Towards the deployment of an open Agent World[1]

Vers le déploiement et l'ouverture d'un monde Agent

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ABSTRACT. *Successes of Agent Technology are overshadowed by a key problem which the Agent community has not yet managed to solve: the communication between agents. This article analyses the issues and proposes solutions for the communication of agents, their implementation, and their deployment, worldwide. These solutions are existing open processes. They can overcome the communication issue and lead Agent Technology towards new frontiers*

RÉSUMÉ. *Les succès des technologies agent sont éclipsés par un problème de fond que la communauté agent n'a pas encore su résoudre: les communications entre agents. Cet article analyse les difficultés et propose des solutions pour la communication des agents, leur réalisation informatique et leur déploiement à l'échelle mondiale. Ces solutions sont des processus ouverts auxquels chacun peut participaticiper pour résoudre le problème de communication et mener la technologie agent vers de nouveaux horizons.*

KEY WORDS: *Agent Technology, FIPA standard, agent deployment, AgentCities. .*

MOTS-CLÉS : *Technologie Agent, standard FIPA, deploiement d'agents, AgentCities.*

[1] Invited conference at the Journées Francophones d'Intelligence Artificielle Distribuée et de Systèmes Multi-Agents (JFIADSMA2000), to be published by Hermes Eds. October 2000.

1. Introduction

The key property of an agent is to communicate with others, whoever and wherever they are. This communication problem has been overlooked in the past, and still stunts the growth of agent technology. The initial growth led agent technology to an anarchic Babel tower scenario, where most of the agents are unable to inter-operate and are therefore defeating their very purpose of existence.

We believe that a standardisation process is needed to lead Agent Technology towards scientific and commercial success. Take the GSM example as a brilliant win of a unique standard over competing proprietary technologies and a tremendous source of growth for the domain of mobile telecommunications.

Three steps need to be reached to assure the growth of Agent Technology:
- A single agent standard, so that all agents can communicate,
- One or several freely accessible implementations of standard agent platforms, running on all kinds of devices through several communication links,
- A large scale deployment of agent technology and services, freely accessible for experimentation and demonstration.

In the first part of this article we present the Foundation for Intelligent Physical Agents (FIPA) the leading agent standard working on the interoperability and standardisation of agents. In the second part we present the European project LEAP (Lightweight Extensible Agent Platform) designing and implementing FIPA agents for as small devices as mobile phones and PDA, and communicating in fixed and wireless infrastructures. Finally we describe AgentCities an initiative to deploy agents technology in a wordwide network prefiguring the intelligent and proactive infrastructure of tomorrow. AgentCities will be an open testbed allowing anybody to add new services on top of the existing ones, develop and experiment composite services on top of them.

1.1. Agents and Agent Platforms

Agents are autonomous pieces of software that can communicate and co-operate between themselves, they have a unique identity, are context sensitive, show a behaviour and, social attitudes, apply policies, and are often used to act on behalf of users inside agent societies.

Agents are living on an Agent platform (AP) which provides them with basic services: white and yellow pages as well as an Agent Communication Channel, inside of an AP and between APs. Agents are naturally distributed and ubiquitous. In case of mobile agents, they can move from one platform to the other. See an illustration of Agents and Agent platforms in Figure 1.

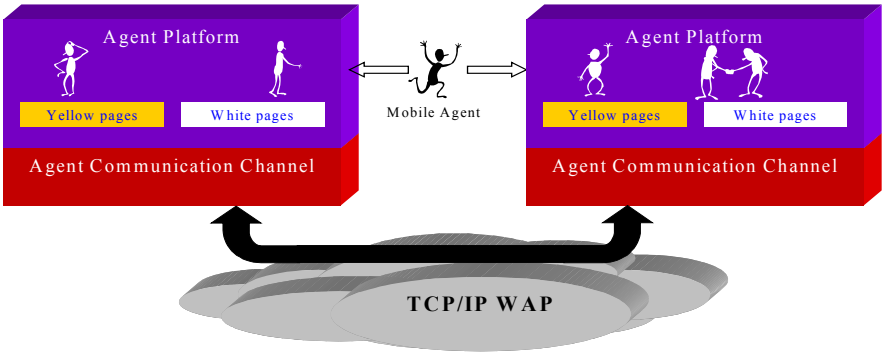

Figure 1. *Agent Platform*

2. An Agent Standard: FIPA [FIPA]

The Foundation for Intelligent Physical Agents (FIPA) is the leading body in agent standardisation.

