

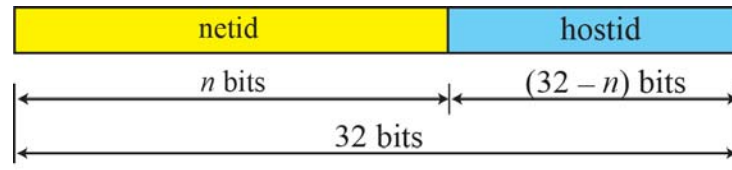
EE981 Network Switching & Routing

Kashif Sharif

Address Allocation

The range of addresses allocated to an organization in classfull addressing was a block of addresses in Class A, B, or C.

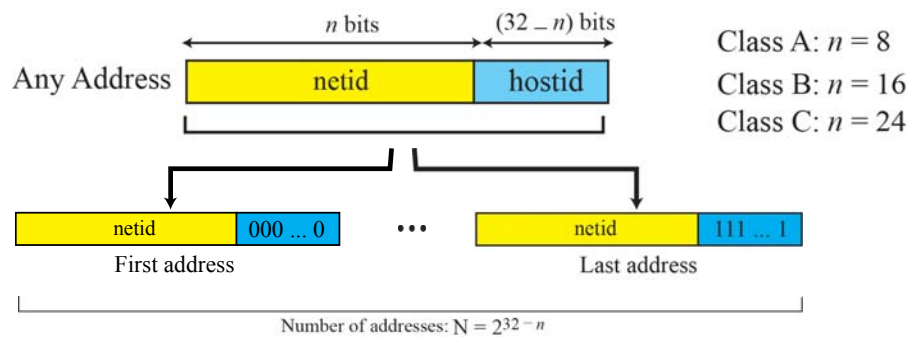
IP Address



Class A: $n = 8$
Class B: $n = 16$
Class C: $n = 24$

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IP Address



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Question

- An address in a block is given as **73.22.17.25**
 - Find the number of addresses in the block,
 - The first address, and
 - The last address.

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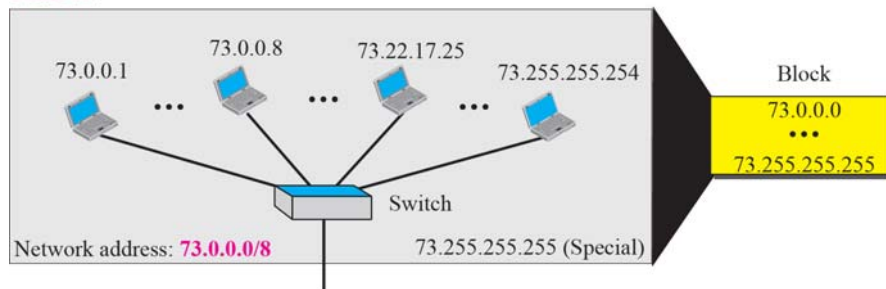
Answer

- Address belongs to a block in class A
 - 73.X.X.X
 - Number of addresses: $2^{24} = 16,777,216$
- First Address: 73.0.0.0
- Last Address: 73.255.255.255

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Network of 73.0.0.0/8

Netid 73: common in all addresses



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Question

- An address in a block is given as **180.8.17.9**
 - Find the number of addresses in the block,
 - The first address, and
 - The last address.

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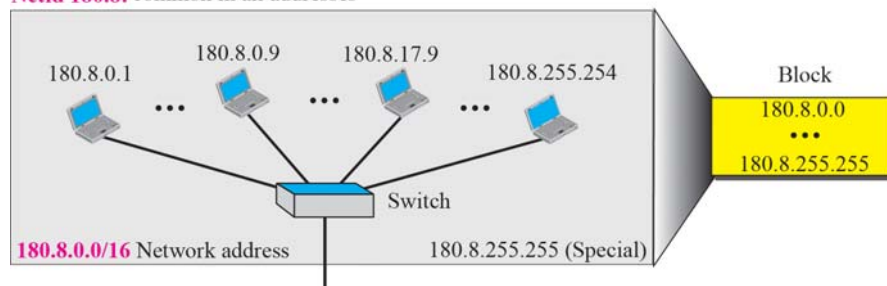
Answer

- Address belongs to a block in class B
 - 180.8.X.X
 - Number of addresses: $2^{16} = 65,536$
- First Address: 180.8.0.0
- Last Address: 180.8.255.255

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Network of 180.8.0.0/16

Netid 180.8: common in all addresses



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Question

- An address in a block is given as **200.11.8.45**
 - Find the number of addresses in the block,
 - The first address, and
 - The last address.

