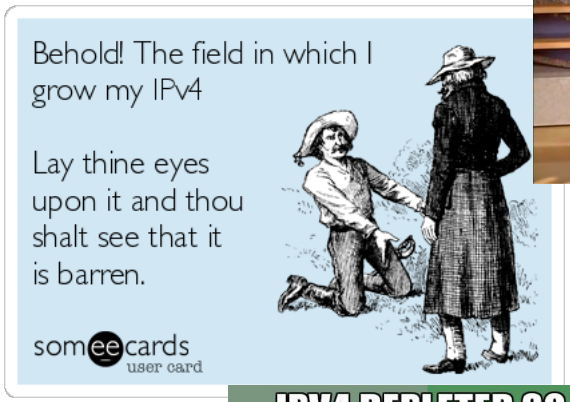

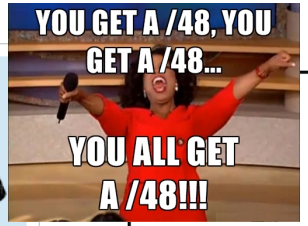

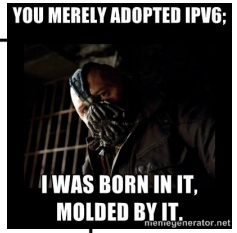

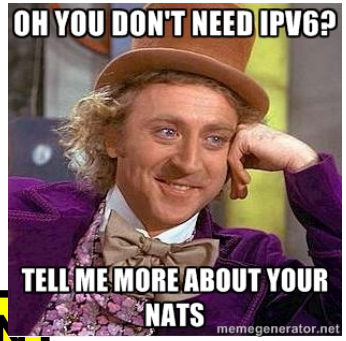

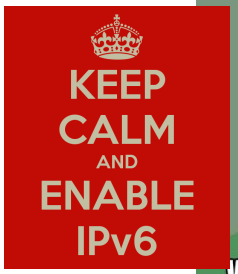

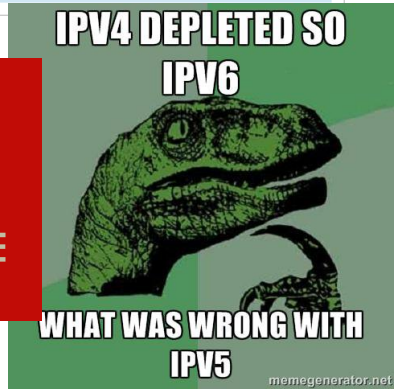

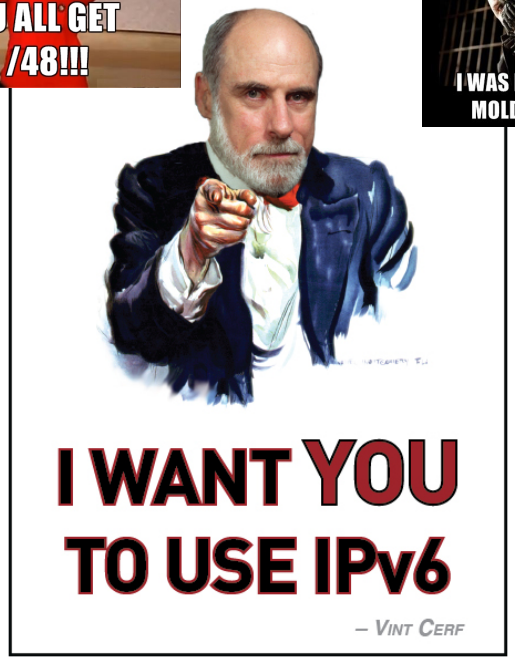

Infoblox
CONTROL YOUR NETWORK

DHCPv6 OPERATIONAL ISSUES

Tom Coffeen

4/7/2016

ABOUT THE PRESENTER

Tom Coffeen
IPv6 Evangelist
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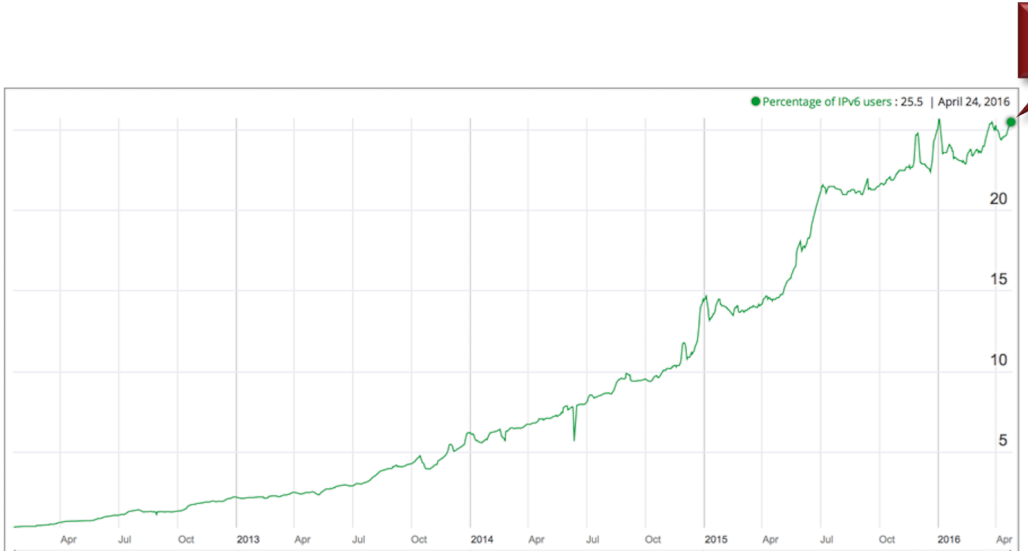
tom@ipv6.works

