

# Internet Protocol Version 6 (IPv6) Basics cheat sheet – v 0.9.2

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## IPv6 quick facts

successor of IPv4 • 128-bit long addresses • that's  $2^{96}$  more IPs than IPv4 • that's  $2^{128}$  or  $3.4 \times 10^{38}$  or over 340 undecillion IPs overall • a customer usually gets a /64 subnet, which yields 4 billion times the IPs available by IPv4 • no need for network address translation (NAT) any more • no broadcasts any more • no ARP • stateless address configuration without DHCP • improved multicast • easy IP renumbering • minimum MTU size 1280 • mobile IPv6 • mandatory IPsec support • extension headers • jumbograms up to 4 GiB

## IPv6 RFCs

Some important IPv6 related RFCs. You can find them online at [http://tools.ietf.org/html/rfc\[RFC number\]](http://tools.ietf.org/html/rfc[RFC number])

<a href="#">RFC 2460</a>	IPv6 Specifications	<a href="#">RFC 4443</a>	ICMPv6 for IPv6
<a href="#">RFC 4291</a>	IPv6 Addressing Architectures	<a href="#">RFC 3587</a>	IPv6 Global Unicast Address Format
<a href="#">RFC 4861</a>	IPv6 Neighbor Discovery	<a href="#">RFC 4193</a>	Unique Local IPv6 Unicast Addresses
<a href="#">RFC 4862</a>	IPv6 Stateless Address Configuration	<a href="#">RFC 2375</a>	IPv6 Multicast Address Assignments
<a href="#">RFC 1981</a>	Path MTU Discovery for IPv6	<a href="#">RFC 3849</a>	IPv6 Address Prefix For Documentation

## IPv6 & ICMPv6 Headers

### IPv6 header

0	8	16	24	32
version	traffic class	flow label		
payload length		next header	hop limit	
source IPv6 address				
destination IPv6 address				

**Version** (4 bits): IP version. Always 6.

**Traffic class** (8 bits): Used for QoS. Like the TOS field in IPv4. [RFC 2474](#).

**Flow label** (20 bits): Used for packet labelling, End-to-end QoS. [RFC 3697](#).

**Payload length** (16 bits): Length of the payload following the header in bytes. Limits the packet size to 64 KB.

**Next header** (8 bits): Following header or protocol. Like protocol type field in IPv4.

**Hop limit** (8 bits): Number of hops until the packet gets discarded. TTL in IPv4.

**Source address** (128 bit): IPv6 source address.

**Destination address** (128 bits): IPv6 destination address.

### ICMPv6 header

0	8	16	24	32
ICMPv6 type	ICMPv6 code	ICMPv6 checksum		
ICMPv6 data				

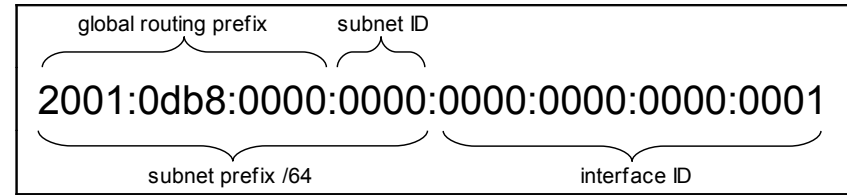
**ICMP type** (8 bits): Error messages have a 0 high-order-bit (types 0 to 127), info messages have a 1 high-order-bit (types 128 to 255).

**ICMP code** (8 bits): Further specifies the kind of message along with the type. F.i. type 1 code 4 is "destination port unreachable".

**ICMP checksum** (16 bits): Checksum to prevent data corruption.

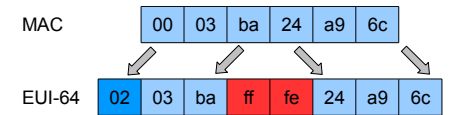
## IPv6 Address Basics

IPv6 address example:



IPv6 addresses are written in hexadecimal and divided into eight pairs of two byte blocks, each containing four hex digits. Addresses can be shortened by skipping leading zeros in each block. This would make 2001:db8:0:0:0:0:0:1 out of the example address.

Additionally, once per IPv6 IP, we can replace consecutive zeros with a double colon: 2001:db8::1. The 64-bit interface ID should be in EUI-64 format. A 48-bit MAC can be transformed to an 64-bit interface ID by inverting the 7<sup>th</sup> (universal) bit and inserting a ff and fe byte after the 3<sup>rd</sup> byte. So the MAC 00:03:ba:24:a9:c6 becomes 0203:baff:fe24:a9c6. See [RFC 4291 Appendix A](#).



## IPv6 Address Scopes

::/128	unspecified address
::1/128	localhost
fe80::/10	link local scope
fec0::/10	site local scope, intended as <a href="#">RFC 1918</a> successor, deprecated in <a href="#">RFC 3879</a>
fc00::/7	unique local unicast scope, <a href="#">RFC 4193</a> , divided into:
fc00::/8	centrally assigned by <i>unkown</i> (see <a href="http://bit.ly/IETFfc00">http://bit.ly/IETFfc00</a> ), routed within a site
fd00::/8	free for all, global ID must be generated randomly, routed within a site
ff00::/8	multicast scope, following after the prefix ff there are 4 bits for flags and 4 bits for the scope. Example: ff02::1 reaches all nodes, ff02::2 reaches all routers
ff02::1:ff/104	solicited-node multicast address, the 24 low-order bits are equal to the interface IP's
::/96	IPv4-Compatible IPv6 Address, example: ::192.168.1.2, deprecated with <a href="#">RFC 4291</a>
::ffff:0:0/96	IPv4-Mapped IPv6 Address, example: ::ffff:192.168.2.1, see <a href="#">RFC 4038</a>
2000::/3	global unicast scope, divided into:
2001::/16	/32 subnets assigned to providers, they assign /48, /56 or /64 to the customer
2001:db8::/32	reserved for use in documentation
2001:678::/29	Provider Independent (PI) addresses and anycasting TLD nameservers
2002::/16	6to4 scope, 2002:c058:6301:: is the 6to4 public router anycast ( <a href="#">RFC 3068</a> )
3ffe::/16	6Bone scope, returned to IANA with <a href="#">RFC 3701</a> , you should not see these

## Multicast Scopes

1	Interface-local	5	Site-local
2	Link-local	8	Organization-Local
4	Admin-local	e	Global

## Neighbor Discovery Message Options

1	Source Link-Layer Address
2	Target Link-Layer Address
3	Prefix Information
4	Redirected Header
5	MTU (max MTU supported by all segments)

