

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 2

Subnet Mask Concepts and Formats

- * Converting Subnet Mask Formats

In This Lesson...

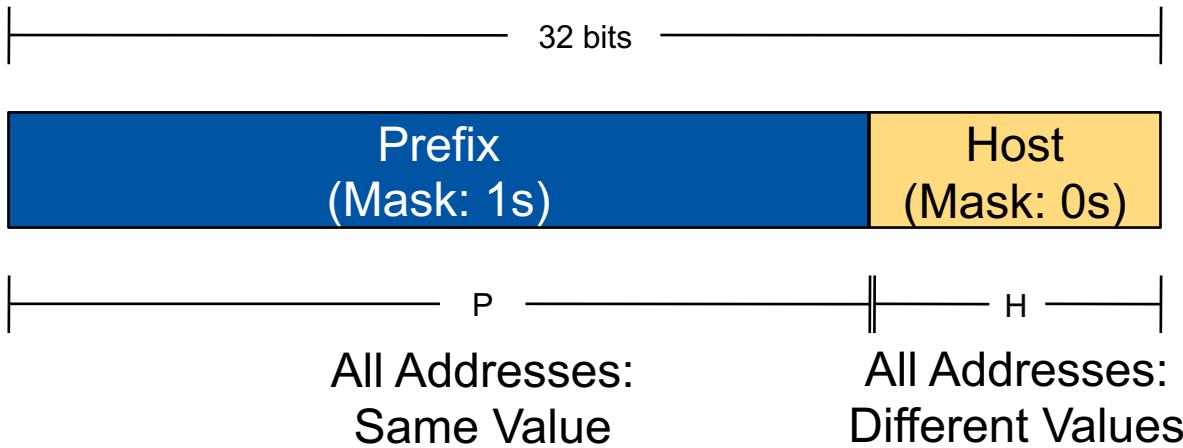
Converting Subnet Mask Formats

- **Subnet Mask Concepts**
- Subnet Mask Formats
- Summary and Terms

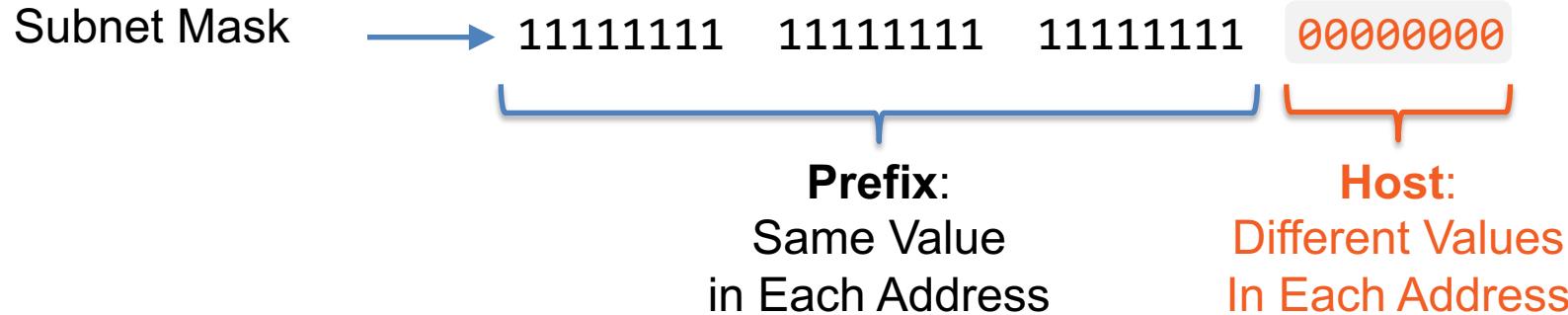
What is a Subnet Mask?

