Slideset 6 of "E-Commerce Applications of Semantic Web Services"

Benjamin Grosof

MIT Sloan School of Management,
http://ebusiness.mit.edu/bgrosof

EC '04 Conference Tutorial

5th ACM Conference on Electronic Commerce, May 17, 2004, New York City

Version Date: April 29, 2004

Sequence Outline of Tutorial

- Introduction & get acquainted
- Overview of Core Technologies of the New Generation Web
  - XML; Web Services; Semantic Web; Semantic Web Services
- Business Process Automation; B2B; EAI; Agents; Standards Role
- Overview of Research Agenda; incl. SWS application scenarios
- End-to-end E-Contracting as business application of SWS
  - SweetDeal rule-based approach, manufacturing SCM example
- (BREAK midway: about here.)
- More depth on Rules and KR for SWS, incl. RuleML
  - Requirements; uses; maturity; rule-based SWS
  - New Fundamental KR Theory, incl. Description LP
- Financial Info & Reporting: ECOIN ontologies/contexts integration
- Trust Management Policies: rules & delegation in authorization
- SWS Research Directions
- SWS E-C Adoption Roadmap; Market Evolution

Trust Management Policies: Role for Semantic Web Rules

- Policies usually well represented as rules
  - E.g., Role-based Access Control
    - This is the most important kind of trust policy in practical deployment today.
- Advantages of standardized SW rules:
  - Familiarity, training
  - Quality and Transparency of implementation in enforcement
  - Reduced Vendor Lock-in
  - Expressive power
  - Integration with rest of business policies

Trust in larger context of Business Policies and Contracts

- Trust/authorization is often closely tied to other business policies, e.g., pricing, bidding, customer selection, lead-time, service level. E.g.,
  - Risk of new business partner B, when supplier S makes bid.
    - ? Will B fulfill its commitments if B places an order?
    - ? Will S lose by reserving capacity while awaiting B's decision?
    - ? Will B leak information to competitors about B's pricing & capacity?

- *From another viewpoint:* Trust is what contracts are all about:
  - Contracts encode agreements that define conditions of trust.

Discussion

- Gray areas: trust/security/privacy policies vs. other business policies
  - Risk vs. benefit

Rule-based Policies for Trust and Security Authorization

- Use rule-based executable specification of security authorization policies, a.k.a. trust management: including delegation, certificates.
  - Straightforwardly generalizes Role-Based Access Control (RBAC).
- Often, authorization/trust policy is really a part of overall contract or business policy, at application-level. Unlike authentication.
- Advantages of rule-based approach, esp. from declarative semantics:
  - easier integration with general business policy.
  - easier to understand and modify by humans.
  - provable guarantees of behavior of implementation.
  - principled handling of negation and conflict.

Rule-based Policies for Trust and Security Authorization

- Use rule-based executable specification of security authorization policies, a.k.a. trust management: including delegation, certificates.
  - Straightforwardly generalizes Role-Based Access Control (RBAC).
- Often, authorization/trust policy is really a part of overall contract or business policy, at application-level. Unlike authentication.
- Advantages of rule-based approach, esp. from declarative semantics:
  - easier integration with general business policy.
  - easier to understand and modify by humans.
  - provable guarantees of behavior of implementation.
  - principled handling of negation and conflict.

Delegation Logic: Goal and Basic Approach*

- Goal: Develop a language that
  - can represent, with significant expressive power, *policies* and *credentials* for authorization in Internet scenarios
  - can provide mechanisms for delegation
  - has a clear declarative semantics

- Approach: Delegation Logic (DL): multi-agent logic programs with delegation to complex delegatees
  - D1LP: extends negation-free OLP $\Rightarrow$ with delegation
  - D2LP: extends Courteous LP $\Rightarrow$ with delegation
  - Tractable "Delegation compiler" similar to courteous compiler.

