# Stop Thinking IPv4 IPv6 is Here

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# "In God we trust, all others bring data."



#### W. Edwards Deming

#### IPv6 is Already Here...



source: http://www.google.com/intl/en/ipv6/statistics.html

#### It's Just not Very Evenly Distributed

Norway IPv6 Adoption: 7.06% Latency / impact: 0ms / 0.02%

doubled since

Russia May 2014 IPv6 Adoption: 0.51% Latency / impact: 0ms / 0.01%

Belgium IPv6 Adoption: 29.26% Latency / impact: 0ms / 0.03%

Germany IPv6 Adoption: 11.73% Latency / impact: -10ms / 0%

 Switzerland

 IPv6 Adoption: 10.41%

 Latency / impact: 0ms / 0.01%

 Greece

 IPv6 Adoption: 5.47%

 Latency / impact: 0ms / 0.01%

#### source: http://www.google.com/intl/en/ipv6/statistics.html

## This Talk...

- is not about 'to deploy or not to deploy'
  is about 'how to
  - is about now to deploy'



#### Same Same but Different

- IPv4-Style:
  - IPv6 is like IPv4 but more addresses
- IPv6-Style:
  - Scoped Address Architecture
  - Multiple addresses per host
  - Neighbor Discovery Protocol
  - Stateless Address AutoConfiguration
  - Fragmentation at source only
  - ...and other interesting stuff...

#### Scoped Address Architecture

- IPv4-Style:
  - All addresses are equal
- IPv6-Style:
  - Every unicast address has a scope<sup>\*</sup> (encoded into address)
    - Link-local (fe80::/10)
    - site-local\*\*
    - global

(\*) other than unspecified address (::) (\*\*) deprecated Recommended reading: RFC4007 "IPv6 Scoped Address Architecture"



#### **Dual-Stack Network**





#### Address Plan

- IPv4-Style:
  - How to choose the subnet size? Shall we renumber later?
- IPv6-Style:
  - /128 for loopbacks
  - /127 for p2p links
  - /64 for everything else

0

"/64 ought to be enough for anybody"

#### Oh RFC1918, Where Art Thou?

- IPv4-Style:
  - I have 10/8, 172.16/12, 192.168/16 + NAT for v4
  - Let's use ULA (fc00:/7) for v6!
- IPv6-Style:
  - No NAT!
  - Global Unique Addresses (GUA) everywhere

#### Takeaway: ULAs are NOT a private space

Recommended reading: http://tools.ietf.org/html/draft-ietf-v6ops-ula-usage-recommendations-04

#### Host Configuration

- IPv4-Style:
  - We used DHCP for v4. We want DHCP for v6!
- IPv6-Style:
  - Occam's razor: Do you \*really\* need DHCP?
  - Stateless Address Autoconfiguration (SLAAC)
  - SLAAC is here \*anyway\*
  - DHCPv6 support is not MANDATORY for hosts
  - RDNSS for configuring DNS information

### First Hop Redundancy

- IPv4-Style:
  - We used VRRP/HSRP for v4. We want the same for v6!
- IPv6-Style:
  - SLAAC is here \*anyway\*
  - Router Advertisements:
    do the job



#### The Host, the Link and the Subnet

#### • IPv4-Style:

- Address + subnet mask => "on-link prefix"
- packets to on-link prefix directly, everything else - via routers

## IPv6-Style: on-link determination is separate from the address assignment

- default: only LLA are on-link
- addresses from the same subnet may be off-link
- addresses from another subnet may be on-link

Recommended reading: RFC5942, "IPv6 Subnet Model: The Relationship between Links and Subnet Prefixes"

#### Dual-Stacking Services: WEB

- IPv4-Style:
  - Just replicate IPv4 config
- IPv6-Style:
  - Think about broken clients!
  - most stacks try IPv6 first

$\Theta \circ \circ$	☆ furry — bash — 67×9
<pre>furry@Wintermute:~&gt;dig a</pre>	www.google.com +short
173.194.113.113	
173.194.113.114	
173.194.113.115	
173.194.113.116	
173.194.113.112	
furry@Wintermute:~>dig ad	aa www.google.com +short
2a00:1450:4001:80b::1010	
furry@Wintermute:~>	

### Dual-Stacking Services: SMTP

- IPv4-Style:
  - Just mimic IPv4 approach
- IPv6-Style:
  - Number of addresses does matter!
  - It is not about protocol version, it is about antispam
  - Strongly recommended reading:

"Sending and receiving emails over IPv6" article by Franck Martin http://engineering.linkedin.com/email/sending-and-receiving-emails-over-ipv6

### Do We Really Need DUAL-stack?

- IPv4-Style:
  - Just replicate IPv4 config
- IPv6-Style:
  - Why deploy/support/monitor/troubleshoot 2 networks?
  - IPv6-only may be an option
     NAT64

Recommended reading: "The Case for IPv6-Only Data Centers" by Tore Anderson https://ripe64.ripe.net/presentations/67-20120417-RIPE64-The\_Case\_for\_IPv6\_Only\_Data\_Centres.pdf

#### Security

IPv4-Style:

no IPv6 - no problem!

IPv6-Style:

if you won't come to
IPv6 then IPv6 must
come to you!



If You Can't Beat Them, Join Them

### Security (contd.)

- IPv4-Style:
  - Just replicate IPv4 configs
- IPv6-Style:
  - Some IPv4 problems are addressed in IPv6
  - IPv6 introduces new functionality
  - New functionality might be misused

#### Some Examples: Firewall Filters

- IPv4-Style:
  - Copy IPv4 ACLs, replace v4 addresses with v6
- IPv6-Style:
  - Remember about link-local addresses
  - Remember about extension headers
  - IPv6 header might be pretty long: how deep can your hardware look into packets?



#### "Always do right. This will gratify some people and astonish the rest."



#### Mark Twain



Enabled IPv6P

#### References

- "IPv6 for IPv4 Experts" book by Yar Tikhiy
  - <u>https://sites.google.</u>
     <u>com/site/yartikhiy/home/ipv6book</u>
- RFC5942, "IPv6 Subnet Model: The Relationship between Links and Subnet Prefixes"
- RFC4007 "IPv6 Scoped Address Architecture"
  - http://tools.ietf.org/html/draft-ietf-v6ops-ula-usage-recommendations-02
- "Sending and receiving emails over IPv6" article by Franck Martin
  - <u>http://engineering.linkedin.com/email/sending-and-receiving-emails-over-ipv6</u>
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