chapter 2

Local Area Networks – An Introduction

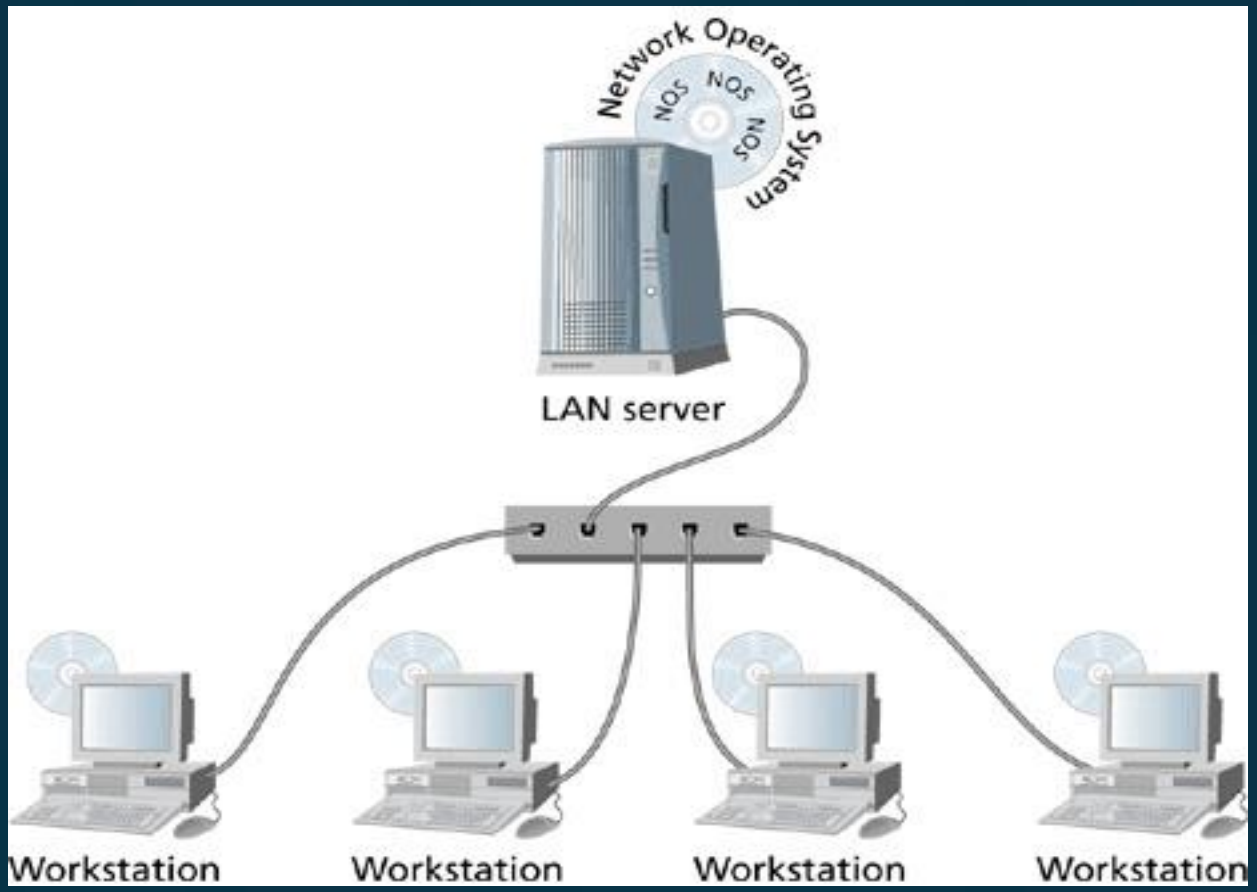
CHAPTER OBJECTIVES

- Define server, LAN services, clients, and describe the role of each in a LAN.
- Describe a mainframe and terminal LAN configuration.
- Discuss peer-to-peer, client-dominant, client/server, and distributed processing LANs.
- Define cable types such as coaxial, twisted-pair, and fiber optic.
- Identify three types of wireless media.
- Describe how network interface cards work.
- Identify types of network interface cards.

TECHNOLOGY OVERVIEW

- LANs utilize specialized hardware and software.
  - Computers that function as servers and workstations.
  - Operating systems that provide services.
  - Network interface cards to connect to the LAN.
  - Cabling or wireless media.
  - Hubs, bridges, switches, routers, and other connectivity devices.

Physical Configuration of a Simple Local Area Network



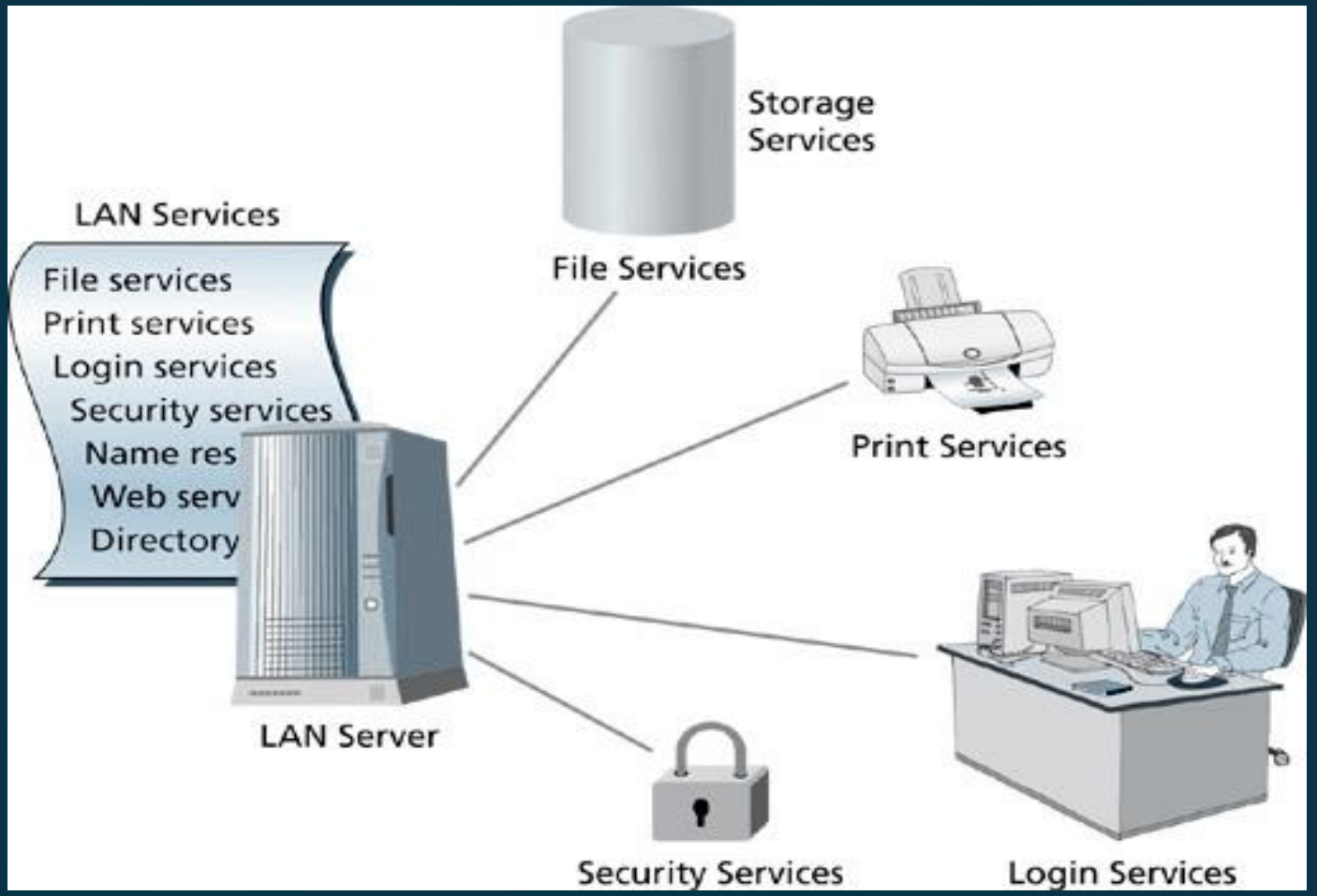
SERVERS

- Server – a computer that connects to a LAN and has network operating system software installed to provide shared LAN services to clients on the network.

