Chapter 9 Review Questions Answer Key

1. What is an industrial network?

   A: For the sake of this chapter, an industrial network is the connection of two or more devices for the purpose of information sharing.

2. What are three things we use networks for?

   A: One great feature of a network is the ability to share resources. Another common use of networks is coordination of machine function and motion. Of course, another key point of networks is transmission of data. Another new trend thanks to networking is remote maintenance.

3. What is the difference between a node and a packet?

   A: A node is anything tied into the network, such as controllers, smart sensors with a processor, communication modules, smart switches that help with information transfer, computers, PLCs, or anything else that can send and receive data. The data sent from node to node is referred to as a packet which includes the address of the sending node, the address of the receiving node, and the transmitted data.

4. What are the advantages and disadvantages of a bus topology?

   A: The advantages of a bus-type network are the ease of adding or removing nodes, easy to setup, and it uses small amounts of wire. The disadvantages include a short or opening in the wire causes part or all of the network to become inoperative, as you add either more nodes or length to the bus the data transmission speed will slow down, and this system is easy to crash.

5. How is a ring topology setup and what is the common method used to manage data transmission on this topology?

   A: A ring topology network has all nodes connected in series to form a continuous loop or ring. This topology often uses something called a token, which is a bit of code that allows a node to transmit information. The token is passed from one node to the next along the ring and if the node with the token does not have data to send, then it just passes the token along.

6. How does a star topology work?

   A: A star topology network uses a central connection point known as the hub node that has connections, often hardwired, leading to each separate device it is responsible for.

7. What is the difference between a hub and a switch?

   A: A network hub, usually called a hub, is basically just a repeater that sends the signal in to all the connected nodes and when we use this device we have a star wiring setup, but a bus operation as far as how data is sent. A switch on the other hand knows the address of each connected node and sends the packet only to the designated node instead of doing a network wide broadcast.

8. What is a tree topology and what are its three levels?

   A: A tree topology network is the combination of a bus network and multiple star networks, usually comprising of three levels of devices. The first level or lowest level is the devices connected to the hub nodes; the second level or next level up is the hub nodes; and the third level or top level is the main hub that controls the flow of data in the network.

9. How is a mesh topology set up?

   A: A mesh topology network consists of multiple connections where each node is connected to all the other nodes or at least several nodes with the ability to share information along those connections. If the topology is a full mesh setup, each node connects with every other node whereas a partial mesh topology has nodes that connect to only three or four other nodes instead of all the other nodes.

10. Which problems do you need to avoid when working with fiber optic cables?

    A: When working with fiber-optic cables, extreme caution should be used as a bend radius that is too small may result in a kink in the cable, which is a sharp bend that causes damage to the fiber optic material. Another concern is any impact, such as a part falling on the cable, or excessive pressure, which occurs when we step on them, can also damage the cable and prevent light transmission.

11. Briefly describe the functionality proscribed by the RS232, RS423, RS422, and RS485 standards.

    A: RS232 was introduced in 1962 and can still be found in industry today, though it is no longer the popular method of communication. It is a full duplex type communication that can send data up to 50 ft. or 15 m at a max speed of 19.2 Kbps and is single ended in that one transmitter sends signals to one receiver. RS423 is similar to RS232, but adds half duplex operation and transmission speeds up to 100 Kbps out to 40 ft. or 12 m which dwindles down to 1 Kbps at the max range of 4000 ft. or 1200 m, despite this, RS423 is rarely used in industrial applications. RS422 can be single ended or multi-drop where one transmitter can talk to multiple receivers, but not all of them. In the case of RS422 it is a max of 10 receivers that one

transmitter can reach. RS422 connections are often half duplex, but full duplex is an option and it has a maximum transmission rate of 10 Mbps (megabits per second) for 50 ft. or 15 m that dwindles down to 100 Kbps at 4000 ft. or 1200 m. RS422 has been used as an extension cord to transmit RS232 communications over long distance, with the use of inline converters, and is an industrial standard still in use. RS485 is the current favorite and is the next step up from RS422 as it can do true multi-point where a transmitter can talk to any receiver with 32 transmitters and receivers on the same cable. In other words, every transmitter has access to all the receivers on the cable. It is often half duplex in operation, though full duplex is an option and it has the same transmission speeds of RS422.

