

Web Systems

Lecture 1

Web System Infrastructure, Protocols, and Applications

Paul I-Hai Lin, Professor of Electrical and Computer Engineering
Technology

Dept. of Computer, Electrical, and Information Technology
College of Engineering, Technology, and Computer Science

<http://www.etcs.ipfw.edu/~lin>

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Web System Infrastructure, Protocols, and Applications

- **Computer Systems:**
 - Client and Server computers, Mobile Devices
 - Client/Server Computing
 - Cloud computing
- **Communications and Networking**
 - Wired, Wireless, Cellular communications
 - Internetworking
 - TCP/IP Protocols and Application Programs
 - Internets, Extranet
- **The Internet Technology**
 - Internet, Web, Packet Switching, TCP/IP Architecture, IP Addresses; Domain Names, DNS, and URLs;

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Web System Infrastructure, Protocols, and Applications

■ The Development of Web

- Web Browsers & Web Servers
 - Search Engine
 - Online Forums and Chat
 - Streaming Media (audio, video, images and pictures)
 - E-commerce, E-business Enterprise app, Social media
 - E-mail, Text Messaging, Multimedia messaging
- Web 2.0 and Services
 - Podcasting, Wikis, Music and Video Services, VoIP, IPTV, Online software, Web Services

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The Internet

■ Internet

- A TCP/IP networked, distributed information system
- A collection of computer networks spread around the world
- The name for a group of worldwide client/server-based information system for sharing resources and for communications
- A global, interactive, dynamic, cross-platform, distributed, hypertext and hypermedia information system

■ Examples of Internet-enabled Services

- Email, File downloading and uploading, WWW Client/Server applications

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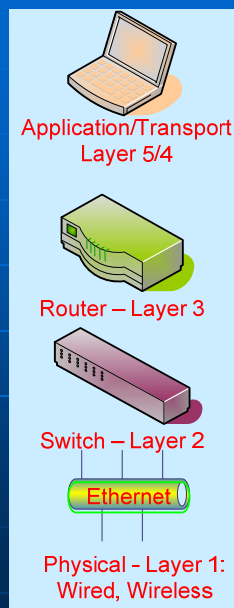
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TCP/IP Protocol Stacks

- TCP/IP RFC (Request for Comments – Standards) - Internet Engineering Task Force, <https://www.ietf.org/>
- System Administration Guide: IP Services, <http://docs.oracle.com/cd/E19253-01/816-4554/ipov-10/index.html>
- TCP/IP Protocol Architecture, <https://technet.microsoft.com/en-us/library/cc958821.aspx>
- TCP/IP Tutorial and Technical Overview - IBM Red Book, 1004 pages <https://www.redbooks.ibm.com/redbooks/pdfs/gg243376.pdf>
- Connecting all the Things in the Internet of Things, May 2017, <https://www.ibm.com/developerworks/library/iot-lp101-connectivity-network-protocols/index.html>

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TCP/IP Protocol – Five Layers

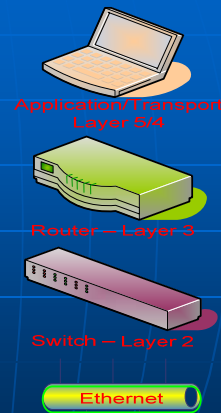


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TCP/IP Layer Model

- **Five Layers** (Encapsulation of data units)

- Layer 5: **Application Layer**
 - Message
- Layer 4: **Transport Layer**
 - Segment or User Datagram
- Layer 3: **Network Layer**
 - Datagram
- Layer 2: **Frame**
 - Data Link Layer
- Layer 1: **Physical Layer**
 - Bits



