EDG Replica Manager and Replica Location Service

Status and Plans

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Data Management Work Package: WP2

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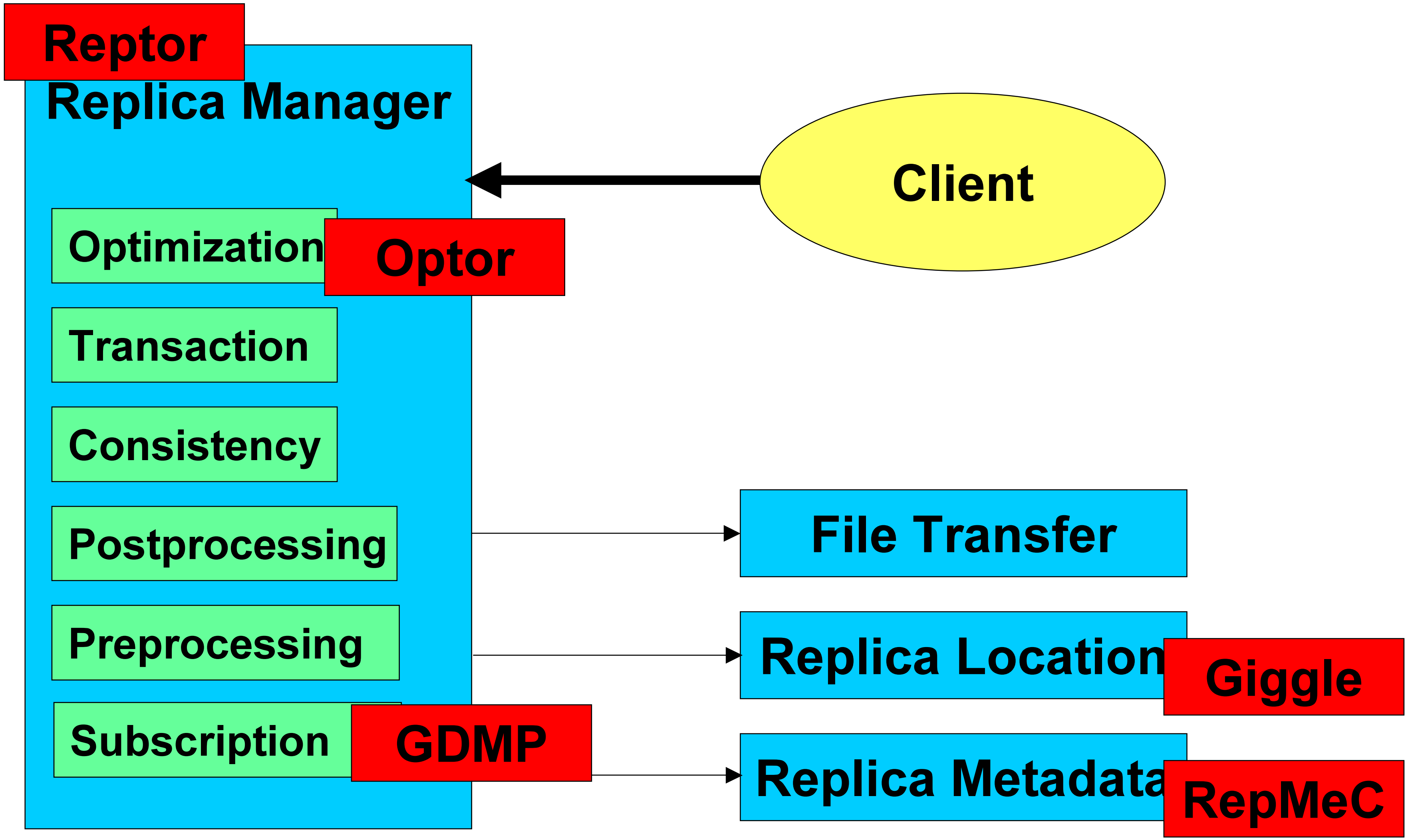
EDG Replication Services



Replica Manager components (1)

Reptor: Replication Manager

- Replication management system.
- Entry point for all clients
- Triggers automated replication of files

