9th Virtual MicroTCA Workshop for Industry and Research

Tuesday, 1 December 2020 - Thursday, 3 December 2020

Virtual Workshop via Zoom

Book of Abstracts

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Operational statistics with MTCA LLRF systems at FLASH and XFEL

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User facilities require an accelerator uptime as high as possible. To help achieve availability of 95% and higher a low level radio frequency (LLRF) on-call service was set in place at DESY to support operation of the European XFEL and FLASH. In this contribution, operational statistics summarizing experts interventions, types of failure and associated downtime will be presented.

Summary:

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Introduction

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Session 1 / 29

Status of MicroTCA.4 in IHEP accelerators

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Development progress of MicroTCA.4 in the last one year at IHEP will be presented. Several new crate products have been localized in China which is under evaluated at IHEP. Also new boards development status including AMCs and RTMs will be shown. Some interoperability issues during test and operation between different modules will be talked. Applications in BEPCII/HEPS accelerator control based on MicroTCA.4 platform will be shown. At last is future plans of our work.

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Welcome and DESY digital strategy

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Exhibitor presentation

Authors: Holger Schlarb[1]; Kay Rehlich[2]

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MicroTCA deployment at the European Spallation Source

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The European Spallation Source is currently in its most intense phase of construction.
The first scientific user programme is planned to start in 2023. ESS is currently installing a large scale MicroTCA system deployment and getting the systems ready for test and commissioning. Hundreds of MicroTCA systems will be deployed including beam instrumentation, control system, interlock and timing functions at ESS.
In this talk, an overview of the current status of the development, installation and testing work of various MicroTCA systems and platforms at ESS will be given as well as a short presentation of MicroTCA community initiatives ESS is involved in.

Summary:

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Overview of MicroTCA.4 Applications for Accelerators based on CAEN ELS Picoammeters

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CAEN ELS FMC-based picoammeters (FMC-Pico-1M4) have been used for a large variety of applications such as beam position monitors, beam loss monitors and as parts of beam stabilization systems and machine protection systems.

With this contribution we present an overview of the CAEN ELS FMC picoammeters installations worldwide.

Standard FMC-Pico-1M4s are mounted on a DAMC-FMC25 AMC carrier equipped with a virtex5 FPGA. In the next future the picoammeters will be mounted on the new born DAMC-FMC2ZUP AMC carrier equipped with a powerful Zynq Ultrascale+ MPSoC, with FMC and FMC+ sockets and White Rabbit endpoint.

Summary:

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Product Update: 1U MTCA.4 Crate

Author: Christian Ganninger[1]

[1] *nVent*

nVent SCHROFF has released its new MicroTCA.4 1U chassis and shipped first units. The presentation will take a closer look at the configuration with its 2 slots for Double Mid-size AMC + RTM slots, its additional 2 Single Mid-size slots, the integrated eMCH and its option to mount an additional embedded Clock Module. The backplane topology with its unique ability to switch between 2 fat-pipe configurations via MCH as well as cooling and power capabilities are presented in this talk.

Summary:

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MicroTCA Technology Lab at DESY: Report on completed and ongoing projects

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The MTCA TechLab at DESY officially opened in 2018 with the directive to foster the MTCA.4 standard to be used in research and industrial automation.
Advancing the establishment of a limited company owned by DESY, we are focusing on three major areas such as Developments in MicroTCA (Hardware, Firmware, Software), High-End Test and Measurement Service and Consulting and highly customized System Configuration and Integration.
This presentation will provide you with a quick summary of our recent activities and achievements and with a concise overview of the future product range.

Summary:

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MTCA beyond physics, an overview

Author: Thomas Holzapfel[1]

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In this presentation, we will give an overview about MTCA applications beyond accelerators. We will also touch a DDS demonstration in MTCA, to provide a consistent data pool along several MTCA systems in real time.

Summary:

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Increasing demands for the MicroTCA Carrier Hub (MCH)

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Increasing demands for modularity and bandwidth especially in Physics applications create a constant challenge to meet the requirements of application from the "low end"(i.e. Industrial PLC type of control) to the "high end"(i.e. data acquisition and processing with high-end FPGAs). Existing switched MOSA (modular open system architecture) approaches such as MicroTCA, which are heavily used in Big Physics application like machine control, need to catch up with the increasing demand. Therefore, a new concept for the MicroTCA Carrier Hub (MCH) is needed which allows a flexible mix-and-match of MCH sub-modules and provides state-of-the art switching technology for slim and fat-pipe fabrics at the same time. The presentation will show how this transition from existing MCHs to future solutions can be smoothly effected while maintaining a maximum on backward compatibility.

