

**AOT
LAB**

Agent and Object Technology Lab
Dipartimento di Ingegneria dell'Informazione
Università degli Studi di Parma



Computer Network

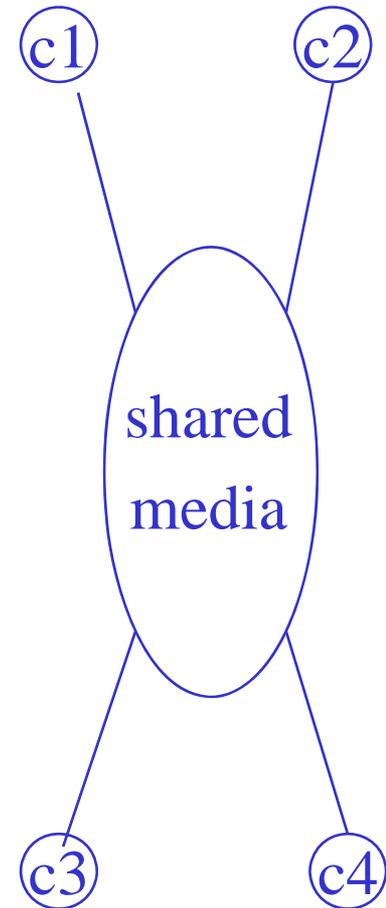
Packet Transmission

Prof. Agostino Poggi

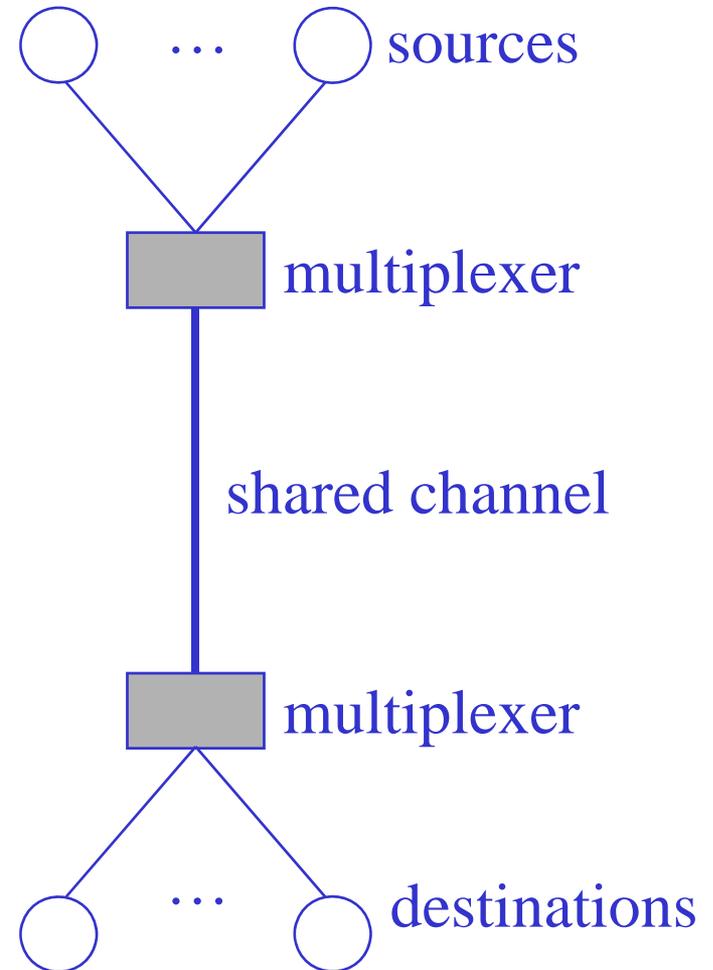
- ◆ Individual connection per pair of computer is useful
 - Flexible throughput
 - Limited synchronization between computers
 - Good security and privacy

- ◆ Individual connection per pair of computers is not reasonable
 - Installing wires is time and money consuming
 - Maintaining wires is money consuming

