

MTCA.4 Tutorial Basics

Introduction in xTCA



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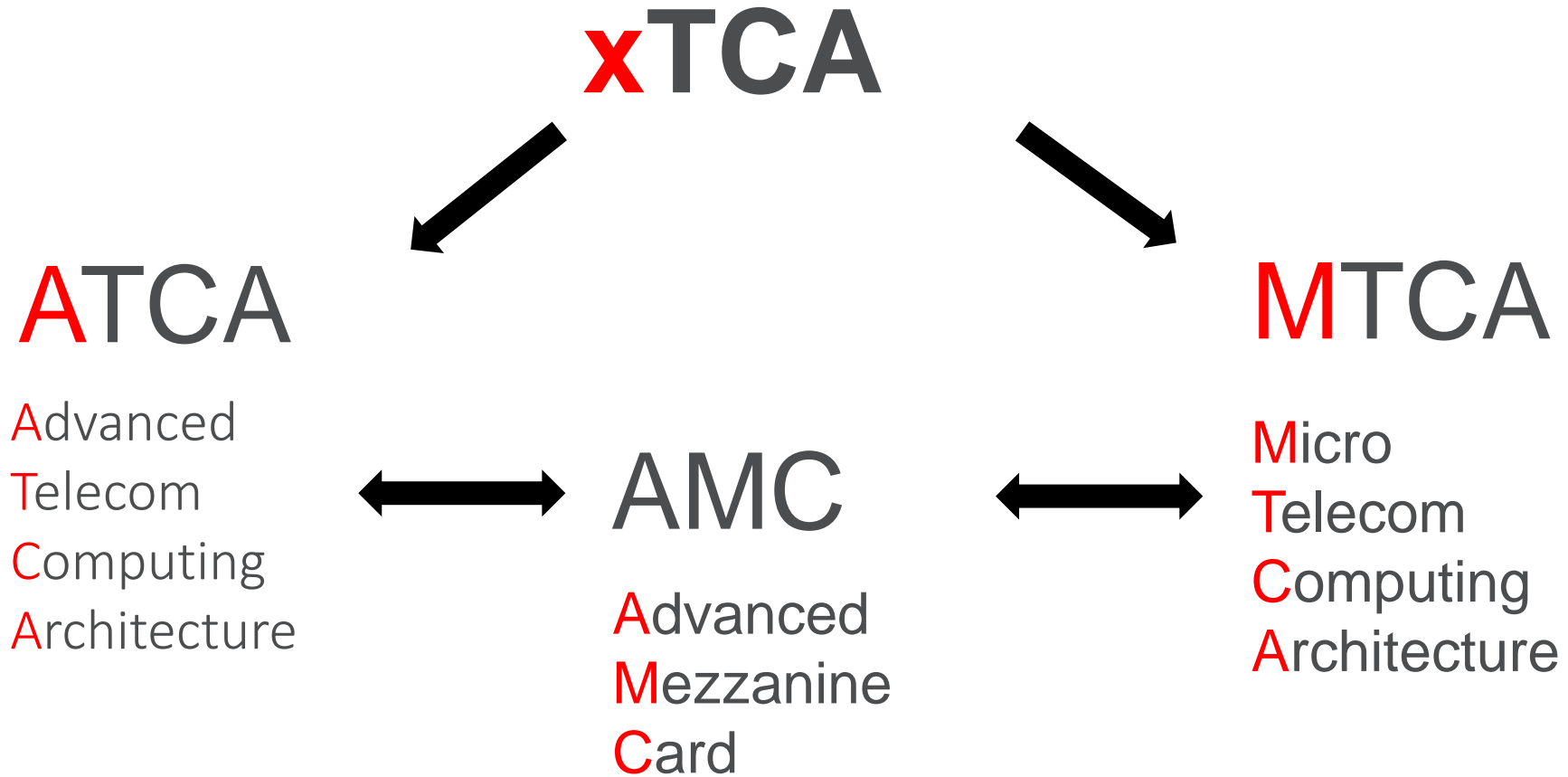
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December 01, 2020
Ralf Waldt
nVent / Schroff GmbH

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

is xTCA?





nVent

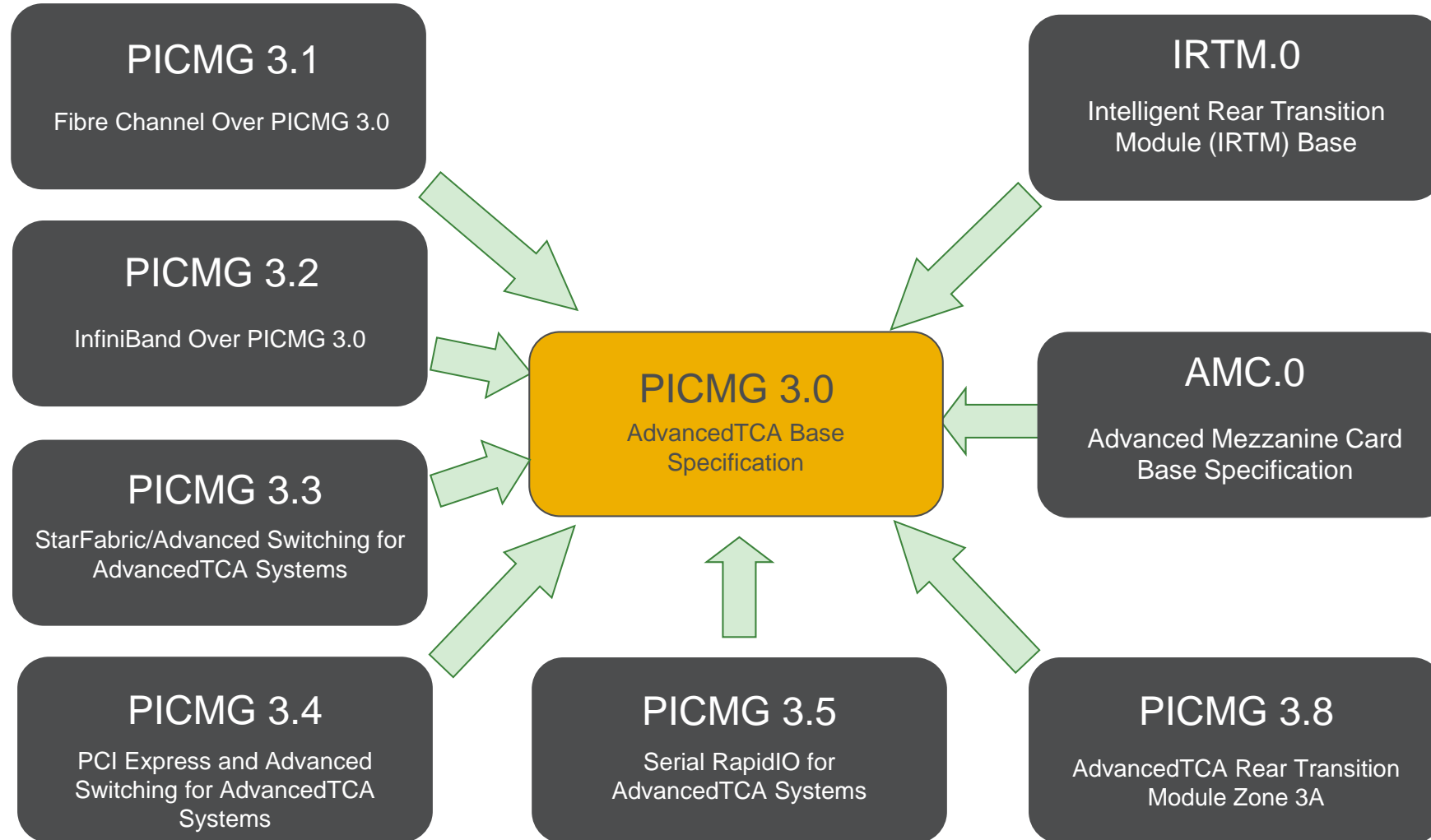
ATCA



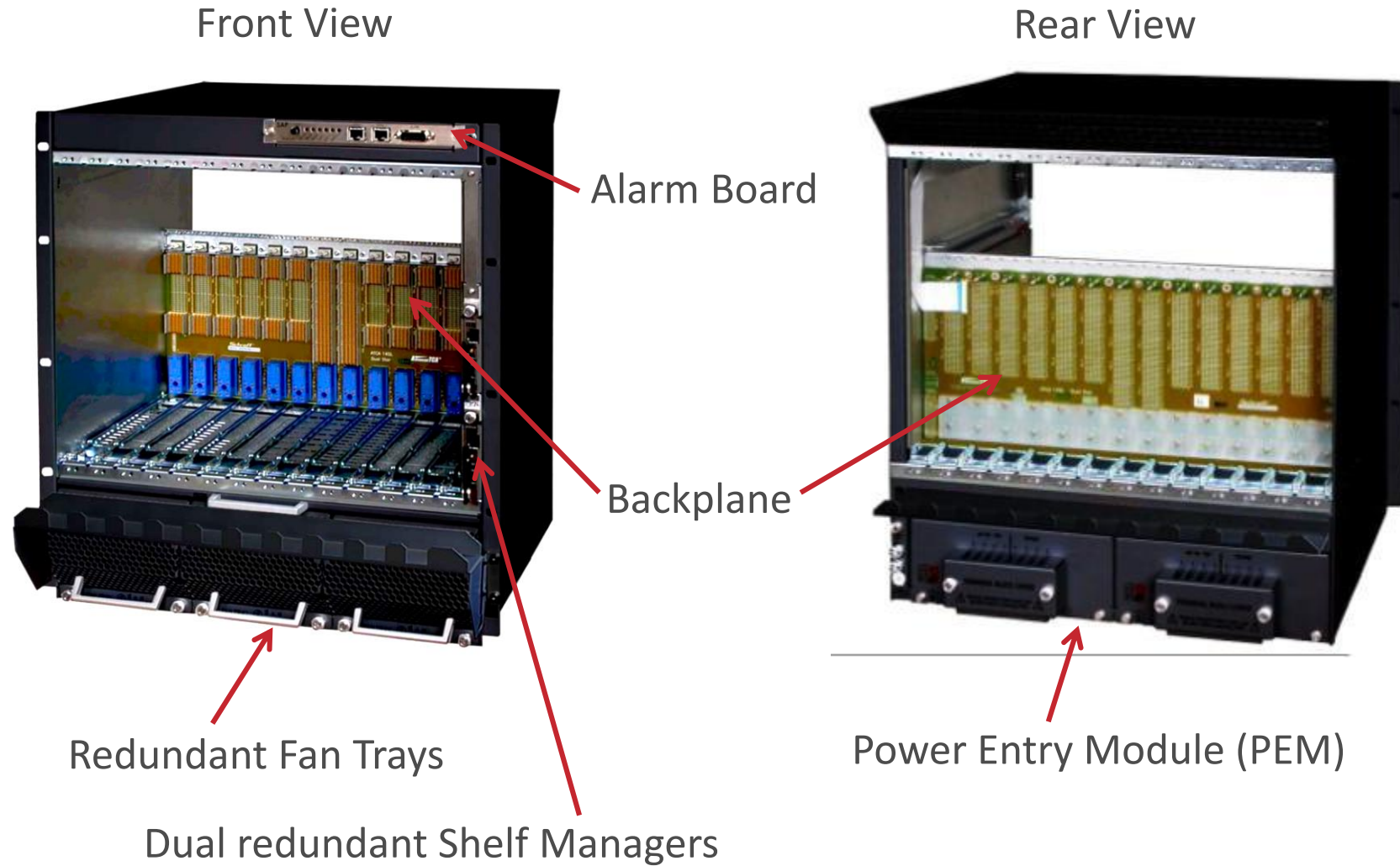
Overview

- **Specification initially targeted to the Telco Industry**
- **Features required for the new standard:**
- **System Availability 99.999% (~5 min/yr)**
- **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 Specification Family



