

Bandwidth on Demand and e-VLBI: Progress in NEXPRes



Image by Paul Boven (boven@jive.nl). Satellite image: Blue Marble Next Generation, courtesy of Nasa Visible Earth (visibleearth.nasa.gov).

NEXPR*es*

1st International VLBI Technology Workshop
Haystack Observatory 2012-10-22

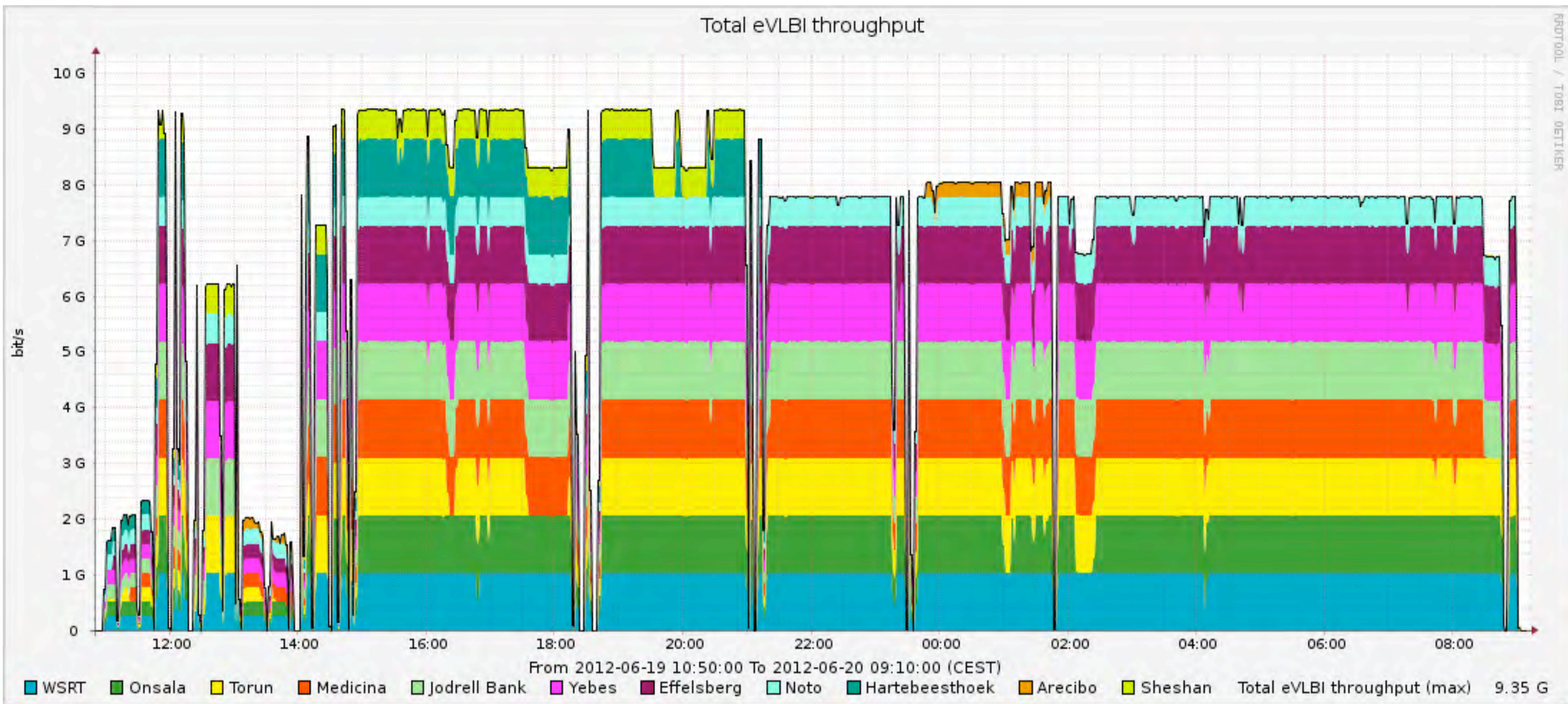
e-EVN Network Overview

Telescope	CC	Bandwidth	RTT (ms)
Sheshan	CN	1G LP (512M to LP)	354 / 180
ATNF	AU	1G LP	343
Hartebeesthoek	SA	2G LP	239
Arecibo	PR	256M / 512M VLAN	154
TIGO	CL	95M R (on demand)	150
Noto	IT	1G LP	53,8
Yebees	ES	10G R	42,1
Torun	PL	1G LP / 10G R	34,9
Onsala	SE	10G VLAN path	34,2
Metsahovi	FI	10G R	32,7
Medicina	IT	10G R	28,4
Jodrell Bank	UK	3x 1G LP	18,6
Effelsberg	DE	10G shared VLAN	13,5
WSRT	NL	2x 1G CWDM	0,57

e-EVN Network Update

- Hartebeesthoek: now a 2Gb/s LP via Africa east-coast undersea cable to Marseille, via GEANT (London) to JIVE
- Jodrell Bank from 2x 1G to 3x 1G (new 1G to e-Merlin)
- New: Noto (using 1Gb/s LP previously used by Medicina)
- Medicina now via routed connection (1024Mb/s)
- Yebees now has 10Gb/s fiber connection
- Sheshan back to 512Mb/s (was limited to 256Mb/s)
- Arecibo now 512Mb/s all hours
- Onsala from 1.5Gb/s to 10Gb/s (shared with LOFAR)

