

# DHCPv6 Operational Challenges

Tom Coffeen, IPv6 Evangelist  
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# Agenda

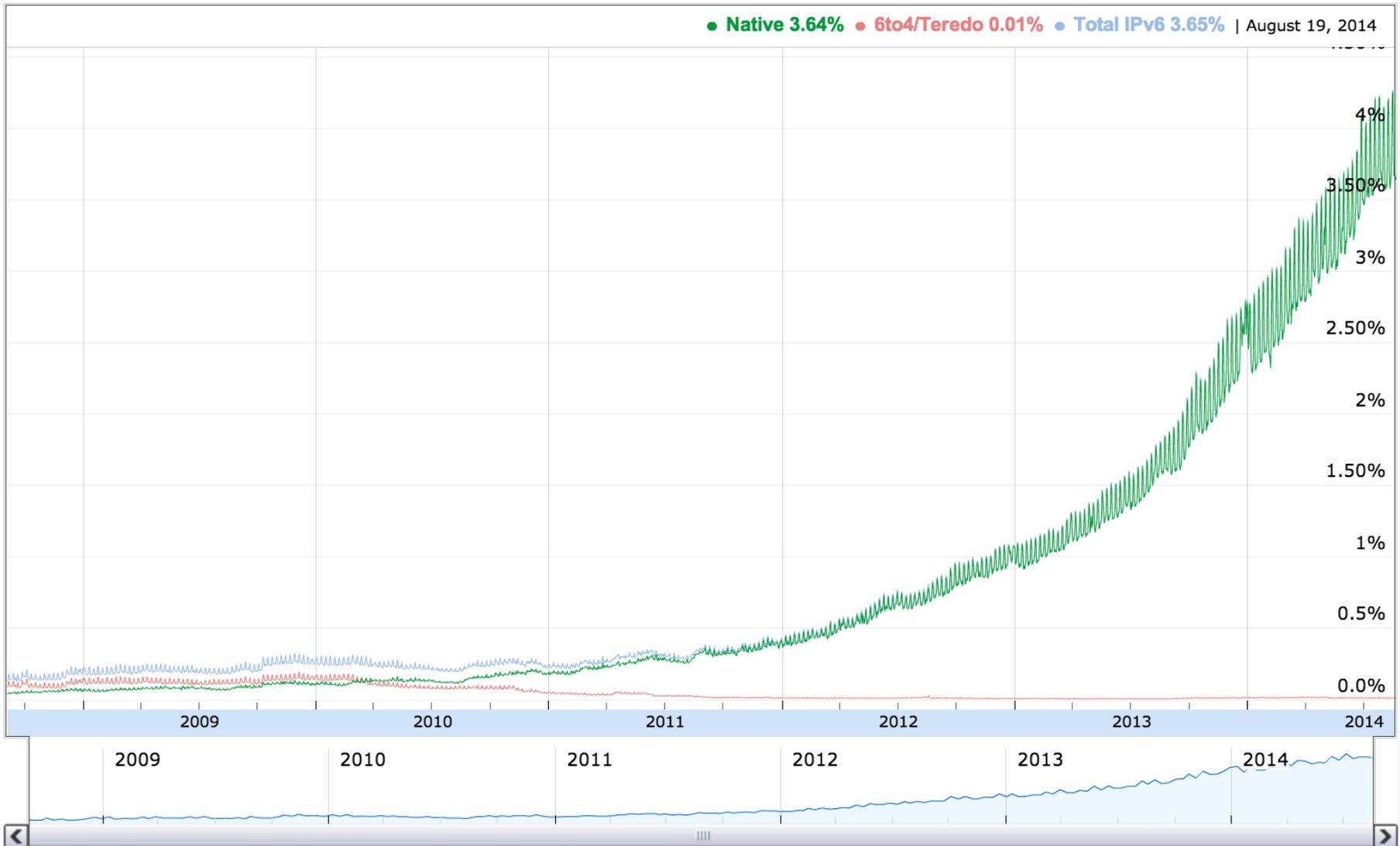
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1. IPv6 is here! (Really, we mean it this time...)
2. DHCPv6 (i.e., Oh, look what IPv6's dragged in!)
3. Stuff that's (more or less) working
  1. Prefix delegation
  2. DHCPv6 fingerprinting
4. Stuff that's (more or less) borked
  1. Failover
  2. Sanity in mixed autoconfig environments
5. Conclusion

