Using RDF to Describe Networks

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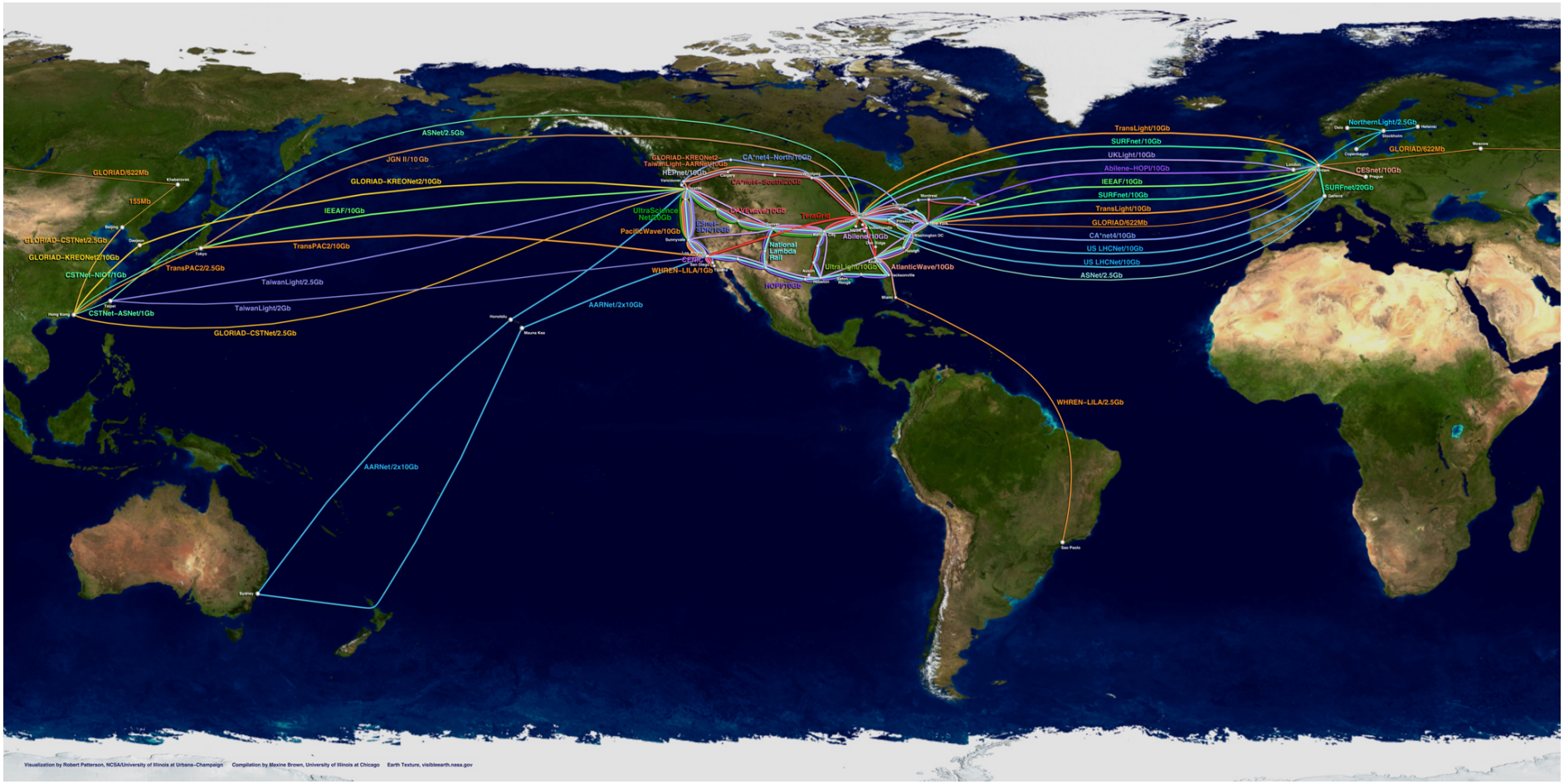
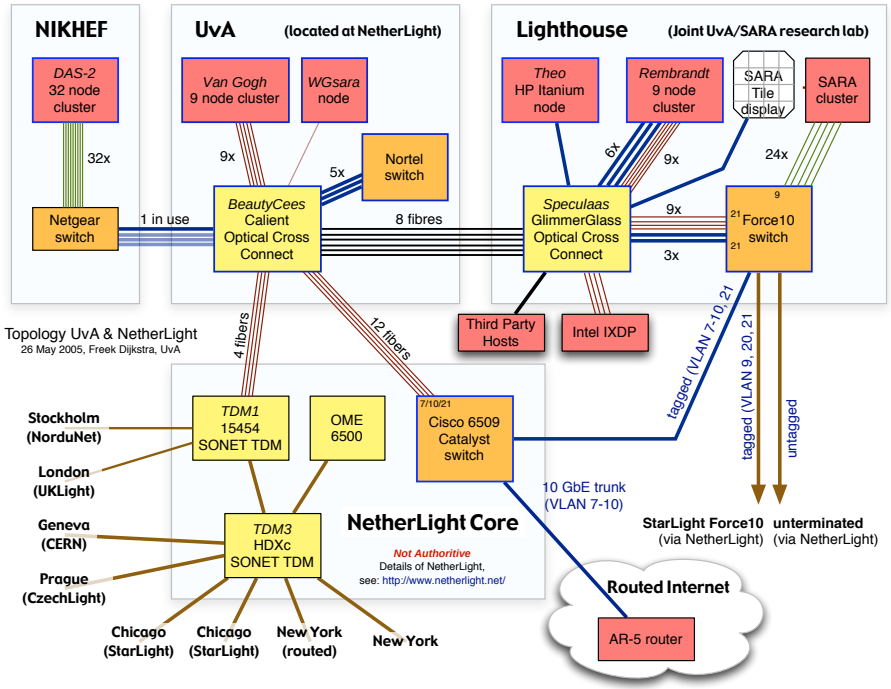
Global Lambda Integrated Facility



