Practical demonstration of Network Descriptions

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Introduction

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Introduction

SARA Computing & Networking Services

Departement High performance networking:

- **SURFnet5** & **SURFnet6** network operations centre (NOC)
- **Netherlight** network operations centre (NOC)
- Partner in Research on Networks GigaPort project

National Supercomputers

Visualization in the CAVE

Resource Description Format (RDF)

- Presentation Jeroen van der Ham (UvA) Glif meeting september 2005
  See: http://www.glif.is/meetings/2005/tech/vdham-rdf.pdf

- Resource Description Format (RDF) is a Semantic Web technique.

Can be used to:

1. ***Provide an overview of resources***
2. ***Make path discovery easier***
3. Do simple problem detection

Example network description

- Netherlight network description in RDF format:

```
<!– Description of TDM3.amsterdam1.netherlight.net -->
<ndl:Device rdf:about="#tdm3.amsterdam1.netherlight.net">
   <ndl:name>tdm3.amsterdam1.netherlight.net</ndl:name>
   <ndl:locatedAt rdf:resource="#amsterdam1.netherlight.net"/>
   <ndl:hasInterface:rdf:resource="#tdm3.amsterdam1.netherlight.net:503/3"/>
</ndl:Device>
```

Example network description

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   <ndl:name>tdm3.amsterdam1.netherlight.net</ndl:name>
   <ndl:locatedAt rdf:resource="#amsterdam1.netherlight.net"/>
   <ndl:hasInterface:rdf:resource="#tdm3.amsterdam1.netherlight.net:503/3"/>
</ndl:Device>


<!– Description of interfaces 503/3  TDM3.amsterdam1.netherlight.net -->
<ndl:Interface rdf:about="#tdm3.amsterdam1.netherlight.net:503/3">
   <ndl:name>tdm3.amsterdam1.netherlight.net:POS503/3</ndl:name>
   <ndl:connectedTo rdf:resource="#tdm1.geneva1.netherlight.net:5/1"/>
   <rdf:capacity rdf:resource="#OC192"/>
 </ndl:Interface>
```

Provide an overview of resources

- Create an overview / list of devices and interfaces
- Create an overview / list of connections (this is used for the dot file)
- Visualization of the network (demonstration)
- Create a graph (demonstration application)

This can all be done by using SPARQL queries