# IPv4 is depleted...

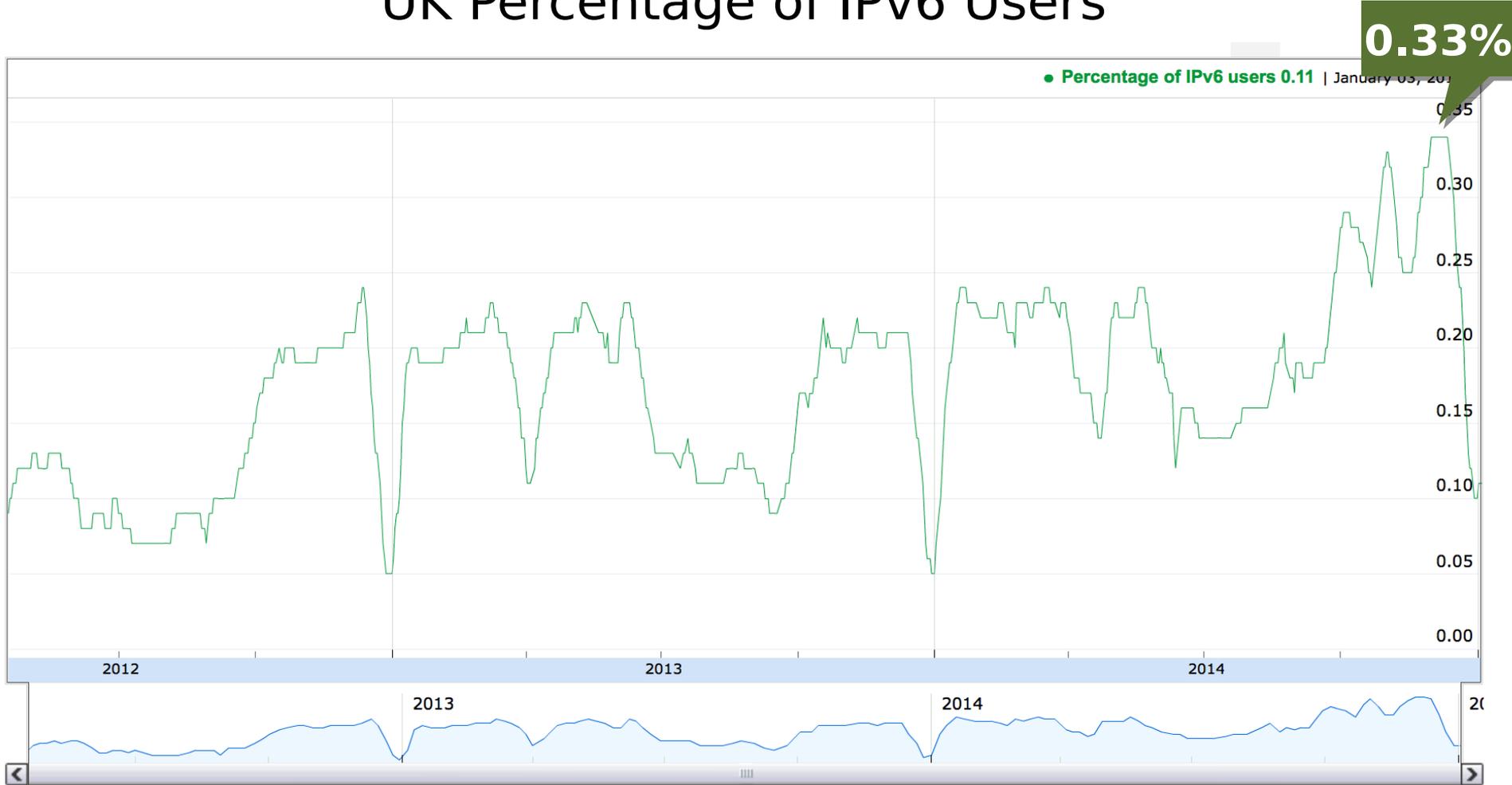


# IPv6 is Here...

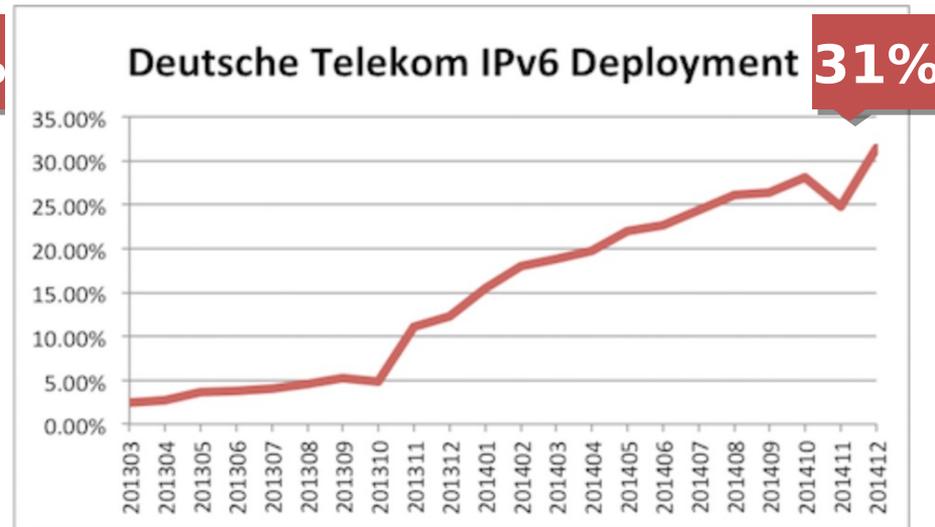
