CN-Basic
L09/10

IP Subnets

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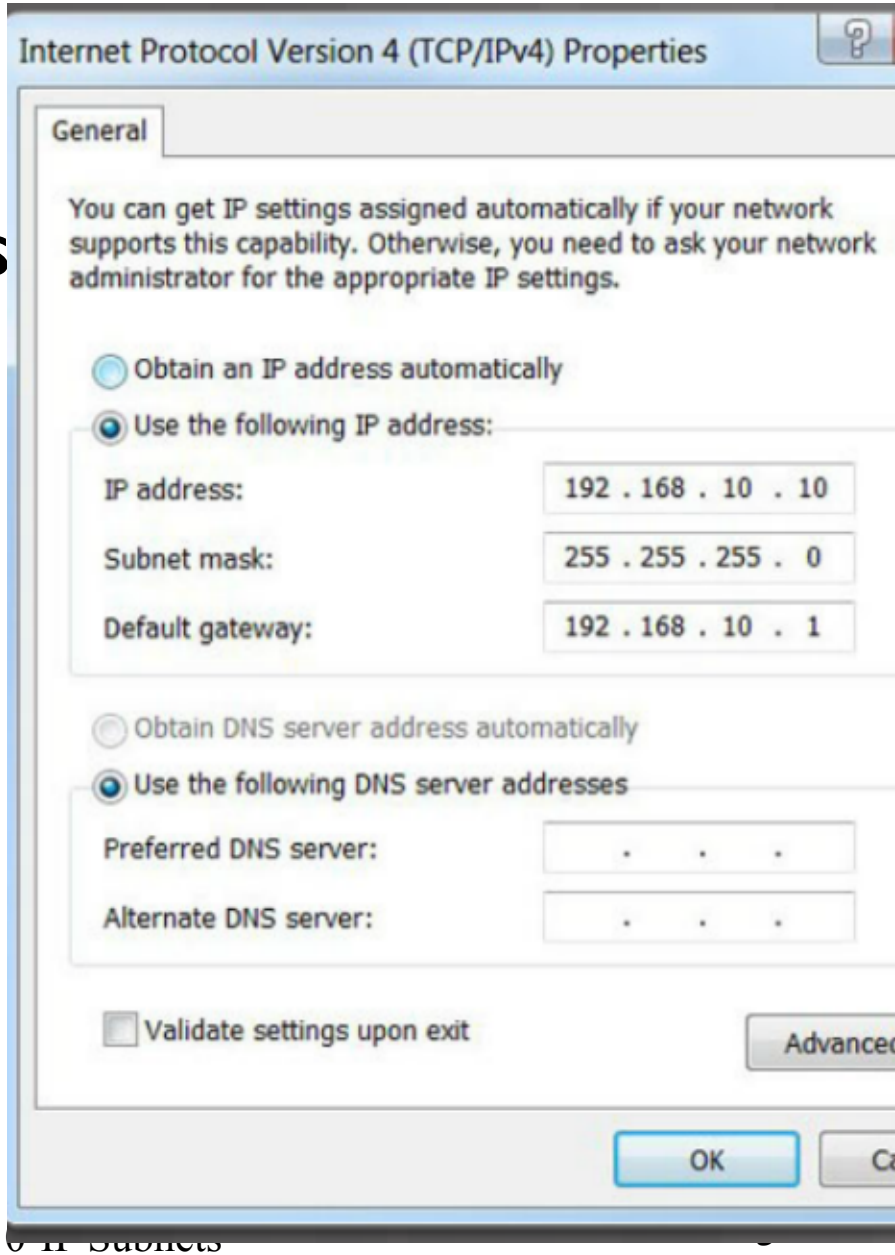
https://www.youtube.com/watch?v=zbOyrZr-Slc

IP Subnet

- Consider your house where you stay.
- It is part of a small locality (or even a street)
- Locality is part of sub-city e.g. south Blore.
- Which is further part of Blore, and in turn
  - Karnataka state and country India.
- The house is part of each of these
- Similarly, IP address is hierarchical
  - It is part of small network, which could be part of bigger network and so on. e.g.
  - Lab network, part of dept network, part of college network etc.