LAN SERVICES

- LAN Services – define the personality of a local area network.
  - Example services include data storage and retrieval services, printing services, shared application access, centralized logon services, directory services, desktop management, and so on.

Basic Services on a Local Area Network



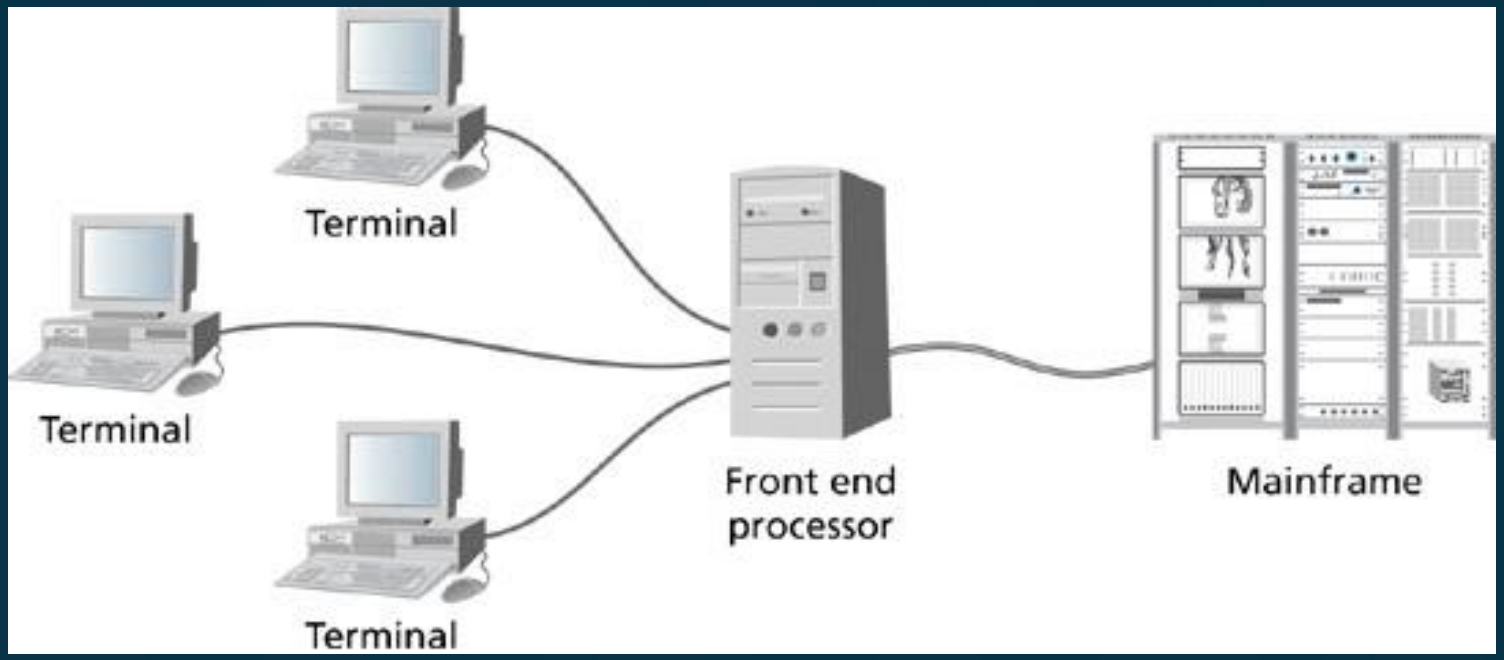
CLIENTS

- A LAN client is a computer that connects a user to the LAN services provided by a server's network operating system.

LAN CONFIGURATIONS

- Mainframes and Terminals – computing functions are performed on the mainframe, and terminals supported data input and data viewing.
  - Because processing takes place at the mainframe, terminals are considered “dumb”.
  - Mainframes deliver a fixed amount of computing power for given level of capital expenditure.
  - Upgrades to processing power are expensive.
  - Application development is expensive.
  - Mainframe technology has been adapted as storage area networking for data storage functions in today’s LANs.

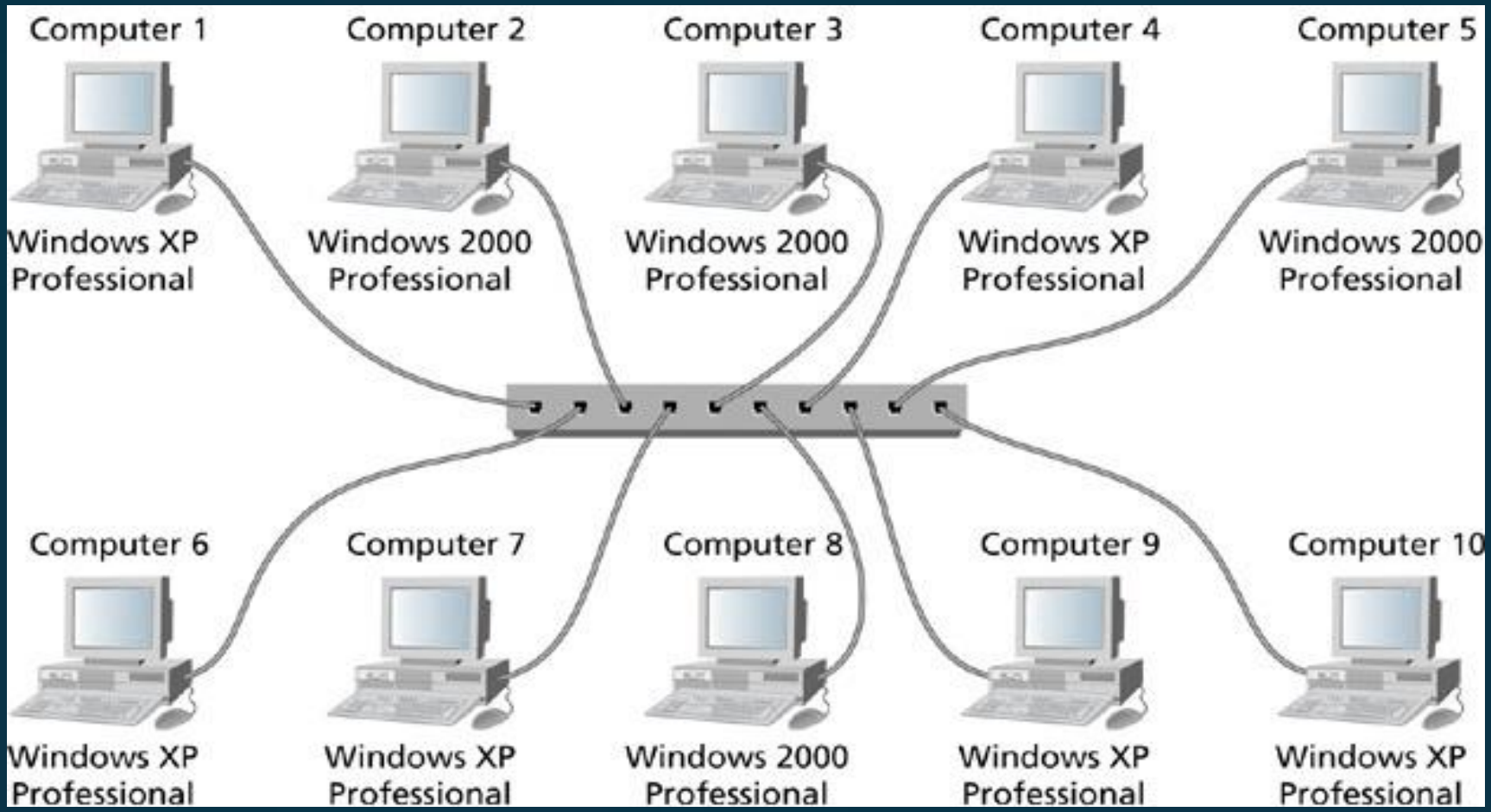
A Mainframe Network



LAN CONFIGURATIONS (cont'd)

