Subnet Mask

Dr. Kiran M
IT Dept., NITK

Previous Session

- Different Classes of IP address.
  - Class A 1.0.0.0 to 126.0.0.0.
  - Class B 128.0.0.0 - 191.225.0.0
  - Class C 192.0.0.0 - 223.255.255.0
  - Class D 224.0.0.0 - 239.255.255.255
  - Class E 240.0.0.0 - 255.255.255.255
- Why Different Classes?
  - Some need more networks and less systems in the each networks.
  - Others need more systems in a network and less number of networks.
- @NITK : We need more networks (LANs in each department and offices) and less number of systems in each LAN.

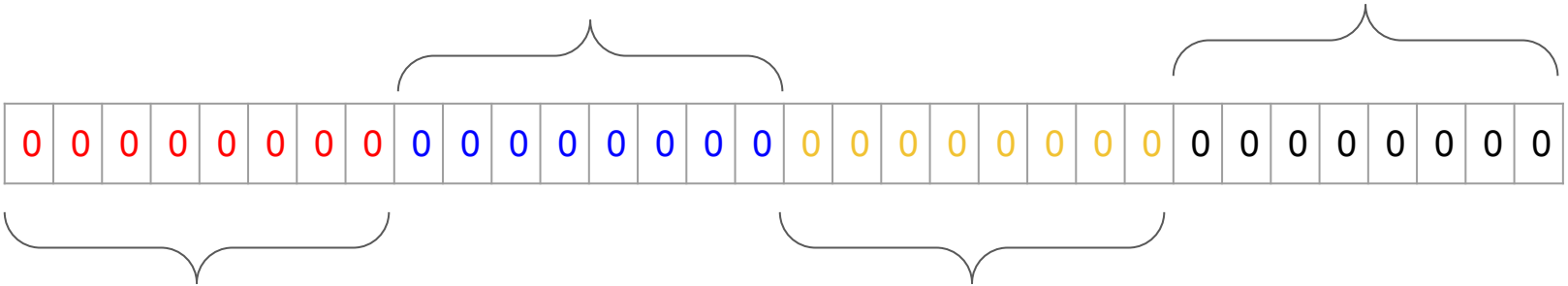
Subnet Masking

- When a packet comes @ router
  - Router has to find out where the received packet should be forwarded.
  - Which is the nearest path to reach the destination network ?
  - Remember
    - @ Network layer Network will be identified.
    - @ DLL Individual System will be identified with in the network..
- Used by the router.
- Used to bifurcate network address and host address in a given IP address.

Subnet Masking Example

10.0.0.1

8 Bit. 8Bit . 8Bit . 8 Bit



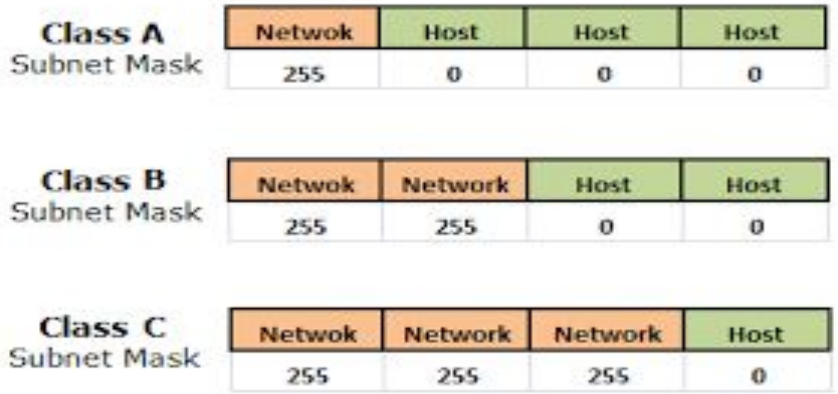
8 bit	7 bit	6 bit	5 bit	4 bit	3 bit	2 bit	1 bit
128	64	32	16	8	4	2	1

