Intelligent agents & integration of business process

Frédéric CAMUZARD
Research Engineer
(Frederic.Camuzard@crm.mot.com)

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Presentation plan

• Introduction
• The Agent technology
• Advantages of Agent based infrastructure for integrating business process
• Conclusion
Introduction

• What is an Agent?

"Autonomous agents are computational systems that inhabit some complex dynamic environment, sense and act autonomously in this environment, and by doing so realize a set of goals or tasks for which they are designed."

Pattie Maes, MIT Media Lab,
Software Agents Group.
The agent technology

• Principles
• Standards
• Applications
Agent in computer science

In the evolution theory of computer science, Software Agents are in the line of descent of Component Oriented programming, and Object Oriented programming.

- inheritance
- polymorphism
- classes
- encapsulation
- interface
- ...

Component Oriented Programming

- reflection
- packaging
- serialization
- repository
- ...

Software Agent Programming

- ACL
- agent framework
- planning
- mobility
- rules
- goal/task-oriented
- autonomous
- ontologies
- collaborative/teams
- ...
# The attributes of software agents

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Meaning</th>
</tr>
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<tbody>
<tr>
<td>Autonomous</td>
<td>Capable of existing independently; has control of it's own actions</td>
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<tr>
<td>Reactive</td>
<td>Senses changes in its environment and responds in a timely manner</td>
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<tr>
<td>Goal-driven</td>
<td>Not merely responds to their environment, takes the initiative to achieve its goal; proactive</td>
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<tr>
<td>Persistent</td>
<td>A continuously running process; temporal</td>
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<tr>
<td>Social</td>
<td>Interacts with other agents (and / or users) using an agent communication language</td>
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<tr>
<td>Intelligent</td>
<td>Ability to learn and reason</td>
</tr>
<tr>
<td>Mobile</td>
<td>Ability to transport itself from one machine to another, retaining its current state</td>
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</table>
The leading Agent Standard: FIPA

Foundation for Intelligent Physical Agents

16 implementations
5 open source implementations
JCP

50+ supporting companies:
BT, Broadcom, CSELT, Motorola, Nortel, IBM, Siemens, Sun, FT, Fujitsu,…

Agent Platform
Yellow pages  White pages
Agent Communication Channel

Internet

Agent Platform
Yellow pages  White pages
Agent Communication Channel

Mobile Agent
Lightweight Extensible Agent Platform
Introduction to software agent approach for m-commerce
Software agent approach for m-commerce

A software agent is an autonomous piece of software. Intelligent software agent can communicate with their peers, reason about their environment, and apply behaviours to achieve goals.
LEAP project information
LEAP project information

- **LEAP** (Lightweight Extensible Agent Platform)
- **Reference:** IST-1999-10211
- **Effort:** 433.6 MM
- **Budget:** 5.4M Euros
- **Run:** Jan 2000 - June 2002
LEAP consortium

- Motorola - Lead partner, Platform and Agents on Handsets
- ADAC - German AA, Running German Trial
- BT - Trial Application, Running UK Trial
- Broadcom - Platform, Application, Trial
- TILAB (ex CSELT) - Platform development
- University of Parma - Platform Development
- Siemens - Agents on Handsets, German Trial
Objectives of LEAP

- Develop a Lightweight Extensible FIPA-compliant Agent Platform
- Become a reference compliant agent platform to support Agent developers
- Develop Agent Applications supporting a mobile enterprise workforce
- Assessment of Applications in Field trials
LEAP Platform
LEAP Architecture

- Field trials Application
- Travel Management
- Work Co-ordination
- Knowledge Management

User GUI’s
Admin GUI’s

Application logic

Generic Agent services

Lightweight Extensible Agent Platform

JVM
OS
Network
A Distributed Platform

- Container
- Yellow pages
- White pages
- Lightweight Container

LEAP Platform

External FIPA Transport Protocol
Platform Roadmap

Jan00
- JADE
- J2SE
- JVM

Dec00
- LEAP
- J2SE
- JVM

Psion NetBook
- LEAP
- JDK1.1.4
- EPOC

Psion 5
- LEAP
- JDK1.1.4
- EPOC

Jan00
- LEAP
- MIDP
- J2ME
- KVM

(Emulator)

Jan01
- LEAP
- MIDP
- J2ME
- KVM

(Emulator)

