



MTCA.4 Tutorial - Basics Introduction in xTCA

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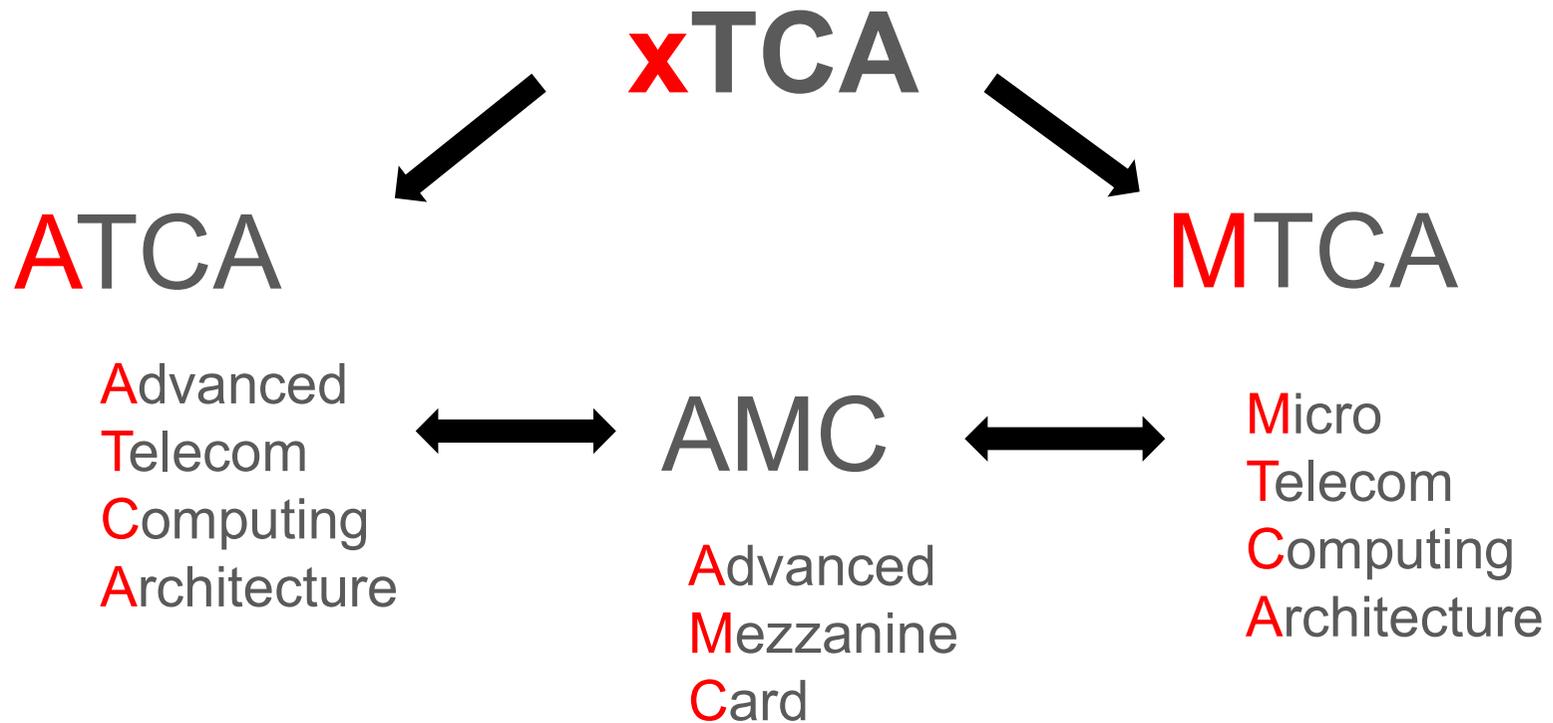


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Agenda

- **What is xTCA?**
- **Specifications Overview**
- **ATCA Features**
- **AMC Features**
- **MTCA.0 Features**
- **MTCA.4**
 - Initial Requirements
 - Mechanical Features
 - Module sizes
 - Keying
 - Backplane
 - Management extensions compared to MTCA.0
 - Hot Swap Transition States
 - Cooling
 - Redundancy
 - MTCA.4.1

What is xTCA?



ATCA

Overview

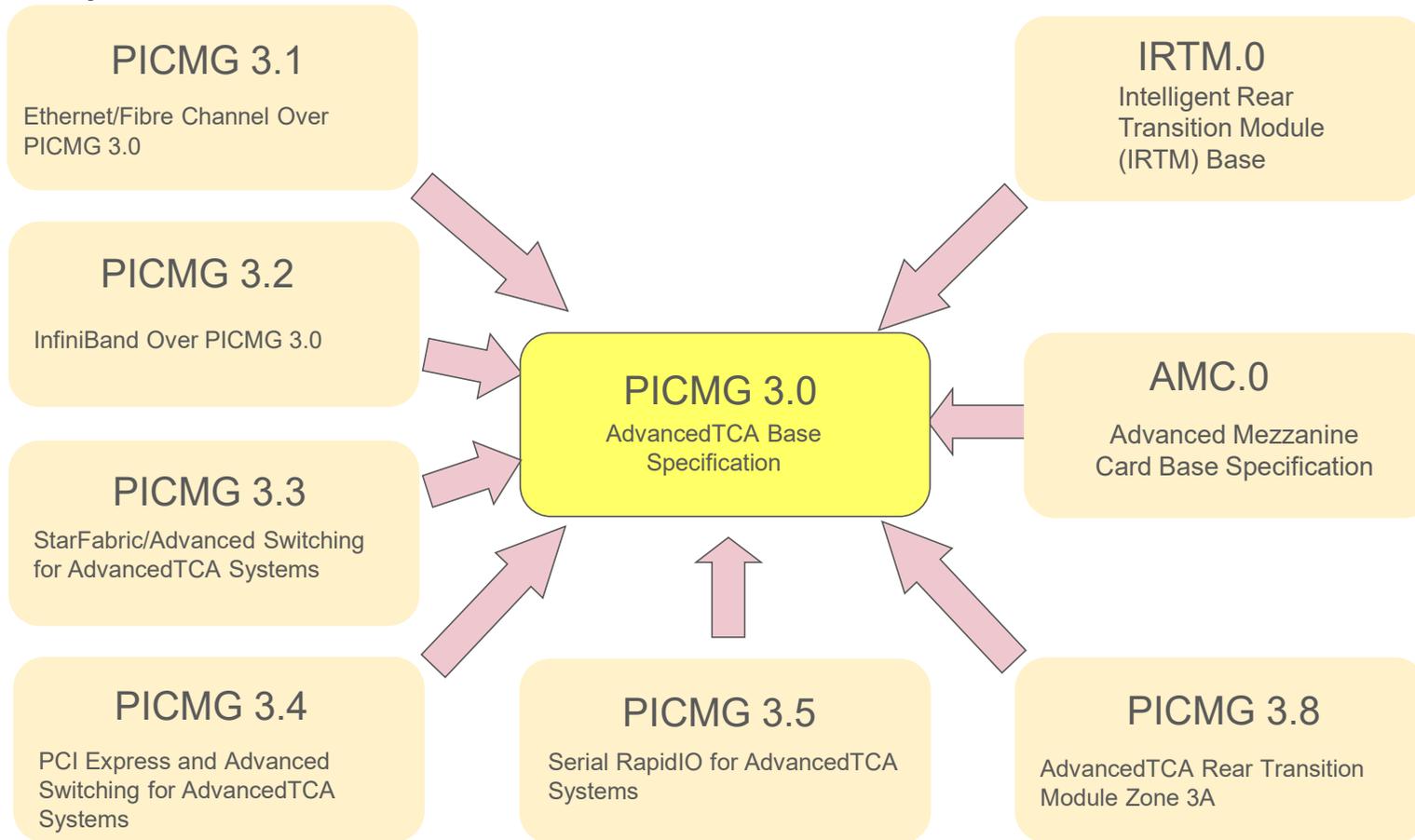
- Specification initially targeted to the Telco Industry
- Features required for the new standard:
 - System Availability 99.999% (~5 min/year)
 - System throughput to 2 Tb/s (full mesh)
 - Port data rate to 40 Gb/s (4 x 10Gb/s), today 100Gb/s
 - Management, monitoring and control!
 - Software infrastructure providing API's, etc.!
- Introduced in 2002

