

Remarks on Rules and Semantic Web Services
for Panel at WWW-2004 on
“Mind Your P’s:
Processes, Protocols, and Policies”

Benjamin Grosf

MIT Sloan School of Management

Information Technologies group

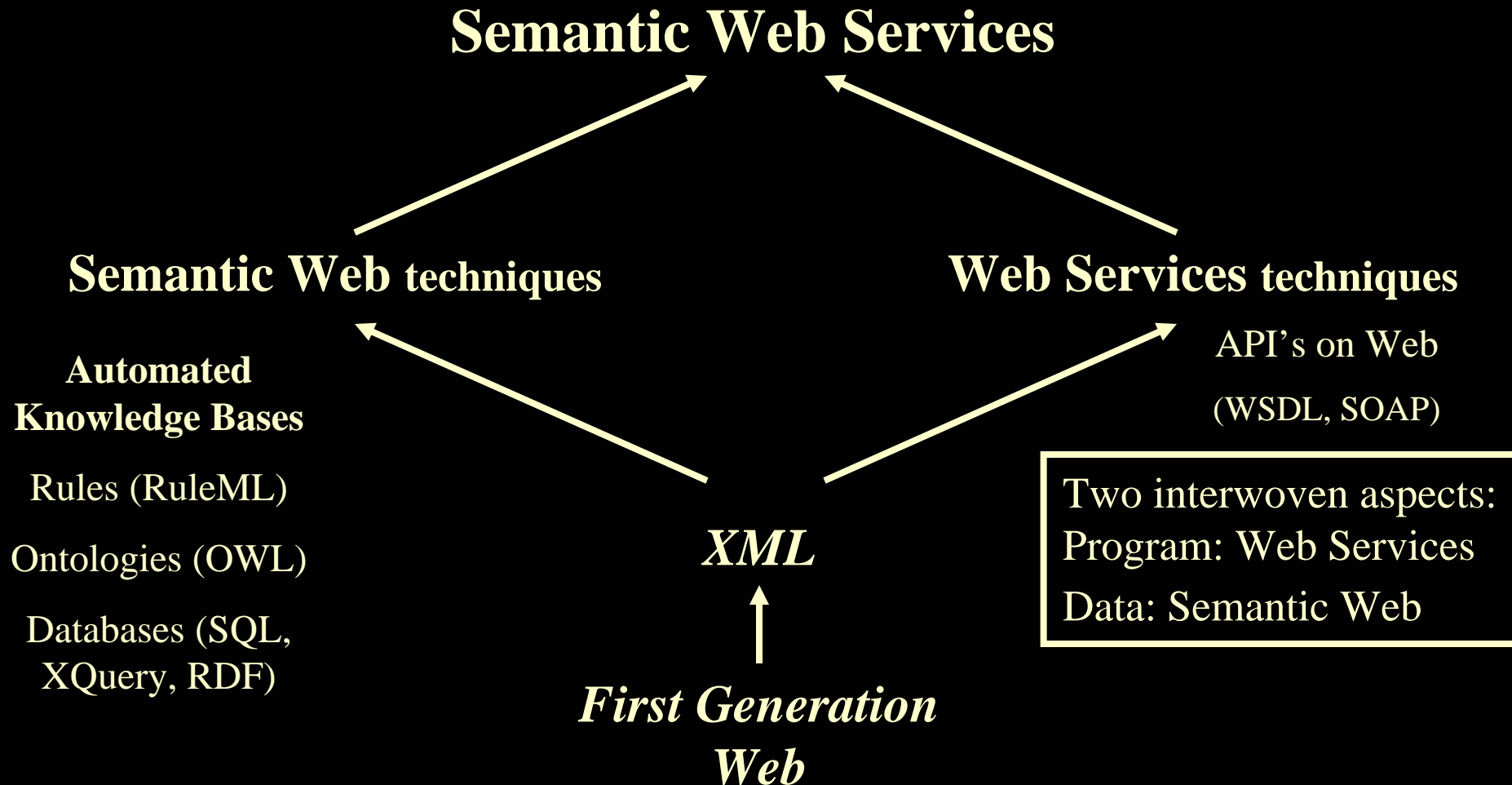
<http://ebusiness.mit.edu/bgrosf>

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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



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.
 - represent sales help, customer help, procurement, authorization/trust, brokering, workflow.
 - 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

[Grosf, Labrou, & Chan EC-99; Wellman, Reeves, & Grosf CI '02; Grosf & 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 [Grosf & 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, & Grosf 2002]
 - Maps between contexts using LP rules, equational ontologies, SQL DB's.
- Business Policies:
 - Trust management (Delegation Logic) [Li, Grosf, & Feigenbaum 2003]:
Extend LP KR to multi-agent delegation. Ex.: security authorization.

