LCG Conditions Database Project

COOL Development and Deployment:

Status and Plans

Andrea Valassi

On behalf of the COOL team

(A.V., D.Front, M.Clemencic, S.A.Schmidt, U.Moosbrugger)

Outline

- What are conditions data?
- Background to COOL
- COOL software overview and status
- Development and deployment perspectives

What are conditions data?

- **Non-event detector data that vary with time**
  - *And may also exist in different versions*
- **Data producers from both online and offline**
  - *Geometry, readout, slow control, alignment, calibration…*
- **Data used for event processing and more**
  - *Detector experts*
  - *Alignment and calibration*
  - *Event reconstruction and analysis*

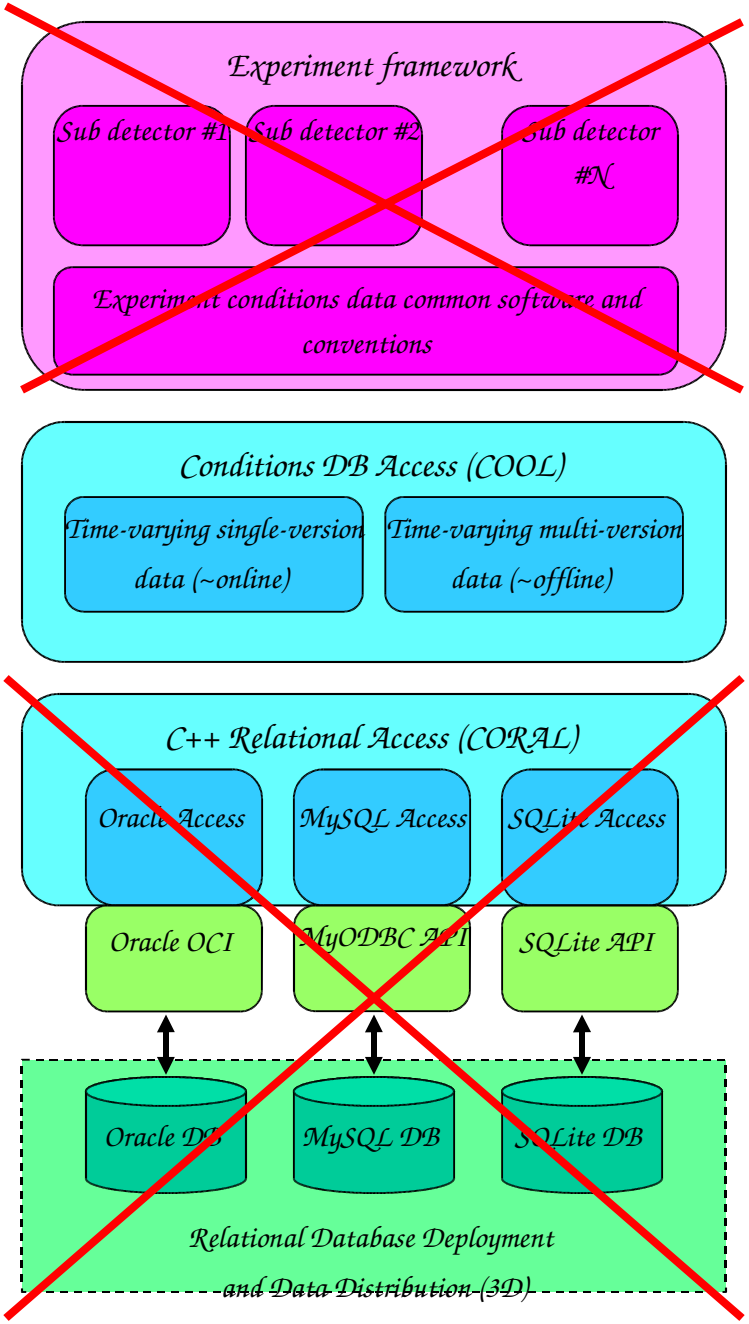
Prehistory

- **Background of common activities in 2000-2003**
  - *Collaboration of IT-DB, LHCb, Atlas, COMPASS, Harp*
    - *Borrowing a few design ideas from the BaBar experience*
  - *C++ API definition and Objectivity implementation*
  - *Oracle implementation of original API ("BLOB" payload)*
  - *MySQL implementation of extended API (flexible payload)*