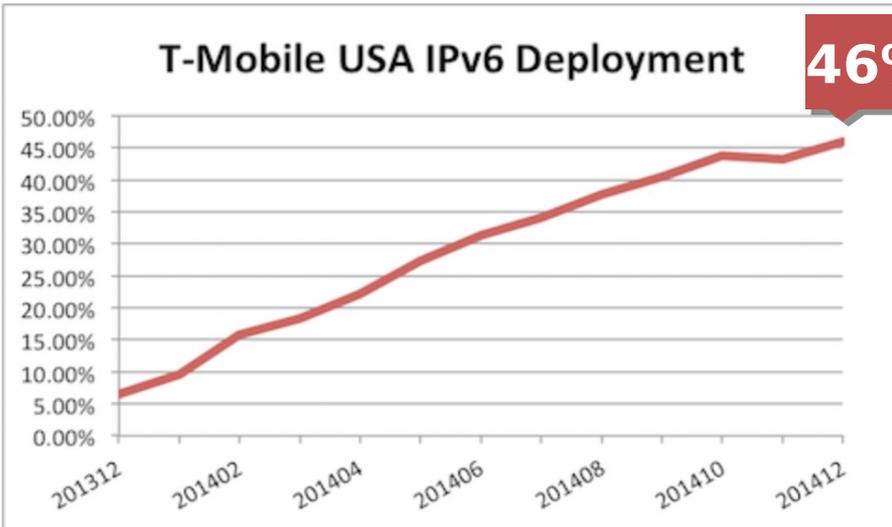
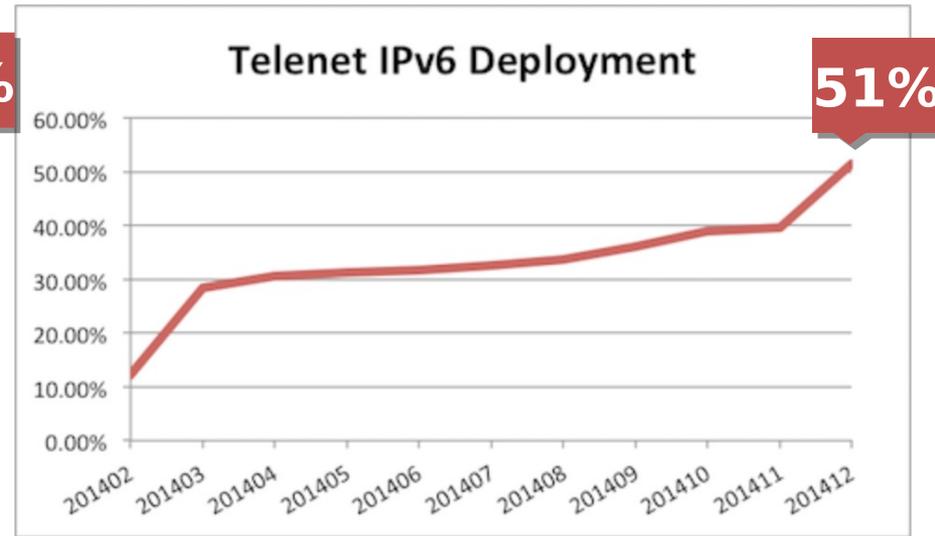
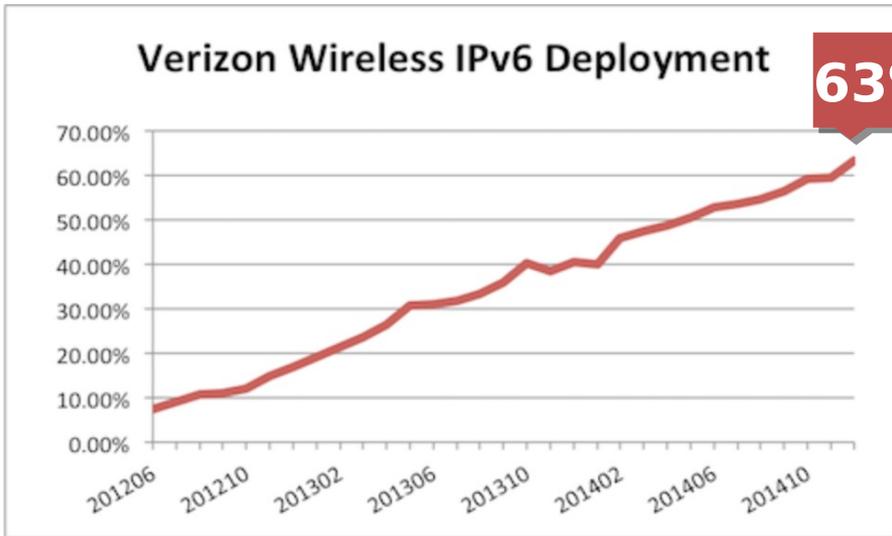


