Introduction: 8th MicroTCA Workshop 2019

Holger Schlarb, Leader of the group MSK/DESY
DESY, 04.12.2019

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

DESY.

Welcome to the 8th MicroTCA Workshop

Keynote Speakers:

S2	**Axel Winter (MPI-IPP):**	Fusion Research
S3	**Jens Stapelfeld (Xilinx):**	Industrial HPC device
S6	**Michael Oelmann (Xilinx):**	RFSoC & GSPS ADC/DACs

Pleased to welcome: **Jessica Isquith (President at PICMG)**

Warm welcome to our:

➔ **Producers and Users from Industry /**

➔ **Scientists and Engineers from Science Community**

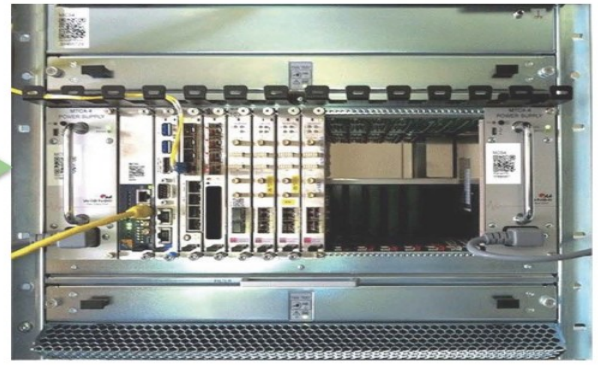
special wel. colleagues from China: Institute of High Energy Physics, Chinese Academy of Sciences; NSRL National Synchrotron Radiation Laboratory; IMP; 中国科学院大连化学物理研究所 Dalian Institute of Chemical Physics, Chinese Academy of Sciences; SINAP

Again …. > 30% are newly registered participants

Let's Recap

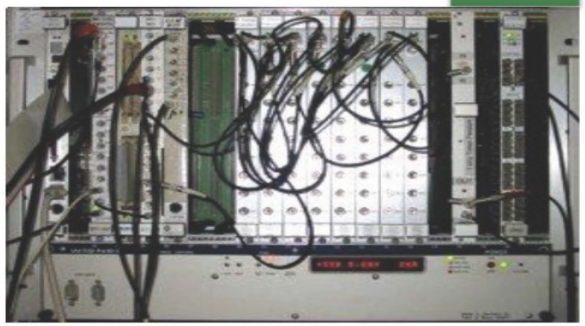
Main motivation …

From VME (FLASH) → MicroTCA (XFEL)



µTCA®

VME is 35 years old!!!



- Redundant fans & power supplies
- Internal clock & trigger distribution
- Modular: reusable components
- Complete remote management
- Modern high-speed data transfer
- Highest signal quality
- I/O cables from rear side

Performance
+
Functions
+
Availability

+ MOSA = Modular Open System Approach

→ no vendor lock-in situation, any company can step in!

→ reduce development expense, design cycle time, and manufacturing costs

→ Access to hardware/software/firmware (specialized functionalities)

Added values / benefits…

Why are we doing this….

- **Large research facilities….**

  Observed diversification of controls electronics (VME + different standards / proprietary) } Refocusing again one standard MicroTCA.4 is tailored to this facilities

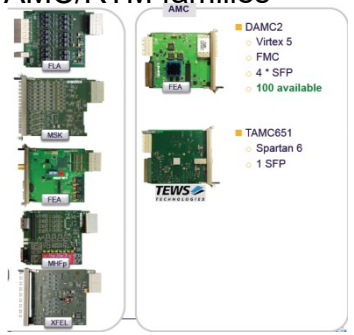
  ➔ Enlarge portfolio, reduced prices, synergies / exchangeability among facilities

- **Headache of controls folks …**

  They love it….

- **Concepts / functional complexity** → AMC/RTM essential

AMC/RTM families



→ Appl. specific / close exchange with vendors

- **Eco system in balanced …?** **Mostly** **→ will grow automatically + some support**
- **Do we get the product we need:** **Mostly** **→ we push the limits / improve product quality**
- **Remark: large research facilities time scale → decades → thankful community**

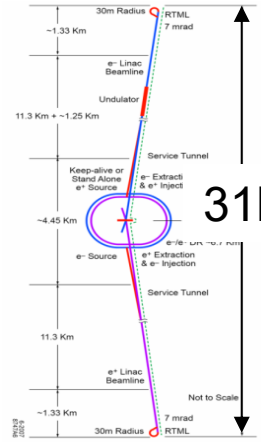
History of MicroTCA@DESY

- **Nov. 2005: Reliability Workshop in Grömitz, Germany**
  - Joint meeting with ILC (intern. linear collider, 33km, 500GeV)
- **Dec. 2007: European XFEL Crate-Standard Workshop**
  - MicroTCA and ATCA was defined to be used
- **Mar. 2009: First PICMG Meeting "xTCA for Physics"**
  - Hardware group: rear I/O and timing
  - Software group: standardization of interfaces for FPGAs…OPsys
- **Oct. 2011: Official announcement of PICMG Specification**
  - "MTCA.4 Enhancements for Rear I/O and Precision Timing"
- **Jul. 2012: Start of Helmholtz Validation Funds till Dec. 2014**
  - „MicroTCA.4 for Industry"
- **Jan. 2014: Reestablish HW/SW PICMG working groups**
  - „MicroTCA.4.1 release: 01.Nov 2016"
- **Oct. 2017: Operation of European XFEL for Users** ➔ T.Wilksen/B.Fernandes/…
- **Feb. 2019: MicroTCA TechLab midterm eval.** ➔ J. Marjanovic + …

