Update on Agents and the Semantic Web

DAML PI Meeting

18 October 2003

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What this talk is and isn't

- Isn't
  - A report on a committee or working group, formal or informal
  - A report about a project
  - A report on a standardization effort
- Is
  - An informal report on that state of play with agents and the semantic web
  - My humble opinion

Overview

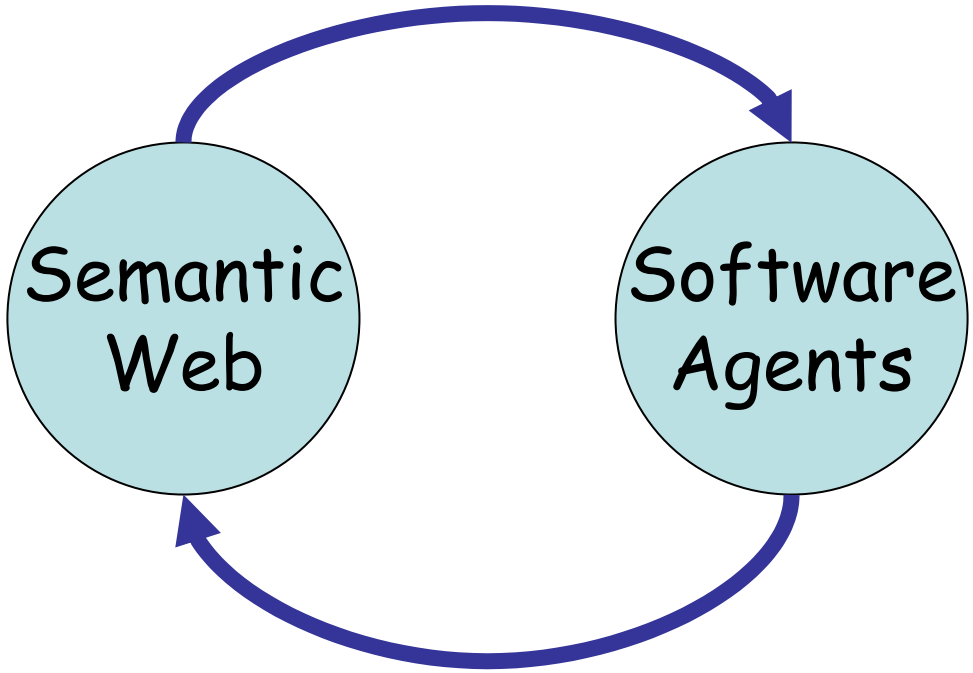
(1) Scoping the issue – what do we mean by agents, anyway

(2) Examples of recent and ongoing work highlighting how OWL* is being used

(3) Recommendations (desires?, low hanging fruit?) for the future

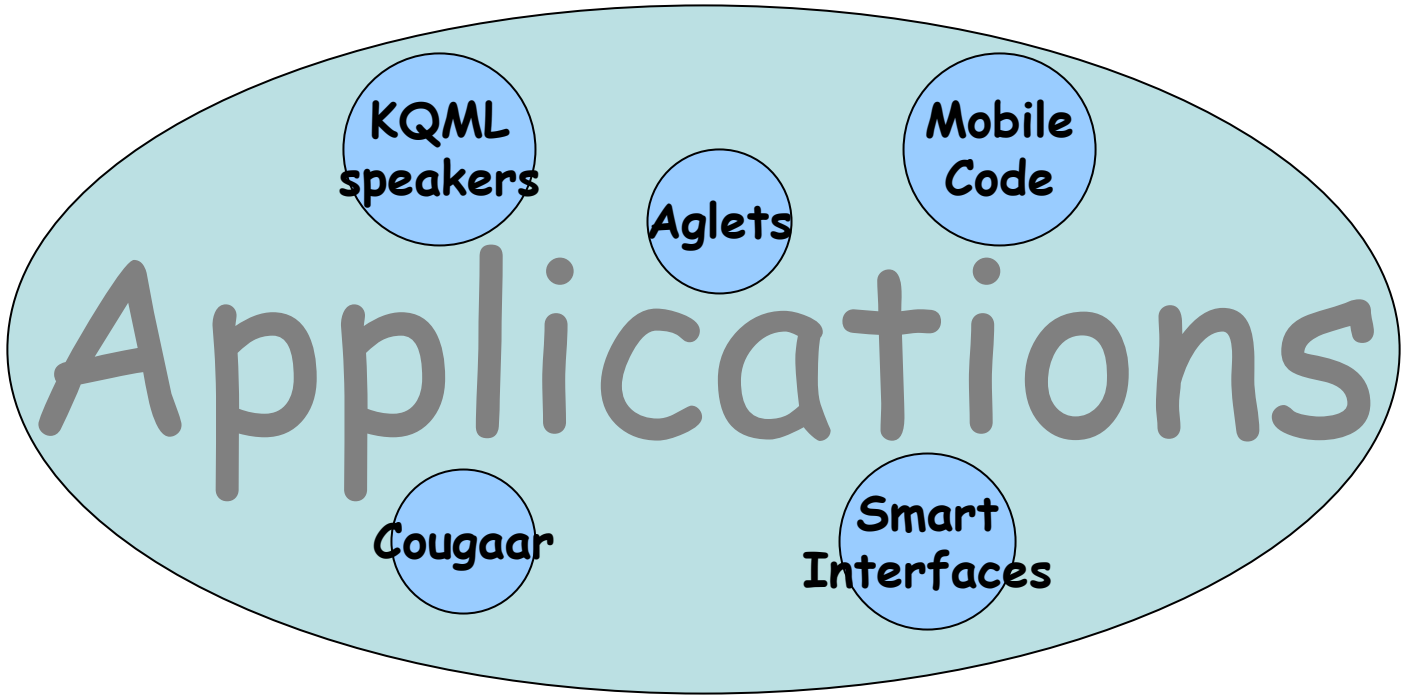
* *We'll use OWL to refer to any of the semantic Web family of languages, including RDF, DAML+OIL and OWL.*

