Reconfiguration of a Distributed Information Fusion System

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Outline

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2. Example
   - System reconfiguration
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5. Reconfiguration
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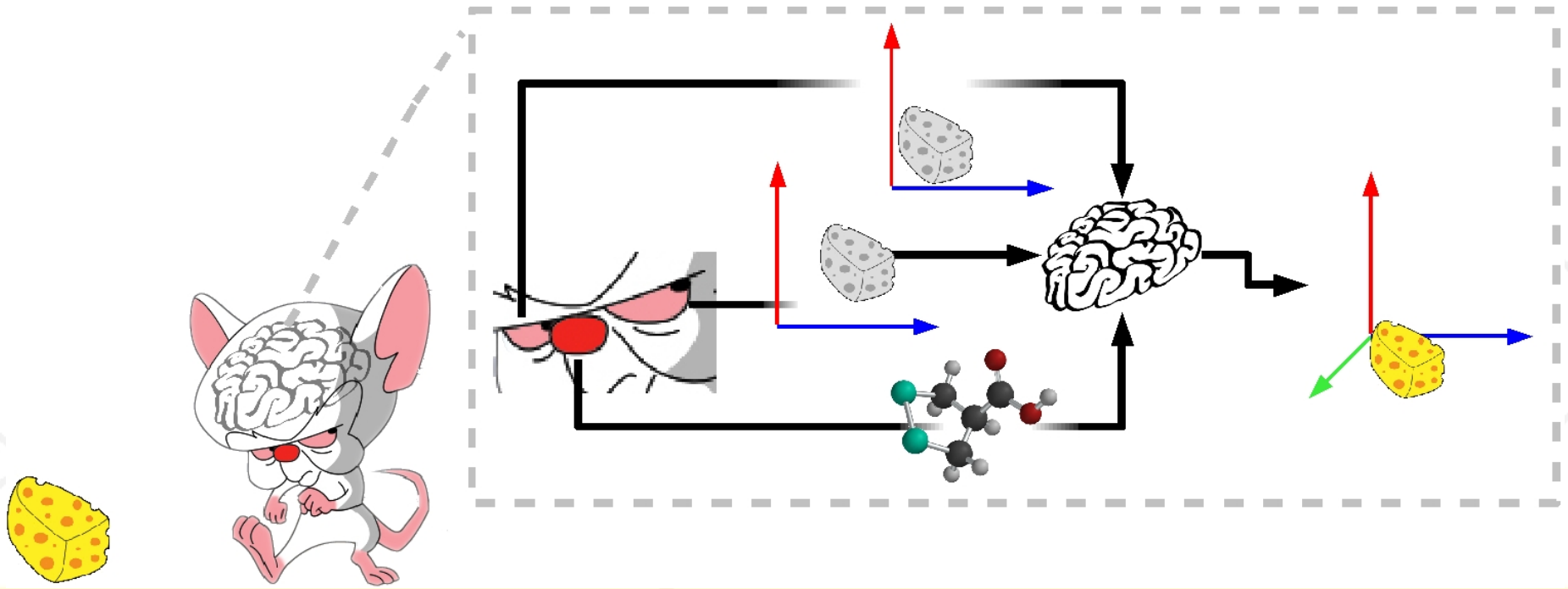
Information Fusion

An Information Fusion Process (IFP) is defined by :

- information sources
- a process

An Information Fusion System (IFS):

- executes an IFP,
- consists of hardware and software elements,
- is often distributed,
- is more and more dynamic:
  - the resources.

