Multi-Agent System and Traffic Simulation

(ADS2008)

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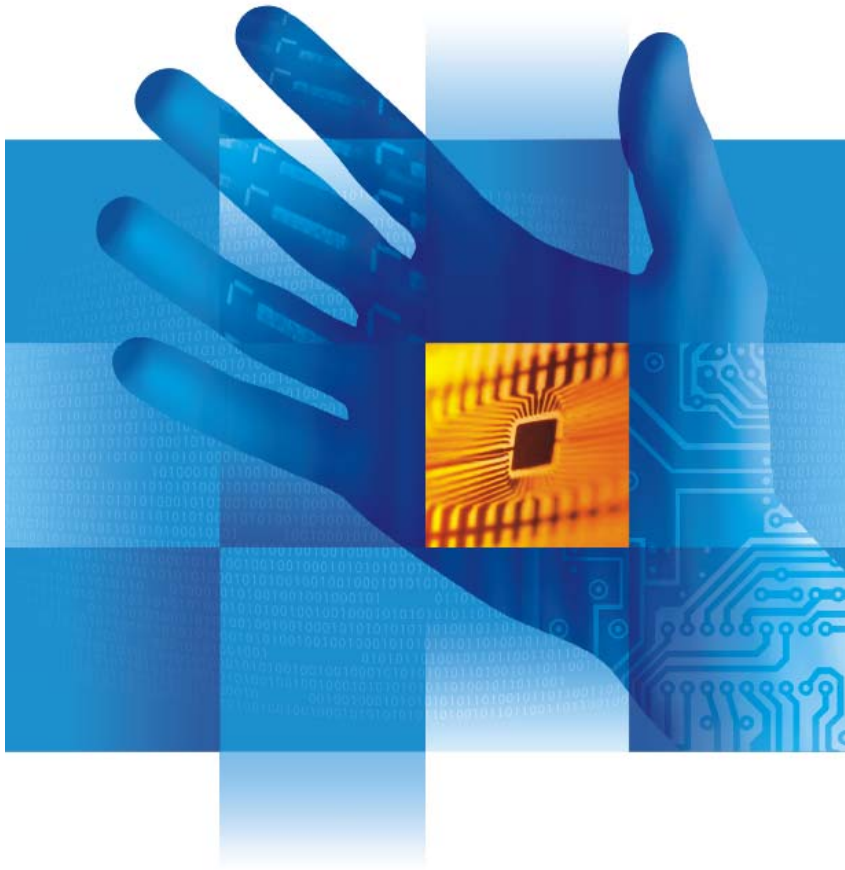

