JADE/MAPS Gateway

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Motivation (1)

• System supporting a glider pilot
  – Health monitoring sensors (context – altitude)
    • Blood pressure
    • Temperature
    • Oxygen level
  – Battery level sensors (context – temperature)
• Care for elderly people
  – Calling emergency services (context – health monitoring)
• Intellignet home
  – Reacting on sensor input to start Roomba (context – party)
Motivation (2)

• What is needed?
  – Sensors are small / focused / have minimal resources
  – Context awareness / “intelligent” operation requires “global view” / large(r) computational resources

• Needed → combination of sensors and “more powerful” resources

• Proposal
  – MAPS + JADE

• Here, we solve a specific technical problem for two selected agent systems
MAPS

- MAPS – agent oriented, JAVA based framework for WSNs, which are based on the SunSpot technology
  - Component-based lightweight agent server architecture
  - Due to limited amount of resources on SunSpot devices, MAPS agents cannot be used to complete complex tasks
  - MAPS agents can read data from built-in and attached sensors
  - MAPS agents communicate via MAPS Events
JADE

- Java Agent Development framework
  - One of the most popular Java-based agent platforms
  - Comply with the Foundation for Intelligent Physical Agents specification (FIPA)
- JADE agents communicate via ACLMessages
  - comply with FIPA ACLMessage Structure Specification
MAPS ⇔ JADE

• For considered systems “MAPS” and “JADE” agents have to communicate
  – Both platforms Java-based
  – Both use different communication mechanisms

• Proposed solution
  – JADE/MAPS Gateway (the gateway) → to send (bidirectionally) messages between JADE agents and MAPS agents
JADE/MAPS Gateway

- **Gateway** has to be on the JADE side of the bridge
- The **gateway** is composed of two parts
  - **JADE part** (a JADE agent) – JADE agents communicate with the **Gateway agent** as with a normal JADE agent
  - **MAPS part** (a *semi-functional MAPS Execution Engine*) - MAPS agents are **not aware** that the gateway (and the JADE agents) belong to a different platform.
JADE/MAPS Gateway (translation mechanism)

- Since ACLMessages are more complex than MAPS Events, the communication from the JADE side to the MAPS side has to be simplified.
- The gateway provides a special message structure (within the GatewayOntology) similar to the structure of MAPS Events.
- The GatewayAgent fills out a MAPS Event based on the special content of an ACLMessage.
- The translation from a MAPS Event to an ACLMessage is the reverse process.
JADE/MAPS Gateway (interaction with the gateway)

- For the JADE side, the gateway provides a special ontology (*GatewayOntology*), which describes actions that can be performed
  - *Register* – assign a MAPS ID to the specified AID and store a pair (AID, MAPS ID)
  - *Unregister*
  - *GetRemoteAgent* – receive list of known MAPS agents
  - *SendMessage* – translate an *ACLMessage* to a *MAPS Event*
- MAPS agents communicate with the gateway as with an *ExecutionEngine* (**nothing has changed**).
JADE/MAPS Gateway (interaction with the *gateway*)

![Diagram of JADE/MAPS Gateway interaction](image-url)
JADE/MAPS Gateway

• Benefits: the gateway has all advantages of being a JADE agent (autonomously performs complex tasks) and this solution does not interfere with the simplicity of MAPS agents

• Restrictions
  – JADE agents have to register themselves with the *gateway* (to be known to the MAPS agents)
  – The *gateway* has no capability of running actual MAPS agents
JADE/MAPS Gateway (implementation)

The component diagram of the gateway
Test Scenario

• Performance test
  – Measures the average time needed by the *gateway* to forward a message from the JADE agent and to process a reply from the MAPS agent (“round-trip” communication)
  – Variable
    • Number of agent pairs composed of one JADE and one MAPS agent (from 1 to 20 pairs)
  – Each test took 5 minutes to complete and was repeated 20 times to obtain a good confidence measure
Test Results

Forwarding time for multiple agents.
Concluding remarks

- *Gateway* will be added to the JADE add-on library.
- If MAPS will be ported to the different sensor hardware, *gateway* will be naturally usable there.
- *Gateway* mechanism can be used also for connecting JADE agents to other agent systems:
  - Translation is localized.
  - Encapsulation of details for both sides.