powerBridge
Computer

**MTCA
System Architecture
Presentation for
CAMECA Ametek**

June 2022

powerBridge Computer — At A Glance

- More than 25 years in the market
- Privately owned
- Over 25 years VME experience
- Own Lab and integration facilities
- powerBridge Computer has delivered over 27.000 VME boards and 5.500 systems
- PICMG member, actively working on MTCA.4 and Next Gen specification
- ISO 9001:2015 and 14001:2015 approved

powerBridge and their partners are the backbone of VITA & PICMG Technology. We are experts of technologies.
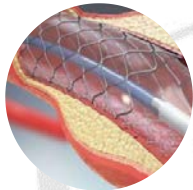
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Industrie

Defense

Luft- und Raumfahrt

Medizintechnik

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Telekom-munikation

Forschung

Transport

powerBridge Computer has the right solution …
From building blocks to systems for any branch

powerBridge
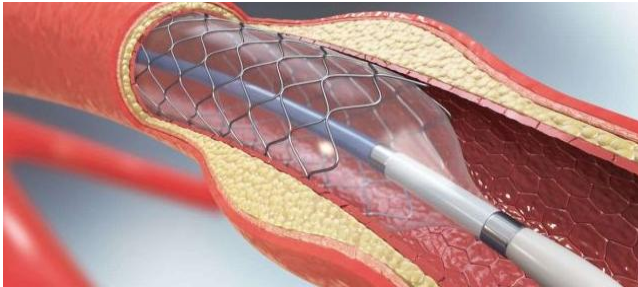C o m p u t e r

In which application is MTCA already used?

MTCA IN THE MARKET

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Industrial Automation

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Transportation

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Defence | Space

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C o m p u t e r
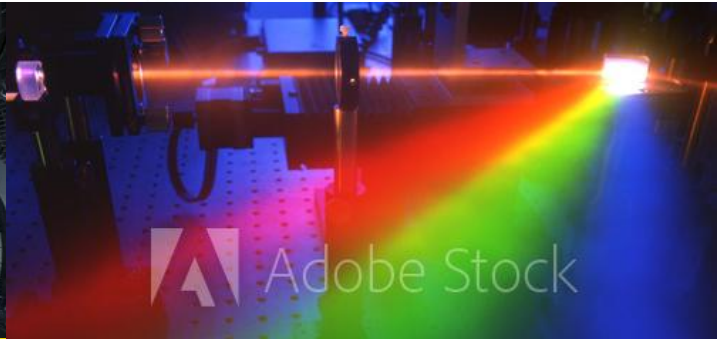
What is MTCA?

OVERVIEW MTCA

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Overview MTCA

Backplane

RTM
Rear Transmission Module

AMC
Advance Mezzanine Card

Chassis

MCH
MTCA Carrier Hub

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What is MTCA?

CHASSIS

1 HE RackPack
2 Full-size AMC

Chassis Overview MTCA

All technical data show just a small selection of possibilties

1 HE RackPack
6 Mid-size AMC

Chassis Overview MTCA

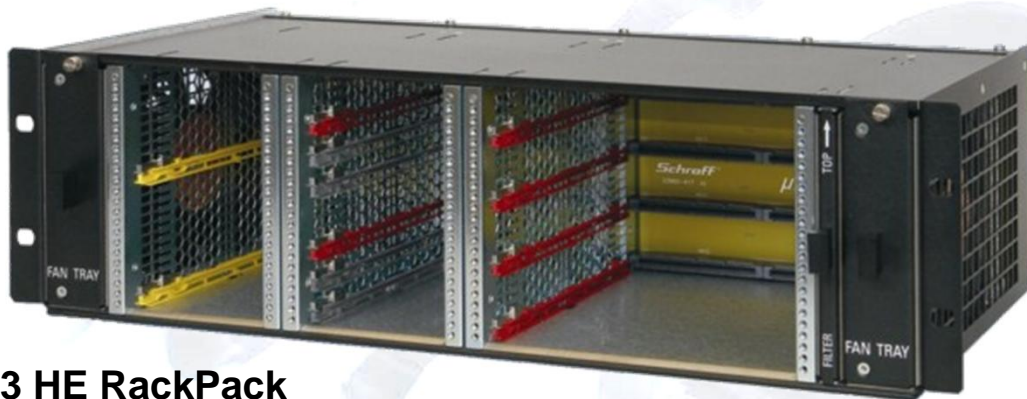**All technical data show just a small selection of possibilties**
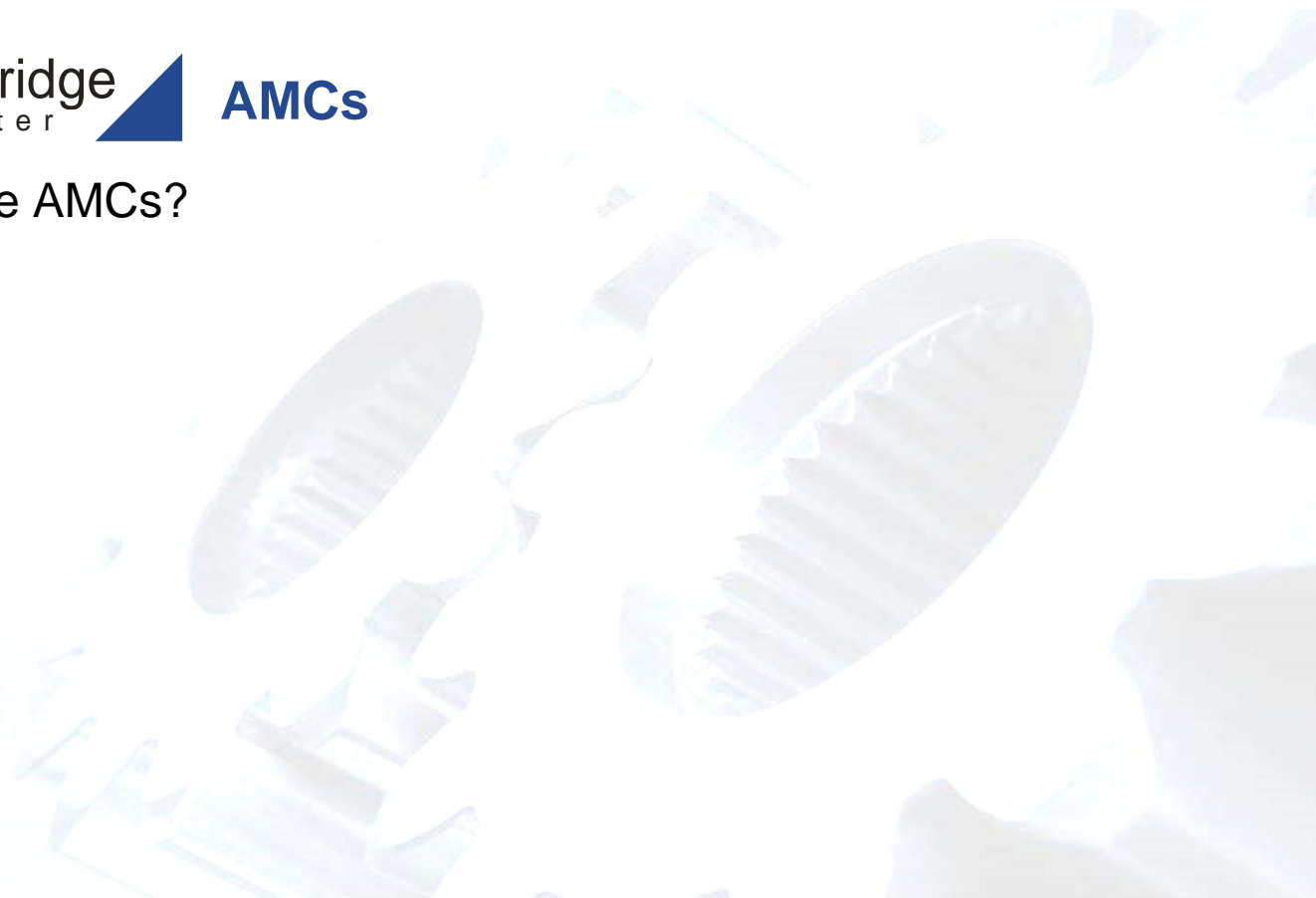
2 HE RackPack
5 double mid-size AMC

Chassis Overview MTCA
All technical data show just a small selection of possibilties

3 HE RackPack
4 double & 2 mid-size AMC

9 HE RackPack
12 double mid-size AMC

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Advancd Mezzanies Card - Overview

AMCs

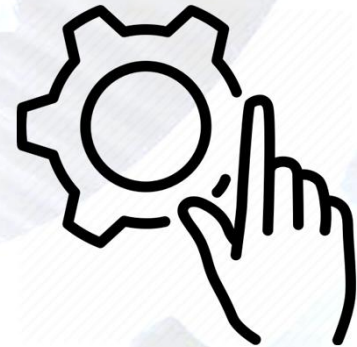# powerBridge Computer AMCs

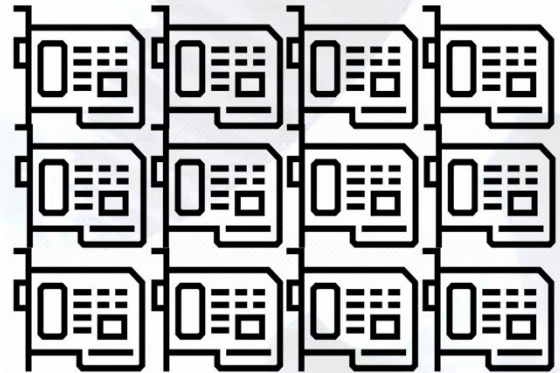What are AMCs?

powerBridge Computer — AMCs

What are AMCs?

