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Let's Deploy IPv6 NOW!

Nicole Wajer, Chief Stroopwafel Officer
@Vlinder_NL
BRKENT-2109

Cisco Webex App

Questions?

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- 1 Find this session in the Cisco Live Mobile App
- 2 Click “Join the Discussion”
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Webex spaces will be moderated by the speaker until November 15, 2024.



<https://ciscolive.ciscoevents.com/ciscolivebot/#BRKENT-2109>







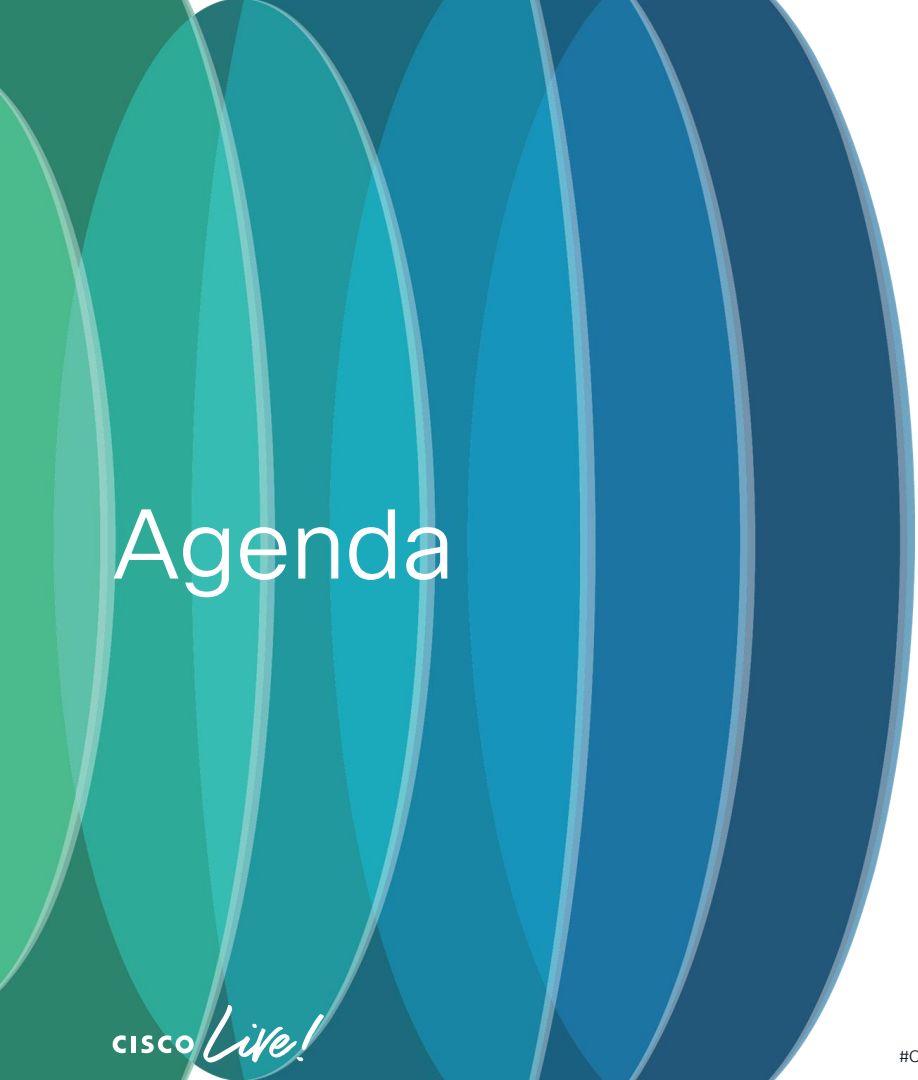
Nicole



Nicole Wajer
Technical Solutions
Architect
@vlinder_nl

Chief Stroopwafel Officer





Agenda

- Understanding the basics
- Beyond the basics
- IPv6 in the Enterprise
- Transition
- Quiz!

IPv6 requirements around the world



Germany:

- CY2024 all new acquired technology needs to be able to work on IPv6-only
- Fully IPv6-only by 2030

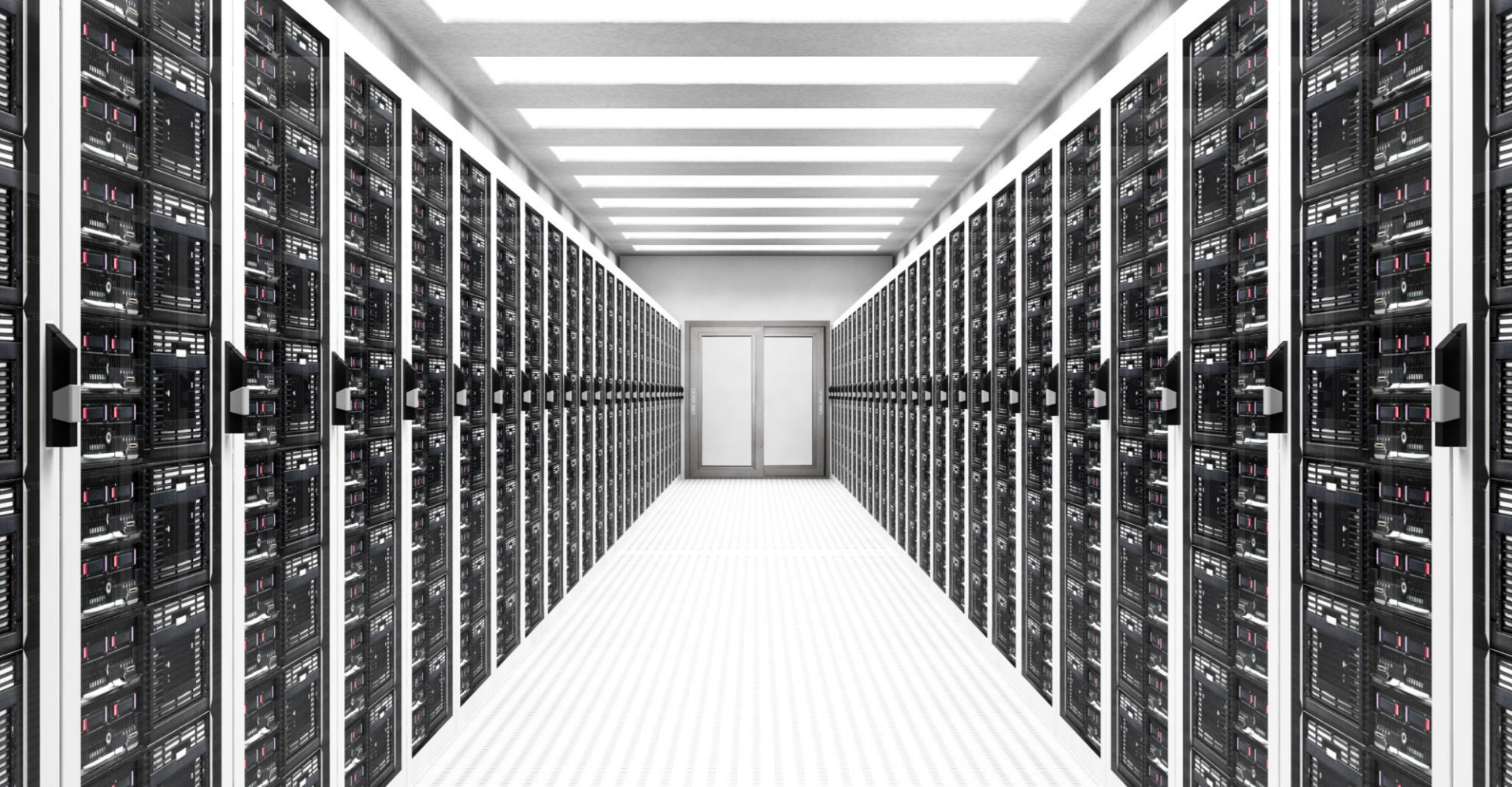
The Address

198.51.100.42

The Address

2001:0db8:4646:0001:0000:0000:0000:1e2a

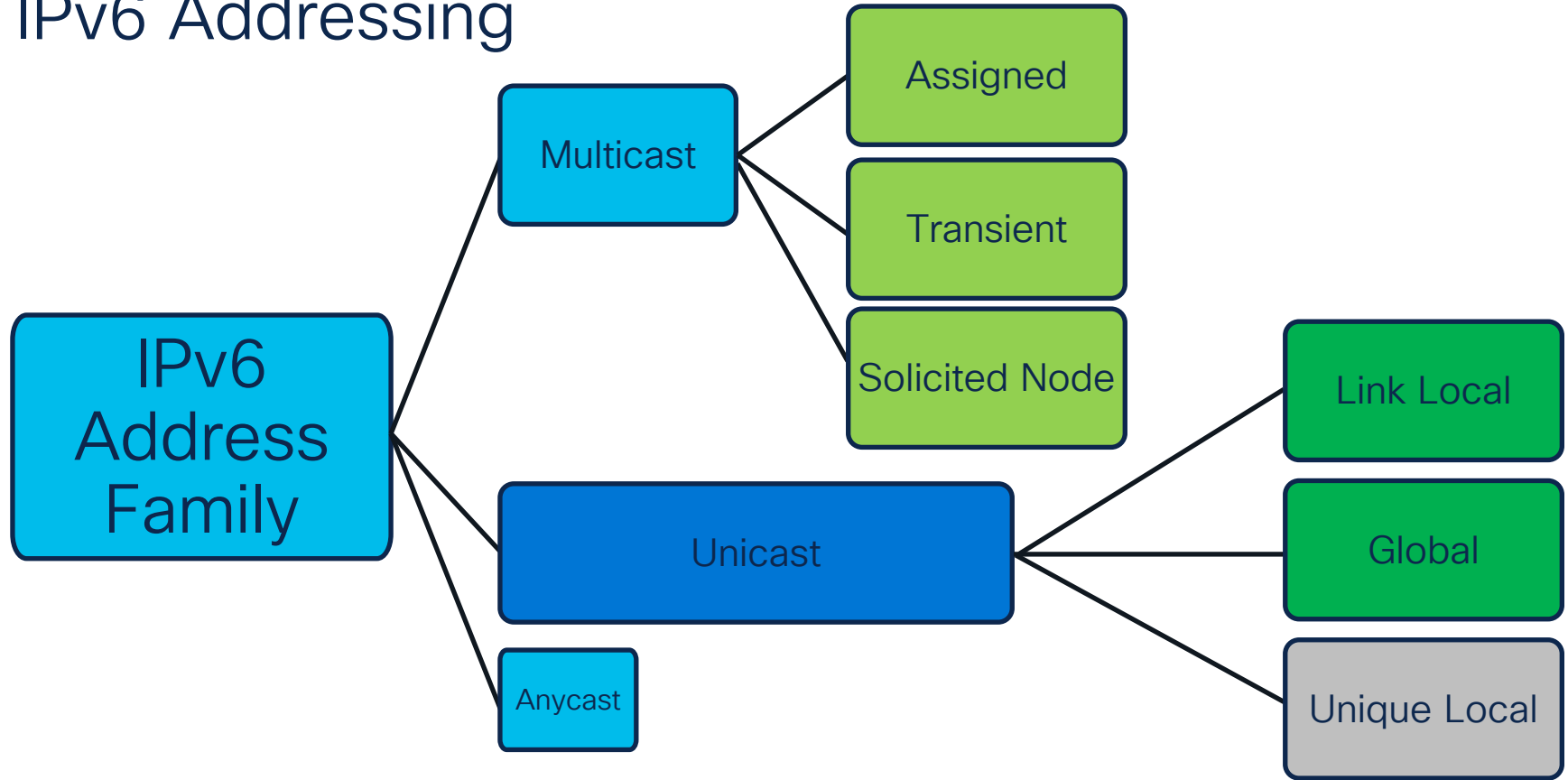








IPv6 Addressing



IPv6 Addresses Format

- Full IPv6 address (128 bits represented by 32 Hex characters)
 - Generally, 50% for network ID, 50% for interface ID, current best practice
 - Meaning a Subnet Prefix is generally a /64
- Leading 0's can be omitted
- The double colon (::) can appear only once

Global Prefix (48) Subnet (16) Interface Id (64)

3fff:0db8:4646:0001:0000:0000:0000:1e2a



3fff:db8:4646:1:0:0:0:1e2a



3fff:db8:4646:1::1e2a

Link-Local address

Non routable exists on single layer 2 domain (fe80::/10)

fe80:0000:0000:0000:xxxx:xxxx:xxxx:xxxx

Unique Local Address

Routable within administrative domain (fc00::/7)

fc00:~::~:~::~:~::~:~::~:****:xxxx:xxxx:xxxx:xxxx

fd00:~::~:~::~:~::~:~::~:****:xxxx:xxxx:xxxx:xxxx

Global Address

Routable across the Internet (2000::/3)

Documentation Prefix 2001:0db8::/32 (July 2004) & 3fff::/20 (July 2024)

2000:****:****:****:xxxx:xxxx:xxxx:xxxx

3fff:****:****:****:xxxx:xxxx:xxxx:xxxx



I will use ULA for my
Enterprise!

RFC6724: Default Address Selection for IPv6

Internet Engineering Task Force (IETF)
Request for Comments: 6724
Obsoletes: [3484](#)
Category: Standards Track
ISSN: 2070-1721

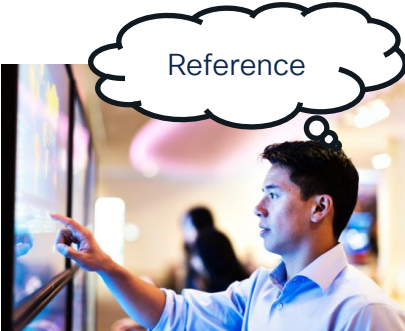
D. Thaler, Ed.
Microsoft
R. Draves
Microsoft Research
A. Matsumoto
NTT
T. Chown
University of Southampton
September 2012

Default Address Selection for Internet Protocol Version 6 (IPv6)

Abstract

This document describes two algorithms, one for source address selection and one for destination address selection. The algorithms specify default behavior for all Internet Protocol version 6 (IPv6) implementations. They do not override choices made by applications or upper-layer protocols, nor do they preclude the development of more advanced mechanisms for address selection. The two algorithms share a common context, including an optional mechanism for allowing administrators to provide policy that can override the default behavior. In dual-stack implementations, the destination address selection algorithm can consider both IPv4 and IPv6 addresses -- depending on the available source addresses, the algorithm might prefer IPv6 addresses over IPv4 addresses, or vice versa.

Default address selection as defined in this specification applies to all IPv6 nodes, including both hosts and routers. This document obsoletes [RFC 3484](#).

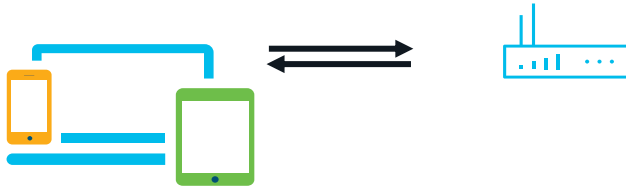


Reference

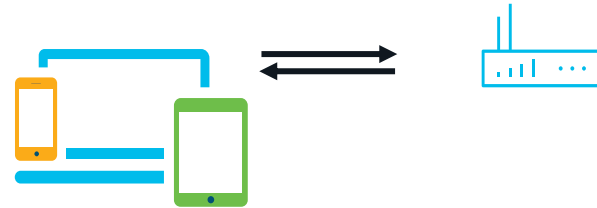
Interface ID Assignment

IPv4 and IPv6 way

Manual Configuration



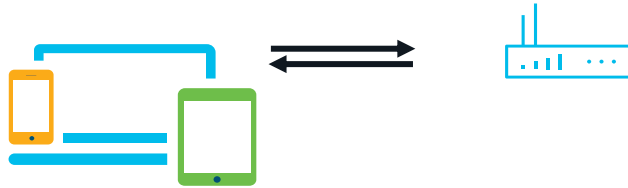
DHCP



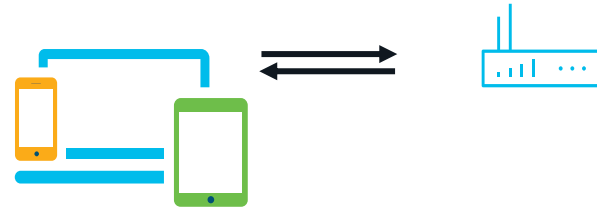
IPv6 interface ID Assignment

IPv6 way

State Less Address Auto Configuration
SLAAC EUI64



SLAAC
Temporary Addresses formally known
Privacy Extensions



***Secure Neighbour Discovery SeND

SLAAC – Pros and Cons



PRO

- No need to do stateful DHCP
- Wide device support (Android!)
- “IPv6 way”



SLAAC – Pros and Cons



PRO

- No need to do stateful DHCP
- Wide device support (Android!)
- “IPv6 way”



CONS

- Some stacks (iOS) are very aggressive with temp. addresses
- More volatility in the binding table/ND
- Address tracing is harder



IPv6 way: I heard about DHCPv4 option 108?



Source: Nicole Wajer

No ARP!
No Broadcast!
How does IPv6
do this?

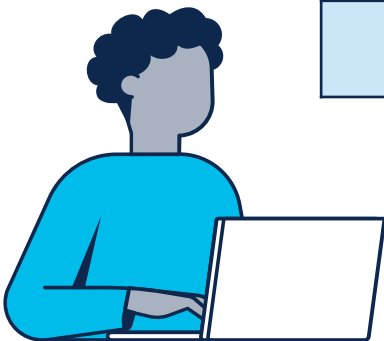
Let me show
you



Neighbor Discovery Protocol – (NDP)

Overview

IPv4	IPv6
ARP Request	Neighbor Solicitation
ARP Reply	Neighbor Advertisement
Broadcast	Solicited Node Multicast



Neighbor Discovery Protocol – (NDP)

Configuration



I should use **Link Local**
(**fe80::/64**) as NDP's
source!

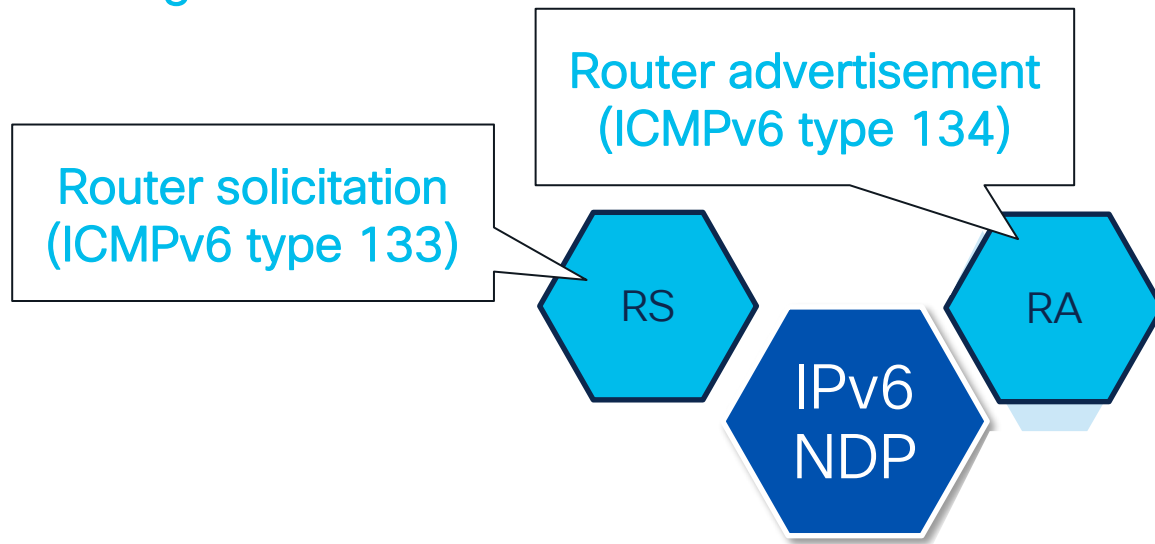
And I need to set the
hop limit to **255**...



