Reliable online data-replication in LHCb

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March 23, 2009

Outline

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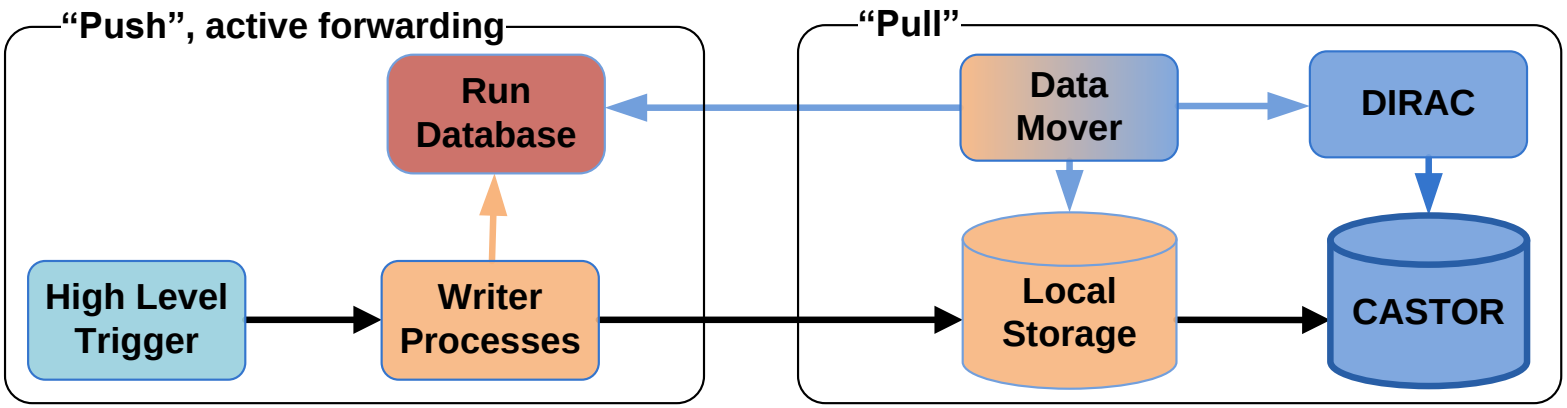
  - Prepare reconstruction and reprocessing by registering the data in the offline databases

Introduction



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  - The HLT sends events to speed optimized file writing processes
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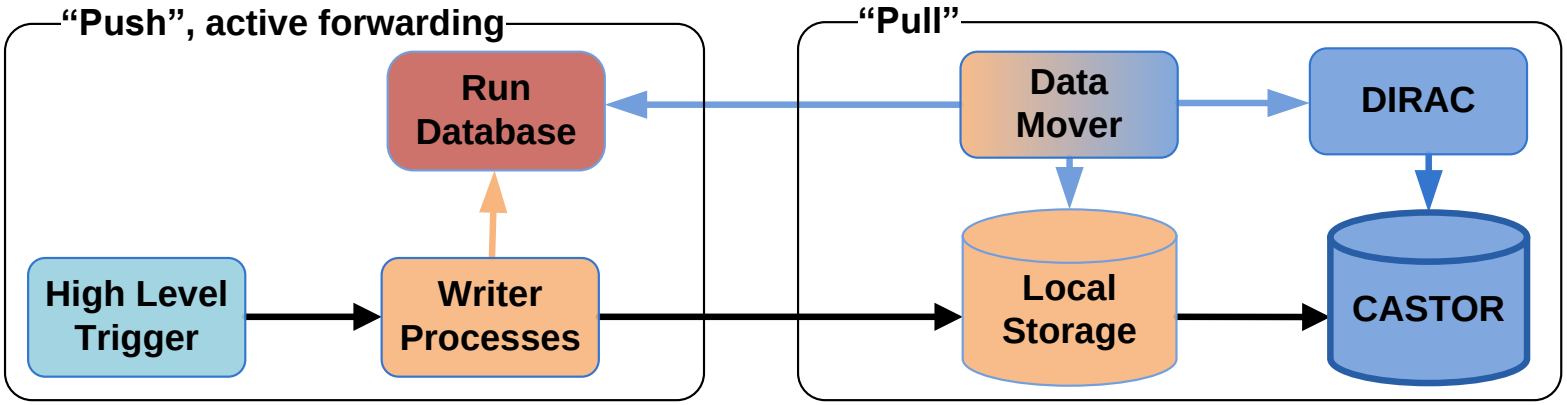