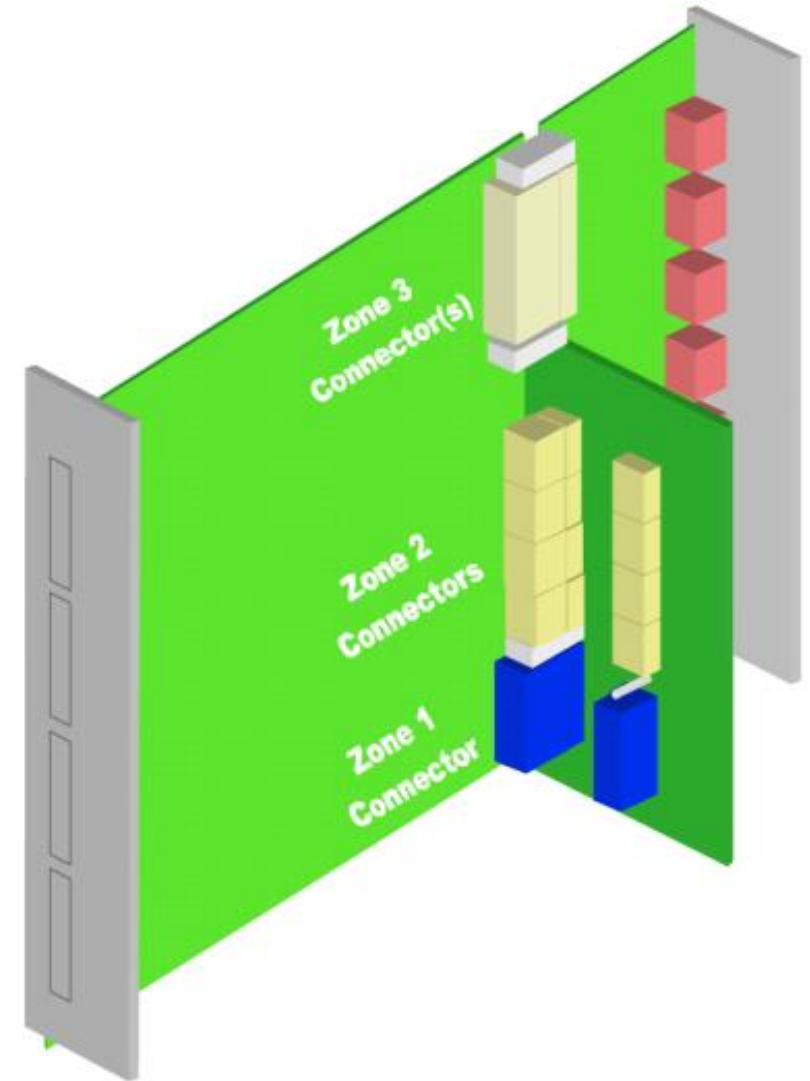
ATCA Shelf Elements



ATCA Shelf Elements

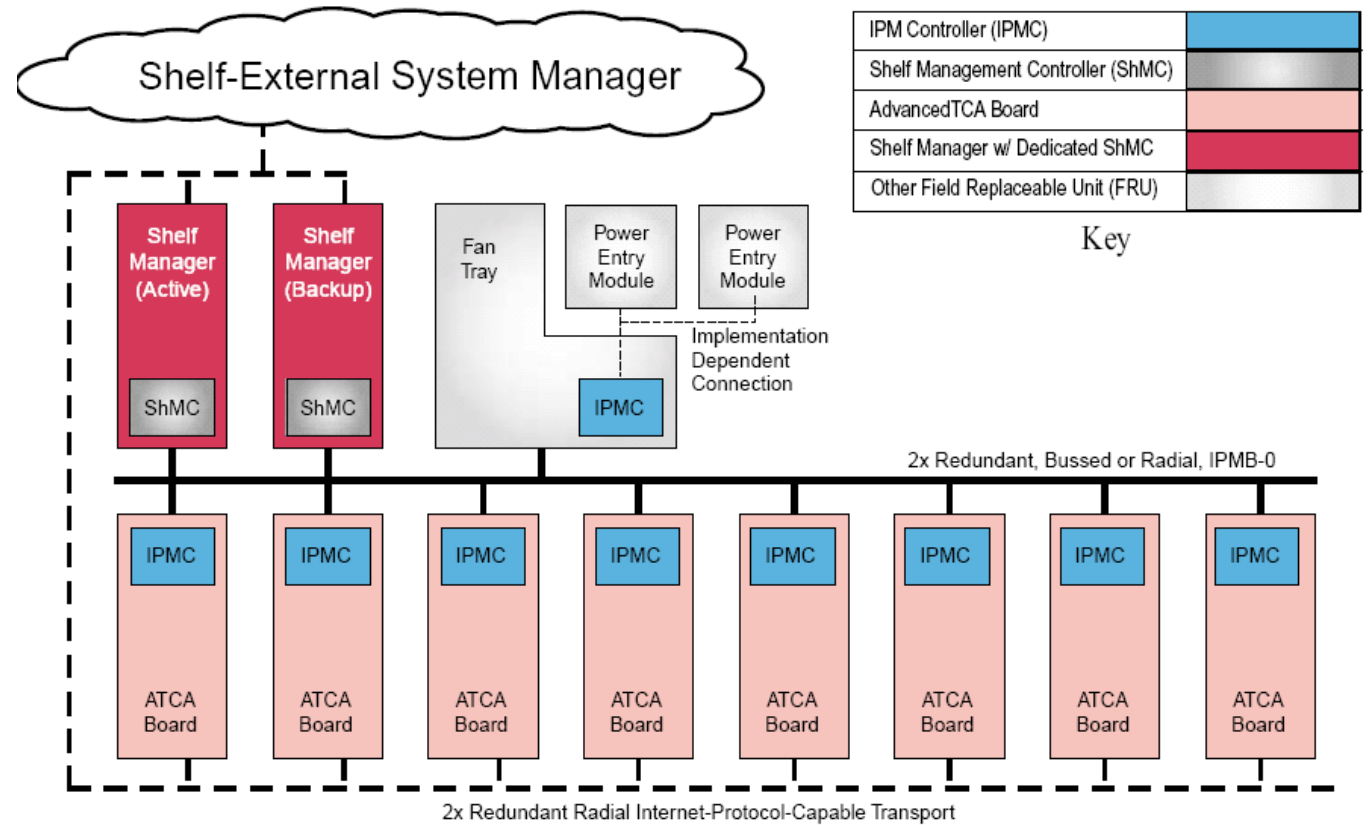
➤ Board size and connectors

- 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

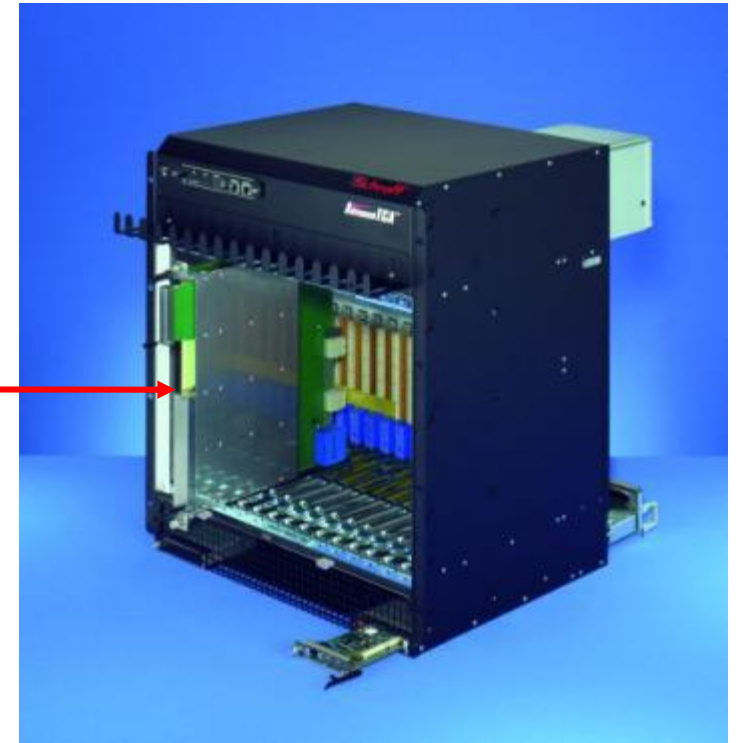
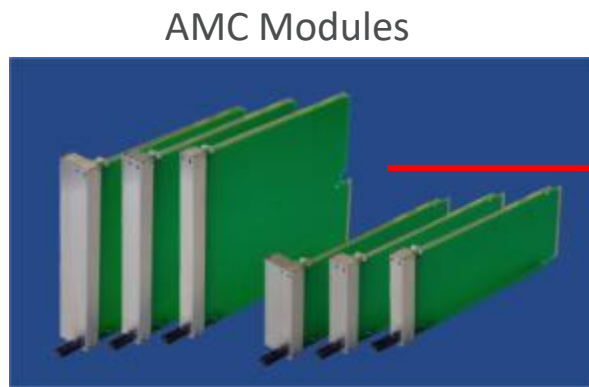
- Dedicated Shelf Management Controller (ShMC)
- ATCA Boards with IPMC
- Protocol IPMI (Physical layer I2C-Bus)
- Intelligent and Managed FRUs
- Bused or Radial IPMB





AMC 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

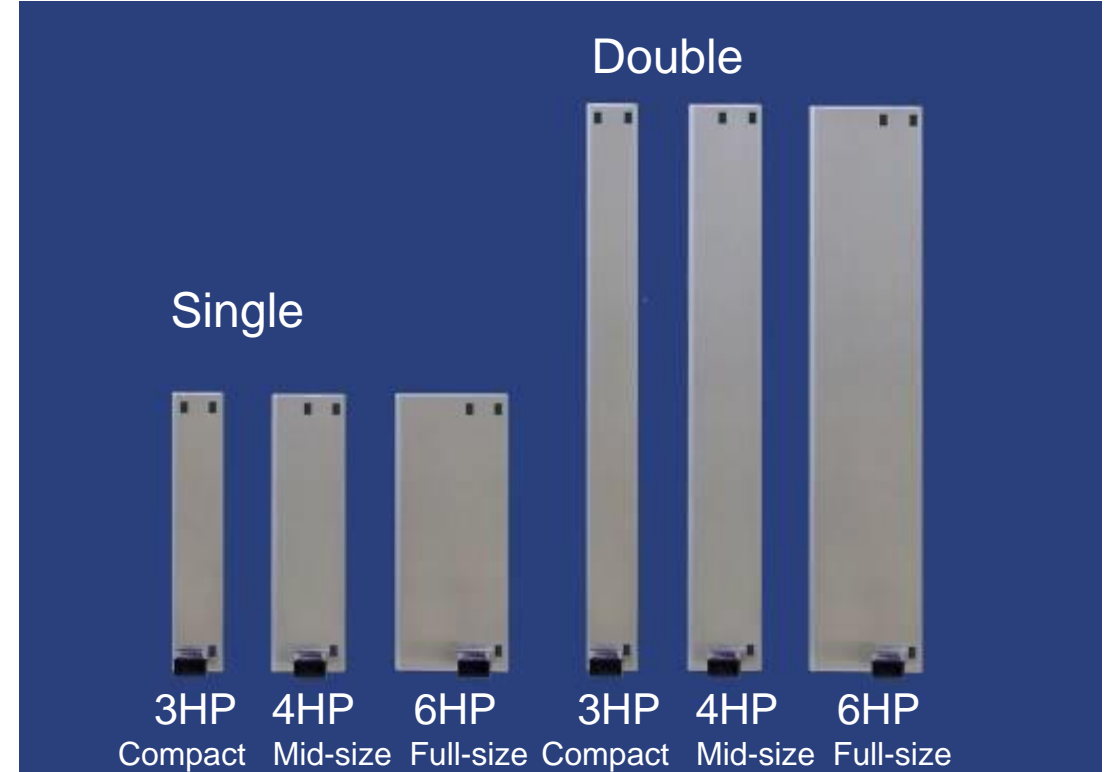
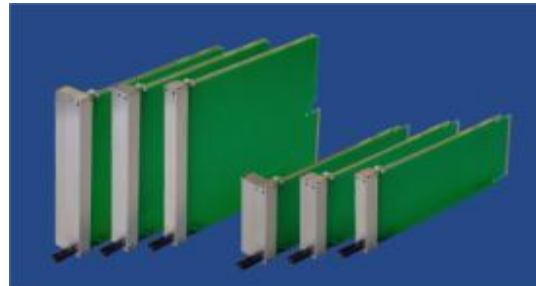
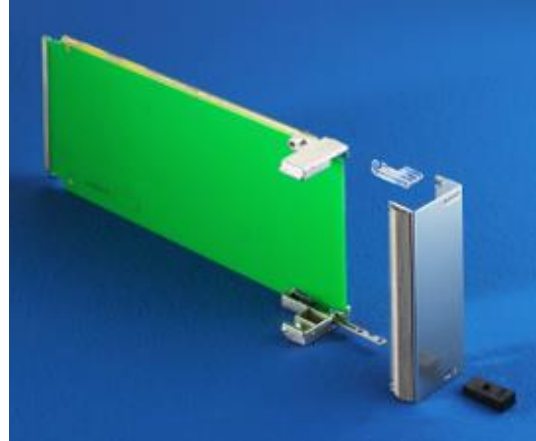