- **LCG Conditions DB project launched in 2003**
  - *Subproject of LCG Persistency Framework (POOL)*

2003 until CHEP 2004

- **Two parallel activities (common project mandate)**
  - *Integrate existing Oracle/MySQL packages into LCG AA*
  - *Review old software and API to plan new developments*
- **Project faced two main problems in this phase**
  - *Lack of manpower for new developments*
  - *Divergence of the two packages*
- **Decision to develop new software just after CHEP**
  - *Following public AA Meeting discussion in October*
  - **Development of COOL started in November 2004**



"Common" project scope

NOT the problems specific to one experiment or one data type (handled by each experiment)

Software for time-varying and versioned data: a common component with a well-defined task

(RDBMS implementation of technology-neutral API)

NOT the generic C++ access to relational data (handled by CORAL)

NOT the generic deployment of relational services and distribution of relational data (handled by 3D – at CERN by IT-PSS)

Conditions data: metadata model

- **Designed to handle data "objects" that**
  - *Can be classified into* **independent data items**
  - ***VARY WITH TIME***
  - *May have different* **versions** *(for given time and data item)*

This 3-D metadata model is still valid!

A CondDBObject has

- *Metadata:*
  - *Data item identifier*
  - *Interval-of-validity [since, until]*
  - *Version information*
- *Data "payload":*
  - *Actual data variables (temperatures, calibration parameters…)*
  - *Separate fields or encoded as a LOB*

A "CondDBObject"

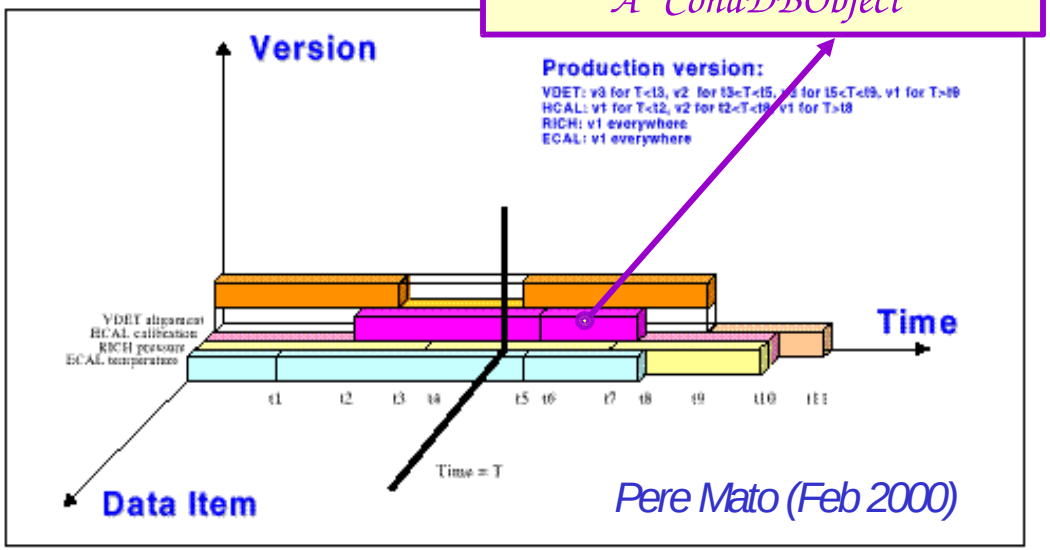


Figure 1 The three axes for identifying uniquely each data item in the condition database

- ***Main use case: fetch data valid at given time and tag***
  - *Inverse lookup (from temperature to time or version) is not a priority*

COOL software overview

- **Merge best ideas of two previous packages**
  - *New API enhances both original and 'extended' APIs*
- **Single implementation for many relational backends**
  - *Encapsulated behind C++ API (no direct SQL user access)*
  - *Support for Oracle, MySQL and SQLite via CORAL*
    - *Attention to Oracle performance (bulk operations, bind variables…)*
- **Maximize integration with other LCG projects**
  - *Reuse infrastructure and software (SPI, SEAL, POOL…)*
  - *Mutually beneficial collaboration with CORAL team*

