

## Wired computer-to-computer connections

### Unit objectives

- Identify wired network cables and connectors
- Install and configure network interface and modem PCI cards

## Topic A

- Topic A: Wired network connections
- Topic B: Network interface cards and modems

## Fiber optic wired connections

- Carries digital signals in the form of pulses of light
- Benefits
  - Thinner and lighter weight
  - Higher carrying capacity
  - Use of digital signals
  - Less signal degradation
  - Less interference
  - Non-flammable
  - More secure

## SONET

- Synchronous Optical Network (SONET)
- ANSI standard for signal transmission on optical networks
- Categories
  - STS-1, OC-1                      51.8 Mbps
  - STS-3, OC-3                      155.5 Mbps
  - STS-12, OC-12                      622.0 Mbps
  - STS-48, OC-48                      2.48 Gbps
  - STS-192, OC-192                      9.95 Gbps
  - STS-768, OC-768                      39.81 Gbps

## Fiber optic connectors

- Ferrule
  - Cap to prevent splitting
  - Terminates end of cable
  - Ease of connecting/disconnecting cable
  - Avoid splicing
  - Must be connected to allow light to pass through correctly

## Fiber optic connector types



## Twisted pair connections

- Common in business applications
- Delivers both voice and data
- Select proper cable type based on
  - Cable's electrical characteristics
  - Conductor size
  - Ability to resist crosstalk
- 3-4 pairs of wire for networking
- Twisted to prevent crosstalk
- More twists equal less crosstalk, but greater attenuation

## UTP categories

- CAT 1 up to 1 Mbps (obsolete)
- CAT 2 4 Mbps
- CAT 3 16 Mbps; 10 MHz
- CAT 4 20 Mbps; 20 MHz
- CAT 5 100 Mbps; 100 MHz  
155 Mbps ATM
- CAT 5e 1000 Mbps; 200 MHz  
155 Mbps ATM
- CAT 6 1000 Mbps; 250 MHz  
155 Mbps ATM
- CAT 6e 10 Gbps; 550 MHz
- CAT 7 10 Gbps; 600 MHz

## Stranded versus solid

- Solid
  - Thicker, more protective covering
  - Less flexible
  - Best for longer network runs and fixed wiring
- Stranded
  - Thinner protective covering
  - More pliable
  - Useful for shorter-distances and movable wiring

## Twisted pair connectors

- Four types for UTP
  - RJ-11
  - RJ-14
  - RJ-25
  - RJ-45
- RJ = Registered Jack
- RJ-11, RJ-14, and RJ-25 used for telephone and modem
- RJ-45 used for TP networking

## RJ connectors

- RJ-11 6P2C
- RJ-14 6P4C
- RJ-25 6P6C
- RJ-45 8P8C

## Modern residential wiring

- Four-pair (or larger) cable
- Fire-resistant "plenum" insulation wrapped tightly around conductors
- Current telephone wire
  - Typically contains two pair of wires—pair 1 is blue and blue/white, pair 2 is orange and orange/white
  - If a third pair of wires is included, it is green and green/white, and attaches to an RJ-25 connector, also known as a 6P6C connector
  - Pins 3 and 4 are used for line 1, pins 2 and 5 are used for line 2, and pins 1 and 6 are used for line 3

## RJ-25 pinout



## RJ-45 connector

- Attaches to 8 wires
- Two connection standards for Ethernet
  - T568A – mostly residential use
  - T568B – mostly commercial use

## Pin numbering of RJ-45 connector



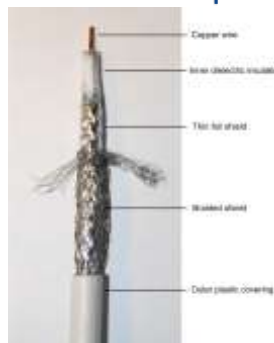
## Terminating CatX to RJ-45



## Coaxial connections

- Found in older networks
- RG-8, RG-11, RG-58 used in Ethernet
- Stranded or solid
- Impedance in ohms  $\Omega$

## Common components of coaxial



## RG standards

- RG-6/U 75  $\Omega$  1.0 mm
- RG-6/UQ 75  $\Omega$  1.0 mm
- RG-8/U 50  $\Omega$  2.17 mm
- RG-9/U 51  $\Omega$  2.17 mm
- RG-11/U 75  $\Omega$  1.63 mm
- RG-58/U 50  $\Omega$  0.9 mm
- RG-59/U 75  $\Omega$  0.81 mm

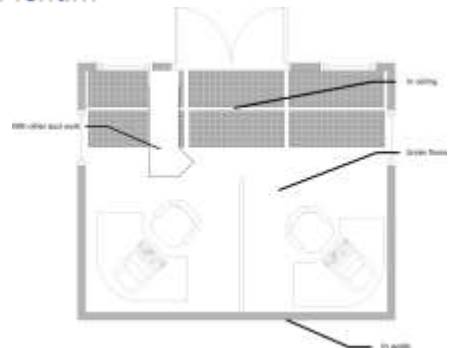
## Thinnet connectors



## Terminating coax with BNC



## Plenum



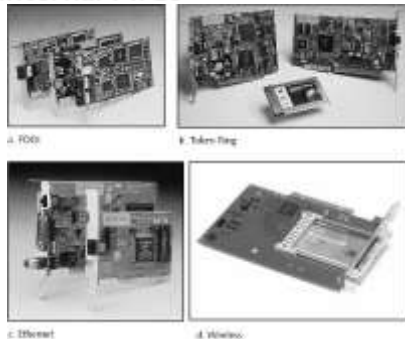
## Topic B

- Topic A: Wired network connections
- Topic B: Network interface cards and modems