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

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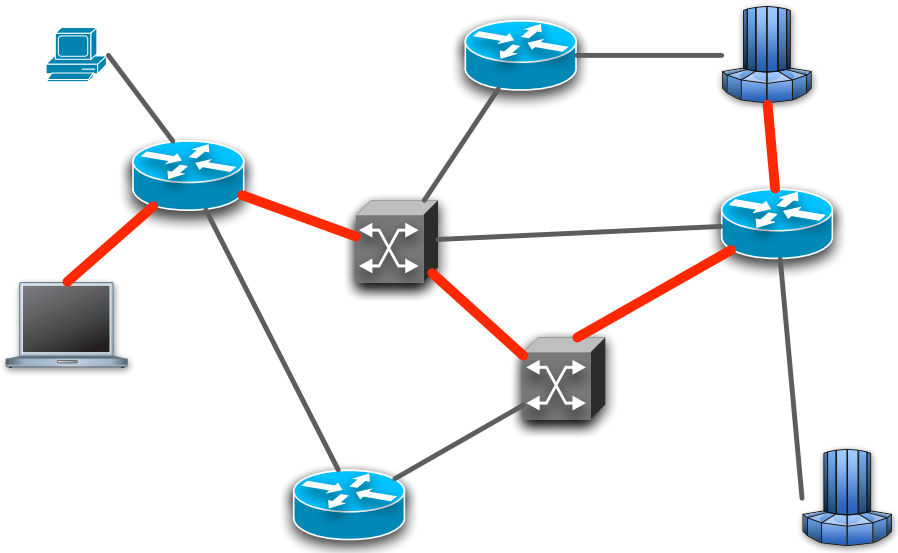

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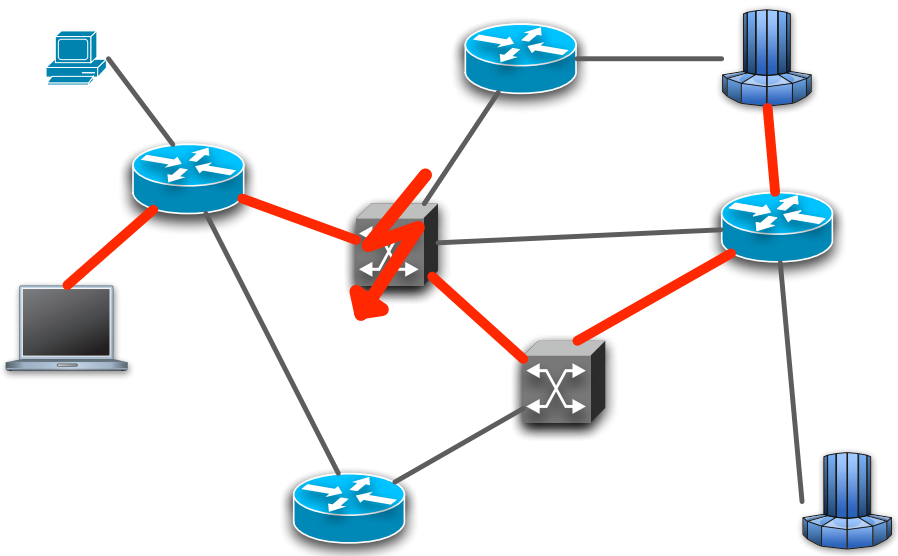

