IP Addressing

Outline

IP Addresses Overview

Address Classes

- Class A
- Class B
- Class C
- Class D
- Class E
- CIDR

Special Address

- loopback address
- local broadcast address

Network Masks

CIDR

- Classless Inter-Domain Routing

What is an IP Address?

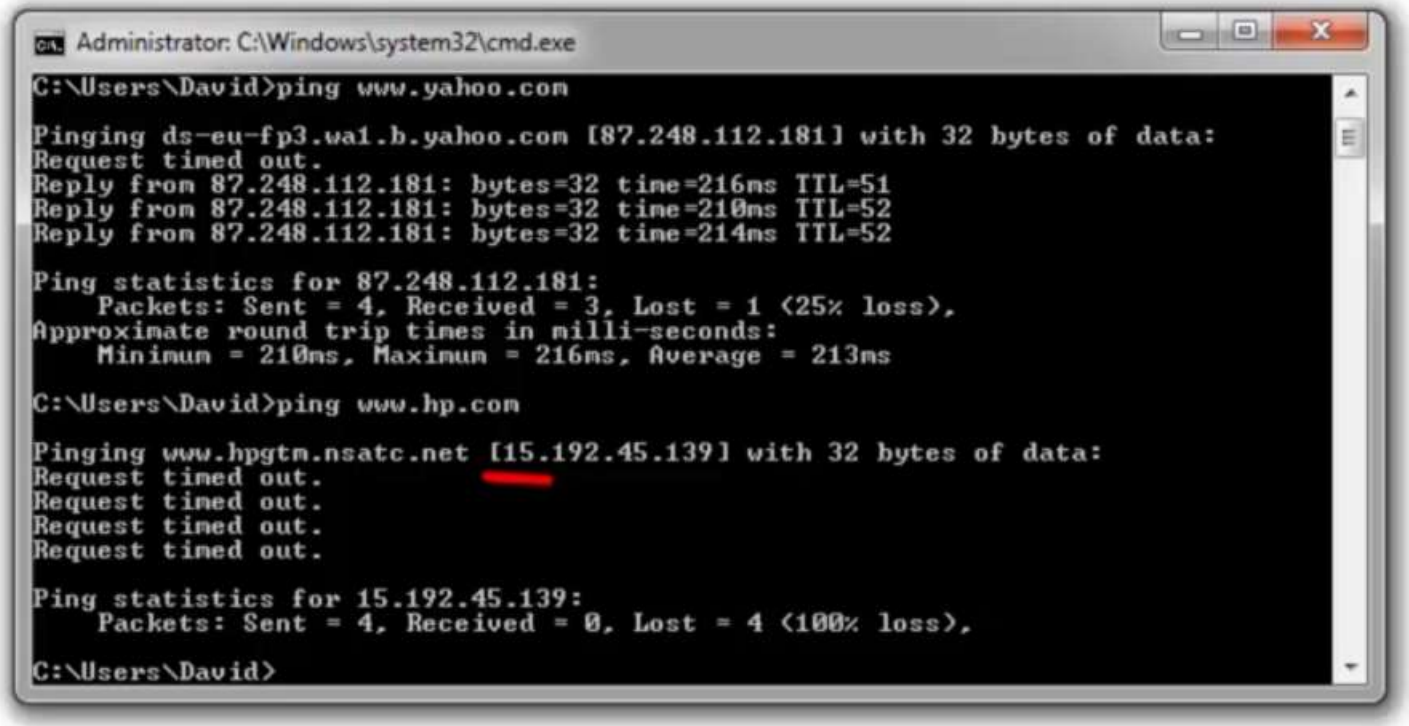
- layer 3 logical address assigned by an administrator
- resides at Layer 3 of OSI Model
- used to identify specific devices on a network
- every device on the Internet has a unique IP address

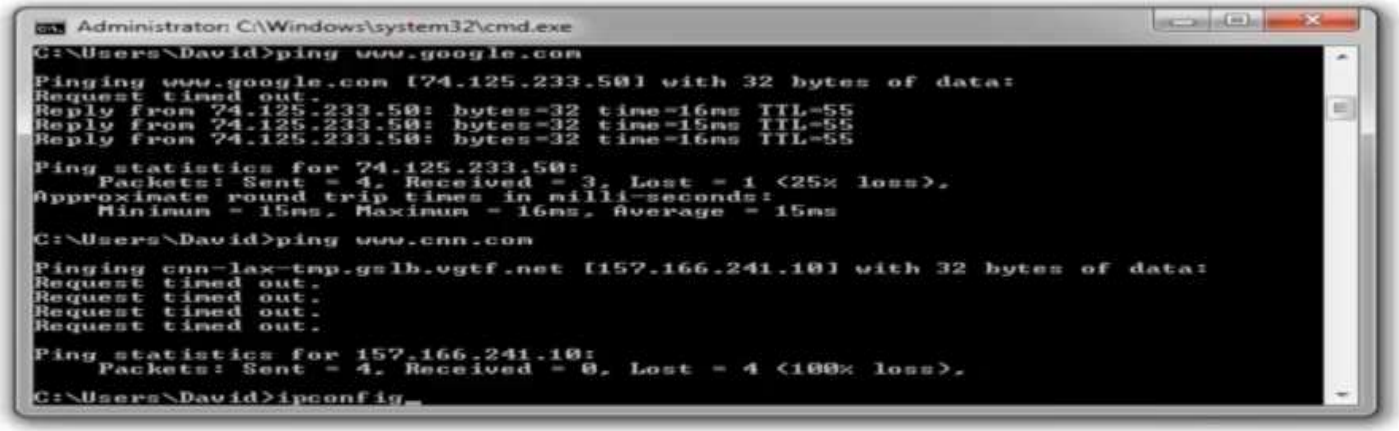
RFC1918 Addresses

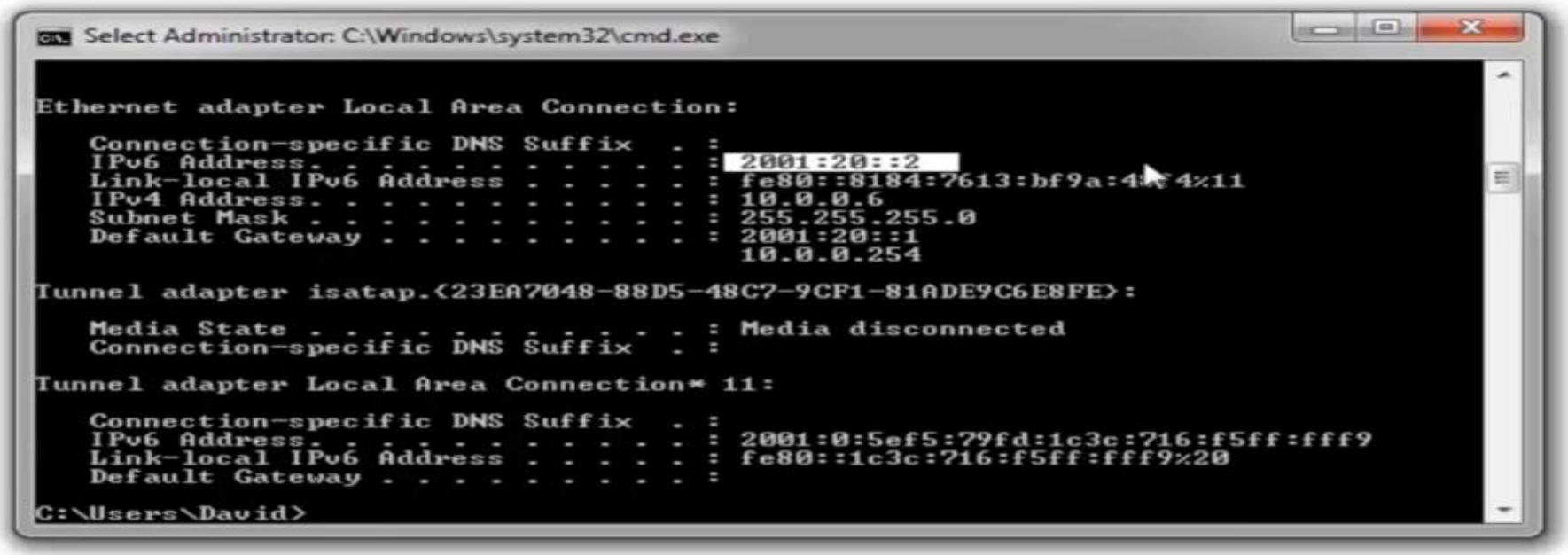
- 10.1.1.1
- 12.1.1.1

Network Address Translation

  - needs to be unique


Administrator: C:\Windows\system32\cmd.exe
C:\Users\David>ping www.yahoo.com
Pinging ds-eu-fp3.wa1.b.yahoo.com [87.248.112.181] with 32 bytes of data:
Request timed out.
Reply from 87.248.112.181: bytes=32 time=216ms TTL=51
Reply from 87.248.112.181: bytes=32 time=210ms TTL=52
Reply from 87.248.112.181: bytes=32 time=214ms TTL=52
Ping statistics for 87.248.112.181:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 210ms, Maximum = 216ms, Average = 213ms
C:\Users\David>ping www.hp.com
Pinging www.hpgtm.nsatc.net [15.192.45.139] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Ping statistics for 15.192.45.139:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\Users\David>


Administrator: C:\Windows\system32\cmd.exe
C:\Users\David>ping www.google.com
Pinging www.google.com [74.125.233.50] with 32 bytes of data:
Request timed out.
Reply from 74.125.233.50: bytes=32 time=16ms TTL=55
Reply from 74.125.233.50: bytes=32 time=15ms TTL=55
Reply from 74.125.233.50: bytes=32 time=16ms TTL=55
Ping statistics for 74.125.233.50:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 15ms, Maximum = 16ms, Average = 15ms
C:\Users\David>ping www.cnn.com
Pinging cnn-lax-tmp.gslb.vgtf.net [157.166.241.10] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.
Ping statistics for 157.166.241.10:
Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
C:\Users\David>ipconfig_


Select Administrator: C:\Windows\system32\cmd.exe
Ethernet adapter Local Area Connection:
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:20::2
Link-local IPv6 Address . . . . . : fe80::8184:7613:bf9a:4
IPv4 Address. . . . . : 10.0.0.6
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 2001:20::1
10.0.0.254
Tunnel adapter isatap.{23EA7048-88D5-48C7-9CF1-81ADE9C6E8FE}:
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
Tunnel adapter Local Area Connection* 11:
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:0:5ef5:79fd:1c3c:716:f5ff:fff9
Link-local IPv6 Address . . . . . : fe80::1c3c:716:f5ff:fff9
Default Gateway . . . . . :
C:\Users\David>