Palm
- LEAP
- MIDP
- J2ME
- KVM

PalmOS

Dec00
- LEAP
- MIDP
- J2ME
- KVM

iPAQ
- LEAP
- pJava
- WinCE

Dec00
- LEAP
- pJava
- EPOC

(Emulator)

Quartz
- LEAP
- JDK1.1.4
- EPOC

Motorola

Siemens

Psion
- LEAP
- JDK1.1.4
- EPOC

Motorola

Siemens

Psion

NetBook

Jan01

Psion 5

Jan00

iPAQ

Palm

Jan01

Motorola

Siemens

Psion

LEAP Agent Services
Decentralised work co-ordination
Creation of Virtual Teams
Collective decision making
Flexibility in work scheduling (e.g. job swapping)

Travel management
Anticipating a user's travel needs
Providing guidance and time estimation
Synchronising the movements of virtual teams

Knowledge Management
Anticipating user knowledge requirements
Accessing and customising knowledge
Providing access to collective knowledge assets in a team
Networking individuals with each other, based on their skills
LEAP Field Trial
• Assessment of Applications in Field trials, each lasting about two weeks:

  BT has 25,000 engineers performing 150,000 installation and repair tasks each day in the UK

  ADAC employs 1600 “Yellow Angels” for road-side assistance in Germany, performing 9600 incidents / repair cases per day while driving 150,000 km
For more information

http://leap.crm-paris.com
Control of Agent-Based Systems Project
Example of Agent application: CoABS

Control of Agent-Based Systems Project

James Hendler - Systems Architecture & Integration - Information Systems Office

Applications: Controlling the run-time integration of heterogeneous systems
Example of Agent application: CoABS

Connection is Dynamic
- Information sources bootstrapped
- Protocol negotiation
- Reaction after connecting

Agents broker network services
- Adapt to bandwidth and resources
- Control agent interaction
- Use mobility as appropriate

Heterogeneity is assumed
- Multiple standards and interfaces
- Semantics negotiated at run time
Example of Agent application: CoABS

The CoABS developments

• A mark-up language for networked agents
  • DARPA Agent Mark-Up Language (DARPA AML)

• Software tools for creating the agents
  • Taskable Agent Software Kit (TASK)

• A middleware layer creates a “software grid”
  • Continuation of CoABS investment
Agentcities.RTD

Testbed for a Worldwide Agent Network: Research and Development
Project general information

• Name: Agentcities.RTD
• Reference: IST-2000-28385
• Effort: 495 MM
• Budget: 6.17 M Euros
• Run: July 2001 - July 2003
Agentcities.RTD worldwide deployment of FIPA agent platforms
Agentcities.RTD Consortium

• Motorola
• Associação para o Desenvolvimento das Telecomunicações e Técnicas de Informática
• AEGIS
• Agentescape AG
• Broadcom Éireann Research
• BTexact Technologies
• Communication Technologies
• Deutsches Forschungszentrum fuer Kuenstliche Intelligenz GmbH
• Ecole Polytechnique Federale de Lausanne
• Fujitsu
• Imperial College of Science, Technology and Medicine
• Queen Mary, University of London
• Universitat Politècnica de Catalunya
• Università degli Studi di Parma
Agentcities.RTD Objectives

The objective of Agentcities.RTD is to create an innovative, technologically well-founded environment supporting high level, dynamic composition of heterogeneous on-line services. The project intends to achieve this by leveraging standards and technology for intelligent agent interoperation and communication to:

• Deploy a worldwide test network of loosely coupled on-line agent platforms with 12 nodes spread across Europe, 1 in Japan and 1 in the USA.

• Enrich the living test environment to support business, financial and semantically rich interactions between the systems in the environment - enabling dynamic value creation.

• Populate the platforms with smart, autonomous services representing information services for the physical cities the platforms are located in - including both building block services and value added services composing lower level components.
Agentcities.RTD detailed Objectives

• O1. **Open Network Architecture**: Achieve advances in technology / understanding of open systems supporting many heterogeneous, autonomous interacting entities to produce sustainable network architecture for on-line open systems.

• O2. **Dynamic Value Creation**: Achieve greater understanding of the type of mechanisms, methodologies and techniques required to achieve seamless, effective service composition in an open dynamic environment.

• O3. **Service Level Interoperability**: Perform validation and refinement of agent communication technologies (such as semantic models, ontology models, content expression techniques and interaction protocols) for use in open dynamic environments.
Agentcities.RTD detailed Objectives

• **TO4: To create a testbed network**: an open, extensible and permanently available agent testbed backbone, which supports high-level semantic interoperability between systems to enable formation of novel, dynamic value constellations.