Summary:

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A MTCA based LLRF for the LILAC injector of the NICA project

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In a cooperation between BEVATECH GmbH and the MTCA TechLab a MicroTCA.4 based Low Level Radio Frequency (LLRF) system was developed and is currently under testing at BEVATECH. This system will be deployed at the Light Ion Linac (LILAC) at the Joint Institute for Nuclear Research (JINR) for the Nuclotron-based Ion Collider facility (NICA). The LLRF system controls the amplitude and phase of 6 cavities at an operating frequency of 162.5 MHz. In addition it is enhanced by controls for six dynamic tuners based on a ChimeraTK system in order to guarantee frequency stability of the cavities.

In this contribution the project and its current status will be shown with emphasis on its key features and possibilities for future projects.

Summary:

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MicroTCA.4 for the ESO Astronomical Detector Controller

Author: Mathias Richerzhagen[1]

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The Extremely Large Telescope (ELT) is under construction on Cerro Armazones in Chile. MicroTCA.4 will be used as a basis for the new modular ESO detector controller for all future visible and IR scientific detectors. The presentation gives an overview over current MTCA.4 related developments at ESO and how the new controller can continue the legacy of the previous ESO detector controller, NGC, that has enabled groundbreaking astronomical discoveries on the Very Large Telescope (VLT) over many years of operation.

Session 3 / 21

Overview of DMCS Projects and MicroTCA.4 Developments

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The Lodz University of Technology, Department of Microelectronics and Computer Science is involved in the development of MicroTCA.4, MicroTCA.4.1 and the future standards from 2007 onwards. Since that time, we have developed various MicroTCA.4 components including Intelligent Platform Management, Advanced Mezzanine Cards (AMCs), Rear Transition Modules (RTMs) for data acquisition and processing systems used in numerous accelerator and fusion projects.

The presentation discusses selected projects currently performed at our department based on the MicroTCA.4 technology.

Firstly, a smart MMC solution is demonstrated on the example of a cost-effective but efficient AMC module that we have developed for the W7-X stellarator. Secondly, the extension of the IPMI specification and further support for FMC modules based on the developed prototype are discussed.
A flexible framework supporting various camera standards based on the MicroTCA.4 technology will be shown as an example of a powerful image acquisition and processing system dedicated for large-scale physics projects.
Finally, the progress of developing the high-power piezo driver (HPD-400) for the European Spallation Source (ESS) accelerator will be presented as an instance of enormous challenge breaking the limitations of the MicroTCA specification.

Summary:

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Digitizers for Big Physics

Teledyne SP Devices provides world-leading modular data acquisition systems. As a long-term partner of MicroTCA Technology Lab, it offers various solutions in μTCA.4 form. Apart from getting a brief overview of the existing portfolio of products, you will get a glimpse of future developments. New functions and implementations will be highlighted and discussed. For example, a new way to take benefit of open FPGA architecture by defining a custom algorithm for advanced trigger requirements. We empower engineers and scientists to capture complex data enabling discovery and differentiated products.

Summary:

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Status of MicroTCA.4 technology at Sirius

Authors: Lucas Russo[1]; Gustavo Bruno[2]; Daniel Tavares[2]; Augusto Fraga Giachero[1]

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Sirius, a new 3 GeV, 250 pm.rad emittance, 4th generation light source in Brazil, is currently operating with friendly users on 4 beamlines. MicroTCA.4 has been chosen as a standard for some demanding data acquisition and feedback systems such as Beam Position Monitors electronics, Fast Orbit Feedback and the LINAC Low Level RF. In this talk, some advancements and upgrades on those systems will be discussed, as well as the hardware platforms, software integration tasks and the problems and debugging difficulties faced during the developments.

Summary:

Session 4 / 3

Design and status of MTCA.4 based LLRF control system for the J-PARC MR

Authors: Yasuyuki Sugiyama[1]; Fumihiko Tamura[2]; Masahito Yoshii[1]

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The Japan Proton Accelerator Research Complex (J-PARC) is a high-intensity proton accelerator facility.
The 30 GeV Main Ring (MR) of the J-PARC delivered the proton beam with a beam power of 500kW as of February 2020.
We observed longitudinal coupled bunch instabilities (CBI) above 450 kW due to the beam loading effect.
To mitigate the CBI, we installed the prototype modules of the low-level-rf (LLRF) system based on the MTCA.4 platform.
The wake voltage at the RF cavity, which causes the CBI, was suppressed by the multi-harmonic vector rf voltage control function implemented in the prototype module.
Suppression of the CBI with the prototype module was a key to achieve a beam power of 500kW in the MR.
Following the prototype's success, we developed the MTCA.4 based LLRF system for the MR with full configuration.
In this workshop, we present the configuration of the system and its preliminary test results.

