SRM-iRODS Interface Development

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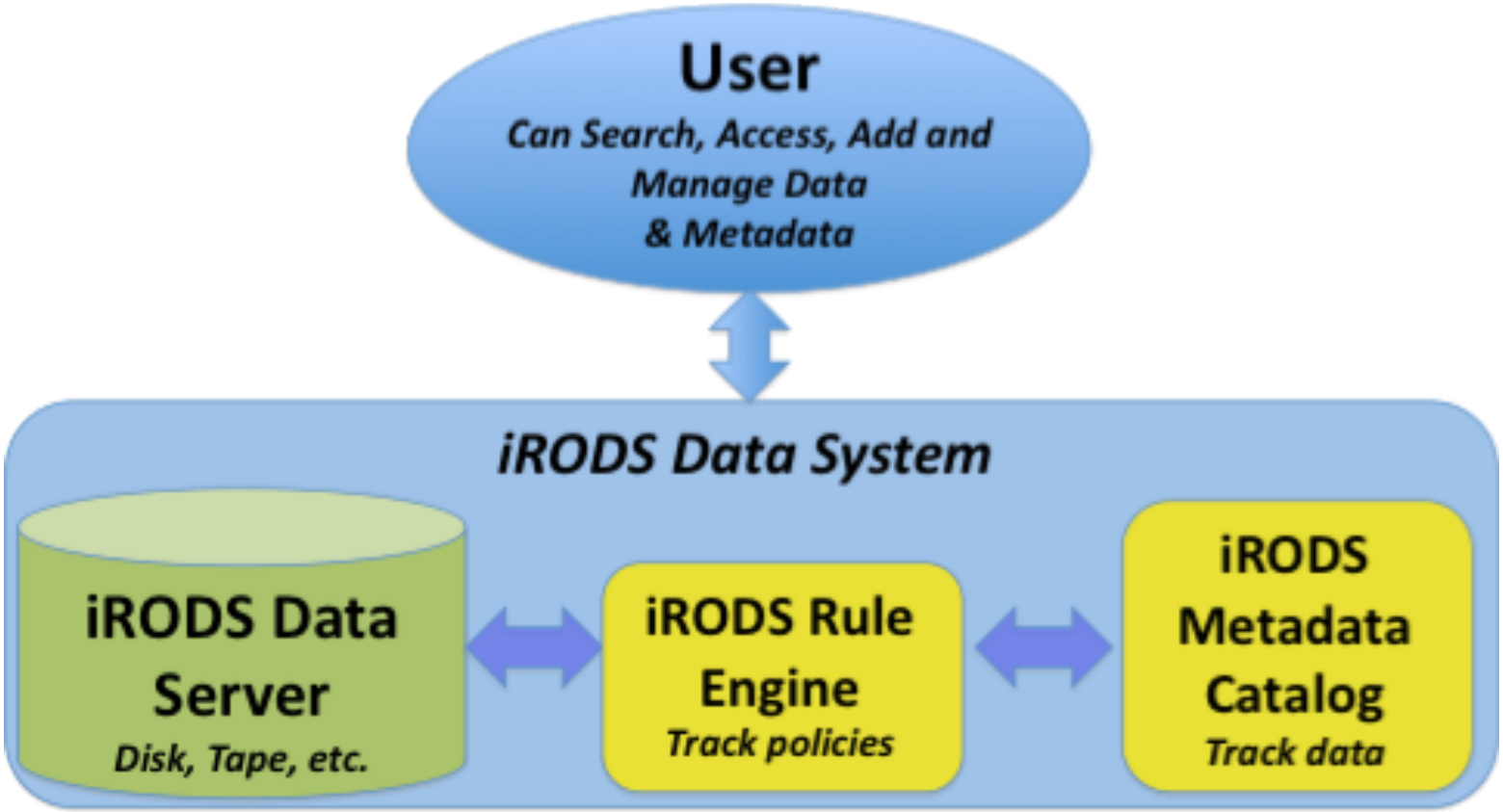
What is iRODS

- Integrated Rule-Oriented Data-management System
- From SRB (Storage Resource Broker) to iRODS
- A community-driven, open source, data grid software solution

iRODS Archiecture



iRODS features

- High-performance network data transfer
- A unified view of disparate data
- Support for a wide range of physical storage
- Easy back up and replication
- Manages metadata
- Controlled access
- Policies, Rules and Micro-services
- Workflows
- Management of large collections

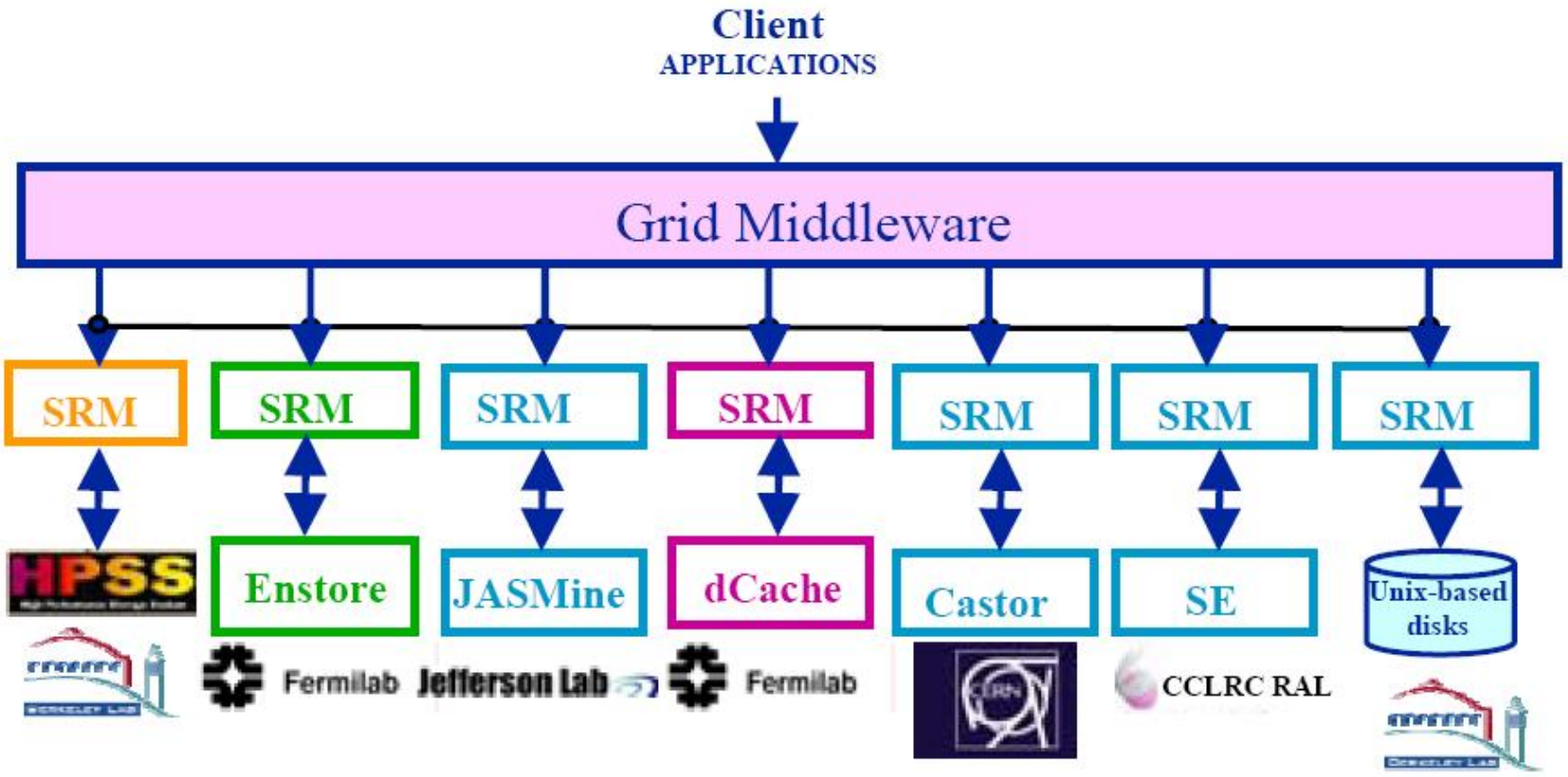
iRODS Applications

- Data grids - Share data
  - Project level data sharing
- Digital libraries - Publish data
  - Specify data context, provide standard services
- Persistent archive - Preserve data
  - Build reference collections
- Real-time sensor systems - Federate data
  - Manage real-time data distribution
- Workflow systems - Analyze data
  - Integrate client- & server-side workflows

Why SRM?

