TOMORROW starts here.

Cisco live!

Mastering IP Subnetting Forever

BRKCRT-9346

Scott Morris & Keith Barker

Tour Guide

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  - Cisco Certified Design Expert
  - Juniper Networks JNCIE-M #153 and JNCIE-ER #102
  - CISSP, CCVP and several other random things!
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Tour Guide

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  - CCIE Route & Switch, Security
  - HP-MASE, Brocade BCNP
  - Juniper Networks JNCIS-ENT/SP
  - Twitter: @KeithBarkerCCIE
  - YouTube: Keith6783

Journey

- Understanding an IPv4 Address
- Mastering the Mask
- Custom Subnetting
- VLSM and Beyond

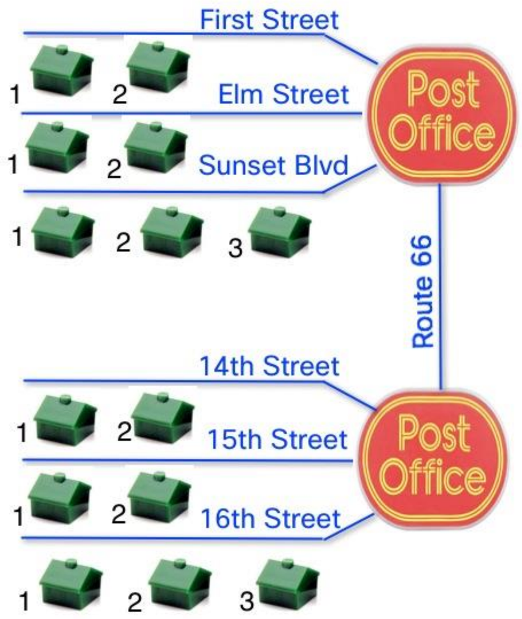
IPv4 Agenda

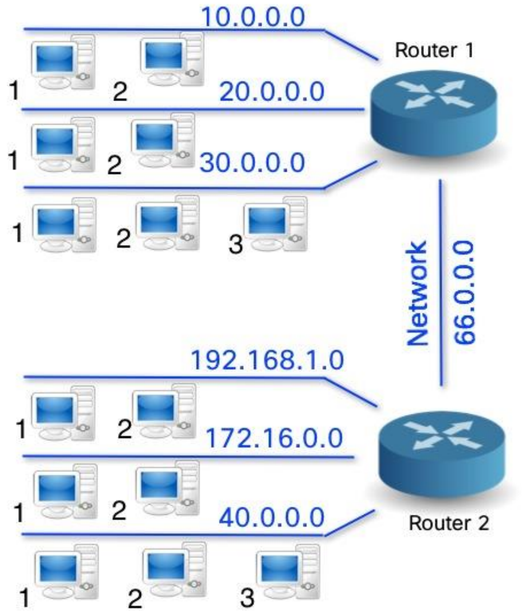
- **Setting the stage**
  - –**Why** the mastery of IP Subnetting skills is so important in the real world
  - –What we know…**or think we know**, can be a factor in our mastery
- **Key elements** in successful execution of the subnetting procedure
  - –Creating a MB-Key, identifying the need in the network, and using your thumbs (and other digits) to create a subnetting addressing scheme
- **Reverse Engineering any** IP Addressing scheme
  - –The magic of application in the real world
- **Extending our IP Subnetting knowledge** into Classless schemes—**VLSM and CIDR**
  - –Variable Length Subnet Masking
  - –Classless Inter-Domain Routing (Address Summarization, Supernetting, IP Address Aggregation)

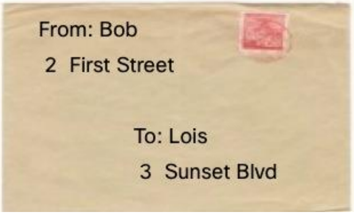
What You Will Need To Be Successful

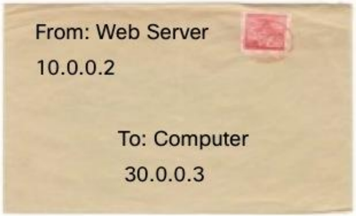
- Something to write with, and write on
- **An open mind…**
  - –If you have failed to master IP subnetting before, it's ok…
  - –If you are already a 'Jedi Master Subnetter', this session may not be for you… or you just may learn a shortcut you haven't used before
- Be willing to practice on your own…
  if you don't use it, you WILL lose it
- **Fill out your session evaluation**

Let's Begin...


First Street
Elm Street
Sunset Blvd
Post Office
Route 66
14th Street
15th Street
16th Street
Post Office
1 2
1 2
1 2 3
1 2
1 2
1 2 3


10.0.0.0
Router 1
20.0.0.0
30.0.0.0
Network 66.0.0.0
192.168.1.0
172.16.0.0
40.0.0.0
Router 2
1 2
1 2
1 2 3
1 2
1 2
1 2 3


From: Bob
2 First Street
To: Lois
3 Sunset Blvd


From: Web Server
10.0.0.2
To: Computer
30.0.0.3

Let’s play everyone’s favorite game called…

Guess that network!

What We Know Already… or Maybe Not

190.16.221.0

10.1.0.255

Question:

How many of these addresses
are valid IP numbers for a Host?

172.16.0.255

128.255.1.255

10.0.255.0

Correct Response? _____ How do you know?

What We Know Already… or Maybe Not

190.16.221.0

10.1.0.255

Question:

How many of these addresses are valid IP numbers for a Host?

172.16.0.255

128.255.1.255

10.0.255.0

Correct Response? __ALL__* How do you know?

What We Know Already… or Should

- An IPv4 address is 32 bits long—4 separate bytes
- An IP address is represented in dotted-decimal notation
  - Each byte is represented by a decimal number separated by a period (called “dotted decimal” notation)
  - Example: 10.100.30.4 or (010.100.030.004)
  - Each byte represented as decimal number (0–255)
- The first byte may be the most important to you when you start…

WHY?

Classification!

What We Know… or Should (Cont.)

- There are three (3) usable unicast IP address classes - A, B and C
- The first byte/number/octet identifies the class that the IP belongs to—"**Classification**"
  - –Correct Classification is a starting point, for mastering IP subnetting

Class	Example	# of Networks	# of Hosts on each network
A – 1-127	24. 0 .0 .0	127	16,777,214
B – 128-191	150.18. 0 .0	16,384	65,534
C – 192-223	198.23.210. 0	2,097,152	254
D – 224-239	224.0.0.10	Multicast	
E – 240-255	Reserved		

Let’s play…

Name that class!

