Formal Modeling and Analysis of Flexible Processes in Mobile Ad-hoc Networks

Aims

Emergency Scenario: Archaeological Site after an Earthquake
- Network of mobile devices
- Team members communicate with one another via wireless links without relying on an underlying infrastructure
- Team members execute sets of activities modeled as workflows
- MANETs topology both influences and is influenced by the workflow
- Modeling workflow modifications as required by topology transformations

Methods

Layered Architecture
- Separating different views with different granularity
- Layered architecture for modeling workflows in MANETs with three different aspects
- Distribution of workflows and mobility issues

GOAL

Adequate specification technique for multi-level modeling of workflows in MANETs

Mobility

1. Workflow Layer: general activities concerning the workflow
2. Team Layer: local view of team members’ workflows
3. Mobility Layer: movement activities for reacting on signals of probable disconnections sent by a predictive layer

Graphical Editor as Eclipse Plug-In
- Based on Graphical Editor Framework (GEF)
- Allows editing and simulation of specialized AHONs with fixed transition types
- P/T-nets and net transformation rules as tokens
- Simulation of P/T-net transformations via graph transformation tool AGG
- Prototypes developed by students in 2007
- Project website with downloads (August ’07): http://tfs.cs.tu-berlin.de/formalnet

Behavior and analysis of AHONs
- Structuring and transformation
- Simulation and validation of AHON behavior
- Compatibility of net transformation and transition firing [Petri Nets’07]
- Property preserving rules as restriction of rules and firing conditions

Research Focus

Tool Support

Contact: J. Padberg, H. Ehrig, K. Hoffmann (hoffmann@cs.tu-berlin.de)
Theoretical Computer Science/Formal Specification Group (TFS)
Technical University of Berlin

Algebraic Higher-Order Nets (AHONs)
- Algebraic high-level nets with P/T-nets and net transformation rules as tokens
- Integration of token game and rule-based transformation of P/T-systems by high-level transition firing
- Suitable algebra, e.g. for calculation of applicability of rules and resulting nets:
  - Predicate enabled(net, transition) is true if transition is enabled in net
  - cod(m) returns codomain of morphism m
  - applicable(rule, match) is true if rule can be applied to match
  - transform(rule, match) applies rule to a net at match morphism and returns the resulting net

Workflow

Net transformations
- Based on algebraic graph transformation, adapted to P/T-nets
- Rules with left hand side (LHS), interface, and right hand side (RHS):
  - Elements matched by LHS and not occurring in interface are being deleted
  - Elements occurring in RHS and not in interface are being created
- All other elements are being preserved

Workflows in layered architectures
- Methodology for modeling workflows in MANETs
- Notion of consistent layer environment
- Maintaining resp. restoring consistency during workflow adaption and execution
- Distribution of workflows for each team member

Contact: J. Padberg, H. Ehrig, K. Hoffmann (hoffmann@cs.tu-berlin.de)
Theoretical Computer Science/Formal Specification Group (TFS)
Technical University of Berlin