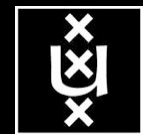
Inter-domain Integration and Interoperation

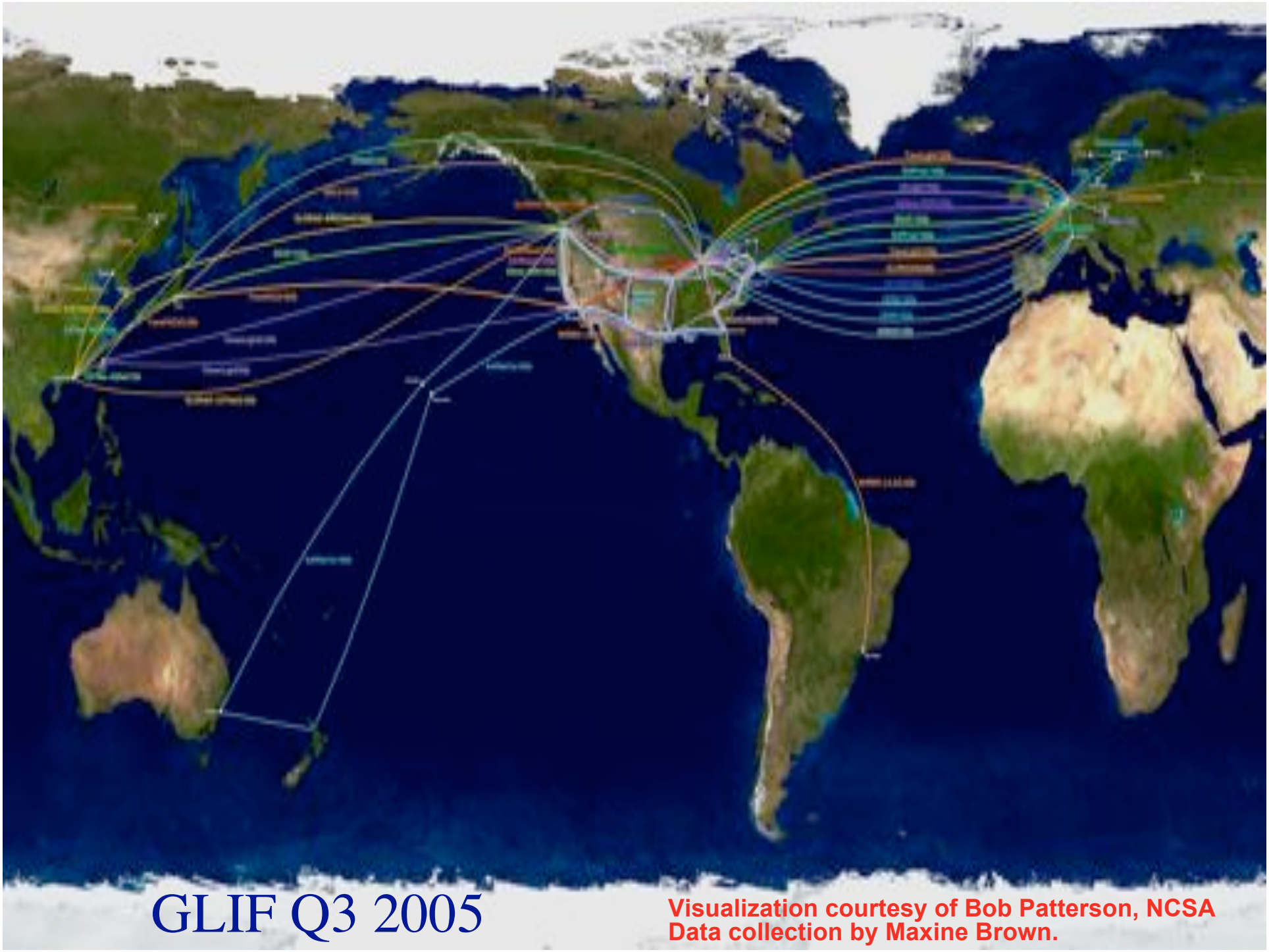
Cees de Laat

University of Amsterdam



What is missing in e-Infrastructure from the e-Science viewpoint?