```
SELECT ?if1 ?if2
WHERE {
    ?if1 ndl:connectedTo ?if2
    ?if2 ndl:connectedTo ?if1
}
```

Provide an overview of resources

- Provide an overview of resources by visualization
- Graphviz - Graph Visualization Software
  - uses .dot file as input
- Relatively easy to generate a .dot input file from an RDF file
- Python script to generate a .dot file from an RDF file*
- Then generate a png,jpg,gif and lots more..
  - `dot -o netherlight.png -Tpng netherlight.dot`

Let's see the result…. ☺

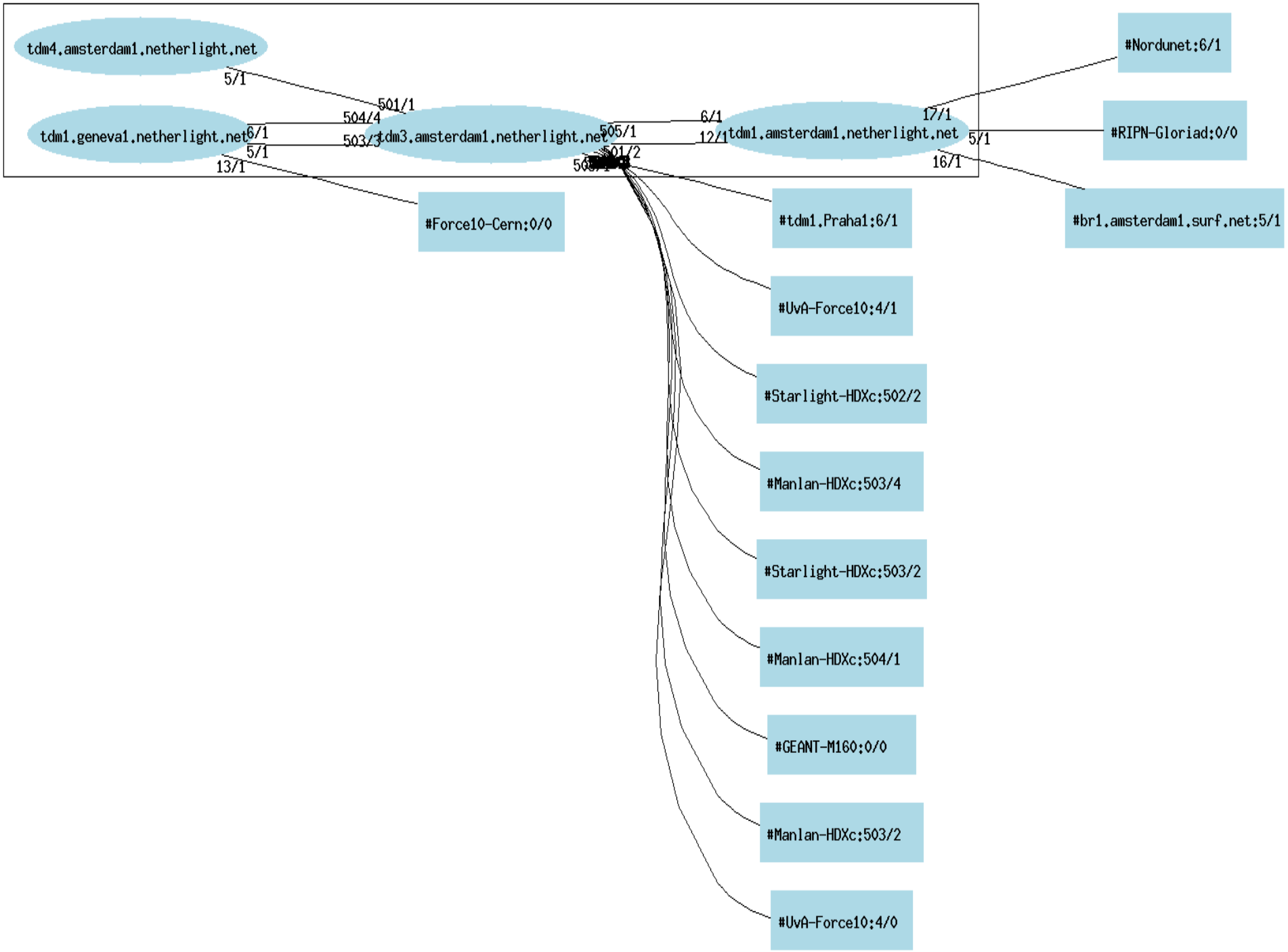
* Author: Jeroen van der Ham, University of Amsterdam

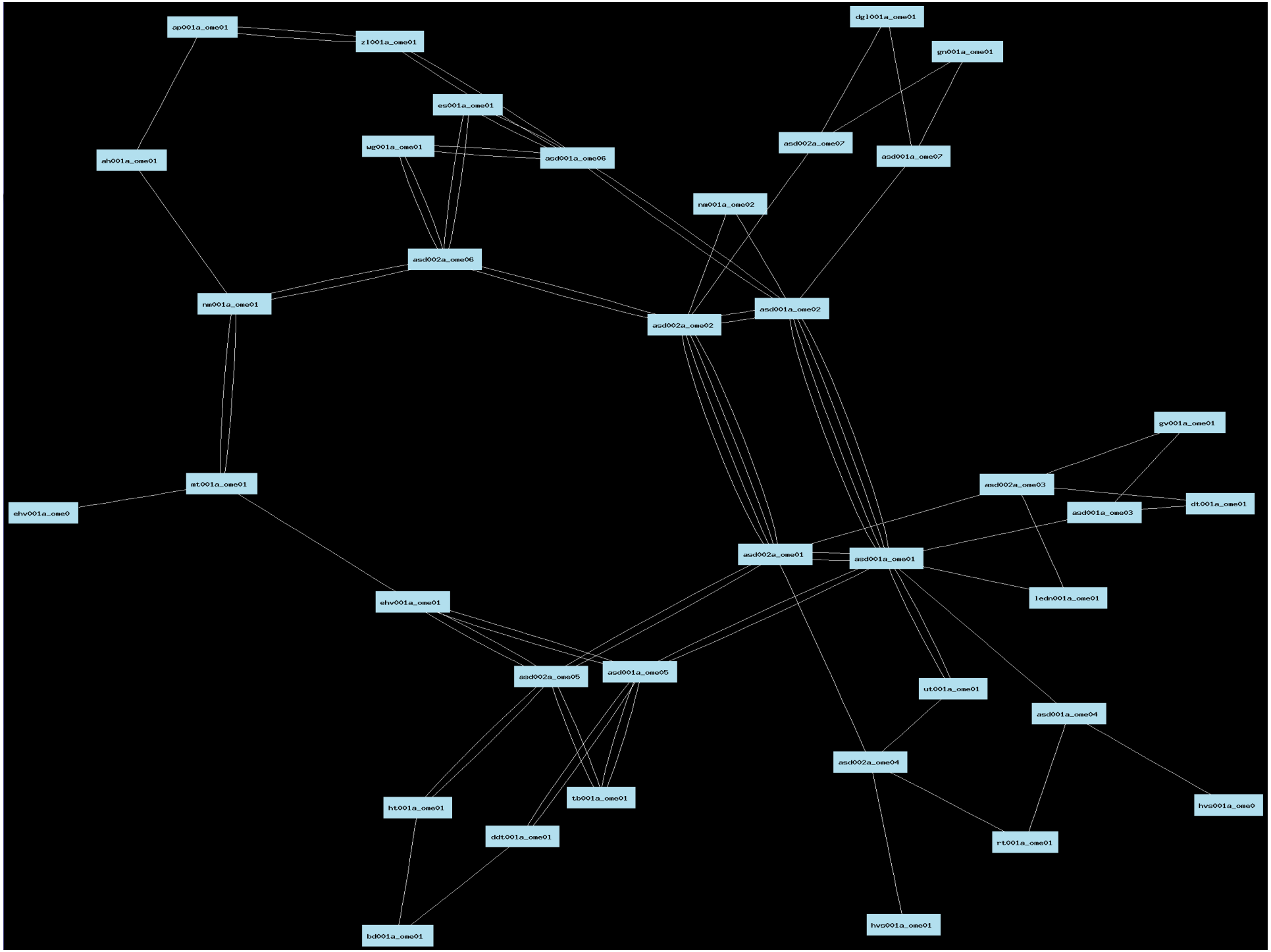
Provide an overview of resources

Visualization of Netherlight network elements.

(Netherlight elements only)

Visualization of Netherlight network elements including edge devices on next slide

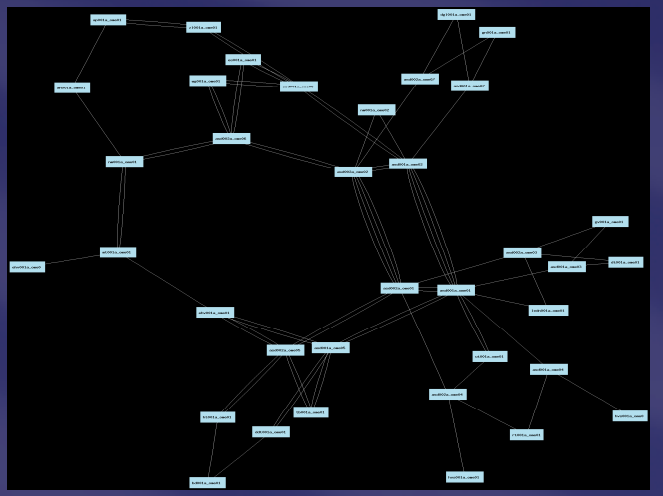

tdm4.amsterdam1.netherlight.net
5/1
501/1
tdm1.geneva1.netherlight.net
6/1
504/4
503/3
5/1
13/1
tdm3.amsterdam1.netherlight.net
505/1
6/1
12/1
501/2
tdm1.amsterdam1.netherlight.net
17/1
5/1
16/1
#Nordunet:6/1
#RIPN-Gloriad:0/0
#br1.amsterdam1.surf.net:5/1
#Force10-Cern:0/0
#tdm1.Praha1:6/1
#UvA-Force10:4/1
#Starlight-HDXc:502/2
#Manlan-HDXc:503/4
#Starlight-HDXc:503/2
#Manlan-HDXc:504/1
#GEANT-M160:0/0
#Manlan-HDXc:503/2
#UvA-Force10:4/0


ap001a_ome01
zl001a_ome01
dgl001a_ome01
gn001a_ome01
es001a_ome01
ah001a_ome01
wg001a_ome01
asd001a_ome06
asd002a_ome07
asd001a_ome07
nm001a_ome02
asd002a_ome06
nm001a_ome01
asd001a_ome02
asd002a_ome02
gv001a_ome01
mt001a_ome01
asd002a_ome03
dt001a_ome01
ehv001a_ome0
asd001a_ome03
asd002a_ome01
asd001a_ome01
ledn001a_ome01
ehv001a_ome01
asd002a_ome05
asd001a_ome05
ut001a_ome01
asd001a_ome04
asd002a_ome04
ht001a_ome01
tb001a_ome01
hvs001a_ome0
ddt001a_ome01
rt001a_ome01
bd001a_ome01
hvs001a_ome01

