The NSW Detector Control System of the ATLAS experiment

LHCP, June 7-12 2021, Paris

C.Paraskevopoulos[1,2]
on behalf of the ATLAS Muon Collaboration
[1]National Technical University of Athens, [2]BrookHaven National Laboratory

Introduction

ATLAS is the largest high-energy physics detector ever built by man. The LHC delivers millions of collisions each second, that take place in the heart of ATLAS. These collisions though, create a dangerous radiation environment, which the detector has to endure. In order to monitor and control the operation of the detector, a framework has been devised, which allows for remote supervision and intervention in the detector and its sub-systems: The Detector Control System (DCS). This control scheme is used daily, in the ATLAS Control Room. It is also used by the subdetector experts to guarantee a safe and efficient Physics run. The main task of the DCS is to enable the coherent and safe operation of the full detector by continuously monitoring its operational parameters and its overall state. The NSW consists of two detector technologies Micromegas and sTGC.

FSM Hierarchy

The NSW DCS projects closely follow the existing look, feel and command structure of MUON DCS, to facilitate the shifter and expert operations. The projects are mapped onto a hierarchy of Finite State Machine (FSM) elements using the Joint COntrols Project (JCOP) FSM toolkit. The FSM is conceived as an abstract machine that is able to be in only one of a finite number of states at a time. The state can change when initiated by a triggering event or condition (transition state). The top node of both MMG and sTGC will propagate its state and receive commands from the ATLAS overall DCS. Shifters will mainly use the DCS FSM and DCS Alarm Screen(Figure 2).

Figure 1: The MMG HV, FSM Side A Panel

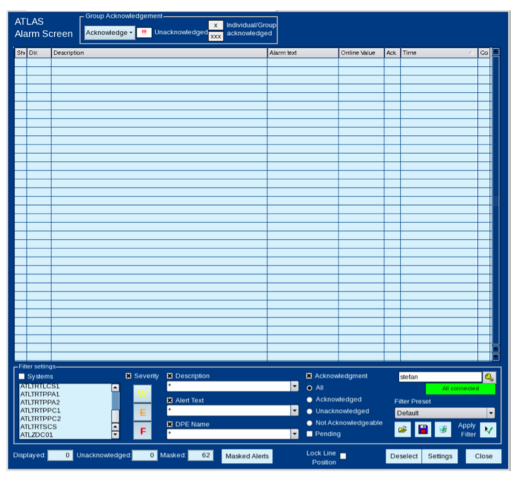

Figure 2: The DCS Alarm Screen

BField Monitoring

Each of the large sTGC sectors has four B-field sensors that are connected through MDT Device Modules (MDM) and read out via the Controller Area Network (CAN) protocol.

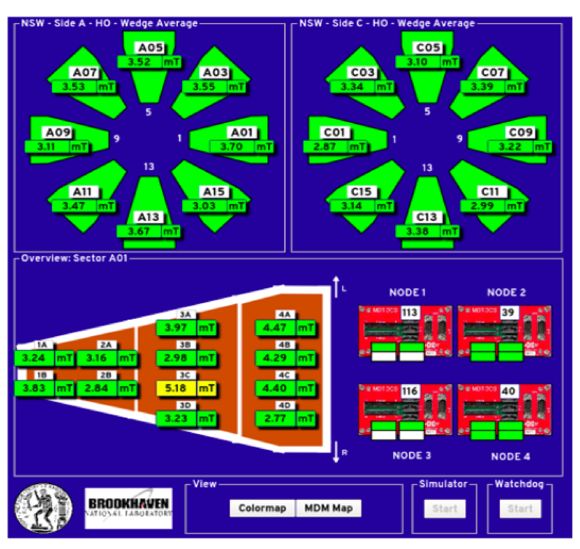

Figure 3: B field monitoring panel

NSW DCS : PS Architecture and Hardware

High and Low voltages for MMG and sTGC are supplied by the widely used CAEN system, which is developed for the LHC experiments. Among its core features are.

- Remote control
- Split of radiation sensitive parts from parts that can be housed in a hostile area
- Compatibility with operation under radiation and magnetic field as in the ATLAS cavern

Communication with the control machines is achieved through OPC UA server-client connection. Side A and C, NSW OPC UA servers, are deployed on the host servers while the OPC UA clients, running on the same machines, gather the address space of the individual channel parameters and transmit them to the projects. The system architecture consists of mainframes, which house the branch controllers, connected with the Low Voltage (LV) and High Voltage (HV) crates. Intermediate Conversion Stage (ICS) modules provide the Low Voltage for the readout cards. ICS will be in the "hostile" area of the system near to the chambers, mounted on the NSW. Eleven CAEN mainframes of type SY4527 will control all LV and HV for NSW. Each HV branch controller is connected with a set of Embedded Assembly SYstem (EASY) crates, which are connected as a daisy-chain. HV Crates and boards are supplied with an external DC power of 48V generated by separate AC-DC converters, while the LV ICS crates are powered from primary generators with adjustable voltage output. The mainframes, generators and branch controllers are located in ATLAS Underground Service areas while while EASY crates and boards in the ATLAS cavern.

