

Multi-Agent Systems

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Introduction to JADE

MESIIA – Master's Degree in Computer Security Engineering and Artificial Intelligence
MAI - Master's Degree in Artificial Intelligence

Outline

1. Agents
2. FIPA
3. JADE
4. Starting JADE
5. More resources

1. Agents

- An intelligent agent is a **computer system** that is capable of independent action on behalf of its user or owner (figuring out what needs to be done to satisfy design objectives, rather than constantly being told)
- They will require the ability to **cooperate**, **coordinate**, and (maybe) **negotiate** with each other, much as people do
- An intelligent agent is a computer system capable of **flexible** autonomous action in some environment. By flexible, we mean:
 - Reactive
 - Proactive
 - Social

2. FIPA

- FIPA: [Foundation for Intelligent Physical Agents](#)
- Defines software standards for heterogeneous and interacting agents and agent-based systems
- Their standard specifications include:
 - ACL Message Structure
 - Communicative Act Library
 - Agent Message Transport Service
 - Contract Net Interaction Protocol
 - ...

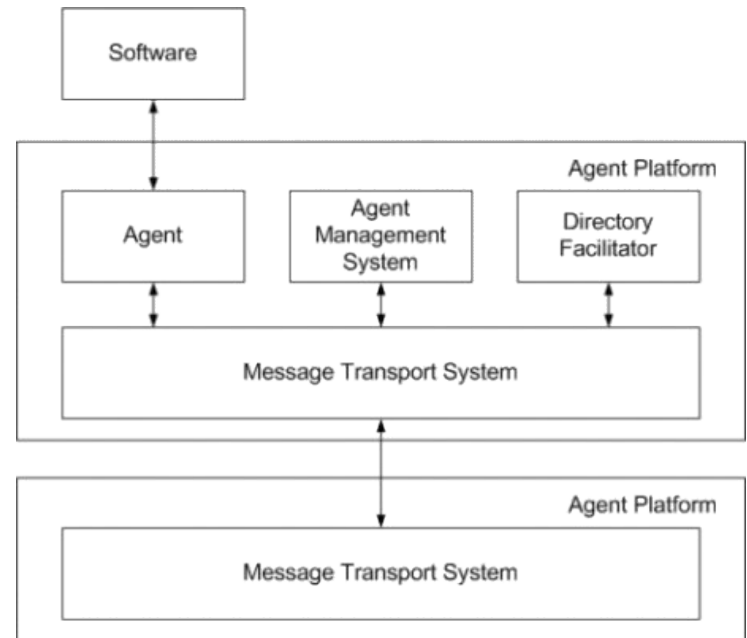


3. JADE

- JADE: [Java Agent DEvelopment Framework](#)
- Compliant with FIPA specifications
- Makes use of the FIPA communication language
- Eases the creation and coordination of FIPA-compliant agents

