An Information Aggregation and Analytics System for ATLAS Frontier

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• Access to Conditions Data in ATLAS
• Motivations for an Analytics System
• Application Description
• Deployment
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Access to Conditions Data in ATLAS

- ATLAS jobs access Conditions data using a distributed caching infrastructure based on Frontier-Squid system.
- Frontier server logs files are mined to index all Conditions data requests in an Elasticsearch repository in Chicago.
- Kibana dashboard is available to study requests and response metrics stored in Elasticsearch.
The Frontier-Squid system suffered from service degradation leading to failures in particularly problematic workflows:

- Real data underlying events "overlayed" on simulation data
- Specialised reprocessing

Requests from these workflows were much less likely to be found in the cache (i.e. low "cache efficiency").

Using Frontier logs we could extract the SQL requests and re-play them on a separate Frontier instance or via COOLR services (a REST API to the ATLAS Conditions database COOL).

The analysis found that several requests were accessing the same payload data but using different SQL requests (…different URLs => not cacheable).

Identification of such problematic requests patterns is essential to improve the system for Run 3.
The Frontier-Analytics project has the purpose to process the requests of particular tasks or during particular time periods and derive summaries of key information which help to isolate the problematic requests for more detailed inspection.

This application is based on python libraries and retrieve data from the existing infrastructure via REST APIs:

- Log data information from Elasticsearch
- Conditions payload and metadata from ATLAS COOL Conditions database.
Select the task-id to explore via Flask.

Celery launches data loading from Elasticsearch. Output parquet files are produced for further processing.

Merge the Elasticsearch data with metadata information from COOLR (add tag, folder names and other information).

Prepare summary plots: requests’ time, response size and counters (MC vs Data, # by schema, cached vs not-cached).

Compute caching efficiency for selected folders (payload data via COOLR).
Deployment site: Chicago University

Usage of GitLab-CI process to prepare Docker images from CERN GitLab. The images can then be deployed in a Kubernetes cluster.

Choice of Chicago was essentially to get the system close to Elasticsearch data and improve the loading speed. Good support from Chicago experts to set up the deployment.
User Interface

https://frontier.uc.ssl-hep.org/

### ElasticSearch Filters

**Search by Task:**
- Task ID

**Search by time range:**
- **mm/dd/yyyy, --|-- --**  
- **mm/dd/yyyy, --|-- --**

**Choose Queries type:**
- All Queries

**The parquet File name:**
- name.parquet

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### Parquet Files List

<table>
<thead>
<tr>
<th>Parquet File Name</th>
<th>size (MB)</th>
<th>Created</th>
<th>Delete</th>
<th>Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>18480400</td>
<td>3.32</td>
<td>Tue Oct 1 17:14:10 2019</td>
<td>🗑️</td>
<td>🗑️</td>
</tr>
<tr>
<td>18628864_pPboverlay</td>
<td>59.55</td>
<td>Fri Oct 4 11:21:35 2019</td>
<td>🗑️</td>
<td>🗑️</td>
</tr>
<tr>
<td>task_14675347</td>
<td>0.70</td>
<td>Thu Oct 3 14:33:42 2019</td>
<td>🗑️</td>
<td>🗑️</td>
</tr>
<tr>
<td>task_18264547</td>
<td>13.43</td>
<td>Thu Oct 3 14:39:04 2019</td>
<td>🗑️</td>
<td>🗑️</td>
</tr>
</tbody>
</table>

Showing 1 to 4 of 4 entries
proton-lead overlay task: 18628864

Data

MC

query percentage per Schema for a given DB

cached
not_cached
Queries with high processing time (>1 s) are mostly from ONL_SCT, in particular from node /SCT/DAQ/Config/Chip.

SCT (Semiconductor Tracker) is part of ATLAS inner detector.
The different queries are queries with a different range in time (so different SQL / URLs to Frontier-Squid).

The different payloads show the number of different conditions data retrieved by those queries.

Ideally we would like to have the same query for the same payload retrieved (to improve caching).

<table>
<thead>
<tr>
<th>Folder</th>
<th>#Queries</th>
<th>#Different Queries</th>
<th>#Different Payloads</th>
<th>Payload size</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONDBR2, ATLAS_COOLONL_SCT, /SCT/DAQ/Config/Chip</td>
<td>3437</td>
<td>2885</td>
<td>2</td>
<td>24.7366361618042</td>
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<tr>
<td>CONDBR2, ATLAS_COOLONL_SCT, /SCT/DAQ/Config/MUR</td>
<td>5635</td>
<td>4067</td>
<td>1</td>
<td>1.027754783630371</td>
</tr>
<tr>
<td>CONDBR2, ATLAS_COOLONL_SCT, /SCT/DAQ/Config/Module</td>
<td>2392</td>
<td>2063</td>
<td>1</td>
<td>0.9073104858398438</td>
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<tr>
<td>CONDBR2, ATLAS_COOLONL_SCT, /SCT/DAQ/Config/ROD</td>
<td>834</td>
<td>804</td>
<td>1</td>
<td>0.034732818603515625</td>
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<tr>
<td>CONDBR2, ATLAS_COOLONL_TDAQ, /TDAQ/OLC/CALIBRATIONS</td>
<td>168779</td>
<td>19805</td>
<td>7</td>
<td>0.021941184997558594</td>
</tr>
</tbody>
</table>
## Summary of Problematic Workflows

<table>
<thead>
<tr>
<th>Workflow type</th>
<th>Subsystems with high query time</th>
<th>Folders with bad caching efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pPb, PbPb overlay:</strong></td>
<td>ONL_SCT, OFL_DCS, OFL_LAR, OFL_TRIGGER, ONL_TDAQ</td>
<td>/SCT/DAQ/Config/Chip, /Module, /MUR, /ROD /TDAQ/OLC/CALIBRATIONS</td>
</tr>
<tr>
<td><strong>EVNT, DRAW-&gt;AOD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reprocessing:</strong></td>
<td>ONL_SCT, OFL_DCS, OFL_TRIGGER, ONL_LAR, ONL_RPC, OFL_TRIGGER</td>
<td>/SCT/DAQ/Config/Chip /TRIGGER/Receivers/Conditions/VgaDac</td>
</tr>
<tr>
<td><strong>DRAW_RPVLL -&gt;DAOD_RPVLL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data scouting:</strong></td>
<td>ONL_TDAQ, ONL_LAR</td>
<td>/TDAQ/OLC/LHC/FILLPARAMS /LAR/Configuration/FEBConfig/Physics/EMECC1</td>
</tr>
<tr>
<td><strong>calibration, DataScouting.merge.RAW -&gt; AOD</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Perf-idtracking:</strong></td>
<td>OFL_DCS (PIXEL and SCT) /PIXEL/DCS/HVCURENT</td>
<td>No calculation done: # of different queries will be equal to # of different payloads for DCS</td>
</tr>
<tr>
<td><strong>pathena, DAOD_EGAM1-&gt;ROOT files</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
We have an application to analyse problematic Conditions data access patterns in several workflows. This application benefits of the existing monitoring infrastructure in Frontier sites like CERN, CC-IN2P3 Lyon, TRIUMF, RAL and University of Chicago (thanks to all experts in each site!).

It will be used by experts in order to improve Conditions data access stability for current operations through LS2 as well as to design more cache-friendly system for Run 3.

The application is easy to deploy in a Kubernetes cluster, thanks to a complete Gitlab-CI chain in place.