3 Areas of New Fundamental KR Theory that enable Key Technical Requirements for SWS

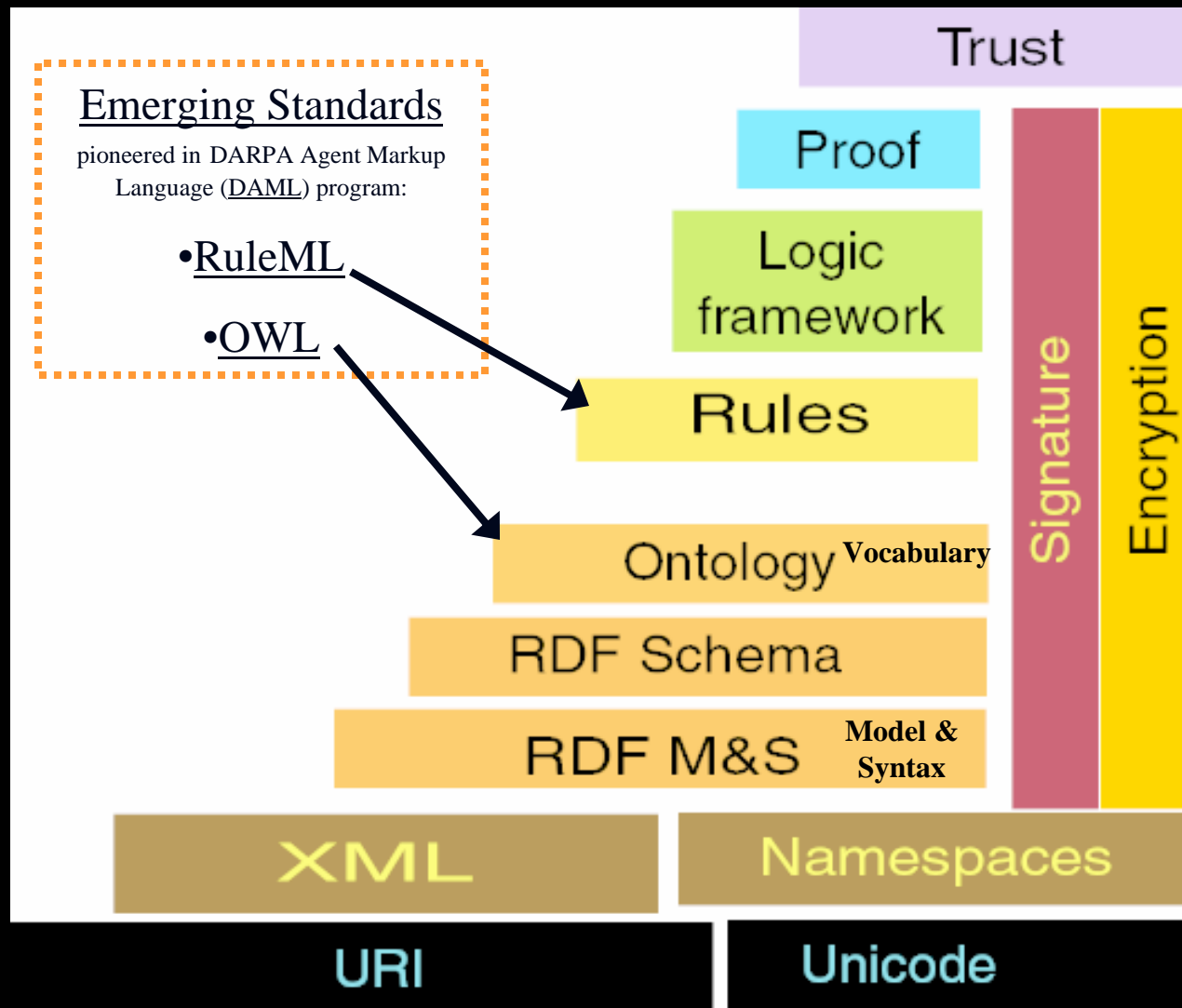
- 1. **Description Logic Programs:** [Grosf, Horrocks, Decker, & Volz WWW-2003]
KR to combine LP (RuleML) rules on top of DL (OWL) ontologies, with:
 - Power in inferencing (including for consistency)
 - Scalability of inferencing
- 2. **Situated Logic Programs:** [Grosf et al 1995; Grosf et al. 2002; Grosf 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:** [Grosf ILPS-97; Grosf, 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/bgrosf>
- 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

OPTIONAL SLIDES FOLLOW

W3C Semantic Web “Stack”: Standardization Steps



[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
 - Inferencing and translation

SWSI Language effort, on top of Current WS Standards Stack

"Wire" Protocols

Service Description

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

SOAP Blocks

SOAP/XMLP

XML

HTTP/SMTP

TCP/IP

SWS Language

Process

WSDL Extensions

WSDL

XML

Registry (UDDI)

Inspection

SWS Initiative (SWSI)
 -- automate Tasks of:
Discovery
Invocation
Interoperation
Deal Negotiation
Composition
Monitoring
Verification

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

SweetDeal Approach

[Grosf, Labrou, & Chan EC-99; Wellman, Reeves, & Grosf Computational Intelligence 2002; Grosf & Poon Intl. J. of Electronic Commerce 2004]

- 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?