- Useful ubiquitous access to photonic networks
  - first mile problems
- Grid programming models which go beyond treating the communication as Virtual Private Networks
- Scaleable optical/photonic network resources preventing cost explosions

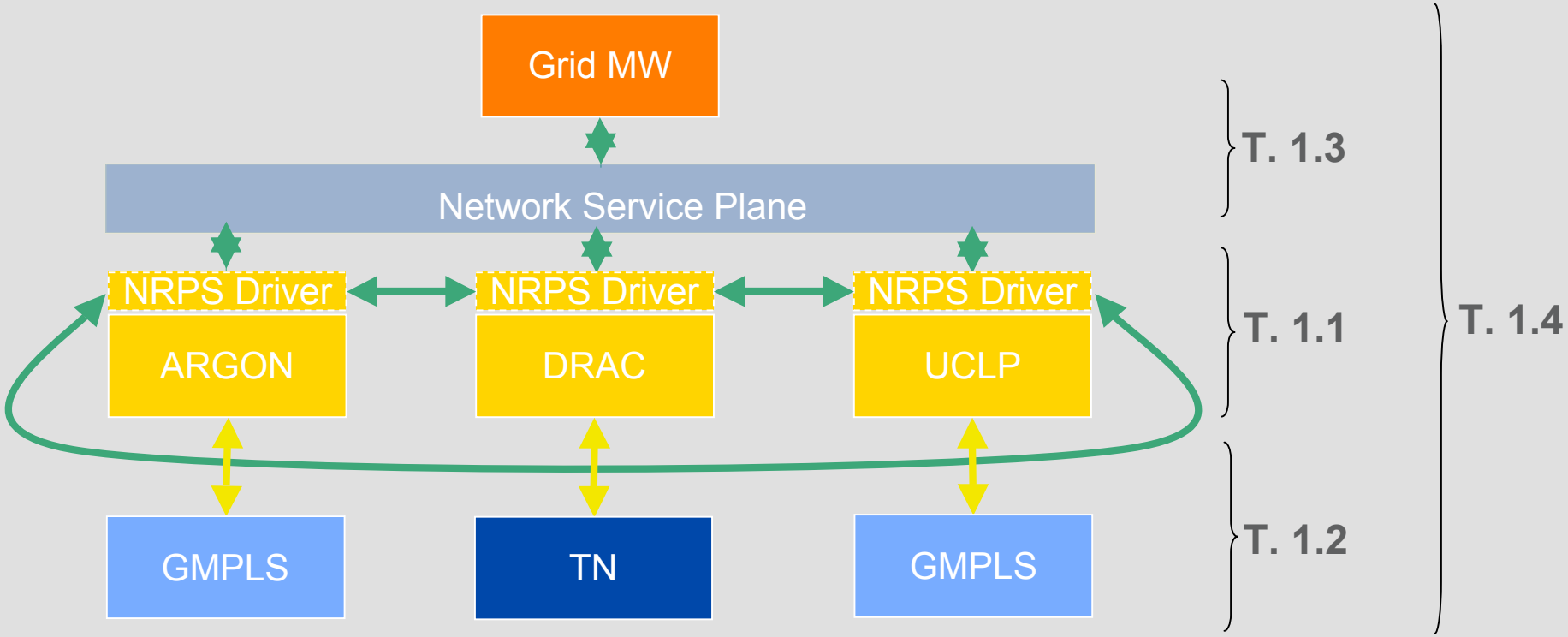

GLIF Q3 2005
Visualization courtesy of Bob Patterson, NCSA
Data collection by Maxine Brown.

MULTI-DOMAIN TESTBED

PROJECT KEY FEATURES 1/3

- **Demonstrate on demand service delivery across multi-domain/multi-vendor research network test-beds on a European and Worldwide scale. The test-bed will include:**
  - EU NRENs: SURFnet, CESNET, PIONIER as well national test-beds (VIOLA, OptiCAT, UKLight)
  - GN2, GLIF and Cross Border Dark Fibre connectivity infrastructure
  - GMPLS, UCLP, DRAC and ARGON control and management planes
  - Multi-vendor equipment environment (ADVA, HITACHI, NORTEL, Vendor's equipment in the participating NREN infrastructure)

WP1: ARCHITECTURE & TASKS (First phase)



Task 1.1 Heterogeneous NRPSs interoperability.