COOL relational implementation

- **Modeling of condition data "objects"**
  - *System-managed common* **"metadata"**
    - *Data items: many tables ("folders"), each with many "channels"*
    - *Interval of validity - IOV: since, until*
    - *Versioning information with handling of interval overlaps*
  - *User-defined schema for* **"data payload"**
    - *Support for simple C++ types as CORAL "AttributeList"*

objectID	channelID	since	until	pressure	temperature

Metadata

System-controlled

(versioning metadata not shown)

Data payload

User-defined schema

(different tables for different schemas)

Milestones

- **Nov 2004: start of COOL software development**
  - *Brand new code, merge ideas of two pre-existing packages*
  - *Initially ~1.3 FTE for development (A.V. and S.A.S.)*
- **Apr 2005: first COOL production release 1.0.0**
  - *Support for Oracle and MySQL through POOL RAL*
  - *Basic insertion/retrieval (single/multi-version, single/bulk)*
- **Oct 2005: Atlas use case performance validation**
  - *One job every 5s, each retrieving 100 MB in 100k rows*
- **Latest of many releases: COOL 1.2.8 (Jan 2006)**
  - *SQLite (July), CLOB, PyCool, multi-channel bulk ops (Aug.), performance tests (Oct.), data copy (Nov.), CORAL (Jan.)*
  - *Team has grown to ~3.5 FTE (IT/LCG, Atlas and LHCb)*

Future perspectives

- **Software consolidation and enhancements**
  - *Major API and schema changes in 1.3.0 (~Apr 2006)*
  - *Implement new features following experiment priorities*
- **Support real life deployment before LHC startup**
  - *Continue to test and improve Tier0 software performance*
  - *Support Atlas and LHCb in setting up distributed services*
  - *Collaboration with 3D and IT-PSS service teams is crucial*

Software enhancement plans

- **Next on the list (COOL 1.3.0 and later)**
  - *AMD64 port and storage precision in API (int32 vs. int64)*
  - *Add table with "channel" metadata ; schema evolution tools*
  - *Improve versioning: user tags (later: HVS hierarchical tags)*
  - *Later: add CORAL monitoring/authentication/indirection*

- **More requests for new functionalities are pending**
  - *Often received at weekly phone meetings*
    - *Handled according to experiment priorities and available manpower*
  - *Formal review later on when API is more stable*

Atlas (offline) deployment

- **COOL fully integrated into Athena since mid-2005**
  - *Small payload stored 'inline', complex payload as POOL refs*
  - *Development priorities: CORAL API, schema evolution, HVS*
- **Most data still in Lisbon MySQL implementation**
  - *Transition phase: complete migration to COOL by mid-2006*
- **Deployment priorities**
  - *Commissioning (now); simulation (Apr); reconstruction (Oct)*
  - *Static replication now (Oracle->SQLite)*
  - *Explore T0-T1 dynamic replication via Oracle streams in 3D*
    - *Interest in distributed Oracle access via Frontier too*

LHCb deployment

- **Conditions DB (COOL) one of many databases**
  - *COOL holds conditions data for reconstruction/analysis*
  - *Other data in PVSS, LFC, Bookkeeping, Configuration DBs*
- **Deployment model (online and offline)**
  - *Masters (r/w) at the pit and CERN T0*
  - *Replicas (r/o) at T1*
  - *Oracle replication via Oracle streams*
- **Data challenge plans in 2006**
  - *Alignment/calibration challenge in Oct (with all T1 sites)*

Summary

- **COOL software is recent but of production quality**
  - *Software developments started in fall 2004 after CHEP04*
  - *Manpower has increased from ~1.3 to ~3.5 FTE*
  - *Single implementation for Oracle, MySQL and SQLite*
- **Tight integration with other LCG projects**
  - *Mutually beneficial collaboration with CORAL project*
  - *Service integration with IT-PSS at CERN and 3D project*
- **Focus moving from development to deployment**
  - *Development of new functionalities is far from finished*
  - *Deployment is progressing fast in Atlas and LHCb*

For more information

- **LCG Conditions Database Project Web page**

  http://lcgapp.cern.ch/project/CondDB

- **Related talks and posters at this conference**
  - *COOL performance and distribution tests (A. Valassi)*
  - *CORAL relational database access software (I. Papadopoulos)*
  - *POOL object persistency into relational databases (G. Govi)*
  - *Software for a variable Atlas detector description (V. Tsulaia)*
  - *LHCb conditions database framework (M. Clemencic)*
  - *Database access in Atlas computing model (S. Vaniachine)*