Basics of IPv4 Addresses
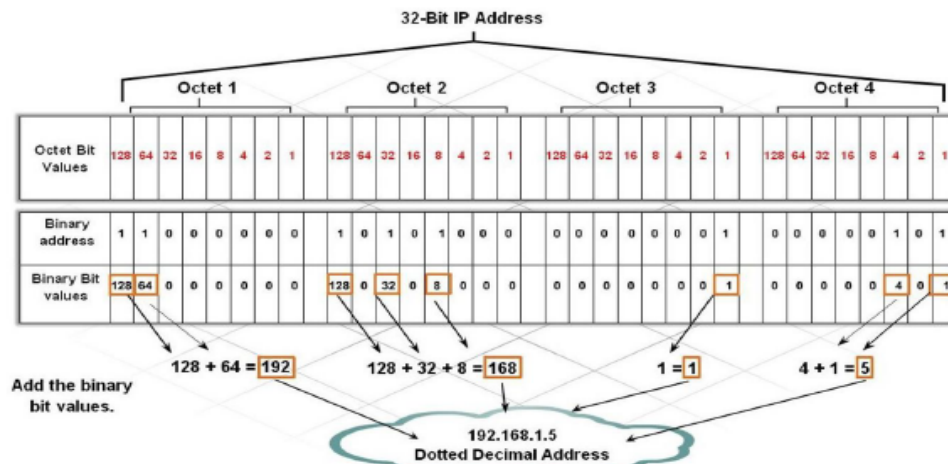
IPv4 Address

- An IP address is a 32-bit address, represented in decimal form

- An IP address divided into four eight-bit blocks. (e.g. 192.168.1.5)

- All devices on an IP network need a unique IP address

- In addition, a subnet mask must be set

- Subnet mask "tells" which network the IP address belongs to.

- The subnet mask is 32-bit long and may look like this 255.255.255.0

Network and Host Portions

- Each IP address is divided into a network and host part.

- The parts are determined by the subnet mask.

- By comparing the mask and the address, you will notice that 255 in mask indicates the network part of the address

|	Network Portion			Host Portion
IPv4 Address	192 . 168 . 10	.	10
	11000000 10101000 00001010			00001010
Subnet Mask	255 . 255 . 255	.	0
	11111111 11111111 11111111			00000000

address 172.16.10.10
mask   255.255.0.0

To identify the network and host portions of an IPv4 address, the subnet mask is compared to the IPv4 address bit for bit, from left to right.

CISCO

Purpose of the network and host portion

- If the network part of the devices' IP address is the same, they can communicate with each other without routing.

- If the network part of the devices' IP addresses is different, they cannot communicate with each other even if a "physical" connection exists.
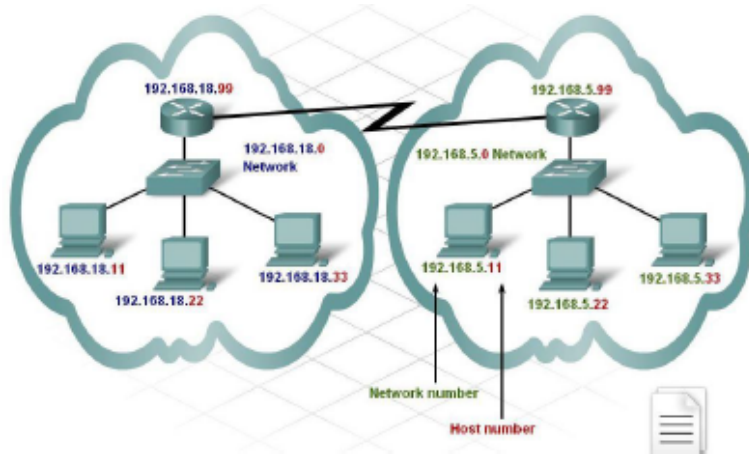
The Prefix Length

- A prefix length is another way used to identify a subnet mask address.

- The prefix length is the number of bits set to 1 in the subnet mask.
- It is written in "slash notation" therefore, count the number of bits in the subnet mask and prepend it with a slash.

