

## Innholdsliste

- 1 Background
- 2 Preparations
- 3 Execution of the test day
  - ◆ 3.1 User feedback: E-mail to technical support
  - ◆ 3.2 User feedback: Article comments
  - ◆ 3.3 User feedback: Test page form submissions
  - ◆ 3.4 User feedback: Netalyzr test reports
- 4 Aftermath
  - ◆ 4.1 Publicity
  - ◆ 4.2 User feedback: Test page form submissions
  - ◆ 4.3 User feedback: Netalyzr reports
  - ◆ 4.4 VG warning message statistics
- 5 Conclusions
  - ◆ 5.1 Why not wait for the ISPs?
  - ◆ 5.2 What we should have done differently
- 6 References

## Background

About a year's worth of measurements had shown that a fraction of the regular visitors (approx. 0.05%) to APDM and VGMM's web pages could experience problems accessing them, if they were dual-stacked<sup>[1]</sup>. This figure had been fairly stable for the last few months, and it seemed that we would not learn more about those users by performing only passive background measurements any longer. We therefore decided to do a IPv6 live-test by activating IPv6 on all of APDM and VGMM's main publications on the 26th of October 0900 CEST, and leave it running for 24 hours.

## Preparations

A web page was set up, where a user could go to test his own connectivity to dual-stacked destinations<sup>[2]</sup>. If he experienced some kind of failure, the page would suggest solutions if applicable to the user in question, in particular to upgrade Opera to the latest version, or to disable IPv6 in Mac OS X. Problematic users would also be asked to run the ICSI Netalyzr<sup>[3]</sup> (a feedback loop had been set up by the Netalyzr administrators so we were notified when the test was run), and also shown a feedback form where they could submit additional information and get more help.

The day before the test, articles was published by both APDM<sup>[4]</sup> and VGMM<sup>[5]</sup>. VGMM also linked this article from their front page. Both of these articles sought to explain IPv6 and the test day in layman's terms, and also provided «test yourself» links to the test page.

## Execution of the test day

The test day was surprisingly undramatic, VGMM even called it an anti-climax. We expected to hear several complaints from end users about the content being unreachable, but it was almost completely silent. Curiously enough, a couple of other minor problems we accidentally introduced on VG.no (unrelated to the dual-stack availability itself) were reported by users almost instantly.

During the day we implemented a JavaScript test on the front page of VG.no that detects broken dual-stack connectivity, and if so show a floating warning message that linked to the explanatory article.

### User feedback: E-mail to technical support

A single connectivity loss complaint was received, from a user that had problem loading VG.no. He stated he was using the Safari web browser and therefore most likely Mac OS X. We suggested he should disable IPv6 in his operating system, and didn't hear back from him later.

This report was contrasted by another one from a happy user who told us that VG.no now loaded twice as fast as usual.

APDM did not receive any direct feedback from end users.

### User feedback: Article comments

A large amount of users commented on VG's article. For the most part, these were from readers interested in technical matters. None included reports of problems accessing the dual-stacked site. There were no comments on APDM's article, presumably because it had not been as well publicised as VGMM's.

### User feedback: Test page form submissions

There was a single submission by a Mac OS X user who had been warned of (working) 6to4 connectivity. He confirmed that he had followed the instructions to disable IPv6, and that after that he had passed the test.

### User feedback: Netalyzr test reports

Prior to and during the test day, 41 users ran the Netalyzr test (without necessarily submitting any feedback information). In order to be shown the link to the Netalyzr test along with the feedback form, the user would have to:

- Fail the test, that is, fail to load a dual-stacked test element or load it using 6to4 or Teredo, and
- Not be running an old version of the Opera web browser (older than version 10.50).

From the 41 test reports, 10 indicated dual-stack failures. Breaking all of them down:

- 6 indicated failures from hosts with public IPv6 addresses
- 2 indicated failures from Mac OS X hosts without public IPv6 addresses
- 2 indicated failures from Mac OS X hosts with 6to4 addresses
- 24 did not indicate any errors
- 3 showed Mac OS X hosts with 6to4 addresses that worked
- 1 showed some kind of internal error in Netalyzr

## IPv6\_test\_day

- 3 were our own (and the Netalyzr crew's) test runs

The 24 users whose reports did not show any errors could either have fixed the problems according to the suggestions on the test page prior to running the test, or the test could have incorrectly have given them a negative result (this was unfortunately quite possible, see below).

