IPv6 Hacking Tools

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IPv6 Hacking Tools

- IPv6 operational basics – you NEED to know and understand this!!
- IPv6 security
- Wireshark basics
- IPv6 in Wireshark
- IPv6 hacking demonstration

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IPv6: Trivia

- In modern day operating systems, is IPv6 an enabled protocol? **YES!**
- Generally, will an IPv6 enabled interface have more than one IPv6 address assigned to it? **YES!**

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IPv6: Trivia

- How many IPv6 GUA addresses can a network interface have that are in the same network? **Up to 4!**
- How many IPv6 GUA addresses can a network interface have that are in different networks? **Almost infinite!**
- Can the IPv6 Link-Local address be the same address for all network interfaces in a host? **YES!**

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IPv6: Trivia

- How does an IPv6 enabled host derive its default gateway? **Via the RA!**
- Does DHCPv6 have a configurable option to provide an IPv6 default gateway? **NO!**
- Does an IPv6 host use its LL or GUA address to communicate to its default gateway? **LL!**

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IPv6: Trivia

- If an IPv6 enabled host has autoconfigured privacy extension addresses and a statically assigned address, which one gets used for off-net communications? **Temporary!**
- If attempting to communicate on-net using your GUA to another IPv6 host, will the communication be successful if the v6 router is not on-net? **NO!**

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IPv6 – a bit more than basics

- Quick IPv6 history
- IPv6 Address basics
- IPv6 Address Autoconfiguration

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IPv6 Brief History

- Fall 1992 – IPv4 addresses will run out someday
- Oct 1993 – DHCP – RFC 1531 – easier IPv4 address management
- Dec 1993 – IPng – RFC 1550 – basic specification for next version IP
- May 1994 – NAT – RFC 1631 – temporary solution before IPng available
- Dec 1995 – RFC 1883 – Basic specifications of IPv6
- Feb 1996 – RFC 1918 – Private Iv4 addresses
- Dec 1998 – RFC 2460 – Full IPv6 defined
- May 2005 – RFC 3927 – APIPA (IPv4)

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Comparing IPv4 & IPv6 Addresses

- IPv4 addresses 2^{32} = 4,294,967,296
- IPv6 addresses 2^{128} = 340,282,366,920,938,463,463,374,607,431,768,211,456
  - which is 340 undecillion
    - 340 trillion trillion trillion
  - 79,228,162,514,264,337,593,543,950,336 times more v6 addresses than v4
- If IP addresses weighed one gram each:
  - IPv4 = half the Empire State Building
  - IPv6 = 56 billion earths

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What is an IPv6 Address?

- IPv6 addresses are very different than IPv4 addresses in the size, numbering system, and delimiter between the numbers
  - 128bit -vs- 32bit
  - colon-hexadecimal -vs- dotted-decimal
  - colon and double colon -vs- period (or “dot” for the real geeks)

Valid IPv6 addresses are comprised of hexadecimal numbers (0-9 & a-f), with colons separating groups of four numbers, with a total of eight groups

(each group is known as “quibble” or “**hextet**”)

- 2001:0db8:1010:61ab:f005:ba11:00da:11a5

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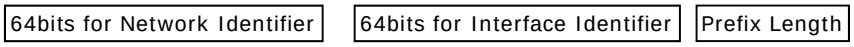
IPv6 default for subnet

- Based on the default definition an IPv6 address is logically divided into two parts: a 64-bit network prefix and a 64-bit interface identifier (IID)
- Therefore, the default subnet size is /64
- 2001:0db8:1010:61ab:f005:ba11:00da:11a5/64



- A single /64 network yields 18 billion-billion possible addresses

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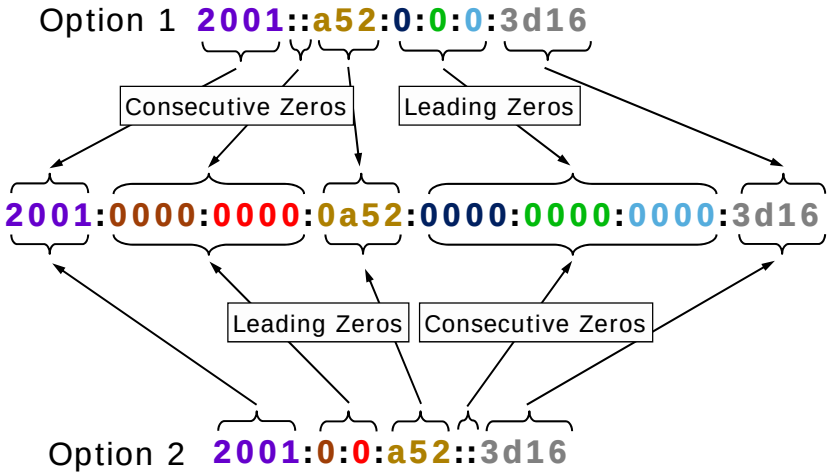
IPv6 shorthand notation



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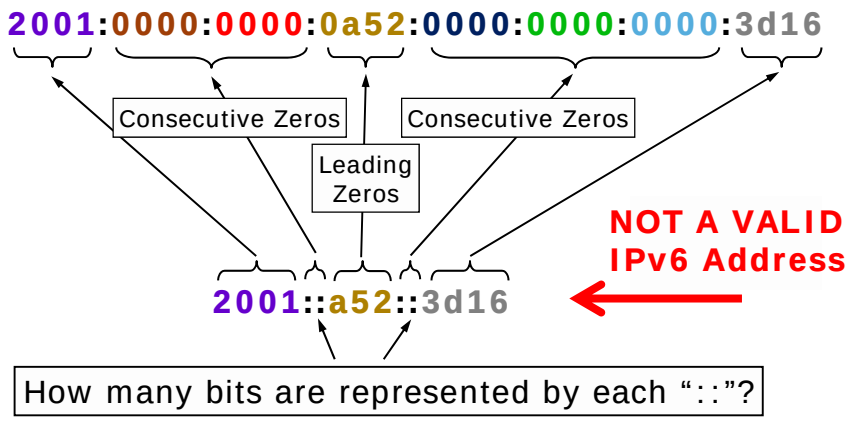
Incorrect shorthand notation



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Address types

Address Type	IPv4	IPv6
Unicast - One-to-one communication	Yes	Yes
Broadcast - One-to-many communication local	Yes	No
Multicast - One-to-many communication local/remote	Yes	Yes
Anycast - One-to-many communication nearest	Yes	Yes

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Address scopes

Address Scope	IPv4	IPv6
Link-Local - Not routable	Yes (is temp, APIPA)	Yes
Global Unicast - Routable to Internet	Aka public	Yes
Unique Local - Routable only within domain	Aka private RFC 1918	RFC 4193

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IPv4/IPv6 special addresses

Address Type	IPv4	IPv6
Default Route	0.0.0.0/0	::/0
Unspecified	0.0.0.0/32	::/128
Loopback	127.0.0.1/8	::1/128
Multicast	224.0.0.0/4	ff00::/8
Link-Local	169.254.0.0/16	fe80::/10
Global Unicast	All others	2000::/3
Unique Local	10.0.0.0/8 172.16.0.0/12 192.168.0.0/16	fc00::/7
Documentation	192.0.2.0/24 198.51.100.0/24 203.0.113.0/24	2001:db8::/32