Summary:

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A LISA Phasemeter based on MicroTCA as ground-support equipment

Author: Oliver Gerberding[1]

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The University of Hamburg, in collaboration with DESY, is developing an electrical ground-support equipment phasemeter, or phasemeter simulator, based on the MicroTCA.4 standard, for the space-based gravitational wave detector LISA, funded by the German Aerospace Agency (DLR). The main task of the phasemeter is to extract the phase of various laser interferometer beat note signals with microcycle precision at frequencies between 0.1mHz and 1Hz. Additional functions include the read-out and generation of ranging and data communication sidebands, frequency control of the lasers and signal acquisition.
The development is conducted in parallel to, and in collaboration with, the development of the flight hardware phasemeter and the simulator will be made available to the partners within the LISA consortium for the assembly, integration, verification and testing (AIVT) phase of the mission and for the technology development of payload items. We present our current design concept, the unique modules we plan to develop, and the proposed interface and timing architecture.

Summary:

Session 4 / 1

MicroTCA @ GSI

Author: René Geißler[1]

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This presentation will handle the current usage of MicroTCA in beam diagnostics devices at GSI as well as our plans for the future.

We currently use MicroTCA systems for measuring beam parameters like position, profile and intensity, for accurate timing control, for measuring voltages and for controlling GPIOs in control applications.

The MicroTCA devices currently in use will be presented as well as our experiences and problems. Our plans to port our systems to the new FAIR accelerator facility and to unify our efforts to a limited number of devices will also be presented.

Summary:

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Application of MTCA.4 with RF Backplane to LLRF and BPM Electronics at SPring-8

Authors: Hirokazu Maesaka[1]; Hideki Dewa[2]; Fujita Takahiro[2]; Toru Fukui[1]; Naoyasu Hosoda[2]; Miho Ishii[2]; Eito Iwai[2]; Mitsuhiro Masaki[2]; Takashi Ohshima[2]; Shiro Takano[2]

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We present the design and basic performance of the MTCA.4-based electronics developed for the new LLRF and BPM systems in SPring-8, which are substitutes for electronics more than 20 years old. We have developed MTCA.4 modules for the new systems, such as a high-speed digitizer AMC, an LLRF RTM, a BPM RTM, and a clock and RF distribution eRTM. To reduce the number of cables, we employed an RF backplane to distribute the clock and the reference RF signals. The high-speed digitizer AMC has 10 ADC channels and 2 DAC channels having a sampling rate of 370 MSPS maximum and a vertical resolution of 16 bits. Input signals with the frequency of 509 MHz are detected in an under-sampling scheme. The digitizer AMC is common to both LLRF and BPM electronics, but the FPGA firmware is different. The input signals are processed by RTMs and transferred to the digitizer AMC. The LLRF RTM has 9 ch. RF inputs, 1 DC coupling input, and 1 vector modulator output. The BPM RTM has 8 signal inputs, corresponding to 2 BPMs. Both RTMs can pass through the ADC sampling clock and the reference signal to the digitizer AMC. The signals for the RF backplane are generated by a newly developed eRTM. We finished the replacement from the old LLRF electronics to the MTCA.4 system last year and now testing BPM electronics with an actual electron beam. Both LLRF and BPM systems are working well in the SPring-8 storage ring.

Summary:

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MicroTCA applications at the European XFEL Experiments - Experience and outlook

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The European X-Ray Free Electron Laser facility (European XFEL) has been receiving users for three years now. Multiple experiments has been conducted using the generated ultra short coherent X-Ray flashes, spaced by 220 ns and with a duration of less than 100 femtoseconds, with results now starting to be published in articles and magazines. The MicroTCA platform is at the centre of timing distribution, data processing from large 2D detectors, fast digitization and processing of pulse signals as well as low latency communication protocol for VETO and Machine Protection System.

The confinement impose this year gave us an opportunity to focus our efforts in stabilizing our hardware solutions and how they are integrated into the acquisition software at XFEL. We spend more time meeting our Instrument colleagues to understand the analysis done in the acquire data, to orient our future developments in the hardware algorithms while also integrating more digitizer boards to our XFEL repository. Finally, we work with an external company to define a suitable hardware solution that will bridge the MicroTCA platform with our PLC infrastructure.

In this presentation, we will provide a summary of our activity surrounding the MicroTCA platform and where we plan to go next year.

