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Module Practice and Quiz

6.4.1

What did I learn in this module?

Purpose of the Data Link Layer

The data link layer of the OSI model (Layer 2) prepares network data for the physical network. The data link layer is responsible for network interface card (NIC) to network interface card communications. Without the data link layer, network layer protocols such as IP, would have to make provisions for connecting to every type of media that could exist along a delivery path. The IEEE 802 LAN/MAN data link layer consists of the following two sublayers: LLC and MAC. The MAC sublayer provides data encapsulation through frame delimiting, addressing, and error detection. Router interfaces encapsulate the packet into the appropriate frame. A suitable media access control method is used to access each link. Engineering organizations that define open standards and protocols that apply to the network access layer include: IEEE, ITU, ISO, and ANSI.

Topologies

The two types of topologies used in LAN and WAN networks are physical and logical. The data link layer "sees" the logical topology of a network when controlling data access to the media. The logical topology influences the type of network framing and media access control used. Three common types of physical WAN topologies are: point-to-point, hub and spoke, and mesh. Physical point-to-point topologies directly connect two end devices (nodes). Adding intermediate physical

connections may not change the logical topology. In multi-access LANs, nodes are interconnected using star or extended star topologies. In this type of topology, nodes are connected to a central intermediary device. Physical LAN topologies include: star, extended star, bus, and ring. Half-duplex communications exchange data in one direction at a time. Full-duplex sends and receives data simultaneously. Two interconnected interfaces must use the same duplex mode or there will be a duplex mismatch creating inefficiency and latency on the link. Ethernet LANs and WLANs are examples of multi-access networks. A multi-access network is a network that can have multiple nodes accessing the network simultaneously. Some multi-access networks require rules to govern how devices share the physical media. There are two basic access control methods for shared media: contention-based access and controlled access. In contention-based multi-access networks, all nodes are operating in half-duplex. There is a process if more than one device transmits at the same time. Examples of contention-based access methods include: CSMA/CD for bus-topology Ethernet LANs and CSMA/CA for WLANs.

Data Link Frame

The data link layer prepares the encapsulated data (usually an IPv4 or IPv6 packet) for transport across the local media by encapsulating it with a header and a trailer to create a frame. The data link protocol is responsible for NIC-to-NIC communications within the same network. There are many different data link layer protocols that describe data link layer frames, each frame type has three basic parts: header, data, and trailer. Unlike other encapsulation protocols, the data link layer appends information in the trailer. There is no one frame structure that meets the needs of all data transportation across all types of media. Depending on the environment, the amount of control information needed in the frame varies to match the access control requirements of the media and logical topology. Frame fields include: frame start and stop indicator flags, addressing, type, control, data, and error detection. The data link layer provides addressing used to transport a frame across shared local media. Device addresses at this layer are physical addresses. Data link layer addressing is contained within the frame header and specifies the frame destination node on the local network. The data link layer address is only used for local delivery. In a TCP/IP network, all OSI Layer 2 protocols work with IP at OSI Layer 3. However, the Layer

2 protocol used depends on the logical topology and the physical media. Each protocol performs media access control for specified Layer 2 logical topologies. The Layer 2 protocol that is used for a particular network topology is determined by the technology used to implement that topology. Data link layer protocols include: Ethernet, 802.11 Wireless, PPP, HDLC, and Frame Relay.

6.4.2

Module Quiz – Data Link Layer 🔖

1. What identifier is used at the data link layer to uniquely identify an Ethernet device?

> ⊘ Topic 6.3.0 – Ethernet frames are identified at the data link layer by their MAC addresses, which are unique to each NIC. IP addresses are used at the network layer, and TCP and UDP port numbers are used at the transport layer. Sequence numbers are fields in TCP headers.

○ IP address

○ sequence number

○ TCP port number

○ UDP port number

○ MAC address

2. What attribute of a NIC would place it at the data link layer of the OSI model?

> ⊘ Topic 6.3.0 – The data link layer describes media access and physical addressing. The encoding of a MAC address on a NIC places it at that layer. Ports and cables are placed at the physical layer of the OSI model. IP addresses are placed at the network layer. The TCP/IP protocol stack describes a different model.

○ attached Ethernet cable

○ IP address

(MAC address

○ TCP/IP protocol stack

○ RJ-45 port

3. Which two engineering organizations define open standards and protocols that apply to the data link layer? (Choose two.)

> ⊘ Topic 6.1.0 - The IANA is responsible for overseeing and managing IP address allocation, domain name management, and protocol identifiers. The EIA is an international standards and trade alliance for electronics organizations, and is best known for its standards related to electrical wiring, connectors, and the 19-inch racks used to mount networking equipment. IEEE defines open standards and protocols that apply to the network access layer.

