Lecture 1

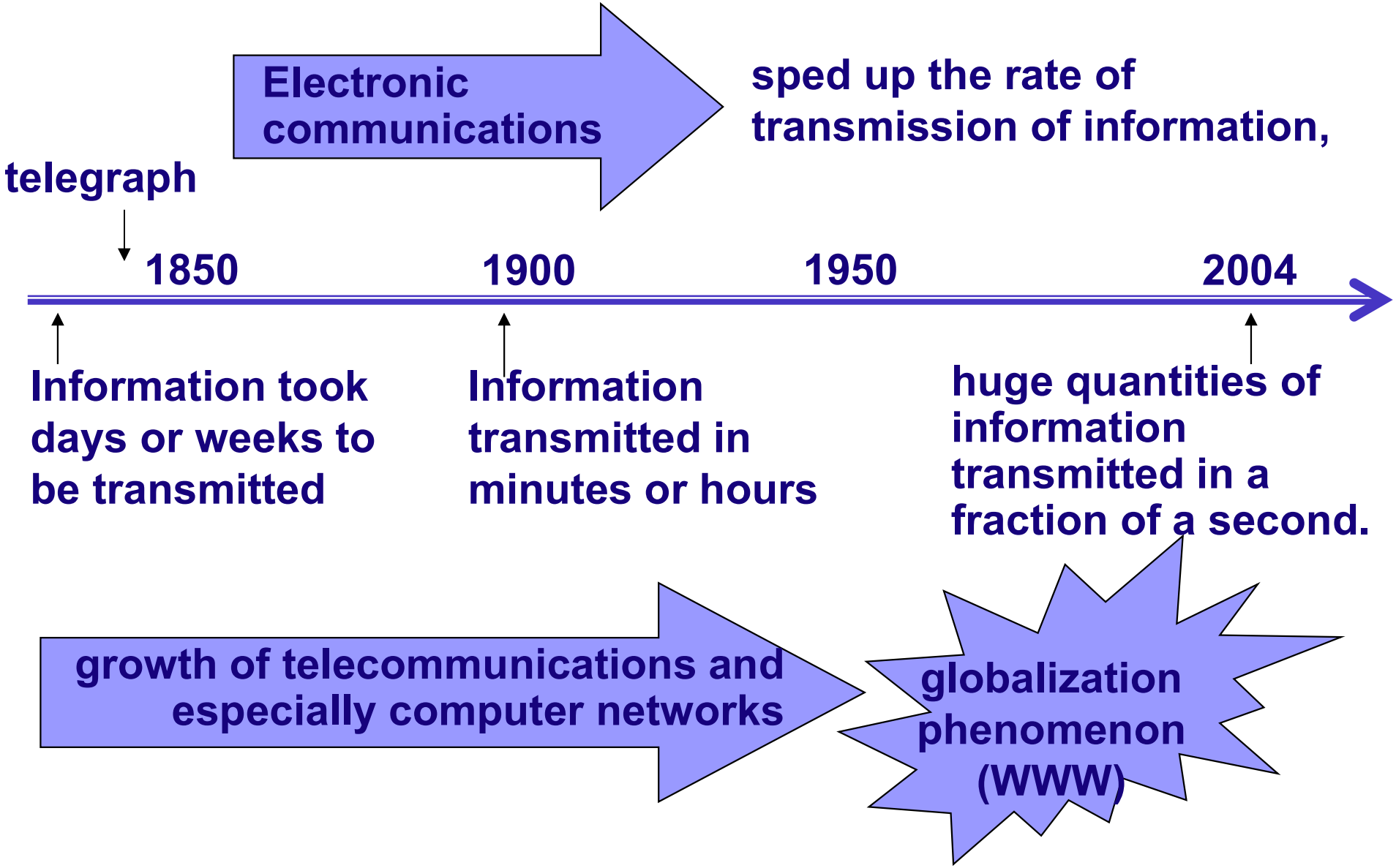
# Introduction to Communications and Networking

(Computer Networks -(CC431)

# Outline

- Brief history
  - Communications, and the Internet
- Data Communications Networks
  - Network components, network types
- Network Models
  - OSI model, Internet model, Layers
- Network Standards
  - Standards making, common standards
- Future Trends
  - Pervasive networking, integration of voice, video, and data, new information services

