Real-Time Data Acquisition and Feedback Control using Linux Intel® Computers*

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This paper describes the experiences of the DIII–D programming staff in adapting Linux-based Intel® computing hardware for use in real-time data acquisition and feedback control systems. Due to the highly dynamic and unstable nature of magnetically confined plasmas in tokamak fusion experiments, real-time data acquisition and feedback control systems are now in routine use with all major tokamaks. At DIII–D, plasmas are created and sustained using a real-time application known as the digital Plasma Control System (PCS). During each experiment, the PCS periodically samples data from hundreds of diagnostic signals and provides these data to control algorithms implemented in software. These algorithms compute the necessary commands to send out to various actuators that affect plasma performance. The DIII–D PCS consists of a group of rack mounted Intel® Xeon™ computer systems running an in-house customized version of the Linux operating system tailored specifically to meet the real-time performance needs of the plasma experiments. Previous papers presented for the DIII–D PCS have briefly touched upon the real-time implementation. This paper will provide a more detailed description of the real-time computing hardware and custom developed software, including recent work to utilize dual Intel® Xeon™ equipped computers within the PCS.

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