IP Characteristics

IPv4

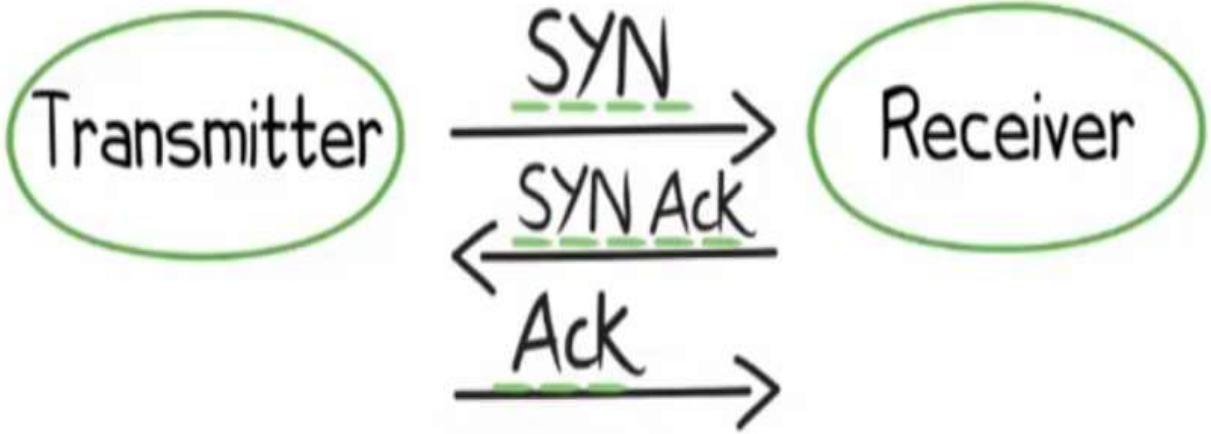
- Layer 3 or network layer protocol
- Connectionless Protocol
  - TCP is connection oriented
- packets treated independently
  - may take different paths
- hierarchical addressing structure
  - Network and Host portion
- best effort delivery
- no data recovery features
  - no built in session
  - no retransmission

TCP

- handle dropped, corrupted and misdirected packets

LEARNCCNA.net

- TCP is connection oriented



- may take different paths

Load Balancing

OSPF - Bandwidth

RIP - Hopcount

Routing Protocol

- determine the best path

Format Overview

IP address **32 bit**

How to convert this address to binary

Octets

x.x.x.x - 8 bits

- 10.1.1.1
- has a hierarchical structure to enable routing
- routing
  - like DHL or FedEx routing parcel based on an address
  - routers route traffic to destination address
    - DA in the packet

Transmitted

- has a hierarchical structure to enable routing
  - network portion
  - host portion

Format Overview

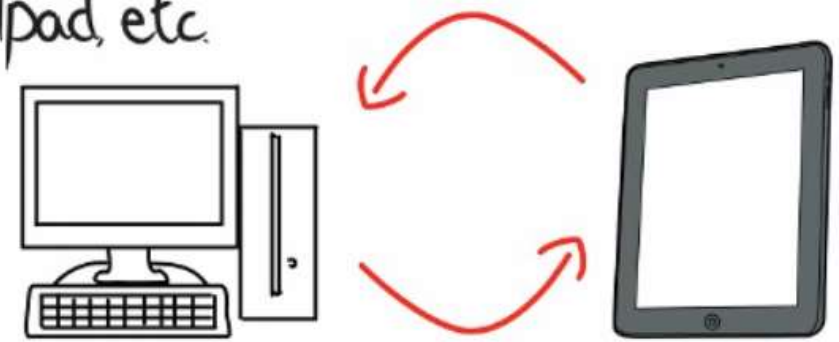
IP Address

Network Address Portion(Network ID)

- identifies a specific network
- routers maintain routing tables that contain the network
- look at destination of IP address and match to network address

Host Address Portion (host ID)

- identifies a specific endpoint on a network
- server, printers, PCs, Iphone, Ipad, etc.



cnn.com
usatoday.com
bbc.co.uk

Format

- IP address is a 32 bit binary number
- Divided into four octets (8 bits or 1 byte)

  00001010.00000001.00001000.00000010

- which is 10.1.8.2

Octet

- 8 binary bits / 1 byte

IPv4 address

- 4 Octets X.X.X.X where X is an octet

Address Classes

Address Classes

- 1981 until introduction of Classless in Domain routing in 1993
- divide IPv4 Address into 5 class

Class A
Class B
Class C
} Unicast Traffic

Class D - multicast
Class E - reserved for future or experimental purposes

IPv6 - does not use address classes
IPv4 - address classes was replaced by CIDR

Class A
Class B
Class C

- support 60 million IP addresses
- replaced by CIDR in 1993

- Accommodate different sizes of networks
- Aids in classifying networks
- determined by the Internet Assigned Numbers Authority (IANA)

Classful Address Format
- network command - RIP

https://en.wikipedia.org/wiki/List_of_assigned_/8_IPv4_address_blocks

Class A

- start with a binary 0 X.X.X.X
- Binary Range:

  0.0.0.0 to 127.255.255.255

First Octet Binary	Decimal
00000000	= 0 (Reserved)
to	
01111111	= 127 (Reserved)

Exception: - 127 is reserved for loopback - 127.0.0.1
- 0 network is reserved for default network - 0.1.1.1

Actual Range: 1.0.0.0 to 126.255.255.255

First Octet Binary	Decimal
00000000	= 1 (Start)
to	
01111110	= 126 (End)

Network & Host Portions

10.1.1.1

Class B

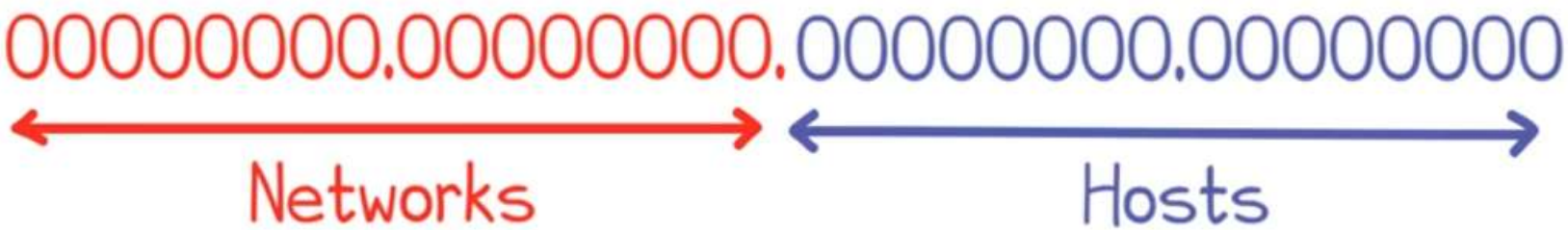
- starts with binary 10 (one & zero not ten)

Binary range:

128.0.0.0 to 191.255.255.255

First Octet Binary	Decimal
10000000	= 128 (Start)
to	
10111111	= 191 (End)

Network & Host Portions



172.16.1.1

Class C

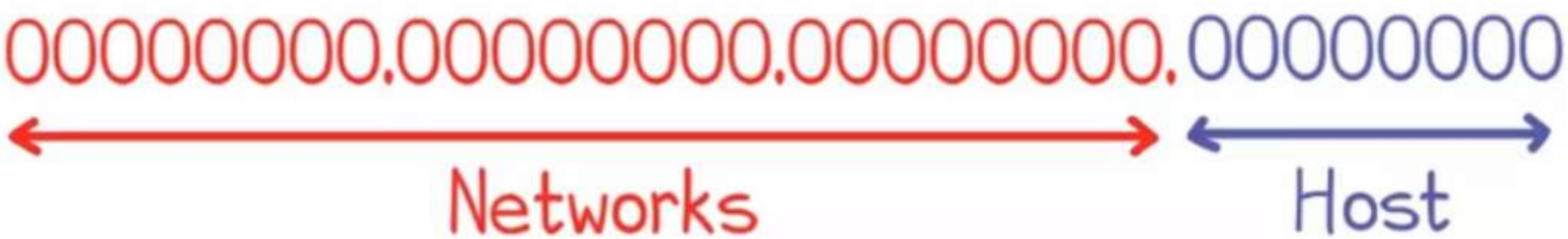
- starts with binary 110 (one, one, zero)

Binary Range:

192.0.0.0 to 223.255.255.255

First Octet Binary	Decimal
11000000	= 192 (Start)
to	
11011111	= 223 (End)

Network & Host Portions



192.168.1.1

Class D

- multicast

224.0.0.X = Link Local Multicasts

- starts with a binary 1110 (one, one, one, zero)

Binary Range:

224.0.0.0 to 239.255.255.255

First Octet Binary

11100000
to
11101111

Decimal

= 224 (Start)

= 239 (End)

239.1.1.1

OSPF
224.0.0.5
224.0.0.6

Class E

- starts with binary 1111 (one, one, one, one)

Binary Range:

240.0.0.0 to 255.255.255.255

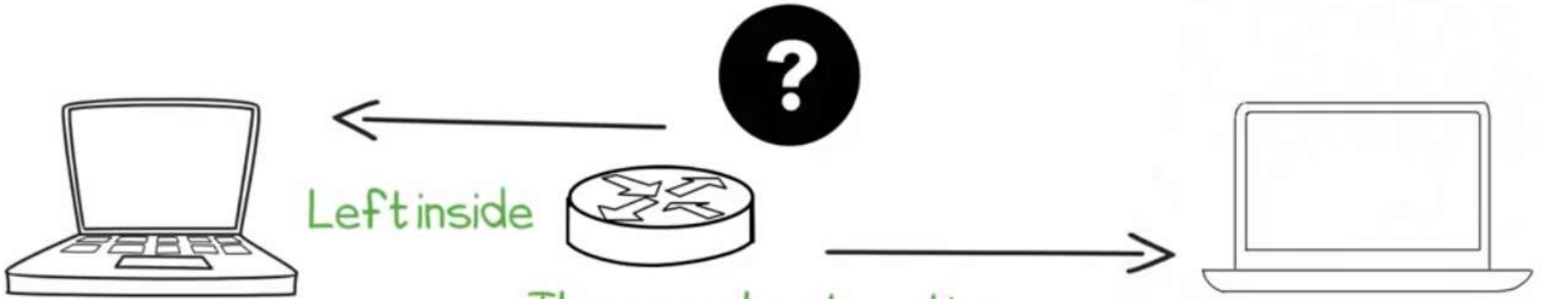
- reserved

Class A Network Address

Network Address

- 10.0.0.0 = Network Address
- 10.1.2.3 = Host Address
- Class A Networks 1 to 126