- ◆ Solution is a shared communication channel
- ◆ Computers must be coordinated to access to the shared channel
- ◆ Coordination requires communication and the time required depends on the distance
- ◆ Shared channel is used for local network

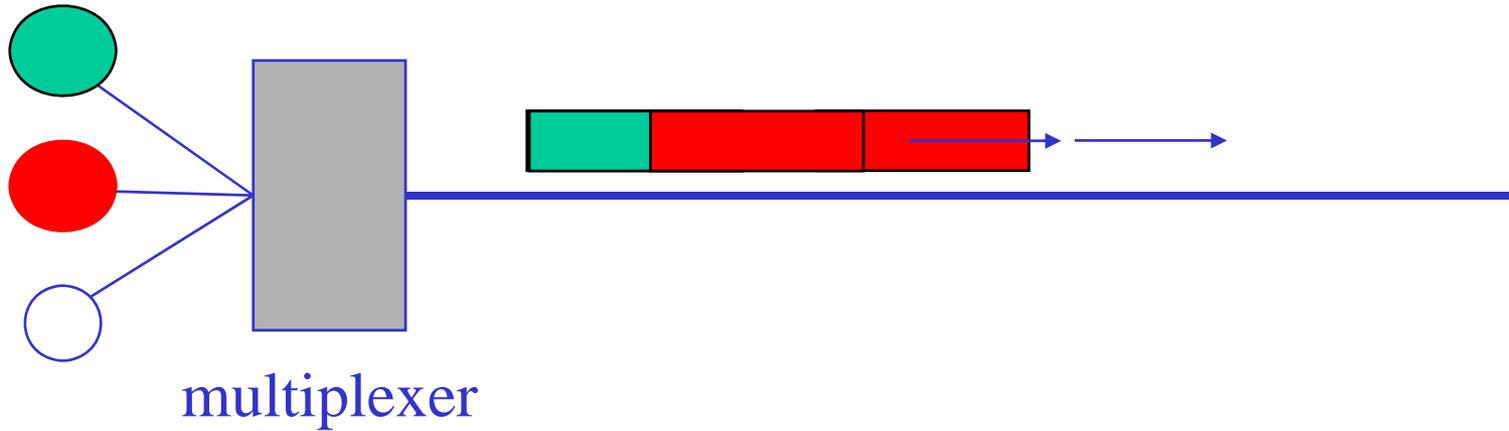


- ◆ Multiple signals with data can be carried on same medium without interference
- ◆ Carrying multiple signals on one medium is called multiplexing

