

# IPv4 Subnetting – Sections

Section 1: Analyzing Individual Subnets

Section 2: Converting Subnet Masks

**Section 3: Analyzing IP Networks**

Section 4: Identifying the Subnets of a Network

Section 5: Analyzing Designs Using Masks

Section 6: Subnetting and the Exam

# IPv4 Subnetting – Section 3

## **Understanding the IPv4 Address Space**

\* Finding Facts about IP Networks

# In This Lesson...

## Understanding the IPv4 Address Space

- **IP Networks Vs. IP Subnets**
- Public IP Networks
- IPv4 Address Classes
- Private IP Networks
- CIDR Blocks
- Summary and Terms

# Defining “IPv4 Subnet”: Noun

1. A Predictable Set of Consecutive Numbers
  - A. **Subnet ID:** The Lowest Number in the Subnet
  - B. **Address Range:** The Numbers in Between
  - C. **Subnet Broadcast Address:** The Highest Number in the Subnet
2. A Set with a **Small Set of Predictable Sizes that are Powers of 2**
  - A. Theoretical Size:  $2^H$  (H is Based on the Subnet Mask)
  - B. Two Reserved Numbers: (Subnet ID, Subnet Broadcast Address)
  - C. Usable Size:  $2^H - 2$
3. **A Subset of an IP Network**

# Defining “IPv4 Network”: Noun

1. A Predictable Set of Consecutive Numbers
  - A. **Network ID:** The Lowest Number in the **Network**
  - B. **Address Range:** The Numbers in Between
  - C. **Network Broadcast Address:** The Highest Number in the **Network**
2. A Set with **Three Specific Predictable Sizes**
  - A. Theoretical Sizes:  $2^8$ , or  $2^{16}$ , or  $2^{24}$
  - B. Two Reserved Numbers: **Network ID**, **Network Broadcast Address**
  - C. Usable Sizes:  $2^8 - 2$ , or  $2^{16} - 2$ , or  $2^{24} - 2$
3. Usable as:
  - A. Use Like a Subnet, as One Set of Addresses
  - B. Subdivide into Smaller Subsets to Create Subnets

# Some Example IPv4 Networks

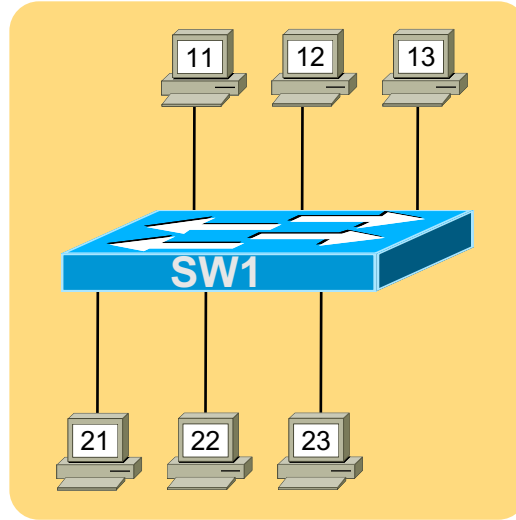
- 1.0.0.0 255.0.0.0 - All Addresses that Begin with 1
- 2.0.0.0 255.0.0.0 - All Addresses that Begin with 2
- 3.0.0.0 255.0.0.0 - All Addresses that Begin with 3
- 4.0.0.0 255.0.0.0 - All Addresses that Begin with 4
- 5.0.0.0 255.0.0.0 - All Addresses that Begin with 5

# Using A Network in a Topology

- VLAN
- Serial Link
- Ethernet WAN

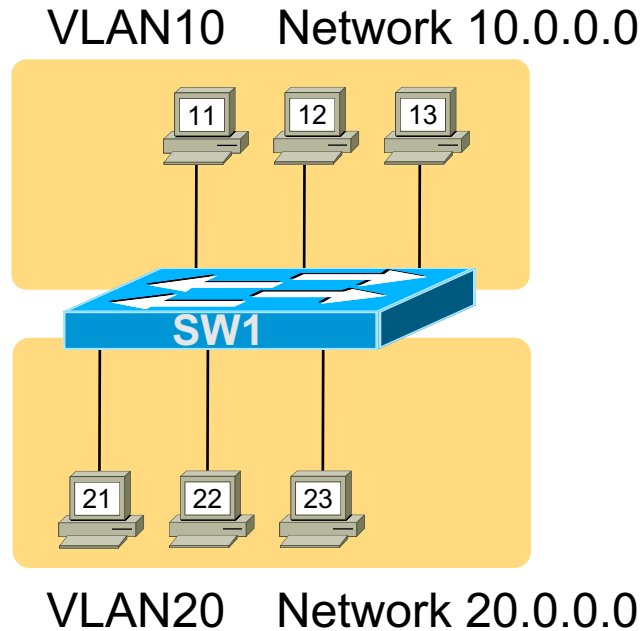
# Topology: One VLAN, One Network

VLAN1      Network 1.0.0.0

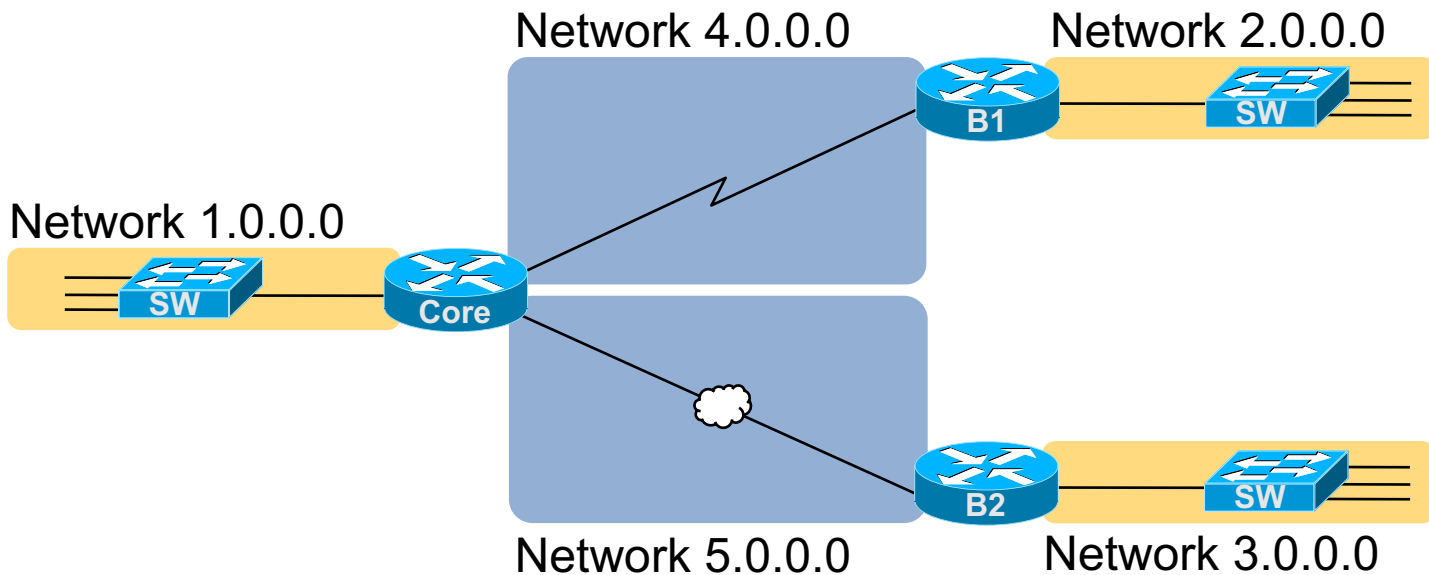




# Topology: Two VLANs, Two Network



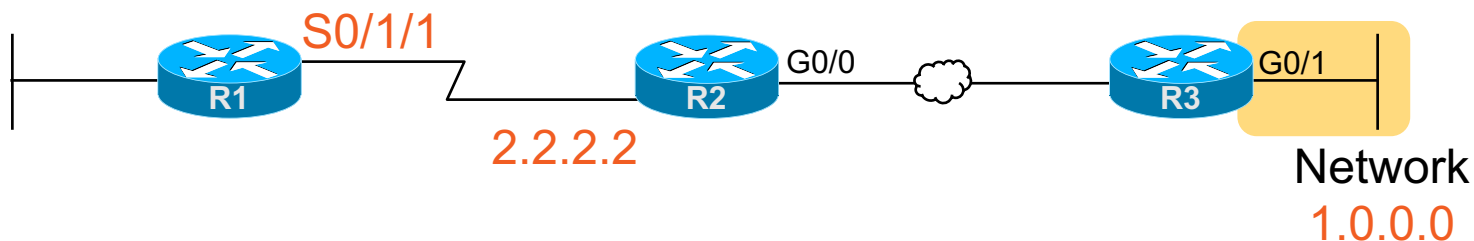
# Three VLANs and Two WAN Links



# Example Routing Table with Network 1.0.0.0

R1 Routing Table

Network	Interface	Next Hop
1.0.0.0	Serial0/1/1	2.2.2.2



# The $2^{24}$ DDN Numbers in Network 1.0.0.0

1. 0. 0. 0  
1. 0. 0. 1  
1. 0. 0. 2  
1. 0. 0. 3  
1. 0. 0. 4  
1. 0. 0. 5  
1. 0. 0. 6  
1. 0. 0. 7  
1. 0. 0. 8  
1. 0. 0. 9  
1. 0. 0. 10  
...  
1. 0. 0.249  
1. 0. 0.250  
1. 0. 0.251  
1. 0. 0.252  
1. 0. 0.253  
1. 0. 0.254  
1. 0. 0.255

$2^{24}$  DDN Numbers  
Begin with 1:  
16,777,216



1.255.255. 0  
1.255.255. 1  
1.255.255. 2  
1.255.255. 3  
1.255.255. 4  
1.255.255. 5  
1.255.255. 6  
1.255.255. 7  
1.255.255. 8  
1.255.255. 9  
1.255.255. 10  
...  
1.255.255.249  
1.255.255.250  
1.255.255.251  
1.255.255.252  
1.255.255.253  
1.255.255.254  
1.255.255.255

# Patterns: $2^{16}$ Subnets of $2^8$ Addresses

1. 0. 0. \_\_  
1. 0. 1. \_\_  
1. 0. 2. \_\_  
1. 0. 3. \_\_  
1. 0. 4. \_\_  
1. 0. 5. \_\_  
1. 0. 6. \_\_  
1. 0. 7. \_\_  
1. 0. 8. \_\_  
1. 0. 9. \_\_  
1. 0. 10. \_\_  
...  
1. 0.249. \_\_  
1. 0.250. \_\_  
1. 0.251. \_\_  
1. 0.252. \_\_  
1. 0.253. \_\_  
1. 0.254. \_\_  
1. 0.255. \_\_

1. 1. 0. \_\_  
1. 1. 1. \_\_  
1. 1. 2. \_\_  
1. 1. 3. \_\_  
1. 1. 4. \_\_  
1. 1. 5. \_\_  
1. 1. 6. \_\_  
1. 1. 7. \_\_  
1. 1. 8. \_\_  
1. 1. 9. \_\_  
1. 1. 10. \_\_  
...  
1. 1.249. \_\_  
1. 1.250. \_\_  
1. 1.251. \_\_  
1. 1.252. \_\_  
1. 1.253. \_\_  
1. 1.254. \_\_  
1. 1.255. \_\_

1. 2. 0. \_\_  
1. 2. 1. \_\_  
1. 2. 2. \_\_  
1. 2. 3. \_\_  
1. 2. 4. \_\_  
1. 2. 5. \_\_  
1. 2. 6. \_\_  
1. 2. 7. \_\_  
1. 2. 8. \_\_  
1. 2. 9. \_\_  
1. 2. 10. \_\_  
...  
1. 2.249. \_\_  
1. 2.250. \_\_  
1. 2.251. \_\_  
1. 2.252. \_\_  
1. 2.253. \_\_  
1. 2.254. \_\_  
1. 2.255. \_\_