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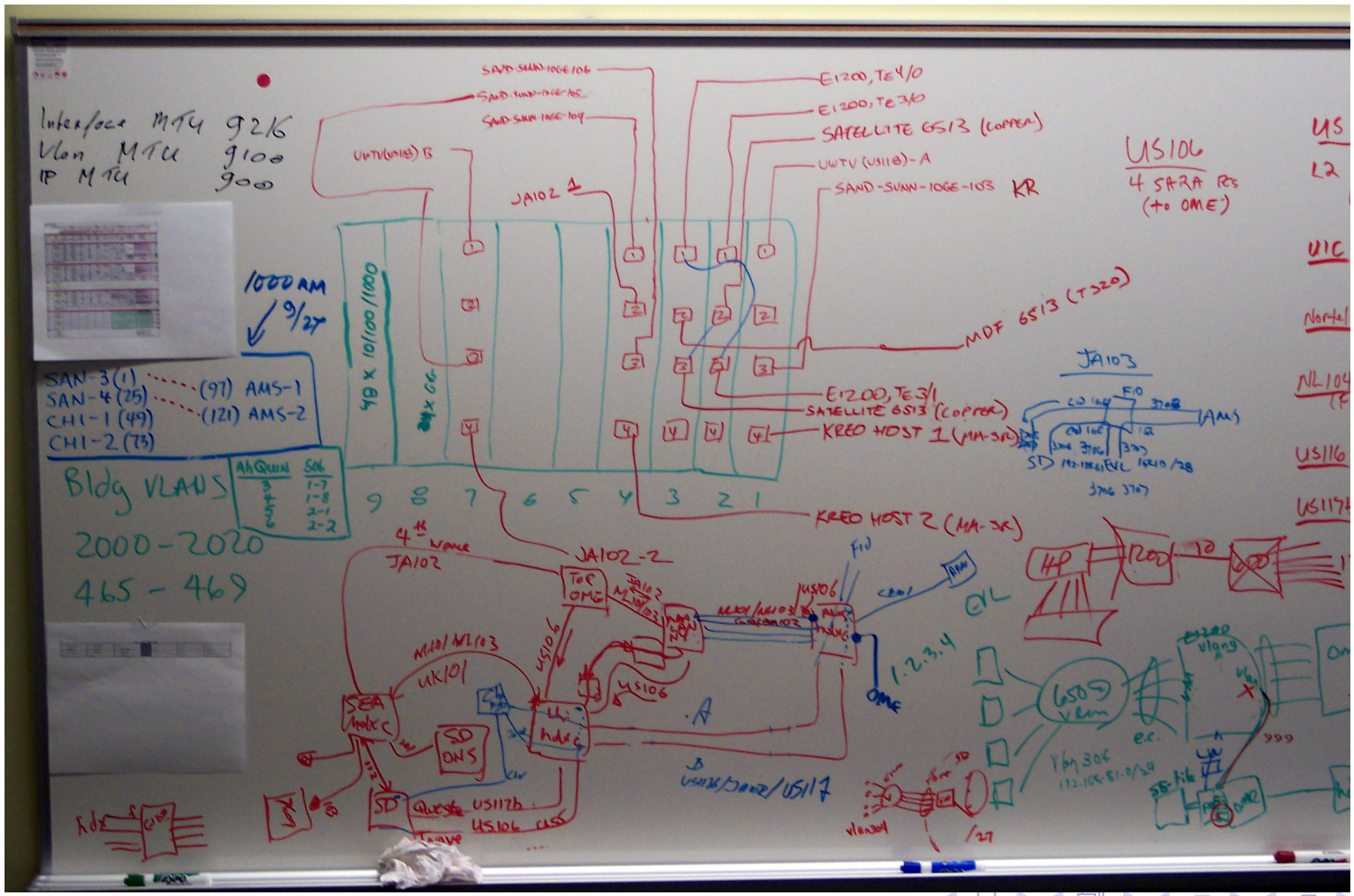
Why Do We Need Network Descriptions NOW?



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*.'

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Semantic Web

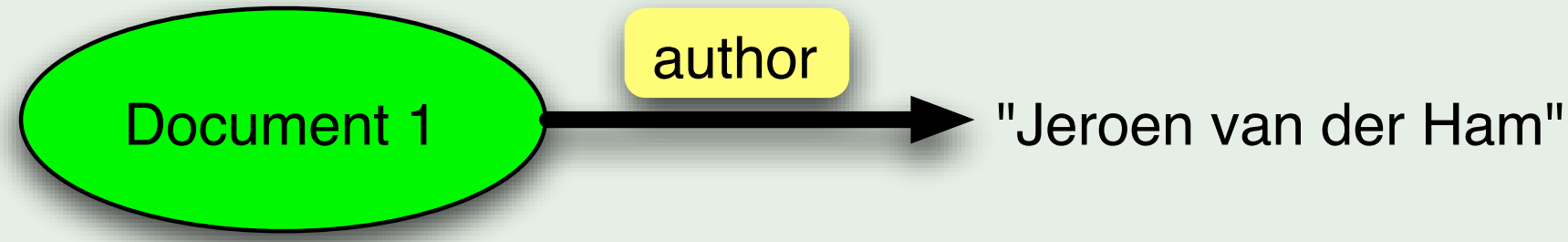
Solution: Use Semantic Web techniques:

> *"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



Subject, Property, Object

- Triplets consist of three elements:

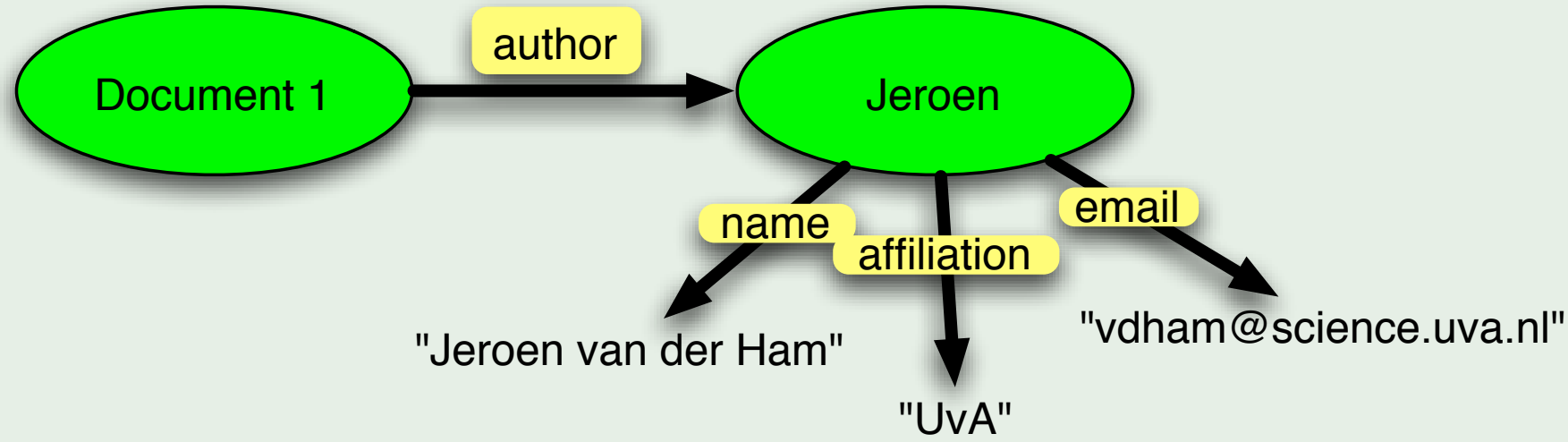
Definition

Subject	The thing it describes.
Predicate	A property the statement describes.
Object	The value of the property.

