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MTCA.4 Tutorial Basics Introduction in xTCA

MTCA Workshop for Industry and Research
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DESY, Hamburg

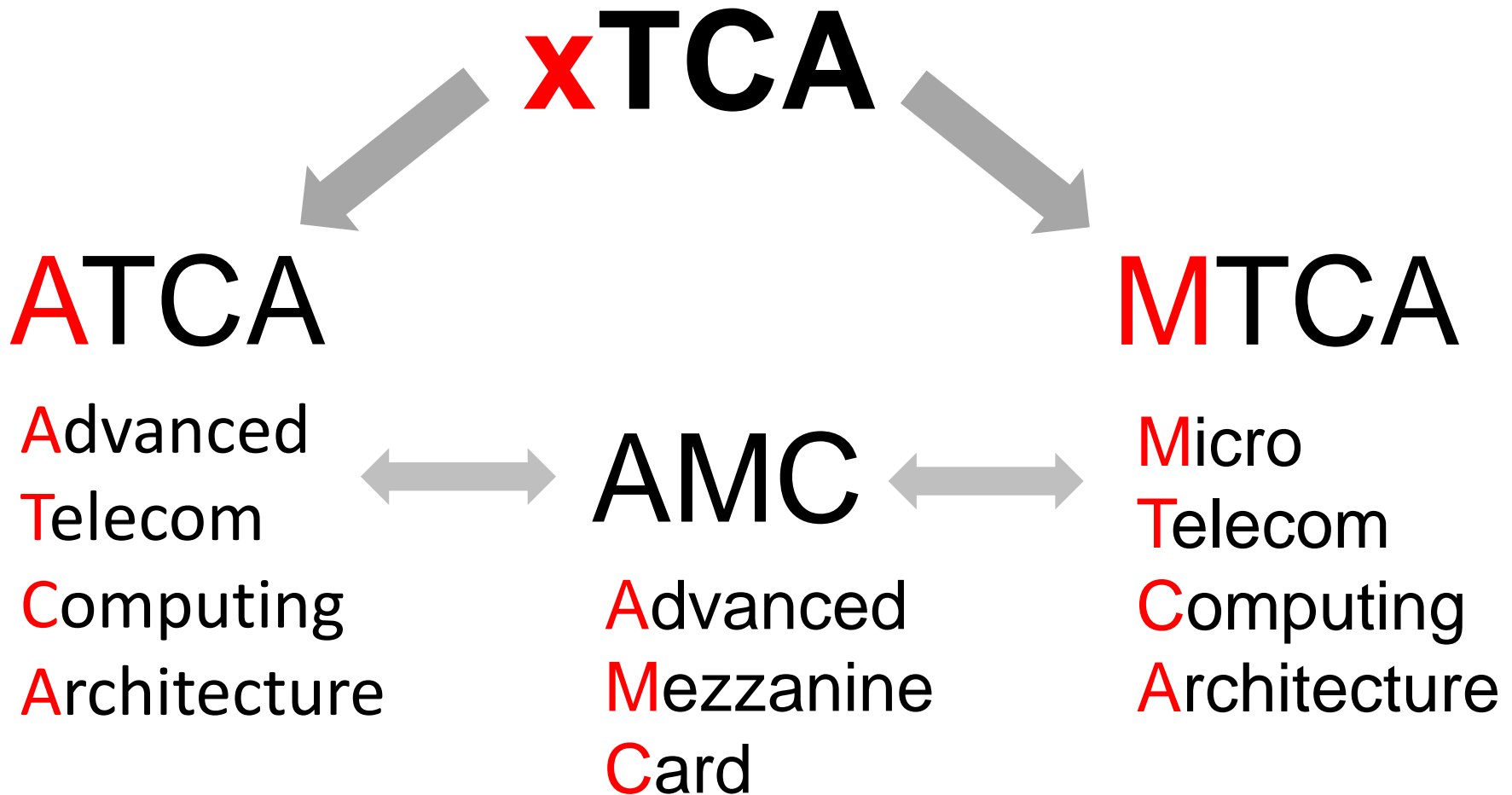
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DESIGN WITH CONFIDENCE™

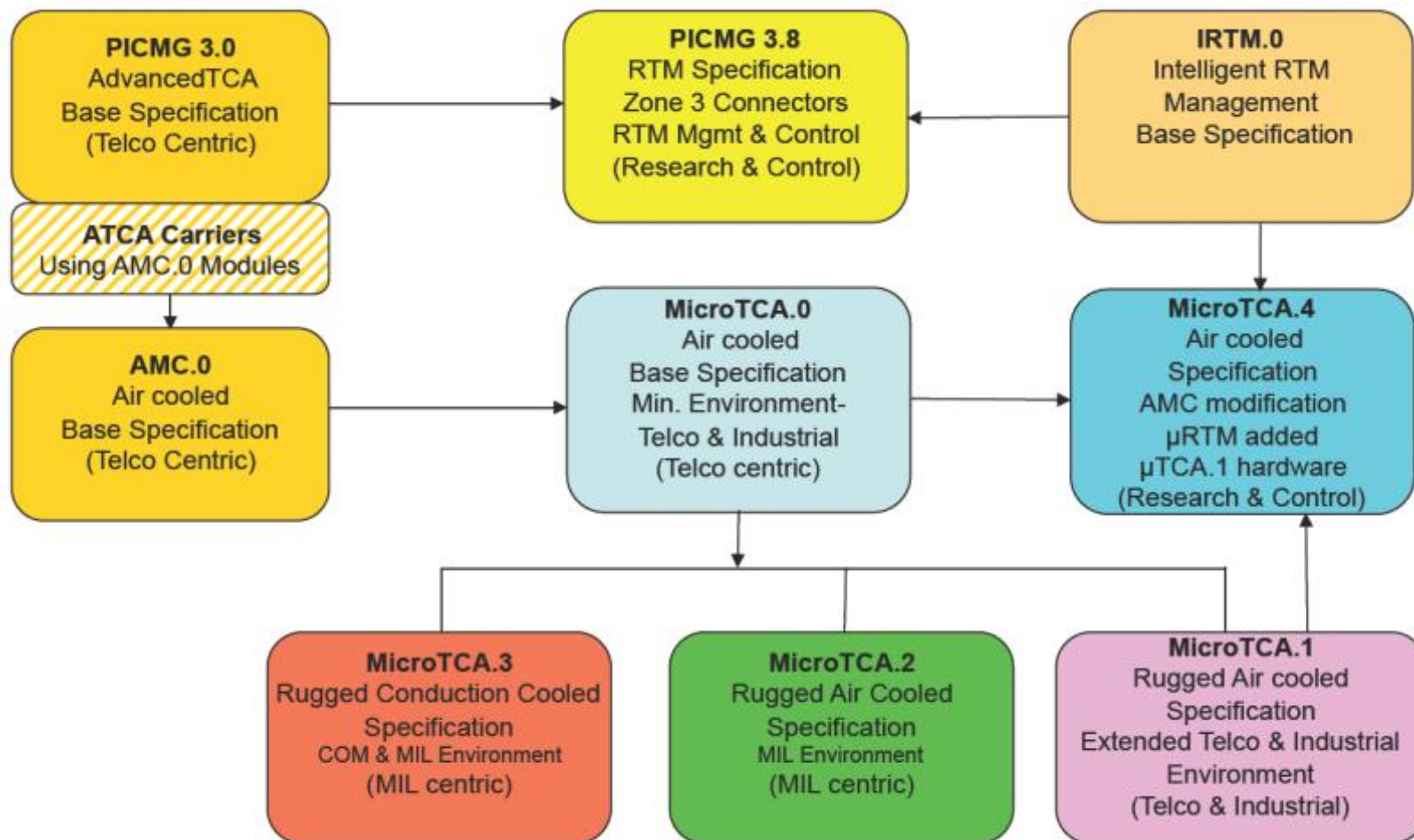
Agenda

- **What is xTCA?**
- **Specifications Overview**
- **ATCA Features**
- **AMC Features**
- **MTCA.0 Features**
- **MTCA.4**
 - **Initial Requirements**
 - **Mechanical Features**
 - **Board sizes**
 - **Management extensions compared to MTCA.0**
 - **Backplane**
 - **Keying**
 - **Cooling**

What is xTCA?



Standards



ATCA

ATCA Features

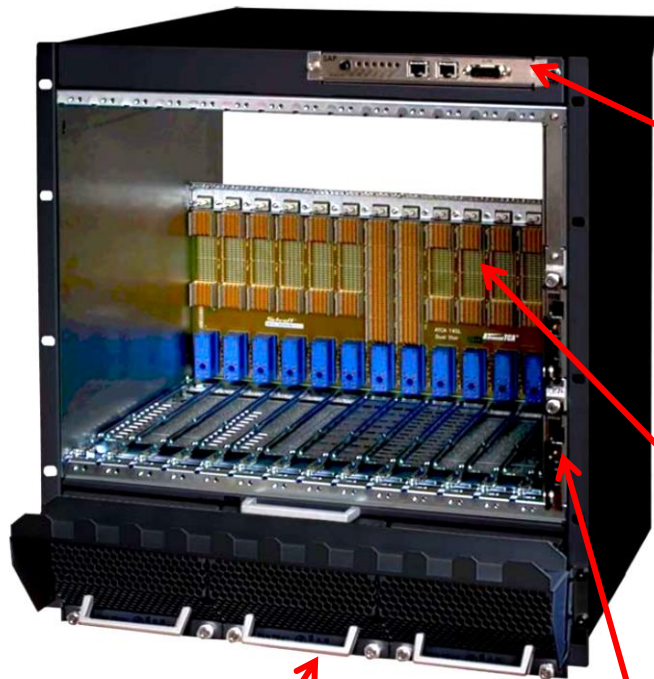
- Sponsored by the PCI Industrial Computer Manufacturers Group (PICMG)
- Released in 2002
- Initially targeted to the Telco industry
- Typically DC powered (48V/60V)
- High Availability features (redundant modules, hot swap, etc.)
- High data throughput
- Remote management and monitoring
- However, features also of interest for other applications than Telco
- AC powered versions also available



ATCA Shelf elements

Front View

Rear View



Alarm Board

Backplane

Redundant Fan Trays

Dual redundant Shelf Managers

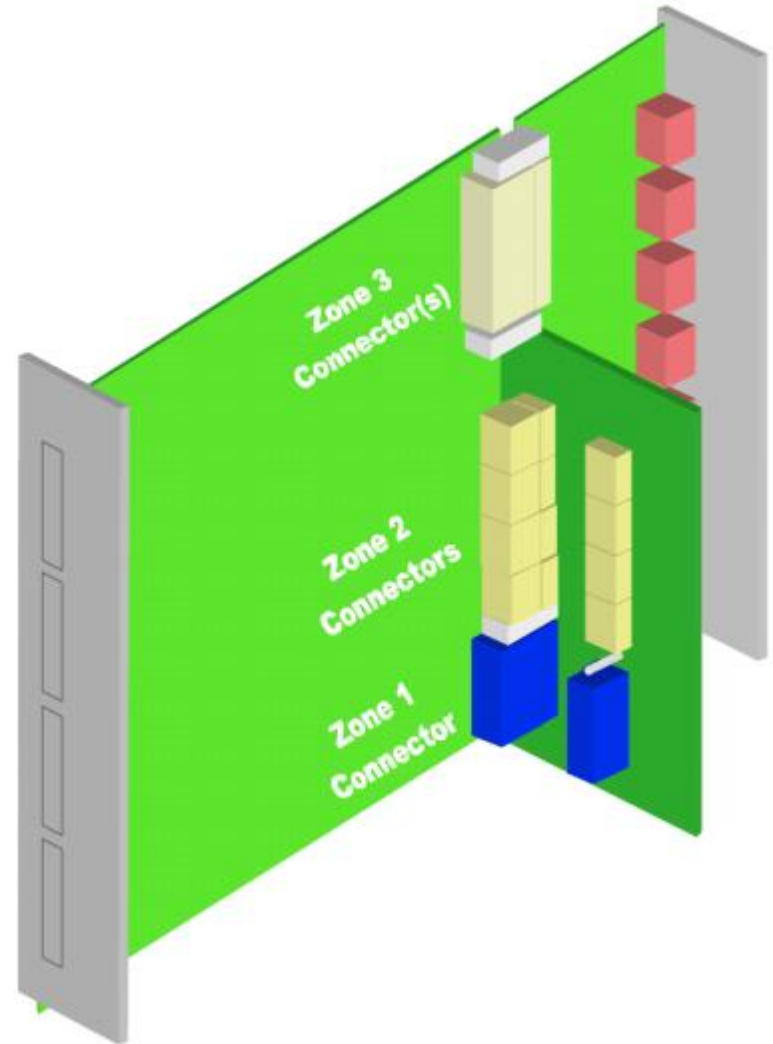


Power Entry Module (PEM)

