Towards Large-scale Deployment of FIPA Systems

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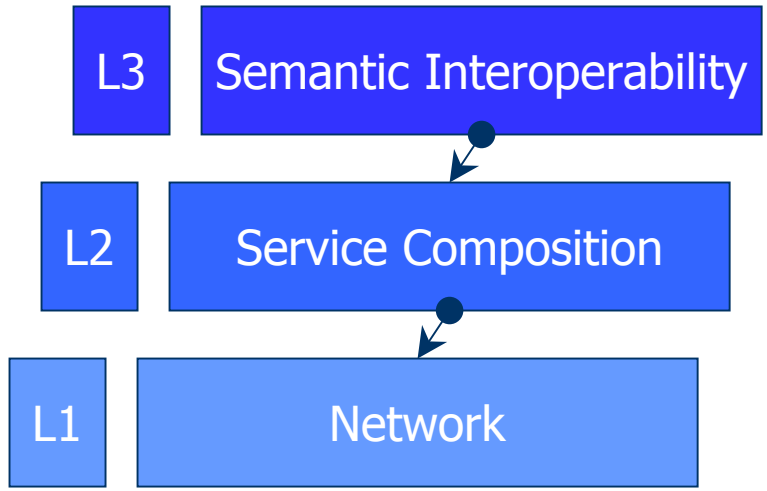
Agentcities

Agentcities Overview

- Goal
  - Create a large-scale, open deployment environment for advanced agent based services
- Activities
  - Significant number of research projects (EU, Finland, Australia, France, …)
  - Around 100 organizations directly or indirectly involved
  - 10 Working Groups
  - Agentcities Task Force

Agentcities.RTD

- EU IST-2000-28385
  - Started July'01
  - 500 Man Months
  - 14 partners
  - Research and Development
- Create the basis for the Agentcities Network
  - Technology Frameworks
  - Backbone network & initial mass of services



- Three layers of activity

http://www.agentcities.org/EURTD

Agentcities.NET

- EU IST-2000-28384
  - Started November ’01
  - 18 Month run time
  - 1 Million Euro Budget
  - 50+ Member organizations
- Objective
  - Fund Agentcities deployment & usage in Europe
- Actions
  - Technical support
  - Deployment Grants (32 awarded)
  - Competition
  - Information Days
  - Working Group Support
  - Student / Researcher Mobility
- Activities Now in full swing

http://www.agentcities.org/EUNET

Where we are now…

- Platform Network
  - Significant numbers of platforms deployed (approaching 50)
  - Relatively stable network (running since October ’01)
  - Steady growth (1 or 2 new platforms per week)
- Service Interoperability
  - Still few services
  - But!
    - First large scale deployment completed July ’02
    - Agentcities.NET services on the horizon
    - Interoperability tests in small clusters
- Service Composition – on the horizon