# IPv6 is...Over There...

## UK Percentage of IPv6 Users



# Some IPv6 Network Operator Measurements



Source: <http://www.worldipv6launch.org/measurements/>

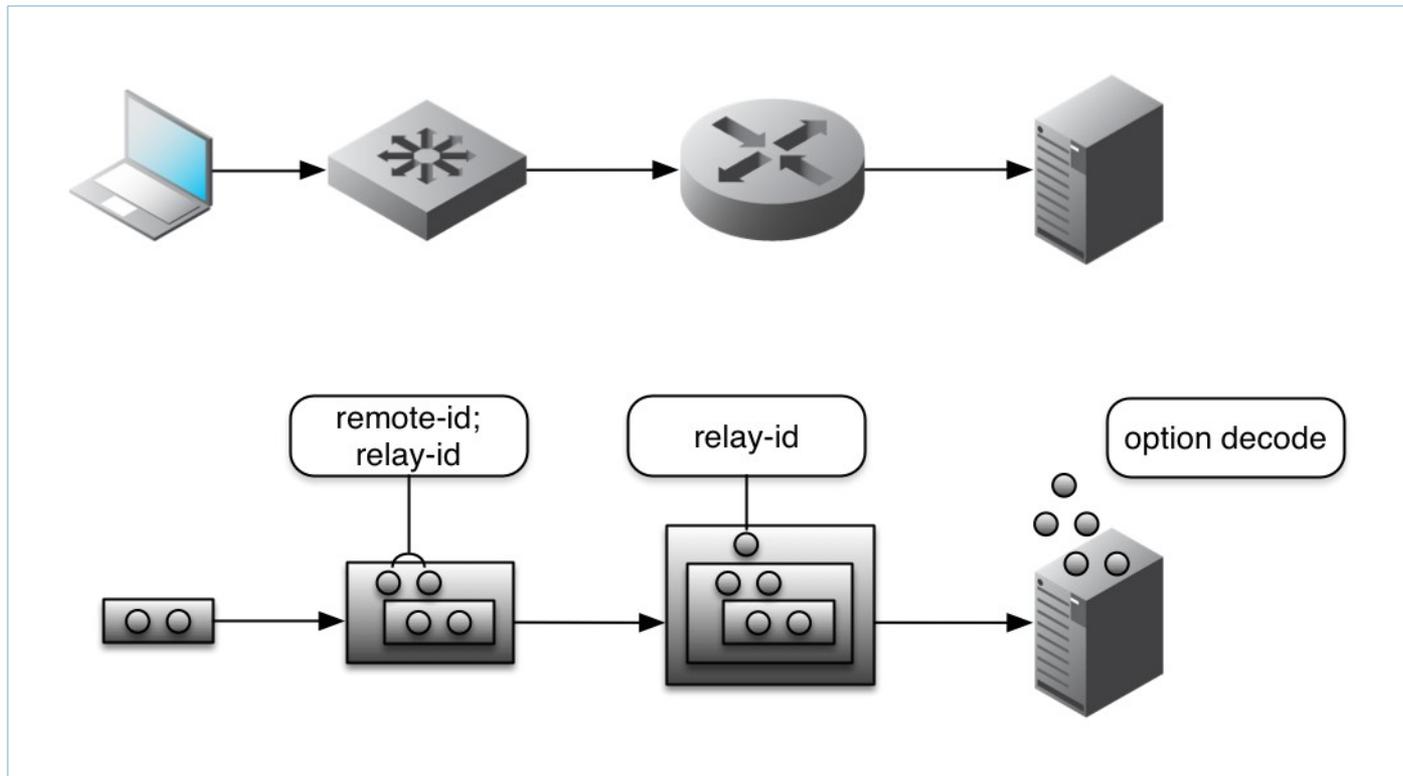
# UK IPv6 Network Operator Measurements



Participating Network	ASN(s)	IPv6 deployment
AAISP	20712	27.96%

## DHCPv6 Prefix Delegation

# DHCPv6 Relay - ISC 4.3



- Custom provisioning of DHCPv6 info for a particular client or client type or circuit ID
- Classes can now be created based on DHCPv6 relay-provided options (rather than just client-provided options)

# DHCPv6 Relay - ISC 4.3

## Remote-ID Option Syntax

Partial standard specification for syntax:

*<enterprise-id><remote-id>*

Result from relay:

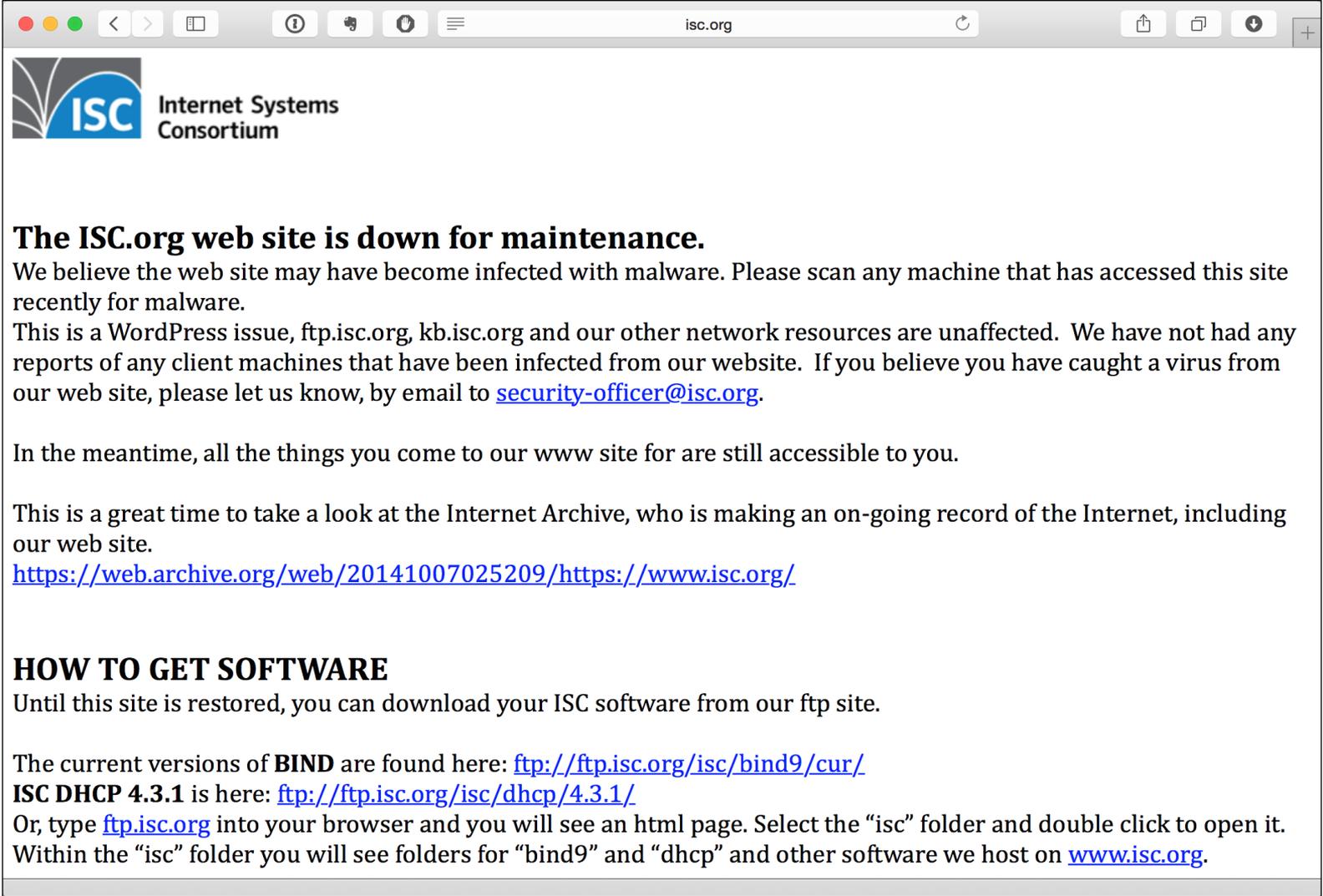
*<enterprise-id><relay-DUID><relay device-type><device-id info>*

↑  
e.g. Brocade

↑  
router

↑  
port or circuit  
number

# DHCPv6 Relay - ISC 4.3



The screenshot shows a web browser window with the address bar set to `isc.org`. The page content includes the ISC logo and a maintenance notice. The notice states that the website is down for maintenance due to a suspected malware infection. It provides instructions for users to scan their machines and reports any issues to `security-officer@isc.org`. It also mentions that other network resources like `ftp.isc.org` and `kb.isc.org` are unaffected. A link to the Internet Archive is provided for users to access the website's history. The page also includes a section titled "HOW TO GET SOFTWARE" which provides instructions on how to download ISC software from their ftp site, including links to the current versions of BIND and ISC DHCP 4.3.1.

