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A Systems Approach

EDITION

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# COMPUTER NETWORKS

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implementing the protocols running within the network. In many respects, network applications and network protocols are very similar—the way an application engages the services of the network is pretty much the same as the way a high-level protocol invokes the services of a low-level protocol. As we will see later in the section, however, there are a couple of important differences.

#### 1.4.1 Application Programming Interface (Sockets)

The place to start when implementing a network application is the interface exported by the network. Since most network protocols are implemented in software (especially those high in the protocol stack), and nearly all computer systems implement their network protocols as part of the operating system, when we refer to the interface “exported by the network,” we are generally referring to the interface that the OS provides to its networking subsystem. This interface is often called the network *application programming interface* (API).

Although each operating system is free to define its own network API (and most have), over time certain of these APIs have become widely supported; that is, they have been ported to operating systems other than their native system. This is what has happened with the *socket interface* originally provided by the Berkeley distribution of Unix, which is now supported in virtually all popular operating systems. The advantage of industrywide support for a single API is that applications can be easily ported from one OS to another. It is important to keep in mind, however, that application programs typically interact with many parts of the OS other than the network; for example, they read and write files, fork concurrent processes, and output to the graphical display. Just because two systems support the same network API does not mean that their file system, process, or graphic interfaces are the same. Still, understanding a widely adopted API like Unix sockets gives us a good place to start.

Before describing the socket interface, it is important to keep two concerns separate in your mind. Each protocol provides a certain set of *services*, and the API provides a *syntax* by which those services can be invoked in this particular OS. The implementation is then responsible for mapping the tangible set of operations and objects defined by the API onto the abstract set of services defined by the protocol. If you have done a good job of defining the interface, then it will be possible to use the syntax of the interface to invoke the services of many different protocols. Such generality was certainly a goal of the socket interface, although it’s far from perfect.

The main abstraction of the socket interface, not surprisingly, is the *socket*. A good way to think of a socket is as the point where a local application process attaches to the network. The interface defines operations for creating a socket, attaching the socket to the network, sending/receiving messages through the socket, and closing the

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