Using RDF to Describe Networks

Jeroen van der Ham
vdham@science.uva.nl

Advanced Internet Research Group
Universiteit van Amsterdam

September 30, 2005
What is GLIF?

- A group of cooperating NRENs, consortia and institutions
- Make lambdas available as integrated global facility
- Sharing their research and knowledge
- Each with different policies
Why Do We Need Network Descriptions?

- To provide an overview of resources
- Make path discovery easier
- Do simple problem detection

To provide an overview of resources, make path discovery easier, and do simple problem detection, network descriptions are necessary. This allows for an overview of resources, making path discovery easier, and facilitating simple problem detection.
Why Do We Need Network Descriptions?

- To provide an overview of resources
- Make path discovery easier
- Do simple problem detection
Why Do We Need Network Descriptions?

- To provide an overview of resources
- Make path discovery easier
- Do simple problem detection
Why Do We Need Network Descriptions NOW?
Problem With Descriptions

- We need a description readable by both **humans** and **computers**.

- **Problem**: Computers still have no common sense.

**Example**

- ‘A is connected to B.’
- ‘There is a connection between A and B.’
Problem With Descriptions

- We need a description readable by both **humans** and **computers**.
- **Problem**: Computers still have no common sense.

**Example**

- ‘A is connected to B.’
- ‘There is a connection between A and B.’
Solution: Use Semantic Web techniques:

“The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation.”

(Tim Berners-Lee)
Resource Description Format

- Resource Description Format (RDF) is a Semantic Web technique.
- RDF is a lightweight ontology system
- it describes things using triplets:

Example

Document 1: "Jeroen van der Ham"
Introduction
Semantic Web
Network Description Language

Subject, Property, Object

• Triplets consist of three elements:

Definition

Subject  The thing it describes.
Predicate  A property the statement describes.
Object  The value of the property.
RDF describes things using triplets:

Example

Document 1 -> Jeroen

author

name: "Jeroen van der Ham"
affiliation: "UvA"
email: "vdham@science.uva.nl"
RDF Data Model

Jeroen van der Ham

name: "Jeroen"

affiliation: "UvA"

email: "vdham@science.uva.nl"
RDF Namespaces

- Unique terminology is achieved using namespaces
- Readable for both computers and people

Example

Uses Dublin Core Namespace.
Real-World RDF Examples

RSS  RDF Site

DOAP  Description of a Project

FOAF  Friend of a Friend
Real-World RDF Examples

RSS  RDF Site
Summary (v1.0)

DOAP  Description of a Project

FOAF  Friend of a Friend
Real-World RDF Examples

RSS
RDF Site
Summary (v1.0)

DOAP
Description of a Project

FOAF
Friend of a Friend
We started on a set of properties and classes to describe networks:
We started on a set of properties and classes to describe networks:

- Location
- Device
- Interface

- locatedAt
- hasInterface
- connectedTo
- description
- name
- switchedTo
Example of NDL

```xml
<ndl:Device rdf:about="#Rembrandt3">
  <ndl:name>Rembrandt3</ndl:name>
  <ndl:locatedAt rdf:resource="#Lighthouse"/>
  <ndl:hasInterface rdf:resource="#Rembrandt3:eth0"/>
</ndl:Device>
```
Example of NDL

<ndl:Device rdf:about="#Rembrandt3">
  <ndl:name>Rembrandt3</ndl:name>
  <ndl:locatedAt rdf:resource="#Lighthouse"/>
  <ndl:hasInterface rdf:resource="#Rembrandt3:eth0"/>
</ndl:Device>

<ndl:Interface rdf:about="#Rembrandt3:eth0">
  <ndl:name>Rembrandt3:eth0</ndl:name>
  <ndl:connectedTo rdf:resource="#Glimmerglass:port3"/>
</ndl:Interface>
Example of NDL

```xml
<ndl:Device rdf:about="#Rembrandt3">
  <ndl:name>Rembrandt3</ndl:name>
  <ndl:locatedAt rdf:resource="#Lighthouse"/>
  <ndl:hasInterface rdf:resource="#Rembrandt3:eth0"/>
</ndl:Device>

<ndl:Interface rdf:about="#Rembrandt3:eth0">
  <ndl:name>Rembrandt3:eth0</ndl:name>
  <ndl:connectedTo rdf:resource="#Glimmerglass:port3"/>
</ndl:Interface>

<ndl:Interface rdf:about="#Glimmerglass:port3">
  <ndl:name>Glimmerglass:port3</ndl:name>
  <ndl:connectedTo rdf:resource="#Rembrandt3:eth0"/>
</ndl:Interface>
```
SPARQL\(^1\) is a SQL-like query language for RDF:

Example

```
SELECT ?host1 ?host2
WHERE { ?if1 ndl:connectedTo ?if2 .
         ?if2 ndl:connectedTo ?if1 .
         ?host1 ndl:hasInterface ?if1 .
         ?host2 ndl:hasInterface ?if2 }
```

\(^1\)SPARQL Protocol And RDF Query Language
Query Result

Rembrandt3

Glimmerglass
Query Result

Rembrandt3

Glimmerglass

Rembrandt4
<ndl:Interface rdf:about="#Glimmerglass:port3">
  <ndl:name>Glimmerglass:port3</ndl:name>
  <ndl:switchedTo rdf:resource="#Glimmerglass:port4"/>
</ndl:Interface>
Distributed Repositories

NDL descriptions can point to other network descriptions:

```xml
<ndl:Interface rdf:about="#Rembrandt3:eth0">
  <ndl:name>Rembrandt3:eth0</ndl:name>
  <ndl:connectedTo rdf:resource="nl:C6509:port7"/>
</ndl:Interface>

<ndl:Interface rdf:about="nl:C6509:port7">
  <rdfs:seeAlso rdf:resource="http://www.netherlight.nl/ndl.rdf"/>
</ndl:Interface>
```
Querying remote information can be done in two ways:

1. Fetch each description, parse it and then query it.

2. Issue SPARQL queries over HTTP or SOAP (WSDL Interface).

Both approaches allow for filtering.
Applying Network Descriptions in GLIF

1. Each institute creates a description of their network
2. Validate and publish using the portal
3. Description must be automatically updated with each change
4. Users use the portal or tools to find paths and resources
Extending NDL

RDF allows for easy extensibility:
- Include geographical information (geo) and use with Google Earth
- Link to FOAF descriptions of administrators
- Include policy information
- etc...
Future Research

- Publish a portal with links to participants
- Tools for automatic generation and updating of descriptions
- Extend NDL to include higher layers
- Security & filtering possibilities
Related Work

- Using RDF for Home Network Configuration
  
  *G. Klyne*

- Using the Semantic Web to Automate the Operation of a Hybrid Internetwork
  
  *Franco Travostino* (to be published, GridNets ’05)
Questions?

More information:
http://www.science.uva.nl/~vdham/research/ndl/