

# Introduction to ILDG

Dirk Pleiter  
DESY Zeuthen



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# Outline

- Introduction
- Metadata
- Middleware
- ILDG in practice
- Infrastructure overview
- Summary

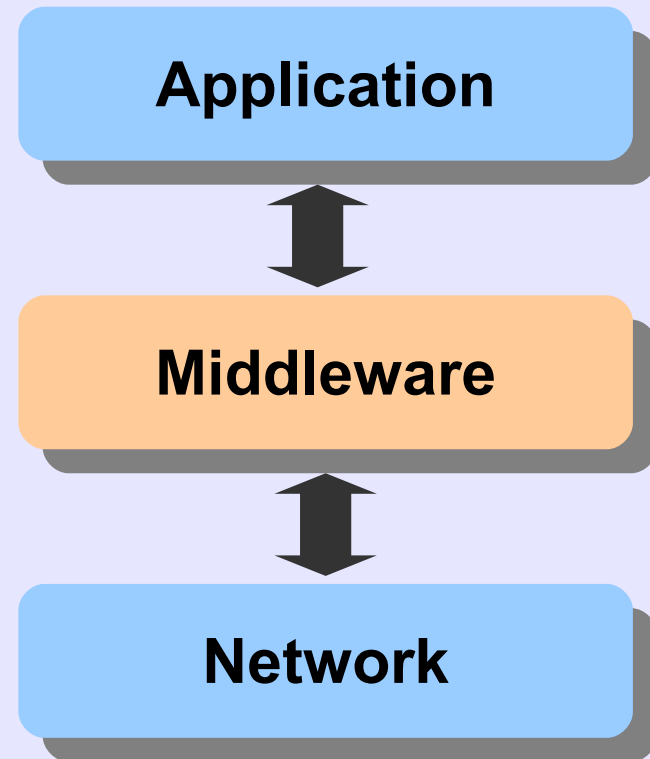
# INTRODUCTION

# What is ILDG?

- Goal of ILDG:
  - Establish an **international grid infrastructure**
  - Long-term storage and **global sharing of data**
- Participating countries: Australia, France, Germany, Italy, Japan, UK, US
  - More users from other countries  
e.g. China, Cyprus, NL, ...
- Requirements
  - Standards for **metadata** and files
  - Standards for **middleware** and common middleware services

# Grid Middleware

- Layer model:
- Service examples:
  - resource discovery
  - uniform data access
  - authentication
  - identity management



# ILDG Concept

- Organised as a federation of Grids
  - Different middleware stacks
    - gLite <http://www.glite.org>
    - Globus Toolkit <http://www.globus.org>
  - Different grid infrastructures
    - EGEE, OSG, WLCG
    - Use available infrastructure (tiny fraction of LHC storage)



# Use cases and services

- Search for scientific data
  - Query **metadata catalogue (MDC)**
- Identify copy of file
  - Query **file catalogue (FC)**
- Download file
  - Access **storage element (SE)**
- Register and manage users
  - **Virtual organisation management**

# METADATA



# Metadata Standards

- Standardize **which** information is provided **how**
- Not all data has to be searchable (i.e. machine processable)
- Requirements for metadata standards:
  - **unique**
  - **extensible**: e.g. allow for new actions
  - **simple**: as simple as possible
  - **general**: allow to describe other data objects

# Technologies

- Standard technology for metadata: **XML**  
Advantages:
  - Human readable
  - Easy to parse by computers
  - Extensible by construction
- Technology to enforce standards on structure and contents of XML documents: **XML schema**  
*“XML Schemas express shared vocabularies and allow machines to carry out rules made by people. They provide a means for defining the structure, content and semantics of XML documents.” (W3C)*

# Ensemble XML Documents

- markovChain
  - markovChainURI: unique identifier
  - management
    - collaboration, projectName, archiveHistory, ...
  - physics
    - size, **action**
  - algorithm

# Configuration XML Document

- gaugeConfiguration
  - management
    - crcChecksum, ...
  - implementation
    - Machine, code, ...
  - algorithm
  - precision
  - markovStep
    - **markovChainURI**, series, update, **dataLFN**

# ILDG File Format

- All files uploaded to ILDG have to conform to file format specification
- Format based on structured files which are packaged using **LIME file format**
  - LIME defined (and implemented!) by USQCD
  - Structure:
    - Records containing ASCII or binary data
    - One or more records combined in one message
    - One or more messages in one file

