

Tutorial MicroTCA Management

“How to become a MicroTCA expert within 30 minutes”

2025 MicroTCA/ATCA International Workshop for Large Scientific Facility Control
Chongqing University
September 15th, 2025

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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. – key facts

- Founded in 1990
- Privately owned and owner lead business
- Based in greater Cologne area in Germany (City of Bonn)
- Focus on **innovation in communication**
- Equipment for reliable operation with longevity commitment, including life-cycle management and upgrade/migration
 - comprehensive standard product line based on modular open standards
 - custom solutions designed to customer defined specification
- Quality „made in Germany“ since more than 35 years



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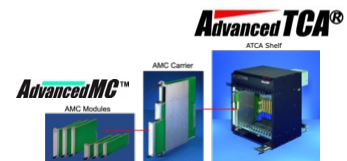
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Where MicroTCA came from

- 2002: **Advanced Telecom Computing Architecture (ATCA)**
 - Telecom carrier grade communication equipment
 - Switched MOSA using serial communication
 - New mezzanine standard: **Advanced Mezzanine Card (AMC)**
- 2006: **Micro Telecom Computing Architecture (MicroTCA, MTCA)**
 - Derived from **Advance Telecom Computing Architecture (ATCA)**
=> common system management and re-use of Advanced Mezzanine Cards (AMCs)
 - Targeting at any telecom application ATCA would be an overkill for
 - Switched MOSA using serial communication



μTCA[®]



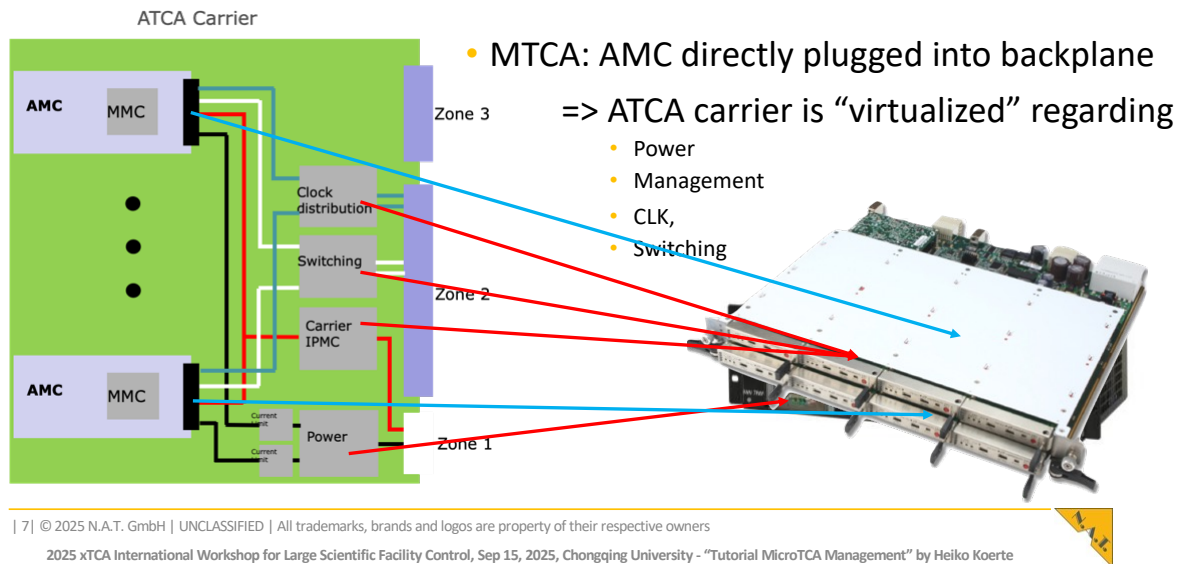
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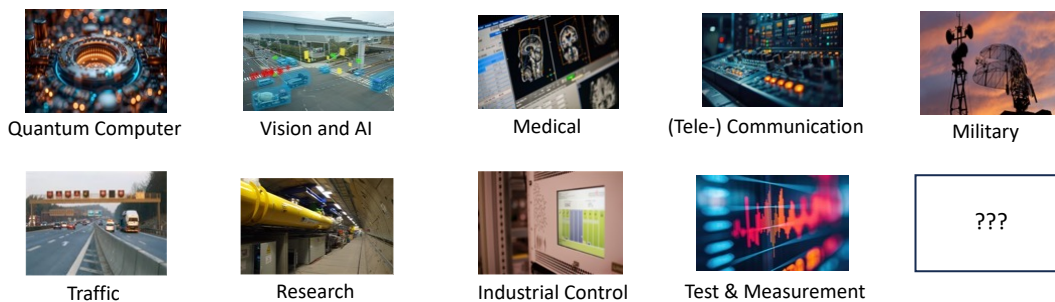
From ATCA to MicroTCA – creating the living environment for AMCs



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Where MicroTCA is being used today

- Today **MicroTCA** (MTCA) is being used in almost any vertical market:



... any many more

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Management Why do we need it?