1.254. 0. \_\_  
1.254. 1. \_\_  
1.254. 2. \_\_  
1.254. 3. \_\_  
1.254. 4. \_\_  
1.254. 5. \_\_  
1.254. 6. \_\_  
1.254. 7. \_\_  
1.254. 8. \_\_  
1.254. 9. \_\_  
1.254. 10. \_\_  
...  
1.254.249. \_\_  
1.254.250. \_\_  
1.254.251. \_\_  
1.254.252. \_\_  
1.254.253. \_\_  
1.254.254. \_\_  
1.254.255. \_\_

1.255. 0. \_\_  
1.255. 1. \_\_  
1.255. 2. \_\_  
1.255. 3. \_\_  
1.255. 4. \_\_  
1.255. 5. \_\_  
1.255. 6. \_\_  
1.255. 7. \_\_  
1.255. 8. \_\_  
1.255. 9. \_\_  
1.255. 10. \_\_  
...  
1.255.249. \_\_  
1.255.250. \_\_  
1.255.251. \_\_  
1.255.252. \_\_  
1.255.253. \_\_  
1.255.254. \_\_  
1.255.255. \_\_

# Three Starting Points for an Enterprise

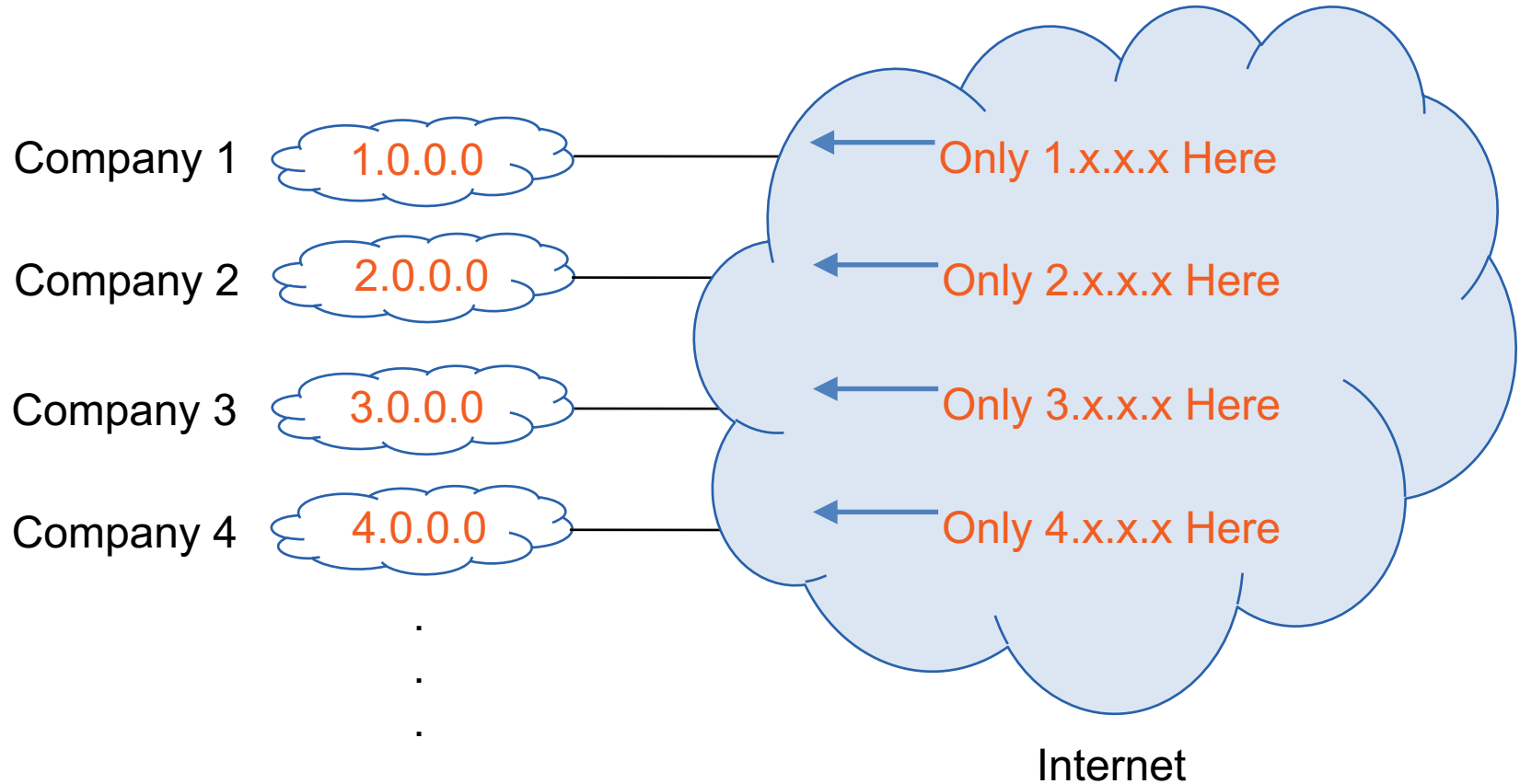
- A Public IP Network
- A Private IP Network
- A CIDR Block (a Subset of a Public Network)

# In This Lesson...

## Understanding the IPv4 Address Space

- IP Networks Vs. IP Subnets
- **Public IP Networks**
- IPv4 Address Classes
- Private IP Networks
- CIDR Blocks
- Summary and Terms

# Original Plan: Unique Networks for All





# Public Network Assignments

Internet Assigned Numbers Authority (IANA)

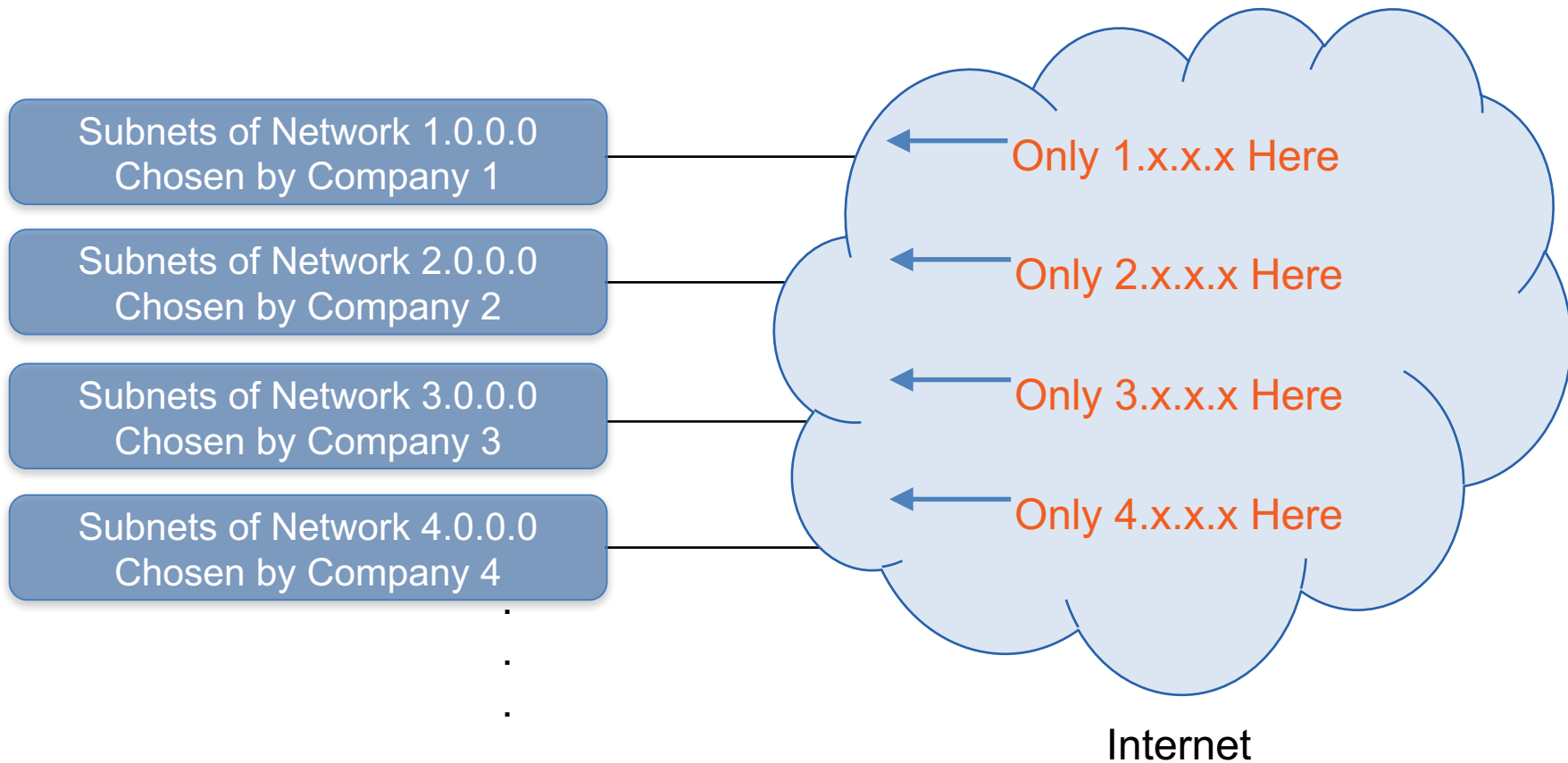
- <https://www.iana.org>

Regional Registries:

- AFRINIC – Africa
- APNIC – Asia/Pacific
- ARIN – North America
- LACNIC – Latin/South America
- RIPE NCC – Europe, Middle East, Central Asia

ISPs

# Subnetting Inside Each Company

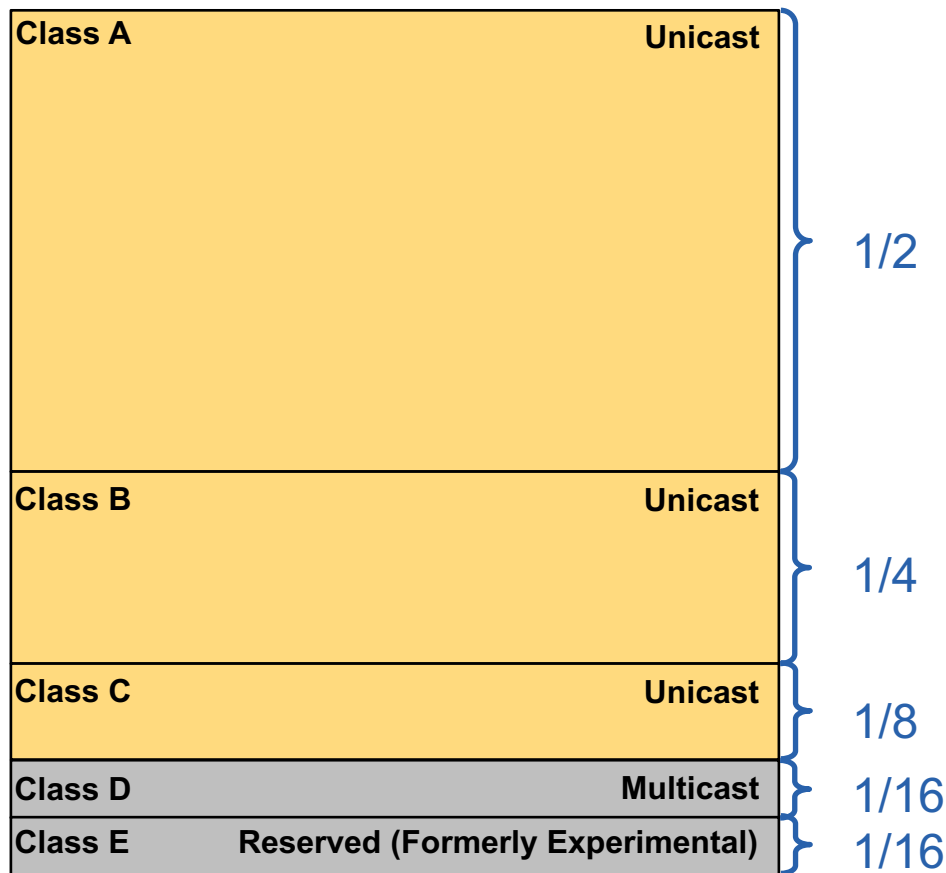


# In This Lesson...

## Understanding the IPv4 Address Space

- IP Networks Vs. IP Subnets
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- **IPv4 Address Classes**
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# Breaking Down the IPv4 Address Space