ATCA Modules

Board size and connectors

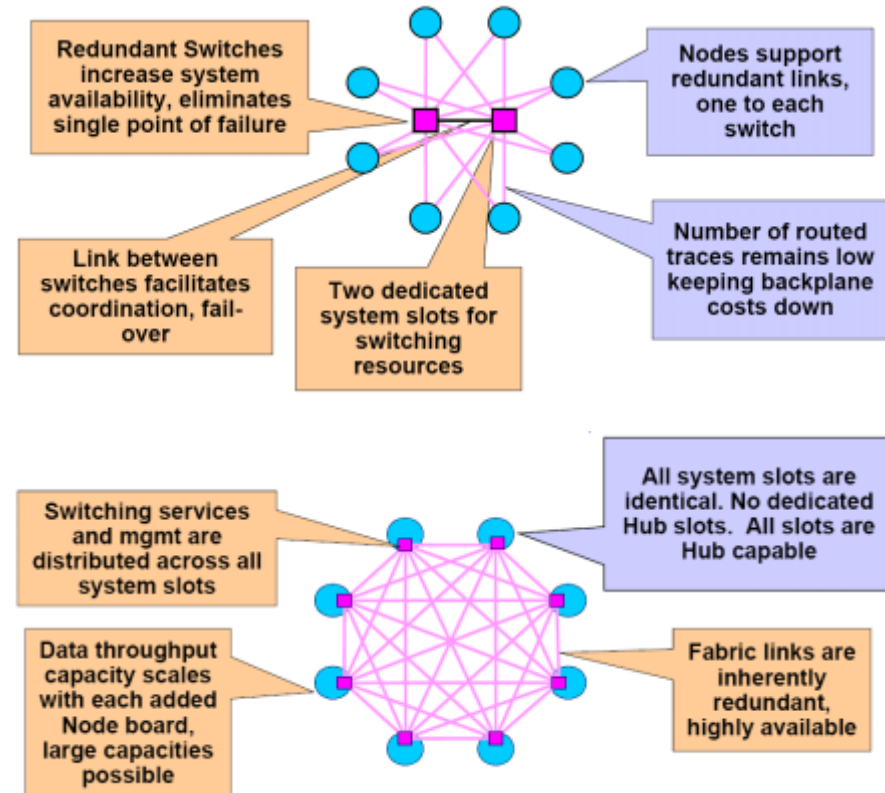
- Front board size 8U x 280
- Rear board (RTM) size 8U x 70 mm
 - Connects directly to front board
- Board width 6HP (1.2")
- Alignment/Key pins
- Zone 1: Management and Power
- Zone 2: Base Interface and Fabric Interface
- Zone 3: Interface to RTM



ATCA Interfaces

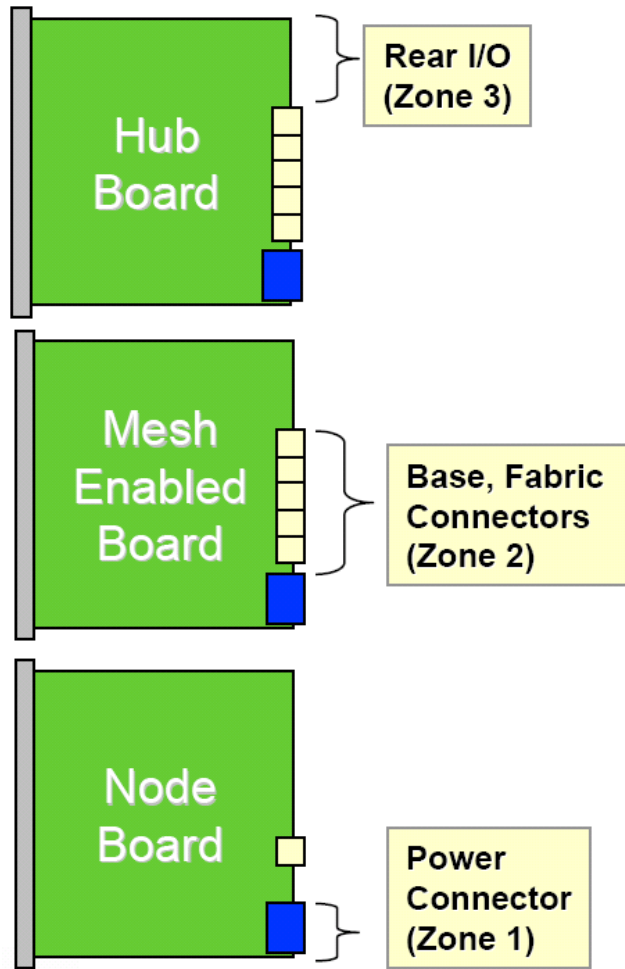
Zone 2 Backplane Interfaces

- Base Interface
 - 10/100/1000 BASE-T Ethernet
 - Always Dual Star topology
- Fabric Interface
 - Star topology
 - Mesh topology
- Clock Interface
 - Three dedicated clock interfaces
- Update Channel
 - Direct connection between two slots



ATCA Modules

Board types



Hub Board

- Supplies switching connective Boards in the shelf
- Installed in designated Hub slots

Mesh Enabled Board

- Direct connection to all Boards in the shelf
- Installed into any slot

Node Board

- Single, Dual, Many Star connections possible
- Installed into any Node slot

ATCA Management

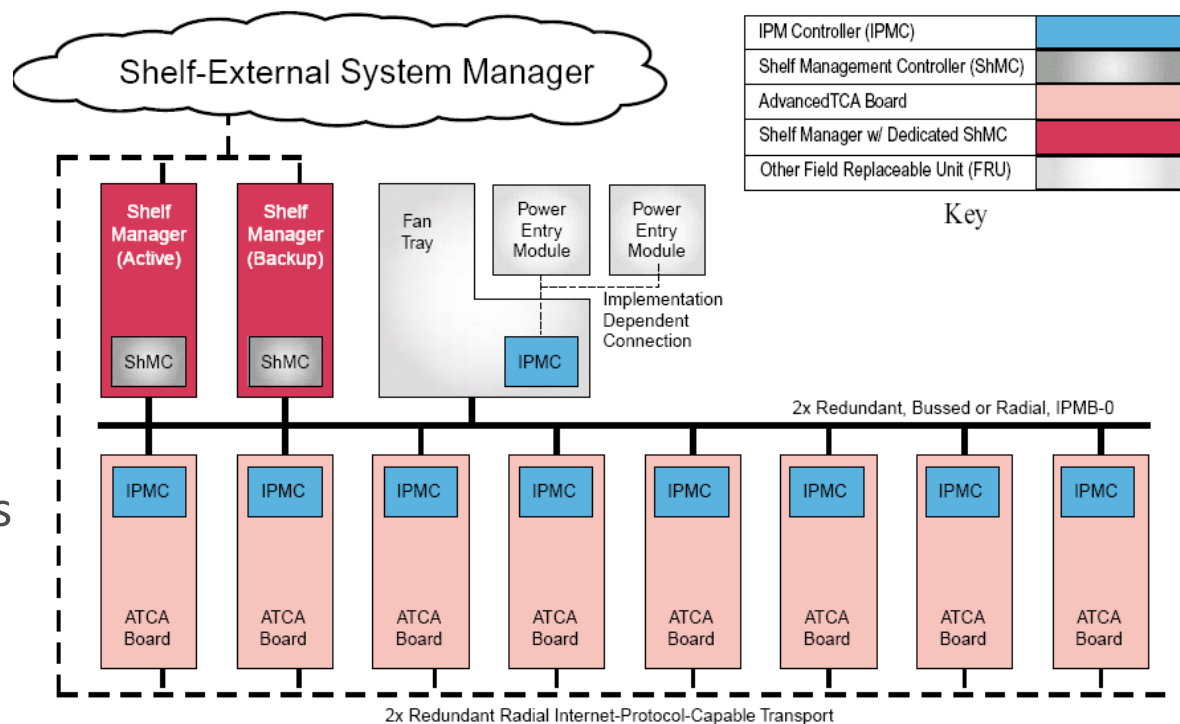
ATCA Shelf Management purpose

- Monitor & control low-level aspects of ATCA boards and other Field Replaceable Units within a shelf
- Watch over basic health of the shelf, report anomalies, take corrective action when needed
- Retrieve inventory information & sensor readings
- Receive event reports and failure notifications from boards and other intelligent FRUs
- Manage power, cooling & interconnect resources in the shelf (electronic keying)



ATCA Management

- Dedicated Shelf Management Controller (ShMC)
- ATCA Boards with IPMC
- Protocol IPMI (Physical layer I²C-Bus)
- Intelligent and Managed FRUs
- Bused or Radial IPMB

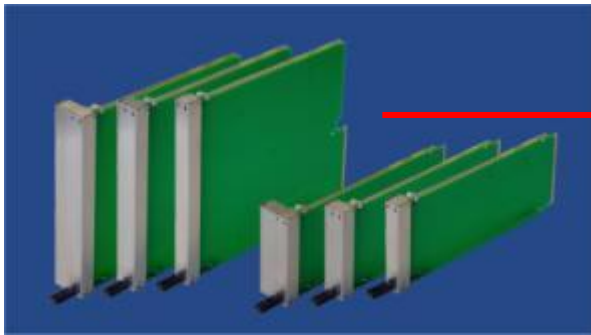


AMC

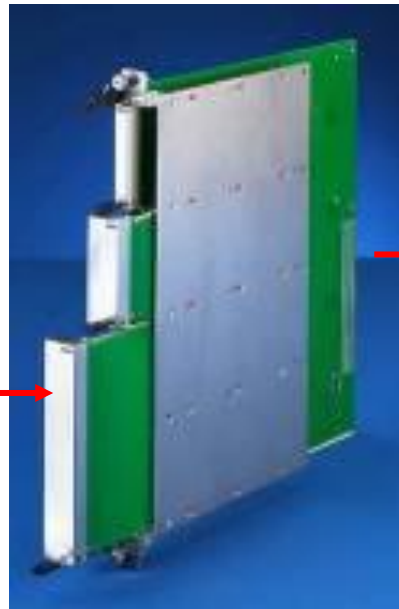
AMC Modules

- Initially developed as function extension for ATCA Boards
- Fully integrated into the ATCA IPMI management structure
- Plugged into a so called ATCA Carrier
- Hot Swap capability

