

### Routing Table @ R1

Dest.	Mask.	Next-hop	Interface
129.186.205.13	/32	129.186.205.13	#1
129.186.0.0	/16	129.187.0.2	#2
0.0.0.0	/0	129.188.0.2	#3
(default entry)			

E.g.

129.186.205.13  
in IP pkt header

matches entry #1, #2, #3  
pick #1  
(Longest Prefix Match)

129.186.200.3

matches entry #2, #3  
pick #2

192.168.33.45

private IP address  
so: discard it

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## Routing Table

✦ Routing table is searched in the following order:

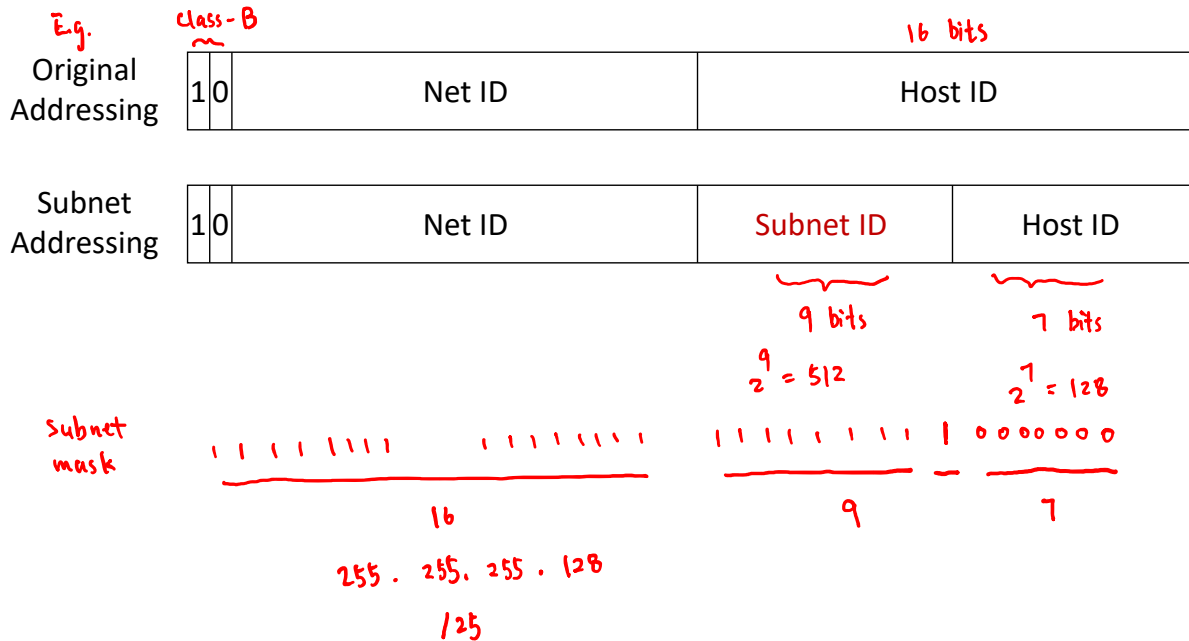
- Longest Prefix Match {
1. Whether the destination IP address appears in one of the table entries (1/32)
  2. Whether the destination network address appears in one of the table entries (with help of network mask)
  3. The default router entry
  4. If none of above searches is successful, declare packet undeliverable, send ICMP "Host Unreachable Error" packet back to the sender

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## Subnet Addressing

- Subnet addressing introduces another hierarchical level

Part of original "Host ID" becomes "Subnet ID"

