Introduction to Network Security
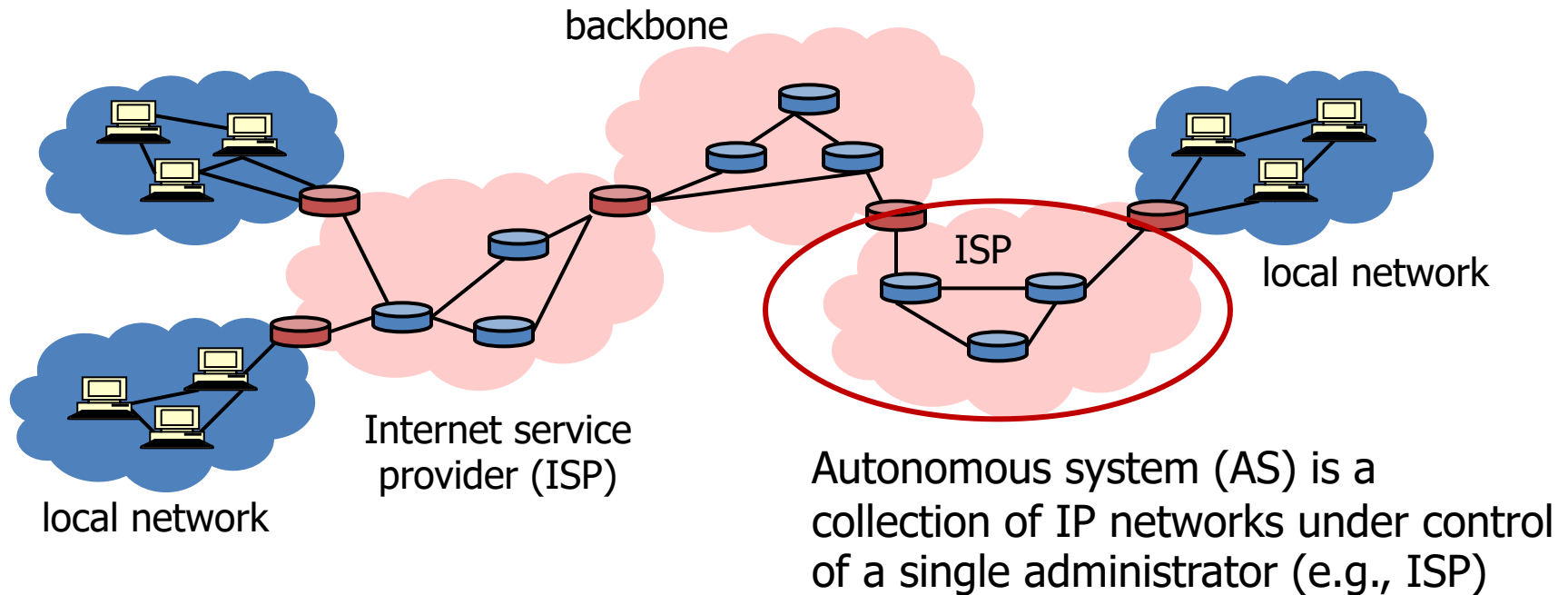
Chapter 3

The Internet

Topics

- The Internet
- Addressing
- Client Server
- Routing

Internet Is a Network of Networks

backbone

ISP

local network

Internet service
provider (ISP)

local network

Autonomous system (AS) is a
collection of IP networks under control
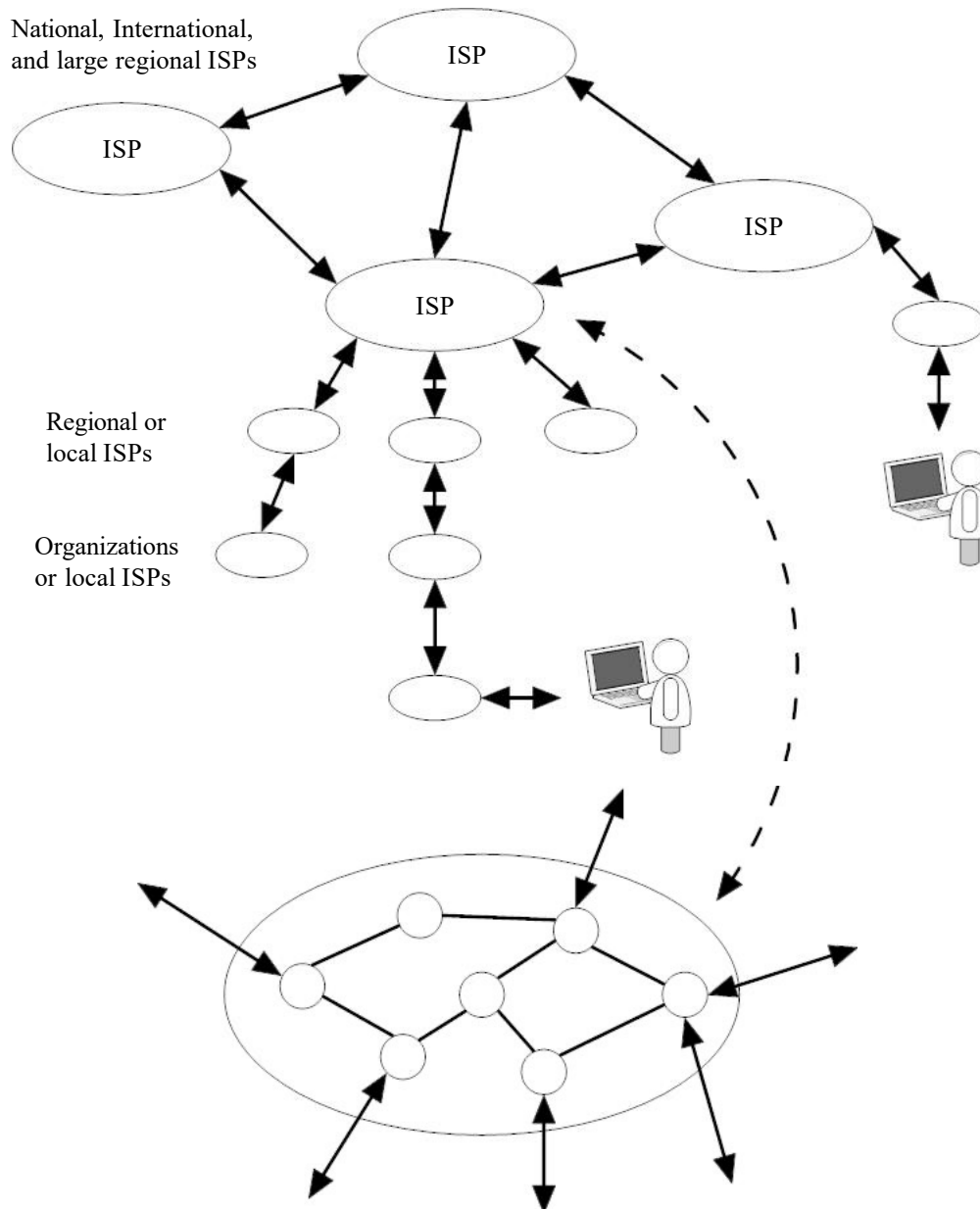of a single administrator (e.g., ISP)

