Heiko Körte
Director Sales & Marketing

Session 101: High-Performance Systems

Extending μTCA™ to Higher Performance Applications

ATCA/MTCA summit, November 10th, 2010

Convention Center, Santa Clara, CA

About N.A.T.

advanced/micro TCA summit
Extending µTCA™ to Higher Performance Applications

- founded in 1990
- based in Sankt Augustin, Germany
- highly profitable
- ISO 9001:2008 (+ military/telecom elements)
- focus: embedded communication
- international customer base
- product lines:
  - board level products: PMC, cPCI, VME, AMC, MCH, etc.
  - software: protocols, applications, drivers, etc.
  - system level products: standard, custom, proprietary

Agenda

- Need for higher performance MicroTCA ?
  - History
  - Current Status
  - Future
- MicroTCA for Physics*
  - Requirements
  - Concept
  - Challenges
- Conclusion

*: the terms "MicroTCA for Physics" or "MTCA.4" refers to the PICMG "xTCA for Physics Working Group 1" and not to a yet adopted sepecification.

Need for higher Performance ?

History Review

- Short Review
  - many applications are based on VME, cPCI or IPCs
  - markets: defence, aerospace, medical, industrial, communication
  - problems:
    - bandwidth needs exceeding capabilities
    - system management (if any) is proprietary
    - concepts for redundancy or fault tolerance are proprietary

⇒ **need for a new concept**
⇒ **need for better and higher performance**

Need for higher Performance ?

History Review

- Results
  - 2003: ATCA
  - 2004: AMC
  - 2006: MicroTCA
  - common features:
    - bandwidth improved: 40Gbps (ATCA), 10Gbps (MTCA)
    - system management mandatory: IPMI/RMCP
    - protocol agnostic: 1GbE, PCIe, SRIO, 10GbE

Need for higher Performance ?
Current Status

- Consequence
  - Markets and Applications adopting MTCA
    - Industrial: larger IPCs and PLCs are replaced by MTCA
    - Telecom: MTCA base stations (UMTS, WiMAX, LTE)
    - Communication: test & measurem., logging + analysis
    - Defence: first communication concepts based on MTCA
    - Aerospace: first ground and airborne systems

⇒ **problems overcome ?**

⇒ **customers satisfied ?**

Need for higher Performance ?

Future

- Problems
  - Misfit in standards
    - MTCA.0 defines 3 CLKs
    - AMC.0 R2 defines 4 CLKs plus 1 Fabric CLK
  - Insufficiencies:
    - cabeling at front of systems
    - insufficient board space (double width no benefit)
    - performance gap between ATCA and MTCA too big

⇒ **need for an improved concept**

⇒ **need for better and higher performance**

Agenda

- Need for higher performance MicroTCA ?
  - History
  - Current Status
  - Future
- MicroTCA for Physics*
  - Requirements
  - Concept
  - Challenges
- Conclusion

*: the terms "MicroTCA for Physics" or "MTCA.4" refers to the PICMG "xTCA for Physics Working Group 1" and not to a yet adopted sepecification.

MicroTCA for Physics

Introduction

- Customer: particle physics
  i.e. DESY, CERN, SLAC, LANL, KEK etc.
- Missing features:
  - no Rear Transition Module (RTM) for MTCA defined
  - special clock and trigger topology
  - sophisticated requirements for the clock and trigger accuracy

