iCAT Interactions in iRODS

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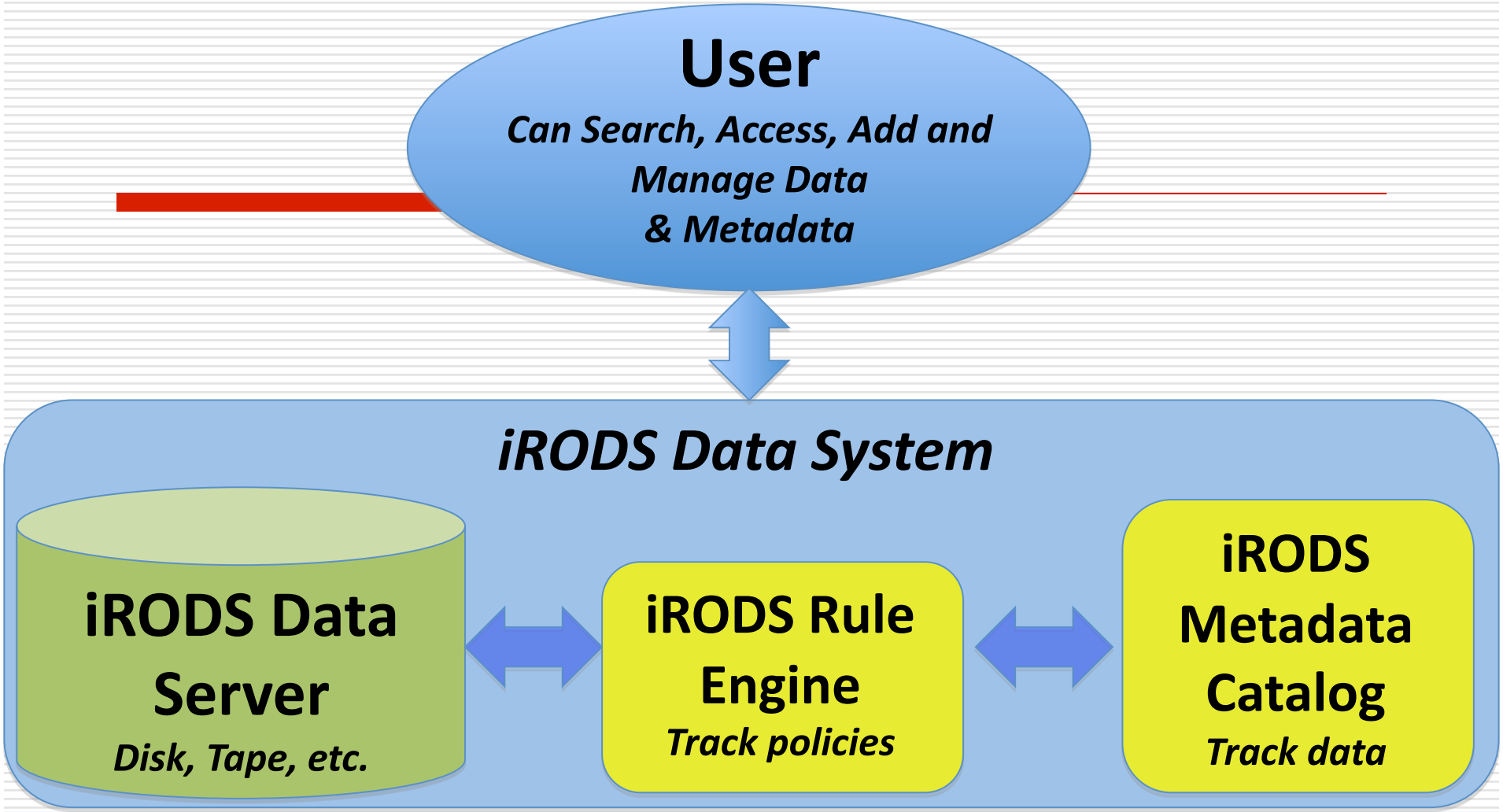
Introduction