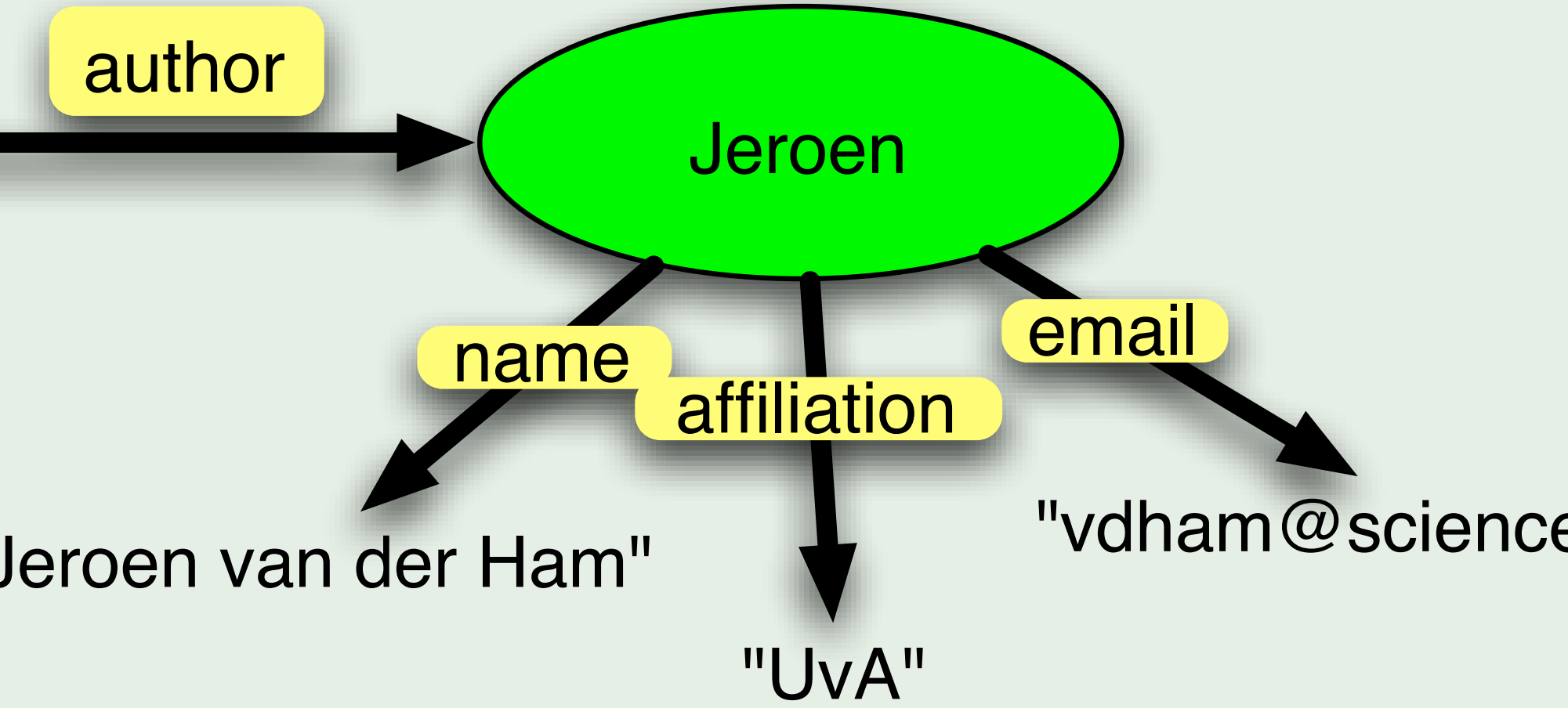
RDF Data Model

- RDF describes things using triplets:

Example



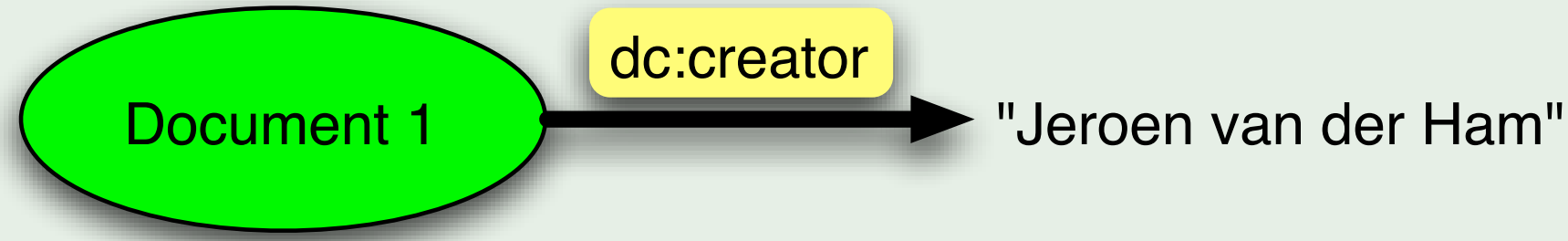
RDF Data Model



RDF Namespaces

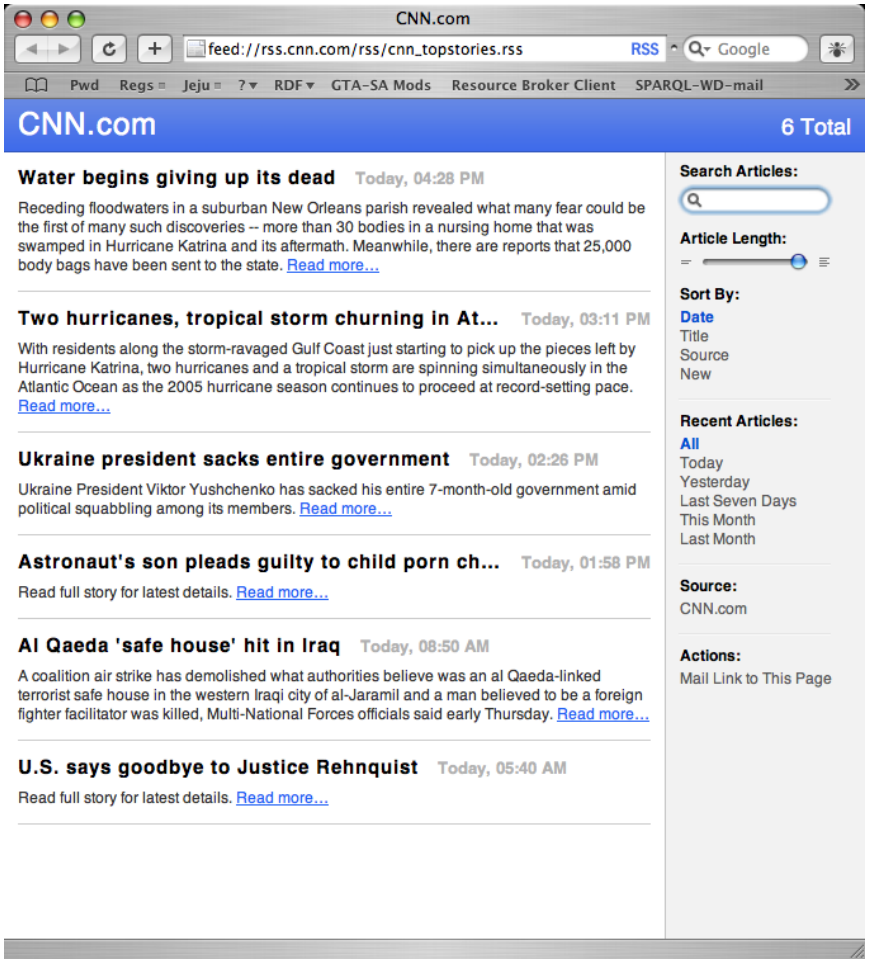
- Unique terminology is achieved using namespaces
- Readable for both computers and people

