Lightpath Planning & Monitoring

Ronald van der Pol

rvdp@sara.nl

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This work is done by

Andree Toonk

Ronald van der Pol

and funded by

SURFnet

GigaPort

Overview

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

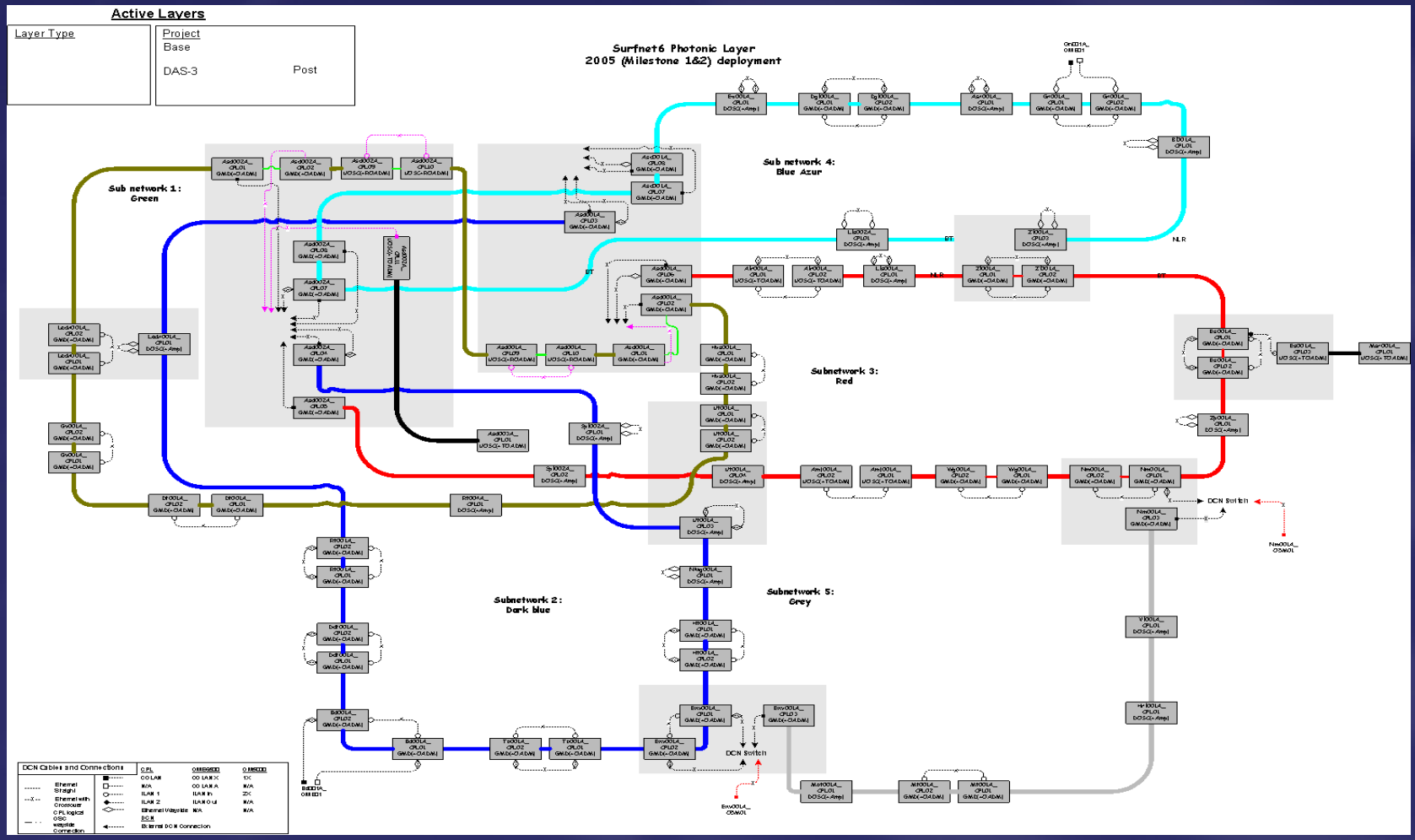
SURFnet6 Topology

- routing
  - Avici
- Optical Network
  - Nortel
- 6000 km dark fiber

Nortel Optical Network

- 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)