(1) The celebrity couple



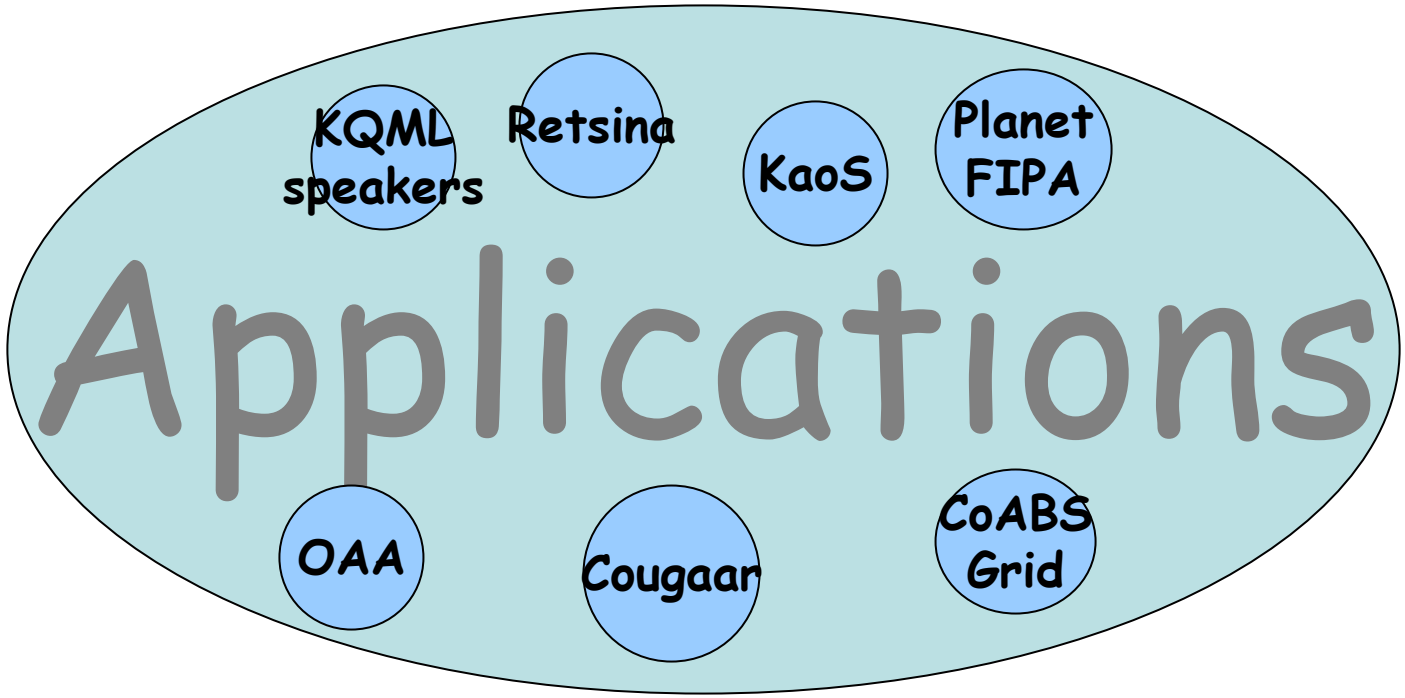
The original vision was that the SW would provide content for internet agents and agents would make the semantic web "come alive". A match made in Heaven.

(1) But what agents?



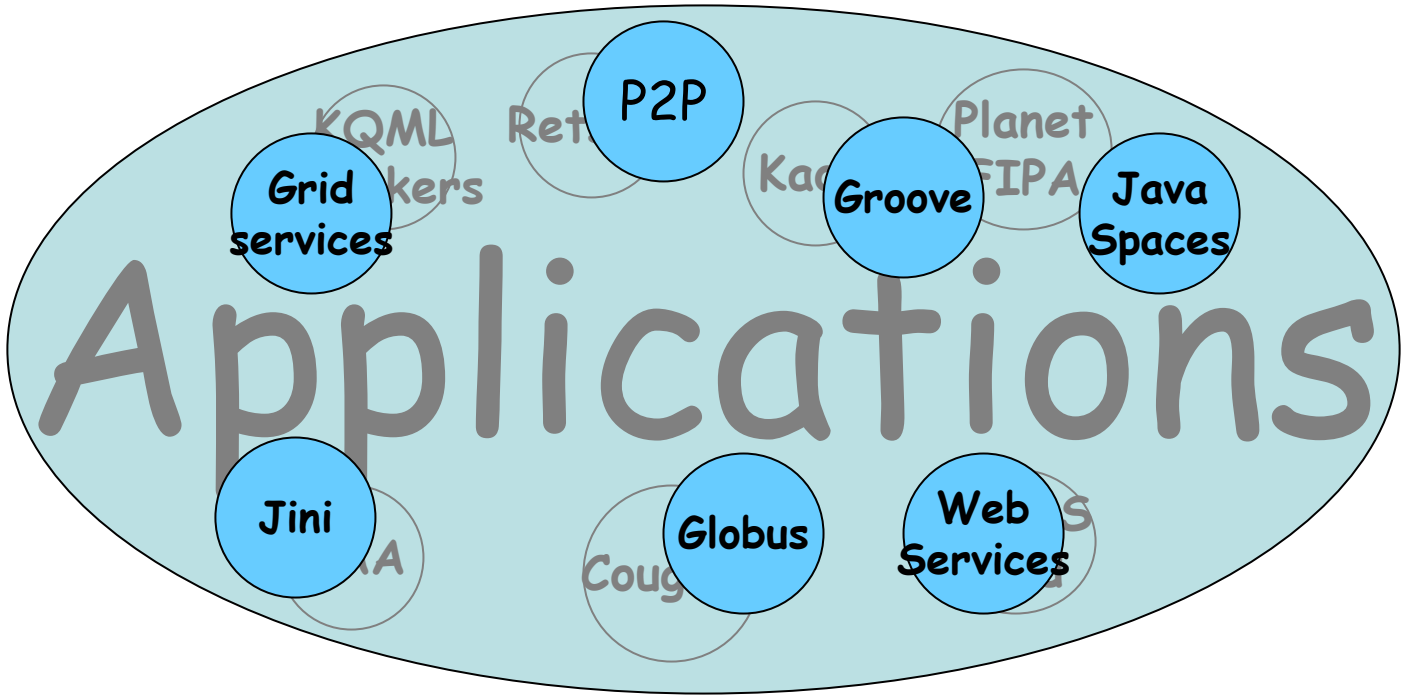
"Agent" has always been an ill-defined term with a broad definition and narrower one. Several narrower ones, in fact.

