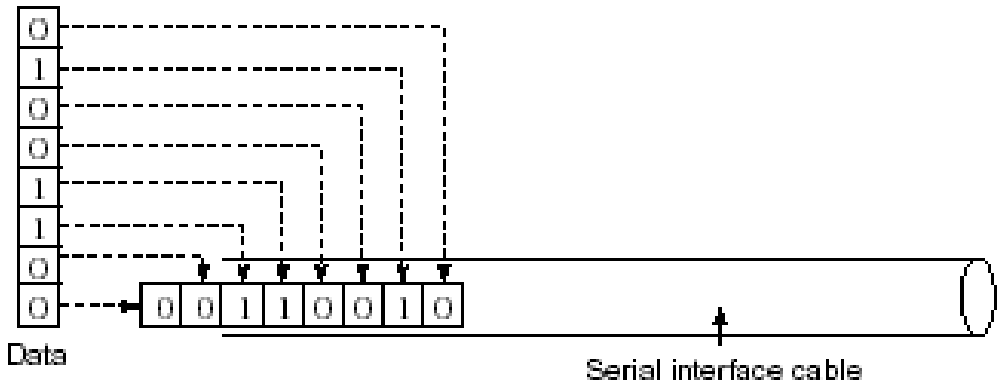
Input / Output Architecture and Devices

Input / Output Interfaces

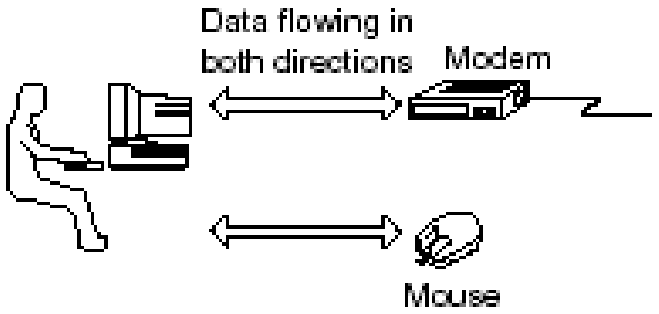
- Serial interface
  - One transmission channel is used
  - Data transferred one bit at a time
  - Transfer rate slow but only one transmission channel is required
  - No signal delay
  - Long-distance transfers
- Types of serial interface
  - RS-232C
  - USB



Input / Output Architecture and Devices

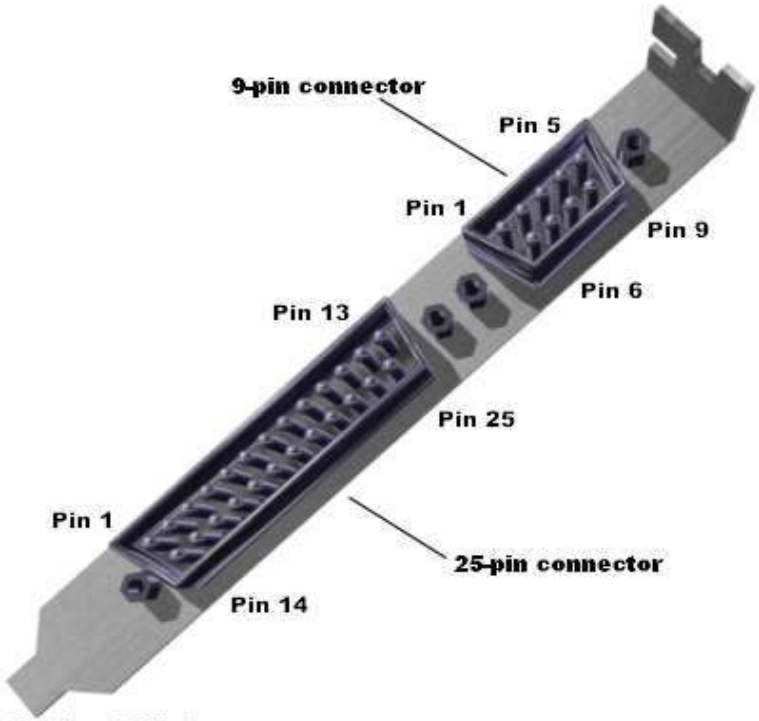
RS-232C

- Short for ***r**ecommended **s**tandard-232C,* a standard interface approved by the Electronic Industries Association (EIA) for connecting serial devices such as modems, mice, serial printers, many display screens
- Supports two types of connectors: DB-25 and DB-9



Serial Port

- Data is serialized taking a byte each time
- Only one wire to transmit the 8-bits data
- Also known as communication (COM) ports
- Are bidirectional



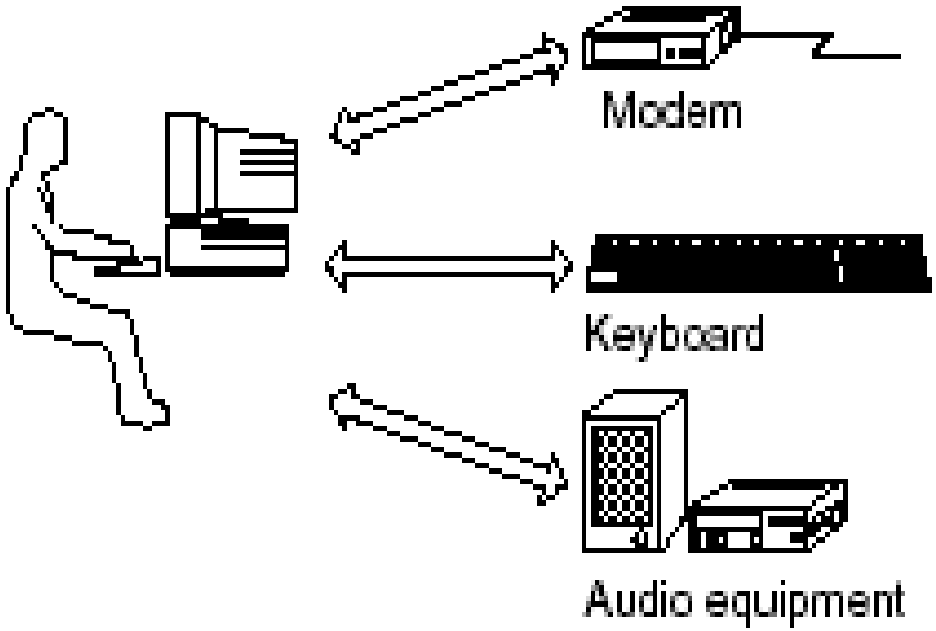
Serial Port

- Relies on a special controller chip, Universal Asynchronous Receiver/Transmitter (UART)
  - Built in buffer (16 to 64 kilobytes)
  - Maximum transfer rate of 115 kbps (kilobits per sec)
  - Enhanced Serial Port (ESP) can reach transfer rate of 460kbps