Class A:
8 bits = network
Consisting of 10 or 12



Network Address 10.0.0.0
10.1.1.1

Network Address 12.0.0.0
12.1.1.1

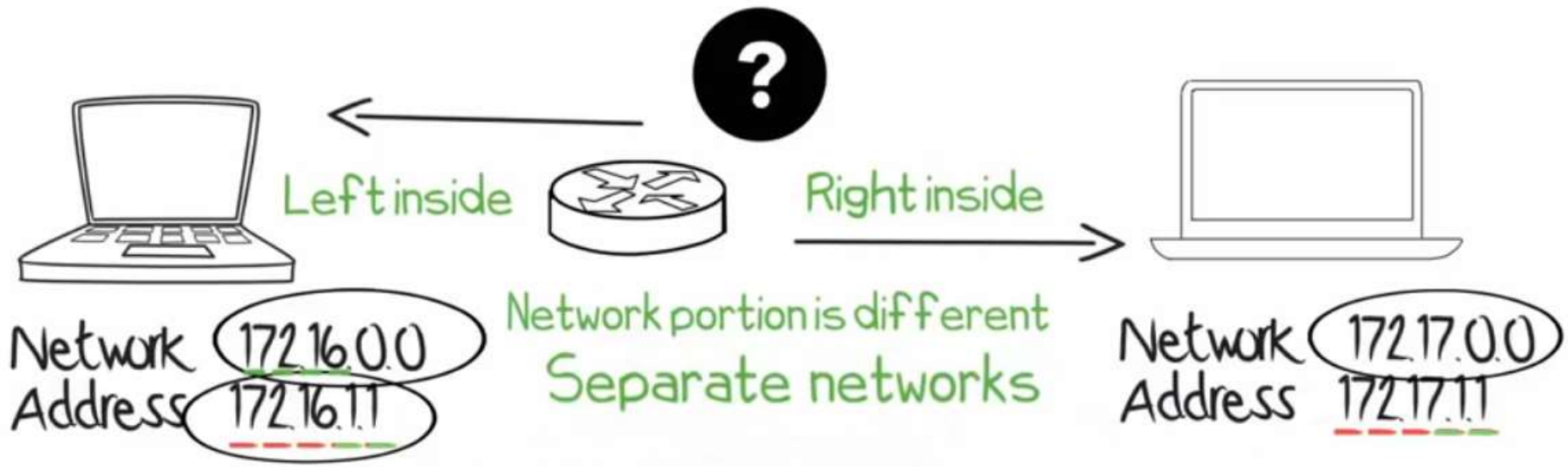
Class B Network Address

Network Address

172.16.0.0 = Network Address

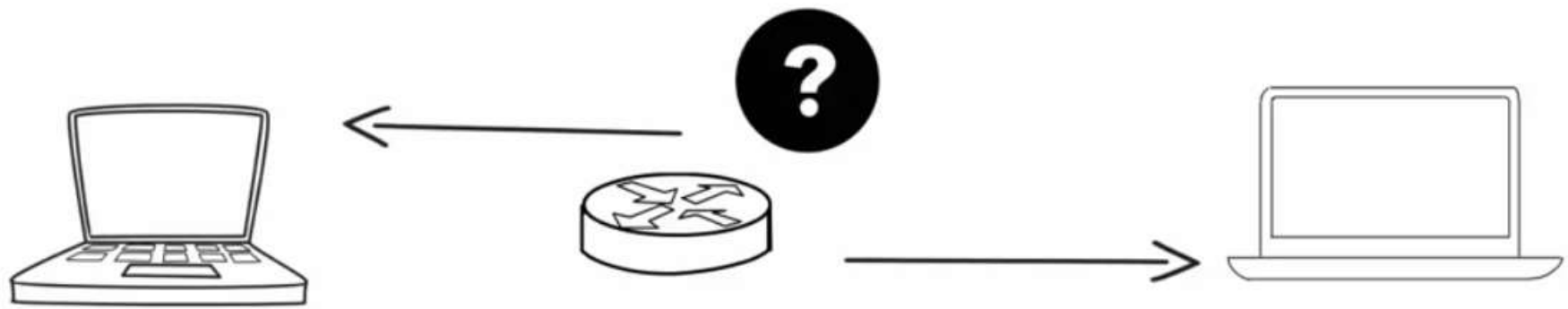
172.16.1.2 = Host Address

Class B Networks 128 to 191



Class C Network Address

Network Address
192.168.1.0 = Network Address
192.168.1.1 = Host Address
Class C networks 192 to 223



Network : 192.168.1.0
Address: 192.168.1.1

Network: 192.168.2.0
Address: 192.168.2.1

Directed Broadcast Address

Directed Broadcast Address

- host sends data to all devices on a specific network
- binary 1s in the entire host portion of the address

