# IEEE-FIPA SA (Standards Activity)

FIPA ROFS-SG (Review of the FIPA Specifications - Study Group) Presentation

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## Objectives

- Summary and organization of the specifications
- Analysis of the scope, assumptions, design issues for the specifications that became standards
- Review of specifications that didn't make standards
  - Including past work related to current WG activities such as mobile agents, human agent interaction, agent services and peer to peer nomadic agents
- Review of applications and trials
- Make recommendations for possible specification maintenance / modifications to support new specification opportunities
- Provide an assessment of related standardization in others standards bodies??

## Resources

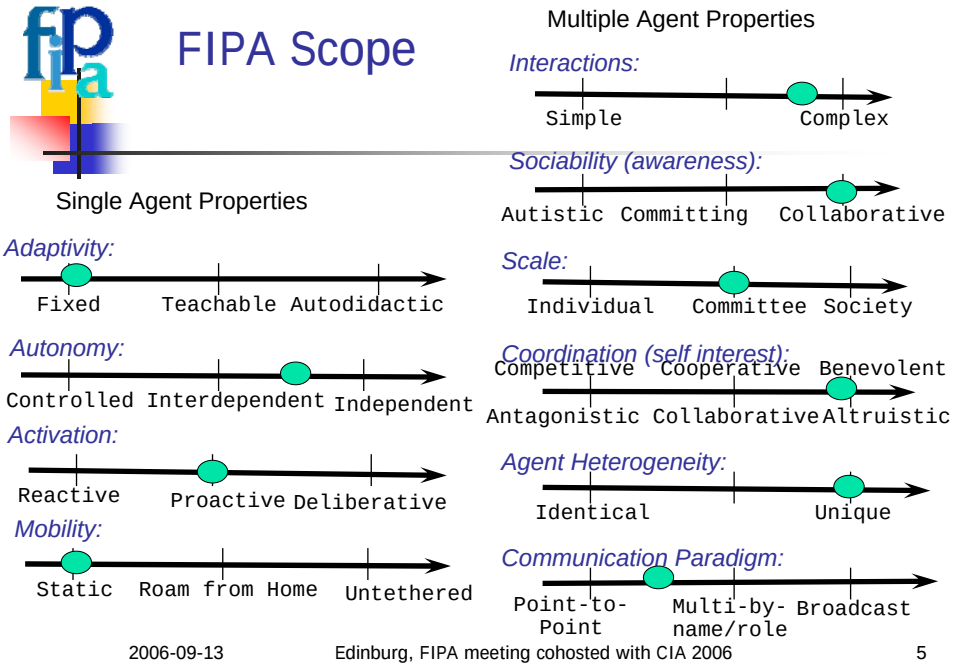
- Web-site: http://www.fipa.org/subgroups/ROFS-SG.html
- Chair: Stefan Poslad, Queen Mary, UoL
- Email: fipa-rofs-chair@ieee.org
- Deliverables status (09/2006)
  - History of FIPA (42 pages)
  - Review Doc, current version 0.6 ~ 60% complete (52 pages) – aim to complete 12/2006



## FIPA History: Milestones

- 1995: FIPA Root formed based upon - agent technologies useful, some are mature, standardisation useful, standardisation of generic technologies possible;
- 1997: FIPA focus along dimensions of agent management, message transport & ACL – 1st set of 7 specifications with subsequent implementations
- 2000: Less fragile abstractions, don't break as technology changes & mappings to commonly used technologies (CORBA, JINI etc); support alternate mechanisms, e.g., transports, content encodings; Explicit definition of implicitly used agent terms; new life-cycle model for standards; new activites started on adhoc network, interoperability & trials, architecture
- 2002: 25 specs standardised & new activities started on Semanics, adhoc, Security, Services, Modelling, Methodologies.
- 2005: FIPA *no longer autonomous* becomes 11th IEEE SA (standards activity)