Subnet Mask	32-bit Address	Prefix Length
255.0.0.0	11111111.00000000.00000000.00000000	/8
255.255.0.0	11111111.11111111.00000000.00000000	/16
255.255.255.0	11111111.11111111.11111111.00000000	/24

Network, Host, and Broadcast Addresses

- Within each network are three types of IP addresses:

  - Network address: first address of the network - **cannot be defined for devices**

  - Broadcast address: last address of teh network - **cannot be defined for devices**

  - Host addresses: all the rest addesses - **can be defined for any device**
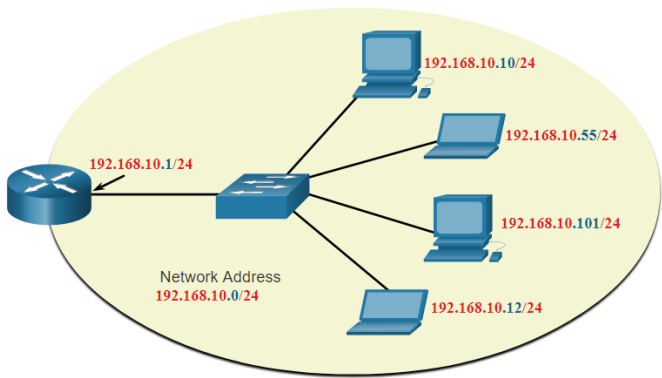
|	Network Portion			Host Portion
Subnet mask **255.255.255.**0 or **/24**	255 11111111	255 11111111	255 11111111	0 00000000
Network address **192.168.10.**0	192 11000000	168 10100000	10 00001010	0 00000000
First address **192.168.10.**1	192 11000000	168 10100000	10 00001010	1 00000001
Last address **192.168.10.**254	192 11000000	168 10100000	10 00001010	254 11111110
Broadcast address **192.168.10.**255	192 11000000	168 10100000	10 00001010	255 11111111

Public and Private IPv4 Addresses

- As defined in in RFC 1918, public IPv4 addresses are globally routed between internet service provider (ISP) routers.

- Private addresses are free to use on your own internal network, as long as each device has a different address.

- However, private addresses are not globally routable and address translation is required for communication to the public network.

Network Address and Prefix	RFC 1918 Private Address Range
10.0.0.0/8	10.0.0.0 - 10.255.255.255
172.16.0.0/12	172.16.0.0 - 172.31.255.255
192.168.0.0/16	192.168.0.0 - 192.168.255.255

Routing to the Internet

- Network Address Translation (NAT) translates private IPv4 addresses to public IPv4 addresses.

- NAT is typically enabled on the edge router connecting to the internet.

- It translates the internal private address to a public global IP address.
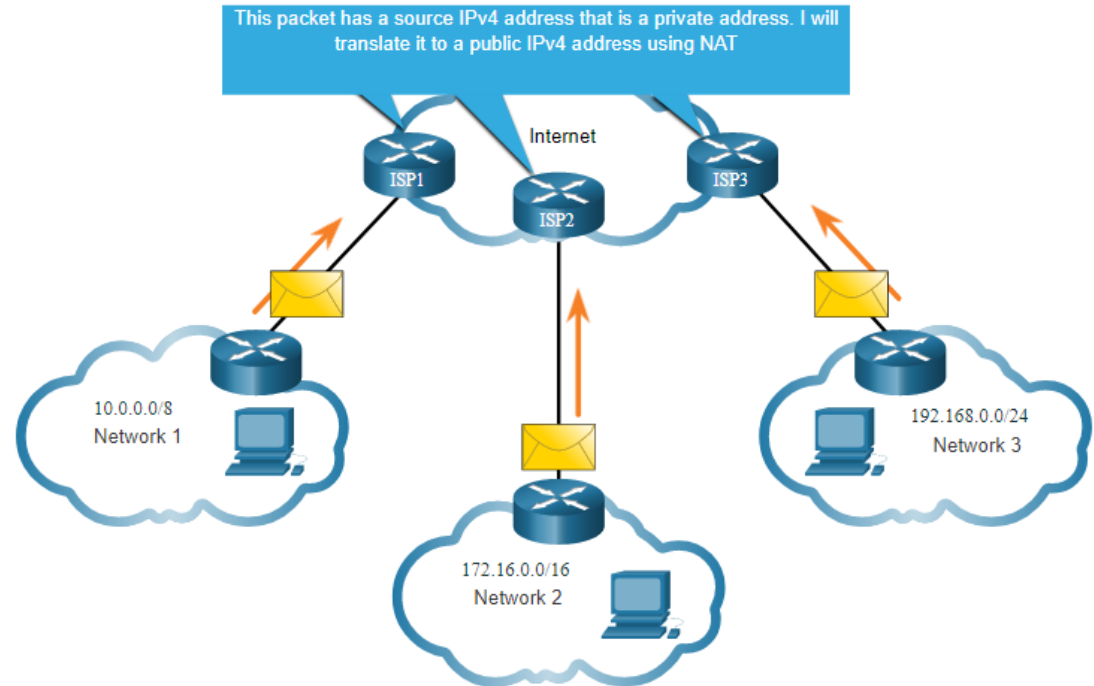
Special Use IPv4 Addresses