Network 172.31.0.0

- directed broadcast = 172.31.255.255

Network Host

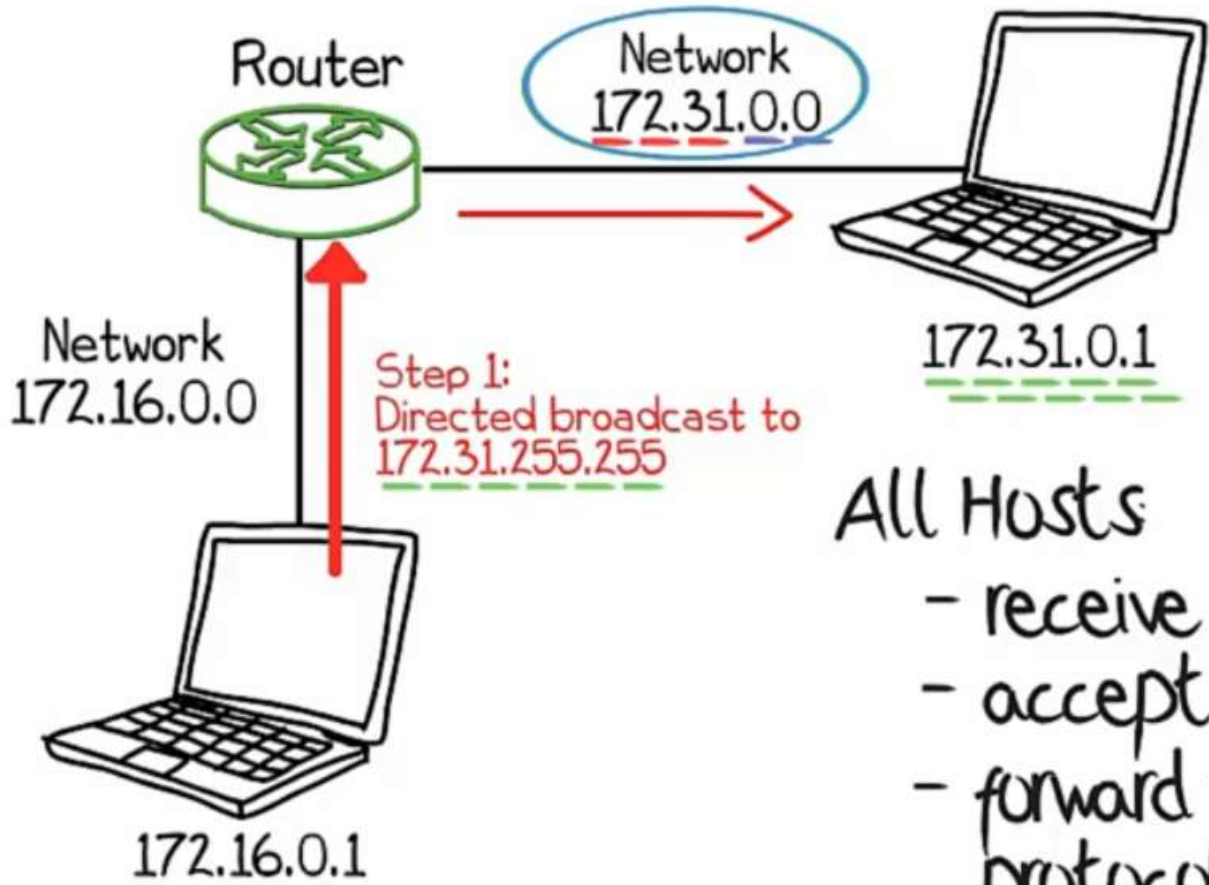
255 in decimal = 1111 1111 in binary

Routers can route directed broadcast

- disabled by default

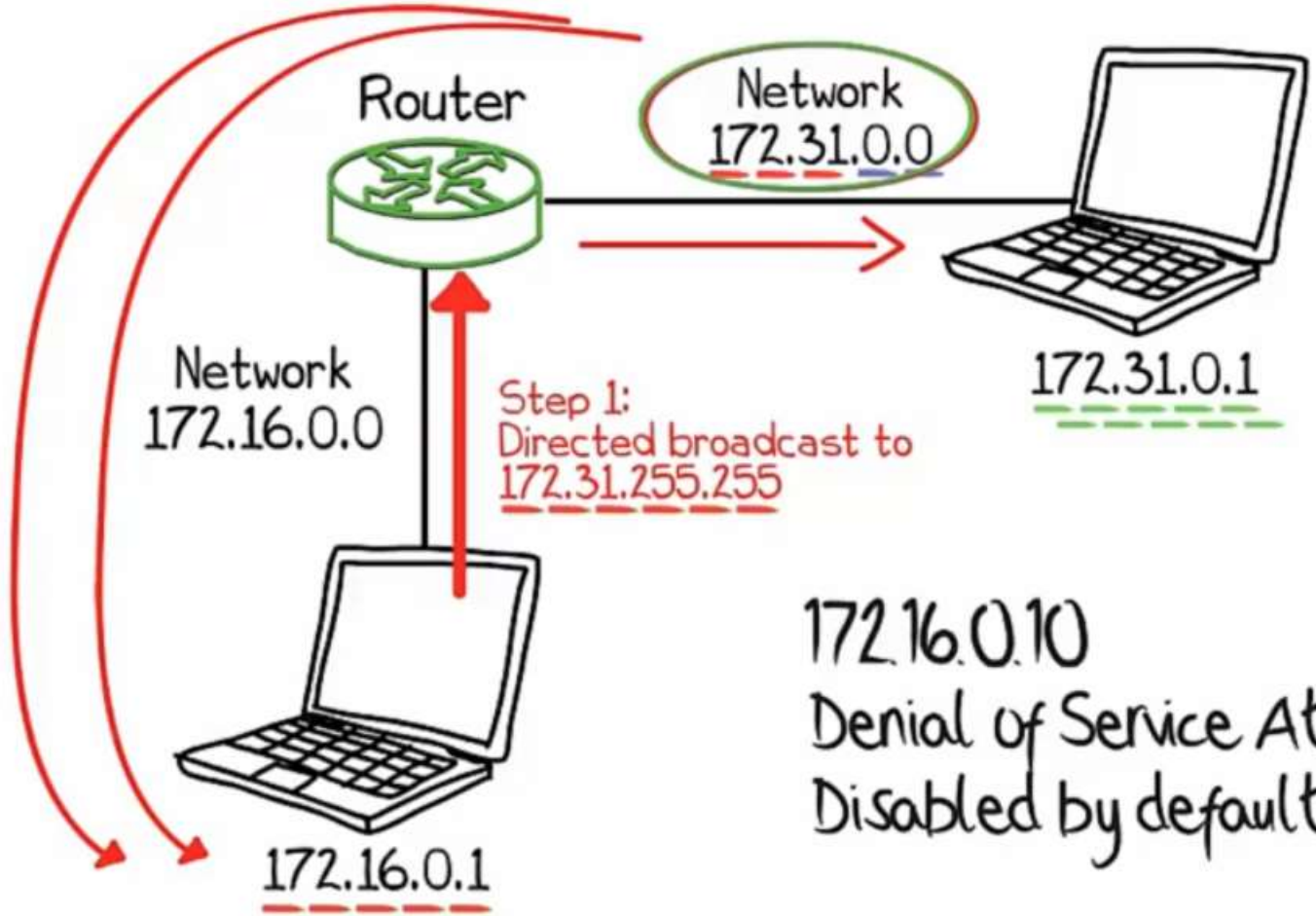
  - hacking utilities that you can download
  - Denial of Service Attacks

Directed Broadcast Address



All Hosts
- receive
- accept
- forward to higher level protocols for processing

Directed Broadcast Address



172.16.0.10

Denial of Service Attacks - SMURF

Disabled by default

Local Broadcast Address

Local Broadcast Address

- communicate with all devices on local network
- address is all binary 1s

  11111111.11111111.11111111.11111111

  255.255.255.255

Example:

- host request an IP address from a DHCP server
  - Dynamic Host Configuration Protocol

- always dropped by routers

  DHCP forwarding or DHCP relay

Local Loopback Address

Local Loopback Address

- used to let a system send a message to itself for testing
- this is very useful to make sure that the TCP/IP stack is correctly installed on a machine
- 127.0.0.1
  - Class A Address
  - 16 Million Addresses

IPv6 - ::1

Routers Loopback Address

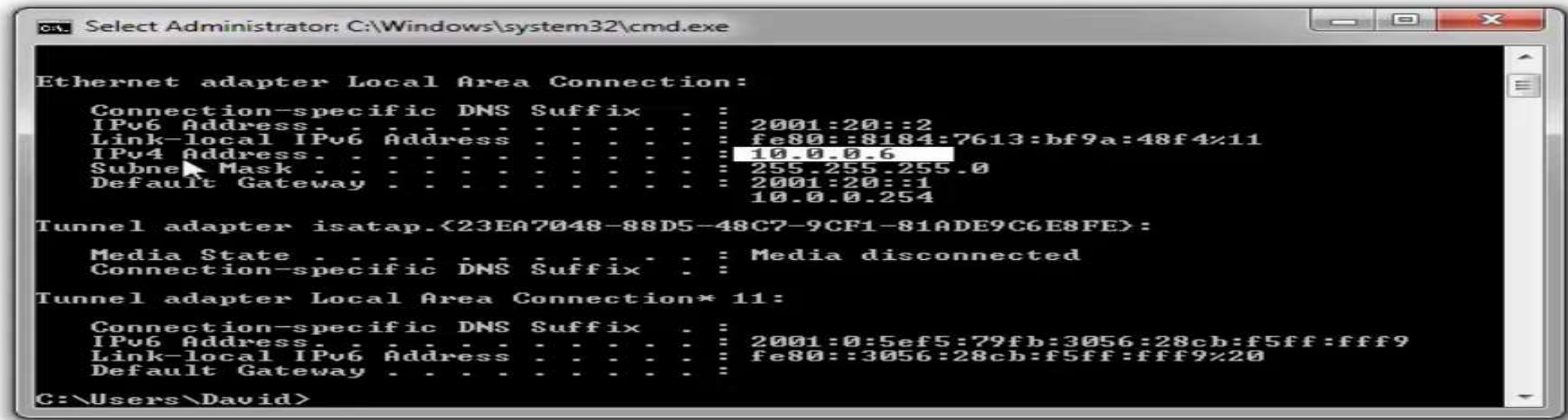
Loopback Interface 10.1.1.1/32

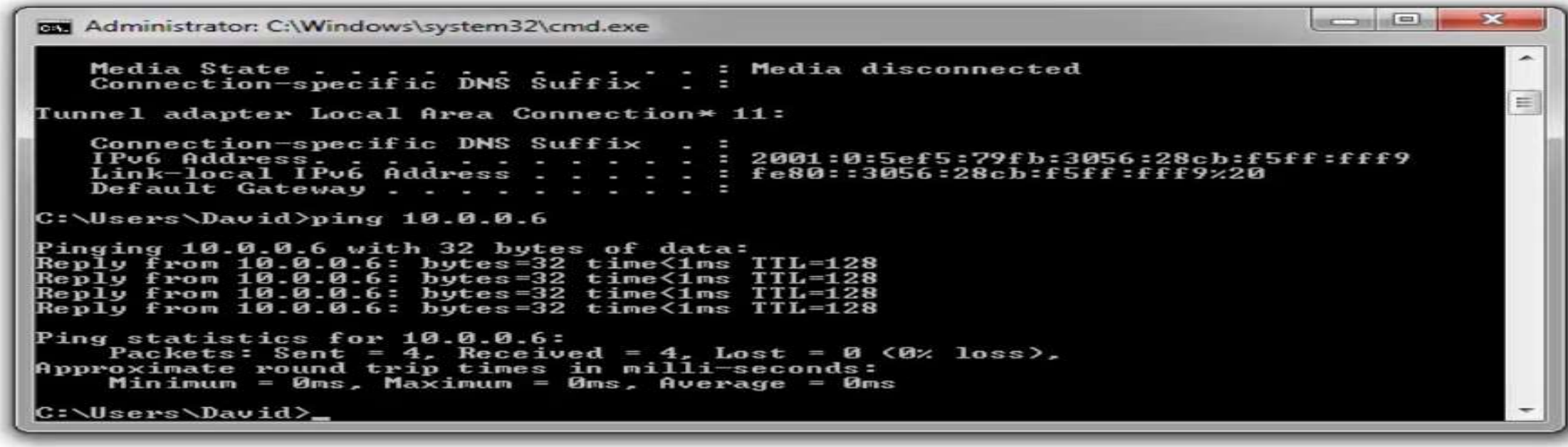
NOTE:

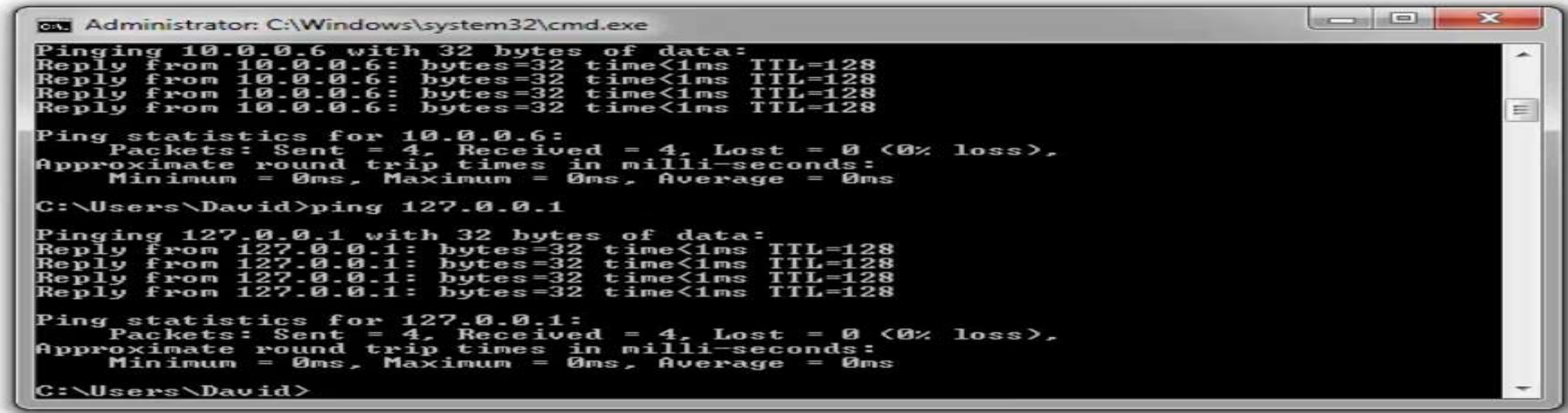
- routers have loopback addresses which are not the same as the local loopback address