Path discovery

- Provisioning a circuit through a ‘big’ network can be time consuming
  1) finding a (protected) path across the network
  2) enough time slots available?

Might sound easy but can be difficult ➔



- Tool written by SARA’s network research group to automate this
- Uses an RDF network description as topology description
- Uses a MySQL database that has knowledge of all current cross connects in the network

Path discovery

- Tool written in Perl *

usage: get_path ne1 slot1-port1 ne2 slot2-port2 #timeslots

shortest path between ne1 and ne2

e.g.
```
./get_path.pl \
 tdm1.amsterdam1.netherlight.net 6-1 \
 tdm1.geneva1.netherlight.net  3-5 \
 21
```

The example above will show you how to provision a circuit between tdm1.geneva1.netherlight.net interface: 6/1 and tdm1.amsterdam1.netherlight.net interface 3/5 with a capacity of 21sts containers (1Gb/s using GFP/VCAT)

*Authors:

- Ronald van der Pol (SARA's network research group)
- Andree Toonk (SARA's network research group)

Provisioning tool

- With the RDF information we build a graph representing the network.
  - SPARQL query that gets all connected interfaces
  - Check if these interfaces have enough free timeslots available (MySQL)
  - Add the two interfaces as vertices to the graph
  - Add the link between them as an edge of the graph
  - Add edges to the graph for all internal connections between all the interfaces of one network element

  - **Now a graph representing the network has been built.**
  - Use the Dijkstra algorithm to find the shortest path
  - Returns all the information to create the (VC4 / STS3c) cross connects on the network elements,
    - Includes: network elements, slots, ports, timeslots (MySQL) all the information to create the cross connects on the network elements,

Provisioning tool: Demo

