e-infrastructure

Seasonal School Demo and Assigments

CAPACITIES

For Programming and ExecutionTools

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On the example of Irrigation Canals Application

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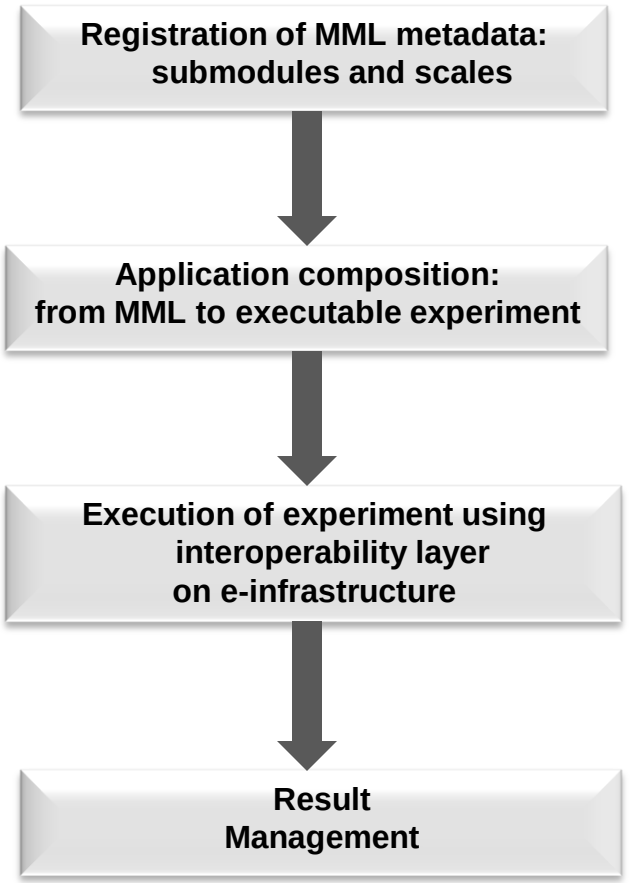
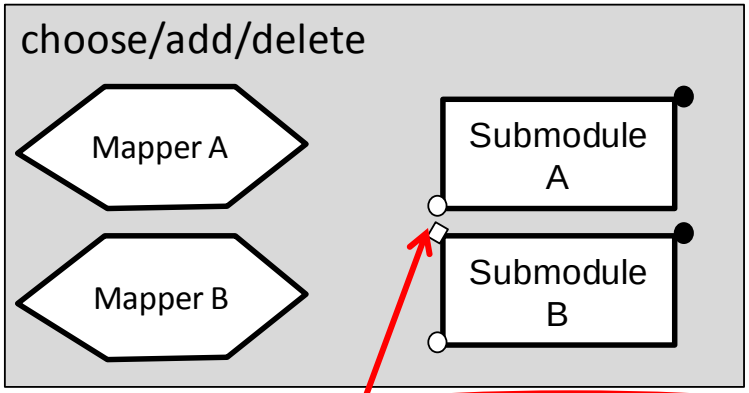
Multiscale Programing and Execution tools

- Support composition of multiscale simulations from single scale models
  - encapsulated as scientific software components
  - distributed in various European e-Infrastructures
  - supporting loosely coupled and tightly coupled paradigm
- based on Multiscale Modelling Language (MML)

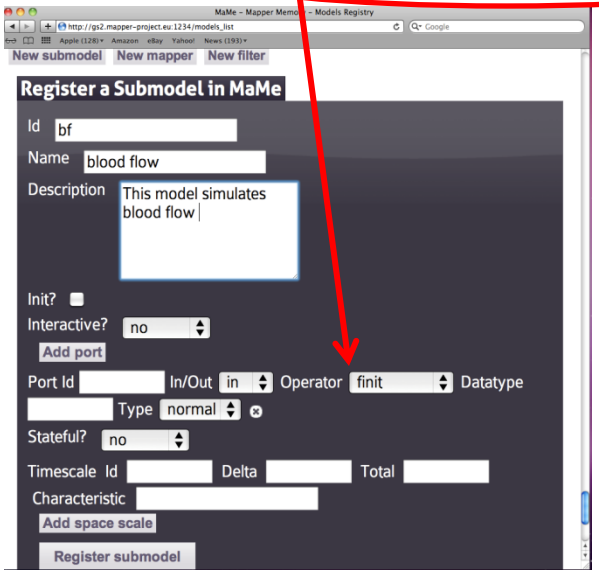


Mapper Memory (MaMe)