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IPv6 well known multicast addresses

Address	Description	Scope
ff01::1	All nodes address	Interface-local
ff02::1	All nodes address	Link-local
ff01::2	All routers address	Interface-local
ff02::2	All routers address	Link-local
ff05::2	All routers address	Site-local
ff02::4	DVMRP routers	Link-local
ff02::5	OSPF drothers	Link-local
ff02::6	OSPF designated routers	Link-local
ff02::9	RIPng routers	Link-local
ff02::a	EIGRPv6 routers	Link-local
ff02::d	All PIM routers	Link-local
ff02::16	ALL MLDv2 routers	Link-local
ff02::1:2	DHCPv6 servers/agents	Link-local
ff02::1:3	DHCPv6 servers/agents	Site-local
ff02::1:ffxx:xxxx	Solicited node address	Link-local

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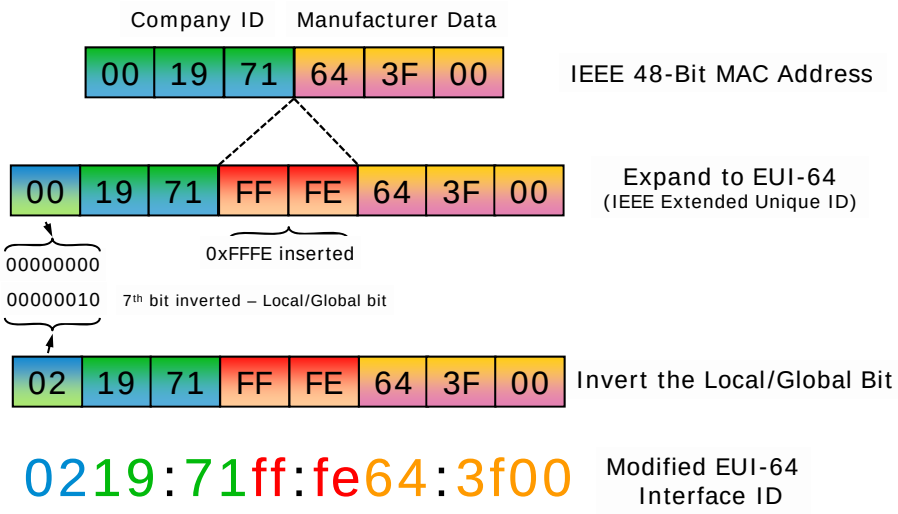
Interface ID from MAC address



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Interface ID from Random Number

- RFC4941 - Privacy Extensions for Stateless Address Autoconfiguration in IPv6
- Initial IID is derived based on mathematical computation to create a “random 64bit number” and appended to prefix to create a GUA
- An additional but different 64bit number is computed, appended to prefix, and tagged “temporary” for a 2nd GUA
- Temporary GUA should be re-computed on a frequent basis
- Temporary GUA is used as primary address for communications, as it is considered “more secure”

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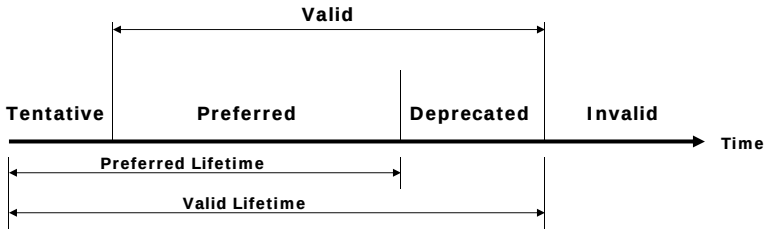
Lifetime states of an IPv6 address



- Tentative – address is in process of verification for uniqueness and is not yet available for regular communications
- Valid – address is valid for use in communication based on Preferred and Deprecated status
- Preferred – address is usable for all communications
- Deprecated – address can still be used for existing sessions, but not for new sessions
- Invalid – an address is no longer available for sending or receiving

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Comparing IPv4 & IPv6 Neighbor Discovery Protocols

IPv4	IPv6
ARP Request	Neighbor Solicitation
ARP Reply	Neighbor Advertisement
Router Solicitation	Router Solicitation
Router Advertisement	Router Advertisement
Gratuitous ARP	Duplicate Address Detection
ARP Cache	Neighbor Cache

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IPv6 Neighbor Discovery Protocol

- Neighbor Discovery Protocol (NDP) is defined in RFC 4861
- NDP provides the following basic IPv6 functions per node
  - Discover what link they are one
  - Learn link prefix addresses
  - Discover the on-link router
  - Discover on-link neighbors
  - Keep track of active neighbors

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NDP ICMPv6 message types

- ICMPv6 type 133 - Router Solicitation (RS)
- ICMPv6 type 134 - Router Advertisement (RA)
- ICMPv6 type 135 - Neighbor Solicitation (NS)
- ICMPv6 type 136 - Neighbor Advertisement (NA)

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IPv6 NDP - Router Solicitation

- A node sends a multicast Router Solicitation message to the “all-routers” address ff02::2 to determine if there are any IPv6 routers on-link

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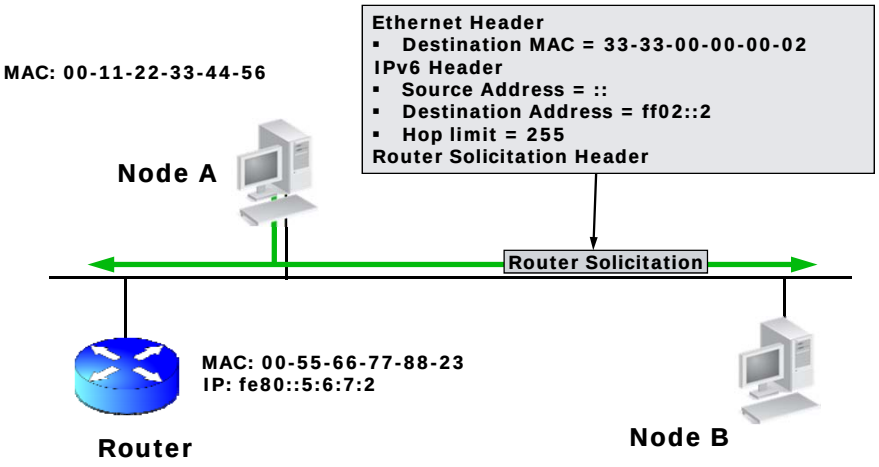
Router Solicitation



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IPv6 NDP - Router Advertisement

- Routers send RAs periodically (appx every 6-10 minutes [is adjustable]) and in reply to an RS (generally sent by a node coming on-link)
- RA informs nodes of status and may contain such information as:
  - Network prefix
  - Link MTU
  - Valid and preferred lifetimes
  - Flags that inform the node method of address autoconfiguration to invoke:
    - SLAAC, Stateful, Stateless-DHCPv6
  - Router on-link status