• **TO5: The collection of sufficient technical knowledge** and understanding of dynamic open environments to facilitate transition to widespread usage in reliable commercial systems.

• **SO6: To understand the significance of open systems** from the perspectives: composition of heterogeneous services, communication between autonomous systems, emergent behaviour in large dynamic systems.

• **DO7: To demonstrate the utility and potential of the technology** by creating a credible, useful, and well-supported initial mass of deployed infrastructure and services which will enable and encourage take up of the technology by third parties.
Agentcities.RTD Operational Goals

• G1. To implement a realistic, decentralised, open distributed system enabling high-level peer-to-peer interoperability between agents on multiple platforms across Europe and the World (WP2).

• G2. To develop a rich trading environment through agent-based business services, enabling business transactions between agents in the system to support the dynamic composition of services in a Just-In-Time manner (WP3).

• G3. To create agent-based applications by deploying hundreds of agents offering diverse services which can turn platforms into “Agentcities” by offering leisure, entertainment and community services for European and World cities (WP4).

• G4. To ensure that the network, platforms and services are open to and accessible by project external users - thereby serving as a continuously running demonstrator and resource for others (WP5).
For more information

http://www.agentcities.org/EU
Advantages of Agent based infrastructure for integrating business process
Automation

Agent based programming allow to develop entities that realise behaviours. These entities can be included in the business process in order to automate it and remove some of the human interactions introducing a level of autonomy into the decision process.
Dialog and conversations

Agent based programming allow to develop entities that communicate using an Agent Communication Language (ACL). This type of communication is based on “speech acts” and exchanges of messages that use a “semantic language” (e.g. SL0). Series of messages can be described in protocols defining the type of messages, and their position in a particular sequence. In the messages the information is transmitted through references to elements of published ontologies. An agent can handle different conversation (identified through a conversation ID) in parallel. This capabilities allow flexibility within application in a distributed environment. These features can exploited in a business environment.
FIPA interoperability

The FIPA standards provide specifications for the interoperation of heterogeneous Agent based systems. The following TCs are working under supervision of the FIPA Architecture Board: Architecture, Compliance, Gateways, Ontologies, Semantics. The specifications produced allow building infrastructure including heterogeneous systems. The Agentcities network is one of them. Through the implementation of this standard, business frameworks could be built including heterogeneous platforms. This area is clearly under research and would benefit from the inputs of business software sellers.

For more information see http://www.fipa.org
FIPA work on Semantics for conventions and contracts

The Semantics Framework SIG in FIPA is dedicated to provide support for manipulating concepts and formal linguistic mechanisms to express the semantics involved in the interoperation of agent systems. This includes the following concepts: Trust, Ontologies, Contracts, Shared Plans, Policies, Conventions, Policy Domains. The definition of such concepts could ease the interoperability between heterogeneous system and can be included in upper layers for building interoperability framework.
m-commerce & agents

The LEAP project (previously presented) offers an implementation of a distributed FIPA Agent platform for building distributed applications over different types of J2ME MIDP compatible devices. This project open the way for building many types of applications including m-commerce. The agent technology developed in this area allow new implementation of the business process in a distributed environment, that matches the emerging needs of the customers.
Agentcities & service aggregation

The Agentcities network of FIPA compliant platforms allow building a global network for Agent based services deployment. In its applications the Agentcities network will offer support for dynamic aggregation of services in order to fulfill precise request. This approach will need development in the area of dynamic contracting, on line billing, trust and commitments. All these applications will benefits from the actual experience in business process management, and open the way to new type of dynamic collaboration within a business framework.
Conclusion

The agent technology is addressing the need for open infrastructures and services, and to support dynamic, mobile enterprises.

This technology is still under research, but it provides some results that could be useful to allow interoperability in the business process.

This technology could really benefit from the existing work in the business process field, and inputs are WELCOME!
References

• Slides 3,6: Definition from http://www.geocities.com/ResearchTriangle/Thinktank/4633/Agents_definition.html

• Slides 24-27: From DARPA work http://coabs.globalinfotek.com/
Back up
Java™ 2 Platform, Micro Edition (J2ME™) encompasses VMs and core APIs specified via Configurations as well as vertical—or market-specific—APIs specified in Profiles.