DIRAC File Catalog

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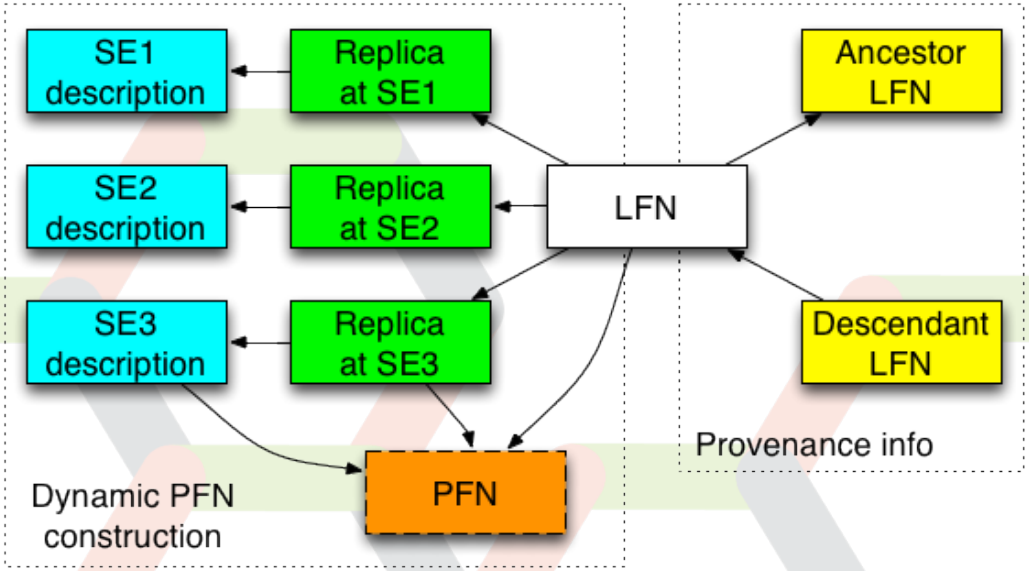
File Catalog

- The DIRAC project has as a goal to provide a full middleware stack to build distributed computing systems
  - With the possibility to easily integrate third party services
- File Catalog is a mandatory part of any distributed Data Management system
- The grid *de facto* standard LFC catalog has certain limitations in functionality and performance
- Rich experience acquired with the LHCb Data Management system
- The DIRAC File Catalog subproject was launched 3 years ago

Replica Catalog

- Standard Replica Catalog functionality
  - Optimized for bulk queries
- On the fly PFN construction
  - Small database footprint
  - Pattern used in LHCb
- Ancestor-descendent relations
  - Basic provenance information
  - Possibility to select ancestors in a given generations



Storage Usage

- Efficient Storage Usage reports
  - Necessary for quota policy management
- Using special prefilled tables
  - Updated at each new file or replica insertion
    - More efficient with bulk insertion
  - Instant reports for any directory
  - Possibility of instant "*du*" command

Storage Usage

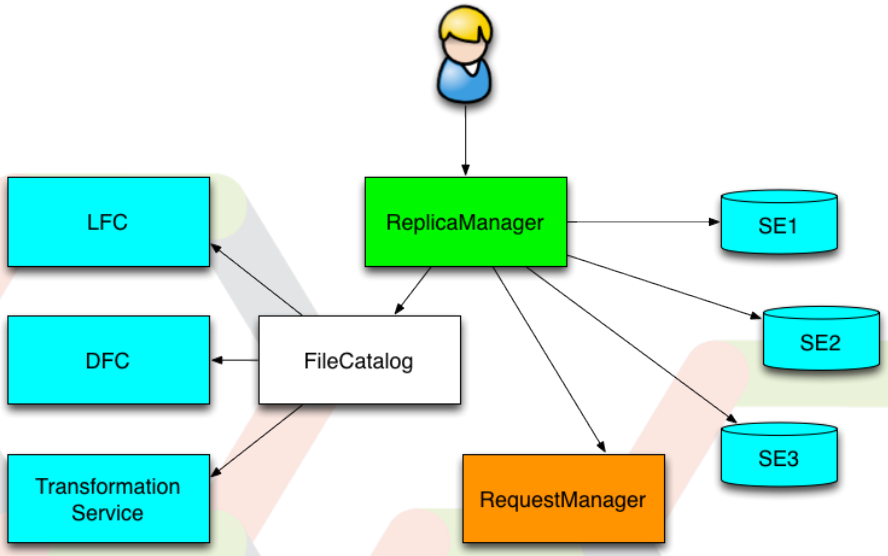
```
FC:/> size -l /lhcb/user/a/atsareg/1
directory: /lhcb/user/a/atsareg/1
Logical Size: 134,756,846 Files: 498 Directories: 500

    StorageElement  Size          Replicas
-------------------------------------------
  1 IN2P3-USER      20,254,050    75
  2 CNAF-USER       18,363,672    68
  3 RAL-USER        16,473,294    61
  4 CERN-USER       19,443,888    72
  5 GRIDKA-USER     21,064,212    78
  6 SARA-USER       20,254,050    75
  7 PIC-USER        18,903,780    70
-------------------------------------------
    Total           134,756,946   499
Query time 0.98 sec
```

