The EU DataGrid – Information and Monitoring Services

The European DataGrid Project Team

http://www.eu-datagrid.org

Aim

- The aim of the Information and Monitoring Service is to deliver a flexible infrastructure that provides information on both
  1. The EU DataGrid itself
     - Mainly for the middleware packages
  2. Grid applications
     - For users
- The current system is based on MDS which only offers the first service – to the middleware.
  - The user may however query it to understand the status of the DataGrid

Overview of Talk

- Requirements of an information and monitoring service
- Globus MDS (Metacomputing Directory Service or Monitoring and Discovery Service as it is now called)
  - OpenLDAP, a hierarchical database
  - EDG GRIS/GIIS hierarchy
  - EDG information providers
  - Searching the information system
- R-GMA (Relational Grid Monitoring Architecture)
  - A relational implementation of the Global Grid Forum's GMA

Some Requirements of a Grid Information & Monitoring Service

- The system must be able to cope with nodes in a distributed environment
- Dynamic addition and deletion of information providers should be supported
- It must have a security system able to address the access to information at a fine level of granularity
- It must be able to work well on an unreliable Wide Area Network (WAN)
- The system must allow new data types to be defined

Globus MDS

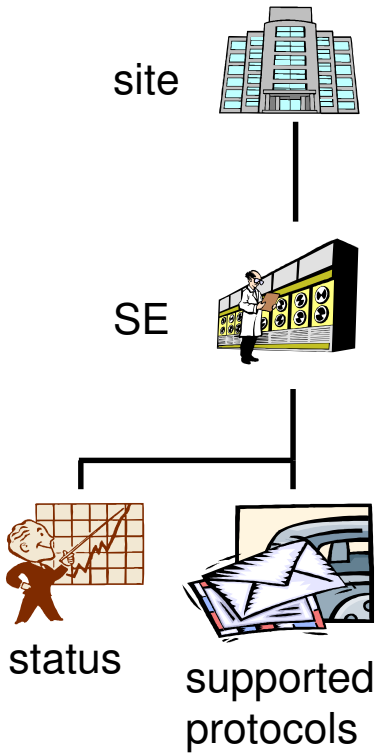
LDAP attributes

- EDG currently uses Globus MDS which is built on OpenLDAP
- A schema describes the attributes and the types of the attributes associated with data objects
- Example – some attributes of SiteInfo:
  - siteName: RALDEV
  - sysAdminContact: grid.sysadmin@rlac.uk
  - userSupportContact: grid.support@rlac.uk
  - siteSecurityContact: grid.security@rlac.uk
  - dataGridVersion: 1.2
  - InstallationDate: 20020704142800Z

LDAP hierarchy

- Lightweight Directory Assess Protocol (LDAP) offers a hierarchical view of information
- The objects are arranged in a Directory Information Tree (DIT)
- One or more attributes represent the Relative Distinguished Name (RDN)
- An object is identified by its Distinguished name
  - This is its RDN with the Distinguished name of its parent

