



# Fusion Engineering and Design

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## A full stack data acquisition, archive and access solution for J-TEXT based on web technologies

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### ABSTRACT

Flexible and fast deployable data acquisition system has always been demanded by tokamak facilities. This work proposes a full stack data acquisition, archive and access solution for J-TEXT based on Web technologies. This solution is based on a single unified control system framework, and all of the above systems are using the same communication interface: HTTP RESTful API that unifies the status monitoring, command sending even diagnostic data accessing and so on, which is called the unified data access. A working system on J-TEXT is built using this full stack solution. It consists of a data acquisition system for ECEI, an archiving system built on HDF5 files, a data management system and a set of unified data access interface to access the experiment data. This working system is integrated into J-TEXT CODAC system which is based on EPICS CA and MDSplus. Flexible and modular design makes it easy to apply this solution to different systems, even using only a part of it. Some diagnostic systems other than ECEI also use this solution to upload their data to the MDSplus database just with different configurations. Users can access data without noticing which data source is providing to them. All the user interface in this system are built as web pages which can be accessed using web browser on various devices.

### 1. Introduction

With the development of fusion research, there are more and more fusion devices around the world, and new equipment and requirements are constantly being added to existing devices, which bring new challenges to the CODAC systems of fusion devices. ITER is the largest tokamak device being built around the world, and the complexity of its control system is unprecedented in the fusion world. It designs a new architecture of CODAC system that is different from the previous devices based on the EPICS, HDF5 and some other mature products, and brings a lot of new technologies [1–3]. For the existing fusion devices, take the J-TEXT as an example, from its first plasma to the present, its peripheries have been continuously expanded and they are all finally integrated into the J-TEXT CODAC system. The CODAC system used by J-TEXT is inspired by the design of ITER CODAC. It adopts the Plant-System design mode, and each subsystem is independently as a Plant-System. Those subsystems run independently and communicate with each other through EPICS PVs (Process Variables). EPICS is a set of software tools, libraries and applications to create distributed control systems for scientific facilities such as accelerators and tokamaks [4]. Those EPICS PVs are variables in the J-TEXT control system and they represent the status, configurations and commands of each

subsystem. However, there are some differences from ITER. J-TEXT does not have a core system. The design of the J-TEXT control system is completely decentralized [5]. For data archiving, the J-TEXT is completely dependent on MDSplus [6] before this work, which is simple and reliable, and has been running smoothly for several years [7]. ITER's data archiving is mainly based on HDF5 format files. It is flexible and powerful, and can meet the requirements of complex types of data collection for ITER [1,8].

Although the CODAC system of J-TEXT based on EPICS and MDSplus has been proven to be reliable, its scalability is not good enough, and the problem of upgrading is becoming more and more troublesome. The DAQ (data acquisition) devices for J-TEXT have a great variety due to different requirements and budgets. Their acquisition softwares, configuration and usage are different from each other, and their generality is very poor. It is very inconvenience for the maintenance and experiment team. And with the increasing application of HDF5 format file due to its efficiency and convenience, J-TEXT is also considering HDF5 as a new way of data storage. In this paper, a new data acquisition, archive, and access system based on the Web is presented. It makes abstract and standardization for different data acquisition systems, uses HDF5 format file for data storage like ITER, and uses MongoDB database for data management [9]. In addition, it uses Web APIs based on HTTP protocol

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