Task 1.2 Interoperability of NRPS and GMPLS control plane.

Task 1.3 Integration of the Network Service Plane.

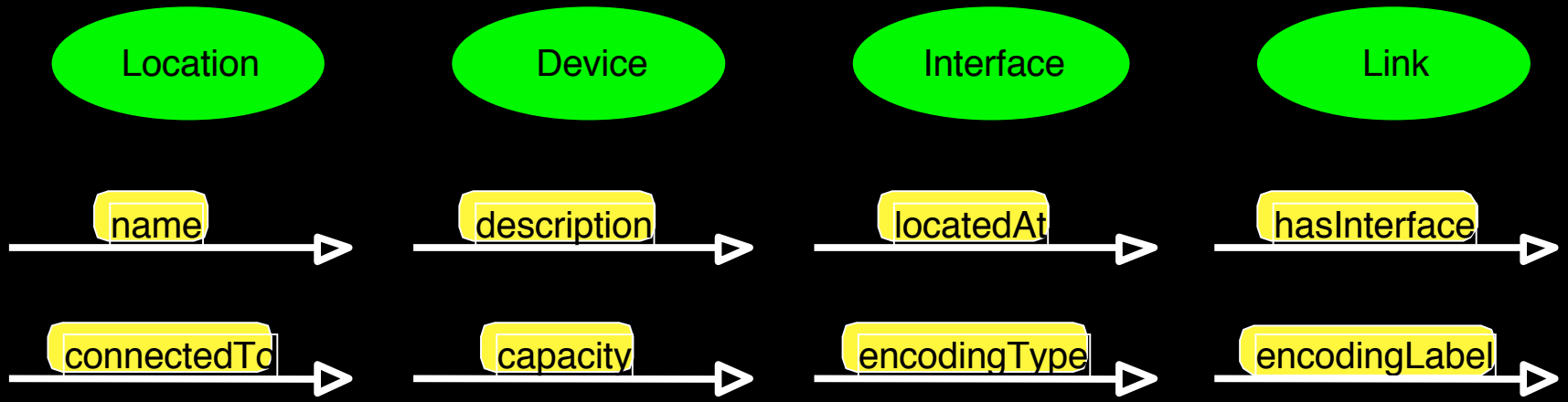
Task 1.4 Interoperability between NRPS, GMPLS and the Service Layer.

Status UvA research

- NDL
- TBN
- TwT
- wvttk

NDL schema

The NDL schema allows for description of network connections among GOLEs.



Standardization effort: *NML workgroup in the OGF*

Do-it-yourself tools (1/3)

NDL Generator form

An NDL file is automatically generated based on user input:

- Location
- Devices
- Interfaces

http://trafficlight.uva.netherlight.nl/NDL-demo/NDL-Generator.html

Do-it-yourself tools (2/3)

NDL Validator

- Syntax MUST be valid
  E.g. hasInterface points to an Interface
- File SHOULD be complete
  Devices have names, graph is connected, etc.

Available as on-line form or command-line tool.

http://trafficlight.uva.netherlight.nl/NDL-demo/NDL-Validator.html

Do-it-yourself tools (3/3)

NDL Visualizers

- NDL to DOT converter
  Visualize with GraphViz
- GoogleMaps network drawings
  Uses geo coordinates in NDL files

