

Lightpath Planning & Monitoring

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This work is done by
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Ronald van der Pol
and funded by
SURFnet
GigaPort

- overview of SURFnet6
- lightpaths in SURFnet6
- requirements for lightpath mgmt
- lightpath tool architecture
- planning and monitoring examples

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- The map illustrates a network of cities in the Netherlands, with lines representing connections between them. Major cities are labeled in blue, including Leeuwarden, Groningen, Assen, Winschoten, Dwingelo, Westerbork, Emmen, Meppel, Hoogeveen, Zwolle, Lelystad, Den Helder, Alkmaar, Haarlem, Amsterdam, Schiphol-Rijk, Lisse, Hilversum, Apeldoorn, Deventer, Enschede, Zutphen, Utrecht, Breukelen, Den Haag, Delft, Rotterdam, Dordrecht, Zierikzee, Middelburg, Vlissingen, Yerseke, Bergen op Zoom, Breda, Tilburg, Wageningen, Arnhem, Nijmegen, Oss, Den Bosch, Eindhoven, Venlo, Maastricht, and Heerlen. The network is most dense in the western and central parts of the country, particularly around Amsterdam and Rotterdam.

- Nortel CPL (Common Photonic Layer)
 - ▶ DWDM
 - ▶ 36 (or 72) wavelengths per fiber
 - 100 GHz (50 GHz) grid
 - ▶ 9 groups of 4 (or 8) wavelengths
- driven by OM5200 and OME6500
 - @ OC192 (9.95 Gbps) speed
- lightpath support (OM5200, OME6500)

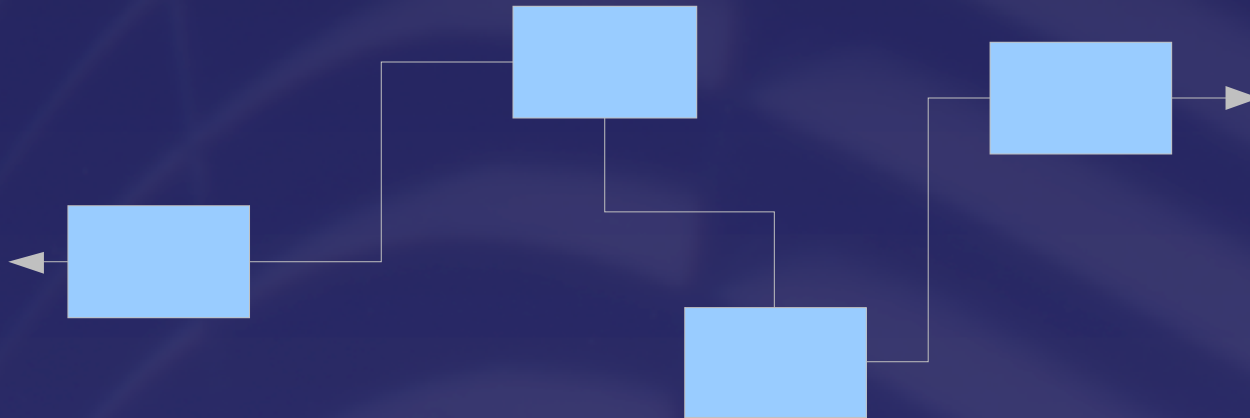


- 150 Mbps, 600 Mbps, 1 Gbps, 10 Gbps
- Ethernet as customer interface
 - ▶ 1 Gbps or 10 Gbps
- VCAT and GFP support
- protected or unprotected

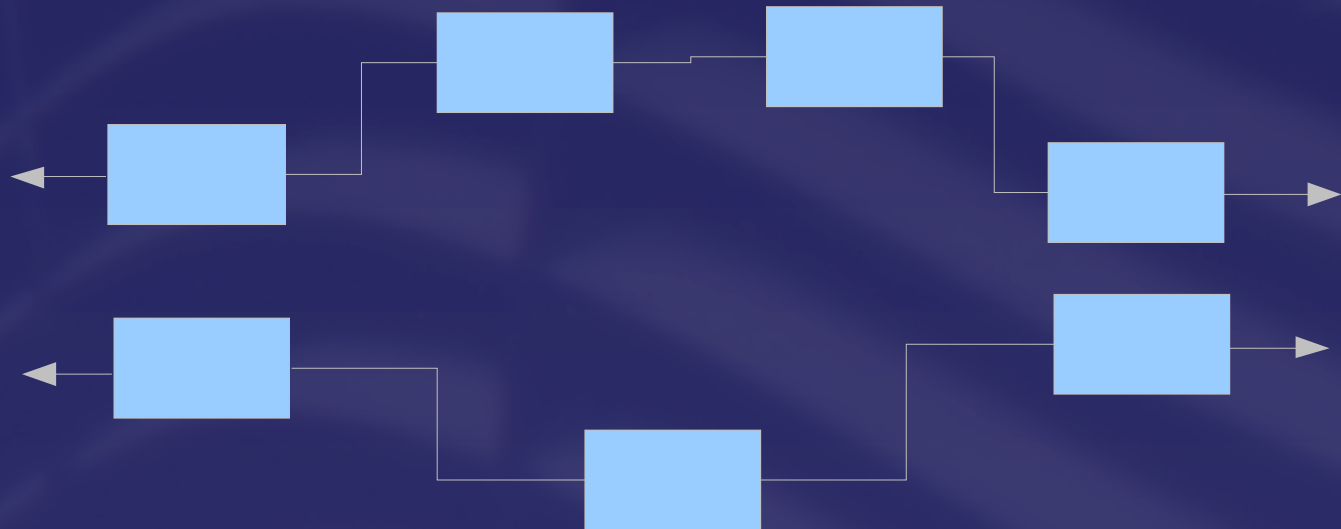
Types of Lightpaths

- unprotected lightpath
- redundant lightpaths
- protected lightpath
- Optical Private Network