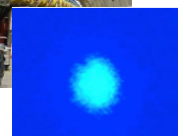
µTCA® AdvancedTCA®

PICMG® Specification MTCA.4

ILC



31km

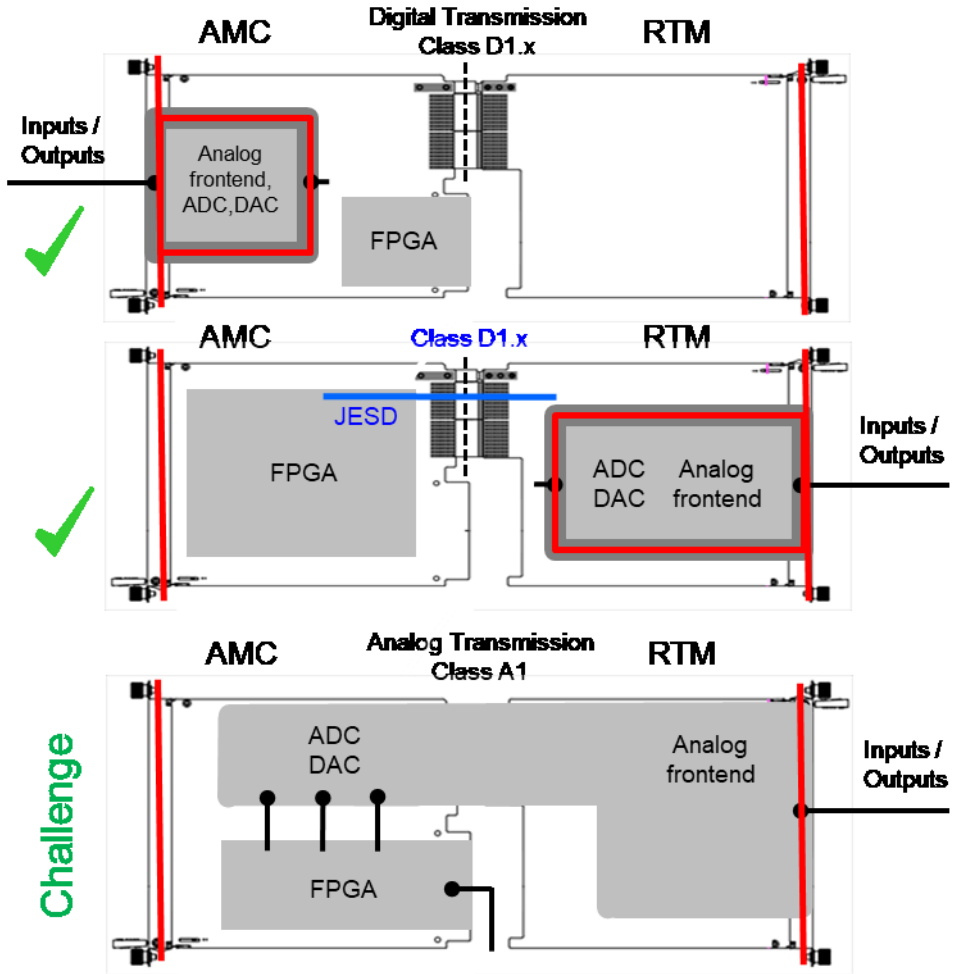


MICROTCA TECHNOLOGY LAB

Helmholtz Validation Fund “MicroTCA for Industry”

Talk by Frank Ludwig, S4

Crate-Level (Modular systems e.g. MicroTCA.4)



Talk by Johannes Zink , S4

Deutsches Elektronen-Synchrotron
Ein Forschungszentrum der Helmholtz-Gemeinschaft
mtca.desy.de

Class RF1.0

Zone 3 Connector Pin Assignment Recommendation for RF Applications between AMC and RTM Boards in the MTCA.4 Standard

Features

MTCA.4 management zone:
- Power, I²C, optional JTAG support

Gigabit-Link zone:
- 1 Gigabit Transceiver Link
- 7 additional Gigabit Transmitter Links

User signal transmission zone:
- 6 LVDS inputs/outputs for user-configuration
- 3 LVDS outputs with fixed direction

Digital clock signal transmission zone:
- 5 LVDS/LVPECL differential inputs for low-jitter clock signals
- 2 LVDS/LVPECL output clock signals
- JESD204B Subclass 1 Compliant interface

Analog signal transmission zone:
- 8 channel AC/DC-coupled single-ended input signals (ADC)
- 4 channel AC/DC-coupled single-ended output signals (DAC)

Applications

- AMC / RTM board design in MTCA.4 standard
- Multi-channel analog-to-digital converters
- Multi-channel signal shaper
- Multi-channel sensor readout and output
- Analog signal conditioning boards
- Low-jitter clock signal sampling and clock recovery

General Description

This Class RF1.0 pin assignment definition of the Zone 3 connector in the MTCA.4 standard is a recommendation mainly for AMC and RTM boards transferring up to 12 analog signals over the Zone 3 connectors. This RF-class is designed for a three row ADF and two six pin coaxial connectors. The main goal is to classify the undefined Zone 3 pin assignment for applications to achieve a high compatibility between AMC and RTM boards.