The FIPA membership is growing. There are currently about 60 member companies, almost equally representing Asia, Europe and America with a strong representation of telecommunication and software companies.

The FIPA standards follow an open process. FIPA meets four times a year, for a one-week period, in which Technical Committees and Work Groups develop the specifications. The participation in FIPA meetings is free. Members are invited to participate as well as anybody who wants to contribute to the technical progress of the work. Everybody can send technical proposals, comments and even submit work-plans to FIPA. In between the meetings the work progresses via email reflectors and sometimes through ad-hoc meetings.

The newly re-designed website: www.fipa.org gives access to all the FIPA information, meetings, registrations, instructions on how to join, activities etc. It also allows the downloading of the standards through various means, either by selecting the status of the specifications, by looking at the functions performed or by asking the latest version. This interface is simple and easy to use, all specifications are just one click away.

2.1. Status of specifications

FIPA achieved a first set of specifications in 97 (FIPA97) and these have been implemented by several companies. This led to interoperability tests in January1999.

Meanwhile FIPA has improved the specifications in 1988, by fixing the faults and worked on security, ontologies, user interface, and communicative acts.
In 1999, FIPA revisited and abstracted the architecture, improved the Agent Communication, changed the naming, extended the transport layers like TCP/IP and WAP so as to reach the world of mobile and wireless applications, and designed nomadic applications. Most of these specifications have now reached the status of "experimental" which means they are stable, coherent and ready for implementation.

2.2. Current work tallies, TC and WG

FIPA has currently four technical committees:

- TC Architecture. Its mission is to construct abstract architectural specifications that provide a framework in which services necessary to support the end-to-end interoperability of agents are made available. In particular, this means that TC Architecture has the responsibility of maintaining the FIPA Abstract Architecture. In addition, current activities revolve around policies and domains to produce the specification of policies in a machine-readable declarative manner and their application to the context of services.

- TC Agreement Mgt Agreement will produce three closely related specifications:

    - Agent Configuration Management Specification allowing the FIPA platforms to manage and maintain large populations of platforms and agents, to define their configurations and dependency links between them, and to provide management and configuration methods,
    - Agreements Specification creating a specification of agreements, or contracts, between agents and a specification of the services within those agreements,
    - Service description ontology describing explicitly and formally agent services, in particular the ones already defined in FIPA agent management specs PC00023,

- TC C addresses FIPA's basic responsibilities in the area of specifying and maintaining an agent communication language, along with libraries of predefined communicative act types, interaction protocols, and content languages,

- TC Gateways covers high level interoperability requested to nomadic application that span over two clearly separate domains in wireless and wireline networks.

FIPA has currently four permanent work groups:

- AgentCities WG is to encourage and support the development of a *continually available*, *publicly accessible* network of deployed FIPA Agent services. The purpose of the network is to serve as an experimental testbed for interoperability testing, application development and as a showcase for FIPA technology. The work group supports the development of the network by engaging in coordination activities such as holding regular meetings and producing informative guidelines for the application of FIPA specifications,

- Image WG is to develop and promote the image of FIPA through several actions like : the edition of the FIPA Inform! Newsletter, the re-design of the FIPA website, edition of an introduction to the FIPA procedures, the specifications and participation, the collection of articles and presentation material, the contact to national and international projects, the sponsorship of conferences, the organisation of software competitions, etc,

- Java Community Process WG is to make the liaison and co-ordinate the efforts between the FIPA specifications and the Java Community Process developing and Agent Environment for Java,

- Product Design and Manufacturing WG explores and promotes using pre-existing FIPA platforms for developing applications for the product design & manufacturing domain. With this activity the WG will provide FIPA with value-added opinions on the accuracy of existing specification documentation for the Product and Manufacturing.

2.3. Some European projects using/developing FIPA technology

2.3.1. FACTS: FIPA Agent Communication Technologies and Services (ACTS Project AC317)

The goal of the FACTS project is to validate the work of FIPA and other standards groups by constructing a number of demonstrator systems based on its proposed standards. The focus of the project is in the interaction between differently-implemented agents. The project will be structured around two development cycles. During phase I, agent interoperability will be tested primarily within each of three application areas. These areas are: 1. audio-visual broadcasting and entertainment; 2. service reservation; and 3. electronic commerce (a travel-based example has been selected). During phase 2, agent interoperability will be tested between the different application areas.

