So first, let’s take an example from 2013 finals Q6a:

10.11.64.41

10.11.64.43

10.11.64.40

10.11.64.42

Find the smallest subnet mask and corresponding network and broadcast addresses

Step 1:

**Identify the different octet among all IPs.**

First octet: All 10

Second octet: All 11

Third octet: All 64

So the odd one out is the fourth octet (we will call this the “critical octet” for now)

Step 2:

**Convert the critical octets to binary.**

40 = 00101000

41 = 00101001

42 = 00101010

43 = 00101011

Step 3:

**Identify a subnet mask that will make all the critical octets same after an AND operation.**

As can be seen above, bits 1 to 6 are all similar, so place 0’s starting from bit 7 onwards, place 1’s for bits 1 to 5.

Mask = 11111100

\*\* Remember that a subnet mask will only have consecutive 1’s, a mask like 11110001 is impossible. Therefore once you start a 0, the rest will remain 0.

Step 4:

**Check the number of available hosts for the chosen mask.**

The number of available hosts can be calculated using 2number of 0’s in in subnet mask - 2 (minus 2 because of network and broadcast addresses)

Therefore in this case, it is 22 - 2 = 2. This is obviously not enough since we need at least 4 hosts.

Step 5:

**If number of available hosts is sufficient, the answer is found. But if insufficient, reduce the number of 1’s (in the subnet mask critical octet) by 1 and try again.**

So the new mask is 11111000, number of hosts is 23 - 2 = 6, should be sufficient. BUT we need an extra check by AND-ing the smallest and largest IP with the subnet mask to determine the network address (critical octet will do).

40 : 00101000 AND 11111000 = 00101000 = 40

43 : 00101011 AND 11111000 = 00101000 = 40

*Houston, we have a problem*

The network address is the same as the smallest IP, which is not good. Therefore we have to reduce another 1 from the mask, becoming 11110000, number of hosts, 24 - 2 = 14.

40 : 00101000 AND 11110000 = 00100000 = 32

43 : 00101011 AND 11110000 = 00100000 = 32

We found our subnet mask, which is 240 for the fourth octet. The full subnet mask notation will be 255.255.255.240 (fill the first to third octets with 1’s)

Step 6:

**Network and broadcast addresses.**

As we found out above, the network address is 10.11.64.32

To determine the broadcast address, just do a bitwise NOT for the subnet mask and OR it with the network address:

10.11.64.32 (00100000 for the fourth octet) OR 0.0.0.15 (00001111 for the fourth octet)

Giving us 10.11.64.47 (00101111 for the fourth octet)

Extra:

To find out the number of available subnets, use this formula 2number of 1’s in critical subnet mask octet

What’s the big deal with all the 1’s and 0’s? Well taking 255.255.255.240 as an example, convert it to binary:

11111111.11111111.11111111.11110000

Network part (borrowed)

Host part

Number of subnets = 24 = 16

Number of hosts = 24 - 2 = 14

For 255.240.0.0

11111111.11110000.00000000.00000000

Network part (borrowed)

Host part

Number of subnets = 24 = 16

Number of hosts = 220 - 2 = 1048574

So what’s the “/” thingy in CIDR notation? For instance, 10.11.64.32/28, this means that there are 28 1’s in the subnet mask, giving us 11111111.11111111.11111111.11110000, which equals to 255.255.255.240