Network

Current Network Snapshot

•46 platforms total / 36 in Europe

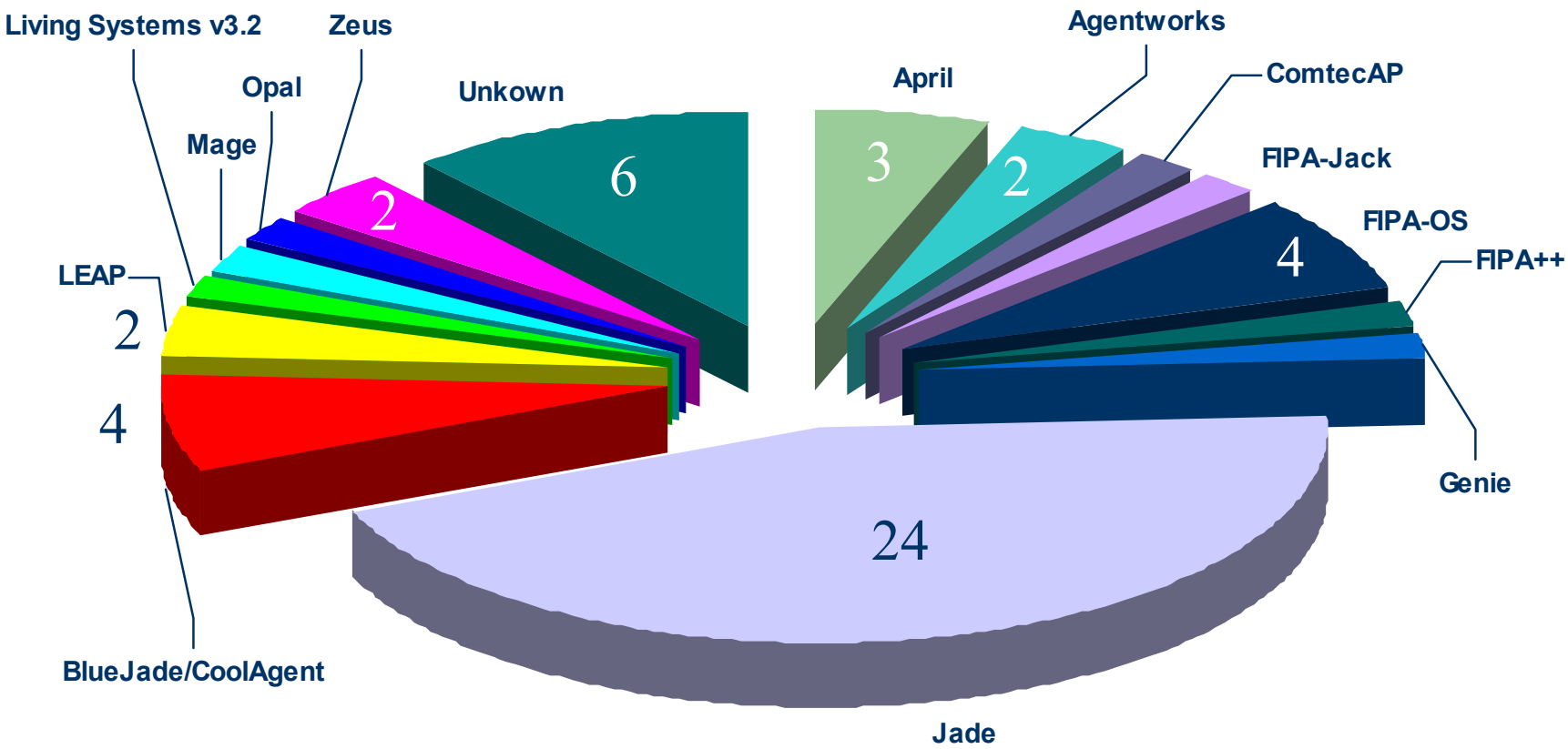
Network Objectives

- Technical
  - Coherent framework / architecture for large-scale open networks of (agent-based) services
  - Support heterogeneous technologies & their re-use
- Operational
  - Build a significant community of users to create a realistic test environment
  - Support users in experimentation with agent based services and their composition
  - Gather experience in using and managing such large-scale open systems

Architecture

- Technologies
  - FIPA HTTP MTP (IIOP some)
  - FIPA XML Envelope
  - FIPA AMS White Pages
  - FIPA DF Yellow Pages
- Not used
  - DF federation
  - Agent Lifecycle Management
- Structure
  - Full Mesh for Messaging
  - Centralized Platform Directory
  - Star topologies for Agent/Service Directories
- Nodes
  - All FIPA Platforms

Composition (Market Share!?)



