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DHCPv6 Operational Challenges

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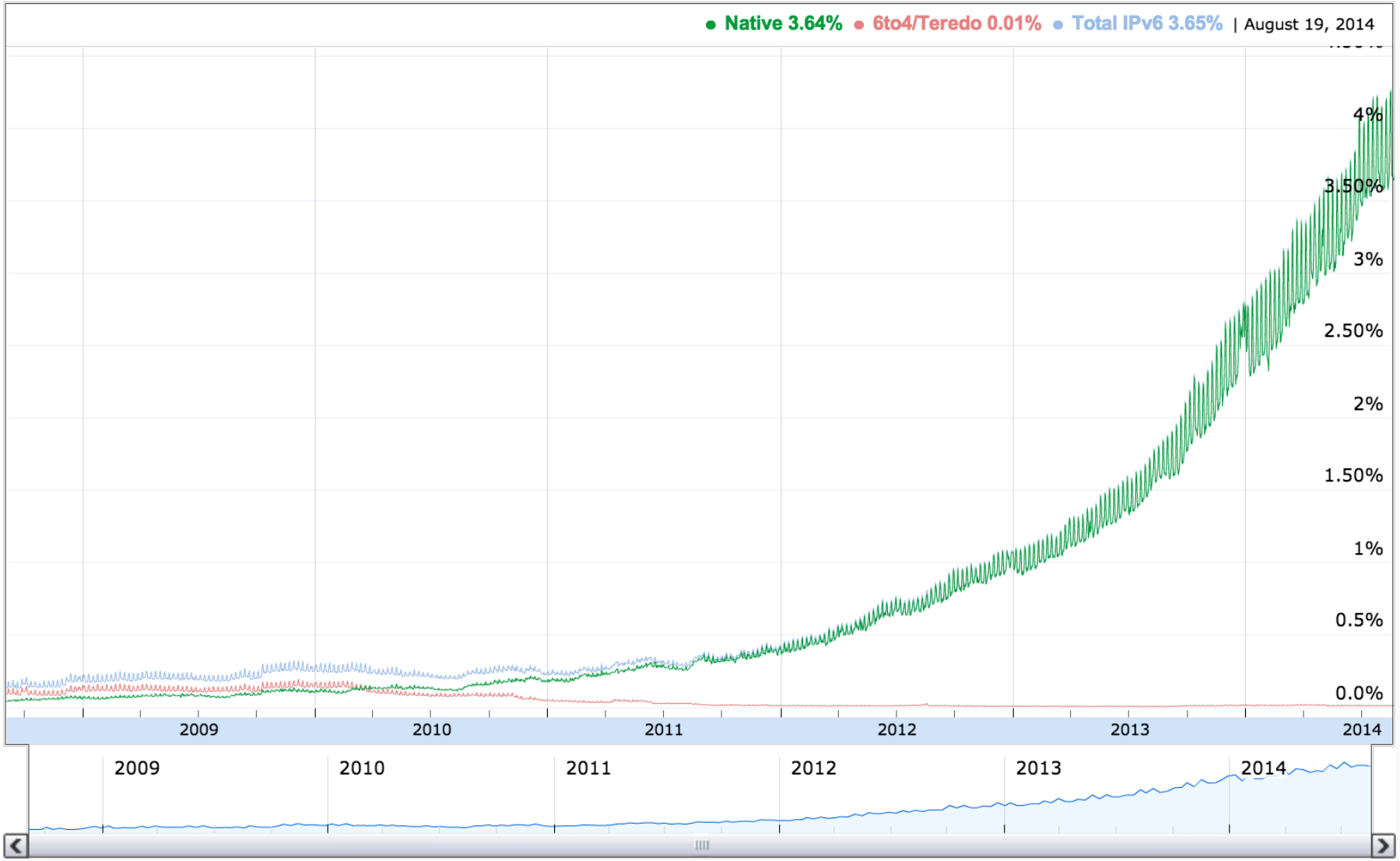
UKNOF January 2015

