FairRoot Virtual Database

Status Report

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Outline

1. FairDB
   - Design
   - FairRoot Integration
2. Features
   - Connectivity
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   - SQL I/O
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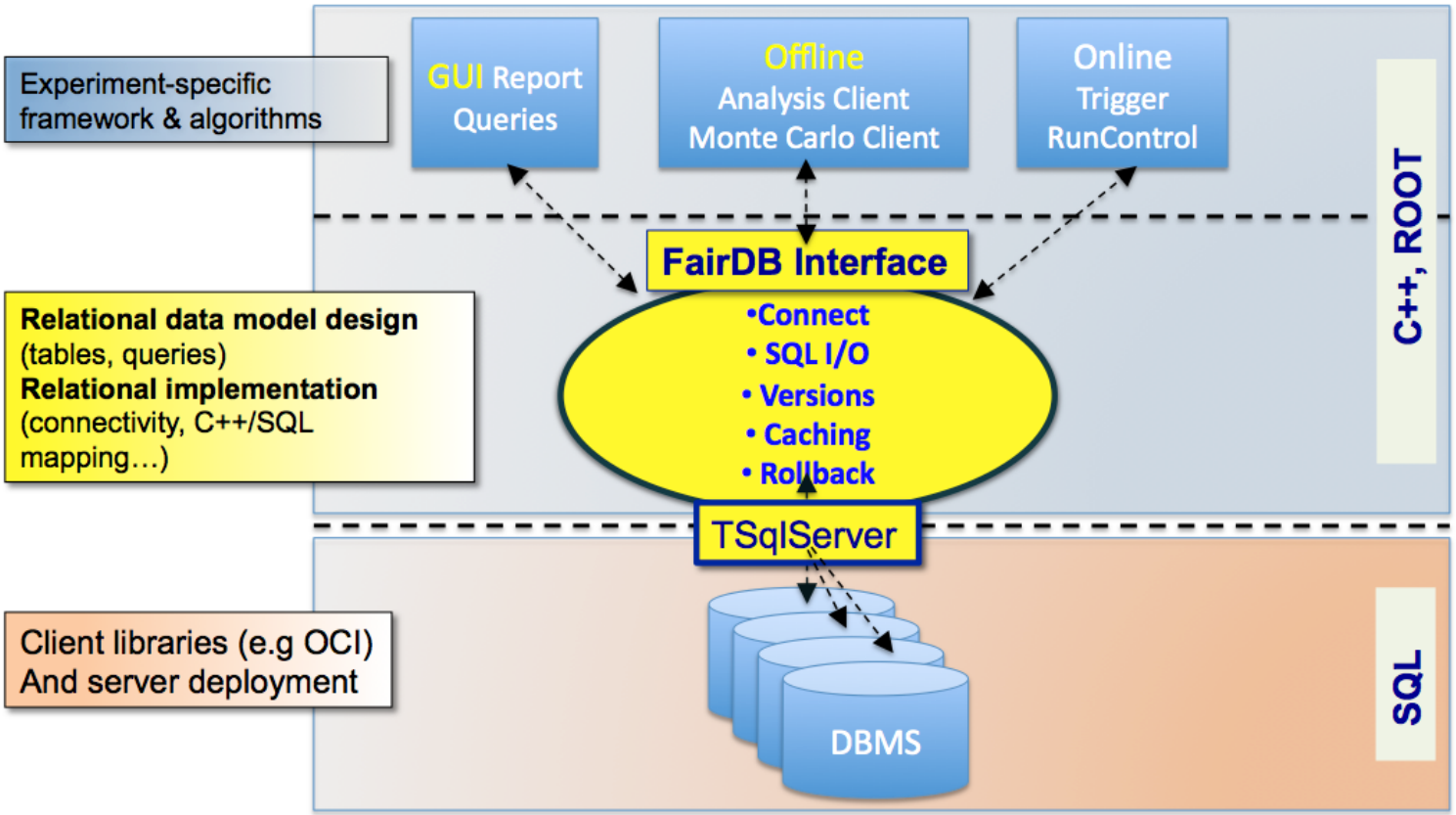
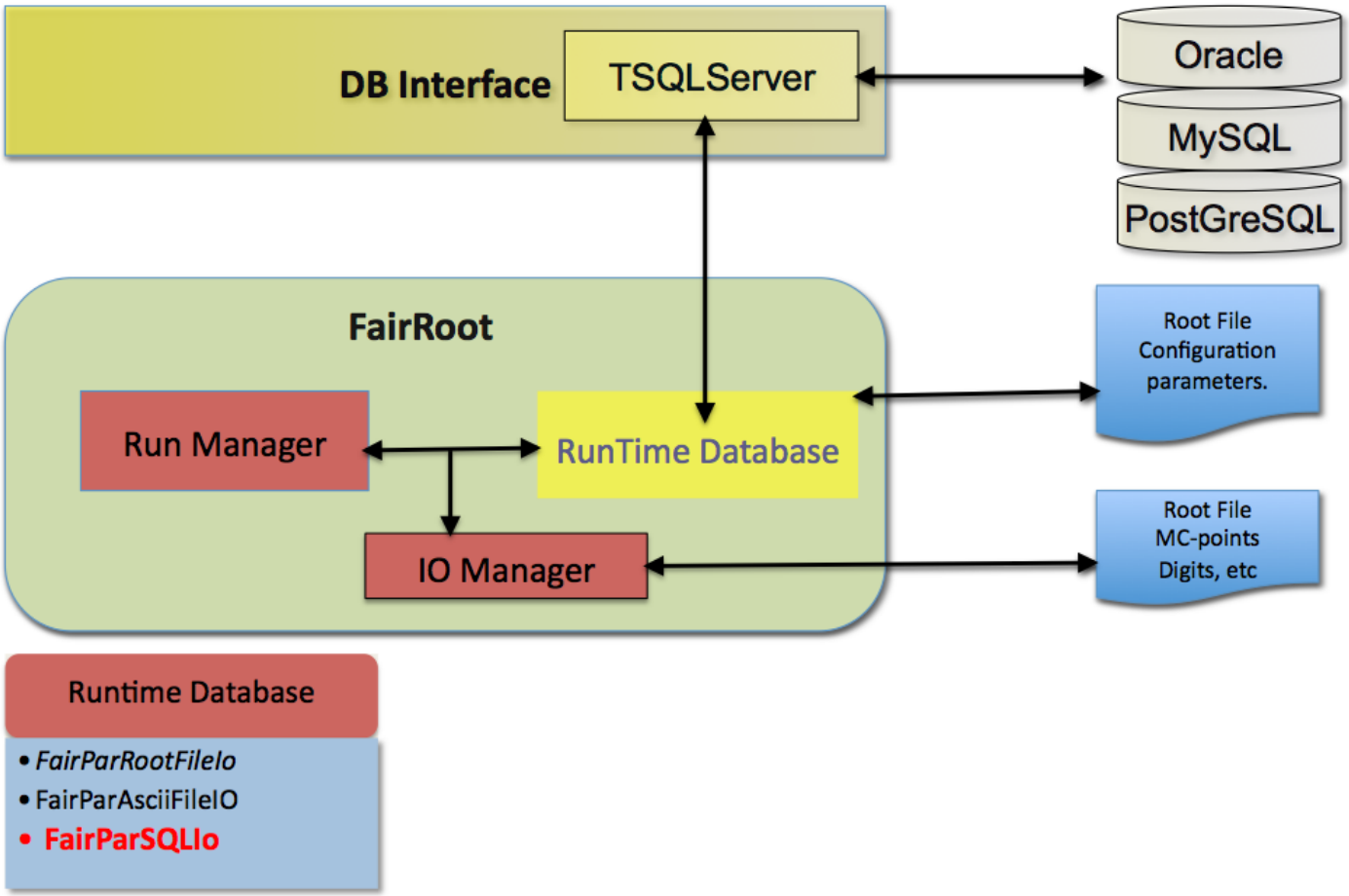
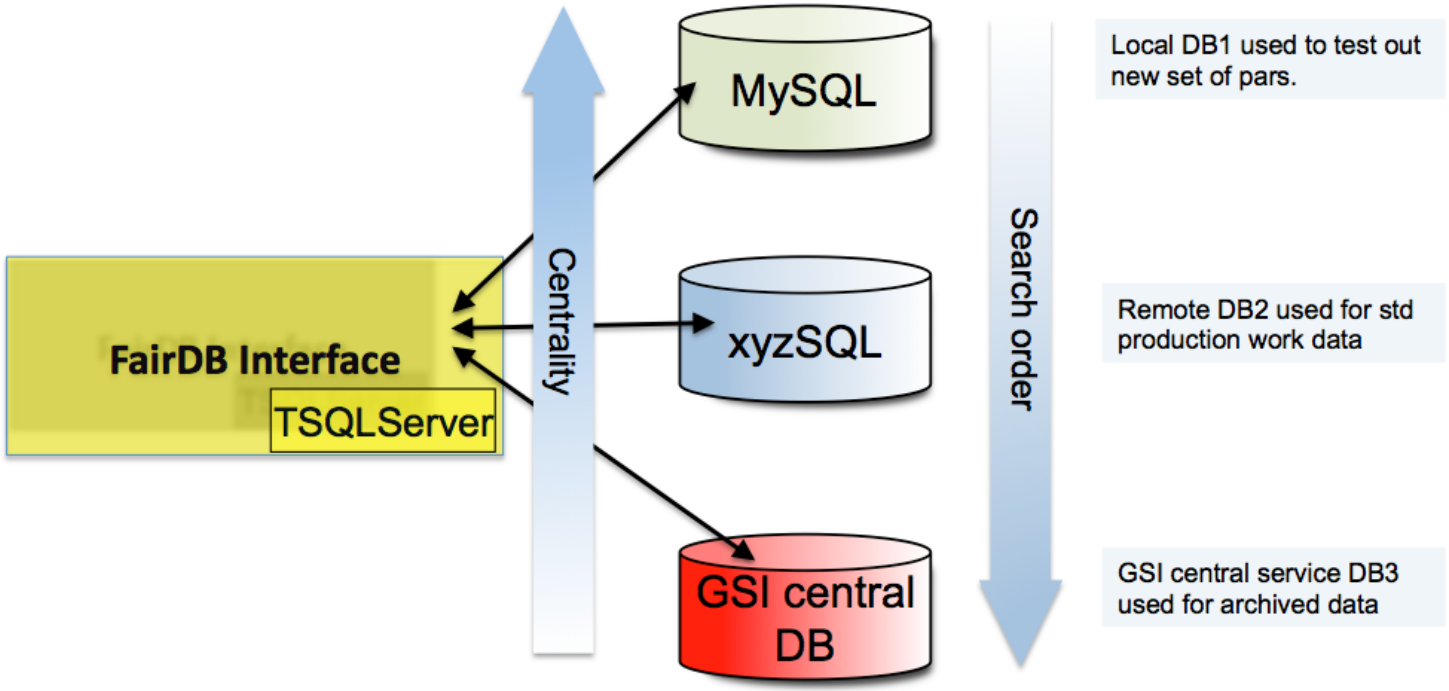
FairDB Design



