

# CMS - HLT Configuration Management System

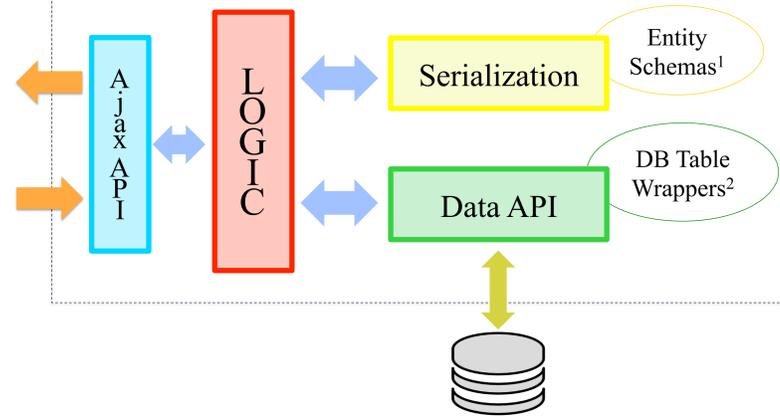
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on behalf of the CMS collaboration

## Overview

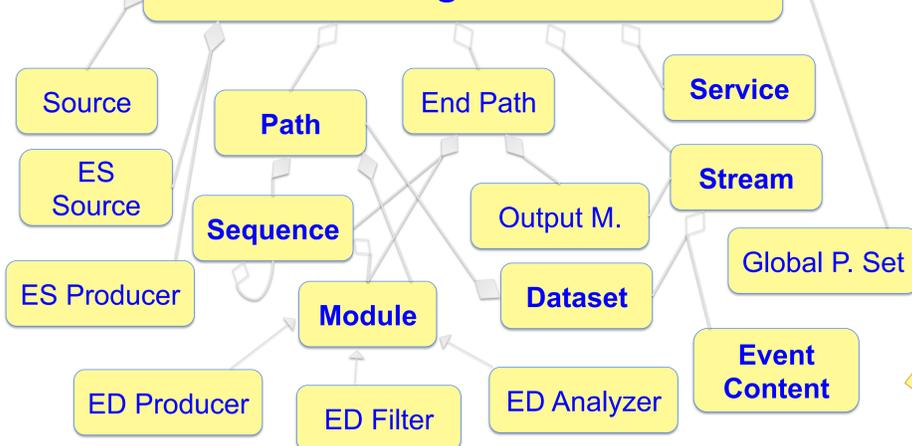
The CMS High Level Trigger (HLT) is a collection of software algorithms that run using an optimized version of the CMS offline reconstruction software. The HLT uses Python configuration files each containing hundreds of "modules", organized in "sequences" and "paths". Each configuration usually uses an average of 2200 different modules and more than 400 independent trigger paths. The complexity of the HLT configurations and their large number require the design of a suitable data management system. The work presented here describes the solution designed to manage the considerable number of configurations developed and to assist the editing of new configurations.



## Logic middleware

The middleware architecture is based on four components, each addressing a specific task. The Ajax API provides the interface used by the GUI to access and manage the contents. The Logic layer implements the operations required to build those contents and perform the required task. The Data API provides to the logic layer a suitable interface to the database, wrapping any low level operation (i.e database query). The Serialization layer ensures the data retrieved by the Logic layer is built according to the standard used in the GUI. This solution is meant to provide high decoupling and high flexibility among the layers. These features can be exploited in case of database schema changes as well as in case of GUI updates. In both cases just minor changes to the Data API and to the Serialization layer respectively would be required, avoiding extensive modification to the rest of the application.

## Configuration

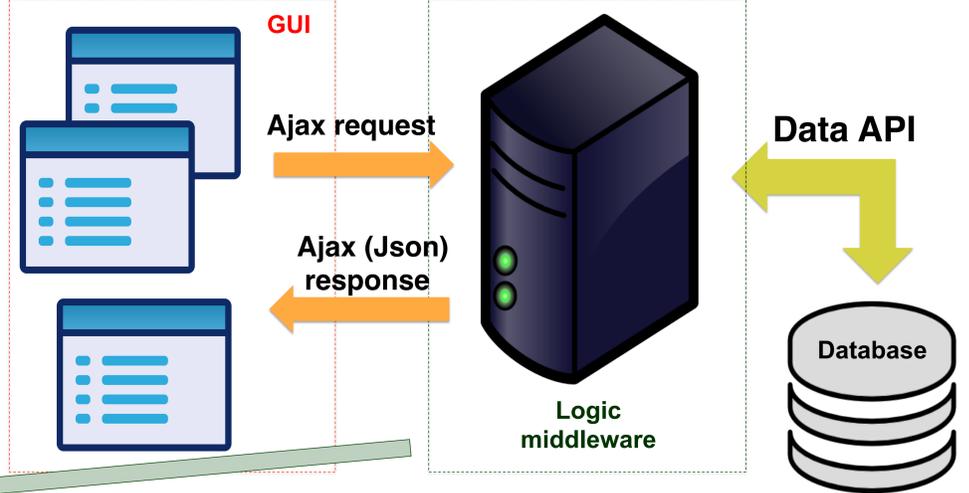


## Domain

The starting point for the system design has been the analysis of the main concepts populating the domain of the CMS HLT configuration. A graphical representation of the entities recognized and the relationships among them is given to provide a view as complete as possible. The main entities of the HLT configuration are represented along with the relationships between them. The arrow line indicates a Generalization-Specialization relationship; while the plain line stands for a simple Association relationship. The hollow diamonds on the containing class represent the Aggregation association with a single line that connects it to the contained class; while the filled diamonds on the containing class symbolize the Composition association with lines that connect it to the contained class.