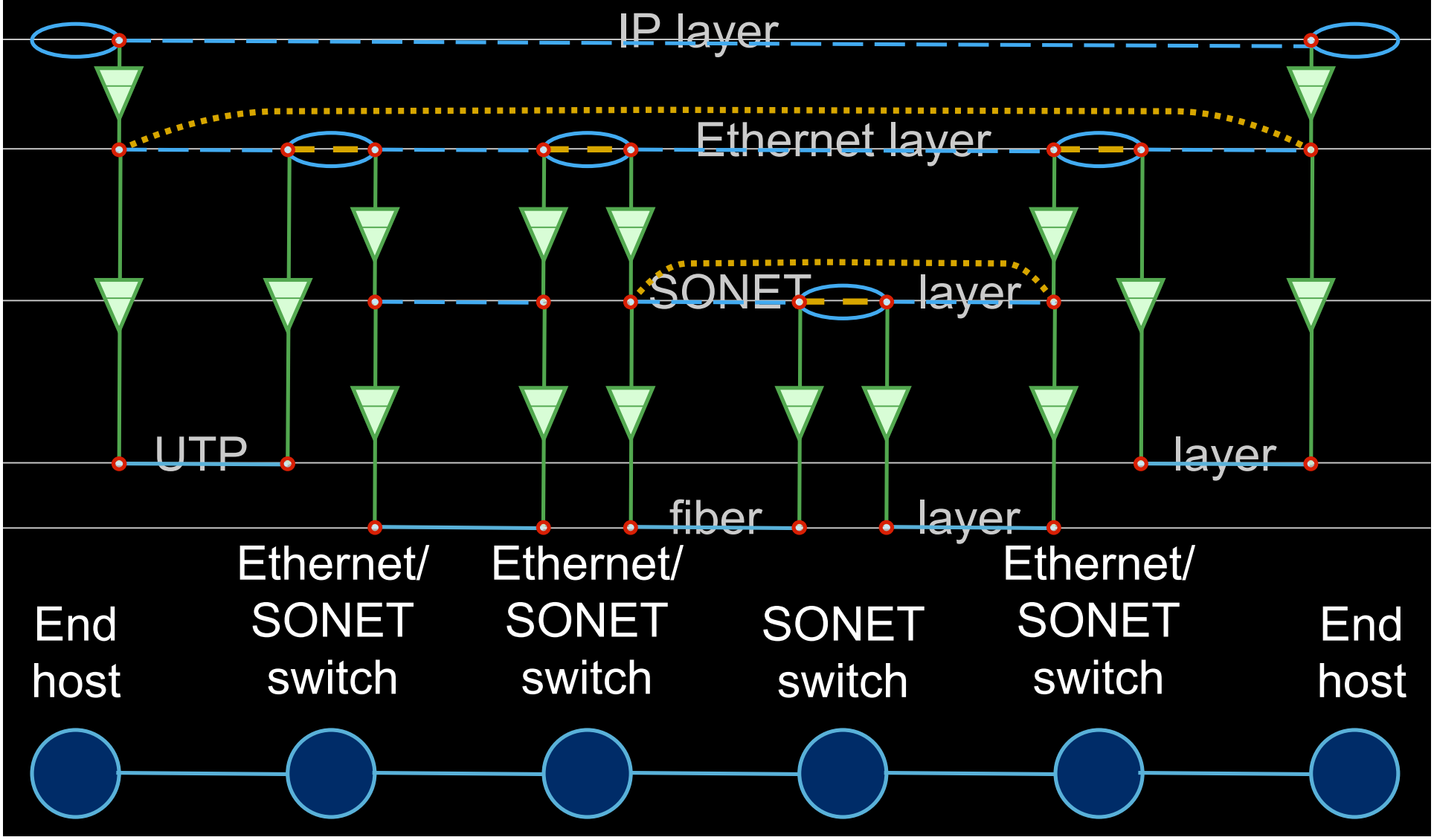
NDL2dot available for download.

http://www.science.uva.nl/~vdham/ndl/utilities/ndl-visualisation.tgz
http://staff.science.uva.nl/~vdham/NDL/googlemap.html

Supercomputing 2006 demo:
multi domain path finding in the GLIF

Multi-layer extensions to NDL

Layer schema based on G.805



OGF NML-WG

Open Grid Forum - Network Markup Language workgroup

Chairs:

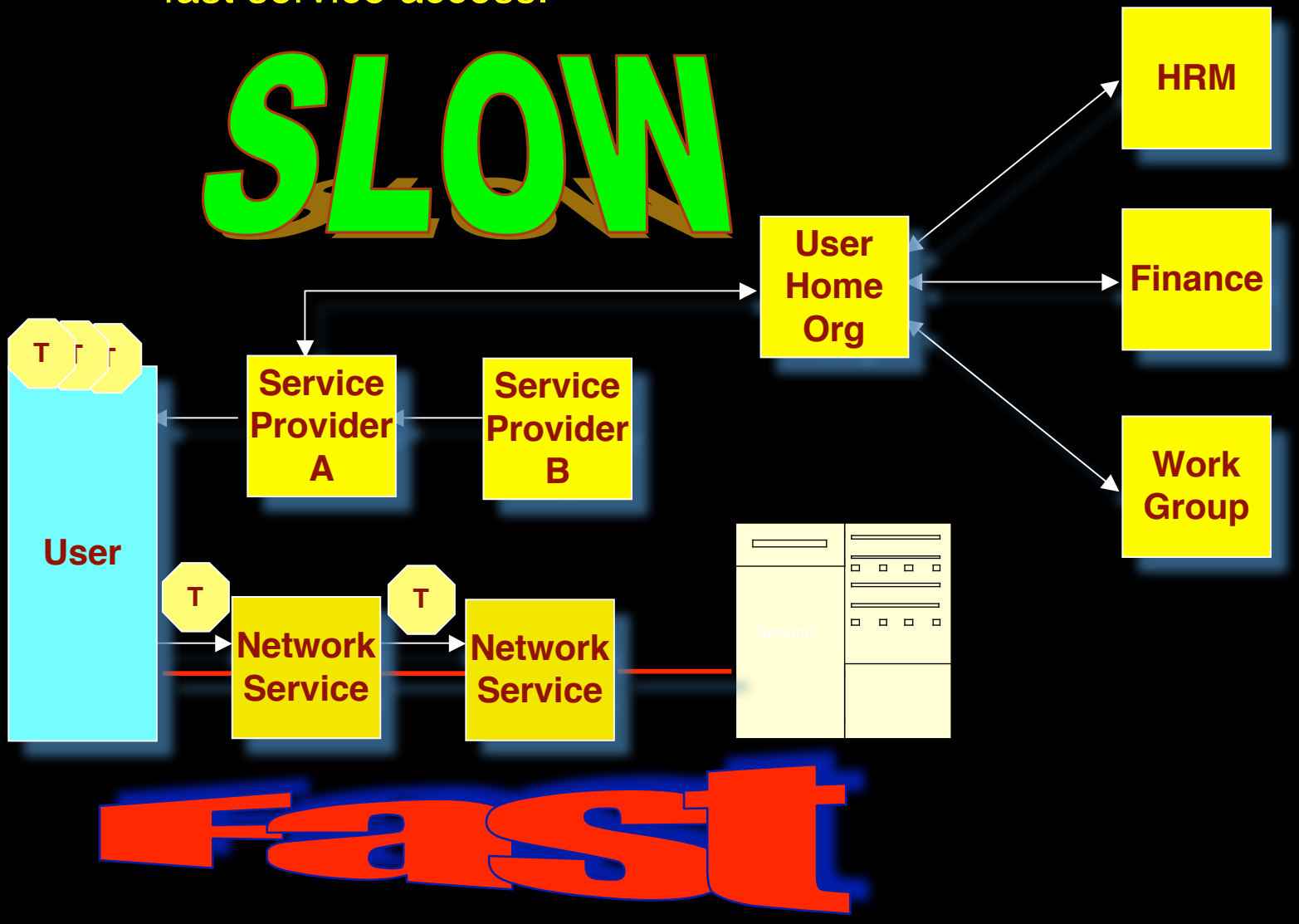
- Paola Grosso – Universiteit van Amsterdam
- Martin Swany – University of Delaware

Purpose:

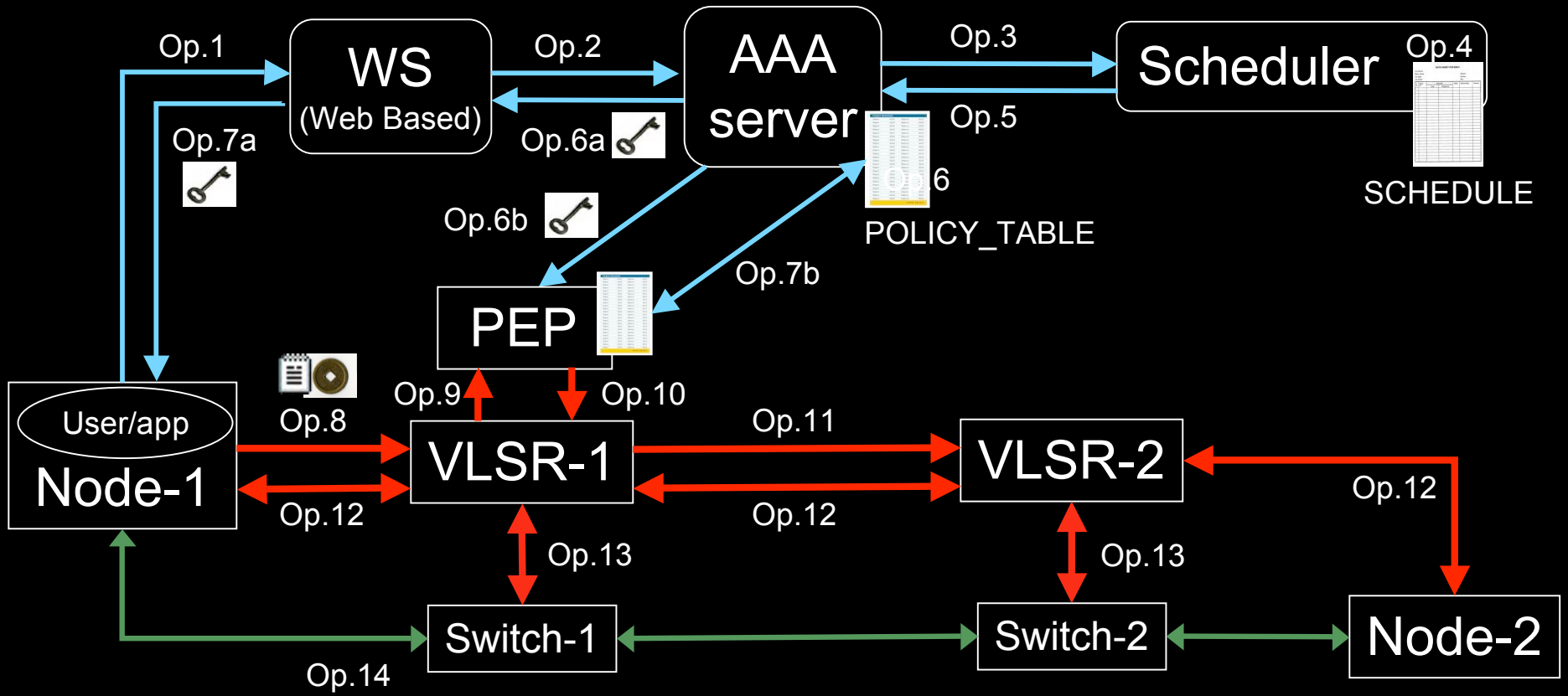
To describe network topologies, so that the outcome is a standardized network description ontology and schema, facilitating interoperability between different projects.

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

TBN: split (time consuming) service authorization process from service access using secure tokens in order to allow fast service access.



Workflow for TBN in GMPLS with DRAGON



1. User (on Node1) requests a path via web to the WS.
2. WS sends the XML requests to the AAA server.
3. AAA server calculates a hashed index number and submits a request to the Scheduler.
4. Scheduler checks the SCHEDULE and add new entry.
5. Scheduler confirms the reservation to the AAA.
6. AAA server updates the POLICY_TABLE.

6a. AAA server issues an encrypted key to the WS.

