

Microsoft® Official Course



Module 5

Implementing IPv4

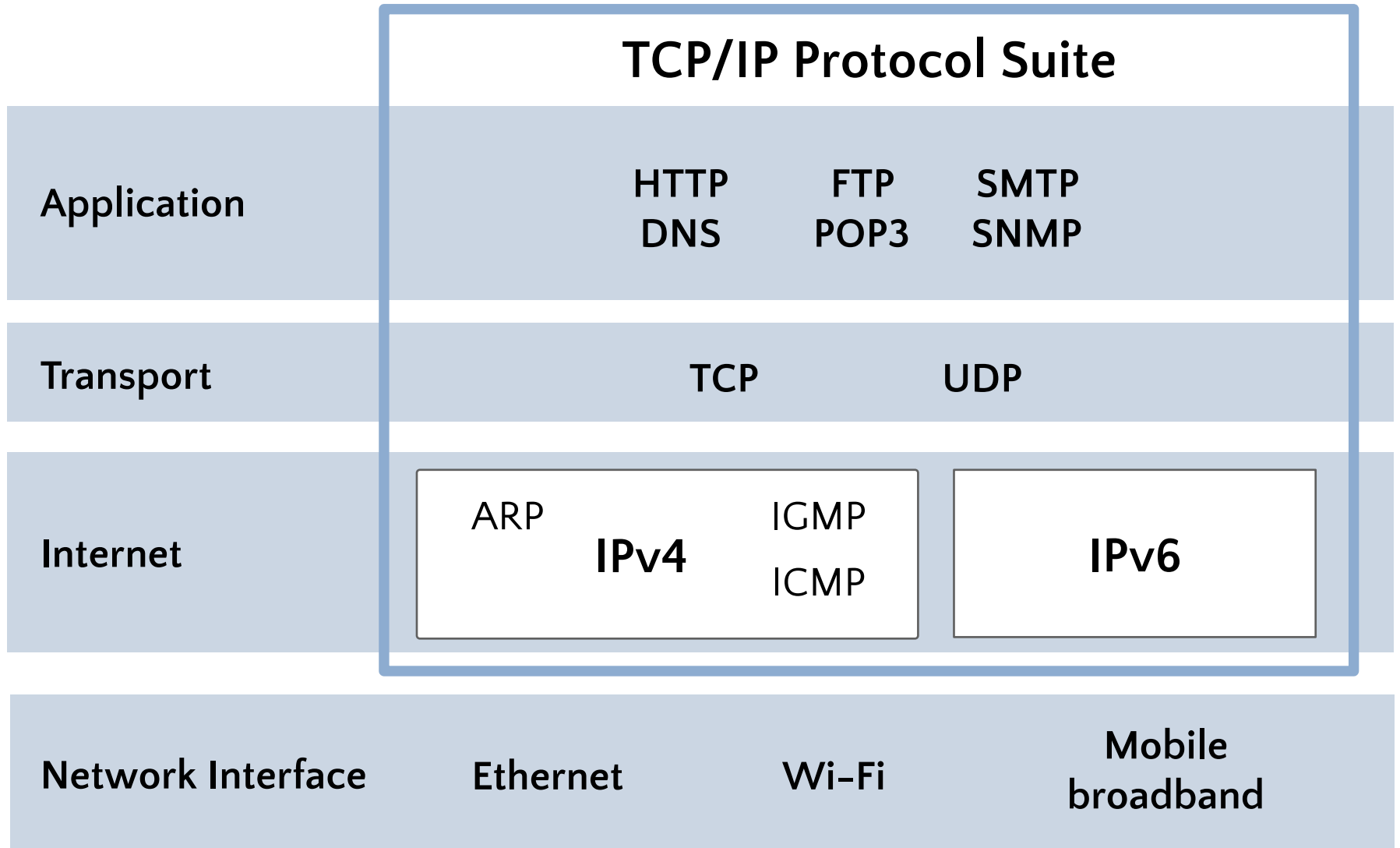
Module Overview

- Overview of TCP/IP
 - Understanding IPv4 Addressing
 - Subnetting and Supernetting
 - Configuring and Troubleshooting IPv4