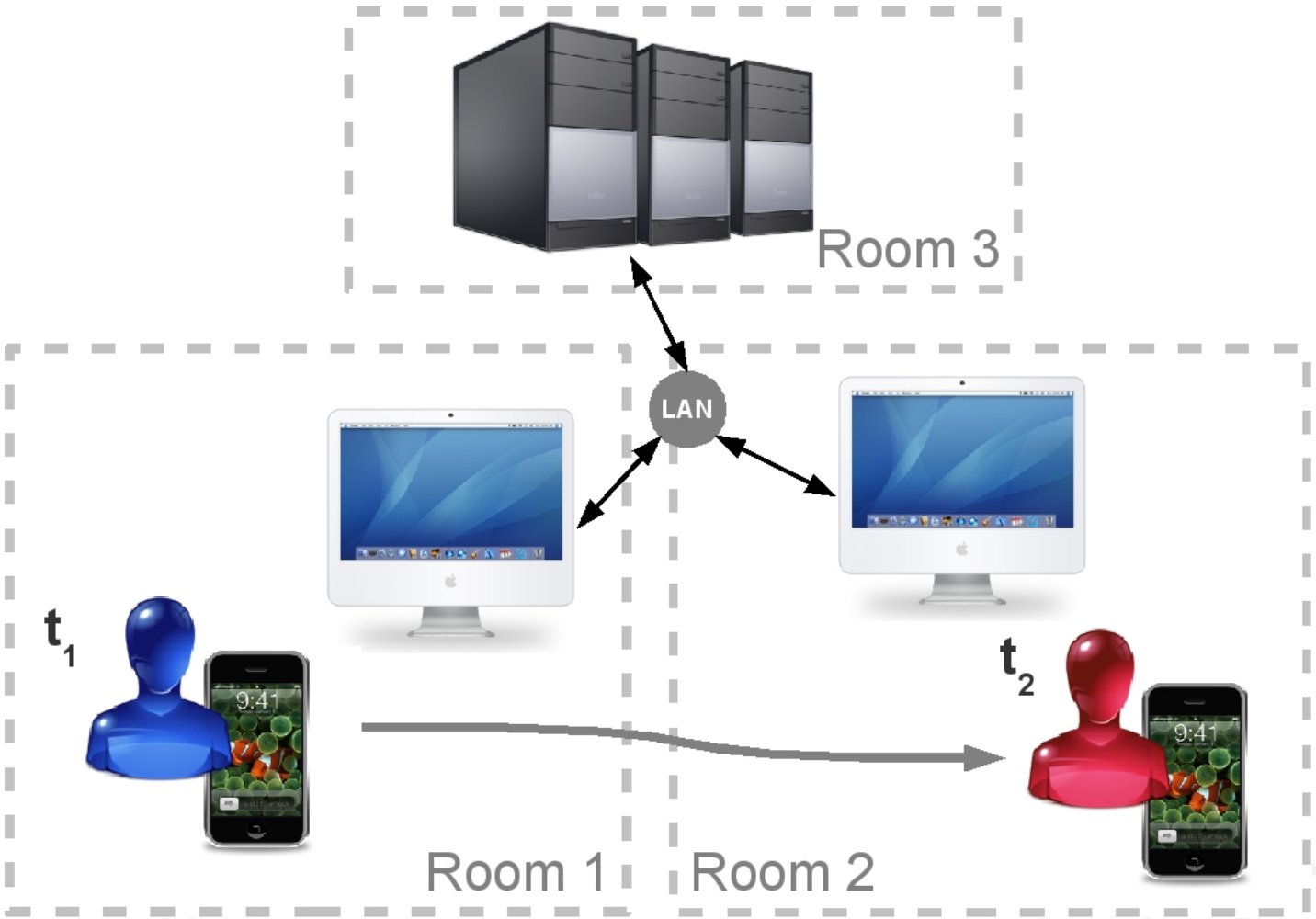


Reconfiguration example

A video of the user's head is produced by his smart-phone.

A filter is applied on the video by computers in room 3.

