NDL/NML

A talk on network topology descriptions.

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The talk title

If you are wondering what this is about….
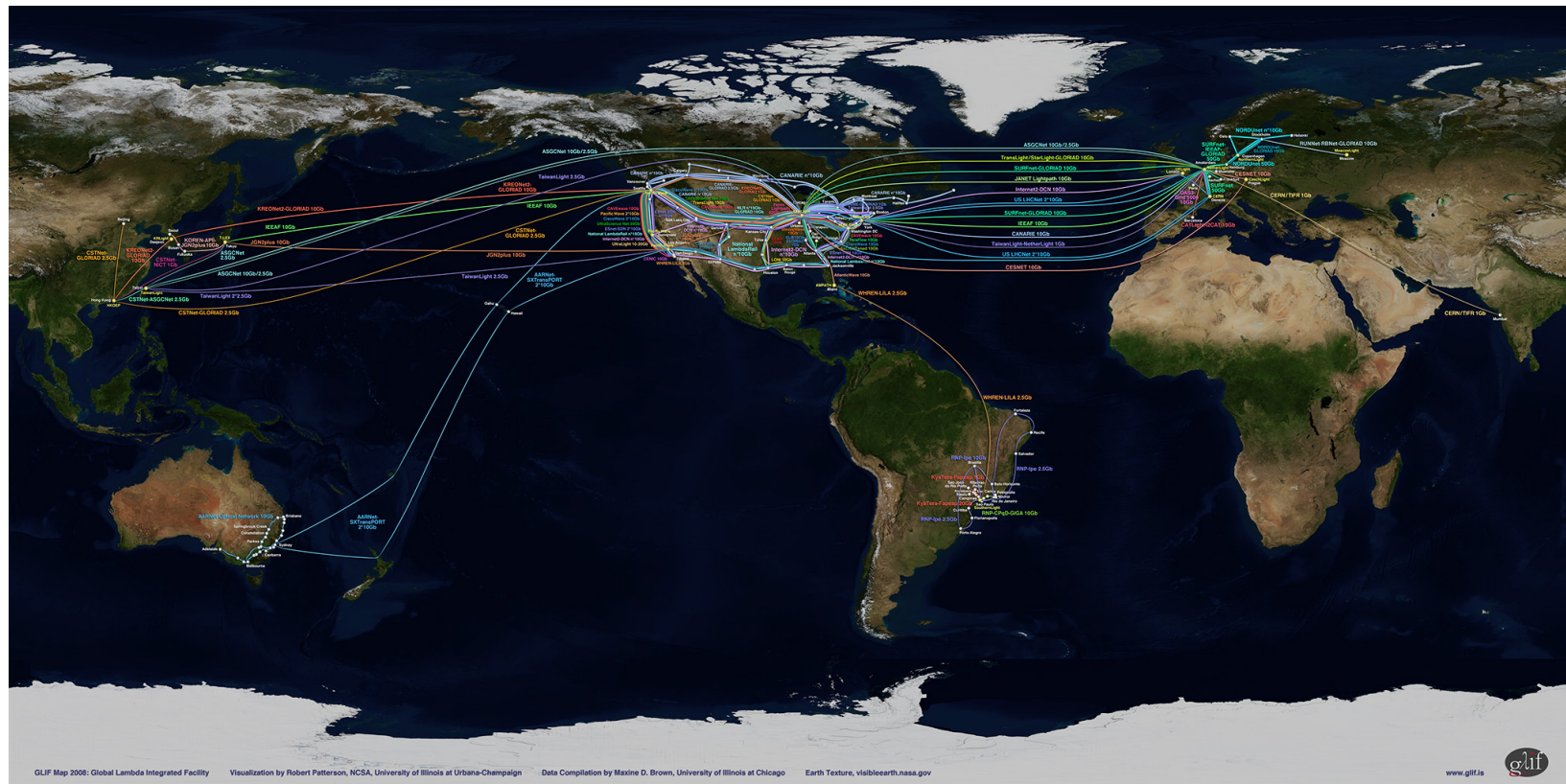
NDL – Network Description Language

An information and data model developed by the SNE group at the University of Amsterdam