ATCA



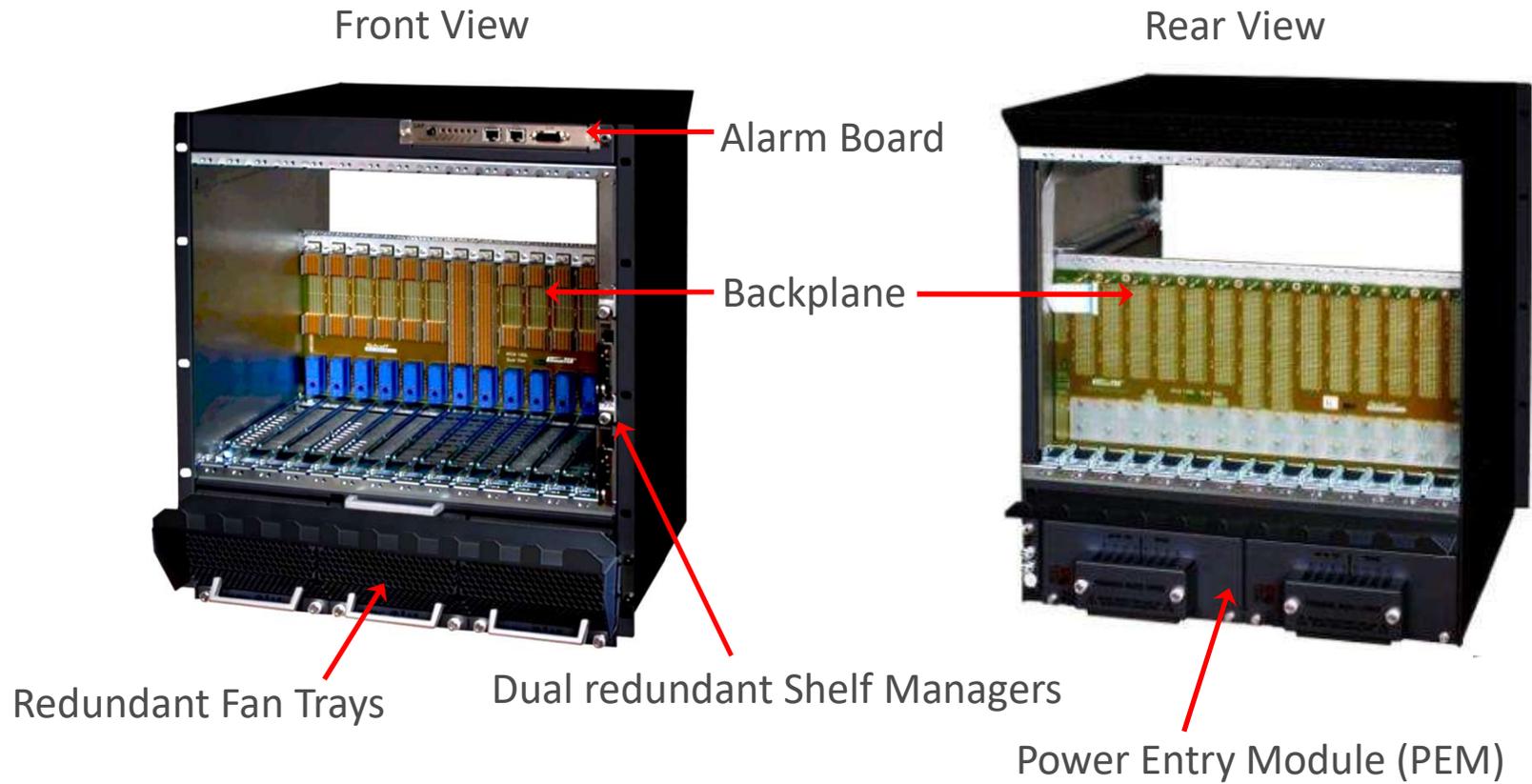
ATCA

Specification Family



ATCA

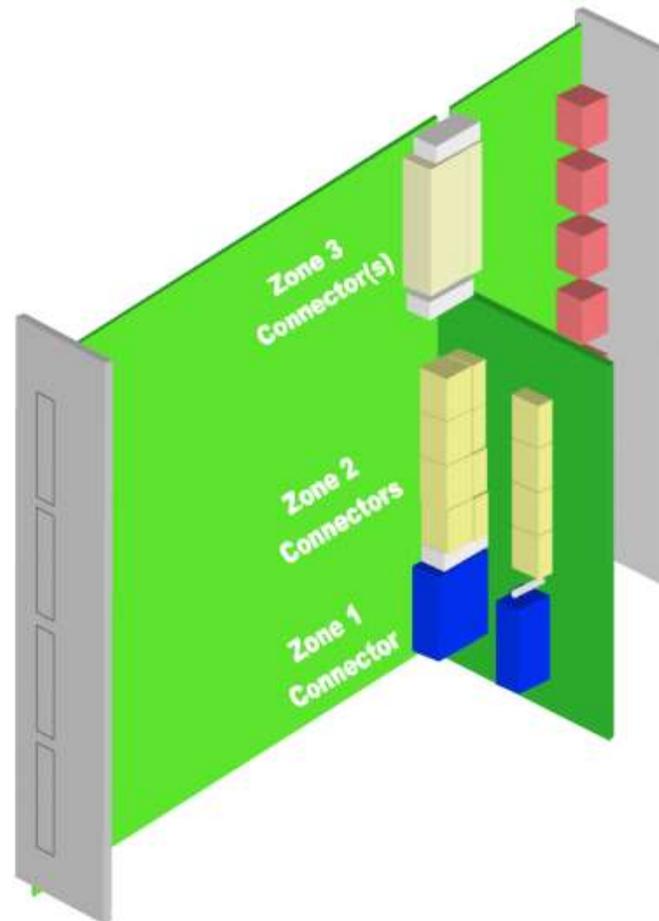
Shelf Elements



ATCA

Board size and connectors

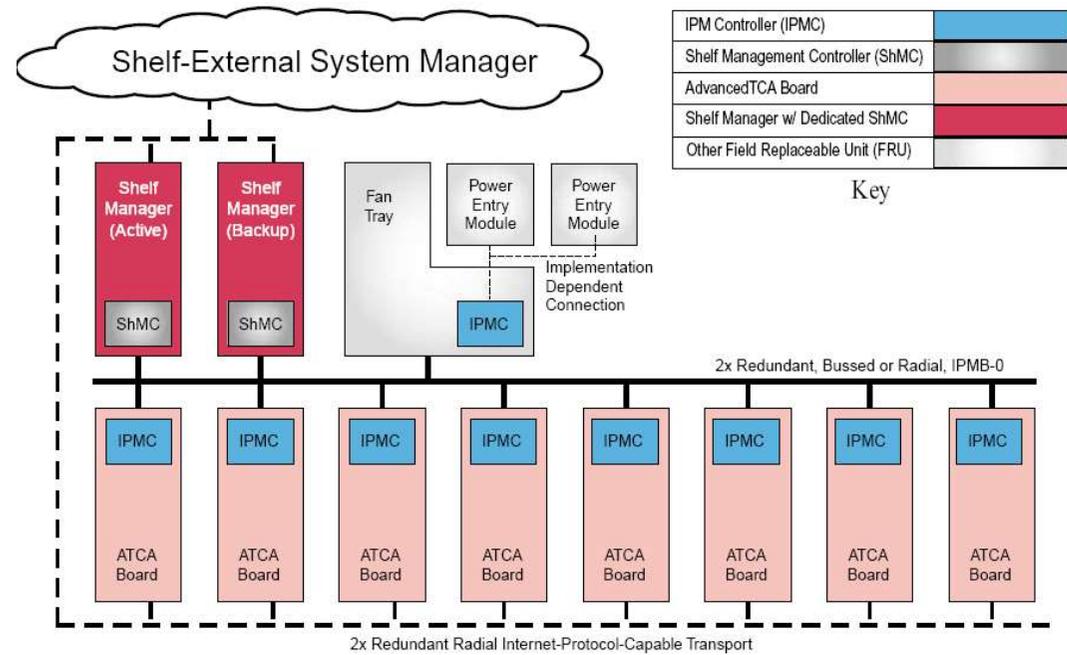
- Front board size 8U x 280
- Rear board (RTM) size 8U x 70 mm
 - Connects directly to front board
- Board width 6HP (1.2")
- Alignment/Key pins
- Zone 1: Management and Power
- Zone 2: Base Interface and Fabric Interface
- Zone 3: Interface to RTM



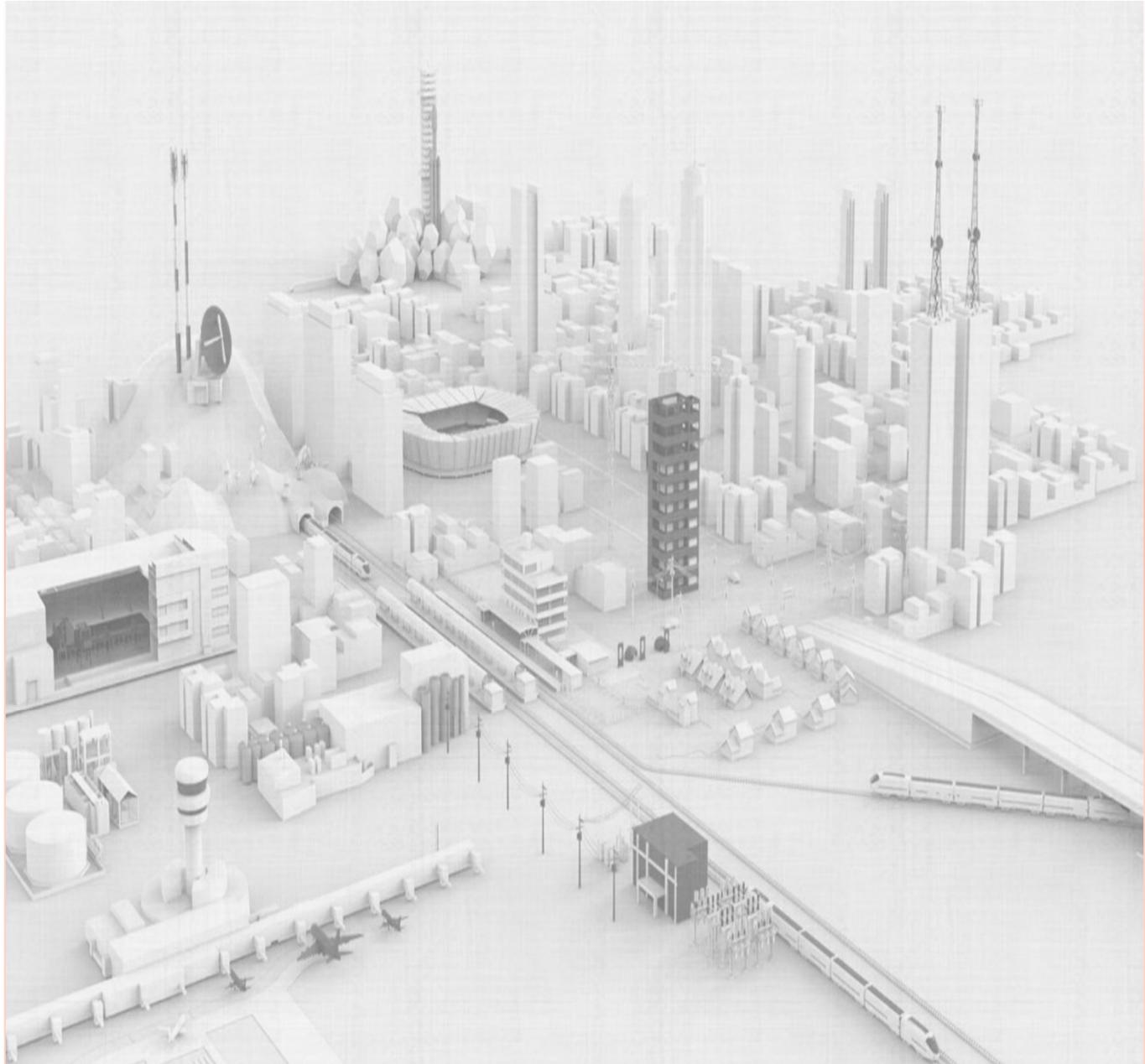
ATCA

Management

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

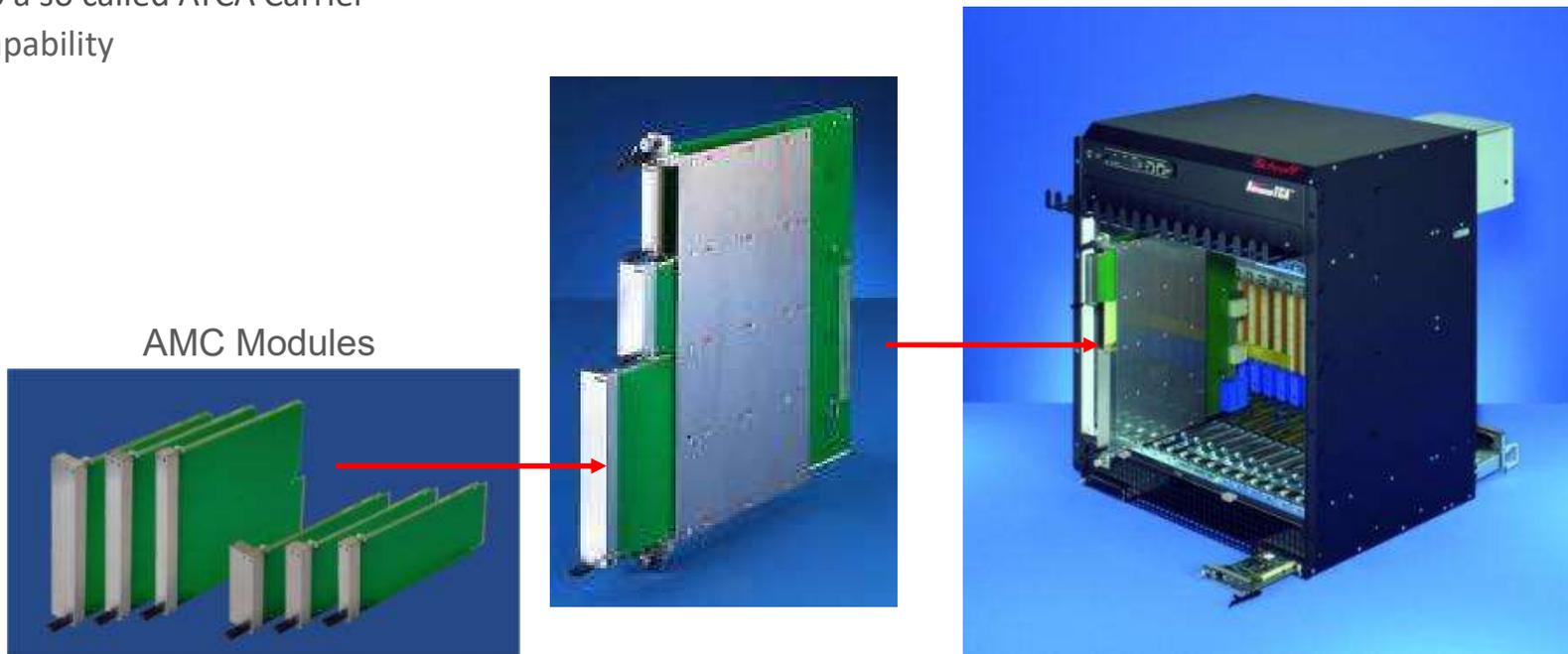


AMC



AMC

- 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

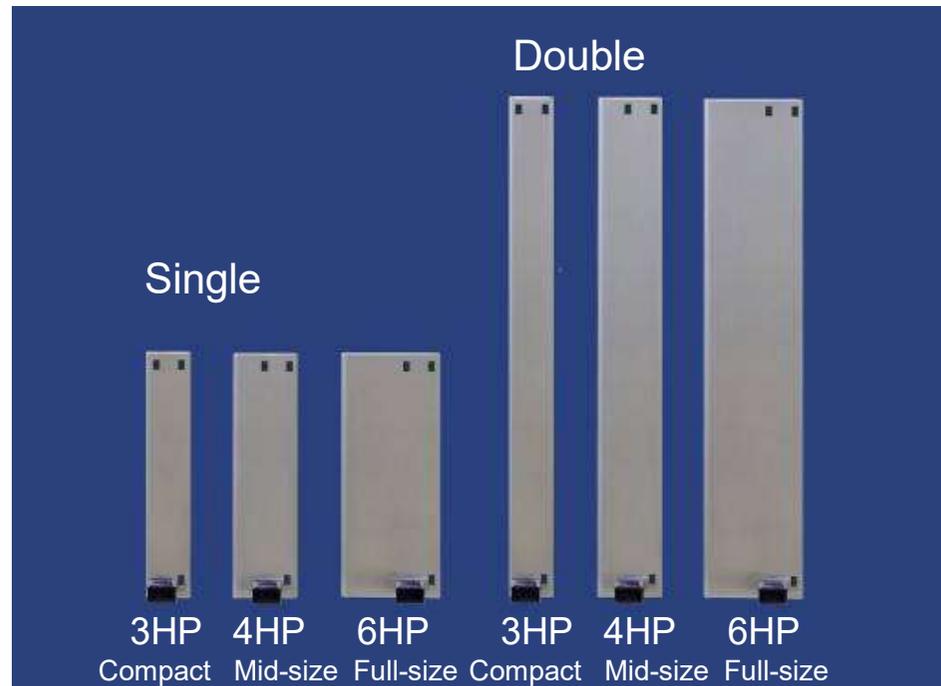
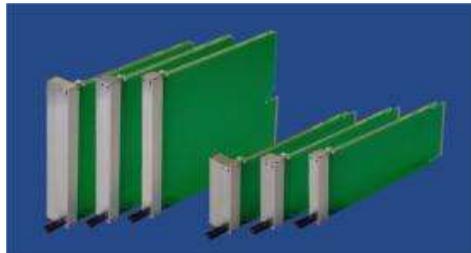
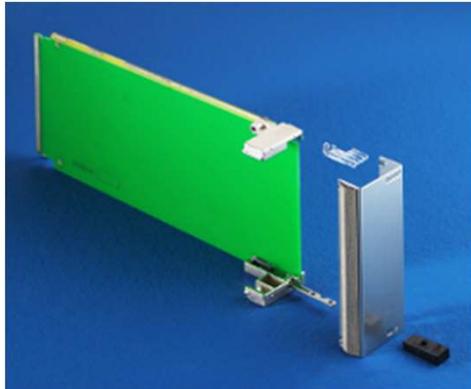
AMC Module Sizes

