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Author(s)	Wojciech Zabołotny
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Document information

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Title Status of the D2.3 („Components of the STS data acquisition chain tested”)

The tests of the STS data acquisition chain components were planned for April 2022 in JINR. Preparation for those tests were performed until February 24th 2022 when the Russian invasion of Ukraine stopped cooperation and communication with the JINR team.

Up to this time, the following state of preparations has been achieved.

The block diagram of the STS readout chain for the BM@N experiment is shown in Figure 1.

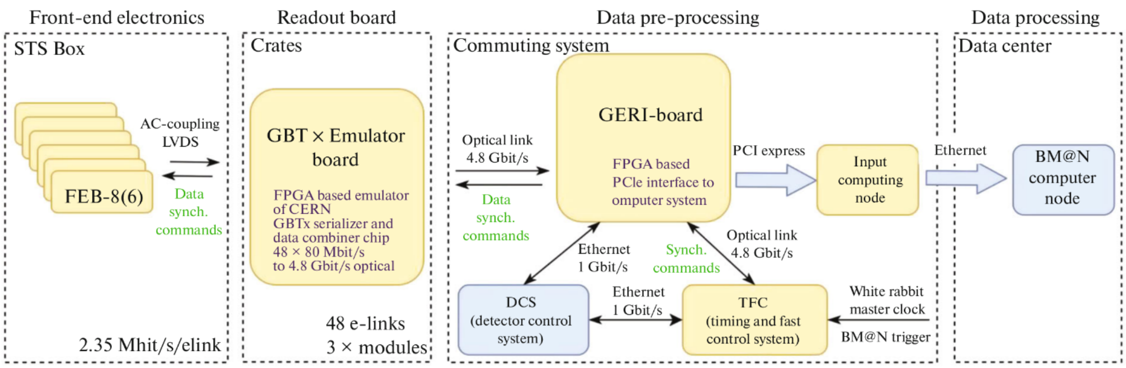

Figure 1: Schematic view of the readout chain of BM@N STS [1].

The prototype GBTxEMU board in the 3U Eurocard form factor with high-density Samtec connectors has been designed, manufactured, and tested at JINR. The manufactured GBTxEMU boards have been successfully used in the laser test bench for STS modules in JINR. The firmware for the GBTxEMU board has been developed [2].

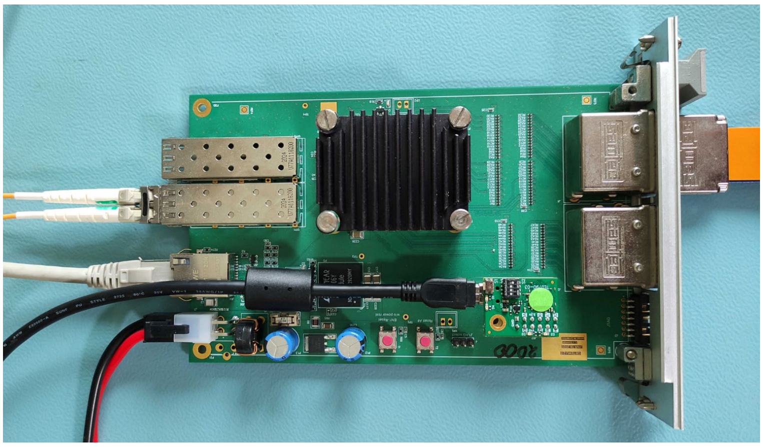

Figure 2: The second version of the GBTxEMU developed at JINR in the Eurocard format [2].

The prototype data acquisition system has been assembled at JINR.

The quality of the synchronization and the stability of the synchronization in time were tested on two STS modules with radiation source Ru-106. Time stability was confirmed during the 24-hours test. The measured time difference between 32 ASICs (two modules) under test is on the level of 24 ns, i.e., ±1 time stamp.

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Later on, tests of synchronization between up to 4 FEBs were performed at JINR.

The investigations on the immunity of the long copper link to the EMI were performed.

The results have shown good immunity. However, a solution with isolating transformers in the downlink was also designed for the case of too high EMI level in the final experiment environment.

The GERI board prototype based on the commercial TEC0330 board from Trenz was prepared. The dedicated firmware for triggerless data acquisition was implemented on the GERI prototype. All essential components have been successfully ported to the GERI hardware platform. The dedicated PCIe core with a DMA engine has been prepared and tested (publication in preparation).

The dedicated Linux kernel driver for the continuous data acquisition and accompanying skeleton data receiving application have been written.

A dedicated emulated QEMU-based environment for testing the DMA engine, driver, and data acquisition application has been prepared [3]. The driver and the skeleton application have been successfully tested, considering the specification formulated for the input computing node. The same tests were also performed in real hardware with a simulated data source.

The Python libraries for controlling the GERI board via the PCIe accessible Wishbone bus have been prepared (based on the ones prepared for the CBM experiment) and tested.

The development of the full control and data acquisition application was started by the JINR team and its Russian collaborators with support from the WUT team. Unfortunately, the cooperation was stopped by the war.

The development of the TFC system was started at JINR with support from WUT and GSI. The ZCU102 board from Xilinx was selected for the TFC master implementation. Unfortunately, the beginning of the war has stopped the cooperation and further progress is unknown.

Publications resulting from the project:

1. D. Dementev et al., "Fast Data-Driven Readout System for the Wide Aperture Silicon Tracking System of the BM@N Experiment," *Physics of Particles and Nuclei* 52, no. 4 (July 1, 2021): 830–834, DOI: 10.1134/S1063779621040213.
2. W.M. Zabołotny et al., "GBTX Emulator for Development and Special Versions of GBT-Based Readout Chains," *Journal of Instrumentation* 16, no. 12 (December 1, 2021): C12022, accessed December 17, 2021, DOI: 10.1088/1748-0221/16/12/C12022 (open access preprint at https://arxiv.org/abs/2109.11591).
3. W. M. Zabołotny, "QEMU-Based Hardware/Software Co-Development for DAQ Systems," *Journal of Instrumentation* 17, no. 04 (April 4, 2022): C04004, DOI: 10.1088/1748-0221/17/04/C04004 (open access preprint at http://arxiv.org/abs/2109.14735).

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