



**Interactive European Grid**

# **A step towards interoperability between Int.EU.Grid and EGEE Grid infrastructures**

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Int.EU.Grid & EGEE MPI Tutorial, Dublin, September 2007



# Why do we need Interoperable Grids

- ❑ More than 20 Grid projects in Europe
  - ▶ Different fields of Science, different Objectives
  - ▶ Different Middlewares, different Services
  - ▶ Same users using more than one Grid
  
- ❑ Are all these projects fully sustainable at long term?
  - ▶ What's the economic/human/administrative effort?
  
- ❑ Modern scientific/economic applications need higher number of resources
  - ▶ Possibility to share/join Grid resources
  
- ❑ Users may want to transparently migrate between different Grids according to their needs

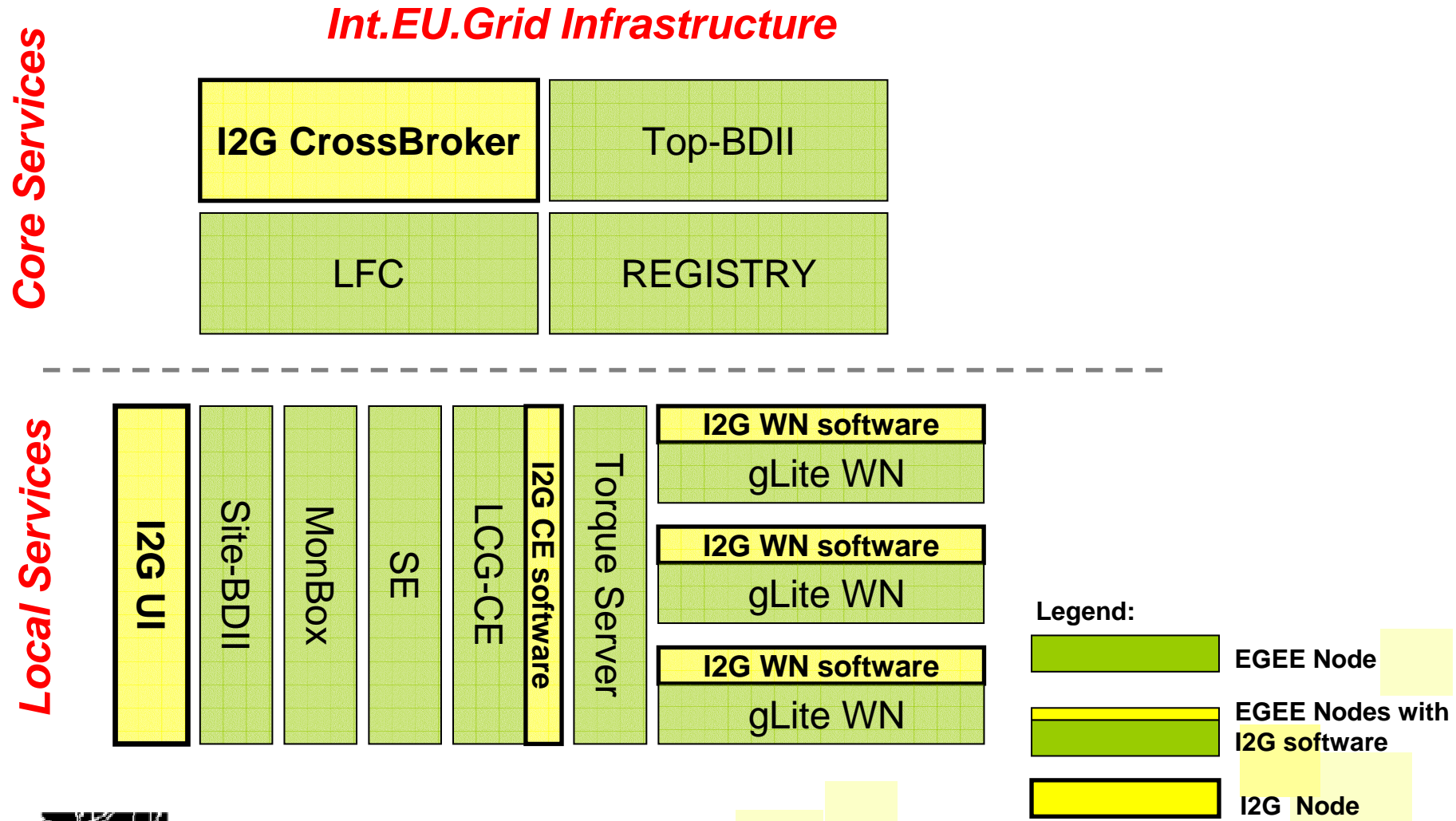
- Int.EU.Grid offers
  - ▶ **Interactivity**
    - "On the Fly" interaction, "On the Fly" response
  - ▶ **Inter and Intra cluster parallel tasks**
    - PACXMPI & OpenMPI
  - ▶ **Visualization and Handling of Video Streams**
    - Graphical VO applications
  
- Int.EU.Grid relies on gLite with additional enhancements
  - ▶ **CrossBroker (enhanced LCG Resource Broker):**
    - Schedules, starts and monitors inter/intra cluster parallel tasks
    - Handles video streams
  - ▶ **A dedicated User Interface (UI)**
    - possibility to submit parallel jobs and applications supporting visualization
  - ▶ **Additional deployment of Int.EU.Grid software on top of the LCG Computing Element and gLite Worker Nodes**

## Interoperability approaches

- We propose 3 different approaches for sites wishing to operate between the two Grid infrastructures:
  - ▶ 1) Lead EGEE admins in the installation of an independent Int.EU.Grid site
    - What to configure; what to do; how to do it...
  - ▶ 2) Present a mechanism so that institutions with separate sites in Int.EU.Grid and in EGEE may share some resources
    - The same physical Worker Nodes
  - ▶ 3) Present a mechanism so that EGEE sites may take advantage of Int.EU.Grid features
    - Without the need to join Int.EU.Grid project,
    - Through the installation of some Int.EU.Grid nodes and via the deployment of specific Int.EU.Grid software.