- AMCs are cards to customize the system to your application.

AMCs

What are AMCs?

- AMCs are cards to customize the system to your application.
- Up to 12 cards for each system

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AMCs are for example:
- powerful CPUs

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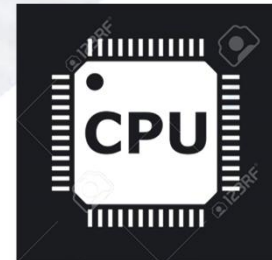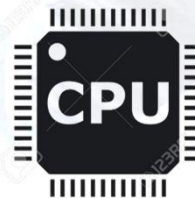- powerful CPUs
- FPGAs

What are AMCs?

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- Up to 12 cards for each system

AMCs are for example:
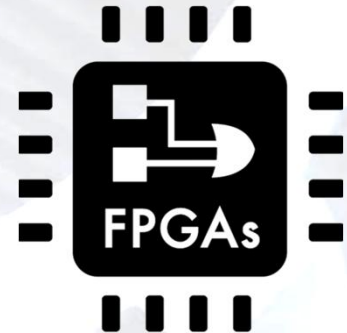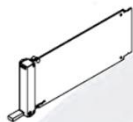
- powerful CPUs
- FPGAs
- fully developed enviroment of I/Os

Module Sizes

Single Modules

(75 mm)

Compact Size (3 TE)   Mid Size (4 TE)   Full Size (6 TE)

Double Modules

(150 mm)
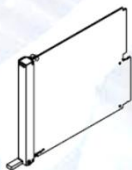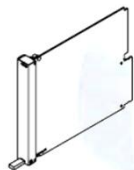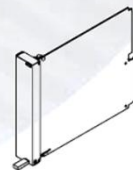
Compact Size (3 TE)   Mid Size (4 TE)   Full Size (6 TE)

AMC – CPU

All technical data show just a small selection of possibilties

Up to 8TB SSD

Intel Xeon E3 | 2x GigE
5 x SATA | 2x PCIe x4 Gen 3

Intel Xeon E3 | 2x SFPx
2x 10 GigE | 2x 2 TB SSD

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AMC – FPGA
All technical data show just a small selection of possibilties

Xilinx FPGA | FMC Mezzanine   Xilinx FPGA | 4x GbE PoE Ports FMC

Xilinx FPGA | FMC Mezzanine

FMC Module | 4 A/D Inputs

AMC – Mezzanines PMC
All technical data show just a small selection of possibilties

AMC Mezzanine Carrier
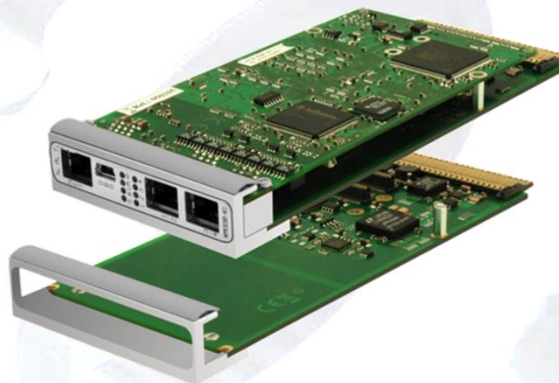
PMC Module

AMC – PMC I/O

All technical data show just a small selection of possibilties

PMC | 64 bit TTL I/O Modul
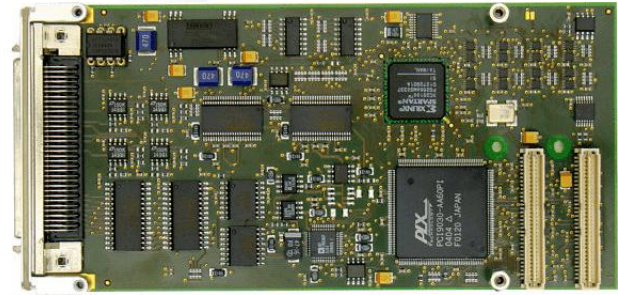
PMC | 32x 16 bit ADC, 8x 16bit DAC

PMC Mezzanines

AMC – XMC

All technical data show just a small selection of possibilties
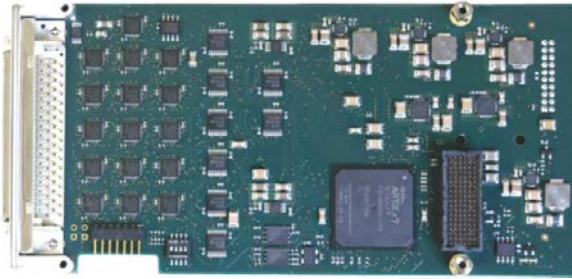
XMC | 16 bit Thermo-/ DMS Modul
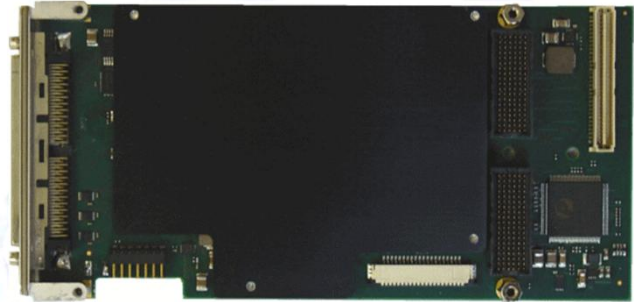
XMC | FPGA mit 48 TTL I/O, 32x 16bit Analog In

XMC Mezzanines

AMC – Feldbus

All technical data show just a small selection of possibilties
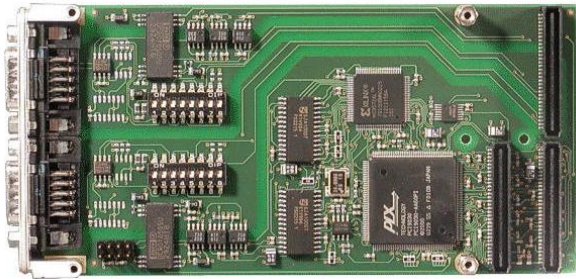
PMC | 2x CAN Bus Interface
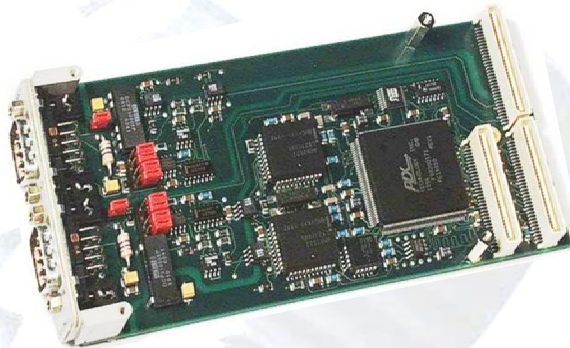
PMC | TPMC816 2-fach CAN Bus Controller mit CAN High-Speed und modifiziertem RS485 Interface

PMC Mezzanines

AMC – Ethernet
All technical data show just a small selection of possibilties
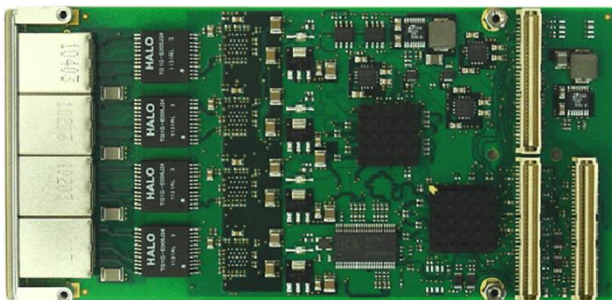
PMC | 4x **1GBase** TX Ethernet Ports

XMC | 2x **10GBase** TX Ethernet Ports

PMC Mezzanines

EXAMPLES

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Example for FPGA Mezzanines

MTCA FOR IMAGE PROCESSING

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Standalone 2nd FMC

Features

- Data Input via GiG E Vision FMC
- Direct access to the inputs via 2nd FMC with HDMI Interfaces.