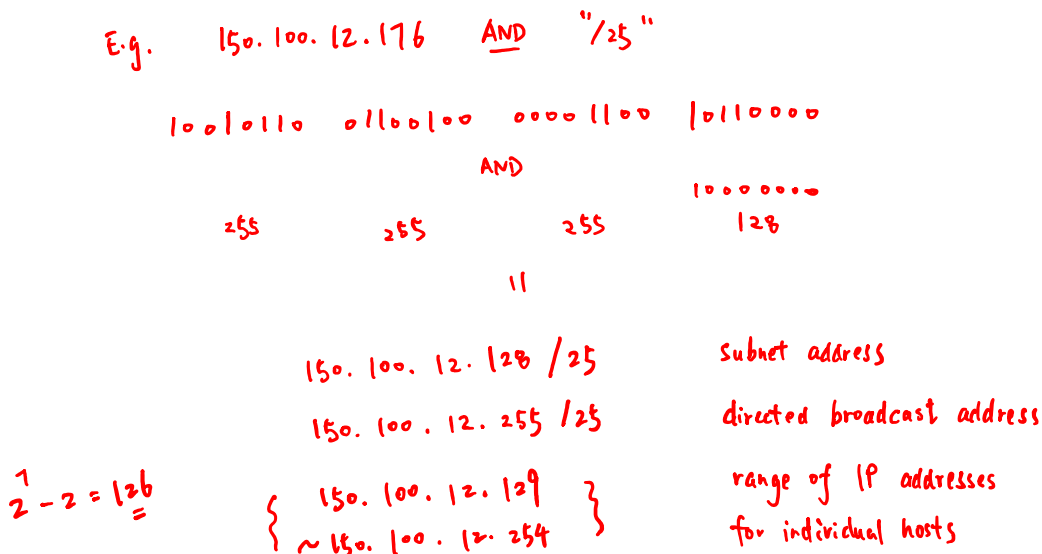


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## Subnet Addressing

- Subnet addressing introduces another hierarchical level

subnet address = IP address AND subnet mask

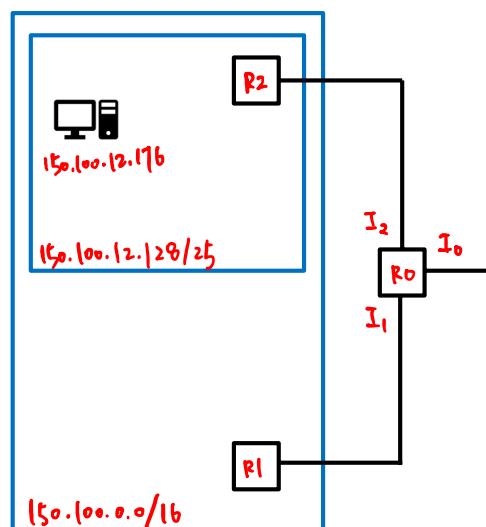


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## Subnet Example

- ✦ Organization is assigned a Class B address block (16 host ID bits) with network ID: **150.100**
- ✦ Create subnets with up to 100 hosts each
  - 7 bits host id sufficient for each subnet
  - $16 - 7 = 9$  bits can be used for subnet ID
- ✦ Apply subnet mask to IP addresses to find the corresponding subnet
  - Example: Find subnet for **150.100.12.176**
    - IP address = **10010110 01100100 00001100 10110000**
    - Mask = **11111111 11111111 11111111 10000000**
    - IP Address & Mask = **10010110 01100100 00001100 10000000**
    - Subnet = **150.100.12.128**
  - Subnet addresses are used by routers within the organization

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### Routing Table @ R0

Dest.	Mask	Next-hop	Interface
150.100.0.0	/16	R1	I1
150.100.12.128	/25	R2	I2
⋮			

E.g.

150.100.12.176 matches #1, #2  
pick #2  
Longest Prefix Match

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150.100.12.128/25 for department #1

1xxxxxx

overlap ↑↓

150.100.12.192/26 for department #2

11xxxxxx ← invalid

01xxxxxx ← valid

150.100.12.64/26

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Rules for Subnetting:

- ① Subnets shall be specified using subnet address and subnet mask
- ② Subnets may have different sizes
- ③ If assigned to different departments, subnets shall not overlap
- ④ One department may be assigned multiple subnets

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E.g.

200.55.66.0 /24 Class-C Address Space

$\underbrace{11001000}_{\text{class C}} \underbrace{0011011101000010}_{\text{netid}} \underbrace{00000000}_{\text{hostid}}$

$$\left. \begin{array}{l} 2^6 - 2 = 62 \\ 2^5 - 2 = 30 \end{array} \right\} 92 > 90$$

↓

D1: 90 hosts  
 $2^7 - 2 = 126 > 90$

$0xxxxxxx$   
 $=$   
 $200.55.66.0/25$

$\Rightarrow \left\{ \begin{array}{l} 00xxxxxx \\ 010xxxxx \\ 011xxxxx \end{array} \right.$

$200.55.66.0/26 \}$  D1  
 $200.55.66.64/27$   
 $200.55.66.96/27$

D2: 60  
 $2^6 - 2 = 62 > 60$

$10xxxxxx$   
 $=$   
 $200.55.66.128/26$

D3: 60  
 $2^6 - 2 = 62 > 60$

$11xxxxxx$   
 $=$   
 $200.55.66.192/26$

D3: 60 → 90

D3

$200.55.66.192/26 \}$  D3  
 $200.55.66.96/27$