IPv6
NDP

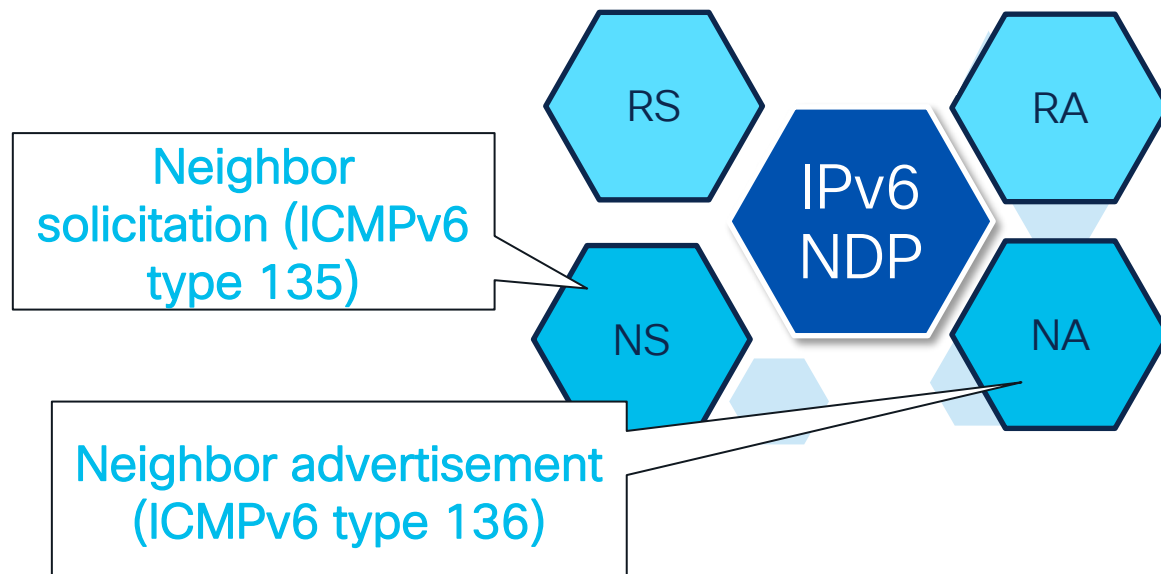
Neighbor Discovery Protocol – (NDP)

Neighbor discovery messages



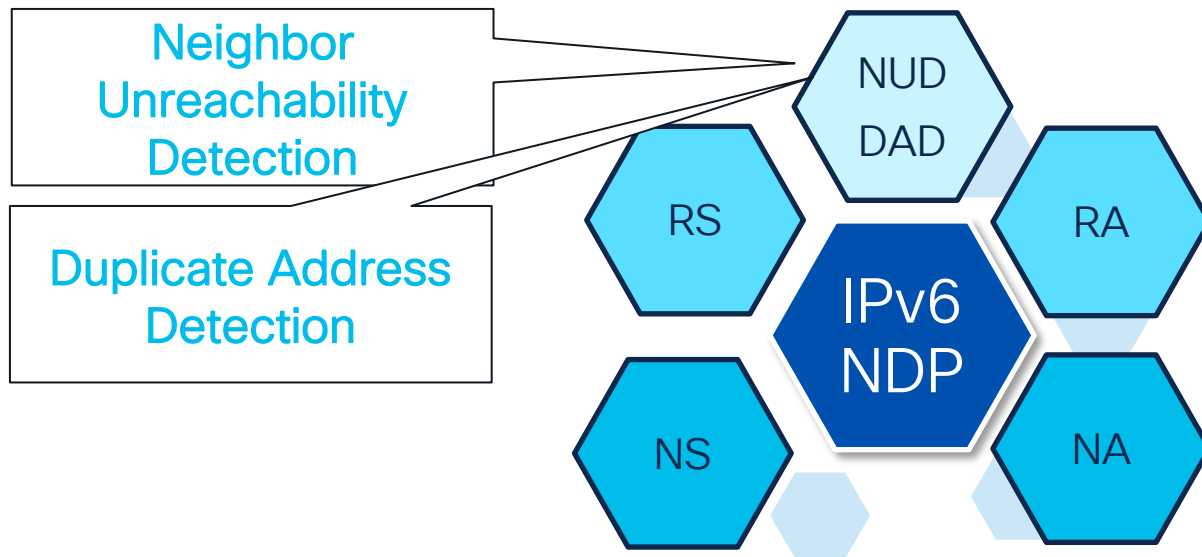
Neighbor Discovery Protocol – (NDP)

Neighbor discovery messages



Neighbor Discovery Protocol – (NDP)

Error detection

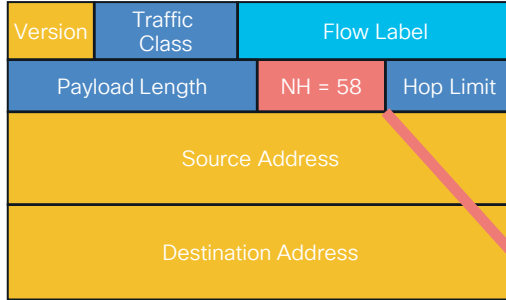


A photograph of two men in a recording studio. The man on the left, wearing a white shirt, dark vest, and blue scarf, is looking towards the man on the right. The man on the right, wearing a leather jacket and a cap, is pointing towards a computer monitor. They are both sitting at a large mixing console. The background features soundproofing panels. Two speech bubbles are overlaid on the image. The first speech bubble, coming from the man on the left, contains the text 'Security: ICMP BLOCK as it's BAD!'. The second speech bubble, coming from the man on the right, contains the text 'ICMPv6? Do we need this?'.

Security: ICMP
BLOCK as it's
BAD!

ICMPv6?
Do we need
this?

ICMPv6 Messages (IPv6 Next Header = 58)



IPv6 NH = 58



Network Working Group
Request for Comments: 4443
Obsoletes: 2463
Updates: 2788
Category: Standards Track

A. Conta
Transwitch
S. Deering
Cisco Systems
M. Gupta, Ed.
Tropos Networks
March 2006

Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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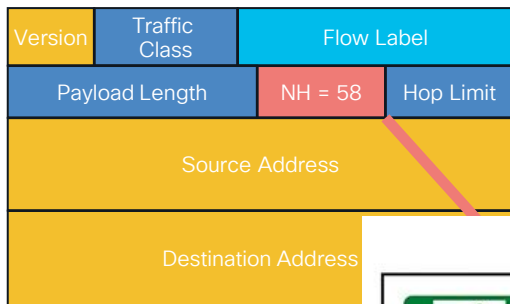
Copyright (C) The Internet Society (2006).

Abstract

This document describes the format of a set of control messages used in ICMPv6 (Internet Control Message Protocol). ICMPv6 is the Internet Control Message Protocol for Internet Protocol version 6 (IPv6).

<https://datatracker.ietf.org/doc/html/rfc4443>

ICMPv6 Messages (IPv6 Next Header = 58)



Network Working Group
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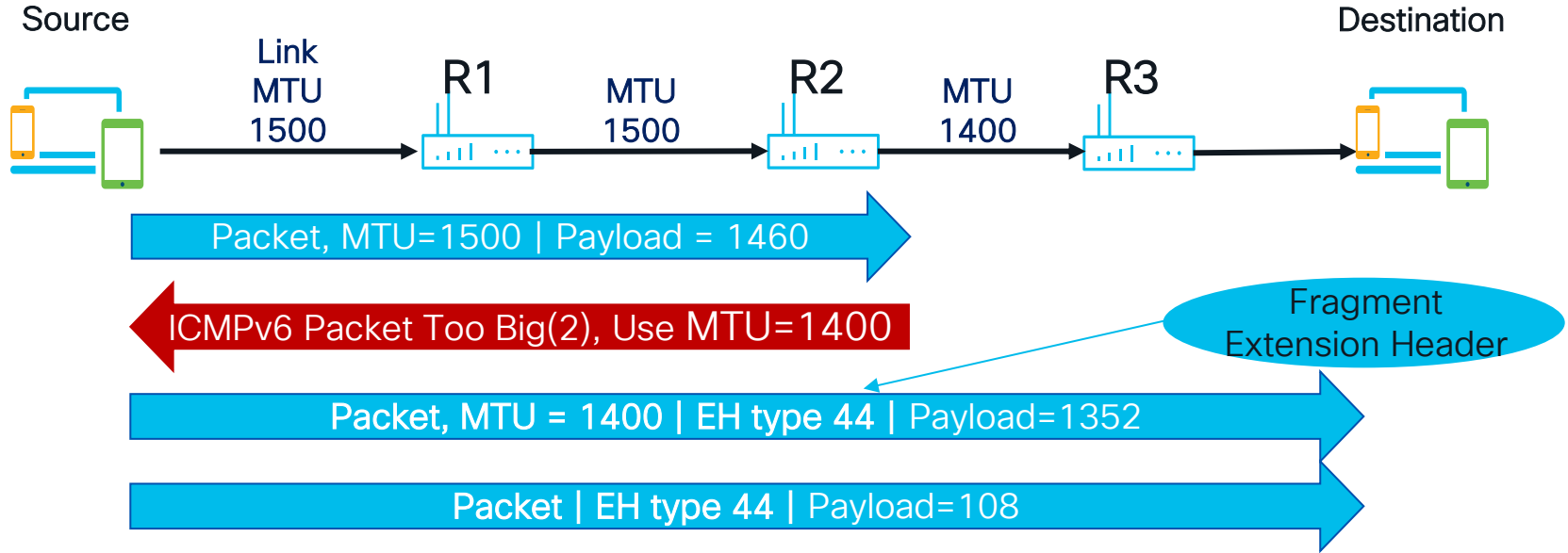
Internet Society (2006).

This document is the format of a set of control messages used by the Internet Message Protocol (ICMPv6). ICMPv6 is the Internet Message Protocol for Internet Protocol version 6.

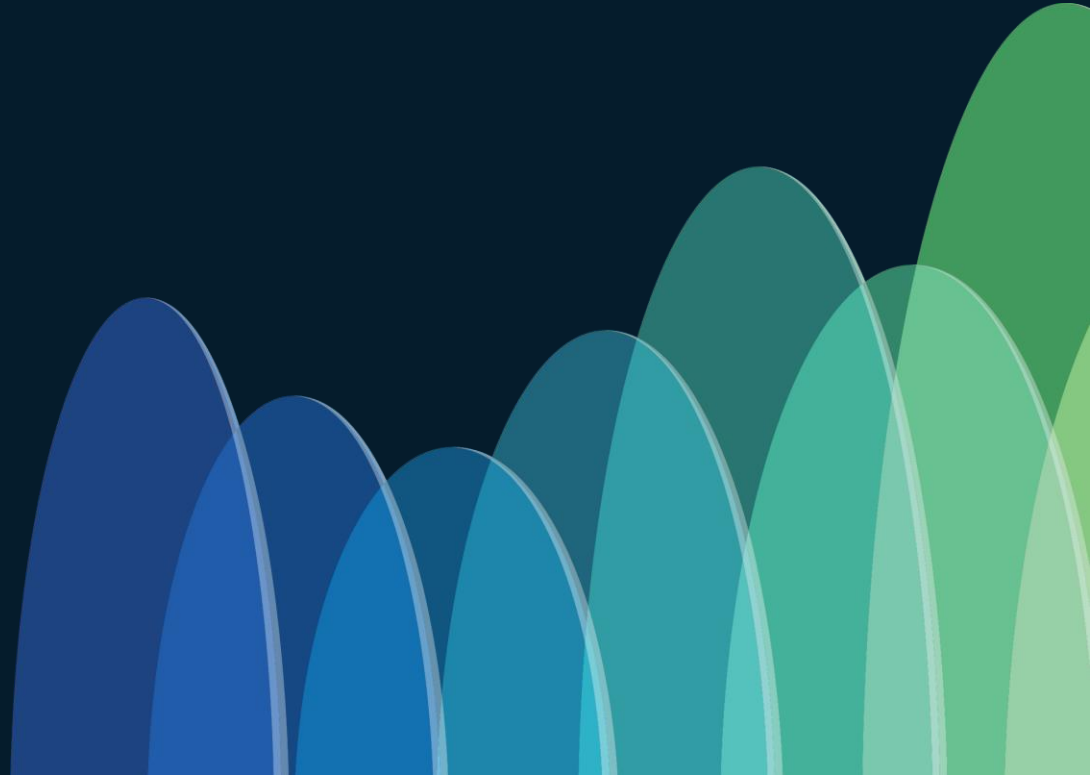
<https://www.ietf.org/doc/html/rfc4443>



Path MTU Discovery

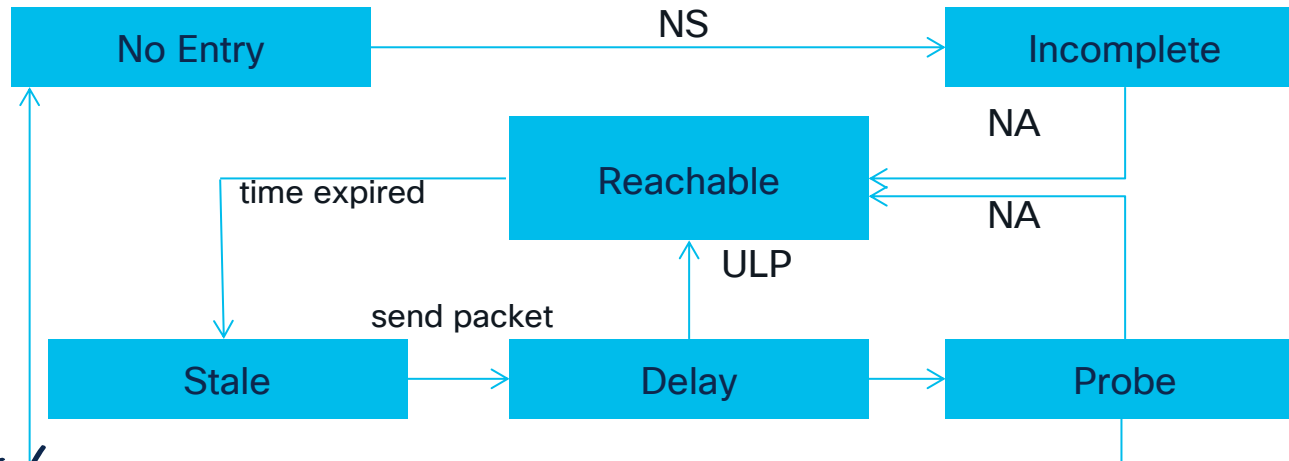


Beyond the Basics



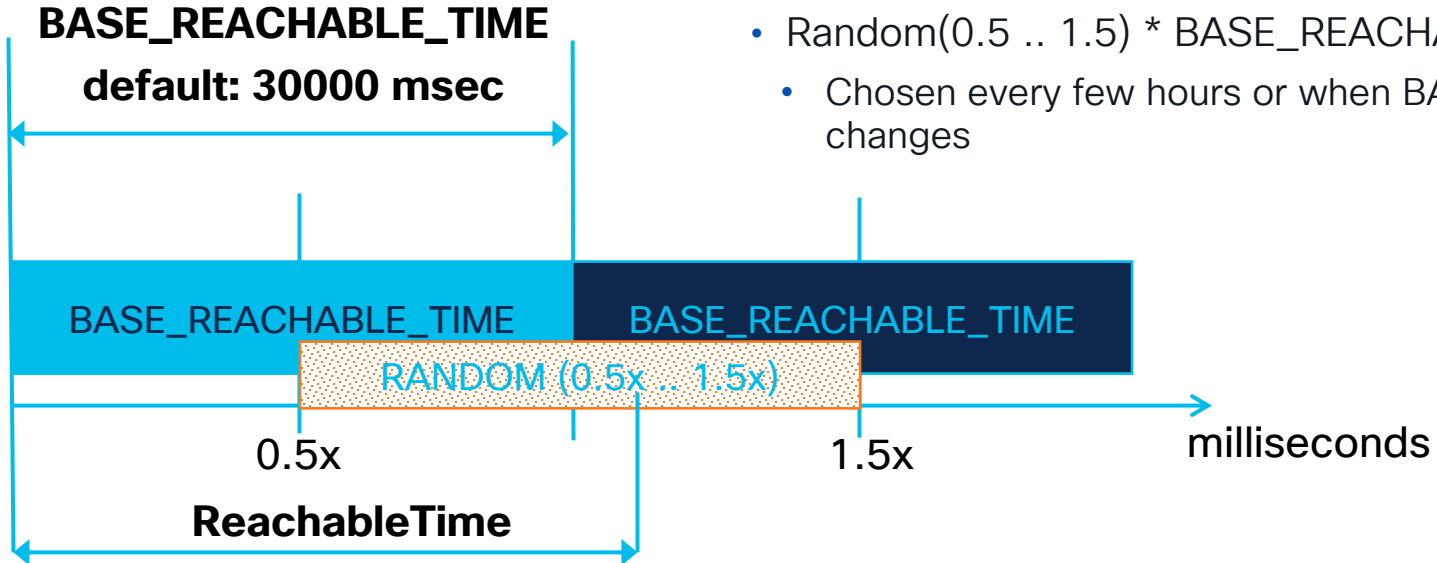
Neighbor Cache State Machine

- Incomplete – Pending address resolution, NS message outstanding
- Reachable – Recently used mapping, Can be refreshed by ULP
- Stale – Not currently communicating, waiting for next queued packet
- Delay – Using stale binding, awaiting (ULP) return traffic
- Probe – Sending Unicast NS to node (after Delay timer, 3x1 sec)

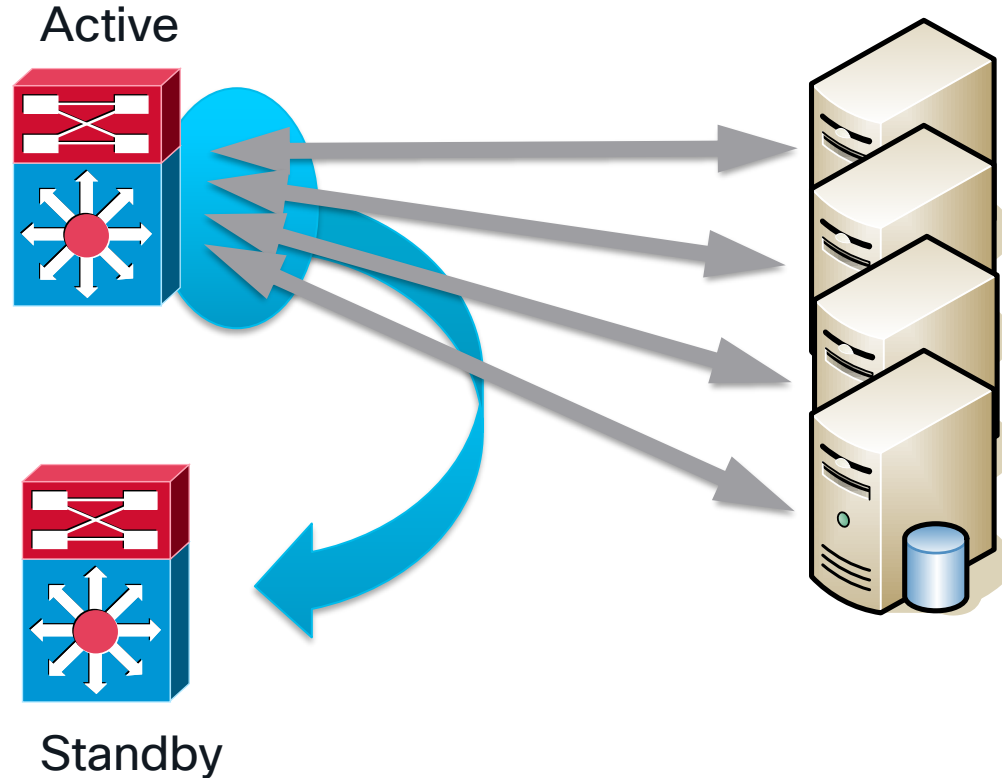


ReachableTime: How Long Is It ?