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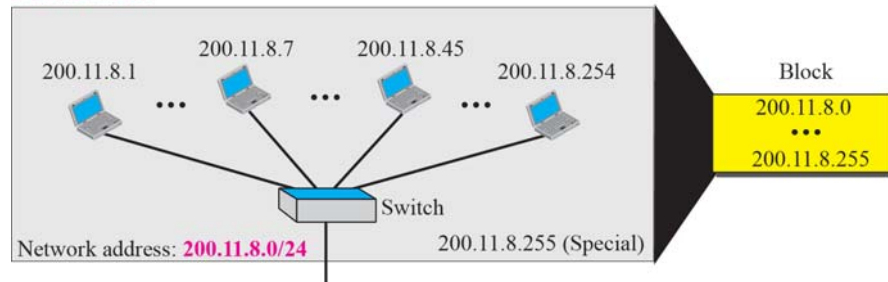
Answer

- Address belongs to a block in class B
 - 200.11.8.X
 - Number of addresses: $2^8 = 256$
- First Address: 200.11.8.0
- Last Address: 200.11.8.255

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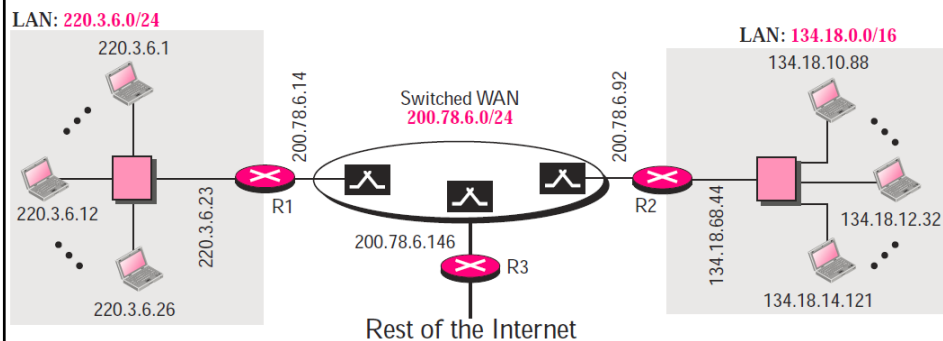
Network of 200.11.8.0/24

Netid **200.11.8**: common in all addresses



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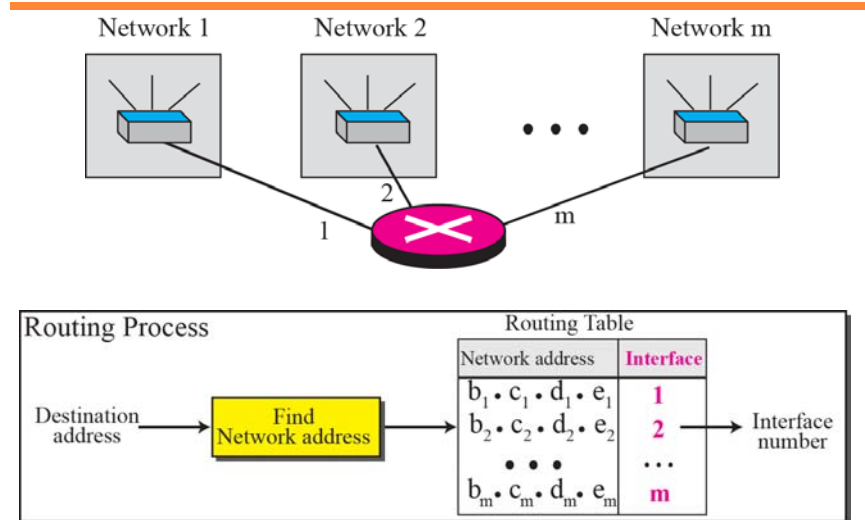
Sample Internet



The Network Address is the Identifier of a Network.