- Semantics-aware persistence store
- Records MML-based metadata about models and scales
- Supports exchanging and reusing MML metadata for
  - other MAPPER tools via REST interface
  - human users within theConsortium via dedicated Web interface

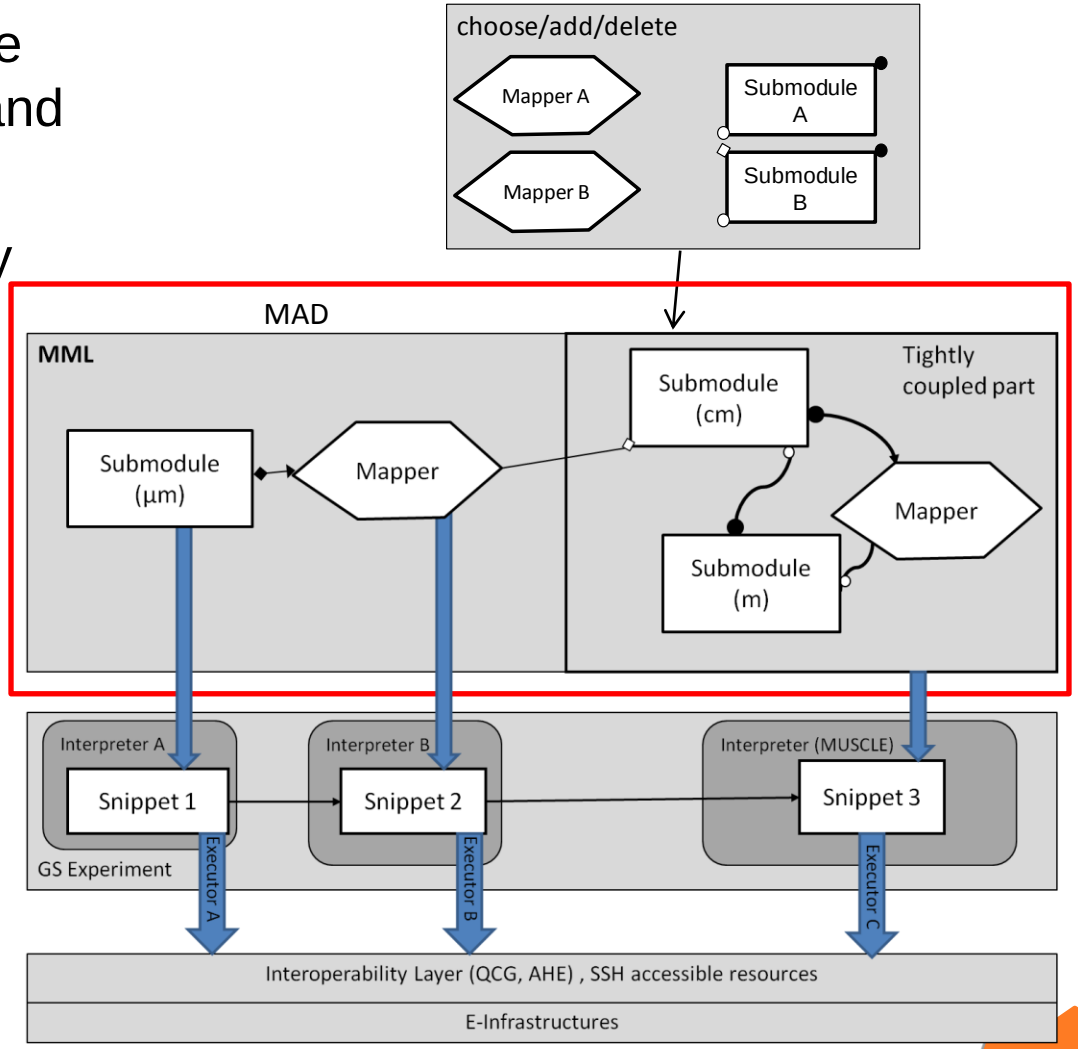


Ports and theiroperators



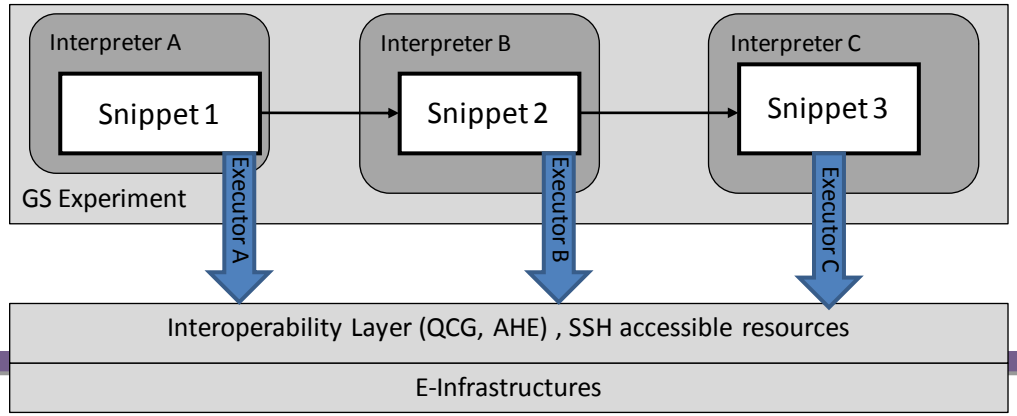
MultiscaleApplication Designer (MAD)

- Supports composing multiscale applications from submodels and mappers registered in MaMe
- Inport/export coupling topology representedin gMML to/from XMML file
- Transforms high level MML description into executable experiment for GridSpace Experiment Workbench



GridSpaceExperimentWorkbench

