



# DESY Workshop 5./6. December 2018

powerBridge Computer



All brands or names are property of their respective holders.



MTCA.4 Starter Kits, including MCH, CPU & PM





AMC Modules



 Spare parts, like filler modules, adapter cables, program and debug tools, test adapter  Carrier + Mezzanines (IP, PMC, XMC, FMC)



 SW & FW Support including BSP, source code drivers, sample applications, FPGA framework



More information at https://msktechweb.desy.de/configurator/



Starter Kit Basic configuration:

- CPU >> AMG 6x/msd
- PSU >> NAT-PM-AC1000
- MCH >> NAT- MCH

Other and additional modules are available on request



- 2U 19" MTCA.4 crate, PICMG MTCA.4 R1.0
- 5 double mid-size AMC slots
- 1 double full-size AMC slot
- 5 double mid-size µRTM slots
- Double full-size MCH slot with µRTM Slot
- Double full-size Power module slot
- Exchangeable cooling unit with front to left or right to left air flow
- Dust filter exchangeable



- 4-core Intel® Xeon® Processor E3-1505M v6:
- 8 Mbytes Cache, 3.0 GHz
- Intel® HD Graphics P630
- 2-core Intel® Core™ i3-7102E Processor:
- 3 Mbytes Cache, 2.1 GHz
- Intel® HD Graphics 6302-core
- Front panel connections including option for 2 x 10 Gigabit
- SFP+ modules for remote connectivity
- Built in SATA microSSD<sup>™</sup> for local boot and data storage
- Two M.2 sites for M-key SSD high speed RAID storage
- Optional µRTM
- Optional I/O in extended options region
- Support for Linux®, Windows® and VxWorks®



- Intel® 4-core processor variants for CPU or GPU intensive processing loads
- 4-core Intel® Xeon® Processor E3-1515M v5:
  - 8 Mbytes Cache, 2.80 GHz
  - Intel Iris<sup>™</sup> Pro Graphics P580
- Gen 3 PCI Express® fabric interface options for flexible connection to other payloads

CONCURRENT S

AM F5x/msd

- Front panel connections including:
  - 2 x 10GBASE-T Ethernet for networking
  - 1 x DisplayPort®, USB and Serial for configuration
  - Optional Flash Drive Module for local boot and data storage
  - Optional I/O in extended options region



# Port 4-7 Bockpare Connection

#### **Advanced Switching Modes**

#### PoE

The onboard Ethernet Switch provides non-blocking Ethernet switch and supports IEEE802.1 Audio/Video Bridging (AVB) and Time Sensitive Network (TSN). The board is capable to drive power to 4 Ethernet links per IEEE802.3 af standard (15.4W per link) or two links per IEEE802.3 at standard (25.5W per link)

#### **Key Features:**

- 4 IEEE 802.3af
- compatible front ports
- Optional IEEE802.3at
- (two channels)
- Feature rich Ethernet switch
- IGbE and 10GbE
- backplane connections
- IEEE802.1
- AVB and TSN support
- High efficient power converter

#### **Ethernet Switching**

The four front panel Ethernet connections can be routed/aggregated to the MTCA backplane's 1GbE ports (0/1) or to the 10GbE fatpipe ports (4-7 or 8-11).

## powerBridge Computer Image Processing Boards

#### FMC-GigE-Vision-PoE





#### Ethernet Switching

The four front panel Ethernet connections can be routed/aggregated to the MTCA backplane's. 1GbE ports (0/1) or to the 10GbE fatpipe ports (4-7 or 8-11).

#### **Key Features:**

- 4 IEEE 802.3af compatible front ports
- High efficient power converter
- FMC HPC Connector

#### **FPGA Carrier Boards**

The **FMC-GigE-Vision** is dedicated to powerful FPGA based FMC carrier boards like the *NAMC-ARRIA10-FMC* or the *NAMC-ZYNQ-FMC* boards for first level picture or video processing/analysis. Due to their high speed interconnect topology FMC modules are the ideal platforms to aggregate and process high bandwidth data streams as provided i.e. by camera links and video streams.