- Report of storage usage for any directory
  - Whole community data
  - Per user data
  - "Logical" storage
    - LFNs, sum of the LFN sizes
  - "Physical" storage
    - Physical replicas, total volume per Storage Element

Data Management components

- For DIRAC users the use of any Storage Element or File Catalog is transparent
  - Community choice which components to use
  - Several File Catalogs can be used in parallel
    - Complementary functionality
    - Redundancy



- Users see depending on the DIRAC Configuration
  - Logical Storage Elements
    - e.g. DIRAC-USER, M3PEC-disk
  - Logical File Catalog

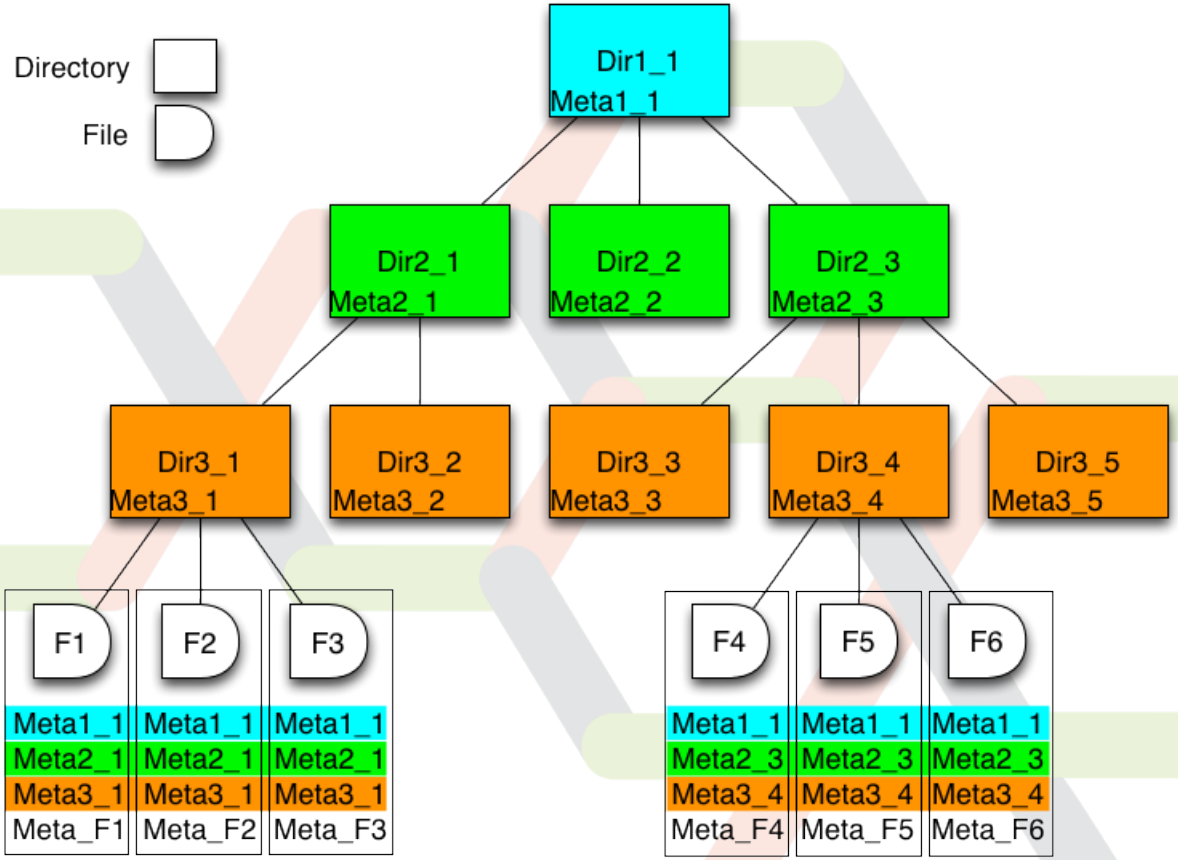
Combined use with LFC

- Using LFC and DFC in parallel is perfectly possible
  - Provided the use of the DIRAC file naming conventions
  - Using DIRAC UI tools for data manipulations (put,get,replicate)
    - Available straightaway for FG-DIRAC users
- If the LFC part is not following the DIRAC file naming conventions
  - The whole PFN for replicas must be registered
    - Reducing the DFC efficiency
    - Non-recommended
- Several communities are willing to evaluate the DFC usage as a possible LFC replacement
  - Biomed, Auger, ...
  - Unclear LFC prospects due to the end of the EMI project
- Tools exist for migration of LFC contents to DFC
- Secure database backend is necessary
  - For example, MySQL service at CC, at CERN, etc