Loopback addresses

- 127.0.0.0 /8 (127.0.0.1 to 127.255.255.254)

- Commonly identified as only 127.0.0.1

- Used on a host to test if TCP/IP is operational.

Link-Local addresses

- 169.254.0.0 /16 (169.254.0.1 to 169.254.255.254)

- Commonly known as the Automatic Private IP Addressing (APIPA) addresses or self-assigned addresses.

- Used by Windows DHCP clients to self-configure when no DHCP servers are available.

IP address configurations

IP configurations

- The IP configuration can be done manually or using the DHCP-service
- You have to configure IP-address, subnet mask and usually IP-address of the gateway and DNS-server
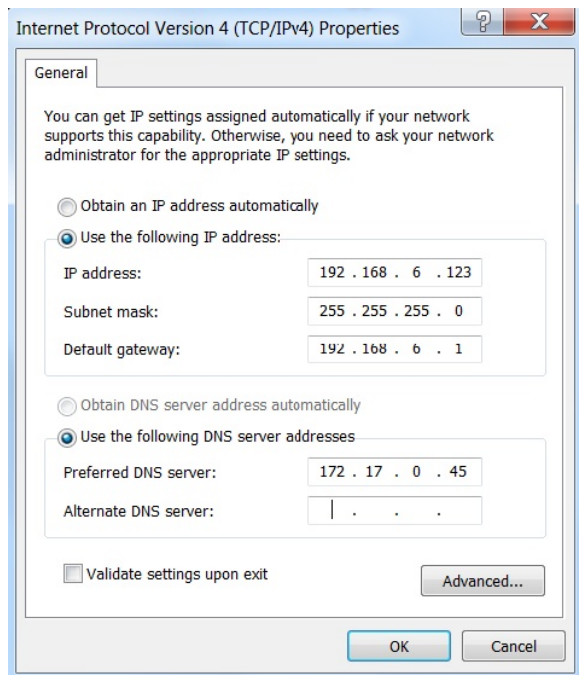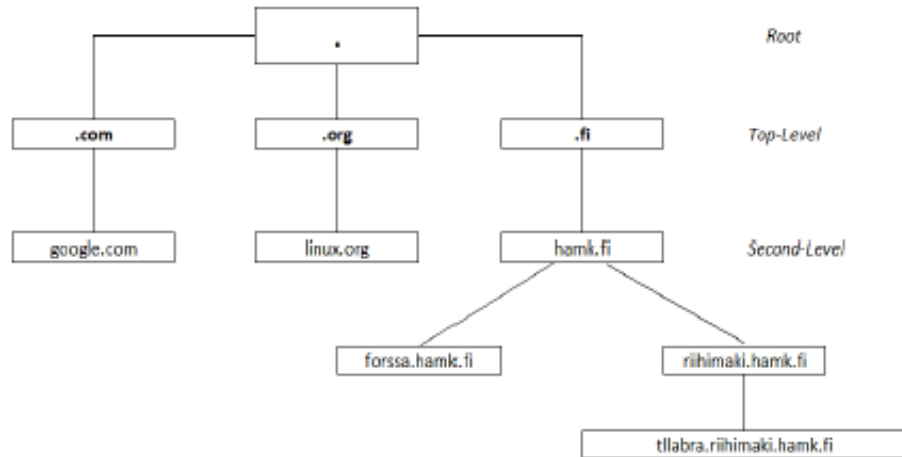
Gateway