2.3.2. MODEST: Multimedia Object Descriptors Extraction from Surveillance Tapes (ACTS Project AC304)

Define and develop a framework for analysing video sequences in order to extract high-level semantic scene interpretation based on:

- the segmentation, tracking and indexing of moving objects in video scenes (in link with the COST 211quat);
- the use of high level descriptors (MPEG-7);
- the use of Intelligent Physical Agents (IPA) for high level reasoning (link with FIPA).

The work will also be performed in the scope of the MPEG-4 standard. The project will be demonstrated in a video surveillance application.

2.3.3. MAPPA: Multimedia Access Through Personal Persistent Agents (ESPRIT Project EP 28831)

MAPPA involves the convergence of research and technology in a number of domains such as common object description, software agents and multimedia user interfaces. These technologies will be integrated in a generic way and applied in the retail industry. This will be done through the implementation of personalised agents which will filter information for customers, draw on behaviour patterns for focused marketing of products and track reward schemes whereby loyal customers are rewarded by retail chains for their continued custom.

2.3.4. MESSAGE: Methodology for Engineering Systems of Software Agents (EURESCOM Project P 907 GI)

The focus of the work is the extension of methodologies for object-oriented software development to agent-oriented applications as well as tools, which support this methodology. This should encompass the whole software life-cycle, analysis, design, implementation, testing, installation, and reiteration. The methodology should be centered around the agent oriented realisation of telematics services and telecommunications applications. The work should make use of experiences made in other EURESCOM projects like P712 and P815, and should take into account work going on in FIPA.

2.4. Open source FIPA platforms

Several FIPA platforms have been developed and tested in large scale projects and are distributed under Open source licence, see Table 1.

Company	**Agent Platform**	**URL**
Comtec (Jp)		http://www.fipa.org/glointe.htm
CSELT (It)	JADE	http://sharon.cselt.it/projects/jade

Fujitsu Labs (USA)	AAP	http://www.sourceforge.net/
Nortel Networks (UK)	FIPA-OS	www.nortelnetworks.com/fipa-os

Table 1. *Open source platforms*

Once you have an Agent Platform, you desire an Agent development environment. ZEUS has been designed for the rapid development of collaborative agent applications. ZEUS is distributed under Open source licence, see Table 2.

Company	**Platform**	**URL**
British Telecom (UK)	ZEUS	http://www.labs.bt.com/projects/agents/zeus/

Table 2. *Agent development environment*

3. An Agent Open Source Agent Environment: the LEAP project [LEAP]

3.1. Overview of the LEAP project

Project LEAP (Lightweight Extensible Agent Platform) addresses the need for open infrastructures and services that support dynamic, mobile enterprises. It will develop innovative agent-based services supporting three requirements of a mobile enterprise workforce: Knowledge management (anticipating individual knowledge requirements), decentralised work co-ordination (empowering individuals, co-ordinating and trading jobs), travel management (planning and co-ordinating individual travel needs).

Central to these agent-based services is the need for a standardised Agent Platform. Project LEAP will develop an agent platform that is - lightweight, executable on small devices such as PDAs and phones; extensible, in size and functionality; operating system agnostic; mobile team management enabling, WAP and TCP/IP supporting; and FIPA compliant. One of the goals of the consortium is to disseminate the Agent Platform in open source at the end of the project.

LEAP is supported by the EU Information Society Technologies under number IST-1999-10211. The LEAP consortium is constituted by: Motorola (co-ordinator), ADAC, Broadcom, BT, CSELT, U. Parma and Siemens. The project started in January 2000 and has a duration of 30 months. The major milestones include the production of a first version of the LEAP platform including lab trials and proof of feasibility, in January 2001. Next step is to provide LEAP Version 2.0 which will physically run on small devices such as PDA's and phones, in September 2001. An

initial version of the agent services supporting the mobile workforce is scheduled for October 2001 with field trials planned for June 2002. These field trials will cover two domains, supporting telecom customer service engineers in maintaining telecom networks, and helping mechanics during emergency road-side assistance.