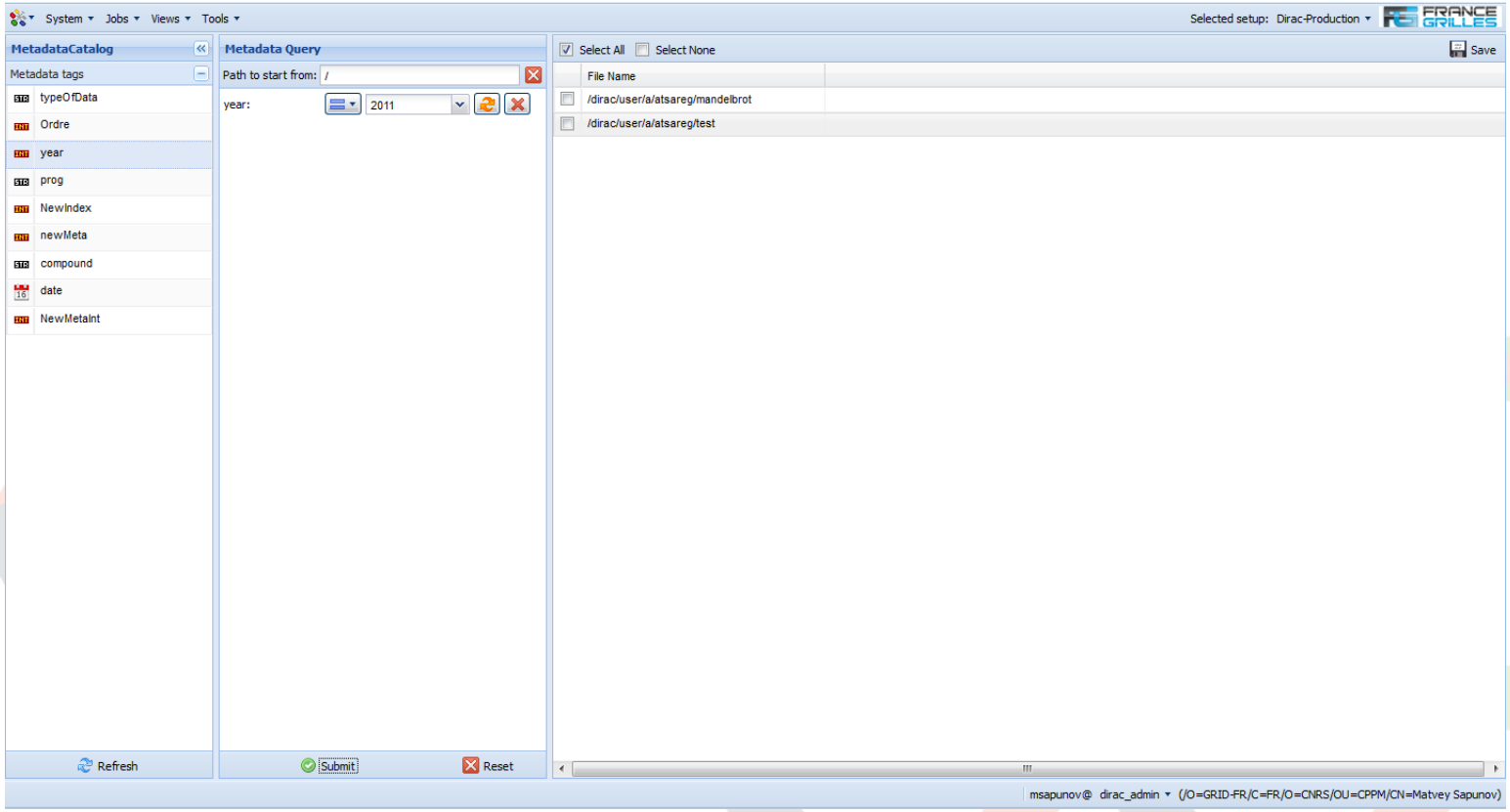
File Catalog Metadata

- Similar functionality with the AMGA metadata service
  - But coupled with the replica catalog to boost efficiency
- Metadata can be associated with each directory as key:value pairs to describe its contents
  - Int, Float, String, DateTime value types
- Some metadata variables can be declared indices
  - Those can be used for data selections
- Subdirectories are inheriting the metadata of their parents
- Data selection with metadata queries. Example:
  - `find . Meta1=Value1 Meta2>3 Meta2<5 Meta3=2,3,4`
