IPv6: Are we there yet?

NANOG 58 – New Orleans

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So where are we?

The more things change…
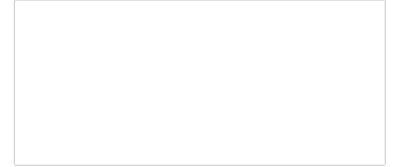
- **How wide is deployment?**

- **SLAAC vs DHCP**

- **Identifying users/machines**

- **Interface "magic"**

- **Org/political challenges**

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The more things keep changing…

- **App changes (esp. browsers)**

- **Policy changes (PTR)**

- **Security and "broadcast domain" changes**

- **IPSEC**

- **IETF Process**

100% by 2012…

The dream…

IPv6 deployment
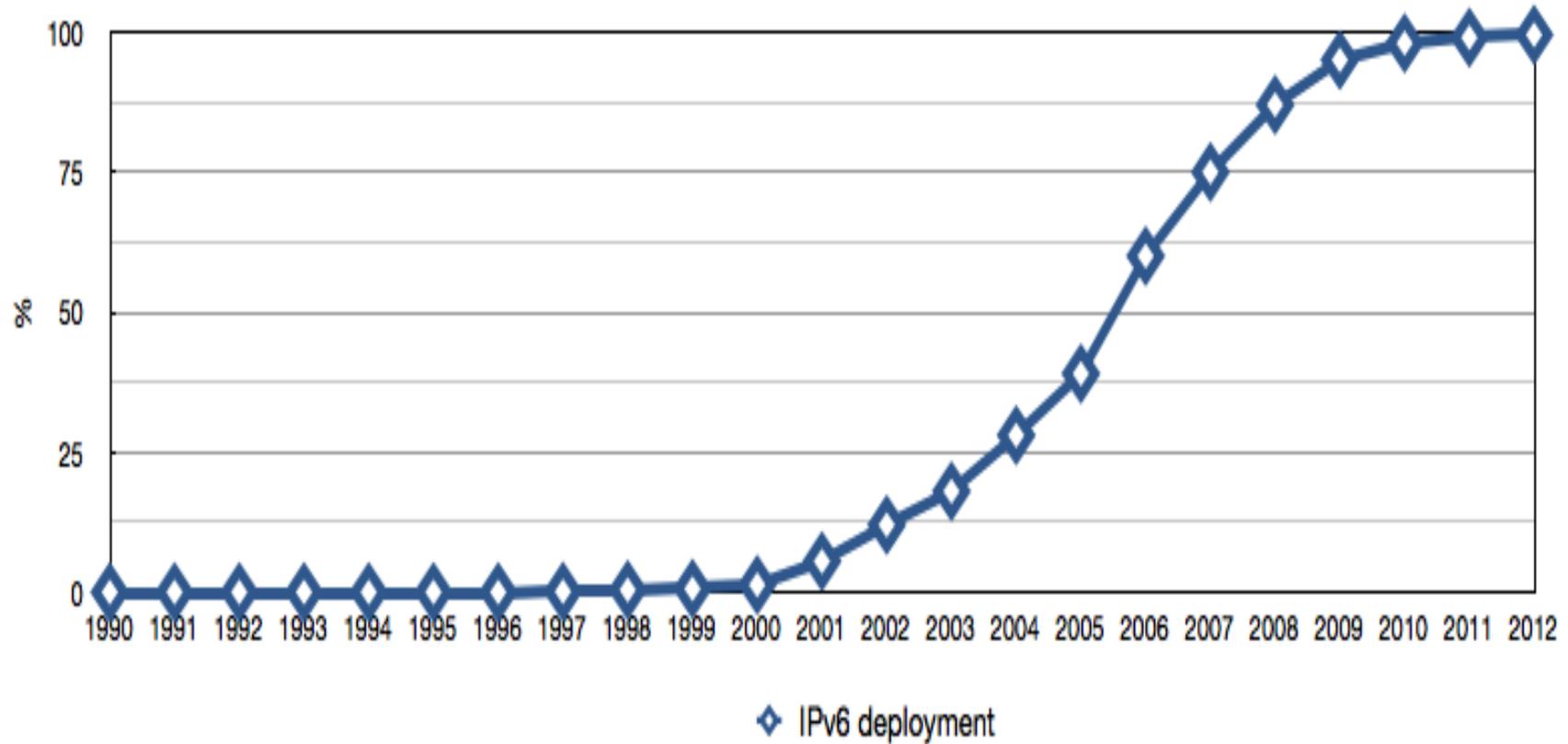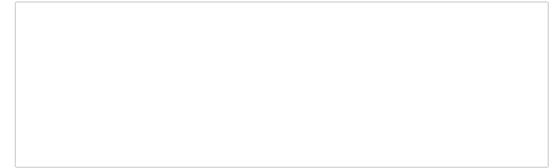
And the reality
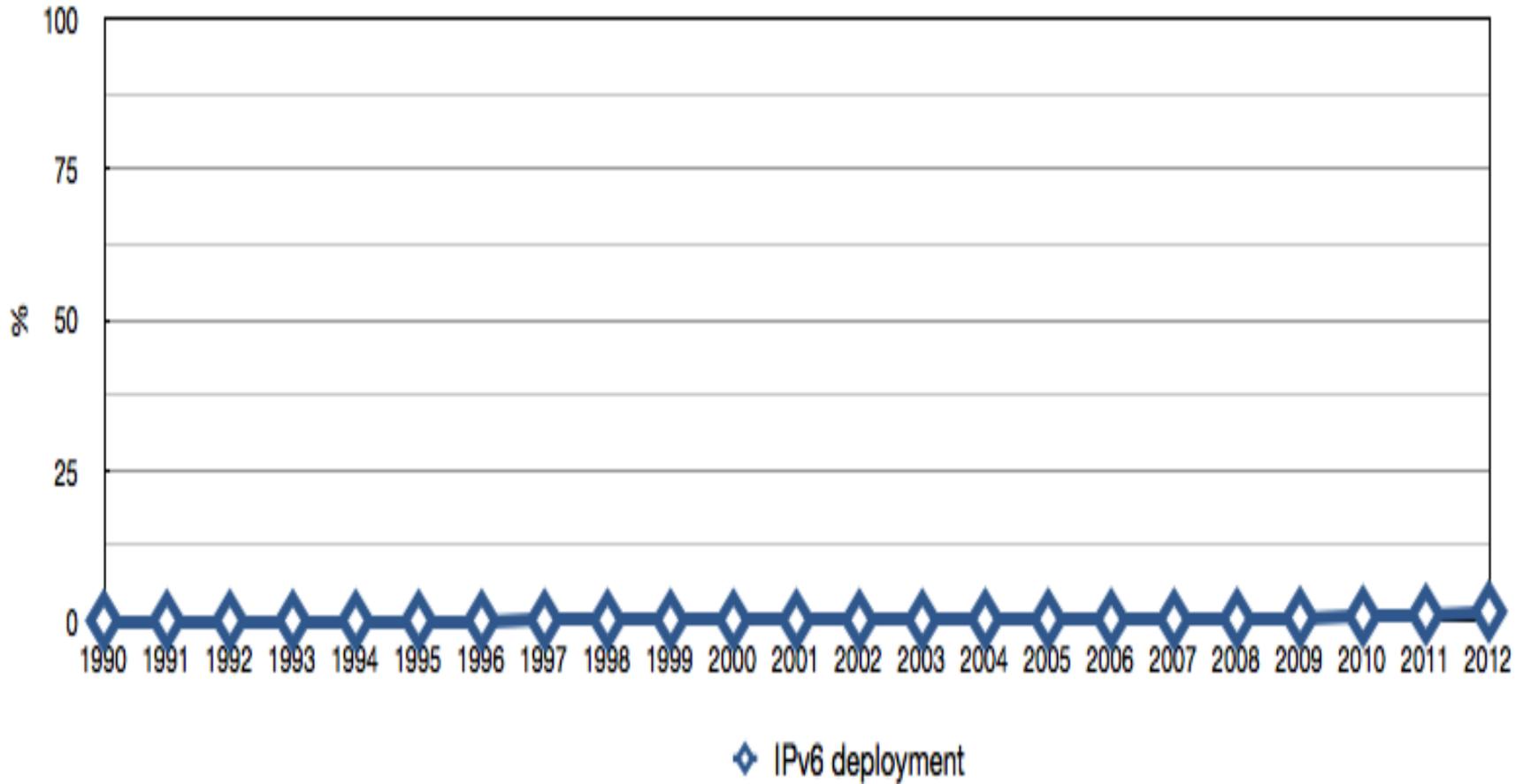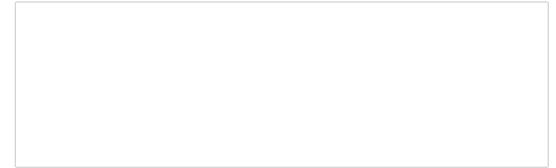
Some better than others
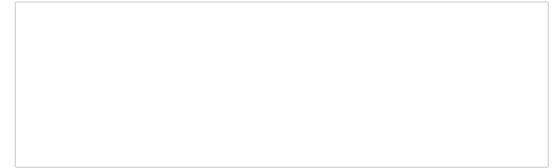
Index	ISO-3166 Code	V6 Use ratio	V6 Users (Est)	Country
1	RO	10.28%	889683	Romania
2	EU	9.29%	0	European Union
3	LU	7.50%	35259	Luxembourg
4	CH	7.38%	476755	Switzerland
5	FR	5.50%	2761915	France
6	JP	4.18%	4210674	Japan
7	BE	3.58%	304461	Belgium
8	DE	3.06%	2078627	Germany
9	US	2.65%	6619195	USA
10	PE	2.16%	227924	Peru