# Collapsing Information Delay



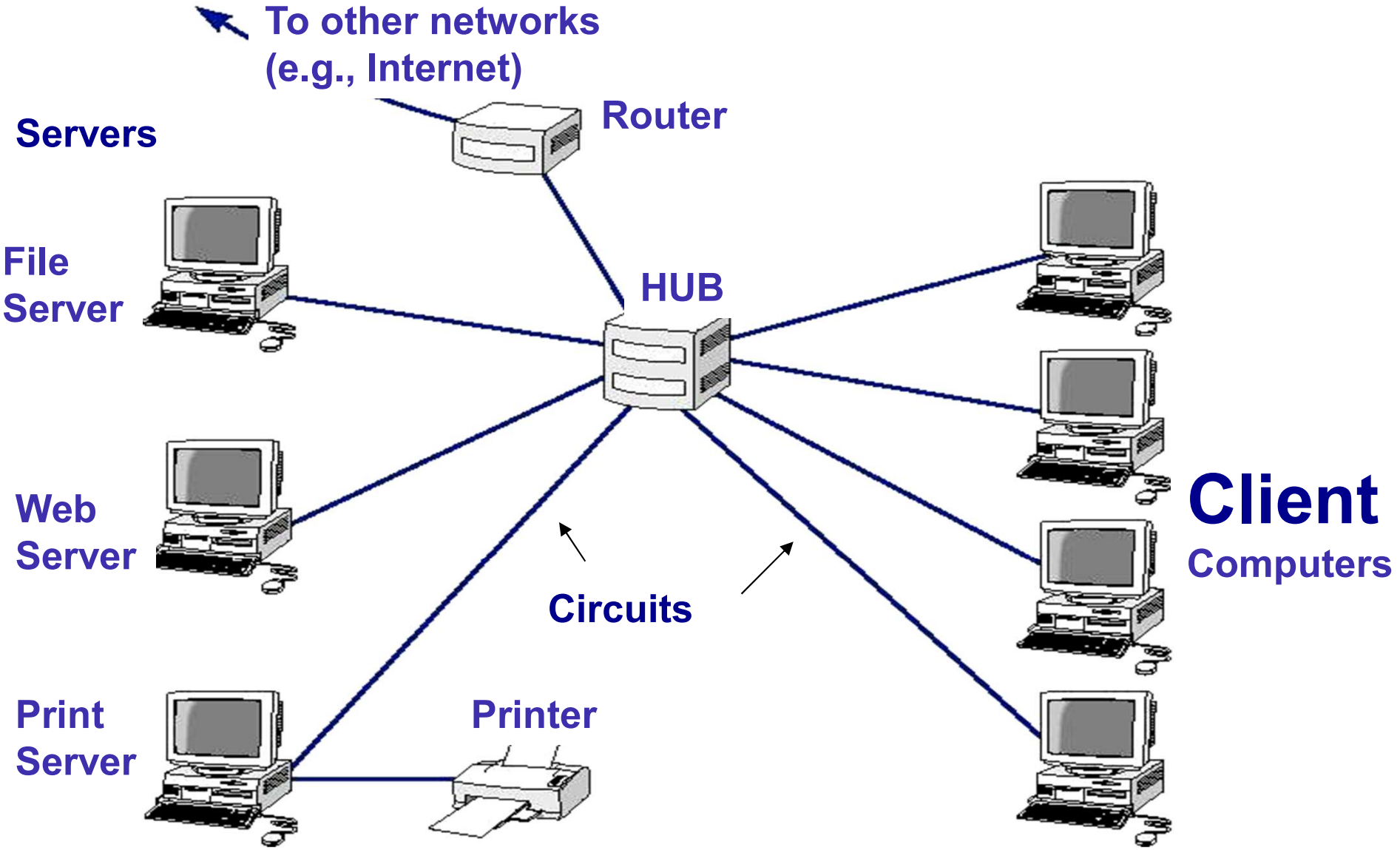
# Three Faces of Networking

- **Fundamental concepts of networking**
  - How data moves from one computer to another over a network
  - Theories of how network operate
- **Technologies in use today**
  - How theories are implemented, specific products
  - How do they work, their use, applications
- **Management of networking technologies**
  - Security
  - Network Design
  - Managing the network

# Network Types (based on Scale)

- Local Area Networks (LANs) - room, building
  - a group of PCs that share a circuit.
- Backbone Networks - less than few kms
  - a high speed backbone linking the LANs at various locations.
- Metropolitan Area Networks (MAN) - (< few 10 kms)
  - connects LANs and BNs at different locations
  - leased lines or other services used to transmit data.
- Wide Area Networks (WANs) - (> few 10 kms)
  - Same as MAN except wider scale

# Components of a Local Area Network



# Intranet vs. Extranet

Both are **private networks**, unlike the **Internet**, whic
publicly accessible.