Example



- Uses Dublin Core Namespace.

Real-World RDF Examples



RSS RDF Site Summary (v1.0)

DOAP Description of a Project

FOAF Friend of a Friend

Real-World RDF Examples

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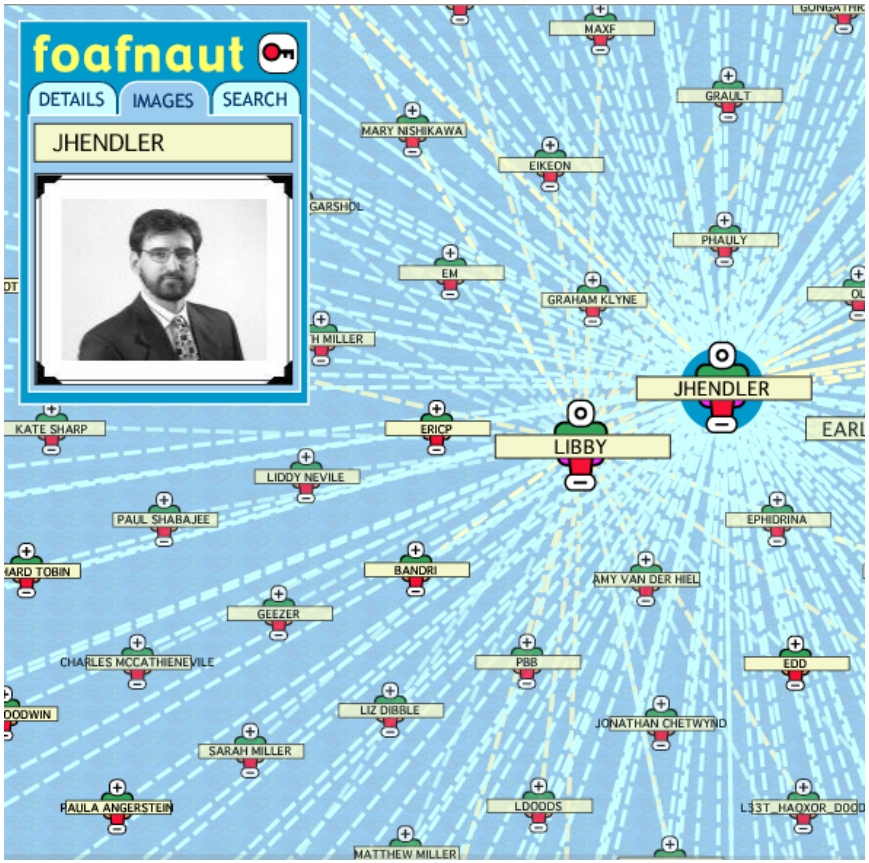

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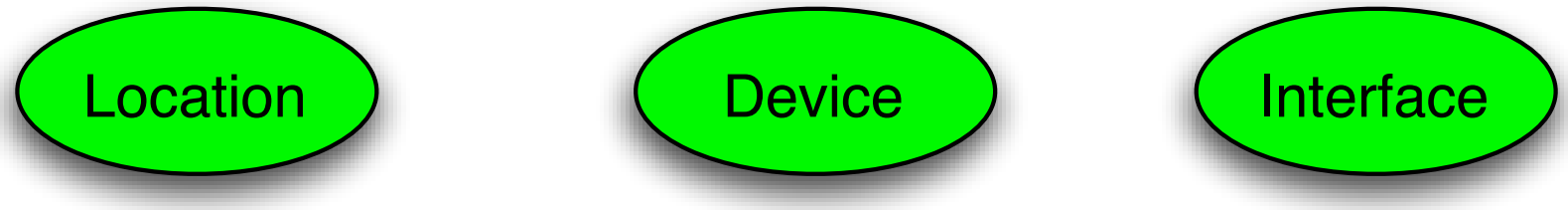
Network Description Language