# Breaking Down the IPv4 Address Space

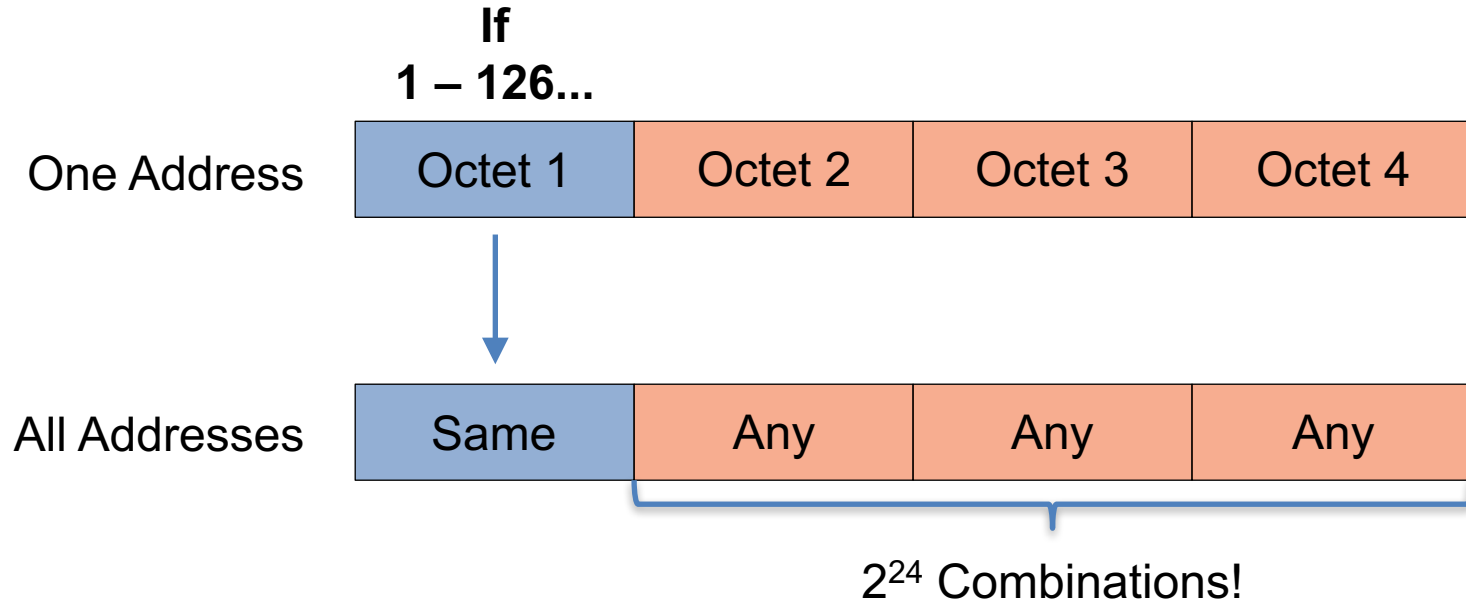
0	Reserved		
1 - 126	Class A	Unicast	1/2
127	Reserved		
128 - 191	Class B	Unicast	1/4
192 - 223	Class C	Unicast	1/8
224 - 239	Class D	Multicast	1/16
240 - 255	Class E	Reserved (Formerly Experimental)	1/16

# IPv4 Address Class

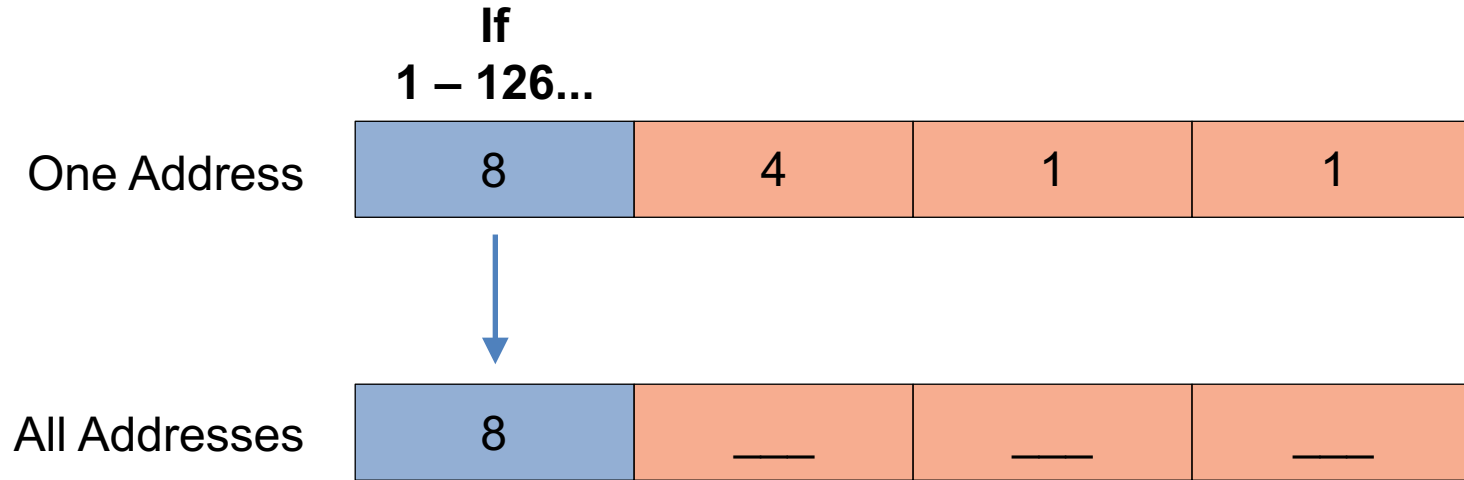
Class	First Octet Values	Purpose
A	1 – 126*	Unicast (large networks)
B	128 – 191	Unicast (medium-sized networks)
C	192 – 223	Unicast (small networks)
D	224 – 239	Multicast
E	240 – 255	Reserved (formerly experimental)

\* First Octet of 0 or 127: Reserved for Special Uses

# Class A Example: Address Identifies Class



# Class A Example: 8.4.1.1

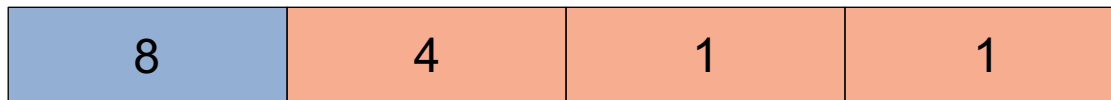




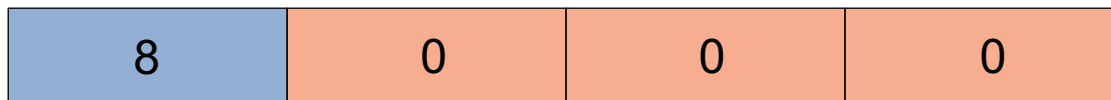
# Class A Example: Network ID and Broadcast

If  
1 – 126...