Serial Port

- Before each byte of data, a start bit value 0 is sent
- After each byte of data, an end bit is sent; it may also send a parity bit

USB



USB

- Universal Serial Bus
  - "A" connectors head upstream toward the computer
  - "B" connectors head downstream and connect to individual devices
  - A single, standardized, easy-to-use way to connect up to 127 devices to a computer

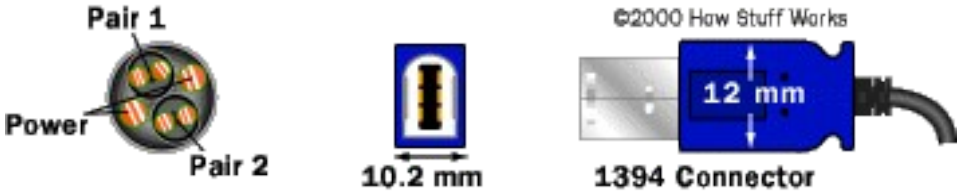
USB

- The bus has a maximum data rate of 12 megabits per second
- Each device can consume up to a maximum of 6 megabits per second (Mbps) of bandwidth
- Supports Plug-and-Play installation and hot plugging
- Each device can consume up to a maximum of 6 megabits per second (Mbps) of bandwidth
- USB 2.0
  - External bus standard that supports data transfer rates of 480 Mbps (480 million bits per second)

USB

- Is host-based, meaning that devices must connect to a computer in order to communicate
- USB 2.0 - maximum data rate of 480 Mbps

IEEE 1394



- Also known as Sony i.Link or as FireWire
- Is plug-and-play
- Uses 64-bit fix addressing
- Is peer-to-peer, meaning that two FireWire cameras can talk to each other without going through a computer

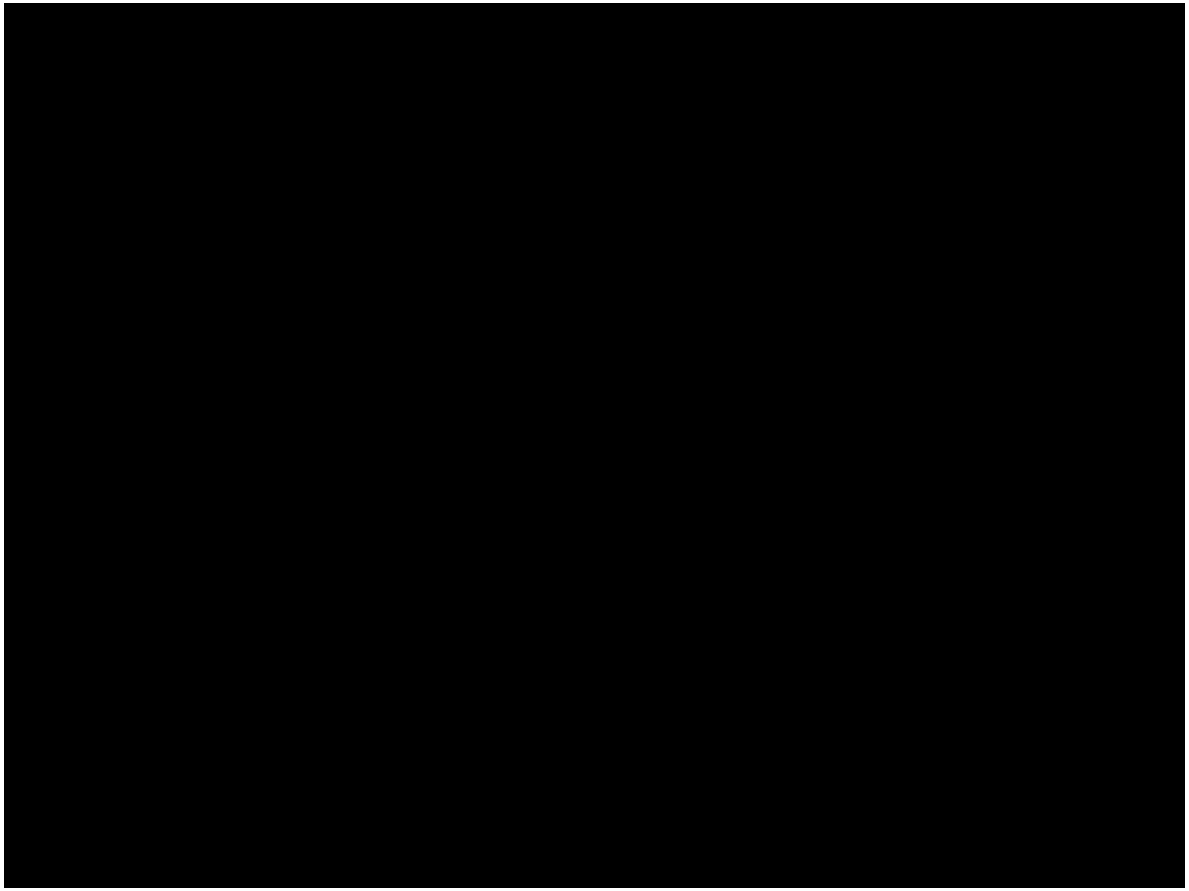
IEEE 1394

- 3 parts to each packet of information sent by a device over FireWire:
  - A 10-bit bus ID that is used to determine which FireWire bus the data came from
  - A 6-bit physical ID that identifies which device on the bus sent the data
  - A 48-bit storage area that is capable of addressing 256 terabytes of information for each node

IEEE 1394

- Maximum data rate is 400Mbps
- In future, 1394b maximum data rate is at least 800Mbps and could hit 3.2Gbps
- Support of isochronous mode means data streams in real-time between the device and the host is guaranteed bandwidth and no error correction