- Peer-to-Peer LANs – fill a business need for organizations that don't have a substantial need for centralized computing power on a dedicated mainframe or server.
  - With peer-to-peer LANs, each computer on the LAN acts as a peer to every other computer.
  - Each computer can provide services to and request services from every other computer on the LAN.
  - Peer computers are generally configured to belong to the same "workgroup"

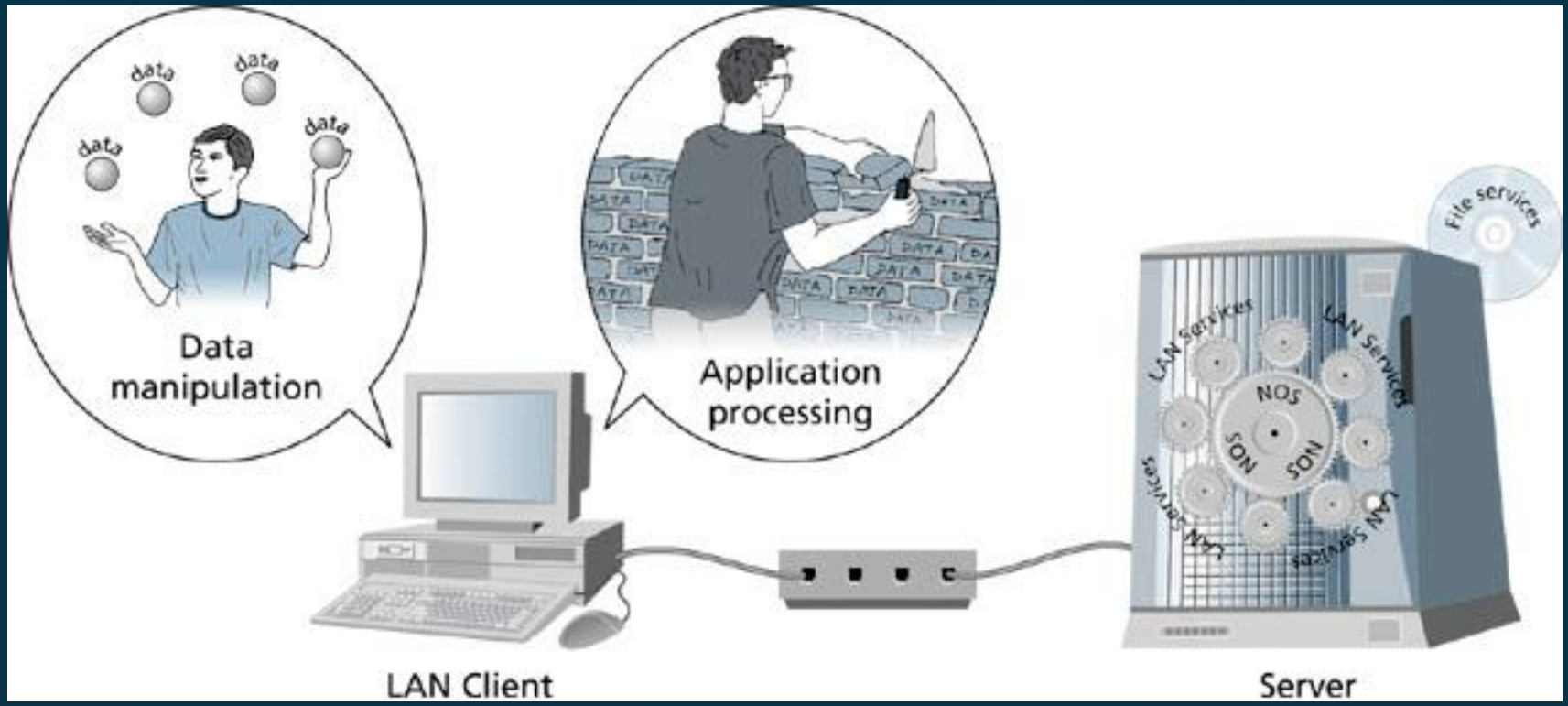
Peer-to-Peer LAN



LAN CONFIGURATIONS (cont'd)

- Client-dominant LANs
  - Evolved during the 1980s from the single-user applications that were developed for individual PCs.
  - Data storage on LAN servers provided centralized file access.
  - Application processing and data manipulation took place on the client.
  - Reduced the dependence on "sneaker-net" between users' PCs.

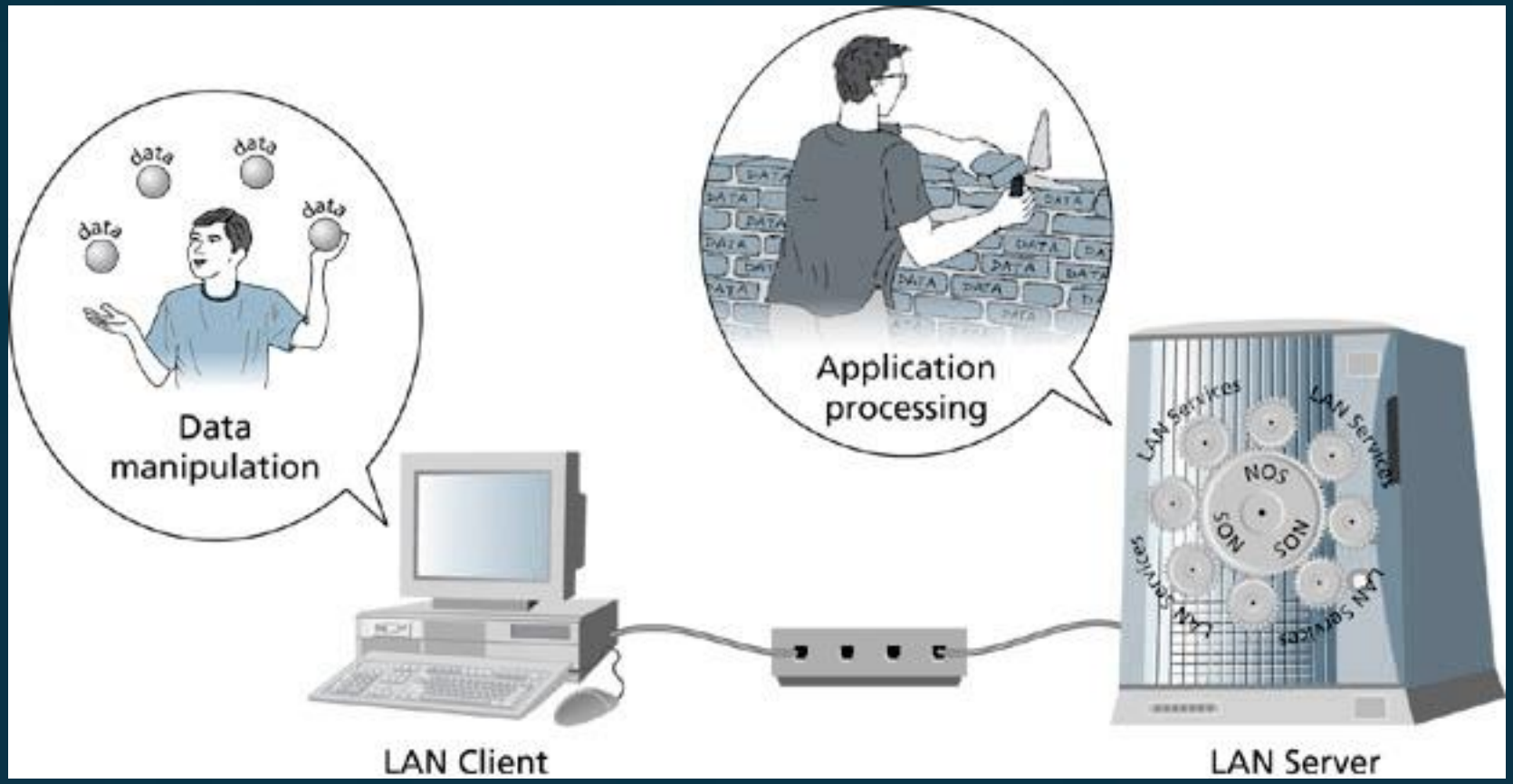
A Client-dominant Local Area Network



LAN CONFIGURATIONS (cont'd)

- Client/Server LANs
  - Some processing is performed at the client and some at the server.
  - Server handles data access and storage.
  - Only required information is copied to the client computer for data manipulation.
  - Benefits to the LAN are reduced demand on the network media and better overall network performance.