TCP/IP for packet routing and connections
Border Gateway Protocol (BGP) for route discovery
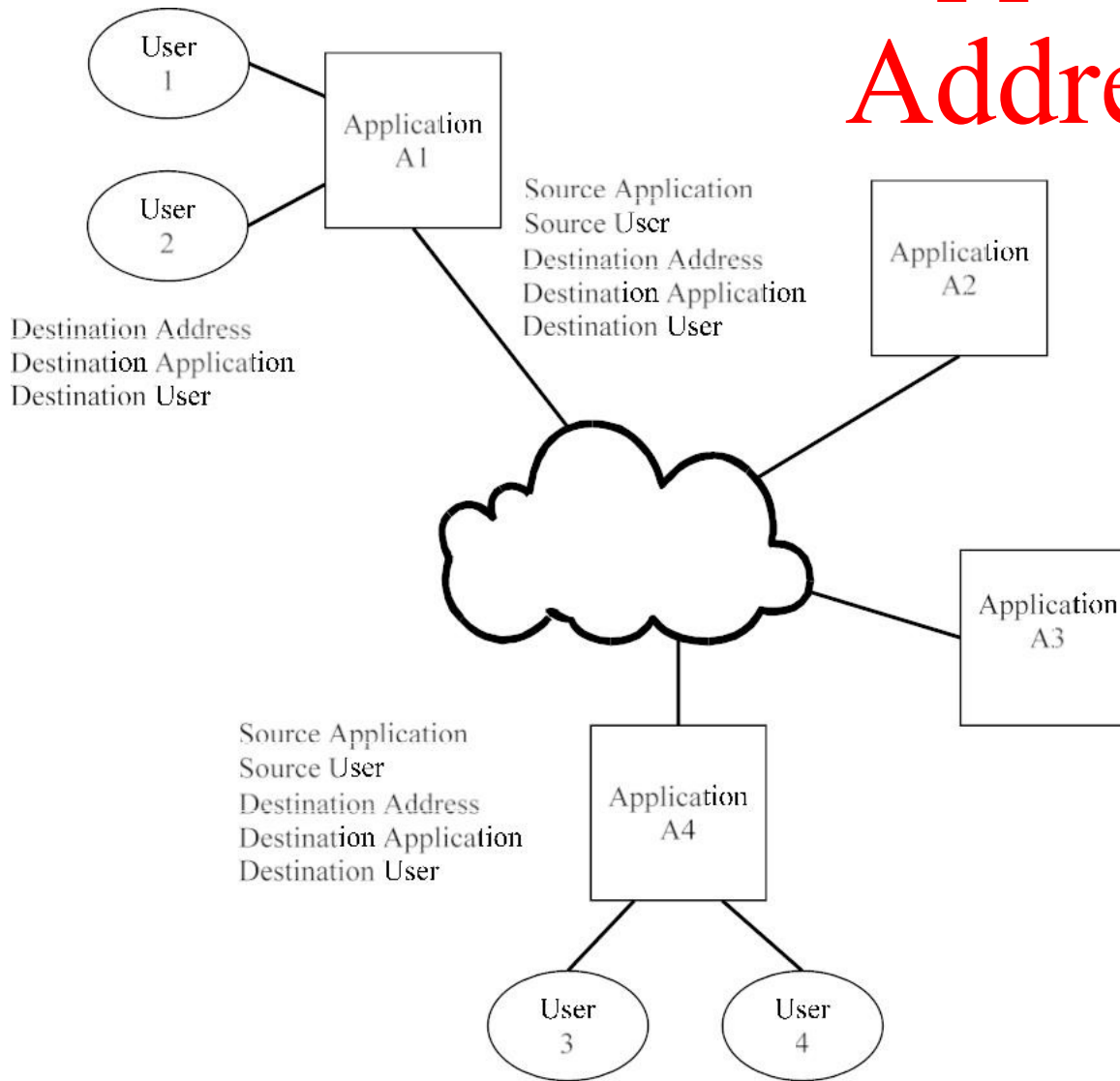Domain Name System (DNS) for IP address discovery

