
New Developments in MicroTCA.4 Instrumentation Standards Extensions for Physics and Industry

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for the xTCA for Physics Collaboration

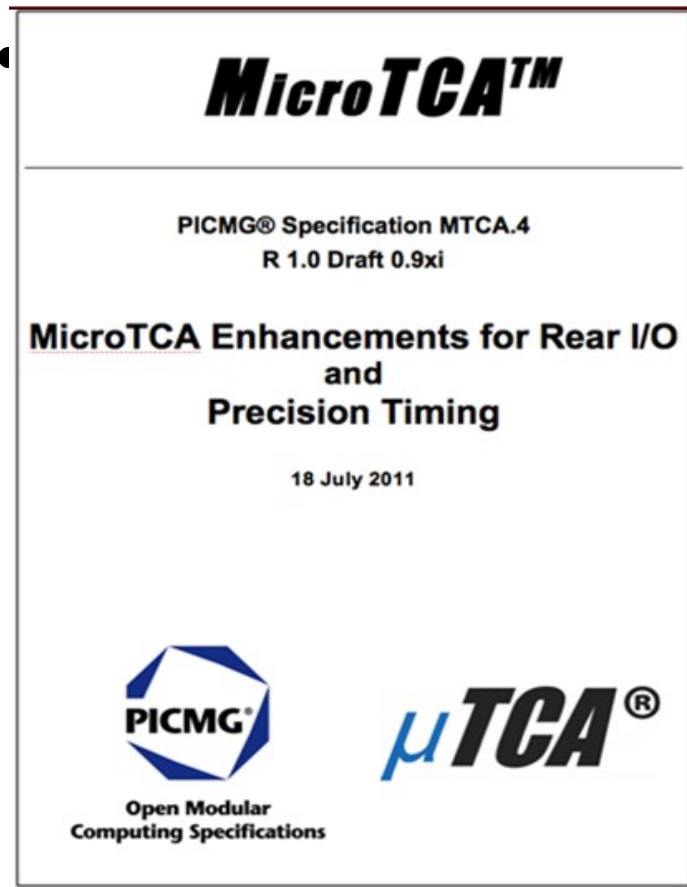
DESY MTCA Workshop Dec 8-10, 2015

PICMG xTCA for Physics History

- 2002 ATCA Announced by PICMG for Telcom
- 2004-06 ATCA & μ TCA PICMG major tutorial
- 2004-11 NSS-MIC paper advocating for ILC
- 2005-07 Snowmass Physics controls paper
- 2005-11 Grömitz talks DESY, SLAC
- 2007-06 First xTCA workshop FNAL
- 2009-06 xTCA for Physics Announced IHEP
- 2011-07 MTCA.4 Announced
- 2016 Q1-Q2 Target for MTCA.4.1, SW Guidelines

MTCA.4 released July 2011

- MTCA.0 Extensions => MTCA.4 for Physics

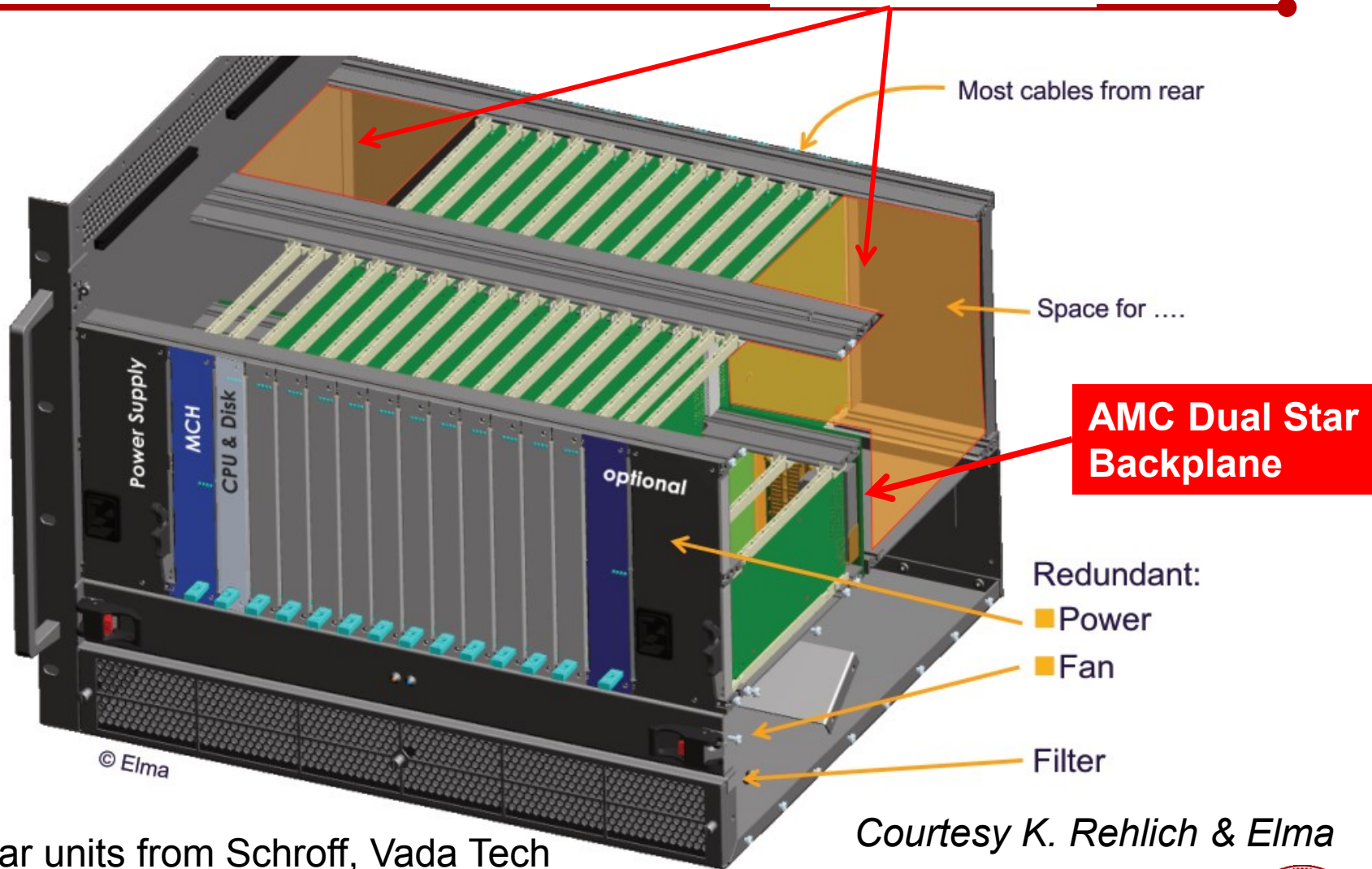


Extension Features:

- Shelf extended rearward to accommodate double-wide RTM analog/digital I/O rear panel
- AMC-RTM connector standardized with E-Keying, JTAG, IPMI Management & Power from AMC to RTM
- Standard AMC Dual Star backplane added low-jitter clock lines, point-to-point connections for vector, interlock summing
- RTM added hot-swap same as AMC

MTCA.4 12-slot Shelf

"Nature abhors a vacuum" - Aristotle



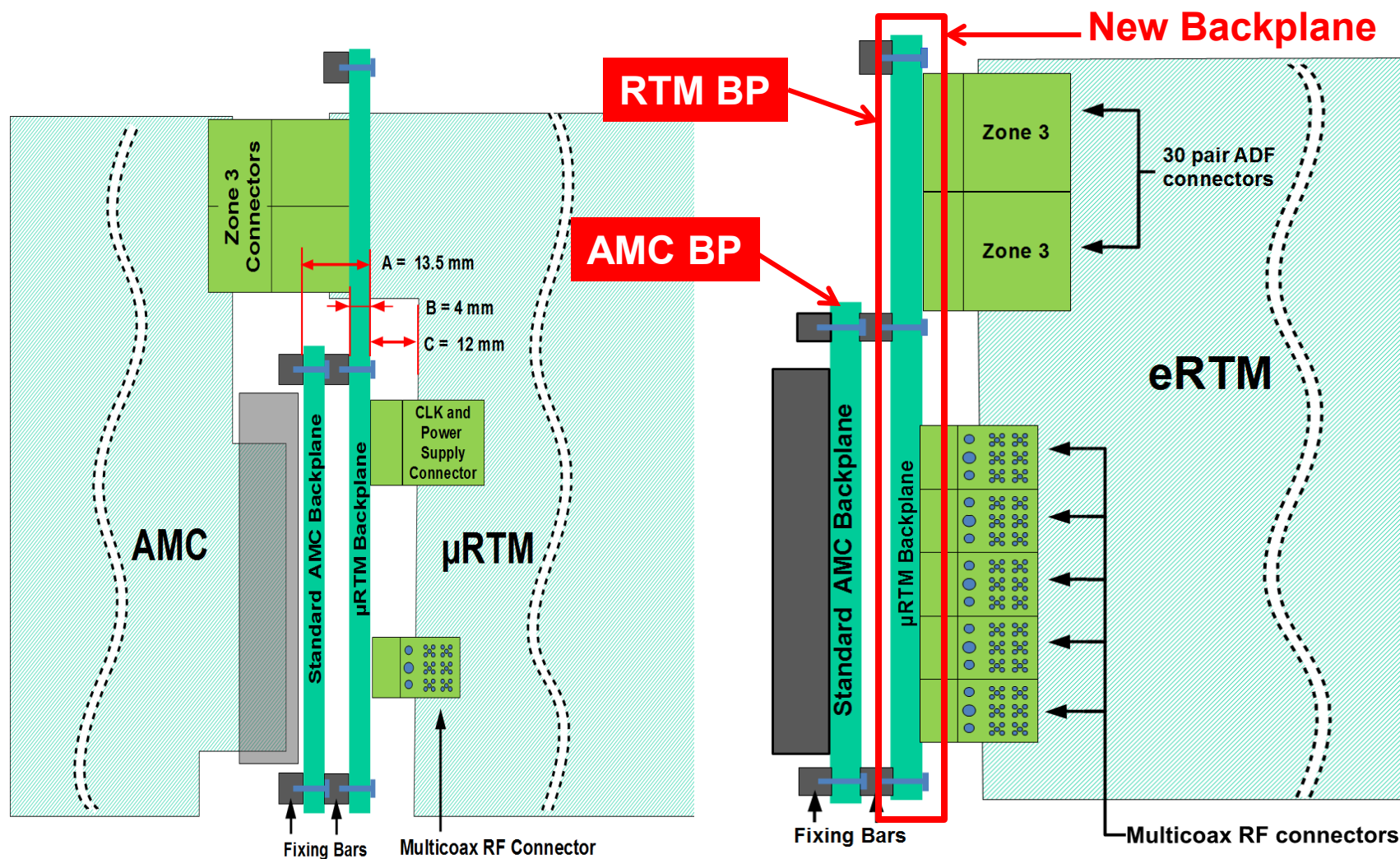
See similar units from Schroff, Vada Tech