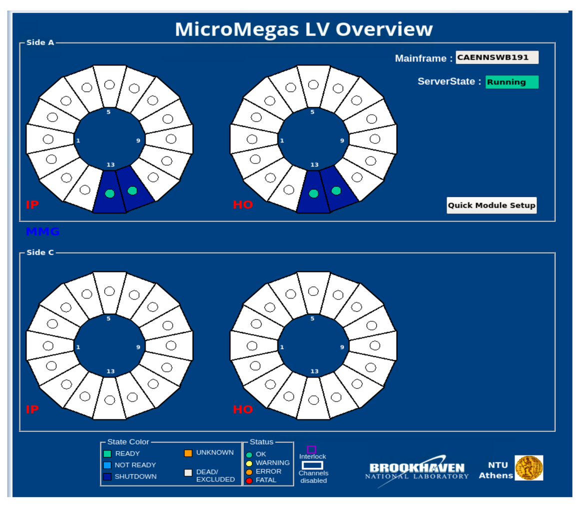

Figure 4: Side A and C, Low Voltage monitoring

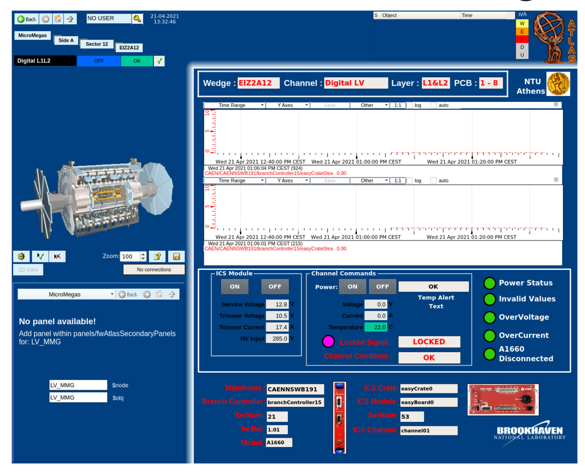

Figure 5: Individual ICS channel monitoring

Electronics Monitoring

The NSW is a fully redundant trigger and tracking detector system, adequately supported by an advanced electronics scheme and ready to handle the challenges of increased instantaneous luminosity at the High Luminosity LHC. Its separate configuration/monitor, readout and trigger path consists of 2.4 million readout channels that result in 100.000 DCS parameters .