Address

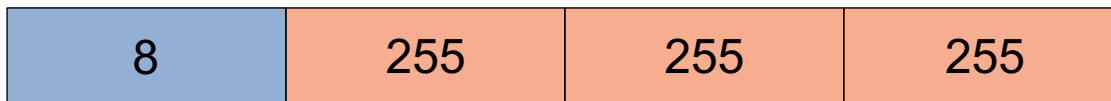


Network ID



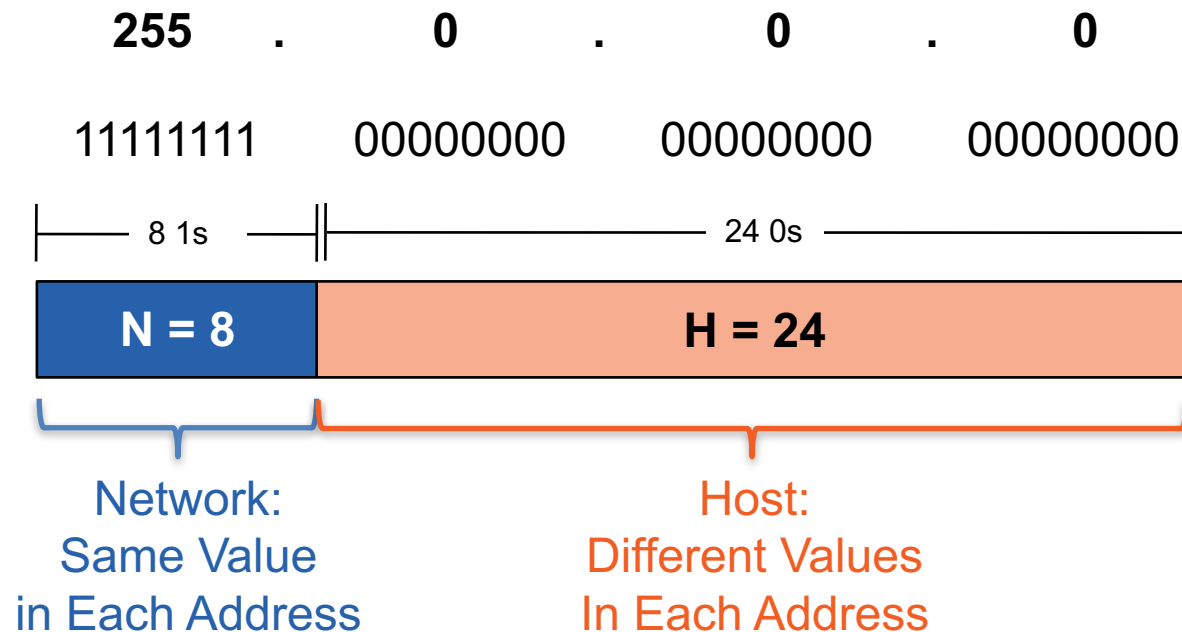
Host Octets = 0

Network  
Broadcast Address



Host Octets = 255

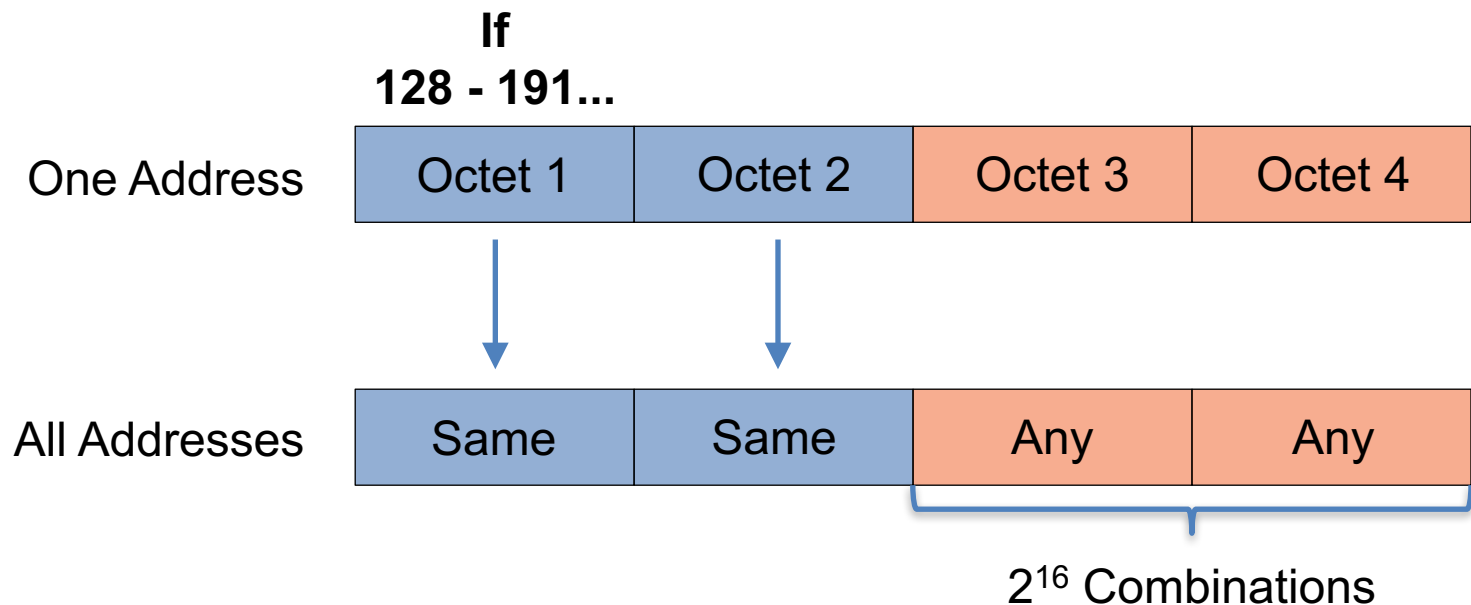
# The Default Mask for Class A Networks



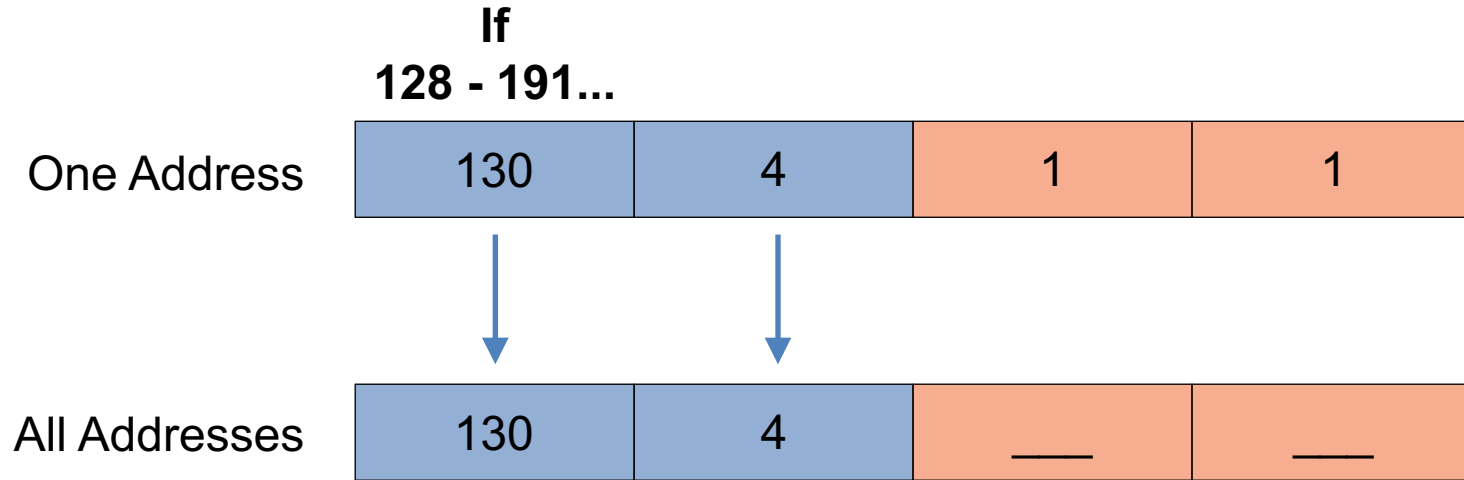
# Key Facts about Each Class A Network

Class	# Octets Equal for All Addresses	Network Octets	Host Octets	Host Bits	Hosts Per Network ( $2^H - 2$ )
A	1	1	3	24	16,777,214

# Class B Example: Address Identifies Class



# Class B Example: 130.4.1.1



# Class B Example: Network ID and Broadcast

If  
128 - 191...

One Address

130	4	1	1
-----	---	---	---



Network ID

130	4	0	0
-----	---	---	---

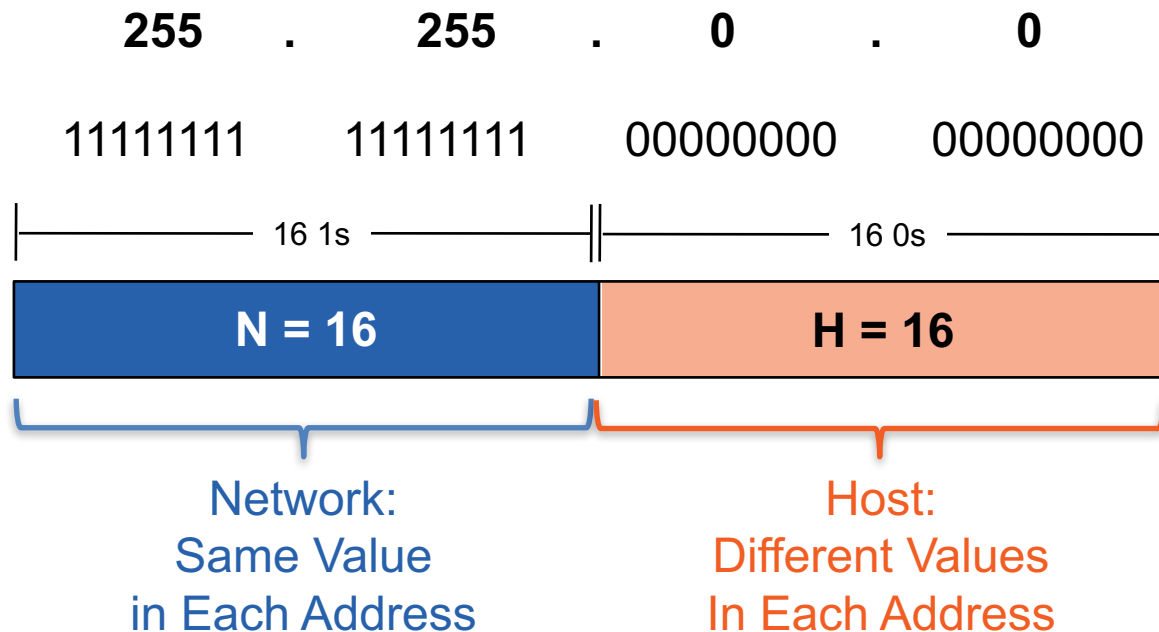
Host Octets = 0

Network  
Broadcast Address

130	4	255	255
-----	---	-----	-----

Host Octets = 255

# The Default Mask for Class B Networks

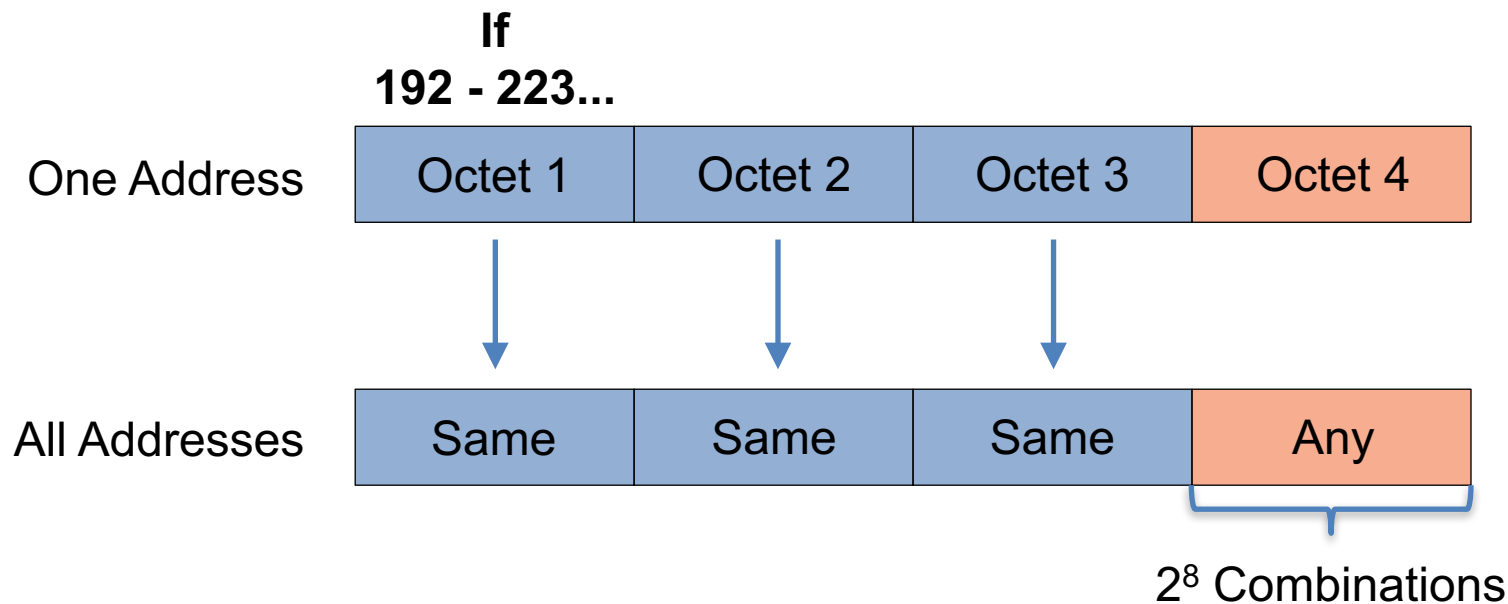


# Sizes Per Class

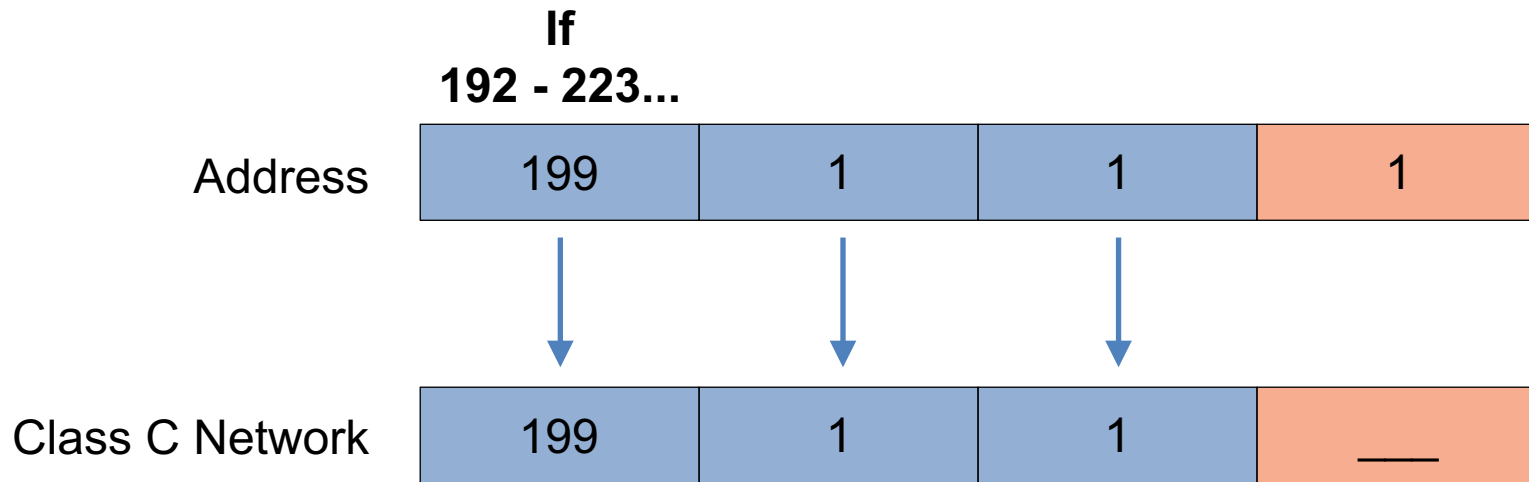
Class	# Octets Equal for All Addresses	Network Octets	Host Octets	Host Bits	Hosts Per Network ( $2^H - 2$ )
A	1	1	3	24	16,777,214
B	2	2	2	16	65,534



# Class C Example: Address Identifies Class



# Class C Example: 199.1.1.1



# Class B Example: Network and Broadcast

If  
192 - 223...