- Storage Elements (SE) can use different type of technologies
  - CASTOR, dCache, DPM, BeStMan,...,etc.
  - DRM (Disk Resource Manager)/TRM (Tape Resource Manager) /HRM (Hierarchical Resource Manager)
- Grid middleware needs to access files with an uniform interface
  - Manage storage resources
  - Not a file transfer protocol

What is SRM?


Client
APPLICATIONS
Grid Middleware
SRM
SRM
SRM
SRM
SRM
SRM
SRM
HPSS
Enstore
JASMine
dCache
Castor
SE
Unix-based disks
Fermilab
Jefferson Lab
Fermilab
CCLRC RAL

What is SRM?

- Storage Resource Managers (SRMs) are middleware components
  - whose function is to provide
    - dynamic space allocation
    - file management

    on shared storage resources on the Grid
  - Different implementations for underlying storage systems are based on the same SRM specification

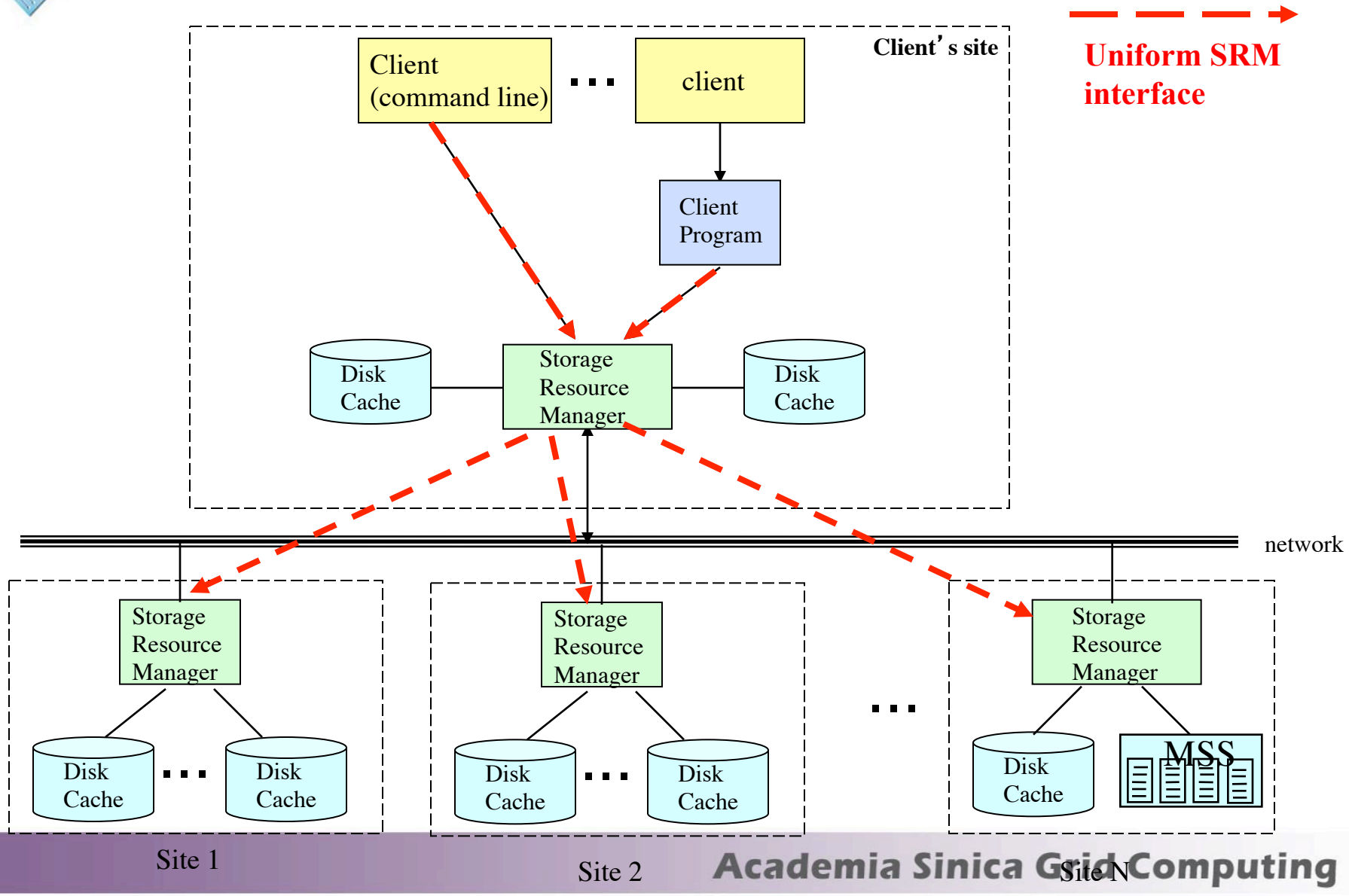
SRM features

- Provides space management
- Provides an uniform access interface
- Manages DRM/Tape/HRM
- Does not transfer files itself.
- Manage the life time of file

SRMs role in grid

- SRMs role in the data grid architecture
  - Shared storage space allocation & reservation
    - important for data intensive applications
  - Get/put files from/into spaces
    - archived files on mass storage systems
  - File transfers from/to remote sites, file replication
  - Negotiate transfer protocols
  - File and space management with lifetime
  - support non-blocking (asynchronous) requests
  - Directory management
  - Interoperate with other SRMs

Client and Peer-to-Peer Uniform Interface



SRM: Main concepts

- Space reservations
- Dynamic space management
- Pinning file in spaces
- Support abstract concept of a file name: Site URL
- Temporary assignment of file names for transfer: Transfer URL
- Directory management and authorization
- Transfer protocol negotiation
- Support for peer to peer request
- Support for asynchronous multi-file requests
- Support abort, suspend, and resume operations
- Non-interference with local policies

Site URL and Transfer URL

- Provide: Site URL (SURL)
  - URL known externally – e.g. in Replica Catalogs
  - e.g srm://fct01.grid.sinica.edu.tw:8443/axis/services/srm?/AS/home/wlueng.ASGC/testFile1.dat
- Get back: Transfer URL (TURL)
  - Path can be different from SURL – SRM internal mapping
  - Protocol chosen by SRM based on request protocol preference
  - e.g gsiftp://t-ap20.grid.sinica.edu.tw:2811/AS/home/wlueng.ASGC/testFile1.dat
- One SURL can have many TURLs
  - Files can be replicated in multiple storage components
  - Files may be in near-line and/or on-line storage
  - In a light-weight SRM (a single file system on disk)
    - SURL may be the same as TURL except protocol
- File sharing is possible
  - Same physical file, but many requests
  - Needs to be managed by SRM implementation

