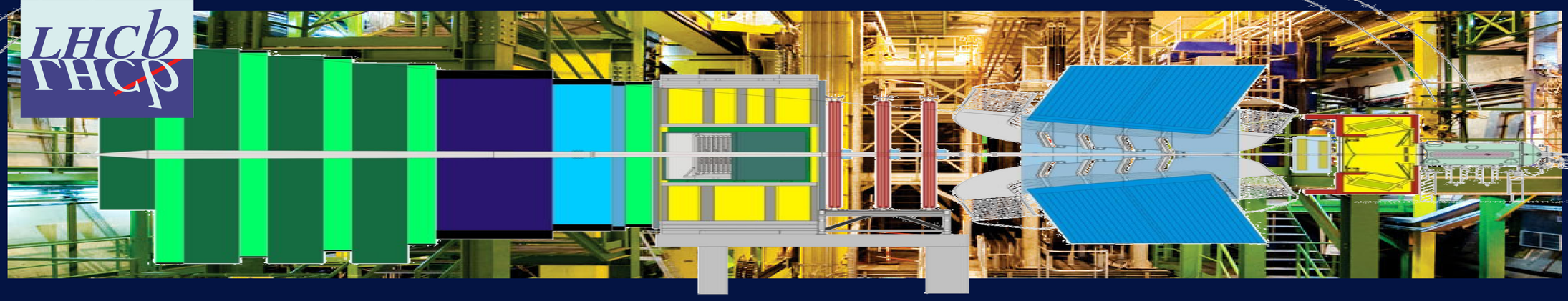


CERN Organisation
Europeenne pour la Recherche
Nucleaire
CH-1211 Geneve 23
Switzerland

LHCb Conditions Database Operation Assistance Systems

M Cattaneo, M Clemencic, H Degaudenzi, R Santinelli and I Shapoval

Note: All leveled data flow diagrams below are shown in the Yourdon-DeMarco DFD notation

Note: LHCb Conditions Database := CondDB

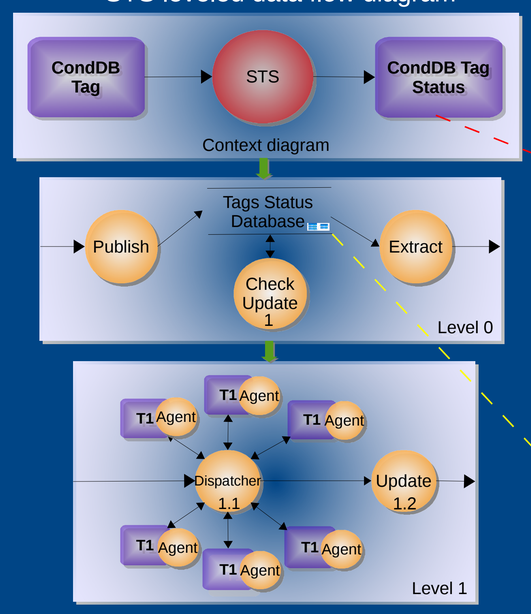
LHCb Conditions Database state tracking system (STS)

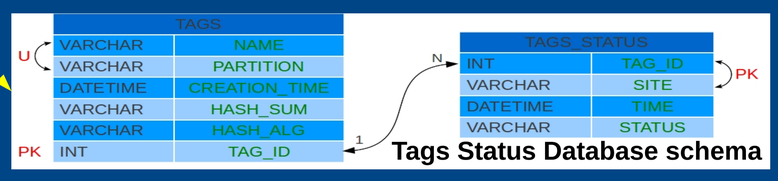
System's Task:
Reliable validation of the Oracle replication of CondDB to Tier-1s (T1s) sites on top of the *Oracle 3D Streams* technology

Motivation:
Monitoring of the CondDB integrity at T1 sites helps to:
- Ensure the LHCb productions pass smoothly (zero job's failure rate due to potential CondDB integrity problems);
- Manage more efficiently the Grid computing resources for the LHCb productions;
- Establish an extra layer of CondDB replication verification to spot any problems left undetected by the *Oracle 3D Streams*

Work-flow:
The CondDB tags required by the LHCb productions are monitored regularly at T1s by STS which:
- Forms a reference CondDB tag state in the Tags Status Database (TSDB);
- Compares regularly the T1's CondDB tag states with the reference ones (based on hash sums) and updates TSDB accordingly;
- Supplies the requesters with the up-to-date CondDB tags status.