AMC Modules



AMC Carrier

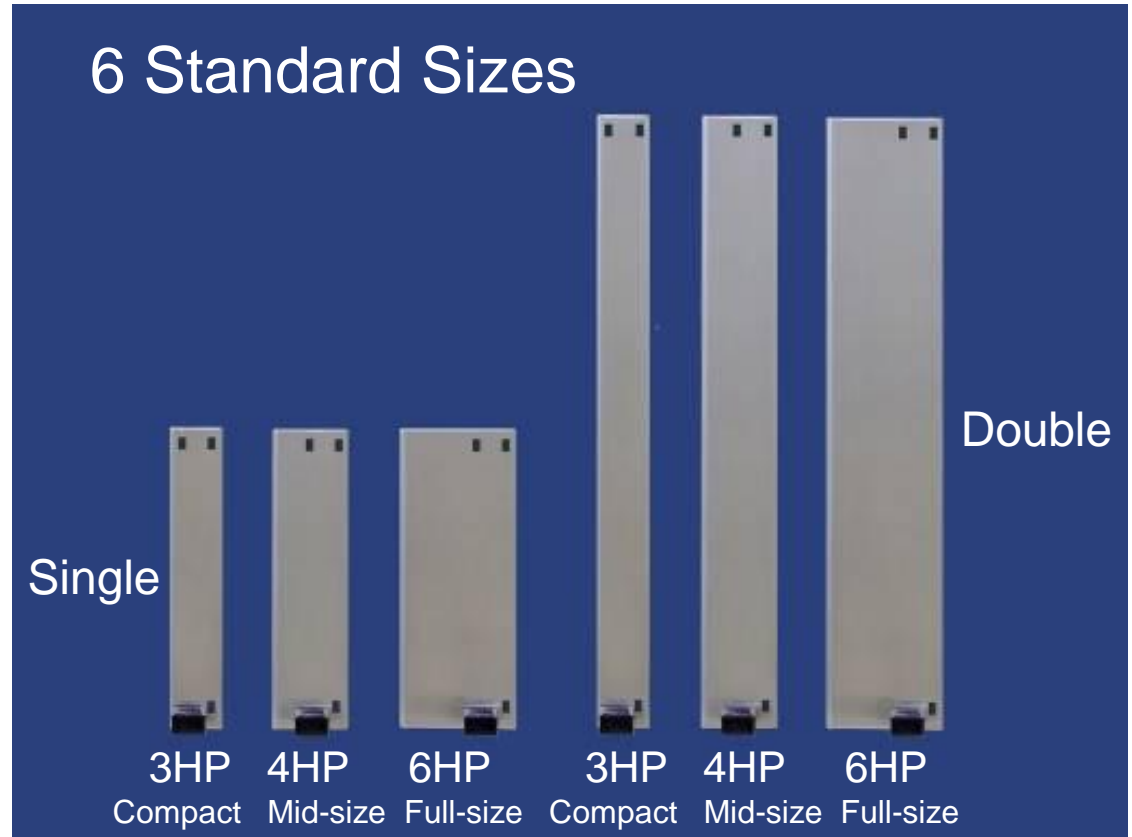
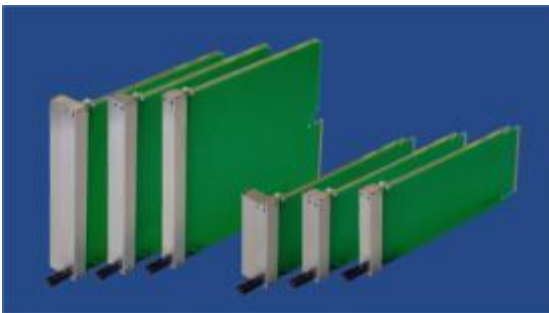
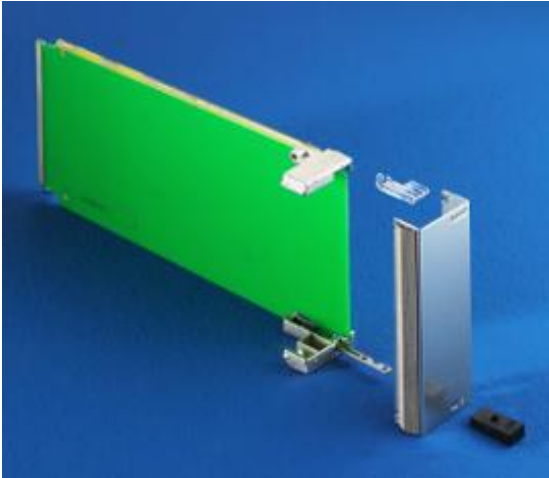


ATCA Chassis



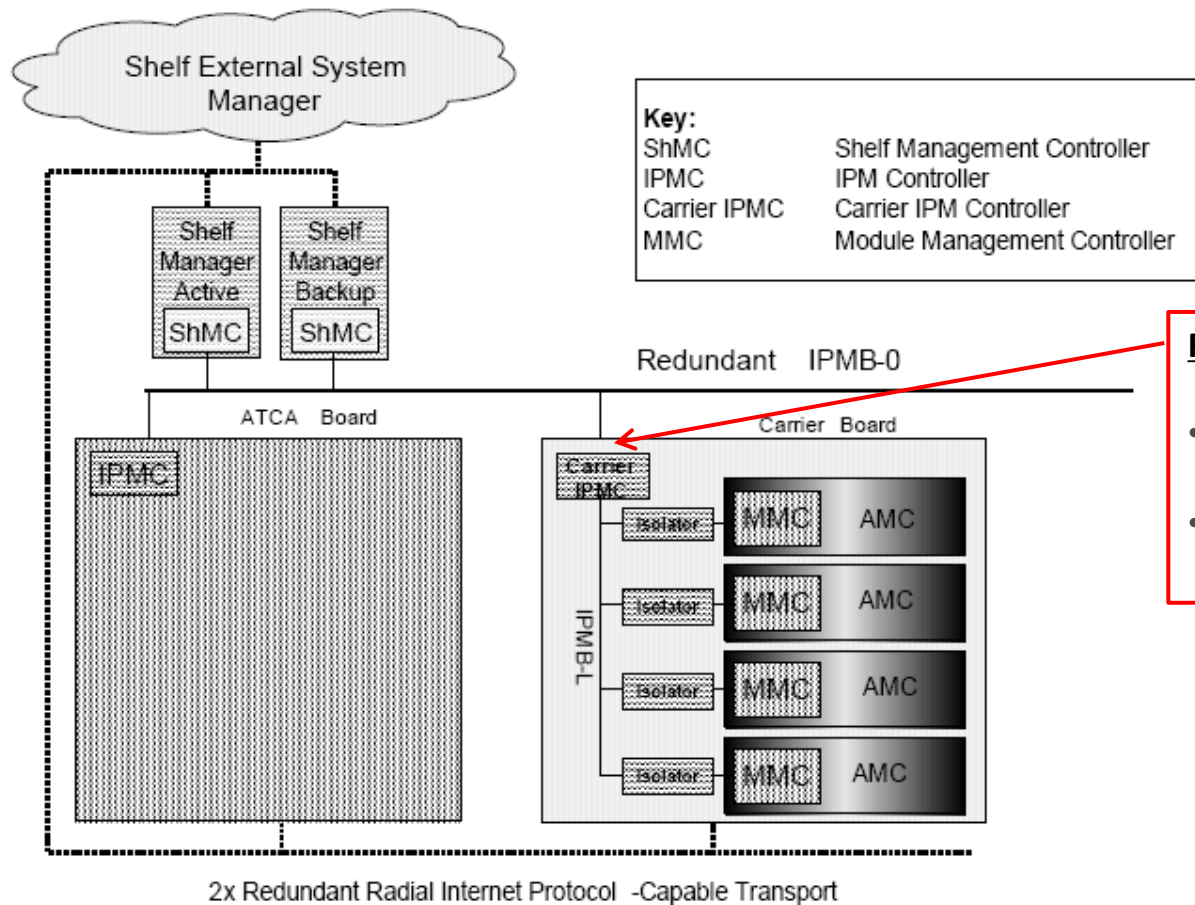
AMC Modules

AMC Module Sizes



AMC Modules

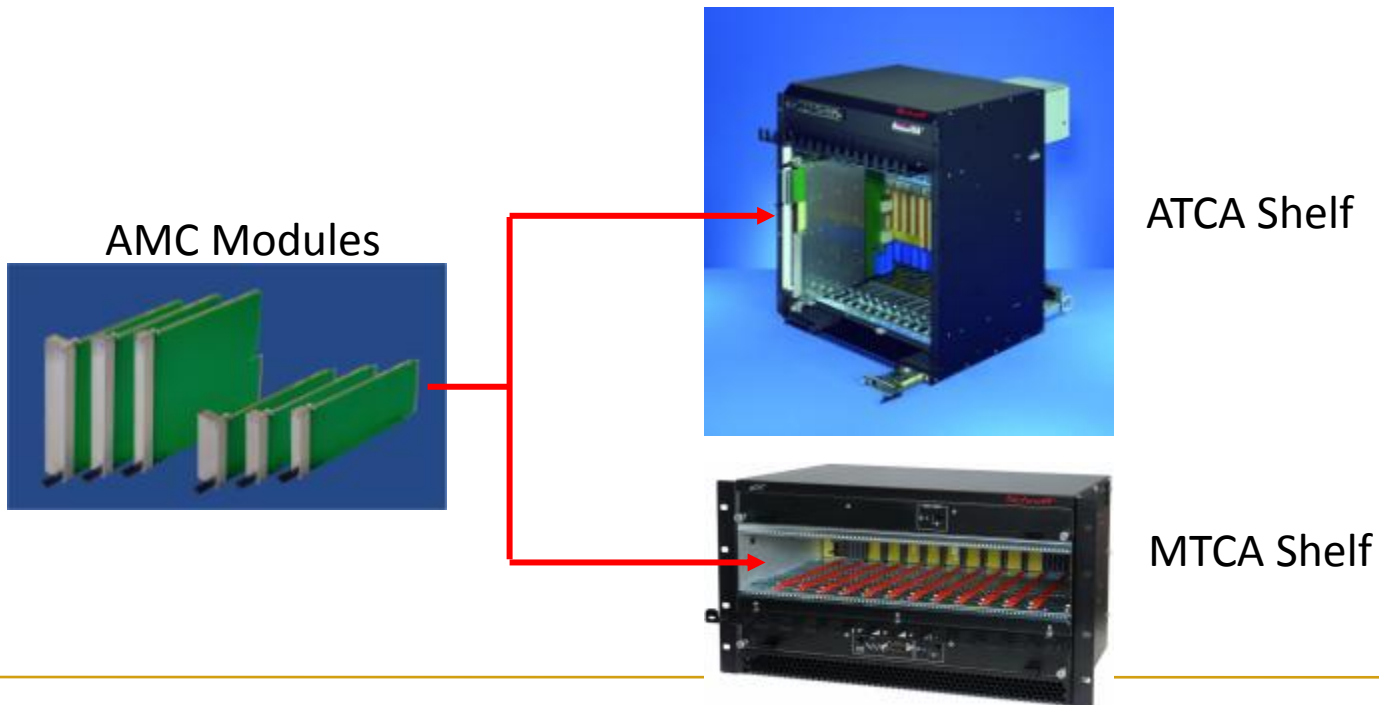
- Carrier IPMC represents the MMC on the AMC as a FRU to the Shelf Manager



MTCA.0

MTCA.0

- The basic idea of MTCA is to have a shelf that contains just AMC modules
- Backplane directly accepts AMC modules
- AMCs are interchangeable between ATCA and MTCA
- The infrastructure of a ATCA Carrier was adapted into the MTCA shelf (power, management, switching)
- No rear I/O, power input and all outputs to the front