Agenda

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

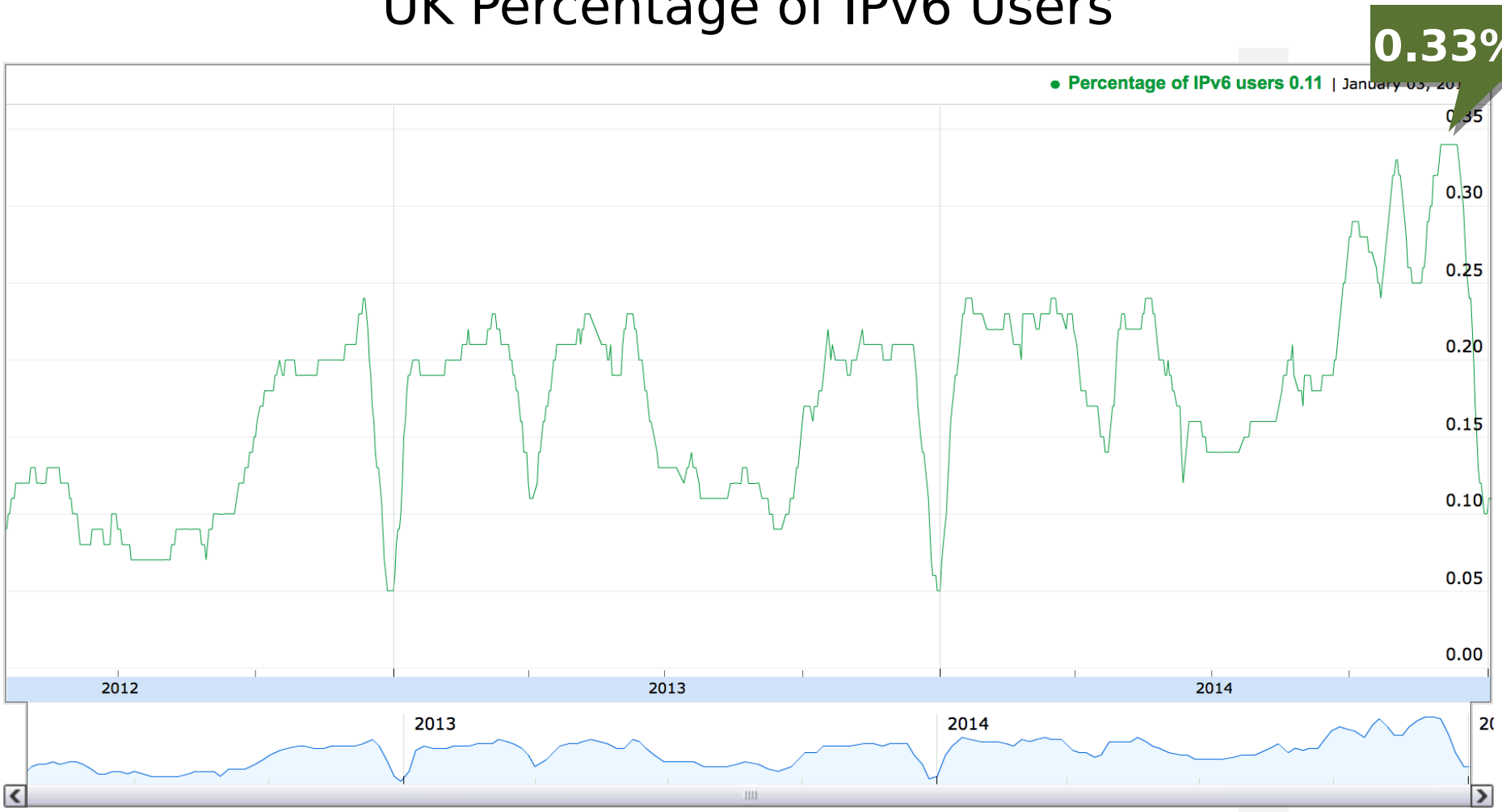
IPv4 is depleted…

IPv6 is Here…

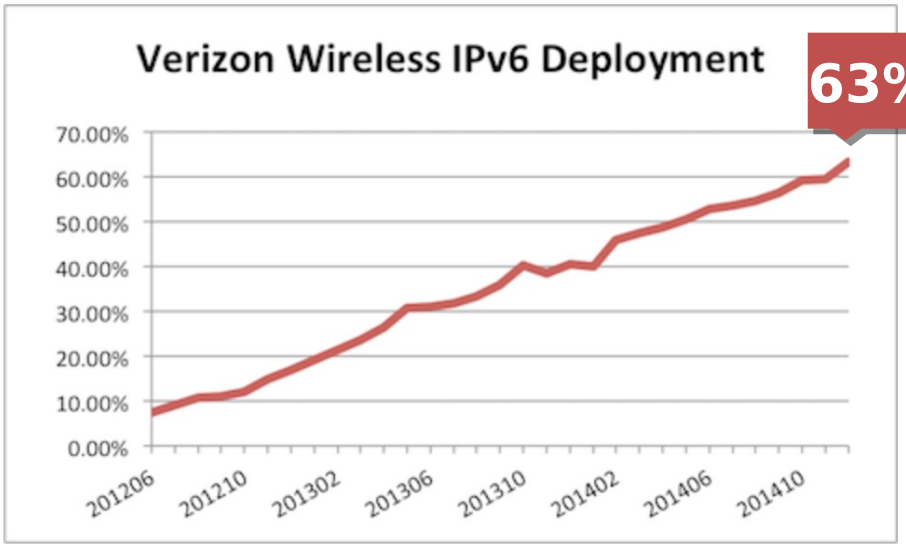


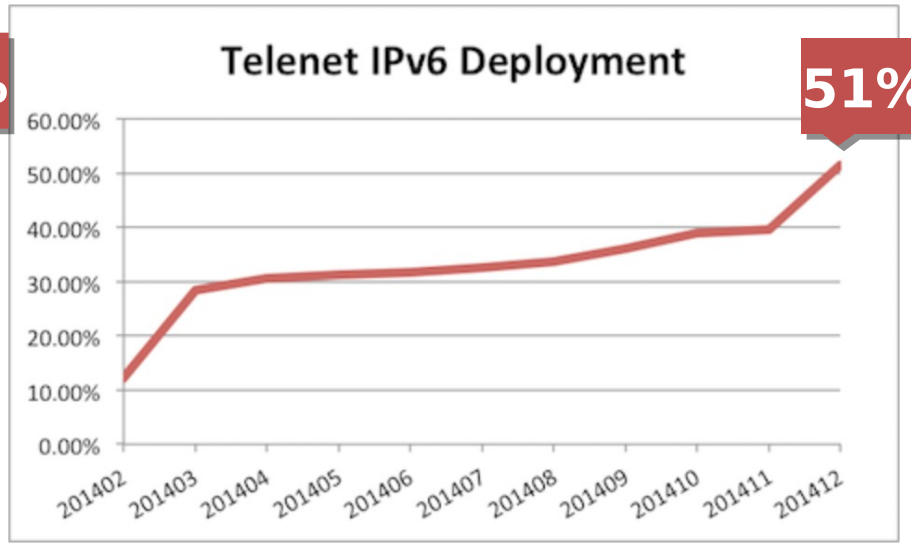
IPv6 is…Over There…

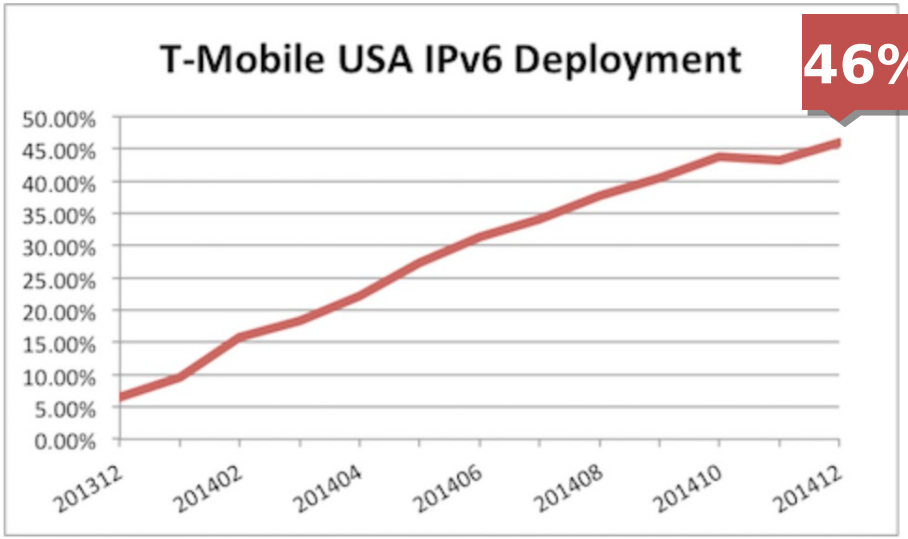
UK Percentage of IPv6 Users

