Tutorial
MicroTCA Management

"How to become a MicroTCA expert – this year: within 25 minutes"

12th MicroTCA Workshop for Research and Industry
DESY, Hamburg
December 5th – 7th, 2023

UNCLASSIFIED

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Agenda

- About N.A.T.
- From ATCA to MTCA - two well connected standards
- Why do we need management?
- What is behind the management?
- How does it work?
- What can you do?

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About N.A.T. – who we are

- Gesellschaft für **N**etzwerk- und **A**utomatisierungs-**T**echnologie mit beschränkter Haftung => **N.A.T.**
- Founded in 1990
- Proud to provide quality ”made in Germany”
  - since more than 33 years by 25 highly professional employees
- Privately owned and owner lead business
- Own purpose-built building of more than 1,600m^2 (17,222ft^2) with on-site centers for
  - hardware and software design
  - pre-manufacturing and test + repair

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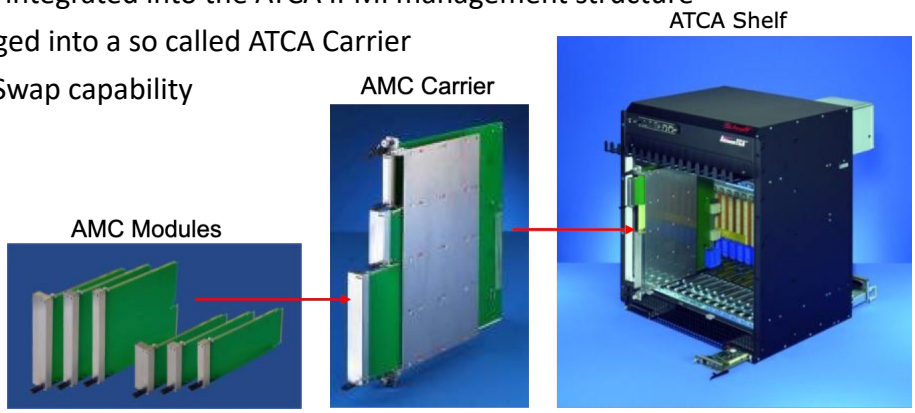
Quick Look At ATCA AMC Modules

- 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



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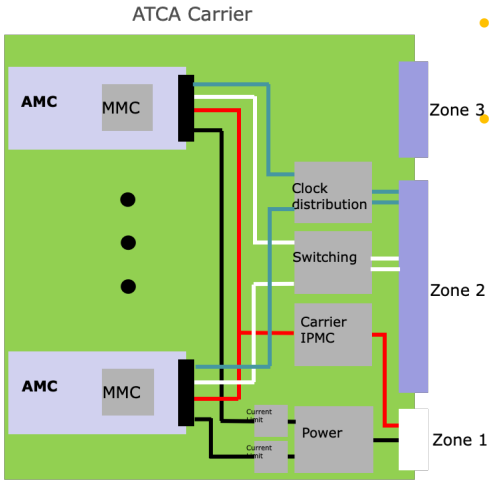
Quick Look At ATCA ATCA carrier – the environment an AMC module lives in



- Idea for MTCA: directly plug AMC onto backplane
- Requires "virtual carrier" providing
  - Power, management, CLK, Switching

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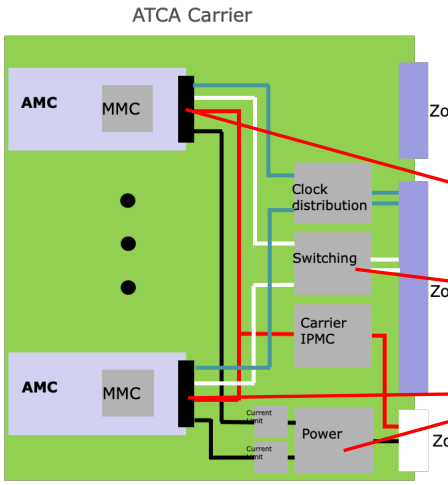
Quick Look At ATCA How to migrate from ATCA to MTCA



- "virtual carrier" consists of
  - MTCA chassis incl. backplane and CUs
  - Power Module
  - MCH for management, CLK, switching