- "Who" is in my system?
 - i.e. list of devices (aka "FRU" for Field Replaceable Unit)
- 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

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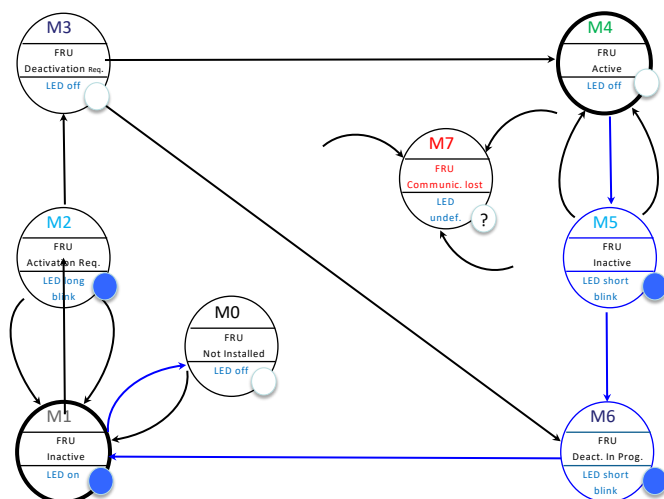
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Management in MTCA FRU M states

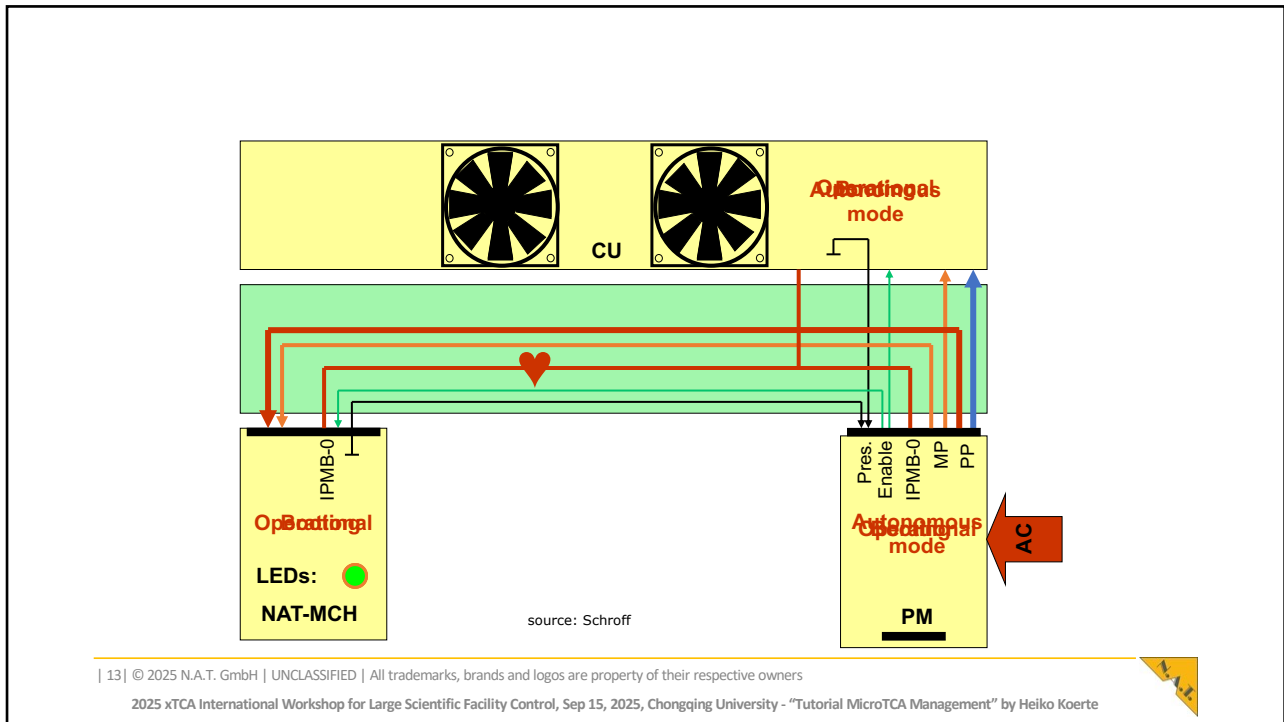
- ATCA and AMC specs define FRU states, aka „M states“
 - Activation
 - FRU proceeds to state M4
 - Deactivation
 - FRU proceeds to state M1
 - Error (coms lost)
 - FRU moves to state M7
- MCH decides if and when module can reach M4
- MMC uses a state machine to control hot-plug/hot-swap