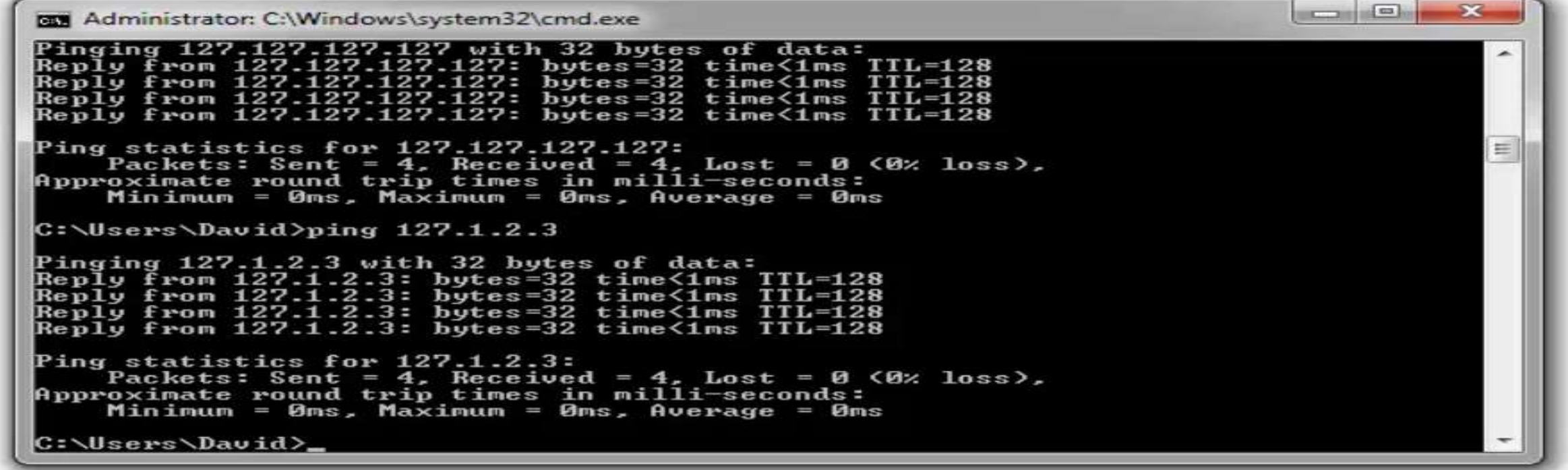
127.X.X.X

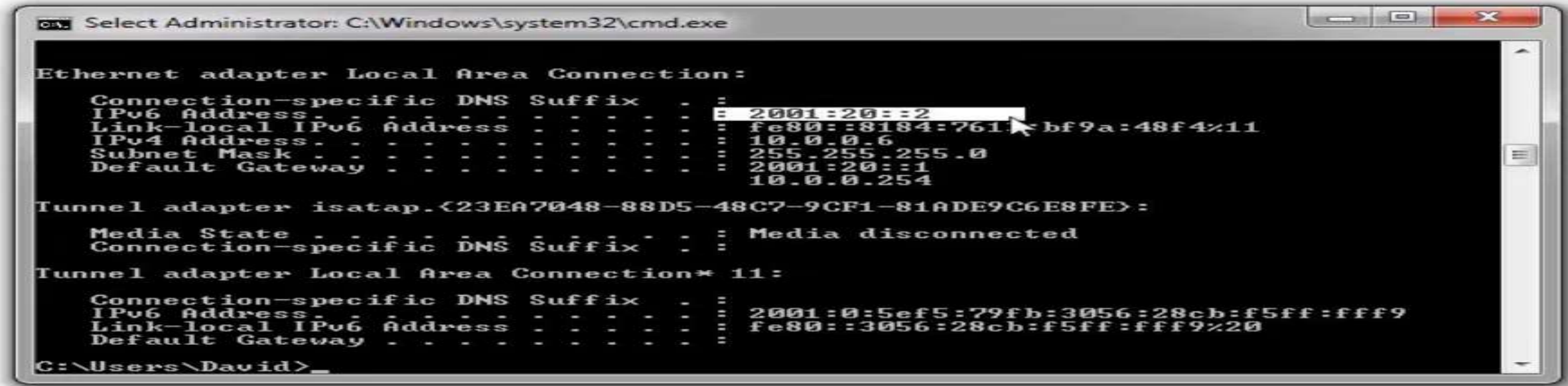

Administrator: C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. All rights reserved.
C:\Users\David>ipconfig_

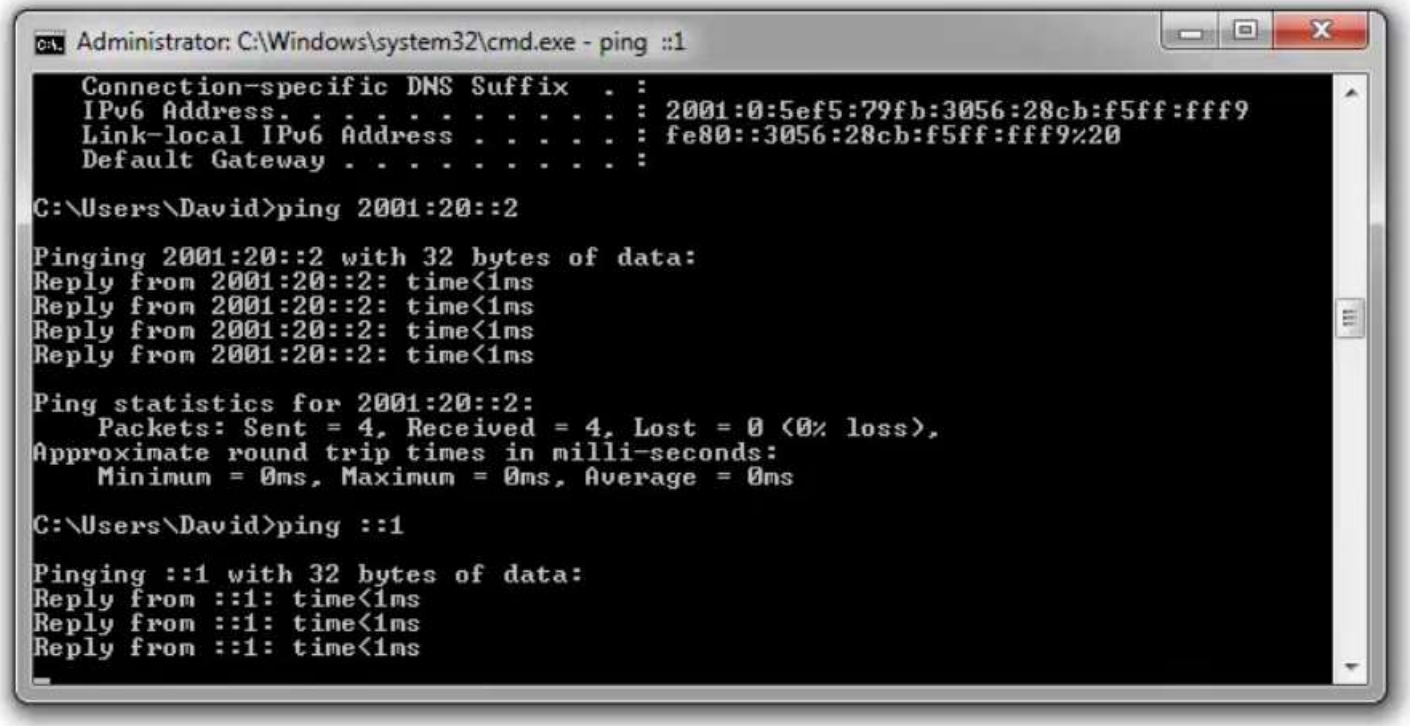

Select Administrator: C:\Windows\system32\cmd.exe
Ethernet adapter Local Area Connection:
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:20::2
Link-local IPv6 Address . . . . . : fe80::8184:7613:bf9a:48f4%11
IPv4 Address. . . . . : 10.0.0.6
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 2001:20::1
10.0.0.254
Tunnel adapter isatap.{23EA7048-88D5-48C7-9CF1-81ADE9C6E8FE}:
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
Tunnel adapter Local Area Connection* 11:
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:0:5ef5:79fb:3056:28cb:f5ff:fff9
Link-local IPv6 Address . . . . . : fe80::3056:28cb:f5ff:fff9%20
Default Gateway . . . . . :
C:\Users\David>

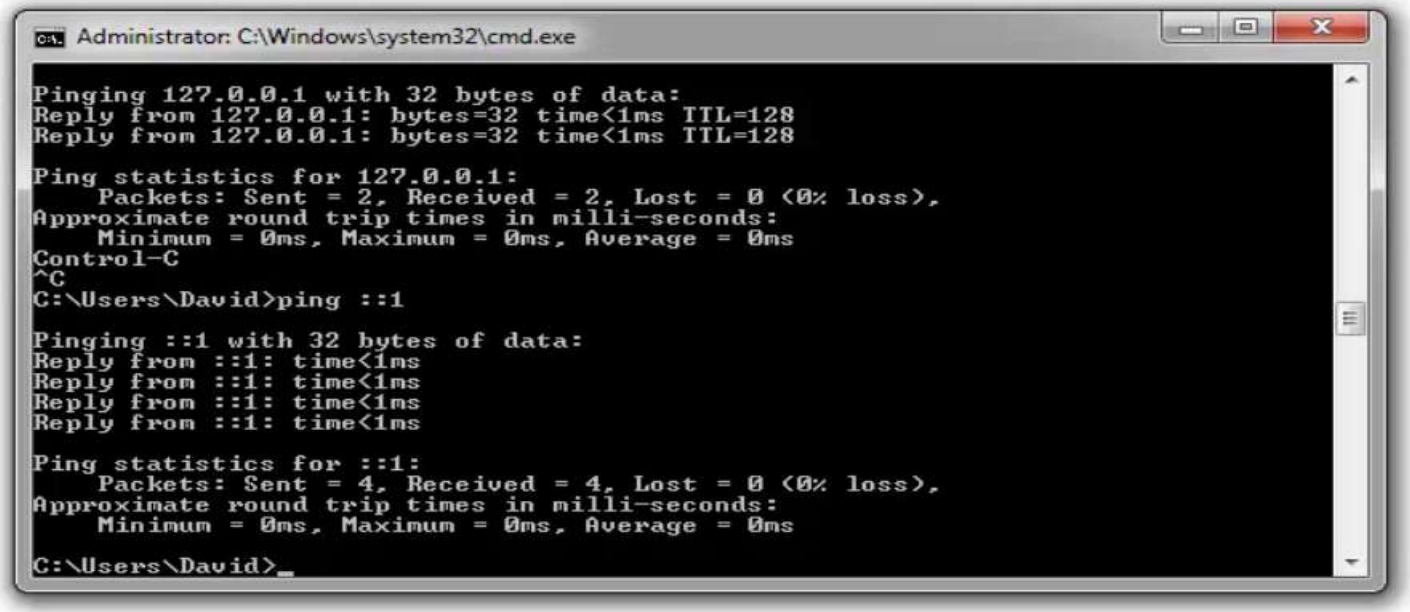

Administrator: C:\Windows\system32\cmd.exe
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
Tunnel adapter Local Area Connection* 11:
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:0:5ef5:79fb:3056:28cb:f5ff:fff9
Link-local IPv6 Address . . . . . : fe80::3056:28cb:f5ff:fff9%20
Default Gateway . . . . . :
C:\Users\David>ping 10.0.0.6
Pinging 10.0.0.6 with 32 bytes of data:
Reply from 10.0.0.6: bytes=32 time<1ms TTL=128
Reply from 10.0.0.6: bytes=32 time<1ms TTL=128
Reply from 10.0.0.6: bytes=32 time<1ms TTL=128
Reply from 10.0.0.6: bytes=32 time<1ms TTL=128
Ping statistics for 10.0.0.6:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\Users\David>