A Client/Server Local Area Network



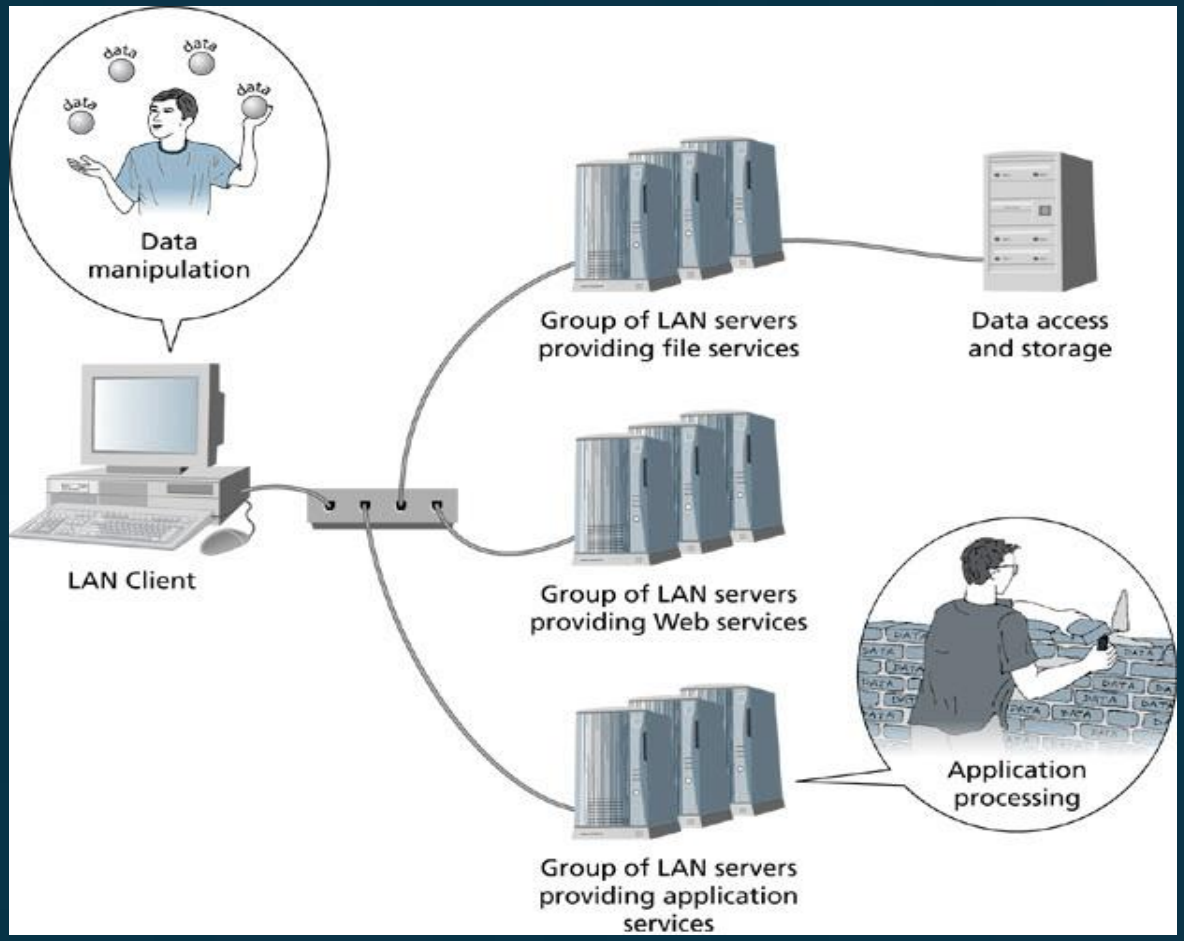
LAN CONFIGURATIONS (cont'd)

- Distributed Processing LANs
  - Data access and storage components are separated out from the data processing component of an application.
  - Application processing is shared across several computers.
  - Different components of an application can be installed on one or more servers.
  - Logic built into the application allows all component modules to communicate.

LAN CONFIGURATIONS (cont'd)

- Distributed Processing LANs (cont'd)
  - Client component of the application doesn't care where the actual processing takes place.
  - This type of LAN scales well to growing processing demands.
  - Load sharing and redundancy provide improved performance.

Distributed Processing



LAN CONFIGURATIONS (cont'd)

- Connecting Computers to a LAN
  - Client computers require a workstation OS and an NOS client.
  - Servers require NOS installation and configuration.
  - Network administrator configures client software and hardware, server hardware and software, protocols, NICs, media, and connectivity devices.

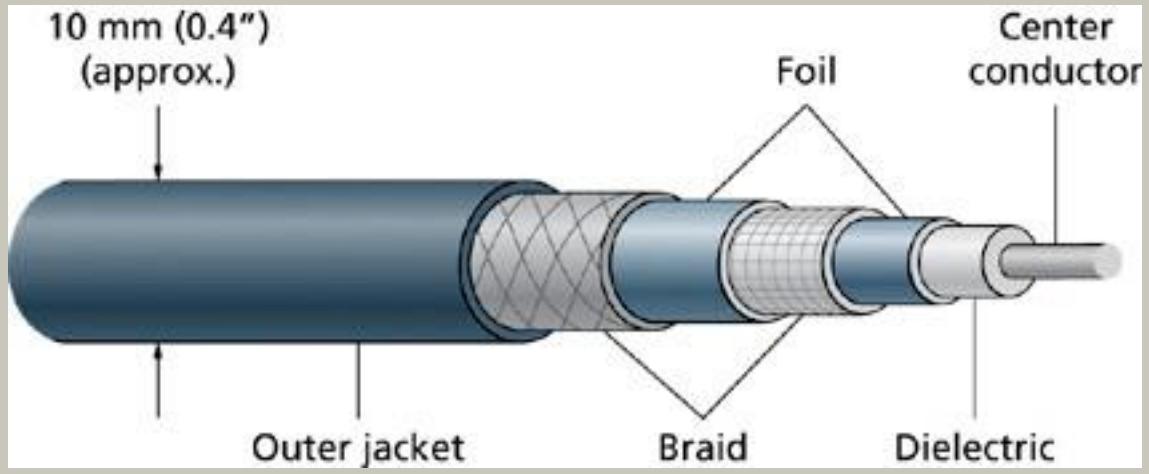
MEDIA TYPES and CONNECTORS

- Coaxial Cable
  - Commonly referred to as “coax”.
  - Consists of two conductors separated by special insulating material.
  - One conductor carries the signal and the other acts as a ground and as shielding.
  - Was a common media choice for early Ethernet LANs.

MEDIA TYPES and CONNECTORS (cont'd)

- Coaxial Cable (cont'd)
  - Thicknet – also known as thick Ethernet cabling – provided data transmission rates up to 10 Mbps over a distance of 500 meters and supported connectivity of 100 computers on a LAN segment.

