

Principles of the SymposiumPlanner Instantiations of Rule Responder

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Overview of Rule Responder (I)

- Rule Responder is a multi-agent system for **collaborative team** and **community** support on the (Semantic) Web
- Enables rule-based collaboration between the distributed human members
- Persons of an organization are assisted by **semi-automated rule-based agents**, which use rules (and various ontologies) to describe the **decision** and **behavioral** logic

Overview of Rule Responder (II)

- Uses Reaction RuleML as the **standardized interchange language**
- Implemented on top of a Mule-based **Enterprise Service Bus (ESB)**



What is SymposiumPlanner?

- Is a series of Rule Responder instantiations for the Q&A sections of the official websites of the RuleML Symposia since 2007.
 - **Organizational Agent (OA)** **filters** and **delegates** incoming queries
 - **Personal Agents (PAs)** **assist** symposium chairs
 - **External Agent (EA)** acts as the **interface** to the organizational agent, i.e. as the single point of entry to support the symposium organization



Why SymposiumPlanner? (I)

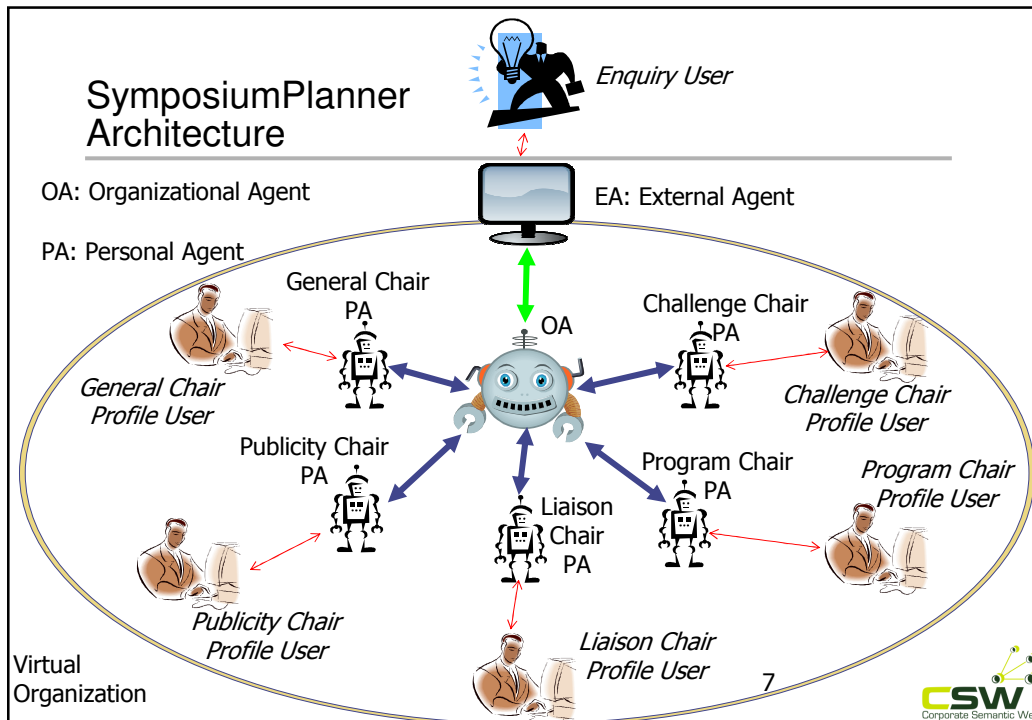
- Coordinating chair responsibilities (responsibility assignment)
- Finding contact information about selected chairs of the symposium
- Helping the program and track chairs with mapping planned paper topics to program and track themes
- Helping the program chair to monitor and possibly move important dates



Why SymposiumPlanner? (II)

- Helping the liaison chair with special events by symposium partners
- Helping the panel chair with managing panel participants
- Helping the publicity chair with sponsoring correspondence
- Answering questions of participants about the conference such as important dates, topics addresses, program schedule etc.





