SECTION – B

TCP/IP:

Subnet Addressing

Outline of the talk

- IP Subnet

IP Subnet

- Basic concept:
  - A subset of a Class A, B or C network.
- IP addresses that do not use subnets consists of
  - A network portion and
  - A host portion
- Represents a static two-level hierarchical addressing model.

IP Subnet (contd.)

- IP subnets introduces a third level of hierarchy
  - A network portion.
  - A subnet portion.
  - A host portion.
- Allow more efficient (and structured utilization of the addresses.
- Uses network masks
  - Natural / Default network masks.
  - Custom / Subnet network masks.

Natural Masks

- Network mask 255.0.0.0 is applied to a class A network 10.0.0.0
  - In binary, the mask is a series of contiguous 1's followed by a series of contiguous 0's.

11111111 00000000 00000000 00000000

Network Portion

Host portion

Natural Masks (contd.)

- Provide a mechanism to split the IP address 10.0.0.20 into
  - A network portion of 10, and
  - A host portion of 20

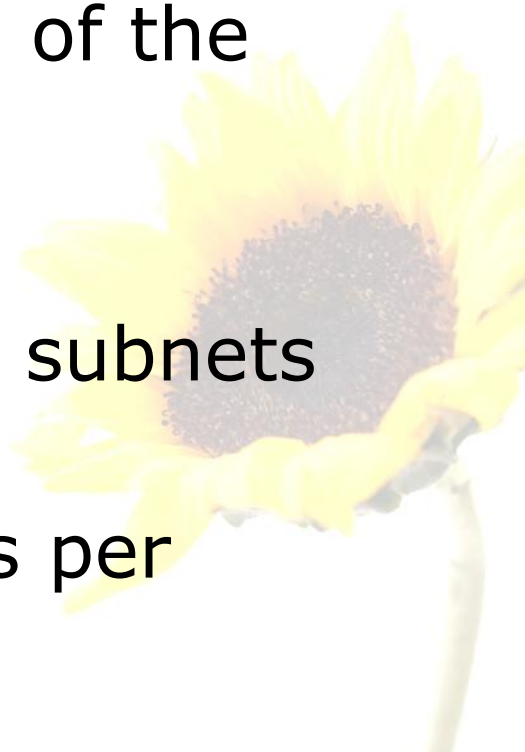
	Decimal	Binary		
IP address:	10.0.0.20	00001010	00000000	00000000 00010100
Mask:	255.0.0.0	11111111	00000000	00000000 00000000
		Network	**Host**	

Natural Masks (contd.)

- Class A, B and C addresses
  - Have fixed division of network and host portions.
  - Can be expressed as masks.
    - Called **natural masks**
  - Natural Masks
    - Class A :: 255.0.0.0
    - Class B :: 255.255.0.0
    - Class C :: 255.255.255.0

Creating Subnets using Masks

- **Masks are very flexible.**
  - Using masks, networks can be divided into smaller subnets.
- **How?**
  - By ending the network portion of the address into the host portion.
- Advantage gained:
  - We can create a large number subnets from one network.
  - Can have less number of hosts per network.



Example: Subnets

- Network mask 255.255.0.0 is applied to a class A network 10.0.0.0
  - This divides the IP address 10.5.0.20 into
    - A network portion of 10.
    - A subnet portion of 5, and
    - A host portion of 20.
  - The 255.255.0.0 mask borrows a portion of the host space, and applies it to the network space,

