OPTIONAL SLIDES for: DAML Rules Update and Issues

Slides on: SweetDeal e-contracting, Semantic Web Services (SWS), and Description Logic Programs (DLP

Presentation for Rules Breakout sessions of DAML PI Meeting, Apr. 8-10, 2003, Miami, FL, USA. http://www.daml.org

Benjamin Grosof*

MIT Sloan School of Management

bgrosof@mit.edu http://www.mit.edu/~bgrosof/

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* co-leads of DAML Rules effort

SweetDeal OPTIONAL SLIDES FOLLOW

Example Contract Proposal with Exception Handling

Represented using RuleML & DAML+OIL, Process Descriptions

Using concise text syntax

(SCLP textfile format)

for concise human reading

```
buyer(co123,acme);
seller(co123,plastics_etc);
product(co123,plastic425);
price(co123,50);
quantity(co123,100);
http://xmlcontracting.org/sd.daml#Contract(co123);
http://xmlcontracting.org/sd.daml#specFor(co123,co123_process);
http://xmlcontracting.org/sd.daml#BuyWithBilateralNegotiation(co123_process);
http://xmlcontracting.org/sd.daml#result(co123,co123_res);
shippingDate(co123,3); // i.e. 3 days after order placed
// base payment = price * quantity
payment(?R,base,?Payment) <-
  http://xmlcontracting.org/sd.daml#result(co123,?R) AND
  price(co123,?P) AND quantity(co123,?Q) AND
  multiply(?P,?Q,?Payment) ;
```

SCLP TextFile Format for (Daml)RuleML

```
payment(?R,base,?Payment) <-
http://xmlcontracting.org/sd.daml#result(co123,?R) AND
price(co123,?P) AND quantity(co123,?Q) AND
multiply(?P,?Q,?Payment) ;
```

```
<drm:imp>
  <drm:_head> <drm:atom>
     <drm:_opr><drm:rel>payment</drm:_opr></drm:rel>    <drm:tup>
     <drm:var>R</drm:var> <drm:ind>base</drm:ind> <drm:var>Payment</drm:var>
  </drm:tup></drm:atom> </drm:_head>
  <drm:_body>
   <drm:andb>
     <drm:atom> <drm:_opr>
       <drm:rel href= "http://xmlcontracting.org/sd.daml#result"/>
         </drm:_opr> <drm:tup>
           <drm:ind>co123</drm:ind> <drm:var>Cust</drm:var>
          </drm:tup> </drm:atom>

... </drm:andb> </drm:_body>  </drm:imp>
```

drm = namespace for damlRuleML

Example Contract Proposal, Continued: lateDeliveryPenalty exception handler module

```
lateDeliveryPenalty_module {
// lateDeliveryPenalty is an instance of PenalizeForContingency
//   (and thus of AvoidException, ExceptionHandler, and Process)
http://xmlcontracting.org/pr.daml#PenalizeForContingency(lateDeliveryPenalty) ;
// lateDeliveryPenalty is intended to avoid exceptions of class
// LateDelivery.
http://xmlcontracting.org/sd.daml#avoidsException(lateDeliveryPenalty,
  http://xmlcontracting.org/pr.daml#LateDelivery);
// penalty = - overdueDays * 200 ; (negative payment by buyer)
<lateDeliveryPenalty_def> payment(?R, contingentPenalty, ?Penalty) <-
  http://xmlcontracting.org/sd.daml#specFor(?CO,?PI) AND
  http://xmlcontracting.org/pr.daml#hasException(?PI,?EI) AND
  http://xmlcontracting.org/pr.daml#isHandledBy(?EI,lateDeliveryPenalty) AND
  http://xmlcontracting.org/sd.daml#result(?CO,?R) AND
  http://xmlcontracting.org/sd.daml#exceptionOccurred(?R,?EI) AND
  shippingDate(?CO,?CODate) AND shippingDate(?R,?RDate) AND
  subtract(?RDate,?CODate,?OverdueDays) AND
  multiply(?OverdueDays, 200, ?Res1) AND multiply(?Res1, -1, ?Penalty) ;
}
<lateDeliveryPenaltyHandlesIt(e1)> // specify lateDeliveryPenalty as a handler for e1
 http://xmlcontracting.org/pr.daml#isHandledBy(e1,lateDeliveryPenalty);
```

