



RIPE TTM
and divining IPv6 routing policies

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Agenda

- Need for a routing policy
- Weaknesses compared to IPv4
- Observations and adjustments
- Conclusion

Background – inet4

“Just pick the shortest route”
isn’t good enough

- IXes and private peerings
- Research networks – Géant, Abilene
- Traffic engineering,
transcontinental peerings

Background – inet6

Problem is even more pronounced
on IPv6 internet

- Tunnels and STM-16s look the same
- Some networks production, some pre-production, some testing
- No such thing as a Tier-1

Forming a policy

Mechanisms by which one can form a routing policy

- Routing policies documented in the DBs
- Often clear distinctions between European and American ASes
- BGP Community policies well defined

Forming a policy – inet6

These mechanisms dont exist
in the IPv6 internet

- 6bone DB not adequate, RIPE DB does not have v6 routing policy support yet
- Tunnels and software forwarding
- Iffy BGP community support

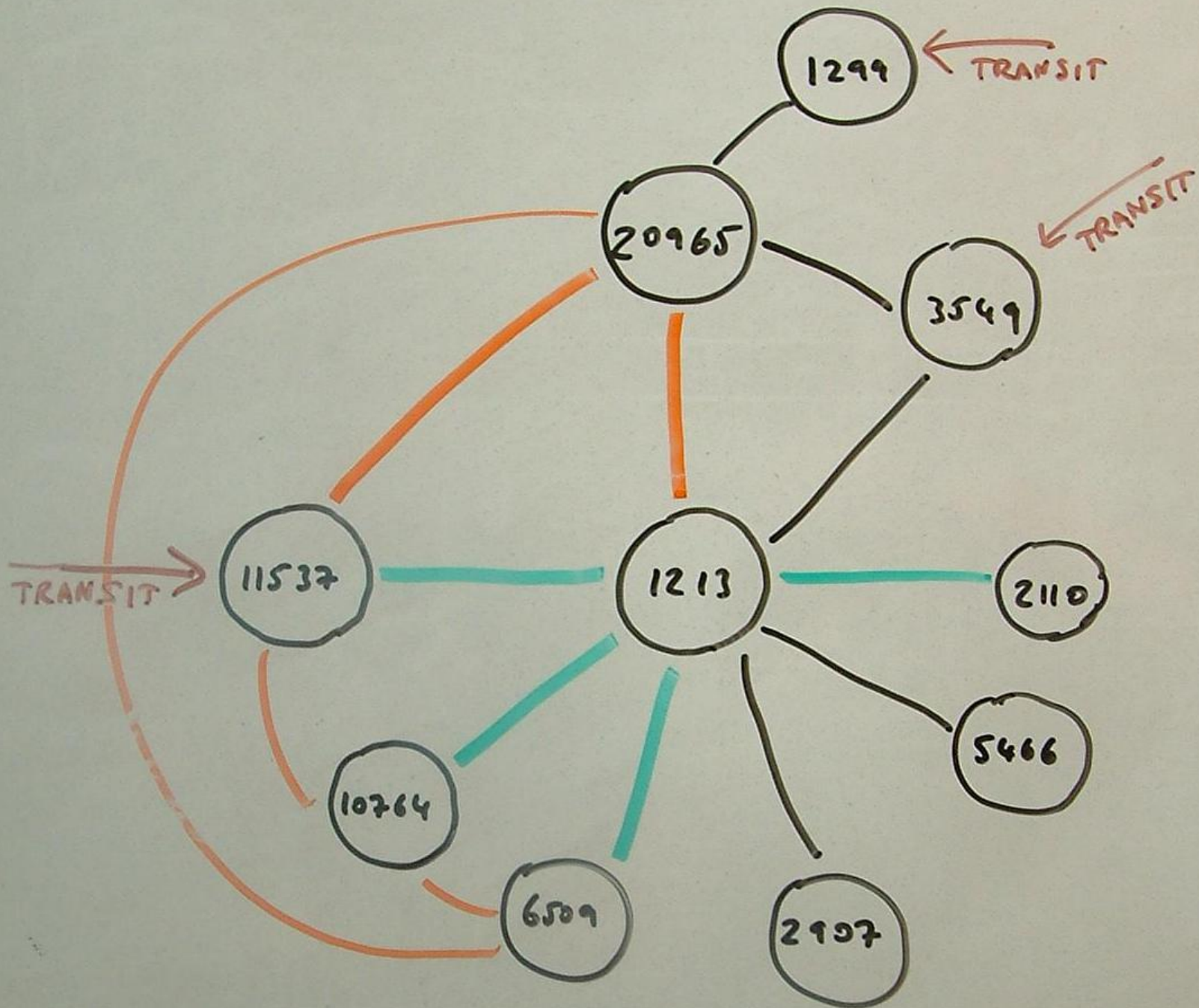
Forming a policy – inet6

So what can we use?

