Network Cheat Sheet

IPv4, IPv6, CIDR, and Subnetting

IPv4 Cheat sheet Basics

- **Address format**: Four octets (32 bits), e.g., 192.168.1.1.
- **Range**: 0.0.0.0 to 255.255.255.255.
- **Classes**:
  - **Class A**: 1.0.0.0 - 126.255.255.255 (/8)
  - **Class B**: 128.0.0.0 - 191.255.255.255 (/16)
  - **Class C**: 192.0.0.0 - 223.255.255.255 (/24)
  - **Class D**: Multicast (224.0.0.0 - 239.255.255.255)
  - **Class E**: Experimental (240.0.0.0 - 255.255.255.255)

IPv4 Subnet Masks

CIDR Notation	Subnet Mask	Wildcard Mask	Hosts
/0	0.0.0.0	255.255.255.255	4,294,967,294
/1	128.0.0.0	127.255.255.255	2,147,483,646
/2	192.0.0.0	63.255.255.255	1,073,741,822
/3	224.0.0.0	31.255.255.255	536,870,910
/4	240.0.0.0	15.255.255.255	268,435,454
/5	248.0.0.0	7.255.255.255	134,217,726
/6	252.0.0.0	3.255.255.255	67,108,862
/7	254.0.0.0	1.255.255.255	33,554,430

/8	255.0.0.0	0.255.255.255	16,777,214
/9	255.128.0.0	0.127.255.255	8,388,606
/10	255.192.0.0	0.63.255.255	4,194,302
/11	255.224.0.0	0.31.255.255	2,097,150
/12	255.240.0.0	0.15.255.255	1,048,574
/13	255.248.0.0	0.7.255.255	524,286
/14	255.252.0.0	0.3.255.255	262,142
/15	255.254.0.0	0.1.255.255	131,070
/16	255.255.0.0	0.0.255.255	65,534
/17	255.255.128.0	0.0.127.255	32,766
/18	255.255.192.0	0.0.63.255	16,382
/19	255.255.224.0	0.0.31.255	8,190
/20	255.255.240.0	0.0.15.255	4,094
/21	255.255.248.0	0.0.7.255	2,046
/22	255.255.252.0	0.0.3.255	1,022
/23	255.255.254.0	0.0.1.255	510
/24	255.255.255.0	0.0.0.255	254
/25	255.255.255.128	0.0.0.127	126
/26	255.255.255.192	0.0.0.63	62
/27	255.255.255.224	0.0.0.31	30
/28	255.255.255.240	0.0.0.15	14
/29	255.255.255.248	0.0.0.7	6
/30	255.255.255.252	0.0.0.3	2
/31	255.255.255.254	0.0.0.1	Used for p2p links
/32	255.255.255.255	0.0.0.0	Single host (1 IP)

Wildcard Masks

- **Used in ACLs** to specify IP ranges.
- **Formula**: Wildcard = 255 - Subnet Mask.

IPv4 Special IPs

- **0.0.0.0**: Default route (any network).
- **127.0.0.1**: Loopback (localhost).
- **169.254.0.0/16**: APIPA (Auto-assigned when DHCP fails).
- **192.168.0.0/16**: Private range (used for internal networks).
- **Broadcast Address**: Last address in the subnet (e.g., 192.168.1.255 for /24).

IPv4 Subnetting Formula

- **Number of Subnets**: 2^n (where n is the number of borrowed host bits).
- **Hosts per Subnet**: 2^h - 2 (where h is the number of host bits, subtracting network and broadcast).

IPv4 Subnetting Example

Divide a /24 into /26:

- Original: 192.168.1.0/24 (254 hosts).
- Subnets: 192.168.1.0/26, 192.168.1.64/26, 192.168.1.128/26, 192.168.1.192/26.
- Hosts per subnet: 62 usable hosts.

Divide a /24 into /30 (for point-to-point connections):

- Original: 192.168.1.0/24.
- Creates 64 subnets, each with 2 usable hosts:

- Subnet 1: 192.168.1.0/30
- Subnet 2: 192.168.1.4/30
- Subnet 3: 192.168.1.8/30

Reserved IP Addresses

- **Network Address**: First address in a subnet (e.g., 192.168.1.0 in /24).
- **Broadcast Address**: Last address in a subnet (e.g., 192.168.1.255 in /24).

