

Introduction to Information Technology

Lecture 3

IT 111

The System Unit: Storage

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Learning Objectives

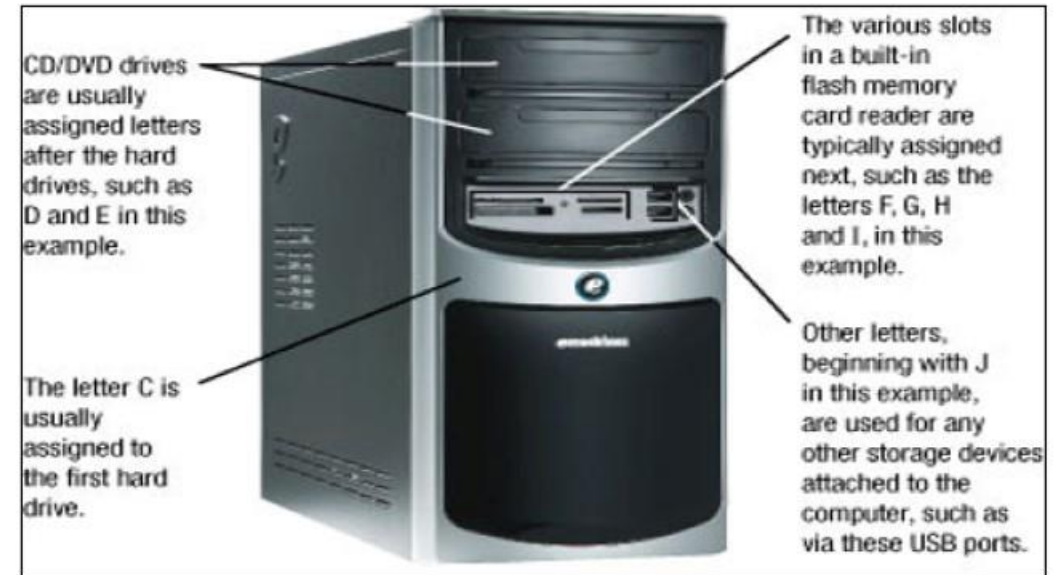
1. Name several general properties of storage systems.
2. Describe the two most common types of hard drives and what they are used for today.
3. Discuss the various types of optical discs available and how they differ from each other.
4. Identify some flash-memory-based storage devices and media and explain how they are used today.
5. List at least three other types of storage systems.
6. Summarize the storage alternatives for a typical personal computer.

How computer memory works

Storage System Characteristics

- Consist of a storage device and a storage medium

- Device: DVD drive, flash memory card reader, etc.
- Medium: DVD disc, flash memory card, etc.
- Medium is inserted into device to be used.
- Storage devices are typically identified by letter.

