Subnet Mask Practice

Bridge Summer 2021

12/6/2021

Reviewing the basics

How to find the # of subnets

2^# of subnet bits in the subnet mask

Network #: 192.168.1.0

Subnet by applying this subnet mask: 255.255.255.240 (/28)

Why /28? What is that?

Look at the subnet mask in binary, and count the # of 1-bits

11111111.11111111.11111111.11110000

Network #: 192.168.1.0

Subnet by applying this subnet mask: 255.255.255.240 (/28)

Is this a Class A, Class B, or Class C network?

192.168.1.0

Is this a Class A, Class B, or Class C network?

192.168.1.0

Class	Leading bits	Start address	End address	Default subnet mask in dot-decimal notation	CIDR notation
Class A	0	*0.0.0.0*	*127.255.255.255*[a]	*255.0.0.0*	*/8*
Class B	10	*128.0.0.0*	*191.255.255.255*	*255.255.0.0*	*/16*
Class C	110	*192.0.0.0*	*223.255.255.255*	*255.255.255.0*	*/24*

Network #: 192.168.1.0

Subnet by applying this subnet mask: 255.255.255.240 (/28)

Class C. First octet falls into the Class C range

192.168.1.0

This means the bits in the first **three** octets are reserved for the network - we can't touch them and they won't change.

11111111.11111111.11111111.11110000

Class A: first octet is reserved for network. Class B: first **two** octets. Class C: first **three** octets.

Network #: 192.168.1.0

Subnet by applying this subnet mask: 255.255.255.240 (/28)

Class C. First octet falls into the Class C range

192.168.1.0

The remaining ones (in purple) must be our subnet bits.

11111111.11111111.11111111.11110000

Network #: 192.168.1.0 (Class C)

Subnet by applying this subnet mask: 255.255.255.240 (/28)

The remaining ones (in purple) must be our subnet bits.

11111111.11111111.11111111.11110000

Subnets = 2^4 = 16 subnets can be created

How to find the # of valid hosts

$2^{\wedge \#\text{ of host bits}} - 2$

(first host ID = network ID)
(last host ID = broadcast ID)

Network #: 192.168.1.0 (Class C)

Subnet by applying this subnet mask: 255.255.255.240 (/28)

Host bits: any remaining bits (in teal)

11111111.11111111.11111111.11110000

Subnets = 2^4 = 16 subnets can be created

Hosts = 2^4 = 16 **- 2** = 14 valid hosts

Network #: 192.168.1.0 (Class C)

Subnet by applying this subnet mask: 255.255.255.240 (/28)

We can create 16 different subnets.

Each of the 16 subnets can have 14 valid hosts.

Your turn:
how many subnets and valid hosts can we create with this network number and this subnet mask? (numbers on next slide)

Network #: 150.150.0.0

Subnet mask: 255.255.255.252 /30

1. What is the class?
2. How many bits are meant for the network?
3. How many subnet bits are there?
4. How many host bits are there?
5. How many subnets & valid hosts are there?

150.150.0.0 is Class B

11111111.11111111.11111111.11111100

Network bits.

Subnets: $2^{14} = 16,384$

Valid hosts: $2^{2} - 2 = 2$

Sample problem.

The network ID is 192.168.4.0 /24
Create three networks for my coffee shop (one for the office, one for the front desk, and one for public use).
List each network ID, the subnet mask, host ID range, number of usable host IDs, and broadcast ID.

STEP ONE: Build the table

SUBNET	1	2	4	8	16	32	64	128	256
HOST									
SUBNET MASK									

The top row is the number of subnets you want/need.
Remember the cafe owner said they needed **three.**

SUBNET	1	2	4	8	16	32	64	128	256
HOST	256	128	64	32	16	8	4	2	1
SUBNET MASK									

The middle row is the number of TOTAL host IDs for each subnet. Remember two of the host IDs are reserved so you should subtract 2 when calculating the number of valid hosts.

SUBNET	1	2	4	8	16	32	64	128	256
HOST	256	128	64	32	16	8	4	2	1
SUBNET MASK	/24	/25	/26	/27	/28	/29	/30	/31	/32

The bottom row is the subnet mask. Remember this is the number of 1-bits if you change it to binary.

SUBNET	1	2	4	8	16	32	64	128	256
HOST	256	128	64	32	16	8	4	2	1
SUBNET MASK	/24	/25	/26	/27	/28	/29	/30	/31	/32

STEP TWO:

Pick the column that has the correct number of subnets you need.
The cafe owner said they needed 3. There is no column that has 3, so we need to go up to 4. (Ex: if you needed 33, you'd have to go up to 64!)

SUBNET	1	2	4	8	16	32	64	128	256
HOST	256	128	64	32	16	8	4	2	1
SUBNET MASK	/24	/25	/26	/27	/28	/29	/30	/31	/32

STEP THREE:

Use the table to see how many total host IDs will be in each subnet (64).
How many valid host IDs will there be?

SUBNET	1	2	4	8	16	32	64	128	256
HOST	256	128	64	32	16	8	4	2	1
SUBNET MASK	/24	/25	/26	/27	/28	/29	/30	/31	/32

STEP THREE:

Use the table to see how many total host IDs will be in each subnet (64).

How many valid host IDs will there be?

64 - 2 = 62.

SUBNET	1	2	4	8	16	32	64	128	256
HOST	256	128	64	32	16	8	4	2	1
SUBNET MASK	/24	/25	/26	/27	/28	/29	/30	/31	/32

STEP FOUR:

Start filling out the answer table.

