Ministry of Higher Education and Scientific Research

Al-Mustaqbal University

College Of Engineering & Technology

Computer Techniques Engineering Department

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Computer Networks Fundamentals

Lecture 6:

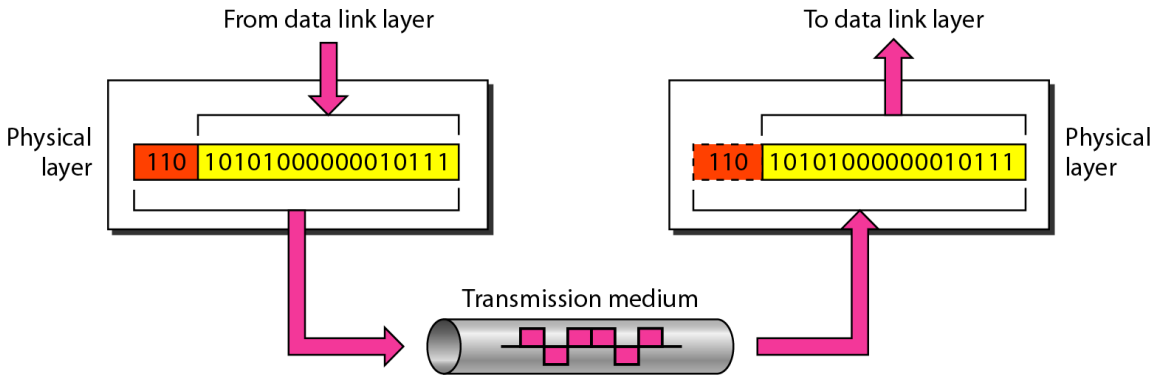
Functions of the Layers

6.1- Functions of the Layers

6.1.1- *Physical Layer*

The physical layer coordinates the functions required to transmit a bit streams over a physical medium. It **deals with** the mechanical and electrical specifications of the primary connections, such as cables, connectors, and signalling options that physically link two nodes on a network.

This first layer receives a data unit from the second layer and puts it into a format capable of being carried by a communications link. It oversees the changing of a bit streams into electromagnetic signals, and their transmission onto and across a medium.



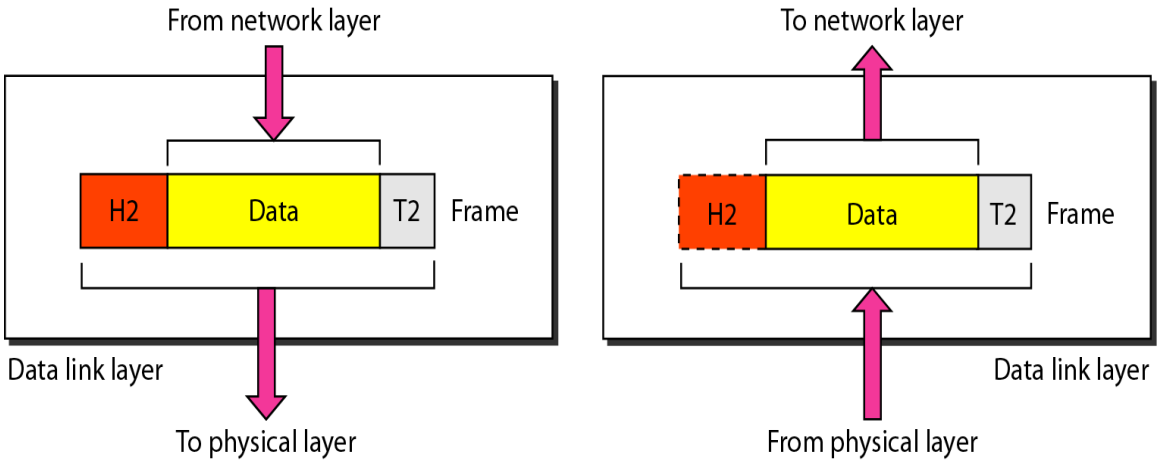
This task requires a number of considerations:

- **Line configuration**: How can two or more devices are linked physically? Are transmission lines to be shared or limited to use between two devices? Is the line available or not?
- **Data transmission mode:** It does transmission flow one-way or both ways between two connected devices. Or does it alternate?
- **Topology:** How network devices arranged? Do they pass data directly to each other or through an intermediary? And by what paths?
- **Signals:** What type of signals is useful for transmitting information?

