WestBox : an object-oriented software component for WEST CODAC

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INTRODUCTION

COntrol, Data Acquisition and Communication (CODAC) real-time software codes are key elements for the operation of a fusion device both for the machine protection and for the optimization of the experiments. In 2013, following the WEST project (W -for tungsten- Environment Steady-state Tokamak) upgrade, the whole legacy acquisition system has been refactored.

The WEST CODAC framework which inherited the older implementations used over 20 years on TORE Supra has been cut into primary software pieces called components, corresponding to basic technical features, such as Database Access, Inter-process Communications, Real-time Device Management, Timing System Network, Finite-State Machine, and Shared Memory Network. In addition, a new component named Westbox has been developed to integrate non-native and cross-platform data acquisition hardware and software from guest collaborators.

Westbox architecture

In WEST, the acquisition software infrastructure is distributed as a Cmake based framework including some small low level C legacy libraries. The libwestbox is the new C++ component based on Qt and including all objects required to perform data acquisitions at IRFM. The last part is the Westbox Client which uses all relevant components on the target acquisition unit.
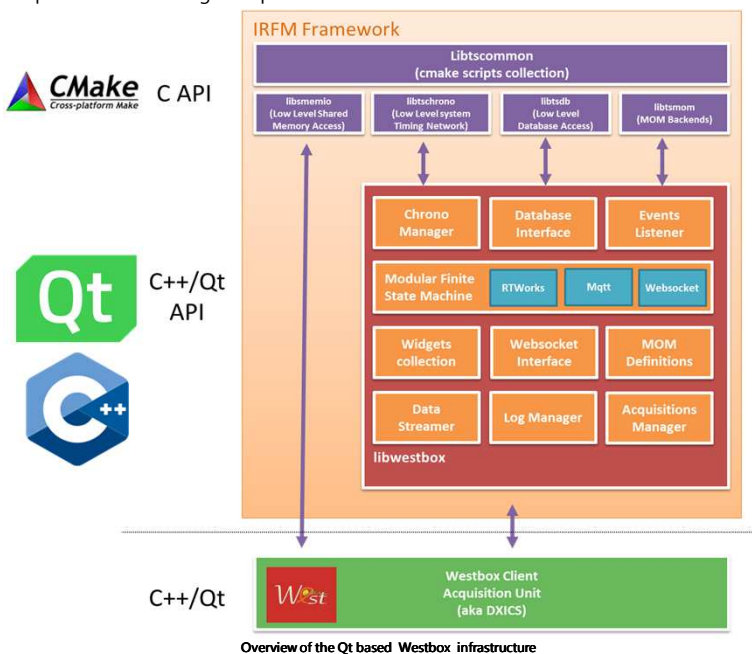
Overview of the Qt based Westbox infrastructure

Acquisition Unit Controller

The Westbox Controller is designed to acquire data during Plasma discharge experiments synchronously with supervision events. It shares data via a shared memory network for Plasma discharge control. A Timing System is in charge of distributing a master clock and discrete Timing events to all units. The Controller follows the Plasma pulse sequence thanks to Mqtt events received from the Supervision. The Controller also stores data files to the database.
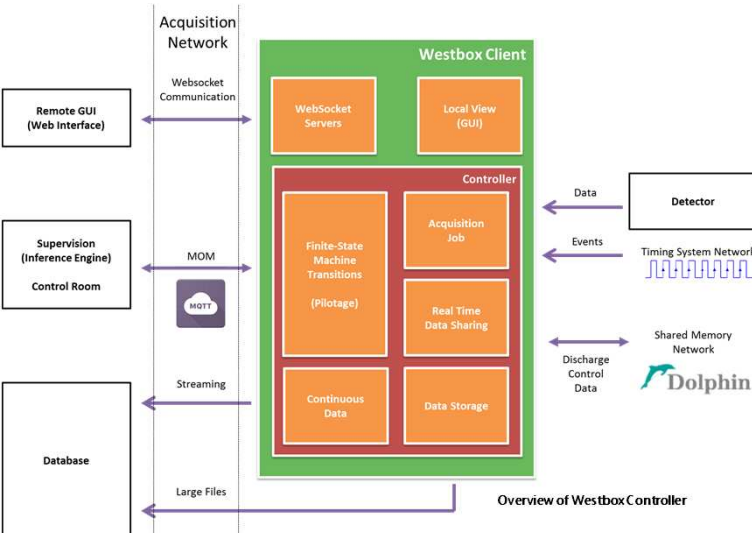
Overview of Westbox Controller

Websockets based controller

The Westbox client can be configured in a "Gateway Mode" in which data acquisition functions are forwarded to a remote controller based on Labview™: the Websocket protocol is used to synchronize finite state machine transitions in the Westbox client and the remote controller, and to communicate with the database server. Multiple storage formats are supported such as IMAS/MDS+ in preparation for ITER.