# 1. Lead EGEE admins in the installation of an independent Int.EU.Grid site

# 1) Int.EU.Grid Arch





# 1) The Int.EU.Grid site: Install the CE

(for EGEE admins)

## □ The Int.EU.Grid CE ("lcg-CE")

- ▶ Same procedures as the installation and configuration of an EGEE lcg-CE [1]
- ▶ OS and middleware versions: **SLC3 and glite 3.0.2**
  - Some Int.EU.Grid sites already use **SLC4)**
- ▶ Packages and Repositories
  - Install lcg-CE (or lcg-CE\_torque) using yaim (apt-get tools) [1]
  - Install **i2g-CE-lcg** meta-package, available in Int.EU.Grid repository, using apt-get tools

```
[root@ce01 ~] # cat /etc/apt/sources.list.d/i2g.list  
rpm http://savannah.fzk.de repository/i2g/production i386 noarch
```

```
[root@ce01 ~] # apt-get update; apt-get install i2g-CE-lcg
```

```
[root@ce01 ~]# rpm -qa | grep i2g  
i2g-CE-lcg-1.1-4  
i2g-openmpi-1.1.2-1  
i2g-profile-0.0.13-1  
i2g-version-1.1-4  
i2g-vomscerts-1.1.0-1  
i2g-yaim-sysconfig-0.0.5-1
```



# 1) The Int.EU.Grid site: Install the CE

(for EGEE admins)

- ▶ Use correct Int.EU.Grid configuration files
  - users.conf & groups.conf files (see Appendixes 1 & 2)
    - 11 VOs: **imain, imon, itut, itest, ifusion, iplanck, ibrain, ienvmod, iusct, ihep and icesga**
    - 4 different VO roles: **int (interactive), tst (test), sgm & prd**
    - VO registration: Int.EU.Grid VOMS web portal [2] and the Int.EU.Grid WIKI [3]
  - site-info.def (see Appendix 3)
  - vo.d/<VO> files (see Appendix 4)
- ▶ Include the **"OPENMPI"** and **"PACXMPI"** tags in the site-info.def

```
CE_RUNTIMEENV= "(...)"
OPENMPI
OPENMPI-1.1.2
OPENMPI-1.1.2-CC
OPENMPI-1.1.2-C++
OPENMPI-1.1.2-cc
OPENMPI-1.1.2-cxx
OPENMPI-1.1.2-f77
PACXMPI "
```

- ▶ Check that I2G VOMS certificates were installed under **/etc/grid-security/vomsdir** and run the configuration using the YAIM tool:

```
[root@ce01 ~]# ./yaim -c -s /root/site-cfg/siteinfo/site-info.def -n CE_torque
```





# 1) The Int.EU.Grid site: Install the UI

(for EGEE admins)

## □ The Int.EU.Grid UI

- ▶ Same procedures as the installation of an EGEE UI [1]
- ▶ OS and middleware versions: **SLC3** and **glite 3.0.2**
- ▶ Packages and Repositories
  - Install **i2g-UI** meta-package using apt-get tools and gLite & Int.EU.Grid repositories

```
[root@ui01 ~] # cat /etc/apt/sources.list.d/i2g.list
rpmhttp://savannah.fzk.de/repository/i2g/production i386 noarch
[root@ui01 ~] # cat /etc/apt/sources.list.d/glite.listrpm
http://glitesoft.cern.ch/EGEE/gLite/APT/R3.0/ rhel30 externals Release3.0 updates
[root@ui01 ~] # apt-get update; apt-get install i2g-UI
```

- ▶ Use correct information for users.conf & groups.conf files (see Appendixes 1 & 2), site-info.def (see Appendix 3) and vo.d/<VO> files (see Appendix 4)
- ▶ Check that I2G VOMS certificates were installed under **/etc/grid-security/vomsdir** and run the configuration using the YAIME tool:

```
[root@ce01 ~]# ./yaim -c -s /root/site-cfg/siteinfo/site-info.def -n I2G_UI
```



# 1) The Int.EU.Grid site: Install the WN

(for EGEE admins)

## □ The Int.EU.Grid Worker Nodes ("glite-UI")

- ▶ Same procedures as the EGEE WN installation [1]
- ▶ No need to share home directories through NFS
- ▶ OS and middleware versions: **SLC3** and **glite 3.0.2**
- ▶ Packages and Repositories
  - Install glite-WN (or glite-WN\_torque) using apt-get tools [1]
  - Install **i2g-WN** meta-package using apt-get tools and gLite & Int.EU.Grid repositories

```
[root@wn01 ~] # cat /etc/apt/sources.list.d/i2g.listrpm
http://savannah.fzk.de/repository/i2g/production i386 noarch
[root@wn01 ~] # apt-get update; apt-get install i2g-WN
[root@wn01 ~]# rpm -qa | grep i2g
i2g-openmpi-1.1.2-1          i2g-vomscerts-1.1.0-1
i2g-version-1.1-4          i2g-profile-0.0.13-1
i2g-mpi-start-0.0.34-1     i2g-yaim-sysconfig-0.0.5-1
```