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Layered Tasks

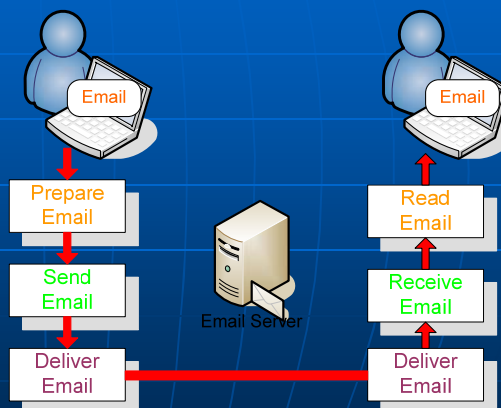
- **Sender, Receiver, and Carrier**

- **Hierarchy**

- Preparation
- Sending
- Delivering

- **Services**

- Higher layer uses lower layer service



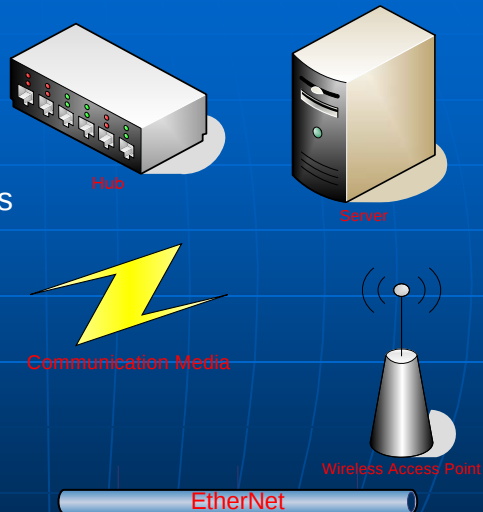
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Networking

■ Involves

- Applications
- Connections of Computers
- Networking Protocols
- Transmission Media
- Networking Devices



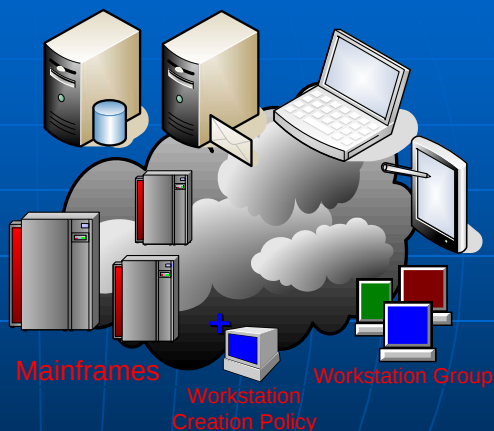
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Computer Networks & Distributed Computer Systems

■ Distributed Processing

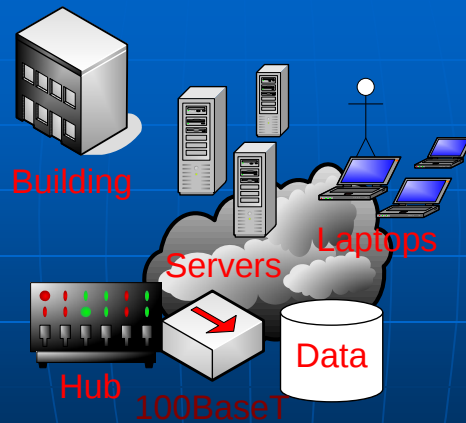
- Loosely connected computer networks
- Many computers collaborating with each other
- Client-Server Computing



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Local Area Networks

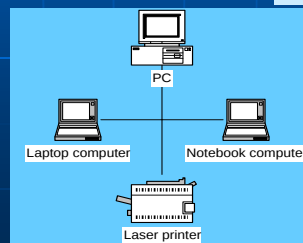
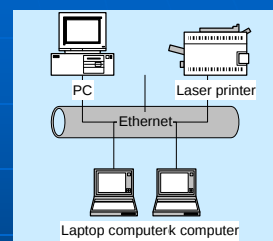


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Multipoint Line Configuration

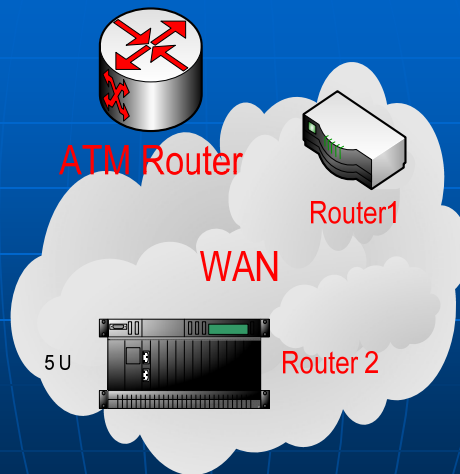
- Multi-drops
- Sharing a single link:
 - Spatially
 - Time sharing