⇒ **adaptions and extensions to MTCA standard required**

Large Hadron Collider (LHC), CERN

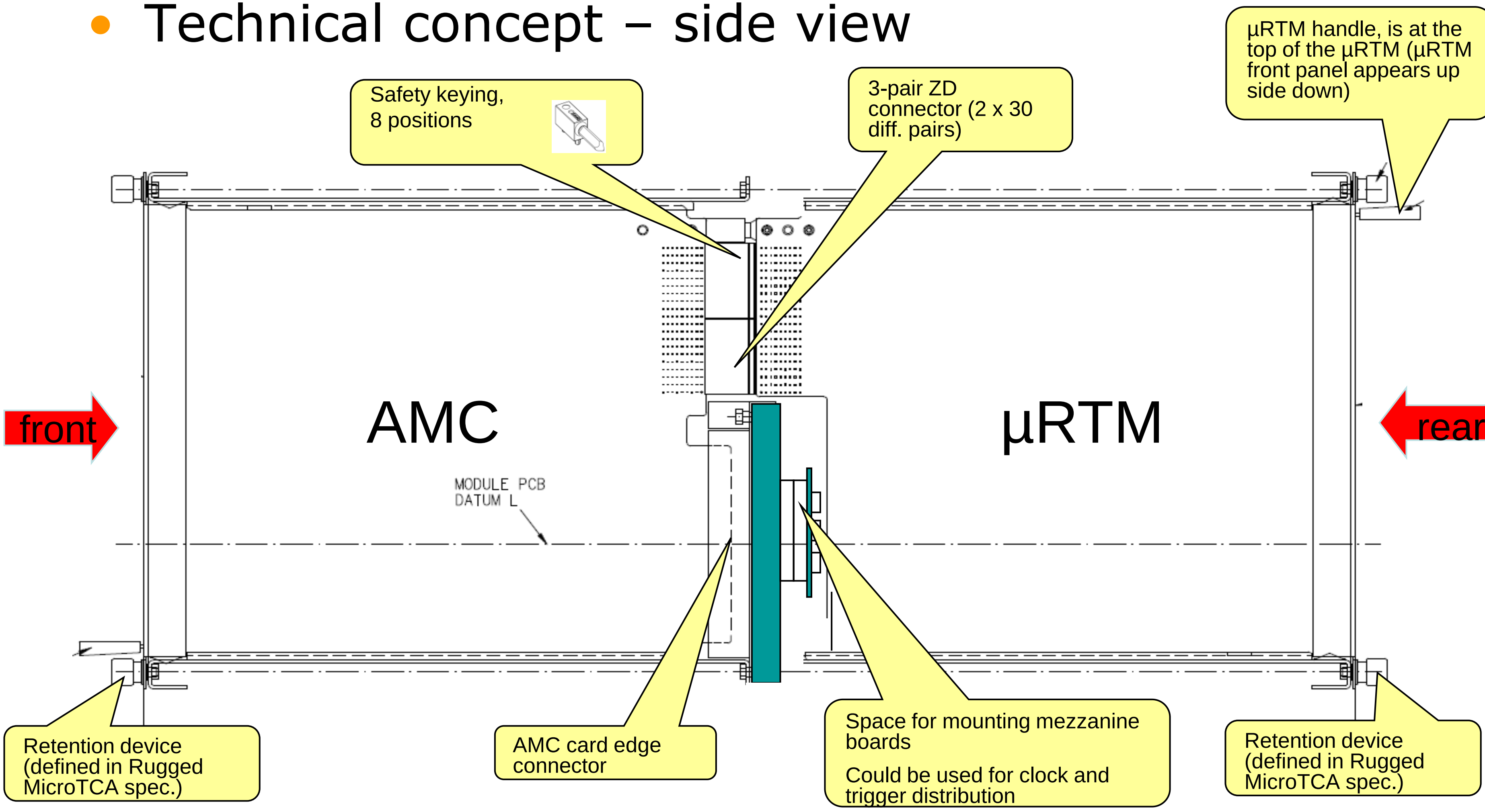
Karlsruher Tritium Neutrino experiment KATRIN

MicroTCA for Physics
Requirements

- Required changes to the standard and concept
  - AMC Module size: double-wide, mid-size
  - large µRTM real estate
  - use front panel mechanics based on Rugged uTCA
  - reuse existing AMC front panels for the µRTM
  - allowing mounting of mezzanine modules on the rear of the backplane
  - Optional zone 3 backplane

