A Web based application to collect, manage and release of alignment and calibration configurations for data processing at CMS

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On behalf of the CMS Collaboration

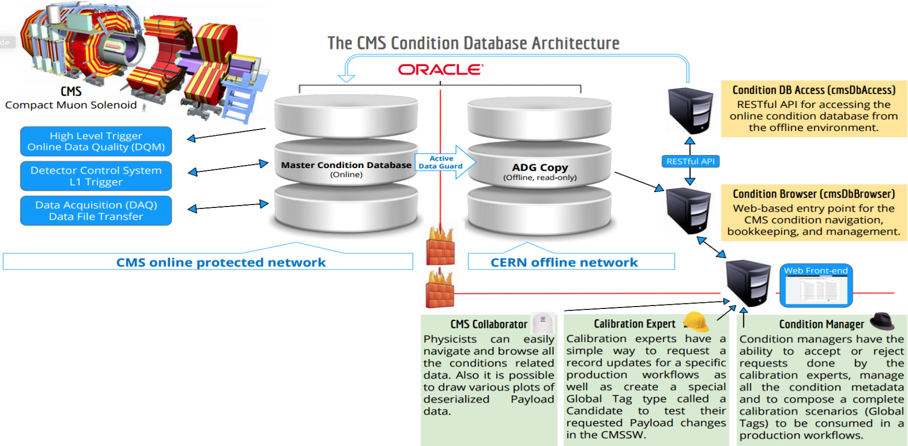
Condition in the CMS Experiment

- CMS detector is under very high solenoid magnetic field and high collision rate, which introduce misalignments in various subsystems,to maintain the physics performance of CMS detector, one has to continuously recalibrate and realign the detector.
- The Conditions are non-event data which describe the evolving status and performance of the several detector components of CMS.
  - In the **High Level Trigger**
  - the processing of the **recorded collisions**
  - the production of simulated events for **data analysis** and studies of **detector upgrades**
- They record a given state of the detector, and measure alignment and calibration constants with **dedicated algorithms**.
- Condition data are crucial for reconstruction of collision events coming from simulated or real data, as well as for physics analysis.
- Beamspot is the position of interaction region between two colliding beams.

Condition Data Model

- The CMS experiment makes a vast use of alignment and calibration measurements in several data processing workflows:
- Condition Data Model
  - **Payload** The "atom" of conditions data is the payload, it represents the set of parameters consumed in the workflows of the physics data processing.
  - **Interval Of Validity (IOV)** time interval during which a given Payload is consumed.
  - **Tag** history of a given calibration or alignment content comprising a set of IOVs and their associate Payloads.
  - **Global Tag(GT)** a consistent set of Tags providing all the condition data needed by a given workflow.

CMS Condition Database Architecture



Condition DB Access (cmsDbAccess)
RESTful API for accessing the online condition database from the offline environment.

Condition Browser (cmsDbBrowser)
Web-based entry point for the CMS condition navigation, bookkeeping, and management.

CMS Collaborator
Physicists can easily navigate and browse all the conditions related data. Also it is possible to draw various plots of deserialized Payload data.

Calibration Expert
Calibration experts have a simple way to request a record updates for a specific production workflows as well as create a special Global Tag type called a Candidate to test their requested Payload changes in the CMSSW.

Condition Manager
Condition managers have the ability to accept or reject requests done by the calibration experts, manage all the condition metadata and to compose a complete calibration scenarios (Global Tags) to be consumed in a production workflows.

CMSDbBrowser

- The Conditions involved in a typical production workflow are usually grouped into up to 300 Tags. This implies the existence of a large number of Tags and Global Tags in the database. A web based application called cmsDbBrowser was created in order to:
- Navigation
  - Intuitive way to inspect-navigate-search existing conditions data and metadata to any **CMS member**.
- Manage
  - Bookkeep the condition metadata by condition managers.
  - Handle Tag update requests submitted by **detector experts**.
  - compose a complete calibration scenarios like Global Tags.
- Monitoring
  - Provide a single entry point to monitor all condition related services.

