

***P-GRADE Portal:
a workflow-oriented generic
application development portal***

Peter Kacsuk
MTA SZTAKI, Hungary
Univ. of Westminster, UK



User concerns of Grid systems

- How to cope with the variety of Grid systems? (**How to move from LCG-2 to gLite?**)
- How to develop/create new Grid applications?
 - To use workflows (DAG)
 - To use MPI codes
- How to execute Grid applications in a fault-tolerant way?
- How to observe (and debug) the application execution in the Grid?
- How to tackle performance issues?
- How to port legacy applications
 - to Grid systems
 - between Grid systems?
- How to interoperate among Grids, how to execute Grid applications over several Grids in a transparent way? (**see Earth Science slides**)
- **The goal of this talk is to show how a portal, like P-GRADE, can solve all these problems at a high abstraction level**



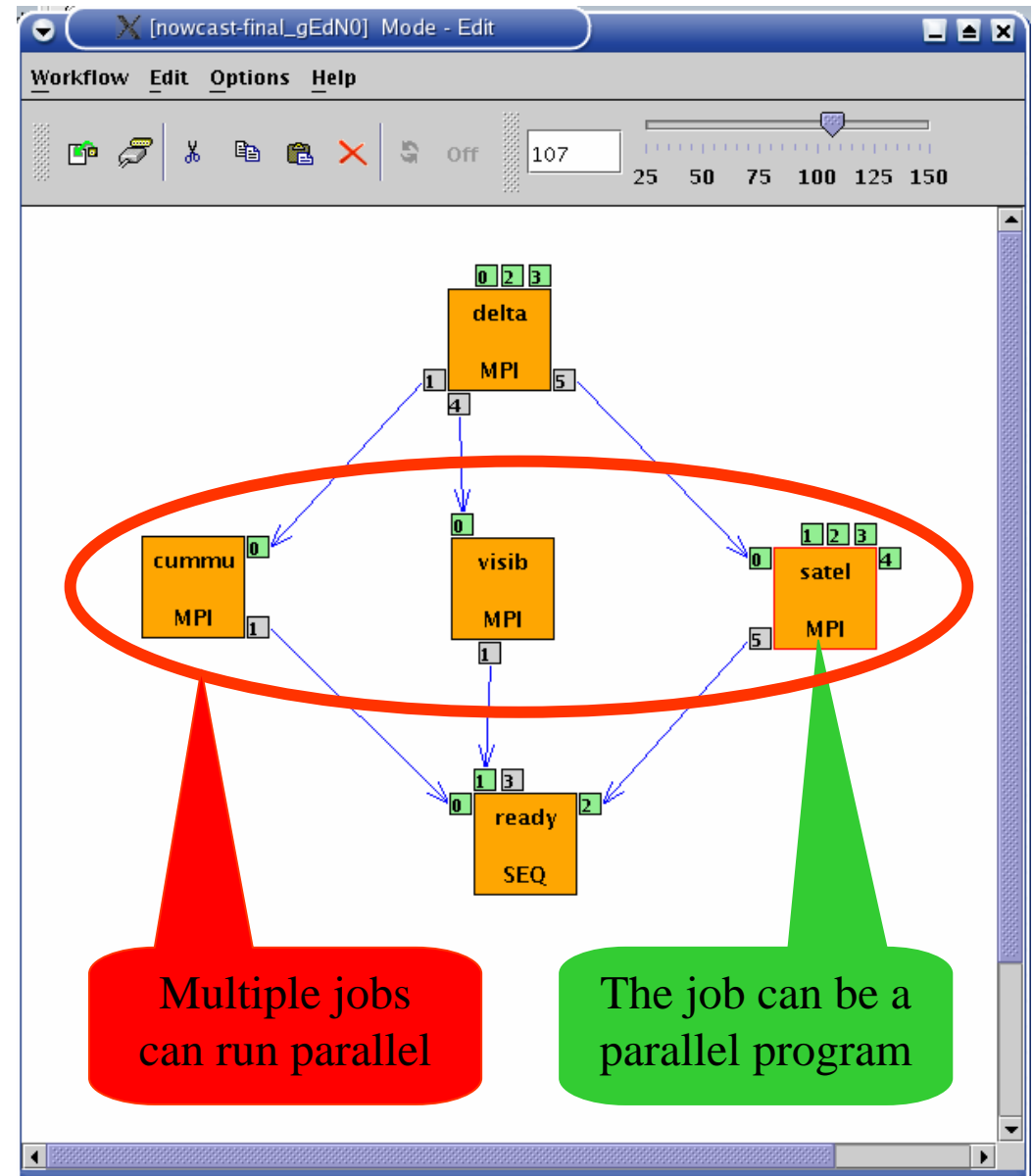
Properties of the P-GRADE Portal

- **General purpose, graphical, workflow-oriented Grid portal**
- Supports the development and execution of workflow-based Grid applications
- Components of the workflows can be
 - Sequential jobs
 - Parallel jobs (MPI, PVM)
 - Legacy code (GEMMLCA) services
- Enables the exploitation of two levels of parallelism
- Solves the interoperability of Grids at the workflow level