Giggle: Replica Location Service

- Local Replica Catalog services LRC: LFN-PFN mappings
- Replica Location Index services RLI: index on LFNs
- Set of configurable servers

GDMP: GRID Data Mirroring Package

- Automated replication of files all over the GRID Storage Elements
- Automatic updating of the replica catalog

RepMec:Replication Metadata Catalogue

- An instance of Spitfire with RDBMS backend and specialized schema

Replica Manager Components (2)

Optor: Optimisation service

- Replica Selection based on economic modelling
- Automated replication for load balancing

Processing

- Hooks for pre- and postprocessing while replicating

Transaction

- Ensure atomic ‘replication’ functionality
- Robustness of service

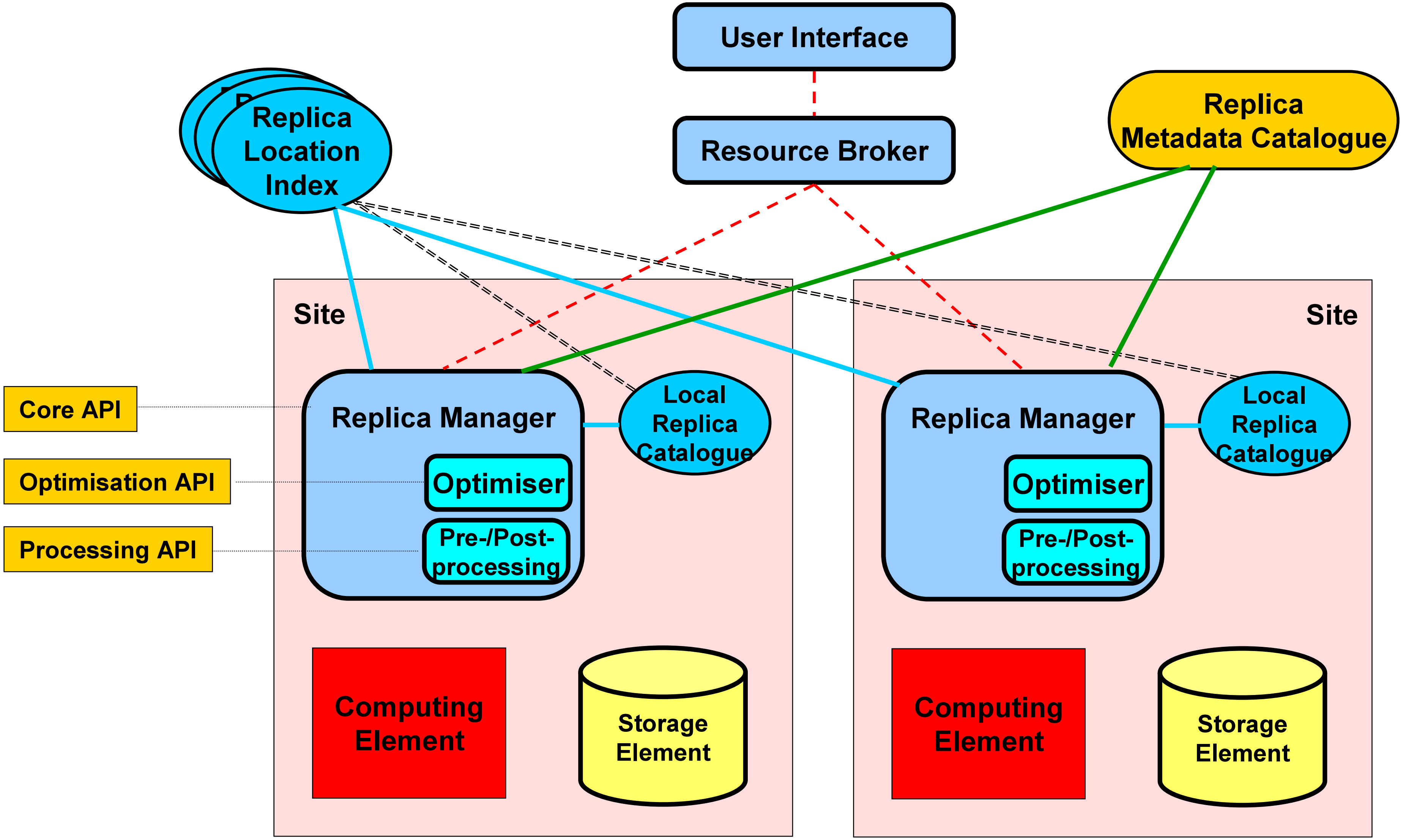
Consistency

- Check consistent state of Replication Services
- Ensure consistent view of files in RLS and SRM
- Ensure consistent Master file attribute

