

WORKFLOW PARTITIONING IN MOBILE INFORMATION SYSTEMS

L. Baresi, A. Maurino, S. Modafferi
Politecnico di Milano

Andrea Maurino

maurino@elet.polimi.it

Outline

- ❑ Motivation
- ❑ Our proposal
- ❑ Graph transformation
- ❑ Partitioning rules
- ❑ Local process view
- ❑ Validation
- ❑ Example
- ❑ Conclusions and future work

Motivation

- ❑ New wireless technologies are creating the technological backbone for MobIS
 - Nomadic actors
 - Dynamic changes
- ❑ New technologies suffer from several problems
 - Reduced number of nodes connected (e.g. Piconet)
 - Lack of inter-networking protocols
 - Lack of efficient routing protocols
- ❑ The nature and the limitations of these technologies impact the design of MobIS

Our proposal

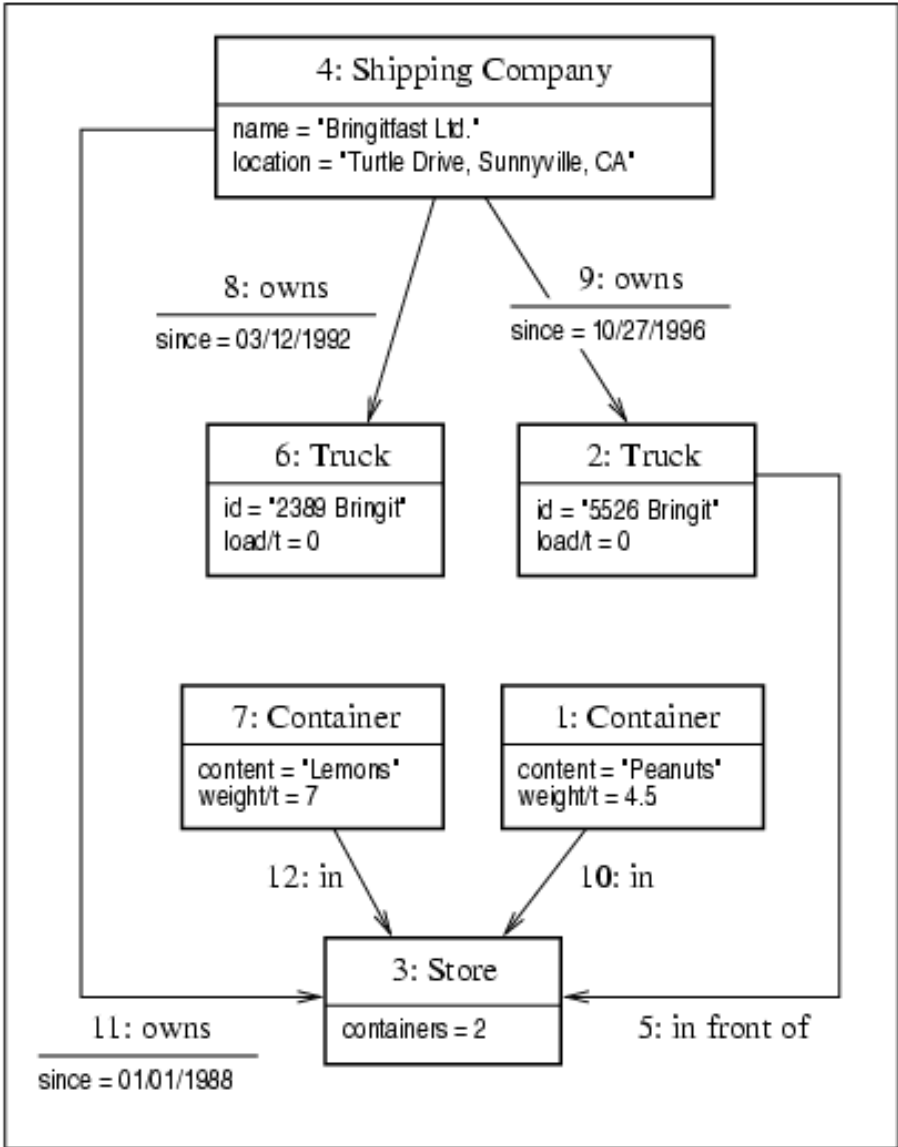
- ❑ Move from centralized to decentralize process orchestration
- ❑ Federation of heterogeneous devices
- ❑ Creation of a set sub-network
 - Based on single network technology
 - With a reduced number of nodes
- ❑ From one-to-any to point-to-point communication
 - Only when it is necessary

Main problems:

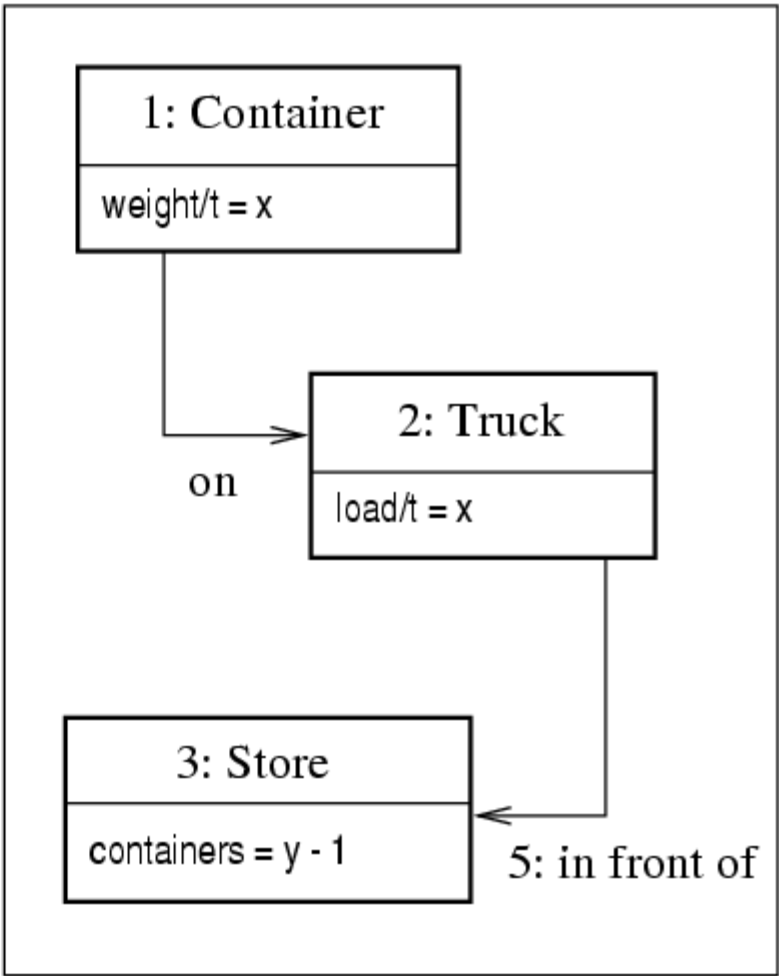
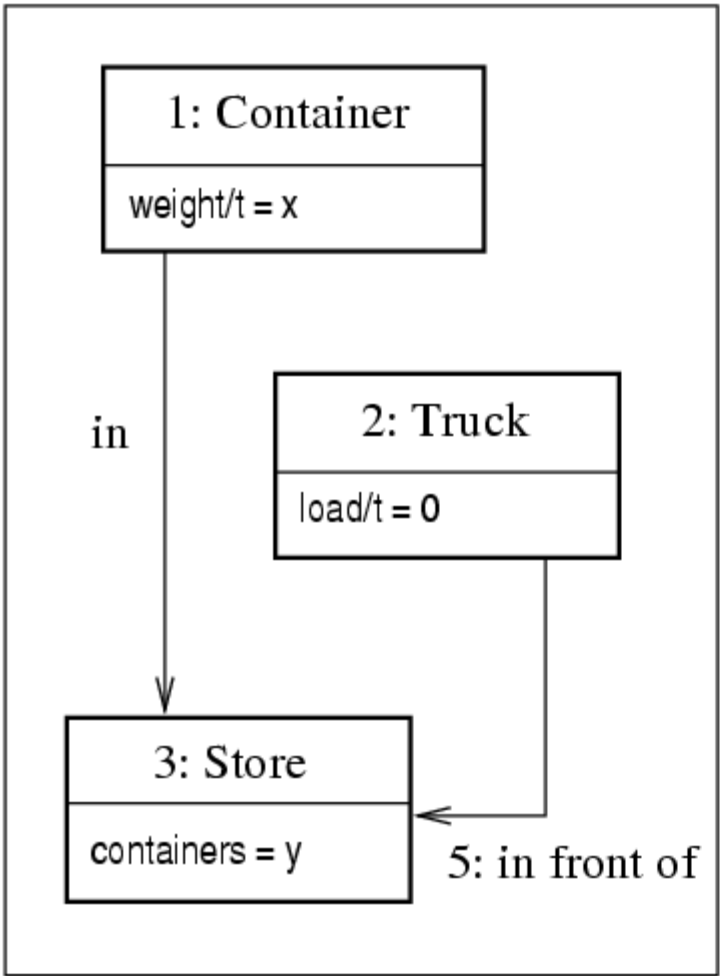
- ❑ How to describe such processes
 - BPEL4WS
- ❑ How to decompose centralized processes maintaining the correct execution flow
 - Special synchronization activities
- ❑ How to automatically decentralize a process
 - Graph transformation
 - AGG tool

Graph Transformation

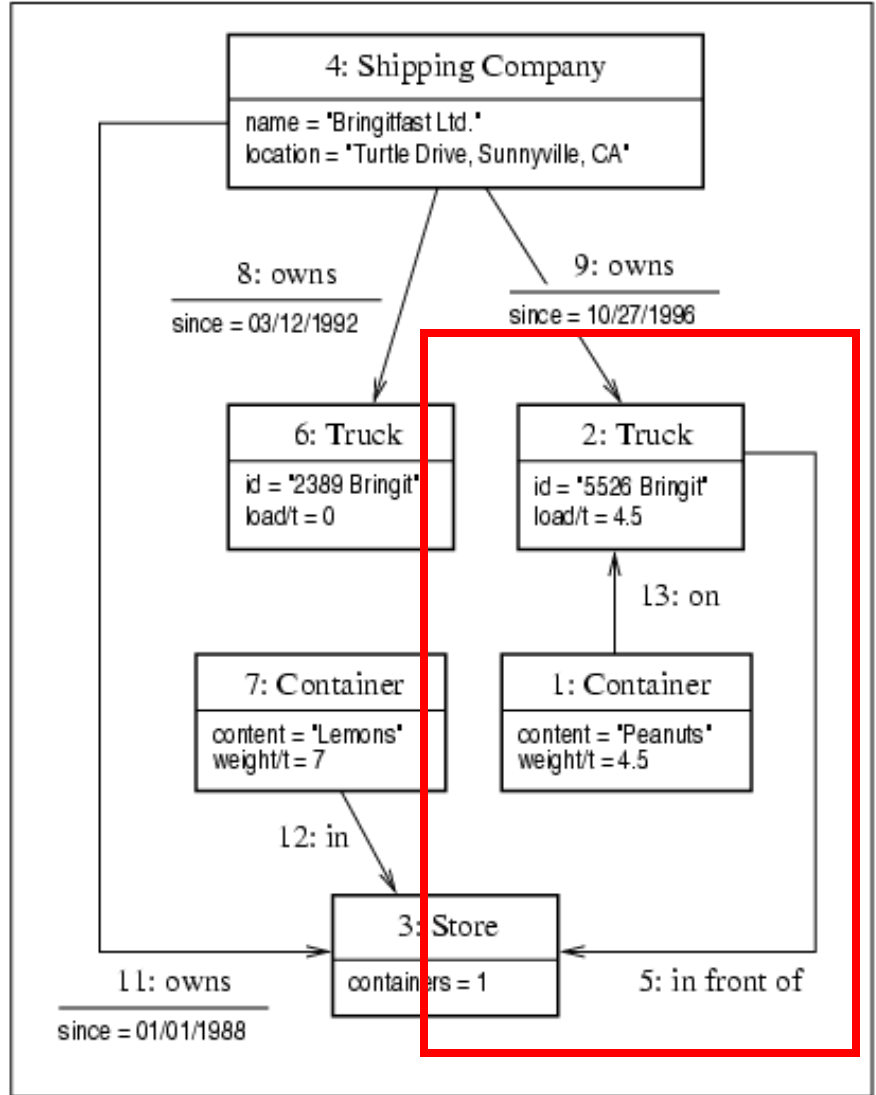
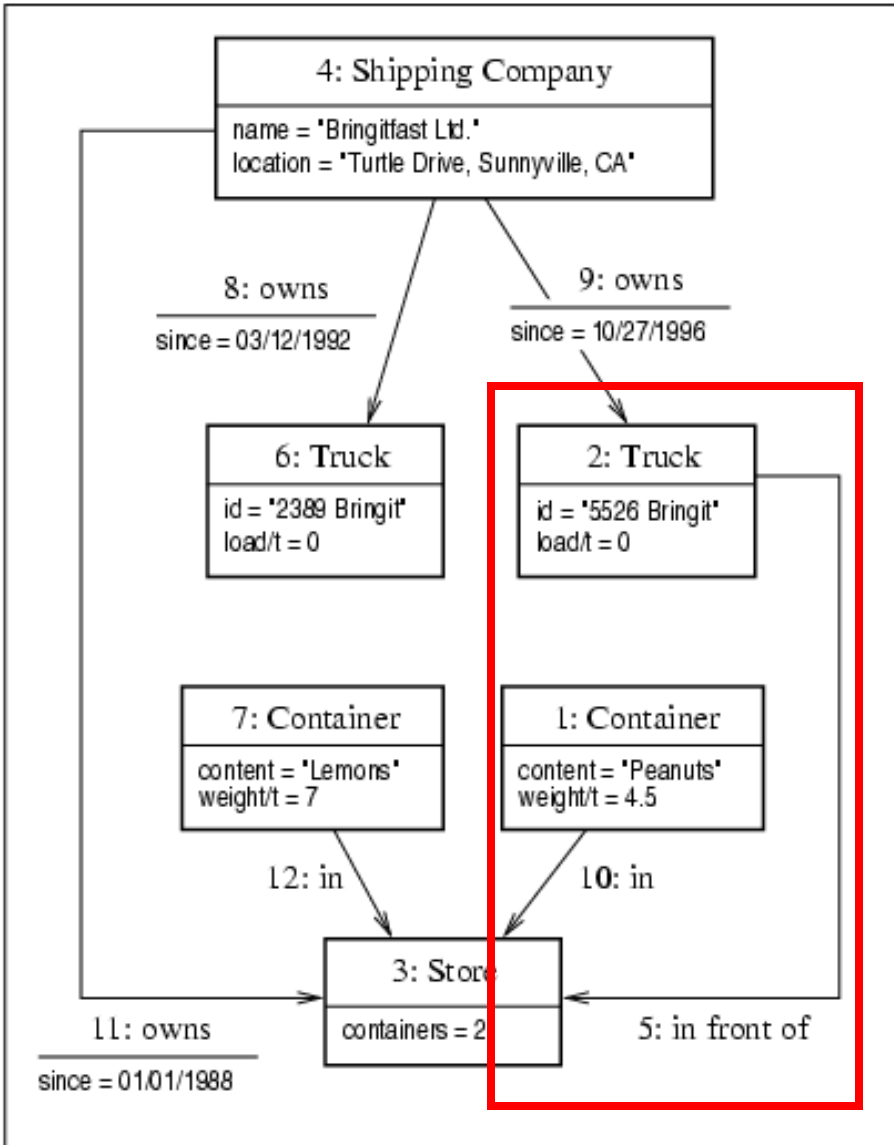
Graph Transformation