* [Li, Grosof, & Feigenbaum, ACM Transactions on Information Systems Security 2003]

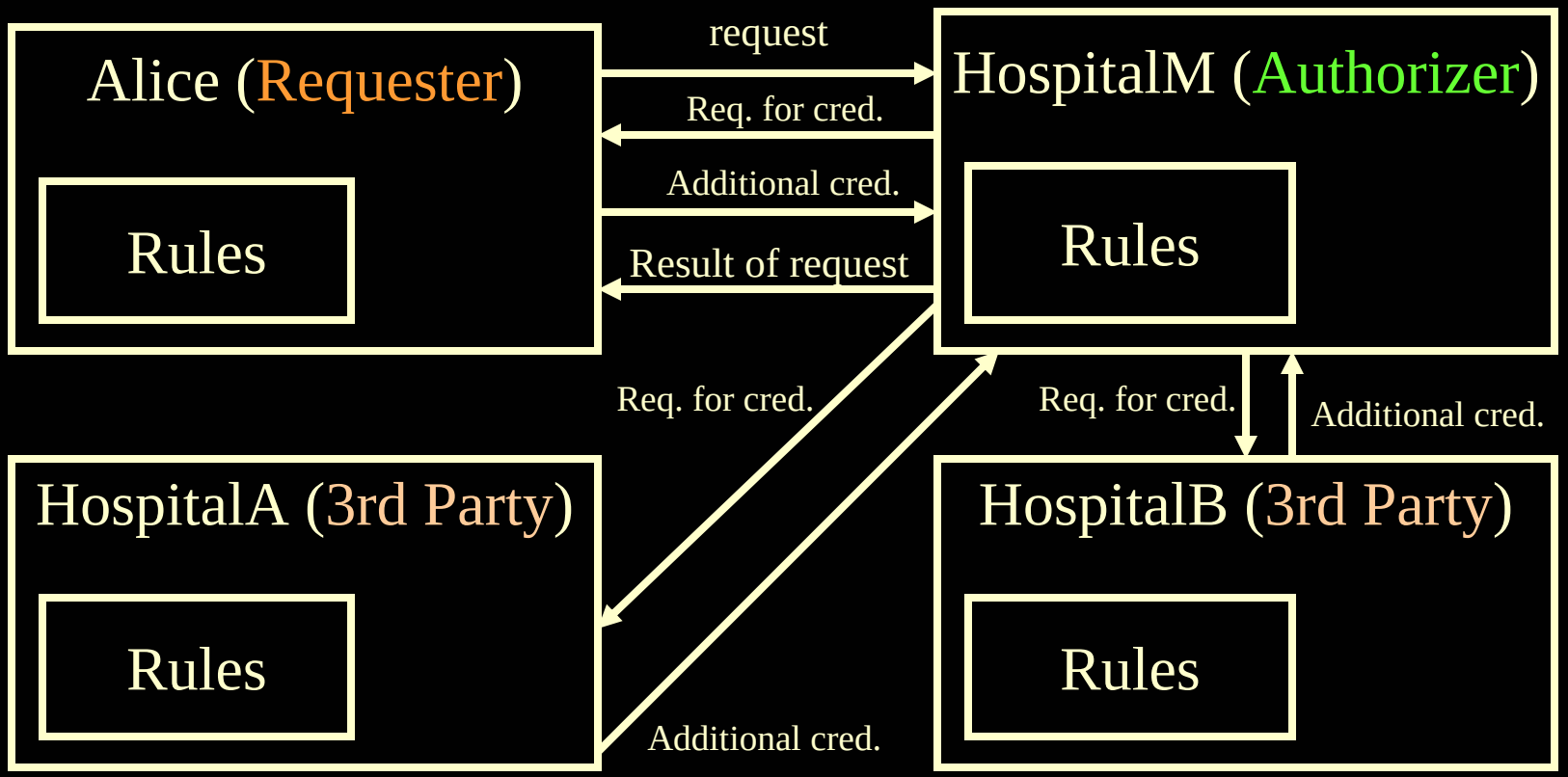
Delegation Logic (D1LP) Example: accessing medical records