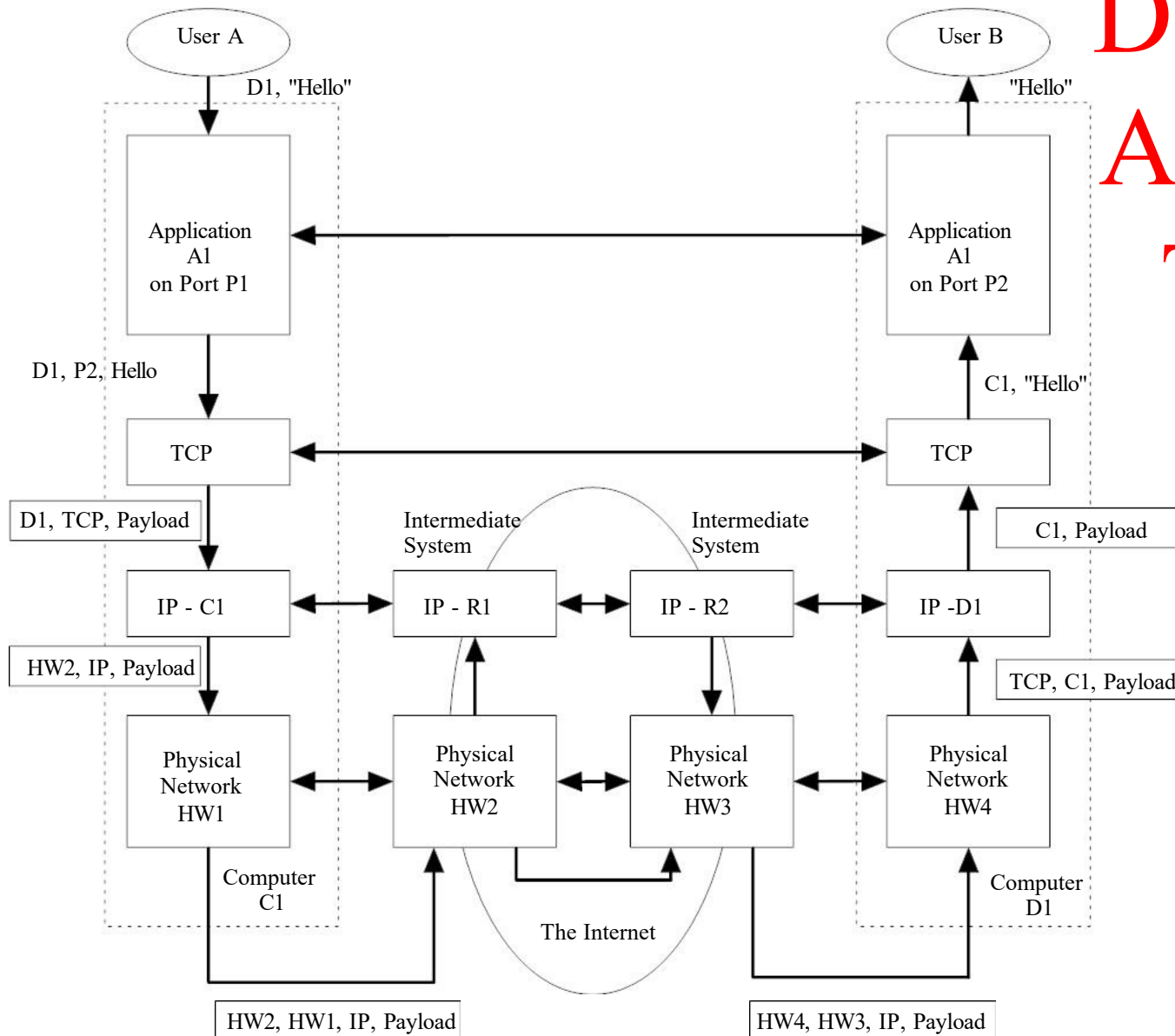# The Internet Hierarchy

National, International, and large regional ISPs

ISP

ISP

ISP

ISP

Regional or local ISPs

Organizations or local ISPs

Internet Addressing

- Different address types

- Hardware address spoofing

- IP address Spoofing

Application Addressing

User 1

User 2

Application A1

Source Application
Source User
Destination Address
Destination Application
Destination User

Application A2

Destination Address
Destination Application
Destination User

Application A3

Source Application
Source User
Destination Address
Destination Application
Destination User

Application A4

User 3

User 4

6

Different Address Types

User A

D1, "Hello"

Application A1 on Port P1

D1, P2, Hello

TCP

D1, TCP, Payload

IP - C1

HW2, IP, Payload

Physical Network HW1

Computer C1

HW2, HW1, IP, Payload

Intermediate System

IP - R1

Physical Network HW2

Intermediate System

IP - R2

Physical Network HW3

The Internet

User B

"Hello"

Application A1 on Port P2

C1, "Hello"