# ILDG records

- ildg-format

```
<?xml version="1.0" encoding="UTF-8"?>
<ildgFormat>
  <version> 1.0 </version>
  <field> su3gauge </field>
  <precision> 32 </precision>
  <lx>20</lx> <ly>20</ly> <lz>20</lz> <lt>64</lt>
</ildgFormat>
```

- ildg-binary-data

- Gauge configuration data

- ildg-data-lfn

- Logical file name, reference to metadata

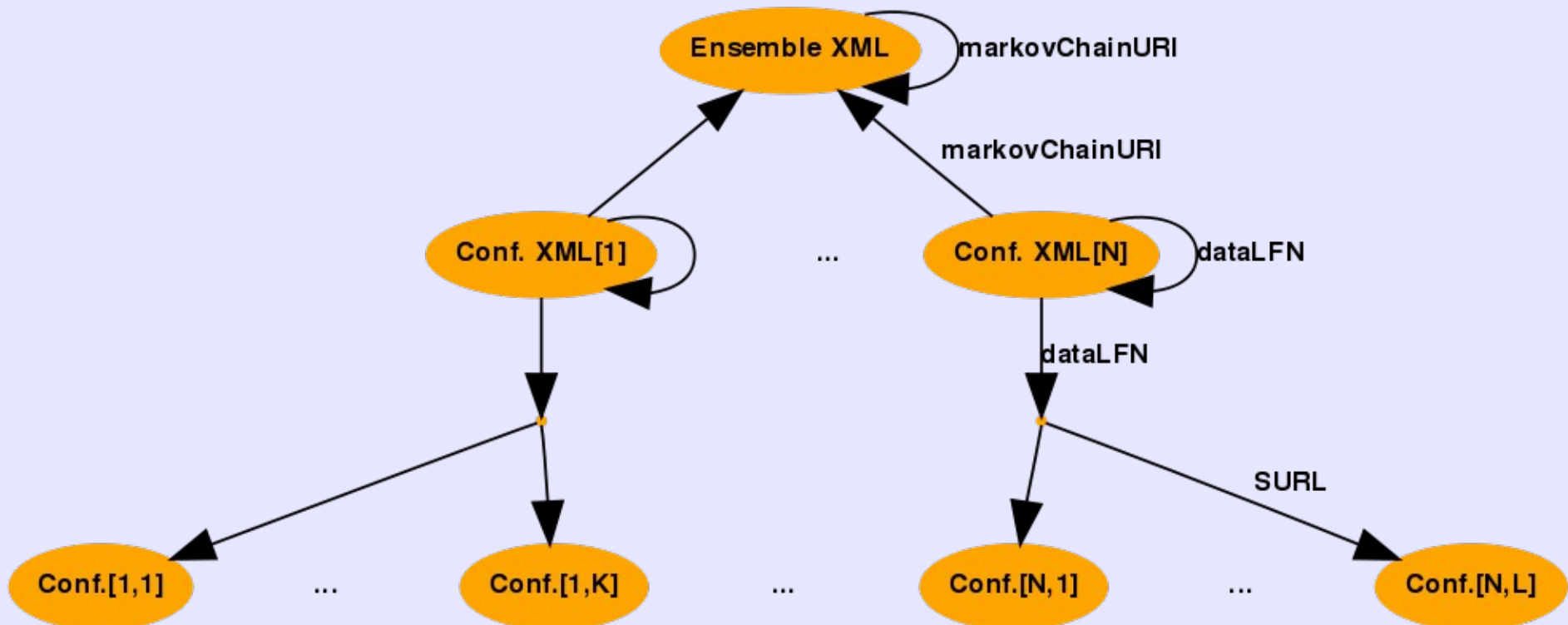
# ILDG File Format (2)

- Users free to add own messages and records (but must not use record type name 'ildg-\*')

Message	Record	LIME record type
#1	...	...
...	...	...
#n	...	...
	#i	ildg-format
	...	...
	#j	ildg-binary-data
	...	...
...	...	...
#m	#1	ildg-data-lfn
...	...	...

