Speeds of LANS & Computers

- LAN speeds are fast compared to CPU speeds.
- Example: A 500 MHz CPU can execute at most 5 instructions for each bit on a 100 Mbps Ethernet. Several instructions are required for each bit.
- It does not make sense to operate a network at a speed suitable for the slowest CPU.
- On the other hand, it does not make sense to require that all computers operate at the same speed.

Speeds of LANS & Computers

- LAN speeds are defined independently of processor speeds.
  - Allows for a mix of attached systems.
  - New computers can be attached without affecting the LAN speed.

Network Interface Hardware

- Since a CPU can’t process data at network speeds, computer systems use special-purpose network hardware.
- network adapter card or network interface card (NIC) - a hardware device that plugs into a computer and connects to a network.
- Most computers come with a NIC preinstalled.
- A NIC is built for one kind of physical network.

NIC & CPU Processing

- A NIC contains sufficient hardware to process data independently of a computer's CPU.
  - Some NICs contain a separate microprocessor.
  - A NIC includes analog circuitry, an interface-to-system bus, buffering, and processing.
- A NIC looks like any other I/O device to the system CPU.

NIC & CPU Processing

- To transmit:
  - The CPU forms packets and instructs the NIC to begin transmission.
  - The CPU can do other things while the NIC handles transmission details.
  - When finished transmitting, the NIC interrupts and informs the CPU.

NIC & CPU Processing

- To receive:
  - The NIC interrupts the CPU only when it receives frames intended for the computer.
  - The NIC discards frames not intended for the computer without bothering the CPU.

Connecting a NIC & a Network

- Two possibilities:
  - The NIC contains all the circuitry and connects directly to the network medium.
  - A cable from the NIC connects to additional circuitry that then attaches to the network medium.
- Example: Thin Ethernet vs 10Base-T. Both are Ethernet, and yet each uses a different connection style.

Thick Ethernet Wiring

- The original Ethernet wiring scheme.
- Uses a thick coaxial cable.
- Formally called 10Base5.
- An Attachment Unit Interface (AUI) cable carries a digital signal from a NIC to a transceiver.
- The transceiver attaches directly to the coax. Its function is to convert a digital signal from a NIC to an analog signal on the coax and vice versa.

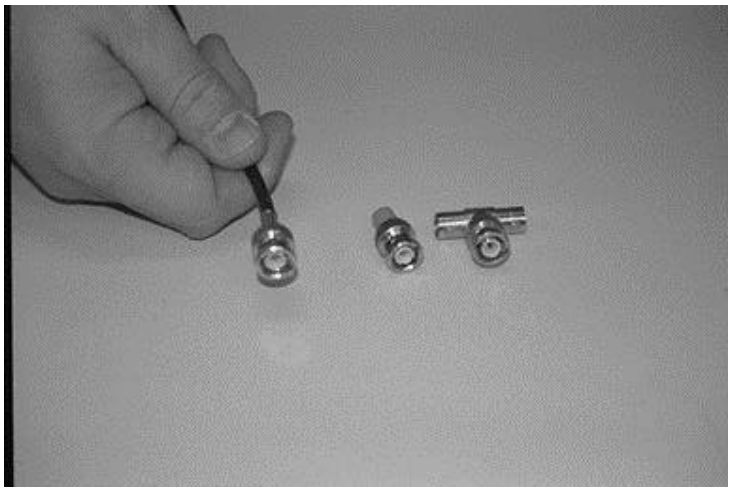
Thick Ethernet Wiring

- In addition to carrying digital signals, an AUI cable has wires to supply power to the transceiver and wires to control the transceiver.
- Each end of the Ethernet cable requires termination.
- terminator - a device (essentially a resistor) to prevent electrical signals from reflecting back.

Connection Multiplexing

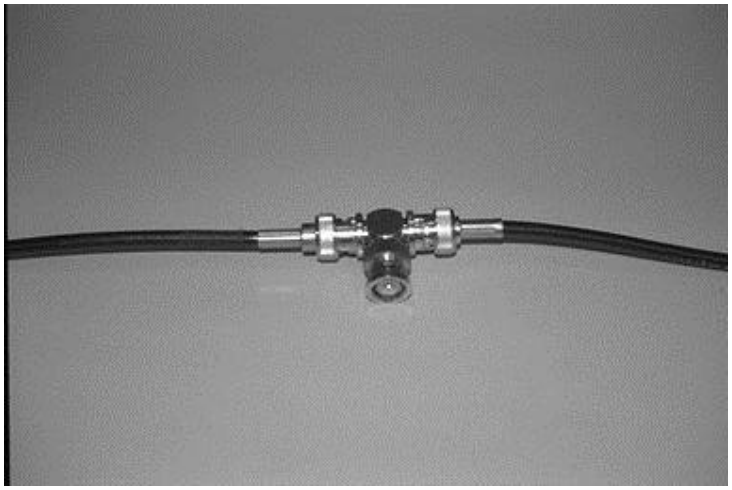
- Thick Ethernet wiring with a transceiver for each station can be inconvenient.
- A connection multiplexor can be used to connect several computers to a single transceiver.
  - Each computer's AUI cable is connected to a connection multiplexor.
  - Only one AUI cable runs from the multiplexor to the Ethernet coax.
- The connection multiplexor is completely invisible to the attached computers.