1. Defined by RFC 950 (Internet Standard Subnetting Procedure)
2. Three Formats:
 - A. A 32-bit Binary Number
 - B. A Dotted Decimal Number (DDN)
 - C. A Prefix Length (/P)
3. Identifies the Number of Bits that:
 - A. Identify the Subnet Number (Prefix Bits)
 - B. Identify a Host in the Subnet (Host Bits)
4. Useful for Calculating Facts about Subnets

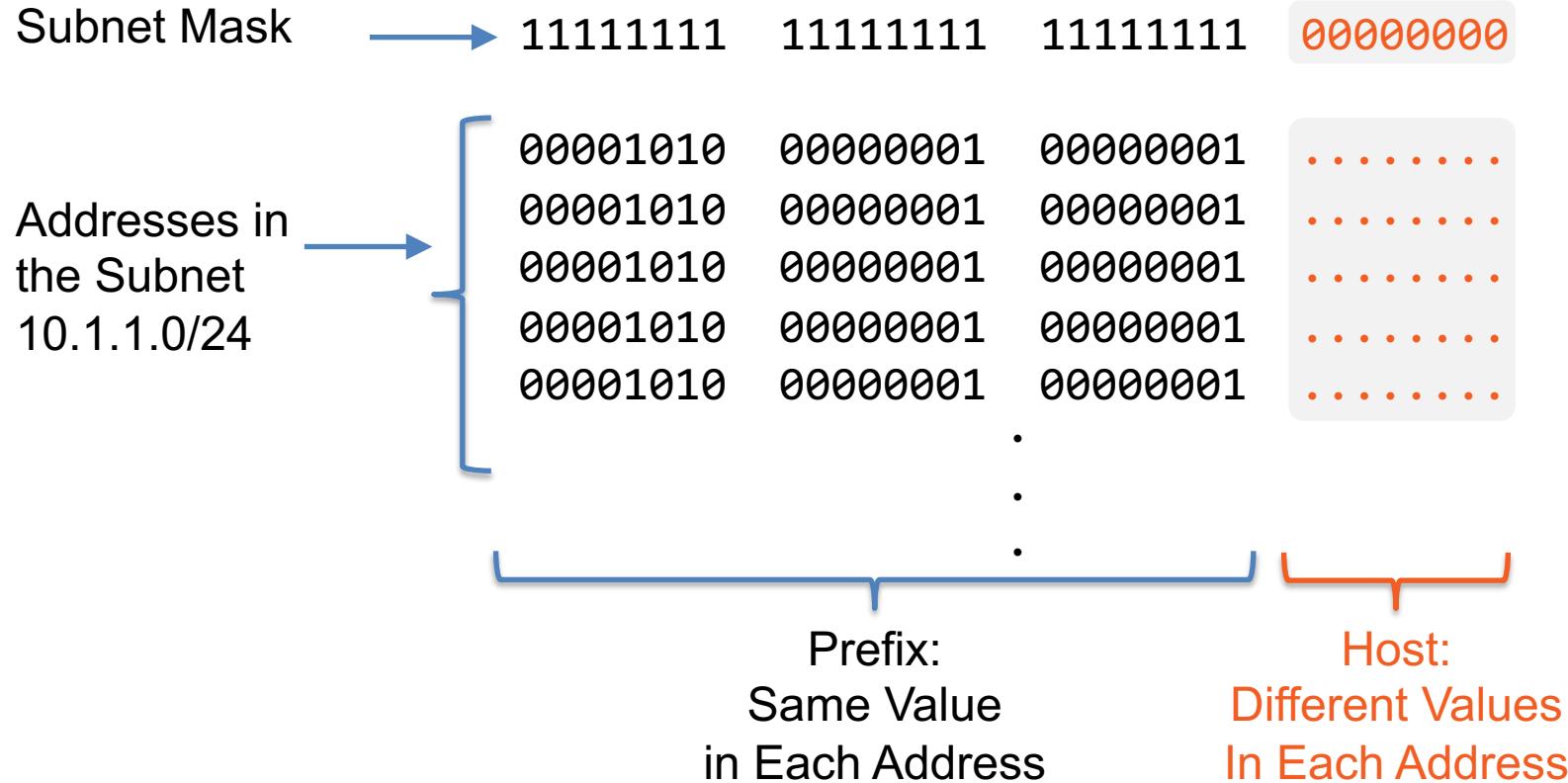
Visual Rule: Mask Defines Prefix + Host



Example 1: 24 Prefix and 8 Host Bits



Example 1: Addresses Have Identical Prefix Bits



