Policy Management for Virtual Communities of Agents

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Web / Grid / P2P / Virtual Communities

Only centralized resource management and global policies?

• may be too heavy burden / affect the core business activities;
• hard to deal with local idiosyncratic situations;
• become more easily obsolete;
• agents cannot enforce local policies of resources they control.

Only decentralized resource management and local policies?

• does not define how resources should be shared among agents;
• local access policies organized according to global policies.

Both global and local policies (MAS-AA, macro-micro).
Example Web Server

- Agent A tries to access web server B.
- Web server B is local resource provider of community C.

Network of dependencies, e.g.:
- A and B depend on C for their membership to the system.
- A depends on B for current and future access to local resource.

Obligations:
1. C tells A not to distribute copyrighted work;
2. B tells A not to store files exceeding 1Gb;
3. C tells B to issue policies respecting global ones.

Problem

"A key problem associated with the formation and operation of distributed virtual communities is that of how to specify and enforce community policies. [...] The exercise of rights is effective only if the resource provider has granted those rights to the community". (Pearlman et al., 2002)

How to rationally balance global & local control in communities?
1. How to define global polices about local policies?
2. How to provide local authorities with the necessary autonomy?

Methodology:
1. Normative control (detective instead of preventative);
2. Combining normative systems and qualitative game theory.
**Formal Framework**

Attributing mental attitudes to normative systems:

1. **Obligations** are defined in the standard BDI framework.
   *‘Your wish is my command’* relates desires and obligations.
2. Interaction agent and normative system modelled as game.
   Methods of game theory applied to normative reasoning.
3. **Violation** is distinguished from behavior that is sanctioned.
   The normative system autonomously decides which behavior counts as a violation, and whether violations are sanctioned.

Paper: formalization along these lines in rule based system.

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**Definition of Obligation**

Extension of Boella and Lesmo’s definition of obligation to do \(a\):

1. Agent A believes that agent N wants that A does \(a\).
2. Agent A believes that agent N desires no violation \(\neg V(\neg a)\), but if N believes \(\neg a\) then it has the goal to do \(V(\neg a)\);
   \(V(\neg a)\) means \(\neg a\) counts as a violation of some norm \(n\).
3. Agent A believes that agent N desires not to sanction \(\neg s\), but if N decides \(V(\neg a)\) then it has goal to sanctio A by \(s\).
   Agent N only sanctions in case of violation.
   Agent A believes that agent N has a way to apply the sanction.
4. Agent A desires \(\neg s\): it does not like the sanction.

Likewise for permissions.
Nested Obligations and Permissions

Reduced to obligations and permissions concerning violations

- Agent $B$ is obligated by agent $C$ to oblige agent $A$ to do $a$ if $q$

$$O_{B,C}(O_{A,B}(a|q)) \iff O_{B,C}(V^B_A(\neg a)|q \land \neg a)$$

where $V^B_A(\neg a)$ is a decision variable of agent $B$.

Nested operators relate local and global policies.

Concluding Remarks

Summary:

1. Balancing global and local policies in virtual communities;
2. Nested operators relate local and global policies;
3. Local resource providers can violate global policies.

Further research:

- Distinguishing enacting permission and granting authorization;
- Delegations of obligations in our framework.