# Databases for the ATLAS Detector Control System – Experience and Future Requirements

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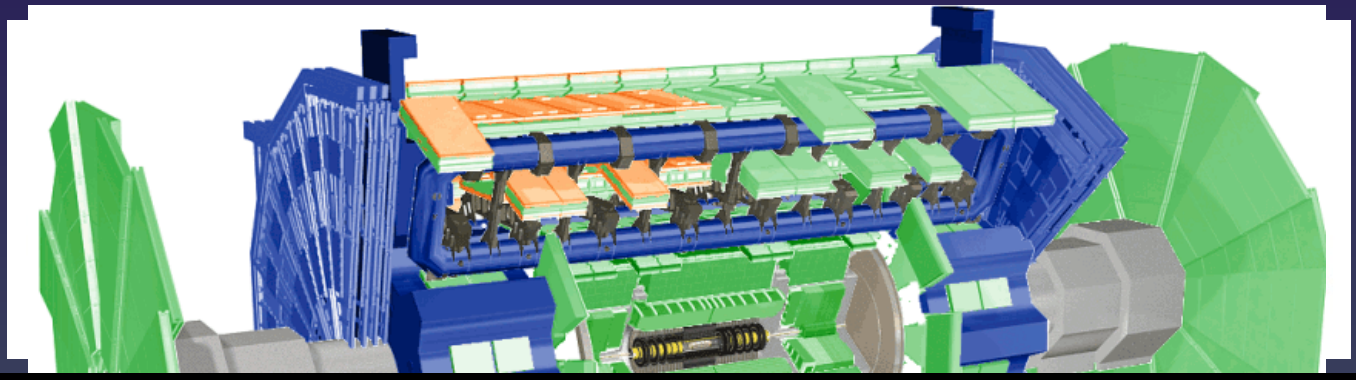
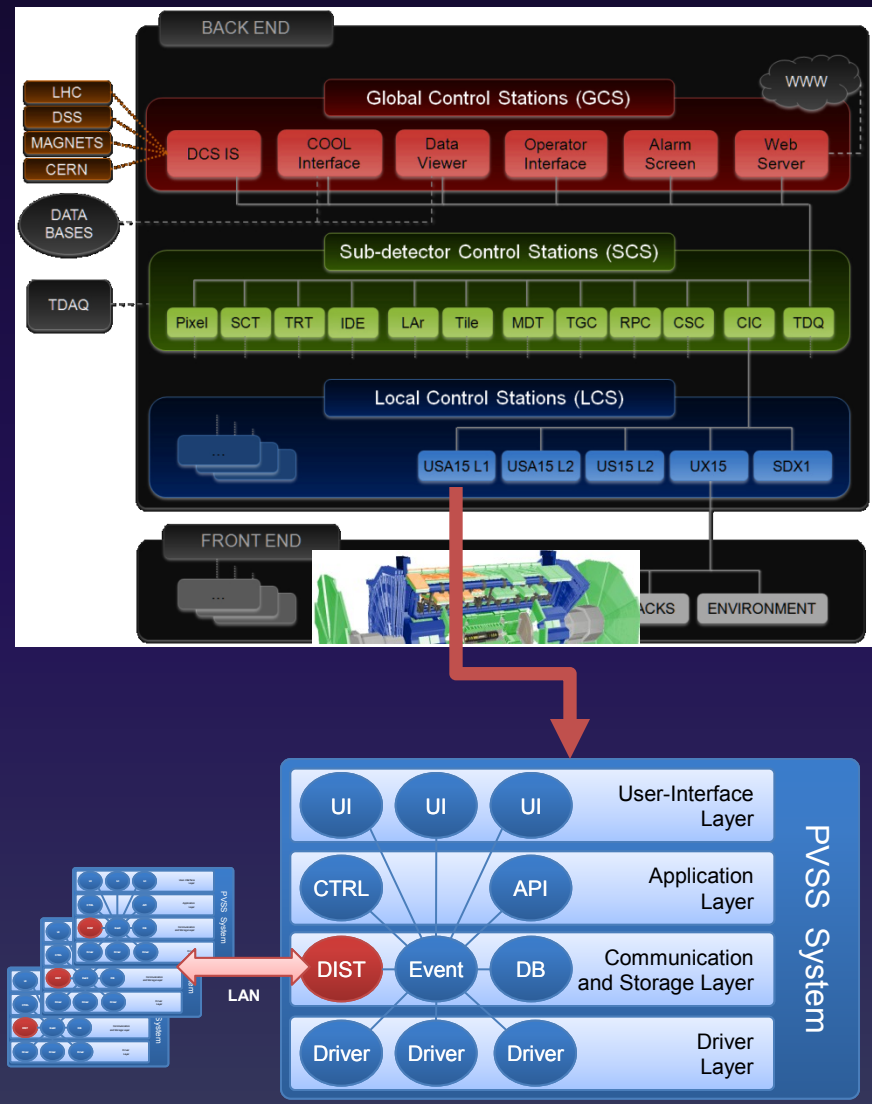
For the ATLAS DCS Community



