A Git-based Conditions Database backend for LHCb

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CERN - LHCb

slides

Introduction

- LHCb has been using COOL/SQLite based CondDB for 12 years
- We wanted to investigate alternative technologies for LHC Run 3
- A Git based implementation was developed and commissioned

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The Conditions Database

Definitions

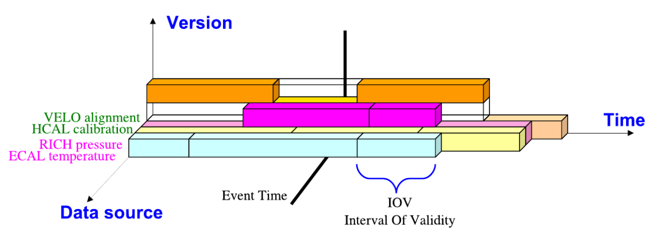
Condition:

Time-varying non-event data required for the correct reconstruction of event data.

Conditions Database (CondDB):

A database for recording and retrieving conditions.

Conditions Database



- 3 dimensions of condition values
  - source/id
  - version
  - time evolution (IOVs)

COOL

- CERN-IT developed Conditions Database library
    - API matching our CondDB model
    - optimized for standard access to conditions
    - multiple backends (via CORAL)
    - Python bindings (via ROOT)

LHCb Conditions Databases

- Same format for detector description and condition data
  - currently XML files
- Small footprint
  - full history in a few GBs
  - deployed as files on CVMFS
- Storage is partitioned in different SQLite files by type of data
  - detector description
    (2 dimensions, no time evolution)
  - alignment and calibrations
    (all 3 dimensions)
  - environment information
    (2 dimensions, no versions)

Git CondDB Design and Implementation

Choosing the Technology

- Old system had limits
  - not ready for multi-threaded applications
  - support of COOL/CORAL limited to bugfixes
  - clumsy data management
- Main requirements
  - file based
  - filesystem-like hierarchy
  - simple management of contributions

Among alternative backends, Git looked promising

Git

Git is a *Distributed Version Control System* with interesting features:

- filesystem structure with versions
- each clone contains all versions
- tags and branches
- built-in incremental synchronization
- data compression and deduplication

but

- no support for the 3^{rd} dimension (IOVs)

The First 2 Dimensions

Git main goal is to track changes to a filesystem hierarchy.

The Detector Description partition of LHCb CondDB is just XML files, with multiple revisions.

Porting the Detector Description data to a Git database is natural.

Adding the 3^{rd} Dimension

Alignments and Calibrations are recorded in LHCb CondDB as XML files with an attached IOV.

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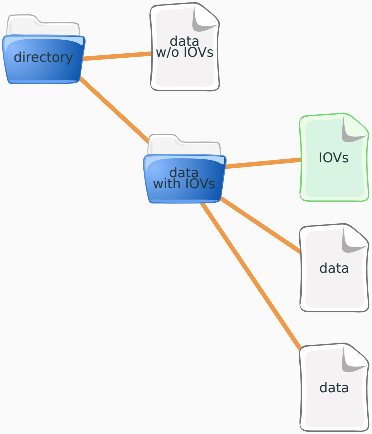
One possibility:
  use directories and metadata files



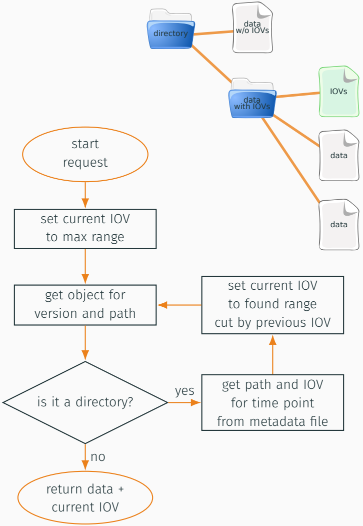
Accessing the Data

A condition payload is identified by:

- version (tag)
- string id (path)
- event time

Git API allow retrieval of payloads by version and path.

Metadata files are simple mappings from IOV to payload.