The Subnet Mask

- Identifies the network to which the host belongs
  - Subnet mask - identifies the network/host portion of the IPv4 address.
  - Default gateway -IP address of the local router which connects you to internet



The Subnet Mask

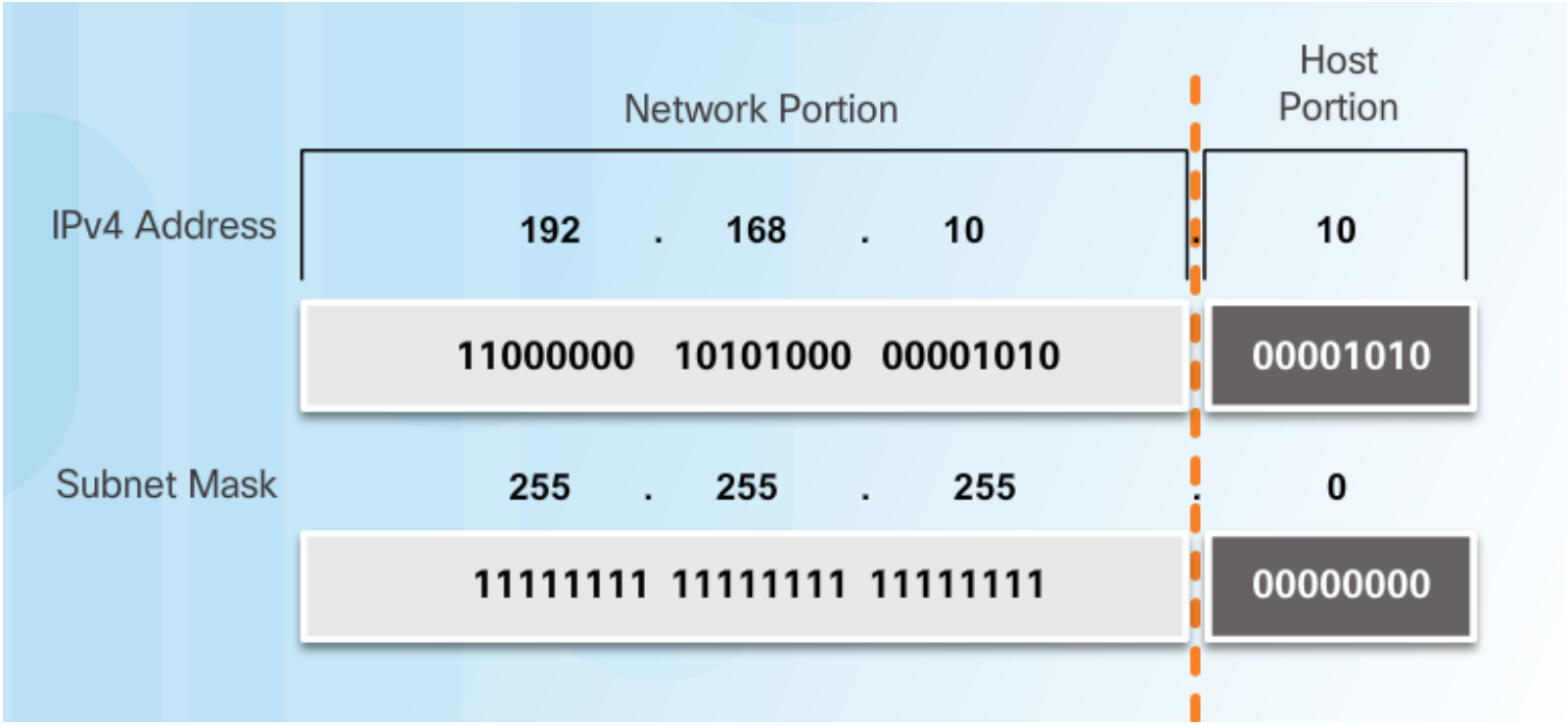
- The subnet mask is specified as /n, which implies that first n bits out of 32 (known as network portion) are set to 1 (from left to right) and remaining bits (known as host portion) are set to 0

```
/8 = 255.0.0.0
   =11111111 00000000 00000000 00000000
/20 = 255.255.240.0
   =11111111 11111111 11110000 00000000
/29 = 255.255.255.248
   =11111111 11111111 11111111 11111000
```