IPv6 STATISTICS

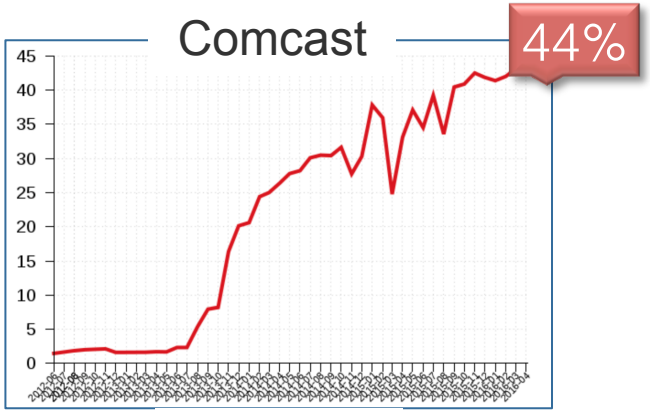
US INTERNET TRAFFIC TO GOOGLE VIA IPv6

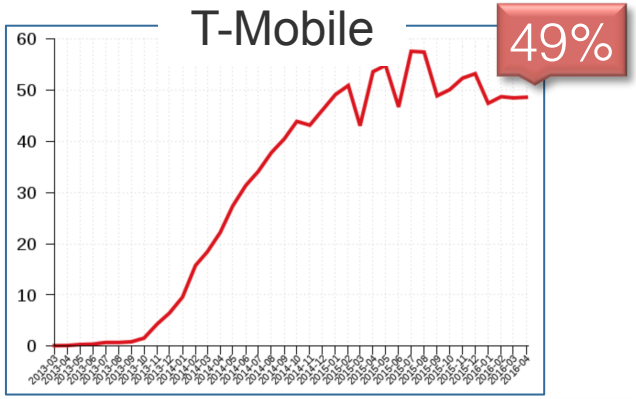


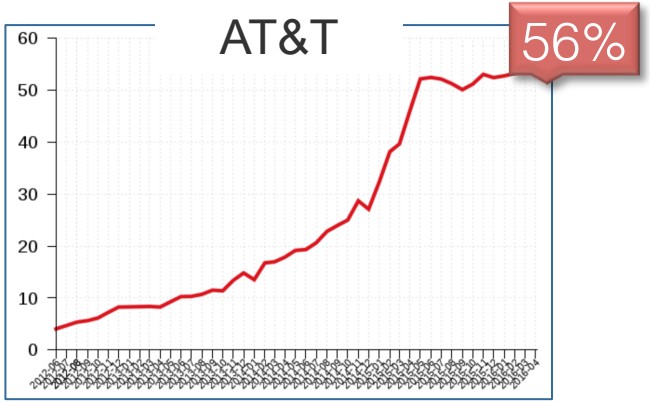
- US Population: 323M
- US Internet penetration: 70%
- Number of Internet Users: 226M
- Percentage of IPv6 Users: 25%

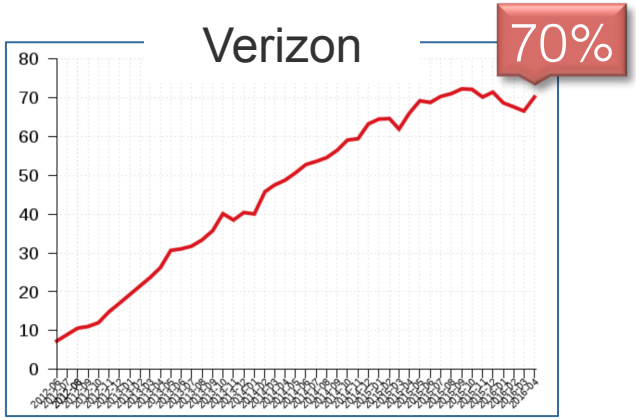
18% of US population uses IPv6:
57 Million IPv6 users

US IPv6 NETWORK OPERATOR STATS









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

2016: IPv4 AS “HISTORIC”?

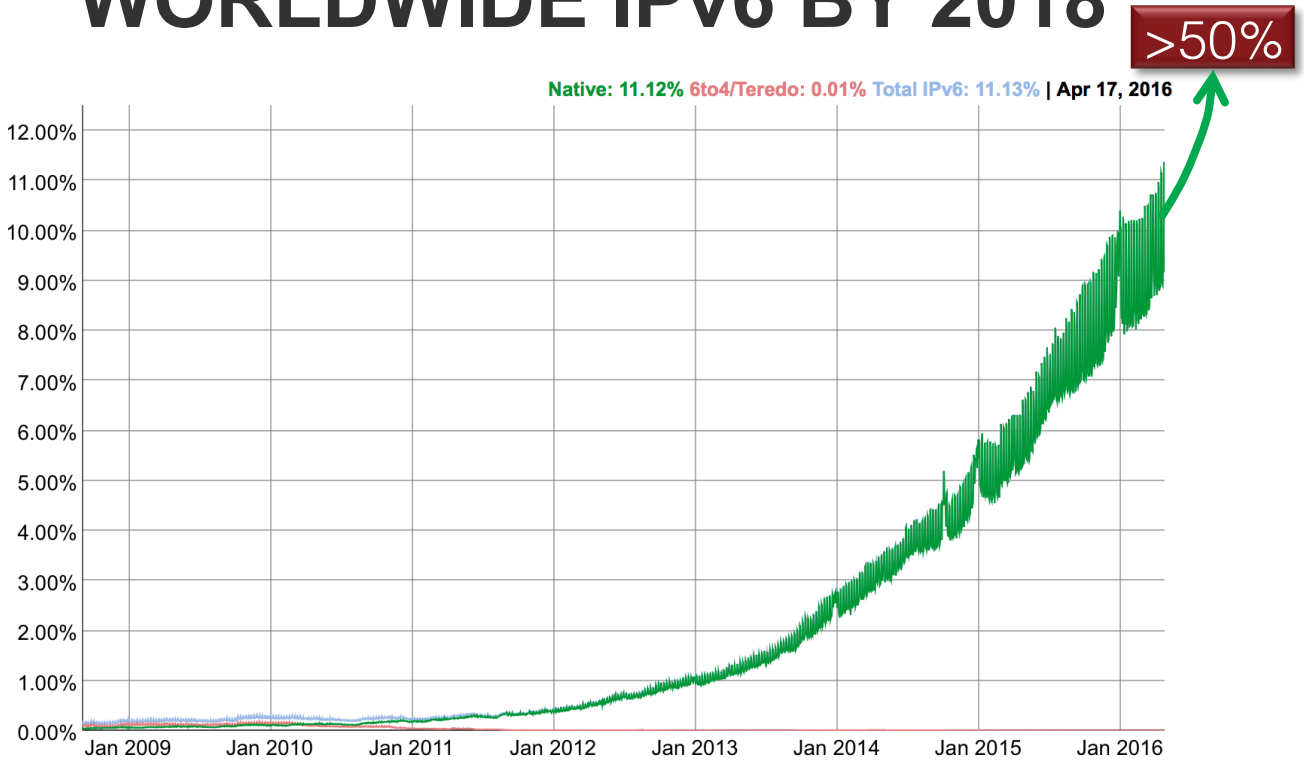
https://tools.ietf.org/html/draft-howard-sunset4-v4historic-00

> "IPv4 has been superseded by IPv6, and is therefore Historic."

> "The term does not indicate that the practice is harmful, but that there will be no further development in IPv4, and therefore those using the old version are advised to transition to the newer version."

> "The term ‘IP,’ without address family specified, is assumed to mean ‘IPv6.’“

WORLDWIDE IPv6 BY 2018



A similar estimate has worldwide Internet traffic to Google over IPv6 at greater than 50% by 2018.

