Enabling Grids for E-sciencE

Practical using EGEE middleware

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Information Society

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- **Please download this file from the agenda page.**
- **You will need to refer to it during the practical.**

- **Browse to:**

  http://agenda.cern.ch/fullAgenda.php?ida=a061940
  - Look at the first practical on the agenda
  - Left click on “transparencies”
  - Select ppt or pdf as you prefer

- **If you do not know LINUX, sit next to someone who does! You will be working in pairs.**
- **NOTE be careful if you cut and paste:**
  - Watch for – becoming .

Scope

- **We are using the VOCE testbed today**
  - Almost-current EGEE production middleware

- **The practical exercises are to illustrate "how"**
  - Not using typical jobs for running on a grid!!
  - But to show how EGEE grid services are used, jobs are submitted, output retrieved,…

- **We will use the Command-Line Interfaces on a "User Interface" (UI) machine**
  - "UI" is your interface to the VOCE Grid
    - Where your digital credentials are held
    - Client tools are already installed

What is VOCE?

CE region specifics

- Central European federation (CE)
  - regional descriptor **heterogeneity** (in both partners & organizations)

	Austria	GUP, UNIINNSBRUCK
	Czech Republic	CESNET
	Hungary	MTA SZTAKI, NIIF, KFKI RMKI, ELUB, BUTE
	Poland	ICM, PSNC, CYFRONET
	Slovakia	II-SAS
	Slovenia	JSI

  - EGEE II regional newcomer Croatia

VOCE infrastructure

- **VOCE - Virtual Organization for Central Europe**
  - provides **complete grid infrastructure** under EGEE wings
    - officially registered as currently the one and only “Regional VO” for Central European (CE) region
  - based on **regional principle**
    - VOCE spans the whole CE Federation
    - core services operated by CESNET
    - resources are provided by several institutions across the CE (these resources are available to all / experienced users registered in VOCE)

VOCE infrastructure

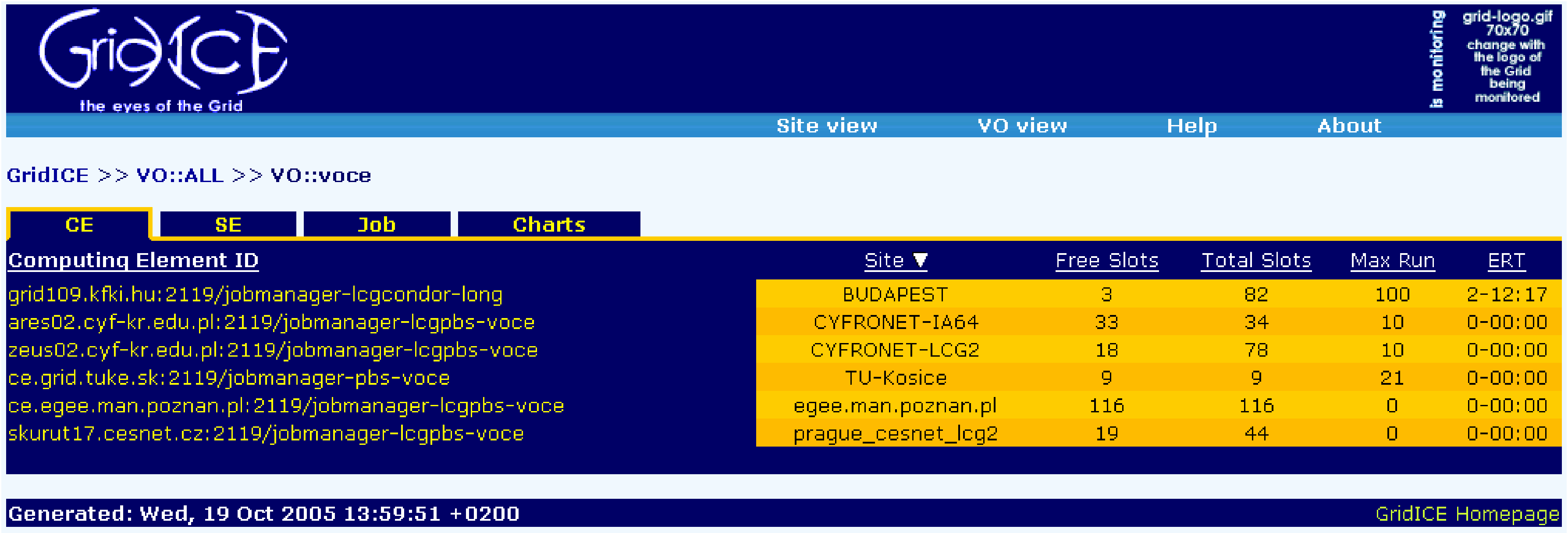
- **VOCE - Description**
  - **fully production environment**
    - VOCE environment allows Grid newcomers to get quickly first experience with Grid computing
    - simultaneously allows users to smoothly move to production use of the Grid in the same environment
  - **self-contained infrastructure**
    - all the relevant services run by VOCE adminsitration
    - currently on LCG middleware but simultaneously available gLite 1.4 installation (undergoing task)

VOCE infrastructure

- **VOCE - Aims**
  - **incubator** for new applications / new application areas
    - assistance in adapting a software for use on the Grid
    - even for applications that do not have any Grid/cluster/remote computing experience
    - outsourcing the burden of running an grid infrastructure to VOCE
  - **generic VO**
    - VOCE is an application neutral virtual organization
      - *not bound to any particular application*
      - *interested in broad scale of application areas*
    - also suitable for training purposes (in cooperation with P-GRADE)

VOCE infrastructure

- **VOCE - Summary of resources**



GridICE >> VO::ALL >> VO::voce

Computing Element ID	Site ▼	Free Slots	Total Slots	Max Run	ERT
grid109.kfki.hu:2119/jobmanager-lcgcondor-long	BUDAPEST	3	82	100	2-12:17
ares02.cyf-kr.edu.pl:2119/jobmanager-lcgpbs-voce	CYFRONET-IA64	33	34	10	0-00:00
zeus02.cyf-kr.edu.pl:2119/jobmanager-lcgpbs-voce	CYFRONET-LCG2	18	78	10	0-00:00
ce.grid.tuke.sk:2119/jobmanager-pbs-voce	TU-Kosice	9	9	21	0-00:00
ce.egee.man.poznan.pl:2119/jobmanager-lcgpbs-voce	egee.man.poznan.pl	116	116	0	0-00:00
skurut17.cesnet.cz:2119/jobmanager-lcgpbs-voce	prague_cesnet_lcg2	19	44	0	0-00:00

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- resources from CESNET (Czech Republic)
  PSNC, CYFRONET, ICM (Poland)
  II-SAS (Slovakia)
  KFKI (Hungary)
- more than 40 registered users from 10 institutes and 4 countries
- in total **539 CPUs, about 5.9 TB disk space**

CE region specifics

- **VOCE - Advantages**
  - **regional self-organization**
    - users are not tightly bound around specific applications
    - the region itself is self-organized from the bottom level

resources	**…**	**infrastructure**
applications	**…**	**high level middleware**

    - potential users are not required to invest special effort to easy use the environment in a production mode
  - **application neutrality**

VOCE infrastructure

- **VOCE - Summary**
  - user registration
    - VOCE registration at http://voce-register.farm.particle.cz/
  - documentation
    - VOCE portal at http://egee.cesnet.cz/en/voce/
  - request tracking
    - send requests to voce@cesnet.cz

Practicals: outline

- **Introduction to the basic services**
  - Authorisation and Authentication
  - Workload Management – simple job submission
  - Information System
  - Data Management
  - “Putting it all together” – more realistic job submission

Proxy creation

Usually, ***BUT NOT TODAY***, you will need to do:

```
grid-proxy-init
```

to create a proxy, then you can upload a long-lived proxy to Myproxy using

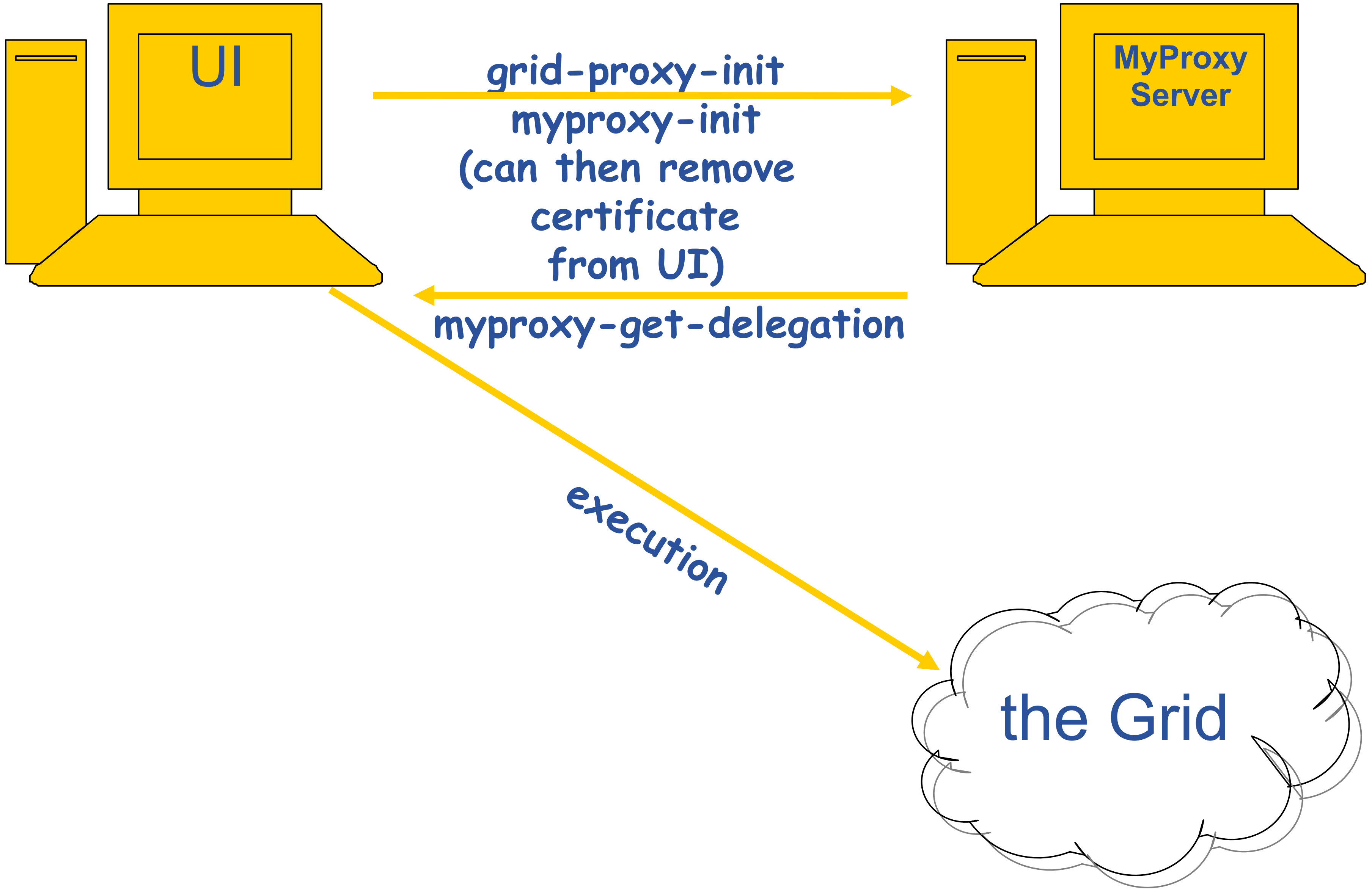
```
myproxy-init -s <myproxy server>
```

“MyProxy”