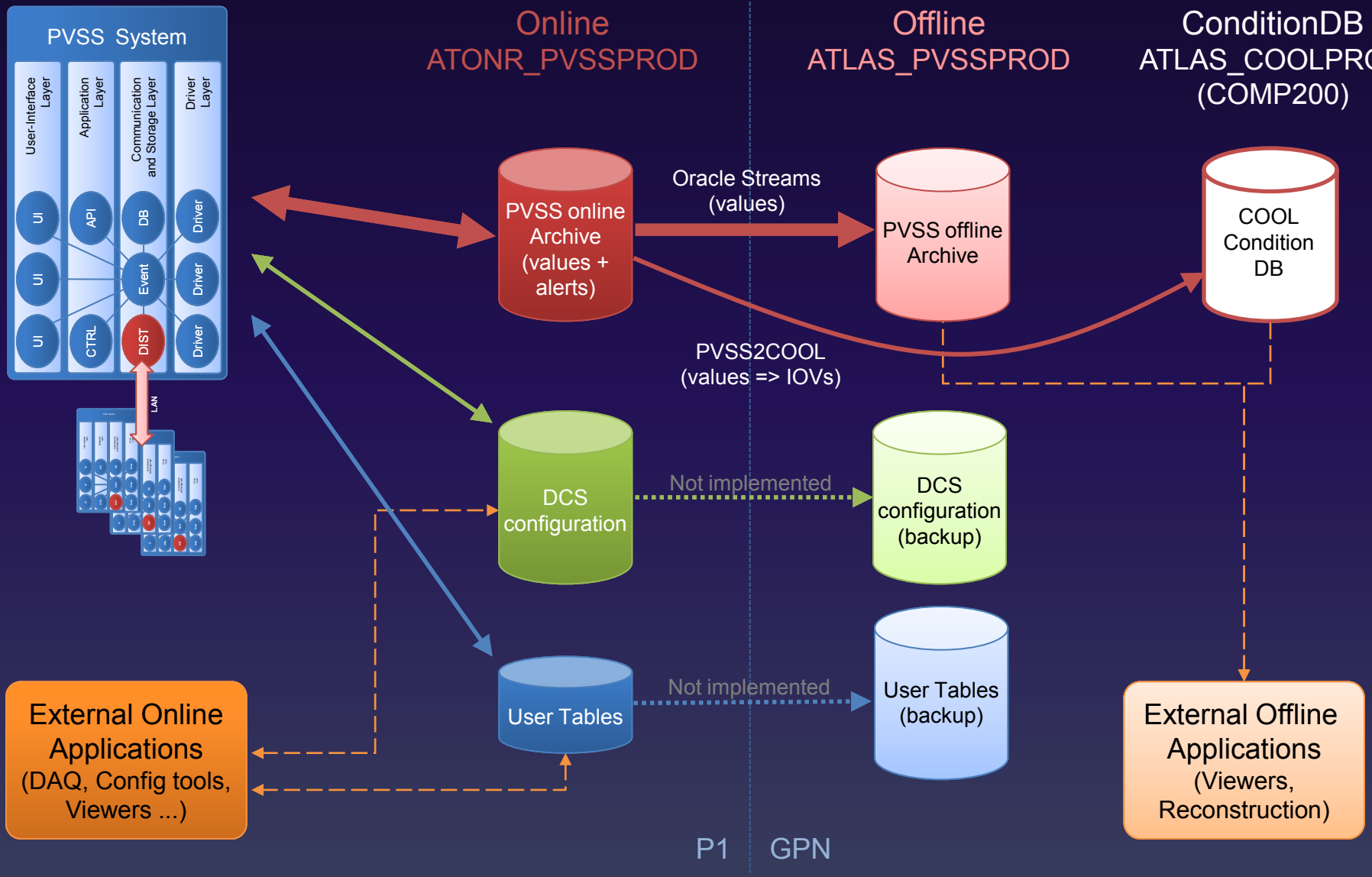
# Detector Control System

## Requirements & Architecture

- *"Monitor and control detector ensuring safe operation"* 24/7
- Readout and process controls data from detector FE ➲ SCADA software PVSS, Distributed over ~150 PCs
- Currently ~20 Million PVSS data entities (data point elements) in ATLAS DCS
- Configuration data stored in dedicated schema
- Archiving of all relevant detector condition parameters to database (~1M) = PVSS Oracle Archive
- Subset of parameters, needed for DQ and offline analysis to be transferred to ATLAS CondDB (COOL) ➲ PVSS2COOL
- COOL data used by T0 reconstruction processes ➲ must be highly available



# DCS Use of Databases



# Writing: DCS Configuration DB

Configuration data:

- PVSS data structure for given DCS application
- Hardware addresses and settings
- Alarm settings

Usage:

- DCS uses JCOP PVSS API for data storage and retrieval
- Data should be and is quasi-static ➲ no resource issue
- Future: additional data expected for detector upgrade
- Open issues:
  - Replication to offline server not possible yet, technical issues to be addressed
  - Owner accounts must be used for reading/writing, EN/ICE following up

| Sub-Detector | Volume [MB] |
|---|---|
| PIX | 16 |
| SCT | 767 |
| TRT | 237 |
| IDE | 12 |
| LAR | 11 |
| TIL | 55 |
| CSC | 13 |
| MDT | 149 |
| RPC | 28 |
| TGC | - |
| CIC | 112 |
| TDQ | 4 |
| FPI | 41 |
| LUCID | 12 |
| System | 103 |
| **Total** | **1560 MB** |

# Writing: PVSS Oracle Archive


## DCS Value/Alert Archive

- Main DB user for writing
- Contains for each DCS parameter update: value, timestamp, status … (~70Bytes)
- More or less constant rates, peak activity mainly correlated with LHC-induced transition (HV ramps) or infrastructure problems (e.g. power cuts)
- Quotas mainly respected except for some time periods needed for detector debugging ➲ we are not too far away from limits