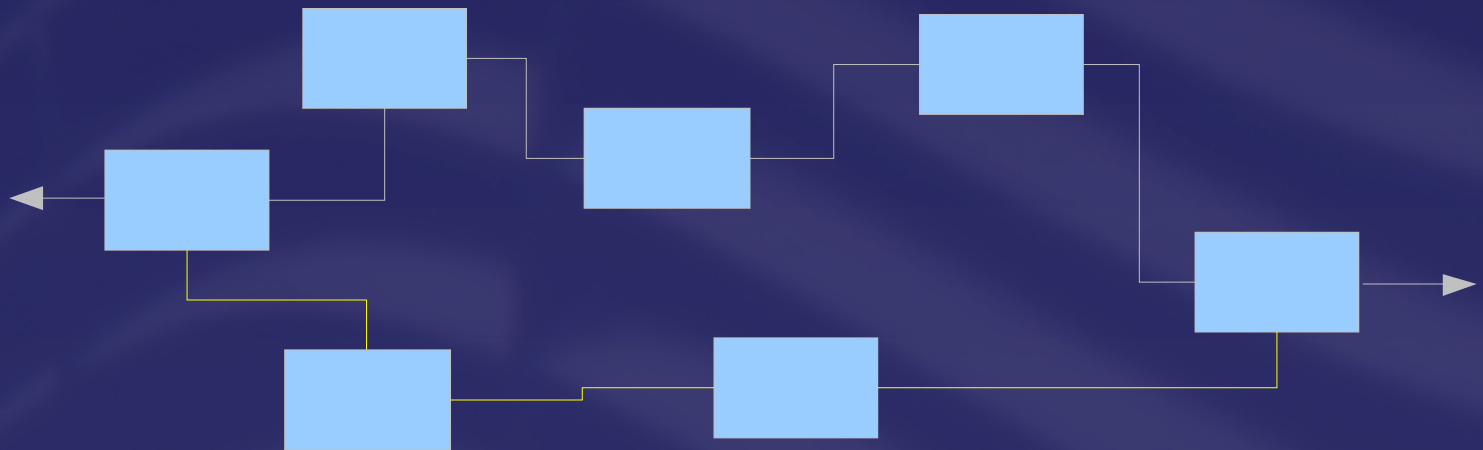
Unprotected Lightpath



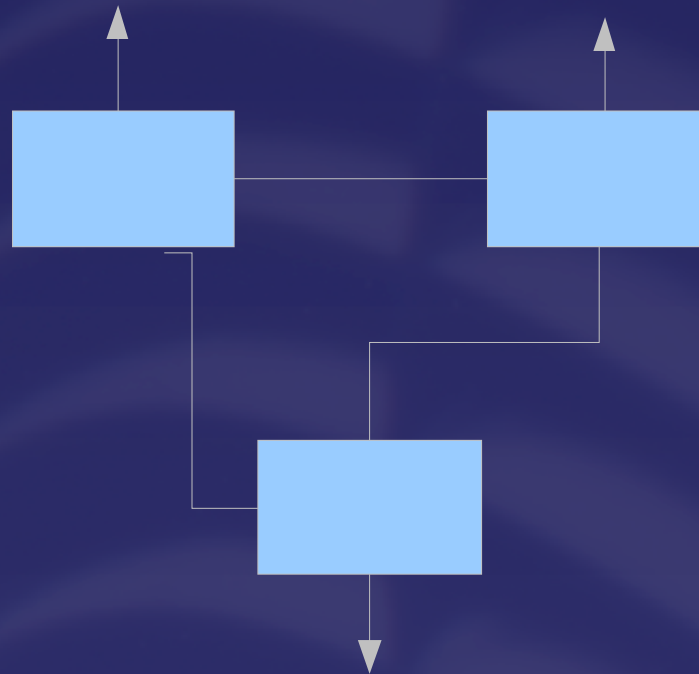
Redundant Lightpath



Protected Lightpath



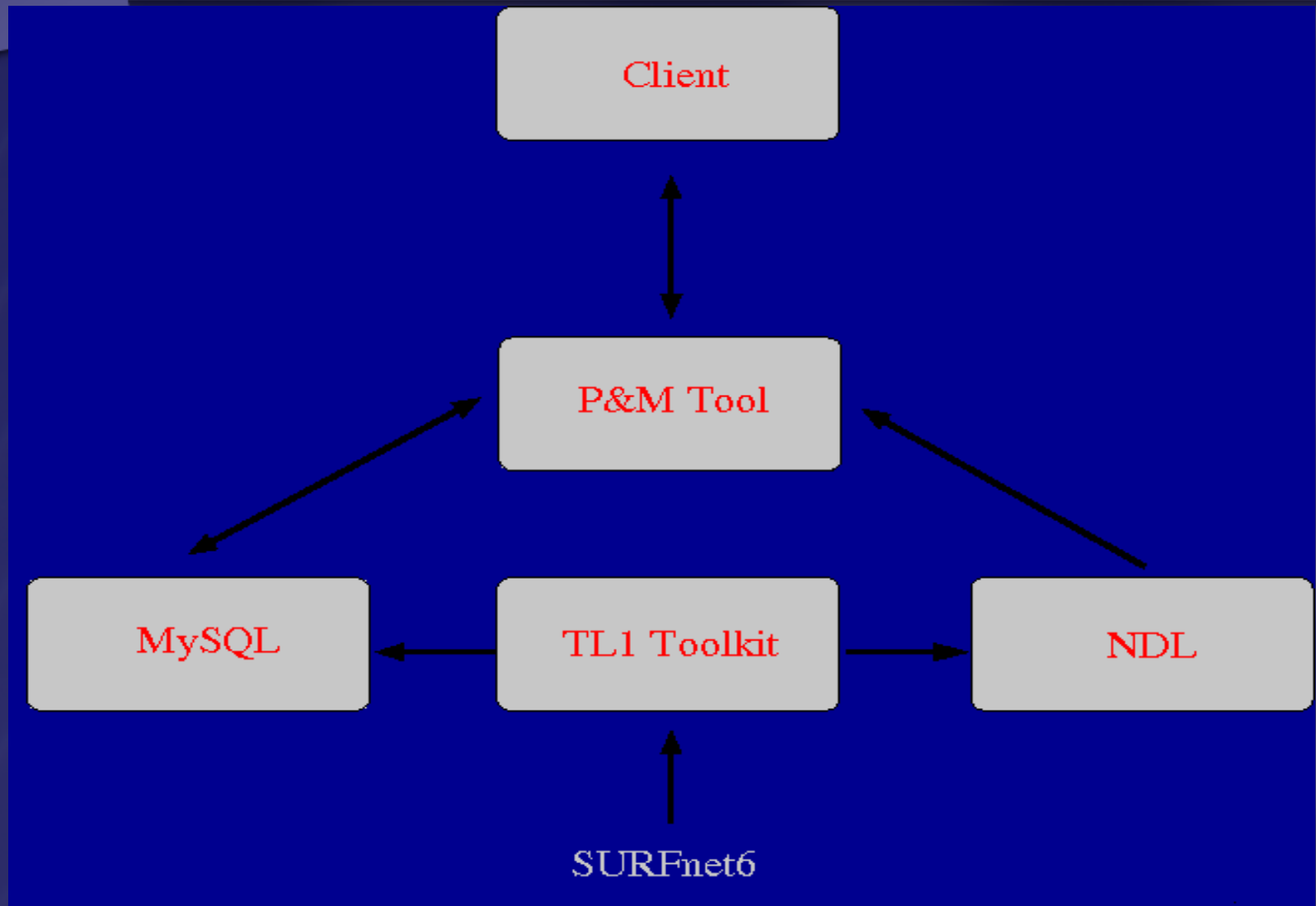
Optical Private Network





- reservation of lightpath resources
 - ▶ customer request
 - ▶ quote and reservation
 - ▶ provisioning with Nortel NMS
- periodic reporting of free resources
- overview of all lightpaths
- mapping lightpath <--> fiber span
- open source software

Architecture



TL1 Toolkit

- Perl module developed by SARA
- Easy interface to TL1 based equipment (e.g. Nortel)
- Reads config from network elements

MySQL database

- ▀ Used to store crossconnect info
- ▀ Used to store alarm information
- ▀ Used to store reservations

Crossconnect table

localhost / localhost / surfnet6 / crossconnects | phpMyAdmin 2.8.2-Debian-0.2 - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/phpmyadmin/index.php?lang=en-utf-8&token=efc04d903282199

Getting Started Latest Headlines NOS.nl | Nieuws, Spo... DFT.nl Nieuws

Sort by key: None Go