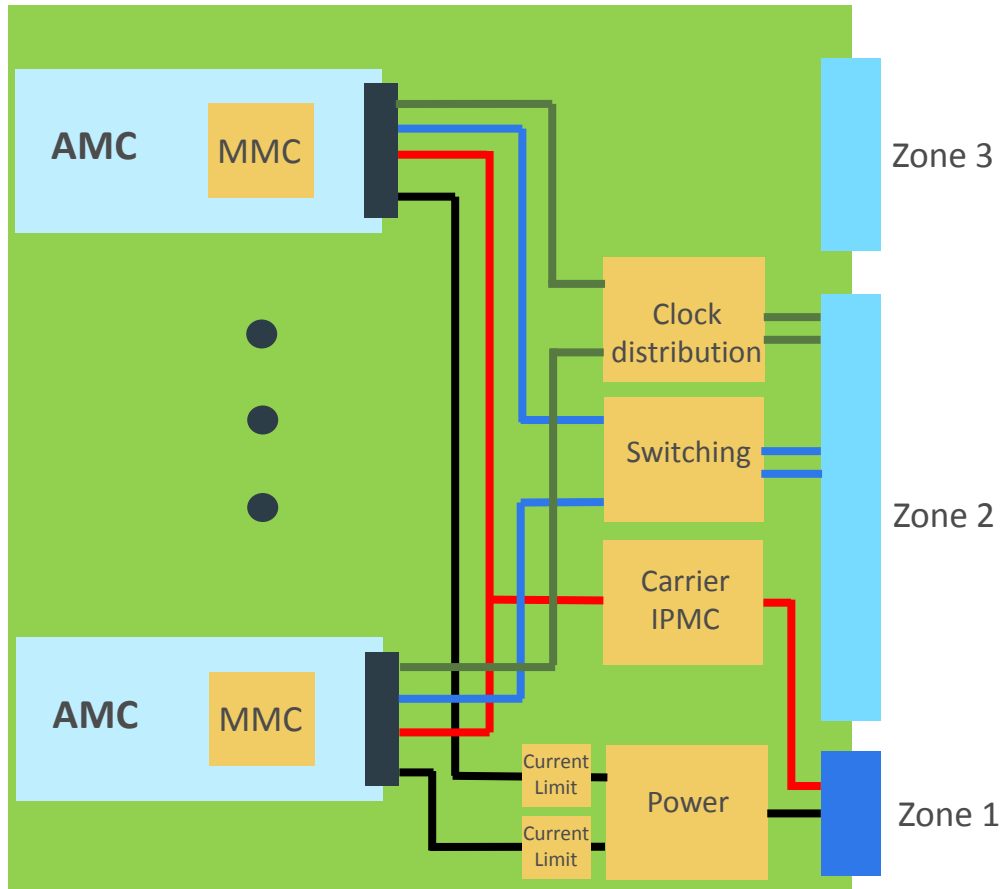


MTCA.0

- As MicroTCA does not use a Carrier board, the power, management, clock distribution and switching functionality must be realized onto another device
- New Module: MCH (**MTCA Carrier Hub**)
 - IPMI management
 - clock distribution / generation
 - Switching functionality
 - JTAG slave / master
 - Redundant MCHs
- New Module: Power Module
 - 12V Payload Power
 - 3.3V Management Power
 - Redundant power modules
- Special MTCA Shelf Slots for these new modules

MTCA.0

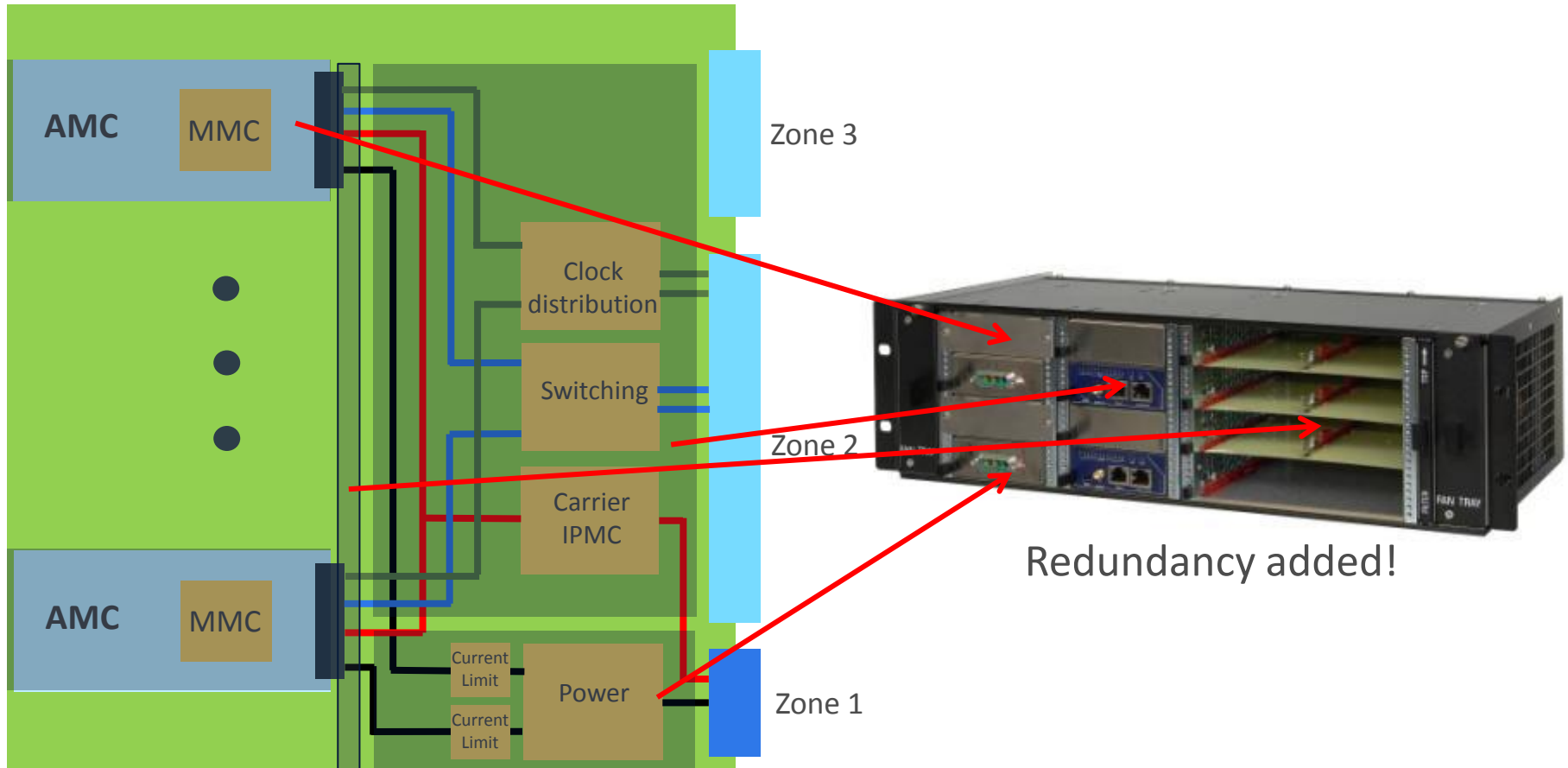
ATCA Carrier



MTCA.0

ATCA Carrier

MTCA Shelf



MTCA.0

Terms and Acronyms

- **MCH** **MicroTCA Carrier Hub**
 - This is the complete module you can buy from a vendor
- **MCMC** **MicroTCA Carrier Management Controller**
 - This is the physical IPMI controller on the MCH
- **MMC** **Module Management Controller**
 - This is the physical IPMI controller on an AMC
- **EMMC** **Enhanced MicroTCA Carrier Management Controller**
 - This is the physical IPMI controller on a Cooling Unit and on Power Module
- **IPMB-0** **Intelligent Platform Management Bus 0**
 - Logical IPMB, physically divided into redundant IPMB-A and IPMB-B
- **IPMB-L** **IPMB-Local**
 - IPMI link between MCH and AMCs
- **I²C-Bus** **Inter-Integrated Circuit Bus. Physical layer for IPMB**

MTCA.4

MTCA.4

Why were extensions needed to the existing MicroTCA specifications?

- **No Rear Transition Module (RTM) defined for MicroTCA**
 - Physics applications typically require a large number of I/O cables. It makes sense to connect them to the rear of the chassis
- **Special clock and trigger topology**
 - MicroTCA.0 specifies 3 Clocks and AMC.0 R2.0 specifies 4 Telecom and 1 Fabric Clock on the AMC Module. Physics applications typically need additional Clocks and Triggers
- **Sophisticated requirements for the clock and trigger accuracy**
 - MicroTCA / AMC defines typical telecom clock signals corresponding to PCIe values. Trigger signals are not specified

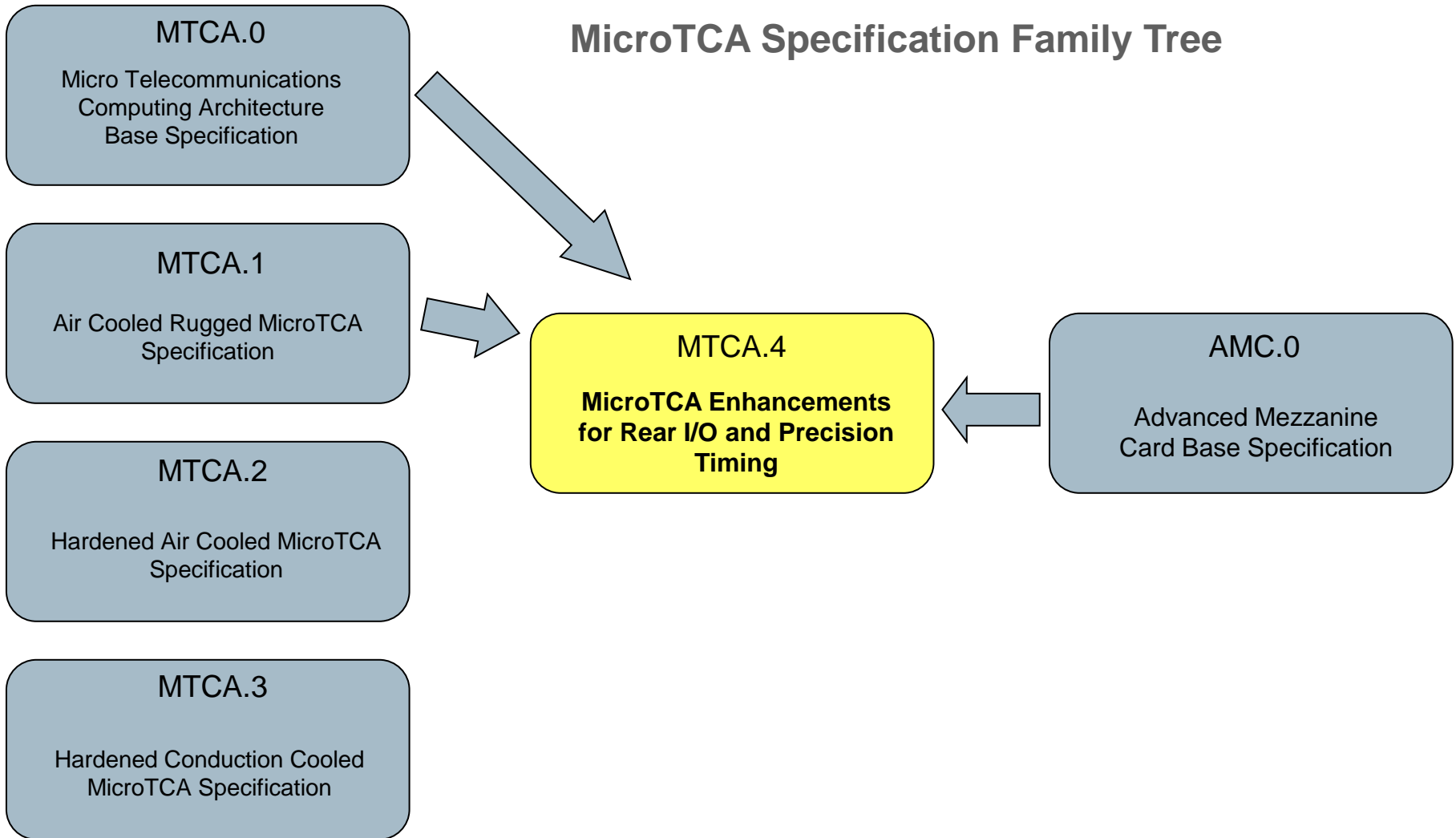
MTCA.4

Requirements for mechanics and sizes

- **AMC Module size: Double, Mid-size**
 - Allows for the max number of 12 AMCs in a 19" wide shelf
- **Large MicroRTM real estate**
 - MicroRTM size approximately the size of the AMC (doubles depth of existing uTCA chassis)
- **Use front panel mechanics based on Rugged MicroTCA (MTCA.1)**
 - Need to mechanically attach a module to avoid it being pushed-out by the corresponding module
 - Use Rugged MicroTCA retention device
- **Reuse existing AMC front panels for the MicroRTM**
- **Allowing mounting of mezzanine modules on the rear of the backplane**
- **Optional zone 3 backplane**
- **Define the management of the system**
- **Suggest clocking and backplane topology**