**The ISC.org web site is down for maintenance.**

We believe the web site may have become infected with malware. Please scan any machine that has accessed this site recently for malware.

This is a WordPress issue, `ftp.isc.org`, `kb.isc.org` and our other network resources are unaffected. We have not had any reports of any client machines that have been infected from our website. If you believe you have caught a virus from our web site, please let us know, by email to [security-officer@isc.org](mailto:security-officer@isc.org).

In the meantime, all the things you come to our `www` site for are still accessible to you.

This is a great time to take a look at the Internet Archive, who is making an on-going record of the Internet, including our web site.  
<https://web.archive.org/web/20141007025209/https://www.isc.org/>

**HOW TO GET SOFTWARE**

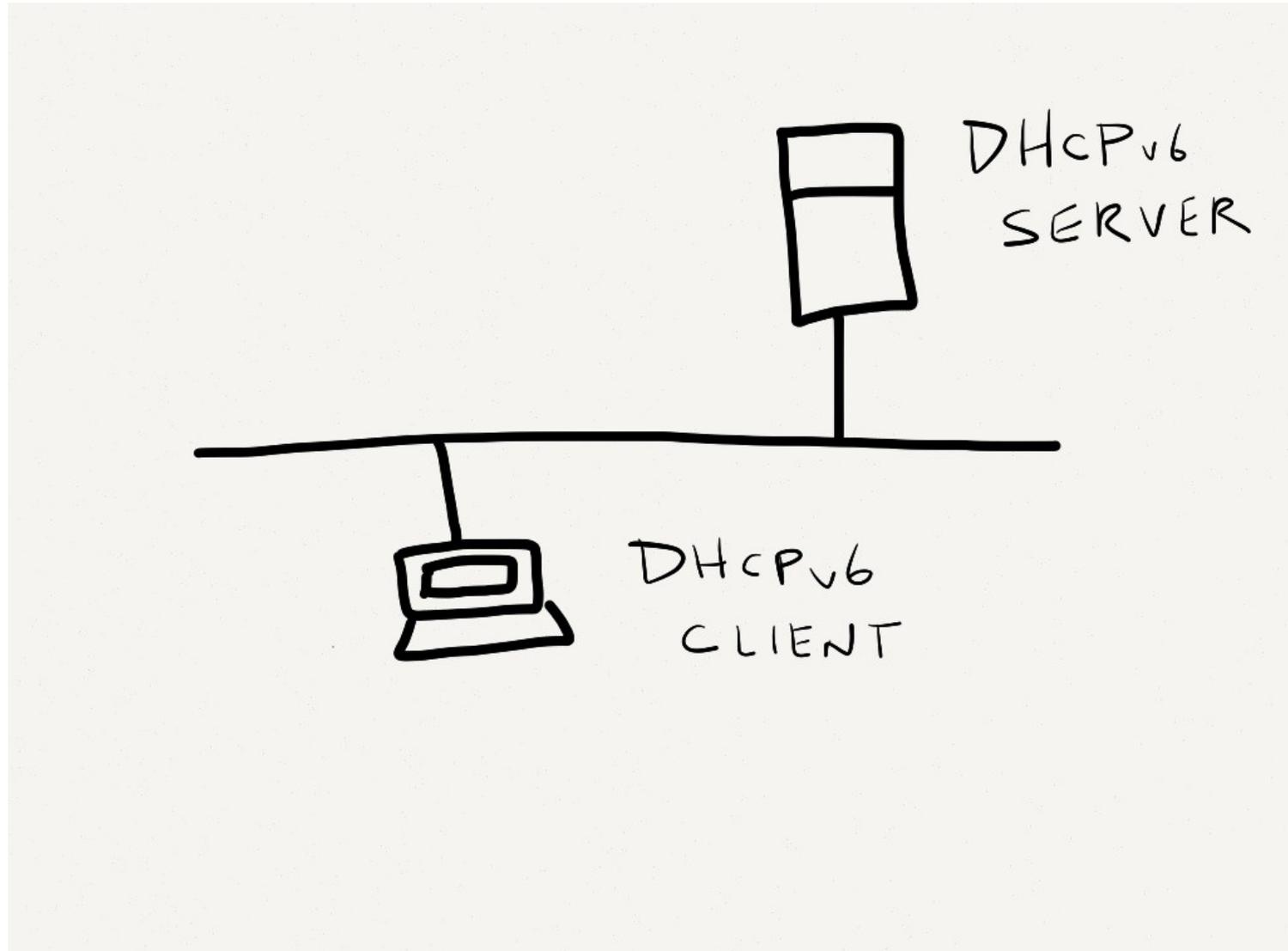
Until this site is restored, you can download your ISC software from our ftp site.