One Address

199	1	1	1
-----	---	---	---



Network ID

199	1	1	0
-----	---	---	---

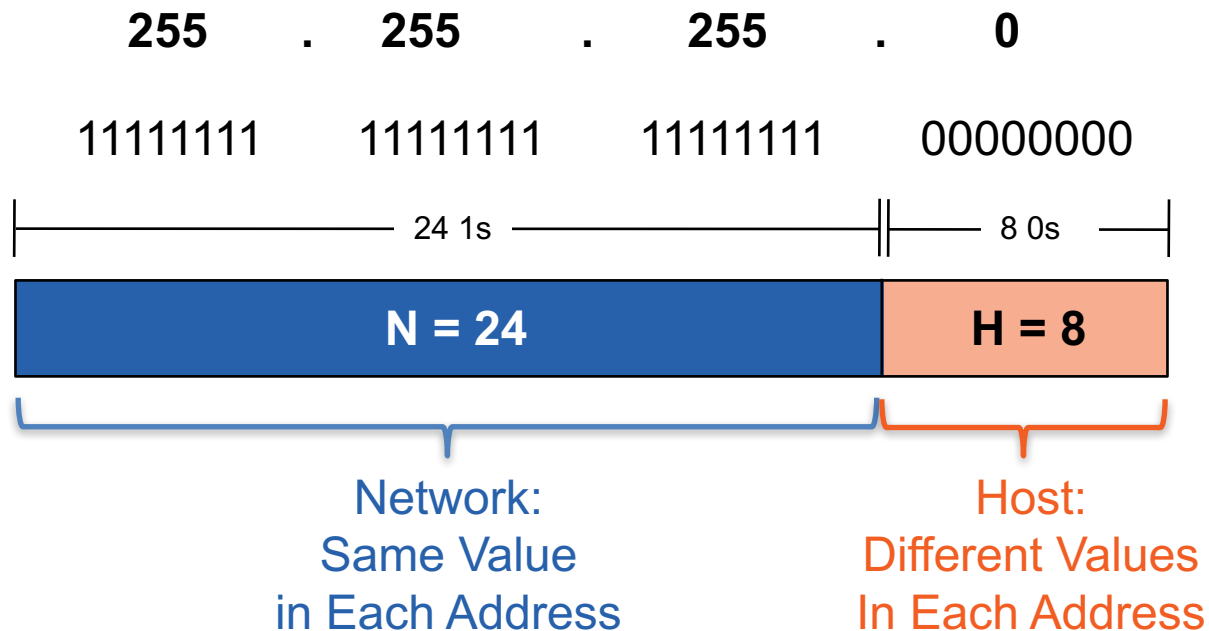
Host Octet = 0

Network  
Broadcast Address

199	1	1	255
-----	---	---	-----

Host Octet = 255

# Class C Networks and Default Mask



# Sizes Per Class

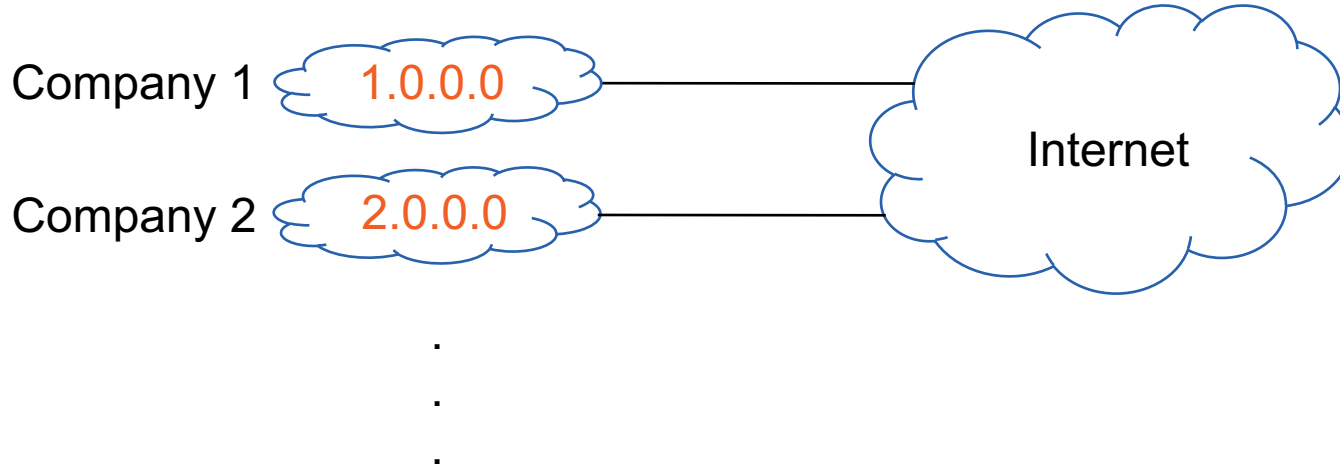
Class	# Octets Equal for All Addresses	Network Octets	Host Octets	Host Bits	Hosts Per Network ( $2^H - 2$ )
A	1	1	3	24	16,777,214
B	2	2	2	16	65,534
C	3	3	1	8	254

# In This Lesson...

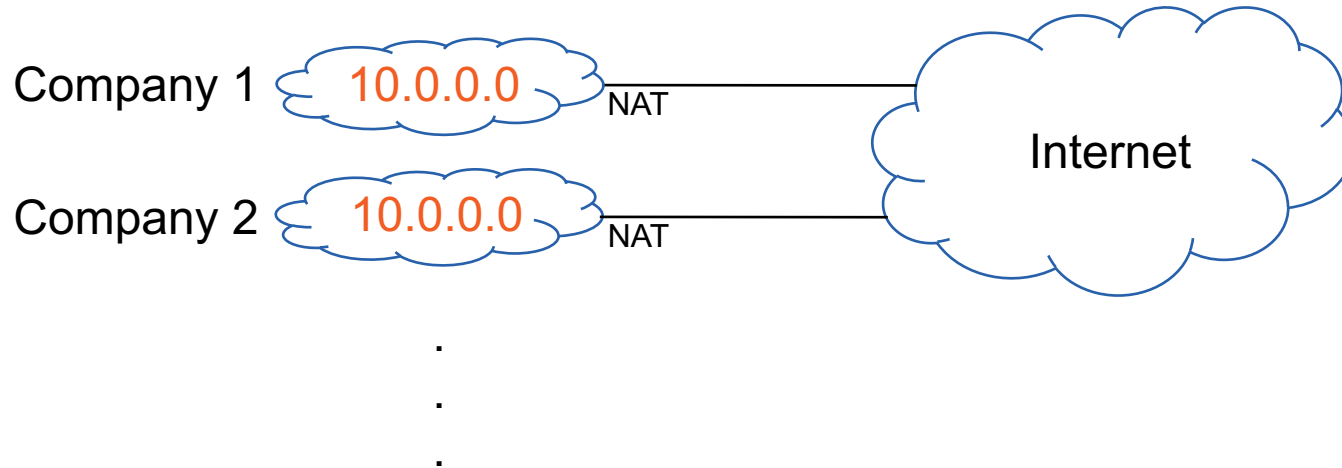
## Addressing, Routing, and IP Networks

- IP Networks Vs. IP Subnets
- Public IP Networks
- IPv4 Address Classes
- **Private IP Networks**
- CIDR Blocks
- Summary and Terms

# Original Plan: Unique Networks for All



# Revised Plan: Choose Privates for Internal Use

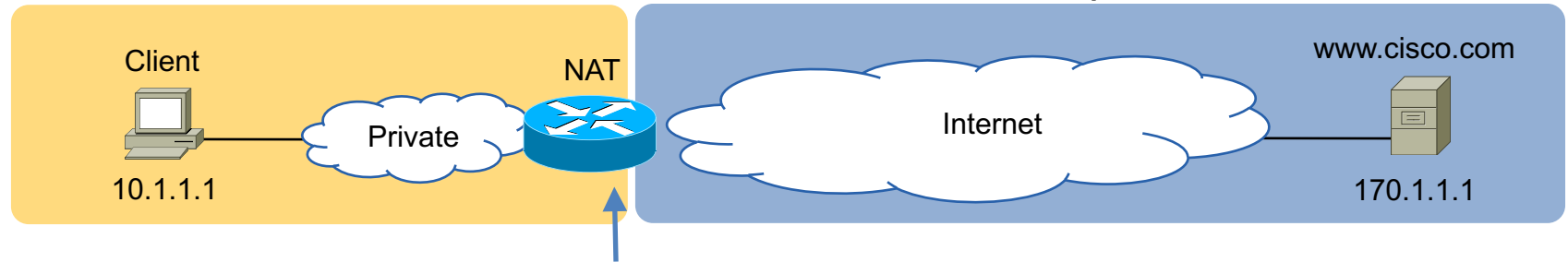




# NAT Basics: Translating Private to Public

Enterprise: Network 10.0.0.0

Internet: Requires Public Addresses

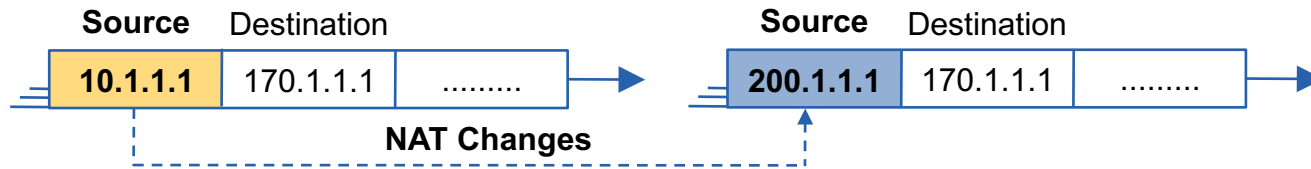


Small Set of Public  
Addresses Available:  
200.1.1.0 – 200.1.1.3

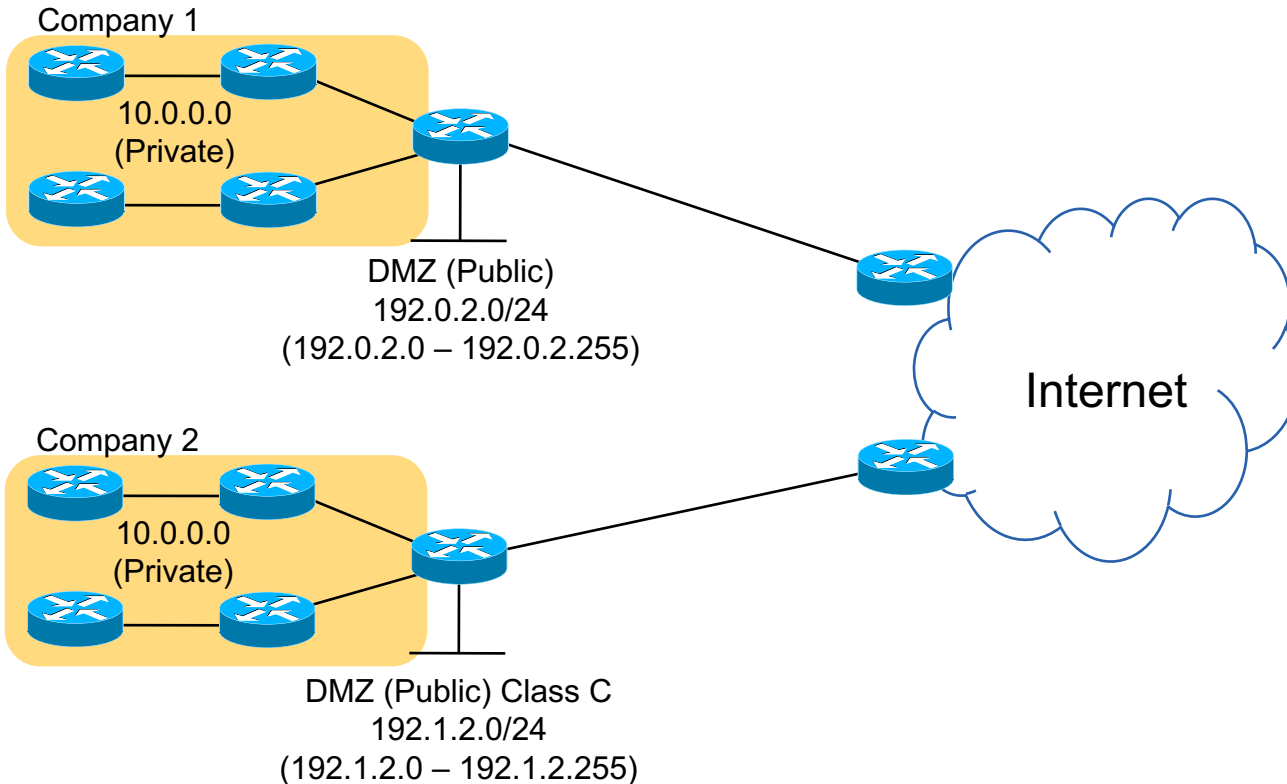
# NAT Basics: Translating Private to Public

