THE PAYLOAD INSPECTOR: A TOOL FOR THE VISUALIZATION OF CALIBRATION AND ALIGNMENT CONSTANTS STORED IN THE CMS CONDITION DATABASE

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ALIGNMENT AND CALIBRATION CONSTANTS
Non-event data also known as “Conditions” describe the evolving status and performance of the several detector components of CMS. They record a given “state” of the detector, and measure alignment and calibration constants with dedicated algorithms. Condition data are crucial for an optimal simulation and reconstruction of collision events. Based on the CMS data model, they are stored onto relational databases as a set of binary objects (BLOBs), serialised using boost libraries within the CMS offline software framework.

OVERVIEW OF THE PAYLOAD INSPECTOR
The Payload Inspector allows detector experts to inspect and monitor alignment and calibration constants stored in the CMS conditions database. The tool consists of two separate layers:

● Deserisation layer: dedicated plugins in the CMS software framework (CMSSW) load payloads from the database and extract the relevant information for rendering the plots with the right display format.
● Visualisation layer: it allows users to generate interactive historical plots for monitoring conditions.

It is integrated into the cmsDbBrowser [1] web-based application, which is the main entry point accessible for all CMS members to browse and manipulate conditions data and metadata.

PAYLOAD INSPECTOR ARCHITECTURE

PAYLOAD INSPECTOR: HOW TO USE IT?
1. In order to use the tool a CMS user has to access the cmsDbBrowser and navigate to Payload Inspector page.
2. User have to select CMSSW version to be used to discover the plugins which consumes calibration constants and returns plot coordinates.
3. From a given set of condition classes, a user selects the plot type and the list of time-ordered payloads to be looked at.
4. From the list of payloads, a user marks the ones to be retrieved by the plugins running on the deserialization layer.
5. A new plot is generated from the selected payloads: it is interactive and shareable, and can be saved in pdf and png formats. A user can easily inspect and monitor selected calibration measurements and see the time evolution of the data.

AVAILABLE PLOT TYPES
The interval of validity in which a given payload can be consumed for event processing can be expressed as:

1. Run
2. Luminosity section (23 s intervals)
3. UTC timestamp

The representation of the condition data depends on the corresponding time validity:

● Line chart for run and luminosity section
● Line chart with datetime for UTC timestamp
● Scatter plot for all time types

DESIGN AND IMPLEMENTATION CHOICES OF THE PAYLOAD INSPECTOR

● The CMS software framework (CMSSW) plugins are developed by detector experts in C++.
● The Paramiko module, which provides a Python interface to SSH protocol, manages the communication between the two servers. JSON is used as a data-interchange format.
● The cmsDbBrowser application backend is developed in Python using the Flask web framework. The visualisation layer of the Payload Inspector is fully integrated into it.
● The Bootstrap CSS framework, together with the jQuery and Highcharts JavaScript libraries, is used for the frontend.

Calibration experts have a simple way to access the web based application from their institutes. Payload Inspector tool provides a way to easily inspect, monitor and share alignment and calibration constants by generating interactive plots from user selected data.