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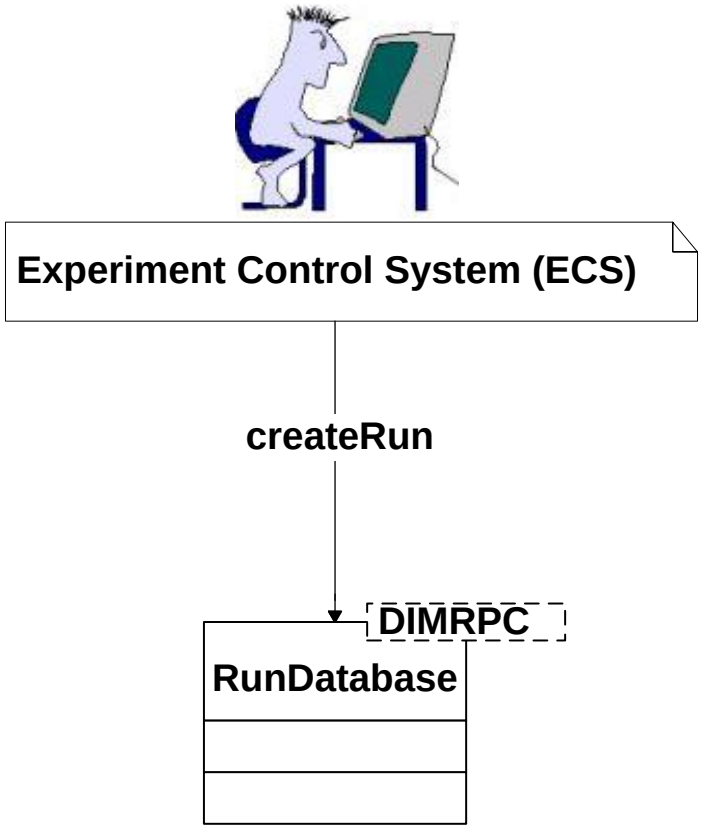
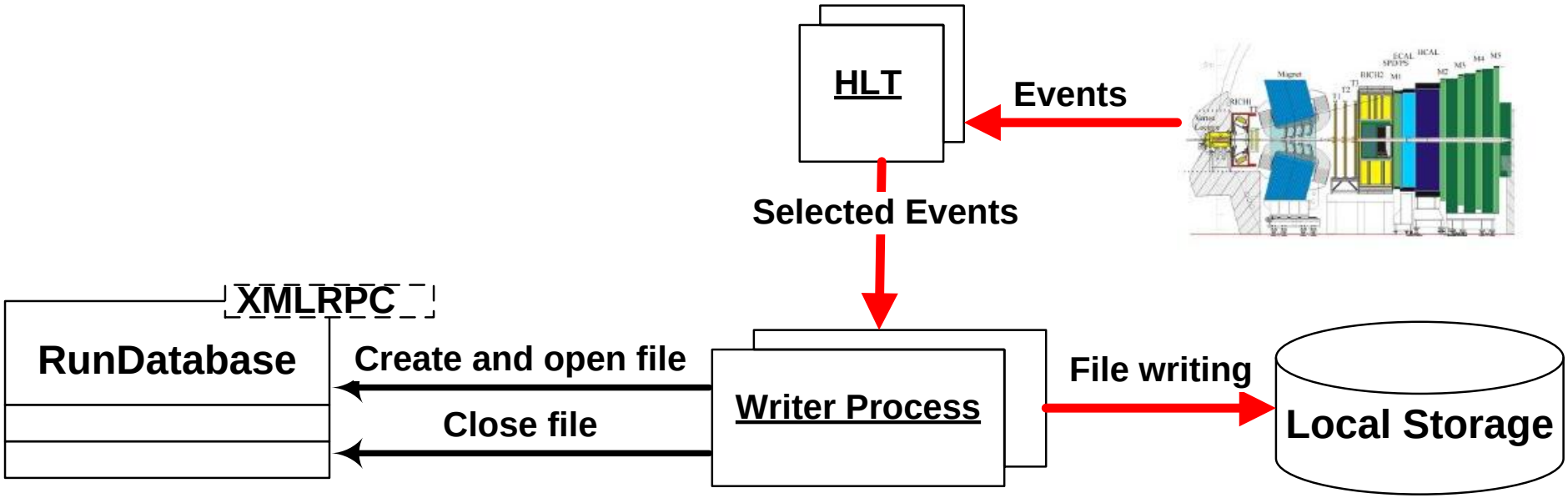
  - The HLT sends events to speed optimized file writing processes
  - File identifiers are retrieved from the Run Database
  - Events are pooled together and are written into files on a local storage system
- From the local storage system to long term storage
  - The Data Mover is polling the Run Database for new files
  - Using LHCb's Grid middleware tool DIRAC these files are then transfered to CASTOR (Cern Advanced Storage Manager) which is CERN's facility for long term storage

Storage System: Run Creation



- Runs (data taking sessions) are created via DIMRPC by the Experiment Control System (ECS)
- After creating the run in the Run Database the run number is returned

Storage System: File Writing



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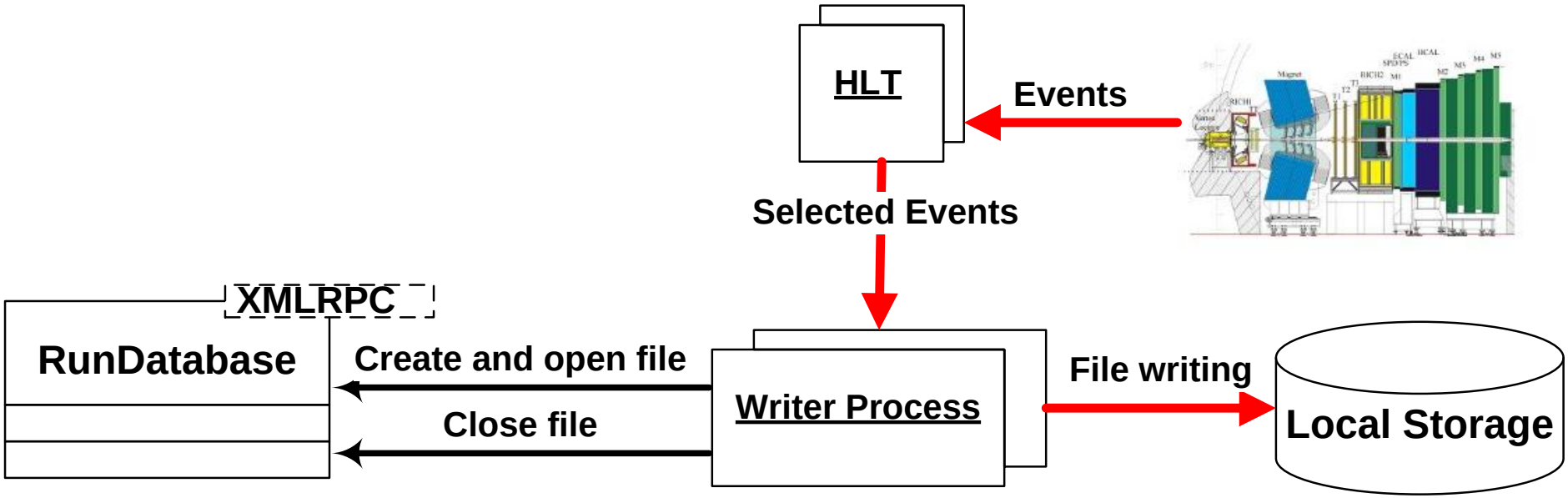