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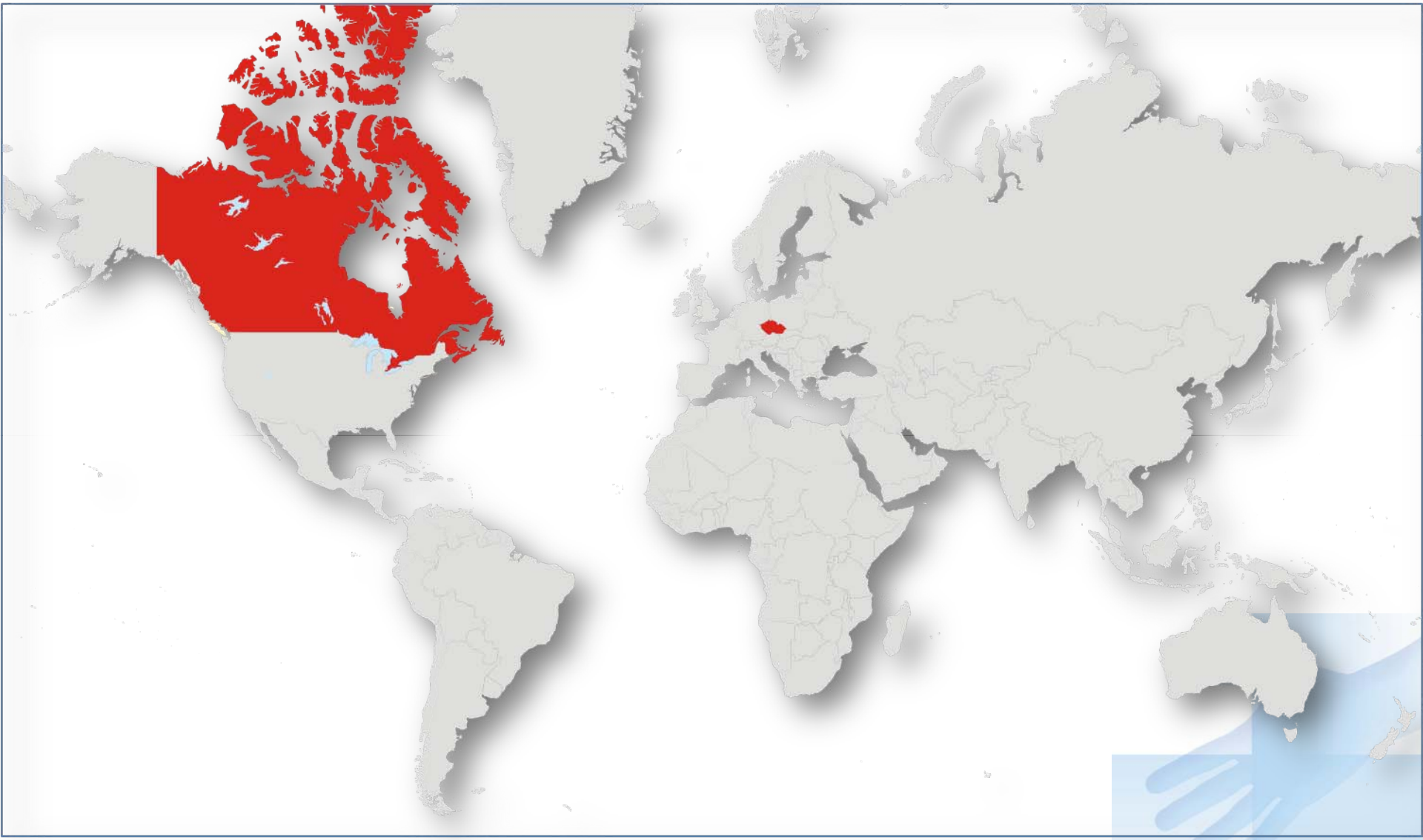


Outline

- Project introduction
- Modeling
  - Agent Behavior Diagrams
- Simulation
  - … traffic
- Conclusion

Project description

- **LabIS** (Research **Lab**oratory of **I**ntelligent **S**ystem)
  - it started 3 years ago
  - 3 studied areas
    - Logic
      - Logical analysis of natural language, knowledge representation, inference machines, TIL-Script development
    - **Processes**
      - Process management, control and coordination, process simulation and prediction
    - MAS & GIS
      - Communication, infrastructure, real data processing

- **Design and implementation** of MAS based on the process modeling, behavior modeling
- **JADE** (Java, .NET) as the framework for ***Agent****Studio* software.

Modeling & Simulation

- Modeling
  - extended UML
  - Agent Behavior Diagram (ABD)
  - Behavior reconfiguration
  - Semi-code generation

AgentStudio designer

AgentStudio simulator

- Simulation
  - The way how to prove the theoretical background
  - Connection to “logic components”
  - Traffic simulation

Agent Behavior Modeling

- The **Agent Behavior** refers to the actions or reactions of an Agent in relation to the environment and some situations. It depends on skills, knowledge and capabilities of particular Agent during its life.

- The **Agent Behavior Modeling** is a process where the particular Behavior is captured as algorithm. The model makes the basis for next phases of software process.