Private IPv4 Address Ranges

Class	Range
Class A	10.0.0.0 to 10.255.255.255
Class B	172.16.0.0 to 172.31.255.255
Class C	192.168.0.0 to 192.168.255.255

Bogon IPv4 addresses

Bogon IP Range	CIDR Notation	Notes
0.0.0.0/8	0.0.0.0/8	"This" network, used for routing
10.0.0.0/8	10.0.0.0/8	Private network (RFC 1918)
100.64.0.0/10	100.64.0.0/10	Carrier-grade NAT (RFC 6598)
127.0.0.0/8	127.0.0.0/8	Loopback addresses
169.254.0.0/16	169.254.0.0/16	Link-local addresses (APIPA)
172.16.0.0/12	172.16.0.0/12	Private network (RFC 1918)
192.0.0.0/24	192.0.0.0/24	IETF protocol assignments
192.0.2.0/24	192.0.2.0/24	Documentation (TEST-NET-1)
192.168.0.0/16	192.168.0.0/16	Private network (RFC 1918)

198.18.0.0/15	198.18.0.0/15	Testing and benchmarking
198.51.100.0/24	198.51.100.0/24	Documentation (TEST-NET-2)
203.0.113.0/24	203.0.113.0/24	Documentation (TEST-NET-3)
224.0.0.0/4	224.0.0.0/4	Multicast addresses
240.0.0.0/4	240.0.0.0/4	Reserved for future use
255.255.255.255/32	255.255.255.255/32	Limited broadcast

Common IPv4 Concepts

- **DHCP**: Dynamic Host Configuration Protocol for automatic IP assignment.
- **NAT**: Network Address Translation, allowing private IPs to access the public Internet.
- **ARP**: Address Resolution Protocol, resolves IP to MAC addresses.

Comprehensive List of IPv4 Commands (Windows, Linux, macOS, etc.)

Windows IPv4 Commands

1. View IP Configuration:

```
ipconfig
```

Displays IPv4 information such as IP address, subnet mask, and gateway.

2. Release IP Address:

```
ipconfig /release
```

Releases the IPv4 address obtained from a DHCP server.

3. Renew IP Address:

```
ipconfig /renew
```

Renews the IPv4 address from the DHCP server.

4. Flush DNS Cache:

```
ipconfig /flushdns
```

Clears the DNS resolver cache.

5. Display DNS Cache:

```
ipconfig /displaydns
```

6. Ping an IP Address:

```
ping <IP_Address>
```

Tests network connectivity to an IP address.

7. Traceroute (Trace the route packets take):

```
tracert <IP_Address>
```

8. Check Active Connections:

```
netstat -an
```

9. Check Routing Table:

```
route print
```

10. Add a Static Route:

```
route add <destination> mask <subnet_mask> <gateway>
```

Example:

```
route add 192.168.1.0 mask 255.255.255.0 192.168.0.1
```

11. Delete a Static Route:

```
route delete <destination>
```

Linux/macOS IPv4 Commands

1. View IP Configuration:

```
ifconfig
```

Shows IPv4 details like IP address and subnet mask (Linux/macOS). OR

```
ip addr show
```

Displays IPv4 and IPv6 addresses (Linux-specific).

2. Bring Up/Down an Interface:

```
sudo ifconfig <interface> up/down
```

3. Release IP Address (DHCP):

```
sudo dhclient -r
```

4. Renew IP Address (DHCP):

```
sudo dhclient
```

5. Ping an IP Address:

```
ping <IP_Address>
```

6. Traceroute:

```
traceroute <IP_Address>
```

7. View Routing Table:

```
netstat -r
```

8. Add Static Route:

```
sudo route add -net <network> netmask <subnet_mask> gw <gateway>
```

Example:

```
sudo route add -net 192.168.1.0 netmask 255.255.255.0 gw 192.168.0.1
```

9. Delete Static Route:

```
sudo route del -net <network> netmask <subnet_mask>
```

10. Check Network Interface Status:

```
ip link show
```

11. Flush DNS Cache (macOS):

```
sudo dscacheutil -flushcache
sudo killall -HUP mDNSResponder
```

12. View DNS Information:

```
cat /etc/resolv.conf
```

Cisco IOS IPv4 Commands (Network Devices)

1. View Interface IP Configuration:

```
show ip interface brief
```

2. Configure an IP Address on an Interface:

```
configure terminal
interface <interface>
ip address <IP_Address> <subnet_mask>
no shutdown
```

3. Configure Default Gateway:

```
ip default-gateway <gateway_IP>
```

4. View Routing Table:

```
show ip route
```

5. Ping an IP Address:

```
ping <IP_Address>
```

6. Traceroute to an IP Address:

```
traceroute <IP_Address>
```

7. Add Static Route:

```
ip route <destination> <subnet_mask> <next_hop>
```

Example:

```
ip route 192.168.1.0 255.255.255.0 192.168.0.1
```

8. Clear ARP Cache:

```
clear arp-cache
```

9. View ARP Table:

```
show ip arp
```

Advanced Network Diagnostic Commands (All Platforms)

1. MTR (Linux/macOS):

```
mtr <IP_Address>
```

Combines ping and traceroute to provide network diagnostics.