Challenge: Network Management

- Require
  - Platform / Agent / Service discovery bootstrapping
  - Information sharing on configurations
  - Active components to track status of network “elements”
- Less important
  - Management of agents on remote platforms
- Solution
  - Centralized Web based management
  - User Accounts – Humans enter bootstrapping data
  - Automated polling to track status
  - JSP / JAMR-ATOMIK
- Problems
  - Centralized, single point of failure

Challenge: Debugging / Testing

- Testing and checking
  - Platform status
  - Message delivery / speed
  - Directory responsiveness, recall and accuracy
- Started with
  - Hand driven n-n tests
  - No longer feasible with 45 platforms
- Solutions
  - Motorola / Agentcities Test suite
  - New on-line monitoring tools & a test regime
  - Agent automated network status checking
- Problems
  - Becomes harder when decentralized

Input to FIPA

- FIPA Management / MTS Specifications:
  - Well tested
  - Many different interoperating implementations
- Potential Problem: MTS / MTP stack does not provide for synchronous communication
  - Firewall traversal
  - Resolve as needed
- Input on DF/AMS to come

Future: Network Evolution

- Technologies
  - SOAP Transport
  - UDDI directory (adopt/support FIPA / Web services work)
  - LDAP
  - Different caching, propagation and query policies (e.g. DNS v's UDDI)
  - Message gateways
  - Mobile networks?
- Structure
  - Model based on domains, sub-domains
  - Flexible organizational structure
  - Exploring various use-cases: internet, intranet, p2p networks

Services

Service Deployment Objectives

- Technical
  - Coherent frameworks / best practice for *service interoperability* and *composition*
  - Supporting heterogeneous technologies & technology re-use
- Operational
  - Build a critical mass of service examples & support their interaction
  - Gather experience in exploiting and managing open environments

Agentcities.RTD Services

Hotel Service

Restaurant Review

Restaurant Booking

Theatre Recommender

GIS Service

Restaurant Finder

Auction House

Transport Info Service

Ontology Service

Trade House

Agent Directory

Payment Service

Security Service

Platform Directory

SMEAccess Service

Service Directory

Demo Period I (July 2002)

- Service Components
  - Limited inter-agent/service interaction
  - Live in the network and accessible
  - http://www.agentcities.org/EURTD/DemoZoneI
- Purpose
  - Experience in Deployment
  - Test interactions with this parties
  - Baseline for composition step

Service Interoperability

- Technologies
  - AUML Protocol Diagrams
  - FIPA ACL / S-expression syntax
  - FIPA-SL
  - ANSI KIF
  - DAML-OIL
- Expect this
  - To become more diverse (already signs at the CL level)
- Structure
  - Instances:
    - Context
    - Conversation
    - Message
    - Content
    - Ontology
  - Frameworks at each level
- Concurs with current FIPA thinking?