```
$ ./get_path.pl tdm3.amsterdam1.netherlight.net 504-3 tdm1.amsterdam1.netherlight.net 17-1 9
path A:
-----
tdm3.amsterdam1.netherlight.net-504-3 1 tdm3.amsterdam1.netherlight.net-501-2 49
tdm3.amsterdam1.netherlight.net-504-3 4 tdm3.amsterdam1.netherlight.net-501-2 52
tdm3.amsterdam1.netherlight.net-504-3 7 tdm3.amsterdam1.netherlight.net-501-2 55
-----
tdm1.amsterdam1.netherlight.net-12-1 49 tdm1.amsterdam1.netherlight.net-17-1 25
tdm1.amsterdam1.netherlight.net-12-1 52 tdm1.amsterdam1.netherlight.net-17-1 28
tdm1.amsterdam1.netherlight.net-12-1 55 tdm1.amsterdam1.netherlight.net-17-1 31


path B:
-----
tdm3.amsterdam1.netherlight.net-504-3 1 tdm3.amsterdam1.netherlight.net-505-1 73
tdm3.amsterdam1.netherlight.net-504-3 4 tdm3.amsterdam1.netherlight.net-505-1 76
tdm3.amsterdam1.netherlight.net-504-3 7 tdm3.amsterdam1.netherlight.net-505-1 79
-----
tdm1.amsterdam1.netherlight.net-6-1 73 tdm1.amsterdam1.netherlight.net-17-1 25
tdm1.amsterdam1.netherlight.net-6-1 76 tdm1.amsterdam1.netherlight.net-17-1 28
tdm1.amsterdam1.netherlight.net-6-1 79 tdm1.amsterdam1.netherlight.net-17-1 31
```

Future: Provisioning tool

- Next step is to generate the TL1 commands
  - All the necessary cross connect information is available

Syntax:

```
ENT-CRS-STS3C:“NE-name":STS3C-shelf-slotA-portA-timeslotA,STS3C-shelf-slotB-portB-
    timeslotB:CTAG-NUMBER::2WAY:CKTID=“name of Xconnect";
```

Example:

```
ENT-CRS-STS3C:“tdm4.amsterdam1.netherlight.net":STS3C-1-6-1-22,STS3C-1-1-3-
    1:66::2WAY:CKTID="DEMO";
```

- Investigate Inter-domain possibility
- SARA already has developed a TL1 toolkit (Perl)*
  - * Easy to execute TL1 commands with TL1 toolkit
  - * Specific functions for: OME6500, CPL, HDXc, ONS15454
  - * Planning to add a `create_Xconnect()` function

* Based on TL1 Perl module of Arien Vijn, Amsterdam Internet Exchange

URLs + Questions

- SARA's network research group:
  Information about TL1 toolkit & RDF tools.
  http://nrg.sara.nl/
  Email: nrg@sara.nl

- Network Description Language:
  http://staff.science.uva.nl/~vdham/research/ndl/

That's all Folks!