SURFnet6 DWDM Subnets



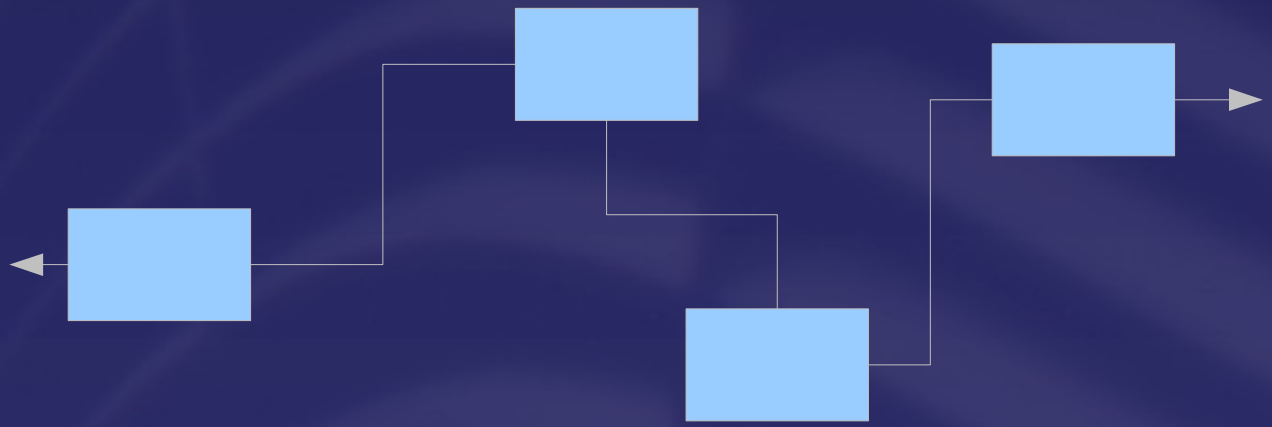
Lightpaths

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

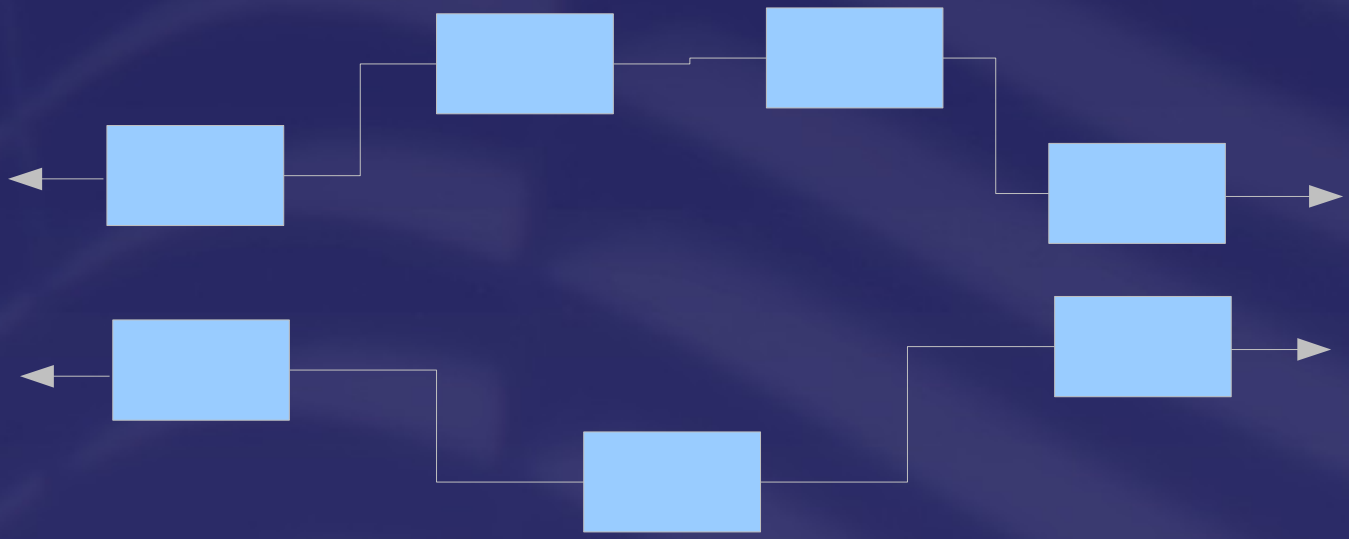
Types of Lightpaths

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

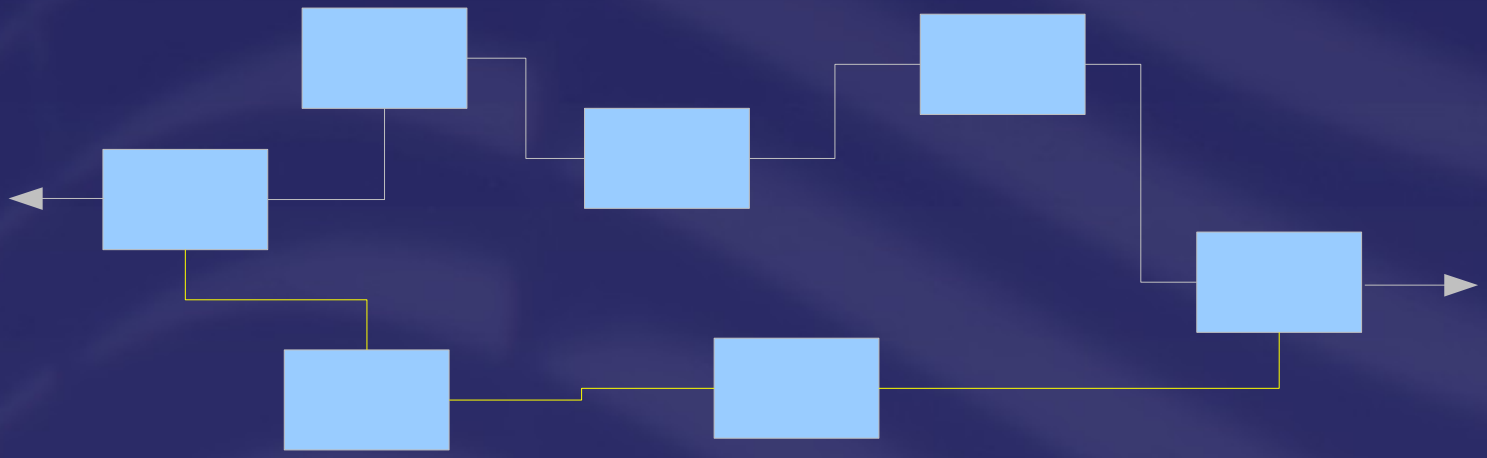
Unprotected Lightpath



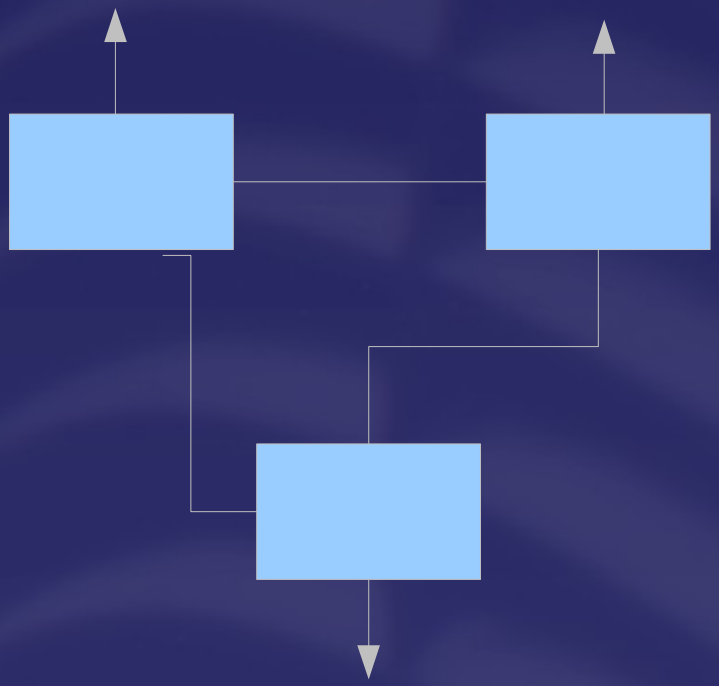
Redundant Lightpath



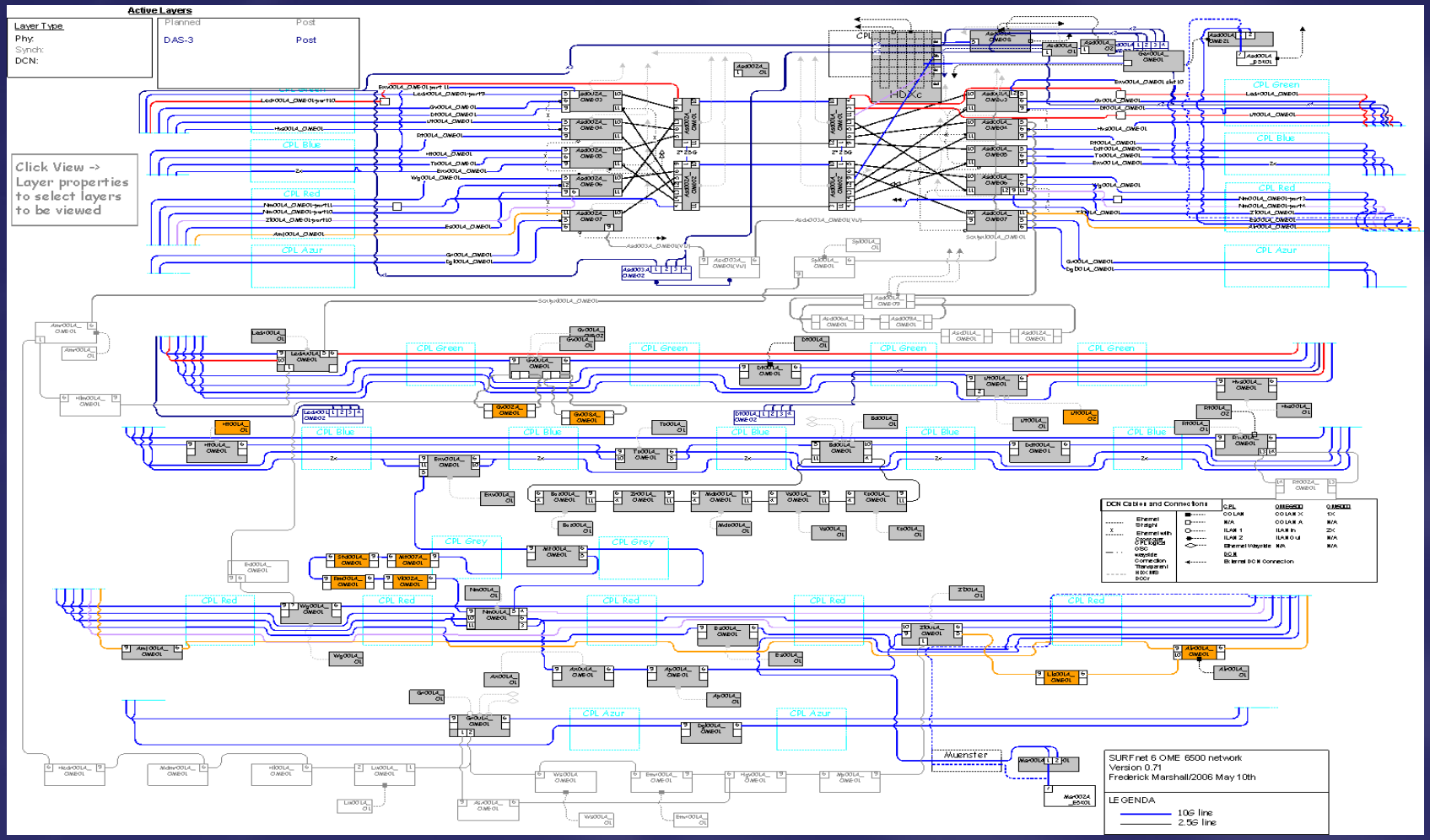
Protected Lightpath



Optical Private Network



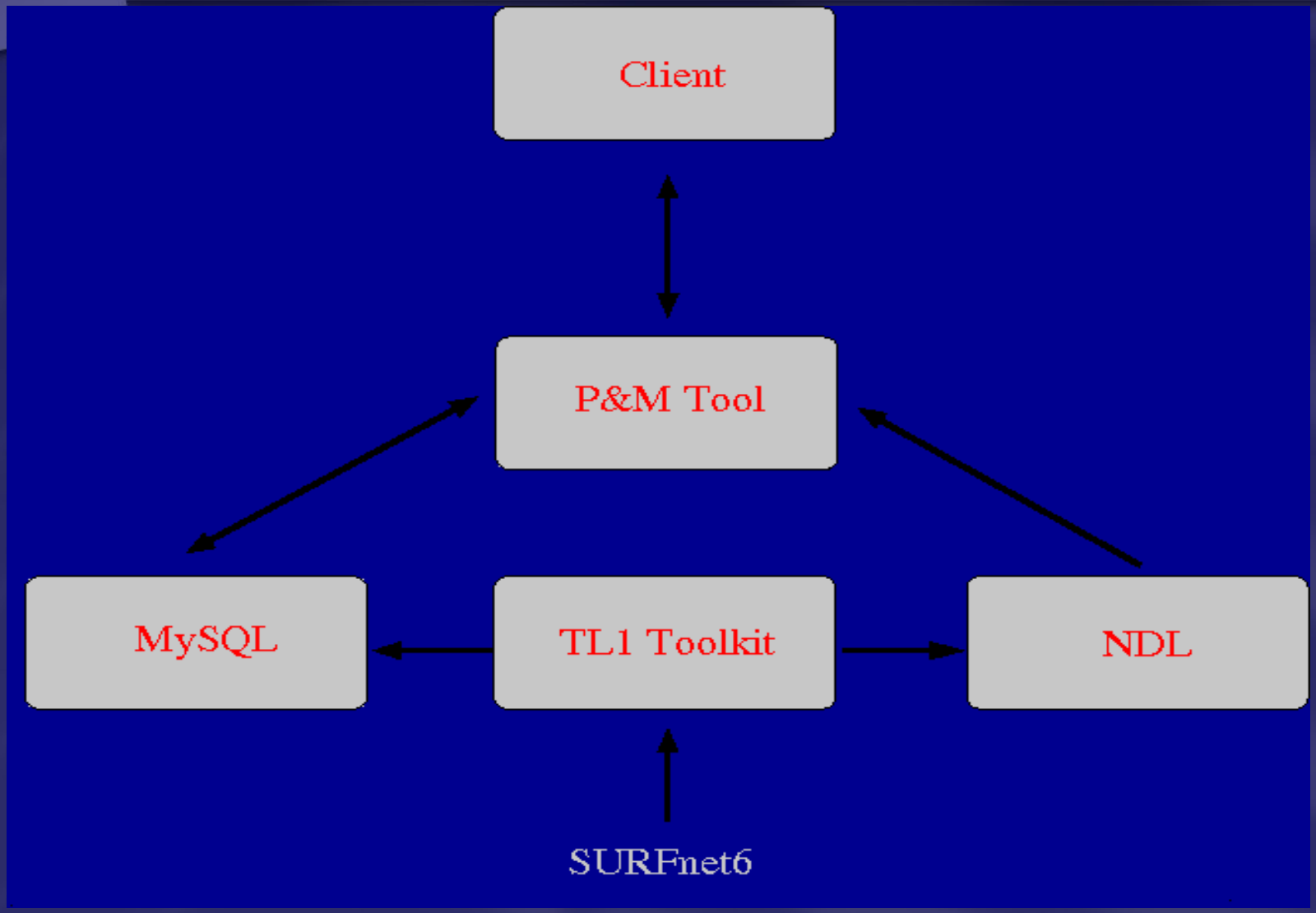
OME6500 NG-SDH layer



Lightpath Management

- 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



Building Blocks

TL1 Toolkit

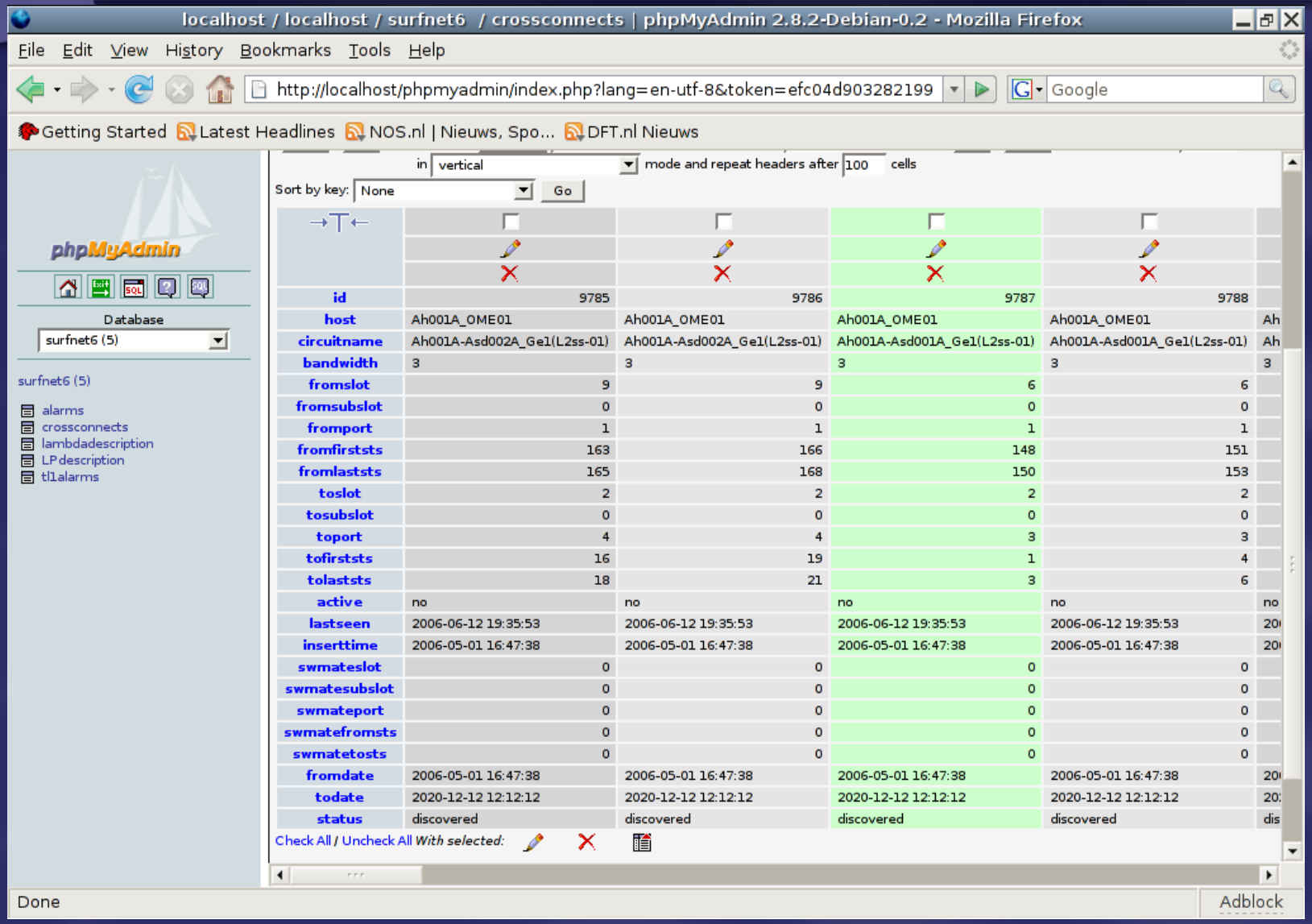
- Perl module developed by SARA
- Easy interface to TL1 based equipment (e.g. Nortel)
- Reads config from network elements

Building Blocks

MySQL database

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