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Some better than others

- **http://www.worldipv6launch.org/measurements/**
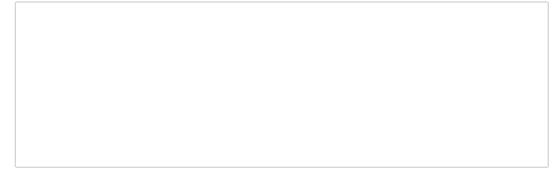
    - **VZW at 30%**

    - **France, Romania & Switzerland**

    - **12% of Alexa 1,000**

    - **IX traffic in EU approaching double digits**

But v4 to v6 is *HARD*...

DUID > Mac address
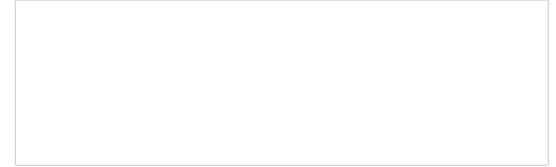
- **Mac address as ID is flawed:**
  - Not always unique
  - Can be altered
  - Multi-interface hosts confuse things

- **But it's what most of the eyeballs on the Internet are ID'ed by currently**

- **DUID (DHCP Unique Identifier) is the replacement in IPv6**

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What DUIDs do right
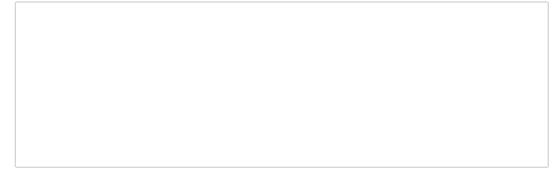
- **One DUID per DHCP server or client**

- **One Identity Association (IA) per network interface on a host**

- **A host can DHCP for all interfaces via DUID/ IA as unique key**

Where DUIDs don't work…
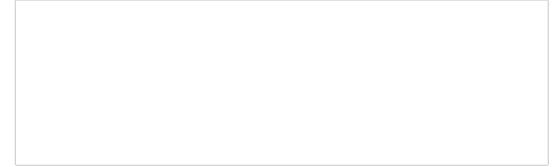
- **Anyone using mac address for identification or filtering**

- **Anyone trying to correlate IPv4 and IPv6 to the same machine/user**

- **Persistent storage of DUID may cause surprises**

But I do dual stack…
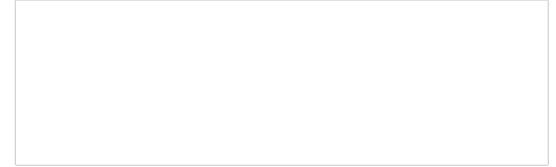
- **How to correlate all addrs to same client:**

  - **draft in ietf: draft-ietf-dhc-dhcpv6-client-link-layer-addr-opt (headed to IESG)**

  - **circuit-id/remote-id work as with DHCPv4**

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RA Season!
Wabbit Season!