RDNs and DNs



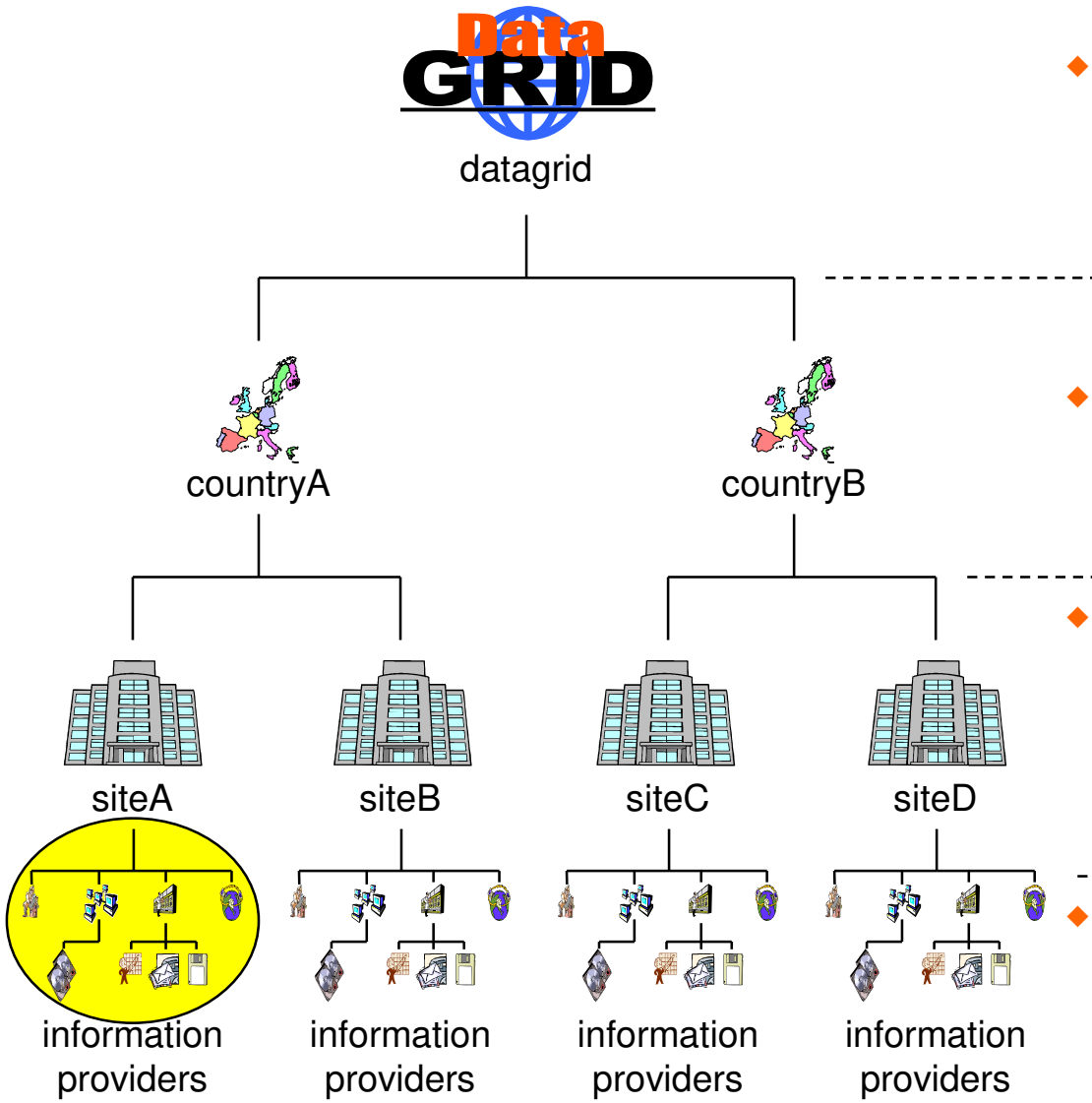
- RDN
  - SE
    - seId=dev02.hepgrid.clrc.ac.uk
  - Status
    - in=status
  - Protocols
    - seProtocol=gridftp
    - seProtocol=rfio
    - seProtocol=file

- DN
  - Site
    - Mds-Vo-name=ral-dev,Mds-Vo-name=uk,o=Grid
  - SE
    - seId=dev02.hepgrid.clrc.ac.uk,Mds-Vo-name=ral-dev,Mds-Vo-name=uk,o=Grid
  - Status
    - in=status,seId=dev02.hepgrid.clrc.ac.uk,Mds-Vo-name=ral-dev,Mds-Vo-name=uk,o=Grid
  - Protocols
    - seProtocol=gridftp, seId=dev02.hepgrid.clrc.ac.uk,Mds-Vo-name=ral-dev,Mds-Vo-name=uk,o=Grid
    - seProtocol=rfio, seId=dev02.hepgrid.clrc.ac.uk,Mds-Vo-name=ral-dev,Mds-Vo-name=uk,o=Grid
    - seProtocol=file, seId=dev02.hepgrid.clrc.ac.uk,Mds-Vo-name=ral-dev,Mds-Vo-name=uk,o=Grid

MDS GRISs & GIISs

- Information providers are scripts which when invoked by the LDAP server make available the desired information
  - Information is cached by the server to improve performance
  - LDAP was designed for use with relatively static data, not rapidly changing data
- Within MDS the EDG information providers are invoked by a local LDAP server, the Grid Resource Information Server (GRIS)
- "Aggregate directories", Grid Information Index Servers (GIIS), are used to group resources
- The GRISs use soft state registration to register with one or more GIISs
- The GIIS can then act as a single point of contact for a number of resources
  - A GIIS may represent a site, country, virtual organization, etc.
- In turn a GIIS may register with another GIIS