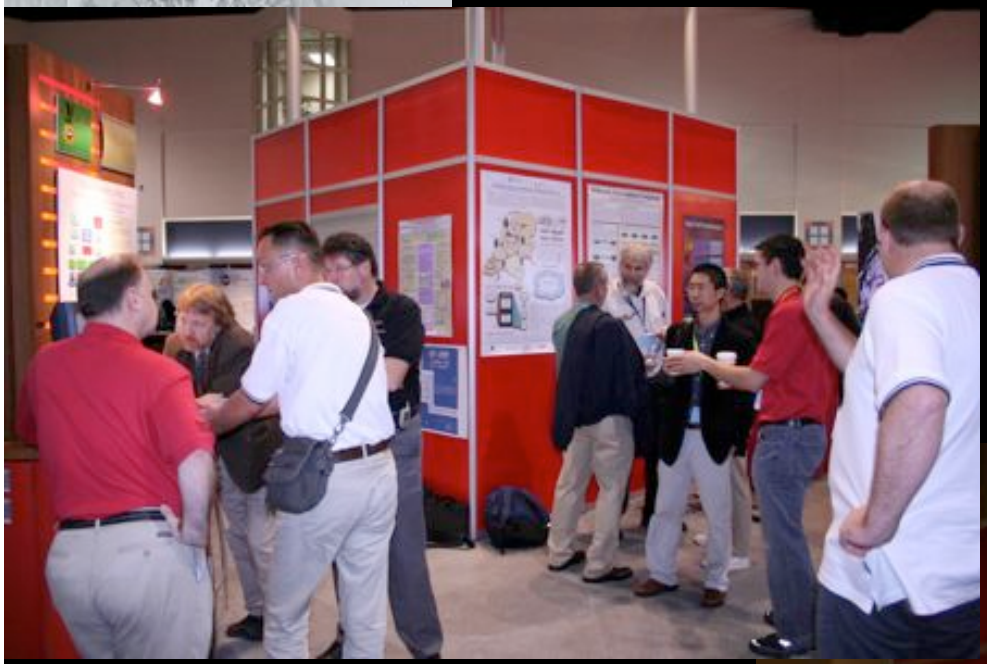
6b. AAA server passes the same key to the PEP.

7a. WS passes the key to the user.

7b. AAA server interacts with PEP to update the local POLICY_TABLE on the PEP.

8. User constructs the RSVP message with extra Token data by using the key and sends to VLSR-1.
9. VLSR-1 queries PEP whether the Token in the RSVP message is valid.
10. PEP checks in the local POLICY_TABLE and return YES.
11. When VLSR-1 receives YES from PEP, it forwards the RSVP message.
12. All nodes process RSVP message(forwarding/response)
13. The Ethernet switches are configured
14. LSP is set up and traffic can flow

Token based GMPLS Demo at SC '06



DRAGON Project

NSF

Leading principles

(in random order)

- Invent solutions that scale
- No single point of failure (no hostmapfile)
- Keep information at the source/owner
  - so that it can be up to date at all times
- Allow every kingdom to implement its own policy, implementation, not invented here...
- Interfaces, protocols, api's count
  - not implementations per-se

What are the hot topics in engineering e-Infrastructures?

- Middleware is the key to unlock the tremendous capacity in dark fiber networks
  - RDF, policy, addressing & routing
  - make these networks functions in WFM systems
  - make infrastructure part of the programming model of Applications
- Utilize the capacity
  - few Tbit/sec/fiber => few 100 times 10 Gbit/s
- reduce cost and complexity of grooming and switching
- power per bit, power per multiplication, etc.
  - 250 W/10 Gbit -> few times 25 kW/fiber/side for > L0
  - costs ~ 1 kEuro (= ~ k$) per kW per year

Revisiting the truck of tapes

Consider one fiber

- **Current technology may allow 320 λ in the frequency bands**
- **Each λ has a bandwidth of 40 Gbit/s**
- **Transport: 320 * $40*10^9$ / 8 = 1600 GByte/sec (160 kW)**

- **Take a 10 metric ton truck**
  - **One tape contains 50 Gbyte, weights 100 gr**
  - **Truck contains (10000 / 0.1) * 50 Gbyte = 5 PByte**

- **Truck / fiber = 5 PByte / 1600 GByte/sec = 3125 s ≈ one hour**
- **For distances further away than a truck drives in one hour (50 km) minus loading and handling 100000 tapes the fiber wins!!!**
- **Note: a 220 hp truck uphill also uses 160 kW!**

Questions?

This work is supported by
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SARA
TNO
NCF