#### ΡοΕ

The board is capable to drive power to 4 Ethernet links per IEEE802.3 af standard (15.4W per link) or two links per IEEE802.3 at standard (25.5W per link)



#### ZYNQ FPGA Board

- Xilinx ZYNQ-7000 XC7Z045 or XC7Z100 FPGA
- High pin-count FMC slot complies with VITA 57.1
- Dual banks of DDR3 memory (1 GB 64-bit, 512MB 32-bit)
- 256 MB NOR quad SPI flash memory
- MicroSD card slot
- AMC.1, AMC.2, AMC.3, AMC.4 and IPMI 2.0 compliant
- JTAG access over backplane
- FMC adapter GbE Vision (see small mezzanine)

#### SanBlaze Storage Board

- One Integrated 2.5" disk drive /SSD
- SAS or SATA protocol and signaling
- Select active Port
- AMC port 3 only
- AMC port 2 only
- Both Ports (SAS only)
- Serial burst data rate 6.0Gb/s
- Capacity options up to 1TB
- Front panel disk activity LED

Pictures: similar to the original boards



#### **Features**

- FMC Vita 57.1 Compliant, Low Pin Count Connector
- Base, Medium, Full, Extended and Dual Base
- Configurations of Camera Link
- PoCL v1.2 support
- Acquisition pixel clock rates up to 85 Mpz
- Supports all Camera Link bit assignment configurations
- Temperature Range: 0°C to 50
- Air Cooled
- FMC Vadj = 2.5 V, 1 max.
- FMC 12V0P 800 m/ ~400 mA per camera PoCL output, dual config)

#### **Front Panel Interfaces**

- Dual Camera Link interface
- 4 LED indicators





Block diagram of the MFMC module



## IFC\_1410 AMC, MTCA.4 Intelligent FMC Carrier

#### **Key Features**

- MTCA.4 mid-size double-width AMC form factor
- NXP QorlQ T2081 CPU @ 1.8 GHz
  - Four dual-threaded e6500 computing cores
  - On-board 2 GB DDR3L-1866 SDRAM
  - High-speed peripheral interfaces supporting PCI Express Gen3 and 10 GB Ethernet
  - Altivec technology-based SIMD engine
  - Non-volatile boot media: NOR and SPI flash
  - Non-volatile storage memory: 4 Gbit NAND flash
- Xilinx Kintex UltraScale Central FPGA:
  - High end Xilinx Kintex UltraScale KU040 (default) or KU060 FPGA
  - 1024 MB dual channel DDR3L-1066 SDRAM
  - Local (SPI flash) and remote (Ethernet) configuration support
  - Up to three embedded PCI Express blocks configurable as End Point or Root Complex
  - Powered by TOSCA III FPGA Design Kit for straight-forward FMC integration and customization
- Dual HPC VITA 57.1 compliant FMC slots
- Ultra low jitter clock inputs on front panel, AMC and RTM interfaces
  - MTCA.4 D1.4-compliant RTM interface
- EPICS Support
  - The whole MTCA.4 ecosystem (AMCs and µRTM modules, ADC/DAC FMCs and TOSCA III FPGA Design Kit) is fully integrated within the EPICS environment by means of open source tools, libraries and applications developed by the Paul Scherrer Institut (PSI) in Switzerland.







## powerBridge Computer Image Processing System

The following project needs only 8 cameras for these complex imaging processes. The application should work with two FPGA AMC's and two GiG EVision FMC's Usable with external storage

### **Requirements for the test:**

- each two cameras deliver overlayed pictures
- to identify different faults, the pictures of all cameras will be compared
- For supporting the identification it's possible to use software features like recouloring, pixel recalculation aso.





#### **Blow Fill Seal machine**

Current status in image processing:

- Up to 8 cameras monitor the process in the inspection system of the bottle blowing and filling machines.
- Each of the 8 cameras take 20 pictures.
  Every Two cameras are triggered together.
- 3, 5-megapixel images of 8 cameras are overlain, sharpened and then reduced. This results in a representation of the object that makes mistakes recognizable (foreign particles, inclusions in the material, hole formation.
- 38.000 images/h per process interval are processed by 8 cameras in one PC.





#### EXTRUDE -

The polymer tube extruded from granules is taken over by the opened form.



#### DEFORM -

When the mold is opened, the container leaves the system and the next cycle begins.



#### BLOW -

The mold closes and fuses the ground. The mandrel sits on the neck of the container and blows the tube with sterile air to the container. Small containers are molded with vacuum.



FILL – About the mandrel is the exactly metered volume filled in the container.



#### CLOSE -

After lifting the mandrel, the head block closes and forms the desired closure.



### The inspection includes:

- Quality and condition of the bottle Purity and homogeneity of the extrusion Purity and homogeneity of the blowed bottle
- Quality of the medium Purity of the medium Possible foreign substance in the liquid Fill height
- 3. Breechlock
- 4. Labeling

Container

# Filled medium Breechlock

Source: Rommel A

Label



## **Concept for an optimized System by pBC for quality inspection:**

- 2HE MTCA system with a number of Xilinx ZynQ AMC's incl. Arm Processor for pre processing with GiGEVision FMC's, 4 Ports for camera connection on each FMC.
- 2 Rootcomplexes with
  2 x AMG 64 with 32 GB RAM and up to 2TB storage on board.
  - One rootcomplex is serving the cameras
  - One rootcomplex is available for x-ray inspection with a number of DAC Boards.
    - For example with 2,4GS/s with 4 channels and 12-14 bit resolution.