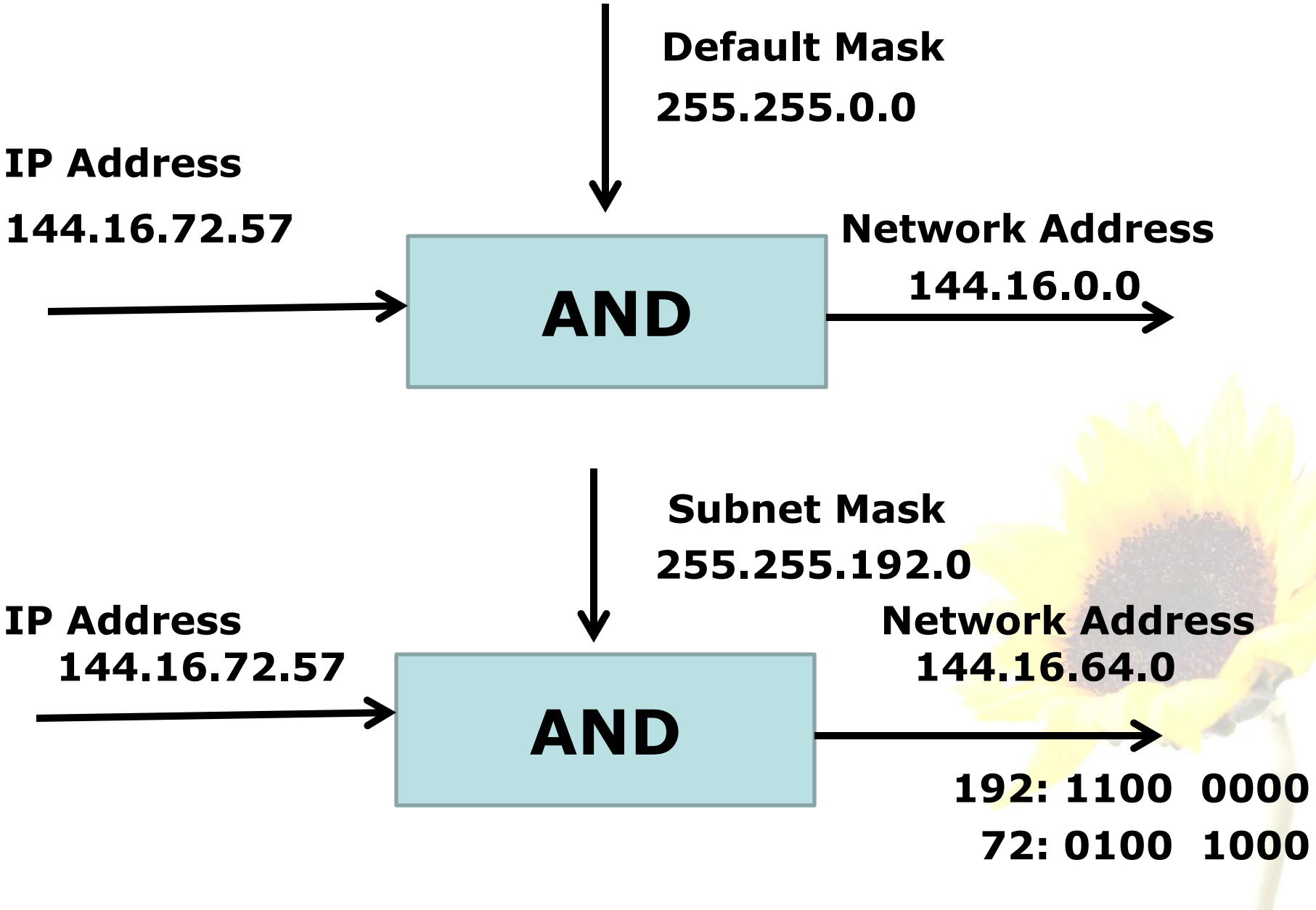
Subnets (contd.)

- What happens?
  - We have now split the network into 256 subnets.
  - Initially it was a single large Class A network (2^{24} – 2 hosts).
    - From 10.0.0.0 to 10.255.0.0
    - The hosts pet subnet decreases to 65,534

Subnet (contd.)

	Decimal	Binary			
IP address:	10.5.0.20	00001010	00000101	00000000	00010100
Mask:	255.255.0.0	11111111	11111111	00000000	00000000
		Network	**Subnet**	**Host**	