- Problem: Hospital HM to decide: requester Alice authorized for patient Peter?
- Policies: HM will authorize only the patient's physician. HM trusts any hospital it knows to certify the physician relationship. Two hospitals together can vouch for a 3rd hospital.
  - HM says authorized(?X, read(medRec(?Y))) if HM says inRole(?X, physic(?Y)).
  - HM delegates inRole(?X, physic(?Y))^1 to threshold(1,?Z, HM says inRole(?Z,hosp)).
  - HM delegates inRole(?H,hosp)^1 to threshold(2 , ?Z, HM says inRole(?Z,hosp)).
- Facts: HC certifies Alice is Peter's physician. HM knows two hospitals HA and HB. HA and HB each certify HC as a hospital.
  - HC says inRole(Alice, physic(Peter)). HA says inRole(Joe, physic(Sue).
  - HM says inRole(HA,hosp). HM says inRole(HB, hosp).
  - HA says inRole(HC,hosp). HB says inRole(HC, hosp).
- Conclusion: HM says authorized(Alice, read(medRec(Peter))). *Joe NOT authorized.*

Example Scenario of Delegation Logic

- Each agent is a principal; in a given scenario one is a requester.
- Each agent initially has a ruleset, that represents policies and/or credentials.
- Agent 1 as requester sends a request to Agent 2 as authorizer.
- The authorizer evaluates the request by executing the authorizer's policies:
  - Performs situated inference of the policy rules.
  - During evaluation, the authorizer also queries other agents (3rd parties, or the requester) for additional relevant credentials (rules).
    - Other agents, when queried, respond by sending credentials to the authorizer.
- After evaluation, the authorizer informs the requester about the decision.

Example Scenario Information Flow



What is a Delegation Relationship?

- What relationships can be viewed as a delegation from *Alice* to *Bob*?

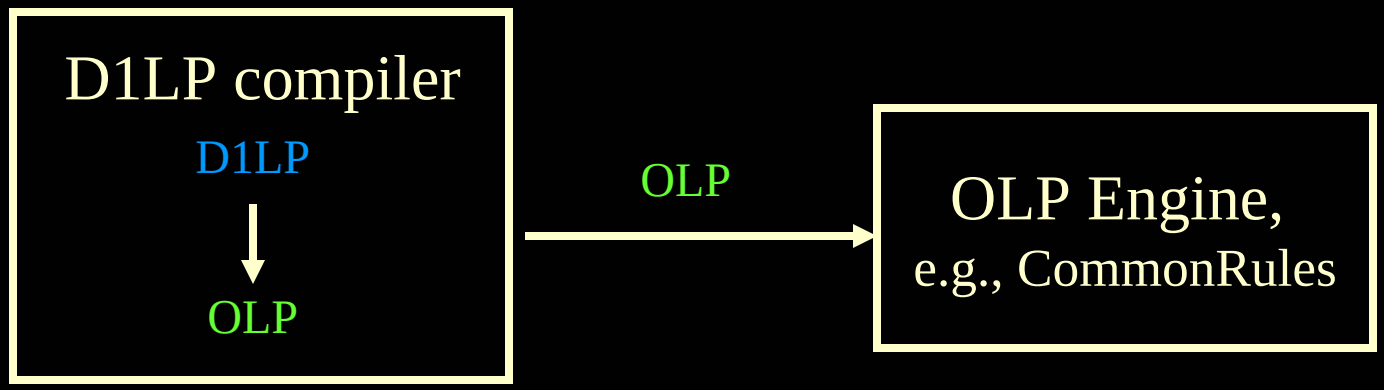
1. Trusting
   - *Alice* trusts *Bob* on something
   - Implication: if *Bob* says something, then *Alice* agrees
2. Entrusting
   - *Alice* allows *Bob* to act on *Alice*'s behalf
   - Implication: a request from *Bob* should be viewed as from *Alice*
3. Granting
   - *Alice* grants certain rights to *Bob*
   - Implication: if *Alice* has a certain right, then *Bob* should also have it

D1LP: Semantics - overview

- An authorizer has *policies* and receives *credentials*. Taken together, these form a rule-set *P*, a.k.a. a logic program.
- The declarative semantics of D1LP decides a unique set of statements that are true according to *P*, *i.e.*, the conclusions of *P*.
- The conclusion set is unique and **finitely computable**.
- Define semantics via a transform to ordinary logic programs:
  - Given a D1LP *P* , define a language *LO_P* that expresses definite logic programs. (definite = without negation-as-failure).
  - Given an model-theoretic interpretation *I* of *LO_P*, transform *P* into a ground definite logic program *O^I* in *LO_P*.