EDG GRIS/GIIS Hierarchy

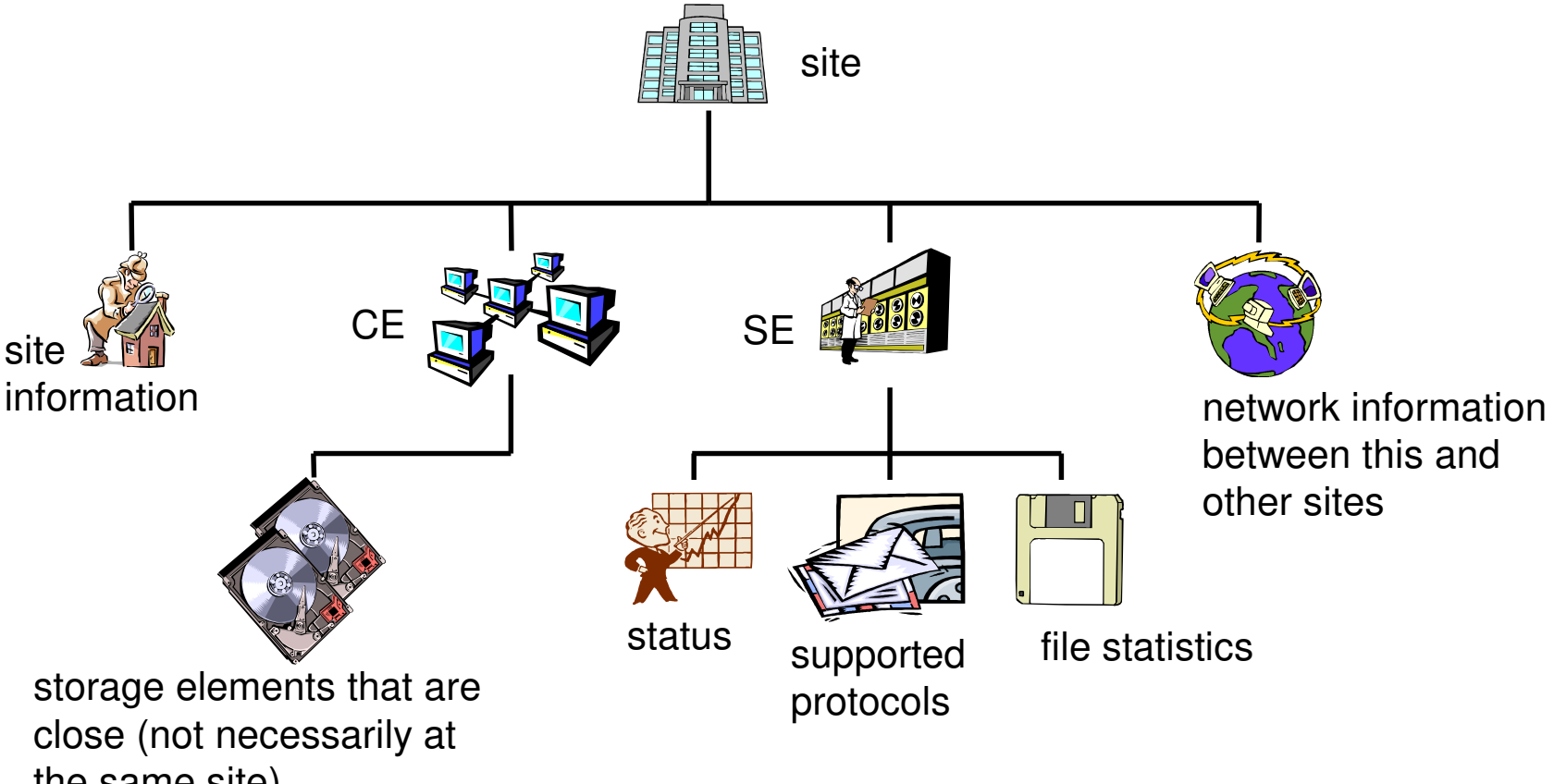


- There is a top level datagrid GIIS to which all of the country GIISs register
- Each country has a GIIS to which all of the site GIISs register
- Each Site has a Grid Information Index Server (GIIS) which acts as a single point of contact for all of the sites resources. The GRISs register with their site GIIS
- Information providers publish information to a local LDAP server known as a Grid Resource Information Server (GRIS)