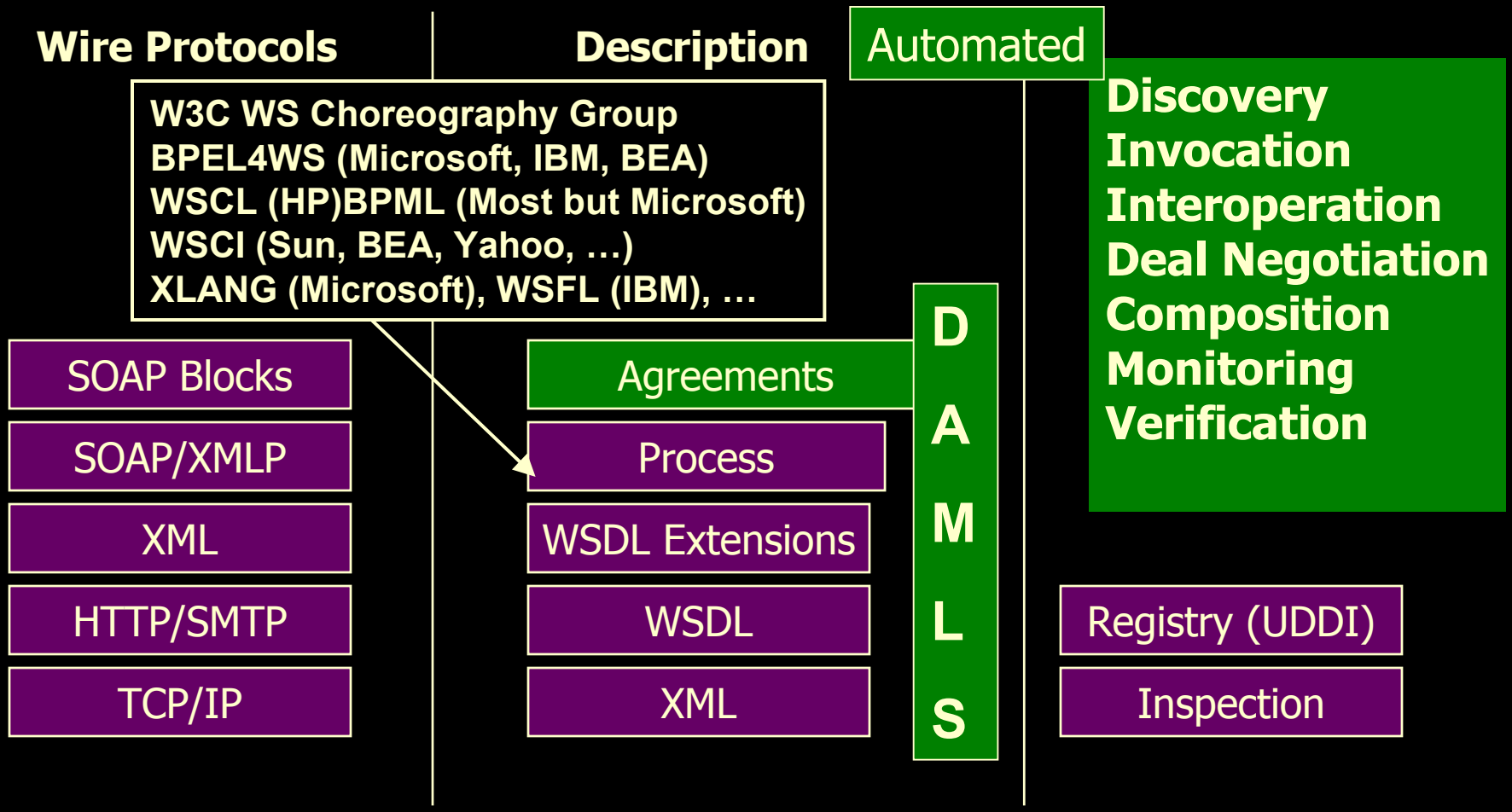
END of SweetDeal OPTIONAL SLIDES

SWS OPTIONAL SLIDES FOLLOW

Semantic Web Services

- Convergence of Semantic Web and Web Services
- Consensus definition and conceptualization still forming
- Semantic (Web Services):
  - Knowledge-based service descriptions, deals
    - Discovery/search, invocation, negotiation, selection, composition, execution, monitoring, verification
  - Integrated knowledge
- (Semantic Web) Services: e.g., infrastructural
  - Knowledge/info/DB integration
  - Inferencing and translation

