Paraméter vizsgálat alapú grid alkalmazások és támogatásuk P-GRADE Portállal

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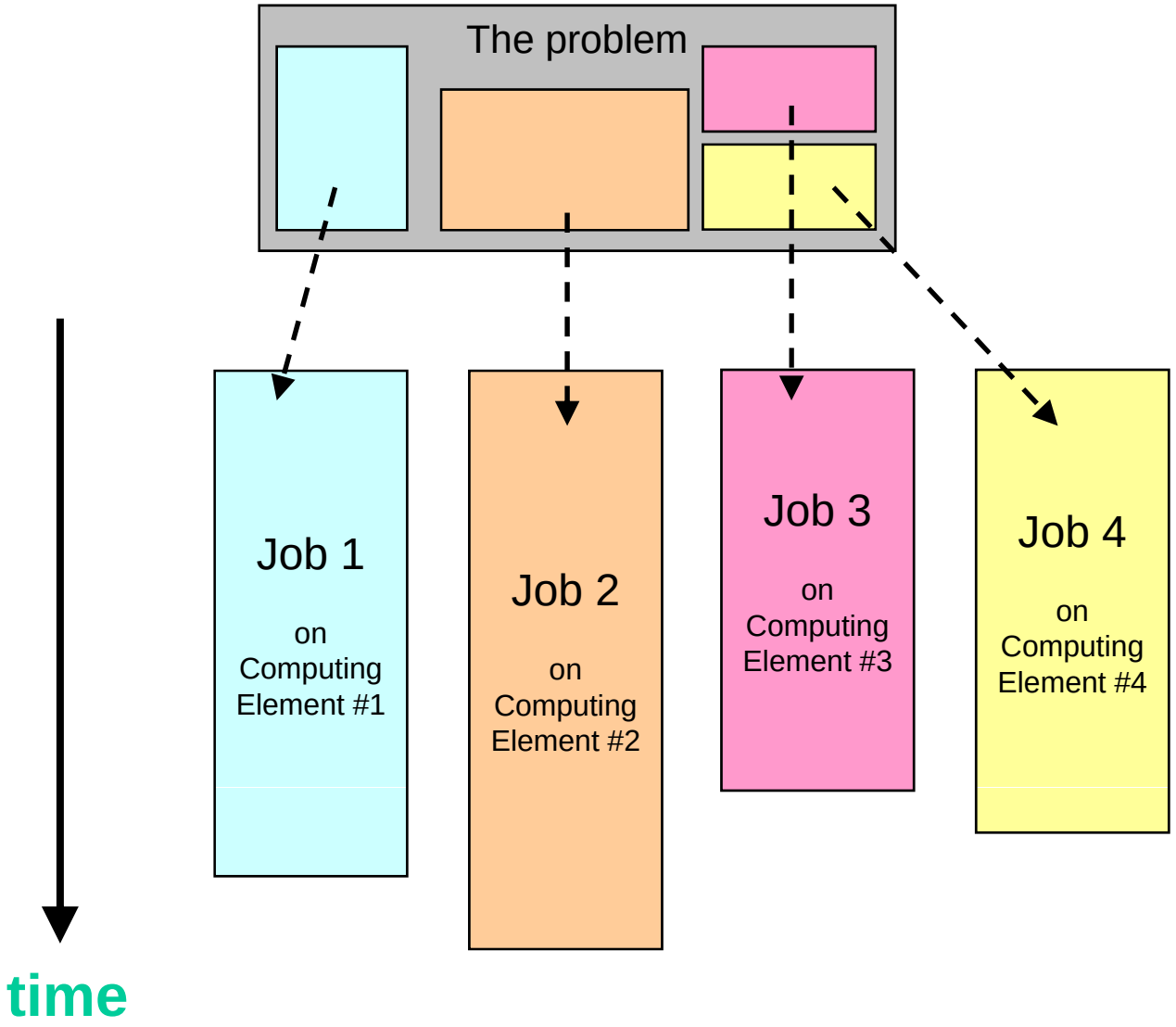
Functional Vs Data parallelism

- Functional Decomposition (Functional Parallelism)
  - Decomposing the problem into different jobs which can be distributed to multiple CEs for simultaneous execution
  - Different executables run on different CEs
  - Good to use when there is not static structure or fixed determination of number of calculations to be performed

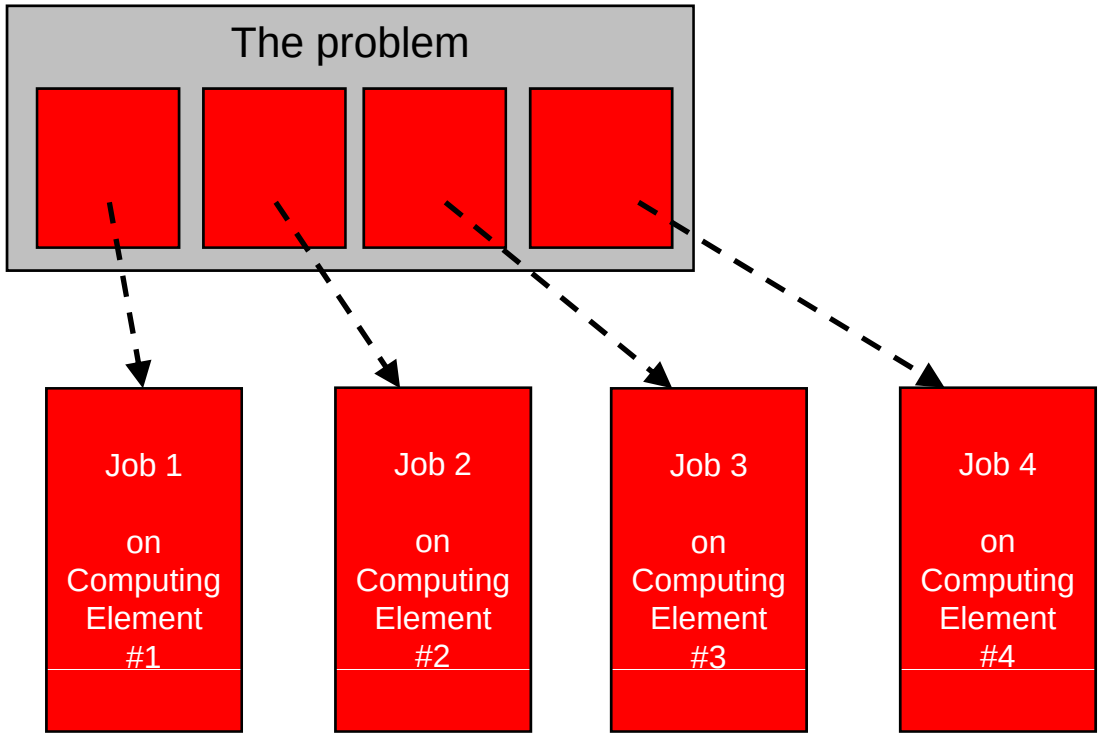
- Domain Decomposition (Data Parallelism)
  - Partitioning the problem's data domain and distributing portions to multiple instances of the same job for simultaneous execution
  - Same executables run on different CEs processing different data
  - Good to use for problems where:
    - data is static (e.g. factoring, solving large matrix or finite difference calculations, parameter studies)
    - dynamic data structure tied to single entity where entity can be subsetted (large multi-body problems)
    - domain is fixed but computation within various regions of the domain is dynamic (fluid vortices models)

- > 90% of grid applications employ data parallelism (parameter study)