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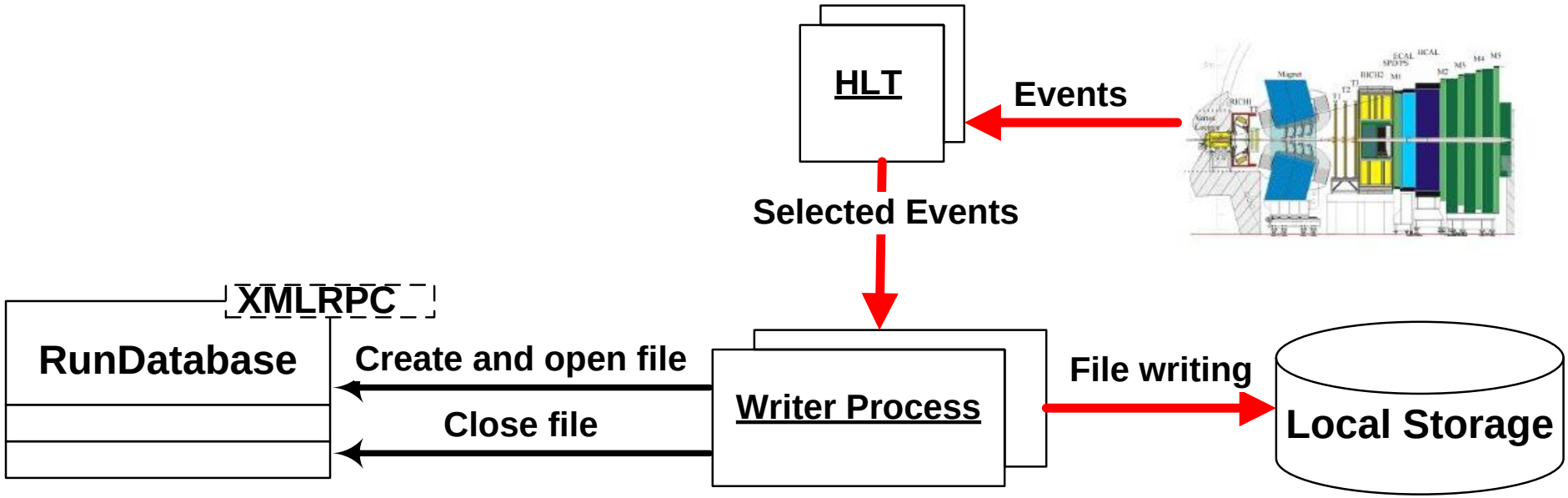

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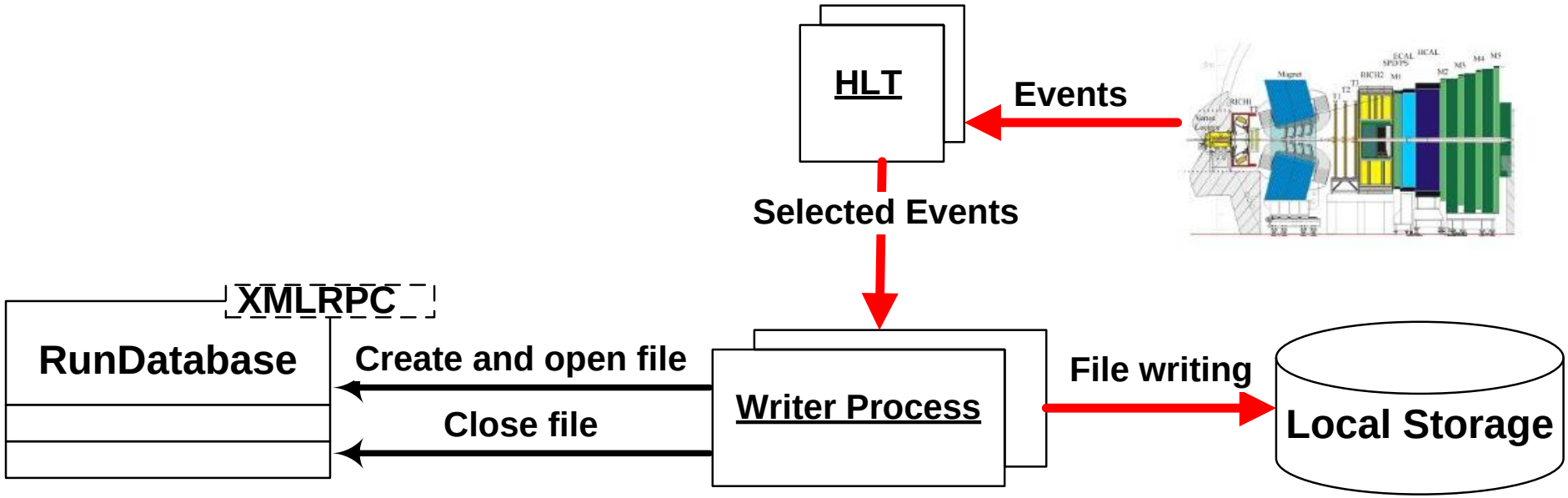

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- When a file is closed, meta data is send via XMLRPC (size, events, etc.)