MTCA.4

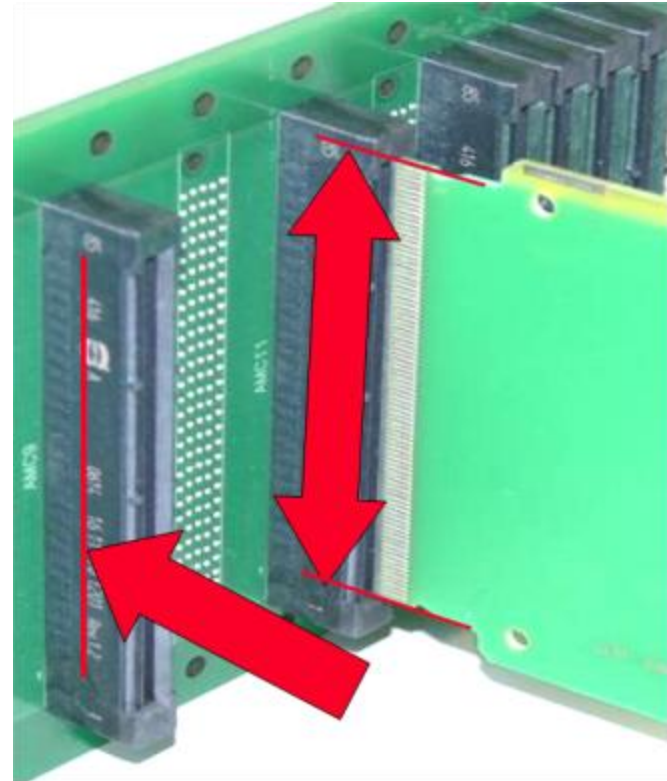
MicroTCA Specification Family Tree



MTCA.4

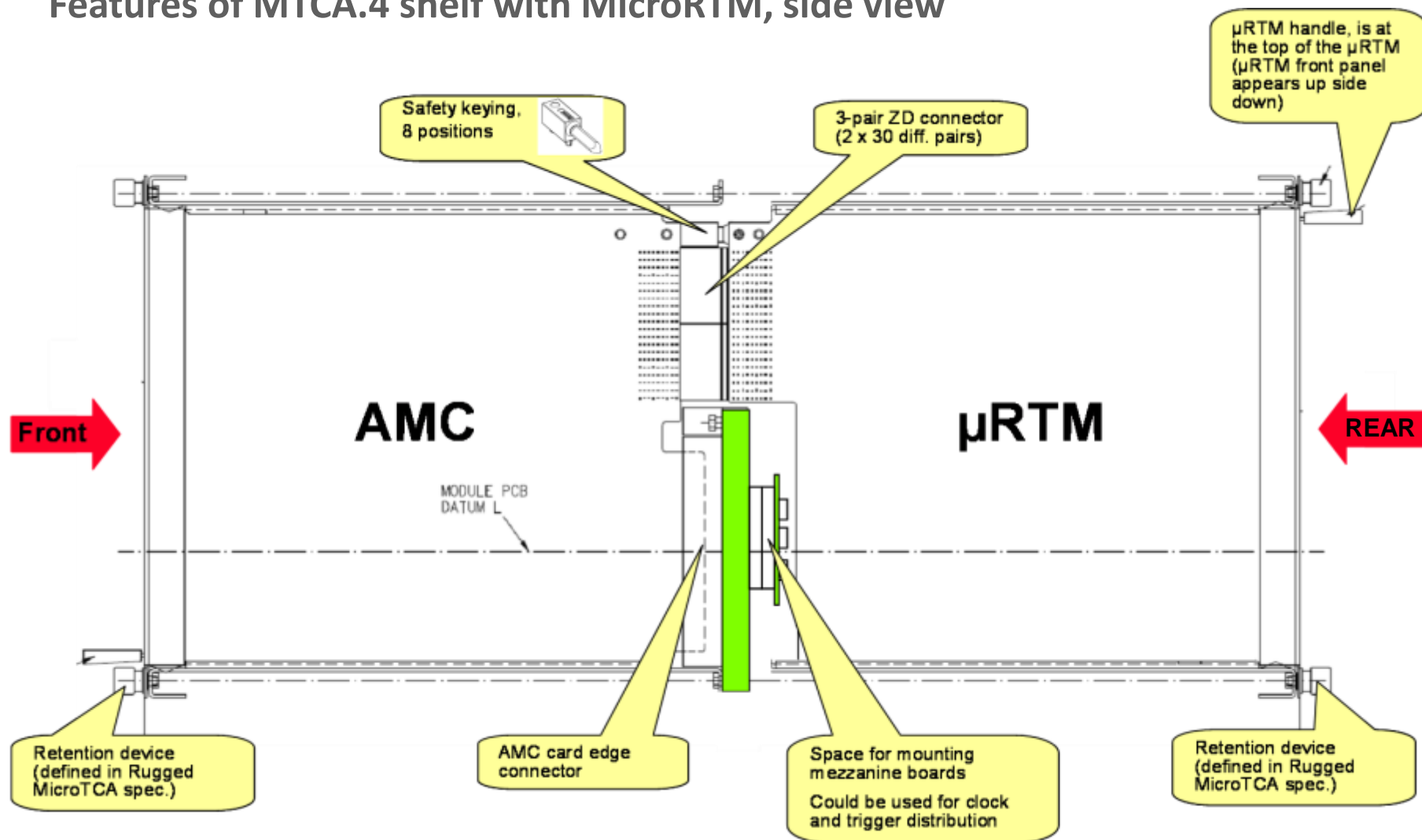
Challenges when developing mechanics for the MicroRTM

- The AMC card edge connector always needs to bottom for safe contact
- The AMC card edge connector does not allow vertical tolerances
- The AMC connector is the dominant connector. Additional tolerances caused by the MicroRTM must not interfere with mating of the AMC card edge connector



MTCA.4

Features of MTCA.4 shelf with MicroRTM, side view

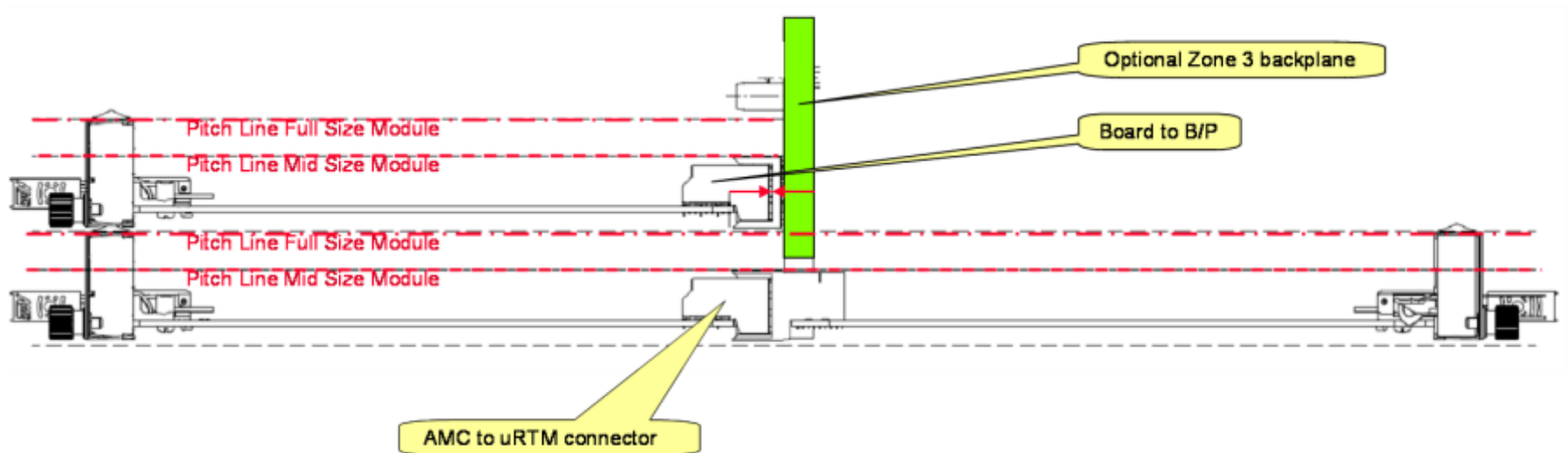


MTCA.4

Features of MTCA.4 shelf with MicroRTM, top view

AMC

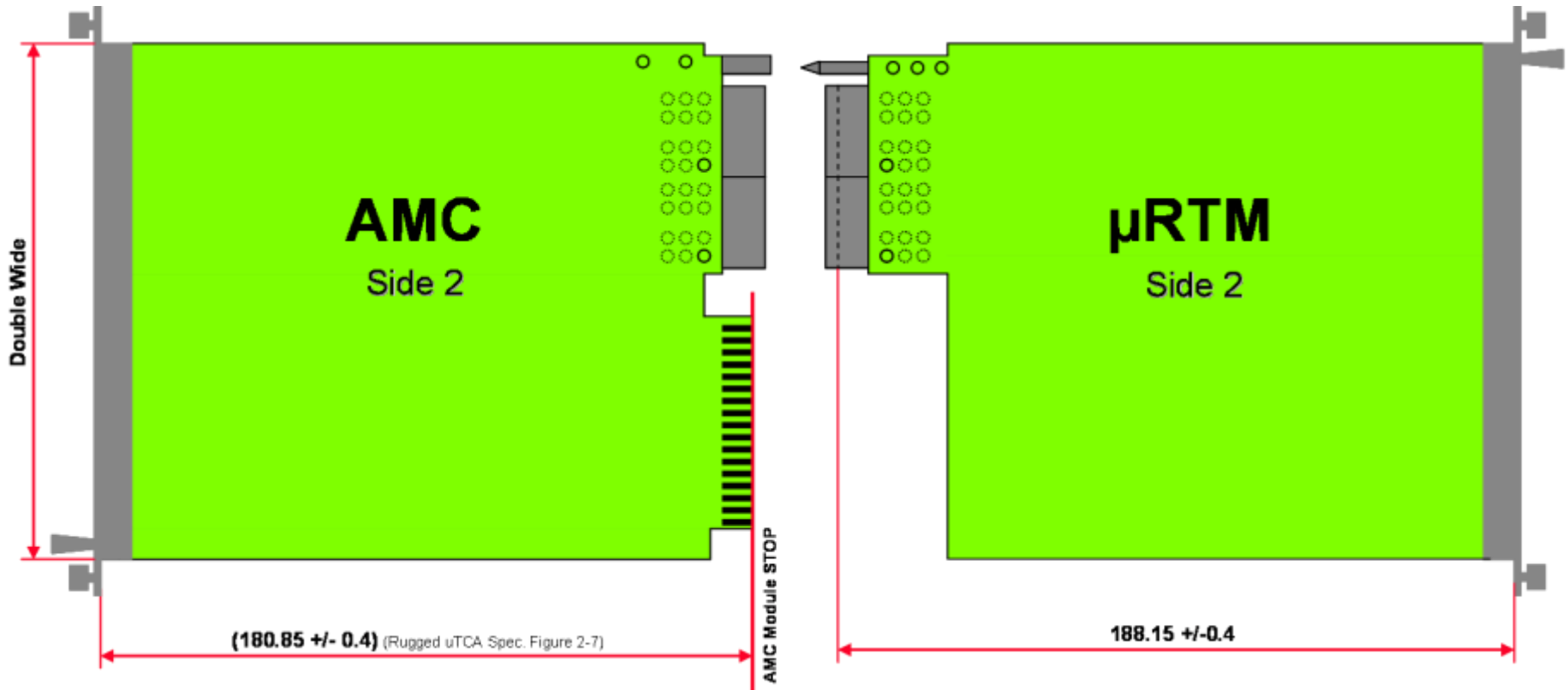
μRTM



- The height of the module limits the connector usage
 - Full-size (6HP): 20 or 30 or 40 pair ADF connector
 - Mid-size (4HP): 20 or 30 pair ADF connector
 - Compact-size (3HP): no ADF connector possible