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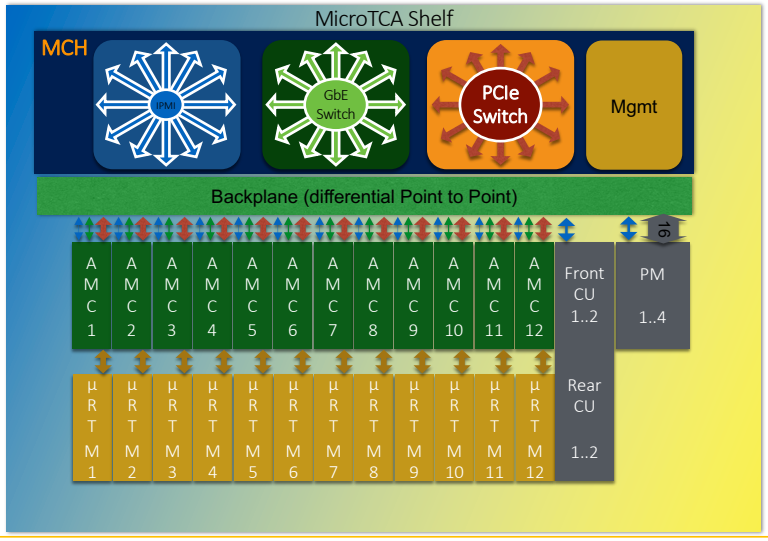
Management Why do we need it?

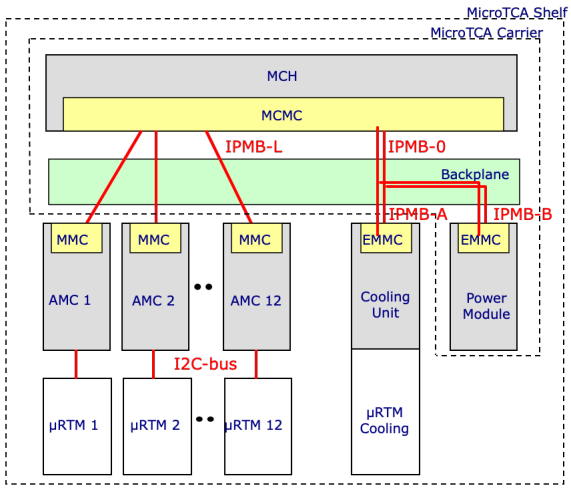
- "Who" is in my system?
  - i.e. list of devices (aka "FRU" for **F**ield **R**eplaceable **U**nit)
- What capabilities does the FRU have?
  - i.e. active connections (AMCs) or RPMs (CUs)
- How healthy is my system?
  - i.e. sensors for current, voltage, temperature
  - i.e. events
- How can I talk to my FRUs?
  - i.e. manipulation of sensors
- How can I service my system?
  - i.e. hot-swap FRUs

MTCA.0.1.2.3.4 Infrastructure of a MTCA system



Management in MTCA Physical Connections And Controllers

- IPMB-L
  - connects the MCMC on the MCH to the MMC on the AMC Modules
  - radial architecture
- IPMB-0 .1
  - connects the MCMC on the MCH to the EMMC on the PMs and CUs
  - bussed architecture
- I2C-bus
  - connects the AMC to its µRTM
  - the µRTM is treated as managed FRU of the AMC



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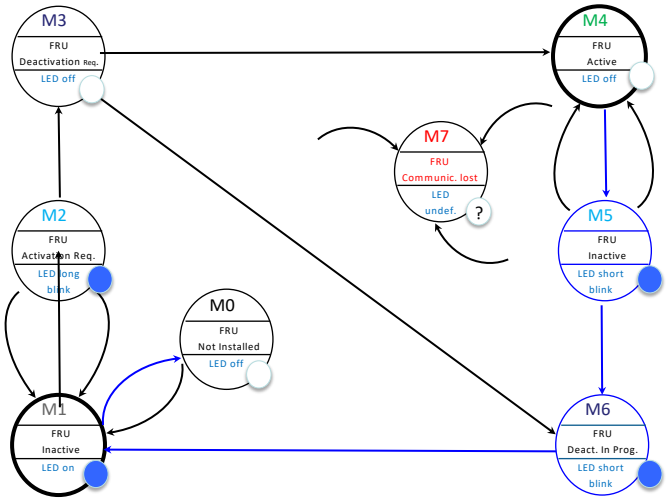
Management in MTCA FRU M states

- PICMG 3.0 and AMC specifications define FRU states, aka „M states"
  - Activation
    - FRU proceeds to state M4
  - Deactivation
    - FRU proceeds to state M1
  - Error (coms lost)
    - FRU moves to state M7
- MCH decides if and when module can reach M4
- MMC uses a state machine to control hot-plug/swap procedure