- The Logical AND subnet mask and IP address gives netowrk number of the host.

The Subnet Mask

- It determines the network number of address
- The network number is obtained by performing bitwise AND operation between subnet mask and IP address.



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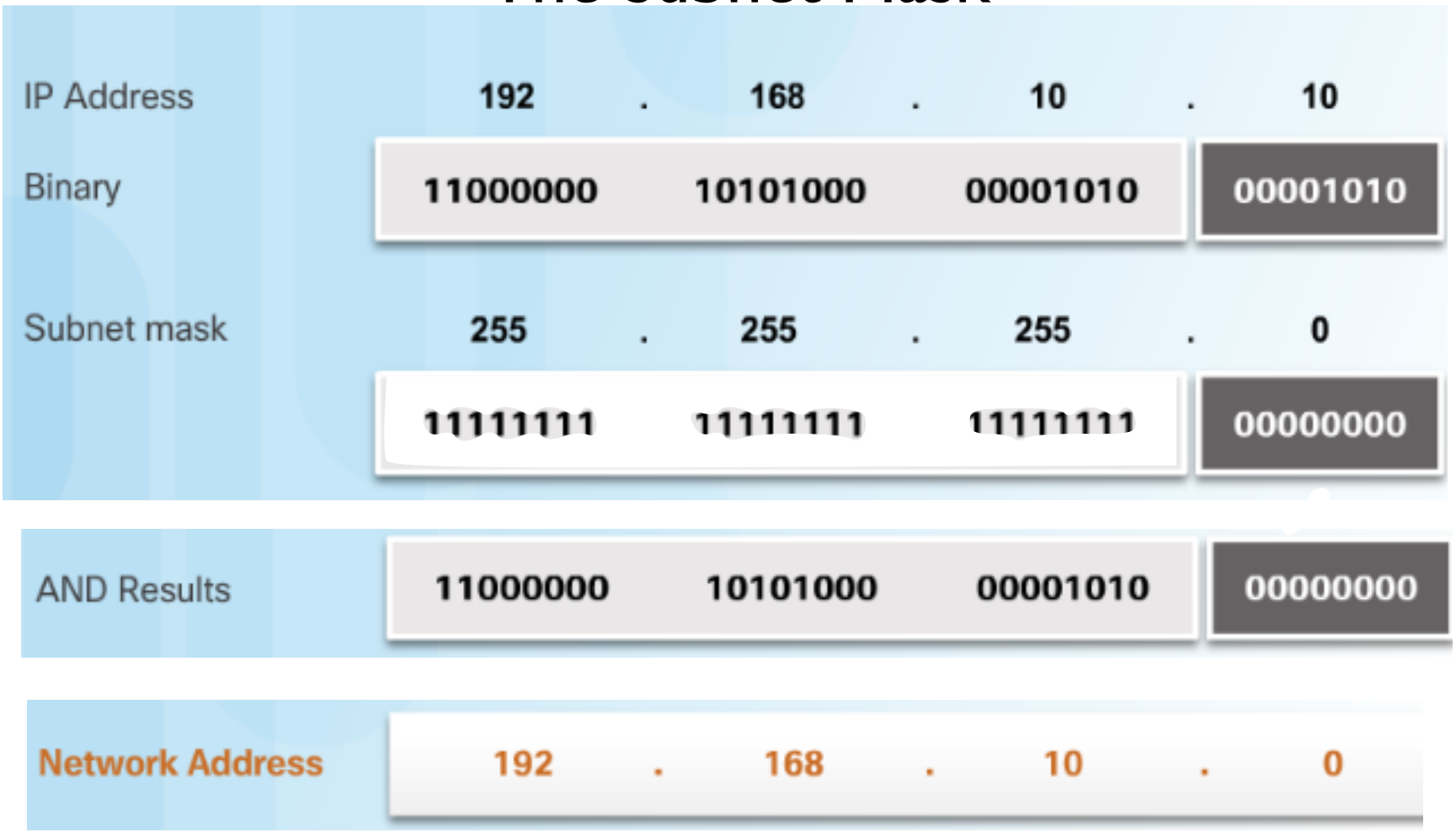
The Subnet Mask