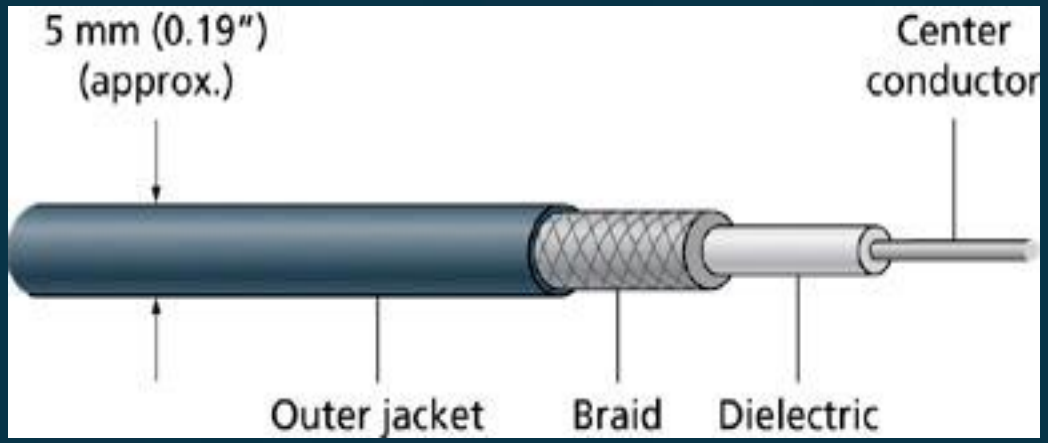
The Characteristics of Thicknet Cabling



MEDIA TYPES and CONNECTORS (cont'd)

- Coaxial Cable (cont'd)
  - Thinnet – also known as thin Ethernet – was introduced in 1985 as an alternative to thicknet.
  - It was cheaper than thicknet.
  - Provided 10 Mbps but over a distance of only 185 meters.
  - 30 computers could attach to a LAN segment.

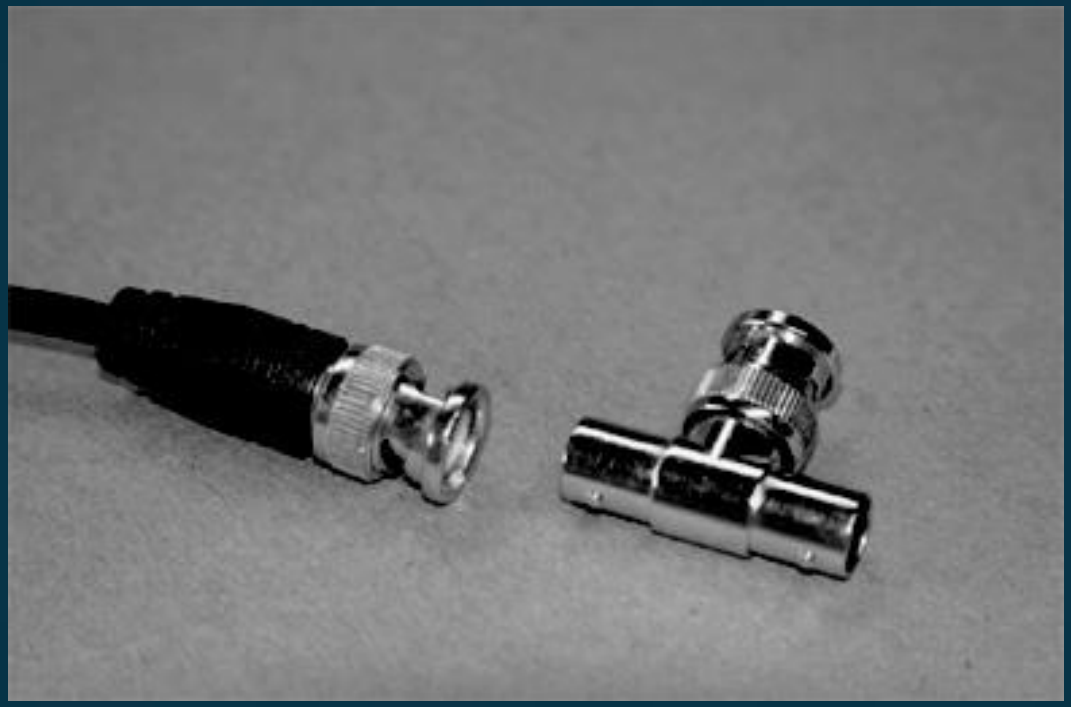
The Characteristics of Thinnet Cabling



MEDIA TYPES and CONNECTORS (cont'd)

- Thinnet Connectors
  - Thinnet uses BNC connectors to connect cabling to cabling, NICs to cabling, and connectivity devices to cabling.

BNC Connectors used with Thinnet Cabling



MEDIA TYPES and CONNECTORS (cont'd)

- Twisted Pair Media
  - Very popular in LAN installations.
  - Consists of several pairs of twisted copper wires.
  - Is available in both unshielded and shielded varieties – UTP and STP.