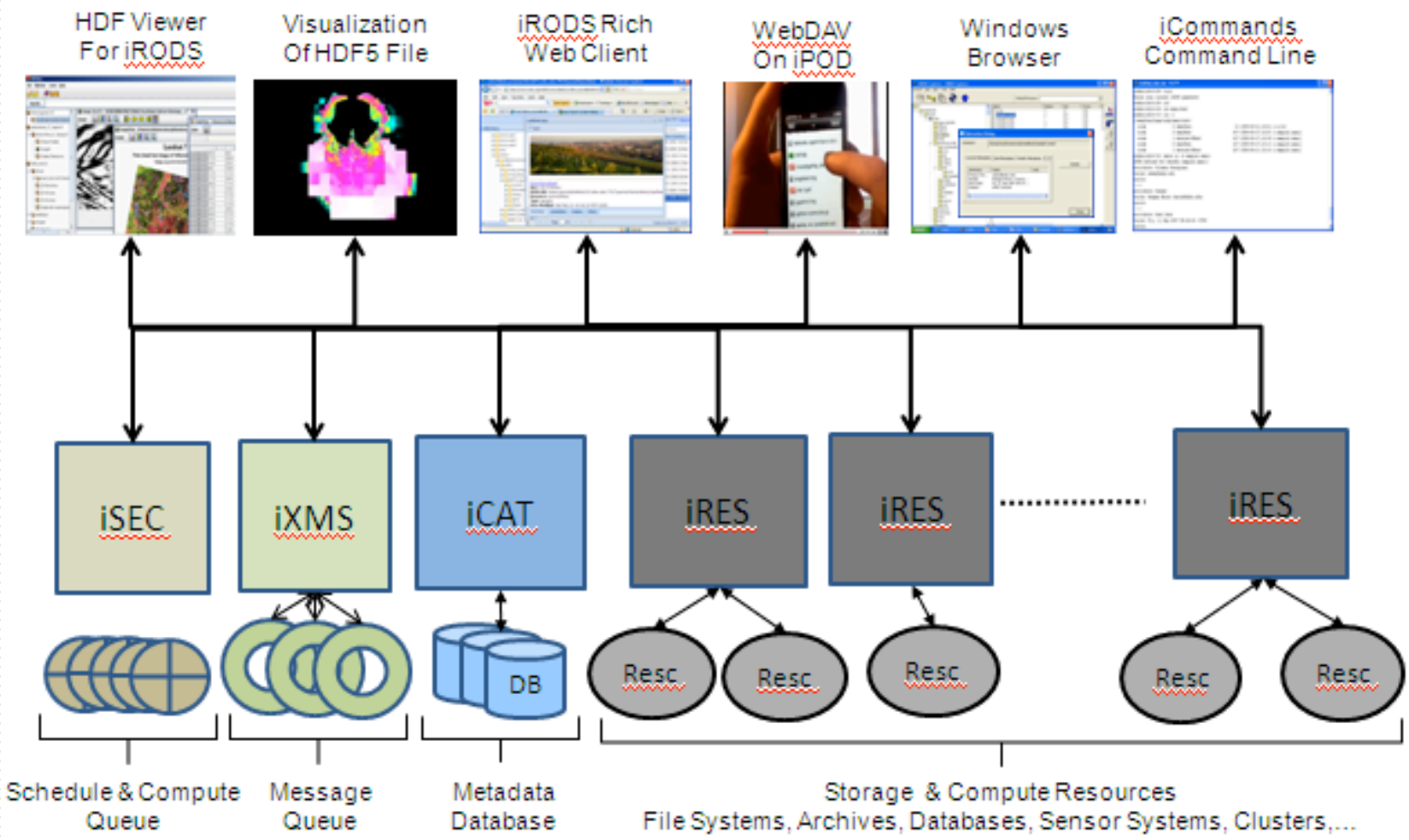
- Role of iCAT
- Internal Interactions: iCAT & iRODS
- User Interactions: iquest
- Rule Interactions:
  - micro-services
  - irule command
- Extensible ICAT