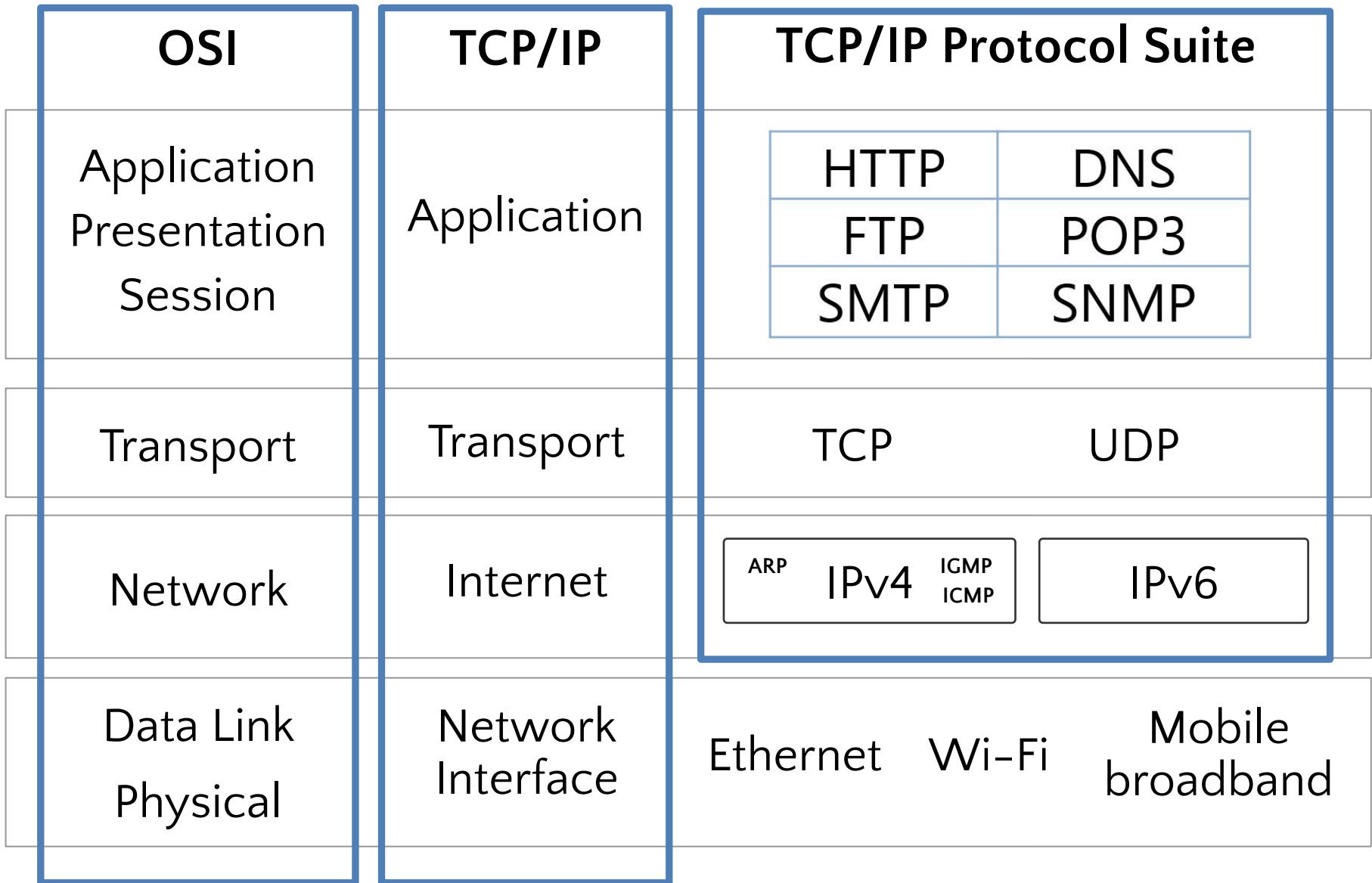
Lesson 1: Overview of TCP/IP

- The TCP/IP Protocol Suite
 - Protocols in the TCP/IP Suite
 - TCP/IP Applications
 - What Is a Socket?

The TCP/IP Protocol Suite



Protocols in the TCP/IP Suite

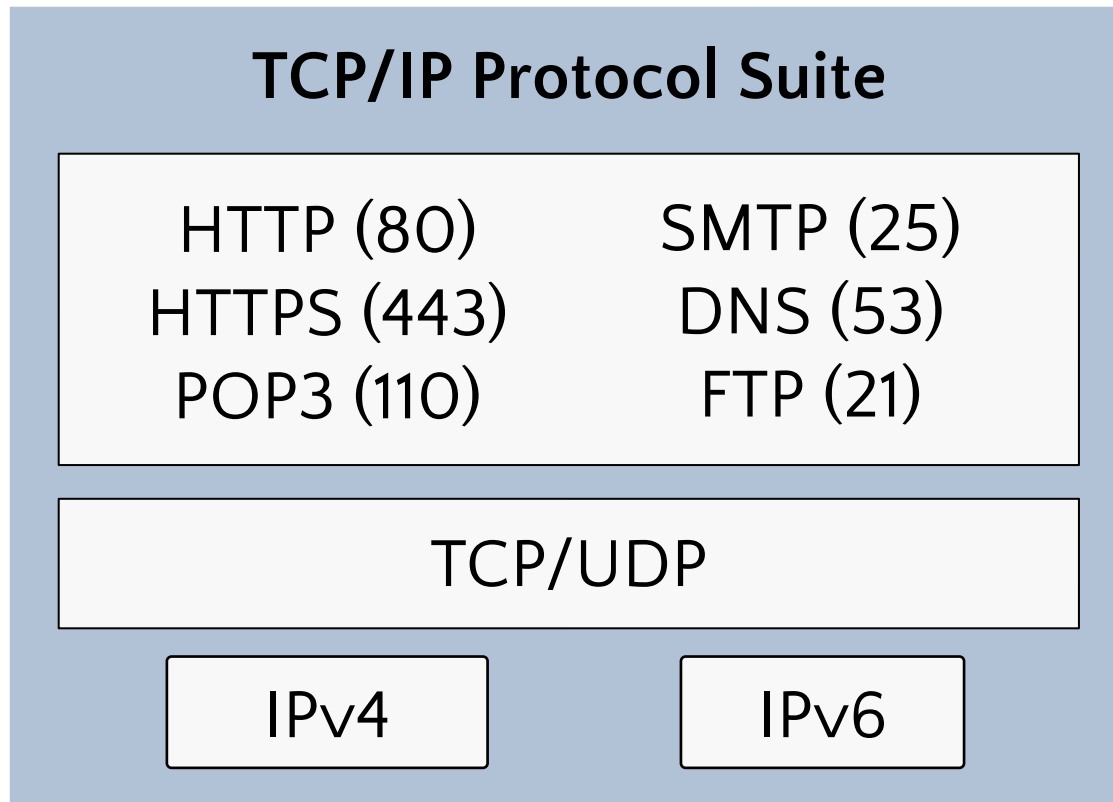


Some common application layer protocols:

- HTTP
- HTTPS
- FTP
- RDP
- SMB
- SMTP
- POP3

What Is a Socket?