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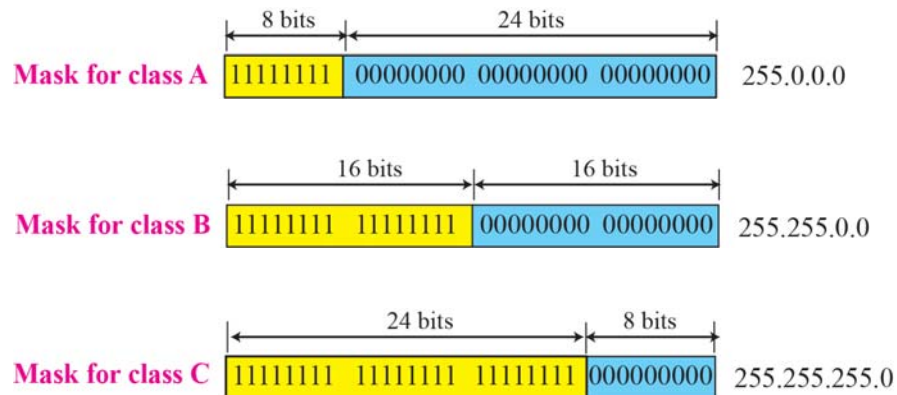
Network Address



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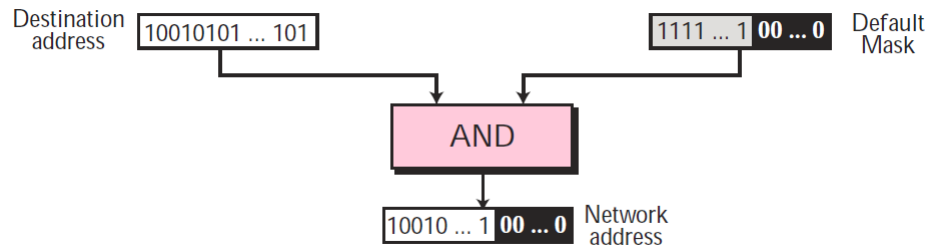
Network Mask

Network mask is important to extract network ID from an IP address.



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Extracting Network Address



Destination address	→	201	.	24	.	67	.	32
Default mask	→	255	.	255	.	0	.	0
Network address	→	201	.	24	.	0	.	0

17

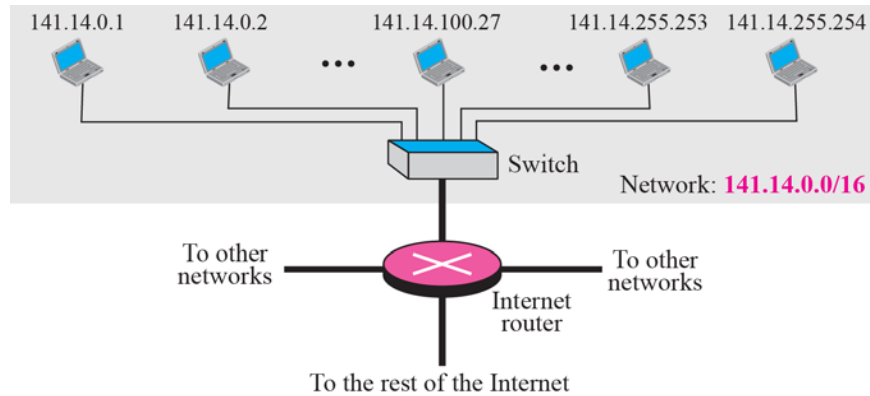
Levels of Addressing

- **Two-Level Addressing**
 - Network ID – Host ID

- **Three-Level Addressing**
 - Network ID – Subnet ID – Host ID

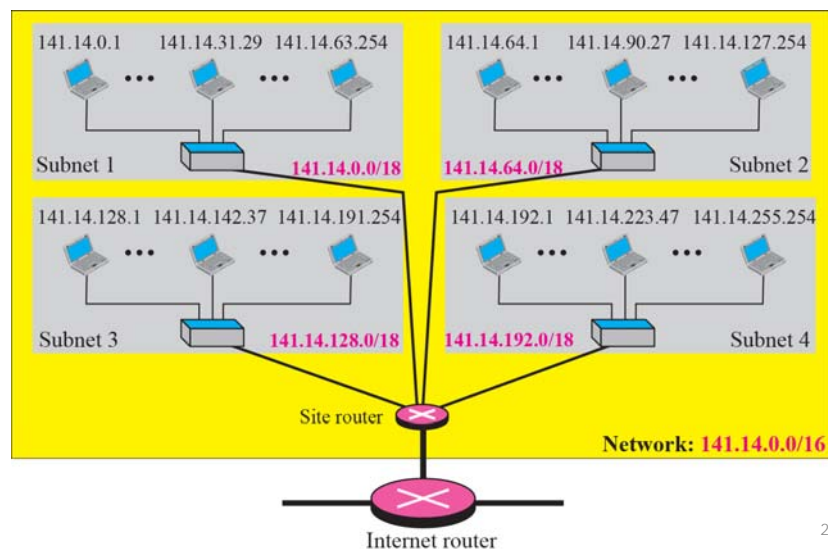
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Subnetting: Single Network 141.14.0.0/16



