
Benjamin Grosof
MIT Sloan School of Management
Information Technologies group
http://ebusiness.mit.edu/bgrosof


5/21/2004 Copyright 2004 by Benjamin Grosof. All Rights Reserved
Quickie Bio of Presenter

• MIT Sloan professor since 2000
• 12 years at IBM T.J. Watson Research; 2 years at startups
• PhD Comp Sci, Stanford; BA Applied Math Econ/Mgmt, Harvard
• Semantic web services is main research area:
  – Rules as core technology
  – Business Applications, Implications, Strategy:
    • e-contracting/supply-chain; finance; trust; …
  – Overall knowledge representation, e-commerce, intelligent agents
• Co-Founder, Rule Markup Language Initiative – the leading emerging standards body in semantic web rules (http://www.ruleml.org)
• Core participant in Semantic Web Services Initiative – which coordinates world-wide SWS research and early standards (http://www.swsi.org)
  – Area Editor for Contracts & Negotiation, Language Committee
  – Co-Chair, Industrial Partners program (SWSIP)
Next Generation Web

Semantic Web Services

Semantic Web techniques

First Generation Web

XML

Web Services techniques

API’s on Web
(WSDL, SOAP)

Two interwoven aspects:
Program: Web Services
Data: Semantic Web

Automated Knowledge Bases
Rules (RuleML)
Ontologies (OWL)
Databases (SQL, XQuery, RDF)
Analysis:
High-Level Requirements for SWS

• Support Biz-Process Communication
  – E.g., B2B SCM, CRM, EAI
  – E.g., e-contracts, financial info, trust management.

• Support SWS Tasks above current WS layers:
Goals wrt Key SWS Tasks

– The point of SWS is knowledge reuse
  • Especially the Knowledge-based service descriptions

– … Across the Key Tasks in our Requirements:
  • Contracts (proposals, request-for-proposals, selection, negotiation, advertising); Discovery; Enactment, Composition; Monitoring, Problem resolution, Exception handling; Verification
  • Business/Trust/Security/Privacy Policies
  • Semantic Interoperability (mappings, specializations)
  • Underlying: Hypothetical Reasoning
**Vision: Uses of Rules in E-Business**

- Rules as an important aspect of coming world of Internet e-business: rule-based business policies & business processes, for B2B & B2C.
  - represent seller’s offerings of *products & services*, capabilities, bids; map offerings from multiple suppliers to common *catalog*.
  - represent buyer’s *requests, interests, bids*; → *matchmaking*.
  - high level of conceptual abstraction; easier for *non-programmers* to understand, specify, *dynamically modify & merge*.
  - executable but can treat as data, separate from code
    - potentially ubiquitous; already wide: e.g., SQL views, queries.
- Rules in communicating applications, e.g., embedded intelligent agents.
SweetDeal Approach:

Rule-based Contracts for E-commerce

[Grosof, Labrou, & Chan EC-99; Wellman, Reeves, & Grosof CI ‘02; Grosof & Poon IJEC ’04]

• Rules as way to specify (part of) business processes, policies, products: as (part of) contract terms.
  – Combined with ontologies.
• Complete or partial contract.
  – As default rules. Update, e.g., in negotiation. Exceptions handling.
• Rules provide high level of conceptual abstraction.
  – easier for non-programmers to understand, specify, dynamically modify & merge. E.g.,
  – by multiple authors, cross-enterprise, cross-application.
• Executable. Integrate with other rule-based business processes.
• SWEET = Semantic WEb Enabling Technology
  – software components, theory, approach
  – pilot application scenarios, incl. contracting (SweetDeal)
Examples of Contract Provisions
Well-Represented by Rules
in Automated Deal Making

• Product descriptions
  – Product catalogs: properties, conditional on other properties.
• Pricing dependent upon: delivery-date, quantity, group memberships, umbrella contract provisions
• Terms & conditions: refund/cancellation timelines/deposits, lateness/quality penalties, ordering lead time, shipping, creditworthiness, biz-partner qualification, service provisions
• Trust
  – Creditworthiness, authorization, required signatures
• Buyer Requirements (RFQ, RFP) wrt the above
• Seller Capabilities (Sourcing, Qualification) wrt the above
Where Rules Shine in
Goals wrt Key SWS Tasks

- Knowledge reuse in knowledge-based service descriptions:
  - … Across the Key Tasks in our Requirements:
    - Contracts (proposals, request-for-proposals, selection, negotiation, advertising); Discovery; Enactment, Composition; Monitoring, Problem resolution, Exception handling; Verification
    - Business/Trust/Security/Privacy Policies
    - Semantic Interoperability (mappings, specializations)
    - Underlying: Hypothetical Reasoning
Where Rules + Ontologies alone are useful,
(alone = without procedural process models)

- LP Rules (RuleML) + ~DL Ontologies (OWL) alone are useful -- enough to be worthwhile – in almost all of the main Tasks areas, with reuse between Tasks as well as between Applications:
  - Advertising, Discovery, and Matchmaking: partial contracts, subsumption
    • E.g., see papers from WWW-2003 EC session (incl. DL-based, SweetDeal)
  - Contracts/selection/negotiation: pricing, policies, contingent provisions
    • E.g., cf. SweetDeal approach
  - Monitoring, problem resolution, exception handling
    • E.g., cf. SweetDeal approach
  - Enactment
    • Via procedural attachments, esp. effectors, events
  - Composition: e.g., via composing service-description knowledge bases by union’ing their rules/ontologies
  - Trust Policies:
    • Most major practical approaches are rule-based already:
      – RBAC, XACML, P3P, etc.
  - Underlying: Hypothetical Reasoning
    • A major strength of Rule-based KR
Some New Research Application Scenarios for Rule-based Semantic Web Services