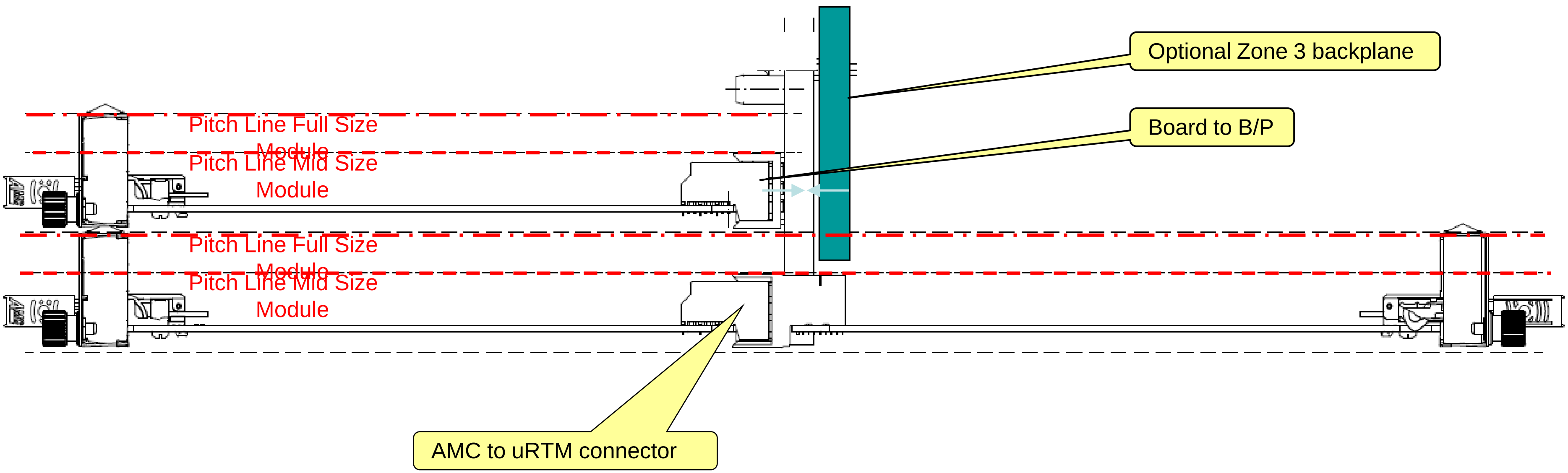
⇒ **new mechanical concept required that at the same time provides backwards compatibility**