Courtesy K. Rehlich & Elma

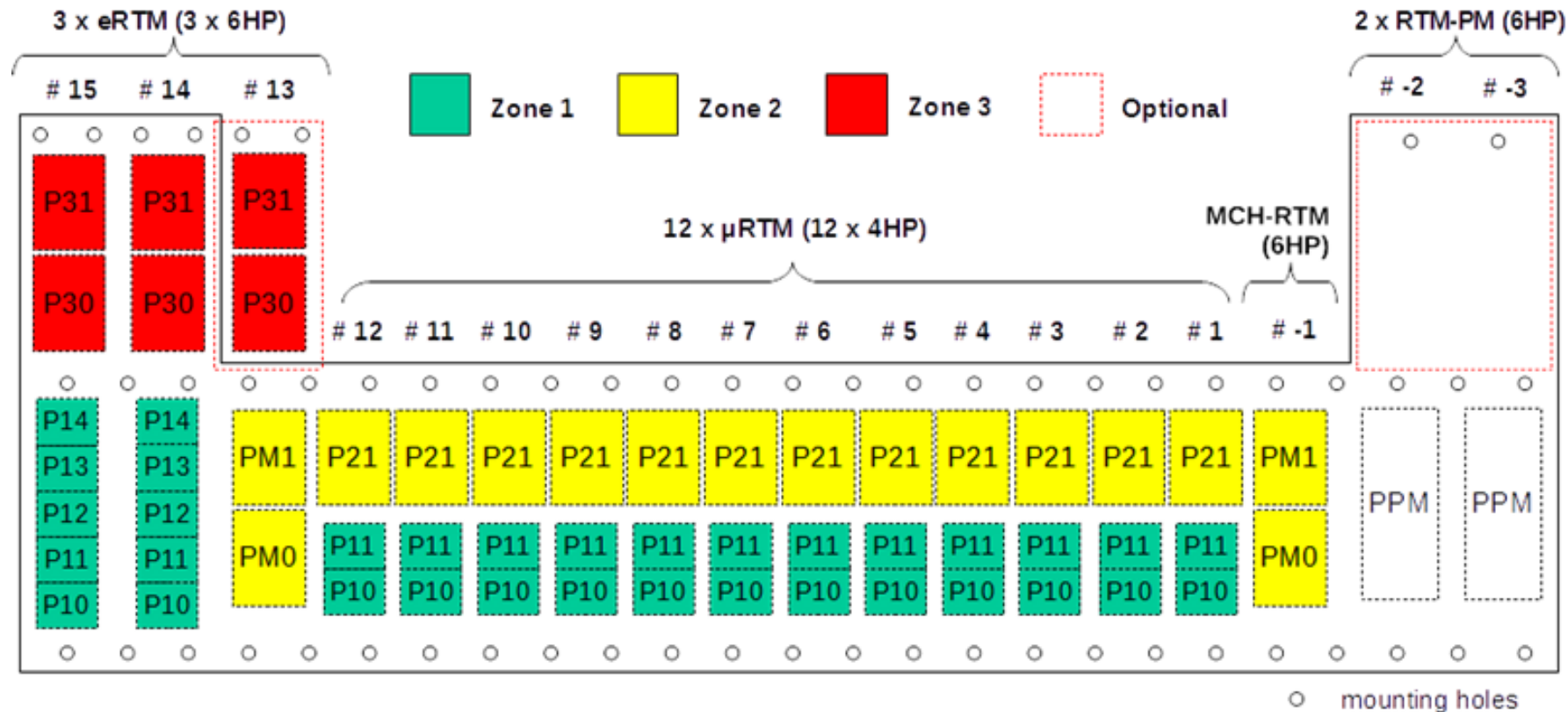
New Extensions for MTCA.4

- 1. Auxiliary Backplane
 - Stimulated by Low Level RF (LLRF) needs but standard generic version adaptable to user needs
- 2. Rear Power Modules (RPMs)
 - Support 12, 3.3V digital; +/- VV Variable Analog for μ RTMs
- 3. MCH-RTM
 - Control RPMs, eRTM special functions, cascaded shelves
- 4. Boards & Protective Covers
 - AMC double wide, μ RTM, eRTM
- 5. Applications Classes of RTMs
 - Guidelines

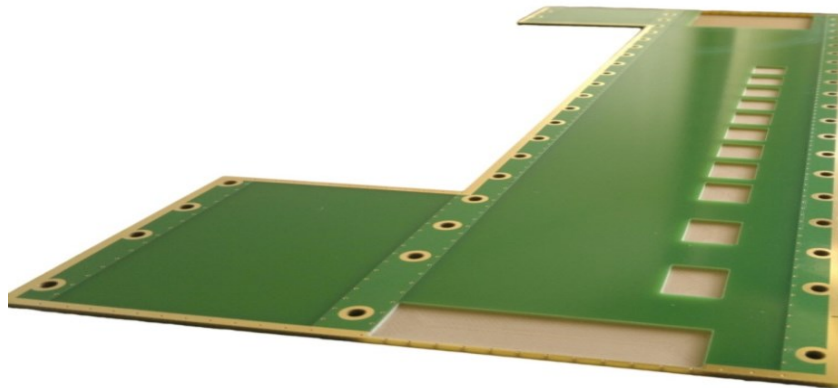
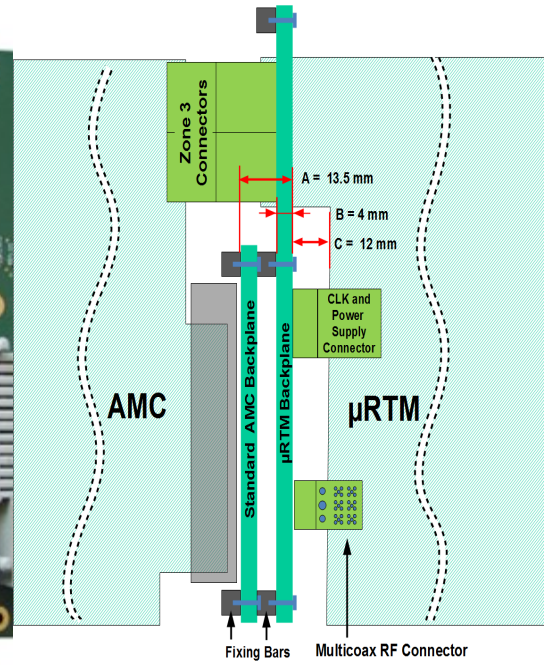
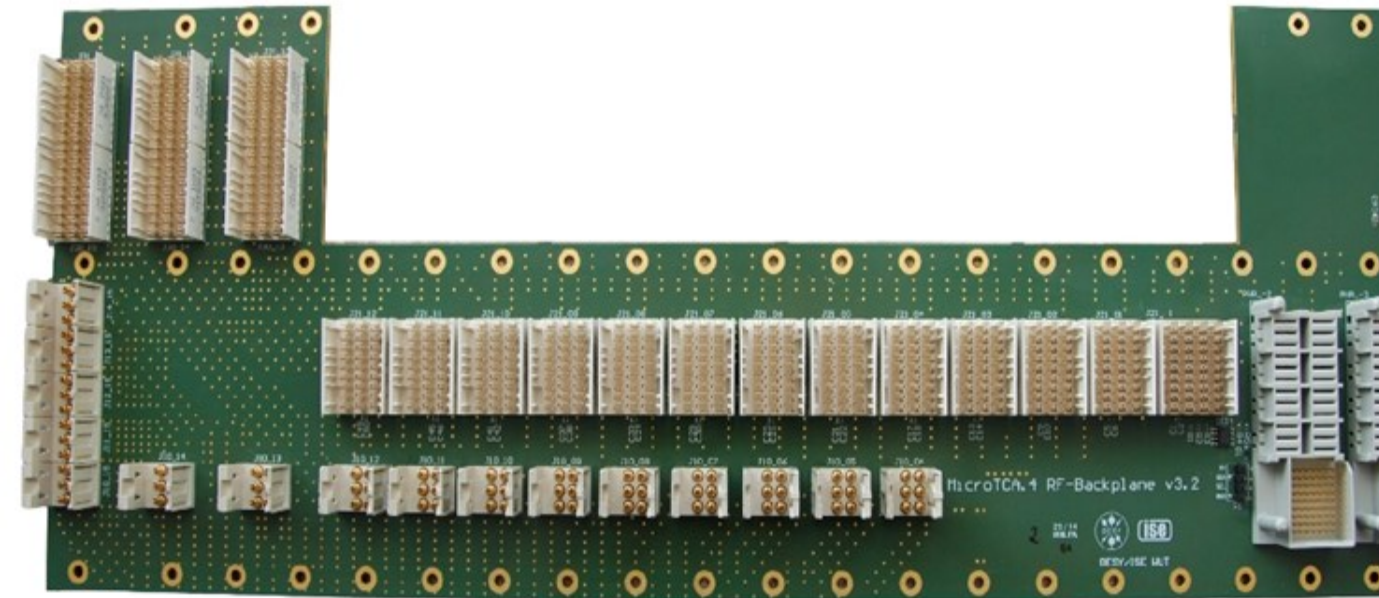
RTM Backplane mating to AMC BP