Current Web Services Standards Stack; Context for Semantic Web Services



[Slide co-authors: Sheila McIlraith (Stanford) , David Martin (SRI International), James Snell (IBM)]

SWS Tasks at higher layers of WS stack

Automation of:

- Web service discovery

  Find me a shipping service that will transport frozen vegetables from San Francisco to Tuktoyuktuk.

- Web service invocation

  Buy me "Harry Potter and the Philosopher's Stone" at www.amazon.com

- Web service deals, i.e., contracts, and their negotiation

  Propose a price with shipping details for used Dell laptops to Sue Smith.

- Web service selection, composition and interoperation

  Make the travel arrangements for my WWW11 conference.

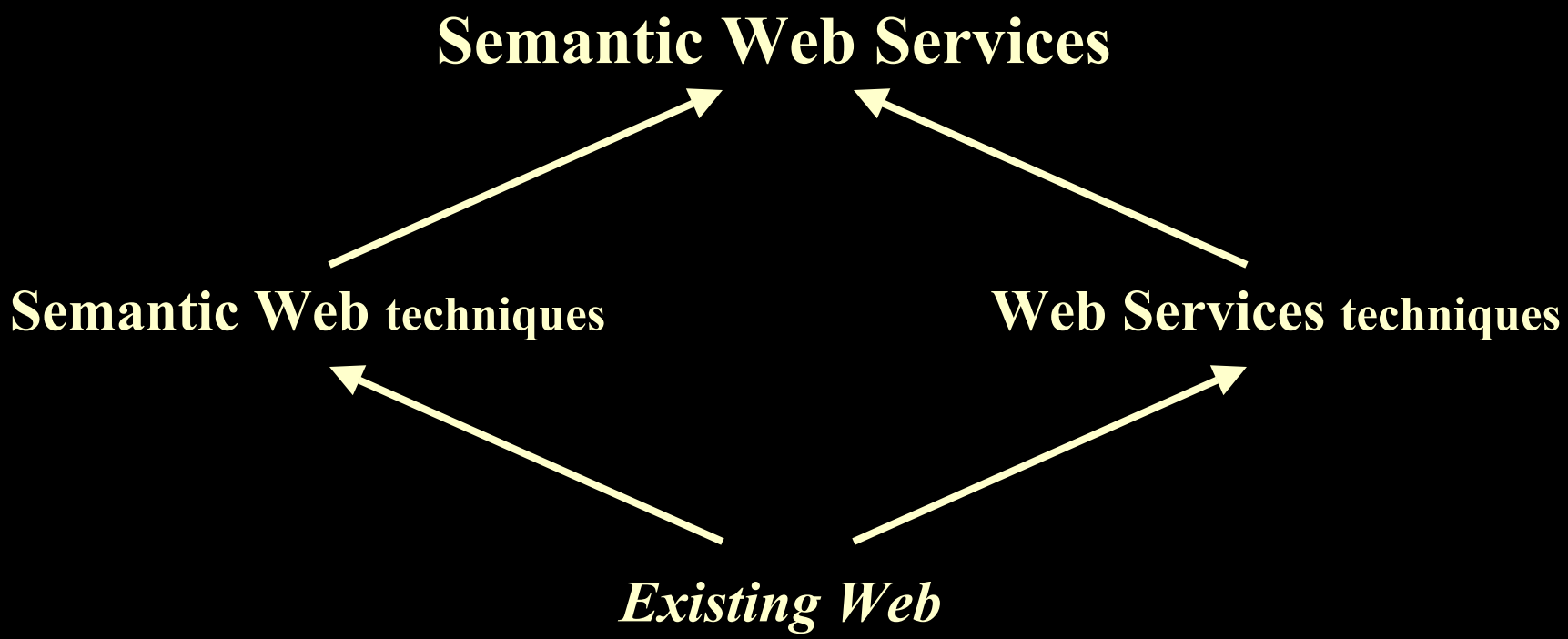
[Modification of slide also by Sheila McIlraith (Stanford) and David Martin (SRI International)]

