Linked-data Architecture

Payam Barnaghi
Centre for Communication Systems Research
University of Surrey

Budapest, May 2010
Future Internet

• \textbf{Extending} the connections
  – More nodes, more connections
  – Any TIME, Any PLACE, Any THING
  – M2M, IoT
  – Billions of interconnected devices

• \textbf{Expanding} the connections
  – Spectrum Optimisation
  – High-bandwidth

• \textbf{Enhancing} the connections
  – Smart networks
  – \textbf{Data} centric and Content-based networking
  – Context-aware networking?
(Future) Web

- Early generation focused on **Presentation**.
  - HTML (rendering the pages)
  - Dynamic pages (often database---->html)
  - Unstructured

- Semantic Web
  - Structured data
  - Semantic annotation
  - Machine interpretable
  - Reasoning and AI enhancements

- Web of Data
  - Interconnecting data resources
  - Semantic data (i.e. RDF) linked to other data
  - Large interconnected data sets
  - **Networked Knowledge**
Future Internet and Future Web

- **More Data centric**
  - Data as
    - Content
    - Context

- **Service oriented developments, Cloud infrastructure**

- **More resources, more nodes, more constraints on traffic, energy efficiency, heterogeneity,**...

- **Issues:**
  - Interoperability
  - Trust, Privacy and Security
  - Resource discovery
  - Automated processes
  - Autonomous communication
  - ...
The role of metadata

• Semantic tagging
• Re-usable ontologies
• Resource description framework(s)
• Structured data, structured query

• Interconnected and linked metadata is better than stand-alone metadata!
Linked-data

Linked data is data presented in a better way and in relation to other resources...
Example: W3C SSN Ontology

SSN-XG annotations

<om:Observation>
  <om:sampleTime><gml:TimeInstant>...</gml:TimeInstant>
  <om:procedure xlink:role="http://www.w3.org/2009/Incubator/ssn-xg/
    xlink:href="http://www.w3.org/2009/Incubator/ssn-xg/"
  <om:observedProperty xlink:href="http://www.w3.org/2009/Incubator/ssn-xg/
    xlink:href="http://sws.geonames.org/"
  <om:featureOfInterest xlink:href="http://sws.geonames.org/
    xlink:href="http://sws.geonames.org/"
  <om:result uom="http://www.w3.org/2009/Incubator/ssn-xg/"
</om:Observation>

SSN-XG ontologies

makes observations of this type

SSN-XG Ontology Scope

Observation

Sensor

Sensor Type X

sensor of type X

location ontology

What it measures

units ontology

units

domain ontology

What it measures

Where it is
Example: Linked sensor data
Example: Linked sensor data (cont’d)
Collectively, the 203 data sets consist of over 25 billion RDF triples, which are interlinked by around 395 million RDF links (September 2010).
How to create linked-data?

- The principles in designing the linked data are defined as:
  - using URI’s as names for things;
  - using HTTP URI’s to enable people to look up those names;
  - provide useful RDF information related to URI’s that are looked up by machine or people;
  - including RDF statements that link to other URI’s to enable discovery of other related concepts of the Web of Data;
What about legacy data?

Example: Ontology learning - Legacy data
OSI/OSI model and envisioned Linked-data interoperability layer

* Source: Stefan Decker (DERI NUI Galway, Ireland), http://fi-ghent.fi-week.eu/files/2010/10/Linked-Data-scheme1.png
Linked-data for...

- Web data and application data
- (Web) Services
- IoT and THINGS descriptions
- Resource descriptions
  - Network resources
  - EoI/Resource/Service
  - Content
  - Context
  - Intelligent decision making
    - Network communications
    - Information communications
- ...

- However, it is still a form of Data Engineering; We still need more intelligent systems, reasoning mechanisms, and effective information processing methods. It helps AI, but does not replace it...
Thank you!

Payam Barnaghi
Centre for Communication Systems Research
Faculty of Engineering and Physical Sciences
University of Surrey
Guildford, UK
Email: p.barnaghi@surrey.ac.uk

http://personal.ee.surrey.ac.uk/Personal/P.Barnaghi/payam-foaf.rdf