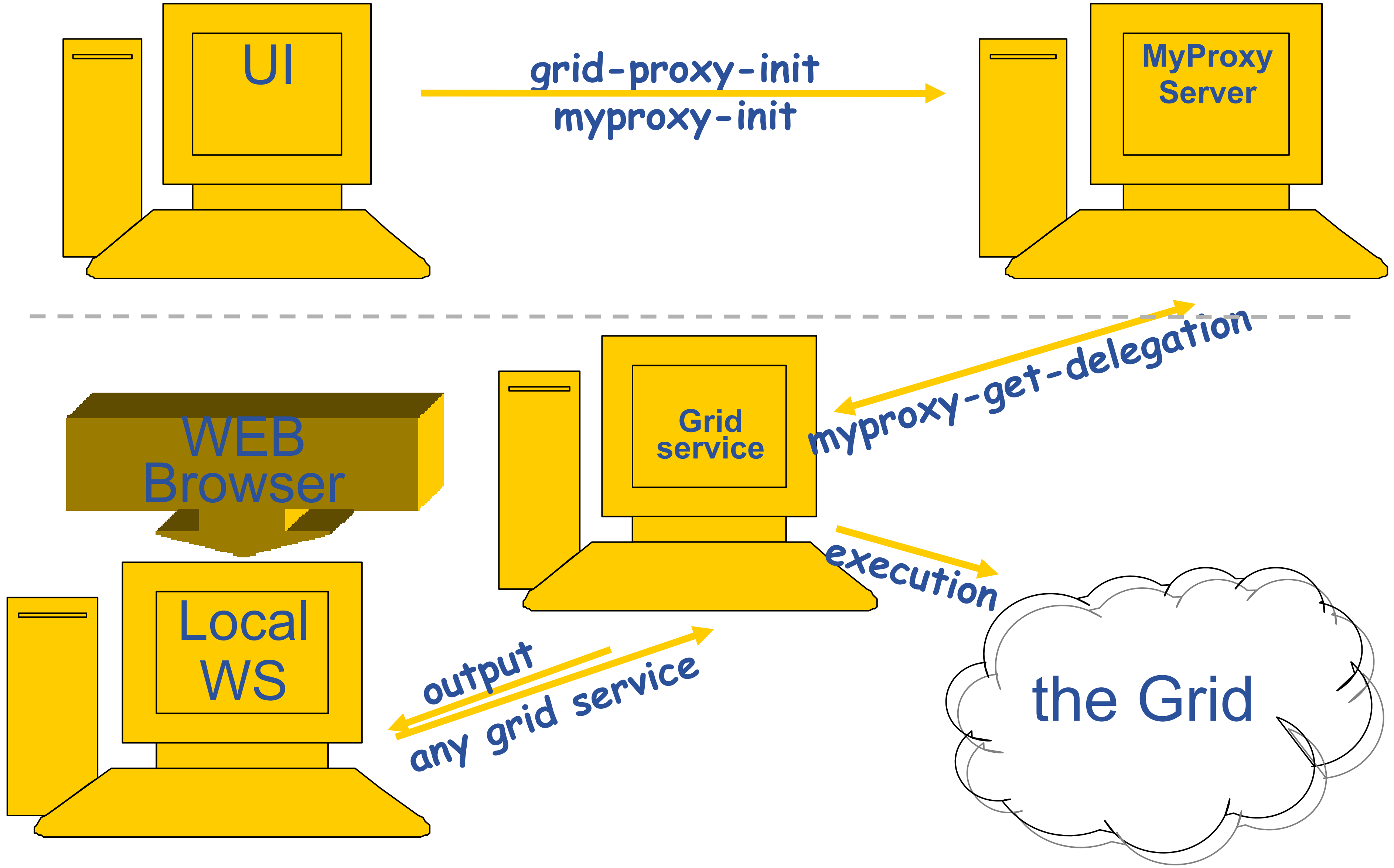
- **You may need:**
  - To interact with a grid from many machines
    - And you realise that you must NOT, EVER leave your certificate where anyone can find and use it…. Its on a USB drive only.
  - To use a portal, and delegate to the portal the right to act on your behalf (by logging in to an account that can make a proxy certificate for you)
  - To run jobs that might last longer than the lifetime of a short-lived proxy

- **Solution: you can store a long-lived proxy in a “MyProxy server” and derive a proxy certificate when needed.**

Grid authentication with MyProxy



Grid authentication with MyProxy



To use the EGEE grid

- **Get an internationally recognised certificate**
  - From a local RA – you will need to see them personally, bringing passport or other identification
- **Contact the virtual organisation (VO) manager**
- **Accept the VO and the EGEE conditions of use**
- **The VO manager authorises you to use resources**
- **Upload your certificate to a "User Interface" machine**
- **You can then upload a long-lived proxy to MyProxy**

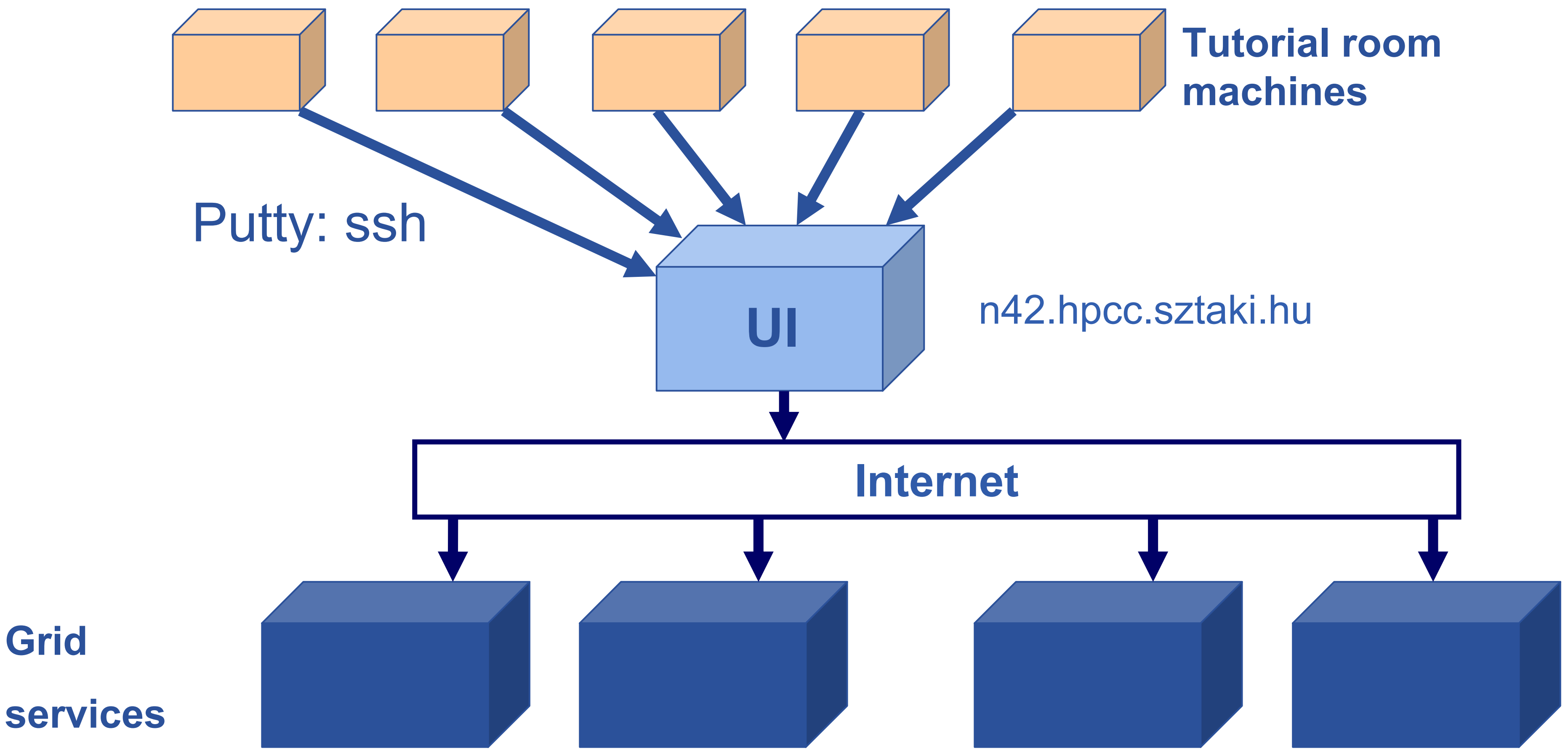
- **We will begin the practical from this stage**
- **You are a member of the VO "voce"**

Time to do something!!!

- Please work in pairs

- 1 of each pair must know how to edit files and use command-line interfaces on UNIX

Our setup


Tutorial room machines
Putty: ssh
UI
n42.hpcc.sztaki.hu
Internet
Grid services

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User Interface Access

Host: n42.hpcc.sztaki.hu

Username: taipeiXX (XX=01…40)

Password: tpXX (XX=01…40)

ssh n42.hpcc.sztaki.hu -l taipeiXX

You are a member of the "voce" VO

- Letter "l"

wait here please!!

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Retrieve a proxy from a MyProxy server

- **myproxy-get-delegation -s cvs.lpds.sztaki.hu -l taipei**

MyProxy server

LETTER “l”

YOU WILL BE ASKED FOR A **PASSPHRASE**

IT IS “**taipei**”

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What is in your proxy??

- Please then type:

grid-proxy-info --all

```
subject  : /C=HU/O=NIIF CA/OU=GRID/OU=NIIF/CN=Gergely
Sipos/Email=sipos@sztaki.hu/CN=proxy/CN=proxy/CN=proxy
issuer   : /C=HU/O=NIIF CA/OU=GRID/OU=NIIF/CN=Gergely
Sipos/Email=sipos@sztaki.hu/CN=proxy/CN=proxy
identity : /C=HU/O=NIIF CA/OU=GRID/OU=NIIF/CN=Gergely
Sipos/Email=sipos@sztaki.hu
type     : full legacy globus proxy
strength : 512 bits
path     : /tmp/x509up_u546
timeleft : 12:01:04
```

- Note /proxy in issuer and subject

Try to use the grid with a proxy

Now you have a proxy try a command

- **hostname.jdl is a file that describes a job we will run. (JDL: Job Description Language)**
- **To see which compute elements (CE)s can run this job use the command:**

```
edg-job-list-match –vo voce hostname.jdl
```

Please try this command!!

The result is a list of the CEs (batch queues) where this job can be run… more later!

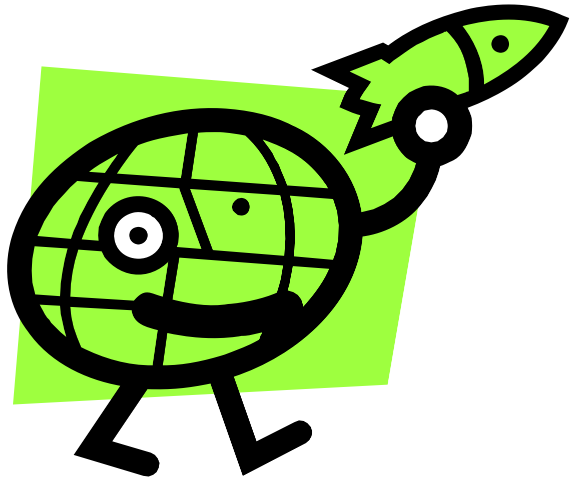
Summary

- **The EGEE grid is built on**
  - Authentication based on X.509 digital certificates
    - Issued by CAs that are internationally recognised (enabling international collaboration)
    - With proxies
  - Authorisation provided via VO services

- **You need to create or download a proxy**
  - This is your logon to the grid

References

- GSI description via www.globus.org
- A Security Architecture for Computational Grids. I. Foster, C. Kesselman, G. Tsudik, S. Tuecke. *Proc. 5th ACM Conference on Computer and Communications Security Conference*, pp. 83-92, 1998.
- A National-Scale Authentication Infrastructure. R. Butler, D. Engert, I. Foster, C. Kesselman, S. Tuecke, J. Volmer, V. Welch. *IEEE Computer*, 33(12):60-66, 2000.



Workload Management System

Workload Management System

- **The user interacts with the EGEE Grid via a** Workload Management System (WMS)

- **What does it allow users to do?**
  - To submit their jobs
  - To execute them on the "best resources"
    - The WMS tries to optimize the usage of resources
  - To get information about their status
  - To retrieve their output

- **WMS "virtualises" the many compute resources of the grid**

- **Why do commands start with edg?**
  - European Data Grid project is a precursor of LCG and EGEE

Job Description Language (JDL)

- **Job submission: a JDL file is sent to the Resource Broker**
- Job Attributes
  - Define the job itself
- Resources
  - Taken into account by the RB for carrying out the matchmaking algorithm (to choose the "best" resource where to submit the job)
  - *Computing Resource*
    - *Used to build expressions of Requirements and/or Rank attributes by the user*
    - *Have to be prefixed with "other."*
  - *Data and Storage resources*
    - *Input data to process, SE where to store output data, protocols spoken by application when accessing SEs*
- **Based upon Condor's *CLASSified ADvertisement language (ClassAd)***

Job Submission

- **edg-job-submit** performs the job submission to the WMS
- Returns a job identifier, not waiting for the job to execute

Usage: **edg-job-submit --vo voce *[options]* <jdl file>**

Principal Options :

--vo <vo name> : perform submission with a different VO than the UI default one ($echo

--output, -o <myjobid file> save jobId in a file, instead of STDIN

Please type:

```
edg-job-submit –vo voce -o myjob.ids hostname.jdl
cat hostname.jdl
cat myjob.ids
```

JDL syntax

- **An attribute is a pair (key, value), where value can be a Boolean, an Integer, a list of strings, ...**
  - <attribute> = <value>;
- **In case of literal string for values:**
  - if a string itself contains double quotes, they must be escaped with a backslash
    - `Arguments = " \"Hello\" 10";`
  - the character “'” cannot be specified in the JDL
  - special characters such as &, |, >, < are only allowed
    - if specified inside a quoted string
    - if preceded by triple \
      - ***`Arguments = "-f file1\\\&file2";`***
- **Comments must be preceded by a sharp character (#) or have to follow the C++ syntax**
- **The JDL is sensitive to blank characters and tabs**
  - they should not follow the semicolon (;) at the end of a line

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JDL – Relevant Attributes

JobType

- *Normal* (simple, sequential job) *Interactive*, *MPICH*
- Or combination of them

Executable (mandatory)

- The command name

Arguments (optional)

- Job command line arguments

StdInput, **StdOutput**, **StdError** (optional)

- Standard input/output/error of the job

InputSandbox (optional)

- List of files on the UI local disk needed by the job for running
- The listed files will automatically staged to the remote resource

OutputSandbox (optional)

- List of files, generated by the job, which have to be retrieved

WMS commands

- **edg-job-submit** < **job id**>
- **edg-job-status <job id**>   check job execution status
- **edg-job-get-output <job id**>
  If job status is 'done', retrieve output, specifying directory to receive it, e.g.:
      edg-job-get-output --dir <outputdir in your UI> -i <file>
- **edg-job-cancel <job id**>   perform job deletion
- **edg-job-get-logging-info <jobid>**
  see log of the job

All of these commands accept the option **–i <myjobidfile>** input from a file created by edg-job-submit to avoid entering long job id by hand.

edg-job-status -i myjob.ids

If "done" then retrieve output and see where your job ran:

edg-job-get-output --dir `pwd` -i myjob.ids

Explore the files!