Practice: Classification—What Class does each IP below belong to?

___ 190.16.21.10

___ 10.1.0.200

___ 192.16.2.210

___ 128.215.3.199

___ 126.7.10.40

Practice: Classification—What Class?

B 190.16.21.10

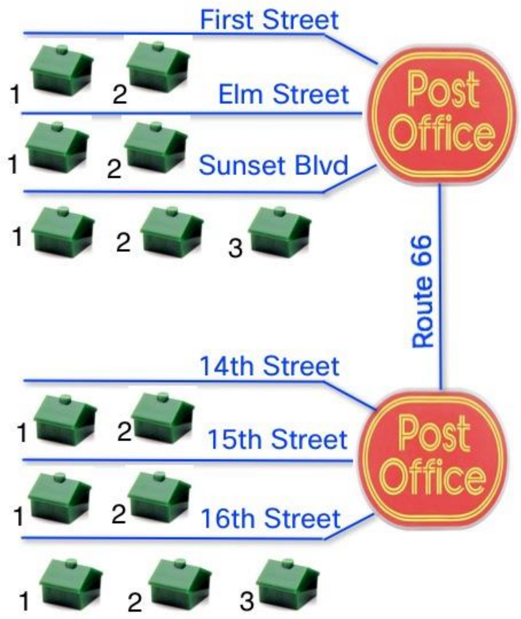
A 10.1.0.200

C 192.16.2.210

B 128.215.3.199

A 126.7.10.40

Nice Work


First Street
Elm Street
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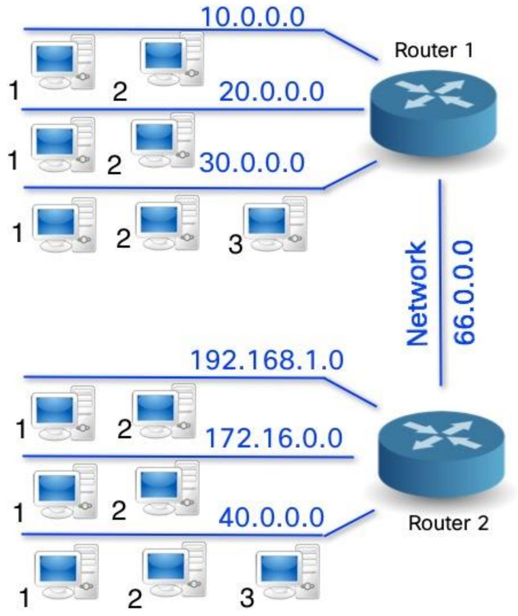
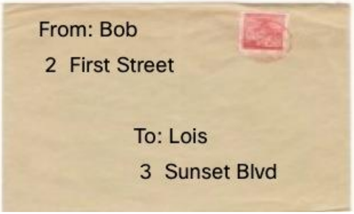
Post Office
Route 66
14th Street
15th Street
16th Street
Post Office
1 2
1 2
1 2 3
1 2
1 2
1 2 3


10.0.0.0
20.0.0.0
30.0.0.0
Router 1
Network 66.0.0.0
192.168.1.0
172.16.0.0
40.0.0.0
Router 2
1 2
1 2
1 2 3
1 2
1 2
1 2 3


From: Bob
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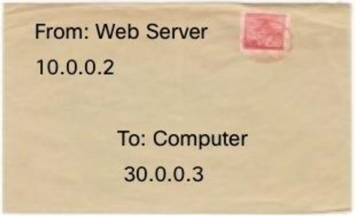

From: Web Server
10.0.0.2
To: Computer
30.0.0.3

Why Knowing the Class Matters

- Network Number 1 | 2 Host Number

- Each class uses a different **default mask**, as a **default** point of separation between Network and Host
  - Referred to as the **"Class Boundary"** (note the line position)

Class	Example	Networks	Hosts
A – 1-127	24.| 0 .0 .0	127	16,777,214
B – 128-191	150.18.| 0 .0	16,384	65,534
C – 192-223	198.23.210.| 0	2,097,152	254

Please put your thinking caps on, it is time for a quiz.

One, two, three….

Practice: Class Boundary—Draw the default Line

B 190.16.21.10

A 10.1.0.200

C 192.16.2.210

B 128.215.3.199

A 126.7.10.40

Practice: Class Boundary—Draw the Line (Cont.)

Network | Host

A 10.1.0.200

Network | Host

B 190.16.21.10

Network | Host

C 192.16.2.210

Network | Host

B 128.215.3.199

Network | Host

A 126.7.10.40

Nice Work, really.

How the Line Is Defined

- In a classful address, every number to the **left** of the **line** is static, and represents the "street" or "network" name.
  - –Classful addresses, left in their classful state, yield exactly '1' subnet (or street)
  - –Every number right of the **line** is ours to use…for what? Host addresses and/or creating custom subnets
- All bits in the mask to the **left** of the **line** are set to a binary 1 (which indicates those bits are network bits)
  - –This identifies the Network portion of the address.
  - –**The network portion of the address is MASKED with 1s**

Network | Host

B 190.16 | 21.10

What is this? → 255.255 | . 0 . 0 The Default Network Mask

10.1.0.200

0000 1010. 0000 0001 . 0000 0000 . 1100 1000
1111 1111. 0000 0000 . 0000 0000 . 0000 0000

Network | Host bits . Host bits . Host bits

Subnet Mask—Where We Draw the Line

- Identifies the division between the Network and the Host portion of an IP Address
- All devices on common network share the same mask, and network bits (same street name).
- The default mask is the number of bits that are reserved by the address class—Default Line position
  - Using the default mask will accommodate only one network (no custom subnets) in the relative class

- A custom Subnet Mask ***can be*** defined by an administrator to accommodate new subnetworks. Done by moving the the dividing line to the right.