The 6 users who had public IPv6 addresses that didn't work had IPv6 addresses belonging to: Intility (2), NTE, Redpill Linpro, Ventelo, and Hurricane Electric. Most likely these ISPs are running IPv6 pilot programmes. In the Redpill Linpro case, a mis-configured switch port was the problem.

Curious side note: One of the users left feedback saying he was connected using a mobile broadband 10km from civilization in the Siberian Taiga. His report did not indicate any problems.

## Aftermath

We turned off the AAAA records at 0900 CEST the 27th of October, as originally planned. VG left the warning code on their front page in place in order to continue to warn broken users and lead them to the article and the test page.

The test day did not have any significant effect on the overall brokenness, the levels returned to approximately the same as before. Some theories as to why not:

- 24 hours might not be enough for users to start caring («It's down, no biggie, I'll check back tomorrow»)
- My brokenness measurements might be a bit overstated, perhaps due to IPv6 having on average higher latency than IPv4
- A large IPv6 deployment might have obscured any positive effect:

The test day apparently prompted the University of Oslo to deploy IPv6 to all their student dormitories ahead of schedule, as these networks have been a hot-spot for 6to4-related Mac OS X brokenness (due to Windows ICS generating «rogue» RAs). Unfortunately, this did not mitigate the rogue RA problems but rather shift it and increase it somewhat. With native IPv6 service, not only OS X gets in trouble, presumably because one of the rogue routers is used as the default route next-hop instead of the legitimate upstream router. This affects about 5000 end users, which is significant enough to cancel out any positive effects from the test day itself. UiO is working on solving the new problems.

## Publicity

Version2, a Danish IT magazine, ran a story about the test day<sup>[6]</sup>, it was mentioned briefly in another article in Digi, a Norwegian IT magazine<sup>[7]</sup>, and we expect Norwegian Computerworld to publish an article (in print) any day now, too.

The Norwegian Post- and Telecom Authority had a national meeting regarding IPv6 deployment status in Norway a couple of days later, and we received lots of positive feedback from various ISPs. Google's presenter even finished off his presentation by a slide that honoured the test day.

## User feedback: Test page form submissions

Two users reported dual-stack failures through the test page feedback form, both running OS X. We suggested disabling IPv6, which one confirmed that worked well, the other one we didn't hear back from.

## User feedback: Netalyzr reports

At the time of writing, 26 more Netalyzr runs have been recorded, 14 of which were failures. Breakdown:

- 6 indicated failures from hosts with public IPv6 addresses
- 5 indicated failures from Mac OS X hosts with 6to4 addresses
- 2 indicated failures from Mac OS X hosts without public IPv6 addresses
- 1 indicated a failures from a Mac OS X host with a bogus IPv6 address (::1:<eui-64>/64)
- 8 did not indicate any errors
- 1 showed a Mac OS X host with 6to4 addresses that worked
- 3 showed some kind of internal error in Netalyzr

The 6 failures from public IPv6 networks were: Hurricane Electric, TDC/Nordiclan, Telenor, unknown (2001:5c0:: - address space squatters?), and University of Oslo's student villages (2).

One of the users with defective 6to4 on OS X left his e-mail address in the Netalyzr report. He was contacted and successfully assisted in disabling IPv6.

## VG warning message statistics

Currently the message box warning users about IPv6 connectivity problems on VG's front page are shown to approx. 200-250 unique IPv4 addresses per hour during daytime, and about 2000-2500 unique addresses per 24 hours.

Regarding the users that are shown the warning box:

- 75% of them are running Mac OS X.
- 40% of them are in domestic university networks.

Not many users are proceeding to the test site via the article linked to in the warning message, so it does not appear to have a significant effect on the brokenness itself. However it might still have function in that it raises awareness about the problem, which might prove useful the day the day we actually go ahead and deploy dual-stack.

## Conclusions

Deploying dual-stack was significantly less problematic than anticipated. There were almost no complaints from end users and zero complaints from management. It is our belief that it is now safe to deploy dual-stack without fearing a business impact.

That said, there are no doubt quite a few users out there that do have problems. While we were able to assist some of these using the test page and the feedback forms, many remains. The problematic users can be roughly divided in two chunks:

1. Mac OS X users affected by rogue 6to4 RAs or similar
2. Power users, with brokered IPv6 tunnels, participating in IPv6 pilot programmes, or are in enterprises which have deployed IPv6 improperly

We don't think we can care too much about the second group. Until there are sufficient amounts of IPv6 content available, they will likely not be inconvenienced enough to fix their own brokenness. Getting the content out there

is the only real way to get them fixed.