SWS Tasks at higher layers of WS stack, continued

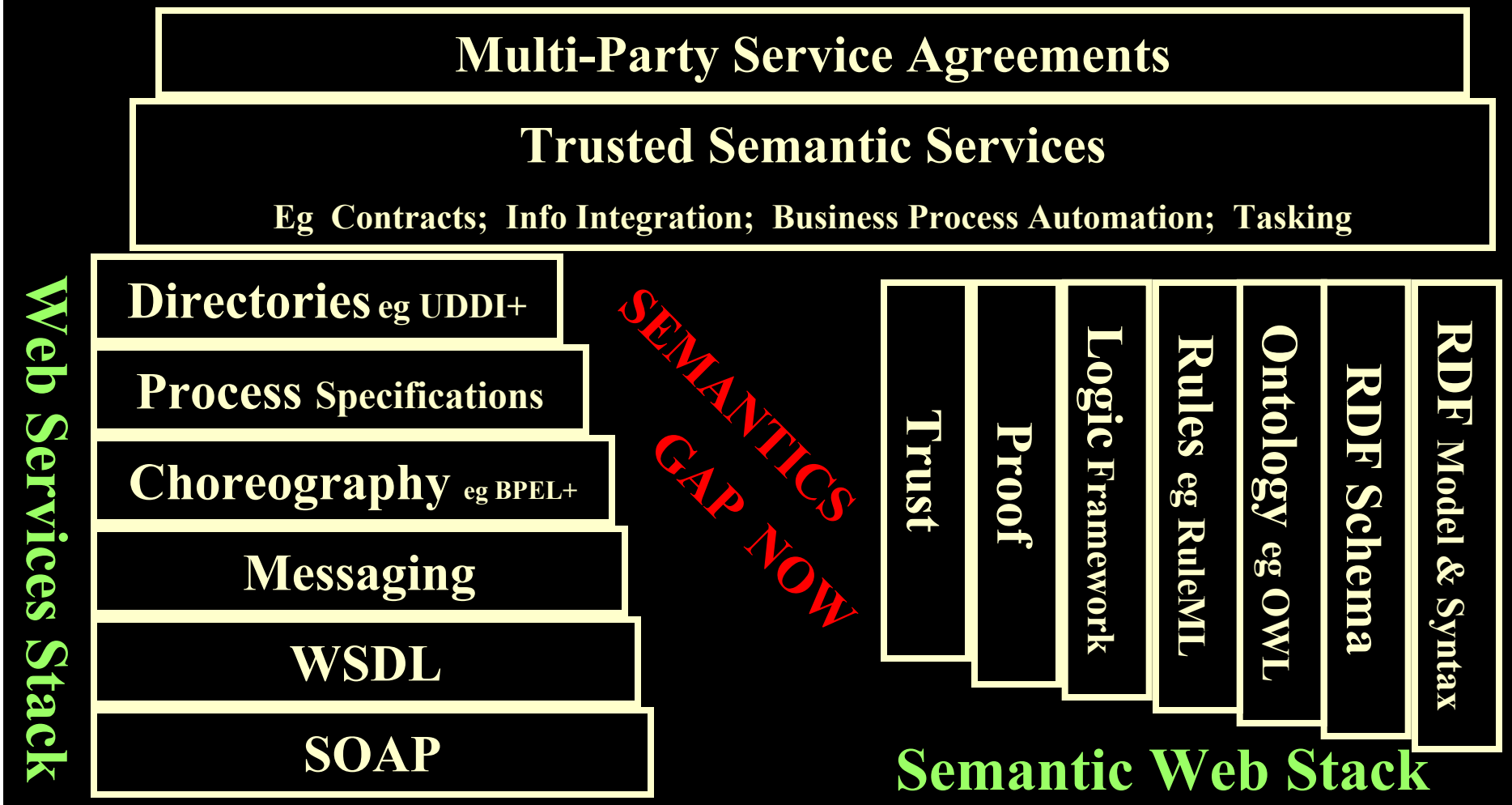
- Web service execution monitoring and problem resolution
  Has my book been shipped yet? … [NO!] Obtain recourse.
- Web service simulation and verification
  Suppose we had to cancel the order after 2 days?
- Web service executably specified at "knowledge level"
  The service is performed by running the contract ruleset through a rule engine.