NAT-AMC -FMC

FMC: Flexible IO

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C o m p u t e r
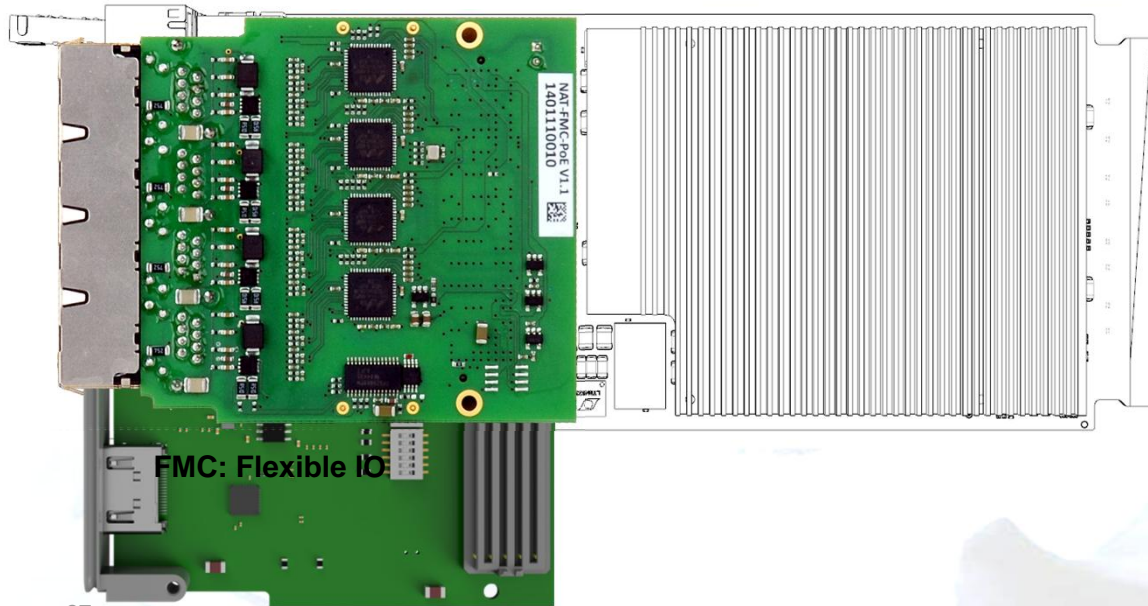
Image Processing System mid-range
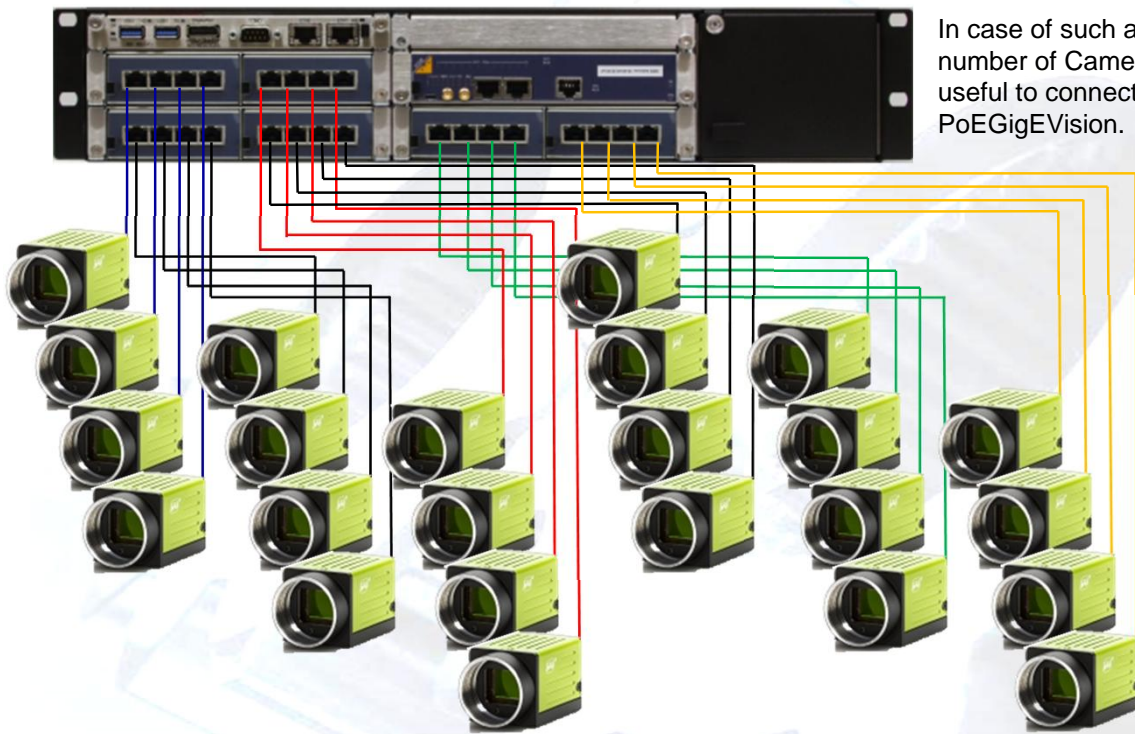
In case of such a
number of Cameras it`s
useful to connect over
PoEGigEVision.

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C o m p u t e r

Example for different Route complexes

TWO COMPUTER IN ONE SINGLE CHASSIS

Challenge:

- Two or more PC-Systems are required

But

- Space is limited
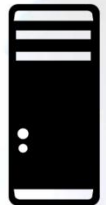
Solution

- One single MTCA Chassis (e.g. 2HE)

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Solution

- One single MTCA Chassis (e.g. 2HE)
- Plug in your required AMCs; e.g. 2x CPU, several I/0

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Computer

Solution

- One single MTCA Chassis (e.g. 2HE)
- Plug in your required AMCs; e.g. 2x CPU, several I/0

CPU 1

I/O for CPU 1

I/O for CPU 1

CPU 2

I/O for CPU 2

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Two Computer in one single Chassis

Solution

- One single MTCA Chassis (e.g. 2HE)
- Plug in your required AMCs; e.g. 2x CPU, several I/0
- Define Root Complex

CPU 1

I/O for CPU 1

I/O for CPU 1

CPU 2

I/O for CPU 2

Two Computer in one single Chassis

Solution

- One single MTCA Chassis (e.g. 2HE)
- Plug in your required AMCs; e.g. 2x CPU, several I/0
- Define Root Complex

CPU 1

I/O for CPU 1

I/O for CPU 1

CPU 2

I/O for CPU 2

Root Complex 1

Two Computer in one single Chassis

Solution

- One single MTCA Chassis (e.g. 2HE)
- Plug in your required AMCs; e.g. 2x CPU, several I/0
- Define Root Complex

CPU 1

I/O for CPU 1

I/O for CPU 1

CPU 2

I/O for CPU 2

Root Complex 1   **Root Complex 2**

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Two Computer in one single Chassis

Solution

- One single MTCA Chassis (e.g. 2HE)
- Plug in your required AMCs; e.g. 2x CPU, several I/0
- Define Root Complex

CPU 1
I/O for CPU 1
I/O for CPU 1

CPU 2

I/O for CPU 2
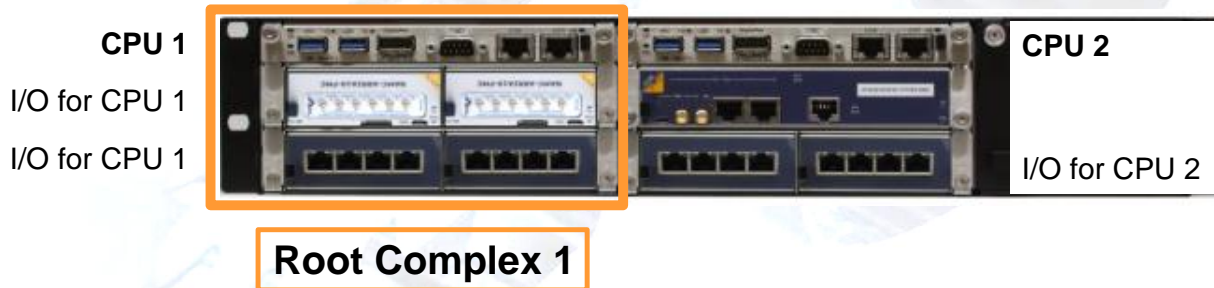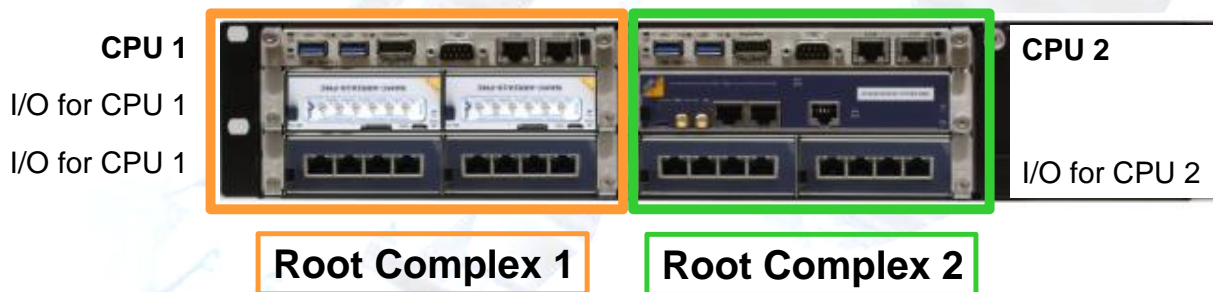
Root Complex 1   **Root Complex 2**
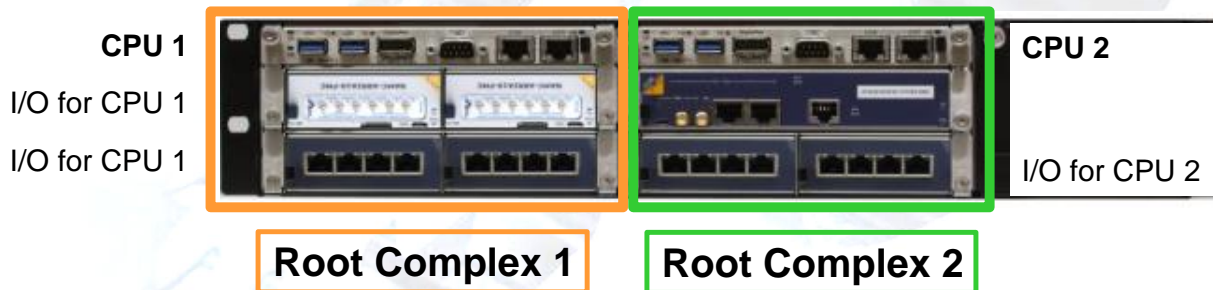
… up to three Root Complexes are possible in a six Slot System