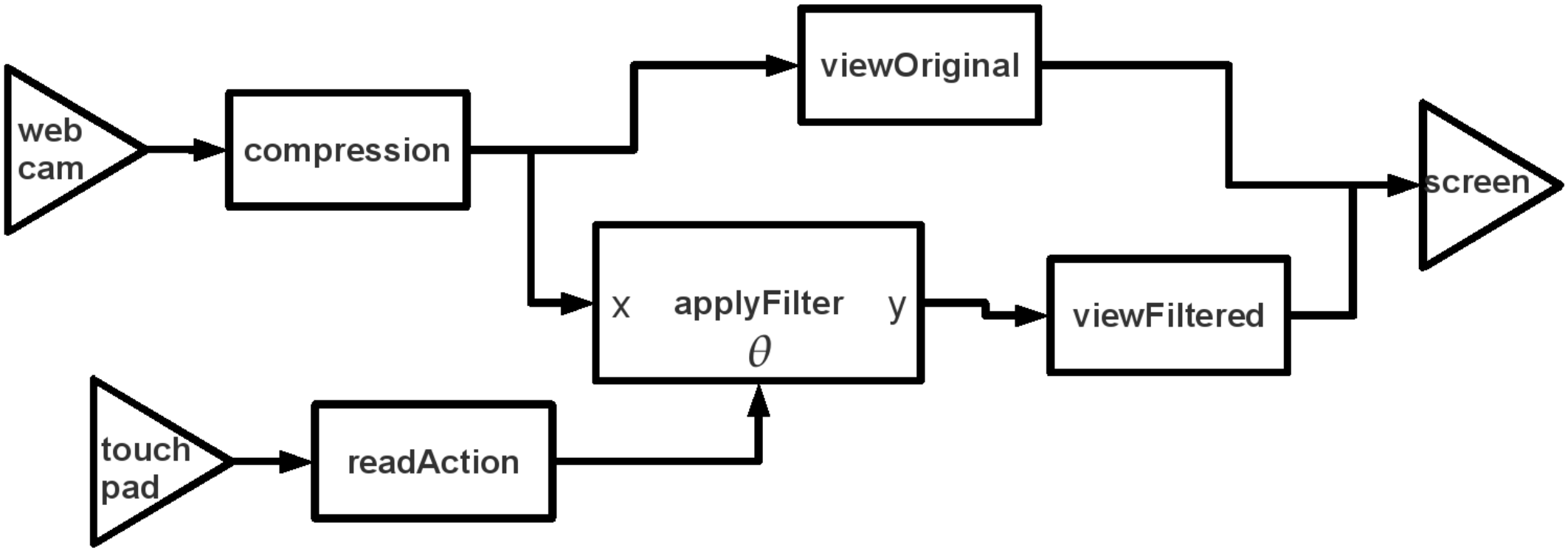
The original and the filtered videos are initially displayed in room 1 and then in room 2.



Reconfiguration appends when the user moves from room1 to room 2.

Fusion process

The IFP is described by a discrete data-flow graph. Nodes are fusion elements (data sources, fusion nodes, data sinks).