AMC Modules

➤ AMC Module Sizes

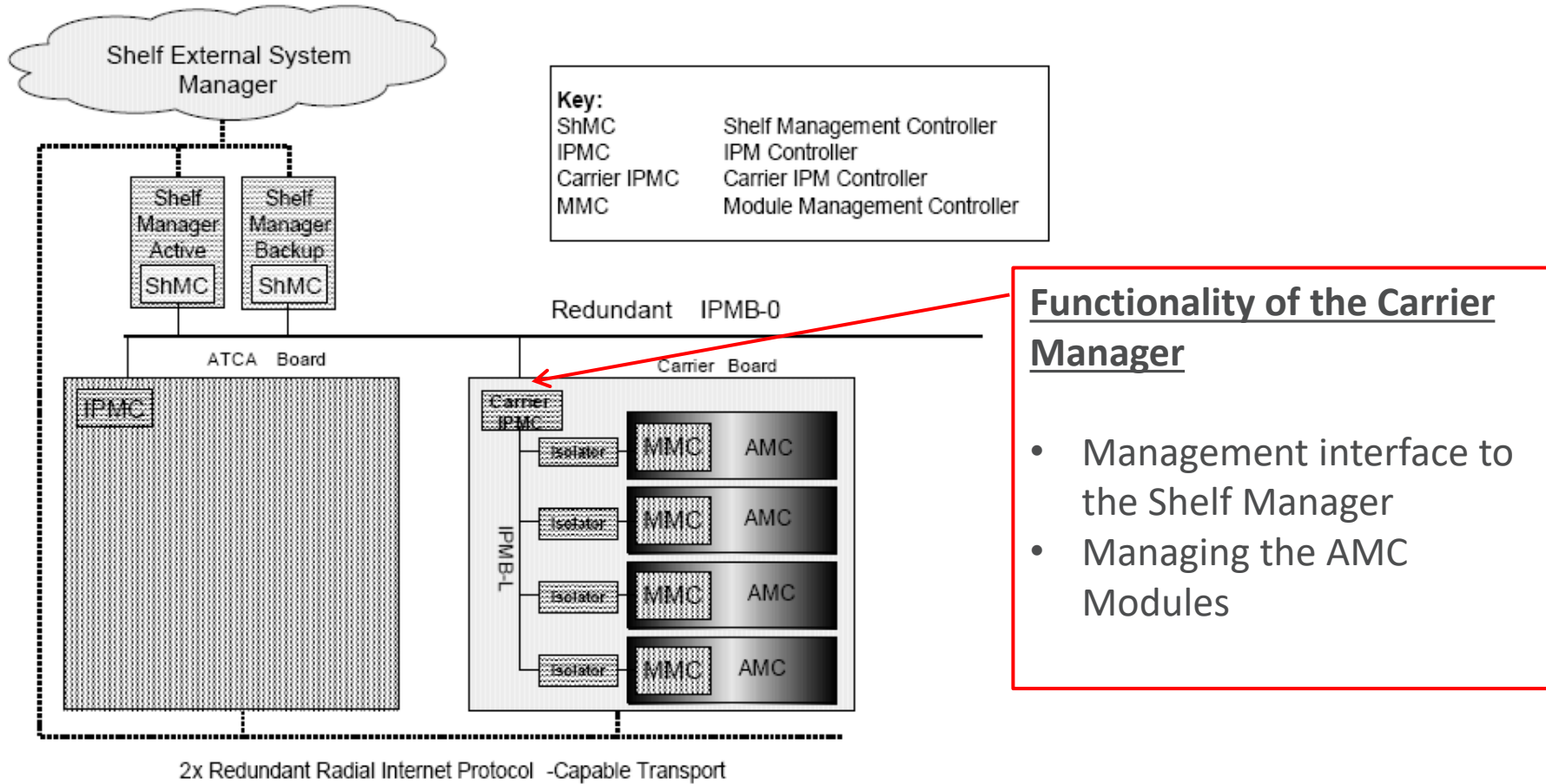
➤ 6 Standard Sizes:

- 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



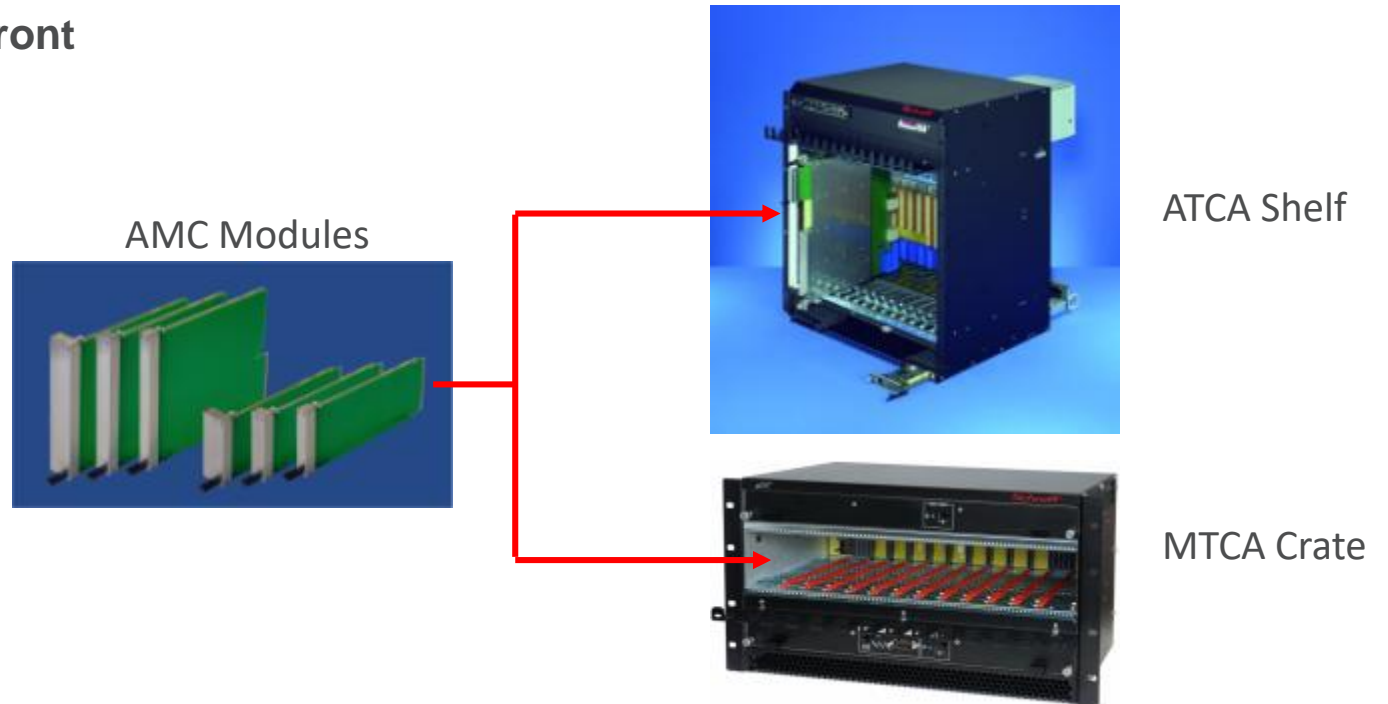


MTCA.0



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

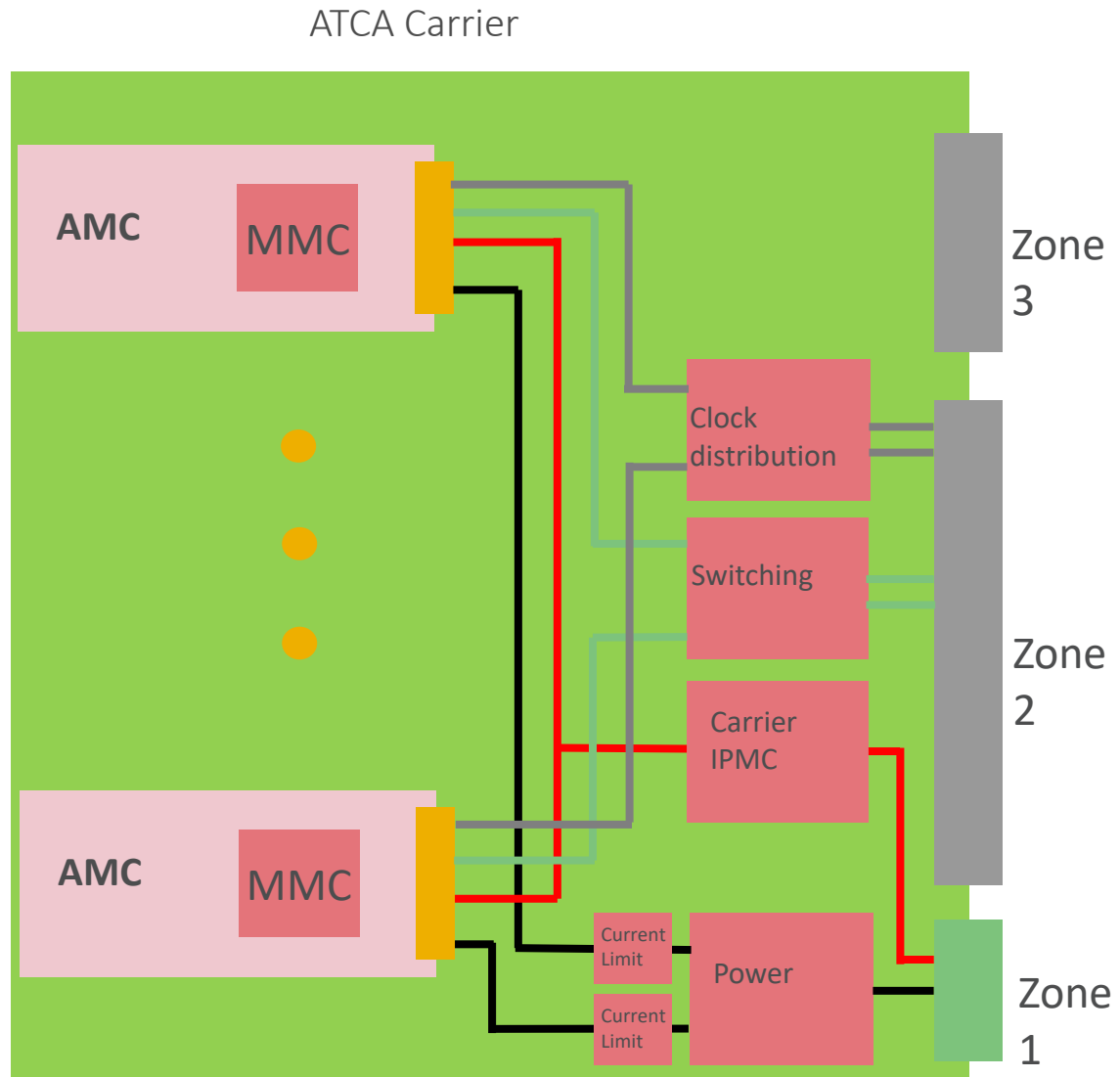
- **As MicroTCA does not use a Carrier board, the power, management, clock distribution and switching functionality must be realized onto another device**

- **Management Module: MCH (MTCA Carrier Hub)**
 - IPMI management
 - clock distribution / generation
 - Switching functionality
 - JTAG slave / master
 - Redundant MCHs

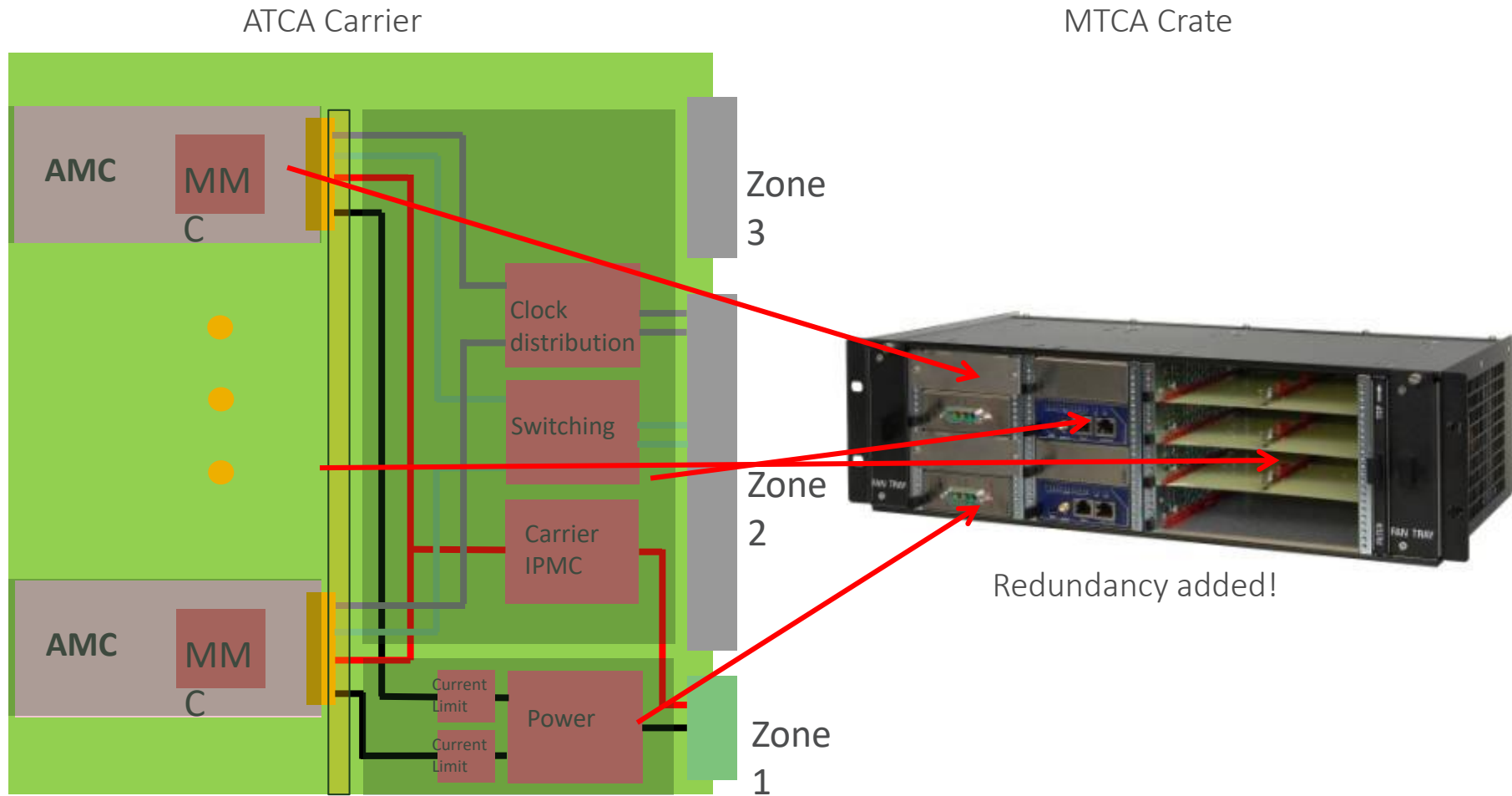
- **Power Module**
 - 12V Payload Power
 - 3.3V Management Power
 - Redundant power modules