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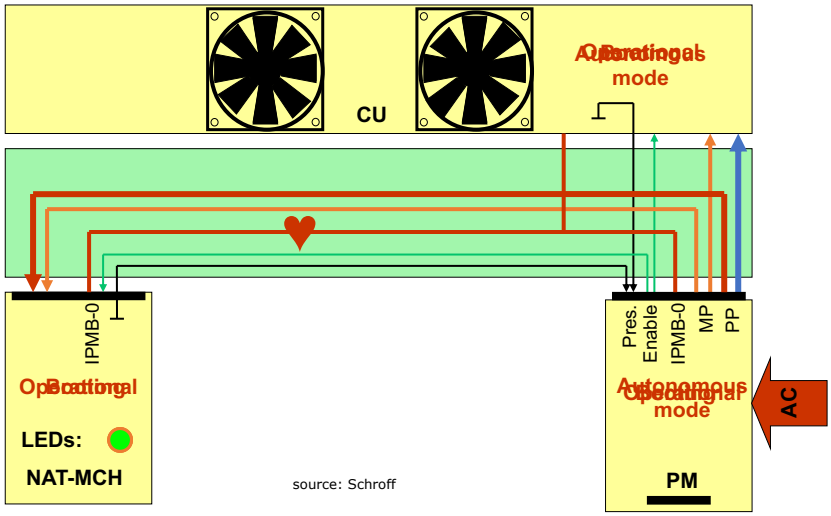

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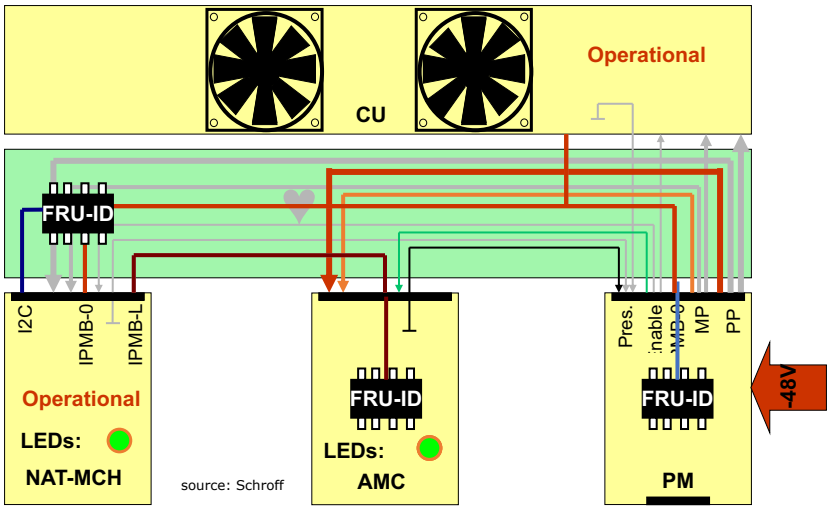

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Management in xTCA What is behind

- Idea of management:
  - Hardware supervision by software (remote control and monitoring)
  - Intelligent handling of events and actions
  - Abstraction of hardware functionality
  - Operating system independent

=> I^2C (**I**nter **I**ntegrated **C**ircuit)

=> IPMI (**I**ntelligent **P**latform **M**anagement **I**nterface)

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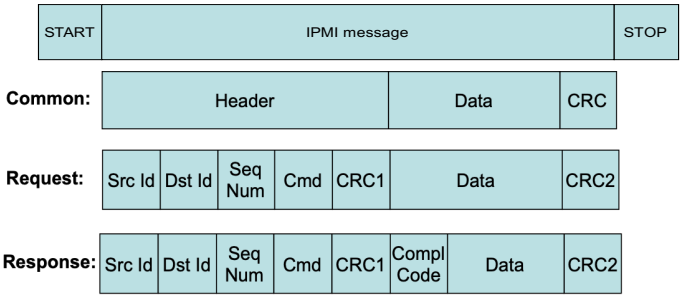
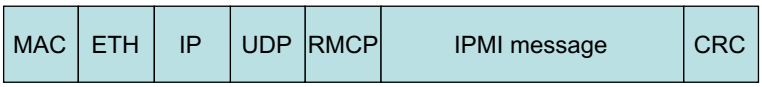
Management in xTCA IPMI

- I²C (**I**nter **I**ntegrated **C**ircuit): two wire multi-master capable bus
- IPMI protocol



- RMCP (**R**emote **M**anagement **C**ontrol **P**rotocol)