- **Encoding:** How are bits (0s and 1s) to be represented by available signalling systems? How data are represented by signals?
- **Interface**: What information must be shared between two closely linked devices to enable and facilitate communication? What is the most efficient way to communicate that information?
- **Medium**: What is the physical environment for the transmission of data?
- **Multiplexing:** Using a single physical line to carry data between many devices at the same time.

6.1.*2- Data link Layer*

The data link layer is **responsible for** delivering data units (groups of bits) from one station to the next *without errors*. It accepts a data unit from the third layer and **adds** meaningful bits to the beginning (header) and end (trailer) that contain addresses and of control information. A data unit with this additional information called a ***Frame***.

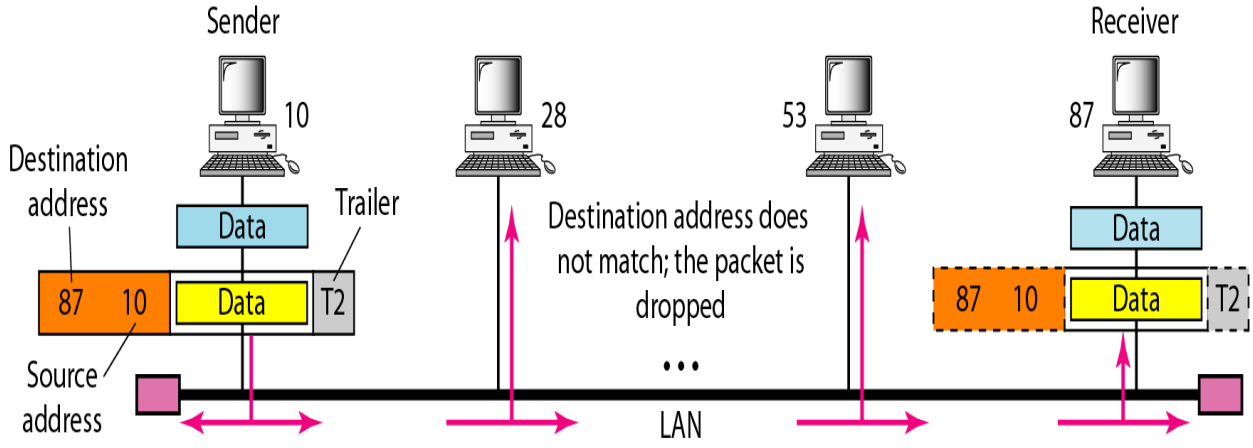


The responsibilities of the data link layer include the following:

- **Node-to-node delivery:** The data link layer is responsible for node-to-node delivery.
- **Physical Addressing:** Headers and trailers added at this layer include the *physical address* of the most recent node and the next intended node.
- **Access control:** When two or more devices connected to the same link, the data-link layer protocols are necessary to determine which device has control over the line at any given time.
- **Flow control:** To avoid overwhelming the receiver, the data link layer regulates the amount of data that can be transmitted at one time. It adds identifying numbers to enable the receiving node to control the ordering of the frames.
- **Error handling:** Data link layer protocols provide for data recovery, usually by having the entire frame retransmitted.

Example:

In Figure below a node with physical address 10 sends a frame to a node with physical address 87. The two nodes connected by a link. At the data link level, this frame contains physical (link) addresses in the header. These are the only addresses needed. The rest of the header contains other information needed at this level. The trailer usually contains extra bits needed for error detection.



