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how!*

## **FIPA and the Internet Revolution**

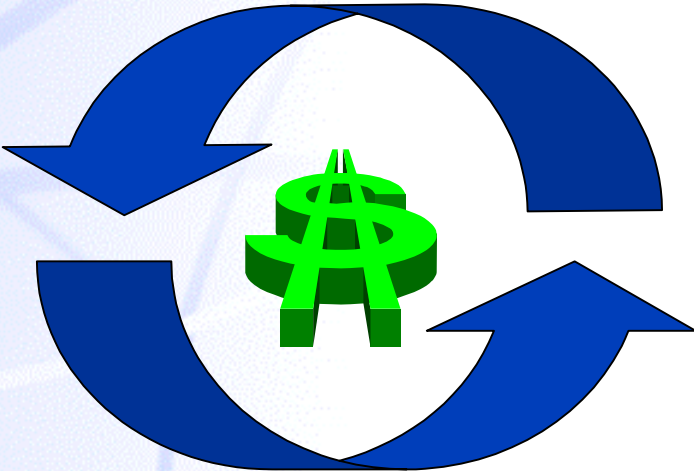
**Phil Buckle and Rob Hadingham  
9 September 1999**

# What is the Internet Revolution?

- **Everything connected**
  - Universal L3 protocol, IP
- **Innovation at the Edge**
  - The core too, but emphasis at the edge
- **Everything communicating ... not yet!**
  - No universal language of discourse
  - Computers don't understand people, yet
  - Computers don't understand content, yet

# Current Trends

**E-Business**



**E-Technology**

**E-Services**

# Future

- A universal communicative language, ACL
- A universal content language, XML/RDF
- Increased machine understanding

Leading to:

- **Collaboration and competition on a global scale**

# Carrier Issues

## Wholesale / Re-sale

- bit pipes
- proactive management
- QoS guarantees
- commodity
- lower risks & margins

## Retail

- getting & keeping customers
- service bundles
- loyalty programs
- branding
- higher risks & margins

# Key Needs

- **Infrastructure**

- Service deployment in zero time
- Architecture for evolution upgrade without mass orchestration

- **New Services: Communication**

- Human to Human
  - minor need for live contact between two or more individuals
- Human to archive
  - Growing market of direct access
- Machine to machine
  - Essential societal support functions
  - Monitoring proper functioning of people & properties

# Software - how will it change?

- Shorter development and deployment times needed
- Smarter software needed
- Smaller projects needed
- Dividing the problem is key
- Never time to get the software right

The solutions:

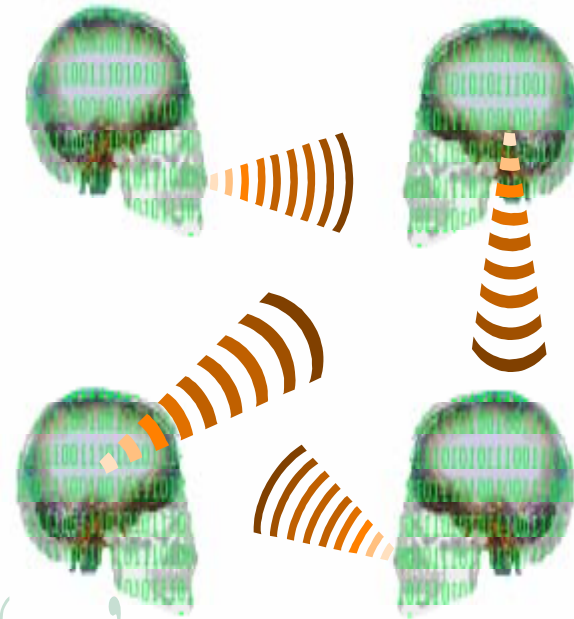
- Components, re-use, and advanced Object Technology
- AI and Heuristic techniques
- Distribution and parallel processing

Together, these lead to:

- **Autonomous Agent technology**

# Intelligent Agents

Encapsulation of software 'smarts'  
Autonomous *components*  
Speech-act communications (ontology based)  
Peer-to-peer (*not* client-server)  
Glue technology/framework  
Toolbox of capabilities  
Collaboration / co-operation



Agents can say 'no'  
Agents can say 'no'

## Applications:

Negotiation (e.g. SLA's)  
Mediation (e.g. multimedia content adaptation)  
Personal assistants (e.g. Meeting Scheduling)  
... *anything* which requires some smart assistance!