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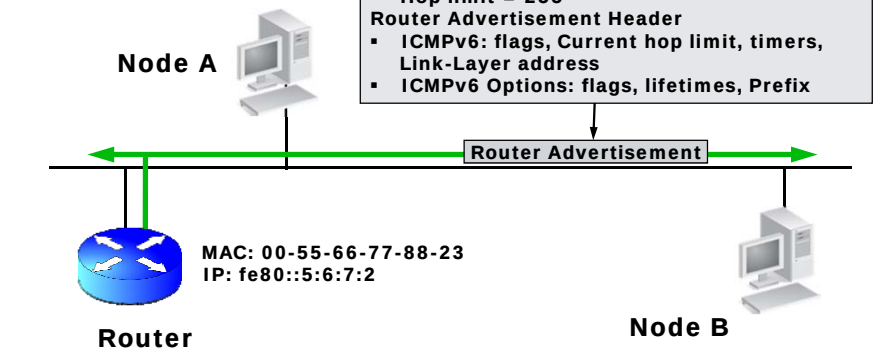
Router Advertisement



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IPv6 NDP - Neighbor Solicitation

- NS is used to find or verify the link-layer address of an on-link node
- NS is used for Duplicate Address Detection
- NS is used for Neighbor Unreachability Detection

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Duplicate Address Detection (DAD)

- When a node initially assigns an IPv6 address to its interface, it must check whether the selected address is unique
- If unique, the address is configured on interface
- To verify uniqueness, the node sends a multicast Neighbor Solicitation message with the:
  - dest MAC of 33:33:<last 32bits of IPv6 mcast addr>
  - dest IPv6 addr of ff02::1:ff<last 24bits of proposed IPv6 addr>
  - source IPv6 of "::" (IPv6 unspecified addr)

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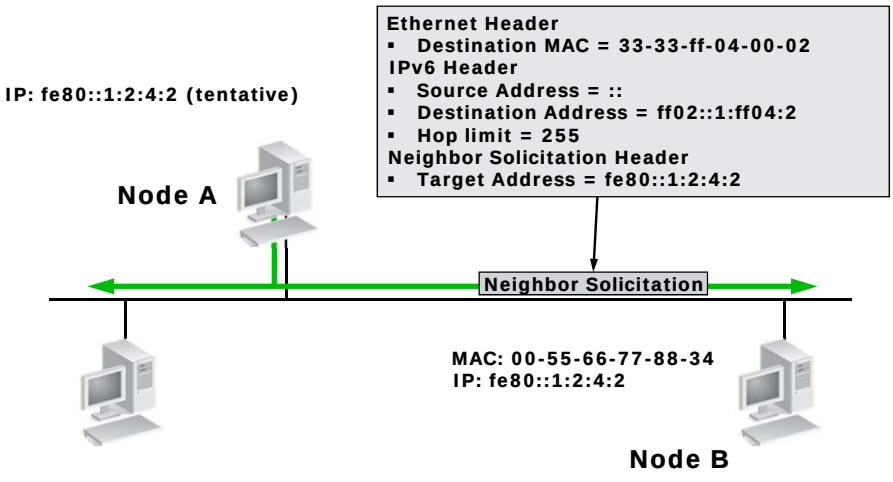
Duplicate Address Detection Neighbor Solicitation



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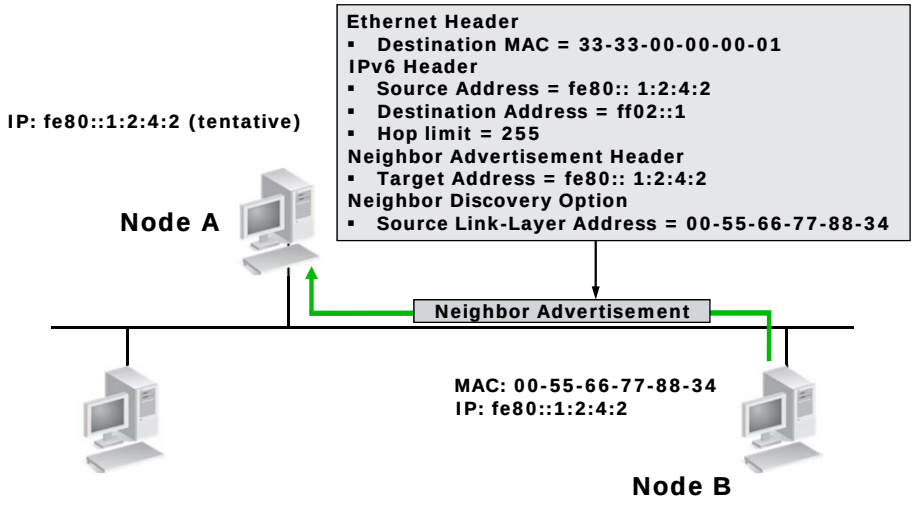
IPv6 NDP - Neighbor Advertisement

- NA is sent as a reply to a Neighbor Solicitation

Duplicate Address Detection Neighbor Advertisement (reply)



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NDP – Neighbor cache

- A node's neighbor cache maintains mappings of IPv6 link-local and GUA addresses for each of it's link-layer addresses
- The neighbor cache also maintains the reachability state for each neighbor using Neighbor Unreachability Detection (NUD)

NDP – Neighbor cache state

- A Neighbor Cache entry can be in one of five states:
  - INCOMPLETE - Address resolution is in progress and the link-layer address is not yet known
  - REACHABLE - Neighbor is known to be reachable within the last reachable time interval
  - STALE - Neighbor requires re-resolution and traffic may flow to this neighbor
  - DELAY - Neighbor is pending re-resolution and traffic might flow to this neighbor
  - PROBE - Neighbor re-resolution is in progress and traffic might flow to this neighbor

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IPv6 autoconfiguration options

Address Autoconfiguration Method	ICMPv6 RA (Type 134) Flags M Flag	O Flag	ICMPv6 RA (Type 134) ICMPv6 Option Prefix Info A Flag	L Flag	Prefix Derived from	Interface ID Derived from	Other Configuration Options	# of IPv6 Addr
Link-Local (always configured)	N/A	N/A	N/A	N/A	Internal (fe80::)	M-EUI-64 or Privacy	Manual	1
Manual	Off	Off	Off	On	Manual	Manual	Manual	2 (LL, Manual)
SLAAC	Off	Off	On	On	RA	M-EUI-64 or Privacy	Manual	3 (LL, IPv6, IPv6 temp)
Stateful (DHCPv6)	On	N/R	Off	On	DHCPv6	DHCPv6	DHCPv6	2 (LL, DHCPv6)
Stateless DHCPv6	Off	On	On	On	RA	M-EUI-64 or Privacy	DHCPv6	3 (LL, IPv6, IPv6 temp)
Combination Stateless & DHCPv6	On	N/R	On	On	RA and DHCPv6	M-EUI-64 or Privacy and DHCPv6	DHCPv6	4 (LL, IPv6, IPv6 temp, DHCPv6)