6 Standard Sizes:

Depth dimension: 180 mm

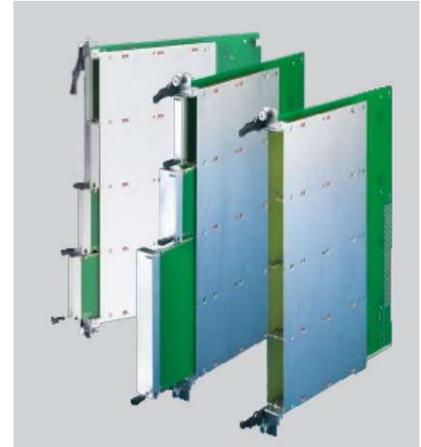
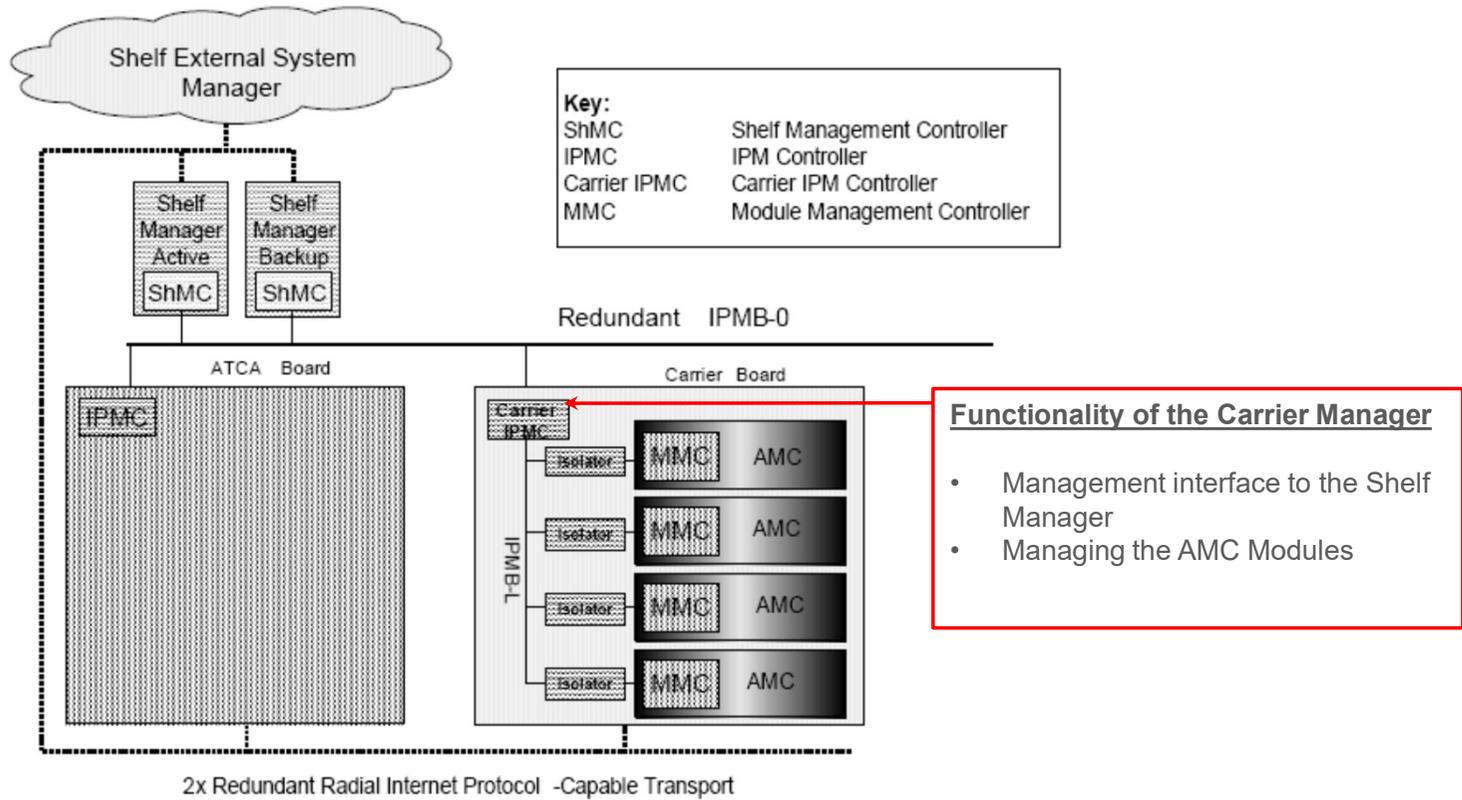
Width dimensions: Single and Double

Height dimensions: Compact, Mid-size and Full-size

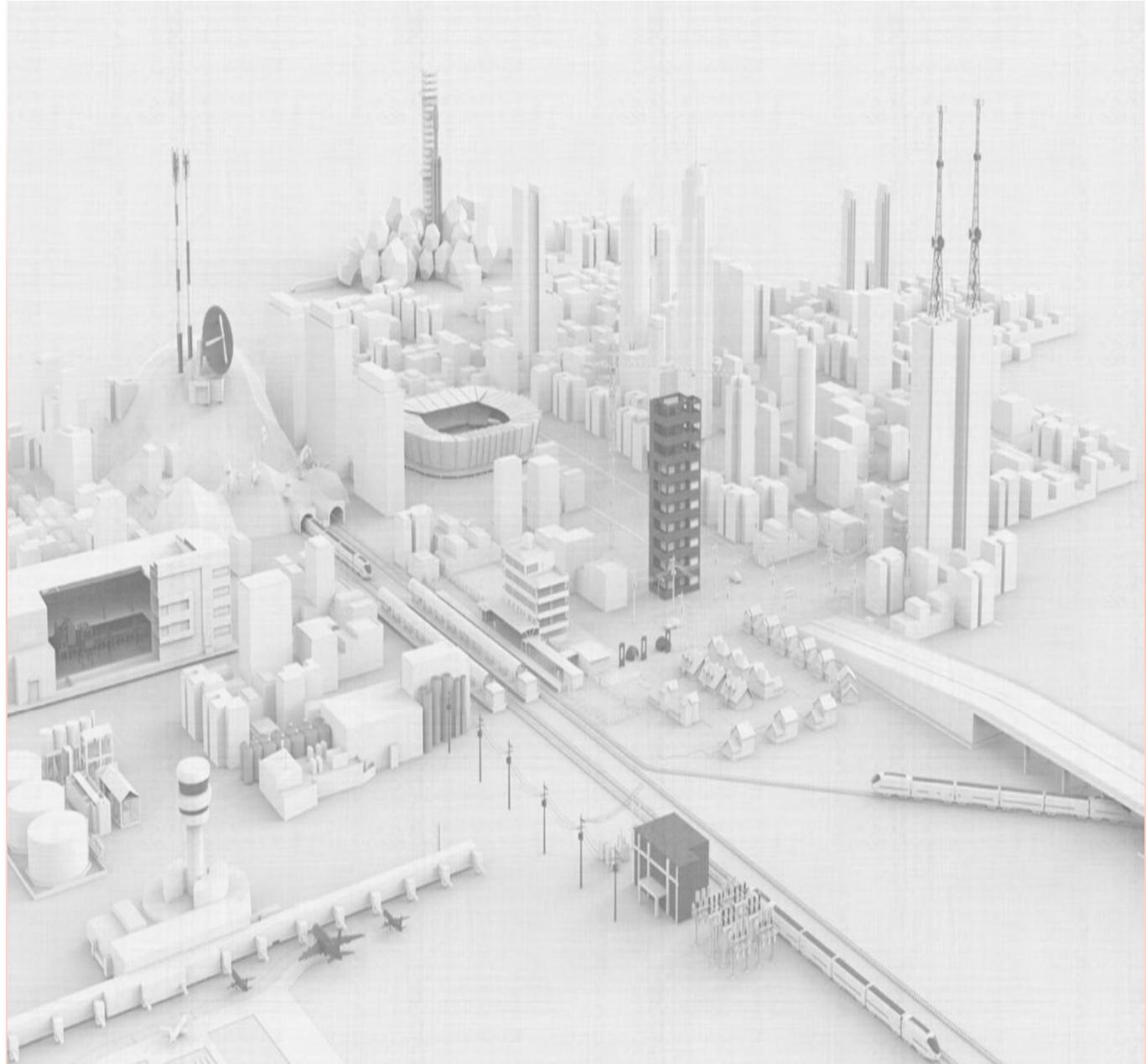


AMC Modules

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

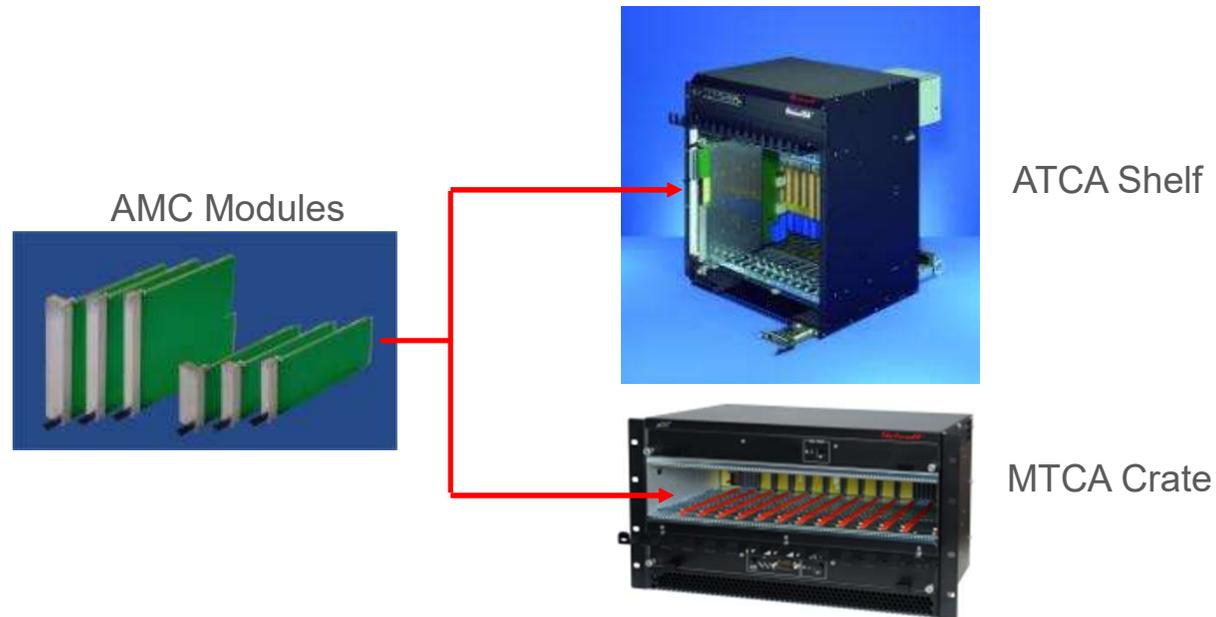


MTCA.0



MTCA.0

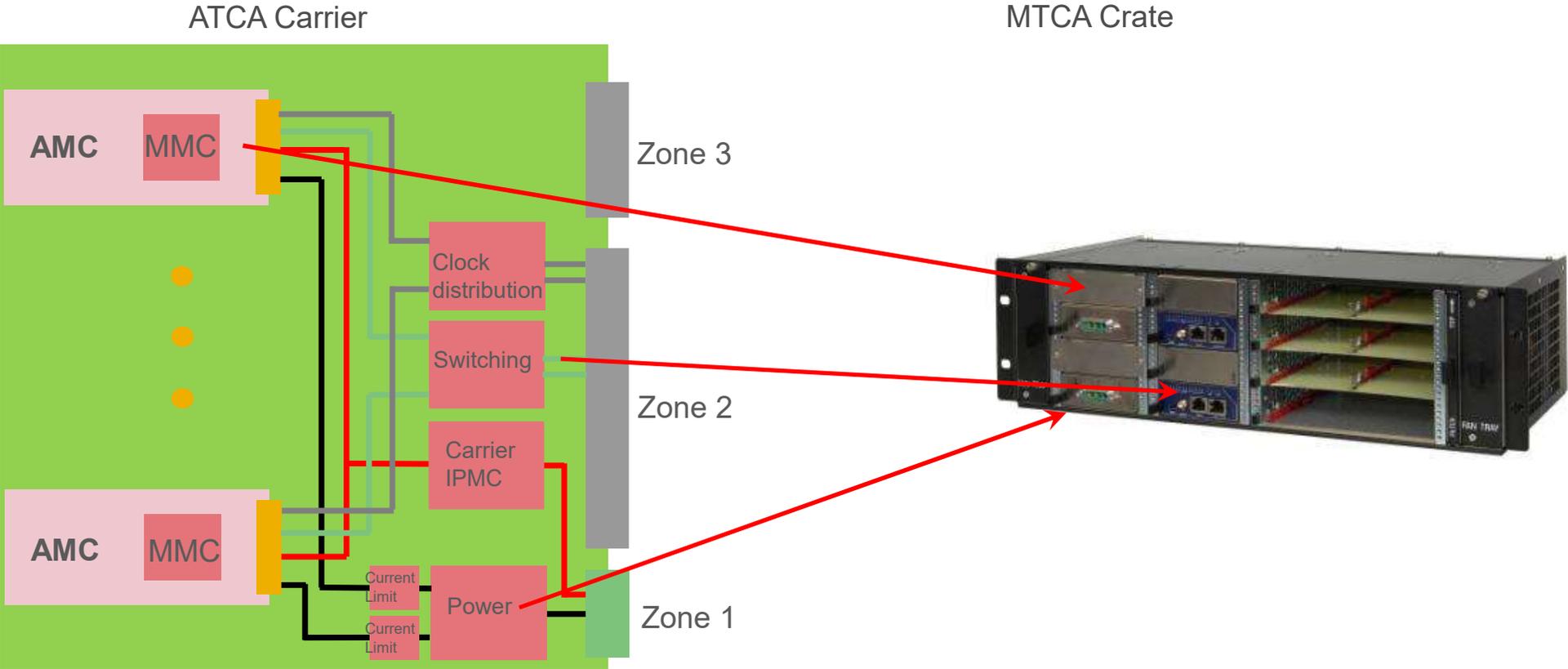
- The basic idea of MTCA is to have a shelf that contains just AMC modules
- Backplane directly accepts AMC modules
- AMCs are interchangeable between ATCA and MTCA
- The infrastructure of a ATCA Carrier was adapted into the MTCA crate (power, management, switching)
- No rear I/O, power input and all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



