Standardized Solution for Management Controller for MTCA.4

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***Abstract*—The Micro Telecommunications Computing Architecture (MTCA) standard is a modern platform, that is gaining popularity in the area of High Energy Physics (HEP) experiments. The standard provides extensive management, monitoring and diagnostics functionality. The hardware management is based on the Intelligent Platform Management Interface (IPMI), that was initially developed for management and monitoring of complex computers operation. The original IPMI specification was extended and new functions required for MTCA hardware management, were added. The Module Management Controller (MMC) is required on each Advanced Mezzanine Card installed in MTCA chassis. The Rear Transition Modules (RTMs) require Rear transition module Management Controller (RMC) that is specified in MTCA.4 extension specification. The commercially available implementations of MMC and RMC are expensive and do not provide the whole functionality that is required by specific HEP applications. Therefore, many research centres and commercial companies work on their own implementation of AMC or RTM controllers. The available implementations suffer because of lack of a standard and interoperability problems.**

The Authors developed a unified solution of management controller fully compliant to AMC and MTCA.4 standards. The MMC v1.00 solution is dedicated for management of AMC and RTM modules. The MMC v1.00 is based on Atmel ATxmega MCU and can be fully customized by user or used as a drop-in-module without any modifications. The paper discusses the functionality of the MMC v1.00 solution. The implementation was verified with developed evaluation kits for AMC and RTM cards.

***Index Terms*—Module Management Controller, Intelligent Platform Management Interface, Advanced Mezzanine Card, Rear Transition Module, Micro Telecommunications Computing Architecture, MTCA.4, High-Energy Physics**

I. Introduction

The Micro Telecommunications Computing Architecture (MTCA) is a compact, modular, cost-effective standard dedicated for demanding applications in telecommunications and computing systems [1]. The main advantage of this architecture is high-level of reliability, availability and maintainability. It is achieved by the use of redundant components and the advanced management based on the Intelligent Platform Management Interface (IPMI). The IPMI is a message-based, hardware-level standard dedicated for management and monitoring of computer systems. The IPMI has been extended and adjusted for the needs of MTCA to support its hardware-specific functionality.

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Thanks to its all aforementioned features, the MTCA standard more frequently finds the application in large-scale research facilities of the high-energy physics [2], [3]. In order to better meet all requirements of such a systems, the MTCA.4 extension has been developed. Beside the new features related to precise synchronization of all system components, the MTCA.4 also introduces new type of module, the Rear Transition Module (RTM). The RTM is connected to the front AMC Advanced Mezzanine Card (AMC) [5] and it is fully managed by this board. The AMC is also responsible for representation of the RTM for system management. It cause the management in MTCA.4 chassis is more complicated and the Module Management Controllers (MMCs) of the front boards should implement additional functions dedicated for the RTM handling [6]. More complex structure of the MMCs and their extended functionality could crate many problems and decrease system stability, when it is not correctly implemented. It contradicts the idea of the IPMI application that should increase the system reliability and availability. For these reason the authors decided to design an unified solution of management controllers for AMC and RTM modules to facilitate designing of MTCA.4-compliant boards and to avoid problems related to the MMC development.

II. MMC v1.00 - Standardized Solution for Management Controller

The solution presented in this paper, called MMC v1.00, is an unified template of Management Controllers for AMC and RTM boards. The idea of this project is to develop ready-to-use solution of MMC and RMC including both hardware (schematics, PCB layouts) and firmware designs. The project is addressed for designers of modules for the MTCA-based systems not familiarised with management requirements. They may use provided components directly in their projects what greatly shorten the time required for hardware design and software development and debugging. The other goal of the project is unification of various existing implementations of management controllers. The project provides standardised solution of MMC and RMC controllers that covers all common functionality that has to be provided by all MTCA.4-compliant modules. Therefore, the MMC v1.00 project may be used without any changes in typical, simple modules or may be a good starting point for designing more dedicated solutions requiring application specific sensors, actuators etc.

