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Early computer networks, like mainframes in the 1970s, used time-sharing terminals for centralized computing. The core concept of a computer network is an interconnected group of autonomous computers capable of exchanging information. Timesharing allows multiple users to share a single computer's time. Distributed systems present multiple autonomous computers as a single system to the user. Interoperability describes computer networks as modular platforms. Computer systems interconnect through interoperability, simplifying communication between companies using different operating systems. Network topology describes the physical or logical layout of interconnected devices and their communication methods, encompassing both physical (wiring) and logical arrangements. Logical topology describes signal flow in a network. Local Area Networks (LANs) cover small areas like offices or schools, while Wide Area Networks (WANs) span continents and are typically operated by telecommunication providers using telephone lines. Peer-to-peer networks are inexpensive and easy to use because they don't need dedicated servers. Server-based networks, while offering more features, are more costly due to the need for dedicated servers. The text also mentions analog and digital signals (further details not provided). Data is usually converted to digital signals for transmission. Digital signals are converted to analog signals for transmission over media like telephone lines. Transmission media is the physical path between sender and receiver, supporting point-to-point or multi-point communication. Optical transmission systems

consist of a light source, transmission medium, and photodetector. Switching techniques include circuit switching (dedicated line), message switching (address-appended message routing), and packet switching (designed to reduce message switching delays). Error control ensures successful data transmission by segmenting the bit stream into blocks and adding redundant bits to each block. A simple method is the parity check, where a parity bit is added to create an even or odd number of ones in the block. Even parity checks for an even number of 1s in a binary number; an odd number indicates an error. Odd parity is the opposite. Checksums add a data element to blocks of data for error detection. Error detection in data transmission and storage uses techniques like Automatic Repeat Request (ARQ), which detects errors and requests retransmission, unlike Forward Error Correction (FEC) which corrects errors directly. Digital-to-digital encoding translates binary data into signal elements for transmission. Digital-to-analog conversion alters an analog signal's characteristics using digital data (0s and 1s), as seen in computer-to-computer data transmission over phone lines. Data exchange between entities is governed by protocols, which are structured in a three-layer model: application, transport, and network access. Each computer application requires a unique Service Access Point (SAP) address for the transport layer to manage multiple applications. The ISO OSI model, developed by the International Organization for Standardization, provides a framework for computer communication architecture and protocol standards, but is not a protocol itself. The OSI model facilitates communication between different systems without requiring hardware or software changes. The physical layer defines

transmission direction and uses repeaters to amplify signals and prevent degradation. Network devices such as hubs, bridges, routers, brouters, switches, and gateways connect computers and networks, enabling information exchange. Hubs connect star networks; bridges filter frames between LAN segments; routers forward data between networks; brouters combine bridge and router functions; switches direct data flow between nodes; and gateways convert between different protocols. The text describes a protocol stack translation process, highlighting challenges like data loss and incompatibility between different protocol stacks (versions 3, 4, 5, and 6). The translation requires careful handling to avoid errors and ensure data integrity.