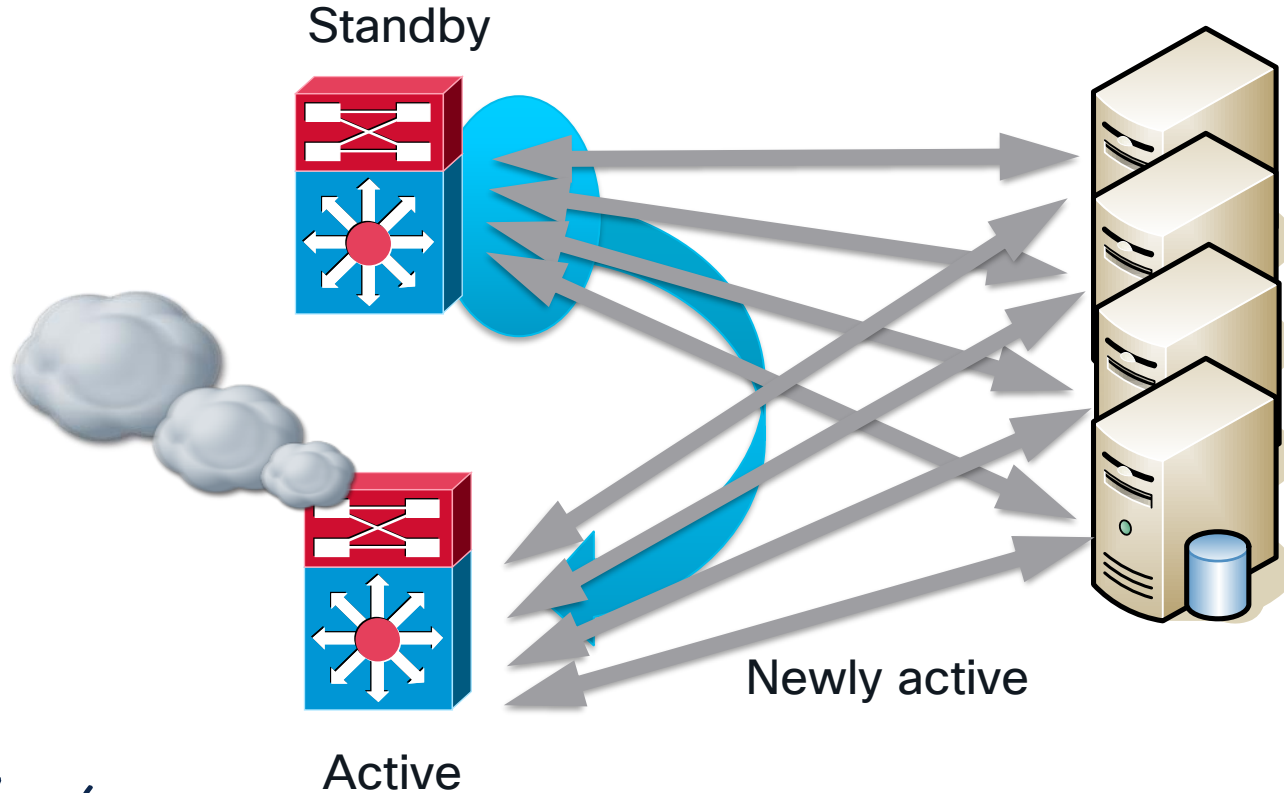
- `BASE_REACHABLE_TIME`
 - Sent in RA or taken from default
 - Value in milliseconds
- $\text{Random}(0.5 \dots 1.5) * \text{BASE_REACHABLE_TIME}$
 - Chosen every few hours or when BASE... changes



Neighbor Table Maintenance



Neighbor Table Maintenance Can Burden The CPU



DC ND Tuning

- If FHRP is present or single gateway: increase reachable time

ipv6 nd reachable-time 600000 ! 10 minutes

TEST !

BASE_REAC
HABLE_TIME

- Pre-populate and maintain the neighbor table

**ipv6 nd cache expire 14400 refresh
ipv6 nd na glean**

Expiry

- Rate-limit the address resolution traffic

mls rate-limit unicast cef glean 1000 10

Burst
size

PPS

- Start with this configuration and adjust depending on the site
- Wrong values can impact the neighbor resolution times!

Lessons learned – The Basics

- Every OS nowadays has IPv6 standard enabled
- 99% It just works without knowing
- Path MTU discovery issues is a
- ICMPv6 should **NOT** be filtered but still is



IPv6 in the Enterprise





Making an IPv6 address plan



IPv6 Address Space – PI vs PA

- Do I get Provider Independent (PI) or Provider “Assigned” (PA)?
 - PI space is great for organizations who want to multihomed to different SPs
 - PA if you are single homed or plan to NAT/Proxy everything with IPv6 (not likely)
- Possible Options for PI
 - Get one large global block from local RIR and subnet out per region
 - Get a separate block from each of the RIR you have presence in
- Most organizations are going down the PI path
 - Getting assignments across regional registries provides “insurance” against changing policies
 - Traffic Engineering



The 4 Rules

1

Simple

You don't want to
spend weeks
explaining it!

The 4 Rules

1

Simple

2

Embed information

To help
troubleshooting and
operation of the
network

Examples:

location, country, PIN, VLAN,
IPv4 addresses in Link Local
and/or Global Addresses

The 4 Rules

1

Simple

2

Embed information

3

Build-in Reserve

Cater for future
growth, mergers &
acquisitions, new
locations

Reserved vs. assigned

The 4 Rules

1

Simple

2

Embed information

3

Build-in Reserve

4

Aggregatable

Good aggregation is essential, just one address block (per location). Ensures scalability and stability

The 4 Rules

Remember Rule #1!!

1

Simple

2

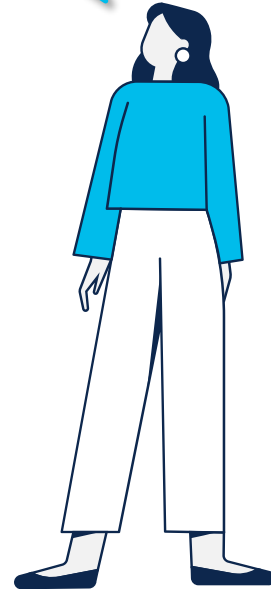
Embed information

3

Build-in Reserve

4

Aggregatable



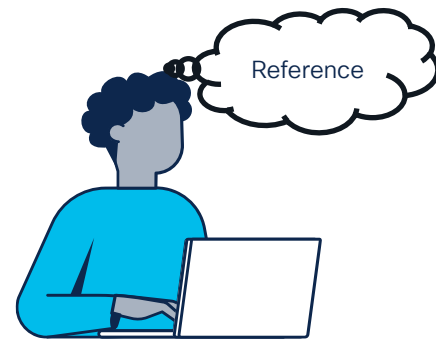
“Do not fear to waste addresses”

Secret Rule #5

WRITE
IT
DOWN
—
LET IT
GO

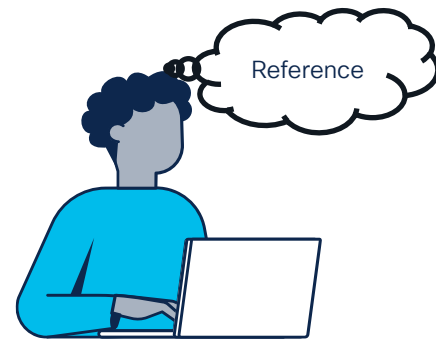


Methodology



- Analyze, where will IPv6 be deployed?
 - Addressing plan needs to be designed globally
- Identify the structure of the addressing plan
 - Based on requirements and considerations discussed earlier
 - Top-down approach
 - This is different from the IPv4 days when # of hosts per subnet was important
- Where and how many locations
 - Countries, regions, locations, buildings, etc.
 - Needs to map onto the physical / logical network topology
- Which services, applications and systems connected in each location
 - E.g. Fixed networks, mobile networks, end-users, ERP, CRM, R&D, etc...

Information Encoding



- Encode information in particular portions of the IPv6 prefix
 - VLANs in the prefix
 - VLAN 4092 → 2001:db8:1234:4092::/64 (alternatively in hex ☺)
 - ISATAP is a thing of the **past** – “Let it Go!”
 - IPv4 address 10.0.13.1 → 2001:db8:1234:100::10:0:13:1
 - Consider security implications!

Turn it ON!



Enable IPv6

```
interface GigabitEthernet2
  description Isolated network for testing
  no ip address
  shutdown
  negotiation auto
  no mop enabled
  no mop sysid
```

Enable IPv6

```
interface GigabitEthernet2
description Isolated network for testing
no ip
shutd
negot
no mop enabled
no mop sysid
```

ipv6 unicast-routing

Show joined multicast group

```
R1#show ipv6 interface ethernet0
Ethernet0 is up, line protocol is up
IPv6 is enabled, link-local address is FE80::200:CFF:FE3A:8B18
Global unicast address(es):
  2001:DB8:46:1234::1 subnet is 2001:DB8:46:1234::/64
Joined group address(es):
  FF02::1
  FF02::2
  FF02::1:FF00:1
  FF02::1:FF3A:8B18
MTU is 1500 bytes
ICMP error messages limited to one every 100 milliseconds
ICMP redirects are enabled
ND DAD is enabled, number of DAD attempts: 1
ND reachable time is 30000 milliseconds
ND router advertisements are sent every 200 seconds
```

EIGRP IPv6 needs “no shutdown”

```
ipv6 router eigrp 1  
  router-id 192.0.2.1  
no shutdown
```

OSPFv2 vs OSPFv3

OSPFv2 == Legacy IP

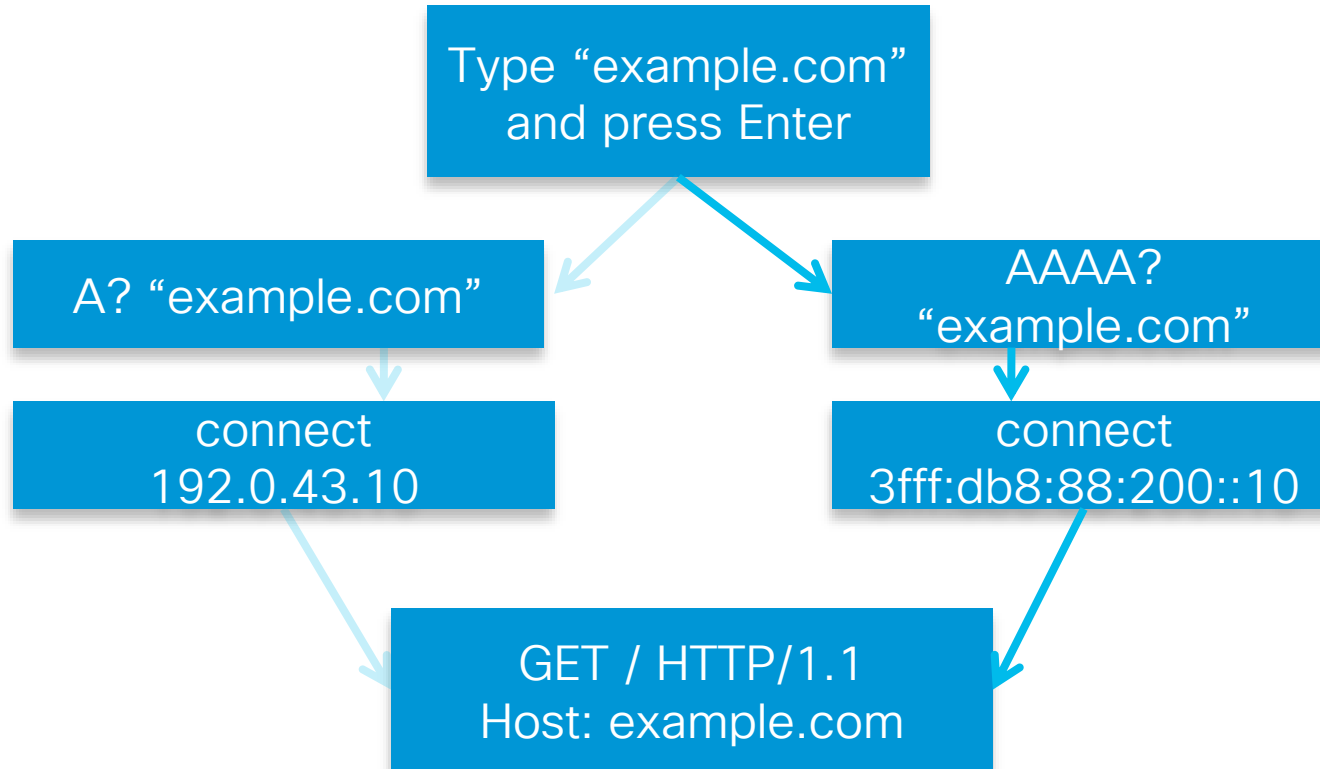
OSPFv3 Support Both!



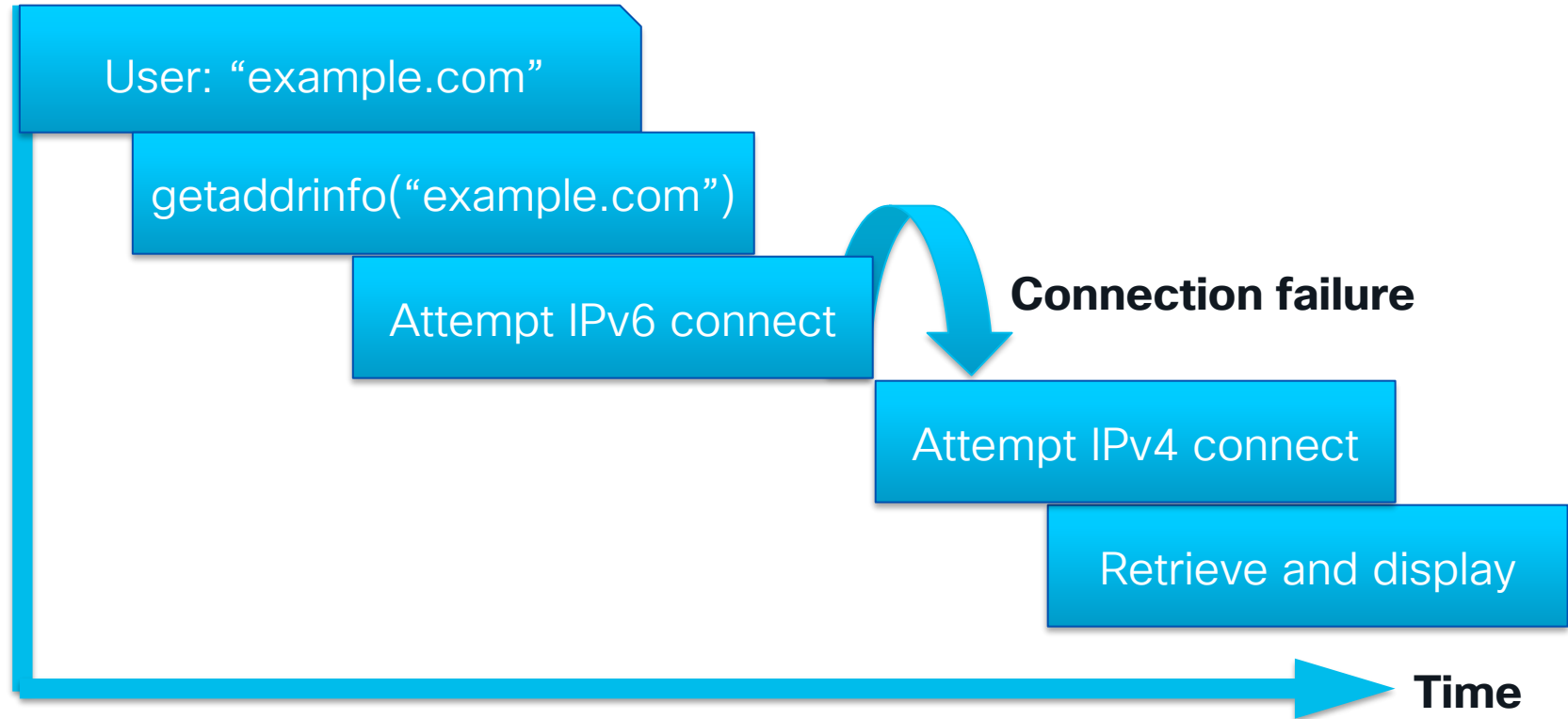
Running Both



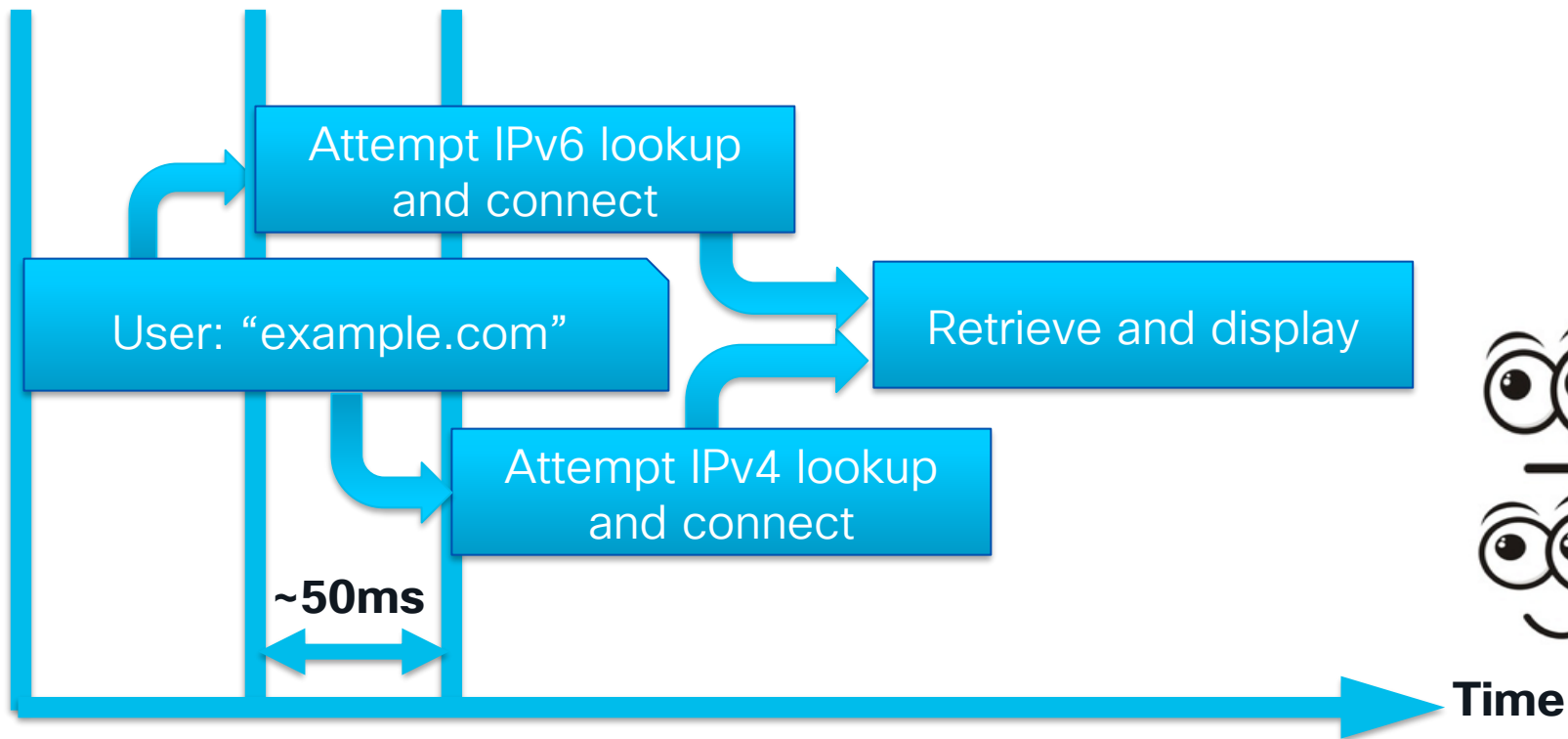
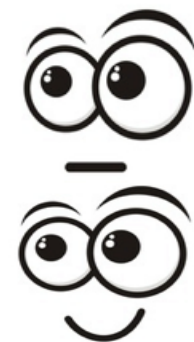
Dualstack: Always remember both protocols