Using the Default 'Class' Mas

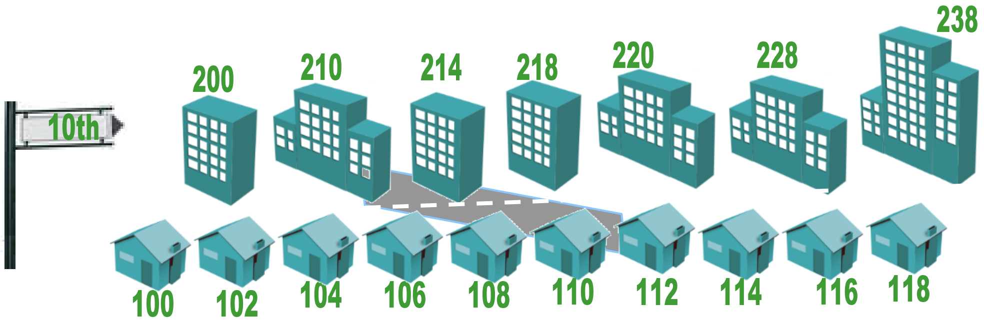
Class A: 10

.0.0.0

Yields Only One Subnet (Street) '10th'

With potentially >16.7 million (2^{24}) hosts on it

Can anyone say 'Congestion?'



All of your resources (addresses) are on the same Subnet

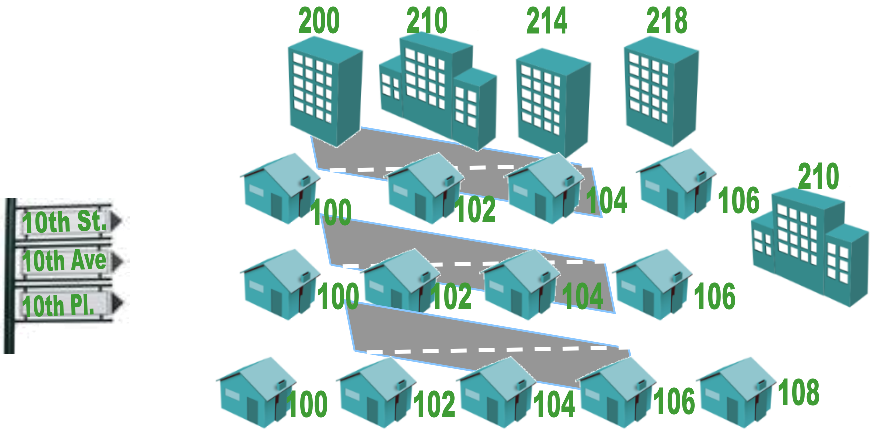
Rules that MUST be followed:

1. ***Each subnet must have a unique identifier (street name)***
2. ***Each node must have an unique address on that street (house number)***

Using a Custom Subnet Mask

Allows the 10 to be broken up into smaller subnets (streets)

Better traffic management, less waste, less congestion



Have we followed the rules?

1. ***Does each subnet have a unique identifier ?***
2. ***Does each node must have an address unique to the subnet ?***

The Question of the Moment…

WHY?

- **Why are IPv4 Subnetting skills so important in the real world?**
  - **It is what makes it relevant to you and your situation that makes it important…**

Understanding the Custom Subnet Mask

- It is the key to mastering the IP subnetting process
  - Classful subnetting, classless (VLSM), CIDR, supernetting,
  - summarization, address aggregation – you name it
  - the customization of the mask is **KEY**

WAIT !

We have a few more things to learn first…

Before Starting the IP Subnetting Process

- Determine the **type** of IP addressing to use
  - Become familiar with reserved addresses (RFC 1918, 5735)
- Determine your network requirements
  - Number of subnets and hosts your implementation requires
- Identify your base address (Starting point, class A, B, or C)
- Write out, and use the “MB-Key” and prepare to use the thumb game.

Identify Subnetting Requirements

- Identify the total number of subnets requiring a unique address:
  - –Unique address required for each LAN subnet
  - –Unique address required for each WAN subnet
- Verify how many hosts are needed per subnet
- Identify and create a subnet mask that accommodates the design
  - –This is where the movement of the line will extend the mask to go beyond its default (moving the mask to the right, bit by bit).

Create the Morris/Barker Key (MB-Key)

- Start with finger row, left to right, then Block Size row right to left, then Mask Value row, left to right.

1st	Fingers	1	2	3	4	5	6	7	8
	Block Size	128	64	32	16	8	4	2	1
2nd									
3rd	Mask Value	128	192	224	240	248	252	254	255

Getting to know the MB-Key

- This is the primary tool that makes the process so easy
  - This box represents any single number in an IP address byte (1 octet) and may be created in pencil or pen (or digitally).

Fingers	1	2	3	4	5	6	7	8
Block Size	128	64	32	16	8	4	2	1
Mask Value	128	192	224	240	248	252	254	255

Subnetting Review

- Classification
  - –A, B or C class boundary (class determines the default mask)
- Line position identifies where the subnet mask "**on**" bits end
  - –Moved further to the right gives you more subnets, but at the same time is restricting how many hosts can be on that subnet
- Network subnetting requirements
  - –Number of subnets required and making sure enough room for desired hosts.
- The MB-Key
  - –Provides many of the answers needed to accomplish the subnetting tasks
  - –The network block size, determined from the key, will be VERY helpful

The process for subnetting

- Classify the address!!!
  - –Is it A, B, or C, and what is the default mask.
- What are your needs?
  - –How many total subnet are to be created?
  - –On a single subnet, how many hosts do you need to support?

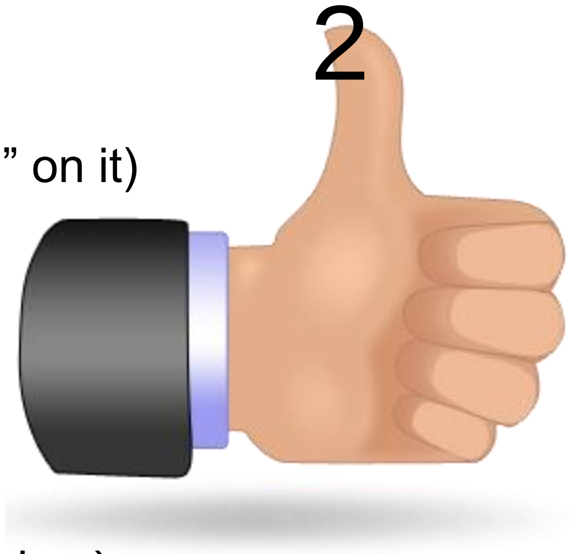
- Create a custom subnet mask for the entire network
  - –Accomplished by moving the **Line** to the right (increasing the bits that are “on” in the mask.)
- Determine subnet ranges, as well as the first, last and broadcast addresses for each new subnet.

