Deploying multi-agent systems on small devices

Cosmin Carabelea
Olivier Boissier
Adina Florea

ENS des Mines de Saint-Etienne
Universitatea "Politehnica" Bucuresti

Plan

- Introduction
- What is a multi-agent platform?
- Multi-agent platforms for small devices
  - portal: MobiAgent
  - surrogate: kSACI
  - embedded: LEAP
- Conclusions

Introduction (1)

- In order to intelligently assist the user in her tasks, applications on smart devices will have to be able to:
  - sense their environment and react to changes in it;
  - interact with the user and with other smart devices.
  - offer some services to the user and proactively compose these services;
- An agent is a computer system situated in an environment and having some of the following characteristics:
  - (adjustable) autonomy
  - reactivity
  - proactivity
  - the ability to interact (communicate, cooperate, negotiate) with other agents
  - the ability to reason about the existing organizational structures

Introduction (2)

- How to ensure a coherent behaviour of the system while allowing the entities in it to have locally autonomous behaviours?
- Similar targeted problems:
  - interaction between the diverse entities in the system;
  - open systems, check-in/check-out procedures, service discovery;
  - trust, reputation;
  - adaptation to new situations.
- One can approach a smart objects problem from the multi-agent point of view, thus taking advantage of a vast area of expertise, methodologies and solutions.

Multi-agent platforms

- A multi-agent platform is a software infrastructure used as an environment for agents' deployment and execution.
- Low-level services:
  - communication primitives
  - agent life-cycle management
  - check-in, check-out procedures
- High-level services:
  - communication and negotiation protocols
  - ontologies
  - organizational structures
- FIPA has produced standards concerning how a multi-agent platform should be structured.

Multi-agent platforms for small devices

- Small devices:
  - Java-enabled, with user-interface, the possibility to communicate with others. E.g. mobile phone, PDA.
  - they should allow the execution of rational, autonomous agents, able to interact with other agents and with the user.
- A classification of multi-agent platforms for small devices:
  - portal platforms – the platform is on a server, not on the small device: MobiAgent
  - surrogate platforms – part of the platform is on the small device, part on a server: kSACI, LEAP (v3.0)
  - embedded platforms – the entire platform is on the small device: MAE, AgentLight, Micro FIPA-OS, LEAP

Portal platforms: MobiAgent

- No links for downloading the platform, only one paper available.
- The system contains an agent gateway on which a multi-agent platform and several agents are executed;
- The user-agent interface is executed as a midlet on the small device;
- The small device – gateway connection is done via HTTP.
- Can be FIPA-compliant, it depends on the platform on the gateway
- It should work on any device that supports J2ME/CLDC/MIDP, including a mobile phone.

Surrogate platforms: kSACI

http://www.cesar.org.br/~rla2/ksaci/

- Extends the SACI platform:
  - KQML messaging;
  - Uses a facilitator for the white-pages and yellow-pages services.
- Each agent executed on a small device is connected via HTTP to a 'proxy' running on a PC;
- The proxy intermediates the communication between its agent and the other agents or the facilitator.
- Not FIPA-compliant.
- Smallest device targeted: mobile phone with J2ME/CLDC/MIDP.

Embedded platforms: Jade-LEAP

http://jade.cselt.it

- Since version 3.0, an add-on of the JADE platform.
- JADE platform:
  - agents are grouped in containers that intermediate the agent communication.
  - In the main-container there are agents providing the mandatory FIPA services: AMS and DF.
  - The Message Transport Service chooses the best protocol to use for agent communication: method invocation, RMI, TCP/IP, etc.
  - FIPA-compliant.
  - Java-based, runs on normal PCs, not small devices.

Embedded platforms: Jade-LEAP

LEAP:

- Works over fixed and wireless networks (WLAN or GPRS).
- Can be configured for different devices, OS and JavaVM.
- On each device/PC there is a container with one or several agents – the main container must be on a PC.
- For the small devices there are two execution modes (v.3.0): stand-alone vs. split.
- Keeps the FIPA-compliancy.
- Smallest device targeted: mobile phone with J2ME/CLDC/MIDP.

Multi-agent platforms for small devices - conclusions

Platform	MobiAgent	kSACI	LEAP	MAE	AgentLight	micro FIPA-OS
Connection to SD	portal	surrogate	surrogate/ embedded	embedded	embedded	embedded
Smallest targeted device	mobile phone	mobile phone	mobile phone	PDA	mobile phone	PocketPC
FIPA-compliant	it may be	no	yes	no	yes (?)	yes
No. of agents on device	0	1	several (pref.1)	several	several	several (pref.1)
Available for download?	no	yes	yes	no	yes	yes
JavaVM used	kVM	kVM	various	various	kVM	PersonalJava

Conclusions

- We have presented a survey of multi-agent platforms for small devices, underlining some of their major characteristics.
- Practical tests (LEAP on a Siemens S55) have shown that the phone supports the platform and an agent, but with a low execution speed.
- We have to answer some questions:
  - What is the integration type between the multi-agent platform and the small device?
  - What is the trade-off between the services the platform provides and its size?
  - Do we need FIPA-compliancy?