IPv4 routing
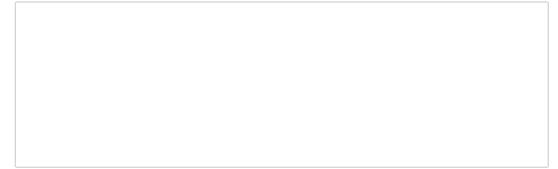
- **Static default route**

- **DHCP server gives default route**

- **Changing network might miss changing DHCP default route**

IPv6 routing
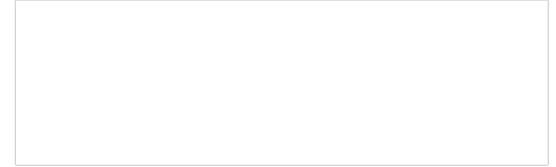
- **Static default route (link local). Ick.**

- **DHCP server can't give default route…**

- **Folks changing routers probably own RA configs**

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Layer 9 (political)
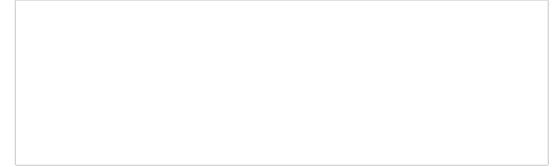
- **Different groups for DNS, DHCP, routers, RAs, IP addr assignment?**

- **Can't just change DHCPv6 or RA, need to coordinate with systems, network, maybe security**

Happy Eyeballs

IPv6. Yes. Have some.
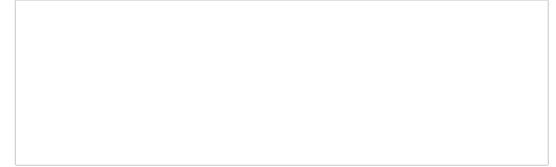
- **Original plan: Always use IPv6/AAAA if available**

- **Result: poor user experience (long timeouts, use of slower links, etc.)**

Err… We meant Happy…
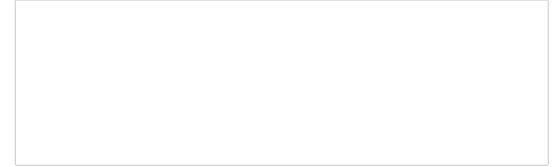
- **Next attempt was to specify draft/RFC**

- **"But that doubles DNS traffic"…**

- **And OS and browser folks both dived on it**

Hence "Hampering Eyeballs"
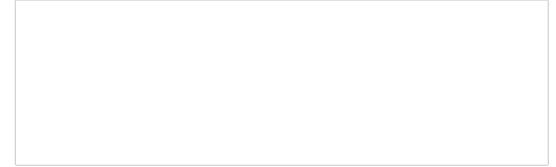
- **Testing by Geoff Huston**

- **Problems with browsers**

- ***Lots*** **of problems with OS X**

- **Windows trying to fix at network layer…**

How do it know?

Source/Destination Address
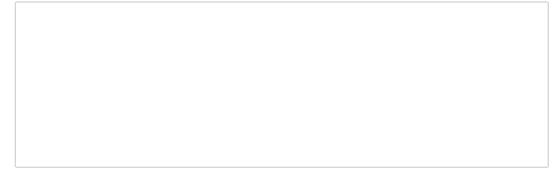
- **Multiple interfaces w/ multiple addrs**

- **Multiple prefixes**

- **Dual stack…**

- **How to choose…**

- **RFC 6724 (formerly RFC 3484)**

RFC 6724
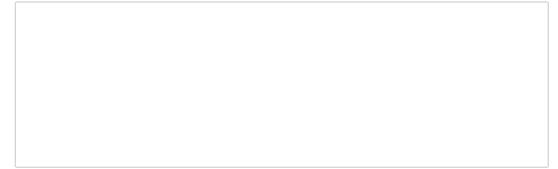
- **Types of addrs:**
  - IPv6: GUA, ULA, Link Local, privacy
  - IPv4: public, APIPA, 1918

- **Some better than others**
  - Consider scope, type, prefix length
  - Avoid deprecated

- **Allow local policy overrides**

Debugging will be fun
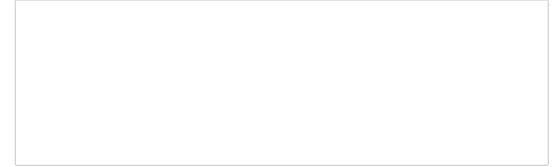
- **Decisions time/context sensitive**