- ▶ Use correct info for users.conf & groups.conf files (see Appendixes 1 & 2), site-info.def (see Appendix 3) and vo.d/<VO> files (see Appendix 4)
- ▶ Check that I2G VOMS certificates are installed in **/etc/grid-security/vomsdir** and run the configuration using the YAIM tool:

```
[root@ce01 ~]# ./yaim -c -s /root/site-cfg/siteinfo/site-info.def -n WN
```

# 1) The Int.EU.Grid site: Check Torque Server

(for EGEE admins)

## □ The Int.EU.Grid Torque Server

- ▶ Same procedures as the installation proposed in YAIM Manual [1]
  - Either you install the Torque Server in the CE or in a separate machine
- ▶ Install the **submit\_filter** [4]
  - Very important for **MPI** to work
  - Otherwise your Torque Server will not be able to take full advantage of all resources, specially in an heterogeneous Cluster

<http://www.balticgrid.org/Members/kpaulikas/elen-glite-MPI.pdf>
- ▶ Install the adequate Torque versions
  - Not all Torque versions may work with the submit filter
  - 1.0.1p6 and similar **are suspected to NOT work.**
  - 2.1.6 is known to work in about half of Int.EU.Grid sites
- ▶ Set **\$cluster=1** and **\$cpu\_per\_node=1** in  
`/opt/globus/lib/perl/Globus/GRAM/JobManager/lcgpbs.pm`

# 1) The Int.EU.Grid site: Other Nodes

(for EGEE admins)

## □ The Int.EU.Grid Storage Element

- ▶ Configure Int.EU.Grid VOs using the users.conf, groups.conf, site-info.def and vo.d/<VO> files depicted in appendixes 1, 2, 3 and 4 and following EGEE procedures [1]
- ▶ A Storage Element for Int.EU.Grid doesn't involve the installation of additional software
- ▶ Site administrators can deploy different flavours of Storage Elements (DPM, Dcache)
  - However, Int.EU.Grid Migrating Desktop application can only interact with a CLASSIC SE

## □ The Int.EU.Grid Monitoring Box

- ▶ Configure the node using the users.conf, groups.conf, site-info.def and vo.d/<VO> files depicted in appendixes 1, 2, 3 and 4 and following EGEE procedures [1]
  - Int.EU.Grid Central Registry should be properly set (REG\_HOST=rgma-server.i2g.cesga.es)
- ▶ A MonBox for Int.EU.Grid doesn't involve the installation of additional software

## □ The Int.EU.Grid site BDII

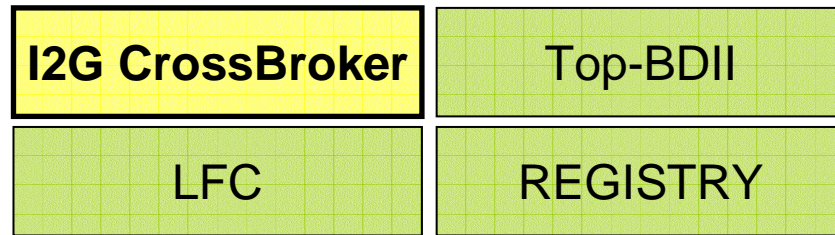
- ▶ Configure the node using the users.conf, groups.conf, site-info.def and vo.d/<VO> files depicted in appendixes 1, 2, 3 and 4 and following EGEE procedures [1]
- ▶ Add the site LDAP string to **i2g-ii01.lip.pt**, the Int.EU.Grid production top-BDII
  - Contact [grid.support@lip.pt](mailto:grid.support@lip.pt)
  - The list of current sites in Int.EU.Grid infrastructure can be consulted in <http://www.lip.pt/grid/i2g-ii01-allsites.conf>

