

# Presentation layer of CMS Online Monitoring System



Data Visualization Framework

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on behalf of OMS development group

# CMS OMS - Online Monitoring System

Upgrade and successor to the CMS [Web-based Monitoring \(WBM\)](#) system

- Aggregate and integrate different sources of information into a central place
- Allow users to view, compare and correlate information
- Display real-time and historical information

# Roadmap

WBM Review  
Decided to upgrade



OMS prototype  
#1

OMS in production.  
Runs in parallel with WBM

OMS kickoff workshop

OMS prototype  
#2

# CMS OMS structure

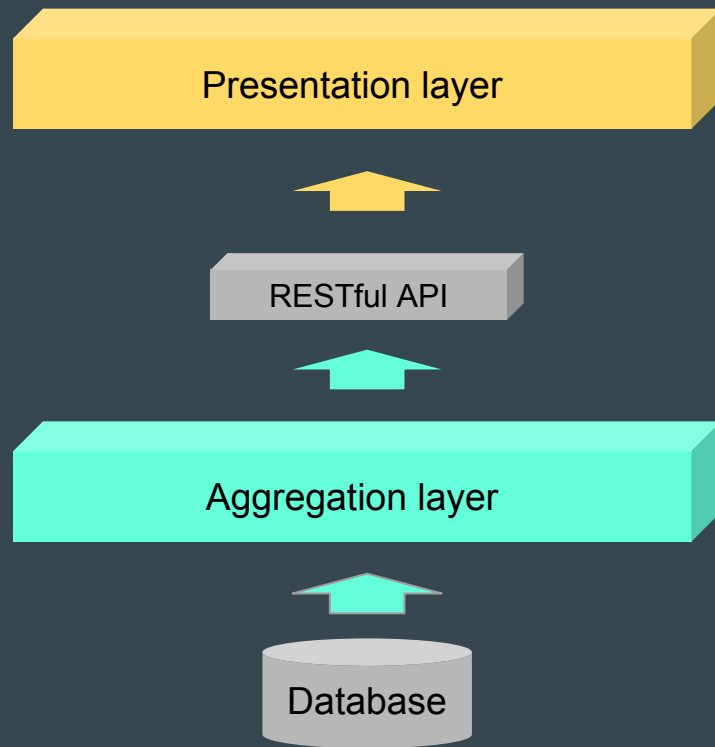
OMS is divided into two separate layers. Layers communicate via RESTful API.

## Aggregation layer

Fetch data from database and expose it via RESTful JSON:API (LHC Fills, CMS Runs, Lumisections, Trigger rates, ...)

## Presentation layer

Fetch data from multiple sources and display it via web interface (Datatables, interactive charts, images, ...)



