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The Control and Data Acquisition System of the DTT experiment

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DTT, Divertor Tokamak Test facility, is currently under construction at the Frascati ENEA Research Center. Its aim is to explore alternative solutions for the extraction of the heat generated by the fusion process. Its Control and Data Acquisition System (CODAS) will (1) orchestrate and synchronize all the DTT systems during Plasma operation and maintenance; (2) acquire data from the experiment diagnostics and plant systems and store it in an experimental database to be used for on-line and off-line analysis; (3) provide real-time Plasma control.
The expected duration of the plasma discharge in DTT is in the order of some tents of seconds and therefore DTT can be considered a long lasting experiment, involving therefore data streaming technologies for data communication and storage. The main DTT CODAS design principles are based on three principles: (1) Taking inspiration from other similar experiments currently under development, namely ITER CODAC, (2) relying on proved solutions already adopted in running experiments with similar constraints and (3) taking advantage from practices widely adopted in the fusion and, more in general, in industry.
Several architectural concepts have been drawn from the ITER project, in particular the definition of a set of networks as the basis for plants integration, the adoption of IEEE1588 to provide overall time synchronization and the use of UDP as the network protocol for the communication among the control components in Plasma control.
In other aspects, the architecture of DTT CODAS differs from that of ITER CODAC, in particular the adoption of frameworks widely adopted in the fusion community, namely MDSplus for the data management and MARTe2 for the orchestration of the real-time plasma control components. MDSplus is in use since decades in many fusion experiments and, in particular, in EAST that is similar to DTT form the data acquisition point of view. For the supervision and orchestration of the components involved in real-time plasma control the MARTe framework has been adopted in DTT. MARTe is not the unique framework for Plasma Control in the fusion community, but it has been adopted in several different fusion experiments and a new release, MARTe2, has been developed by F4E under strict quality procedures.
Besides the adoption of software frameworks, other successful practices have ben drawn from the fusion community and from industry. In particular, the adoption of Simulink as 'lingua franca'for the definition of the algorithms involved in plasma control is becoming a standard approach in fusion experiments, relying also on automated tools that minimize or completely eliminate the need of manual translation from the Simulink definition into the actual C++ component implementation.
The most important contribution of industrial experience to DTT CODAS is the adoption of OPC-UA communication middleware for overall communication with plasm plant systems for slow control. Thanks to wide adoption of this standard in industrial communication, many solutions, including open-source ones, are available and at the same time the standard is well known by the industrial partners involved in the development of plant systems such as vacuum, cooling and power supplies.

Speaker's Affiliation

Consorzio RFX

Member State or IGO

Italy

Primary authors: MANDUCHI, Gabriele; AMBROSINO, Roberto

Co-authors: Mr ZANON, Fabio; SARTORI, Filippo; PACCAGNELLA, Giorgio; Dr MARTINI, Giulio; Dr BONCAGNI, Luca; Dr FERRON, Nicolo'; Mr MOSETTI, Pierandrea

Presenter: MANDUCHI, Gabriele

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