in vertical mode and repeat headers after 100 cells

id	9785	9786	9787	9788
host	Ah001A_OME01	Ah001A_OME01	Ah001A_OME01	Ah001A_OME01
circuitname	Ah001A-Asd002A_Gel(L2ss-01)	Ah001A-Asd002A_Gel(L2ss-01)	Ah001A-Asd001A_Gel(L2ss-01)	Ah001A-Asd001A_Gel(L2ss-01)
bandwidth	3	3	3	3
fromslot	9	9	6	6
fromsubslot	0	0	0	0
fromport	1	1	1	1
fromfirststs	163	166	148	151
fromlaststs	165	168	150	153
toslot	2	2	2	2
tosubslot	0	0	0	0
toport	4	4	3	3
tofirststs	16	19	1	4
tolaststs	18	21	3	6
active	no	no	no	no
lastseen	2006-06-12 19:35:53	2006-06-12 19:35:53	2006-06-12 19:35:53	2006-06-12 19:35:53
inserttime	2006-05-01 16:47:38	2006-05-01 16:47:38	2006-05-01 16:47:38	2006-05-01 16:47:38
swmateslot	0	0	0	0
swmatesubslot	0	0	0	0
swmateport	0	0	0	0
swmatefromsts	0	0	0	0
swmatetosts	0	0	0	0
fromdate	2006-05-01 16:47:38	2006-05-01 16:47:38	2006-05-01 16:47:38	2006-05-01 16:47:38
todate	2020-12-12 12:12:12	2020-12-12 12:12:12	2020-12-12 12:12:12	2020-12-12 12:12:12
status	discovered	discovered	discovered	discovered

Check All / Uncheck All With selected:

Done Adblock

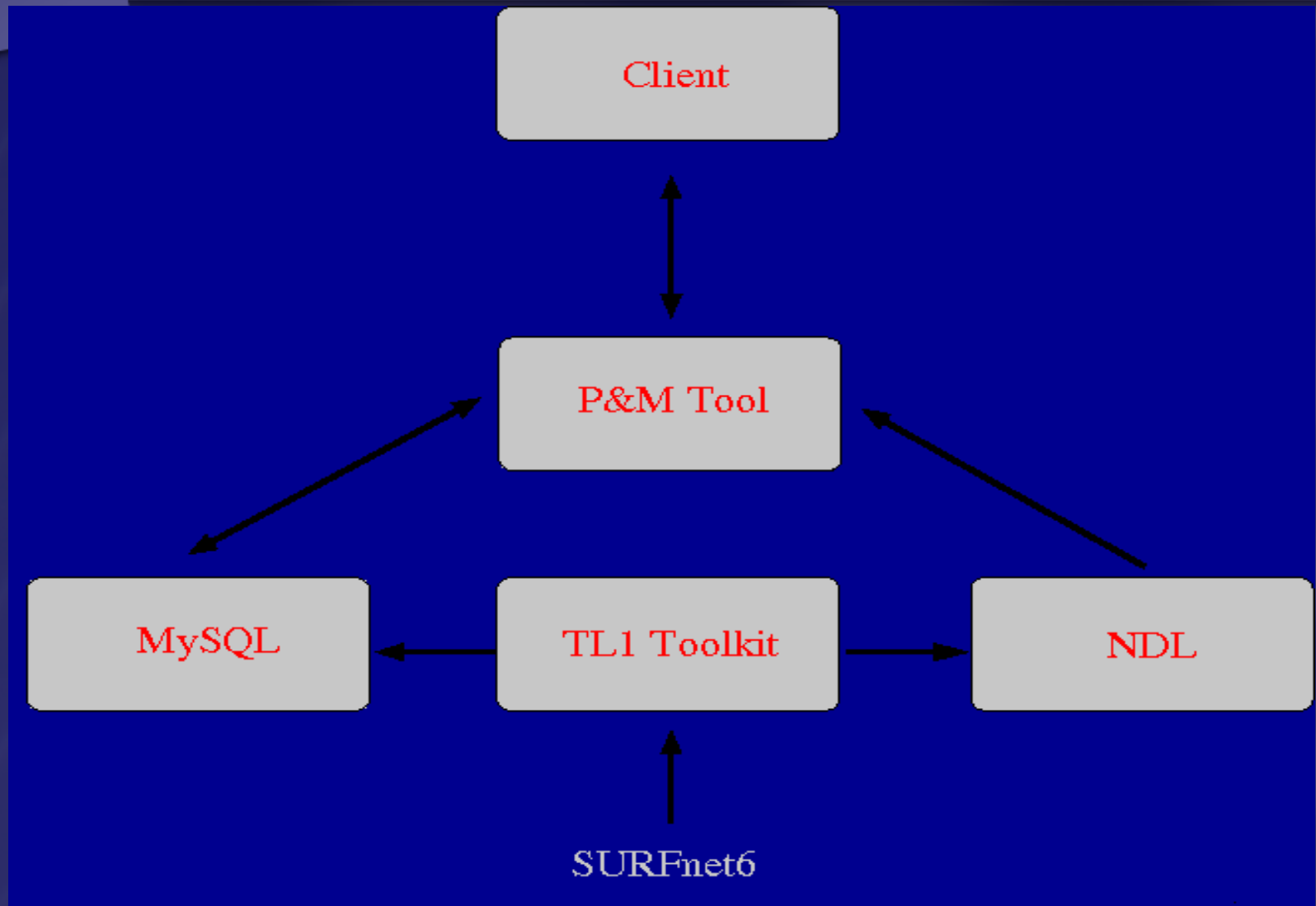
NDL

- Network Description Language
- Framework developed by UvA
- NDL Perl module developed by SARA
- SURFnet6 NDL file generated from actual network configs (with TL1 Toolkit)
- Uses Section Trace for neighbour info

Planning and Monitoring Server

- Read info from MySQL database
- Read NDL topology information
- Provide info via Web Services
- Write reservations to database

Architecture



Planning Example (1/4)

Path Provisioning - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/cgi-bin/webform.cgi

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Please choose the two endpoints of the lightpath:

Ah001a_ome01:1/1

Ah001a_ome01:1/1

next

Done

Adblock

Planning Example (2/4)

Path Provisioning - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/cgi-bin/webform.cgi

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SURFnet6
Research on Networks

NOC

Please choose the two endpoints of the lightpath:

Asn001a_ome01:1/2

Ledn001a_ome01:2/2

next

Done

Adblock

Planning Example (3/4)

Path Provisioning - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/cgi-bin/webform.cgi

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 SURFnet6
Research on Networks **NOC**

Lightpath between Asn001a_ome01:1/2 and Ledn001a_ome01:2/2:

Should this be a protected path? ☐ yes ☒ no

How many VC-4s?

Name of this lightpath:

(finding a path may take some time)

Done

Planning Example (4/4)

Path Provisioning - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/cgi-bin/webform.cgi

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 SURFnet6
Research on Networks **NOC**

Path	
From	To
Asn001a_ome01:1/2	Asn001a_ome01:9/1
Gn001a_ome01:2/2	Gn001a_ome01:9/1
Asd002a_ome07:5/1	Asd002a_ome07:10/1
Asd002a_ome02:5/1	Asd002a_ome02:1/1
Asd002a_ome01:1/1	Asd002a_ome01:4/1
Ledn001a_ome01:10/1	Ledn001a_ome01:2/2

Cancel Reserve in Database

Done Adblock

Algorithm (1/2)

- Read NDL file with topology
- build graph
 - vertices: interfaces
 - edges: transmission lines between interfaces
 - + full mesh between interfaces within OME
- Read MySQL timeslot information
- Remove interfaces with too few free timeslots
- Apply metrics: prefer center stages in Amsterdam
- Run Dijkstra Constraint Based Shortest Path Algorithm