A socket is a combination of an IP address, a transport protocol, and a port



Lesson 2: Understanding IPv4 Addressing

- IPv4 Addressing
 - Public and Private IPv4 Addresses
 - How Dotted Decimal Notation Relates to Binary Numbers
 - Simple IPv4 Implementations
 - More Complex IPv4 Implementations

IPv4 Addressing

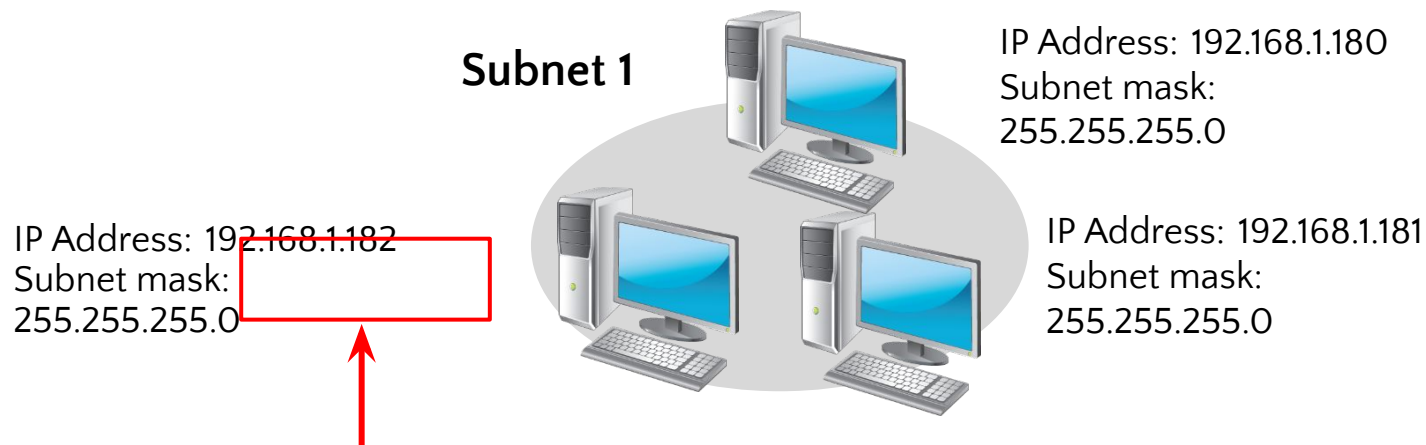
- Each networked computer must be assigned a unique IPv4 address
- Network communication for a computer is directed to the IPv4 address of the computer
- Each IPv4 address contains:
 - ✓ Network ID, identifying the network
 - ✓ Host ID, identifying the computer
- The subnet mask identifies which part of the IPv4 address is the network ID (255) and which is the host ID (0)

IP address	172	16	0	10
Subnet mask	255	255	0	0
Network ID	172	16	0	0
Host ID	0	0	0	10