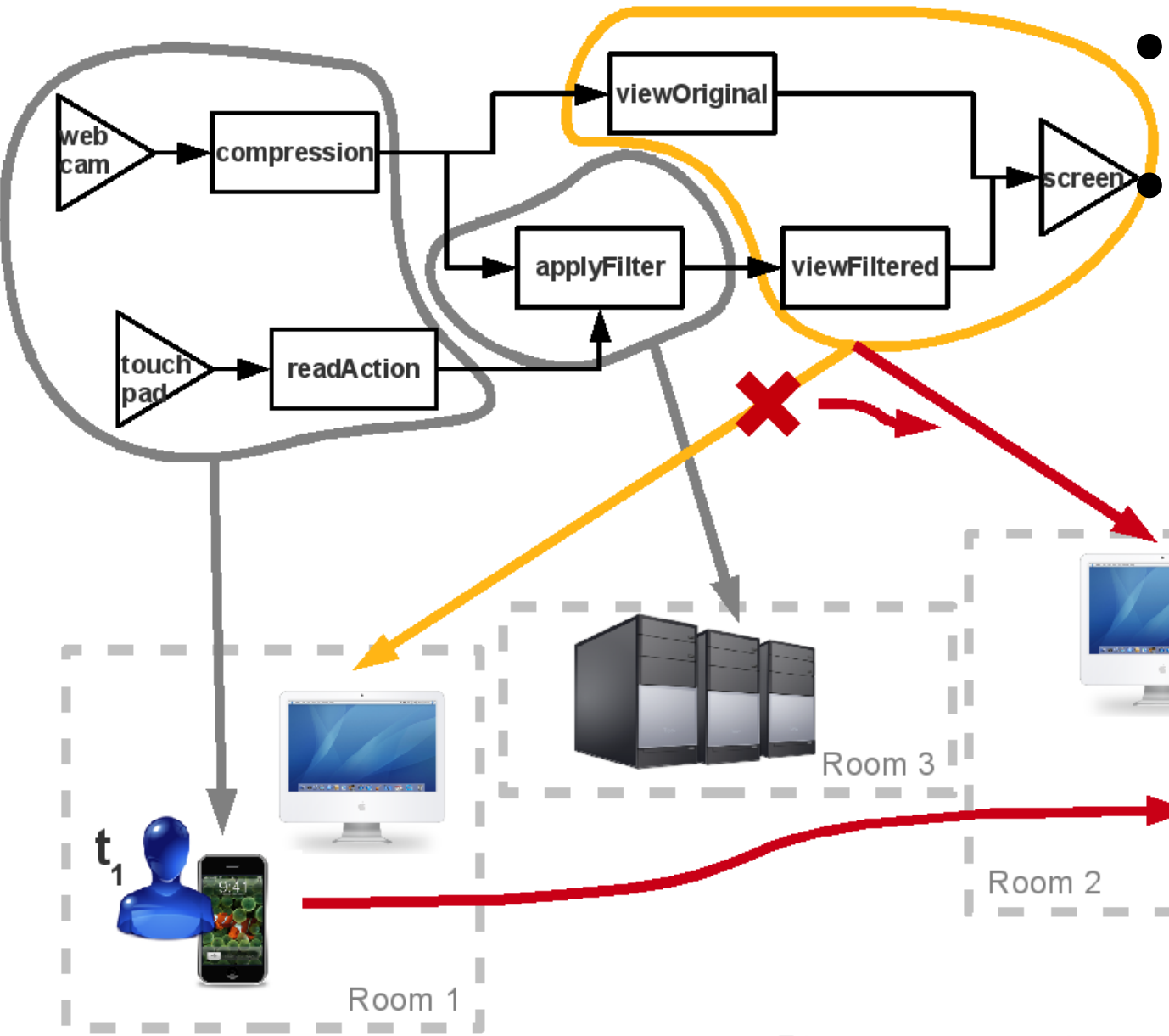


Compatible with usual information fusion models.

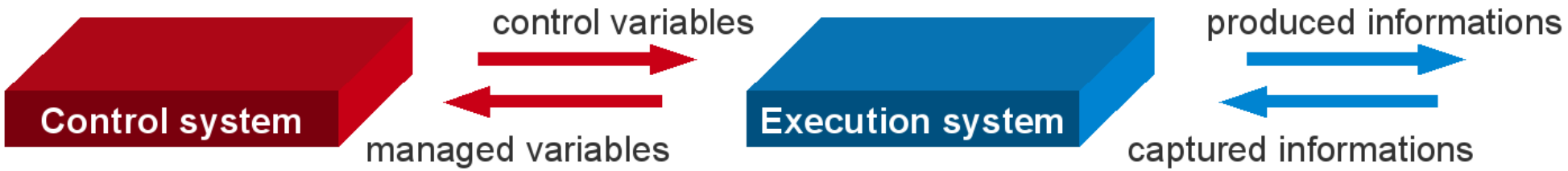
Configuration of an IFS

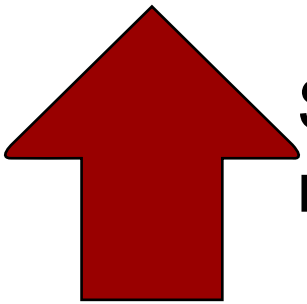
A configuration defines:

- an assignment of the fusion elements,
- a path through the network for each data transfer.

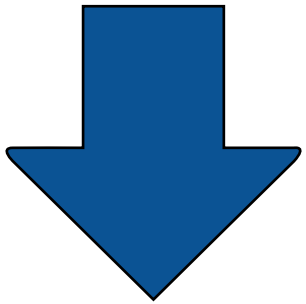


Two sub-systems

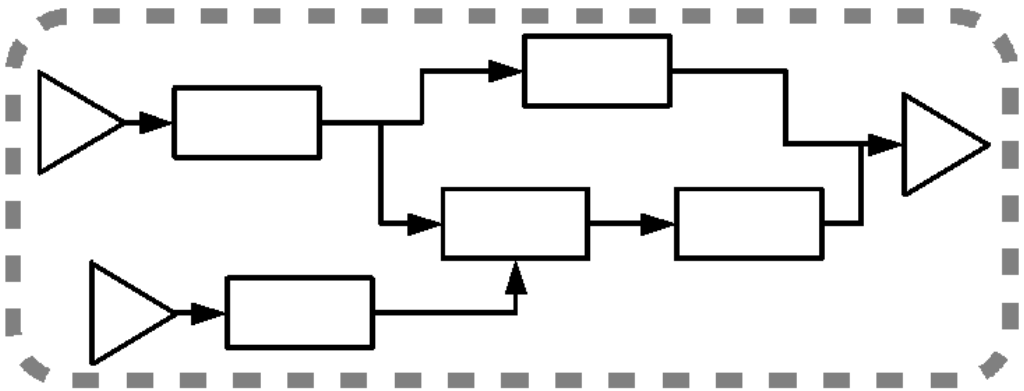




Search for a
new configuration.

