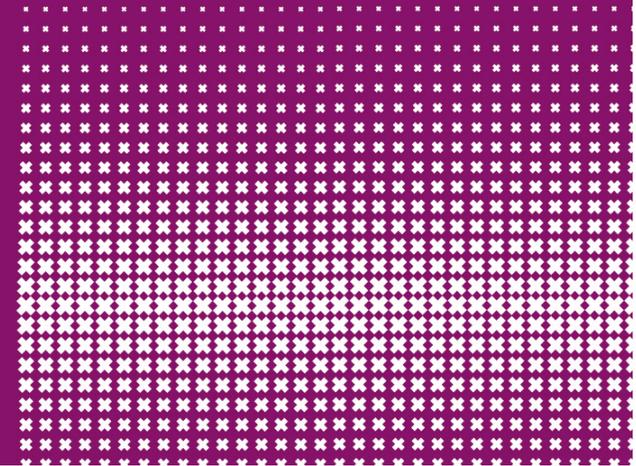




Dr. Paola Grosso

System and Network Engineering Research Group



Infrastructures modeling

The solution to interoperability?

Who am I?

- Assistant Professor in the SNE group
- Italian
 - Graduated at the University of Turin (Italy)

- ... but leaving outside Italy since 14 years
 - Stanford Linear Accelerator Center (USA)
 - University of Amsterdam (NL)

- p.grosso@uva.nl
- <http://staff.science.uva.nl/~grosso/>



Before I start....

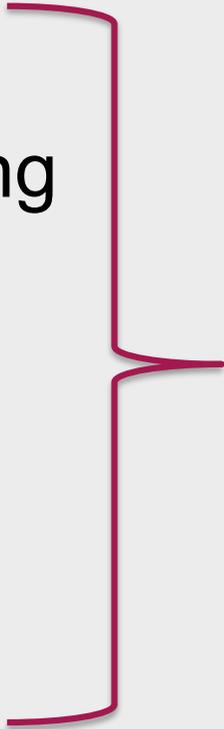
WHY AM I HERE?

OSDC and PIRE

- OSDC: an open-source, cloud-based infrastructure that allows scientists to manage, analyze, integrate and share medium to large size scientific datasets.
- PIRE: an international research and education experience.

Infrastructures

- Network
 - Computing
 - Storage
- and....
- Data



Putting it all together



Holistic approach and cloud approach ?

- Holistic approach: solving it all together, with a combined and optimal use of network, computation and storage
- Cloud approach: map-reduce, get the network out of the way
 - (mis?)-quoting Ian Sommerville

Are they different or not?

SNE

- System and Network Engineering

- Lead by prof. Cees de Laat
- ~30 researchers working in the group
- Strong tie to education with own master program
- Many national and international projects

- More information at the website:

<http://sne.science.uva.nl/>

SNE main research question

- quality of service and on-demand creation of virtual infrastructure including the underlying network
- managing sustainability and privacy in a distributed, heterogenous infrastructure

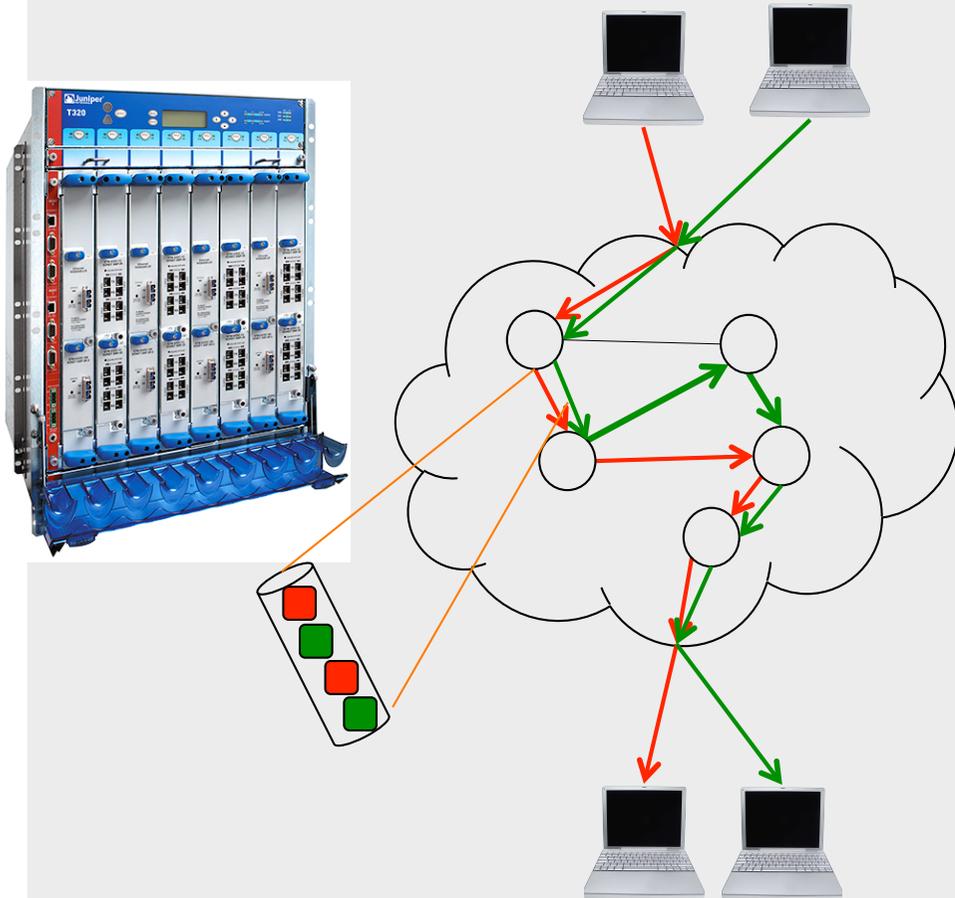


What is happening?