- Technical concept – side view

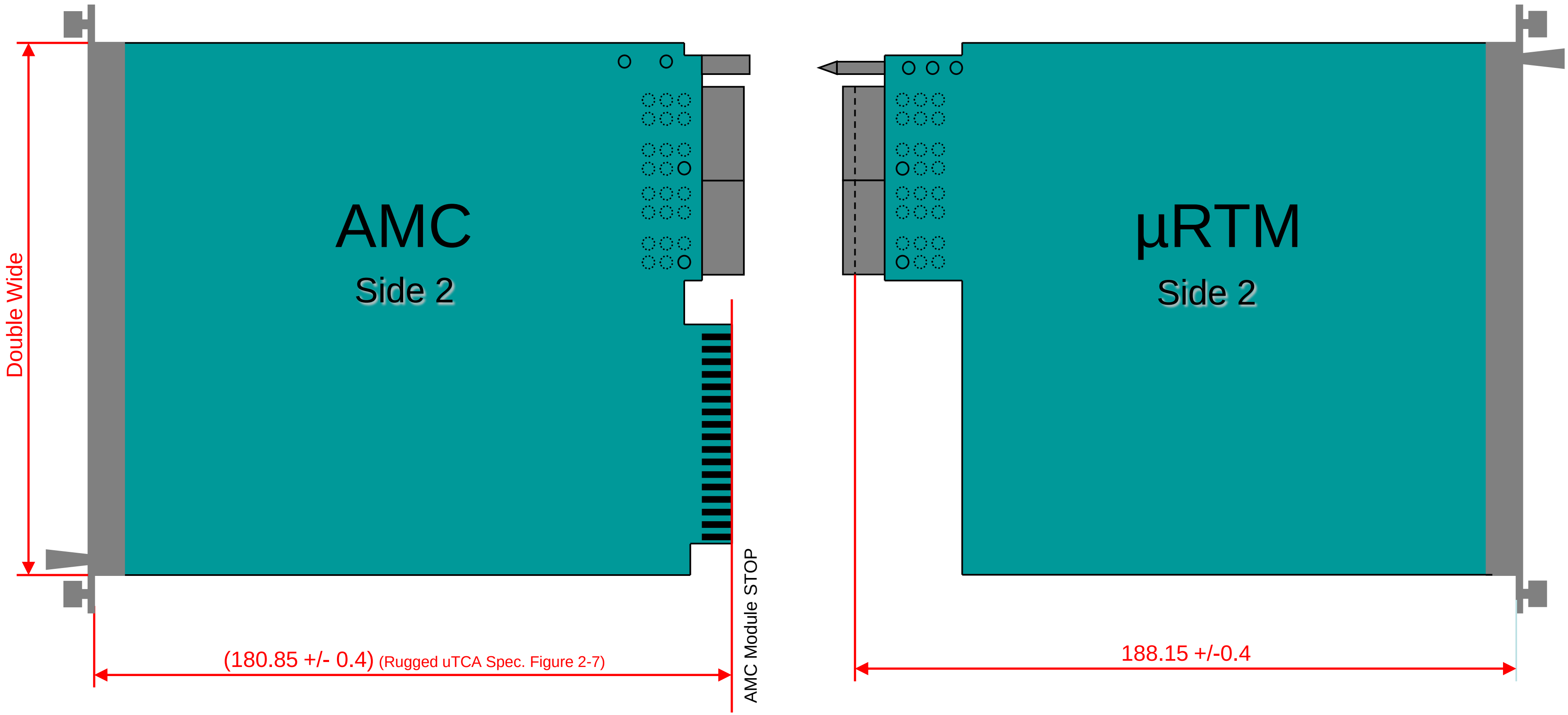


- Technical concept – top view

AMC µRTM



- Technical concept – mechanical sizes



Technical concept – management

IPMB-L

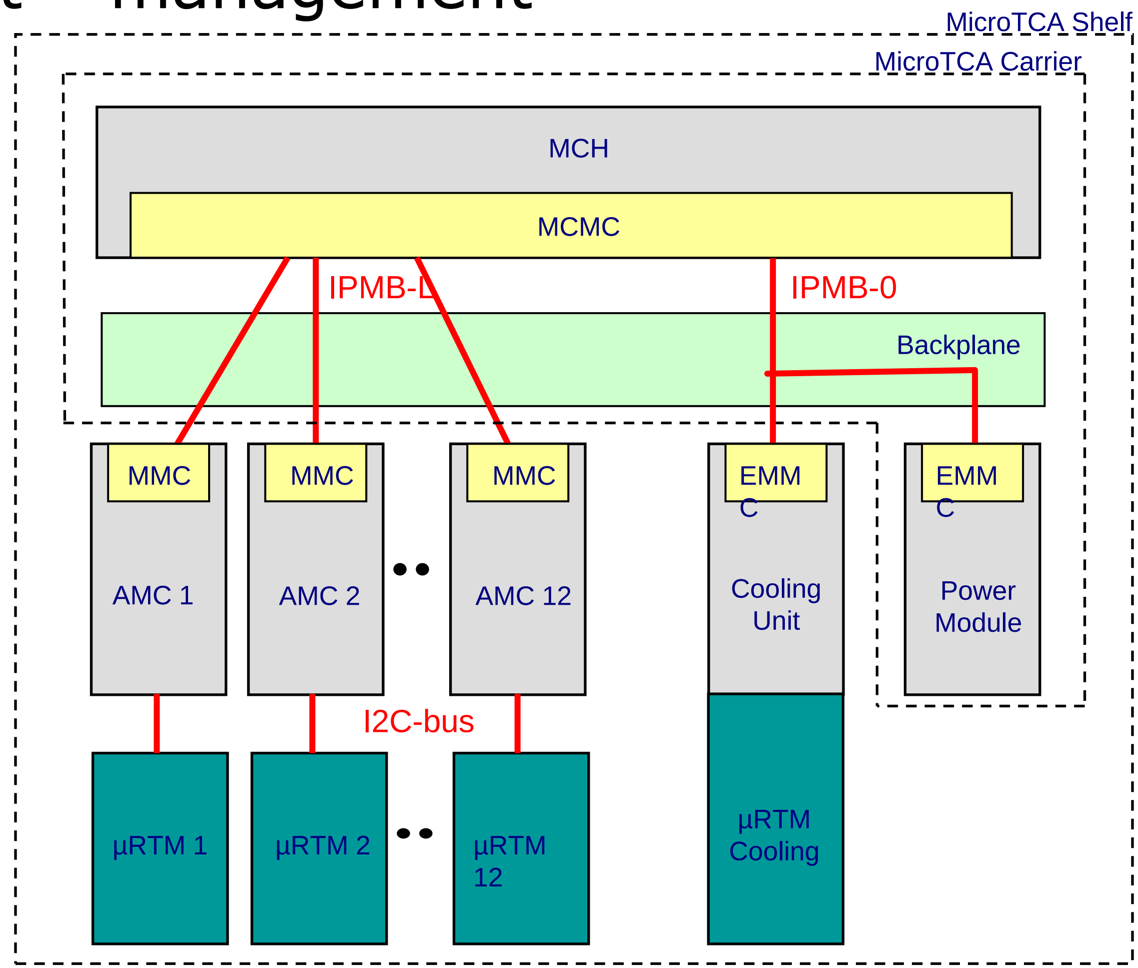
- Connects the MCMC on the MCH to the MMC on the AMC Modules
- Radial architecture