NML – Network Markup Language

A working group within the Open Grid Forum

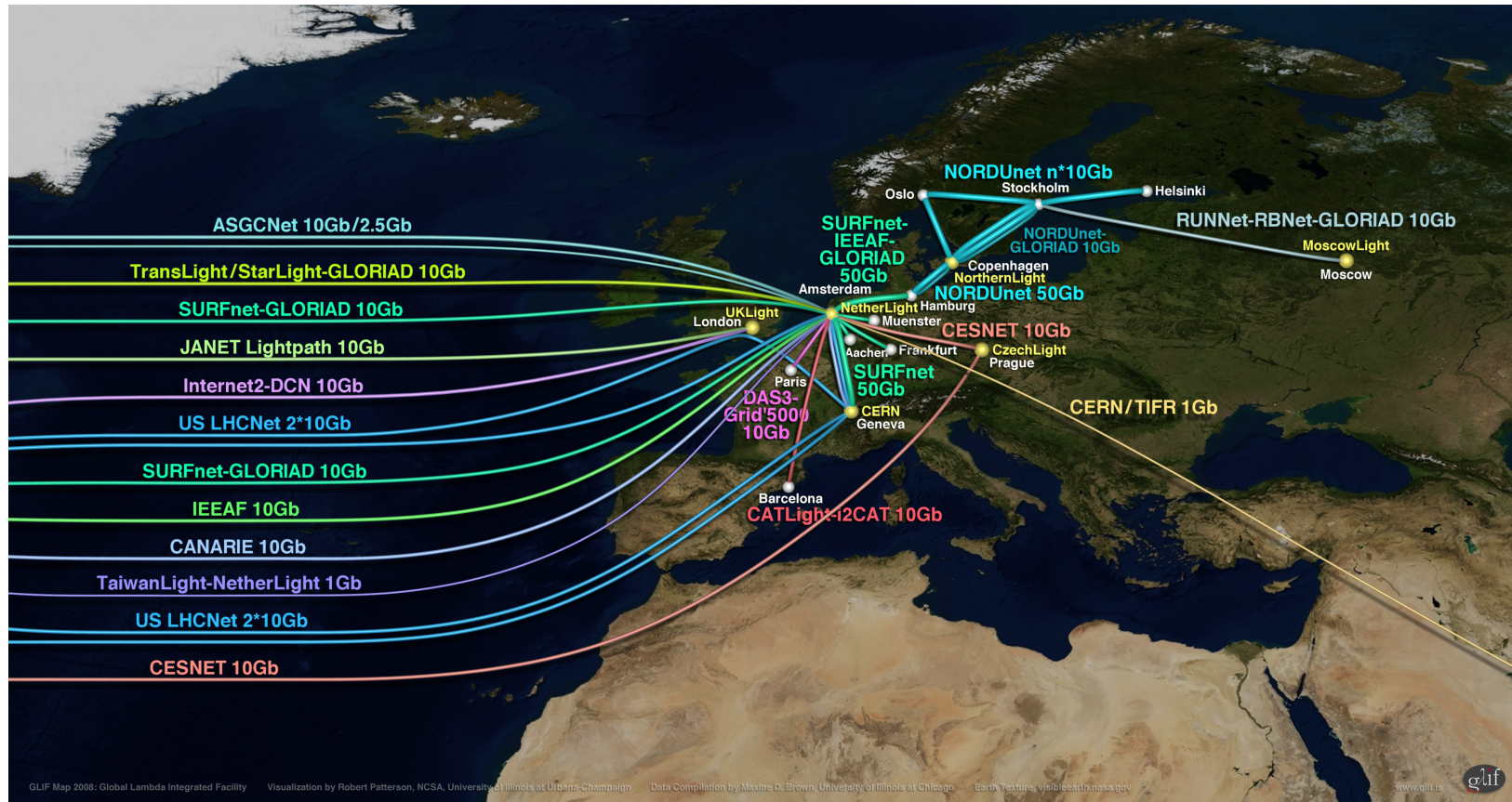… but actually what we really are talking about is *network topology description and exchange.*

A network of lightpaths

The GLIF network

Zooming in

The GLIF network in Europe

Dec. 08 2009

The problem

The issues:

- What is there?
- What is available?
- How do I "manage" information on lightpaths?
- How do I communicate with external domains?
- What do I expose to external domains?

The keywords:

- Common terminology
- Interoperability
- Topology exchanges

A new approach

The Semantic Web.

In the words of T. Berners-Lee:

I have a dream for the Web [in which computers] become capable of analyzing all the data on the Web – the content, links, and transactions between people and computers.

RDF - Resource Description Framework -   provides a way to categorize information:

- resources are described by URIs;

- triplets define the relations between resources:

NDL

The Network Description Language.

http://www.science.uva.nl/research/sne/ndl/

An <u>ontology</u> for computer networks that uses RDF.

An ontology is a formal representation of a set of concepts within a domain and the relationships between those concepts. It is used to reason about the properties of that domain, and may be used to define the domain.

Eth-0

Eth-1

Left-Device

Right-Device

**GigaPort**
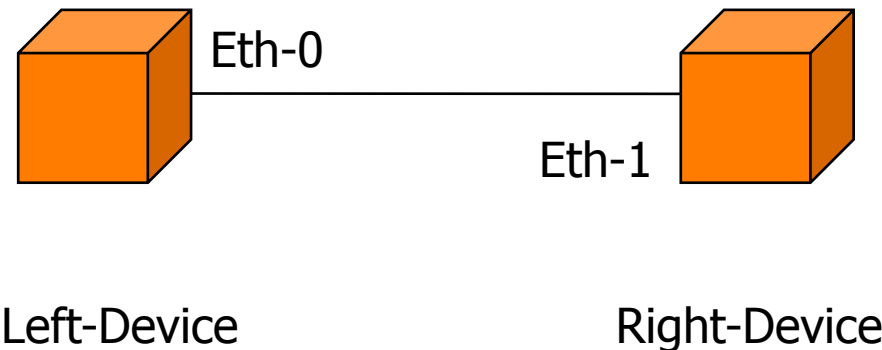
```
<?xml version="1.0" encoding="UTF-8"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
     xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
     xmlns:ndl="http://www.science.uva.nl/research/sne/ndl#"
     xmlns:geo="http://www.w3.org/2003/01/geo/wgs84_pos#">

<!-- Description of Terena-example-->
<ndl:Location rdf:about="#Here">
  <rdfs:label>Terena-example</rdfs:label>
  <geo:lat>10</geo:lat>
</ndl:Location>
```

```
<!--Left device:eth0-->
<ndl:Interface rdf:about="#Left-device:eth0">
<rdf:type rdf:resource="http://www.science.uva.nl/research/sne/ndl
/ethernet#EthernetInterface"/>
  <rdfs:label>Left-device:eth0</rdfs:label>
  <ndl:linkedTo rdf:resource="#Right-device:eth1"/>
</ndl:Interface>

<!--Right-device:eth1-->
<ndl:Interface rdf:about="#Right-device:eth1">
<rdf:type rdf:resource="http://www.science.uva.nl/research/sne/ndl
/ethernet#EthernetInterface"/>
  <rdfs:label>Right-device:eth1</rdfs:label>
  <ndl:linkedTo rdf:resource="#Left-device:eth0"/>
</ndl:Interface>

</rdf:RDF>
```