Military Tag



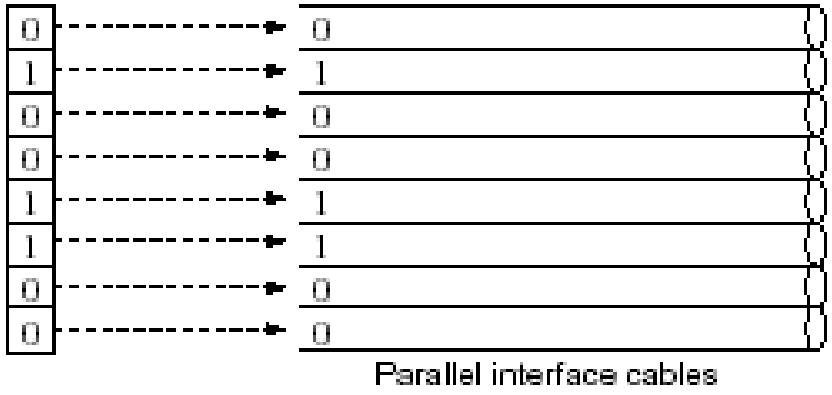
Input / Output Interfaces

- IrDA (infrared Data Association)
  - Wireless technology
  - Easy connection as no cables are used
  - Used mainly in PDA (Personal Digital Assistants) and mobile computing
  - Ranges in speed between 2.4kbps and 4.0Mbps
  - Deploy infrared light pulses
  - IrDA devices depend on being in direct line of sight with each other to communicate

Input / Output Architecture and Devices

Parallel Interface

- Data transferred in parallel resulting in high transfer rate.
- Using 8 or 16 cables
- Multiple transmission channels
- High cost
- Short distances



Parallel Port

- DB-25 – a 25-pin female connector
- 36-pin Centronics male connector
- To connect between the printer and the computer

Input / Output Architecture and Devices

Input / Output Interfaces

- Centronics interface
  - A printer interface
  - 8-bit parallel transfer
  - Unidirectional
  - Peer to peer connections only
  - Transfer rate is 150kbps

Parallel Port

- 8-bit of data consecutively each time
- Are bidirectional
- Standard Parallel Port (SPP)
  - Can reach transfer rate of 50kb~100kb per second

Parallel Port

- Enhanced Parallel Port (EPP)
  - Can reach transfer rate of 500kb ~ 2Mb per second
  - Targeted specifically non-printer devices
- Extended Capabilities Port (ECP)
  - Designed to provide improved speed and functionality for printers

Input / Output Architecture and Devices

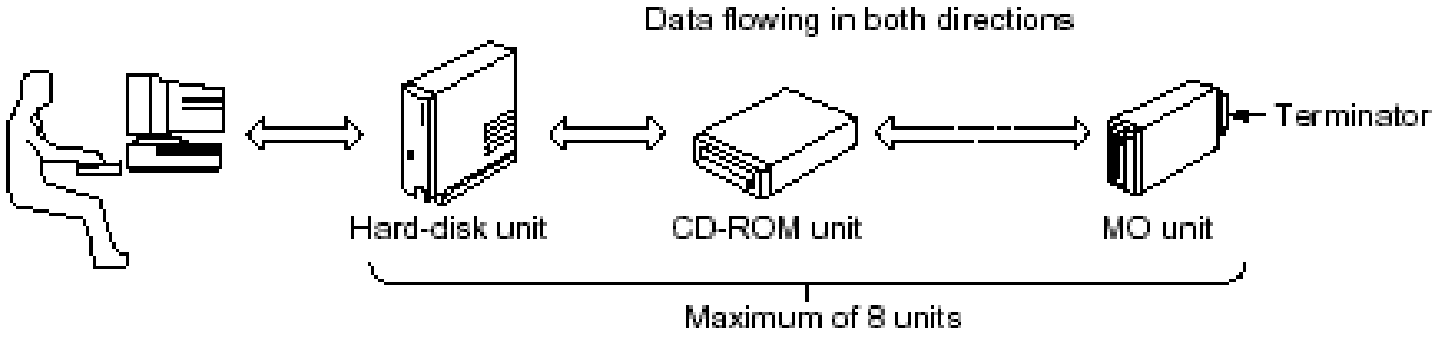
Input / Output Interfaces

- GPIB (General Purpose Interface Bus)
  - The standard's number is IEEE488
  - 8-bit parallel transfers
  - 24 signal lines
  - Transmission distance limit is 20 m
  - Data transfer rate between 1 kbps to 1 Mbps
  - Connect up to 15 devices (instruments) possible
  - A reliable bus system especially designed for connecting computers and instruments
  - Lasted for the past 25 years, but may be replaced in the future especially the speed in concern

Input / Output Architecture and Devices

Input / Output Interfaces

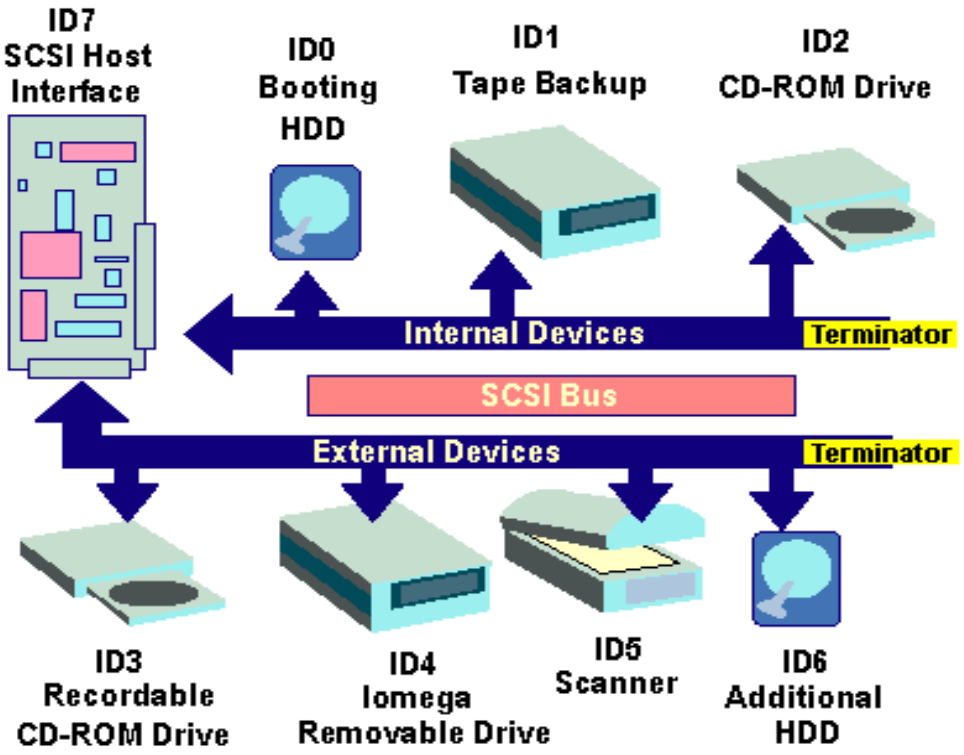
- SCSI (Small Computer Systems Interface)
  - Bi-directional
  - SCSI (Transfer rate: 1.5 to 4Mbps)
  - SCSI-2 (Transfer rate: up to 20Mbps)
  - SCSI-2 uses 50-pin connectors (or 25-pin connector)
  - Up to 8 auxiliary devices can be daisy-chained together
  - An ID is assigned to each connected device
  - Each end of the chain must be terminated.