(1) But what agents?



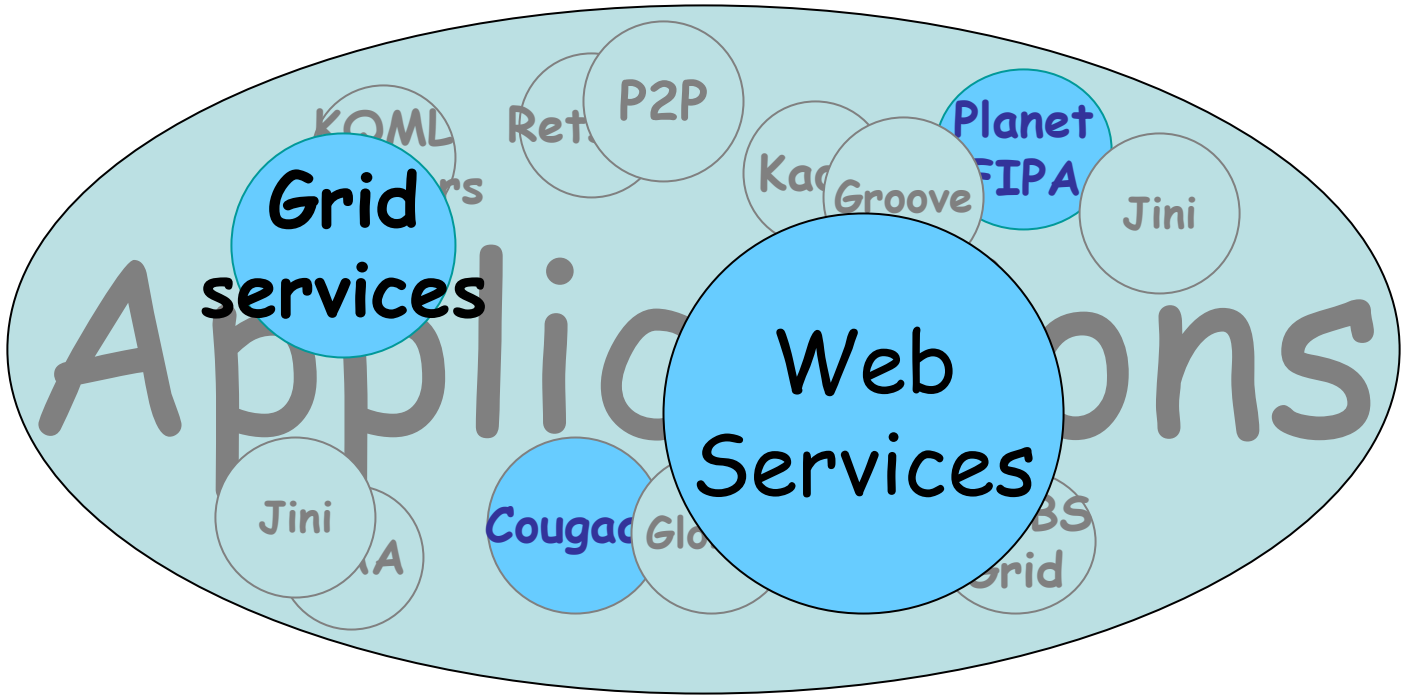
Even narrowing the focus to distributed and autonomous, cooperating applications supported by a common middleware infrastructure leaves a mess.

(1) But what agents?



And the space sprouts new middleware species every month. Most computer scientists prefer creating frameworks over using them

(1) But what agents?



Right now, the smart money is on Web Services with a side bet on Grid Services. The smart money is not loyal and evolves with the times.

(1) Scoping the issue

We better be catholic in our notion of agents -- as applications having, or at least *aspiring* to have, advanced characteristics…

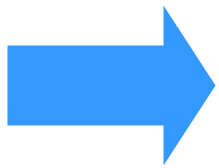
- Agents do things and are autonomous – focus on decisions and actions (describing and constraining)
- Agents are social – focus on policies constraining behavior, managing conflicting obligations
- Agents are part of a peer community – focus on knowledge and task sharing, cooperative behavior
- Agents represent people and organizations – focus on acquiring and using modeling users and organizations.
- Agents adapt and learn – focus on public declarative knowledge and ML techniques.

(1) Scoping the issue

- We must make sure we are developing ideas and technology that is consistent with (i.e., could be applied to) some current, popular vision.
  - In 2003, this is probably Web Services
- A common research strategy is to develop and test ideas in a rich agent framework (e.g., Cougaar, FIPA, CoABS).
  - With an eye toward porting to web services

Agents as stalking horses

How **is** OWL being used in rich agent frameworks?



How **can** OWL be used in (say) Smart Web Services?

That OWL helps in developing better agent-based applications is strong evidence that it will be helpful in doing the same in future frameworks. **How Owl helps** is similarly informative.

