Addressing and Forwarding

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Problem Statement

- Flat Addressing: N hosts needs N entries in the table (MAC addresses)
- Millions of hosts, address lookup in forwarding becomes a bottleneck
- Need a method of reducing entries in the forwarding table for scalability purposes

MAC

here forwarding table have to include all the people in the world

Vijay, son of Ajay, grandson of Sanjay - . . . Air India flight

Rinki, daughter of Pinki, granddaughter of Dinky - . . . Air India flight

here we just need to include tthe countries in the world

IP → List of countries

India - Air India flight

India, Mumbai, Powai, B-4, Vijay

India, Delhi, Dwaraka, D-16, Rinki

Solution: Hierarchical Addressing

- Structure to addresses: Address captures location in the network topology
- IP address (32 bits) consists of two parts: network and host
  - Network part identifies the network to which host is connected
  - Host part uniquely identifies each host in the network
- How does this help?
  - An entire network (in some specific direction) could be represented by a single entry at a router

IP Address

- Size of network and host part are not the same
- Organizations obtain set of addresses of a given class
- Divided into five classes

  - Class A: 0, network(7), host(24); Mask 8
  - Class B: 10, network(14), host(16); Mask 16
  - Class C:110, network(21), host(8); Mask 24
  - Class D: 1110, bits-28 (Multicast)
  - Class E: 1111, bits 28 (Reserved)

IP Address

not allocated to organizations

if u have a packet with desrination addr as private adress..
it will not be routed it will be dropped in public internet

- Private IP addresses:
  - A: 10.0.0.0 through 10.255.255.255
  - B: 172.16.0.0 through 172.31.0.0
  - C: 192.168.0.0 through 192.168.255.0.
  - 127.0.0.1 is loopback address.