Crossconnect table



id	9785	9786	9787	9788	
host	Ah001A_OME01	Ah001A_OME01	Ah001A_OME01	Ah001A_OME01	Ah
circuitname	Ah001A-Asd002A_Ge1(L2ss-01)	Ah001A-Asd002A_Ge1(L2ss-01)	Ah001A-Asd001A_Ge1(L2ss-01)	Ah001A-Asd001A_Ge1(L2ss-01)	Ah
bandwidth	3	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	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	20
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	20
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	20
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	20
status	discovered	discovered	discovered	discovered	dis

Building Blocks

NDL

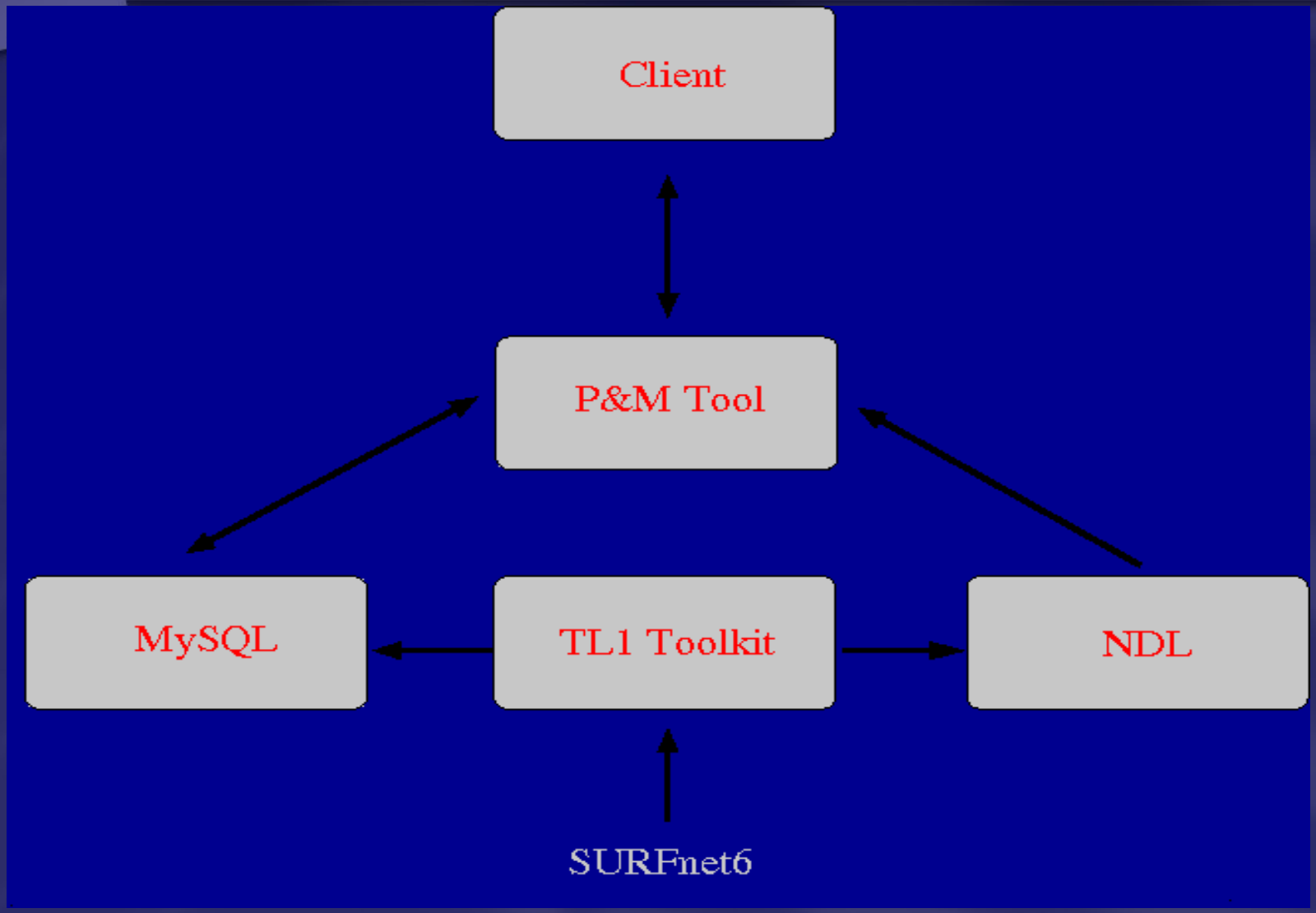
- Network Description Language
- Framework developed by UvA
- NDL Perl module developed by SARA
- SURFnet6 NDL file generated from actual network configs (with TL1 Toolkit)
- Uses Section Trace for neighbour info