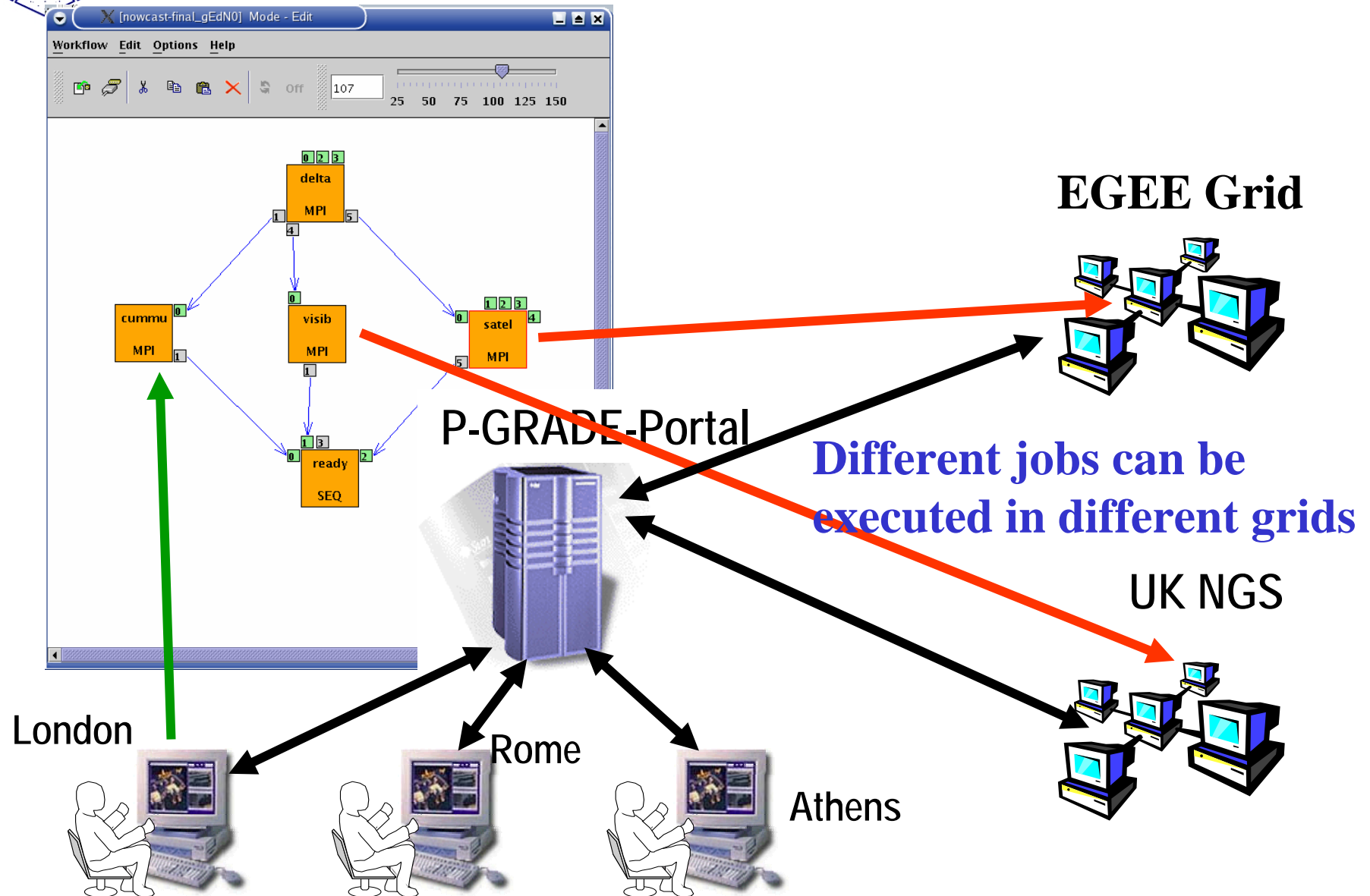
Two levels of parallelism by the P-GRADE workflow

- Semantics of the workflow enables two levels of parallelism:
 - Parallel execution inside a workflow node
 - Parallel execution among workflow nodes
- The P-GRADE Portal workflow concept enables the efficient parallelization of complex problems





Solving Grid interoperability by P-GRADE Portal





Properties of P-GRADE Grid Portal

- Grid services supported by the portal:
 - **MyProxy** – proxy credential management
 - **GridFTP** – file transfer
 - **GT2/GT3/GT4 GRAM** – job execution
 - **Mercury** – parallel job monitoring
 - **PROVE** – workflow & job execution visualization
 - **BDII and MDS** – obtain information about resources
 - **LCG-2 broker** – resource selection
 - **GEMMLCA** – invoke legacy codes
- **GridSphere** based
 - Easy to expand with new portlets
 - Easy to tailor to end-user needs
- Support for **grid interoperability** at workflow level



P-GRADE portal in a nutshell

The screenshot displays the P-Grade portal interface across multiple browser windows. The main window shows a workflow editor with a central node labeled 'delta' and 'MPI' connected to other nodes. A sidebar on the left lists 'Globus resou' and 'fs0_das2.cs.vu'. Below the workflow editor, a 'Job list' table is visible, showing the status of various jobs. The bottom window shows a 'Tracefile visualization' for the workflow 'nowcast-final_gEdn0_b'.