![powerBridge Computer logo]

MTCA Carrier Hub - Overview

MCH

Overview MTCA

Backplane

RTM
Rear Transmission Module

AMC
Advanced Mezzanine Card

Chassis

MCH
MTCA Carrier Hub
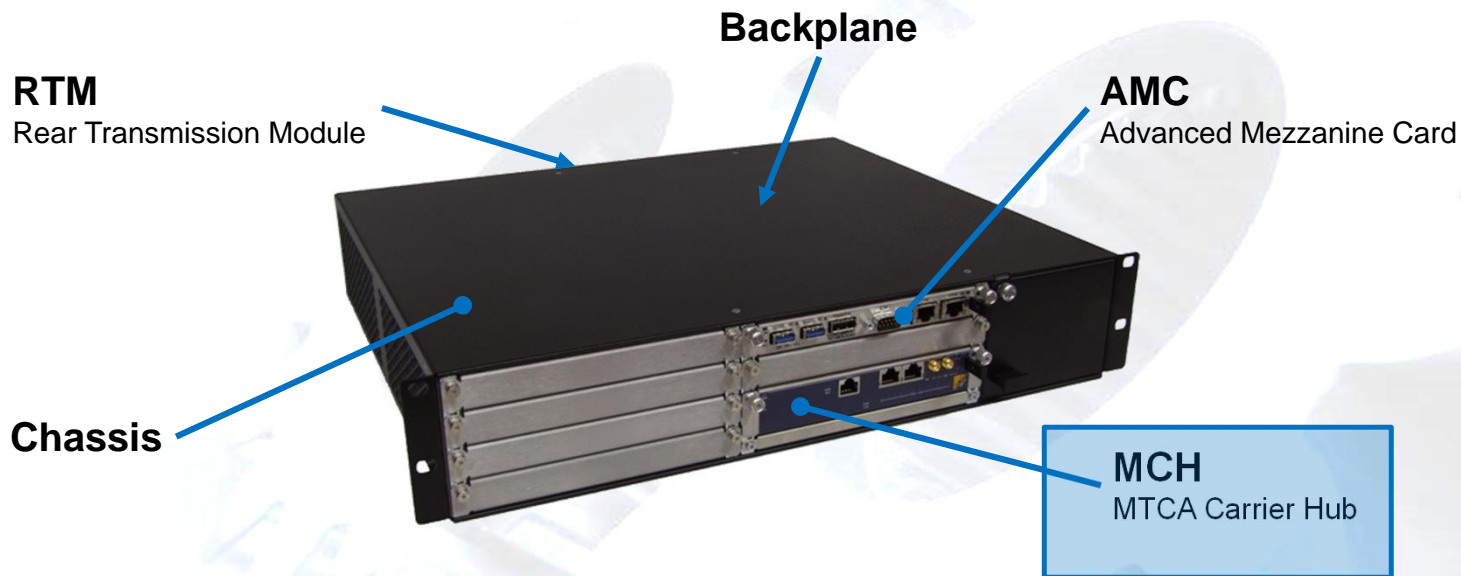
- **Base Functions**
    - **System Manager for:**
        - Chassis and Fan unit
        - Power modules
        - Payload cards Manager AMC's

    - **Hotswap Manager**
        - Replacement of cards during operation without downtime
        - Redundancy manager (option)
    - **Base Switch**
        - 1 GbE witch between all cards in a system (12 AMC and 1 or 2 MCH)

![powerBridge Computer logo]
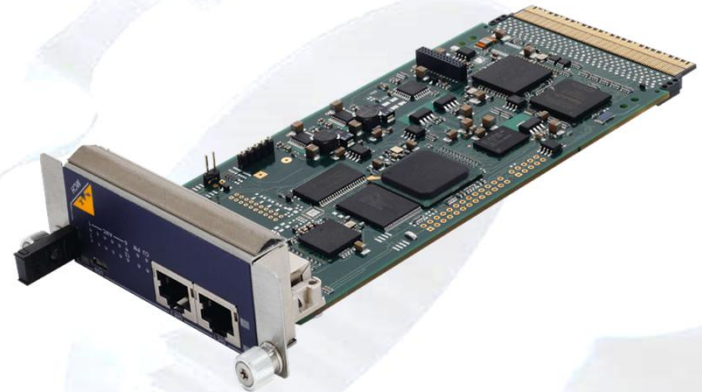
Optional Functions

- Clock module
    - Clock distribution inside system
    - Clock in/out from/to external Systems
- Fabric switching
    - PCIe Gen 3 x4– x16 (1-16 Gb/s)
    - XAUI, 2.5, 10, 40, 100 GbE switch
    - SRIO witch (8 Gb/s)
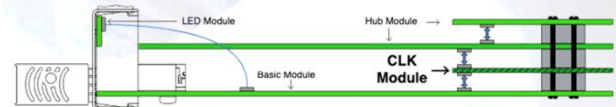
What is an MCH?

- The MCH is managing the system configuration, e.g. different root complexes
- The MCH provide external/internal clocks to the AMC
- The MCH integrate e.g. PCIe Switches
- Uplink x16 possibility to external devices

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MCH Management Software „NAT View"

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Computer

MCH Management Software „NAT View"

1. Overview and purpose.

NATview is an easy to use visualization tool for any MicroTCA system that includes a NAT-MCH. NATview allows the user to view at and manipulate the components of the MicroTCA system in a graphical way.

2. Platform independence.

NATview runs on every platform that can execute Oracle Java 1.7. It has been successfully tested on Windows (XP to 10), Linux (Ubuntu, SuSE) and MacOS X (Leopard to High Sierra).

3. No installation required - even runs from a memory stick.

4. Comprehensive graphical overview of the system state.

5. Read current sensor values.

Check the current sensor states and values. Even monitor values over time. Monitor multiple sensors at the same time!