A Fantastic Option for “Qty” questions.

How many bits, above and beyond the default mask, do we need to allocate as “network bits” to create new subnets?

Answer: Play the Finger/thumb game.

Example: You need 20 new subnets.
(prepare your thumb, which has a “2” on it)



(We will walk you through this, right now. Please stand up)

Subnetting Example 1: IP Network Design

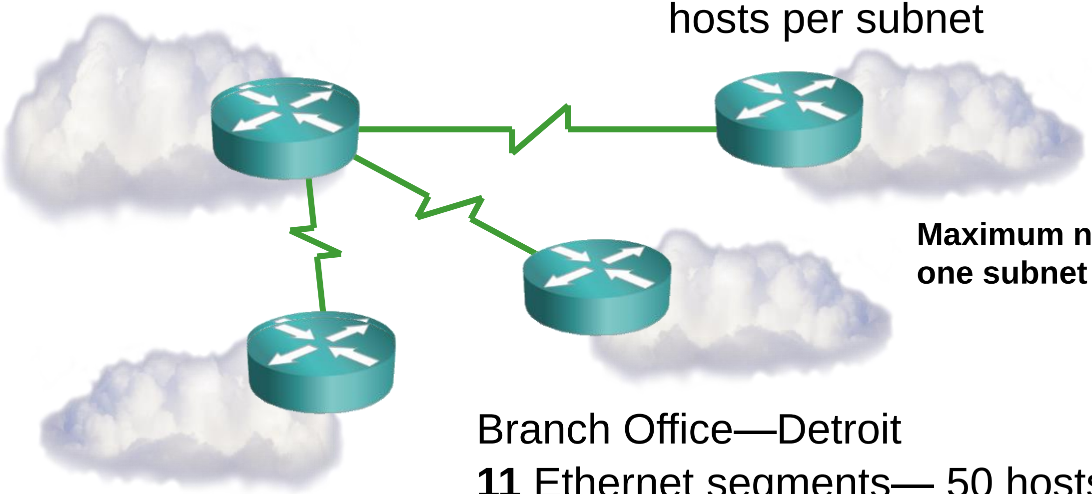
Central Office— Orlando

23 Ethernet segments—200 hosts per subnet

Branch Office—Lexington

8 Ethernet segments— 50 hosts per subnet

23 +
8 +
12 +
11 +
3 = **57**



Maximum number of hosts on any one subnet will be 200

Branch Office—Detroit

11 Ethernet segments— 50 hosts per subnet

Branch Office—Las Vegas

12 Ethernet segments—
150 hosts per subnet

172.16.0.0 /16 should be used.

Regarding any quantity question, use the thumb game. The goal is at least 57 subnets.

Cisco live!

Subnetting Example 1

- Base Address: 172 . 16 . 0 . 0

Classification: Class B

11111111 . 11111111 . 00000000 . 00000000

255 . 255 . 0 . 0

- Sample design indicates accommodation of **57** subnets (Including WAN) with no more than **200** hosts per subnet (Including router interfaces)
  - **57** is the key factor here.

  We need to support at least **57** subnets, which will require 6 additional bits (stolen from the host portion) assigned to represent network address.
  - Mask (the ON bits) will grow/move 6 positions to the right.

After we move the mask 6 positions, the MB-Key tells us the new mask.

Octet 1 Octet 2

172 . 16 .

255 . 255 .

252 is the subnet mask value in octet 3

Octet 3

Fingers	1	2	3	4	5	6	7	8
Block Size	128	64	32	16	8	4	2	1
Mask Value	128	192	224	240	248	252	254	255

The new, custom subnet mask

255 . 255 . 252 . 0

Total Number of Subnets = 64

What We Are Left with for Host IPs?

MASKED BITS | **Host Bits**

8 bits	8 bits	6 bits	10 bits unused
255 .	255 .	252 .	0

/22 bit Mask - 10 bits for use by hosts

- Remember the original network design requirements:
  - **57** Subnets needed—we ended up with 64 (a few extra).
  - Maximum **200 hosts per subnet**—there are 254 address available in Octet 4 alone (8 bits) and we have 10 bits to use.

We can use the thumb game (with host bits), to identify how may hosts will fit into the host address space (fingers represent host bits).

Where We Are in the Process…

- Classify the address!!!
  - –Identify the class A-B-C
  - –Draw the initial **Line**
  - –Fill in the default mask information

DONE

- Obtain information about your network
  - –How many total subnets are to be created? **57**
  - –On a single subnet, what is the maximum number of hosts needed? **200**

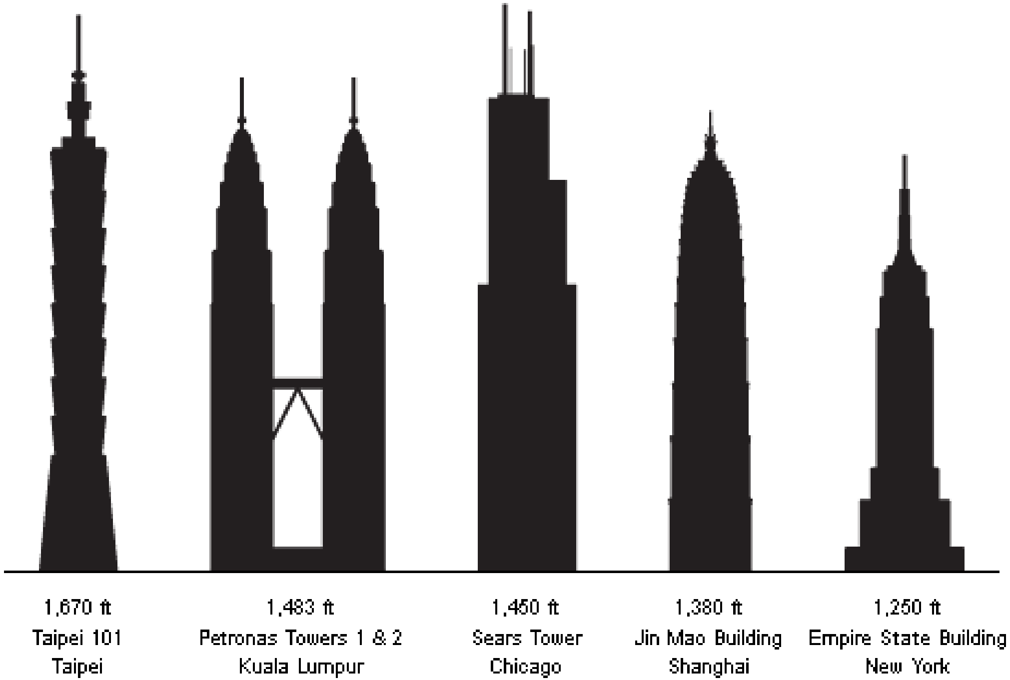
DONE

- Create a custom subnet mask for the entire network
  - –Accomplished by moving the **Line** to the right
  - –New Subnet Mask number is left of the **Line** Position