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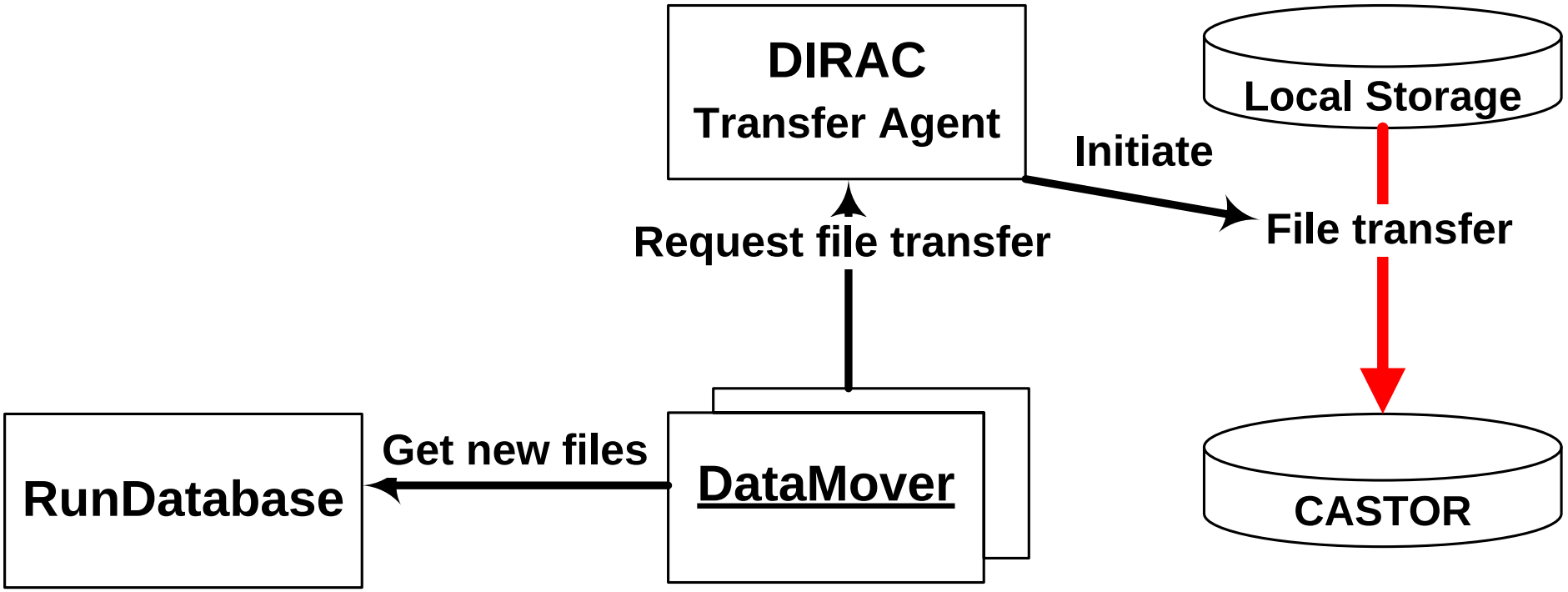

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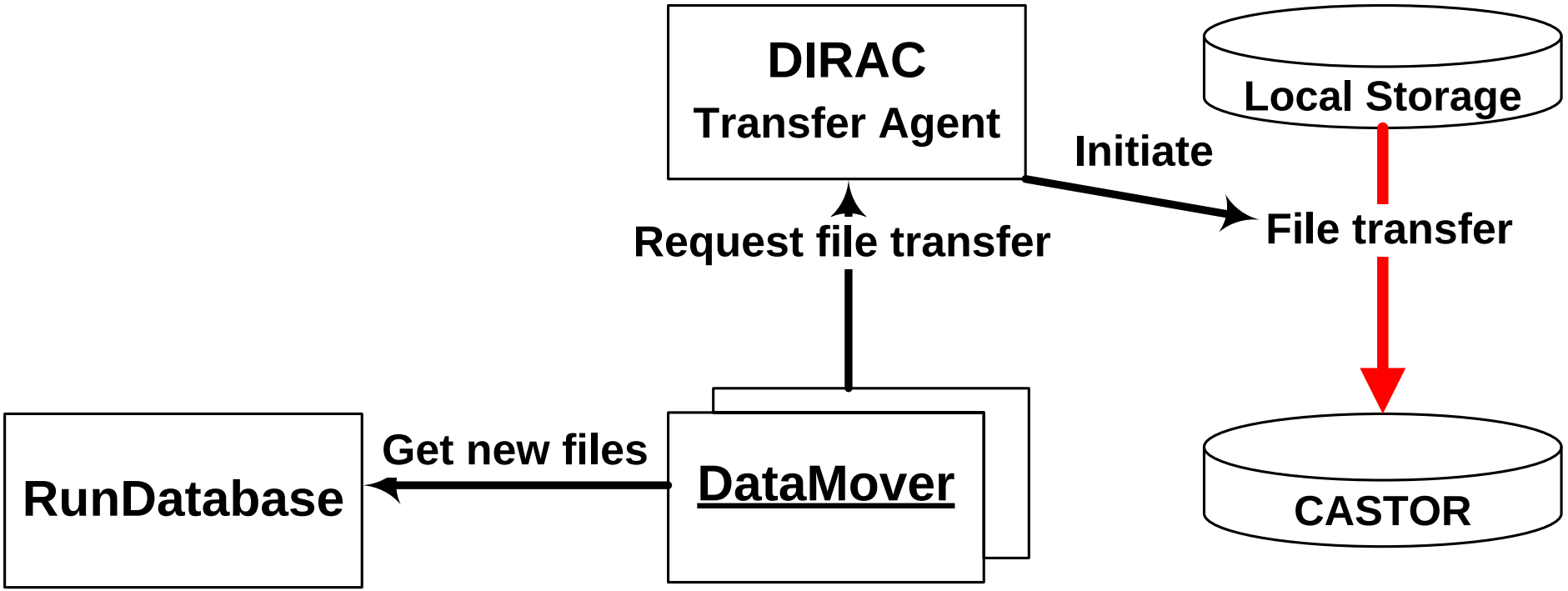