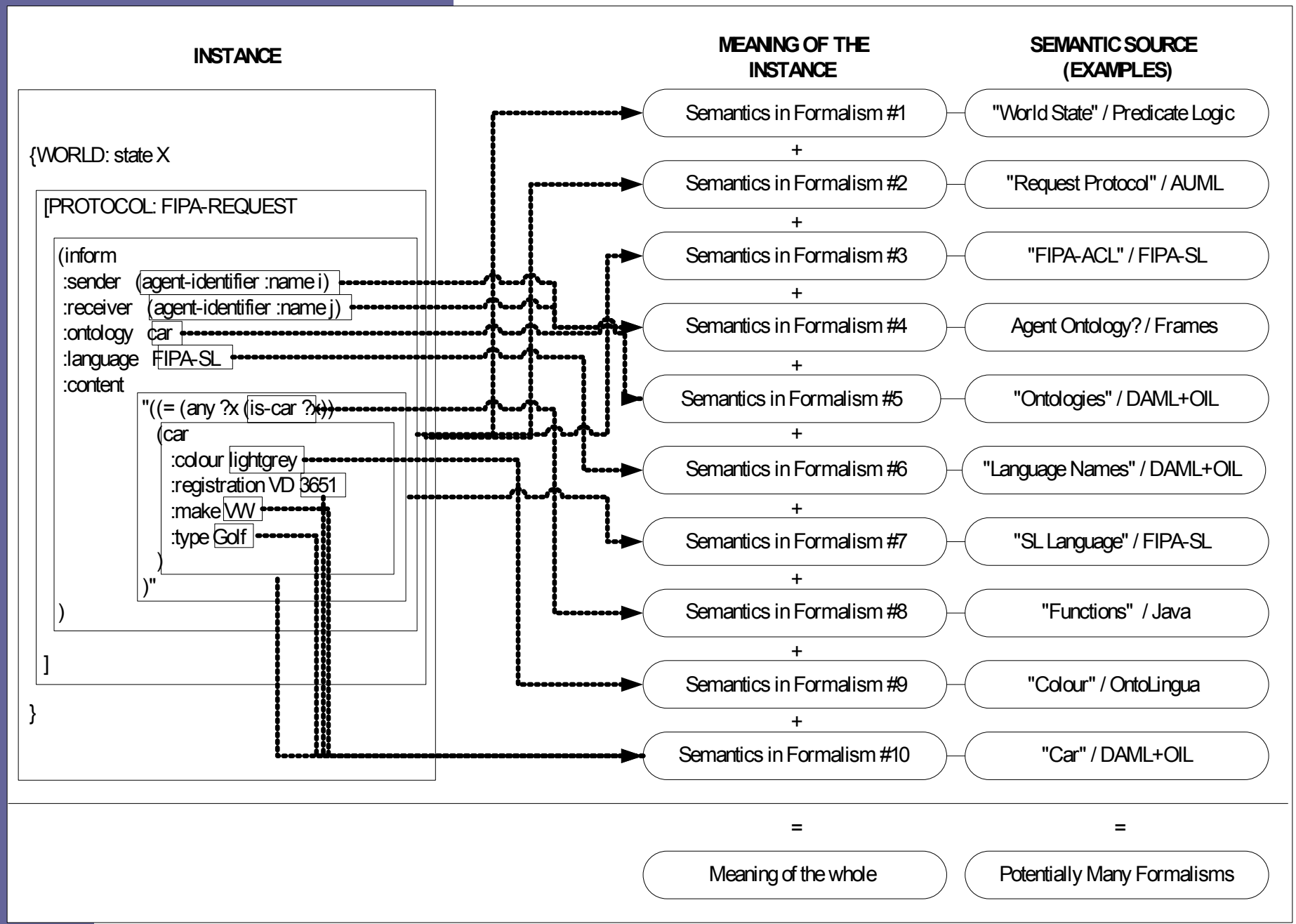
Challenge: Ontology Usage

- Ontology Management
  - (Cross)referencing, storing, publishing ontologies
  - Ontology evolution and versioning
- OO style ontologies / logical languages
  - No obvious way to define functions, actions and the like
- Solutions
  - Include subdivisions / upper ontologies in domain descriptions
    - Object
    - Action
    - Function
  - SL support ontology
  - Ontology server efforts and namespacing

Challenge: Semantic Stack

- Current Usage of Semantics
  - Developers only
  - hard-coded message template analysis in implementations
- Overall reasoning problem is too complex
- There are few (no?) tools to help

- Solutions
  - Targeting complete specification (for human analysis) as first goal
  - Then proceed to partial automation of message generation
  - Reducing the scope of messages in each interaction
- Longer term approach
  - Gather system building experience before finalizing framework


INSTANCE
MEANING OF THE INSTANCE
SEMANTIC SOURCE (EXAMPLES)
{WORLD: state X
[PROTOCOL: FIPA-REQUEST
(inform
:sender (agent-identifier :name i)
:receiver (agent-identifier :name j)
:ontology car
:language FIPA-SL
:content
"((= (any ?x (is-car ?x))
(car
:colour lightgrey
:registration VD 3651
:make VW
:type Golf
)
)"
)
]
}
Semantics in Formalism #1
"World State" / Predicate Logic
+
Semantics in Formalism #2
"Request Protocol" / AUML
+
Semantics in Formalism #3
"FIPA-ACL" / FIPA-SL
+
Semantics in Formalism #4
Agent Ontology? / Frames
+
Semantics in Formalism #5
"Ontologies" / DAML+OIL
+
Semantics in Formalism #6
"Language Names" / DAML+OIL
+
Semantics in Formalism #7
"SL Language" / FIPA-SL
+
Semantics in Formalism #8
"Functions" / Java
+
Semantics in Formalism #9
"Colour" / OntoLingua
+
Semantics in Formalism #10
"Car" / DAML+OIL
=
=
Meaning of the whole
Potentially Many Formalisms