MTCA.0

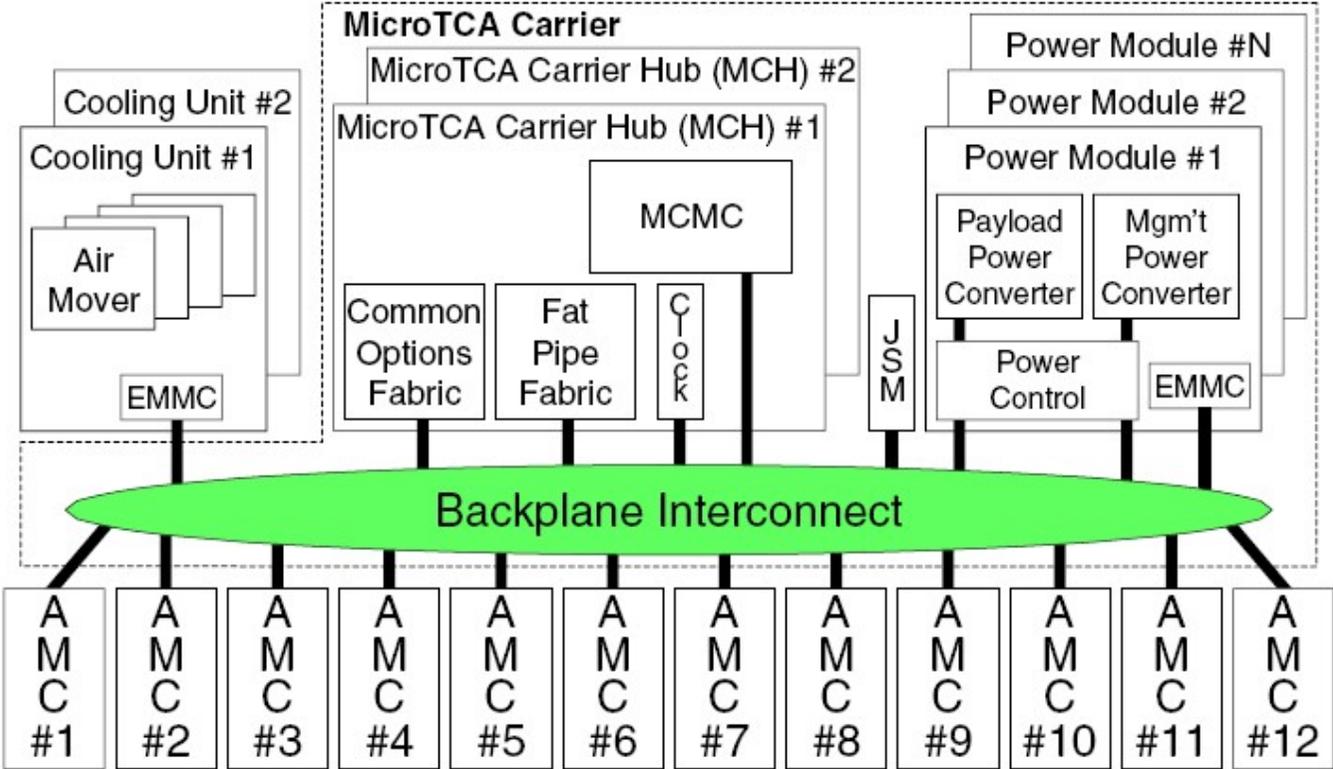
- As MicroTCA does not use a Carrier board.
The power, management, clock distribution and switching functionality must be realized onto another device
- Management Module: MCH (**MTCA Carrier Hub**)
 - IPMI management
 - clock distribution / generation
 - Switching functionality
 - JTAG slave / master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

MTCA.0



MTCA.0

MicroTCA block diagram



MTCA.0

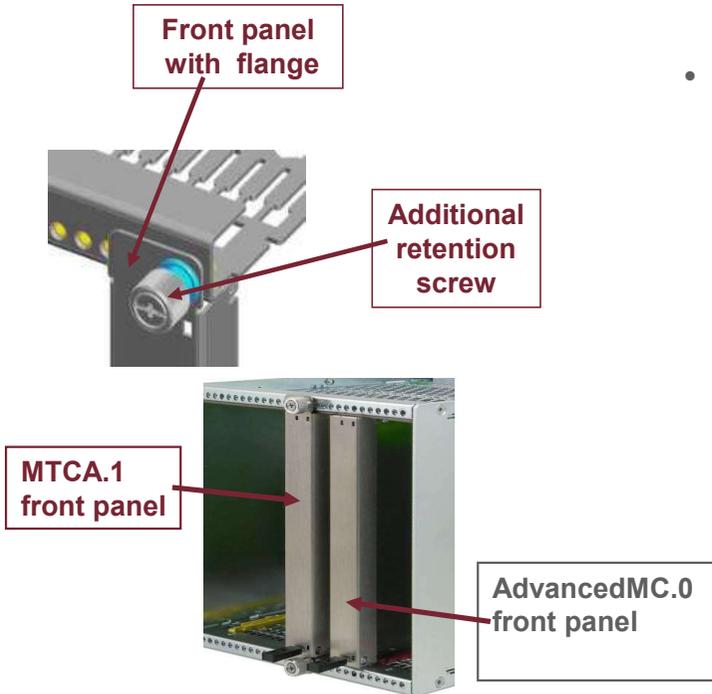
Terms and Acronyms

- **MCH** MicroTCA Carrier Hub
 - Management and switching module
- **MCMC** MicroTCA Carrier Management Controller
 - Physical IPMI controller on the MCH
- **MMC** Module Management Controller
 - Physical IPMI controller on an AMC
- **EMMC** Enhanced MicroTCA Carrier Management Controller
 - 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

MTCA.1 - 3

MTCA.1

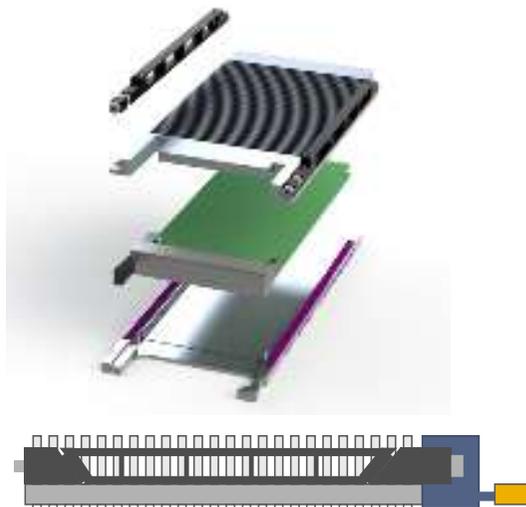
AdvancedMC front panel has to be fastened (screwed) to the subrack



MTCA.2

Hardened Air Cooled MicroTCA

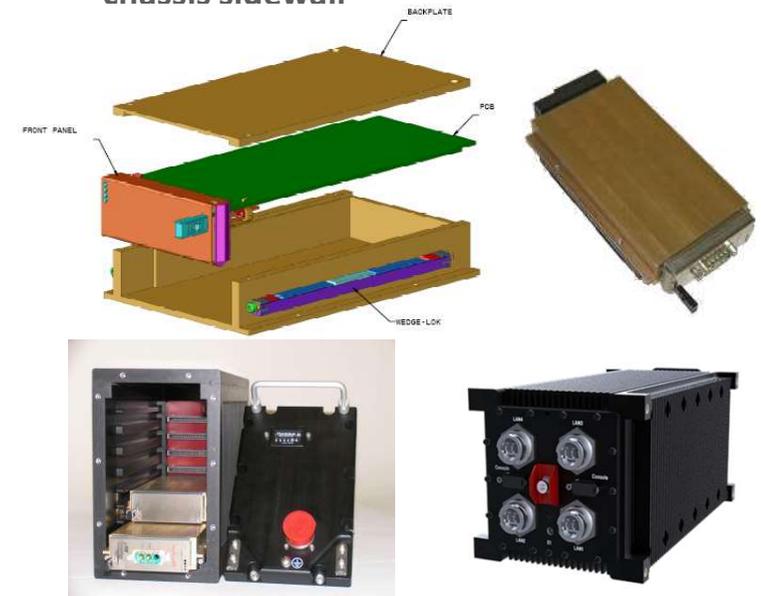
- For Telecommunication outdoor and military air, land and sea applications
- Clamshell System for high shock & vibration requirements
- Retainer solution allows forced air flow through heat sinks



MTCA.3

Conduction Cooled MicroTCA

- For Telecommunication outdoor and military air, land and sea applications
- Standard AMC board in a clamshell provides a thermal conduction path to the thermal interface surfaces of the chassis sidewall



MTCA.4



MTCA.4

Why were extensions needed to the existing MicroTCA specifications?

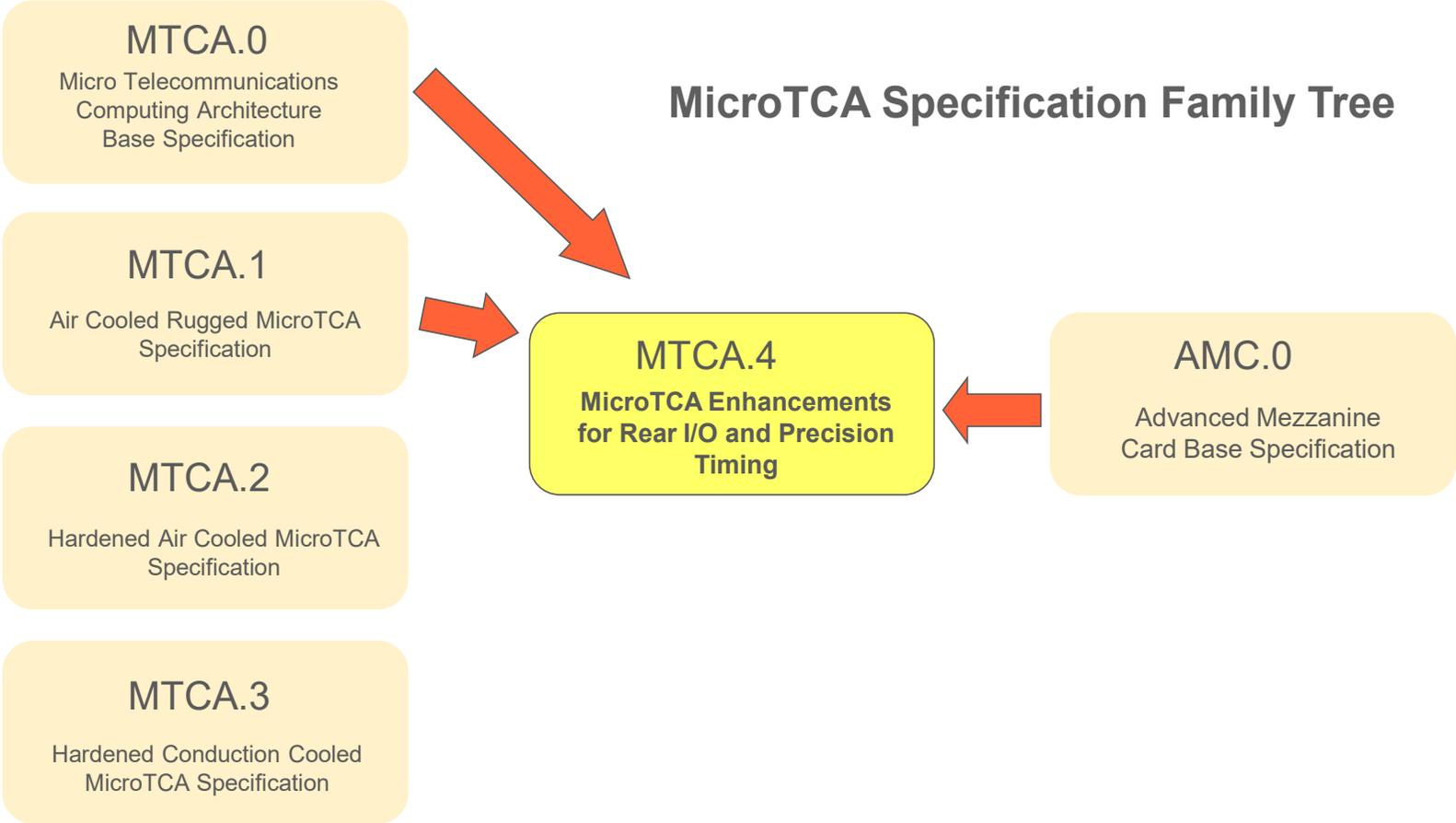
- **No Rear Transition Module (RTM) defined for MicroTCA**
 - Requirement for a large number of I/O cables.
It makes sense to connect them to the rear of the chassis
- **Special clock and trigger topology**
 - MicroTCA.0 specifies 3 Clocks and AMC.0 R2.0 specifies 4 Telecom and 1 Fabric Clock on the 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**
 - In a 19" wide crate the AMC module size double mid-size allows front configuration of:
 - max. 2 MCHs
 - max. 4 power units
 - max. 12 AMCs
- **Large MicroRTM real estate**
 - MicroRTM size approximately the size of the AMC (doubles depth of existing MTCA 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