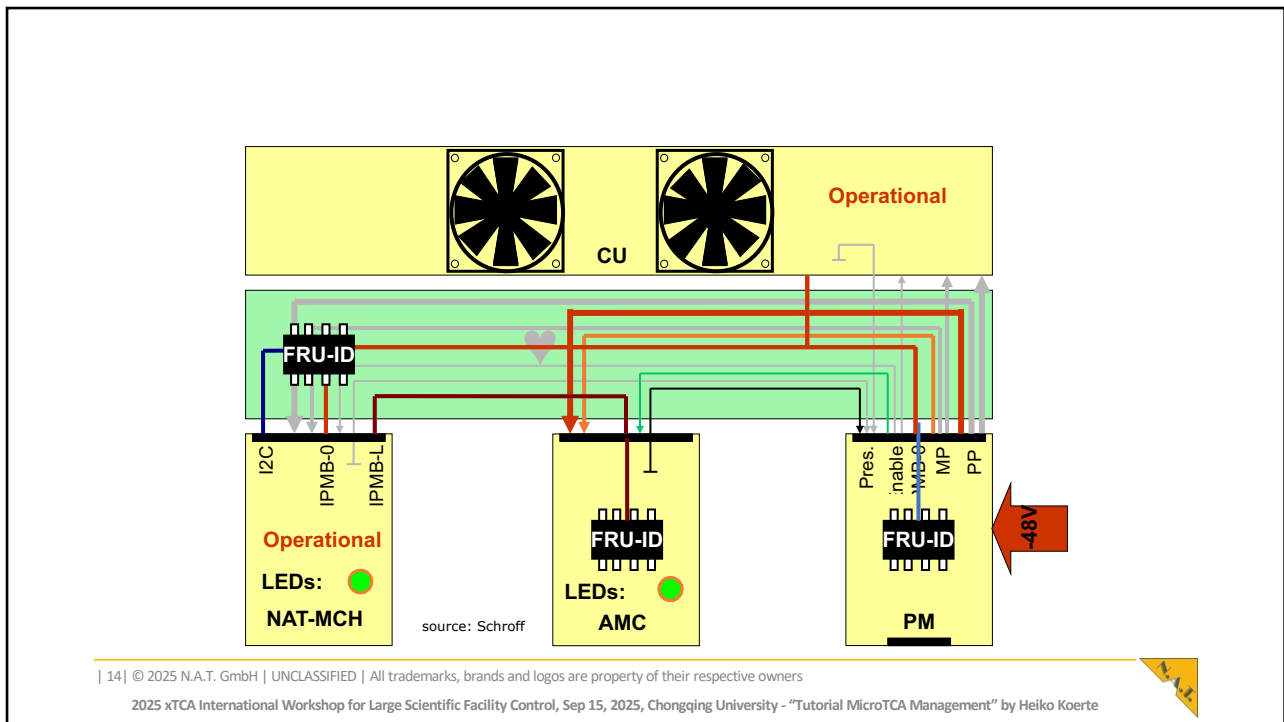
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Useful CLI commands

NAT-MCH Gen3

- show_ekey
- show_fru
- show_fruinfo <fru_id>
- show_cu
- show_pm
- show_sensorinfo <fru_id>

NAT-MCH Gen4

- print ekey
- print fru
- print fruinfo <fru_id>
- print cu
- print pm
- print sensorinfo <fru_id>

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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

=> I²C (Inter Integrated Circuit): 2-wire, multi-master capable bus

=> IPMI (Intelligent Platform Management Interface) protocol

=> RMCP (Remote Management Control Protocol)

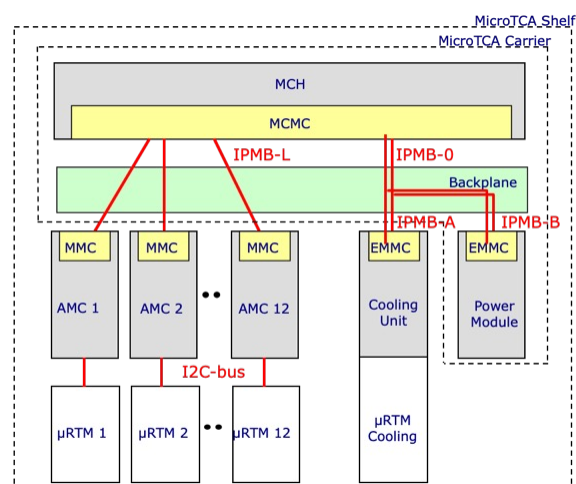
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Management in MTCA Physical Connections And Controllers