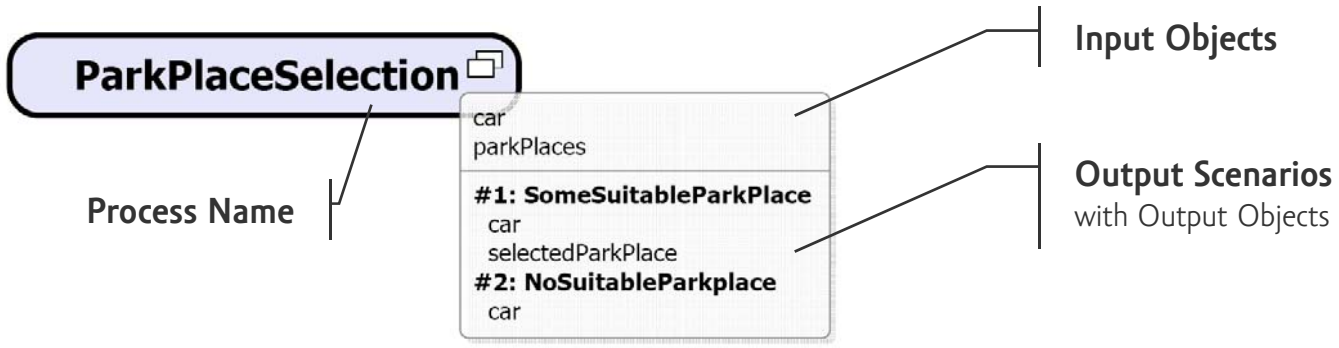
What is the Agent Behavior Diagram?

- It is a tool that helps us to model and specify the behaviors of agents.
- It is based on standard "UML Activity Diagram" technique.

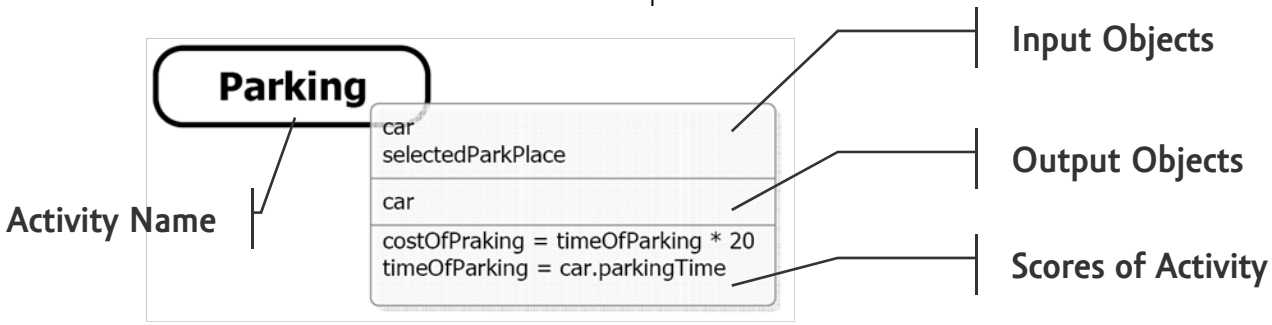
- Why a new diagram?
  - additional process specification
  - ensure the modification of MAS
  - conjunction of graphical and textual data which helps the programmers to imagine final behavior
  - it represents a background for further behavior reconfiguration