2. Present a mechanism so that institutions with separate sites in Int.EU.Grid and in EGEE may share some resources

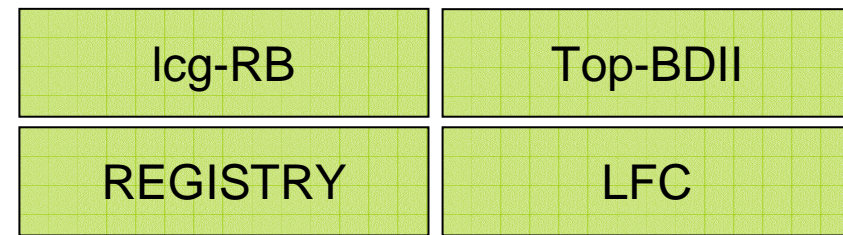
## 2) EGEE and Int.EU.Grid sharing WNs

Core Services

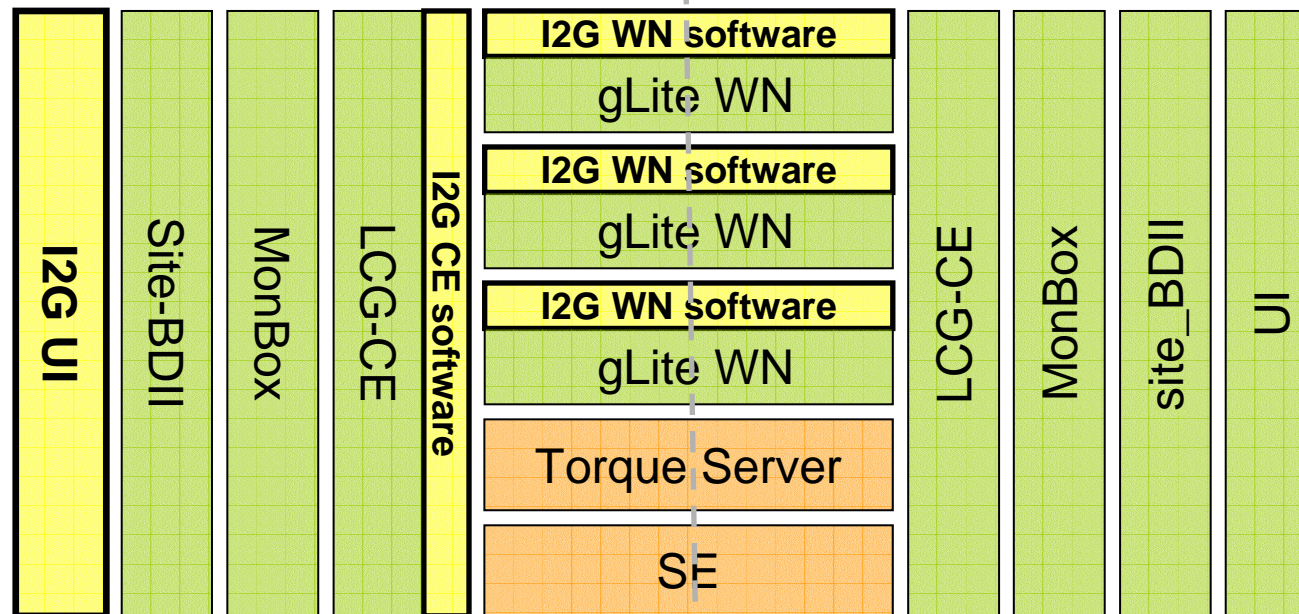
### Int.EU.Grid Infrastructure



### EGEE Infrastructure



Local Services



## 2) Sharing Resources between Grids

- Common features opens a window for interoperability. Some complexity comes from the underlying gLite/LCG services:
  - ▶ Central Services
    - **R-GMA Server** and **Central Registry (independant for each project)**
    - **Top-BDII can be configured to support sites from other projects** and the **Broker** linked with it **can start jobs in those sites**
      - High Level hierarchy decision
    - **LFC & MyProxyServer are configured on a VO basis**
      - Transparently shared between infrastructures
  - ▶ Site Services
    - **LCG-CE & MonBox** have to be **project dedicated**
      - Each CE only publishes accounting info in a dedicated MonBox and each MonBox in a dedicated Central Registry
    - **Site-BDII may publish VO resources from different Grids**
      - But this information may end up in top-BDIIs where it is not allowed.
    - **SE & LRMS are configured on a VO basis**
      - Transparently shared between infrastructures
    - **WNs may be shared between infrastructures** through the deployment of specific software and setting up proper env var

## 2) How to share physical WNs

### □ **Configure EGEE Worker Nodes to support Int.EU.Grid VOs**

- ▶ This approach is especially aimed to sites belonging to both infrastructures
  - Instead of having two sets of WNs, they could start having a single and bigger set of execution machines, minimizing the administrative and management effort.
  - The jobs from the different infrastructures will still be submitted via dedicated Computing Elements
- ▶ See slide #9 to know how to install Int.EU.Grid software on top of an EGEE gLite WN and how to re-configure the machine
  - The users.conf, groups.conf, site-info.def and vo.d/<vo> files must now contain info regarding VOs from both infrastructures (EGEE and Int.EU.Grid)
- ▶ EGEE and Int.EU.Grid entry Grid doors for the site must be LCG CEs
  - basic changes at the JobManager level of the Int.EU.Grid CE have to be implemented.



## 2) Change Int.EU.Grid CE JobManager

- ❑ **The JobManager in the Int.EU.Grid CE is changed to overwrite EGEE default environment variables in the WNs**
  - ▶ See patch in appendix 5 (NOTE: The JM will be rewritten if the node is re-configured)
  - ▶ Reads the user proxy and extracts the user VO
  - ▶ Reads a configuration file mapping VOs with the environment variables
  - ▶ If the user VO matches any of the VOs defined in the mapping file, it exports the corresponding environment variables
  
- ❑ **Some of the environment variables identified up to now are:**
  - ▶ LCG\_GFAL\_INFOSYS: Must point to the proper Top-BDII;
  - ▶ VO\_<USER\_VO>\_DEFAULT\_SE: The default Storage Element
  - ▶ VO\_<USER\_VO>\_SW\_DIR: The VO software directory.
  
- ❑ **The VO/environment mapping file**
  - ▶ Placed in /opt/globus/lib/perl/Globus/GRAM/JobManager/vo\_environment