RTM Backplane Connector Zones

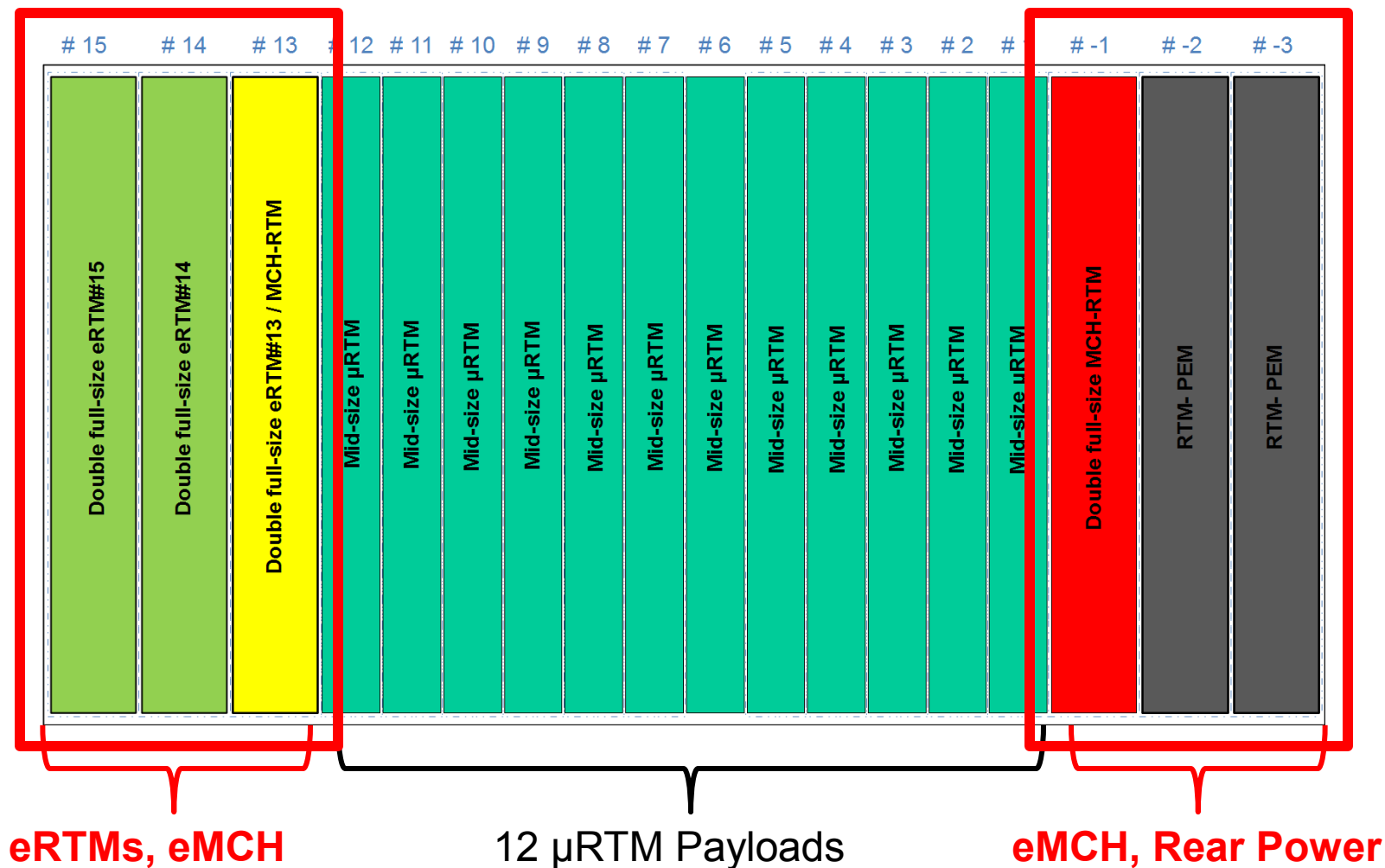


RTM Backplane Rear/Side Views, Shield



Shield protects analog circuits from digital noise from front AMC backplane

New Layout for Extensions (Rear)



μRTM Backplane System Extensions

MicroTCA™

**Note New
MTCA.4.1**

PICMG® Specification MTCA.4.1 Enhancements
R 1.0 D0.9

MicroTCA.4 Enhancements

- ❖ **Auxiliary Backplane for Rear Transition Modules (μRTMs & MCH RTM)**
- ❖ **Rear Power Modules (RPMs)**
- ❖ **MCH Management Support & Extended Rear Transition Module (MCH-RTM)**
- ❖ **AMC & RTM Protective Covers**
- ❖ **Applications Classes of μRTMs |**

Backplane Features:

- LLRF inspired but LLRF features NOT included (Zone1)
- Zone 1 area left free for possible user defined apps
- Zone 2 & 3 extensions assigned for μRTM, eRTM, MCH-RTM
- Note that the RF backplane is commercially available
- Note that custom Zone 1 designs will result in custom μRTMs as well

Conditions for Use

- DESY has patented features of the RTM backplane.
- PICMG requires that an IP notification be placed in the document and that owner agrees to license.
- DESY agrees to freely license to MTCA.4 developers for use on MTCA.4.
- Correct language needs to be added to document.