IIT Bombay

wifi AP

NAT

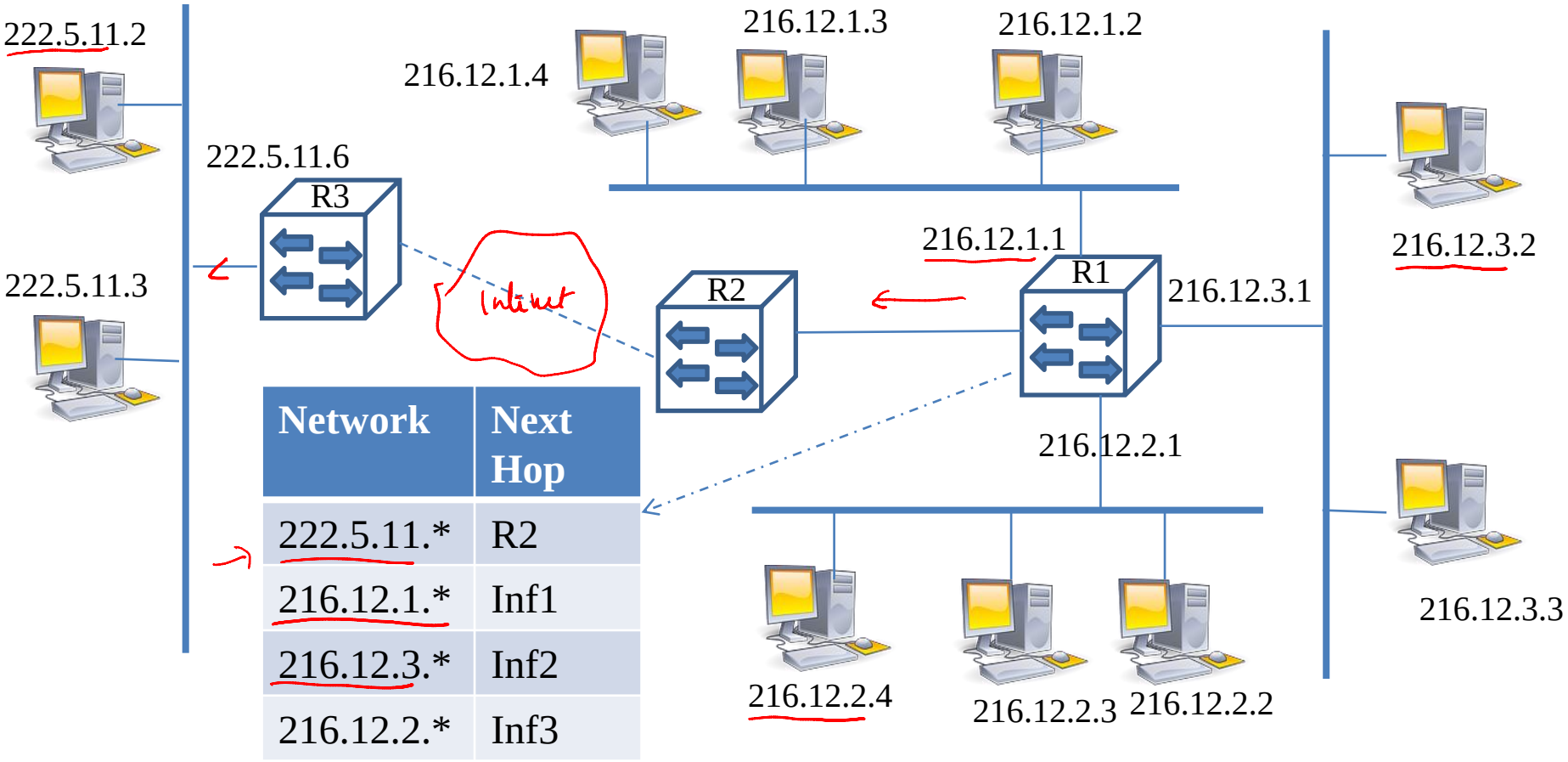
communicate between processes in a host

127.0.0.0 to 127.255.255.255

loopback address block

↳ with 'ifconfig lo'

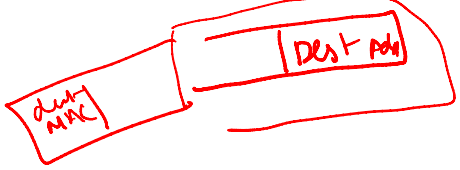
Example: Class C



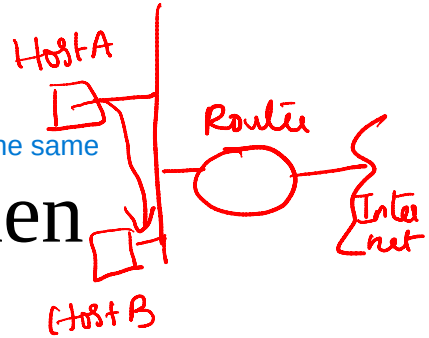
Network	Next Hop
222.5.11.*	R2
216.12.1.*	Inf1
216.12.3.*	Inf2
216.12.2.*	Inf3

Points to Note

- Every datagram contains IP address of destination host
  - Network part of IP address uniquely identifies a single physical network
- All nodes that share the same network part are connected to the same physical network
- Every physical network has at least one router that is connected to at least one other physical network.



Forwarding at Host



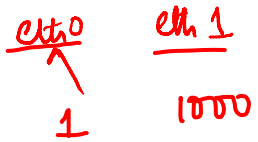
extended LAN, or swithched network... all are part of the same physical network

- If (NetNum of Dest = my NetNum) then
  - deliver packet to destination directly
  - use ARP to get MAC address corresponding to dest IP address

Else deliver packet to default router

- use ARP to get MAC address corresponding to router IP address

Linux Usage



giving weights to paths/interfaces..
it forces to use eth0 over eth1

```
kameswari@asterix:~$ route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.129.0.0      *               255.255.0.0     U     1      0        0 eth0
link-local      *               255.255.0.0     U     1000   0        0 eth0
default         router.it.iitb. 0.0.0.0         UG    0      0        0 eth0
kameswari@asterix:~$
kameswari@asterix:~$
kameswari@asterix:~$ route -n
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
10.129.0.0      0.0.0.0         255.255.0.0     U     1      0        0 eth0
169.254.0.0     0.0.0.0         255.255.0.0     U     1000   0        0 eth0
0.0.0.0         10.129.250.1    0.0.0.0         UG    0      0        0 eth0
kameswari@asterix:~$
```

mask says how many bits correspond to network portion

see 1st 2 bytes

weight to path

U -- path active

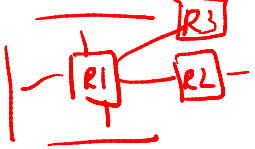
UG -- active+going via gateway

Windows Usage

```
IPv4 Route Table
===========================================================================
Active Routes:
Network Destination        Netmask          Gateway       Interface  Metric
          0.0.0.0          0.0.0.0      10.129.250.1   10.129.154.135     40
        10.129.128.0      255.255.128.0      On-link     10.129.154.135    296
      10.129.154.135  255.255.255.255      On-link     10.129.154.135    296
      10.129.255.255  255.255.255.255      On-link     10.129.154.135    296
        127.0.0.0        255.0.0.0          On-link         127.0.0.1    306
        127.0.0.1  255.255.255.255      On-link         127.0.0.1    306
  127.255.255.255  255.255.255.255      On-link         127.0.0.1    306
        224.0.0.0        240.0.0.0          On-link         127.0.0.1    306
        224.0.0.0        240.0.0.0          On-link     10.129.154.135    296
  255.255.255.255  255.255.255.255      On-link         127.0.0.1    306
  255.255.255.255  255.255.255.255      On-link     10.129.154.135    296
===========================================================================
```

Obtained via “route print” command

Forwarding at Router



- If (NetNum of Dest = NetNum of one of my interfaces) then
  - deliver packet to destination over that interface

  Else if (NetNum of Dest is in my forwarding table) then
  - deliver packet to NextHop router

  Else deliver packet to default router

Summary

- Top concern: Scalability
- Handled via hierarchical addressing
  - IP address has a network and a host part
  - Significantly reduces entries in forwarding table
- Looked at how forwarding is done at host and router based on the addressing scheme
- Ahead: Address assignment inefficiency