EDG Information Providers

- The EDG have produced information providers:
  - Site information
  - The Computing Element
  - The Storage Element
  - Network Monitoring
- All of the EDG data objects are dynamic, they have a time stamp and a time to live (used by the cache mechanism) associated with them

EDG Information Providers & the Directory Information Tree



- Note that there are 2 hierarchies:
  - The GIIS/GRIS structure
  - The DIT

Siteinfo

```
in=siteinfo,Mds-Vo-name=ral-dev,Mds-Vo-name=uk,o=Grid
objectClass: SiteInfo
objectClass: DataGridTop
objectClass: DynamicObject
siteName: RALDEV
sysAdminContact: grid.sysadmin@rlac.uk
userSupportContact: grid.support@rlac.uk
siteSecurityContact: grid.security@rlac.uk
dataGridVersion: 1.2
installationDate: 20020704142800Z
```

Storage Element

seId=dev02.hepgrid.clrc.ac.uk,Mds-Vo-name=ral-dev,Mds-Vo-name=uk,o=Grid

objectClass: StorageElement

objectClass: DataGridTop

objectClass: DynamicObject

SEId: dev02.hepgrid.clrc.ac.uk

CloseCE: dev01.hepgrid.clrc.ac.uk:2119/jobmanager-pbs-M

SEtypearchitecture: disk

SEsize: 13177

SEResourceContactString: grid.support@rl.ac.uk

SEvo: wpsix, :/flatfiles/05/wpsix

Storage Element Protocols

seProtocol=gridftp, seId=dev02.hepgrid.clrc.ac.uk, Mds-Vo-name=ral-dev, Mds-Vo-name=uk, o=Grid
objectClass: StorageElementProtocol
objectClass: DataGridTop
objectClass: DynamicObject
SEId: dev02.hepgrid.clrc.ac.uk
SEProtocol: gridftp
Port: 2811

seProtocol=rfio, seId=dev02.hepgrid.clrc.ac.uk, Mds-Vo-name=ral-dev, Mds-Vo-name=uk, o=Grid
objectClass: StorageElementProtocol
objectClass: DataGridTop
objectClass: DynamicObject
SEId: dev02.hepgrid.clrc.ac.uk
SEProtocol: rfio
Port: 3147

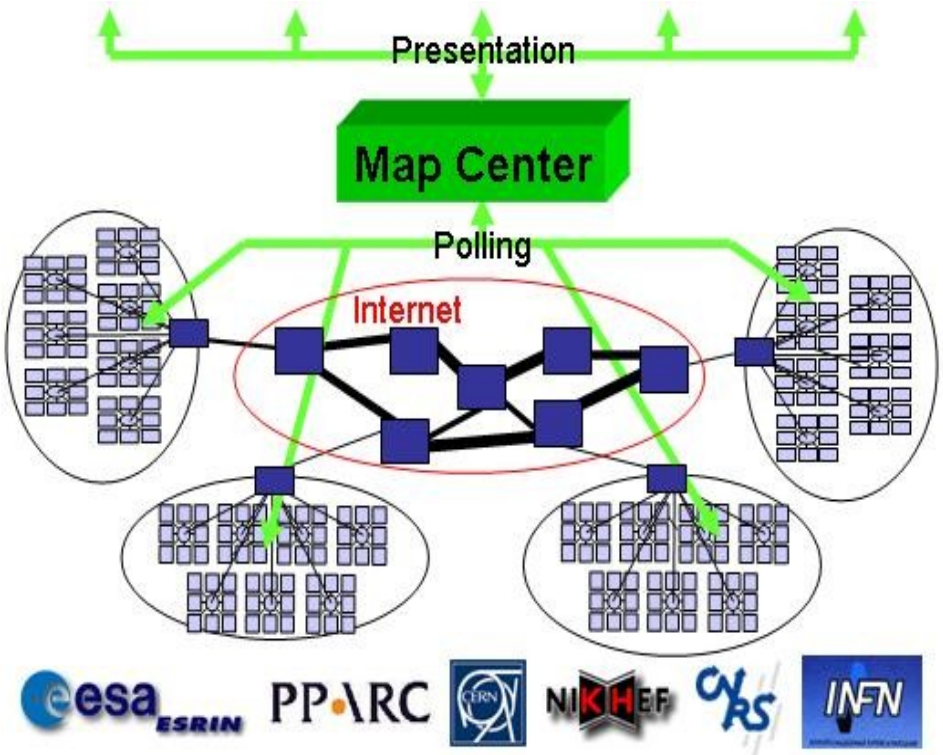
seProtocol=file, seId=dev02.hepgrid.clrc.ac.uk, Mds-Vo-name=ral-dev, Mds-Vo-name=uk, o=Grid
objectClass: StorageElementProtocol
objectClass: DataGridTop
objectClass: DynamicObject
SEId: dev02.hepgrid.clrc.ac.uk
SEProtocol: file