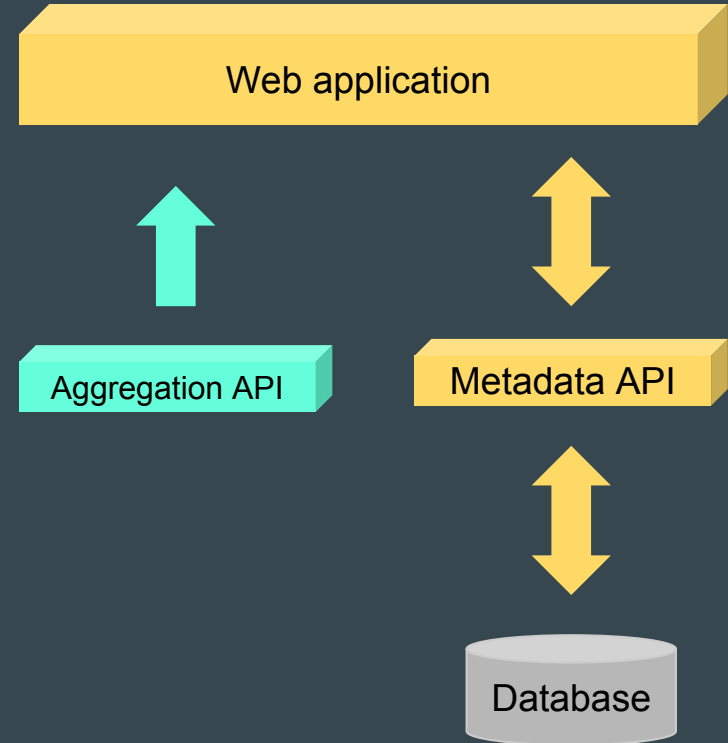
# Presentation layer

**Metadata API** provides portal configuration:

- Workspaces, Folders, Pages
- Page layout (controller & portlets & relations)
- Portlet type, size, position
- User privileges

**Web application** is graphical user interface:

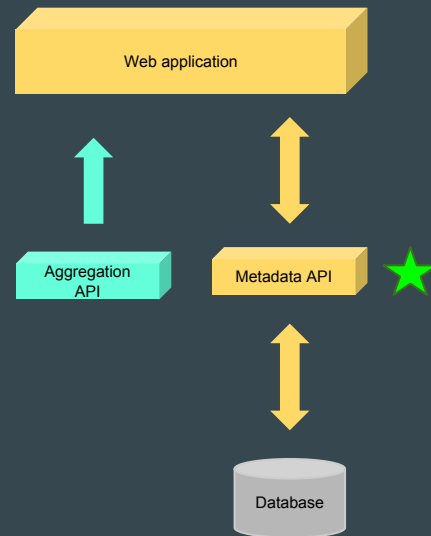
- User friendly
- Interactive
- Responsive
- Customizable



# Metadata API

python + Flask + SQLAlchemy

- ✓ RESTful
- ✓ CRUD
- ✓ JSON:API specification
- ✓ Test coverage
- ✓ Scalable

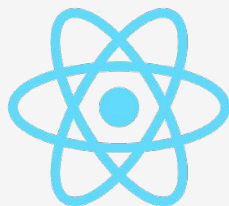
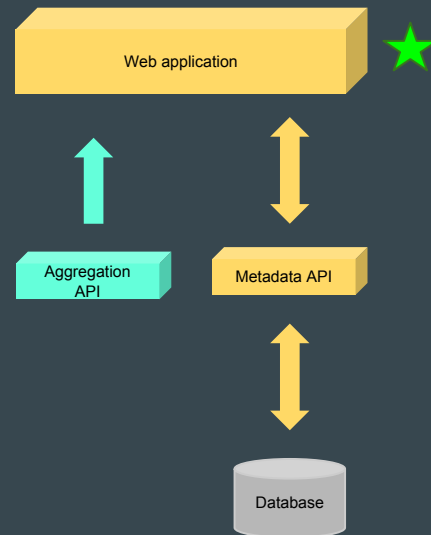


# Web Application

State of the art technologies:

- ES6
- ReactJS
- Redux
- Material-UI
- Highcharts

- ✓ Lightweight
- ✓ Responsive
- ✓ Interactive
- ✓ Scalable



React



Redux



Material-UI

# Content organisation

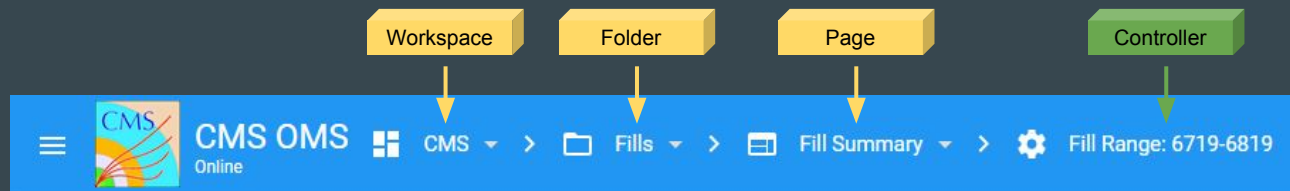
**Workspace** – top-level container defines organizational unit, sub-detector, etc.