Graph Transformation



Graph Transformation



Partitioning rules

- ❑ To decompose a BPEL process we transform the XML description of bpel into a graph by means of the IBM UML profile
- ❑ Each UML basic activity is rendered as a node
 - Each node has a device attribute
- ❑ Links are rendered as edges of type FOLLOW between activities
- ❑ Structured activities are rendered with two special-purpose Activity nodes.

Task
Device=1
Type=StartSwitch
Name=StartSwitch
Value=5

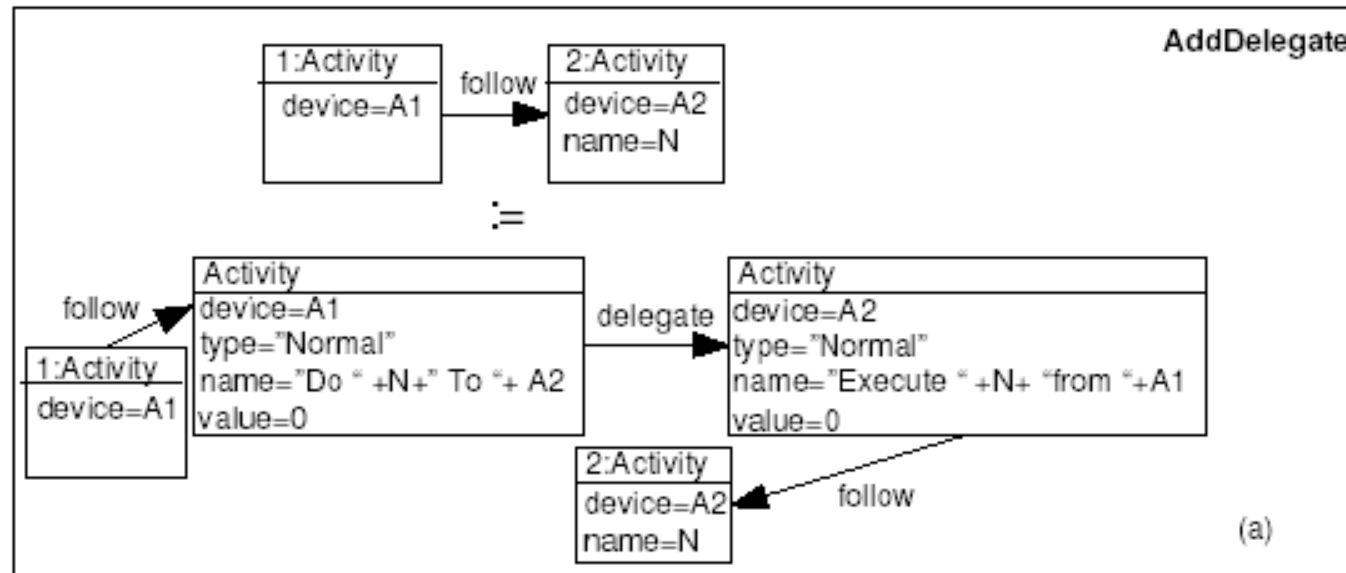
Task
Device=1
Type=EndSwitch
Name=EndSwitch
Value=5

Partitioning rules

- ❑ The designer must assign all activities to controllers
 - The control of the execution of a specific activity can be assigned to a single device;
 - The **StartLoop** and **EndLoop** nodes of While structured activities must to be assigned to the same device
 - The **Start** node of Pick, Switch, and While structured activities is in charge of evaluating the condition
 - The workflow has no global variables and all the variables are passed as parameters among different actors

