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Using Context- and Content-Based Trust Policies on the Semantic Web

The current discussion about a future Semantic Web trust architecture is focused on reputational trust mechanisms using explicit trust ratings. What is often overlooked is the fact that, besides of ratings, huge parts of the application-specific data published on the Semantic Web are also trust relevant and therefore can be used for flexible, fine-grained trust evaluations. We propose the usage of context- and content-based trust mechanisms and outline a trust architecture which allows the formulation of subjective, task-specific trust policies as a combination of reputation-, context-, and content-based trust mechanisms.

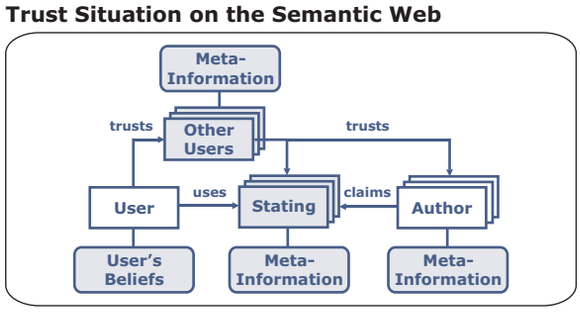
Trust Mechanisms

Reputation-Based Trust Mechanisms include rating systems like the one used by eBay and Web-Of-Trust mechanisms. The general problem with these approaches is that they require explicit and topic-specific trust ratings and that, in many situations, providing such ratings and keeping them up-to-date puts an unrealistically heavy burden on information consumers.

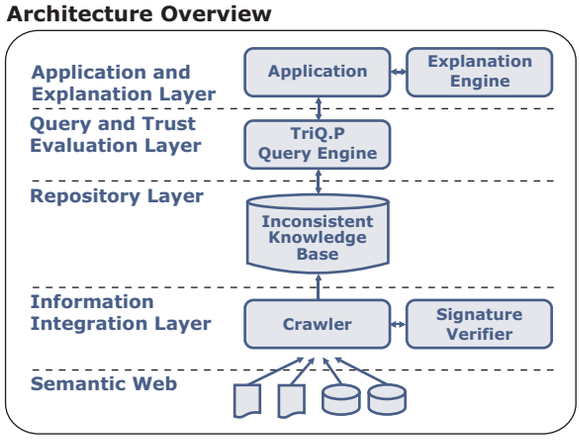
Context-Based Trust Mechanisms use meta-information about the circumstances in which information has been claimed, e.g. who said what, when, and why. They include role-based trust mechanisms, using the author's role or his membership in a specific group, for trust decisions. Example policies from this category are "Prefer product descriptions published by the manufacturer over descriptions published by a vendor" or "Distrust everything a vendor says about his competitor."

Content-Based Trust Mechanisms: These approaches do not use metadata about information, but rules and axioms together with the information content itself, and related information about the same topic published by other authors. Example policies following this approach are "Believe information which has been stated by at least 5 independent sources" or "Distrust product prices that are more than 50% below the average price."

Trust Situation on the Semantic Web



Architecture Overview



Trust Architecture

For storing aggregated information we use Named Graphs, an extension to RDF which avoids the usage of reification while attaching provenance information to graphs. For querying aggregated information we use TriQL.P a query language which allows the expression of trust policies within queries and returns justification trees together with the query results.

Set of Named Graphs Serialized with TriG

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix swp: <http://www.w3.org/2004/03/trix/swp-1/> .
@prefix dc: <http://purl.org/dc/elements/1.1/> .
@prefix ex: <http:// www.example.org#> .
@prefix : <http://www.example.org/exampleDocument#> .

:G1 { ex:Monica ex:name "Monica Murphy" .
      ex:Monica rdf:type ex:Person .
      ex:Monica ex:homepage <http://www.monicamurphy.org> .
      ex:Monica ex:email <mailto:monica@monicamurphy.org> .
      ex:Monica ex:skill ex:Programming .
      ex:Monica ex:skill ex:Management }

:G2 { ex:Chris rdf:type ex:Person .
      ex:Chris ex:skill ex:Programming .
      ex:Chris ex:affiliation ex:ProjectInterVal .
      ex:Chris ex:affiliation ex:ProjectKnowledgeNet }

:G3 { :G1 swp:assertedBy _:w1 .
      _:w1 swp:authority ex:Chris .
      _:w1 dc:date "2003-10-02"^^xsd:date .
      :G2 swp:assertedBy _:w2 .
      :G3 swp:assertedBy _:w2 .
      _:w2 dc:date "2003-09-03"^^xsd:date .
      _:w2 swp:authority ex:Chris .
      ex:Chris rdf:type ex:Person .
      ex:Chris ex:email <mailto:chris@bizer.de> }
```

TriQL.P Example Query

The following TriQL.P query retrieves all individuals having the skill "Programming", based only on claims by people who have an affiliation to at least 2 projects involving "Programming".

```
SELECT ?person
WHERE ?graph  (?person km:skill km:Programming .
               ?person rdf:type km:Person )
              (?graph swp:assertedBy ?warrant .
               ?warrant swp:authority ?author )
              (?author km:affiliation ?project )
              (?project rdf:type km:Project .
               ?project km:topic km:Programming )
AND COUNT(?project) >= 2
USING km FOR <http://www.example.org/vocabulary#>
      rdf FOR <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
      swp FOR <http://www.w3.org/2004/03/trix/swp-1/>
```

The query might return Monica because Chris claims that Monica has the skill "Programming" and Chris works for project InterVal and project KnowledgeNet, both having the topic "Programming". In this case the following justification tree would be attached to the binding "?person = ex:Monica".

Justification Tree

Claimed in	Justification Bindings
ex:Graph1	?graph (?person km:skill km:Programming . ?person rdf:type km:Person) ?graph = ex:Graph1 ?person = ex:Monica
ex:Graph2	(?graph swp:assertedBy ?warrant . ?warrant swp:authority ?author) ?graph = ex:Graph1 ?warrant = ex:Warrant2 ?author = ex:Chris
ex:Graph3	(?author km:affiliation ?project) ?author = ex:Chris ?project = ex:projectInterVal
ex:Graph3	(?author km:affiliation ?project) ?author = ex:Chris ?project = ex:projectKnowledgeNet
ex:Graph4	(?project rdf:type km:Project . ?project km:topic km:Programming) ?project = ex:projectInterVal
ex:Graph5	(?project rdf:type km:Project . ?project km:topic km:Programming) ?project = ex:projectKnowledgeNet

More information about our trust architecture, TriQL.P example queries and justification trees are found at:
http://www.wiwiss.fu-berlin.de/suhl/bizer/TriQLP