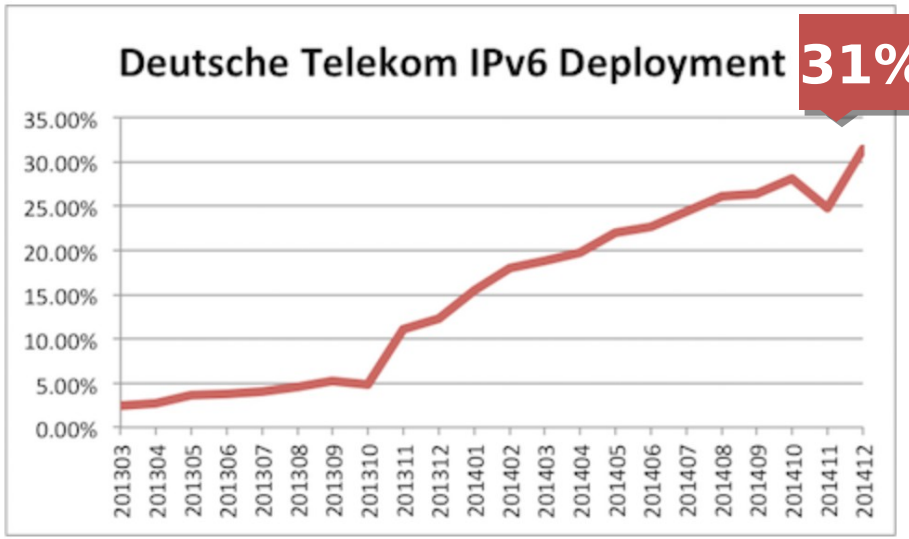


Some IPv6 Network Operator Measurements









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

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UK IPv6 Network Operator Measurements

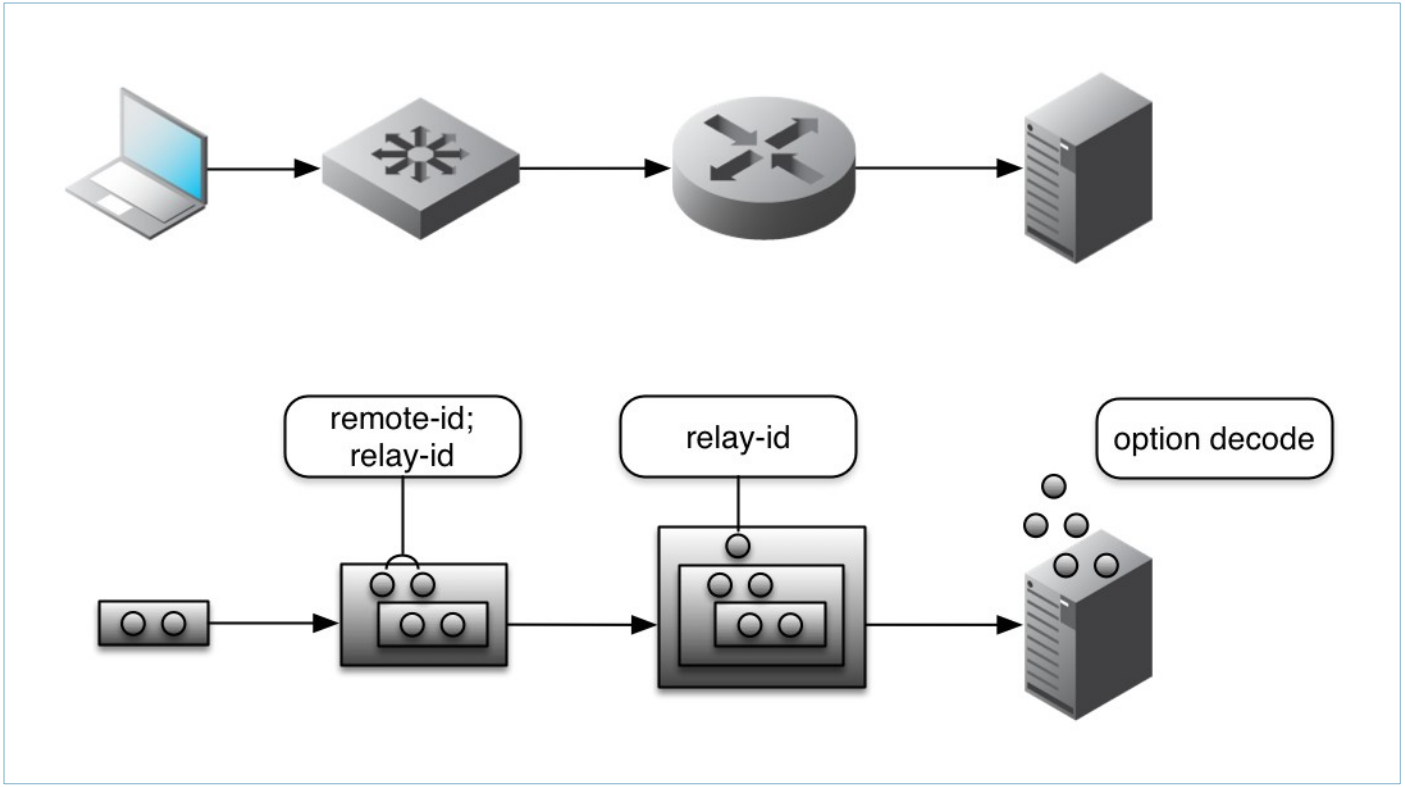
Participating Network	ASN(s)	IPv6 deployment
AAISP	20712	27.96%