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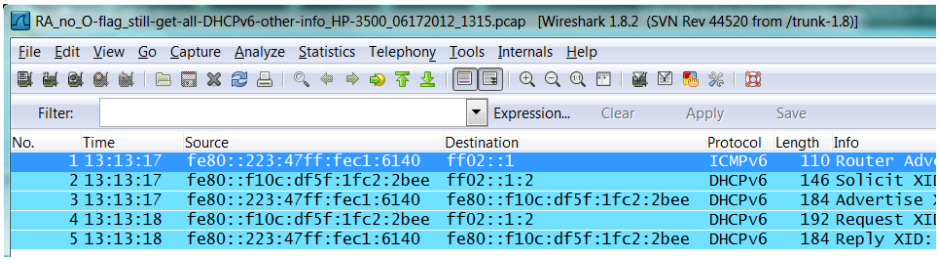
IPv6 Stateful (DHCPv6) process



- DHCPv6**S**olicit = DHCP**D**iscover (IPv4)
- DHCPv6**A**dvertise = DHCP**O**ffer (IPv4)
- DHCPv6**R**equest = DHCP**R**equest (IPv4)
- DHCPv6**R**eply = DHCP**A**ck (IPv4)

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IPv6 Security concerns

- If M-EUI-64 based address, can determine manufacturer of interface, which may lead to what type of device it is, and where in the network in may be located
- Since IPv6 is enabled by default in many operating systems and devices, simple scan of network will provide tons of info
- Many “tools” already available for exploitation of devices/systems
- Easy to spoof clients with rogue RA
- If there is a “Temporary” IPv6 address (in addition to a “regular” configured IPv6 address), it is used for outbound communications by the client. “Temporary” IPv6 addresses can change frequently

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IPv6 Threats to access networks

- IPv6 uses ICMPv6 for many LAN operations
  - Stateless auto-configuration
  - IPv6 equivalent of IPv4 ARP
- New multicast addresses that can enable an attacker to identify key resources on a network
- Spoofed RAs can renumber hosts, have hosts “drop” an IPv6 address, or initiate a MITM attack with redirect
- DHCPv6 spoofing
  - Force nodes to believe all addresses are on-link

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ICMPv6 is Required for IPv6

Type	Description
1	Destination unreachable
2	Packet too big
3	Time exceeded
4	Parameter problem
128	Echo Request
129	Echo Reply
130	Multicast Listener Query
131	Multicast Listener Report
132	Multicast Listener Done
133	Router Solicitation (RS)
134	Router Advertisement (RA)
135	Neighbor Solicitation (NS)
136	Neighbor Advertisement (NA)
137	Redirect message

Traceroute
Ping
Multicast Listener Discovery
Prefix Advertisement
ARP replacement

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IPv6 attacks

- Neighbor Discovery attacks
  - NDP Spoofing
  - DAD DoS attack
- Router Advertisement attacks
  - RA flooding
  - Rogue RA
- DHCPv6 spoofing
  - Force nodes to believe all addresses are on-link

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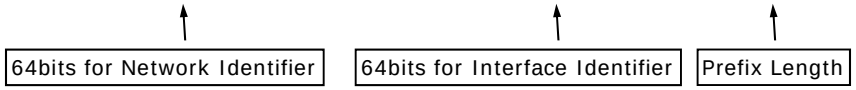
IPv6 Network scanning

- 2001:0db8:1010:61ab:f005:ba11:00da:11a5/64



- Since prefix is defined, don't scan there, need only scan lower 64 bits (18BB #'s!!!!!!)
- Scan last section for IPv4 looking addresses (0-254)
- Scan middle of IID for "fffe", then scan for known OID
- Scan for known hex words
- Scan for IPv4 address converted to hex notation
  - 10.1.1.1 = 0a01:0101 -or- a01:101 -or- 10:1:1:1

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Wireshark

- Basics
- Color rules
- Display filters
- Columns
- Configuration profiles
- Packet annotation

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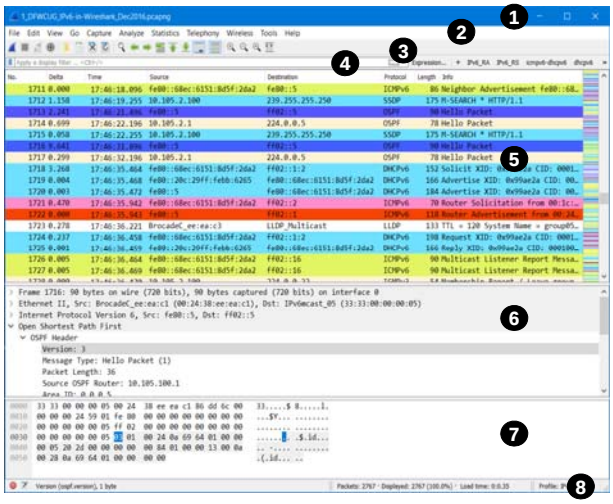
Wireshark main view



1. Title bar — trace file name or capture device name
2. Main menu — standard menu
3. Main toolbar — quick access
4. Display filter area — reduce the amount of traffic you see
5. Packet List pane — summary of each frame
6. Packet Details pane — dissected frames
7. Packet Bytes pane — hex and ASCII details
8. Status Bar — access to the Expert, annotations, file location, packet counts, and profiles

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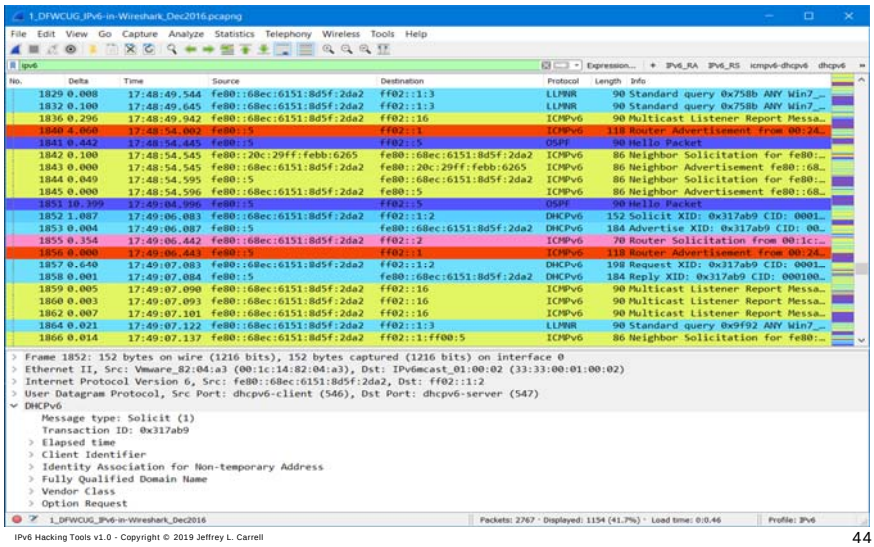
Jeff's IPv6 Wireshark



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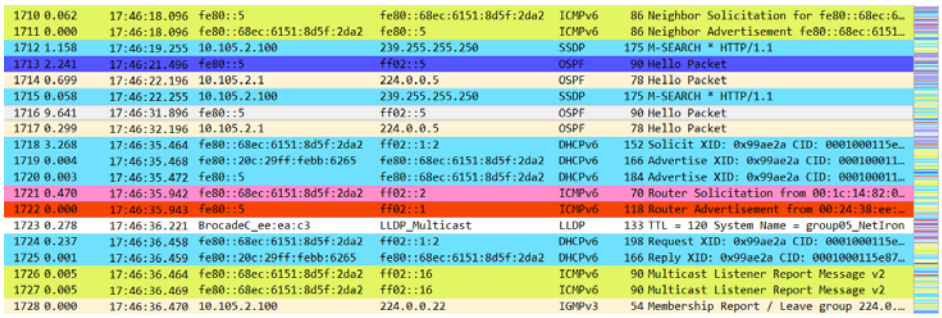
Coloring rules