Overview of iRODS Data System

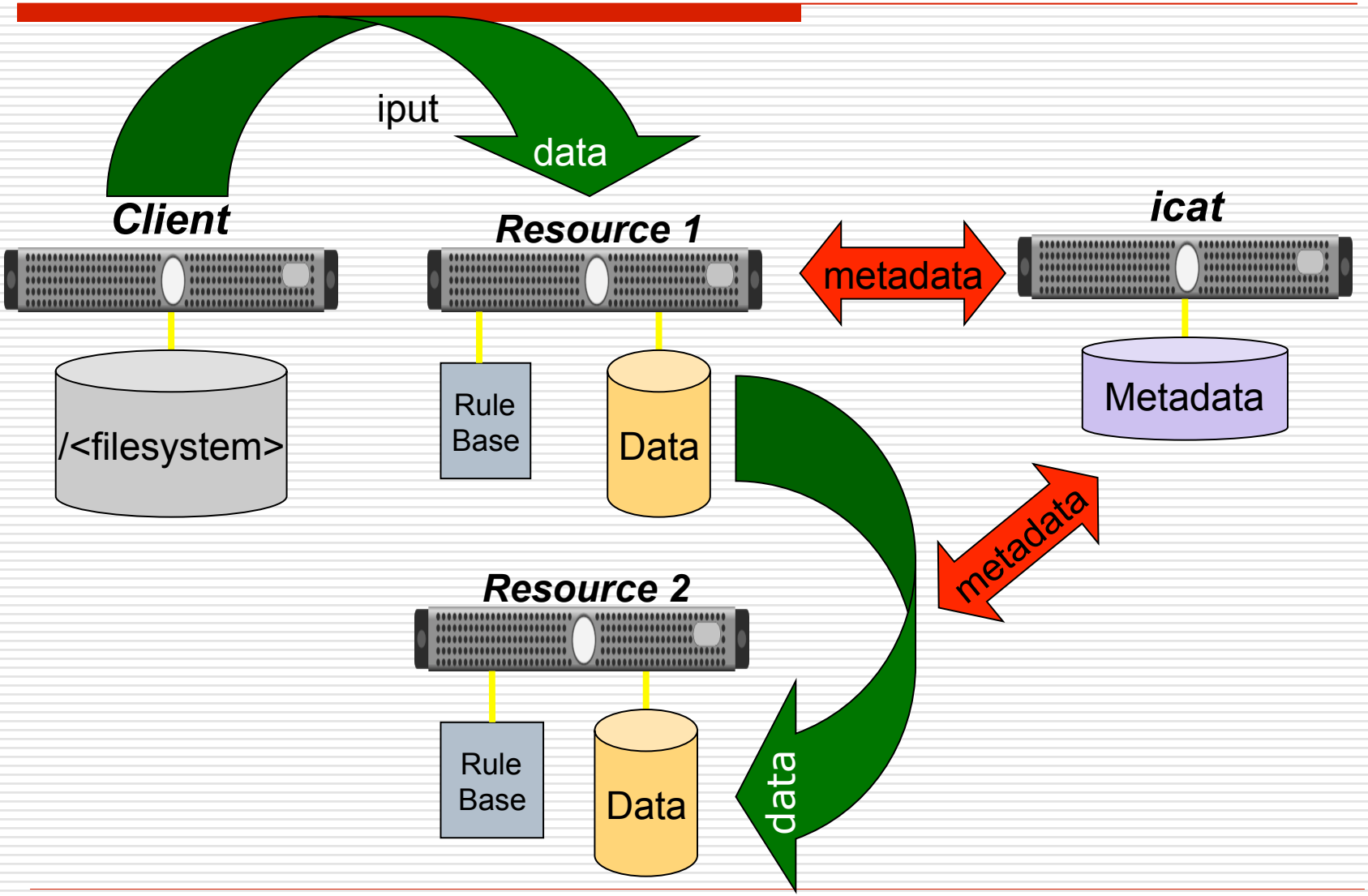


*Access data with Web-based Browser or iRODS GUI or Command Line clients.

