Integrating Organisation within a MAS Coordination Infrastructure

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Motivation

- Premise
  - Security / Organisation / Coordination as different views on the same problem
    - >> governing interaction within complex systems
- Goal
  - Unified conceptual framework
    - >> modelling & engineering
    - >> infrastructure as the key target
      - infrastructure model
      - specific methodologies
  - Unified (view of) abstractions
    - >> infrastructure as abstraction provider
      - abstractions from design to run time

Agent Society /Organisation Background

- AOSE
  - societal/organizational abstractions used more and more in AOSE
  - mostly at the analysis and design stages
- Information Systems
  - security / management concerns
  - RBAC models
- Theory of Organisation
  - social / psychological theories

What do we learn?

- Stages of Organisational Structures
  - Abstraction and Concretion (Agent)
- Multi-level Structure
  - Organisation/Society/Agents
- Role-based Model
  - Role-Base Access Control
  - Role Admission/Activation
- Organisation Structure & *Rules*
  - agent-role + inter-role relationships

Our meta-model

- Organisation Structures
  - society class / society
  - role / agent
- Organisation Rules
  - agent-role / inter-role relationships
    - >> role admission/activation
  - resource access control
    - >> role-based access control

Agent Coordination Background

- Coordination + Context Abstractions
  - Tuple Centres
    - >> multiple, distributed, programmable coordination
    - >> mediate agent-to-agent & agent-to-resource interaction
    - >> encapsulating coordination laws
      - explicitly represented
      - making them available for agent inspection / modification
    - >> belong to the agent environment
  - Agent Coordination Contexts
    - >> environment interface toward the agent
    - >> mediate agent-to-environment interaction
    - >> define the agent environment