1710	0.062	17:46:18.096	fe80::5	fe80::68ec:6151:8d5f:2da2	ICMPv6	86 Neighbor Solicitation for fe80::68ec:6…
1711	0.000	17:46:18.096	fe80::68ec:6151:8d5f:2da2	fe80::5	ICMPv6	86 Neighbor Advertisement fe80::68ec:6151…
1712	1.158	17:46:19.255	10.105.2.100	239.255.255.250	SSDP	175 M-SEARCH * HTTP/1.1
1713	2.241	17:46:21.496	fe80::5	ff02::5	OSPF	90 Hello Packet
1714	0.699	17:46:22.196	10.105.2.1	224.0.0.5	OSPF	78 Hello Packet
1715	0.058	17:46:22.255	10.105.2.100	239.255.255.250	SSDP	175 M-SEARCH * HTTP/1.1
1716	9.641	17:46:31.896	fe80::5	ff02::5	OSPF	90 Hello Packet
1717	0.299	17:46:32.196	10.105.2.1	224.0.0.5	OSPF	78 Hello Packet
1718	3.268	17:46:35.464	fe80::68ec:6151:8d5f:2da2	ff02::1:2	DHCPv6	152 Solicit XID: 0x99ae2a CID: 0001000115e…
1719	0.004	17:46:35.468	fe80::20c:29ff:febb:6265	fe80::68ec:6151:8d5f:2da2	DHCPv6	166 Advertise XID: 0x99ae2a CID: 000100011…
1720	0.003	17:46:35.472	fe80::5	fe80::68ec:6151:8d5f:2da2	DHCPv6	184 Advertise XID: 0x99ae2a CID: 000100011…
1721	0.470	17:46:35.942	fe80::68ec:6151:8d5f:2da2	ff02::2	ICMPv6	70 Router Solicitation from 00:1c:14:82:0…
1722	0.000	17:46:35.943	fe80::5	ff02::1	ICMPv6	118 Router Advertisement from 00:24:38:ee:…
1723	0.278	17:46:36.221	BrocadeC_ee:ea:c3	LLDP_Multicast	LLDP	133 TTL = 120 System Name = group05_NetIron
1724	0.237	17:46:36.458	fe80::68ec:6151:8d5f:2da2	ff02::1:2	DHCPv6	198 Request XID: 0x99ae2a CID: 0001000115e…
1725	0.001	17:46:36.459	fe80::20c:29ff:febb:6265	fe80::68ec:6151:8d5f:2da2	DHCPv6	166 Reply XID: 0x99ae2a CID: 0001000115e87…
1726	0.005	17:46:36.464	fe80::68ec:6151:8d5f:2da2	ff02::16	ICMPv6	90 Multicast Listener Report Message v2
1727	0.005	17:46:36.469	fe80::68ec:6151:8d5f:2da2	ff02::16	ICMPv6	90 Multicast Listener Report Message v2
1728	0.000	17:46:36.470	10.105.2.100	224.0.0.22	IGMPv3	54 Membership Report / Leave group 224.0.…

- Colors help you focus on specific addresses, protocols, events, and possibly find errors quickly

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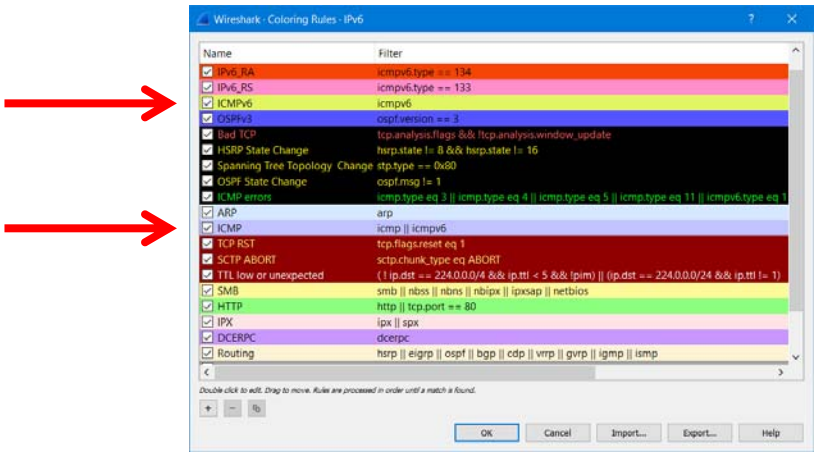
Color rule processing order



- Color rules read like a router ACL or firewall rule
  - First color rule that matches wins

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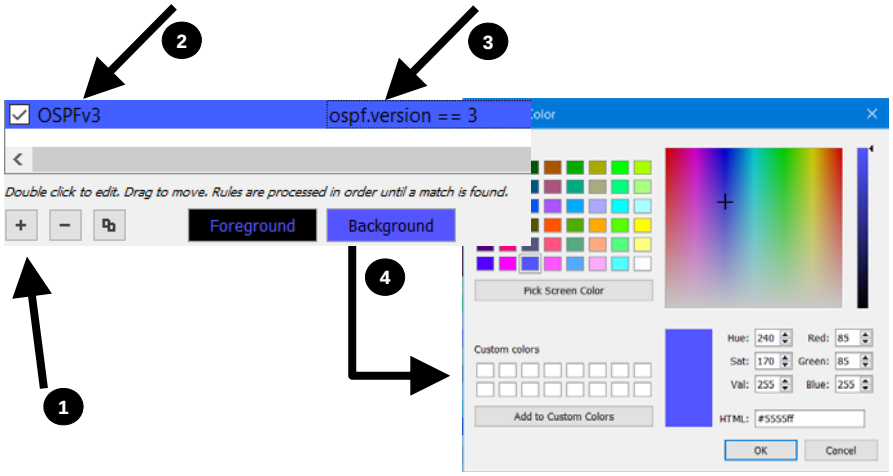
Color rule creation



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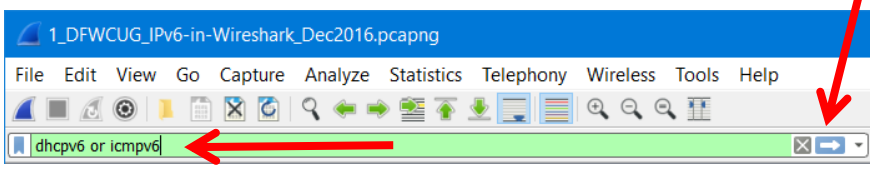
Using Wireshark to view IPv6 pkts

- IPv6 display filter families
  - ipv6
  - icmpv6
  - dhcpv6
- IPv6 related display filters:
  - http://www.wireshark.org/docs/dfref/i/ipv6.html