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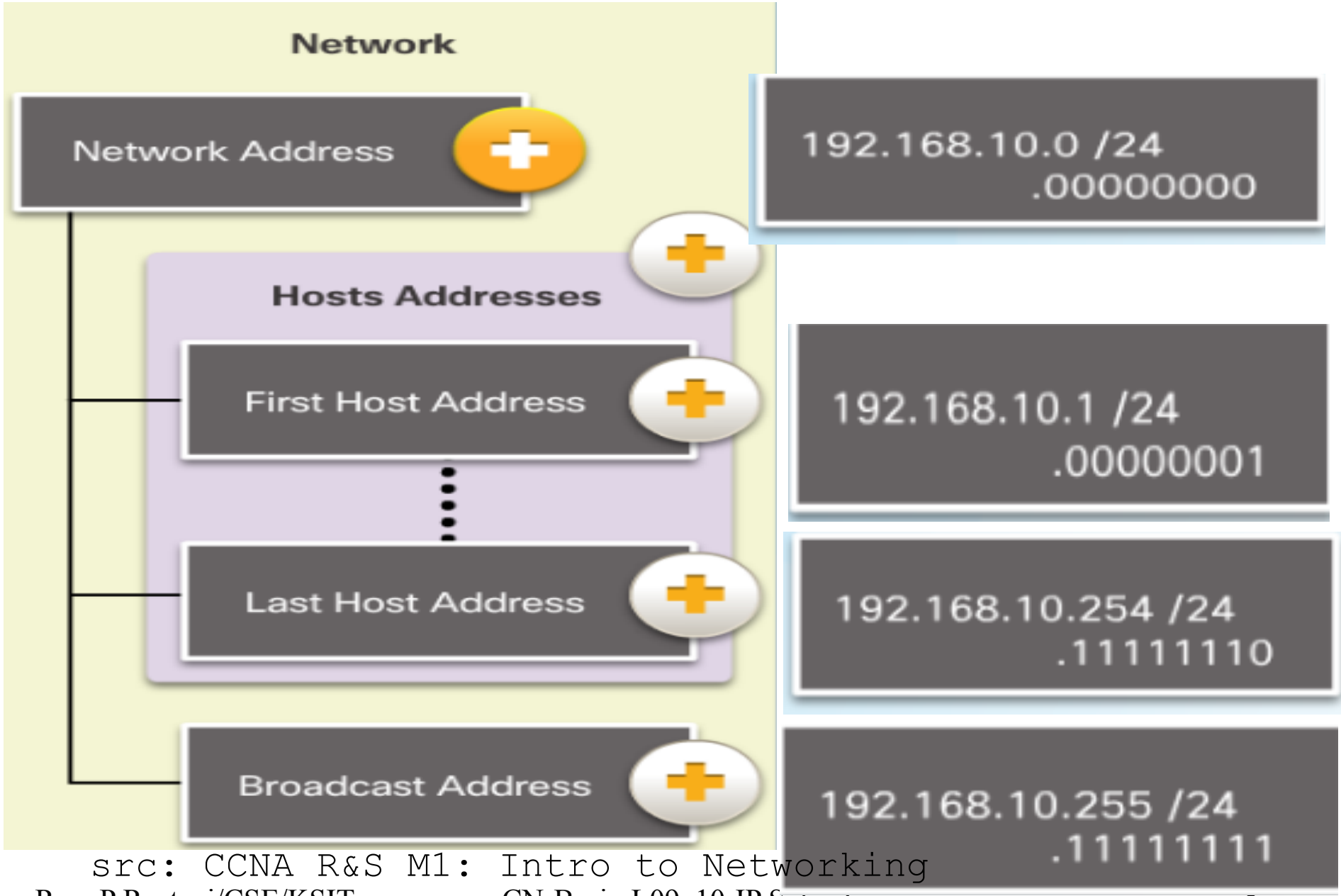
Network, Host, and Broadcast Addresses