JDL – running a script

```
Type = "Job";
JobType = "Normal";
Executable = "/bin/bash";
StdOutput = “std.out";
StdError = “std.err";
InputSandbox = {“yourscript.sh"};
OutputSandbox = {“std.err",“std.out"};
Arguments = "yourscript.sh";
```

JDL – Requirements

- “Requirement” constrains the RB
- Only one requirement can be specified - if there is more than one, only the last one is taken into account
  - If you need several Requirements, combine them through logical operators (&&, ||, !, ...).
- Examples:

```
#Insert a requirement to select a short queue
Requirements = (other.GlueCEPolicyMaxWallClockTime < 1440);

#Insert a requirement to select a long queue
Requirements = (other.GlueCEPolicyMaxWallClockTime > 1440);

#Insert a requirement to select an infinite queue
Requirements = (other.GlueCEPolicyMaxWallClockTime > 2880);

#Insert a requirement to use a particular CE Queue.
Requirements = other.GlueCEUniqueID ==
   "grid010.ct.infn.it:2119/jobmanager-lcgpbs-long";
```

Exercise

```
#!/bin/sh
hostname
date
whoami
```

create a new script, yourscript.sh

cp hostname.jdl taipei1.jdl

Then:

Modify taipei1.jdl file so yourscript.sh will be run

Add a requirement that the job should be run in a short queue

Submit the job, check its status, find which queue it is in

Read on whilst your job runs!

Matching Jobs to Resources

- **edg-job-list-match** returns suitable resources for execution
- No job submission is performed

- Usage: **edg-job-list-match** ***[options]*** **<jdl file>**

- **Principal Options** :

--vo <vo name> : perform list-match with a different VO than the UI default one

--**rank** show resources in order of ranking

--output, -o <output file> redirect output to a file, instead of STDIN

--debug show function calls and parameters

Exercise continued

Use edg-job-list-match and compare the output with the two jdl files you submitted before: hostname.jdl and taipei1.jdl.

(The second was directed to a short-job queue.)

For each job you submitted (unless you've already retrieved the output, then submit another using taipei1.jdl):

Use edg-job-get-logging-info and follow the job's history

Check status and when "done" retrieve the output

- **Next slides are extras – do them if you have time before we start on Information Systems**

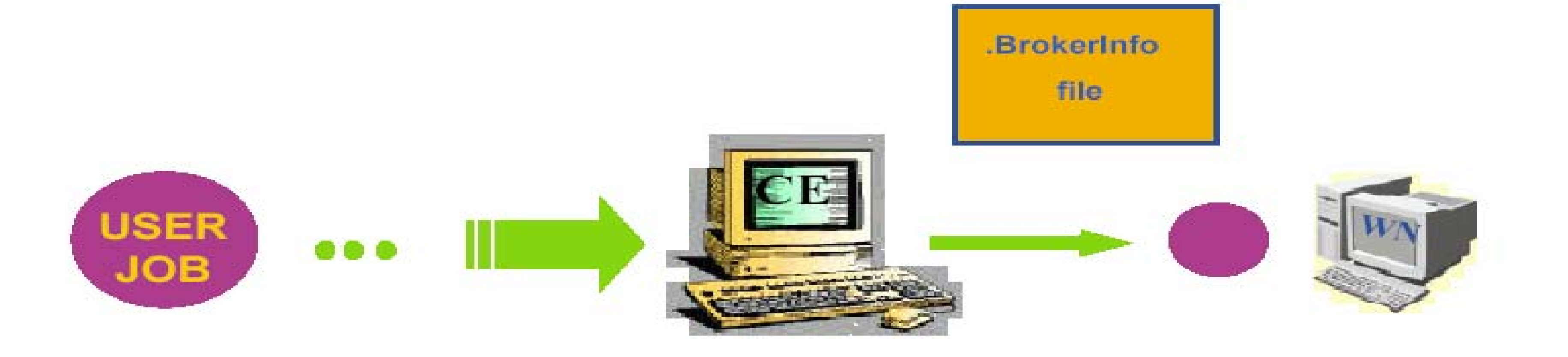
.BrokerInfo file

- It is a mechanism by which a job can access at some information about itself…at execution time!
- The Resource Broker creates and attaches this file to the job when it is ready to be transferred to the resource that best matches the request.
- Two ways for parsing elements from .BrokerInfo file:

1)Directly from the Worker Node at execution time;

2)From User Interface, but only if you have inserted the name of ".BrokerInfo" file in the JDL's OutputSandbox, and you have just retrieved job output, once that job has been Done;

edg-brokerinfo [options] function param



Example of .BrokerInfo file

```
[       ComputingElement =
          [
            CloseStorageElements =
              {
                [
                        GlueSAStateAvailableSpace =
    14029724;
                        GlueCESEBindCEAccesspoint
    = "/flatfiles/SE00";
                        mount =
    GlueCESEBindCEAccessPoint;
                        name = "grid003.cecalc.ula.ve";
                        freespace =
    GlueSAStateAvailableSpace
                   ]
              };
            name =
    "grid006.cecalc.ula.ve:2119/jobmanager-
    lcgpbs-infinite"
         ];
     InputFNs =
        {
        };
     StorageElements =
        {
        };
     VirtualOrganisation = "voce"    ]
```

edg-brokerinfo getCE

edg-brokerinfo getDataAccessProtocol

edg-brokerinfo getInputData

edg-brokerinfo getSEs

edg-brokerinfo getCloseSEs

edg-brokerinfo getSEMountPoint <SE>

edg-brokerinfo getSEFreeSpace <SE>

edg-brokerinfo getSEProtocols <SE>

edg-brokerinfo getSEPort <SE> <Protocol>

edg-brokerinfo getVirtualOrganization

edg-brokerinfo getAccessCost

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Exercises

Exercise part 1

- Create a file called startScriptBrokerInfo.sh with this content:

```
#!/bin/sh
MY_NAME= "your username"
WORKER_NODE_NAME=`hostname`

echo "Hello $MY_NAME, from $WORKER_NODE_NAME"
ls -a
echo "This job is running on this CE: "
/opt/edg/bin/edg-brokerinfo getCE
```

Exercise continued

Exercise part 2

- Create a file called **scriptBrokerInfo.jdl** with the following content:

```
[
Executable = "startScriptBrokerInfo.sh";
   StdOutput = "std.out";
   StdError = "std.err";
   VirtualOrganisation = “voce";
   InputSandbox = {"startScriptBrokerInfo.sh"};
   OutputSandbox = {"std.out","std.err",".BrokerInfo"};
   RetryCount = 7;
 ]
```

Remove leading/trailing “spaces” in the JDL file

Exercise continued

1. Replace your name in the script startScriptBrokerInfo.sh;
2. Submit the JDL file / Query the status / Retrieve Output scriptBrokerInfo.jdl;
3. In JobOutput folder, go into directory of the job that you have just retrieved and inspect the .BrokerInfo file.
4. Practice with the edg-brokerinfo command and its functions.

Practical: The Information Systems

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Uses of the Information System

If you are a user

Retrieve information about
• Grid resources and status
• Resources that can run your job
• Status of your jobs

If you are a middleware developer

Workload Management System:
Matching job requirements and Grid resources

Monitoring Services:
Retrieving information about Grid Resources status and availability

If you are site manager or service

You “generate” the information for example relative to your site or to a given service

Evolution

- **The data published in the Information System (IS) conforms to the GLUE (Grid Laboratory for a Uniform Environment) Schema. The GLUE Schema aims to define a common conceptual data model to be used for Grid resources.** http://infnforge.cnaf.infn.it/glueinfomodel/
- **In LCG-2, the BDII (Berkeley DB Information Index),** based on an updated version of the Monitoring and Discovery Service (MDS), from Globus, was adopted as main provider of the Information Service.
- **R-GMA (Relational Grid Monitoring Architecture)** is now adopted as IS in both the EGEE production grid (mainly “LCG-2”) and in the pre-production grid (moving to “gLite 3.0”)

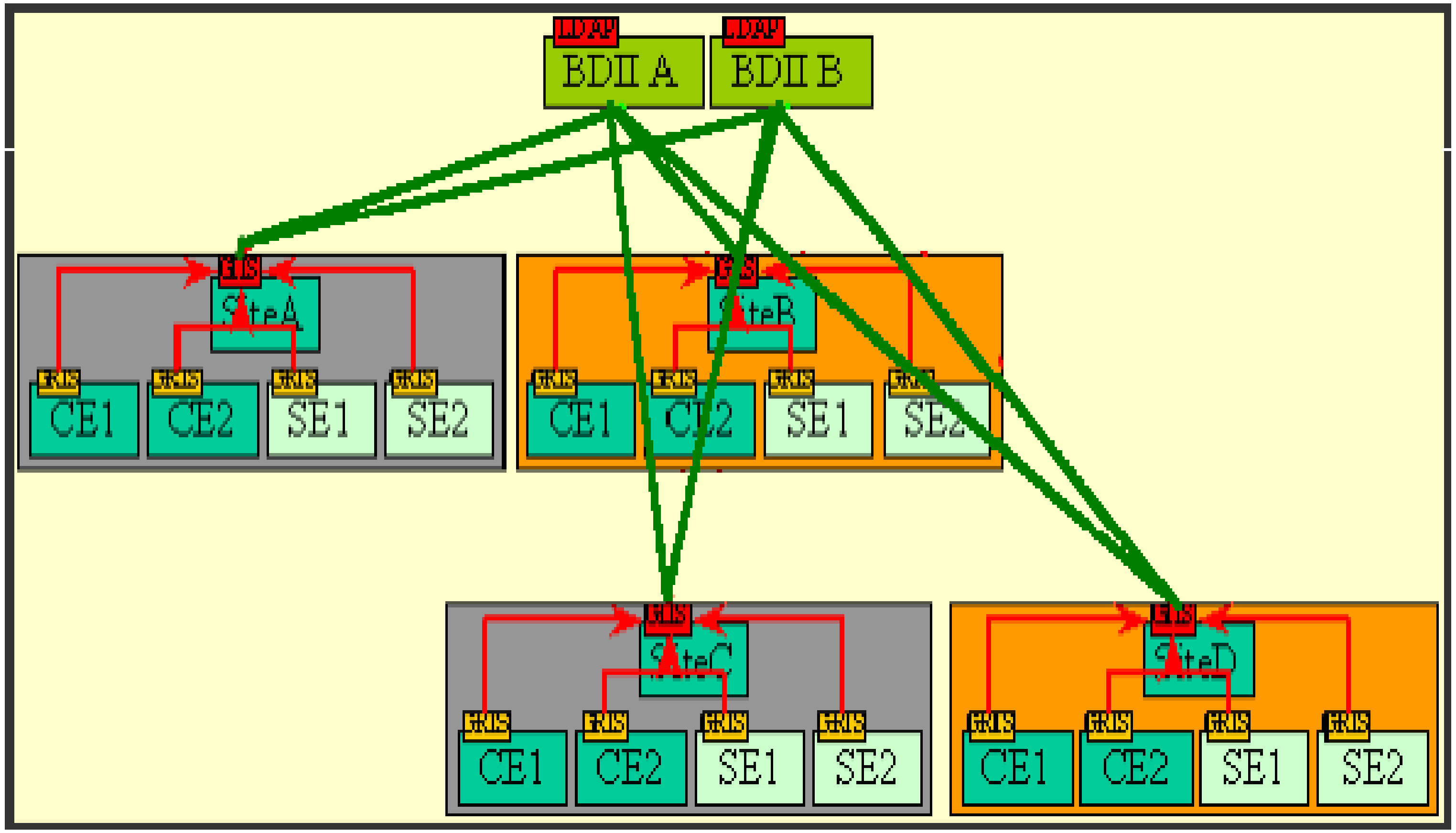
Overview Of Practicals

- **BDII Information System**
  - *main Information System for the current production grid*
  - **Two sets of commands:**
    - **lcg-infosites: simple, meets most needs**
    - (lcg-info: supports more complex queries – NOT TODAY!!)