iRODS Distributed Data Management



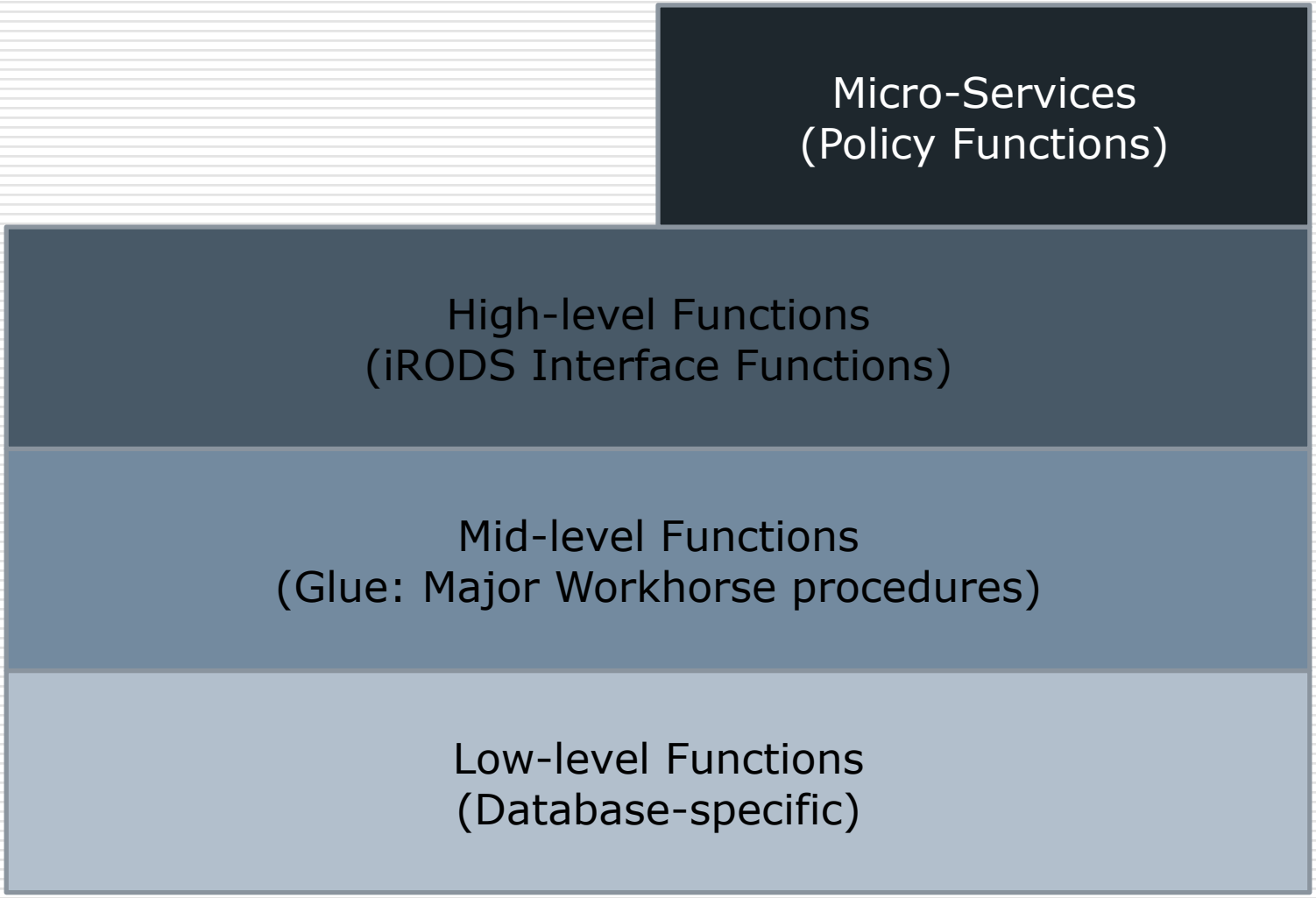
iput With Replication



Role of iCAT in iRODS

- iCAT stores persistent information about all aspects of iRODS
- State Information about the whole data grid
- Provides a Mapping from Logical Names to Physical Names
  - Example: demoResc maps to a
    - Host-address: brick14.sdsc.edu
    - Vault Path in File: /data/g1/
- Stores usability Information such as ACLs, Audit trails, Quotas, Groups, …
- iCAT is transactional -- all or none

Software Layers in iCAT



iCAT and iRODS

- Only One iCAT per iRODS Grid
- Information stored in vendor database: Postgres, Oracle, MySQL.
- Has a Very Rich Schema
  - User is transparent to this schema
  - User sees one humongous table
- Has an extensibility component
  - Helps in customizing iCAT to user needs
  - Can add new tables to iRODS Schema and use the same software framework

iRODS interacting with iCAT

- Specific Interactions
  - Special Function Calls Particular to the needs of iRODS
  - Example:
- General Interactions: Generic Calls based on single-table schema.
  - Query
  - Update: Insert, Delete, Modify

General Interactions

High Level APIs

- rsGenQuery
- rsGeneralRowInsert
- rsGeneralRowPurge
- rsGeneralUpdate

- rsGeneralAdmin -- administrative api
- rsUserAdmin -- special case for user

- rsModAVUMetadata -- triplet api

Needed by core & micro-service developers

Easy way of Querying iCAT: iQuest (1)

- iCommand utility for querying the iCAT
- It is in pseudo-SQL format
  - SQL is a query language for databases
  - Stands for structured query language
- You view the whole iCAT as one large table

  (iCAT has more than 20 tables)