Workflow	Job	Hostname	Status	Logs	Output	Action
nowcast-final_gEdn0_b	summu	n0.hpcc.sztaki.hu	3_finished	-	-	Attach Delete
	delta	n0.hpcc.sztaki.hu	3_finished	-	Err	
	ready	n0.hpcc.sztaki.hu	3_finished	-	Err	
	satel	n0.hpcc.sztaki.hu	3_finished	-	-	
	visib	n0.hpcc.sztaki.hu	3_finished	-	-	

Proxy management

Definition of Grid resources

Workflow creation

Job mapping to Grid resources

Workflow management and execution visualization

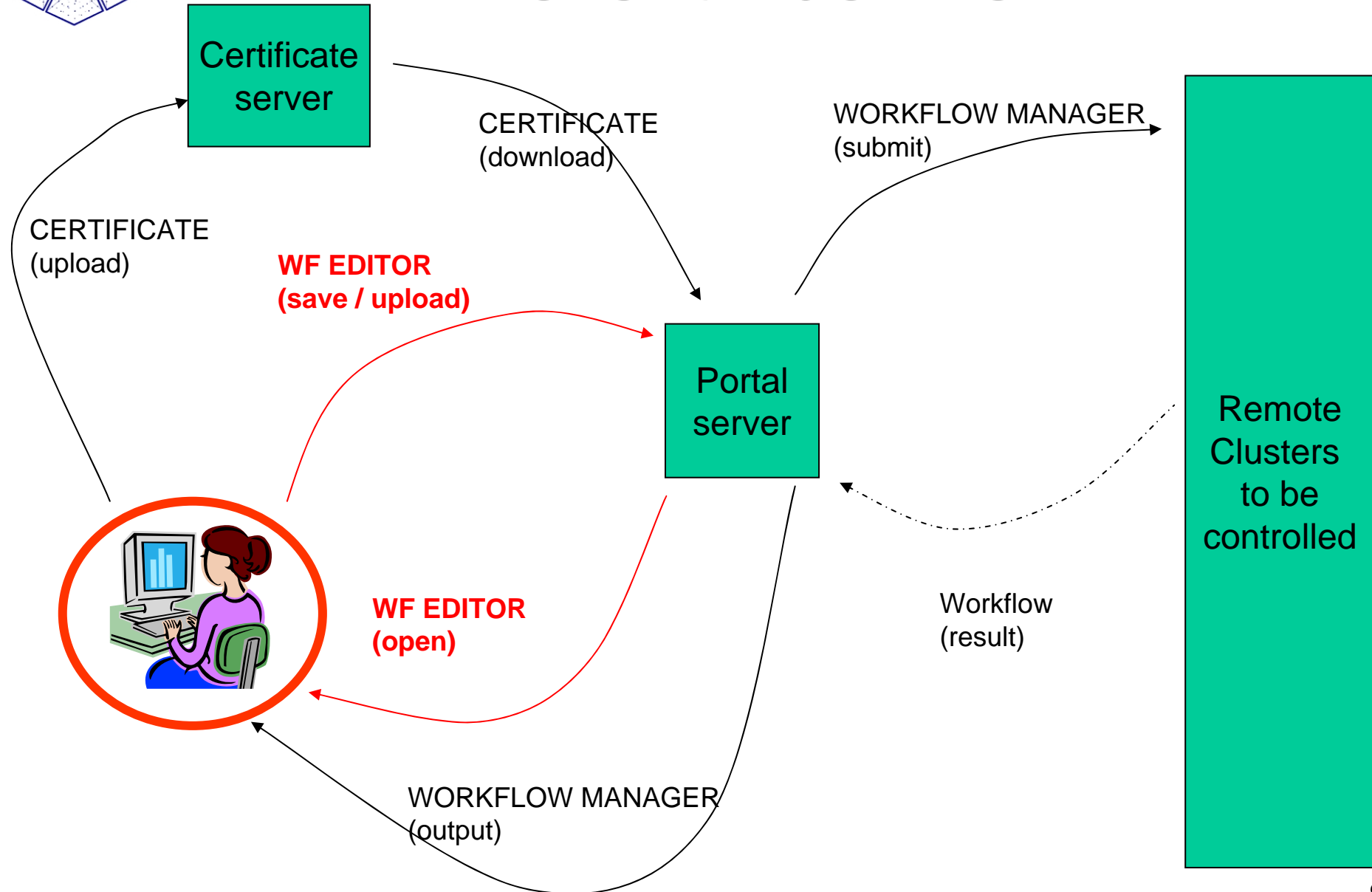


User concerns of Grid systems

- How to cope with the variety of Grid systems?
- ➔ **How to develop/create new Grid applications?**
- How to execute Grid applications in a fault-tolerant way?
- How to observe the application execution in the Grid?
- How to tackle performance issues?
- How to port legacy applications
 - to Grid systems
 - between Grid systems?
- How to execute Grid applications over several Grids in a transparent way?



Workflow creation at the client machine





Workflow Editor: Grid aware workflow mapping

A screenshot of the Workflow Editor application. The main window title is "Workflow Editor - [LM_9_DEMO_TOTAL] Mode - Edit". The menu bar includes "Workflow", "Edit", "Options", and "Help". A toolbar with various icons is visible. A dialog box titled "LM_P properties" is open, showing configuration options for a job. An arrow points from a yellow "LM_P" icon in the workflow editor to the dialog box. The dialog box contains the following fields:

- Name: LM_P
- Job Type: SEQ MPI PVM
- Job Executable: LM_5.bin
- File Browser: [button]
- Instrument:
- Process Number: 7
- Attributes: -n -m
- Grid: SEE-GRID (dropdown)
- Monitor:
- Resource: n40.hpcc.sztaki.hu:jobmanager-fork (dropdown menu open showing options: ce01.grid.acad.bg:jobmanager-fork, grid-ce.ii.edu.mk:jobmanager-fork, grid1.irb.hr:jobmanager-fork, grid1.netmode.ece.ntua.gr:jobmanager-fork, n40.hpcc.sztaki.hu:jobmanager-fork, prof.salla6.inima.at:jobmanager-fork)



