$ cd reference / CIDR and subnet sizes

CIDR prefixes, subnet masks and address ranges

A prefix length says how many leading bits of an address identify the network. The remaining bits number the hosts.

[01] IPv4 prefix table

PREFIX	NETMASK	ADDRESSES	USABLE HOSTS
/8	255.0.0.0	16,777,216	16,777,214
/12	255.240.0.0	1,048,576	1,048,574
/16	255.255.0.0	65,536	65,534
/20	255.255.240.0	4,096	4,094
/22	255.255.252.0	1,024	1,022
/23	255.255.254.0	512	510
/24	255.255.255.0	256	254
/25	255.255.255.128	128	126
/26	255.255.255.192	64	62
/27	255.255.255.224	32	30
/28	255.255.255.240	16	14
/29	255.255.255.248	8	6
/30	255.255.255.252	4	2
/31	255.255.255.254	2	2 (point-to-point, RFC 3021)
/32	255.255.255.255	1	1 (single host)

Addresses: 2^(32 - prefix). Usable hosts: that number minus the network and broadcast addresses, except for /31 and /32.

[02] Doing it by hand

Find the octet where the prefix ends and the block size there: 256 minus the mask octet. For `/26` the mask octet is 192 and the block size 64, so the networks in the last octet start at 0, 64, 128 and 192. The address `192.168.10.77/26` falls in the block starting at 64:

```
network    192.168.10.64
first      192.168.10.65
last       192.168.10.126
broadcast  192.168.10.127
```

Two prefixes can be merged into one only if they are adjacent and the lower one starts on a boundary of the larger size. `10.0.0.0/24` and `10.0.1.0/24` merge into `10.0.0.0/23`; `10.0.1.0/24` and `10.0.2.0/24` do not.

[03] Special IPv4 ranges

RANGE	PURPOSE
`10.0.0.0/8`	private (RFC 1918)
`172.16.0.0/12`	private (RFC 1918): 172.16.0.0 to 172.31.255.255
`192.168.0.0/16`	private (RFC 1918)
`100.64.0.0/10`	shared space for carrier-grade NAT (RFC 6598)
`192.0.0.0/24`	IETF protocol assignments (RFC 6890)
`127.0.0.0/8`	loopback; the whole /8, not only 127.0.0.1
`169.254.0.0/16`	link-local, self-assigned when DHCP fails
`192.0.2.0/24`, `198.51.100.0/24`, `203.0.113.0/24`	documentation and examples
`198.18.0.0/15`	benchmark testing
`224.0.0.0/4`	multicast
`240.0.0.0/4`	reserved
`255.255.255.255/32`	limited broadcast
`0.0.0.0/8`	"this network"; 0.0.0.0 as a listen address means all interfaces

[04] IPv6 prefixes in use

PREFIX	TYPICAL MEANING
/32	allocation to an ISP or a large organisation
/48	one site; 65,536 subnets of /64
/56	common delegation to a home or small office; 256 subnets

PREFIX	TYPICAL MEANING
/64	one subnet (LAN or VLAN); required for SLAAC
/127	link between two routers (RFC 6164)
/128	a single address, such as a loopback or a host route

RANGE	PURPOSE
::1/128	loopback
fe80::/10	link-local; every interface has one
fc00::/7	unique local addresses, in practice fd00::/8
2001:db8::/32, 3fff::/20	documentation (RFC 3849, RFC 9637)
100::/64	discard-only (RFC 6666)
ff00::/8	multicast
::ffff:0:0/96	IPv4-mapped addresses, such as ::ffff:192.0.2.1
2000::/3	global unicast

[05] Writing IPv6 addresses

An address is eight groups of four hex digits. Leading zeros in a group may be dropped, and one run of all-zero groups may be replaced by `::`, once per address. RFC 5952 fixes a canonical form so that the same address is always written the same way: lowercase, no leading zeros, `::` for the longest run of two or more zero groups, the first one if two runs tie.

```
2001:0db8:0000:0000:0000:ff00:0042:8329   full
2001:db8:0:0:0:ff00:42:8329               leading zeros dropped
2001:db8::ff00:42:8329                    canonical
```

In URLs an IPv6 address goes in brackets so the port can be told apart: `[2001:db8::1]:8443`.

[06] Sources

[1] IANA IPv4 special-purpose address registry

[2] IANA IPv6 special-purpose address registry

[3] RFC 1918: private addresses

[4] RFC 3021: /31 links

[5] RFC 6164: /127 links

[6] RFC 4291: IPv6 addressing

[7] RFC 5952: writing IPv6 addresses

[8] RFC 9637: 3fff::/20 for documentation