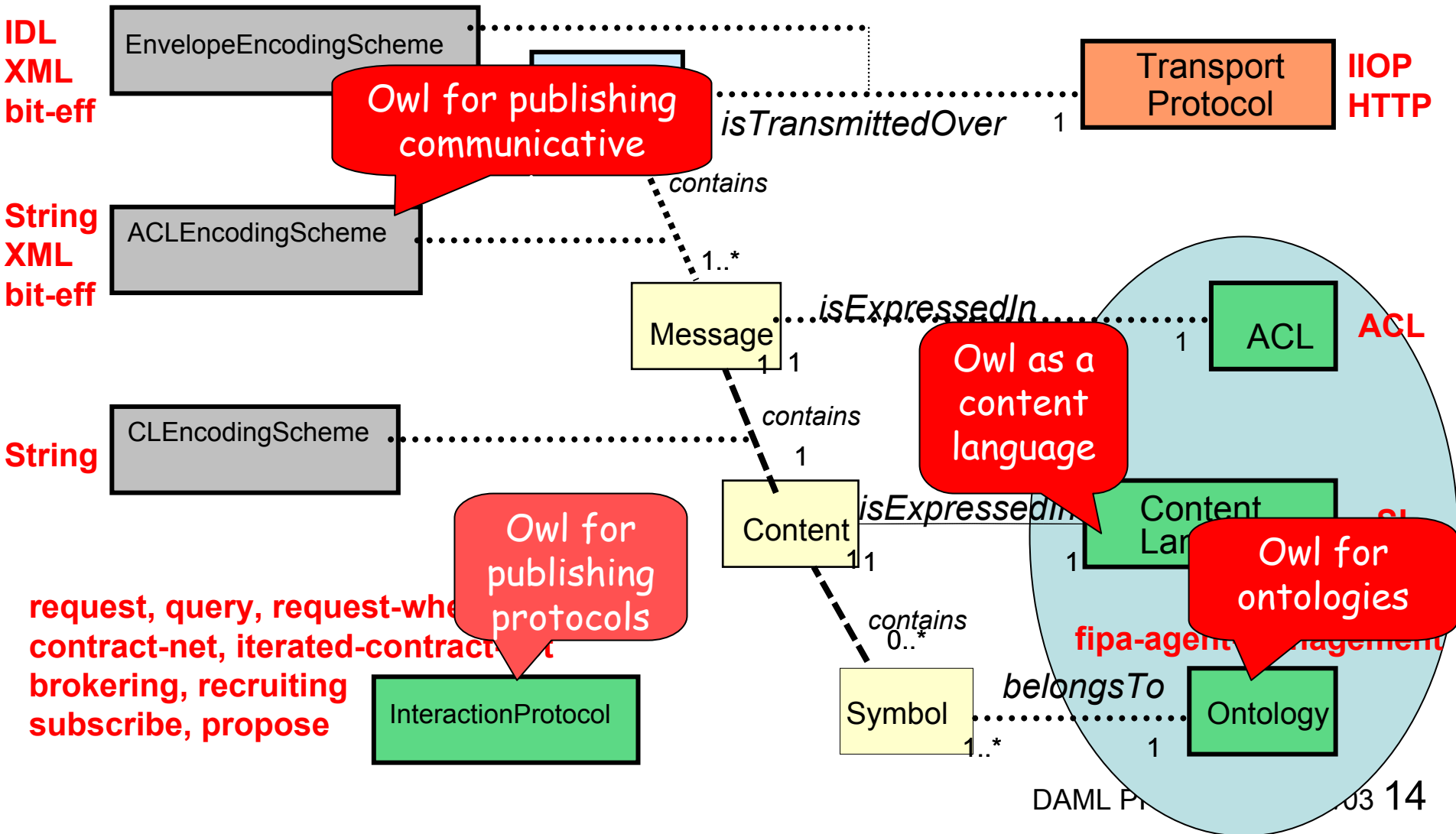
(2) OWL in GOFMAS

- I'll give some examples of current work that uses OWL in GOFMAS.
  - Good Old Fashioned Multi-Agent Systems
- April PI meeting: DAML+OIL and SONAT, ALP, Ultralog, Cougaar and Retsina
- October: FIPA, Taga, Cobra, Policy languages, CMU myCampus, Agentcities