However, intentionally breaking the Mac OS X users in the other are something we are reluctant to do, as these are «innocent» users that have no responsibility for their own problems, nor the technical knowledge necessary to diagnose it. Fortunately the release of Mac OS X 10.6.5 is imminent<sup>[8]</sup> and will solve most, if not all, of those users' problems.

Our decision is therefore to deploy dual-stack shortly after the release of Mac OS X 10.6.5.

### **Why not wait for the ISPs?**

The ISPs will inevitably have to deploy Large Scale NAT (LSN) systems in order to share IPv4 addresses between their individual subscribers. For instance: Telenor has publically stated that they will have to do this for their mobile in the beginning of 2011, while Altibox has said they will have to do the same for their Fibre-to-the-Home customers by the end of 2011. These LSN systems will without doubt cause a degraded performance compared to today. This is illustrated by the fact that Telenor Mobil and NetCom earlier had LSN systems in front of all their mobile broadband subscribers, but both migrated away from it to the use of public IPv4 addresses due to performance and scalability issues with LSN, especially after smartphones exploded in popularity.

In order to serve content with the best possible performance, we need to make the content available over IPv6 so that we completely avoid the slower IPv4-with-LSN path. For this to work it is crucial that the ISPs also deploy IPv6 to their end users, and by pushing ahead and deploying IPv6 content now, we give them an incentive to work towards IPv6 deployment (in addition to the inevitable LSN deployments). The feedback we received directly at the Post- and Telecom Authority's meeting is that this kind of incentive is greatly welcome, especially for those ISPs that still have a way to go in convincing upper management to fully embrace IPv6.

By deploying now we break the chicken and the egg stalemate, and do our part to avoid ending up in a situation where the content side do not deploy IPv6 due to the lack of ISP support, and the ISP side do not deploy IPv6 due to the lack of content side support, and the users have no choice but to use a lower-performing IPv4/LSN path to access online services and content.

### **What we should have done differently**

*Improvement #1:* We should have made a more robust test page. It was too simplistic, as it only attempted to load a dual-stacked test element and warned if that did not succeed in after a set timeout of 10 seconds. This likely caused quite a few users to be incorrectly warned about dual-stack failures, especially users with slow or poor-quality internet connections. The number of finished tests is at the time of writing as follows:

- 25549 OK - the dual-stack object was successfully retrieved (using either IPv4 or IPv6)
- 62 warnings - the dual-stack object was successfully retrieved using Teredo or 6to4
- 460 failures - the dual-stack object did not load within 10 seconds

These numbers should not be used to extrapolate some kind of average brokenness. The numbers are biased towards failures due to the simplicity of the test as well as the fact that only broken users are shown the warning box on VG's front page, which in turn leads to the test page. In addition a some of the failures were intentionally triggered when developing the JavaScript code.

*Improvement #2:* The test page should have included the result of the test in the ID string included in the link to Netalyzr, which would have allowed us to see if a certain user had been using e.g. 6to4 prior to running the

## IPv6\_test\_day

Netalyzr analysis. That way we would have been able to tell if the user actually followed the instructions on the page, thereby fixing his own problems before running Netalyzr.

*Improvement #3:* VG's article was published on web site that was accidentally dual-stacked along with the main site, which probably made it more difficult for anyone with problems to access the page and comment. This was fixed at around 1300 CEST, four hours after the start of the test.

*Improvement #4:* We should probably have attempted to publicise the test day even more in advance. However the entire test day was a engineer-driven project that was done with minimal involvement from management, which would have been necessary in order to make a bigger event out of it.

## References

1. ? <http://fud.no/ipv6>
2. ? <http://ipv6test.redpill-linpro.com>
3. ? <http://netalyzr.icsi.berkeley.edu/>
4. ? [http://blogg.api.no/-/bulletin/show/604121\\_vi-tester-neste-generasjon-internett](http://blogg.api.no/-/bulletin/show/604121_vi-tester-neste-generasjon-internett)
5. ? <http://meta.vgb.no/2010/10/25/vg-tester-neste-generasjons-internett/>
6. ? <http://www.version2.dk/artikel/16742-norge-rykker-koerer-med-ipv6-paa-landets-stoerste-netavis>
7. ? <http://www.digi.no/854835/snart-kommer-de-norske-isp-ene-med-ipv6>
8. ? <http://www.macstories.net/news/itunes-10-1-and-os-x-10-6-5-coming-tomorrow-ios-4-2-on-friday-at-10-am-pst>