- **Dedicated Slots for these modules are located in the MTCA crate**

MTCA.0

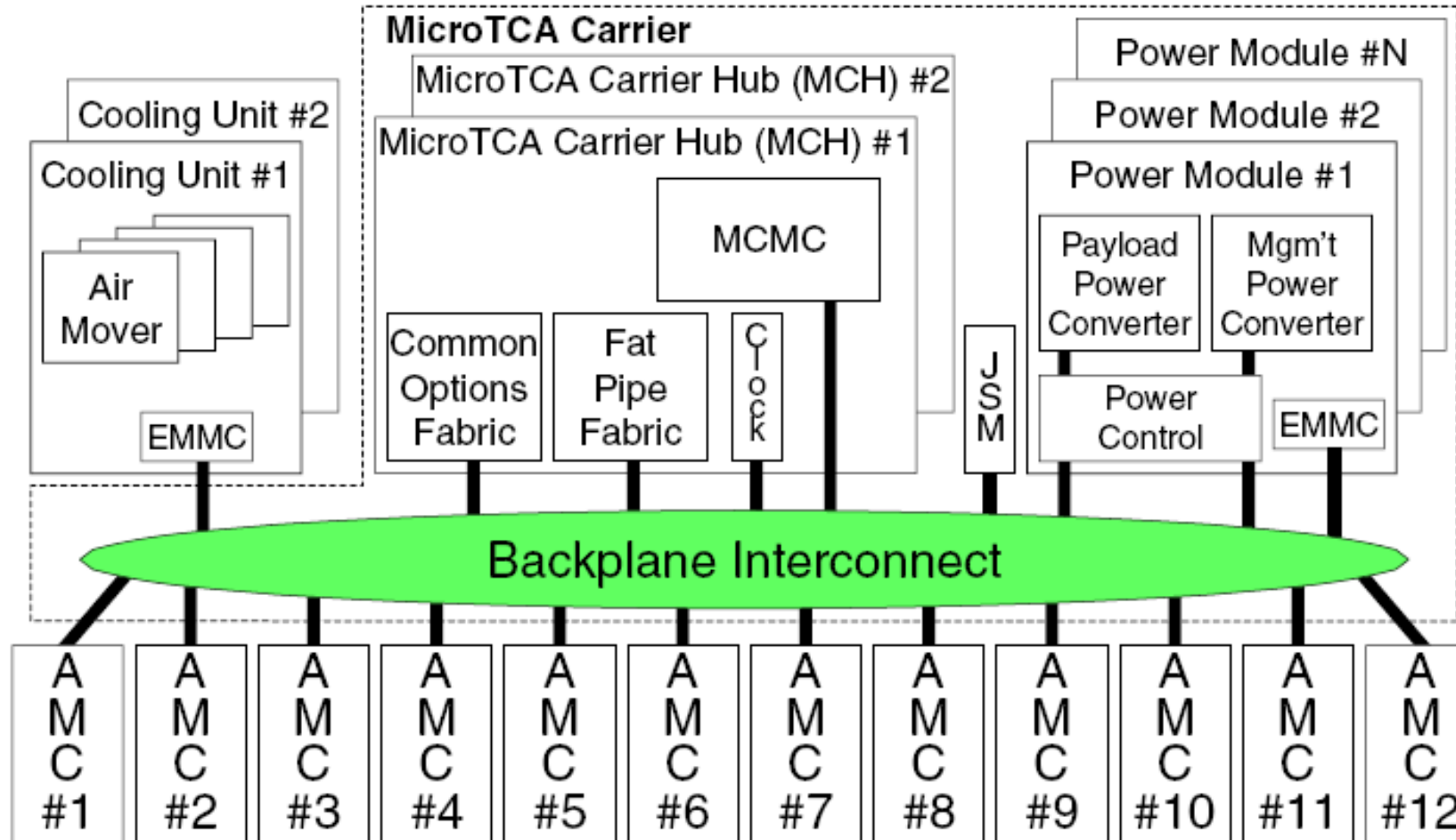


MTCA.0



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.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

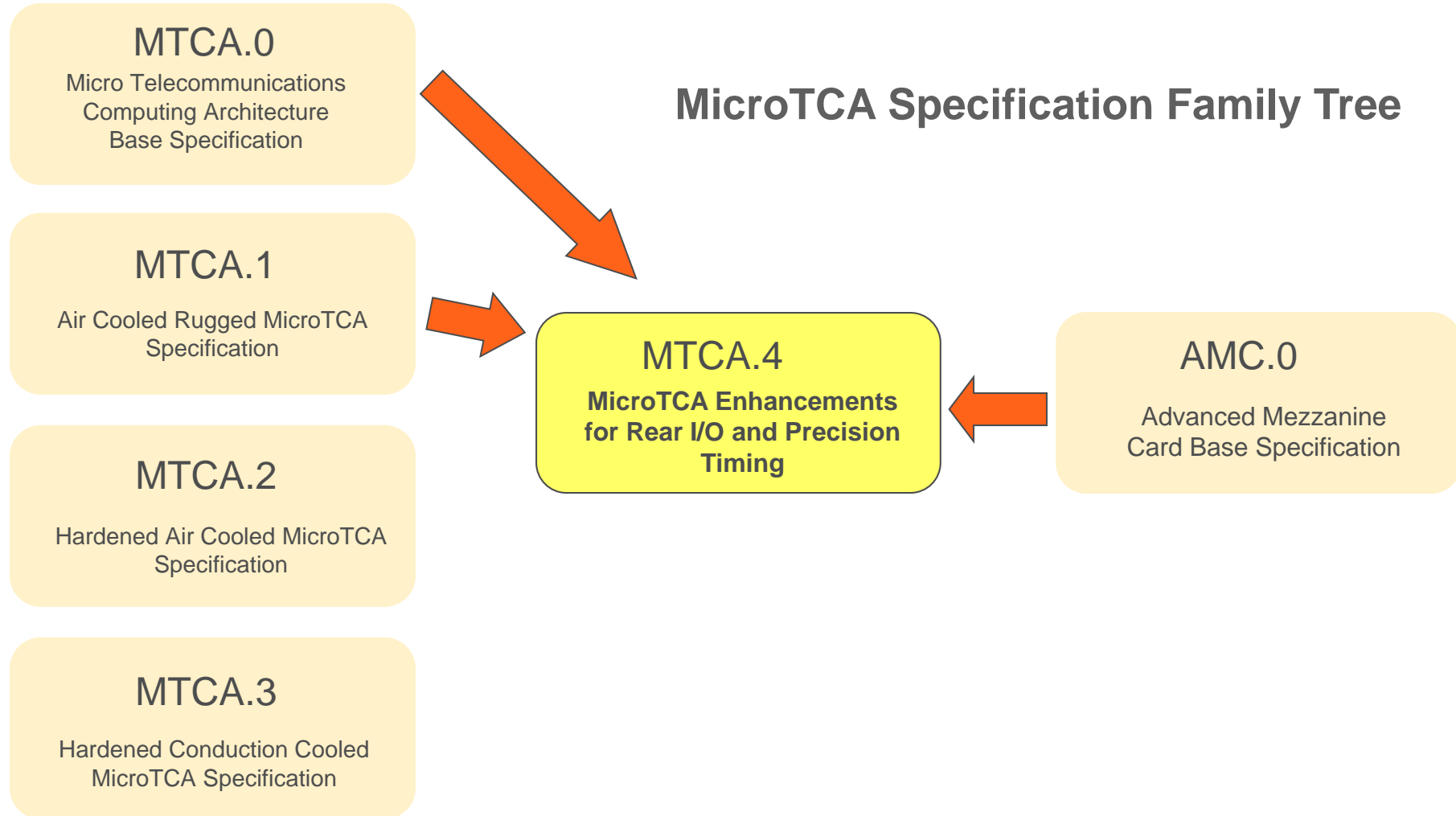
➤ Allowing mounting of mezzanine modules on the rear of the backplane

➤ Optional zone 3 backplane

➤ Define the management of the system

➤ Suggest clocking and backplane topology

MTCA.4



MTCA.4

Typical MTCA.4 Crate



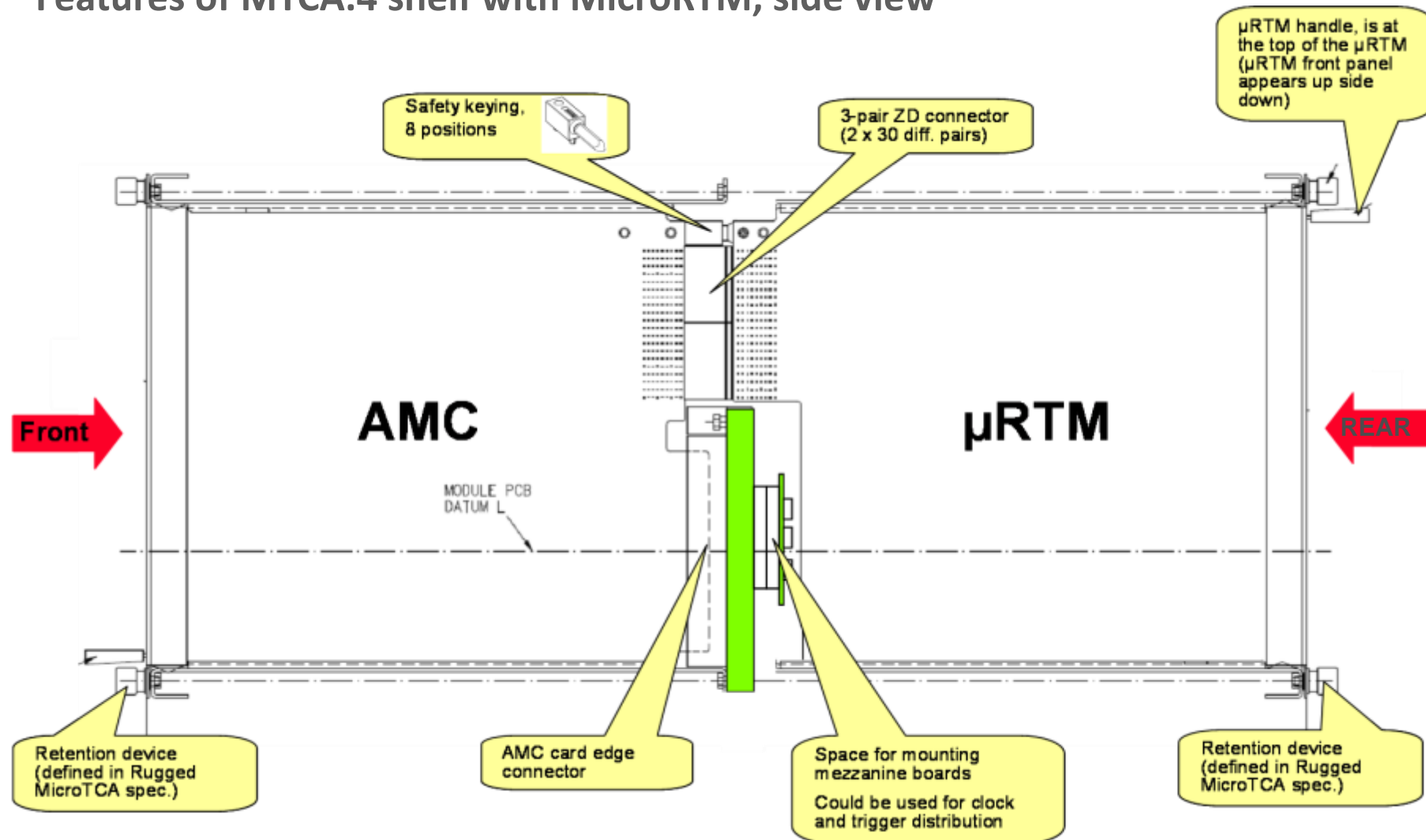
- 1 Upper Cooling Unit (CU1)
- 2 Lower Cooling
- 3 Air filter
- 4 ESD Wrist Strap Terminal
- 5 Cable Tray Unit (CU2)
- 6 Backplane
- 7 Card cage



