DAML PI Meeting Status Briefing:

A Semantic Web Environment for Mobile Context-Aware Services

Norman M. Sadeh,

School of Computer Science – Carnegie Mellon University

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

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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

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Rules in OWL

- 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

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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

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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>
  </rdf:RDF>
```

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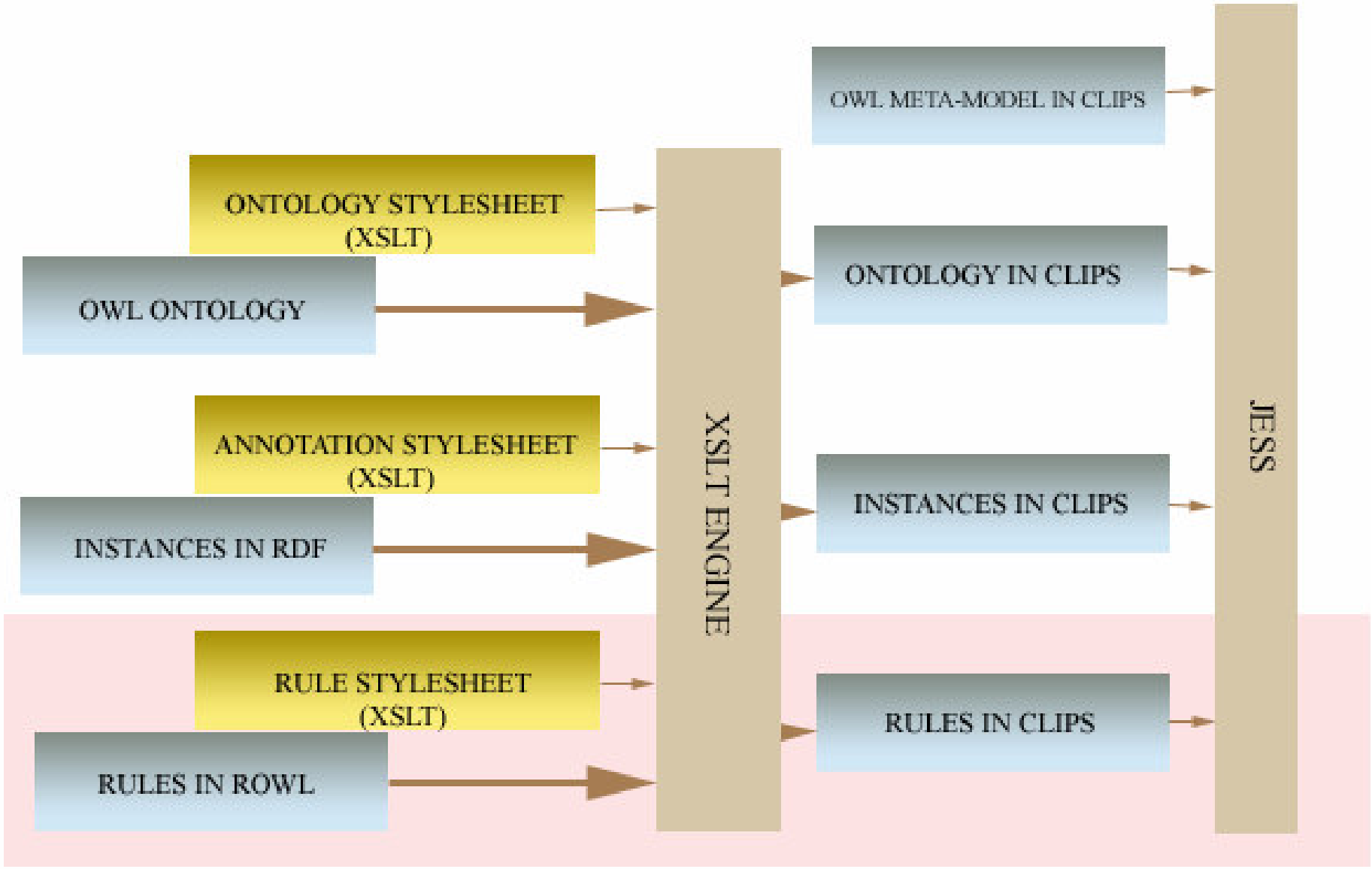
Translation Engine for Jess



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

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Current ROWL Release (March 2004)

- 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

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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

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Framing Service Invocation Rules

```
<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:precondition>
  <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>
```

