Managing Groups of Files in a Rule Oriented Data Management System (iRODS)

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Content

Definitions (1/2)

Grid
Unites many systems within a virtual network

Data Grid
Access to distributed data resources or repositories

Data Grid Management System
Middleware software to "glue" resources together

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Definitions (2/2)

SRB - Storage Resource Broker

- Data Grid middleware developed at the San Diego Supercomputer Center (SDSC)
- Distributed file system, based on a client-server architecture
- Access files seamlessly across a distributed environment

iRODS - Rule Oriented Data System

- New Data Grid middleware developed at the San Diego Supercomputer Center (SDSC)
- Same features than SRB and more
- Express management policies as rules

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SRB Overview

- Location transparency

- Improved reliability and availability

- Fault tolerance

- Single Sign On

- Integrated data access

- Federation

SRB Acceptance

- Used in more than 100 projects world-wide
- More than a PetaByte stored in SRB systems
  - Taiwan National Data Archives
  - BIRN - Biomedical Informatics Research Network
  - National Optical Astronomers Observatory (NOAO)
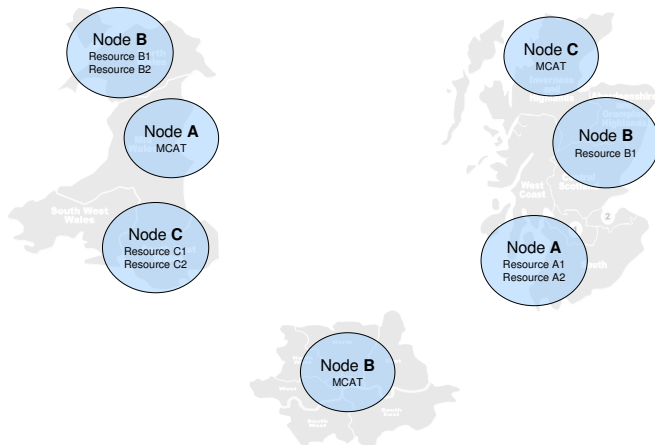 - UK eScience
  - ....