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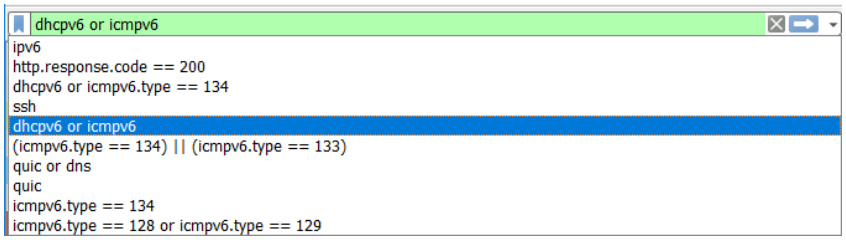
Display filters – option 1



- The Filter bar will change colors as you type to signify correct syntax for the filter
  - Green – syntax is correct
  - Red – syntax is incorrect
  - Yellow – syntax is suspect
- The Filter dropdown will show last 10 filters used
- You can save Filter definitions for frequent use

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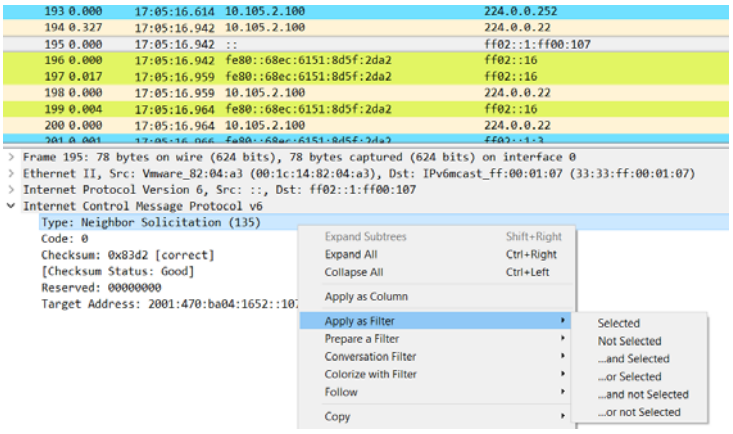
Display filters – option 2



- In the Packet Details view, right-click on a specific field to build a filter

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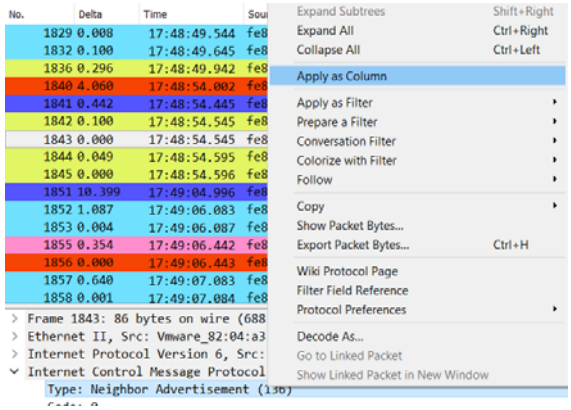
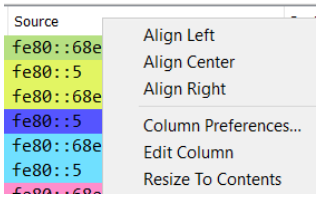
Columns





- Right-click column headings to sort, rename, align, etc
- In the Packet Details view, right-click on a specific field to Apply as Column

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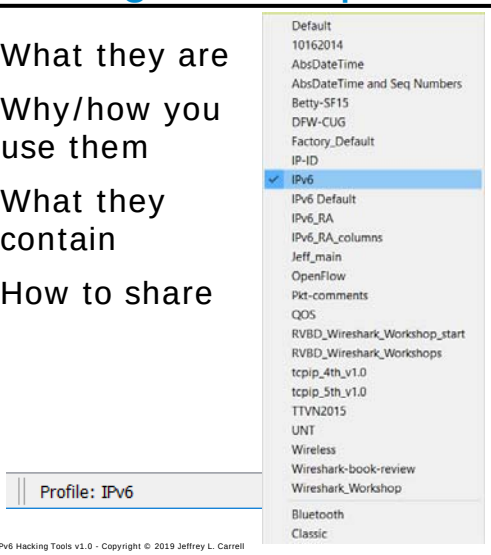
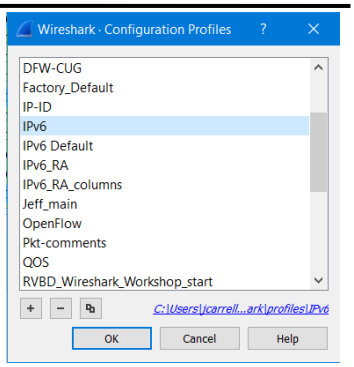
Configuration profiles

- What they are
- Why/how you use them
- What they contain
- How to share





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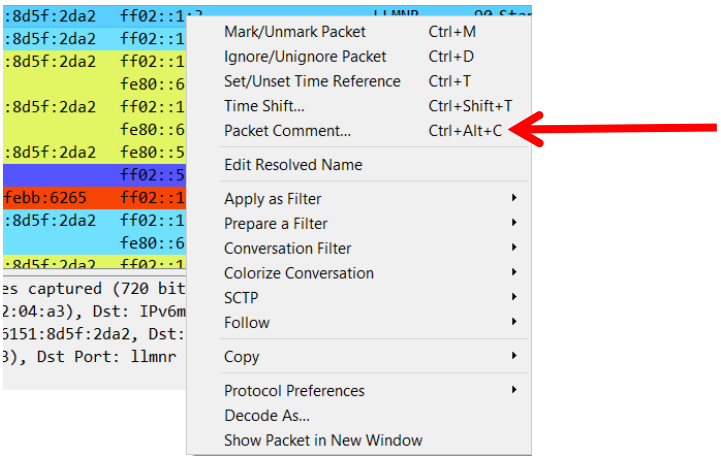
Packet annotation



- Right click packet, select Packet Comment

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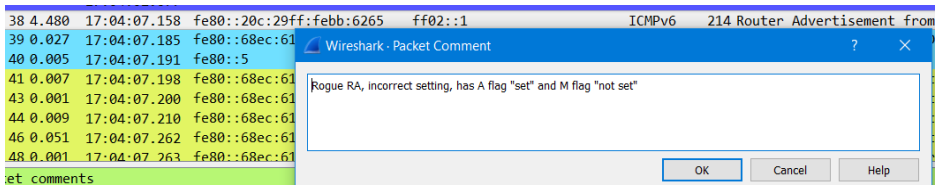
Packet annotation



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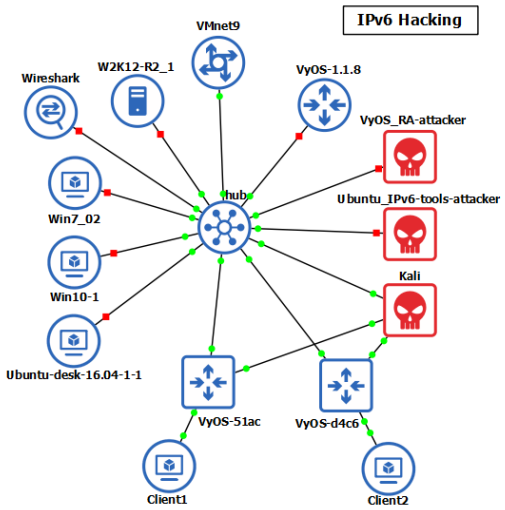
IPv6 Hacking!