Summary:

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Multi-Channel Piezo Driver Boards

Author: Peter Jänker[1]

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Electromechanically systems are irreplaceable in nearly every technical product. In this technical family piezo converter have a very unique selling proposition: high dynamics, ultra-precision, and very high forces per size. They are used for sensor as well as actuation purposes. Piezo actuators have rather small stroke capability. Thus, they are ideal for high tech systems which require high dynamics and or ultra-precision. Piezo is ideal for micro and nano-positioning systems with unrivaled resolution and control capabilities.

PIEZOTECHNICS manufactures and supplies specialized electronics for piezo drives. For the market of high energy particle accelerators Piezotechnics supply piezo driver for MTCA systems. Piezotechnics produce under DESY licence the 4-channel piezo driver "PZT4". In last two years more than ninety units were supplied to accelerator labs und are running with high reliability in prominent experiments.

Further developments of Piezotechnics are directed to expand product range and service for their customers. In the MTCA market a 8-channel is in development.

Summary:

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Basic-AMC –the low-cost MicroTCA.4 Compliant Module

Authors: Dariusz Makowski[1]; Aleksander Mielczarek[2]; Patryk Nowak vel Nowakowski[3]; Axel Winter[4]

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Various Advanced Mezzanine Cards (AMCs) are developed based on the MicroTCA.4 technology. The standard always requires basic functionality including: Module Management and Rear-Transition Module Controllers, fabric interface, power supply, clock and synchronization. The module usually provides some programable resources that can be used by the final application.

A cost-effective but effective AMC module was developed for the W7-X stellarator. The rationale for this project was to develop a very simple module providing basic functions required in many projects in a short period of time. The AMC module is equipped with Xilinx Artix-7 FPGA, PCIe x4, gen. 2 fabric interface, TCLK and MLVDS lines and Zone 3 digital connection.
Moreover, the module has 4 programmable digital lines on the front panel. The development and production costs were further optimised using the smart Module Management Controller developed at Lodz University of Technology, Department of Microelectronics and Computer Science.

Summary:

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Next Generation SoC-based AMC developments at DESY

Authors: Simone Farina[1]; Michael Fenner[2]

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In the last few years FPGA chip-makers have shifted their focus towards the development of System on Chip architectures with an ever growing level of peripherals integration to target the new needs of the telecommunication and datacenter markets. Following these trends, DESY and MTCA Technology Lab started the development a set of AMC cards to enable the MTCA market to benefit from these new architectures.
This talk focuses on the results of these developments and both the newly available and currently under development cards will be presented.
Two universal FMC Carrier boards have been released:
• the DAMC-FMC2ZUP is high-end HPC FMC/FMC+ (VITA 57.4) carrier card
based on the Zynq Ultrascale+ MPSoC family of FPGAs. The board
supports a D1.1 compliant RTM module and offers many features
typically only provided by CPU AMCs like DisplayPort, USB and SATA.
• the DAMC-FMC1Z7IO is a cost-optimized I/O controller board based on the Zynq-7000 family of FPGAs, it provides a 48-signals connectivity on the front panel and also supports a LPC FMC mezzanine and a RTM compliant with class D1.1 .
For Signal acquisition applications two digitizes are under development:
• the DAMC-DS812ZUP is a High Sampling Rate, low latency, Digitizer board based on the Zynq Ultrascale+ MPSoC family of FPGAs. The board provides 8 12-bit ADC channels sampling at 800MSPS, accessible either by coaxial connectors on the front panel or by a RTM compliant to the new RF1 class, and a flexible clocking scheme.
• the DAMC-DS5G14ZUP is a Digitizer card leveraging the new Zynq Ultrascale+ RFSoC family of FPGAs, it provides 8 14-bit ADC channels sampling at up to 5GSPS, accessible either through front panel or an RTM compliant to the new RF1 class, and 8 14-bit DAC channels at up to 10GSPS while also retaining many of the CPU-like features already available on the DAMC-FMC2ZUP.
Another recent addition to DESY portfolio is the DRTM-MXC, a RTM specifically designed to support Mobile PCI eXpress Modules, including high performance mobile graphics cards, that targets AI/ML applications.
DESY commitment to ease the development of MTCA electronics brought to the release of a ready to use MMC module. The MMC-Stamp is provided with pre-programmed firmware and allows engineers to focus on the main features of the new designs, relieving them from the task of complying with the MTCA underlying infrastructure management requirements.

Summary:

Session 5 / 13

MicroTCA Motion Controller

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Synchrotron beamline is a complex spectroscopic system comprising numerous actuators and sensors. Successful scans demand data acquisition and precise motion control of multitude motors distributed over several parts of the system (diffractometer, monochromator, shutters).