TCP

C1, Payload

IP -D1

TCP, C1, Payload

Physical Network HW4

Computer D1

HW4, HW3, IP, Payload
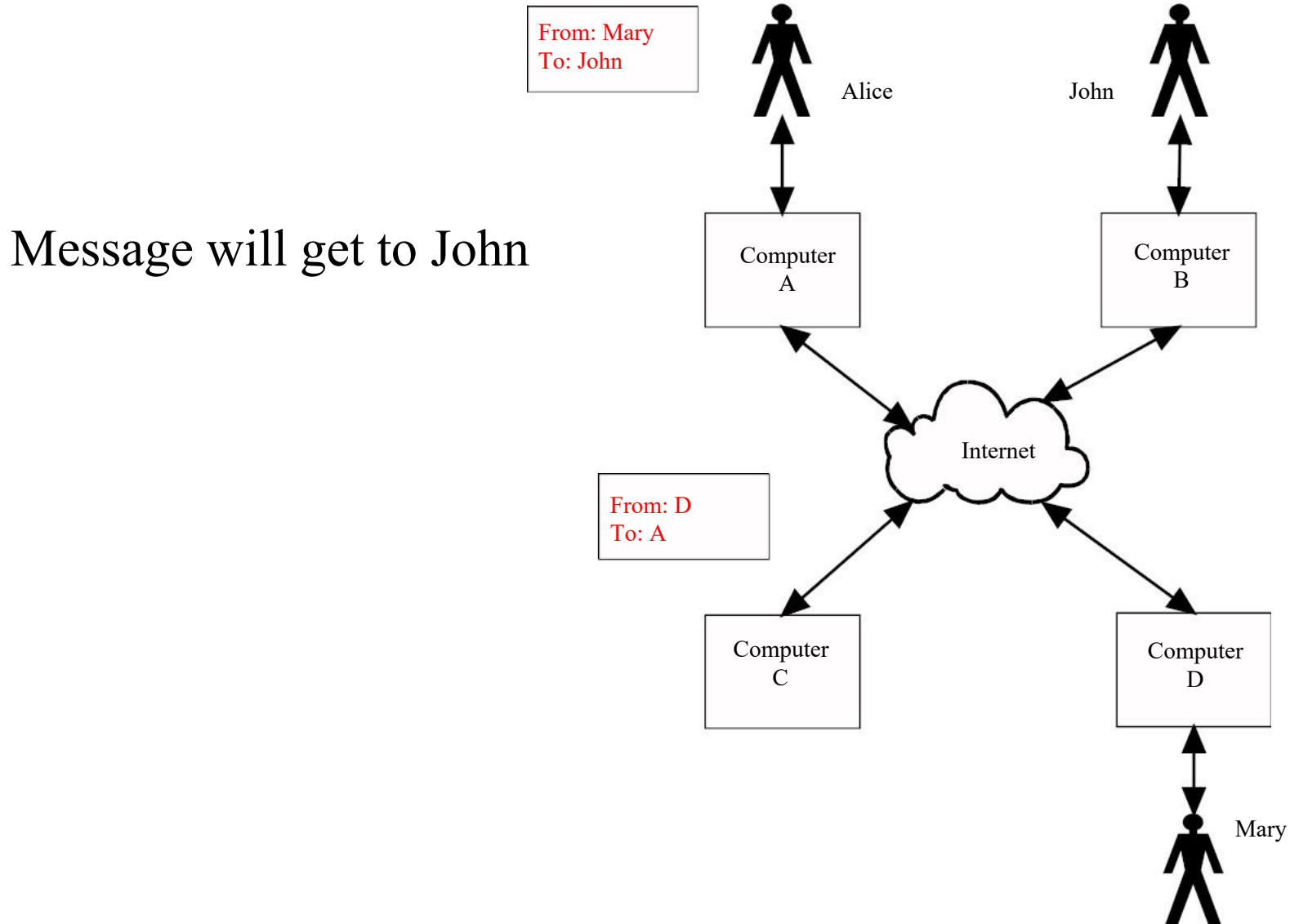
Address spoofing

- Who can generate the address?
- Spoofing is the ability to change the address
- Who can "see" (sniff) the traffic?

IP address Spoofing and Sniffing

From: Mary
To: John

Alice

John

Message will get to John

Computer
A

Computer
B

Internet

From: D
To: A

Computer
C

Computer
D

Mary

9

IP Address Space

- In Version 4 the IP address is 32 Bits
- Total IP address space is 4,294,967,296

IP addresses

- The IP address is written as a four-tuple where each tuple is in decimal and are separated by a "." (called a dot). When talking about an address you pronounce the word dot. So 129.186.5.102 is pronounced 129 dot 186 dot 5 dot 102

CIDR Scheme (Classless Inter-Domain Routing)

