Introduction to Network Security

Chapter 3

The Internet

Topics

- The Internet
- Addressing
- Client Server
- Routing

The Internet

- User's View

The Internet Hierarchy

National, International,
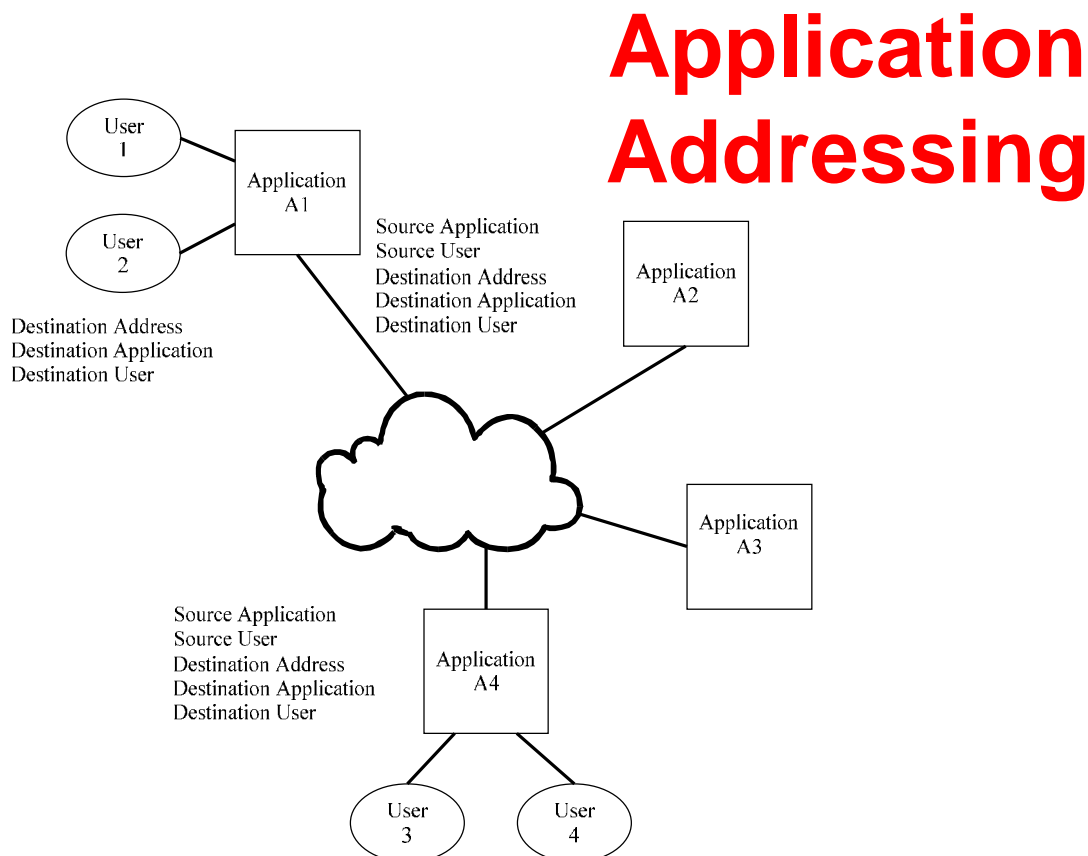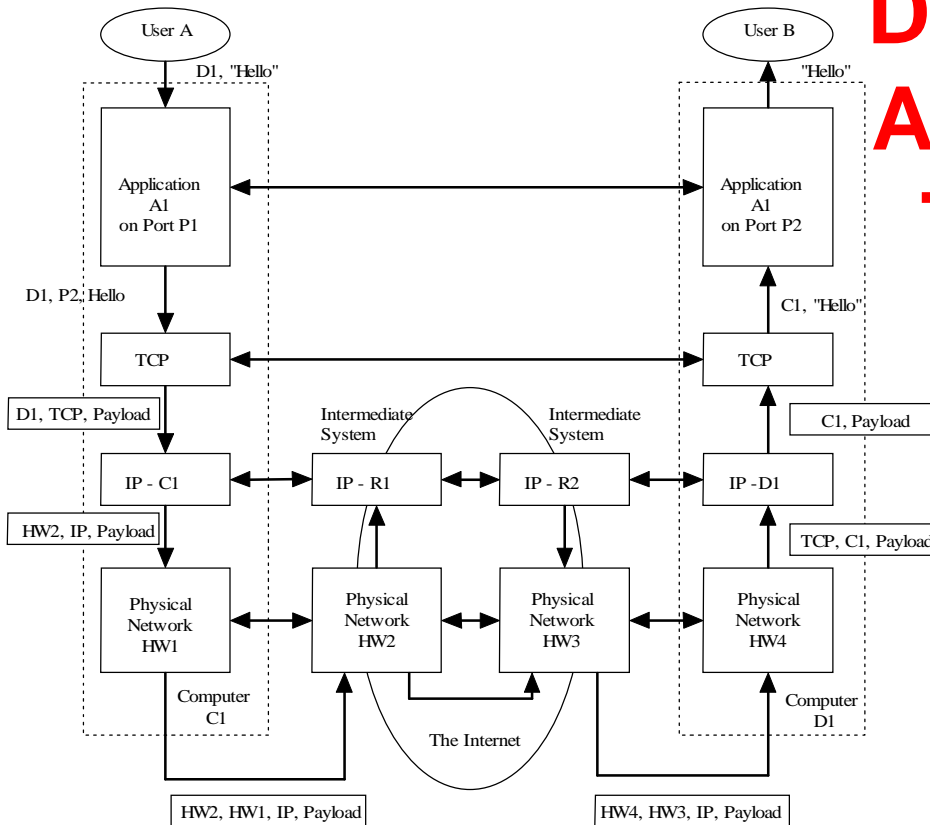and large regional ISPs

