

# Internet Protocol Subnets

COMP476

## Internet Addresses

- An Internet Address is composed of two parts, a netid and a hostid.
- The hostid identifies the particular host on a network.
- The netid identifies the network where the host is connected.
- A computer physically connected to two networks needs two Internet addresses.

## Internet Address Classes

class				
A	NetID	hostID	hostID	hostID
B	NetID	NetID	hostID	hostID
C	NetID	NetID	NetID	hostID

## IP Routing Procedure

Assume computer **A** wants to send one datagram to computer **B**

1. **A** sends a DNS request to the local Domain Name Server asking for the IP address of **B**.
2. The DNS sends the IP address of **B** to **A**.
3. The netid portion of **A**'s IP address is compared with the netid portion of **B**'s IP address.

4. If the netid of the sender and receiver are the same, then the destination is on the same network. **A** can send the packet directly to **B**.
5. If the netids are different, **A** must send the packet to the gateway.
6. The gateway will forward the packet to another gateway that is closer to the destination's domain.
7. The gateway at the destination's domain will send the frame to **B**

## Subnet Masks

- To separate the local host's NetID, the IP address can be logically ANDed with bit mask that has 1 bits for the NetID and 0 bits for the HostID.

class A	255. 0 . 0 .0
class B	255.255. 0 .0
class C	255.255.255.0

## Source Address Netid

152.8.251.41 source IP address

10011000.00001000.11111011.00101001  
 AND 11111111.11111111.00000000.00000000  
 10011000.00001000.00000000.00000000

## Destination Address Netid

15.181.0.31 destination IP address

00001111.10110101.00000000.00011111  
 AND 11111111.11111111.00000000.00000000  
 00001111.10110101.00000000.00000000

The results are different so the datagram must be sent to the gateway.

## Hierarchical Routing

- The Internet Protocol routes IP datagrams to the destination domain or network.
- Once a packet arrives in the destination network, it is assumed that the packet will find its way to the destination host over bridges and repeaters.

## IP Subnets

- Internet Protocol Subnets is a method of dividing a large domain into smaller subdomains.
- Packets are routed following the same rules used for domains.
- Some of the bits of the HostID are used locally as an extension of the NetID.
- The world still routes packets by the usual NetID, but locally the NetID is extended to create sub-domains

## Extending the NetID

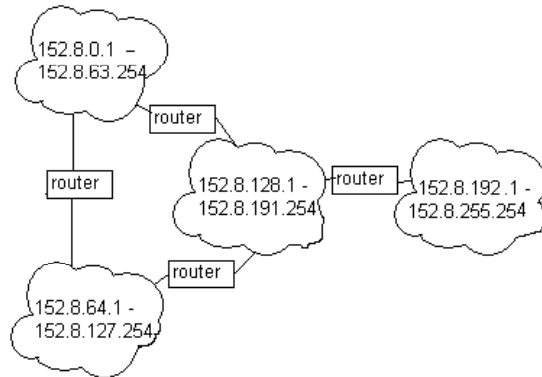
- A domain can be physically separated into multiple subdomains.
- Subdomains are connected by routers.
- For N subdomains,  $\log_2 N$  upper bits of the HostID are locally used with the NetID.
- All IP addresses in a physical subdomain must have the same  $\log_2 N$  upper bits.

## subnet mask for 4 class B sub-domains

255.255.192.0 =  
11111111.11111111.11000000.00000000

Two bits of the Hostid portion of the address are used to separate the subnets.

## Example Subnet



## 152.8.251.41 to 152.8.244.21

152.8.251.41 source IP address

```

10011000.00001000.11111011.00101001
AND 11111111.11111111.11000000.00000000
10011000.00001000.11000000.00000000
  
```

## 152.8.251.41 to 152.8.244.21

152.8.244.21 destination IP address

```

10011000.00001000.11110100.00010101
AND 11111111.11111111.11000000.00000000
10011000.00001000.11000000.00000000
  
```

The results of the two ANDs are identical.  
The destination is in the same subdomain.

## Example 152.8.251.41 to 152.8.47.14

152.8.251.41 source IP address

```

10011000.00001000.11111011.00101001
AND 11111111.11111111.11000000.00000000
10011000.00001000.11000000.00000000
  
```

## Example 152.8.251.41 to 152.8.47.14

152.8.47.14 destination IP address

```

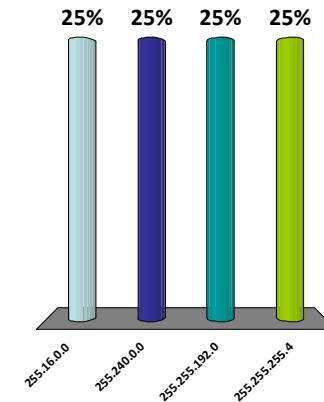
10011000.00001000.00101111.00001110
AND 11111111.11111111.11000000.00000000
10011000.00001000.00000000.00000000

```

The results of the two ANDs are different.  
The destination is in another subdomain.

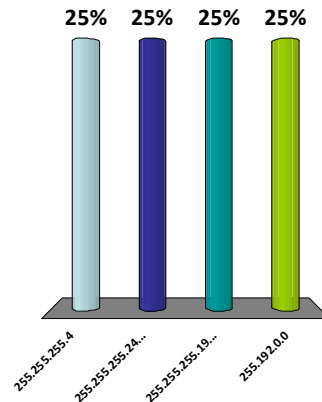
## What is the subnet mask for a Class A network with 16 subnets?

1. 255.16.0.0
2. 255.240.0.0
3. 255.255.192.0
4. 255.255.255.4



## What is the subnet mask for a Class C network with 4 subnets?

1. 255.255.255.4
2. 255.255.255.240
3. 255.255.255.192
4. 255.192.0.0



## CIDR addresses

- The division between NetID and HostID can be expressed explicitly using the Classless Inter-Domain Routing (CIDR) notation.
- IP addresses can be written in the usual dotted notation followed by a slash and the number of bits to be used for the NetID.

152.8.108.138/22