## Can be:

Small or big  
Static or mobile  
Smart or dumb  
Long- or short-lived



# Agent Standards

- **OMG (Object Management Group)**
  - RFI for Agent Technology
  - MASIF
- **DARPA CoABS**
  - Knowledge Querying and Manipulation Language (KQML-2) - an inter-agent messaging language
- **Agent Society**
- **FIPA**

# FIPA - Foundation for Intelligent Physical Agents

- **Started in December 1996**
  - commitment to develop and publish international standards for agents, covering the *external behaviour* of *generic technologies* or components of agent systems
- **Established as a not-for-profit organisation registered in Switzerland**
- **Currently 50+ member organisations from 11 countries**
  - members include: IBM, Siemens, Hitachi, Lucent, CSELT, France Télécom, BT, Nortel Networks, Sun, Fujitsu, Imperial College, UMBC, NTT, Alcatel, Motorola, NHK, HP, Nokia, Sonera plus many others

# FIPA Process

- **Open process**

- Similar to MPEG and DAVIC
- Low-cost membership
- Documents produced by meetings are made public
- Comments and review invited from the agent community at large
- Contributors are invited to attend meetings even if not members

- **Standard's Published**

- FIPA97 v1 published October 1997
- FIPA97 v2 and FIPA98 v1 published October 1998
- FIPA97 v3, FIPA98 v2 and FIPA99 v1 to be published October 1999

# FIPA's contributions to Agent Standards

- **Middleware support**
  - Registration, location services
  - Communication services
  - Portability and mobility
  - Security, authentication etc.
- **Agent Communication Language**
  - semantics
  - conversation protocols
  - commitments, responsibility etc.
  - etiquette

# FIPA's contributions to Agent Standards

- **Inter-working with native software**
  - Acting as wrapper of legacy software
  - existing databases
  - domain related expertise
- **Agent Human Communication**
  - What is to be communicated
    - concepts, manner, style, content related behaviour, emotional sensitivity, etiquette, personal profiles
  - How to communicate
    - device related expertise, rendering

# ACL Communicative acts

Accept-proposal	Agree	Cancel	Cfp
Confirm	Disconfirm	Failure	Inform
Inform-if	Inform-ref	Not-understood	Propose
Query-if	Query-ref	Refuse	Reject-proposal
Request	Request-when	Request-whenever	Subscribe

# ACL semantics

- **SL logical framework**

- extend first order predicate calculus with modal operators
  - $B_i p$  - agent  $i$  believes that  $p$  is true
  - $U_i p$  - agent  $i$  is uncertain of  $p$ , but believes that  $p$  is more likely than  $\neg p$
  - $I_i p$  - agent  $i$  intends to make  $p$  true of the world
- action definitions
  - $\langle i, act \rangle$  - the action  $act$  performed by agent  $i$ , with given feasibility preconditions (FP) and rational effect (RE)
  - action operators *Done*, *Feasible*,  $|$ ,  $;$

- **Example**

$\langle i, \text{inform}(j, \phi) \rangle$

FP:  $B_i \phi \wedge \neg B_i (B_i \phi \vee U_i \phi)$

RE:  $B_j \alpha$

# Example ACL Message Exchange

Agent i requests j to inform it whether Singapore is in the UK:

```
(request
  :sender i
  :receiver j
  :content
    (inform-if :sender j
              :receiver i
              :content (in Singapore UK )
              :language sl
              :ontology geography)
  :language sl
  :reply-with query-07)
```

Agent j replies that it is not:

```
(inform
  :sender j
  :receiver i
  :content (not (in Singapore UK ))
  :language sl
  :in-reply-to query-07)
```



# FIPA: Current Activities

- **Specifications**

- Architecture
- Agent Management
- Message Transport
- Agent Naming
- Agent Configuration
- Agent Communication
  - Abstract ACL syntax
  - Content languages (e.g. XML, RDF, KIF)
- Nomadic Application Support

- **Publicity**

- Meeting Scheduler Application
- FIPA Application Competition

# FIPA Commercialisation Barriers

- FIPA 97 & 98 specs available
- Many 'closed' implementations under development (mainly FIPA members)
- Technology ready, framework/platform instances not so ready
- Many interested parties, initial hurdle to application
- Few people have seen inter-operating FIPA applications - tests underway
- No reference implementation
- No validation / verification of FIPA