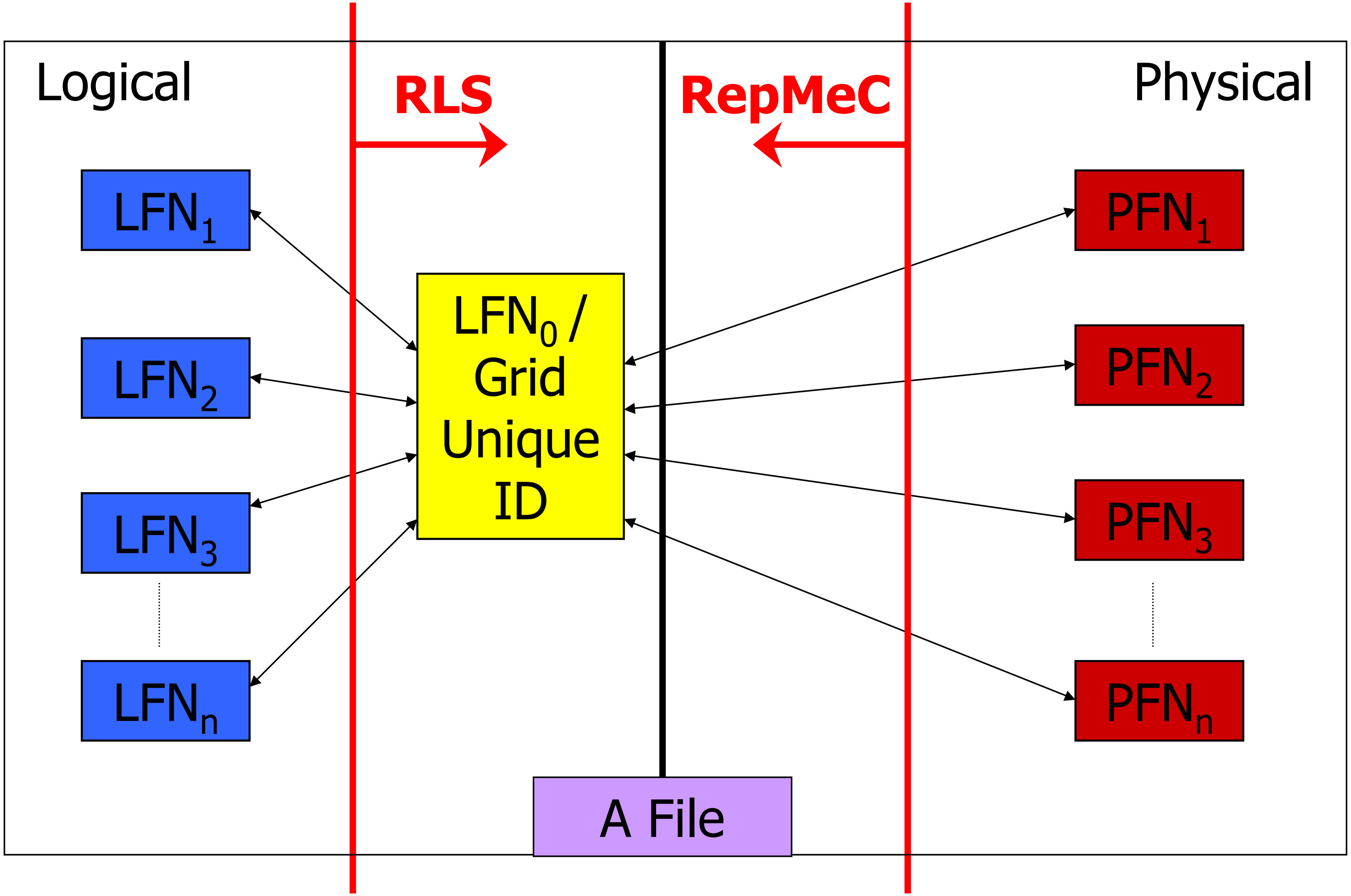
File Transfer

- GridFTP and other protocols

Replica Manager Architecture



File mappings



Replica location problem

Given a unique logical identifier for some given data, determine the physical location of one or more physical instances of this data

Replica Location Service:

- maintains information on the physical location of files
- maintains mapping between the logical identifier of data and all its physical instances
- provides access to this information

RLS Requirements

- Versioning & read only data
  - distinct versions of files can be uniquely identified
  - data published to the community are immutable
- Size
  - scale to hundreds of replica sites, 50 x 10^8 LFNs, 500 x 10^8 PFNs
- Performance
  - 200 updates/second, average response time < 10ms
- Security
  - knowledge and existence of private data must be protected
  - storage system protects integrity of data content
- Consistency
  - view of all available PFNs not necessarily consistent
- Reliability
  - no single point of failure,
  - local and global state decoupled,
    - failure of remote component does not hinder access to local component

Giggle Framework

Giggle: A Framework for Constructing Scalable Replica Location Services

- Joint collaboration between WP2 and Globus
- Paper submitted to SC2002

- Independent local state maintained in Local Replica Catalogues : LRCs
- Unreliable collective state maintained in Replica Location Indices : RLIs
- Soft state maintenance of RLI state
  - relaxed consistency in the RLI, full state information in LRC