10.0.0.1 Binary Version

0	0	0	0	0	0	0	0	
128	64	32	16	8	4	2	1	
0	0	0	0	1	0	1	0	10
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1

0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Subnet Mask for Different Classes of IP Address



10.0.0.1 - Class A IP Address - 255.0.0.0

Image Source: Internet

255.0.0.0 Binary Version

0	0	0	0	0	0	0	0	
128	64	32	16	8	4	2	1	
1	1	1	1	1	1	1	1	255
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0

1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

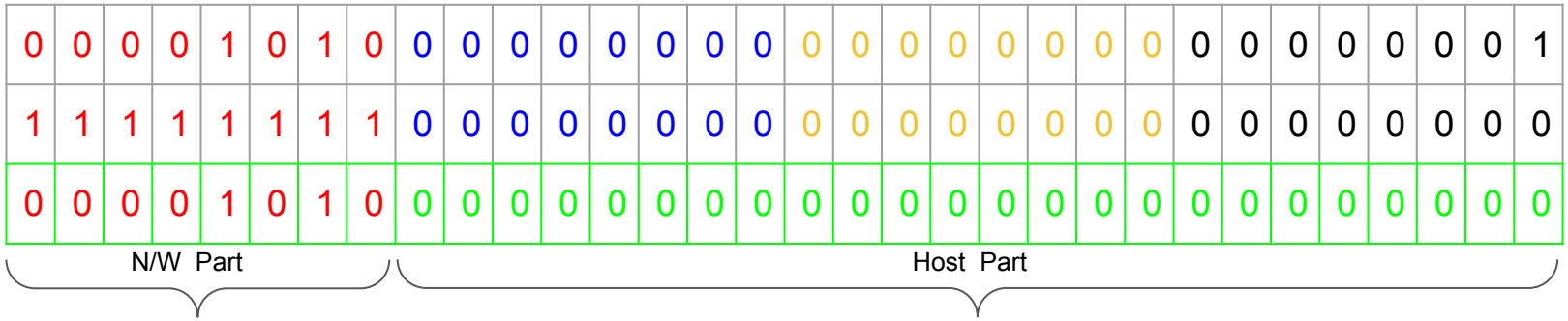
Binary AND Operation of IP and Subnet Mask

0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

10.0.0.1

255.0.0.0

Binary AND Operation of IP and Subnet Mask



10.0.0.1

255.0.0.0

8 bit	7 bit	6 bit	5 bit	4 bit	3 bit	2 bit	1 bit
128	64	32	16	8	4	2	1
0	0	0	0	1	0	1	0

10.0.0.0

Another Example

- Sow how router extracts network address from 216.3.128.28
- Class C Address
- 255.255.255.0 - Subnet Mask

216.3.128.28 Binary Version

0	0	0	0	0	0	0	0	
128	64	32	16	8	4	2	1	
1	1	0	1	1	0	0	0	216

128 + 64 + 16 + 8 = 216

1	1	0	1	1	0	0	0																			

216.3.128.28 Binary Version

0	0	0	0	0	0	0	0	
128	64	32	16	8	4	2	1	
1	1	0	1	1	0	0	0	216
0	0	0	0	0	0	1	1	3

1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	1												

216.3.128.28 Binary Version

0	0	0	0	0	0	0	0	
128	64	32	16	8	4	2	1	
1	1	0	1	1	0	0	0	216
0	0	0	0	0	0	1	1	3
1	0	0	0	0	0	0	0	128

1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0							

216.3.128.28 Binary Version

0	0	0	0	0	0	0	0	
128	64	32	16	8	4	2	1	
1	1	0	1	1	0	0	0	216
0	0	0	0	0	0	1	1	3
1	0	0	0	0	0	0	0	128
0	0	0	1	1	1	0	0	28