- Types of addresses in network 192.168.10.0/24
  - Network Address -
    - host portion is all 0s (.00000000)
  - First Host address - host portion is all 0s and ends with a 1 (.00000001)
  - Last Host address - host portion is all 1s and ends with a 0 (.11111110)
  - Broadcast Address -
    - host portion is all 1s (.11111111)
- Total number of assignable addresses: 2^8-2
- Total assignable addresses with mask /n: $2^{32-n}-2$
  - all 0s is n/w number, all 1s is broadcast

Network, Host, and Broadcast Addresses



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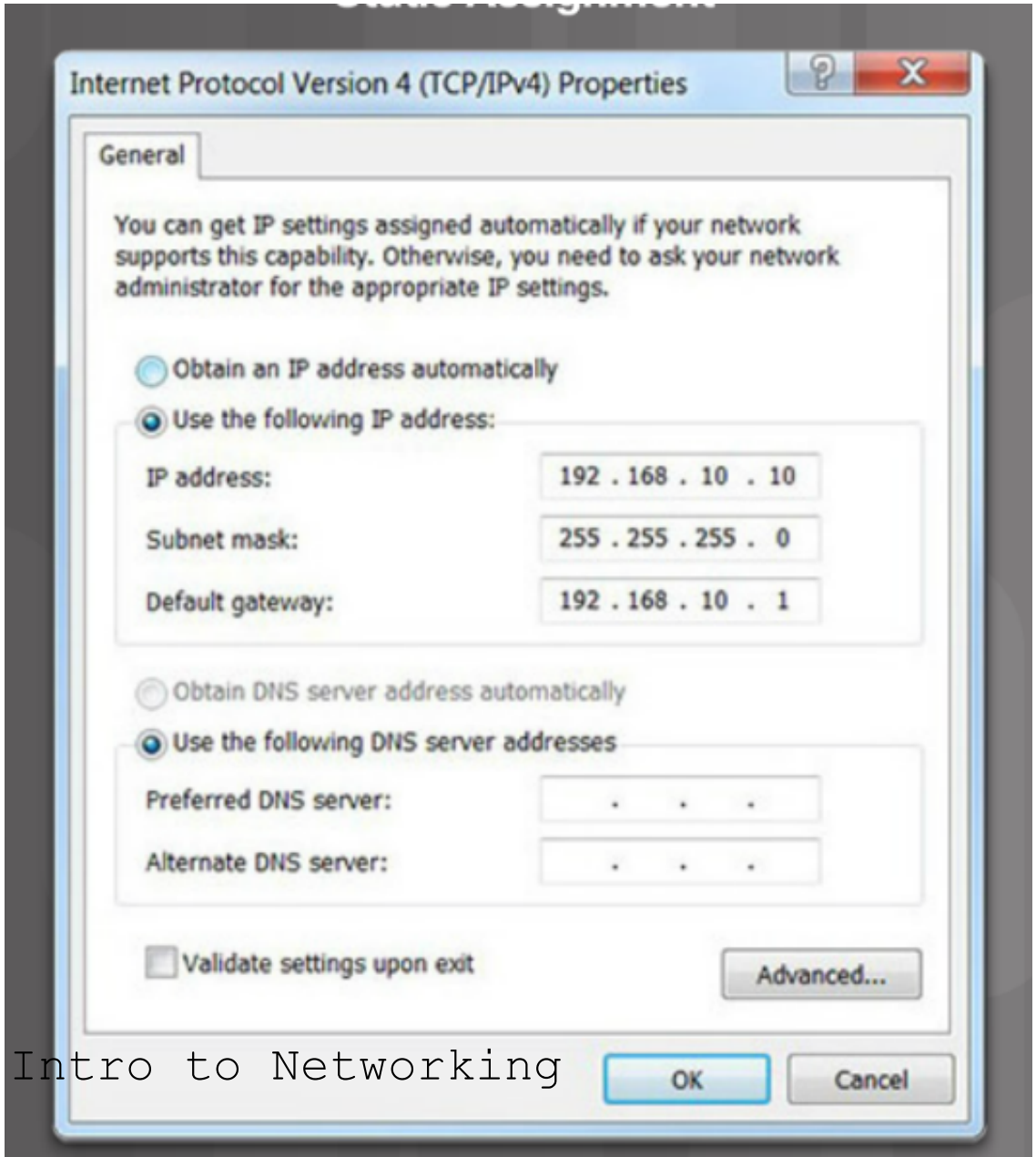
Static IPv4 Address Assignment to a Host