The problem: RFC3484, if IPv6 connection fails



RFC8305 in a nutshell (RFC6555 Obsolete)



Source: @adynue

RFC8305: Happy Eyeballs: Success with Dual-Stack Hosts

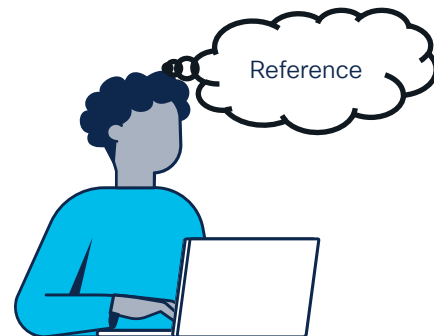
Internet Engineering Task Force (IETF)
Request for Comments: 6555
Category: Standards Track
ISSN: 2070-1721

D. Wing
A. Yourtchenko
Cisco
April 2012

Happy Eyeballs: Success with Dual-Stack Hosts

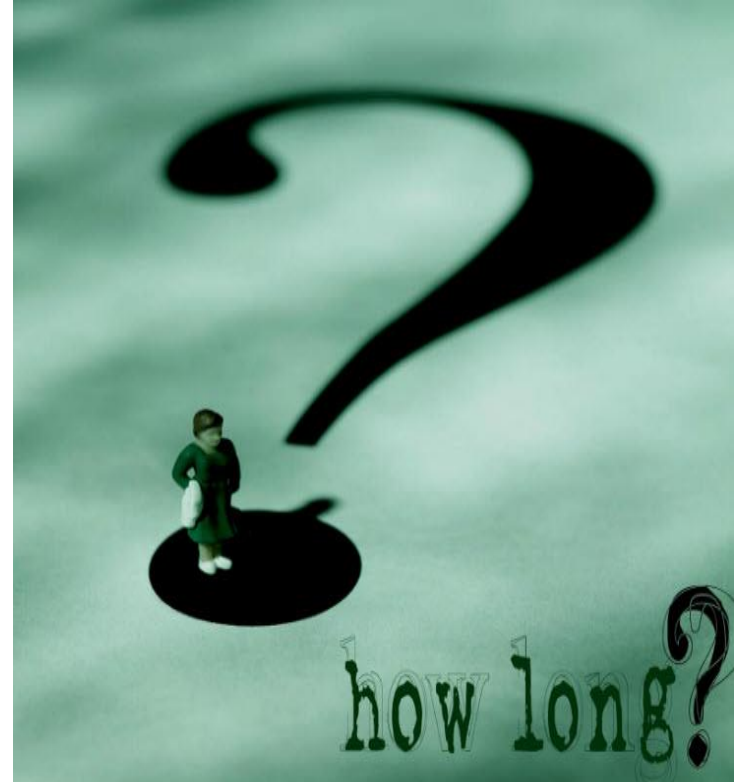
Abstract

When a server's IPv4 path and protocol are working, but the server's IPv6 path and protocol are not working, a dual-stack client application experiences significant connection delay compared to an IPv4-only client. This is undesirable because it causes the dual-stack client to have a worse user experience. This document specifies requirements for algorithms that reduce this user-visible delay and provides an algorithm.



Nicole – I haven't started, where should I start?

- Frontend webservice
- DNS
- Email gateway
- <one size does not fit all>





NIST guidelines for secure IPv6 deployment; RFC4890

Table 3-7. ICMPv6 Recommended Filtering Actions – Must Not Drop & Should Not Drop

Message (Type)	Must Not Drop		Should Not Drop	
	Transit	Local	Transit	Local
Maintenance of Communication:	Allow non-local when associated with allowed connections			
Destination Unreachable (1) – All codes	•	•		
Packet Too Big (2)	•	•		
Time Exceeded (3) – Code 0 only	•	•		
Parameter Problem (4) – Codes 1 and 2 only	•	•		
Connectivity Checking:	Allow/disallow non-local based on topology/information concealment policy			
Echo Request (128)	•	•		
Echo Response (129)				
Neighbor Solicitation (130)				
Neighbor Advertisement (131)				
Inverse Neighbor Discovery Solicitation (141)		•		
Inverse Neighbor Discovery Advertisement (142)		•		
Link-Local Multicast Receiver Notification:	Allow in link-local traffic only			
Listener Query (130)		•		
Listener Report (131)		•		
Listener Done (132)		•		
Listener Report v2 (143)		•		

Learn more!

See BRKSEC-3200 in
On Demand Library

<http://csrc.nist.gov/publications/nistpubs/800-119/sp800-119.pdf>

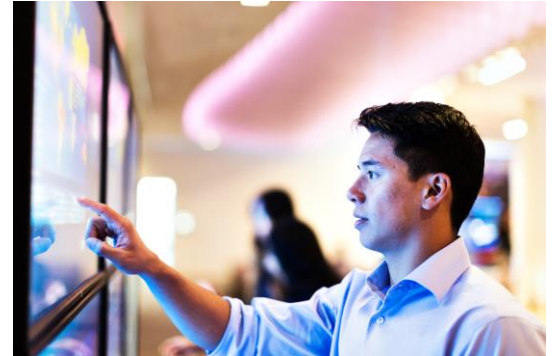
<http://www.ietf.org/rfc/rfc4890.txt>

IPv6 in the Enterprise

- Most companies will go **now** Dual Stack (the time is now!)
- **ICMPv6 is your friend!**
- **Don't** try to force 1:1 feature comparison with the Legacy Protocol
- IPv6 address plan is so much easier than the 1990's.
- Leave the legacy protocol behind – **Let it Go**



CISCO *Live!*



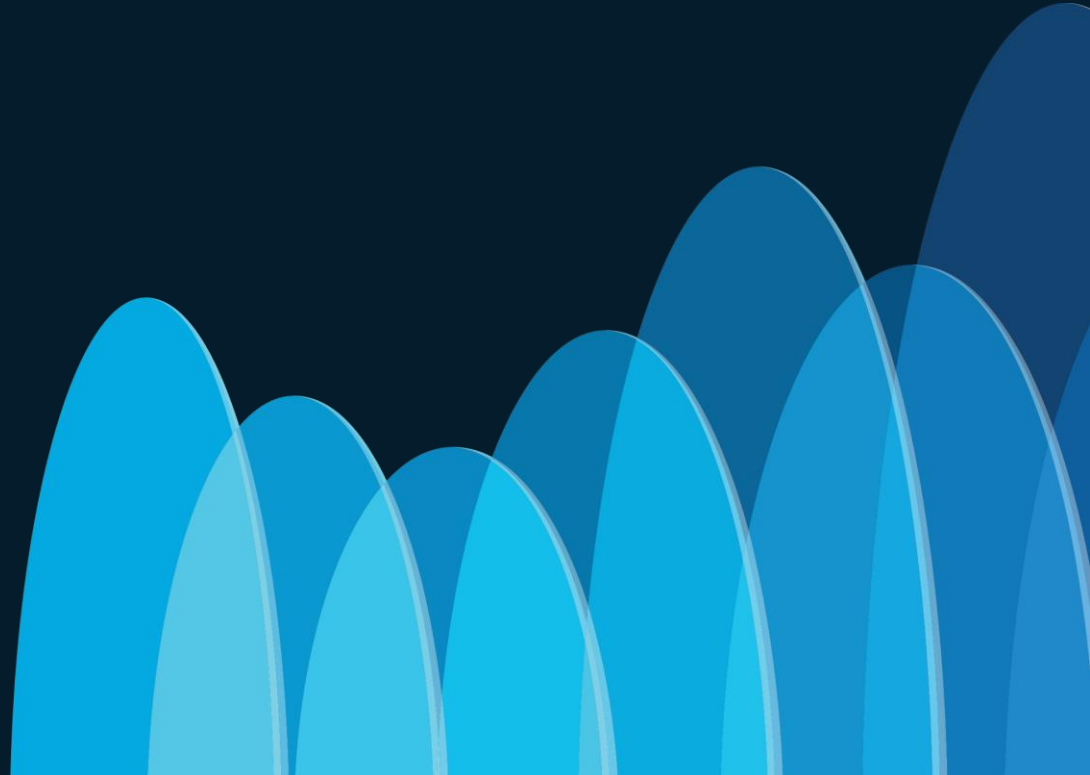
IPv6-only?



Is it possible?

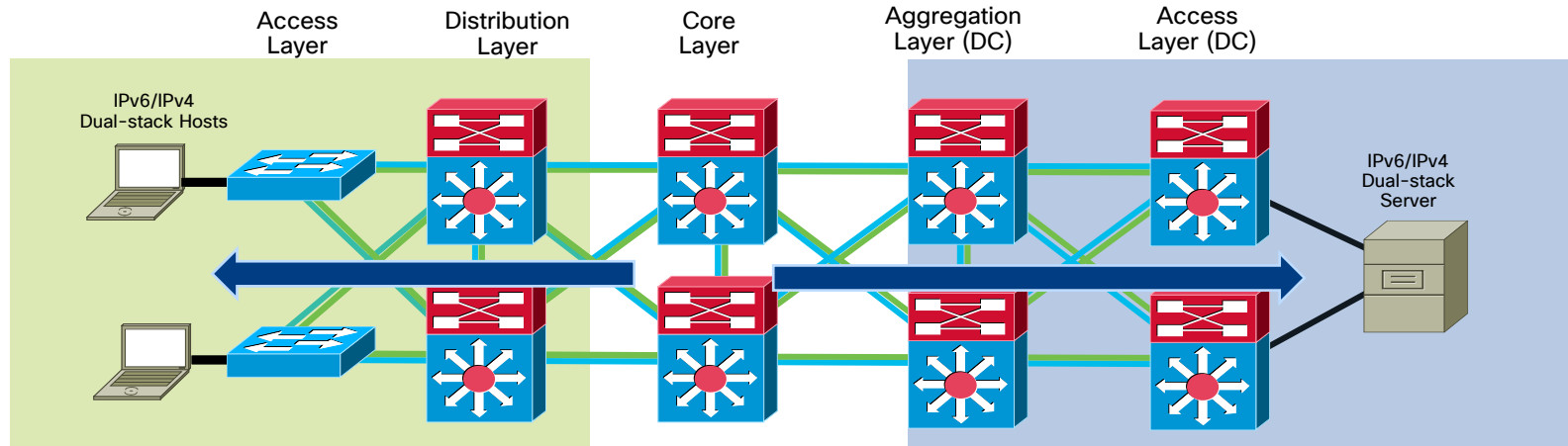


Transition your network



Dual Stack Mode

- Preferred Method, Versatile, Scalable and Highest Performance
- No Dependency on IPv4, runs in parallel on the same HW
- No tunnelling, MTU, NAT or performance degrading technologies
- Does require IPv6 support on all devices



Dual-Stack – Pros



PRO

- Classic standard solution model
- Supports legacy (IPv4) applications
- Widely available
- Once services are on IPv6, IPv4 can simply be discontinued



Dual-Stack – Pros and Cons



PRO

- Classic standard solution model
- Supports legacy (IPv4) applications
- Widely available
- Once services are on IPv6, IPv4 can simply be discontinued



CONS

- Doesn't solve IPv4 exhaustion
- Increased CapEx+OpEx
- Scalability concerns
- Policy synchronization
- Security: larger attack surface
- Hidden brokenness

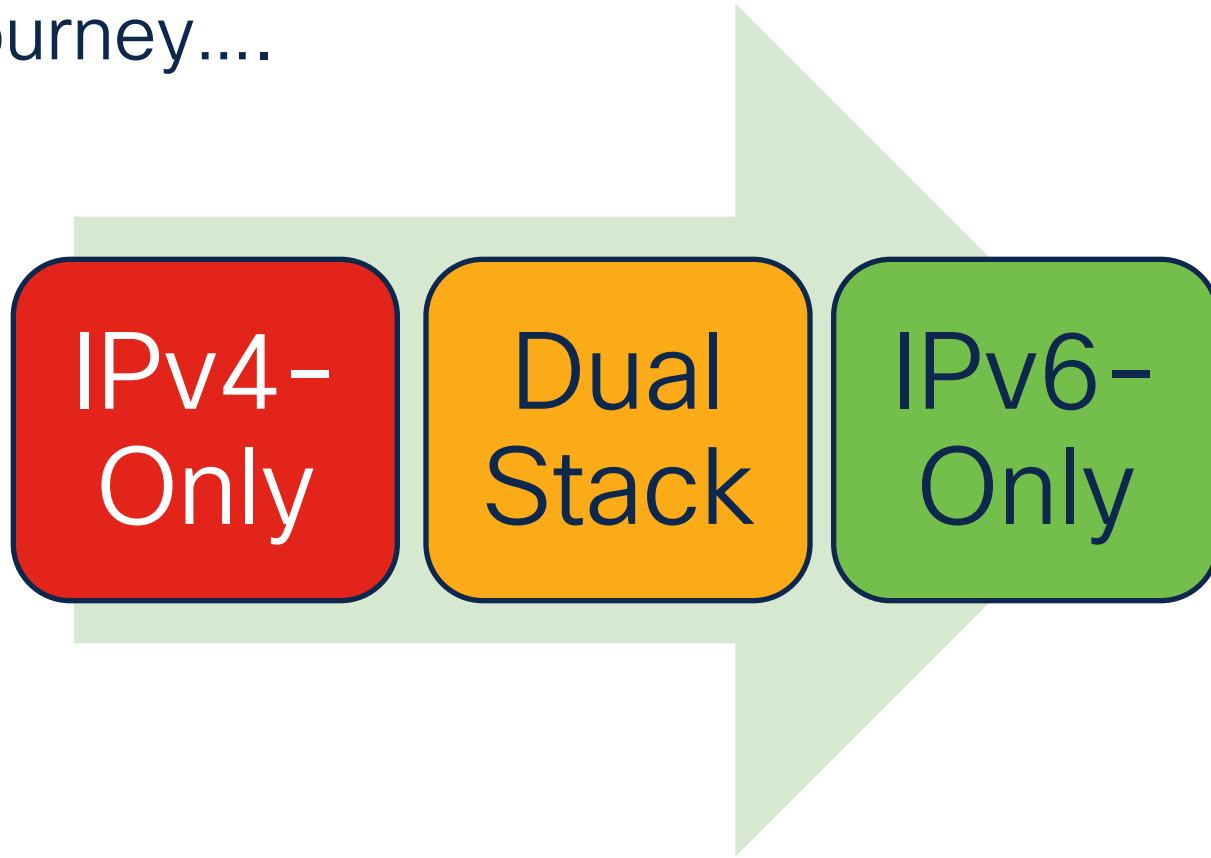


The transition towards IPv6-only



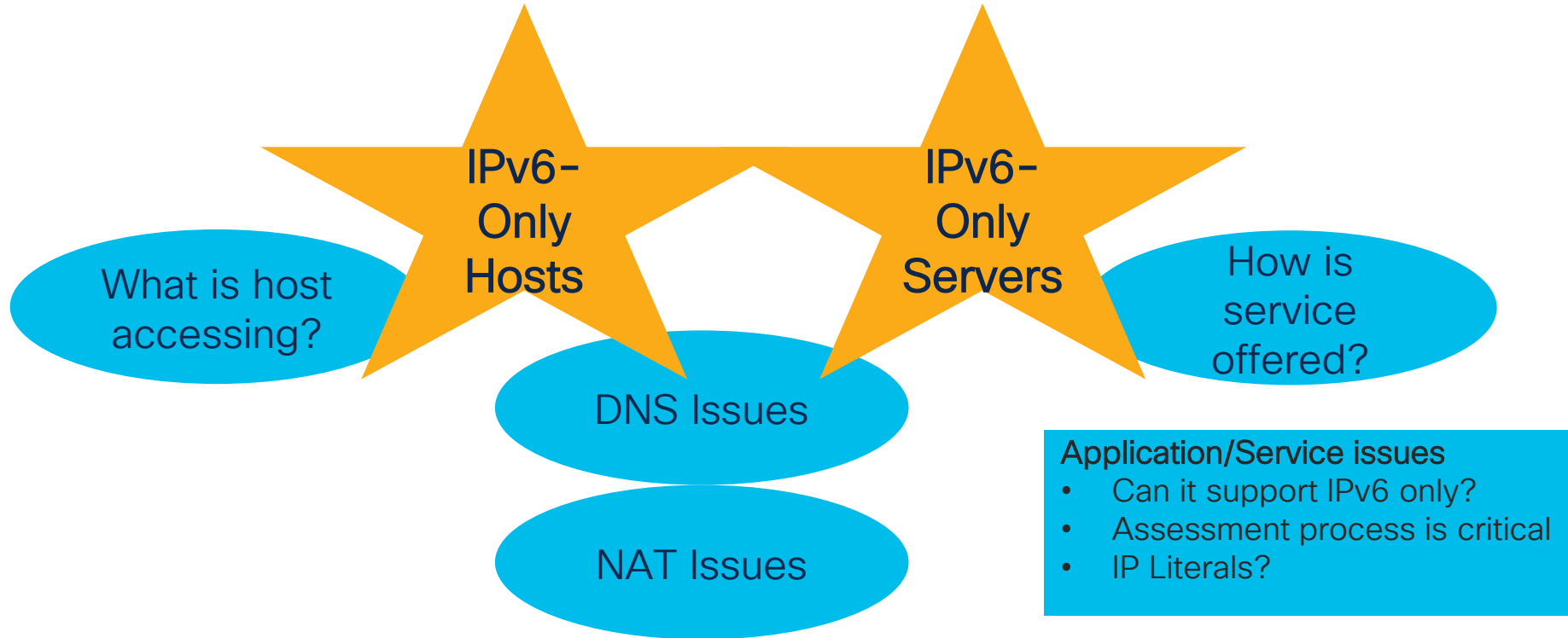
Source: Nicole Wajer

The Journey....