New e-VLBI speed record: 9.35 Gb/s



11 telescopes (10 simultaneous)
4 continents

JIVE network

3x 10Gb/s SURFnet

7x 1Gb/s lightpath

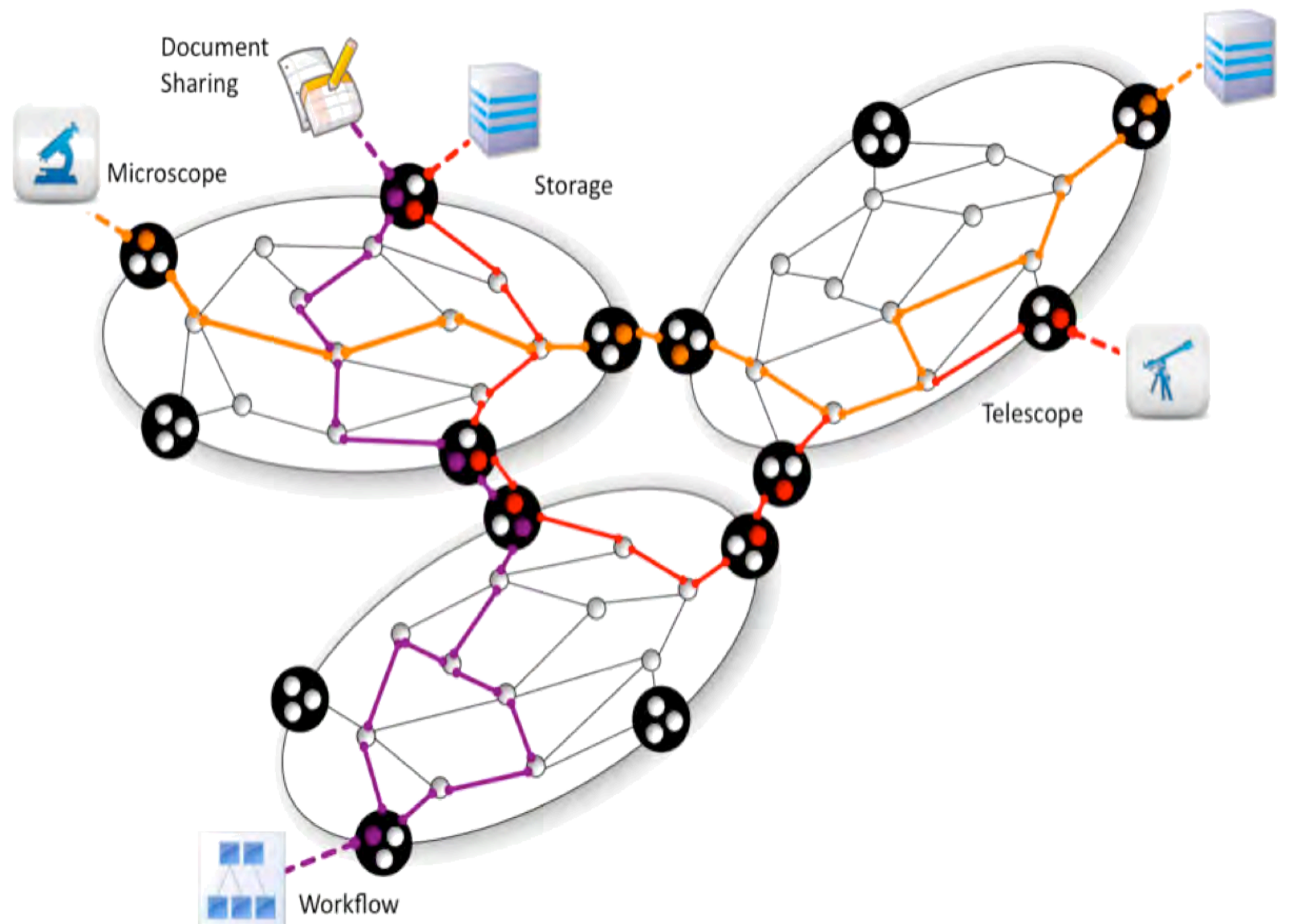
2x 1Gb/s CWDM

32x 10Gbase-T



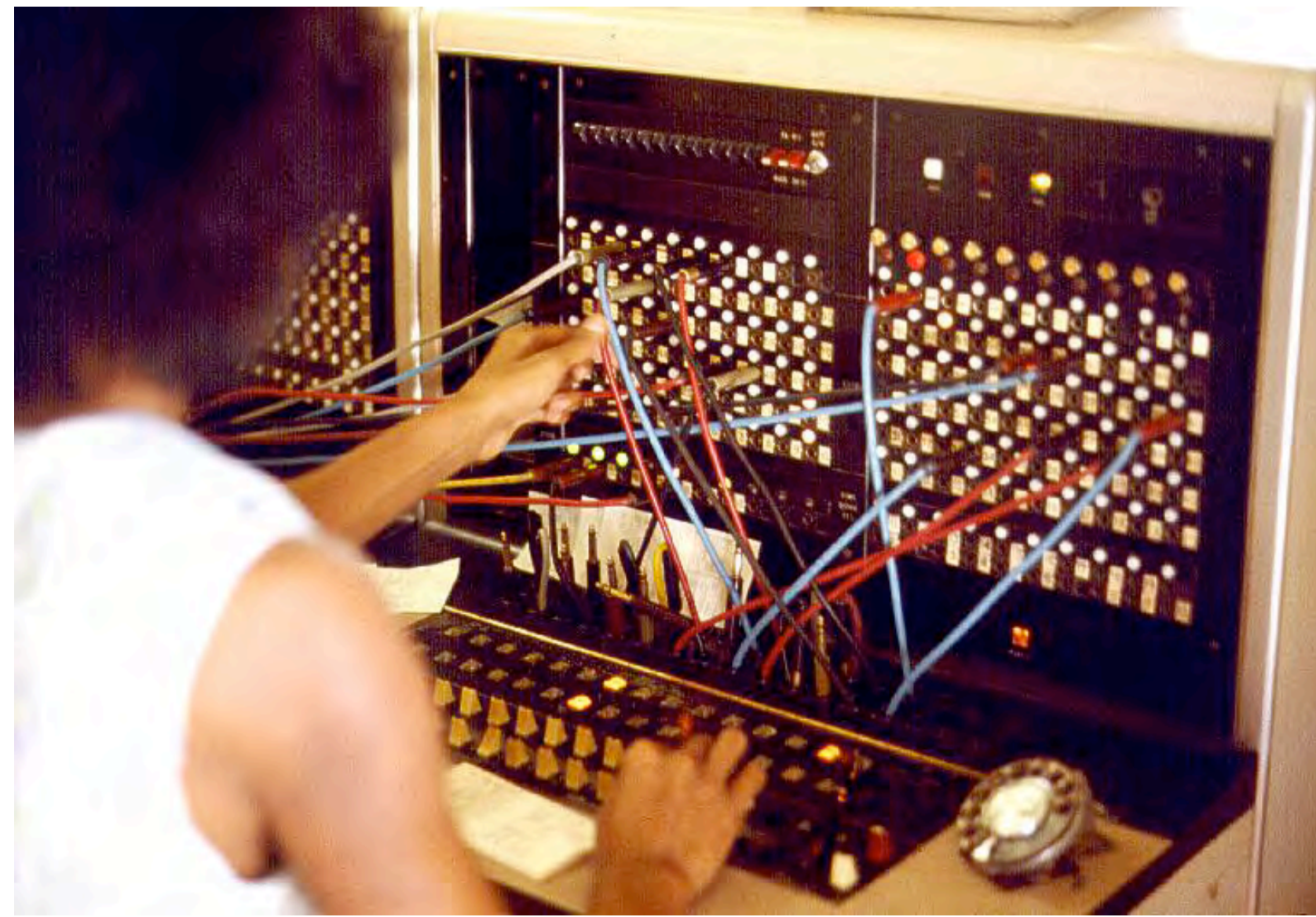
Bandwidth-on-Demand

- A service where end-users can request a dedicated network path between points in a network, with a particular bandwidth, MTU, delay etc.
- Interface is through a webform or web-service
- Several NRENs offer such a service:
 - GEANT
 - ESNET
 - SURFnet
 - NORDUnet
 - etc...



Why Bandwidth-on-Demand ?

- e-VLBI traffic is high BW, constant-rate, UDP, Jumbo frames. Where possible, use dedicated/private network resources
- We don't use the resources full-time:
 - 3 VLBI sessions per year, 2-3 weeks, monthly e-VLBI 24hrs
 - Configuration of array changes due to obs. requirement
- BoD promises more efficient use of (scarce) international and local networking resources
- Becomes especially important at 4Gb/s and higher speeds
- A lightpath is a string of SPF. BoD would allow 'routing' around outages



WP6: High Bandwidth on Demand



Task 1: Integration of e-VLBI with Bandwidth-on-Demand (JIVE, SURFnet, NORDUnet, OSO, CSIRO)

Task 2: On-demand access for large archives (ASTRON, SURFnet)

Task 3: Testing and validation of on-demand circuits (UMAN, JIVE)

Task 4: Multi Gbps on demand for e-VLBI (4Gb/s, 10Gb/s) (JIVE, SURFnet, NORDUnet, OSO)