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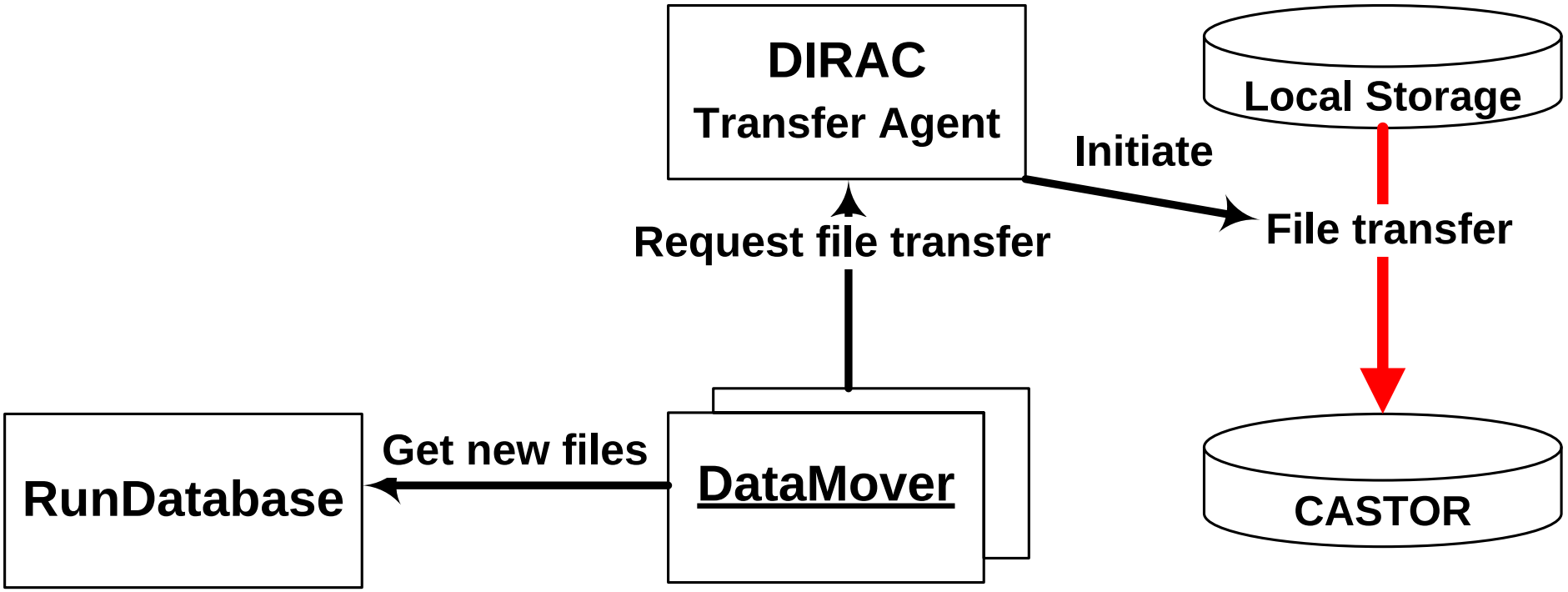

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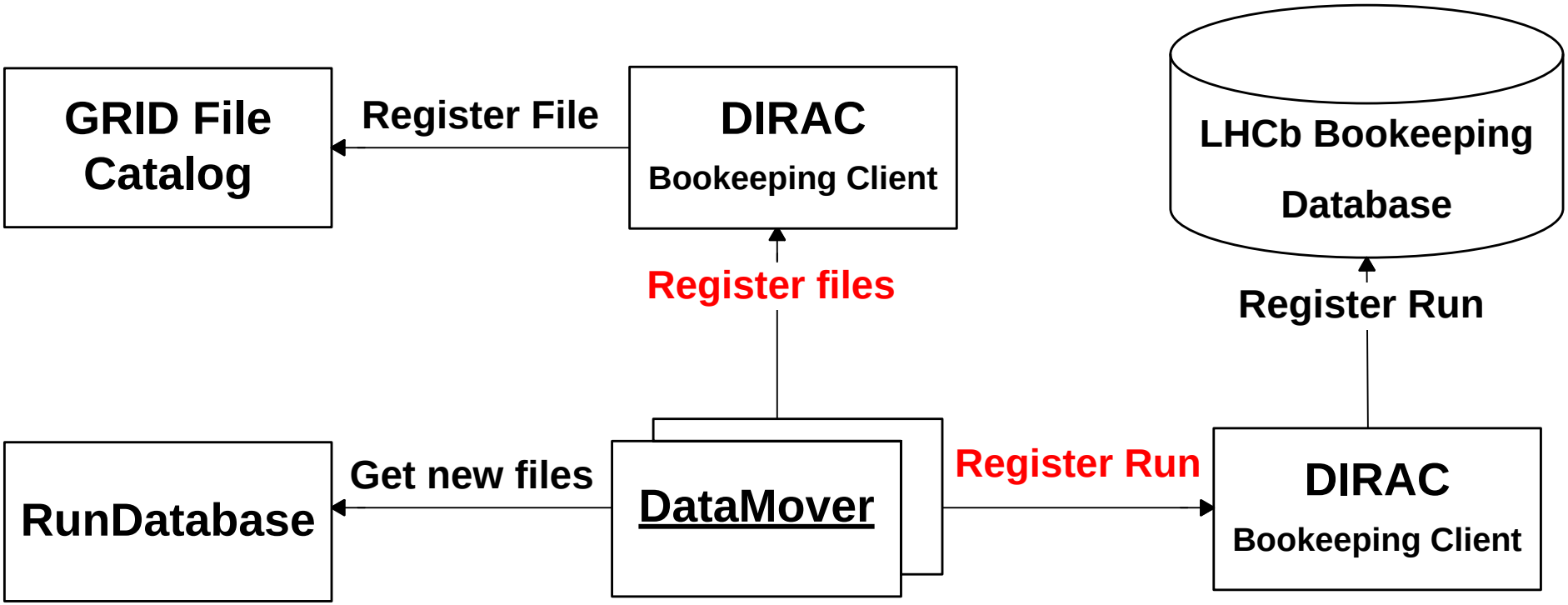
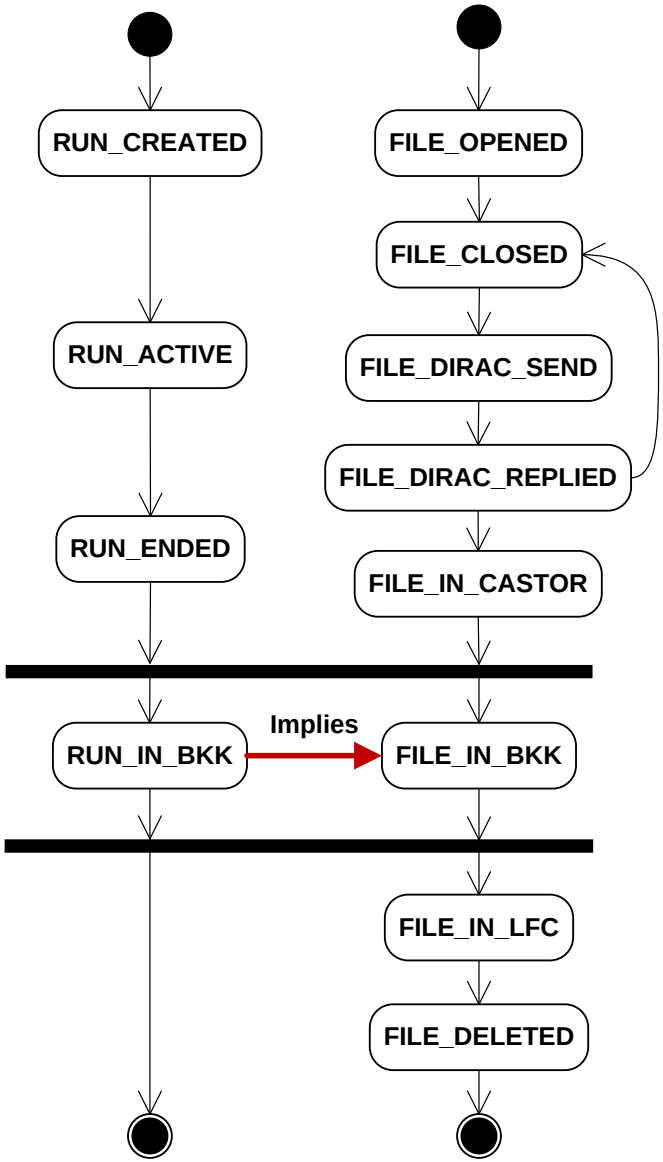
Storage System: Bookkeeping and Grid File Catalog