The block diagram of AMC and RTM management controllers is presented in Figure 1. The MMC is based on an Atmel ATxmega microcontroller. The microcontroller is

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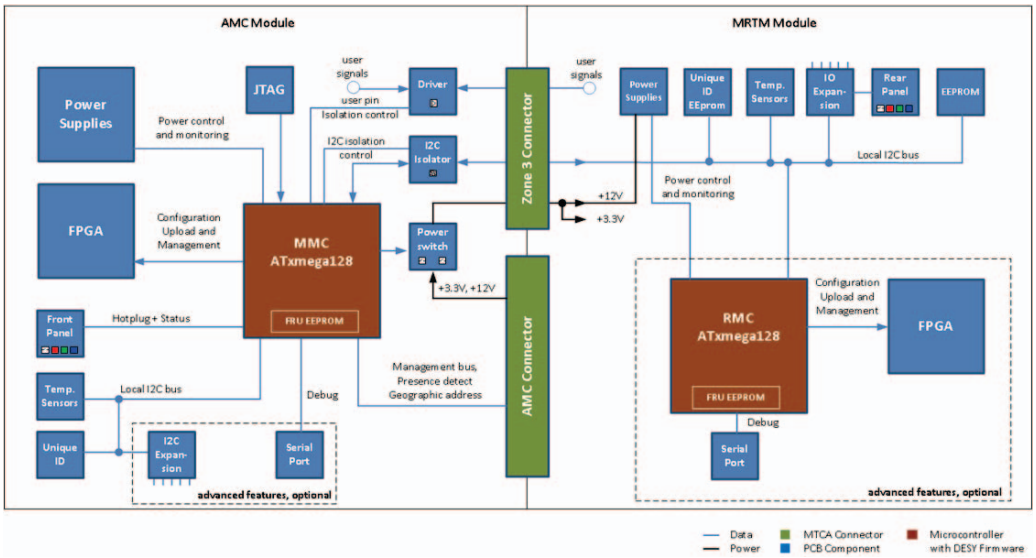

Fig. 1. Block diagram of the AMC and RTM management

connected directly to supervising system (via IPMI bus) and implements all the required MMC controller features. The microcontroller reports the current status of the board, allow the power supply control and managing the module operational states. Moreover, it monitors the operational parameters of the board i.e. temperature, voltage, current using set of sensors connected to dedicated peripheral I^2C bus. It is also responsible for FPGA management and monitoring. The microcontroller provides also functions for handling the RTM module. It manages the power supply of the RTM using dedicated power supply controller and controls its operational state.

Within the project, two evaluation boards (eval-kits), AMC and RTM, have been designed and manufactured (see Figure 2). The boards are a valuable reference for users of the MMC v1.00. They implement the proposed hardware solution of the MMC and RMC and may be useful to familiarize with operation principles of the management controllers. The are also good test platform allowing development and verification of additional, customized functions of the MMCs.

III. Conclusions and Plans for Future

The MMC v1.00 solution is the first attend to provide an unified IPMI templates for AMC and RTM cards. Schematics diagrams, hardware and initial implementation of firmware were developed. The implementation was evaluated and tested with designed eval-kit boards that allow fast development of IPMI management for MTCA.4 modules. The MMC v1.00 templates were applied for the first modules of the LLRF control system of the European XFEL accelerator: low-latency data processing module (DAMC-TCK7) and Vector Modulator (DRTM-VMLF).

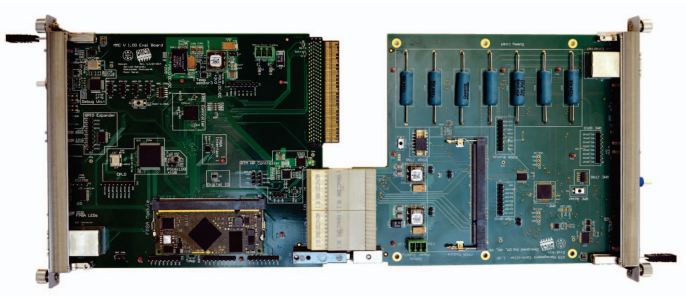

Fig. 2. The photograph of the AMC and RTM eval-kits

The current solution covers all basic functionality required by the MTCA.4 specification. It also provides new functions useful for development and application of hardware used in High Energy Physics experiments. However, the firmware for the MMC is still under development and new, more advanced functions are being added. In the next steps, the authors are planing to prepare framework for firmware developers. The framework will provide generic functionality, common for all MTCA.4 modules. It may be freely modified to adjust the presented solution to the requirements of the specific module.

Acknowledgment

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