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Multiple Fast Controller Synchronization for ITER Control System Model

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ITER Control System Model (ICM) is a currently developed simulation platform for CODAC, which is a control system responsible for integrating and controlling all plant systems of ITER. ICM is a full-scale implementation of CODAC that follows all hardware and software standards, but does not include any I/O to physical components of ITER. This will serve as an excellent test environment for performance and scalability of upcoming plant system modules and new releases of CODAC software.

ICM mimics CODAC infrastructure by combining both virtual and physical servers for different applications. Less demanding services are hosted as virtual instances on two dedicated hypervisors. More demanding real-time applications will be hosted on separate fast controllers connected over physical high performance networks that closely mimic the server infrastructure of ITER.

Current real-time configuration of ICM consists of 4 operational fast controllers running Intel Xeon CPUs (2x @ 1.80 GHz, 1x @ 2.00 GHz and 1x @ 3.50 GHz). Configuration is scheduled to be expanded by 4 additional controllers (1x Xeon @ 3.50 GHz and 3x i7-4790S @ 3.20 GHz) and possibly more in the future. Each fast controller contains a timestamping-capable network port which is synchronized to a dedicated grandmaster clock using IEEE 1588-2008 protocol. In addition, each controller is paired with a 10GbE network expansion card connected over a dedicated high performance multicast-capable cut-through switch infrastructure that represents ITER Synchronous Databus Network (SDN). Similar SDN connections have already been tested on individual controllers with application-to-application latency below 50µs and relatively low jitter, which are expected to improve with upcoming releases of CODAC software.

This test scenario investigates the performance and reliability of the distributed multiple fast controller synchronization and the associated deterministic communication infrastructure. This evaluation is necessary for developing future simulations that will incorporate demanding data processing and real-time control of the plasma.

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