- The Data Mover uses the DIRAC Bookkeeping Client to...
  - ...register runs in LHCb's Bookkeeping database
  - ...register files in the Grid file catalog

Data life cycle



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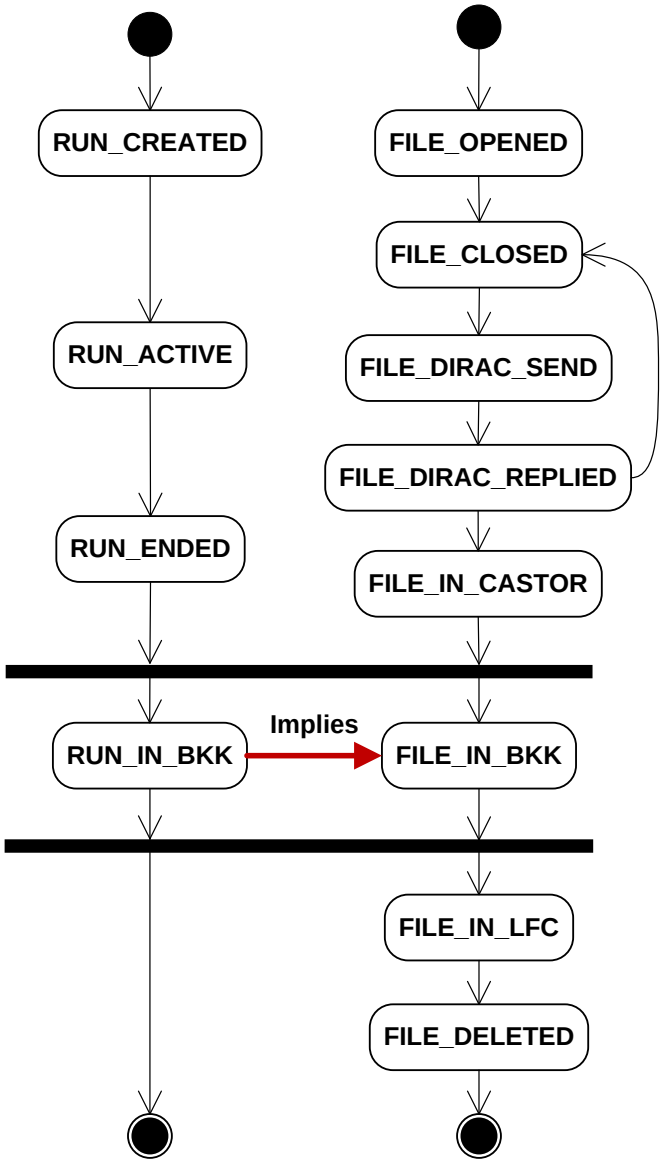

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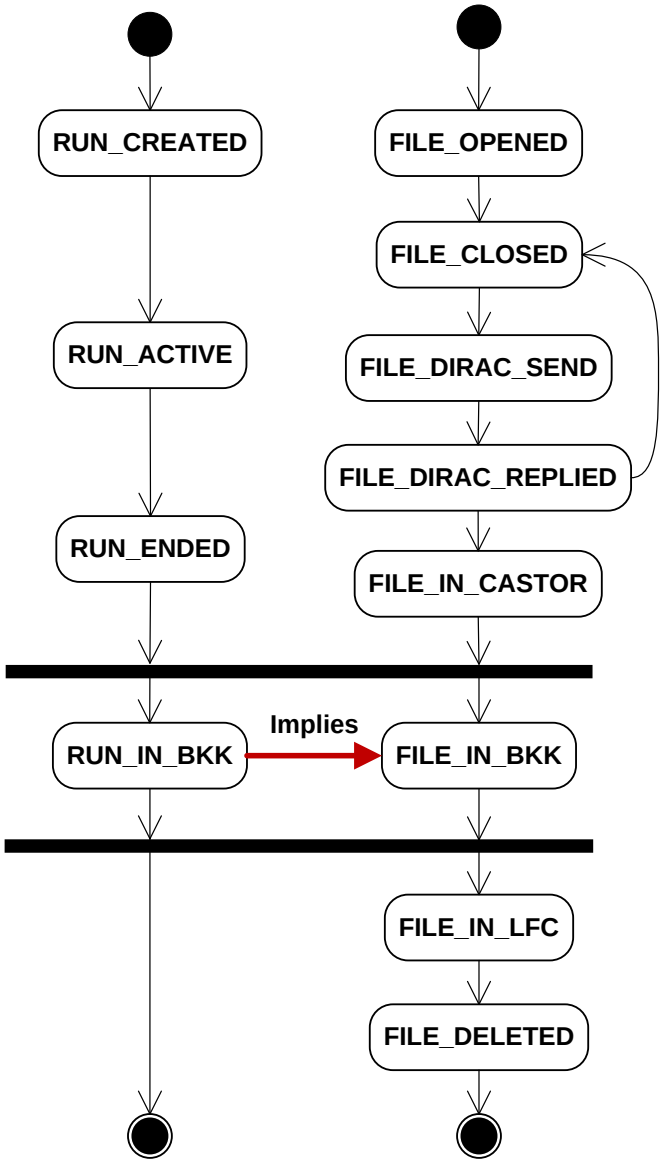