DONE

- The **Line** Position provides more information
  - –Find the number directly below the chosen mask value—**This is the block size**…will give you everything you need to complete the process
    - Subnet addresses | Range of host IDs | Broadcast addresses

Block Size Matters



Completing the Last Step in the Process

4 is the block size for each new subnet

Octet 3

Fingers	1	2	3	4	5	6	7	8
Block Size	128	64	32	16	8	4	2	1
Mask Value	128	192	224	240	248	252	254	255

252 is the mask for octet 3

- The **Block Size Increment Value** is used to determine all subnets, host ranges and broadcast addresses.

Allocating the Subnet, Host, and Broadcast Addresses Using 4, the ‘Block Size’

Subnet Name	Address	Mask	Dec Mask	Assignable Range	Broadcast
Subnet 0	172.16.0.0	/22	255.255.252.0	172.16.0.1 - 172.16.3.254	172.16.3.255
Subnet 4	172.16.4.0	/22	255.255.252.0	172.16.4.1 - 172.16.7.254	172.16.7.255
Subnet 8	172.16.8.0	/22	255.255.252.0	172.16.8.1 - 172.16.11.254	172.16.11.255
Subnet 12	172.16.12.0	/22	255.255.252.0	172.16.12.1 - 172.16.15.254	172.16.15.255
Subnet 16	172.16.16.0	/22	255.255.252.0	172.16.16.1 - 172.16.19.254	172.16.19.255
Subnet 20	172.16.20.0	/22	255.255.252.0	172.16.20.1 - 172.16.23.254	172.16.23.255
Subnet 24	172.16.24.0	/22	255.255.252.0	172.16.24.1 - 172.16.27.254	172.16.27.255
Subnet 28	172.16.28.0	/22	255.255.252.0	172.16.28.1 - 172.16.31.254	172.16.31.255
Subnet 32	172.16.32.0	/22	255.255.252.0	172.16.32.1 - 172.16.35.254	172.16.35.255
Subnet 36	172.16.36.0	/22	255.255.252.0	172.16.36.1 - 172.16.39.254	172.16.39.255

Regarding subnet 16, broadcast is next subnet -1.

Question:

If we take some of the host bits, and now use them to be part of the network address, don't we now have less "host bits" than before?

How many host addresses do we have available on each subnet?

Regarding any quantity question, use the thumb/finger game. The goal this time is to see how many hosts, can be given addresses on each new subnet, based on how many host bits are still available.

Number of Valid Host IPs Per Subnet

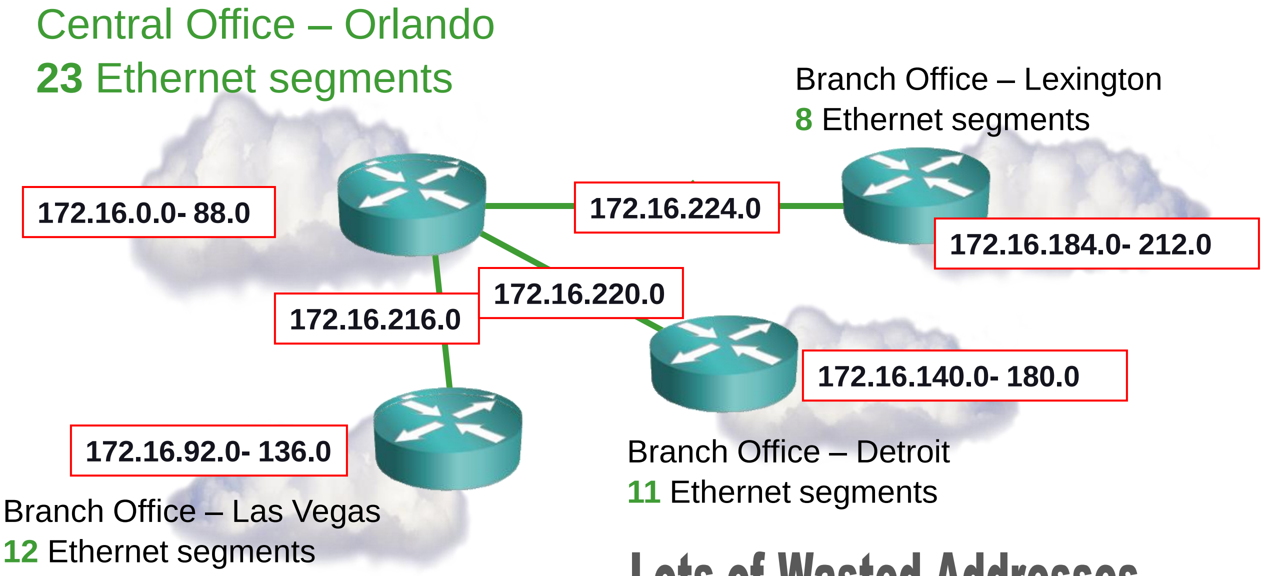
- To determine how many hosts can exist **per subnet**, use the thumb game, and verbally count out the number of host bits (bits not taken by the mask, starting from the right). In our case it is 10 bits (1024) and subtract 2

  Subtract 2— is because one is the subnet address and the other is the broadcast address of each network. Neither can be assigned as a valid interface IP address for any host.