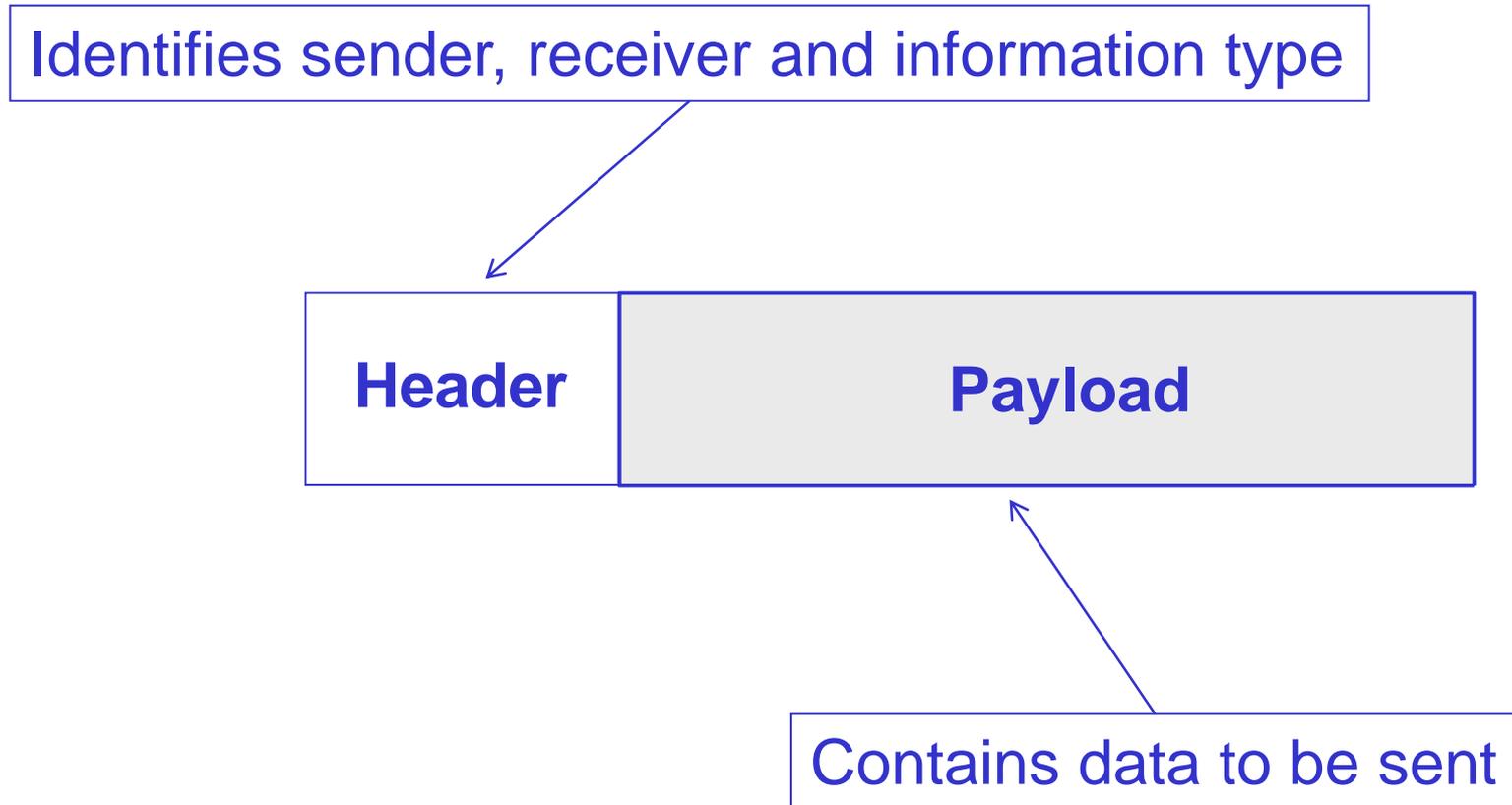


- ◆ Multiplexing prevents interference
- ◆ Each destination receives only data sent by corresponding source
- ◆ Two basic types
 - Time Division Multiplexing (TDM)
 - Frequency Division Multiplexing (FDM)
- ◆ FDM is called Wave Division Multiplexing when applied to light
- ◆ Some dialup modem use multiple carriers to improve performance

- ◆ A shared communication channel must ensure that all the computers have fair access to its resources
- ◆ Fairness can be guaranteed
 - Divide data into small unit called packets
 - Allow each computer opportunity to send a packet before any station send another
- ◆ This solution is a form of TDM



- ◆ Packet size and form depend on the network type
- ◆ A packet must contains information about sender, receiver and about the type of its content
- ◆ A packet for a particular technology is called frame
- ◆ Frame beginning and end are usually marked by special sequences of bits (tags)



- ◆ Conflicts between tags and data are managed through bit/byte stuffing techniques
- ◆ For example, if the tag is 01111110
 - Sender
 - Whenever it encounters five consecutive ones in the data stream
 - It automatically adds a zero into the outgoing stream
 - Receiver
 - When it sees five consecutive incoming ones followed by a zero
 - It automatically removes the zero