FairDB within FairRoot



Connectivity



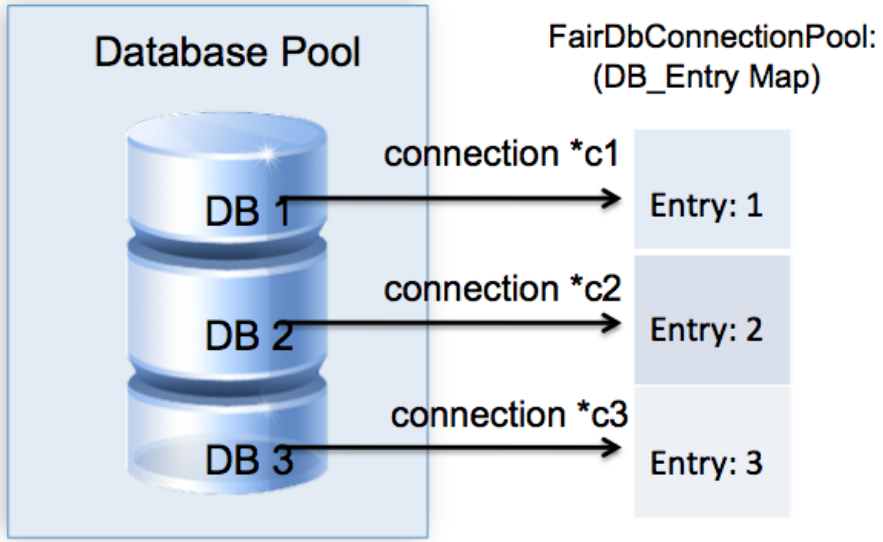
Configuration

- **JDBC style:** defines a list of DB URLs, a user name and a password
- Configuration via environment variables of type `FAIRDB_TSQL_*`

Configuration example:

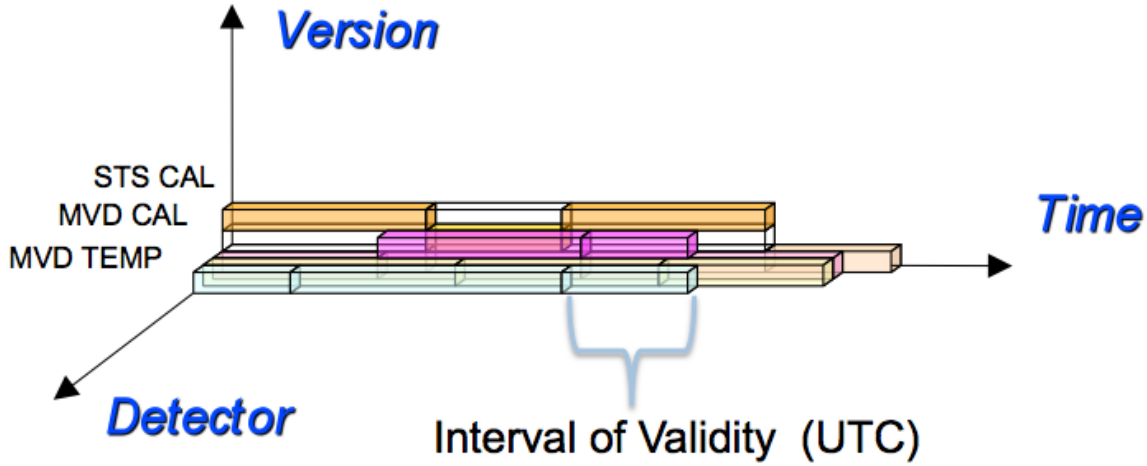
```
export FAIRDB_TSQL_URL="     mysql://localhost/r3b;
                             pgsql://localhost:5432/R3B"

export FAIRDB_TSQL_USER="    mysql_r3b";"postgres"
export FAIRDB_TSQL_PSWD="    password1";"password2"
```

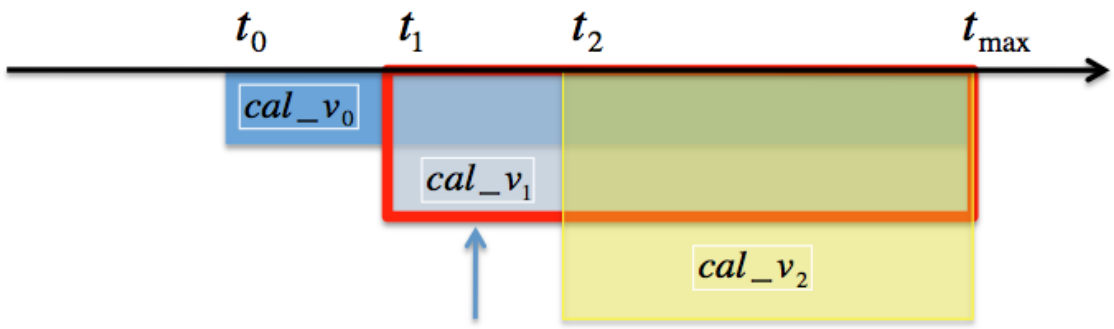
Multiple Connections




```
// SQL-IO Interface
 FairParTSQLIo* inp = new FairParTSQLIo();

// Get access to the connector class
const FairDbConnectionPool& fConn = inp->GetConnections();

// Get number of connected databases
Int_t n_db = fConn.GetNumDb();

//Loop over all connections
for(Int_t i=0;i<n_db;++i){
 // create SQL statement
 auto_ptr<FairDbStatement> fStmt(fConn.CreateStatement(i));
 fStmt->Commit("DROP TABLE IF EXISTS  FAIRDBTUTPAR");
 …
}
```

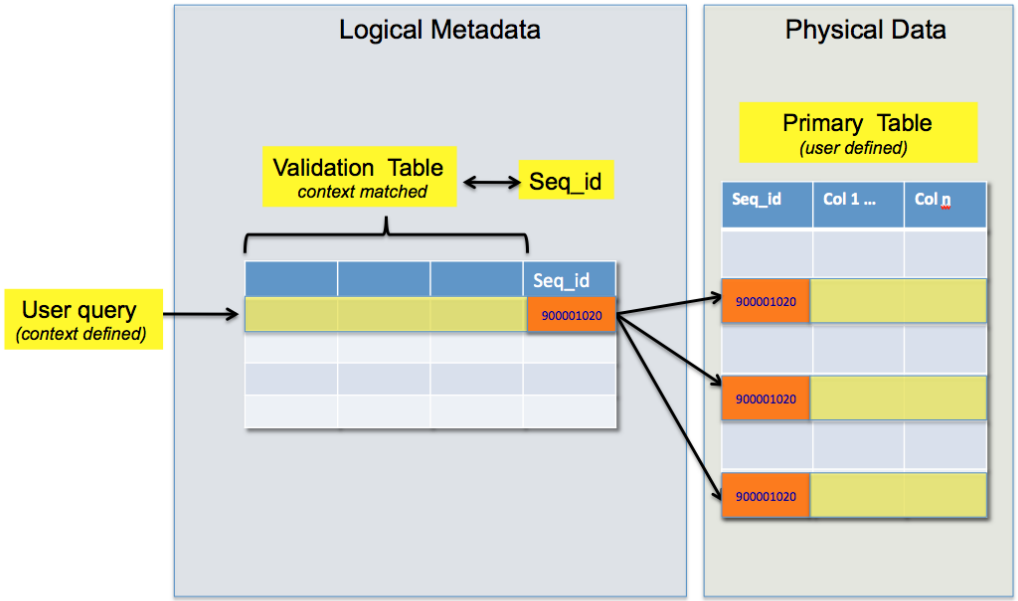
Concepts





RunID $\Leftrightarrow$ time $t \in [t_1, t_2]$

Version Management



Query process:

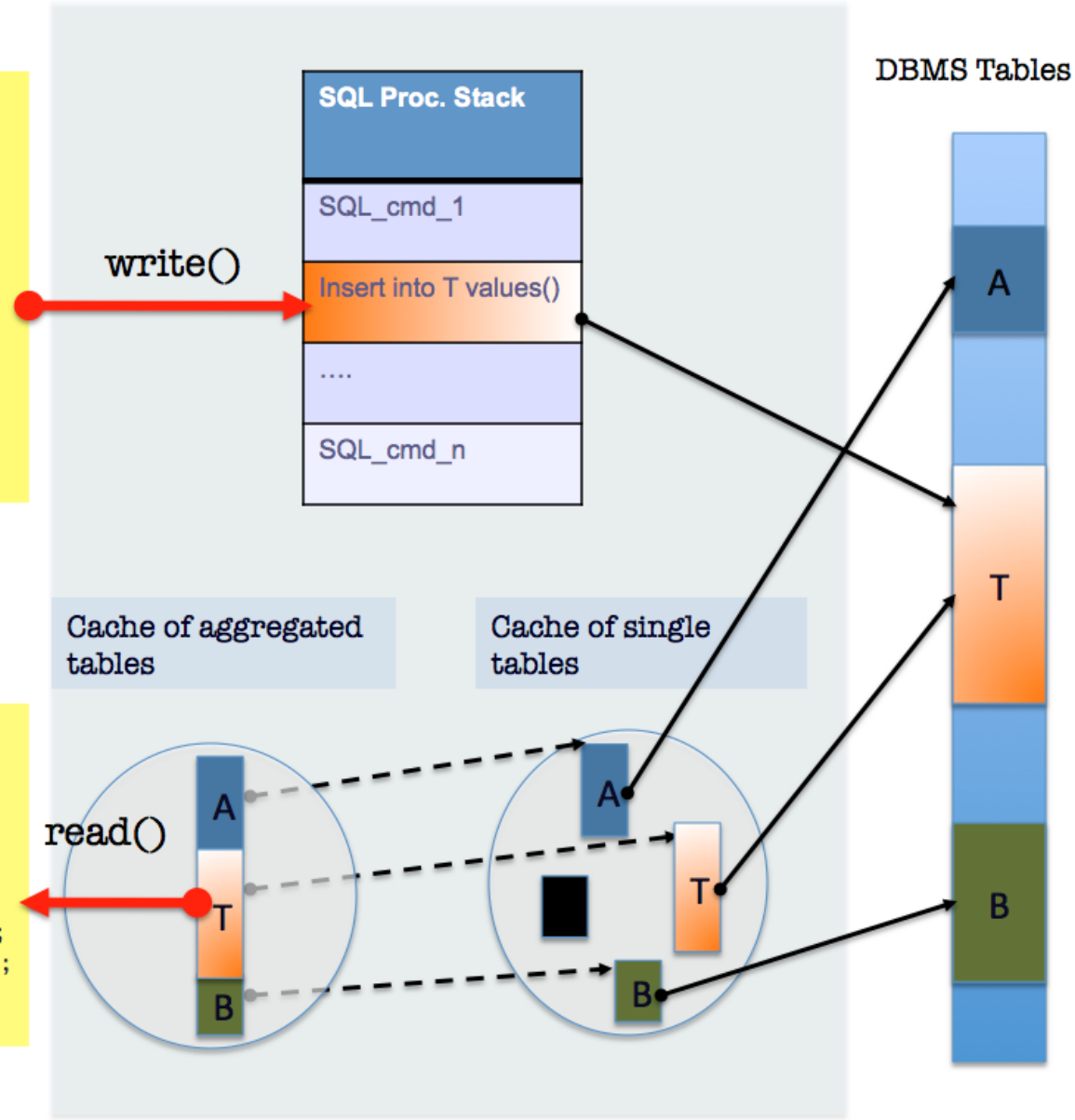
1. Condition (`timestamp, detector, version`) as primary key
2. Condition converted to a unique **seq_id**
3. **seq_id** used as key to access all rows in the main table
4. System gives user access of all such rows

I/O Components

- **Data Organization**
  - **Condition:** event date, time, version, detector
  - **Interval:** a condition extended to a time window
  - `ObjToTableMap:` Object mapped to single row in a table
  - **Single or Composite:** (a set of `ObjToTableMap:` sharing a Interval)
- **I/O process**
- **Write** by **Interval of Validity (IoV)**
  - Use case: *do calibrate channel in crate , estimate interval of validity which it remains valid and store in the DB*
- **Read** using a **Condition**
  - Use case: *given a condition, get all calibration constants for every channel in every crate.*
  - **Caching mechanism:** cache owns query results for reuse, caller just gets const pointer.

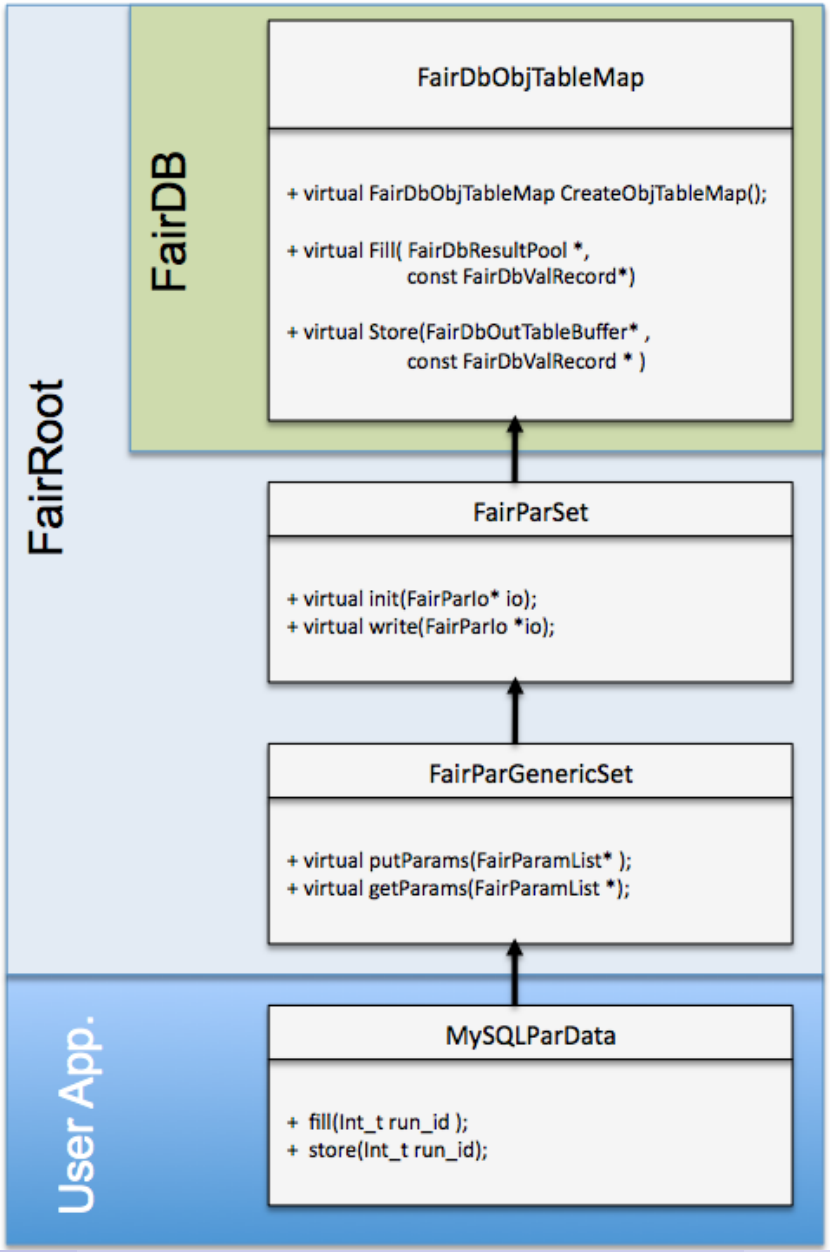
Templated SQL I/O

```
// Writing by IOV
const ValInterval iov;

// Create Template I/O
FairDbWriter<MyParam> writer(iov)

// Fill writer with rows of Agg
MyParam par0, par1, ...;

writer<< par0<<par1<< ....;

// Commit
writer.Close()
```