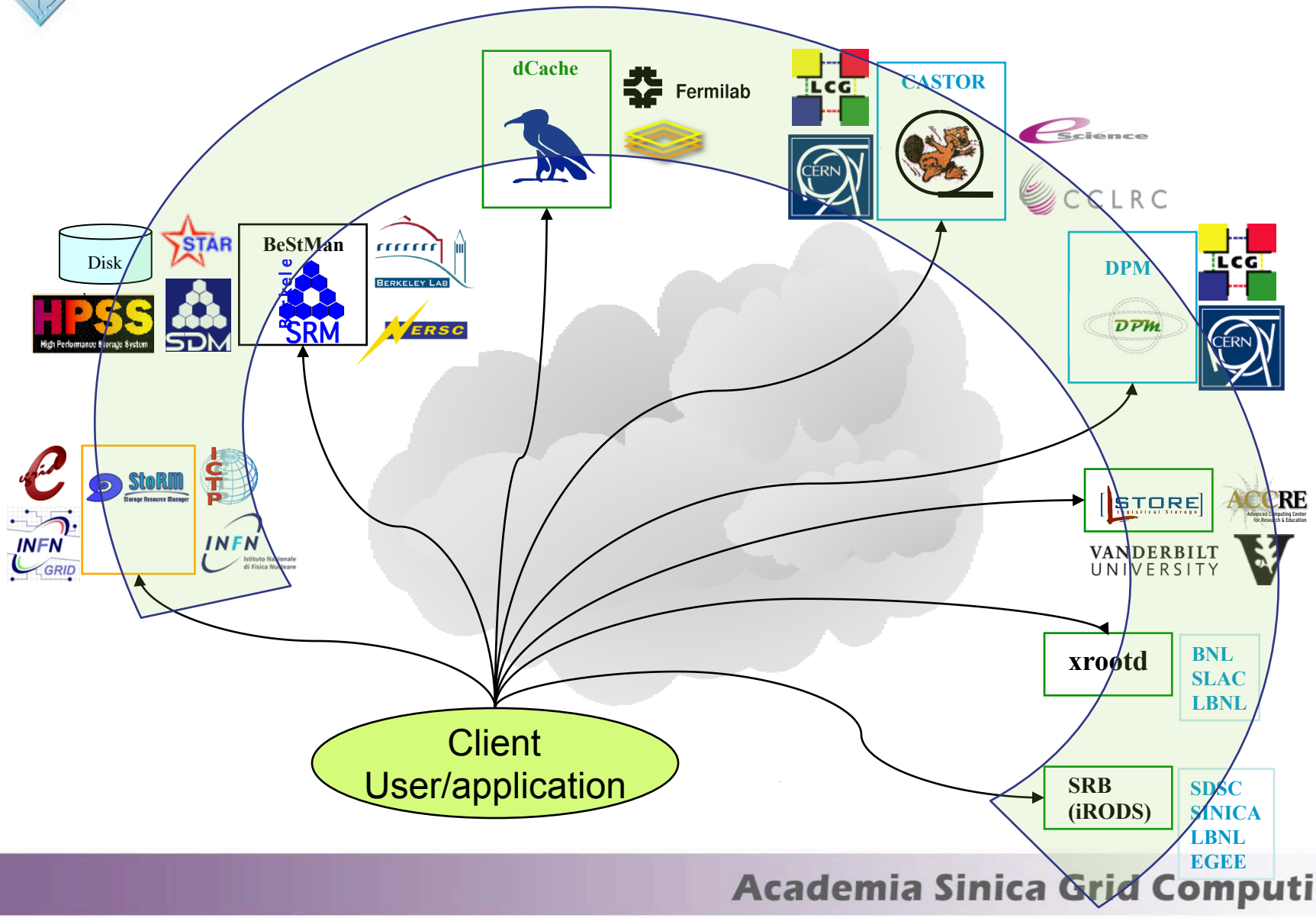
Transfer protocol negotiation

- Negotiation
  - Client provides an ordered list of preferred transfer protocols
  - SRM returns first protocol from the list it supports
  - Example
    - Client provided protocols list: bbftp, gridftp, ftp
    - SRM returns: gridftp
- Advantages
  - Easy to introduce new protocols
  - User controls which transfer protocol to use
- How it is returned?
  - The protocol of the Transfer URL (TURL)
  - Example: gsiftp://t-ap20.grid.sinica.edu.tw:2811/AS/home/wlueng.ASGC/testFile1.dat

SRM v2.2 Interface

- *Data transfer functions* to get files into SRM spaces from the client's local system or from other remote storage systems, and to retrieve them
  - srmPrepareToGet, srmPrepareToPut, srmBringOnline, srmCopy
- *Space management functions* to reserve, release, and manage spaces, their types and lifetimes.
  - srmReserveSpace, srmReleaseSpace, srmUpdateSpace, srmGetSpaceTokens
- *Lifetime management functions* to manage lifetimes of space and files.
  - srmReleaseFiles, srmPutDone, srmExtendFileLifeTime
- *Directory management functions* to create/remove directories, rename files, remove files and retrieve file information.
  - srmMkdir, srmRmdir, srmMv, srmRm, srmLs
- *Request management functions* to query status of requests and manage requests
  - srmStatusOf{Get,Put,Copy,BringOnline}Request, srmGetRequestSummary, srmGetRequestTokens, srmAbortRequest, srmAbortFiles, srmSuspendRequest, srmResumeRequest
- Other functions include Discovery and Permission functions
  - srmPing, srmGetTransferProtocols, srmCheckPermission, srmSetPermission, etc.

