



Prototype application for control and debugging of CMS upgrade projects

Dominic Mills-Howell

Supervisor: Marcelo Vincente

August 10, 2016

European Organization for Nuclear Research (CERN)

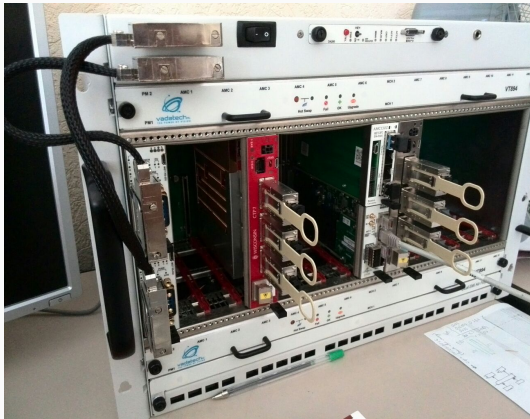
Introduction

Following the high-luminosity upgrades of the LHC, many subsystems of the CMS experiment require upgrading and others are using the LHC shutdowns as an opportunity to improve performance.

- The upgrades, themselves, highlight the exigency to attack problems that were previously unaddressed.
- One such problem is the need for a tool that allows the users to easily monitor, debug, and test custom hardware.

Introduction (cont'd)

The current CMS upgrades involve the use of powerful, flexible and compact processing cards, such as, the Calorimeter Trigger Processor Card (CTP7).



Why CTP7?

The CTP7 is a powerful tool that uses the Virtex-7 FPGA as its primary data processor and is the first in CMS to employ the ZYNQ SoC running embedded Linux to provide TCP/IP communication and on-board support functions.

There are plans for using the CTP7 in other future CMS projects, and also it is being currently used in research and development.

Methodology & Design of Prototype

Methodology and Design

The goal of this project is to create a working Django web application that will interface with the necessary hardware to be used for the new high-luminosity upgrades.

- The application should be able to connect with the CTP7 hardware and receive the data from the sensors in an asynchronous distributed manner via TCP/IP. Certain Python libraries will be integrated to meet these objectives.
- The web application should be capable of adding new hardware, loading/adding registers, plotting the relevant graphs from the necessary data read from the sensors, and triggering alarms in case of any issues.

Methodology and Design

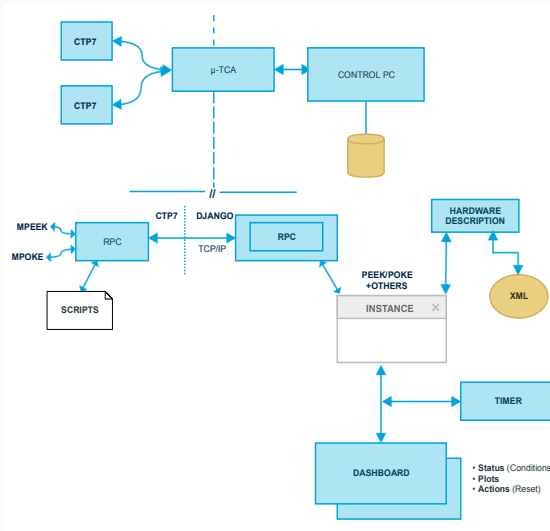


Diagram showing the schematics of the proposed design.

Methodology and Design (specific features)

- To integrate the Celery library to manage the data received from the sensors in a distributed asynchronous manner.
- To integrate the Bokeh library to produce real-time plots from the asynchronous data read from the sensors.
- Implement functionality to trigger alarms in case of any faulty hardware.
- Create a language agnostic description of the hardware with XML.

Future plans

Further improvements on the functionality of the Django application can be made by generalising the functionality to be used on devices other than the CTP7, as well as, incorporating other features/libraries not mentioned here in the near future.

M. Baber, et al., "*Development and testing of an upgrade to the CMS level-1 calorimeter trigger.*", Journal of Instrumentation 9.01 (2014): C01006.

A. Svetek, et al., "*The Calorimeter Trigger Processor Card: the next generation of high speed algorithmic data processing at CMS.*", Journal of Instrumentation 11.02 (2016): C02011.

B. Kreis, et al., "*Run 2 upgrades to the CMS Level-1 calorimeter trigger.*" Journal of Instrumentation 11.01 (2016): C01051. APA

Thank you!

Questions?