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Wide Area Networks (WANs)



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TCP/IP Protocol Stack

TCP / IP Layers	TCP / IP Protocol Examples
5 – Application Layer	Standard TCP/IP services: ftp, tftp, telnet, ping commands, etc Linux/Unix commands: rlogin, rsh Name services: NIS, DNS (domain name system), Directory services: LDAP File services: NFS Network administration/management: SNMP (simple network management) Route management: RDISC (router discover server protocol), RIP (routing information protocol)
4 – Transport Layer	TCP UDP – User Datagram Protocol SCTP – Reliable connection-oriented transport protocol (for supporting connections between systems with more than one address)
3 – Internet Layer	IPv4, IPv6 ARP – Address Resolution Protocol ICMP – Internet Control Message Protocol
2 – Data Link Layer	PPP – point-to-point protocol IEEE 802.3 (Ethernet) Token Ring
1 – Physical Layer	RS 232, 485, ADSL (Asymmetric Digital Subscriber Line), DSL FDDI (Fiber Distributed Data Interface)

TCP/IP Protocol Suite

- TCP/IP (Transmission Control Protocol/Internetworking Protocol) Layering Model
- TCP/IP Applications
- Domain Names
- TELNET
- FTP (File Transfer Protocol)
- HTTP (HyperText Transfer Protocol)
- HTTPS (secure)
- And more

Internet Applications and Addressing

- Email addressing
- Web server addressing (domain name, IP address)
- TELNET addressing (Web)
- FTP address

Internet Content/File Types

- **Email text**
- **HTML** (Hypertext Markup Language) document
- **Hypertext** -- a technique used to link one word or phrase to another word or phrase in a virtual digital publishing system
- **Hypermedia** -- a technique used in the Web documents to link one media to another media in the forms of words, color graphics, video clip, etc

Internet Content/File Types

- **RTF** (Rich Text) - a super ASCII format established by Microsoft in 1980, can be imported to many other systems such as all Windows word processors, and Macs.
- **Postscript** - a highly sophisticated and precise page description language that is used for formatting and typesetting the print media. It is a proprietary format owned by Adobes

Internet Content/File Types

- **MIME** (Multipurpose Internet Mail Extension) for sending binary data
- **Color Graphics File**
 - **GIF** – Graphics Interchange Format
 - **JPEG** – Joint Photographic Experts Group
- **Video** – Digital motion video
 - .mov – QuickTime Movie (plug-in player)
 - .avi – Audio/Video Interleaved (1992, Microsoft)
 - .mpg – a multimedia standard supporting video, audio, and streaming by Moving Picture Expert Group
- **Embedded Programs: JavaScript, Java Applet**

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Internet Content/File Types

Audio File formats:

- wav – Waveform Audio File for PC (uncompressed, CD-quality sound file)
- mp3 – the MPEG Layer 3 format (Moving Picture Experts Group)
- aiff – Audio Interchange File Format for the MAC
- avi – Audio, Video Interleaved
- au – standard audio file format used by Sun, Unix and Java
- midi: Music Instrument Digital Interface, non-streaming audio file
- Real Audio/Video (not-in-real-time audio/ video) - steaming audio/video

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Enterprise Applications

- **E-commerce**
 - high availability and security
- **Messaging/Groupware**
- **Content monitoring**
- **Security**
- **Network Management**
- **Servers:**
 - Web server
 - File and Print server
 - Database server
 - Mail server

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Enterprise Applications

- **Intranet:**
 - A network within an enterprise uses TCP/IP, HTTP, and other Internet protocols
- **Extranet:**
 - A private secure extension of an enterprise via a corporate intranet that allows you and your customer, vendors, and other business partners to communicate and do business using standard Internet technology.
- **Virtual Private Network (VPN)**
 - A private network uses public telecommunication infrastructure. Privacy is maintained by the use of tunneling protocol, encryption, and other security procedures.