IPMB-0

- Connects the MCMC on the MCH to the EMMC on the PM and CU
- Bused architecture

I2C-bus

- Connects the AMC to the µRTM
- The µRTM is treated as managed FRU of the AMC
- Not yet defined: management of RTM fans



- Technical concept – power requirement
  - 60 Watts per AMC slot and 20 Watts per uRTM slot
  - 12 slots, 80 Watts ea. = 960 Watts (720W front + 240W rear)
  - 2 MCHs, 37.5 Watts ea. = 75 Watts
  - 2 CUs, 80 Watts ea. = 160 Watts

→ total PM output power = 1195 Watts

Assuming efficiency of PM = 90%

→ total PM output power = 1195 Watts
→ total PM input power = 1328 Watts

MicroTCA for Physics

Challenges – cooling

Extending μTCA™ to Higher Performance Applications

- Technical concept – cooling requirement
  - 12 AMCs + 12 uRTMS + 2 MCHs + 2CU
    - ➔ total PM input power = 1328 Watts
  - The uRTM has the same depth as the AMC
    - ➔ own fans for the uRTM
  - physics require a uRTM temperature control within a range of 1°C
    - ➔ independent speed control of AMC and uRTM fans

Challenge: independent fan control for AMC fans and RTM fans is not addressed in the current MTCA specification