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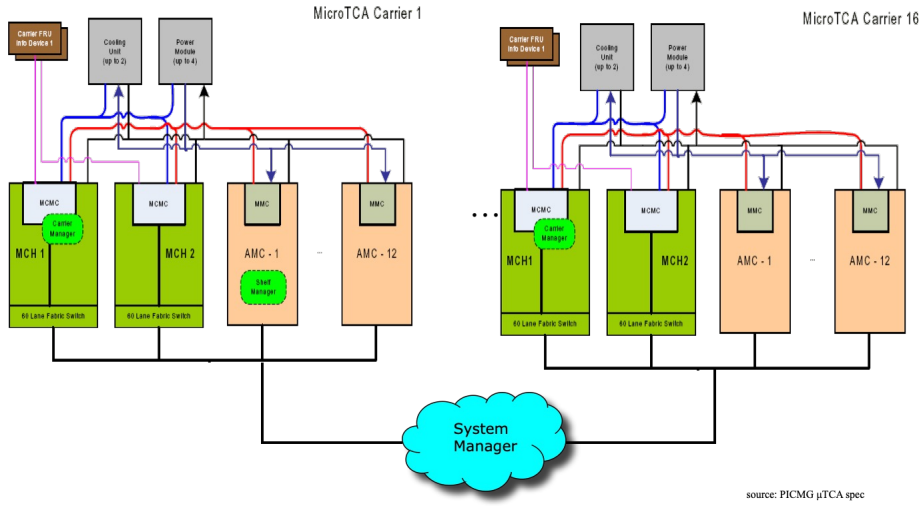
Management in MTCA Management Structure



source: PICMG µTCA spec

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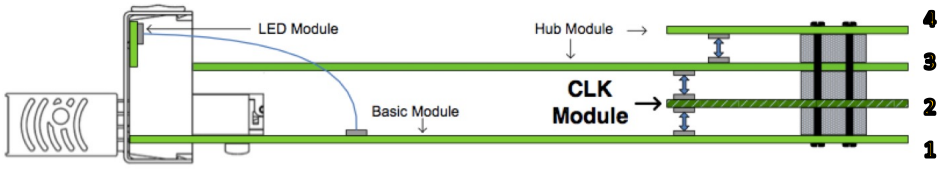
MTCA Carrier Hub (MCH) Adaptable to application demands



1. Basic Module with GbE-Switch to all AMC slots and **Management: carrier manager, shelf manager, system manager**
2. Clock Module for CLK #1-3 to all AMC slots
3. Fat Pipe Hub Module for AMC slots #1-6
4. Fat Pipe signals for AMC slots #7-12

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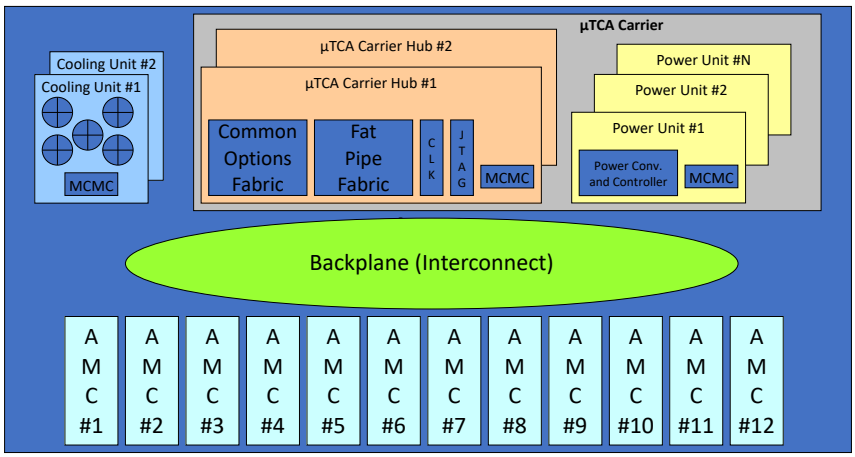
Excursus: fat pipes and clocks within a MicroTCA system



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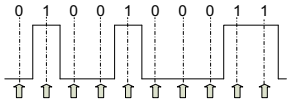
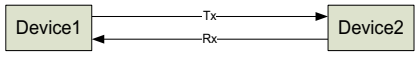
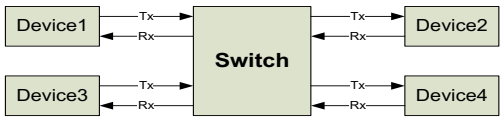
Excursus: fat pipes

- Bits are transmitted one after the other over single data line
- Every data byte (8bit) is transformed to 10bit symbol that contains enough transitions
  → **8B/10B Coding**
- Clock is recovered from serial stream
- Bidirectional transmission via dedicated Tx and Rx lines
  - One Tx/Rx pair is called "**Lane**"
- Multiple Devices interconnect by **switches**







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Excursus: fat pipes within a MicroTCA system