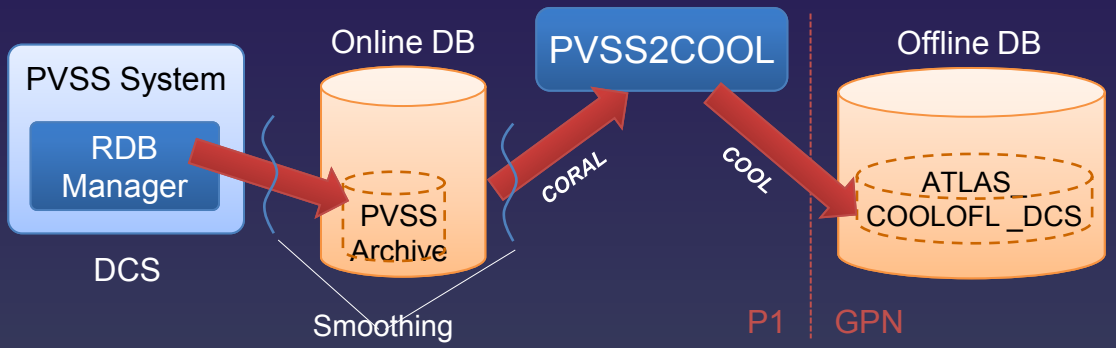
*Stats 01.03.-31.05.2011

| Sub-Detector | Volume [GB] | | Rate* | |
|---|---|---|---|---|
| | Online | Offline | [MB/Day] | [GB/Year] |
| PIX | 376 | 833 | 694 | 253 |
| SCT | 141 | 381 | 257 | 94 |
| TRT | 287 | 596 | 526 | 192 |
| IDE | 618 | 990 | 632 | 231 |
| LAR | 317 | 869 | 1573 | 574 |
| TIL | 190 | 501 | 390 | 142 |
| CSC | 18 | 24 | 24 | 9 |
| MDT | 177 | 320 | 272 | 99 |
| RPC | 482 | 980 | 827 | 302 |
| TGC | 296 | 476 | 126 | 46 |
| MUO | 10 | 12 | 40 | 14 |
| GCS + CIC | 339 | 597 | 743 | 271 |
| TDQ | 224 | 364 | 366 | 137 |
| ZDC | 10 | 13 | 16 | 6 |
| LUCID | 50 | 68 | 87 | 32 |
| **Total** | **3535 GB** | **7024 GB** | **6573** | **2402** |

# Writing: Conditions Data from DCS

PVSS2COOL

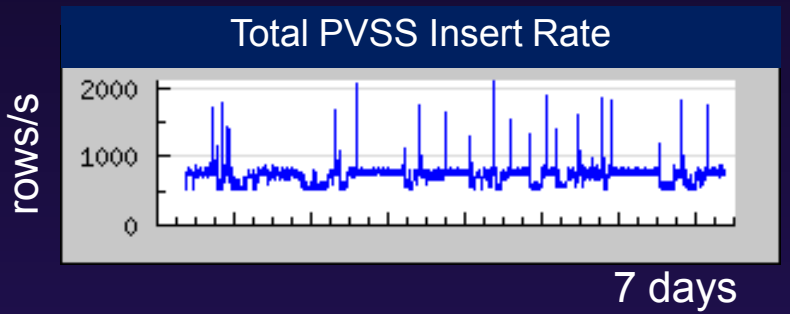
- Subset of DCS data in PVSS Oracle Archive is needed for offline physics reconstruction
- Reconstruction uses ATLAS ConditionsDB (COOL)
- Dedicated application PVSS2COOL takes PVSS data from ATONR and writes it to configured COOL folders (common schema) on offline database
- Implementation based on LCG libraries (CORAL)
- Static COOL folder configuration is done by DCS experts within PVSS
- Expect significant increase of data transfer in future due to more refined reconstruction / data quality evaluations




| Sub-Det | COOL [GB] | PVSS [GB] | COOL/PVSS [%] |
|---|---|---|---|
| PIX | 7,4 | 376 | 2 |
| SCT | 33,1 | 141 | 23 |
| TRT | 6,1 | 287 | 2 |
| IDE | 0,1 | 618 | 0.01 |
| LAR | 82,9 | 317 | 26 |
| TIL | 3,9 | 190 | 2 |
| CSC | 0,03 | 18 | 0.15 |
| MDT | 1,2 | 177 | 0.66 |
| RPC | 1,2 | 482 | 0.24 |
| TGC | 0,2 | 296 | 0.06 |
| GCS | 0,3 | 339 | 0.08 |
| TDQ | 0,2 | 224 | 0.08 |
| ZDC | 4,2 | 10 | 42 |
| LUCID | 0,5 | 50 | 1 |
| **Total** | **141 GB** | **3525 GB** | **4%** |

Stats 01.06.2011

# Writing: Operations




## Operational Experience

- Very stable operations ☺
- Streaming works well but sensitive to additional load, exposes online system to problems with offline DB
- Database problems not always obvious for ATLAS operators ➲ ATLAS DBAs + DCS developed dedicated online DB Monitoring, allowed to create DB-related DCS alarms
- PVSS Archive: short DB unavailability is usually well compensated by local buffering of PVSS processes
- Problems are usually followed up very quickly by ATLAS DBAs and IT DB support

# Writing: Remaining Issues


Remaining Issues

- PVSS Alerts should be available on Offline DB instance (replication issue)
- Database/network connection handling
  - In Oracle client, had recovery problems with sudden Oracle node reboot, rare
  - In PVSS client API (ctrlRDBaccess), being followed by EN/ICE
  - ➲ Online DB STANDBY switch-over not fully transparent
- Rare crashes of PVSS archive insert process (RDB Manager), being followed by EN/ICE & ETM
- PVSS2COOL: CORAL hang-ups when DB becomes unavailable during transactions, followed by LCG developers