Example 1: Two Reserved Numbers

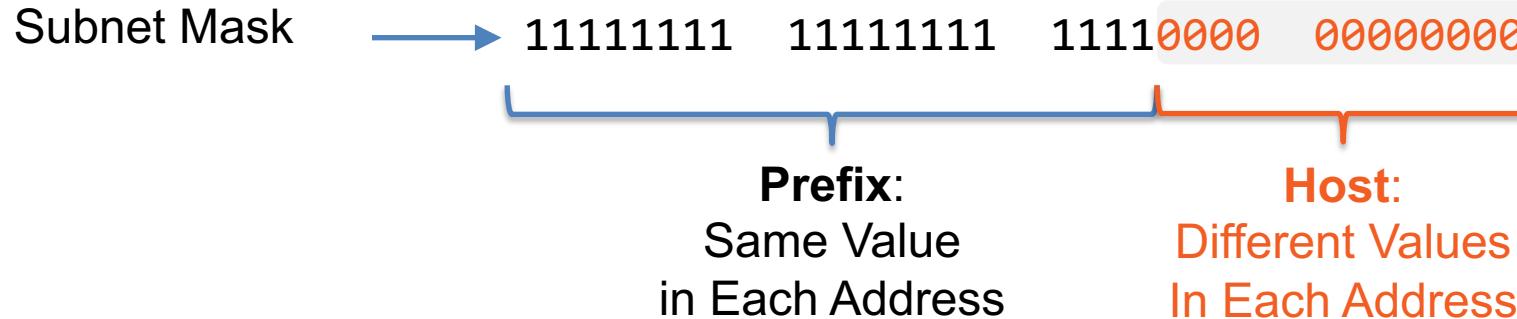
Subnet ID →	00001010	00000001	00000001	00000000	10.1.1.0
	00001010	00000001	00000001	00000001	10.1.1.1
	00001010	00000001	00000001	00000010	10.1.1.2
	00001010	00000001	00000001	00000011	10.1.1.3
	00001010	00000001	00000001	00000100	10.1.1.4
	00001010	00000001	00000001	00000101	10.1.1.5
			•		
			•		
			•		
Broadcast →	00001010	00000001	00000001	11111110	10.1.1.254
	00001010	00000001	00000001	11111111	10.1.1.255

