Distributed Trust

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http://umbc.edu/~finin/papers/ijcai01/

Context

- ✓ Focus on trust from a "security perspective"
- ✓ Building on concepts like authentication, authorization, role-based access control, public key infrastructure, digital signatures, authoritative sources of information, etc.

Three Scenarios

1. Supply Chain Management System
   - ✓Already implemented
2. Dynamic Wireless Environment
   - ✓Ongoing work
3. Distributed Trust for Web Services
   - ✓Future work
   - ✓To be applied to ITTALKS (http://www.ittalks.org/)

Scenario 1: Supply Chain Mgmt

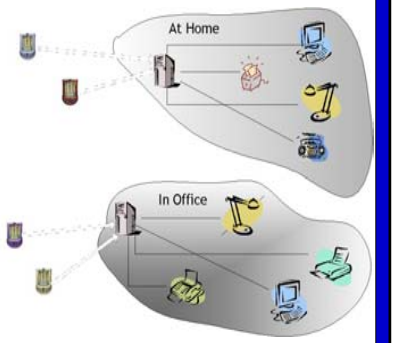
- ✓ Inter company information access
- ✓ Sharing/accessing information, and performing actions across (or within) organizations
- ✓ have to observe organizational policies for security and authorization.

Implemented for the NIST ATP EECOMS project

Scenario 2 : Dynamic Wireless Environment

Working with dynamic, ad hoc wireless environments like Bluetooth

- Unknown entities are involved
- Wireless devices are resource poor
- Authenticate other wireless devices
- Need to communicate and sometimes use other devices



Scenario 3: ITTALKS

- **ITTALKS** is a database driven web site of IT related talks at UMBC and other institutions. The database contains information on
  - Seminar events
  - People (speakers, hosts, users,…)
  - Places (rooms, institutions,…)

http://ittalks.org/

- This database is used to dynamically generate web pages and DAML descriptions for the talks and related information.
- Notifications are sent to registered users and/or their agents via email, SMS, WAP, and/or KQML for talks matching their interests, location and schedule.

What is Distributed Trust

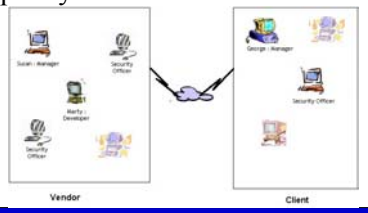
✓ Issues
- No central authority
- logging in is not possible
- Access control for entities never encountered before

We use *Distributed Trust* to solve these issues

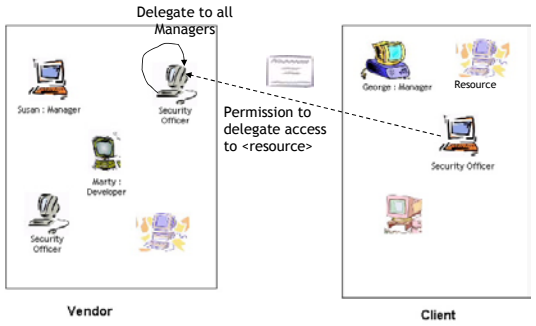
✓ trust = policies + credentials + delegation actions + proofs of deontic properties

Design for SCM

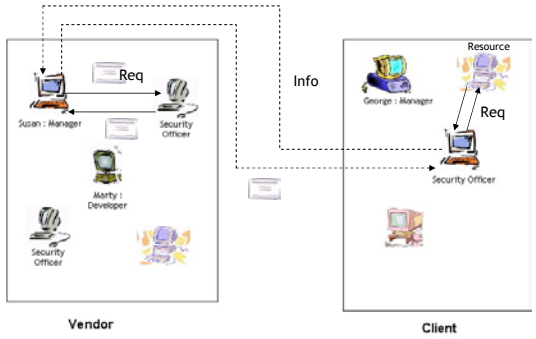
✓ Companies have security policies
✓ Policy enforced by a number of 'security officers'
✓ Each agent in the system has an ID certificate, X.509
✓ All communication via signed messages
✓ Trust and policy info encoded as horn clauses