Websockets are also used with a Web based interface to monitor the remote unit in real time, and to dispatch all event traces to a remote log server and a dashboard for post-experiment analysis.
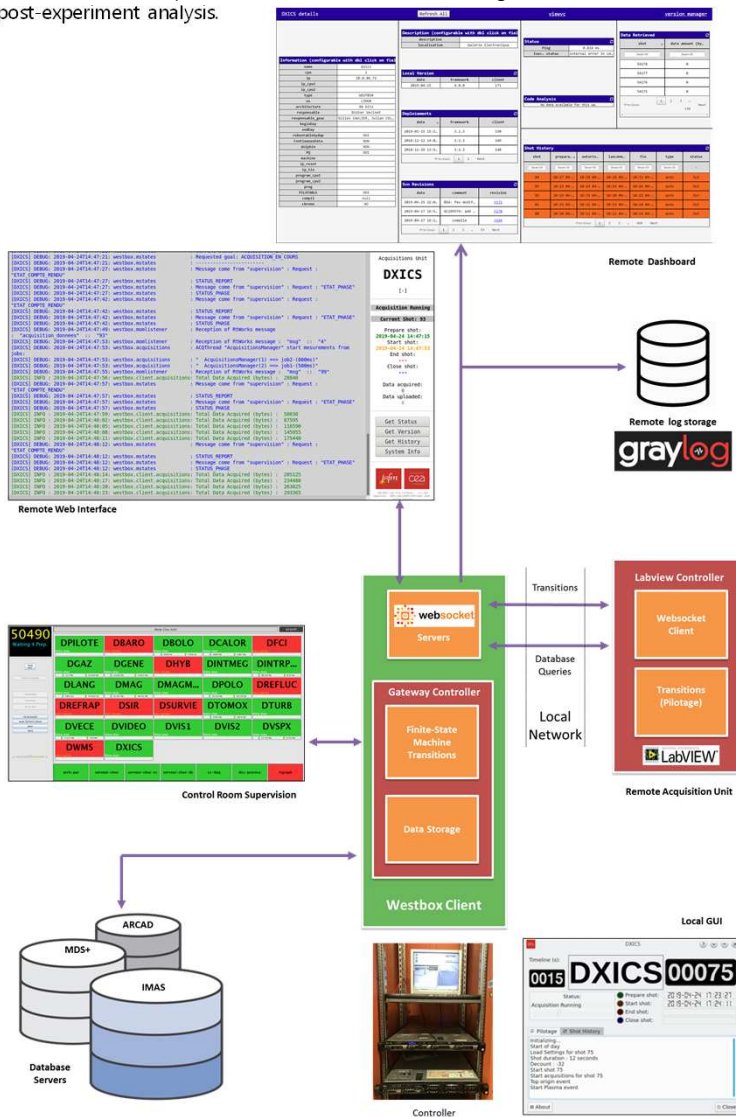
Overview of the Websocket based infrastructure with a remote delegate Labview Controller

CONCLUSION

A versatile Westbox Controller was design and has been successfully used with many different guest devices as part of the distributed data acquisition infrastructure of WEST.

On going developments, include provided Python Controllers and EPICS.

Functions	Devices	Collaborations
X-ray Imaging Crystal Spectrometer (DXICS)	Dectris / Pilatus – Ni Labview	Massachusetts Institute of Technology
Plasma Video Recorder (DVIDEO)	Unigraf	University of Technology of Compiègne
Fiber Bragg grating temperature mesurement (DTFIB)	Ni Labview	French National Research Agency (ANR)
Plasma electronic density (DCAES)	D-TACQ	Kstar project
Equilibria of toroidal plasma (DCEDRE)	Ni Labview	University of Beirut
Real Time Xmode mesurements (DEQUI)	Dolphin	Inria
W detection Spectroscopy (DECE2D)	Oxford Instruments / Andor	Korea Institute of Science
Low Energy X Ray (DGEM)	Custom ASIC	Warsaw University of Technology
Reflectometry (DREFRAP)	Tecktronix / Spectrum	Laboratoire de physique des plasmas
Slow Control PLC Gateway (CCDAQ)	Schneider / Modbus	
PCS Time System Gateway (POLLONCHRONO)	National Instruments	Max-Planck-Institut für Plasmaphysik,
Visible Ray Spectroscopy (DVIS5)	Ni / Princeton	Princeton Plasma Physics Laboratory
Infrared Thermography (DIR)	Sundance	Euratom