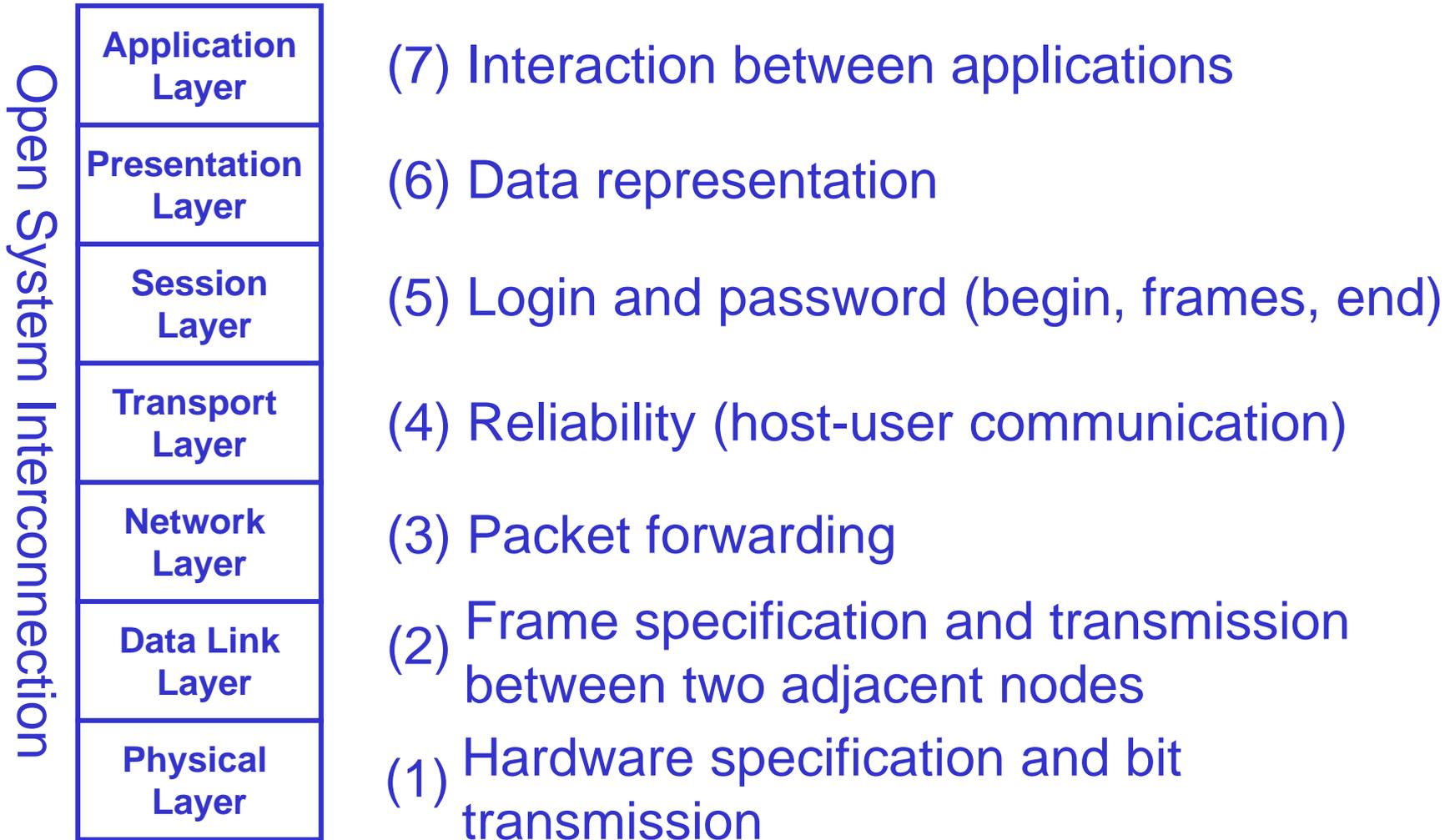
- ◆ Communication hardware provides mechanisms to transfer bits from one point to another
- ◆ Using raw hardware to communicate is analogous to programming using machine code
- ◆ Computers use complex software that provides a high-level communication interface for applications
 - Handling most low-level communication details
 - Managing most communication problems
- ◆ All parties involved in a communication must agree on a set of rules to be used when exchanging data
 - Diplomats call such an agreement a protocol