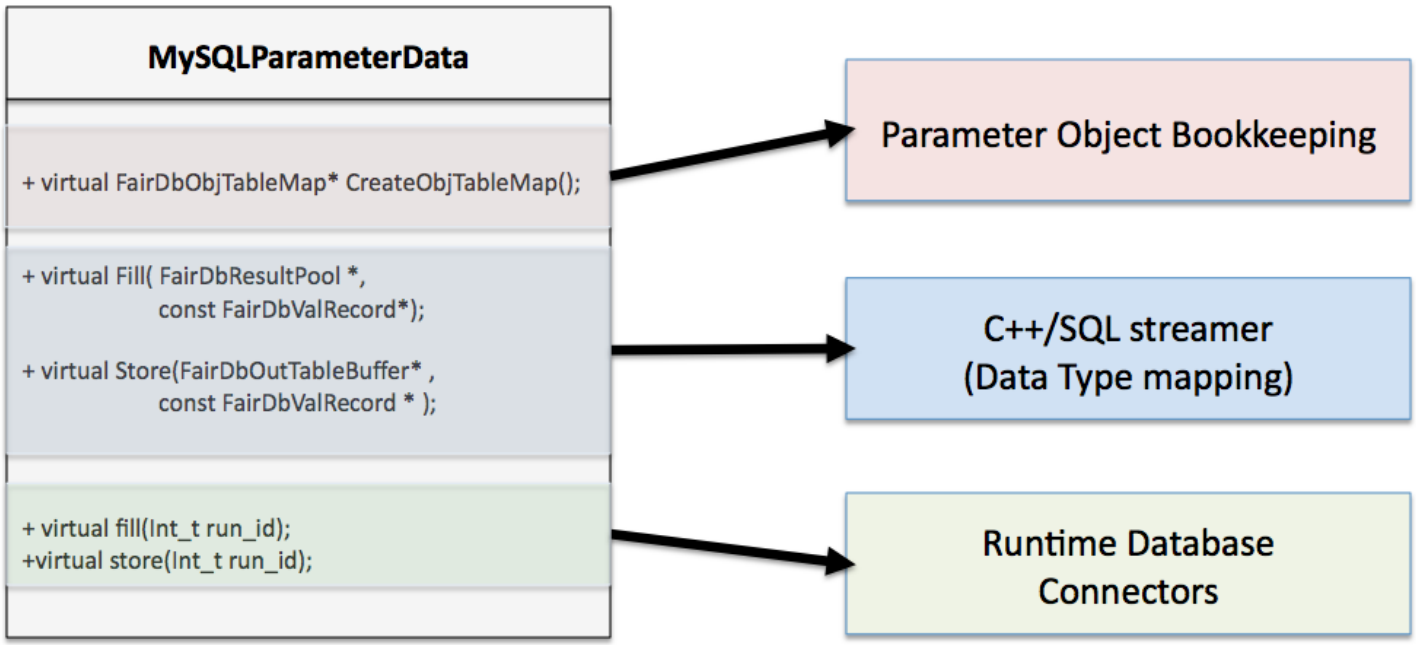



```
// Reading with Condition
const ValCondition cond;

//Set up the templated reader
FairDbReader<MyParam> reader(cond);

// retrieve all rows
const MyParam* row0 = reader.GetRow(0);
const MyParam* row1 = reader.GetRow(1);
```

