

# Various runtime environments in Grid by means of virtualization of working nodes\*

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# Motivation

- Grid systems are used for calculations and data processing in various applied areas:
  - biomedicine,
  - nanotechnology and materials science,
  - cosmophysics
  - high energy physics
  - industrial and commercial
- Jobs are developed for definite runtime environments (RE):
  - OS: Linux, MS Windows, UNIX,
  - Libraries: perl, specific application libraries
  - File systems

# Motivation (cont.)

- Grid WNs operate offer a fixed RE (homogeneous infrastructure)
  - EGEE/WLCG – Scientific Linux-4.1
  - There is some «private» installation on other clones of Linux
  - Definitely MS Windows is not in the list



If applied jobs were not developed initially for the particular RE of the WNs, they cannot be directly processed in the Grid

# Objective & Approach

- Main objective is to propose a method for batch processing in Grid (EGEE/WLCG flavoured) of jobs prepared for various RE
  - in particular, jobs developed for MS Windows, should be able to be processed by WNs operating under OS Linux.
- The method is based on virtualization of WNs by using virtual machines (VM)
- The work is intended mainly for EGEE/RDIG grid infrastructure
  - → implementation should be based on gLite MW

# VM Choice

- Types of virtualization:
  - Hardware emulation
  - Full virtualization
  - Paravirtualization
  - Operating system-level virtualization
- Paravirtualization – a good matching of functional abilities (with the hardware support: Intel VT / AMD-V) & low overheads
- Most attractive VMM of this type: Xen (<http://www.xen.org>)