Interoperability in SRM v2.2

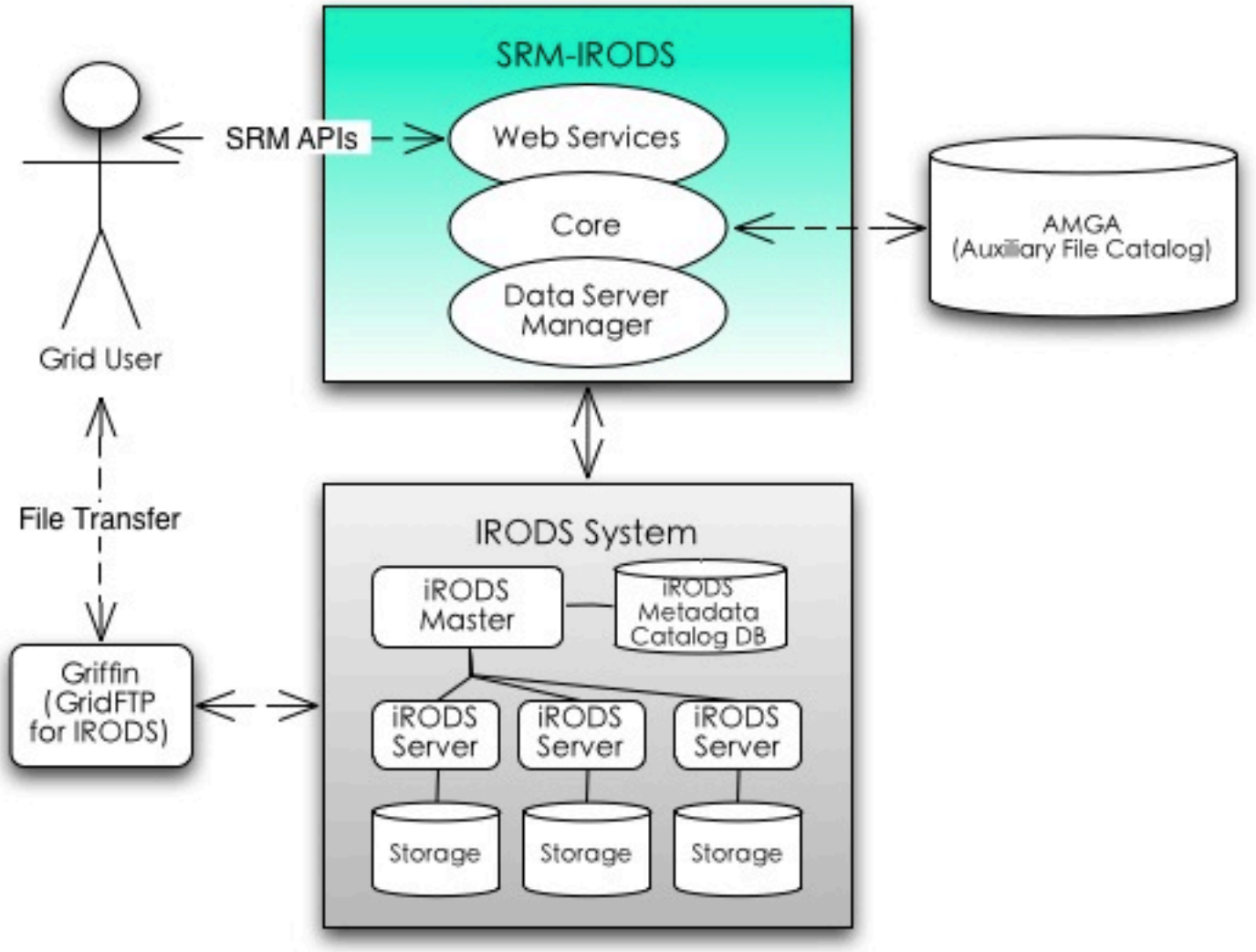


When iRODS met SRM

- Make iRODS an archival system of gLite-based e-Infrastructure.
- Support flexible lifetime policy for files
- Impose the VO-based resource policy and security control to iRODS as the Grid infrastructure.

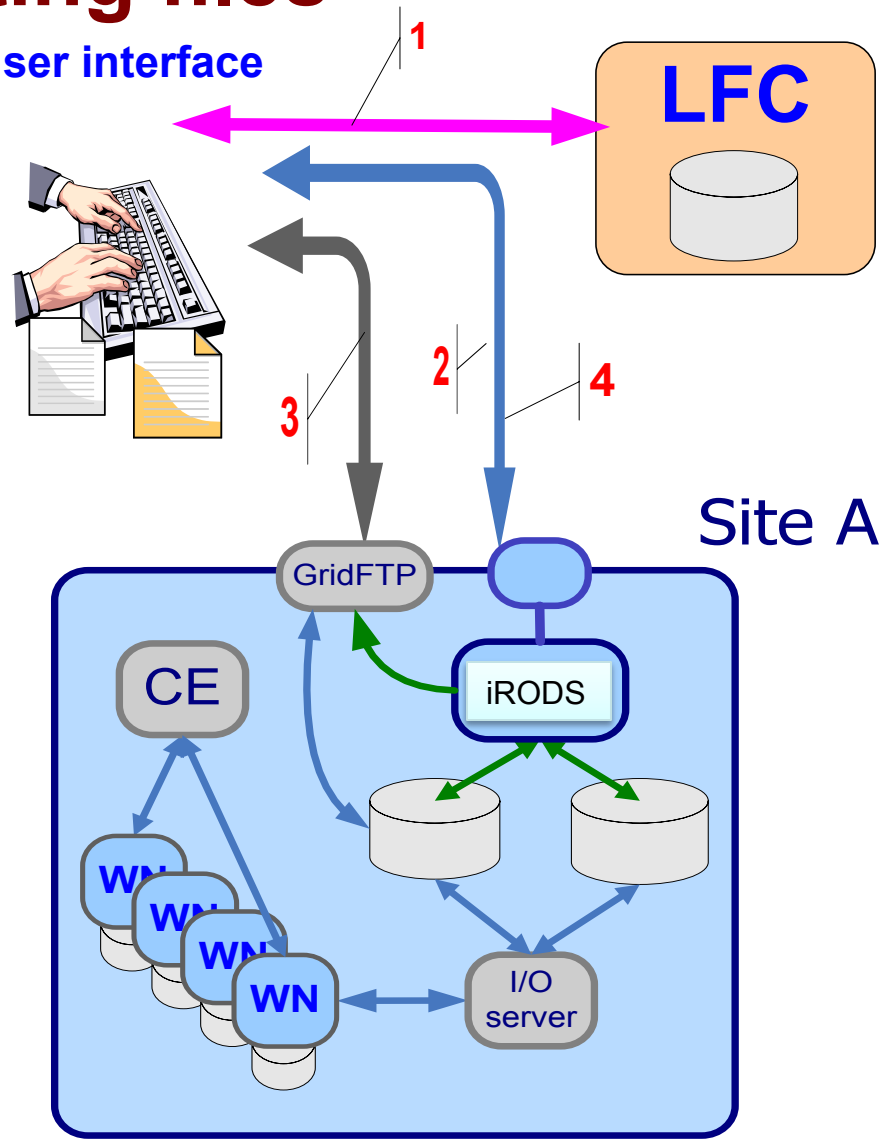
SRM-iRODS implementations

SRM-iRODS Archiecture



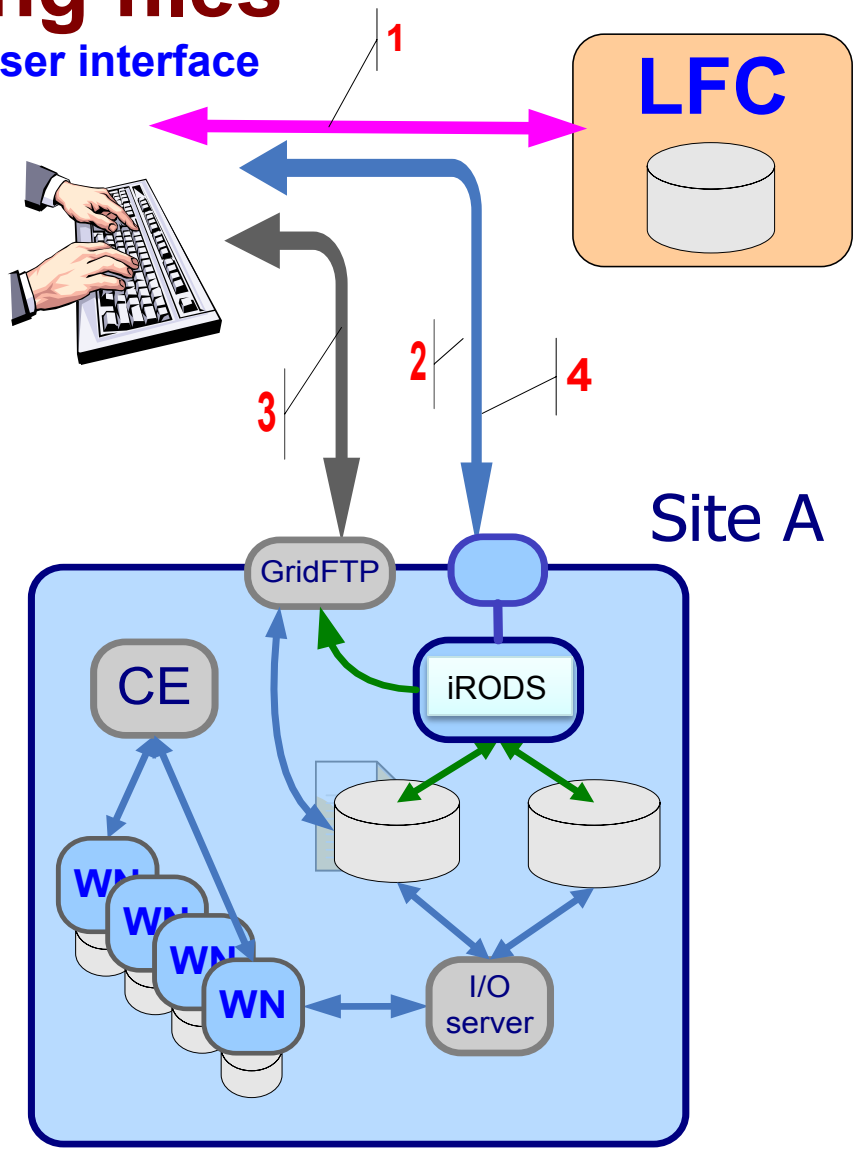
Use Case: putting files

1. Create a new LFN entry in LFC, return a SURL.
2. srmPrepateToPut (SURL)
3. Transfer the file to iRODs use GridFTP
4. srmPutDone (SURL)