- **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 μ RTM
 - the μ RTM is treated as managed FRU of the AMC



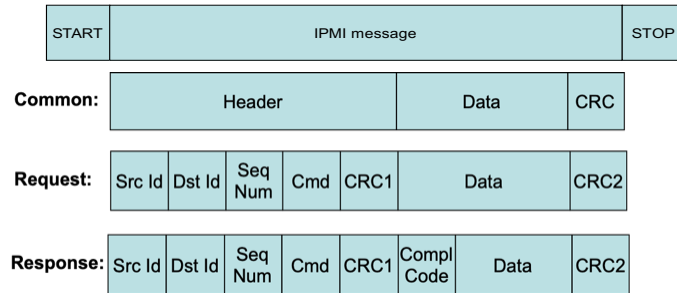
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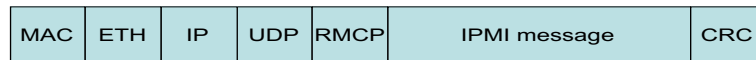
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Management in xTCA IPMI

- IPMI protocol



- RMCP:



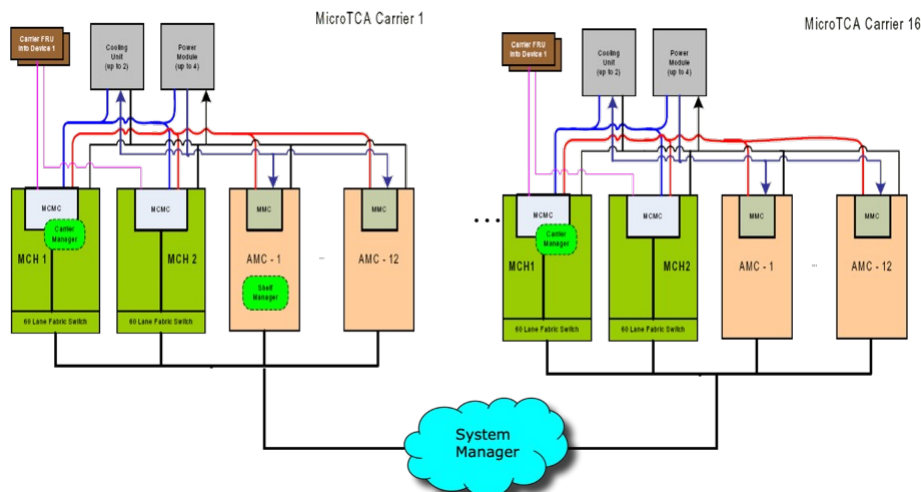
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Management in MTCA Management Structure



source: PICMG µTCA spec

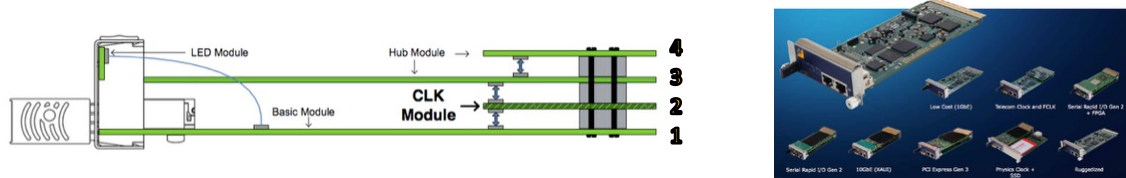
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MTCA Carrier Hub (MCH) Adaptable to application demands