- File metadata can also be defined

DFC Metadata



Web Portal interface

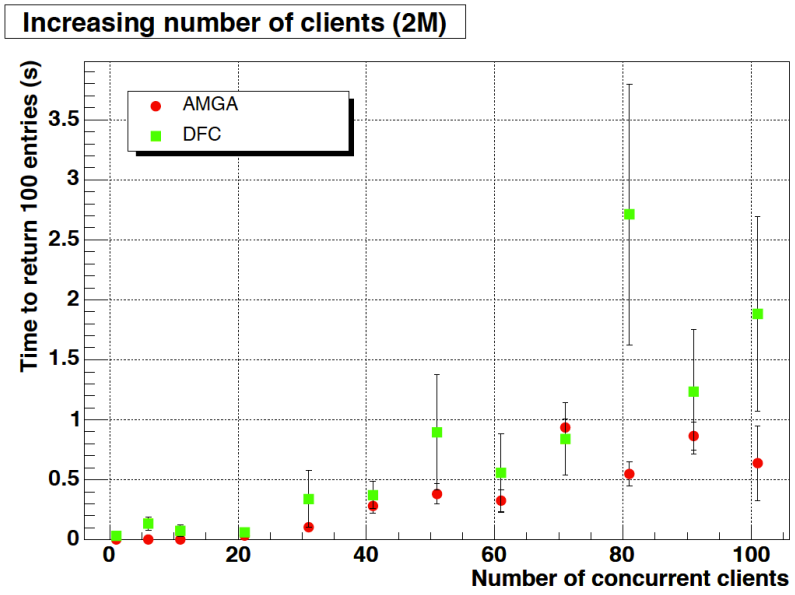


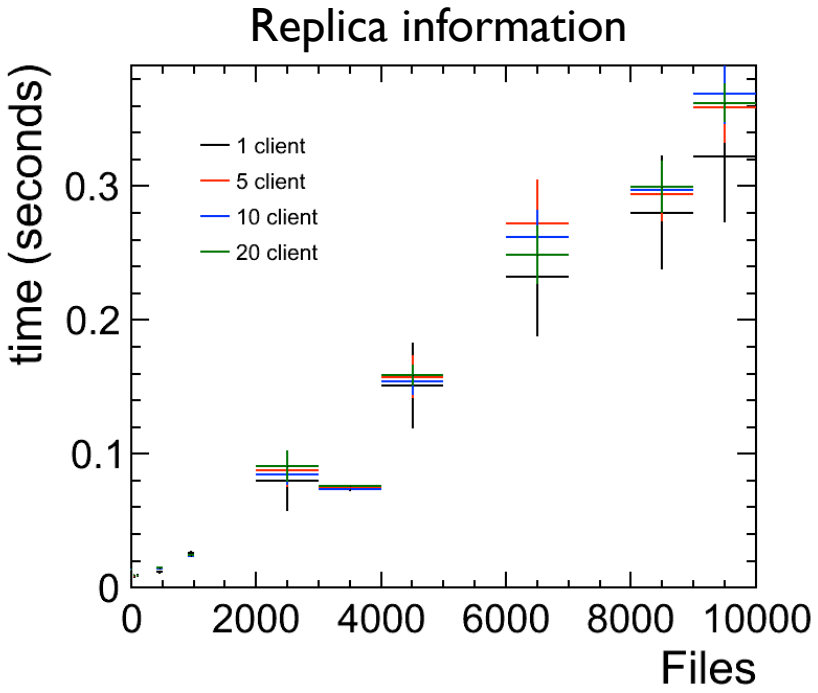
- Data search by metadata
- Basic information about data
- Data downloads
- More functionality to come

DIRAC File Catalog evaluation

- ILC/CLIC Collaboration experience
  - ~1M files
  - Intensive use of metadata, provenance data

File search by metadata





- BES Collaboration made a thorough comparison of DFC vs AMGA
  - Similar performance
  - More suitable functionality