Appendix: Classes of μ RTMs

- **Goals: Optimize analog performance, increase interoperability**
- **Analog, digital and mixed signal configurations**
- **A1.1, A2.1, D1.0, 1.1, 1..2, 1.3.**
- **A is mixed analog-digital; D primarily digital**

7.2 Class A1.1 Zone 3 Connector Pin Assignment for Analog AMC/ μ RTM Applications

7.2.1 Features

+	MTCA.4 management zone	Power, I ² C, optional JTAG support
	Analog signal transmission zone	10 channel AC-coupled differential input signals 10 channel DC-coupled differential input signals 5 channel DC-coupled differential output signals
	Digital clock signal transmission zone	6 AC-coupled differential inputs for low-jitter clock signals
	User signal transmission zone	6 LVDS inputs / outputs for user-configuration 3 LVDS outputs with fixed output direction Optional dual high-speed link

¶ 126 This Class A1.1 pin assignment requires a common μ RTM management implementation to make AMC and μ RTM boards compatible. Appropriate management interface templates for this Class are available on <http://mtca.desy.de>.

7.2.4 Zone Description

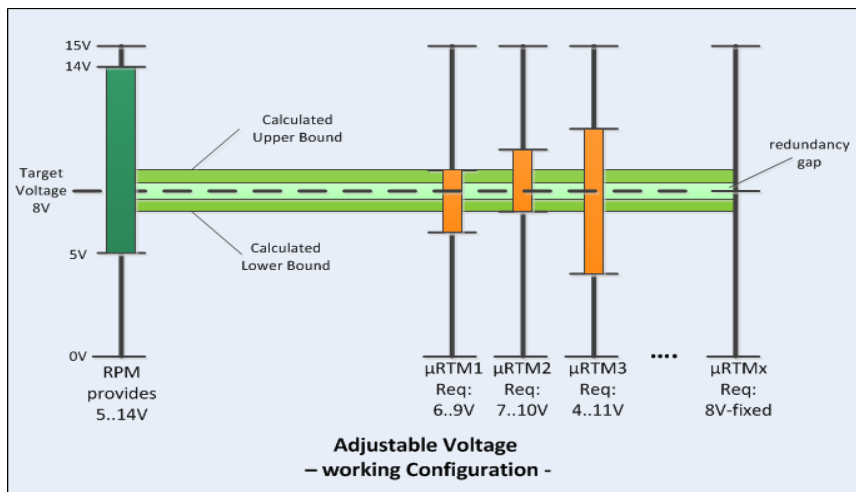
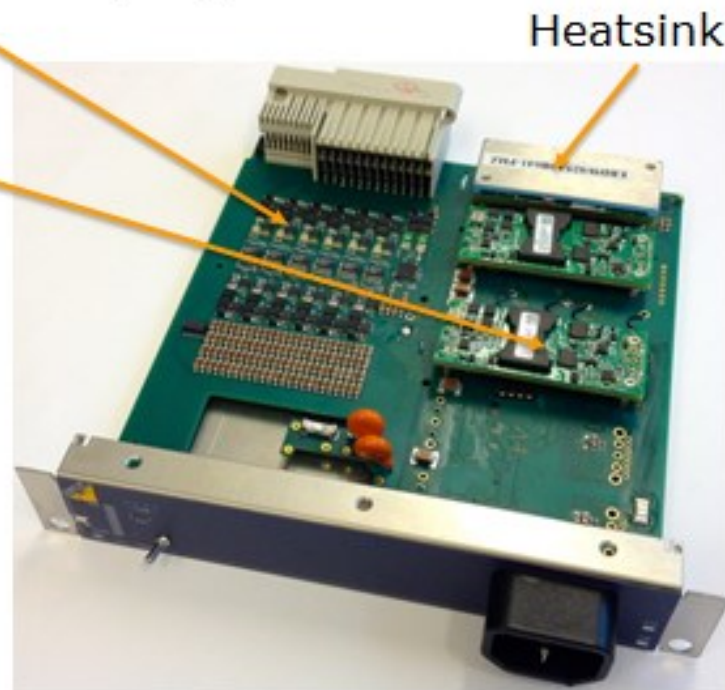
¶ 127 As depicted in Table 6-19 below, the zones in the analog Class A1.1 consist of a management zone, user zone, digital clock zone and analog differential signal zone. The signal placement and filling sequence is done such, that the most sensitive signals have to be filled-up from connector (J31 row 10) to (J30 row 3) and signals emitting high distortions filled-up vice versa.

Rear Power Modules

- Rear Power Module as Power Supply Carrier (PSC) for
 - ✦ AC600 sub module with card cage

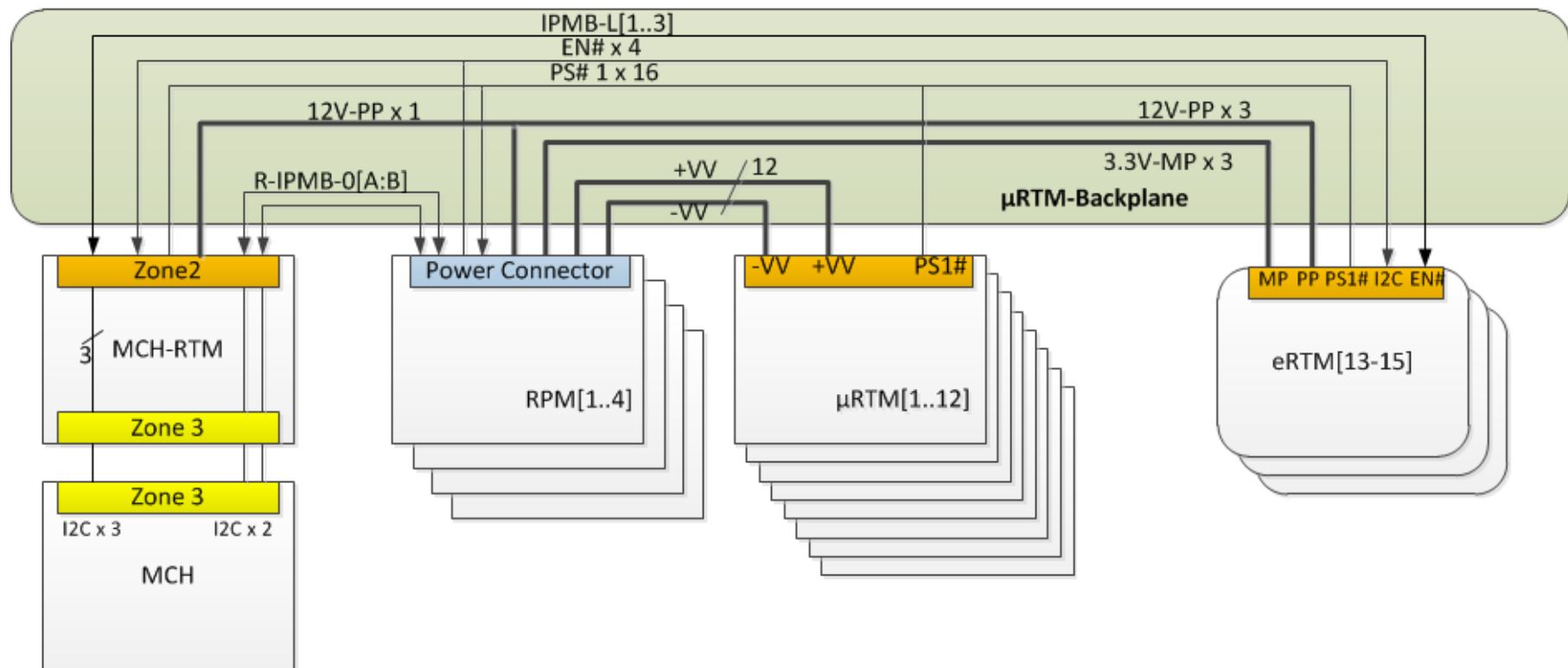
- ✦ Up to 4 Sub modules for +V, -V
- ✦ Submodules in different formats