Enterprise: Network 10.0.0.0

Internet: Requires Public Addresses



# Private Network + 1 Public Class C Network



# Private IP Networks

Class of Networks	Private IP Networks	Number of Networks
A	10.0.0.0	1
B	172.16.0.0 through 171.31.0.0	16
C	192.168.0.0 through 192.168.255.0	256

# 16 Private Class B Networks

172.16.0.0	172.24.0.0
172.17.0.0	172.25.0.0
172.18.0.0	172.26.0.0
172.19.0.0	172.27.0.0
172.20.0.0	172.28.0.0
172.21.0.0	172.29.0.0
172.22.0.0	172.30.0.0
172.23.0.0	172.31.0.0

# 256 Private Class C Networks

192.168.0.0	192.168.12.0	192.168.24.0		192.168.244.0
192.168.1.0	192.168.13.0	192.168.25.0		192.168.245.0
192.168.2.0	192.168.14.0	192.168.26.0		192.168.246.0
192.168.3.0	192.168.15.0	192.168.27.0		192.168.247.0
192.168.4.0	192.168.16.0	192.168.28.0		192.168.248.0
192.168.5.0	192.168.17.0	192.168.29.0		192.168.249.0
192.168.6.0	192.168.18.0	192.168.30.0	. . .	192.168.250.0
192.168.7.0	192.168.19.0	192.168.31.0		192.168.251.0
192.168.8.0	192.168.20.0	192.168.32.0		192.168.252.0
192.168.9.0	192.168.21.0	192.168.33.0		192.168.253.0
192.168.10.0	192.168.22.0	192.168.34.0		192.168.254.0
192.168.11.0	192.168.23.0	192.168.35.0		192.168.255.0

# In This Lesson...

## Addressing, Routing, and IP Networks

- IP Networks Vs. IP Subnets
- Public IP Networks
- IPv4 Address Classes
- Private IP Networks
- **CIDR Blocks**
- Summary and Terms

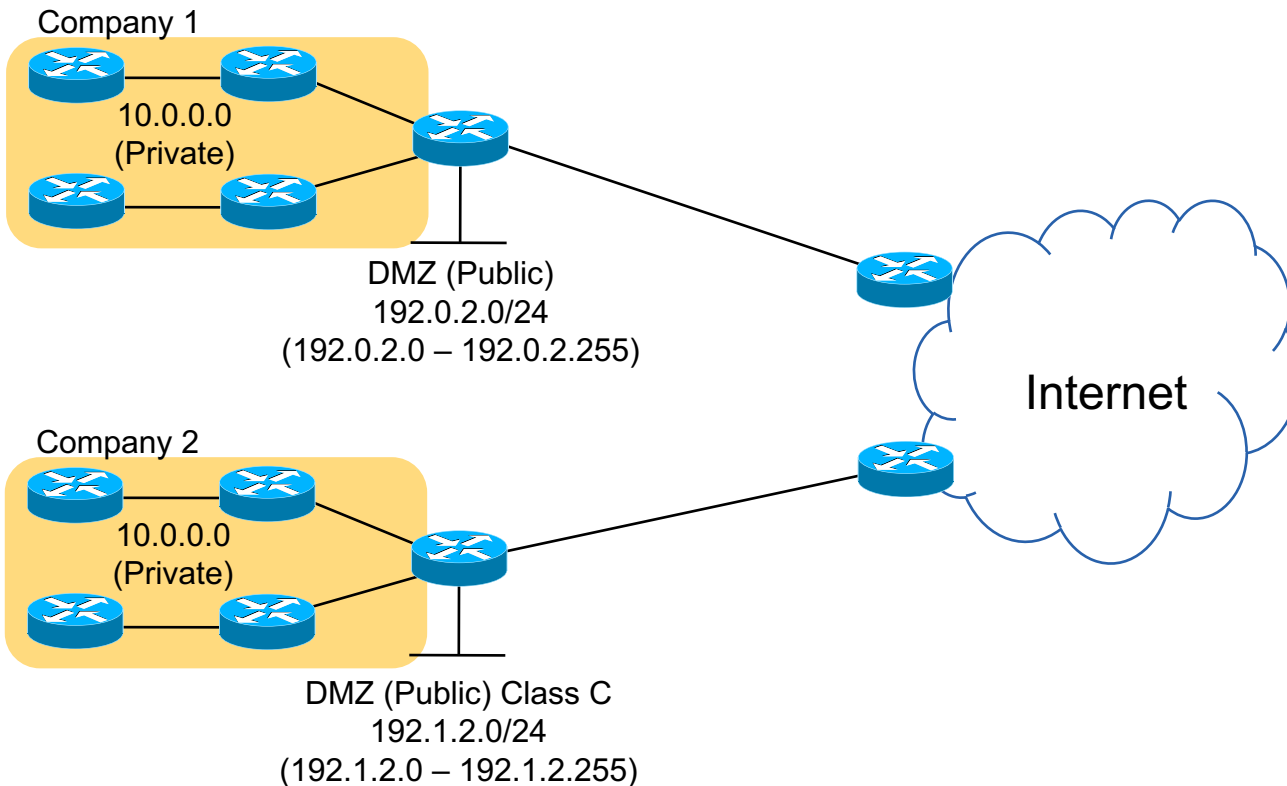
# Original Plan: Wasteful, Limited

Class A, B:            Many Addresses Unused  
Inflexible:            3 Sizes Only

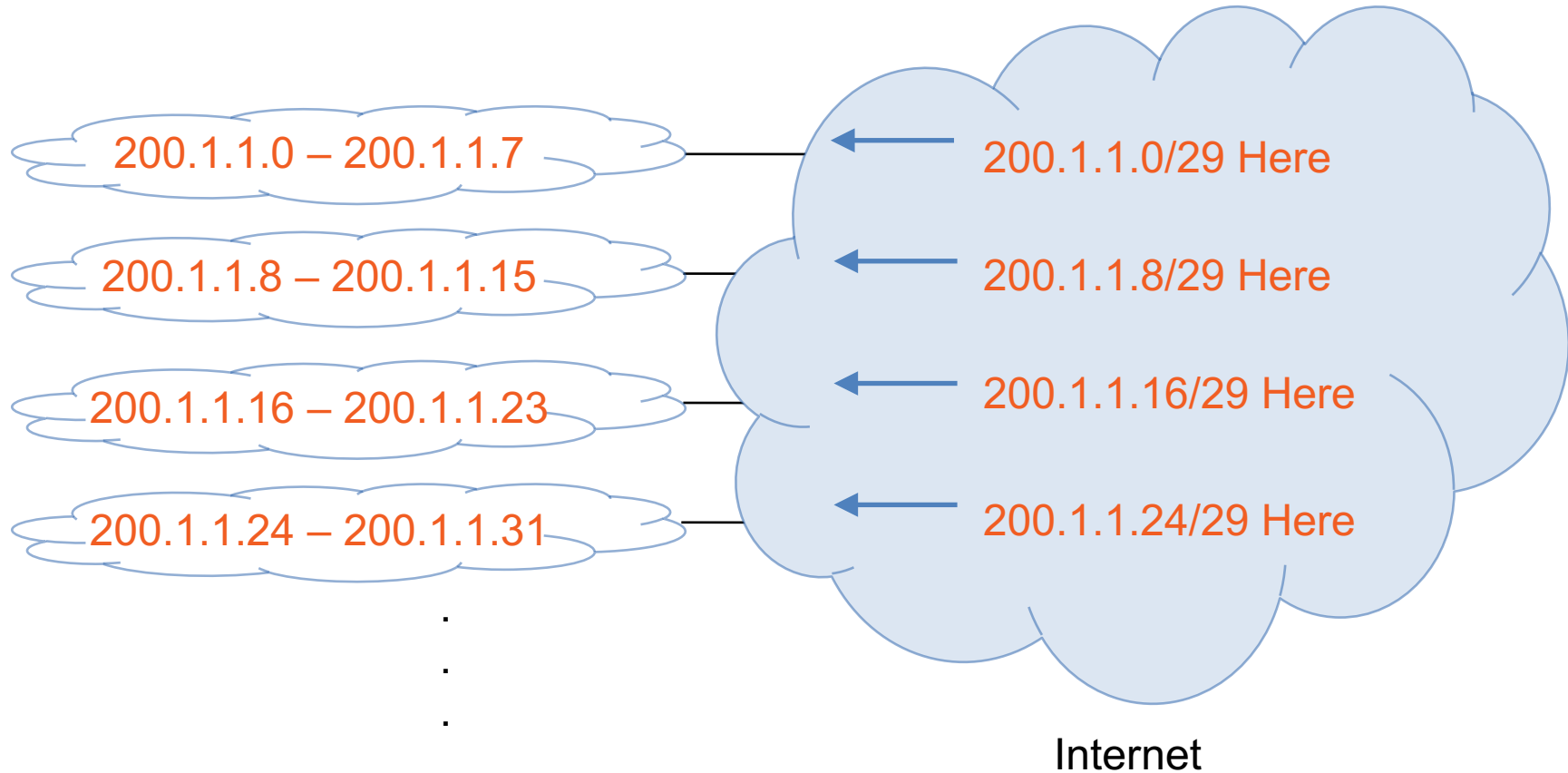
Class	# Octets Equal for All Addresses	Network Octets	Host Octets	Host Bits	Hosts Per Network ( $2^H - 2$ )
A	1	1	3	24	16,777,214
B	2	2	2	16	65,534
C	3	3	1	8	254