Building Blocks

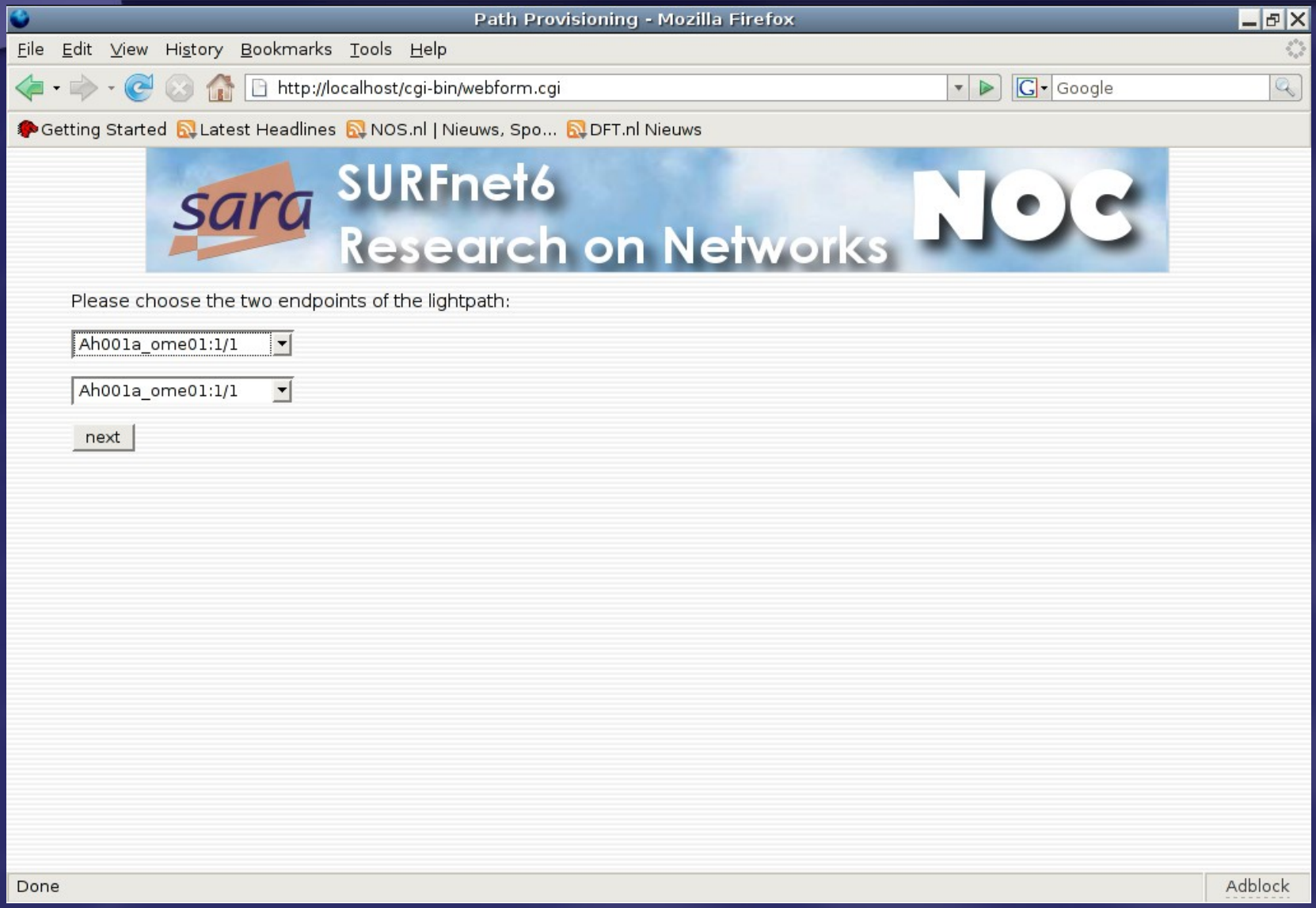
Planning and Monitoring Server

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

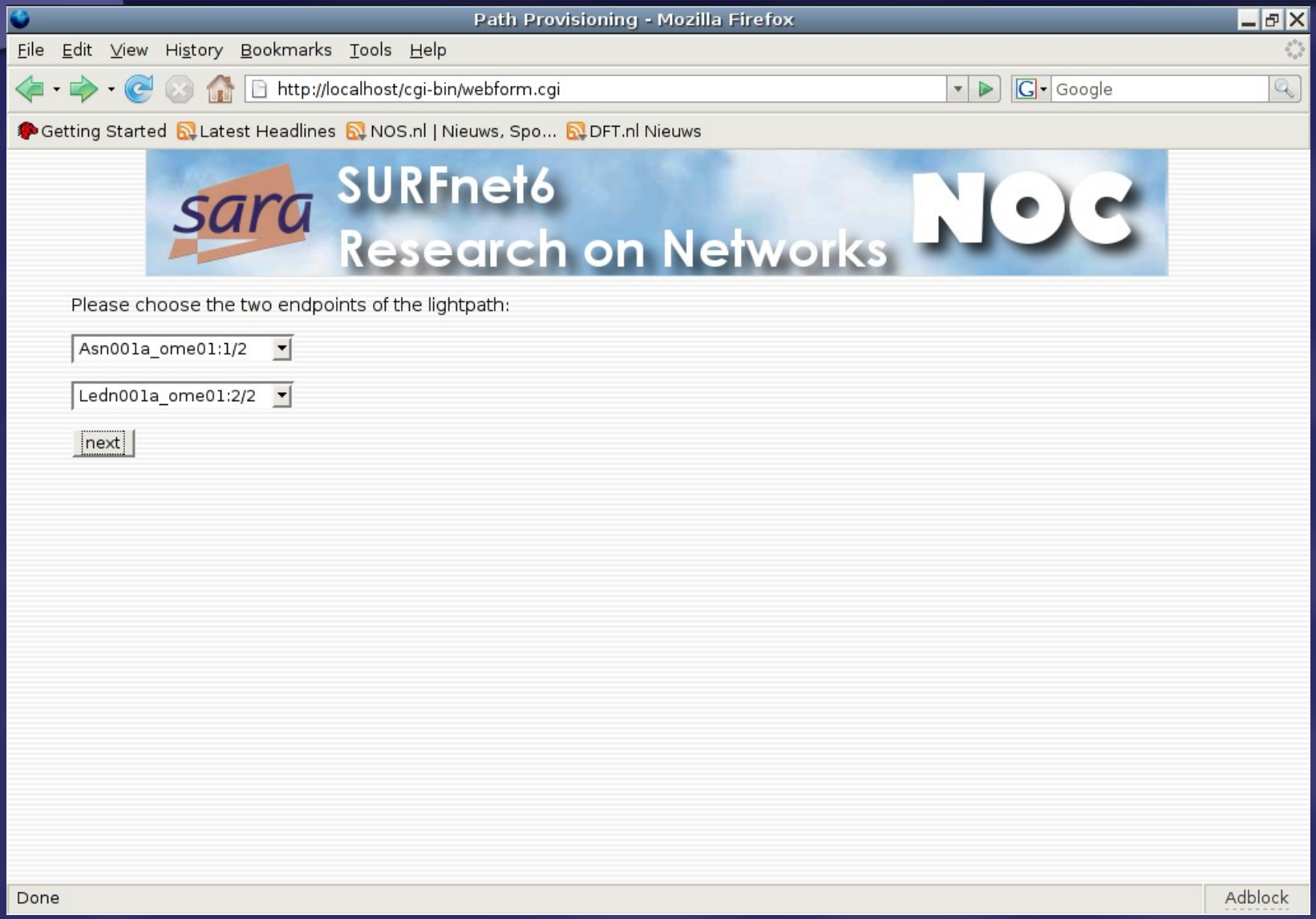
Architecture



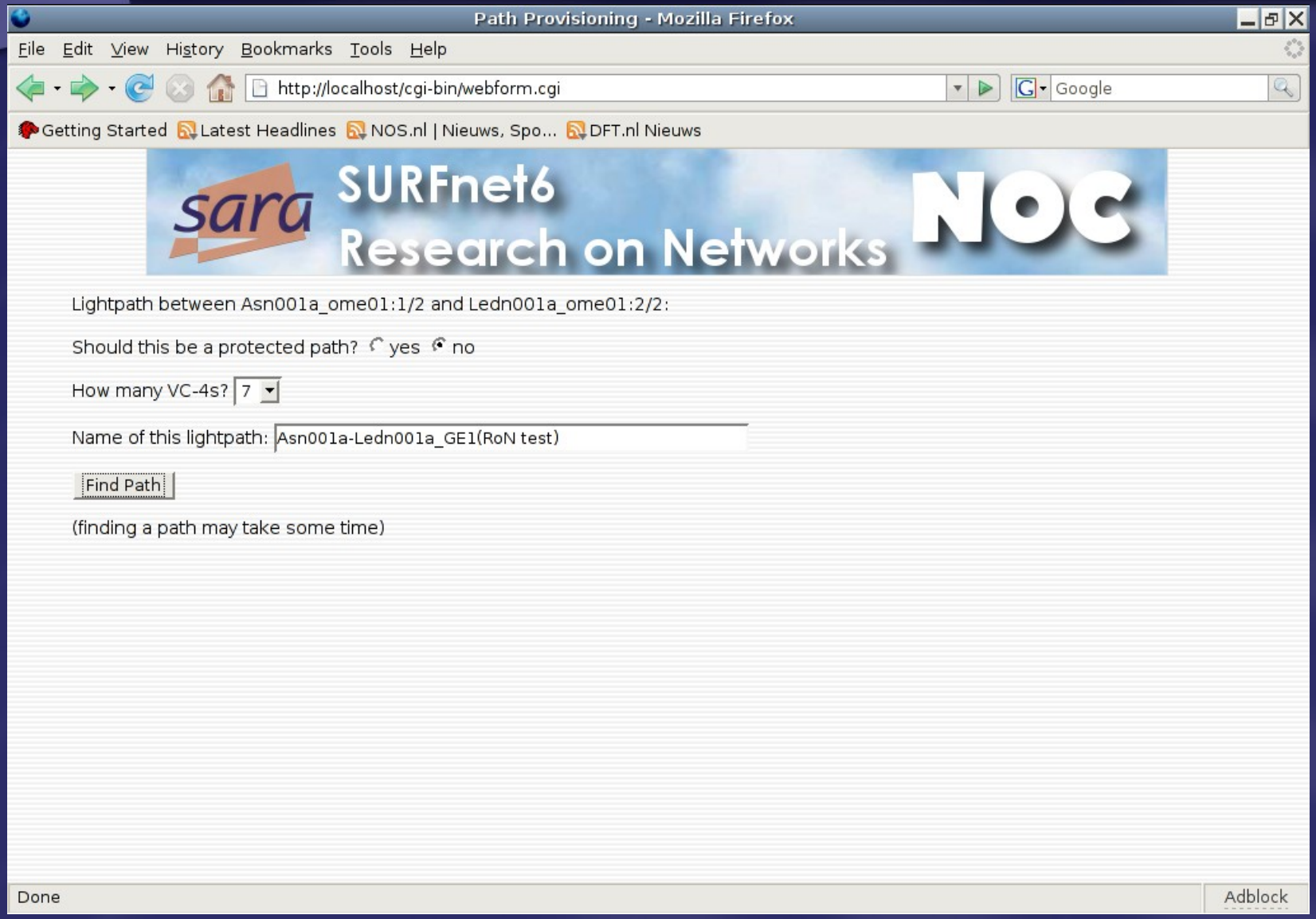
Planning Example (1/4)



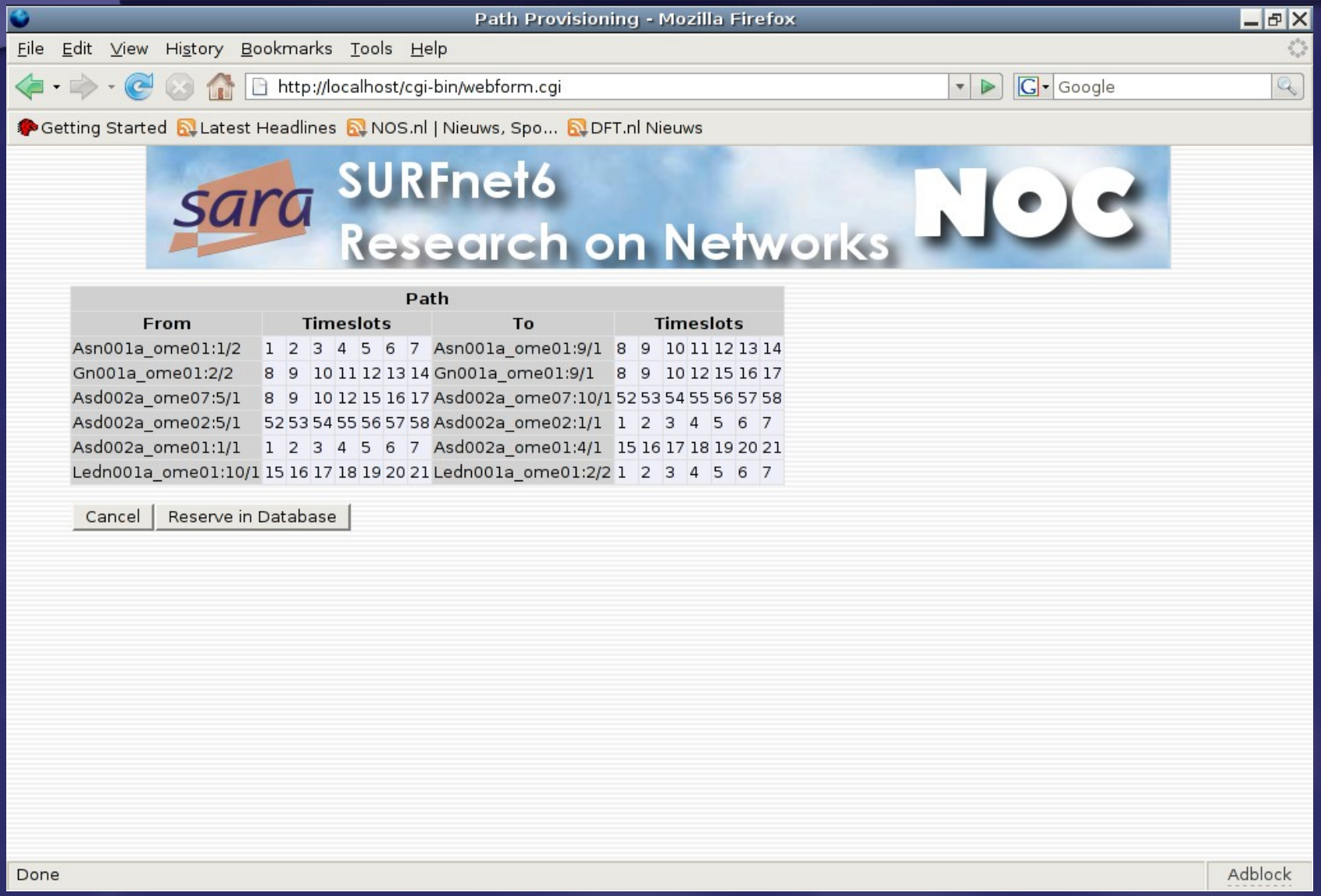
Planning Example (2/4)



Planning Example (3/4)



Planning Example (4/4)



Path														
From	Timeslots							To	Timeslots						
Asn001a_ome01:1/2	1	2	3	4	5	6	7	Asn001a_ome01:9/1	8	9	10	11	12	13	14
Gn001a_ome01:2/2	8	9	10	11	12	13	14	Gn001a_ome01:9/1	8	9	10	12	15	16	17
Asd002a_ome07:5/1	8	9	10	12	15	16	17	Asd002a_ome07:10/1	52	53	54	55	56	57	58