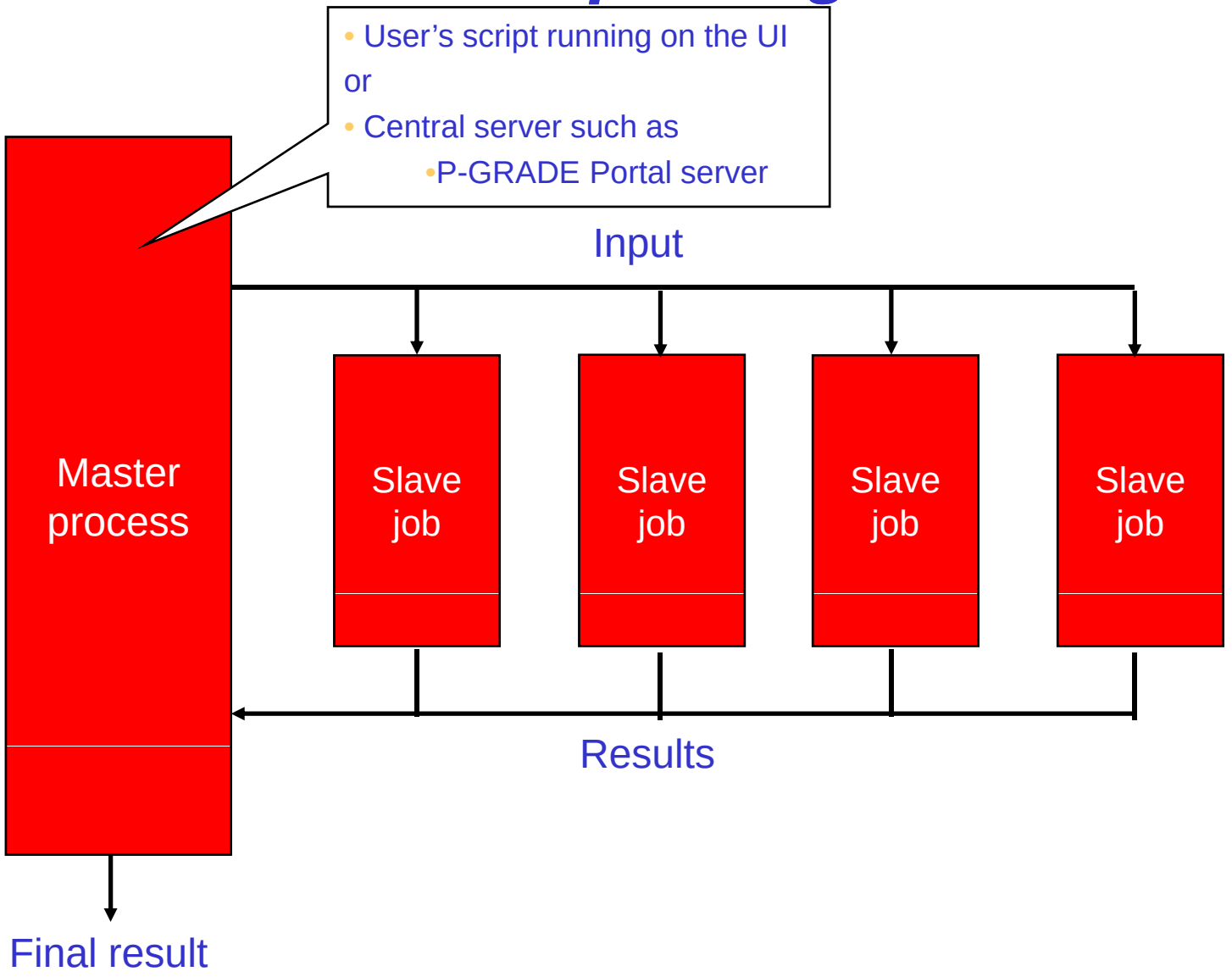
Functional parallelism



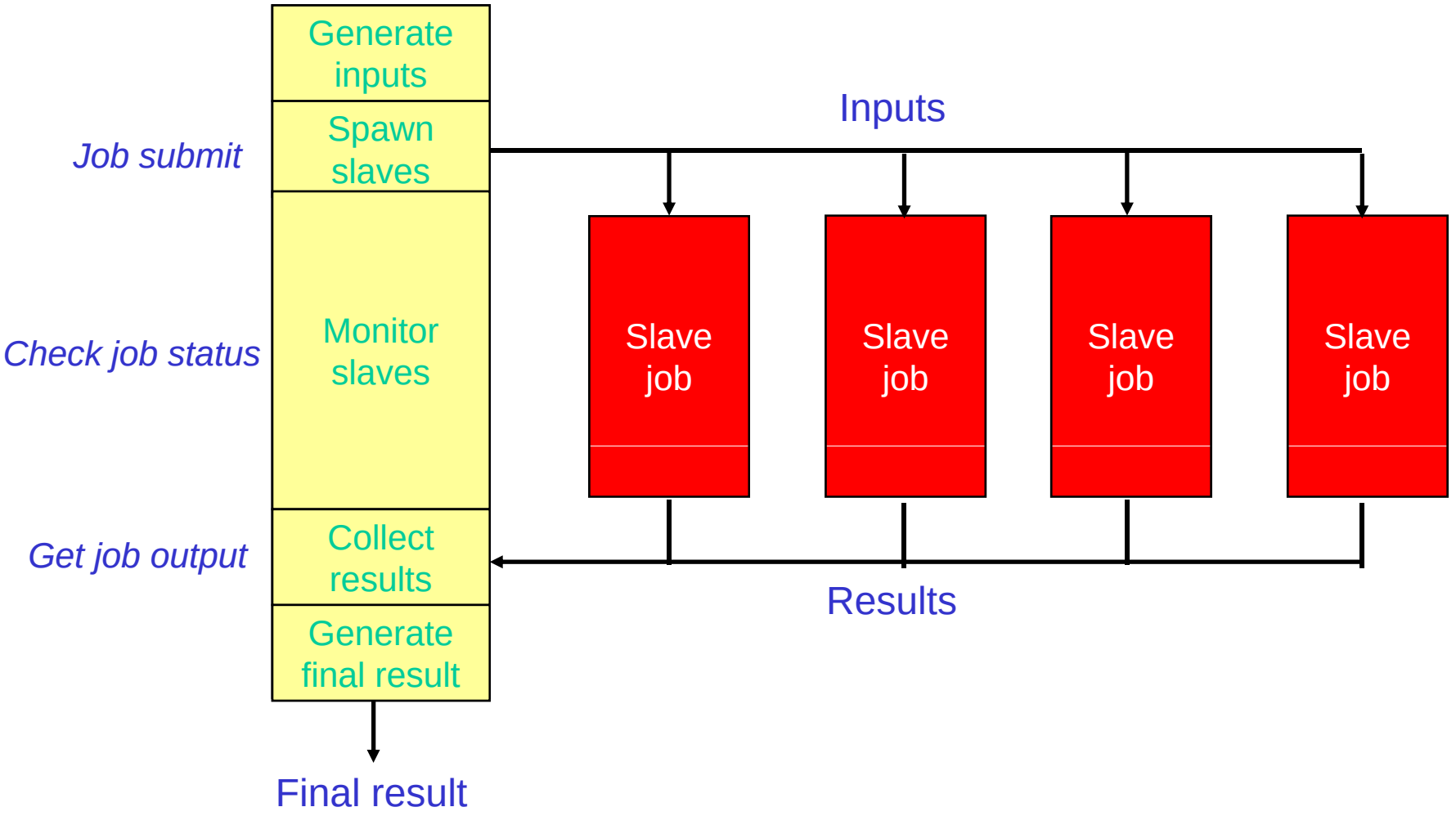
Data parallelism



Data parallelism: Master-slave paradigm



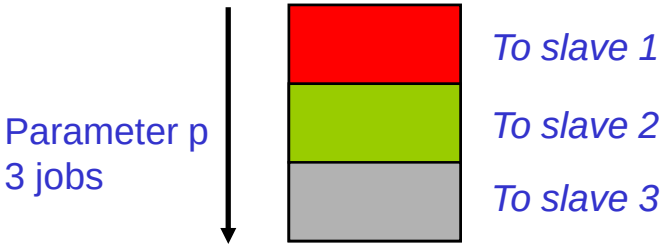
Structure of the master



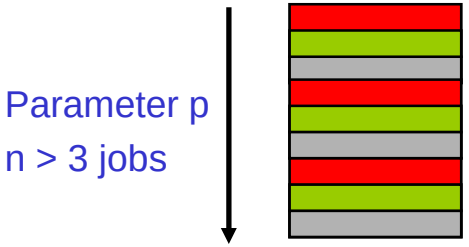
Data splitting techniques

- **One Dimensional Data Distribution**

Block Distribution

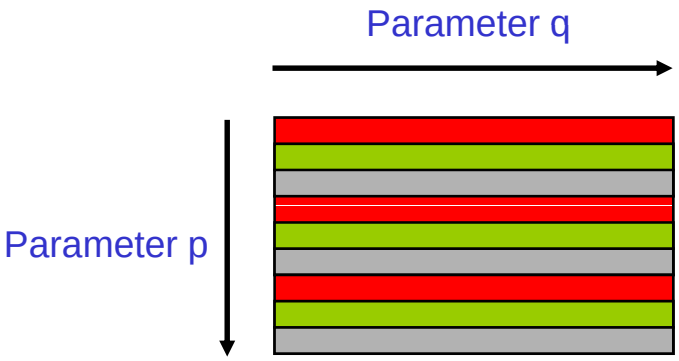


Cyclic Distribution

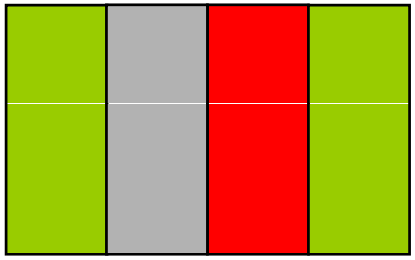


- **Two Dimensional Data Distribution**

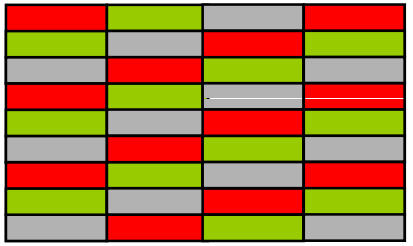
Cyclic block



Block Cyclic



Block Block



- **N Dimensional Data Distribution**

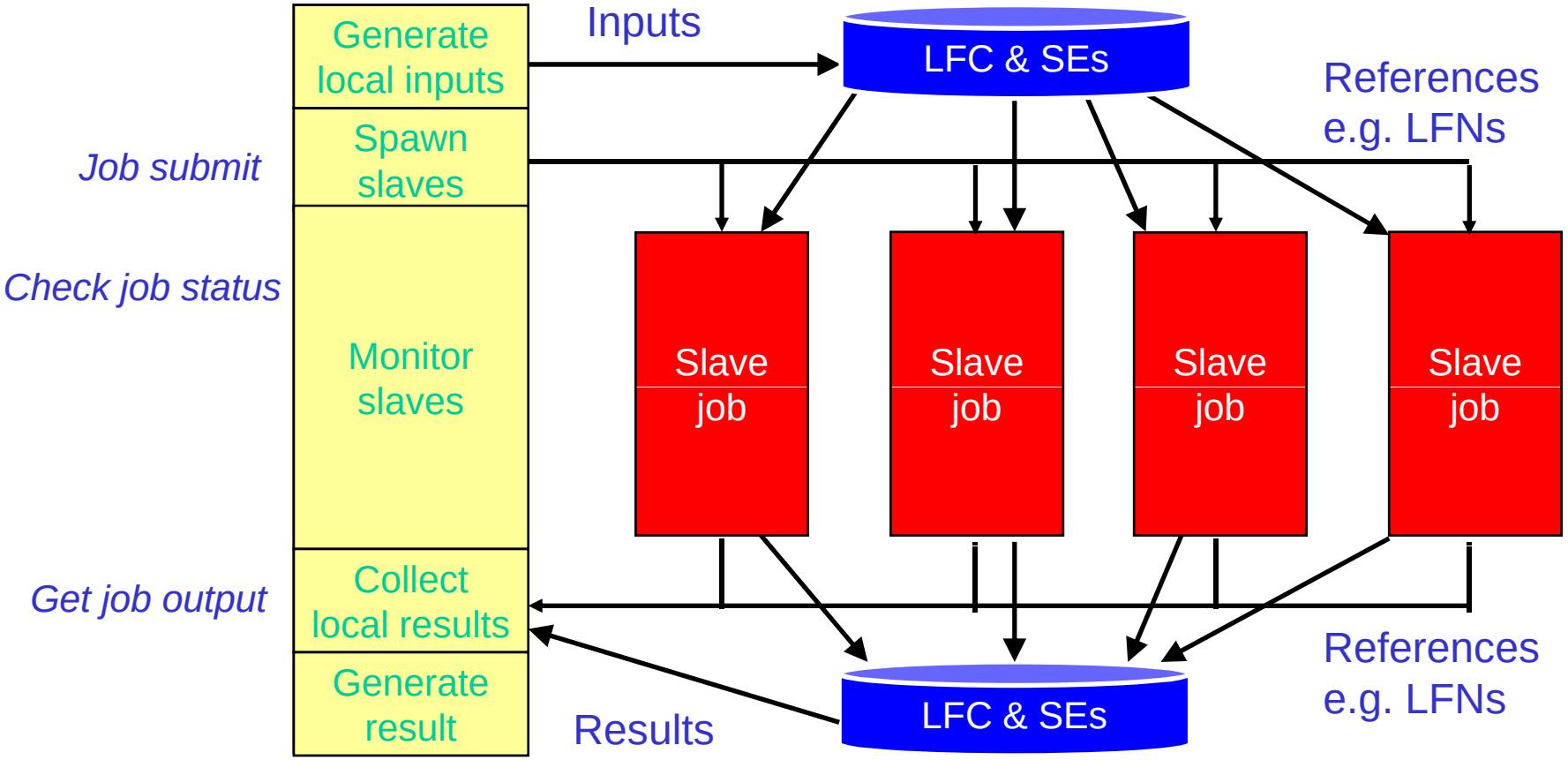
Choose data item size carefully

- Large data → Less jobs → long jobs:
  - Smaller overall submission overhead
    - Middleware overhead 5-10 minutes / job
    - Waiting queue overhead 0-X minutes / job → depends on VO load
  - Unequal utilization of resources
    - Slow and fast resources must do the same amount of work

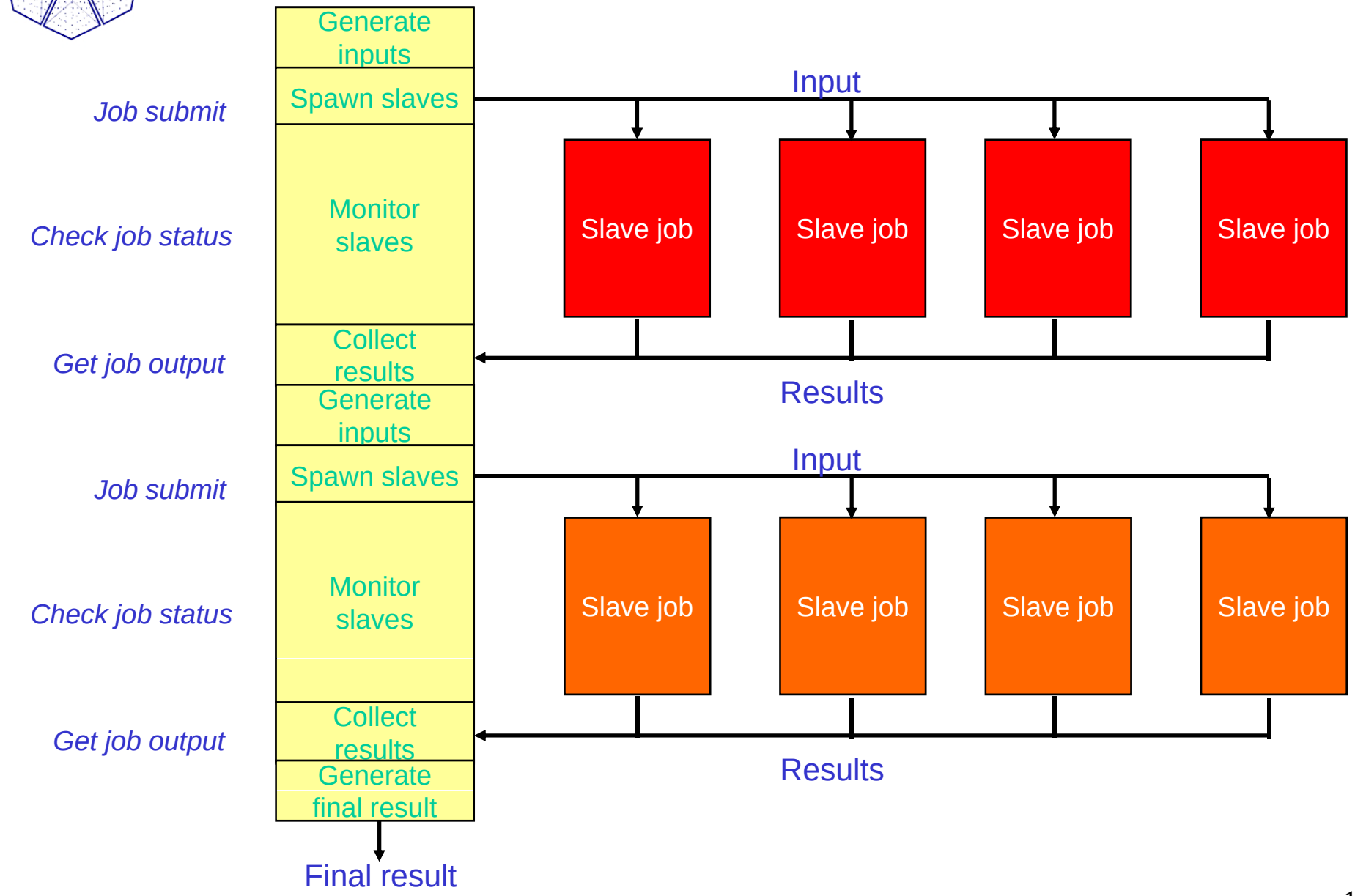
- More jobs → short jobs:
  - Better load balancing
    - Faster machines do more
    - Overall execution time can be shorter…unless the VO load is high
  - Submission overhead is bigger