FairParSet Redesigned



SQL-Aware Parameter Class



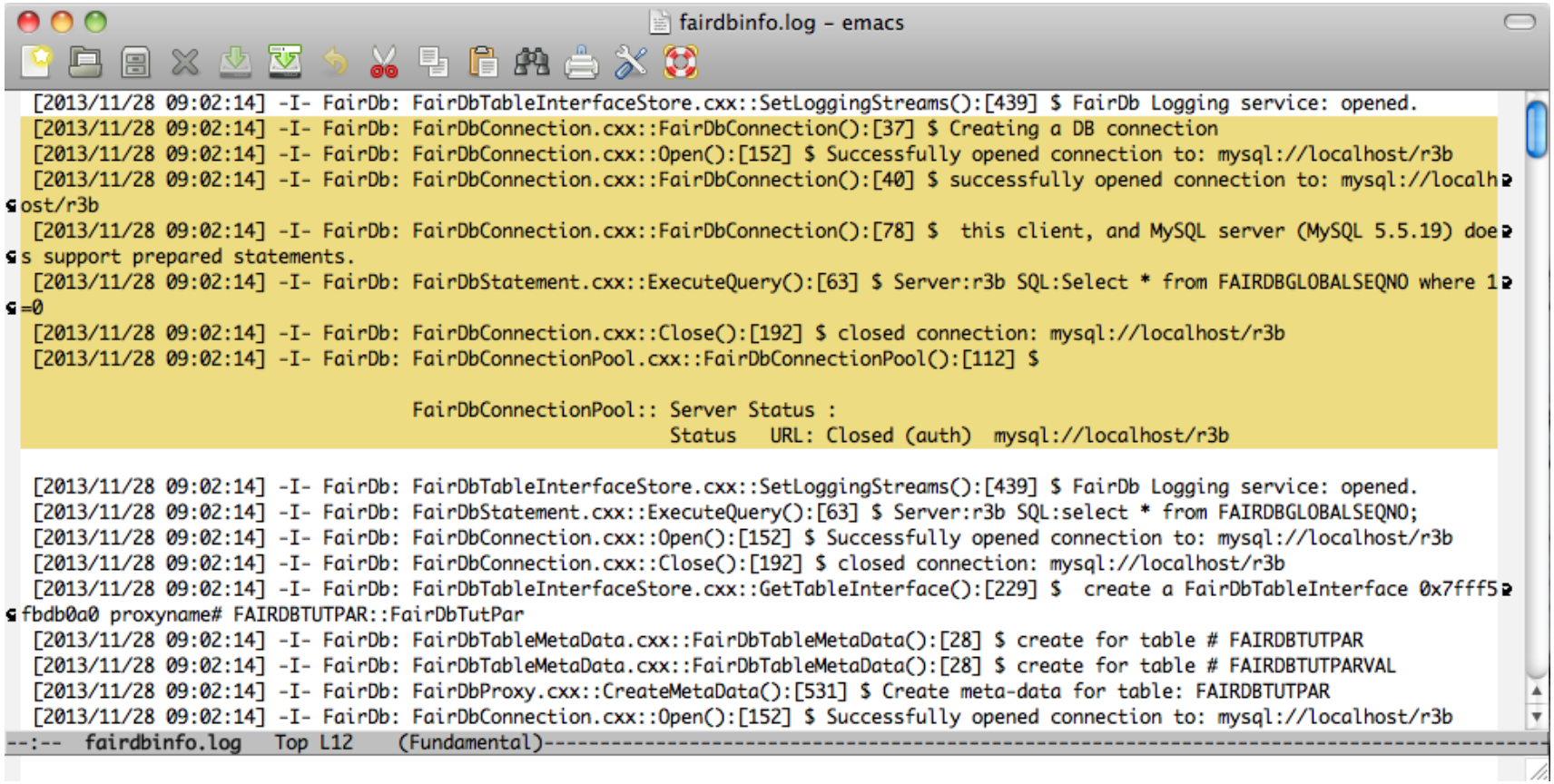
Data Types

type: Int_t, Float_t, Double_t, Char_t, Text_t, UChar_t, class type

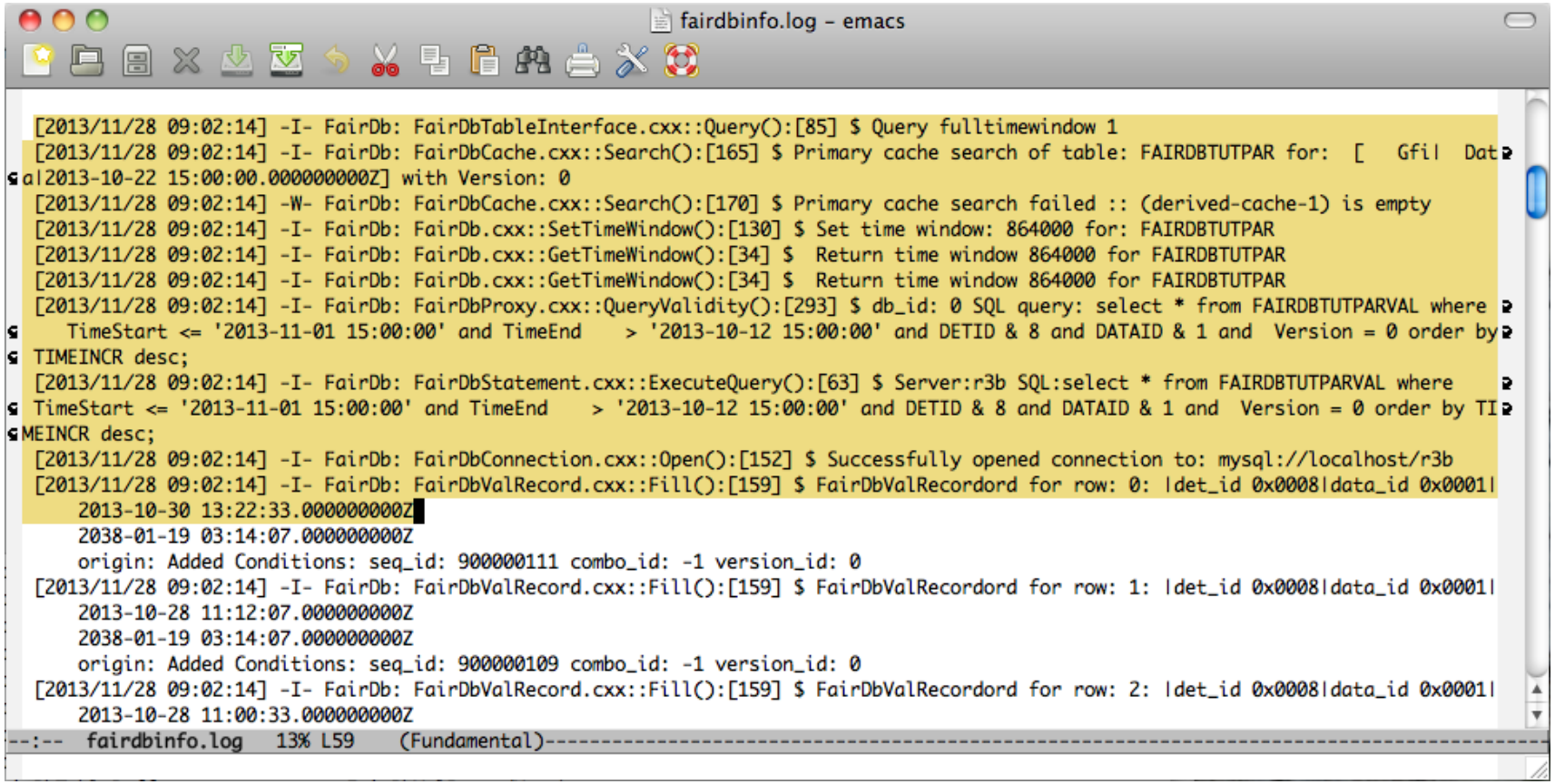
stored as byte array (RAW or BLOB)
number of values (single value or array)
class version
streamer info, root version for ROOT classes
own version management

any class derived from TObject
decoded in the analysis interface
by ROOT streamer