lcg-infosites

LCG Information Service

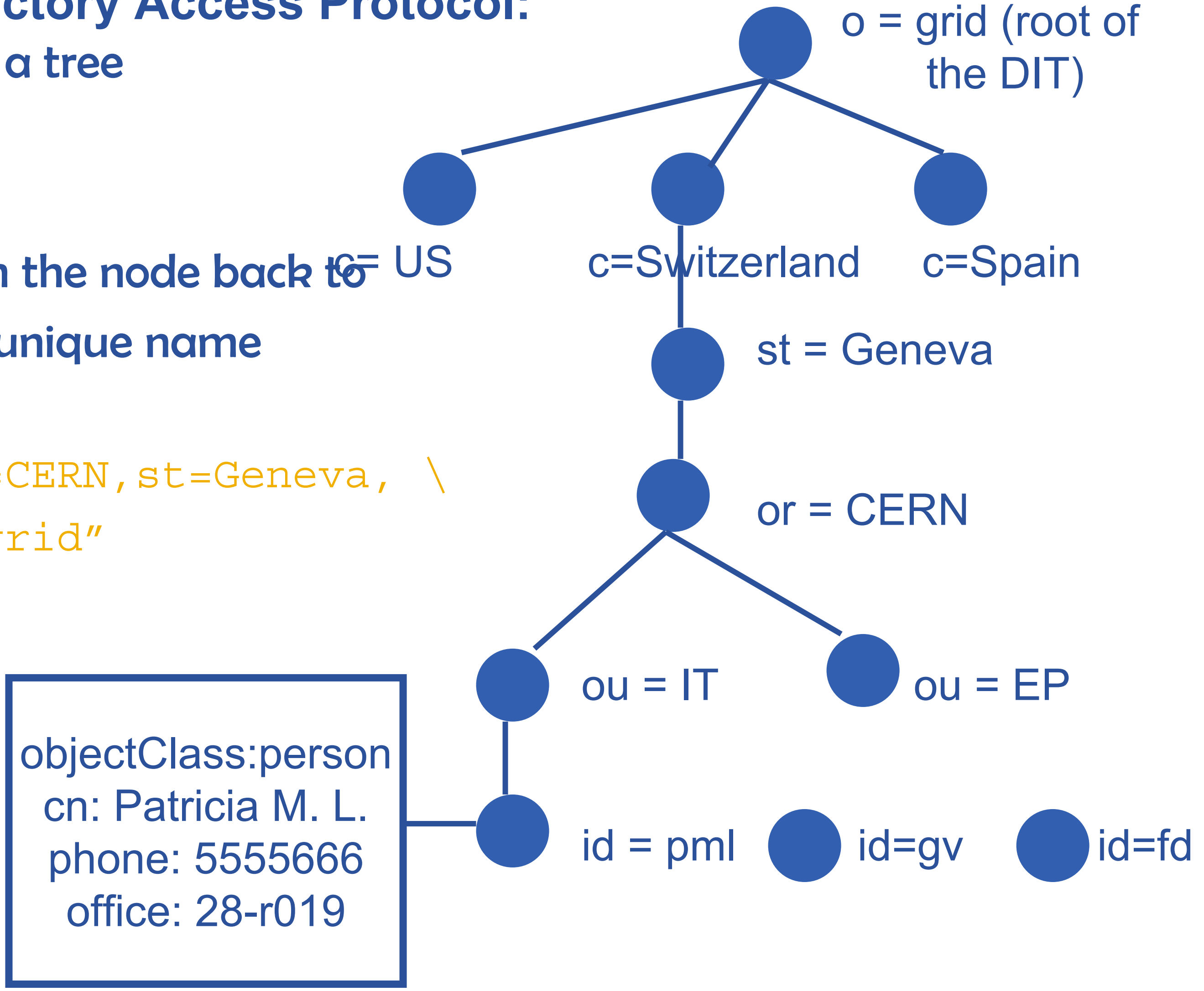
- a user or a service can query
  - the BDII (usual mode)
  - LDAP servers on each site



The LDAP Protocol

- **Lightweight Directory Access Protocol:**
  structures data as a tree

- Following a path from the node back to the root of the DIT, a unique name is built (the DN):
  `"id=pml,ou=IT,or=CERN,st=Geneva, \ c=Switzerland,o=grid"`



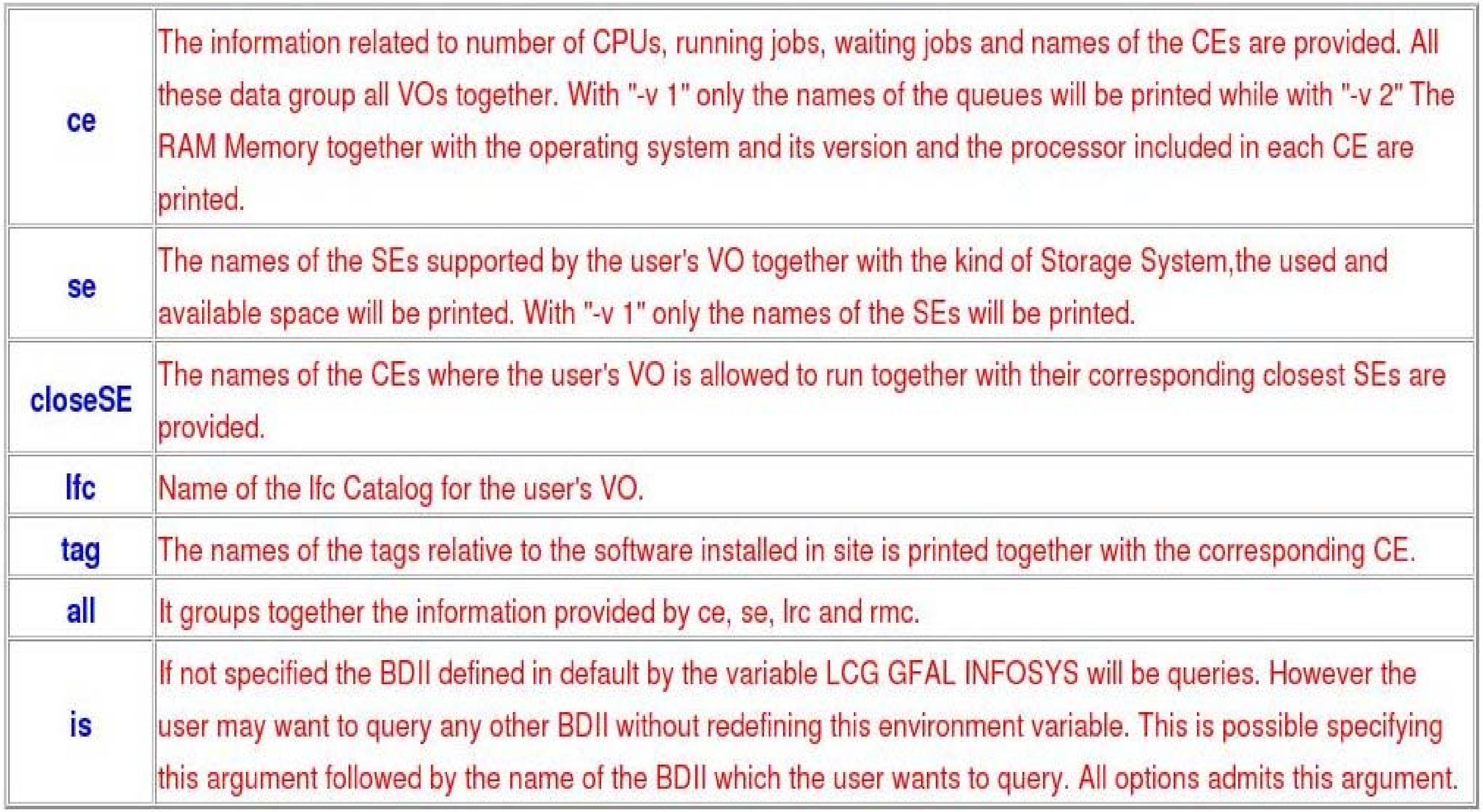
lcg-infosites

- **The lcg-infosites command can be used as an easy way to retrieve information on Grid resources for most use cases.**

USAGE: lcg-infosites --vo <vo name> options -v <verbose level> --is <BDII to query>

- Check if LCG_GFAL_INFOSYS environment variable is correctly set to the local GILDA Information Index (BDII)
- **echo $LCG_GFAL_INFOSYS**
  - **export LCG_GFAL_INFOSYS=grid152.kfki.hu:2170**

lcg-infosites options



ce	The information related to number of CPUs, running jobs, waiting jobs and names of the CEs are provided. All these data group all VOs together. With "-v 1" only the names of the queues will be printed while with "-v 2" The RAM Memory together with the operating system and its version and the processor included in each CE are printed.
se	The names of the SEs supported by the user's VO together with the kind of Storage System,the used and available space will be printed. With "-v 1" only the names of the SEs will be printed.
closeSE	The names of the CEs where the user's VO is allowed to run together with their corresponding closest SEs are provided.
lfc	Name of the lfc Catalog for the user's VO.
tag	The names of the tags relative to the software installed in site is printed together with the corresponding CE.
all	It groups together the information provided by ce, se, lrc and rmc.
is	If not specified the BDII defined in default by the variable LCG GFAL INFOSYS will be queries. However the user may want to query any other BDII without redefining this environment variable. This is possible specifying this argument followed by the name of the BDII which the user wants to query. All options admits this argument.

PRACTICAL: lcg-infosites

- In the next 15 minutes, run the commands shown in following slides to explore GILDA using lcg-infosites.

Obtaining information about CE

$ lcg-infosites --vo voce ce

```
****************************************************************
These are the related data for voce: (in terms of queues and CPUs)
****************************************************************
#CPU    Free    Total Jobs      Running Waiting ComputingElement
----------------------------------------------------------
   4       3         0              0        0          cn01.be.itu.edu.tr:2119/jobmanager-lcglsf-long
   4       3         0              0        0          cn01.be.itu.edu.tr:2119/jobmanager-lcglsf-short
  34      33         0              0        0          grid010.ct.infn.it:2119/jobmanager-lcgpbs-long
  16      16         0              0        0          grid011f.cnaf.infn.it:2119/jobmanager-lcgpbs-long
   1       1         0             0         0          grid006.cecalc.ula.ve:2119/jobmanager-lcgpbs-log
   2       1         1              0        1           gildace.oact.inaf.it:2119/jobmanager-lcgpbs-short
[..]
```

$ lcg-infosites --vo voce ce --v 2

```
RAMMemory     Operating System    System Version      Processor          CE Name
------------------------------------------------------------------------------------------------
1024                   SLC          3                    P4          ced-ce0.datagrid.cnr.it
4096                   SLC          3                    Xeon          cn01.be.itu.edu.tr
1024                   SLC          3                    PIII          cna02.cna.unicamp.br
 917                   SLC          3                    PIII          gilda-ce-01.pd.infn.it
1024                   SLC          3                    Athlon          gildace.oact.inaf.it
1024                   SLC          3                    Xeon          grid-ce.bio.dist.unige.it
[..]
```

Obtaining information about SE

```
$ lcg-infosites --vo voce se

**************************************************************
These are the related data for voce: (in terms of SE)
**************************************************************

Avail Space(Kb) Used Space(Kb)    Type              SEs
----------------------------------------------------------------------------
143547680        2472756          disk            cn02.be.itu.edu.tr
168727984        118549624        disk           grid009.ct.infn.it
13908644         2819288          disk           grid003.cecalc.ula.ve
108741124        2442872          disk           gildase.oact.inaf.it
28211488         2948292          disk           testbed005.cnaf.infn.it
349001680        33028            disk           gilda-se-01.pd.infn.it
31724384         2819596          disk           cna03.cna.unicamp.br
387834656        629136           disk           grid-se.bio.dist.unige.it
```

Listing the close Storage Elements

```
$ lcg-infosites --vo voce closeSE

Name of the CE: cn01.be.itu.edu.tr:2119/jobmanager-lcglsf-long
Name of the close SE:   cn02.be.itu.edu.tr

Name of the CE: cn01.be.itu.edu.tr:2119/jobmanager-lcglsf-short
Name of the close SE:   cn02.be.itu.edu.tr

Name of the CE: grid010.ct.infn.it:2119/jobmanager-lcgpbs-long
Name of the close SE:   grid009.ct.infn.it

Name of the CE: grid011f.cnaf.infn.it:2119/jobmanager-lcgpbs-long
Name of the close SE:   testbed005.cnaf.infn.it
```

- “close” is defined by the CE’s manager

Listing tags of installed software

```
$ lcg-infosites --vo voce tag

****************************************************************************
Information for voce relative to their software tags included in each CE
****************************************************************************

Name of the TAG: VO-gilda-GEANT
Name of the TAG: VO-gilda-GKS05
    Name of the CE:cn01.be.itu.edu.tr

Name of the TAG: VO-gilda-slc3_ia32_gcc323
Name of the TAG: VO-gilda-CMKIN_5_1_1
Name of the TAG: VO-gilda-GEANT
Name of the TAG: VO-gilda-GKS05
    Name of the CE:grid010.ct.infn.it

[..]
```

- VO managers can cause installation of software for their VO onto Worker Nodes of a CE with the agreement of site managers
- A utility can be run to define a tag for each software package installed so these CEs can be identified

- Next slides are extras!
- They show some lcg-info commands
- If you have time, try some

lcg-info intro

- This command can be used to list either CEs or the SEs that satisfy a given set of conditions, and to print the values of a given set of attributes.
- The information is taken from the BDII specified by the LCG_GFAL_INFOSYS environment variable.