Agent Behavior Diagram elements

Extended Process Node
with additional information shape



Extended Activity Node
with additional information shape



Agent Behavior Diagram elements

Send Activity Node

one-to-one Agent communication
with additional information shape

Objects related to the Message
Input Objects in case of Send Activity

Message Receiver
one Agent of specified type

Send Activity Node

one-to-more Agent communication
with additional information shape

Message Receiver
all Agents of specified type

Receive Activity Node

one-to-one Agent communication
with additional information shape

Message Identification

Objects related to the Message
Output Objects in case of Receive Activity

Message Sender
one Agent of specified type

Agent Behavior Diagram elements

Receive Activity Node

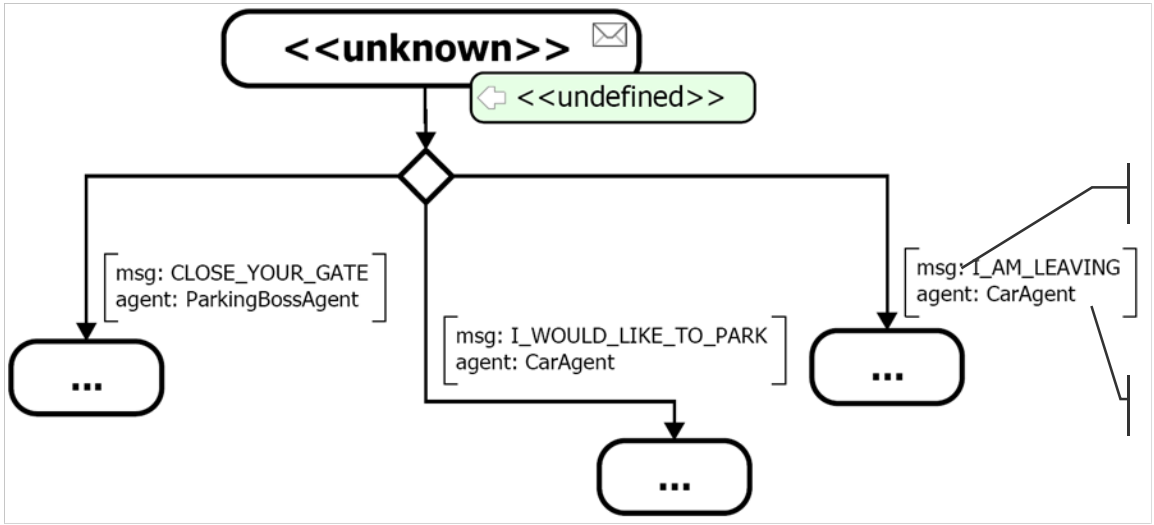
defined Message from unknown Sender
with additional information shape

Receive Activity Node

undefined Message from one defined Sender

Receive Activity Node

undefined Message from unknown Sender



Process and Realization

- The **Process** is a naturally designed sequence of operations or events, possibly taking up time, space, expertise or other resource, which produces some outcome. The Processes form the behavior of an Agent.

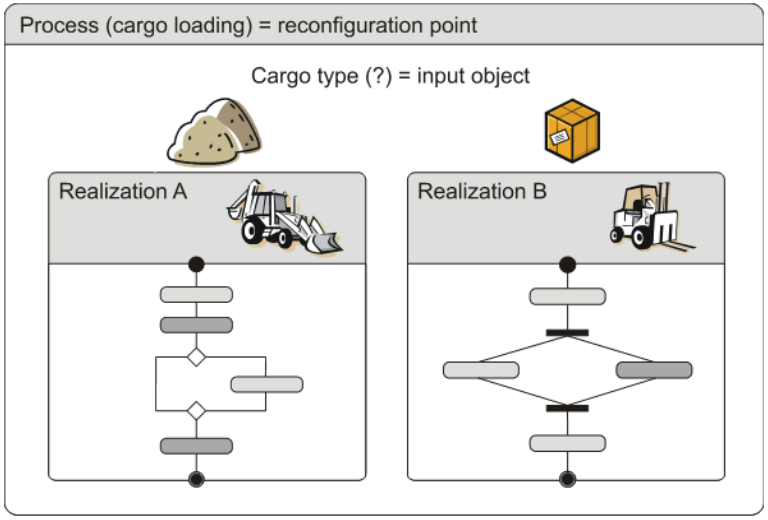
- The **Realization** is a model element that provides an description for implementation of an process element. By other words, the realization is one of possible algorithms for process firing; this algorithm is specified by one “Agent Behaviour Diagram”.