STS leveled data flow diagram





LHCb Conditions Database deployment and backup system (DBS)

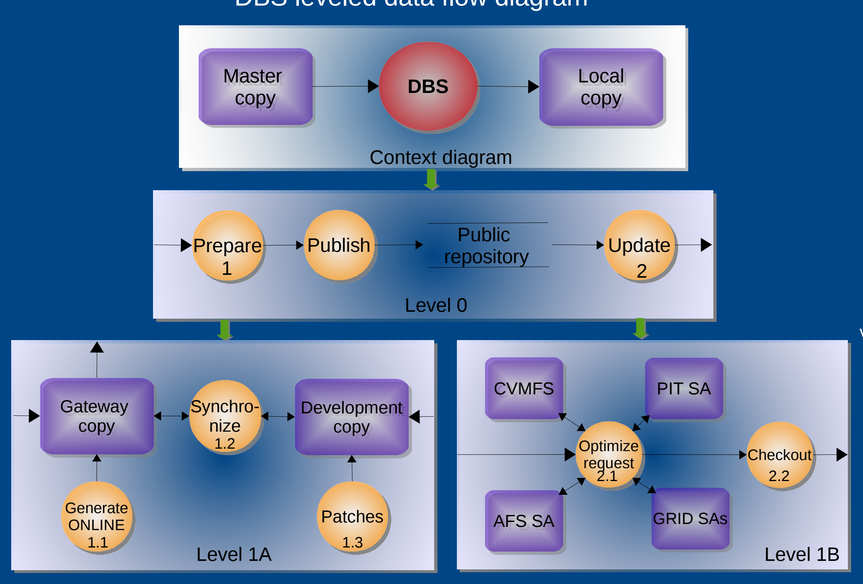
System's Task:
Prompt, efficient and reliable deployment of the SQLite-based CondDB to LHCb computing environment (T1s, T2s, LHCb Pit, CVMFS shared areas (SAs), AFS SAs)

Motivation:
(1) Faster turn-around of the SQLite-based CondDB releases (no dependency on standard LHCb package-based release cycle):
- Immediate “visibility” to all consumers of the new CondDB release once published to the public repository;
- Almost immediate synchronization between Oracle-based and SQLite-based CondDB

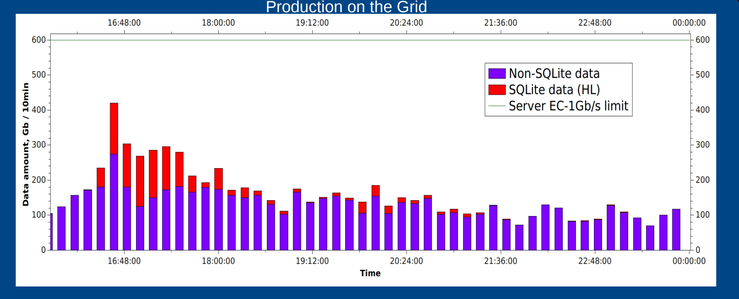
(2) More efficient storage of the SQLite-based CondDB releases (no duplication of the database payload)

(3) The switch from the Oracle-based to always up-to-date SQLite-based CondDB in data processing on the Grid provides the following benefits:
- No need for Oracle CondDB at T1s;
- Better robustness in terms of job's connectivity to CondDB;
- More prompt data processing at T1s (no *Oracle Streams* replication latency any more);
- Better flexibility: prompt reconstruction at T2s is possible (not in the standard LHCb Computing model)

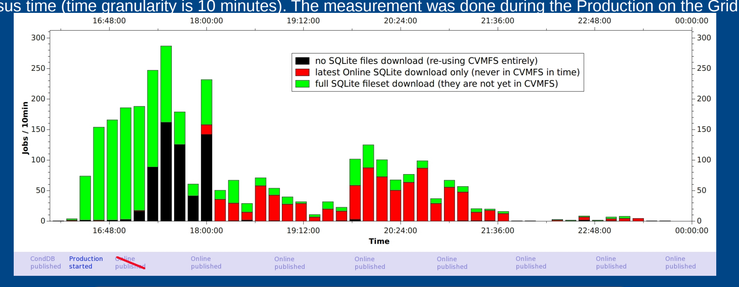
DBS leveled data flow diagram



SQLite versus non-SQLite data amount downloaded from the LHCb distribution server during the Production on the Grid



Number of LHCb jobs sorted by the number of SQLite files downloaded from the LHCb distribution server versus time (time granularity is 10 minutes). The measurement was done during the Production on the Grid



Work-flow (see the figure above)**:**
The procedure is very similar to the one at the core of the CERN Virtual Machine FileSystem (CVMFS):

- Prepare the SQLite-based CondDB image to be deployed;
- Publish the CondDB image to the public repository (this moment it becomes available for every consumer);
- Update the local CondDB copies of the LHCb computing environment (T1s, T2s, LHCb Pit, CVMFS SAs, AFS SAs).