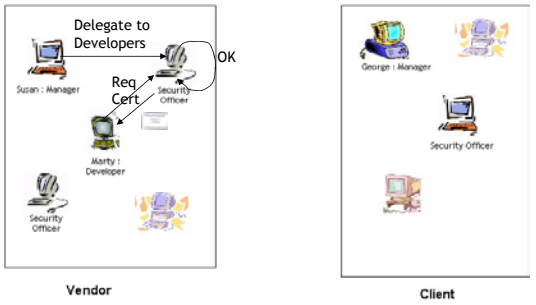
How it works : Initialization



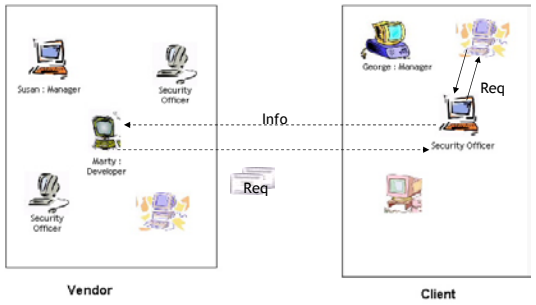
How it works : Request



How it works : Delegation



How it works : Request



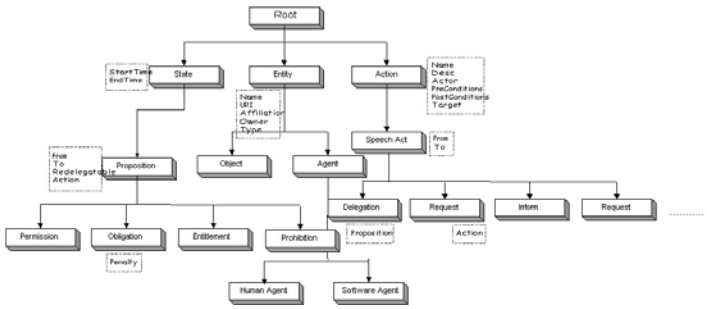
Ongoing Work

- ✓ Specifying ontology for permissions, obligations, entitlements, prohibitions in DAML/RDF
- ✓ Also model distributed belief
- ✓ Encoded in DAML and/or RDF
- ✓ Delegating of permissions, obligations, entitlements, prohibitions and belief
- ✓ To avoid the permission revocation problem we use "short lived propositions", e.g.
  "My proof that agent xyzzy has permission to do action X is good until time *t*."

Distributed Belief

- ✓ A policy specified that "UMBC CSEE faculty are allowed to do X", but how do we determine who they are?
- ✓ Our dtrust language allows us to say
  "We accept *http://www.csee.umbc.edu/faculty.html* as a trusted source of information about membership in the class *http://umbc.edu/ontologies/people#faculty"*
- ✓ faculty.html has a human-readable faculty list (in HTML) and (possibly signed) statements (in DAML) asserting who the faculty are.
- ✓ Beliefs can be delegated as well
  "I delegate my belief about *phdAdvisee* property to all CSEE faculty"

Dtrust Ontology



What is DAML ?

DAML = **D**arpa **A**gent **M**arkup **L**anguage *

- ✓Goal is to define a language for the semantic web
- ✓Developing language spec, tools, applications
- ✓DAML is a language for the Semantic Web

* for more information see http://www.daml.org/

How does DAML help ?

DAML will enable the next major generation of Web/Internet technology...

- The 1st generation, the Internet, enabled disparate machines to exchange data.
- The 2nd generation, the World Wide Web, enabled new applications on top of the growing Internet, making enormous amounts of information available
- The next generation of the net is an "agent-enabled" resource (the "Semantic Web") which makes a huge amount of information available in machine-readable form creating a revolution in new applications, environments, and b2b e-commerce.

…by enabling "agent" communication at a Web-wide scale.


A DAML dtrust Example

- ✓ Susan *delegates* to Marty the ability to access all her files
- ✓ Between 10.00 am on 8/1/2001 to 12.00 am on 8/5/2001
- ✓ He is also allowed to *re-delegate* this ability
- ✓ But he can only *re-delegate* to agents affiliated to UMBC and on one of Susan's file called file123.txt


A DAML dtrust Example

```
<!-- Susan's agent -->
<agent>
        <name>susan-agent</name>
        <affiliation>UMBC</affiliation>
        <owner>susan</owner>
</agent>

<!-- Marty's agent -->
<agent>
        <name>marty-agent</name>
        <affiliation>UMBC</affiliation>
        <owner>marty</owner>
</agent>

<!-- all agents affiliated to UMBC -->
<agent rdf:ID="umbc-agent">
        <affiliation>UMBC</affiliation>
</agent>

<!-- Susan's file, file123.txt -->
<object>
        <name>file123.txt</name>
        <owner>susan-agent</owner>
        <type>FILE</type>
</object>
```

```
<!-- all files belonging to Susan -->
<object rdf:ID="susan-files">
        <owner>susan-agent</owner>
        <type>FILE</type>
</object>


%% informing the system the meaning of readfileaccesss
%% add more properties
<!-- ReadFileAction -->
<rdfs:Class rdf:ID="ReadFileAccess">
        <rdfs:subClassOf rdf:resource="#Action"/>
        <rdfs:label>ReadFileAccess</rdfs:label>
</rdfs:Class>
```


A DAML dtrust Example (cont)

```
<delegation rdf:ID="Delegation1">
        <from>susan-agent</from>
        <to>marty-agent</to>
        <permission>
                <from>susan-agent</from>
                <to>marty-agent</to>
                <starttime>2001:8:1:10:00</starttime>
                <endtime>2001:8:5:24:00</endtime>
                <readfileaccess>
                        <name>ReadFileAccess</name>
                        <actor>umbc-agent</actor>
                        <targets>susan-files</targets>
                        <redelegatable>
                                <permission>
                                        <readfileaccess>
                                                <actor>umbc-agent</actor>
                                                <targets>file123.txt</targets>
                                        </readfileaccess>
                                </permission>
                        </redelegatable>
                        <precondition>
                                <request>
                                        <readfileaccess>
                                                <targets>susan-files</targets>
                                        </readfileaccess>
                                </request>
                        </precondition>
                </readfileaccess>
        </permission>
</delegation>
```


Future Work

- ✓ Use XML Signatures to sign DAML statements
- ✓ Incorporate a reputation mechanism
- ✓ Handle conflicting policies
- ✓ Develop a *dtrust* language for web services

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Summary

- ✓ We have developed an infrastructure for *distributed trust*
- ✓ Designed a representation for trust info, credentials and policies
- ✓ Shown its feasibility through implementation
- ✓ Discussed some of our current work with the representation of security and trust info in a semantic language like DAML
- ✓ Future research directions

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