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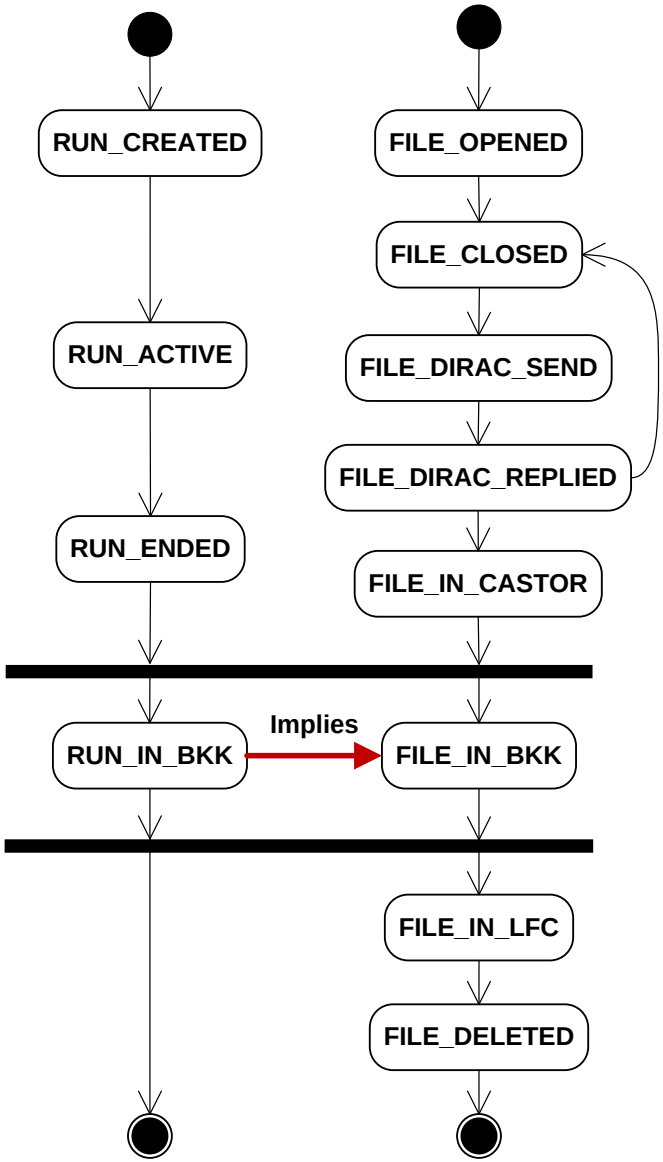

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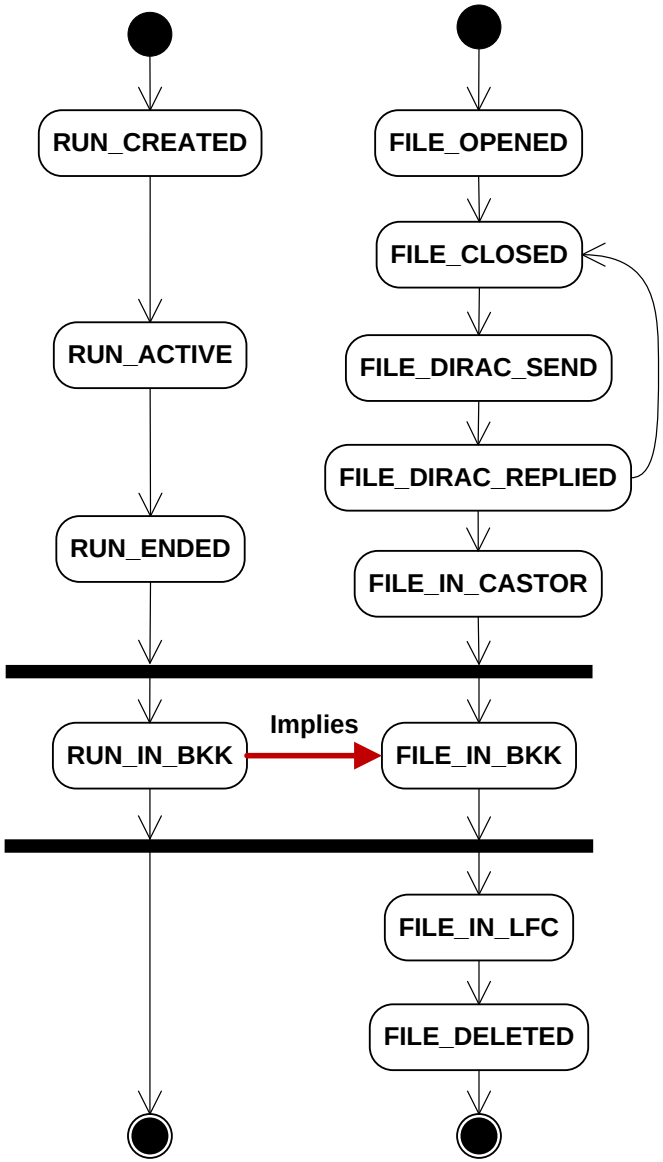