- Traffic between networks always passes through a gateway
- A gateway can be a router, a routing switch, or a any device that can forward traffic based on IP addresses.
- In the picture below, 192.168.18.99 is the gateway for network 192.168.18.0 and 192.168.5.99 is the gateway for network 192.168.5.0.
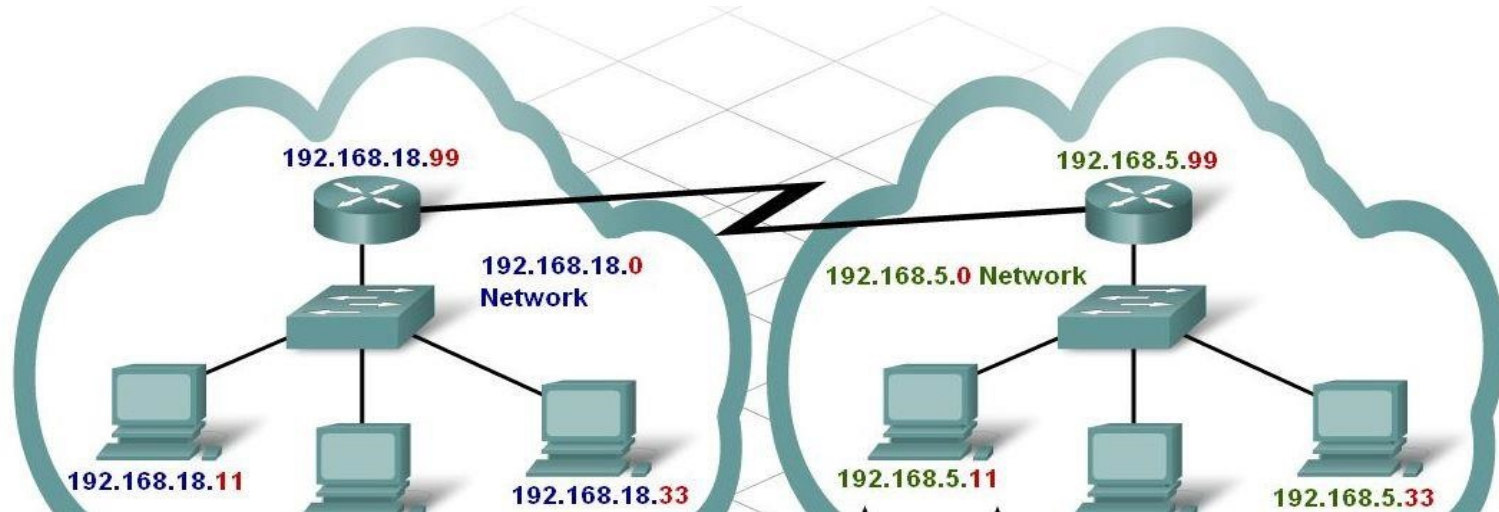
DNS - Domain Name Service

- DNS is a distributed name database where hosts look up IP addresses for domain names
- Each device is assigned IP-address of primary DNS server, where name queries are primarily sent.
- If the primary DNS does not know the answer, the query is forwarded to the next level of the tree.
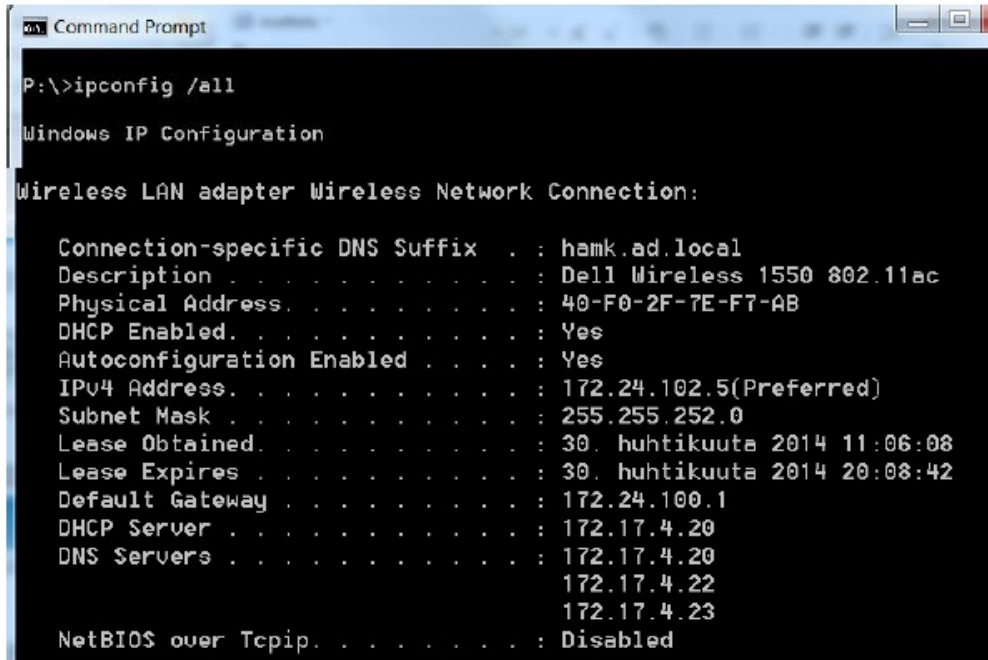
DHCP - Dynamic Host Configuration Protocol