SCSI

Three basic types

- SCSI I
  - Bus width 8 bits
  - Up to 8 devices
  - Bus speed of 5Mhz
  - Transfer rate up to 5Mbps



SCSI

- Three basic types
  - SCSI II
    - Bus width 16 bits (for Wide SCSI)
    - Up to 16 devices (for Wide SCSI)
    - Bus speed of 10MHz (for Fast SCSI)
    - Transfer rate up to 10Mbps for both Wide SCSI and Fast SCSI
    - Transfer rate up to 20Mbps for Wide/Fast SCSI

SCSI

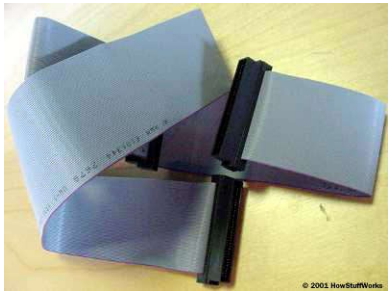
- Three basic types
  - SCSI III
    - Standards are based on variations of the SCSI Parallel Interface (SPI)
    - Mostly begin with the term "Ultra" (Ultra for SPI variations, Ultra2 for SPI-2 variations and Ultra3 for SPI-3 variations)
    - Bus speed between 20MHz ~ 40MHz
    - Transfer rate between 20Mbps ~ 160Mbps

SCSI System

- Three components
  - Controller
    - Also known as host adapter
    - Can be an expansion card or a chip on the motherboard

SCSI System

- Three components
  - Device
    - Each SCSI device has a unique identifier
    - Devices with an adapter built in are called embedded SCSI devices
  - Cable

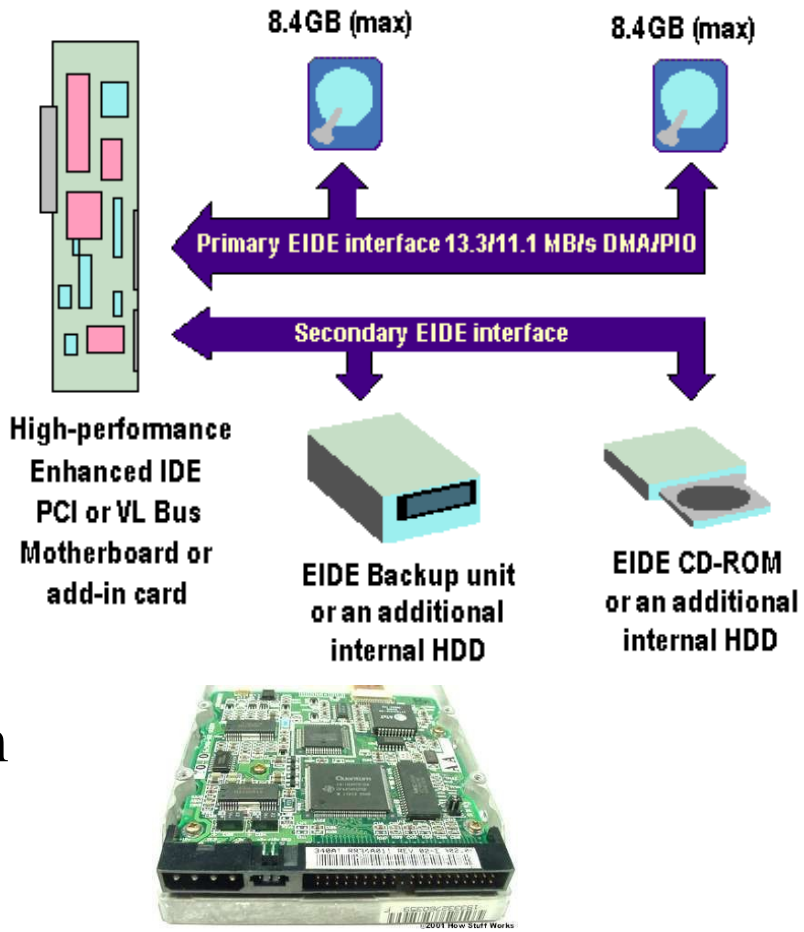


Internal SCSI ribbon cable

External SCSI cable

IDE

- Integrated Drive Electronics
- A single IDE interface can support 2 devices
- Most motherboards come with dual IDE interfaces (primary and secondary) for up to 4 IDE devices
- The controller is integrated with the device



IDE Variations

- Also known as AT Attachment (ATA) interface
  - ATA-1
    - Provides signal timing for direct memory access (DMA) (i.e. the drive send the information directly to memory)
    - Provides signal timing for programmed input/output (PIO) functions (i.e. the CPU manages the information transfer)
    - DMA transfer rate is 4.16MBps

IDE Variations

- ATA-2
  - Often known as EIDE, or Fast ATA, or Fast ATA-2
  - Provides full direct memory access (DMA)
  - DMA transfer rate is 16.67MBps
- ATA-3
  - Addition of Self-Monitoring Analysis and Reporting Technology (SMART)
  - Adds password protection to access drives, providing a valuable security feature

IDE Variations

- ATA-4
  - Also known as Ultra DMA, Ultra ATA and Ultra ATA/33
  - Ultra DMA support
  - The integration of the AT Attachment Program Interface (ATAPI) standard - a common interface for CD-ROM drives, tape backup drives and other removable storage devices
  - Bus transfer rate is 33.33MBps

IDE Variations

- ATA-5
  - Also known as Ultra ATA/66
  - Bus transfer rate is 66.67MBps
- ATA-6
  - Also known as Ultra ATA/100
  - Bus transfer rate is 100MBps
- High pin count
- High voltage
- Cable problems