  - You give conditions for picking rows from the “universal” table
  - You give a list of column names to pick values in the rows
  - SELECT DATA_NAME

    WHERE DATA_NAME like ’%.txt’

    AND COLL_NAME = ’/myzone/home/me’

iQuest Column Names

- Found in rodsGenQueryNames.h
- Example:

USER_NAME USER_ZONE USER_TYPE
ZONE_NAME USER_ID RESC_ID
RESC_NAME RESC_LOC RESC_VAULT_PATH
RESC_STATUS DATA_ID DATA_NAME
DATA_TYPE DATA_PATH DATA_RESC_NAME
COLL_NAME DATA_CHECKSUM
DATA_COMMENTS DATA_CREATE_TIME
COLL_OWNER_NAME COLL_ACCESS_NAME
META_DATA_ATTR_NAME META_DATA_ATTR_VALUE

Easy way of Querying iCAT: iQuest (2)

- The iquest command:

  iquest [format] selectQuery

- Samples:

```
iquest   ”SELECT DATA_NAME WHERE  DATA_NAME like ’%.txt’ ”
iquest   ”File  %s  has %-2.2s  copies”
         ”SELECT  DATA_NAME ,  DATA_REPL_NUM”
```

- Complicated Example:

```
iquest "User %-9.9s uses %14.14s bytes in %8.8s files in '%s'”
        “SELECT USER_NAME, sum(DATA_SIZE),
          count(DATA_NAME),    RESC_NAME”
User sekar has 25342 bytes in 342 files in demoResc
User sekar has 34529 bytes in 412 files in tapeResc
```

How to query in iRule (1)

- Two Micro-services:
  - msiMakeQuery(*colList, *cond, *queryStr)
    - Takes a list of columns and a condition string and creates a pseudo-SQL query-string
    - Alas! Does not do formats; but don't despair!!
  - msiExecStrCondQuery(*queryStr, *genQOut)
    - Takes the query-string executes it in iCAT and returns the answer-table in an internal structure
- Sample-rule:Given a condition get the answer-table

```
acExecMyQuery(*C,*T)||
        msiMakeQuery("DATA_NAME,COLL_NAME",*C,*S)##
        msiExecStrCondQuery(*S,*T) | nop
```

- But *T is an internal structure and not printable!!