MTCA.4

Typical MTCA.4 Crate



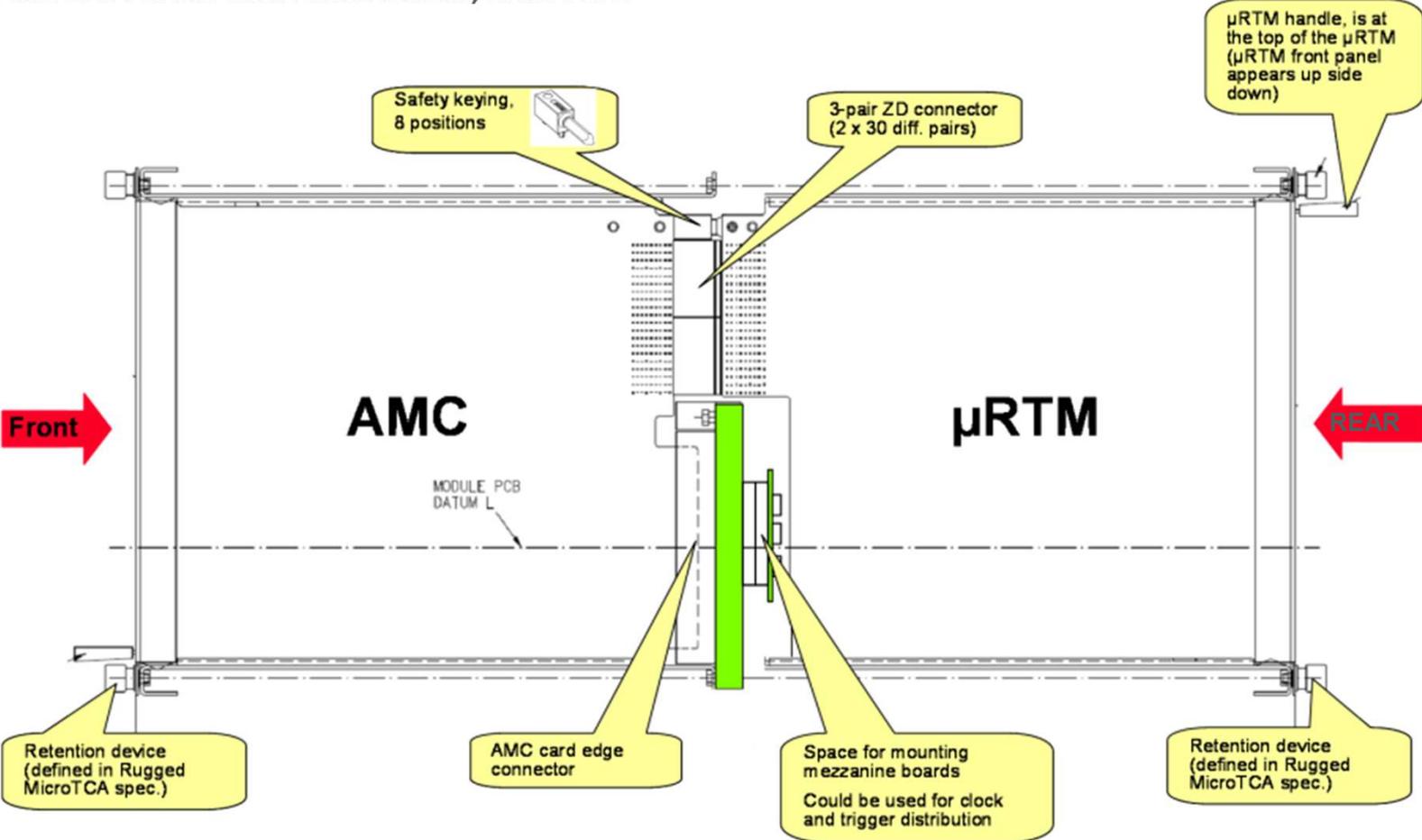
- 1 Upper Cooling Unit (CU1)
- 2 Lower Cooling
- 3 Air filter
- 4 ESD Wrist Strap Terminal
- 5 Cable Tray Unit (CU2)
- 6 Backplane
- 7 Card cage



- 8 Rear card cage
- 9 Cable Tray
- 10 Ground Terminal

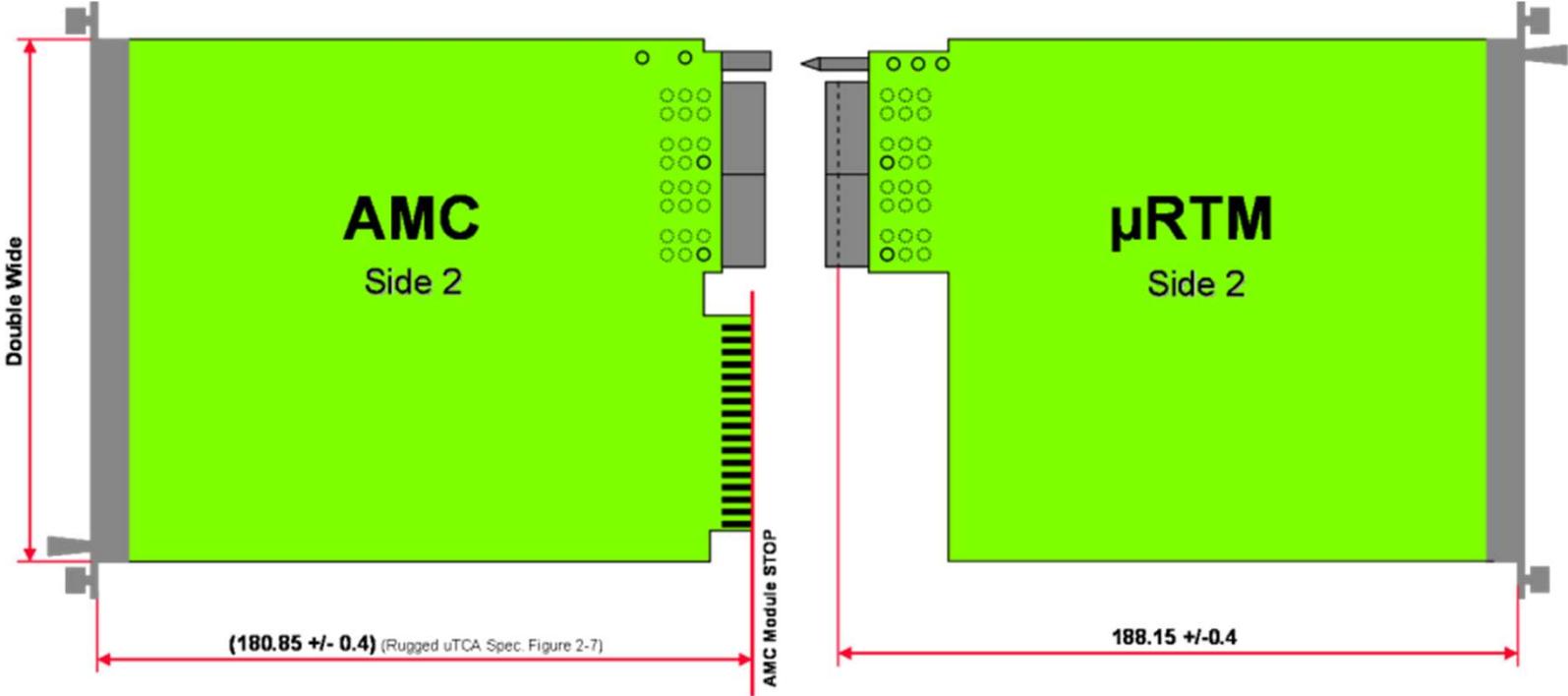
MTCA.4

Features of MTCA.4 shelf with MicroRTM, side view



MTCA.4

Module Sizes



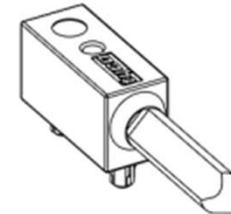
MTCA.4

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

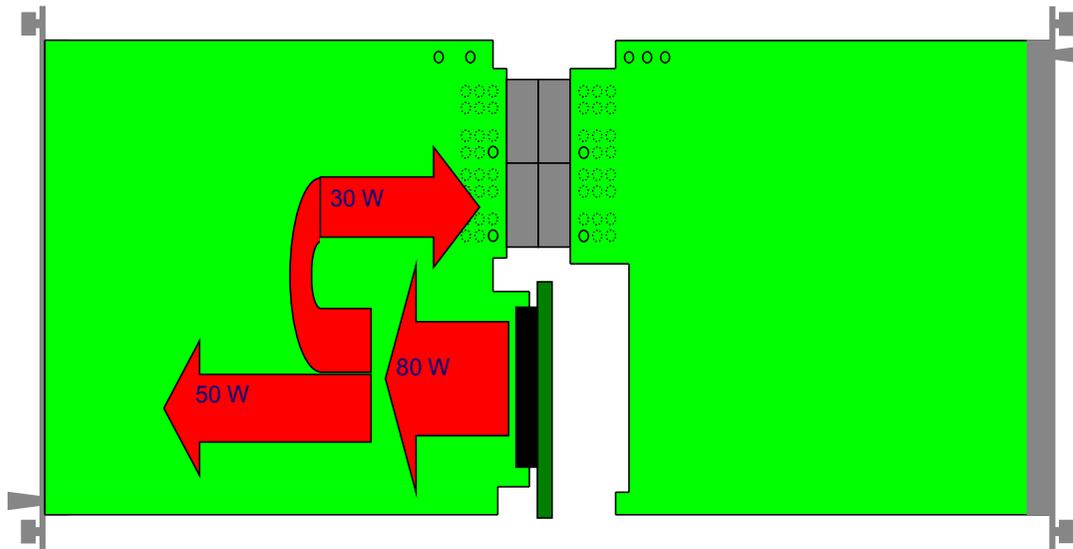
N	Data Signal in Volts
1	LVDS
2	0 – ± 1
3	$>\pm 1$ – ± 3.3
4	$>\pm 3.3$ – ± 10
5	$>\pm 10$
6	Reserved
7	Reserved
8	Reserved