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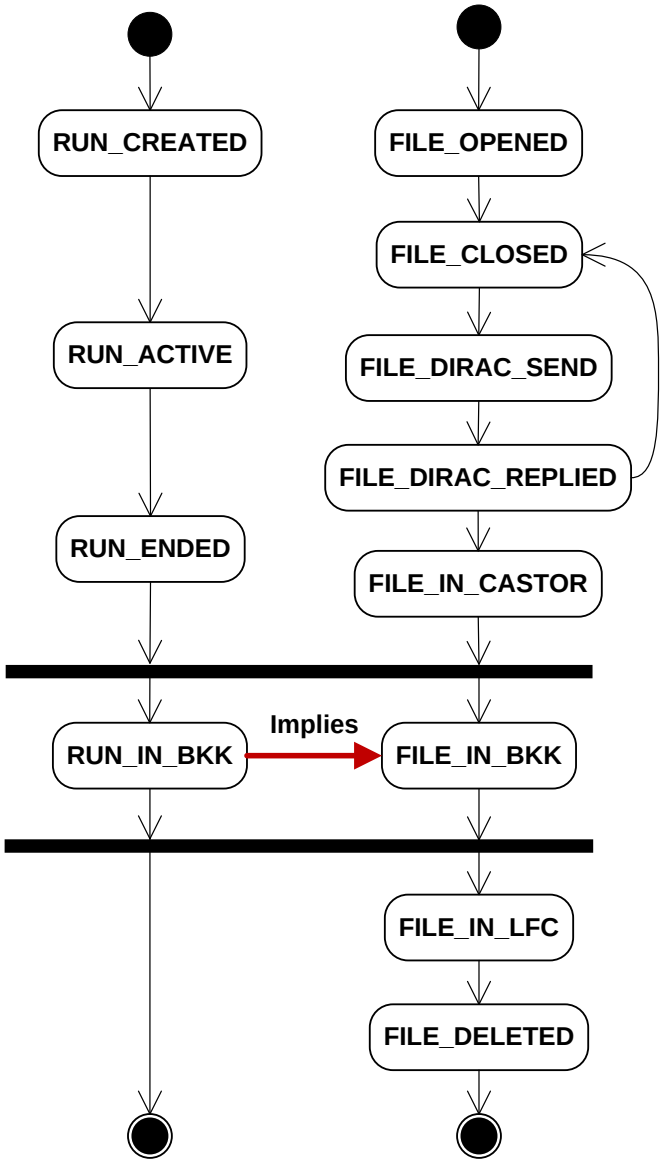

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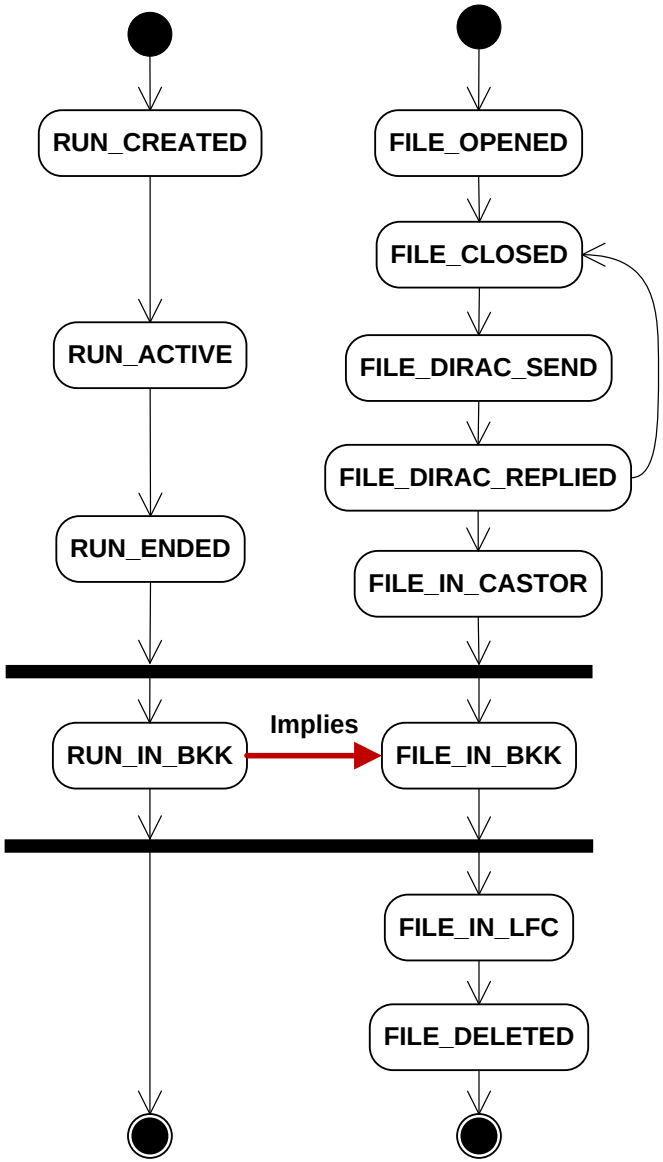

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    - ★ File Deletion: FILE_DELETED

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- Implementation in Python
  - Fast development cycle (compared to C++)
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- Use of an abstraction layer to access the database

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- Introspection
  - Used to find all public methods
  - Automatically done on every startup of the XMLRPC- and DIMRPC-Servers
  - Servers are always providing the latest version of the Run Database interface
  - No maintenance in the servers necessary

Implementation of the Run Database Abstraction Layer

- Written in Python
- Use of SQLAlchemy[1] , which is a Python SQL Toolkit
  - Table and Column definitions are given within normal Python code
  - Ability to sync table definitions with the database
  - No SQL queries: SELECTS are build with SQLAlchemy constructs

[1] sqlalchemy.org

Reliability

- Needs for reliability
  - All components of the system are still under development
  - Runs are sometimes stopped "unfriendly" (process just killed, no clean up)
  - Files are sometimes not closed (and so the final meta is missing)
  - When a writer process dies some meta date is missing
  - Before the files in the local storage system can be transfered and registered, all meta data has to exist

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- Tools (command line, web interface) to check entries in the Run Database
- Retries and cross-checks
  - Failed tasks will be retried (need for retries e.g. when a network was down or a server was not running)
  - Before the transition to the next task an intensive check is done

Additional logging into a database

- Standard logging is done via the Linux syslog daemon
- for each run or file and each state there is one entry
  - Contains date of last action
  - In error cases it gives a description of the error
- There exists a command line tool accessible for administrators and users to retrieve these entries.
- Very fast track of the history
- Can be much faster scanned than log files which are probably moved by log rotation

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- $\approx 140\,TiB$ Total data, $\approx 98\,TiB$ which has been moved to long term storage

Conclusion

Main Aspects for reliable online data-replication:

- Use of grid middleware for all tasks (DIRAC)
- Simple design, small components, dedicated for a single task
- Fault tolerance
- Retries
- Automatic check and repair routines
- Detailed logging, tools for dealing with the logs