- Compression of soft states
  - compress LFN information based on knowledge of logical collections
- Membership and partitioning information maintenance
  - RLS components change over time : failure, new components added
  - Service discovery and system policies

Local Replica Catalogue (LRC)

- Maintains replica information at a single site
  - Complete locally consistent record
  - Queries across multiple sites not supported
- Maintains mappings between LFNs and PFNs on associated storage systems
  - Coordinates its contents with those of the storage system
- Responds to the following queries:
  - Given an LFN, find the set of PFNS associated with that LFN
  - Given a PFN, find the set of LFNS associated with that PFN
- Supports authentication and authorisation when processing remote requests
- Periodically sends information about its state to the RLIs

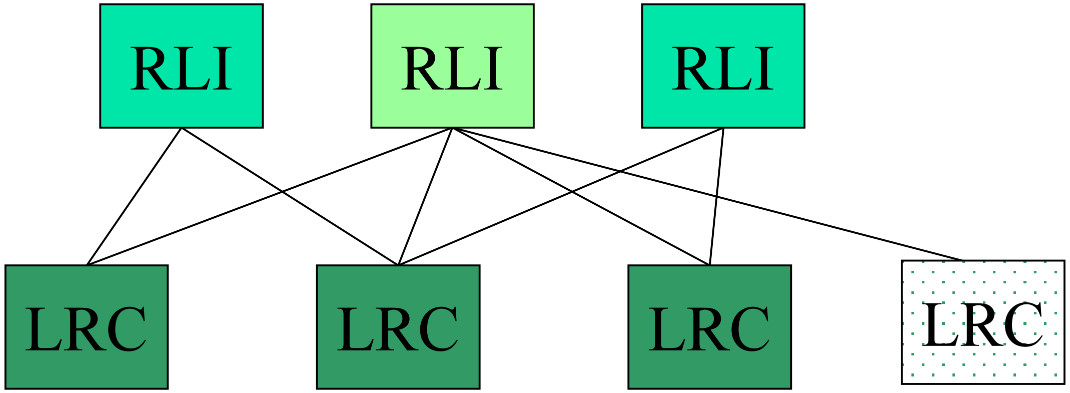
Replica Location Index (RLI)

Index structure needed to support queries across multiple sites

- One or more RLIs to map LFNs to LRCs
  - Structure w.r.t LRCs can be freely defined
  - redundancy, performance, scalability
- Geographical partitioning – all PFNs of a set of LRCs are indexed
- Namespace partitioning 1 – for load balancing purposes
- Namespace partitioning 2 – only LFNs adhering to a specified pattern are indexed for all LRCs
  - possibly not good for load balancing
- Many identical RLIs may be set up for load balancing

RLS Architecture (1)

A 2 level RLS layout: The RLIs contain pointers to LRCs only.