# FIPA Scope






# FIPA History: activities (TC, WG, SIG)

| | | | | | |
|---|---|---|---|---|---|
| 2003 | Communication : Ontology, **Semantics** | Software Engineering: **Interaction Protocol, Modeling, Methodology** | Infrastructure: Ad-Hoc, Services, Security | | |
| 2001 | ACL | **Agreement Mgt** | Architecture | **Gateways** | **Transport. AgentCities, DPMG, JCP, Security** |
| 2000 | ACL | **Nomadic** | **Interop** | **Architecture** | Agent Management |
| 1998-9 | ACL | Agent Management | Msg Transport | **Security, Mobility, Human-Agent Interaction, Ontology Service** | |
| 1997 | ACL | Agent Management | Msg Transport | **APPS: PA, Travel, Audio-video, VPN** | |

## MAS specifications in 1997

| | |
|---|---|
| Applications | 4 (PA, Travel, Audio-video, VPN) |
| services | 2 Agent mgt, transport |
| Interaction Protocols | 0 |
| Communicative Acts | 1 (library of 20? CAs) |
| Content Expression | 0 |
| Ontologies | 0 |
| Messaging | 0 |
| Encoding | 0 |
| Transport | 0 |
| **FIPA ACL 'Stack'** | **7 Specs. (No ref. implementations mandated)** |



## MAS specifications in 1998

| | |
|---|---|
| Applications | 4 (PA, Travel, Audio-video, VPN) |
| services | 6 Agent mgt, transport, Security, Mobility, Human-Agent Interaction, Ontology Service |
| Interaction Protocols | 0 |
| Communicative Acts | 1 (library of 20? CAs) |
| Content Expression | 0 |
| Ontologies | 0 |
| Messaging | 0 |
| Encoding | 0 |
| Transport | 0 |
| **FIPA ACL 'Stack'** | **11 Specs. (No ref. implementations mandated)** |

## MAS Comms protocol stack: specs. that became standards in 2002

| | |
|---|---|
| Services | 6 Abstract, Agent mgt, transport, nomadic App Mgt, Device Ontology, QoS specification. |
| Interaction Protocols | 9 |
| Communicative Acts | 1 (library of 22 CAs) |
| Content Expression | 1 (SL) |
| Ontologies | 0 |
| Messaging | 1 (ACL structure) |
| Encoding | 3 (bit-efficient, String, XML) |
| Transport | 2 protocols (IIOP, HTTP), 2 transport encodings |

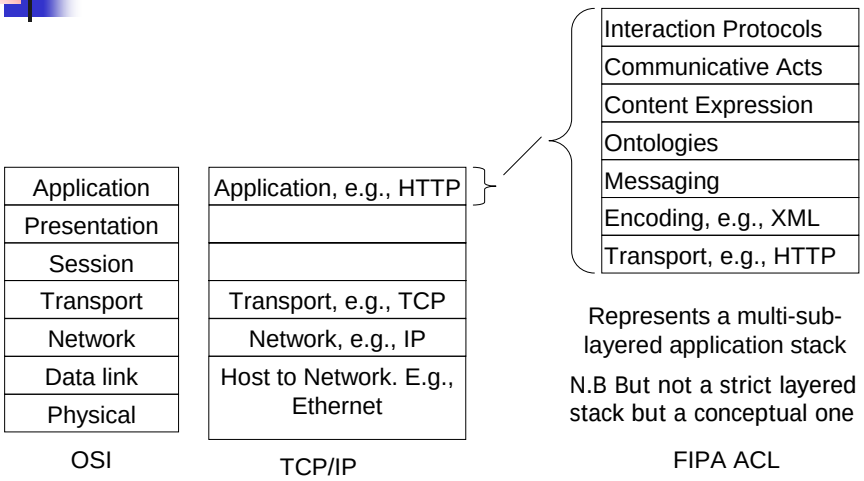
**FIPA ACL 'Stack'** **25 Specs. (ref. implementations mandated)**



## Viewpoints of the FIPA Specifications

- Layered communication protocol view
  - CA or Agent Communication as Actions Model
  - CA Beliefs and Intentions Model
  - Meta-linguistic CA Model
- Process-oriented / Interaction Model
- Service Model
- Abstract Architecture Model
  - Reifying Abstract Architectures
  - Agent Management or Agent Platform Model
- No Agency model