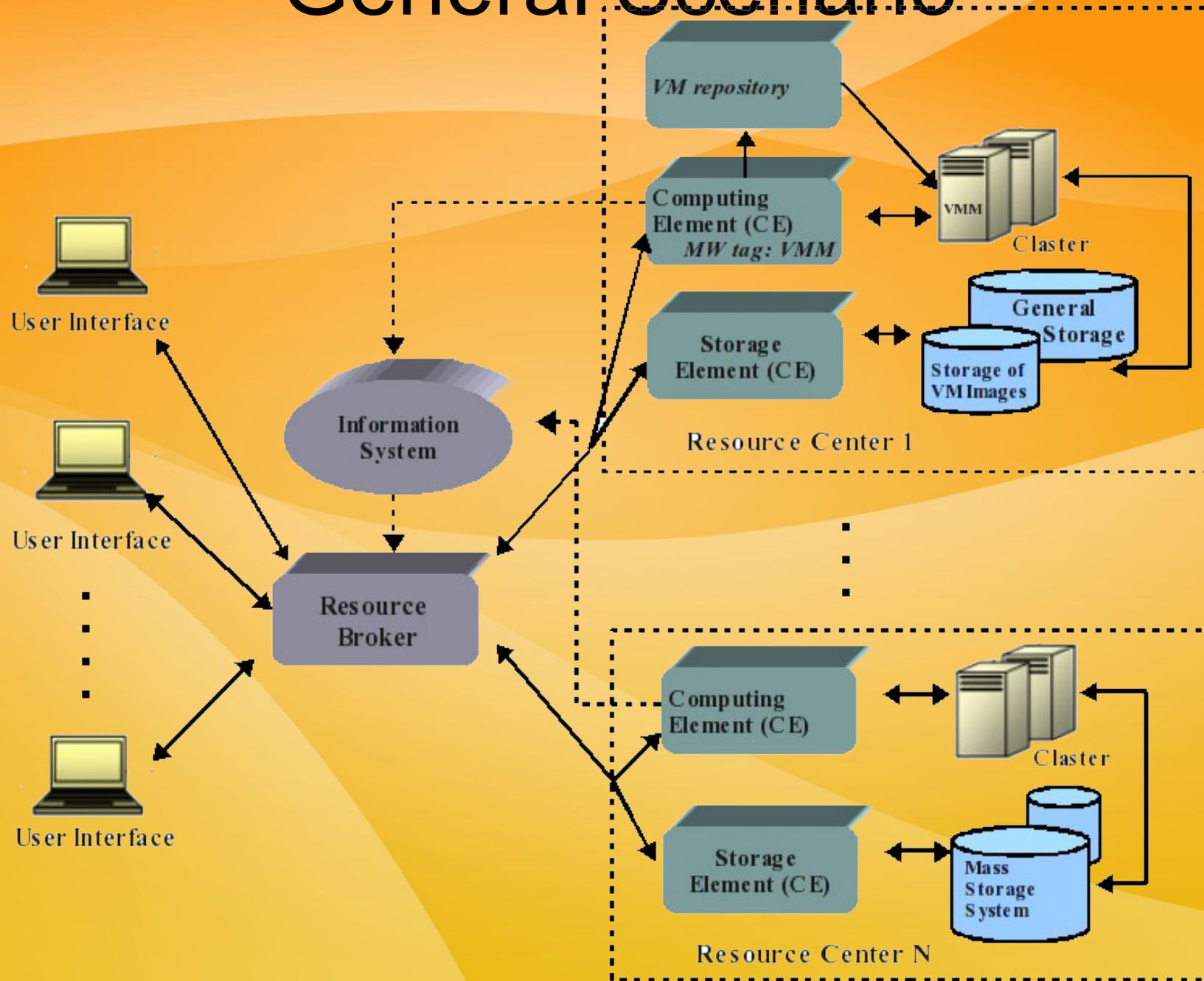
# Necessary gLite modification

- In our approach enabling job processing in various RE requires a *minimal* gLite modification – only WNs must be modified:
  - wrapping script `jobwrapper` must be modified
  - 2 new scripts must be added
    - `jobwrapper-vee`
    - `xenrun`
  - VMM must be installed
  - Disk images with REs must be available in WN's (N)FS
- CE configuration peculiarity:
  - `/opt/edg/var/info/host/host.list` with content:  
`VEE-REname1`  
`VEE-REname2`  
`...`

# General Scenario

- A user in the JDL-file specifies required RE by using the Glue schema attribute *GlueHostApplicationSoftwareRunTimeEnvironment*
- WMS with the help of IS finds an appropriate RC with CE matching the requirement in the JDL-file and submits the job to this CE
- The CE processes the job in the usual (gLite) manner and transfers it to the local batch system and eventually to a modified WN

# General Scenario



# Sample of JDL-file

```
Executable = "testJob.exe";
```

```
StdOutput = "testJob.out";
```

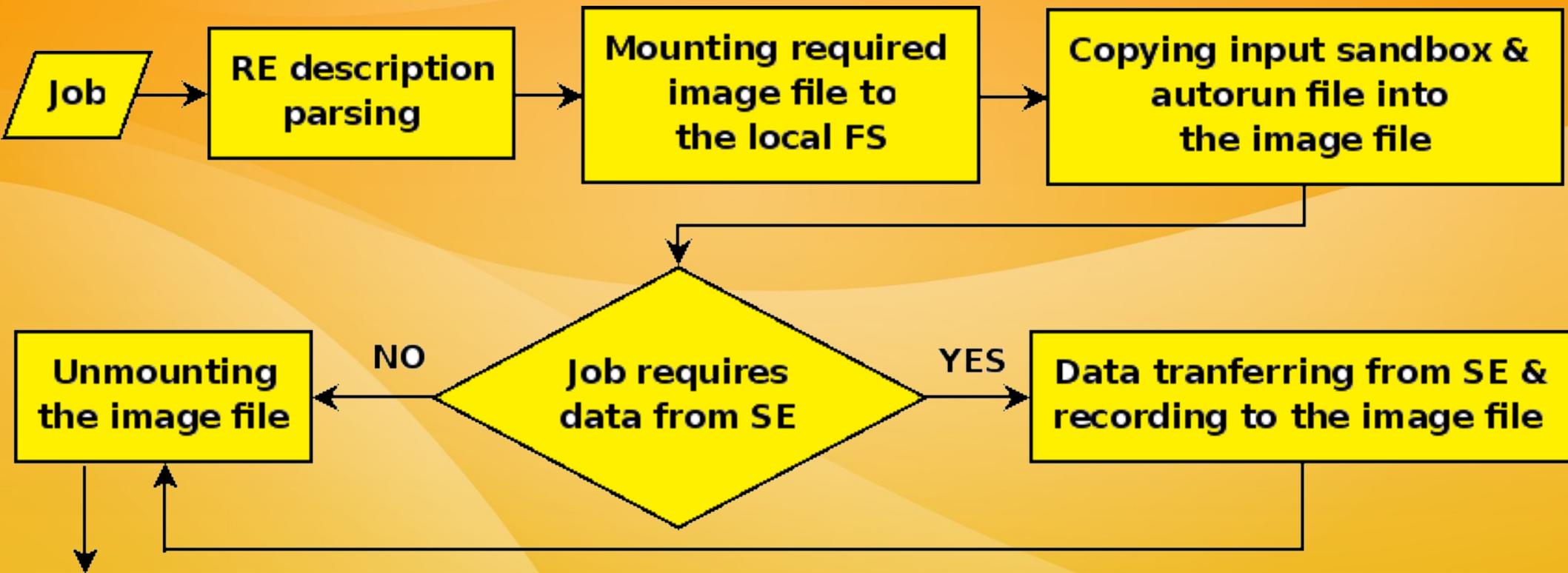
```
StdError = "testJob.err";
```

```
InputSandbox = {"/testJob.exe", "job.jdl"};
```