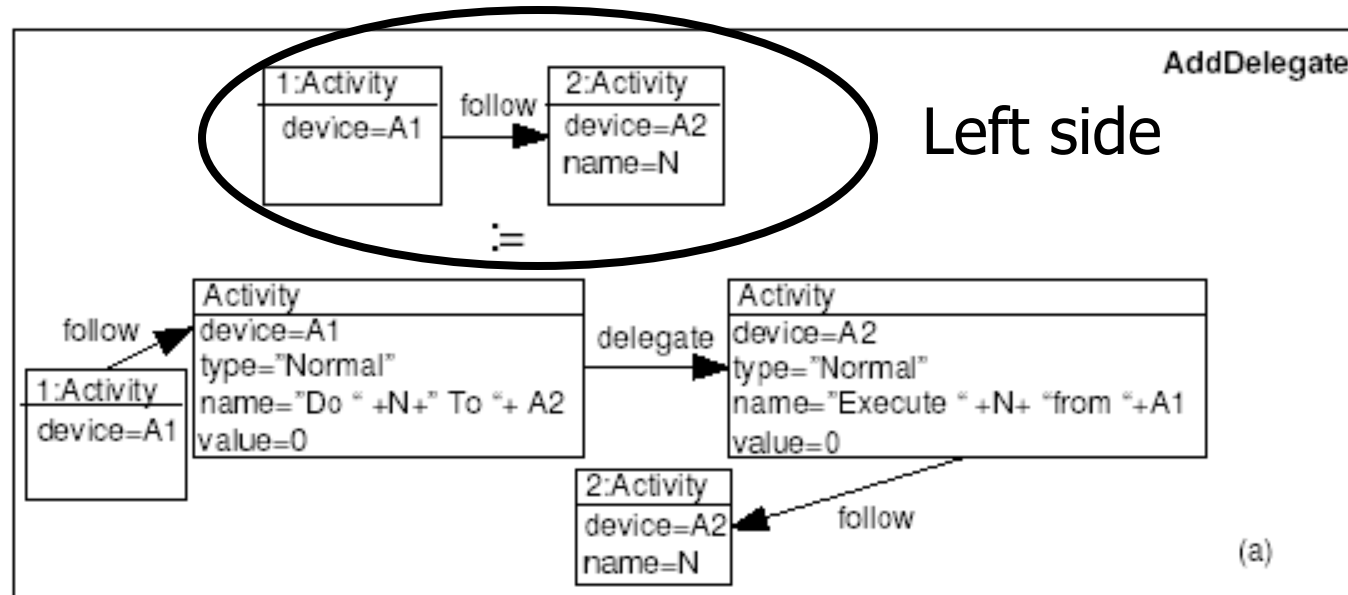
Partitioning rules

- We organize rules into layers
 - a rule of layer i is evaluated before rules of layer j with $i < j$
- Level 0: synchronize the execution flow between activities



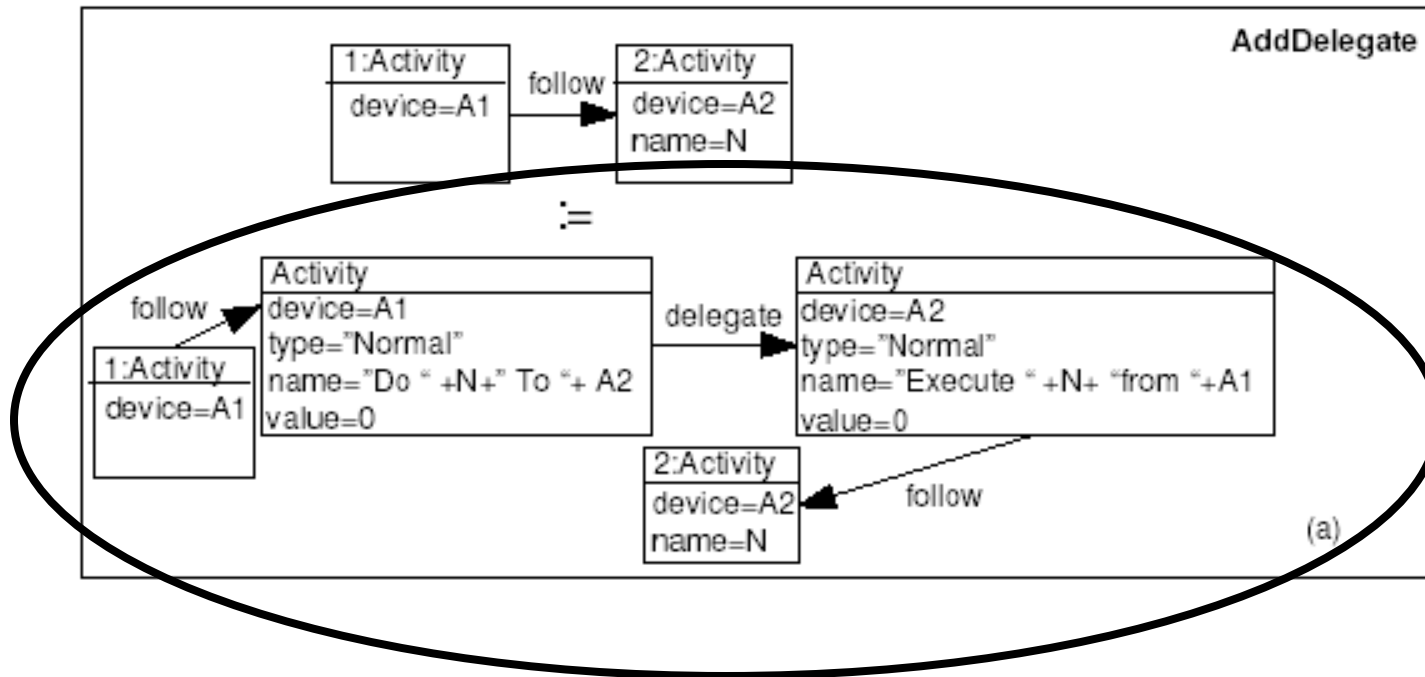
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Partitioning rules