Distribution of large data sets

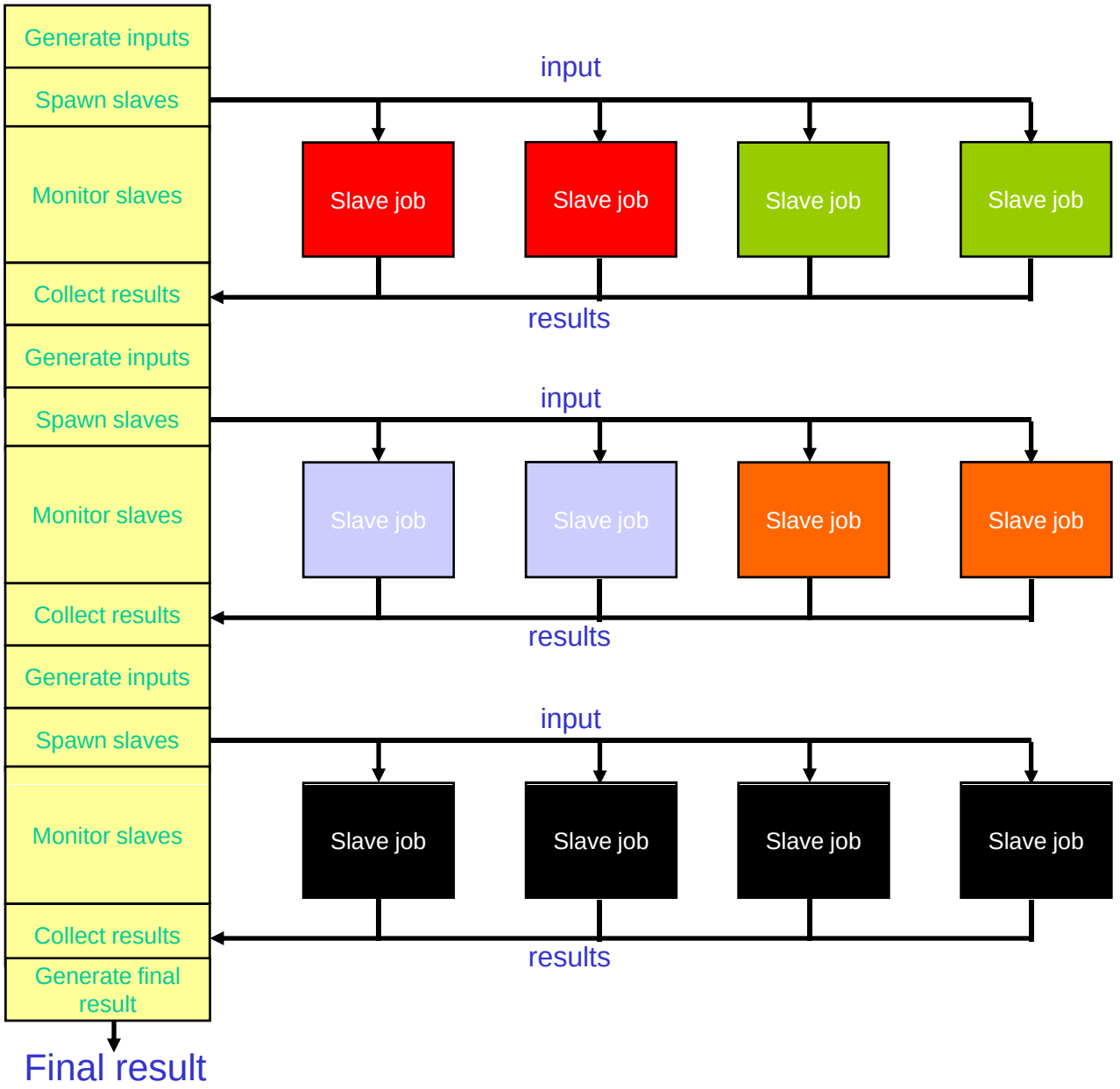
- Slaves receives only data reference from master and download real data from Storage Element
- Slaves put results into Storage Elements and return LFNs