Storage Element Status

```
in=status,seId=dev02.hepgrid.clrc.ac.uk,Mds-Vo-name=ral-dev,Mds-Vo-name=uk,o=Grid
objectClass: StorageElementStatus
objectClass: DataGridTop
objectClass: DynamicObject
SEfreespace: 12031
SEId: dev02.hepgrid.clrc.ac.uk
```

Map Centre

- An easy way to browse the data available in the Information and Monitoring Service is to use Map Centre
- http://ccwp7.in2p3.fr/mapcenter/datagrid-d/

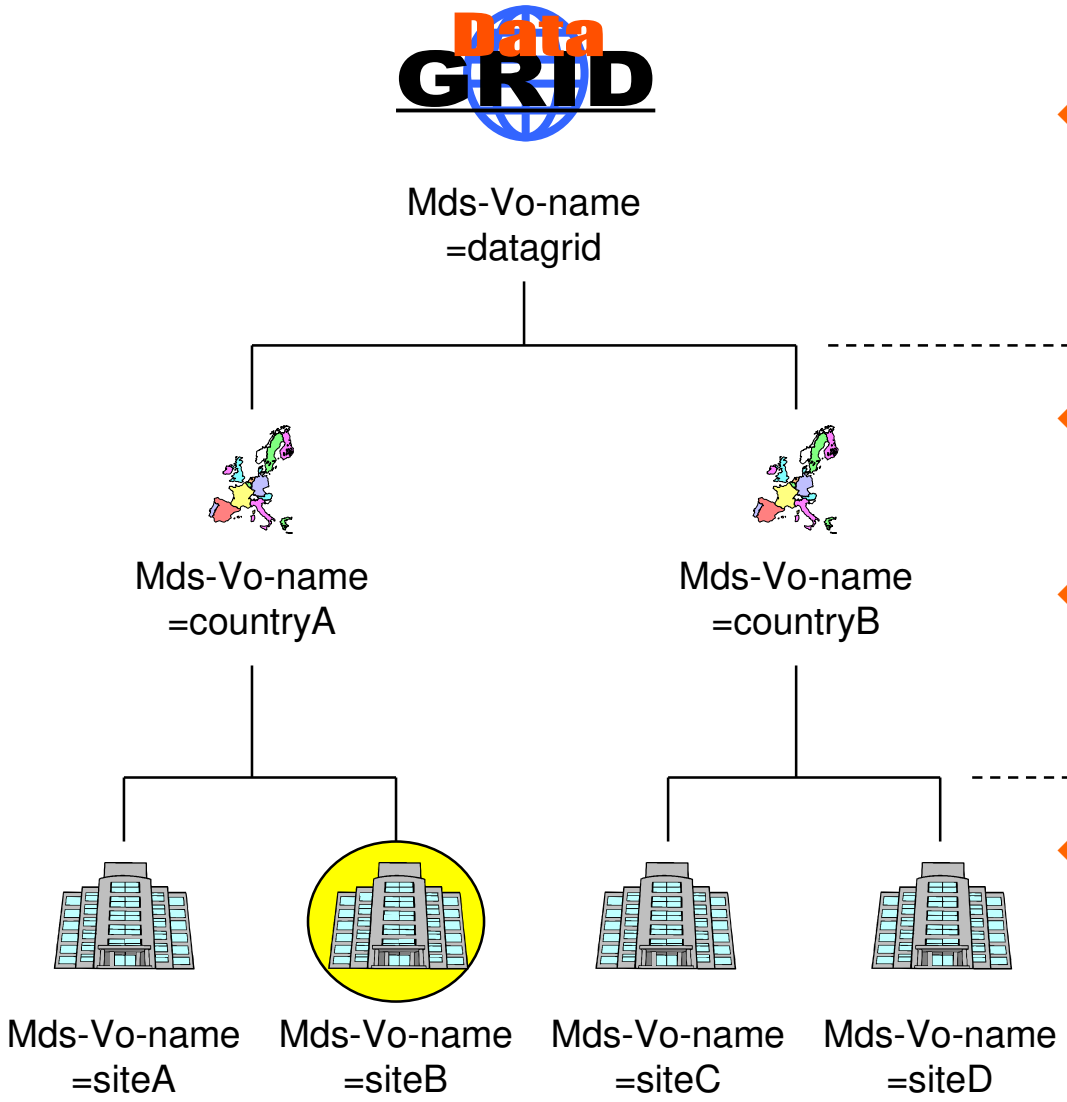


Querying the Information & Monitoring Service

- Queries can be posed to the current Information and Monitoring Service using LDAP search commands:

```
$ldapsearch\
  -x\                                              "simple" authentication
  -H ldap://lxshare0225.cern.ch:2135\              uniform resource identifier
  -b 'Mds-Vo-name=datagrid,o=grid\                 base distinguished name for search
  'objectclass=StorageElment'\                     filter
  seId SEsize \                                    attributes to be returned
  -s base|one|sub                                  scope of the search specifying just
                                                       the base object, one-levelor
                                                       the complete subtree
```

Querying the GRIS/GIIS Hierarchy



- Mds-Vo-name=datagrid,o=grid
  - This will look at all the data
- Mds-Vo-name=siteB, Mds-Vo-name=countryA, Mds-Vo-name=datagrid,o=grid
  - This will look at all the data from siteB
- Mds-Vo-name=countryA,o=grid
  - This will look at all the data from countryA
- Mds-Vo-name=siteB, Mds-Vo-name=countryA,o=grid
  - This will look at all the data from siteB
- Mds-Vo-name=siteB,o=grid
  - This will look at all the data from siteB

R-GMA

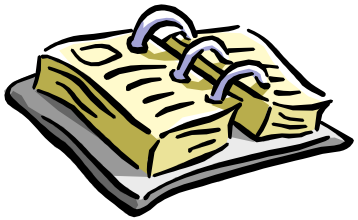
Relational - Grid Monitoring Architecture

R-GMA

- LDAP does not allow queries over different objects