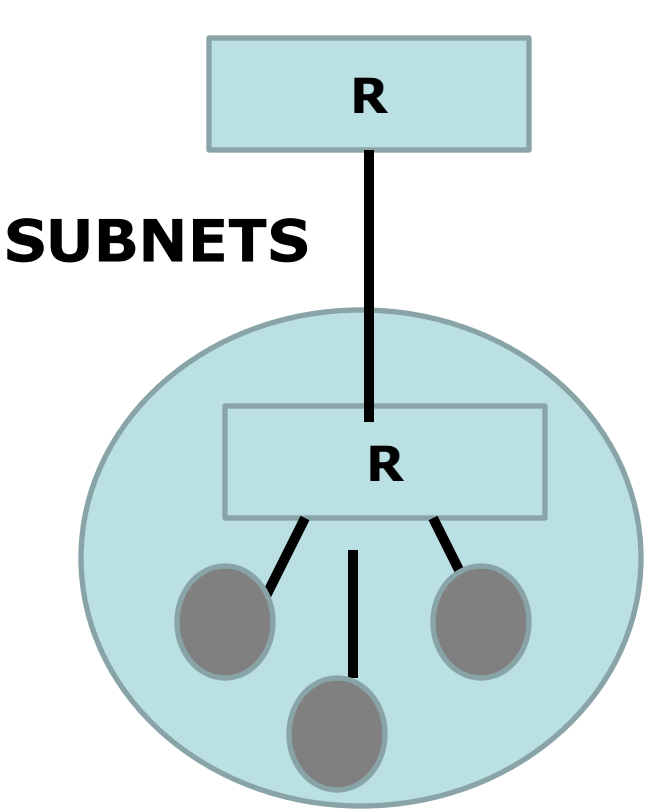
Default Mask and Subnet Mask

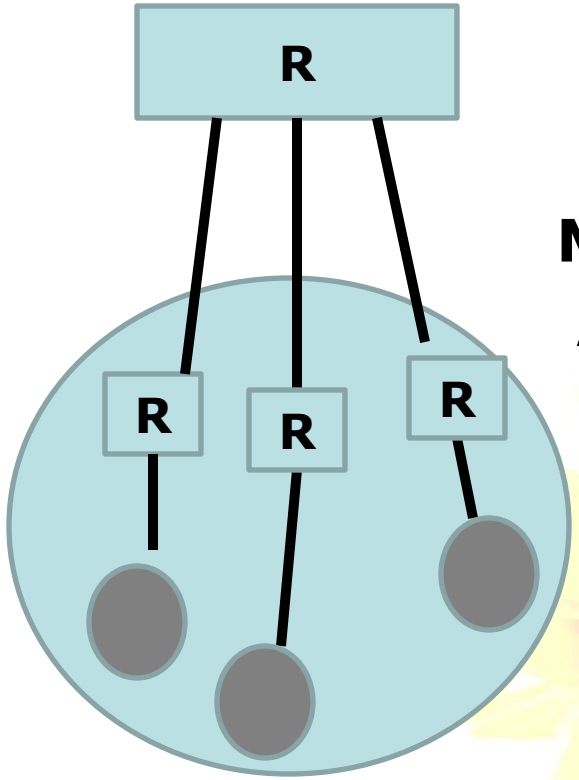


Subnet vs. Multiple Address Classes

- Subnets
  - Managing of subnets is done by local network administrator
  - Single entry is external router tables.
- Multiple Address Classes
  - Multiple entries in external router tables.
  - Additional overhead on the backbone (external) routers.

Comparison





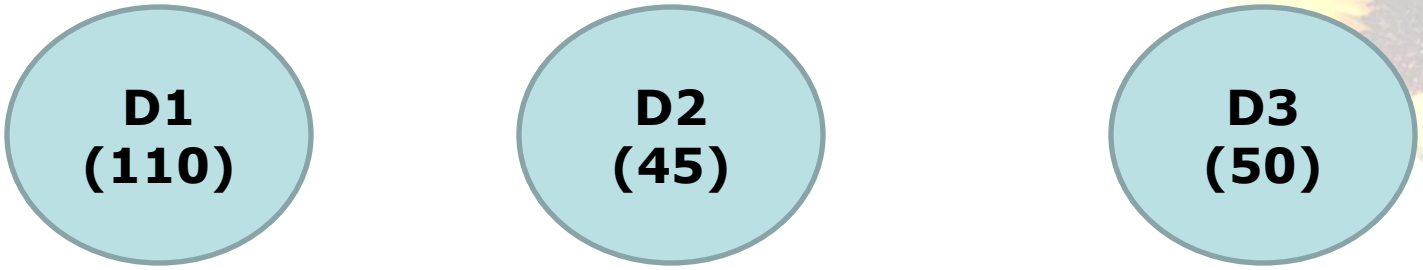
MULTIPLE ADDRESS CLASSES

Variable Length Subnet Mask (VLSM)

- Basic concept
  - The same network can be configured with different masks.
  - Can have subnets of different sizes
  - Allows better utilization of available addresses.

Example: VLSM

- Suppose we are assigned a Class C network 192.203.17.0
  - To be divided into three subnets
    - Corresponding to three departments
    - With 110, 45 and 50 hosts respectively.



The Example (contd.)

- Available subnet options:
  - The network mask will be the Class C natural mask 255.255.255.0
  - Subnet masks of the form 255.255.255.X
    - Can be used to divide the network into more subnets.