Administrator: C:\Windows\system32\cmd.exe
Pinging 10.0.0.6 with 32 bytes of data:
Reply from 10.0.0.6: bytes=32 time<1ms TTL=128
Reply from 10.0.0.6: bytes=32 time<1ms TTL=128
Reply from 10.0.0.6: bytes=32 time<1ms TTL=128
Reply from 10.0.0.6: bytes=32 time<1ms TTL=128
Ping statistics for 10.0.0.6:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\Users\David>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\David>


Administrator: C:\Windows\system32\cmd.exe
Pinging 127.127.127.127 with 32 bytes of data:
Reply from 127.127.127.127: bytes=32 time<1ms TTL=128
Reply from 127.127.127.127: bytes=32 time<1ms TTL=128
Reply from 127.127.127.127: bytes=32 time<1ms TTL=128
Reply from 127.127.127.127: bytes=32 time<1ms TTL=128
Ping statistics for 127.127.127.127:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\Users\David>ping 127.1.2.3
Pinging 127.1.2.3 with 32 bytes of data:
Reply from 127.1.2.3: bytes=32 time<1ms TTL=128
Reply from 127.1.2.3: bytes=32 time<1ms TTL=128
Reply from 127.1.2.3: bytes=32 time<1ms TTL=128
Reply from 127.1.2.3: bytes=32 time<1ms TTL=128
Ping statistics for 127.1.2.3:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\Users\David>


Select Administrator: C:\Windows\system32\cmd.exe
Ethernet adapter Local Area Connection:
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:20::2
Link-local IPv6 Address . . . . . : fe80::8184:761
bf9a:48f4%11
IPv4 Address. . . . . : 10.0.0.6
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 2001:20::1
10.0.0.254
Tunnel adapter isatap.{23EA7048-88D5-48C7-9CF1-81ADE9C6E8FE}:
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
Tunnel adapter Local Area Connection* 11:
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:0:5ef5:79fb:3056:28cb:f5ff:fff9
Link-local IPv6 Address . . . . . : fe80::3056:28cb:f5ff:fff9%20
Default Gateway . . . . . :
C:\Users\David>


Administrator: C:\Windows\system32\cmd.exe - ping ::1
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:0:5ef5:79fb:3056:28cb:f5ff:fff9
Link-local IPv6 Address . . . . . : fe80::3056:28cb:f5ff:fff9%20
Default Gateway . . . . . :
C:\Users\David>ping 2001:20::2
Pinging 2001:20::2 with 32 bytes of data:
Reply from 2001:20::2: time<1ms
Reply from 2001:20::2: time<1ms
Reply from 2001:20::2: time<1ms
Reply from 2001:20::2: time<1ms
Ping statistics for 2001:20::2:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\Users\David>ping ::1
Pinging ::1 with 32 bytes of data:
Reply from ::1: time<1ms
Reply from ::1: time<1ms
Reply from ::1: time<1ms


Administrator: C:\Windows\system32\cmd.exe
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
Ping statistics for 127.0.0.1:
Packets: Sent = 2, Received = 2, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
Control-C
^C
C:\Users\David>ping ::1
Pinging ::1 with 32 bytes of data:
Reply from ::1: time<1ms
Reply from ::1: time<1ms
Reply from ::1: time<1ms
Reply from ::1: time<1ms
Ping statistics for ::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\David>

Private Addresses

RFC - Request for Comments
- Internet Standards

RFC1149 - IP over Avian Carriers

RFC1918 - Private IP Addresses
- non routable on the Internet

https://datatracker.ietf.org/doc/html/rfc1149
https://datatracker.ietf.org/doc/html/rfc1918

Private Addresses

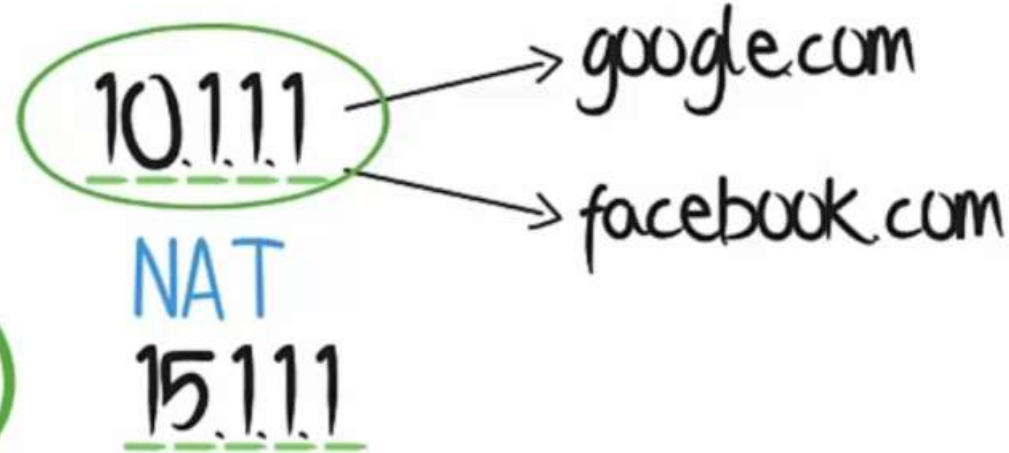
RFC1918 - non routable on the Internet

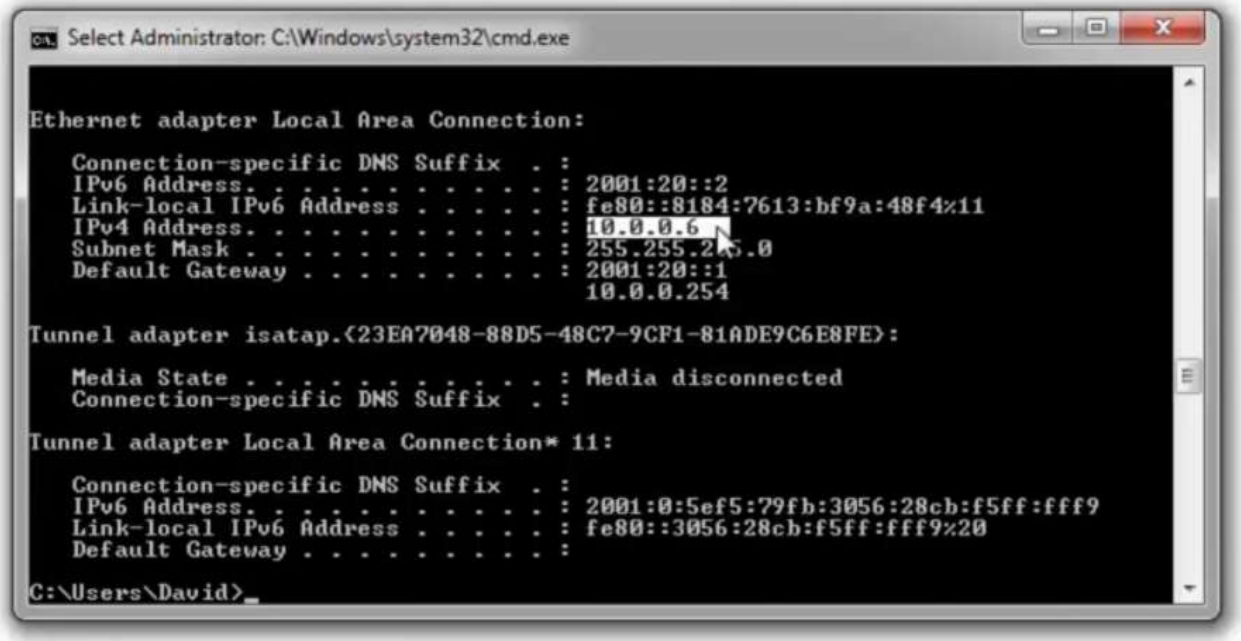
Three blocks of IP addresses

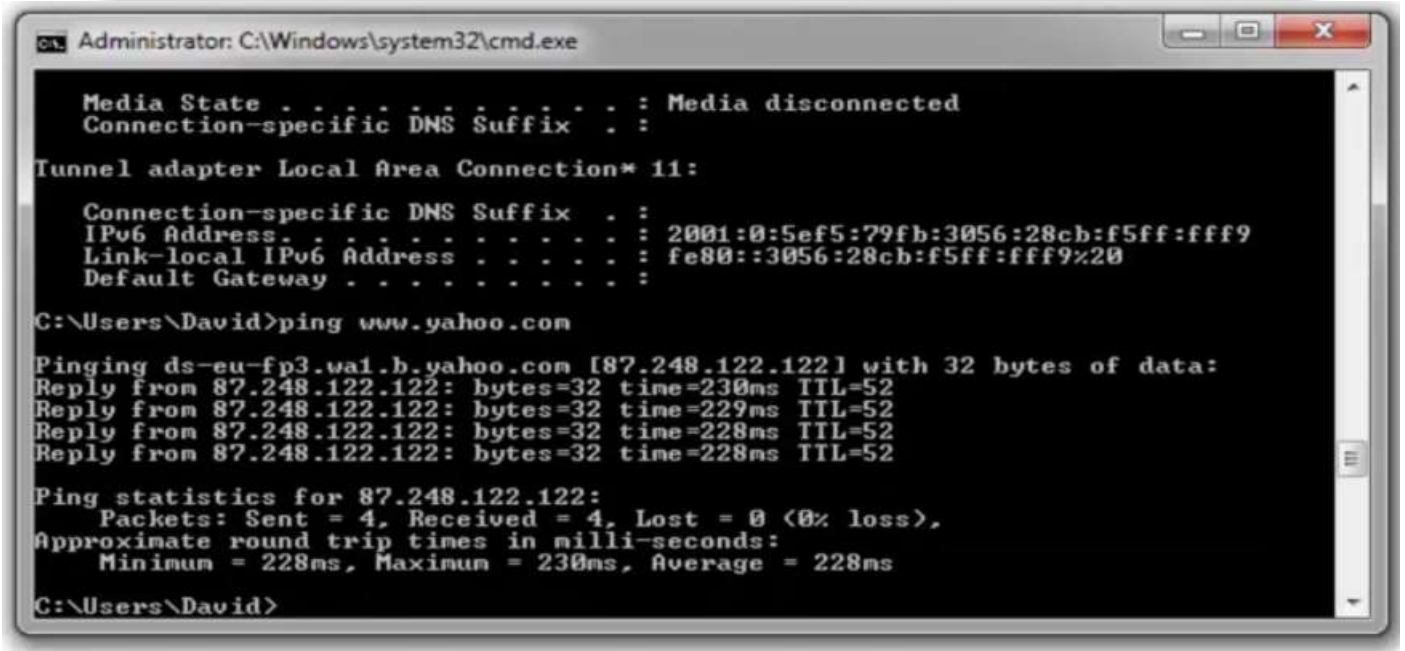
- 1 Class A Network
- 16 Class B networks
- 256 Class C networks