IPv4 Addressing

An IPv4 configuration identifies a computer to other computers on a network

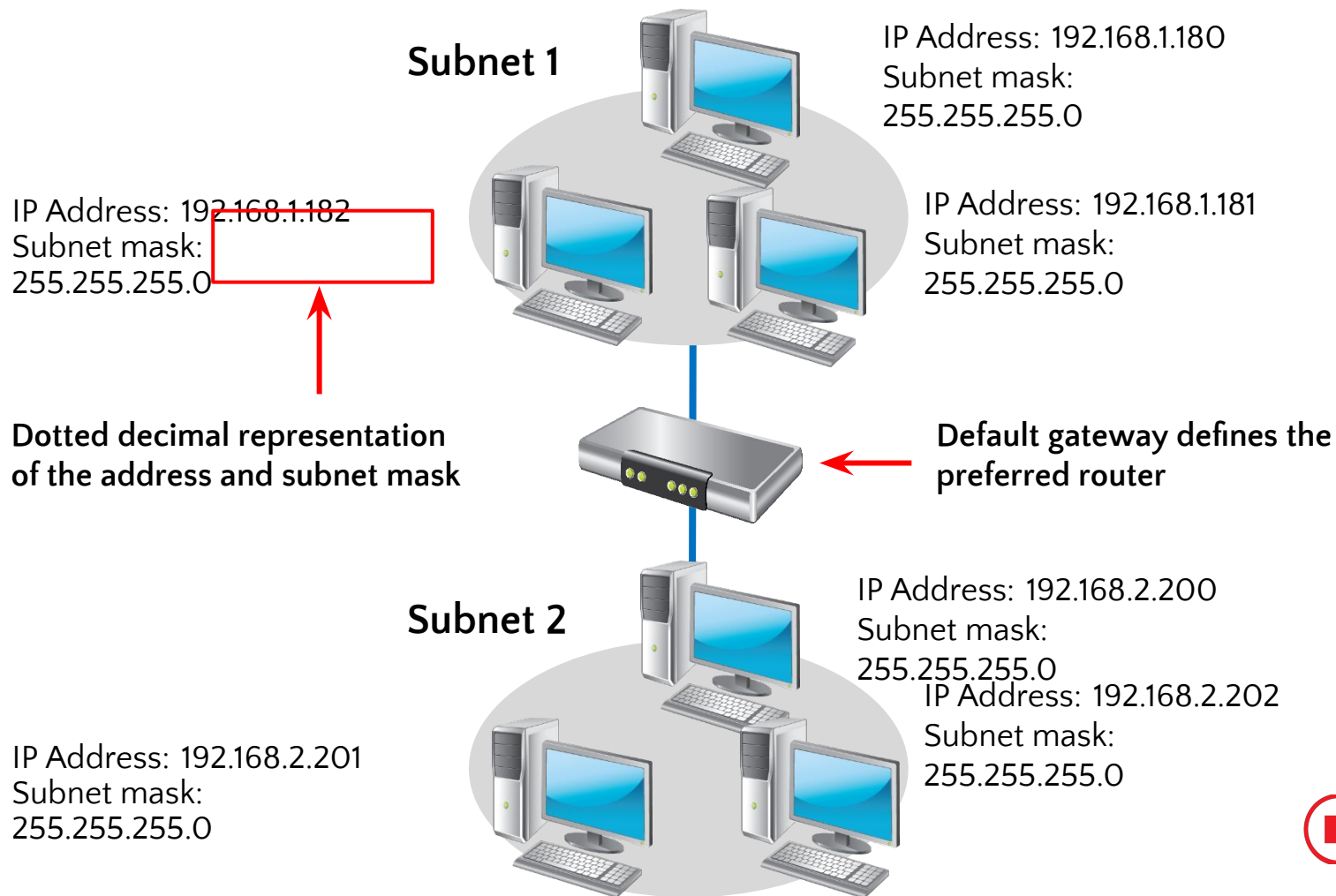


Dotted decimal representation
of the address and subnet mask



IPv4 Addressing

An IPv4 configuration identifies a computer to other computers on a network



Public and Private IPv4 Addresses

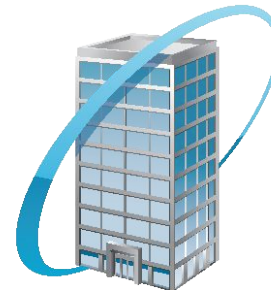
Public

- Required by devices and hosts that connect directly to the Internet
- Must be globally unique
- Routable on the Internet
- Must be assigned by IANA/RIR



Private

- Not routable on the Internet
 - 10.0.0.0/8
 - 172.16.0.0/12
 - 192.168.0.0./16
- Can be assigned locally by an organization
- Must be translated to access the Internet



How Dotted Decimal Notation Relates to Binary Numbers

Dotted decimal notation is based on the decimal number system, but computers use IP addresses in binary

Within an 8-bit octet, each bit position has a decimal value:

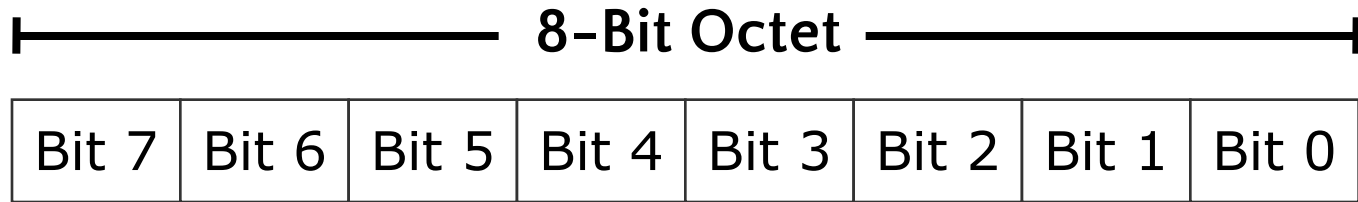
- A bit that is set to 0 always has a zero value
- A bit that is set to 1 can be converted to a decimal value
- The low-order bit represents a decimal value of 1
- The high-order bit represents a decimal value of 128

If all bits in an octet are set to 1, then the octet's decimal value is 255, the highest possible value of an octet:

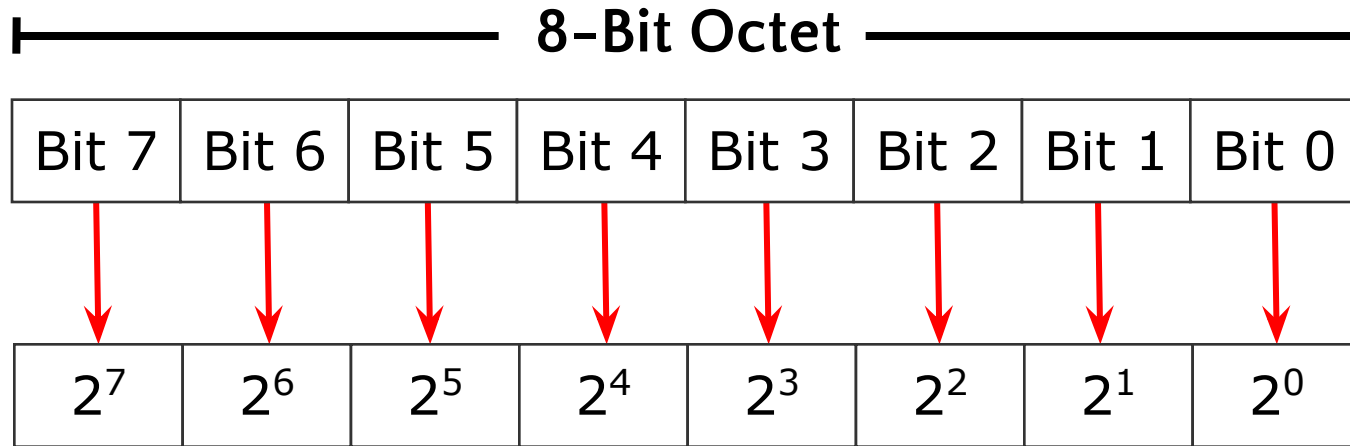
$$128 + 64 + 32 + 16 + 8 + 4 + 2 + 1$$



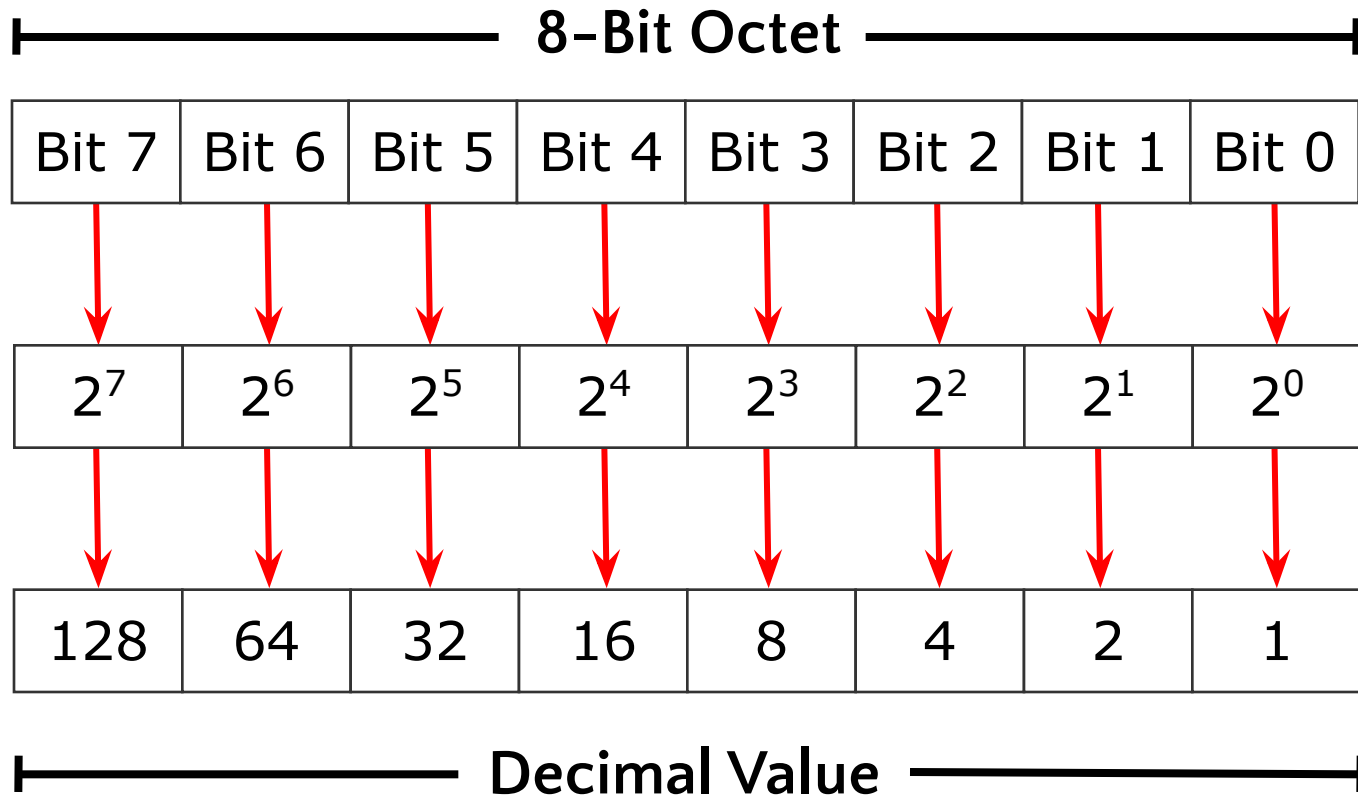
How Dotted Decimal Notation Relates to Binary Numbers