Architecture
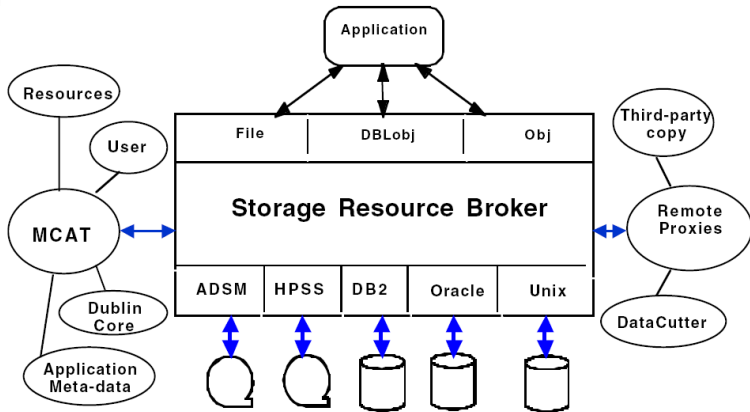
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[1] R. Moore. Knowledge-based grids. IEEE Symposium on Mass Storage Systems and Technologies, IEEE Computer Society, 2003
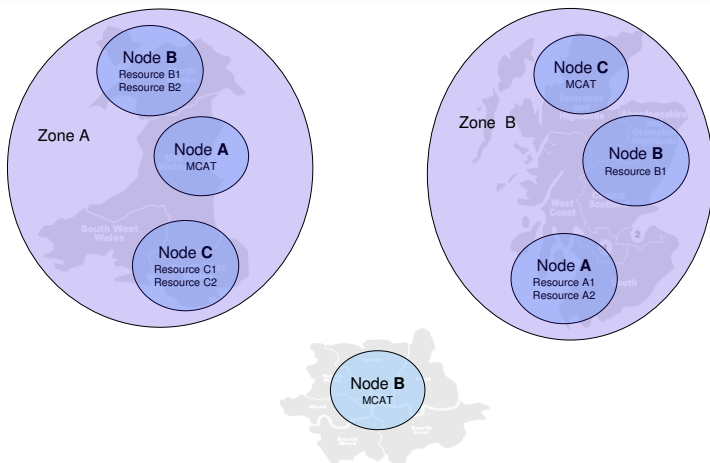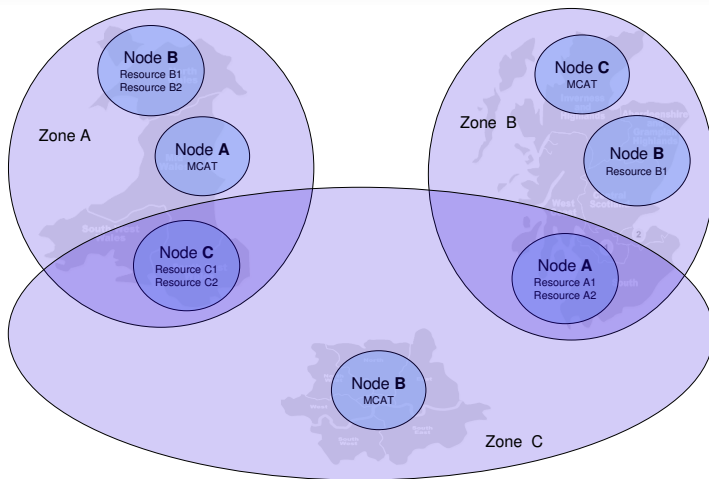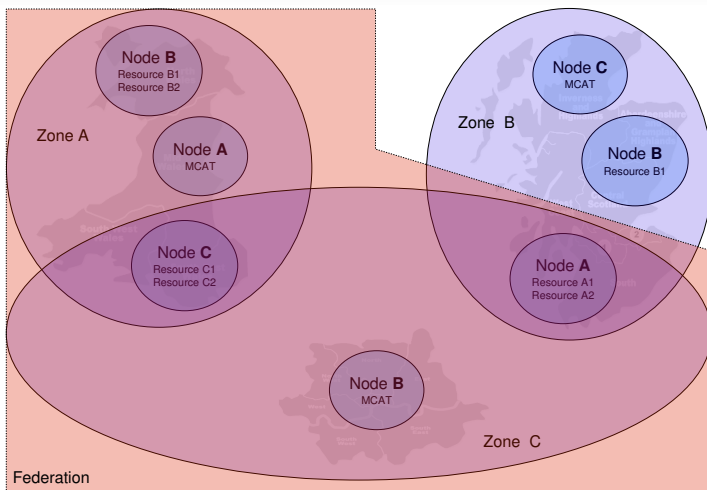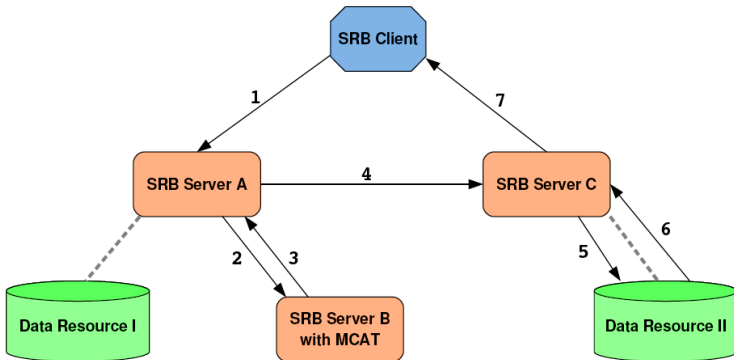
Example

Example

Example

Example

Example

Data Flow

2

_____

2 based on http://www.vislab.uq.edu.au/research/SRB/background.html

Why a new system ?

SRB Shortcomings

- SRB is quite complex

- Many operations

- Intelligence is hard-code

- Extensions/modifications require extreme care

- Does not allow incorporation of data management policies

Aims

- System which is more flexible than SRB

  - Additional post processing on ingestion
  - Use workflows for server-side data management
  - Provide queued and batch processing