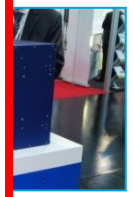
This Class RF1.0 pin assignment requires a common RTM management implementation to make AMC and RTM boards compatible. Appropriate management interface templates for this Class are available on mtca.desy.de.

AMC ZONE 3 CONNECTOR PIN ASSIGNMENT RECOMMENDATION

		Digital Clock I/O	Digital fixed I/O	Digital Clock Input	Digital user I/O		Standard GbX Links			MTCA.4 Management	
J30		10	9	8	7	6	5	4	3	2	1
-	f	AMC-CLK-	OUT1-/D7-	RF-CLK3-	D5-	D2-	GBT7-TX-	GBT4-TX-	GBT1-TX-	TMS	TDO
+	e	AMC-CLK+	OUT1+/D7+	RF-CLK3+	D5+	D2+	GBT7-TX+	GBT4-TX+	GBT1-TX+	TDI	TCK
-	d	RF-CLK2-	OUT0-/D6-	RF-CLK1-	D4-	D1-	GBT6-TX-	GBT3-TX-	GBT0-TX-	SCL	SDA
+	c	RF-CLK2+	OUT0+/D6+	RF-CLK1+	D4+	D1+	GBT6-TX+	GBT3-TX+	GBT0-TX+	MP	PS#
-	b	RF-CLK0-	AMC-TCLK-	RTM-CLK-	D3-	D0-CC-	GBT5-TX-	GBT2-TX-	GBT0-RX-	PWRB2	PWRB1
+	a	RF-CLK0+	AMC-TCLK+	RTM-CLK+	D3+	D0-CC+	GBT5-TX+	GBT2-TX+	GBT0-RX+	PWRA2	PWRA1

		Single Ended Analog Signals		
J31		3	2	1
B		ADC-IN7	DAC-OUT1	DAC-OUT3
A		ADC-IN6	DAC-OUT0	DAC-OUT2
J32		3	2	1
B		ADC-IN1	ADC-IN3	ADC-IN5
A		ADC-IN0	ADC-IN2	ADC-IN4

Table 1: Zone 3 - Class RF1.0 pin assignment J30, J31 and J32 connector, AMC side view



European XFEL Linac: final construction 2015 - 17

The Cold Linac

Racks for:
- Vacuum
- Cryo
- Magnets
- RF
- LLRF
- Coupler
- Diagnostics

Pulse Transformer for Klystron

10 MW Klystron with 2 Wave Guides, 1.3 GHz

MicroTCA Technology Lab

MICROTCA TECHNOLOGY LAB
A HELMHOLTZ INNOVATION LAB

- **April 18: Inauguration**

MicroTCA Technology Lab opens at DESY

Helmholtz Innovation Lab an outstanding example of successful technology transfer

- **Feb 19: Mid-term evaluation passed**

Partners:

struck innovative systeme, CAENels, BEVATECH, powerBridge Computer, TELEDYNE SP DEVICES Everywhereyoulook, ROHDE&SCHWARZ, Schroff, WIENER, elspec group GmbH, vadatech, EMCOMO

Core Activities

Custom Development MTCA.4 (Hardware, Firmware, Software)