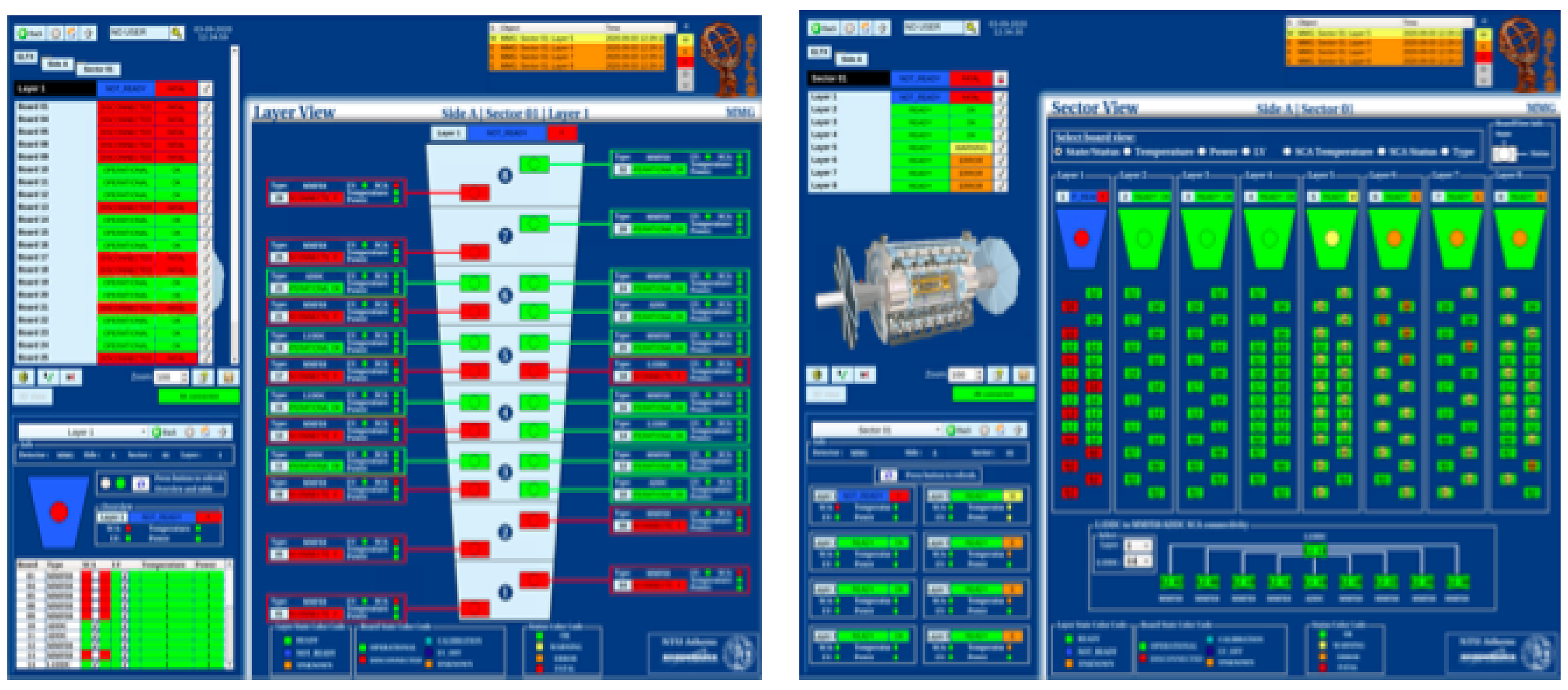

Figure 6: The NSW Electronics monitoring Panel

Temperature Monitoring

MDT Device Modules (MDM), which operated well during previous Run periods, will be used in NSW. MDMs are Radiation and Magnetic tolerant, based on Embedded Local Monitor Board technology. Every NSW Sector will have 36 TSensors on chamber and 16 for cooling channel monitoring. Information about CanOpen OPC UA Server, which is the interface between hardware and projects, IP and HO wedges monitoring and cooling temperature sensor alarm handling is included.

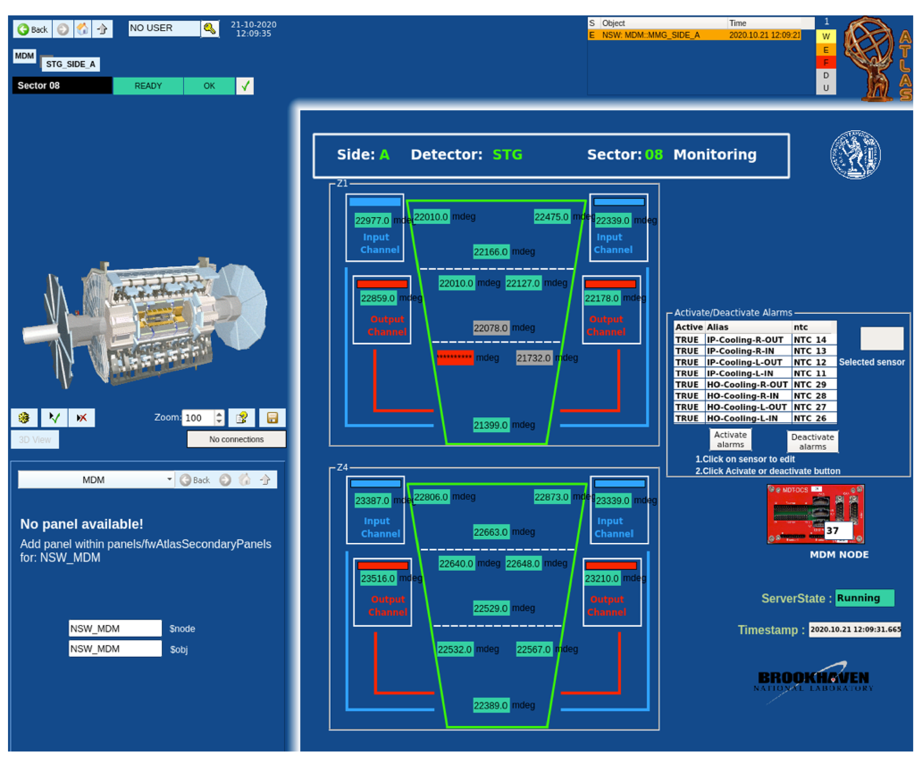

Figure 7: NSW double Wedge monitoring