



# 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

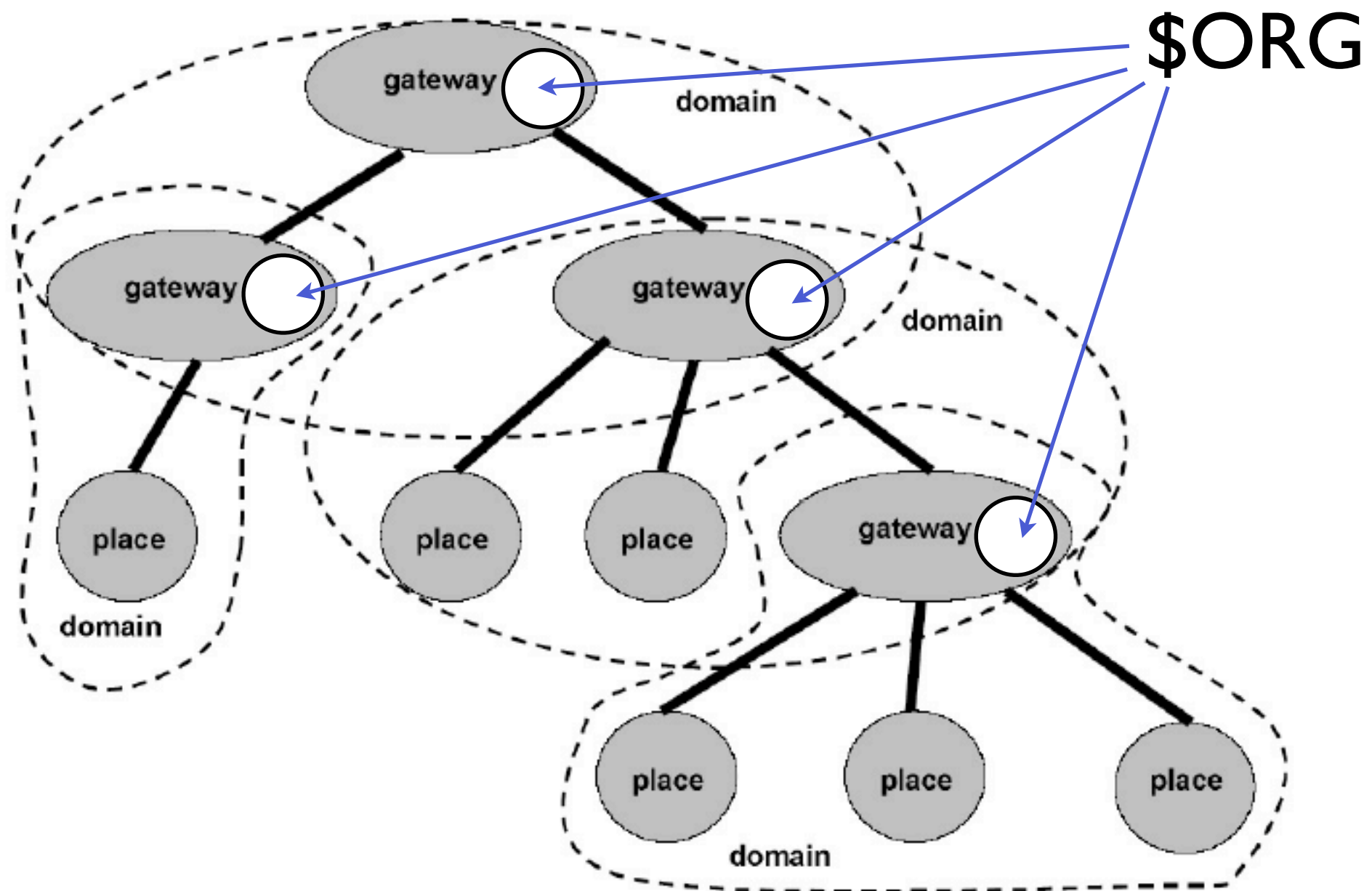
- Organisation Abstraction
  - defines the presence of an agent within a system
  - defines the admissible agent actions
    - >> access control / security
    - >> based on the agent roles
- Integration with Coordination
  - meta-level denotation of agent (inter)action
    - >> allowed / not allowed,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