Eth-0

Eth-1
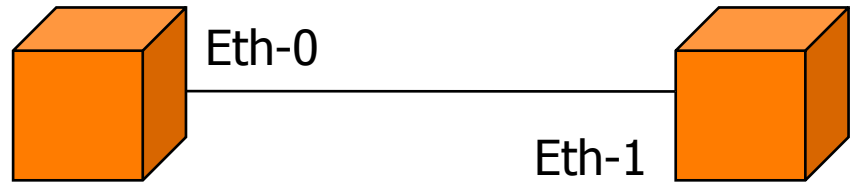
Left-Device

Right-Device

```
<!--Left-device-->
<ndl:Device rdf:about="#Left-device">
  <rdfs:label>Left-device</rdfs:label>

  <ndl:locatedAt rdf:resource="#Here"/>
  <ndl:hasInterface rdf:resource="#Left-device:eth0"/>
</ndl:Device>
```
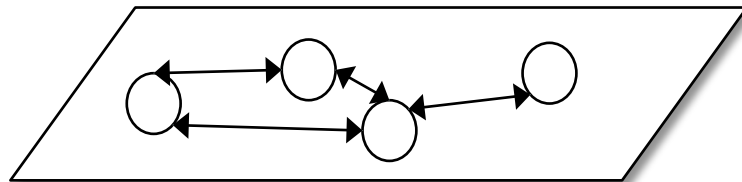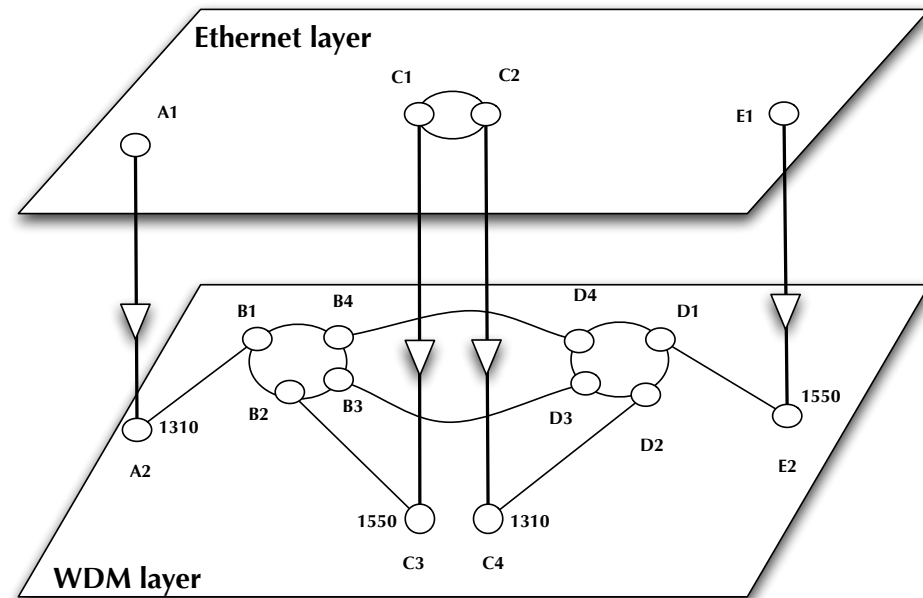
```
<!--Right-device-->
<ndl:Device rdf:about="#Right-device">
  <rdfs:label>Right-device</rdfs:label>
  <ndl:locatedAt rdf:resource="#Here"/>
  <ndl:hasInterface rdf:resource="#Right-device:eth1"/>
</ndl:Device>
```
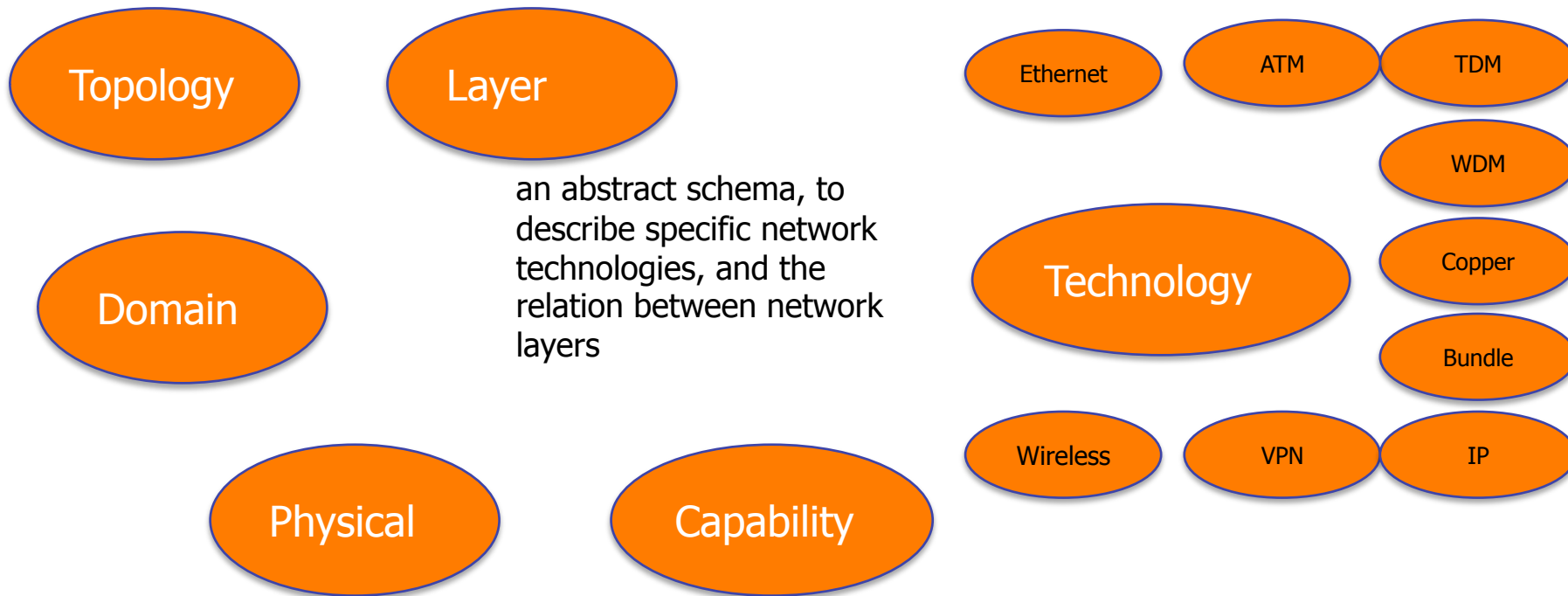
Layered networks