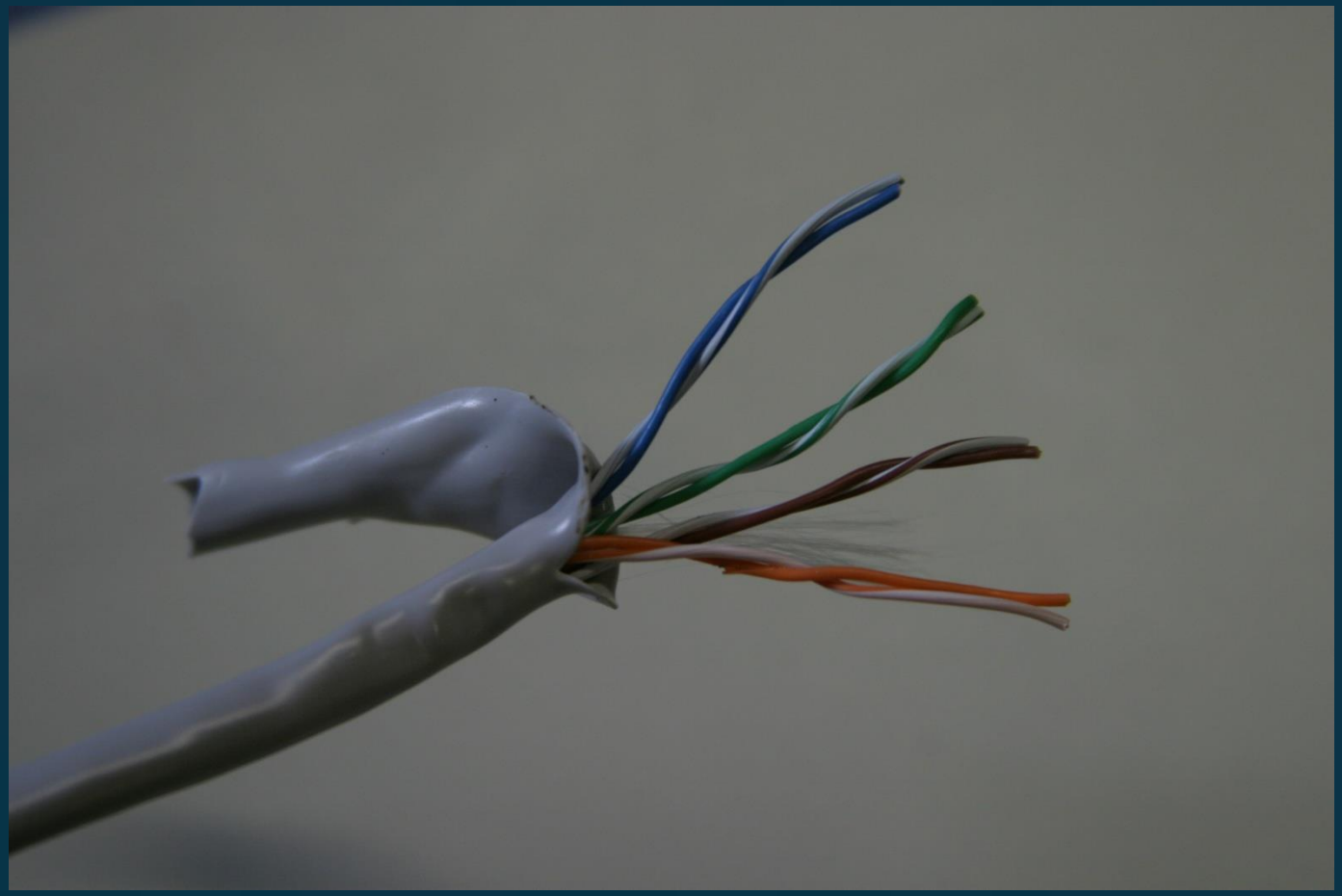
Common UTP Media Standards

TABLE 2.1
Common UTP Media Standards

Media Type	Maximum Data Rate	Where Used
Cat 1 UTP	less than 1 Mbps	Home telephone lines
Cat 2 UTP	4 Mbps	4 Mbps Token Ring networks, older POTs lines—1983–1993
Cat 3 UTP	100 Mbps[a]	4 Mbps Token Ring networks, 10 Mbps Ethernet LANs, some 100 Mbps Ethernet LANs, and POTs lines installed after 1993
Cat 4 UTP	100 Mbps[b]	4 or 16 Mbps Token Ring networks, 10 Mbps Ethernet LANs, some 100 Mbps Ethernet LANs
Cat 5 UTP	1,000 Mbps[c]	4 or 16 Mbps Token Ring networks, 10 and 100 Mbps Ethernet LANs, 1 Gbps Ethernet LANs—with four pairs ATM at 155 Mbps, FDDI
Cat 5e UTP	1 Gbps	10, 100, and 1,000 Mbps Ethernet ATM at 155 Mbps
Cat 6 UTP	10 Gbps	High-speed multimedia applications over future Ethernet LANs with speeds greater than 1 Gbps

[a] Category 3 can support 100 Mbps Ethernet LANs only if the NICs are 100BaseT4 NICs. The *100* means 100 Mbps, *Base* means a single communications channel, the *T* represents twisted pair, and the *4* designates four twisted pairs (eight wires total).
[b] Category 4 can also support 100 Mbps Ethernet only if the NICs are 100BaseT4.
[c] Category 5 can only support 1 Gbps Ethernet when implemented as 1000BaseT4. This means 1,000 Mbps (1 Gbps), single channel, twisted pair, four pairs.

Unshielded Twisted-Pair Cabling



MEDIA TYPES and CONNECTORS (cont'd)

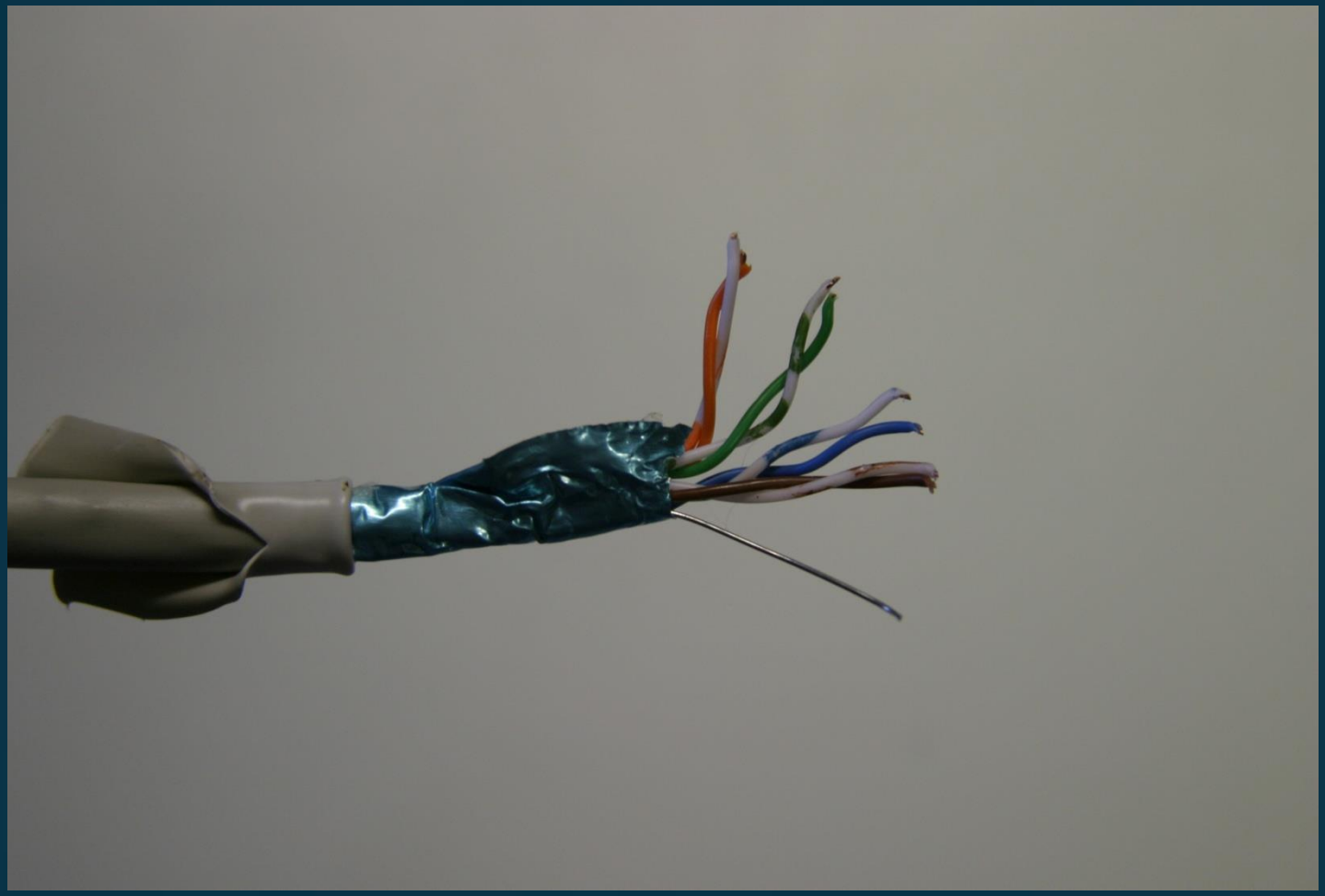
- UTP Connectors
  - UTP cabling is terminated with UTP 8-pin connectors.
  - UTP connectors are commonly referred to as RJ-45 connectors.

UTP Cable Connectors

MEDIA TYPES and CONNECTORS (cont'd)

- Shielded Twisted Pair
  - Provides the same connectivity benefits as UTP, but STP adds two levels of shielding material to protect data transmissions from EMI (Electromagnetic Interference).