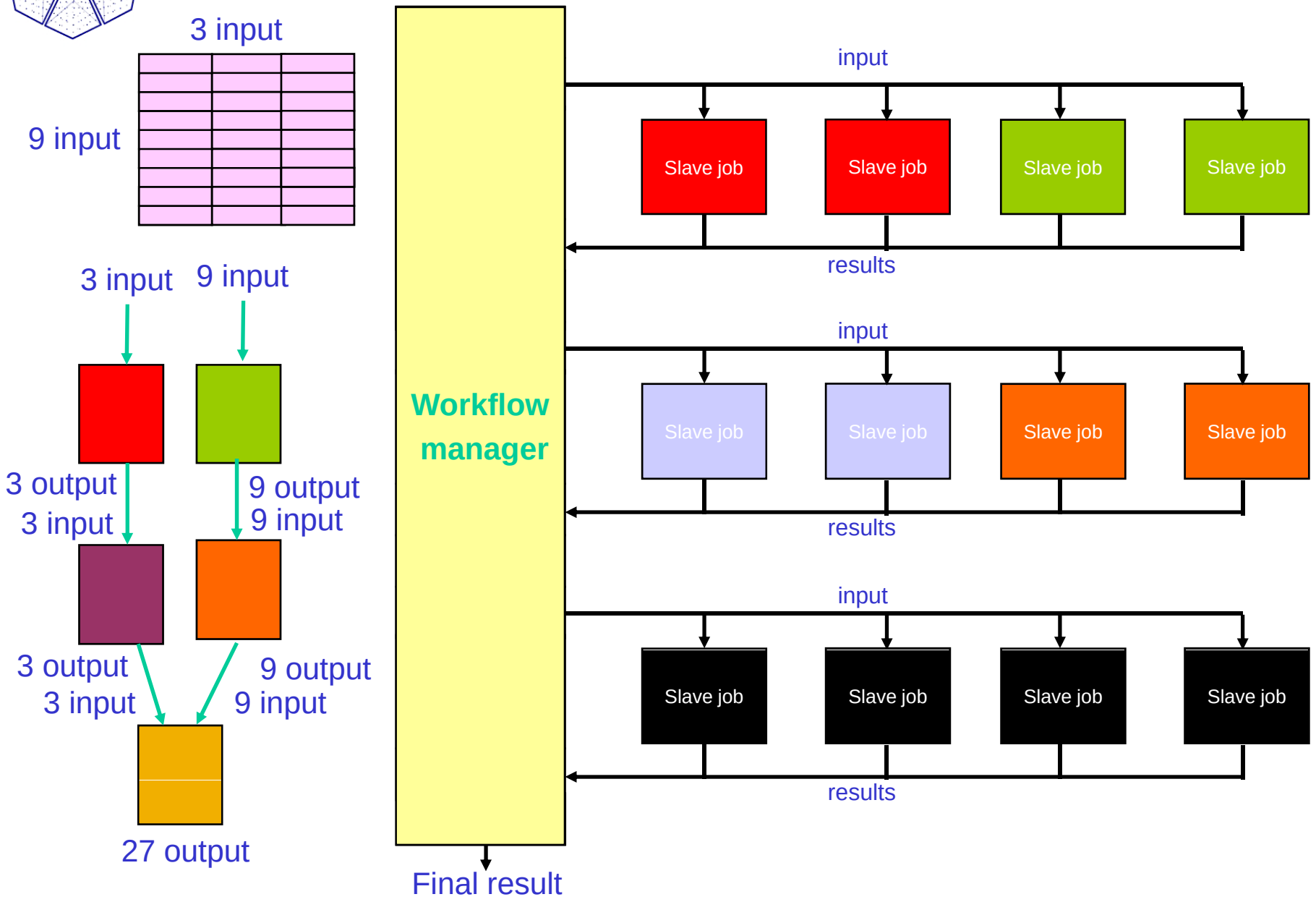
Multi-level master-slave



Complex master-slave

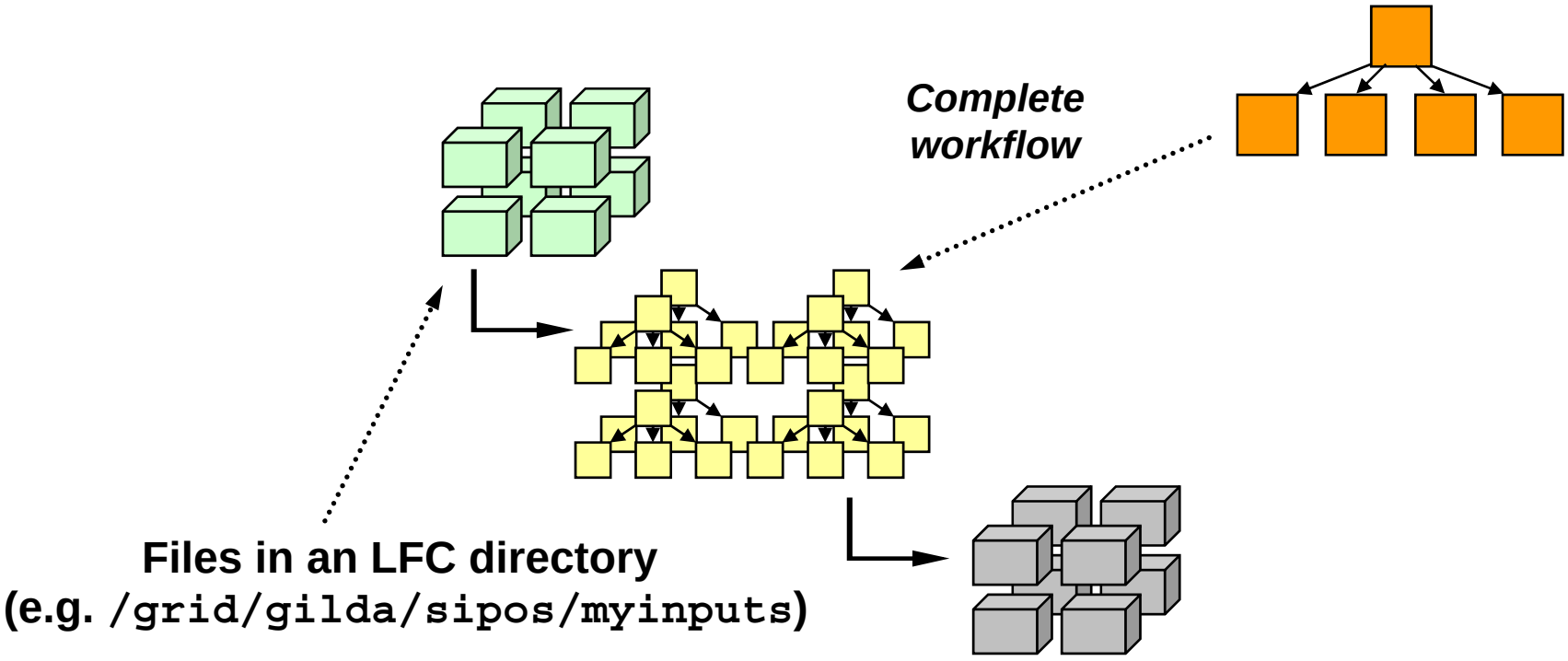


Complex master-slave = Parameter study workflow

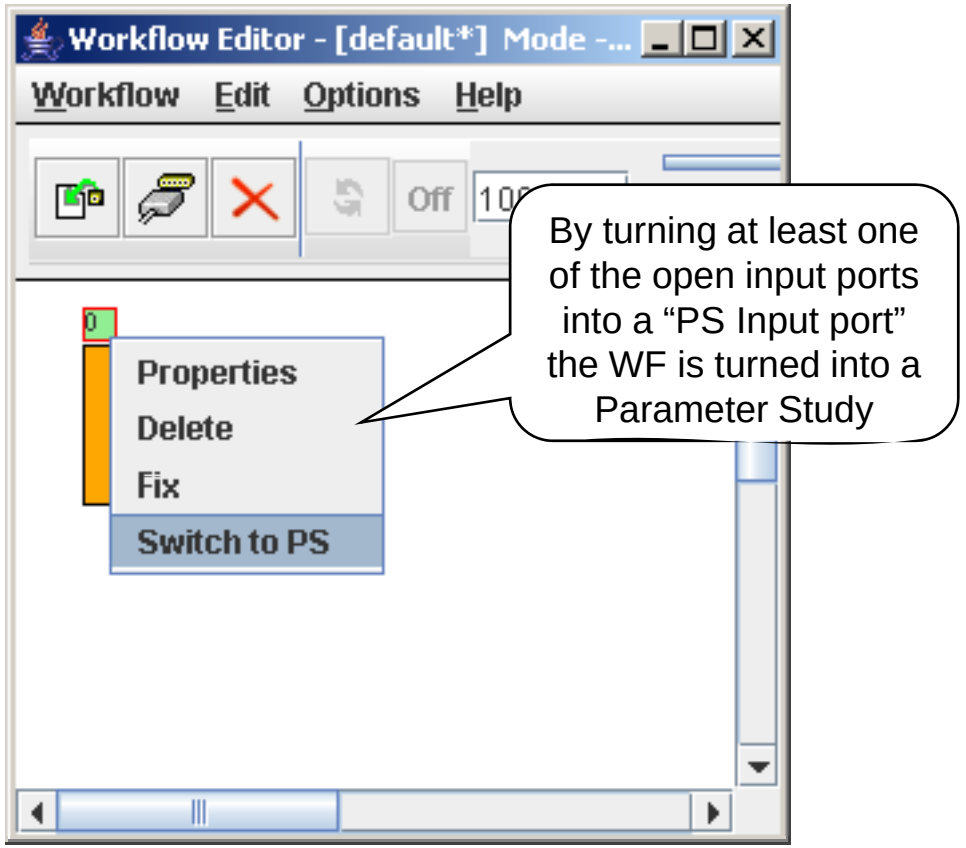


Parameter Study workflow support in P-GRADE Portal

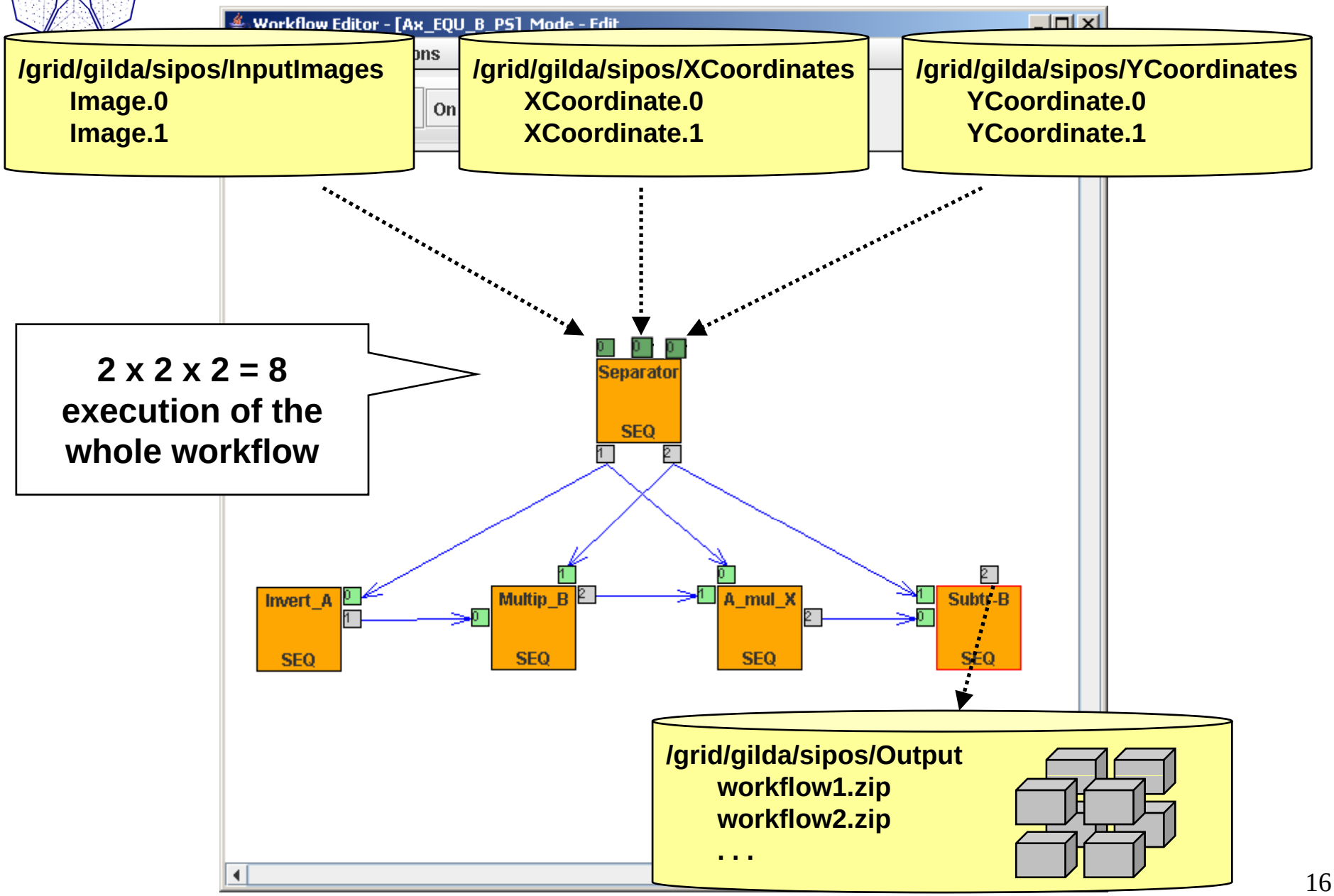
Scaling up a workflow to a parameter study with P-GRADE