- Lots of looking glasses
- WHOIS DBs, Google and mail account managers for BGP community support
- RIPE TTM project...

Our main peers

- Géant – EU academic internet
strict filtering, also provides transit
- Abilene – US academic internet
no filtering, provides transit
- Tunnel to Global Crossing
no significant filtering, provides transit
- There are others



IPv6 outbound traffic

Local preferences:

- 250: EU peer, native, hardware
- 240: US peer, native, hardware
- 150: EU peer, native, software
- 140: US peer, native, software
- 100: tunnel
 - including routes marked tunneled as such by Abilene/Géant

IPv6 inbound traffic

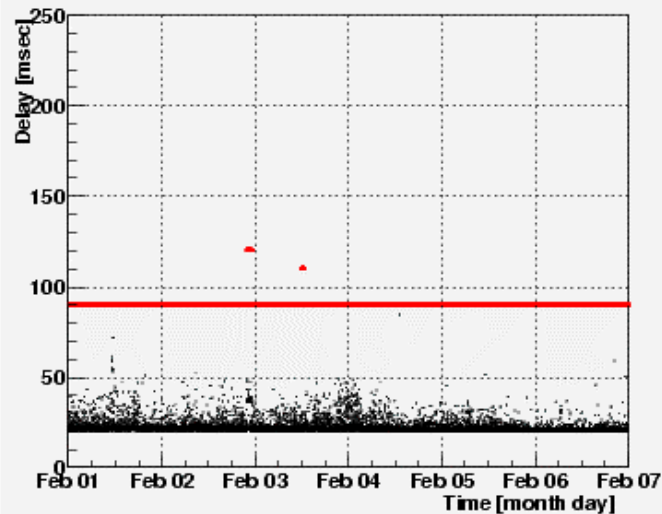
- Use AS-path stuffing to steer traffic toward better links
- EU/US peers, native links, hardware forwarding
 - ➔ do not prepend
- EU/US peers, native links, software forwarding
 - ➔ prepend 1213 1213
- Tunnels
 - ➔ prepend 1213 1213 1213

HEAnet->Géant

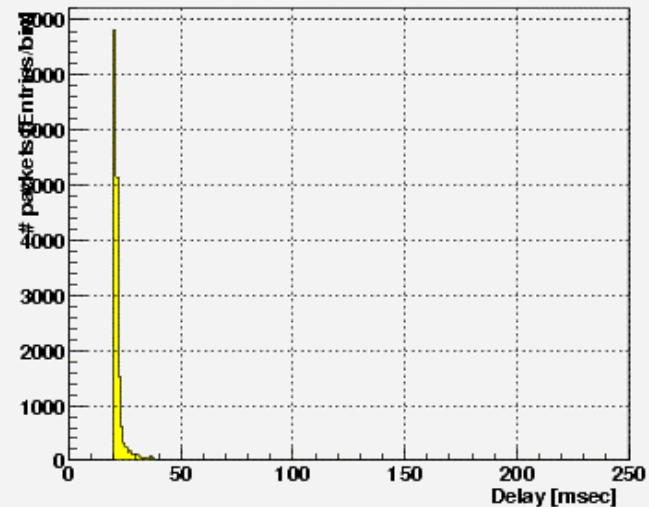
IPv6

Delays from tt35 to tt55. Start: 2004-02-01 00:00 End: 2004-02-07 00:00 UTC

PacketDelay, Number of hops*10



PacketDelay



STATISTICS:

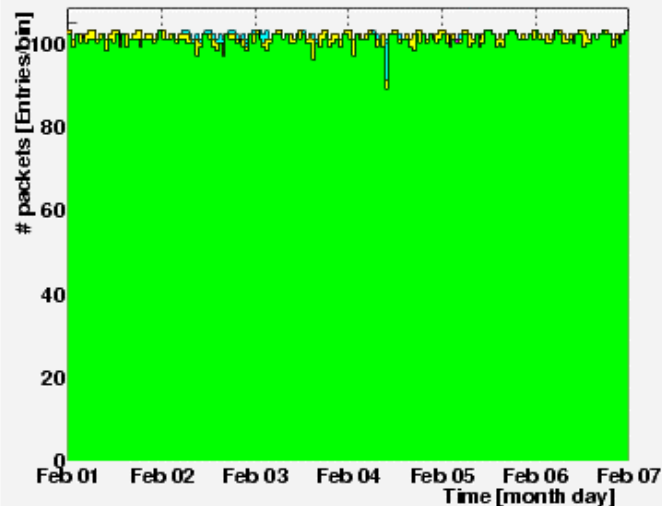
Delay & Hops:

Entries: 16907
Overflow: 0
Underflow: 0
2.5 Perc: 20.7ms
Median: 21.0ms
97.5 Perc: 32.9ms
Mean: 22.2ms
RMS: 3.3ms
Min. hops: 9
Max. hops: 12

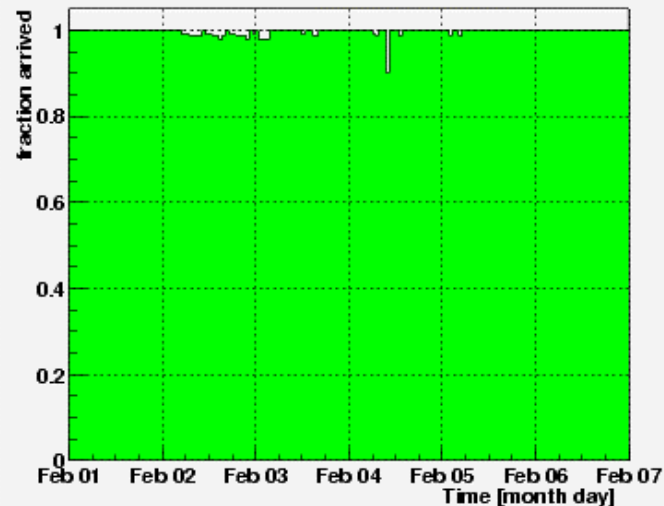
Packets sent/valid:

Total: 17139
Valid: 16907 = 98.6 %
Send bad: 1 = 0.0058 %
Recv bad: 186 = 1.1 %
2 Clocks bad: 0 = 0 %
Lost: 45 = 0.26 %

Packets sent/valid



Packets arrived/lost



Packets lost:

2.5 Perc: 0.0%
Median: 0.0%
97.5 Perc: 1.9%
Uptime: 100 %

Over-all statistic:

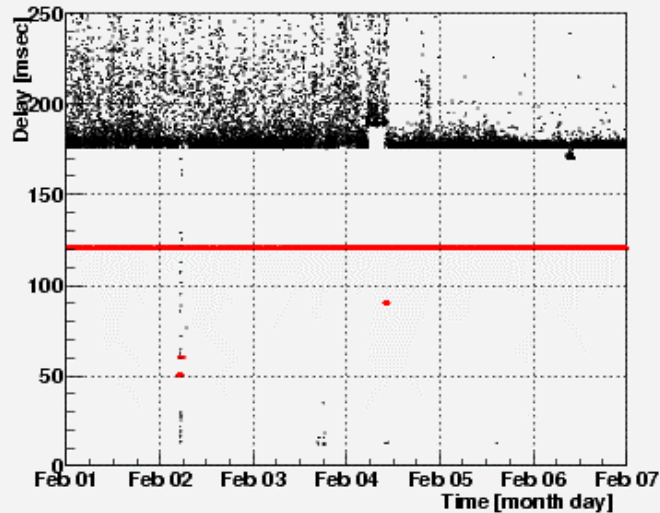
Time period: 6 days
Number of routing vectors: 6
flaps: 12
Number of bins: 168
Minutes/bin: 51.4

