A Normative Agent-based Model for Sharing Data in Secure Trustworthy Digital Market Places

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Secure Digital Market Place architectural sketch

- Algorithm supplier(s)
- Data supplier(s)
- National Law & Regulations
- Market rules
- adjudication
- Secure Digital Marketplace Member Organisation
- Agreement
- Registry
- Deployment Models
- Deployment Specification
- Future Internet Capabilities
- Parameterization & authorizations
- Customer(s)
- Dispute Resolution
- Accounting & Auditing
- Market rules
- Market rules & Market model
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The needs for STDMPs.

- Bring competitors together to share data to achieve a common goal.
- Use shared data for different purposes.
- Create a trusted infrastructure to process data.
Motivation

1. How do the rules that express the social system’s policy impact the different members’ behavior and what is the emergent behavior of the regulated systems?

2. How can agents identify non-compliant society members and respond to them by adapting their behavior?
Goal

• Development of an extended version of the BDI agent model (N-BDI*)

• Extension of the BDI control loop

• Enabling us to study how norms can be used to create STDMPs.
N-BDI*
N-BDI* architecture

Beliefset
- Inc. Rules
- Duty-claim
- Right
- Power-liability

Utility Planner
- Inc. Risk
- Sanction
- Reward
- Cost
- Benefits

Goal

Plan

Action

Belief

Goal

Observation

Action

Observer

Plan

Act?

Power-ability

Condition → Act → Situation

Act is allowed?

conflict?

update beliefset

update beliefset

Modified Control Loop

- Divided an agent planner component in two sub-components:
  1. Planner to generate plans based on the agent preferences
  2. Select the most appropriate plan based on the plan utility
- Include norms to the agent’s belief-set

Algorithm 1: Modified control loop for the extended BDI agent (N-BDI®), where O= observation, B= Belief set, G= Goal set, P= Plan set, and A_p= Actions.

Given an agent \(\{O, B, G, P, A_p, Norms\}\)

repeat
  \[O := Observe(O + Norms);\]
  \[B := Revise(B, O);\]
  \[G := Generate G (B);\]
  \[P := \forall g \in G \rightarrow generate P(B, G);\]
  \[P := Calculate U_p \forall p \in P(B, G, P);\]
  \[Pref P := Update P to Pref P(B, G, A_p, P);\]
  \[B := revise(B, Pref);\]
  \[A_p := \{norms(Power), Allowed?\};\]
  \[take (A_p);\]
until forever;

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Norm

• A norm\(^1\) is defined as a tuple
  \[ n = (\text{role}, \text{normtype}, \text{conditions}, \text{action}) \]

• Role: indicates the organizational position;
• Norm: type is one of the four modal verbs “can” (power), “can not” (disability), “must” (duty) and “must not” (the obligation to not do something!);
• Condition\(^2\): describes when and where the norm holds;
• Action: action specifies the particular action to which the normative relation is assigned (norm adoption);

\(^1\) Oren et al., 2009
\(^2\) Pre-condition and Post-condition have been extracted from the GDPR.
**From GDPR to Normative Expression (Example)**

- **NormCollectData** that describes the *permission to collect personal data* from the *data subject*, where the *collector* is the *LH agent* consisting of two sub-agents (*LH’s controller, LH’s processor*).

<table>
<thead>
<tr>
<th>Agent</th>
<th>Role</th>
<th>Normative Relation</th>
<th>Condition</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>LH Agent</td>
<td>LH’s Controller</td>
<td>Power</td>
<td>“iff” <em>legitimate</em> purpose of collecting data is <em>specified explicit</em> “AND” the LH’s controller has provided the data subject with the information on the <em>collecting</em> of his personal data’</td>
<td>Collecting Data</td>
</tr>
<tr>
<td></td>
<td>LH’s Processor</td>
<td>Power</td>
<td>“iff” <em>processing</em> of data is <em>compatible</em> with the purposes for which data was collected “AND” controller took appropriate measures to provide information relating to processing to the data <em>subject</em> “AND” the LH’s controller has provided the data subject with the information on the processing of his personal data”</td>
<td>Processing Data</td>
</tr>
</tbody>
</table>
Assumption

• Each agent consists of two subagents of Collector and Processor.

• Contract are a set of Permissions.

• LH’s controller defined the set of licenses.

• Licenses have a defined a set of conditions on using data.
STDMPs

• LH: license holding agents who hold data and can provide data to the market (the STDMPs);

• TEI: agents who monitor the members’ behavior;

• TRF: Transformation agents who hold the algorithms, have a need for the LH’s data that can be provide through the STDMPs.
Scenario
Simulation

SAFE INTERNET

This action is not authorized!

You can compare it with a biscuit tin. The rules are described and built in.
Simulation

Setup

• Implement the STDMP’s agent with BDI agent in Jadex.
• Two BDI agents as the Controller and Processor.
• Norm engine has been implemented as a part of the belief-set.
• STDMP formed by different airlines companies.

Aim

• Monitor the negotiation process between the agents.
• Check each requested transaction against the GDPR.

**Simulation**

- Inform data subject
- Check each transaction
- Monitor the negotiation
Future work

• Design and implement the rule engine as an external component.
• Monitor activities to detect of (non-)compliance in networked societies
• Define enforcement activities would enhance compliance.
• Study the flipping point of the society.
Questions?

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