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P3.036 NI p2p streaming powered multiple fpga real-time data processing system on J-TEXT tokamak diagnostics

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On tokamaks, there are many diagnostics, which need real-time data acquisition and processing to provide useful information for plasma control. Some of the diagnostics required fast processing of multiple very high sampling rate signals. It is often difficult to achieve even with modern multi-core CPUs. This is due to moving large amount of data from the digitizers to the system ram would hurt the deterministic performance significantly. FPGA data processing is a better choice when speed and deterministic performance is required. When the task is too heavy for a single FPGA to implement, transfer large data between FPGAs is also required. On the polarimeter-interferometer diagnostics on J-TEXT, in order to calculate the density profile of the plasma in real-time, multiple chords of line-integrated density must be calculated first. The data acquisition system for the polarimeter-interferometer is equipped with 5 FlexRIO FPGAs, only one is acquiring the reference signal. Density calculation for every probing chord needs the reference signal. So this signal needs to be transfer to other FPGAs with strict real-time requirement. Mismatching a single sample the result would be completely incorrect. NI P2P streaming allow the FPGA to transfer data without burdening the process. In the paper, the determinism characteristic and other performance of the P2P streaming is tested, and a mechanism to align local digitized samples with P2P streamed samples is presented. These results can be applied to other real-time data processing system that requires multiple FPGAs.

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