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

DHCPv6 – What's (More or Less) Working

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

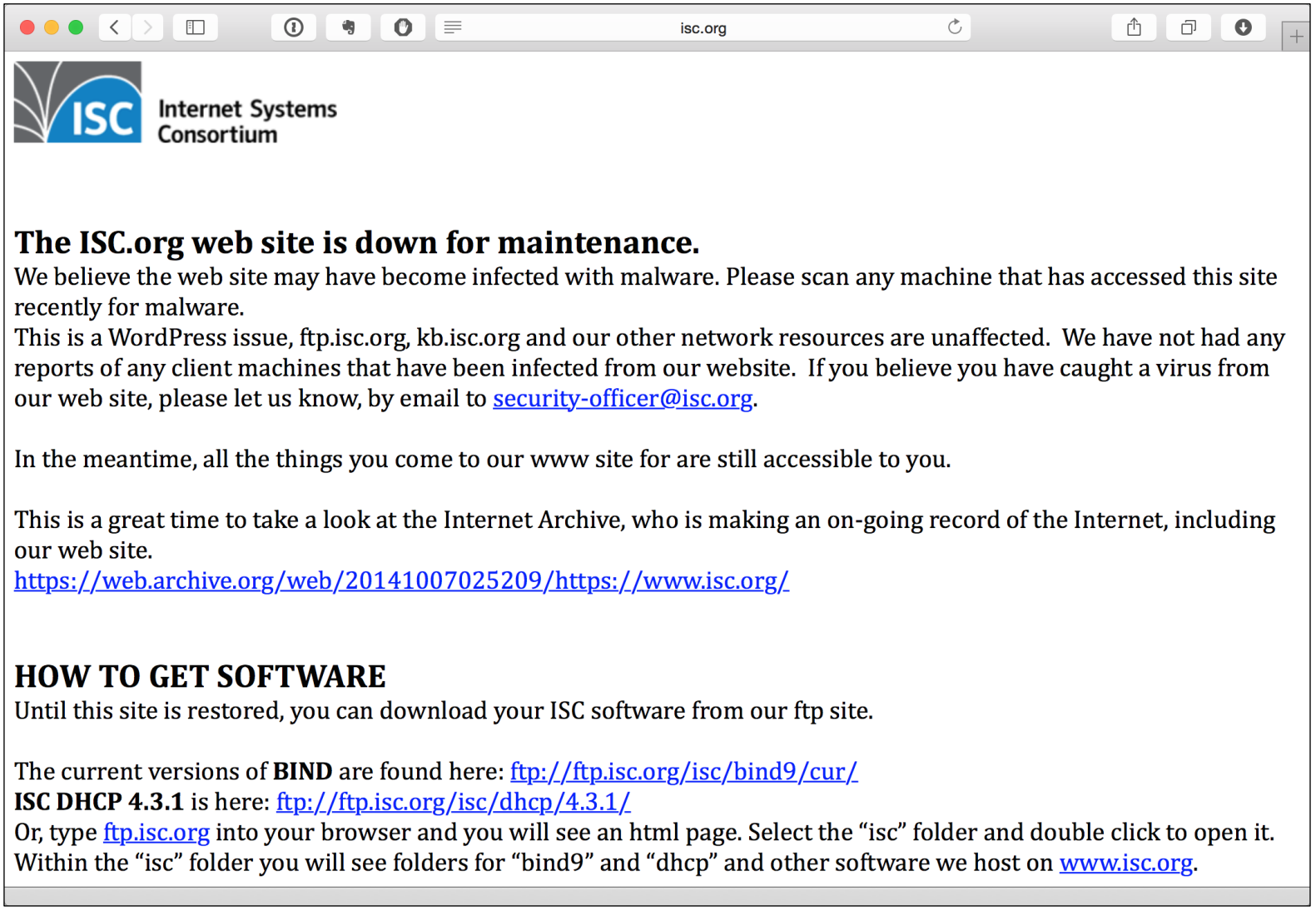
Partial standard specification for syntax:

<enterprise-id><remote-id>

Result from relay:

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

DHCPv6 Relay – ISC 4.3



DHCPv6 Fingerprinting

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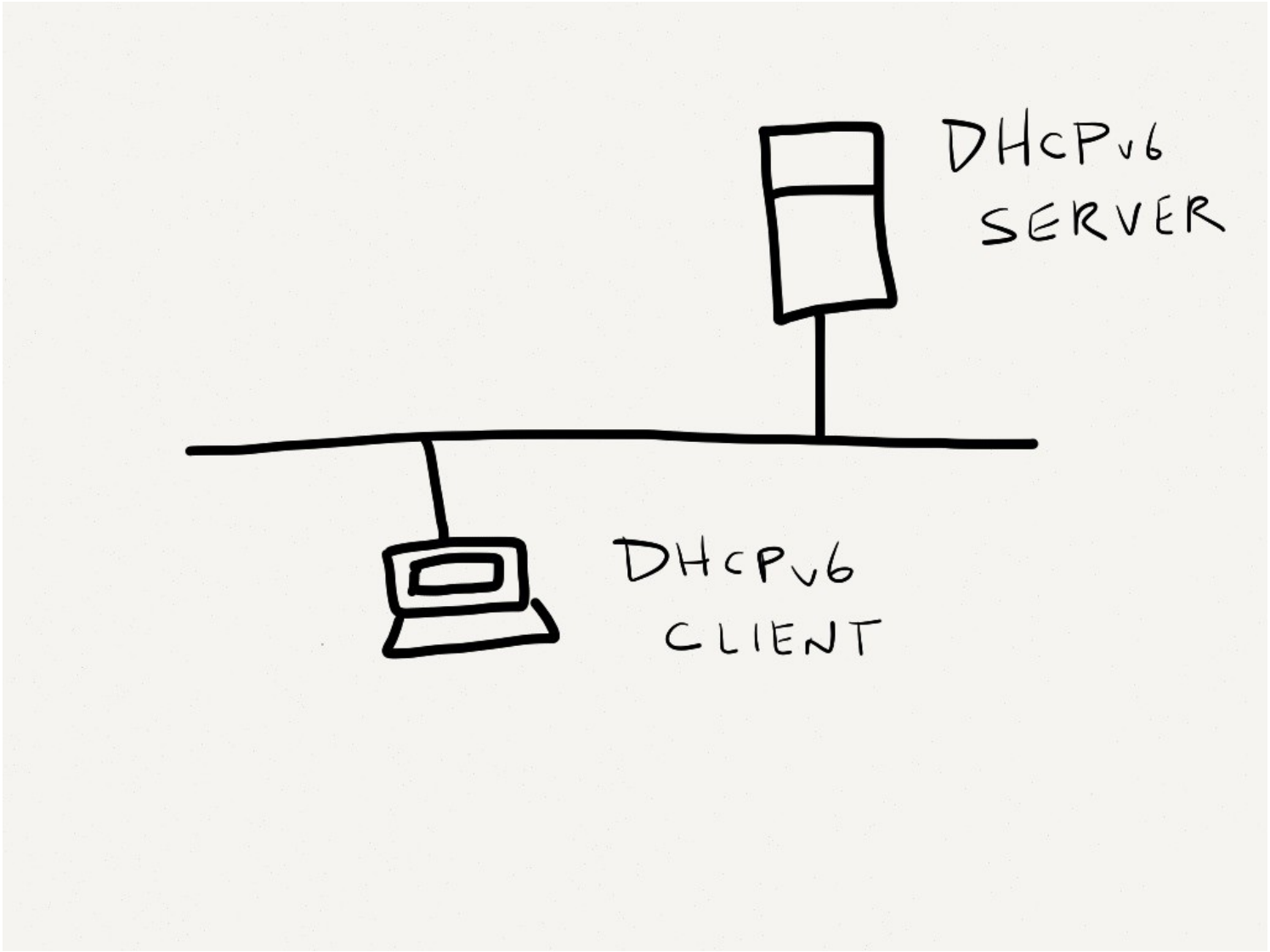
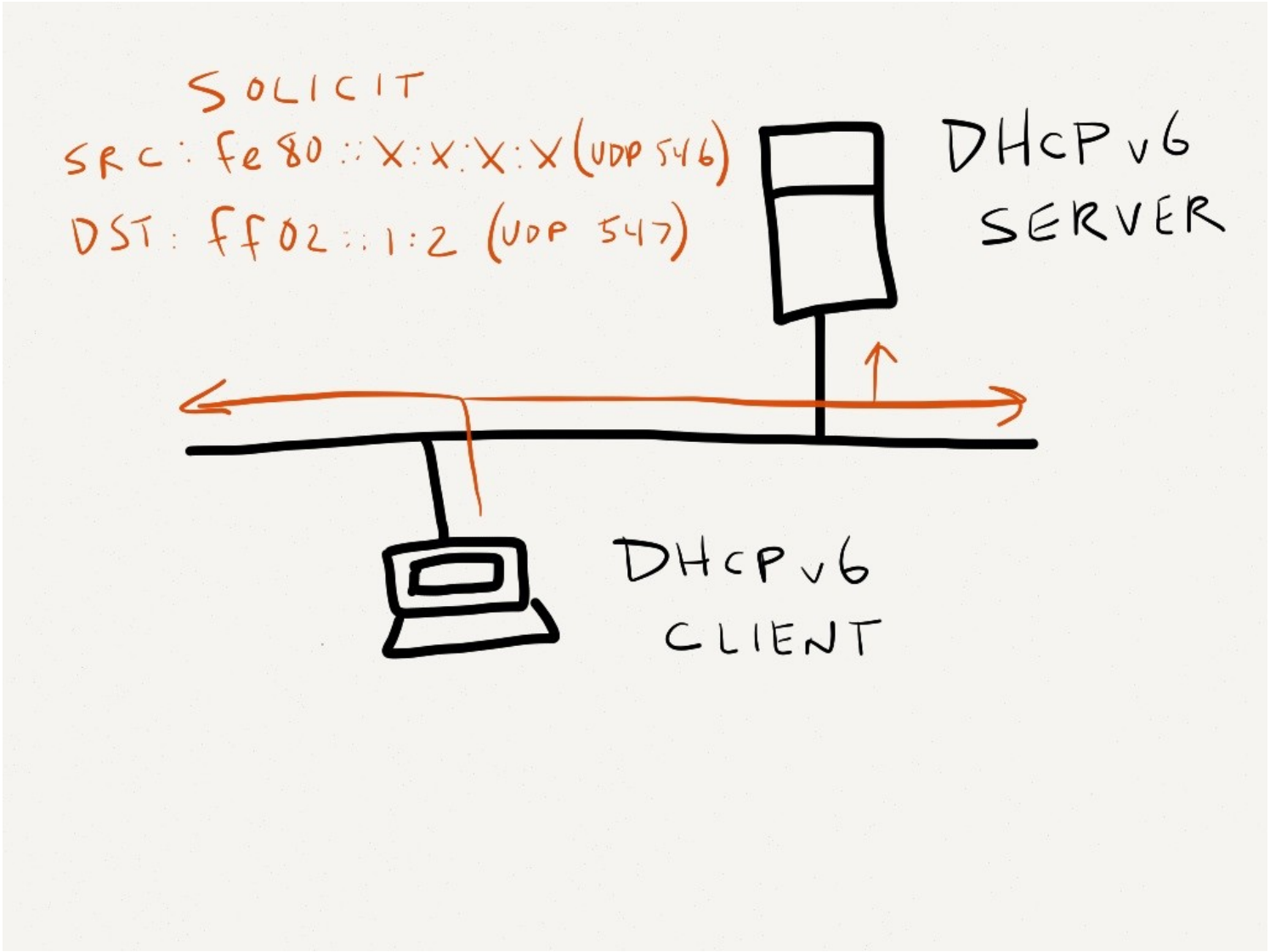
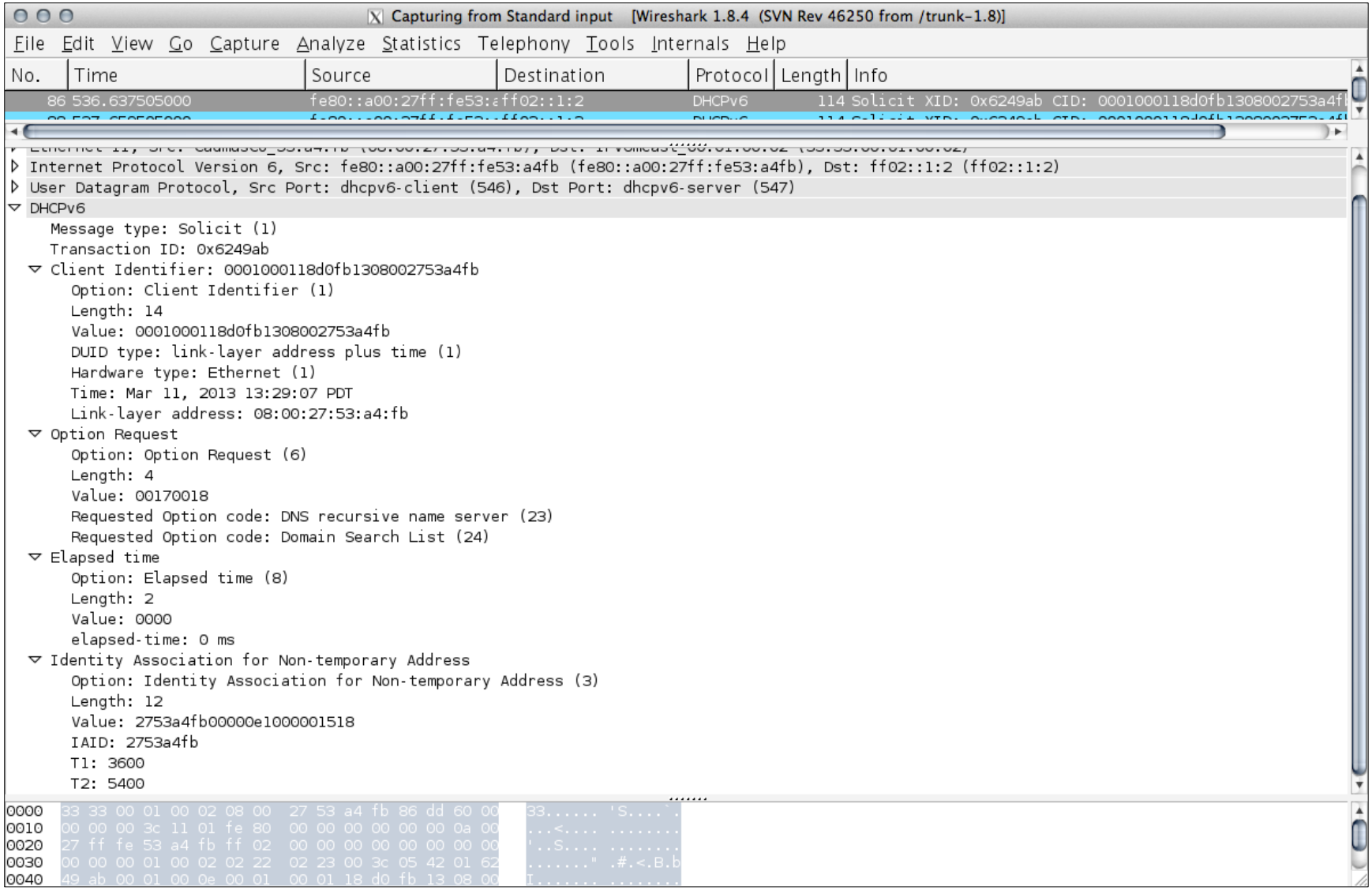