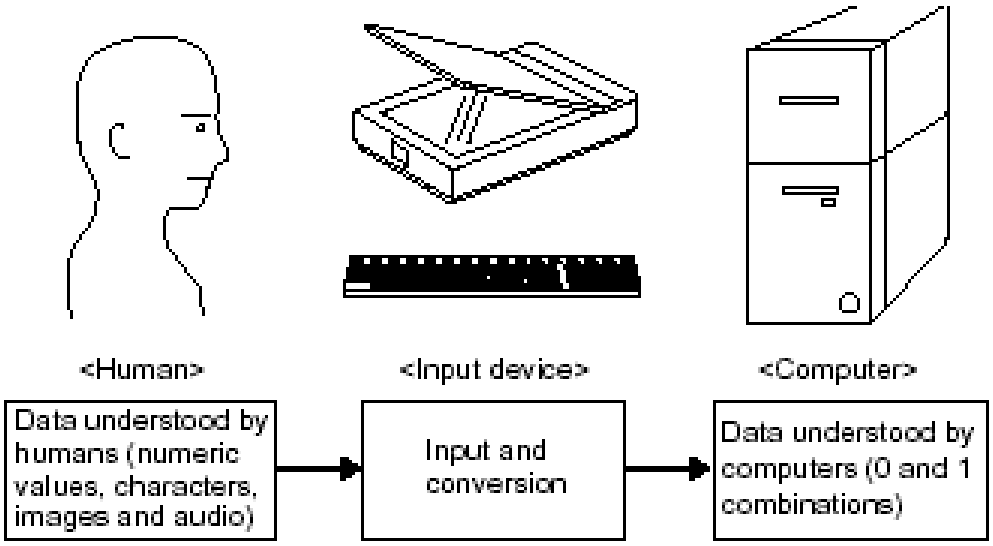
ATA Serial

- Ideal for mobile, enabling OEM to use one standard interface
- Thin and flexible cable that can be up to one meter in length
- Hot-plug opportunity
- Transfer rate starts at 1.5Gbps

I/O Architecture and devices

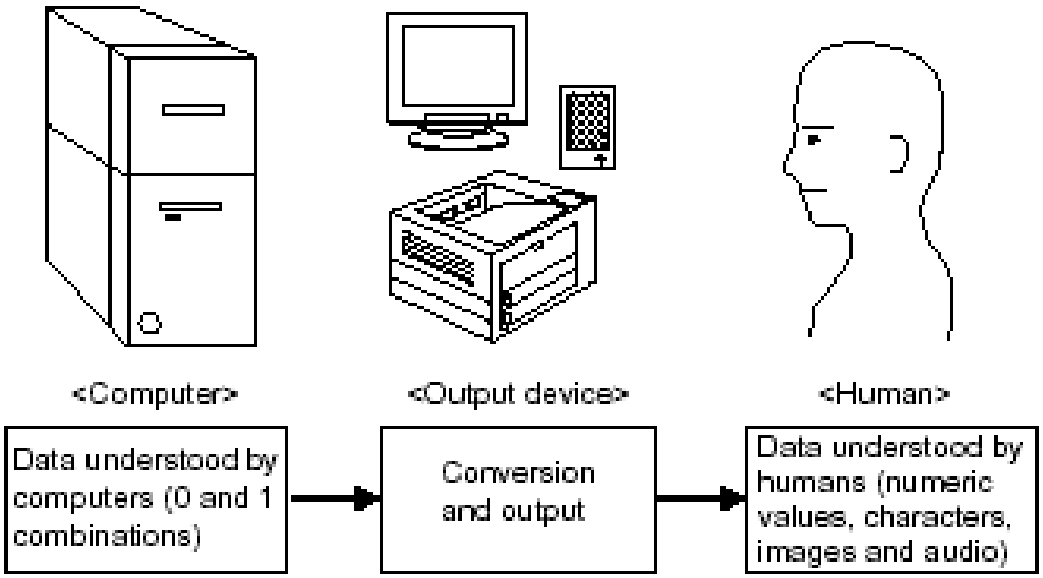
Input Devices

- Converts data that can be understood by humans such as mouse movement into a data format (0 and 1 combinations) that can be understood by computers and loads it into RAM.

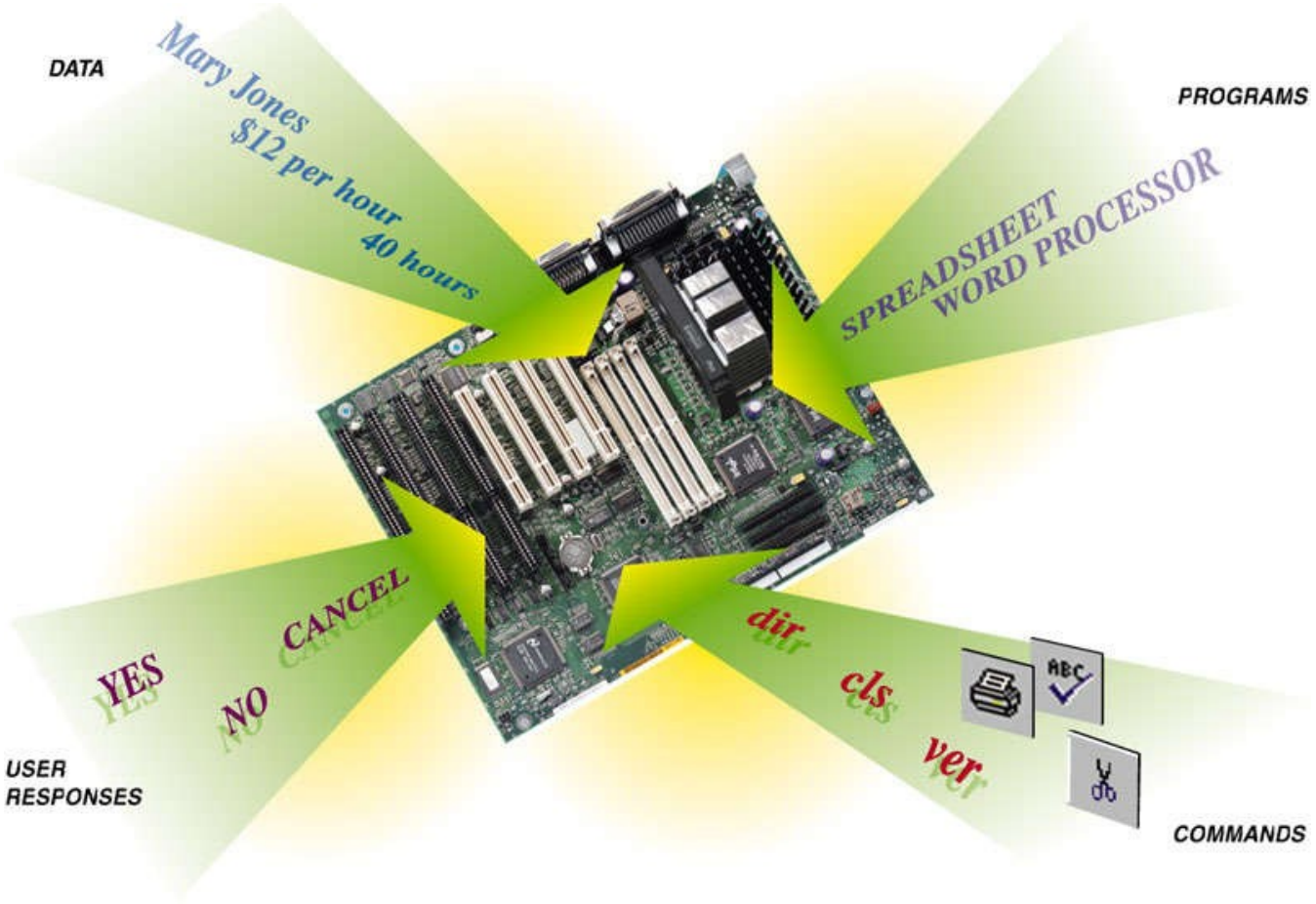


Output Devices

- Convert the data processed in the computer (0s and 1s) into data that can be understood by humans (characters, images, video, audio)



Input Devices



What are Input Devices?

