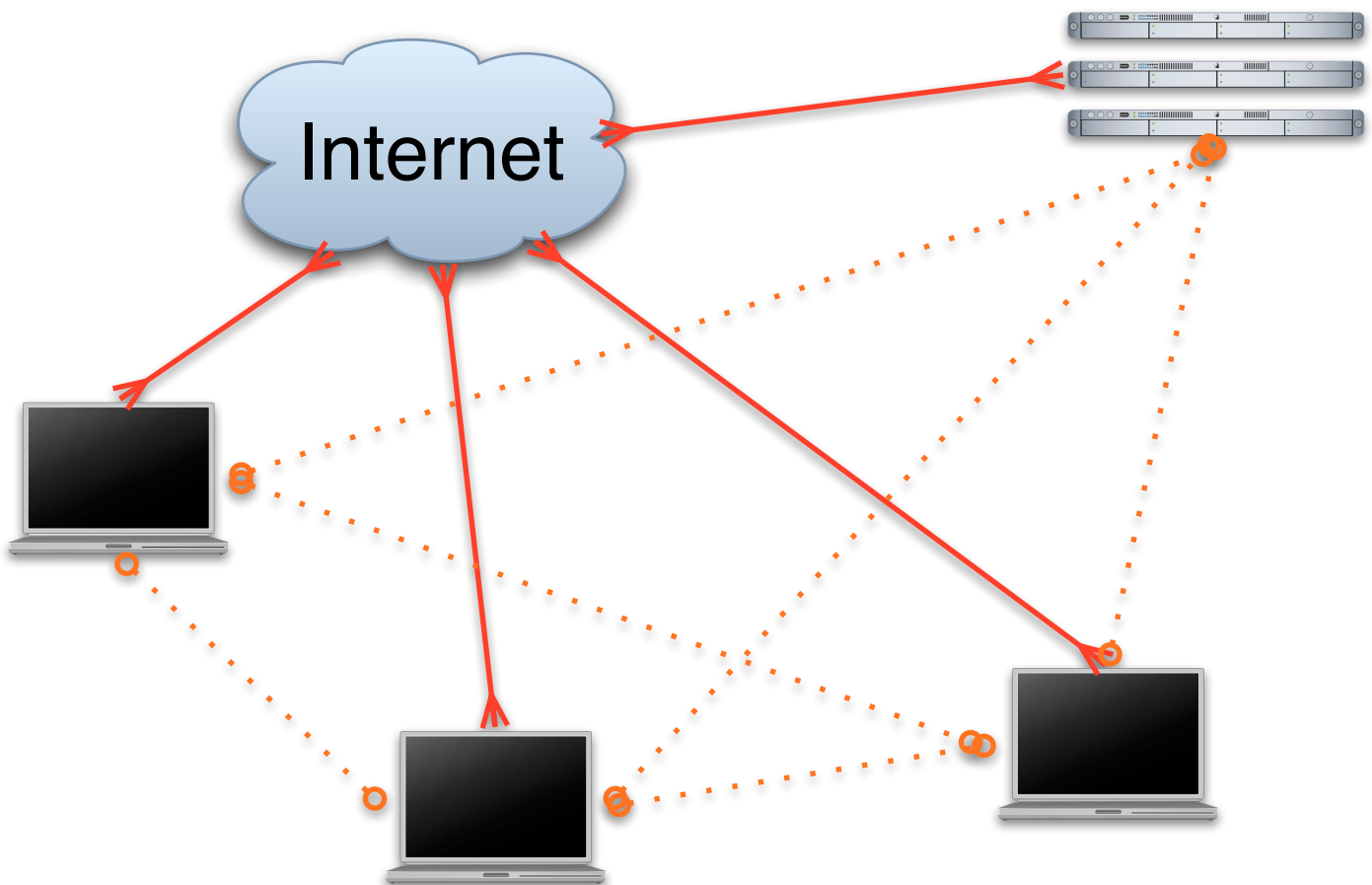# Ch1: Concepts, Protocols, Terminology
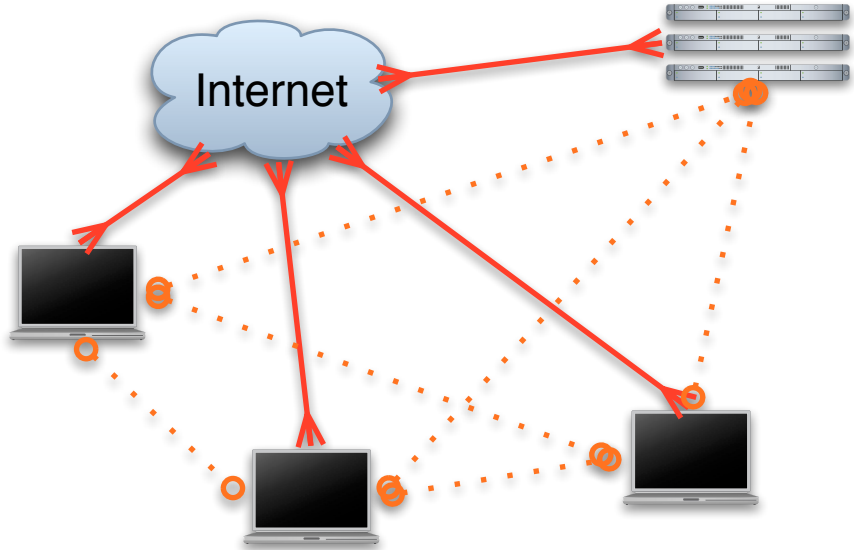
In this chapter:
- sending/receiving messages
- network protocols
- addressing mechanisms
- client/server programming