6. Backplane Connectivity Viewer

Comprehensive display of the backplane connections.
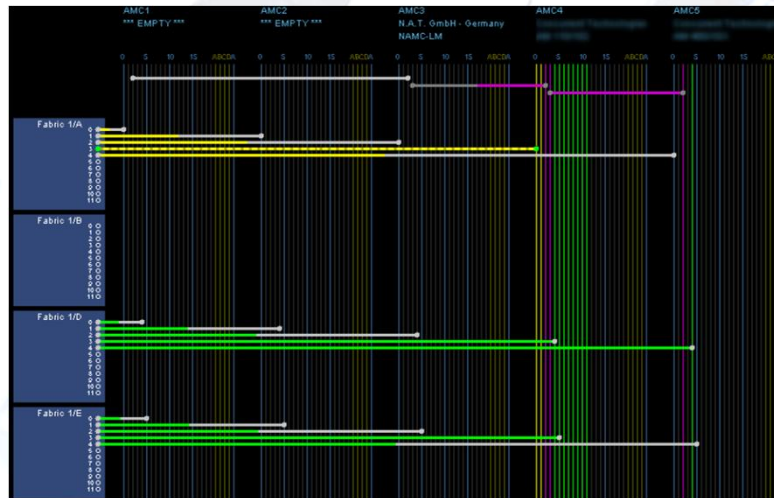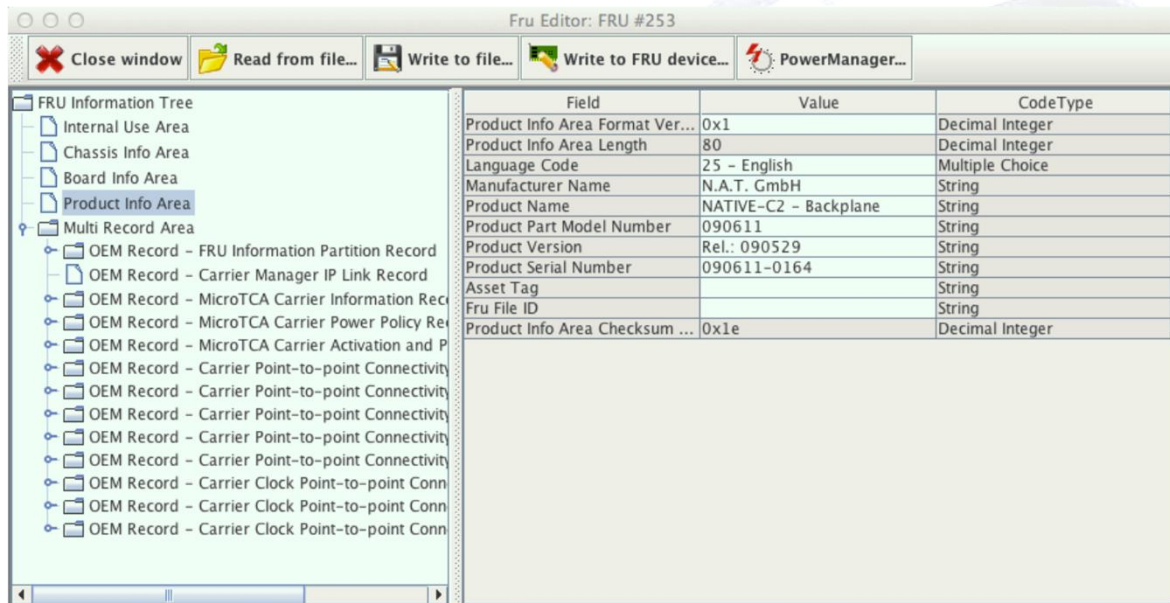Understand why the system does not boot or why the PCIe does not work.

7. FRU Editor

Check and modify the FRU info data of every FRU device in the system (if you have the license to do so).

Field	Value	CodeType
Product Info Area Format Ver...	0x1	Decimal Integer
Product Info Area Length	80	Decimal Integer
Language Code	25 – English	Multiple Choice
Manufacturer Name	N.A.T. GmbH	String
Product Name	NATIVE-C2 – Backplane	String
Product Part Model Number	090611	String
Product Version	Rel.: 090529	String
Product Serial Number	090611–0164	String
Asset Tag		String
Fru File ID		String
Product Info Area Checksum ...	0x1e	Decimal Integer

FRU Editor tree (left panel):
- FRU Information Tree
  - Internal Use Area
  - Chassis Info Area
  - Board Info Area
  - Product Info Area
  - Multi Record Area
    - OEM Record – FRU Information Partition Record
    - OEM Record – Carrier Manager IP Link Record
    - OEM Record – MicroTCA Carrier Information Rec
    - OEM Record – MicroTCA Carrier Power Policy Re
    - OEM Record – MicroTCA Carrier Activation and P
    - OEM Record – Carrier Point-to-point Connectivit
    - OEM Record – Carrier Point-to-point Connectivit
    - OEM Record – Carrier Point-to-point Connectivit
    - OEM Record – Carrier Point-to-point Connectivit
    - OEM Record – Carrier Point-to-point Connectivit
    - OEM Record – Carrier Clock Point-to-point Conn
    - OEM Record – Carrier Clock Point-to-point Conn
    - OEM Record – Carrier Clock Point-to-point Conn

Toolbar: Close window | Read from file... | Write to file... | Write to FRU device... | PowerManager...

Fru Editor: FRU #253

8. Power Manager (reworked)

Easily change the power configuration – load sharing or redundancy – in no time with just a few mouse clicks. Switch all power channels for one power unit on or off with a single mouse click!

9. System Dump

When in trouble give your supporter the information they need – easy as 1-2-3:

System Dump

System Dump File:

C:\Users\sperl.NATEUROPE\Desktop\Systemdump.txt

Dump progress:

0%

Start dump

Close Dialog
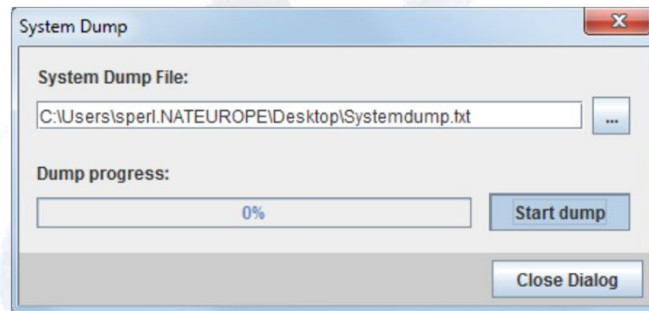
10. HPM Update Update

the system firmware with a few mouse-clicks. No cryptic command lines!

12. Support for Non-Standard Systems

Displays the AMCs correctly even for non-standard orientations:

North	West	South	East

13. Checks for updates of the application on startup

Never miss a new NATview release again. NATview will only inform about a new release – download and installation is up to you so you are always in control!

14. Extendend help viewer

Quick help information is only one mouse click away.

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C o m p u t e r
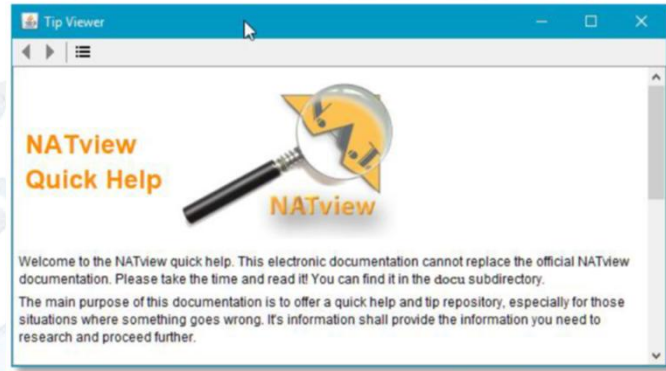
The connection in MTCA

BACKPLANE

powerBridge Computer — Backplane

- Passive backplane
- LVDS - Low Voltage Differential Signaling (ANSI/TIA/EIA-644-1995)
- Star/ Dual Star topology
- Large variety of transmission protocols
  - Ethernet
  - PCI Express
  - S-ATA/SAS
  - Serial Rapid I/O

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Various of MCTA

MTCA .4

INTRODUCTION REAR TRANSMISSION MODULES - RTM

Challenge | Request:

e.g.: fast processing of analog/digital signals on FPGA for controlling complex and time critical applications

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MTCA .4 - RTM

Challenge | Request:

e.g.: fast processing of analog/digital signals on FPGA for controlling complex and time critical applications

Technical details:

- Sampling frequency: up to 10 GS/s
- Sampling rate: up to 16bit

Challenge | Request:

e.g.: fast processing of analog/digital signals on FPGA for controlling complex and time critical applications

Technical details:

- Sampling frequency: up to 10 GS/s
- Sampling rate: up to 16bit

➜ Collecting Data on AMCs and processing on another AMC/CPU does not perform fast enough!

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MTCA .4 - RTM

Challenge | Request:

Solution:

Connecting I/O Modules direct to the AMC by an several Plug (Zone 3 - connector)

      - Signals goes direct to the FPGA / no DSP necessary

      - fast processing

RTM   **AMC**

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MTCA .4 - RTM

Solution:

Solution:

Connecting I/O Modules direct to the AMC by an several Plug
(Zone 3 - connector)

- Signals go direct to the FPGA ➔ no DSP necessary
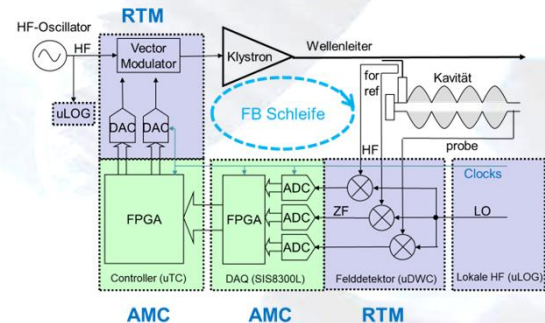
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MTCA .4 - RTM