Regional or
local ISPs

Organizations
or local ISPs
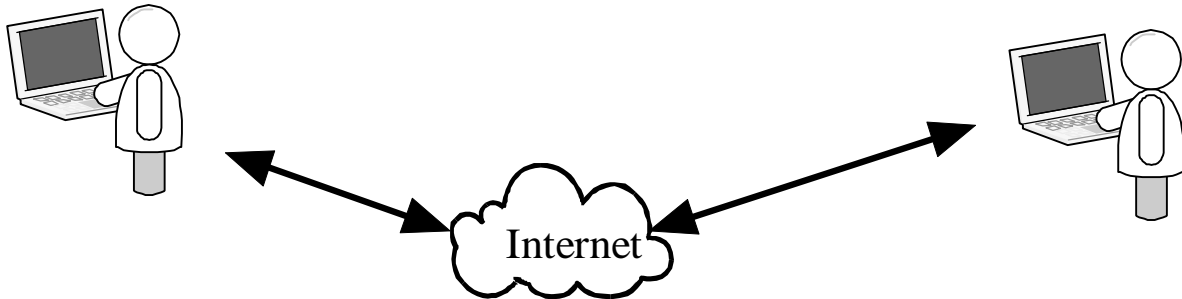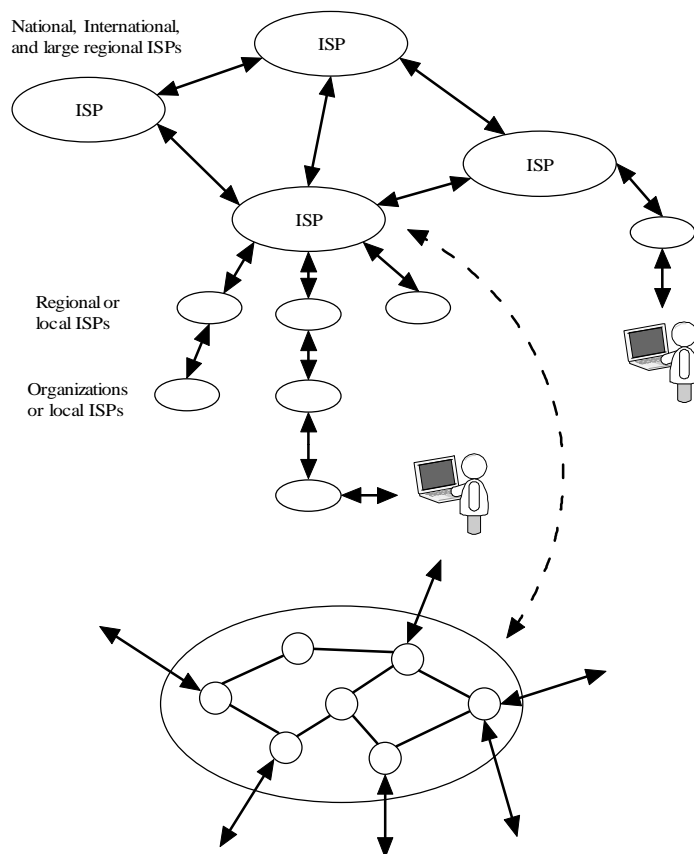
Internet Addressing