Use Case: getting files

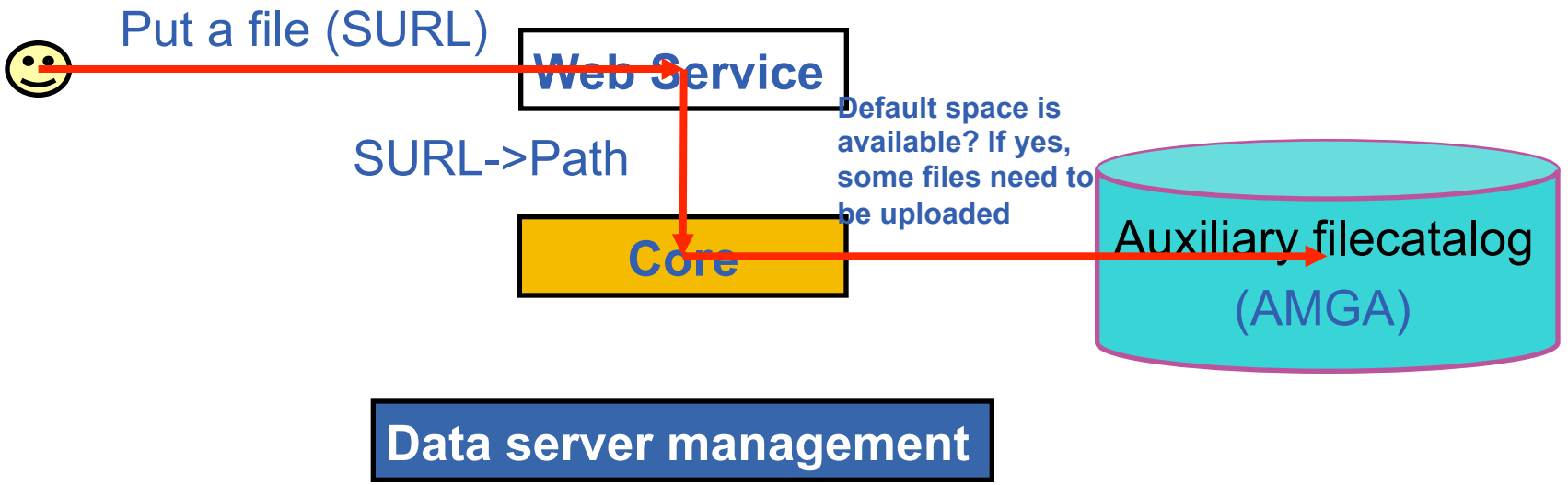
1. Query the file catalog to retrieve the SURL from the LFN.
2. srmPrepateToGet (SURL)
3. Transfer the file (read)
4. srmReleaseFile (SURL)

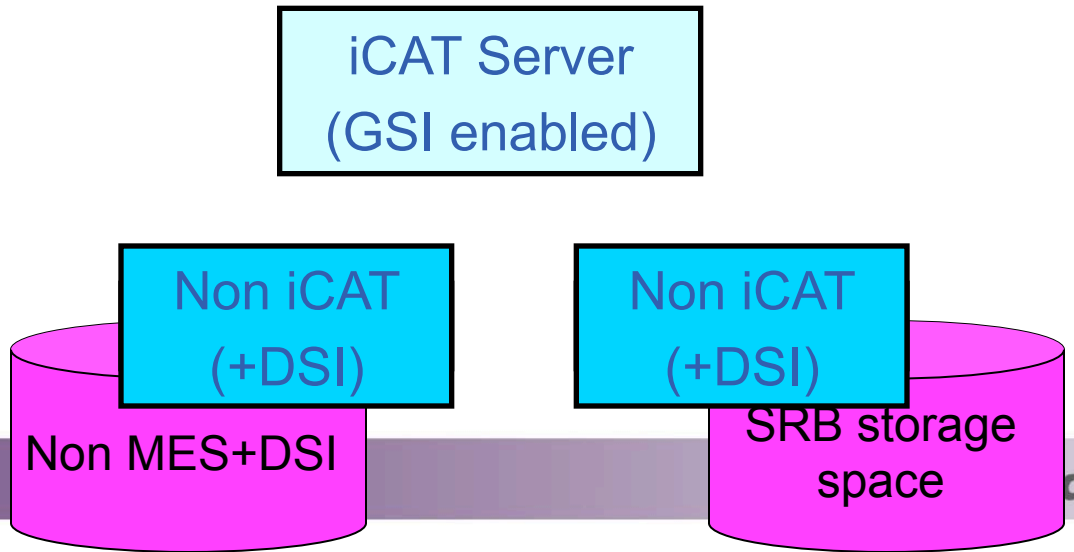


Information in Auxiliary File Catalog

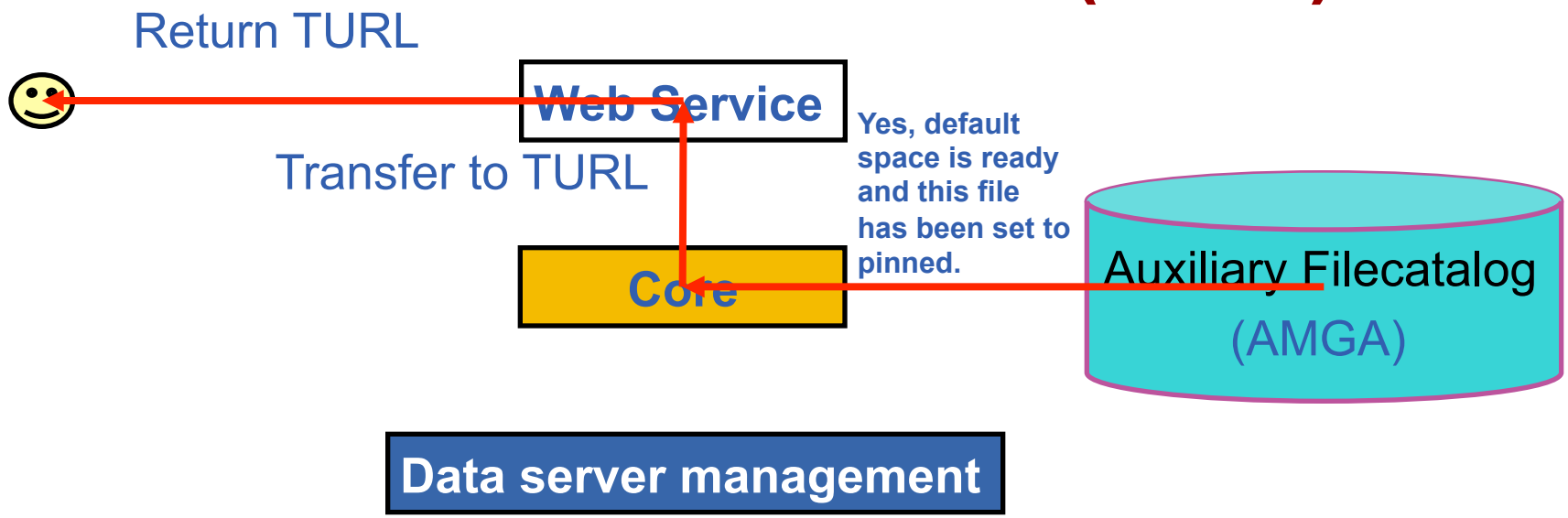
- AMGA server, it stores partial filecatalog, resource and iRODS host information…
  - Users Information
  - Resources Information
  - Files Information
  - Space Metadata
  - Resource States
  - …