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Zone 3 connector

RTM   **AMC**

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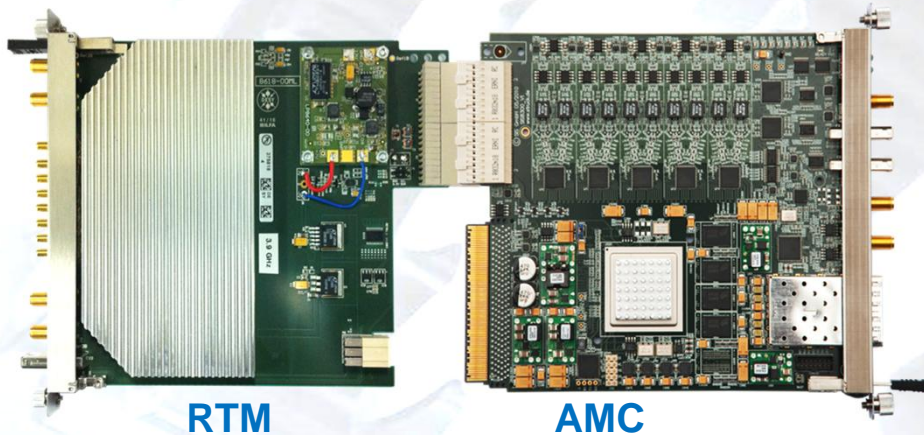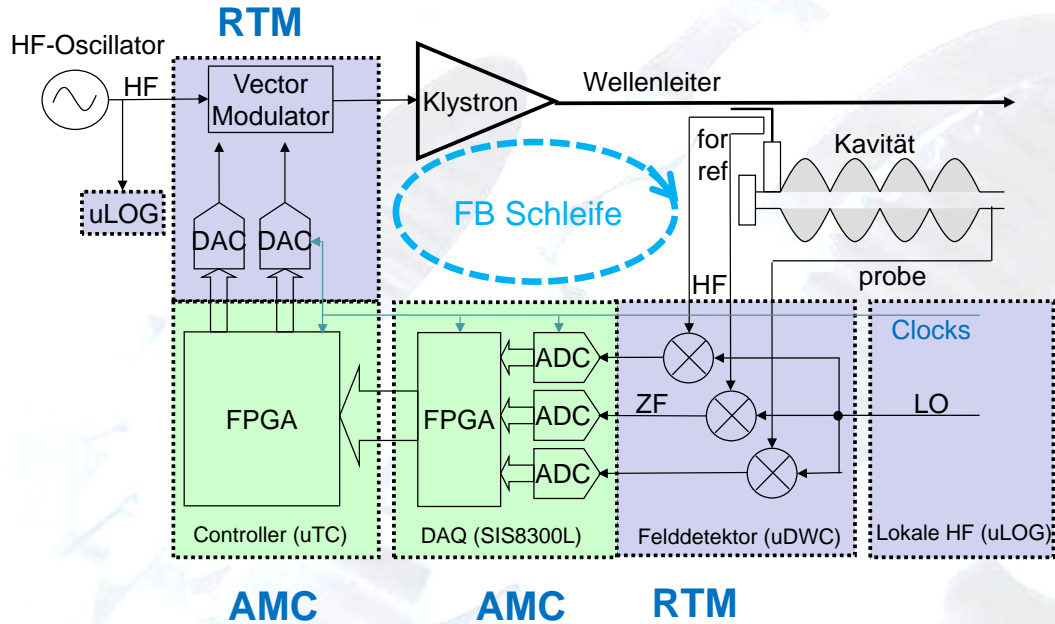
Solution:

Connecting I/O Modules direct to the AMC by an several Plug (Zone 3 - connector)

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      - fast processing

BACK — Zone 3 — FRONT

RTM — AMC

Analogue — Digital

RF backplane — AMC backplane

9 Slot high frequency (0-6GHz) RF backplane (DESY)

Multi-channel local oscillator generator , high frequency signal and low-jitter clock fan-out module

DRTM-LOG1300

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C o m p u t e r
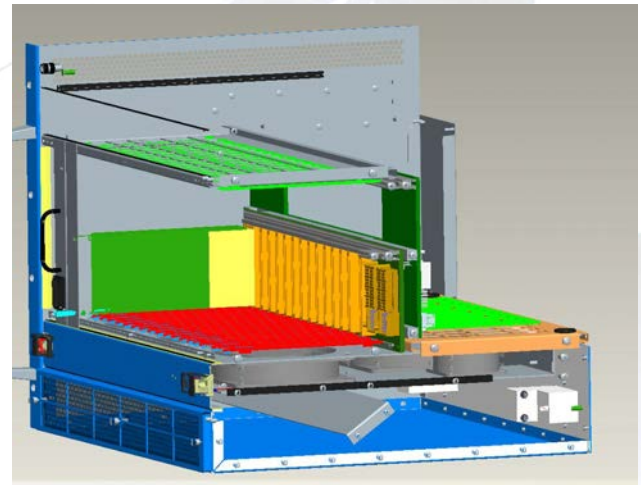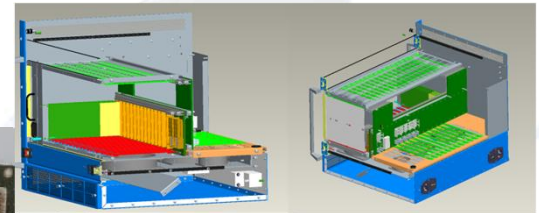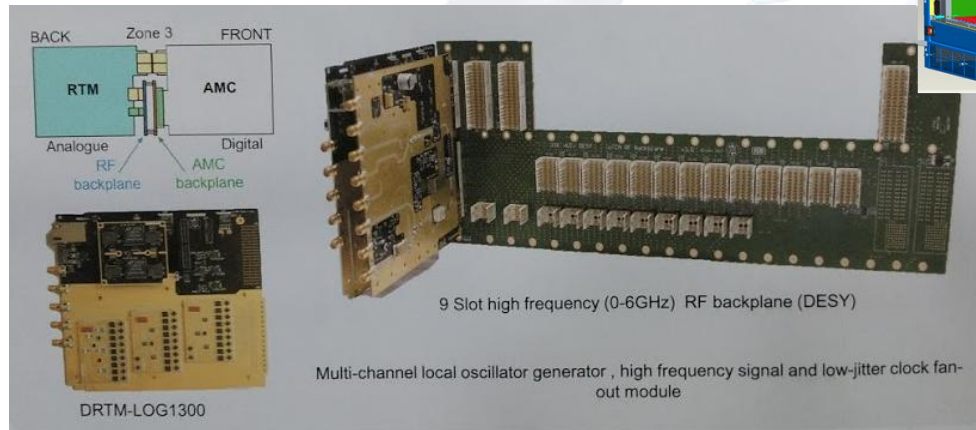
Various of MCTA

ADVANTAGES MTCA

Advantages MTCA

- Add the modules your application need
  - FPGA, I/O, CPU,
  - GigE, PCIe, 40GBASE

  - Fully developed enviroment of I/Os

Advantages MTCA
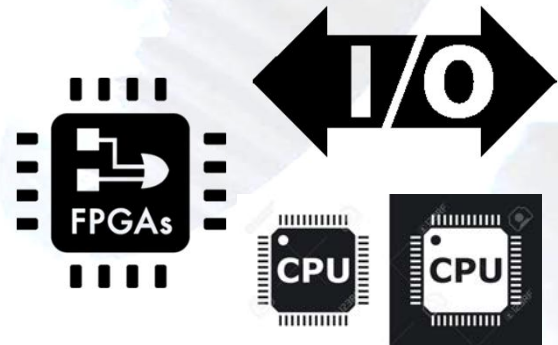
- Add the modules your application need
- Keep the system up-to-date
  - Change modules, as the new application need
  - Simply extend your system
  - The system fits to your application

ACTUAL PRODUCT

- Add the modules your application need
- Keep the system up-to-date
- Easy to maintain
  - Change your module, during the system is running

Advantages MTCA

- Add the modules your application need
- Keep the system up-to-date
- Easy to maintain
  - Change your module, during the system is running
  - The MTCA System monitors, controls and supervises various parameter

Advantages MTCA

- Add the modules your application need
- Keep the system up-to-date
- Easy to maintainan
- Simply increase the reliability
  - Various options of the deepness of the redundant
    - Redundancy of single boards
    - Redundancy of cooling and power supply
    - Redundancy of all board
    - Redundancy of the system
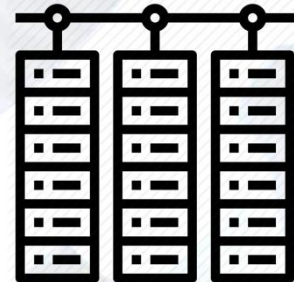
Advantages MTCA

- Add the modules your application need
- Keep the system up-to-date
- Easy to maintainan
- Simply increase the reliability
- Future Safe!
  - power**B**ridge is working in PICMG on the next level MTCA (e.g. 100GbE, PCIe 4/5, backward compatibility)