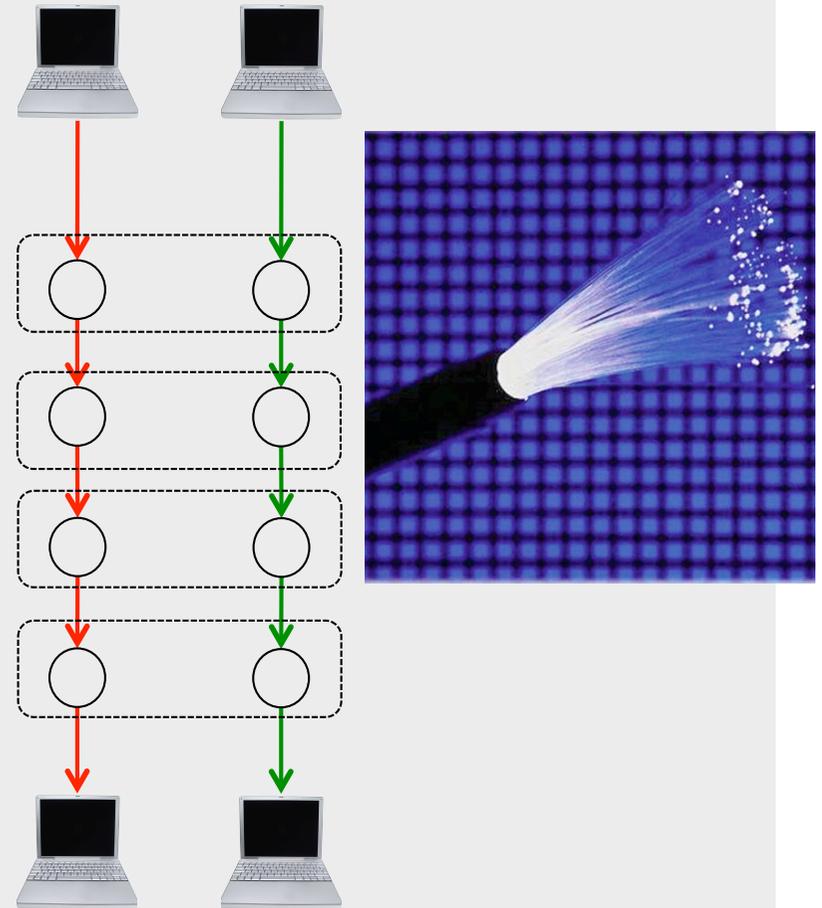
DEVELOPMENT IN NETWORKS

Hybrid networks

Packet switching

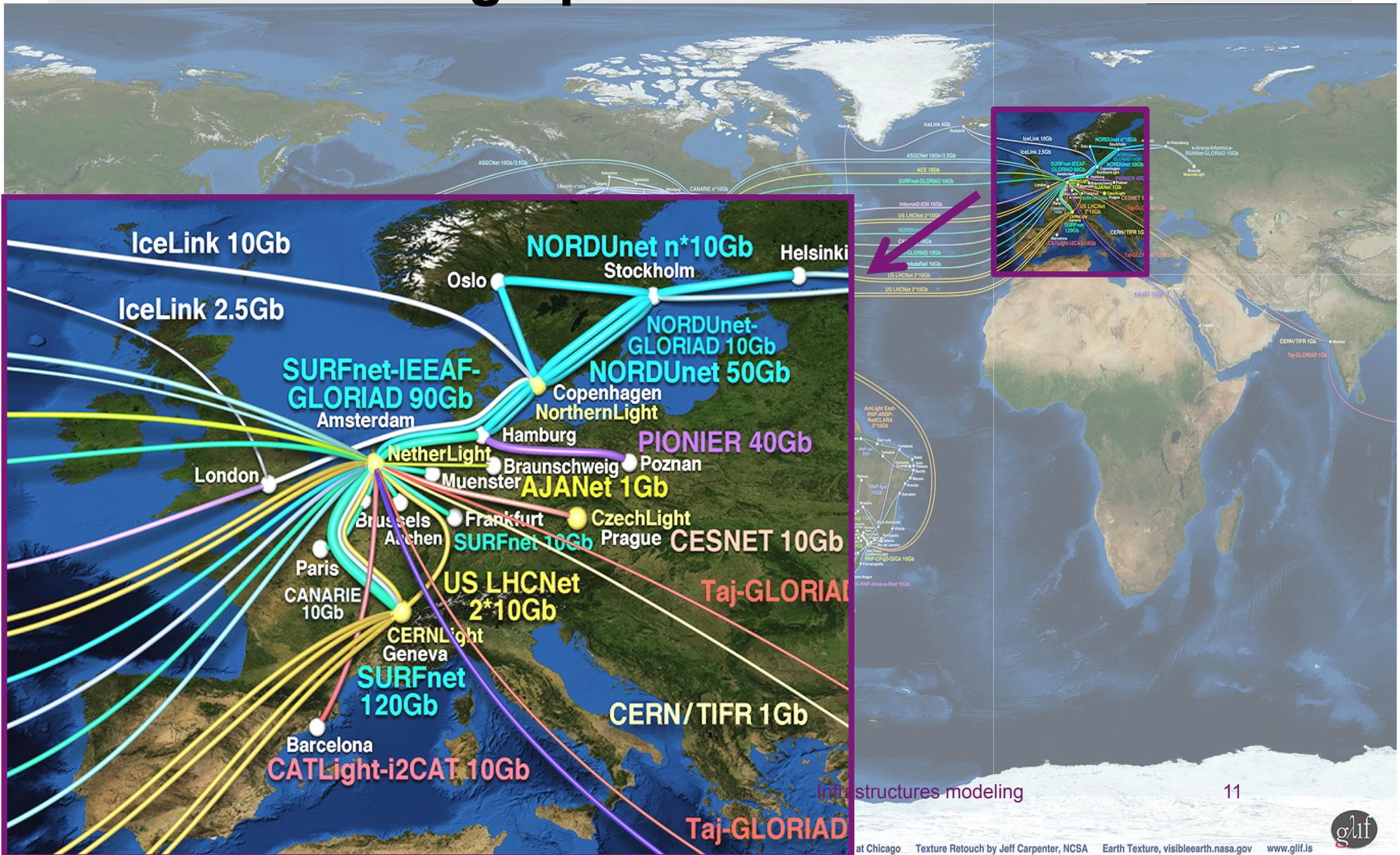


Circuit switching



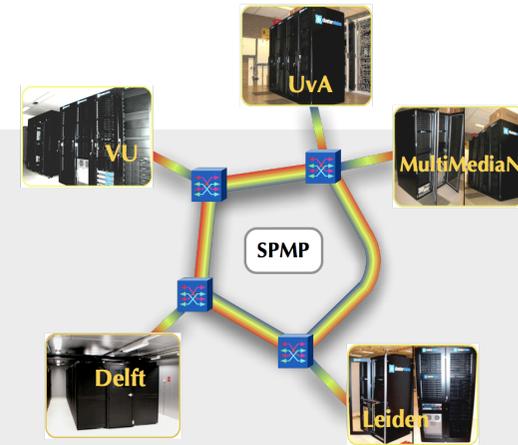


The GLIF – lightpaths around the world



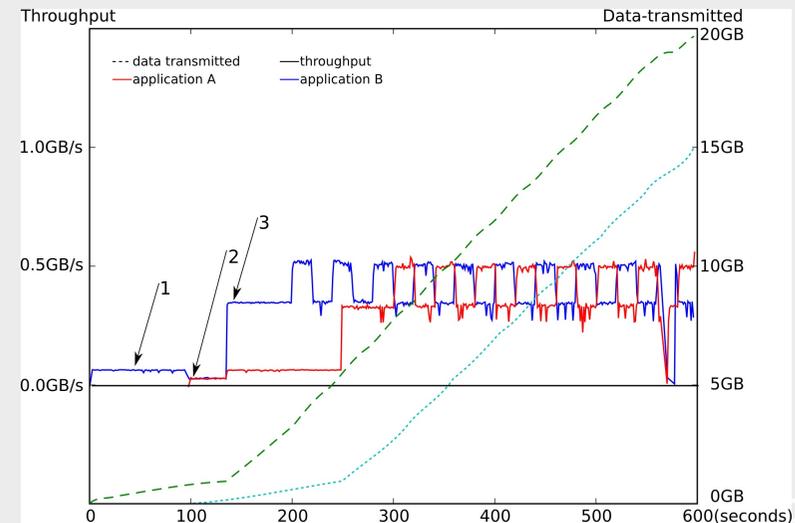
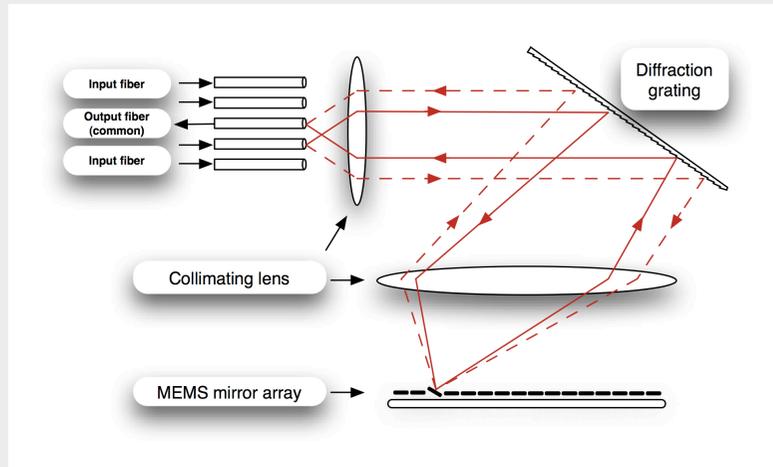
Dynamic lightpath switching

- How do we move from static to dynamic lightpaths?
- How do we achieve fast switching times?



