHz Master Oscillator

8x 1.354 GHz LO

8x 1.3 GHz CAL

18 x 81 MHz clocks

10x 54 MHz IF signals

VM 1.3 GHz modulated output

LO Generator Module

10x 1.3 GHz RF signals
Cable management is a fundamental problem for many applications.
What about hiding „internal” LLRF connections inside of the crate?

RF Backplane Solution
Advantages of the RF Backplane Concept

System with signals distributed outside the crate

- Improved cable management
- Higher reliability
- Space reduction

System with RF Backplane

- Improved cable management
- Higher reliability
- Space reduction
AMC-RTM Pair – Side View

AMC

AMC Backplane

RTM

Zone 3
Abbreviation uRFB - uTCA RF Backplane
AMC-RTM Pair – RF Backplane Connectors

Abbreviation uRFB - uTCA RF Backplane

AMC Backplane
RTM Backplane

ERMET ZD, 3x10 diff. pairs
Radiall Coaxipack 2 6-pin, 6GHz RF connectors
Prototype Developments: uRFB v1.0 and v2.0

v1.0 Installed in the crate

v2.0

- Boards developed to test interconnections and prove feasibility of the uRFB concept
- Fully passive signal distribution
Prototype Board Tests

- Measurements in laboratory and in the crate filled with digital boards

- No detectable signal spectrum degradation – recorded signal spectrum in range 9kHz – 3.5GHz revealed no spectral lines at level above instrument noise floor (-75 dBm)

- Very small influence on phase noise and jitter. Detected jitter degradation of below 10fs (corresponds to below 400μV rms noise in bandwidth 10Hz – 10MHz)

- Signal spectrum recorded by AMC digitizers comparable with uRFB to the one recorded without (measurements by M. Hoffmann)

- **Proven feasibility of the uRFB concept for LLRF**
uRFB v3.0 – Final Concept Highlights

- **Fully compatible to the standard.** No mechanical collision with standard RTM boards. Supported by crate manufacturers.

- **Hot plug functionality for RF signals.** IPMI extension for uRFB worked out with N.A.T.

- uRFB fully passive. All intelligence in modules -> great flexibility for users.

- Developed a concept of extended RTM (eRTM) boards.

- Redundant high performance rear power supply for analog applications.
J30 and J31 mechanically compatible to Zone 3

Patent pending
Basic Features of uRFB v3.0

- Supports up to 4 eRTMs (slots 15, 14, 13 and -2)
- Supports up to 9 RTMs
- Support two redundant Rear Power Supply Modules (RPMs)
- Provide managed power supply for RTMs and eRTMs
  - +12V for eRTMs
  - +3.3V MP for eRTMs
  - +/- 7V for RTMs
- Slot 15 for signal entry (uLOG, eRTM15)
  - Min. 22 x CLK signals
  - 9xLO, 9xREF and 9xCAL distribution
- eRTM15 can be power supplied either by RPMs or by MCH

- Separate power supply for each RTM and eRTM slot
V3.0 PCB Prototype

PCB Designer: T. Leśniak, support P. Kownacki
Will be available on the MTCA webpage soon
uRFB Test Boards

Input test board (eRTM) – in production

Output test board (RTM)

PCB Designer: B. Gąsowski

PCB Designer: J. Dobosz
Near Future of The RF Backplane

New modules expected soon:

- Input test boards
- MCH_RTM for management
- Rear Power Modules
- uLOG (LO generation module, eRTM)

Many tests are planned like management, signal integrity, EMI and reliability

Performance limits should be evaluated within the HVF
One of the Next Steps: uRFB for Small Form Factor Crates
• Interest and ideas for potential further uRFB applications are welcome

• You are invited for discussion in the BOF part after this session

Thank you for attention!