A BRIEF DHCPv6 REVIEW

COMPARING DHCPv4 WITH DHCPv6

Characteristic	DHCPv4	DHCPv6
Address type used for server discovery/solicitation	Broadcast	Multicast
Default gateway	Obtained from server	Provided by RA
DHCP transaction acronym	“DORA” (Discovery, Offer, Request, Acknowledgement)	“SARR” (Solicit, Advertise, Request, Reply)
Host Identifier	MAC address	DUID
Source Address/Port	0.0.0.0, 68 (UDP)	link-local, 546 (UDP)
Destination Address/Port	255.255.255.255, 67 (UDP)	ff02::1:2, 547 (UDP)

THE DHCP UNIQUE IDENTIFIER (DUID)

- Used by DHCPv6 instead of the MAC address to identify clients and servers
  - One, unique DUID per client
  - One, unique DUID per server
- Variable in length
- Set at boot time (persistent across reboots)

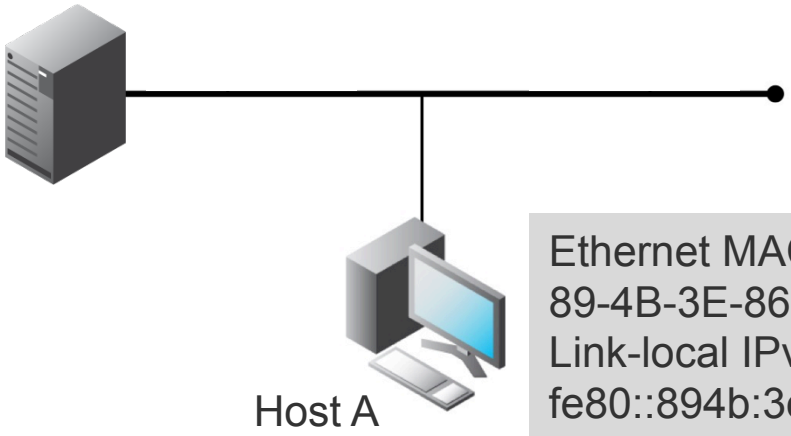
THE IDENTITY ASSOCIATION (IA)

- Used by the DHCPv6 server to identify, group, and manage sets of related, assigned IPv6 addresses
  - Client interfaces have multiple IPv6 addresses
  - One IA is assigned per interface
- Since IPv6 addresses can be temporary or non-temporary, separate IAs are created for each category
  - IA_NA for non-temporary addresses
  - IA_TA for temporary addresses

STATEFUL VS. STATELESS DHCPv6

Characteristic	Stateful DHCPv6	Stateless DHCPv6
IPv6 Address	via DHCPv6 server	via SLAAC
Additional DHCP options (DNS servers, domain-search list, etc)	via DHCPv6 server	via DHCPv6 server
Default gateway	Provided by RA	Provided by RA

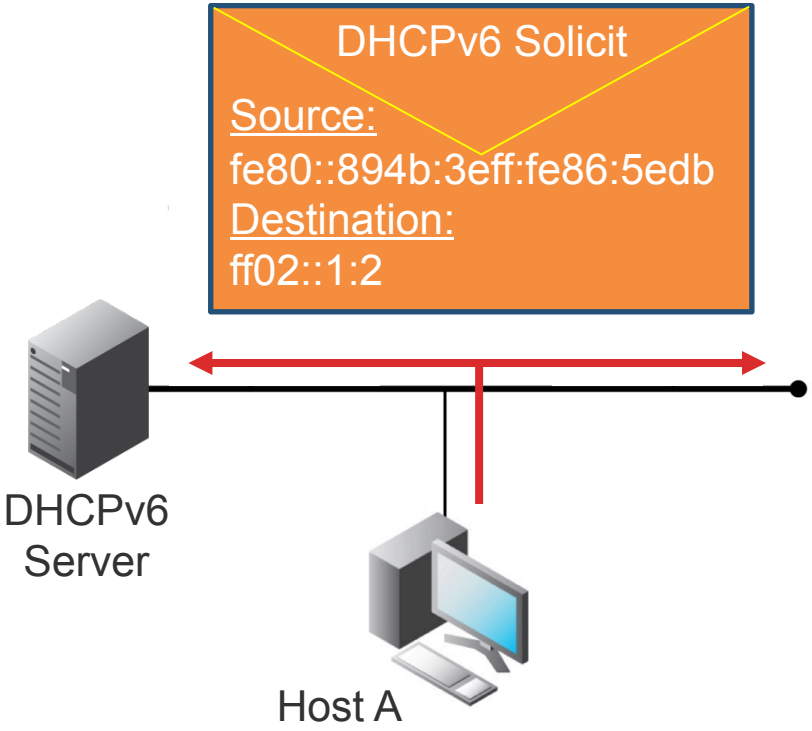
DHCPv6 IN ACTION



1. IPv6 Host A has a valid (tested with DAD) link-local address (derived from its MAC address)

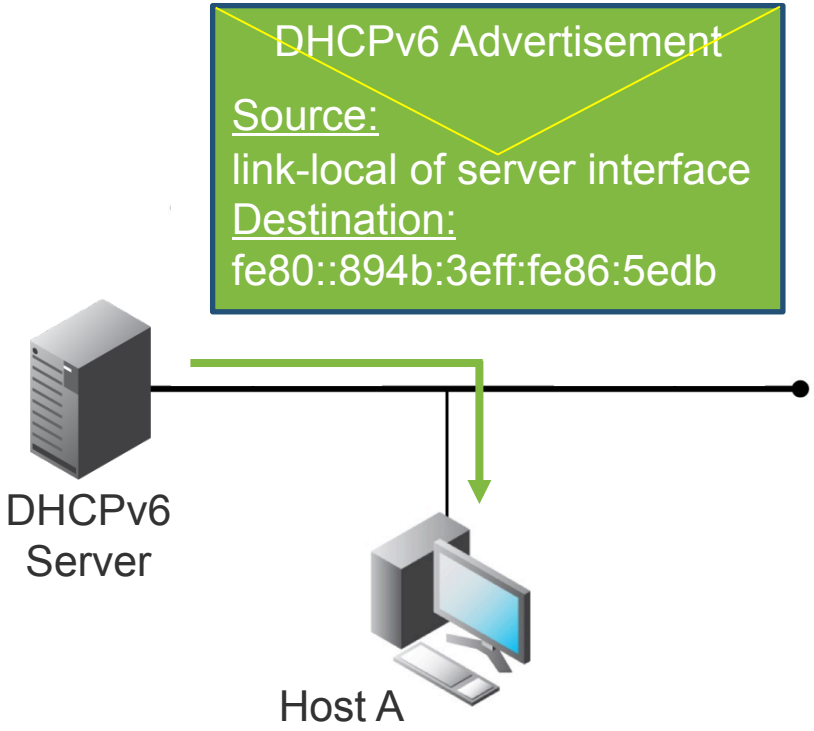
Ethernet MAC:
89-4B-3E-86-5E-DB
Link-local IPv6 address:
fe80::894b:3eff:fe86:5edb