```
(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)
)
```

Framing Privacy Rules - Access Control & Obfuscation

```
<sowl:ReadAccessRule>
  <rdfs:label>people can only know I am on or off campus</rdfs:label>
  <sowl:target>
    <mc:Person rdf:ID="&variable;#owner">
      <mc:location rdf:resource="&variable;#location"/>
    </mc:Person>
  </sowl:target>
  <sowl:check>
   <rowl:And>
     <rowl:condition>
       <mc:E-Wallet rdf:ID="&variable;#e-Wallet">
         <mc:owner> <mc:Person rdf:ID="&variable;#owner"/> </mc:owner>
       </mc:E-Wallet>
     </rowl:condition>
     <rowl:condition>
       <mc:Place rdf:ID="http://www.cmu.edu">
          <mc:include rdf:resource="&variable;#location" />
       </mc:Place>
     </rowl:condition>
     <rowl:not-condition>
       <qowl:Query rdf:ID="&variable;#query">
         <qowl:sender rdf:resource="&variable;#owner" />
       </qowl:Query>
     </rowl:not-condition>
   </rowl:And>
  </sowl:check>
  <sowl:revision>
    <mc:Person rdf:ID="&variable;#owner">
      <mc:location rdf:resource="http://www.cmu.edu"/>
    </mc:Person>
  </sowl:revision>
</sowl:ReadAccessRule>
```

http://norman.at.home/

Privacy rule: grant access to location when on campus but obfuscate ~~precision~~ **truth**