How to query in iRule (2)

- So, to print,
  - we need to take the values out of the structure
    - msiGetValByKey(*Row, *ColName, *Value)
    - Given a row of the table, and a column name, it returns the value of that column.
  - How do we print a value?
    - writeLine(*where, *what)
    - writeLine (stdout, ”Hello World!”)
  - How to get a row from the table (of rows)
    - Use the forEachExec system micro-service

```
forEachExec(*T, msiGetValByKey(*T, DATA_NAME, *Value)##
                writeLine(File Name is *Value) , nop )
```

How to query in iRule (3)

Finally, we can put all together:

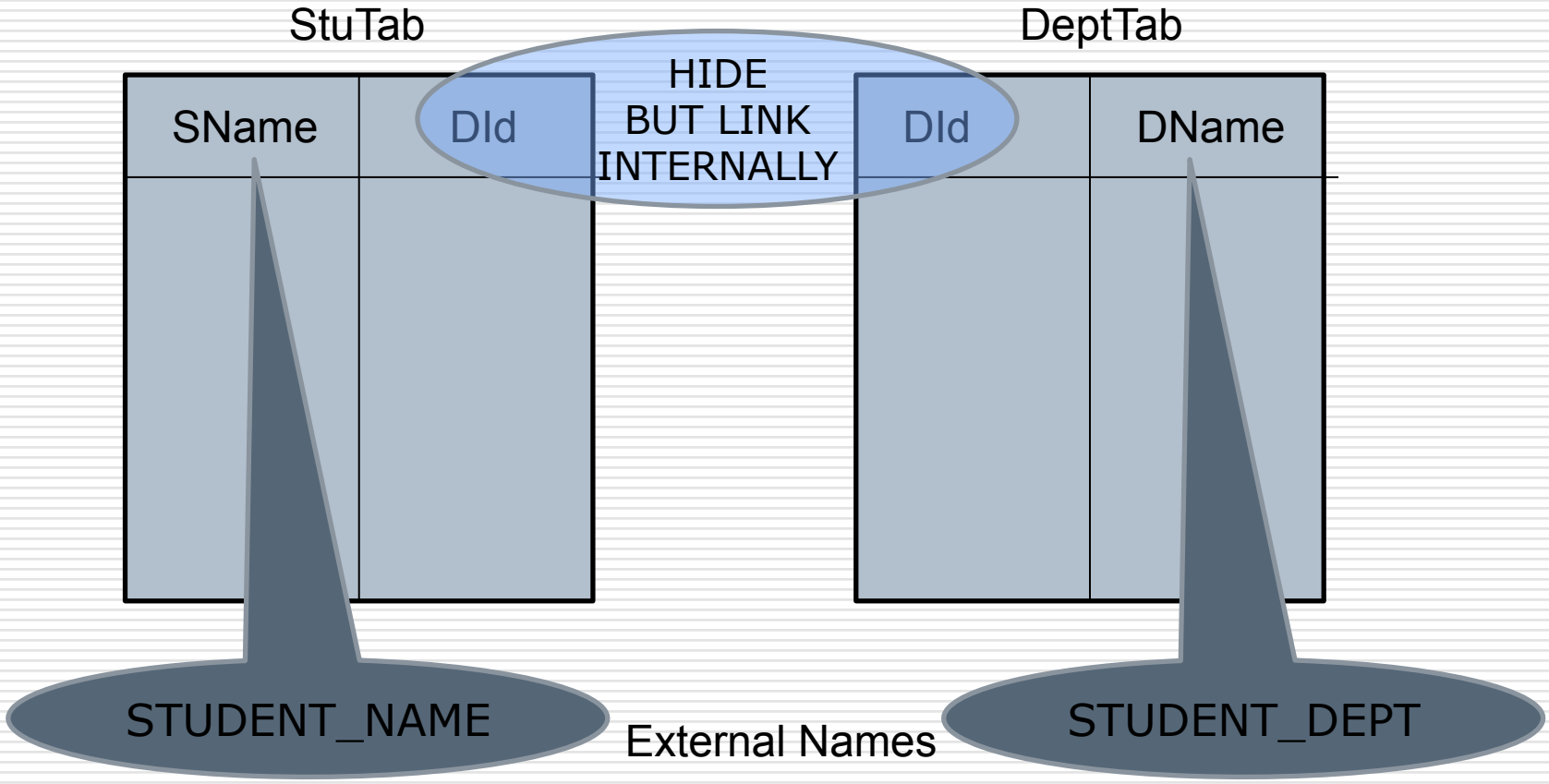
```
myRule(*Cond)
{
  msiMakeQuery("DATA_NAME,COLL_NAME",*Cond,*S);
  msiExecStrCondQuery(*S,*T);
  forEachExec(*T) /* for each row in answer table T */
  {
     msiGetValByKey(*T, DATA_NAME, *DV);
     msiGetValByKey(*T, COLL_NAME, *CV):
     writeLine(File *DV  is in Collection *CV)
   }
}
```