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

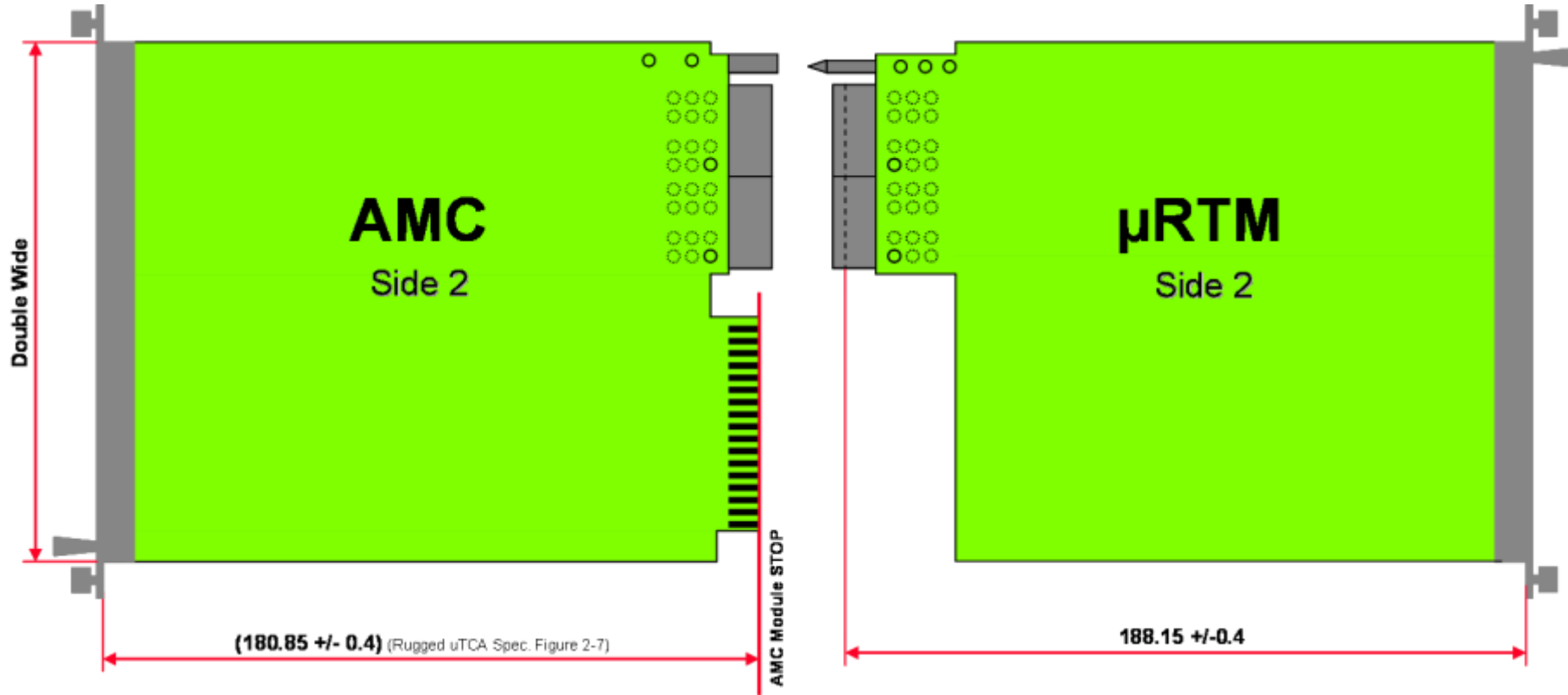
MTCA.4

Features of MTCA.4 shelf with MicroRTM, side view



MTCA.4



















Module Sizes



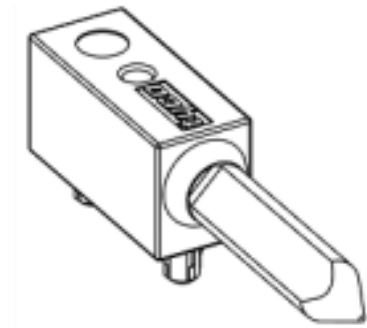
MTCA.4

➤ 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	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		

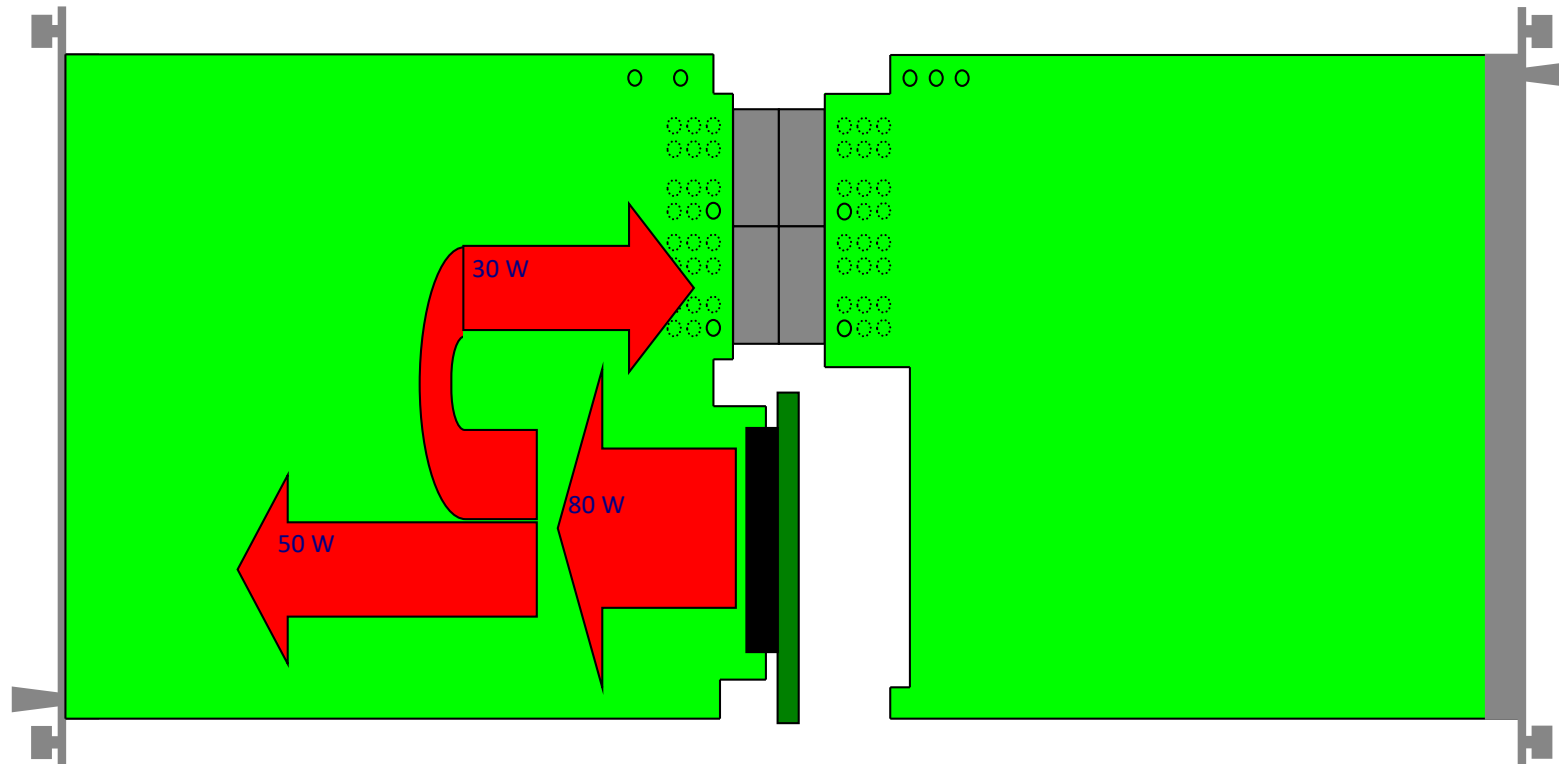
N	Data Signal in Volts
1	LVDS
2	0 – ± 1
3	$> \pm 1$ – ± 3.3
4	$> \pm 3.3$ – ± 10
5	$> \pm 10$
6	Reserved
7	Reserved
8	Reserved



MTCA.4

➤ Front board and MicroRTM power distribution

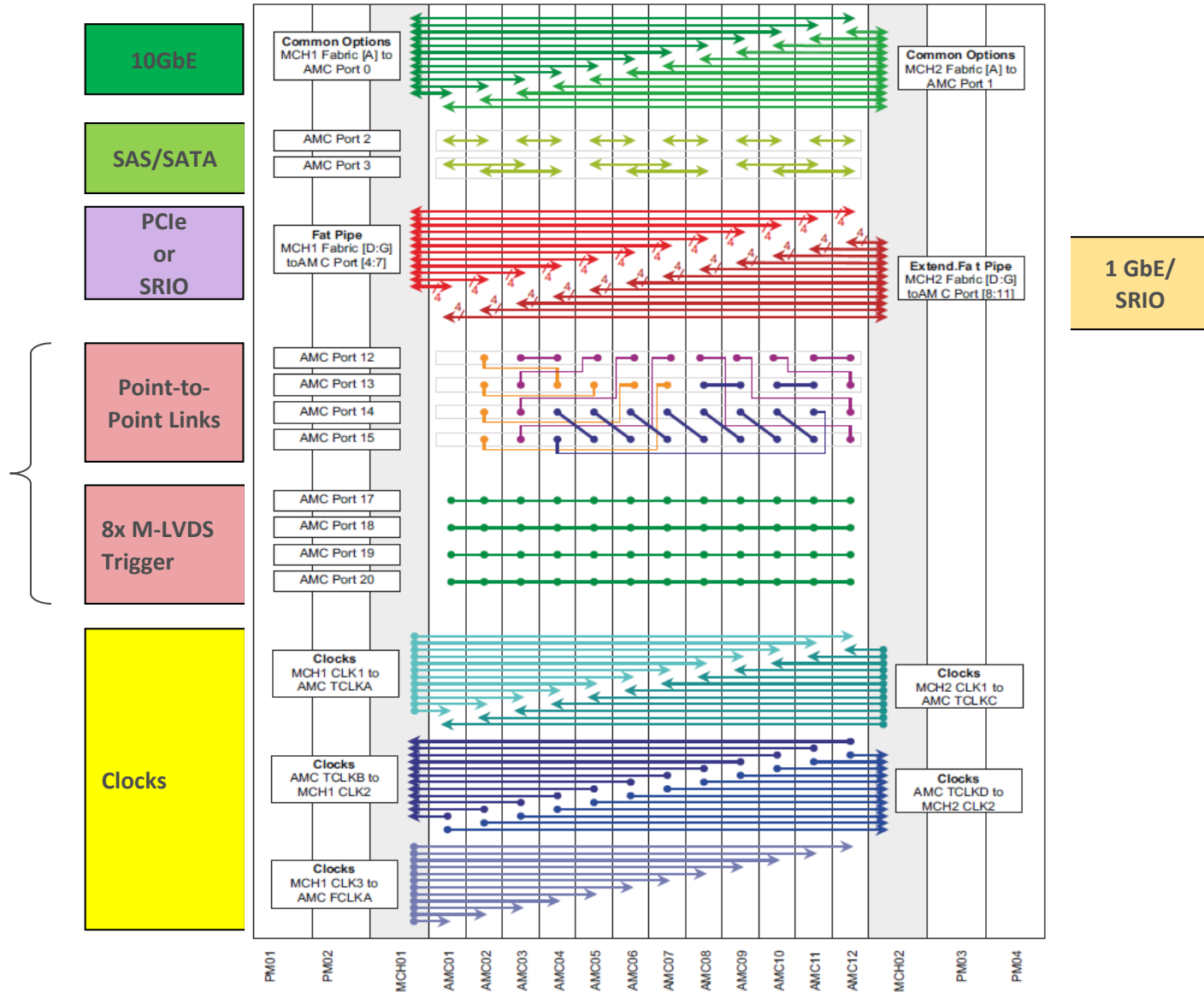
- The total power for a slot (front board and RTM) is supplied through the front board AMC connector
- The MicroRTM power is supplied from the front board through the Zone 3 connectors
- Total available power for a slot is 80 Watts, the MicroRTM power is limited to 30 Watts
- The power required by the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



