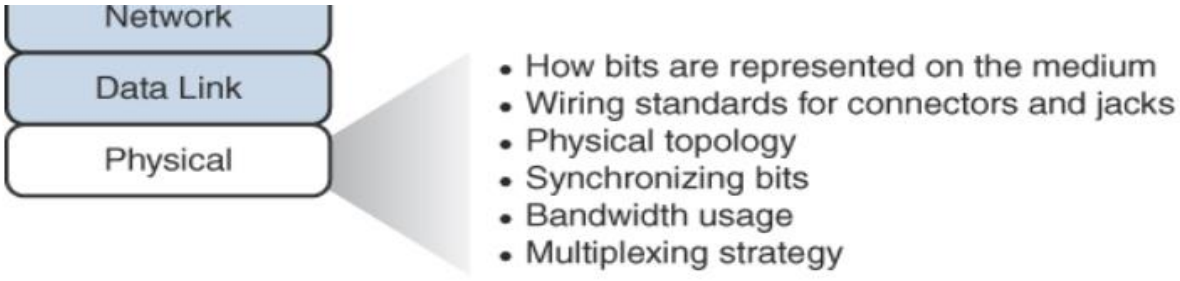
Layer 1: The Physical Layer: The concern of the physical layer, as shown in Figure 1-4, is the transmission of bits on the network along with the physical and electrical characteristics of the network.



The physical layer defines the following: 1. **How to represent bits on the medium:** Data on a computer network is represented as a binary expression. Chapter 4, "IP Addressing," discusses binary in much more detail. Electrical voltage (on copper wiring) or light (carried via fiber-optic cabling) can represent these 1s and 0s. For example, the presence or absence of voltage on a wire portrays a binary 1 or a binary 0, respectively, as illustrated in Figure 1-5. Similarly, the presence or absence of light on a fiber-optic cable renders a 1 or 0 in binary. This type of approach is called current state modulation.

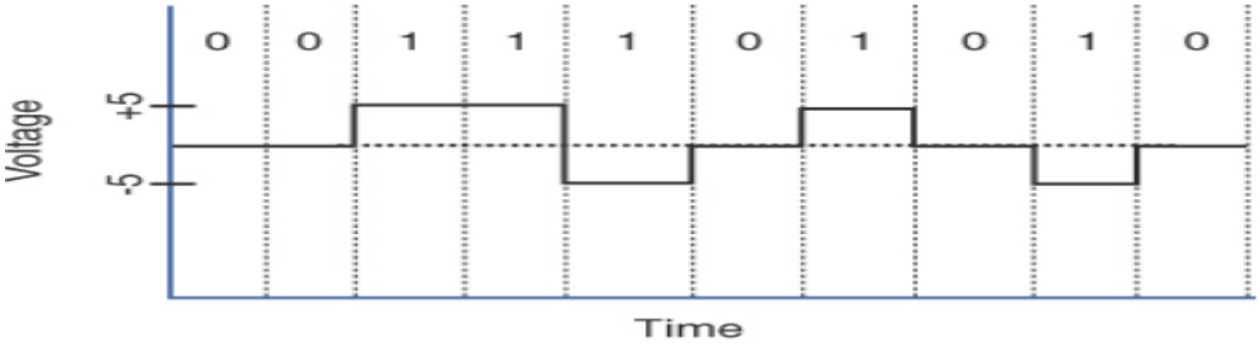


FIGURE 1-5 Current State Modulation

An alternative approach to portraying binary data is state transition modulation, as shown in Figure 1-6, where the transition between voltages or the presence of light shows a binary value.