- Fat pipes aka fabrics
- Defined by PICMG AMC.x series
  - AMC.0 – Base Specification
  - AMC.1 – PCI Express (PCIe): gen 1, gen 2, gen 3
  - AMC.2 – Ethernet: 1GbE, XAUI, 10GbE, 40GbE
  - AMC.3 – Storage (SAS)
  - AMC.4 – Serial RapidIO (SRIO)
- Link width: x1, x2, x4, lanes aka “ports”
- Compatibility between AMC and switch on MCH ensured by e-keying
- All signal levels are LVDS => incompatibility could not cause damage

Excursus: clocking within a MicroTCA system

- Defined by PICMG MTCA.0 and AMC.0
  - frequency limited to 100MHz by spec
  - from an MCH perspective: CLK1, CLK2, CL3
  - from an AMC perspective: TCLKx and FCLK
  - mapping between CLK1-2 and TCLKx/FLCK provided by the backplane
  - Compatibility between AMC and switch on MCH ensured by e-keying

Con.	Region	Port	Function	non-redundant system (1x MCH)	redundant system (2x MCH)
Basic Side	Clock	TCKLA	Telecom Clock A	CLK1	1-CLK1
		TCLKB	Telecom Clock B	CLK2	1+2-CLK2
		FCLK	Fabric Clock or redundant TCLKA	CLK3	2-CLK1
	Common Options	0	1GbE	1-A	1-A
		1	redundant 1GbE		2-A
		2	SAS/SATA	1-B	1-B
		3	redundant SAS/SATA		2-B
	Fat Pipe	4	PCIe or 1GbE or 10GbE or SRIO	1-D	1-D
		5	PCIe or 1GbE or 10GbE or SRIO	1-E	1-E
		6	PCIe or 1GbE or 10GbE or SRIO	1-F	1-F
		7	PCIe or 1GbE or 10GbE or SRIO	1-G	1-G
	Extended Fat Pipe	8	1GbE or 10GbE or SRIO		2-D
Extended Side		9	1GbE or 10GbE or SRIO		2-E
		10	1GbE or 10GbE or SRIO		2-F
		11	1GbE or 10GbE or SRIO		2-G
	Extended Options	12	APS or Point-2-Point or rearIO		
		13	Point-2-Point or rearIO		
		14	Point-2-Point or rearIO		
		15	Point-2-Point or rearIO		
		TCLKC+D	Telecom Clocks C+D		
		17	1GbE or 10GbE or SRIO		
		18	1GbE or 10GbE or SRIO		
		19	1GbE or 10GbE or SRIO		
		20	1GbE or 10GbE or SRIO		

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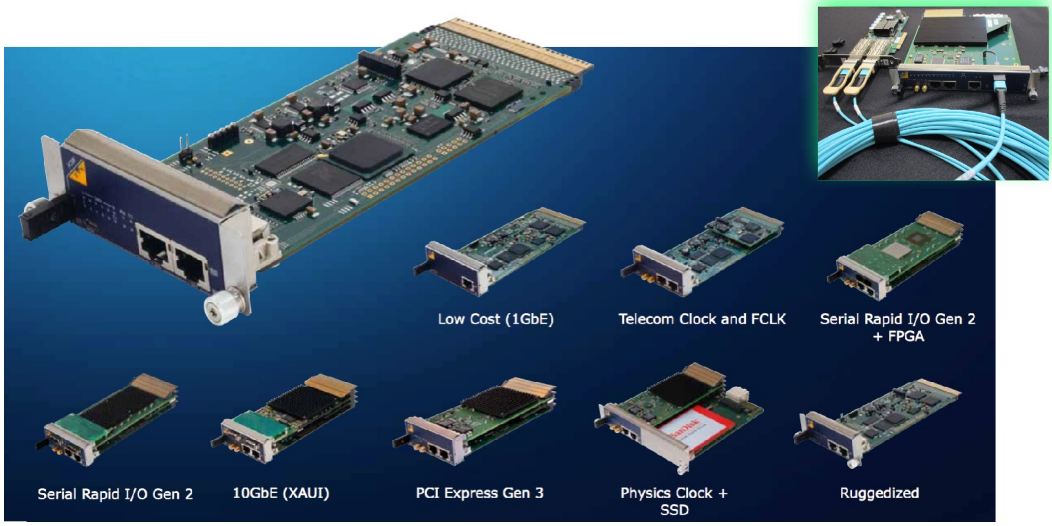

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  - i.e. active connections (AMCs) or RPMs (CUs)
- How healthy is my system?
  - i.e. sensors for current, voltage, temperature
  - i.e. events
- How can I interfere with my FRUs?
  - i.e. manipulation of sensors
- How can I service my system?
  - i.e. hot-swap FRUs

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Summary

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Thank you for your attention !

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