- Different address types
- Hardware address spoofing
- IP address Spoofing
- IP address Space

Application Addressing

Different Address Types

Slide diagram labels:

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

The Internet

Intermediate System — IP - R2

Physical Network HW3

IP - D1

TCP, C1, Payload

Physical Network HW4

Computer D1

HW4, HW3, IP, Payload

C1, Payload

TCP

C1, "Hello"

Application A1 on Port P2

User B — "Hello"

Address spoofing

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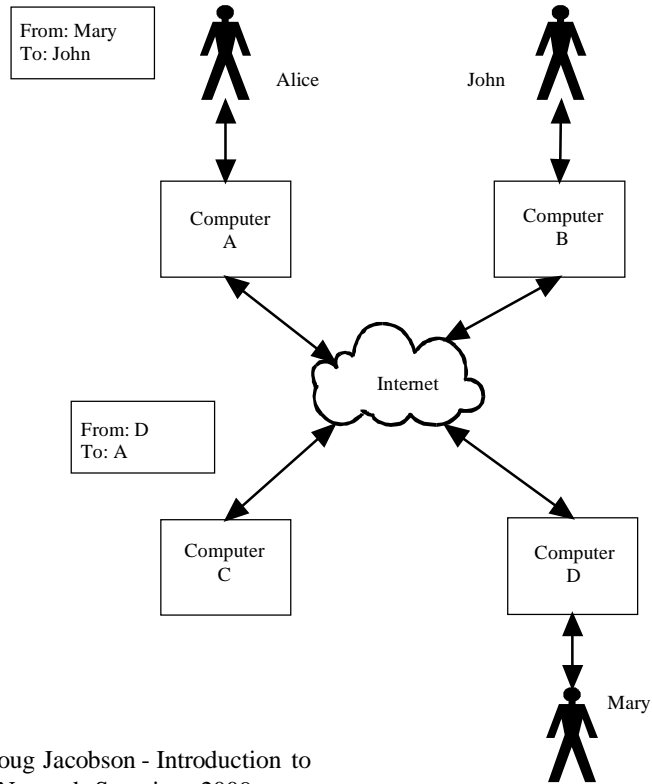- Who can "see" (sniff) the traffic?