- The query syntax is like this:

  attr1 op1 valueN, ...

  attrN opN valueN

After the upgrading of the new GLUE SCHEMA it's not possible use the operator '>' and '<'

where *attrN* is an attribute name

op is =, >= or <=, and the cuts are ANDed.

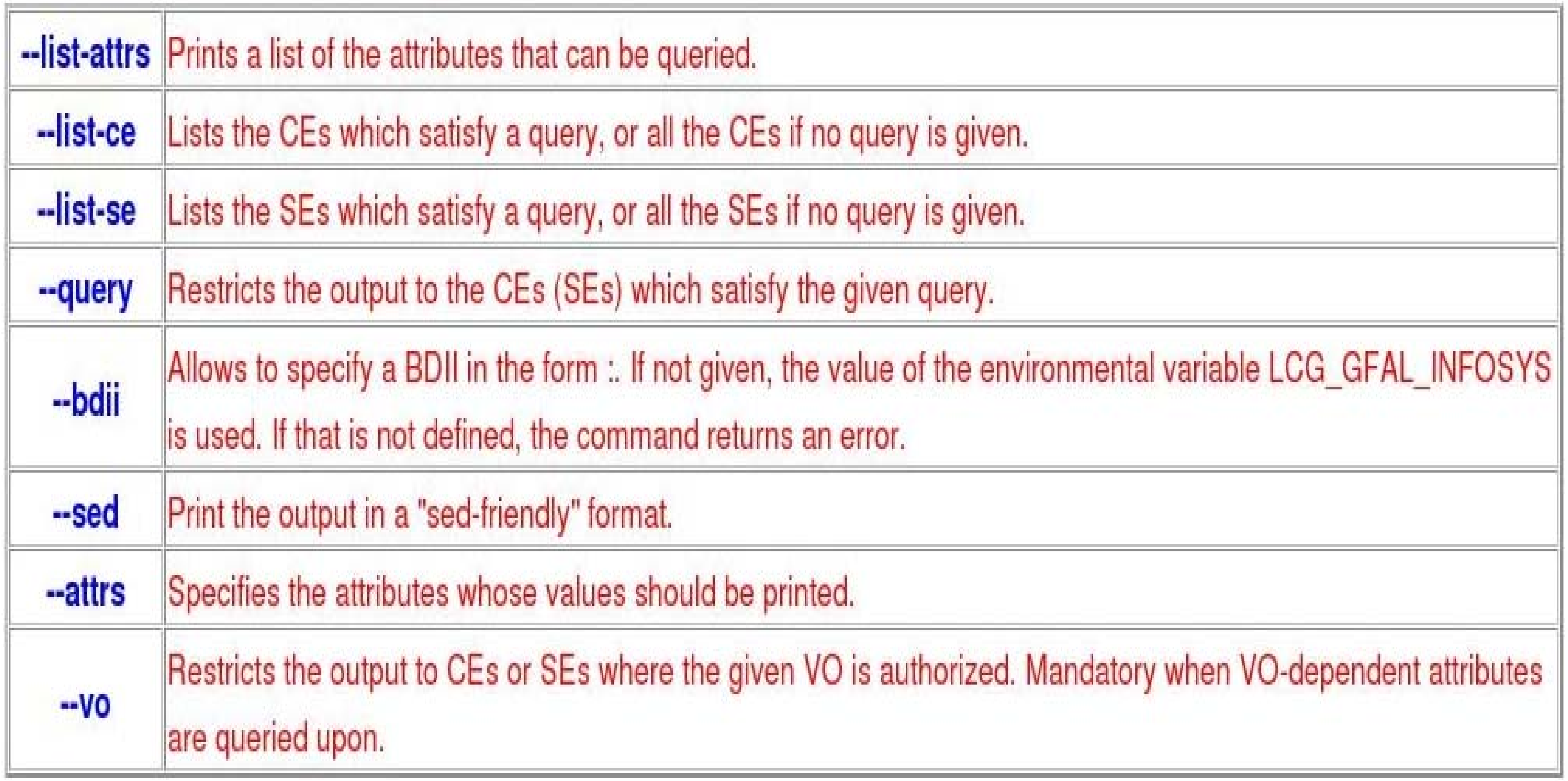
The cuts are comma-separated and spaces are not allowed.

lcg-info usage

USAGE

```
lcg-info --list-ce [--bdii bdii] [--vo vo] [--sed] [--query query]  [--attrs list]

lcg-info --list-se [--bdii bdii] [--vo vo] [--sed] [--query query] [--attrs list]

lcg-info --list-attrs

lcg-info --help
```

lcg-info options



--list-attrs	Prints a list of the attributes that can be queried.
--list-ce	Lists the CEs which satisfy a query, or all the CEs if no query is given.
--list-se	Lists the SEs which satisfy a query, or all the SEs if no query is given.
--query	Restricts the output to the CEs (SEs) which satisfy the given query.
--bdii	Allows to specify a BDII in the form :. If not given, the value of the environmental variable LCG_GFAL_INFOSYS is used. If that is not defined, the command returns an error.
--sed	Print the output in a "sed-friendly" format.
--attrs	Specifies the attributes whose values should be printed.
--vo	Restricts the output to CEs or SEs where the given VO is authorized. Mandatory when VO-dependent attributes are queried upon.

Get the list of supported attributes

```
$ lcg-info --list-attrs
```

Attribute name	Glue object class	Glue attribute name
MaxTime	GlueCE	GlueCEPolicyMaxWallClockTime
CEStatus	GlueCE	GlueCEStateStatus
TotalJobs	GlueCE	GlueCEStateTotalJobs
CEVOs	GlueCE	GlueCEAccessControlBaseRule
TotalCPUs	GlueCE	GlueCEInfoTotalCPUs
FreeCPUs	GlueCE	GlueCEStateFreeCPUs
CE	GlueCE	GlueCEUniqueID
WaitingJobs	GlueCE	GlueCEStateWaitingJobs
RunningJobs	GlueCE	GlueCEStateRunningJobs
CloseCE	GlueCESEBindGroup	GlueCESEBindGroupCEUniqueID
CloseSE	GlueCESEBindGroup	GlueCESEBindGroupSEUniqueID
SEVOs	GlueSA	GlueSAAccessControlBaseRule
UsedSpace	GlueSA	GlueSAStateUsedSpace
AvailableSpace	GlueSA	GlueSAStateAvailableSpace
Type	GlueSE	GlueSEType
SE	GlueSE	GlueSEUniqueID
Protocol	GlueSEAccessProtocol	GlueSEAccessProtocolType
ArchType	GlueSL	GlueSLArchitectureType
Processor	GlueSubCluster	GlueHostProcessorModel
OS	GlueSubCluster	GlueHostOperatingSystemName
Cluster	GlueSubCluster	GlueSubClusterUniqueID
Tag	GlueSubCluster	GlueHostApplicationSoftwareRunTimeEnvironment
Memory	GlueSubCluster	GlueHostMainMemoryRAMSize

Enabling Grids for E-sciencE

lcg-info examples

List all the CE(s) that can run MPICH, giving the number of free CPUs and the tags of installed software

```
$ lcg-info --vo voce --list-ce --query 'Tag=MPICH' --attrs 'FreeCPUs,Tag'
```

- Careful here!
- No space allowed here!

```
-…..
 CE: grid-ce.bio.dist.unige.it:2119/jobmanager-lcgpbs-long
  - FreeCPUs          6
  - Tag               LCG-2
                    LCG-2_1_0
                    LCG-2_1_1
….
```

lcg-info examples

List all the CE(s) in the BDII satisfying given conditions

$ lcg-info --list-ce --query 'FreeCPUs=2' --attrs 'FreeCPUs,OS'

```
- - CE: gildace.oact.inaf.it:2119/jobmanager-lcgpbs-infinite
  - FreeCPUs          2
  - OS                SLC

- CE: gildace.oact.inaf.it:2119/jobmanager-lcgpbs-long
  - FreeCPUs          2
  - OS                SLC

- CE: gildace.oact.inaf.it:2119/jobmanager-lcgpbs-short
  - FreeCPUs          2
  - OS                SLC

- CE: trigrid-ce00.unime.it:2119/jobmanager-lcgpbs-infinite
  - FreeCPUs          2
  - OS                _UNDEF_
[..]
```

lcg-info examples (cont.)

List all the CE(s) which satisfying the condition FreeCPU >=30

```
$ lcg-info --list-ce --query 'FreeCPUs >= 30' --attrs 'FreeCPUs'
```

• fails

```
- CE: grid010.ct.infn.it:2119/jobmanager-lcgpbs-long
  - FreeCPUs          33

- CE: grid010.ct.infn.it:2119/jobmanager-lcgpbs-short
  - FreeCPUs          33

- CE: grid010.ct.infn.it:2119/jobmanager-lcgpbs-infinite
  - FreeCPUs          33

[..]
```

Print all the tags published by a specific query

$ lcg-info --list-ce --query 'CE=*grid010.ct.infn.it:2119*' --attrs 'Tag'

```
PBS
INFN
CATANIA
LCG-2
LCG-2_1_0
LCG-2_1_1
LCG-2_2_0
LCG-2_3_0
LCG-2_3_1
LCG-2_4_0
R-GMA
AFS
CMS-1.1.0
ATLAS-6.0.4
GATE-1.0.0-3
LHCb-1.1.1
IDL-5.4
CMSIM-125
ALICE-4.01.00
ALIEN-1.32.14
POVRAY-3.5
DEMTOOLS-1.0
CMKIN-VALID
CMKIN-1.1.0
CMSIM-VALID
CSOUND-4.13
MPICH
VIRGO-1.0
CMS-OSCAR-2.4.5
LHCb_dbase_common-v3r1
GEANT4-6
VLC-0.7.2
EGEODE-1.0
RASTER3D
SCILAB-2.6
G95-3.5.0
MAGIC-6.19
CODESA3D-1.0
VO-gilda-slc3_ia32_gcc323
VO-gilda-CMKIN_5_1_1
VO-gilda-GEANT
VO-gilda-GKS05
```

List the SEs satisfying given query

```
$ lcg-info -vo voce --list-se --query 'AvailableSpace>=100000' --attrs 'CloseCE'

- SE: cn02.be.itu.edu.tr
  - CloseCE         cn01.be.itu.edu.tr:2119/jobmanager-lcglsf-long
                cn01.be.itu.edu.tr:2119/jobmanager-lcglsf-short
                cn01.be.itu.edu.tr:2119/jobmanager-lcglsf-infinite

- SE: grid009.ct.infn.it
  - CloseCE         grid010.ct.infn.it:2119/jobmanager-lcgpbs-long
                grid010.ct.infn.it:2119/jobmanager-lcgpbs-short
                grid010.ct.infn.it:2119/jobmanager-lcgpbs-infinite

- SE: ced-se0.datagrid.cnr.it
  - CloseCE         ced-ce0.datagrid.cnr.it:2119/jobmanager-lcgpbs-long
                ced-ce0.datagrid.cnr.it:2119/jobmanager-lcgpbs-short
                ced-ce0.datagrid.cnr.it:2119/jobmanager-lcgpbs-infinite

- SE: grid003.cecablc.ula.ve
  - CloseCE         grid006.cecalc.ula.ve:2119/jobmanager-lcgpbs-cert
                grid006.cecalc.ula.ve:2119/jobmanager-lcgpbs-long
                grid006.cecalc.ula.ve:2119/jobmanager-lcgpbs-short
                grid006.cecalc.ula.ve:2119/jobmanager-lcgpbs-infinite

[..]
```