DAS-3+StarPlane

WSS- Wavelength-Selective Switches



P. Grosso, D. Marchal, J.Maassen, E. Bernier, L. Xu and C.de Laet
 Dynamic photonic lightpaths in the StarPlane network
 In: Future Generation Computer Systems, Volume 25, Issue 2, 2009, Pages 132-136

P. Grosso , L. Xu, JP Velders, C. de Laet
 StarPlane - A National Dynamic Photonic Network Controlled by Grid Applications
 In: Emerald Journal of Internet Research, Vol.17, Issue 5, 2007, Page: 546 - 553

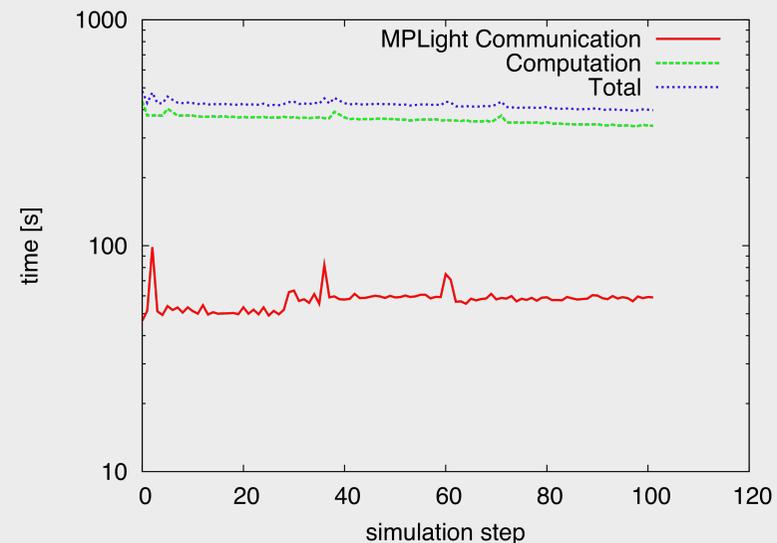
e-Science application of lightpaths - CosmoGrid

Many scientific application have a distributed nature:

- Data are collected from many places, see radio-astronomy eVLBI/SCARLe.
- Data are sent to multiple location for computation, see cosmological simulation – CosmoGrid.

Dynamic lightpaths have proven to support this type of applications.

CosmoGrid



Software defined networks

- Move the intelligence out of the network hardware: application/software programmable networks.



Open Flow

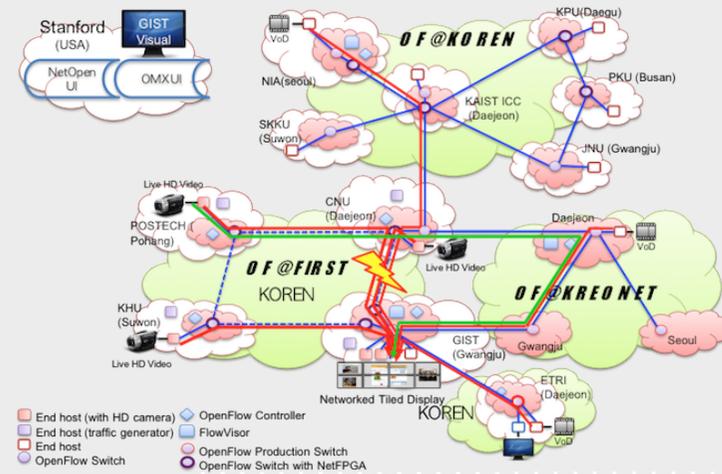
<http://www.internet2.edu/network/ose/>



<http://fif.kr/wg/testbed/wiki.php/FrontPage>

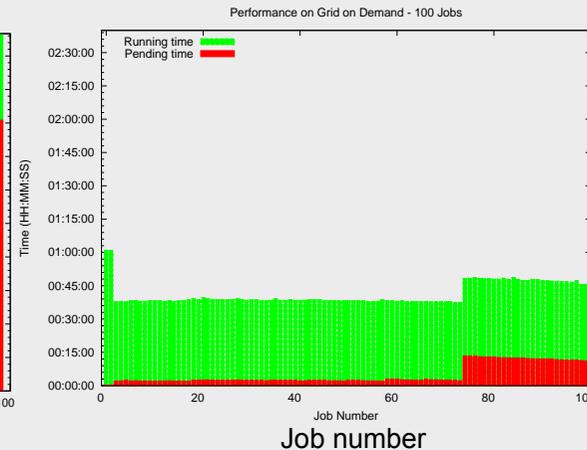
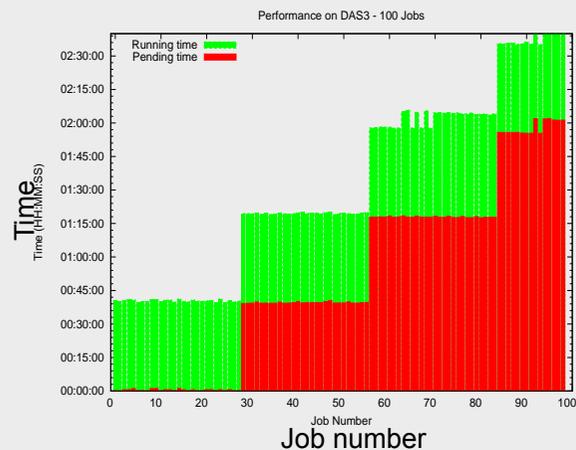


<http://www.fp7-ofelia.eu/>



Grid on demands

- If computing is ‘infinite’ and movable, then workflows and applications can *program* the network.