🟩 Multiply indexed LRC for higher availability

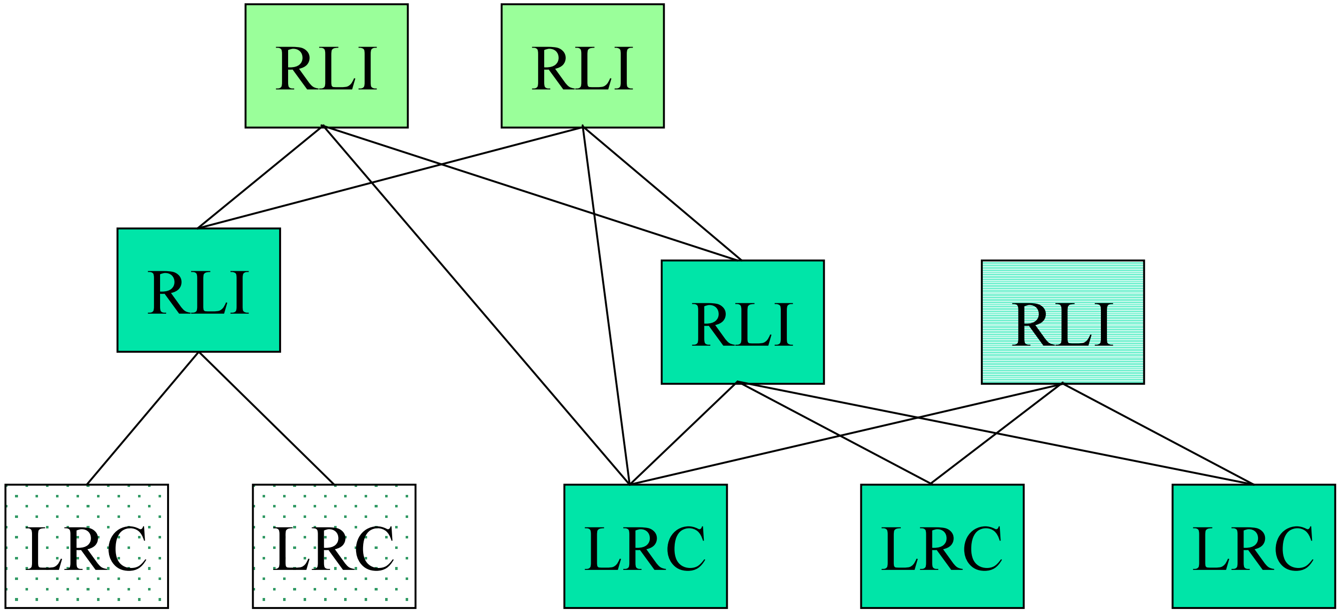
⬚ LRC indexed by only one RLI

🟩 RLI indexing over the full namespace (all LRCs are indexed)

🟩 RLI indexing over a subset of LRCs

RLS Architecture (2)