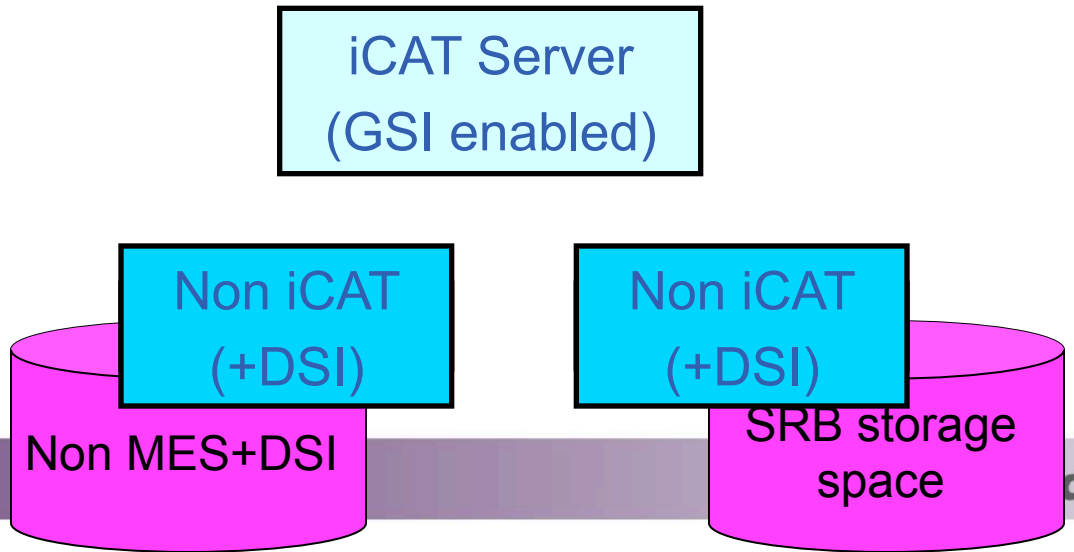
Architecture Overview





Architecture Overview (cont.)





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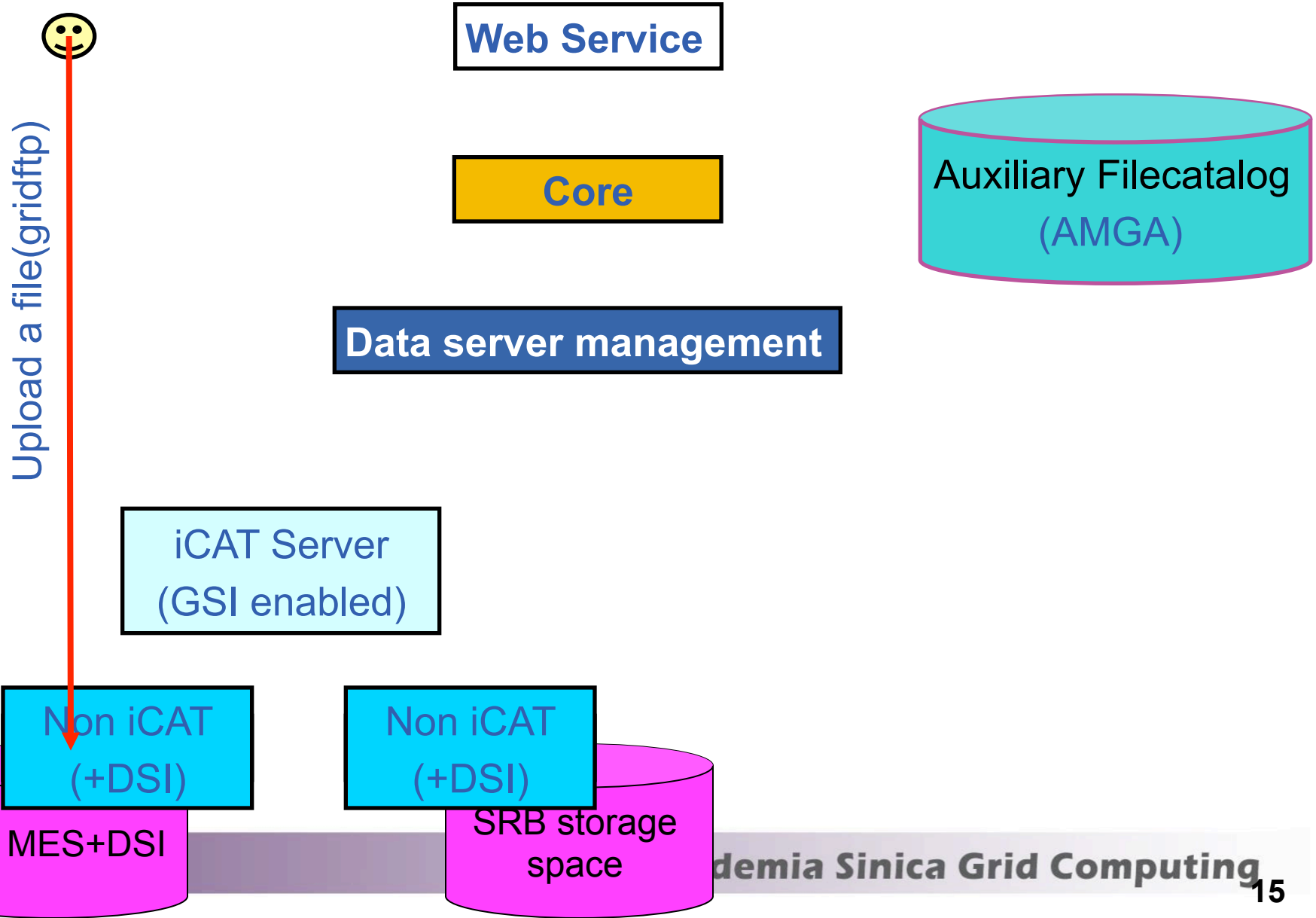
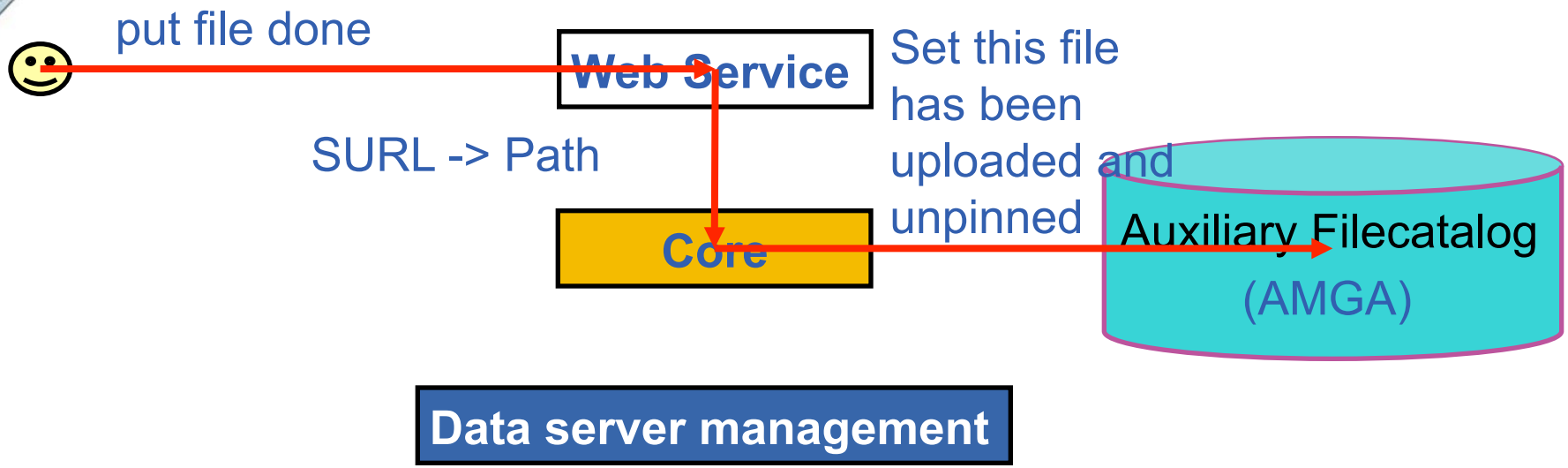
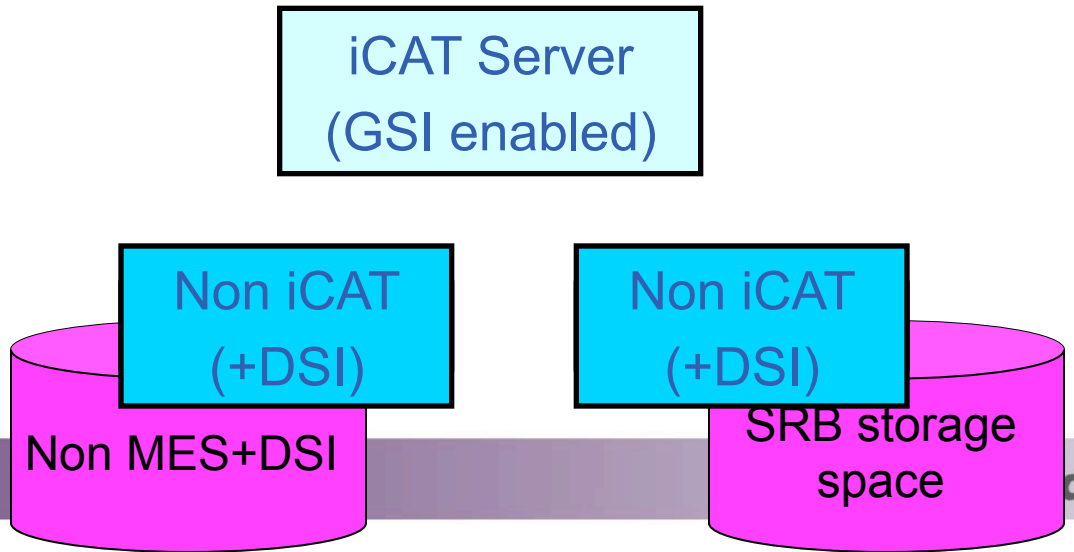