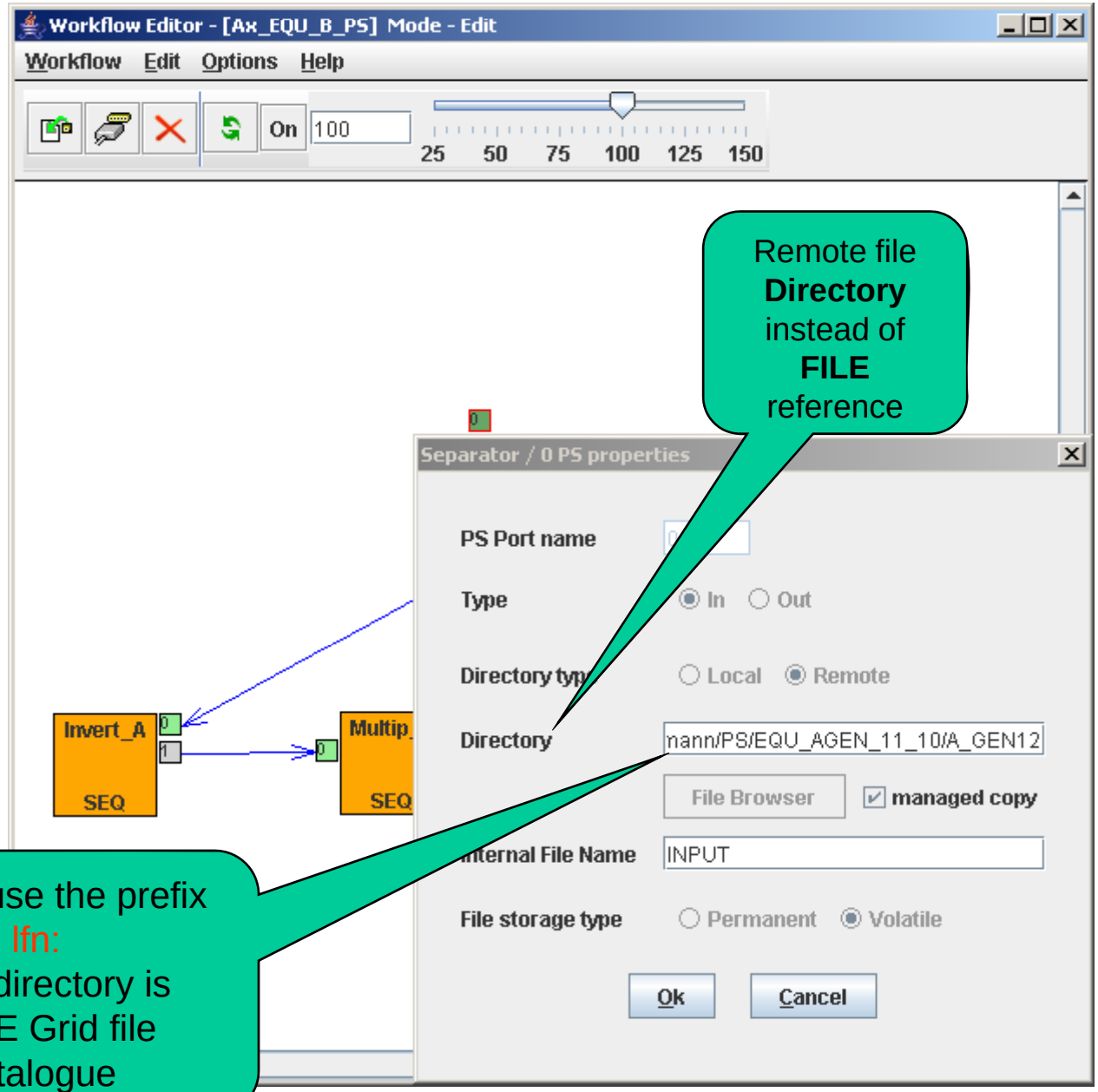
Turning a WF into a parameter study



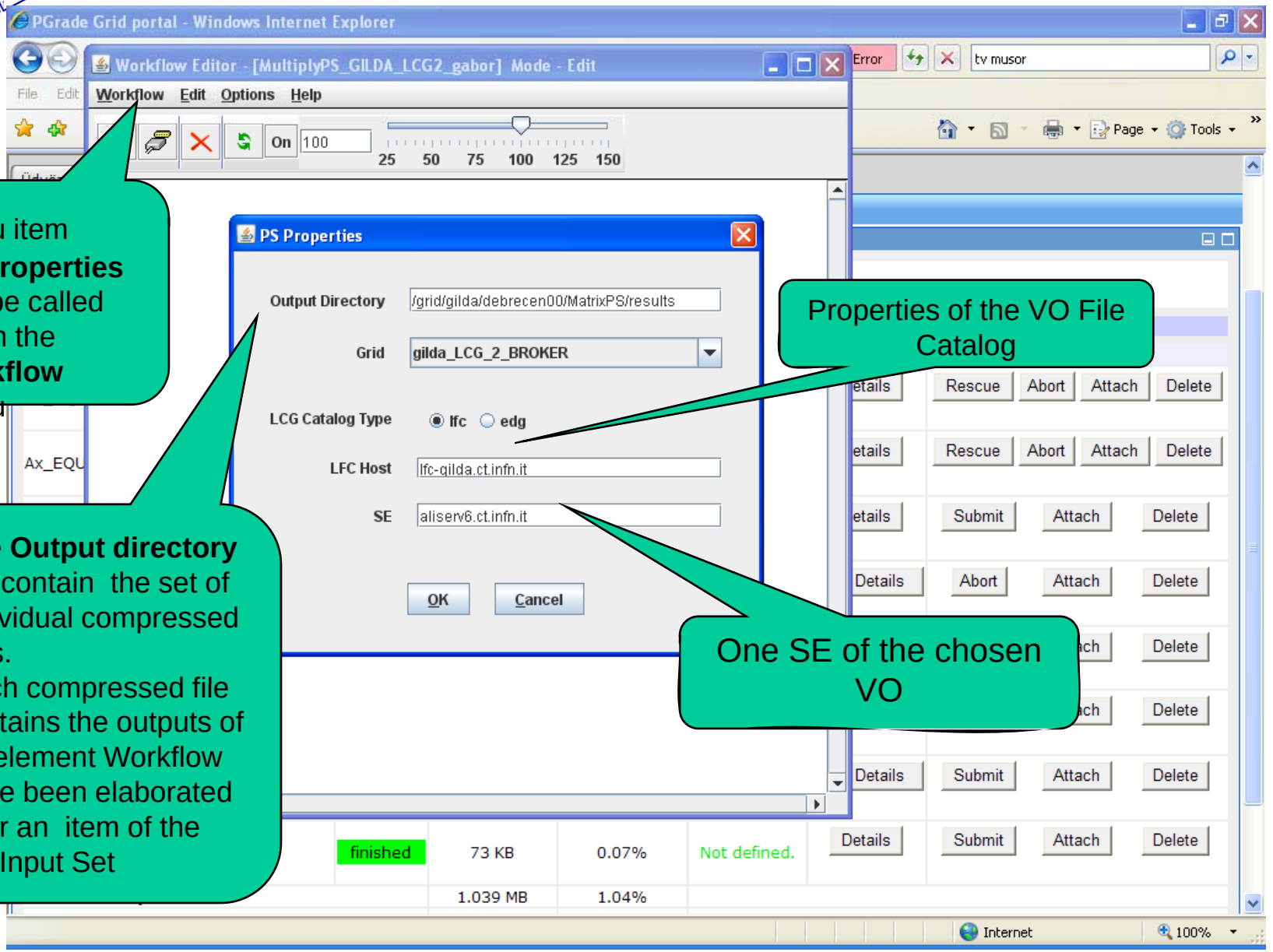
Input-output files are stored in SEs



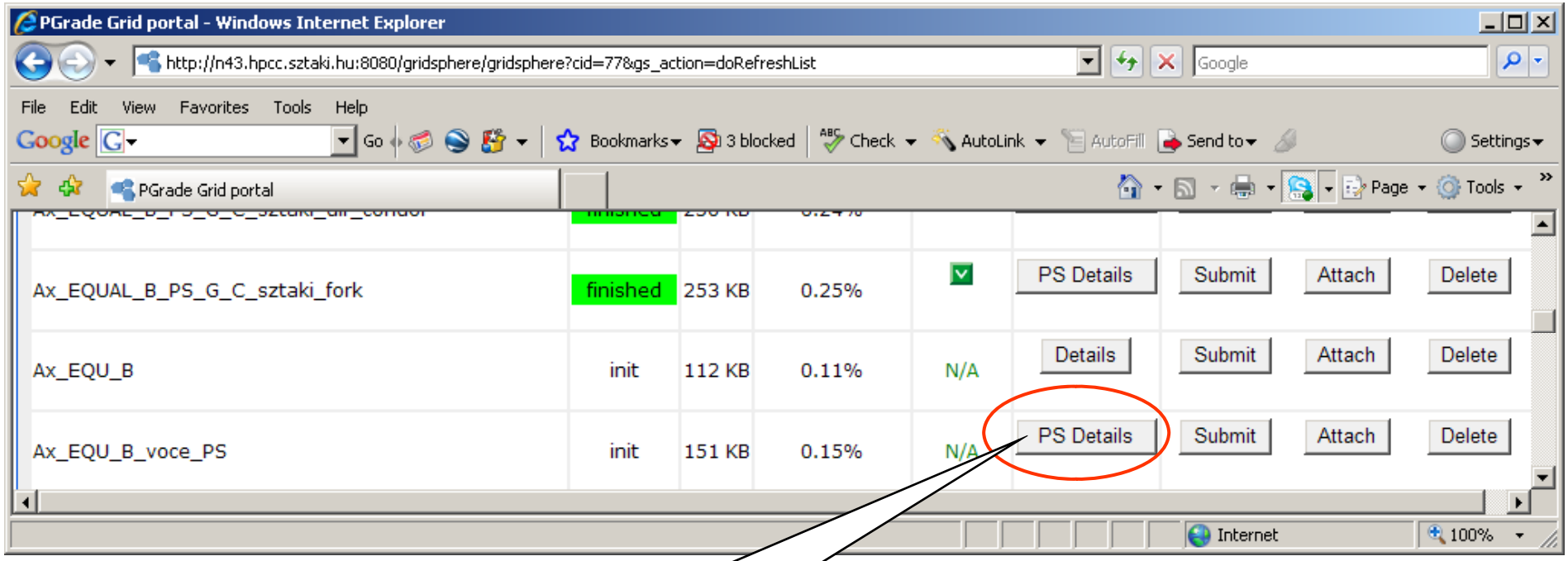
PS Input Port of Simple PS



Simple PS Activity 2: placement of result



Executing PS workflows



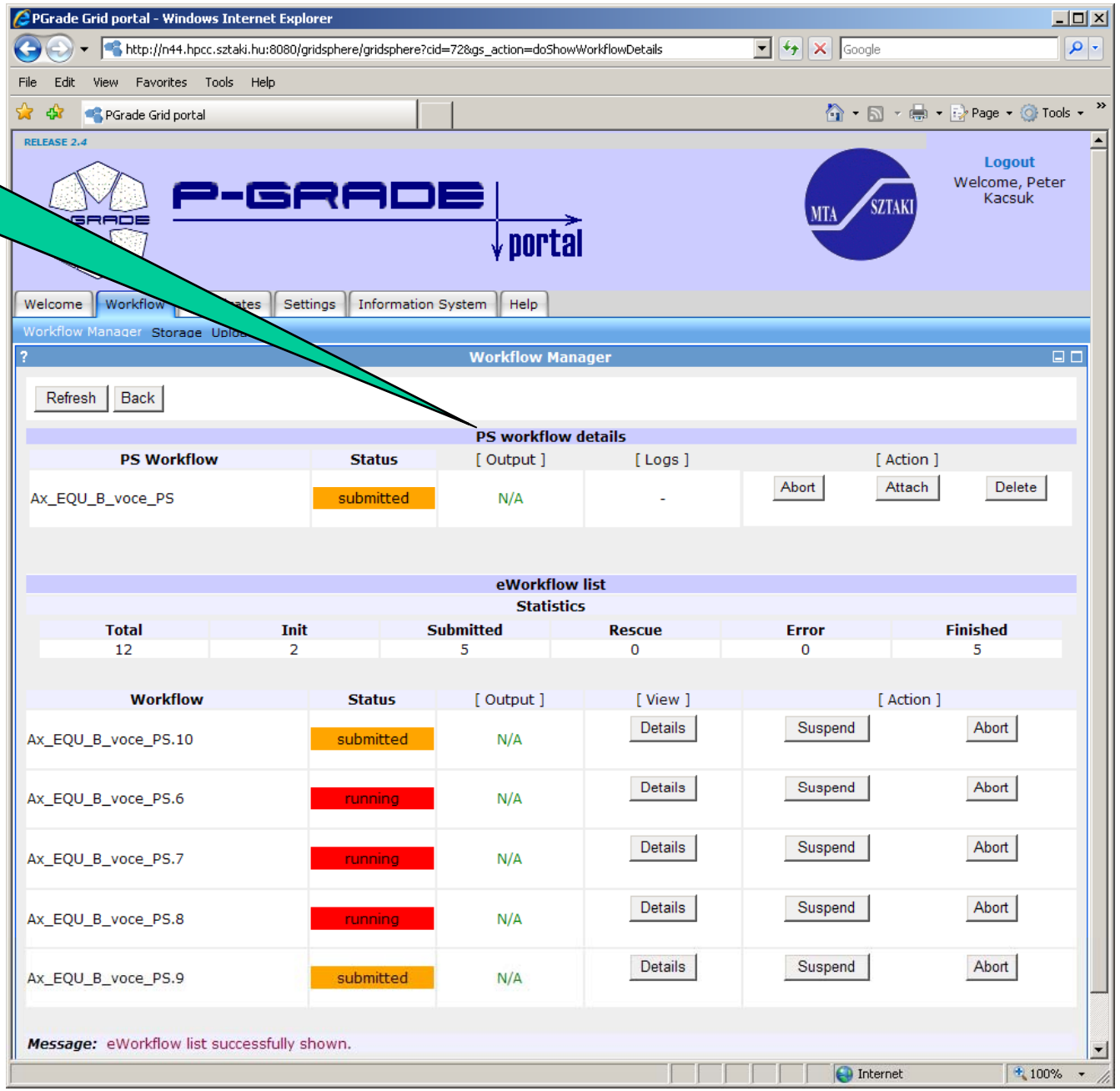
PS Details for parameter sweep workflows applications

Workflow Manager List PS Details view ***showing eWF-s***

New, middle level list to render the details of a PS Workflow

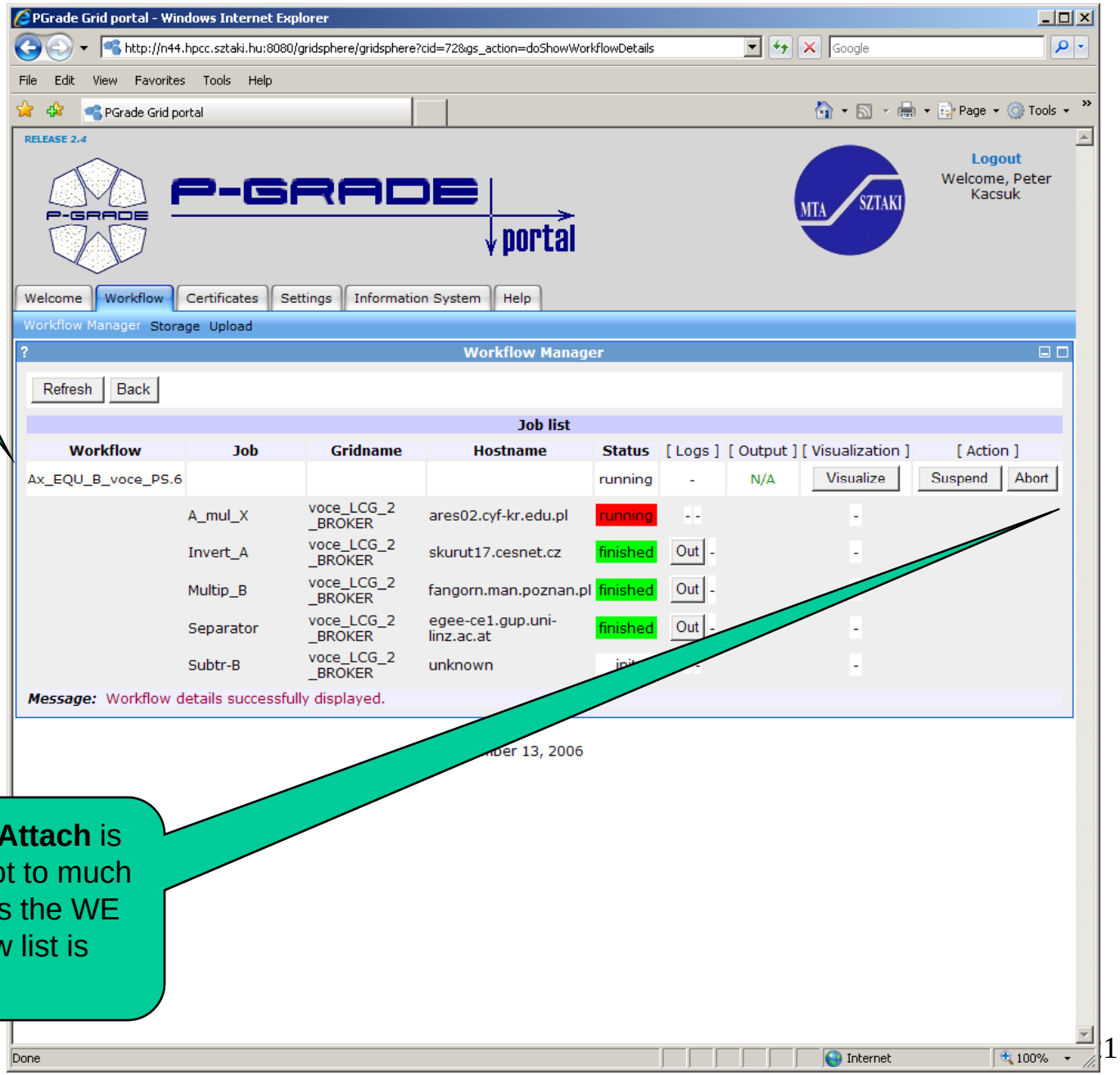
Statistics shows the progress of the elaboration of the whole PS

The eWorkflow buffer list shows the state of the Workflows being processed.