- Intranet
  - **IN**side the organization
  - A LAN that uses the Internet technologies
  - Open only those inside the organization
  - Example: insurance related information provided to employees over an intranet

- Extranet
  - **EX**Tended access outside the organization
  - A LAN that uses the Internet technologies
  - Open only those invited users outside the organization
  - Accessible through the Internet
  - Example: **Suppliers and customers accessing inventory information in a company over an extranet**

# Intranet vs. Extranet

| Feature | Intranet | Extranet |
|---|---|---|
| **Access** | Only authorized members **inside the organization** | Authorized **people outside the organization** as well |
| **Purpose** | Internal communication and resource sharing | Secure collaboration with external partners |
| **Users** | Employees, managers, internal staff | Employees + suppliers, customers, partners, etc. |
| **Security** | Restricted to the organization | Restricted, but allows selected outsiders |
| **Example** | University portal where faculty access internal documents | University system that allows an external training organization to access selected student information |
| **Internet** | Usually uses web technologies but is private | Uses Internet technologies with controlled external access |

Used for **internal communication and resource sharing** **secure communication & resource sharing with authorized external users**

# Intranet vs. Extranet

Both are **private networks**, unlike the **Internet**, which is publicly accessible.

**Intranet or Extranet**

•A hospital's internal employee portal → ……

•A hospital portal where an authorized insurance company can access specific patient/claims information → ……

