WORKFLOW PARTITIONING IN MOBILE INFORMATION SYSTEMS
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Outline

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- 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

1: Container
weight/t = x

2: Truck
load/t = 0

3: Store
containers = y

5: in front of

1: Container
weight/t = x

2: Truck
load/t = x

3: Store
containers = y \cdot 1

5: in front of
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.
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 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
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
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 p1 may disable p2, or p2 may disable p1
- 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

Communication of switch
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