Details ***view of the*** **eWF** *Ax_EQU_B_voce_PS.6*

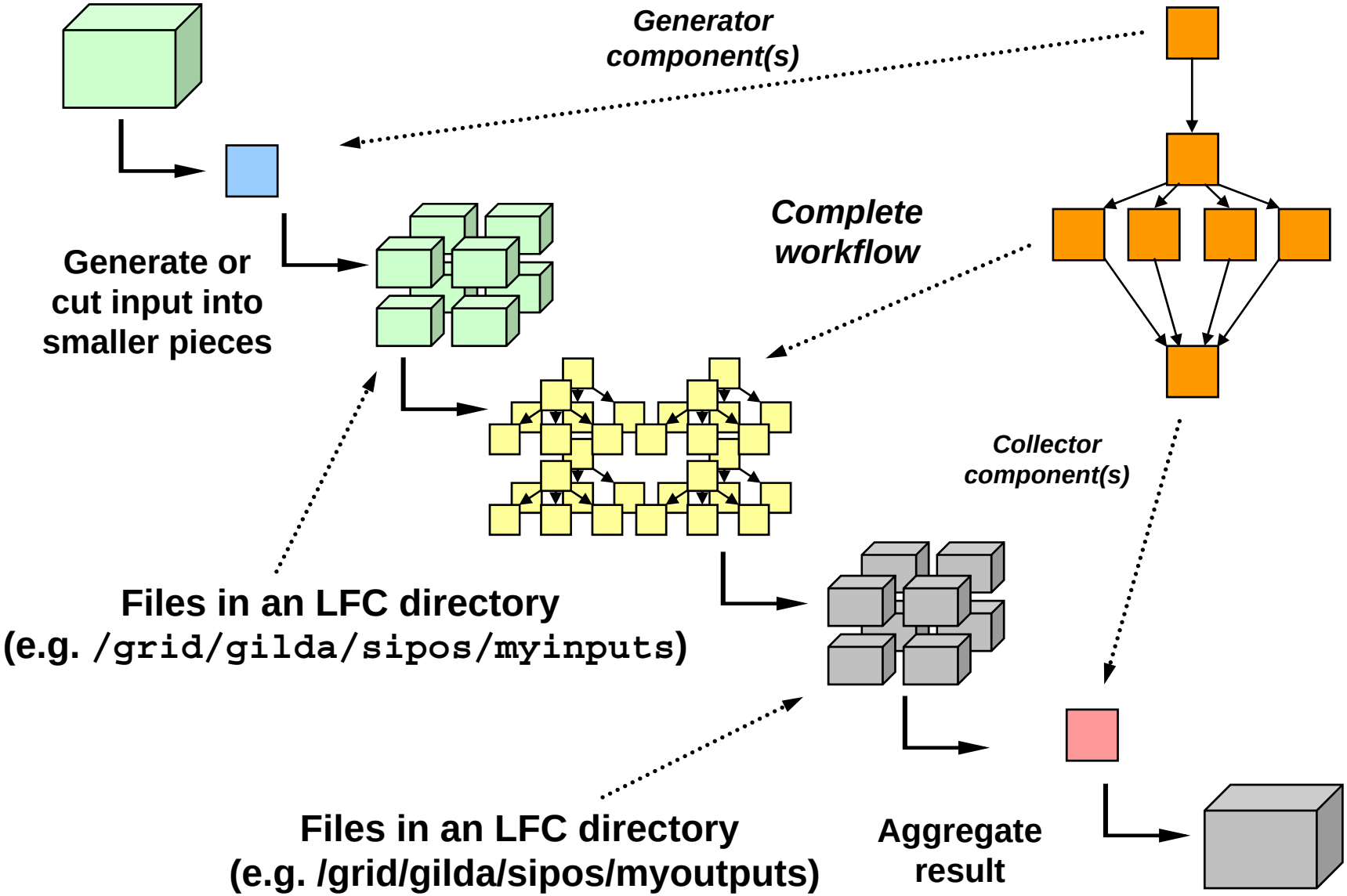
Job level details of an eWorkflow



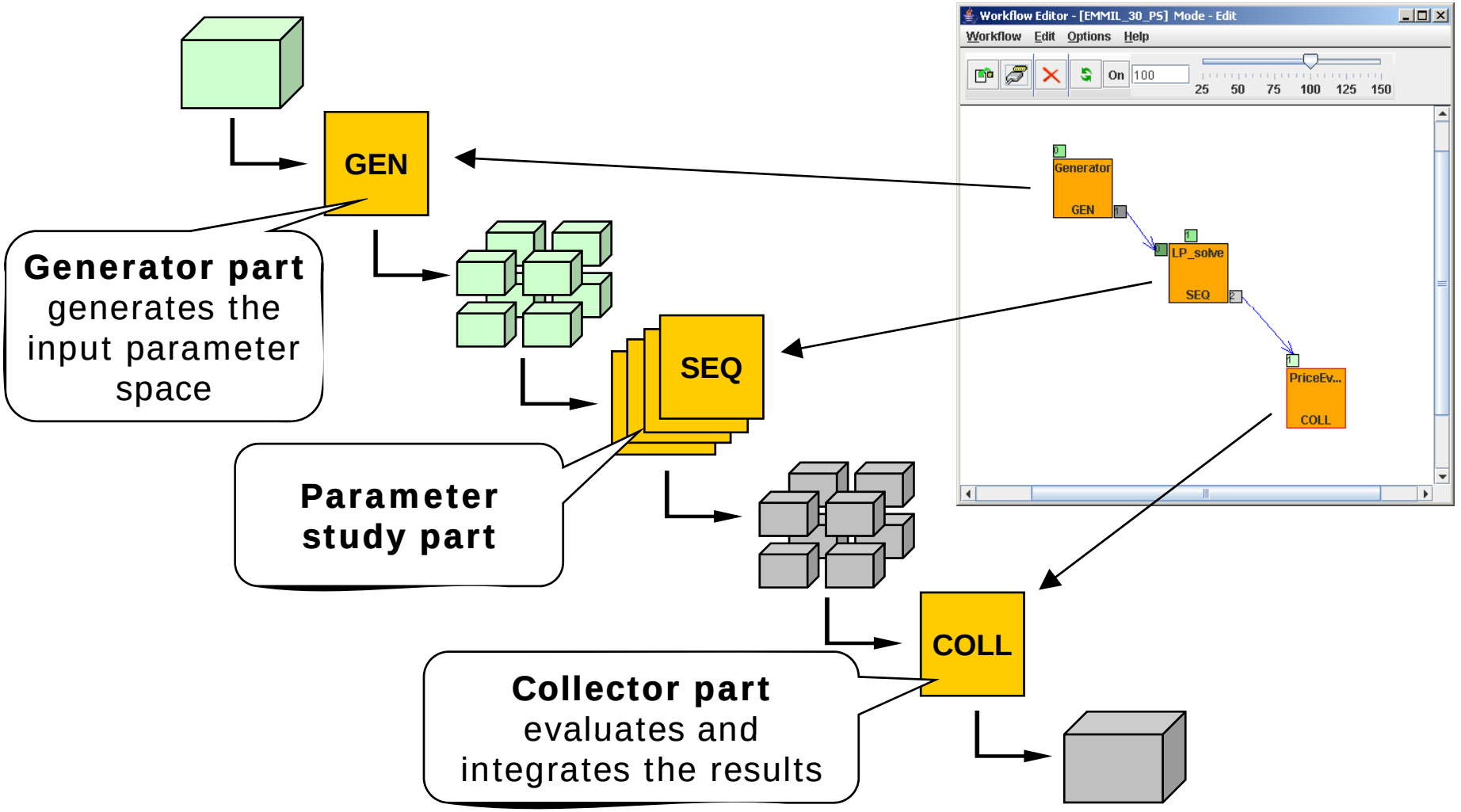
See, that the button **Attach** is missing as there is not to much importance to access the WE until the eWorkflow list is exhausted

