8-2 Cyber Playbook Submission
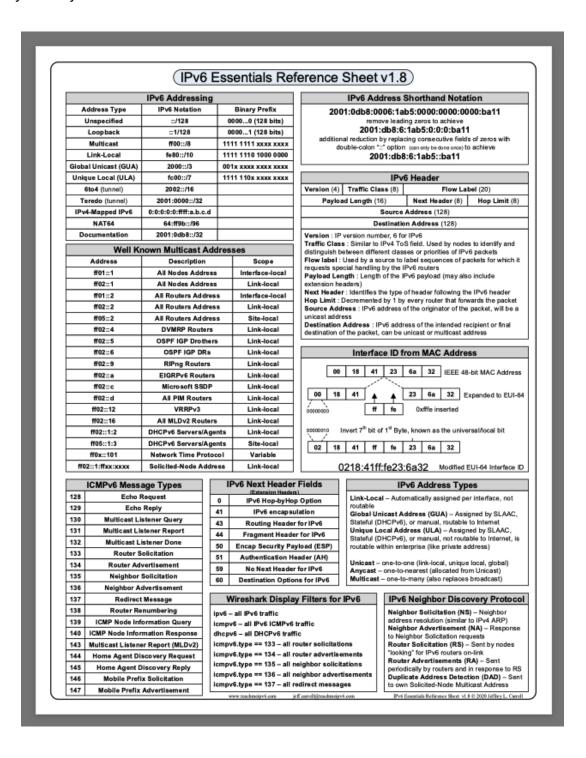
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IPv6 Essentials Reference Sheet v1.8

IPv6 Addressing

Address Type	IPv6 Notation	Binary Prefix
Unspecified	::/128	0000...0 (128 bits)
Loopback	::1/128	0000...1 (128 bits)
Multicast	ff00::/8	1111 1111 xxxx xxxx
Link-Local	fe80::/10	1111 1110 1000 0000
Global Unicast (GUA)	2000::/3	001x xxxx xxxx xxxx
Unique Local (ULA)	fc00::/7	1111 110x xxxx xxxx
6to4 (tunnel)	2002::/16	
Teredo (tunnel)	2001:0000::/32	
IPv4-Mapped IPv6	0:0:0:0:0:ffff:a.b.c.d	
NAT64	64:ff9b::/96	
Documentation	2001:0db8::/32	

IPv6 Address Shorthand Notation

2001:0db8:0006:1ab5:0000:0000:0000:ba11
remove leading zeros to achieve
2001:db8:6:1ab5:0:0:0:ba11
additional reduction by replacing consecutive fields of zeros with double-colon "::" option (can only be done once) to achieve
2001:db8:6:1ab5::ba11

IPv6 Header

Version (4)	Traffic Class (8)		Flow Label (20)	
Payload Length (16)			Next Header (8)	Hop Limit (8)
Source Address (128)				
Destination Address (128)				

Version : IP version number, 6 for IPv6
Traffic Class : Similar to IPv4 ToS field. Used by nodes to identify and distinguish between different classes or priorities of IPv6 packets
Flow label : Used by a source to label sequences of packets for which it requests special handling by the IPv6 routers
Payload Length : Length of the IPv6 payload (may also include extension headers)
Next Header : Identifies the type of header following the IPv6 header
Hop Limit : Decremented by 1 by every router that forwards the packet
Source Address : IPv6 address of the originator of the packet, will be a unicast address
Destination Address : IPv6 address of the intended recipient or final destination of the packet, can be unicast or multicast address

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 IGP Drothers	Link-local
ff02::6	OSPF IGP DRs	Link-local
ff02::9	RIPng Routers	Link-local
ff02::a	EIGRPv6 Routers	Link-local
ff02::c	Microsoft SSDP	Link-local
ff02::d	All PIM Routers	Link-local
ff02::12	VRRPv3	Link-local
ff02::16	All MLDv2 Routers	Link-local
ff02::1:2	DHCPv6 Servers/Agents	Link-local
ff05::1:3	DHCPv6 Servers/Agents	Site-local
ff0x::101	Network Time Protocol	Variable
ff02::1:ffxx:xxxx	Solicited-Node Address	Link-local