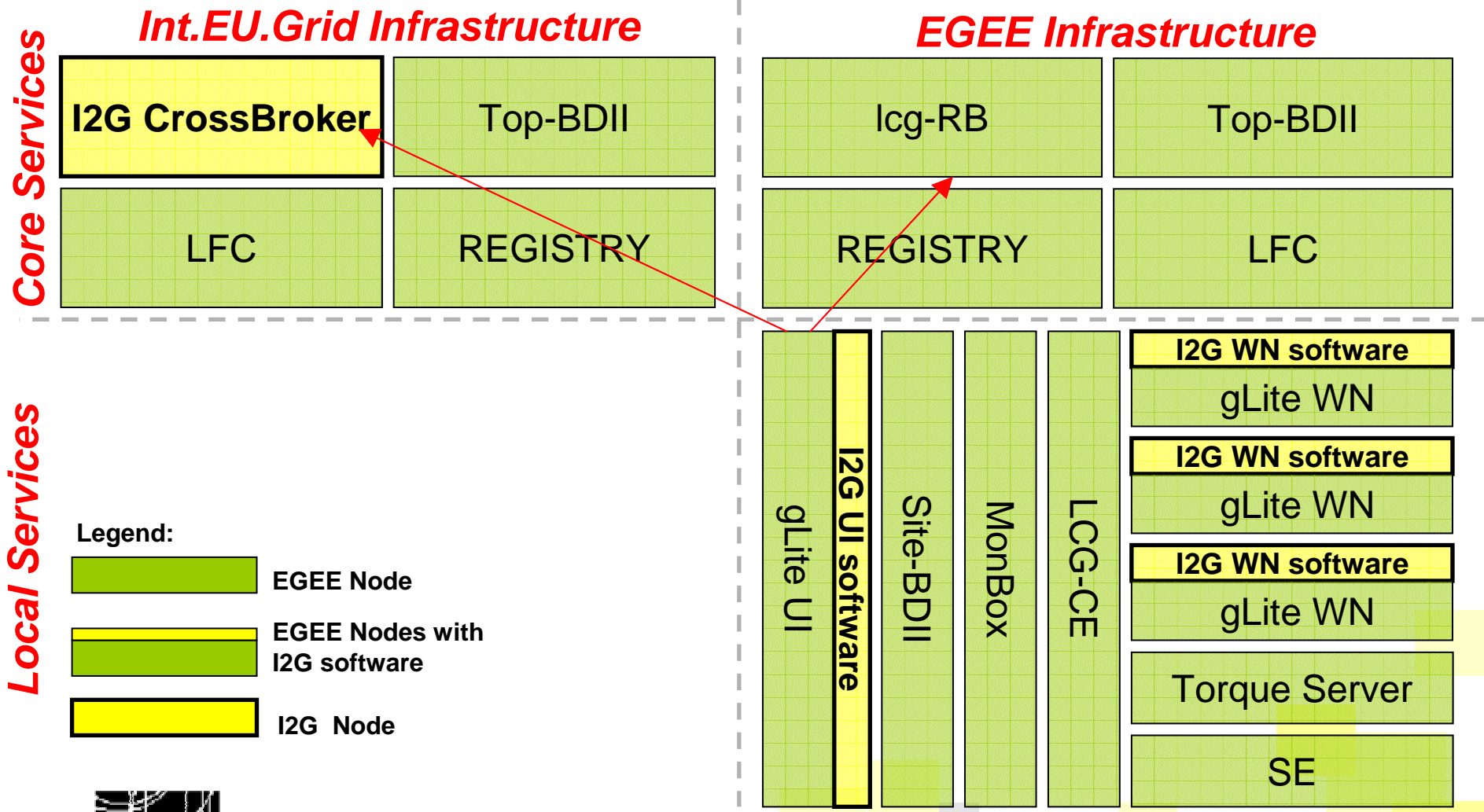
```
[root@i2g-ce01 JobManager]# cat /opt/globus/lib/perl/Globus/GRAM/JobManager/vo_environment  
imain LCG_GFAL_INFOSYS="i2g-ii01.lip.pt:2170" VO_DTEAM_DEFAULT_SE="dcache01.lip.pt"  
VO_DTEAM_SW_DIR="/exper-sw/imainsoft"
```

### 3. Present a mechanism so that EGEE sites may take advantage of Int.EU.Grid features

## 3) EGEE WNs supporting Int.EU.Grid features

- ❑ **Configure EGEE Worker Nodes to support Int.EU.Grid features**
  - ▶ See slide #9 to know how to install Int.EU.Grid software on top of an EGEE gLite WN and how to re-configure the machine
    - The users.conf, groups.conf, site-info.def and vo.d/<vo> files must now contain info regarding VOs from EGEE only
  - ▶ No changes needed at the lcg-CE JM level

### 3) EGEE taking profit from Int.EU.Grid



# EGEE UIs supporting Int.EU.Grid features

## □ Configure glite-UI to coexist with a I2G-UI

- ▶ Install and configure a glite-UI as described in YAIM manual [1]
  - The users.conf, groups.conf, site-info.def and vo.d/<vo> files must now contain info regarding EGEE VOs only

```
[root@ui01 ~]# ./yaim -i -s site-info.def -m glite-UI; ./yaim -c -s site-info.def -n UI
```

- ▶ Install relevant Int.EU.Grid rpms

```
[root@wn01 ~] # cat /etc/apt/sources.list.d/i2g.listrpm
```

```
http://savannah.fzk.de/repository/i2g/production i386 noarch
```

```
[root@ui01 ~] # apt-get update; apt-get install i2g-profile i2g-vomscerts i2g-yaim-sysconfig i2g-wl-services-common i2g-wl-logging-api-c i2g-wl-logging-api-cpp i2g-wl-logging-api-sh i2g-wl-bypass i2g-wl-chkpt-api i2g-wl-common-api i2g-wl-common-api-java i2g-wl-common-api-java-interface i2g-wl-ui-api-cpp i2g-wl-ui-api-java i2g-wl-ui-api-java-interface i2g-wl-ui-cli i2g-wl-ui-config i2g-wl-ui-gui i2g-wl-config i2g-yaim-workload_manager_client gvid xvid i2glogin cpp gcc gcc-c++ gcc-g77 i2g-openmpi i2g-pacx-openmpi
```

- ▶ Configure appropriate Int.EU.Grid functions

```
[root@ui01 ~]# ./yaim -r -s site-info.def -f config_i2g_sysconfig -f config_i2g_workload_manager_client
```