# Writing: Future Needs & Wishes

Performance/Volume Related:

- Data rate is expected to increase moderately:
  - Due to needs in operation (additional parameters need archiving)
  - New detector components in upgrade stages
  - ➲ Very rough estimate: factor 2 compared to today's rate should be sufficient (volume accordingly)
- Persistency of data on online server is at minimum (1 year), possible to increase?
- Latency of Online ➔ Offline replication should not increase

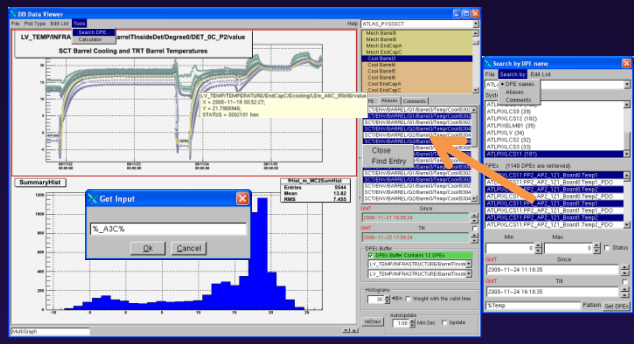
Structure Related:

- Often debugging data is not needed for > 1 month time ➲ need for additional short-term DB space (PVSS Archive, per sub-detector) independent of regular archives, would allow to further reduce regular archiving rate
- Additional schema for PVSS Logging, exists on integration database but never brought to production

# Reading: PVSS Archive – Tools

## Use Cases for Data Access

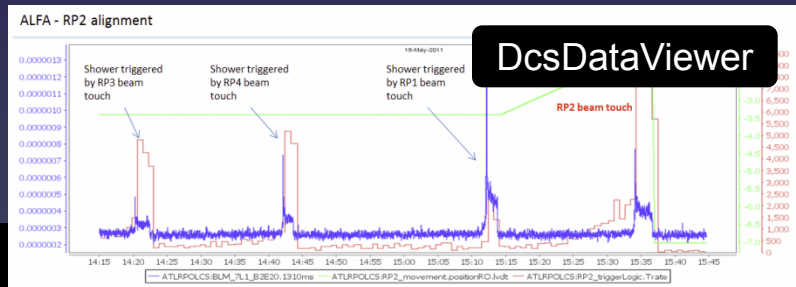
1) Sophisticated access and analysis tool for Oracle data from inside CERN, batch mode, multiple output formats
2) Easy-to-use, web-based tool to access Oracle data from graphical output, possible to embed into other applications
3) API for custom applications



DBExplorer

## Available Tools in ATLAS

1) ROOT-based analysis tool: DBExplorer (author: S. Kovalenko)
   - Trends, histograms for given parameters and given time range
   - Last-value request mode for use with online histogramming, optimizations of offline DB done with DBAs
2) Web-based: DcsDataViewer
   - Client-server-architecture, server: python (CherryPy, cxOracle), client: Java (GWT)
   - DB access only from within server with DB protection mechanisms
   - Query optimizations done with DBAs (in DB schema and application implementation)
3) JCOP PL/SQL API to PVSS Archive schema
   - Recently developed by EN/ICE-SCD, list of pending feature requests
   - Encapsulates standard query types for PVSS data access
   - Should avoid any direct SQL (expensive queries)
   - Important to maintain for future upgrades
   - Help from IT for performance improvements?




DcsDataViewer

## General Issue: reading performance

Improvements possible in the future? Hardware or software?

# Conclusions

- Oracle databases are reliable storage for ATLAS DCS configuration and conditions data
- Only moderate increase of insert rates/volume needs expected during next years
- PVSS Archive: we could use some temporary space which can accept insert rates beyond quota limit
- Few remaining issues for operations to be ironed out
- Data access tools available but performance is an issue

**Many thanks to ATLAS and IT DBAs for the excellent job!!** (and also for not complaining too much about late and always changing requests from the users)