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Subnetting: Four Sub-Networks /16 /18



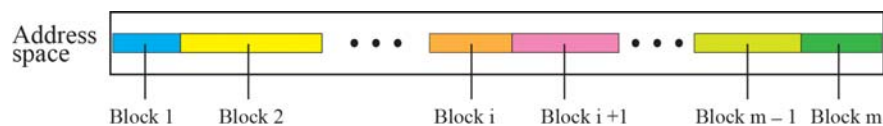
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Classless Architecture

- Wastage of IP address is a massive problem
 - Fixed length blocks of classfull architecture
- Classless Architecture introduces variable length blocks

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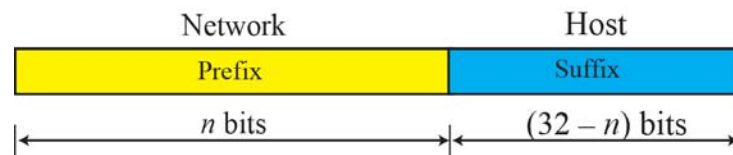
Variable Length Blocks



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Variable Length Blocks

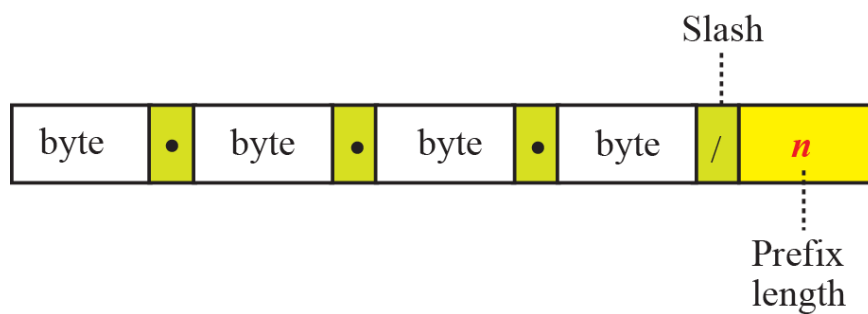
In classless addressing, the prefix defines the network and the suffix defines the host.



The prefix length in classless addressing can be 1 to 32.

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Representing Classless Addresses



In classless addressing, we need to know one of the addresses in the block and the prefix length to define the block.

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Question

230.8.24.56

belongs to which block?

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Answer: Possible Blocks

Prefix length:16	→	Block:	230.8.0.0	to	230.8.255.255
Prefix length:20	→	Block:	230.8.16.0	to	230.8.31.255
Prefix length:26	→	Block:	230.8.24.0	to	230.8.24.63
Prefix length:27	→	Block:	230.8.24.32	to	230.8.24.63
Prefix length:29	→	Block:	230.8.24.56	to	230.8.24.63
Prefix length:31	→	Block:	230.8.24.56	to	230.8.24.57

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Examples

- Address 12.23.24.78/8
 - Network mask is 255.0.0.0
 - Mask has eight 1s and twenty-four 0s
 - Prefix length is 8; suffix length is 24
- Address 130.11.232.156/16
 - Network mask is 255.255.0.0
 - Mask has sixteen 1s and sixteen 0s
 - Prefix length is 16; suffix length is 16
- Address 167.199.170.82/27
 - Network mask is 255.255.255.224
 - Mask has twenty-seven 1s and five 0s
 - Prefix length is 27; suffix length is 5

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IP Subnetting

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IP Subnetting

- Ability to divide the Host part of IP into smaller groups
- Groups referred to as subnets
- Need:
 - Separation of concern
 - Policy based control
 - Flow and information control

Decision to create subnets is based on infrastructure, operational and Policy requirements.

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IP Subnetting

- Subnetting is always driven by the requirements
- Q: How many sub-networks are required?
- Q: How many hosts in each subnet are needed?
- Sub-netting can be performed on class full address or class less addresses.