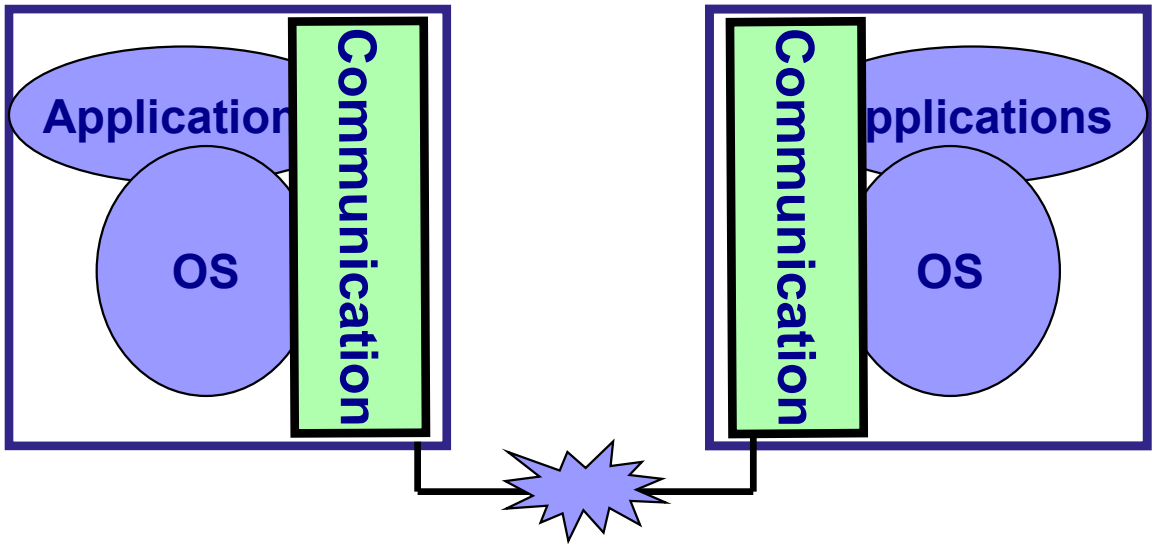
# Intranet vs. Extranet

**Exercise:**

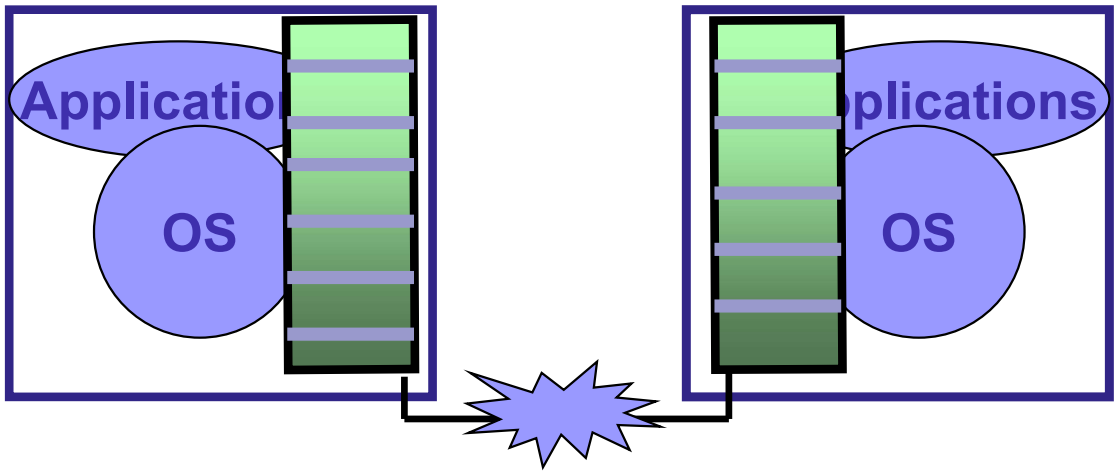
**Complelet using Internet, Intranet, or Extranet for each case:**

1. Employees of a company use a private website to access internal HR documents.
2. A customer uses Google to search for information.
3. A company gives one of its suppliers access to a specific part of its internal system.
4. University employees access internal policies through a private portal.
5. Anyone can access a public news website.
6. A manufacturer allows its distributors to check product availability through a secure portal.
7. Employees share files and announcements through the company's internal network.
8. A student uses Wikipedia to research a topic.

# Implementation of Communications Functions




Single layer implementation




**Multi layer implementation**

-Breaking down into smaller components

-Easier to implement

# Multi-layer Network Models

- The two most important such network models: OSI and Internet
- **Open Systems Interconnection Model**
  - Created by International Standards Organization (ISO) as a framework for computer network standards in 1984
  - **Based on 7 layers**
- **Internet Model**
  - Created by DARPA originally in early 70's
  - Developed to solve to the problem of internetworking
  - **Based on 5 layers**
  - Based on Transmission Control Protocol/ Internet Protocol (TCP/IP) suite

# 7-Layer Model of OSI

| Physical | DataLink | Network | Transport | Session | Presentation | Application |
|---|---|---|---|---|---|---|

Please Do Not Touch Steve's Pet Alligator

- Application Layer
  - set of utilities used by application programs
- Presentation Layer
  - formats data for presentation to the user
  - provides data interfaces, data compression and translation between different data formats
- Session Layer
  - initiates, maintains and terminates each logical session between sender and receiver

# 7-Layer Model of OSI

- Transport Layer
  - deals with end-to-end issues such as segmenting the message for network transport, and maintaining the logical connections between sender and receiver
- **Network Layer**
  - **responsible for making routing decisions**
- Data Link Layer
  - deals with message delineation, error control and network medium access control
- Physical Layer
  - defines how individual bits are formatted to be transmitted through the network