How Dotted Decimal Notation Relates to Binary Numbers

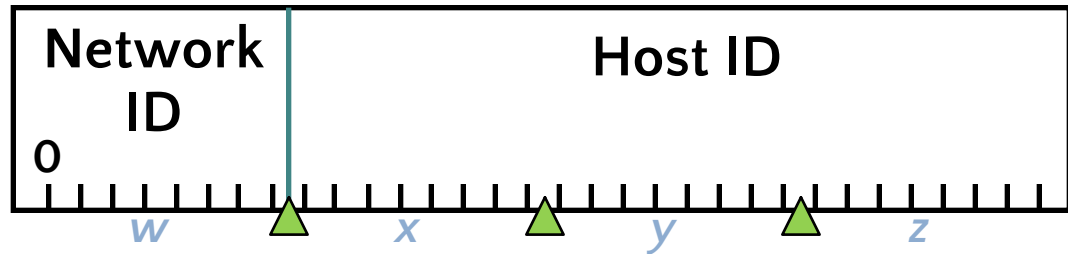


How Dotted Decimal Notation Relates to Binary Numbers

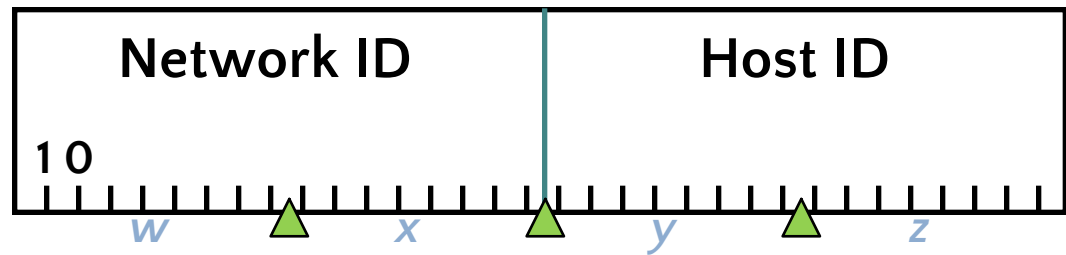


Simple IPv4 Implementations

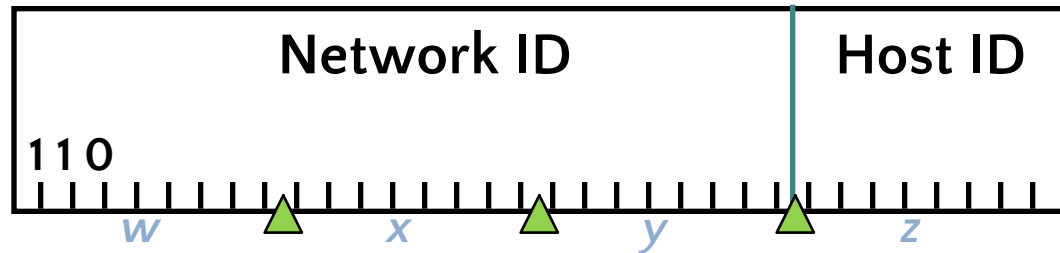
Class A (/8)
Large Network



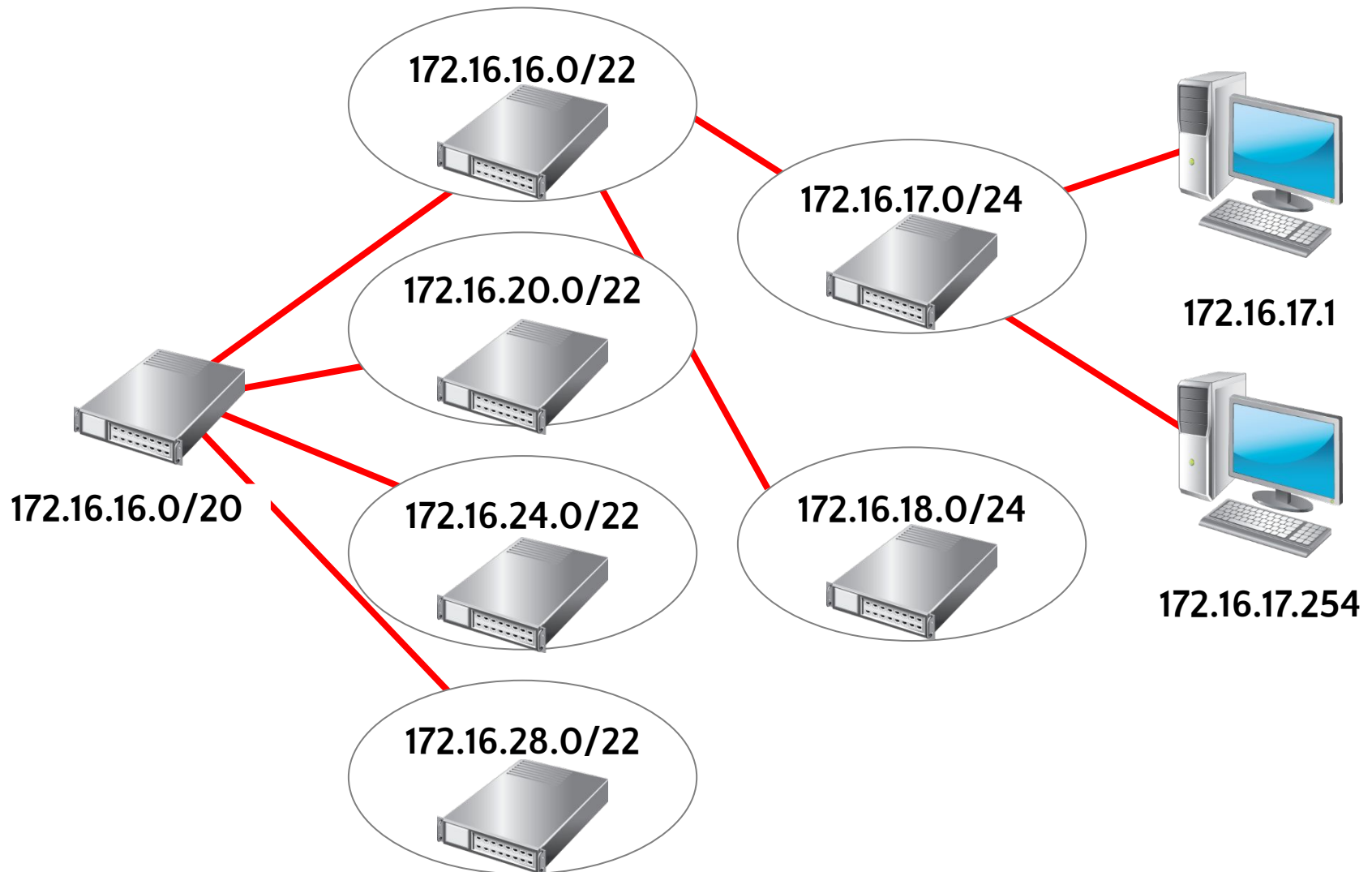
Class B (/16)
Medium
Network



Class C (/24)
Small Network



More Complex IPv4 Implementations



Lesson 3: Subnetting and Supernetting

- How Bits Are Used in a Subnet Mask or Prefix Length

The Benefits of Using Subnetting

Calculating Subnet Addresses

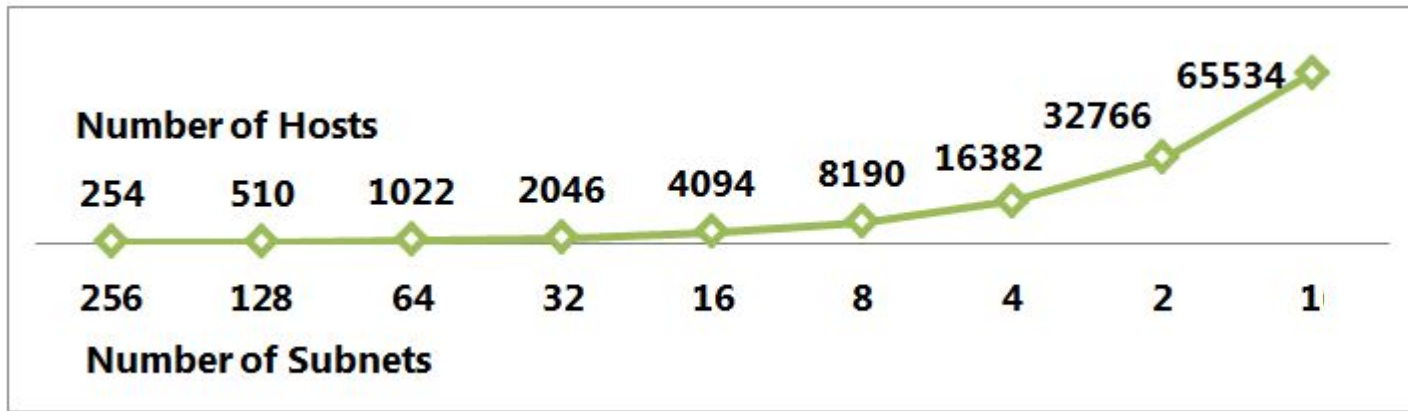
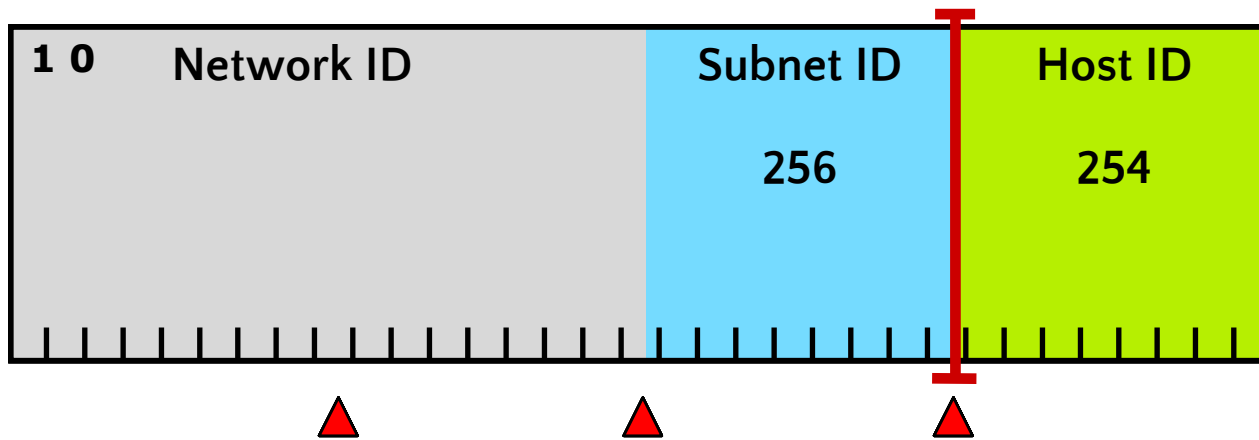
Calculating Host Addresses