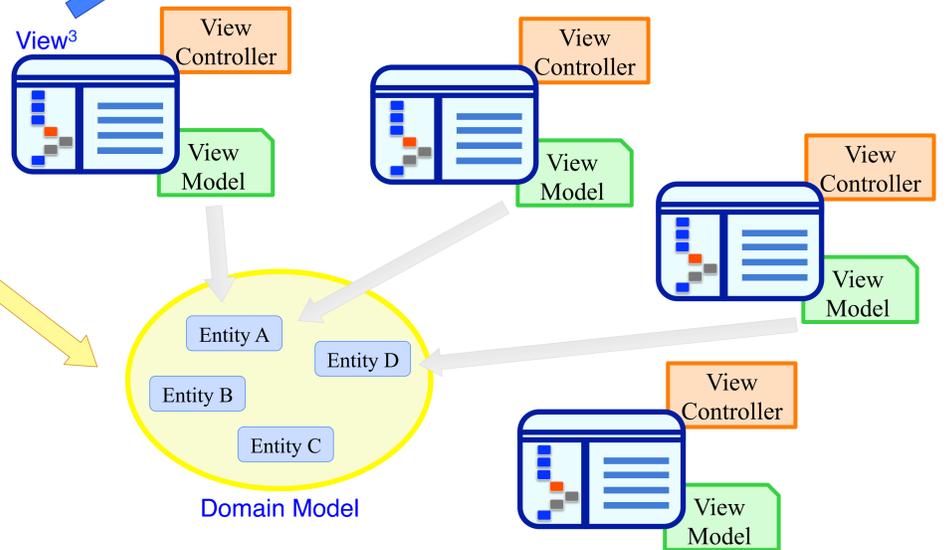
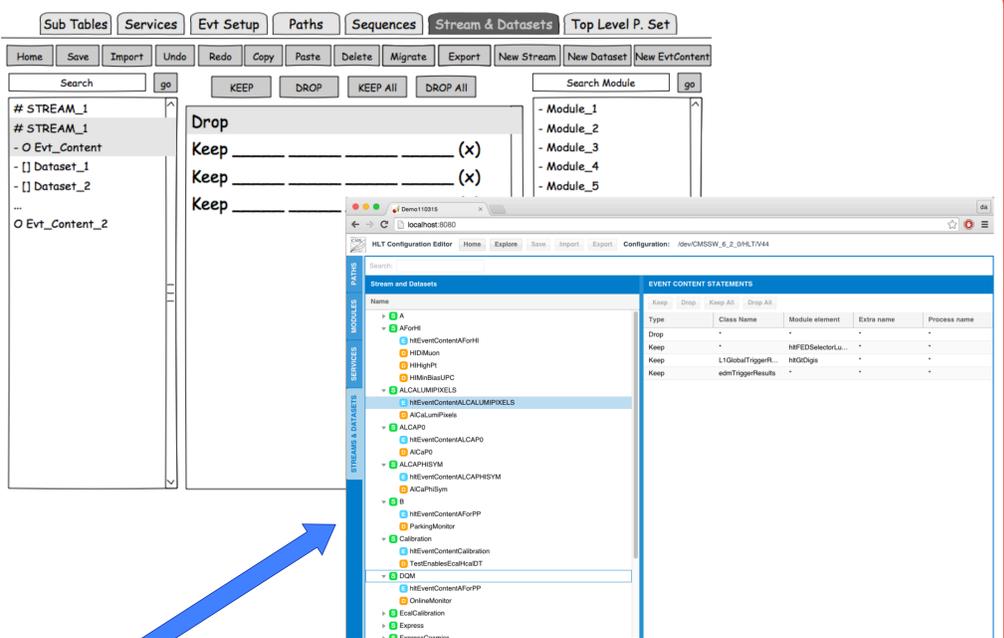
## References

1. <http://marshmallow.readthedocs.org/en/latest/>
2. <http://docs.sqlalchemy.org/en/latest/orm/>
3. <http://docs.sencha.com/extjs/5.1/>
4. Li, Liu. "Analysis and Application of MVVM Pattern." Microcomputer Applications 12 (2012): 019.



## Architecture

The system is required to be remotely accessible and OS-independent as well as maintainable and easy to use. To meet these requirements a three layer architecture has been chosen. On top of the "ConfDB" database, a business logic middleware has been designed to handle the database operations, to check on the users security rights and to send a configuration to the user interface in a suitable format. The graphical user interface (GUI) allows the user to explore, modify and manage the configurations.



## GUI Design

The GUI design was carried out first by exposing paper sketches to the end-users and based on their feedback a software mockup was implemented. The need to provide customized features for each main entity in the Configuration domain led us to choose the Model-View-View<sup>4</sup> (MVVM) design pattern for the GUI web application. In this pattern each view is provided with its own controller and the instances of the domain model concerning that view. At the end of the development process, a usability test will be carried out in order to measure the impact that the new GUI has on the development of configurations for the CMS-HLT.