IP address Spoofing and Sniffing

Message will get to John

Return message will go
back to Alice

From: Mary
To: John

Alice   John

Computer
A

Computer
B

Internet

From: D
To: A

Computer
C

Computer
D

Mary

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

IP Addressing

Computer
D1
197.12.15.10

IP Address
197.12.15.254

IP Address
207.10.2.200

IP Address
207.10.2.254

Network 1
IP = 197.12.15.0
Mask = 255.255.255.0

Router
R1

Network 2
IP = 207.10.2.0
Mask = 255.255.255.0

Router
R2

Computer
D2
197.12.15.20

Computer
D3
207.10.2.5
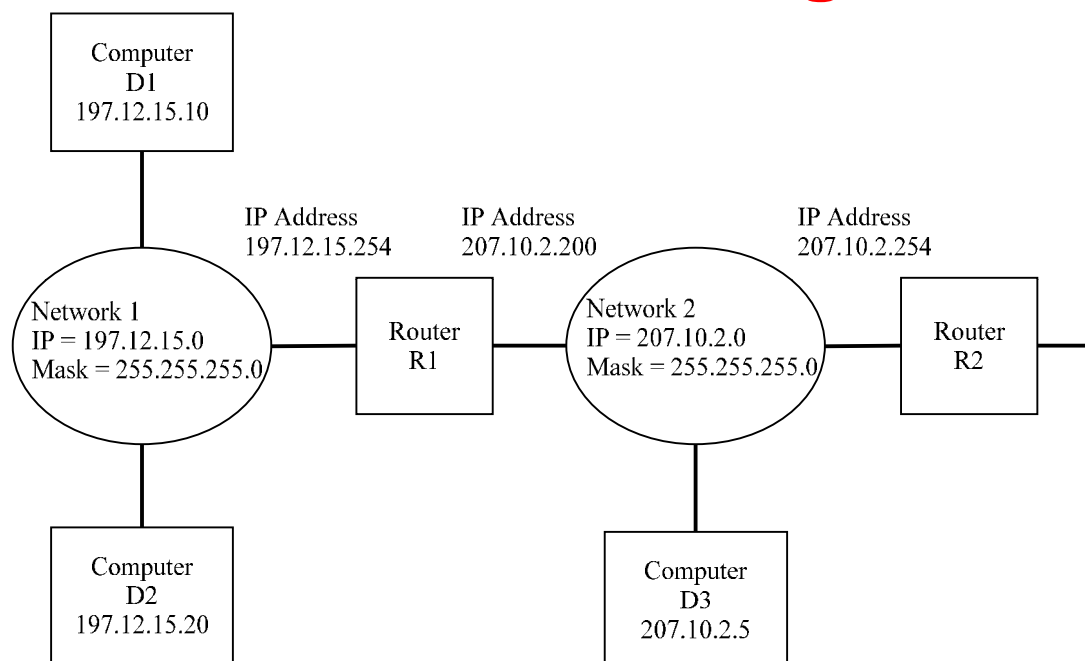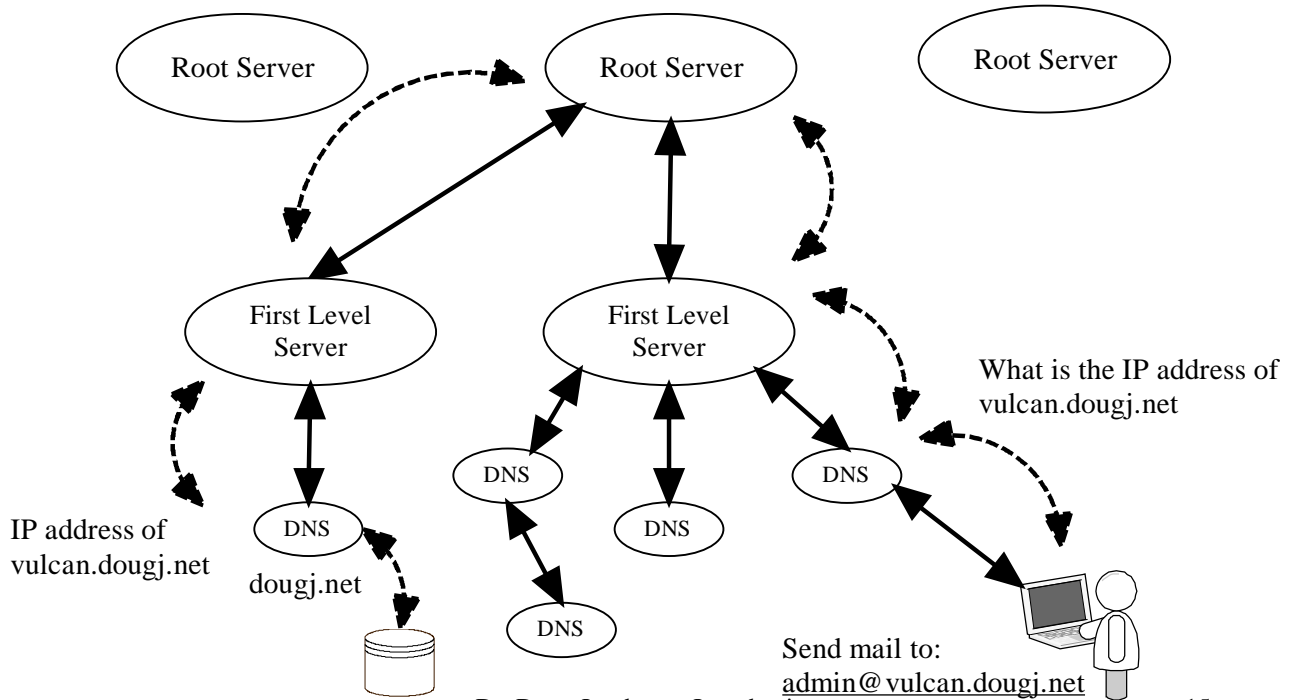
Figure 3.5 Networks in the Internet