R.Strijkers, W.Toorop, A.van Hoof, P. Grosso,
A.Belloum, D.Vasuining, C. de Laat, R. Meijer
*AMOS: Using the Cloud for On-Demand Execution
of e-Science Applications*
In: Proc. eScience2010 conf, Dec. 2010

User programmable networks



Virtual networks

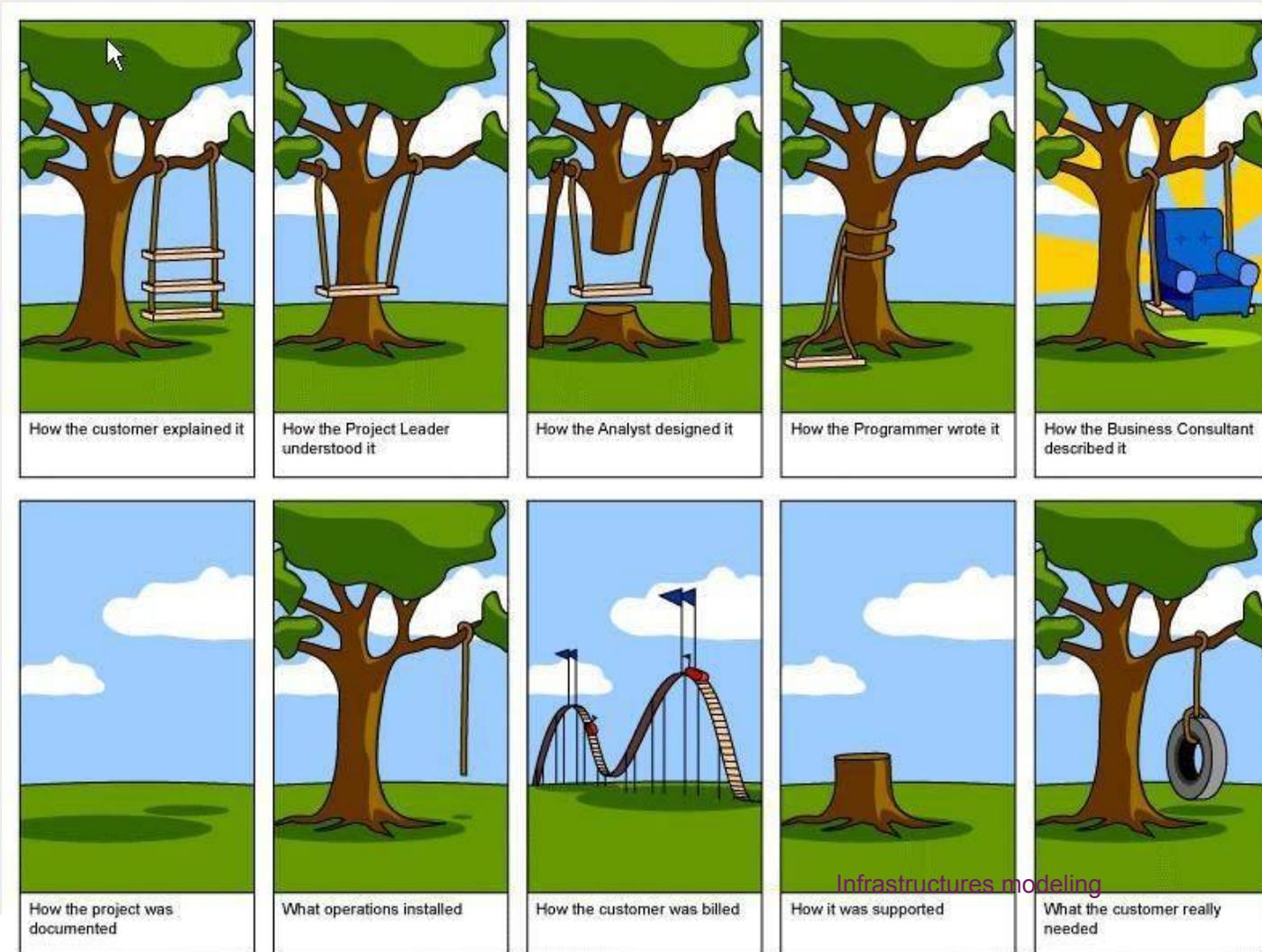
- Virtualization in networking equipment
 - Virtual routers
 - Virtual switches
 - Virtual links



How do you describe the underlying (network) infrastructure?

MODELING

Intermezzo: without a data model



Infrastructures modeling

Finding a common language



■ Information model

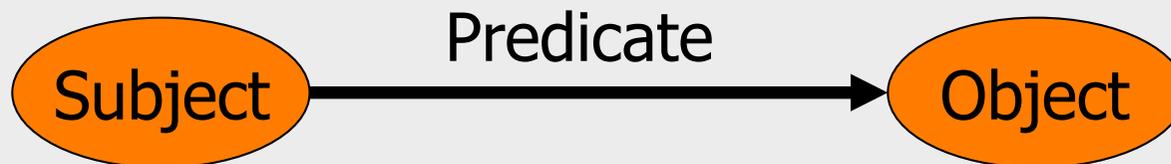
- An information model describes resources at a conceptual layer.

■ Data model

- A data model describes protocols and implementation details, based on the representation of concepts and their relations provided by the information model.

The Semantic Web

- RDF - **Resource Description Framework** - provides a way to categorize information:
 - resources are described by URIs;
 - triples define the relations between resources:

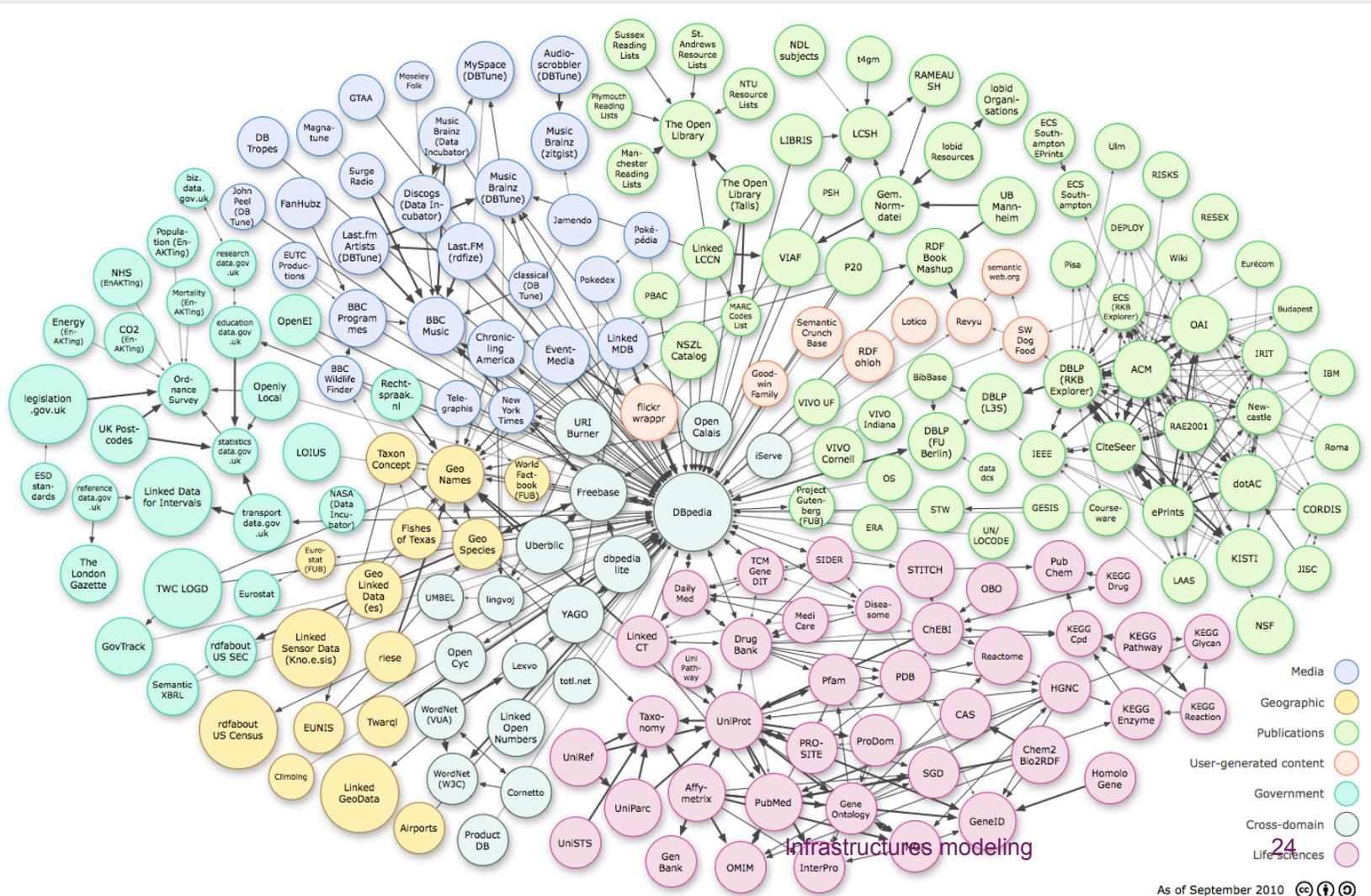


- OWL – **Web Ontology Language** - has stronger support for classes, attributes and constraints
 - Operations (unions, intersections, complements, cardinality constraints)

Ontologies

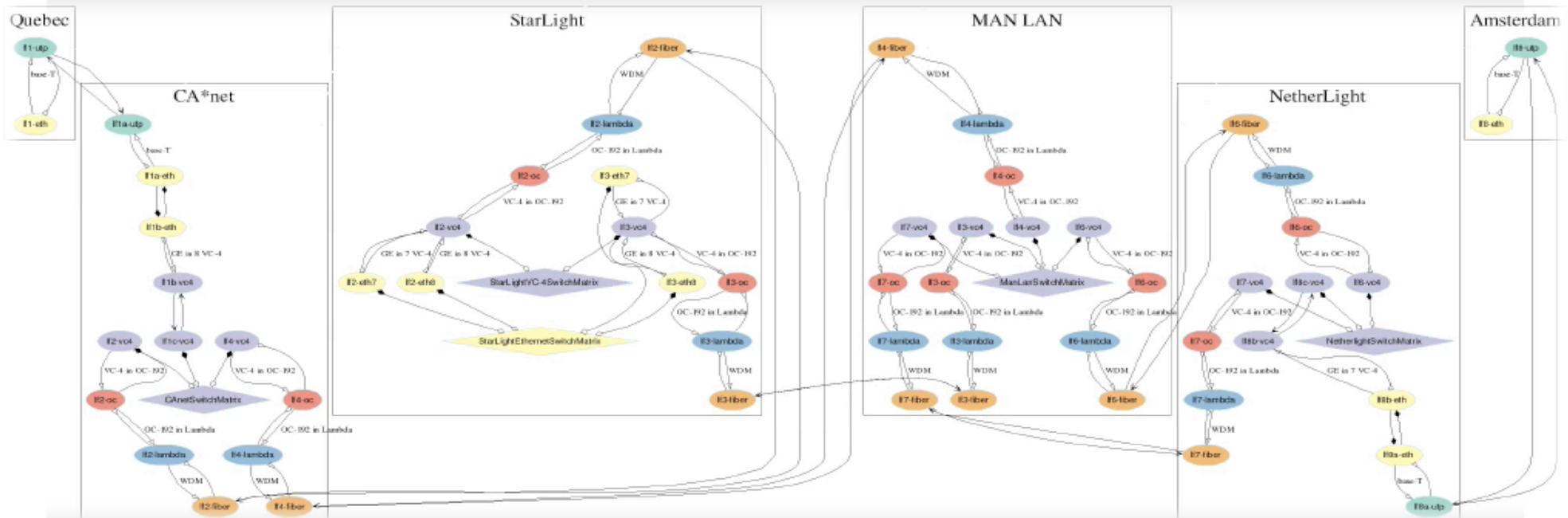
- An **ontology** is a formal representation of a set of concepts within a domain and the relationships between those concepts.
- It is used to reason about the properties of that domain, and may be used to define the domain:

Open Linked Data



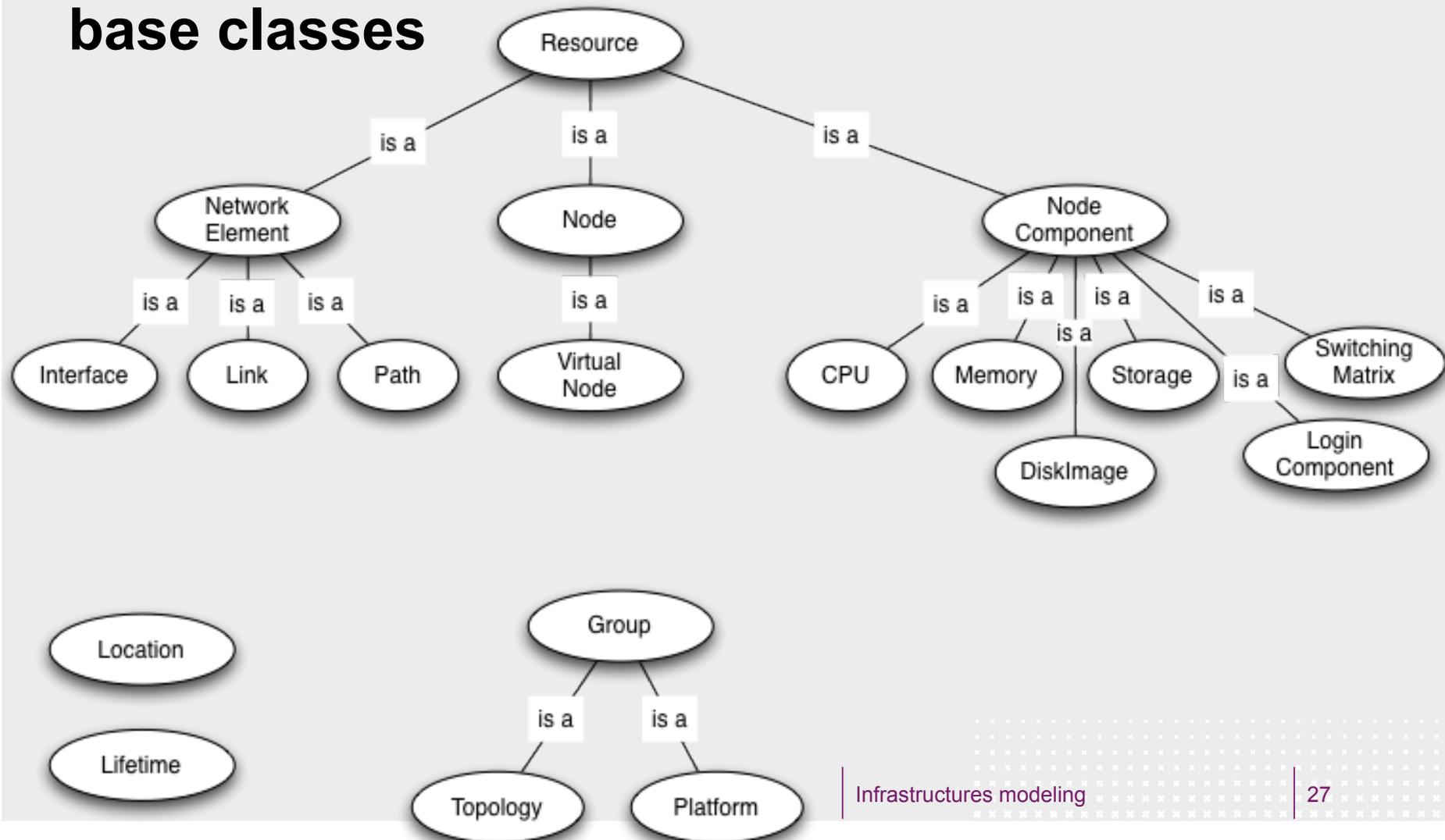
Path finding in multi-layer multi-domain networks