2. NSLookup (Windows/Linux/macOS):

```
nslookup <domain_name>
```

Queries DNS servers for domain-to-IP resolution.

3. Dig (Linux/macOS):

```
dig <domain_name>
```

4. Check Open Ports (Linux/macOS/Windows):

```
netstat -tuln
```

5. Check Active Connections and Listening Ports (Windows):

```
netstat -aon
```

Firewall Commands

Windows Firewall

1. View Firewall Rules:

```
netsh advfirewall firewall show rule name=all
```

2. Add Firewall Rule:

```
netsh advfirewall firewall add rule name="Allow HTTP" protocol=TCP dir=in localport=80 action=allow
```

3. Delete Firewall Rule:

```
netsh advfirewall firewall delete rule name="Allow HTTP"
```

Linux IPTables

1. View Current Rules:

```
sudo iptables -L
```

2. Add Rule to Allow Port:

```
sudo iptables -A INPUT -p tcp --dport 80 -j ACCEPT
```

3. Delete Rule:

```
sudo iptables -D INPUT -p tcp --dport 80 -j ACCEPT
```

IPv6 Cheat Sheet Basics

Basic IPv6 Structure

- **IPv6 address**: 128 bits, divided into eight 16-bit blocks (hexadecimal).
    - Example: 2001:0db8:85a3:0000:0000:8a2e:0370:7334
    - **Compressed form**: 2001:db8:85a3::8a2e:370:7334 (omit leading zeros & consecutive zeros).

Prefix Length (Similar to Subnet Mask in IPv4)

- Notation: /64, /48, etc.
- Example: 2001:db8::/64 (first 64 bits are the network part).

Reserved IPv6 Addresses

- **Loopback**: ::1
- **Unspecified Address**: :: (similar to 0.0.0.0 in IPv4).
- **Link-Local**: fe80::/10 (used for local network communication).
- **Unique Local Address (ULA)**: fc00::/7 (private networks, like IPv4's 10.0.0.0/8).
- **Multicast**: ff00::/8

Wildcard Notations

Zero Compression: ::

- Example: 2001:db8::1 (represents 2001:db8:0000:0000:0000:0000:0000:0001).

Omitting leading zeros: 2001:0db8:0000:0000:8a2e:0370:7334 becomes 2001:db8::8a2e:370:7334.

IPv6 Address Types

- **Global Unicast**: Globally unique, routable on the internet. (Prefix 2000::/3)
- **Link-Local**: Used within a local network (Prefix fe80::/10).
- **Multicast**: For sending to multiple interfaces (Prefix ff00::/8).
- **Anycast**: Address assigned to multiple interfaces, routed to the nearest.

IPv6 to Binary Conversion

Convert each hexadecimal block to 16-bit binary.

- Example: 2001:db8::1 becomes:
    - 2001 → 0010000000000001
    - db8 → 0000110110111000
    - ::1 → 0000000000000001 (remaining blocks are zero)

IPv6 Address Planning

Common Subnetting Prefix Lengths:

- /64: Standard subnet size, commonly used for a local network.
- /48: Often allocated to organizations for further subnetting.
- /56: A smaller block often given to end-users by ISPs.

Neighbor Discovery (Equivalent of ARP in IPv4)

Neighbor Discovery: Uses ICMPv6 for address resolution and managing network relationships.

Command:

```
ip -6 neigh
```

ICMPv6

Used for error messages and diagnostics (like ping and traceroute in IPv4).

- **Type 1**: Destination unreachable.
- **Type 2**: Packet too big.
- **Type 128**: Echo request.
- **Type 129**: Echo reply.

IPv6 Transition Mechanisms

- **Dual Stack**: Devices run both IPv4 and IPv6.
- **Tunneling**: Encapsulates IPv6 packets in IPv4 (e.g., **6to4**, **Teredo**).
- **NAT64/DNS64**: Translates IPv6 traffic to IPv4 for IPv4-only networks.

Common IPv6 Prefixes

Prefix	Purpose
::/128	Unspecified address
::1/128	Loopback address
fe80::/10	Link-local addresses
fc00::/7	Unique local addresses (ULA)
ff00::/8	Multicast
2000::/3	Global Unicast
::ffff:0:0/96	IPv4-mapped addresses

Comprehensive List of IPv6 Commands (Windows, Linux, macOS, etc.)