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

DNS

DNS

DNS

DNS

DNS

What is the IP address of
vulcan.dougj.net

IP address of
vulcan.dougj.net

dougj.net

Send mail to:
admin@vulcan.dougj.net

Client Server Model

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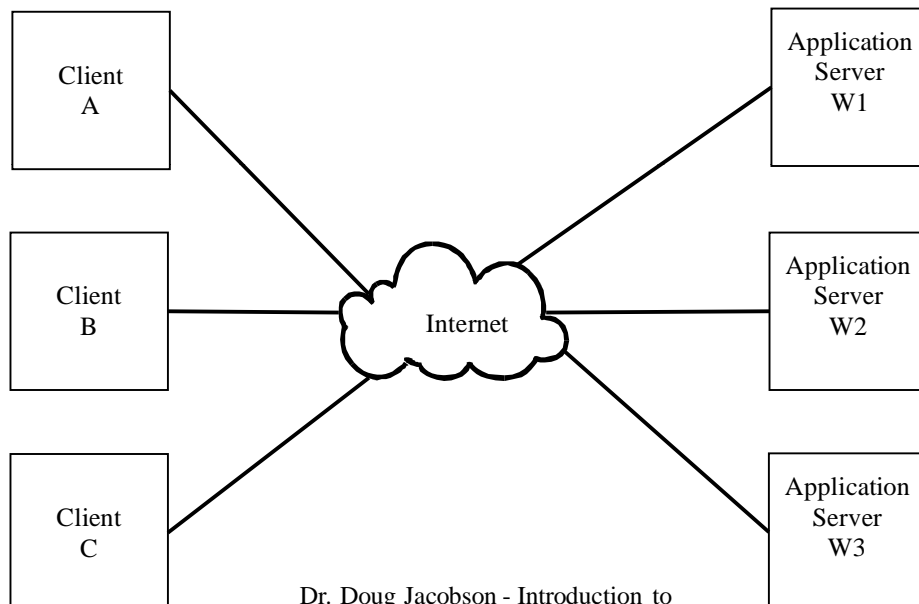
Client
A

Client
B

Client
C

Internet

Application
Server
W1

Application
Server
W2

Application
Server
W3

Client Server model

Server 1	Server 2	Client 1	Client 2

open_socket ()
listen(Port A)
fd = accept()

open_socket ()
listen(Port B)
fd = accept()

open_socket()
connect(IP, Port)

open_socket()
connect(IP, Port)