Architecture Overview (cont.)





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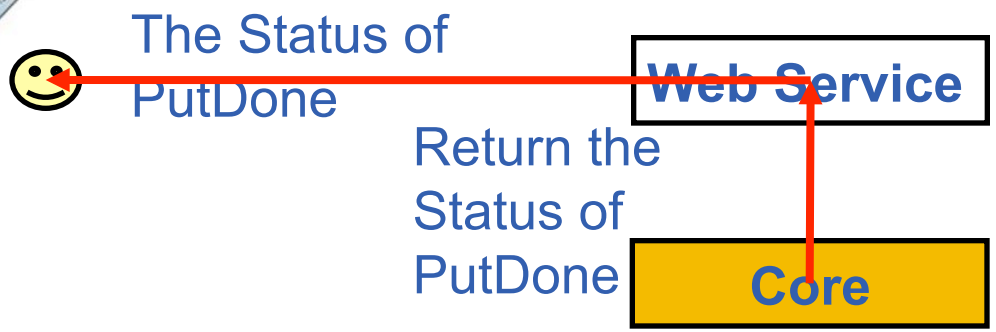


Auxiliary filecatalog (AMGA)

Data server management

iCAT Server (GSI enabled)

Non iCAT (+DSI)

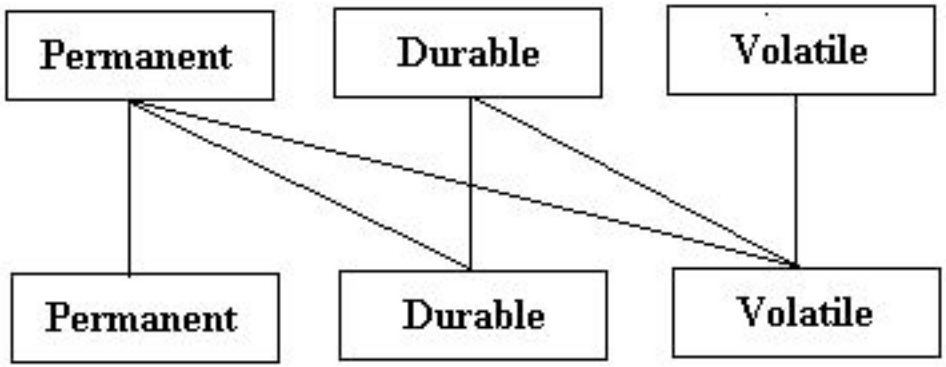
Non MES+DSI

Non iCAT (+DSI)

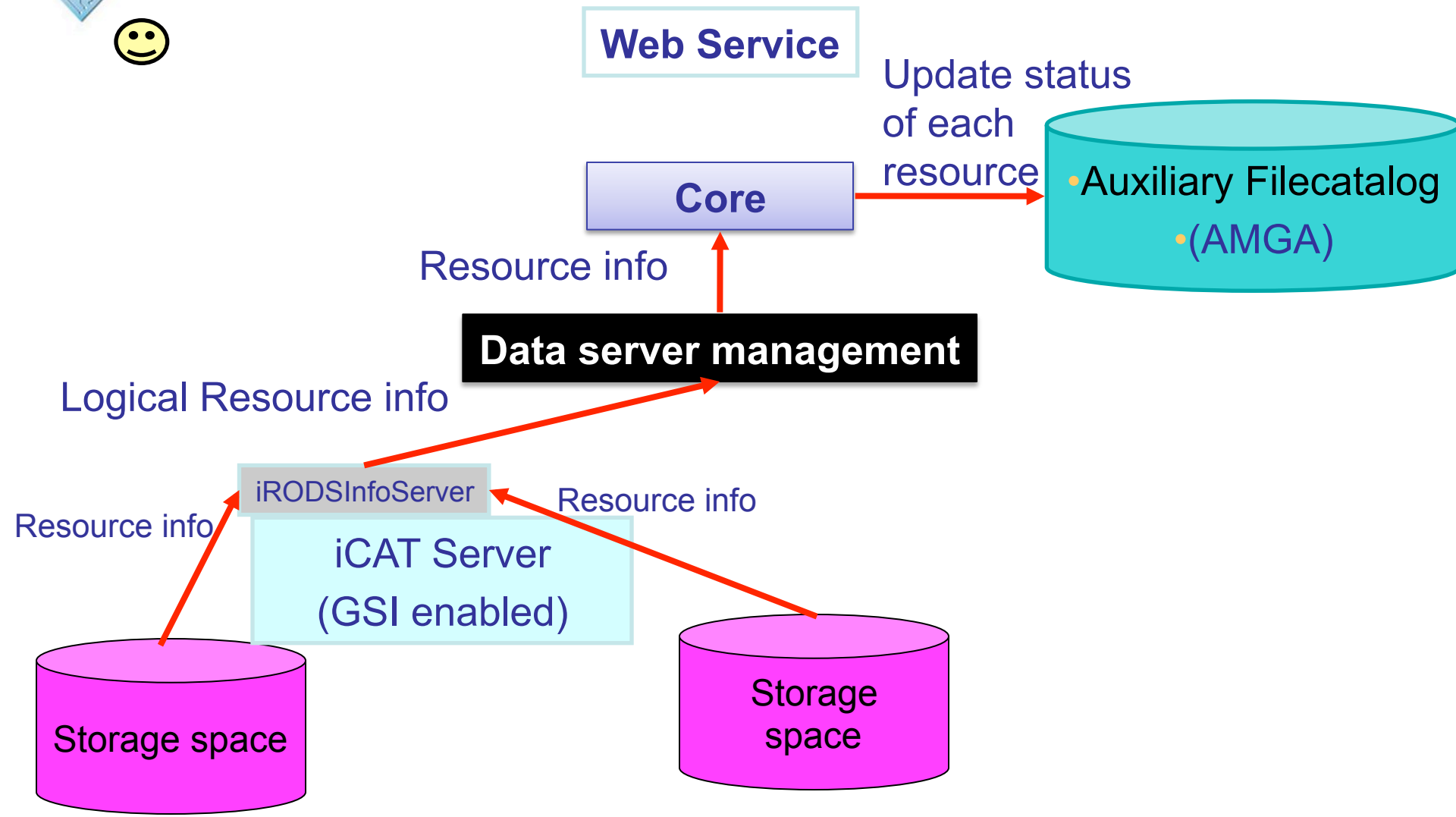
SRB storage space

Support Flexible File/Space Types

- SRM system has a caching mechanism and has to take care of SRM issues like file lifetime, space management,…,etc.
  - Permanent space
  - Volatile space
  - Durable space
- Implementation
  - **Use AMGA as auxiliary catalog and record all space usage, space type, and some file metadata inside.**