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Disclaimer

DO NOT execute these security assessment tools on a network without proper authorization.

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IPv6 Attack tools

- Attack Toolkits
  - THC-IPv6
    - https://github.com/vanhauser-thc/thc-ipv6
  - SI6 Networks IPv6 Toolkit
    - https://github.com/fgont/ipv6toolkit
- Scanners
  - Nmap, halfscan6 (older)
- Packet forgery
  - Scapy
  - Chiron

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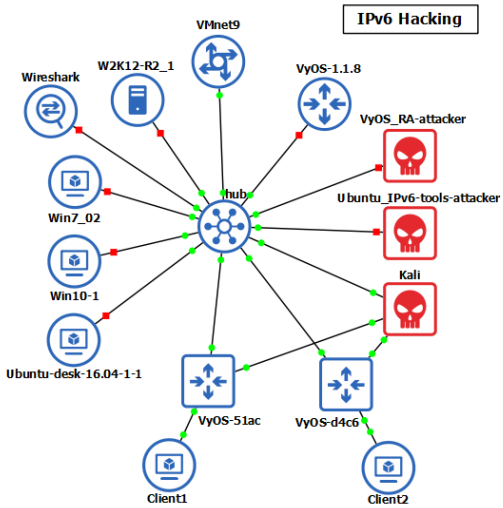
IPv6 Hacking!



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RA attack – Windows 10 result

Windows 10 v1809

```
Ethernet adapter VMware Network Adapter VMnet9:

   Connection-specific DNS Suffix  . : ipv6sandbox.com
   Description . . . . . . . . . . . : VMware Virtual Ethernet Adapter for VMnet9
   Physical Address. . . . . . . . . : 00-50-56-C0-00-09
   DHCP Enabled. . . . . . . . . . . : No
   Autoconfiguration Enabled . . . . : Yes
   IPv6 Address. . . . . . . . . . . : 2001:db8:1ab:ba5e::103(Preferred)
   Lease Obtained. . . . . . . . . . : Sunday, February 17, 2019 11:20:41 PM
   Lease Expires . . . . . . . . . . : Monday, February 18, 2019 3:15:44 AM
   IPv6 Address. . . . . . . . . . . : 2001:db8:74c:2bad:7541:ed0d:3d78:a192(Preferred)
   Temporary IPv6 Address. . . . . . : 2001:db8:74c:2bad:bc85:ff77:73c1:3033(Preferred)
   Link-local IPv6 Address . . . . . : fe80::7541:ed0d:3d78:a192%37(Preferred)
   IPv4 Address. . . . . . . . . . . : 10.1.0.25(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : fe80::20c:29ff:fe17:957b%37
                                       fe80::20c:29ff:fe87:99ba%37
                                       10.1.0.1
   DHCPv6 IAID . . . . . . . . . . . : 1459638358
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-20-6A-6C-49-48-0F-CF-D9-1F-62
   DNS Servers . . . . . . . . . . . : 2001:db8:1ab:ba5e::2000
                                       2001:db8:74c:2bad::53
   NetBIOS over Tcpip. . . . . . . . : Enabled
   Connection-specific DNS Suffix Search List :
                                       ipv6sandbox.com
```

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RA attack – Windows 10 result

Windows 10 v1803

```
Ethernet adapter Ethernet0:

   Connection-specific DNS Suffix  . : ipv6sandbox.com
   Description . . . . . . . . . . . : Intel(R) PRO/1000 MT Network Connection
   Physical Address. . . . . . . . . : 00-0C-29-4D-60-50
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv6 Address. . . . . . . . . . . : 2001:db8:1ab:ba5e::109(Preferred)
   Lease Obtained. . . . . . . . . . : Monday, February 18, 2019 2:55:20 AM
   Lease Expires . . . . . . . . . . : Monday, February 18, 2019 3:10:20 AM
   IPv6 Address. . . . . . . . . . . : 2001:db8:74c:2bad:6105:a7b6:28a2:d0f7(Preferred)
   Temporary IPv6 Address. . . . . . : 2001:db8:74c:2bad:d452:5d0a:17c0:2c71(Preferred)
   Link-local IPv6 Address . . . . . : fe80::6105:a7b6:28a2:d0f7%6(Preferred)
   IPv4 Address. . . . . . . . . . . : 10.1.0.101(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : Monday, February 18, 2019 2:55:18 AM
   Lease Expires . . . . . . . . . . : Monday, February 18, 2019 3:25:18 AM
   Default Gateway . . . . . . . . . : fe80::20c:29ff:fe17:957b%6
                                       fe80::20c:29ff:fe87:99ba%6
                                       10.1.0.1
   DHCP Server . . . . . . . . . . . : 10.1.0.200
   DHCPv6 IAID . . . . . . . . . . . : 67111977
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-23-02-DB-52-00-0C-29-4D-60-50
   DNS Servers . . . . . . . . . . . : 2001:db8:1ab:ba5e::2000
                                       10.1.0.200
   NetBIOS over Tcpip. . . . . . . . : Enabled
   Connection-specific DNS Suffix Search List :
                                       ipv6sandbox.com
```

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RA attack – Windows 7SP1 result

Windows 7 SP1

```
Ethernet adapter Local Area Connection:

   Connection-specific DNS Suffix  . : ipv6sandbox.com
   Description . . . . . . . . . . . : Intel(R) PRO/1000 MT Network Connection
   Physical Address. . . . . . . . . : 00-0C-29-7D-7F-F7
   DHCP Enabled. . . . . . . . . . . : Yes
   Autoconfiguration Enabled . . . . : Yes
   IPv6 Address. . . . . . . . . . . : 2001:db8:1ab:ba5e::105(Preferred)
   Lease Obtained. . . . . . . . . . : Monday, February 18, 2019 03:06:15
   Lease Expires . . . . . . . . . . : Monday, February 18, 2019 03:21:15
   IPv6 Address. . . . . . . . . . . : 2001:db8:74c:2bad:251f:dd3:a5b0:e337(Preferred)
   Temporary IPv6 Address. . . . . . : 2001:db8:74c:2bad:3522:df1:f11a:b718(Preferred)
   Link-local IPv6 Address . . . . . : fe80::251f:dd3:a5b0:e337%10(Preferred)
   IPv4 Address. . . . . . . . . . . : 10.1.0.100(Preferred)
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Lease Obtained. . . . . . . . . . : Monday, February 18, 2019 00:08:44
   Lease Expires . . . . . . . . . . : Monday, February 18, 2019 03:23:44
   Default Gateway . . . . . . . . . : fe80::20c:29ff:fe17:957b%10
                                       fe80::20c:29ff:fe87:99ba%10
                                       10.1.0.1
   DHCP Server . . . . . . . . . . . : 10.1.0.200
   DHCPv6 IAID . . . . . . . . . . . : 234884137
   DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-1D-13-B0-C1-00-0C-29-C0-CD-D8
   DNS Servers . . . . . . . . . . . : 2001:db8:1ab:ba5e::2000
                                       10.1.0.200
   NetBIOS over Tcpip. . . . . . . . : Enabled
   Connection-specific DNS Suffix Search List :
                                       ipv6sandbox.com
```