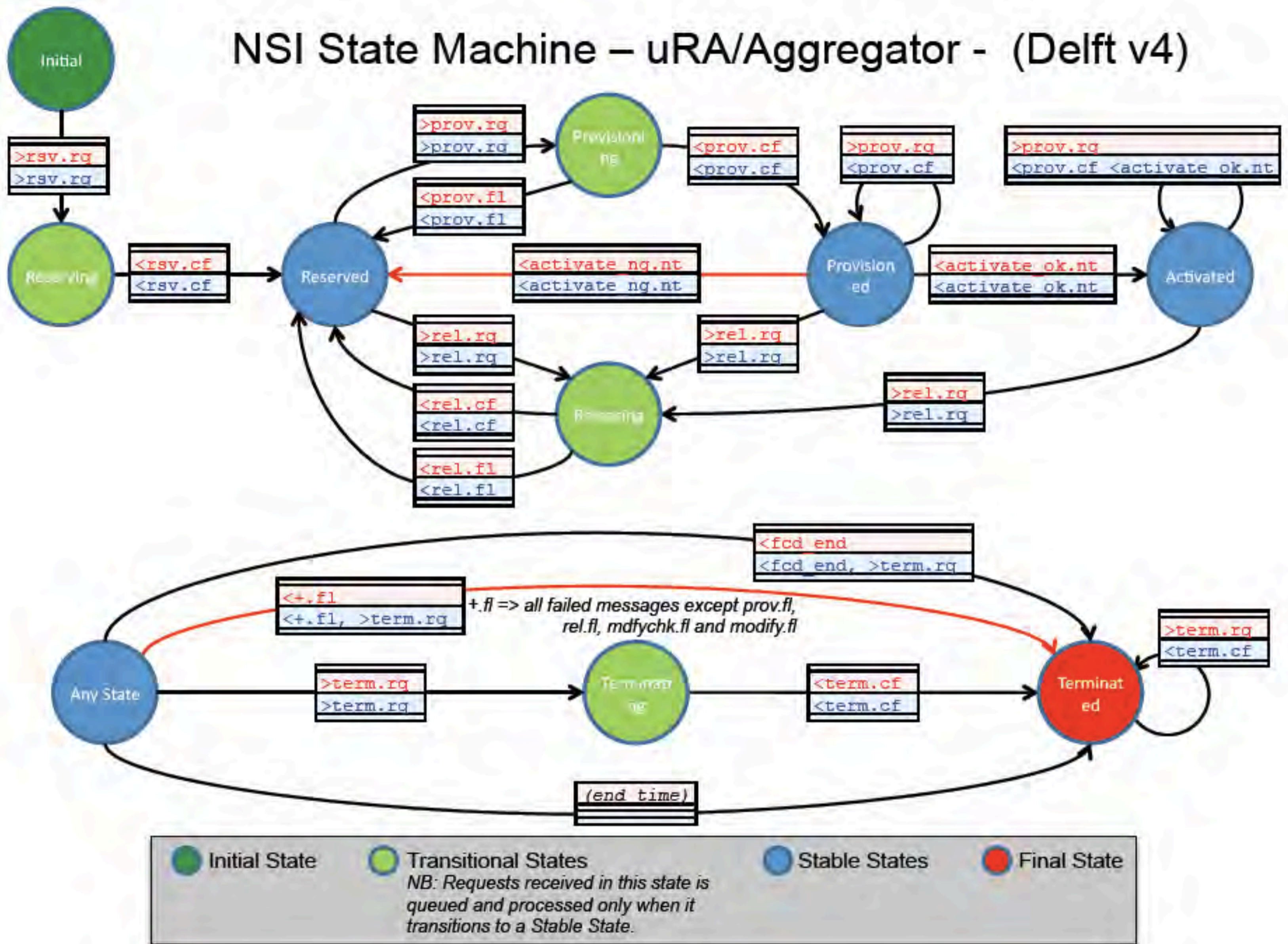
Network Service Interface: NSI

- Several NRENs already offer Bandwidth-on-Demand services within their own network
- International BoD is much more challenging as each NREN uses their own network equipment vendor, transport technology, network management, BoD system
- VLBI requires long-distance, inter-domain network paths
- NSI is an open standard for inter-domain BoD currently under development. Standardization is through the Open Grid Forum (OGF)
- Participants include GEANT, NORDUnet, SURFnet, GLIF
- Standard is a work-in-progress, still being defined, but testbeds are available

Network Service Interface: NSI

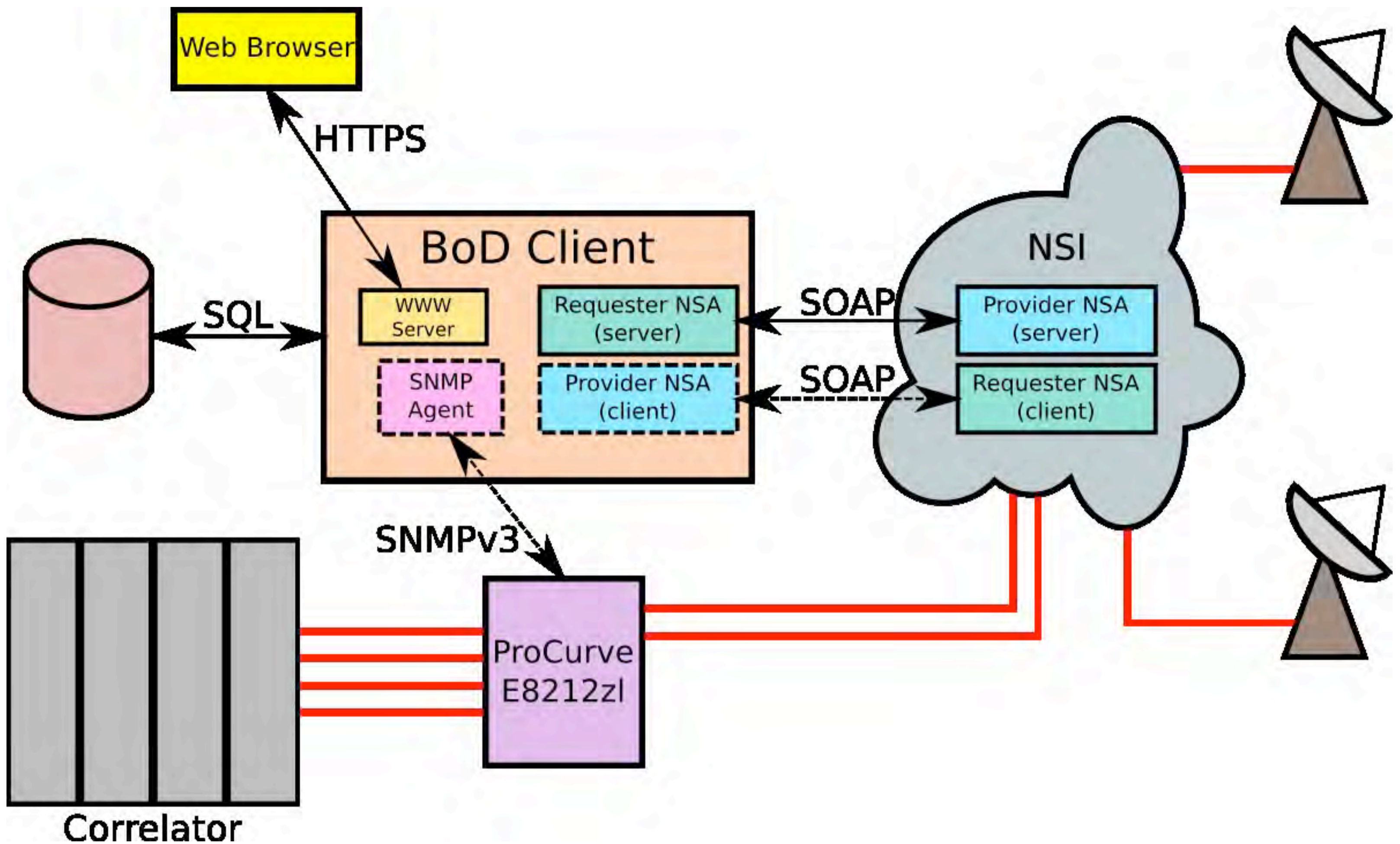
- NSI will offer a number of services:
 - Topology Service
 - Pathfinding Service
 - Connection Service
 - Monitoring/verification Service
- At this moment, only the connection service is available
- Defines a 'Requester' and 'Provider' agent, who together execute a distributed state machine
 - Reserved (a future or current scheduled reservation)
 - Activated (link is up, available)
 - Terminated

NSI State Machine – uRA/Aggregator - (Delft v4)



(And 4 more pages of state machine)

The NEXPReS NSI client



Built using Linux, Apache, PHP, MySQL


NSI client screenshots


Bandwidth on Demand client - Mozilla Firefox

File Edit View History Bookmarks Tools Help

JV Bandwidth on Demand client

loopyjive.nl/~bloemhof/nsi-test/requester/index.php

 **Bandwidth on Demand**
NSI reservation tool.



Login Logout Log files

New Connection

Info

JIVE BoD client

New Connection

STP

Source
urn:ogf:network:stp:jive.ets:dw1-2001

Destination
urn:ogf:network:stp:jive.ets:dw1-2001

Bandwidth
10 Gb/s

Period

Start 2012-05-10 14:25:48 **Start after** 30 sec.