F. Dijkstra, J. van der Ham, P. Grosso and C. de Laat.
A path finding implementation for multi-layer networks, In: Future Generation Computer Systems, Vol.25, Issue 2, Feb. 2009, pp.142-146

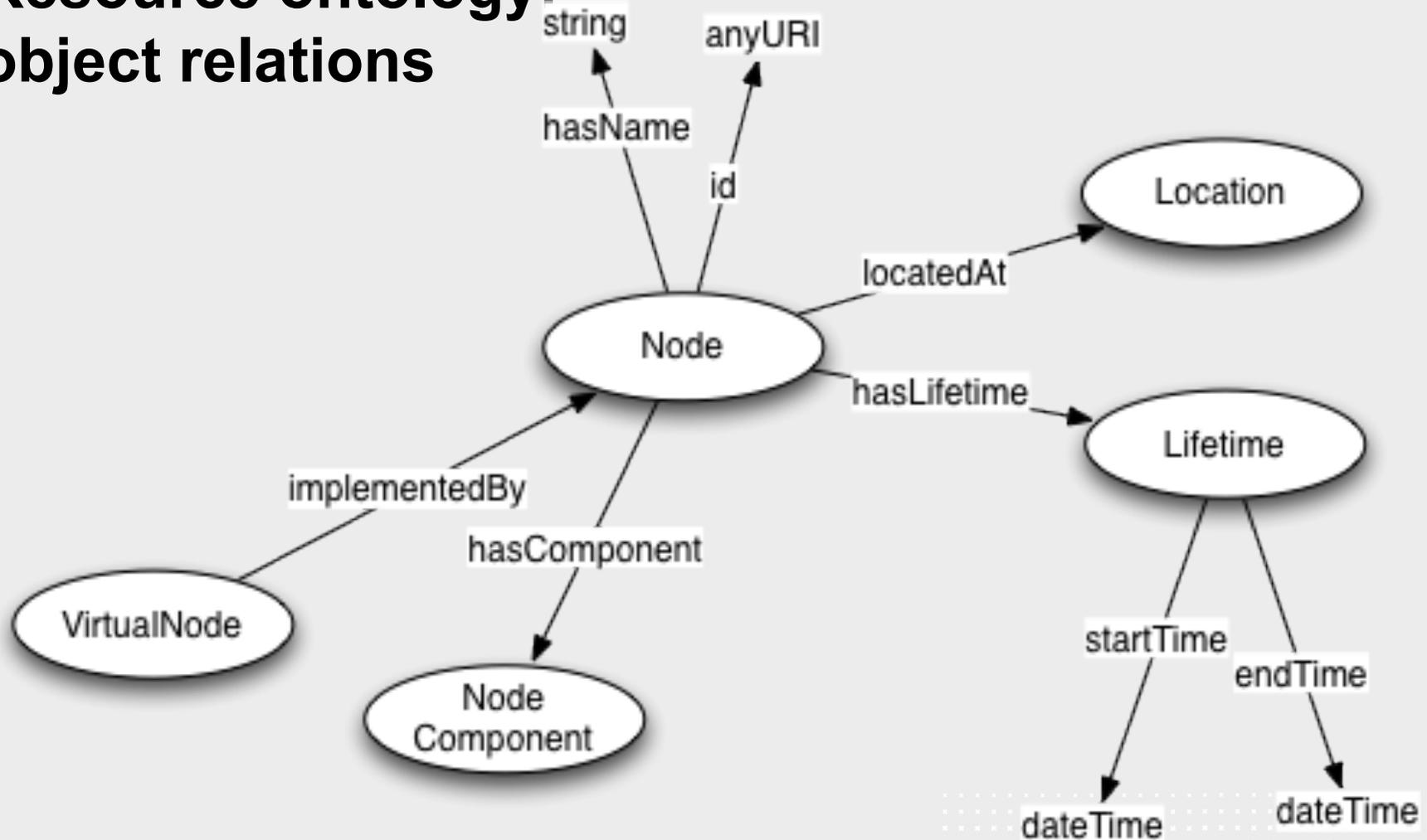


A. Taal, P. Grosso, J. van der Ham and C de Laat
Path finding strategies for multi-domain multi-domain network architectures
 In: Proceedings of the Cracow Grid workshop 2010