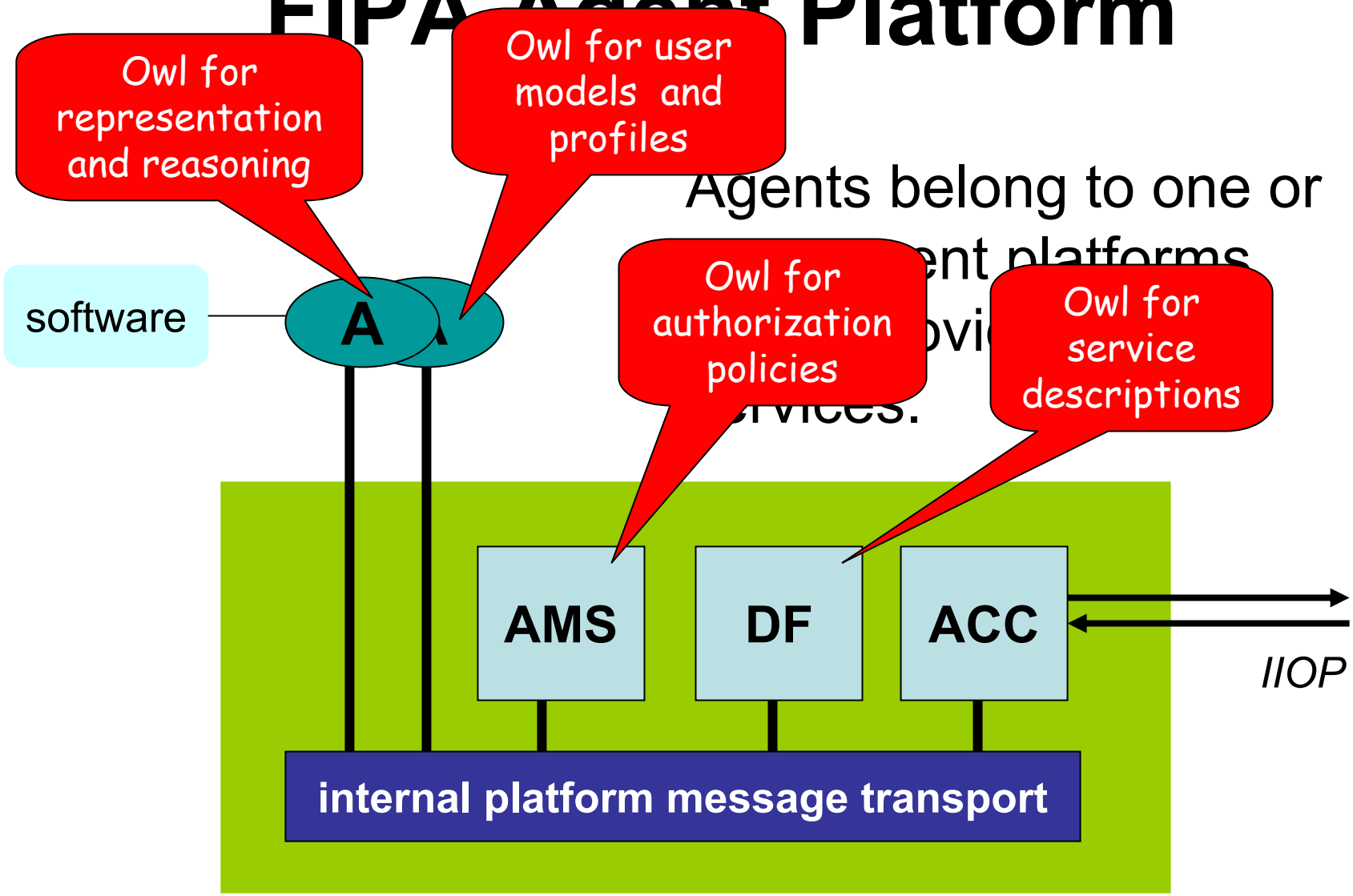
OWL in FIPA

- FIPA is the most widely used MAS framework
  - Well developed and documents standards
  - Good open source software
- RDF is one of FIPA's standard content languages
- OWL is widely used within the FIPA community, though it has not yet been formally adopted as a FIPA compliant content language

FIPA Standards Overview



FIPA Agent Platform



Agents belong to one or
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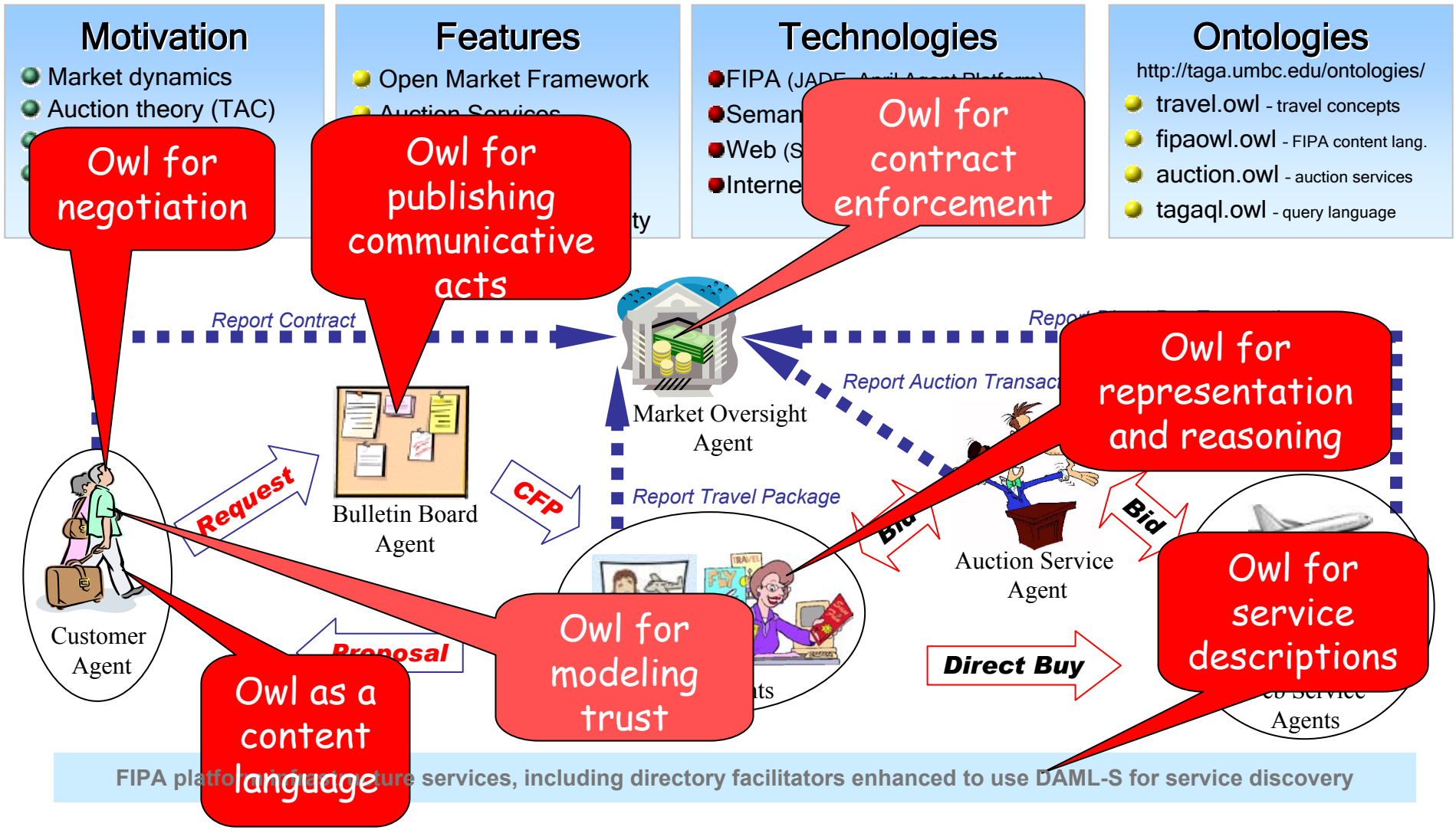
Travel Agent Game in Agentcities