Data Management

Scope of data services

- **Files that are write-once, read-many**
- **Files are replicated to be**
  - "Close" to compute elements for efficiency
  - Resilient to SE failure
- **Usually you will use logical filenames to access files.**
  - map to one file or to several replicas
  - Mapping held in a database called a catalogue

DM Overview

Two sets of commands

- **LFC = LCG File Catalogue**
    - LCG = LHC Compute Grid
    - LHC = Large Hadron Collider

  – Use LFC commands to interact with the catalogue only
    - To create catalogue directory
    - List files

  – Used by you and by lcg-utils

- **lcg-utils**
  – File management functions
  – Couples file upload, replication … and catalog operations
  – Keeps SEs and catalogue in step!
- **(also GFAL API exists – to read blocks from files on SE's… can't always copy files to a worker node!)**

LFC basics

LFC has a directory tree structure

/grid/<VO_name>/ <you create it>

LFC Namespace **Defined by the user**

- **All members of a given VO have read-write permissions in their directory**

- **Commands look like UNIX with “lfc-” in front (often)**

•We will be using /grid/voce/taipei and /grid/voce/taipei/XX where XX is your user number (01-40)

Check your environment

- **Check / set the following environment variables to specify the catalog type and its location:**

  To check:

  echo $LCG_CATALOG_TYPE should be lfc

  echo $LFC_HOST should be skurut2.cesnet.cz

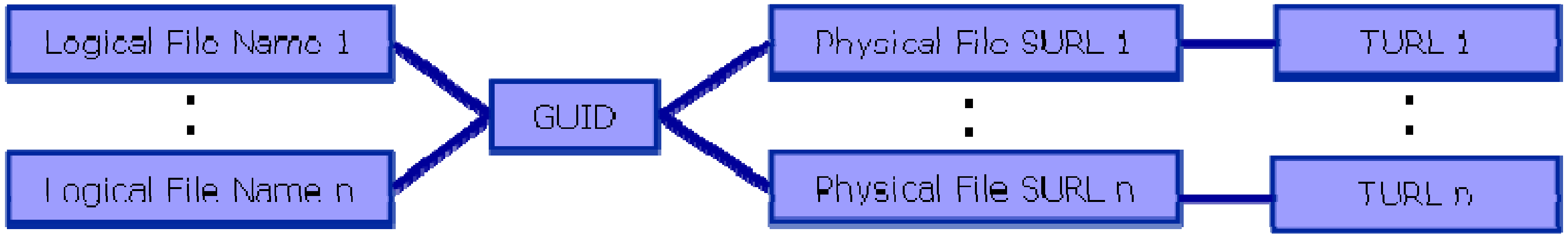
  To set:

  export LCG_CATALOG_TYPE=lfc

  export LFC_HOST=skurut2.cesnet.cz

Name conventions

- **Logical File Name (LFN)**
  - An alias created by a user to refer to some item of data, e.g. "lfn:cms/20030203/run2/track1"
- **Globally Unique Identifier (GUID)**
  - A non-human-readable unique identifier for an item of data, e.g. "guid:f81d4fae-7dec-11d0-a765-00a0c91e6bf6"
- **Site URL (SURL) (or Physical File Name (PFN) or Site FN)**
  - The location of an actual piece of data on a storage system, e.g.
    "srm://pcrd24.cern.ch/flatfiles/cms/output10_1" (SRM)
    "sfn://lxshare0209.cern.ch/data/alice/ntuples.dat" (Classic SE)
- **Transport URL (TURL)**
  - Temporary locator of a replica + access protocol: understood by a SE, e.g.
    "rfio://lxshare0209.cern.ch//data/alice/ntuples.dat"



We are about to…

- List directory
- Upload a file to an SE and register a logical name (lfn) in the catalog
- Create a duplicate in another SE
- List the replicas

- Create a second logical file name for a file
- Download a file from an SE to the UI

- And then: Use the lfn so that a job runs on a CE “close” to one of the SEs that holds a file

lcg-utils

- The LCG Data Management tools (usually called ***lcg-utils***) allow users to copy files between UI, CE, WN and a SE, to register entries in the File Catalog and replicate files between SEs.

Listing a directory

Listing the entries of a LFC directory : lfc-ls

lfc-ls [-cdiLlRTu] [--comment] path…

where *path* specifies the LFC pathname (mandatory)

- ***-l*** (it is a lowercase "L") outputs long listing
- ***-R*** lists the contents of directories recursively (don't use it AT ALL)

Try it!

```
$ lfc-ls -l /grid/voce/taipei
```

Setting LFC_HOME

- LFC_HOME to use relative paths

Now SET LFC_HOME as follows:

```
$ export LFC_HOME=/grid/voce/taipei/
```

Then try the equivalent of the lfc-ls you just did:

```
$ lfc-ls -l
```

```
This is now the same as
 lfc-ls -l /grid/voce/taipei
```

lcg-utils: lfc-mkdir, lcg-cr

Upload a file to a SE and register it into the catalog

Do anything to make a new file! E.g.

```
$  ls –l  > aNewFile.txt
```

Create a new folder in the LFC:

```
$ lfc-mkdir XX
```
, where XX is your usernumber

To discover which SEs you can use :

```
$  lcg-infosites --vo voce se
```

Choose an SE from the results)

Copy and the file to a SE, and register it in the LFC

```
lcg-cr --vo voce file://`pwd`/aNewFile.txt -l lfn:XX/my.dat -d <se>
guid:….
lfc-ls XX
```

Today, not zeus03.cyf-kr.edu.pl

New logical filename

Details of lcg-cr

lcg-cr -d dest_file | dest_host -l lfn [-g guid] [-l lfn]
[-v | --verbose] --vo vo src_file

where

- ***dest_host*** is the fully qualified hostname of the destination SE
- ***(dest_file*** is a valid SURL (both sfn:// or srm:// format are valid))
- ***guid*** specifies the Grid Unique IDentifier. If this option is not present, a GUID is generated internally
- ***lfn*** specifies the Logical File Name associated with the file
- ***vo*** specifies the Virtual Organization the user belongs to
- ***src_file*** specifies the source file name: the protocol can be *file:///* or *gsiftp:///*

Replicate a file

Copying a file from one SE to another one and register it in the Catalog

```
lcg-rep -d dest_file | dest_host [-v | --verbose] --vo vo src_file
```

where

- ***dest_host*** is the fully qualified hostname of the destination SE
- ***dest_file*** is a valid SURL (both sfn:// or srm:// are valid)
- ***vo*** specifies the Virtual Organization the user belongs to
- ***src_file*** specifies the source file name: the protocol can be LFN, GUID or SURL. An SURL scheme can be sfn: for a classical SE or srm:

```
lcg-rep --vo voce -d <AnotherSE>  lfn:XX/my.dat
```

List replicas

Listing of replicas for a given LFN, GUID or SURL

lcg-lr --vo vo file

where

- ***vo*** specifies the Virtual Organization the user belongs to
- **file** specifies the Logical File Name, the Grid Unique IDentifier or the Site URL. An SURL scheme can be sfn: for a classical SE or srm:

- **Example:**

$ lcg-lr --vo voce lfn:XX/my.dat

Create duplicate lfn

Creating a duplicate logical file name

(does not create a new physical file!)

lfc-ln -s file linkname

lfc-ln -s directory linkname

Create a link to the specified *file* or *directory* with *linkname*

– *Do this command please:*

$ lfc-ln -s \

/grid/voce/taipei/test/my.dat \

/grid/voce/taipei/XX/myNameForData.txt

New lfn

Original lfn

Let's check the new link using lfc-ls with long listing (-l)

$ lfc-ls -l /grid/voce/taipei/XX

```
… myNameFOrData.txt -> /grid/voce/taipei/test/data.txt
```

From SE to the UI or a Worker: lcg-cp

Downloading a Grid file from a SE to a local destination

lcg-cp [-v | --verbose] --vo vo src_file dest_file

where

- ***vo*** specifies the Virtual Organization the user belongs to
- ***src_file*** specifies the source file name: the protocol can be LFN, GUID, SURL or local file. An SURL scheme can be sfn: for a classical SE or srm:
- ***dest_file*** specifies the destination. Example:

```
$ lcg-cp --vo voce lfn:XX/my.dat
  file://`pwd`/<mylocalfilename>.txt
```

LFC Catalog commands

Adding/deleting metadata information

lfc-setcomment path comment

lfc-delcomment path

taipei: SKIP THIS

lfc-setcomment adds/replaces a *comment* associated with a file/directory in the LFC Catalog

lfc-delcomment deletes a comment previously added

- Example:

  lfc-setcomment taipeiXX/my.dat "Hello Taipei"

- Check your job with..

  lfc-ls --comment taipeiXX/my.dat

LFC Catalog commands

taipei: SKIP THIS

- Example:

lfc-delcomment /grid/voce/user.example

- Check your job with..

lfc-ls –l --comment /grid/voce/user.example

```
-rw-rw-r--   1 4401     4400          0 Jun 21 09:38 /grid/voce/user.example
```

LFC Catalog commands

Summary of the LFC Catalog commands

lfc-chmod	Change access mode of the LFC file/directory
lfc-chown	Change owner and group of the LFC file-directory
lfc-delcomment	Delete the comment associated with the file/directory
lfc-getacl	Get file/directory access control lists
lfc-ln	Make a symbolic link to a file/directory
lfc-ls	List file/directory entries in a directory
lfc-mkdir	Create a directory
lfc-rename	Rename a file/directory
lfc-rm	Remove a file/directory
lfc-setacl	Set file/directory access control lists
lfc-setcomment	Add/replace a comment

Summary of lcg-utils commands

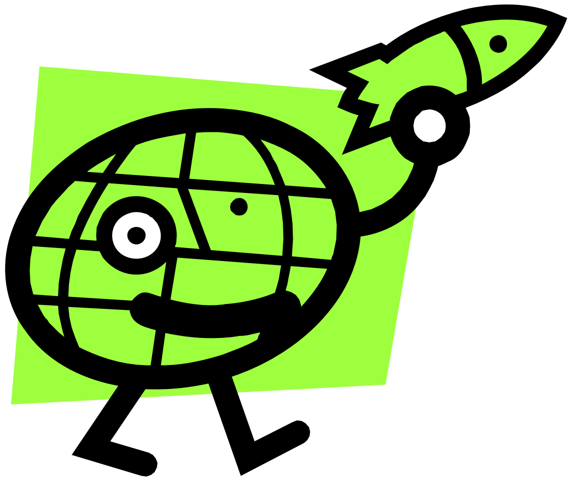
Replica Management

lcg-cp	Copies a grid file to a local destination
lcg-cr	Copies a file to a SE and registers the file in the catalog
lcg-del	Delete one file
lcg-rep	Replication between SEs and registration of the replica
lcg-gt	Gets the TURL for a given SURL and transfer protocol
lcg-sd	Sets file status to “Done” for a given SURL in a SRM request

Data management summary

- **You have used:**
- **LFC commands to query the catalog**
  - This maps logical filenames to symbolic links and to physical files (usually including replicas)

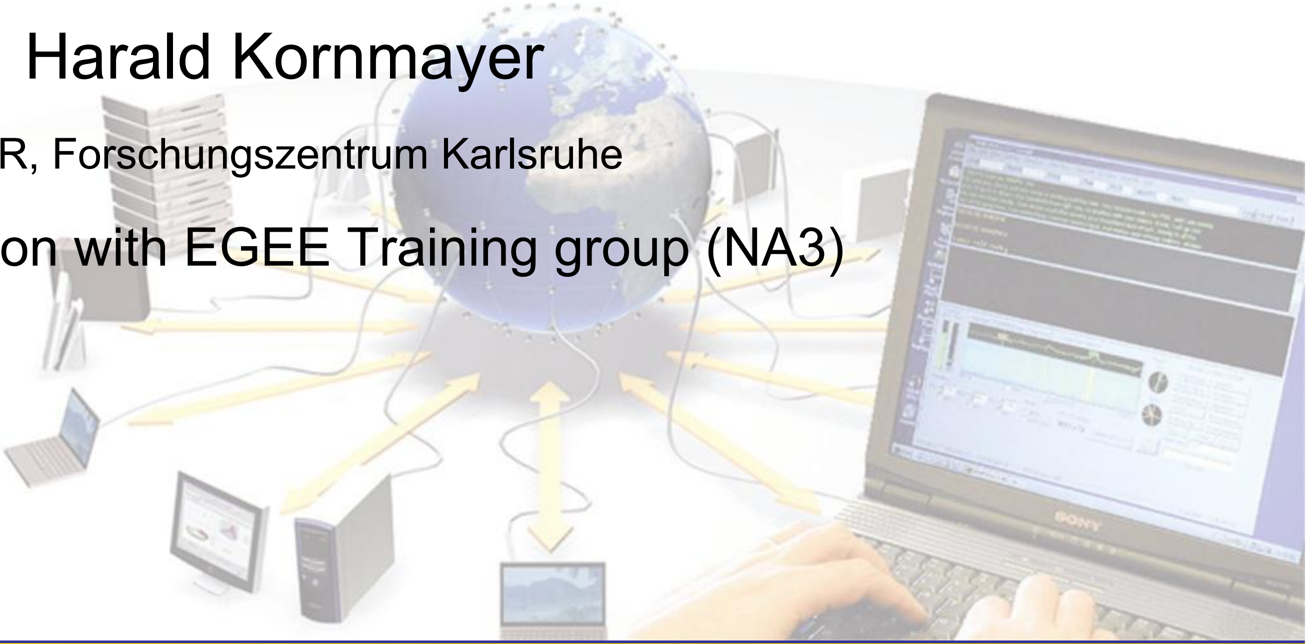
- **Lcg_utils to copy files to and from SEs and to keep the LFC catalogue up-to-date**



“Putting it all together!”

