

TCP/IP

UNIX Network Administration

CIS 68C2-01
Mike Cappella

TCP/IP

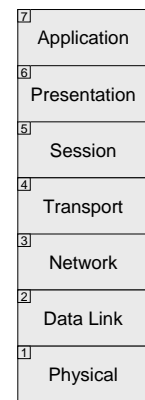
- What is TCP/IP?
 - TCP/IP is a suite of protocols
 - Protocol: formal rules of behavior
 - A sampling of the protocols defined in TCP/IP
 - UDP, TCP, ARP, IPv4, IPv6, ICMP, RARP, ...
 - TCP/IP is TCP over IP
 - Transmission Control Protocol
 - Internet Protocol

TCP/IP

- Features of TCP/IP
 - Open protocol standards
 - Most defined in Request for Comments (RFCs)
 - Others defined in MIL STD and IEN (abandon)
 - Hardware independent
 - TCP/IP can be carried over Ethernet, token ring, dial-up, serial lines, FDDI, etc.
 - Common addressing scheme
 - Each host is uniquely identifiable worldwide
 - Standardized high-level protocols
 - Allows user services

ISO's OSI Networking Model

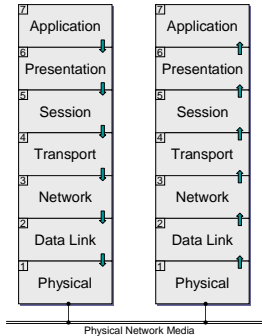
- OSI Reference Model
 - Open Systems Interconnect
 - Defined by International Standards Organization (ISO)
 - Defines 7 Functional Layers
 - Each layer defines a function performed when data is exchanged between cooperating applications across a network
 - Layers are data communication functions
 - Not individual protocols
 - A layer's function may be performed by many protocols



ISO's OSI Networking Model

■ The 7 Layer Stack

- Data travels...
 - ...down the stack to be transmitted to the network
 - ...up the stack when received from the network
- Each layer knows how to pass data to the layer above and below itself
- Each protocol communicates with its peer across network



Updated: 4/11/2002

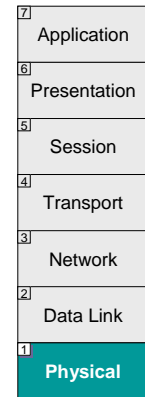
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ISO's OSI Networking Model

■ Layer 1 – Physical Layer

- Defines hardware characteristics of physical media
- Uses existing hardware media standards
 - IEEE 802.3
 - RS232C
 - V.35



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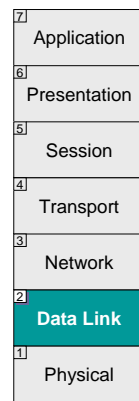
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ISO's OSI Networking Model

■ Layer 2 – Data Link Layer

- Reliable delivery of data across physical network
 - *Reliable* does not mean *guaranteed*
- TCP/IP generally does not use this layer directly



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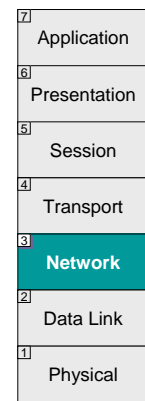
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ISO's OSI Networking Model

■ Layer 3 – Network Layer

- Manages connections across network
- Performed in IP of TCP/IP
 - Isolates upper layers from underlying physical network
 - Handles addressing and data delivery
 - TCP/IP's Network Layer



Updated: 4/11/2002

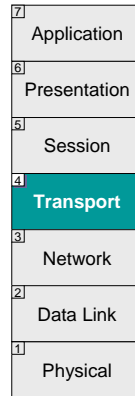
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ISO's OSI Networking Model

■ Layer 4 – Transport Layer

- Guarantees the accurate transmission of data across a network
- Performed in TCP of TCP/IP
- TCP/IP also has UDP
 - No reliability
 - Connectionless



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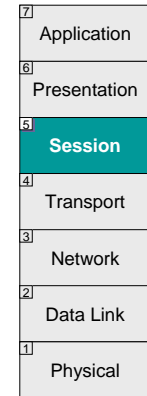
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ISO's OSI Networking Model

■ Layer 5 – Session Layer

- Manages sessions (connections) between applications across network
- Implemented in TCP/IP in Transport Layer
 - Connections are called sockets and ports
 - Not sessions



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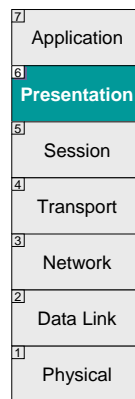
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ISO's OSI Networking Model

■ Layer 6 – Presentation Layer

- Describes how data is represented between two applications
- Required to allow applications to exchange data
- Standard data presentation routines are defined
- Often handled within applications
 - Also handled via TCP protocols such as XDR or MIME



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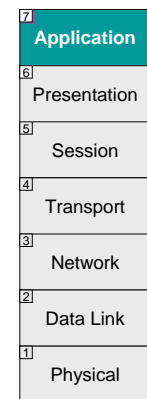
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ISO's OSI Networking Model