Prefix Host

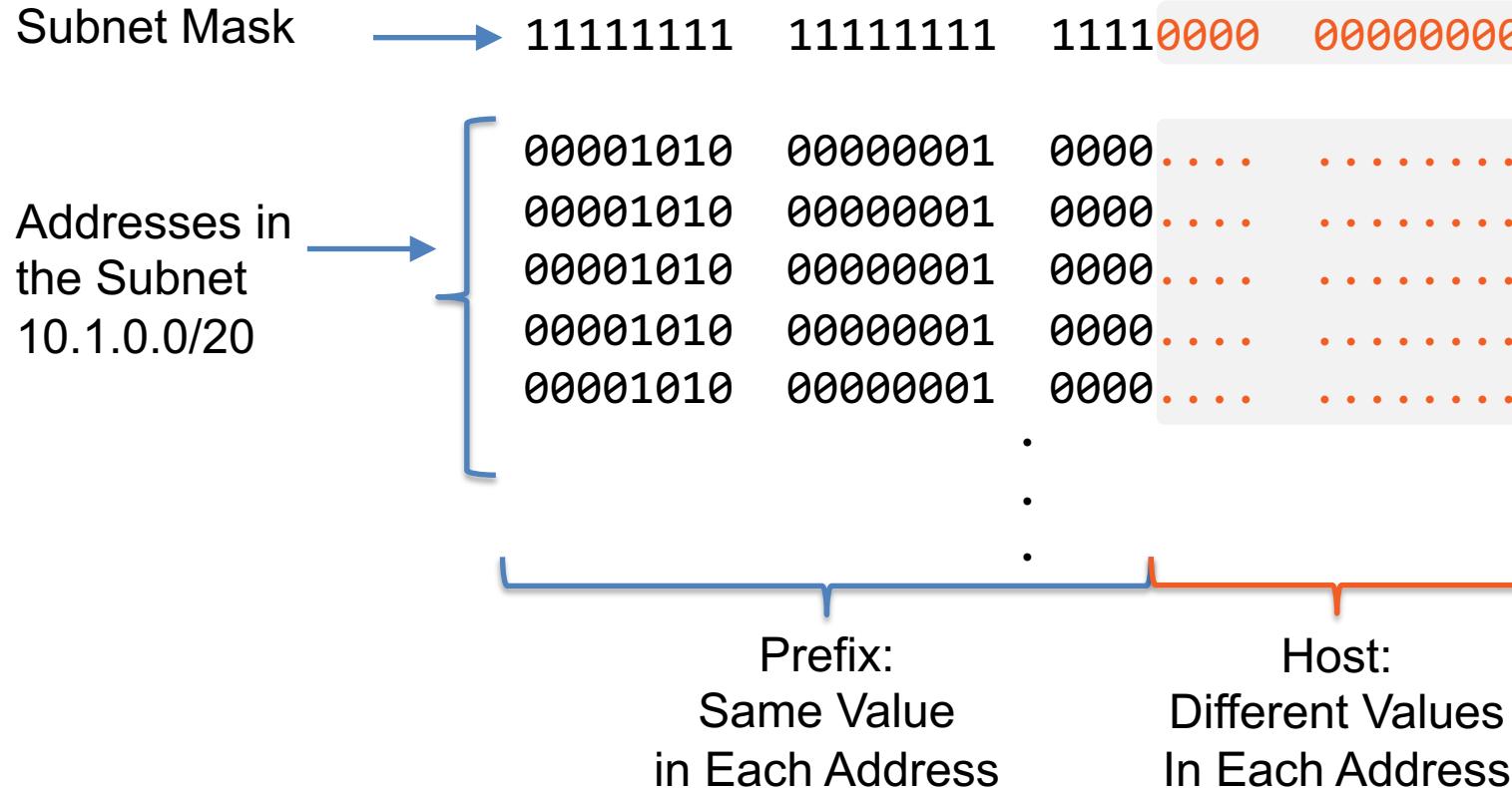
Example 1: DDN IP Addresses

Subnet ID →	10.1.1. 0	10.1.1.246
	10.1.1. 1	10.1.1.247
	10.1.1. 2	10.1.1.248
	10.1.1. 3	10.1.1.249
	10.1.1. 4	10.1.1.250
	10.1.1. 5	10.1.1.251
	10.1.1. 6	10.1.1.252
	10.1.1. 7	10.1.1.253
	10.1.1. 8	10.1.1.254
	10.1.1. 9	10.1.1.255 ← Subnet Broadcast Address
	.	
	.	
	.	

Example 2: 20 Prefix and 12 Host Bits



Example 2: Addresses Have Identical Prefix Bits



Example 2: Two Reserved Numbers

Subnet ID →	00001010	00000001	0000 0000	00000000	10.1.0.0
	00001010	00000001	0000 0000	00000001	10.1.0.1
	00001010	00000001	0000 0000	00000010	10.1.0.2
	00001010	00000001	0000 0000	00000011	10.1.0.3
			.		
			.		
			.		
	00001010	00000001	0000 1111	11111110	10.1.15.252
	00001010	00000001	0000 1111	11111110	10.1.15.253
	00001010	00000001	0000 1111	11111110	10.1.15.254
Broadcast →	00001010	00000001	0000 1111	11111111	10.1.15.255

Prefix Host



Example 2: DDN IP Addresses

Subnet ID →	10.1.0. 0	10.1.15. 246
	10.1.0. 1	10.1.15. 247
	10.1.0. 2	10.1.15. 248
	10.1.0. 3	10.1.15. 249
	10.1.0. 4	10.1.15. 250
	10.1.0. 5	10.1.15. 251
	10.1.0. 6	10.1.15. 252
	10.1.0. 7	10.1.15. 253
	10.1.0. 8	10.1.15. 254
	10.1.0. 9	10.1.15. 255 ← Subnet Broadcast Address
	.	
	.	
	.	