☑ Institute of Electrical and Electronics Engineers (IEEE)

☐ Electronic Industries Alliance (EIA)

☑ International Telecommunication Union (ITU)

☐ Internet Assigned Numbers Authority (IANA)

☐ Internet Society (ISOC)

4. What is true concerning physical and logical topologies?

> ⊘ Topic 6.2.0 - Physical topologies show the physical interconnection of devices. Logical topologies show the way the network will transfer data between connected nodes.

○ Physical topologies are concerned with how a network transfers frames.

(Logical topologies refer to how a network transfers data between devices.

○ The logical topology is always the same as the

physical topology.

◯ Physical topologies display the IP addressing scheme of each network.

5. What method is used to manage contention-based access on a wireless network?

⊘ Topic 6.2.0 – Carrier sense multiple access with collision avoidance (CSMA/CA) is used with wireless networking technology to mediate media contention. Carrier sense multiple access with collision detection (CSMA/CD) is used with wired Ethernet technology to mediate media contention. Priority ordering and token passing are not used (or not a method) for media access control.

◯ token passing
◯ CSMA/CA
◯ CSMA/CD
◯ priority ordering

6. A technician has been asked to develop a physical topology for a network that provides a high level of redundancy. Which physical topology requires that every node is attached to every other node on the network?

⊘ Topic 6.2.0 – The mesh topology provides high availability because every node is connected to all other nodes. Mesh topologies can be found in WANs. A partial mesh topology can also be used where some, but not all, end points connect to one another.

◯ ring
◯ bus
◯ mesh
◯ hierarchical
◯ star

7. Which statement describes the half-duplex mode of data transmission?

> ⊘ Topic 6.2.0 – The data that is transmitted over the network can flow using one of three modes:
> - **Simplex** – Data can only flow in one direction.
> - **Half-duplex** – Data flows in one direction at a time.
> - **Full-duplex** – Data flows in both directions at the same time.

○ Data that is transmitted over the network flows in one direction at a time.

○ Data that is transmitted over the network flows in one direction to many different destinations simultaneously.

○ Data that is transmitted over the network flows in both directions at the same time.

○ Data that is transmitted over the network can only flow in one direction.

8. Which is a function of the Logical Link Control (LLC) sublayer?

> ⊘ Topic 6.1.0 – Defining the media access processes that are performed by the hardware and providing data link layer addressing are functions of the MAC sublayer. The data link layer accepts Layer 3 packets and packages them into data units that are called frames.

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data units that are called packets

○ to provide data link layer addressing

○ to define the media access processes that are performed by the hardware

9. Which data link layer media access control method does Ethernet use with legacy Ethernet hubs?

> ✓ Topic 6.2.0 - CSMA/CD is used by Ethernet networks using legacy Ethernet hubs. CSMA/CA is used by 802.11-based wireless networks.

○ determinism

○ turn taking

◔ CSMA/CD

○ token passing

10. What are the two sublayers of the OSI model data link layer? (Choose two.)

> ✓ Topic 6.1.0 - The data link layer of the OSI model is divided into two sublayers: the Media Access Control (MAC) sublayer and the Logical Link Control (LLC) sublayer.

☐ physical

☐ internet

☐ network access

☐ transport

☑ MAC

☑ LLC

11. Which layer of the OSI model is responsible for specifying the encapsulation method used for specific types of media?

> ✓ Topic 6.3.0 - Encapsulation is a function of the data link layer. Different media types require different data link layer encapsulation.

○ physical

◔ data link

○ application

○

transport

12. What type of physical topology can be created by connecting all Ethernet cables to a central device?

> ⊘ Topic 6.2.0 – Devices connected to the Ethernet star topology connect to either a hub or a switch.

○ bus

○ ring

○ mesh

◌ star

13. What are two services performed by the data link layer of the OSI model? (Choose two.)

> ⊘ Topic 6.1.0 – The data link layer is responsible for the exchange of frames between nodes over a physical network media. Specifically the data link layer performs two basic services:
> ○ It accepts Layer 3 packets and encapsulates them into frames.
> ○ It provides media access control and performs error detection.
>
> Path determination is a service provided at Layer 3. A Layer 2 switch builds a MAC address table as part of its operation, but path determination is not the service that is provided by the data link layer.

☐ It fragments data packets into the MTU size.

☑ It provides media access control and performs error detection.

☐ It monitors the Layer 2 communication by building a MAC address table.

☑ It accepts Layer 3 packets and encapsulates them into frames.

☐ It determines the path to forward packets.

14. Although CSMA/CD is still a feature of Ethernet, why is it no longer necessary?

> ⊘ Topic 6.2.0 - The use of Layer 2 switches operating in full-duplex mode eliminates collisions, thereby eliminating the need for CSMA/CD.

○ the use of CSMA/CA

○ the virtually unlimited availability of IPv6 addresses

● the use of full-duplex capable Layer 2 switches

○ the use of Gigabit Ethernet speeds

○ the development of half-duplex switch operation

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