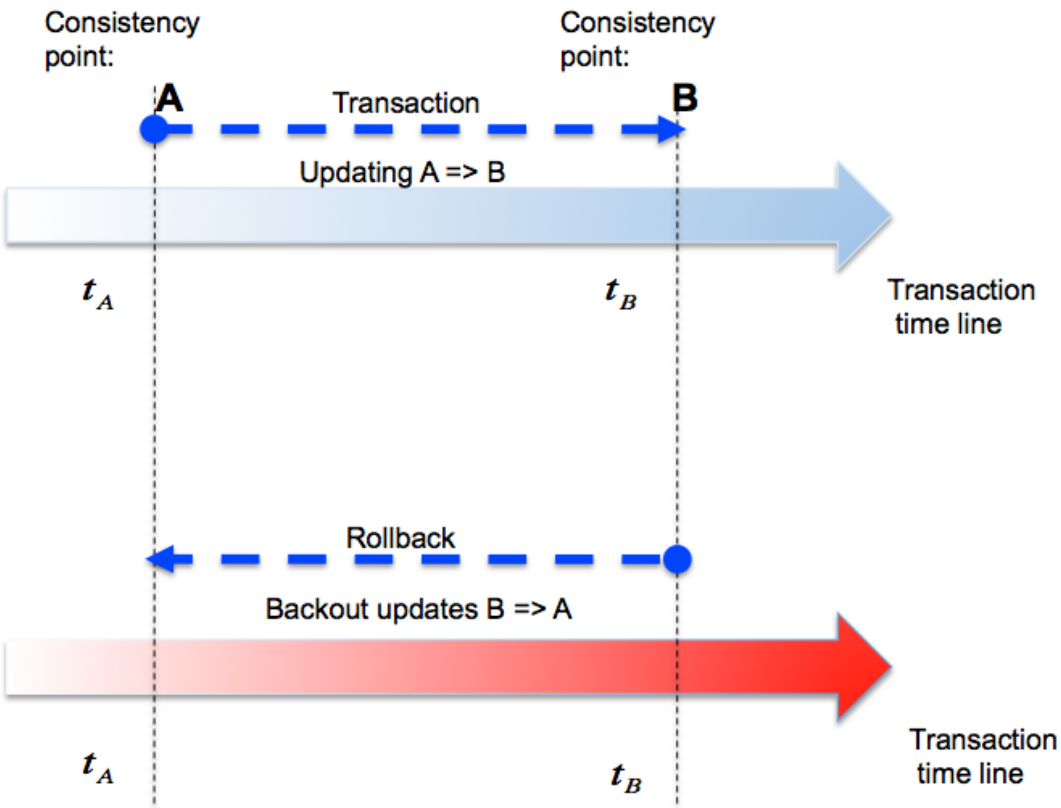
Connection Info



SQL Info


fairdbinfo.log - emacs
[2013/11/28 09:02:14] -I- FairDb: FairDbTableInterface.cxx::Query():[85] $ Query fulltimewindow 1
[2013/11/28 09:02:14] -I- FairDb: FairDbCache.cxx::Search():[165] $ Primary cache search of table: FAIRDBTUTPAR for: [Gfi| Dat
a|2013-10-22 15:00:00.000000000Z] with Version: 0
[2013/11/28 09:02:14] -W- FairDb: FairDbCache.cxx::Search():[170] $ Primary cache search failed :: (derived-cache-1) is empty
[2013/11/28 09:02:14] -I- FairDb: FairDb.cxx::SetTimeWindow():[130] $ Set time window: 864000 for: FAIRDBTUTPAR
[2013/11/28 09:02:14] -I- FairDb: FairDb.cxx::GetTimeWindow():[34] $ Return time window 864000 for FAIRDBTUTPAR
[2013/11/28 09:02:14] -I- FairDb: FairDb.cxx::GetTimeWindow():[34] $ Return time window 864000 for FAIRDBTUTPAR
[2013/11/28 09:02:14] -I- FairDb: FairDbProxy.cxx::QueryValidity():[293] $ db_id: 0 SQL query: select * from FAIRDBTUTPARVAL where
TimeStart <= '2013-11-01 15:00:00' and TimeEnd > '2013-10-12 15:00:00' and DETID & 8 and DATAID & 1 and Version = 0 order by
TIMEINCR desc;
[2013/11/28 09:02:14] -I- FairDb: FairDbStatement.cxx::ExecuteQuery():[63] $ Server:r3b SQL:select * from FAIRDBTUTPARVAL where
TimeStart <= '2013-11-01 15:00:00' and TimeEnd > '2013-10-12 15:00:00' and DETID & 8 and DATAID & 1 and Version = 0 order by TI
MEINCR desc;
[2013/11/28 09:02:14] -I- FairDb: FairDbConnection.cxx::Open():[152] $ Successfully opened connection to: mysql://localhost/r3b
[2013/11/28 09:02:14] -I- FairDb: FairDbValRecord.cxx::Fill():[159] $ FairDbValRecordord for row: 0: |det_id 0x0008|data_id 0x0001|
2013-10-30 13:22:33.000000000Z
2038-01-19 03:14:07.000000000Z
origin: Added Conditions: seq_id: 900000111 combo_id: -1 version_id: 0
[2013/11/28 09:02:14] -I- FairDb: FairDbValRecord.cxx::Fill():[159] $ FairDbValRecordord for row: 1: |det_id 0x0008|data_id 0x0001|
2013-10-28 11:12:07.000000000Z
2038-01-19 03:14:07.000000000Z
origin: Added Conditions: seq_id: 900000109 combo_id: -1 version_id: 0
[2013/11/28 09:02:14] -I- FairDb: FairDbValRecord.cxx::Fill():[159] $ FairDbValRecordord for row: 2: |det_id 0x0008|data_id 0x0001|
2013-10-28 11:00:33.000000000Z
--:-- fairdbinfo.log 13% L59 (Fundamental)

Rollback




```
FairParTSQLIo inp_io;

// Global
inp_io.SetRollback("2013-10-01","*")

// Selective
inp_io.SetRollback("2013-10-01","CALTOF*")
inp_io.SetRollback("2013-08-01","GFI*")
```

Availability

- External packages **April 2013 or higher release**
  - Root with **DB plugins**
  - FairRoot installation (`svn` or `cvmfs`)
- Use the **trunk** version of FairRoot base (or 12/2013 release)

```
https://subversion.gsi.de/fairroot/fairbase/trunk/base
```

- Add the new example directory containing the FairDB `tutorial5`

```
https://subversion.gsi.de/fairroot/fairbase/trunk/example
```

- adapt the FairDB config script **dbconfig.sh**

FairDbTutPar

```
class FairDbTutPar : public FairParGenericSet
        {
 public : // ....

private:
  // Strip Parameters
 Double_t fTopPitch;     // Strip pitch on top wafer side
 Double_t fTopAnchor;    // Anchor point of top strip#0
 Int_t    fTopNrFE;      // NFE attached to top wafer side
string    fFeType;       // Frontend type name
...

// I/O  member functions
            virtual void Fill(FairDbResultPoll* ,
                        const FairDbValRecord*);
            virtual void Store(FairDbOutTableBuffer*,
                        const FairDbValRecord* ) const;
            virtual void fill(UInt_t rid);
            virtual void store(UInt_t rid);

            // Validity frame definition
            virtual ValCondition GetContext(UInt_t rid) {
              return ValCondition(Detector::kGfi,
                                  Datatype::kData,
                                  ValTimeStamp(rid));
...         }
```

sql_param_write.C

```
FairRuntimeDb* db = FairRuntimeDb::instance();
cout << "-I- FairRuntimeDb created ----> " << db << endl;

// Create in memory the relevant container
FairDbTutPar* p1 = (FairDbTutPar*)(db->getContainer("TUTParDefault"));
FairDbTutPar* p2 = (FairDbTutPar*)(db->getContainer("TUTParAlternative"));

// Set the Ascii IO as first input
FairParAsciiFileIo* inp1 = new FairParAsciiFileIo();

TString work = getenv("VMCWORKDIR");
TString filename = work + "/example/Tutorial5/macros/ascii-example.par";
inp1->open(filename.Data(),"in");
db->setFirstInput(inp1);

// Set the SQL based IO as second input
        FairParTSQLIo* inp2 = new FairParTSQLIo();
        inp2->open();
        db->setSecondInput(inp2);

        // <INIT> containers from Ascii input
        // with assigned  RunId

       db->initContainers(runId);
       p1->Print();
       p2->Print();

       // <WRITE> back containers to the user-defined
       // Database using the SQL based IO of the
       // second input.

       db->setOutput(inp2);
       db->writeContainers();
```