Single layer network:

Simple

Useful for abstractions

Multi layer network:

Complex

Realistic

Schemas

http://www.science.uva.nl/research/sne/ndl/?c=01-Schemas

Topology

Layer

an abstract schema, to describe specific network technologies, and the relation between network layers

Domain

Physical

Capability

Ethernet

ATM

TDM

WDM

Technology

Copper

Bundle

Wireless

VPN
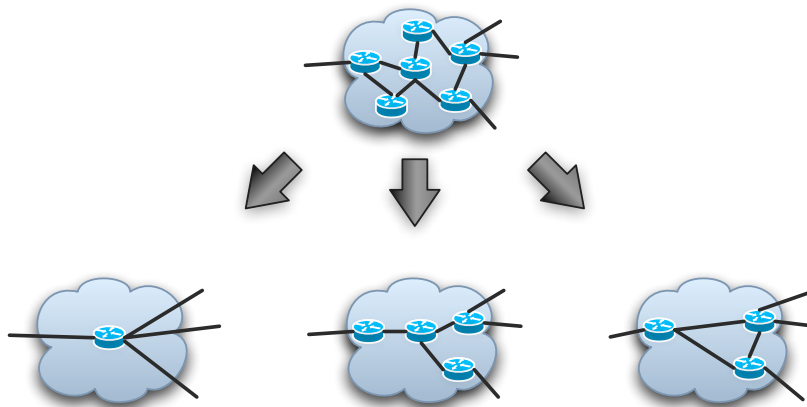
IP
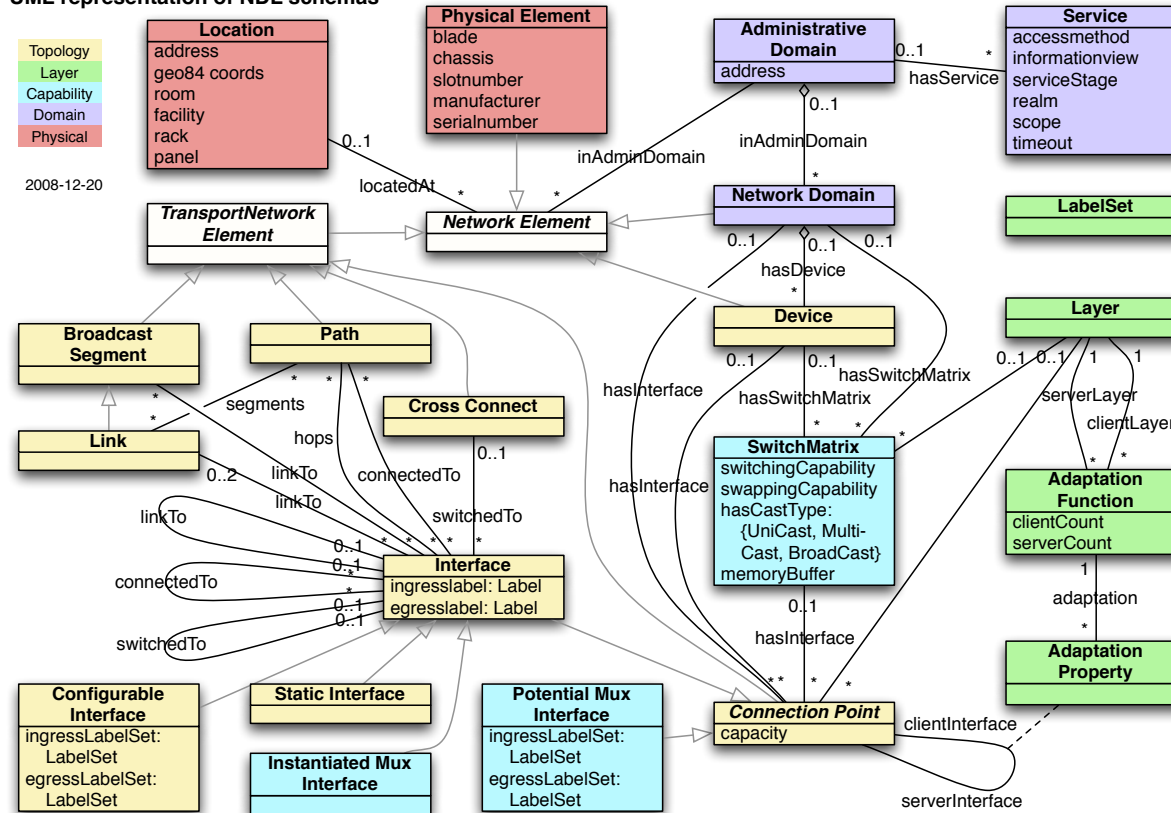
Topology aggregation with NDL

