Semantic Web & Mobile Information Access

Ora Lassila
Research Fellow
Head of Data Modeling and Management
Software and Applications Laboratory
Nokia Research Center
&
Elected Member of Advisory Board
World Wide Web Consortium (W3C)

_keynote @ Wireless Connections 2005_
CAVEAT EMPTOR:

• Research guy talking…
• Contains personal opinions
• Use at your own risk!
Semantic Web: A Brief Introduction

• Web (content) was built for humans
  • for the most part, human interpretation is needed to accomplish tasks on the Web
  • automation is difficult (esp. automating unforeseen situations)

• We need “machine-friendly” content
  • solution: content with accessible formal semantics
    • allow machines to reason about information

• Current Web essentially gives us a framework for “pointing”
  • but this pointing has no meaning (except sometimes through human interpretation)

• Can we improve on this? Maybe…
  • Note: for us humans, separating our own interpretation from (largely syntactic) representation is hard
Motivation & Drivers

- Original driver: Automation
  - it would be nice if computers could do more (on the Web)
  - origins of the Semantic Web are in *metadata*

- Short term goal: Interoperability
  - combining information from multiple sources
  - Web Services: discovery, composition, “serendipity”

- Long term goal: Make computers work *on our behalf*
  - (instead of using them like tools)
  - remove humans from the loop to the extent possible
Semantics via Sharing

• Controlled vocabularies
  • better interoperability if same terms are always used to denote same thing
    • e.g., instead of arbitrary keywords, choose from a list

• What is an “ontology”
  1. a controlled vocabulary
  2. a concept taxonomy
  3. other relations between concepts
    • definition: “A specification of conceptualization” (Gruber)

• Library scientists are good with this
  • Dewey Decimal System is an ontology
“I was told that XML is enough...?”

• Typical answer: “yes” (sorry, incorrect)
• What’s going on here...?
  • XML offers a way to introduce new syntax (new names, tags, ...), but no way to introduce, coordinate or share semantics
  • XML’s data model is a tree: if your (representational) problem does not lend itself to be a tree, you lose (sorry – this is even before we get to the “semantics” part)
• Hype still abounds: e.g., “The industry is clearly focusing in on [XML] as the lingua franca to enable Web services...” *
  • not only is XML not a lingua franca, it is not even a lingua

* from a major IT company white paper
Stepping Towards the Semantic Web

- Semantic Web is built in a layered manner
- Not everybody needs all the layers

- Encoding characters: Unicode
- Encoding structure: XML
- Sharing semantics: RDF
- Simple taxonomies: RDF Schema
- Rich ontologies: OWL
- Rules & Queries

- more coming...
- underway
- done (W3C Rec)
- done (W3C Rec)
- done (W3C Rec)
- done (W3C Rec)
Mobile Web Access Today

- Web access on mobile devices is available today
- Some *technical limitations*
  - network (bandwidth, latency)
  - display (typically small)
  - input (often no full keyboard)
- Content is typically designed for "standard devices"
  - (= PCs: high bandwidth, large display)
  - most (commercial) content is *rendering-oriented*
Some Issues with Mobile Web Access

- We can overcome the *technical* limitations
  - 3G networks are coming!
  - great progress: mobile browsers are *really* improving
- But the real limitations are of *different* nature…
- Mobile devices are used in “unusual” situations
  - when laptops, etc., are not viable (e.g., in the car)
  - typically, when paying attention to something else
    - mobile users are *attention-constrained*
  - consequently, *browsing* might not be the ideal paradigm for information access
- What do we need?
  - information/content that’s not rendering-oriented
  - more automation (now, humans essentially do all the work)
Web Services to the Rescue?

- What are Web Services, really?
  - (“RPC done fancy” – Tim Berners-Lee)
  - integration technology
  - interaction technology (here’s where we can do something)

- Web Services represent a departure from the rendering-oriented Web
  - services make no commitments about specific user interfaces
  - Web Service paradigm decouples user interfaces from service semantics
    - this may even enable higher asynchronicity

- Caveat: Confusing standards situation
  - many standards, standards organizations, “industry white papers”…
  - and again, this architecture was designed for “standard” devices and fast networks
Semantic Web to the Rescue?

- Semantic Web will improve the interoperability of information systems
- Information, in more “raw” form, with semantics, can be used in many different ways
  - not tied to specific rendering, specific device, specific browser, etc.
- Context-awareness and user modeling may be the key
  - Ontological technologies are well suited to context processing

*The more we know about the user, the less we have to ask*
“Semantic Web Services”? Huh?

- Semantic Web technologies can be used for making content more “understandable” to automated systems.
- When this idea is applied to Web Services:
  - automatic discovery, composition and invocation are enabled;
    - first step: DARPA’s OWL-S activity (Stanford, CMU, Yale, SRI, BBN, Nokia, many others…)
    - let’s not forget the “Tower of Babble” (from Genesis 11:1-9)
  - If we can infer what data and services are about, many things become possible, e.g.
    - dynamic, context-dependent generation of user interfaces
    - substitution of “equivalent” services
- Web Services are a good abstraction of all kinds of functionality.
Nokia & the Semantic Web

- Strong participation in W3C (etc.) standardization efforts
- Active research program
  - rich metadata
  - context-awareness
  - automatic generation of user interfaces
  - “small” reasoning engines
  - our own open source toolkit
  - etc.
- Deployment...
  - e.g., Forum Nokia uses semantic metadata to automate Web site organization
Summary

- Semantic Web is about *data* (as opposed to “content”)
  - allows data from different sources to be combined (automatically)
  - allows machines to do more for you
  - relaxes the dependence on pre-determined formatting and UIs

- Mobile Web access is *difficult*
  - nature of usage situations is the *real* obstacle
    - ultimately, browsing may have to replaced with more efficient and more appropriate techniques
  - we need *answers to questions*, not just content to see and read

- Web Services represent decoupling of functionality and UIs
  - but this may not be enough…

- Semantic Web Services enable systems to automatically take advantage of Web Services
  - e.g., context-dependent operation
Next Steps (for You)

- Learn more about the Semantic Web
  - e.g., http://www.w3.org/2001/sw/
- Think in terms of *data*, not in terms of *content*
- Think “ontologically”