The beamlines at DESY facility use legacy VMEbus motion control cards that are limited in I/O features and processing power. We have developed a MicroTCA compliant card that provides control of 16 motors per card in synchronous mode.

Processing power and I/O features of MicroTCA Motion Controller card(hereinafter DAMC-MOTCTRL) permit continuous scans, on the fly data analysis, cloud integration and daisy chaining. Conjunction of MicroTCA and DAMC-MOTCTRL architecture provides unparalleled flexibility in retrofitting or building completely new systems.

A beamline can be controlled either by a single MicroTCA crate that includes several DAMC-MOTCTRL cards or by several distributed MicroTCA crates. All DAMC-MOTCTRL cards at a beamline can communicate with each other either via MicroTCA backplane or via optical fiber. This attribute provides a control of synchronized motion of several motors at different locations within beamline premises.

Summary:

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Update on MicroTCA developments at Soleil

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SOLEIL is a third generation Synchrotron source located near Paris, France. During the last 18 years, 29 beamlines have been built and it delivers photon beams in a broad range of wavelengths available from Terahertz to hard X-rays. Today SOLEIL envision a major upgrade of the accelerators and beamlines toward a brighter light source. In order to address some actual obsolescence and to prepare systems upgrade on machine and beamlines to address new challenges, the microTCA technology is identified. This presentation will provide an overview of the ongoing work on microTCA, the development under progress, the organization build to address this technology in a collaborative manner and the roadmap for SOLEIL.

Summary:

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MicroTCA Control System for Neutral Atom Quantum Computing

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Atom Computing venture-backed startup in Berkeley, California that is building a quantum computer based on optically-trapped neutral atoms. Inspired by particle accelerator control systems developed for high energy physics, we have selected MicroTCA 4 as the basis for the electronic control system that prepares, manipulates, and reads out qubit states that are the basis of quantum computations. This presentation will detail the rationale behind Atom Computing's choice of MTCA and summarize the custom AMC and RTM module development efforts that underway to specifically address the requirements of neutral atom quantum computing applications.

Summary:

This presentation will cover a novel industrial application of MicroTCA 4– a control system for a neutral atom quantum computer.

Session 6 / 4

Chassis Cooling: A „hot"topic

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Cooling is always a „hot"topic when configuring crates. Especially now, with the next generation of MicroTCA currently in discussion within PICMG we will soon see modules that consume much more power, going beyond the existing 80 Watts limit. This talk calls to mind the basics of cooling and what mistakes to avoid to keep the modules cool. It also shows which tools crate manufacturers use to simulate and test the cooling performance from a crate level down to the module level.

Summary:

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Development of the MicroTCA standard: preparing the next generation

Author: Kay Rehlich[1]

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The MicroTCA standard has evolved from a telecom oriented market towards industrial and science applications over the years. It still supports actual industrial technologies. To keep the MicroTCA standard able to solve future applications it has to adapt to the progressing technologies. A main goal in the development is to keep all changes compatible with the existing standard to preserve the investments. The presentation will report on the ideas and status of the New PICMG working group for a next generation MicroTCA.

Summary:

Session 6 / 9

New MTCA solutions for Quantum Technologies and Big Science

Authors: Grzegorz Kasprowicz[1]; Pawel Kulik[2]; Krzysztof Macias[2]; Filip Switakowski[1]; Anna Kaminska[1]

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We will present a set of new open hardware modules in MTCA format developed in a large collaboration of research and private sector institutions including Creotech Instruments, Warsaw University of Technology, US ARL, University of Maryland, University of Oxford, QUARTIQ, M-Labs, CERN and LNLS. The modules allow for efficient and flexible integration of multi-purpose control systems. Use cases include Big Science applications and development of Quantum Technologies. The modules include a Smart AWG, a powerful RFSoC-AMC and AMC FMC Carrier boards with several validated extensions. They are compatible with open-source ARTIQ software for quantum physics laboratories. The modules support White Rabbit sub-nanosecond time synchronization. Alternatively, an extension card for N.A.T. MicroTCA carrier hub (MCH) can be implemented for controlling multiple slave devices in real time using the ARTIQ distributed real-time IO (DRTIO) protocol.