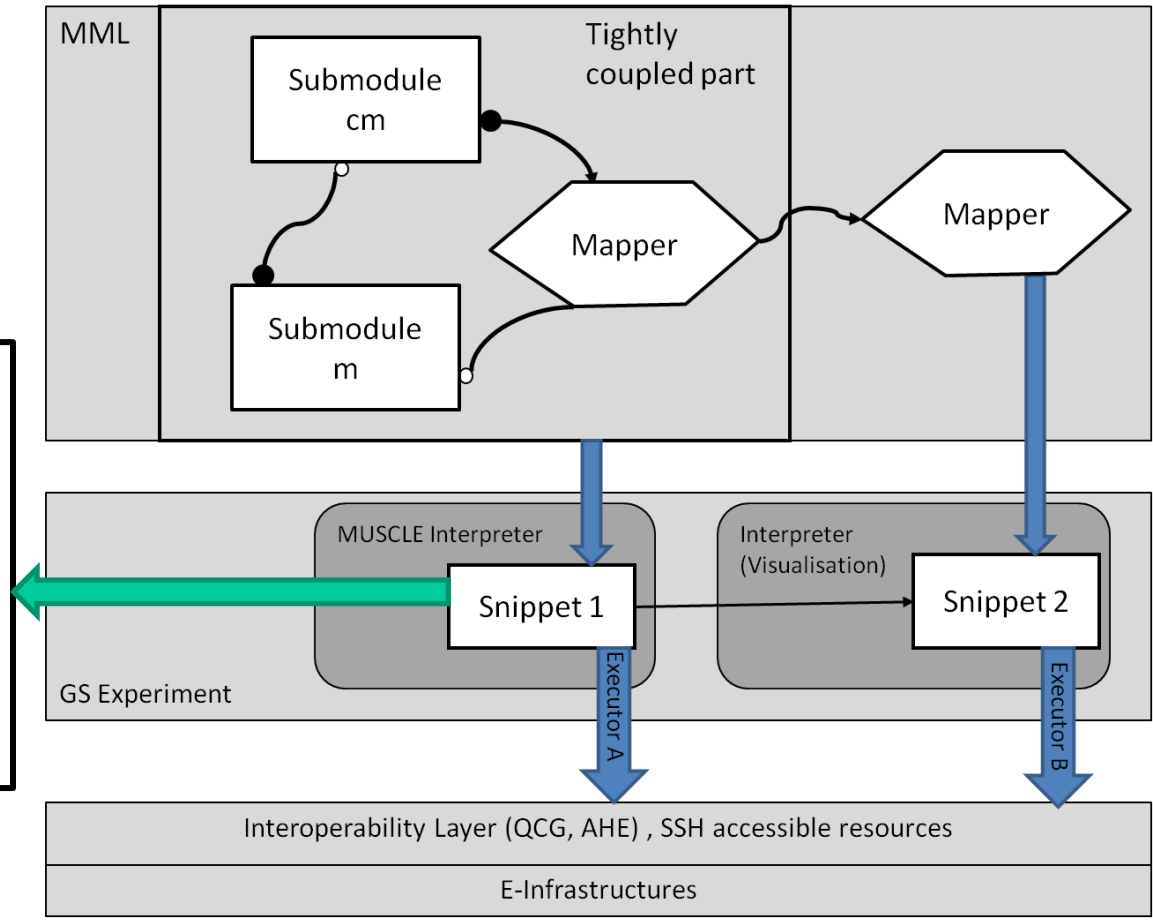
- Supports **execution and result management** of infrastructure independent experiments
- **Experiment** - application composed of code fragments called **snippets**, expressed in:
  - general-purpose scripting programming languages(Bash, Ruby, Perl etc.)
  - domain-specific languages (CxA in MUSCLE, LAMMPS, Matlab etc)
- Snippets are evaluated by respective programs called **interpreters**
- **Executors**- responsible for snippets execution on various computational resources – servers, clusters, grid via
  - direct SSH on UserInterface (UI) machine
  - Interoperability layer (QCG, AHE)
- Each snippet of the same experiment can be executed on different resource