Visualization of monitoring system information

PGrade Portal - Microsoft Internet Explorer

http://hgportal.hpcc.sztaki.hu:7080/gridsphere/gridsphere?action=doChangeVO&cid=15

Workflow Certificates Settings Information System Help

MDS Monitor **CG Monitor**

Monitor

Select Grid: SEE-GRID View

Select VO: seegrid View

Grid: SEE-GRID VO: seegrid

Sites

Site Name	Computing Element						Storage Element		
	CPU			Job			Space		
	Total	Free	Usage	Running	Waiting	Load	Total	Available	Usage
AEGIS01-PHY-SCL	112	80	29%	7	0	0%	226.793 GB	216.34 GB	5%
AEGIS02-RCUB	20	20	0%	0	0	0%	398.466 GB	396.58 GB	0%
BG01-IPP	54	18	67%	4	0	0%	609.554 GB	473.543 GB	22%
BG02-IM	20	16	20%	1	0	0%	131.775 GB	79.957 GB	39%
BG03-IPP-N	3	3	0%	0	0	0%	566.608 GB	566.376 GB	0%
BG04-ACAD	48	32	33%	2	5	71%	554.647 GB	475.767 GB	14%
HR-01-RBI	60	12	80%	4	0	0%	78.317 GB	6.271 GB	92%
MK-01-UKIM_II	28	28	0%	0	0	0%	69.709 GB	69.075 GB	1%
RO-01-ICI	54	24	56%	5	36	88%	849.666 GB	828.387 GB	3%
ROGRID-NIPNE-01	24	24	0%	0	0	0%	862.807 GB	848.676 GB	2%
SZTAKI	4	4	0%	0	0	0%	4.566 GB	2.871 GB	37%
tubitakcg2	35	28	20%	1	0	0%	1.335 TB	1.335 TB	0%

Kész Internet



Non-Grid aware (abstract) workflow mapping

Can be used if the selected Grid (eg. LCG-2)
has a broker:

1. Describe the requirements of the job
2. Select a Grid with broker
3. The workflow manager will contact the broker to find the best resource for your job



Workflow Editor extension with JDL

Select an LCG-2 based Grid!

Don't select any resource!

Define job requirements with the "Job Description Language"!

The screenshot shows the 'BrokerTest properties' dialog box in the Workflow Editor. The dialog has a title bar 'Workflow Editor - [default*] Mode - Edit' and a menu bar with 'Workflow', 'Edit', 'Options', and 'Help'. Below the menu bar is a toolbar with icons for file operations and a progress slider set to 100. The main area contains the following fields:

- Name: BrokerTest
- Job Type: SEQ MPI PVM
- Job Executable: D:\A-TEST\Cell.exe (with a File Browser button)
- Instrument:
- Process Number: (empty text box)
- Attributes: (empty text box)
- Grid: HUNGRID_LCG_2_B... (dropdown menu)
- Monitor:
- Resource: grid151.kfki.hu (dropdown menu)
- JDL: JDL Editor... (button)

At the bottom are 'Ok' and 'Cancel' buttons. Three red arrows point from the text on the left to the Grid, Resource, and JDL fields.