## 3) EGEE taking profit from Int.EU.Grid

### □ Broker issues

- ▶ Ask that EGEE sites supporting parallel application via Int.EU.Grid software are added in Int.EU.Grid top-BDII
- ▶ Configure EGEE/Int.EU.Grid Brokers on a VO basis
  - Set /opt/i2g/etc/<VO> as:

```
[root@ui01 root]# cat /opt/i2g/etc/dteam/i2g_wl_ui.conf  
[  
VirtualOrganisation = "dteam";  
NSAddresses = "i2g-rb02.lip.pt:7772";  
LBAddresses = "i2g-rb02.lip.pt:9000";  
MyProxyServer = "px01.lip.pt "  
]
```

- ▶ Configure Logging destination to the CrossBroker
  - Set LoggingDestination = "i2g-rb02.lip.pt:9002" in /opt/i2g/etc/i2g\_wl\_ui\_cmd\_var.conf

- Three interoperability options:
  - ▶ An EGEE site admin should now be able to install a separate Int.EU.Grid site
  - ▶ The same institution with different sites in EGEE and Int.EU.Grid should be now able to share the same physical Worker Nodes
    - Jobs from both Grid are scheduled to the sites by different BrokersI
    - Are submitted to the Cluster via dedicated CEs
    - Interact with different CEs
    - The only intersection between the two infrastructures will just be the physical WNs
  - ▶ EGEE sites may now try to use Int.EU,Grid features
    - Parallelization and Visualization
    - EGEE Worker Nodes and EGEE UIs will have to support some specific Int.EU.Grid software to take full advantage of Int.EU.Grid capabilities

- ❑ **[1] Yaim Guide:**  
<http://glite.web.cern.ch/glite/documentation/default.asp>
  
- ❑ **[2] Int.EU.Grid VOMS:**  
<https://i2g-voms.lip.pt:8443/vomses/>
  
- ❑ **[3] Int.EU.Grid WIKI:**  
[https://wiki.fzk.de/i2g/index.php/Main\\_Page](https://wiki.fzk.de/i2g/index.php/Main_Page)
  
- ❑ **[4] Int.EU.Grid WIKI MPI:**  
[https://wiki.fzk.de/i2g/index.php/MPI\\_with\\_Torque](https://wiki.fzk.de/i2g/index.php/MPI_with_Torque)





# Appendix 1: Int.EU.Grid users.conf

```
[root@ce01 ~]# cat users.conf
10996:imaintst:10000:imain:imain:tst:
10997:imainint:10000:imain:imain:int:
10998:imainsgm:10000:imain:imain:sgm:
10999:imainprd:10000:imain:imain:prd:
10001:imain001:10000:imain:imain::
11997:imonint:11000:imon:imon:int:
11998:imonsgm:11000:imon:imon:sgm:
11001:imon001:11000:imon:imon::
12996:itutst:12000:itut:itut:tst:
12997:itutint:12000:itut:itut:int:
12998:itutsgm:12000:itut:itut:sgm:
12999:itutprd:12000:itut:itut:prd:
12001:itut001:12000:itut:itut::
13996:itesttst:13000:itest:itest:tst:
13997:itestint:13000:itest:itest:int:
13998:itestsgm:13000:itest:itest:sgm:
13999:itestprd:13000:itest:itest:prd:
13001:itest001:13000:itest:itest::
14996:ifusiontst:14000:ifusion:ifusion:tst:
14997:ifusionint:14000:ifusion:ifusion:int:
14998:ifusionsgm:14000:ifusion:ifusion:sgm:
14999:ifusionprd:14000:ifusion:ifusion:prd:
14001:ifusion001:14000:ifusion:ifusion::
15996:iplancktst:15000:iplanck:iplanck:tst:
15997:iplanckint:15000:iplanck:iplanck:int:
15998:iplancksgm:15000:iplanck:iplanck:sgm:
15999:iplanckprd:15000:iplanck:iplanck:prd:
15001:iplanck001:15000:iplanck:iplanck::
16996:ibrainstst:16000:ibrain:ibrain:tst:
16997:ibrainint:16000:ibrain:ibrain:int:
16998:ibrainsgm:16000:ibrain:ibrain:sgm:
16999:ibrainprd:16000:ibrain:ibrain:prd:
16001:ibrain001:16000:ibrain:ibrain::
17996:ienvmodtst:17000:ienvmod:ienvmod:tst:
17997:ienvmodint:17000:ienvmod:ienvmod:int:
17998:ienvmodsgm:17000:ienvmod:ienvmod:sgm:
17999:ienvmodprd:17000:ienvmod:ienvmod:prd:
17001:ienvmod001:17000:ienvmod:ienvmod::
18996:iuscttst:18000:iusct:iusct:tst:
18997:iusctint:18000:iusct:iusct:int:
18998:iusctsgm:18000:iusct:iusct:sgm:
18999:iusctprd:18000:iusct:iusct:prd:
18001:iusct001:18000:iusct:iusct::
19996:iheptst:19000:ihep:ihep:tst:
19997:ihepint:19000:ihep:ihep:int:
19998:ihepsgm:19000:ihep:ihep:sgm:
19999:ihepprd:19000:ihep:ihep:prd:
19001:ihep001:19000:ihep:ihep::
21996:icesgatst:21000:icesga:icesga:tst:
21997:icesgaint:21000:icesga:icesga:int:
21998:icesgasgm:21000:icesga:icesga:sgm:
21999:icesgaprd:21000:icesga:icesga:prd:
21001:icesga001:21000:icesga:icesga::
```