[Modification of slide also by Sheila McIlraith (Stanford) and David Martin (SRI International)]

Next Generation Web

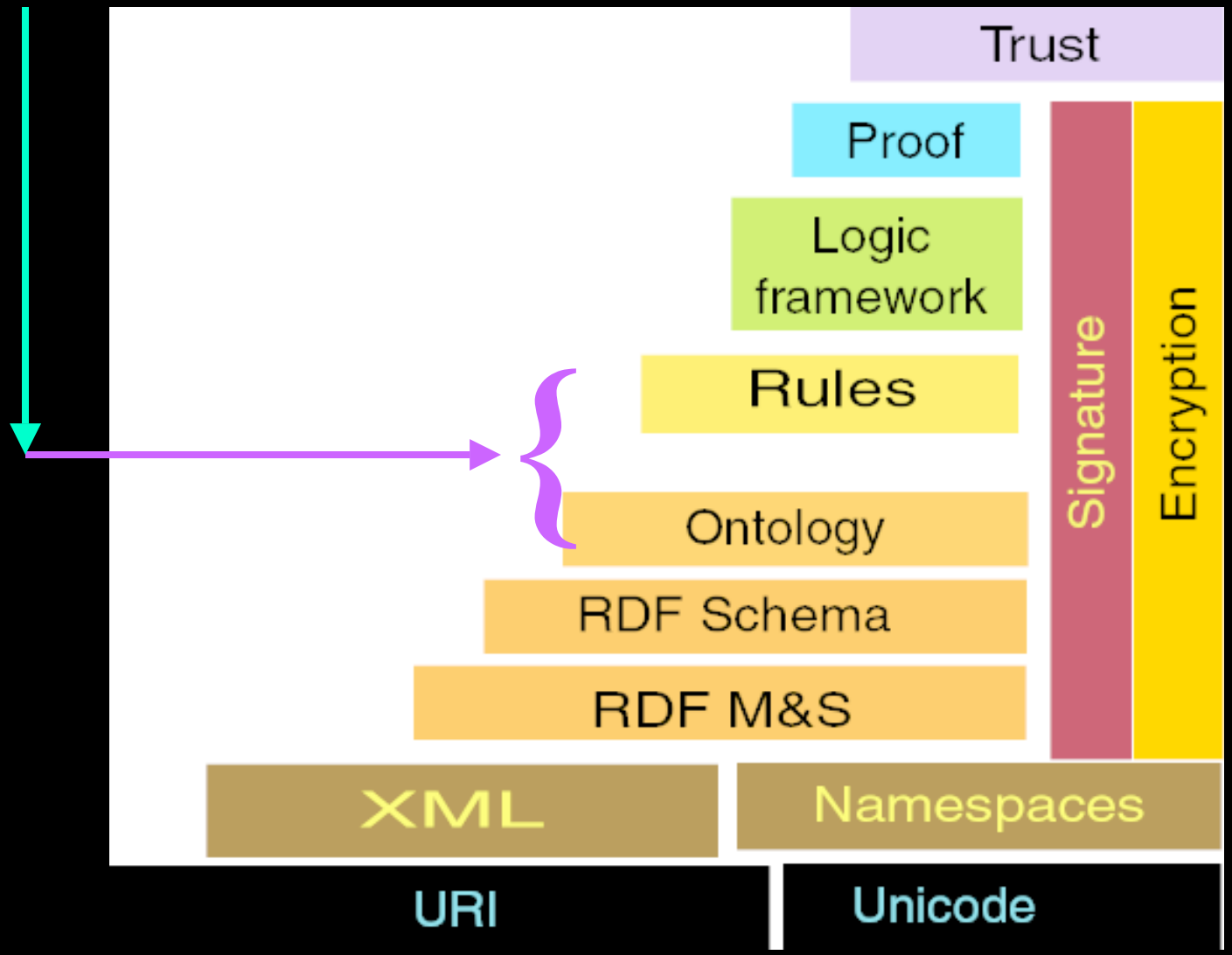


Semantic Web Services Stack Diagram



4/14/2003

Motivation from Semantic Web "Stack"