192.168.60.5/**24**

Indicate the first 24 bits are network ID

Special IP Addresses

Private IP Addresses
    10.0.0.0/8
    172.16.0.0/12
    192.168.0.0/16

Loopback Address
    127.0.0.0/8
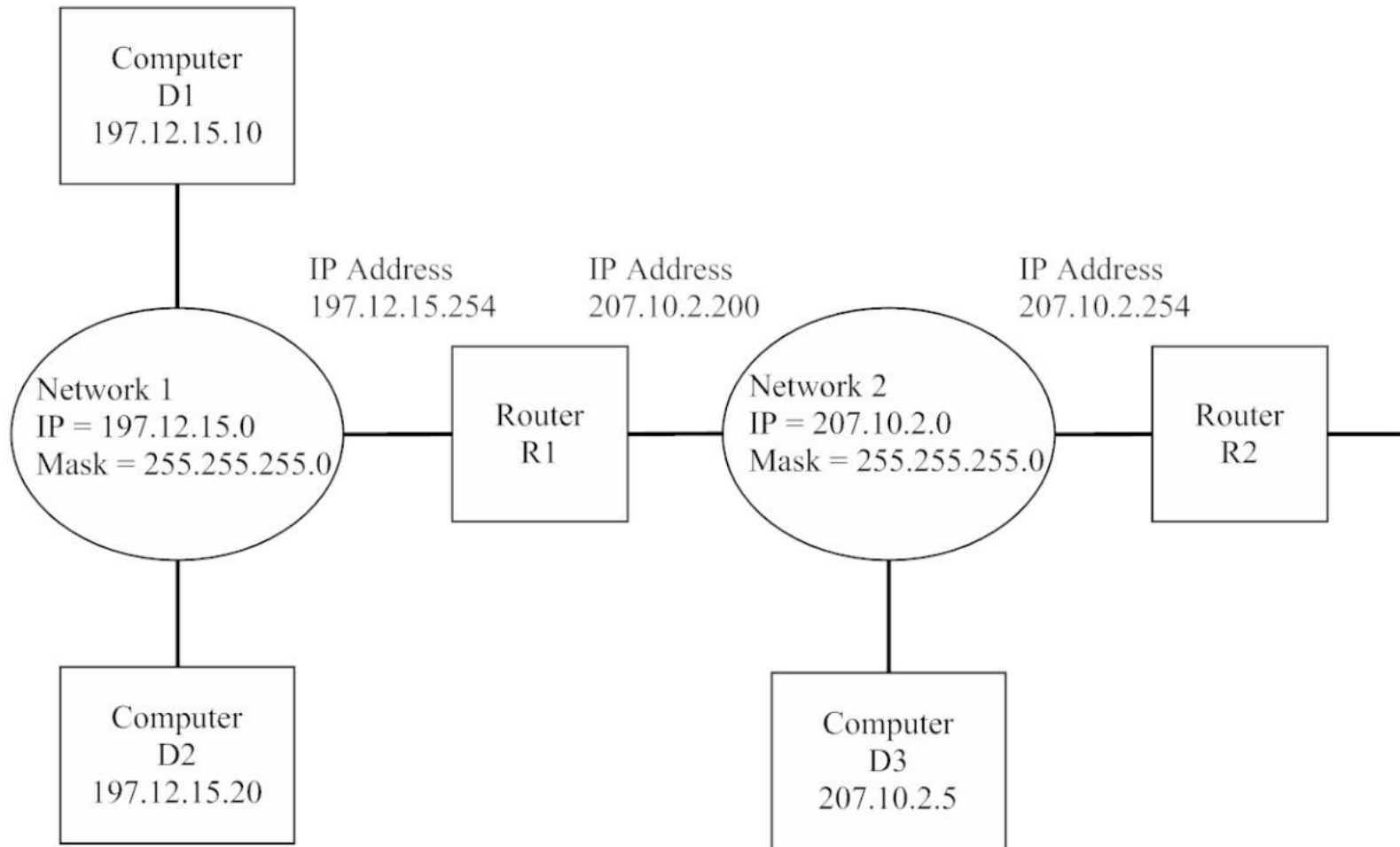   Commonly used: 127.0.0.1