12. Which topology does DeviceNet use? How many nodes and field devices will it support?

    A: DeviceNet is based on a controller area network technology which uses a bus topology. DeviceNet networks support 64 addressable nodes, a maximum of 2048 field devices, and is designed to control sensors, switches, valves, and other such devices. It is often controlled by a PLC.

13. What are the advantages of ControlNet? Which cables are used by this system?

    A: One of the major advantages of ControlNet is its higher data transmission speed at a maximum of approximately 5 Mbps. Additionally, all devices on the network are capable of communicating with each other. One of the big ones is the network is deterministic, which means we can set the minimum rate of data transfer within given parameters and the system will keep the timeline we set. ControlNet also has built in redundancy, the ability of multiple masters to control the same I/O, and

constant transmission times that are unaffected by devices leaving or entering the network. ControlNet data is primarily transmitted over coaxial cables or fiber-optic cables as both of these cables offer higher noise immunity, which is extremely desirable for high-speed data transmission.

14. How does master/slave communication work?

    A: In master/slave communication the controller, the master, asks for data from nodes, the slaves, and they only respond when directed. This method ensures clean communication and allows for precise timing of messages.

15. How does Ethernet/IP work and what are some of its advantages?

    A: Ethernet/IP is a network that uses the standard Ethernet protocol and Transmission Control Protocol/Internet Protocol (TCP/IP). One significant advantage of using TCP/IP is data packets are routed the best way to their destination to avoid data bottlenecks at either 10 Mbps or 100 Mbps. The development of Ethernet/IP came about as a result of the need to gather more plant information and process it and offers several distinct advantages over both the DeviceNet and ControlNet including: transfer of large data files, network diagnostics, the ability to perform controller operations, and device configuration and programming.

16. Which type of topology does Profibus use? What is the maximum number of nodes per segment and the maximum number of repeaters and total nodes per network?

    A: Profibus works with a bus or tree type topology with a maximum of 32 stations or nodes per segment, which we can add segments to with a repeater. The recommendation is no more than 4 repeaters, creating a maximum number of 127 nodes per network.

17. How does polling data transfer work?

    A: Polling controls communication via the master or requesting unit sending a signal asking the slave or sending unit if it has any data to send. If the answer is yes, the data is transmitted from the sending/slave unit. If the answer is no, the master/requesting unit moves on to the next node.

18. How does peer-to-peer communication work?

    A: Peer-to-Peer (P2P) communication is where each node can talk directly to one another without having to go through a third node, such as the main controller, and can act as sender or receiver of data.

19. What is the difference between Profibus DP and Profibus PA?

    A: Profibus DP (decentralized periphery) is a device-level bus that supports both analog and digital signals and is generally designed for controlling a specific machine from inside the control cabinet. Profibus PA (process automation) was introduced in the late 1990s to support process automation applications and manage smart process instrumentation. This protocol was designed specifically for the process industry with the goal of replacing 4-20 mA transmissions using two-wire connection carrying power and data. Where Profibus DP is designed to work in the machine controller, Profibus PA is designed to work outside a specific machine mounted in a safe location where it can manage multiple processes at once.

20. How does producer/consumer communication work?

    A: The producer/consumer communication method is where a device produces or sends information with specific identifiers attached and other devices consume the

data that matches the identifiers they are looking for. This method can allow multiple devices to consume a single produced transmission.

21. How are new devices added to Foundation Fieldbus protocol systems?

    A: When a new device is added to the network, it joins at one of four special default addresses specifically reserved for this purpose. The configuration tool assigns a physical device tag which holds the permanent address assigned in the next step. Using system management services, an unused address is assigned to the device. The tag is then stored in non-volatile device memory so the information is maintained even when power is lost. This process repeats for everything new on the network until all the devices have a tag with a permanent address.

22. What is the maximum transmission speed and distance of Fieldbus H1?

    A: The wired version of Fieldbus is known as Fieldbus H1and is capable of data transmission speeds of 31.25 Kbps to a maximum wired distance of 6232 ft. or 1900 m when #18 AWG individually shielded, twisted pair wire is used.

23. Which of the protocols discussed in this chapter work with the IEEE 802.3 Ethernet standard?

    A: Ethernet/IP, ProfiNet, and Fieldbus HSE

24. What are the five main things to keep in mind when working to integrate systems?

    A: 1. the process involved
    2. the equipment involved
    3. the protocol(s) used
    4. the data tracked
    5. the work environment