DHCPv6 IN ACTION



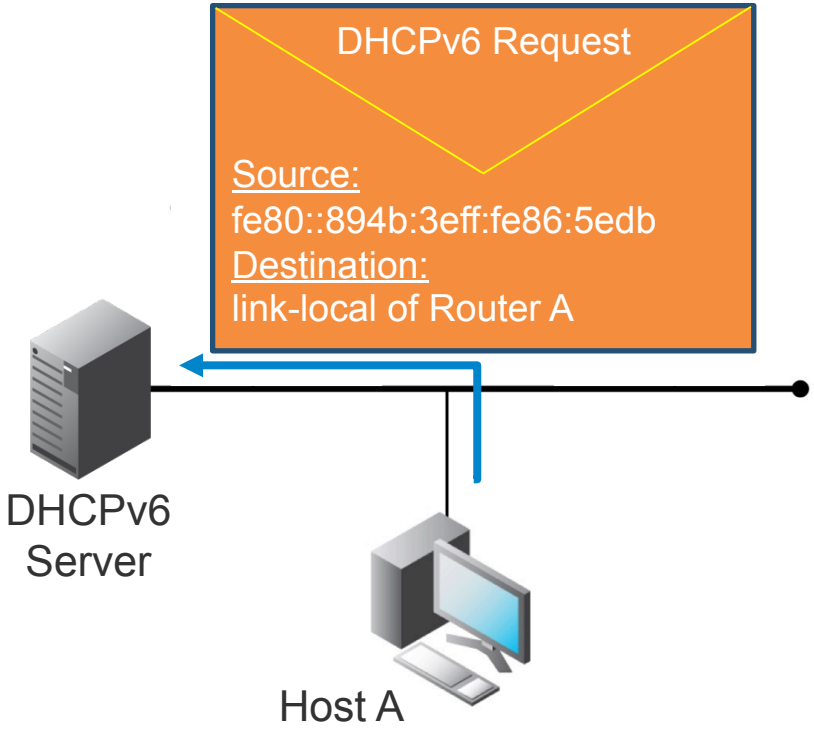
2 IPv6 Host A sends a DHCPv6 Solicit to the link-local scope all-DHCP-servers multicast address

DHCPv6 IN ACTION



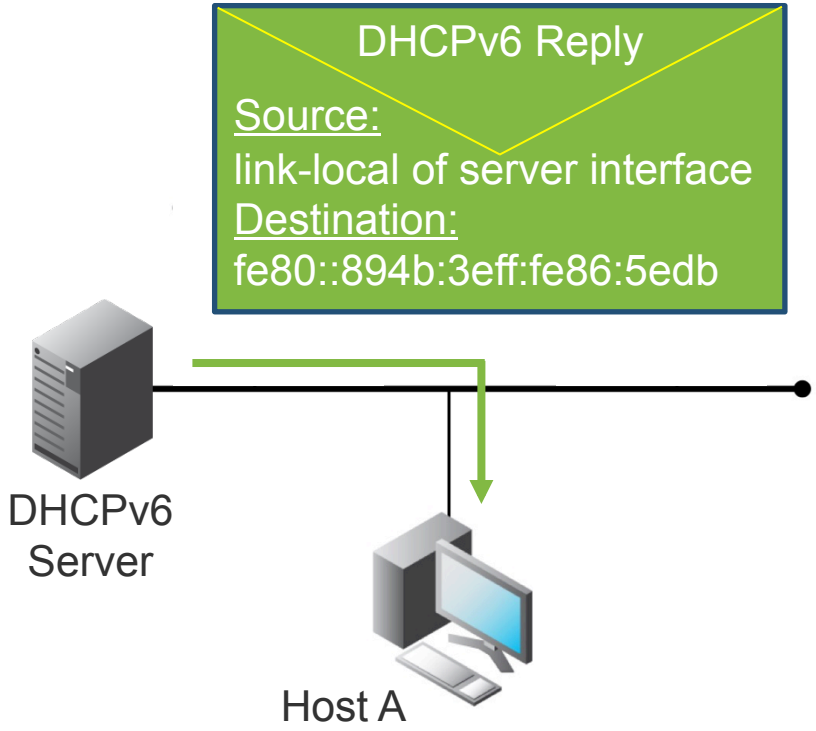
3 A listening DHCPv6 server responds with a unicast DHCPv6 Advertisement addressed to the link-local address of the soliciting client

DHCPv6 IN ACTION



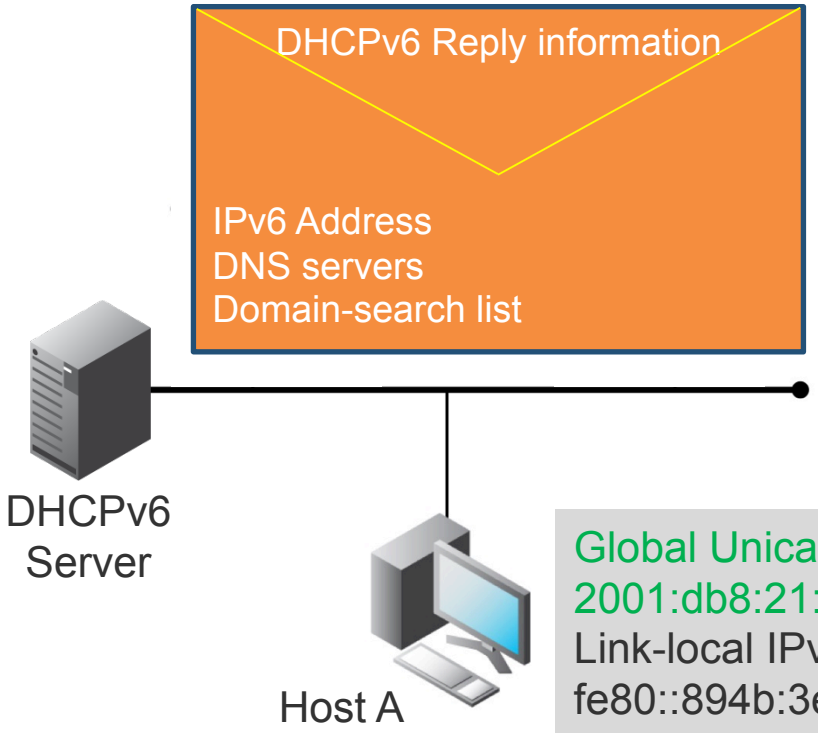
4 Host A unicasts a DHCPv6 Request to the server

DHCPv6 IN ACTION



5 The DHCPv6 server responds with a unicast DHCPv6 Reply containing the IPv6 address and any additional network configuration options