The current versions of **BIND** are found here: <ftp://ftp.isc.org/isc/bind9/cur/>  
**ISC DHCP 4.3.1** is here: <ftp://ftp.isc.org/isc/dhcp/4.3.1/>

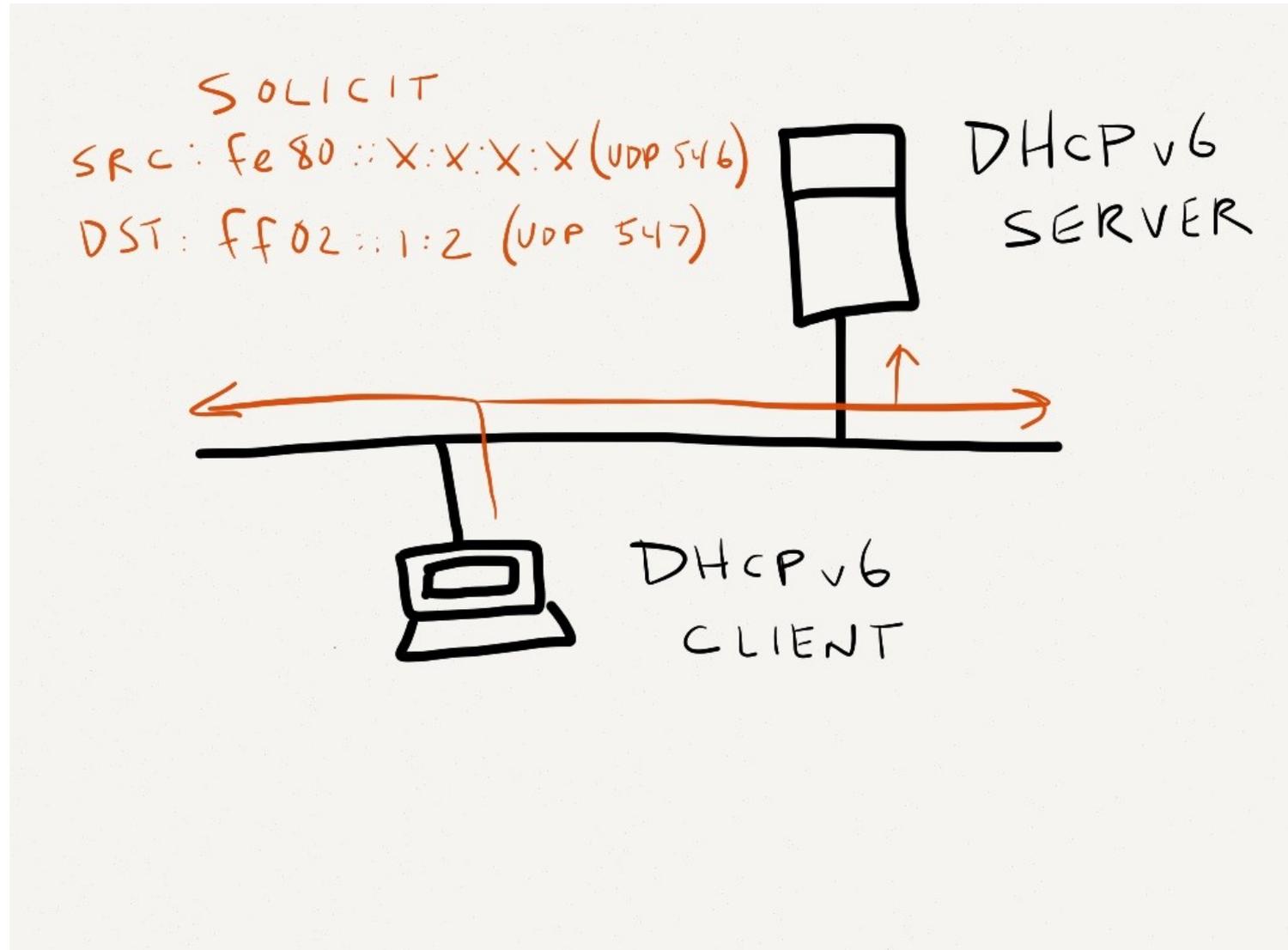
Or, type [ftp.isc.org](ftp://ftp.isc.org) into your browser and you will see an html page. Select the "isc" folder and double click to open it. Within the "isc" folder you will see folders for "bind9" and "dhcp" and other software we host on [www.isc.org](http://www.isc.org).

## DHCPv6 Fingerprinting

# DHCPv6 Fingerprinting



# DHCPv6 Fingerprinting



# DHCPv6 Fingerprinting

Wireshark 1.8.4 (SVN Rev 46250 from /trunk-1.8) - Capturing from Standard input

No.	Time	Source	Destination	Protocol	Length	Info
86	536.637505000	fe80::a00:27ff:fe53:eff02::1:2	ff02::1:2	DHCPv6	114	Solicit XID: 0x6249ab CID: 0001000118d0fb1308002753a4fb

Packet 86 details:

- Ethernet II, Src: cadmm300\_08:00:27:53:a4:fb (08:00:27:53:a4:fb), Dst: ff02::1:2 (ff02::1:2)
- Internet Protocol Version 6, Src: fe80::a00:27ff:fe53:a4fb (fe80::a00:27ff:fe53:a4fb), Dst: ff02::1:2 (ff02::1:2)
- User Datagram Protocol, Src Port: dhcpv6-client (546), Dst Port: dhcpv6-server (547)
- DHCPv6
  - Message type: Solicit (1)
  - Transaction ID: 0x6249ab
  - Client Identifier: 0001000118d0fb1308002753a4fb
    - Option: Client Identifier (1)
      - Length: 14
      - Value: 0001000118d0fb1308002753a4fb
      - DUID type: link-layer address plus time (1)
      - Hardware type: Ethernet (1)
      - Time: Mar 11, 2013 13:29:07 PDT
      - Link-layer address: 08:00:27:53:a4:fb
  - Option Request
    - Option: Option Request (6)
      - Length: 4
      - Value: 00170018
      - Requested Option code: DNS recursive name server (23)
      - Requested Option code: Domain Search List (24)
  - Elapsed time
    - Option: Elapsed time (8)
      - Length: 2
      - Value: 0000
      - elapsed-time: 0 ms
  - Identity Association for Non-temporary Address
    - Option: Identity Association for Non-temporary Address (3)
      - Length: 12
      - Value: 2753a4fb00000e1000001518
      - IAID: 2753a4fb
      - T1: 3600
      - T2: 5400

