Bandwidth on Demand and e-VLBI: Progress in NEXPReS

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

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## e-EVN Network Overview

<table>
<thead>
<tr>
<th>Telescope</th>
<th>CC</th>
<th>Bandwidth</th>
<th>RTT (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheshan</td>
<td>CN</td>
<td>1G LP (512M to LP)</td>
<td>354 / 180</td>
</tr>
<tr>
<td>ATNF</td>
<td>AU</td>
<td>1G LP</td>
<td>343</td>
</tr>
<tr>
<td>Hartebeesthoek</td>
<td>SA</td>
<td>2G LP</td>
<td>239</td>
</tr>
<tr>
<td>Arecoibo</td>
<td>PR</td>
<td>256M / 512M VLAN</td>
<td>154</td>
</tr>
<tr>
<td>TIGO</td>
<td>CL</td>
<td>95M R (on demand)</td>
<td>150</td>
</tr>
<tr>
<td>Noto</td>
<td>IT</td>
<td>1G LP</td>
<td>53.8</td>
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<tr>
<td>Yebes</td>
<td>ES</td>
<td>10G R</td>
<td>42.1</td>
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<tr>
<td>Torun</td>
<td>PL</td>
<td>1G LP / 10G R</td>
<td>34.9</td>
</tr>
<tr>
<td>Onsala</td>
<td>SE</td>
<td>10G VLAN path</td>
<td>34.2</td>
</tr>
<tr>
<td>Metsahovii</td>
<td>FI</td>
<td>10G R</td>
<td>32.7</td>
</tr>
<tr>
<td>Medicina</td>
<td>IT</td>
<td>10G R</td>
<td>28.4</td>
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<tr>
<td>Jodrell Bank</td>
<td>UK</td>
<td>3x 1G LP</td>
<td>18.6</td>
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<td>Effelsberg</td>
<td>DE</td>
<td>10G shared VLAN</td>
<td>13.5</td>
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<tr>
<td>WSRT</td>
<td>NL</td>
<td>2x 1G CWDM</td>
<td>0.57</td>
</tr>
</tbody>
</table>
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)

• Yebes 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
The NEXPReS NSI client

Built using Linux, Apache, PHP, MySQL
NSI client screenshots
NSI client screenshots
NSI client screenshots

Bandwidth on Demand
NSI reservation tool.

New Connection

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.

Connections

<table>
<thead>
<tr>
<th>Id</th>
<th>Status</th>
<th>STP</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requested</td>
<td>Actual</td>
<td>Source</td>
<td>from</td>
</tr>
</tbody>
</table>
NSI client screenshots
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

Local flooding: 3x 4Gb/s gave 18 Gb/s
Traffic loss due to flooding within SURFnet
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)