DAML PI Meeting Status Briefing:

A Semantic Web Environment for Mobile Context-Aware Services

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Outline

- Overview of Activities
- ROWL
- Translation Engine for Jess
- ROWL Extensions
- Rule Editor
- Semantic eWallet
- Enforcing Context-Sensitive Preferences and Policies
- Status & Future Activities
- References
Overview of Activities

- **Rules:** ROWL reasoning engine
  - Released as tool
  - Applications:
    - Decision & service invocation rules for context-aware message delivery
    - Privacy & service invocation rules for Semantic eWallet
    - Privacy & service invocation rules for context-aware museum tour guide
    - Privacy rules for health care application

- **Security**
  - **Semantic eWallet:** multi-tier semantic web reasoner
    - Enforcing context-sensitive policies
      - e.g. access control policies, obfuscation policies, etc.
    - Integration with certificate verification
  - A version to be released as tool

- **Web Services**
  - Active participation in SWSA
ROWL rules are Horn clauses of the type
- Body => Head
  - *Horn clauses* allow for conjunctions of facts in the Body but only a single fact in the Head

In its current release, ROWL provides constructs to express *forward-chaining* rules in RDF and serialized in RDF/XML
  - Extensions for backward chaining rules and other specialized rules have been built but not yet released

Rules can refer to ontologies and annotations and contain variables

Rules expressed as *OWL ontology*
Writing Rules in ROWL

- **Variable declaration**
  - `<rowl:Variable rdf:ID="person"/>`
  - Person can now be used as a variable in the body and head part of the rule

- ROWL also lets you make references to classes and instances

- **ROWL constructs**
  - **Rule**: encapsulates the head and the body
  - **Label**: used for synthesizing the name of the rule in Jess
  - **Head**: Encapsulates the head
  - **Body**: Encapsulates the body
Rule Example

- People who list me as their friend are members of my FriendCircle

```
<rowl:Variable rdf:ID="person"/>
<rowl:Rule rdf:ID="rule1">
  <rdfs:label> Friends belong to my FriendCircle Group </rdfs:label>
  <rowl:head rdf:parseType="Collection">
    <foo:FriendCircle rdf:about="&app;#my_mates">
      <foo:member>
        <foo:Person rdf:about="#person"/>
      </foo:member>
    </foo:FriendCircle>
  </rowl:head>
  <rowl:body rdf:parseType="Collection">
    <foo:Person rdf:about="#person">
      <foo:friend rdf:resource="&app;#me"/>
    </foo:Person>
  </rowl:body>
</rowl:Rule>
```
Translation Engine for Jess

Transform rules expressed as ROWL instances into native Jess rules – *defrules*

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ROWL is used to frame rules in RDF/XML syntax using an OWL (ROWL) ontology

Release consists of the following components:
- XSLT stylesheets for transforming OWL ontologies to native Jess code
- XSLT stylesheets for transforming RDF instances to native Jess code
- XSLT stylesheets for transforming Rules to native Jess rules - defrules
- OWL Meta-model in CLIPS
- Hooks for other reasoning engines
ROWL Extensions

Implemented but not yet released:

- Framing Backward Chaining Rules
- Semantic eWallet Engine
  - Framing Privacy Rules
  - Framing Service Invocation Rules
- Rule Editors
- Framing Queries
Framing Service Invocation Rules

(defrule provide-location-for-IP-Address (declare (salience 50))
  ...
  (need-dynamic-triple
    (predicate "http://sadehlab.cs.cmu.edu/mycampus#location")
    (subject ?entity)
    (object ?location)
  )
  ...
  =>
    (call-web-service "qname" "http://mycampus/WiFiService#" (...) "ip" ?ip)
)

<wowl:ServiceRule wowl:salience="50">
  <rdfs:label>provide location for IP Address</rdfs:label>
  <wowl:output>
    <mc:Entity rdf:ID="&variable;#entity">
      <mc:location rdf:resource="&variable;#location" />
    </mc:Entity>
  </wowl:output>
  <wowl:precondition>
    <mc:Entity rdf:ID="&variable;#entity"><mc:ip>&variable;#ip</mc:ip>
  </mc:Entity>
  <wowl:call>
    <wowl:Service wowl:name="call-web-service">
      <wowl:qname>http://mycampus/WiFiService#</wowl:qname>
      <wowl:endpoint>http://128.2.68.34:7788</wowl:endpoint>
      <wowl:method>GetLocation</wowl:method>
      <wowl:ip>&variable;#ip</wowl:ip>
    </wowl:Service>
  </wowl:call>
</wowl:ServiceRule>
Framing Privacy Rules - Access Control & Obfuscation

