WIDE AREA HIGH SPEED NETWORKS

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CHAPTER 1

Data Networks

In the early years of computer networking, organizations that needed robust wide area data transmission facilities had only one choice: They had to connect sites using costly point-to-point digital leased lines.

Point-to-point leased line technology is well understood and very reliable. Leased digital line speeds range from 9.6 kilobits per second (Kbps) to millions of bits per second (Mbps). An organization can count on steady, uninterrupted bandwidth and low, predictable delay between two sites when it installs a leased line.

However, leased lines have a number of disadvantages. They are costly to set up. Monthly charges are proportional to distance and are substantial. The cost of a fully meshed network (like the one shown in Figure 1.1) is very steep if the sites are far from one another.

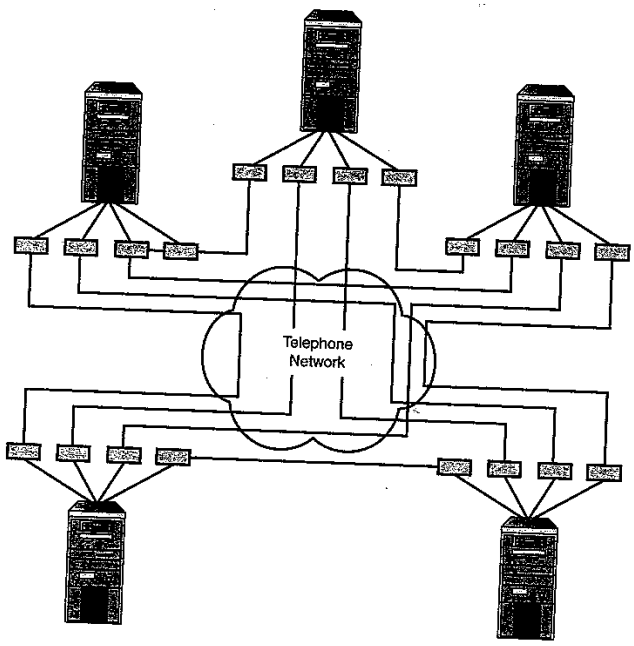
Furthermore, a network like the one in Figure 1.1 is complicated to maintain. The 5-node network in the figure contains 10 lines and 20 CSU/DSU access devices. An organization that wants to connect N nodes with a fully meshed network of leased lines needs to support

$(N^2-N)/2$ lines

N^2-N access devices

For example, meshing 20 sites requires 190 lines and 380 access devices, and meshing 30 sites requires 435 lines and 870 access devices.

Figure 1.1 A fully meshed leased line network.



ITU-T Public Data Network Architecture

A more cost-effective option called a *public data network* was introduced in the early 1980s by the ITU-T, the ruling standards body for telephone networks. A company that operates a public data network is called a *public data network service provider* or, more succinctly, a *service provider*.

The data network architecture introduced by the ITU-T has a lot in common with the architecture of a telephone network. In a public telephone network

- There is a standard interface between an end-user device—a telephone—and the public network.
- Customers (also called *subscribers*) can set up switched circuits on demand or contract for permanent circuits.
- Telephone networks all over the world are linked into a global telephone system. This is possible because the ITU-T has defined a standard network-to-network interface.

- There is a standard interface between an organization's private telephone network (implemented by a PBX) and a public telephone network.

Similarly, for the ITU-T data network architecture

- There is a standard interface between an access device, such as a computer, router, bridge, or switch, and the network.
- Customers can set up switched circuits on demand or contract for permanent circuits.
- Public data networks all over the world can be linked into a global data network. This is possible because the ITU-T defined a standard data network-to-network interface.
- An organization's private data network (implemented by appropriate data network switches) can be connected to a public data network via a standard interface.

Some key features that make data networks very different from conventional telephone networks are

- The cost of a public data network circuit does not depend on the distance traversed across the data networks.
- A subscriber device can establish hundreds of concurrent circuits via one port on the device and one communications line that connects the port to the data network.

Figure 1.2 is a conceptual illustration of the way an organization plugs systems into a public data network and sets up circuits between systems. For example, in Figure 1.2, there are three circuits between System A and other systems attached to the data network. The three circuits share the single line that connects System A to the network.

Figure 1.3 shows a close-up view of a line that connects a system to a data network. The customer's system is called an *access device*. The line is called an *access line*. The black lines represent circuits that share the access line.

Virtual Circuits

A data network circuit is called a *virtual* circuit because, unlike a telephone call, a fixed bandwidth is not reserved for the exclusive use of the circuit. Instead, traffic for many circuits shares links within the network. This is a reasonable design to use for data transmissions, which are intermittent and bursty.

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