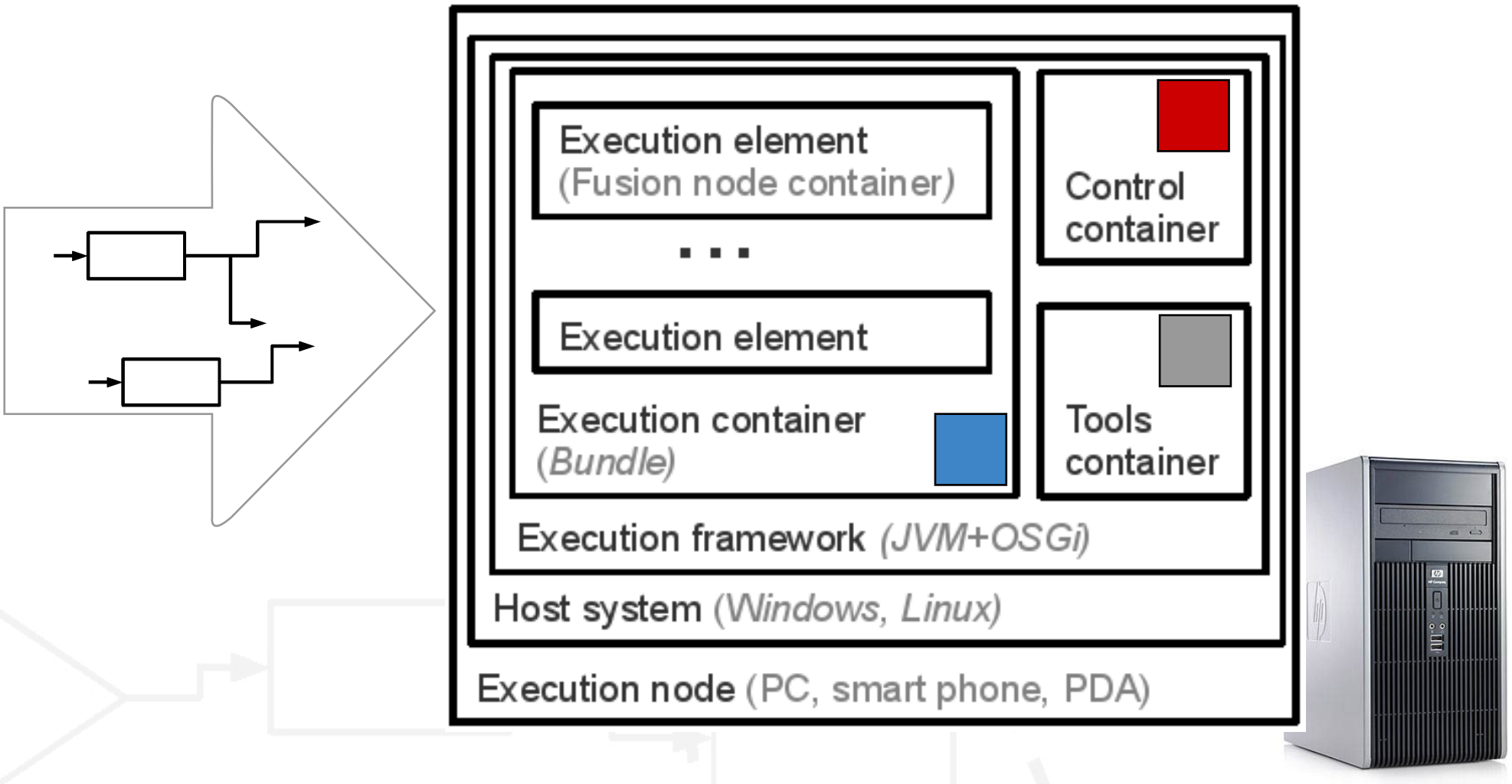


Deployment
and execution
of a configuration.



Runtime framework hierarchy

An execution node is a set of host systems.
A host system is a set of execution frameworks.



Need for reconfiguration (1)

Configuration errors and failures:

- failure state
  - the system cannot produce some of the results,

Two kinds of errors are detected:

- Inter-execution framework errors:
  - an execution framework "disappears",
- Intra-execution framework errors:
  - deadlock on a resource,
  - time-out connection inside an execution element.

Error recovery strategy

- selection of the first configuration compatible with the available resources,

Need for reconfiguration (2)

Configuration improvement:

- even without any error, the control system tries to improve the runtime system permanently.

A formal model based on GSPN is built, at runtime, from the configuration of the system.
To improve the runtime system:

- the control system updates the model parameters,
- and computes its rewards.