6.1.3- ***Network Layer***

The network layer is **responsible for** the *source-to-destination* delivery of a packet across multiple network links. Whereas the data link layer oversees *node-to-node* delivery, the network layer **ensures** that each **packet** gets from its point of origin to its final destination successfully and efficiently.

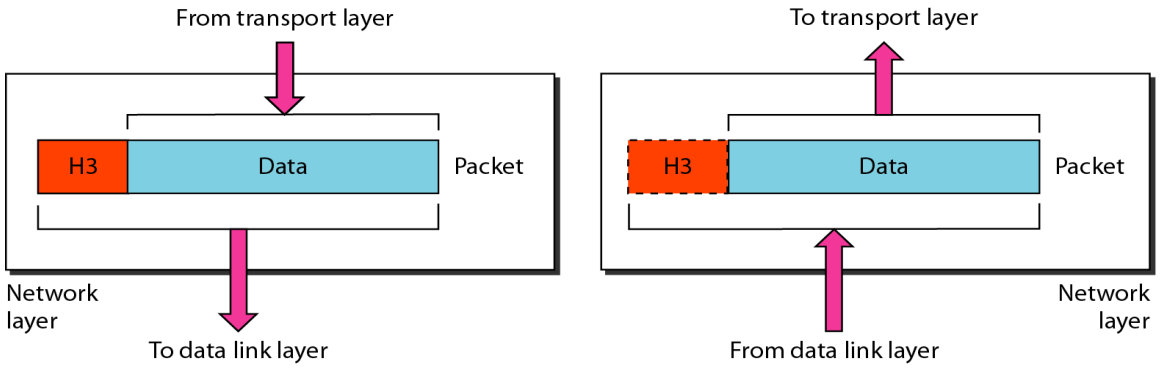
To make such end-to-end delivery possible, the network layer **provides** two related services: *Addressing and routing***.**

Addressing end devices - In the same way that a phone has a unique telephone number, end devices must be configured with a unique IP address for identification on the network. An end device with a configured IP address is referred to as a host.

Routing means selecting the best path for sending a packet from one point to another, when more than one path is available.

Routing requires the addition of a header that includes, among other, information, the source and destination addresses of the packet. These addresses are different from the physical (node) addresses included in the data link header; it is known as a ***logical address***.

Physical addresses are of current to next node only; they are changes as a frame move from one node to another. Whereas the logical addresses are those for the original source to the final destination, and do not changed during packet transmission.

