Chapter 10
LAN Wiring, Physical Topology and Interface Hardware

Introduction

• Interface cards
  – Why a separate card
  – How to connect the interface to the computer
  – What is a “transceiver”?
• LAN wiring schemes
• Logical and physical topology

Network interface hardware

• CPU can’t process data at network speeds
• Computer systems use special purpose hardware for network connection
  – Typically a separate card in the backplane
  – Network adapter card or network interface card (NIC)
• Connector at back of computer then accepts cable to physical network

I/O interfaces

• CPU can’t process data at network speeds
• Computer systems use special purpose hardware for network connection

Speeds of LANs and computers

• LAN data transmission speeds are typically “fast” relative to CPU speeds
• 100MHz CPU could execute only one instruction for each bit on a 100Mhz Ethernet
• LAN speeds are defined independent of any specific processor speeds
  – Allows for mix of attached systems
  – New computers can be attached without affecting LAN speeds
### NIC and CPU processing

- NIC contains sufficient hardware to process data independent of system CPU
  - Some NICs contain separate microprocessor
  - Includes analog circuitry, interface to system bus, buffering and processing
- Looks like any other I/O device to system CPU
  - System CPU forms message request
  - Sends instructions to NIC to transmit data
  - Receives interrupt on arrival of incoming data

### Connection between NIC and physical network

- Two alternatives:
  - NIC contains all circuitry and connects directly to network medium
  - Cable from NIC connects to additional circuitry that then attaches to the network medium
- Thin Ethernet vs. 10Base-T
- Both are Ethernet; network technology not limited to one style of connection

### NICs and network hardware

- NIC is built for one kind of physical network
  - Ethernet interface can’t be used with token ring
  - ATM interface can’t be used with FDDI
- Some NICs can be used with different, similar hardware
  - Thick, thin and 10Base-T Ethernet
  - 10Mbps and 100Mbps Ethernet
**Thick Ethernet wiring**

- Uses thick coax cable
- AUI cable (or transceiver or drop cable connects from NIC to transceiver
- AUI cable carries digital signal from NIC to transceiver
- Transceiver generates analog signal on coax
- Wires in AUI cable carry digital signals, power and other control signals

**Thin Ethernet wiring**

- Uses thin coax that is cheaper and easier to install than thick Ethernet coax
- Transceiver electronics built into NIC; NIC connects directly to network medium
- Coax cable uses BNC connector

**Connection multiplexing**

- In some circumstances, transceivers may be inconvenient; e.g., workstations in a lab
- Connection multiplexor connects multiple computers to a single transceiver
  - Each computer’s AUI cable connects to connection multiplexor
  - One AUI from multiplexor to Ethernet coax
- Connection multiplexor completely invisible to attached computers

**Thick Ethernet example**

- Thick Ethernet also requires termination to avoid signal reflectance
Thin Ethernet wiring (continued)

- Useful when many computers are located close to each other
- May be unreliable - any disconnection disrupts entire network

10Base-T

- Variously called 10Base-T, twisted pair or TP Ethernet
- Replaces AUI cable with twisted pair cable
- Replaces thick coax with hub

Thin Ethernet wiring (continued)

- Coax runs directly to back of each connected computer
- T connector attaches directly to NIC
Hubs

- Extension of connection multiplexing concept
- Sometimes called “Ethernet-in-a-box”
- Effectively a very short Ethernet with very long AUI cables
- Can be connected into larger Ethernets

Protocol software and Ethernet wiring

- All wiring technologies use identical Ethernet specification
  - Same frame format
  - Same CSMA/CD algorithms
- Can mix different technologies in one Ethernet
- NICs can provide all three connection technologies
Comparison of wiring schemes

- Separate transceiver allows computer to be powered off or disconnected from network without disrupting other communication
- Transceiver may be located in an inconvenient place
- Finding malfunctioning transceiver can be hard
- Thin coax takes minimum of cable
- Disconnecting one computer (or one loose connection) can disrupt entire network
- Hub wiring centralizes electronics and connections, making management easier
- Bottom line - 10Base-T most popular because of cost
Topologies and network technologies

- 10Base-T network topology is a bus; wiring topology is a star
- Token ring network topology is a ring; wiring topology is a star
- Remember to distinguish between logical and physical topologies