# Internet's 5-Layer Model



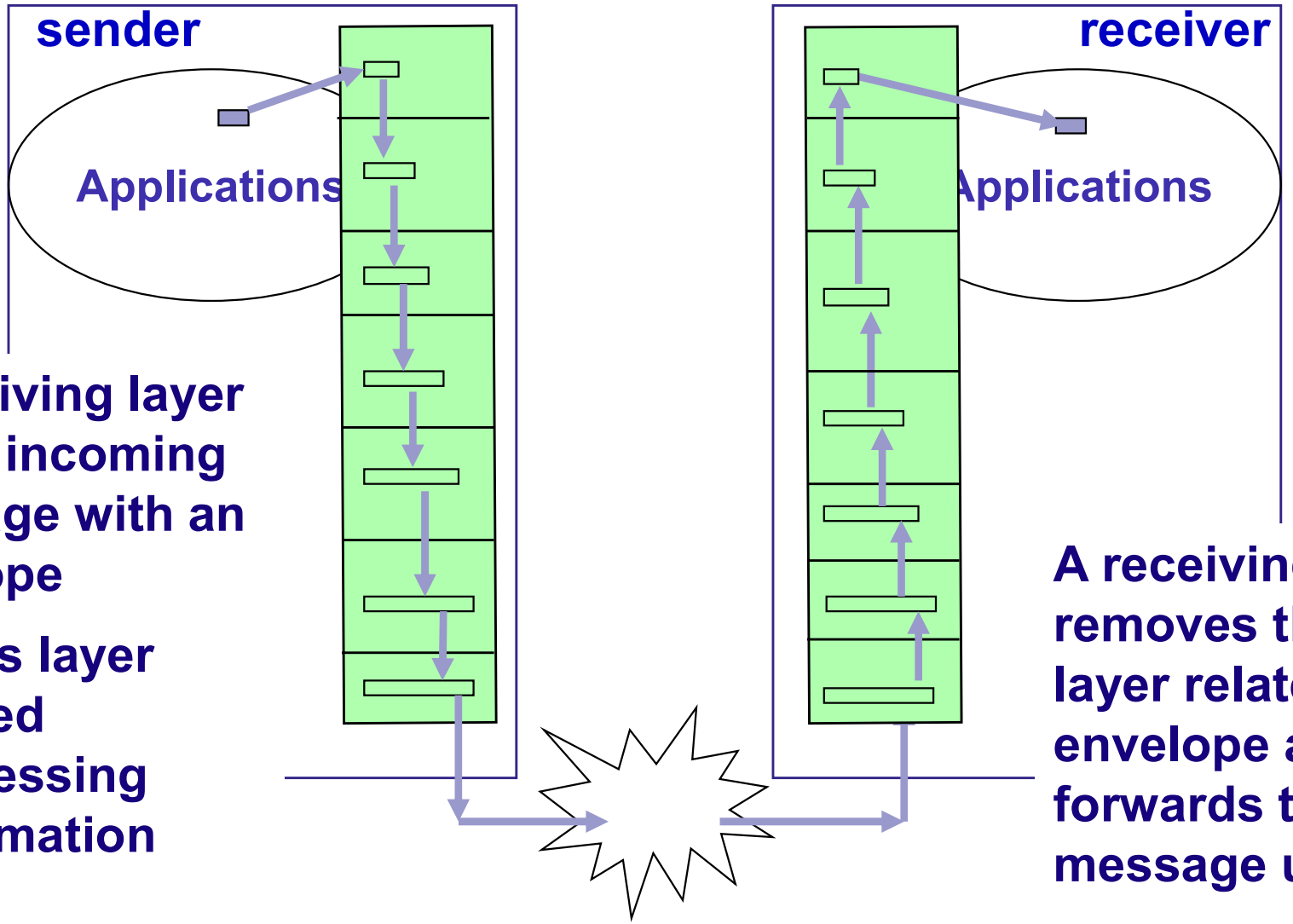

Please Do Not Touch Alligator

- Application Layer
  - used by application program
- Transport Layer
  - responsible for establishing end-to-end connections, translates domain names into numeric addresses and segments messages
- Network Layer - same as in OSI model
- Data Link Layer - same as in OSI model
- Physical Layer - same as in OSI model

# Comparison of Network Models

| OSI Model | Internet Model | Groups of Layers |
|---|---|---|
| 7. Application Layer | 5. Application Layer | ***Application Layer*** |
| 6. Presentation Layer | | |
| 5. Session Layer | | |
| 4. Transport Layer | 4. Transport Layer | ***Internetwork Layer*** |
| 3. Network Layer | 3. Network Layer | |
| 2. Data Link Layer | 2. Data Link Layer | ***Hardware Layer*** |
| 1. Physical Layer | 1. Physical Layer | |