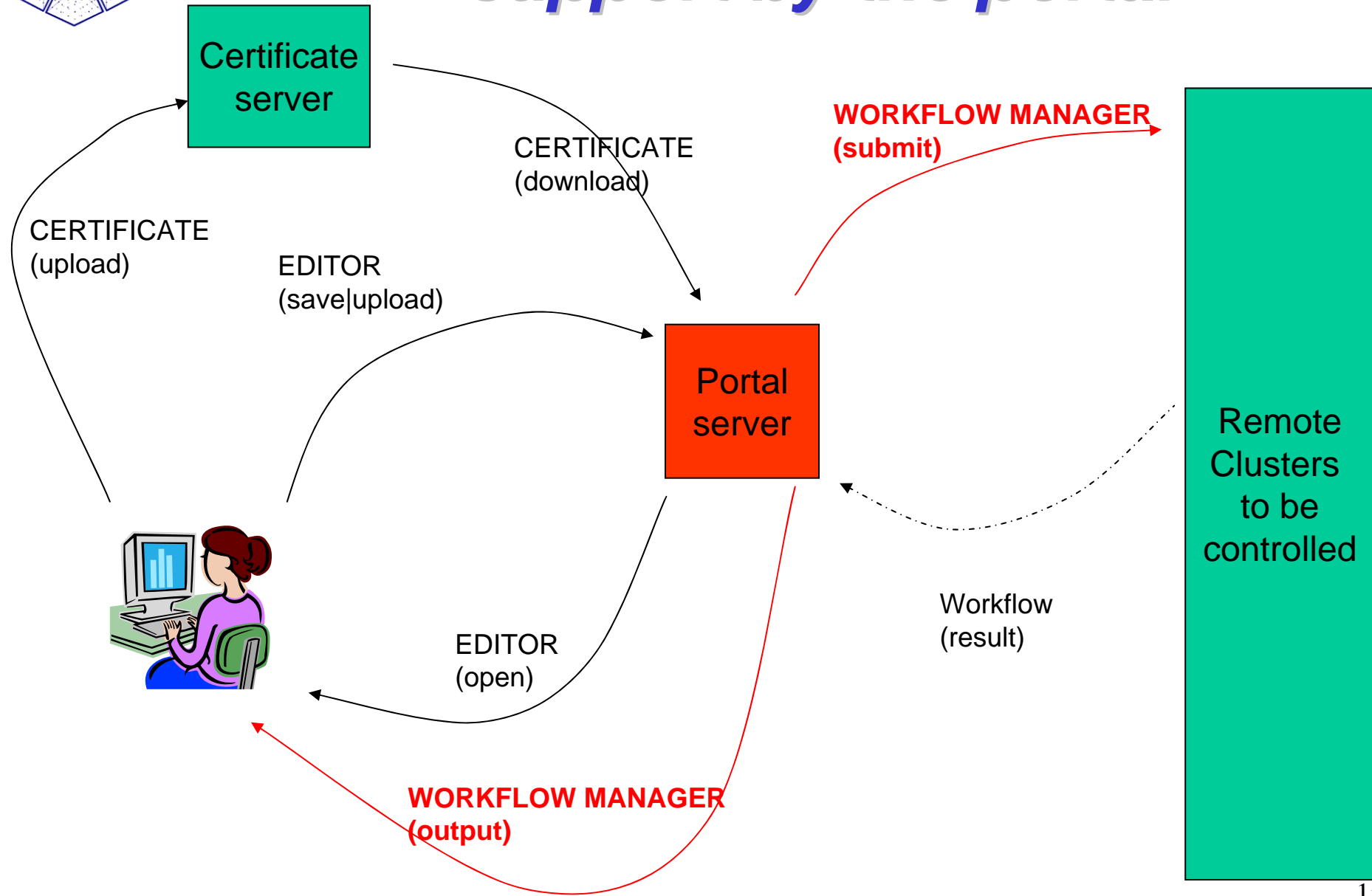


User concerns of Grid systems

- How to cope with the variety of Grid systems?
- How to develop new Grid applications?
- ➔ **How to execute Grid applications in a fault-tolerant way?**
- How to observe the application execution in the Grid?
- How to tackle performance issues?
- How to port legacy applications
 - to Grid systems
 - between Grid systems?
- How to execute Grid applications over several Grids in a transparent way?



Workflow execution support by the portal





Workflow Manager Portlet

The screenshot shows the PGrade Portal Workflow Manager interface. The main content is a table titled "Job list" with columns: Workflow, Job, Gridname, Hostname, Status, [Logs], [Output], and [Visualization]. The table contains several rows of job data. Two rows are circled in red: the first row with Job "INIT" and Gridname "SEE-GRID", and the last row with Job "TIFF" and Gridname "HUNGRID". The Status column uses color coding: "finished" is green, "running" is red, and "init" is white. There are also buttons for "Visualize", "All", and "Abort" in the visualization column.

Workflow	Job	Gridname	Hostname	Status	[Logs]	[Output]	[Visualization]
LM_9_DEMO_TOTAL				running	-	N/A	Visualize All Abort
	INIT	SEE-GRID	ce01.grid.acad.bg	finished	-	-	-
	LM_P	SEE-GRID	n40.hpcc.sztaki.hu	running	Out	-	Visualize
	LM_P.2	SEE-GRID	n40.hpcc.sztaki.hu	running	Out	-	Visualize
	LM_S	SEE-GRID	grid-ce.ii.edu.mk	finished	Out	-	-
	LM_S.2	SEE-GRID	grid1.irb.hr	finished	Out	-	-
	LM_S.3	SEE-GRID	grid1.netmode.ece.ntua.gr	finished	Out	-	-
	LM_S.4	SEE-GRID	grid1.irb.hr	finished	Out	-	-
	LM_S.5	SEE-GRID	testbed001.grid.icl.ro	finished	Out	-	-
	LM_S.6	HUNGRID	chemgrid3.chemres.hu	finished	Out	-	-
	TIFF	HUNGRID	grid109.kfki.hu	init	-	-	-

Message: Job list refreshed.

- Displays the list of jobs and their status

- The current status of the jobs are represented by colors

- Provides access to their logs and outputs, and visualizes them

White/Red/Green color means the job is initialised/running/finished



Rescuing a failed workflow

A job failed during workflow execution

Read the error log to know why

Attach the workflow editor

Workflow	Job	Gridname	Hostname	Status	Action
demo-RESCUE	Count1	SZTAKI-GRID	n0 .hpc.sztaki.hu	finished	Out -
	Count2	SZTAKI-GRID	n0 .hpc.sztaki.hu	finished	Out -
	Count3	HUNGRID	chemgrid3 .chemres.hu	error	- Err
	Count4	SZTAKI-GRID	n0 .hpc.sztaki.hu	submitted	--

Message: Workflow details successfully displayed.

