

Protocol Architecture The "Common Language"

Need for Protocols

- **Protocols are a set of rules and conventions.** By enforcing that communicating parties adhere to a common protocol, communication is made possible.

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Network Architecture

- A **Network Architecture** is a structured set of protocols that implement the exchange of information between computers

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Programming the Communication

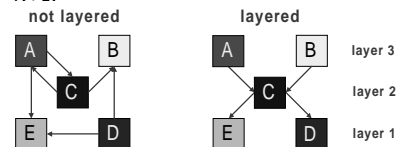
- Any complex programming task is made simpler by using several levels of abstraction
- Abstraction hides the programming details of lower levels
- Communication tasks give rise to standard abstractions
- Committees such as the IETF (Internet Engineering Task Force) are in charge for standardizing the abstractions related to internet communication

The Levels of Abstraction

- Multiple levels of communication abstractions have been defined by standardization bodies
- Each level is enforced by a corresponding protocol
- Each level uses the abstract services of the level below
- Abstraction achieves separation of concerns
 - A protocol needn't know how the lower-level abstractions are implemented and what the higher level abstractions are.

Layered Network Architecture

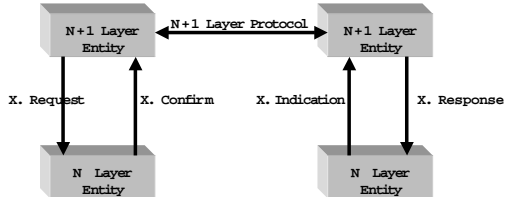
- In a **Layered Network Architecture**, the services are grouped in a hierarchy of layers.
 - A protocol of layer N uses only services of layer N-1.
 - A protocol of layer N provides services only to layer N+1.



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Service Primitives

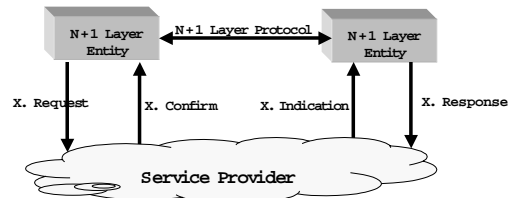
- Assume that some protocol implements service "X".



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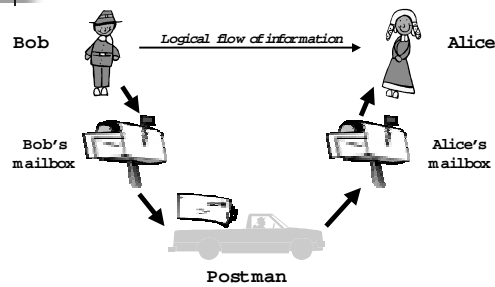
Service Primitives

- Recall:** A layer N+1 protocol entity sees the lower layers only as an abstract service provider



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Example: Sending a Letter



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(Un-)Acknowledged Service

- Unconfirmed service:



- Acknowledged service:



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Protocol Architectures

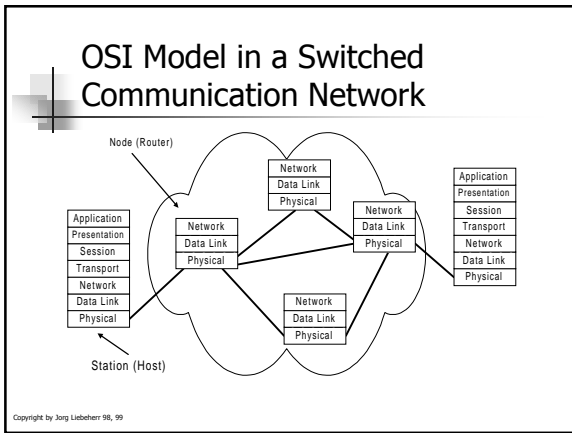
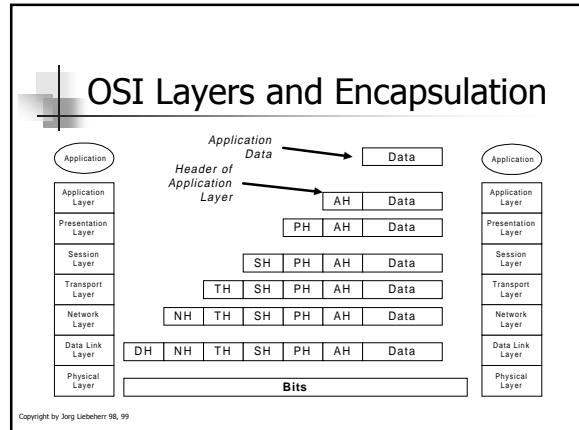
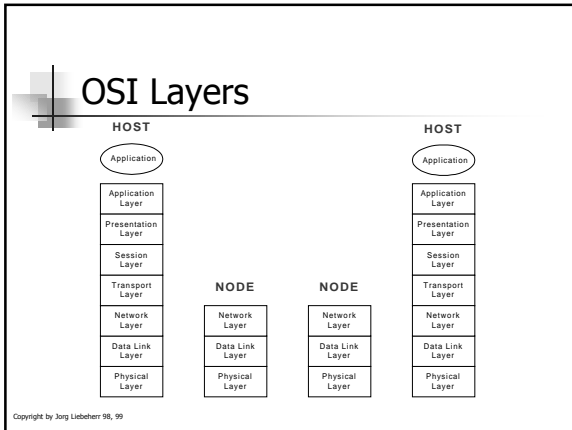
- There are only few protocol architectures that are relevant today:
 - OSI Reference Model
 - TCP/IP Protocols Suite
 - ATM Protocol Stack

