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**STANDARDS FOR AGENTS  
AND  
AGENT BASED SYSTEMS  
(FIPA)**

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## **INTRODUCTION**

The world is becoming more connected. Internet usage is growing explosively, mobile data services are reaching users worldwide and businesses are moving to the web to connect with the customers, suppliers and partners. Agent technology has the potential to play a key role in this “revolution” by automating processes, enriching system-system communication and bringing more intelligence service provision. To realise this potential, agents require standards, they need to communicate to discover their peers, to negotiate and to co-operate in an open environment where everybody can add their contribution when and how it is deemed appropriate.

## **FIPA: OPEN STANDARDS FOR SOFTWARE AGENTS**

The Foundation for Intelligent Physical Agents (FIPA) was formed in 1996 as a non-profit organisation with the remit of producing software standards for heterogeneous and interacting agents and agent-based systems across multiple vendors' platforms. This is expressed more formally in FIPA's official mission statement:

The promotion of technologies and interoperability specifications that facilitate the end-to-end interworking of intelligent agent systems in modern commercial and industrial settings.

The emphasis here is therefore on the practical commercial and industrial uses of agent systems. The aim is to bring together the latest advances in agent research with industry best practice in software, networks and business systems.

FIPA undertakes its work at meetings that are held four times a year and conducts its standardisation process in a collaborative and open manner as specifications are publicly accessible during their life time and participation to meetings is free of charge.

## **STRUCTURE OF FIPA**

FIPA is organised and structured according to two groups:

### **Administrative Groups**

The FIPA Board of Directors (BoD) is responsible for managing and conducting the business of the FIPA organisation.

The FIPA Architecture Board (FAB) is the authority within FIPA that is responsible for ensuring the consistency, accuracy and suitability of FIPA's technical work.

The FIPA secretariat, in charge of administration, logistics, membership and information dissemination of FIPA.

The Image committee is building some communication channels for FIPA and presentations of the standard inside and outside the Agent Community.

### **Technical Groups**

FIPA's core standardisation activities are centred around the creation and maintenance of specifications.

Technical Committees (TCs) produce technical work and write the FIPA specifications. The life cycle of a TC starts with a work plan submitted to the FAB. If approved, the FAB proposes to create a TC, the BoD takes the decision and the TC is created with the mission to fulfil the work plan.

Working Groups (WGs) are designed to carry out other aspects of FIPA's work, which are not necessarily defined by technology; they may have an application focus or be responsible for coordinating implementation activities. The lifecycle of a WG is similar to the one of a TC.

Special Interest Groups (SIGs) undertake auxiliary work which is of interest to sections of FIPA membership, such as liaising with other standards bodies and dealing with emerging technologies which might be suitable for standardisation.

## **FIPA SPECIFICATION**

Since January 2000, FIPA has adopted a new procedure for classifying, organising and releasing specifications to ensure coherence, completeness and consistency of its work as well as its relevance to industrial and commercial interests. This section provides an overview of the new specification structure and the current set of FIPA specifications.

### **SPECIFICATION STRUCTURE**

FIPA specifications are divided into five categories: Applications, Abstract Architecture, Agent Communication, Agent Management and Agent Message Transport (see Figure 1). Each area of specifications has one or more specification documents assigned to it and involved one or more technical committees or working groups.

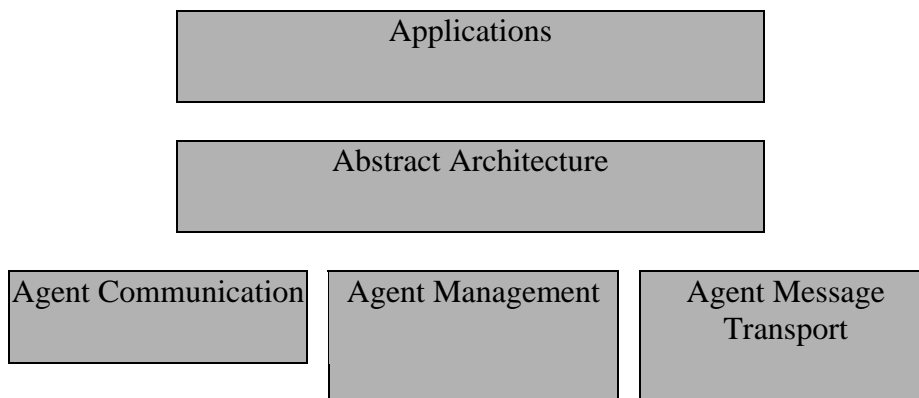


Figure 1: FIPA Specification breakdown  
Current Generation of FIPA Specifications

## **ABSTRACT ARCHITECTURE**

The purpose of the FIPA Abstract Architecture is to foster interoperability and reusability, this leads to the identification of architectural abstractions linked by their relationships. It makes a distinction between those elements which can easily be defined in an abstract manner, such as agent message transport, FIPA ACL, directory services and content languages, and between those elements that cannot, such as agent management and agent mobility. These are considered difficult to represent abstractly since they occur too close to the concrete realisation (implementation) of an agent system and very little commonality can be derived from analysing them. Yet, these issues will have to be addressed by developers and the abstract architecture will provide a number of instantiation guidelines in the future for specific groupings of implementation technologies.