3.2. The Lightweight Extensible Agent Platform

LEAP is a precursor of the second generation of FIPA-compliant platforms. It represents a major technical challenge as it aims to become the first integrated agent development environment capable of generating agent applications which are then executed on run time environments implemented over a large family of devices and communication mechanisms. LEAP will be shared amongst device manufacturers like Ericsson, Motorola and Siemens, and service providers ADAC, BT, and CSELT, and can be downloaded under open source licence agreements.

LEAP starts as an independent development branch of JADE under the LGPL licence and will eventually be merged with the JADE mainstream at the end of the project where LEAP will replace JADE's kernel. As such, LEAP concentrates on the Lightweight and Extensible aspects whereas JADE continues independently its evolution towards environmental functions such as monitoring facilities, visualisation packages, ontologies and policies.

In parallel, Project LEAP leads the evolution of application development tool ZEUS under the Mozilla licence. ZEUS will be used on top of LEAP to generate LEAP agents and complete application design in the tools provided by ZEUS. Figure 2 gives an overview of LEAP and the related open source projects.

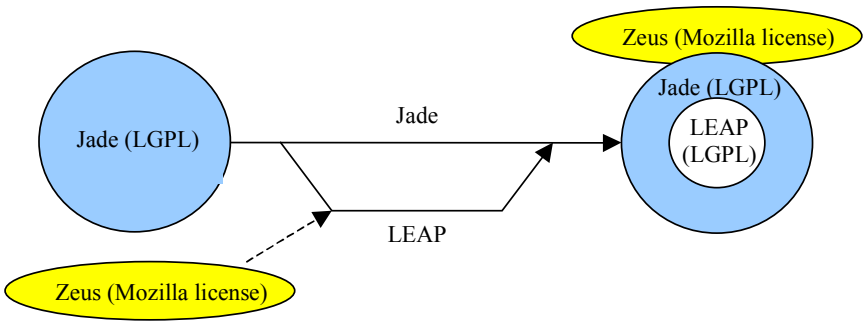

Figure 2. *LEAP development process*

3.3. LEAP implementation

In order to be operating system agnostic the LEAP consortium decided to base the development on Java technology. Considering the diversity of existing devices the Java technology is now regrouped into three editions, each having varying levels of functionality and resource requirements:
- Java 2 Enterprise Edition (J2EE);
- Java 2 Standard Edition (J2SE);
- Java 2 Micro Edition (J2ME) is intrinsically modular and scalable. The J2ME introduces the notion of a "Configuration" which specifies a subset of the Java virtual machine features. There are currently two configurations within J2ME:
- Connected Device Configuration (CDC);
- Connection Limited Device Configuration (CLDC).

As shown in Figure 3, the majority of functionality in CLDC and CDC has been inherited from J2SE. In addition, CLDC and CDC introduce a number of features, display and communication, specifically designed for small-footprint devices.

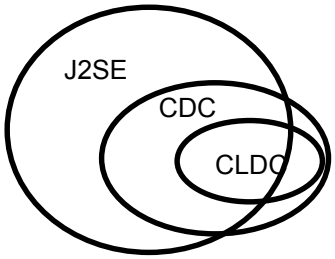

Figure 3. *J2ME configurations versus J2SE (from* [JAVA])

J2ME also defines "Profiles" providing API's that extend a configuration for a specific class of device or use case. It is expected that no new configurations will be added to J2ME and that all new functionality will be expressed in terms of profiles. Currently there are three proposed profiles: Foundation profile for CDC; Personal profile for CDC; and the Mobile Information Device profile for CLDC.

3.4. Operational requirements

- The platform shall be developed in Java,
- Both JVM and KVM virtual machines shall be supported,
- The LEAP kernel shall be compatible with both the J2SE and J2ME (CLDC) specifications,
- The communication module will be developed in at least two versions, relying on the network communication support API that will be provided by the J2SE and CLDC respectively,

- In particular it shall be possible to run the LEAP platform in its minimal configuration (the configuration supporting only the basic functionality) on whatever device where a Virtual Machine is present i) compliant to the J2ME/CLDC and ii) providing a concrete implementation of at least one network protocol,
- The other LEAP optional modules may rely on configuration-specific classes depending on their expected deployment,
- Optimisations should take into account both the device and server environments where LEAP will be deployed.