The life on an IPv6-only island/world

What do I need to be concerned about?



Internet Engineering Task Force (IETF)
Request for Comments: [8925](#)
Updates: [2563](#)
Category: Standards Track
Published: October 2020
ISSN: 2070-1721

L. Colitti
Google
J. Linkova
Google
M. Richardson
Sandelman
T. Mrugalski
ISC

IPv6-Only Preferred Option for DHCPv4

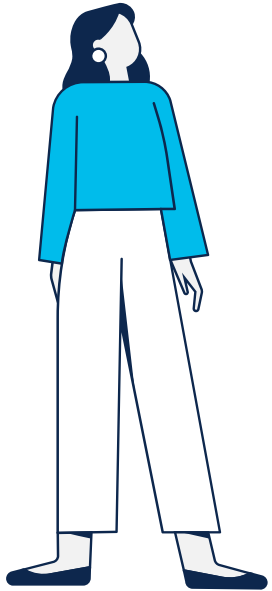
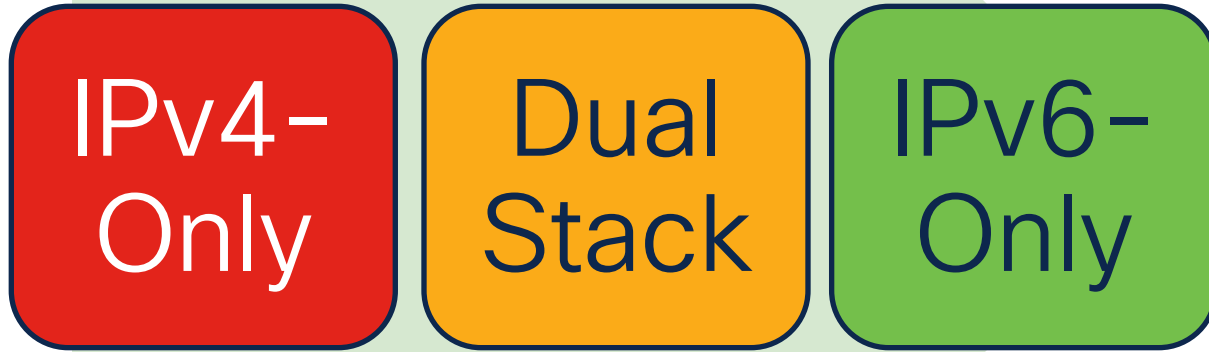


RFC8925

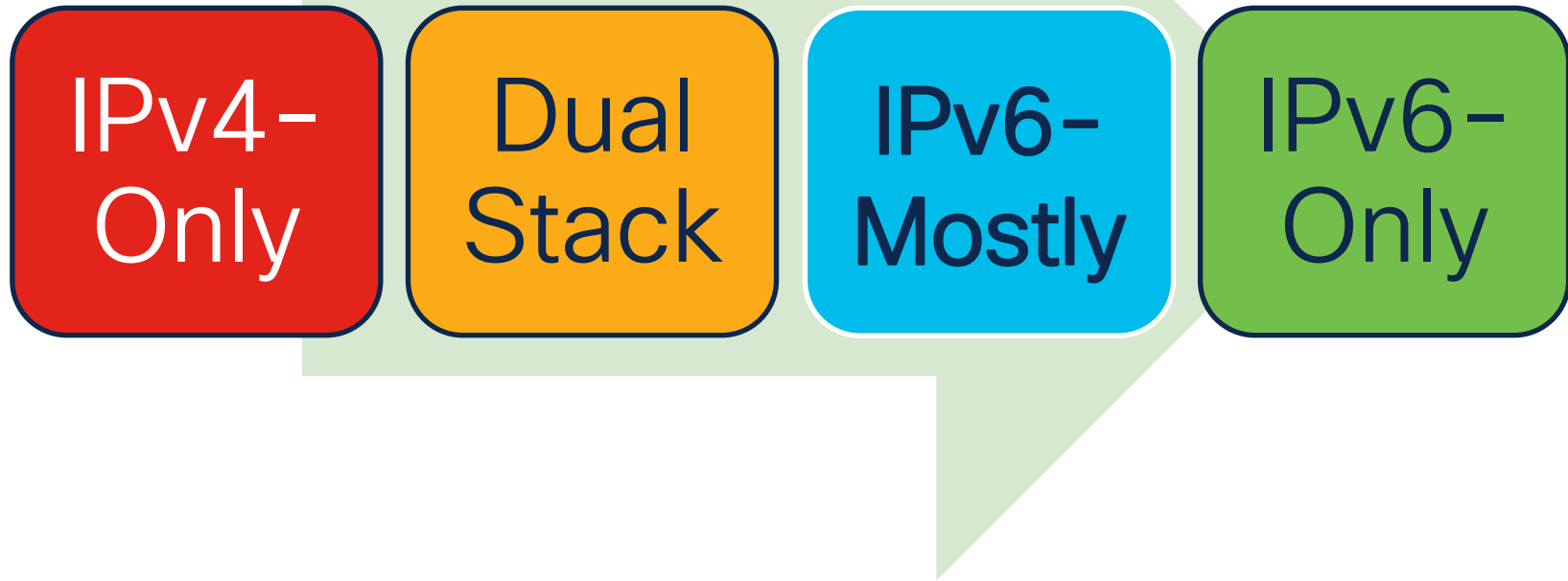
Abstract

This document specifies a DHCPv4 option to indicate that a host supports an IPv6-only mode and is willing to forgo obtaining an IPv4 address if the network provides IPv6 connectivity. It also updates RFC 2563 to specify DHCPv4 server behavior when the server receives a DHCPDISCOVER not containing the Auto-Configure option but containing the new option defined in this document.

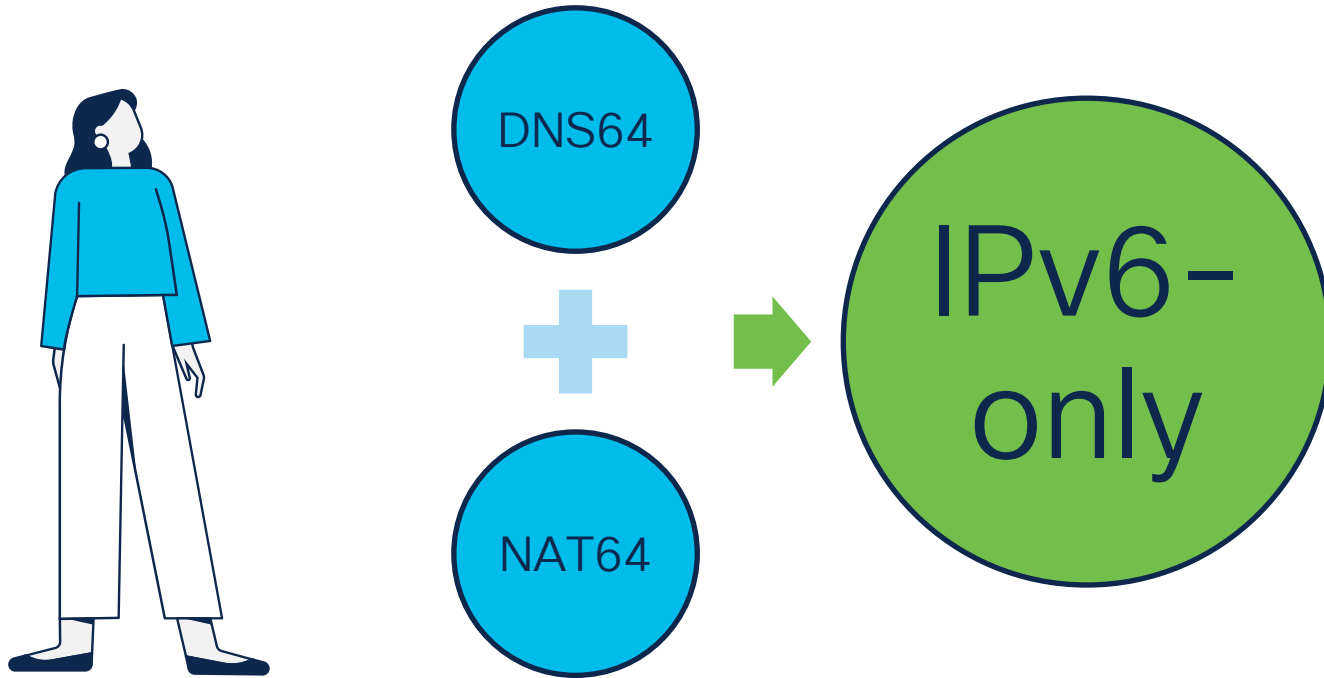
The Journey....



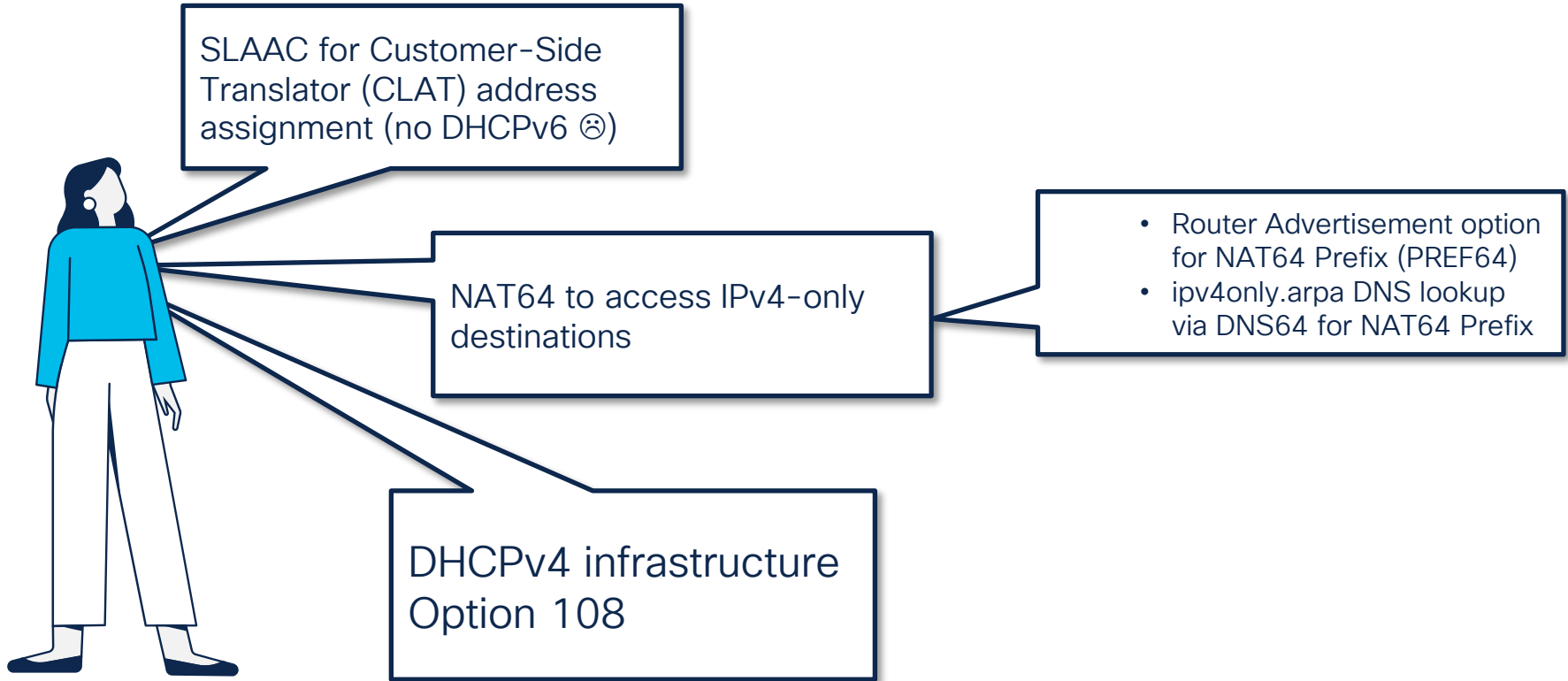
The Journey....



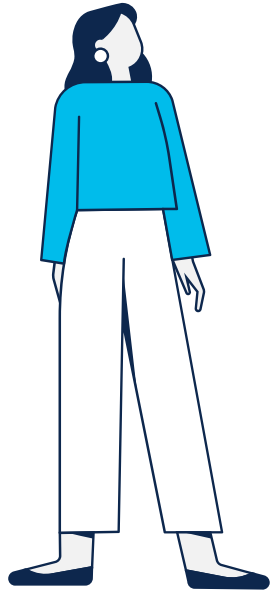
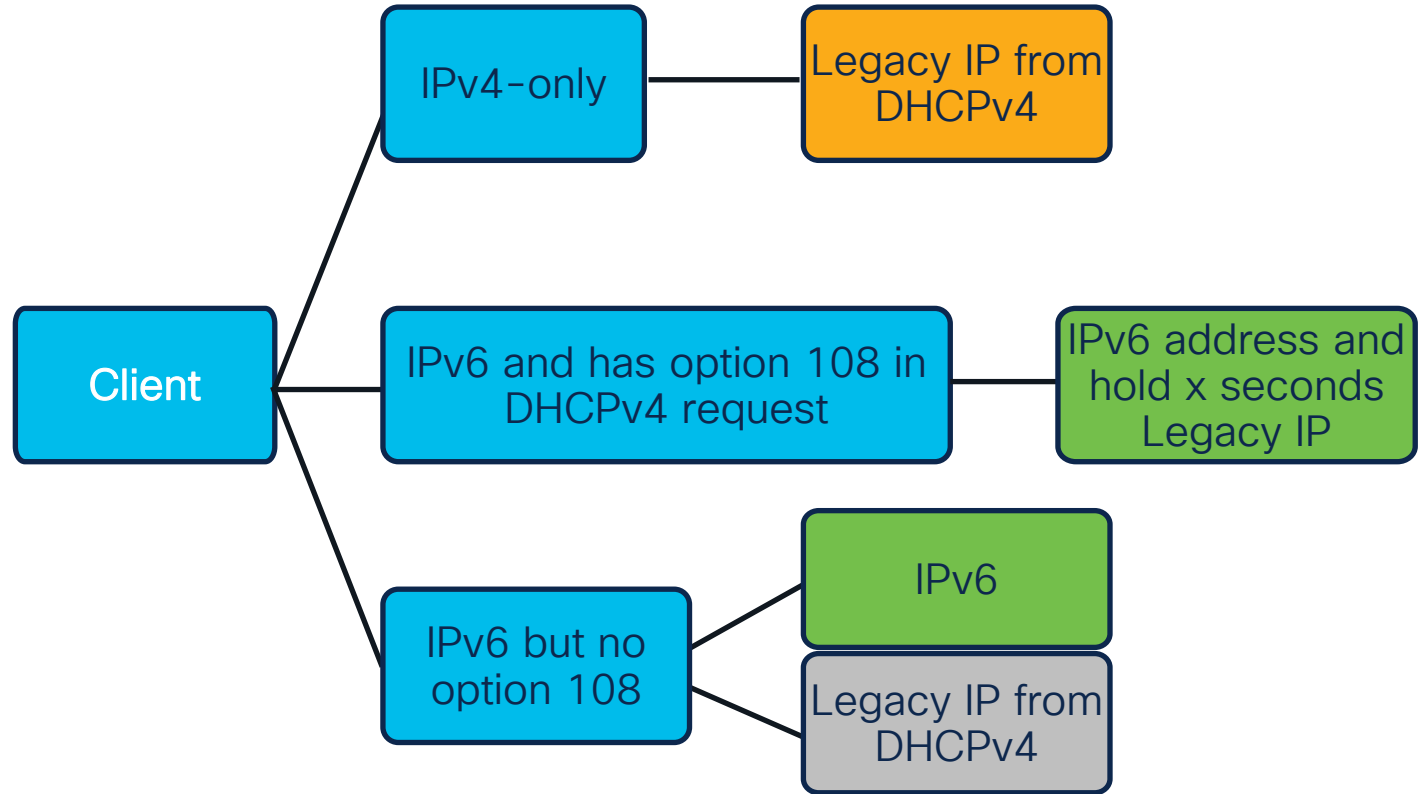
IPv6-only enterprise talking with Legacy World



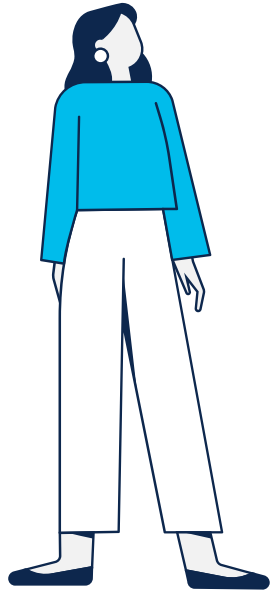
What is required in my network for IPv6-Mostly?