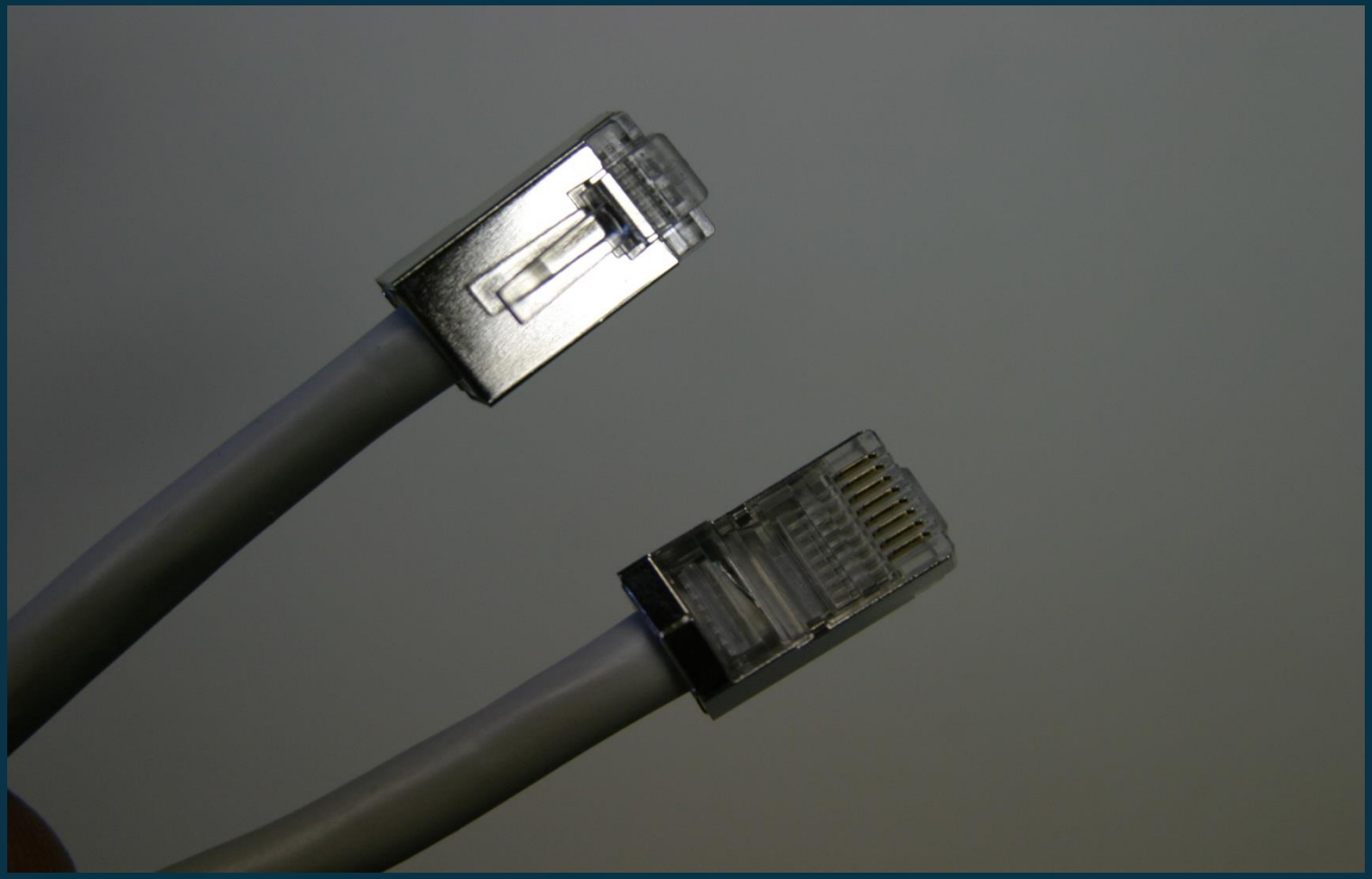
Shielded Twisted-Pair Cabling



MEDIA TYPES and CONNECTORS (cont'd)

- STP Connectors
  - Very much like UTP connectors, except STP connectors provide a ground casing to which the shielding of the STP cabling is connected.

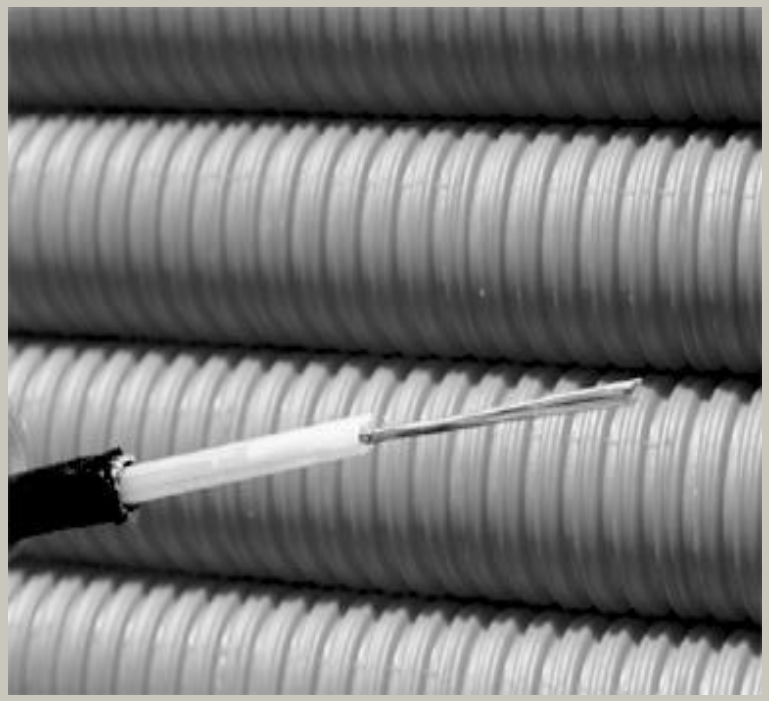
STP Cable Connectors



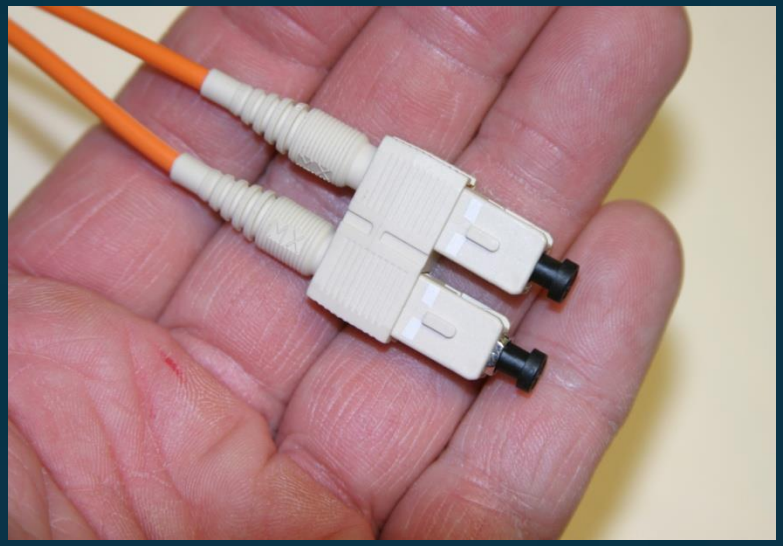
MEDIA TYPES and CONNECTORS (cont'd)

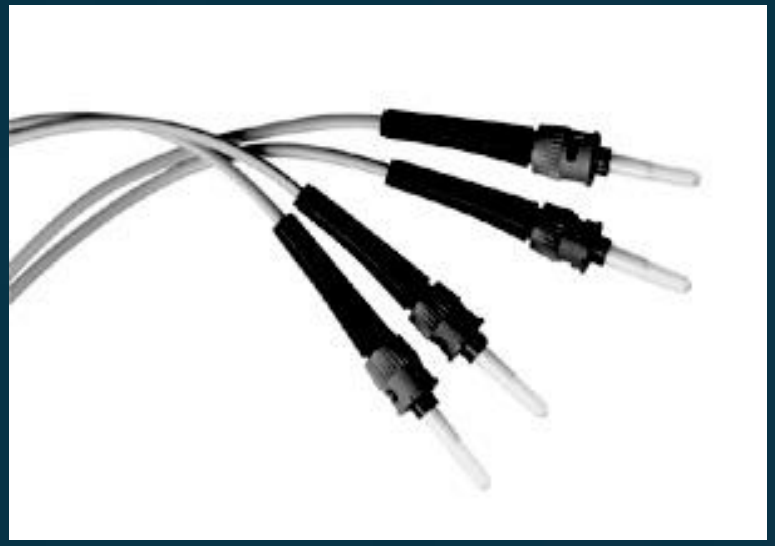
- Fiber-Optic Media
  - Uses glass or plastic fibers to transmit pulses of light.
  - Used where high data rates and large volumes of data transmissions are required.
  - Typical implementations include two fiber-optic cables between source and destination devices – one for transmitting and one for receiving.
  - FO media is not susceptible to EMI.
  - FO media can support greater distances and higher transmission rates than copper cabling.