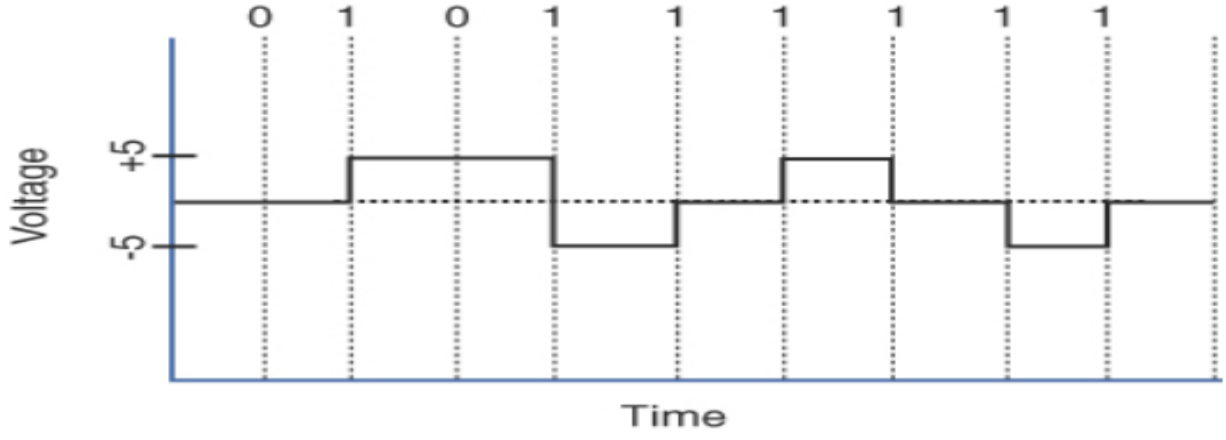


FIGURE 1-6 Transition Modulation

Note: Other modulation types you might be familiar with from radio include amplitude modulation (AM) and frequency modulation (FM). AM uses a variation in a waveform's amplitude (that is, signal

strength) to portray the original signal. FM uses a variation in frequency to stand for the original signal. 2. **Wiring standards for connectors and jacks:** Chapter 3, "Network Media Types," describes several standards for network connectors. For example, the TIA/EIA-568-B standard describes how to wire an RJ-45 connector for use on a 100BASE-TX Ethernet network, as shown in Figure 1-7.

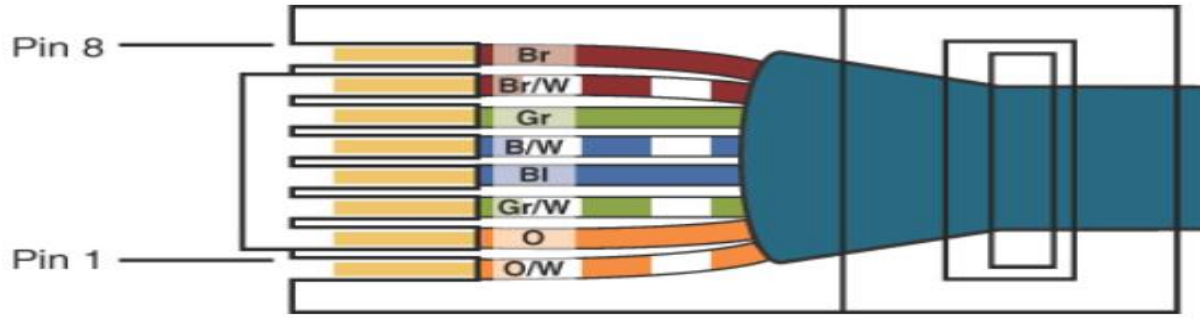


FIGURE 1-7 TIA/EIA-568-B Wiring Standard

3. **Physical topology:** Layer 1 devices view a network as a physical topology (as opposed to a logical topology). Examples of a physical topology include bus, ring, and star topologies, as described in Chapter 2, "Network Topologies and Types." 3. **Synchronizing bits:** For two networked devices to successfully communicate at the physical layer, they must agree on when one bit stops and another bit starts. Specifically, the devices need a method to synchronize the bits. Two basic approaches to bit synchronization are asynchronous and synchronous synchronization: *. **Asynchronous:** With this approach, a sender states that it is about to start transmitting by sending a start bit to the receiver. When the receiver sees this, it starts its own internal clock to measure the next bits. After the sender transmits its data, it sends a stop bit to say that it has finished its transmission. **. **Synchronous:** This approach synchronizes the internal clocks of the sender and the receiver to ensure that they agree on when bits begin and end. A common approach to make this synchronization happen is to use an external clock (for example, a clock provided by a service provider). The sender and receiver then reference this external clock. 4. **Bandwidth usage:** The two fundamental approaches to bandwidth usage on a network are broadband and baseband: *. **Broadband:** Broadband technologies divide the bandwidth available on a medium (for example, copper or fiber-optic cabling) into different channels. A sender can then transmit different communication streams over the various channels. For example, consider frequency-division multiplexing (FDM) used by a cable modem. Specifically, a cable modem uses certain ranges of frequencies on the cable coming into your home from the local cable company to carry incoming data, another range of frequencies for outgoing data, and several other frequency ranges for various TV stations. **. **Baseband:** Baseband technologies use all the available frequencies on a medium to send data. Ethernet is an example of a networking technology that uses baseband. 5. Multiplexing strategy: sessions to share the same physical medium. Cable TV, as previously mentioned, allows you to receive multiple channels over a single physical medium (for example, a coaxial cable plugged into the back of your television). Here are some of the most common approaches to multiplexing: **Time-division multiplexing (TDM):** TDM supports different communication sessions (for example, different telephone conversations in a telephony network) on the same physical medium by causing the sessions to take turns. For a brief period, defined as a time slot, data from the first session is sent, followed by data from the second session. This continues until all sessions have had a turn, and the process repeats.

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