Interface ID from MAC Address

| 00 | 18 | 41 | 23 | 6a | 32 | IEEE 48-bit MAC Address |

| 00 | 18 | 41 | | | 23 | 6a | 32 | Expanded to EUI-64 |

00000000   ff fe   0xfffe inserted

00000010   Invert 7th bit of 1st Byte, known as the universal/local bit

| 02 | 18 | 41 | ff | fe | 23 | 6a | 32 |

0218:41ff:fe23:6a32   Modified EUI-64 Interface ID

ICMPv6 Message Types

128	Echo Request
129	Echo Reply
130	Multicast Listener Query
131	Multicast Listener Report
132	Multicast Listener Done
133	Router Solicitation
134	Router Advertisement
135	Neighbor Solicitation
136	Neighbor Advertisement
137	Redirect Message
138	Router Renumbering
139	ICMP Node Information Query
140	ICMP Node Information Response
143	Multicast Listener Report (MLDv2)
144	Home Agent Discovery Request
145	Home Agent Discovery Reply
146	Mobile Prefix Solicitation
147	Mobile Prefix Advertisement

IPv6 Next Header Fields
(Extension Headers)

0	IPv6 Hop-byHop Option
41	IPv6 encapsulation
43	Routing Header for IPv6
44	Fragment Header for IPv6
50	Encap Security Payload (ESP)
51	Authentication Header (AH)
59	No Next Header for IPv6
60	Destination Options for IPv6

IPv6 Address Types

Link-Local – Automatically assigned per interface, not routable
Global Unicast Address (GUA) – Assigned by SLAAC, Stateful (DHCPv6), or manual, routable to Internet
Unique Local Address (ULA) – Assigned by SLAAC, Stateful (DHCPv6), or manual, not routable to Internet, is routable within enterprise (like private address)

Unicast – one-to-one (link-local, unique local, global)
Anycast – one-to-nearest (allocated from Unicast)
Multicast – one-to-many (also replaces broadcast)

Wireshark Display Filters for IPv6

ipv6 – all IPv6 traffic
icmpv6 – all IPv6 ICMPv6 traffic
dhcpv6 – all DHCPv6 traffic
icmpv6.type == 133 – all router solicitations
icmpv6.type == 134 – all router advertisements
icmpv6.type == 135 – all neighbor solicitations
icmpv6.type == 136 – all neighbor advertisements
icmpv6.type == 137 – all redirect messages

IPv6 Neighbor Discovery Protocol

Neighbor Solicitation (NS) – Neighbor address resolution (similar to IPv4 ARP)
Neighbor Advertisement (NA) – Response to Neighbor Solicitation requests
Router Solicitation (RS) – Sent by nodes "looking" for IPv6 routers on-link
Router Advertisements (RA) – Sent periodically by routers and in response to RS
Duplicate Address Detection (DAD) – Sent to own Solicited-Node Multicast Address

www.teachmeipv6.com   jeff.carroll@teachmeipv6.com   IPv6 Essentials Reference Sheet v1.8 © 2020 Jeffrey L. Carroll

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I have chosen the IPv6 Essentials Cheat Sheet. The IPv6 Addressing section of the IPv6 Essentials Reference Sheet is an invaluable resource, particularly for professionals in the future of network technology and infrastructure. As the depletion of IPv4 addresses necessitates a shift towards the more abundant IPv6 space, understanding the various types of IPv6 addresses is

imperative. This section demystifies the structure of global unicast, link-local, and unique local addresses and provides a clear and concise reference for their proper use and scope. Proficiency in these addressing schemes is fundamental to designing and managing modern, scalable networks. Moreover, as Internet-connected devices continue to increase in the age of the Internet of Things (IoT), the importance of mastering IPv6 addressing will only amplify, making this knowledge not just currently relevant but increasingly critical in the years to come.