End 2012-05-10 14:26:48 **Period** 1 min.

Refresh times

Reserve & Provision

Connections

Id	Status		STP	Period		
	Requested	Actual		Source	Destination	from to


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- urn:ogf:network:stp:jive.ets:dw1-2001
- urn:ogf:network:stp:jive.ets:dw2-2001
- urn:ogf:network:stp:jive.ets:dw3-2001
- urn:ogf:network:stp:jive.ets:dw4-2001
- urn:ogf:network:stp:netherlight.ets:jive1-1901**
- urn:ogf:network:stp:netherlight.ets:jive2-1901
- urn:ogf:network:stp:netherlight.ets:jive3-1901
- urn:ogf:network:stp:netherlight.ets:jive4-1901
- urn:ogf:network:stp:netherlight.ets:uva-82
- urn:ogf:network:stp:netherlight.ets:uva2-82
- urn:ogf:network:stp:northernlight.ets:ams-81
- urn:ogf:network:stp:northernlight.ets:nl-jive-2001
- urn:ogf:network:stp:northernlight.ets:onsala-2001
- urn:ogf:network:stp:northernlight.ets:ps-81

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Bandwidth on Demand

NSI reservation tool.



Login Logout Log files

New Connection

Info

JIVE BoD client

NEXPRES

New Connection

STP

Source
urn:ogf:network:stp:netherlight.ets:jive1-1901

Destination
urn:ogf:network:stp:netherlight.ets:jive2-1901

Bandwidth
10 Gb/s

Reserve & Provision

Period

Start 2012-05-10 14:29:08 **Start after** 1 min.

End 2012-05-10 14:30:08 **Period** 1 min.

Refresh times

Connections

Id	Status		STP		Period	
	Requested	Actual	Source	Destination	from	to
urn:uuid:ade8a5c1-9a9b-1	Provisioned	Reserving	urn:ogf:network:stp:netherlight.ets;	urn:ogf:network:stp:netherlight.ets;	2012-05-10 14:29:08	2012-05-10 14:30:08

NSI client screenshots


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JV Bandwidth on Demand client


loopyjive.nl/~bloemhof/nsi-test/requester/index.php

Google



Bandwidth on Demand

NSI reservation tool.



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New Connection

STP

Source
urn:ogf:network:stp:netherlight.ets:jive1-1901

Destination
urn:ogf:network:stp:netherlight.ets:jive2-1901

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Id	Status		STP		Period	
	Requested	Actual	Source	Destination	from	to
urn:uuid:ade8a5c1-9a9b-1	Provisioned	Provisioned	urn:ogf:network:stp:netherlight.ets;	urn:ogf:network:stp:netherlight.ets;	2012-05-10 14:29:08	2012-05-10 14:30:08


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JIVE BoD client

New Connection

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Source
urn:ogf:network:stp:netherlight.ets:jive1-1901

Destination
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Bandwidth
10 Gb/s

Reserve & Provision

Period

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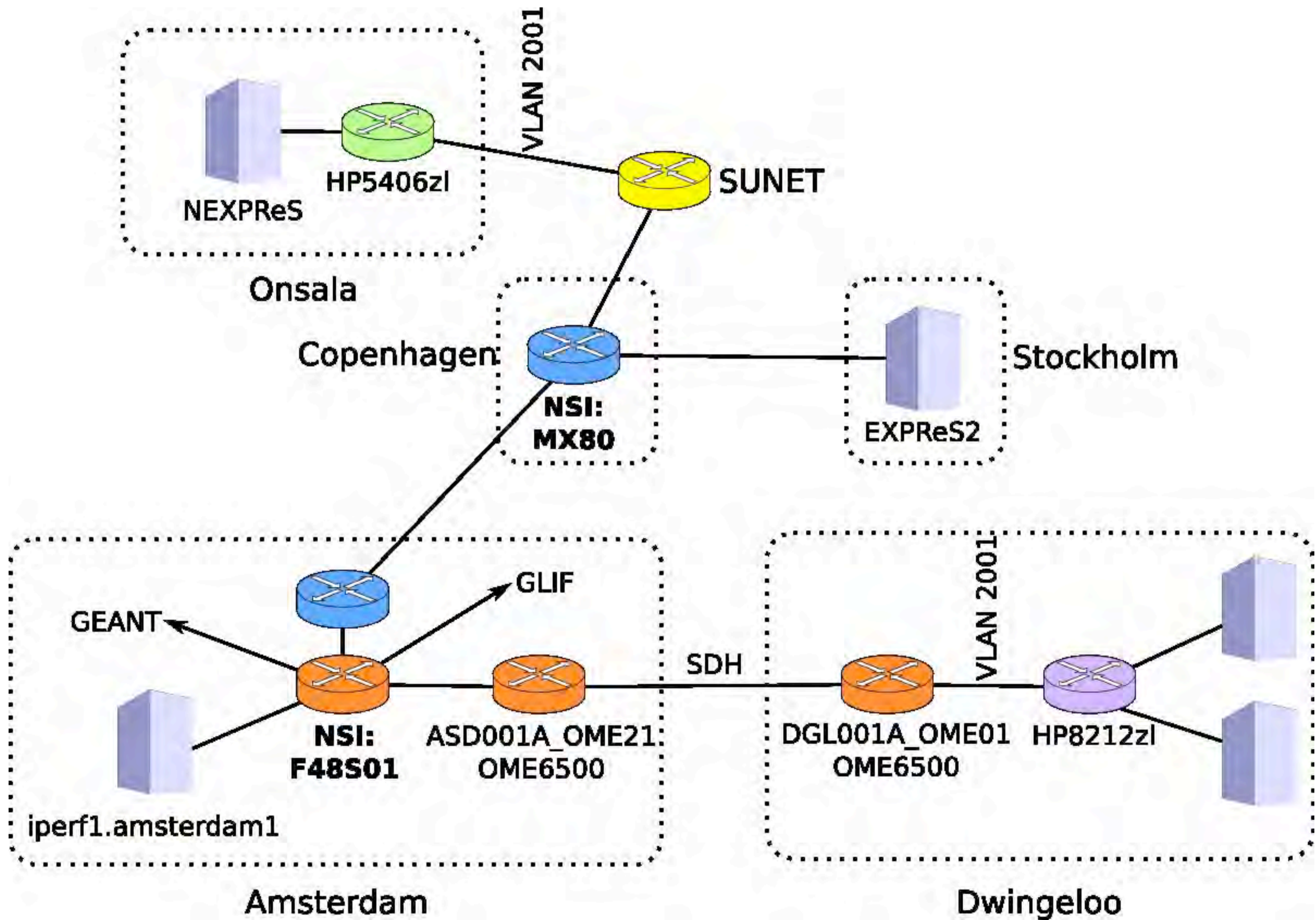
End 2012-05-10 14:30:08 **Period** 1 min.