- Any hardware component that allows you to enter data, programs, commands, and user responses into a computer
  - Keyboard
  - Pointing devices
  - Scanners and reading devices
  - Optical readers
  - Digital cameras

The Keyboard

- Primary input device
- Typical Keyboard:
  - Typing area
  - Numeric keypad
  - Status lights
  - Arrow keys
  - Function keys
  - Special keys
    - Toggle keys
    - Ctrl-Alt-Del

Function Keys

COMMAND SUMMARY

Command	Function Key(s)	Menu	Button
Close Word	ALT+F4	File|Exit	
Copy	SHIFT+F2	Edit|Copy	
Office Assistant	F1	Help|Microsoft Word Help	
Open	CTRL+F12	File|Open	
Print	CTRL+SHIFT +F12	File|Print	
Print Preview	CTRL+F2	File|Print Preview	
Save	SHIFT+F12	File|Save	
Spelling and Grammar	F7	Tools|Spelling and Grammar	

Key Name	Key Purpose
ALT	Short for Alternate. When pressed in combination with another key(s), usually issues a command. Meaning varies depending on application.
Arrow keys	Moves the insertion point in the direction of the arrow. For example, the UP ARROW key moves the insertion point up one position.
BACKSPACE	Erases the character to the left of the insertion point.
Break	Often pressed in combination with another key to stop or suspend execution of a program.
CAPS LOCK	A toggle key that when activated, shifts alphabetic letters to uppercase. It does not affect keys with numbers, punctuation marks, or other symbols.
CTRL	Short for Control. When pressed in combination with another key(s), usually issues a command. Meaning of CONTROL key combinations varies depending on application.
DELETE	Erases the character to the right of the insertion point. Also used to erase selected objects. Sometimes abbreviated DEL.
END	Usually moves the insertion point to an ending position, such as the end of a line.
ENTER	Also called Return key. Used at end of a command to direct computer to process command. Also used to create a new paragraph in a word processing application.
ESC	Short for Escape. Often used to quit a program or operation.
Function keys	Labeled F1, F2, F3, and so on. Meaning of each function key varies depending on application.
HOME	Usually sends the insertion point to a beginning location, such as the top of a document or beginning of a line.
INSERT	Usually toggles between insert and overwrite modes.
NUM LOCK	Short for Numeric Lock. A toggle key that when activated, causes numeric keypad keys to function like a calculator. When deactivated, numeric keypad keys move insertion point.
PAGE DOWN	Causes the insertion point to move down a certain number of lines. Sometimes abbreviated PGDN.
PAGE UP	Causes the insertion point to move up a certain number of lines. Sometimes abbreviated PGUP.
Pause	Temporarily suspends a program or command.
PRINT SCREEN	Captures screen images.
SCROLL LOCK	Has no function in most current applications.
SHIFT	When pressed in combination with a letter key, causes the letter to be in uppercase.
TAB	Moves insertion point from place to place. Also used to insert tab characters into a word processing document.

The Keyboard

- Keyboard Types

(QWERTY)

(Dvorak)

The Keyboard

- Other keyboard types
  - Enhanced keyboards
    - 12 function keys
    - 2 CTRL keys, 2 ALT keys
    - A set of arrow and additional keys between the typing area and the numeric keypad
  - Wireless keyboards
    - Transmit data via infrared waves
  - WYSIWYG

Laptop and Handheld Keyboards

- Built into the top of the system unit

Ergonomic Keyboards

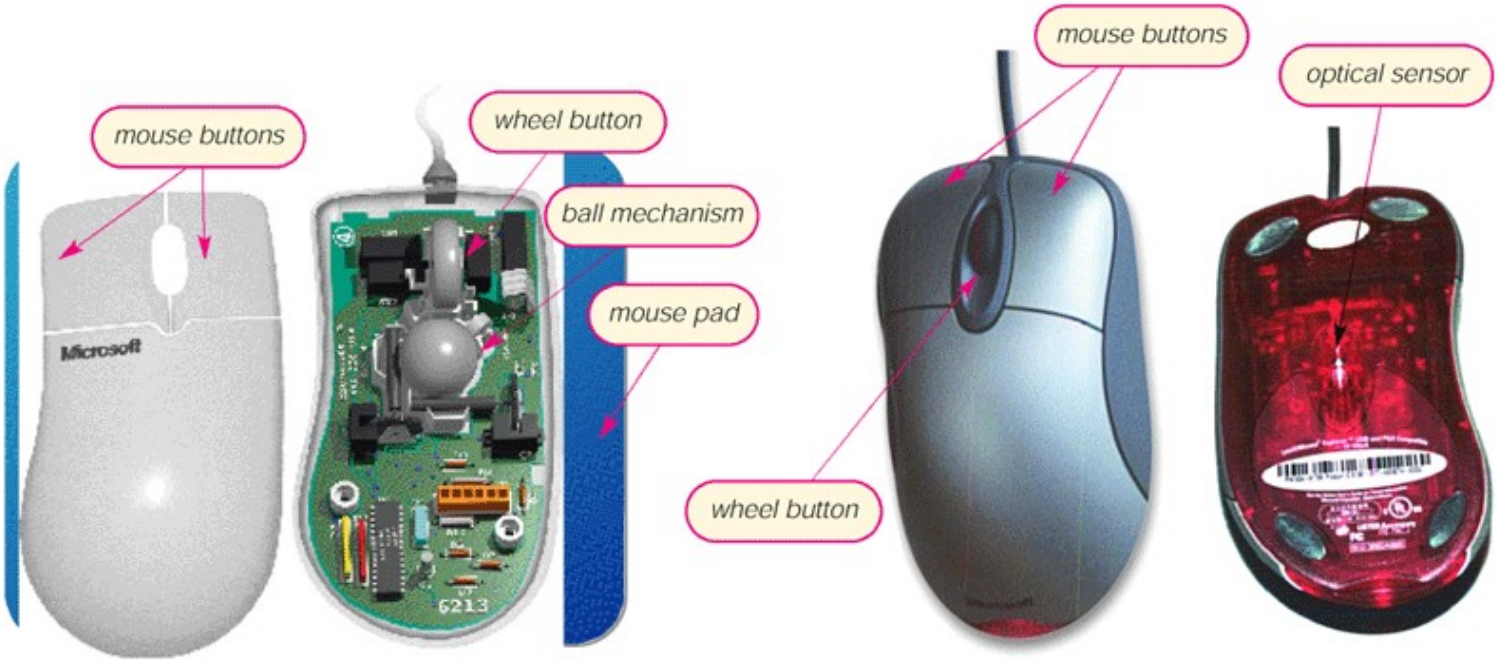
- Used for comfort, efficiency and safety