3.5. The LEAP services

The project develops key enabling technologies that facilitate virtual team working and managed risk-taking through decentralised policy-based management and workforce empowerment. In particular three agent-based services will be implemented to address the following requirements:

- knowledge management - anticipating a user's knowledge requirements by accessing and customising knowledge (based on the user's skill, location, current job and type of display) and providing access to collective knowledge assets in the team (by networking individuals with each other, based on their current needs),
- decentralised work co-ordination - empowering individuals to collectively co-ordinate activities (e.g. by trading jobs, automatically negotiating for work, and expressing personal preferences) within an agreed policy framework;
- travel management - anticipating a user's travel needs, providing guidance and time estimation so as to synchronise the movements of virtual teams working over vast geographic areas.

The added value of agent-based services is demonstrated in the management of mobile virtual teams. Knowledge management, in particular maintaining the coherence of knowledge that is accessed and modified by hundreds of users 'on the fly', is another major challenge. There is also the problem of the co-ordination of a task carried out by several individuals, due to the need to synchronise their actions at various critical stages. Agents on mobile devices are invaluable assistants in these applications, as they can handle tasks even when a user's device is disconnected from the network.
The deployment ubiquity of applications is a key asset. With ubiquitous deployment, a developer can design and develop an agent-based service without undue concern for its deployment environment. The application is deployed according to operational needs (based on network bandwidth, plus the processing power and physical memory of the target device). Thus future applications may be highly autonomous, migrating from servers to hand-held devices as and when required. The deployment of applications and their services is managed through configuration tools, on a case-by-case basis.

3.6. The LEAP field trials

The mobile team management applications are deployed in the real world, in two Field Trials, over a one-month time period, and covering large geographical areas. In-the-van crew gets orders, synchronise their tasks, retrieve documentation, interact with other team members to co-operate, get help and information and exchange tasks 'on the fly' according to their preferences and location, supported in all these operations by pro-active agents running on their hand-held devices.

3.6.1. Road side assistance

An ADAC-member has a breakdown/accident with his car. He calls the ADAC PHZ (PannenHilfeZentrale; Breakdown Assistance Centre) to ask for help. Based on the membership-id he is recognised as a member, or he has to give detailed information about his own person and his car (and the breakdown). The PHZ has to dispatch a "yellow angel" to the customer. The PHZ builds up the communication with the LEAP-Agent Platform. The LEAP-Agent Platform's first task is to assist the "yellow angel" offering him the best route (calculated by a route calculation module) and traffic information of his area. The route is displayed on his WAP-Device on the map, and the traffic information is shown with icons overlapping the map. On the way to the breakdown the AGENT-Server (LEAP-Agent Platform) investigates the "Technical Car Database" autonomously to find information about common problems of that customer's car, and possible ways on how to fix those problems. The mc[3] Agent collects technical data for the car and autonomously uploads the data to the yellow angel's mobile device.

Once the car is repaired, the "yellow angel" can provide the member with current traffic information, as collected though ADAC members. In case of impossibility of immediate repair the "yellow angel" offers tourism information (Hotels, Restaurant, Points of Interest, etc.) to the member to help him/her to plan alternatives.

This field trial involves team work when one "yellow angel" is not able to solve the problem. He sends the request to the Agent-Network, to find fellow "yellow angels" who have solved similar defects/breakdowns. Therefore in this agent-network Knowledge Distribution has to be implemented based on the AGENT-Platform and its functionality. This will be the main focus of the Field Trial.

3.6.2. Telecommunication network maintenance

The domain of the BT Field Trial is that of telecommunications engineers performing field-based installation and repair tasks. The engineers will use the LEAP application in the open air via mobile devices i.e. PDAs and mobile 'phones. The services in the BT Field Trial will be the same as those used in the ADAC Field Trial. They will aid engineers to receive work requests, synchronise tasks, retrieve documentation, reach other members to co-operate, get help & information, and exchange tasks on the fly according to the engineers' preferences and positions.

However the application logic will differ, to take account of the different combinations of agent services required and with the non-agent business logic.

Customer service engineers do not represent the only remote workers in BT. Sales teams, home workers and virtual call centres are all candidate workers for the agent services. In fact, agents may provide a unique and beneficial way to increase communication and productivity between remote and static works within BT, e.g. between engineers and call centre workers.

The BT Field Trial will aim to facilitate a more customer-focused approach (an increase in quality and personalisation), which will be of considerable value to the customer. From a field engineer's perspective, the LEAP application will provide the benefits which come from having valuable and customised information available, i.e. doing a better job, greater freedom to influence job schedules, and a more sociable working environment provided through the virtual team working facilities. These benefits are expected to lead to greater job satisfaction and a more enthusiastic and empowered workforce.