- **How to train staff and users**

- **Local tools to dump all info**

- **Packet sniffers?**

And what don't we know yet…

Default route
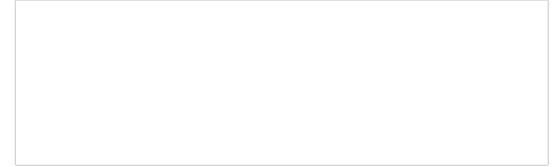
- **Multiple default routes from RAs**

- **No more HSRP/VRRP! Maybe…**

- **But does this actually work?**

- **Not all Oss did the right thing (Fedora, ???)**

What else will we find…
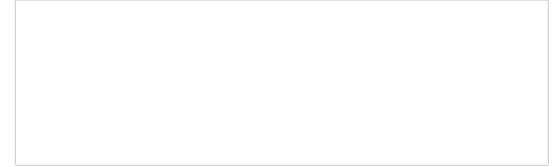
- **AIX makes multiple AAAA/ip6.arpa queries with no working IPv6 stack**

- **draft-liu-bonica-dhcpv6-slaac-problem**

- **Making apps IPv6 ready:**
  - **https://ripe66.ripe.net/archives/video/1194**

- **And there will be more…**

CPEs & PD

I can save $5/customer and…
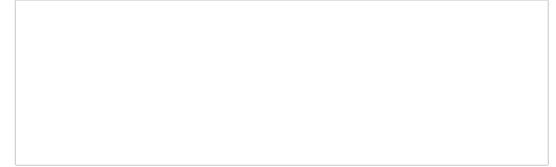
- … make my support burden a nightmare

- RIPE 554: http://www.ripe.net/ripe/docs/ripe-554

- CableLabs and UNHIOL

I can't NAT?
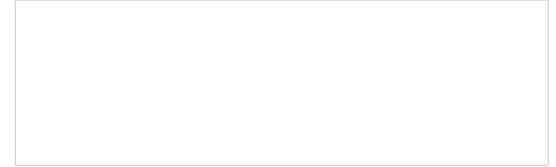
- **No…**

- **And /64 for house isn't enough**

- **But how big?**

- **And how to route?**

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Sorry, Mom. Use OSPF
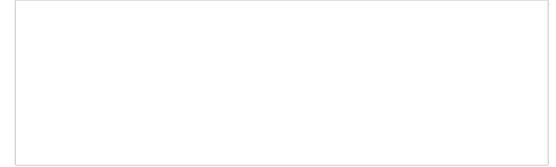
- **OSPF or IS/IS in homes? Really?**

- **HOMENET WG**

- **HIPNET**

Reverse/PTR goo

How did this all start?

- **ftp (ftp.uu.net, ftp.wustl.edu)**
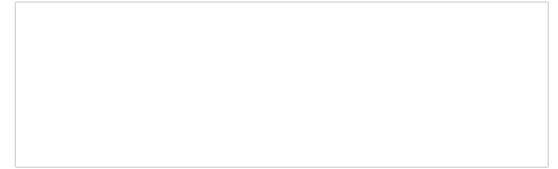
- **SMTP**

- **Security devices**

- **Silly web things**

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How did we do it IPv4
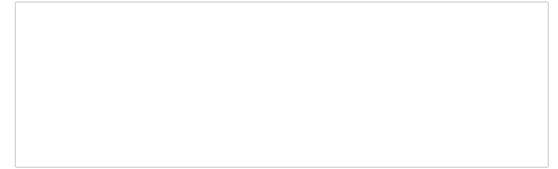
- **By hand (ow)**

- **Scripts**

- **$GENERATE**

- **IPAM**

How would that work for IPv6
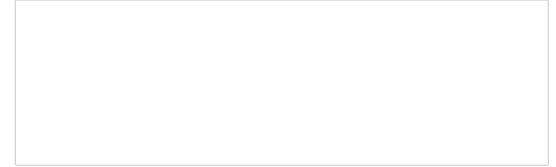
- **A single subnet is a /64**