NETWORK ID	SUBNET MASK	HOST ID RANGE	# USABLE HOST IDs	BROADCAST ID
	/26		62	
	/26		62	
	/26		62	
	/26		62	

SUBNET	1	2	4	8	16	32	64	128	256
HOST	256	128	64	32	16	8	4	2	1
		/25	/26	/27	/28	/29	/30	/31	/32

Remember all the network bits are going to be the same! We can stick them into the three columns for now

STEP FOUR:

lling out the answer table.

NETWORK	SUBNET MASK	HOST ID RANGE	# USABLE HOST IDs	BROADCAST ID
192.168.4.	/26	192.168.4.	62	192.168.4.
192.168.4.	/26	192.168.4.	62	192.168.4.
192.168.4.	/26	192.168.4.	62	192.168.4.
192.168.4.	/26	192.168.4.	62	192.168.4.

SUBNET	1	2	4	8	16	32	64	128	256
HOST	256	128	64	32	16	8	4	2	1
SUBNET MASK	/24	/25	/26	/27	/28	/29	/30	/31	/32

For the network ID, just add the <u>total</u> number of hosts to get the first network ID of each subnet

NETWORK ID			LE HOST IDs	BROADCAST ID
192.168.4.0	/26		62	192.168.4.
192.168.4.64	/26	192.168.4.	62	192.168.4.
192.168.4.128	/26	192.168.4.	62	192.168.4.
192.168.4.192	/26	192.168.4.	62	192.168.4.

SUBNET	1	2	4	8	16	32	64	128	256
HOST	256	128	64	32				2	1
SUBNET MASK	/24	/25							

The broadcast ID is the last network ID in the range.

Start filling out

NETWORK ID	SUBNET MASK	HOST ID RANGE	# USABLE HOST IDS	BROADCAST ID
192.168.4.0	/26	192.168.4.	62	192.168.4.63
192.168.4.64	/26	192.168.4.	62	192.168.4.127
192.168.4.128	/26	192.168.4.	62	192.168.4.191
192.168.4.192	/26	192.168.4.	62	192.168.4.255

SUBNET	1	2	4	8	16	32	64	128	256
HOST	256	128	64	32				2	1
SUBNET MASK	/24	/25							

Host ID range is simply the hosts in between the network ID and broadcast ID

Start filling out

NETWORK ID	SUBNET	HOST ID RANGE	#	BROADCAST ID
192.168.4.0	/26	192.168.4.1 - 192.168.4.62	62	192.168.4.63
192.168.4.64	/26	192.168.4.65 - 192.168.4.126	62	192.168.4.127
192.168.4.128	/26	192.168.4.129 - 192.168.4.190	62	192.168.4.191
192.168.4.192	/26	192.168.4.193 - 192.168.4.254	62	192.168.4.255

The subnet mask table can be expanded…

a. Start with **1**, double until you reach **128** *(right to left)*

b. Subtract top row from **256**

c. From /32, list CIDR notation *(right to left)*

d. Continue on next row for 3rd octet *(right to left)*

128	**64**	**32**	**16**	**8**	**4**	**2**	**1**	Group Size
128	**192**	**224**	**240**	**248**	**252**	**254**	**255**	Subnet Mask
/25	**/26**	**/27**	**/28**	**/29**	**/30**	**/31**	**/32**	CIDR
/17	**/18**	**/19**	**/20**	**/21**	**/22**	**/23**	**/24**	3rd Octet

Practice more subnetting problems (and get really fast) here:
https://subnetipv4.com/

Scroll down to see an entire video series that explains how to get really good at subnetting problems (and the extended subnet table). I found this video series to be very helpful

How to calculate subnet mask...

PROBLEM:

What is the subnet mask if the IP address is 27.37.57.239/25?

1. Find out how many bits are left over for the host. Take 32 minus the "slash number"; in this case, the "slash number" is 25.

32 - 25 = 7

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1a. Perform 2 ^ x. Here, x = 7, from step 1.

2^7 = 128

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1b. Subtract 2 to see how many possible hosts could be in the network.

128 - 2 = 126. 126 possible hosts.

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2. In this problem, no more calculation is necessary. The answer would actually be that from 1a (128). The subnet mask would then be 255.255.255.128.

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PROBLEM:

We have two IP addresses: 8.8.8.129/27 and 8.8.8.7/27. Are they on the same subnet?

1. Find out how many bits are left for the host. 32 - 27 = 5.
1a. Perform 2^x, where x = 5 (the answer from 1). 2^5 = 32.
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2. Divide 256/the result from 1a. 256/32 = 8.
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3. Split up the (decimal) numbers from 0 - 256 into 8 equal ranges (zero is included!)

0 - 31 -> 8.8.8.7 belongs here, because 7 is between 0 and 31
32 - 63
64 - 95
96 - 127
128 - 159 -> 8.8.8.129 belongs here, because 129 is between 128 and 159
160 - 191
192 - 223
224 - 255
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4. Compare the two given IP addresses. Check to see if the host bits fall into the same range. We can see from step 3 that 8.8.8.7 and 8.8.8.129 do NOT fall into the same range, therefore they are NOT on the same subnet.

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PROBLEM:

We have been assigned:
- IP network: 192.1.1.0/24
- 20 computers need IP addresses (in NYC)
- 20 computers need IP addresses (in SF)
- 2 routers, 1 WAN link