**Folder** – lower-level container contains Pages organized by context.

**Page** – lowest-level content container contains of one or more Portlets.

**Controller** - (optional) component allows user to filter result set.

Portlet - a content presentation component.





# Components: Controller

Controller is a **reusable** filtering component.

**User selected** filter is applied to all Portlets within the Page.

**Year Controller**  
Yearly Summary controller

Year:  Runtime Type:

APPLY OK CLOSE RESET

**L1 Algo Trigger Controller**  
L1 Algo Trigger Report Controller

Run:  Bit:

APPLY OK CLOSE RESET

**Run Report**  
Run Report controller

Run:  Sequence:

APPLY OK CLOSE RESET

**Fill Summary**  
Fill Summary controller

Fill Range:  From:  To:

Date Range:  From:  To:

Era:

Controller Options

- Stable beam only
- Protons only
- Ions only
- Protons-Ions only

APPLY OK CLOSE RESET

**Run Summary**  
Run Summary controller

Fill:

Run Range:  From:  To:

Date Range:  From:  To:

Components Online Status

<input type="checkbox"/> Castor	<input type="checkbox"/> PIXEL	<input type="checkbox"/> DOM	<input type="checkbox"/> DT
<input type="checkbox"/> CSC	<input type="checkbox"/> PIXEL_UP	<input type="checkbox"/> TRACKER	<input type="checkbox"/> ES
<input type="checkbox"/> CTGPS_TOT	<input type="checkbox"/> RPC	<input type="checkbox"/> HCAL	<input type="checkbox"/> HF
<input type="checkbox"/> DAQ	<input type="checkbox"/> SCAL	<input type="checkbox"/> ECAL	<input type="checkbox"/> TRG

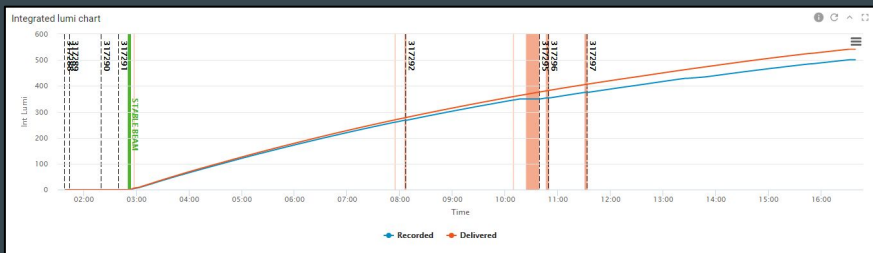
Sequence:

APPLY OK CLOSE RESET

# Components: Portlet

Portlet is a **reusable** content presentation component.

Displays **single** well-defined aspect of information: chart, datatable, text, etc.



The "Last Values" portlet displays the following statistics:

- Run: [318301](#)
- Fill: [6821](#)
- Sequence: GLOBAL-RUN
- L1 key: [l1\\_trg\\_cosmics2018/v92](#)

Control icons for description, refresh, collapse, and full screen are located in the top right corner.

- Description tooltip
- Refresh button
- Collapse mode
- Full Screen mode

Run	Duration	Start Time	End Time	Del. Lumi $\mu\text{b}^{-1}$	Rec. Lumi $\mu\text{b}^{-1}$	L1 Triggers	L1/HLT Mode
<a href="#">286520</a>	07:45:18	2016-12-04 21:17:47	2016-12-05 05:03:05	26.015	25.749	<a href="#">293923217</a>	<a href="#">collisionsHI2016</a>
<a href="#">286519</a>	06:03:01	2016-12-04 15:13:33	2016-12-04 21:16:34	33.178	30.892	<a href="#">248831191</a>	<a href="#">collisionsHI2016</a>
<a href="#">286518</a>	00:42:40	2016-12-04 14:28:34	2016-12-04 15:11:14	5.130	4.690	<a href="#">32267167</a>	<a href="#">collisionsHI2016</a>
<a href="#">286517</a>	01:14:26	2016-12-04 13:12:53	2016-12-04 14:27:19	9.393	8.292	<a href="#">54291303</a>	<a href="#">collisionsHI2016</a>
<a href="#">286516</a>	02:59:13	2016-12-04 10:12:28	2016-12-04 13:11:41	27.389	26.317	<a href="#">153576494</a>	<a href="#">collisionsHI2016</a>