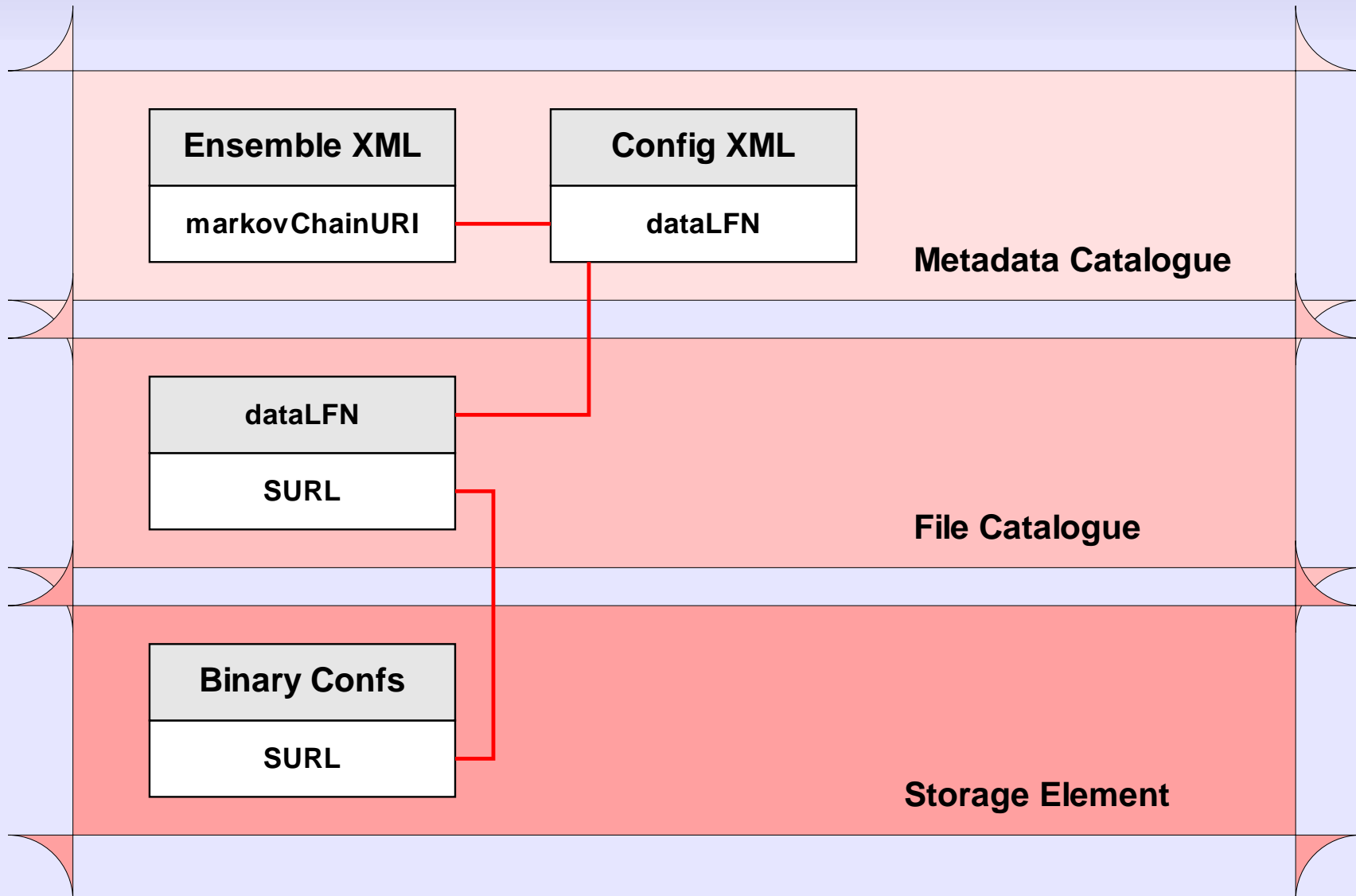
# Linking Metadata and Data

Objects	Links
Ensemble XML document	<code>markovChainURI</code>
Configuration XML document	<code>dataLFN</code>
Binary data file	<code>dataLFN</code>