- ◆ A network protocol defines a "language" of rules and conventions for communication between network devices
- ◆ A protocol includes formatting rules that specify how data is packaged into messages
- ◆ It also may include conventions like message acknowledgement or data compression to support reliable and/or high-performance network communication

- ◆ Hardware is low level
- ◆ Many problems can occur
 - Bits corrupted or destroyed
 - Entire packet lost
 - Packet duplicated
 - Packet delivered out of order
- ◆ Need mechanisms to distinguish among
 - Multiple computers on a network
 - Multiple applications on a computer
 - Multiple copies of a single application on a computer

- ◆ Physical transmission
 - Cable, fiber optic, radio frequency
- ◆ Encoding techniques
 - How do you differentiate between the end of one message and the beginning of another?
- ◆ Network to Network Communication
 - How do you route a message from one computer to another computer a number of hops away?
- ◆ Reliability
 - Messages can get corrupted and lost during transmission

- ◆ Need of different protocols working together
- ◆ Each protocol solves part of communication problem
- ◆ Protocols are designed in layers
 - Each layer provides services to layer above, and 'consumes' services provided by layer below
 - Incoming or outgoing data passes from one module to another
 - Each layer appends/removes an header
- ◆ Known as protocol suite or protocol family



- ◆ Defines the electrical and physical specifications for devices
 - Pins layout, voltages, cable specifications, hubs, repeaters, network adapters, host bus adapters, etc.
- ◆ Its major functions and services are:
 - Establishment and termination of a connection to a communications medium
 - Participation in the process whereby the communication resources are effectively shared among multiple users
 - Modulation, or conversion between the representation of digital data in user equipment and the corresponding signals transmitted over a communications channel

- ◆ The Data Link Layer of the OSI model is responsible for communications between adjacent network nodes
 - Defines procedures for operating the communication links
 - Defines frames packets
 - Detects and corrects packets transmit errors