Design and Implementation Choice of CMS Condition Browser

- The backend of cmsDbBrowser is implemented in Python programming language using the Flask web framework.
- As an Object Relational Mapper SQLAlchemy is used which handles all the database transactions.
- For the frontend the Bootstrap CSS framework is used together with the jQuery and Highcharts JavaScript libraries.

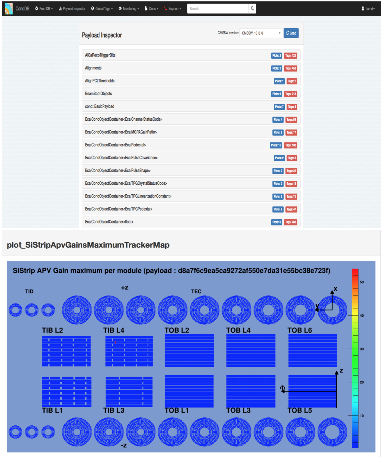
Operational Experience 2017

- **Service Users**
  - Few 100 CMS users, 50 frequent users of this service.
- **Search Service**
  - Users do more than 1000 search per month
- **Global Tag Request**
  - 1000 GT created over the year
- We have 1000 of uploads every month to database that this service monitor there status.
- This application has been proven Vital in catching the problems and there have been few incidents which we have solved because of quick notifications from this service which basically results in maintaining the good quality of data for physics analysis

Payload Inspector

- The Payload Inspector was created in order to let detector experts to inspect and monitor alignment and calibration measurements stored in the CMS conditions database
- The plots are developed in c++ by the experts of each system following a schema of templated c++ classes, and that the browser can discover the monitoring plots thus implemented discovering dynamically from CMS Software (CMSSW) releases
- The tool consists of two separate layers:
- **Deserialization layer:**
  - This consists of dedicated C++ plugins inside CMSSW which will load the payloads from DB and extract the relevant information for rendering the plots.
- **Visualization layer:**
  - Allows users to generate interactive historical plots for monitoring conditions.

Payload Inspector



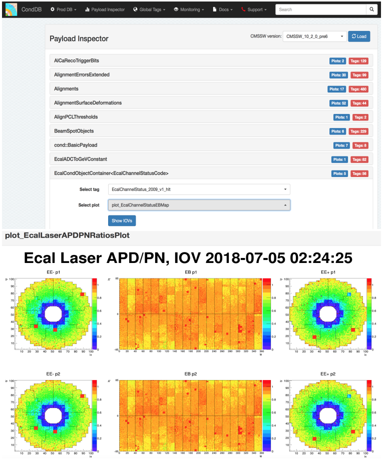
Payload Inspector

CMSSW version: CMSSW_10_0_0 Load

AlCaRecoTriggerBits	Plots: 2	Tags: 125
Alignments	Plots: 2	Tags: 452
AlignPCLThresholds	Plots: 1	Tags: 2
BeamSpotObjects	Plots: 6	Tags: 218
cond::BasicPayload	Plots: 7	Tags: 8
EcalCondObjectContainer<EcalChannelStatusCode>	Plots: 4	Tags: 54
EcalCondObjectContainer<EcalMGPAGainRatio>	Plots: 2	Tags: 17
EcalCondObjectContainer<EcalPedestal>	Plots: 15	Tags: 130
EcalCondObjectContainer<EcalPulseCovariance>	Plots: 2	Tags: 3
EcalCondObjectContainer<EcalPulseShape>	Plots: 2	Tags: 21
EcalCondObjectContainer<EcalTPGCrystalStatusCode>	Plots: 2	Tags: 15
EcalCondObjectContainer<EcalTPGLinearizationConstant>	Plots: 2	Tags: 75
EcalCondObjectContainer<EcalTPGPedestal>	Plots: 2	Tags: 47
EcalCondObjectContainer<float>	Plots: 6	Tags: 263

plot_SiStripApvGainsMaximumTrackerMap

SiStrip APV Gain maximum per module (payload : d8a7f6c9ea5ca9272af550e7da31e55bc38e723f)