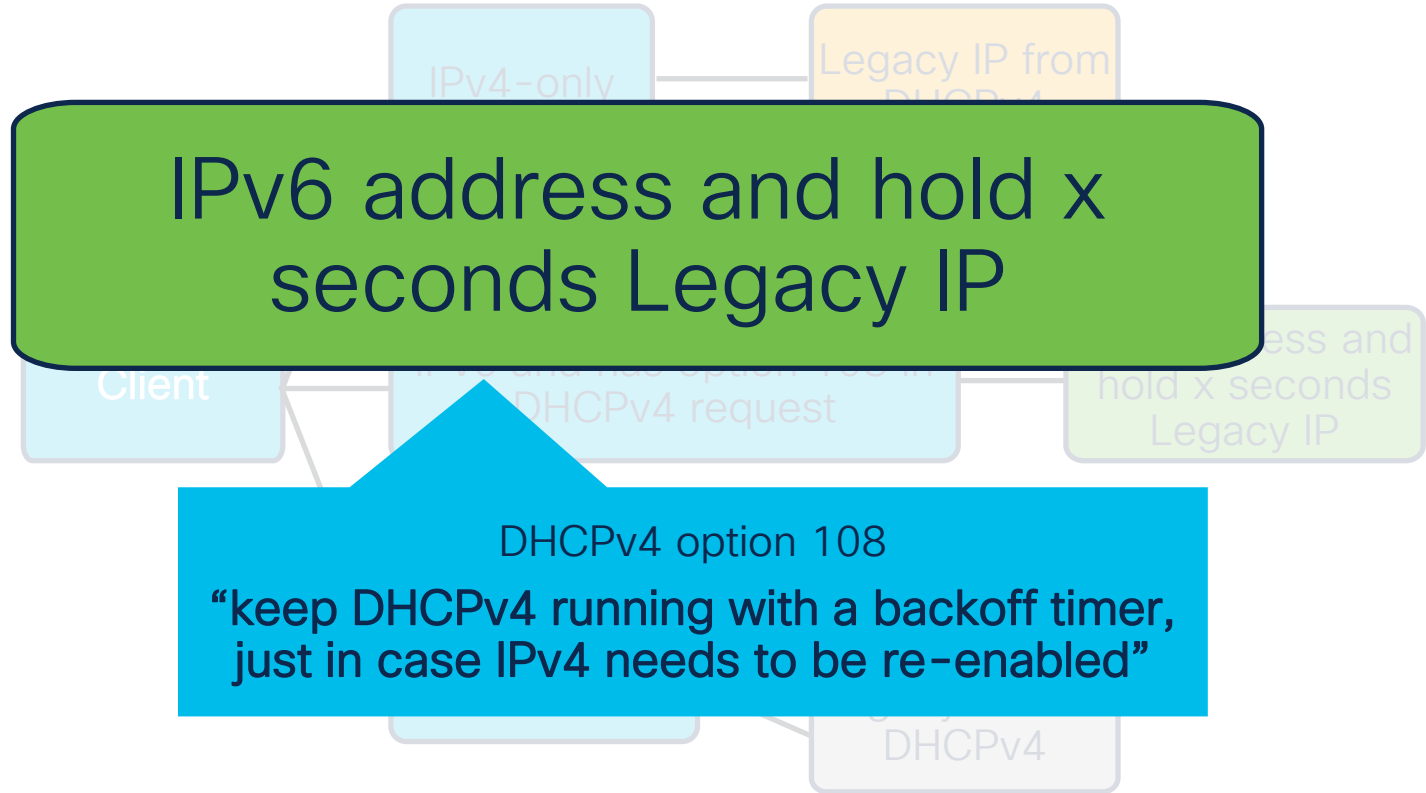
How does IPv6-mostly work?



How does IPv6-mostly work?



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Option 108 supported today in....(OS)

- All Android ✓
- iOS (15+) ✓
- MacOS 13+ ✓
- Windows (In Progress)
 - Windows 11 Plans to Expand CLAT Support
 - <https://techcommunity.microsoft.com/t5/networking-blog/windows-11-plans-to-expand-clat-support/ba-p/4078173>
- Linux (In Progress)

A nice path towards your IPv6-only journey



Source: Nicole Wajer

IPv6-only.....mostly

- It's not so lonely
- IPv4-stacked turned off on OS and nothing else (nat64/dns64) breaks 50%.
- Test your applications there might be hidden legacy protocol code left



“Dual-Stack where
you can Tunnel
where you must”



2012

“IPv6-mostly(Only)
where you can,
Dual-Stack where
you must”



Quiz time!





*"IPv6 is Internet broccoli.
Good for us in the long
run but no immediate
sugar rush from
deploying it now"*

Shameless self promotion of my own Quotes - Nicole Wajer





[EXT] Everything you always wanted to know about IPv6 but were a...

• Cisco's Internet Highway of IPv6

<https://eurl.io/#Pw7m5J7S->



Keynote Deep Dives

Wednesday
10:30am – 11:30am



Experiences Amplified:
How AI Can Fuel Better Employee and Customer Experiences

Level 1
Room 106



Smart, Secure, Seamless:
Transforming Experiences with Next-Generation Networking

Level 2
Room 204



Harness a Bold New Era:
Transform Data Centre and Service Provider Connectivity

Level 2
Room 203



Securing User to Application and Everything in Between

Level 2
Melbourne Room 2



Unlocking Digital Resilience through Unified Observability

The HUB
Centre Stage

Continue your education

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CISCO *Live!*

Capture the Flag

Gamified Hands-On Labs and Activities

Play CTF at Cisco Live and earn continuing education credits. Redeem them to renew your Cisco Certifications

NEW!

Check out the Design Clinic and test your network and security design skills



Top CTF players will be awarded at the CTF Award Ceremony on Wednesday at 4pm

Grab your spot and start playing!



#CiscoLiveAPJC

CTF booth at The World of Solutions

Learn/Test your skills and even earn Cisco CE Credits*

Complete Your Session Evaluations



Complete a minimum of 4 session surveys and the Overall Event Survey to claim a **Cisco Live T-Shirt**.



Complete your surveys in the **Cisco Live** mobile app.





Thank you

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#CiscoLiveAPJC

Resources

Training Options

- HexaBuild
 - <https://hexabuild.arlo.co/w/>
- Pluralsight
 - <https://www.pluralsight.com/courses/ipv6-introduction-to-protocol>
 - <https://www.pluralsight.com/courses/ipv6-microsoft-windows>
- NterOne
 - <https://www.nerone.com/training/cisco/courses/ip6fd>
- O'Reilly LiveLessons
 - <https://www.oreilly.com/videos/ipv6-design-and/9780134655529>
- Rick Graziani – YouTube Playlist
 - <https://www.youtube.com/playlist?list=PLMLm7-g0V0kfGg8g8KutNFK7rS3laA9QQ>

Cisco Live! (On-Demand)

IPv6:: It's Happening! – BRKIPV-2191 – Nathan Sherrard

<https://www.ciscolive.com/c/dam/r/ciscolive/global-event/docs/2023/pdf/BRKIPV-2191.pdf>

What Do you Mean there isn't a Broadcast? – BRKIPV-1616 – Fish Fishburne

<https://www.ciscolive.com/c/dam/r/ciscolive/global-event/docs/2023/pdf/BRKIPV-1616.pdf>

Deploying IPv6 in the Cloud – BRKIPV-3927 – Shannon McFarland

<https://www.ciscolive.com/c/dam/r/ciscolive/global-event/docs/2023/pdf/BRKIPV-3927.pdf>

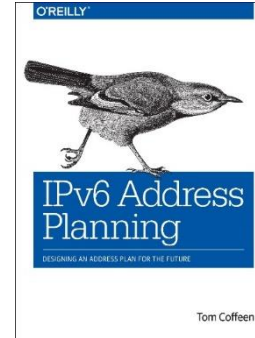
Resources – Books



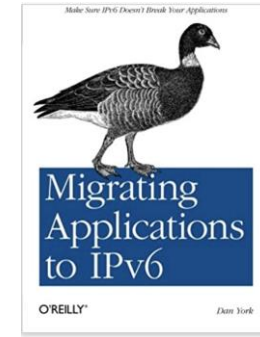
<https://www.amazon.com/IPv6-Fundamentals-Straightforward-Approach-Understanding/dp/1587144778>



<https://www.oreilly.com/library/view/dns-and-bind/9781449308025/>



<https://www.amazon.com/IPv6-Address-Planning-Designing-Future/dp/1491902760>



<https://www.oreilly.com/library/view/migrating-applications-to/9781449309688/>

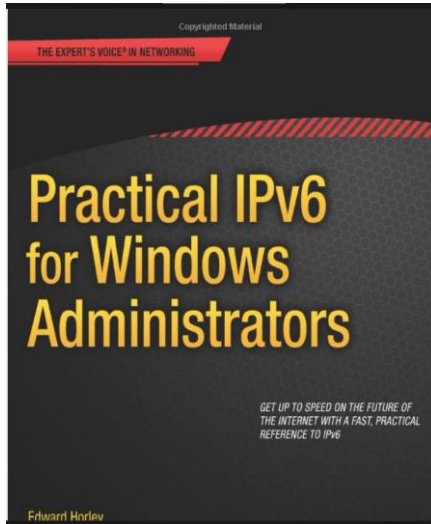
Additional Books:

Cisco Press – <https://www.ciscopress.com/store/ipv6-design-and-deployment-livelessons-9780134655512>

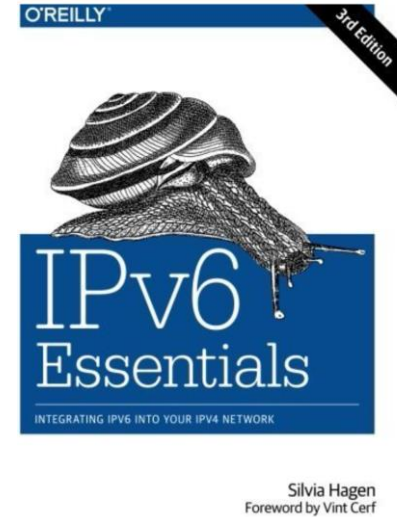
Cisco Press – <https://www.ciscopress.com/store/ipv6-fundamentals-livelessons-a-straightforward-approach-9781587204579>

O'Reilly Media – <https://www.oreilly.com/library/view/introduction-to-ipv6/9781771375269/>

More Books



<https://amzn.eu/d/1GhV2Gn>



<https://amzn.eu/d/i5PVjAs>

Online References



IPv6 Buzz Podcast - <https://packetpushers.net/series/ipv6-buzz/>

Infoblox IPv6 Center of Excellence - <https://blogs.infoblox.com/category/ipv6-coe/>

ARIN IPv6 Information - <https://www.arin.net/resources/guide/ipv6/>

APNIC IPv6 Information - <https://www.apnic.net/community/ipv6/>

RIPE IPv6 Info Centre - <https://www.ripe.net/publications/ipv6-info-centre>

Akamai IPv6 Adoption Visualization - <https://www.akamai.com/internet-station/cyber-attacks/state-of-the-internet-report/ipv6-adoption-visualization>

Cisco 6lab - <https://6lab.cisco.com/>

Google IPv6 Statistics - <https://www.google.com/intl/en/ipv6/statistics.html>

Tunnelbroker Hurricane Electric - <https://tunnelbroker.net/>

World IPv6 Launch - <https://www.worldipv6launch.org/>

IPv6 troubleshooting for Helpdesks

- <http://isp.testipv6.com> →

Test IPv6

FAQ

Mirrors

Test your IPv6 connectivity.

For the Help Desk

Summary

Tests Run

Share Results / Contact

Other IPv6 Sites

Your Internet help desk may ask you for the information below.

Help desk code: 46

Dual Stack

IPv4: Good, AS109 - CISCOSYSTEMS - Cisco Systems, Inc.,US

IPv6: Good, AS109 - CISCOSYSTEMS - Cisco Systems, Inc.,US

OtherSites: 52/52 good

IPv4 address: 173.38.209.8

IPv6 address: 2001:420:c0c1:17:f121:40c4:c046:ce86

More information about this page, including how to bookmark it: [faq_helpdesk.html](http://isp.testipv6.com/faq_helpdesk.html).

If your Internet help desk asks you to mail the 'results url', copy and paste the following UI current numeric Internet Protocol address(es). We do not recommend posting this link on

<http://isp.testipv6.com/?ip4=173.38.209.8&ip6=2001:420:c0c1:17:f121:40c4:c046:ce86&a=ok>



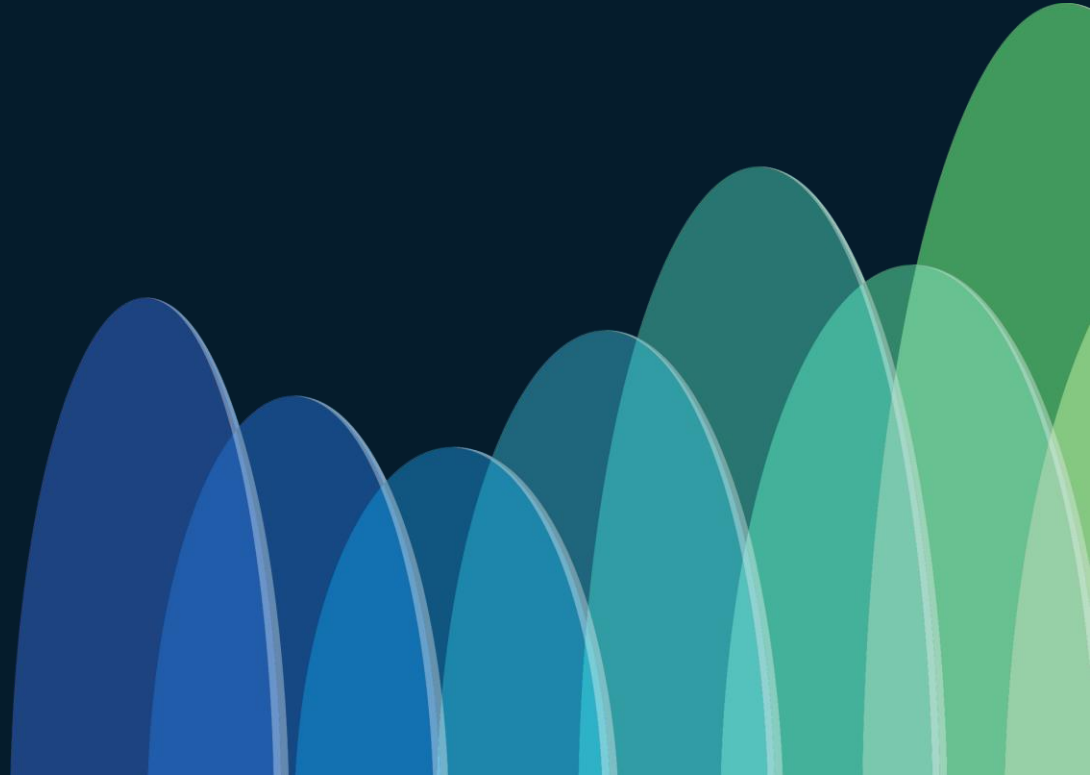
<https://www.ripe.net/ripe/groups/tf/bcop/ipv6-troubleshooting-for-residential-isp-helpdesks>

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GO BEYOND

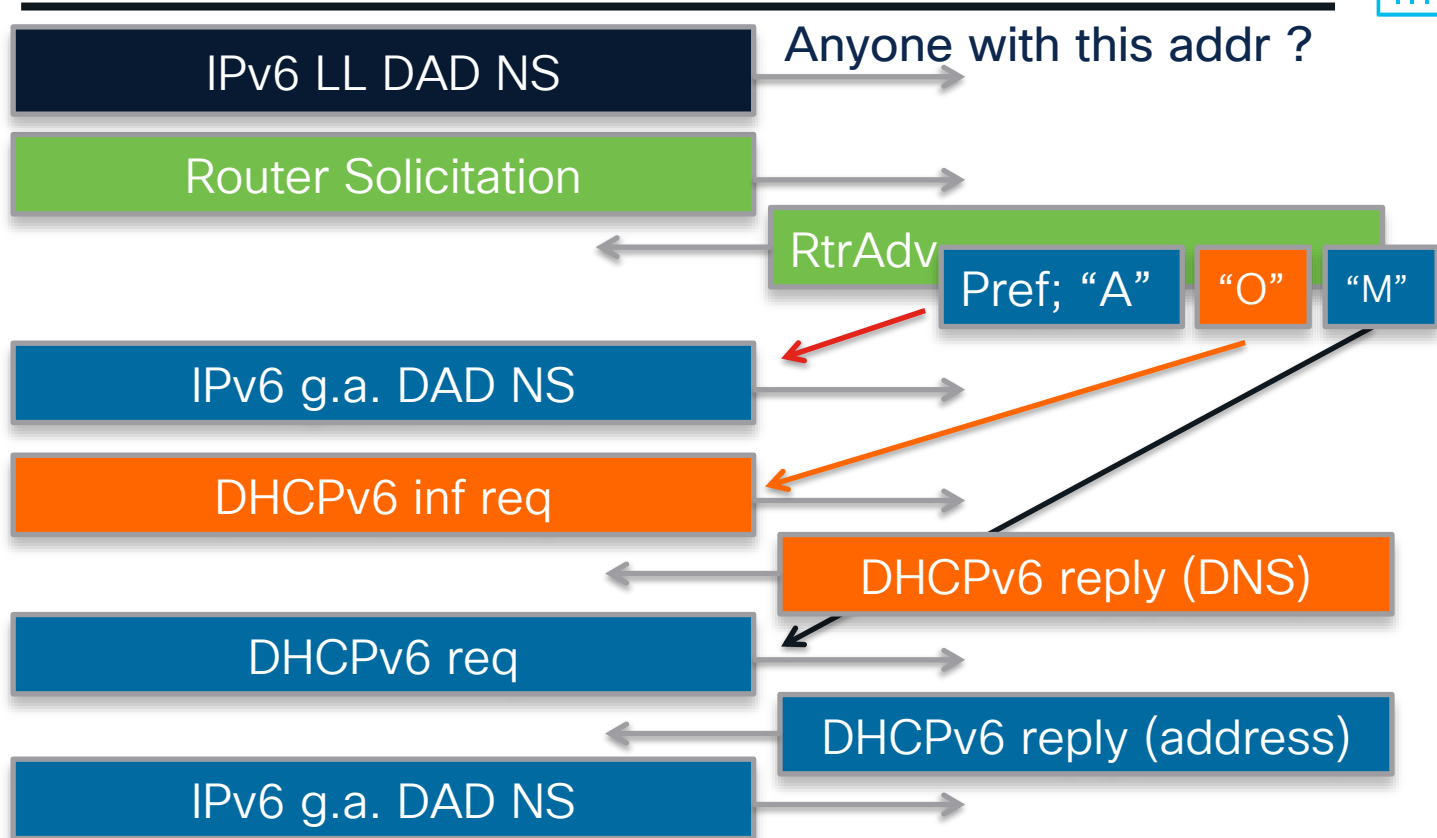
#CiscoLiveAPJC

Extra IPv6 Fun



Host Attachment

IPv6 Host Attachment Procedure





Host Attachment In The Wild Wireshark “Sniffer” Time!