# Message Transmission Using Layers



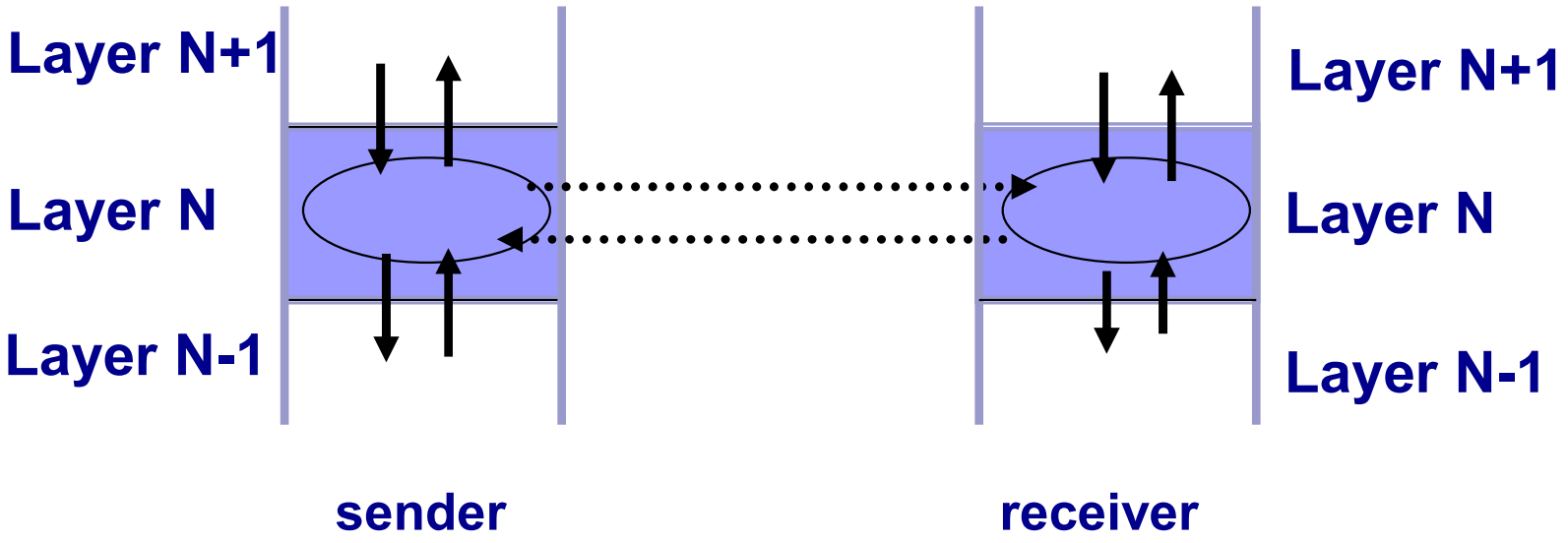

A receiving layer wraps incoming message with an envelope

- Adds layer related addressing information

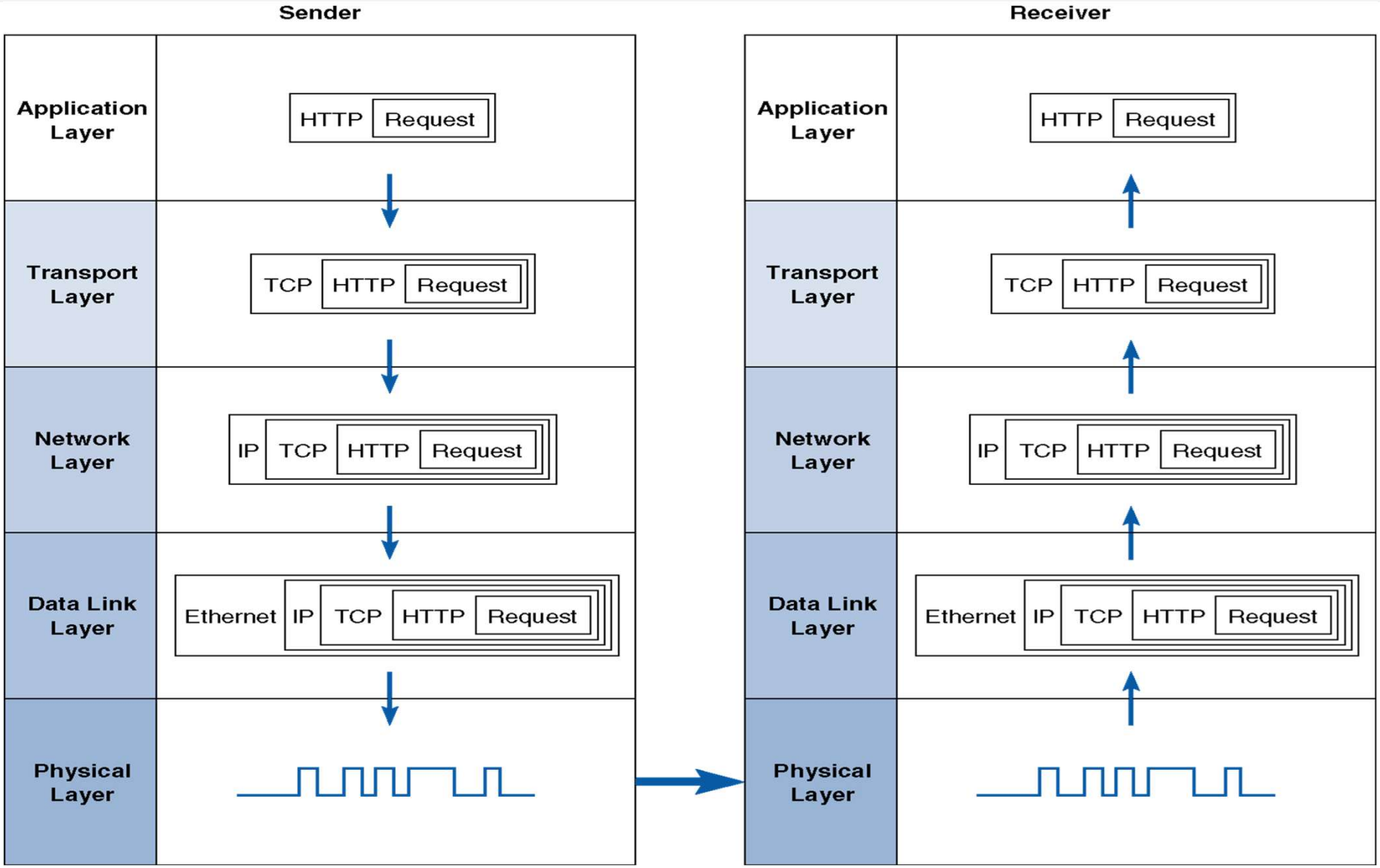
A receiving layer removes the layer related envelope and forwards the message up

# Protocols

- Used by Network model layers
- Sets of rules to define how to communicate at each layer and how to interface with adjacent layers



# Message Transmission Example



# Standards

- **Importance**
  - Provide a “fixed” way for hardware and/or software systems (different companies) to communicate
  - Help promote competition and decrease the price
- **Types of Standards**
  - Formal standards
    - Developed by an industry or government standards-making body
  - De-facto standards
    - Emerge in the marketplace and widely used
    - Lack official backing by a standards-making body

# Major Standards Bodies

- **ISO (International Organization for Standardization)**
  - Technical recommendations for data communication interfaces
  - Composed of each country's national standards orgs.
- **ITU-T (International Telecommunications Union –Telecom Group**
  - Technical recommendations about telephone, telegraph and data communications interfaces
- **ANSI (American National Standards Institute)**
  - Coordinating organization for US (not a standards- making body)