Refresh times

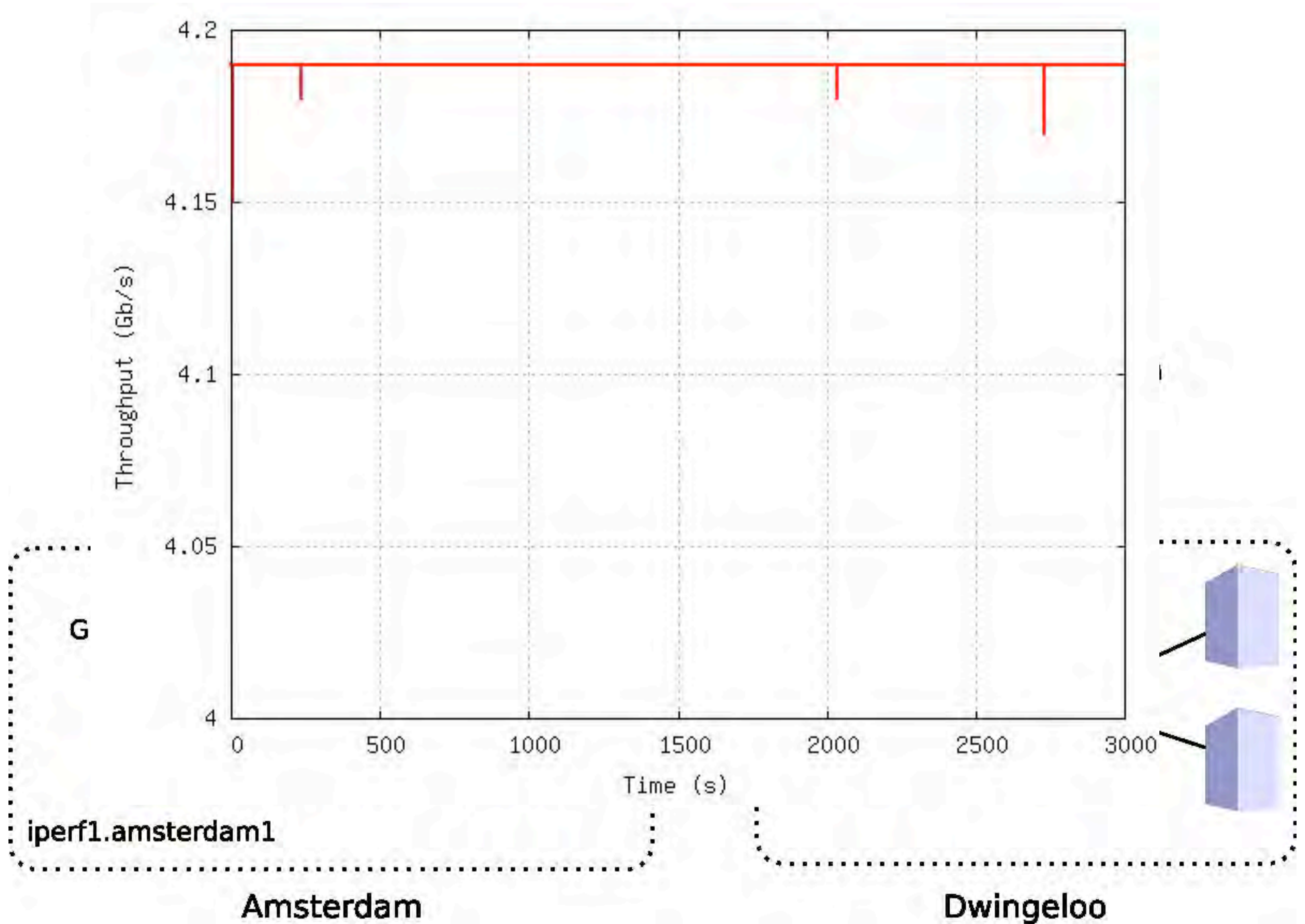
Connections

Id	Status		STP		Period	
	Requested	Actual	Source	Destination	from	to
urn:uuid:ade8a5c1-9a9b-1	Provisioned	Terminated	urn:ogf:network:stp:netherlight.ets:	urn:ogf:network:stp:netherlight.ets:	2012-05-10 14:29:08	2012-05-10 14:30:08