1. Job thats write results to a SE
2. Scripting to run multiple jobs
3. Running job “close” to SE with required input data

Grid Training for the MAGIC Grid How To submit Corsika?



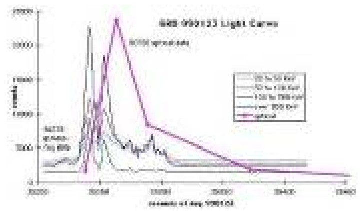
Harald Kornmayer

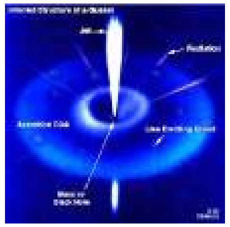
IWR, Forschungszentrum Karlsruhe

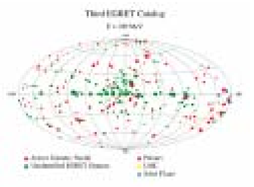
in cooperation with EGEE Training group (NA3)

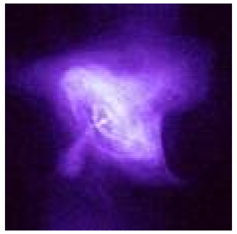
MAGIC

- **Ground based Air Cerenkov Telescope 17 m diameter**
- **Physics Goals:**
  - Origin of VHE Gamma rays
  - Active Galactic Nuclei
  - Supernova Remnants
  - Unidentified EGRET sources
  - Gamma Ray Burst
- **MAGIC II will come 2007**
- **Grid added value**
  - Enable "(e-)scientific" collaboration between partners
  - Enable the cooperation between different experiments
  - Enable the participation on Virtual Observatories

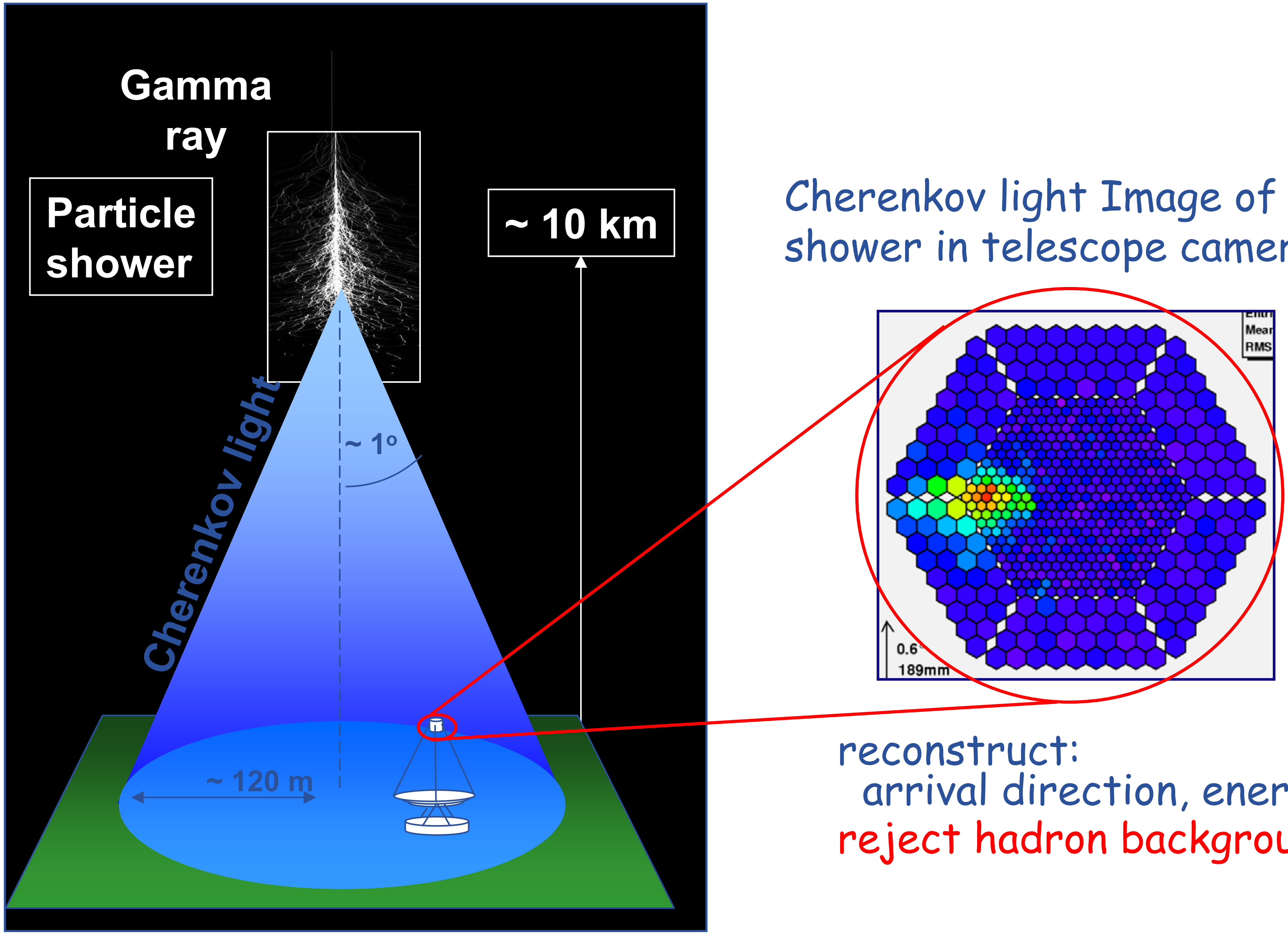








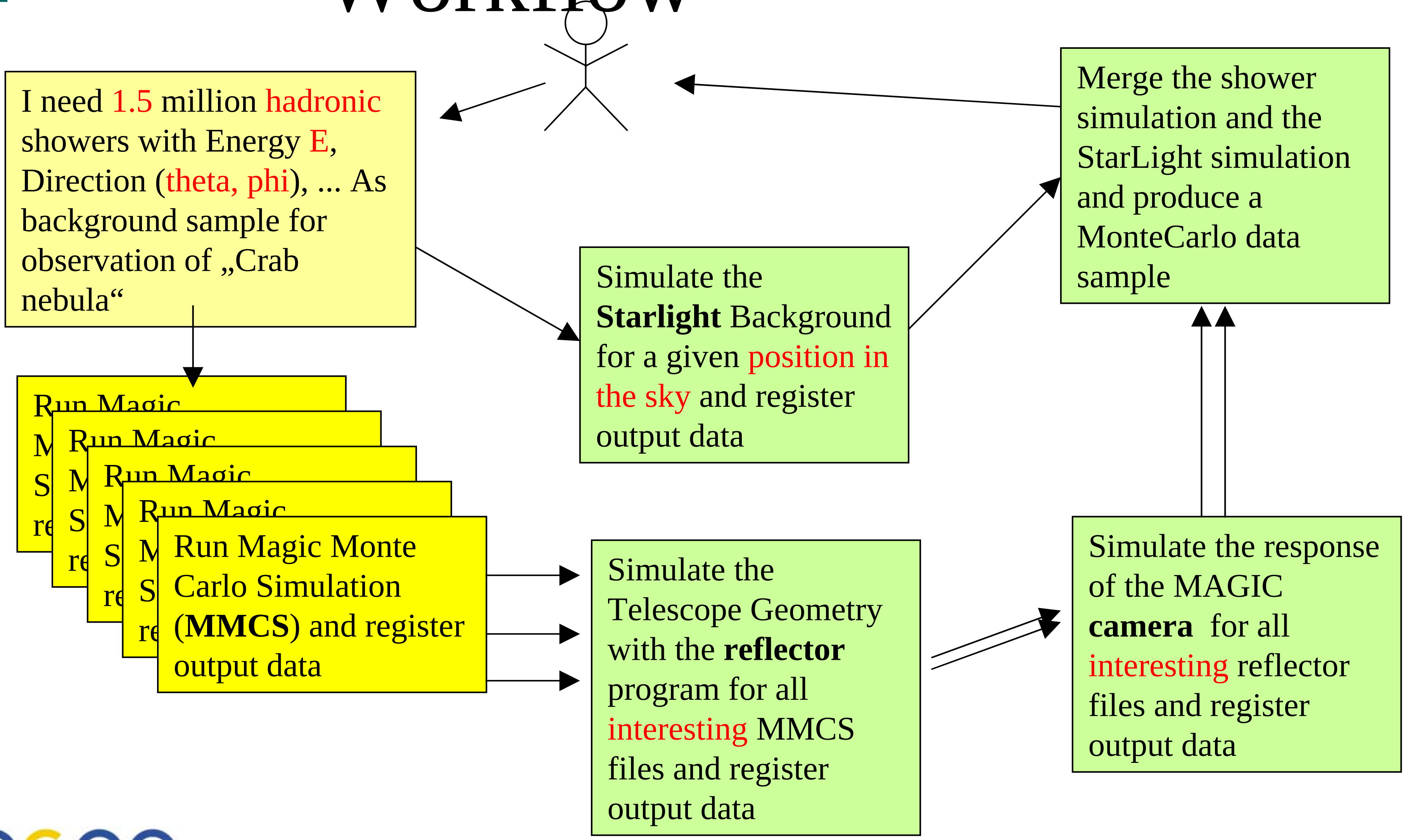
Ground based γ-ray astronomy



Cherenkov light Image of particle shower in telescope camera

reconstruct:
arrival direction, energy
reject hadron background

MAGIC Monte Carlo Workflow


I need 1.5 million hadronic showers with Energy E, Direction (theta, phi), ... As background sample for observation of „Crab nebula“

Run Magic Monte Carlo Simulation (**MMCS**) and register output data

Simulate the **Starlight** Background for a given position in the sky and register output data

