19.2.5 Very Small Aperture Satellite (VSAT)

VSAT technologies, which have a dish size of less than 3 meters, have made it possible to use satellites to provide Internet access to individuals or small businesses. Although it provides high data rates, VSAT incurs long delays.

19.2.6 Power Line Communication (PLC)

PLC uses high frequencies to send data along power lines. The idea is to use existing infrastructure to deliver Internet access. Although much research has been done, the technology has not enjoyed widespread deployment.

19.3 LAN Technologies

19.3.1 Token Ring

After LANs were invented, many groups proposed designs or built experimental prototypes, and development of LAN technologies continued for twenty years before Ethernet came to dominate. Some of the early work on LANs explored token passing as an access control mechanism, and IBM chose to create a token passing LAN technology that was known as *IBM Token Ring*. Despite a lower data rate (initially 4 Mbps and eventually 16 Mbps) and high cost, IBM's Token Ring was widely accepted by corporate information technology departments, and was a major LAN technology for many years.

19.3.2 Fiber And Copper Distributed Data Interconnect (FDDI And CDDI)

By the late 1980s, it became apparent that the two chief LAN technologies, Ethernet at 10 Mbps and IBM's Token Ring at 16 Mbps, had insufficient data rates to meet growing demand. The FDDI standard was created to increase LAN data rates to 100 Mbps. At the time, higher data rates required the use of optical fiber instead of copper wiring. FDDI used a pair of *counter-rotating rings* to provide redundancy — if an FDDI ring was cut, hardware automatically looped the data path to route traffic around the failure and keep the ring active. FDDI introduced one of the earliest LAN switches in which each computer connected directly to a central FDDI mechanism. Thus, FDDI had a physical star topology and a logical ring topology.

Because it offered the highest data rate available at the time and the opportunity for redundancy, FDDI became popular as a high-speed interconnect among computers in a data center. However, the high cost and special expertise needed to install fiber discouraged most organizations from replacing copper wiring. To complete with faster Ethernet, a version of FDDI was created that ran over copper wiring (CDDI). Ultimately, Ethernet proved to have lower cost, and FDDI/CDDI technologies vanished.