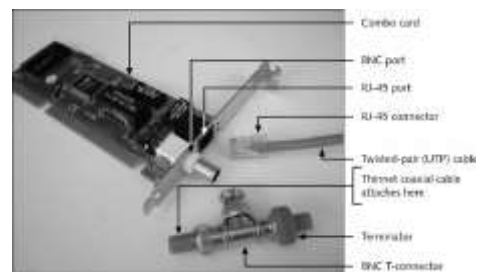
## Network adapter

- Also known as
  - Network board
  - Network Interface Card (NIC)
- A communication channel between computer's motherboard and network
- Sends and receives information from the system bus in parallel
- Sends and receives information from the network in series
- Converts data into network appropriate signal

## Internal NICs



## PCI Ethernet card



## Notebook computers

- NIC built-in
- Older use PCMCIA adapters
- PCMCIA hot swappable

## NIC selection

- Match NIC to
  - Network architecture to which it connects
  - Specific type of cable connection it uses
  - Type of slot in the computer in which it's installed
- New systems PCI card
- Older systems ISA or EISA

## Addressing

- MAC address
- IPv4 address
- IPv6 address
- Character-based name
- Port address

## Identifying addresses

OSI model	Protocols	Identifying address
Application Presentation Session	HTTP, SMTP, POP, IRC, FTP	Port address and IP address (or domain name)
Transport	TCP or UDP	IP address (or domain name)
Network (or Internet)	IP	IP address (or domain name)
Data Link Physical	Ethernet	MAC address

## MAC address

- Function at OSI Data Link layer
- Hosts use OS to discover MAC addresses of other hosts on same network
- Can't discover host MAC addresses on other networks
- Three important points
  - MAC addresses don't change
  - All hosts on a LAN communicate by their MAC addresses
  - MAC addresses alone can't be used to communicate between two computers on different LANs

## IPv4

- 32 bits long
- 4 bytes separated by periods – each called an octet
- Largest binary 11111111 = 255
- 4.3 billion potential IP addresses
- Divided into two parts
  - Network identification
  - Host identification

## IPv6

- 128-bit address
- 16 bytes
- Displayed in hexadecimal
- Group address in hexadecimal, two bytes at a time, separated by colons (:)
- Can remove leading zeros
- Can compress address by using double colons (::) for bytes with all zeros

## Character-based names

- Host
- NetBIOS
- DNS – resolves host names to IP address

## Domain Name System (DNS)

- Server with database matching host name to IP address
- DNS name has three parts
  - Computer name
  - Domain name
  - Top-level domain name
- Can also have subdomains to further divide

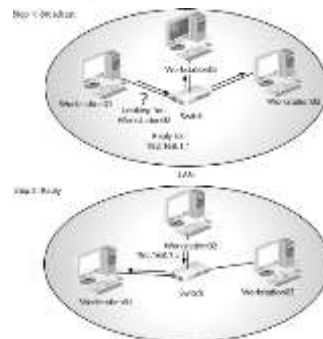
## Top-level domains

- Suffix at end of DNS name
- Common
  - .com for general business
  - .org for nonprofit organizations
  - .edu for educational organizations
  - .gov for government organizations
  - .mil for military organizations
  - .net for Internet organizations (hosting companies and ISPs)
  - .int for international
- Also suffixes for countries and specialties such as aviation

## NetBIOS

- 16 character name
- First 15 characters available for the name
- 16th character reserved to describe a particular service or functionality
- Can include:
  - Letters
  - Numbers
  - ! @ # \$ % ^ & ( ) - \_ ' { } . ~
- Must be unique

## Resolving NetBIOS by broadcast



## Resolving NetBIOS by WINS

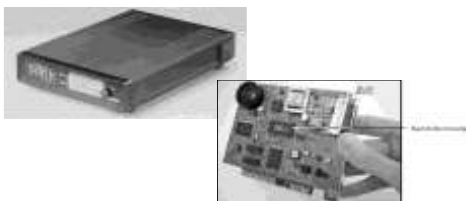
- Windows Internet Name Service (WINS)
- Microsoft product
- Database of NetBIOS names
- Hosts register with WINS
- WINS resolves NetBIOS name to IP address

## Port addresses

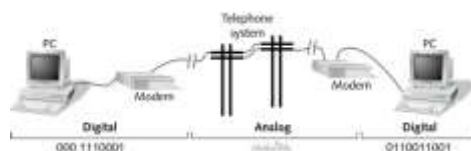
- Services listen on ports
- Port numbers 0 to 1024 are reserved for privileged services
- Socket — combination of an IP address and a port number

## Modems

- Connect computer to computer through phone line
- External or internal
- Converts signals from digital to analog and back



## Modulation/demodulation

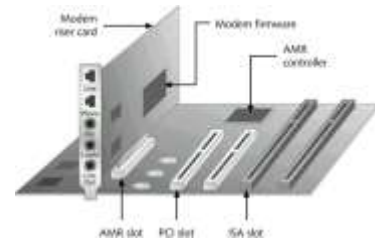


## Connections



## Riser cards

- Audio Modem Riser (AMR)
- Communications and Networking Riser (CNR)
- Advanced Communications Riser (ACR)



## Softmodems

- Implement modem functions through software
- Most popular — WinModem
- WinModem — Windows-based combination of simple hardware and modem function emulation software
- Less expensive
- Tied to operating system

## Dial-up connection creation

- Home users connect to ISP
- Business users connect to remote access server
- In Vista, create using “Set up a connection or network” wizard

## Dial-up connection properties

- Phone number
- Dialing rules
- Dialing options
- Redial attempts
- Security — Advanced (custom settings)
- Protocols and services
- Internet connection sharing

## Unit summary

- Identified wired network cables and connectors
- Installed and configured network interface and modem PCI cards