Packet bytes (hex):

```
0000 33 33 00 01 00 02 08 00 27 53 a4 fb 86 dd 60 00 33.....'S.....
0010 00 00 00 3c 11 01 fe 80 00 00 00 00 00 00 0a 00 ...<.....
0020 27 ff fe 53 a4 fb ff 02 00 00 00 00 00 00 00 00 ...S.....
0030 00 00 00 01 00 02 02 22 02 23 00 3c 05 42 01 62 .....".#.<.B.b
0040 49 ab 00 01 00 0e 00 01 00 01 18 d0 fb 13 08 00 T.....
```

# DHCPv6 Fingerprinting

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No.	Time	Source	Destination	Protocol	Length	Info
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Packet Details:

- Ethernet II, Src: cadumbe0\_53:a4:fb (08:00:27:53:a4:fb), Dst: ff02::1:2 (ff02::1:2)
- Internet Protocol Version 6, Src: fe80::a00:27ff:fe53:a4fb (fe80::a00:27ff:fe53:a4fb), Dst: ff02::1:2 (ff02::1:2)
- User Datagram Protocol, Src Port: dhcpv6-client (546), Dst Port: dhcpv6-server (547)
- DHCPv6**
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      - Time: Mar 11, 2013 13:29:07 PDT
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Packet Bytes:

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0010 00 00 00 3c 11 01 fe 80 00 00 00 00 00 00 0a 00 ...<.....
0020 27 ff fe 53 a4 fb ff 02 00 00 00 00 00 00 00 00 '..S.....
0030 00 00 00 01 00 02 02 22 02 23 00 3c 05 42 01 62 .....".#.<.B.b
0040 49 ab 00 01 00 0e 00 01 00 01 18 d0 fb 13 08 00 T.....
```

# DHCPv6 Fingerprinting

IPv4 DHCP Option Request (Option

55)



DHCPv6 Option Request (Option

6)

- Typically, fewer options appear under Option 6 in a DHCPv6 SOLICIT
- Other elements may be required to validate the device type or system
  - Vendor Class field (where present)
  - Timing how often the client sends a SOLICIT message
  - In dual-stack environments, correlation with the IPv4 fingerprint
  - The Client Identifier field in a DHCPv6 SOLICIT

# DHCPv6 Fingerprinting