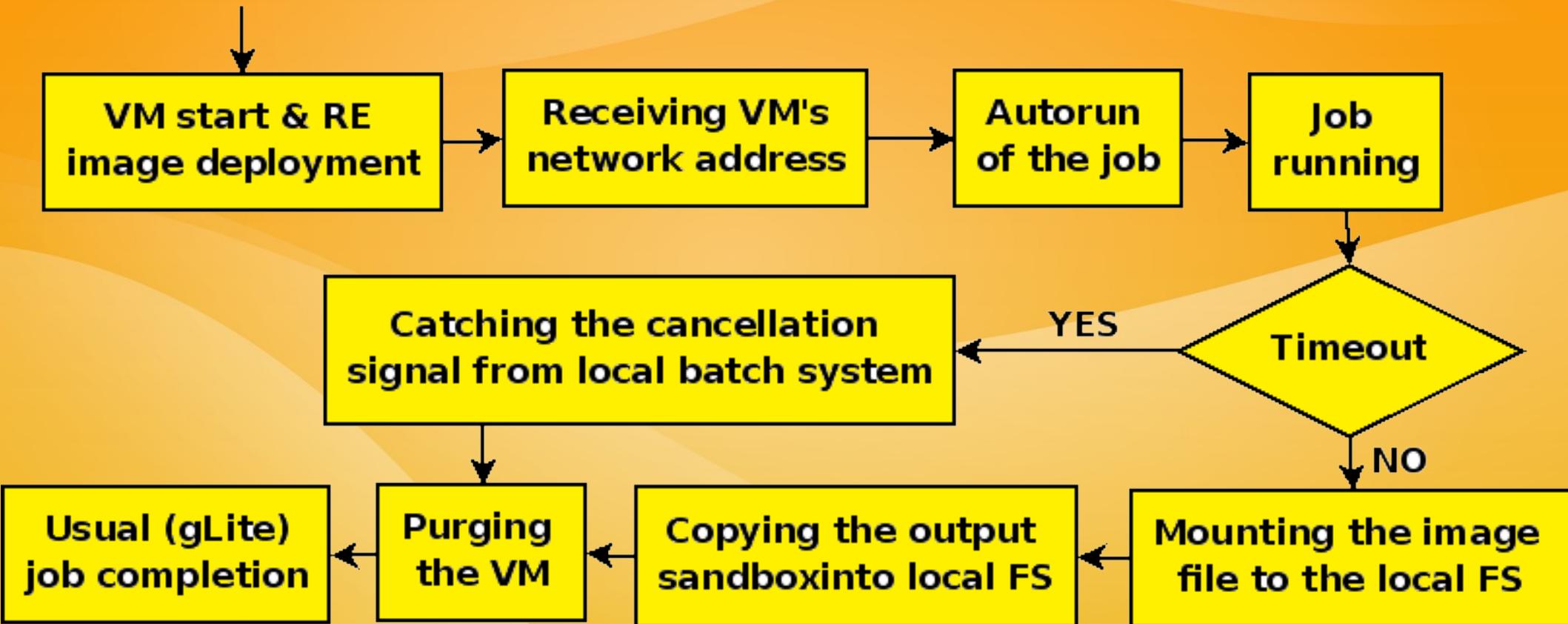
```
OutputSandbox = {"testJob.out", "testJob.err"};
```

```
Requirements = Member("VEE-REname1",  
    other.GlueHostApplicationSoftwareRunTimeEnvironment);
```

# Algorithm of Job Processing by a modified WN



# Algorithm of Job Processing by a modified WN (2)



# Conclusion

- The approach suggested provides a substantial extension of the class of applied problems that can be solved with the aid of global grid-infrastructures
- Minimal intervention into existing middleware gLite
  - The only CE was modified
- A repository of pre-installed VM's for most popular RE
- Rather small overhead for job execution. It is about 10%.

# Plans

We are planning to add to the current realization

- Possibilities to use custom RE's prepared by user and transfer to the WN with job
- Data transfer while job running
  - At least via gsi-ftp client.

# References

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**Thank you for your attention!**