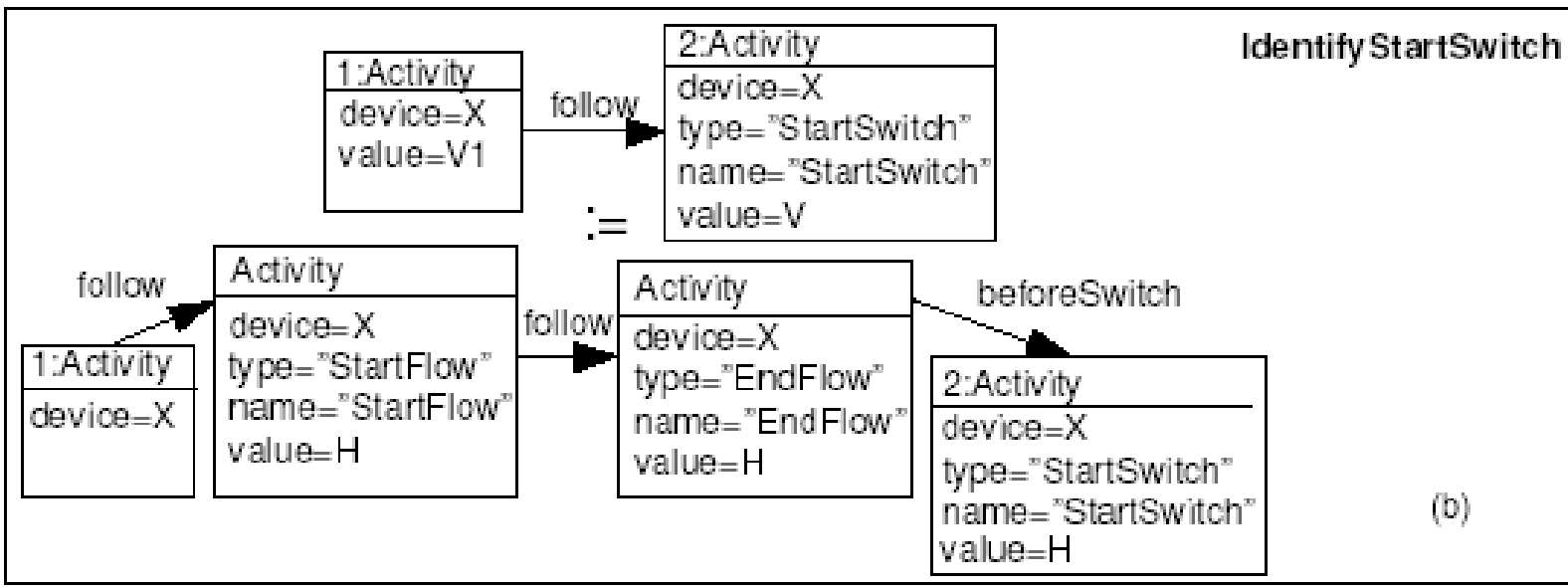
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Right side

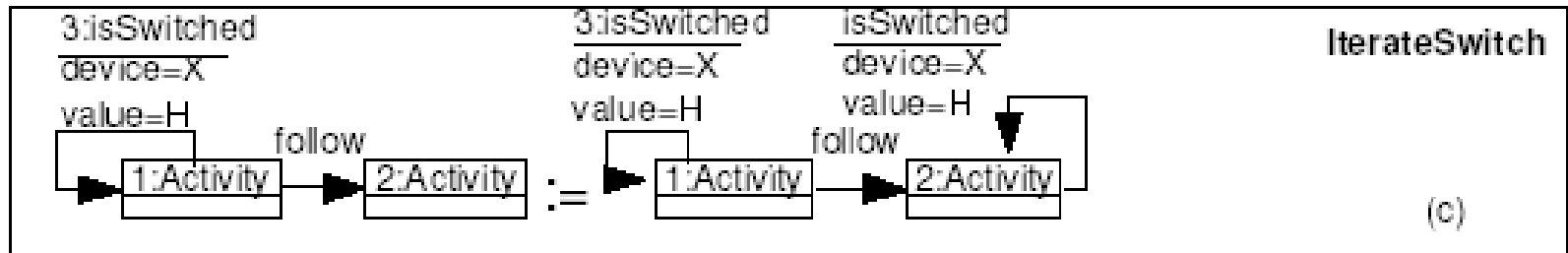
Partitioning rules

- Layer 1 identifies switch nodes



Partitioning rules

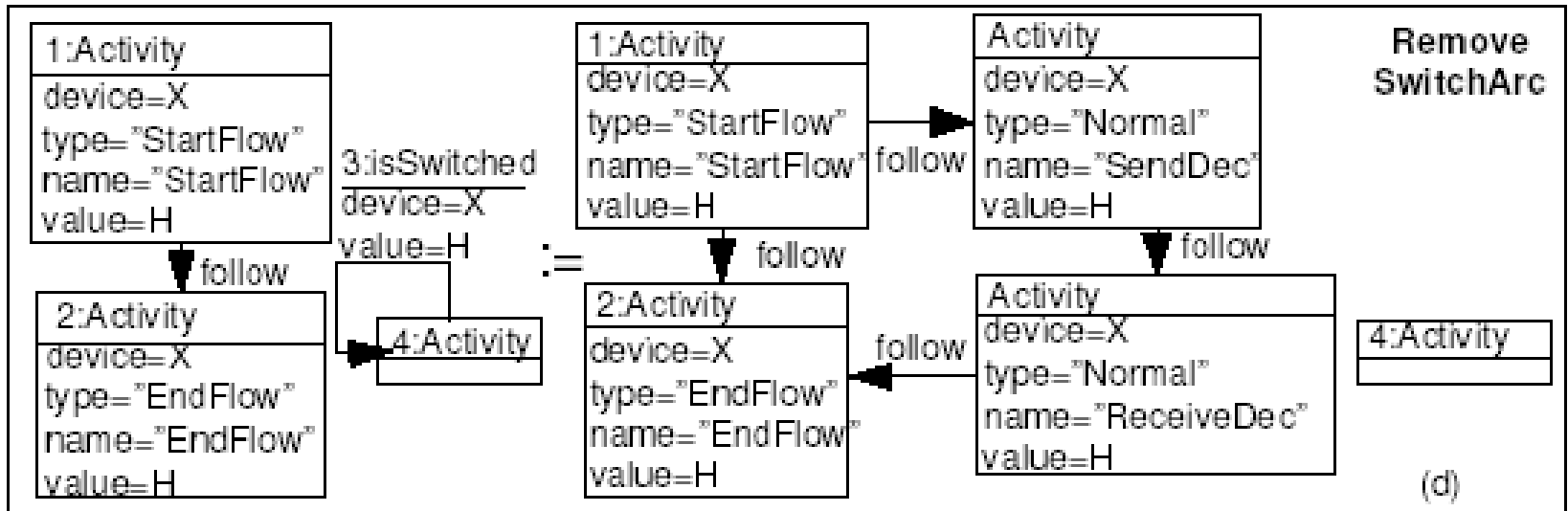
- Layer 2 adds isSwitched arcs to all nodes involved within the switch



- Partitioning of while activity

Partitioning rules

- Layer 3 fills the added flow activities



- The last set of rules (layer 4) removes the extra arcs added previously

Local process view

- ❑ Next step: creation of the local views for decentralizing the workflow execution
- ❑ The definition is realized by the following rules
 - Remove all activities whose execution is not controlled by the current actor
 - Translate all structured activities, with the exception of Sequences, that do not include "local" activities into Sequences with no tasks

