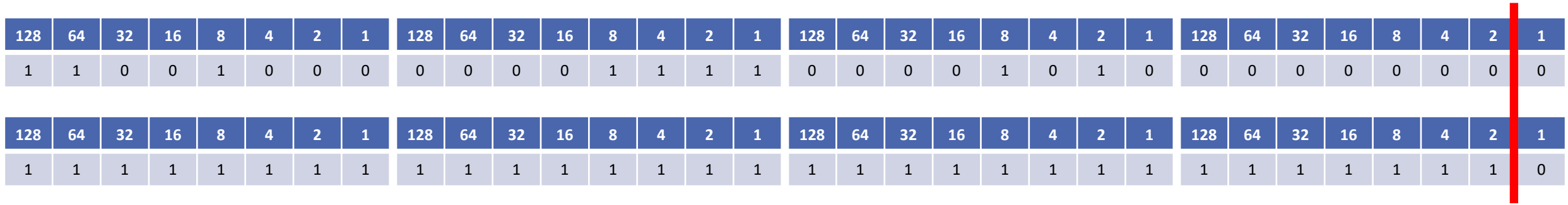
Class C /31 Subnet

- Let's say we've been allocated Class C 200.15.10.0/24



128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

- If we move the line all the way to the right we're now using /31 (or 255.255.255.254)
- This leaves one bit for the host address, with a possible value of 0 or 1
- It borrows 7 bits for the network address
- This gives us 128 subnets (2^7) which accommodate 2 hosts each

Class C /31 Subnet

- Let's say we've been allocated Class C 200.15.10.0/24.

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

- We subnet using /31. Valid host addresses:
  - 200.15.10.0 to 200.15.10.1
  - 200.15.10.2 to 200.15.10.3
  - Etc., to:
  - 200.15.10.254 to 200.15.10.255

But Wait!

- Let's say we've been allocated Class C 200.15.10.0/24.

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

- What about the network and broadcast address?!
- /31 breaks the standard rules of IP addressing.
- /31 subnets are supported on Cisco routers for point to point links (which have no need for a network or broadcast address.)

Class C /30 Subnet

- Let's say we've been allocated Class C 200.15.10.0/24

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0

- Let's move the line back a place. We're now using /30 (or 255.255.255.252)
- This leaves 2 bits for the host address, $2^2 = 4$, minus 2 for the network and broadcast address = 2 possible hosts
- It borrows 6 bits for the network address
- This gives us 64 subnets (2^6) which accommodate 2 hosts each

Class C /30 Subnet

- Notice that the line is after the 4. The network address goes up in values of 4.

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0

- Valid host addresses:
  - 200.15.10.1 to 200.15.10.2 (network .0, broadcast .3)
  - 200.15.10.5 to 200.15.10.6 (network .4, broadcast .7)
  - Etc., to:
  - 200.15.10.253 to 200.15.10.254 (network .252, broadcast .255)

/31 vs /30

- /31 and /30 both accommodate 2 hosts per subnet
- /31 supports 128 subnets, /30 only 64
- /31 is useful if you need to maximise use of your address space
- /30 is more standard and commonly used
- **For the CCNA exam, use /30 when a subnet to support 2 hosts is required, unless told to use /31**

Class C /29 Subnet

- Let's say we've been allocated Class C 200.15.10.0/24

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0

- Let's move the line back a place. We're now using /29 (or 255.255.255.248)
- This leaves 3 bits for the host address, 2^3 minus 2 = 6 possible hosts
- It borrows 5 bits for the network address
- This gives us 32 subnets (2^5) which accommodate 6 hosts each

Class C /29 Subnet

- Notice that the line is after the 8. The network address goes up in values of 8.

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	0	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0

128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0

- Valid host addresses:
  - 200.15.10.1 to 200.15.10.6 (network .0, broadcast .7)
  - 200.15.10.9 to 200.15.10.14 (network .8, broadcast .15)
  - Etc., to:
  - 200.15.10.249 to 200.15.10.254 (network .248, broadcast .255)

Other Class C Subnet Masks

- We can carry on moving the line back a place

- /28 (or 255.255.255.240) = 16 networks of 14 hosts each
- /27 (or 255.255.255.224) = 8 networks of 30 hosts each
- /26 (or 255.255.255.192) = 4 networks of 62 hosts each
- /25 (or 255.255.255.128) = 2 networks of 126 hosts each
- /24 (or 255.255.255.0) = 1 network of 254 hosts

Variable Length Subnet Masks VLSM

- Early routing protocols only supported Fixed Length Subnet Masking (FLSM) where all subnets had to be the same size. You couldn't have a subnet with 14 hosts and another subnet with 64 hosts in the same network.
- All modern routing protocols support Variable Length Subnet Masking. This allows us to size subnets differently according to how many hosts they have.