- Some devices like printers, servers and network devices require a fixed IP address.
- Hosts in a small network can also be configured with static addresses.



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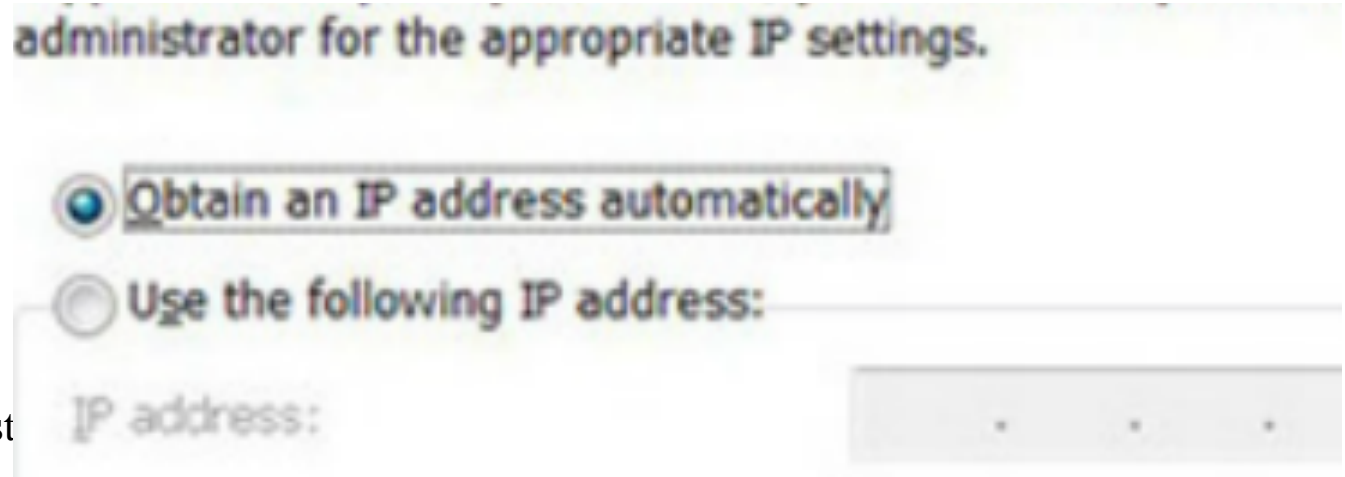
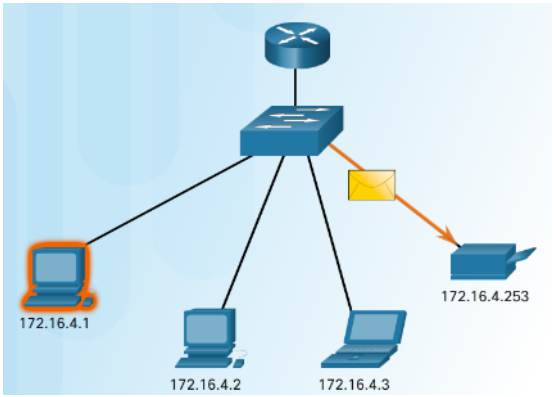
Dynamic IPv4 Address Assignment to a Host