Validation

Partitioning rules have a functional behaviour are confluent and terminates

- OK, by critical pair analysis offered by AGG tool
 - There exists a critical pair if and only if p_1 may disable p_2 , or p_2 may disable p_1
- We do not find any critical pair so it is demonstrated that our partitioning rules have a functional behaviour
- The execution of the original workflow is preserved.
 - Empirical positive responses

Validating example

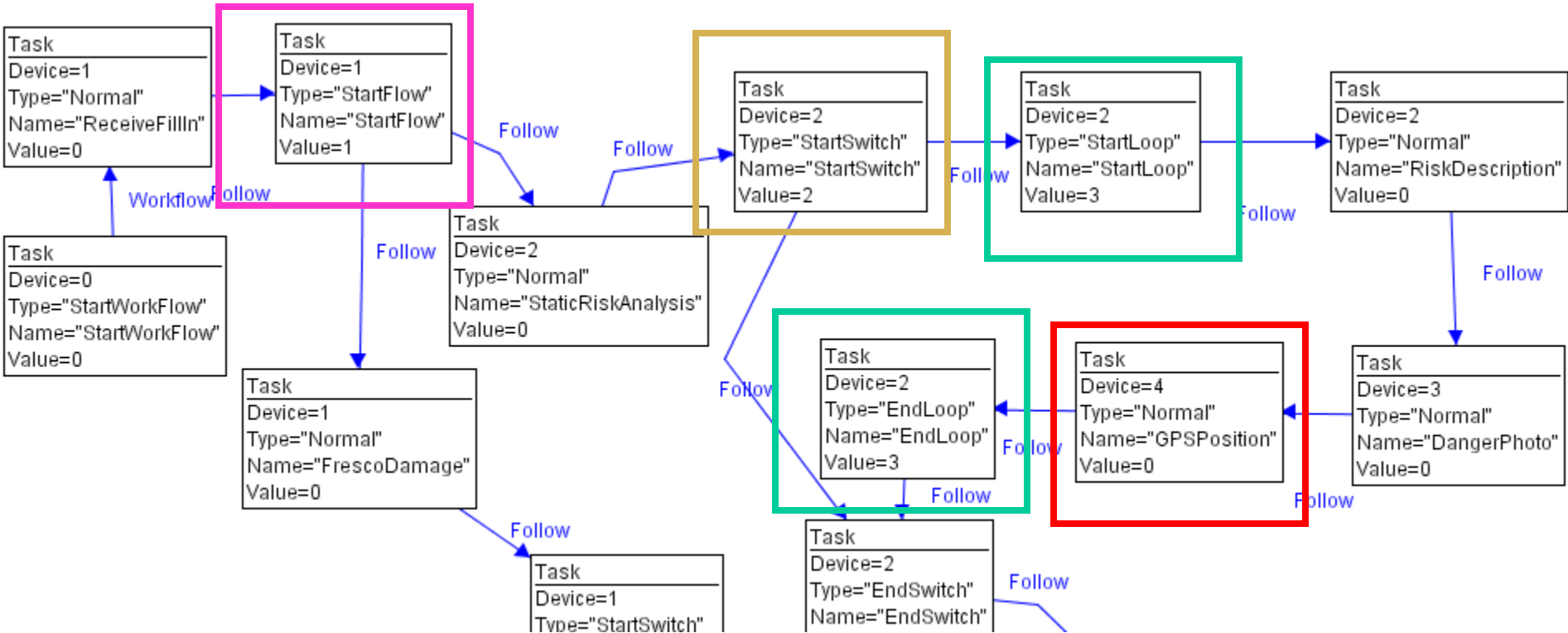
- ❑ In 1990 the Italian government started the MARIS project, but it does not foresee the data acquisition phase by means of mobile devices
- ❑ We want to create a mobile information system able to acquire information of goods in an electronic way
 - In fact a number of “small” goods are placed in non urban contexts (e.g. country, mountain and so on)
 - The use of mobile devices and networks is mandatory in this environment

Validating example

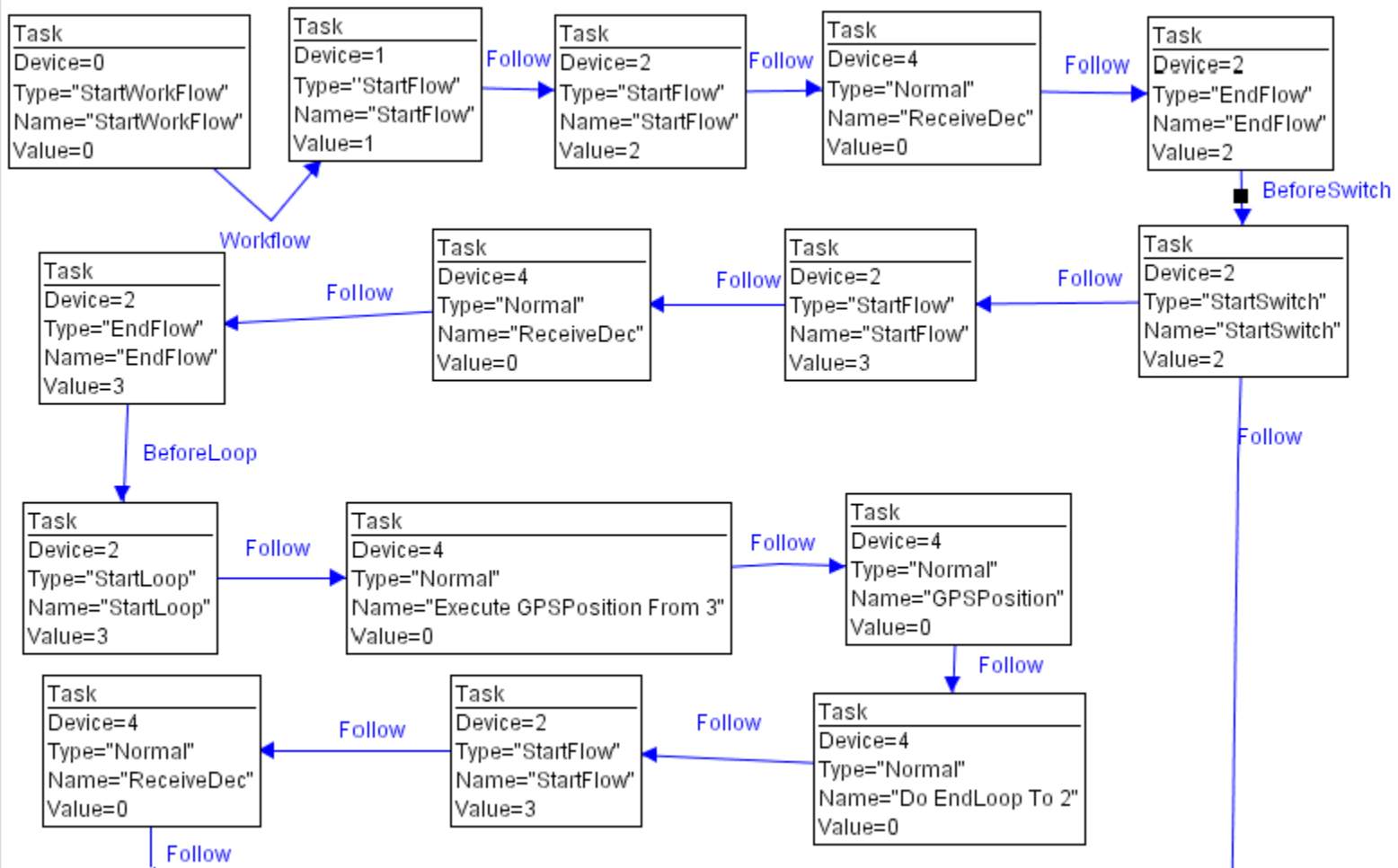
- ❑ Our process is the description of a given cultural site through a site description card
- ❑ The card is composed of a number of items
 - according to the specificities of what is described
- ❑ First we define the AGG graph
 - XML representation
- ❑ Then we apply our rules