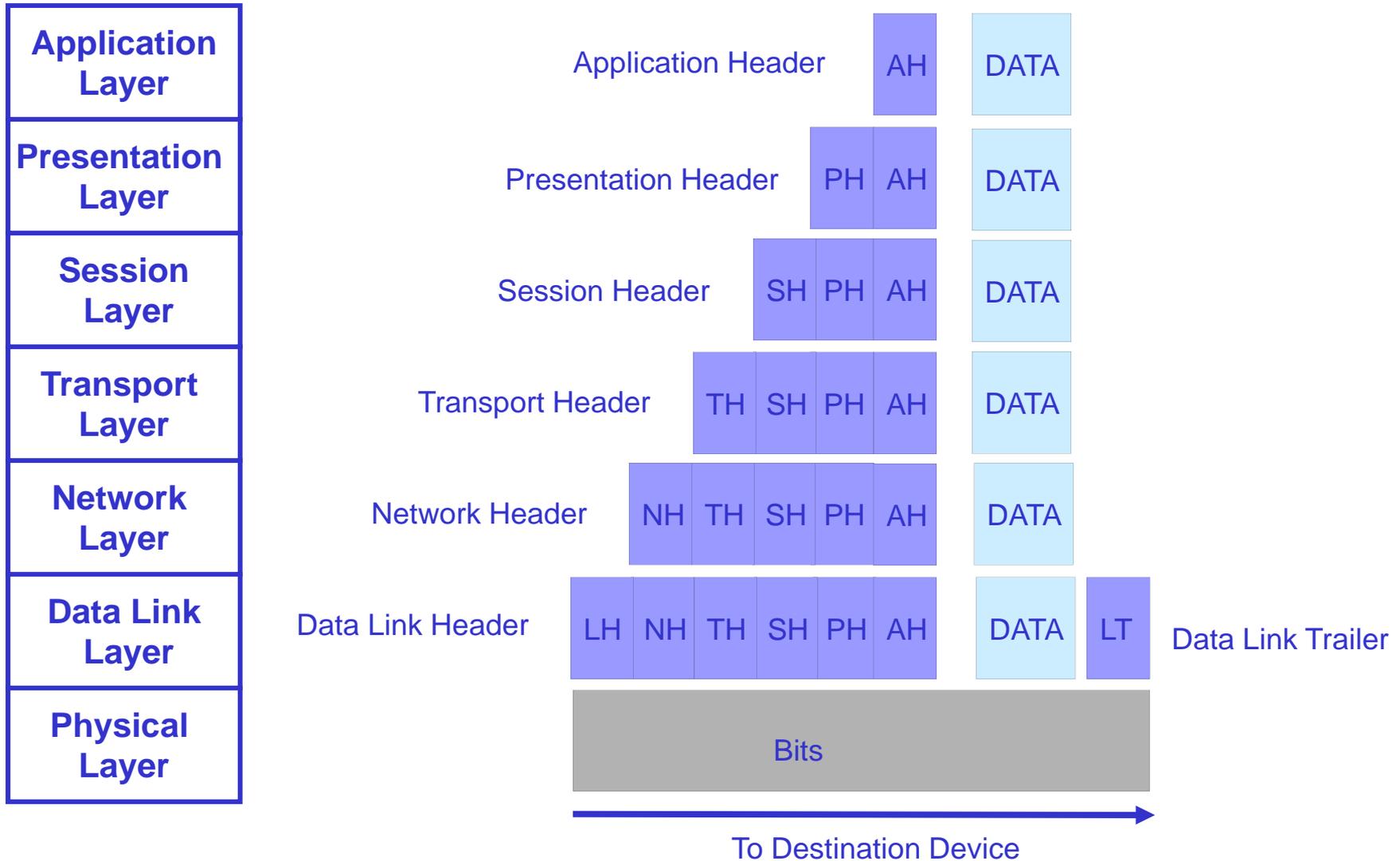
- ◆ Provides the functional and procedural means of transferring variable length data sequences from a source to a destination
 - Provides switching and routing technologies, creating logical paths, known as virtual circuits, for transmitting data from node to node
 - Routing and forwarding are functions of this layer, as well as addressing, internetworking, error handling, congestion control and packet sequencing

- ◆ Provides transparent transfer of data between end users, providing reliable data transfer services to the upper layers
 - Controls the reliability of a given link through flow control, segmentation/desegmentation, and error control
 - Keep track of the segments and retransmit those that fail for protocols that are state and connection oriented