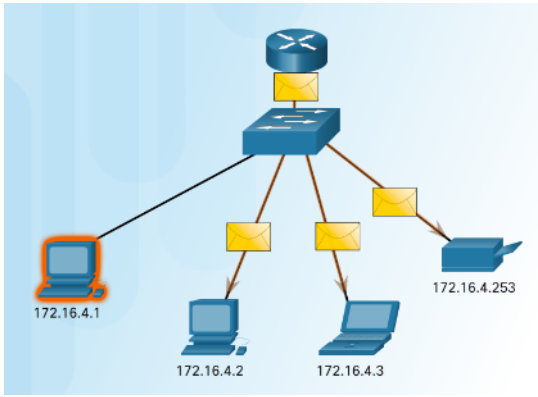
- Most networks use Dynamic Host Configuration Protocol (DHCP) to assign IPv4 addresses dynamically.
- The DHCP server provides an IPv4 address, subnet mask, default gateway, and other configuration information.
- DHCP leases the addresses to hosts for a certain length of time.
- If the host is powered down or taken off the network, the address is returned to the pool for reuse.

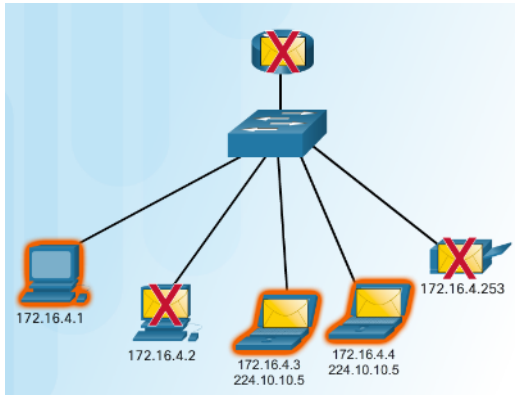


IPv4 Communication

- Address categories







- Unicast – one to one communication.
- Broadcast– one to all.
- Multicast – one to a select group.

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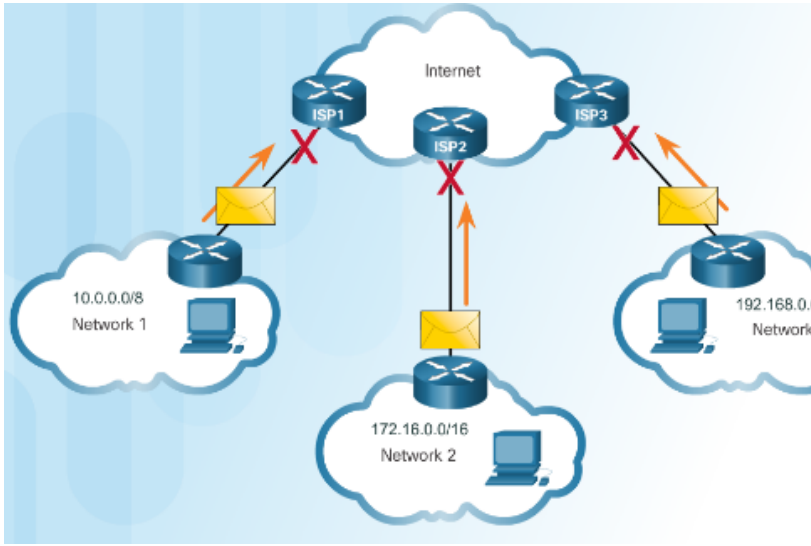
Public and Private IPv4 Addresses