Internet

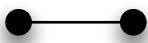# Networks and Graph Theory
(an aside)
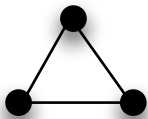

5 node network

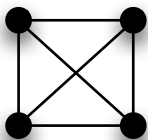## Some Fully Connected Graphs

K1

K2

K3

K4

K5
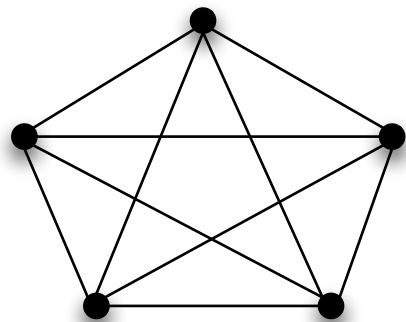
how many edges
for n nodes?

Networking Challenges

- scalability: we can't just directly connect every computer to every other computer on the network

  for n nodes: $\sum i$, $(i = 0, n\text{-}1)$
  $$= n(n\text{-}1)/2 \text{ edges}$$

- routing: finding a path from source to destination

- protocols:
  - break up large messages
  - send messages in pieces
  - send along one or more paths
  - reassemble messages as the pieces arrive
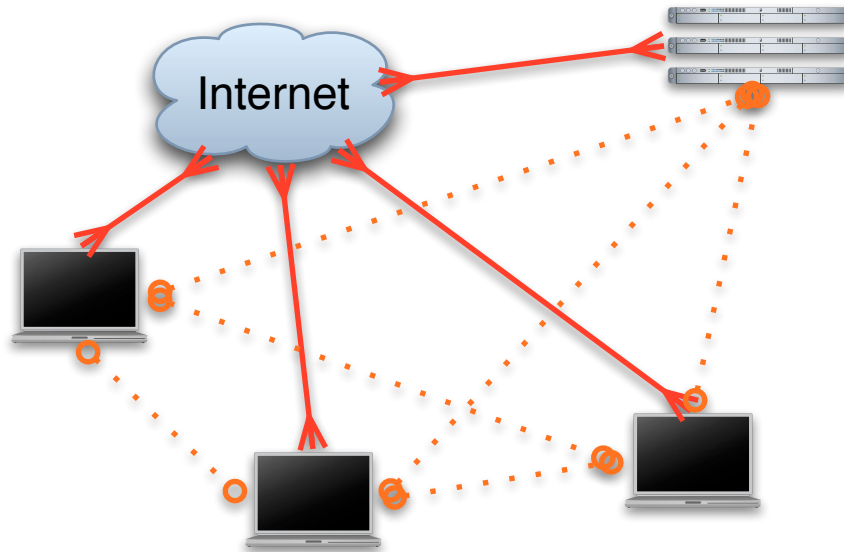
1.1 Clients, Servers, and Peers

- Servers provide services (what services?)

- Clients use services (how?)