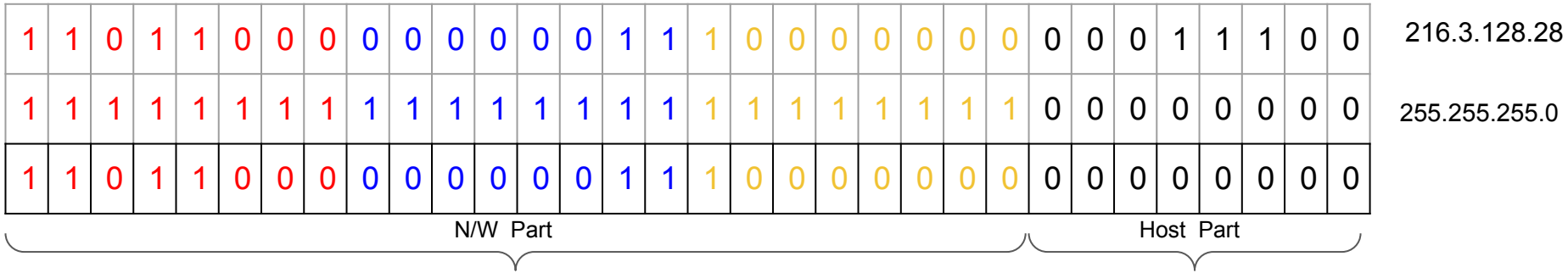
1	1	0	1	1	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0

255.255.255.0 Binary Version

0	0	0	0	0	0	0	0	
128	64	32	16	8	4	2	1	
1	1	1	1	1	1	1	1	255
1	1	1	1	1	1	1	1	255
1	1	1	1	1	1	1	1	255
0	0	0	0	0	0	0	0	0

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	0	0	0	0	0

Binary AND Operation of IP and Subnet Mask

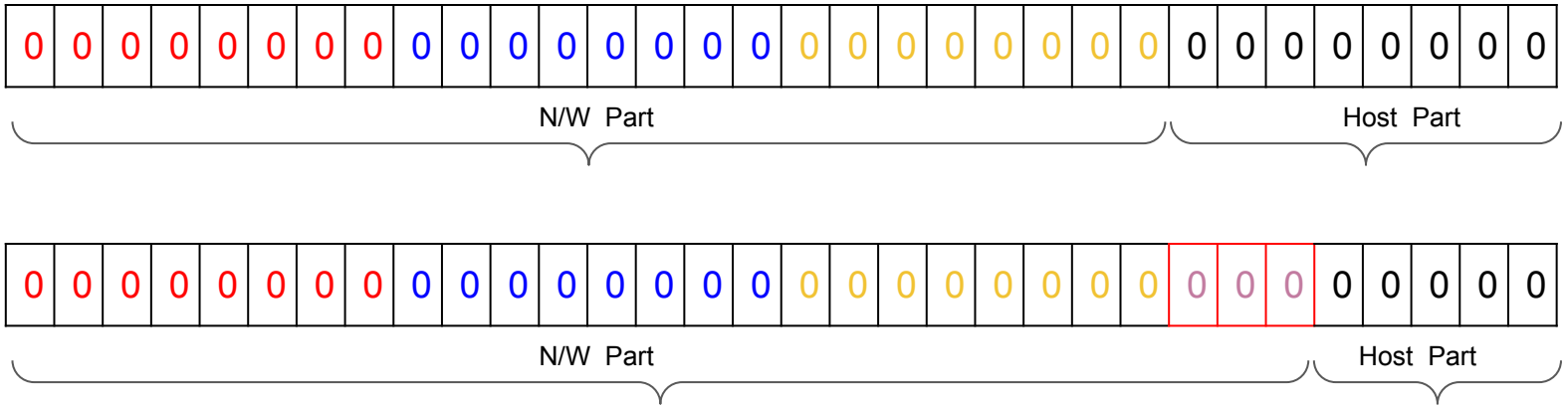


216.3.128.0

Class C - 192.0.0.0 to 223.255.255.0

- Small Scale Networks (LANs)
- It supports total 2,097,150 networks.
- Total Systems/Hosts per network - 254
- Subnet Mask
  - 255.255.255.0
- What if I need another 200 more networks ?
  - 20,97,150 + 100 = 20,97,350

- What if, if I need another 200 networks in Class C?
  - 20,97,150 + 200 = 20,97,350
- Borrow some bits from the host part.