## MAS Communication protocol stack viewpoint




Represents a multi-sub-layered application stack

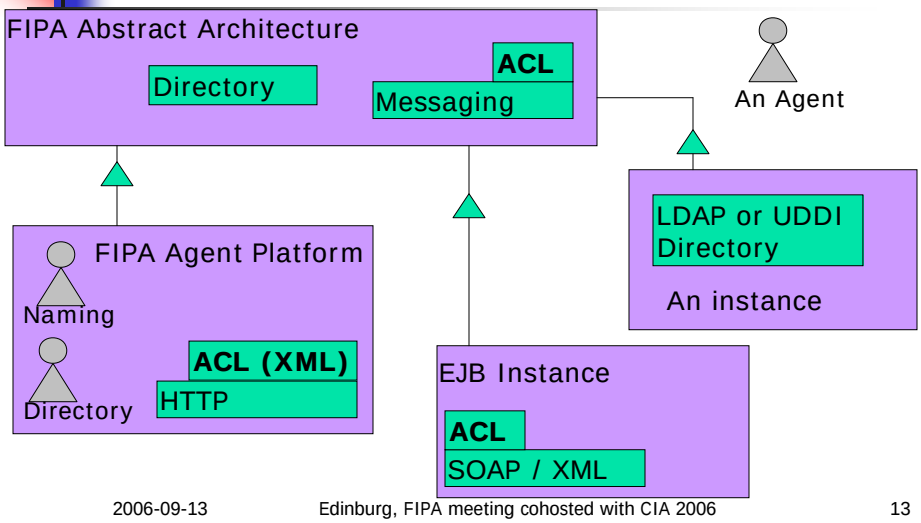
N.B But not a strict layered stack but a conceptual one



## FIPA interaction protocols viewpoint

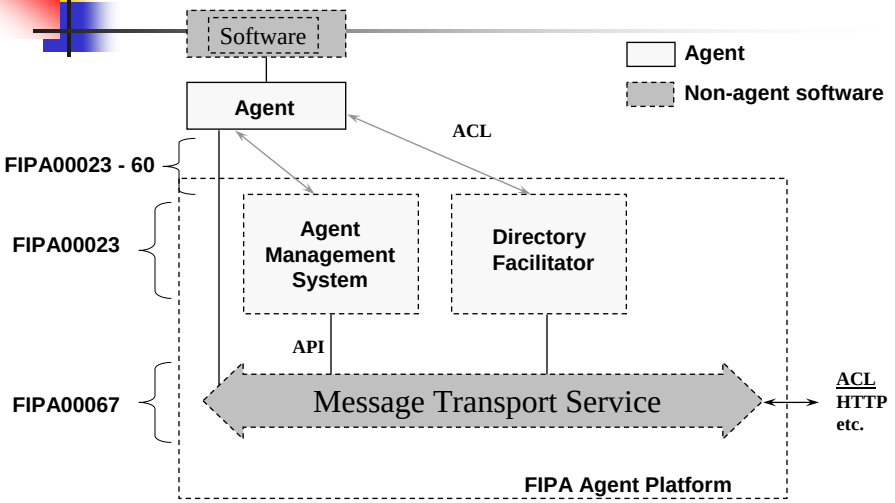
| Interaction Protocol | Task / info-sharing | Push / Pull | 1-1 / 1-m receivers |
|---|---|---|---|
| Request | Tasks | Pull | 1-1 |
| Request-when(ever) | Tasks | Push | 1-1 |
| Query | Info. | Pull | 1-1 |
| Contract-Net/Iterated CN | Task | Push | 1-m |
| English / Dutch Auction | Info | Pull | 1-m |
| Broker | Info | Pull | 1-m |
| Recruit | Task | Pull | 1-m |
| Subscribe | Info | Push | 1-1 |
| Propose | Task | Pull | 1-1 |