Payload Inspector

CMSSW version: CMSSW_10_2_0_pre6 Load

AlCaRecoTriggerBits	Plots: 2	Tags: 129
AlignmentErrorsExtended	Plots: 30	Tags: 99
Alignments	Plots: 17	Tags: 480
AlignmentSurfaceDeformations	Plots: 52	Tags: 44
AlignPCLThresholds	Plots: 1	Tags: 2
BeamSpotObjects	Plots: 6	Tags: 229
cond::BasicPayload	Plots: 7	Tags: 8
EcalADCToGeVConstant	Plots: 1	Tags: 82
EcalCondObjectContainer<EcalChannelStatusCode>	Plots: 5	Tags: 56

Select tag: EcalChannelStatus_2009_v1_hlt

Select plot: plot_EcalChannelStatusEBMap

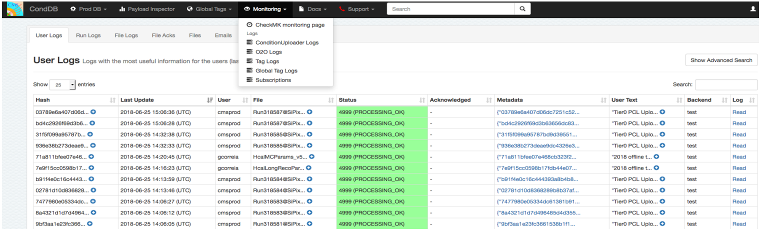
Show IOVs

plot_EcalLaserAPDPNRatiosPlot

Ecal Laser APD/PN, IOV 2018-07-05 02:24:25

Monitoring

- Monitoring section in the cmsDbBrowser displays various log pages:
- **ConditionUploader logs** - Condition upload is a tool to update one or more tags in the official database, here you can see the status of your upload in detail.
- **O2O logs** - Online to Offline(O2O) is a process that convert the online data formate to more meaningful data formate to offline, so that other process can understand and use it for physics data taking.
- **Tag logs** - Shows recent changes done on Tags.
- **Global Tag Logs** - Detail description about all the tag for a given GT.



User Logs Logs with the most useful information for the users (las

Show 25 entries

Search:

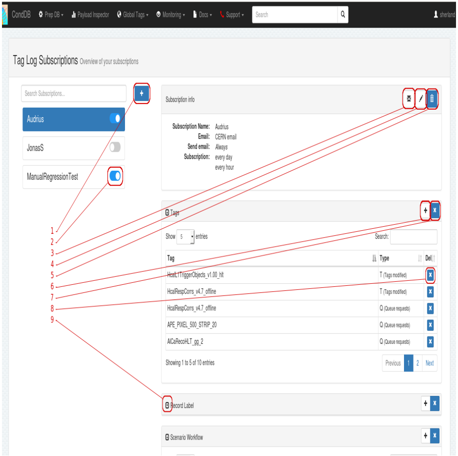
Hash	Last Update	User	File	Status	Acknowledged	Metadata	User Text	Backend	Log
03789e6a407d06d...	2018-06-25 15:06:36 (UTC)	cmsprod	Run318587@SiPix...	4999 (PROCESSING_OK)	-	{"03789e6a407d06dc7251c52...	"Tier0 PCL Uplo...	test	Read
bd4c2926f69d3b6...	2018-06-25 15:06:28 (UTC)	cmsprod	Run318587@SiPix...	4999 (PROCESSING_OK)	-	{"bd4c2926f69d3b63656dc83...	"Tier0 PCL Uplo...	test	Read
31f5f099a95787b...	2018-06-25 14:32:38 (UTC)	cmsprod	Run318585@SiPix...	4999 (PROCESSING_OK)	-	{"31f5f099a95787bd9d39551...	"Tier0 PCL Uplo...	test	Read
936e38b273deae9...	2018-06-25 14:32:33 (UTC)	cmsprod	Run318585@SiPix...	4999 (PROCESSING_OK)	-	{"936e38b273deae9dc4326e3...	"Tier0 PCL Uplo...	test	Read
71a811bfee07e46...	2018-06-25 14:20:45 (UTC)	gcorreia	HcalMCParams_v5...	4999 (PROCESSING_OK)	-	{"71a811bfee07e468cb323f2...	"2018 offline t...	test	Read
7e9f15cc0598b17...	2018-06-25 14:16:23 (UTC)	gcorreia	HcalLongRecoPar...	4999 (PROCESSING_OK)	-	{"7e9f15cc0598b17fdb44e07...	"2018 offline t...	test	Read
b91f4e0c16c4443...	2018-06-25 14:13:59 (UTC)	cmsprod	Run318584@SiPix...	4999 (PROCESSING_OK)	-	{"b91f4e0c16c444393a8b4b8...	"Tier0 PCL Uplo...	test	Read
02781d10d836828...	2018-06-25 14:13:46 (UTC)	cmsprod	Run318584@SiPix...	4999 (PROCESSING_OK)	-	{"02781d10d8368289b8b37af...	"Tier0 PCL Uplo...	test	Read
7477980e05334dc...	2018-06-25 14:06:27 (UTC)	cmsprod	Run318583@SiPix...	4999 (PROCESSING_OK)	-	{"7477980e05334dc61381b91...	"Tier0 PCL Uplo...	test	Read
8a4321d1d7d4964...	2018-06-25 14:06:12 (UTC)	cmsprod	Run318583@SiPix...	4999 (PROCESSING_OK)	-	{"8a4321d1d7d496485d4d355...	"Tier0 PCL Uplo...	test	Read
9bf3aa1e23fc366...	2018-06-25 14:06:05 (UTC)	cmsprod	Run318581@SiPix...	4999 (PROCESSING_OK)	-	{"9bf3aa1e23fc3661538b1f1...	"Tier0 PCL Uplo...	test	Read

Subscription

- **Goal**
  - Provide users with a customizable way to receive updates through email about modification and creation of data in the conditions database.
- **Users**
  - **Users:** Who wants to be notified about changes being made to relevant data.
  - **Expert:** Whose job is to validate and further process work done by others, who want to know when tags are appended to productions GTs
- **Tag Log Events**
  - New tags created
  - IOVs inserted -When someone has attached a new payloads, containing alignment and calibrations to an existing tag
- **Global Tag Log**
  - **Global tags created** When someone has created a new global tag
  - **Global tag map request** When a tag is requested/rejected/approved to be included in a global tag

Subscription

- 1-Create new subscription
- 2-Subscription activation toggle.
- 3-Send email
- 4-Edit subscription
- 5-Delete subscription
- 6-Add entities
- 7-Remove all entities
- 8-Remove entity
- 9-Toggle panel collapse



Tag Log Subscriptions Overview of your subscriptions

Subscription Name: Audrius
Email: CERN email
Send email: *Always*
Subscription: every day
every hour

Tag	Type	Del
HcalL1TriggerObjects_v1.00_hlt	T (Tags modified)	×
HcalRespCorrs_v4.7_offline	T (Tags modified)	×
HcalRespCorrs_v4.7_offline	Q (Queue requests)	×
APE_PIXEL_500_STRIP_20	Q (Queue requests)	×
AlCaRecoHLT_gg_2	Q (Queue requests)	×

Showing 1 to 5 of 10 entries

Summary

- Monitoring the CMS condition data.
- Recording the status of the experiment and of the ongoing data taking
- Accepting conditions data updates provided by the detector experts
- Aggregating and navigating the calibration scenarios
- Distributing conditions for consumption by the collaborators.

Thank You!

Do you have any questions?