Single layer network.
Topology schema

Jeroen v/d Ham worked on "Path finding with aggregated topologies in inter-domain optical networks".

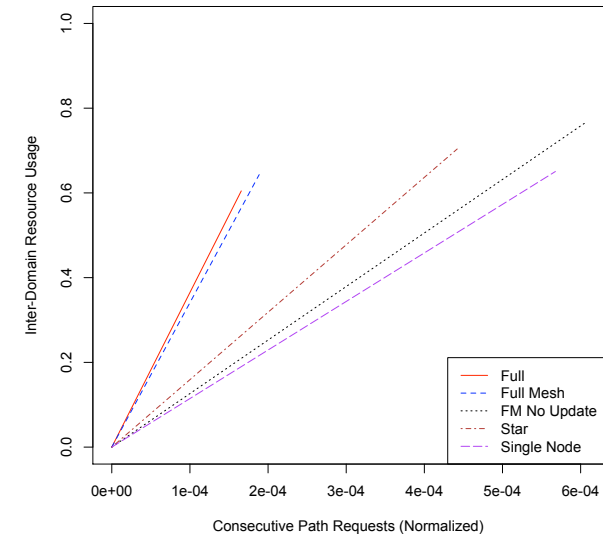Initial linear growth
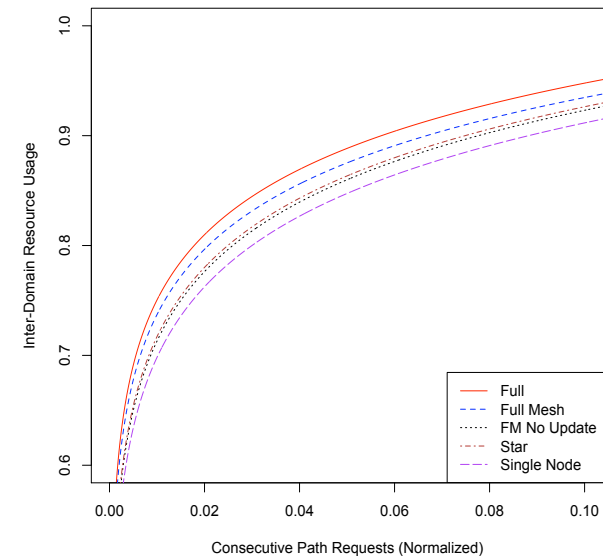
Logarithmic growth

Aggregation strategies:
- Single node
- Star
- Full mesh

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Multi-layer path finding with NDL