MTCA.4

MTCA.4 Backplane 12-Slot

Extended Options



MTCA.4

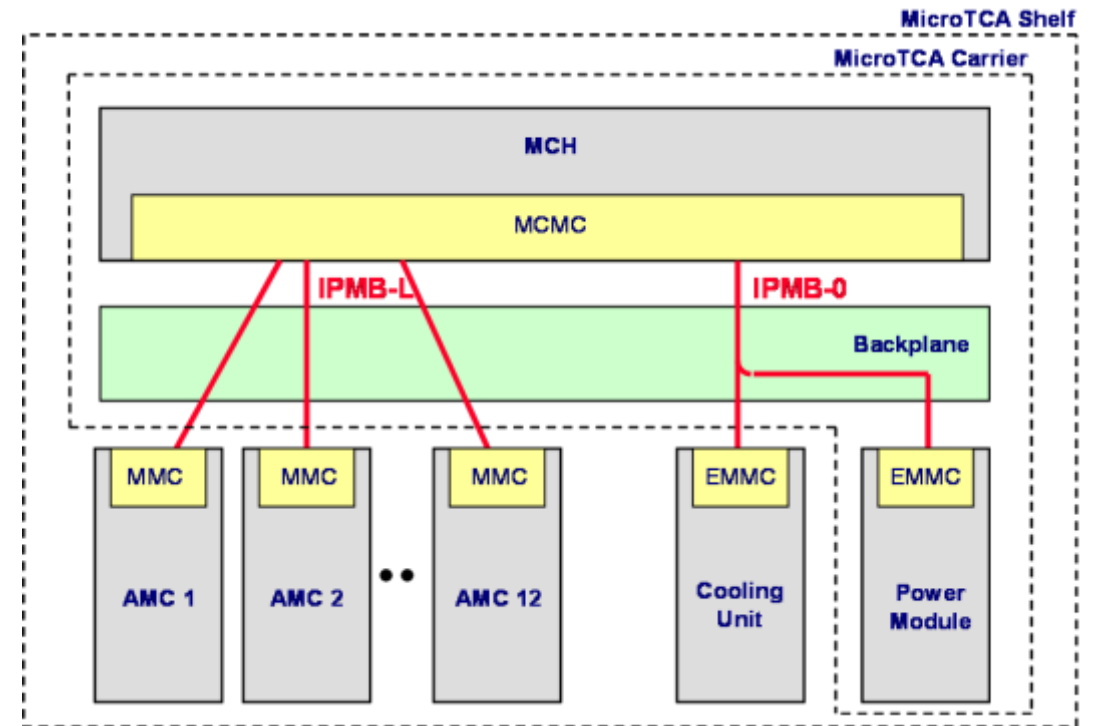
➤ Management defined in AMC.0 / MTCA.0

➤ 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

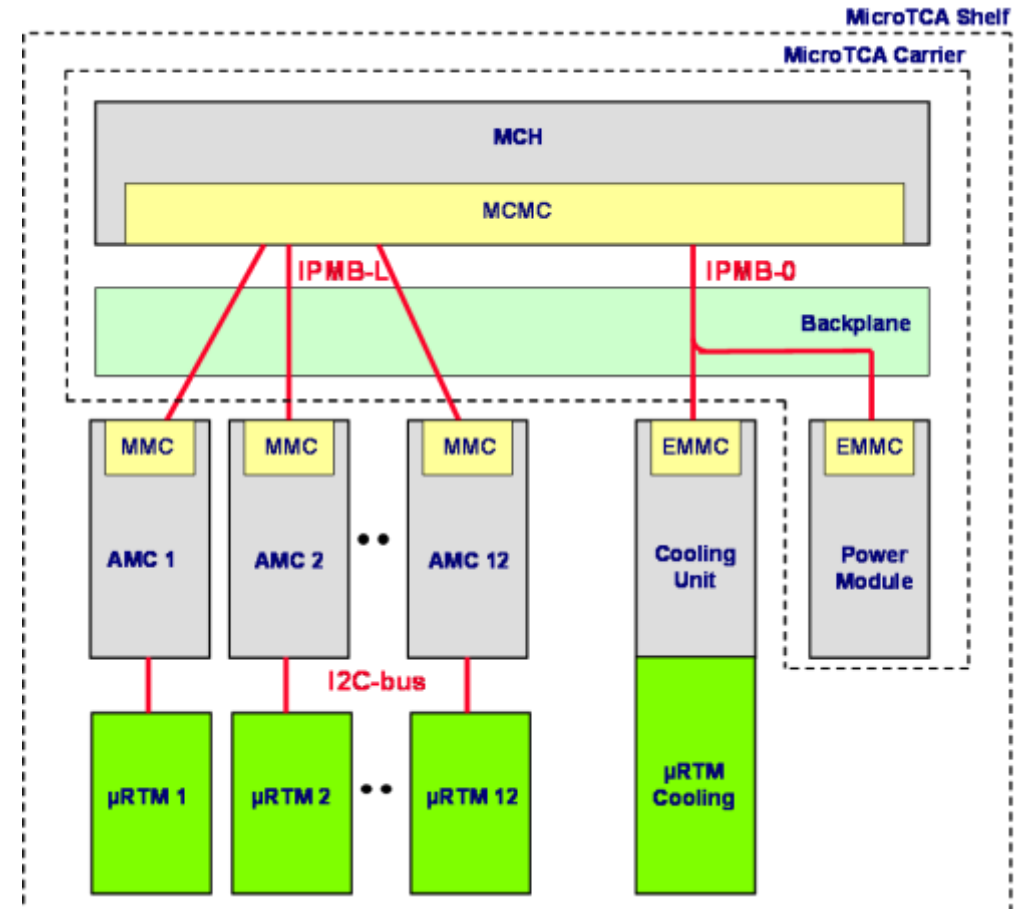
- Connects the MCMC on the MCH to the MMC on the AMC Modules
- Radial architecture