High-end Test and Measurement

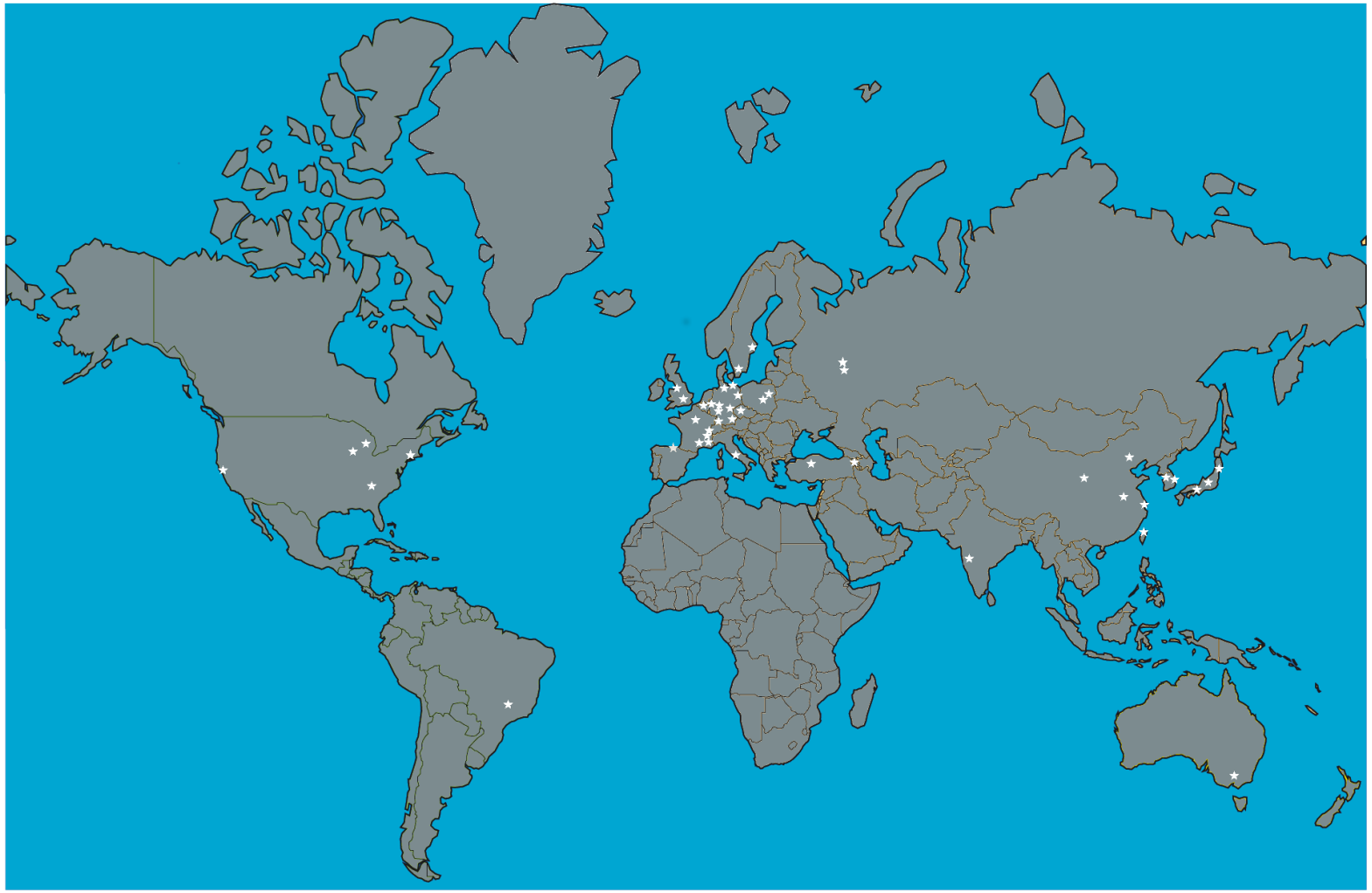
System Configuration and Integration

New Application Areas for MicroTCA

➔ S4: talk by Jan Marjanovic

MicroTCA(.4) users worldwide

as we had contact… de facto new standard for large scale research facilities!!!



Drivers:

➔ Ray Larsen (SLAC)
(heading PICMG HW Group on MTCA)

➔ Shinichiro Michizone (KEK)
(first implementation MTCA.0 in an acc.)

➔ Kay Rehlich (DESY)
(XFEL controls, first large scale impl.)

➔ Anders Johansson (Lund Uni.)
(early adopter at ESS)

….. any many more …

Regional variations:

➔ Customer support / producers

Application fields / early adopters:

➔ Particle accelerator community
➔ Plasma fusion facilities
➔ Experiments
- Photon science
- Neutron science
- Nuclear science

Outreach & experimenting with new formats…

- **Co-organized workshops ~ 2.5 d**

CN: MTCA/ATCA, Beijing, June 2019, 99 participants

→ **Summary given by Xinpeng Ma (IHEP), S2.**

- **Workshops prior to conferences ~ 0.5 d**

US: ICALEPCS19, NYC, Oct. 2019, ~ 40 participants

ICALEPCS 2019

	Welcome	Kay REHLICH	
	Marriott at the Brooklyn Bridge		13:30 - 13:35
	25 years of open PICMG standards: benefits for industry and research	Jessica ISQUITH	
	Marriott at the Brooklyn Bridge		13:35 - 13:55
14:00	MicroTCA.4 status and developments	Kay REHLICH	
	Marriott at the Brooklyn Bridge		13:55 - 14:15
	MicroTCA management	Mr. Heiko KÖRTE	
	Marriott at the Brooklyn Bridge		14:15 - 14:40
	MicroTCA at European Spallation Source	Timo KORHONEN	
	Marriott at the Brooklyn Bridge		14:40 - 15:05
15:00	MicroTCA activities in KEK and J-PARC	Norihiko KAMIKUBOTA	
	Marriott at the Brooklyn Bridge		15:05 - 15:30
	Coffee Break		
	Marriott at the Brooklyn Bridge		15:30 - 16:00
16:00	MicroTCA at XFEL / DESY	Dr. Holger SCHLARB	
	Marriott at the Brooklyn Bridge		16:00 - 16:24
	Open Source Universal PCIe Driver for MicroTCA	Mr. Ludwig PETROSYAN	
	Marriott at the Brooklyn Bridge		16:25 - 16:42
	FPGA developments in MicroTCA	Mr. Jan MARJANOVIC	
	Marriott at the Brooklyn Bridge		16:42 - 17:00
17:00	MTCA.4 in CERN Accelerators	Javier SERRANO	
	Marriott at the Brooklyn Bridge		17:00 - 17:20