IP Addressing

Figure 3.5 Networks in the Internet
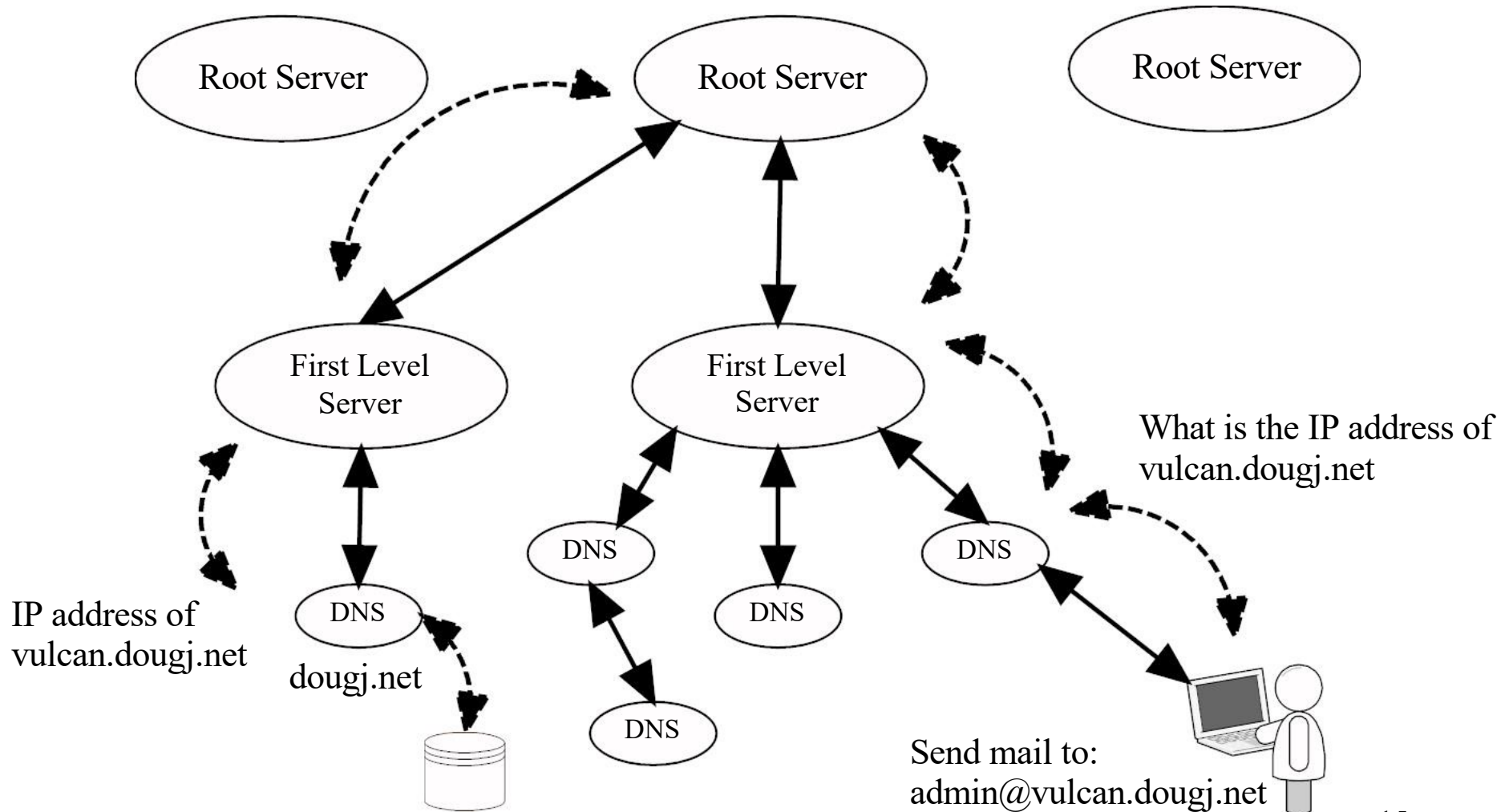
Machine names

- The format for the machine name is:
  - machine.domain   Where:
    - machine is unique to the domain or subdomain.
    - and domain is a single domain or a series of subdomains.

Domain Name Conversion

- Now lets look at how we can convert a machine name into an IP address.