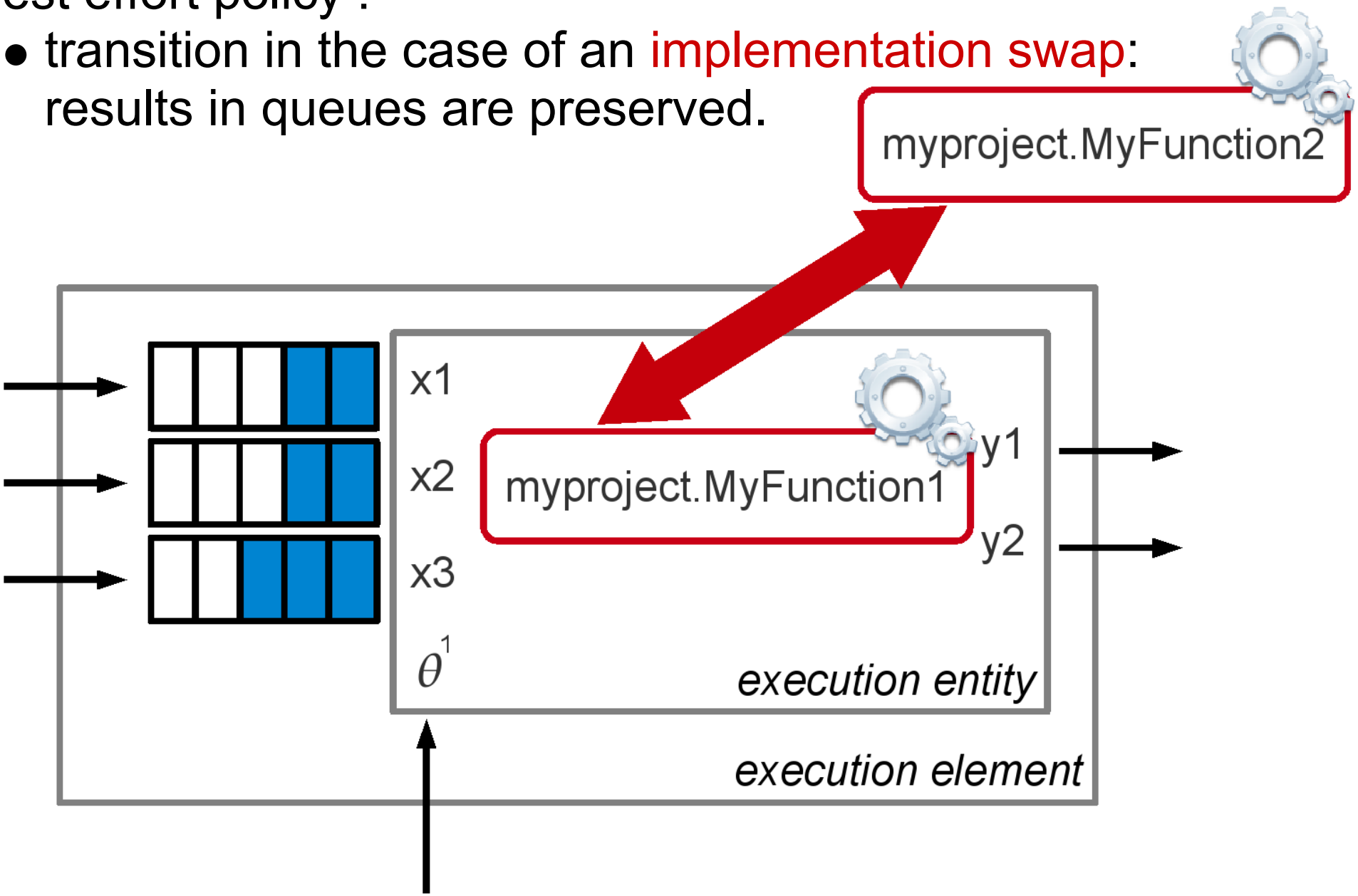
Configuration improvement strategy

- a "significantly better" configuration is selected,
  - the comparison is based on reward values computed from the configuration model.