http://taga.umbc.edu/

agentcities

http://agentcities.org/
http://agentcities.net/

- Agentcities includes a number of large demonstrator projects (Agentcities.RTD)

- OWL is the de facto standard for publishing ontologies in agentcities and openNet
- Some projects are large, involving ~10 groups and ~100 agents
- These could not have been done without a common ontology standard.

OWL Policy Languages

- Declarative policy language for describing policies over actions
- UMBC Rei and IHMC KaoS/KPAT
- Both express and reason over permissions, prohibitions, obligations and dispensations in RDF and OWL incorporating OWL descriptions
- Used in Genoa II (Rei) and Ultralog (KaoS)

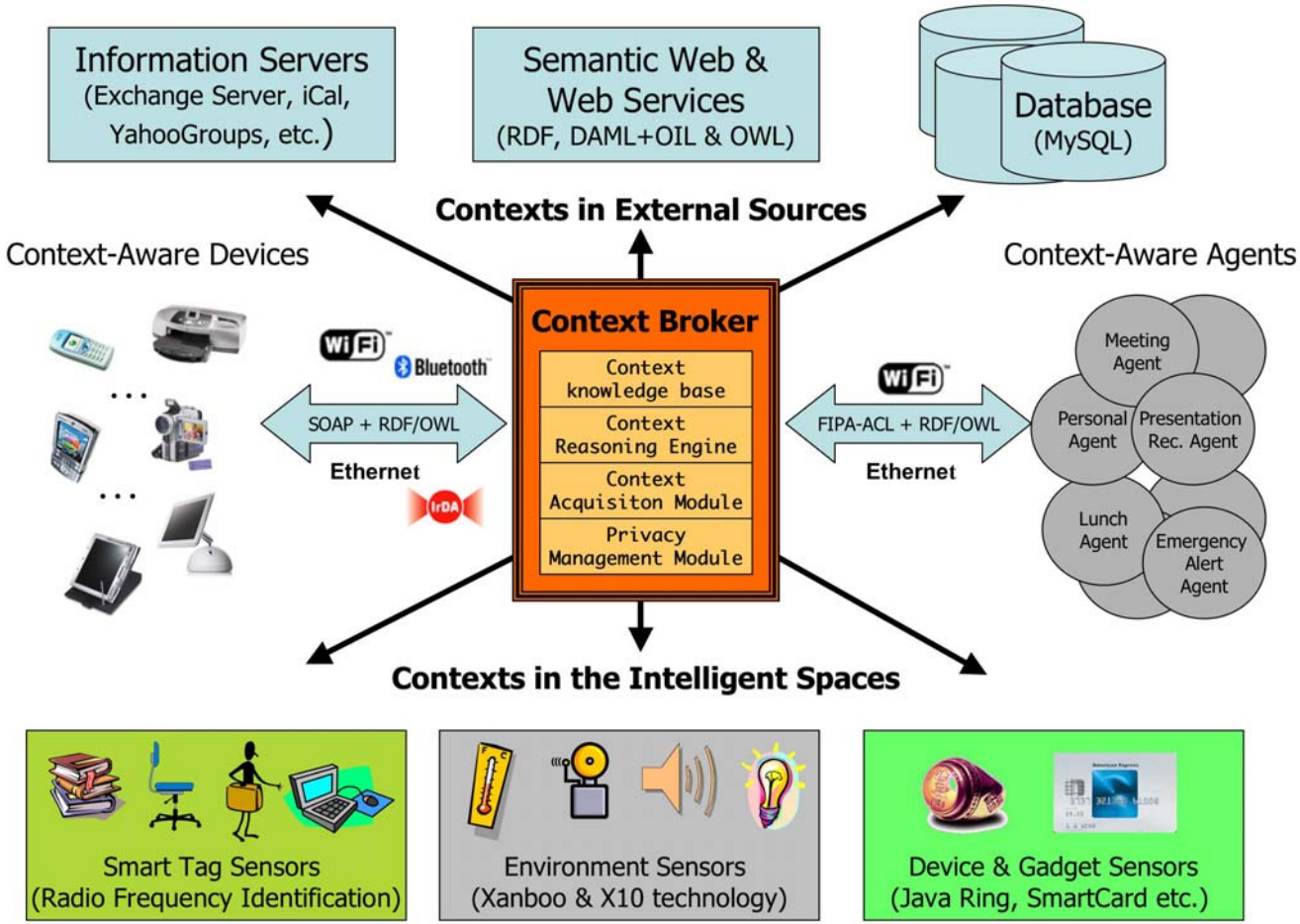
OWL in Pervasive Computing

- Agents and the semantic web show up together in several advanced pervasive computing projects
  - CMU myCampus
  - UMBC Cobra
  - Fujitsu Task Computing
- OWL used for agent communication
- OWL-S used for service representation
- OWL used for policy representation

UMBC Cobra

OWL usage

- Ontologies
- Content language
- F-OWL reasoner
- REI policy language
- DAML-Time components