Wi-Fi: en0

ip6

No.	Time	Source	Destination	Protocol	Length	Info
7	0.007437	fe80::f65c:89ff:feb4:8c3	ff02::2	ICMPv6	62	Router Solicitation
12	0.016085	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	ICMPv6	230	Router Advertisement from a0:f3:c1:ff:49:92
39	0.191713	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	142	Confirm XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3...
40	0.193907	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	163	Reply XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3
60	0.526502	::	ff02::1:fffb4:8c3	ICMPv6	78	Neighbor Solicitation for fd33:af04:eb8d:0:f65c:89ff:fe...
105	0.568780	2001:470:1f15:289:9500:7c17:9c09:ce79	2a00:1450:4013:c00::6c	TCP	98	63086 → 993 [SYN] Seq=0 Win=65535 Len=0 MSS=1220 WS=32 ...
109	0.571217	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	114	Solicit XID: 0x936496 CID: 000100011e9645d9f45c89b408c3

▶ Frame 7: 62 bytes on wire (496 bits), 62 bytes captured (496 bits) on interface 0
 ▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_02 (33:33:00:00:00:02)
 ▶ Internet Protocol Version 6, Src: fe80::f65c:89ff:feb4:8c3, Dst: ff02::2
 ▼ Internet Control Message Protocol v6
 Type: Router Solicitation (133)
 Code: 0
 Checksum: 0xf562 [correct]
 Reserved: 00000000

Internet Protocol Version 6: Protocol

Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%) Profile: Default

Wi-Fi: en0

ipv6

No.	Time	Source	Destination	Protocol	Length	Info
7	0.007437	fe80::f65c:89ff:feb4:8c3	ff02::2	ICMPv6	62	Router Solicitation
12	0.016085	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	ICMPv6	230	Router Advertisement from a0:f3:c1:ff:49:92
39	0.191713	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	142	Confirm XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3...
40	0.193907	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	163	Reply XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3
60	0.526502	::	ff02::1:ff4:8c3	ICMPv6	78	Neighbor Solicitation for fd33:af04:eb8d:0:f65c:89ff:fe...
105	0.568780	2001:470:1f15:289:9500:7c17:9c09:ce79	2a00:1450:4013:c00::6c	TCP	98	63086 → 993 [SYN] Seq=0 Win=65535 Len=0 MSS=1220 WS=32 ...
109	0.571217	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	114	Solicit XID: 0x936496 CID: 000100011e9645d9f45c89b408c3

▶ Frame 7: 62 bytes on wire (496 bits), 62 bytes captured (496 bits) on interface 0

▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_02 (33:33:00:00:00:02)

▶ Internet Protocol Version 6, Src: fe80::f65c:89ff:feb4:8c3, Dst: ff02::2

▼ Internet Control Message Protocol v6

Type: Router Solicitation (133)

Code: 0

Checksum: 0xf562 [correct]

Internet Protocol Version 6: Protocol

Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%) Profile: Default



Wi-Fi: en0

No.	Time	Details
12	0.39	<p>Frame 12: 230 bytes on wire (1840 bits), 230 bytes captured (1840 bits) on interface 0</p> <p>Ethernet II, Src: Tp-LinkT_ff:49:92 (a0:f3:c1:ff:49:92), Dst: Apple_b4:08:c3 (f4:5c:89:b4:08:c3)</p> <p>Internet Protocol Version 6, Src: fe80::a2f3:c1ff:feff:4992, Dst: fe80::f65c:89ff:feb4:8c3</p> <p>Internet Control Message Protocol v6</p> <p style="margin-left: 20px;">Type: Router Advertisement (134)</p> <p style="margin-left: 20px;">Code: 0</p> <p style="margin-left: 20px;">Checksum: 0x825d [correct]</p> <p style="margin-left: 20px;">Cur hop limit: 64</p> <p style="margin-left: 20px;">Flags: 0xc0</p> <p style="margin-left: 40px;">1... .. = Managed address configuration: Set</p> <p style="margin-left: 40px;">.1.. = Other configuration: Set</p> <p style="margin-left: 40px;">..0. = Home Agent: Not set</p> <p style="margin-left: 40px;">...0 0... = Prf (Default Router Preference): Medium (0)</p> <p style="margin-left: 40px;">.... .0.. = Proxy: Not set</p> <p style="margin-left: 40px;">.... ..0. = Reserved: 0</p> <p style="margin-left: 20px;">Router lifetime (s): 1800</p> <p style="margin-left: 20px;">Reachable time (ms): 0</p> <p style="margin-left: 20px;">Retrans timer (ms): 0</p> <p style="margin-left: 20px;">ICMPv6 Option (Source link-layer address : a0:f3:c1:ff:49:92)</p> <p style="margin-left: 20px;">ICMPv6 Option (MTU : 1280)</p> <p style="margin-left: 20px;">ICMPv6 Option (Prefix information : 2001:470:1f15:289::/64)</p> <p style="margin-left: 20px;">ICMPv6 Option (Prefix information : fd33:af04:eb8d::/64)</p> <p style="margin-left: 20px;">ICMPv6 Option (Route Information : Medium fd33:af04:eb8d::/48)</p> <p style="margin-left: 20px;">ICMPv6 Option (Recursive DNS Server 2001:470:1f15:289::1)</p> <p style="margin-left: 20px;">ICMPv6 Option (DNS Search List Option lan)</p> <p style="margin-left: 20px;">ICMPv6 Option (Advertisement Interval : 600000)</p>

Expression... +

f45c89b408c3...

5c89b408c3

f65c:89ff:fe...

=1220 WS=32 ...

f45c89b408c3

Profile: Default

Wi-Fi: en0

ipv6

No.	Time	Source	Destination	Protocol	Length	Info
7	0.007437	fe80::f65c:89ff:feb4:8c3	ff02::2	ICMPv6	62	Router Solicitation
12	0.016085	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	ICMPv6	230	Router Advertisement from a0:f3:c1:ff:49:92
39	0.191713	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	142	Confirm XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3...
40	0.193907	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	163	Reply XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3
60	0.526502	::	ff02::1:1:ffb4:8c3	ICMPv6	78	Neighbor Solicitation for fd33:af04:eb8d:0:f65c:89ff:fe...
105	0.568780	2001:470:1f15:289:9500:7c17:9c09:ce79	2a00:1450:4013:c00::6c	TCP	98	63086 → 993 [SYN] Seq=0 Win=65535 Len=0 MSS=1220 WS=32 ...
109	0.571217	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	114	Solicit XID: 0x936496 CID: 000100011e9645d9f45c89b408c3

▶ Frame 39: 142 bytes on wire (1136 bits), 142 bytes captured (1136 bits) on interface 0
 ▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_01:00:02 (33:33:00:01:00:02)
 ▶ Internet Protocol Version 6, Src: fe80::f65c:89ff:feb4:8c3, Dst: ff02::1:2
 ▶ User Datagram Protocol, Src Port: 546 (546), Dst Port: 546 (546)

▼ DHCPv6

- Message type: Confirm (4)
- Transaction ID: 0x8bbf90
- ▶ Client Identifier
- ▶ Option Request
- ▶ Elapsed time
- ▼ Identity Association for Non-temporary Address
 - Option: Identity Association for Non-temporary Address
 - Length: 40
 - Value: 0000000000000000000000000000000050018fd33af04eb8d0000...
 - IAID: 00000000
 - T1: 0
 - T2: 0
- ▼ IA Address
 - Option: IA Address (5)
 - Length: 24
 - Value: fd33af04eb8d0000000000000000000007cd00000000000000000
 - IPv6 address: fd33:af04:eb8d::7cd
 - Preferred lifetime: 0
 - Valid lifetime: 0

Internet Protocol Version 6: Protocol

Wi-Fi: en0

ip6

No.	Time	Source	Destination	Protocol	Length	Info
7	0.007437	fe80::f65c:89ff:feb4:8c3	ff02::2	ICMPv6	62	Router Solicitation
12	0.016085	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	ICMPv6	230	Router Advertisement from a0:f3:c1:ff:49:92
39	0.191713	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	142	Confirm XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3...
40	0.193907	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	163	Reply XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3
60	0.526502	::	ff02::1:fffb4:8c3	ICMPv6	78	Neighbor Solicitation for fd33:af04:eb8d:0:f65c:89ff:fe...
105	0.568780	2001:470:1f15:289:9500:7c17:9c09:ce79	2a00:1450:4013:c00::6c	TCP	98	63086 → 993 [SYN] Seq=0 Win=65535 Len=0 MSS=1220 WS=32 ...
109	0.571217	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	114	Solicit XID: 0x936496 CID: 000100011e9645d9f45c89b408c3

▶ Frame 40: 163 bytes on wire (1304 bits), 163 bytes captured (1304 bits) on interface 0

▶ Ethernet II, Src: Tp-LinkT_ff:49:92 (a0:f3:c1:ff:49:92), Dst: Apple_b4:08:c3 (f4:5c:89:b4:08:c3)

▼ Internet Protocol Version 6, Src: fe80::a2f3:c1ff:feff:4992, Dst: fe80::f65c:89ff:feb4:8c3

0110 = Version: 6

▶ 0000 0000 = Traffic class: 0x00 (DSCP: CS0, ECN: Not-ECT)

..... 0000 0000 0000 0000 = Flowlabel: 0x00000000

Payload length: 109

Next header: UDP (17)

Hop limit: 64

Source: fe80::a2f3:c1ff:feff:4992

[Source SA MAC: Tp-LinkT_ff:49:92 (a0:f3:c1:ff:49:92)]

Destination: fe80::f65c:89ff:feb4:8c3

[Destination SA MAC: Apple_b4:08:c3 (f4:5c:89:b4:08:c3)]

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

▶ User Datagram Protocol, Src Port: 547 (547), Dst Port: 546 (546)

▼ DHCPv6

Message type: Reply (7)

Transaction ID: 0x8bbf90

▼ Server Identifier

Option: Server Identifier (2)

Length: 10

Value: 00030001a0f3c1ff4992

DUID: 00030001a0f3c1ff4992

DUID Type: link-layer address (3)

Hardware type: Ethernet (1)

Link-layer address: a0:f3:c1:ff:49:92

wireshark_pcapng_en0_20160519182107_NGSxSR

Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%) Profile: Default

Wi-Fi: en0

ip6

No.	Time	Source	Destination	Protocol	Length	Info
7	0.007437	fe80::f65c:89ff:feb4:8c3	ff02::2	ICMPv6	62	Router Solicitation
12	0.016085	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	ICMPv6	230	Router Advertisement from a0:f3:c1:ff:49:92
39	0.191713	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	142	Confirm XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3...
40	0.193907	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	163	Reply XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3
60	0.526502	::	ff02::1:ff4:8c3	ICMPv6	78	Neighbor Solicitation for fd33:af04:eb8d:0:f65c:89ff:fe...
105	0.568780	2001:470:1f15:289:9500:7c17:9c09:ce79	2a00:1450:4013:c00::6c	TCP	98	63086 → 993 [SYN] Seq=0 Win=65535 Len=0 MSS=1220 WS=32 ...
109	0.571217	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	114	Solicit XID: 0x936496 CID: 000100011e9645d9f45c89b408c3

▶ Frame 60: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0

▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_ff:b4:08:c3 (33:33:ff:b4:08:c3)

▼ Internet Protocol Version 6, Src: ::, Dst: ff02::1:ff4:8c3

0110 = Version: 6

▶ 0000 0000 = Traffic class: 0x00 (DSCP: CS0, ECN: Not-ECT)

..... 0000 0000 0000 0000 = Flowlabel: 0x00000000

Payload length: 24

Next header: ICMPv6 (58)

Hop limit: 255

Source: ::

Destination: ff02::1:ff4:8c3

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

▼ Internet Control Message Protocol v6

Type: Neighbor Solicitation (135)

Code: 0

Checksum: 0x5196 [correct]

Reserved: 00000000

Target Address: fd33:af04:eb8d:0:f65c:89ff:feb4:8c3

Internet Protocol Version 6: Protocol

Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%)

Profile: Default

Wi-Fi: en0

ipv6

No.	Time	Source	Destination	Protocol	Length	Info
7	0.007437	fe80::f65c:89ff:feb4:8c3	ff02::2	ICMPv6	62	Router Solicitation
12	0.016085	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	ICMPv6	230	Router Advertisement from a0:f3:c1:ff:49:92
39	0.191713	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	142	Confirm XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3...
40	0.193907	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	163	Reply XID: 0x8bbf90 CID: 000100011e9645d9f45c89b408c3
60	0.526502	::	ff02::1:fffb4:8c3	ICMPv6	78	Neighbor Solicitation for fd33:af04:eb8d:0:f65c:89ff:fe...
105	0.568780	2001:470:1f15:289:9500:7c17:9c09:ce79	2a00:1450:4013:c00::6c	TCP	98	63086 → 993 [SYN] Seq=0 Win=65535 Len=0 MSS=1220 WS=32 ...
109	0.571217	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	114	Solicit XID: 0x936496 CID: 000100011e9645d9f45c89b408c3

▶ Frame 60: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0

▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_ff:b4:08:c3 (33:33:ff:b4:08:c3)

▼ Internet Protocol Version 6, Src: ::, Dst: ff02::1:fffb4:8c3

0110 = Version: 6

▶ 0000 0000 = Traffic class: 0x00 (DSCP: CS0, ECN: Not-ECT)

.... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000

Payload length: 24

Next header: ICMPv6 (58)

Hop limit: 255

Source: ::

Destination: ff02::1:fffb4:8c3

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

▼ Internet Control Message Protocol v6

Type: Neighbor Solicitation (135)

Code: 0

Checksum: 0x5196 [correct]

Reserved: 00000000

Target Address: fd33:af04:eb8d:0:f65c:89ff:feb4:8c3

▶ Frame 60: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0

▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_ff:b4:08:c3 (33:33:ff:b4:08:c3)

▼ Internet Protocol Version 6, Src: ::, Dst: ff02::1:fffb4:8c3

0110 = Version: 6

▶ 0000 0000 = Traffic class: 0x00 (DSCP: CS0, ECN: Not-ECT)

.... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000

Payload length: 24

Next header: ICMPv6 (58)

Hop limit: 255

Source: ::

Destination: ff02::1:fffb4:8c3

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

▼ Internet Control Message Protocol v6

Type: Neighbor Solicitation (135)

Code: 0

Checksum: 0x5196 [correct]

Reserved: 00000000

Target Address: fd33:af04:eb8d:0:f65c:89ff:feb4:8c3

Internet Protocol Version 6: Protocol

No.	Time	Source
105	0.568780	2001:47f
109	0.571217	fe80::f
113	0.574190	fe80::a
116	0.591664	2001:47f
129	0.654411	fe80::f
130	0.687292	::
139	0.716622	::

▶ Frame 109: 114 bytes on wire
 ▶ Ethernet II, Src: Apple_b4:0
 ▶ Internet Protocol Version 6,
 ▶ User Datagram Protocol, Src
 ▼ DHCPv6

Message type: Solicit (1)
 Transaction ID: 0x936496
 ▶ Client Identifier
 ▶ Option Request
 ▼ 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: 00000000000000000000000000000000
 IAID: 00000000
 T1: 0
 T2: 0

▼ DHCPv6

Message type: Solicit (1)

Transaction ID: 0x936496

▶ Client Identifier

▶ Option Request

▼ 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: 00000000000000000000000000000000

IAID: 00000000

T1: 0

T2: 0

Wireshark packet capture analysis showing IPv6 traffic. The interface is set to 'ipv6'.

No.	Time	Source	Destination	Protocol	Length	Info
129	0.654411	fe80::f65c:89ff:feb4:8c3	ff02::fb	MDNS	287	Standard query 0x0000 PTR _airport._tcp.local, "QU" que...
130	0.687292	::	ff02::1:ffb4:8c3	ICMPv6	78	Neighbor Solicitation for fe80::f65c:89ff:feb4:8c3
139	0.716622	::	ff02::1:ffb4:8c3	ICMPv6	78	Neighbor Solicitation for 2001:470:1f15:289:f65c:89ff:f...
140	0.716674	::	ff02::1:ffb7:f1d5	ICMPv6	78	Neighbor Solicitation for fd33:af04:eb8d:0:644c:4383:c5...
141	0.728485	fe80::f65c:89ff:feb4:8c3	ff02::1:ffb4:8c3	ICMPv6	86	Multicast Listener Report

Frame 130: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0

Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_ff:b4:08:c3 (33:33:ff:b4:08:c3)

Internet Protocol Version 6, Src: ::, Dst: ff02::1:ffb4:8c3

0110 = Version: 6

.... 0000 0000 = Traffic class: 0x00 (DSCP: CS0, ECN: Not-ECT)

.... 0000 0000 0000 0000 = Flowlabel: 0x00000000

Payload length: 24

Next header: ICMPv6 (58)

Hop limit: 255

Source: ::

Destination: ff02::1:ffb4:8c3

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

Internet Control Message Protocol v6

Type: Neighbor Solicitation (135)

Code: 0

Checksum: 0xeadb [correct]

Reserved: 00000000

Target Address: fe80::f65c:89ff:feb4:8c3

78 Neighbor Solicitation for fe80::f65c:89ff:feb4:8c3

78 Neighbor Solicitation for 2001:470:1f15:289:f65c:89ff:f...

78 Neighbor Solicitation for fd33:af04:eb8d:0:644c:4383:c5...

Wireshark pcapng_en0_20160519182107_NGSxSR

Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%)

Profile: Default

Wi-Fi: en0

ip6

No.	Time	Source	Destination	Protocol	Length	Info
113	0.574190	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	183	Advertise XID: 0x936496 CID: 000100011e9645d9f45c89b408...
116	0.591664	2001:470:1f15:289:9500:7c17:9c09:ce79	2a00:1450:4013:c00::6c	TCP	98	63087 → 993 [SYN] Seq=0 Win=65535 Len=0 MSS=1220 WS=32 ...
129	0.654411	fe80::f65c:89ff:feb4:8c3	ff02::fb	MDNS	287	Standard query 0x0000 PTR _airport._tcp.local, "QU" que...
130	0.687292	::	ff02::1:ffb4:8c3	ICMPv6	78	Neighbor Solicitation for fe80::f65c:89ff:feb4:8c3
139	0.716622	::	ff02::1:ffb4:8c3	ICMPv6	78	Neighbor Solicitation for 2001:470:1f15:289:f65c:89ff:f...
140	0.716674	::	ff02::1:ffb7:f1d5	ICMPv6	78	Neighbor Solicitation for fd33:af04:eb8d:0:644c:4383:c5...
141	0.728485	fe80::f65c:89ff:feb4:8c3	ff02::1:ffb4:8c3	ICMPv6	86	Multicast Listener Report

▶ Frame 139: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0

▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_ff:b4:08:c3 (33:33:ff:b4:08:c3)

▼ Internet Protocol Version 6, Src: ::, Dst: ff02::1:ffb4:8c3

0110 = Version: 6

▶ 0000 0000 = Traffic class: 0x00 (DSCP: CS0, ECN: Not-ECT)

.... 0000 0000 0000 0000 = Flowlabel: 0x00000000

Payload length: 24

Next header: ICMPv6 (58)

Hop limit: 255

Source: ::

Destination: ff02::1:ffb4:8c3

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

▼ Internet Control Message Protocol v6

Type: Neighbor Solicitation (135)

Code: 0

Checksum: 0xa34d [correct]

Reserved: 00000000

Target Address: 2001:470:1f15:289:f65c:89ff:feb4:8c3

wireshark_pcapng_en0_20160519182107_NGSxSR

Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%)

Profile: Default

Wi-Fi: en0

ip6

No.	Time	Source	Destination	Protocol	Length	Info
113	0.574190	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	183	Advertise XID: 0x936496 CID: 000100011e9645d9f45c89b408...
116	0.591664	2001:470:1f15:289:9500:7c17:9c09:ce79	2a00:1450:4013:c00::6c	TCP	98	63087 → 993 [SYN] Seq=0 Win=65535 Len=0 MSS=1220 WS=32 ...
129	0.654411	fe80::f65c:89ff:feb4:8c3	ff02::fb	MDNS	287	Standard query 0x0000 PTR _airport._tcp.local, "QU" que...
130	0.687292	::	ff02::1:ffb4:8c3	ICMPv6	78	Neighbor Solicitation for fe80::f65c:89ff:feb4:8c3
139	0.716622	::	ff02::1:ffb4:8c3	ICMPv6	78	Neighbor Solicitation for 2001:470:1f15:289:f65c:89ff:f...
140	0.716674	::	ff02::1:ffb7:f1d5	ICMPv6	78	Neighbor Solicitation for fd33:af04:eb8d:0:644c:4383:c5...
141	0.728485	fe80::f65c:89ff:feb4:8c3	ff02::1:ffb4:8c3	ICMPv6	86	Multicast Listener Report

▶ Frame 140: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0

▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_ff:b7:f1:d5 (33:33:ff:b7:f1:d5)