## FIPA Abstract Architecture Specification: middleware services to support agent comms.






## FIPA Agent Platform – a grounding for the Abstract architecture

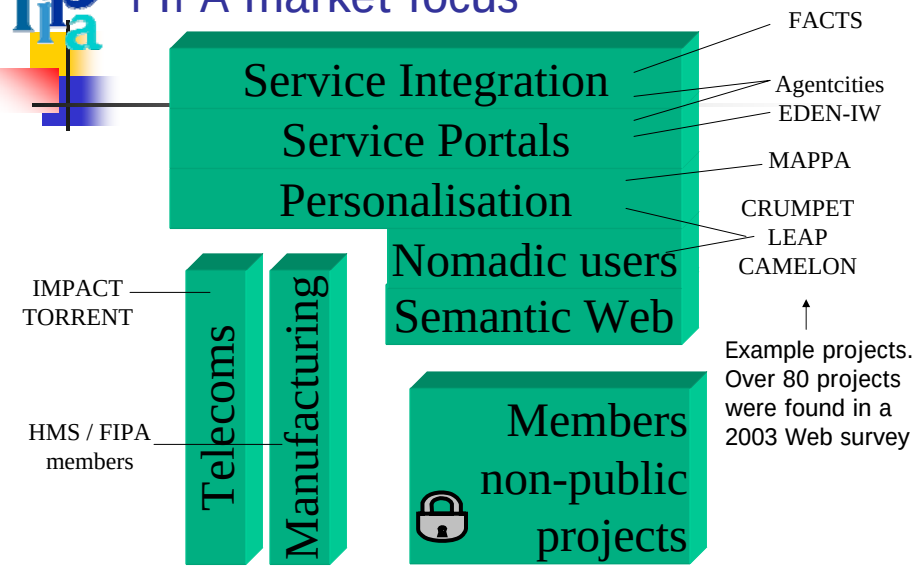


## Deployed FIPA MAS Systems

- 17: 5 open-source toolkits – 1 still living (JADE), many proprietary ones
- JCP or Java Community process developed JAS, the Java Agent Service, JSR87, reference API for the FIPA abstract architecture specification
- Many projects, e.g., FACTS, MARINER, Agentcities (80 projects surveyed in 2003)
- How do toolkits deal with the ACL semantics and other theoretical agent properties?
  - Although models for ACL semantics, IP semantics mostly used in practice
- Interoperability testing and FIPA compliance
  - Two main trials and use of specs. in many heterogeneous projects



## FIPA market focus



## Strengths of the ACL model

- Set of MAS design models that can lead to computation models of logic-based and semantic models, that are abstract and flexible enough to be independent of specific technologies but yet able to be grounded using specific technologies
- Specifications of a rich set of CA, communication primitives that support information sharing information created, information queries and task sharing.
  - There is a Formal semantics to define each CA and some computational models of these have been built and tested, although most computation models of the CAs rely on the semantics of the CAs to relate to the pattern of use of the CA
- Specifications of Interaction Patterns of the CAs that support cooperative and competitive, push and pull interaction, one to one and one to many interaction, information and task sharing.
- Specifications of a generic Architecture model and service model.
- Specifications have been tested in practice and demonstrated that they enable interoperability and open service invocation.
- Holistic framework interlinks semantic knowledge-based content with semantic comms protocols and communications context for exchanging the content
- Development life-cycle for specifying, experimenting with implementations and standardising mature implementations,
- Range of tools including open source ones that implement the specifications
- Widely deployed specifications have been used in numerous applications and projects.



## Features and Constraints of the Models

- (Described in more detail in the ROFS review report)
- CA Model Features
  - Use of BDI semantics for CA
    - *FIPA CA semantics as viewed by the sender's mental attitude*
    - *Meaning of CA varies dependent on the context*
    - *Agents act sincerely.*
    - *Other criticisms and limitations of the BDI model*
    - Use of alternative (to BDI) semantics for FIPA-ACL
  - Use of alternative semantics for CA
    - *Third-party semantics based upon social commitments.*
    - *Contract programming model semantic*
    - *Commitments based upon social conventions*
    - *Semantics for a wider environment.*
    - *Semantics underspecified*
  - Choice of CAs for the standardised set
  - CA Set extensibility
  - CA Use to Share Semantic content