HEAnet->Tunnel

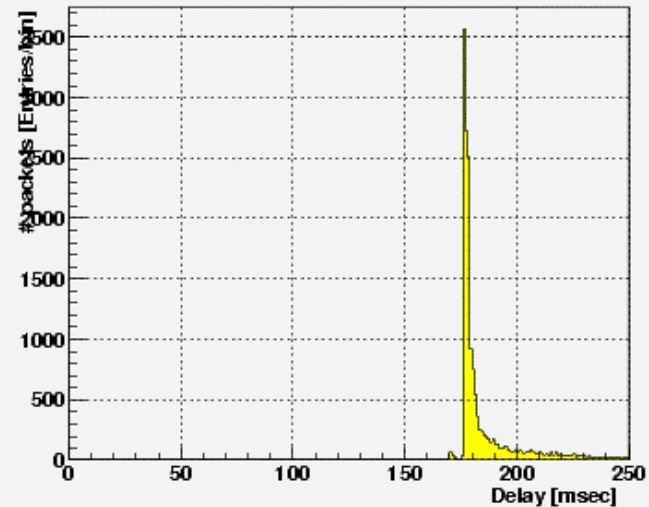
IPv6

Delays from tt35 to tt01. Start: 2004-02-01 00:00 End: 2004-02-07 00:00 UTC

PacketDelay, Number of hops*10



PacketDelay



STATISTICS:

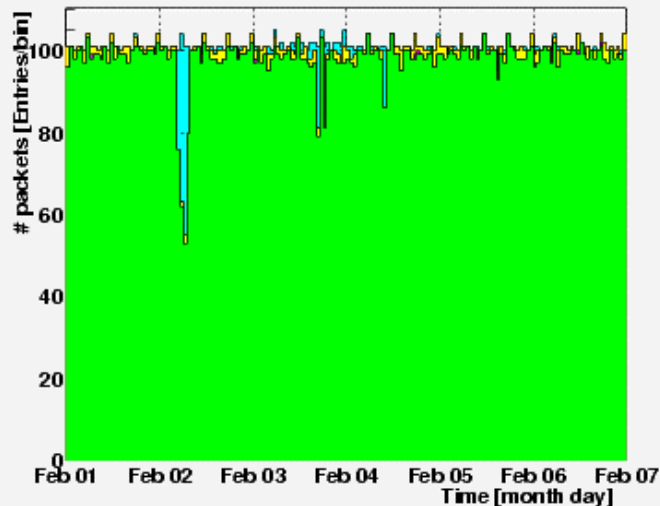
Delay & Hops:

Entries: 16480
Overflow: 581
Underflow: 0
2.5 Perc: 176.1ms
Median: 178.5ms
97.5 Perc: 261.6ms
Mean: 184.3ms
RMS: 15.9ms
Min. hops: 5
Max. hops: 30

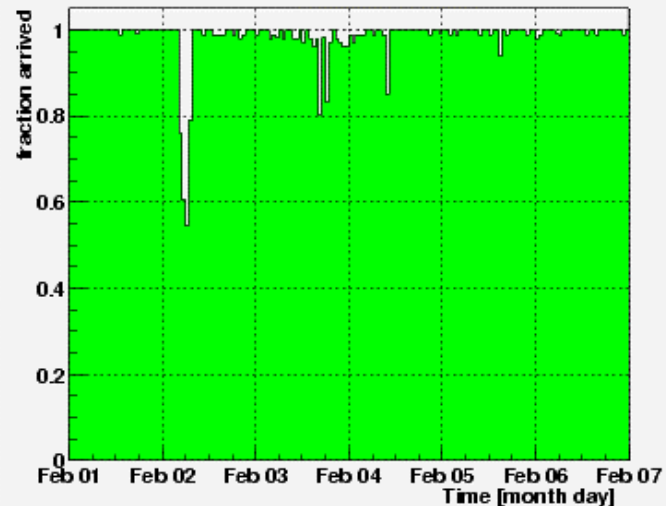
Packets sent/valid:

Total: 17006
Valid: 16480 = 96.9 %
Send bad: 6 = 0.035 %
Recv bad: 253 = 1.5 %
2 Clocks bad: 0 = 0 %
Lost: 267 = 1.6 %

Packets sent/valid



Packets arrived/lost



Packets lost:

2.5 Perc: 0.0%
Median: 0.0%
97.5 Perc: 19.8%
Uptime: 100 %

Over-all statistic:

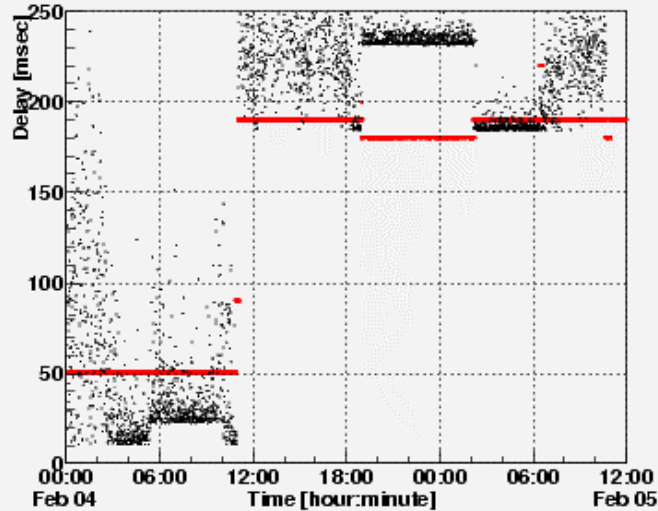
Time period: 6 days
Number of routing vectors: 9
flaps: 14
Number of bins: 168
Minutes/bin: 51.4

Some got worse!

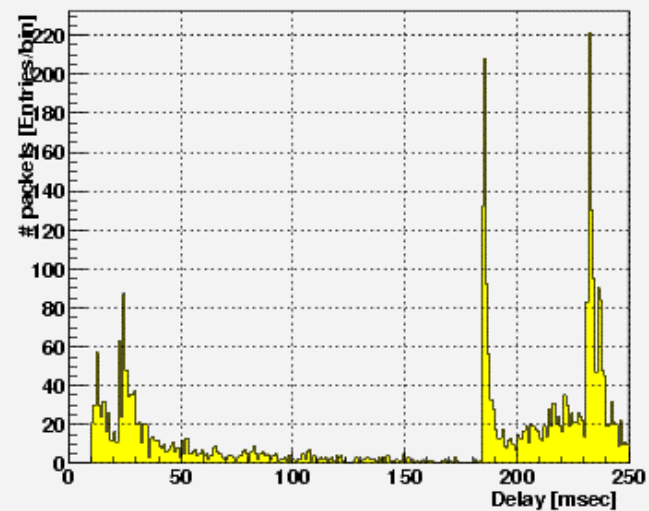
IPv6

Delays from tt35 to tt52. Start: 2004-02-04 00:00 End: 2004-02-05 12:00 UTC

PacketDelay, Number of hops*10



PacketDelay



STATISTICS:

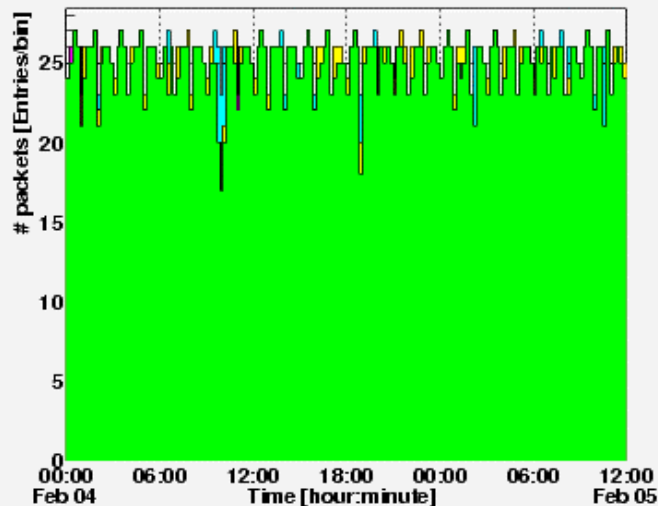
Delay & Hops:

Entries: 4176
Overflow: 639
Underflow: 0
2.5 Perc: 12.9ms
Median: 211.6ms
97.5 Perc: 405.6ms
Mean: 156.8ms
RMS: 86.5ms
Min. hops: 5
Max. hops: 30

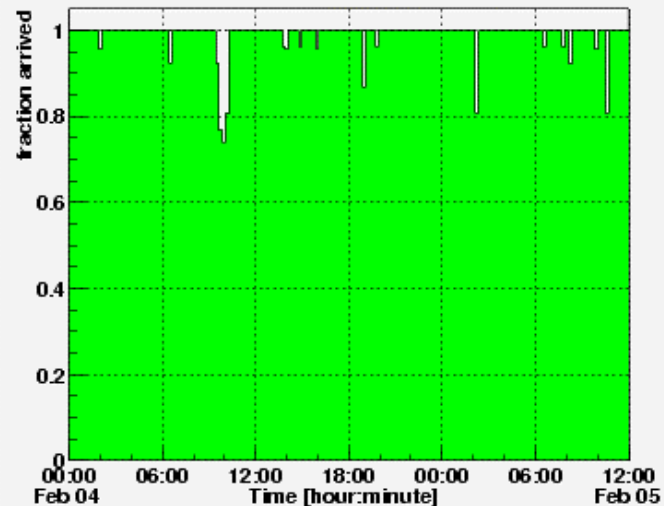
Packets sent/valid:

Total: 4284
Valid: 4176 = 97.5 %
Send bad: 2 = 0.047 %
Recv bad: 61 = 1.4 %
2 Clocks bad: 0 = 0 %
Lost: 45 = 1.1 %

Packets sent/valid



Packets arrived/lost



Packets lost:

2.5 Perc: 0.0%
Median: 0.0%
97.5 Perc: 19.2%
Uptime: 100 %

Over-all statistic:

Time period: 1 day
Number of routing vectors: 13
flaps: 14
Number of bins: 168
Minutes/bin: 12.8

Why the change?

- Checked traceroutes from TTM (results came in the following day)
- Some routes which originally used our tunnel to Global Crossing in Amsterdam now used Abilene
- But the performance went down – why?

Why the change?

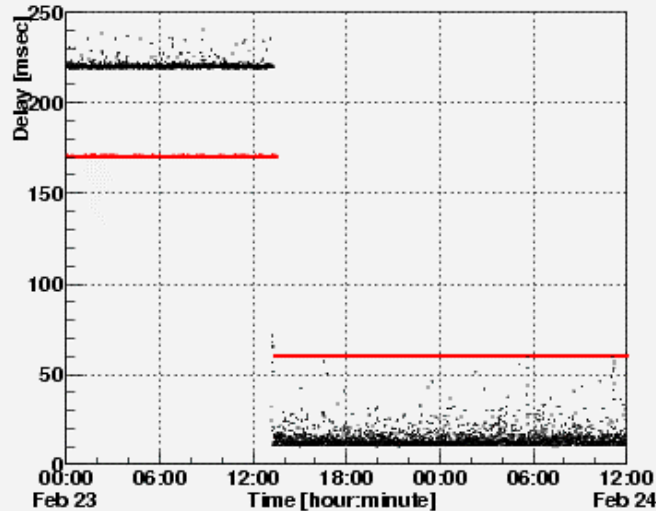
- Intra-Abilene routes are excellent, as are most of their onward connections
- Abilene mark tunnels with 11537:600 – these had lower localpref assigned
- But some international routes (ITN) from Abilene already come from Europe – lowered the localpref on these also