# Appendix 2: Int.EU.Grid groups.conf

```
[root@ce01 ~]# cat groups.conf
"/VO=imain/GROUP=/imain/ROLE=swadmin":::sgm:
"/VO=imain/GROUP=/imain/ROLE=test":::tst:
"/VO=imain/GROUP=/imain/ROLE=interactive":::int:
"/VO=imain/GROUP=/imain/ROLE=production":::prd:
"/VO=imain/GROUP=/imain":::
"/VO=imon/GROUP=/imon/ROLE=swadmin":::sgm:
"/VO=imon/GROUP=/imon/ROLE=interactive":::int:
"/VO=imon/GROUP=/imon":::
"/VO=itut/GROUP=/itut/ROLE=swadmin":::sgm:
"/VO=itut/GROUP=/itut/ROLE=test":::tst:
"/VO=itut/GROUP=/itut/ROLE=interactive":::int:
"/VO=itut/GROUP=/itut/ROLE=production":::prd:
"/VO=itut/GROUP=/itut":::
"/VO=itest/GROUP=/itest/ROLE=swadmin":::sgm:
"/VO=itest/GROUP=/itest/ROLE=test":::tst:
"/VO=itest/GROUP=/itest/ROLE=interactive":::int:
"/VO=itest/GROUP=/itest/ROLE=production":::prd:
"/VO=itest/GROUP=/itest/testing/ROLE=interactive":::int:
"/VO=itest/GROUP=/itest/testing":::
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"/VO=ifusion/GROUP=/ifusion/ROLE=test":::tst:
"/VO=ifusion/GROUP=/ifusion/ROLE=interactive":::int:
"/VO=ifusion/GROUP=/ifusion/ROLE=production":::prd:
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"/VO=iplanck/GROUP=/iplanck/ROLE=swadmin":::sgm:
"/VO=iplanck/GROUP=/iplanck/ROLE=test":::tst:
"/VO=iplanck/GROUP=/iplanck/ROLE=interactive":::int:
"/VO=iplanck/GROUP=/iplanck/ROLE=production":::prd:
"/VO=iplanck/GROUP=/iplanck":::
"/VO=ibrain/GROUP=/ibrain/ROLE=swadmin":::sgm:
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"/VO=ibrain/GROUP=/ibrain/ROLE=interactive":::int:
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"/VO=ienvmod/GROUP=/ienvmod/ROLE=production":::prd:
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"/VO=iusct/GROUP=/iusct/ROLE=interactive":::int:
"/VO=iusct/GROUP=/iusct/ROLE=production":::prd:
"/VO=iusct/GROUP=/iusct":::
"/VO=ihep/GROUP=/ihep/ROLE=swadmin":::sgm:
"/VO=ihep/GROUP=/ihep/ROLE=test":::tst:
"/VO=ihep/GROUP=/ihep/ROLE=interactive":::int:
"/VO=ihep/GROUP=/ihep/ROLE=production":::prd:
"/VO=ihep/GROUP=/ihep":::"/VO=ihep/GROUP=/icesga":::
```

## Appendix 3: Int.EU.Grid site-info.def relevant variables

```

- CE_HOST=ce01.$MY_DOMAIN           # The site CE for Int.EU.Grid
- RB_HOST=i2g-rb01.$MY_DOMAIN       # The Int.Eu.Grid CrossBroker
- PX_HOST=px01.$MY_DOMAIN           # The Int.EU.Grid Proxy Server
- BDII_HOST=i2g-ii01.$MY_DOMAIN     # The Int.EU.Grid top-BDII
- MON_HOST=i2g-mon01.$MY_DOMAIN     # The site MON for Int.EU.Grid
- REG_HOST=rgma-server.i2g.cesga.es # The Int.EU.Grid Central Registry
- LFC_HOST=lfc01.$MY_DOMAIN         # The Int.EU.Grid LFC
- BDII_HTTP_URL=http://www.lip.pt/grid/i2g-ii01-allsites.conf
- VOS="imain imon itut itest ifusion iplanck ibrain ienvmod iusct ihep icesga"
- QUEUES="imain imon itut itest ifusion iplanck ibrain ienvmod iusct ihep icesga"
- IMAIN_GROUP_ENABLE="imain /VO=imain/GROUP=/imain/ROLE=swadmin /VO=imain/GROUP=/imain/ROLE=test
  /VO=imain/GROUP=/imain/ROLE=interactive /VO=imain/GROUP=/imain/ROLE=production"
- IMON_GROUP_ENABLE="imon /VO=imon/GROUP=/imon/ROLE=swadmin /VO=imon/GROUP=/imon/ROLE=interactive"
- ITUT_GROUP_ENABLE="itut /VO=itut/GROUP=/itut/ROLE=swadmin /VO=itut/GROUP=/itut/ROLE=test
  /VO=itut/GROUP=/itut/ROLE=interactive /VO=itut/GROUP=/itut/ROLE=production"
- ITEST_GROUP_ENABLE="itest /VO=itest/GROUP=/itest/ROLE=swadmin /VO=itest/GROUP=/itest/ROLE=test
  /VO=itest/GROUP=/itest/ROLE=interactive /VO=itest/GROUP=/itest/ROLE=production
  /VO=itest/GROUP=/itest/testing/ROLE=interactive /VO=itest/GROUP=/itest/testing"
- IFUSION_GROUP_ENABLE="ifusion /VO=ifusion/GROUP=/ifusion/ROLE=swadmin /VO=ifusion/GROUP=/ifusion/ROLE=test
  /VO=ifusion/GROUP=/ifusion/ROLE=interactive /VO=ifusion/GROUP=/ifusion/ROLE=production"
- IPLANCK_GROUP_ENABLE="iplanck /VO=iplanck/GROUP=/iplanck/ROLE=swadmin /VO=iplanck/GROUP=/iplanck/ROLE=test
  /VO=iplanck/GROUP=/iplanck/ROLE=interactive /VO=iplanck/GROUP=/iplanck/ROLE=production"
- IBRAIN_GROUP_ENABLE="ibrain /VO=ibrain/GROUP=/ibrain/ROLE=swadmin /VO=ibrain/GROUP=/ibrain/ROLE=test
  /VO=ibrain/GROUP=/ibrain/ROLE=interactive /VO=ibrain/GROUP=/ibrain/ROLE=production"
- IENVMOD_GROUP_ENABLE="ienvmod /VO=ienvmod/GROUP=/ienvmod/ROLE=swadmin /VO=ienvmod/GROUP=/ienvmod/ROLE=test
  /VO=ienvmod/GROUP=/ienvmod/ROLE=interactive /VO=ienvmod/GROUP=/ienvmod/ROLE=production"
- IUSCT_GROUP_ENABLE="iusct /VO=iusct/GROUP=/iusct/ROLE=swadmin /VO=iusct/GROUP=/iusct/ROLE=test
  /VO=iusct/GROUP=/iusct/ROLE=interactive /VO=iusct/GROUP=/iusct/ROLE=production"
- IHEP_GROUP_ENABLE="ihep /VO=ihep/GROUP=/ihep/ROLE=swadmin /VO=ihep/GROUP=/ihep/ROLE=test
  /VO=ihep/GROUP=/ihep/ROLE=interactive /VO=ihep/GROUP=/ihep/ROLE=production"
- ICESGA_GROUP_ENABLE="icesga"