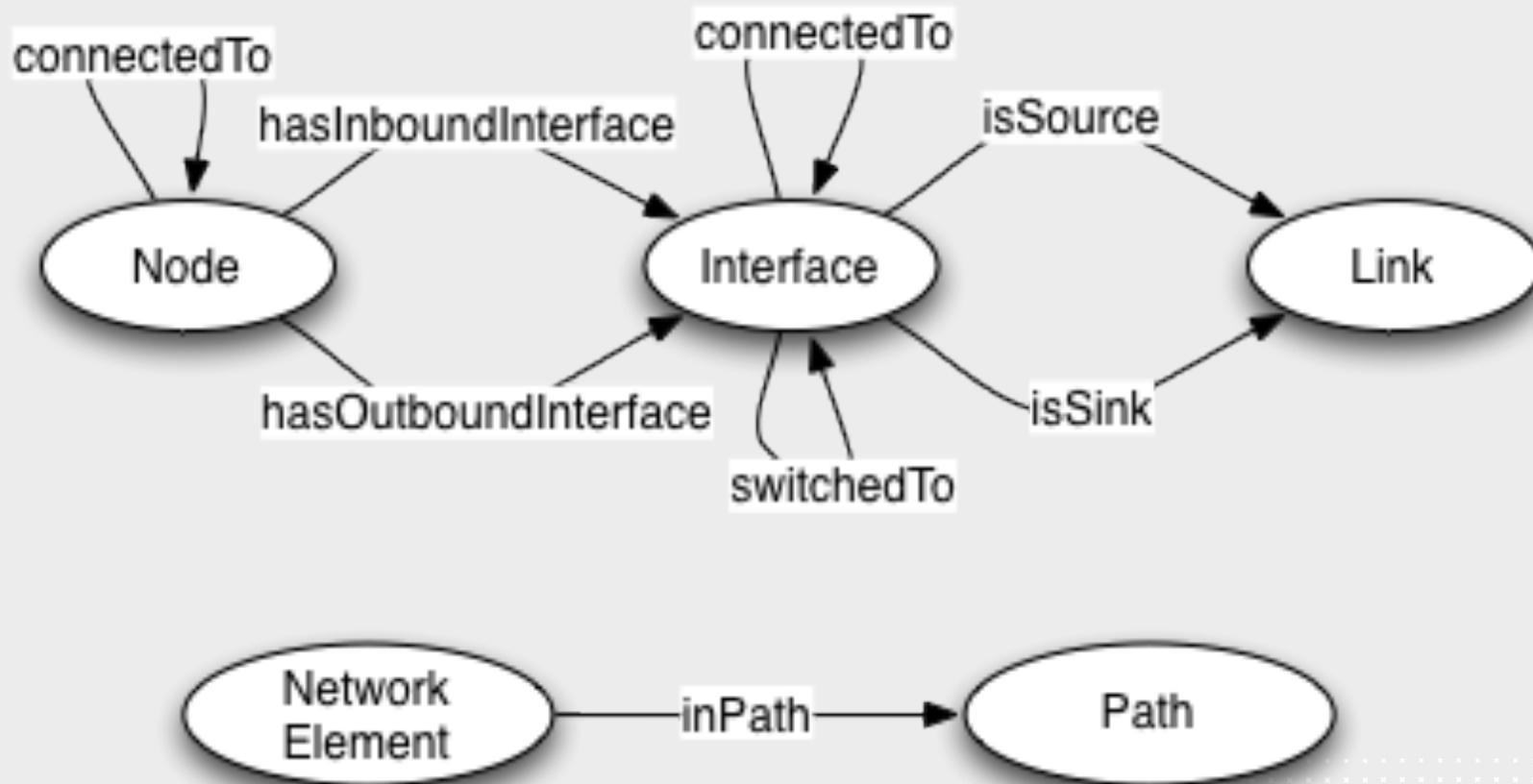
Resource ontology: base classes



Resource ontology: object relations

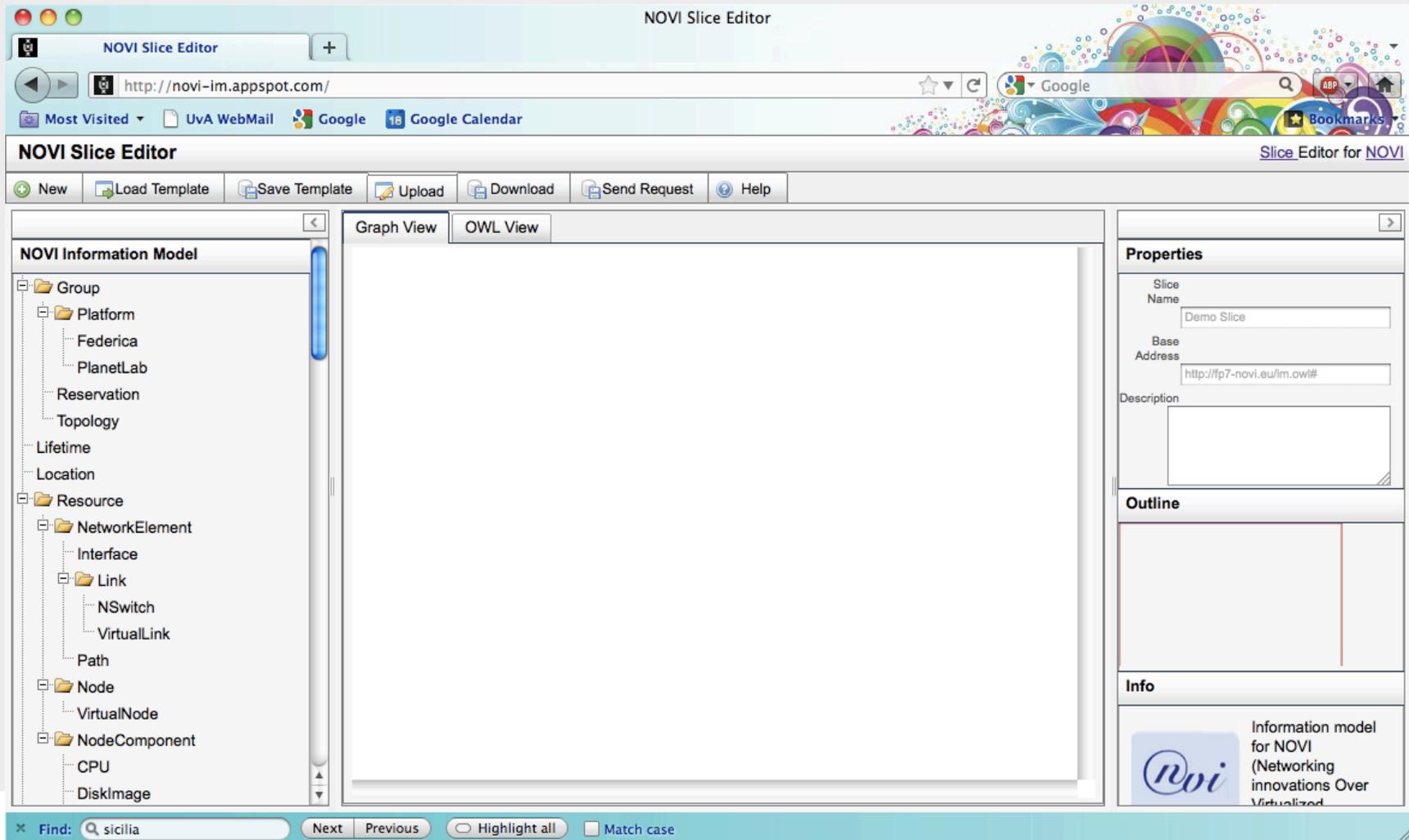


Resource ontology: network connectivity



Ontology editor

- <http://novi-im.appspot.com/>



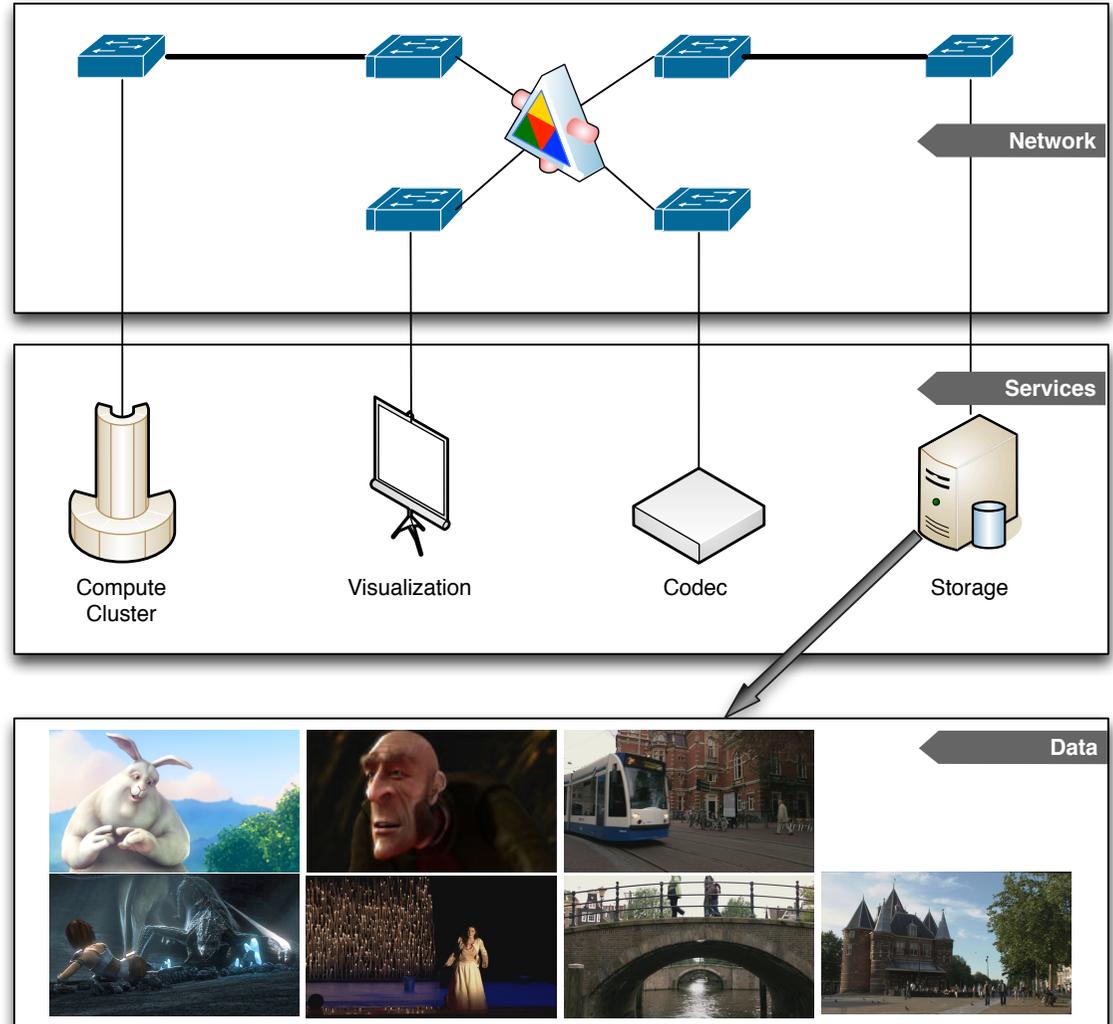
The screenshot displays the NOVI Slice Editor web application. The browser window title is "NOVI Slice Editor" and the address bar shows "http://novi-im.appspot.com/". The application interface includes a top navigation bar with buttons for "New", "Load Template", "Save Template", "Upload", "Download", "Send Request", and "Help". The main workspace is divided into three sections: a left-hand "NOVI Information Model" tree, a central "Graph View" (currently selected) and "OWL View" area, and a right-hand "Properties" and "Outline" panel. The "NOVI Information Model" tree is expanded to show a hierarchy of classes: Group (Platform: Federica, PlanetLab; Reservation; Topology; Lifetime; Location; Resource: NetworkElement (Interface; Link: NSwitch, VirtualLink; Path); Node: VirtualNode; NodeComponent: CPU, DiskImage). The "Properties" panel shows fields for "Slice Name" (Demo Slice), "Base Address" (http://fp7-novi.eu/im.owl#), and "Description". The "Info" panel at the bottom right features the NOVI logo and the text "Information model for NOVI (Networking innovations Over Virtualized)". The bottom status bar includes a search field with "scilia" and options for "Next", "Previous", "Highlight all", and "Match case".

NML and NSI

- Standardization effort in Open Grid Forum – OGF
 - NML – Network Markup Language working group
 - NSI – Network Service Interface working group

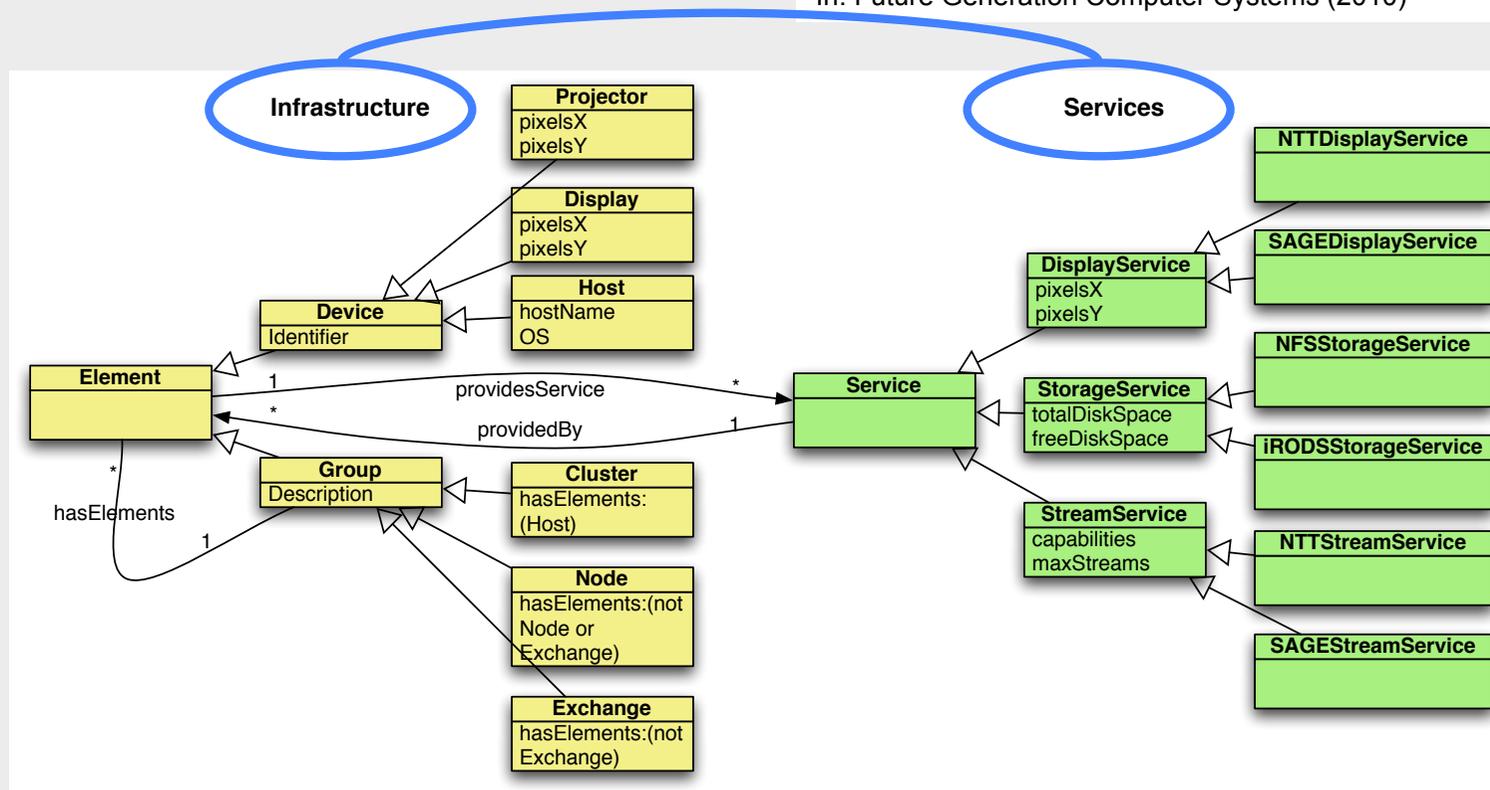
CineGrid

- <http://www.cinegrid.org>
- <http://cgdev.uvalight.nl/home/>



From infrastructure to services

R.Koning, P.Grosso and C.de Laet
Using ontologies for resource description in the CineGrid Exchange
 In: Future Generation Computer Systems (2010)





QUESTIONS?