Freek Dijkstra with his Ph.D thesis on "Framework for Path Finding in Multi-Layer Transport Networks".
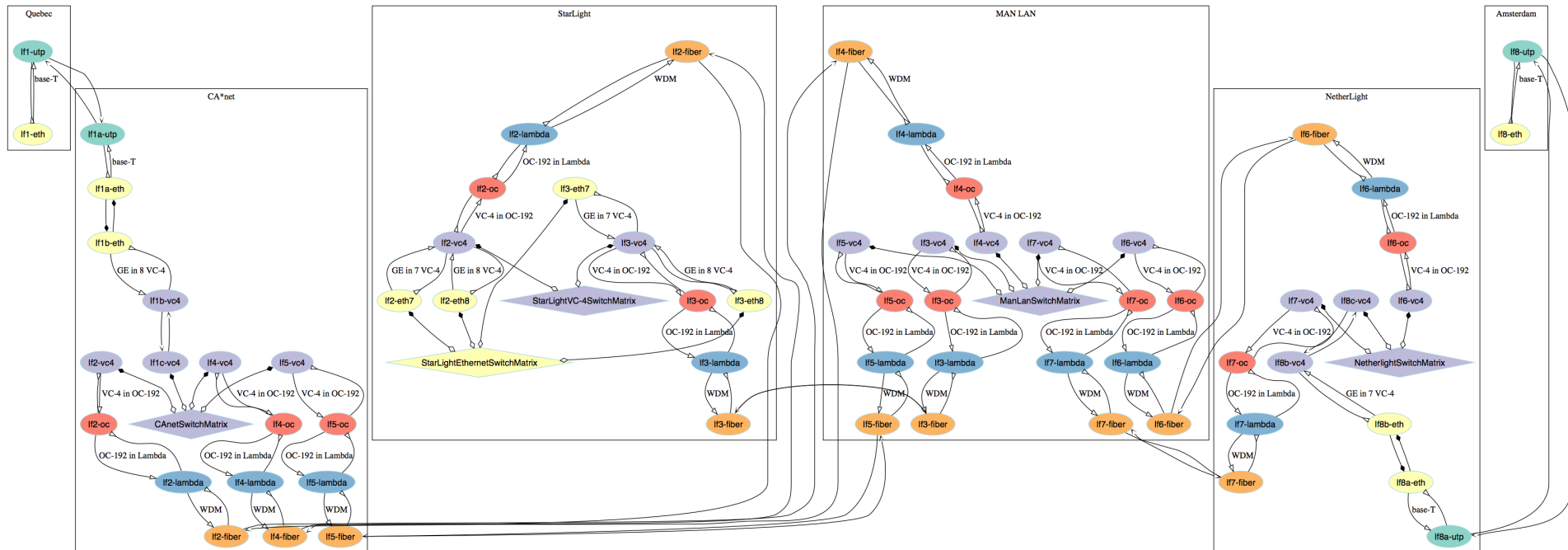
More out there

All provisioning systems have developed their own internal topology descriptions. A couple of examples:

- CNIS – Common Network Information Service

    A topology database used by the GEANT on-demand services.

- Topology descriptions in IDC:

    The DCN topology derives from the OGF NMWG – Network Measurement Working Group topology schema.

- Topology descriptions in Harmony:

    Concept of TNA to identify the endpoints of lightpath requests.

We worked at translation software to enhance interoperability.

DCN – NDL translation

J. Vd Ham worked at the translation software: *"Translating From DCN to NDL and Back Again"*

Technical report Technical Report UVA-SNE-2009-02 , October 2009
available at: http://www.science.uva.nl/research/sne/publications/
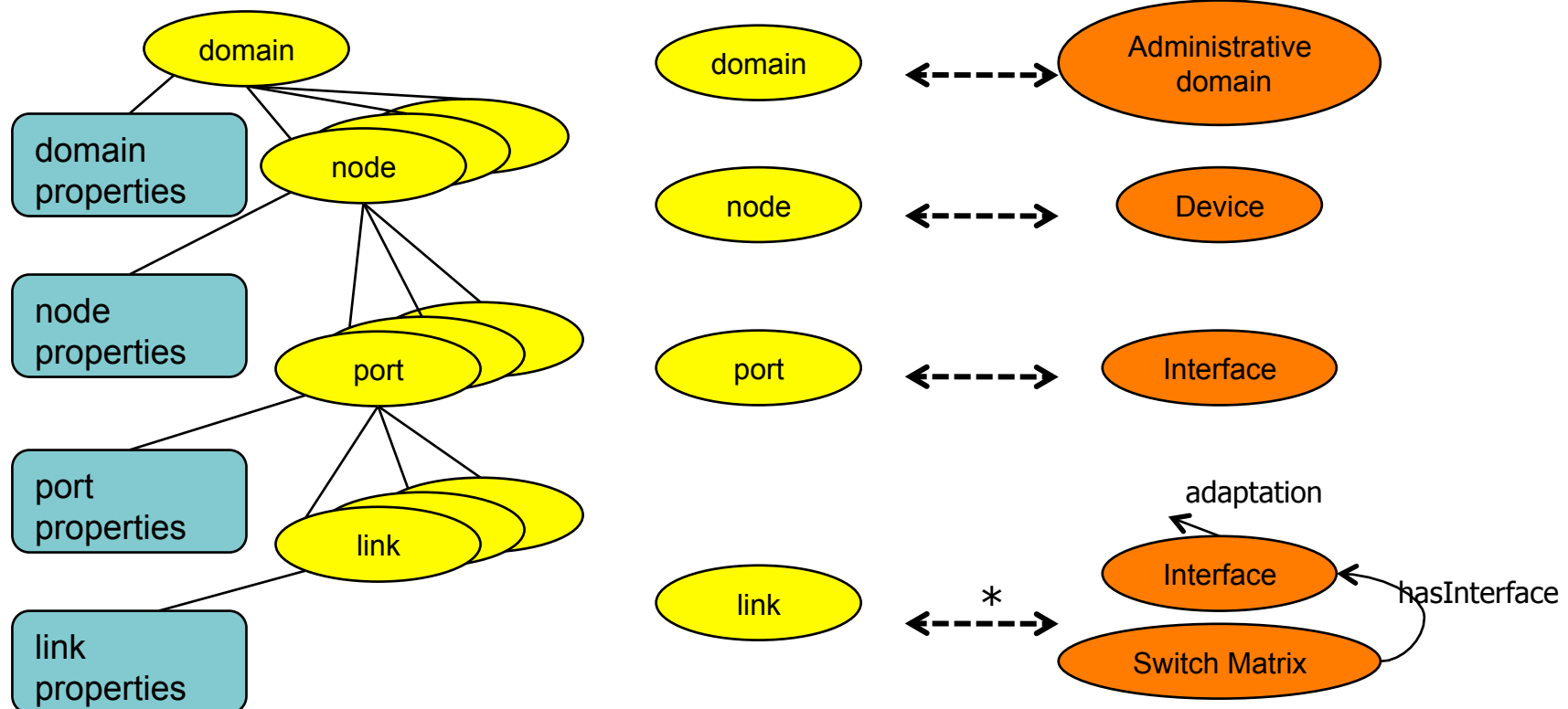
IDC –Harmony endpoint translators