```

## Appendix 4: Int.EU.Grid vo.d/ <VO>

**Note:** For other VOs, just change the string "imain" by the corresponding VO name and check the VOMS ports for each VO in the Int.EU.Grid VOMS web portal [2]

```
[root@ce01 ~]# cat ./vo.d/imain
VOMS_SERVERS="vomss://i2g-voms.lip.pt:8443/voms/imain?/imain/ 'vomss://i2gvoms01.ifca.es:8443/voms/imain?/imain/ "
SW_DIR=$VO_SW_DIR/imainsoft
DEFAULT_SE=$CLASSIC_HOST
STORAGE_DIR=$CLASSIC_STORAGE_DIR/imain
QUEUES="imaingridsdj "
VOMSES="imain i2g-voms.lip.pt 20001 /C=PT/O=LIPCA/O=LIP/OU=Lisboa/CN=i2g-voms.lip.pt imain' 'imain i2gvoms01.ifca.es 20001
/C=ES/O=DATAGRID-ES/O=IFCA/CN=host/i2gvoms01.ifca.es imain'"
```

## Appendix 5: Patch to Int.EU.Grid CE

The patch should be introduced in the middle of the JobManager submit\_to\_batch\_system subroutine, after the \$rsh\_env definition:

```
my @library_vars=('LD_LIBRARY_PATH');
if($Config::Config{osname} eq 'irix')
{
    push(@library_vars,'LD_LIBRARYN32_PATH');
    push(@library_vars,'LD_LIBRARY64_PATH');
}
my $rsh_env = "";
my $local_x509 = '-';
my @new_env;

foreach my $tuple ($description->environment())
{
    $tuple->[0] =~ s"/\#\#\#"/g;
    $tuple->[1] =~ s"/\#\#\#"/g;
    $self->helper_armour($tuple->[0]);
    $self->helper_armour($tuple->[1]);

    push(@new_env, $tuple->[0] . "=" . $tuple->[1] . "");
    $local_x509 = $tuple->[1] if $tuple->[0] eq 'X509_USER_PROXY';

    $rsh_env .= $tuple->[0] . "=" . $tuple->[1] . "\n"
        . "export " . $tuple->[0] . "\n";
}
###
# -> INTRODUCE THE PATCH HERE
# -> INTRODUCE THE PATCH HERE
# -> INTRODUCE THE PATCH HERE
###

$pbs_job_script->print("#PBS -v " . join(',', @new_env) . "\n");
```

```
# Read the VO from the user proxy
my $vo_user_line=`/opt/edg/bin/voms-proxy-info --file $local_x509 --all |
grep VO`;
my ($vo_tag,$vo_user)=split(/:/,$vo_user_line);
$vo_user=~s/\#s+//g;
# Read the vo_environment configuration file
my (%VOCONFIG);
$VOCONFIG{'vo_environment'} =
'/opt/globus/lib/perl/Globus/GRAM/JobManager/vo_environment';
my $voenv = new IO::File($VOCONFIG{'vo_environment'}, "r")
    or die "Unable to open VO environment mapping configuration file.";
# For every line in the environment configuration map
while ( defined( $_ = $voenv->getline ) ) {
    next if /^#\#s+$/; # Skip if comment
    next if /^#\#s+$/; # Skip if whitespace
    # Several chars (#s+), white space (#s+)
    if (/^(#s+)#s+((#s+)#s+)/) {
        # If it's a constraint entry, extract the values.
        my $vo_name = $1;
        s/^(#s+)#s+//g;
        my @vo_varens = split(/#s/);
        foreach my $vo_varenv (@vo_varens)
        # Add @new_env with the VO specific env variables
        { push(@new_env,$vo_varenv) if $vo_name eq $vo_user;
        }
    } else {
        warn "Unrecognised entry in ".$VOCONFIG{'vo_environment'}."":
        '$_'\n";
    }
}
$voenv->close;
```