MTCA.4

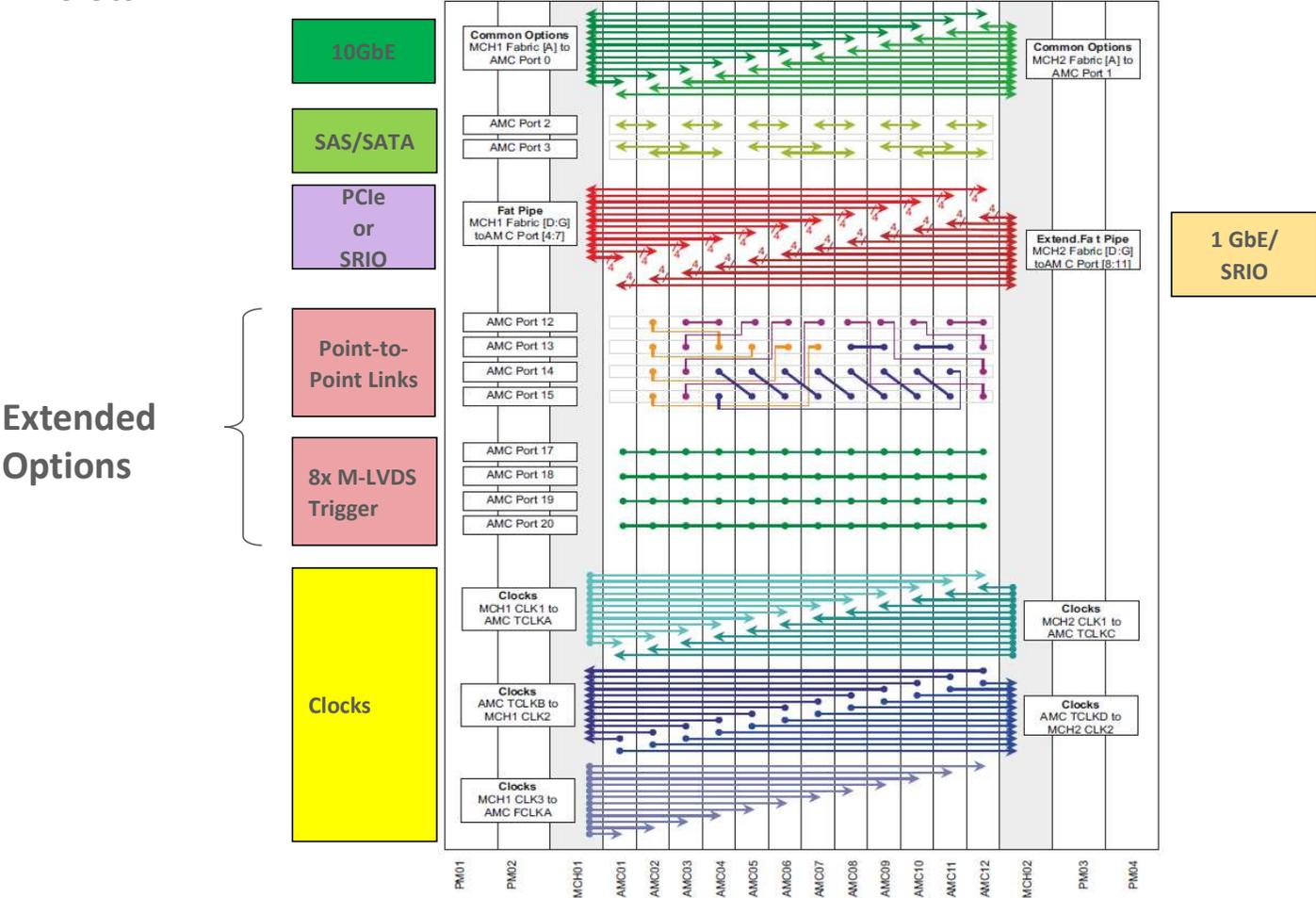
Front board and MicroRTM power distribution

- 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



MTCA.4

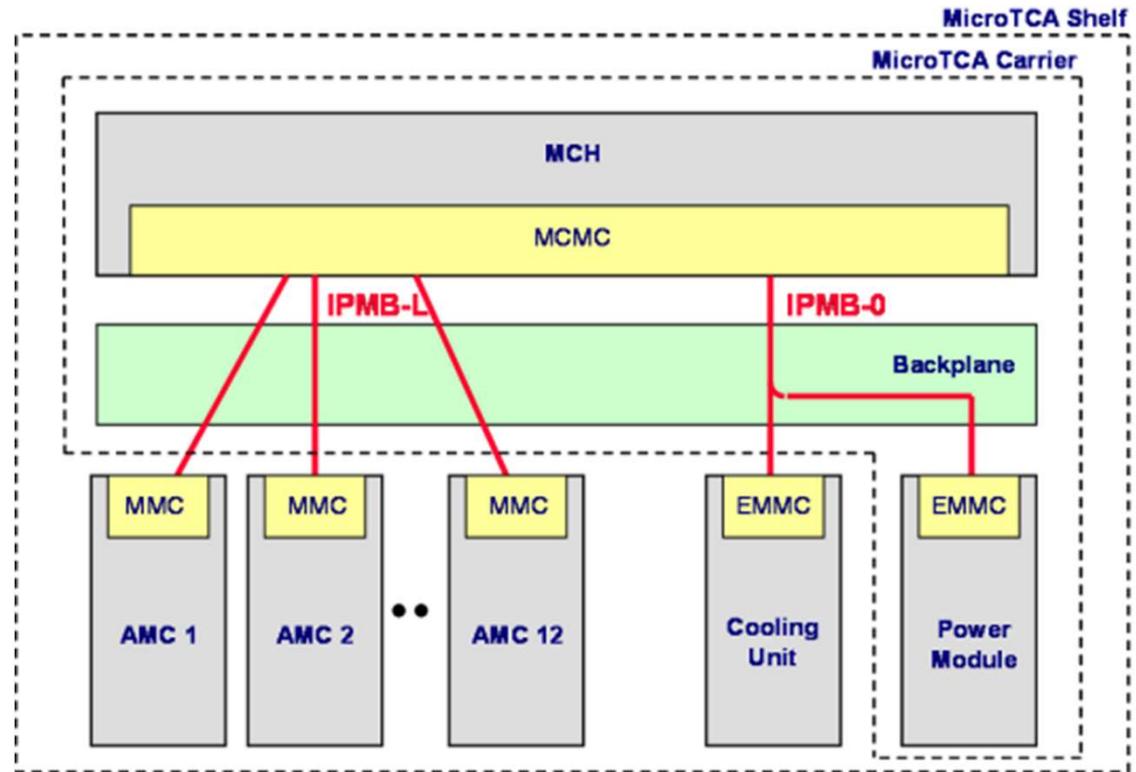
MTCA.4 Backplane 12-Slots



MTCA.4

Management defined in AMC.0 / MTCA.0

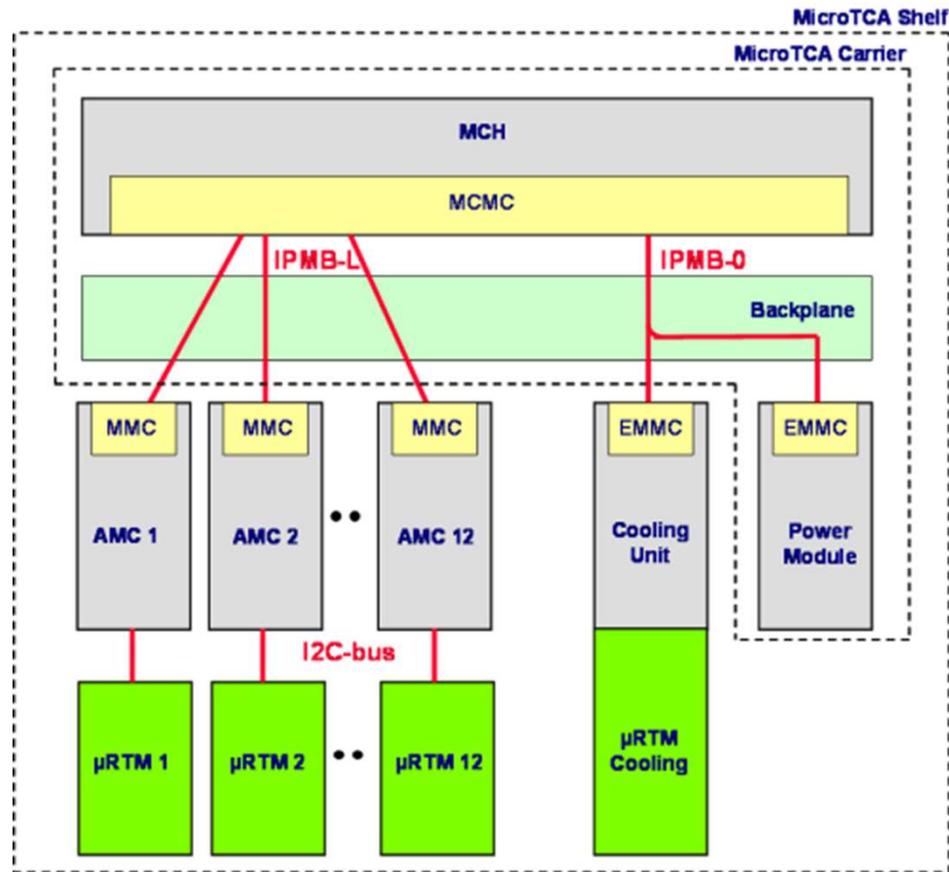
- **IPMB-L**
 - Connects the MCMC on the MCH to the MMC on the AMC Modules
 - Radial architecture
- **IPMB-0**
 - Connects the MCMC on the MCH to the EMMC on the PM and CU
 - Bused architecture