Pointing Devices

- An input device that allows you to control a pointer on the screen
  - Block arrow
  - I-beam
  - Pointing hand

Mouse

- How a mouse works

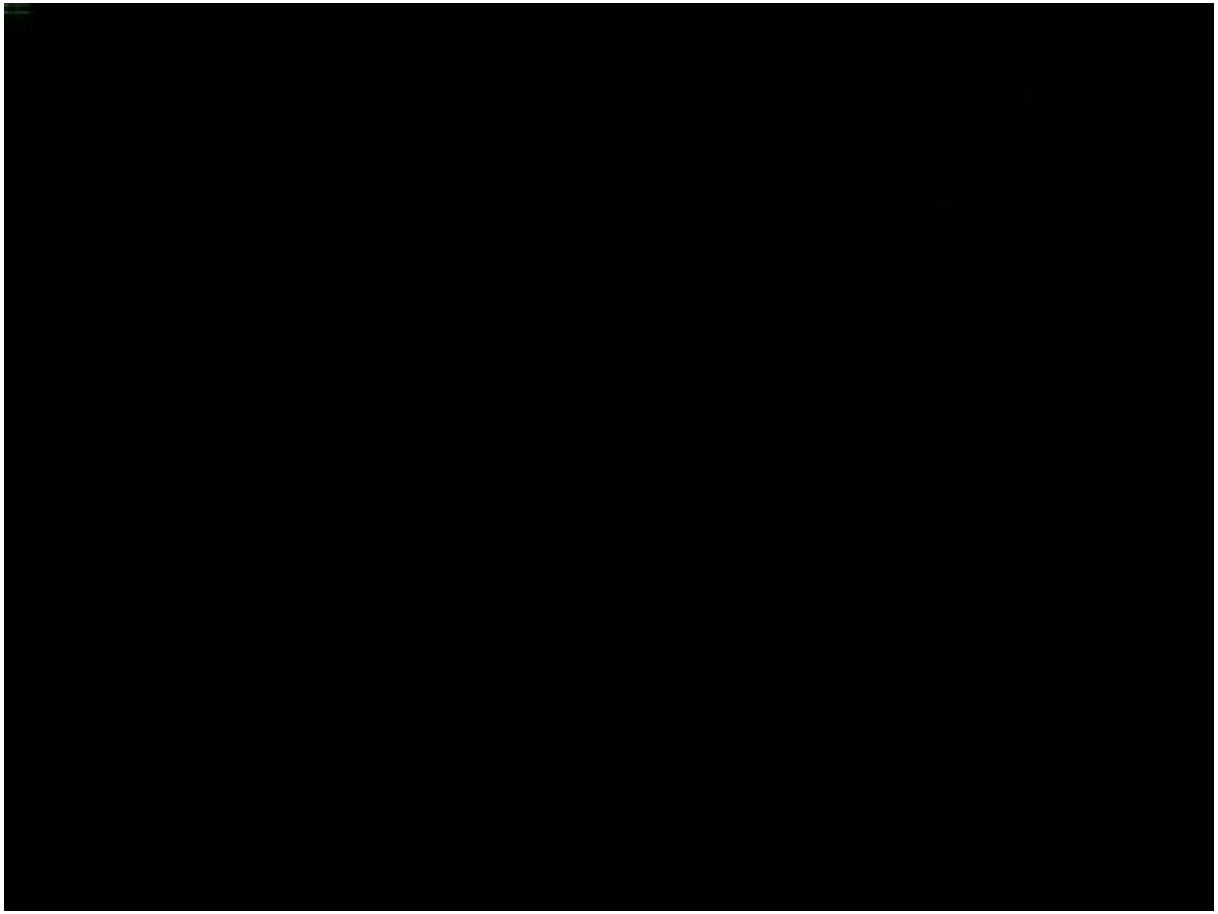


Using a mouse

MOUSE OPERATIONS

Operation	Mouse Action	Example
Point	Move the mouse across a flat surface until the pointer rests on the item of choice on the desktop.	Position the pointer on the screen.
Click	Press and release the primary mouse button, which usually is the left mouse button.	Select or deselect items on the screen or start a program or program feature.
Right-click	Press and release the secondary mouse button, which usually is the right mouse button.	Display a shortcut menu.
Double-click	Quickly press and release the primary mouse button twice without moving the mouse.	Start a program or program feature.
Drag	Point to an item, hold down the left mouse button, move the item to the desired location on the screen, and then release the left mouse button.	Move an object from one location to another or draw pictures.
Right-drag	Point to an item, hold down the right mouse button, move the item to the desired location on the screen, and then release the right mouse button.	Display a shortcut menu after moving an object from one location to another.
Rotate wheel	Roll the wheel forward or backward.	Scroll up or down a few lines.
Press wheel button	Press the wheel button while moving the mouse on the desktop.	Scroll continuously.