Asd002a_ome02:5/1	52	53	54	55	56	57	58	Asd002a_ome02:1/1	1	2	3	4	5	6	7
Asd002a_ome01:1/1	1	2	3	4	5	6	7	Asd002a_ome01:4/1	15	16	17	18	19	20	21
Ledn001a_ome01:10/1	15	16	17	18	19	20	21	Ledn001a_ome01:2/2	1	2	3	4	5	6	7

Cancel | Reserve in Database

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)

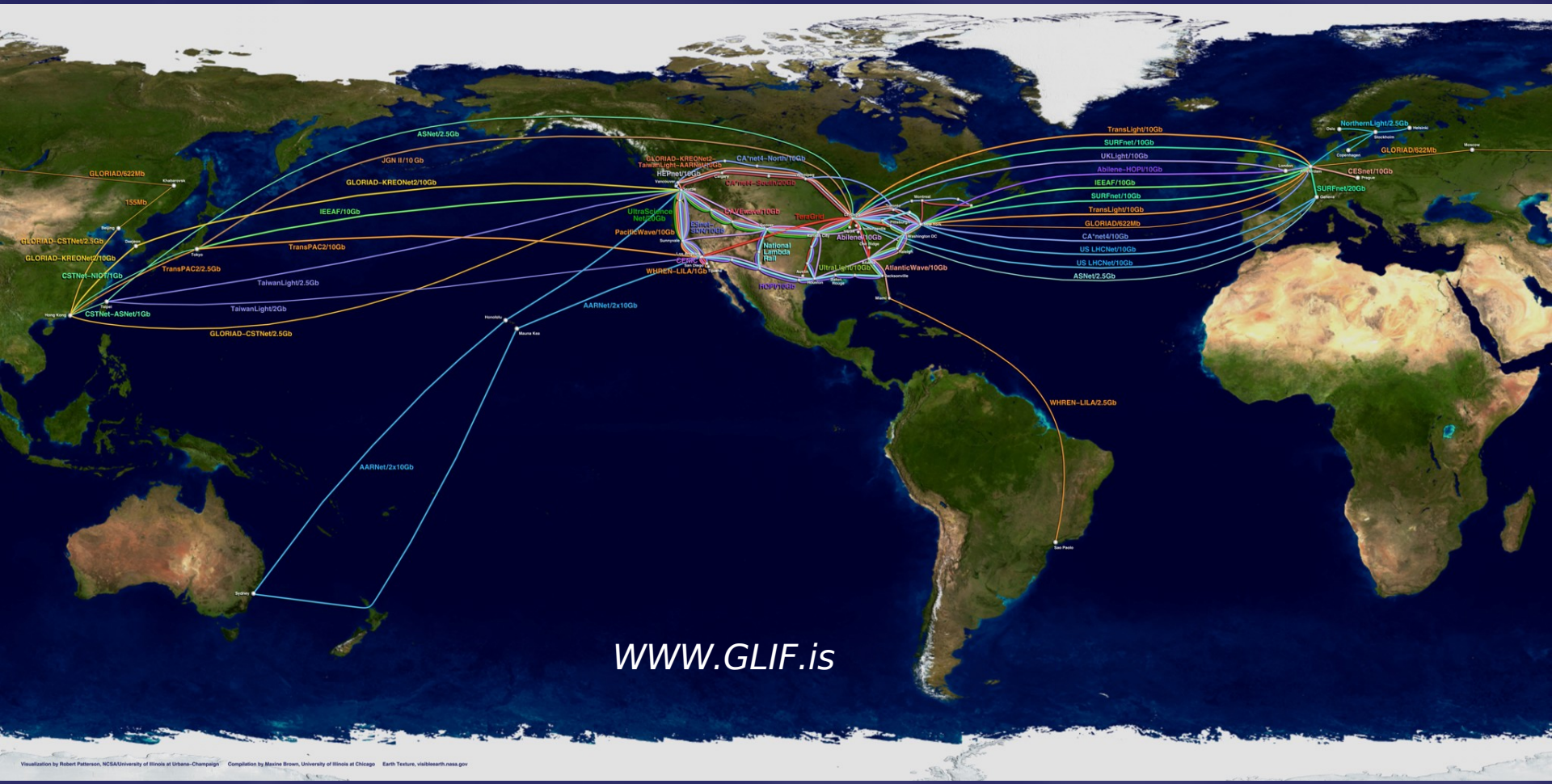
- For protected paths:
  - run Dijkstra for primary path
  - remove interfaces of primary path
  - run Dijkstra for backup path
- Loose protection: disjoint transmission lines only
- Strict protection:
  - disjoint transmission lines
  - disjoint OME equipment (except start/end)