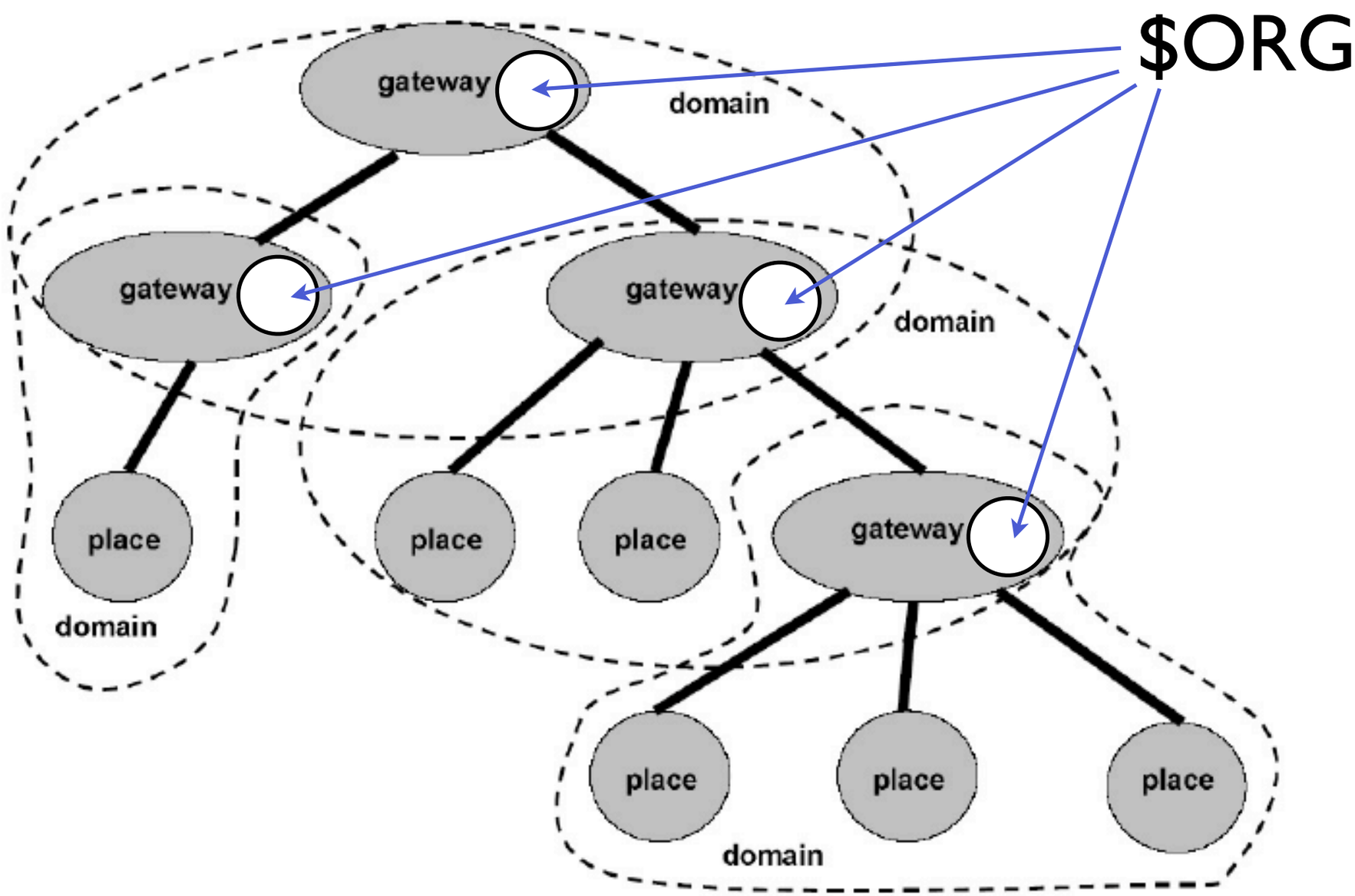
Agent Coordination Context

- Organisation Abstraction
  - defines the presence of an agent within a system
  - defines the admissible agent actions
    - >> access control / security
    - >> based on the agent roles
- Integration with Coordination
  - meta-level denotation of agent (inter)action
    - >> allowed / not allowed, cost, time, …
  - makes admissible actions explicitly represented
    - >> and available to agent inspection
- Organisational Structures
  - dynamically inspectable
    - >> modifiable through $ORG