MTCA.4

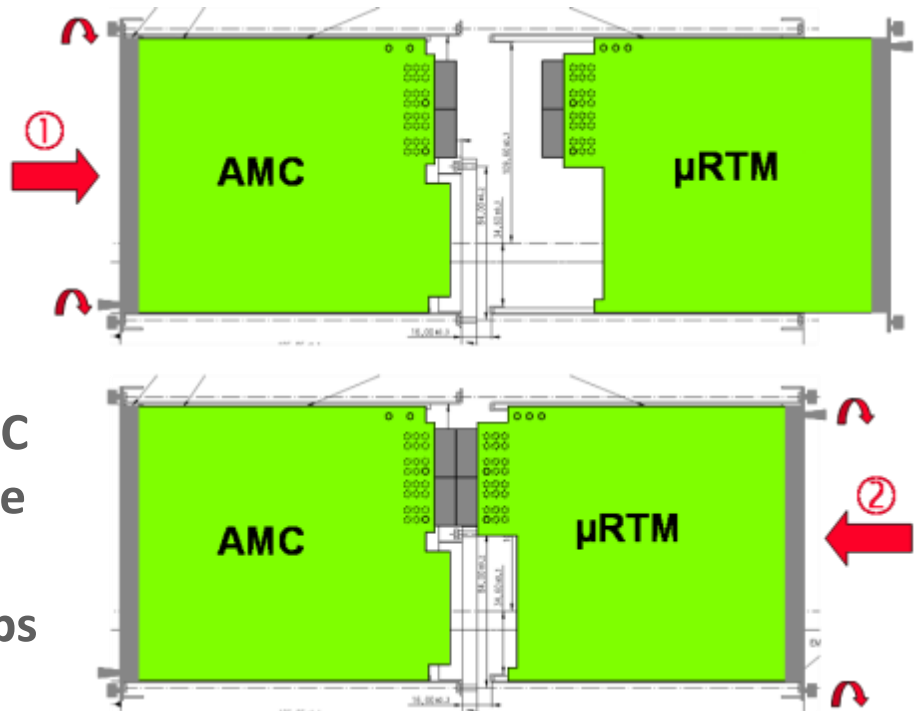
Module Sizes



MTCA.4

Module Insertion Sequence

- The dominant role of the AMC card edge connector makes it necessary to follow an insertion sequence in order to avoid damage
- Step 1: Insert AMC and fix the retention device
- Step 2: Insert the μ RTM and fix the retention device
- After this initial installation of the AMC and the μ RTM one or the other may be removed as necessary (If both boards are removed follow again the two steps above)



MTCA.4

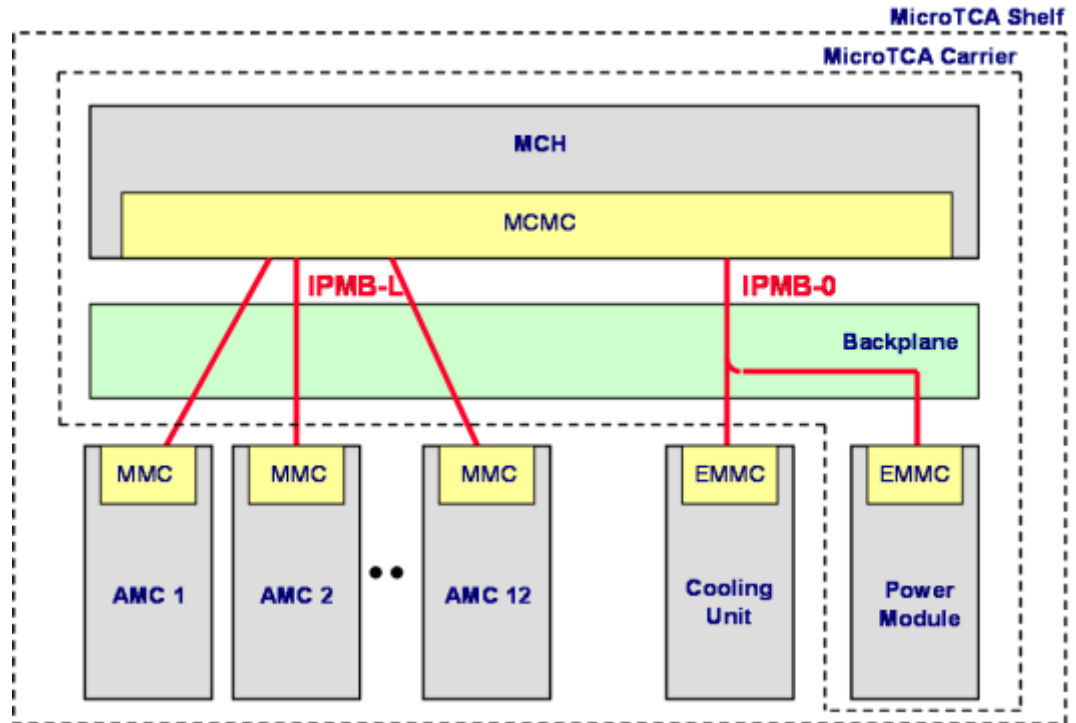
Management defined in AMC.0 / MTCA.0

- **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



MTCA.4

Management extensions in MTCA.4

- **IPMB-L**

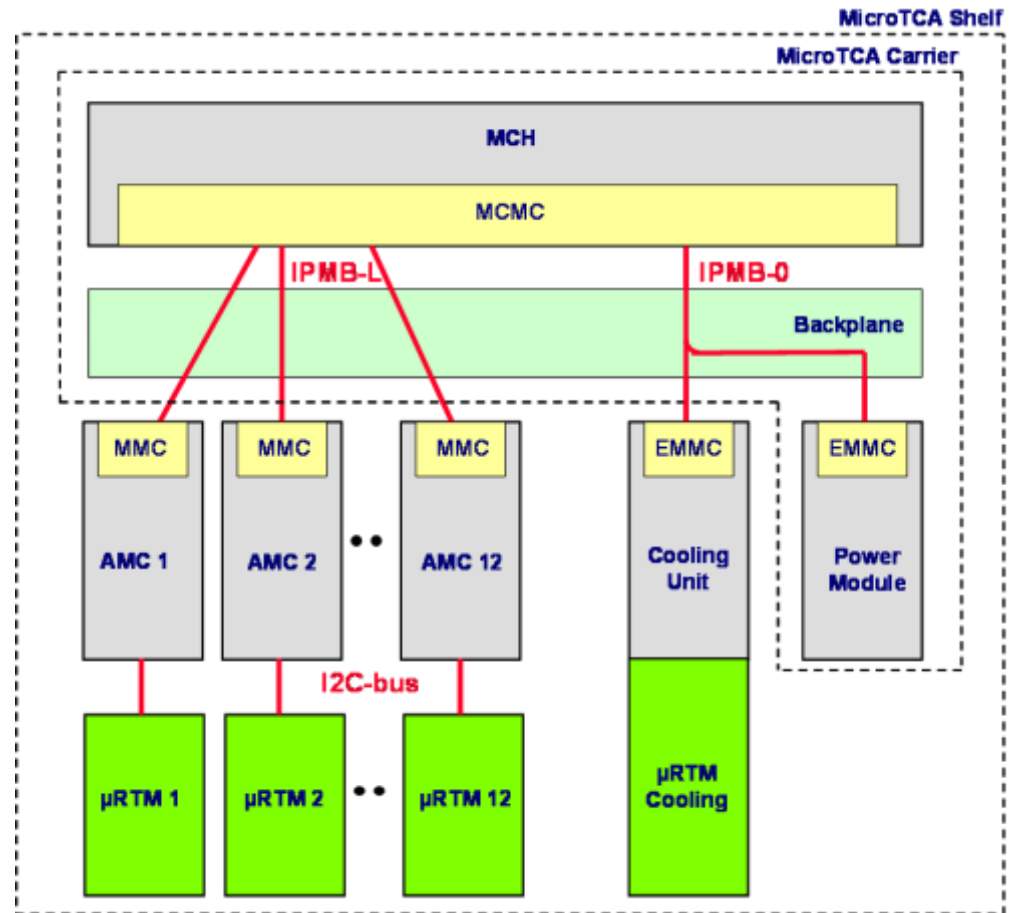
- Connects the MCMC on the MCH to the MMC on the AMC Modules
- Radial architecture