Algorithm (2/2)

■ For protected paths:

- run Dijkstra for primary path
- remove interfaces of primary path
- run Dijkstra for backup path

■ Loose protection: disjoint transmission lines only

■ Strict protection:

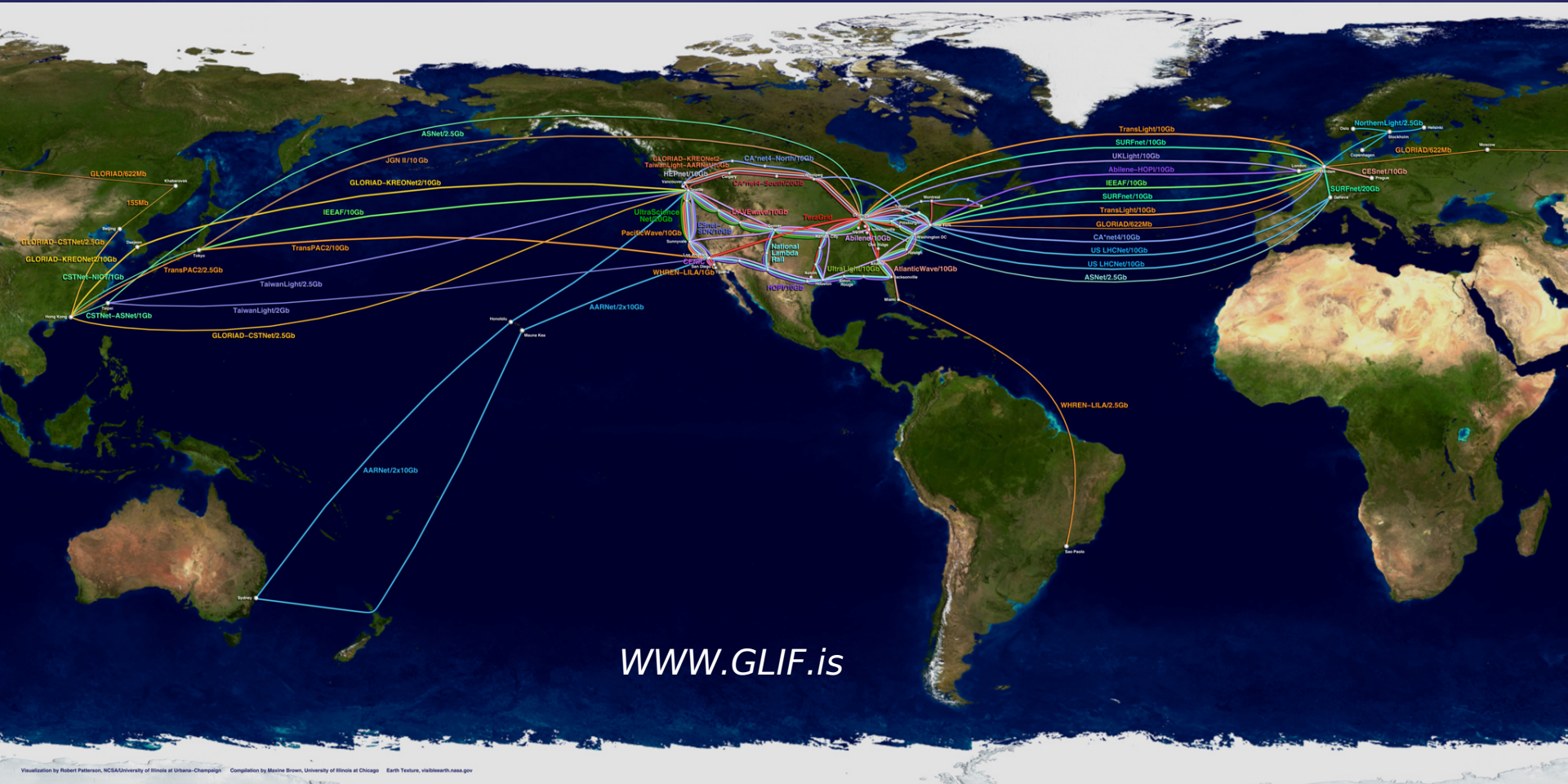
- disjoint transmission lines
- disjoint OME equipment (except start/end)

- Europe's largest Optical Exchange
- Interconnect for lightpaths
- Participant in GLIF and Gloriad
- Nortel HDXc at the heart



GLIF

Global Lambda Integrated Facility



WWW.GLIF.is



The screenshot shows a Mozilla Firefox browser window titled "NetherLight NOC - Mozilla Firefox". The address bar displays "http://noc.netherlight.net/". The page has a yellow header with the "NL Light" logo on the left and the text "NetherLight NOC" on the right. The main content area is white and contains several sections:

- About this page**: A paragraph stating that the page contains operational information about [NetherLight](#), the optical exchange point in the Netherlands. It mentions that lightpath status information and topology pictures are targeted to other GOLE operators and that the page is **work in progress**.
- Lightpath Overview**: A paragraph stating that the overview is the [actual status of the lightpaths going through NetherLight](#). It mentions that the page was built with the help of SARA's TL1 Toolkit and provides a link to [TL1-Toolkit](#) for more information and examples. It also mentions that there are some [example scripts](#) available showing how the monitoring of NetherLight is done.
- Network topology**: A paragraph stating that they try to keep this [network topology picture](#) of NetherLight up to date. It mentions that NetherLight is [connected](#) to several other [GLIF Open Lightpath Exchanges](#). It also mentions that there is a [NetherLight NDL](#) file available.
- Open tickets**: A paragraph stating that there is a [list of open tickets](#) and that users should look for tickets that start with *NetherLight* (not SURFnet6).
- NOC contact information**: A paragraph stating that the [contact information](#) is available on the GLIF website.



