The Subnet Mask

- A host can send traffic directly to another host on the same subnet via switches
- For a host to send traffic to another host in a different subnet, it must be forwarded by a router
- The host therefore needs to understand if the destination is on the same or a different subnet in order to know how to send it
- The subnet mask is used for this
- The subnet mask is also 32 bits long, and can be written in dotted decimal or slash notation



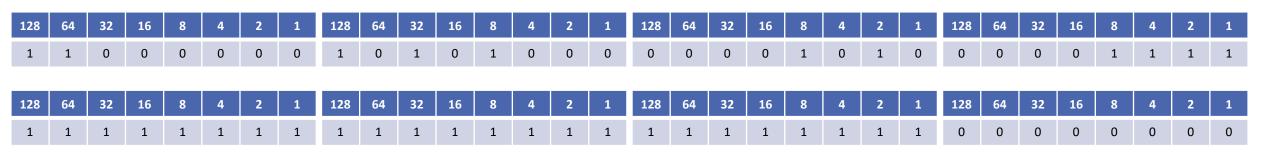
Network and Host Portion

- A host's IP address is divided into a network portion and a host portion
- The subnet mask defines where the boundary is
- The easiest way to explain this is through example...
- Let's say the host's IP address is 192.168.10.15 and its subnet mask is 255.255.255.0
- We write the IP address out in binary notation, and then the subnet mask underneath



Subnet 'Masking'





- The IP address is compared ('masked') with the subnet mask
- A '1' in the subnet mask indicates that bit in the IP address is part of the network address
- A '0' indicates the bit is part of the host address



The Network Portion



- In our example, the network address portion is 192.168.10
- The host address portion is .15



Local Subnet or Routed Traffic





128 1	64 1	32 0	16	8	4 0	2	0	128 1	64 0	32	16	8	4 0	0	0	128	64 0	32 0	16 0	8	4 0	2	0	128 0	64 0	32 0	16 0	8	1	2	1
128																															

- If the host wants to communicate with another host with an IP address which also begins with 192.168.10. (for example 192.168.10.20), it knows it's on the same subnet and it can send the traffic directly
- If it wants to communicate with another host with any other network address (for example 192.168.11.20), it knows it has to send the traffic via a router

Local Subnet or Routed Traffic



128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	1	1
128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1

- For a destination address to be in the same subnet, the network portion has to be exactly 192.168.10.
- Otherwise it's in a different subnet and traffic must be sent via a router



Valid Subnet Masks



128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	1	1
128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	0	1

- The subnet mask always begins with contiguous '1's
- For example, 1111111111110000.00000000.00000000 is a legal subnet mask
- 11101101.11110000.11100000.00001111 is not



The Host Portion



																128															
1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	1	1	1
128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1		64	32		8	4	2	1	128	64	32	16	8	4	2	1

- The host portion of the address is available to be allocated to the different hosts on the subnet (eg PCs, Servers, Printers, Router Interfaces and Switch Management Addresses)
- With two exceptions (coming up after the next slide)...



Host Addresses

- The host portion of the address specifies the individual host and must be unique on that subnet
- Hosts do not have to be numbered sequentially
- If the network portion of the address is 10.10.10, you can have a host with IP address 10.10.10.10 and another host with 10.10.10.20
- You can't have two different hosts both with IP address 10.10.10.10. That would be a duplicate IP address. Whenever another host sent traffic to 10.10.10.10, the network wouldn't know which one to send it to.
- We could have host 10.10.10.10 on one subnet and host 10.10.20.10 on another subnet



The Network Address (Network ID)

9 192.168.10.15 / 255.255.255.0



					128												
128	64				128												1 0

- All 0's in the host portion designates the network address and is not allowed to be allocated to a host
- In our example the network address is 192.168.10.0

12	28	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
	1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0

The Broadcast Address





								128																							
1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1	1	1	1	1	1	1
128	64	32		8	4	2	1	128	64	32	16	8			1	128	64				4	2	1	128	64	32	16	8	4	2	1

- All 1's designates the directed broadcast address for the subnet
- Traffic with this destination address will be sent to all hosts in the subnet
- In our example the broadcast address is 192.168.10.255

128	6	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1		1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	1	1	1	1	1	1	1	1

Host Addresses



9 192.168.10.15 / 255.255.255.0

				128												1
				128												1

That leaves 192.168.10.1 to 192.168.10.254 available to be allocated to hosts

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0