The OSI Model and Encapsulation:This chapter covers the following topics related to Objective 1.1 (Compare and contrast the Open Systems Interconnection [OSI] model,layers and encapsulation concepts) of the CompTIA Network+ N10-008.certification exam:OSI model: Layer 1—Physical Layer 2—Data link,Layer 3—Network,Layer 4—Transport,Layer 5—Session,Layer 6—Presentation,Layer 7—Application. Data encapsulation and decapsulation within the OSI model context: 1. Ethernet header 2. Internet Protocol (IP) header, 3. Transmission Control Protocol (TCP)/User Datagram Protocol 4. (UDP) headers,5. TCP flags, 6. Payload, 7. Maximum transmission unit (MTU); Way back in 1977, the International Organization for Standardization (ISO) developed a subcommittee to focus on the interoperability of multivendor communications systems. This is fancy language for getting network "thingies" to communicate with each other, even if different companies made those network "thingies." What sprang from this subcommittee was the Open Systems Interconnection (OSI) reference model (also referred to as the OSI model or the OSI stack). Thanks to this model, you can talk about any networking technology and categorize that technology as residing at one or more of the seven layers of the model. This chapter defines those seven layers and offers examples of what you might find at each layer. It also contrasts the OSI model with another model—the TCP/IP stack, also known as the Department of Defense (DoD) model—that focuses on Internet Protocol (IP) communications. The Purpose of Reference Models: Throughout this book, various protocols and devices that play a role in your network (and your networking career) are introduced. To better understand how a technology fits in, it helps to have a common point of reference against which various technologies from different vendors can be compared. Understanding the OSI model is useful in troubleshooting networks. One of the most common ways of categorizing the function of a network technology is to say at what layer (or layers) of the OSI model that technology runs. Understanding how that technology performs a certain function at a certain layer of the OSI model helps you determine whether one device is going to be able to communicate with another device, which might or might not be using a similar technology, at that layer of the OSI reference model. For example, when your end-user device connects to a web server on the Internet, your service provider assigns your device an IP address. Similarly, the web server to which you are communicating has an IP address. As described in this chapter, an IP address lives at Layer 3 (the network layer) of the OSI model. Because your device and the web server use a common protocol (that is, IP) at Layer 3, they are capable of communicating with one another. Notice also in this example that you are interested in receiving the data from the web server, which will be web pages filed with text and graphics and maybe even videos. This is the information you are really after. You (typically) do not care about the IP addresses in use or any of the other information required by the network devices to make this transfer happen. In technical terms, you are interested in the payload of the packets sent from the web server. The payload provides a simple and generic method of describing the data itself, which is separate and distinct from any of the other information required for proper transmission. Personally, I have been in the computer-networking industry since 1996, and I have had the OSI model explained in many classes I have attended and books I have read. From this, I have taken away a collection of metaphors to help describe the operation of the different layers of the OSI model. Some of the metaphors involve sending a letter from one location to another or placing a message in a series of envelopes. These are often excellent metaphors for encapsulation and decapsulation (covered later in this chapter), but they do not work all that well for the OSI model in general. My favorite way to describe the OSI model is to simply think of it as being analogous to a bookshelf. If you were to look this or any other bookshelf in my home office, you would see that I have organized diverse types of books on different shelves. One shelf holds my collection of technical books, another shelf holds the books I wrote for Pearson and other publishers, another shelf holds books regarding self-improvement and finance. I have grouped similar books together on each shelf, just as the OSI model groups similar protocols and functions together in a layer. A common pitfall my readers meet when studying the OSI model is to try to

neatly fit all the devices and protocols in their network into one of the OSI model's seven layers. However, not every technology fits perfectly into these layers. In fact, some networks might not have any technologies running at one or more of these layers. This reminds me of my favorite statement about the OSI model. It comes from Rich Seifert's book The Switch Book. In that book, Rich reminds us that the OSI model is a reference model, not a reverence model. That is, no cosmic law states that all technologies must cleanly plug into the model. So, as you discover the characteristics of the OSI model layers throughout this chapter, remember that these layers are like shelves for organizing similar protocols and functions, not immutable laws. **Note: When first studying the OSI model, my students quickly realize that the model was created for the reasons described earlier. Later in their information technology (IT) careers, they realize the biggest value of the OSI model to them: to aid in troubleshooting network problems. Check out my video in the Additional Resources section at the end of this chapter, where I walk you through exactly how this is true!** The OSI Model: As previously described, the OSI model consists of seven layers: Layer 1: The physical layer, Layer 2: The data link layer ,Layer 3: The network layer, Layer 4: The transport layer, Layer 5: The session layer, Layer 6: The presentation layer, Layer 7: The application layer. **Note: Various mnemonics are available to help memorize these layers in their proper order. A top-down (that is, starting at the top of the stack with Layer 7 and working your way down to Layer 1) memory aid is All People Seem To Need Data Processing. Another common technique is Please Do Not Throw Sausage Pizza Away, which begins at Layer 1 and works up to Layer 7.** At the physical layer, binary expressions (that is, a series of 1s and 0s) represent data. A binary expression is created using bits, where a bit is a single 1 or a single 0. At upper layers, however, bits are grouped together, into what is known as a protocol data unit (PDU) or a data service unit. Engineers tend to use the term packet generically to refer to these PDUs. However, PDUs might have an added name, depending on their OSI layer. Figure 1-3 illustrates these PDU names. A common memory aid for these PDUs is Some People Fear Birthdays, where the S in Some reminds us of the S in Segments. The P in People reminds us of the P in Packets, and the F in Fear reflects the F in Frames. Finally, the B in Birthdays reminds us of the B in Bits. (If you have never heard this memory aid before, I am not that surprised as I invented it!)

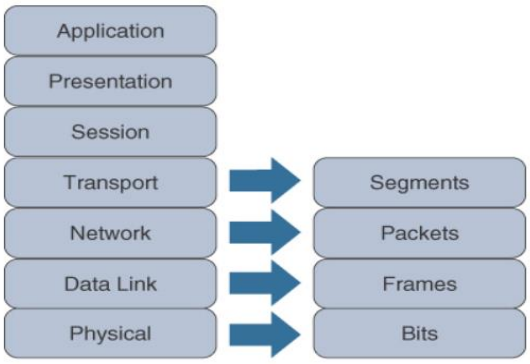


**FIGURE 1-3** PDU Names

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