Applications
Places
System
Fri May 18, 15:57:21

NetherLight lightpaths - Mozilla Firefox

File Edit View History Bookmarks Tools Help

NetherLight lightpath status overview

ok	2,5Gig SURFnet-Abilene
ok	Amsterdam-chicago-DRAGON-1gbs
ok	Amsterdam-NewYork-DRAGON-1gbs
ok	Caltech-CERN
ok	CERN-ASnet-1
ok	CERN-ASnet-2
ok	CERN-MANlan-Canarie-Triumph-1
ok	CERN-MANlan-Canarie-Triumph-5Gig
ok	CERN-SARA
ok	F10-WAN-PHY-TST
ok	Iperf_i2cat_test
ok	IRNC - GEANT/Abilene OC192
ok	LHC-CERN-RIPN
ok	MAN LAN Laag 2 Exchange New York
ok	NBD Amsterdam-Torun_polen
ok	Prague ASnet - Korea
ok	Prague-Chicago(ViLab)
ok	Prague-Chicago-IoP-FNAL
ok	RIPN to Moscow
ok	RIPN-StarLight-Terraflow-project
ok	RIPN/GLORIAD
ok	SARA-Deisa
ok	Shanghai-jive test
DOWN	tdm1.ams1.netherlight -- Oslo (score project)
ok	tdm3.ams1_ManLAN-1GIG(Score-N-light)

click on the lightpath name to get more information about the status/route and alarms for this specific lightpath.

Page generated on: 2007-05-18 15:56:53

Use this form to get a list of lightpaths going through a specific port:

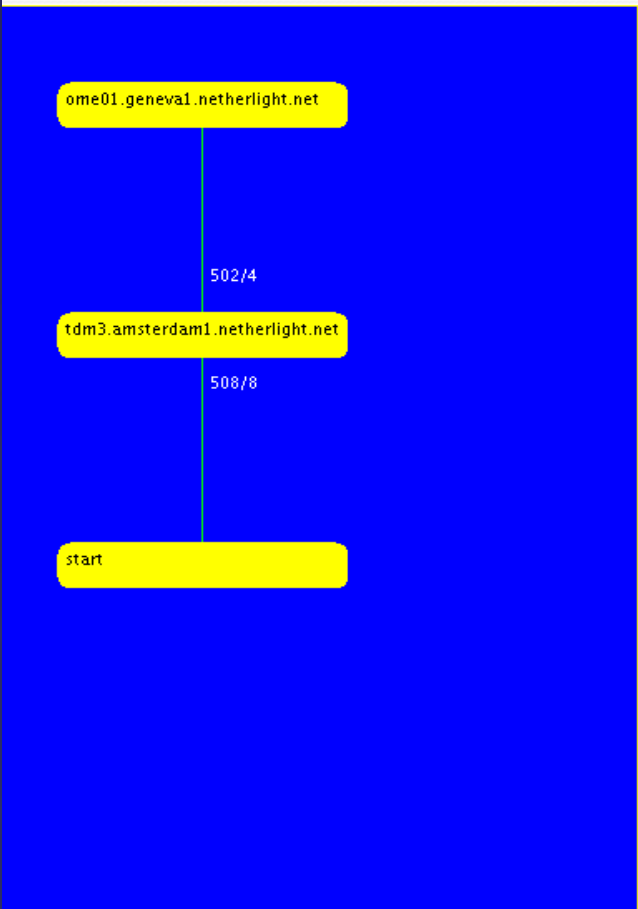
device:
slot:
subslot:

xterm (3)
NetherLight lightpaths - Mozilla Firefox
TNC2007-presentatie.ppt - OpenOffice....

Applications Places System Fri May 18, 15:58:38

Netherlight TL1 Circuits - Mozilla Firefox

File Edit View History Bookmarks Tools Help



```

graph TD
    A[ome01.geneva1.netherlight.net] ---|502/4| B[tdm3.amsterdam1.netherlight.net]
    B ---|508/8| C[start]
        
```

circuit details: CERN-ASnet-2

Power by the [TL1-Toolkit!](#)

NE	circuitname	bandwidth	begin	end	Alarm
gen001a_ome01.netherlight.net	CERN-ASnet-2 STS-3		6/1/22-24	2/1/1-3	OK
gen001a_ome01.netherlight.net	CERN-ASnet-2 STS-3		6/1/25-27	2/1/4-6	OK
gen001a_ome01.netherlight.net	CERN-ASnet-2 STS-3		6/1/28-30	2/1/7-9	OK
gen001a_ome01.netherlight.net	CERN-ASnet-2 STS-3		6/1/31-33	2/1/10-12	OK
gen001a_ome01.netherlight.net	CERN-ASnet-2 STS-3		6/1/34-36	2/1/13-15	OK
gen001a_ome01.netherlight.net	CERN-ASnet-2 STS-3		6/1/37-39	2/1/16-18	OK
gen001a_ome01.netherlight.net	CERN-ASnet-2 STS-3		6/1/40-42	2/1/19-21	OK
tdm3.amsterdam1.netherlight.net	CERN-ASnet-2 STS-3		502/0/4/40-42	508/1/8/19-21	OK
tdm3.amsterdam1.netherlight.net	CERN-ASnet-2 STS-3		502/0/4/37-39	508/1/8/16-18	OK
tdm3.amsterdam1.netherlight.net	CERN-ASnet-2 STS-3		502/0/4/34-36	508/1/8/13-15	OK
tdm3.amsterdam1.netherlight.net	CERN-ASnet-2 STS-3		502/0/4/31-33	508/1/8/10-12	OK
tdm3.amsterdam1.netherlight.net	CERN-ASnet-2 STS-3		502/0/4/28-30	508/1/8/7-9	OK
tdm3.amsterdam1.netherlight.net	CERN-ASnet-2 STS-3		502/0/4/25-27	508/1/8/4-6	OK
tdm3.amsterdam1.netherlight.net	CERN-ASnet-2 STS-3		502/0/4/22-24	508/1/8/1-3	OK