Checking Disk Status



Checking Disk Status

- How to get the disk usage of the space?
  - Need to know the free and used space on iRODS server
  - iRODS provide the mechanism to monitor resource usag: SL_DISK_SPACE
  - We need to know the usage
    - Space management
- Implementation
  - iRODSInfoServer:
    - Deployed on iRODS master server

Progress

- Space Management Functions
  - srmReserveSpace
  - srmReleaseSpace
  - srmUpdateSpace
  - srmGetSpaceMetaData
  - srmChangeSpaceForFiles
  - srmGetSpaceTokens
- Permission Functions
  - srmSetPermission
  - srmCheckPermission
  - srmGetPermission
- Directory Functions.
  - srmMkdir
  - srmRmdir
  - srmRm
  - srmLs
  - srmMv

- **Data Transfer Functions**
  - srmPrepareToGet
  - srmBringOnline
  - srmPrepareToPut
  - srmCopy
  - srmStatusOfCopyRequest
  - srmReleaseFiles
  - srmPutDone
  - srmAbortRequest
  - srmSuspendRequest
  - srmResumeRequest
  - srmGetRequestSummary
  - srmGetRequestTokens
- **Discovery Functions**
  - srmGetTransferProtocols
  - srmPing

SRM API: srmPing

srmPing(): used to verify the responsiveness of the service, to retrieve the SRM version and other internal information.

SRM API: srmPrepareToPut

srmPrepareToPut(): used to write files into the storage. Upon the client's request, SRM prepares a TURL so that client can write data into the TURL.

Lifetime (pinning expiration time) is assigned on the TURL.

- Target space token and SURLs
- Asynchronous operation (typically)
  - Request token returned by SRM service
  - Request status may be checked through *srmStatusOfPutRequest()* with the returned request token.

SRM API: srmPrepareToGet

srmPrepareToGet(): used to bring files upon the cilent's request. It assigns TURL so that client can access the file.

- Source SURLs
- Asynchronous operation (typically)
  - Request token returned by SRM service
  - Request status may be checked through *srmStatusOfGetRequest()* with the returned request token.
- Similar function: *srmBringOnline()*, bring files online but do not return TURLs.

SRM API: srmStatusOfPut/ GetRequest

- *srmPrepareOfPutRequest()*: used to check the status of the previously request *srmPrepareToPut*. Client can get target TURLs if the status is *SRM_SUCCESS*.
- *srmPrepareOfGetRequest()*: used to check the status of the previously request *srmPrepareToGet*. Client can get source TURLs if the status is *SRM_SUCCESS*.

SRM API: srmPutDone and srmReleaseFiles

srmPutDone(): used to notify the SRM that the client completed the file transfer(s) to the TURL (s). This should normally follow *srmPrepareToPut*.

srmReleaseFiles(): used to release pins on the previously requested “copies” of the SURLs. This function normally follows *srmPrepareToGet* and *srmBringOnline* functions.

SRM API: srmReserveSpace and srmGetSpaceMetadata

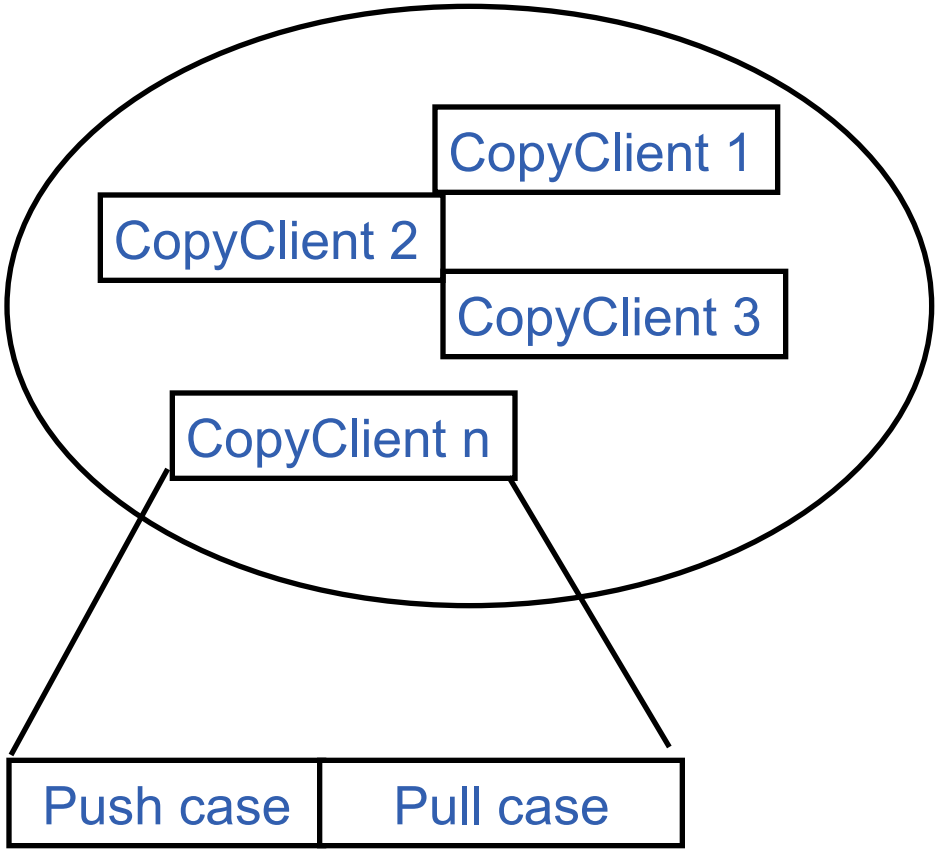
- *srmReserveSpace()*: used to reserve a space in advance for the upcoming requests to get some guarantee on the file management.
- *srmGetSpaceMetadata()*: used to get information of a space. Space token must be provided, and space tokens are returned upon a completion of a space reservation through *srmReserveSpace*.

Synchronous and Asynchronous

SRM service provides two class of methods:

- **Asynchronous methods** (non-blocking call)
- **Synchronous methods** (blocking call)

Asynchronous Operations



Progress

- The 1st stage:
  - Core Functions
    - Space Management Functions.
    - Permission Functions.
    - Directory Functions.
    - Data Transfer Functions.
    - Discovery Functions.
  - AMGA DB Schema
  - iRODS Server Manager
    - iRODSInfoServer

Progress (Cont.)

- 2nd stage
  - Internal space management functions
    - Use a thread to recycle expired space
  - Asynchronous operation
    - Space functions
    - Transfer functions

References

- SRM working group:
  - http://sdm.lbl.gov/srm-wg/
- iRODS:
  - https://www.irods.org/
- AMGA:
  - http://amga.web.cern.ch/amga
- Globus:
  - http://www.globus.org
- CoG:
  - http://wiki.cogkit.org/index.php/Main_Page
- Axis:
  - http://ws.apache.org/axis/