Summary:

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MicroTCA used in the Dark Matter experiment ALPS

Authors: Sven Karstensen[1]; Tim Wilksen[2]; Ludwig Petrosyan[2]; Holger Kay[2]

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Light through a wall - The ALPS experiment is a seemingly proposal to make “light shine through a wall”. To achieve this, a laser beam is directed through a powerful magnetic field generated by decommissioned dipole magnets from the HERA ring accelerator. In the event that WISPs (weakly interacting sub-eV particles) do actually exist, some of the photons (particles of light) in the laser beam should disappear and change into lightweight particles (Axion). Installed in the middle between the magnets is a wall that stops the laser beam. The theory is that any WISPs produced would be able to pass through the wall –since they react so rarely with other particles, solid matter is no obstacle for them.

To achieve the necessary measurement results, TEWS TAMC532 MicroTCA ADCs are used here in a completely different way, as they are used in High Energy experiments or accelerators like FLASH or XFEL. Instead of getting a 10 Hz trigger, they have to be used in a way to measure constantly with 16kHz triggers over months without any interruption and a highly stable timing source.

In this talk it will be shown how the technical implementation has been done inside the DOOCS control system at DESY.

Summary:

Session 7 / 17

The MicroTCA.4 based LLRF system for CW operation at ELBE

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A digital LLRF control has been implemented at the CW linac ELBE at Helmholtz-Zentrum Dresden-Rossendorf. The system is based on the MicroTCA.4 standard and drives four superconducting TESLA cavities and two normal conducting buncher cavities. The system enables a higher flexibility of the field control, improved diagnostics and field stability compared to the analogue system which was used before. The presentation will give an overview on the system, its performance and a review of the user operation started in August 2020.

Summary:

Session 7 / 8

Progress report on the MicroTCA-based event timing system for HEPS

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The high-energy photon source (HEPS) is a 6-GeV ultralow emittance synchrotron radiation light source being built in China. The HEPS global timing system has been designed using MicroTCA.4 based event timing technologies. A prototype bench test system has been developed, and some critical parameters of the timing system have been tested and confirmed using this prototype system. This report gives a short introduction to the current status of the HEPS global timing system. It also presents an R&D work of designing a MicroTCA.4 timing card, called IAMC-TIMR1.

Summary:

Session 7 / 6

Life with MTCA at J-PARC

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The next-generation LLRF control system based on MTCA.4 for the J-PARC RCS was successfully deployed in 2019. The performance of the beam loading compensation is much improved and the high intensity beam up to the design intensity, 8.3e13 protons per pulse, is stably accelerated. During the development, we have been supported by the various ingenuity of Japanese companies. The EPICS IOC on the Zynq FPGA is prepared by the company and it makes it simple to debug the

system and build operating interfaces. The front panels of the AMC and RTM are reinforced to avoid deformation due to strong force during insertion and removal. A small part is attached to the switch of the power supply for reducing the chance of misoperation. The lightweight MTCA.4 shelf is easy to handle. We present these helpful ingenuity. Our happy life with MTCA is supported by the companies.

Summary:

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The MicroTCA.4 based LLRF system and other applications at NSRL

A digital LLRF control system based on the MicroTCA.4 standard has been implemented in normal conducting linac at national synchrotron radiation laboratory(NSRL),university of science and technology of China (USTC). The presentation will give an overview on the system architecture and control algorithm like predistortion linearizer and phase feed-forward will be discussed. And fluctuation of waveforms from pulse to pulse is still a problem to be solved. Also the MicroTCA.4 applications on BPM and timing in NSRL will be mentioned in the presentation.

Summary:

Session 7 / 41

Overview of MicroTCA-based LLRF at SXFEL

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The Shanghai soft X-ray Free-Electron Laser facility (SXFEL) is the first X-band FEL facility in China, being developed in two steps, the SXFEL test facility (SXFEL-TF) and the SXFEL user facility (SXFEL-UF).The SXFEL-TF, generates 8.8 nm FEL radiation using an 840 MeV electron Linac passing through the two-stage cascaded HGHG-HGHG or EEHG-HGHG (echo-enabled harmonic generation, high-gain harmonic generation) scheme, started construction at the end of 2014, began commissioning by the end of 2016, and passed national acceptance testing in November 2020. Now, the SXFEL-UF is under construction, with an upgrading the linac energy to 1.5GeV, and the building of a second undulator line and five experimental end-stations.
MicroTCA-based Low Level RF (LLRF) system plays an important role in electromagnetic field control, signal monitoring and machine protection. There are 12 RF stations in SXFEL-TF with different frequencies (S-band, C-band and X-band). This talk gives an introduction of the development of the software and the firmware, operation status and performance of the LLRF system.