# Features and Constraints of the Models 2

- ACL Model features
  - Limitations of Speech Act Model of linguistics
  - There are alternatives for different parts of protocol stack: FIPA-ACL Syntax:
    - Content Language, Interaction protocols, Domain Ontologies.
    - But not for these: Semantics of individual CA must use the BDI semantics, set of CA instances
  - Technology specific versus technology neutral mode
  - Semantics and conceptualisation for the whole ACL model
- Patterns of CA: IP Model features
  - Semantics of IP
  - IP Flexibility and Extensibility
  - Choice of IPs for the standard set
  - IP Model Notation and Expressivity
- Architectural and Service Model features
  - Abstraction to give flexibility vs. grounding
  - Which core agent middleware services



# Future work: Ideas

- ACL and existing specifications
  - No modifications – are used in practice 'as is' with its 'features'
  - Limited Modifications of some features of ACL etc
    - In a way that remains compatible with standard specs?
  - Develop new agent communication models
    - e.g., semantics, that moves away from speech acts? Etc
    - Maybe more difficult to keep compatibility with existing model
- Develop New specifications
  - Uncompleted specs & candidates for future specs such as mobility, human agent interaction etc.
  - May not be compatible with existing FIPA specs.
  - Need to consider who are the stake-holders for the new specs.

## Future work: ACL & its Management

- Improve features of the FIPA specifications that restrict the ability to:
  - Synthesise new CAs and IPs, to be able to statically and dynamically vary the semantics of the CAs and IPs
- Develop a specification of CAs that can support multiple heterogeneous types of agent communication to support the exchange of knowledge, multiple semantics, human interaction, non-agent computation and network interaction
  - This implies that MAS need a multi-lateral view of CA semantics rather than a single one such as mentalistic attitudes.
- Enable parameters and constraints of communication protocols to be explicitly modelled such that more flexible and richer interaction can occur.
- Specify more flexible agent middleware service interaction in directory services. Develop specifications to aid the design, implementation, reconfiguration, maintenance and management of MASs.



## Future work: uncompleted specs & candidates for future specs

- Semantics
  - Semantics based upon linguistic approach
  - Semantics based upon an institutions and policies
- Agent management
  - Agent Security management
  - Agent Configuration Management
- Mobile Agents (MA)
- Ubiquitous Computing
- Human Agent Interaction (HAI)
- Services and SOAs

## Current ongoing WG activities

The following IEEE FIPA work and study groups have been formed and approved:

- Agents and Web Services Interoperability Working Group (AWSI WG)
- Human-Agent Communications Working Group (HAC WG)
- Mobile Agents Working Group (MA WG)
- P2P Nomadic Agents Working Group (P2PNA WG)
- Review of the FIPA Specifications - Study Group (ROFS SG )

ROFS SG will review

- Any FIPA's past experiences, previous related work and models
- Features and Limitations of any old related FIPA models & suggested improvements



## Conclusions

- Standard communication specifications naturally have critics.
- Often, there is a variety of stake-holder interests in specifying standards leading to standards that may be either considered to be too expressive or not expressive enough for designers and implementers to use or that are difficult to embed in existing infrastructures.
- In addition, standards may need adjustment or not work well in specific applications.
- There are also those who argue that standards may not be able to always guarantee consistent design and interoperability - these points are true for standardisation in general, not just for MAS standards.
- However, these challenges should not distract from the benefits of standards as a key enabler to support interoperability and open service interaction in practice and to lead to a critical mass of users and uptake.
- Good standardisation is about striking an optimal balance between developing expressive, flexile, abstract models of key behaviours versus being able to reify models in a constrained way, to successfully deploy them.

# Conclusions 2

- For a MAS model that specifies the interoperability of agents to be become widely deployed, the trade-off between theoretical and pragmatic issues must be carefully balanced.
- It needs to consider the concerns of, requirements, to support multiple stake-holders, not just the theoreticians that develop the underlying theoretical models but also the computation model specifiers, application and tool developers and business and academic end-users.
- There needs to life-cycle to propose specifications with effective computation models:
  - that can support maintenance and maturity of specs., incorporate feedback from use by a wider community of users over a longer period.