```
▼ DHCPv6
  Message type: Solicit (1)
  Transaction ID: 0x6249ab
  ▼ Client Identifier: 0001000118d0fb1308002753a4fb
    Option: Client Identifier (1)
    Length: 14
    Value: 0001000118d0fb1308002753a4fb
    DUID type: link-layer address plus time (1)
    Hardware type: Ethernet (1)
    Time: Mar 11, 2013 13:29:07 PDT
    Link-layer address: 08:00:27:53:a4:fb
  ▼ Option Request
    Option: Option Request (6)
    Length: 4
    Value: 00170018
    Requested Option code: DNS recursive name server (23)
    Requested Option code: Domain Search List (24)
  ▼ Elapsed time
    Option: Elapsed time (8)
    Length: 2
    Value: 0000
    elapsed-time: 0 ms
  ▼ Identity Association for Non-temporary Address
    Option: Identity Association for Non-temporary Address (3)
```

# DHCPv6 Fingerprinting



=

SOLICIT,  
1, 6, 23,  
24, 8, and  
3

=



Fedora  
17

# DHCPv6 Fingerprinting and BYOD



# DHCPv6 Fingerprinting and BYOD

- Actionable data
  - (Very basic) Security
    - Is this type of device allowed on the network? (i.e., will it be allowed an IP address assignment via DHCP)
  - Reporting
    - What devices are connecting (or attempting to connect)?
- Passive -- no additional transactional overhead
  - compare with **nmap** host OS detection

# DHCPv6 Fingerprints



- Currently, 198 unique fingerprints for DHCP
- None for DHCPv6
  - Likely due to a lack of general IPv6 deployment in environments where fingerprinting is potentially most useful (i.e., enterprise/corporate networks)
  - Thus, BYOD not generally a challenge for IPv6 (*yet...*)

## DHCPv6 Failover

# DHCPv6 Failover

- Often repeated that it's not needed (unless you're doing PD)
  - Many enterprises are insisting on it
    - “We do it this way in IPv4 and we want to be able to do it the same way in IPv6...”
- Still no standards
  - DHCPv6 Failover Requirements
    - draft-ietf-dhc-dhcpv6-failover-requirements-07
  - DHCPv6 Failover Design
    - draft-ietf-dhc-dhcpv6-failover-design-04
- Still no proprietary implementations

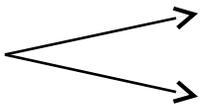


# DHCPv6 Failover

- **Workarounds:**

- **Split prefixes**

- **Take a /64 and split it into two /65s, one per DHCPv6 server; e.g.:**

2001:db8:1:1::/64  2001:db8:1:1:0000::/65  
2001:db8:1:1:8000::/65

- **Use DHCPv6 Preference option**

(primary server at 255, secondary at 0)

- **Drawback: Over time, uneven distribution of leases between servers**

- **Additional workarounds in *RFC 6853 - DHCPv6 Redundancy Considerations***

## SLAAC/DHCPv6 Interaction

# DHCPv6 - Autoaddressing Review

- SLAAC
  - Routers advertise prefixes that identify the subnet(s) associated with a link, while hosts generate an "interface identifier" that uniquely identifies an interface on a subnet. An address is formed by combining the two.

# DHCPv6 - Autoaddressing Review

- DHCPv6 (stateful)
  - The Dynamic Host Configuration Protocol for IPv6 (DHCP) enables DHCP servers to pass configuration parameters such as IPv6 network addresses to IPv6 nodes. It offers the capability of automatic allocation of reusable network addresses and additional configuration flexibility.

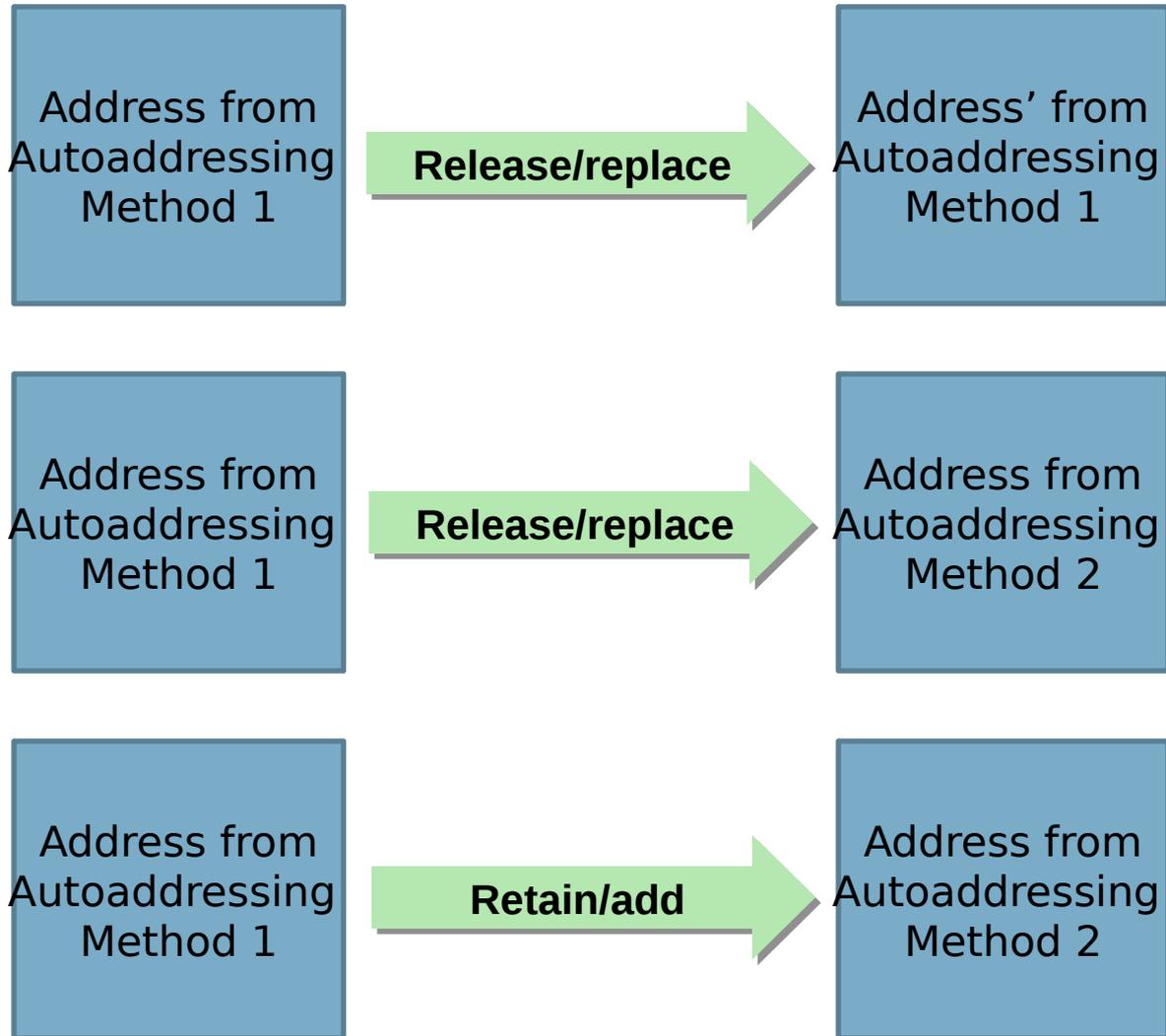
# DHCPv6 - Autoaddressing Review

- DHCPv6 (stateless)
  - Used by nodes to obtain configuration information, such as the addresses of DNS recursive name servers, that does not require the maintenance of any dynamic state for individual clients. A node that uses stateless DHCP must have obtained its IPv6 addresses through some other mechanism, typically stateless address autoconfiguration.

# DHCPv6 - Autoaddressing Review

Auto-address Configuration Method	ICMPv6 RA (Type 134)			Resulting IPv6 Addresses Configured	Additional Configuration Options (DNS servers, domain search list, TFTP, etc)
	A Flag	M Flag	O Flag		
SLAAC	1	0	0	Link-local, IPv6, Temporary IPv6	Not provided
Stateless DHCPv6	1	0	1	Link-local, IPv6, Temporary IPv6	DHCPv6
Stateful DHCPv6	0	1	unread	Link-local, DHCPv6	DHCPv6

# Autoaddressing - Renumbering scenarios



# DHCPv6/SLAAC Interaction

Host State	Input	Behavior
Host has not acquired any addresses	No RA	Some popular OSES acquire DHCPv6 addresses.
Host has not acquired any addresses	RA with M=0, O=1	Some popular OSES acquire other info from DHCPv6 addresses. Others do so only if A=1.
Host has acquired address from DHCPv6 only	RA with M=0	Some OSES release DHCPv6 immediately. Some release upon expiry.
Host has acquired address from SLAAC only	RA with M=1	Some OSES release DHCPv6 immediately. Some release only if SLAAC address expires and can't be refreshed.

# DHCPv6/SLAAC Interaction

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Test, test, then test some more...

# Questions?

[tcoffeen@infoblox.com](mailto:tcoffeen@infoblox.com)

twitter: @ipv6tom

# References

- *ISC DHCP 4.3.0 is now online!*
  - <https://www.isc.org/blogs/isc-dhcp-4-3-0-is-live/>
- *Dynamic Host Configuration Protocol for IPv6 (DHCPv6), RFC 3315, IETF, Jul. 2003*
- Chatter on the Wire: A look at DHCPv6 traffic, by Eric Kollmann, Nov. 2010
  - <http://chatteronthewire.org/download/chatter-dhcpv6.pdf>