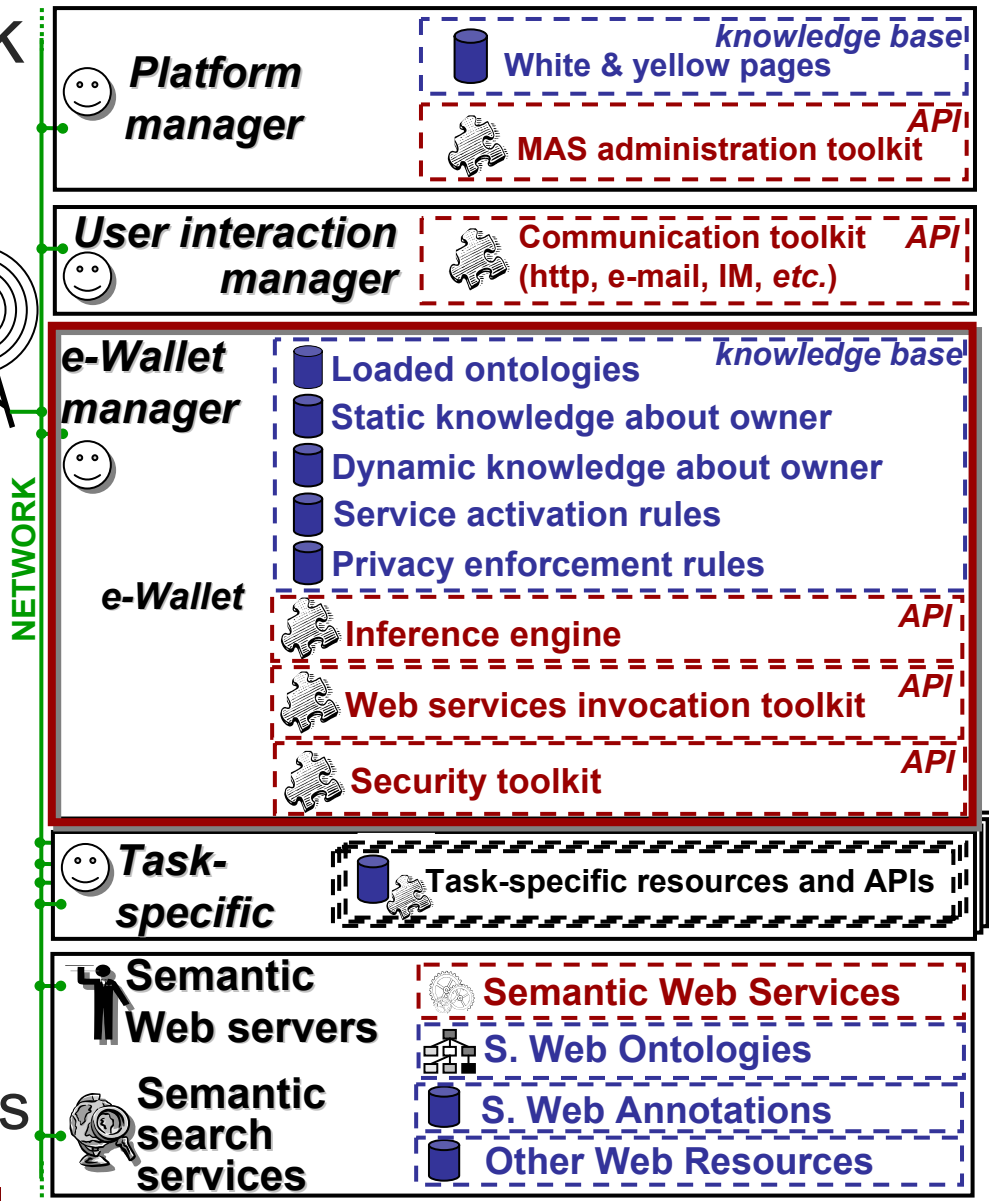


http://cobra.umbc.edu/

myCampus

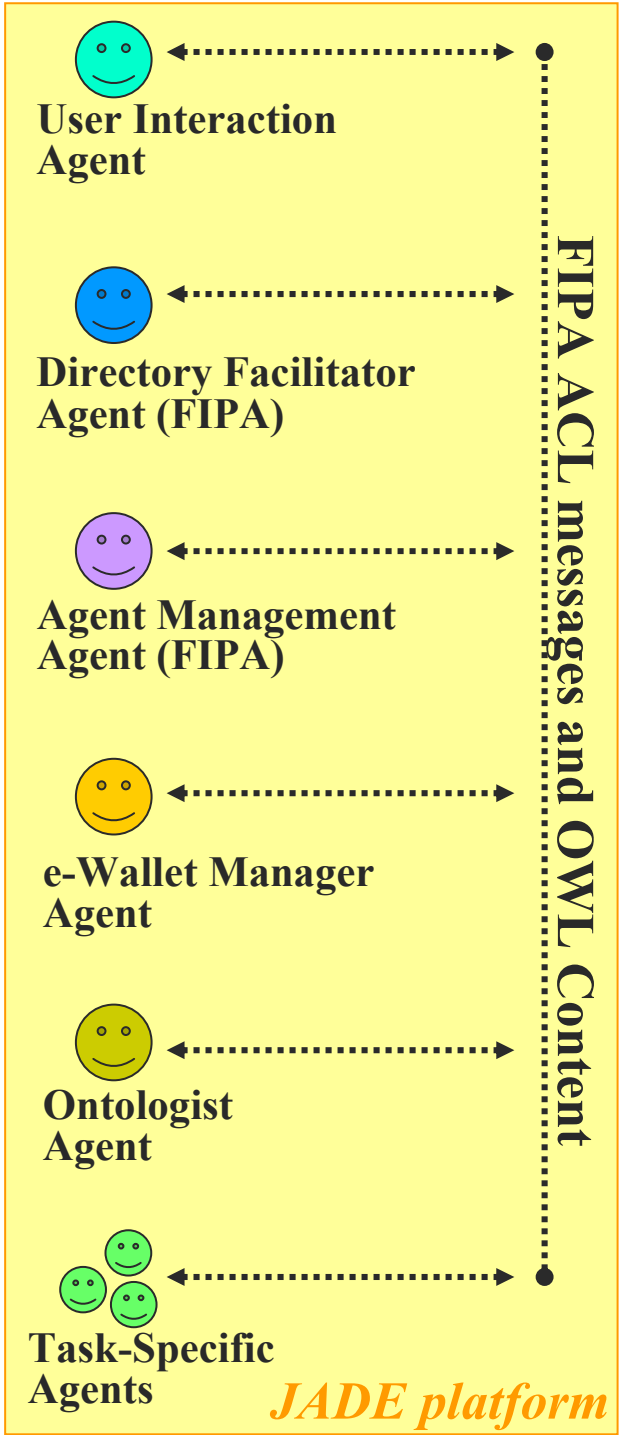
Open architecture – mobile access

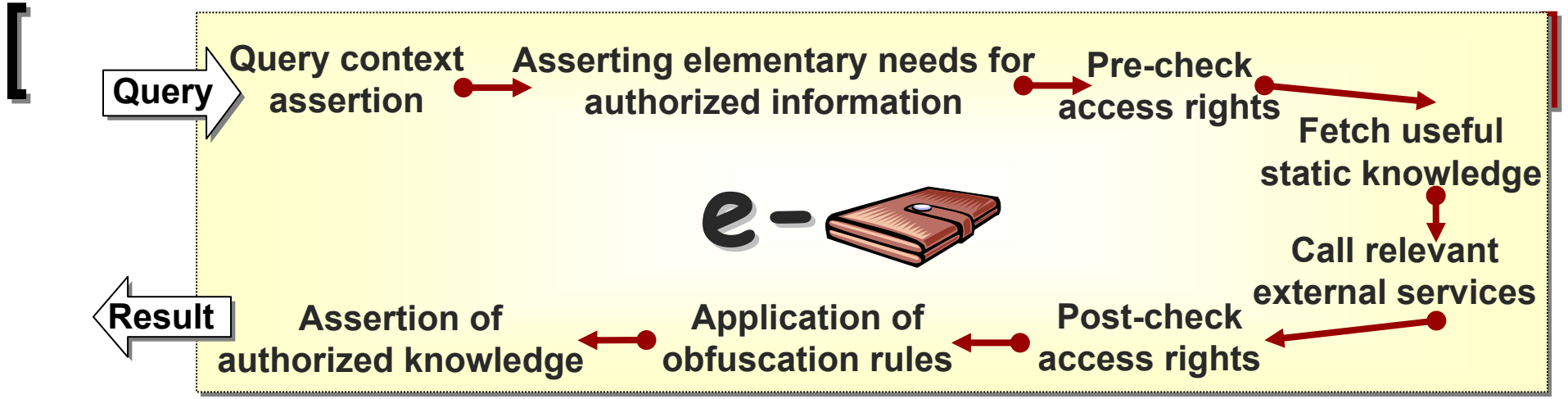
- PDA & Wireless Network
- Agent roles:
  - Platform manager
  - User interaction manager
  - Growing collection of task-specific agents
  - e-Wallet manager
- Web resources
  - Semantic Web services
  - Semantic Web ontologies
  - Semantic Web annotations
  - Search engines



FIPA MAS Architecture

- Architecture implementation
  - Rely on FIPA standard
  - JADE = one of the most used frwk
- Five agent types implemented for core functionalities:
  - Interacting with the users
  - Finding the agents
  - Accessing profiles and context
  - Obtaining ontologies
- Ready to host task-specific agents





Example : Query from John inquiring about Mary's location

- e.g. the sender of the query is John
- e.g. the query of John requires to access Mary's location
- e.g. (1) is John allowed to see Mary's location given what we know about the context of the query?
  (2) Mary said she only allows colleagues to see her location when she is on campus
  (3) John is a colleague of Mary
- *Not useful in this example*
- e.g. location tracking functionality or Mary's calendar
- e.g. is Mary on campus?
- e.g. Mary is willing to disclose the building but not the room she is in
- e.g. Mary is in Smith Hall

Other Programs using DAML Services

- AgentLink III (EU FP6 Coordinated Action)