Managed by redundant MCH

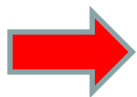
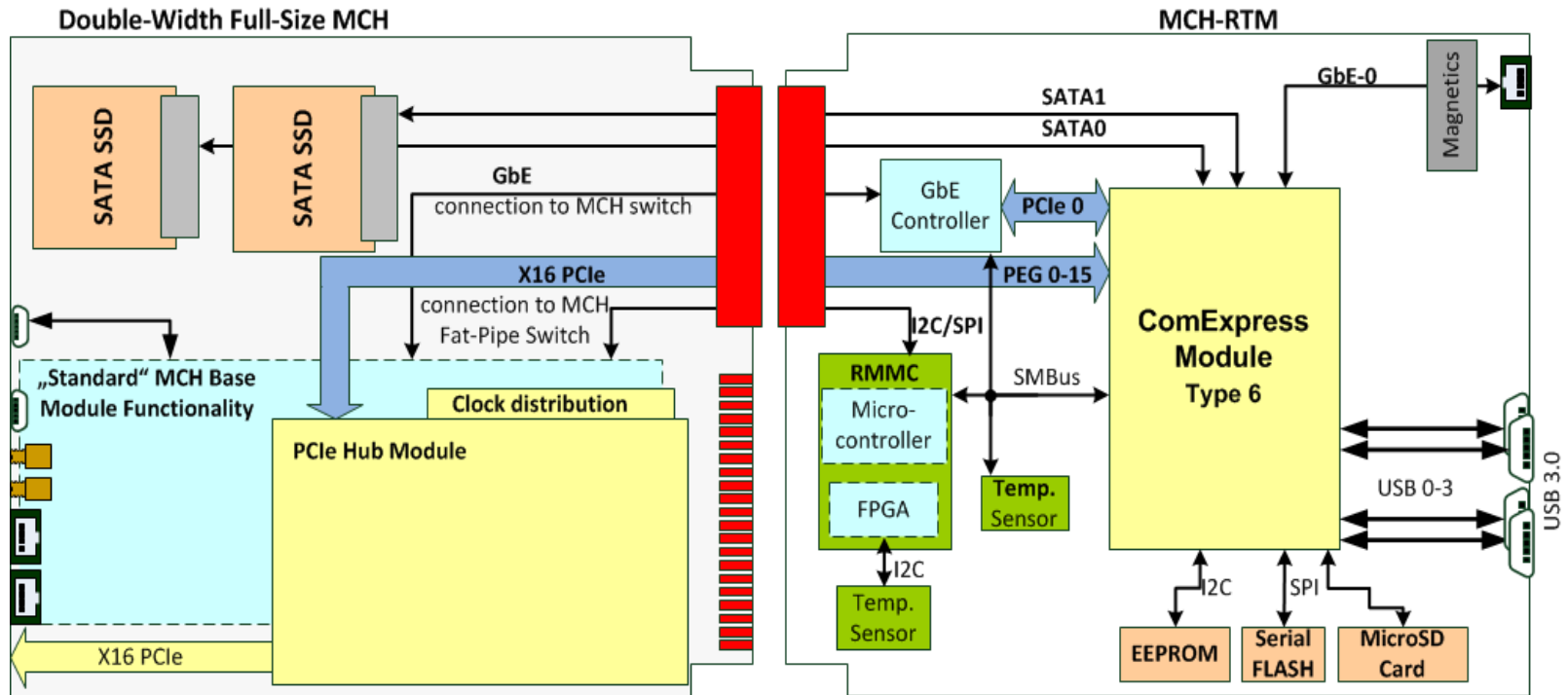


Courtesy N.A.T.