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RA attack – Ubuntu Desktop result

Ubuntu Desktop v16.04

```
GENERAL.DEVICE:                         ens33
GENERAL.TYPE:                           ethernet
GENERAL.HWADDR:                         00:0C:29:17:A8:67
GENERAL.MTU:                            1500
GENERAL.STATE:                          100 (connected)
GENERAL.CONNECTION:                     Wired connection 1
GENERAL.CON-PATH:                       /org/freedesktop/NetworkManager/ActiveConnection/11
WIRED-PROPERTIES.CARRIER:               on
IP4.ADDRESS[1]:                         10.1.0.103/24
IP4.GATEWAY:                            10.1.0.1
IP4.DNS[1]:                             10.1.0.200
IP4.DOMAIN[1]:                          ipv6sandbox.com
IP6.ADDRESS[1]:                         2001:db8:74c:2bad:ad9d:1d87:6075:6dfc/64
IP6.ADDRESS[2]:                         2001:db8:1ab:ba5e::101/128
IP6.ADDRESS[3]:                         fe80::8146:5985:1023:590e/64
IP6.GATEWAY:                            fe80::20c:29ff:fe17:957b
IP6.ROUTE[1]:                           dst = 2001:db8:74c:2bad::/64, nh = ::, mt = 100
IP6.ROUTE[2]:                           dst = 2001:db8:1ab:ba5e::/64, nh = ::, mt = 100
IP6.DNS[1]:                             2001:db8:74c:2bad::53
IP6.DNS[2]:                             2001:db8:1ab:ba5e::2000
```

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IPv6 Essentials Cheat Sheet

http://teachmeipv6.com/IPv6-Essentials-Cheat-Sheet.pdf

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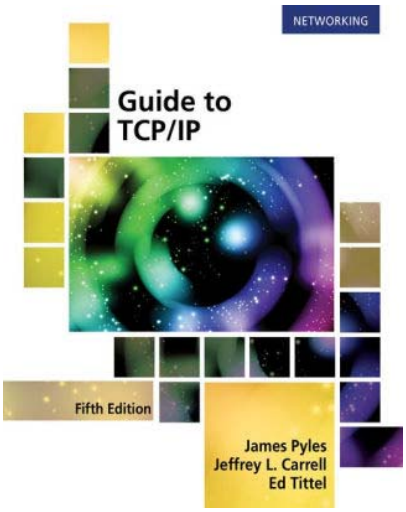
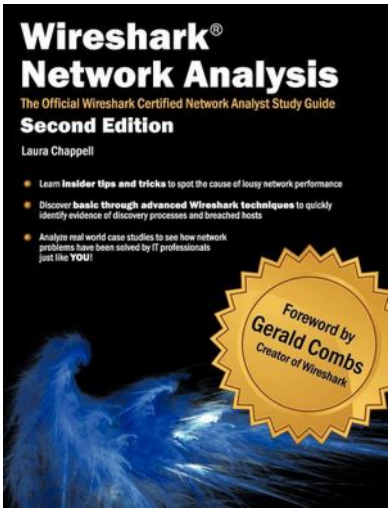
Resources





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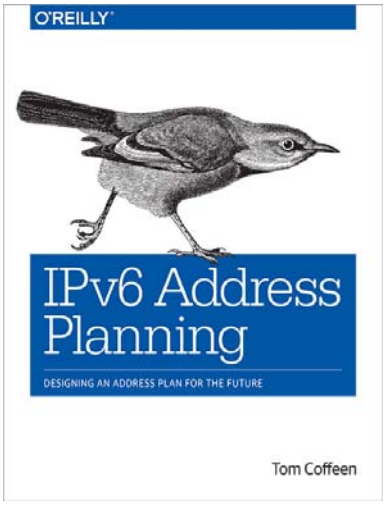
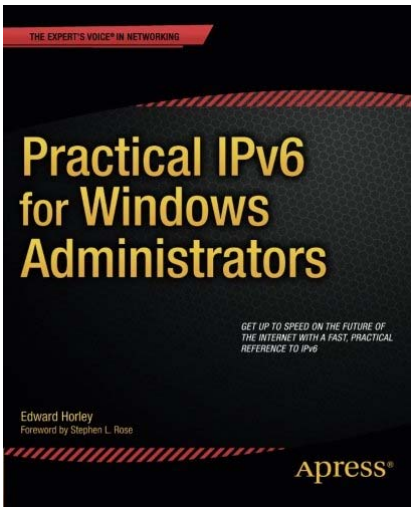
Resources





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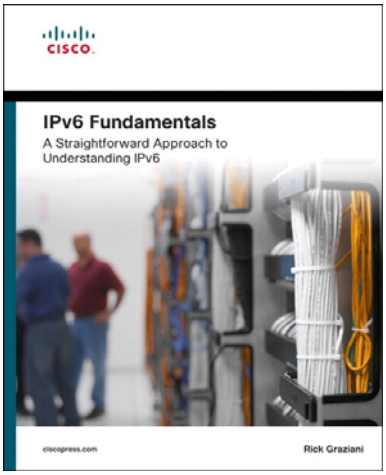
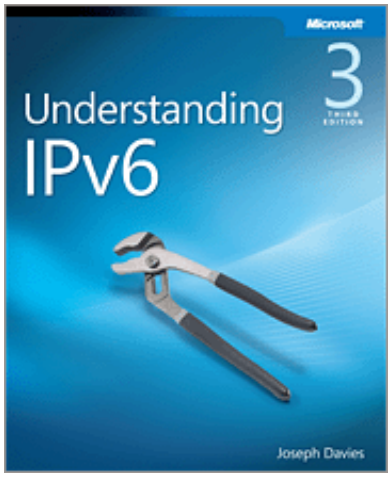
Resources





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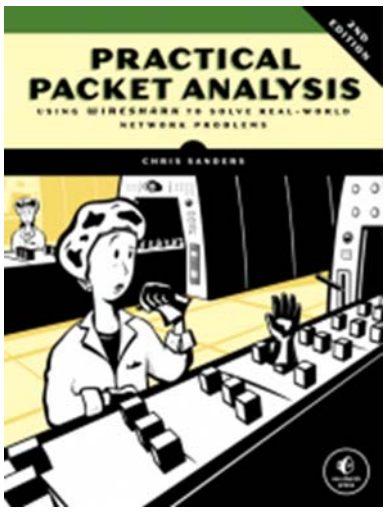
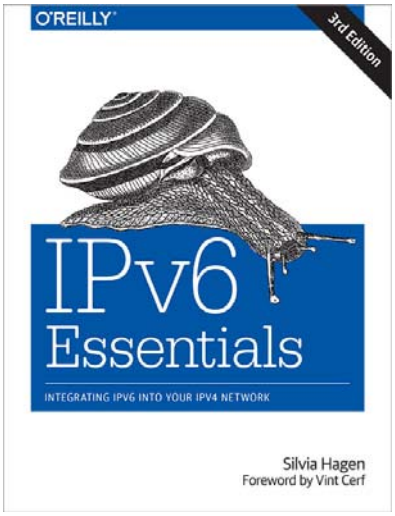
Resources





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Thank You for Attending!

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- Twitter: @JeffCarrell_v6

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