- If I borrow the host bits,
  - The number of systems in each network reduces.
- We can reduce the number of systems in each LAN and increase the no. of networks accordingly.
- Class Less Inter Domain Routing (CIDR)

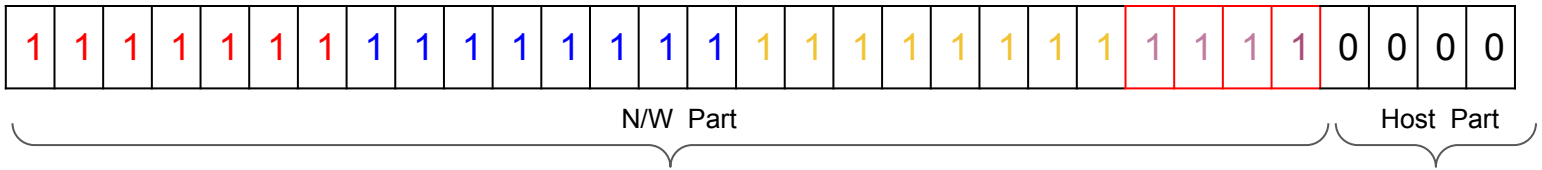
216.128.3.0/28 - CIDR

216. 128. 3. 0 / 28

N/W Address

8 + 8 + 8 = 24

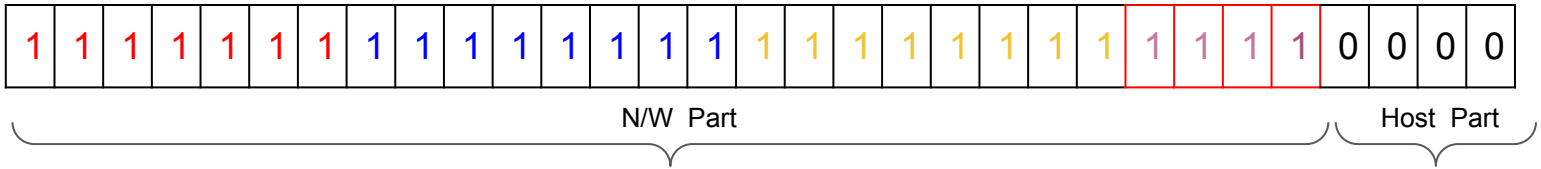
Remaining 4 Bits are borrowed from host part to make 28 bits.



What about the Subnet Mask ?

No class is followed

Hence, 255.255.255.0 can not be used, though the address is an Class C address



255.255.255. (128 + 64 + 32 + 16)

255.255.255.240

216.128.3.0/28

How many additional networks are possible ?

How many IP addresses is possible in each network ?

- 2^n total additional Networks are possible
  - where n is the total no. of bits borrowed.
- 2^n total systems can be connected in each network
  - where n is the total no. remaining bits in the host part.

- 2^n total additional Networks are possible
  - Bits borrowed - 4
  - 2^4 - 16 networks
- 2^n total hosts possible in each network
  - Bits remaining in host part - 4
  - 2^4 - 16 systems in each network.

- 2^n total IP Address (host) possible in each network
  - Bits remaining in host part - 4
  - 2^4 - 16 host in each network.
- How ?

We can use only 14 Addresses in each network.

0 0 0 0 Network Address
0 0 0 1
0 0 1 0
0 0 1 1
0 1 0 0
0 1 0 1
0 1 1 0
0 1 1 1
1 0 0 0
1 0 1 0
1 0 1 1
1 1 0 0
1 1 0 1
1 1 1 0
1 1 1 1 Broadcast Address