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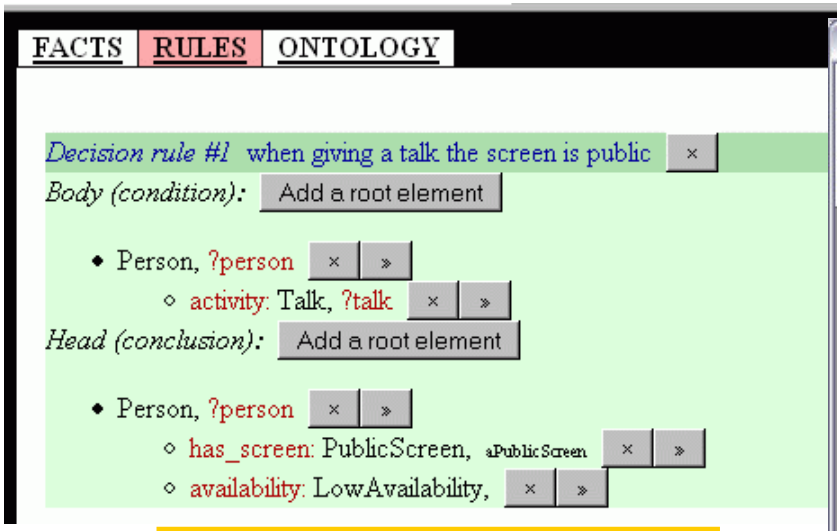
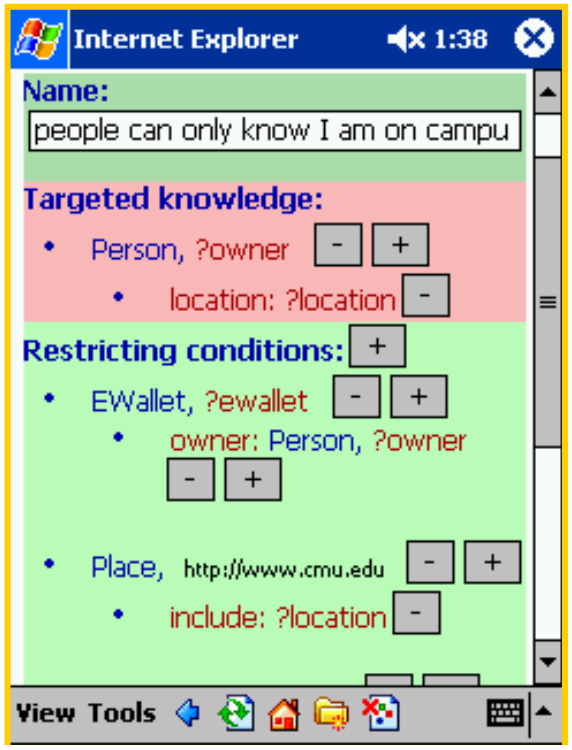
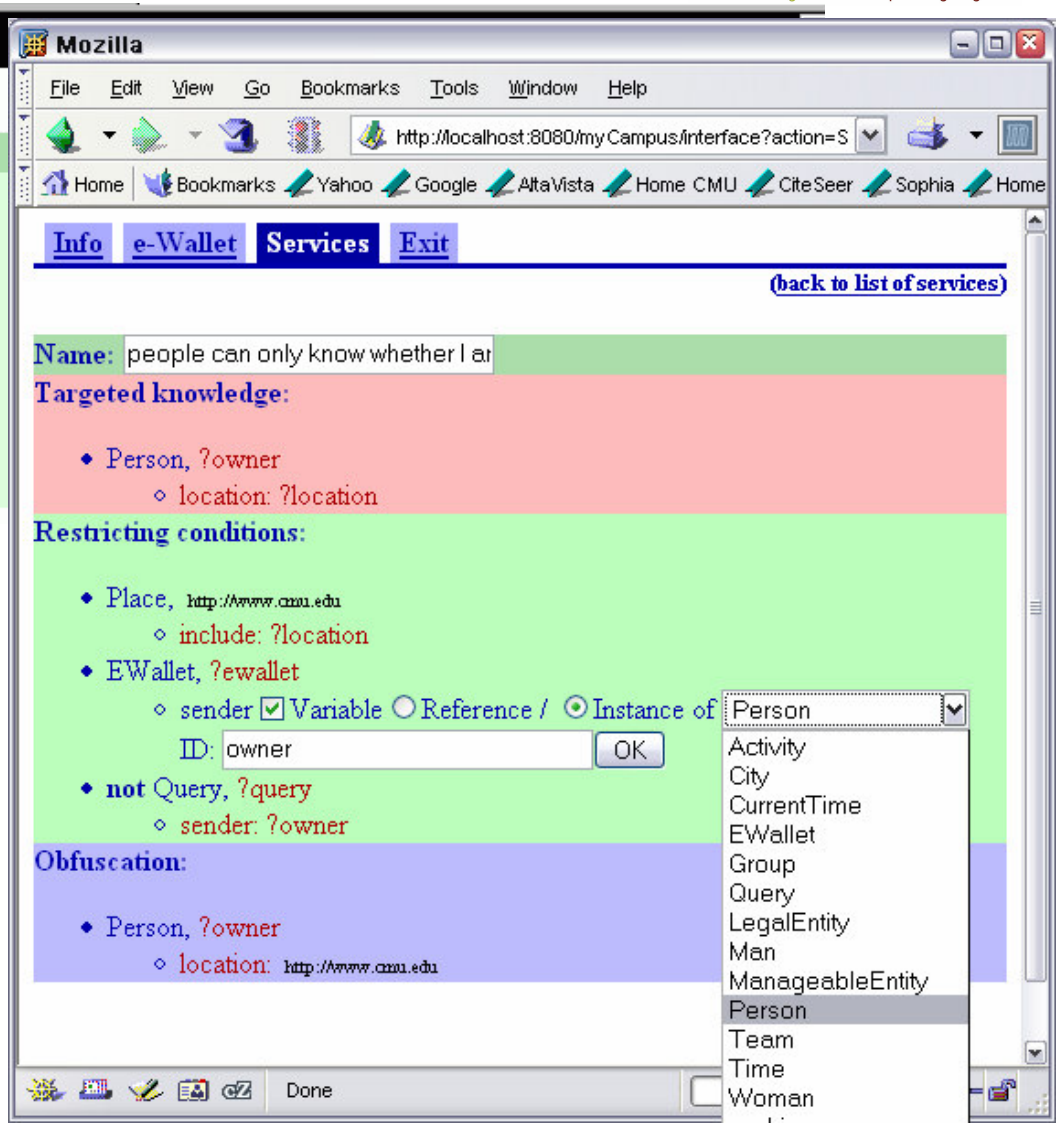
Rule Editors







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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)

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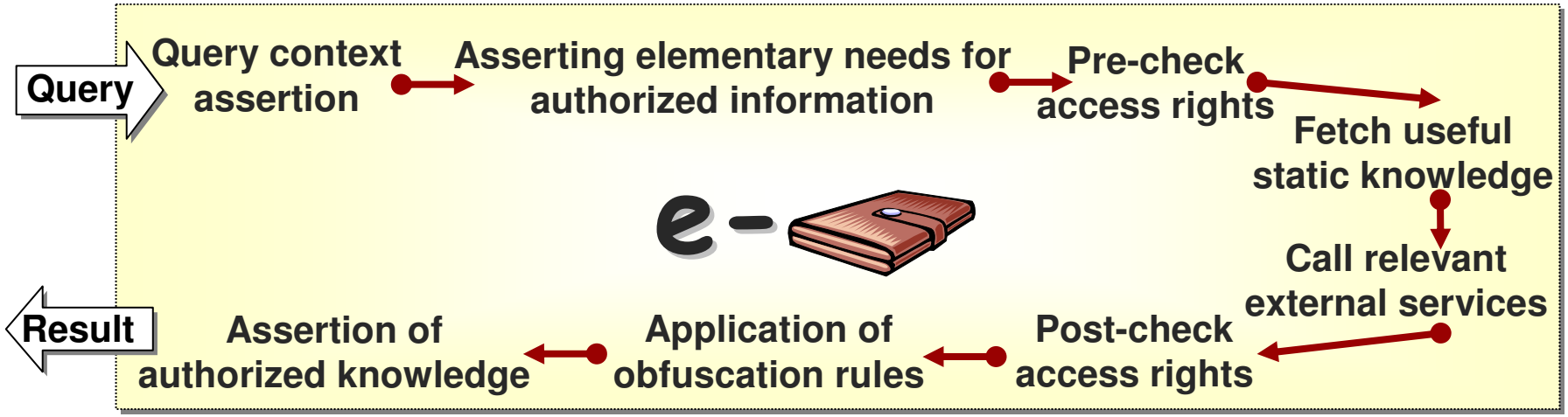
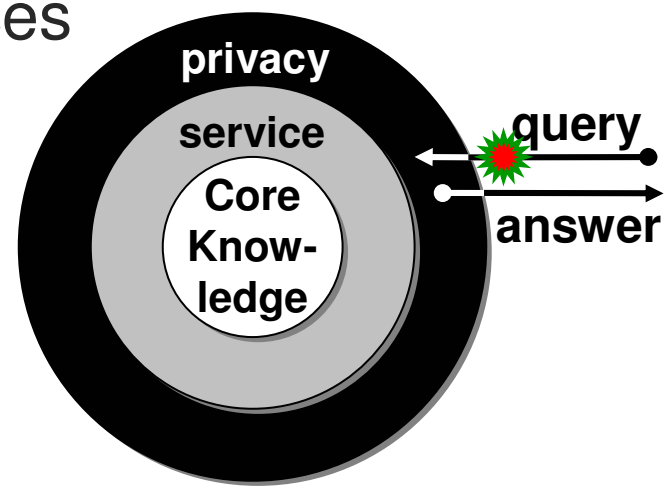


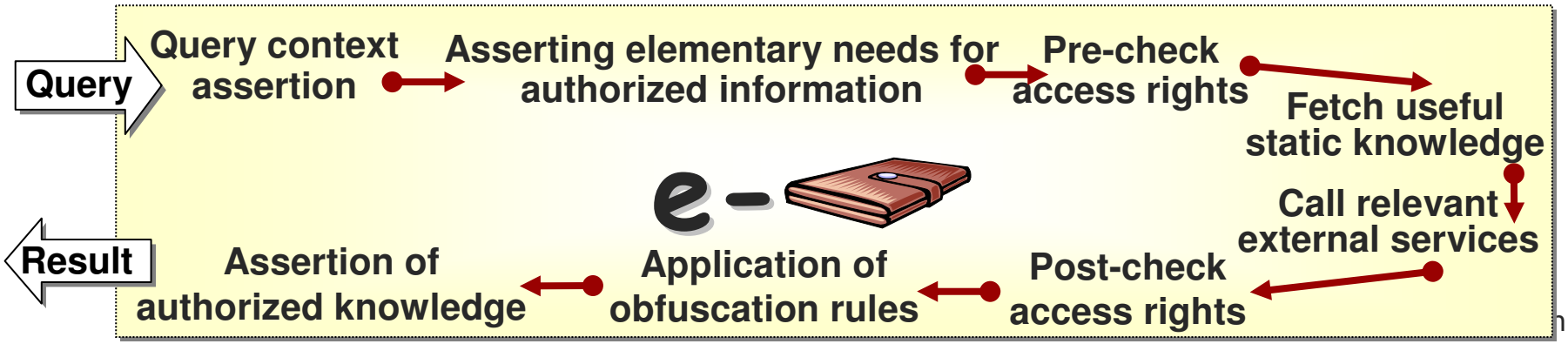
Example : Query from John inquiring about Mary's location

- 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