- **IEEE (Institute of Electrical and Electronic Engineers)**
  - Professional society; also develops mostly LAN standards

# Some Data Comm. Standards

| Layer | Common Standards |
|---|---|
| 5. Application layer | HTTP, HTML (Web)<br>MPEG, H.323 (audio/video)<br>IMAP, POP (e-mail) |
| 4. Transport layer | TCP (Internet)<br>SPX (Novell LANs) |
| 3. Network layer | IP (Internet)<br>IPX (Novell LANs) |
| 2. Data link layer | Ethernet (LAN)<br>Frame Relay (WAN)<br>PPP (dial-up via modem for |
| 1. Physical layer | RS-232c cable (LAN)<br>Category 5 twisted pair (LAN)<br>V.92 (56 kbps modem) |

# Universal Networking

- Means “Network access everywhere”
  - Exponential **growth of Network** use
- Many new types of devices will have network capability
  - Exponential **growth of data rates** for all kinds of networking
- Broadband communications
  - Use circuits with 1 Mbps or higher (e.g., DSL)

# New Information Services

- World Wide Web based
  - Many new types of information services becoming available
    - Services that help ensure quality of information received over www
- Application Service Providers (ASPs)
  - Develop specific systems for companies
    - Providing and operating a payroll system for a company that does not have one of its own
- Information Utilities (Future of ASPs)
  - Providing a wide range of info services (email, web, payroll, etc.) (similar to electric or water utilities)