Personal Agents

- Act in a **rule-based manner** on behalf of symposium chairs
- Work on a profile of FOAF-like **facts** and FOAF-extending **rules** that encode 'routine' knowledge of symposium chairs

Organizational Agents

- Represents goals and strategies shared by each member of the **Symposium organization**
- Contains **rule sets** that describe the policies, regulations, opportunities, and expertise of its organization



External Agents

- **Exchange messages** with (the public interface of) organizational agents, sending queries (requests), receiving answers (results), or interchanging complete rule sets
- Constitute the **public interface** to the OA of a Symposium's virtual organization through which enquiry users can send queries and receive answers

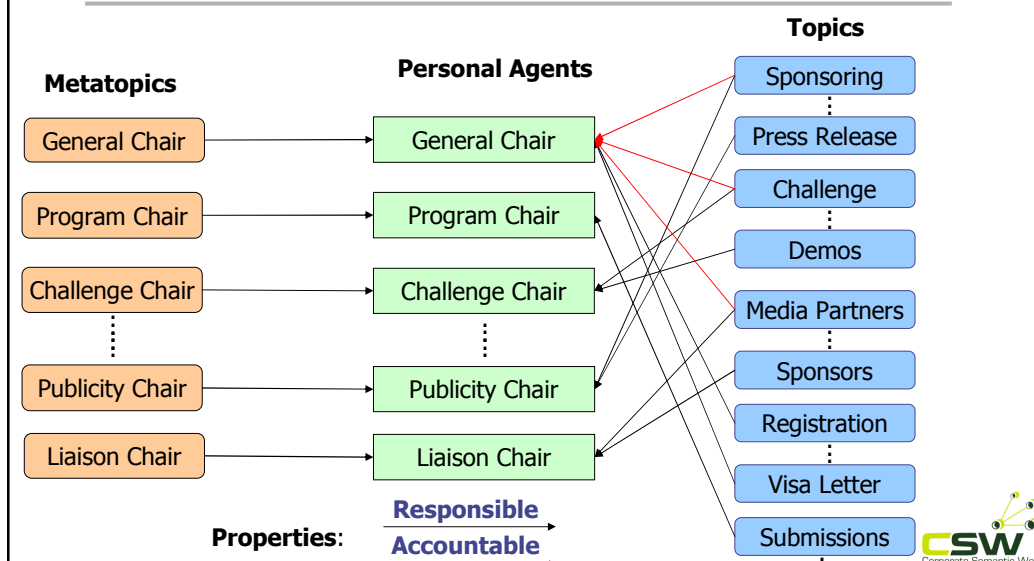


Query Delegation to Personal Agents

- The Organizational Agent delegates queries to appropriate Personal Agents
- Tasks for the symposium organization are managed via a **Role Assignment Matrix**
- Defined here by an OWL Lite ontology (alternatives: RDFS, RuleML, ...)
- Assigns (meta) topics to PAs within the virtual organization: ... *see next slide* ...



Role Assignment Ontology



Query Answering for Personal Agents

- Some queries have more than one answer
- The PA will send the answers one at a time to the OA
 - Interleaved backtracking and transmission
- When the PA finds no more answers, it sends an **end-of-transmission** message



Reaction RuleML

- Is a branch of the RuleML family that supports actions and events
- Works as interchange language between agents, where Reaction RuleML **messages** are sent through the ESB
- The ESB carries RuleML queries (requests), answers (results), and rule bases to/from agents



Example Reaction RuleML Message

```
<RuleML xmlns="http://www.ruleml.org/0.91/xsd"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.ruleml.org/0.91/xsd
http://ibis.in.tum.de/research/ReactionRuleML/0.2/rr.xsd"
xmlns:ruleml2011="http://ibis.in.tum.de/projects/paw#">
  <Message mode="outbound" directive="query-sync">
    <oid> <Ind> RuleML-2011-IJCAI </Ind> </oid>
    <protocol> <Ind>esb</Ind> </protocol>
    <sender> <Ind>User</Ind> </sender>
    <content>
      <Atom>
        <Rel>getContact</Rel>
        <Ind> ruleml2011ATijcai_GeneralChair </Ind>
        <Var>Contact</Var>
      </Atom>
    </content>
  </Message>
</RuleML>
```



Performatives

- The attribute **directive="..."** specifies the pragmatic performative
 - Message exchange/interaction protocols
- are used to understand the pragmatic context of the message
 - such as: query-sync, answer and etc.