MCH-RTM Backplane Management

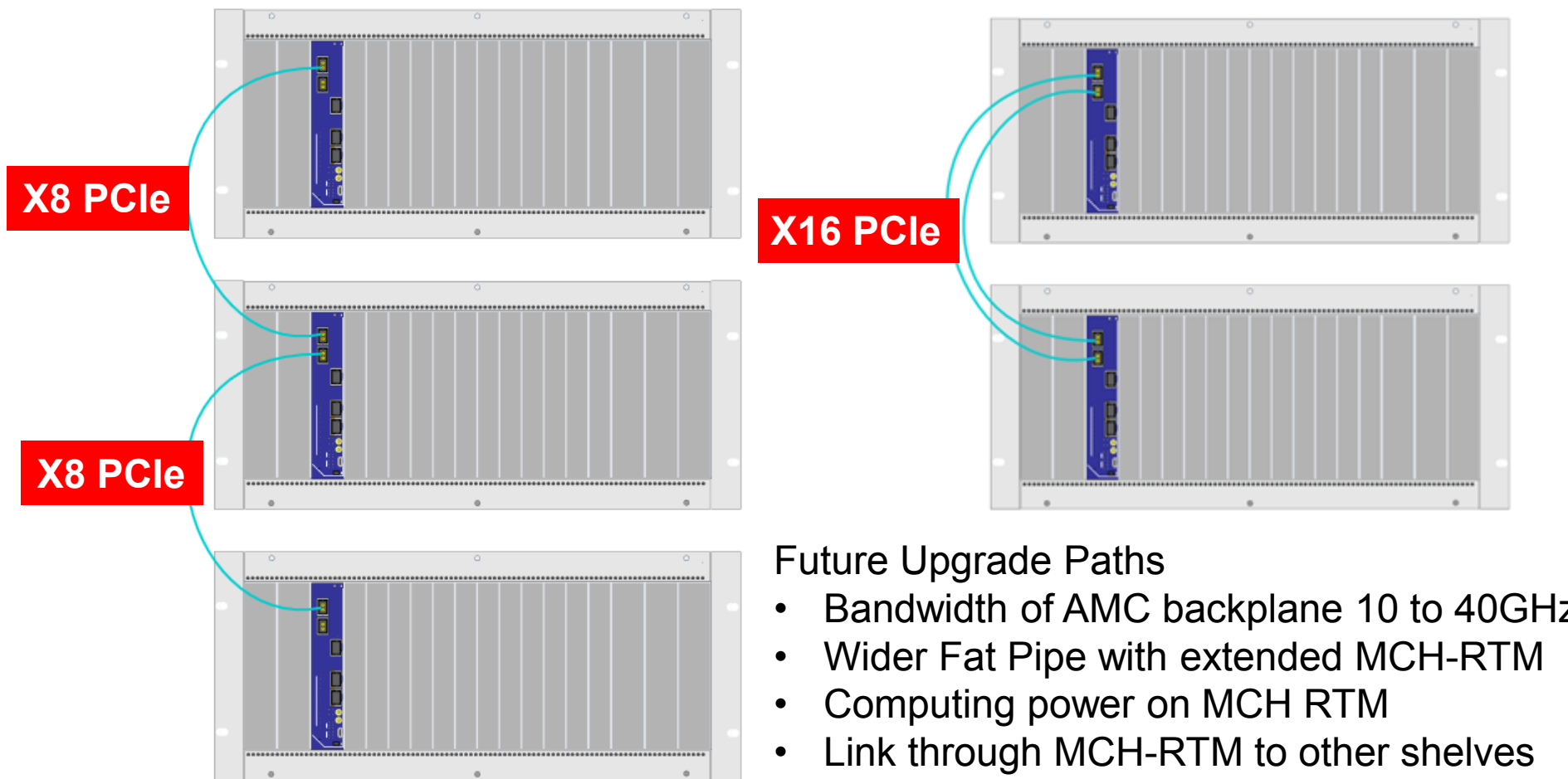


MCH-RTM with ComExpress Option



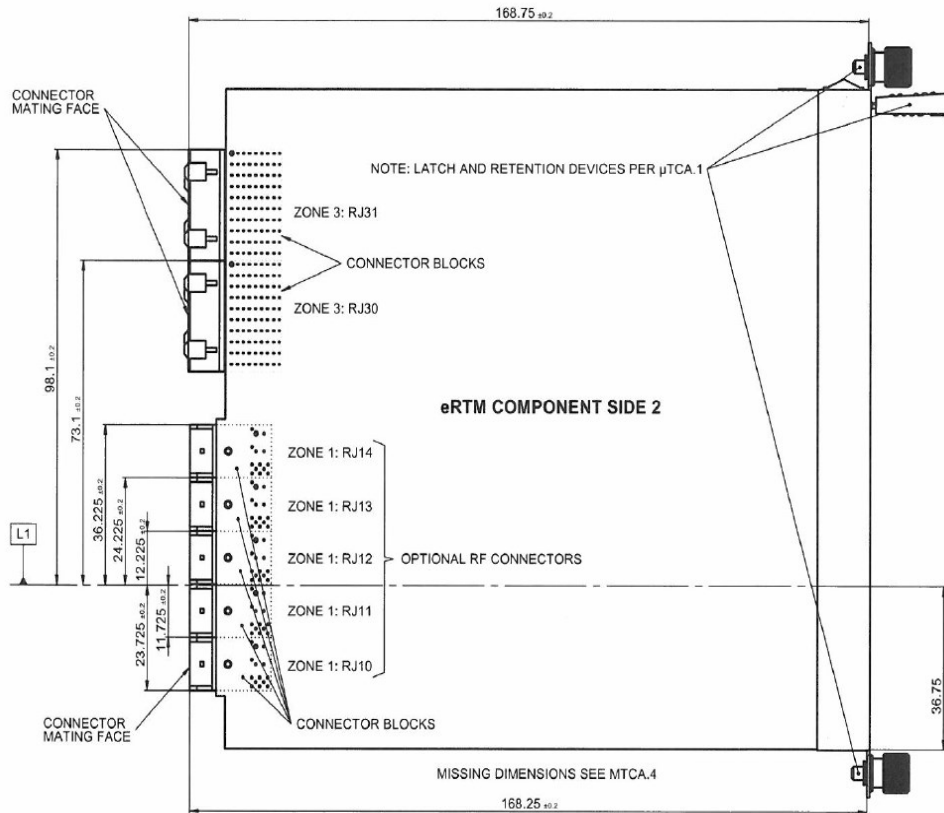
Besides managing backplane power modules, eRTMs, MCH-RTM also provides wider Fat Pipe bandwidth, additional processor power, access to other shelves