Rows per page: 5 | Page 1 of 3

The heatmap displays run statistics for various runs. The columns represent different metrics, and the rows represent individual runs. The cells are colored green or red, indicating the status of each run.

# Components: Portlet

Run Summary

Run ↓	Duration	Start Time	End Time	Del. Lumi $pb^{-1}$	Rec. Lumi $pb^{-1}$	L1 Triggers	L1/HLT Mode
<a href="#">318877</a>	04:03:37	2018-06-28 20:48:42	2018-06-29 00:52:19	157.346	152.885	<a href="#">876437745</a>	<a href="#">collisions2018</a>
<a href="#">318876</a>	01:03:28	2018-06-28 19:44:24	2018-06-28 20:47:52	47.401	44.185	<a href="#">2338883654</a>	<a href="#">collisions2018</a>
<a href="#">318874</a>	02:04:55	2018-06-28 17:38:51	2018-06-28 19:43:46	100.164	94.792	<a href="#">505486155</a>	<a href="#">collisions2018</a>
<a href="#">318872</a>	01:52:08	2018-06-28 15:44:01	2018-06-28 17:36:09	94.516	88.548	<a href="#">418417488</a>	<a href="#">collisions2018</a>
<a href="#">318871</a>	00:00:58	2018-06-28 15:40:44	2018-06-28 15:41:42	0.000	0.000		<a href="#">collisions2018</a>

Rows per page: 5 Page 1 of 2

```
[
  {
    "duration": 14617,
    "start_time": "2018-06-28T20:48:42Z",
    "l1_triggers_counter": 876437745,
    "l1_hlt_mode": "collisions2018",
    "end_time": "2018-06-29T00:52:19Z",
    "delivered_lumi": 157.346391,
    "recorded_lumi": 152.885063
  },
  ...
]
```

```
{
  "label": "Run",
  "name": "run_number",
  "props": {
    "href": "/cms/runs/report?cms_run=%",
    "params": ["run_number"],
    "type": "link"
  }
}
```

```
{
  "label": "Duration",
  "name": "duration",
  "props": {
    "type": "duration"
  }
}
```

```
{
  "label": "Del. Lumi",
  "name": "delivered_lumi",
  "show_units": true,
  "props": {
    "ndigits": 3,
    "type": "float"
  }
}
```

↑  
Aggregation API

↕  
Metadata API

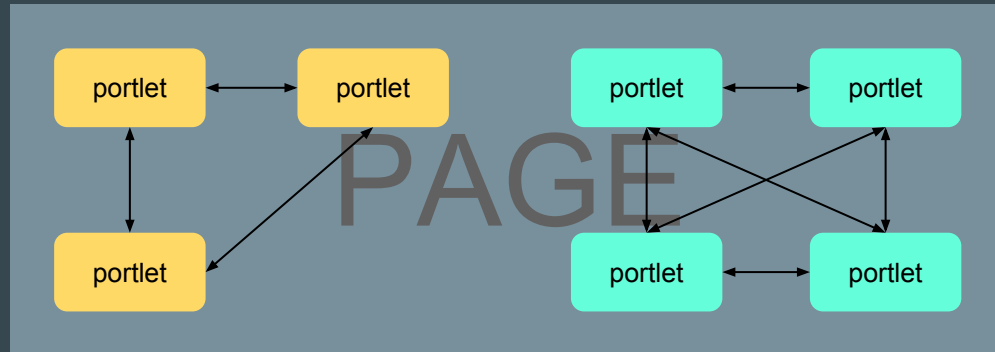
# “Master-detail”

Similar to Master-Detail, but it is **Many-to-Many** relationship.