⇒ **standardized solution required, still a ToDo**

MicroTCA for Physics
Challenges – bandwidth

Extending µTCA™ to Higher Performance Applications

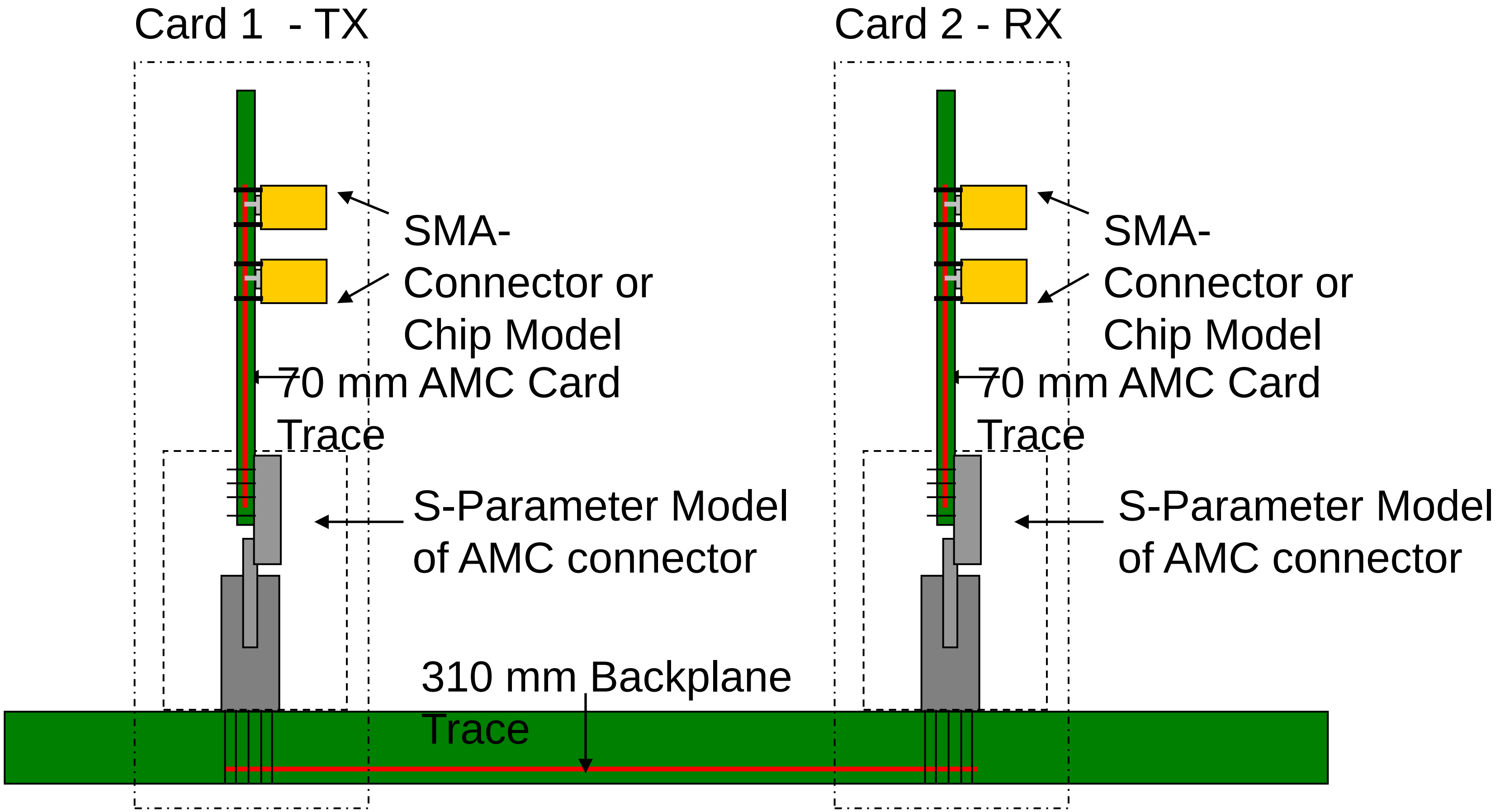
- Technical concept – bandwidth
  - currently used with MTCA: Gen1 of PCIe and SRIO
    - ➔ bandwidth of 10Gbps (3.125Gbps per lane)
  - future use requirement: Gen2 of PCIe and SRIO
    - ➔ bandwidth of 20Gbps (6.25Gbps per lane)

- Challenge:
  - currently used backplane connectors and AMC plugs commonly tested with 3.125GHz per lane

