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Control, Data Acquisition and Communication at W7-X using mTCA for the 2022/23 campaign

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The superconducting stellarator W7-X underwent a major overhaul between 2018-2022 with the installation of an actively-cooled divertor and inner wall. The CoDaC System also received a significant overhaul and expansion. The protection of the new divertor required substantial enhancement of the Fast Interlock System, which necessitated a new hardware infrastructure and new implementation. The real-time system had to be ported from the existing VXworks implementation to a real-time linux, in order to accommodate the new divertor protection system. In addition to work on the central components of CoDaC, around 15 completely new diagnostic systems were implemented and another 20 were significantly enhanced. This included a new mTCA-based camera acquisition framework with now enables all cameras at W7-X (which includes CameraLink, CameraLink HS and GigEVision) to run on the same hardware platform with minimal adaption of the software.

As W7-X is geared towards steady-state operation, all data has to be streamed to the archive and cannot be stored locally and uploaded at a later time. The addition of >24 high-speed cameras required a substantial upgrade of the network streaming capacity and the central storage. In order to reduce the requirements as much as possible, a real-time lossless compression algorithm has been implemented for camera data, which was adapted to the W7-X environment yielding a >60% compression rate.

This paper will provide an overview of the changes and upgrades of the W7-X CoDaC system from 2018-2022 and show results from the OP 2.1 campaign with special emphasis on the newly introduced mTCA-based systems and the ones currently under development.

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