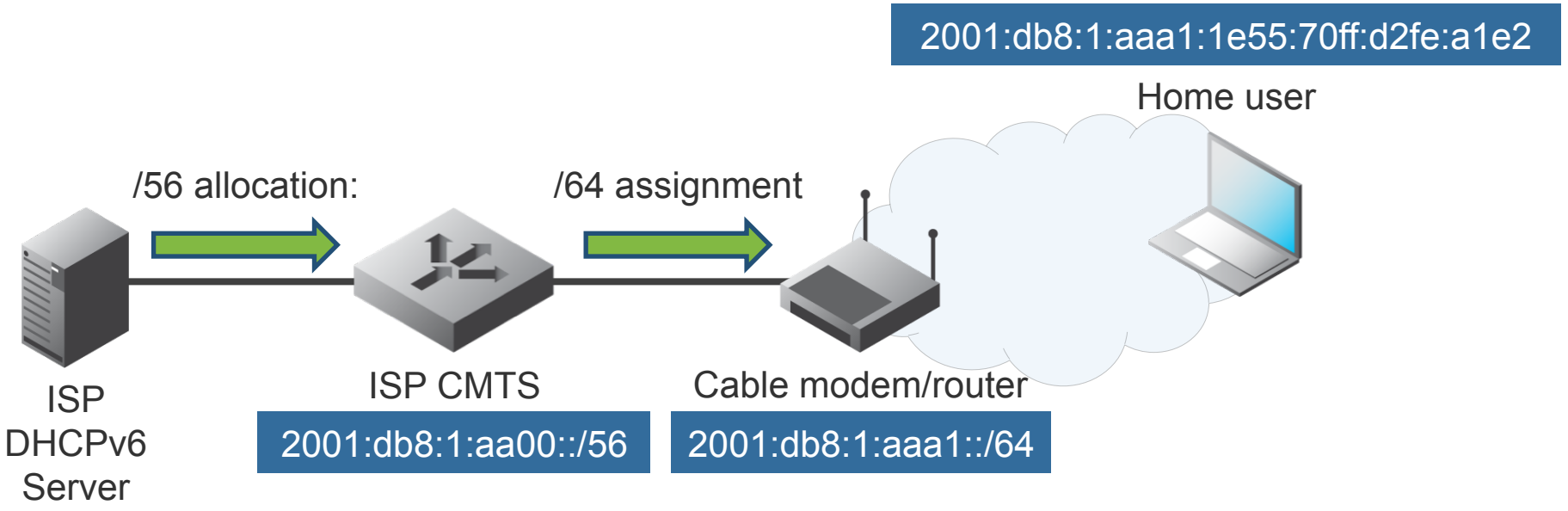
DHCPv6 IN ACTION



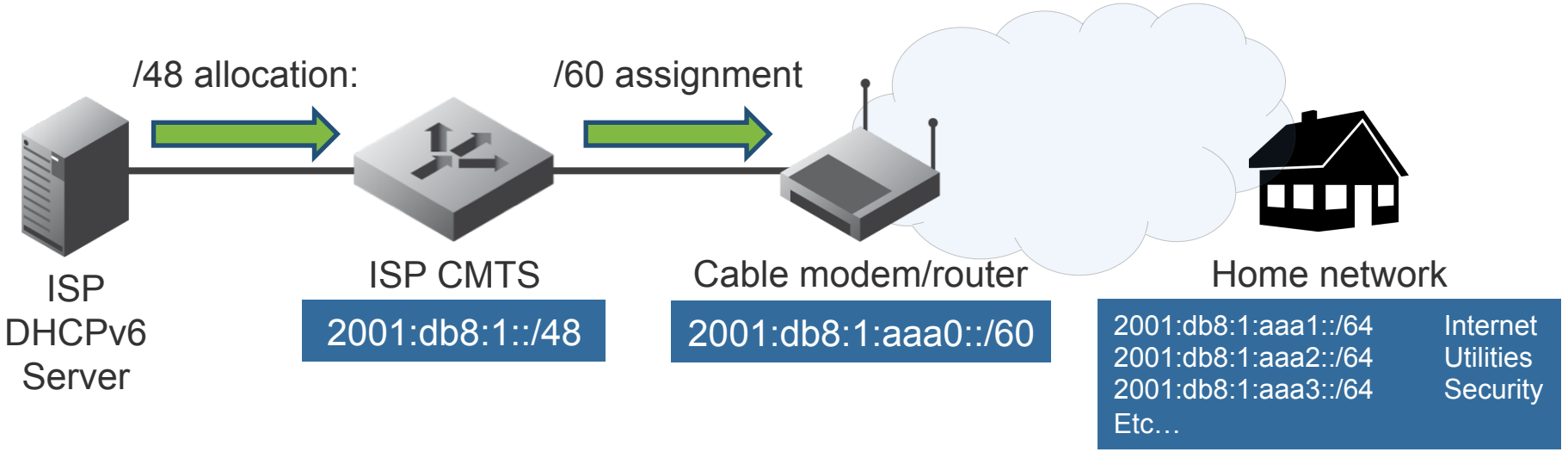
6 IPv6 Host A configures an IPv6 address and other network parameters from the information provided in the DHCPv6 Reply

Global Unicast Address:
2001:db8:21:12::100
Link-local IPv6 address:
fe80::894b:3eff:fe86:5edb

DHCPv6 PREFIX DELEGATION



DHCPv6 PREFIX DELEGATION (HOMENET)



THE DHCPv6 CONTEXT

DHCPv6 ENVIRONMENTS

- Corporate LAN environments
- When additional administrative control is needed
- Wherever DHCPv4 is deployed today*
- Where Prefix Delegation (PD) is needed
- Stateless DHCPv6 might be used where the clients do not support Stateful DHCPv6

MANAGING DHCPv6

IPv6 AUTO-ADDRESSING FLAG SETTINGS

Auto-address Configuration Method	ICMPv6 RA (Type 134)			Resulting IPv6 Addresses Configured	Additional Configuration Options *(DNS servers, domain search list, etc.)*
	A Flag	M Flag	O Flag		
SLAAC	1	0	0	Link-local, IPv6, Temporary IPv6	Manual (unless client supports RFC 6106/RDNSS)
Stateless DHCPv6	1	0	1	Link-local, IPv6, Temporary IPv6	DHCPv6
Stateful DHCPv6	0	1	N/R	Link-local, DHCPv6	DHCPv6