Summary:

Session 8 / **36**

MTCA-based Diagnostics at W7-X - a Status Update

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A number of MTCA-based diagnostics are being implemented at the moment for the upcoming operation phase in 2022. This concerns a divertor protection system with more than 20 individual cameras in different standards (CameraLink & CameraLink HS) as well as spectrometer diagnostics with 20 legacy IEEE1394-based cameras and a 100+ channel bolometer with custom build analog RTM DAQ boards.

This presentation will give an overview of the status of the different projects.

Summary:

Session 8 / **35**

Possible applications of MicroTCA at PETRA IV

Author: Martin Tolkiehn[1]

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I will give a short overview of the plans for PETRA IV upgrade and
I will present some MTCA applications, which are currently being tested and
developed at the P24 beamline, and which might be relevant for PETRA IV

Summary:

Session 8 / **18**

MTCA for photon diagnostic and user experiments at FLASH

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At the free-electron laser FLASH@DESY we use MTCA based devices for several different tasks in the photon diagnostics and for user experiments. In particular ADCs are our main work horse to record information about investigated interactions. Several experimental techniques using ADCs as well as their requirements and limits will be presented. In addition, examples of data recording and analysis are given.

Summary:

Session 8 / 15

A new major release of ChimeraTK ApplicationCore and DeviceAccess

Authors: Martin Killenberg[1]; Martin Hierholzer[2]; Jens Georg[2]; Christoph Kampmeyer[2]; Tomasz Kozak[3]; Nadeem Shehzad[2]; Jan Timm[2]; Geogin Varghese[2]

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ChimeraTK is a software framework for the development of control applications. Recently, version 02.00 of ChimeraTK's DeviceAccess, ApplicationCore and ControlSystemAdapter libraries have been released. They feature a new exception reporting and handling scheme, which has been introduced to work consistently across all libraries of the framework. It implements automatic recovery from device errors and proper device initialisation after malfunctioning and at application start.

Summary:

Session 8 / 7

Synchronization several EtherCAT networks through mTCA

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In different application in industry as well research Centre, there is the need to synchronize different EtherCAT networks with high time accuracy. The more precise the time stamp requirements become, the more difficult this task becomes with classical solutions.
By means of a newly developed AMC board, the time signals can be synchronously fed into and read from up to 8 independent EtherCAT networks. A new possibility to connect classical industrial solutions with high performance mTCA systems in a flexible and cost-effective way. This new mTCA solution developed by N.A.T will be used for the first time for the research area at xFEL in Hamburg.

Summary:

A new EtherCAT multi-slave solution in AMC formfactor will allow users to connect classical industrial solutions to high performance MicroTCA systems. The talk will provide a comparison of this new AMC

to classical solutions and highlight the advantages and benefits for users at the example of the European XFEL.

Session 9 / 10

Modernization of MMC software development at DESY using open-source tools

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The Module Management Controller (MMC) is a mandatory component of every AMC board. DESY is developing, maintaining and licensing a turn-key MMC solution that is used on several hundred boards in different facilities - on DESY's own products as well as on third-party AMC boards developed by industrial customers and project partners.

With the growing number of different boards, the maintenance of the codebase becomes more and more challenging, as every improvement needs to be integrated, tested and deployed to each product containing our MMC solution. With introduction of the DMMC-STAMP System-on-Module (SoM), the microcontroller was changed from ATxmega to ARM Cortex-M4, requiring a full migration of the code, but offering a powerful platform much better suited to high level software abstractions which help to keep the growing codebase maintainable.

This presentation gives an overview of improvements made to the MMC software development process and environment: a cross-platform build system based on open source tools, supporting continuous integration and utilities to facilitate production, such as a YAML-based FRU generator (FRUGY) and an automated test suite. Finally, there is an overview of several ways the DMMC-STAMP software can be adapted to provide application-specific functionality for a new AMC board.

Summary:

Session 9 / 30

EPICS for IPMI in MTCA.4 systems at ESS

Authors: Wojciech Cichalewski[1]; Wojciech Jalmuzna[2]; Kacper Klys[2]

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This talk summarizes an effort of the IPMI functionality support for MTCA.4 systems in the ESS facility.

Summary:

Session 9 / 26

Generic data acquisition control system stack for MTCA ADC hardware

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Cosylab is the world leading integrator of control systems for big physics facilities. We frequently integrate high speed data acquisition devices on the MicroTCA platform for our customers. To simplify this process we have developed a generic control system stack that allows us to support a large set of MicroTCA ADC hardware boards with minimal firmware and software modifications. Our firmware supports generic data acquisition up to 32 bit sample width and also generic data generation. The firmware modules are implemented in a way so that support for MRF timing modules can be added and allow the board to act as a MRF timing receiver. On the software side we implemented the control software stack in NDS which means that we offer support for EPICS and TANGO control systems out of the box.