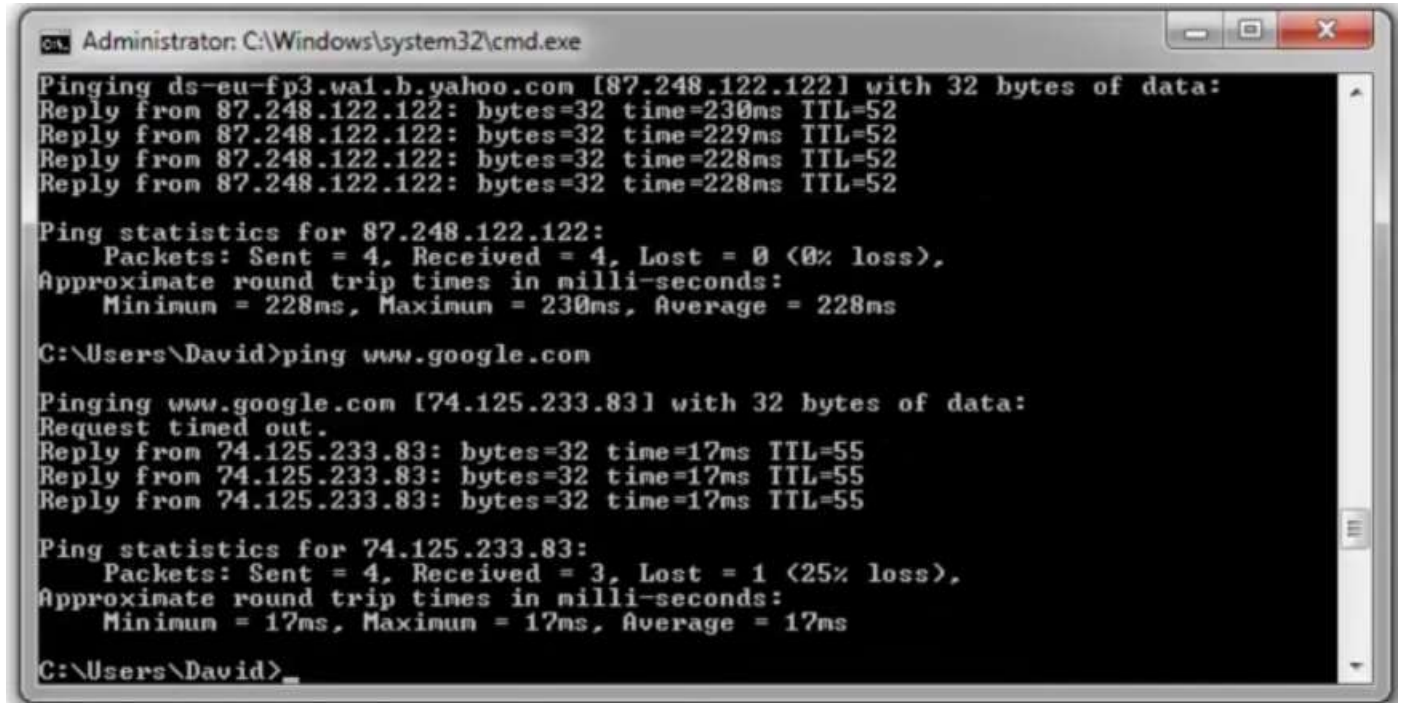
Private:

- 10.0.0.0 to 10.255.255.255
- 172.16.0.0 to 172.31.255.255
- 192.168.0.0 to 192.168.255.255




Select Administrator: C:\Windows\system32\cmd.exe
Ethernet adapter Local Area Connection:
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:20::2
Link-local IPv6 Address . . . . . : fe80::8184:7613:bf9a:48f4%11
IPv4 Address. . . . . : 10.0.0.6
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 2001:20::1
10.0.0.254
Tunnel adapter isatap.{23EA7048-88D5-48C7-9CF1-81ADE9C6E8FE}:
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
Tunnel adapter Local Area Connection* 11:
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:0:5ef5:79fb:3056:28cb:f5ff:fff9
Link-local IPv6 Address . . . . . : fe80::3056:28cb:f5ff:fff9%20
Default Gateway . . . . . :
C:\Users\David>


Administrator: C:\Windows\system32\cmd.exe
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . :
Tunnel adapter Local Area Connection* 11:
Connection-specific DNS Suffix . :
IPv6 Address. . . . . : 2001:0:5ef5:79fb:3056:28cb:f5ff:fff9
Link-local IPv6 Address . . . . . : fe80::3056:28cb:f5ff:fff9%20
Default Gateway . . . . . :
C:\Users\David>ping www.yahoo.com
Pinging ds-eu-fp3.wa1.b.yahoo.com [87.248.122.122] with 32 bytes of data:
Reply from 87.248.122.122: bytes=32 time=230ms TTL=52
Reply from 87.248.122.122: bytes=32 time=229ms TTL=52
Reply from 87.248.122.122: bytes=32 time=228ms TTL=52
Reply from 87.248.122.122: bytes=32 time=228ms TTL=52
Ping statistics for 87.248.122.122:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 228ms, Maximum = 230ms, Average = 228ms
C:\Users\David>


Administrator: C:\Windows\system32\cmd.exe
Pinging ds-eu-fp3.wa1.b.yahoo.com [87.248.122.122] with 32 bytes of data:
Reply from 87.248.122.122: bytes=32 time=230ms TTL=52
Reply from 87.248.122.122: bytes=32 time=229ms TTL=52
Reply from 87.248.122.122: bytes=32 time=228ms TTL=52
Reply from 87.248.122.122: bytes=32 time=228ms TTL=52
Ping statistics for 87.248.122.122:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 228ms, Maximum = 230ms, Average = 228ms
C:\Users\David>ping www.google.com
Pinging www.google.com [74.125.233.83] with 32 bytes of data:
Request timed out.
Reply from 74.125.233.83: bytes=32 time=17ms TTL=55
Reply from 74.125.233.83: bytes=32 time=17ms TTL=55
Reply from 74.125.233.83: bytes=32 time=17ms TTL=55
Ping statistics for 74.125.233.83:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 17ms, Maximum = 17ms, Average = 17ms
C:\Users\David>

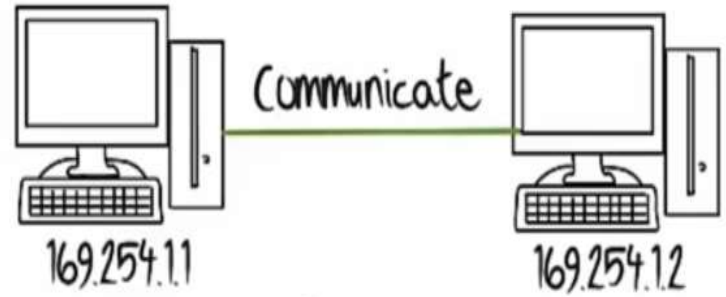
IPv4 Link - Local Addresses

- RFC3927 https://datatracker.ietf.org/doc/html/rfc3927
  - Automatic Private IP Address (APIPA) ← Microsoft

PC configured for DHCP
- when no server is available
  * range 169.254.0.0/16
  * (169.254.0.0 255.255.0.0)

~~- allocate address using DHCP~~
~~- manually configure ip address~~

- allow two computers to communicate when there are no DHCP servers available
- can immediately communicate without configuration
- host randomly generate the host specific part of the address

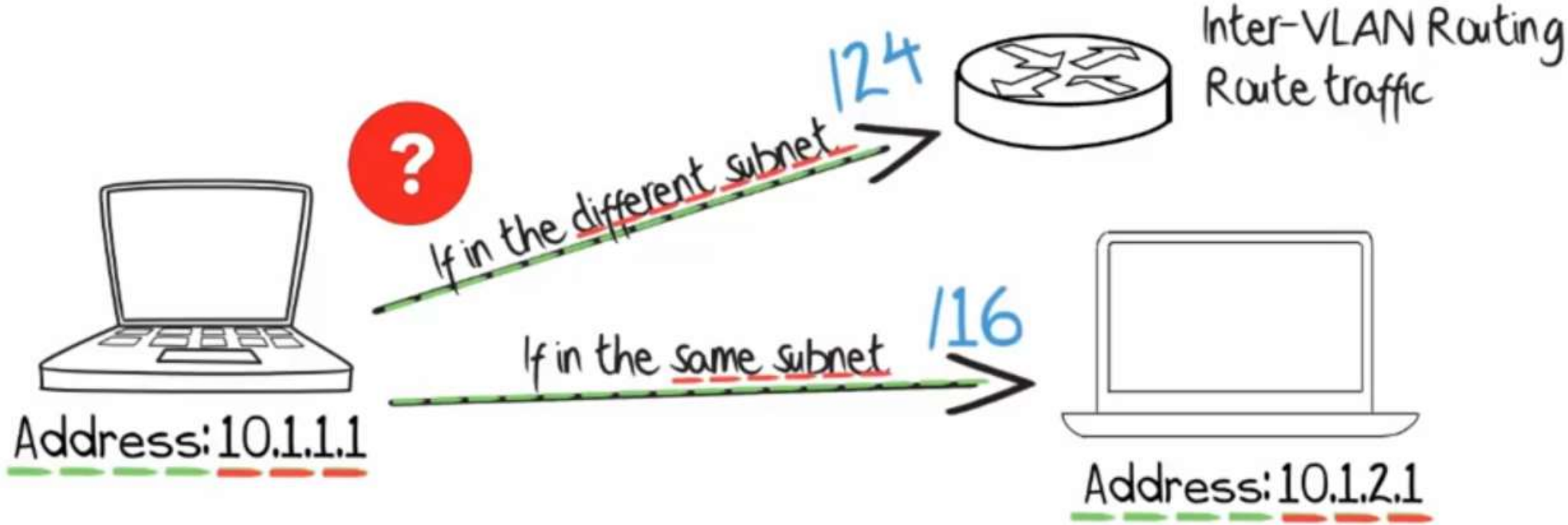


- ipconfig 169.254.X.X

Subnet Mask

Network Address

- used to determine network and host portion
- is a device remote or local ?