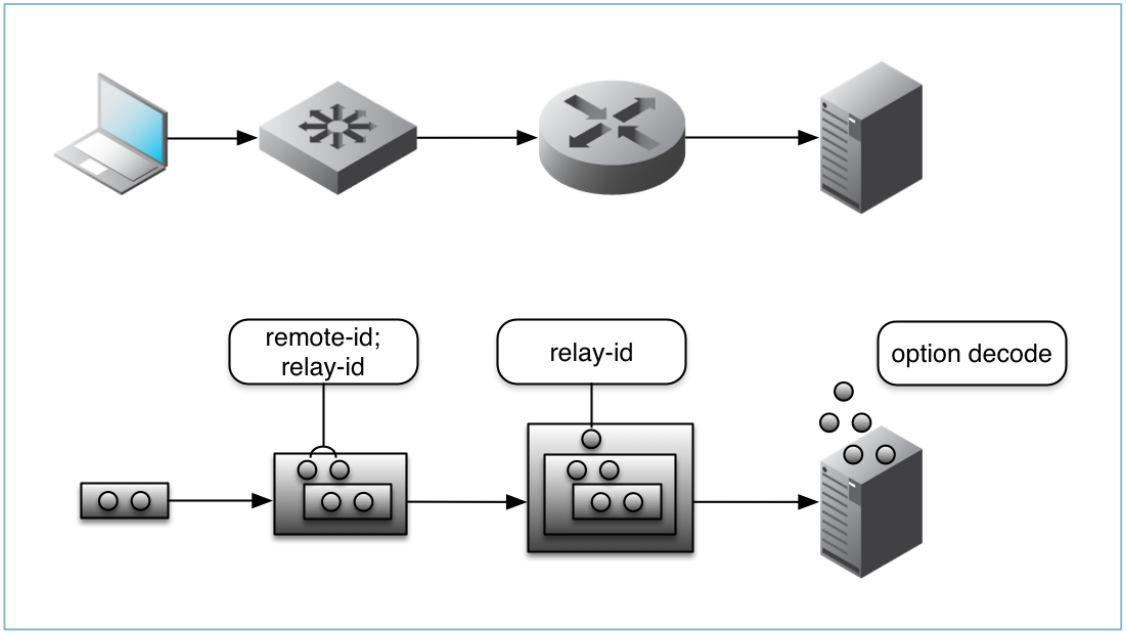
IPv6 AUTOADDRESSING: STRANGE BEHAVIOR

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 CLIENTS: STRANGE BEHAVIOR

Scenario	OS X	Windows 7/8/10
A=0, M=0, O=0, DHCPv6 present	No address	DHCPv6

DHCPv6 RELAY



- 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

Remote-ID Option Syntax

Partial standard specification for syntax:

<enterprise-id><remote-id>

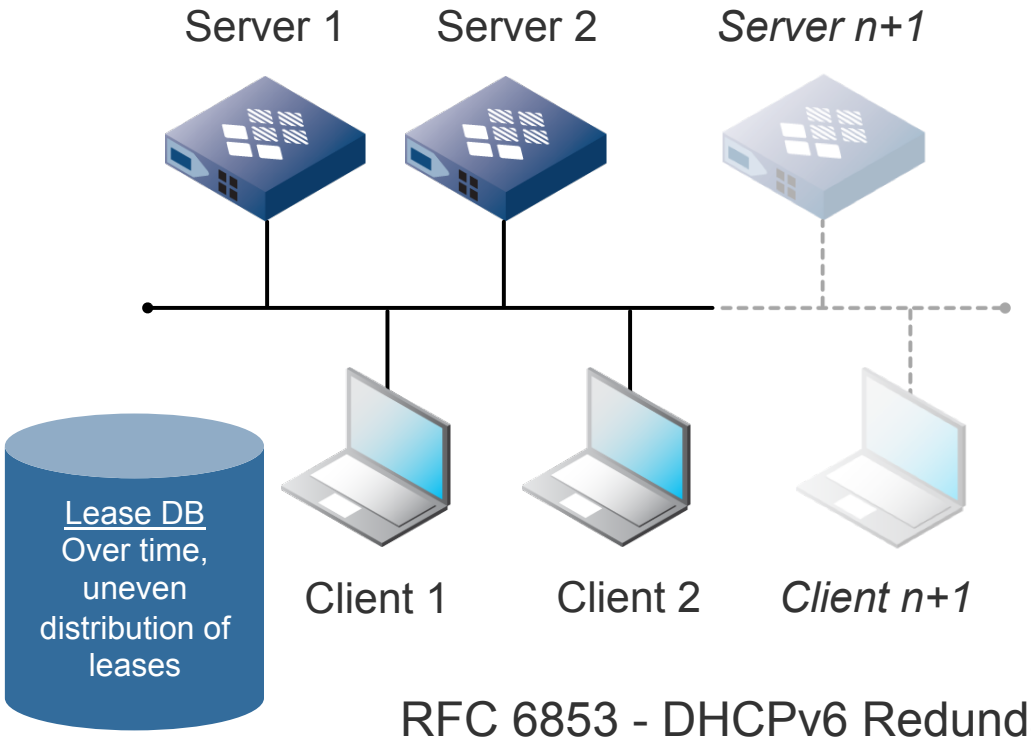
Result from relay:

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

DHCPv6 FAILOVER

- Often repeated that it's not needed (unless you're doing PD)
  - No proprietary implementation (yet…)
  - 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."
- Existing RFCs
  - RFC 6853 DHCPv6 Redundancy Deployment Considerations
  - RFC 7031 DHCPv6 Failover Requirements
- New Draft
  - DHCPv6 Failover Protocol
  - https://tools.ietf.org/html/draft-ietf-dhc-dhcpv6-failover-protocol-01

FAILOVER WORKAROUND: SPLIT PREFIXES



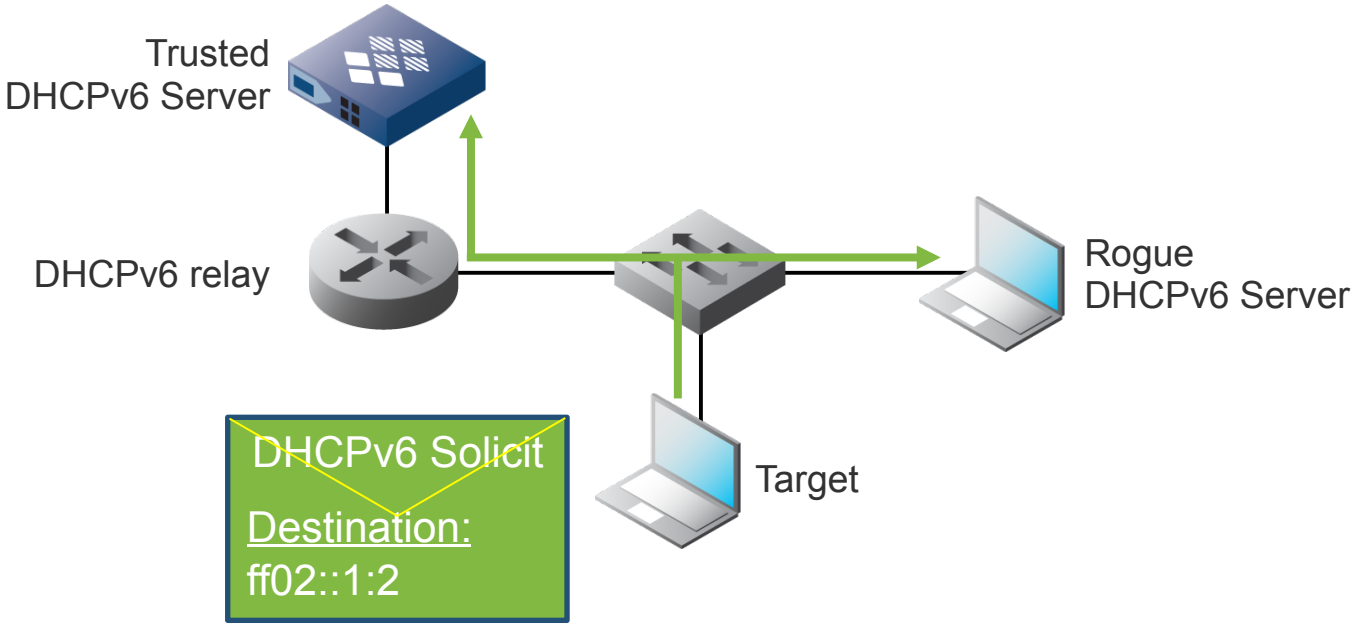
Server 1
Prefix = 2001:db8:1:1::/64
Pool = 2001:db8:1:1:0000::/65
Pref = 255