Privacy rule: grant access to location when on campus but obfuscate precision.

http://norman.at.home/
Rule Editors

Decision rule #1: when giving a talk the screen is public

Body (condition): Add a root element

- Person, ?person
  - activity: Talk, ?talk

Head (conclusion): Add a root element

- Person, ?person
  - has_screen: PublicScreen, ?PublicScreen
  - availability: LowAvailability, ?LowAvailability

Name: people can only know whether I am on campus

Targeted knowledge:
- Person, ?owner
  - location: ?location

Restricting conditions:
- Place, http://www.cmu.edu
  - include: ?location
- EWallet, ?wallet
  - sender: ?owner

Obfuscation:
- Person, ?owner
  - location: http://www.cmu.edu
**e-Wallet Reasoning Engine**

**Semantic e-Wallet:**

- Unified front end to a set of resources modeled as services
  - e.g. resources of an individual user or an organization
- Acts as both *clearinghouse* and *gatekeeper* to a user’s resources, which are modeled as web services
  - e.g. individual user or an entire organization
- Relies on:
  - Resource identification rules
  - Security & privacy/confidentiality policies, e.g.:
    - **Access control policies**
      - “Only my colleagues can access my calendar and only on weekdays”
    - **Obfuscation policies**
      - “My classmates can only see the building I am in but not the actual room”
- Includes *policies whose enforcement requires accessing external resources* (e.g. context-sensitive policies)
Example: *Query from John inquiring about Mary’s location*

- e.g. the sender of the query is John
- e.g. the query of John requires to access Mary’s location
- e.g. (1) is John allowed to see Mary’s location given what we know about the context of the query?
  - (2) Mary said she only allows colleagues to see her location when she is on campus
  - (3) John is a colleague of Mary

**Not useful in this example**

- e.g. location tracking functionality or Mary’s calendar
- e.g. is Mary on campus?
- e.g. Mary is willing to disclose the building but not the room she is in
- e.g. Mary is in Smith Hall
Design of an e-Wallet

- Three-layer architecture: *security through typing*
  - Core knowledge: static & dynamic knowledge of user
  - Service Layer: invoke external sources of knowledge: web services and personal resources
  - Privacy layer: enforce privacy rules on external requests: access control & obfuscation rules
  - Backward chaining migration: privacy rules, service rules, static migration rules
Summary of e-Wallet implementation

- Ontology in OWL
- Annotation in OWL
- Rule in (R)OWL
- Services in (W)OWL
- Privacy in (S)OWL
- Query in (Q)OWL

Rules:
- Ontology stylesheet
- Annotation stylesheet
- Rule stylesheet
- Service stylesheet
- Privacy stylesheet
- Query stylesheet

OWL Meta-model in CLIPS
- Ontology in CLIPS
- Annotation in CLIPS
- Rule in CLIPS
- Service rule in CLIPS
- Privacy rule in CLIPS
- Query rules in CLIPS

XSLT Engine

JESS

Result in OWL

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Current Status and Future Plans

Tools:

- ROWL:
  - First version publicly released in March 2004
    - Forward chaining rules only
  - Next version by the end of July:
    - Will include backward chaining rules
    - Queries
    - Java utilities
  - A version of the eWallet by the end of October

Additional work:

- Convergence with SWRL
  - New member of joint committee
- Security: integration with certificate verification
- SWSA contribution
References

- **ROWL Release**
  
  http://mycampus.sadehlab.cs.cmu.edu/public_pages/ROWL/ROWL.html
  
  – Also accessible via http://www.daml.org/rules/

  
  http://almond.srv.cs.cmu.edu/~sadeh/Publications/Small%20Selection/Semantic_Web_Technologies_ArticleWSJ.pdf

- **MyCampus project (incl. video clip):**
  
  http://almond.srv.cs.cmu.edu/~sadeh/mycampus.html

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