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Network Mask

- Network Mask is used to extract the prefix/network part of the IP address.
- A mask contains all 1's as the prefix and 0's as host part
- e.g.
 - Class C network Mask
 - 11111111111111111111111111111111100000000
 - 255.255.255.0
 - 151.33.65.88/17
 - 1111111111111111111110000000000000000
 - 255.255.128.0

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IP Subnetting

- Division of postfix into two parts
- E.g.
- You ISP allocates you the following address
 - Network IP: 151.33.128.0/17
 - Network mask: 255.255.128.0

Binary Representation

100111010001000110000000000000000

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IP Subnetting

- Postfix divided into 2 parts
 - Bits representing subnets
 - Bits representing hosts in each subnet
- E.g. 5 bits of subnet part
 - 100111010001000110000000000000000
- Possible subnets: $2^5 = 32$ (RFC 1878)
- Possible hosts per subnet: $2^{10} - 2$
 - Network and Broadcast address
 - IP addresses wasted

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IP Subnetting

- The mask changes based upon the subnet bits
 - New mask inside the AS will include the subnet bits as 1's
 - Host bits remain zero
- Every subnet will be identified by its first address
- Broadcast address for every subnet is all 1's in host part only

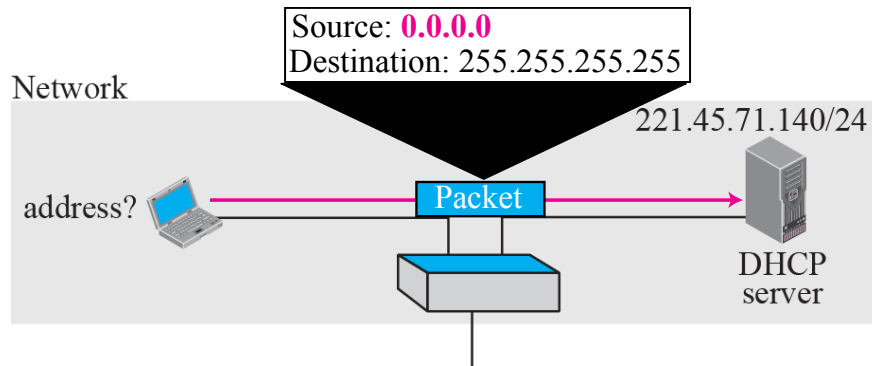
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Example

- You are hired as the CTO of AngryBee Technologies. You have now an IP address of 151.33.128.0/17
- You are tasked with subdividing the address to isolate different departments and their devices.
- Initial investigation suggests that there are 25 departments, and on average there are 700 nodes requiring IP addresses. But Warehouse (Dept. No. 3) and Customer Support (Dept. No. 4) have 1115 and 4190 nodes respectively.
- How will you subnet? Show subnet address ranges, Subnet masks, and Broadcast address for each department.

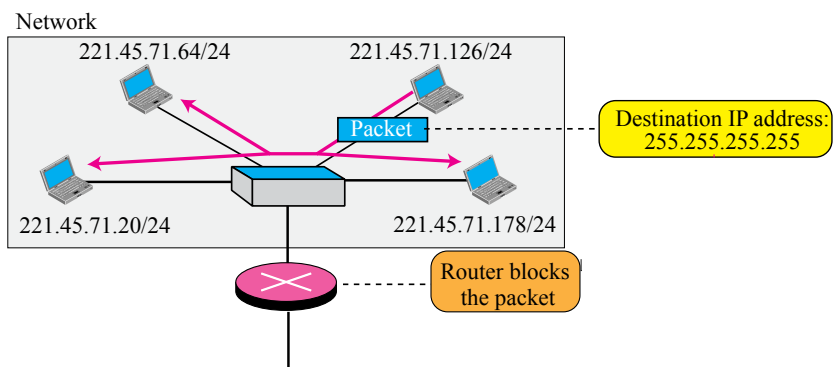
Special IP Addresses

Special IP Addresses (Not globally routed)



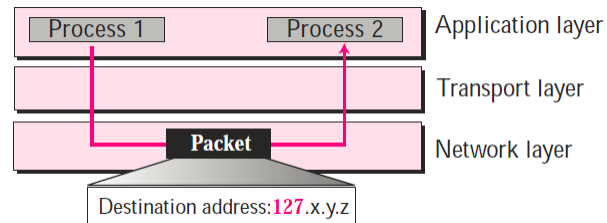
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Limited Broadcast



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Loopback Address



127.0.0.0/8

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Private Addresses

<i>Block</i>	<i>Number of addresses</i>
10.0.0.0/8	16,777,216
172.16.0.0/12	1,047,584

<i>Block</i>	<i>Number of addresses</i>
192.168.0.0/16	65,536
169.254.0.0/16	65,536

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