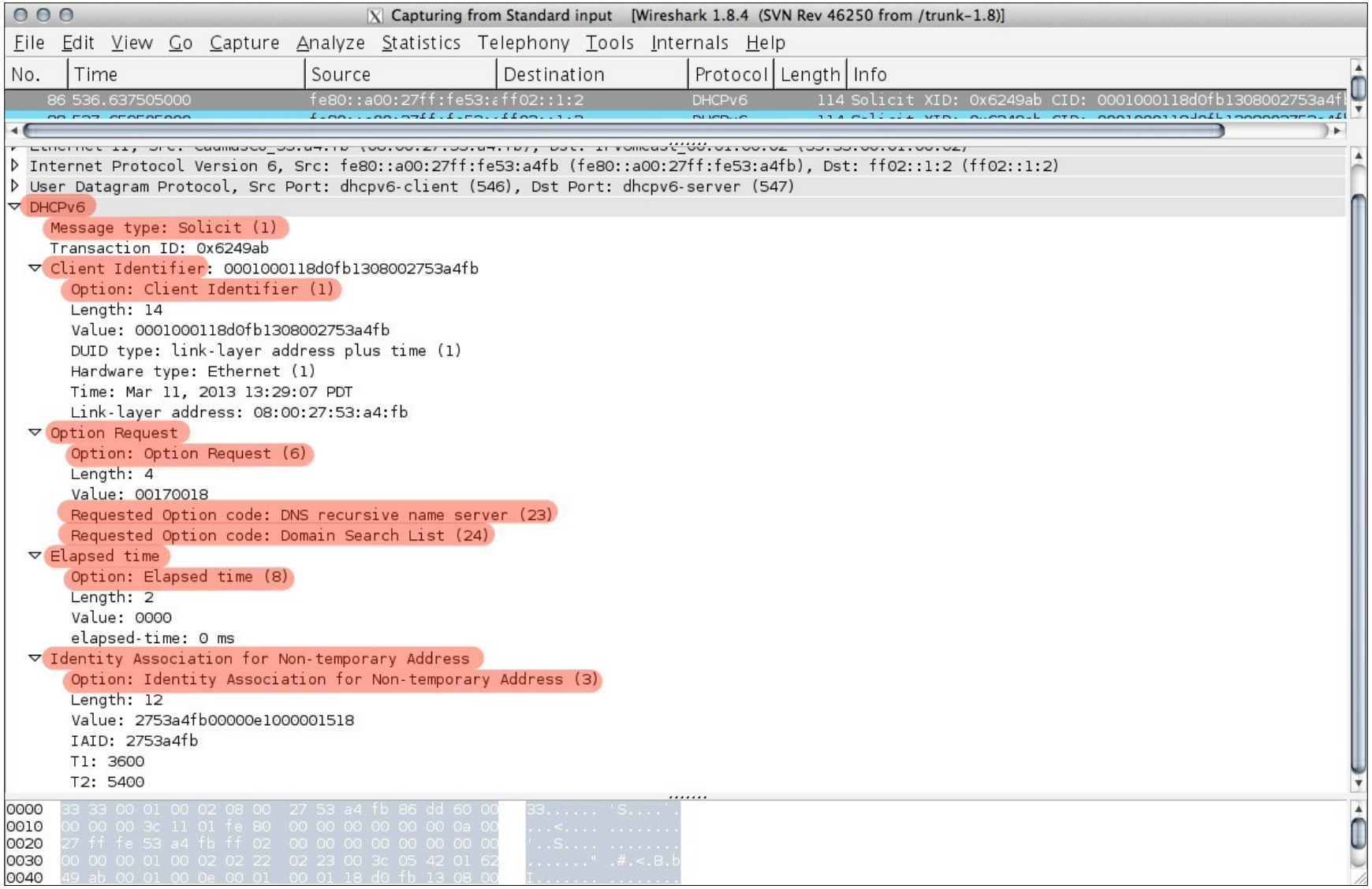
DHCPv6 Fingerprinting



DHCPv6 Fingerprinting



DHCPv6 Fingerprinting



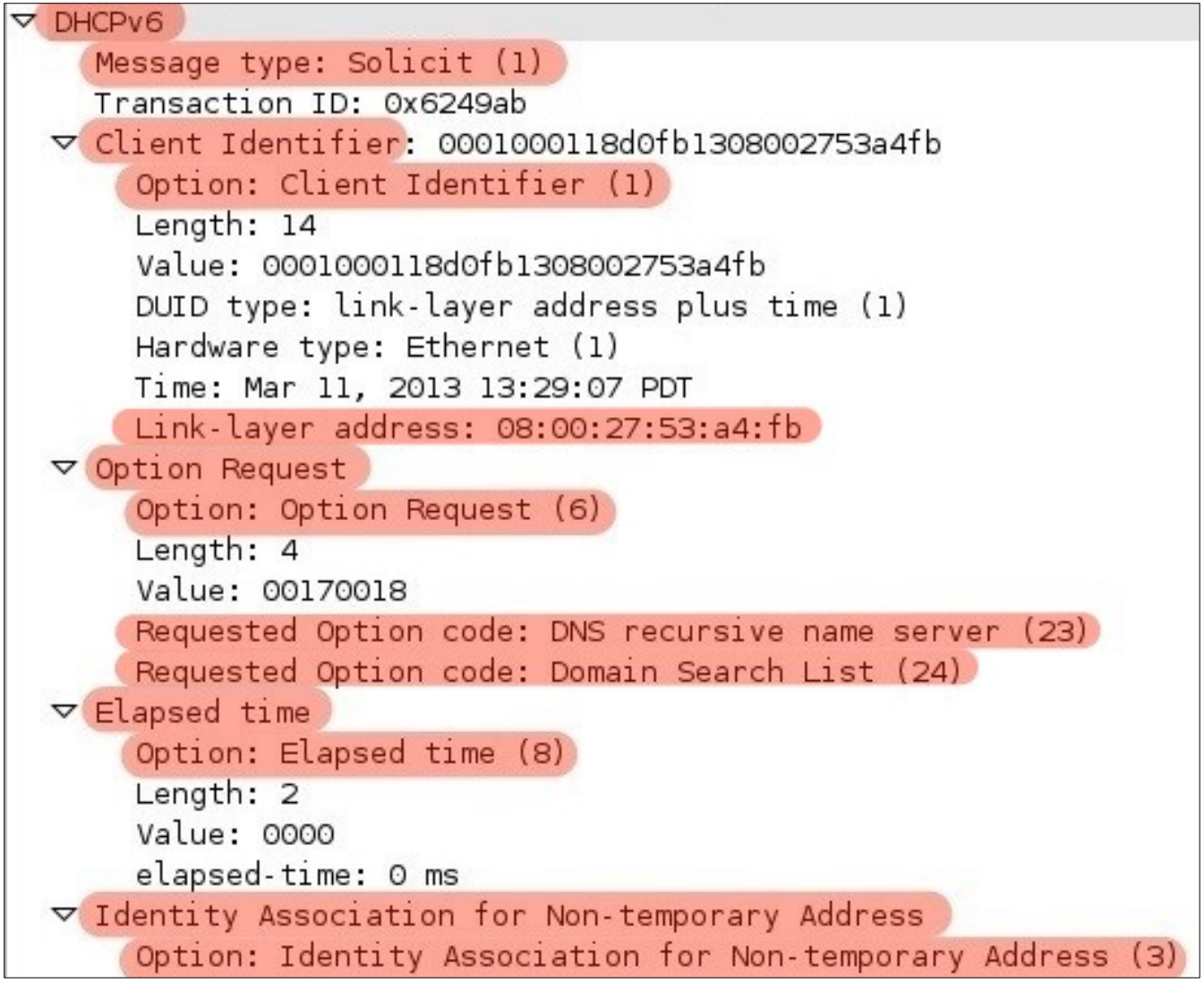
DHCPv6 Fingerprinting

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 Fingerprinting

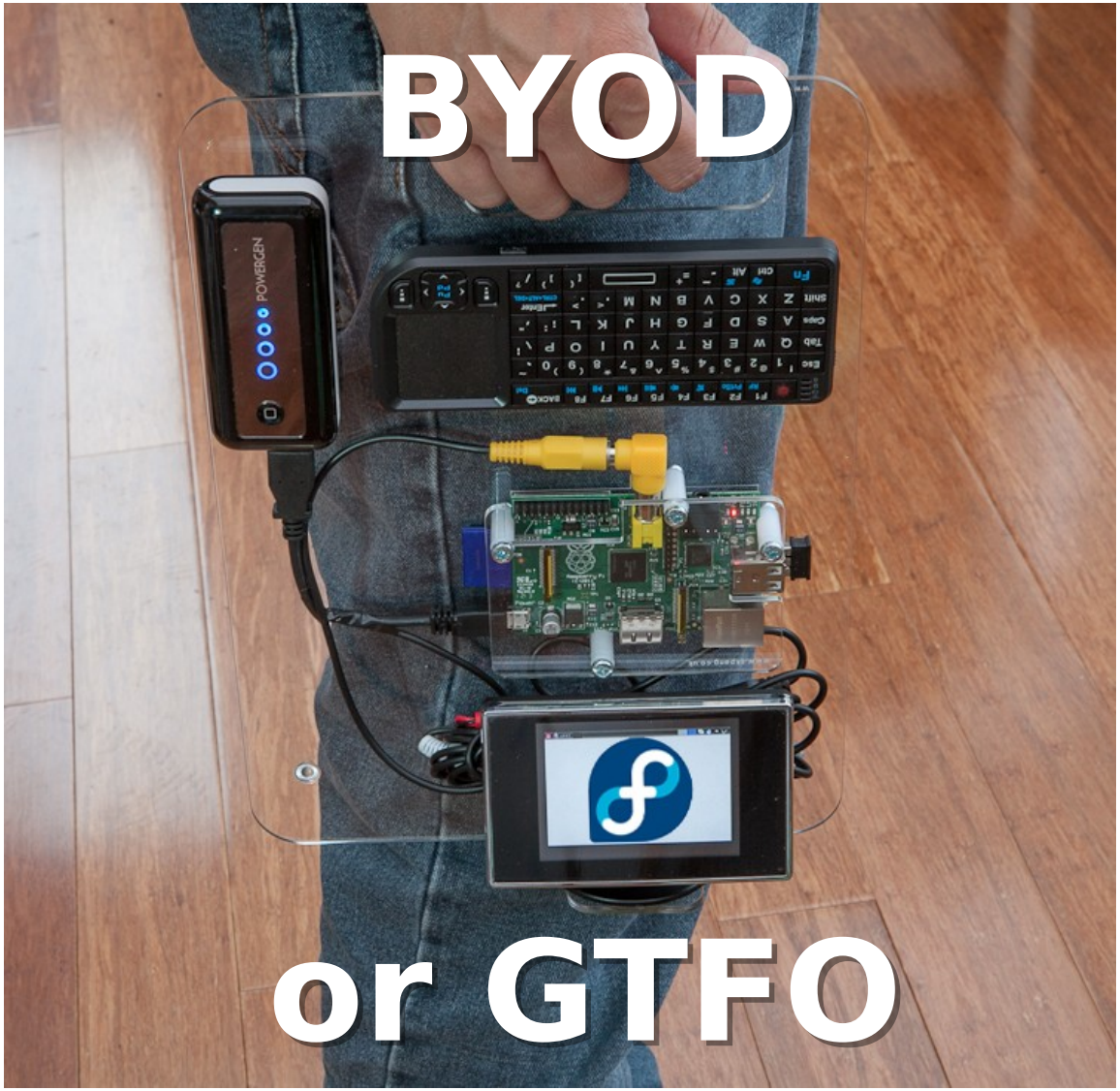
=

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 – What's Borked

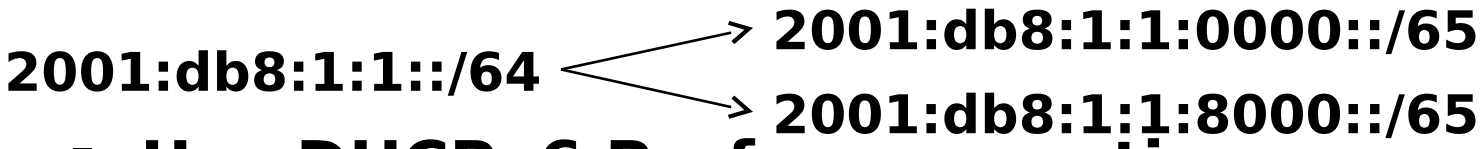
DHCPv6 Failover

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 implementati

DHCPv6 Failover

