Peertrust: Automated Trust Negotiation for Peers on the Semantic Web

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Outline

- Introduction
- Trust Negotiation
- PeerTrust Language
- How PeerTrust Works
- Conclusions & Further Work
Traditional Access Control for Decentralized Systems

Assumption: I already know you---you have a local account!
Challenges

- Bi-directional regulation of information disclosure
  - Based on digital credentials and security policies

- Identity based vs. property based

- Automate the interchange of policies and credentials?

- Automate the way credentials are obtained and disclosed?

- And how to do it in a distributed way !!
Trust Negotiation

- Establish trust iteratively and bilaterally by the disclosure of credentials and by requests for credentials
- Trust is based on parties’ properties
- Every party can define access control policies to control outsiders’ access to their sensitive resources
Step 1: Alice requests a service from Bob

Step 2: Bob discloses his policy for the service

Step 3: Alice discloses her policy for VISA

Step 4: Bob discloses his BBB credential

Step 5: Alice discloses her VISA card credential

Step 6: Bob grants access to the service
PeerTrust Language

Based on distributed logic programs

- Datalog with constraints
- Some new syntax features: @, signedBy, $, contexts

Features:

- Expression of complex conditions
- Sensitive policies
- Delegation
- Negotiation strategies
Syntax (I)

Definite horn clauses
- First order horn rules
- $lit_0 \leftarrow lit_1, ..., lit_n$

References to other peers
- Authorities
  - Reason about statements done by other peers
  - $lit_i@\text{Authority}$
  - E.g.: $\text{preferred}(X) \leftarrow \text{student}(X) @ \text{“UIUC”}$.
  - Can be nested: $\text{preferred}(X) \leftarrow \text{student}(X) @ \text{“UIUC”} @ X$.
- Context attached to literals
  - Specify disclosure requirements
  - Requester: Refers to the peer who asked a particular query
  - $\text{member(“E-Learn”) @ “BBB”}$ $\text{Requester = “eOrg”}$. 
Syntax (& II)

- Context attached to rules
  - Represent release policies
  - $\text{lit}_0 \leftarrow_{\text{context}_0} \text{lit}_1, \ldots, \text{lit}_n$
  - $\text{student(“Alice”) @ “UIUC”} \leftarrow_{\text{Requester = “eOrg”}}$
  - Default: Requester = Self

Signed Rules
- Copies of rules defined by other peers
- $\text{lit}_i @ \text{Authority signedBy [Issuer]}$
- E.g.: $\text{student(“Alice”) @ “UIUC” signedBy [“UIUC”]}$. 
How It Works: Alice & E-Learn (I)

E-Learn:

discountEnroll(Course,Party) $ Requester = Party \leftarrow
preferred(Party) @ "ELENA".

preferred(X) @ "ELENA" \leftarrow
signedBy["ELENA"]
student(X) @ "UIUC".

member("E-Learn") @ "BBB" signedBy["BBB"].
How It Works: Alice & E-Learn (II)

UIUC:

\[
\text{student}(X) \land \text{Requester = "UIUC Registrar"} \leftarrow \\
\text{student}(X) \land \text{"UIUC Registrar"}.
\]

Alice:

\[
\text{student}(X) \land \text{"UIUC"} \\
\text{$\text{member( Requester ) @ "BBB" @ Requester.}$}
\]

\[
\text{student}(X) \land \text{"UIUC"} \leftarrow \text{true} \\
\text{signedBy["UIUC"]} \\
\text{student}(X) \land \text{"UIUC Registrar"}.
\]
How It Works: Alice & E-Learn (& III)

**UIUC Registrar**

**Step 5**: Alice requests his student ID

**Step 6**: UIUC discloses Alice’s student ID

**Alice**

**Step 1**: Alice requests a discount to E-Learn

**Step 2**: E-Learn requires Alice student ID

**Step 3**: Alice requests E-Learn’s BBB membership

**Step 4**: E-Learn discloses its BBB membership

**E-Learn**

**Step 7**: Alice discloses her student ID

**Step 8**: E-Learn gives a discount to Alice
Conclusions & Future Work

- PeerTrust policy language
  - Bilateral negotiation and establishment of trust
  - Distributed
  - Supports:
    - Delegation
    - Signed Rules
    - Policy protection
    - Negotiation strategies

Further work:

- Formal guarantees to prove that negotiation terminates
  - How peer’s behavior affects the negotiation?
- Strategies for negotiation among n peers
Thank You!

Questions