Portlets can be assigned into **groups**. Multiple groups can be within a Page.

Portlets communicate with each other only within a group scope.

Action in one Portlet causes other Portlets update accordingly.



# “Master-detail” example

CMS OMS Online    CMS > Triggers > L1 Current Rates > Run: 318187    09 06 UTC 11 06 Local

### Trigger Configuration

Run: [318187](#)  
L1/HLT Mode: [cosmics2018](#)

### L1 Triggers in Last LS

Trigger	Rate Hz	Count
<input type="checkbox"/> L1A Calibration	100.39	2340
<input checked="" type="checkbox"/> L1A Physics	79.06	1843
<input type="checkbox"/> L1A Random	48723.30	1135780
<input type="checkbox"/> L1A Total	48902.75	1139922
<input type="checkbox"/> PhysicsGeneratedFDL GT	88.89	2072
<input type="checkbox"/> PhysicsGeneratedFDL TCDS	88.89	2072
<input type="checkbox"/> TriggersPhysicsLost	9.82	229
<input type="checkbox"/> TriggersPhysicsLostBeamActive	0.00	0
<input type="checkbox"/> TriggersPhysicsLostBeamInactive	9.82	229

### Deadtimes for Last LS

Name	%	Count
<input type="checkbox"/> Total	2.59	24214459
<input type="checkbox"/> TTS	0.00	50
<input type="checkbox"/> Trigger Rules	0.30	2847548
<input type="checkbox"/> Bunch Mask	0.98	9174788
<input type="checkbox"/> ReTri	0.00	0
<input type="checkbox"/> APVE	0.61	5696658

### L1 Trigger Chart

Logarithmic scale    Display time in UTC

### L1 Algo Triggers in Last LS

Bit	Name	Masked	Pre-DT Counts Before Prescale	Pre-DT Rate, Hz Before Prescale	Pre-DT Counts After Prescale	Pre-DT Rate, Hz After Prescale	Post-DT Counts From HLT	Post-DT Rate, Hz From HLT	Initial Prescale	Final Prescale
<input type="checkbox"/>	0 <a href="#">L1_SingleMuCosmics</a>	False	1992	85.455	1992	85.455				
<input type="checkbox"/>	1 <a href="#">L1_SingleMuCosmics_BMTF</a>	False	1534	65.808	1534	65.808				
<input type="checkbox"/>	2 <a href="#">L1_SingleMuCosmics_OMTF</a>	False	489	20.978	489	20.978				
<input type="checkbox"/>	3 <a href="#">L1_SingleMuCosmics_EMFTF</a>	False	0	0	0	0				
<input checked="" type="checkbox"/>	4 <a href="#">L1_SingleMuOpen</a>	False	1992	85.455	1992	85.455				
<input type="checkbox"/>	5 <a href="#">L1_SingleMu0_DO</a>	False	1992	85.455	0	0				
<input type="checkbox"/>	6 <a href="#">L1_SingleMu0_BMTF</a>	False	1534	65.808	1534	65.808				
<input type="checkbox"/>	7 <a href="#">L1_SingleMu0_OMTF</a>	False	489	20.978	489	20.978				
<input type="checkbox"/>	8 <a href="#">L1_SingleMu0_EMFTF</a>	False	0	0	0	0				

# Portal: Edit Mode

Still under heavy development.

Privileged users can **realtime**:

- Add/Remove/Resize/Rearrange existing Portlets within a Page.
- Create/Update/Delete/Reorder Folders and Pages

No need to redeploy!

# Future plan

OMS in production.  
Runs in parallel with WBM

OMS in production.  
Shutdown WBM