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



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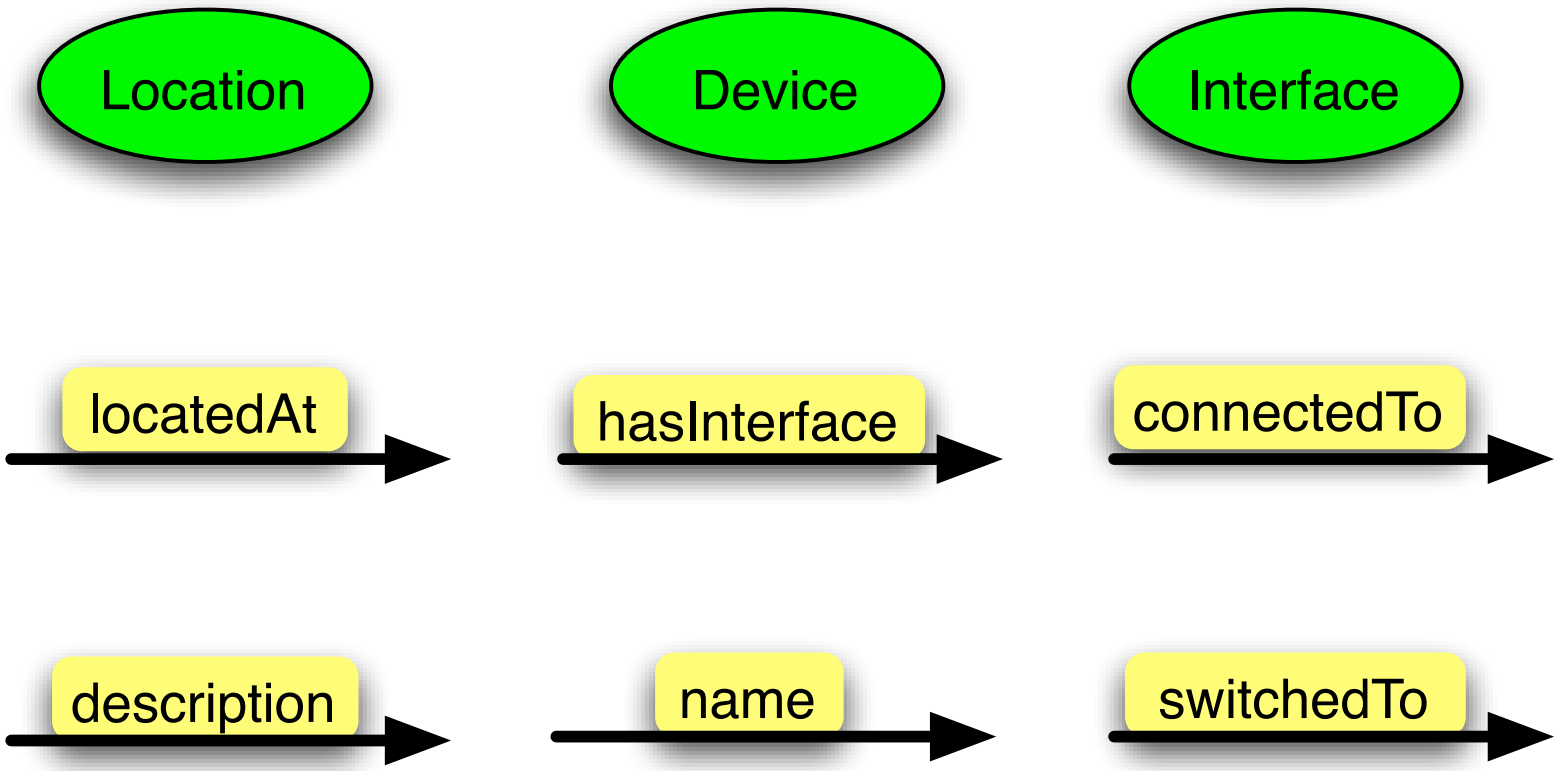

Example of NDL

```
<ndl:Device rdf:about="#Rembrandt3">
    <ndl:name>Rembrandt3</ndl:name>
    <ndl:locatedAt rdf:resource="#Lighthouse"/>
    <ndl:hasInterface rdf:resource="#Rembrandt3:eth0"/>
</ndl:Device>
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<ndl:Interface rdf:about="#Rembrandt3:eth0">
    <ndl:name>Rembrandt3:eth0</ndl:name>
    <ndl:connectedTo rdf:resource="#Glimmerglass:port3"/>
</ndl:Interface>
```