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

END of SWS OPTIONAL SLIDES

DLP OPTIONAL SLIDES FOLLOW

Candidate: First Order Logic

- FOL has practical and expressive drawbacks for union of DL and Rules:
  - Intractable
  - Lacks non-monotonicity and procedural attachments
  - Unfamiliar to mainstream software engineers
- Variant of DLP: "Horn Description Logic (HDL)"
  - Intersection of Horn Logic and Description Logic
  - Subset of FOL
- (general concept of "Description Rules": covers DLP or HDL)

Examples of DL beyond DLP

- DLP is a *strict* subset of DL.
- Examples of DL that is not (completely) representable in DLP:
  - State a subclass of a complex class expression which is a disjunction. E.g.,
    - (Human $\cap$ Adult) $\subseteq$ (Man $\cup$ Woman)
  - State a subclass of a complex class expression which is an existential. E.g.,
    - Radio $\subseteq \exists$ hasSpeaker.Tuner
- Why not? Because: LP/Horn, and thus DLP, cannot represent a "disjunction in the head".

Examples of LP beyond DLP

- DLP is a *strict* subset of Horn LP.
- Examples of Horn LP that are not (completely) representable in DLP:
  - A rule involving multiple variables. E.g.,
    - PotentialLoveInterestBetween(?X,?Y)
      ← Man(?X) /\ Woman(?Y).
  - Chaining (besides simple transitivity) to derive values of Properties. E.g.,
    - InvolvedIn(?Company, ?Industry)
      ← Subsidiary(?Company, ?Unit)
      /\ AreaOf(?Unit, ?Industry).
- Why not? Essentially because: Decidability of DLs crucially dependent on tree model property.
  - Intuition: DL's not used to represent "more than one free variable at a time".

Benefits: What DLP Enables, in Principle

- LP rules "on top of" DL ontologies.
- Translation of LP rules to/from DL ontologies.
- Use of efficient LP rule/DBMS engines for DL fragment.
- Development of ontologies in LP.
- Development of rules in DL.
- Translation of LP conclusions to DL.
- Translation of DL conclusions to LP.

DL Task Scenarios / Use Cases -- how well do they map to Rules?

- 1. Infer Categorization
  - Rules appear to often handle this well.
- 2. Infer Subsumptions
  - Rules appear to often be more awkward.
- 3. Configuration: seems to involve both categorization and subsumption.

Related Work to DLP

- CARIN [Halevy et al, late 90's] on extending DL with some aspects of LP. For DL-ish tasks.
- [Antoniou 2002] on Defeasible Logic rules + Description Logic (variant) ontologies

Some additional Bibliography

- Antoniou, Grigoris. "A Nonmonotonic Rule System using Ontologies". Proc. Intl. Wksh. On Rule Markup Languages for Business Rules on the Semantic Web, held 6/02 at the 1st Intl. Semantic Web Conf. (ISWC-2002).
- Firat, Aykut and Madnick, Stuart, and Grosof, Benjamin. "Knowledge Integration to Overcome Ontological Heterogeneity: Challenges from Financial Information Systems". Proc. Intl. Conf. on Information Systems (ICIS), 12/02.
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- Grosof, Benjamin, Horrocks, Ian, Volz, Raphael, and Decker, Stefan. "Description Logic Programs: Combining Logic Programs with Description Logic". Proc. Intl. Conf. on World Wide Web (WWW-2003), held 5/03, Budapest.

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- Grosof, Benjamin and Gandhe, Mahesh and Finin, Tim. "SweetJess: Translating DamlRuleML to Jess". Proc. Intl. Wksh. on Rule Markup Languages for Business Rules on the Semantic Web, held 6/02 at the 1st Intl. Semantic Web Conf. (ISWC-2002).
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