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Internet Web-Enabled Applications

- E-Commerce: B2C (Business to Customer), B2B (Business to Business)
- E-Health
- Smart Power Grid
- Electronics publishing with multimedia technology
- Database applications
- Application Service Provider
- Customer Relationship Management (CRM)
- Supply Chain Management (SCM)
- Enterprise Management (ERP)
- Connected smart infrastructure (smartphone, IoTs, smart cities, etc)

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Internet Web-Enabled Applications

- Distance Education
- Email/Messaging
- Teleconferencing
- Entertainment
- Content Delivery/Advertisement
- Machine Control and Monitoring
- Cloud-based Services

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TCP/IP and Internet

- **Internet**
 - A virtual network system that is formed by using routers to connect physical networks around the world
- **Routers**
 - Special purpose computers dedicated to interconnecting heterogeneous networks
- **Internet Activities Board (IAB)**
 - The Internet Engineering Task Force (IETF)
 - The Internet Research Task Force (IRTF)
 - Request For Comments (RFC) process
 - Proposed Standard - Draft Standard - Full-fledged Standard
 - <http://www.w3.org>

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TCP/IP Applications

- **Ping** (echo service)
- **Telnet** (RFC 854)
 - Remote Login terminal emulation protocol that enable clients to log on to remote hosts on the network
 - Provide access to a computer connected to the network
- **FTP** – File Transfer Protocol, (RFC 959)
 - RFC 959
 - File transfer applications that enables users to transfer files between hosts across network
 - Provides two virtual connections:
 - Data transfer or exchange (port 20, TCP)
 - Control (commands, replies, process updates; port 21, TCP)
- **SMTP** (Simple Mail Transfer Protocol, RFC 821)
 - Mail service

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TCP/IP Applications

- **SNMP** (Simple Network Management Protocol)
 - RFC 821
 - Simple Network Management Protocol) - used to remotely manage and monitor network devices
- **DNS** (Domain Name Services) - domain names to IP address translation

TCP/IP Applications

- **HTTP** (HyperText Transfer Protocol)
 - Establish a connection between the client and server
 - For transferring hypertext (mixed media) documents through WWW
 - Use TCP/IP to support communications between Web servers and Web clients
 - HTTP Communications:
 - A Request from a Web client (client → Server)
 - A Response from the Web server (server → client)
 - Close or terminate the connection

TCP/IP Applications

- **NFS** (Network File System) - File Access Protocol
- **POP** (Post Office Protocol)
- Network News Transfer Protocol
- **RPC** (Remote Procedure Call) - Transfer Procedure (function) Call to another machine
- **TFTP** (Trivial File Transfer Protocol))

Transport Layer

- **Transport Layer**
 - Specify how to ensure reliable transfer
 - Defines two protocols
 - Transmission Control Protocol (connection oriented, reliable)
 - User Datagram Protocol (connectionless, not reliable)

Domain Names

- Human-friendly reference names associated with IP address
- For TCP/IP based network system
- Standardized in hierarchical fashion
- An example:

www.purdue.edu

edu - Top level domain name

purdue - main or network specific domain name

www - Web server

Domain Name System (DNS)

- DNS identifies each host on the Internet
- Similar to the Telephone Number System (country code, area code, number)
- A Name Server using Client-Server model
- Tree Structure (Root, Leaves):
 - Organization (Generic) domain
 - Country domain
 - Reverse
- Unique Domain Name → Unique IP address

Domain Organization

- ICANN (Internet Corporation for Assigned Names and Numbers), <http://www.icann.org/>
 - The authority governs global Internet domain name system
 - com Commercial Organization
 - edu Educational Institution
 - gov Government Institution
 - int International Organization
 - mil Military Groups
 - net Network Support Center
 - org Non-profit Organizations
 - gTLD (Generic Top-Level Domain) Program, <http://www.icann.org/en/registries/>

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Domain Organization

- November 16, 2000: ICANN, the authority that governs global Internet domain name system, has approved seven new domains extensions, in addition to .com, .net and .org:
biz, info, name, pro, aero, coop, museum
- New gTLD (Generic Top-Level Domains), <http://newgtlds.icann.org/en/>
 - Overview (Video), <http://newgtlds.icann.org/en/announcements-and-media/video/overview-en>

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Summary