July 29, 2005

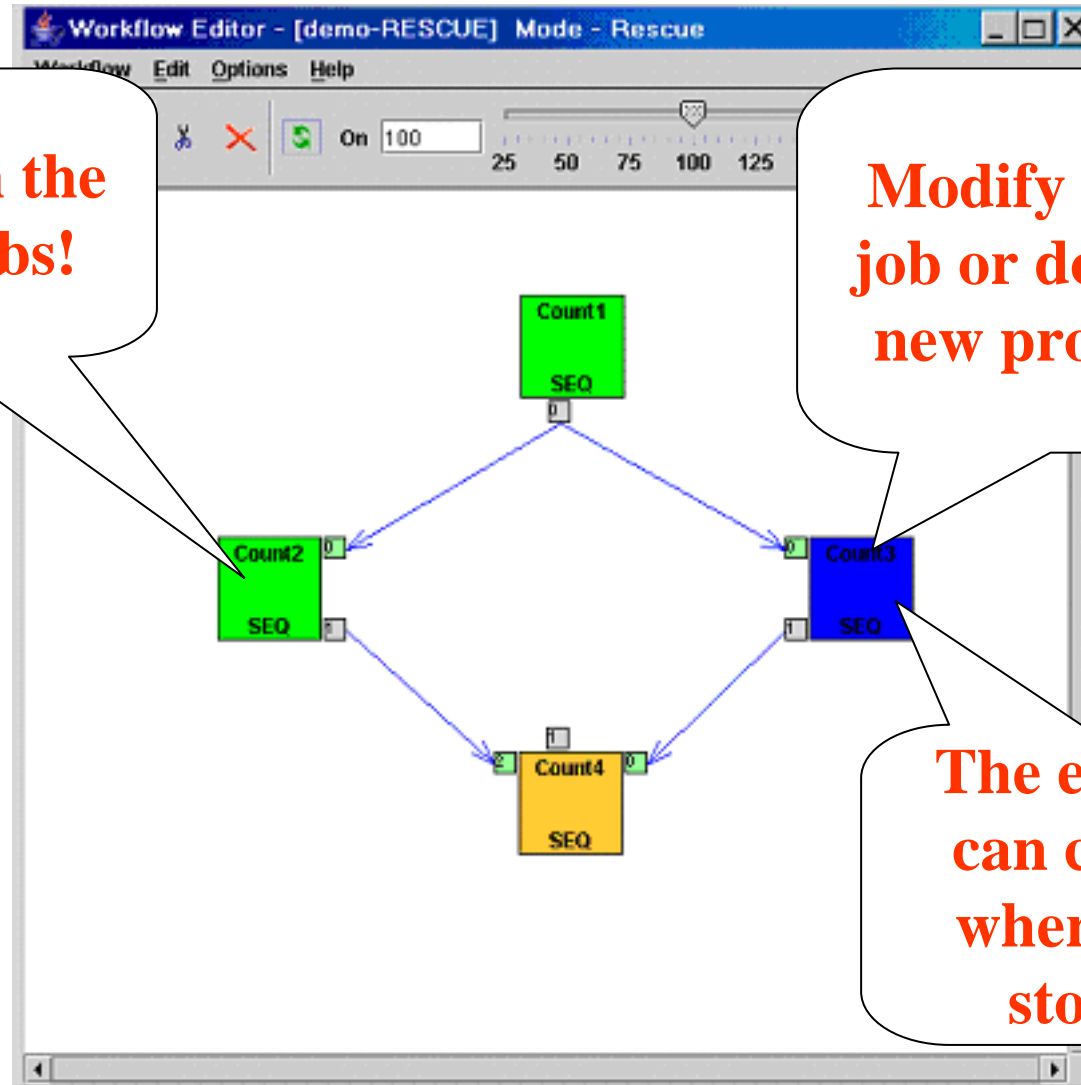


Rescuing a failed workflow

Don't touch the finished jobs!

Modify the failed job or download a new proxy for it.

The execution can continue where it was stopped!





User concerns of Grid systems

- How to cope with the variety of Grid systems?
- How to develop new Grid applications?
- How to execute Grid applications in a fault-tolerant way?
- ➔ How to observe the application execution in the Grid?
- ➔ How to tackle performance issues?
 - How to port legacy applications
 - to Grid systems
 - between Grid systems?
 - How to execute Grid applications over several Grids in a transparent way?



On-Line Monitoring

PGrade Portal - Microsoft Internet Explorer

http://hgportal.hpcc.sztaki.hu:7080/gridsphere/gridsphere?action=doVisualizeWorkflowTrace&cid=2

Workflow Certificates Settings Information System Help

Workflow Manager

Tracefile visualization

workflow: LM_9_DEMO_TOTAL

Trace View Info

Task Name	Start Time	End Time	Color
LM_P.2	~1m40s	~5m0s	Green
LM_S.3	~1m40s	~5m0s	Black
LM_S.2	~1m40s	~3m20s	Black
LM_S	~1m40s	~5m0s	Black
TIFF	~6m40s	~10m0s	Green
grid109.kfki.hu	~1m40s	~5m0s	Black
INIT	~1m40s	~5m0s	Black
ce01.grid.acad.bg	~1m40s	~5m0s	Black
LM_S.5	~1m40s	~3m20s	Black
LM_S.6	~1m40s	~3m20s	Black
LM_S.4	~1m40s	~3m20s	Black
LM_P	~1m40s	~5m0s	Black

Width:
Height:

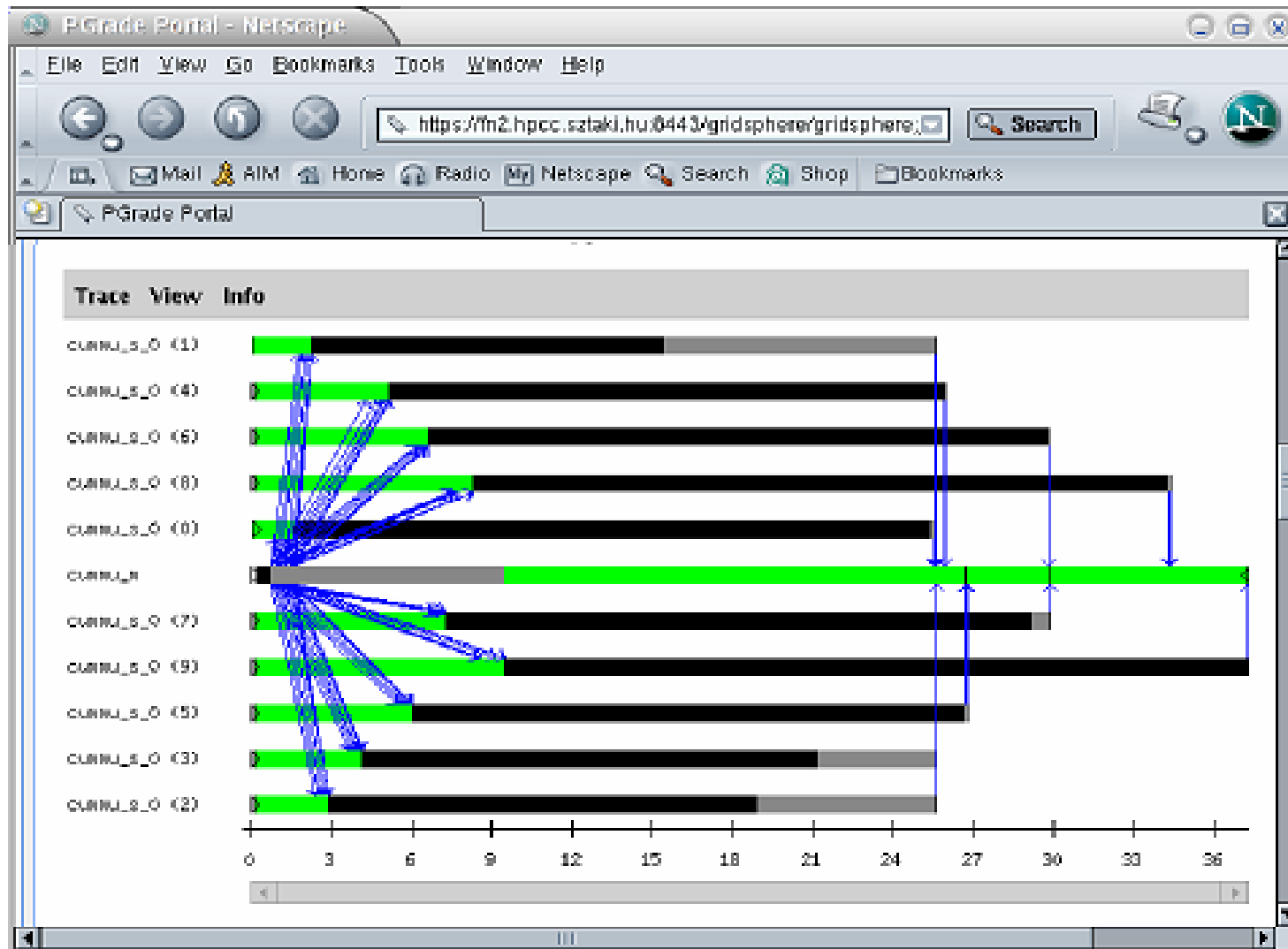
0s 1m40s 3m20s 5m0s 6m40s 8m20s 10m0s

Applet sztaki.trace.client.TraceClientApplet started

Internet



Job execution visualization





User concerns of Grid systems

- How to cope with the variety of Grid systems?
- How to develop new Grid applications?
- How to execute Grid applications in a fault-tolerant way?
- How to observe the application execution in the Grid?
- How to tackle performance issues?
- **How to port legacy applications**
 - to Grid systems
 - between Grid systems?
- How to execute Grid applications over several Grids in a transparent way?



GEMMLCA legacy code architecture objectives



- To deploy legacy code applications as Grid services **without reengineering the original code** and minimal user effort

GEMMLCA

- To create Grid workflows where components can also be legacy code applications

GEMMLCA &

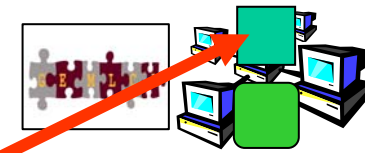
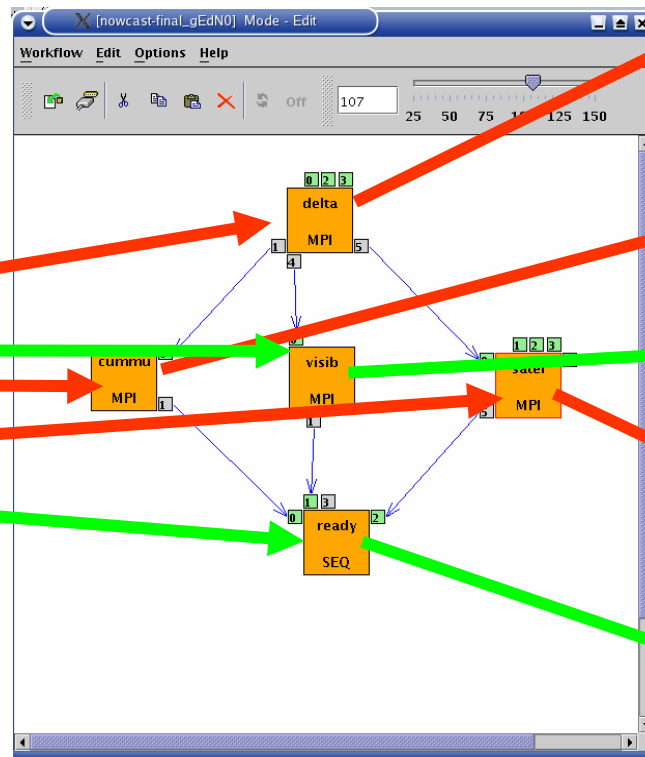
- To make these functions available from a Grid Portal

**P-GRADE
Portal
Integration**

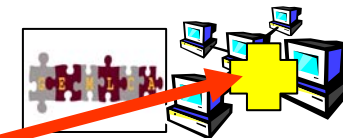


Combining legacy and non-legacy components

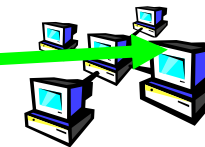
Combine legacy codes
with new codes
inside the same workflow!