1022

Subnetting Example 1: Applying the Subnets to the Network Locations

Use Contiguous Blocks of Addresses
When Assigning Subnet IDs to Each Network Location



Lots of Wasted Addresses...
We'll Take of That With VLSM

Another way of representing the mask bits that are "ON" /nn

Subnet Name	Address	Mask	Dec Mask	Assignable Range	Broadcast
Subnet 0	172.16.0.0	/22	255.255.252.0	172.16.0.1 - 172.16.3.254	172.16.3.255
Subnet 4	172.16.4.0	/22	255.255.252.0	172.16.4.1 - 172.16.7.254	172.16.7.255
Subnet 8	172.16.8.0	/22	255.255.252.0	172.16.8.1 - 172.16.11.254	172.16.11.255
Subnet 12	172.16.12.0	/22	255.255.252.0	172.16.12.1 - 172.16.15.254	172.16.15.255
Subnet 16	172.16.16.0	/22	255.255.252.0	172.16.16.1 - 172.16.19.254	172.16.19.255
Subnet 20	172.16.20.0	/22	255.255.252.0	172.16.20.1 - 172.16.23.254	172.16.23.255
Subnet 24	172.16.24.0	/22	255.255.252.0	172.16.24.1 - 172.16.27.254	172.16.27.255
Subnet 28	172.16.28.0	/22	255.255.252.0	172.16.28.1 - 172.16.31.254	172.16.31.255
Subnet 32	172.16.32.0	/22	255.255.252.0	172.16.32.1 - 172.16.35.254	172.16.35.255
Subnet 36	172.16.36.0	/22	255.255.252.0	172.16.36.1 - 172.16.39.254	172.16.39.255

CIDR Notation for 2nd, 3rd, and 4th octets

128	192	224	240	248	252	254	255
/9	/10	/11	/12	/13	/14	/15	/16
/17	/18	/19	/20	/21	/22	/23	/24
/25	/26	/27	/28	/29	/30	/31	/32

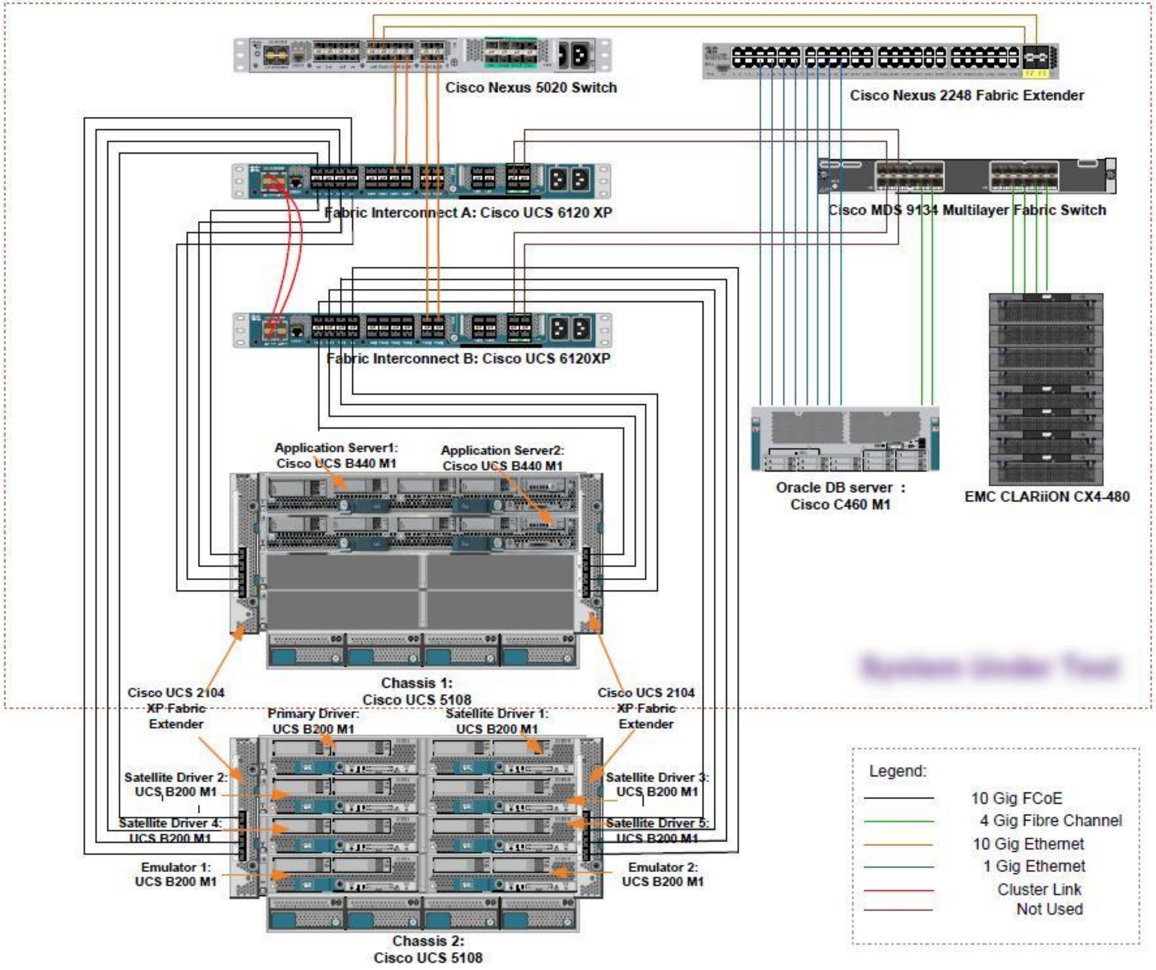
Reverse Engineering Any IP Scheme

- One of the most **powerful troubleshooting skills** you can keep in your arsenal
  - Given an IP address and mask, what is the subnet address?
  - Given an IP address and mask, what is the subnet broadcast address?
  - Given an IP address and mask, what are the assignable IP addresses in that network/subnet?
  - Given a network number and a static subnet mask, what are the valid subnet numbers?
  - Here is all of the information you may have been given:

Host 10.48.39.106 /21

Sometimes a graphic helps.

Imagine that the host with the IP address of **10.48.39.106 /21** is a Windows or Unix server, being virtualized in here ...


Cisco Nexus 5020 Switch
Cisco Nexus 2248 Fabric Extender
Fabric Interconnect A: Cisco UCS 6120 XP
Cisco MDS 9134 Multilayer Fabric Switch
Fabric Interconnect B: Cisco UCS 6120XP
Application Server1: Cisco UCS B440 M1
Application Server2: Cisco UCS B440 M1
Oracle DB server : Cisco C460 M1
EMC CLARiiON CX4-480
Cisco UCS 2104 XP Fabric Extender
Chassis 1: Cisco UCS 5108
Cisco UCS 2104 XP Fabric Extender
Primary Driver: UCS B200 M1
Satellite Driver 1: UCS B200 M1
Satellite Driver 2: UCS B200 M1
Satellite Driver 3: UCS B200 M1
Satellite Driver 4: UCS B200 M1
Satellite Driver 5: UCS B200 M1
Emulator 1: UCS B200 M1
Emulator 2: UCS B200 M1
Chassis 2: Cisco UCS 5108
Legend:
10 Gig FCoE
4 Gig Fibre Channel
10 Gig Ethernet
1 Gig Ethernet
Cluster Link
Not Used

Let’s do this one together.