# Private w/ NAT: Also Wasteful



# Example: CIDR Blocks, Size 8 Each

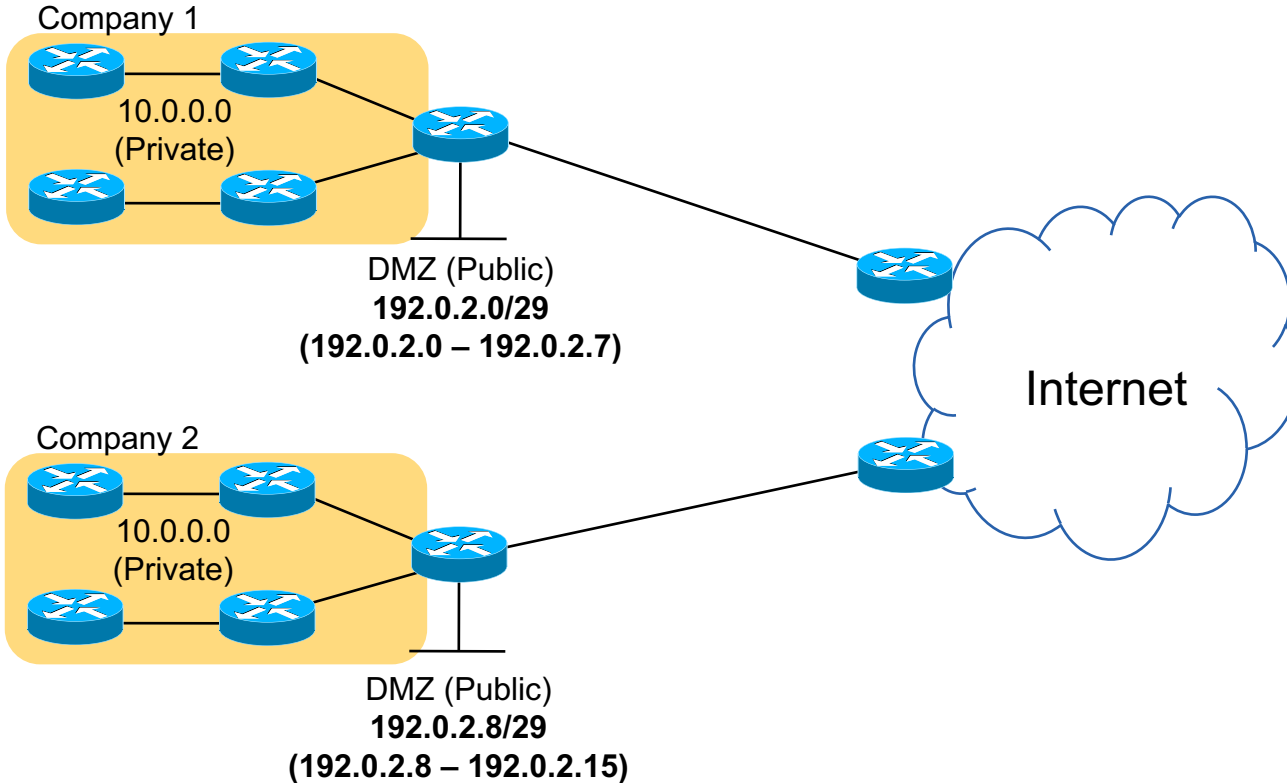


# CIDR Block Terminology

## Classless Interdomain Routing (CIDR) Block

- Public Address Block
- "Classless": Not a Class A, B, or C Network; Usually Smaller
- Allocates Only the Smallest Block to Meet the Need, Saving Addresses

# Private Classful + Small Public CIDR Block



# In This Lesson...

## Addressing, Routing, and IP Networks

- IP Networks Vs. IP Subnets
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- **Summary and Terms**

# Options for Enterprise IPv4 Addresses

## Public Network

- IANA etc. Allocates Most of Address Space as Public (Unique in Universe)
- Original Plan: Ask and Receive a Public Classful Network
- Last 20 Years: Use Private, NAT, CIDR

## Private Network

- IANA Reserves Some Classful Networks for Special Purposes
- Private Networks: For Use Within an Organization
- Private Networks + NAT: Clients Can Communicate to Internet

## Classless Interdomain Routing (CIDR) Block

- Public Address Block
- Sizes are Any  $2^H$ , so Less Waste
- Normally Relies on Also Using Private Network and NAT

# Terms from this Topic

## **Networks:**

Network ID

Network Number (Synonym)

Network Address (Synonym)

Network Broadcast Address

## **Masks:**

Mask

Subnet Mask

Prefix Length

Prefix Bits

Network Bits

Host Bits

## **Address Groups:**

Address Block

Private IP Network

Public IP Network

CIDR Block

## **Miscellaneous**

Classless Interdomain Routing (CIDR)

# IPv4 Subnetting – Sections

Section 1: Analyzing Individual Subnets

Section 2: Converting Subnet Masks

**Section 3: Analyzing IP Networks**

Section 4: Identifying the Subnets of a Network

Section 5: Analyzing Designs Using Masks

Section 6: Subnetting and the Exam



# IPv4 Subnetting – Section 3

Understanding the IPv4 Address Space

**\* Finding Facts about IP Networks**

# In This Lesson...

## Analyzing Classful IPv4 Networks

- **The Process: Finding Facts about a Network**
- Another Process: Calculating Facts about a Network
- Learning Stages and Practice

# Process 1: Finding Basic Facts about a Network

## 1. Determine the Class

- A. Class A: 1<sup>st</sup> Octet 1 – 126
- B. Class B: 1<sup>st</sup> Octet 128 – 191
- C. Class C: 1<sup>st</sup> Octet 192 – 223

## 2. Record the Number of Network and Host Octets (Classes A, B, C)

- A. Class A: 1 Network, 3 Host
- B. Class B: 2 Network, 2 Host
- C. Class C: 3 Network, 1 Host

## 3. Record the Default Mask

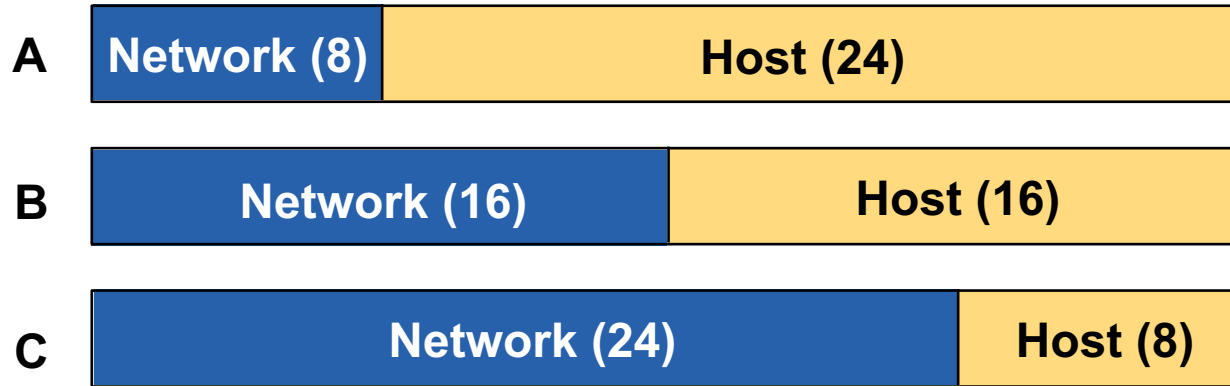
- A. Class A: 255.0.0.0
- B. Class B: 255.255.0.0
- C. Class C: 255.255.255.0

# Determine Class Based on First Octet Values

Range of First Octet (Inclusive)	Class	# Network Octets	# Host Octets	Default Mask
1..126*	A	1	3	255.0.0.0
128..191	B	2	2	255.255.0.0
192..223	C	3	1	255.255.255.0
224..239	D	N/A	N/A	N/A
240..255	E	N/A	N/A	N/A

\* First Octet of 0 or 127: Reserved for Special Uses

# Size of Network and Host Fields – No Subnetting



# In Class Discussion Examples

Problem Number	IP Address	Class	# Network Octets	# Host Octets	Default Mask
1	10.1.2.3				
2	172.20.1.1				
3	200.3.4.5				
4	227.3.4.5				
5	241.5.4.3				

# In Class Discussion Examples

Problem Number	IP Address	Class	# Network Octets	# Host Octets	Default Mask
1	10.1.2.3	A	1	3	255.0.0.0
2	172.20.1.1	B	2	2	255.255.0.0
3	200.3.4.5	C	3	1	255.255.255.0
4	227.3.4.5	D	N/A	N/A	N/A
5	241.5.4.3	E	N/A	N/A	N/A

# In This Lesson...

## Analyzing Classful IPv4 Networks

- The Process: Finding Facts about a Network
- **Another Process: Calculating Facts about a Network**
- Learning Stages and Practice



# Process 2: Calculating Classful Network Facts

## 1. Set up the Problem on Paper

- A. Write: Mask Above, Address Below, Column Aligned
- B. Leave Space for: Network ID, Network Broadcast Address, Two More Values

## 2. For Each Column, If Mask = 255:

- A. Copy Address Octets(s) to Network ID
- B. Copy Address Octets(s) to Network Broadcast Address

## 3. For Each Column, If Mask = 0:

- A. Write 0s in the Network ID
- B. Write 255s in Network Broadcast Address

## 4. To Find the Range of Addresses:

- A. In 4<sup>th</sup> Octet, Network ID: +1
- B. In 4<sup>th</sup> Octet, Broadcast: -1

# Example Question 1

Problem Number	IP Address	Network ID	First Address	Last Address	Network Broadcast Address
1	10.1.2.3				
2	172.20.1.1				
3	200.3.4.5				
4	227.3.4.5				
5	241.5.4.3				

# Building Network and Broadcast Values

1. Set up the Problem on Paper

A. Mask Above, Address Below, Column Aligned

B. Space for: Network ID, Broadcast, +2

255.	0.	0.	0	Default Mask Address
10.	1.	2.	3	
.	.	.		Network ID
.	.	.		Broadcast

# Building Network and Broadcast Values

2. If Mask = 255:

A. Copy Address Octet(s) to Network ID

B. Copy Address Octet(s) to Broadcast Address

255.	0.	0.	0	Default Mask Address
10.	1.	2.	3	

<sup>Ⓐ</sup> 10.	.	.	Network ID

<sup>Ⓑ</sup> 10.	.	.	Broadcast

# Building Network and Broadcast Values

3. If Mask = 0:

A. Write 0s in the Network ID

B. Write 255s in Network Broadcast Address

255.	0.	0.	0	Default Mask Address
10.	1.	2.	3	

10.	<sup>(A)</sup> 0.	<sup>(A)</sup> 0.	<sup>(A)</sup> 0	Network ID

10.	<sup>(B)</sup> 255.	<sup>(B)</sup> 255.	<sup>(B)</sup> 255	Broadcast

# Range of Addresses in the Network

4. To Find the Range of Addresses in the Network:

A. In 4<sup>th</sup> Octet, Network ID: +1

B. In 4<sup>th</sup> Octet, Broadcast: -1

255.	0.	0.	0	Default Mask Address
10.	1.	2.	3	

10.	0.	0.	0	Network ID

			↓ (A)
--	--	--	-------

10.	0.	0.	1	First Address Last Address

10.	255.	255.	254
-----	------	------	-----

			↑ (B)
--	--	--	-------

10.	255.	255.	255	Broadcast
-----	------	------	-----	-----------

# Example Question 2

Problem Number	IP Address	Network ID	First Address	Last Address	Network Broadcast Address
1	10.1.2.3	10.0.0.0	10.0.0.1	10.255.255.254	10.255.255.255
2	172.20.1.1				
3	200.3.4.5				

# Building Network and Broadcast Values

1. Set up the Problem on Paper

A. Mask Above, Address Below, Column Aligned

B. Space for: Network ID, Broadcast, +2

255.	255.	0.	0	Default Mask Address
172.	20.	1.	1	
.	.	.		Network ID
.	.	.		Broadcast