4. An Agent Open Agent Infrastructure deployment: AgentCities [ACITIES]

4.1. Goal

The objective of AgentCities is to help realise the research and commercial potential of agent applications and accelerate the deployment of next generation Internet services by:

- Deploying infrastructure: building a standardised, publicly accessible, continually available, pan-European network of agent platforms providing the necessary connectivity and infrastructure to host agent-based services,
- Deploying services: populating this network with a rich assortment of commercial grade agent-based services to form building blocks for advanced agent applications,
- Fostering research collaboration: promoting the network as a Europe wide focal point for agent research and development, thereby enabling cross-fertilisation between existing and future projects.

4.2. Description

At a first glance, AgentCities deploys FIPA agent platforms in different cities, for example in Figure 4, Paris and San Francisco. These platforms inter-operate, host services and advertise them through their Directory Facilitator (DF). The hosted services can be of any kind, but at the start of the project we will focus on tourist

information, restaurants, hotels, so that we can deploy similar services in a network, learn how to represent them and provide interoperability at service level. This set of (platforms + services) is called AgentCities; it allows services to be hosted and discovered in a distributed dynamic environment. On top of those "basic" services, users can conceive combined services and offer new functions to the existing infrastructure and its users. This represents opportunities for commercial added value, as well as a fantastic unparalleled testbed for experimenting ideas in the real world.

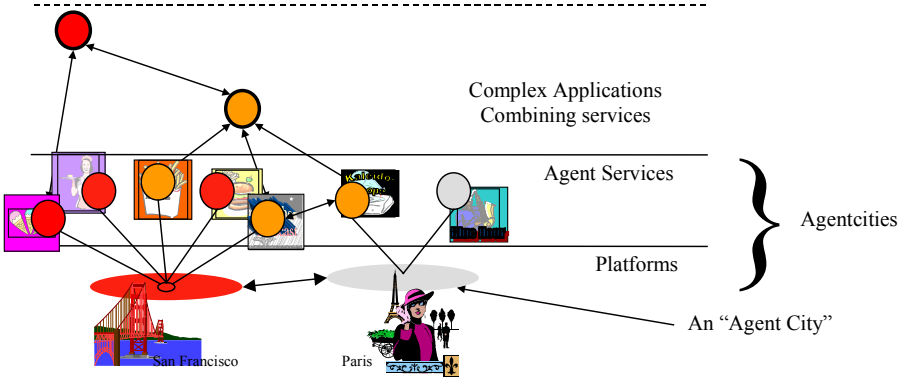

Figure 4. *An overview of AgentCities*

4.3. Innovation

The key innovation of the AgentCities project is to provide the first open deployment of agent technology at a world scale providing:

- A common infrastructure based on an internationally recognised standard,
- A common meeting / interface point for cross fertilisation between existing Agent research, industrial applications and future European projects,
- A backbone of core platforms encouraging others to connect and join (creating a greater network effect and hence a richer service environment),
- Access to ontologies and service description to move towards interoperability at the service level,
- A baseline set of deployed agent services that can be used as building blocks by application developers to create innovative value added services,
- A true practical test for FIPA standards.

4.4. Deployment scenario

4.4.1. Infrastructure Deployment

Some participants in AgentCities will each deploy and maintain a FIPA compliant agent platform representing a single city (Berlin, Chicago, Helsinki, Lausanne, Lisbon, London, Paris, San Francisco, etc.). The platform will have published publicly accessible addresses and support FIPA specified Agent management services and form the AgentCities backbone network. The platforms will be interconnected to enable message transfer between agents on any of the platforms.

The resulting backbone network will act as resource for agent application developers to:

- Enable their agents to interact with service agents developed by others,
- Test applications in a realistic, distributed, open environment,
- Share examples of service models, ontologies and experiences with the usage of FIPA standards,
- Use as a benchmark environment for FIPA compliance testing.

4.4.2. Service Deployment

Each platform will deploy a set of services which model the town or city it is intended to represent. The first services deployed in the testbed will centre on information and transaction services for real world objects such as bars, restaurants, hotels, travel infrastructure, theatres etc. which can be found in cities and other real world places, They will use:

- FIPA ACL, an agent communication language based on speech act theory,
- Standard FIPA ACL compatible content langages,
- Shared public ontologies (as determined by the FIPA AgentCities Workgroup),
- FIPA defined agent management services (directories, communication and naming).