Good example of cooperation

- The DFC development is a good example of cooperation of developers and users
  - ILC/CLIC, BES, CTA
    - Many bug reports and fixes
    - Many optimization suggestions
    - Comparison with LFC inspired many optimization ideas
  - BES
    - Comparison/competition with AMGA inspired many optimization ideas, still more to come
    - Many improvements in the catalog console interface
      - Command and data automatic completion
  - CTA
    - Many fruitful discussions on the nature of the metadata and the best way to express it in the DFC service
    - More flexible metadata schema to suit the CTA needs is in the works

Conclusions

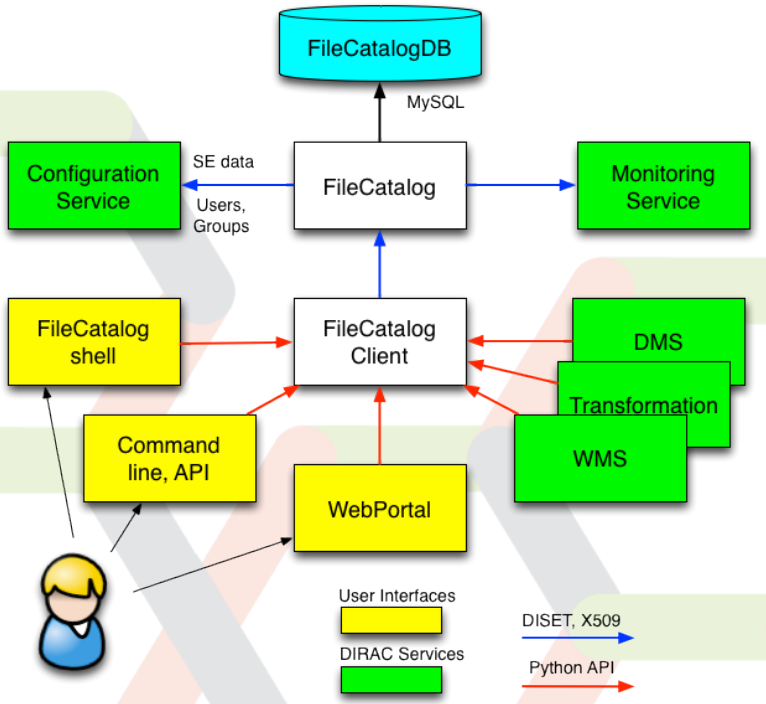
- DFC is a service combining both Replica and Metadata Catalog functionality
- It is created based on rich experience with the LFC and Bookkeeping service in the LHCb experiment
- It is becoming a mature service used in several projects with performance and functionality equivalent to LFC and AMGA
- More developments in managing Metadata are on the way

DIRAC
THE INTERWARE

Backup

DIRAC native service

- DFC is fully built in the DISET framework
- Part of the DIRAC set of services
  - Coupled to Configuration and Monitoring services
  - MySQL backend
- Accessible with a standardized FileCatalog client
- Client tools
  - command line
  - CLI
  - Python API



Metadata development

- The currently available DirectoryMetadata module
  - Subdirectory inherits the parent metadata
  - Subdirectory can not override parent metadata values
  - Simple to implement, allows for dynamic metadata optimization
  - Allow for a simple and intuitive GUI interface
  - Limiting in the description of real life cases
- The new DirectoryTagMetadata module is in the works
  - Inspired by the CTA case
  - Subdirectories can provide additional values to the parents
  - Allow for data tags – metadata with multiple values
  - The work is in progress
- Different modules can be chosen by configuration parameters of the given DFC service

Combined use with LFC

- The LHCb case
  - LFC is the main replica catalog
    - Central instance at CERN
  - DFC is alternative write-only catalog
    - Kept in sync with LFC via a common FileCatalog client
    - Synchronization ensured by the failover mechanism
    - Can replace the actual heavy StorageUsage service
  - Deployment plan
    - Installing an empty DFC service
    - Starting to put new data in both catalogs
      - Ignoring errors due to orphan replicas
    - Copying the existing LFC data to DFC in parallel

Further plans

- Metadata optimization
  - Metatags
  - Metaqueries
  - Query efficiency optimization
- Better Directory and File Metadata integration
  - Transparent to the user
  - Dynamically reorganized to increase efficiency
- Tighter coupling with the Transformation System
  - Possibility to register data driven operations
    - Possible now with the Transformation DB as an independent catalog
  - Basis for the Replication Service
    - Similar to the Globus Online or iRods services