- **Application & Topical specific workshops**

SATELLITE WORKSHOP - Photon Science

MicroTCA Workshop

Thursday, 24 January 2019, seminar room 4a, bldg.1, DESY

PROGRAMME			
14:00	Cagil Gümüs	MicroTCA Technology Lab	Welcome and Introduction to the MicroTCA Technology Lab
14.15	Vollrath Dirksen	N.A.T. GmbH	Introduction to MTCA
15:15	Paolo Scarbolo	CAEN ELS	Photon Beam Monitoring in MTCA.4 and Applications
15:35	Fini Jastrow	DESY	MTCA at FLASH
15:50	Coffee break (30 Min.)		
16:20	Aaron Gornott	MicroTCA Technology Lab	Camera Read-out with MicroTCA
16:35	Kay Rehlich	DESY	Timing in MTCA
16:50	Jan Marjanovic	MicroTCA Technology Lab	Digital and analog I/O solutions in MicroTCA
17:05	Laurent Weber	Teledyne SP Devices	Latest MTCA High-Performance Digitizer Technology
17:20	Martin Killenberg	DESY	ChimeraTK -- A software tool kit for hardware access and control application development
17:35	Coffee break (15 Min.)		
17:50	Jan Timm	DESY	DAQ System for energy dispersive detectors
18:05	Martin Tolkiehn	DESY	Plans for a new motor controller in MTCA
18:20	Martin Tolkiehn	DESY	Discussion on future developments

- **Exhibitions:** FEL2019, IBIC2019, ICALEPCS20, IEEE-NNS/MIC19, xTCA@CN19

- **Trade & fairs**

embeddedworld2019 Exhibition&Conference ... it's a smarter world

PICMG

Upcoming events 2020…

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12

- **Workshops prior to conferences ~ 0.5 d**

Vietnam: RT2020, Quy Nhon, Sun. 12.04.2020
→ K. Rehlich/H. Körte/D. Makowski

- **Workshops prior to conferences ~ 0.5 d**

CN: EPICS Conf., Beijing, May 2020
→ Paul Chu/Xinpeng Ma/ Prof. Jingi Li

中国科学技术大学
University of Science and Technology of China

- **Workshop ~ 2.5 d**

CN: MicroTCA Workshop@China, Hefei 28-30.06,2020
→ Prof. Zeran Zhou, USTC

NSRL National Synchrotron Radiation Laboratory

- **Workshops ~ 3 d**

JP: MicroTCA Workshop@Japan, Tsukuba, 30.09-02.10.2020
→ Fumihiko Tamura, J-PARC

KEK-JAPAN

- **Workshops ~ 3 d**

DE: 9th MicroTCA Workshop 01.12-03.12.2020

DESY.

MicroTCA TECHNOLOGY LAB
A HELMHOLTZ INNOVATION LAB

Next large scale project for DESY….

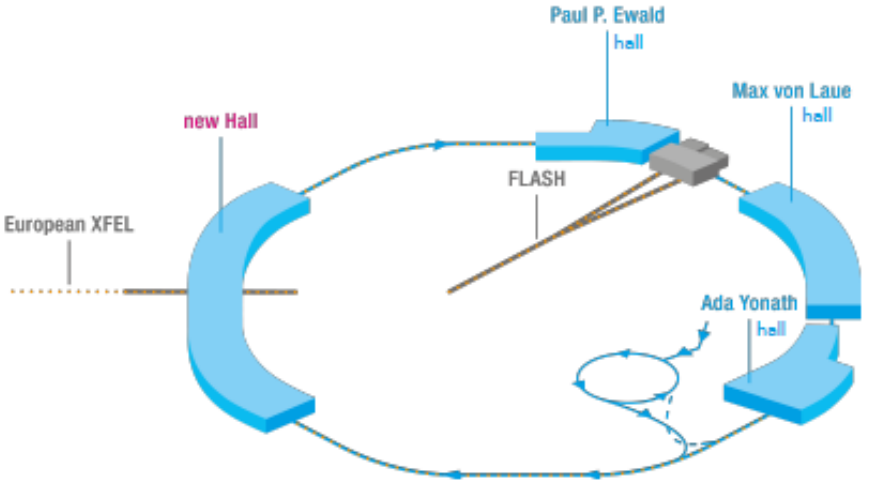
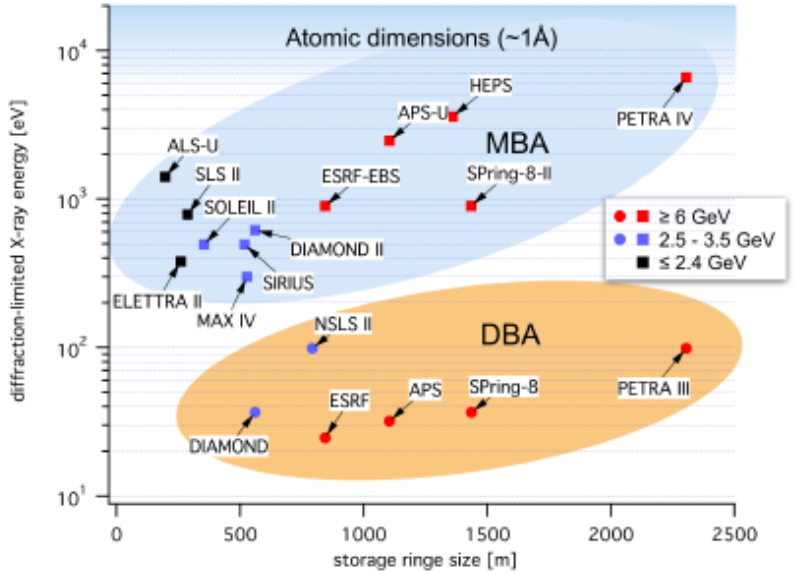