The Subnet Options

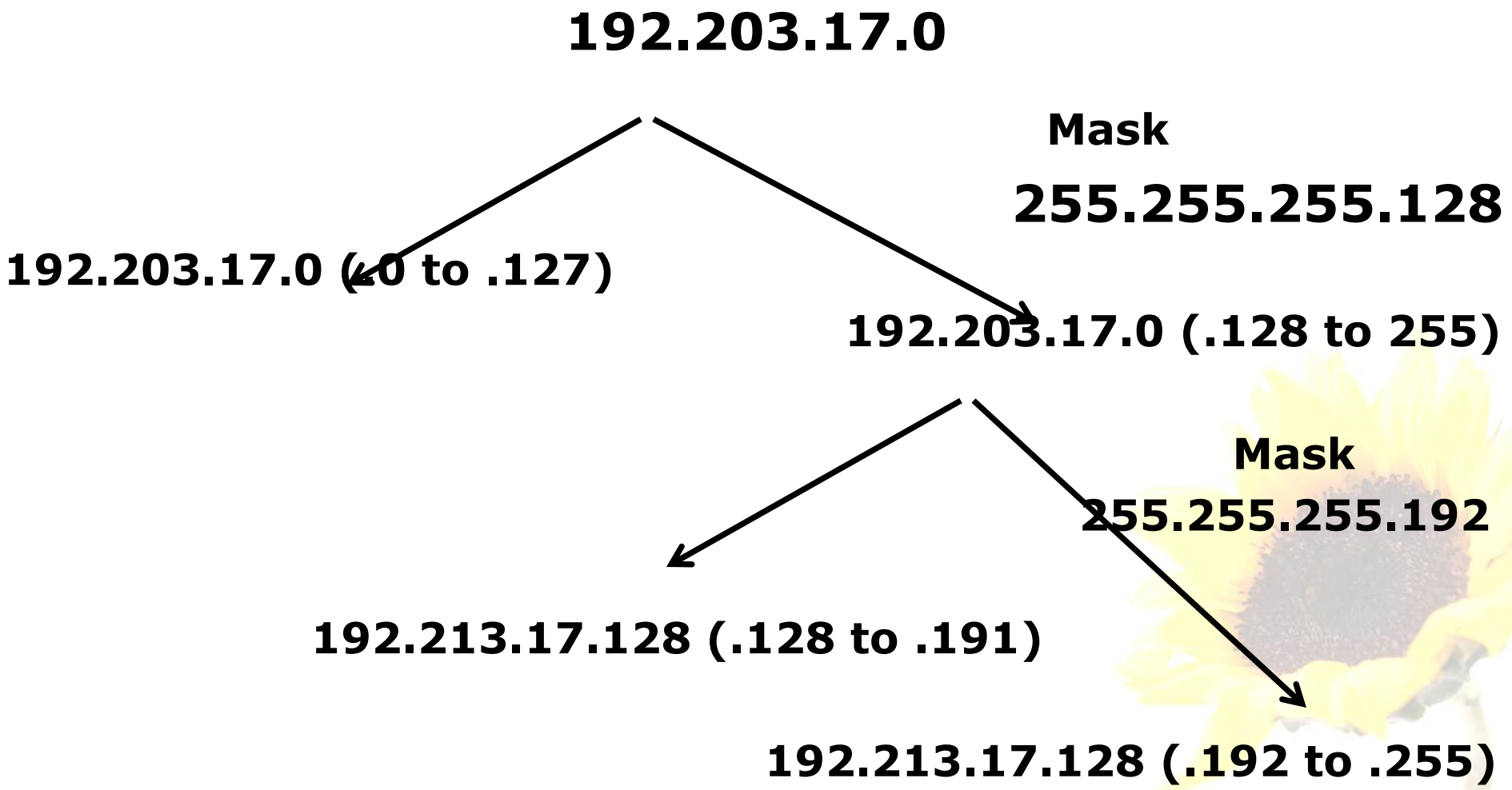
X	X (in binary)	No. of Subnets	No of Hosts
128	1000 0000	2	128
192	1100 0000	4	64
224	1110 0000	8	32
240	1111 0000	16	16
248	11111000	32	8
252	1111 1100	64	4

- Cannot satisfy the requirements (110, 45, 50)

The VSLM Option

- **Basic concept:**
  - First use the mask 255.255.255.128 to divide the network address into two subnets with 128 hosts each.
    - **192.203.17.0 (.0 to .127)**
    - **192.203.`7.0 (.128 to .255)**

The VSLM Option (contd.)



Running out of IP addresses

- Growing demand for IP addresses
  - Severe strain on the classful model
  - Due to wastage of address space.
- Measures taken:
  - Creative allocation of IP addresses
  - Classless Inter-Domain Routing (CIDR)
  - Private IP addresses, and Network Address Translation (NAT)
  - IP version 6 (IPv6)