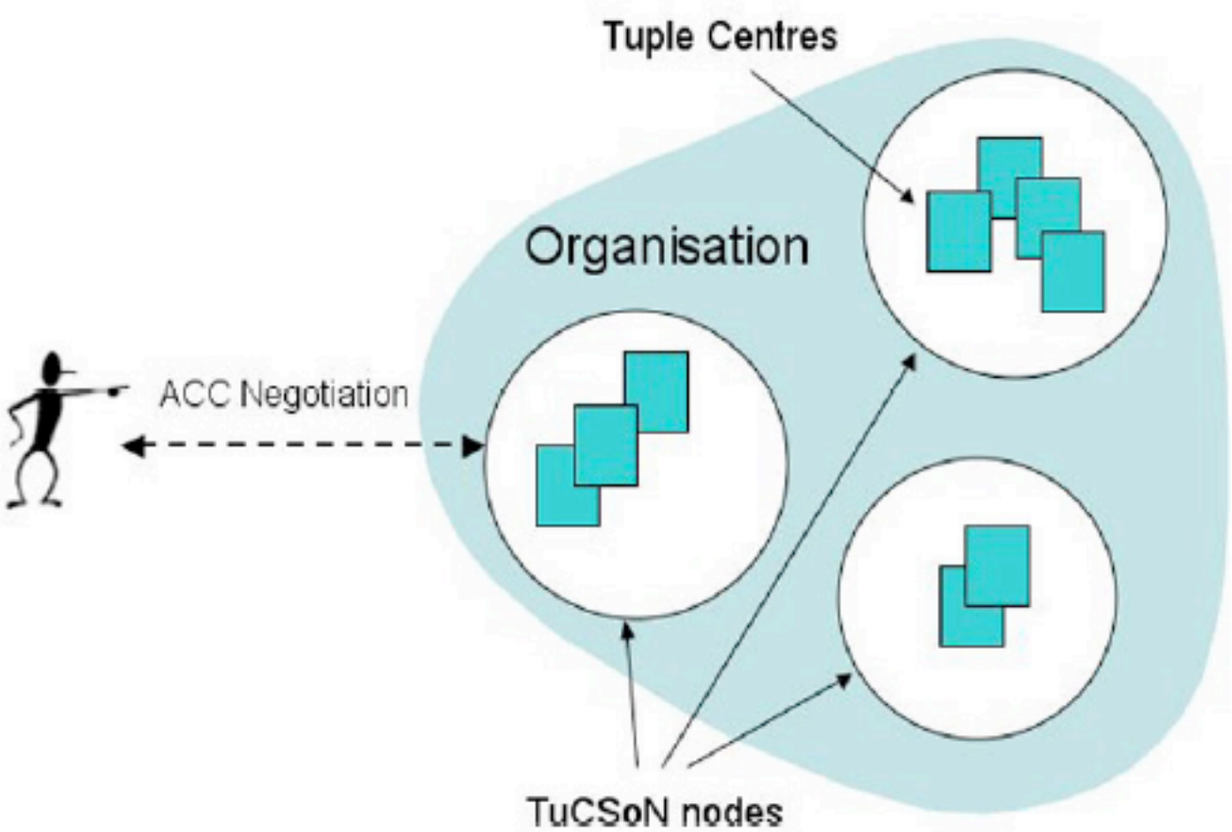
Extending TuCSoN Infrastructure

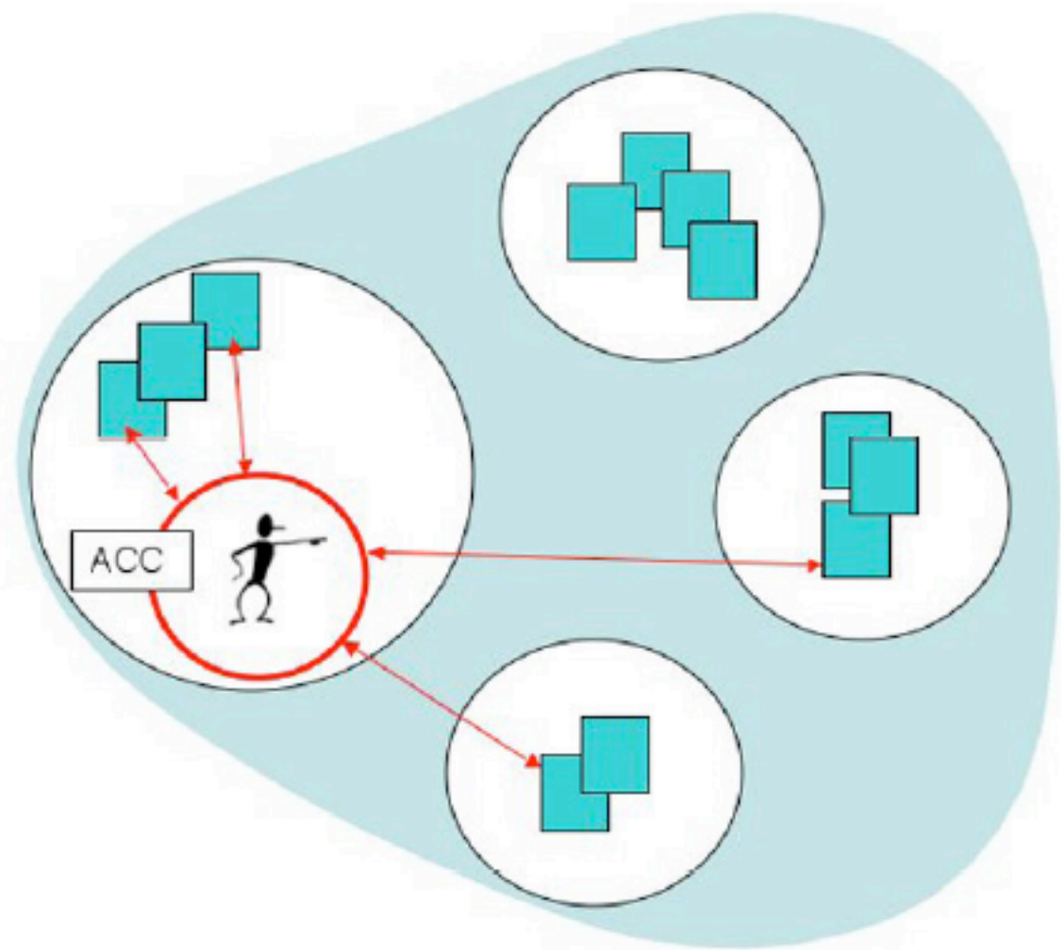
- ACC as a first class abstraction
  - provided by the infrastructure at run time
- Topology
  - Organisation & Coordination
    - >> gateways & (hierarchical) domains
    - >> topology defined as organisational feature
  - $ORG tuple centre
    - >> embedding organisation structures & rules
    - >> $ORG(*OrgID*)