Other interesting micro-services

- msiAssociateKeyValuePairsToObj
- msiExecStrCondQueryWithOptions
- msiGetContInxFromGenQueryOut
- msiGetMoreRows
- msiAddSelectFieldToGenQuery
- msiAddConditionToGenQuery
- msiPrintGenQueryOutToBuffer
- msiPrintGenQueryInp
- msiRemoveKeyValuePairsFromObj
- msiAssociateKeyValuePairsToObj

Extensible ICAT

Student and Department Tables



Extensible iCAT

- Modules/extendedICAT
- New Tables and their relationships are coded in extendedICAT.h
  - Define Internal COLUMNS

```
#define COL_ONE  100001
#define COL_TWO  100002
#define COL_ID1   100003
#define COL_ID2   100004
```

  - Define External Names for the COLUMNS

```
{ COL_ONE,  "STUDENT_NAME"},
{ COL_TWO,  "STUDENT_DEPT"},
```

Extensible ICAT

- Map Internal COLUMN to DB table

  {COL_ONE, “stuTab”, “SName”},

  {COL_TWO, “deptTab”, “Dname”},

  {COL_ID1, “stuTab”, “DId”},

  {COL_ID2, “deptTab”, “DId”},

- Map Links between tables for automatic SQL generation

  {“stuTab”, “DId”, “deptTab”, “DId”},

Querying Ext ICAT

- Query:

  iquest "SELECT STUDENT_NAME WHERE STUDENT_DEPT = 'sils' AND STUDENT_NAME like 'Terrel%'"

- Similar to:

  iquest "SELECT DATA_NAME WHERE COLL_NAME like '/home/sekar/%'"