- **IPMB-0**

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

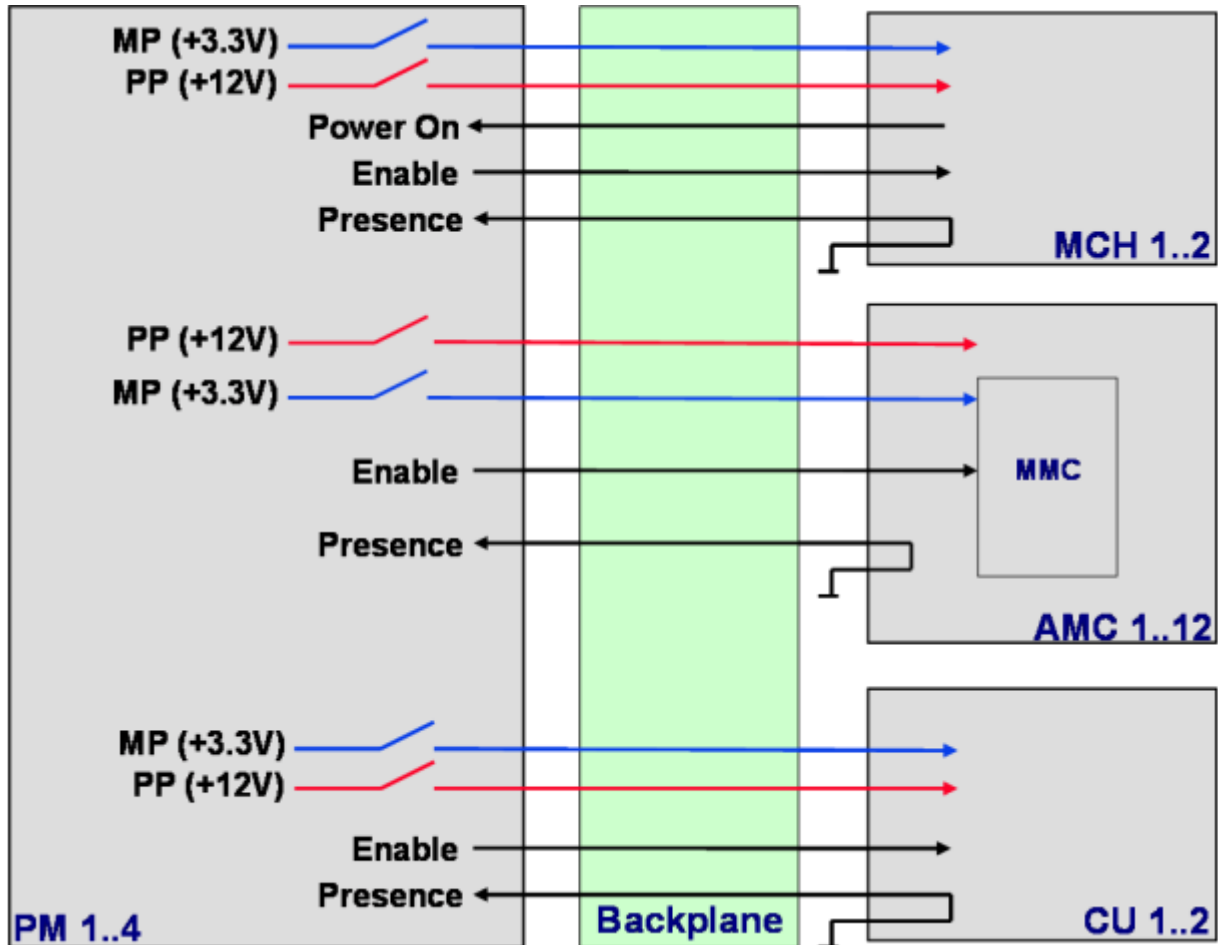
- **I²C-Bus**

- Connects the AMC to the μ RTM
- The μ RTM is treated as managed FRU of the AMC



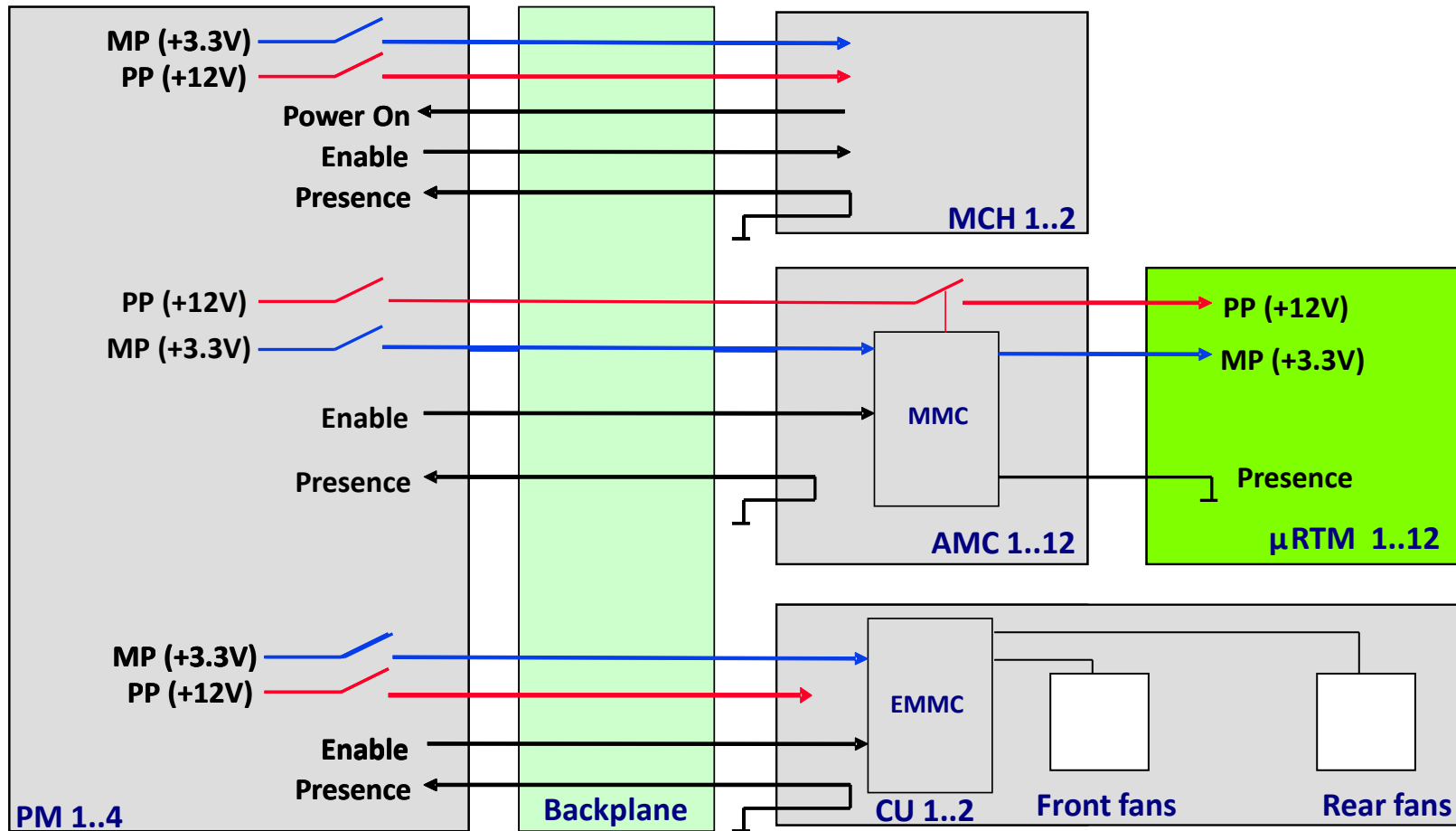
MTCA.4

Control signals as defined per AMC.0 / MTCA.0



MTCA.4



















Additional RTM control signals for MTCA.4



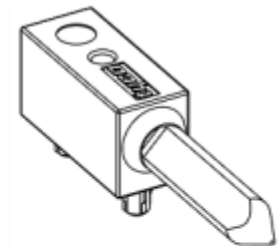
MTCA.4

Alignment and Keying

- mechanical keying prevents a module from being inserted which is not electrically compatible and could cause damage
- Eight keying positions are implemented that define the electrical interface

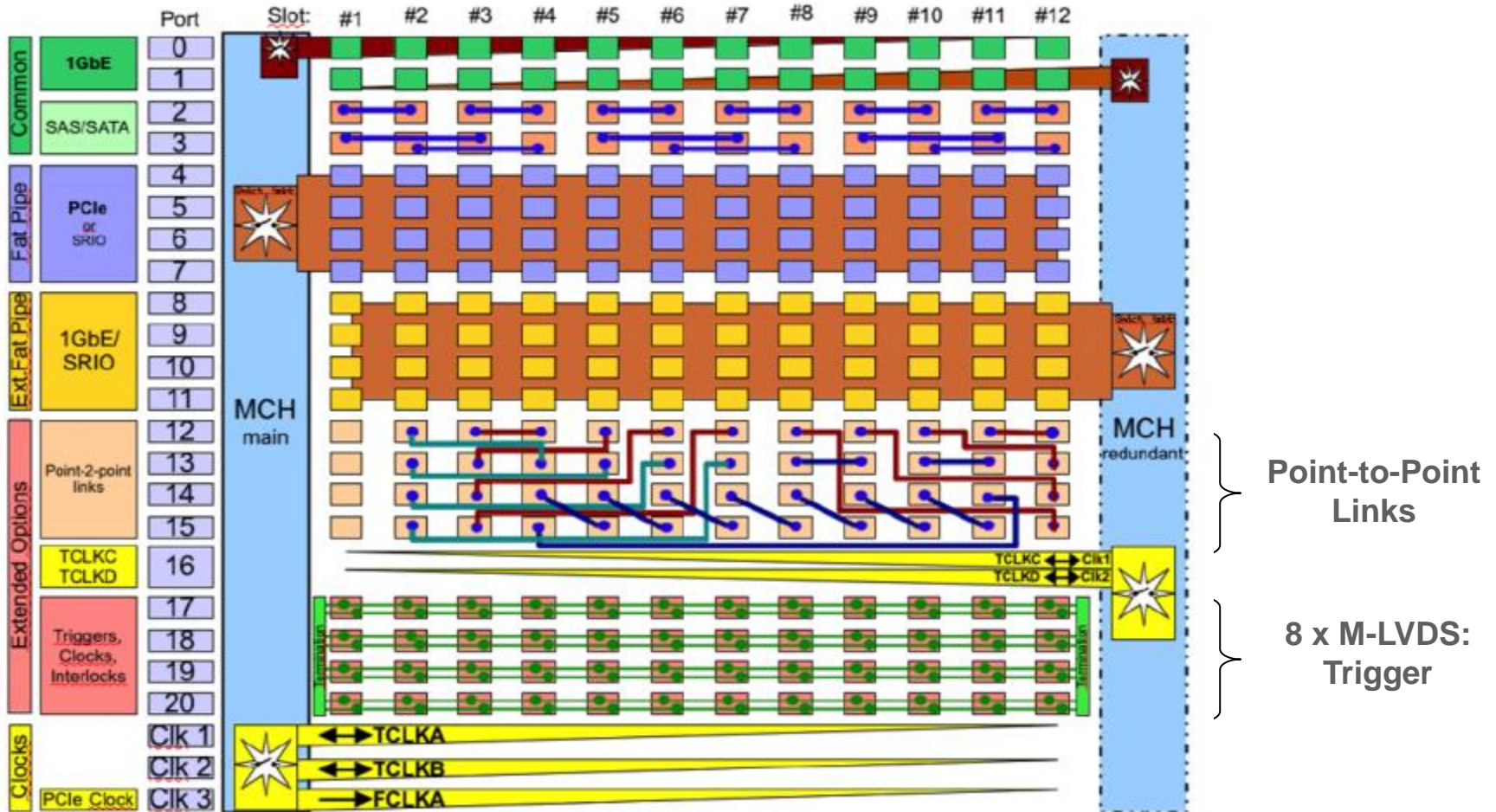
N	A Rotation in degrees	View into rear of AMC	View into rear of μ RTM
		Receptacle	Post
1	0		
2	45		
3	90		
4	135		
5	180		
6	225		
7	270		
8	315		
0	NA		

N	Data Signal in Volts
1	LVDS
2	0 – ± 1
3	$>\pm 1$ – ± 3.3
4	$>\pm 3.3$ – ± 10
5	$>\pm 10$
6	Reserved
7	Reserved
8	Reserved