  - I.e. you can only query based on attributes of an object (no "Joins")
- MDS is not designed for applications to publish their own data
  - It has relatively static descriptions of the data being published – the schema.
- R-GMA is a relational implementation of the Grid Monitoring Architecture (GMA) of the GGF
  - The relational model is very flexible and allows complex queries which make use of information in multiple objects
  - R-GMA provides a means for anyone to publish any information on the Grid – can also do the job of the current MDS
  - It is highly dynamic – with new Producers of information being noticed by existing Consumers

R-GMA
The Consumer Producer Model

Producer



Registry

Consumer

Command flow

Information flow

- Use the Grid Monitoring Architecture from Global Grid Forum
- A relational implementation
- Applied to both information and monitoring
- Creates impression that you have one RDBMS per VirtualOrganization

Relational Approach

- Not a general distributed RDBMS system, but a way to use the relational model in a distributed environment where ACID properties are not generally important.
- Producers — announce: SQL "CREATE TABLE"; publish: SQL "INSERT"
- Consumers — collect: SQL "SELECT"

- The mediator is a component within the Consumer which locates one or more Producers and combines the information as necessary

Summary

- The current information system is Globus MDS
  - This uses LDAP as its underlying data interface
  - The are a number of EDG information providers
- The new Information and Monitoring Service is R-GMA
  - Early version in 1.2
  - It can support complex SQL queries
  - It can return a single result set or stream data
  - Grid applications can publish data

The End

- Information and Monitoring Services
  - http://hepunx.rl.ac.uk/edg/wp3/