Network Mask

- allows us to determine the portion of address which is the host and the network

Determine:

Remote

- thus be reached via a default gateway - different subnet

Local

- does not require a default gateway- same subnet

Network Mask

Class A, B, and C networks have default masks, also known as natural masks

Class A : 255.0.0.0
Class B : 255.255.0.0
Class C : 255.255.255.0

Network Mask

Class A network that hasn't been subnetted would have an address/mask pair similar to

- 10.1.1.1 255.0.0.0 10.0.0.0

Convert the address and mask to binary numbers

10.1.1.1 = 00001010.00000001.00000001.00000001

255.0.0.0 = 11111111.00000000.00000000.00000000

1 - Network

0 - Hosts

Network Mask

Two Simple Rules:

- any address bits which have corresponding mask bit set to 1 represent the network ID
- any address bits that have corresponding mask bits set to 0 represent the node ID

10.1.1.1 = 00001010.00000001.00000001.00000001
255.0.0.0 = 11111111.00000000.00000000.00000000

Netid = 00001010 = 10
Hostid = 00000001.00000001.00000001 = 1.1.1

1.1.1.1 255.255.0.0 1.1.0.0

1.1.1.1 = 00000001.00000001.00000001.00000001
255.255.0.0 = 11111111.11111111.00000000.00000000

Netid = 00000001.00000001 = 1.1
Hostid = 00000001.00000001 = .1.1

Local or Remote ?

To work out if another host is local

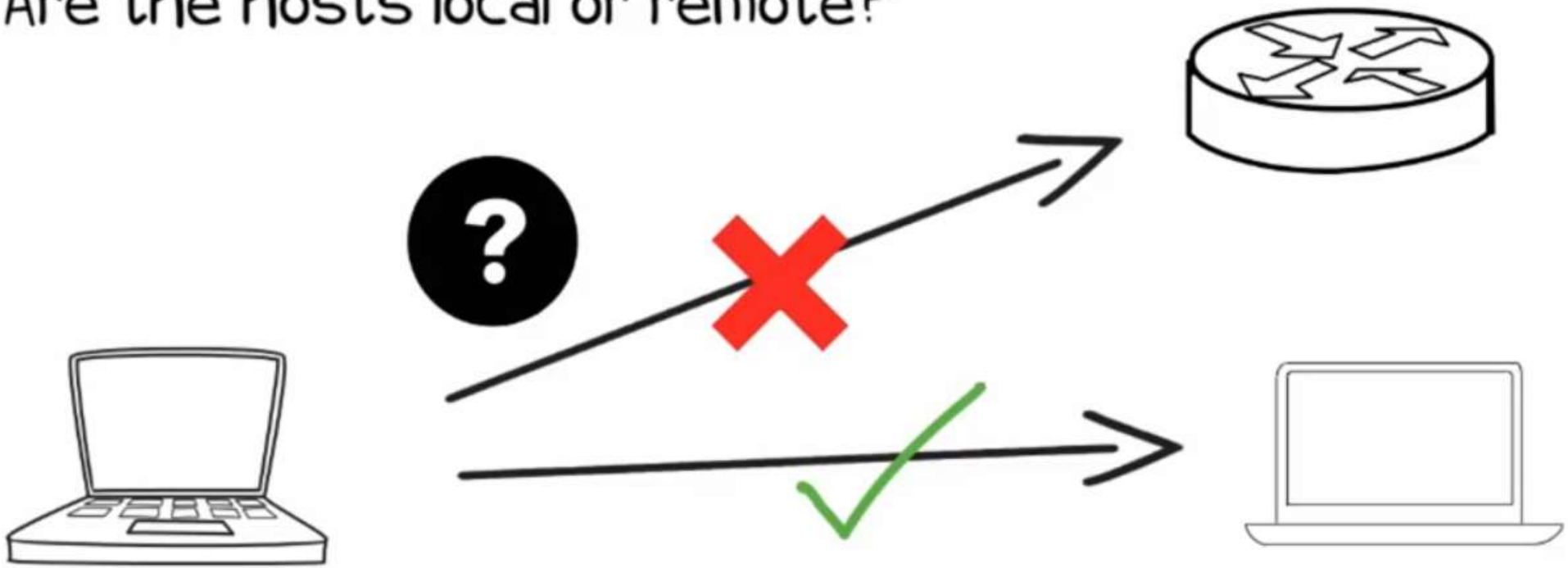
- check the network portion of the address
- compare to the other host

If they are the same they are local

If they are not the same, we are remote

Subnet Mask

Are the hosts local or remote?



Network:
10.1.1.1
255.255.0.0

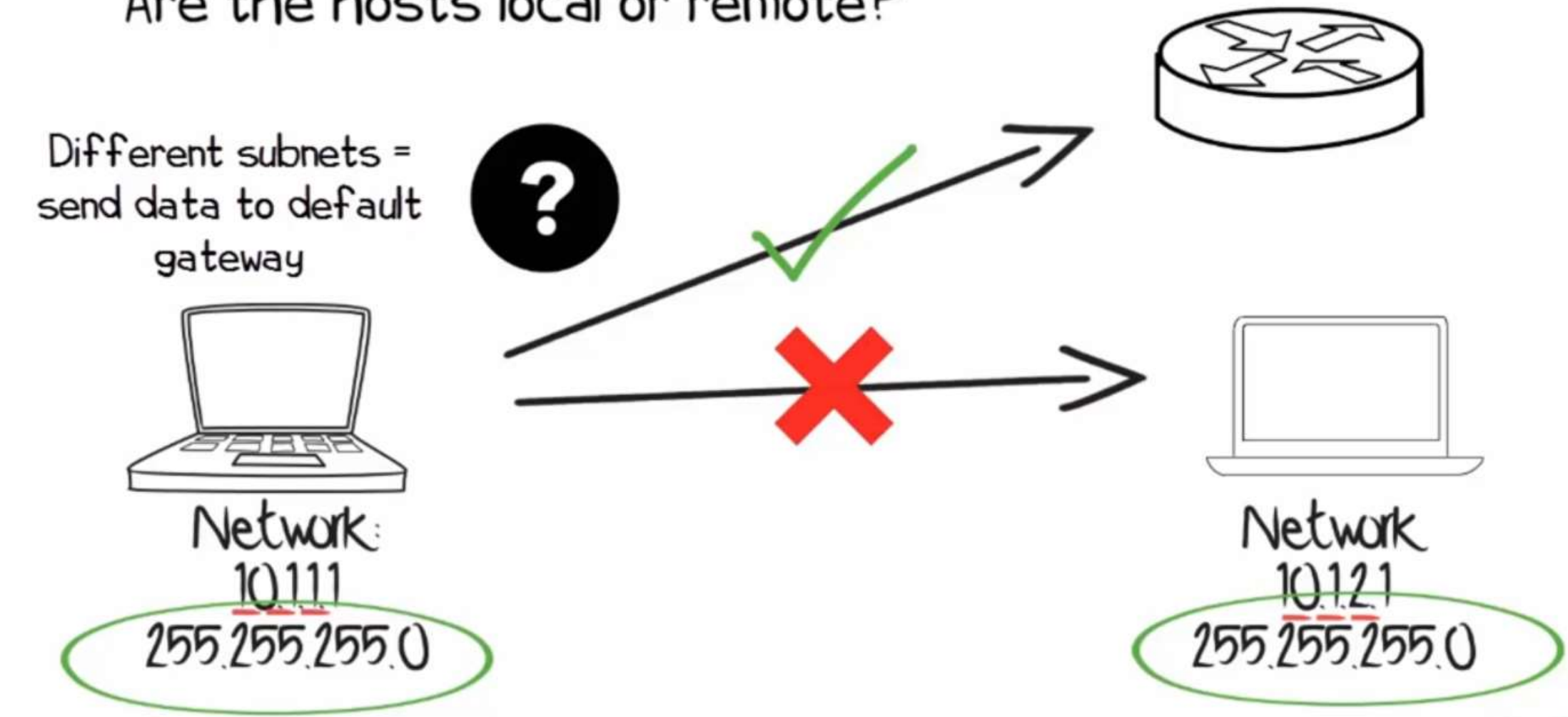
Arp message
It will try to communicate with 10.1.2.1 on the local segment - directly and not to default gateway

Network
10.1.2.1
255.255.0.0

Subnet Mask

Are the hosts local or remote?

Different subnets = send data to default gateway



Discontiguous Network Mask

- cisco devices do not support discontiguous mask

11110000.11111111.00000110.11000000 = 240.255.3.191

Only contiguous subnet mask are supported:

11111111.11110000.00000000.00000000 = 255.240.0.0

11111111.11111111.11000000.00000000 = 255.255.192.0

0.0.0.240

CIDR (Classless Inter-Domain Routing)

- Introduced in 1993
- Replaces Classful IP Addressing
- Variable Length Subnet Mask (VLSM)

Use	10.0.0.0/8 notation
Rather than	10.0.0.0 255.0.0.0 notation

/X Mask (CIDR Notation)

Dotted decimal: 255.255.255.0

Binary bits: /24

Convert mask to binary

255 = 11111111 (8 binary 1's)
255 = 11111111 (8 binary 1's)
255 = 11111111 (8 binary 1's)
0 = 00000000 (0 binary 1's)

thus 255.255.255.0 can be written as /24

255.255.0.0 /16

8 + 8 = 16

- Mask must be CONTIGUOUS

/X Masks (CIDR Notation)

255.224.0.0

11111111.11100000.00000000.00000000

11 binary 1's or /11

255.224.0.0 = /11

Variable Length Subnet Mask

Class A - /8
Class B - /16
Class C - /24

CIDR (Classless Inter-Domain Routing)

Problems

Class A
- 16,777,214 host addresses
- Mask of 255.0.0.0

Class B
- 65,534 host addresses
- Mask of 255.255.0.0

Class C
- 254 host addresses
- Mask of 255.255.255.0

replaced with CIDR