- There are two ways that this conversion can take place.
  - The first is to use a table on each host which maintains the mapping between names and IP addresses. This method required very large tables and made it hard to update.
  - The second, and preferred, method is to use a nameserver. The nameserver is actually a set of nameservers each having authority over different domains and subdomains.
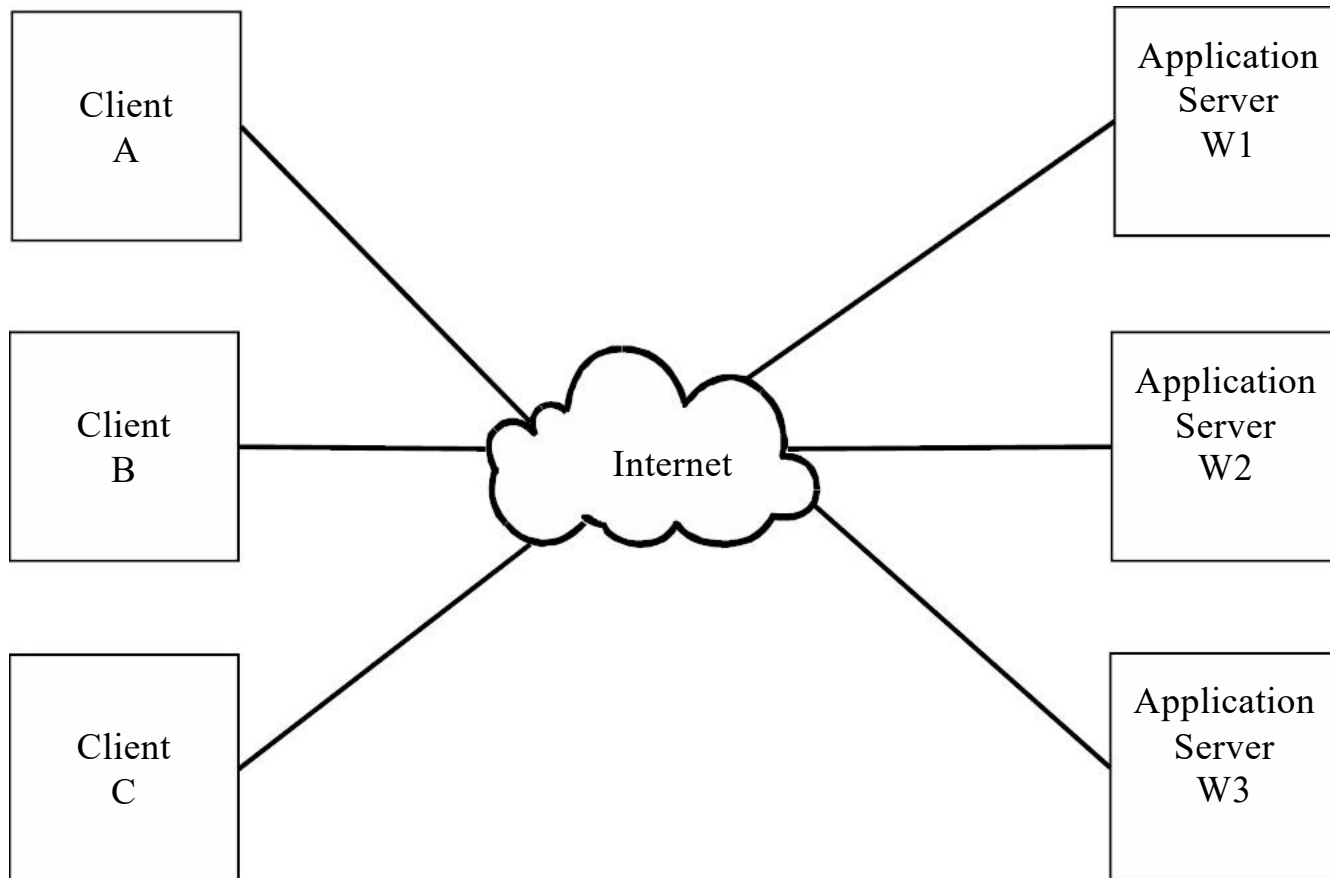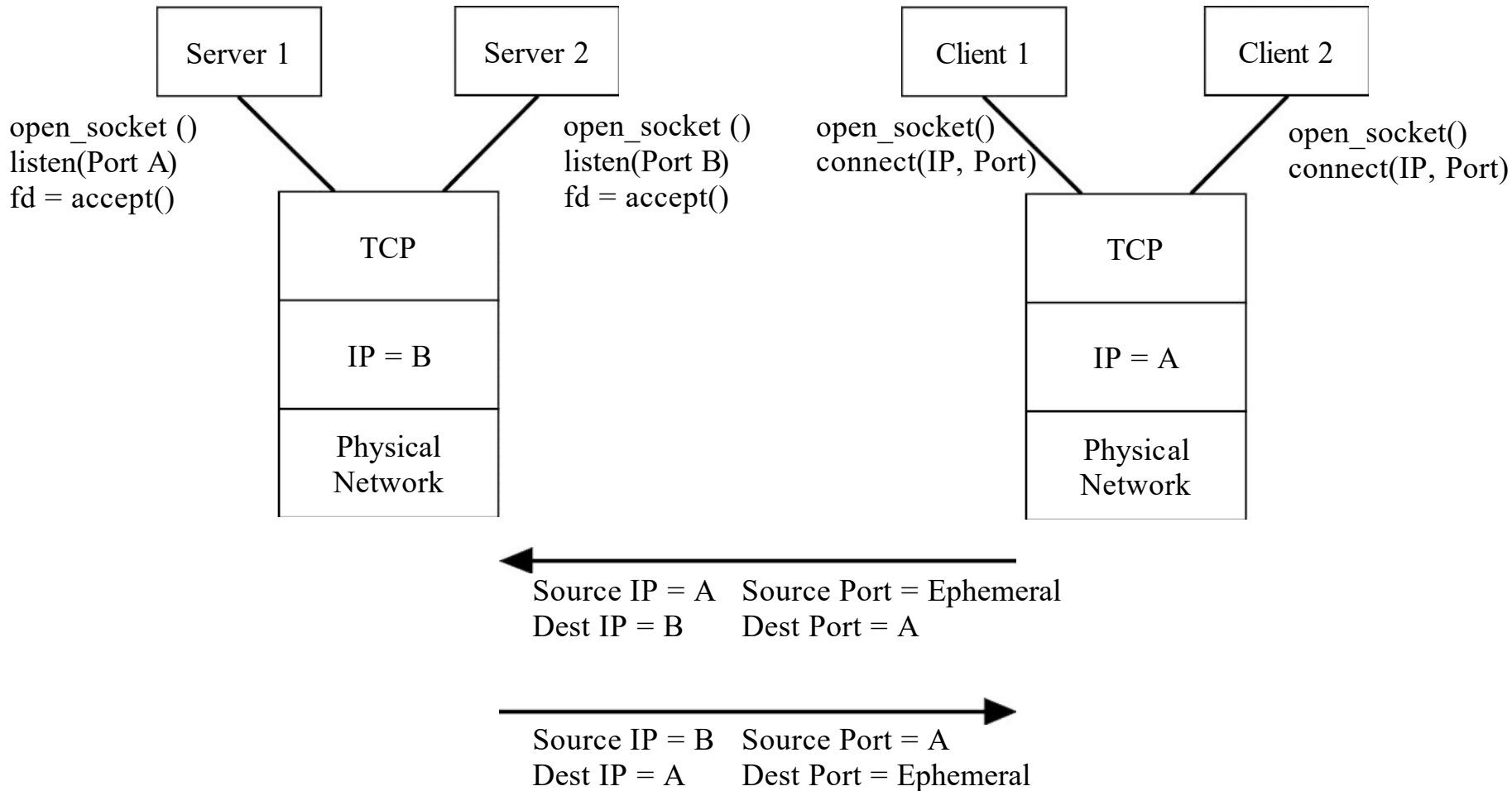
DNS Model