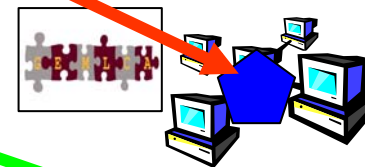
Code invocation



Code invocation



Job submission



Code invocation



Job submission

Use successfully
executed new code
as legacy code



Legacy code registration page

Workflow Certificates Settings Demo Help GEMLCA Administration Tools Macroscopic Visualiser

Resource Selector Legacy Code Information Descriptor Creator

GEMLCA LCID Administration Portlet

GEMLCA Legacy Code Interface Descriptor composer

Legacy code Environment Paramaters:

maximumProcessors

executable

minimumProcessors

maximumJob

jobManager

id

description

List of legacy code Arguments:

name	file	order	fixed	inputOutput	mandatory	regexp	friendlyName	commandline	initialValue
------	------	-------	-------	-------------	-----------	--------	--------------	-------------	--------------

New argument entry form:

name

file

order

fixed

inputOutput

mandatory

regexp

friendlyName

commandline

initialValue



GEMLCA client in a nutshell: Traffic Simulation Workflow

Workflow creation

Definition of legacy
code service
properties

Monitoring and
execution
visualization

The screenshot displays the GEMLCA client interface, which is a Java applet running in a Mozilla browser. The main window is titled "Workflow Editor - [sztaki6] Mode - Edit". It features a menu bar with "Workflow", "Edit", "Options", and "Help". Below the menu is a toolbar with various icons for file operations and a slider control set to "100". The main workspace contains a yellow box labeled "Job0" with "GEMLCA" written below it. A "Job0 properties" dialog box is open in the foreground, partially overlapping the main workspace. Below the main workspace is a "PGrade Portal - Mozilla" browser window. The browser's address bar shows the URL "http://parsifal.8080/gridsphere/gridsphere?action=doVisualizeWorkflowTrace&cid=2". The browser content area displays the "Workflow Manager" interface, which includes a "Tracefile visualization" section. This section shows a Gantt chart for a workflow named "sztaki6". The chart has a time axis from 0s to 10m0s. A list of jobs is shown on the left, including Job1, Job3, Job5, Job0, Job7, Job8, Job4, and Job2, each with its corresponding URL. The Gantt chart shows the execution timeline for these jobs, with Job0 being the longest and most central task. A "Message" box at the bottom of the browser window states "Message: Attempt to visualize successful." and "Applet sztaki.trace.client.TraceClientApplet started".



References of P-GRADE portal

- **Official portal of**
 - SEE-GRID infrastructure
 - HUNGRID infrastructure



- **P-GRADE portal is available as service for:**

- VOCE
- UK National Grid Service



National Grid Service

core production computational and data grid

- **Under preparation for**

- Croatian Grid
- EGRID (Italy)
- GridIreland



How to access P-GRADE Portal?

- If you are interested in using P-GRADE Portal:
 - Take a look at www.lpds.sztaki.hu/pgportal
 - **If you are a user, get an account for one of its production installations:**
 - **HUNGrid** portal – SZTAKI
 - **VOCE** portal – SZTAKI
 - **SEEGRID** portal – SZTAKI
 - **UK NGS** portal – University of Westminster
 - **If you are the administrator of a VO or Grid, ask SZTAKI to install P-GRADE Portal for your VO or Grid:**
 - **EGRID VO** portal – ICTP
 - **Croatian Grid** portal – Boskovic Institute



New, planned features

- **Parameter study support at**
 - Job level
 - Workflow level
- **New types of parallelism** (collaboration with Johan Montagnat):
 - Pipeline parallelism (e.g. Planck VO and biomed community need it)
 - multi-thread parallelism
- **Collaborative portal** (collaboration with Univ. of Reading)
- **Automatic testing of Grid services and resources from the portal** (collaboration with Univ. of Westminster)
 - Intelligent brokering
 - **Intelligent error messages**
 - **Automatic handling of error situations**
- **New application-oriented portlets** (collaboration with E-Grid and Croatian Grid)
- **Interactive workflow development and debugging support**



Final conclusions

- **Users should access any Grids transparently by Grid portals**
- **Every Grid should be accessed via different portals in order to provide a choice for the users**
 - **In the case of EGEE:**
 - Genius Portal
 - P-GRADE Portal
 - **In the case of UK NGS:**
 - Daresbury Portal
 - P-GRADE Portal
- **P-GRADE Portal provides the following principles:**
 - **Learn once, use everywhere**
 - **Develop once, execute anywhere**
- We are ready to collaborate with any team and support any EGEE application by the portal, and extend it with the special needs of the application

www.lpds.sztaki.hu/pgportal/



Grid-Enabling Legacy Applications and Supporting End Users Workshop

***within the framework of the
15th IEEE International Symposium on
High Performance Distributed
Computing
HPDC'15
Paris, France
June 19-23, 2006***

- **IMPORTANT DATES**

- Paper Abstract Submission: February 06, 2006
- Full Papers Submission: February 13, 2006
- Notice of Acceptance: March 27, 2006
- Final Manuscript Due: April 24, 2006
- Workshop: June 20, 2006