Host 10.48.39.106 /21

1. Look at the mask, to determine the block size within that octet.

2. Use block size to identify the ranges as well as the first, last and broadcast addresses for each subnet

Fingers	1	2	3	4	5	6	7	8
Block Size	128	64	32	16	8	4	2	1
Mask Value	128	192	224	240	248	252	254	255

Process

- Using Block Size, calculate the subnets, to see where the host belongs.
- First host address is the subnet +1
- Next subnet -1 is current subnet broadcast, -1 more is last valid host.

Subnet Name	Address	Mask	Dec Mask	Assignable Range	Broadcast
Subnet 0	10.48.0.0	/21	255.255.248.0	10.48.0.1 - 10.48.7.254	10.48.7.255
Subnet 8	10.48.8.0	/21	255.255.248.0	10.48.8.1 - 10.48.15.254	10.48.15.255
Subnet 16	10.48.16.0	/21	255.255.248.0	10.48.16.1 - 10.48.23.254	10.48.23.255
Subnet 24	10.48.24.0	/21	255.255.248.0	10.48.24.1 - 10.48.31.254	10.48.31.255
Subnet 32	10.48.32.0	/21	255.255.248.0	10.48.32.1 - 10.48.39.254	10.48.39.255
Subnet 40	10.48.40.0	/21	255.255.248.0	10.48.40.1 - 10.48.47.254	10.48.47.255
Etc…	10.48.48.0	/21	255.255.248.0	10.48.48.1 - 10.48.55.254	10.48.55.255

Reverse Engineering Results

Host 10.48.39.106/21

1. Given an IP address and mask, what is the subnet number? **Subnet ID: 10.48.32.0 /21**

1. Given an IP address and mask, what is the subnet broadcast address? **Broadcast: 10.48.39.255**

2. Given an IP address and mask, what are the assignable IP addresses in that network/subnet?
Host Range: 10.48.32.1 - 10.48.39.254 - **Increments of 8**

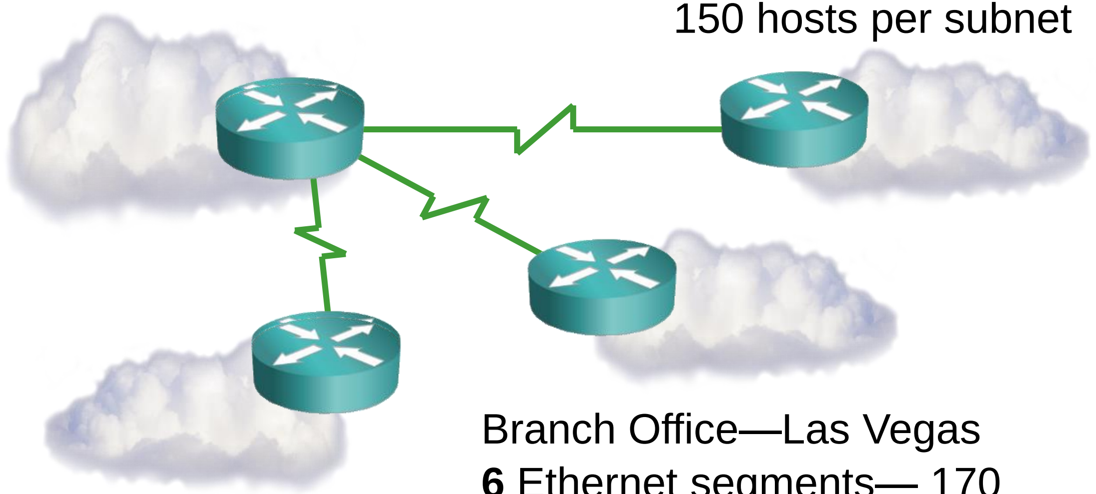
4. Given a network number and a static subnet mask, what are the valid subnet numbers?
Any increment of 8, beginning with 0, total of 2^{13} subnets available

Subnetting Challenge: Your IP Network Design

Central Office—Washington, DC
7 Ethernet segments—200 hosts per subnet

Branch Office—Tampa
6 Ethernet segments—150 hosts per subnet

7+
6 +
4 +
6 +
3 = **26**



Branch Office—Las Vegas
6 Ethernet segments— 170 hosts per subnet

Branch Office—Grand Cayman
4 Ethernet segments—185 hosts per subnet

Network Assigned 150.1.0.0 /16

Maximum number of hosts on any one subnet will be 200

Let’s do this one together…

1. Beginning with a class B address, use the thumb game to find out how many bits to use for custom subnetting (for 26 subnets)
2. Move the mask, that many bits
3. Use block size to identify the ranges
4. Verify you have enough host address space

Fingers	1	2	3	4	5	6	7	8
Block Size	128	64	32	16	8	4	2	1
Mask Value	128	192	224	240	248	252	254	255

Great Job! You Have Passed Level 1!

- You have just learned the entire classful subnetting process using not much math
  - –Everything else from here on out, uses these same techniques, tools and processes

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Bonus Topics !

- **Level 2**—Classless Subnetting (VLSM)
- **Level 3**—Classless Inter-Domain Routing (CIDR)
  - –Supernetting, address aggregation, summary addressing

Subnetting (Classless) VLSM

- Variable Length Subnet Masking
  - Allows for more efficient use of IP space
  - Less waste on smaller subnets where fewer addresses are necessary

Understanding VLSM

- Instead of creating a single subnet mask to accommodate your total IP subnet number (working from the left)…
- **Identify a subnet mask for each subnet individually (work from the right side)**
  - Move the line as far to the right as you can, while leaving just enough room for the hosts on that subnet
  - Example, WAN link, with only 2 devices on the network (point to point connection)

Getting the most out of a block: 192.168.1.0/24

- Allocate biggest networks first.
- Use the next valid block as a new starting point, and change the mask as needed, keeping in mind leaving enough host bits for host addressing.