Challenge: Namespaces & Names

- Referencing things:
  - Ontologies, protocols, languages etc.
  - Either existing ones (e.g. fipa-request) or new ones: “my ontology”
- Dereferencing things
  - Linking a token to a specification (for and agent or for a developer)
- Solutions
  - URN namespace
  - Simple web based management & creation
  - Now being tested
- Problems
  - Currently not Agent readable
  - No distributed management

Challenge: Service Description

- Many types of description required
  - Human readable
  - Machine readable
  - Multiple formats
- None of the formalisms are really complete

- Solutions
  - Split class definition and instance
  - HTML template to gather information
  - Limited machine readable elements in the DF
- Problems
  - Maintenance
  - Versioning
  - Machine readable formalisms

Challenge: Testing

- Message Interoperability
  - Checking Agents could “handle” messages defined in the interfaces
- Linking Messages & Behaviour
  - Verifying ACL semantics
  - Verifying correct agent actions
- Solutions
  - Message templates provided & tested by others
  - Ontologies restricted to reduce range of possible messages
- Problems
  - Still limited to simple templates
  - Logic not being exploited

Input to FIPA

- Tokens and Names
  - Input made on XML Namespace compatible tokens
- Need mechanisms for referencing multiple ontologies
  - X2S/Ontology Submission made and discussion started

Input for FIPA

- Problem: lack of a “viable” content language
  - The FIPA standard languages are untested, have few tools available or have other perceived problems
  - There is no clear choice
  - SL / KIF fill a gap for now but this is concerns for the future
- Problem: current ACL semantics are perceived to be flawed
  - They are currently not directly used but are important for the future
- Problem:
  - How to test interactions based on ACL / SL / KIF?

Future: Service Composition

- Service interoperability
  - Closely linked with service composition
- The current services are components
  - Little linkage between them
  - No dynamic discovery, evaluation and usage

Demo Period II (Spring 2003)

- Service Composition Demonstration
  - Dynamic Service Discovery
  - Dynamic Service Composition
    - Maintaining relationships over time
    - Reacting to change
  - Integration of Business and Information Services
  - Integration of Business and End Customer User Experiences

Well – that's the plan anyway…

Service Composition

- Technologies
  - Choices still being made
- Preliminary work:
  - Evaluation of different description languages
  - Experimentation with DAML-S
  - Investigation of reasoning requirements
- Structure
  - Recommendation of one or more description languages
  - Diverse reasoning strategies
  - Links to semantic frameworks and coordination technologies to capture on-going relationships

Conclusions and On-going Activities

Next…

- Working Group Activities
- Agentcities Competition
- iD2 and iD3
  - Lisbon, Portugal: 9/10 December
  - Barcelona, Spain: Feb 2003
- Formation of ACTF
- Project Activity
- Agentcities.NET
  - 32 groups deploying Agentcities platforms & Services
- Agentcities.RTD
  - Documentation of service deployment experiences
  - Interoperability & composition frameworks for Agentcities
  - Second generation network architecture
  - Service Composition

Building Agentcities:

- Is a huge challenge
  - 9 months to deploy the first real services
  - At least another 9 to make them work together effectively and dynamically
- Progressing well
  - Very considerable interest
- Would be impossible without FIPA
  - No other standard addresses higher level of communication
  - Interoperability between different agent toolkits is critical
  - The easy access through free toolkits is essential
- Hope will continue to generate useful input

The End

```
(query-ref
   :sender (agent-identifier :name steve)
   :receivers (set (…))
   :language FIPA-SL
   :content
         “((any ?x (question ?x)))”
)
```

Resources

- http://www.agentcities.org
  - http://www.agentcities.org/EURTD
  - http://www.agentcities.org/EUNET
  - http://www.agentcities.org/Challenge02
- http://www.agentcities.net