TCP
IP = B
Physical Network

TCP
IP = A
Physical Network

Source IP = A   Source Port = Ephemeral
Dest IP = B   Dest Port = A
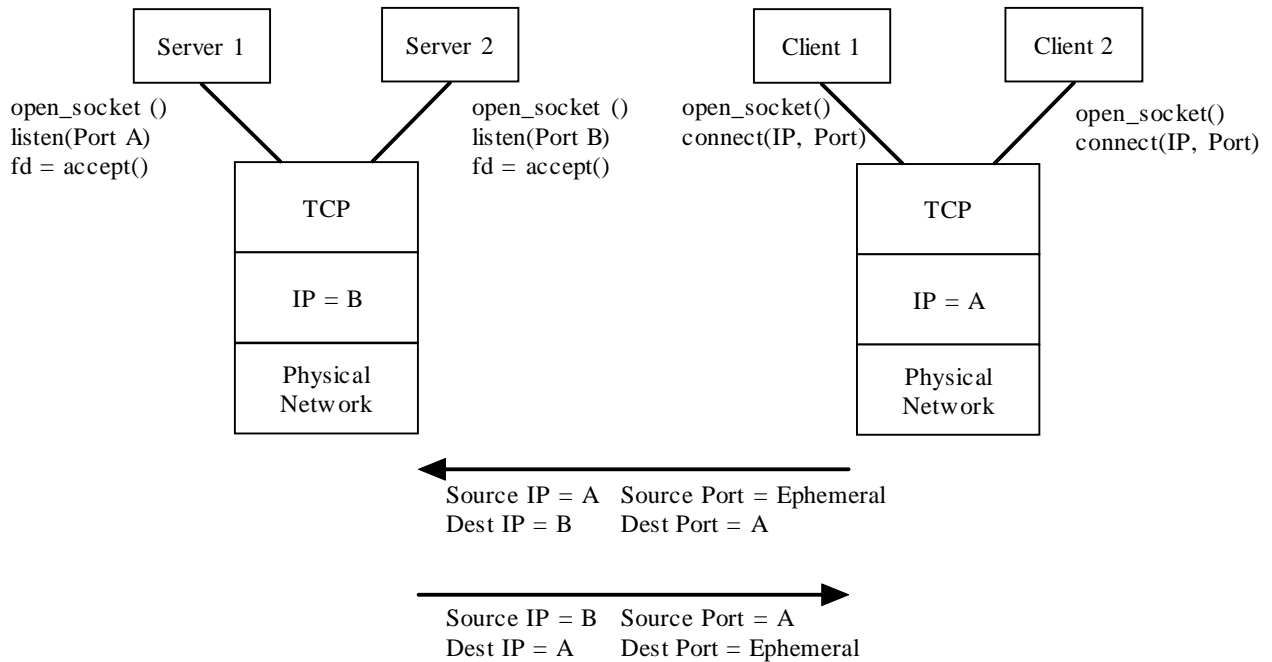
Source IP = B   Source Port = A
Dest IP = A   Dest Port = Ephemeral