Example of NDL

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

Querying RDF Repositories

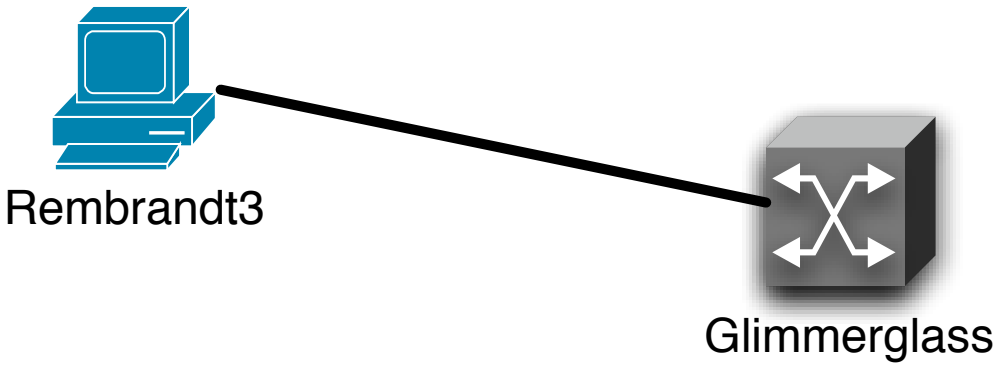
SPARQL[1] is a SQL-like query language for RDF:

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



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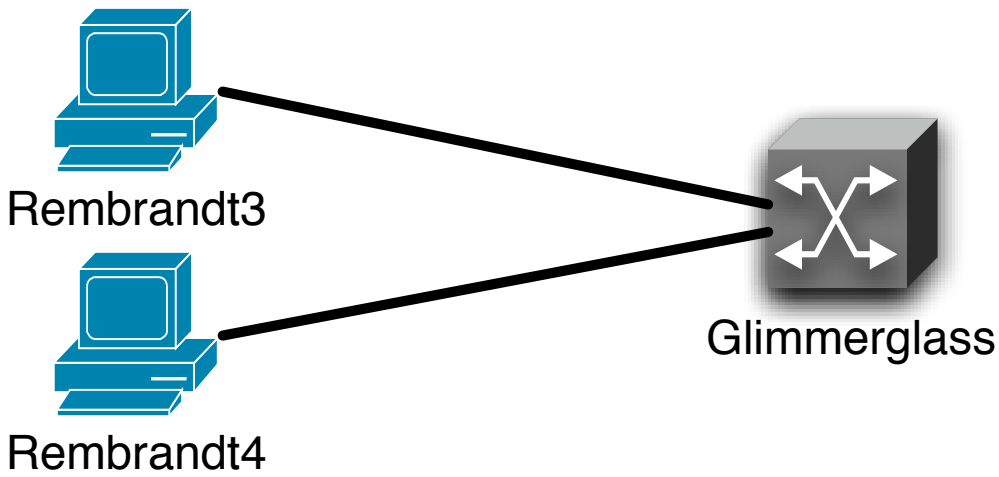
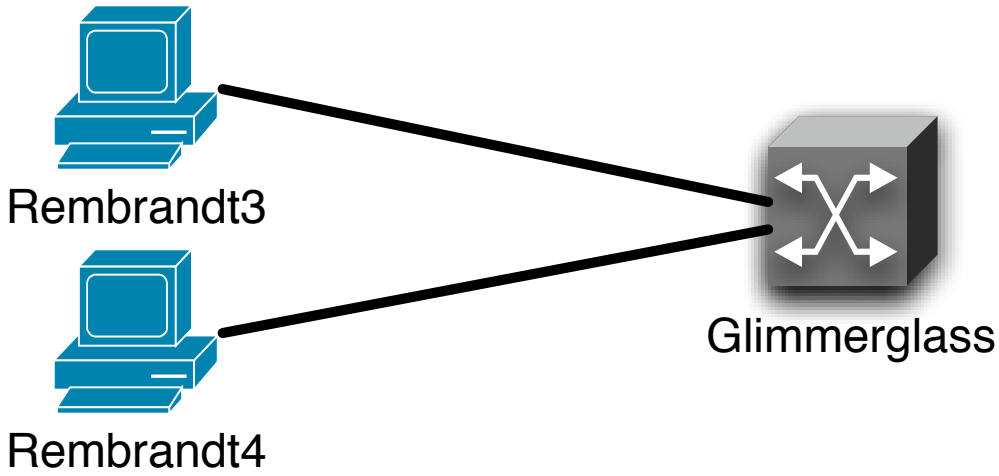


Query Result




```
<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:

```
<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>
```

SPARQL & Distributed Repositories

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?

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More information:

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