D1LP Compiler (Architecture)

- Java Implementation (part of CommonRules research prototype)



- Prolog Implementation:
  - The compiler is written in Prolog
  - The compiler dynamically asserts OLP rules into Prolog engine
  - Uses Prolog engine to do inference

Outline of
Trust Management, Security, and Privacy

- Overview
  - Aspects and Issues for Management
  - Techniques
- Trust Policies
  - Delegation
  - Rules

Platform for Privacy Preferences (P3P)

- W3C P3P is leading technical standard for privacy policies representation and enforcement
- Client privacy policies specified in a simple rule language (APPEL, part of P3P)
- Has not achieved great usage yet
- Microsoft dominance of browsers a strategic issue
  - Many believe it is an inhibitor to progress
  - *Discussion: What do you think?*

eXtensible Access Control Language (XACML)

- Oasis XACML is leading technical standard for access control policies in XML
  - Access to XML info
  - Policies in XML
- Uses a rule-based approach
  - Including for prioritized combination of policies

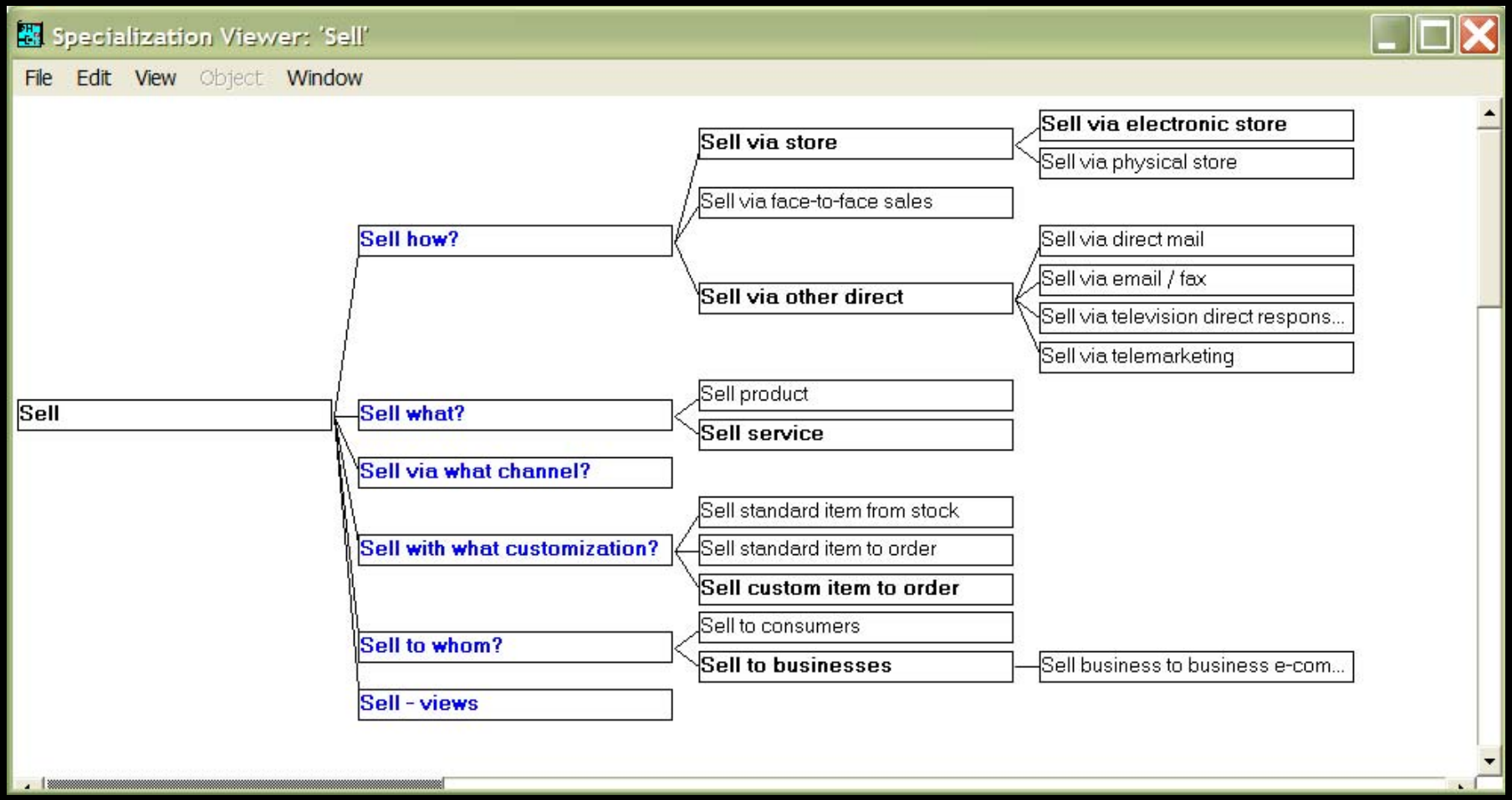
Sequence Outline of Tutorial

- Introduction & get acquainted
- Overview of Core Technologies of the New Generation Web
  - XML; Web Services; Semantic Web; Semantic Web Services
- Business Process Automation; B2B; EAI; Agents; Standards Role
- Overview of Research Agenda; incl. SWS application scenarios
- End-to-end E-Contracting as business application of SWS
  - SweetDeal rule-based approach, manufacturing SCM example
- (BREAK midway: about here.)
- More depth on Rules and KR for SWS, incl. RuleML
  - Requirements; uses; maturity; rule-based SWS
  - New Fundamental KR Theory, incl. Description LP
- Financial Info & Reporting: ECOIN ontologies/contexts integration
- Trust Management Policies: rules & delegation in authorization
- SWS Research Directions