Discussion: Creating a Subnetting Scheme for a New Office

What Is Supernetting?

How Bits Are Used in a Subnet Mask or Prefix Length

Class B Address with Subnet



The Benefits of Using Subnetting

When you subdivide a network into subnets, you create a unique ID for each subnet that is derived from the main network ID

By using subnets, you can:

- Use a single network address across multiple locations
- Reduce network congestion by segmenting traffic
- Increase security by using firewalls
- Overcome limitations of current technologies

Calculating Subnet Addresses

When determining subnet addresses you should:

- Choose the number of subnet bits based on the number of subnets required
- Use 2^n to determine the number of subnets available from n bits

For five locations, the following three subnet bits are required:

- 5 locations = 5 subnets required
- $2^2 = 4$ subnets (not enough)
- $2^3 = 8$ subnets

Calculating Host Addresses

When determining host addresses you should:

- Choose the number of host bits based on the number of hosts that you require on each subnet
- Use $2^n - 2$ to determine the number of hosts that are available on each subnet

For subnets with 100 hosts, seven host bits are required:

- $2^6 - 2 = 62$ hosts (not enough)
- $2^7 - 2 = 126$ hosts

Discussion: Creating a Subnetting Scheme for a New Office

- How many subnets are required?
- How many bits are required to create that number of subnets?
- How many hosts are required on each subnet?
- How many bits are required to support that number of hosts?
- What is an appropriate subnet mask that would satisfy these requirements?



20 minutes

What Is Supernetting?

- Supernetting combines multiple small networks into a larger network
- The networks that you combine must be contiguous
- The following table shows an example of supernetting two class C networks

192.168. 00010000 .00000000/24	192.168.16.0 – 192.168.16.255
192.168. 00010001 .00000000/24	192.168.17.0 – 192.168.17.255
192.168. 00010000 .00000000/23	192.168.16.0 – 192.168.17.255

Lesson 4: Configuring and Troubleshooting IPv4

- Configuring IPv4 Manually
- Configuring IPv4 Automatically
- Using Windows PowerShell Cmdlets to Troubleshoot IPv4
- IPv4 Troubleshooting Tools
- The IPv4 Troubleshooting Process
- What Is Microsoft Message Analyzer?
- Demonstration: How to Capture and Analyze Network Traffic by Using Microsoft Message Analyzer

Configuring IPv4 Manually

Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

Obtain an IP address automatically

Use the following IP address:

IP address: 10 . 10 . 0 . 10

Subnet mask: 255 . 255 . 0 . 0

Default gateway: 10 . 10 . 0 . 1

Obtain DNS server address automatically

Use the following DNS server addresses:

Preferred DNS server: 10 . 10 . 0 . 10

Alternate DNS server: . . .

Validate settings upon exit

Advanced...

OK Cancel



Configuring IPv4 Manually

Examples using Windows PowerShell cmdlets:

```
New-NetIPAddress -InterfaceAlias "Local Area Connection" -IPAddress 10.10.0.10  
-PrefixLength 24 -DefaultGateway 10.10.0.1
```

```
Set-DNSClientServerAddresses -InterfaceAlias "Local Area Connection"  
-ServerAddresses 10.12.0.1,10.12.0.2
```

Example using the netsh command-line tool:

```
Netsh interface ipv4 set address name="Local Area Connection" source=static addr=10.10.0.10  
mask=255.255.255.0 gateway=10.10.0.1
```



Configuring IPv4 Automatically

DHCP Server with
IPv4 Scope



IPv4 DHCP Client



```
Set-NetIPInterface -InterfaceAlias "Local Area Connection"  
-Dhcp Enabled
```

```
Restart-NetAdapter -Name "Local Area Connection"
```

New Windows PowerShell cmdlets include:

- `Get-NetAdapter`
- `Restart-NetAdapter`
- `Get-NetIPInterface`
- `Get-NetIPAddress`
- `Get-NetRoute`
- `Get-NetConnectionProfile`
- `Get-DNSClientCache`
- `Get-DNSClientServerAddress`
- `Register-DnsClient`
- `Set-DnsClient`
- `Set-DnsClientGlobalSetting`

