Experiences from an IPv6-Only World at Ericsson

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Moving to an IPv6-Only Network

Our sites had been in dual stack for years

It all worked very well, so clearly we had to try something else

› At some point someone will move to this type of a network – perhaps some of our customers in the mobile operator world

We had several goals:

› Find out what breaks with IPv6-only networking and feed the results back to various vendors, IETF, ...

› Test an early version of our NAT64 product

› Build an understanding to recommend dual stack and IPv6-only for the appropriate situations

Our IPv6-Only Network

Two sites were involved:

› ER NomadicLab and my home
› A small group of opt-in users

An alternate network with

› No IPv4 at all (no DHCP, no routing)
› Separate prefixes/VLANs/wireless
› NAT64 for access to the IPv4 Internet
› IPv6 servers, IPv6 Internet access, whitelists, etc already in place

Experiences

The bottom line

› IPv6-only is possible today

› I do not have to go back any more

› Some pain involved; not for everyone yet

– But a big difference between mobile and general environments

In more detail:

› Many things **do** break

› Lack of IPv6 support and previously unseen bugs

› Some users went back to dual stack because of this

› Key issue is true IPv6 support, not so much NAT64

IPv6-Only

Plenty of things work well:

› Browsing generally not an issue at all (I saw 2 IPv4 literals in 2 months)

› E-mail, software updates, many chat systems, streaming

On some handsets you can reach 100% functionality

But there are some issues in general environments:

› Host operating system testing issues

› Some applications fail

› Many appliances do not support IPv6

› Firewall support (particularly for fragments)

Example issues with operating systems

› Old RA info not removed after network change (Linux)

› Network manager needs to be told to not expect IPv4 (Apple, Ubuntu)

› DNS discovery problems (Ubuntu, Windows)

IPv6-Only

Example issues with applications

› By far the biggest complaint was about Skype

› Some chat accounts fail, too: MSN, AIM/ICQ

  – But FB, GMAIL, JABBER do work

› Secondlife clients do not work

   Many games fail in their network/LAN version

Unable to connect to Second Life.
DNS could not resolve the host name.
Please verify that you can connect to the www.secondlife.com
web site. If you can, but continue to receive this error,
please go to the support section and report this problem.

Close
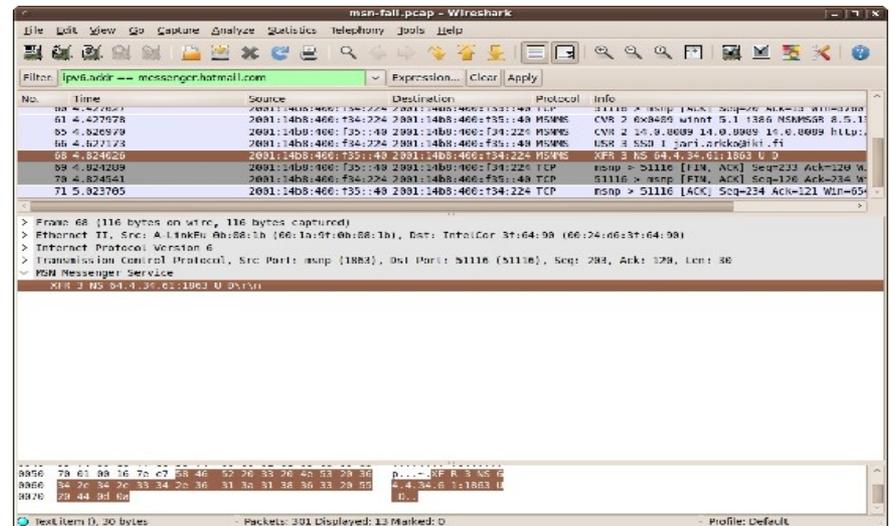
IPv6-Only Messaging

System	Works?
Facebook on the web (http)	**Yes**
Facebook via a client (xmpp)	**Yes**
Jabber.org chat service (xmpp)	**Yes**
Gmail chat on the web (http)	**Yes**
Gmail chat via a client (xmpp)	**Yes**
Gtalk client	**No**
AIM (AOL)	**No**
ICQ (AOL)	**No**
Skype	**No**
MSN	**No**
Webex	(tests in progress)
Sametime	(tests in progress)

IPv6-Only Gaming

GAME	Works in LAN/NW mode?
Web-based (e.g. armorgames)	**Yes**
Runescape (on the web)	**No**
Flat out 2	**No**
Battlefield	**No**
Secondlife	**No**
Guild Wars	**No**
Age of Empires	**No**
Star Wars: Empire at War	**No**
Crysis	**No**
Lord of the Rings: Conquest	**No**
Rome Total War	**No**
Lord of the Rings: Battle for Middle Earth 2	**No**

NAT64-Based Connectivity

Main conclusions

› Generally works well, when the application is capable of using IPv6 APIs and addresses

› Initially we had some implementation bugs, but the NAT64 operation is very stable at this point

› Relies even more heavily than dual stack on IPv6 connectivity: on dual stack you can fallback to IPv4, with NAT64 and DNS64 you can not (according to the spec)

But we have also some measurements...

Web Connectivity Comparisons

› We compared various network configurations, using wget and Alexa top 1000 web site list

› YMMV – temporary glitches, your location in the routing infrastructure, client software (browser vs. wget) may affect the results

Mode	Failure rate	Notes
IPv4-only	1.9%	
IPv6-only	96%	Google sites are among the few exceptions here
IPv6-only & NAT64	2.1%	Mostly due to IPv4-literals

Literal IPv4 Address on Web Pages

› With 1000 top sites, 0.2% needed an IPv4 literal to render all components in their top page

› With 10.000 top sites, this number increases to 2%

› Unfortunately, its hard to make any conclusions about this, as it is often the case that there are unresolvable or inaccessible components on a web page anyway

› Personal anecdotal evidence says this is not a big problem

› But clearly, cleaning this up would be useful

Conclusions and Recommendations

Recommendations:

› Dual stack should still be our preferred mode of operation

› IPv6-only can be considered for special environments today

  – Such as mobile networks that have control of terminals

  – But even so, needs care!

› With effort, general IPv6-only becomes easier in the future

Work list to improve the situation:

› DNS discovery

› NAT64 specification details

› IPv6 support for Skype, messaging and gaming

› Fix bugs (repeat 500 times)

› Clean the Internet of IPv4 literals

› Measurements on failures and delays, analysis of reasons

› Some ALG work?

Questions? Comments?