Objective Coordination for FIPA Agents

Andrea Omicini

joint with

Alessandro Ricci, Giovanni Rimassa, Mirko Viroli

Integrating Objective & Subjective Coordination in FIPA: A Roadmap to TuCSoN

WOA 2003 – Villasimius, 10-11 settembre 2003
Outline

• Subjective & Objective Coordination
  - The Gap and the Bridge (Activity Theory)
• Crossing the Bridge
  - Extending FIPA Model towards Objective Coordination
  - TuCSoN + FIPA Model Investigation
• Research Plan
The Babel’s Tower of Coordination

- Possibly, the most un-coordinated research area
- A multiplicity of non-related approaches
  - from a huge and heterogeneous range of research fields
- First successful attempt for a rationale
  - Objective vs. Subjective (Schumacher)
  - Methodological gap (Omicini, Ossowski & Ricci)
Subjective Coordination

- Coordination from the agent’s viewpoint
  - Components are the *coordinating* entities
  - Assumes some deliberative / intelligent capability by components

- Historically: from DAI

- Our champion today
  - FIPA model / JADE infrastructure
Objective Coordination

- Coordination from the designer’s viewpoint
  - Components are the coordinated entities
- Assumes no deliberative / intelligent capability by components
  - typically disregards them…
- Historically: from SE / PDS / PL
- Our champion today
  - TuCSoN model & infrastructure
Aim of this paper

- Given the separate development, the gap is no longer confined to models…
  - the need to bridge the gap is even more urgent

- Here we try to devise out a possible roadmap towards a possible convergence between
  - the TuCSoN and FIPA models
  - the TuCSoN and JADE infrastructures
Activity Theory

- Conceptual Framework for (human) Collective Work Analysis
  - Activity
    - Objectives & Context
  - Artifacts
    - Mediated Interaction

- Collaborative Activities
  - Coordination artifacts
Levels of Collaborative Activity

- **co-construction**: identifying the social objectives & tasks
- **co-operation**: designing & building the coordination artifacts for social task achievement
- **co-ordination**: using the coordination artifacts
Bridging the Gap

Integrating Objective & Subjective Coordination in FIPA: A Roadmap to TuCSoN

WOA 2003
FIPA toward Objective Coordination

- Goal
  - Embedding Coordination Artifacts in FIPA / JADE

- Conceptual premise
  - Artifacts are not ontologically equivalent to agents
    - Agents should not be expected to interact with artifacts by means of Speech Acts

- Agent-Artifact Interaction modelled through Physical Acts
FIPA Model

- Speech Act Theory
  - performatives come along with any message
  - and give it a non-ambiguous meaning

- Semantics Interoperability
  - intentional stance, BDI model
  - Feasibility Preconditions and Rational Effects

- Subjective approach if there is one…
TuCSoN for Dummies

- MAS Coordination Infrastructure
  - Coordination as a Service
    - ReSpecT Tuple Centre Coordination model
    - Distributed Coordination Space
  - Coordination, Organisation, Security
    - Agent Coordination Context
  - Orthogonality w.r.t. the Agent Model / Platform
ACC Negotiation and Entrance

ACC Negotiation

Tuple Centres

Organisation

TuCSoN nodes

TuCSoN nodes

ACC

WOA 2003 Integrating Objective & Subjective Coordination in FIPA: A Roadmap to TuCSoN
TuCSoN + FIPA

- TuCSoN Coordination Model
  + FIPA Agent Model
    - TuCSoN Tuple Centres as Coordination Artifacts for FIPA Agents
    - FIPA Ontology of TuCSoN Coordination Primitives for Semantic Interoperability
      - possibly embedded in ACCs
Agents & Coordination Artifacts

• Two basic categories
  • agents as *users* of artifacts
    • typically co-ordination level
  • agents as *managers* of artifacts
    • typically co-operation level
Coordination Artifacts in FIPA (I)

- Modelling ACC Negotiation
  - TuCSoN Welcome Service as a FIPA Agent
  > Speech Act Request to enter into a (TuCSoN) Organisational Context
• ACC Negotiation and Entrance

(request
  :sender (agent-identifier :name sensorXYZ)
  :receiver (set (agent-identifier
                  :name tucson_welcome_service))
  :ontology tucson-ontology
  :language PCL
  :protocol ACC-Negotiation
  :content
    (action
      'agent-identifier' (name: 'sensorXYZ'),
      enterACC(society(health_monitoring),
      role(temperature_sensor))))

Examples (I)
Coordination Artifacts in FIPA (II)

- Modelling Use of Coordination Artifacts
  - Tuple Centre Coordination Actions as Physical Acts
  - out / in / rd / inp / rdp
- Need for a Suitable Ontology
  - to define FP / RE of coordination primitives as physical acts
Examples (II)

• Interaction with Tuple Centres

(out

  :agent (agent-identifier :name sensorXYZ)
  :target (tuple-centre( patient('Alessandro') ))
  :ontology TuCSOn-ACC-Use
  :language PCL
  :content (temperature(37.5)))

(in

  :agent (agent-identifier :name healthControllerXYZ)
  :target (tuple-centre( patient('Alessandro') ))
  :ontology TuCSOn-ACC-Use
  :language PCL
  :content (temperature(X)))
Coordination Artifacts in FIPA (III)

- Modelling Management of Coord. Artifacts
  - Tuple Centre Behaviour Specification Actions as Physical Acts
  - set_spec / get_spec

- Need for a Suitable Ontology
  - to define FP / RE of behaviour specification primitives as physical acts
  - maybe the same as before, maybe not – quite a complex matter
Examples (III)

- Behavior Specification of Tuple Centres

```
(set_spec
 :agent (agent identifier :name healthController)
 :target (tuple-centre(patient('Alessandro')))
 :ontology TuCSoN-ACC-Use
 :language PCL
 :content (reaction(out(temperature(T)), (
 rd_r(pressure(P)),
 in_r(product(Old)), out_r(product(P*T)))))
 reaction(out(pressure(P)), (
 rd_r(temperature(T)),
 in_r(product(Old)), out_r(product(P*T)))))
```

Benefits for FIPA Agents

• Advantages of Obj. Coordination in Subj.
  - uncoupling for openness and dynamism
  - specific / efficient abstractions
  - controlled / automated interaction

• Runtime support for Coordination
  - Dynamic inspection of coordination laws
  - Dynamic change / adaptation of coordination strategies & activities
Research Plan

• FIPA Ontologies & Formal Semantics
  - ACC Negotiation
  - Coordination Artifacts Use & Administration
• Investigating ACC for Semantic Interoperatibility
• Investigating Infrastructure Integration
  - JADE + TuCSoN
• Verification