# Information/Data Storage



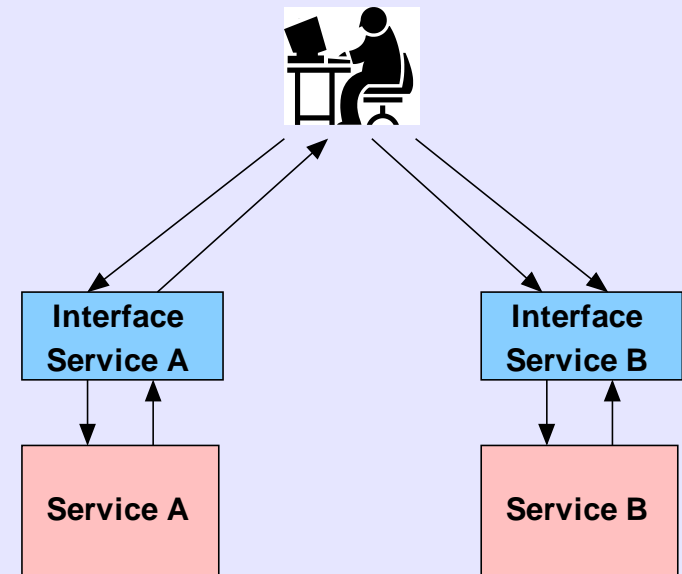
# MIDDLEWARE

# Reminder: Use cases and services

- Search for scientific data
  - Query **metadata catalogue (MDC)**
- Identify copy of file
  - Query **file catalogue (FC)**
- Download file
  - Access **storage element (SE)**
- Register and manage users
  - **Virtual organisation management**

# Interoperability Challenge

- Adopt common Grid standards
  - Provide service which implements given standard
  - Example: Storage Resource Manager (SRM)
- Define and implement interface services
  - Standardized interface service
  - Interface service executes request on behalf of user
    - Problem: credential delegation



# Metadata Catalogue

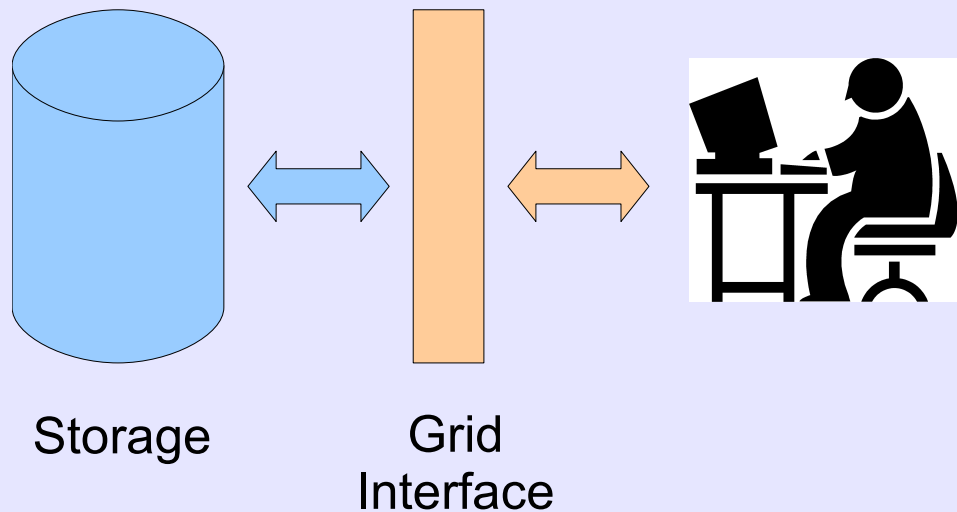
- Catalogue = database with following functionalities:
  - Query and download XML documents
  - Insert/update/delete XML documents
- Different implementations:
  - Generic XML database (e.g. eXist)
  - XML relational mapper + RDBMS (e.g. MySQL)
- ILDG interface services provide access only to some functions

# Grid File Catalogues

- File catalogue task
  - Map logical file name to physical file names
  - Possibly: file metadata (e.g. checksums)
- Popular implementations:
  - GT Replica Location Service (RLS)
    - Flexible set of attributes
  - LCG File Catalogue (LFC)
    - Optimised for scalability
- ILDG interface: `getURL`, `getFCinfo`