# Extending TuCSoN Infrastructure

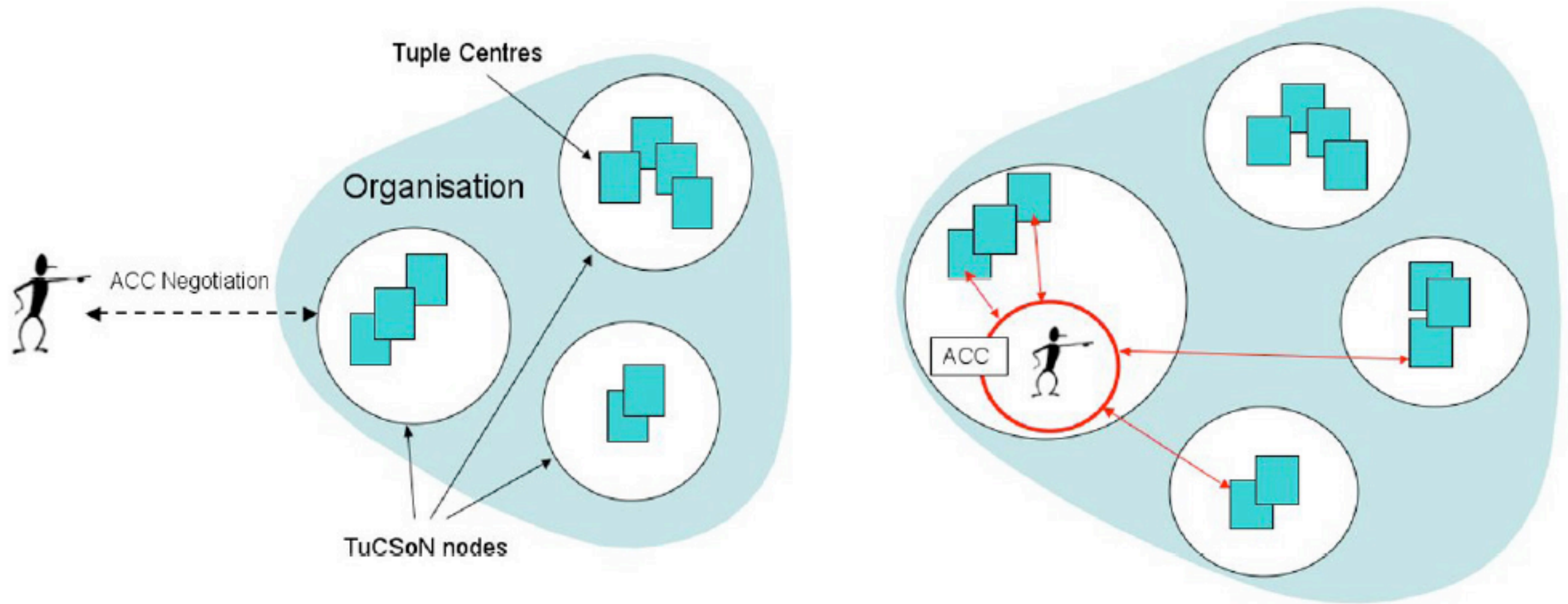
- ACC as a first class abstraction
  - provided by the infrastructure at run time
- Topology
  - Organisation & Coordination
    - >> gateways & (hierarchical) domains
    - >> topology defined as organisational feature
  - \$ORG tuple centre
    - >> embedding organisation structures & rules
    - >>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



# Topology & Organisation



# ACC Negotiation & Entrance



# TuCSoN Infrastructure Levels

ORGANISATION LAYER	Agent Coordination Contexts Organisation Ontology
COORDINATION LAYER	Tuple Centres
TOPOLOGY LAYER	Domains (Gateways and places)
COMMUNICATION INFRASTRUCTURE	Discovery Coordination Action Transfer
OPERATING ENVIRONMENT	Machines, OS, Network Multicast, Transport Layer (TCP/IP, Wireless, Infrared, SSL)

# 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