Examples of Fiber Optic Cabling



An Example of Fiber-Optic Cable Connectors





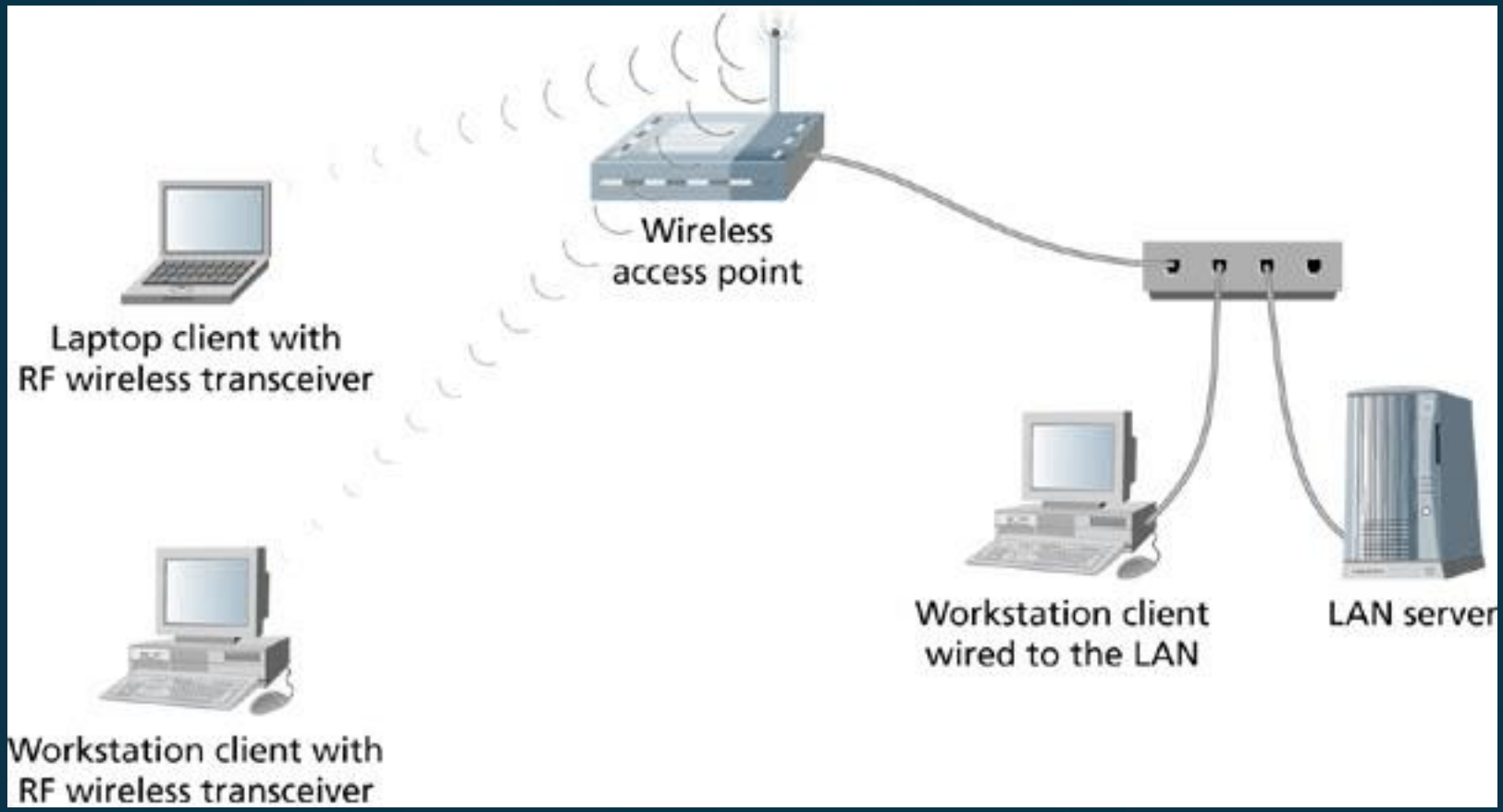
MEDIA TYPES and CONNECTORS (cont'd)

- Wireless Media
  - Does not require an electrical or optical conductor.
  - Options include radio frequency, infrared, and microwave.

MEDIA TYPES and CONNECTORS (cont'd)

- Wireless Media – Radio Frequency
  - Each LAN device has a transceiver and antenna.
  - Wireless LAN radio frequencies do not interfere with radio stations.
  - Radio frequencies are allocated by the KCC
  - Wireless devices use access points for connecting to a LAN.

RF Wireless LAN Devices on a Local Area Network



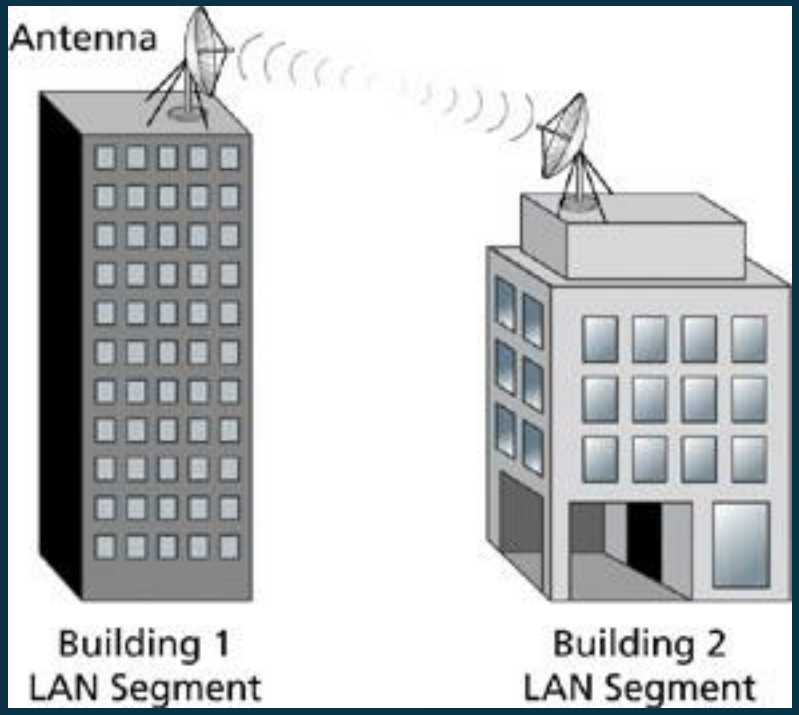
MEDIA TYPES and CONNECTORS (cont'd)

- Wireless Media – Infrared
  - Uses light frequencies for data transmission.
  - Generally limited to very short distances.
  - Susceptible to many types of interference.
  - Can be used in point-to-point or broadcast transmissions.

MEDIA TYPES and CONNECTORS (cont'd)

- Wireless Media – Microwave
  - Uses very high frequency radio waves for data transmission.
  - When used in LAN applications is generally implemented for transmissions between buildings.
  - Terrestrial microwave uses parabolic antennas to transmit data.

Terrestrial Microwave Data Communications



MEDIA TYPES and CONNECTORS (cont'd)

- Wireless Connectors
  - Wireless data transmissions don't use connectors that are analogous to the connectors used in coax, twisted-pair, and fiber optic cabling.
  - Instead, wireless devices use antennas and transceivers to make connections between wireless devices.

NETWORK INTERFACE CARDS

- Network Interface Card
  - Also known as a network adapter, network card, or simply NIC.
  - A NIC is the interface between a computer or other networking device and a LAN.
  - NICs are available in various forms – built in to a computer's motherboard, as a separate expansion card, as a PC card, as a USB device, etc.

Examples of Ethernet NICs

NETWORK INTERFACE CARDS (cont'd)

- Network Interface Card (cont'd)
  - Different transmission rates are available – 10 Mbps, 100 Mbps, 1000 Mbps, 10 Gbps, etc.
  - Different architectures are available – Ethernet, Token Ring, FDDI (Fiber Distributed Data Interface), ATM (Asynchronous Transfer Mode), etc.

NETWORK INTERFACE CARDS (cont'd)

- What NICs do
  - NICs translate data from a computer into an acceptable format for the transmission medium.
  - NICs segment data into frames.
  - NICs provide the physical node address of a device.

NETWORK INTERFACE CARDS (cont'd)

- NIC Characteristics
  - NIC drivers allow a NIC to communicate with workstation operating systems and network operating systems.
  - Many NICs have built in features that provide management capabilities and enhanced performance features.
  - NIC management features include abilities such as the ability to turn on a PC's power via an external command.