Advanced PS WFs in P-GRADE Portal

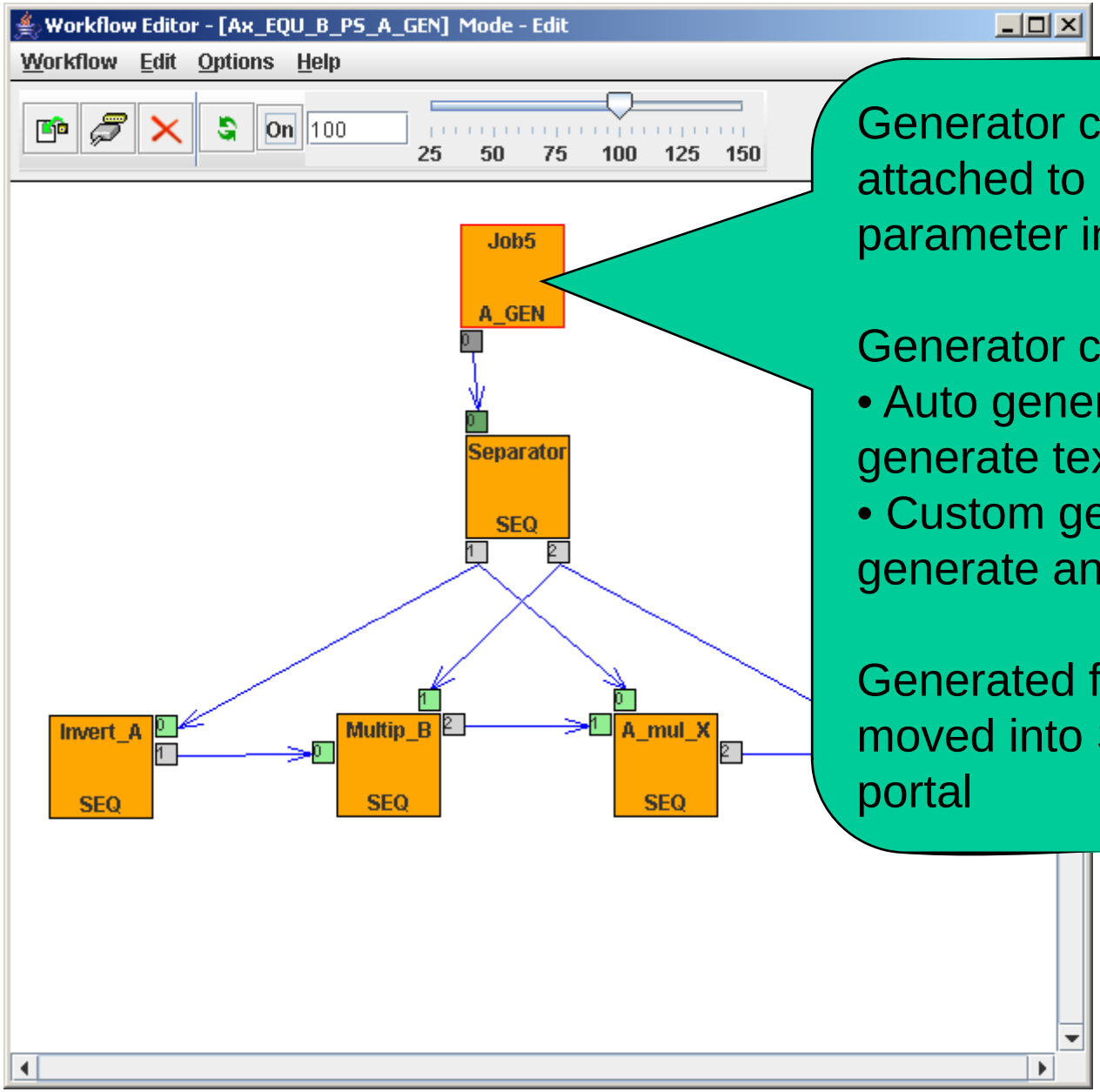
Advanced parameter studies



Concept of advanced parameter study workflows



Parameter generator

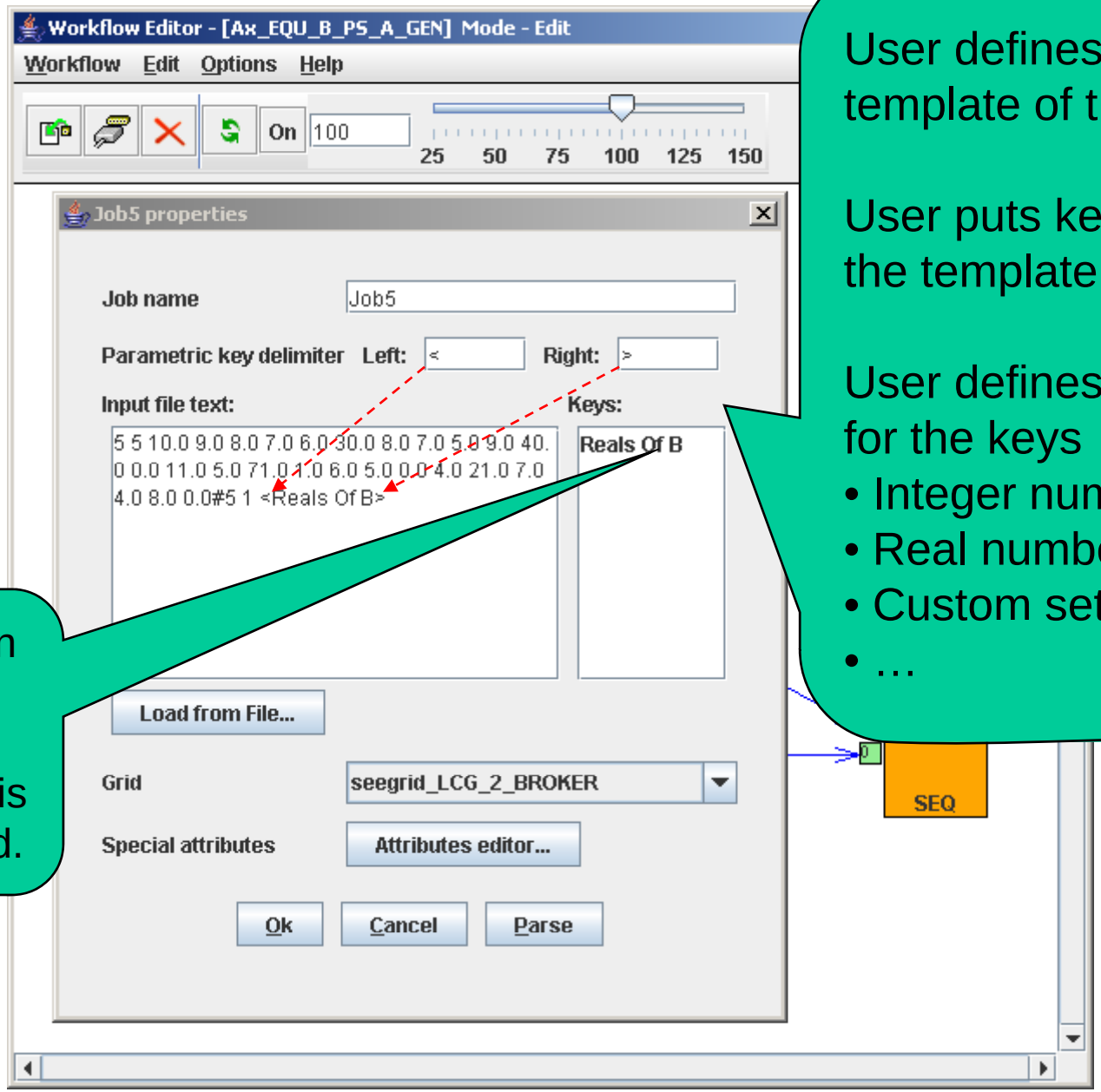


Generator can be attached to any parameter input port

Generator can be
- Auto generator: to generate text files
- Custom generator: to generate any content

Generated files are moved into SE by the portal

Definition Window of Auto Generator Job



User defines the template of the text file

User puts keys into the template

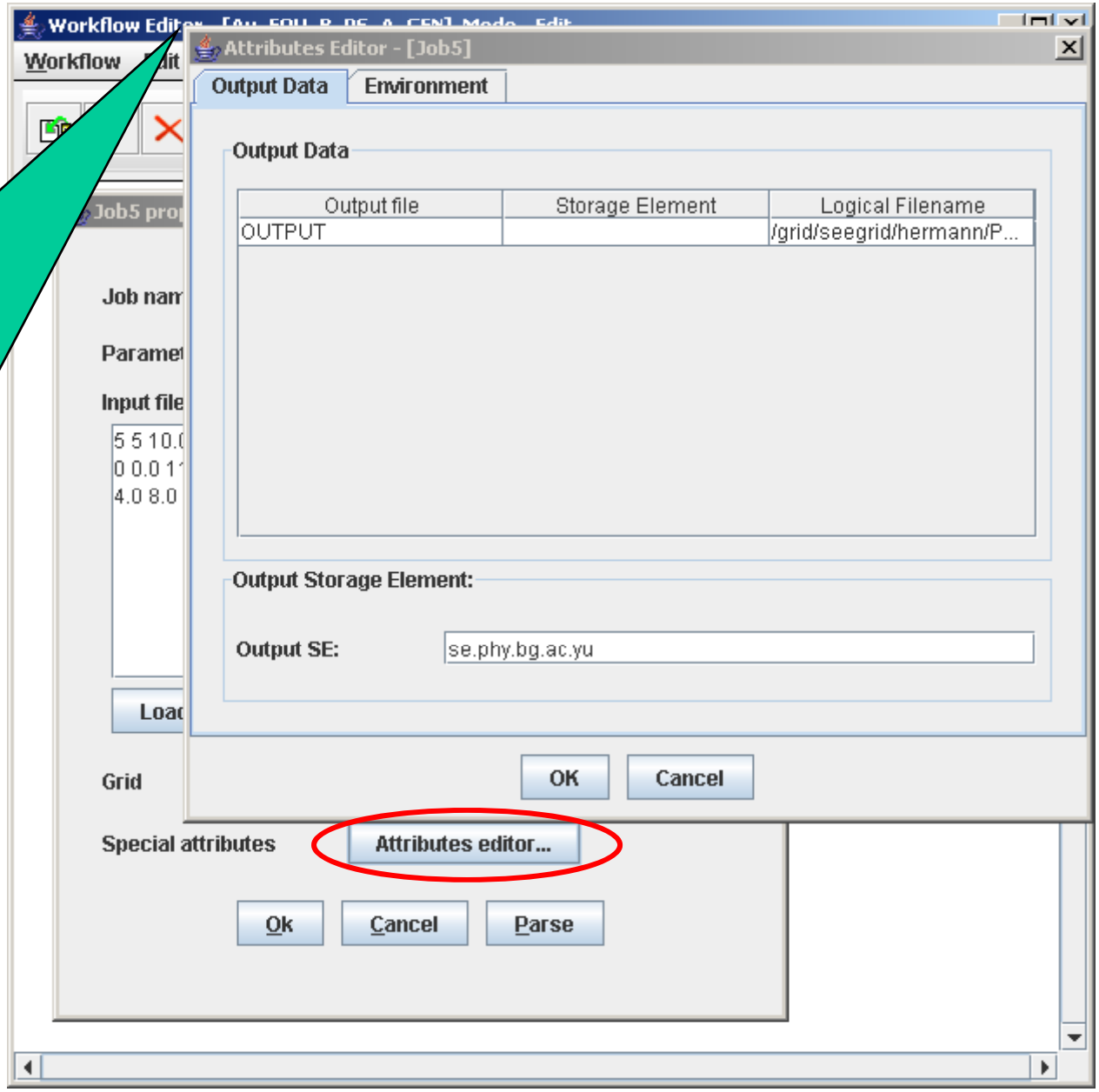
User defines values for the keys
- Integer number
- Real number
- Custom set
- …

By clicking on a key the definition window for this key is opened.

(Auto) Generator Attribute Editor for SE definition

Attribute Editor defines the properties of remote files created by the Generator:

1. Storage Element must be defined if an LCG like (EGEE) file access has been defined in the PS Output Port belonging to the Generator



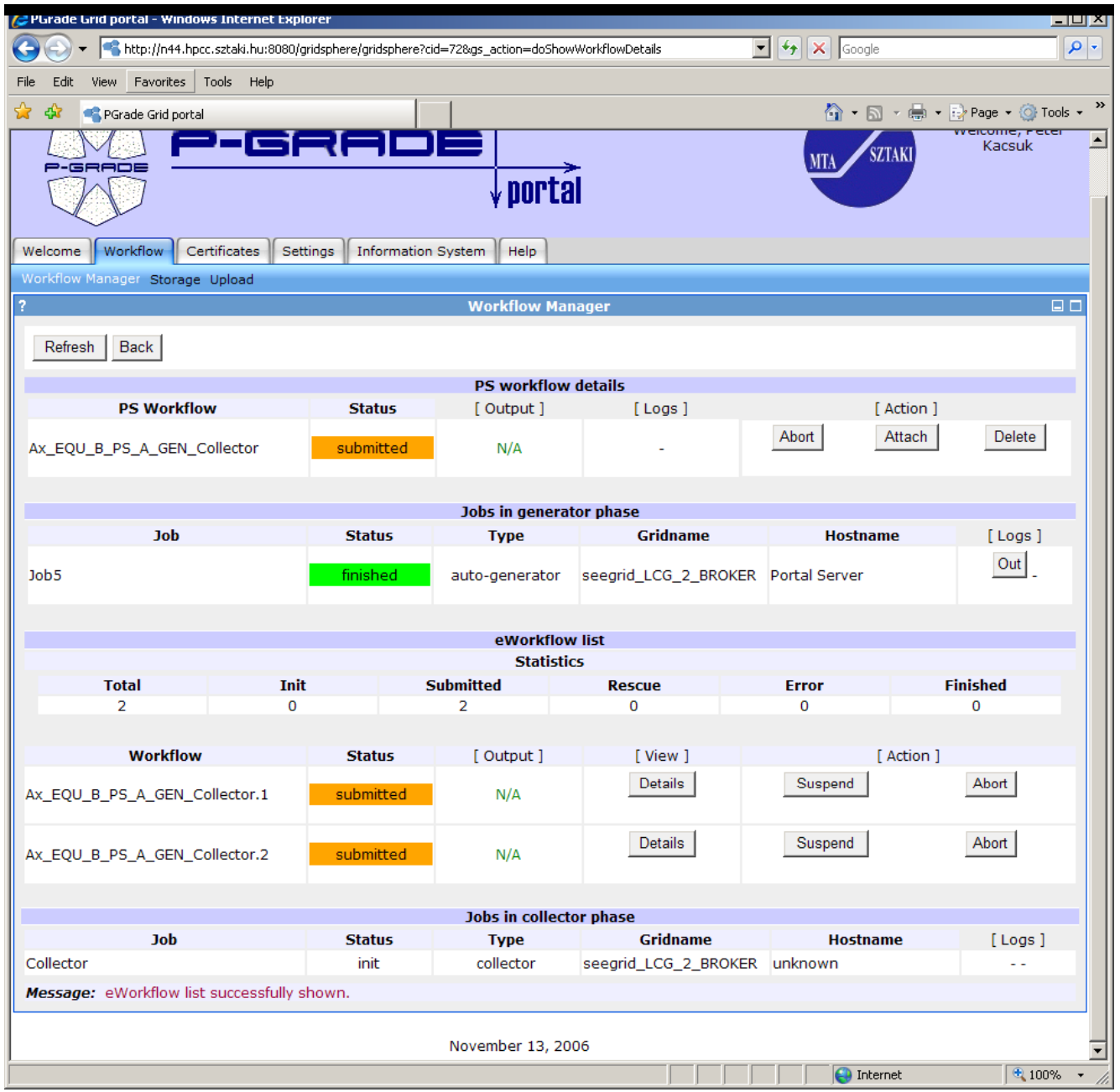
Detailed view of a PS workflow

Generator job(s)