NetherLight Monitoring

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

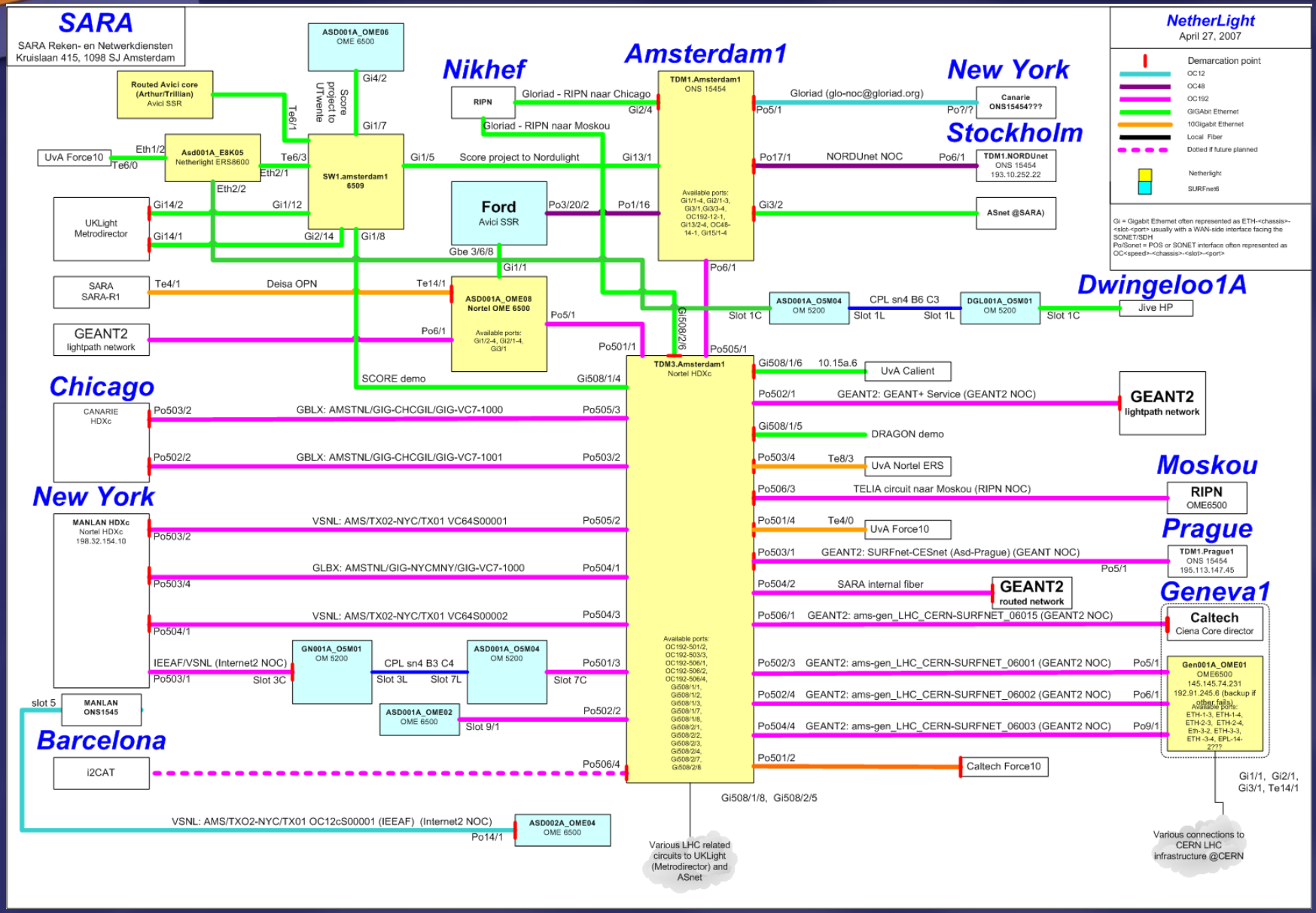
GLIF

Global Lambda Integrated Facility

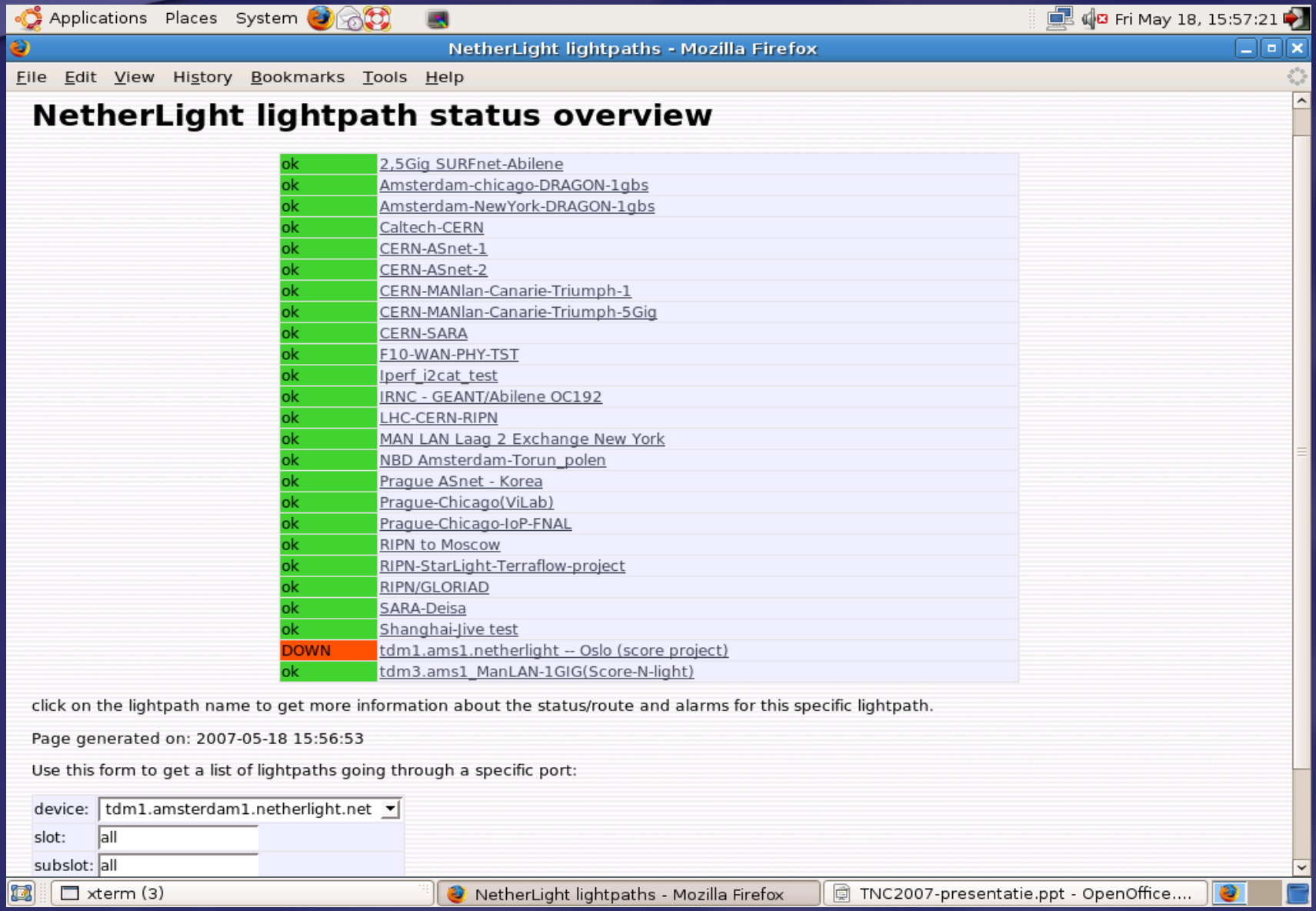


htpp://www.netherlight.net/