PICMG®

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C o m p u t e r

Various of MCTA

SUMMARY

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CPU

GPGPU as RTM

MTCA Kombinationen
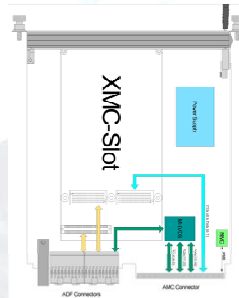
**Carrier
XMC/FMC**

**SFP +
GPU
I/O, etc.**

MTCA Kombinationen
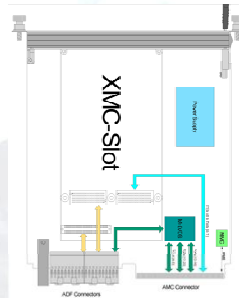
FPGA

FMC
- I/O
- SDR

Chassis Variation MTCA

Examples
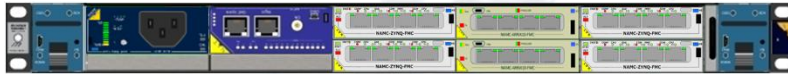
Several Computer in one single Chassis

CPU 1

I/O for CPU 1

I/O for CPU 1

CPU 2

I/O for CPU 2

Root Complex 1   **Root Complex 2**
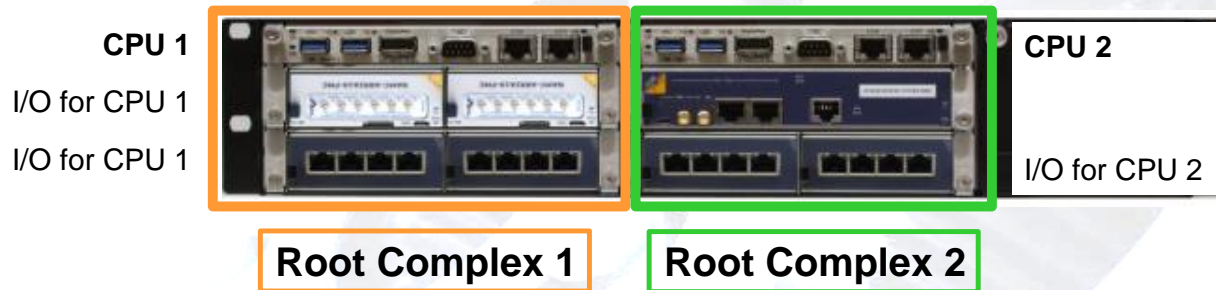
… up to three Root Complexes are possible in 6 Slot Chassis

Systemproposal
Migration from VME to MTCA.0

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Computer

CAMECA System (actually)

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Used Boards

MVME 162

TVME200 4 Slot Industry Pack VMEbus Carrier
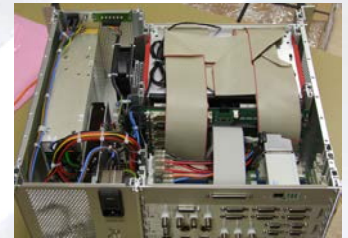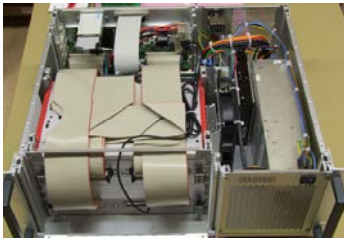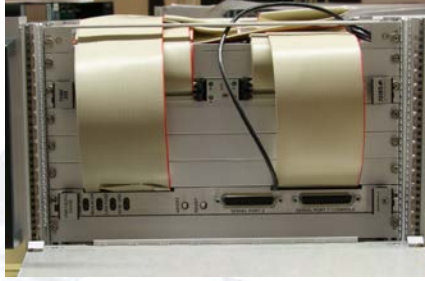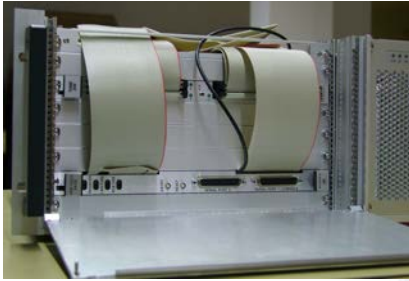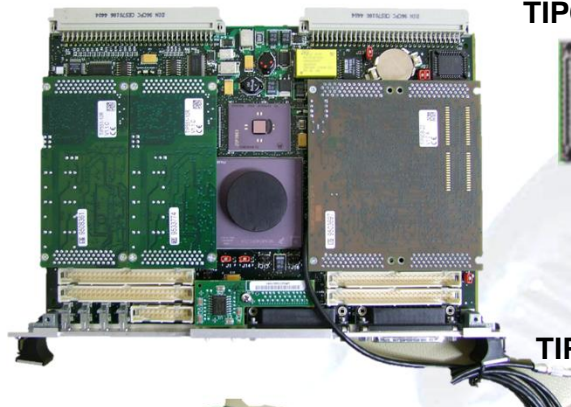
TIP675 48 TTL I/O Lines

TIP551 4 Channel of Isolated 16 bit D/A Conversion
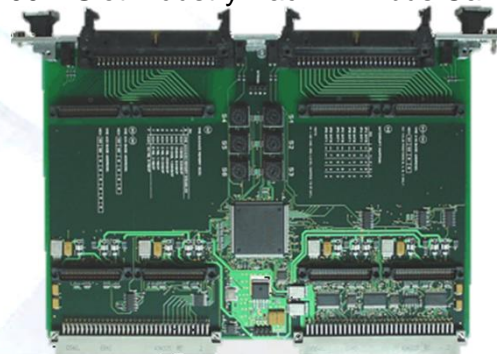
TIP866 8 Channel Serial Interface RS232/TTL/RS422

TIP501 16 Channel of Isolated 16 bit A/D Conversion

TIP866-TM-20 Transition Module (8 x RJ45) for TIP866/867

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14	1	TIP908-20	SCAN-IP TIP908-20	CAMECA
15	1	TIP908-TM-10	Transition Modul TIP908-TM-10	CAMECA
16	1	TIP908-TM-20	Transition Modul TIP908-TM-20	CAMECA

Special modules designed by TEWS Technologies.
TEWS is ready to redesign the modules for other platforms.

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Bill of Materials Old/New

Legacy System VME

Po	Me	Art.-Nr. (12)	Art.-Bez. (40)	Lieferant
0	1	**CH2007-SYS-C**	Consists:	WS
1	1	CH2007-PT	4HE 19" VME64 7-Slot System	Schroff
2	3	FP6/4	Frontplatte 6HE/4TE, chromatiert	Schroff
3	2	FP6/4S	EMV Frontplatte 6HE/4TE, komplett	Abrams
4	2	TVME200-10R	6HE-VMEbus Karte, 4 IP-Slots, FP-I/O	CAMECA
5	1	TIP675-10R	IP-Modul, 48 TTL Tri-State Ein/Ausgänge	CAMECA
6	1	Cabl/TR-675	Adapterkabel gecrimpt, FBL-X10-A	pBC
7	2	TIP551-10R	IP-Modul, 4-fach 16-bit DAC	CAMECA
8	2	Cabl/TR-551	Adapterkabel gecrimpt, FBL-X11-A, FBL-X13-B	pBC
9	1	TIP501-10R	IP-Modul,16 ADC, 16bit, optisch isol.	CAMECA
10	1	TIP866-20R	IndustryPak Modul, 8 RS422, FIFO	CAMECA
11	1	TIP866-10R	IP-Modul, 8 RS232 Ports, FIFO	CAMECA
12	2	TIP866-TM-20R	Transition Modul für TIP866, R-J-45	CAMECA
13	15	MTG-00797	Montage für CH2007-SYS	pBC
14	1	TIP908-20	SCAN-IP TIP908-20	CAMECA
15	1	TIP908-TM-10	Transition Modul TIP908-TM-10	CAMECA
16	1	TIP908-TM-20	Transition Modul TIP908-TM-20	CAMECA

New System MTCA

Po	ME	Art. Nr.	Art. Bez.	Lieferant
0	1	Chassis	12Slot 4 U or similar	Schroff
1	1	AMC/E5/LX2	CPU	Concurrent/NAT
2	5	PMC Carrier	SWFS PMC Carrier	NAT
3	1	Storage AMC	SWFS Storage AMC	Vadatech
4				
5	1	TPMC680-10R	64-bit TTL I/O, 8 x 8-bit Port, interrupts, handshake modes, HD68, 7 ports available at P14 I/O	TEWS
6	1	TPMC551-10R	8 Channel Isolated 16 bit D/A, +/- 10V or 0-10V, DB25	TEWS
7	1	TPMC533-10R	32x differential ADC, 16x DAC and 8x Digital I/O, Simultaneous Sampling, HDRA100	TEWS
8	1	TPMC461-11R	8 Channel Serial RS422, HD50	TEWS
9	1	TPMC461-10R	8 Channel Serial RS232, HD50	TEWS
10	N		Cable	pBC WS
11	1	NAT-PM 600	Powersupply as requested	NAT
12	1	MCH	Management Board for MTCA	NAT
13	8	MTG-00797	Montage für CH2007-SYS	pBC