One Department Per Student

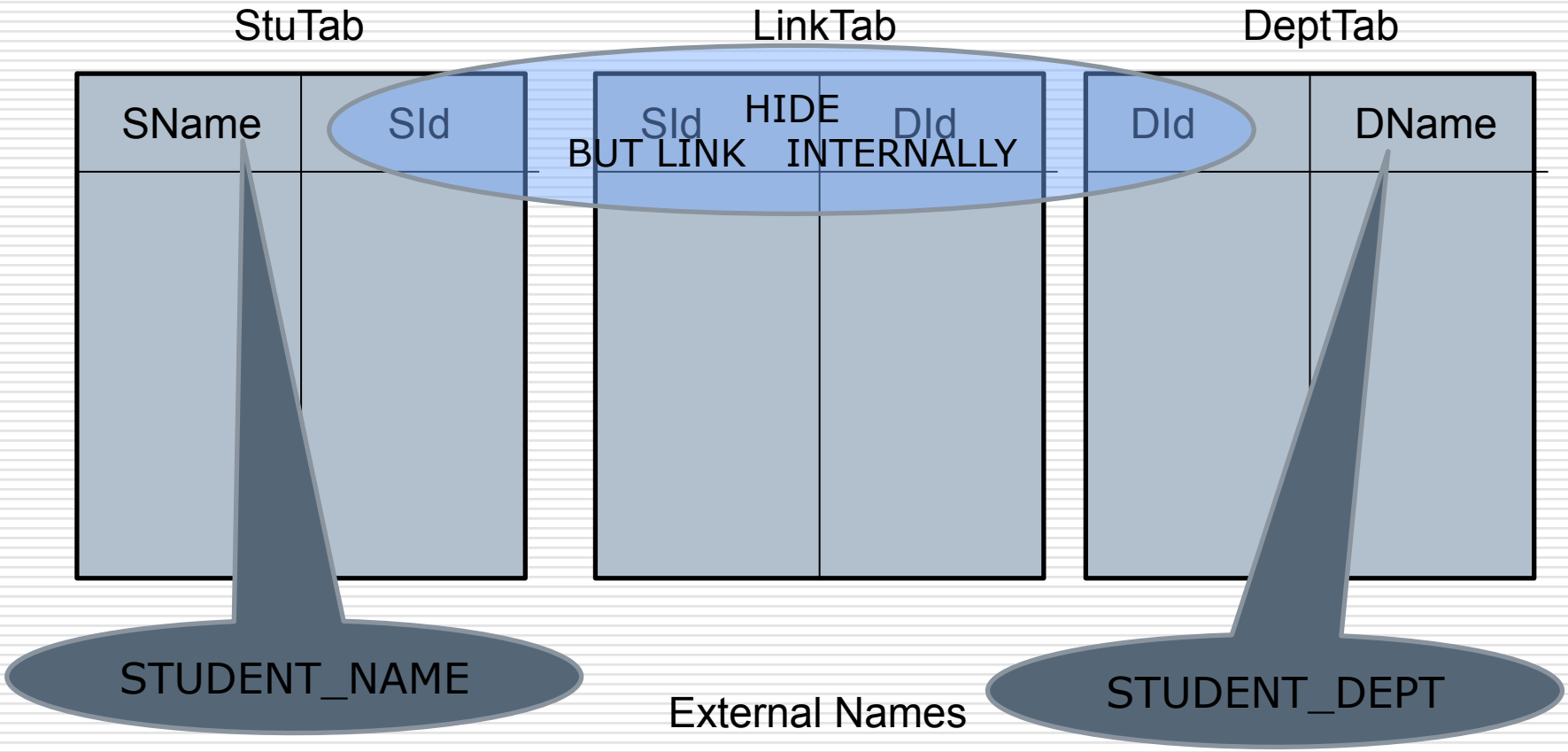
StuTab

SName	DId

DeptTab

DId	DName

Student In more than one Department



Hides schema changes (to some extant)

What Does Ext ICAT Buy Us?

- Can integrate with Core ICAT Tables.
- Example:
  - Student's can be iRODS Users.
  - Link STUDENT_NAME to USER_NAME
- Can link Data Objects with Standard Metadata Schemas cast in RDB
- Example:
  - FITS metadata for astronomy images
  - DICOM for MRI
- Can Now Query on these Metadata Schemas and get associated data
- Extraction/Metadata Ingestion possible with micro-services
- No need to maintain another DB

Conclusion

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  - irule command
- Extensible ICAT