# What Is a Storage Element?

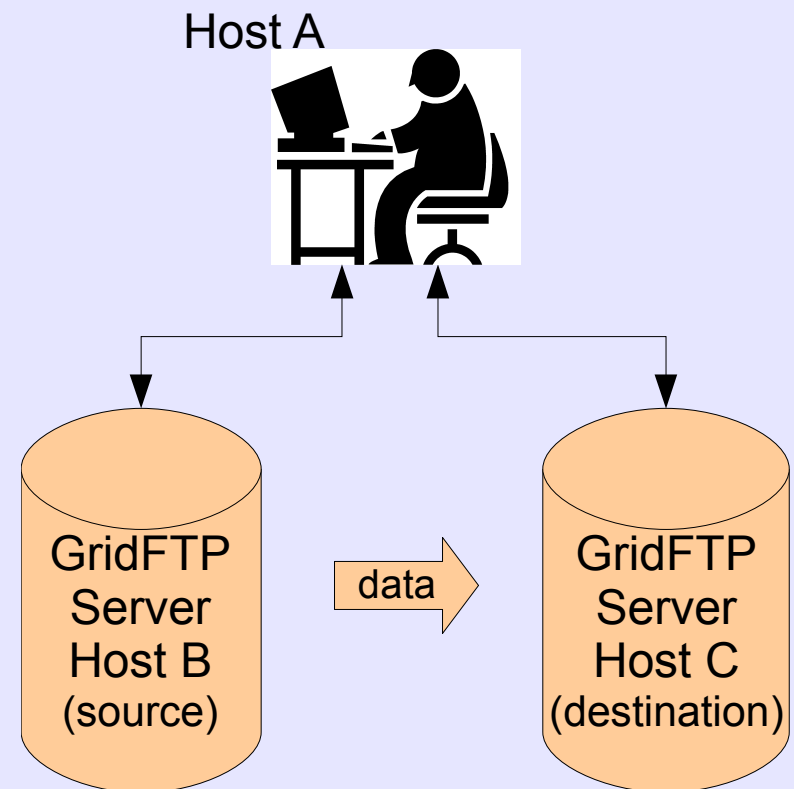
- Very simple storage element:



- Will not work for large storage (multi-PBytes)  
→ Need scaling architecture

# GridFTP

- GridFTP protocol developed by GGF as extension of FTP protocol
- Features:
  - Grid Security Infrastructure (GSI) support
  - Parallel data transfer (multiple TCP streams)
  - Third-party control of data transfer





# SRM

- Storage Resource Management protocol
  - Reservation and scheduling of storage resources
- Standardised access to heterogeneous storage
  - Simple disk
  - Robotic tape storage systems
  - Distributed disk cache, hierarchical storage system
- Features
  - File transfer protocol negotiation
  - Dynamic transfer URL (TURL) allocation

# SRM get

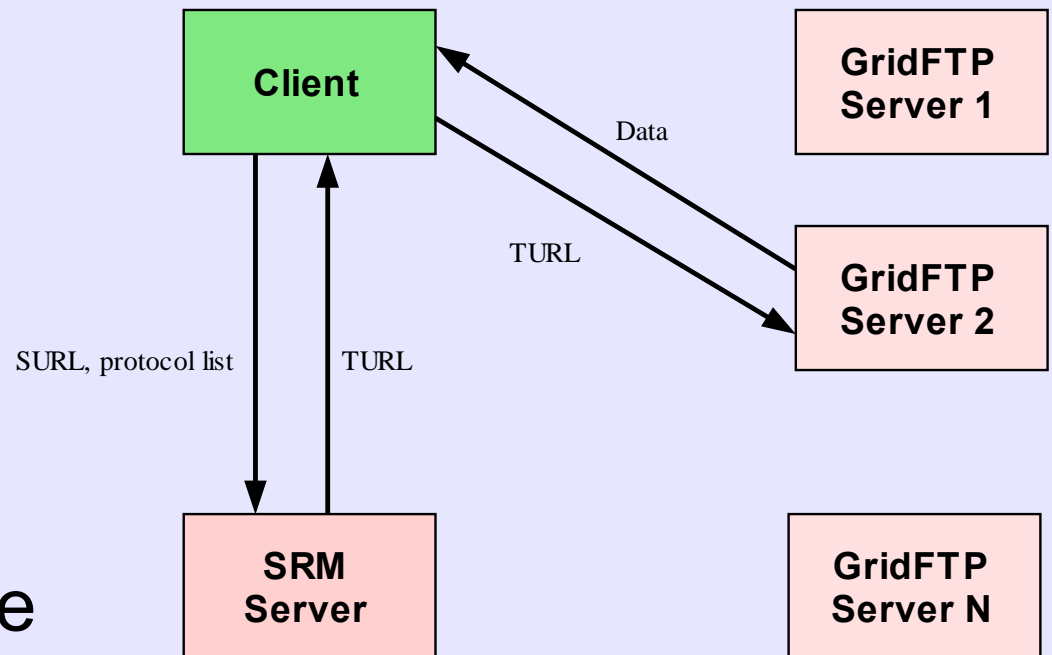
- Client sends get to SRM server

- SURL, protocol list

- SRM server returns TURL

- GridFTP server selected, e.g., depending on load
  - Possibly wait until file has been staged