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



  - **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***

DHCPv6 – What's Borked

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.

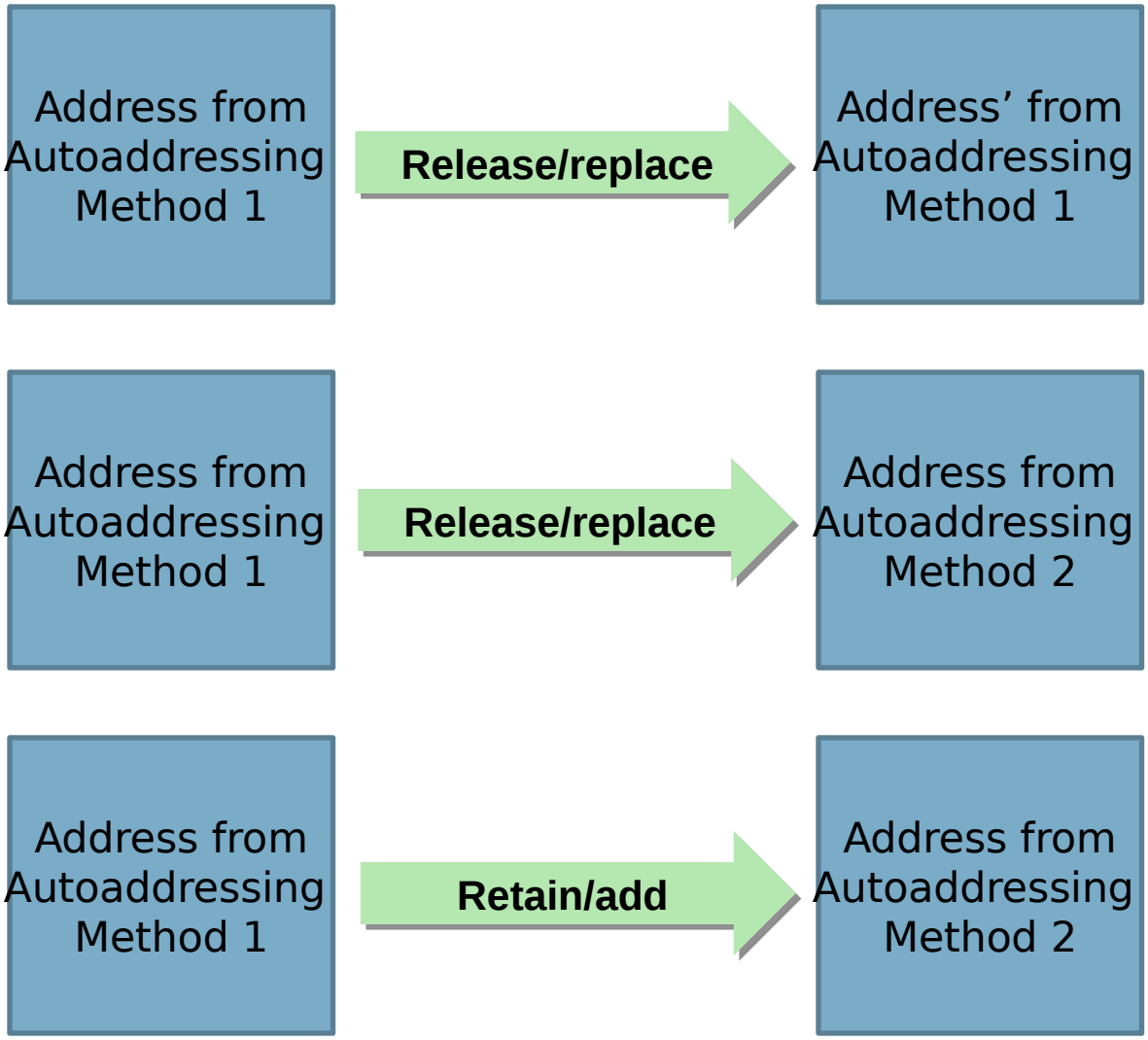
DHCPv6 – Autoaddressing Review

- 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

Test, test, then test some more...

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Questions?

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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