Figure 1.1.: *PETRA IV storage ring and accelerators. The new experimental hall in the west is located largely underground.*

PETRA IV.

Upgrade of PETRA III to the Ultimate 3D X-ray Microscope
Conceptual Design Report

- CDR release 11/2019
- ~ 100 x higher brightness (20/4nm)
- TDR 2020-2022
- Construction 2025 – 2027
- ➢ **MicroTCA baseline**
- ➢ **Enormous data rates**



Next steps: MicroTCA standard…

- **MicroTCA.4** 2009 – 11/2011
- **MicroTCA.4.1** 2014 – 11/2016
- **MicroTCA.4.x / AMC.x** 11/2019 submitted

Statement of Work Proposal
MicroTCA Next Generation

- ➢ Increase power consumption per slot: 160…240 W
- ➢ Transfer bandwidth: 100GbE/ PCIe Gen4&5/ PAM4
- ➢ Number of smaller cleanups and improvements…

while keeping the backward compatibility…

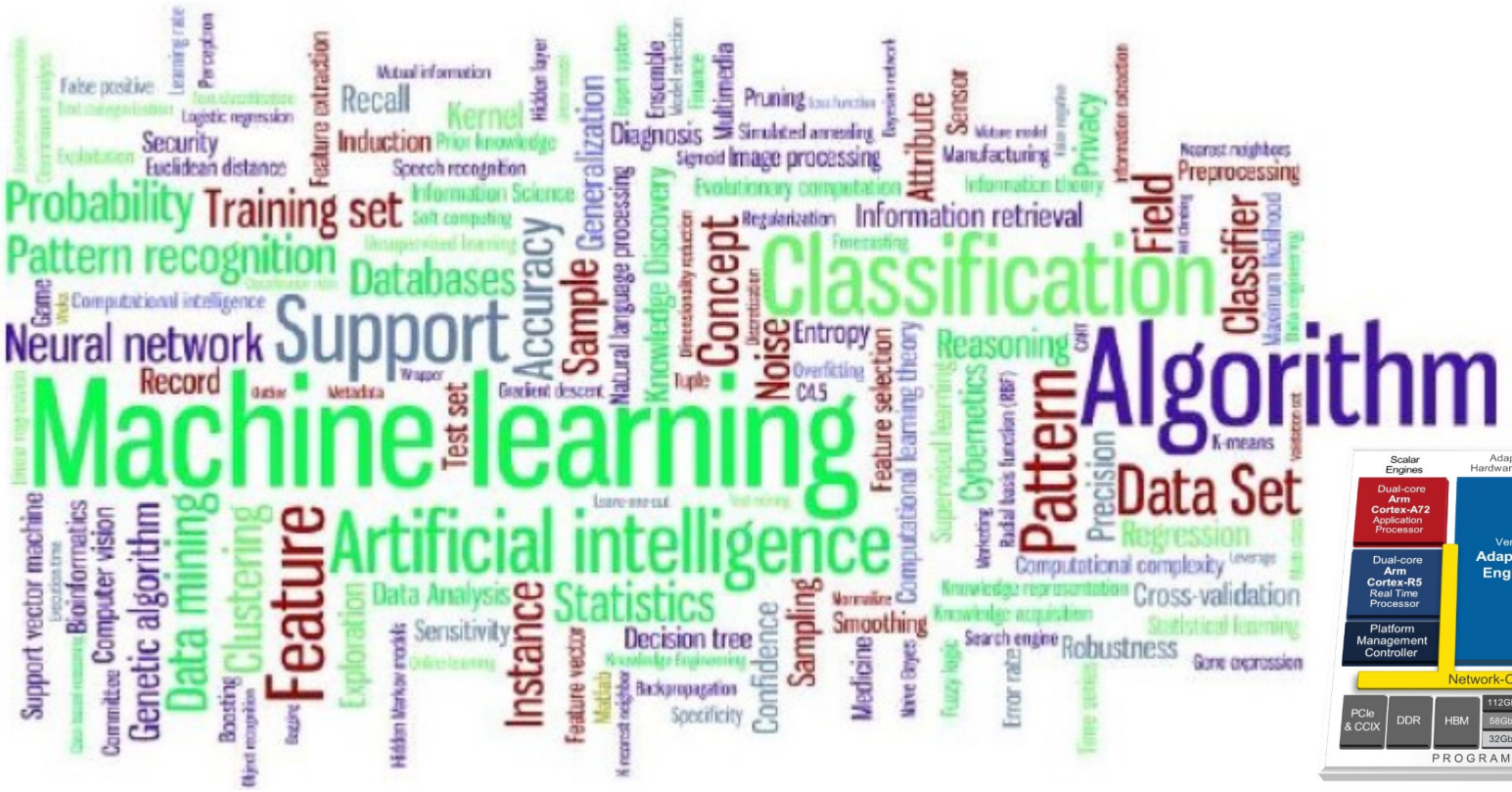
➔ **Wrap up** by Kay Rehlich: “MicroTCA Next Generation: Plans for the Future”