A hierarchical RLS topology: The RLIs point to LRCs and RLIs



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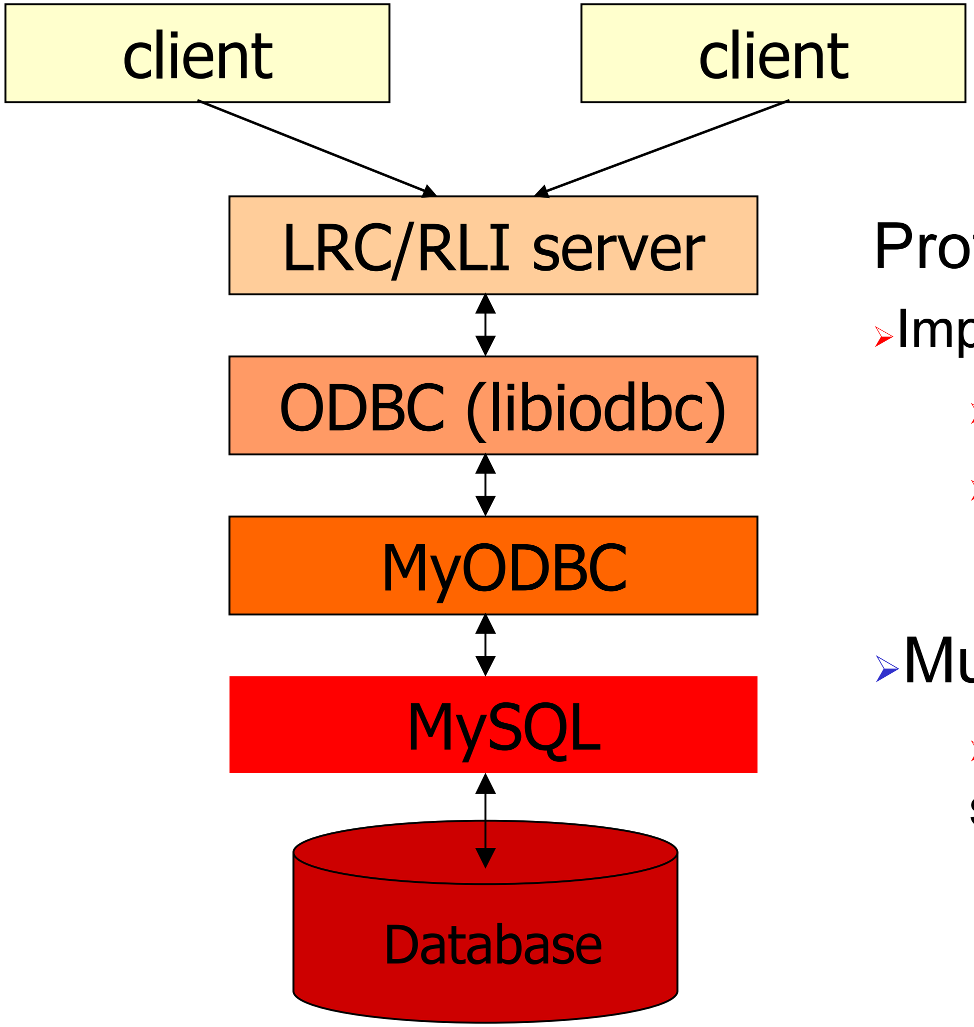
RLS Server Prototype



Prototype implementation:

- Implemented in C; relies on
  - Grid Security Infrastructure
  - globus_io_socket layer

- Multithreaded server
  - configure as an LRC and/or RLI server

Performance results (1)

Preliminary results only !

- Performance results document will be released soon

- Platforms
  - Solaris 2.8 (US) Red Hat Linux 6.1 (CERN)
- Time to add/create/delete/read an LFN entry
  - Number of entries in LRC from 0 -> 1000k
  - ~ 15-16 ms , no noticeable increase in time with database size
- Time to perform soft state update
  - Increases linearly with the number of entries in the LRC
  - ~8 secs for 1000 entries in LRC
  - ~10000 secs for 1000k entries in the LRC
- ~1667 queries/sec, 67 updates/second

Release plans

- RLS is currently installed on 4 EDG nodes at CERN
- Current release is an alpha :
- Initial testing debugging completed
- Giggle paper submitted to SC2002 with preliminary performance results
- Final performance results expected by end July
- Expect to have an RLS - RPM by end of June 2002
- Expect to have a full set of integrated replication services for testbed2 by the end of September

Future work

- Web Services paradigm – the RLS is one of the early adopters of the Open Grid Services Architecture
  - OGSA interface will be available by the end of this year, still needs exact definition
- Compression of RLI state – bloom filters.