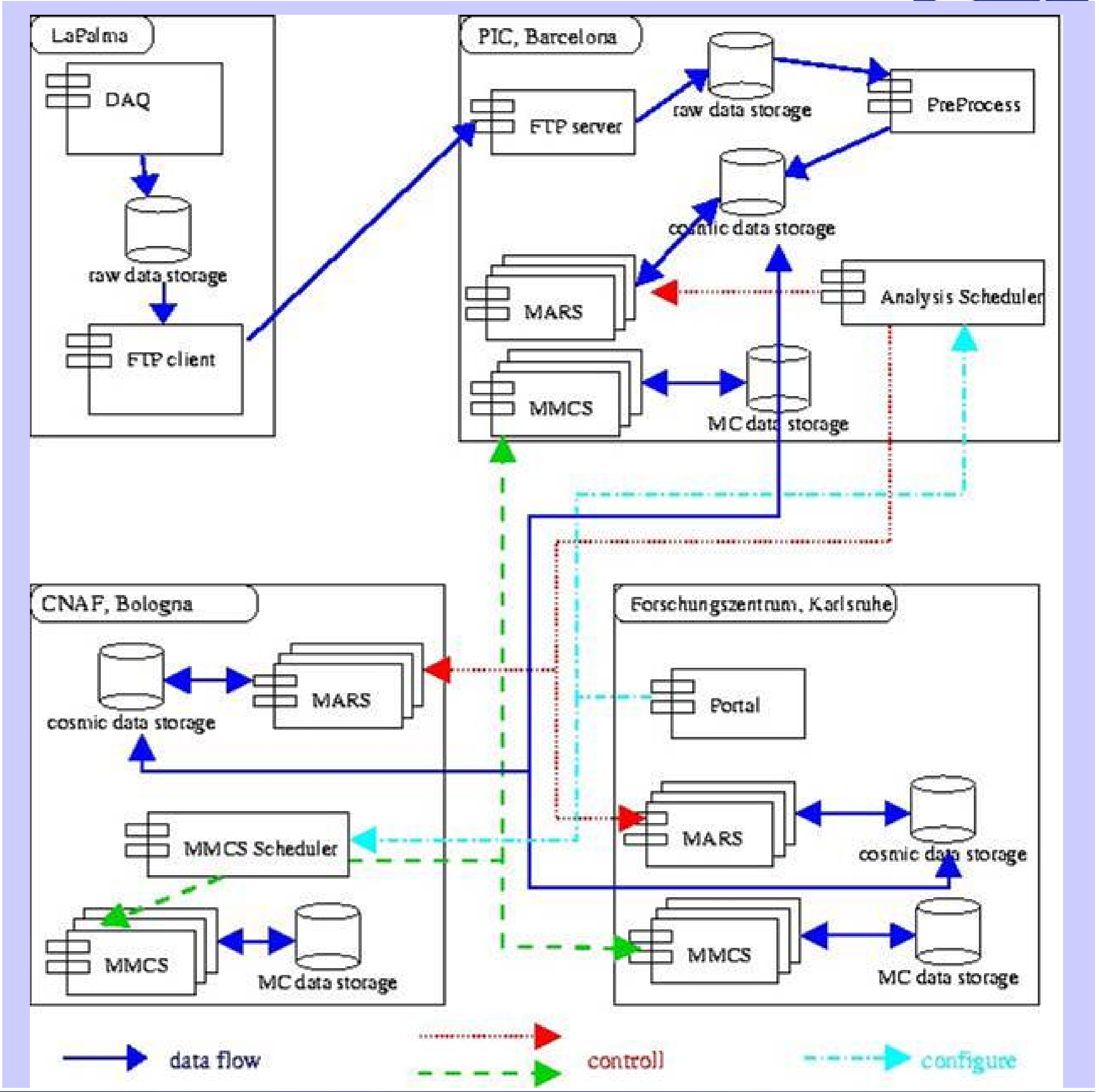
Simulate the Telescope Geometry with the **reflector** program for all interesting MMCS files and register output data

Simulate the response of the MAGIC **camera** for all interesting reflector files and register output data

Merge the shower simulation and the StarLight simulation and produce a MonteCarlo data sample

MAGIC Grid – the idea

- Build a Grid system with
  - FZK (Germany)
  - CNAF(Italy)
  - PIC (Spain)
- MAGIC applied as a generic application for EGEE
- MAGIC got accepted with the air shower Monte Carlo simulation based on CORSIKA



A MAGIC practical

- Run one of the CORSIKA simulations.
- We will:
  - Obtain tar file from an SE
  - Inspect the JDL
    - How it uses sandboxes to transfer files
    - How it sets executable flag
  - Modify the jdl
  - Submit the job
  - Explore the output, jdl and script used

How to keep the CORSIKA output?

- To keep the data on the Grid
  - important for big files!
  - so others can acess them
- Amend the JDL to define your lfn and select SE
  - Use full path name
  - Use info system to choose an SE (or one you used earlier!)

```
Executable = "registerCorsika.sh" ;
....
....
OutputSandbox = {"registerCorsika.out",
"registerCorsika.err"};
OutputData={
[
  Outputfile = "./cer000001";
  LogicalFileName =
"lfn:/grid/voce/taipei/XX/mmcs_cer000001";
  StorageElement = "Enter SE name";
],
[
  Outputfile = "./dat000001";
  LogicalFileName =
"lfn:/grid/voce/taipei/XX/mmcs_dat000001";
  StorageElement = " Enter SE name";
```

Exercise

- **Go into the directory “magic” in your UI account**
- **Amend the .jdl to**
  - write result files to an SE and register those files in your namespace in the LFC
  - use a short queue
- **Submit the job, saving the id in a file**

MAGIC exercise continued

- When the job is submitted, go on to the next exercise whilst you wait for it to run.
- Once it has completed, retrieve the output and step through it with the jdl and the script

How to execute CORSIKA on the Grid

- **Notice from the *ls -l* listed in the output that it is necessary to set the execute flag on the file.**

```
Executable = „executeCorsika.sh" ;
StdOutput  = „executeCorsika.out";
StdError   = „executeCorsika.err";
InputSandbox  = {
"executeCorsika.sh",
"corsika/cc6023p-linux",
"corsika/EGSDAT3_.05",
"corsika/EGSDAT3_.15",
"corsika/EGSDAT3_.4",
"corsika/EGSDAT3_1.",
"corsika/EGSDAT3_3.",
"corsika/NUCLEAR.BIN",
"corsika/NUCNUCCS",
"corsika/VENUSDAT",
"corsika/atmprof1.dat",
"corsika/atmprof2.dat",
"corsika/atmprof3.dat",
"corsika/atmprof4.dat",
"corsika/atmprof5.dat",
"corsika/atmprof6.dat",
"corsika/atmprof9.dat",
"input_card"
};
OutputSandbox = {„executeCorsika.out",
„executeCorsika.err"};
RetryCount = 5;
```

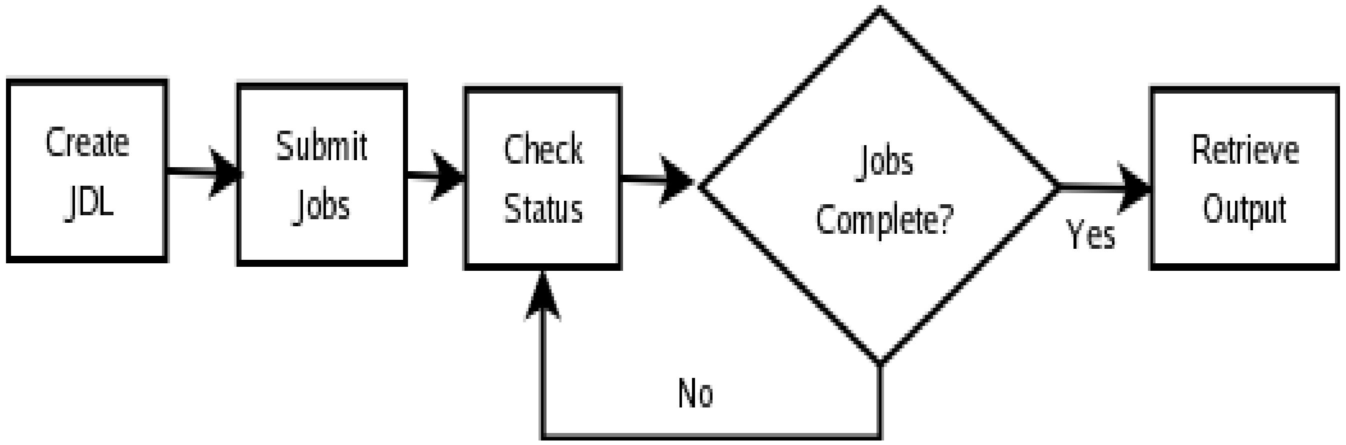
```
echo "Execution of Corsika on the Grid"

echo " started on Host"
hostname

echo " "
echo "   Content of working directory"
ls -l

echo " "
echo " Change the rights of executable "
chmod u+x cc6023p-linux
ls -l cc6023p-linux

echo " "
echo "   Start the job "
echo "cc6023p-linux < input_card"
./cc6023p-linux  < input_card

echo " "
echo "   Content of ./data"
ls cer* dat*

echo " "
echo "Finished "
```

A scripting example

- A common requirement is to run many concurrent jobs.
- This example gives you a pattern for this.

A scripting example

- **We have seen that, to run a job on the grid**
  - Create a JDL file
  - Submit job
  - Check the jobs status until it is complete
  - Retrieve output
- **This process can be automated**

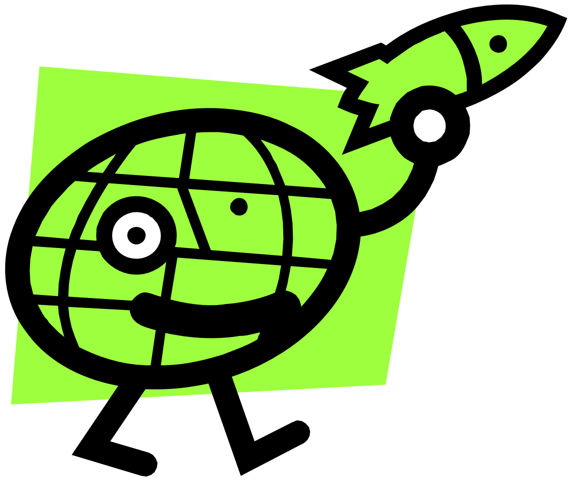


Description

- **submit-dictionary-jobs.sh**
  - submits a cascade of simple jobs, each with the same executable but different arguments
  - called with one argument n, the number of jobs to submit
  - gets random dictionary words and creates n jdl files with those words as parameters to the script echoword.sh
  - echoword.sh simply echoes the word back to stdout
  - submits each job
  - waits for all jobs to complete by running edg-job-status -i jobidfile and parsing the output
  - when all jobs have completed it retrieves the n output files
  - finally it concatenates the output from each output file into the one results file and echoes that to the screen

Exercise-part 2

- You have already created a logical filename /grid/voce/taipei/taipeixx/script.tar (slide 85)
- Download that file using lcg-utils - command lcg-??
- Untar it into its own directory to see two script files
- Open a second window onto GILDA
- Run the script
- ./submit-dictionary-jobs.sh 4
- [do not use more than 4 please!]
- Whilst it is running explore the script in the second window.
- [Then check completion of any previous jobs]



Workload Management System
More realistic examples

1. Job thats writes results to a SE
2. Scripting to run multiple jobs
3. Running job “close” to SE with required input data

Exercise

- **GOAL:**

  Submit a job that does data management: it will retrieve a file previously registered into the catalog.
- **Steps to follow up:**
  - Remember the lfn of a file you entered earlier: lfc-ls will help!
  - create a script.sh file with the following content:

```
#!/bin/sh
/bin/hostname
#Change the LFN_NAME to download from the Catalog.
echo "Start to download.."
lcg-cp --vo voce lfn:<lfn you choose> file:`pwd`/output.dat
echo "Done.."
```

exercise (II)

- Create the JobWithData.jdl:

```
Type = "job";
JobType = "Normal";
Executable = "/bin/sh";
Arguments = "script.sh";
InputData={"lfn:<your file>"};
DataAccessProtocol={"gsiftp"};
VirtualOrganisation = "voce";
StdOutput = "std.out";
StdError = "std.err";
InputSandbox = {"script.sh"};
OutputSandbox = {"std.out","std.err","output.dat"};
```

- Tells RB that you want to run close to this.
- Does not retrieve the file…it might be HUGE!!

- Submit it to the grid
- Retrieve the output and verify the content of output.dat

Housekeeping

- **At the end of the practical**
- **Destroy your proxy certificate: grid-proxy-destroy**
  - Always do this when you've finished
- **Please delete all the files you created on SE's by using the lfc-ls command to find them in $LFC_HOME/taipei/XX (refer to next slide)…**

Deleting replicas

Deleting replicas

- **lcg-del [-a] [-s se] [-v | --verbose] --vo vo file**

where

- ***a*** is used to delete all replicas of the given file
- ***se*** specifies the SE from which you want to remove the replica
- ***vo*** specifies the Virtual Organization the user belongs to
- ***file*** specifies the Logical File Name, the Grid Unique IDentifier or the Site URL. An SURL scheme can be sfn: for a classical SE or srm:.

Example:

- delete one replica

```
$ lcg-del --vo voce -s <se> lfn:<name>
```

- delete all the replicas

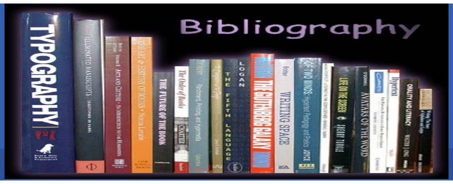
```
$ lcg-del -a --vo voce lfn:<name>
```

- let's check if the previous command was successful

```
$ lcg-lr --vo voce lfn:<name>
lcg_lr: No such file or directory
```

Monitoring

- **Two examples of monitoring systems**
- **http://gridportal.hep.ph.ic.ac.uk/rtm/**
- **http://infnforge.cnaf.infn.it/gridice/index.php/Main/GridICEWork**



References

- **LCG-2 User Guide Manual Series**

  https://edms.cern.ch/file/454439/LCG-2-UserGuide.html