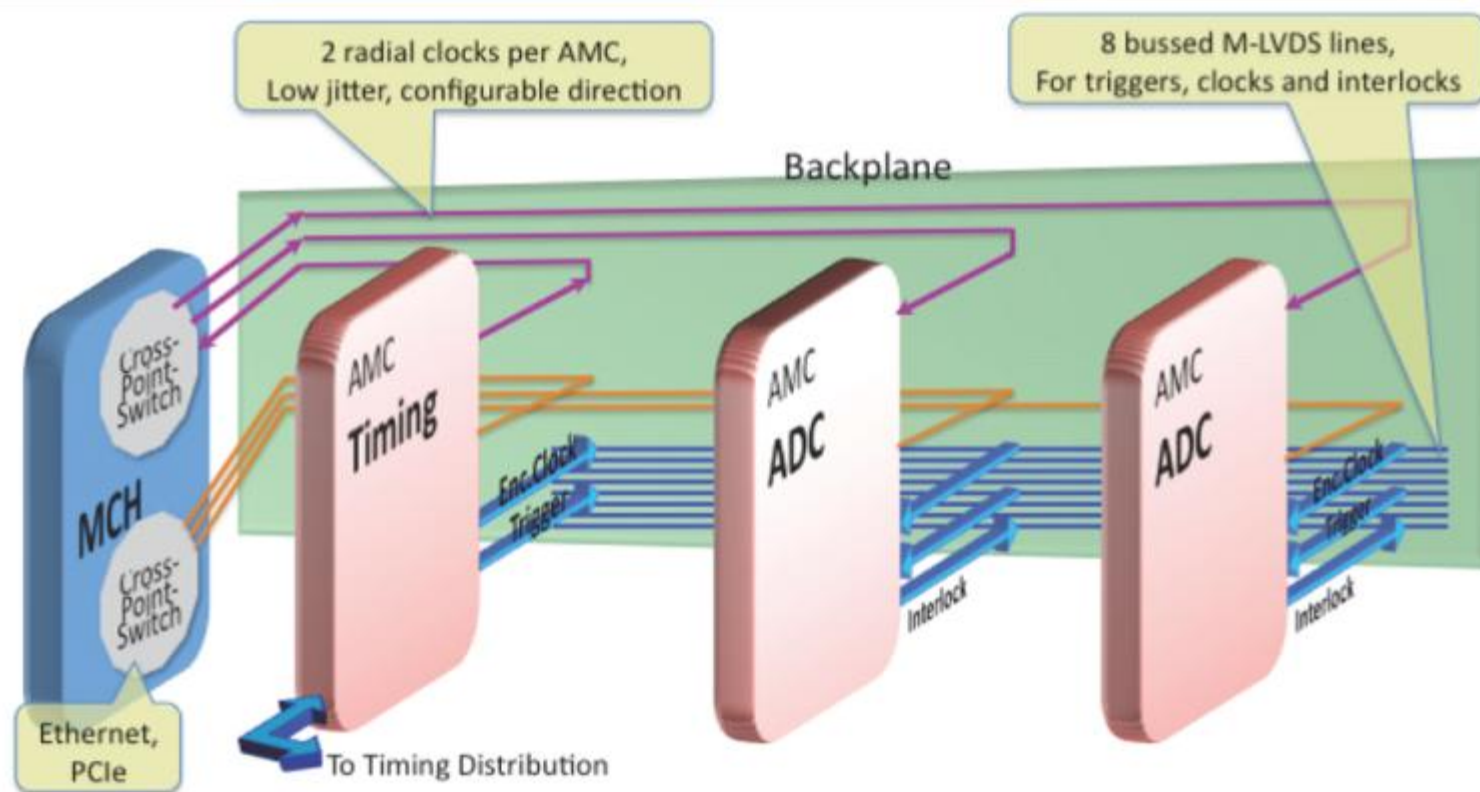
MTCA.4

12-Slot MTCA.4 Backplane



MTCA.4

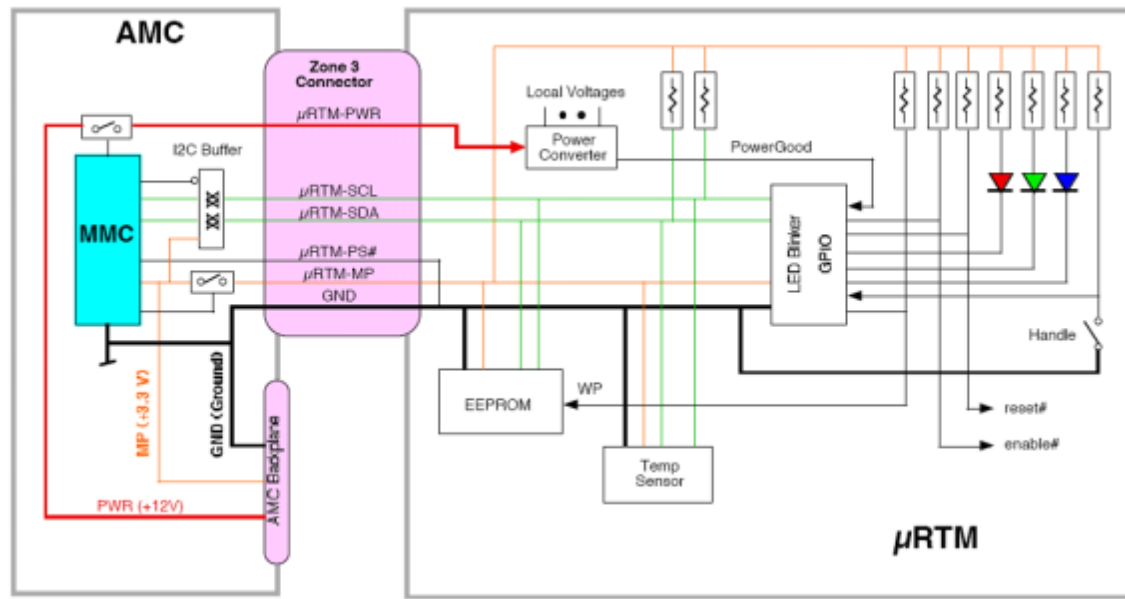
Clock, Trigger and Interlock Signals



MTCA.4

MicroRTM Management

- A management interface is defined on the lower zone 3 connector
- Management and power signals:
 - μ RTM-MP: Management Power for the EEPROM, Temp. Sensor and I/O Expander
 - μ RTM-PWR: Payload power for the RTM
 - μ RTM-PS#: RTM Presence signal, grounded on the RTM
 - μ RTM-SCL/SDR: I²C bus coming from the AMC MMC going to the RTM



MTCA.4

Shelf Cooling

- Some Physics applications require independent cooling of the front boards and the rear boards due to thermally sensitive oscillators on the rear boards. Also, independent fan speed control contributes to lower noise and power consumption
- The fans for the front board and the rear board are on one physical Cooling Unit
- Existing specifications did not deal with independent fan speeds on one physical Cooling Unit
- MTCA.4 enhances the commands „Get Fan Speed Properties“ and „Get/Set Fan Level“ to include a bit telling the MCH whether the Cooling Unit supports independent cooling and telling the Cooling Unit whether a „Get/Set Fan Level“-command targets the front or the rear fans

MTCA.4

MTCA.4 fan speed control commands

Table 3-9: MTCA.4 Get Fan Speed Properties

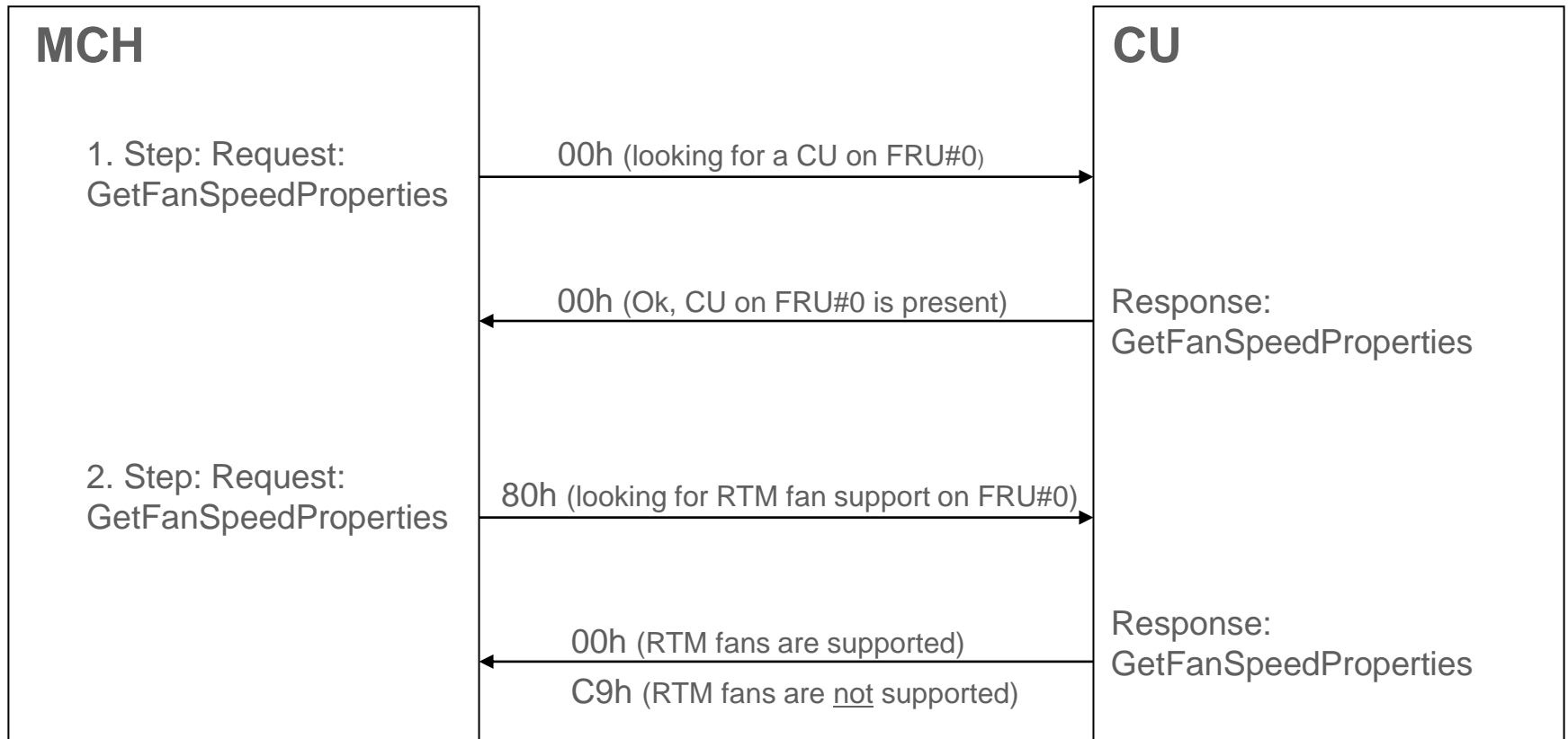
Request sent by the MCH

Response sent by the CU

Data Type	Byte	Data Field
Request Data	1	<i>PICMG Identifier</i> . Indicates that this is a PICMG-defined group extension command. A value of 00h is used.
	2	If the Fan Tray does not support RTM Fan control: <i>FRU Device ID</i> . Indicates the FRU device for which the command is intended. If the Fan Tray supports RTM Fan control: [7] – <i>RTM Fan Speed Properties</i> . This bit is set to 1b to indicate that the Get Fan Speed Properties query is for the RTM fans. This bit is set to 0b to indicate that the Get Fan Speed Properties query is for the front fans. [6..0] – <i>FRU Device ID</i> . Indicates the FRU device for which the command is intended.
Response Data	1	<i>Completion Code</i>
	2	<i>PICMG Identifier</i> . Indicates that this is a PICMG-defined group extension command. A value of 00h is used.
	3	<i>Minimum Speed Level</i> . This field describes the minimum setting that is accepted by the <i>Set Fan Level</i> command.
	4	<i>Maximum Speed Level</i> . This field describes the maximum setting that is accepted by the <i>Set Fan Level</i> command.
	5	<i>Normal Operating Level</i> . This field represents the default normal fan speed recommended by the fan manufacturer.
	6	<i>Fan Tray Properties</i> . This field holds properties of the Fan Tray. [7] – <i>Local Control Mode Supported</i> . This bit is set to 1b if the Fan Tray supports automatic adjustment of the fan speed. [6:0] – <i>Reserved</i>

MTCA.4

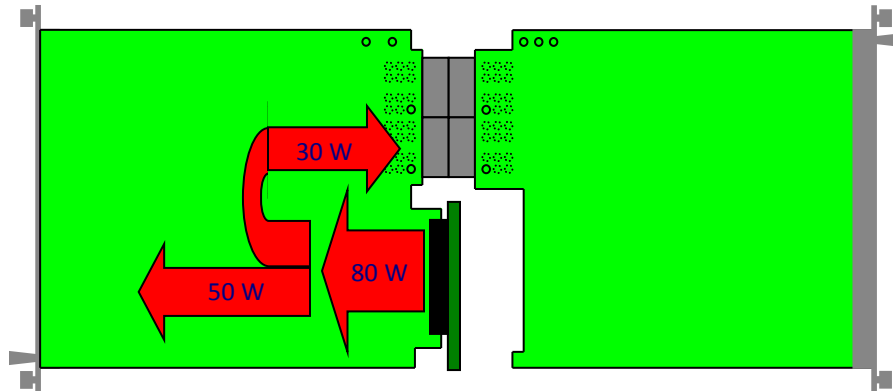
Sequence of IPMI commands to determine whether the CU supports independant MicroRTM cooling



MTCA.4

Front board and MicroRTM power requirements

- The total power for a slot (front board and RTM) is supplied through the front board AMC connector
- The MicroRTM power is supplied from the front board through the Zone 3 connectors
- Total available power for a slot is 80 Watts, the MicroRTM power is limited to 30 Watts
- The power required by the MicroRTM is subtracted from the power for the front board



Thank you

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