Mask Terms

Subnet Mask
Network Mask
Mask

Address Mask
Bit Mask
Net Mask

Mask
CIDR Mask
Slash Mask

Prefix Mask
Prefix Length
Prefix Notation

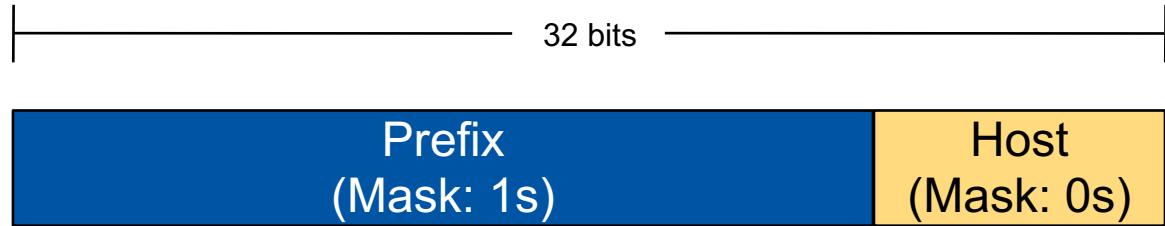
In This Lesson...

Converting Subnet Mask Formats

- Subnet Mask Concepts
- **Subnet Mask Formats**
- Summary and Terms

Binary Masks: Rules

- 32 Bits Long
- Binary 1s:
 - On the Left
 - Contiguous
- Binary 0s:
 - On the Right
 - Contiguous



Binary Masks: Formatting

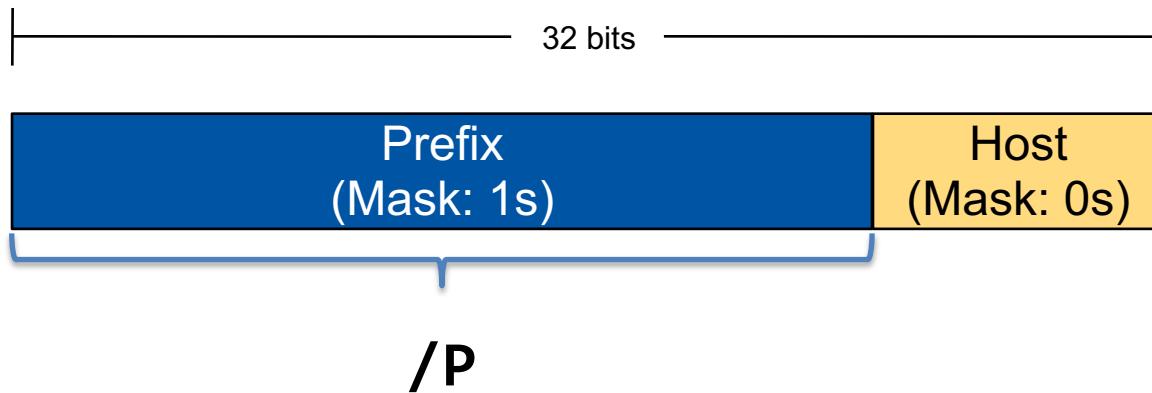
1111111111111111111111111100000000

11111111 11111111 11111111 00000000

11111111 . 11111111 . 11111111 . 00000000

Prefix Masks: Rules

- A Better Way to Write the Mask: /P
 - P is the Number of Binary 1s in the Mask
 - Also Called CIDR Mask



Prefix Masks: Examples

11111111	00000000	00000000	00000000	/8
11111111	11110000	00000000	00000000	/12
11111111	11111111	00000000	00000000	/16
11111111	11111111	11111000	00000000	/21
11111111	11111111	11111111	00000000	/24
11111111	11111111	11111111	11111100	/30

DDN Masks: Rules

- A Better Way to Write the Mask: a Dotted Decimal Number (DDN)
 - Conversion of Binary to DDN (Same Idea as IP Addresses)
 - Original Method to Write Mask in Decimal

11111111.11111111.11110000.00000000

Binary Mask



255



255



240



0

DDN Mask

The Nine DDN Octet Values

Decimal Value	Binary	Number of Binary 1's
0	00000000	0
128	10000000	1
192	11000000	2
224	11100000	3
240	11110000	4
248	11111000	5
252	11111100	6
254	11111110	7
255	11111111	8

Binary Rules:

- Binary 1s and 0s Must be Contiguous
- Binary 1s on the Left

DDN Masks: Examples

11111111	00000000	00000000	00000000	255.0.0.0
11111111	11110000	00000000	00000000	255.240.0.0
11111111	11111111	00000000	00000000	255.255.0.0
11111111	11111111	11111000	00000000	255.255.248.0
11111111	11111111	11111111	00000000	255.255.255.0
11111111	11111111	11111111	11111100	255.255.255.252