➤ IPMB-0

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

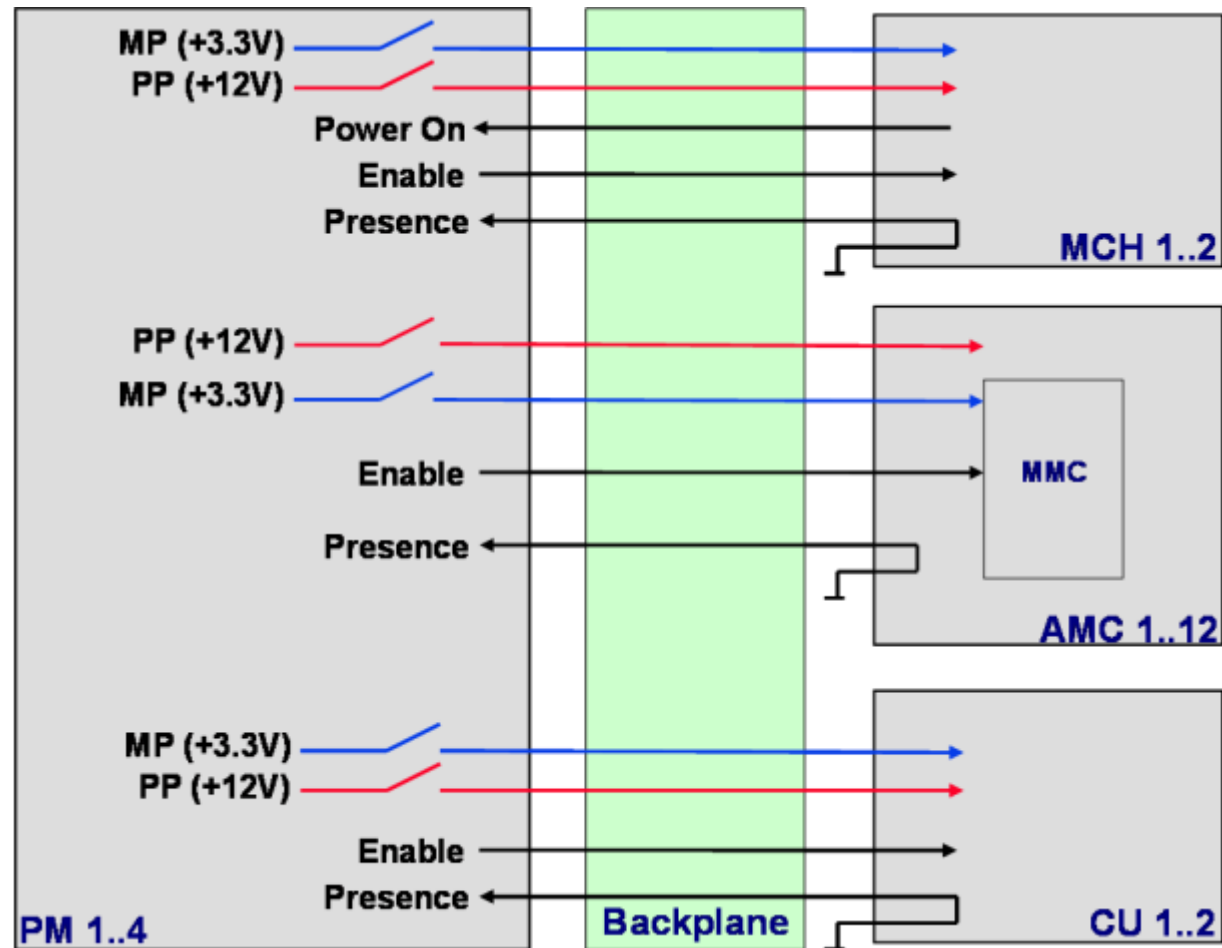
➤ I2C-Bus

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



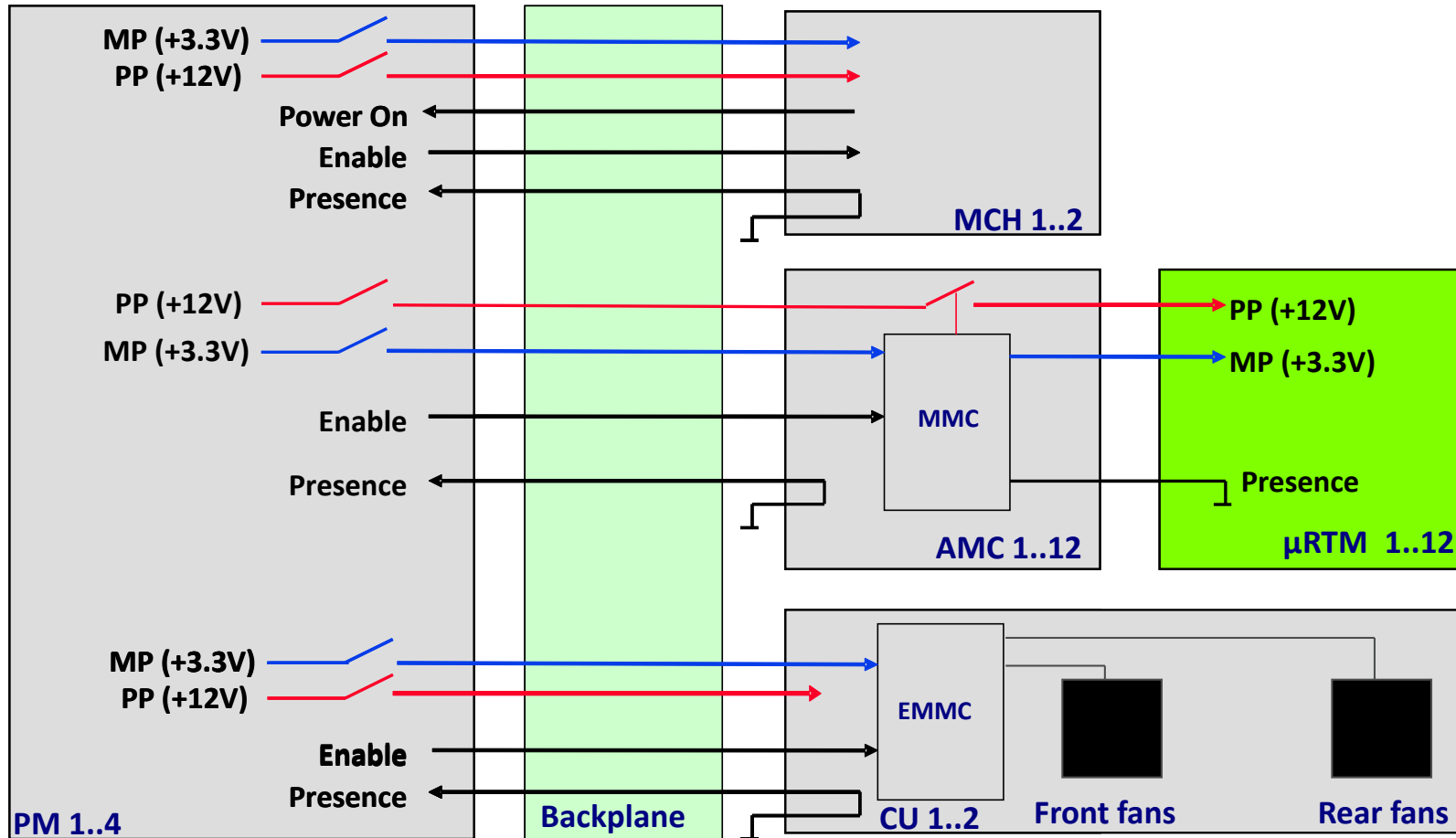
MTCA.4

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



MTCA.4

Additional RTM control signals for MTCA.4



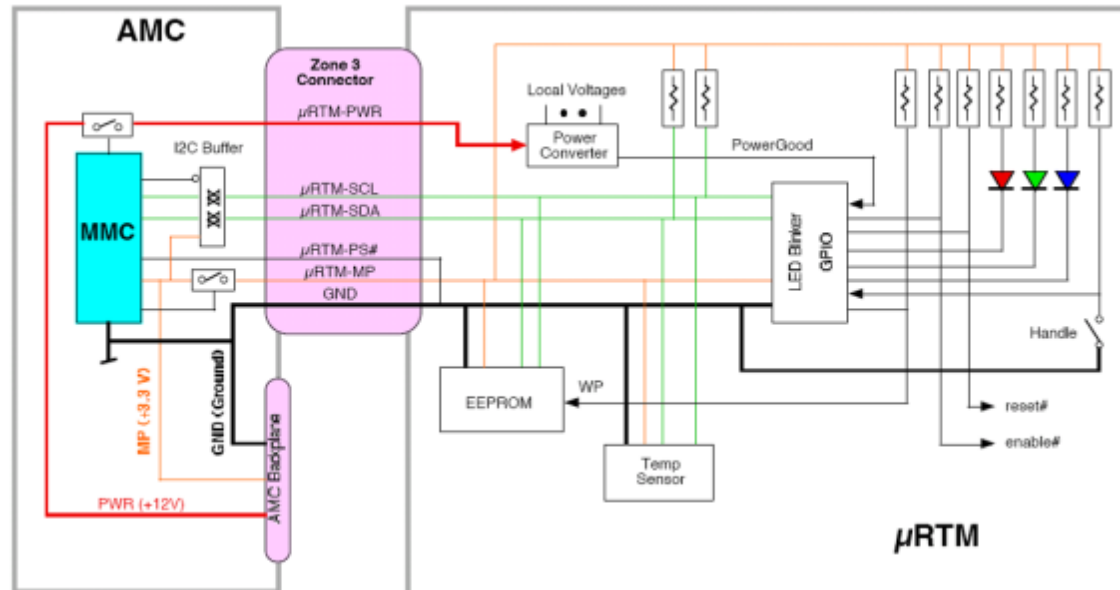
MTCA.4

MicroRTM Management

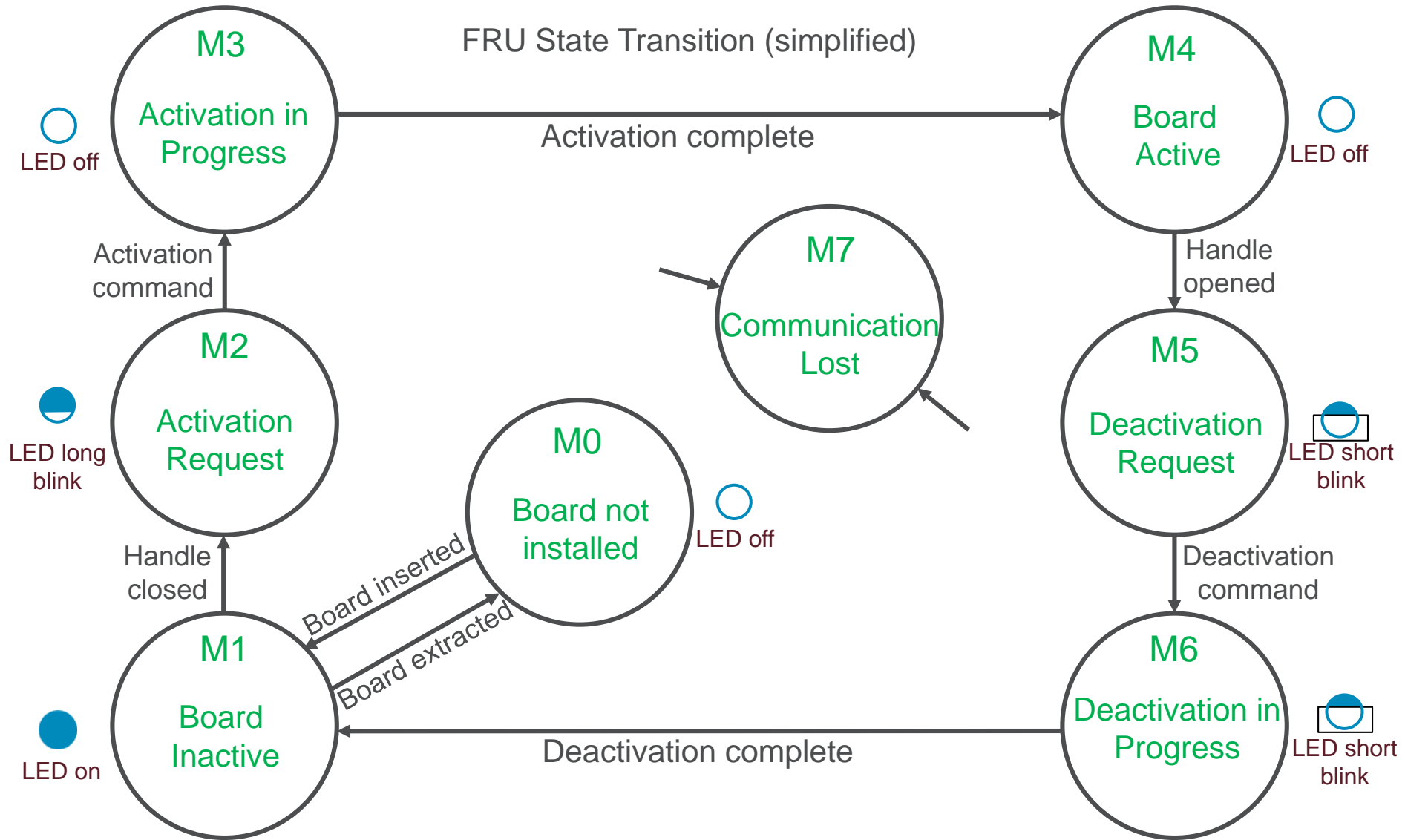
➤ A management interface is defined on the lower zone 3 connector

➤ 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



MTCA.4

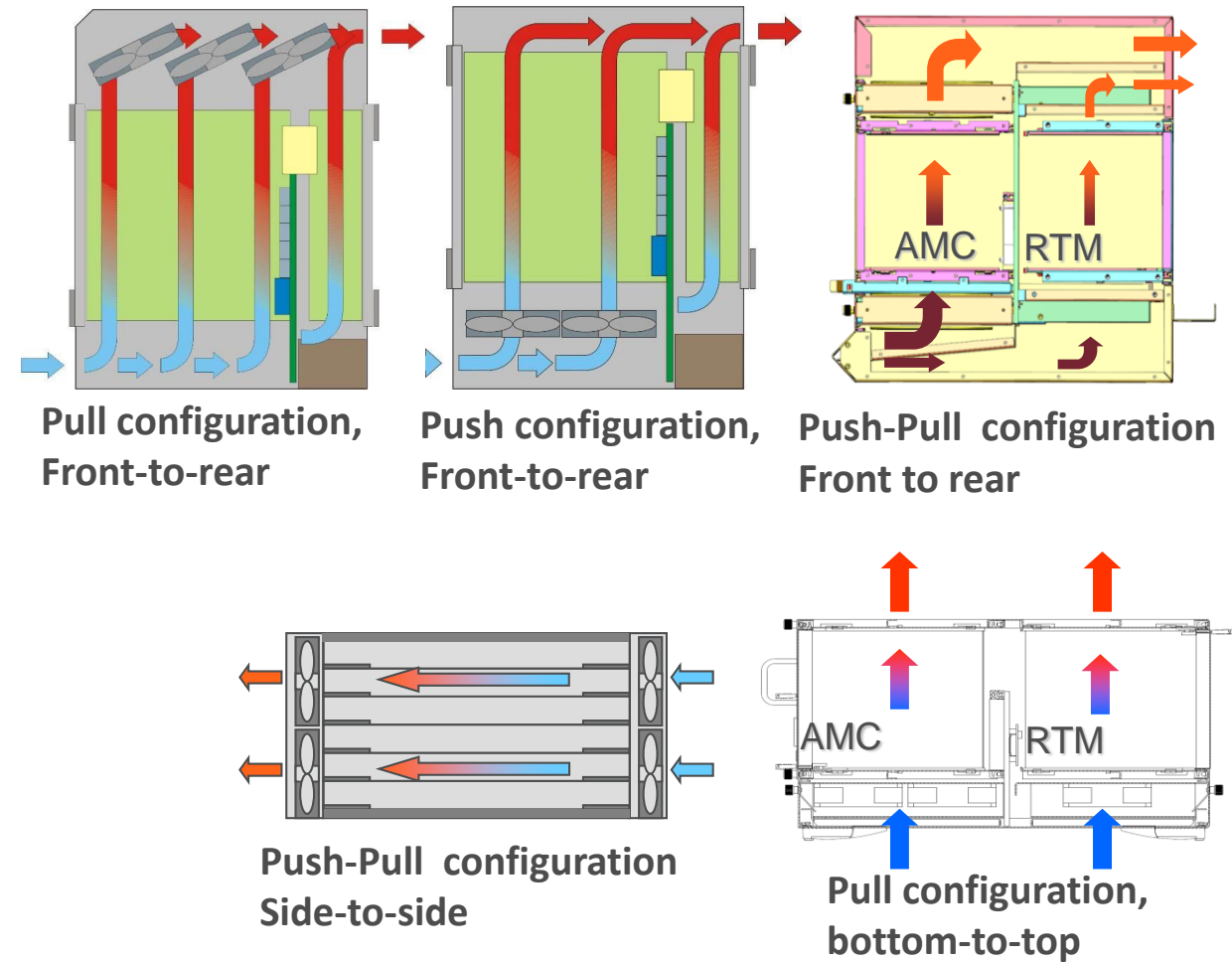
Cooling concepts

➤ 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



MTCA.4

Redundancy

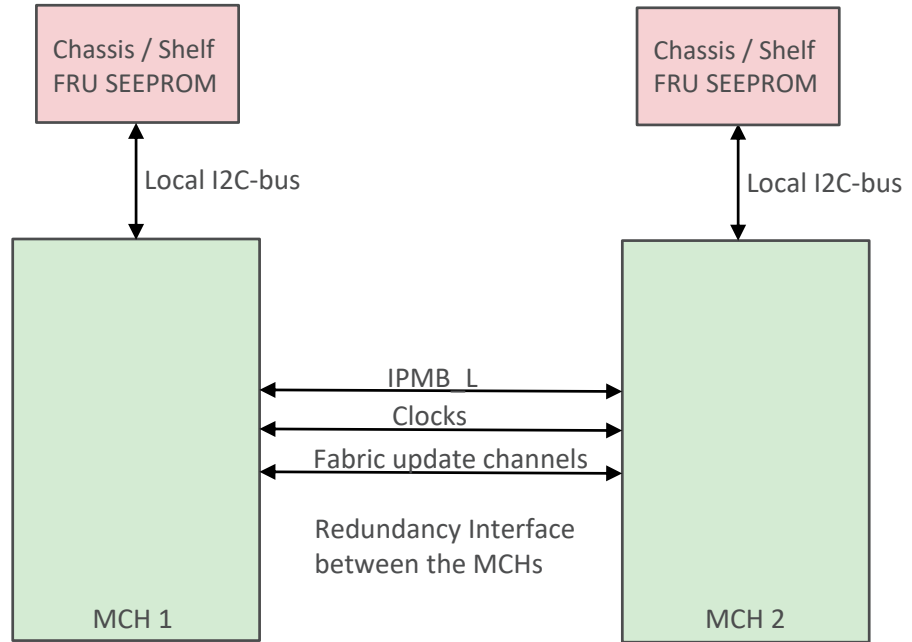
- For high availability applications all modules are redundant:
- 2 x MCH
- 4 x Power Module
- 2 x Cooling Unit
- IPMB-0:
One logical bus divided into two physical busses: IPMB-A and IPMB-B



MTCA.4

MCH Redundancy

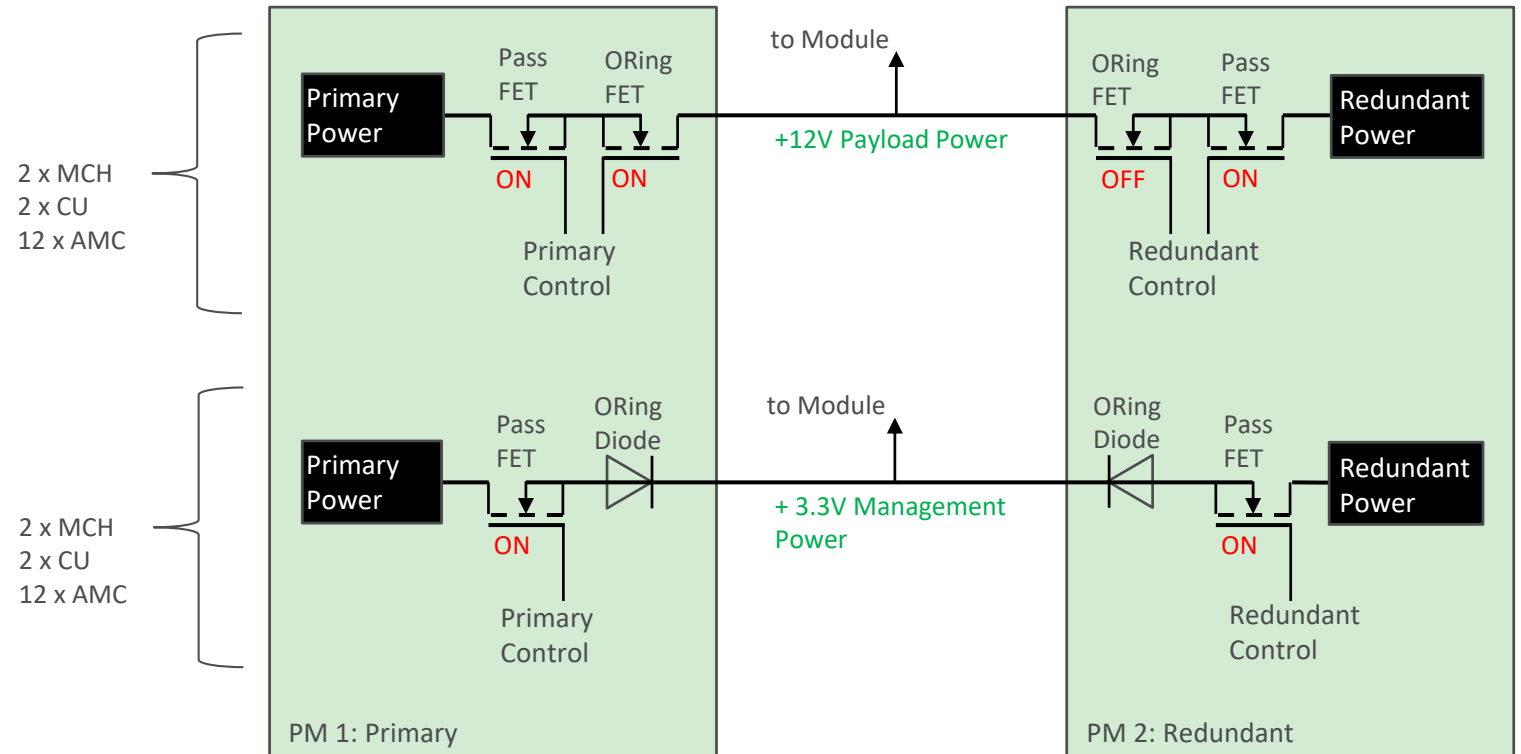
- Two MCH: One is Master, One is Redundant
- Redundant chassis / shelf FRU Information SEEPROM
- Redundancy Interface between the two MCH
- Redundancy defined in chassis / shelf FRU information