The latter areas are updated automatically once DBS detects that the public repository is updated.
The public repository stores efficiently the previous CondDB images to a certain backup depth.

Update process features
- Differentiated downloads from the public repository (only the differences between the local image and the repository are downloaded);
- Caching is used on the Grid T1s sites;
- Robustness against distribution server unavailability;
- Transaction correctness verification;
- Robustness against local CondDB image damages (automatic damage type detection and auto-restore)
- Robustness against abnormal update process termination (à la “power-off”): the local copy image is always left in a consistent state

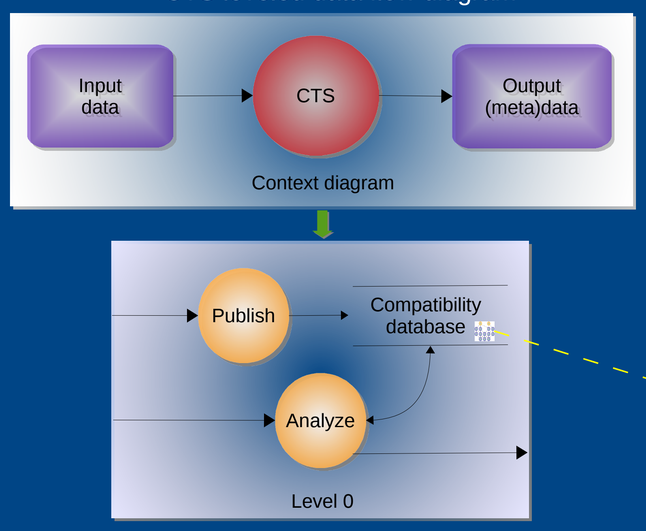
LHCb Conditions Database compatibility tracking system (CTS): a graph driven approach

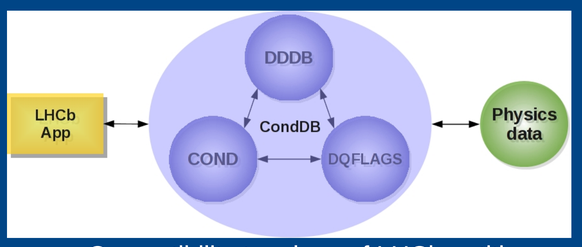
System's Task:
Track and perform automatic verification of LHCb Conditions Database, LHCb applications and physics data states cross-compatibilities for each LHCb job execution.

Motivation:
In the LHCb computing model the compatibilities of the LHCb applications and LHCb Conditions database states are not tracked and are managed in a manual and very limited way. This is too error prone. Some of the harmful consequences of a met incompatibility are:
- LHCb job execution failures, sometimes completely misleading: lost time and computing resources;
- Even without an explicit job failure an incompatibility may lead to partially or completely incorrect LHCb application results.

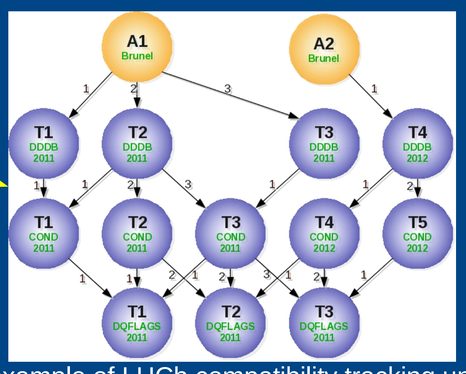
Work-flow:
CTS performs two mainstream actions:
- stores in the Compatibility Database new compatibility relations in the graph (shown on the right side);
- analyzes the graph to get the compatibility solution for certain LHCb job execution plan

CTS leveled data flow diagram





Compatibility topology of LHCb entities



An example of LHCb compatibility tracking unit: directed acyclic weighted attributed graph

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