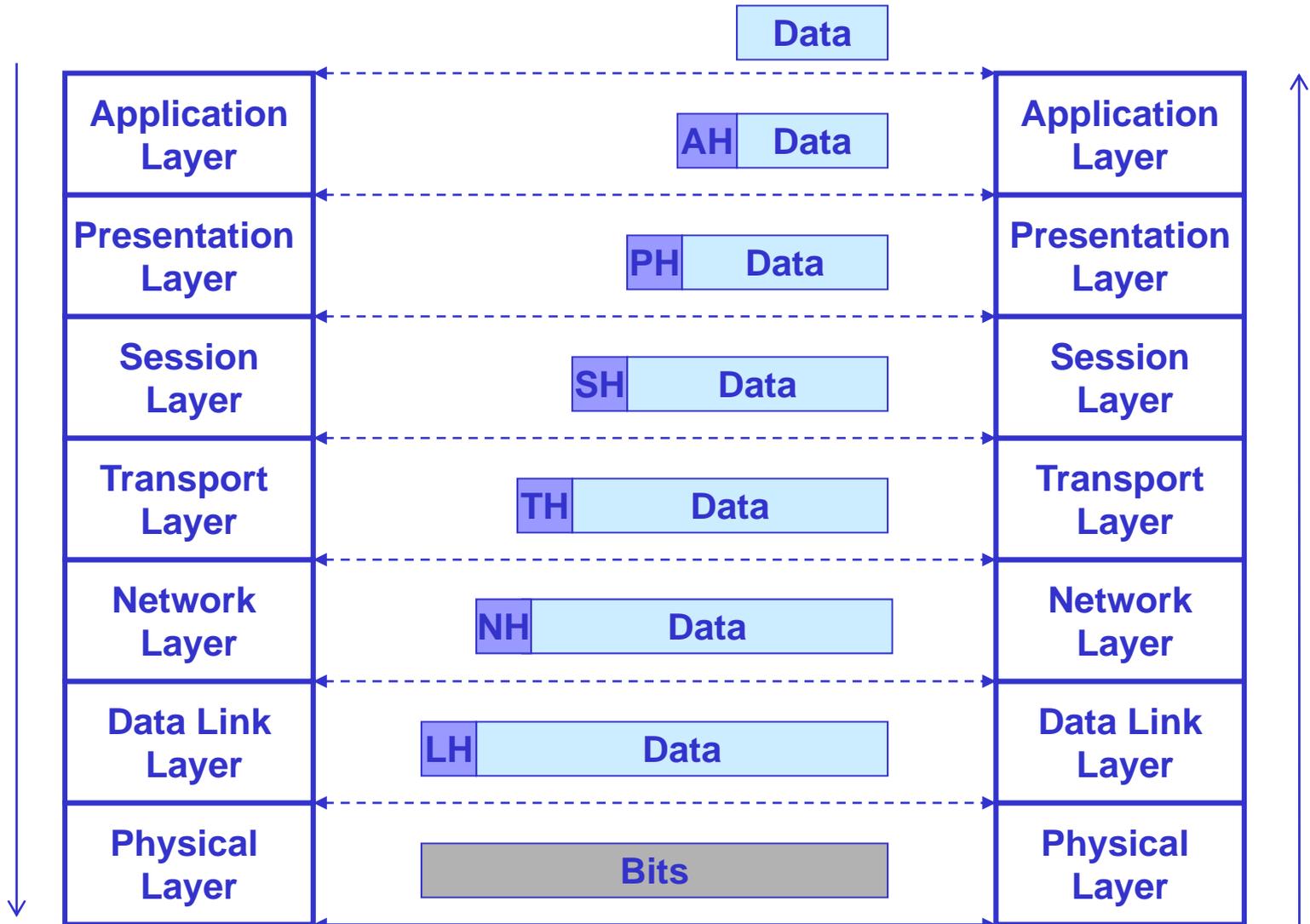
- ◆ Controls the dialogues (connections) between computers
 - Establishes, manages and terminates the connections between the local and remote application
 - Provides for full-duplex, half-duplex, or simplex operation, and establishes check pointing, adjournment, termination, and restart procedures.

- ◆ The presentation layer ensures that the information that the application layer of one system sends out is readable by the application layer of another system
 - If necessary, the presentation layer translates between multiple data formats by using a common format
 - Moreover, it provides encryption and compression of data

- ◆ The application layer provides network services to the user's applications
- ◆ Interacts with software applications that implement a communicating component
- ◆ Its functions typically include identifying communication partners, determining resource availability, and synchronizing communication



Interaction among Layers



- ◆ *Local Area Networks (LAN):* 10m - few km
 - Ethernet/Fast Ethernet/Gigabit Ethernet
 - Token Bus, Token Ring, FDDI
 - Wireless LAN (WLAN, up to a few 100 m)
- ◆ *Metropolitan Area Network (MAN):* 10 - 100 km
 - DQDB
 - FDDI, Resilient Packet Ring
 - Gigabit Ethernet
- ◆ *Wide Area Networks (WAN):* 100 - 10000 km
 - Frame Relay
 - ATM
 - SDH