ExampleUseCase CanalApplication

- Tightly coupled Java based canal simulation using MUSCLE
- Stand-alone canal visualizer and movie maker

```
# declare kernels which can be launched in the CxA
cxa.add_kernel('submodel_instance1, 'my.submodelA')
cxa.add_kernel('submodel_instance2', 'my.submodelB')
…
# configure connection scheme of the CxA
cs = cxa.cs
# configure unidirectional connection betweenkernels
cs.attach ' submodel_instance1'=> 'submodel_instance2' do
   tie 'portA', 'portB'
   …..
end
…
```



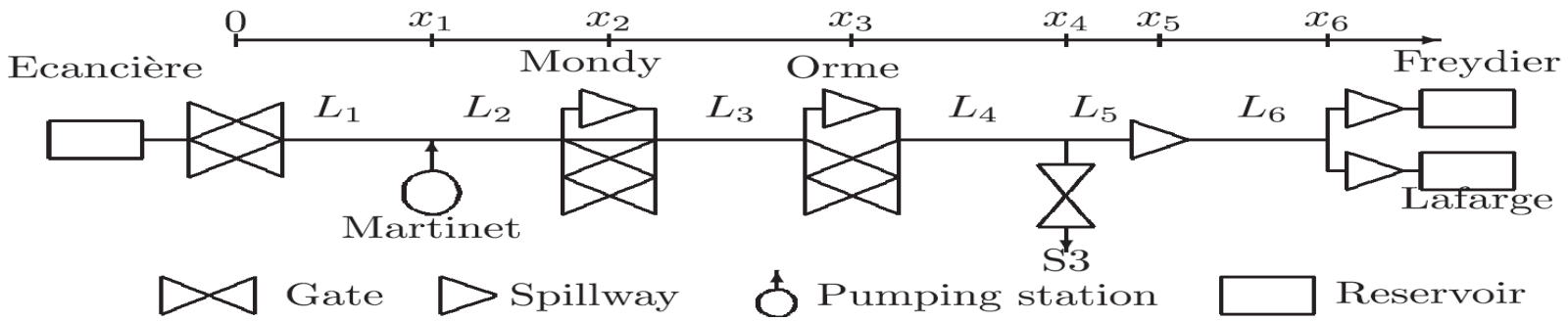
Irrigation Canals Application

Objectives:

- Provide a mutiscale based model for the entire irrigation canal network "La Bourne".
- A activecontrol and optimal management :
  - History of the main unusual events/perturbations.
  - To run several scenarios in order to find the optimal configuration.
  - A real-time-control and optimization of the water exploitation

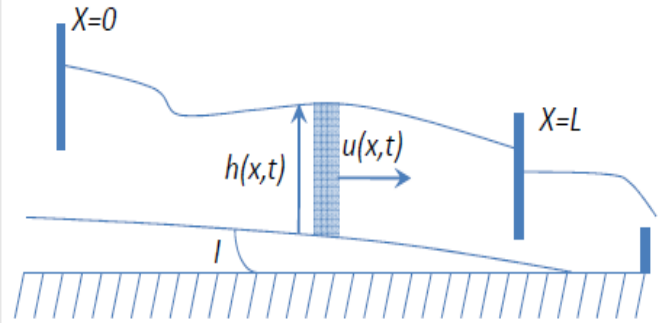
Canal network "La Bourne" features:

- 15-30 millions m^3 of water are distributed to ~9000 clients for a total irrigated area of 10,000 ha
- It measures 46 km of length
- It includes several junctions: tunnels, bridges, spillway, ...etc.