- Peers (simulated only)

1.3 The Internet and IP Addresses

• An internet is a network of networks

• IP: "Internet Protocol" (a network
    communication protocol)

• The Internet: the world's largest
  IP-based network

• Every computing device on the
  Internet has its own unique
  IP address

• IP address: e.g., 143.229.6.42
  quad notation: n.n.n.n
  where each n is an 8-bit number
  (range: 0 to 255; 00 to FF)

1.2 Ports and Sockets

- Port:
  - a logical connection to a computer
  - range: $1 \leq$ port# ≤ 65535
  - std services: $1 \leq$ port# ≤ 1023

- Socket:
  - a communication endpoint
  - an abstract concept; not hardware
  - client creates a socket on its end
  - server creates a socket on its end

1.4 Internet Services, URLs and DNS

- Services are provided by a computer with an IP address

- A computer, in general, could provide many services

- Each service is associated with a port number

- "Famous" port numbers:
  - SSH, 22 (secure shell)
  - smtp, 25 (simple mail transfer prot)
  - HTTP, 80 (hypertext transfer prot)
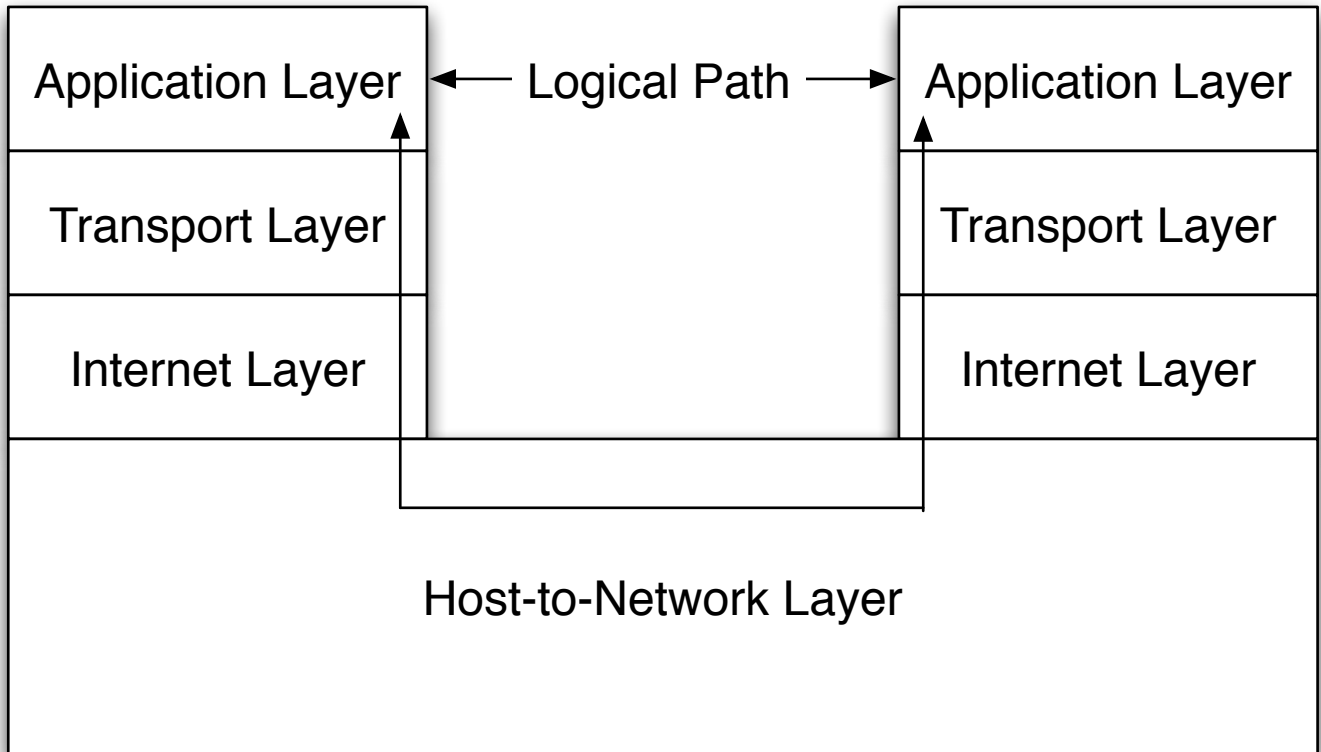 - POP3, 110 (post office prot v.3)

1.4 Internet Services, URLs and DNS

- Since most people can't remember
  big numbers very well...

- DNS: Domain Name System
  -- a mapping from a string to a num
  -- e.g. www.cs.vassar.edu maps to
          143.229.6.42

- Can refer to a computer's port via
  its domain name just as with its
  IP address

The 4-layer network model
(Fig. 1.1, p. 6)

Application Layer	← Logical Path →	Application Layer
Transport Layer		Transport Layer
Internet Layer		Internet Layer
Host-to-Network Layer		

1.5 TCP

Transmission Control Protocol

- Transport Layer
- error-checking/correcting
- reliable
- takes more time to ensure reliability:
  - -- all packets arrive, and put into correct order

1.6 UDP

User Datagram Protocol

- Transport Layer
- no error-checking/correcting
- unreliable: no guarantee of packet arrival or order of arrival
- fast!
- e.g., streaming, live feeds