Cascading Shelves via MCH-RTM

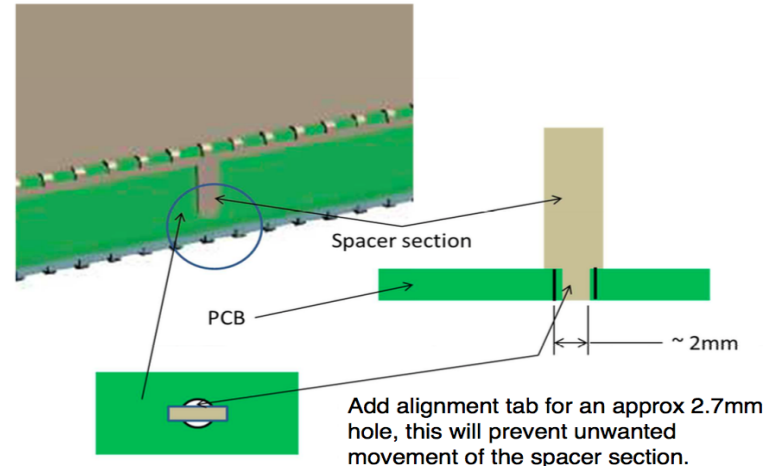
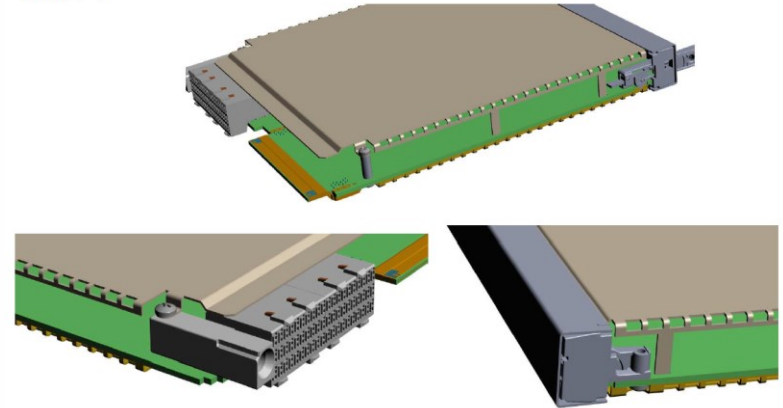


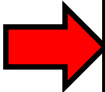
Cascade of MTCA-4 crates (example PCIeexpress) to extend AMC slots

AMC, μ RTM Boards & Covers

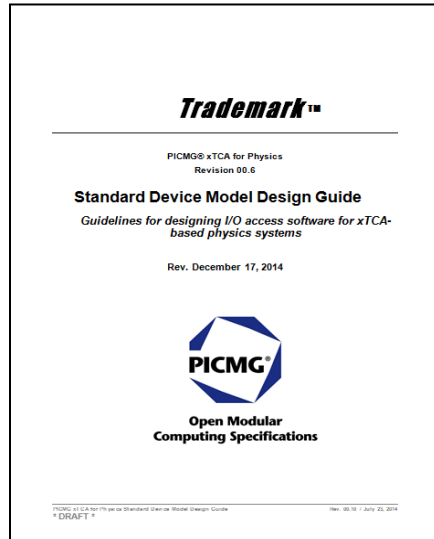


Side 1



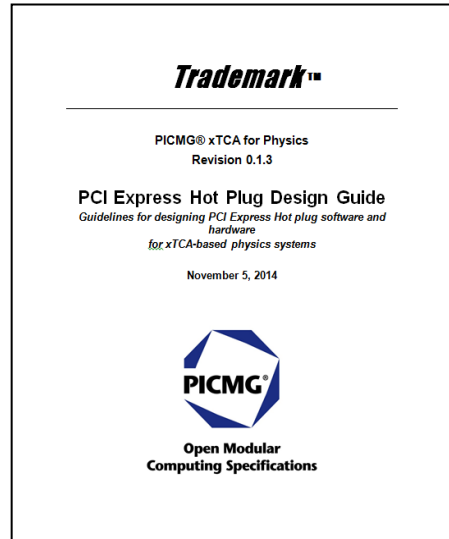
 Detailed designs included for AMC, μ RTM, eRTM PCBs, top & bottom protective covers

Software Guidelines



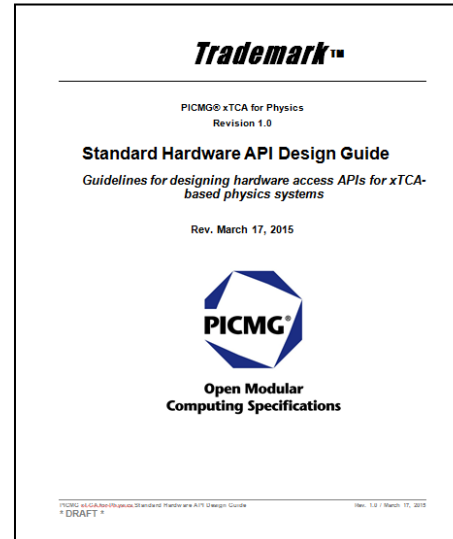
Standard
Device Model
SDM

90%



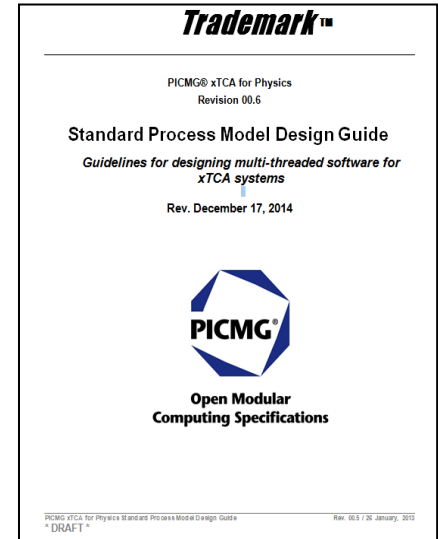
Standard
Hot Plug
Procedure
SHPP

90%



Standard
Hardware API
SHAPI

98%



Standard
Process Model
SPM

80%

Final Steps

- Hardware Extensions
 - Small edits, DESY IP language to be added to document
 - Submit to Committee for final vote
 - Submit to PICMG membership Dec. 2015 for approval
 - Nominal 3-month approval process ~ April 2016
- Software Guidelines
 - Same process as above
 - SHAPI in December 2015; SDM, Hot Plug Jan 2016
 - SPM needs EPICS use case to complete, target Q1 2016, Q2 for PICMG Approval

Summary Status & Future

- New Hardware Extensions
 - Document in final touch-up prior to final submittal to PICMG; All items documented prototyped & verified; LLRF example but many adaptations possible; Free license for MTCA.4 apps from DESY
- New Software Extensions
 - Technically 3 of 4 ready for review after final editing; SPM delayed into 2016; use case software will be available in a repository
- HW, SW Committees
 - Dissolve after Statement of Work complete; renew if new standards work needed; Physics Coordinating Committee can continue to correct, update or renew in future

Key Contributors

Hardware WG

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Laboratories

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- ITER
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- IN2P3 Saclay
- ESSB Portugal

Companies

- Triple Ring
- Pentair Schroff
- Elma
- NAT
- TEWS
- PowerBridge
- VadaTech