Transition between configurations (1)

Best effort policy :

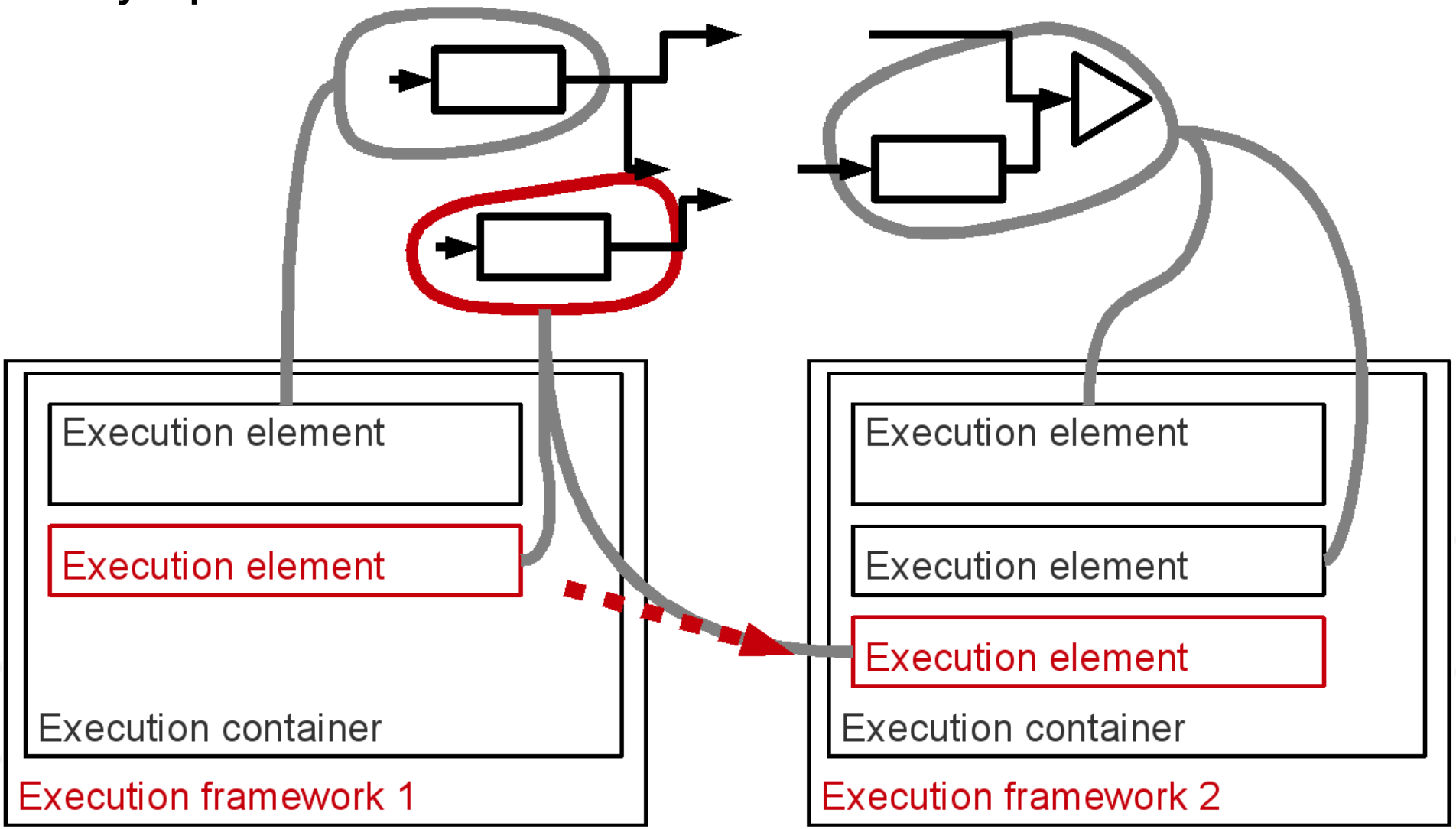
- transition in the case of an implementation swap: results in queues are preserved.



Transition between configurations (2)

Best effort policy :

- transition in the case of a new assignment:
  only updated execution elements are deleted.