- Client initiates file transfer from GridFTP server



# Virtual Organisation (VO)

- Collection of people from different institutions working to solve a common goal
- VO is *consumer* of resources (e.g. storage) provided by resource *providers*
  - VO members share common resources
  - VO establishes resource-usage agreements with grid resource providers
- VO manages membership

# VOM Registration Service (VOMRS)

- GUI: <https://grid-voms.desy.de:8443/vo/ildg/vomrs>
- User action:
  - Load certificate into browser and connect to VOMRS
  - Fill registration form and nominate representative
  - After email address verification acknowledge VO usage rules
- Representative action
  - Approve/deny application
  - $\geq 2$  representatives per regional Grid

# ILDG IN PRACTICE

# Install GUI

- Goto <http://www-zeuthen.desy.de/latfor/ldg>  
→ UserDoc → Software and follow instructions
- RPM-based installation, many Linux flavours
- Install
  - `gui-3.0-1.*.noarch.rpm`,  
`gui-default-3.0-1.*.noarch.rpm`
  - `env.rpm`
  - `cert.rpm` **cert.rpm requires regular update**
  - `jre.rpm`, `jre-default.rpm`
  - `ltools.rpm`, `ltools-default.rpm`
  - `srmcp.rpm`, `srmcp-default.rpm`
  - `ildg-client.rpm` `ildg-client-default.rpm`

# Get Grid Identity

- Obtain certificate
  - Details depend on local situation
- Join VO ILDG:  
<https://grid-voms.desy.de:8443/vo/ildg/vomrs>

# MDC Portals

- Web interfaces:
  - <http://globe-meta.ifh.de:8080/lenya/hpc/live/LDG/mdc.html>
  - <http://cssm.sasr.edu.au/ildg/>
- ILDG Browser Client
  - <http://forge.nesc.ac.uk/projects/qcdgrid/>
- Download metadata using ildg-client:

```
ildg-get --mdc-only {__URI__|__LFN__}
```

```
% ildg-get --mdc-only \  
uri://ldg/qcdsf/clover_nf2/b5p20kp13420-16x32  
% ildg-get --mdc-only \  
lfn://ldg/qcdsf/clover_nf2/b5p20kp13420-16x32/ape.001.000305.dat
```



# Tutorial: Query File Catalogue

- Fetch list of replicas for a particular LFN using `ildg-client`:

```
% ildg-get --fc-only \  
  lfn://ldg/qcdsf/clover_nf2/b5p20kp13420-16x32/ape.001.000305.dat  
srm://ccsrm02.in2p3.fr/pnfs/in2p3.fr/data/ildg/qcdsf/clover_nf2/b5p20kp13420-16x32/ape.001.000305.dat  
srm://dcache.fz-juelich.de/pnfs/fz-juelich.de/data/ildg/qcdsf/clover_nf2/b5p20kp13420-16x32/ape.001.000305.dat  
srm://dcache.zib.de/pnfs/zib.de/data/ildg/qcdsf/clover_nf2/b5p20kp13420-16x32/ape.001.000305.dat  
srm://globe-door.ifh.de/pnfs/ifh.de/acs/qcdsf/pleiter1/ukqcdsf/b5p20/kp13420-16x32/confs-ildg/ape.001.000305.dat  
srm://grid-se3.desy.de/pnfs/desy.de/data/ildg/qcdsf/clover_nf2/b5p20kp13420-16x32/ape.001.000305.dat
```

- First call takes long ← credential delegation
  - Interface service stores delegated credential
- Watch details: `ildg-get -debug=3 ...`

# Download File

- Download file

```
% ildg-get \  
lfn://ldg/qcdfsf/clover_nf2/b5p20kp13420-16x32/ape.001.000305.dat
```

- For more details increase debug level, e.g.:  
--debug=3
- Verify checksum:  
`ildg_cksum <file>`
- Check contents:  
`lime_contents <file>`