Agent Communication Protocols

- **In-Only**
 - Message is sent from agent₁ to agent₂;
then agent₂ executes performative
- **Request-Response**
 - Performs above In-Only;
then agent₂ sends response to agent₁
- **Request-Response-Acknowledge**
 - Performs Request-Response;
then agent₁ sends an acknowledgement to agent₂
- **Workflows**
 - Generalizes the above protocols to allow other compositions of message interchange between agents



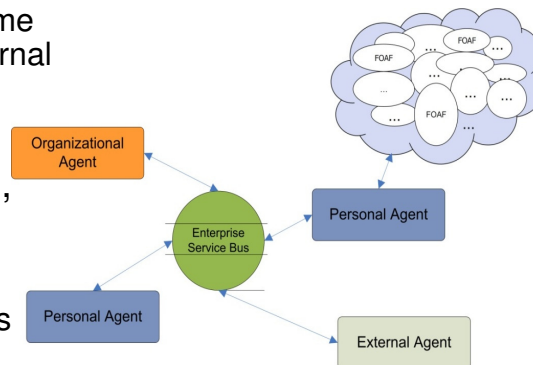
Translation between Interchange Language and Proprietary Languages

- Each **rule engine** can use its *own rule language*
- Agents require the translations between **interchange language** and proprietary languages



Integration with External Sources

- External data sources are dynamically queried at runtime and used as facts in the internal knowledge base of an agent
 - Such as: calendars, vocabulary definitions, web pages, personal data
- Via query languages such as SQL, SPARQL, etc.



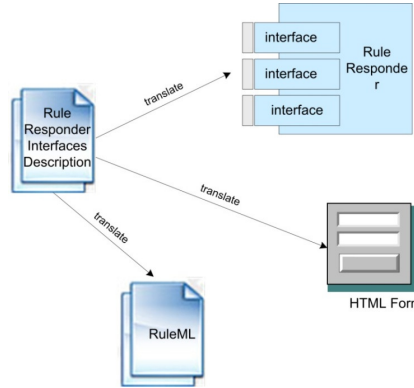
User Client

- Ways of issuing queries:
 - Follow a menu to create and fill **HTML forms**
 - Or use **Attempto Controlled English** (a rich subset of standard English designed to serve as knowledge representation language)

***Attempto Project:** <http://attempto.ifi.uzh.ch/site/>

Queries Defined by Organizational Agent Interfaces

- Describe public interfaces of rule functions with an XML file
- Translate interfaces descriptions to HTML forms
- Construct Reaction RuleML queries with interface descriptions and parameter values



Issue Query with Attempto Controlled English



Example:

"Who are the authors of 'Rule-based Distributed and Agent Systems'?"

```

<DRS domain="">
  <Question>
    <DRS domain="A B C">
      <query obj="A" question="who" sentid="1" tokid="1"/>
      <relation obj1="C" rel="of" obj2="string('Rule-based Distributed and Agent Systems')" sentid="1" tokid="5"/>
      <object ref="C" noun="author" struct="countable" unit="na" numrel="geq" num="2" sentid="1" tokid="4"/>
      <predicate ref="B" verb="be" subj="A" obj="C" sentid="1" tokid="2"/>
    </DRS>
  </Question>
</DRS>
    
```

```

<Atom>
  <Rel>getAuthorsOfPaper</Rel>
  <Ind>'Rule-based Distributed and Agent Systems'</Ind>
  <Var>author</Var>
</Atom>
    
```



Communication Middleware

- **Mule** Enterprise Service Bus (ESB)
 - Is used to create communication end points at each Personal and Organizational Agent
 - Provides a highly scalable and flexible application messaging framework to communicate synchronously or asynchronously
 - Supports a variety of transport protocols (including HTTP, JMS, JDBC, SOAP, etc.)
 - Is based on a staged event-driven architecture (SEDA)



Rule Engines

- Prova: Prolog + Java
- OO jDREW: Object Oriented java Deductive Reasoning Engine for the Web
- (others: DR-Device, Euler, Drools, ...)



Prova

- is both a rule language and a rule engine
- tight integration of Java and Semantic Web technologies
- separates the logic of data access from computation
- is used to realize mainly the Organizational Agents of Rule Responder



OO jDREW

- OO jDREW is used to realize the Personal agents of Rule Responder
- Implements Hornlog RuleML for agent reasoning (Horn logic rules)
- Supports rules in two formats:
 - POSL: Positional Slotted presentation syntax
 - RuleML: XML interchange syntax
(can be generated from POSL:
<http://www.ruleml.org/posl/converter.jnlp>)



Conclusion

- SymposiumPlanner was implemented & tested for various instantiations (<http://ruleml.org/SymposiumPlanner/>) and deployed for RuleML-2007/.../2011 [Q&A](#)
- Its Organizational Agents delegate external queries to topic-assigned Personal Agents acting as committee chairs
- It couples rule engines such as [Prova](#) and [OOjDREW](#) via ESB middleware and [Reaction RuleML](#) interchange format



Questions?