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xterm (3) Netherlight TL1 Circuits - Mozilla Firefox TNC2007-presentatie.ppt - OpenOffice....

Netherlight TL1 Circuits - Mozilla Firefox

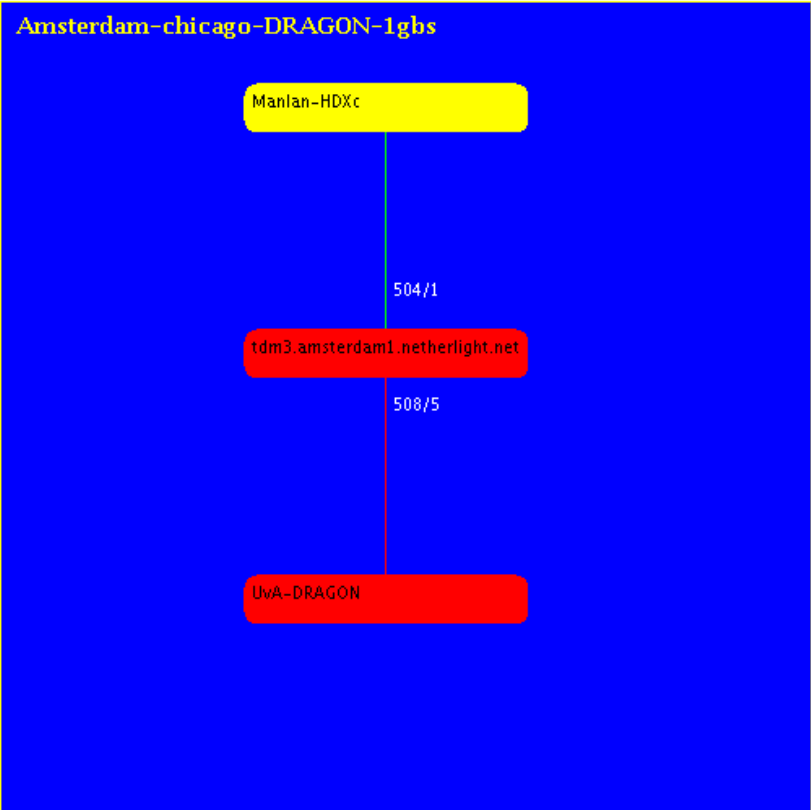
File Edit View History Bookmarks Tools Help

http://noc.netherlight.net/cgi-bin/drawjava.pl?Amsterdam-chicago-DRAGON-1gbs Google

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Back

Amsterdam-chicago-DRAGON-1gbs



```

graph TD
    A[Manlan-HDXc] ---|504/1| B[tdm3.amsterdam1.netherlight.net]
    B ---|508/5| C[UvA-DRAGON]
        
```

circuit details: Amsterdam-chicago-DRAGON

Status for this circuit is: **DOWN**

Powered by the [TL1-Toolkit!](#)

NE	circuitname	bandwidth	begin
tdm3.amsterdam1.netherlight.net	Amsterdam-chicago-DRAGON-1gbs	STS-3	508/5/1-3

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Done

Adblock

Lighpath status overview - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://localhost/cgi-bin/LP-status.pl

Getting Started Latest Headlines NOS.nl | Nieuws, Spo... DFT.nl Nieuws

182	up	Spl001A-Asd001	GE1(InHolland SN6 IP)
183	up	Spl001A-Asd002	GE1(InHolland SN6 IP)
184	up	Spl001A Gv001A	Ge1(InHolland-Gv)
185	up	Spl001A Gv001A	Ge2(InHolland-Gv)
186	up	Std001A EHV001A	Ge1(Fontys-Std)
187	up	Tb001A EHV001A	Ge1(Fontys-Tb)
188	up	Ut001A-Asd001A	GE1(OU-Ut)
189	up	Ut001A-Asd001A	GE1(OU Ut)
190	up	Ut001A-Asd001a	GE1(OWINSP)
191	up	Ut001A-Asd002A	Ge1(OU-Ut)
192	up	Ut001A-Dt001A	GE-TNO Soesterberg
193	up	Ut001A-DT001A	GE1-TNO Soesterberg
194	up	VC4	
195	up	Veq001A EHV001A	Ge1(Fontys-Veghel)
196	up	Vl002A EHV001A	Ge1(Fontys-Venlo)
197	up	Vs001A-Asd001A	3VC4(HZeeland)
198	up	Vs001A-Asd001A	Ge1(OU-Vs)
199	up	Vs001A-Asd002A	3VC4(Roosevelt)
200	up	Vs001A-Asd002A	1VC4(HZeeland)
201	up	Vs001A-Asd002A	3VC4(Roosevelt)
202	up	Vs001A-Asd002A	Ge1(OU-Vs)
203	up	Vs001A-Mdb001A	Ge1(LP Zebi Hzee)
204	up	Vs001A-Mdb001A	Ge2(LP Zebi Hzee)
205	up	Wq001A-Lls001A	GE3(WUR-DLO)
206	up	Ws-Emn-Asd002A	GE1(L2SS01)
207	up	Ws-Emn-Asd002A	Ge1L2SS01)
208	up	Ws Asd001A	GE1 (L2SS-Ws-Mp)
209	up	Yer001A-Asd002A	1VC4(NIOO)
210	up	Zl001A-Asd001A	L2ss-01
211	up	Zl001A-Asd002A	L2ss-01
212	up	Zl003A-Asd001A	GE2(OU-Zl)
213	up	Zl003A-Asd001A	GE2(OU Zl)
214	up	Zl003A-Asd002A	GE2(OU-Zl)
215	up	Zl003A-Asd002A	GE2(OU Zl)