Behaviour Reconfiguration

1. **The Specification Phase**
2. **The Selection Phase** - checking of the applicable Realizations of a given Process and finding the most suitable one.
    1. the selection of applicable Realizations – based on Input Objects occurrence
    2. the finding the most suitable Realizations - based on Input Objects values and properties, Scores, etc.
3. **The Execution Phase**

loose material

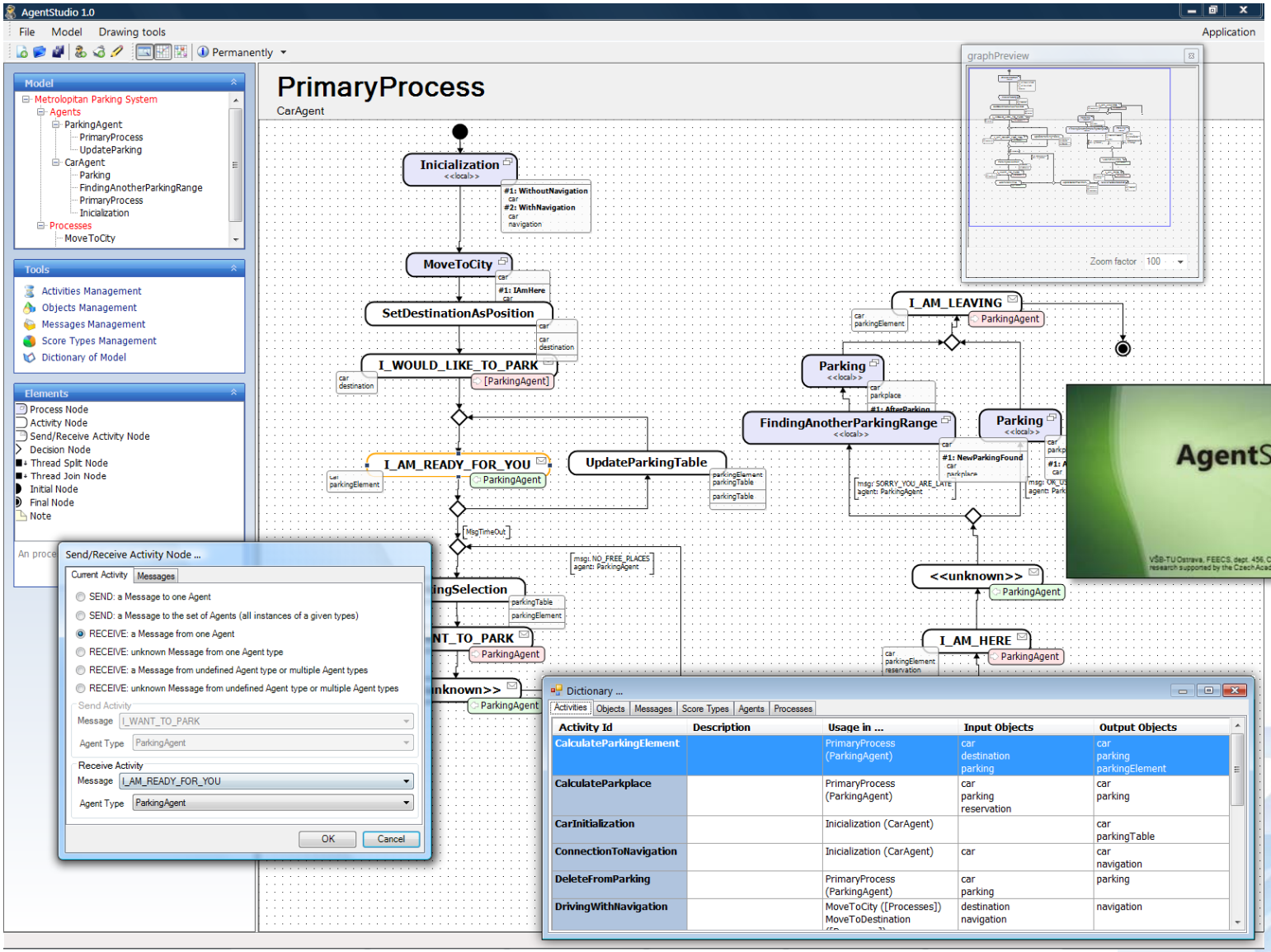
use excavator



solid material

use lift truck

AgentStudio Designer



Modeling & Simulation

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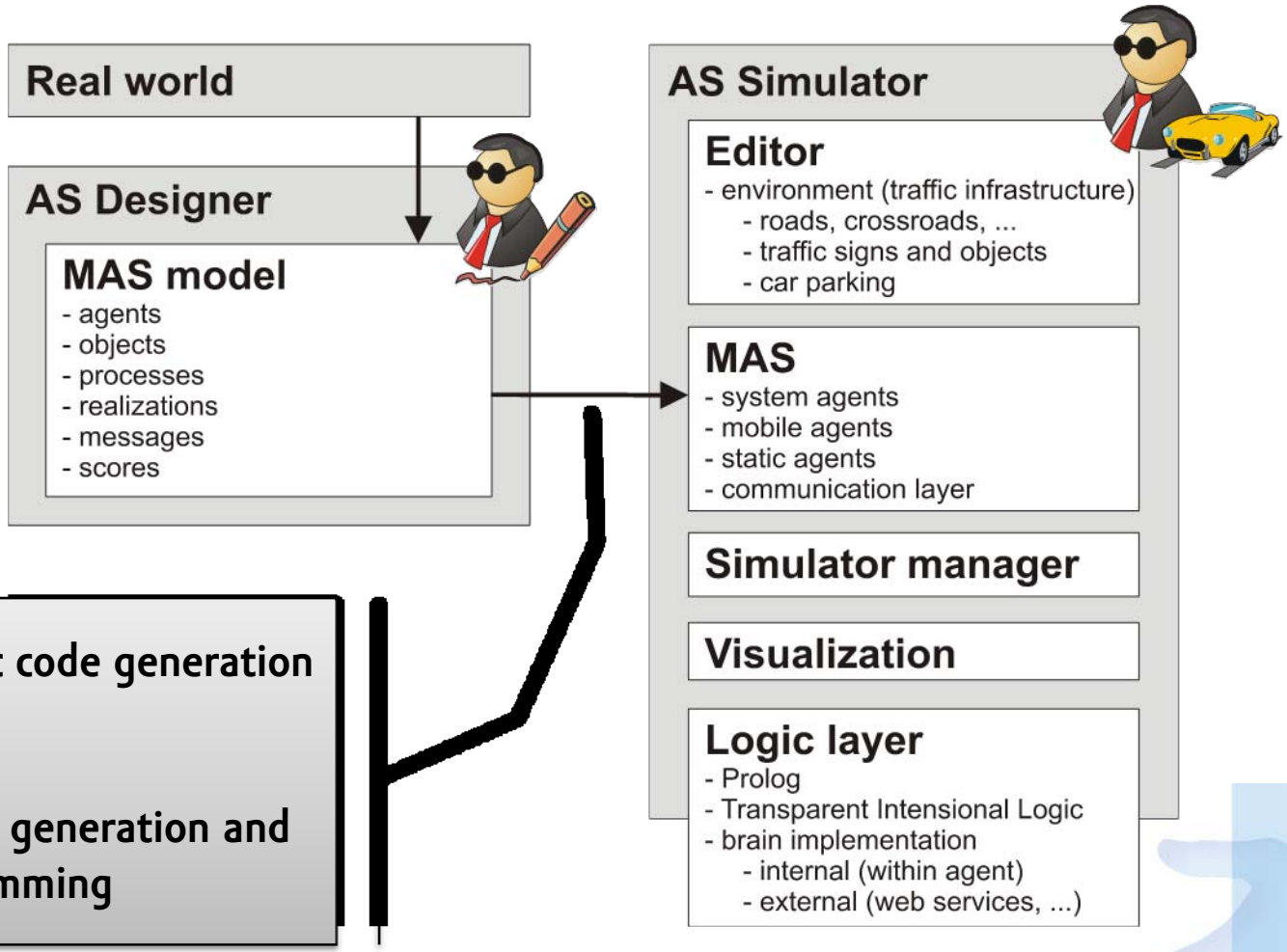
Simulations