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- Subnet Mask Concepts
- Subnet Mask Formats
- **Summary and Terms**

Terms from this Topic

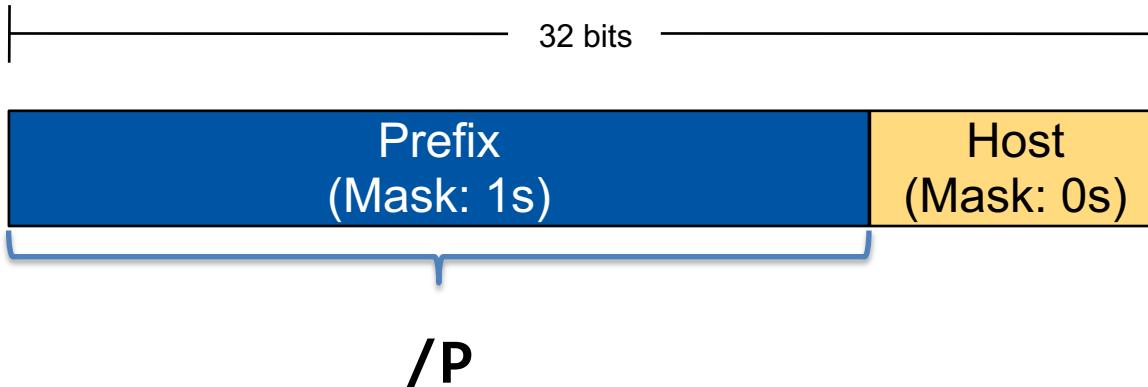
Subnet Mask
Network Mask
Mask

Mask
CIDR Mask
Slash Mask

Address Mask
Bit Mask
Net Mask

Prefix Mask
Prefix Length
Prefix Notation

Summary: Key Concepts



11111111.11111111.11110000.00000000

Binary Mask

↓ ↓ ↓ ↓
255 . 255 . 240 . 0

DDN Mask

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Section 6: Subnetting and the Exam

IPv4 Subnetting – Section 2

Subnet Mask Concepts and Formats

*** Converting Subnet Mask Formats**

In This Lesson...

Converting Subnet Mask Formats

- **Converting DDN to Prefix**
- Converting Prefix to DDN
- Learning Stages and Practice

Text Rules: DDN to Prefix

- 1. Set up the Problem on Paper**
 - A. Write the DDN Mask with Wide Columns
 - B. Leave Three Rows of Space for: Binary Mask, Addition, Prefix Mask
- 2. For Each Octet, Convert Decimal Value to 8-Bit Binary**
 - A. Use Memory or Notes
- 3. Count the Number of Binary 1's in the Mask**
 - A. Count the Binary 1's in Each Octet; Write the Values
 - B. Add the Per-Octet Counts
- 4. Write the Prefix Mask as a / Followed by the Total from Step 3**

Visual Rules: Convert DDN Mask to Prefix

① Decimal . Decimal . Decimal . Decimal



② Binary(8) . Binary(8) . Binary(8) . Binary(8)



③ #1s + #1s + #1s + #1s =

④ /P

Step 1: 255.255.240.0

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	255	.	240

Binary Mask

Counting 1's

Prefix Mask

Step 2: 255.255.240.0

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	255	.	240
			.	0

↓ ↓ ↓ ↓

11111111.11111111.11110000.00000000 ② Binary Mask

Steps 3, 4: 255.255.240.0

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	255	.	240

↓ ↓ ↓ ↓
11111111.11111111.11110000.00000000 ② Binary Mask

↓ ↓ ↓ ↓
8 + 8 + 4 + 0 = 20 ③
Counting 1's

④
/20 Prefix Mask

Step 1: 255.255.255.224

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	255	.	255

Binary Mask

Counting 1's

Prefix Mask

Step 2: 255.255.255.224

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	255	.	255

↓ ↓ ↓ ↓

11111111.11111111.11111111.11100000 ② Binary Mask

Steps 3, 4: 255.255.255.224

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	255	.	224



11111111.11111111.11111111.11100000 ②

Binary Mask



8

+

8

+

8

+

3

=

27

Counting 1's

③

④
/27

Prefix Mask

Step 1: 255.254.0.0

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	254	.	0

Binary Mask

Counting 1's

Prefix Mask

Step 2: 255.254.0.0

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	254	.	0



11111111.11111110.00000000.00000000 ②

Binary Mask

Steps 3, 4: 255.254.0.0

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	254	.	0



11111111.11111110.00000000.00000000 ②

Binary Mask



8

+

7

+

0

+

0

=

③ 15

Counting 1's

④
/15

Prefix Mask

In This Lesson...