Server 2
Prefix = 2001:db8:1:1::/64
Pool = 2001:db8:1:1:8000::/65
Pref = 0

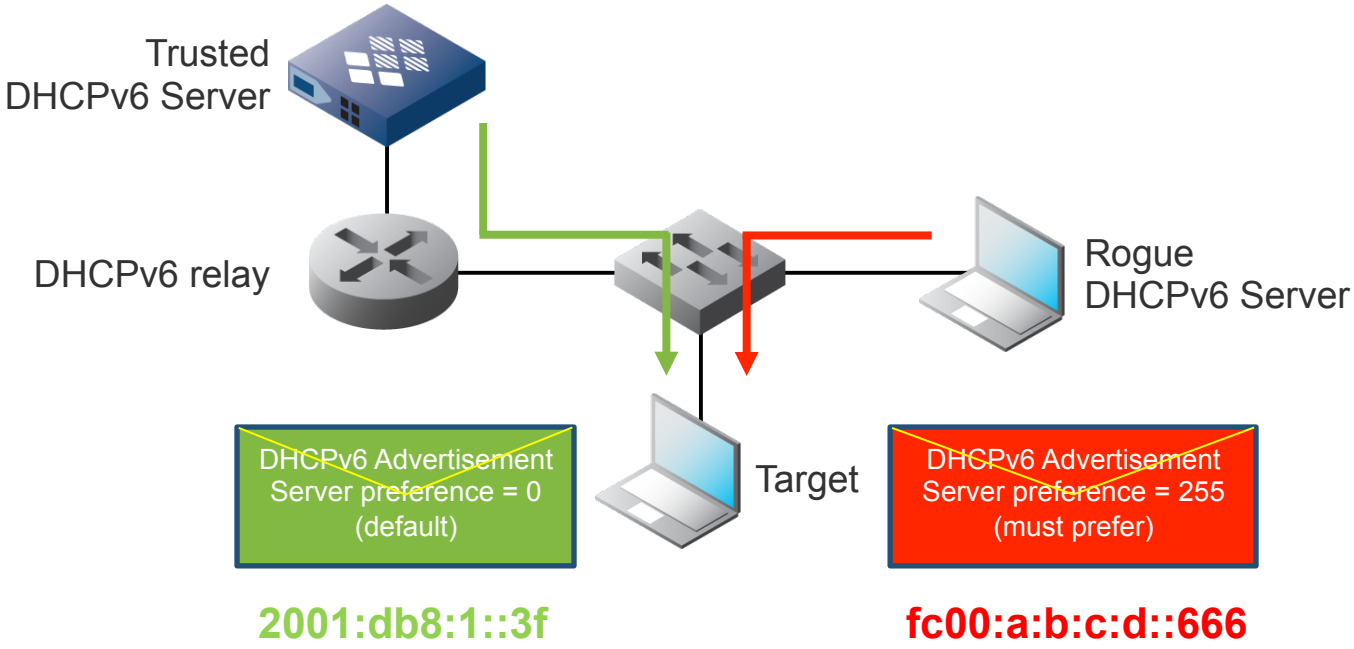
Server n+1
Prefix = 2001:db8:1:1::/64
Pool = <varies>
Pref = <0-255>

RFC 6853 - DHCPv6 Redundancy Considerations

FIRST-HOP SECURITY: DHCPv6 GUARD



FIRST-HOP SECURITY: DHCPv6 GUARD



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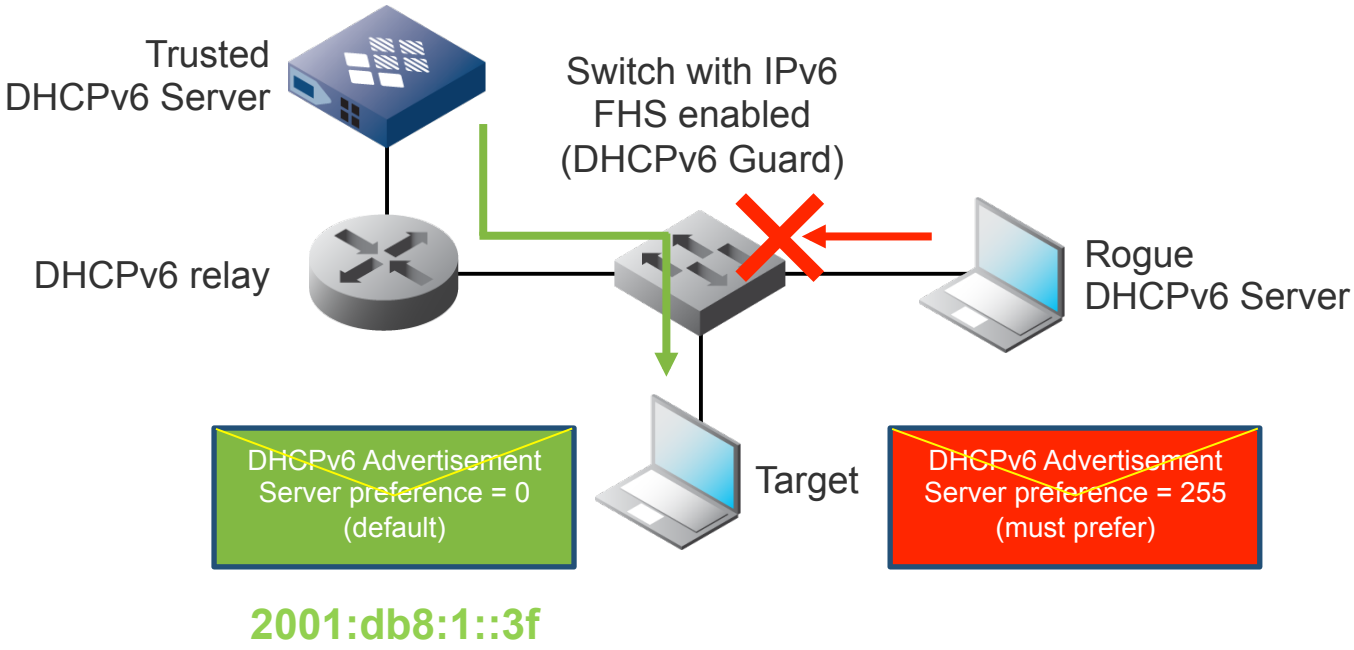
FIRST-HOP SECURITY: DHCPv6 GUARD