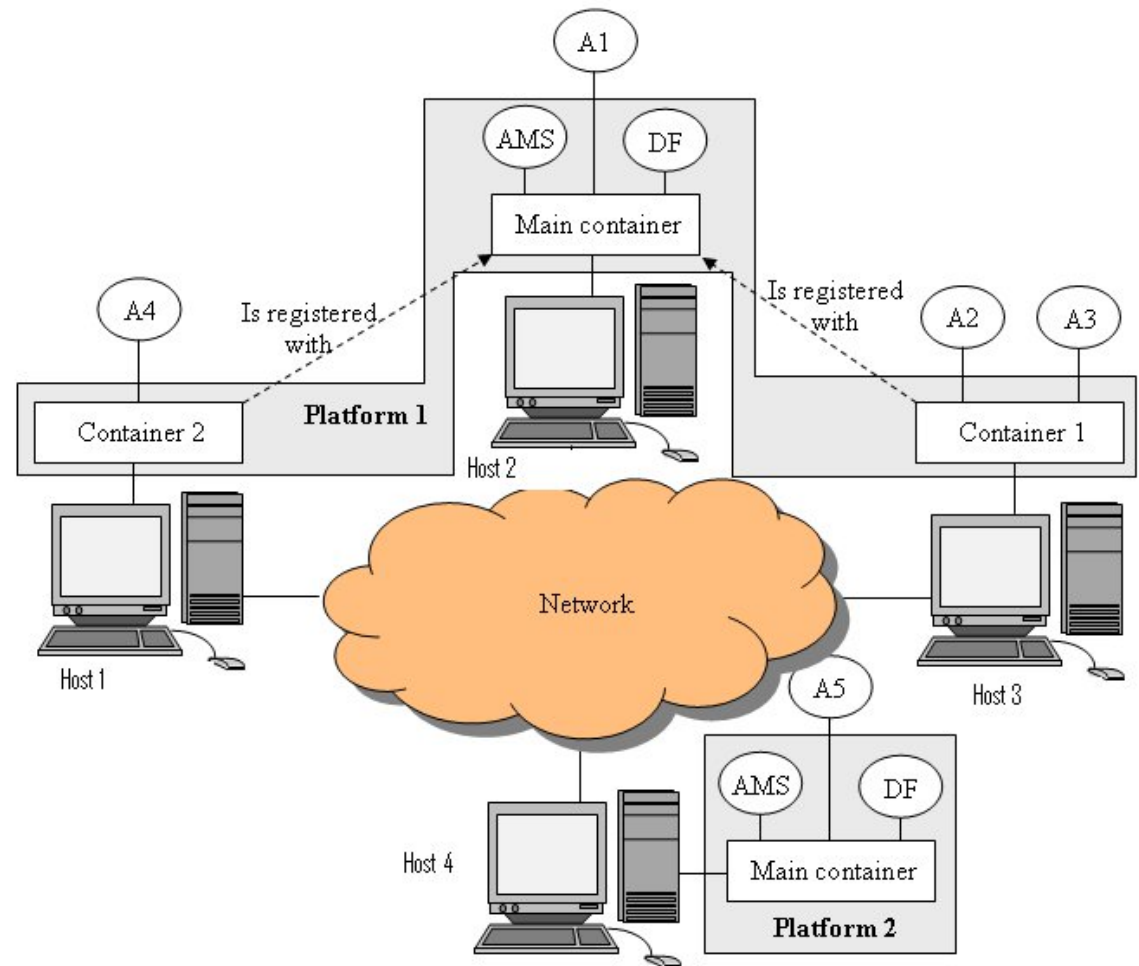
3. JADE: Architecture

- **Agent Management System (AMS):** Management actions. Start agents, kill agents, etc.
- **Directory Facilitator (DF):** Yellow Pages service. Find other agents providing certain services
- **Message Transport System (MTS):** sends messages between agents in the same or different platform



3. JADE: Architecture

- **Container:** can contain multiple agents
- **Platform:** set of active containers. Must always contain a **Main Container**



3. JADE: Services

Directory Facilitator

- Register
- Deregister
- Modify
- Search

Agent Management System

- Create an agent
- Kill an agent
- Suspend the execution of an agent
- Resume the execution of an agent
- Other management tasks (MTP, container management, etc.)

4. Starting JADE

Some additional options can be specified:

- **-container**: new agents will be stored in a new container. By default, are in the main-container
- **-gui**: starts a GUI managed by the Remote Management Agent
- **-host**: host where the agent runs. By default, localhost
- **-port**: by default 1099
- **-agents agentName:path.to.Agent(arg1,arg2): semicolon (;)** separated list with the agents to be started with JADE

Each parameter is introduced as a new *argument* in the Maven *profiles* section.

Reminder: arguments of options must be introduced in new *argument* lines. **Blank spaces are not allowed in the arguments**

4. Starting JADE: Exercise

1. Take a look at the *HelloWorldAgent* class, and try to guess what does this Agent do
2. Create a new Maven profile named **hello-world**
3. The **hello-world** profile has to:
 - Start the JADE GUI
 - Create a new agent named *helloWorld* of class *HelloWorldAgent*
 - Have the parameter “Hello world!” for the *helloWorld* agent
4. Compile and execute the **hello-world** profile
5. **Always** shut down the platform by selecting **File -> Shut down agent platform** on the JADE GUI. If issues arise because the platform has not been gracefully shutdown, execute *mvn clean*

4. Starting JADE: Exercise solution

- The Maven profile should be:

```
<profile>
  <id>hello-world</id>
  <build><plugins><plugin>
    <groupId>org.codehaus.mojo</groupId>
    <artifactId>exec-maven-plugin</artifactId>
    <version>3.1.0</version>
    <configuration>
      <mainClass>jade.Boot</mainClass>
      <arguments>
        <argument>-gui</argument>
        <argument>-agents</argument>
        <argument>helloWorld:urv.imas.HelloWorldAgent(Hello World !)</argument>
      </arguments>
    </configuration>
  </plugin></plugins></build>
</profile>
```

4. Starting JADE: Exercise solution

- Maven command to compile and run the *hello-world* profile:
 - `mvn install -P hello-world exec:java`
- After running the Maven profile using **Run Anything**, the following logs should appear in your terminal:

```
INFO: -----  
Agent container Main-Container@10.5.0.2 is ready.  
-----  
de set. 04, 2023 12:33:49 P. M. urv.imas.HelloWorldAgent setup  
INFO: Hello World !  
de set. 04, 2023 12:33:49 P. M. urv.imas.HelloWorldAgent takeDown  
INFO: Agent helloWorld terminating.
```

5. More resources

- [FIPA Protocols](#)
- [JADE Javadoc](#)
- [JADE Guides](#)
- [JADE Maven Setup for Beginners](#)