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The CERN Accelerator Logging Service - 10 Years In Operation

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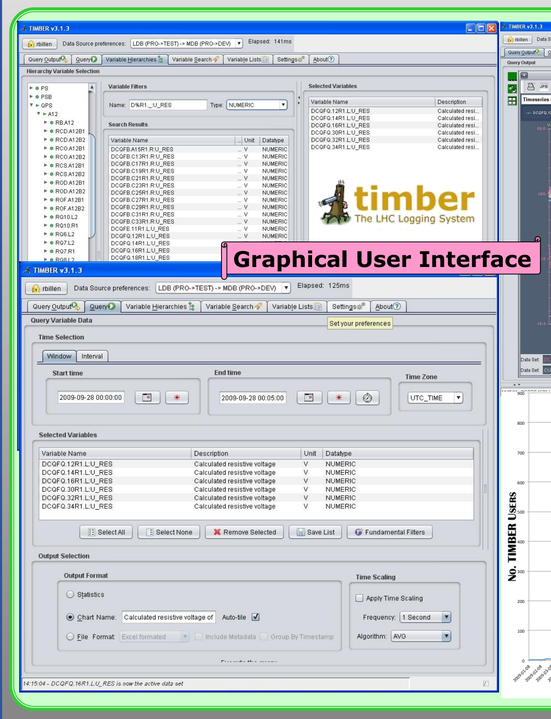
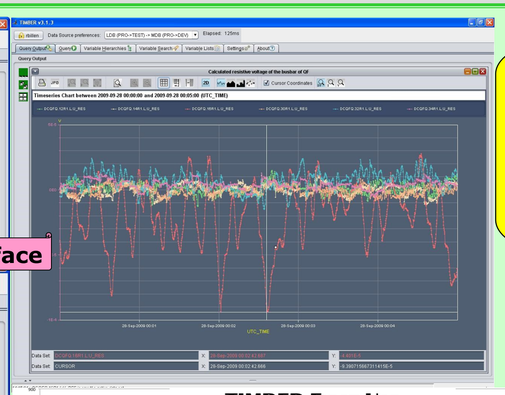
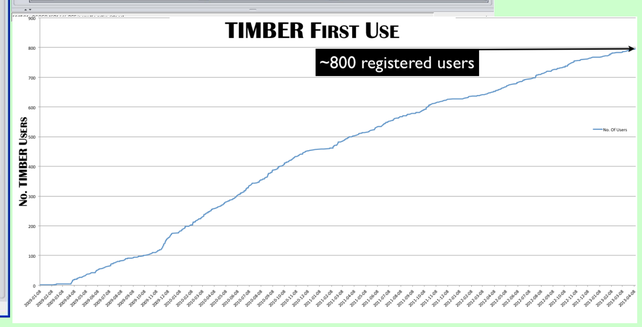
Abstract

During the 10 years since it's first operational use, the scope and scale of the CERN Accelerator Logging Service (LS) has evolved significantly: from an LHC specific service expected to store 1TB / year; to a CERN-wide service spanning the complete accelerator complex (including related sub-systems and experiments) currently storing more than 50 TB / year on-line for some 1 million signals. Despite the massive increase over initial expectations the LS remains reliable, and highly usable - this can be attested to by the 5 million daily / average number of data extraction requests, from close to 1000 users.

Although a highly successful service, demands on the LS are expected to increase significantly as CERN prepares LHC for running at top energy, which is likely to result in at least doubling current data volumes. Furthermore, focus is now shifting firmly towards a need to perform complex analysis on logged data, which in-turn presents new challenges. The accompanying paper reflects on 10 years as an operational service, in terms of how it has managed to scale to meet growing demands, what has worked well, and lessons learned. On-going developments, and future evolution are also discussed.