Data and Metadata Tables

```
1 • select * from FAIRDBTUTPAR;
```

100% 27:1

Filter: Edit: File:

SEQNO	ROW_ID	TOPPITCH	TOPANCHOR	TOPNRFE	FETYPE
900000001	1	0.01	-3	10	APV25
900000002	1	0.0075	-2	14	APV22
900000003	1	0.01	-3	10	APV25
▶ 900000004	1	0.0075	-2	14	APV22
900000005	1	0.01	-3	10	APV25
900000006	1	0.0075	-2	14	APV22

```
1 • select * from FAIRDBTUTPARVAL;
```

100% 1:2

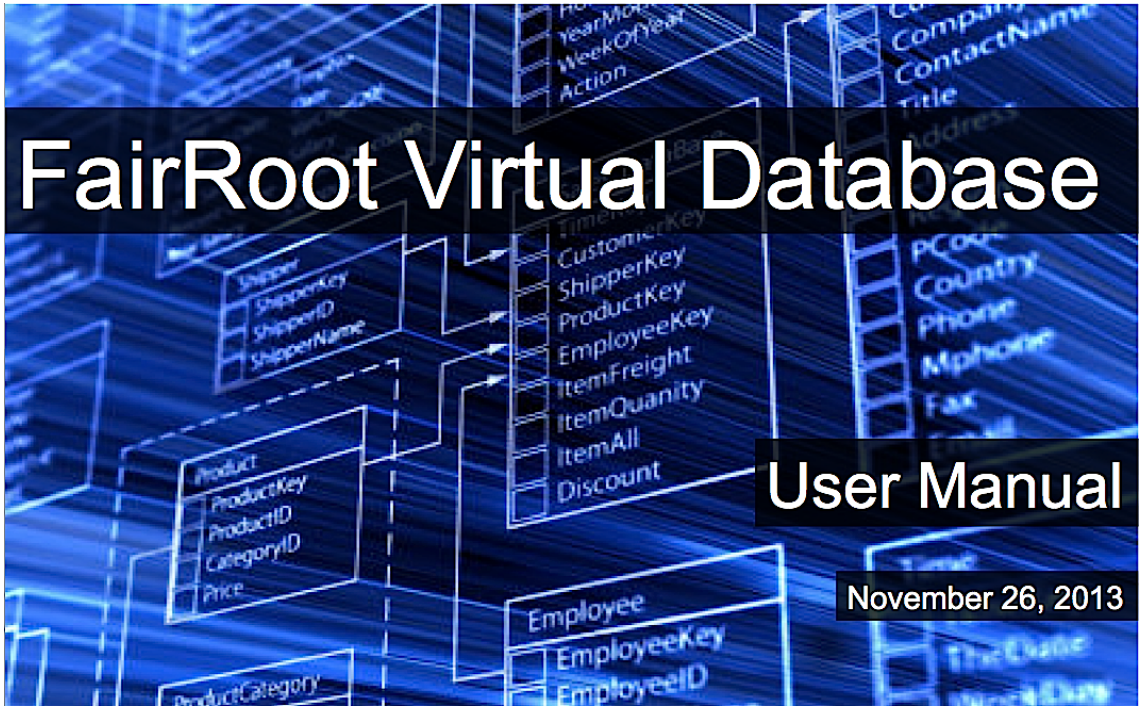
Filter: Edit: File:

SEQNO	TIMESTART	TIMEEND	DETID	DATAID	VERSION	COMPOSITEID	TIMEINCR	TIMETRANS
900000001	2013-10-22 ...	2038-01-19 ...	8	1	0	-1	2013-10-22 ...	2013-10-22 14:27:54
900000002	2013-10-22 ...	2038-01-19 ...	8	1	1	-1	2013-10-22 ...	2013-10-22 14:27:54
900000003	2013-10-22 ...	2038-01-19 ...	8	1	0	-1	2013-10-22 ...	2013-10-22 14:27:57
▶ 900000004	2013-10-22 ...	2038-01-19 ...	8	1	1	-1	2013-10-22 ...	2013-10-22 14:27:57
900000005	2013-10-23 ...	2038-01-19 ...	8	1	0	-1	2013-10-22 ...	2013-10-23 07:03:14
900000006	2013-10-23 ...	2038-01-19 ...	8	1	1	-1	2013-10-22 ...	2013-10-23 07:03:14
900000007	2013-10-23 ...	2038-01-19 ...	8	1	0	-1	2013-10-22 ...	2013-10-23 07:07:28
900000008	2013-10-23 ...	2038-01-19 ...	8	1	1	-1	2013-10-22 ...	2013-10-23 07:07:28
900000009	2013-10-23 ...	2038-01-19 ...	8	1	0	-1	2013-10-22 ...	2013-10-23 07:08:47

sql_param_read.C

```
// Create a Runtime Database singleton.
        FairRuntimeDb* db = FairRuntimeDb::instance();

        // Set the SQL IO as first input
        FairParTSQLIo* inp = new FairParTSQLIo();
        inp->open();
        db->setFirstInput(inp);

        // Create the container via the factory if not already created
        FairDbTutPar* p1 = (FairDbTutPar*)(db->getContainer("TUTParDefault"));
        FairDbTutPar* p2 = (FairDbTutPar*)(db->getContainer("TUTParAlternative"));

        // Create a dummy runID using date in UTC from which
        // corresponding  parameters will be initialised

        ValTimeStamp tStamp(2013,04,08,08,17,00);
        UInt_t runId = tStamp.GetSec();
        cout << "-I- looking for parameters at runID# " << runId << endl;
        cout << "-I- corresponding  time in runID (UTC) " << tStamp.AsString("c") << endl;

        // Use the generated RunID to initialised the parameter
        // using the SQL-based IO input
        db->initContainers(runId);

        pp1->Print();
        pp2->Print();
```

User Manual



Contents

Contents

Conclusion

- A new FairRoot database interface is available
- It does not fix the DBMS technology
  - MySQL
  - Oracle
  - PostGreSQL
  - ... NoSQL ?
- **User Manual** (available in PDF format)
- Ongoing work
  - Finalizing PostGreSQL integration
  - Realistic tests (R3B/Epics, R3B/LandO2 ...)
- User feedback needed !