■ Layer 7 – Application Layer

- Applications
 - Network applications and utilities
 - Daemons providing network services
- TCP/IP Application
 - Considered anything above Transport Layer



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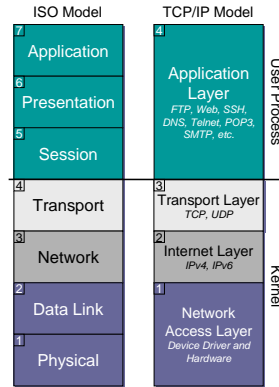
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TCP/IP Protocol Architecture

TCP/IP Architecture

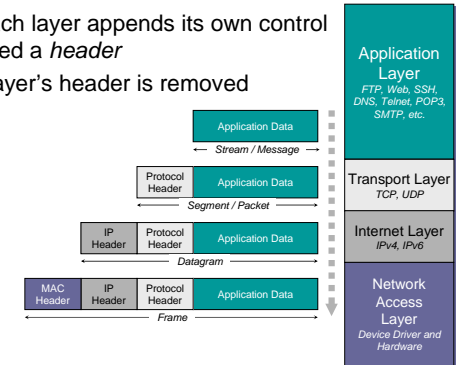
- ❑ OSI is considered overkill
 - Complex and inefficient
- ❑ TCP/IP is described with a simpler model
- ❑ TCP/IP has 3 to 5 layers
 - No universal agreement on exact layer definitions



TCP/IP Protocol Architecture

Data Encapsulation

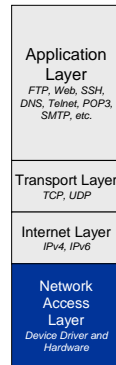
- ❑ On transmit, each layer appends its own control information called a *header*
- ❑ On receive, a layer's header is removed



TCP/IP Protocol Architecture

Network Access Layer

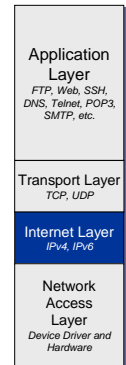
- ❑ Maps IP address into physical address
 - Physical address scheme depends on media
 - RFC 826: Address Resolution Protocol (ARP)
 - ❑ Specifies IP address to Ethernet address translation
- ❑ Encapsulates IP datagram
 - RFC 894: Specifies IP datagram encapsulation for Ethernet networks
 - ❑ MAC header
- ❑ Frame delivery to/from the physical network media



TCP/IP Protocol Architecture

Internet Layer

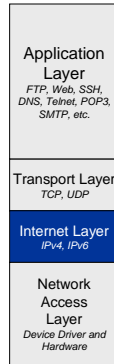
- ❑ RFC 791: Internet Protocol (IP)
 - Defines ...
 - ❑ The datagram
 - Contains the destination IP address
 - ❑ The internet addressing scheme
 - ❑ How data is moved between the network access and transport layers
 - ❑ Routing of datagrams to hosts
 - ❑ Datagram fragmentation and re-assembly
 - IP is a connectionless protocol



TCP/IP Protocol Architecture

■ Internet Layer *(continued)*

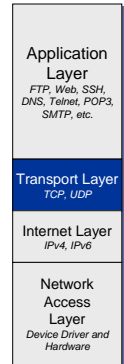
- Routing
 - Systems can only deliver packets to hosts directly attached to same physical network
 - Packets are switched from one network to another by routers (also called gateways)
- Fragmentation and re-assembly
 - IP ensures frames are sized according to the needs of the underlying physical media
 - Frame sizes (Maximum Transmission Unit)
 - Ethernet: 1500 bytes
 - FDDI: 4500 bytes



TCP/IP Protocol Architecture

■ Transport Layer

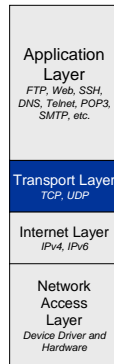
- Delivers data between Internet Layer and Application Layer
- Data delivered to a particular *service*
 - Specified by the destination port in the transport layer header
- Two most common protocols
 - UDP Protocol
 - Best-effort, connectionless datagrams
 - TCP Protocol
 - Reliable, connection-oriented byte-stream



TCP/IP Protocol Architecture

■ Transport Layer *(continued)*

- RFC 768: UDP Protocol
 - Minimal overhead
 - Connectionless datagram delivery
 - Delivery is not guaranteed
- RFC 793: TCP Protocol
 - Reliable
 - PAR – Positive Acknowledgment with Re-transmission
 - Checksums used to ensure correct data delivered
 - Connection oriented (End-to-end connection)
 - Established with three-way handshake
 - Byte Stream
 - TCP data is continuous stream of bytes



TCP/IP Protocol Architecture

■ Application Layer

- Many networking applications and *services*
 - User programs: telnet, ftp, http, etc.
 - Daemons: DNS, NFS, NIS, etc.
- Applications/servers listen to a particular TCP/UDP port number
 - Packet directed using the destination port in Transport Layer's header