- Rule-based architecture to provide flexibility

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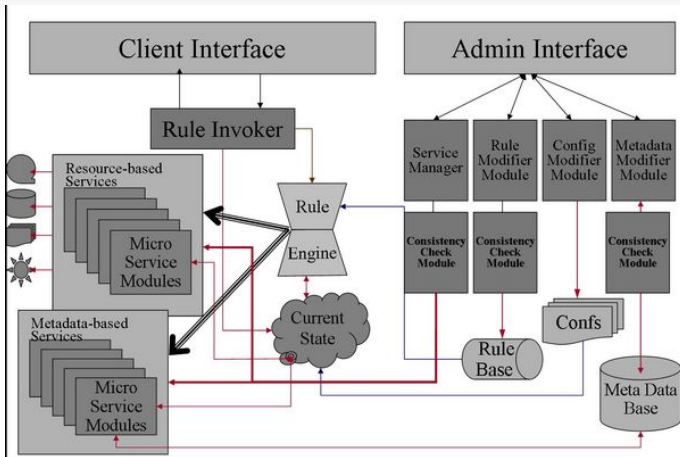
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Managing Groups of Files in a, Rule Oriented Data Management System (iRODS)

iRODS Overview

- Open source client-server middleware

- Rule based management

- User can individualise work flow

- Only needed services compiled

Architecture

Rules

- Instructions, triggered by events

- Microservices (C-Functions)

- System individualisation

- Pre- and post processing

Rule Format

actionDef|condition|workflow-chain|recovery-chain

Example

HAAW(*A,*B)||HAAW-Bundle(*A,*B)|nop

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Rule Types

- **Atomic** - applied immediately
- **Deferred** - support deferred consistent constraints
- **Periodic** - typically used to validate assertions

Motivation

THE PROBLEM !

- Small files - inefficient use of mass storage capabilities

- Improve usage of storage space

- Overcome performance problems within SRB - container concept

- Container downsides
    - No extensible metadata functionality
    - Not very efficient
    - No decrease in size
    - Tied to SRB
    - No container handling outside SRB

Motivation

WHAT DO WE WANT !

- Replace SRB containers

- Archives within the system

- Archive handling in and outside iRODS

- Improve handling of huge amount of small files within iRODS

- Extensible metadata capabilities

- Plug- and Play

Requirements

- Mounted Collections

- Basic requirements
  - Store all types of files
  - Add, delete, update files
  - Dynamically adjust of archive size
  - Accessable/usable in- and outside of iRODS
  - Searchable
  - Metadata
  - Single File only
  - Open Source

- Further requirements
  - Performance
  - Small Overhead compared to stored data
  - Compression
  - Encryption
  - Platform independent
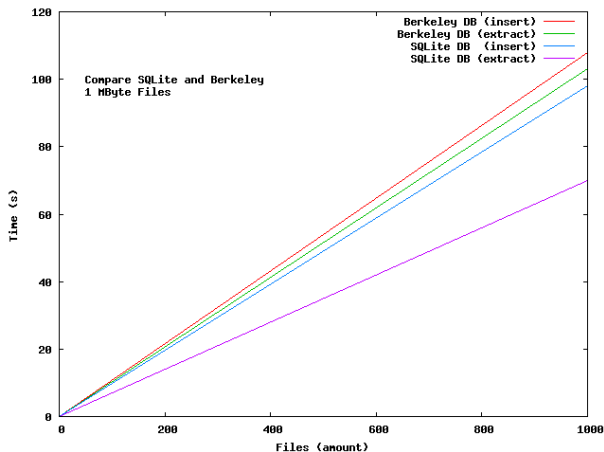
Finding the Right System

- Database engine
    - Structured
    - Fast
    - Safe

- Single file only database

- Open source engines
    - Berkeley Database
    - Apache Derby
    - SQLite

- Standalone application

Database Performance Tests
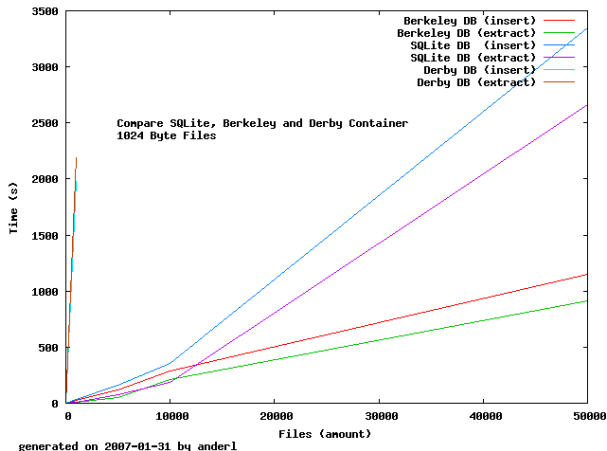
Database Performance Tests