IPv6 Commands for Linux

1. Viewing IPv6 Addresses & Interfaces:

View all IP addresses:

```
ip -6 addr show
```

Display network interfaces:

```
ifconfig -a
```

or

```
ip link show
```

2. Assigning IPv6 Address to an Interface:

Add IPv6 address to an interface:

```
sudo ip -6 addr add 2001:db8::1/64 dev eth0
```

Remove IPv6 address from an interface:

```
sudo ip -6 addr del 2001:db8::1/64 dev eth0
```

3.IPv6 Routes:

Add IPv6 route:

```
sudo ip -6 route add 2001:db8::/64 via fe80::1 dev eth0
```

Delete IPv6 route:

```
sudo ip -6 route del 2001:db8::/64
```

View IPv6 routing table:

```
ip -6 route show
```

4. Ping and Traceroute:

Ping an IPv6 address:

```
ping6 2001:db8::1
```

Traceroute to an IPv6 address:

```
traceroute6 2001:db8::1
```

5. Neighbor Discovery (IPv6 ARP equivalent):

Show neighbor cache:

```
ip -6 neigh show
```

Manually add a neighbor entry:

```
sudo ip -6 neigh add 2001:db8::1 lladdr 00:11:22:33:44:55 dev eth0
```

6. ICMPv6:

Allow ICMPv6 in the firewall (for `iptables`):

```
sudo ip6tables -A INPUT -p ipv6-icmp -j ACCEPT
```

7. Enable/Disable IPv6 on an Interface:

Disable IPv6 on an interface:

```
sudo sysctl -w net.ipv6.conf.eth0.disable_ipv6=1
```

Enable IPv6 on an interface:

```
sudo sysctl -w net.ipv6.conf.eth0.disable_ipv6=0
```

8. IPv6 Forwarding:

Enable IPv6 forwarding:

```
sudo sysctl -w net.ipv6.conf.all.forwarding=1
```

Disable IPv6 forwarding:

```
sudo sysctl -w net.ipv6.conf.all.forwarding=0
```

IPv6 Commands for Windows

1. Viewing IPv6 Configuration:

View IPv6 addresses:

```
ipconfig /all
```

View network interfaces:

```
netsh interface ipv6 show interfaces
```

2. Assigning IPv6 Address:

Assign an IPv6 address to an interface:

```
netsh interface ipv6 set address "Ethernet" 2001:db8::1
```

Remove an IPv6 address:

```
netsh interface ipv6 delete address "Ethernet" 2001:db8::1
```

3. IPv6 Routes:

Add an IPv6 route:

```
netsh interface ipv6 add route 2001:db8::/64 "Ethernet" fe80::1
```

Delete an IPv6 route:

```
netsh interface ipv6 delete route 2001:db8::/64 "Ethernet"
```

View IPv6 routing table:

```
netsh interface ipv6 show routes
```

4. Ping and Tracert:

Ping an IPv6 address:

```
ping -6 2001:db8::1
```

Traceroute to an IPv6 address:

```
tracert -6 2001:db8::1
```

5. Neighbor Discovery:

View neighbor cache:

```
netsh interface ipv6 show neighbors
```

6. ICMPv6:

Allow ICMPv6 through Windows Firewall:

```
netsh advfirewall firewall add rule name="Allow ICMPv6" protocol=icmpv6:all dir=in action=allow
```

IPv6 Commands for macOS

1. Viewing IPv6 Configuration:

View IPv6 addresses:

```
ifconfig
```

Show network interfaces:

```
networksetup -listallhardwareports
```

2. Assigning IPv6 Address:

Assign an IPv6 address to an interface:

```
sudo ifconfig en0 inet6 2001:db8::1 prefixlen 64
```

Remove an IPv6 address:

```
sudo ifconfig en0 inet6 delete 2001:db8::1
```

3.IPv6 Routes:

Add an IPv6 route:

```
sudo route -n add -inet6 2001:db8::/64 fe80::1
```

Delete an IPv6 route:

```
sudo route -n delete -inet6 2001:db8::/64
```

View IPv6 routing table:

```
netstat -nr -f inet6
```

4. Ping and Traceroute:

Ping an IPv6 address:

```
ping6 2001:db8::1
```

Traceroute to an IPv6 address:

```
traceroute6 2001:db8::1
```

5. Neighbor Discovery:

Show neighbor cache:

```
ndp -a
```

Manually add a neighbor entry:

```
sudo ndp -s 2001:db8::1 00:11:22:33:44:55
```

Additional IPv6 Utilities Across Platforms

1. IPv6 Address Compression/Decompression:

IPv6 Address Compression Tool:

Compress:

```
ipv6calc --addr2compress 2001:0db8:0000:0000:0000:0000:0000:0001
```

Decompress:

```
ipv6calc --addr2uncompress 2001:db8::1`
```

2. IPv6 Packet Capture:

tcpdump for IPv6 traffic:

```
sudo tcpdump -i eth0 ip6
```

3. Test IPv6 Connectivity:

Check IPv6 connectivity (browser-based):

```
http://test-ipv6.com
```