MTCA.4

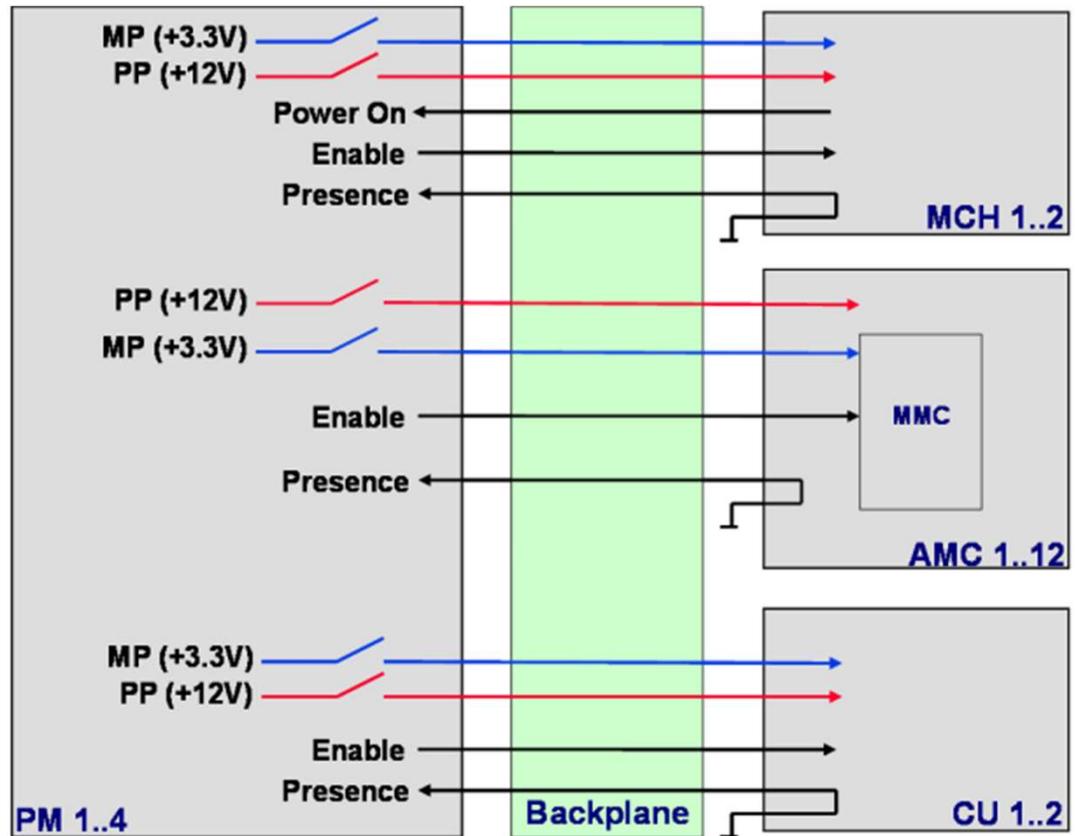
Management extensions in MTCA.4

- **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



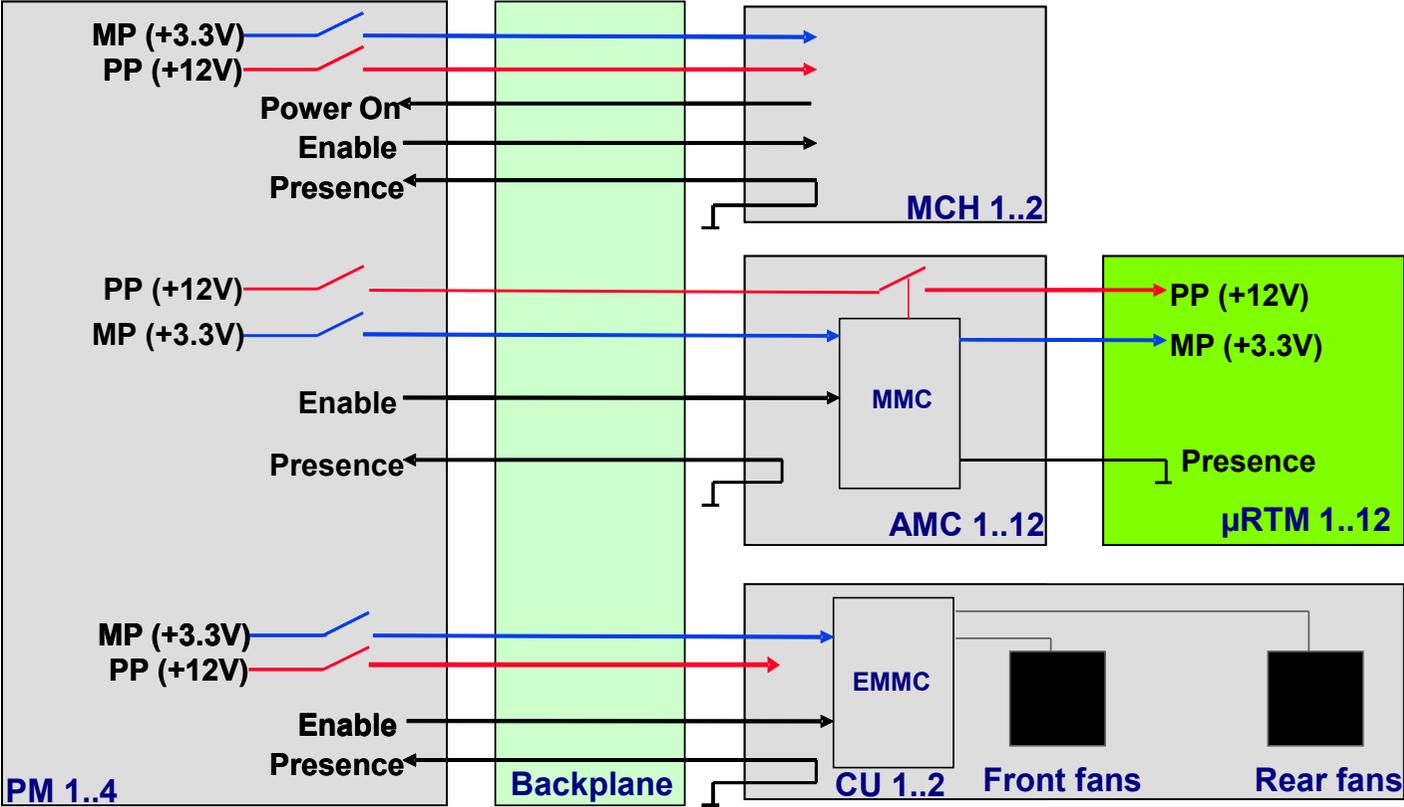
MTCA.4

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



MTCA.4

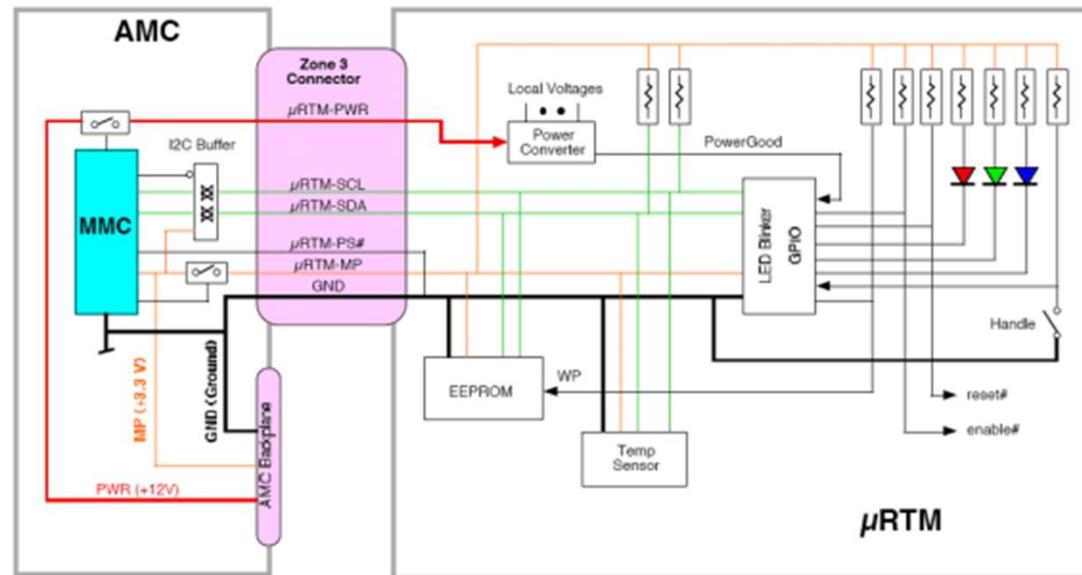
Additional RTM control signals for MTCA.4



MTCA.4

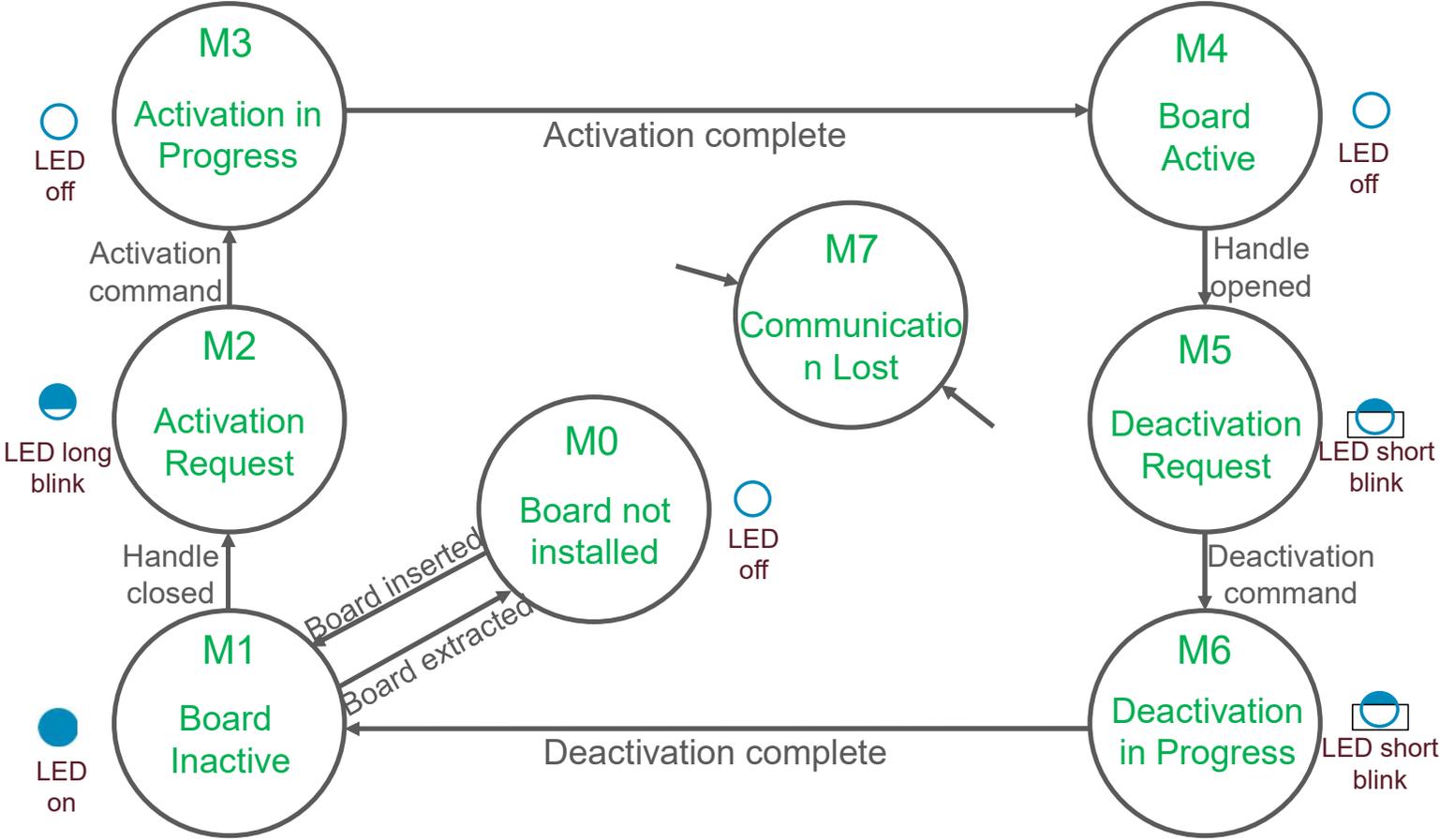
MicroRTM Management

- 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

FRU State Transition (simplified)



MTCA.4

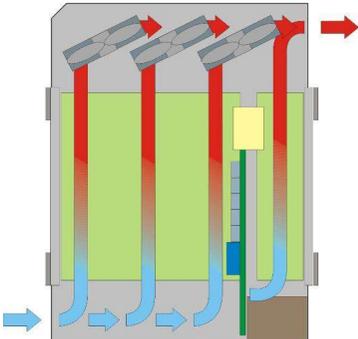
Cooling concepts

The cooling concept depends on the installation situation of the chassis:

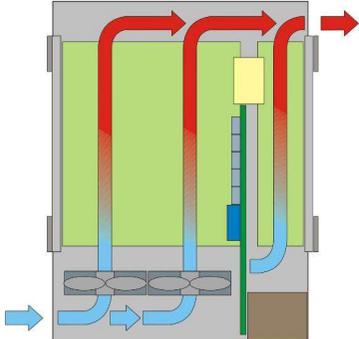
- Front-to-rear air flow
- Side-to-side air flow
- Bottom-to-top air flow
- Front-to-side air flow

Fan configuration:

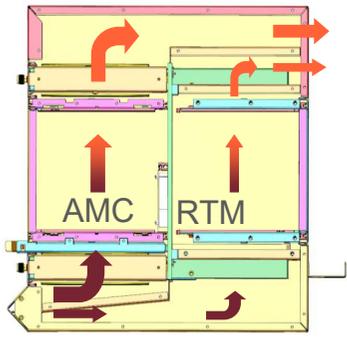
- Push
- Pull
- Push-pull



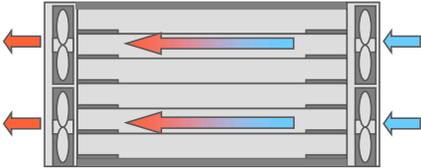
Pull configuration, Front-to-rear



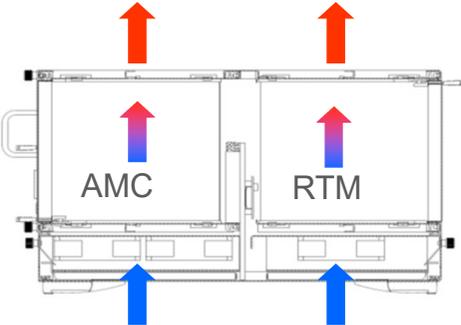
Push configuration, Front-to-rear



Push-Pull configuration Front to rear



Push-Pull configuration Side-to-side



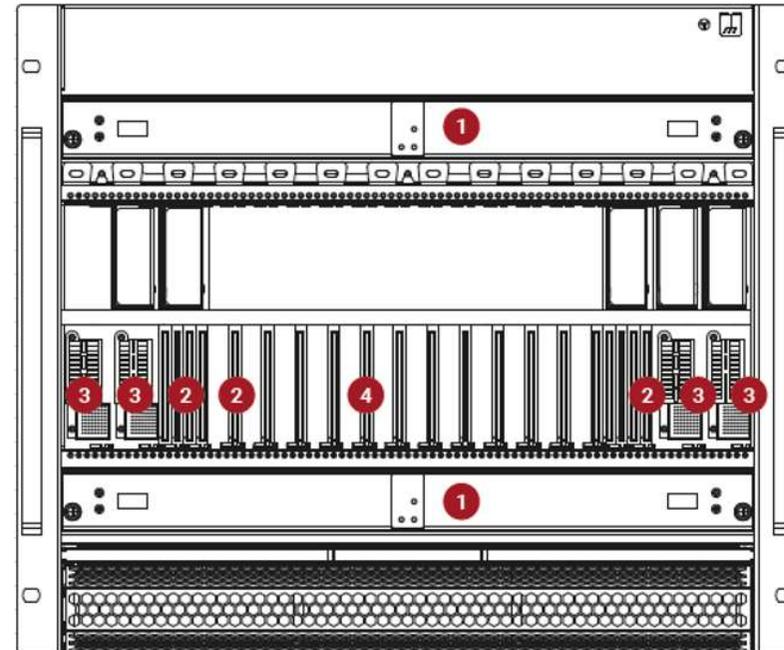
Pull configuration, bottom-to-top

MTCA.4

Redundancy

For high availability applications all modules are redundant:

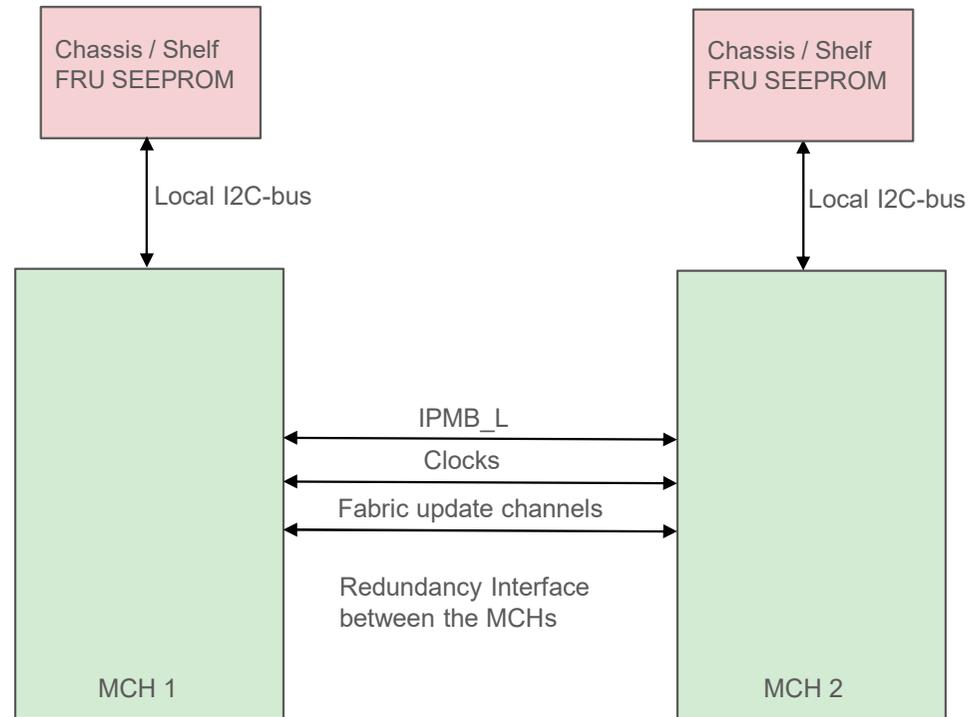
- 2 x Cooling Unit (1) in push-pull configuration
- 2 x MCH (2)
- 4 x Power Module (3)
- IPMB-0:
One logical bus divided into two physical busses: IPMB-A and IPMB-B



