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The read-out and data transmission for the new focal plane detector for the NUMEN project.

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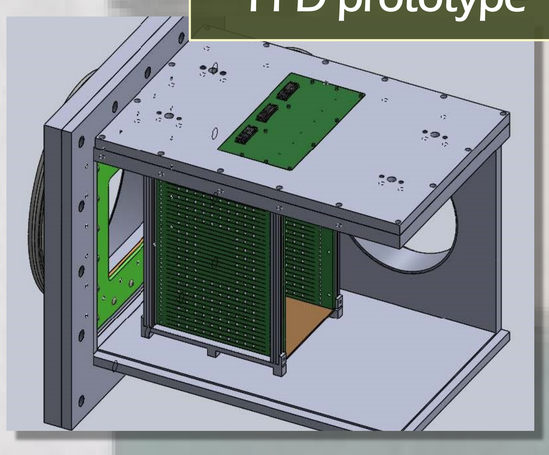
ABSTRACT

• The main task of the read-out electronics for the new NUMEN[1] focal plane detector (FPD) is the real-time data collection from the front-end boards and the high bandwidth transmission to data acquisition, the remote configuration and the slow control of the front-end electronics and the synchronization of the whole detector. The read-out electronics architecture, thought as modular and expandable to the final size of the detectors, is based on System On Module (SOM). This very versatile device couples high performance FPGA to powerful processor architecture and allow a graphical approach to the programming and interfacing. The results of the test of the prototypes are presented.

MAGNEX spectrometer

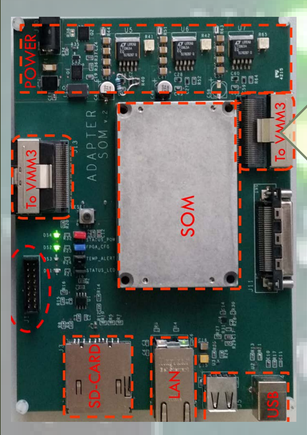
With the incoming upgrades of the cyclotron at Laboratori Nazionali del Sud (LNS), an upgrade of the FPD of the MAGNEX spectrometer[2] will be necessary, including its front-end (FE) and read-out (RO) electronics, able to sustain an higher event rate (up to 10MHz in the NUMEN experiment). The Segmented anode and the FE electronics were totally redesigned with a solution that includes the VMM3 chip. (See Poster Bongiovanni D. "The Front-end for the new focal plane detector for the NUMEN project"). This solution led to the development of a totally digital RO based on System On Module (SOM) by National Instruments.

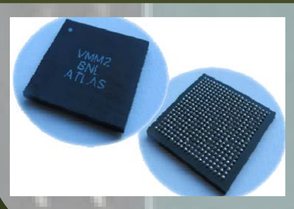
FPD prototype



STATUS

A full custom board hosting SOM and interfacing the VMM chip was developed to test the functionalities of the ASIC. A graphical user interface was developed in LabVIEW to perform slow control and DAQ.





System On Module (SOM)

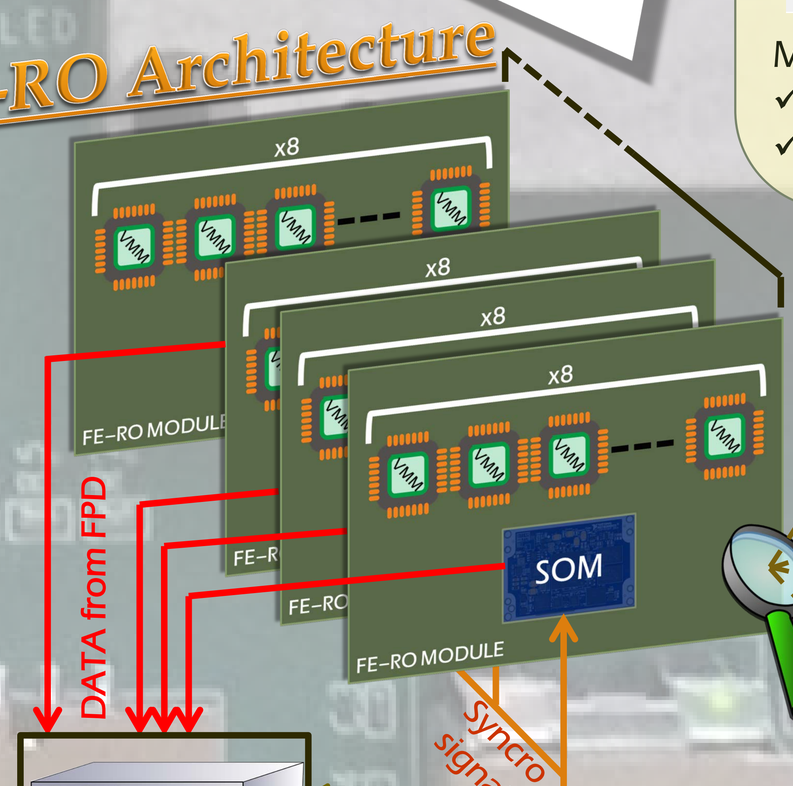
The System on Module (SOM) is a very small, flexible, reliable, high-performance, industrial-grade, deployment-ready embedded computer that combines an ARM processor, NI Linux Real-Time OS and a programmable Xilinx FPGA.