  - **http://www.agentlink.org/** – starts Jan'04
  - Collaboration closely with FP6 Knowledge Management NOEs
    - Knowledge Web, Rewerse, Muscle, Aim@Shape, KB2.0
- Ontoweb & KnoweldgeWeb (EU FP5/6 Networks of Excellence)
  - **http://www.ontoweb.org/**
  - Several projects have semantic services bias, inc WSMF & IRS2
- Semantic Grid Research Group
  - **http://www.semanticgrid.org/GGF/**
  - Part of the Grid Global Forum
- Agentcities Worldwide Agent Technology Competition
  - **http://www.agentcities.org/EUNET/Competition/**
  - ID3 in Barcelona (Feb 2003) featured finals of Agent Technology Competition.
- Advanced Knowledge Technologies (AKT)
  - **http://www.aktors.org/**
  - Over 46 tools available for Semantic Web Research
  - Ongoing effort to convert into OWL-S Semantic Web Services…

(3) Status, IMHO

- OWL is the de facto standard for publishing ontologies in the agents community
- The Web aspects of OWL help agents deliver on their core mission – being distributed, ubiquitous and useful.
- OWL-S is a strong attractor and improves on native schemes

(3) What's next?

- Develop and publish reference ontologies in support of MAS (e.g., security, protocols, trust)
- Get OWL related specifications accepted as part of appropriate standards (e.g., get OWL in FIPA's content language library, advocate URIs as identifiers)
- Package and make available appropriate plugins for different agent infrastructures and implementations (e.g., an OWL plugin for the popular JADE implementation of a FIPA platform)