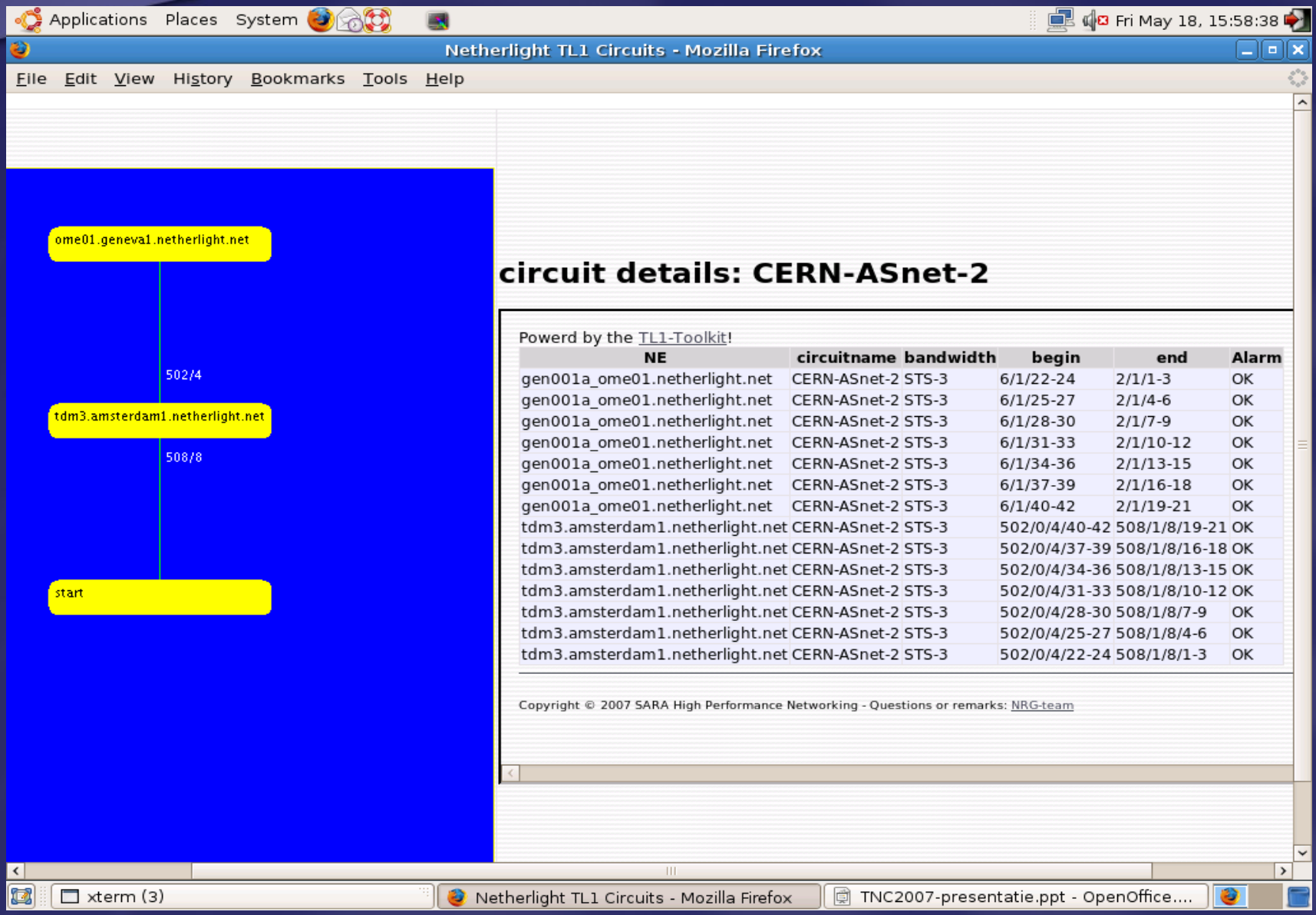
NetherLight Topology



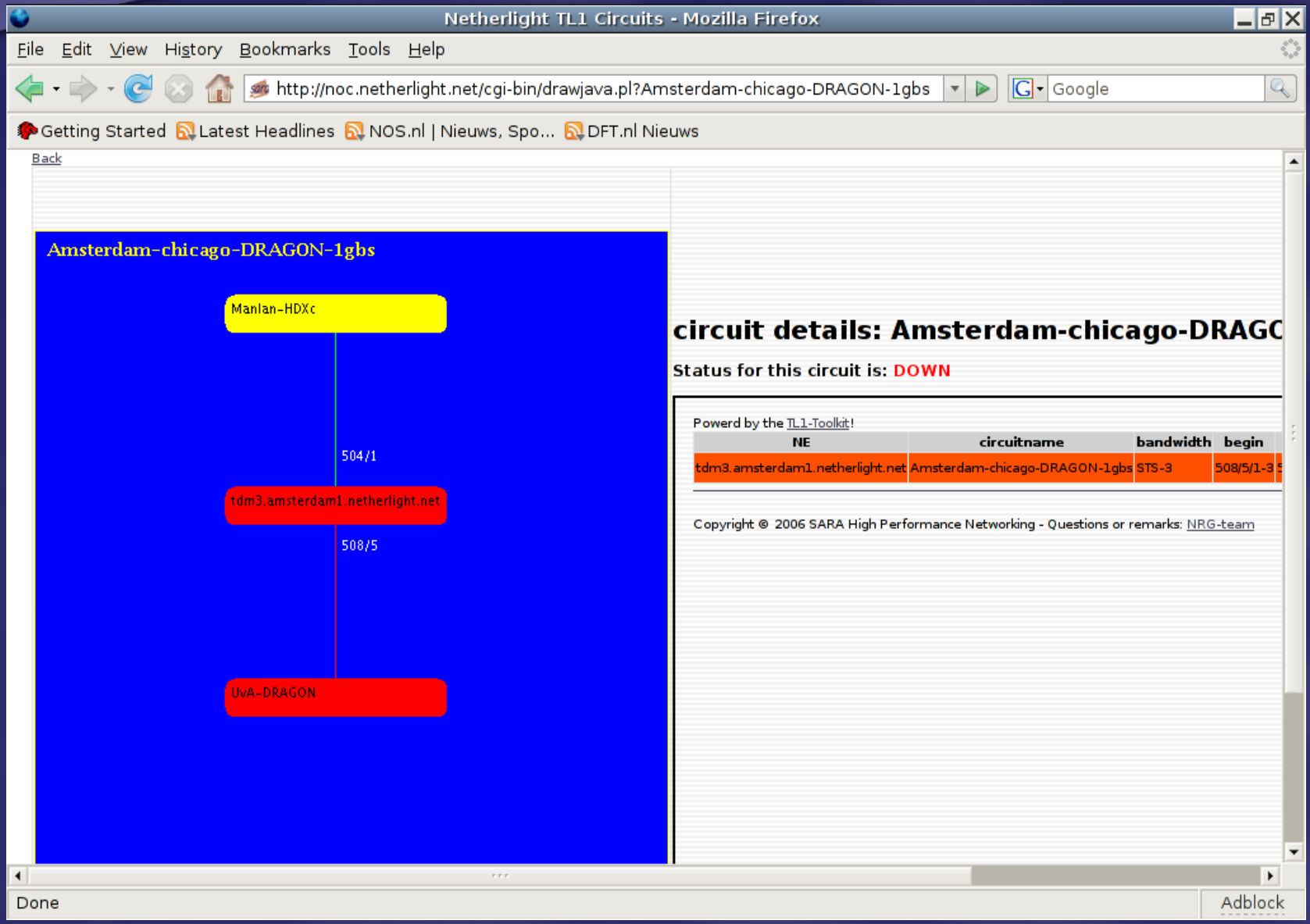
Monitoring in NetherLight (1/3)



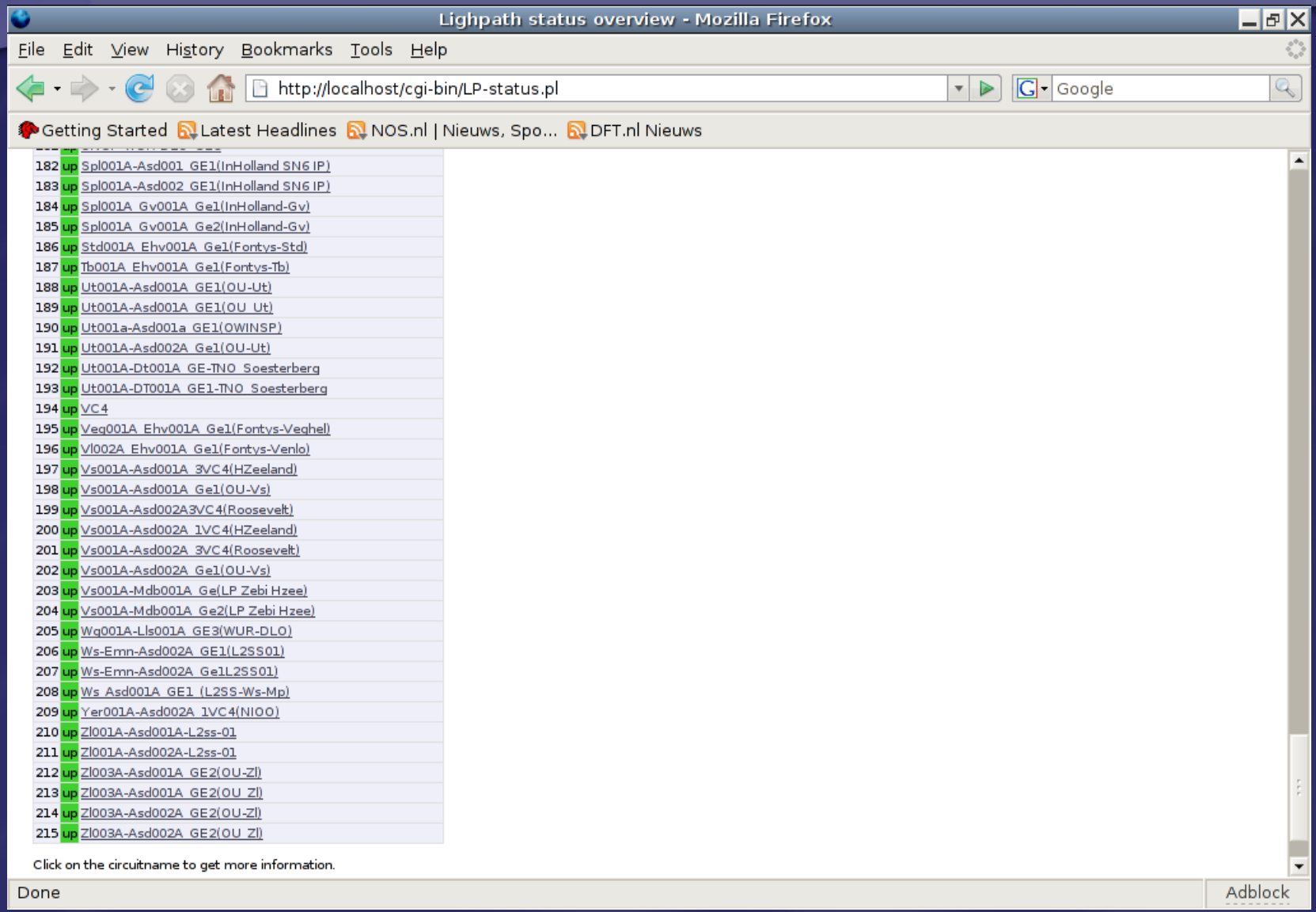
Monitoring in NetherLight (2/3)