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 A
Stream B
Stream C

User 1

User 2

Client A

Web Server W1

The Internet

Stream D

Web Server W2

Client B

Stream E

User 3

User 4
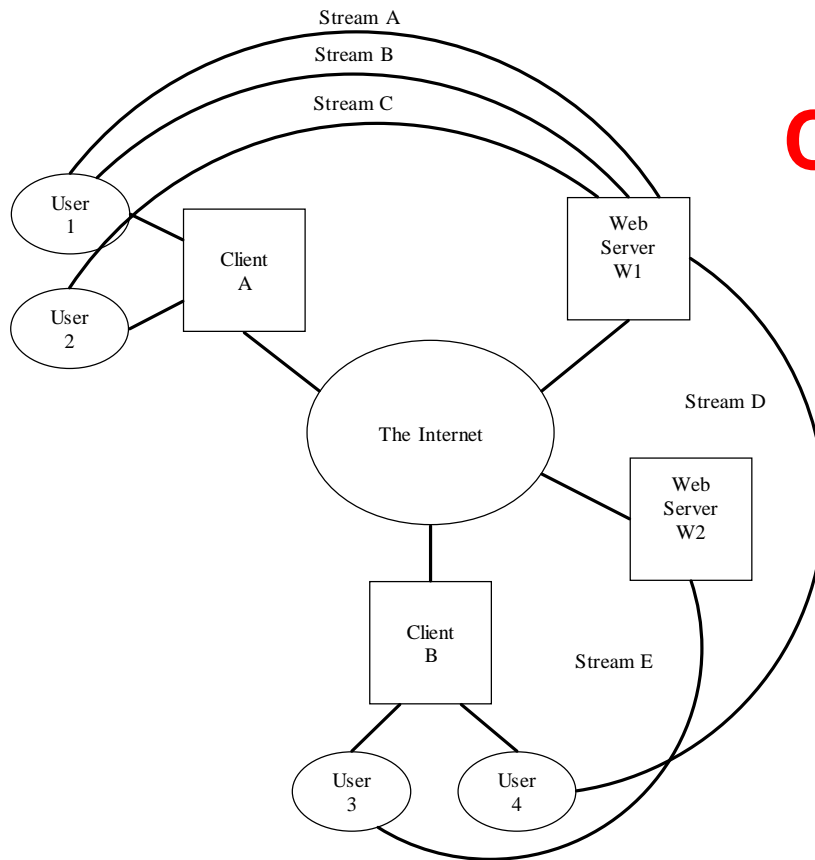
Multiple Connections

| 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
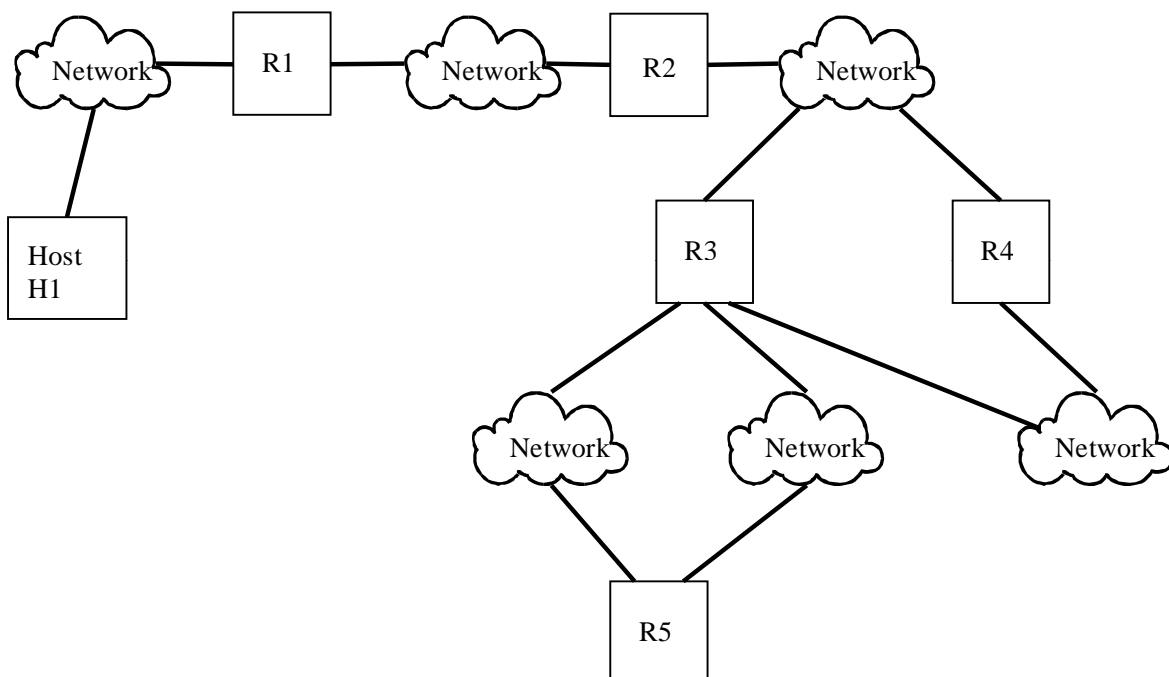
Dynamic vs Static

- 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