▼ Internet Protocol Version 6, Src: ::, Dst: ff02::1:ffb7:f1d5

0110 = Version: 6

▶ 0000 0000 = Traffic class: 0x00 (DSCP: CS0, ECN: Not-ECT)

..... 0000 0000 0000 0000 = Flowlabel: 0x00000000

Payload length: 24

Next header: ICMPv6 (58)

Hop limit: 255

Source: ::

Destination: ff02::1:ffb7:f1d5

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

▼ Internet Control Message Protocol v6

Type: Neighbor Solicitation (135)

Code: 0

Checksum: 0x90f7 [correct]

Reserved: 00000000

Target Address: fd33:af04:eb8d:0:644c:4383:c5b7:f1d5



wireshark_pcapng_en0_20160519182107_NGSxSR

Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%)

Profile: Default

Wi-Fi: en0

ip6

No.	Time	Source	Destination	Protocol	Length	Info
141	0.728485	fe80::f65c:89ff:feb4:8c3	ff02::1:ffb4:8c3	ICMPv6	86	Multicast Listener Report
142	0.728486	fe80::f65c:89ff:feb4:8c3	ff02::2:ff64:38e7	ICMPv6	86	Multicast Listener Report
143	0.728546	fe80::f65c:89ff:feb4:8c3	ff02::1:ff09:ce79	ICMPv6	86	Multicast Listener Report
144	0.728546	fe80::f65c:89ff:feb4:8c3	ff02::1:ffb7:f1d5	ICMPv6	86	Multicast Listener Report
145	0.728547	fe80::f65c:89ff:feb4:8c3	ff02::fb	ICMPv6	86	Multicast Listener Done
146	0.728547	fe80::f65c:89ff:feb4:8c3	ff02::fb	ICMPv6	86	Multicast Listener Report
147	0.728547	fe80::f65c:89ff:feb4:8c3	ff02::fb	ICMPv6	86	Multicast Listener Done

▶ Frame 144: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0

▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_ff:b7:f1:d5 (33:33:ff:b7:f1:d5)

▼ Internet Protocol Version 6, Src: fe80::f65c:89ff:feb4:8c3, Dst: ff02::1:ffb7:f1d5

0110 = Version: 6

▶ 0000 0000 = Traffic class: 0x00 (DSCP: CS0, ECN: Not-ECT)

..... 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000

Payload length: 32

Next header: IPv6 Hop-by-Hop Option (0)

Hop limit: 1

Source: fe80::f65c:89ff:feb4:8c3

[Source SA MAC: Apple_b4:08:c3 (f4:5c:89:b4:08:c3)]

Destination: ff02::1:ffb7:f1d5

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

▼ Hop-by-Hop Options

Next Header: ICMPv6 (58)

Length: 0 (8 bytes)

▶ IPv6 Option (PadN)

▶ IPv6 Option (Router Alert)

▼ Internet Control Message Protocol v6

Type: Multicast Listener Report (131)

Code: 0

Checksum: 0x1534 [correct]

Maximum Response Delay [ms]: 0

Reserved: 0000

Multicast Address: ff02::1:ffb7:f1d5

Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%) Profile: Default



Wi-Fi: en0

ipv6

No.	Time	Source	Destination	Protocol	Length	Info
141	0.000000	ff02::1:ffb4:8c3	ff02::1:ffb7:f1d5	ICMPv6	86	Multicast Listener Report
142	0.000000	ff02::2:ff64:38e7	ff02::1:ffb7:f1d5	ICMPv6	86	Multicast Listener Report
143	0.000000	ff02::1:ff09:ce79	ff02::1:ffb7:f1d5	ICMPv6	86	Multicast Listener Report
144	0.000000	ff02::1:ffb7:f1d5	ff02::1:ffb7:f1d5	ICMPv6	86	Multicast Listener Report
145	0.000000	ff02::fb	ff02::1:ffb7:f1d5	ICMPv6	86	Multicast Listener Done
146	0.000000	ff02::fb	ff02::1:ffb7:f1d5	ICMPv6	86	Multicast Listener Report
147	0.000000	ff02::fb	ff02::1:ffb7:f1d5	ICMPv6	86	Multicast Listener Done

Frame 1: Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: ff02::fb, Protocol: Internet Control Message Protocol v6 (58)

Internet Control Message Protocol v6

Type: Multicast Listener Report (131)

Code: 0

Checksum: 0x1534 [correct]

Maximum Response Delay [ms]: 0

Reserved: 0000

Multicast Address: ff02::1:ffb7:f1d5

Payload length: 32

Next header: IPv6 Hop-by-Hop Option (0)

Hop limit: 1

Source: fe80::f65c:89ff:feb4:8c3

[Source SA MAC: Apple_b4:08:c3 (f4:5c:89:b4:08:c3)]

Destination: ff02::1:ffb7:f1d5

[Source GeoIP: Unknown]

[Destination GeoIP: Unknown]

Hop-by-Hop Options

Next Header: ICMPv6 (58)

Length: 0 (8 bytes)

IPv6 Option (PadN)

IPv6 Option (Router Alert)

Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%) Profile: Default

Wi-Fi: en0

ip6

No.	Time	Source	Destination	Protocol	Length	Info
162	0.822814	fe80::a2f3:c1ff:feff:4992	ff02::1	ICMPv6	86	Multicast Listener Query
163	0.823768	fe80::a2f3:c1ff:feff:4992	ff02::1	ICMPv6	86	Multicast Listener Query
176	0.866847	::	ff02::1:ff09:ce79	ICMPv6	78	Neighbor Solicitation for 2001:470:1f15:289:9500:7c17:9...
463	1.577676	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	156	Request XID: 0xbe2c2 CID: 000100011e9645d9f45c89b408c3 ...
464	1.579741	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	215	Reply XID: 0xbe2c2 CID: 000100011e9645d9f45c89b408c3 IA...
475	1.639431	fe80::a2f3:c1ff:feff:4992	ff02::1:ff09:ce79	ICMPv6	86	Neighbor Solicitation for 2001:470:1f15:289:9500:7c17:9...
476	1.639507	fe80::f65c:89ff:feb4:8c3	fe80::a2f3:c1ff:feff:4992	ICMPv6	86	Neighbor Advertisement 2001:470:1f15:289:9500:7c17:9c09...

▶ Frame 176: 78 bytes on wire (624 bits), 78 bytes captured (624 bits) on interface 0
 ▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: IPv6mcast_ff:09:ce:79 (33:33:ff:09:ce:79)
 ▼ Internet Protocol Version 6, Src: ::, Dst: ff02::1:ff09:ce79

0110 = Version: 6
 ▶ 0000 0000 = Traffic class: 0x00 (DSCP: CS0, ECN: Not-ECT)
 0000 0000 0000 0000 0000 = Flowlabel: 0x00000000
 Payload length: 24
 Next header: ICMPv6 (58)
 Hop limit: 255
 Source: ::
 Destination: ff02::1:ff09:ce79
 [Source GeoIP: Unknown]
 [Destination GeoIP: Unknown]

▼ Internet Control Message Protocol v6
 Type: Neighbor Solicitation (135)
 Code: 0

Target Address: 2001:470:1f15:289:9500:7c17:9c09:ce79

wireshark_pcapng_en0_20160519182107_NGSxSR
 Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%)
 Profile: Default

Wi-Fi: en0

ip6

No.	Time	Source	Destination	Protocol	Length	Info
162	0.822814	fe80::a2f3:c1ff:fe				
163	0.823768	fe80::a2f3:c1ff:fe				
176	0.866847	::				
463	1.577676	fe80::f65c:89ff:fe				9500:7c17:9...
464	1.579741	fe80::a2f3:c1ff:fe				5c89b408c3 ...
475	1.639431	fe80::a2f3:c1ff:fe				:89b408c3 IA...
476	1.639507	fe80::f65c:89ff:fe				9500:7c17:9...

Frame 463: 156 bytes on wire (1248 bits)

- Ethernet II, Src: Apple_b4:08:c3 (f4:5c)
- Internet Protocol Version 6, Src: fe80:
- User Datagram Protocol, Src Port: 546 (
- DHCPv6
 - Message type: Request (3)
 - Transaction ID: 0x0be2c2
 - Client Identifier
 - Option Request
 - Elapsed time
 - Server Identifier
 - Identity Association for Non-temporary Address
 - Option: Identity Association for Non-temporary Address (3)
 - Length: 40
 - Value: 0000000000000000000000000000000050018fd33af04eb8d0000...
 - IAID: 00000000
 - T1: 0
 - T2: 0
 - IA Address
 - Option: IA Address (5)
 - Length: 24
 - Value: fd33af04eb8d000000000000000000007cd0000000000000000
 - IPv6 address: fd33:af04:eb8d::7cd
 - Preferred lifetime: 0
 - Valid lifetime: 0

9500:7c17:909...

Profile: Default

Wi-Fi: en0

ip6

No.	Time	Source
162	0.822814	fe80::a2f3:c1ff:feff:4992
163	0.823768	fe80::a2f3:c1ff:feff:4992
176	0.866847	::
463	1.577676	fe80::f65c:89ff:feb4:8c3
464	1.579741	fe80::a2f3:c1ff:feff:4992
475	1.639431	fe80::a2f3:c1ff:feff:4992
476	1.639507	fe80::f65c:89ff:feb4:8c3

Internet Protocol Version 6, Src: fe80::a2f3:c1ff:feff:4992, Dst Port: 547 (547), Src Port: 547 (547), Dst Port: 547 (547)

User Datagram Protocol, Src Port: 547 (547), Dst Port: 547 (547)

DHCPv6

Message type: Reply (7)
Transaction ID: 0x0be2c2

- Server Identifier
- Client Identifier
- SOL_MAX_RT
- DNS recursive name server
- Domain Search List
- Reconfigure Accept
- Authentication
- Identity Association for Non-temporary Address
 - Option: Identity Association for Non-temporary Address (3)
Length: 40
Value: 000000000000054600000870000050018fd33af04eb8d0000...
IAID: 00000000
T1: 21600
T2: 34560
 - IA Address
 - Option: IA Address (5)
Length: 24
Value: fd33af04eb8d000000000000000007cdfffff
IPv6 address: fd33:af04:eb8d::7cd
Preferred lifetime: infinity
Preferred lifetime: infinity

wireshark_pcapng_en0_20160519182107_NGSxSR

Message type: Reply (7)
Transaction ID: 0x0be2c2

- Server Identifier
- Client Identifier
- SOL_MAX_RT
- DNS recursive name server
- Domain Search List
- Reconfigure Accept
- Authentication
- Identity Association for Non-temporary Address
 - Option: Identity Association for Non-temporary Address (3)
Length: 40
Value: 000000000000054600000870000050018fd33af04eb8d0000...
IAID: 00000000
T1: 21600
T2: 34560
 - IA Address
 - Option: IA Address (5)
Length: 24
Value: fd33af04eb8d000000000000000007cdfffff
IPv6 address: fd33:af04:eb8d::7cd
Preferred lifetime: infinity
Preferred lifetime: infinity

Wi-Fi: en0

ip6

No.	Time	Source	Destination	Protocol	Length	Info
463	1.577676	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	156	Request XID: 0xbe2c2 CID: 000100011e9645d9f45c89b408c3 ...
464	1.579741	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	215	Reply XID: 0xbe2c2 CID: 000100011e9645d9f45c89b408c3 IA...
475	1.639431	fe80::a2f3:c1ff:feff:4992	ff02::1:ff09:ce79	ICMPv6	86	Neighbor Solicitation for 2001:470:1f15:289:9500:7c17:9...
476	1.639507	fe80::f65c:89ff:feb4:8c3	fe80::a2f3:c1ff:feff:4992	ICMPv6	86	Neighbor Advertisement 2001:470:1f15:289:9500:7c17:9c09...
479	1.640398	2a00:1450:4013:c00::6c	2001:470:1f15:289:9500:7c17:9c09:ce79	TCP	94	993 → 63086 [SYN, ACK] Seq=0 Ack=1 Win=43520 Len=0 MSS=...
480	1.640400	2a00:1450:4013:c00::6c	2001:470:1f15:289:9500:7c17:9c09:ce79	TCP	94	993 → 63087 [SYN, ACK] Seq=0 Ack=1 Win=43520 Len=0 MSS=...
481	1.640449	2001:470:1f15:289:9500:7c17:9c09:ce79	2a00:1450:4013:c00::6c	TCP	74	63086 → 993 [RST] Seq=1 Win=0 Len=0

- ▶ Frame 475: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0
- ▶ Ethernet II, Src: Tp-LinkT_ff:49:92 (a0:f3:c1:ff:49:92), Dst: IPv6mcast_ff:09:ce:79 (33:33:ff:09:ce:79)
- ▶ Internet Protocol Version 6, Src: fe80::a2f3:c1ff:feff:4992, Dst: ff02::1:ff09:ce79
- ▼ Internet Control Message Protocol v6
 - Type: Neighbor Solicitation (135)
 - Code: 0
 - Checksum: 0x90e5
 - Reserved: 000000
 - Target Address: 2001:470:1f15:289:9500:7c17:9c09:ce79
 - ▼ ICMPv6 Option (Source link-layer address : a0:f3:c1:ff:49:92)
 - Type: Source link-layer address (1)
 - Length: 1 (8 bytes)
 - Link-layer address: Tp-LinkT_ff:49:92 (a0:f3:c1:ff:49:92)

wireshark_pcapng_en0_20160519182107_NGSxSR

Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%)

Profile: Default

Wi-Fi: en0

Filter: **ipv6**

No.	Time	Source	Destination	Protocol	Length	Info
463	1.577676	fe80::f65c:89ff:feb4:8c3	ff02::1:2	DHCPv6	156	Request XID: 0xbe2c2 CID: 000100011e9645d9f45c89b408c3 ...
464	1.579741	fe80::a2f3:c1ff:feff:4992	fe80::f65c:89ff:feb4:8c3	DHCPv6	215	Reply XID: 0xbe2c2 CID: 000100011e9645d9f45c89b408c3 IA...
475	1.639431	fe80::a2f3:c1ff:feff:4992	ff02::1:ff09:ce79	ICMPv6	86	Neighbor Solicitation for 2001:470:1f15:289:9500:7c17:9...
476	1.639507	fe80::f65c:89ff:feb4:8c3	fe80::a2f3:c1ff:feff:4992	ICMPv6	86	Neighbor Advertisement 2001:470:1f15:289:9500:7c17:9c09...
479	1.640398	2a00:1450:4013:c00::6c	2001:470:1f15:289:9500:7c17:9c09:ce79	TCP	94	993 → 63086 [SYN, ACK] Seq=0 Ack=1 Win=43520 Len=0 MSS=...
480	1.640400	2a00:1450:4013:c00::6c	2001:470:1f15:289:9500:7c17:9c09:ce79	TCP	94	993 → 63087 [SYN, ACK] Seq=0 Ack=1 Win=43520 Len=0 MSS=...
481	1.640449	2001:470:1f15:289:9500:7c17:9c09:ce79	2a00:1450:4013:c00::6c	TCP	74	63086 → 993 [RST] Seq=1 Win=0 Len=0

▶ Frame 476: 86 bytes on wire (688 bits), 86 bytes captured (688 bits) on interface 0
 ▶ Ethernet II, Src: Apple_b4:08:c3 (f4:5c:89:b4:08:c3), Dst: Tp-LinkT_ff:49:92 (a0:f3:c1:ff:49:92)
 ▶ Internet Protocol Version 6, Src: fe80::f65c:89ff:feb4:8c3, Dst: fe80::a2f3:c1ff:feff:4992
 ▼ Internet Control Message Protocol v6

```

Type: Neigh
Code: 0
Checksum: 0
▶ Flags: 0x40
Target Addr
▼ ICMPv6 Opti
  Type: Ta
  Length: 1
  Link-lay
    Type: Neighbor Advertisement (136)
    Code: 0
    Checksum: 0xbac8 [correct]
    ▶ Flags: 0x40000000
    Target Address: 2001:470:1f15:289:9500:7c17:9c09:ce79
    ▼ ICMPv6 Option (Target link-layer address : f4:5c:89:b4:08:c3)
      Type: Target link-layer address (2)
      Length: 1 (8 bytes)
      Link-layer address: Apple_b4:08:c3 (f4:5c:89:b4:08:c3)
  
```

wireshark_pcapng_en0_20160519182107_NGSxSR

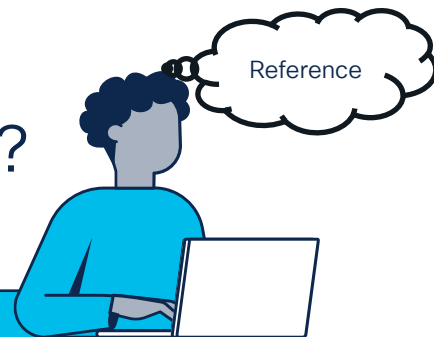
Packets: 1385 · Displayed: 309 (22.3%) · Dropped: 0 (0.0%) Profile: Default

Host State Post-Attachment

```
ayourtch — -bash — 101x26
[AYOURTCH-M-D1HB:~ ayourtch$ ifconfig en0
en0: flags=8863<UP,BROADCAST,SMART,RUNNING,SIMPLEX,MULTICAST> mtu 1500
    ether f4:5c:89:b4:08:c3
    inet6 fe80::f65c:89ff:feb4:8c3%en0 prefixlen 64 scopeid 0x4
    inet 192.168.1.235 netmask 0xfffff00 broadcast 192.168.1.255
    inet6 2001:470:1f15:289:f65c:89ff:feb4:8c3 prefixlen 64 autoconf
    inet6 2001:470:1f15:289:9500:7c17:9c09:ce79 prefixlen 64 autoconf temporary
    inet6 fd33:af04:eb8d::f65c:89ff:feb4:8c3 prefixlen 64 autoconf
    inet6 fd33:af04:eb8d::644c:4383:c5b7:f1d5 prefixlen 64 autoconf temporary
    inet6 fd33:af04:eb8d::7cd prefixlen 64 dynamic
    nd6 options=1<PERFORMNUD>
    media: autoselect
    status: active
```

```
inet6 fe80::f65c:89ff:feb4:8c3%en0 prefixlen 64 scopeid 0x4
inet 192.168.1.235 netmask 0xfffff00 broadcast 192.168.1.255
inet6 2001:470:1f15:289:f65c:89ff:feb4:8c3 prefixlen 64 autoconf
inet6 2001:470:1f15:289:9500:7c17:9c09:ce79 prefixlen 64 autoconf temporary
inet6 fd33:af04:eb8d::f65c:89ff:feb4:8c3 prefixlen 64 autoconf
inet6 fd33:af04:eb8d::644c:4383:c5b7:f1d5 prefixlen 64 autoconf temporary
inet6 fd33:af04:eb8d::7cd prefixlen 64 dynamic
```

M-, O-, A- flags: (Too) Many to choose from ?



Host State	Input	Behavior
Host has not acquired any addresses	No RA	Some OS perform DHCPv6, some do not
Host has not acquired any addresses	RA with M=0, O=1	Some OS acquire info only if A=1
Host has acquired DHCPv6 addresses (M=1, A=0)	RA with M=0	Some OS release DHCPv6 addresses immediately, some not
Host has acquired SLAAC-only addresses (A=1, M=0)	RA with M=1	Some OS acquire DHCPv6 address immediately, some not

<https://tools.ietf.org/html/draft-ietf-v6ops-dhcpv6-slaac-problem>