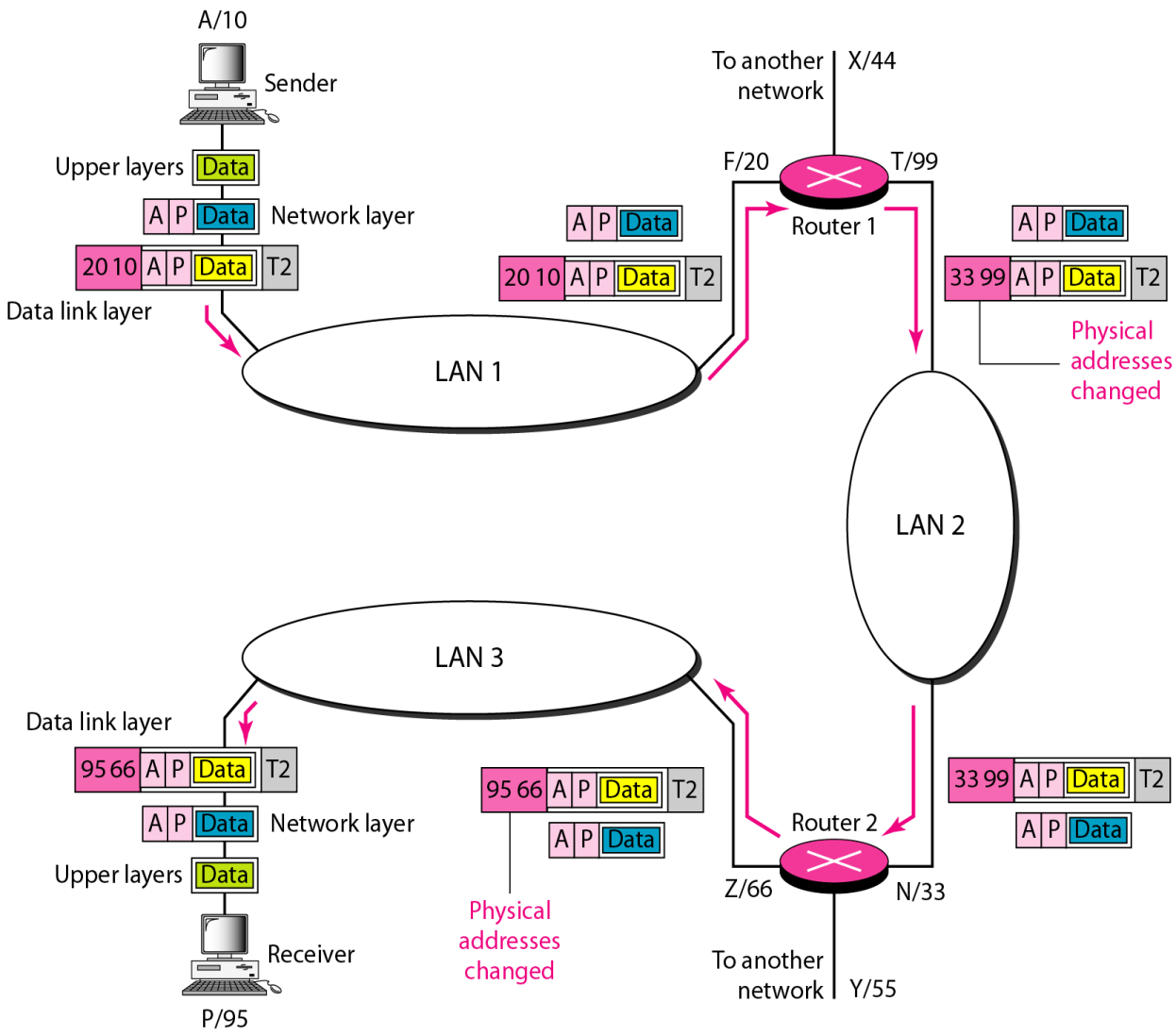


Specific responsibilities of the network layer include the following:

- **Source-to-destination delivery:** Moving a packet (best effort) from its point of origin to its intended destination across multiple network links.,
- **Logical addressing:** Inclusion of the source and destination addresses in the header.
- **Routing:** Deciding which of multiple paths a packet should take.
- **Address transformation:** Interpreting logical addresses to find their physical equivalents.

Example

Now imagine that in Figure below we want to send data from a node with network address **A**, physical address 10, located on one local area network, to a node with a network address **P**, physical address 95, located on another local area network. Because the two devices are located on different networks, we cannot use link addresses only. What we need here are universal addresses that can pass through the boundaries of local area networks. The network (logical) addresses have this characteristic. The packet at the network layer contains the logical addresses, which remain the same from the original source to the destination (A and P. respectively, in the figure). They will not change when we go from network to network. However, the physical addresses will change when the packet moves from one network to another. The box with the R is a router (intemetwork device), which we will discuss later


A/10
Sender
Upper layers
Data
A P Data
Network layer
20 10 A P Data T2
Data link layer
LAN 1
To another network
X/44
F/20
T/99
Router 1
A P Data
20 10 A P Data T2
33 99 A P Data T2
Physical addresses changed
LAN 2
LAN 3
Data link layer
95 66 A P Data T2
A P Data
Network layer
Upper layers
Data
Receiver
P/95
95 66 A P Data T2
A P Data
Physical addresses changed
Router 2
Z/66
N/33
33 99 A P Data T2
A P Data
To another network
Y/55