Better Mice



Other Pointing Devices

- Trackball
  - Like a mouse, but the ball is on top
  - Often used on laptop computers
- Touchpad
  - Flat, rectangular pointing device that is sensitive to pressure and motion
  - Often used with laptop computers

Other Pointing Devices

- Pointing stick
  - Pressure sensitive pointing device shaped like a pencil eraser
  - Moves pointer as pressure is applied
  - Often used on laptop computers
- Joystick
  - Uses the movement of a vertical lever
  - Often used with games

Other Pointing Devices

- Touch screen
  - Monitor has a touch-sensitive panel
  - Used to issue simple commands or choose from a list of options
  - Kiosks

Other Pointing Devices

- Pen input
  - Light pen
    - Contains light source or can detect light
  - Pen computing
    - Stylus used
    - Handwriting recognition software
  - Graphics tablet
    - Each location on the tablet corresponds to a location on the screen
    - Puck
- Pointing Devices

Scanners and Reading Devices

- Optical Scanner
  - Result stored as bitmap
  - Resolution
  - Types of scanners
    - Flatbed
    - Sheet-fed
    - Drum
- Business Cards Scanning

Scanners and Reading Devices

- Optical Readers
  - Uses light to read characters, marks, and codes and then converts them into digital data that can be processed by a computer
  - Optical character recognition (OCR)
    - Reads character printed in OCR font
    - Turn-around documents
  - Optical mark recognition (OMR)
    - Reads hand-drawn marks

Scanners and Reading Devices

- Bar code scanner
  - Uses laser beams
  - Universal Product Code (UPC)
  - Widely used types of bar codes
- Magnetic Ink Character Recognition (MICR) Reader
  - Used in banking industry
  - Preprinted on cheques - bank code, account number, and cheque number

Scanners

Data collection devices

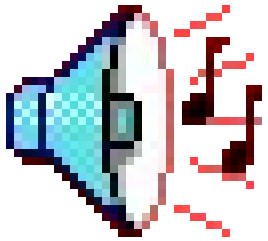
- Used to obtain data directly at the location where the transaction or event takes place
- Geographic information system (GIS)

Digital Cameras

- Allows you to take pictures and store the photographed images digitally
  - Download, or transfer, pictures to your computer
  - Edit, print, fax, mail, or post on the Web
  - Studio camera
  - Field camera
  - Point-and-shoot camera

Digital Camera

Audio Input



- Entering music, speech, or sound effects
- Sound card
- MIDI devices
- Waveforms (WAV files)
- MP3 files (DVD Quality)
- Voice Input

Audio Input

- Speech Recognition
  - Computer's capability of distinguishing spoken words
  - Speaker dependent/independent systems
    - Voice templates
    - Discrete speech recognition
    - Continuous speech recognition
    - Natural language voice interface

Speech Recognition Applications

SPEECH RECOGNITION APPLICATIONS

Speech Recognition Application	Explanation	Example Uses
Command	Controls equipment	• Issue instructions to personal computer • Dial a cellular telephone • Route calls in an automated telephone system
Dictation/Data Entry	Types spoken words	• Office employees dictate letters • Doctors update hospital patient records • Reporters write stories • Lawyers develop briefs • Bankers transfer funds among bank accounts
Information Access	Enables access to products and services	• Access credit card account information • Access product information

Video Input

- Entering a full-motion recording into a computer and storing the video on a hard disk or some other medium
- Video capture card
- Moving Picture Experts Group (MPEG)

Video Input

- Videoconferencing
  - Meeting between two or more geographically separated individuals who use a network to transmit audio and video data
  - Requires
    - Microphone
    - Speakers
    - Video camera
  - Whiteboard-based interaction

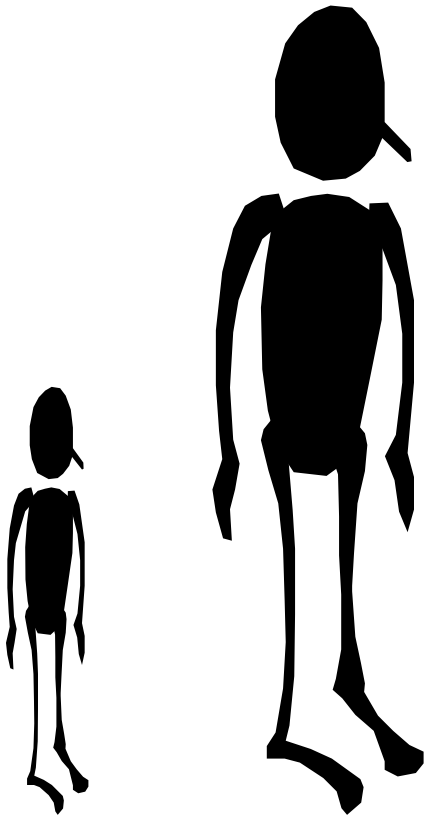
Audio and Video Input

- Compression
  - 1MB
  - Full-motion video takes app. 30MB per second

Compression solves the problem of storage

Compression

- A fat cat sat on a bat (22 bytes)
  - A token (*) is used to represent "at"
  - A f* c* s* on a b* (18 bytes)
  - Alternatively, token is used to represent "at "
  - A f*c*s*on a bat (16 bytes)



Compression

- Audio compression
  - MP3 – Remove the highest and lowest ends of the audio spectrum (mostly inaudible to humans)
- Video compression
  - Inter-Frame compression
    - MPEG Moving Pictures Experts Group - Video compression algorithm which uses the fact that there are usually only small changes from one "frame" to the next so they only need to encode the starting frame and a sequence of differences between frames. This is known as "inter-frame coding" or "3D coding".

Input devices for physically challenged users

- Issues that need to be addressed
  - Cannot interact with their computer because of physical, psycho-cognitive, socio-cultural and situational impairments
- Australian legislation
  - Disability Discrimination Act applies to all services whether provided for payment or not
    - Covers everything from employment and education to sale or rental of real estate to provision of information, services or facilities on the Internet

Input devices for physically challenged users

- Head-mounted pointers
  - Headmaster – electronic pointing device worn on the head and in used in conjunction with a sip and puff switch to emulate clicking
  - Headmouse – head controlled wireless pointing device
- Voice recognition software
  - Dragon Dictate, Plain Talk
- Keyboard
  - Intellikeys - allows users to touch large or small areas on a keyboard overlay (user designed) to operate a computer
- Screen reading software
  - Windows Accessibility Options

Input Device Users Guide

USER	INPUT DEVICE
Home User	• Enhanced keyboard or ergonomic keyboard • Mouse • Joystick • 30-bit 600 x 1200 dpi color scanner • Digital camera • Microphone • Video digitizer • PC camera
SMALL BUSINESS USER	• Enhanced keyboard or ergonomic keyboard • Mouse • 36-bit 600 x 1200 dpi color scanner • Digital camera • Microphone • PC camera
MOBILE USER	• Wireless mouse for laptop computer • Trackball, touchpad, or pointing stick on laptop computer • Pen computer • Digital camera
LARGE BUSINESS USER	• Enhanced keyboard or ergonomic keyboard • Mouse • Touch screen • Pen computer with light pen • 36-bit 1200 x 1200 dpi color scanner • OCR or OMR or bar code reader or MICR reader • Microphone • Video camera for videoconferences • Speech recognition program
POWER USER	• Enhanced keyboard or ergonomic keyboard • Optical mouse • Graphics tablet • 36-bit 1200 x 1200 dpi color scanner • Digital camera • Microphone • Video capture card • Video digitizer