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OSI Reference Model

- The OSI model defines seven layers:
 - Layer 7: Application Layer
 - Layer 6: Presentation Layer
 - Layer 5: Session Layer
 - Layer 4: Transport Layer
 - Layer 3: Network Layer
 - Layer 2: Data Link Layer
 - Layer 1: Physical Layer
- Interconnection Media

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- ## A Tour of the OSI Layers
- **Physical Layer (Layer 1):**
 - Converts bits into electrical or optical signals
 - Transmits these signals over the hardware communication medium
 - Example: RS-232
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- ## A Tour of the OSI Layers
- **Data Link Layer (Layer 2):**
 - Reliably transfers frames over a link
 - Performs synchronization, error control, flow control
 - Example: PPP
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- ## A Tour of the OSI Layers
- **Network Layer (Layer 3):**
 - Moves packets inside the network
 - Performs routing, addressing, switching, congestion control
 - Example: IP
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A Tour of the OSI Layers

- **Transport Layer (Layer 4):**
 - Controls delivery of data between hosts
 - Connection management, error control, flow control, multiplexing, TCP, UDP.

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A Tour of the OSI Layers

- **Session Layer (Layer 5):**
 - Support the dialog between cooperating application programs
 - Session management, synchronization
 - Example: RPC

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A Tour of the OSI Layers

- **Presentation Layer (Layer 6):**
 - Data conversion into application format
 - Encryption/decryption
 - Secure sockets

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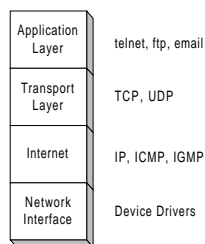
A Tour of the OSI Layers

- **Application Layer (Layer 7):**
 - Provides network access to application programs
 - Everything is application specific
 - Example: File Transfer, Electronic Mail

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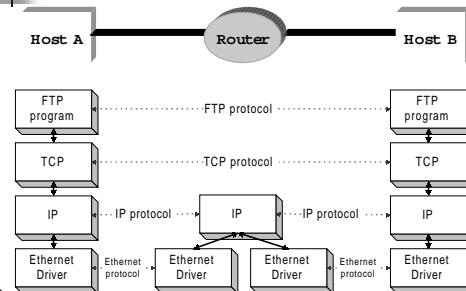
TCP/IP Protocol Suite

- The TCP/IP protocol suite was first defined in 1974
- The TCP/IP protocol suite is the protocol architecture of the **Internet**
- The TCP/IP suite has four layers: Application, Transport, Internet, and Network Interface Layer



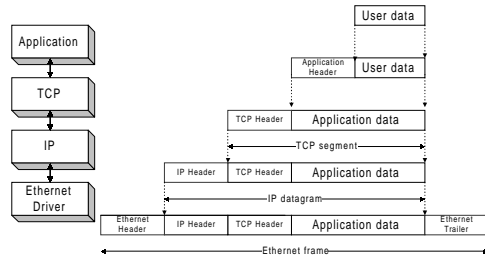
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Example: File Transfer



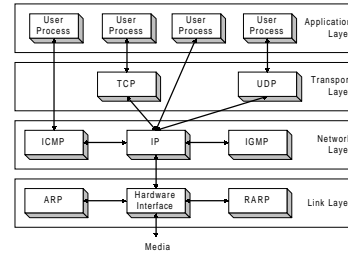
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Encapsulation in the TCP/IP Suite



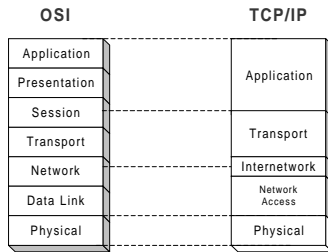
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TCP/IP Protocol Suite



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Comparison of OSI Model and TCP/IP Suite



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