**Optimized System for the described application:** 

8 cameras managed only with two FPGA boards (Xilinx ZynqQ 70xx Series)



## **Go Series**

- 5-megapixel 2/3" CMOS imager (global shutter)
- Up to 22.7 fps at full resolution
- 3.45 µm square pixels
- Small size (29 x 29 x 41.5 mm, excluding lens mount)
- 8/10-bit output in choice of monochrome or raw Bayer color models (12-bit output available in video process bypass mode)
- Exposure control from 14 µs to 8 seconds in 1 µs steps
- 2X binning for increased speed and sensitivity (monochrome only)
- Single and multi-ROI modes for flexible windowing and use of smaller optics
- Automatic Level Control (ALC) for dynamic lighting conditions
- Accepts power over GigE Vision interface or separate 6-pin connector
- High reliability: MTBF > 200,000 hours
- C-mount lens mount





Source: JAI ltd.





## **Quantity of the cameras?**

- Up to 8 Cameras, Data processing with Processor (Xeon Exxx) build a convinient solution
- >8 Cameras, Data processing with FPGA because of the higher amount of data and synchronization of the cameras is more useful than processor solutions

(Caution: take care for the power consumption)

- Option: More rootcomplexes for different functions
- Option II: GPGPU solution with MXM modules on an AMC Carrier
- Option III: Storage Solution with internal and external mass storages. (RAID Formation etc.)



Outlook for the future

# powerBridge:

- Boardselection (for new applications)
  - GPGPU Boards
  - Deep Learning Modules
- Systemintegration
  - Example: Imageprocessing with deep learning effects)
- Test and Certification

# Adlink/NVIDIA

- Board development
- OEM/ODM Products for value added solutions
- Management Software, Security and Cloud solutions



## powerBridge Computer EGX-MXM-P1000/(P2000\*)

Pascal P1000(GP107) MXM Embedded Graphic module

#### EGX-M-P1000 features

- MXM 3.1 Type A FF (82 x 70 mm)
- 640 CUDA cores
- 1.8 TFLOPS peak FP32 performance
- 4 GB GDDR5 memory
- 96 GB/s maximal memory bandwidth
- Support up to 4 UHD displays
- Maximum Package power 48W
- 5-years longevity support

#### Environmental

- Operating Temperature: CT 0~55C/WT -40~ 85C
- Operating RH 5% to 90%





P620/P2000\* is under planning in 2H'18





## Pascal P1000(GP107) MXM Embedded Graphic module

- 4 DisplayPort 1.4 digital video outputs:
- support for High Dynamic Range (HDR) video
- 4K at 120Hz or 5K at 60Hz with 10-bit color depth
- Pascal GPGPU parallel processing:
  - 640 CUDA® cores
  - CUDA Toolkit 8.0, CUDA Compute version 6.1
  - OpenCL<sup>™</sup> 1.2, DirectX<sup>®</sup> 12, OpenGL 4.5, Vulcan 1.0
  - Memory width: 128-bit
  - Maximum memory bandwidth: 96 GB/s
  - PCle x16 Gen3 supports
- NVENC/NVDEC accelerator for HEVC (H.265) and AVC (H.264) hardware encode/decode
- Windows (7/10) and Linux drivers, 64bit
- Mechanicals
  - PCB thickness (1.2 mm)
  - Gold plating on connector card edge (30 µin)
  - Standard MXM 3.1 connector
- Conformal coating options
- Operating temperature: CT / WT



step file available for mechanical fitting



No GPUDirect RDMA

GPUDirect RDMA







# **Usable for**

- Data acceleration
- Graphic processing
- Number crunching (relief of the CPU)
- and a lot more add ons for the System.

## Disadvantages

- High power consumption for one board (up to 50W)
- Boardsolutions are actually only as mezzanines available (MXM; XMC)



+ Movidius



Movidius MA2485x2 mPCle for Embedded Deep Learning

#### EDL-mPCle-MA2485

- PCle mini card FF (30 x 50 mm)
- 1x/2x Myriad X MA2485 w/ ROM
- OpenVINO Golden release supported

#### On Each MA2485

- 16x Programmable 128-bit VLIW Vector Processors
- 16x Configurable MIPI Lanes
- Enhanced Vision Accelerators
- 2.5 MB of On-Chip Memory

#### **Environmental**

- Tests will start in 1st Quarter of 2019





(intel)







Open Visual Inference & Neural Network Optimization





Let's discuss your requirements and test our performance!

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