# Building Network and Broadcast Values

2. If Mask = 255:

A. Copy Address Octet(s) to Network ID

B. Copy Address Octet(s) to Broadcast Address

255.	255.	0.	0	Default Mask Address
172.	20.	1.	1	

<sup>Ⓐ</sup> 172.	<sup>Ⓐ</sup> 20.	.	.	Network ID

<sup>Ⓑ</sup> 172.	<sup>Ⓑ</sup> 20.	.	.	Broadcast

# Building Network and Broadcast Values

3. If Mask = 0:

A. Write 0s in the Network ID

B. Write 255s in Network Broadcast Address

255.	255.	0.	0	Default Mask Address
172.	20.	2.	3	

172.	20.	<sup>(A)</sup> 0.	<sup>(A)</sup> 0	Network ID

172.	20.	<sup>(B)</sup> 255.	<sup>(B)</sup> 255	Broadcast

# Range of Addresses in the Network

4. To Find the Range of Addresses in the Network:

A. In 4<sup>th</sup> Octet, Network ID: +1

B. In 4<sup>th</sup> Octet, Broadcast: -1

255.	255.	0.	0	Default Mask Address
172.	20.	1.	1	

172.	20.	0.	0	Network ID
------	-----	----	---	------------

			↓ (A)
--	--	--	-------

172.	20.	0.	1	First Address
------	-----	----	---	---------------

172.	20.	255.	254	Last Address
------	-----	------	-----	--------------

			↑ (B)
--	--	--	-------

172.	20.	255.	255	Broadcast
------	-----	------	-----	-----------

# Example Question 3

Problem Number	IP Address	Network ID	First Address	Last Address	Network Broadcast Address
1	10.1.2.3	10.0.0.0	10.0.0.1	10.255.255.254	10.255.255.255
2	172.20.1.1	172.20.0.0	172.20.0.1	172.20.255.254	172.20.255.255
3	200.3.4.5				

# Building Network and Broadcast Values

1. Set up the Problem on Paper

A. Mask Above, Address Below, Column Aligned

B. Space for: Network ID, Broadcast, +2

255.	255.	255.	0	Default Mask Address
200.	3.	4.	5	
.	.	.		Network ID
.	.	.		Broadcast

# Building Network and Broadcast Values

2. If Mask = 255:

A. Copy Address Octet(s) to Network ID

B. Copy Address Octet(s) to Broadcast Address

255.	255.	255.	0	Default Mask Address
200.	3.	4.	5	

<sup>Ⓐ</sup> 200.	<sup>Ⓐ</sup> 3.	<sup>Ⓐ</sup> 4.	0	Network ID
----------------------	--------------------	--------------------	---	------------

<sup>Ⓑ</sup> 200.	<sup>Ⓑ</sup> 3.	<sup>Ⓑ</sup> 4.	255	Broadcast
----------------------	--------------------	--------------------	-----	-----------

# Building Network and Broadcast Values

3. If Mask = 0:

A. Write 0s in the Network ID

B. Write 255s in Network Broadcast Address

255.	255.	255.	0	Default Mask Address
200.	3.	4.	5	

200.	3.	4.	<sup>(A)</sup> 0	Network ID

200.	3.	4.	<sup>(B)</sup> 255	Broadcast

# Range of Addresses in the Network

4. To Find the Range of Addresses in the Network:

A. In 4<sup>th</sup> Octet, Network ID: +1

B. In 4<sup>th</sup> Octet, Broadcast: -1

255 . 255 . 255 . 0  
200 . 3 . 4 . 5

Default Mask  
Address

200 . 3 . 4 . 0

Network ID

200 . 3 . 4 . 1

First Address

200 . 3 . 4 . 254

Last Address

200 . 3 . 4 . 255

Broadcast



# Example Question 3

Problem Number	IP Address	Network ID	First Address	Last Address	Network Broadcast Address
1	10.1.2.3	10.0.0.0	10.0.0.1	10.255.255.254	10.255.255.255
2	172.20.1.1	172.20.0.0	172.20.0.1	172.20.255.254	172.20.255.255
3	200.3.4.5	200.3.4.0	200.3.4.1	200.3.4.254	200.3.4.255

# In This Lesson...

## Analyzing Classful IPv4 Networks

- The Process: Finding Facts about a Network
- Another Process: Calculating Facts about a Network
- **Learning Stages and Practice**

# Stages

Stage	Primary Study Goal	Have You Understood and Memorized Ideas and Processes?	Do You Get 100% Correct?	Do You Go Fast?
1	Learning	No		
2	Perfecting	Yes	No	
3	Accelerating	Yes	Yes	No
4	Completed	Yes	Yes	Yes

# Stage 1 (Learn) Advice for This Exercise

## Approach to the Exercises:

1. Use Notes/Examples
2. Check Answer if Unsure
3. Investigate Mistakes
4. **Ask Instructor to Work the Problem!**

## Graduate to Stage 2 Now if:

1. Could Hide All Notes and Still Answer!

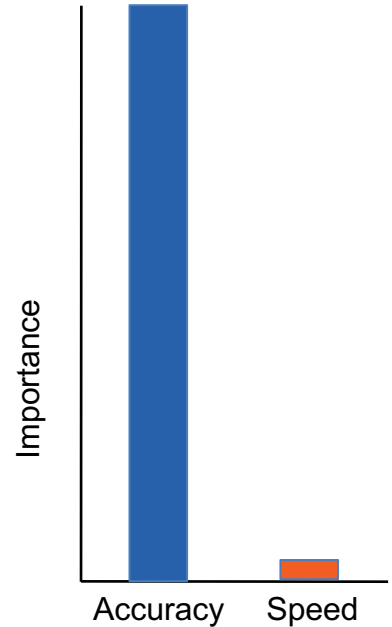
# Stage 2 (Perfect) Advice for This Exercise

## Approach to the Exercises:

1. No Notes
2. Take Your Time
3. Complete a Question Set before Checking Answers

## Graduate to Stage 3 Now if:

1. 100% Correct on Two Sets



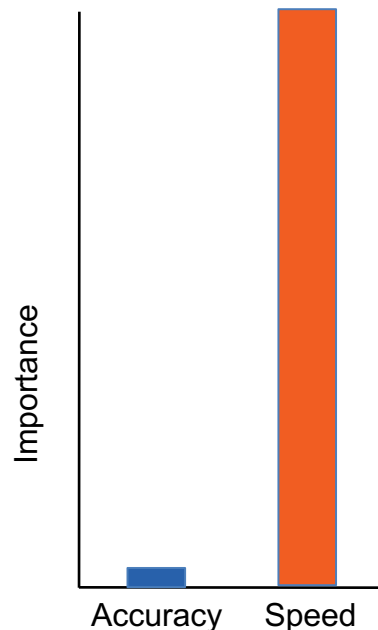
# Stage 3 (Accelerate) Advice for this Exercise

## Study Approach:

1. Each Time Trial:
  - A. Write Pre-exam Notes
  - B. Set a Per-item Time Goal
  - C. Start Clock
  - D. Complete the Entire Question Set
  - E. Compare your Speed to Time Goal

## Graduate to Stage 4 Now if:

1. Don't! For now, keep practicing for speed.



# Speed Goals for CCNA Exam

Subnetting Processes	Book Speed Goals	Your Speed Goal	Your Current Speed	Your Current Stage
Find Classful Network Facts *	10			
Convert Mask Formats *	10			
Find Subnet Facts	30			
Interpret Design w/ Mask	15			
Choose One Mask	15			
Find All Subnet IDs *	45			

\* These Time Estimates Do Not Include the Time to Write/Type the Answers

# Practice!

Exercises for:

“Calculate Classful Network Facts”



# Come Back to Class!

Exercises for:

“Calculate Classful Network Facts”

Time Finished!

# IPv4 Subnetting – Sections

Section 1: Analyzing Individual Subnets

Section 2: Converting Subnet Masks

Section 3: Analyzing IP Networks

Section 4: Identifying the Subnets of a Network

Section 5: Analyzing Designs Using Masks

Section 6: Subnetting and the Exam

# Tomorrow's Schedule!

- **First 20 Minutes:** Office Hours!
  - I'll Answer Questions about Day 1!
  - **NO NEW MATERIAL!**
- 20 Minutes After the Hour: Lecture Begins!
  - New Material!

# Course Outline

## Day 1

**Section 1:** Analyzing Existing Subnets

**Section 2:** Converting Subnet Masks

**Section 3:** Analyzing IP Networks

## Day 2

Office Hours (QA for the First 20 Minutes)

**Section 4:** Finding All Subnets in a Network

**Section 5:** Analyzing Designs Using Masks

**Section 6:** Subnetting and the Exam

# Self-Evaluation Time!

Subnetting Processes	Book Speed Goals	Your Speed Goal	Your Current Speed	Your Stage Goal During Class	Your Current Stage
Find Classful Network Facts *	10				
Convert Mask Formats *	10				
Find Subnet Facts	30				
Interpret Design w/ Mask	15				
Choose One Mask	15				
Find All Subnet IDs *	45				

\* These Time Estimates Do Not Include the Time to Write/Type the Answers

# Homework (Optional): Work the Problems

- I will Re-Paste Today's Practice Problem Links So You Can Find Them!
- Complete Today's Practice Problems if You Didn't Finish!

# Homework/Practice: Cert Guide

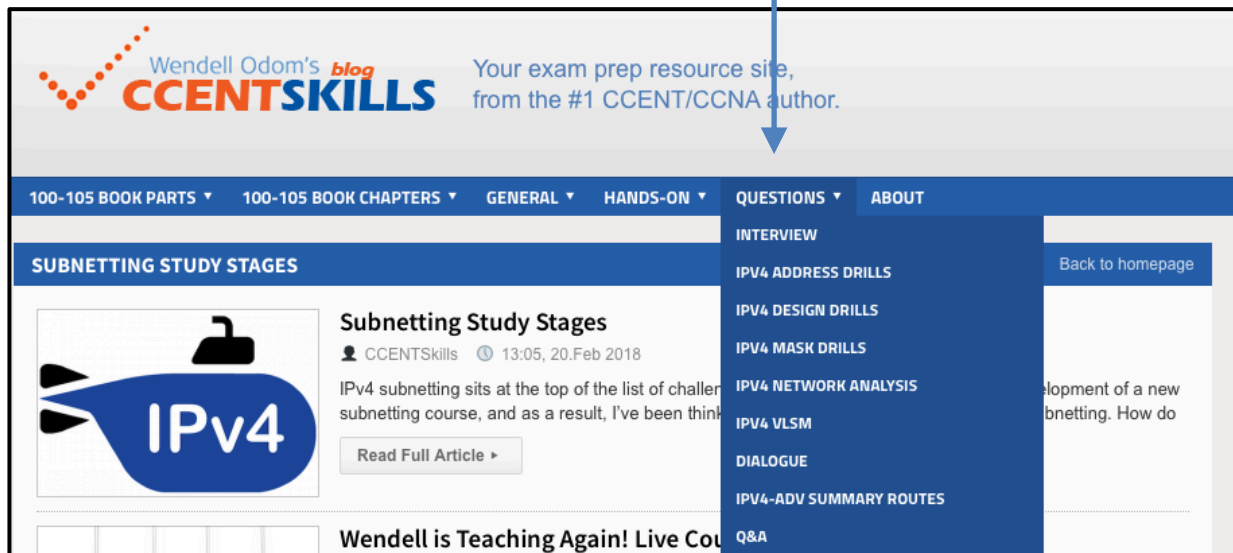
- [ICND1 Official Cert Guide](#)
  - Part of Safari
  - Many Practice Questions
  - Lighter Colors in the Table

Book Element	Types of Problems
Appendix D	Find Classful Facts
Appendix E	Convert Masks
Appendix E	Interpret Masks
Appendix F	Find Subnet Facts
Appendix G	Choose Masks
Appendix G	Find All Subnets
Appendix H	VLSM

# Homework/Practice: Wendell's Blog

- [Wendell's CCENT Skills Blog](https://blog.certskills.com/ccent)
  - [blog.certskills.com/ccent](https://blog.certskills.com/ccent)
  - Look in "Questions" Tab

Click "Questions"





# Homework/Practice: Build Your Own

- Use Any Subnetting Calculator
  - Windows: Solarwinds Subnetting Calculator
  - Linux/Mac: ipcalc command-line tool
  - Look in “Questions” Tab

```
Wendell-Odoms-iMac:~ wendellodom$ ipcalc -b 192.168.1.55/27
Address:    192.168.1.55
Netmask:    255.255.255.224 = 27
Wildcard:   0.0.0.31
=>
Network:    192.168.1.32/27
HostMin:    192.168.1.33
HostMax:    192.168.1.62
Broadcast:  192.168.1.63
Hosts/Net:  30
```

Class C, Private Internet