- SWS E-C Adoption Roadmap; Market Evolution

SWS Research Directions

- Requirements Analysis
- Fundamental KR theory, techniques, tools:
  - Recent: Courteous LP, Situated LP, Description LP
  - More: nonmon OO ontologies, multi-agent nonmon, equational ontologies, context mappings, …
- Fundamental theory of semantic descriptions of services
- Web Services / Business Processes Knowledge Bases:
  - MIT Process Handbook as candidate nucleus for shared business process ontology for SWS
    - Open Process Handbook Initiative: *an open-source version, is in progress.* (http://ccs.mit.edu/ph)

Some Specializations of "Sell" in the MIT Process Handbook (PH)



SWS Research Directions, continued

- Standards: Rules (RuleML/DAML), SWS (SWSI); W3C; Oasis; (also OAG, OMG, others); incl. wrt e-commerce (e.g., ebXML, EDI), vertical industries, horizontal tasks
- Applications: e-contracting, finance, trust mgm., travel
- Fundamental theory for e-contracting
  - Interoperable business objects, policies (e.g., trust), business processes, 3rd-party services
- Strategy wrt SWS uses, adoption, markets

Sequence Outline of Tutorial

- Introduction & get acquainted
- Overview of Core Technologies of the New Generation Web
  - XML; Web Services; Semantic Web; Semantic Web Services
- Business Process Automation; B2B; EAI; Agents; Standards Role
- Overview of Research Agenda; incl. SWS application scenarios
- End-to-end E-Contracting as business application of SWS
  - SweetDeal rule-based approach, manufacturing SCM example
- (BREAK midway: about here.)
- More depth on Rules and KR for SWS, incl. RuleML
  - Requirements; uses; maturity; rule-based SWS
  - New Fundamental KR Theory, incl. Description LP
- Financial Info & Reporting: ECOIN ontologies/contexts integration
- Trust Management Policies: rules & delegation in authorization
- SWS Research Directions
- SWS E-C Adoption Roadmap; Market Evolution