- What we want to simulate?
  - behaviors of agents based on given laws
    - e.g. highway code, business rules, etc.
  - process reconfiguration and objective achieving
  - decision making based on first order logic and/or TIL
    - the comparison of different inference machines
    - knowledge exchange and distribution

- Why the traffic simulations?
  - “clear” rules
  - it is easy to model different situations
  - real data

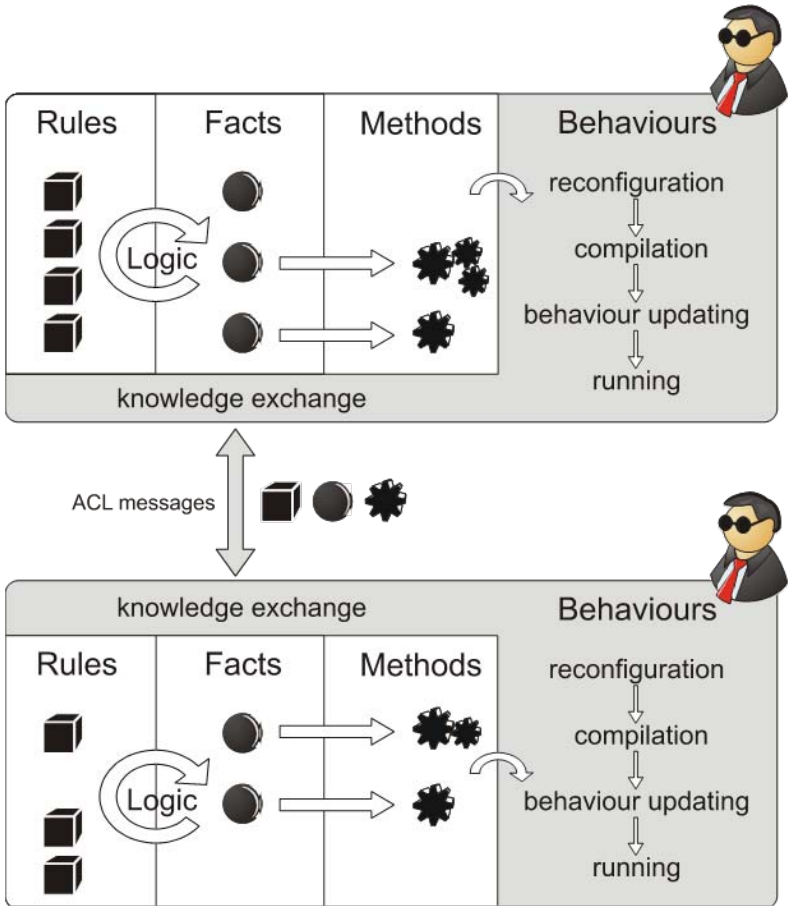
AgentStudio



Semi-automatic code generation based on ABDs

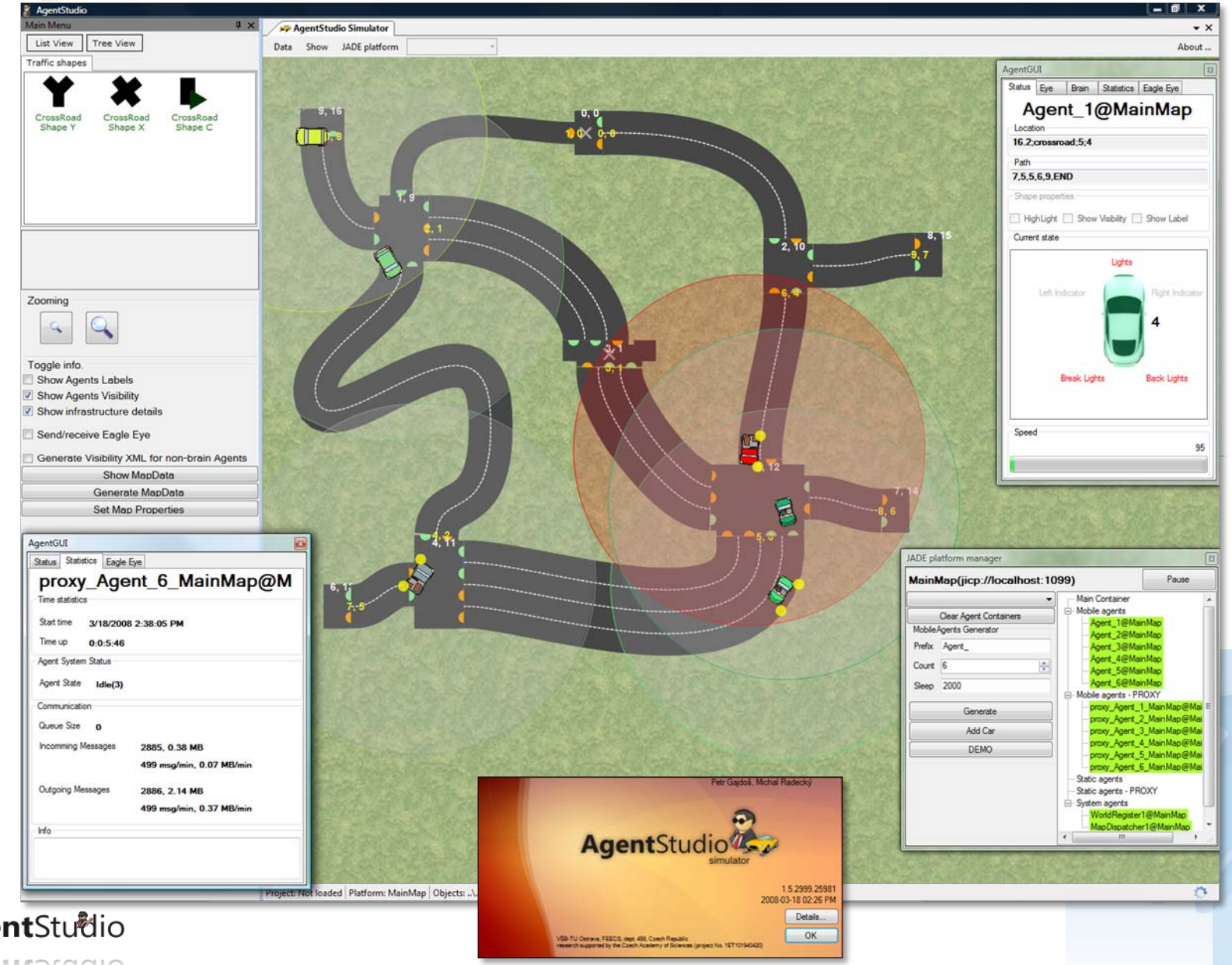
Code skeletons generation and manual programming

Agent architecture



- knowledge base
  - rules
    - first order logic
    - TIL
  - facts
    - world data
    - ontology
  - Methods
    - elementary program codes which do not depend on MAS architecture
- Behaviors
  - process-reconfiguration
  - dynamic dll codes
- ACL messages

AgentStudio Simulator



Future Work

- Specification of correct and complete meta-model of MAS Model
- Formalization of this meta-model, its components and “Agent Behavior Diagram” (Petri Nets, π-calculus, etc.)
- Map the MAS Model onto the other forms (XML, analytic tools, etc.) and semi-automatic MAS code generation
- Integration of the reconfiguration approach to the complex approaches of Agents` intelligence

Thank you for your attention …