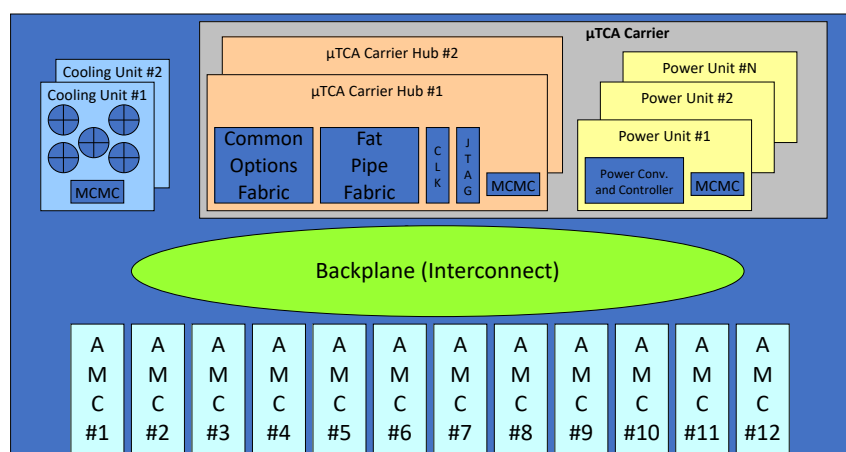
1. Basic Module with GbE-Switch to all AMC slots and **Management: carrier manager, shelf manager, system manager**
2. Clock Module for CLK #1-3 to all AMC slots
3. Fat Pipe Hub Module for AMC slots #1-6
4. Fat Pipe signals for AMC slots #7-12

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Excursus: fat pipes and clocks within a MicroTCA system



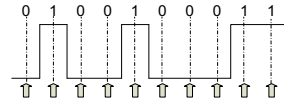
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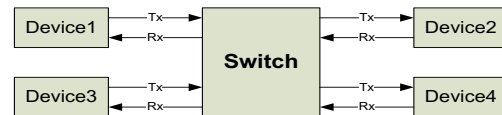
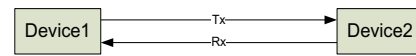
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Excursus: fat pipes

- Bits are transmitted one after the other over single data line
- **8B/10B Coding**: every data byte (8bit) is transformed to 10bit symbol that contains enough transitions



- 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 (gen 4)
 - 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

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Che

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lspci
00:00.0 Host bridge: Intel Corporation 2nd Generation Core Processor Family DRAM Controller (rev 09)
00:01.0 PCI bridge: Intel Corporation Xeon E3-1200/2nd Generation Core Processor Family PCI Express Root Port (rev 09)
00:01.1 PCI bridge: Intel Corporation Xeon E3-1200/2nd Generation Core Processor Family PCI Express Root Port (rev 09)
00:02.0 VGA compatible controller: Intel Corporation 2nd Generation Core Processor Family Integrated Graphics Controller (rev 09)
00:16.0 Communication controller: Intel Corporation 6 Series Chipset Family MEI Controller #1 (rev 04)
00:19.0 Ethernet controller: Intel Corporation 82579LM Gigabit Network Connection (rev 04)
00:1a.0 USB Controller: Intel Corporation 6 Series Chipset Family USB Enhanced Host Controller #2 (rev 04)
00:1c.0 PCI bridge: Intel Corporation 6 Series Chipset Family PCI Express Root Port 1 (rev b4)
00:1d.0 USB Controller: Intel Corporation 6 Series Chipset Family USB Enhanced Host Controller #1 (rev 04)
00:1f.0 ISA bridge: Intel Corporation QM67 Express Chipset Family LPC Controller (rev 04)
00:1f.2 IDE interface: Intel Corporation 6 Series Chipset Family 4 port SATA IDE Controller (rev 04)
00:1f.5 IDE interface: Intel Corporation 6 Series Chipset Family 2 port SATA IDE Controller (rev 04)
01:00.0 PCI bridge: Integrated Device Technology Inc. Device 808f
01:00.2 System peripheral: Integrated Device Technology Inc. Device 808f
02:08.0 PCI bridge: Integrated Device Technology Inc. Device 808f
03:00.0 PCI bridge: PLX Technology Inc. Device 8748 (rev ba)
04:00.0 PCI bridge: PLX Technology Inc. Device 8748 (rev ba)
04:01.0 PCI bridge: PLX Technology Inc. Device 8748 (rev ba)
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04:12.0 PCI bridge: PLX Technology Inc. Device 8748 (rev ba)
04:13.0 PCI bridge: PLX Technology Inc. Device 8748 (rev ba)
09:00.0 RAM memory: Xilinx Corporation Device 0037
0a:00.0 RAM memory: Xilinx Corporation Device 0037
10:00.0 Ethernet controller: Intel Corporation 82580 Gigabit Backplane Connection (rev 01)
10:00.1 Ethernet controller: Intel Corporation 82580 Gigabit Backplane Connection (rev 01)

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AMC 2
AMC 2
AMC 2
AMC 2
AMC 4
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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 FLCK
 - mapping between CLK1-2 and TCLKx/FLCK provided by the backplane
 - Compatibility between AMC and switch on MCH ensured by e-keying

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Thank you for your attention !

Heiko Körte

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