Used By:
- ***120 Custom Applications***
- ***TIMBER (Generic GUI)***

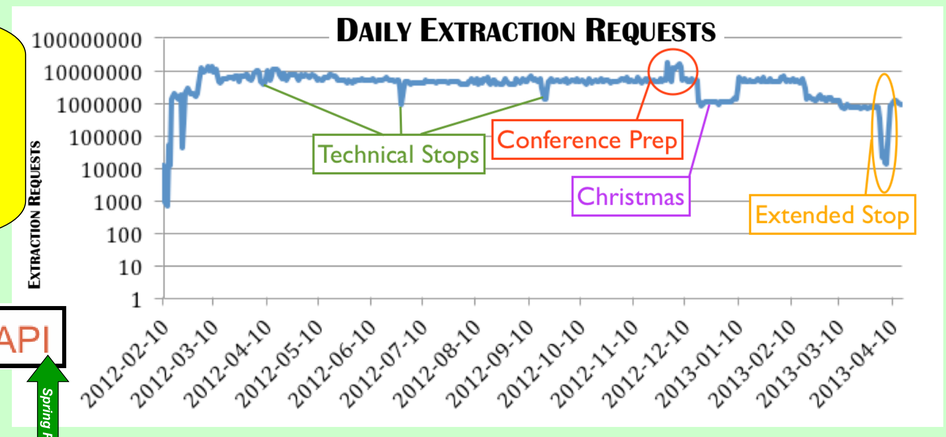
On Average:
5 Million Extraction Requests / Day