Converting Subnet Mask Formats

- Converting DDN to Prefix
- **Converting Prefix to DDN**
- Learning Stages and Practice

Text Rules: Prefix to DDN

1. Set up the Problem on Paper

- A. Write the Prefix Mask (/P) at the Top
- B. Create Four Columns (One Per Octet), Each Wide Enough for 8 Bits
- C. Leave Space for Three Rows: Binary Mask, Working Space, DDN Mask

2. Create the Binary Mask

- A. Write P Binary 1s, Starting on the Left Working to the Right
- B. Write Only 8 Bits Per Octet
- C. Complete the 32-Bit Binary Mask with 0's

3. Create the DDN Mask

- A. Use Memory or Notes of Nine Mask Octet Values

Step 1: /20



Step 2: /20

/20

Prefix Mask

Octet 1

Octet 2

Octet 3

Octet 4

Binary Mask

11111111

11111111

1111



Steps 2, 3: /20

/20

Prefix Mask

Octet 1

Octet 2

Octet 3

Octet 4

11111111

11111111

11110000

00000000

Binary Mask

②

②

②



255



255



240



0

③ DDN Mask

Step 1: /27



Step 2: /27

/27

Prefix Mask

Octet 1

Octet 2

Octet 3

Octet 4

Binary Mask

11111111

11111111

11111111

111



Steps 2, 3: /27

/27

Prefix Mask

Octet 1

Octet 2

Octet 3

Octet 4

11111111

11111111

11111111

11100000

Binary Mask

②

②

②

②



255



255



255



224

③ DDN Mask

Step 1: /15



Step 2: /15



Steps 2, 3: /15

/15

Prefix Mask

Octet 1

Octet 2

Octet 3

Octet 4

11111111

11111110

00000000

00000000

Binary Mask

②

②



255



254



0



0

③

DDN Mask

In This Lesson...

Converting Subnet Mask Formats

- Converting DDN to Prefix
- Converting Prefix to DDN
- **Learning Stages and Practice**

Labs 3 and 4

Lab 3

DDN



Binary



Prefix

DDN



Binary

Prefix

Lab 4

Prefix



Binary



DDN

Prefix



Binary

DDN

Stages: Study Suggestions

Stage	Study Suggestions
1 (Learning)	Do Not Skip the Binary Mask; Write All Steps
2 (Perfecting)	Skip the Binary Mask , but Write Other Steps
3 (Accelerating)	A. Skip Writing as Much as Possible B. Practice List of 9 Mask Octet Values as End to Itself C. Goal: Thinking the Answer is Faster Than Writing

Stage 3 Speed Practice Exercises

Lab 3

Decimal	Binary 1's
0	
255	
224	
128	
192	
248	
64	
254	
160	

Lab 4

Binary 1's	Decimal
0	
4	
7	
2	
4	
5	
9	
8	
1	

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

Stage 2 Worksheet

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	255	.	240

$$8 + 8 + 4 + 0 = 20 \text{ Counting 1's}$$

③
/20

Prefix Mask

Stage 3: Final Practice Step

Octet 1	Octet 2	Octet 3	Octet 4	DDN Mask
255	.	255	.	240 . 0

/20⁽⁴⁾

Prefix Mask

Binary Shorthand

Instead of
Binary... ...Write #
 Binary 1's

Binary	Number of Binary 1's
00000000	0
10000000	1
11000000	2
11100000	3
11110000	4
11111000	5
11111100	6
11111110	7
11111111	8

Practice!

Exercises for:

Lab 3: “Convert DDN Mask To Prefix Mask”

Lab 4: “Convert Prefix Mask to DDN Mask”

Come Back to Class!

Exercises for:

Lab 3: “Convert DDN Mask To Prefix Mask”

Lab 4: “Convert Prefix Mask to DDN Mask”

Time Finished!