The first concrete realization of the abstract architecture will be the Java Agent Service project which is being developed as part of the Java Community Process.

## **AGENT MESSAGE TRANSPORT**

The FIPA Agent Message Transport Specifications deal with the delivery and representation of messages across different network transport protocols, including wireline and wireless environments.

At the message transport level, a message consists of a message envelope and a message body. The envelope contains specific transport requirements and information that is used by the Message Transport Service (MTS) on each agent platform to route and handle messages. The message body is the payload and is usually expressed in FIPA ACL but is opaque to the MTS since it may be compressed or encoded.

The MTS on each agent platform can support any number of message transport protocols and will normally translate between a FIPA-supported MTP that is used for interoperable communication between heterogeneous agent platforms (such as XML over HTTP) and an MTP that is used internally to the agent platform (such as Java objects over the Java Messaging Service).

Consequently, the components of the MTS are designed to be modular and extensible to handle different message transport protocols, message envelope and FIPA ACL representations in the future.

## **AGENT MANAGEMENT**

The FIPA Agent Management Specification provides the framework within which FIPA agents exist and operate. It establishes the logical reference model for the creation, registration, location, communication, migration and retirement of agents.

In conjunction with the FIPA Agent Message Transport Specifications, the FIPA Agent Management Specification also provides support for intermittently connected devices, such as laptop computers and personal digital assistants through message buffering, redirection and proxying.

## **AGENT COMMUNICATION**

Developers of multi-agent systems require specialised communication techniques in order to structure the interactions in their agent systems. Ad hoc techniques are usually not sufficiently well designed or documented to be consistently extensible and implementable by others, or generally applicable to a wide set of agent problems. The FIPA specifications for agent communication address these issues. The core of these specifications was largely completed in FIPA 97, but this specification set has required continual maintenance and development since then. The specifications of the communication language, along with libraries of predefined communicative act types, interaction protocols and content languages were developed:

- FIPA ACL Communicative Act Specifications is the library of all the 22 FIPA communicative acts and their requirements
- FIPA ACL Message Structure Specification describes the grammatical structure of the FIPA ACL

## **AGENT APPLICATION**

FIPA has developed specifications of four agent-based applications that contain service and ontology descriptions and case scenarios:

Personal Travel Assistance: individualised, automated access to travel services.

Audio-Visual Entertainment and Broadcasting: negotiating, filtering, and retrieving audio-visual information, in particular for digital broadcasting networks .

Network Management and Provisioning: automated provisioning of dynamic Virtual Private Network services where a user wants to set up a multi-media connection with several other users.

Personal Assistant: management of a user's personal meeting schedule, in particular in determining time and place arrangements for meetings with several participants.

Additionally, the Agent Software Integration specification contains guidelines for integrating legacy software, that is, software that does not communicate using FIPA ACL.

## **CURRENT IMPLEMENTATION OF FIPA SPECIFICATION**

Sixteen FIPA platforms have been implemented by diverse companies, four of these are freely accessible under open source. These FIPA platforms have been distributed and tested in large-scale projects, which collectively have been downloaded several thousands of times.

In addition to a choice of FIPA platforms which are aimed at agent researchers with software development experience, there is also a need for agent development environments that cater for non-specialists. ZEUS is one such platform and it is based around a GUI that facilitates the rapid development of collaborative agent applications

The next generation of platforms is already under development: two ongoing European projects include work on enabling the FIPA platforms for wireless devices , and a Java Community Process (JAS) addressing Java Interfaces for agent services has recently started [JAS-2000].

## **CONCLUSIONS**

FIPA has devoted its first years to specify the basics elements of an agent-based world, defining the Communication language, the management and the connection to existing software. This initial specification has been implemented by several teams and showed the way for further improvement towards a more modular agent environment capable of evolution and integration of new technologies, e.g. using several Message Transport Layers, and moving towards higher levels of abstraction. Four of these new implementations are already accessible in open source, and new FIPA implementations enable now agents to run on small wireless devices such as PDA. As such FIPA is making an important contribution to the practical and commercial viability of agent systems by providing a good basis to develop future agent-based applications.

FIPA is now looking ahead to some of the major challenges that are already beginning to arise in the new “networked” world, and works on specifications for:

- Domains, policies, agreements and contracts, security, dependencies between large numbers of agents, and agent usage of ontology.
- Key applications such as product manufacturing and design and peer-to-peer systems.
- Large-scale deployment of agent systems in open environments.

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