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

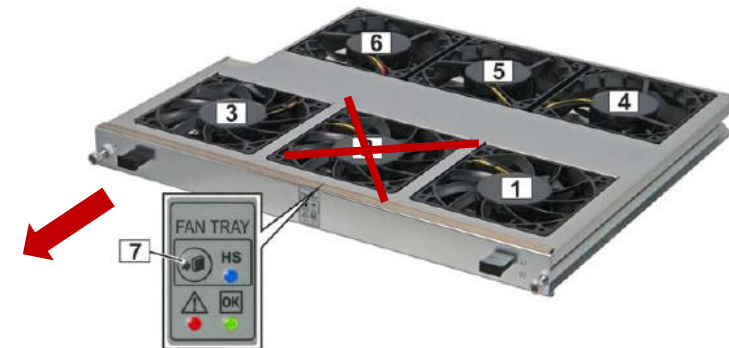
- Redundant Cooling Units in push-pull configuration
- Scenario 1: fan failure
- Scenario 2: Cooling Unit replacement

Pull



Push

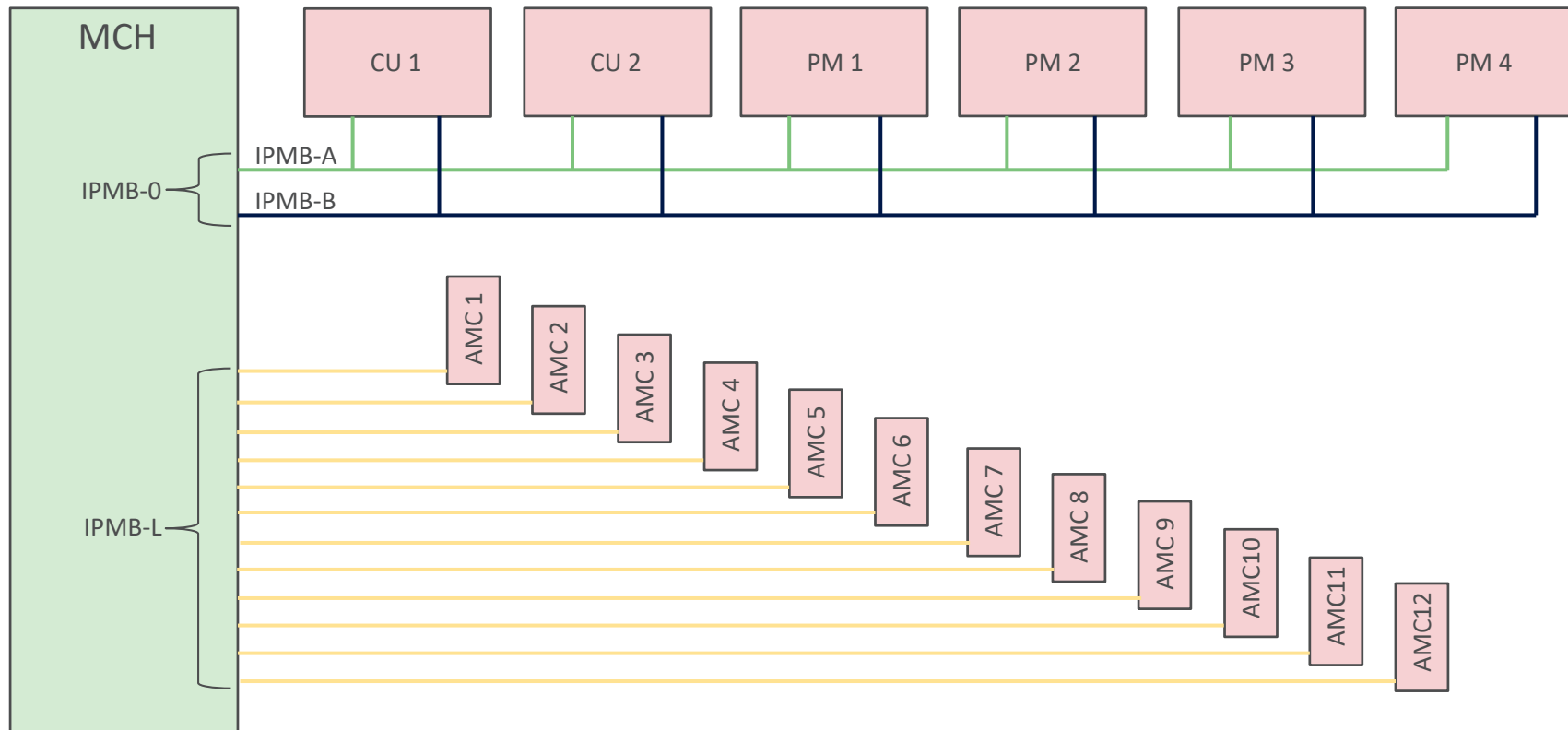
- 1 – 6 Fan
- 7 Hot Swap bush button
- 8 CU1
- 9 CU2



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



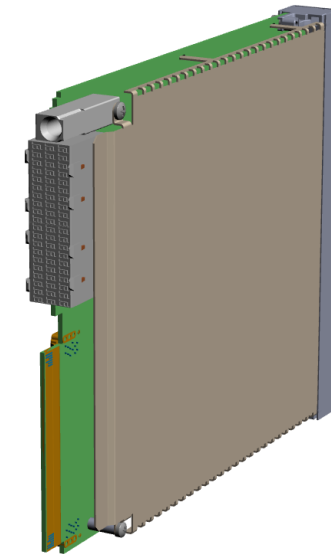
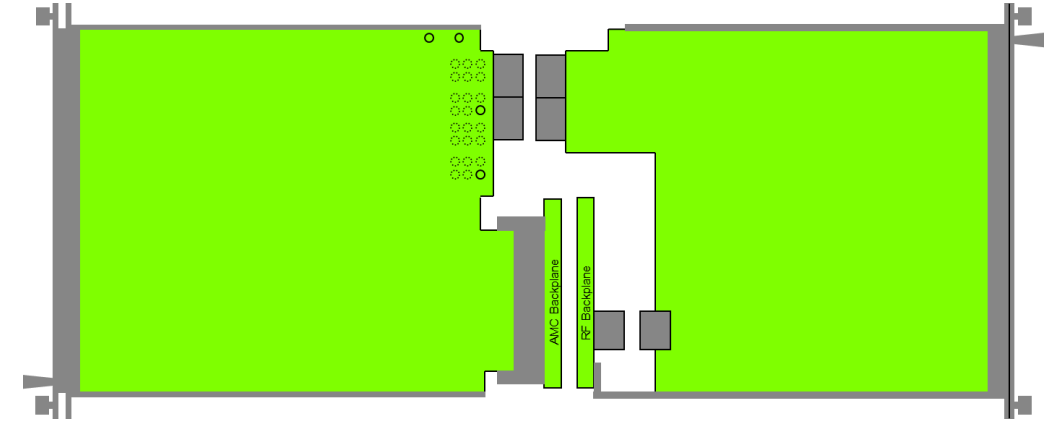
MTCA.4

Standardization continued:

MTCA.4 Standardization activities

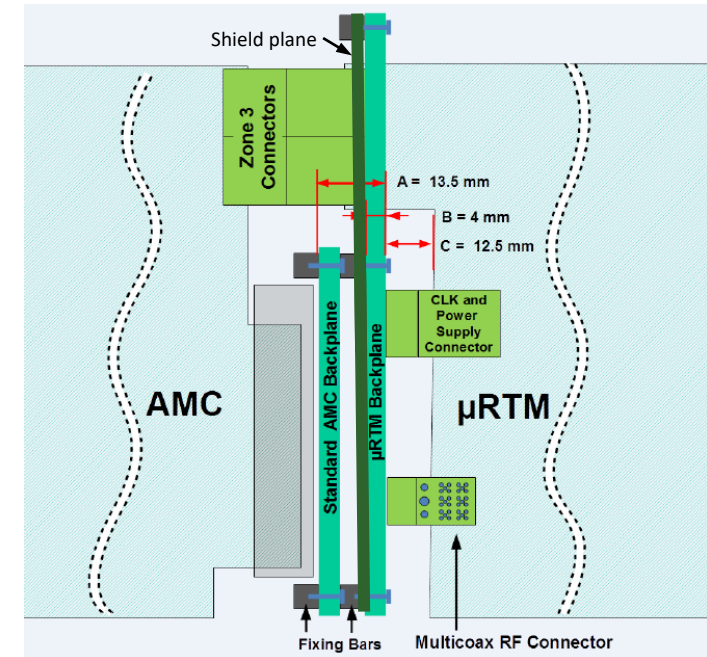
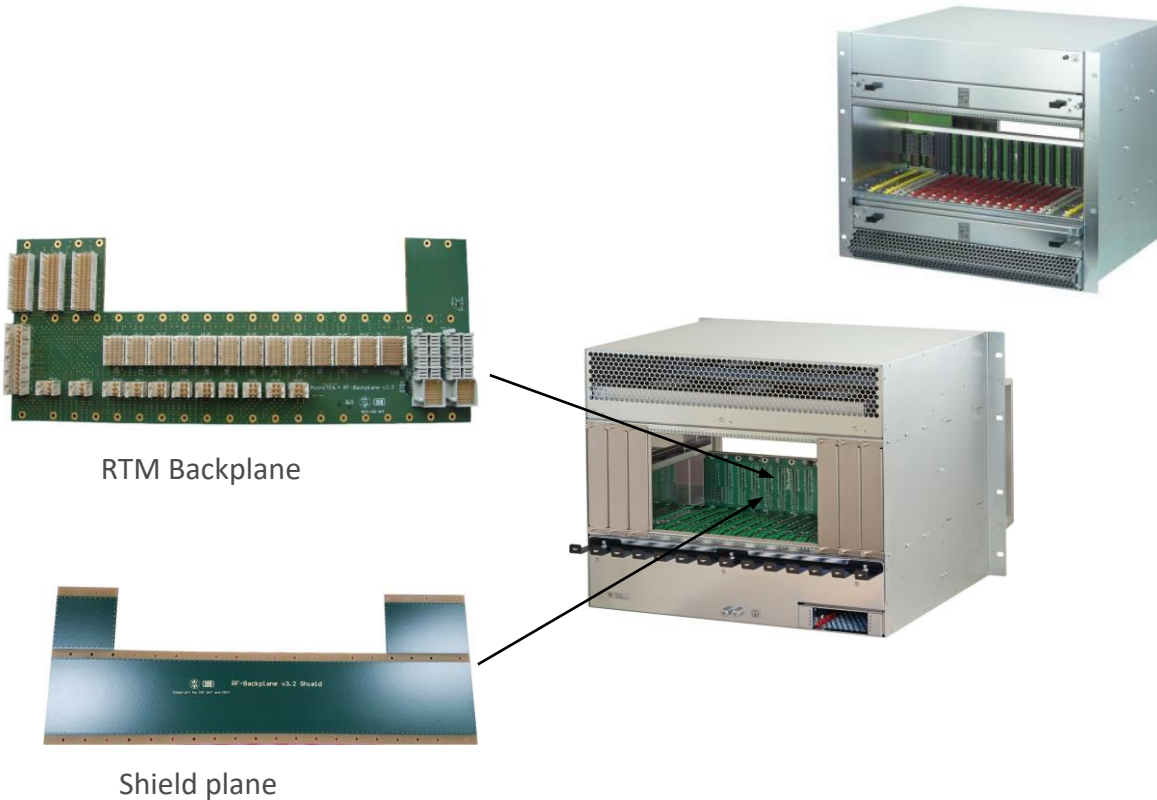
- **Definition of a RTM Auxiliary Backplane (MTCA.4.1)**
 - Based on the LLRF backplane
 - Optional connector usage

- **Protective mechanical cover for AMC and RTM modules**
 - Protective cover to mechanically protect components
 - For Side A and Side B



MTCA.4

- 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)

MTCA.4

MTCA.4.1 Rear Power Module

- The rear power module is connected with the RTM backplane and it provides additional power to the RTMs.
- 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!