➔ **Session 4:** Future of MicroTCA…

➔ **Participation in PICMG working group** highly desired/ become member of 

Close relationship…

BIG DATA

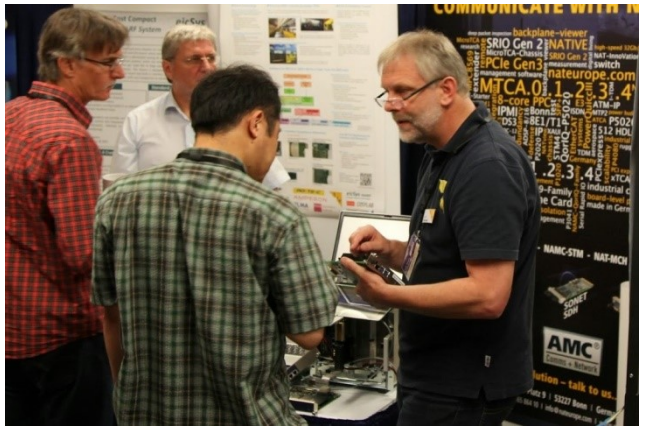


AI Eng.

Will be an enabler technology for AI frontiers

Unfortunately, also very said news….

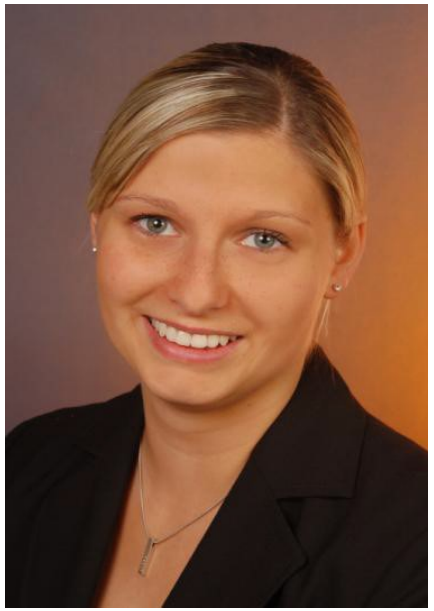
Our colleague and very good friend **Vollrath Dirksen** passed way… 19. June 2019 †



Workshop Organisation

Organization …

Questions?



Hanna Kunze

Pre-Workshops

Tuesday, December 3th

- **Plugfest**
  - ❖ Opportunity to test your application with vendors on different platform configurations
    - Organizer: Michael Fenner (DESY)
    - 21 participants

- **Rohde & Schwarz Tutorial**
  - ❖ How are Signal and Power Integrity related to Power Supply Stability
    - Speaker: Falko Jirka (R&S)
    - 39 participants

- **MicroTCA Tutorials for beginners**
  - ❖ Basic tutorial addresses beginners of the MicroTCA standard
    - Speaker: R. Waldt (nVent), K. Rehlich (DESY), Heiko Koerte (N.A.T.)
    - 30 participants

- **DMA over PCIe with FPGA**
  - ❖ Introduction to the software suite ChimeraTK
    - Speaker: Jan Marjanovic (MicroTCA Tech. Lab)
    - 44 participants

- **Machine Protection in MicroTCA**
  - ❖ Tutorial special session will focus on machine protection systems
    - Speaker: C. Roberts (SNS), J. Jaeger (DESY), S. Gabourin (ESS) and S. Farina (MicroTCA Tech. Lab)
    - 56 participants

- **Introduction to ChimeraTK**
  - ❖ Tool kit to write application servers for control systems
    - Speaker: M. Killenberg (DESY), M. Hierholzer (DESY)
    - 21 participants

Workshop Dinner

Wednesday, December 4th

- Harbour Cruise with “MS Hanseatic”
- Shuttle busses start at 6.30 pm in front of the CFEL
- Departure of MS Hanseatic: 7.30 pm, Überseebrücke Hamburg
- returning around 11:00 pm to DESY (main gate)
- More information -> abstract book
- Please inform the registration desk if you can not attend!