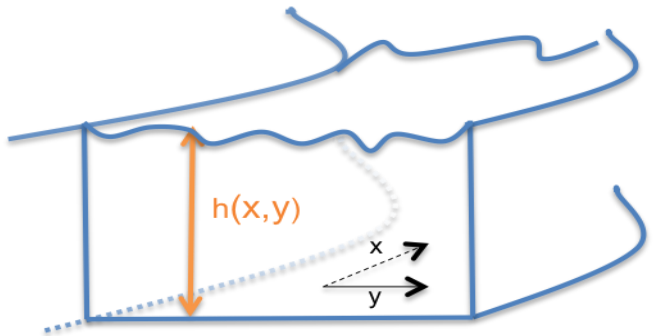
taken from Najib slides

Water Model of DifferentScales (MML submodels)



LB models for long canal reaches .
LB-Shallow Water 1D

CxA coupling



The water height varies with respect to X and Y.
LB-Shallow water 2D

CxA coupling

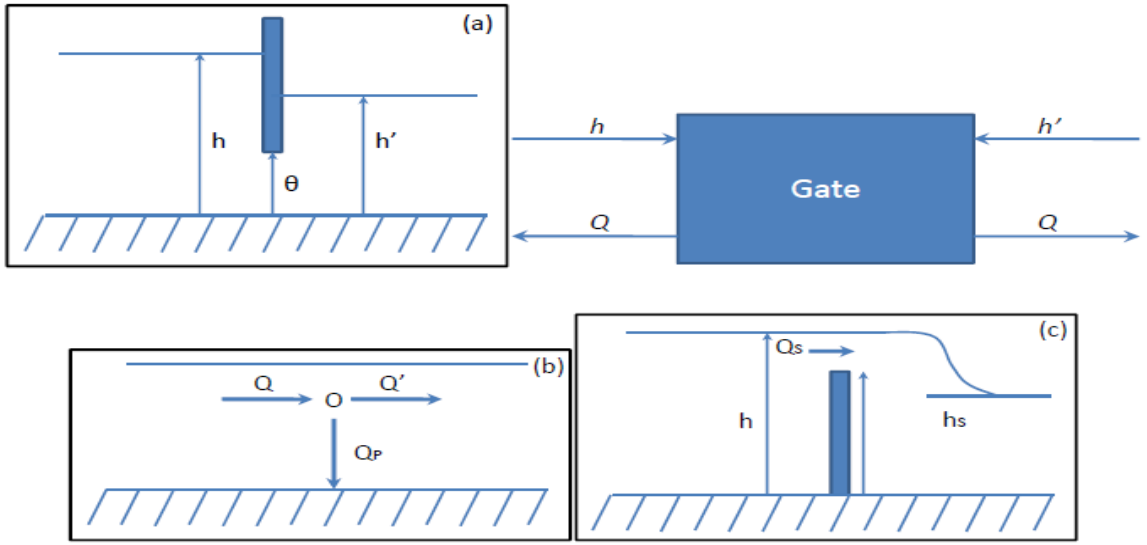
CxA coupling

LB-Free Surface 3D

- Flow around gates/transport of sediments
-It requires supercomputing capabilities

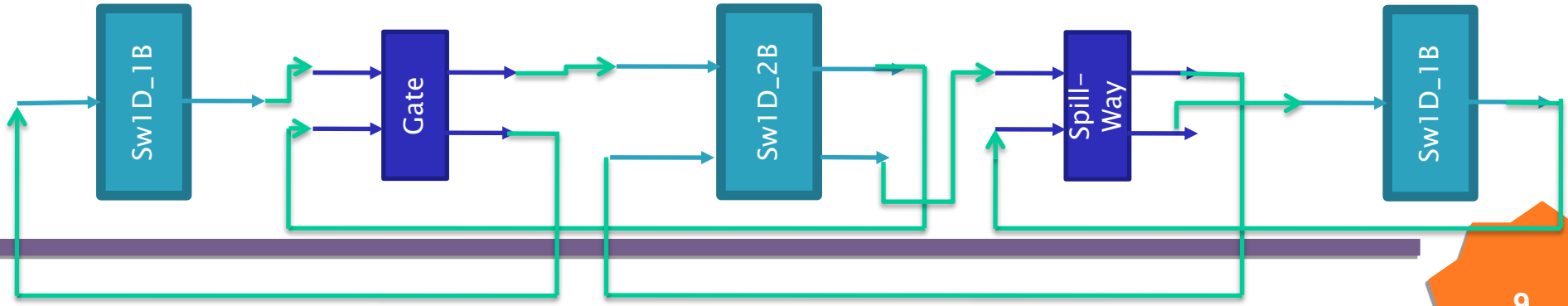
taken from: Pham van Thang et al. Journal of Computational Physics,229(19) :7373-7400, 2010

JunctionsTypes for Shallow water 1D



(a) Gate
(b) Pump
(c) SpillWay

Example schema



Demo and Assigments