GigaPort

F. Wan worked at the translation software: *"Interoperability of lightpath provisioning systems in a multi-domain testbed"* (submitted to TridentCom 2010)
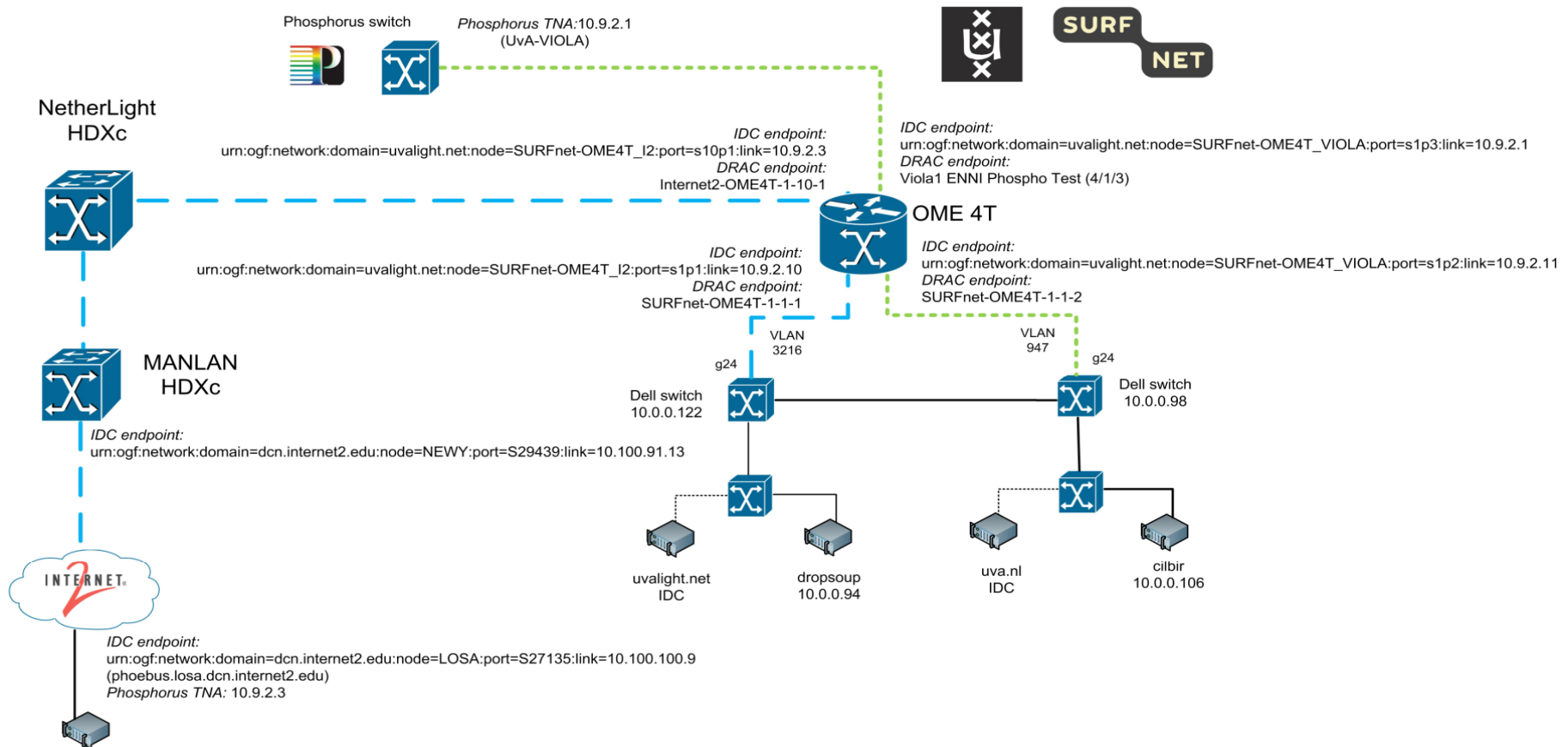
NML

The Network Markup Language working group (NML-WG) in OGF tries to :

combine efforts of multiple projects to describe network topologies, so that the outcome is a standardised network description ontology and schema, facilitating interoperability between different projects.

Current chairs: F. Dijkstra (SARA) and M. Swany (Udel).

Current document in progress: the first NML schema.