Click on the circuitname to get more information.

Done

Adblock

interface information for Asd001a_ome05

Interface	Card Type	Neighbour	Capacity (STS Timeslots)	number of free STS timeslots
Asd001a_ome05:1/1	GigE	NA	21	0
Asd001a_ome05:1/2	GigE	NA	21	0
Asd001a_ome05:1/3	GigE	NA	21	21
Asd001a_ome05:1/4	GigE	NA	21	0
Asd001a_ome05:10/1	SONET	Asd001a_ome01:9/1	192	84
Asd001a_ome05:11/1	SONET	Asd001a_ome02:12/1	192	87
Asd001a_ome05:2/1	GigE	NA	21	0
Asd001a_ome05:2/2	GigE	NA	21	0
Asd001a_ome05:2/3	GigE	NA	21	0
Asd001a_ome05:2/4	GigE	NA	21	0
Asd001a_ome05:3/1	GigE	NA	21	18
Asd001a_ome05:3/2	GigE	NA	21	21
Asd001a_ome05:3/3	GigE	NA	21	18
Asd001a_ome05:3/4	GigE	NA	21	21
Asd001a_ome05:4/1	GigE	NA	21	0
Asd001a_ome05:4/2	GigE	NA	21	18
Asd001a_ome05:4/3	GigE	NA	21	21
Asd001a_ome05:4/4	GigE	NA	21	0
Asd001a_ome05:5/1	SONET	Ddt001a_ome01:6/1	192	21
Asd001a_ome05:6/1	SONET	Tb001a_ome01:6/1	192	129
Asd001a_ome05:9/1	SONET	Elv001a_ome01:6/1	192	0

Backbone usage

Ah001a_ome01:6/1 - Ap001a_ome01:9/1	OC192 - free timeslots 42	78%
Ah001a_ome01:9/1 - Nm001a_ome01:6/1	OC192 - free timeslots 39	80%
Alr001a_ome01:6/1 - Asd001a_ome07:11/1	OC192 - free timeslots 129	33%
Amr001a_ome01:1/1 - Hedr001a_ome01:2/1	OC48 - free timeslots 0	100%
Amr001a_ome01:1/2 - Hlm001a_ome01:6/1	OC48 - free timeslots 6	88%
Amr001a_ome01:5/1 - Asd001a_ome04:5/1	OC192 - free timeslots 102	47%
Ap001a_ome01:6/1 - Zl001a_ome01:9/1	OC192 - free timeslots 42	78%
Ap001a_ome01:9/1 - Ah001a_ome01:6/1	OC192 - free timeslots 42	78%
Asd001a_ome01:1/1 - Asd001a_ome02:1/1	OC48 - free timeslots 6	88%
Asd001a_ome01:1/2 - Asd001a_ome02:1/2	OC48 - free timeslots 6	88%
Asd001a_ome01:10/1 - Asd002a_ome01:10/1	OC192 - free timeslots 51	73%
Asd001a_ome01:12/1 - Asd002a_ome01:11/1	OC192 - free timeslots 192	0%
Asd001a_ome01:13/1 - Asd001a_ome06:11/1	OC192 - free timeslots 69	64%
Asd001a_ome01:3/1 - Ut001a_ome01:6/1	OC192 - free timeslots 150	22%
Asd001a_ome01:4/1 - Ledn001a_ome01:5/1	OC192 - free timeslots 108	44%
Asd001a_ome01:5/1 - Asd001a_ome03:10/1	OC192 - free timeslots 3	98%
Asd001a_ome01:6/1 - Asd001a_ome04:10/1	OC192 - free timeslots 60	69%
Asd001a_ome01:9/1 - Asd001a_ome05:10/1	OC192 - free timeslots 84	56%
Asd001a_ome02:1/1 - Asd001a_ome01:1/1	OC48 - free timeslots 6	88%
Asd001a_ome02:1/2 - Asd001a_ome01:1/2	OC48 - free timeslots 6	88%
Asd001a_ome02:10/1 - Asd002a_ome02:10/1	OC192 - free timeslots 6	97%
Asd001a_ome02:12/1 - Asd001a_ome05:11/1	OC192 - free timeslots 87	55%
Asd001a_ome02:13/1 - Asd001a_ome04:11/1	OC192 - free timeslots 150	22%
Asd001a_ome02:14/1 - Asd001a_ome03:11/1	OC192 - free timeslots 108	44%
Asd001a_ome02:3/1 -	OC192 - free timeslots 186	3%
Asd001a_ome02:4/1 - Nm001a_ome02:6/1	OC192 - free timeslots 192	0%

Timeslot Information

Es001a_ome01 6/1

free
reserved
used

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

Thank you!

Ronald van der Pol

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<http://nrg.sara.nl/>