Contributions

Model

- Information Fusion Process description
- Configuration model
  - fusion elements assignment
  - links assignment
- Runtime evaluation of the configuration

Implementation

- Reconfiguration mechanism
  - error recovery
  - configuration improvement
- Transition policy
  - implementation swap
  - new assignment

Future work

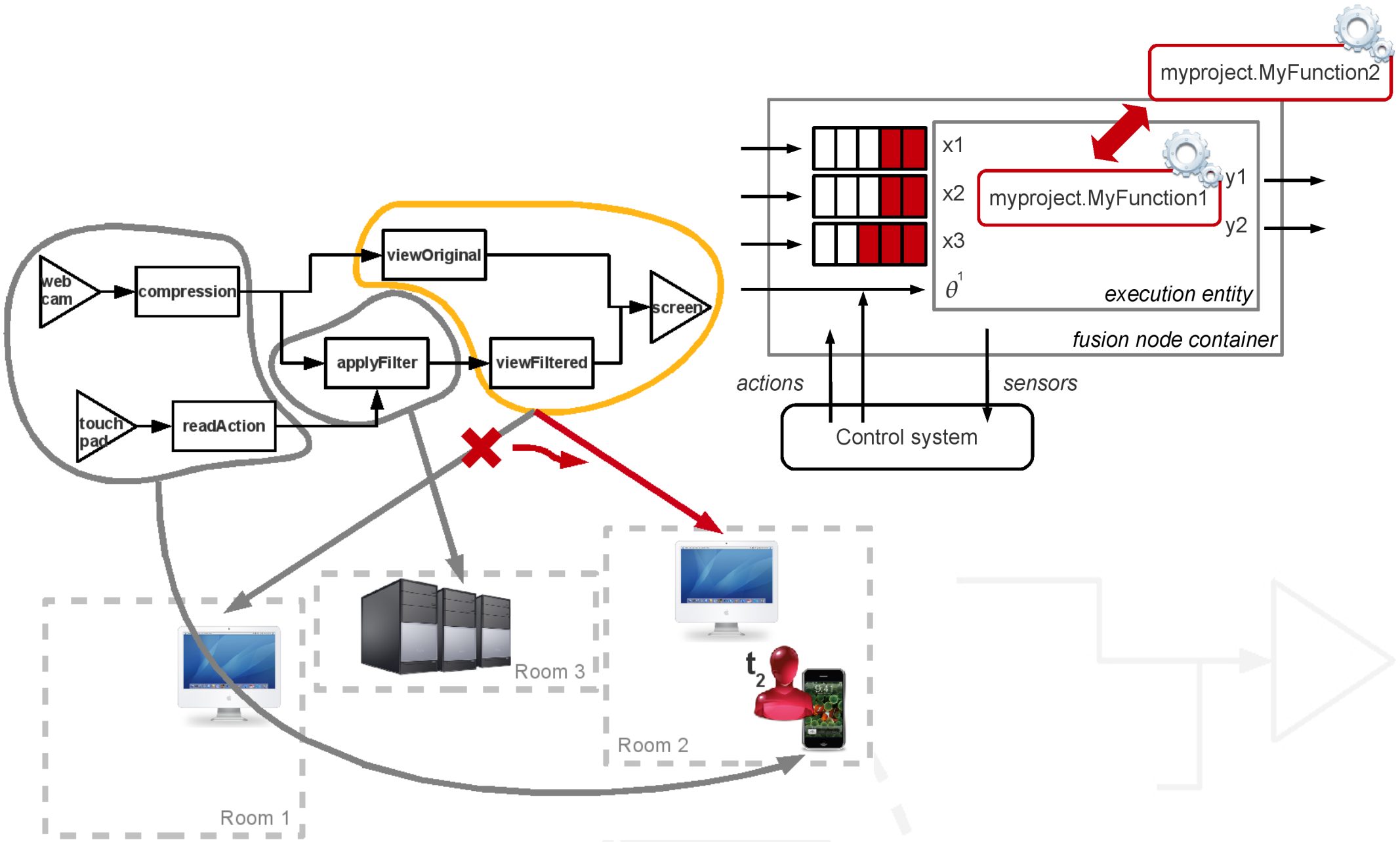
Model

- Configuration search algorithm
  - definition of the characteristics of a configuration from its description,

Implementation

- Distributed configuration evaluation
- Extension of the framework architecture

Any questions ?



Selection of a new configuration

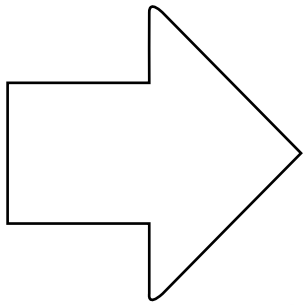
Constraint programming approach

Constraints

- fusion functions are compatible with a subset of execution framework,
- connections between fusion functions are fixed,

Objectives

- global maximal usage of the set of the execution frameworks,
- global "short" physical communication between fusion functions.



The problem is finally sent to a CSP solver.