- **A /64 has 18 quintillion (4 bil x 4 bil) addrs**

- **A PTR record has 34 labels in IPv6**

- **Anyone got a computer with enough disk or RAM to hold one /64 zone file?**

So what are we left with?
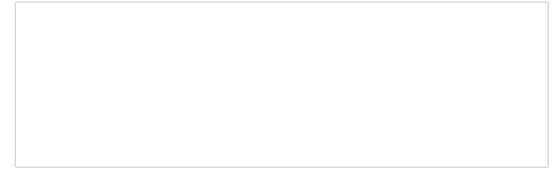
- **Admit that PTRs are pointless**

- **Pre-populate (assuming FTL travel…)**

- **Pre-populate statics for routers & big servers**

- **As above plus DHCP server adding clients**

- **Lie on the fly (if not doing DNSSEC)**

ICMPv6
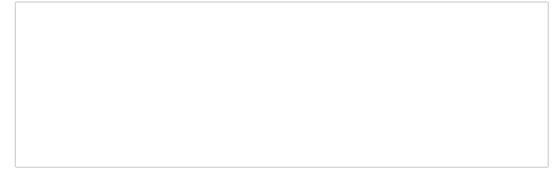
ICMPv6

- **Required for:**

  - **DAD**

  - **Finding routers (RA/SLAAC)**

  - **Finding servers (DHCP)**

  - **PMTUD**

 - **Connectivity (echo request/response)**

  - **Network errors**

ICMPv6 Filtering
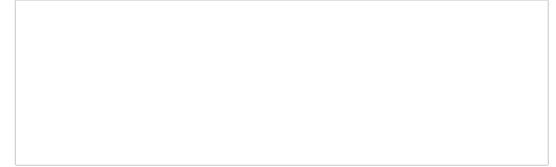
- **Filter it all and you don't have a useful network**

- **ICMPv6 much more detailed/precise in types and functions**

- **RFC 4890 has excellent filtering practices**

IPSEC
Myth vs Reality

The Myth
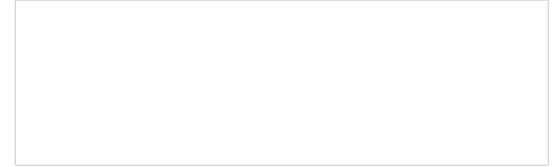
IPSEC in IPv6 is better than IPv4 because it was designed in and mandated.

And the reality
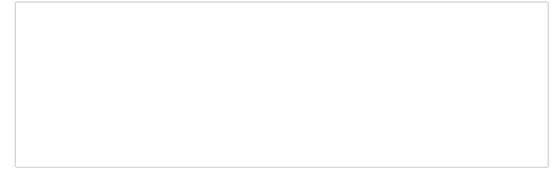
- **RFCs said "MUST" support IPSEC (but softening to "SHOULD"…)**

- **Didn't define "support", let vendors do it**

- **Vendors shipped, didn't enable**

- **No PKI…**

IETF Blue
Light Special

The more things change…
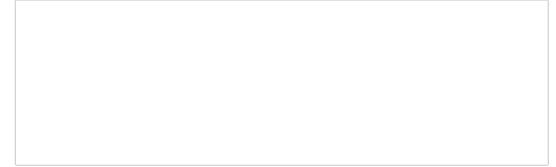
- **… the more they keep changing**

- **DHC: 19 drafts, 73 RFCs**

- **IPv6: 12 drafts, 52 RFCs**

- **More every IETF meeting**

And some RFCs are old…
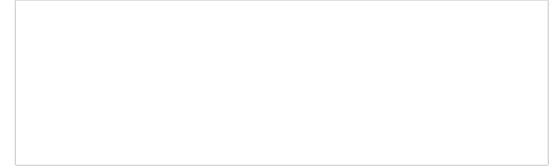
- **RFC 3315 needs rewrite (liu/bonica)**

- **/etc/resolv.conf & RFC 6731**

- **Or problems are new (MIF)**

- **PKI and key mgmt (DNSSEC/DANE/RPKI)**

What to do?
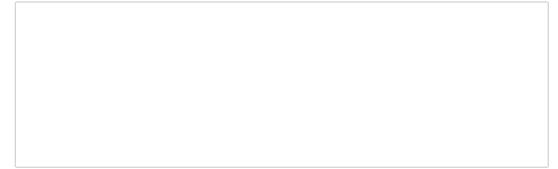
- **Join the WG mailing lists**

- **Come to IETF if you can**

- **Coordinate with other operators (IPBCOP.org)**

- **Beat on vendors**

Q & A

Thank you!