MTCA.4

MCH Redundancy

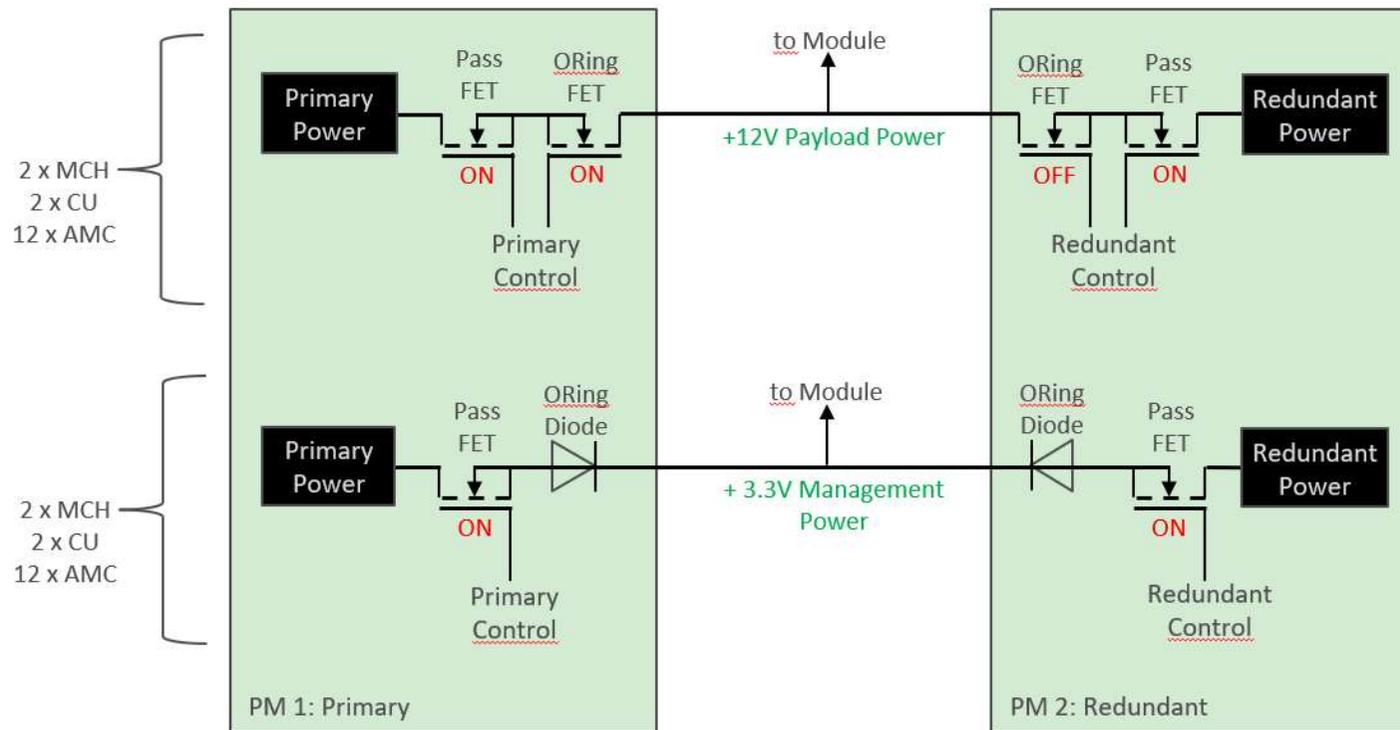
- Two MCH: One is Master, One is Redundant
- Redundant chassis / shelf FRU Information SEEPROM
- Redundancy Interface between the two MCH
- Redundancy defined in chassis / shelf FRU information



MTCA.4

Power Module Redundancy

- Up to 4 Power Modules per chassis
- Redundancy mode defined in shelf FRU file
- Individual power channel to each module and FRU



MTCA.4

Cooling Unit Redundancy

- Redundant Cooling Units in push-pull configuration
- Scenario 1: fan failure
- Scenario 2: Cooling Unit replacement

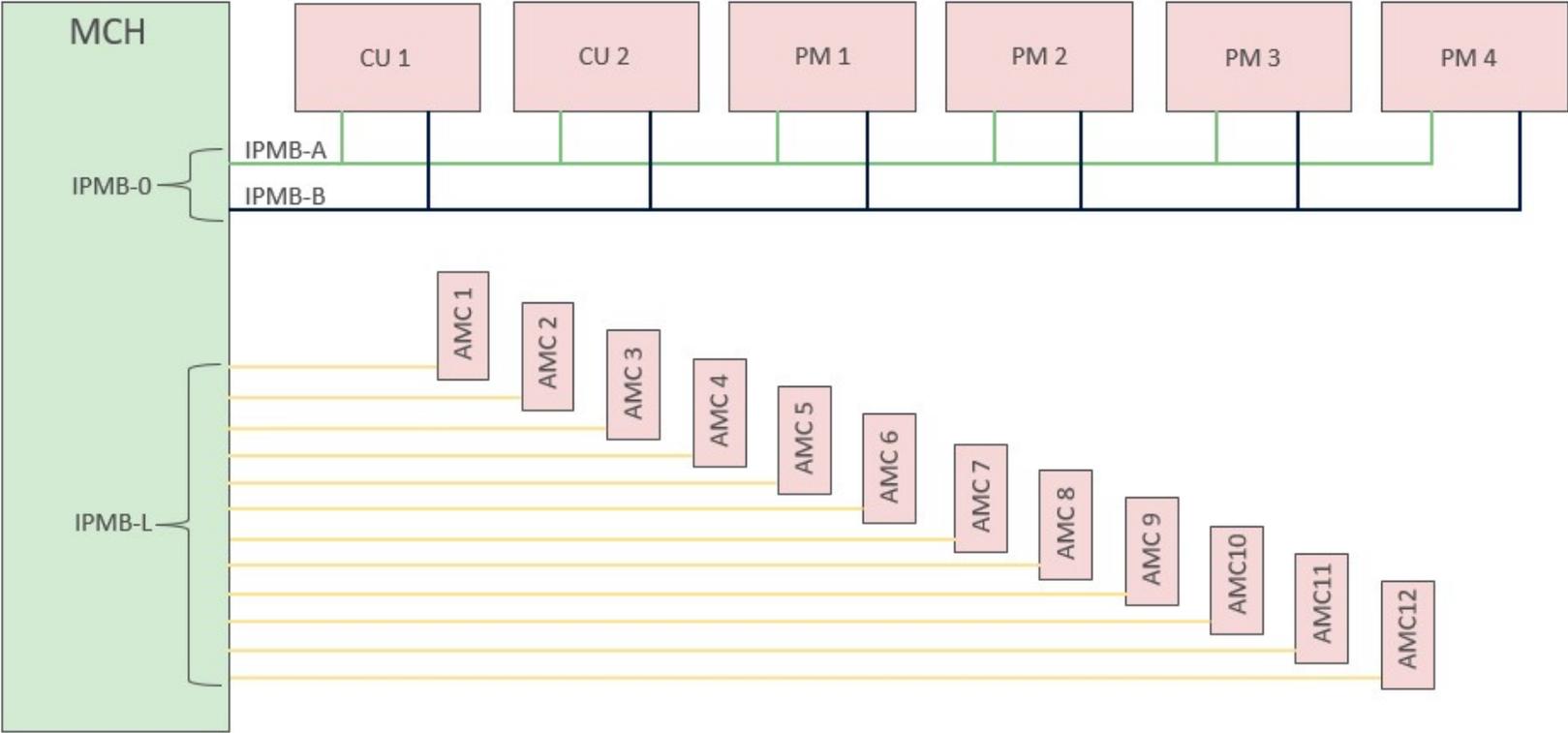


- 1 – 6 Fan
- 7 Hot Swap bush button
- 8 CU1
- 9 CU2

MTCA.4

IPMB redundancy

- Individual IPMB-L to each AMC
- Redundant logical IPMB-0 to PMs and CUs



MTCA.4

MTCA.4 Chassis types

Various different MTCA.4 crates available:

- Laboratory use
- Fully redundant
- Compact sizes
- Small form factors
- Different cooling concepts
- Different backplane topologies

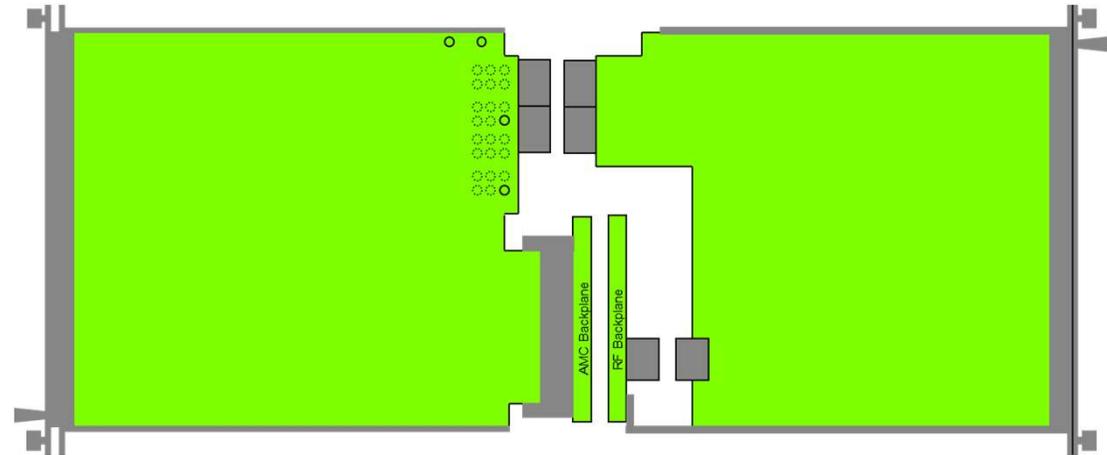


MTCA.4.1

Standardization continued: MTCA.4.1

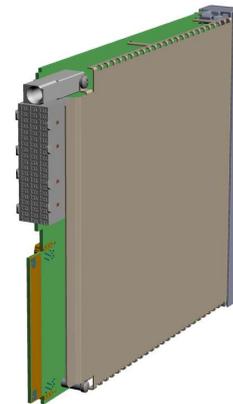
Definition of a RTM Auxiliary Backplane (MTCA.4.1)

- Based on the LLRF backplane
- Optional connector usage



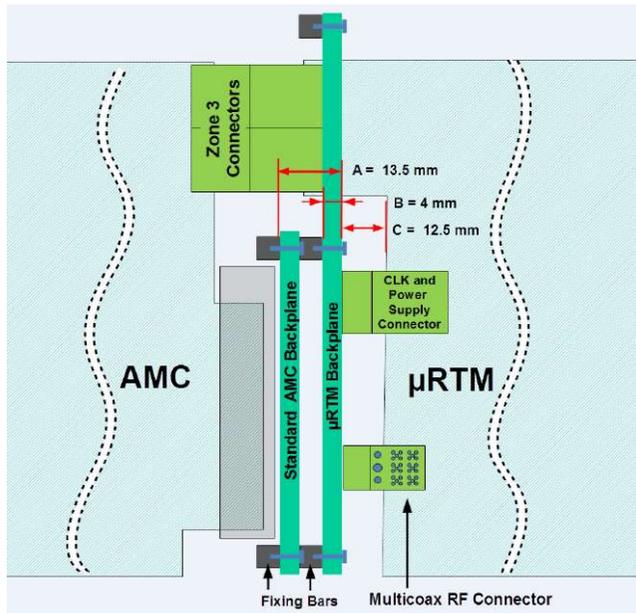
Protective mechanical cover for AMC and RTM modules

- Protective cover to mechanically protect components
- For Side A and Side B



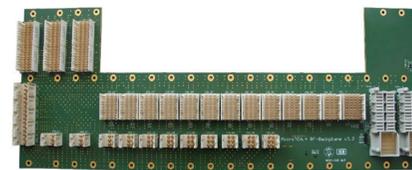
MTCA.4.1

- Auxiliary backplane for rear transition modules
- Rear power modules
- MCH Management Support & Extended Rear Transition Module (MCH-RTM)



Location for the RTM backplane in a MTCA.4 shelf

Dimension: Height: 159.5mm
 Width: 424.5mm
 Thickness: 2mm (backplane) + 2mm (shield extension)



RTM Backplane



Shield plane



MTCA.4.1

MTCA.4.1 Rear Power Module

The rear power module provides additional power to the RTMs via the RTM backplane

Output power: up to 600W

Dimensions: Double width, full-size but reduced depth due to the connector position on the RTM backplane

Depth: 185,85 mm – distance the AMC backplane to the RTM backplane

MTCA.4.1 MCH-RTM

The MCH-RTM can contain CPU, storage and peripherals which saves space in the AMC area.

Dimensions: Double width, full-size, depth 185,85 mm



Thank you