Summary:

Session 9 / 27

IRIO-OpenCL: Applications of OpenCL to instrumentation use cases for the MTCA platform

Authors: Astrain Miguel[1]; Mariano Ruiz[2]; Antonio Carpeño[1]; Sergio Esquembri[1]; Victor Costa[1]; Julian Nieto[1]; Alberto De Gracia[1]

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Development of computing platforms has been shifting to the usage of heterogeneous languages for some time now. The newest C++ standards are incorporating these heterogeneous characteristics into the language. In this context, we developed IRIO-OpenCL to simplify the integration of heterogeneous hardware with the Instrumentation & Control systems that are required on Big Science facilities. The focus is to use COTS hardware, with the advanced computing techniques to reduce development time. We present a set of problems that have been solved using OpenCL for scientific applications, two applications of machine learning (ML) for neutron and gamma discrimination, and the implementation of CCL algorithm for hot spot detection in plasmas.
The two machine learning applications aim to explore the feasibility of real time solutions to the neutron and gamma discrimination problem, but they do so in different ways. The first implementation is the direct implementation of a NN proposed in the latest literature. The NN has been implemented in the FPGA using the OpenCL standard. The different hardware elements have been implemented with kernels, a global DDR memory and some additional synchronization/communication elements (the data is passed using OpenCL pipes avoiding the external RAM access). The HW application is managed by an NDS device driver specifically designed to initialize the OpenCL runtime environment, initialize the global DDR memory with the weights and bias and to retrieve the result of the output of the classifier. The IRIO-OpenCL software module helps to implement this interface. The second implementation focused on a completely new model architecture trained TensorFlow. The dataset was obtained from a collaboration with JET. We implemented a 1D CNN using floating point operations which achieved a classification accuracy of 99.5% in the TensorFlow model. The implementation of this prototype uses 50% of the total area in the ARRIA 10 FPGA, with kernels working at 190MHz. The ARRIA10 based systems is capable of classifying around 79kevent/s.
The Hot Spot detection algorithm is used to control the temperature of the divertor and the wall in

a tokamak. This work applies heterogeneous computing techniques based on the OpenCL standard to the real-time hot spot detection problem and obtains performance values in an MTCA platform. OpenCL reduces the development time, improves portability, and simplify the evaluation and validation of each part of the algorithm to find the best-suited device in the heterogeneous system. The proposed solution enables balancing the computational load between an FPGA and a GPU. The algorithm has been adapted and optimized, taking profit on the particularities of each platform.

Summary:

Session 9 / 23

IPMI Support for FMC modules in MTCA.4 Systems

Authors: Patryk Nowak vel Nowakowski[1]; Dariusz Makowski[1]

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The FPGA Mezzanine Cards (FMCs) are commonly used in various industrial and scientific projects. FMCs are also often used as an modular extension of Advanced Mezzanine Cards (AMCs) in MicroTCA.4 systems. However, there is no standardized way of identifying FMC module by the FMC Carrier in such systems. It is especially problematic as the FMCs requires a dedicated IO voltage (Vadj) that must be compliant with the power supply of the carrier module FPGA device. Incorrect IO voltage may cause damage to the module or carrier.

Therefore, an extension of AMC and MicroTCA specifications is required. It could include a support for Field Replaceable Unit (FRU) present on the FMC module. I addition, FMC carrier could continuously check voltages and currents of the FMC module. Proper diagnostics can improve reliability of the module and whole system. FRU and sensors of the FMC module could be displayed in MCH terminal in a similar manner as it is currently done for Rear Transition Modules (RTMs).

Available on the market FMCs are often complex and can consume a significant amount of power, that need to be dissipated in form of heat. Therefore, components on the modules can easily reach high temperatures. MicroTCA.4 systems use temperature sensors available on AMC and RTM cards to actively control fan speed in the chassis. In similar way, the FMC temperature sensor could allow to monitor health of the module and take required measures in order to sustain operation of the FMC. Currently, VITA 57 standard does not specify a temperature sensor nor the I2C address for it. Therefore, the IPMI standards for MicroTCA, AMC and VITA 57 ought to be extended in the future.

In the presented work we developed and tested a prototype of MMC suitable for FMC carrier modules. It showed that IPMI specification could be extended to support FMC modules.

Summary:

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Close out

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Summary:

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Tutorial 4 Using FPGA boards in MicroTCA

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Introduction

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Summary:

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Tutorial 1 AMC, MicroTCA: the basics

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Tutorial 2 MCH and power unit: system basics

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Tutorial 3 MicroTCA management

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