Thin Ethernet Wiring



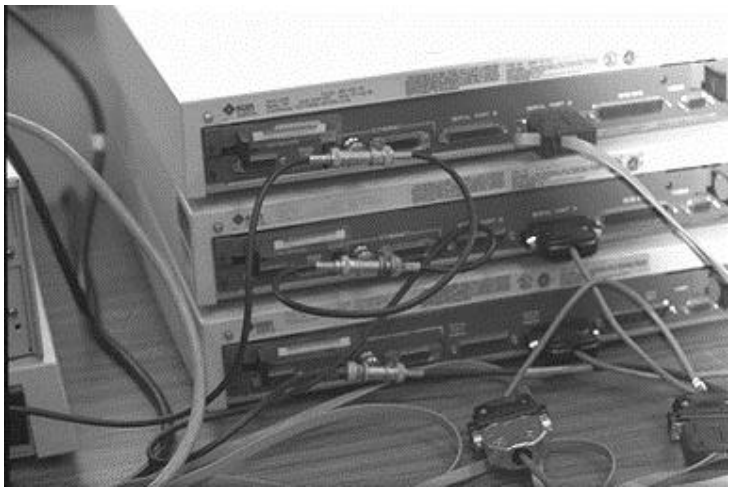
- Uses a thinner more flexible coaxial cable.
- Cheaper and easier to install.
- The transceiver electronics are built into the NIC.
- Thin Ethernet does not use an AUI cable.
- The connection from a NIC to the Ethernet cable is made with a BNC connector.

Thin Ethernet Wiring



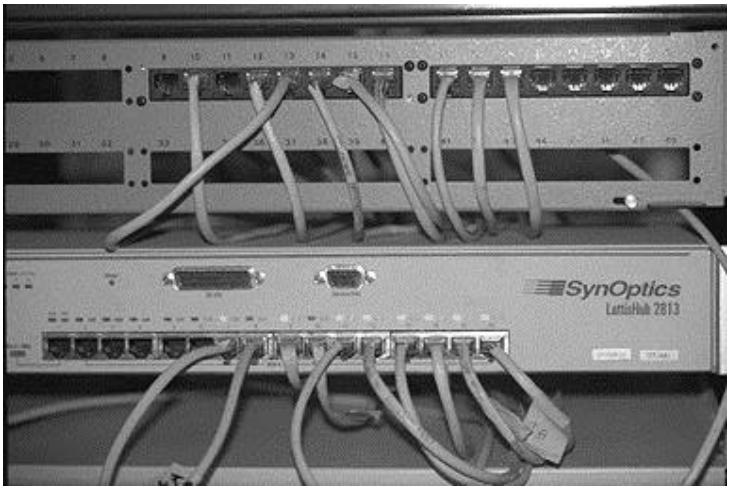
- The thin Ethernet coax runs directly to the back of each computer.
- A T connector attaches directly to a NIC.

Thin Ethernet Wiring



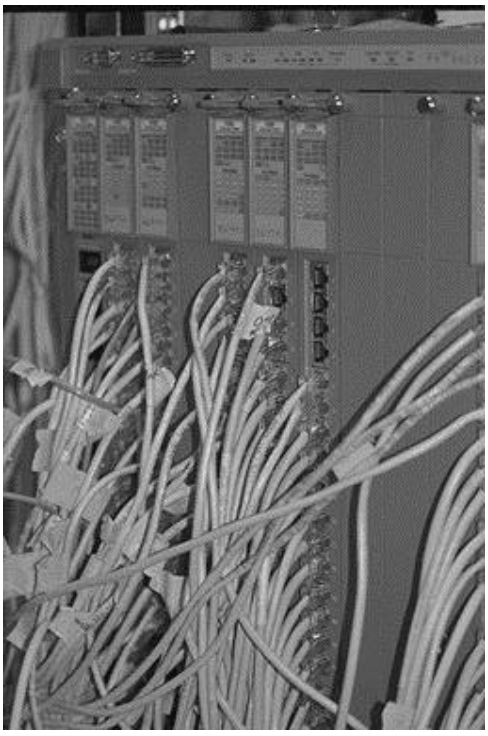
- Thin Ethernet is useful when many computers are located near each other.
- May be unreliable.

Twisted-Pair Ethernet



- Also called 10Base-T or TP Ethernet.
- Replaces AUI cable with twister-pair cable and RJ-45 connectors.
- Replaces thick coax with a hub.

Hubs



- A hub is an extension of the connection multiplexing concept.
- Sometimes called an “Ethernet in a box.”
- A hub is effectively a very short Ethernet cable with very long AUI cables.
- Hubs come in all sizes.

Protocol Software & Ethernet Wiring

- All wiring schemes use the same Ethernet specification.
  - Same frame format.
  - Same CSMA/CD algorithms.
- A NIC can provide connections for all 3 wiring schemes.
- The protocol software does not and cannot distinguish the wiring scheme.

Comparison of Wiring Schemes

- Separate transceivers allow computers to be turned off or disconnected from a network without disrupting others.
- Transceivers are often located in inconvenient locations.
- Finding a malfunctioning transceiver can be difficult.
- The original thick Ethernet coax is more expensive than thin Ethernet coax which, in turn, is more expensive than 10Base-T.

Comparison of Wiring Schemes

- Disconnecting one computer from a thin Ethernet or a loose connection on a thin Ethernet can disrupt an entire network.
- Hub wiring centralizes the electronics and makes management easier.
- Disconnecting a single wire from a hub disables only one computer and not the rest of the network.
- Bottom line: 10Base-T is the most popular wiring scheme.

  Reason: Cost.

Physical vs Logical Topologies

- Be careful to distinguish between a network's physical and logical topologies.

	Physical	Logical
10Base-T Ethernet		
"bus in a box"	star	bus
Hub Token Ring		
"ring in a box"	star	ring