DESY Tours

SCHEDULE

DESY Tour #1: Wed, 4 Dec, 12:30-13:30

DESY Tour #2: Thurs, 5 Dec, 12:30-13:30

DESY Tour #2: Thurs, 5 Dec, 13:00-14:00

ORGA INFO

- Tour covers XFEL Injector and PETRA3
- Meeting point: CFEL Foyer, registration desk
- If you are interested but did not register, come to the registration desk to check out free slots
- **Please be on time!**

General information

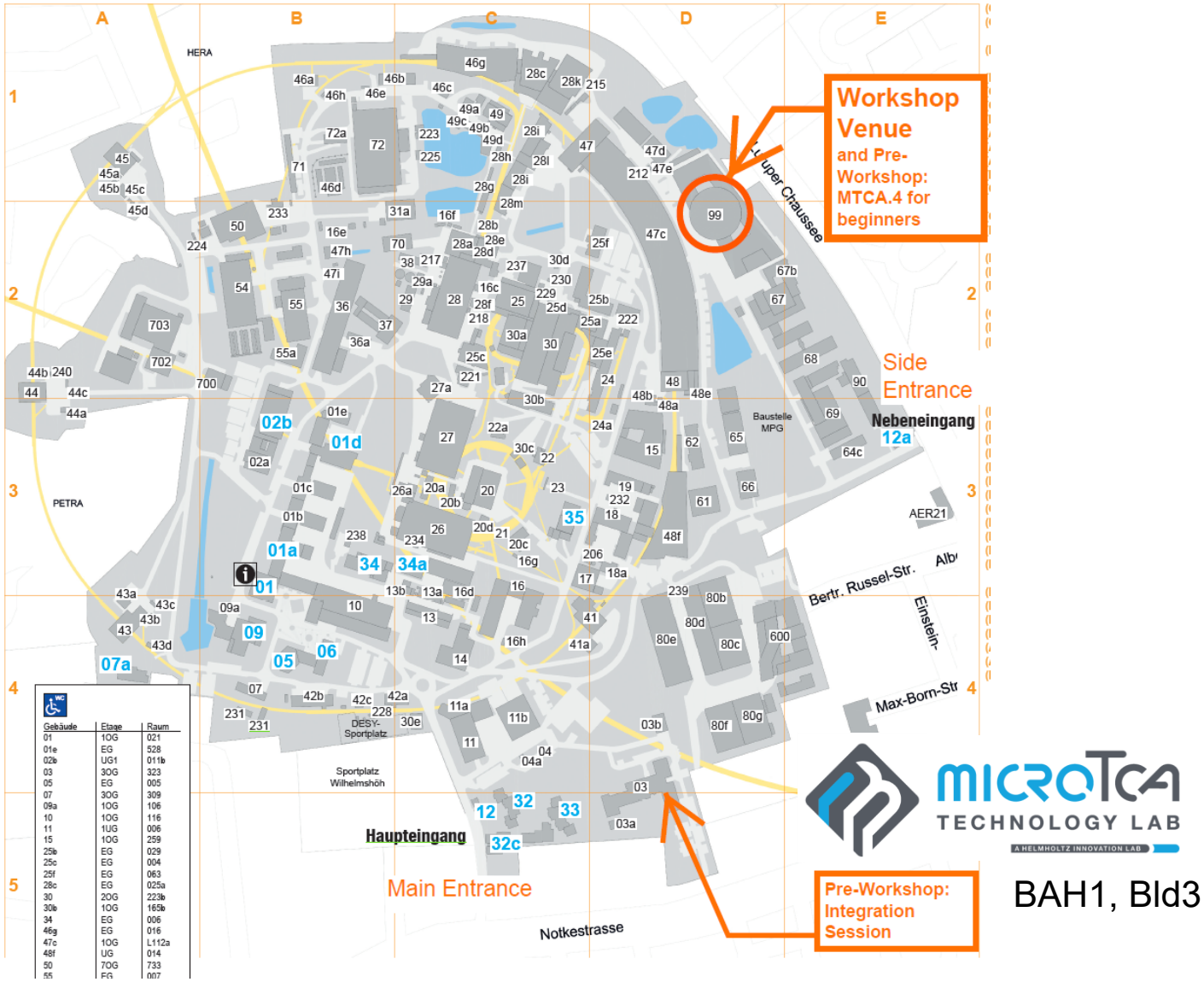
Speaker info

- 12 minutes slot for each talk plus 3 min for questions
- Presentations need to be handed to the organization team before the session starts
- Magic presenter (please do not use your own laptop)

WLAN

- Name: **MTCA Workshop**
- WPA/WPA2-PSK: **ohv3aiFi4eJ4**

Workshop Venue



Thank you!

Wish you an informative
and pleasant
8th MicroTCA Workshop!

Thank you for your attention!

Thank you for coming.