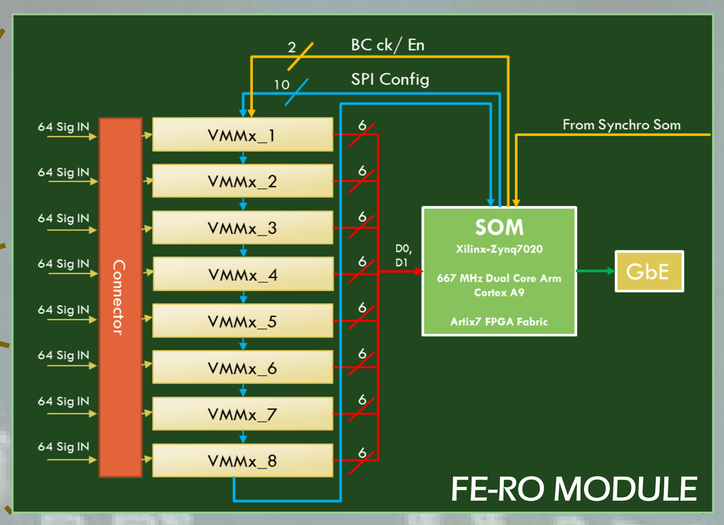
Processor SoC	Xilinx Zynq-7020
	667 MHz Dual-Core ARM Cortex-A9
	Artix-7 FPGA Fabric
Size	50.8 mm x 78.2 mm (2 in. x 3 in.)
Power	Typical: 3W to 5 W | Max: 10W
Dedicated Processor I/O	Gigabit Ethernet, USB 2.0 Host, USB 2.0 Host/Device, SDHC, RS232 TX/RX
Memory	Nonvolatile: 512 MB
	DRAM: 512 MB
Operating Temperature	-40 °C to 85 °C Local Ambient
FPGA I/O	160 Digital I/O Channels 16 Single-Ended 3.3V 144 Single-Ended / 72 Differential (3 banks with user-supplied voltage)
	Configurable Peripherals: Gigabit Ethernet, RS232 x3, RS485 x2, CAN x2

Measured Performance of SOM:

- ✓ Sampling of 128 digital input SE @230MHz
- ✓ Sampling of 64 digital input SE @350MHz

FE-RO Architecture





The main idea for the design of the new FPD is to use the same architecture of FE and RO both for the tracker and the Particles Identification Detector (PID) wall. Then, the specifications are:

- ✓ About 6000 channels to be read (about 2000 for the tracker and 4000 for the PID-wall)
- ✓ Foreseen event – rate up to 100 KHz/cm
- ✓ Modularity and scalability
- ✓ Ease of maintenance
- ✓ Radiation tolerance
- ✓ Low power and low cost

Each SOM can manage up to 8 VMM chips. Due to the maximum foreseen event rate, the number of VMM chip will be chosen as the best tradeoff between the minimum number of boards and a sustainable data throughput.

For further informations scan the Qrcode or send an e-mail to danilo.bonanno@ct.infn.it

You can download a digital copy of this poster as pdf file here

REFERENCES:

1. https://web.infn.it/NUMEN/index.php/it/
2. F. Cappuzzello, et al., The MAGNEX spectrometer: Results and perspectives, Eur. Phys. J. A 52 (6) 167 (2016), DOI: 10.1140/epja/i2016-16167-1.