Root Server

Root Server

Root Server

First Level
Server

First Level
Server

What is the IP address of
vulcan.dougj.net

DNS

DNS

DNS

IP address of
vulcan.dougj.net

DNS

DNS

dougj.net

DNS

Send mail to:
admin@vulcan.dougj.net

15

Client Server Model

Full name: server.dougj.net
IP address:
Listening Port: 80

Client Server model

Client Server Model

| Packets from client to server	
Source IP	Client's IP address
Destination IP	Server's IP address
Source Port	Ephemeral port
Destination Port	Server's port number (often well known)
Packets from server to client	
Source IP	Server's IP address
Destination IP	Client's IP address
Source Port	Server's port number (often well known)
Destination Port	Ephemeral port

Multiple Connections

Stream	Source IP	Destination IP	Source Port	Destination Port
A	A	W1	Ephemeral A1	80
B	A	W1	Ephemeral A2	80
C	A	W1	Ephemeral A3	80
D	B	W1	Ephemeral B1	80
E	B	W2	Ephemeral B2	80

Routing

- All hosts and gateways store routing tables

- Each row in the route table contains:
  - Destination address or address range
  - Next hop for that destination address range
  - The physical interface to use for that address range. (ie: which Ethernet card to use)

Example: Destination   Next   Interface
              129.186.4.0   129.186.5.254   en0

Routing
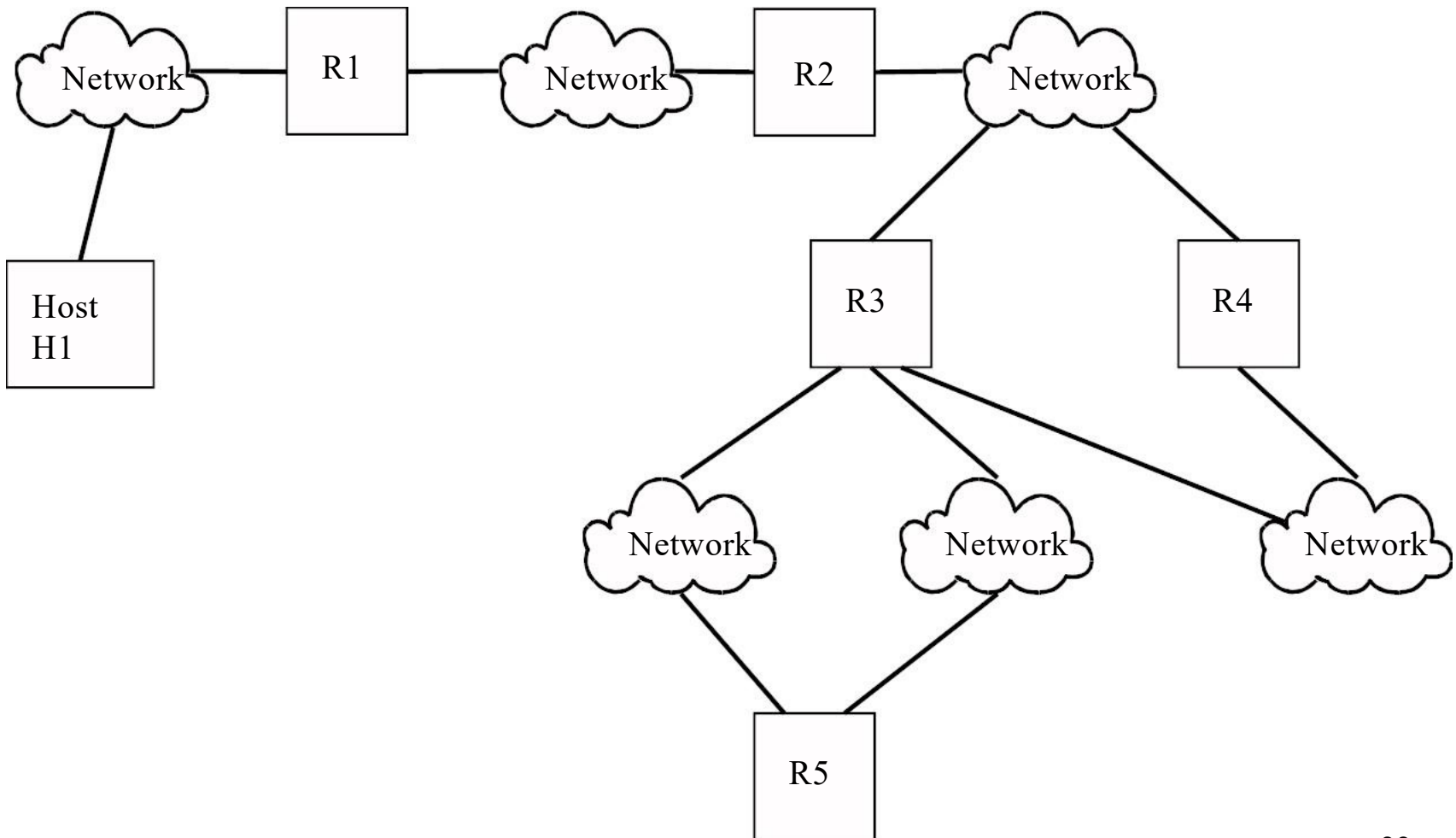
Dynamic vs Static

- Static
  - Tables built at system configuration time.
  - Used in small networks or networks with only one way out
- Dynamic
  - Tables are modified based on network parameters
  - Used in larger networks with multiple paths

Routing Example

Destination	Next Hop
Network 1	Direct
Default	Router R1

Destination	Next Hop
Network 1	Direct
Network 2	Direct
Default	Router R2

Computer D1

Network 1

Router R1

Network 2

Router R2

Internet

Computer D2

Computer D3