Validating example

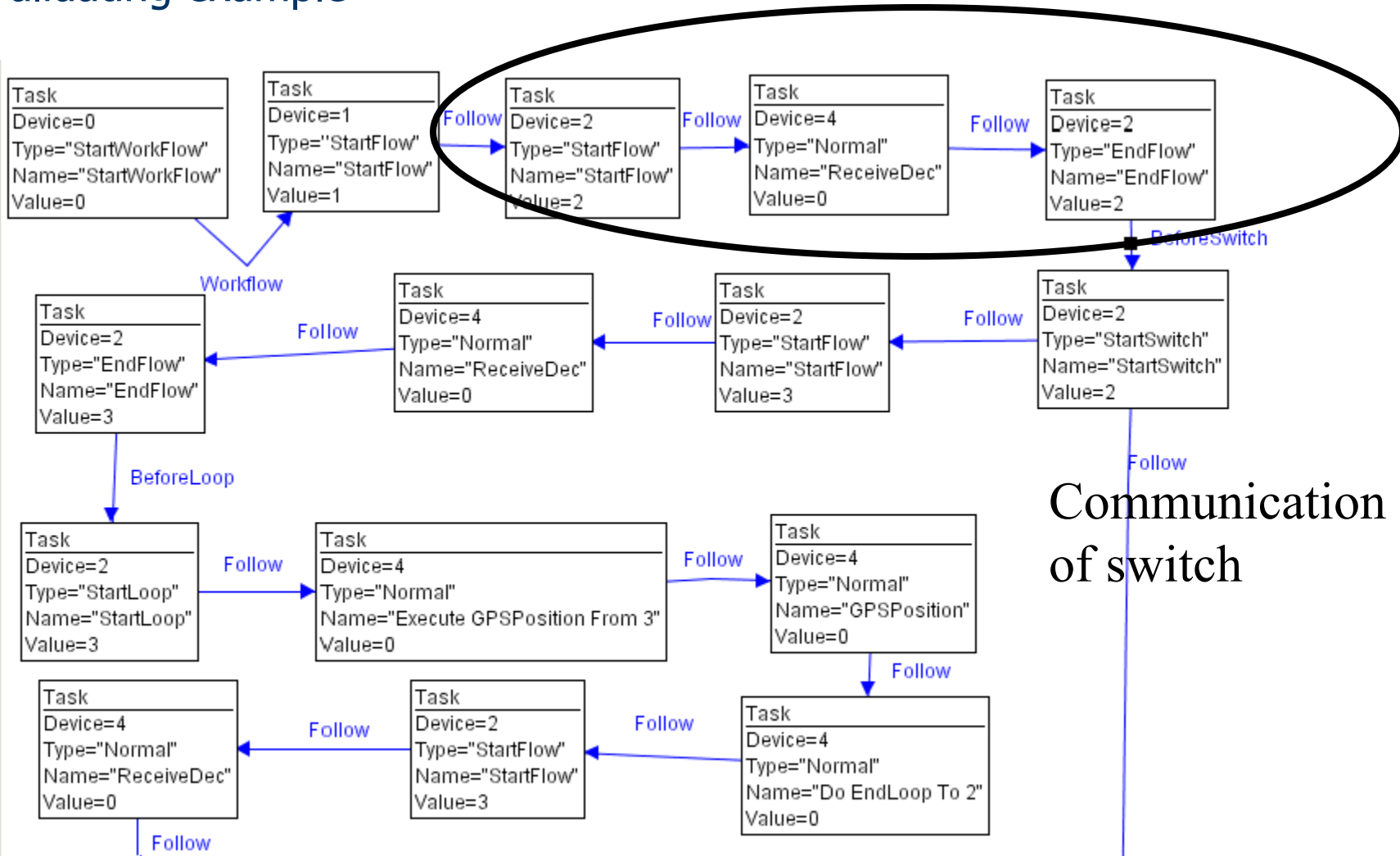
Validating example



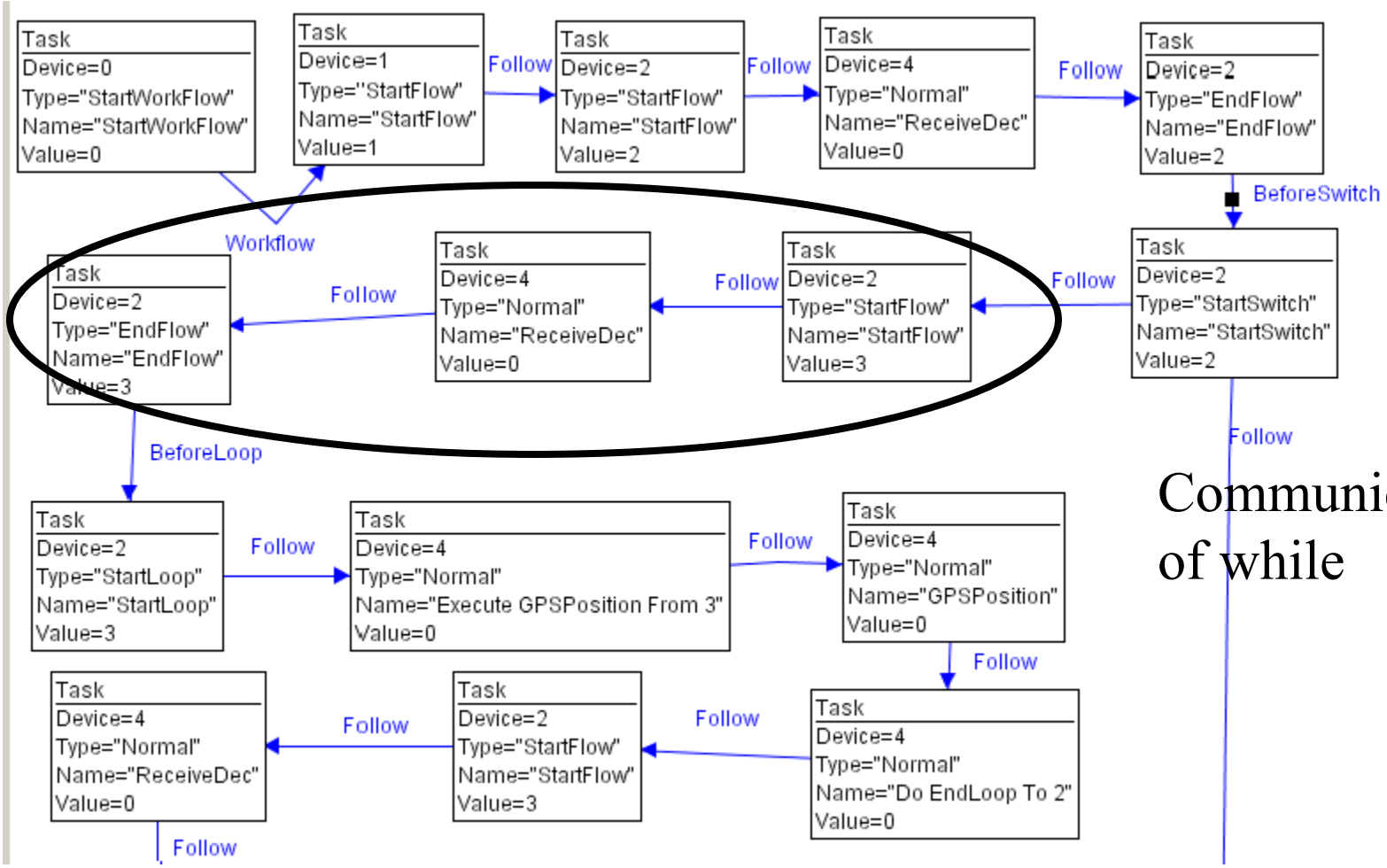
Validating example



Validating example

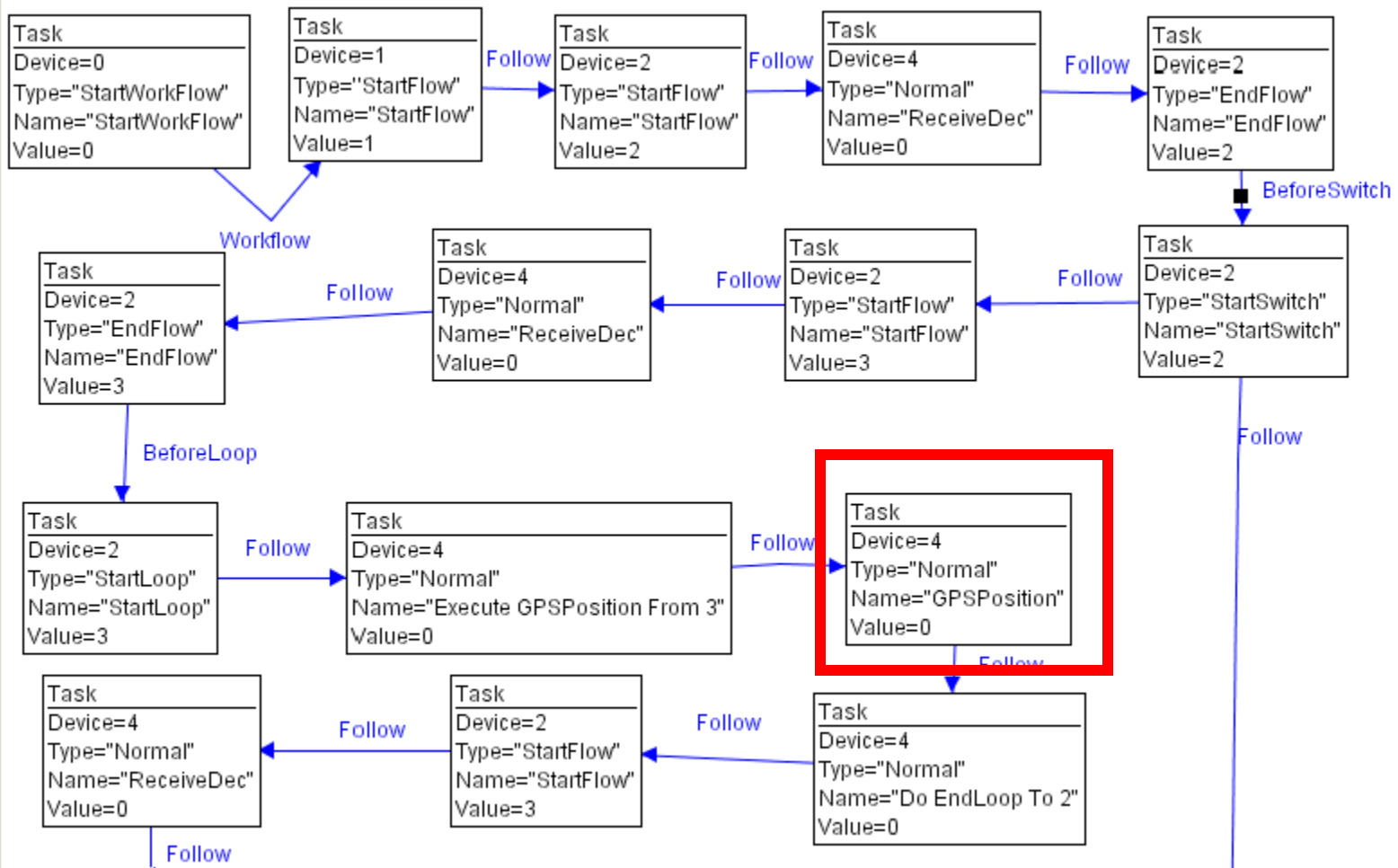


Validating example



Communication of while

Validating example



Conclusions and future work

- ❑ Use of graph transformation system to decompose a workflow specification
 - AGG tool
 - We partially demonstrated that our rules preserve the behaviour of workflow execution
 - Validation through examples
- ❑ Future Work
 - Complete the demonstration
 - Transactional behaviour
 - Complete tool support