- When using the DHCP service, there must be a device/server in the network that maintains the service.
- The DHCP server assigns an IP address and mask to the device upon request
  - It also "tells" the Gateway and DNS IP addresses if necessary.
- The location of the DHCP server in the network may vary depending on the network, as shown in the picture below
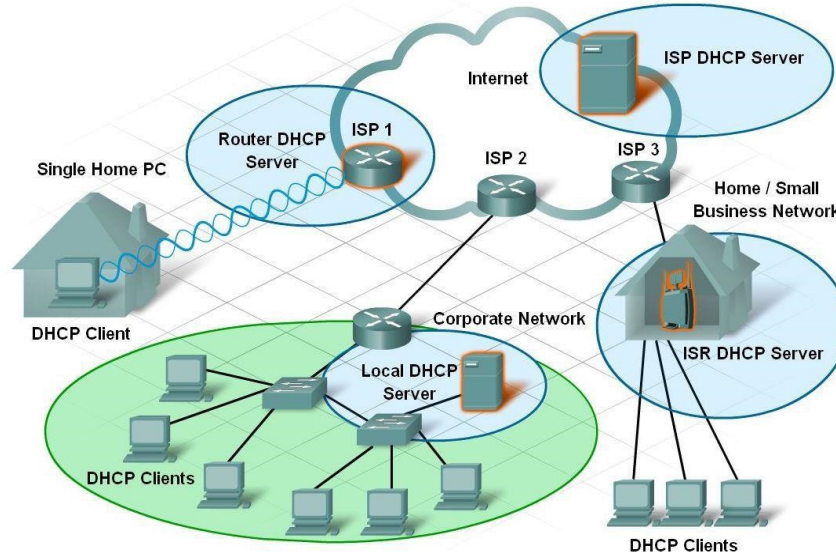
Viewing your IP settings

- ipconfig, ipconfig/all commands
- You can check the IP settings on a Windows with the ipconfig command.


```
Command Prompt

P:\>ipconfig /all

Windows IP Configuration

Wireless LAN adapter Wireless Network Connection:

    Connection-specific DNS Suffix  . : hamk.ad.local
    Description . . . . . . . . . . . : Dell Wireless 1550 802.11ac
    Physical Address. . . . . . . . . : 40-F0-2F-7E-F7-AB
    DHCP Enabled. . . . . . . . . . . : Yes
    Autoconfiguration Enabled . . . . : Yes
    IPv4 Address. . . . . . . . . . . : 172.24.102.5(Preferred)
    Subnet Mask . . . . . . . . . . . : 255.255.252.0
    Lease Obtained. . . . . . . . . . : 30. huhtikuuta 2014 11:06:08
    Lease Expires . . . . . . . . . . : 30. huhtikuuta 2014 20:08:42
    Default Gateway . . . . . . . . . : 172.24.100.1
    DHCP Server . . . . . . . . . . . : 172.17.4.20
    DNS Servers . . . . . . . . . . . : 172.17.4.20
                                        172.17.4.22
                                        172.17.4.23
    NetBIOS over Tcpip. . . . . . . . : Disabled
```

Connection functionality testing

- ping command
- You can test the connection from your own device to other devices
- Type the recipient's IP address after the ping command

```
P:\>ping 127.0.0.1

Pinging 127.0.0.1 with 32 bytes of data:
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128

Ping statistics for 127.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

P:\>
```