⇒ **connectors and plugs need to improve to 6.25GHz**

MicroTCA for Physics
Challenges – bandwidth

- test setup

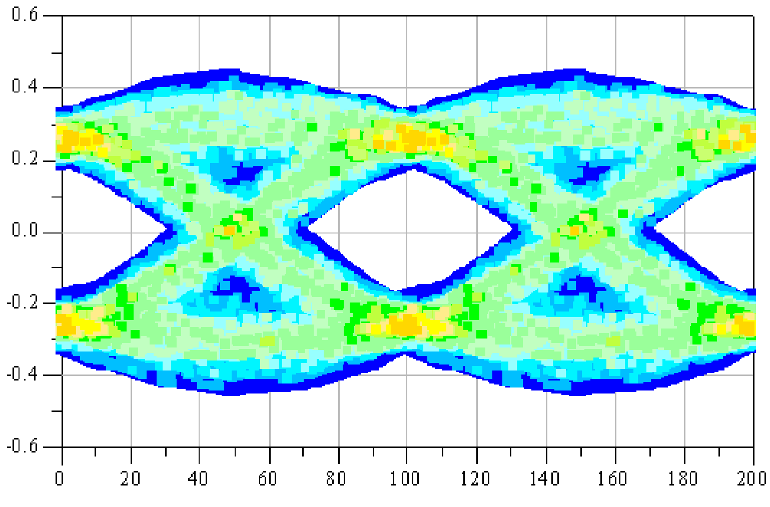


MicroTCA for Physics

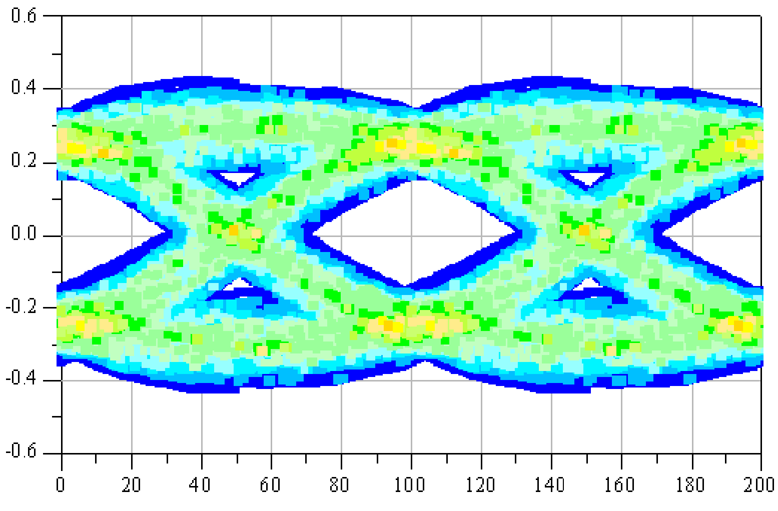
Challenges – bandwidth

Extending μTCA™ to Higher Performance Applications

- Results
  - 10.3125 Gbaud per second per differential pair
  - eye diagrams



Card edge connector



AMC Plug connector

Agenda

- Need for higher performance MicroTCA ?
  - History
  - Current Status
  - Future
- MicroTCA for Physics*
  - Requirements
  - Concept
  - Challenges
- Conclusion

*: the terms "MicroTCA for Physics" or "MTCA.4" refers to the PICMG "xTCA for Physics Working Group 1" and not to a yet adopted sepecification.

Conclusion

Extending µTCA to Higher Performance Applications

- Need for higher performance has always been driving factor because of:
  - more space
  - enhanced features (i.e. management, fault tolerance, etc.)
  - higher bandwidth

  ➔ Is there need for higher performance with MTCA? **YES!**

- MicroTCA for Physics has added new challenges
  - introduction of uRTMs

    ➔ backplane extension, cooling, management, etc.
  - use of 2nd generation of protocols

    ➔ twice the bandwidth of MTCA systems used today

Conclusion

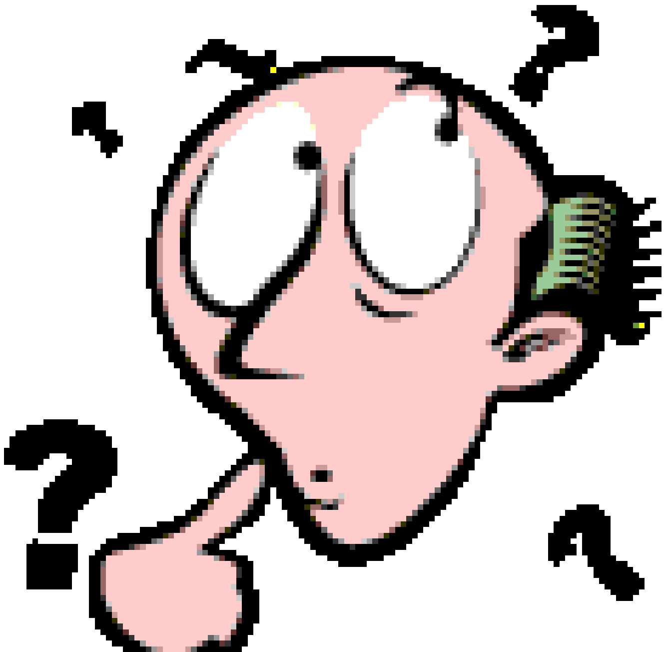
- with MTCA.4* the gap between MTCA and ATCA has been closed:

- MTCA has grown up and left its childhood, making it attractive as a solid and sound platform to an even larger number of applications.

This was it ...

I know, you have heard what I said ...

... but ...



... I am not sure if this was what I meant ...