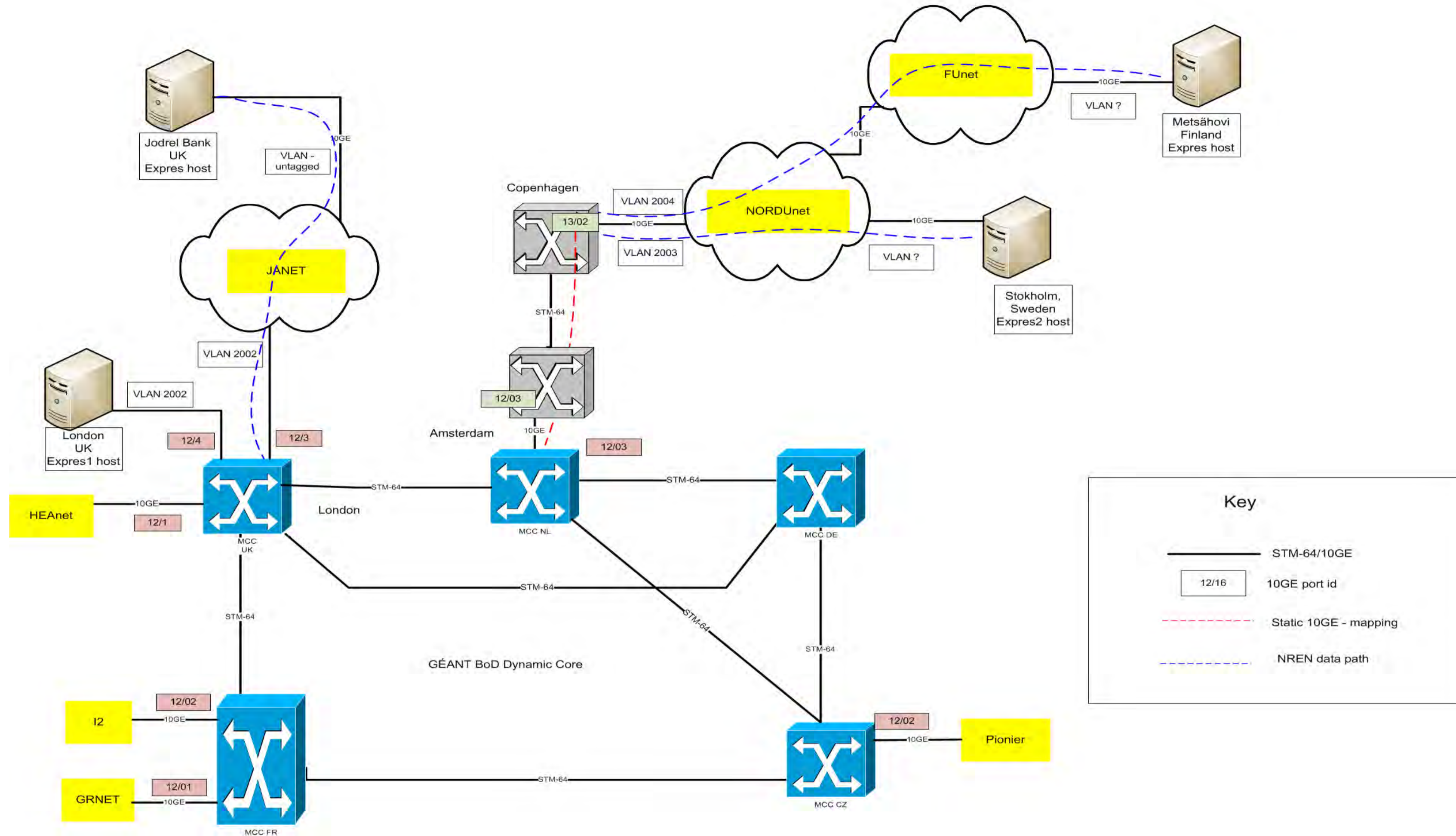
NEXPReS D6.7: 4Gb/s international BoD



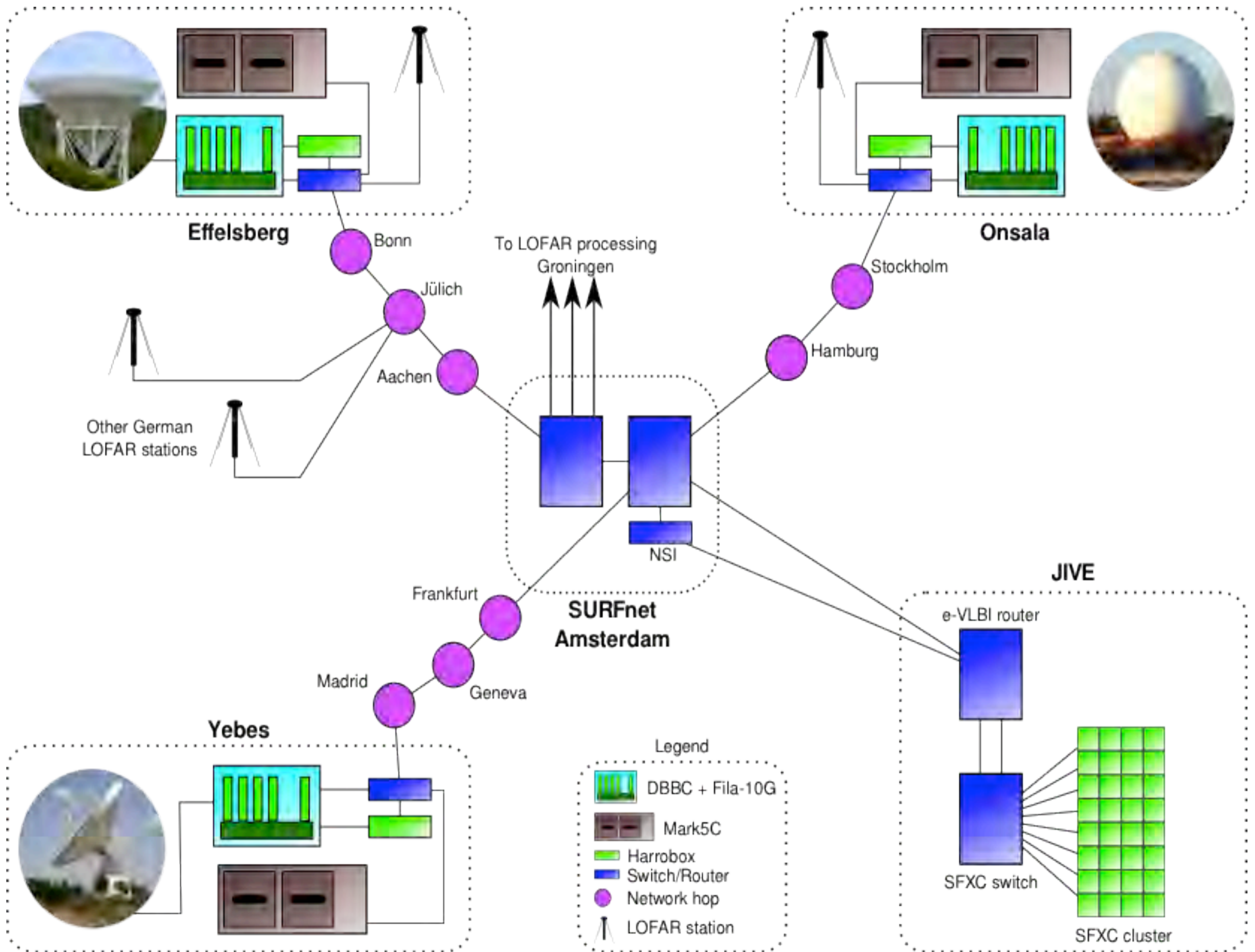
NEXPreS D6.7: 4Gb/s international BoD



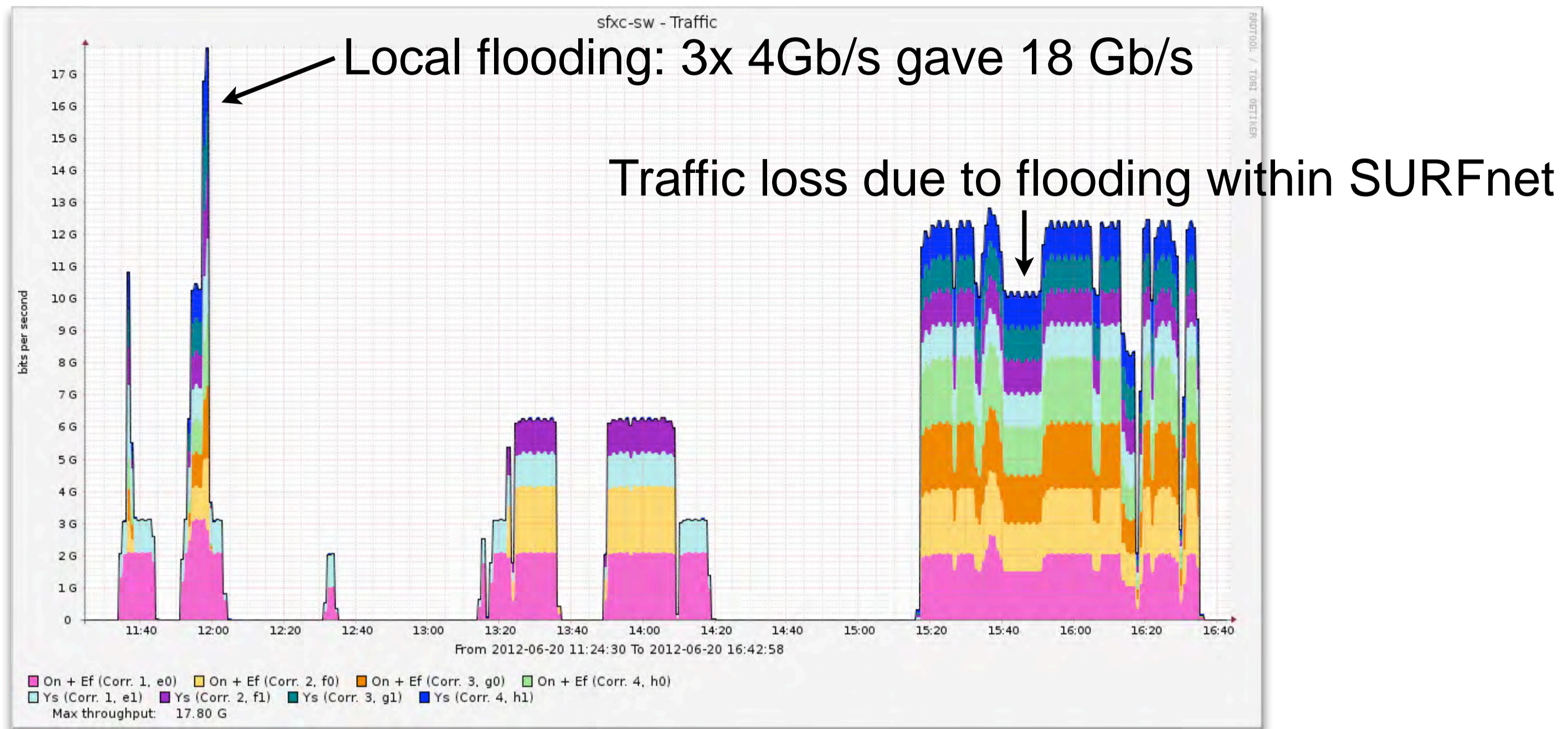
NEXPReS D6.7: 4Gb/s international BoD



WP5 4Gb/s demo (used NSI for OSO)



An aside: beware of flooding



- Network switches flood when they don't know on which port the destination MAC-address is connected
- Reply packet updates switch forwarding table (for 5 min)
- Updated jive5ab to send back a packet once a minute
- Mark5C does not send replies, not even ARP reply

WP6 Deliverables in P3 (final year)

- D6.04: Month 30 (december 2012)
BoD Scheduling interface for LOFAR LTA
- D6.06: Month 30
Demo of integrated BoD testing and validation
- D6.08: Month 30
Demonstration of international BoD at 10Gb/s
- D6.05: Month 33 (march 2013)
Demonstration of BoD for an operational LTA
- D6.02: Month 36 (june 2013)
Operational use of BoD on at least one e-VLBI link



D6.02: Operational use of BoD on at least one e-VLBI link

- Concluding deliverable for WP6
- Integrate and demonstrate all parts:
 - Schedule observation + bandwidth
 - Automated configuration of network routing
 - Automated testing of configured link
- “At least” one e-VLBI link, but ambition is to use more than one
- Due at the end of the project (June 2013)