Monitoring in NetherLight (3/3)



SURFnet6 lightpaths

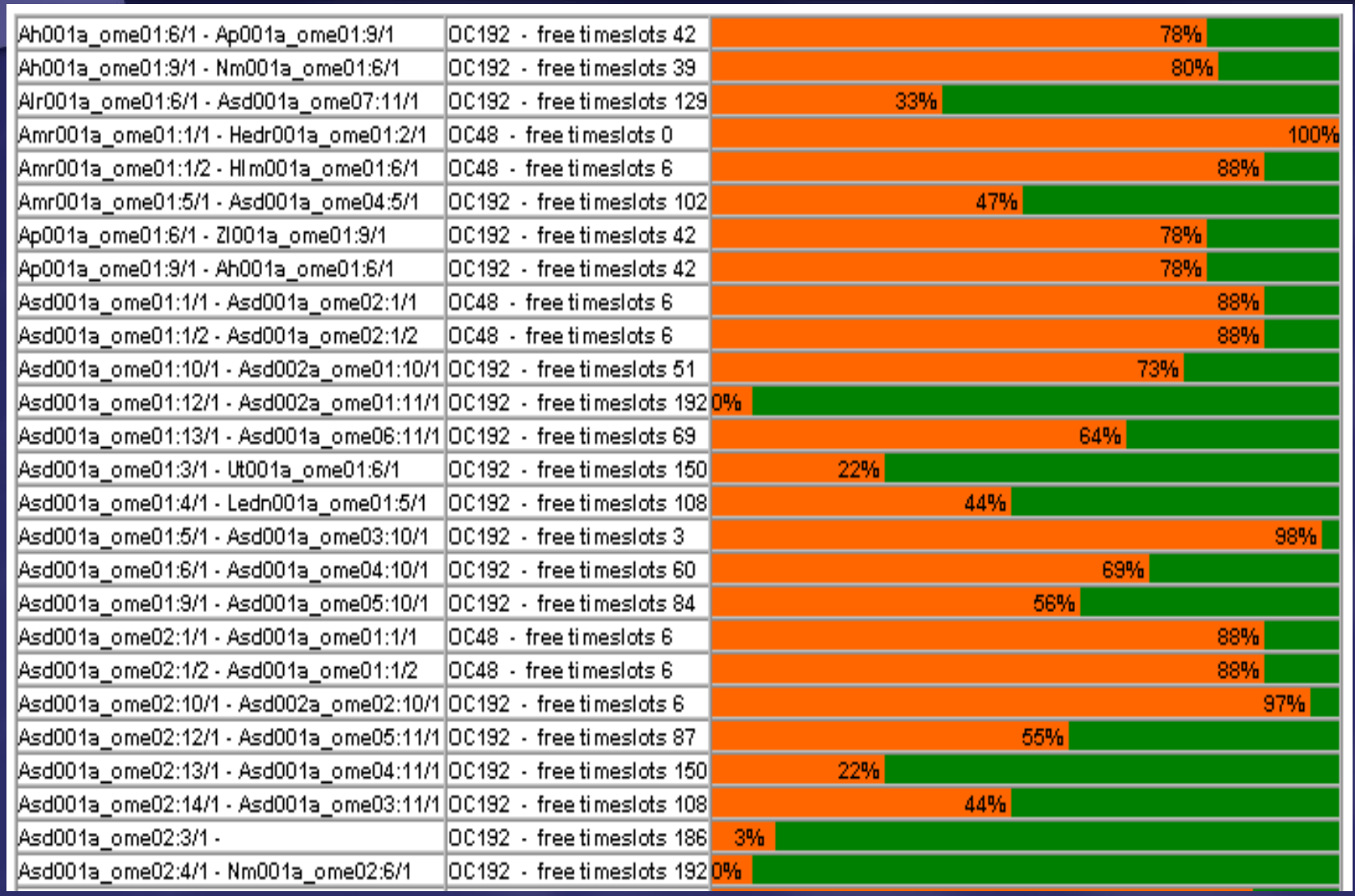


Resources Overview

interface information for Asd001a_ome05

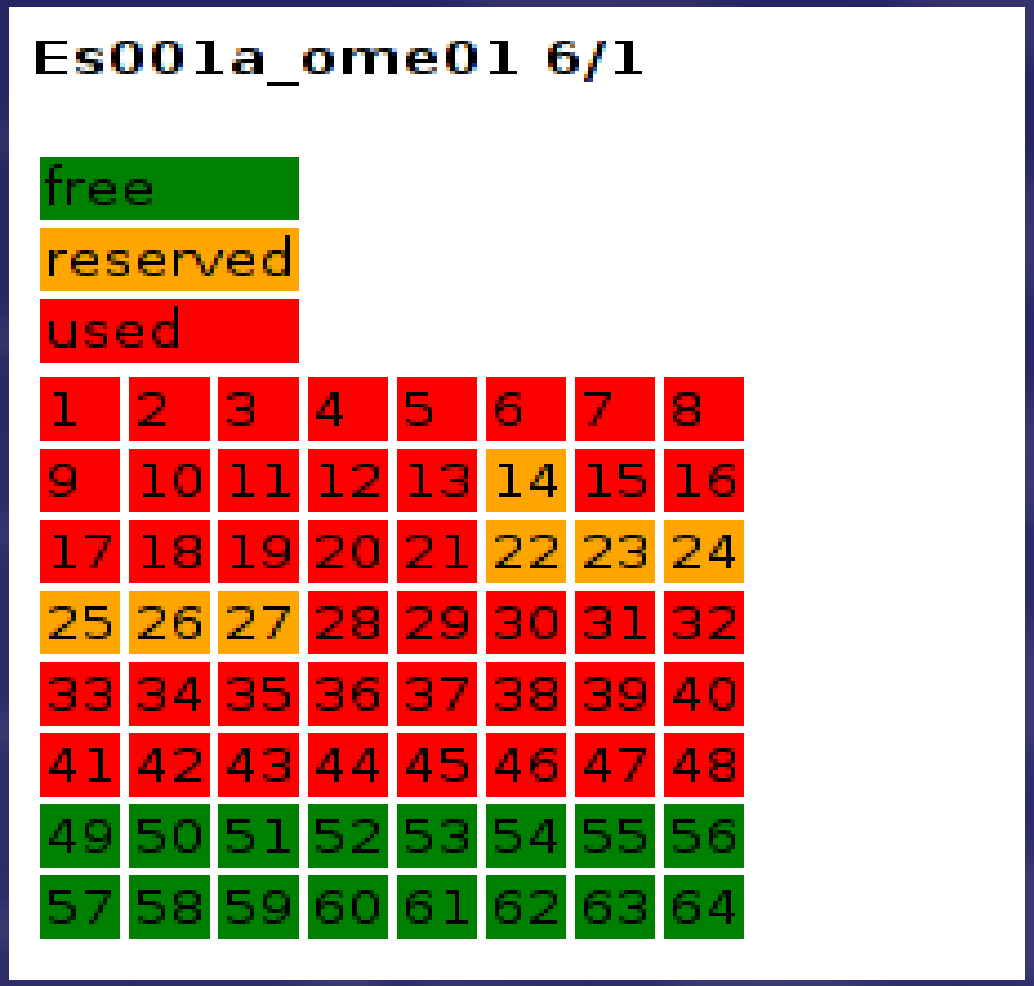
Interface	Card Type	Neigbour	Capacity (STS Timeslots)	number of free STS timeslots
Asd001a_ome05:1/1	GigE	NA	21	0
Asd001a_ome05:1/2	GigE	NA	21	0
Asd001a_ome05:1/3	GigE	NA	21	21
Asd001a_ome05:1/4	GigE	NA	21	0
Asd001a_ome05:10/1	SONET	Asd001a_ome01:9/1	192	84
Asd001a_ome05:11/1	SONET	Asd001a_ome02:12/1	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	Ehv001a_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



Thank you!

Ronald van der Pol

rvdp@sara.nl

http://nrg.sara.nl/

Poster at the lunch break this afternoon