TIP675-10R -> TPMC680-10R   TIP866-20R -> TPMC866-11R

TIP551-10R -> TPMC551-10R   TIP866-10R -> TPMC866-10R

TIP501-10R -> TPMC533-10R   TIP866-TM-20R -> TPMC866-TM-20R

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Computer

Chassisdesign

Depth mm	296.0
Hight mm	177.8
Slotnumber	12
Description	MTCA.0 4U Subrack
Backplane	Dual Star 40Gbps Transferrate
Hight	4 U
Width 19"	84 HP

- Two hot-swap fan cassettes on the rear of the housing,
- each with a Cooling Unit Manager (CU EMMC),
- Air flow from the front bottom to the back
- Air filter, exchangeable from the front, with presence signal
- 4 U, 19 "rack system for
- 12 single mid-size AMC modules, 2 single full-size MCHs and 2 power modules with a width of up to 12 HP
- According to specification PICMG MTCA.0 R1.0
- Clock topology according to PICMG AMC.0 R2.0
- Backplane with dual-star topology, direct connections for S-ATA / SAS

Other chassis sizes
and slot numbers
are also available

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CPU Board Intel
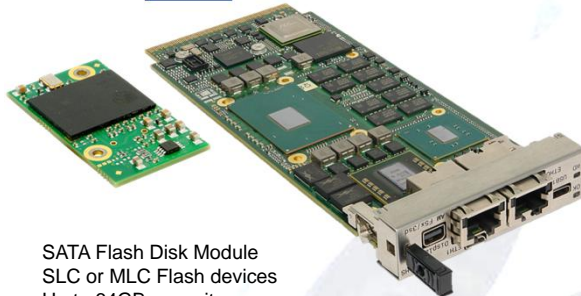
SATA Flash Disk Module
SLC or MLC Flash devices
Up to 64GB capacity

Key Features

- AM F54/341-60
- Single Mid-Size AMC module
- Intel® Skylake 4-core Intel Xeon E3-1505 L v5 (**25W TDP**) processor
- 16 Gbytes DRAM
- Front panel connections:
- 2 x 10GBASE-T (100/1000/10000) Ethernet for networking
- DisplayPort™v1.2,
- USB3.0
- RS232 Serial interface
- 64 GB Flash Drive Module for local boot and data storage
- BSP´s availabel for Windows, Linux and VxWorks
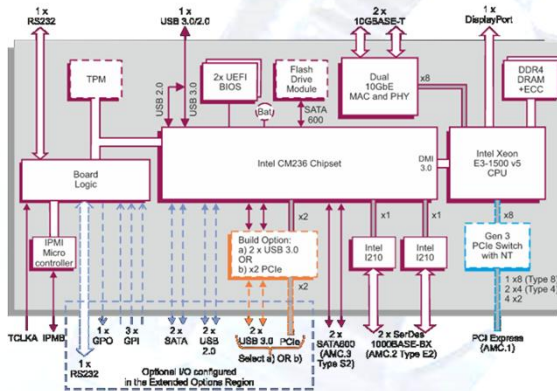
> There would be some effort required to port the software application to a board with Intel processor and PCIe bus.

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![powerBridge Computer]

CPU Board NXP Layerscape
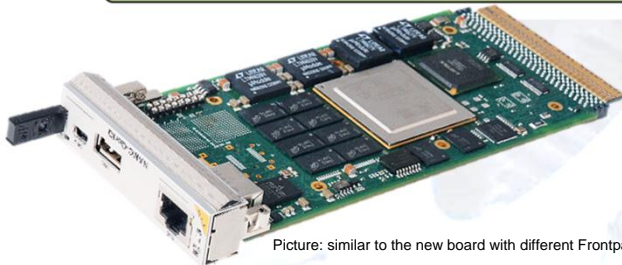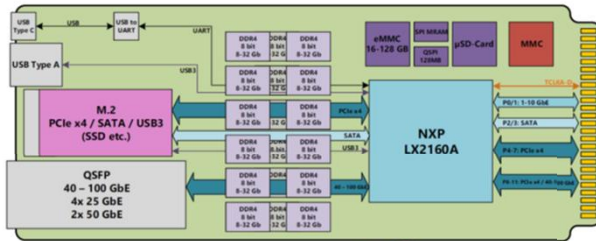
Picture: similar to the new board with different Frontpanel

This AMC is designed with the latest generation of NXP ARM CPUs. With up to 16 Cortex-A72 cores, PCIe- and SerDes-Interfaces as well as an Ethernet switch on-chip, the LX2160A is ideally suited for networking related usage. VxWorks can run on these new boards. There will be BSPs for VxW 7.x.

MAIN FEATURES

CPU
• NXP LX2160A ARM CPU • 16x ARM A72 cores @ up to 2.2 GHz
• 24 SerDes
• 2x 72b DDR4
• TDP ~30W (@2.2 GHz)
• Embedded Ethernet Switch
• Frame Processing Hardware Engine

Memory
• 2x 64bit wide DRAM with ECC (72bit): up to 64GB total
• 128MB QSPI
• SPI MRAM
• 16 – 128GB eMMC
• MicroSD-Card

MMC
• Atmel ATxMega 128

Front Panel Connectivity
• QSFP-Transceiver • 1x 40G / 100G Ethernet (via x4 optical Lanes)
• 4x 10G / 25G Ethernet (each optical Lane operated separately)
• 2x 50G Ethernet (2x x2 optical Lanes operation)
• USB3 Type A
• Console via USB Type C
• Status / Fault / Hot-Swap LEDs

Environmental
Operating Environment
• 0 to +55 degrees Celsius
• Humidity: 5% to 95% (non-condensing)

2 Slot Evaluation system

Features:

- 2Slot MTCA.0 System
- 1x AMF5x/msd; 1x XMC or PMC on Carrierboard
- Embedded MCH
- Internal Powersupply
- GbE Interface

examples

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pBC Supply Chain

The System is complete configured and tested:
- 5 x AMC´s (1x CPU; 4x PMC auf Carrier
- 2 x powersupplies
- 2 x MCHs

Including OS, without customer software application

AC or DC
Power units

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**powerBridge** Computer | Future

… what´s your application?

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Computer

Various of MCTA

ACCESSORIES

Various of MCTA

TECHNICAL DEEPNESS
MCH / PLUG IN/OUT OF AMC´S

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C o m p u t e r

- MTCA System can act as EtherCAT Master
  - Configuration and management of EtherCAT networks
  - Cyclic exchange of process data
  - Sophisticated API common to all implementations as interface between the application and the EtherCAT master stack
  - Mailbox based communication with:

    - **CAN application protocol over EtherCAT (CoE)**
    - **Ethernet over EtherCAT (EoE)**
    - **File over EtherCAT (FoE)**
    - **Servo Drive over EtherCAT (SoE)**

  - Built-in detailed diagnostics and profiling functions
  - Written in ANSI-C designed with high performance, small resource usage and scalability in mind
  - The core components are operating system (OS) and CPU architecture independent
  - Adaption to many prevalent (real-time) operating systems available from stock
  - EtherCAT Master Class A according to ETG.1500

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C o m p u t e r

Fieldbus.
EtherCAT. Slaves.

EPS-9905
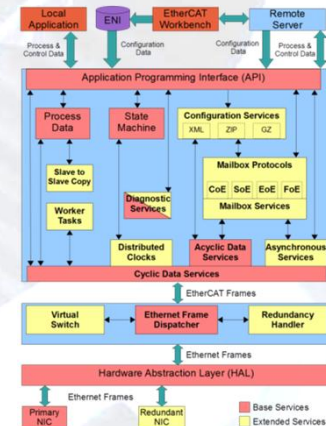
EPS-6000

EtherCAT Slave modules

- EPS-6000 EtherCAT bus coupler
- EPS-1132 digital input 32 channel with SPI interface (sinking type)
- EPS-2032 digital output 32 channel with SPI interface (sourcing type)
- EPS-2308 relay output 8 channel and 8 digital input with SPI interface
- EPS-3032 analogue input 32 channel (+/-10V) with SPI interface
- EPS-3216 analogue input 16 channel (0~20mA) with SPI interface
- EPS-3504 RTD input thermal 4 channel with SPI interface
- EPS-4008 analogue output 8 channel with SPI interface
- EPS-7002 pulse output motion controller 2 channel with SPI interface

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C o m p u t e r

JTAG adapter.

Ease of programming.

- JTAG Switch Module (JSM) in single mid/full size AMC form factor with onboard FPGA to adapt to any JSM pin-out at AMC type backplane connector (default N.A.T. pin out, others on request)

- JTAG download via MCH through Ethernet

- JTAG programming connector at front panel

- Automatic arbitration between JTAG Masters

- Target selection through JTAG information

- Overrule of automatic operation and dedicated selection of JTAG target by front panel elements

- Multiple JSM pinout configurations via FPGA

powerBridge
C o m p u t e r

AMC extender
Easy of development

- AMC extender are passive extenders
- Front AMC extender module
- Rear µRTM extender module
- Enables access to AMC modules and signals
- Supports all fabric connectors
- available with additional power supply for development