Name of Subnet	Allocated Size	Address	Mask	Dec Mask	Assignable Range	Broadcast
HQ Main	62	192.168.1.0	/26	255.255.255.192	192.168.1.1 - 192.168.1.62	192.168.1.63
Branch 1	62	192.168.1.64	/26	255.255.255.192	192.168.1.65 - 192.168.1.126	192.168.1.127
Branch 2	62	192.168.1.128	/26	255.255.255.192	192.168.1.129 - 192.168.1.190	192.168.1.191
Branch 3	30	192.168.1.192	/27	255.255.255.224	192.168.1.193 - 192.168.1.222	192.168.1.223
HQ DMZ	6	192.168.1.224	/29	255.255.255.248	192.168.1.225 - 192.168.1.230	192.168.1.231
WAN 1	2	192.168.1.232	/30	255.255.255.252	192.168.1.233 - 192.168.1.234	192.168.1.235
WAN 2	2	192.168.1.236	/30	255.255.255.252	192.168.1.237 - 192.168.1.238	192.168.1.239
WAN 3	2	192.168.1.240	/30	255.255.255.252	192.168.1.241 - 192.168.1.242	192.168.1.243

Applying VLSM to a Network Design

Rules:

- Identify all of the subnets within your operational area and determine their approximate size (host population)
- VLSM must be implemented on a standard binary block size: 2, 4, 8,16, 32, and so on
- All routers and multi-layer switches must be running a routing protocol capable of exchanging subnet mask information within their route update packets
- Classless routing protocols, like EIGRP, OSPF, and RIP2
- When Implementing VLSM, allocate subnet IDs to the largest networks first, then work your way down to the smallest networks

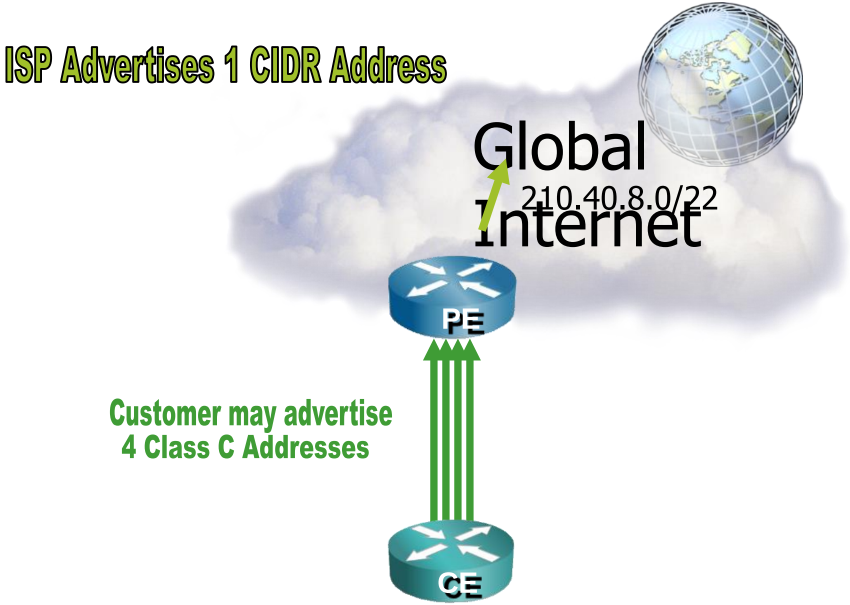
Level 3—RFCs 1338 and 1519 (latest)

- Same game…many names
  - –CIDR—Classless Inter-Domain Routing
  - –Supernetting
  - –IPv4 address aggregation
  - –IP address summarization
- All of these follow the same basic process
  - –Advertise a single IP subnet address/mask on a router which implies multiple IP subnets
  - –10.0.0.0/8 implies all ‘10’ networks
  - –Must have a contiguous ‘block’ to implement (2, 4, 8, 16, 32, etc.)

Classless Interdomain Routing

- One method to help control IP addresses depletion
- Reduce Internet routing table size (BGP Table)
  - Blocks of contiguous addresses (4, 8,16, etc.) are assigned to ISPs
  - ISPs assign IP addresses to customers in contiguous blocks
  - Blocks are summarized to reduce router advertisements and route table size
- Check out
  - www.traceroute.org/#USA—scroll down to route servers where you can telnet to a live Cisco BGP router and view the complete BGP table

What Is CIDR? The Beginning of the End (binary)



Internet Service Provider

Customer Edge Network
Requires 4 Class C Addresses

Contiguous Addresses

210.40.8.0/24
210.40.9.0/24
210.40.10.0/24
210.40.11.0/24

Summarization or Aggregation

- Group/summarize:
  - 172.16.31.0
  - 172.16.32.0
  - 172.16.33.0
  - 172.16.34.0

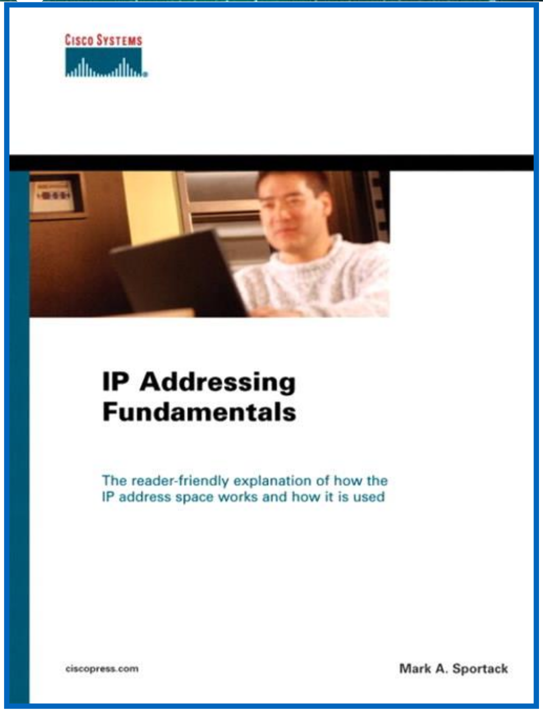
Summarization or Aggregation

- Group/summarize:
  - 172.16.31.31 = **00**01 1111
  - 172.16.32.32 = **00**10 0000
  - 172.16.33.33 = **00**10 0001
  - 172.16.34.34 = **00**10 0010

172.16.0.0 **/18**

Recommended Reading

- Continue your Networkers at Cisco Live learning experience with further reading from Cisco Press
- Check the Recommended Reading flyer for suggested books



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