# REGIONAL GRID OVERVIEW

# Regional Grids: Australia

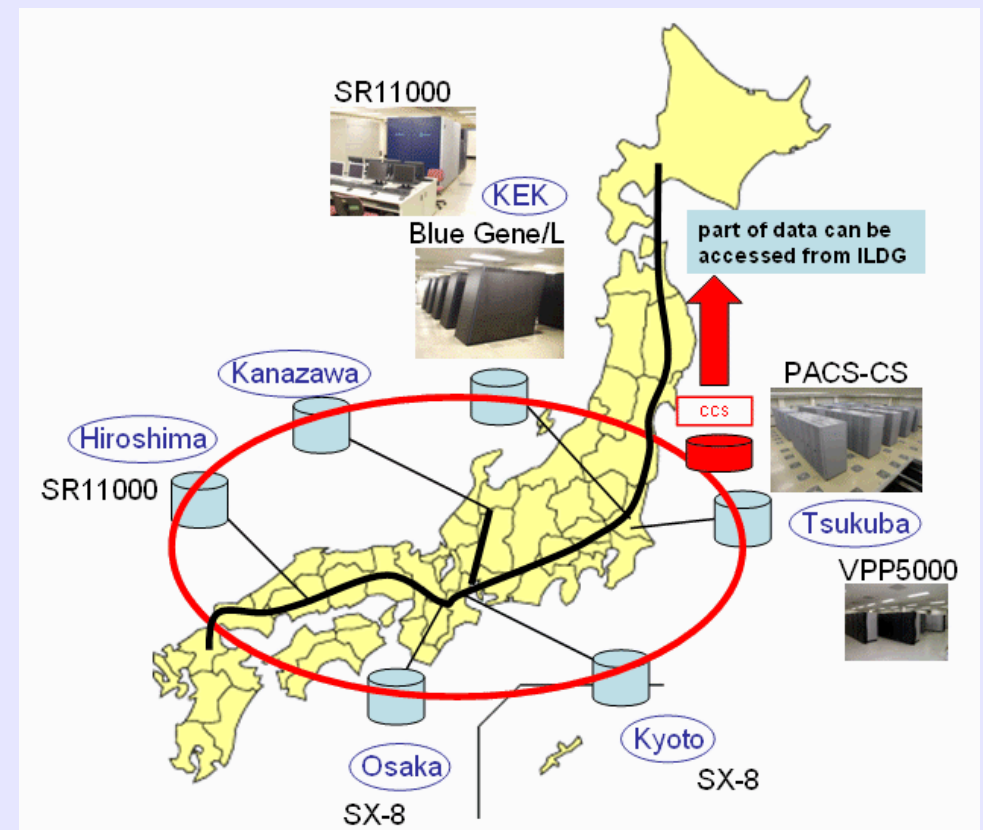
- Catalogue services
- dCache based storage element
- Host of global ILDG services:
  - Monitoring service
  - Global web-site <http://www.lqcd.org/ildg>
- See <http://cssm.sasr.edu.au/ildg/>



# Regional Grids: Japan



- Catalogue services
- Relevant computing centres access global file system Gfarm
- Grid-FTP server provides external access
- See <http://www.jldg.org>



# Regional Grids: UK

- Catalogue services
- 6 storage nodes
- See talk by George Beckett and <http://www.gridpp.ac.uk/qcdgrid/>



# Regional Grids: US



US Lattice Quantum Chromodynamics

- Catalogue services
- dCache storage element at FNAL
- See <http://www.usqcd.org/ildg/>

# Regional Grids: France/Germany/Italy

- LatFor Datagrid (LDG)  
<http://www-zeuthen.desy.de/latfor/ldg>
  - Catalogue services:
    - Metadata catalogue (DESY, Zeuthen)
    - File catalogue (DESY, Hamburg)
  - dCache based storage elements in
    - France: Lyon
    - Germany: Berlin, Hamburg, Jülich, Zeuthen
- SE does not have to be dCache, LCG-compliant is sufficient





# More sites to come ...



# Use cases SE in Parma

- Upload configurations produced in Italy
    - Later replicated to other SE
  - Hold copy of data currently analysed by users in Italy
    - Retrieve copy from other SE
  - Advantages:
    - Faster access
    - Save network resources
- **Get grid-storage close to HPC systems**

# SUMMARY

# Summary

- ILDG concept: Federation of regional Grids
  - 5 regional grids in operation
- Interoperability challenge:
  - Adopt common Grid standards
  - Define and implement interface services

# Conclusions

- Growing number of large physics collaborations use ILDG infrastructure
  - Gaining grid access requires efforts
    - Install Grid client software
    - Request certificate from CA
    - Join the VO
  - Efforts pay-off
    - Distributed generation and analysis of data