...and got better again

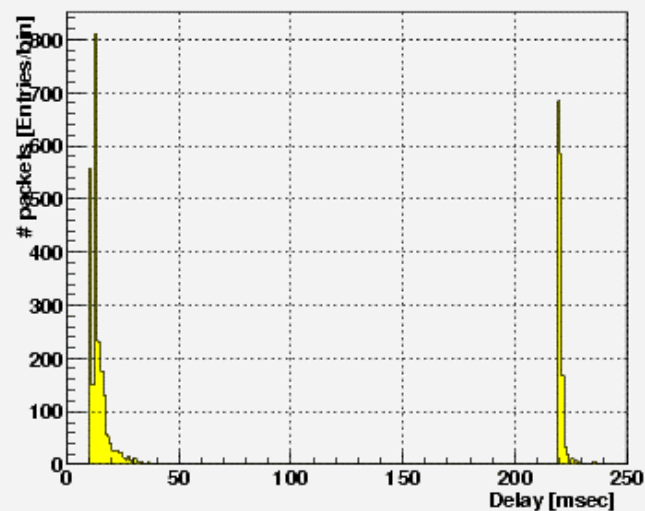
IPv6

Delays from tt35 to tt52. Start: 2004-02-23 00:00 End: 2004-02-24 12:00 UTC

PacketDelay, Number of hops*10



PacketDelay



STATISTICS:

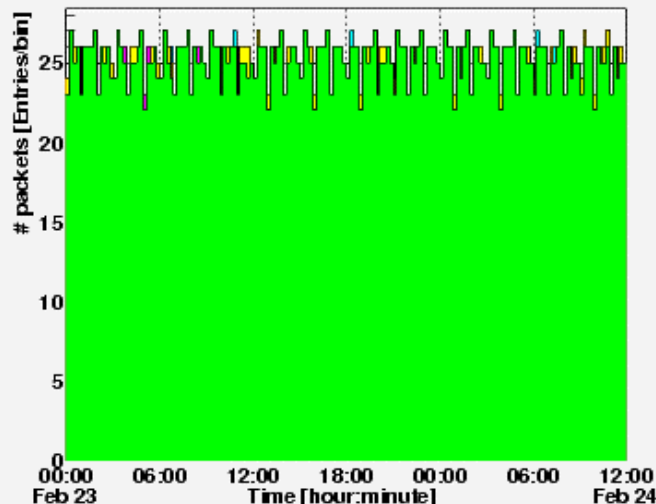
Delay & Hops:

Entries: 4228
Overflow: 1
Underflow: 0
2.5 Perc: 10.6ms
Median: 15.7ms
97.5 Perc: 222.1ms
Mean: 89.9ms
RMS: 99.4ms
Min. hops: 6
Max. hops: 17

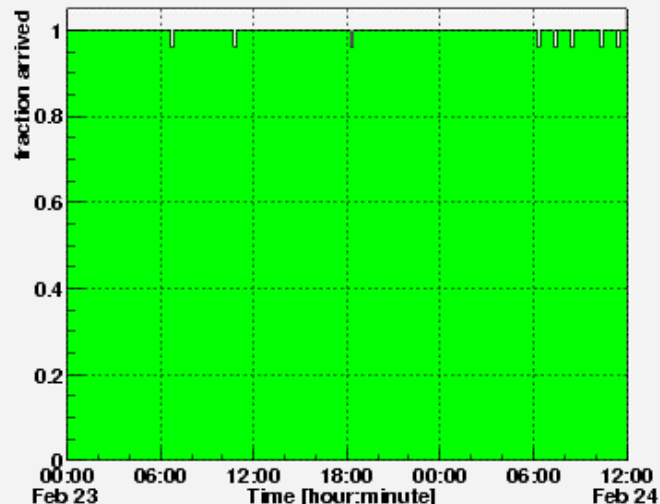
Packets sent/valid:

Total: 4284
Valid: 4228 = 98.7 %
Send bad: 4 = 0.093 %
Recv bad: 44 = 1 %
2 Clocks bad: 0 = 0 %
Lost: 8 = 0.19 %

Packets sent/valid



Packets arrived/lost



Packets lost:

2.5 Perc: 0.0%
Median: 0.0%
97.5 Perc: 3.8%
Uptime: 100 %

Over-all statistic:

Time period: 1 day
Number of routing vectors: 2
flaps: 1
Number of bins: 168
Minutes/bin: 12.8

Summary

- If some peers filter and some don't, traffic may not go the way you expect
- Finding what to expect is very difficult in the absence of routing registries
- Sometimes a tunnel is better than a native link, if the peers of your peer are good
- If you have a TTM box, much closer attention can be paid *by others* to your connectivity