- **SweetDeal** [Grosof & Poon WWW-2003] configurable reusable e-contracts:
  - Represents modular modification of proposals, service provisions
  - *LP rules* as KR. E.g., prices, late delivery exception handling.
  - *On top of DL ontologies* about business processes from MIT Process Handbook
  - Evolved from EECOMS pilot on agent-based manufacturing SCM
    ($51M NIST ATP 1996-2000 IBM, Boeing, TRW, Vitria, others)

- **Financial knowledge integration (ECOIN)** [Firat, Madnick, & Grosof 2002]
  - Maps between contexts using LP rules, equational ontologies, SQL DB’s.

- **Business Policies:**
  - **Trust management (Delegation Logic)** [Li, Grosof, & Feigenbaum 2003]:
3 Areas of New Fundamental KR Theory that enable Key Technical Requirements for SWS

1. **Description Logic Programs:** [Grosof, Horrocks, Decker, & Volz WWW-2003]
   - KR to combine LP (RuleML) rules on top of DL (OWL) ontologies, with:
     - Power in inferencing (including for consistency)
     - Scaleability of inferencing

2. **Situated Logic Programs:** [Grosof et al 1995; Grosof et al. 2002; Grosof ECRA 2004]
   - KR to hook rules (with ontologies) up to (web) services
     - Rules use services, e.g., to query, message, act with side-effects
     - Rules constitute services executably, e.g., workflow-y business processes

3. **Courteous Logic Programs:** [Grosof ILPS-97; Grosof, Labrou, & Chan EC-99]
   - KR to combine rules from many sources, with:
     - Prioritized conflict handling to enable consistency, modularity; scaleably
     - Interoperable syntax and semantics
     - Well represents default inheritance in process ontologies (courteous inheritance)

*RuleML includes support for (1.)-(3.).*
Where are the Holdups? 
... and Challenges for Research

• KR & standards to integrate Rules with Ontologies more expressively
• KR, & later standards, to represent Services descriptions using Rules and Ontologies.
  – A step is our SweetDeal approach; much current work in SWSI.
• KR & strategy to leverage legacy content, e.g., OO service/process ontologies
  – A rich research area. We are doing much current work on that.
    • Preliminary-version approach is available as paper “Beyond Monotonic Inheritance: Towards Semantic Web Process Ontologies” at http://ebusiness.mit.edu/bgrossof

• Procedural process models aspect of SWS, as underlying foundation
  – Messy, many competing conceptual approaches
  – Realm of slow progress; much energy in WS standards efforts:
    • Oasis WSBPEL, W3C WS Choreography
W3C Semantic Web “Stack”: Standardization Steps

Emerging Standards
pioneered in DARPA Agent Markup Language (DAML) program:

• RuleML
• OWL

[Diagram http://www.w3.org/DesignIssues/diagrams/sw-stack-2002.png is courtesy Tim Berners-Lee]
Semantic Web Services

• Convergence of Semantic Web and Web Services
• Consensus definition and conceptualization still forming
• Semantic (Web Services):
  – Knowledge-based service descriptions, deals
    • Policies, contracts, discovery/search, negotiation, selection, composition, enactment, monitoring, verification
    • Advantage: **reuse** of knowledge across app’s, these tasks
  – Integrated knowledge
• (Semantic Web) Services: e.g., infrastructural
  – Knowledge/info/DB integration
  – Infererencing and translation
**SWSI Language effort**, on top of Current WS Standards Stack

**“Wire” Protocols**

- W3C WS Choreography Group
- WSBPEL (Microsoft, IBM, BEA)
- WSCL (HP) BPML (Most but Microsoft)
- WSCI (Sun, BEA, Yahoo, …)
- XLANG (Microsoft), WSFL (IBM), …

**Service Description**

- SOAP Blocks
- SOAP/XMLP
- XML
- HTTP/SMTP
- TCP/IP

**SWS Language**

- Process
- WSDL Extensions
- WSDL
- XML

**SWSI Initiative (SWSI)**

-- automate Tasks of:
- Discovery
- Invocation
- Interoperation
- Deal Negotiation
- Composition
- Monitoring
- Verification

[Slide authors: Benjamin Grosof (MIT Sloan), Sheila McIlraith (Stanford), David Martin (SRI International), James Snell (IBM)]

5/21/2004 Copyright 2004 by Benjamin Grosof. All Rights Reserved
SweetDeal Approach

• SWEET = Semantic WEb Enabling Technology
  – software components, theory, approach
  – pilot application scenarios, incl. contracting (SweetDeal)

• Uses/contributes emerging standards for XML and knowledge representation:
  – RuleML semantic web rules
  – OWL ontologies (W3C)

• Uses repositories of business processes and contracts
  – MIT Process Handbook (Sloan IT)
  – legal/regulatory sources: law firms, ABA, CommonAccord, … Suggestions welcome!!
Problem: Reusable Knowledge to Describe Services

• Has two aspects:

1. Technical/technique problem: what form of knowledge? I.e., what knowledge representation to standardize on?

2. Content investment problem: how to leverage to accomplish the reuse of legacy business process knowledge?