IPv4 Troubleshooting Tools

Use the following tools to troubleshoot IPv4:

- Ipconfig
- Ping
- Tracert
- Pathping
- Telnet
- Netstat
- Resource Monitor
- Windows Network Diagnostics
- Event Viewer

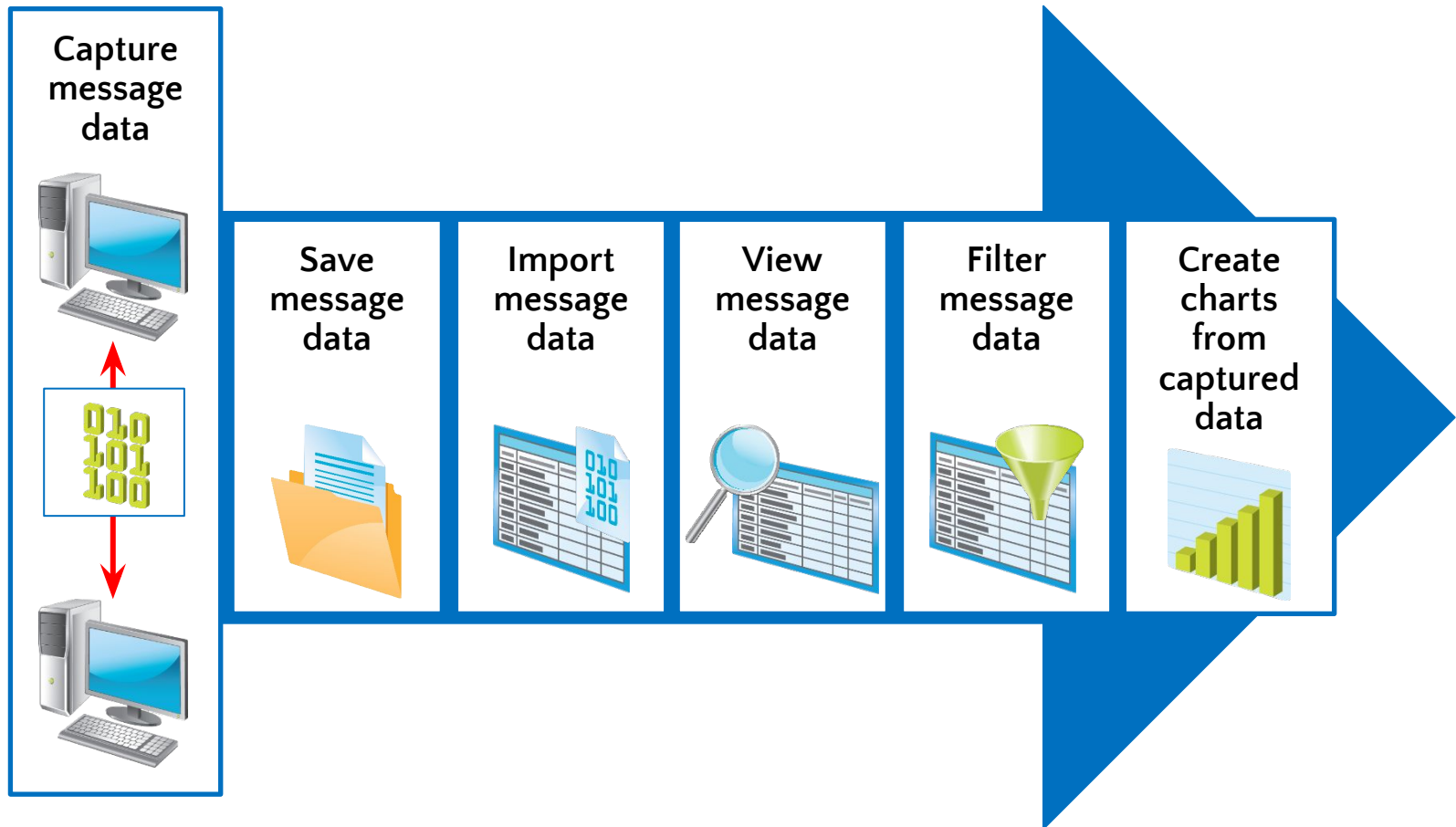
The IPv4 Troubleshooting Process

After you identify the scope of the problem, use the following tools to troubleshoot network connectivity:

Verify the network configuration is correct	Get-NetIPAddress	ipconfig
Identify the network path between hosts	Test-NetConnection -TraceRoute	tracert
See if the remote host responds	Test-NetConnection	ping
Test the service on a remote host	Test-NetConnection -Port	Telnet
See if the default gateway responds	Test-NetConnection	ping

What Is Microsoft Message Analyzer?

You can use Microsoft Message Analyzer to perform the following network analysis tasks:



Demonstration: How to Capture and Analyze Network Traffic by Using Microsoft Message Analyzer

In this demonstration, you will see how to:

- Start a new Capture/Trace in Microsoft Message Analyzer
- Capture packets from a ping request
- Analyze the captured network traffic
- Filter the network traffic



Lab: Implementing IPv4

- Exercise 1: Identifying Appropriate Subnets
- Exercise 2: Troubleshooting IPv4

Logon Information

Virtual machines **20410D-LON-DC1**

20410D-LON-RTR

20410D-LON-SVR2

User name **Adatum\Administrator**

Password **Pa\$\$wOrd**

Estimated Time: 45 minutes

Lab Scenario

You have recently accepted a promotion to the server support team. One of your first assignments is configuring the infrastructure service for a new branch office.

After a security review, your manager has asked you to calculate new subnets for the branch office to support segmenting network traffic. You also need to troubleshoot a connectivity problem on a server in the branch office.

Lab Review

- Why is variable-length subnetting required in this lab?

Which Windows PowerShell cmdlet can you use to view the local routing table of a computer instead of using route print?

Module Review and Takeaways

- Review Questions
 - Best Practices
 - Common Issues and Troubleshooting Tips
- Tools