Why SQLite

- Derby
  - Java
  - Very slow

- Berkely
  - Not single database file although described as single file only database
  - Slower with larger files

SQLite

"Small. Fast. Reliable."[4]

- Single-file Cross-platform Database

- Zero-Configuration

- Cross-platform (Linux (Unix), MacOSX, OS/2, Win32 and WinCE)

- Self-Contained

- Public Domain (free to copy, modify, publish, use, compile, sell, or distribute SQLite code)

- Transactions are ACID

  - **A**tomic
  - **C**onsistent
  - **I**solated
  - **D**urable

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[4] http://www.sqlite.org

HAAW Archive

- SQLite database
    - Performance
    - Open Source
    - Single File
    - Embedded

- Metadata capabilities

- Independent of iRODS

- Hybrid of 7zip and SQLite
    - Overcome limitations in space
        - terabyte-sized databases
        - maximum length of a string or BLOB - 2 GB
    - Compression algorithm (LZMA compression[5])
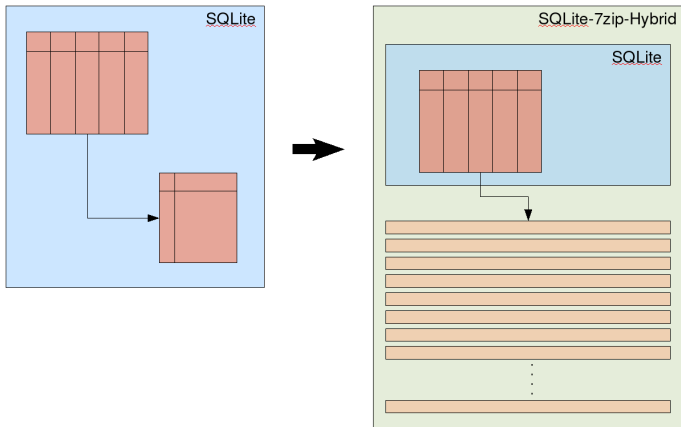   - Encryption algorithm (AES-256 encryption[6])

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[5]LZMA - Lempel-Ziv-Markov chain-Algorithm

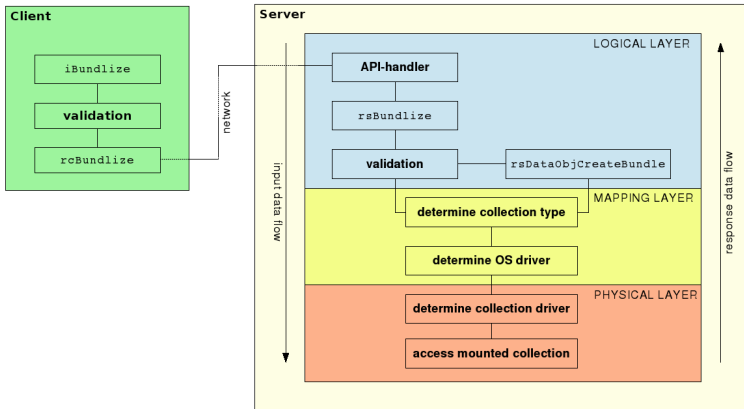[6]AES - Advanced Encryption Standard

7zip

- File archiver

- High compression ratio

- Open source software (most source code under GNU LGPL license)

- LZMA SDK (Software Development Kit)

SQLite - 7zip - Hybrid

Framework

Framework mostly developed by Mike Wan (San Diego Supercomputer Center)

Summery

- Definitions

- SRB

- iRODS

- Mounted Collections

Thank you !

- Presentation Arcot (RAJA) Rajasekar, Data Grid Technologies Group, SDSC,UCSD, 2007

- R. Moore. Knowledge-based grids. IEEE Symposium on Mass Storage Systems and Technologies, IEEE Computer Society, 2003

- B. Strong, D. Corney, P. Berrisford, T. Folkes, C. Moreton-Smith, and K. Kleese- Van-Dam. Key lessons in the efficient archive of small files to the CCLRC MSS using SRB. Technical report, IEEE, 2005

- http://irods.sdsc.edu/

- http://www.sqlite.org

- http://www.7-zip.org/