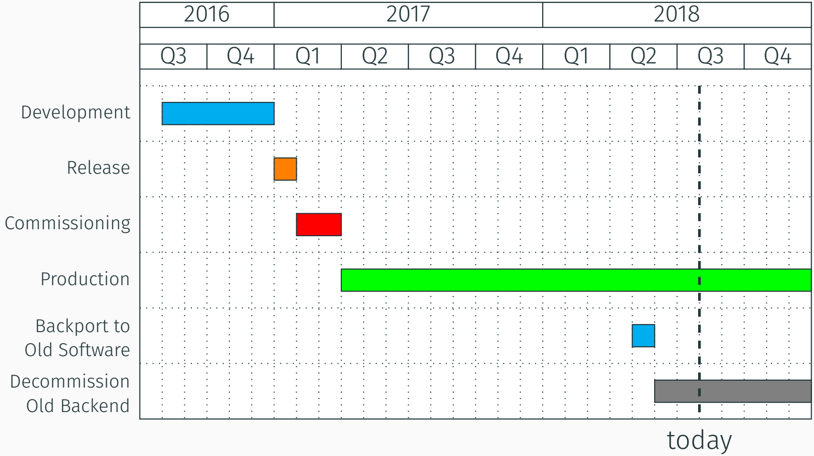
LHCb CondDB Ecosystem Changes

Not just the CondDB backend

- data management
  - custom tools for CondDB I/O → text editors
- contributions management
  - JIRA + custom tools → Gitlab + merge requests
- database files deployment
  - custom web based sync tools → Git native sync protcol

Git CondDB in Production

Commissioning



From conception to production in less than one year!

Performance: Time

Time to load all objects for a given version and event time:

Backend	Total Time
COOL/SQLite	8.1 s
Git	3.5 s

- Host
  - Intel(R) Core(TM) i7-7560U CPU @ 2.40GHz
  - Data from CVMFS with SSD local disk
- $\sim$ 13000 queries to CondDB
- XML parsing + objects creation $\rightarrow \sim$ 20 s

Performance: Size

Space on Disk (as of May 2017) in MB

	SQLite	Git bare
Det. Desc.	34	3
Align. + Calib.	730	285
Environment	2300	357
Simulation	25	9

average $\sim 5\times$ reduction

(Git CondDB includes LHCb Upgrade Detector Description)

Summary

Summary

- Other technologies are available
  - see HSF CWP on Conditions Data
- Git fits our main requirements and more
  - faster, smaller, large community support, tools, ...
- Current implementation very simple
  - not much time spent in optimization (e.g. IOV lookup)
- Git CondDB has been used in production since 2017 data taking
  - although intended as R&D for Run 3
- Changes are planned for Run 3
  - investigating DD4hep Detector Description framework (poster #111)
  - new data format for Detector Description and Conditions
  - but we are planning to keep Git as backend

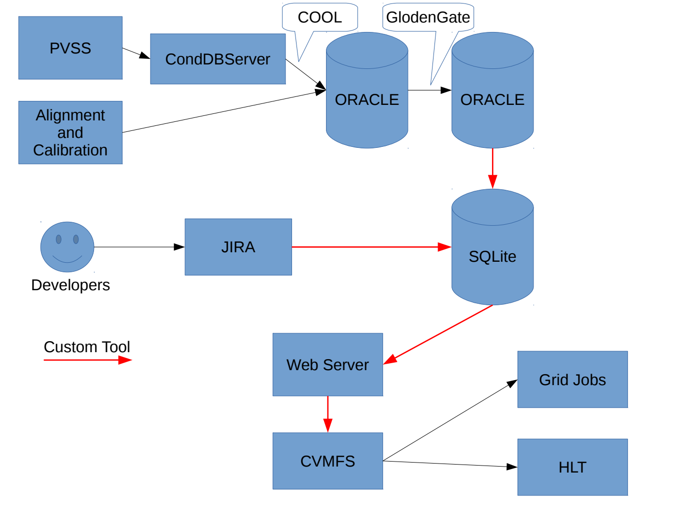
Back Up Slides

Why a Recursive Algorithm?

Why use recursion instead of simple branching?

1. call to object retrieval Git API in only one place
2. allow partitioning of metadata files for faster lookup
   $\mathcal{O}(\log n)$ instead of $\mathcal{O}(n)$

Infrastructure: COOL



Infrastructure: Git