ADDRESS PLANNING FOR DHCPv6

- Rules of address planning generally shouldn't change regardless of which autoaddressing method used (i.e., stateful or stateless DHCPv6 or SLAAC)
  - /48 per site
  - /64 per VLAN
- How the /48 is carved up within the site depends on the topological complexity (or lack of it) in the site

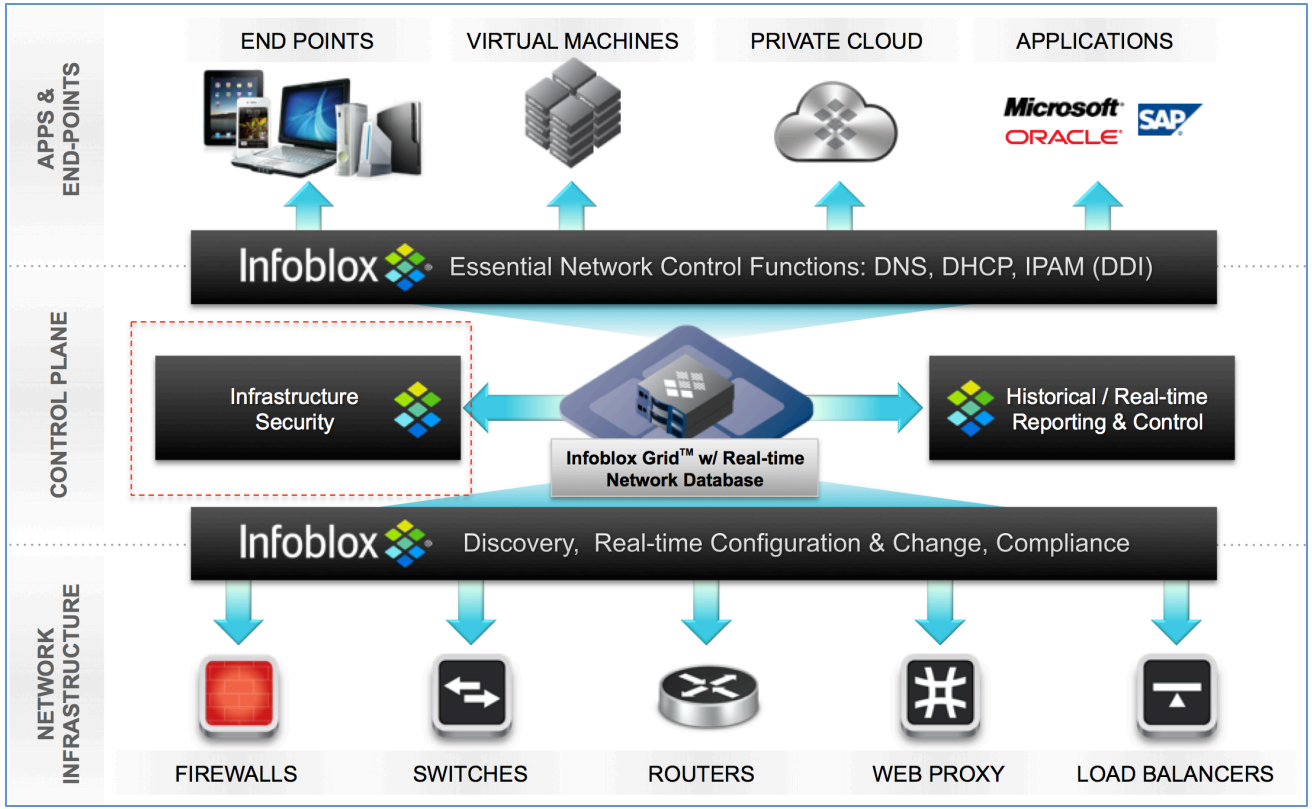
DHCPv6 FOR ANDROID!

- Pros
  - It's a DHCPv6 client for Android!

http://forum.xda-developers.com/android/apps-games/app-dhcpv6-client-t3176443

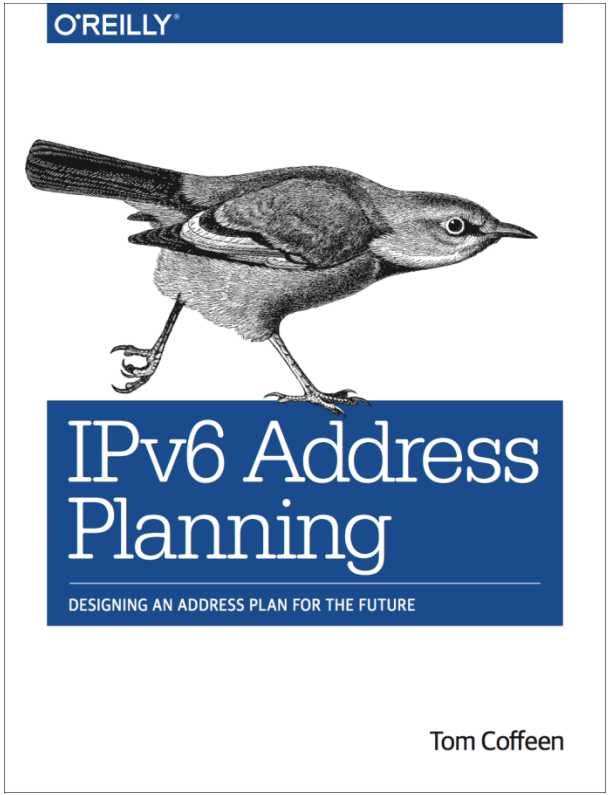
- Cons
  - Requires *root*
    - i.e., not manageable for enterprise deployments

DDI WITH IPv6



- *General IPv4/IPv6 feature parity*
  - DHCPv6 (Stateful and stateless)
  - DNS queries
  - DNS responses over v6
  - AAAA records
  - IPAM/DHCP networks/ ranges
  - Fixed addresses
  - Hosts – dual stack
  - IPv6 NetMap
  - IPv6 Discovery
  - GUI/API/SNMP
  - Gateway discovery
  - RIR allocation and updates
- *Transition technology*
  - DNS64(NAT64)

IPv6 Address Planning, O'Reilly Media, 2015



- For IT network architects, engineers, and administrators
- Comprehensive overview and current best-practices for designing, deploying, and maintaining an effective IPv6 addressing plan

Q&A

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