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ITER plant configuration system

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The ITER plant configuration system is a component of Control, Data Access and Communication (CODAC) Supervision (SUP) system and is tasked to derive machine parameters from planned experiment schedule, conduct multi-stage engineering verification process involving a wide range of codes (e.g. electromagnetic induced forces on mechanical structures, scarce resource budget management, etc.), and eventually load machine parameters to the plant control system as part of the experiment preparation.

The ITER plant configuration system interfaces to Machine Operation, to a heterogeneous set of data repositories (e.g. experiment schedule, machine geometry and condition, operating limits, live measurements, plant system self-description data, etc.), and the hundreds plant systems that compose the ITER machine.

The architecture and detailed design is being elaborated as a joint initiative between ITER Organization (IO) and Fusion for Energy (F4E, ITER European Domestic Agency) and will be submitted to a peer review process during the coming CODAC final design review scheduled in 2020. The architecture promotes a strong decoupling between variables and data types definition, data access, transformation and verification codes, and the configuration workflow management. The strong decoupling enables offline composition and verification of the experiment schedule, distinct life-cycles and qualification processes for the various components; it ensures a high degree of testability, etc.

The detailed design is being substantiated with representative scale prototypes. Transformation and verification codes take the form of C/C++, Matlab and/or python functions, and are provided for execution by means of EPICS 7 (pvAccess) services which support dynamic discovery of interfaces and data types, and a concurrent execution model. EPICS 7 services are also deployed atop plant system interfaces and support a synchronous transaction model for structured configuration variables; interface adapters are tasked to propagate and complement the transaction with data integrity verification through to remote controllers. Interface adapters cover obviously the serialisation of structured pvAccess variables to EPICS records through ChannelAccess, the mapping to OPC UA servers, etc. XML based domain specific language is proposed to describe and organise the configuration workflow process. Distributed MARTe2 applications are used as workflow executor.

The presentation aims at clarifying the context, presenting the architecture and substantiating arguments, the technical choices, as well as successes and difficulties encountered with using EPICS 7 during the prototyping activities.

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