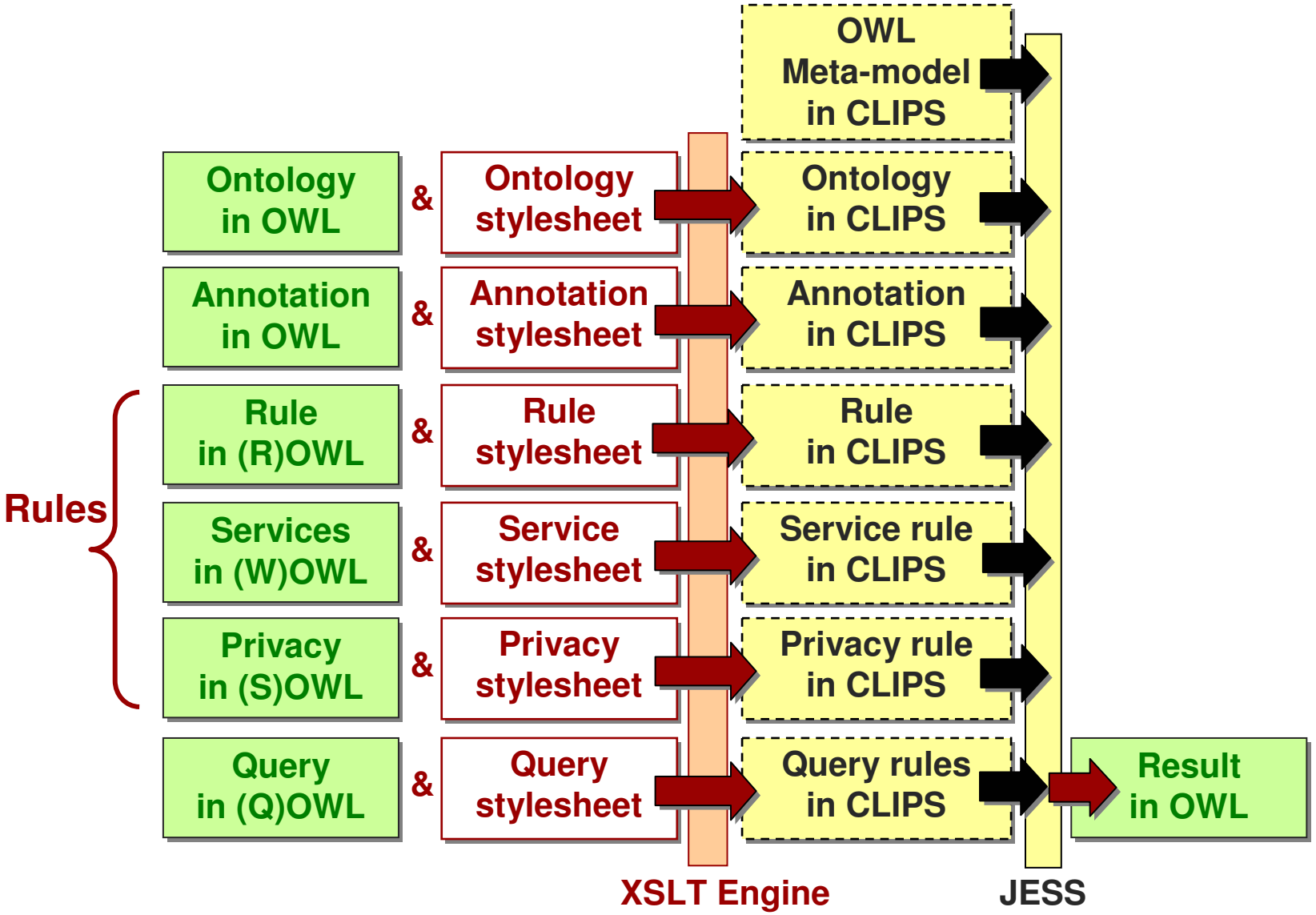
Design of an e-Wallet

- 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



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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

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References

- ROWL Release

http://mycampus.sadehlab.cs.cmu.edu/public_pages/ROWL/ROWL.html

  - Also accessible via http://www.daml.org/rules/

- Semantic eWallet – Web Semantics Journal (Apr. 2004): 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.htm

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