NML in UML

GigaPort

Location — locatedAt

Lifetime
sequence of
(start,end)

Network Object
name: <string>
id: <URI>

from
to

Relation
type:
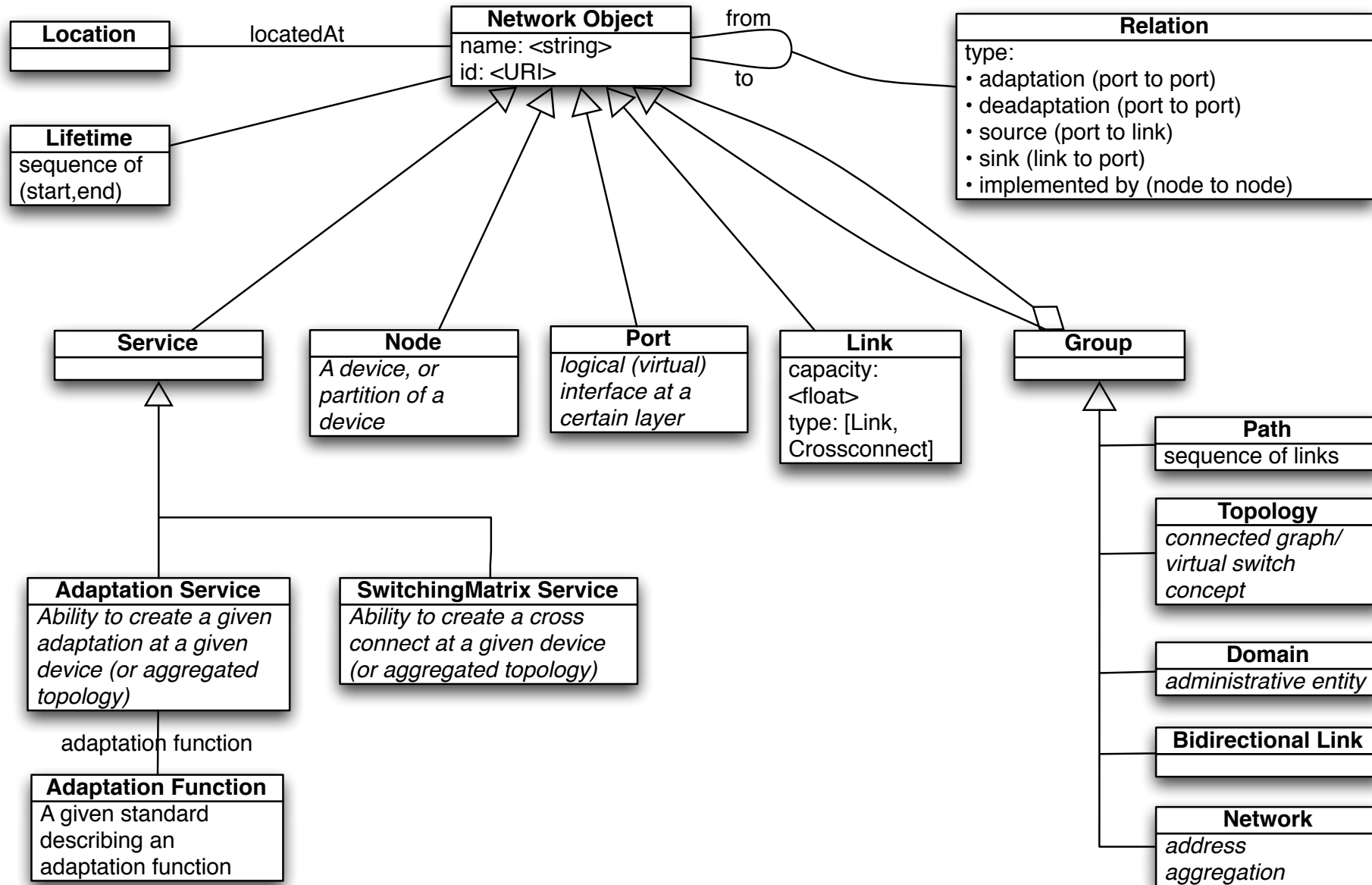• adaptation (port to port)
• deadaptation (port to port)
• source (port to link)
• sink (link to port)
• implemented by (node to node)

Service

Node
A device, or
partition of a
device

Port
logical (virtual)
interface at a
certain layer

Link
capacity:
<float>
type: [Link,
Crossconnect]

Group

Adaptation Service
Ability to create a given
adaptation at a given
device (or aggregated
topology)

SwitchingMatrix Service
Ability to create a cross
connect at a given device
(or aggregated topology)

adaptation function

Adaptation Function
A given standard
describing an
adaptation function

Path
sequence of links

Topology
connected graph/
virtual switch
concept

Domain
administrative entity

Bidirectional Link

Network
address
aggregation

Future work

The three main points of this talk:

- Topology description harmonization is at the base of interoperability of (lightpath) provisioning systems.

- The outcome of the NML working group will provide the community with a standardized schema.

- NDL has pioneered a new approach by using Semantic Web and RDF to describe resources and allows distributed and (potential) reasoning over connections.

To conclude

Some pointers:

- NDL website
    - http://www.science.uva.nl/research/sne/ndl

- NML- WG website
    - https://forge.gridforum.org/sf/projects/nml-wg

More questions:

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