Nine by Nine
Who am I?

• Scientific, engineering and networked software systems architecture
  – Motion capture, mechanism design, IP address translation, MIMEsweeper

• Internet and Web standards
  – Internet fax, email, instant messaging, content negotiation

• Most recently, Semantic Web (RDF)
  – I believe this technology is set to have a big impact on computer application development
Data – Knowledge – Meaning

- Meaning?
- Knowledge
  - semantics
  - RDF Applications
  - structure
  - XML
  - character
  - Unicode
  - raw
  - Bits, Octets

Physical

Deep philosophical territory: not going here
In the limited sense of KR

26 Feb 2004 Semantic Web Applications
Open Building Blocks

*Standing on the shoulders of giants*

- Much recent progress in Internet software is built upon open standards and open building blocks
- Open infrastructure is not hostage to proprietary systems vendors
- *There's a freedom about the Internet: As long as we accept the rules of sending packets around, we can send packets containing anything to anywhere.*
  - Tim Berners-Lee
- Semantic Web technology follows this pattern

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Evolving Use of Information

- Consider computer applications that should be sharing common information
- Typically, data is not readily shared
- Data must be re-entered or converted, which is expensive and error-prone
Example

- Employee information distributed across disparate IT systems

Diagram:
- HR
- Employees
- Payees
- Finance
- Users
- Security
Semantic Web Technologies
Proposed benefits

- Re-use information designs
- Use open building blocks to process common information
- Integrate data sources: new uses for existing data

Collect, Process, Extract
The Semantic Web
Evolving the Web

• Evolution of the Web to a network of application usable information
  – open standards from W3C
  – open software from many sources

• An open-ended framework for combining and exploiting information from a wide range of sources
Semantic Web Building Blocks

• Resource Description Framework (RDF)
  – An XML-based standard knowledge representation format for exchanging arbitrary information

• Web Ontology Language (OWL)
  – A standard for describing classes of objects and enabling inference

• RDF Query, RDF Rules, Access, and more
  – Pre-standardization, software components
(Detour: example data)

• Example from network configuration, describes features of a user and a computer system
  – RDF/XML (link)
  – Notation 3 (link)
  – Graph (link:PNG)
What kinds of application?

- Diverse, semi-structured information
- Open-ended: evolving functions and data
- Examples:
  - Personal information management (Chandler)
  - Social networking (FOAF)
  - Information syndication (RSS, PRISM)
  - Library/museum data (Dublin Core, Harmony)
  - Network security and configuration (SWAD-E)
What can be Achieved?

- Integration of diverse data sources
- Focus on information needs
- Generate new knowledge
Aggregation + Inference = New Knowledge

• Building on the success of XML
  – Common syntactic framework for data representation, supporting use of common tools
  – But, lacking semantics, provides no basis for automatic aggregation of diverse sources

• RDF: a semantic framework
  – Automatic aggregation (graph merging)
  – Inference from aggregated data sources generates new knowledge
  • Domain knowledge from ontologies and inference rules
Aggregation + Inference: Example

• Consider three datasets, describing:
  – vehicles’ passenger capacities
  – the capacity of some roads
  – the effect of policy options on vehicle usage

• Aggregation and inference may yield:
  – passenger transportation capacity of a given road in response to various policy options
  – using existing open software building blocks

• [Example (link:TBD)]
What needs to be done?

• Information design
• Data-use strategies and inference rules
• Mechanisms for acquisition of existing data sources
• Mechanisms for presentation or utilization of the resulting information
Benefits

• Greater use of off-the-shelf software
  – reduced development cost and risk

• Re-use of information designs
  – reduced application design costs; better
    information sharing between applications

• Flexibility
  – systems can adapt as requirements evolve

• Open access to information making
  possible new applications
Recommendation: Low risk approach

- Focus on information requirements
  - this is unlikely to be wasted effort
- Start with a limited goal, progress by steps
  - adapting to evolving requirements is an advantage of SW technology; if it can do this for large projects it certainly must be able to do so for early experimental projects
- Use existing open building blocks
Proposed evaluation steps

• Decide if this can help your application
  – Identify a well-defined, constrained sub-goal
  – Design an initial information model
  – Prototype data and inference rules
  – Explore some variations

• Develop simple mechanisms to present existing data as RDF

• Start with a simple sub-problem, scoped to just a few days work
Where are we now?

• Semantic Web is new technology
  – about 10 years after the original WWW
• Many applications are experimental
• The goals may be inevitable...
  – Applications working together with users’ information, not owning it
  – drawing background knowledge from the Web
  – less dependence on hand-coded bespoke software
  • ... but the particular technology is not
Conclusion:
Semantic Web Technology Today

- World Wide Web incremental advance
- Evolvable approach to information
- Leverages open software building blocks
- Builds on diversity
  - creating new knowledge
  - enabling new applications
- Low-risk adoption strategy
  - by incremental, re-usuable steps
End

- **Contact information:**
  - info@ninebynine.net
  - http://www.ninebynine.net/

- **References:**
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  - http://www.scientificamerican.com/article.cfm?articleID=00048144-10D2-1C70-84A9809EC588EF21&catID=2
  - http://www.w3.org/rdf
Nine by Nine
What can we offer?

- We have participated actively in development of RDF core standard
- Developed open source software for inference and proof-checking in RDF data
- Design RDF applications
  - including CC/PP, a W3C recommendation
- Offer help with Semantic Web information design and technology evaluation
Data - Information - Knowledge
End