4.4.3. Research Collaboration

Once in place, the AgentCities backbone and potentially other available supplementary platforms, will form an ideal medium for rich interaction between agent research projects. To exploit this and to learn from the experiences of building the testbed the project will include a "network of excellence" of AgentCities participants.

In particular we expect AgentCities to play a major role in bridging the gap between the academic and industrial agent research.

4.5. Liaison with standards (FIPA / W3C / Industry standards bodies)

AgentCities will co-ordinate its actions with international standards bodies:

- **FIPA**: in order to disseminate results, provide input to FIPA standards and stimulate the development of tools and software to encourage the deployment of FIPA technology.
- **W3C**: Many of the issues tackled in AgentCities will be related to emerging web technologies such as XML, RDF and Java. It is expected that AgentCities will generate valuable input related to the convergence of web and agent technology.
- **Industry Standards**: Modelling services in the experimental testbed will generate useful first results in terms of possible ontologies, service descriptions and interaction protocols for selected application domains. These results can then be used to generate input to the respective industry regulating bodies when they consider possible standards for service automation.

4.6. Technical Challenge

At a technological level Agent technology is ripe for exploitation. However no common experimental resource exists to test applications and services in an open environment. This in turn limits investment and commitment in the technology. AgentCities should generate a critical mass of available agent infrastructure and services to attract contributors and create significant new opportunities in the following areas:

- **Service level interoperability:** current Internet services rely on protocols such as (TCP/IP and HTTP for example) and format standards and conventions (such as HTML) to provide their services, the higher level of understanding the content of the services being provided is handled by the human user. AgentCities services attempt to go further than existing protocols and systems by building systems interoperable at the service level. This is achieved by providing service specifications, content language, semantics and ontologies for application programmers,
- **Ontology management:** providing services over the testbed will mean contributors must build ontologies for the domains being modelled. In the long term this raises many issues regarding how ontologies are best managed, represented, maintained and distributed,
- **Managing large populations of agents:** Although the agents deployed in the testbed are by definition autonomous, the services which they provide will create complex interdependencies. This raises many issues in the configuration and deployment of such heterogeneous distributed systems,
- **Legal/Security issues of automated transactions:** a host of issues may arise before autonomous systems can be allowed to carry out legally binding transactions,

- **Agent Communication:** AgentCities would arguably be the first major test of the use of current semantic models underlying agent communication in an open system,
- **Large scale Agent Infrastructure:** for providing next generation Internet services, based on automating information, exchange and transactions as a parallel channel to user browsing,
- **Development Service level tools:** for agent application development which parallel the current web design and software engineering tools by making it easier for developers to build and deploy automated services.

5. Conclusion

Agent technology is sometimes decomposed into three different levels according to their semantics. Agents do:
1 Communicate,
2 Understand applications and contexts,
3 Negotiate and co-operate.

The key added value raising the fascination for intelligent agents comes from levels 2 and 3. However, those values have only been partially demonstrated so far, often in toy environments, because of a poor infrastructure supporting the communication layer 1, which does not work at large scale, nor inter-operate and therefore not scale up- .

As a consequence, even more individual efforts have been invested in this layer 1, multiplying the number of proprietary platforms, languages etc, and building up a chaos which failed to solve the initial problem and constantly discredit the growth of agent technology.

This article proposes a solution for layer 1, by adopting a standard (FIPA), using open-source implementations, and deploying this infrastructure at a credible size (AgentCities). The main characteristics of this triple proposal is the participation in three open processes - a standard, an open-source implementation (but people can also develop their own platforms if they wish), an open experimental network - in which everybody is welcome to share views and contribute towards the resolution of this complex problem.

Benefits of this strategy are shared amongst participants:
- Adopting this approach releases resources to focus on the noble tasks of agents, the Agent Communication Languages, the Service Level Agreements, service level interoperability, the negotiations and co-operations, etc,
- The deployment of AgentCities gives a true testbed linked to existing services. It can prefigure the services of the internet of tomorrow for - the academic researchers who can make proof of concepts at a credible scale, the industrials

who can manufacture high quality software, and the business partners who can develop added value services and provide them to clients-.

6. Thanks

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