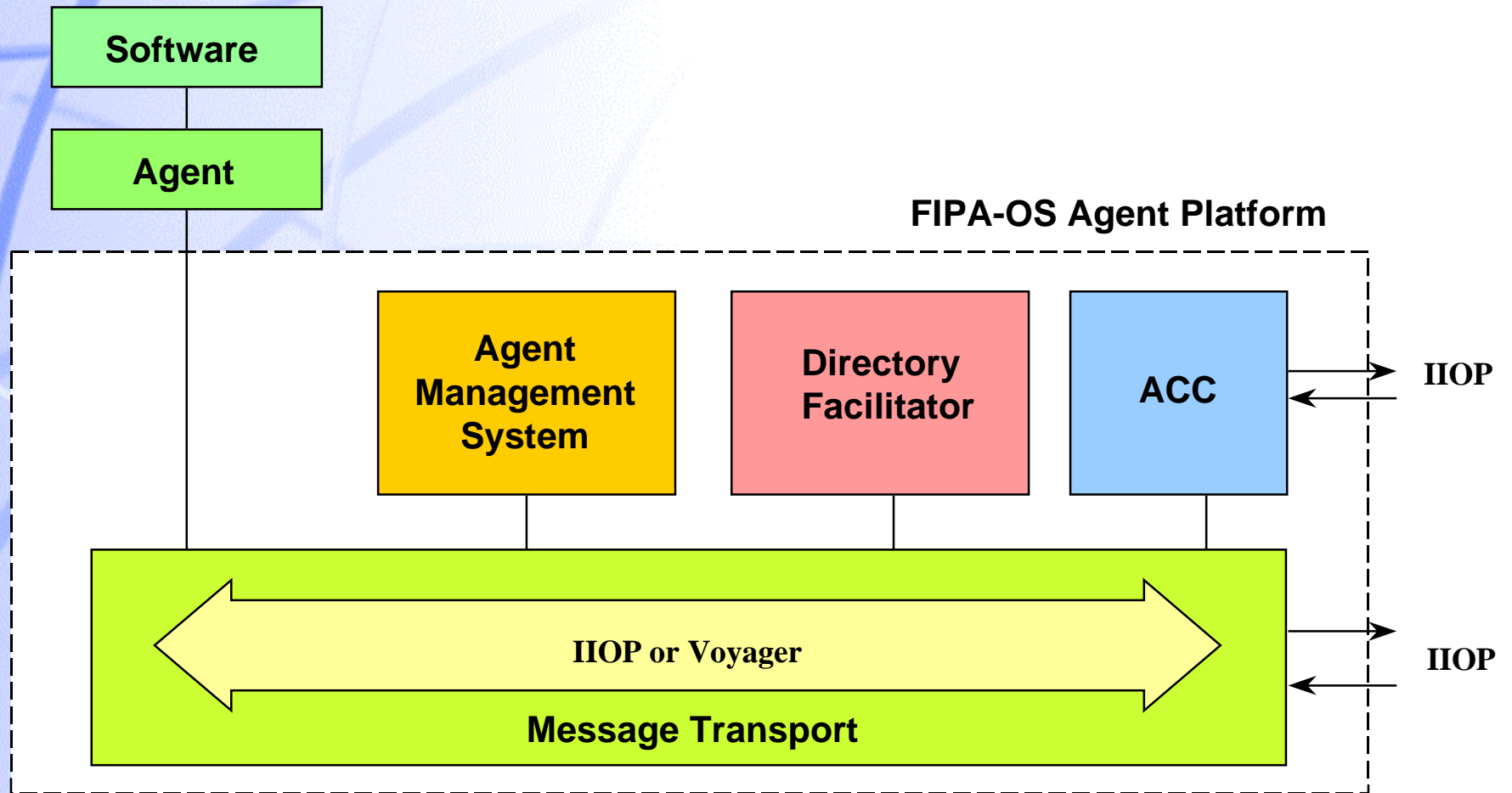
# FIPA Commercialisation Solution - FIPA-OS

*FIPA-OS is a Open Source implementation of FIPA and is available for free.*

*<http://www.nortelnetworks.com/fipa-os> for more information.*

- A 'reference implementation' of the FIPA open standard for agent interoperability
- OS means Open Source, freely available and modifiable source code (cf Linux)
- Enables adoption of FIPA without the need to implement the specifications
- Assist in validating and evolving FIPA standards

# FIPA-OS Agent Platform



# FIPA Application Competition

- **Up to US\$10000 prize**
- **To be judged in April 2000**
- **Members and non-members can enter**
- **Interoperability extra value, but not essential**
- **More details from <http://www.fipa.org/>**

# Further Information

*FIPA-OS is a  
Open Source  
implementation  
of FIPA and is  
available for  
free.*

- **FIPA**
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