SW Early Adoption Candidates: High-Level View

- "Death. Taxes. Integration."
- Application/Info Integration:
  - Intra-enterprise
    - EAI, M&A; XML infrastructure trend
  - Inter-enterprise
    - E-Commerce: procurement, SCM
  - Combo
    - Business partners, extranet trend

SWS Adoption Roadmap: Strategy Considerations

- Expect see beginning in a lot of B2B interoperability or heterogeneous-info-integration intensive (e.g., finance, travel)
  - Actually, probably 1st intra-enterprise, e.g., EAI
- Reduce costs of communication in procurement, operations, customer service, supply chain ordering and logistics
  - increase speed, creates value, increases dynamism
  - macro effects create
    - stability sometimes (e.g., supply chain reactions due to lag; other negative feedbacks)
    - volatility sometimes (e.g., perhaps financial market swings)
  - increase flexibility, decrease lock-in
- Agility in business processes, supply chains

SW Early Adopters: Areas by Industry or Task

- Early SW techniques already in use:
  - e-contracting, supply chain incl. procurement
    - manufacturing, e.g. computer/electronics (RosettaNet), automotive (Covisint),
    - EECOMS pilot (Boeing, IBM, TRW, Baan)
    - office supplies (OBI)
    - retailing: shopbots and salesbots: comparisons, recommendations
    - extensive standards activity: Oasis ebXML, XML eContracts, UN UBL, EDI

SW Early Adopters: Areas by Industry or Task

- *Continued:* Early SW techniques already in use:
  - cyber goods:
    - financial services (rules; onto translation)
    - travel "agency", i.e.: tickets, packages (AI smarts for scheduling)
  - military intelligence (e.g., funded DAML)

Sequence Outline of Tutorial

- Introduction & get acquainted
- Overview of Core Technologies of the New Generation Web
  - XML; Web Services; Semantic Web; Semantic Web Services
- Business Process Automation; B2B; EAI; Agents; Standards Role
- Overview of Research Agenda; incl. SWS application scenarios
- End-to-end E-Contracting as business application of SWS
  - SweetDeal rule-based approach, manufacturing SCM example
- (BREAK midway: about here.)
- More depth on Rules and KR for SWS, incl. RuleML
  - Requirements; uses; maturity; rule-based SWS
  - New Fundamental KR Theory, incl. Description LP
- Financial Info & Reporting: ECOIN ontologies/contexts integration
- Trust Management Policies: rules & delegation in authorization
- SWS Research Directions
- SWS E-C Adoption Roadmap; Market Evolution

Discussion: Early Adoption Application Prospects for SWS

- What business applications do you think are likely or interesting?
  - By vertical industry domain, e.g., health care or security
  - By task, e.g., authorization
  - By kind of shared information, e.g., patient records
  - By aspect of business relationships, e.g., provider network
- What do you think are entrepreneurial opportunity areas?

Content Outline of Tutorial

1. Intro
   a. Overview and get acquainted
   b. b. XML & B2B
2. Semantic Web Services: concepts, technologies, standards
   a. Semantic Web, Web Services, and their convergence
   b. Rules and RuleML
   c. Combining Rules with Ontologies
3. 3. Application Scenarios in depth:
   a. E-Contracting including business policies
   b. Financial Knowledge Integration including ontology translations
   c. Authorization and Trust including privacy, multi-agent delegation
4. Windup and Discussion
   a. a. Prospective Early Adopter areas for SWS in EC

Acknowledgements

- SweetDeal e-contracting: student: Terrence Poon
- Situated Courteous Logic Programs: collaborator on implementation: Hoi Chan
- RuleML design: collaborators: Harold Boley, Said Tabet
- ECOIN: collaborators: Aykut Firat, Stuart Madnick

- Support for the work was provided by
  - DARPA Agent Markup Language program
  - Center for eBusiness @ MIT Vision Fund