Overall statistics of workflow instances

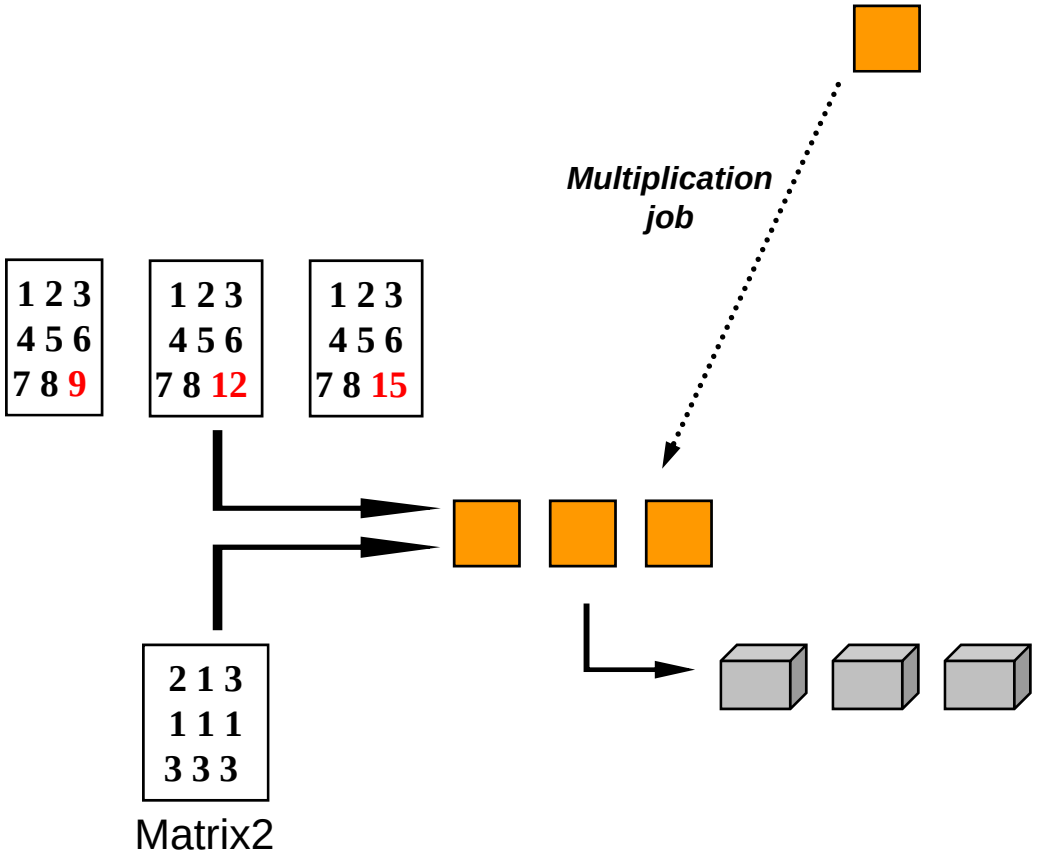
Workflow instances

Collector job(s)

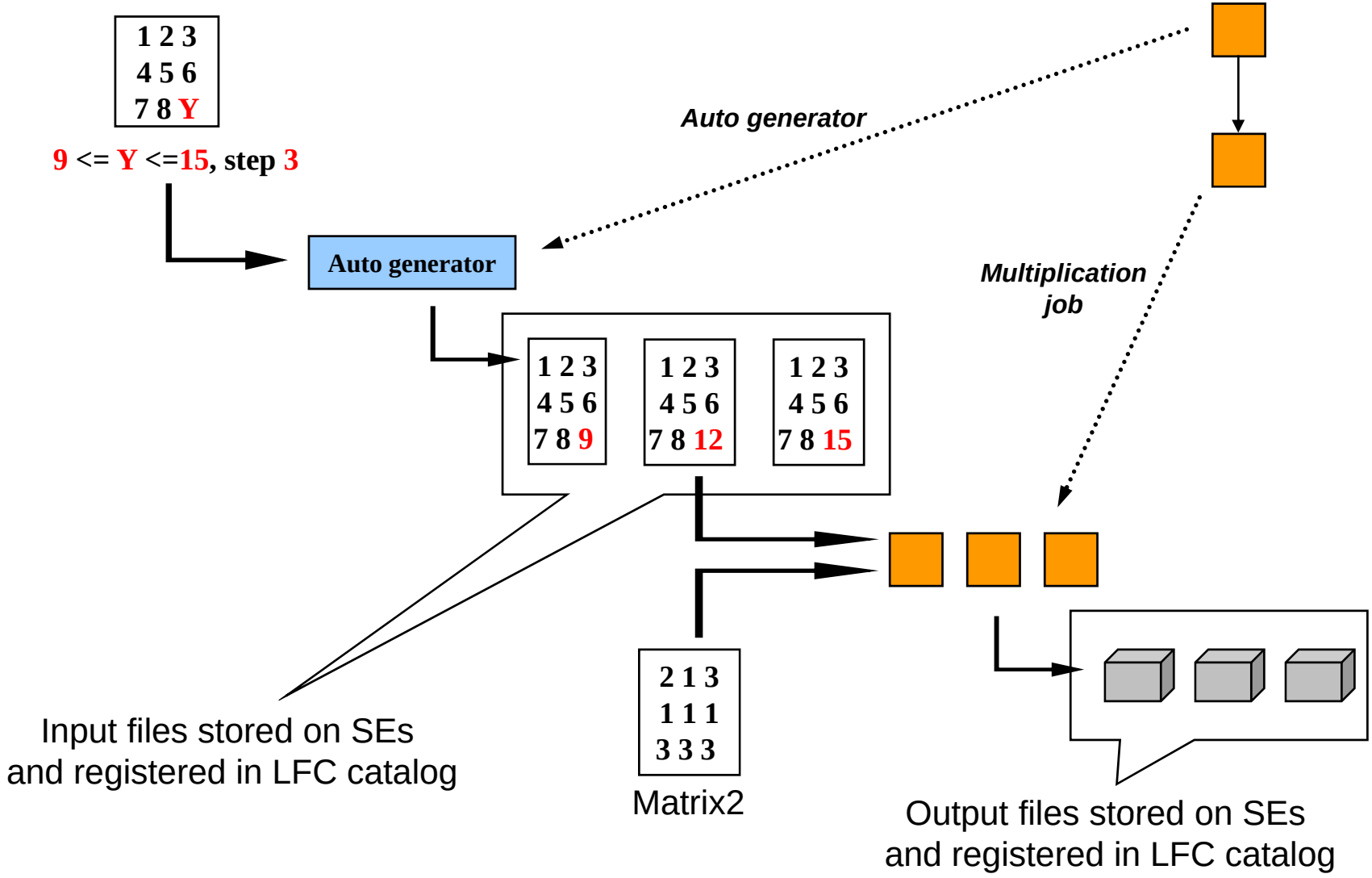


Gyakorlat

Exercise
Matrix multiplication PS



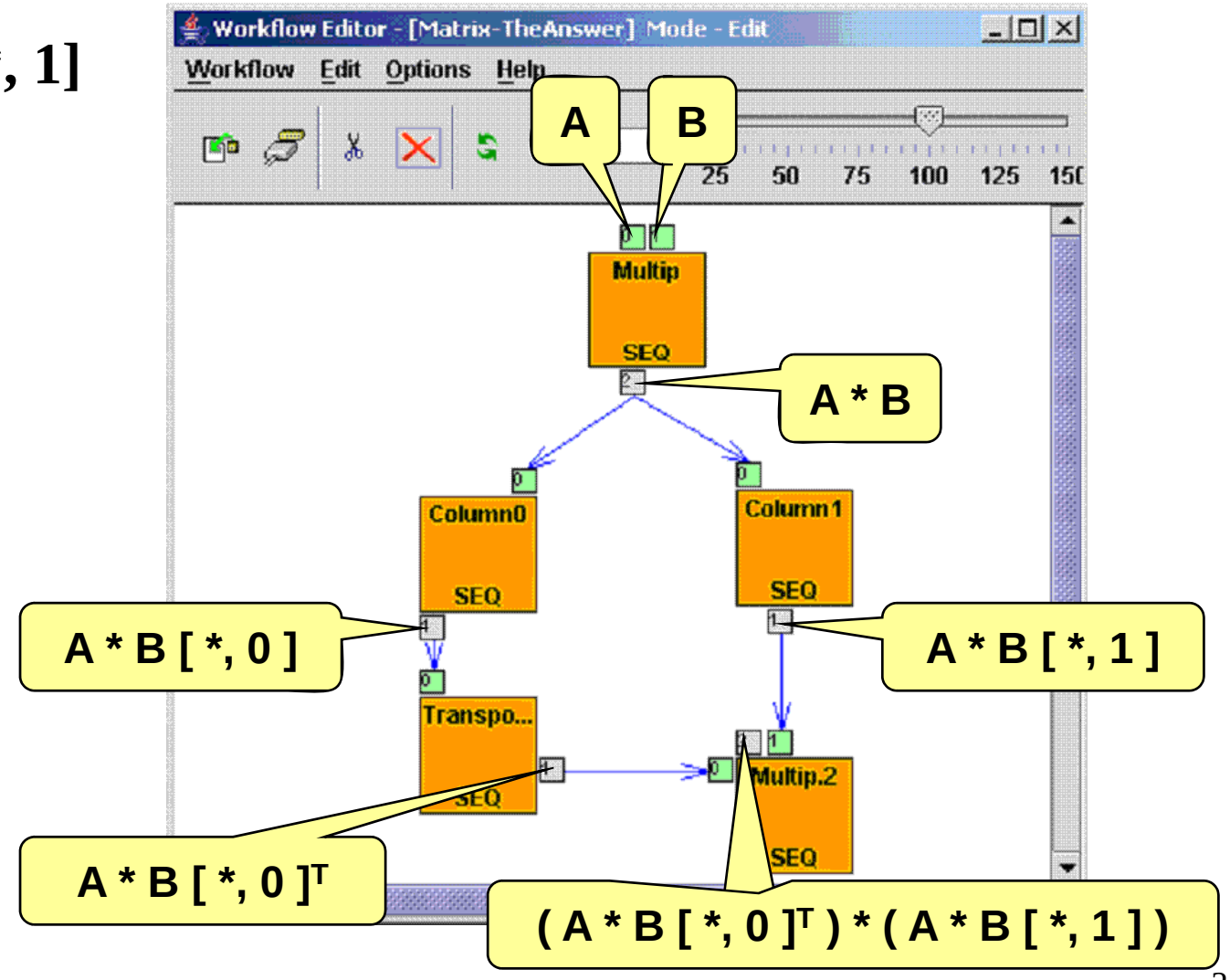
Exercise
Matrix multiplication PS



Exercise 2

Turn the matrix operations WF into a parameter study

$AB[*, 0]^T * AB[*, 1]$



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Develop once, execute anywhere

Questions?

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