Topology & Organisation

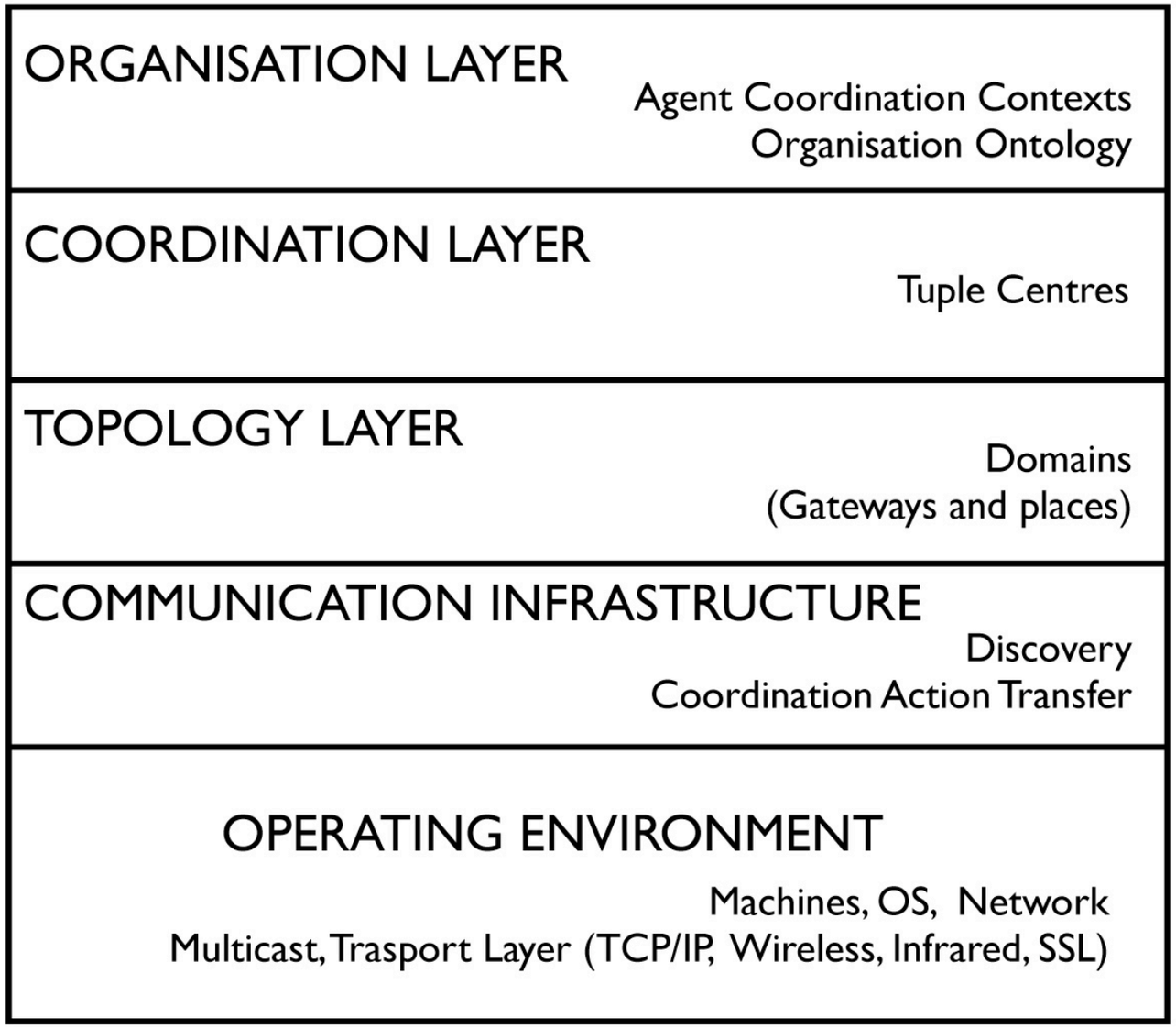


ACC Negotiation & Entrance





TuCSoN Infrastructure Levels



TuCSoN Organisation Model

- Modelling Organisation Structures
  - organisation tuples within **`$ORG(OrgID)`**
  - Abstraction Level

```
>> society_class(SocietyClassID, AbstractionContext)
>> role(RoleID, SocietyClassID, Cardinality, Policy)
```

  - Agent Level

```
>> society(SocietyID, SocietyClassID, ConcreteContext)
>> agent(AgentID, RoleID, SocietyID:SocietyClassID)
```

- Organisation Rules
  - Agent-role relationships

```
>> allowed_membership(AgentID, RoleID, SocietyClassID)
>> forbidden_membership(AgentID, RoleID, SocietyClassID)
```

  - Inter-role relationships

```
>> role_excludes(RoleIDA, SocietyClassIDA, RoleIDB,
   SocietyClassIDB)
>> role_requires(RoleIDA, SocietyClassIDA, RoleIDB,
   SocietyClassIDB)
```

Outcomes

- Continuum from design to runtime
  - promoting integrated AOSE methodology
    - >> e.g. SODA
- Handling security at different levels
  - uniform framework
    - >> access control & agent protocols
- Organisational intelligence
  - self-configuration / adaptation
    - >> inspecting / affecting organisation / coordination outcomes to dynamically adapt the system behaviour

Ongoing & Future Works

- Model
  - ACC language & formal semantics
    - >> process algebra or FOL?
  - Improving the role model
  - Implementing e-Institutions
    - >> modelling commitments & obligations
  - Time & cost
- Projects
  - WfMS
  - Systems & Law