- Private Addresses
  - Not routable
  - Introduced in mid 1990s due to depletion of IPv4 addresses
  - Used only in internal networks.
  - Must be translated to a public IPv4 to be routable.
  - Defined by RFC 1918
- Private Address Blocks
  - 10.0.0.0 /8 or
    - 10.0.0.0 to 10.255.255.255
  - 172.16.0.0 /12 or
    - 172.16.0.0 to 172.31.255.255
  - 192.168.0.0 /16, or
    - 192.168.0.0 to 192.168.255.255



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Special User IPv4 Addresses

- Loopback addresses (`127.0.0.0/8` or `127.0.0.1`)
  - Used on a host to test if the TCP/IP configuration is operational.
- Link-Local addresses (`169.254.0.0/16` or `169.254.0.1`)
  - Commonly known as Automatic Private IP Addressing (APIPA) addresses.
  - Used by Windows client to self configure if no DHCP server available.
- TEST-NET addresses (`192.0.2.0/24` or `192.0.2.0` to `192.0.2.255`)
  - Used for teaching and learning.

Special User IPv4 Addresses

```
C:\Users\NetAcad> 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

C:\Users\NetAcad> ping 127.1.1.1

Pinging 127.1.1.1 with 32 bytes of data:
Reply from 127.1.1.1: bytes=32 time<1ms TTL=128
Reply from 127.1.1.1: bytes=32 time<1ms TTL=128
Reply from 127.1.1.1: bytes=32 time<1ms TTL=128
Reply from 127.1.1.1: bytes=32 time<1ms TTL=128
```

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Case Study 01

- A machine has been assigned the IP address `192.168.37.241/27`. Find the following for the network to which this host belongs.
  - Subnet mask (using DDN notation)
  - Network number
  - First assignable IP address
  - Last assignable IP address
  - Broadcast address

Case Study 02

- Connect your laptop/desktop to internet.
  - Mostly this would be assigned using DHCP
- Note down the IP address and subnet mask.
  - e.g. `192.168.1.11/24`
- Change the configuration to static IP and assign the same IP address/mask as before.
  - `ping google.com` (verifies it works).
- Change the IP address by adding `16` to last octet (e.g. `192.168.1.27`) and netmask by adding `4` i.e `/28`
  - You will be unable to access internet
- Restore the mask to its earlie value `/24`, and internet works.
- Analyze the role of subnet masks

Case Study 03

- Take two machines (any of laptops/desktops etc) and call them A and B. If these are windows, disable the firewall.
- Assign the following IP Address (Static config)
  - `A:192.168.1.11/26, B:192.168.1.66/26`
- Ping A and B from each other, check if it fails
- Change both subnet masks to `/25` and ping again.
  - Verify ping is successful.
  - Analyze why it failed earlier
- Experiment with differnet IP Address and netmask
  - Analyze your results (both success & failure)

Case Study 04

- Issue the following command on your terminal.
  - `ping 127.1` (don't type two middle octets).
  - Does ping work successfully? Analyze the results.
- Note: This is called shorthand notation. If the address contains less than `4` octets, then host interprets it by adding required number of `0`s just before last the octet. Examples
  - `127.1` ⇨ `127.0.0.1`
  - `3` ⇨ `0.0.0.3`
  - `127.1.3` ⇨`127.1.0.3`

Summary

- IP Subnets
  - –netmask (in DDN form) and in `/n` form
- Terms with IP subnet
  - –Network number
  - –Broadcast address
  - –First assignable and last assignable address
- IP Address types:
  - –Unicast, multicast and broadcast address
-