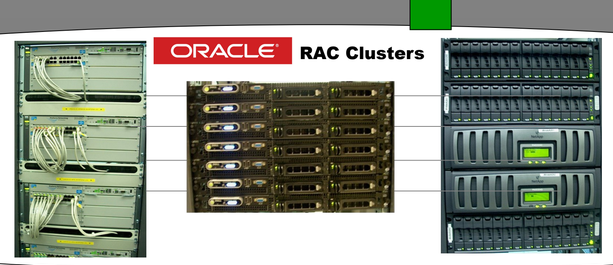
Extraction API

Spring RMI

Extraction Service

JDBC





Logging Service Processes

Data-Driven In-Memory Value Filtering

16x

Data Writing API

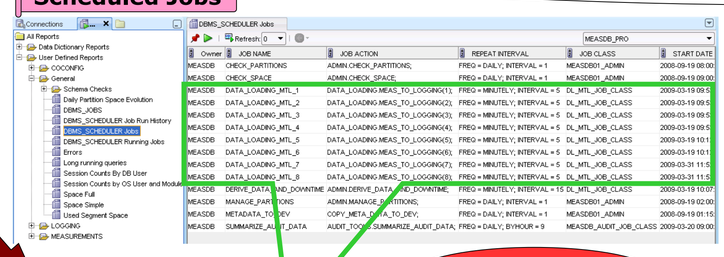
Logging Process

JAPC Monitoring

Bulk JDBC

Device / Property Data

Scheduled Jobs



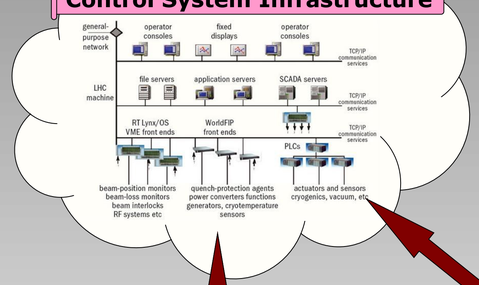
Database Servers

Short-Term Measurement Database
275GB / day

PL/SQL Filter

Long-Term Logging Database
160GB / day

Control System Infrastructure

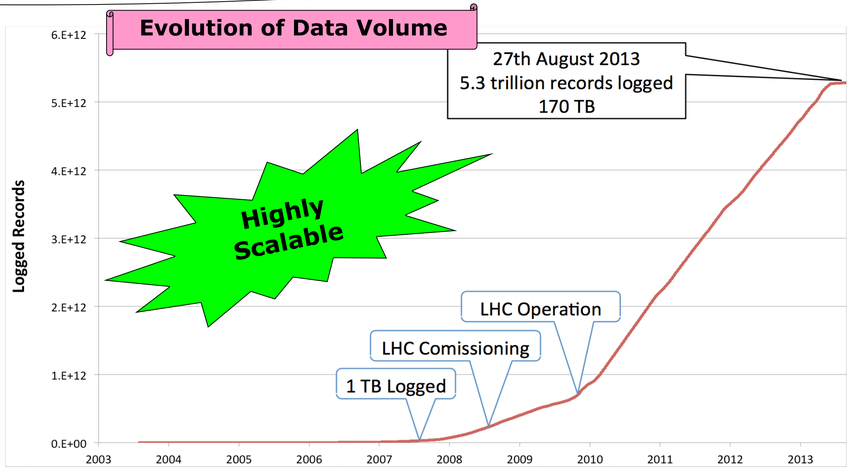



```
create table data_numeric (
  variable_id number,
  utc_stamp   timestamp (9),
  value       number,
  constraint dn_pk           primary key (variable_id, utc_stamp),
  constraint dn_variable_fk  foreign key (variable_id)
    references meta_variables (variable_id)
)
organization index compress 1
partition by range (utc_stamp) (
  partition part_dn_2003h2   values less than (timestamp '2004-01-01 00:00:00') tablespace old_log_data,
  ...
  partition part_dn_2004q3   values less than (timestamp '2004-10-01 00:00:00')  tablespace old_log_data,
  ...
  partition part_dn_200507   values less than (timestamp '2005-08-01 00:00:00') tablespace old_log_data,
  ...
  partition part_dn_20070301 values less than (timestamp '2007-03-02 00:00:00') tablespace old_log_data,
  ...
  partition part_dn_20091005 values less than (timestamp '2009-10-06 00:00:00') tablespace log_data_20091005,
  partition part_dn_20091006 values less than (timestamp '2009-10-07 00:00:00') tablespace log_data_20091006,
  partition part_dn_20091007 values less than (timestamp '2009-10-08 00:00:00') tablespace log_data_20091007
```

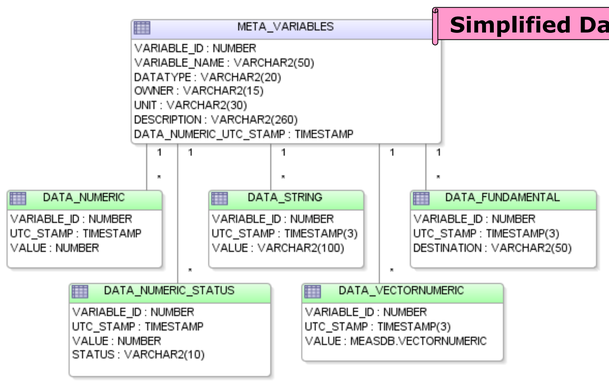
Compressed Index Organized Tables

Daily Range Partitions & Tablespaces

Evolution of Data Volume



Simplified Data Model



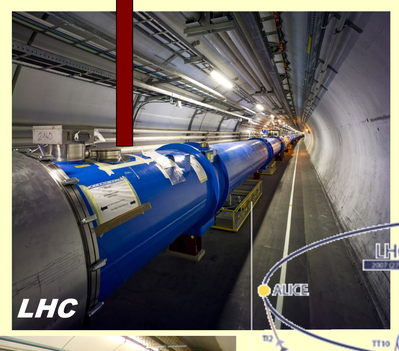
A bit of history:

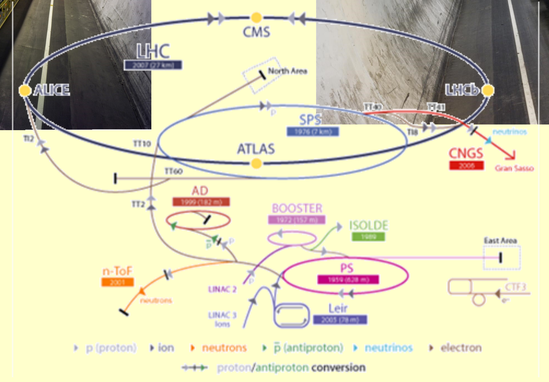
The LEP Logging System was put in place in 1992, three years after the commissioning of LEP.

Systematic logging of LEP hardware and physics parameters, and being able to correlate this data, enabled a performance increase of LEP operation.

For LHC, the project for a logging system was started in 2001, several years before beam operation.

CERN Accelerator Complex





Summary

After 10 years in operation, with close to zero downtime, and playing a vital role in the commissioning and operation of CERNs particle accelerators, sub-systems and experiments – the Logging Service can be considered a great success.

Good instrumentation has proven to be a vital ingredient for this success – understanding system usage has helped shape the LS to meet requirements.

Providing a successful service inevitably leads to ever increasing demands being placed upon it. Efforts are on going to bring additional value to the end-users of the LS, and to ensure continued scalability for the future.