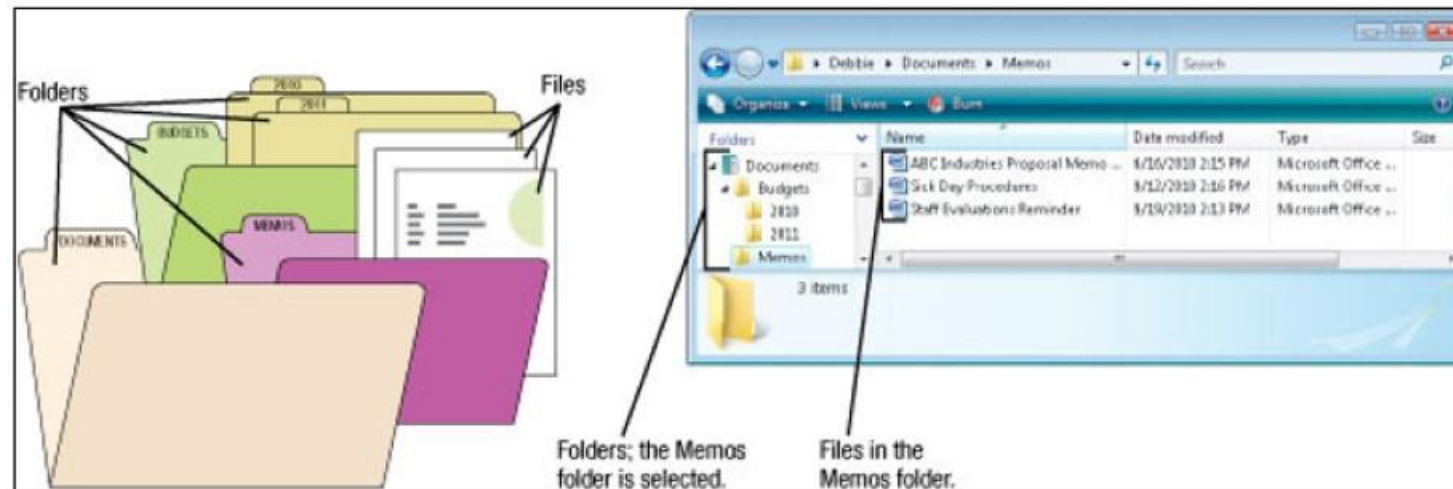


Storage System Characteristics

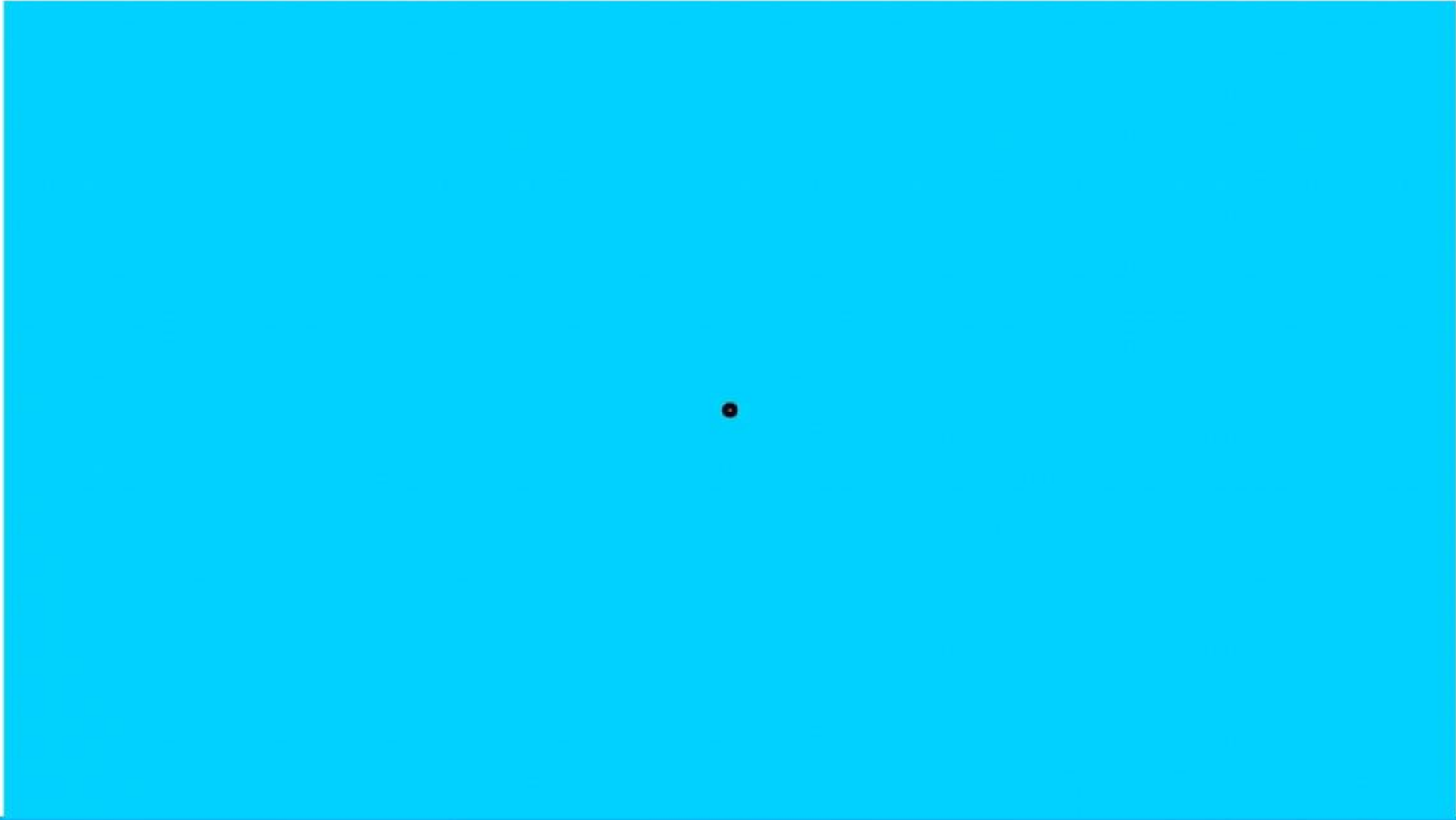
- Can be internal, external, or remote.
- Are nonvolatile.
- Logical file representation: The user's view of the way data is stored.
- Physical file representation: The actual physical way the data is stored on the storage media as viewed by the computer.
- Storage technologies:
 - Magnetic (conventional hard drives).
 - Optical (optical discs).
 - Electrons (flash memory media).

Logical vs. Physical Representation

- File: Anything stored on a storage medium, such as a program, document, digital image, or song.
- Filename: Name given to a file by the user.
- Folder: Named place on a storage medium into which files can be stored.



How Do Hard Drives Work



Hard Drives

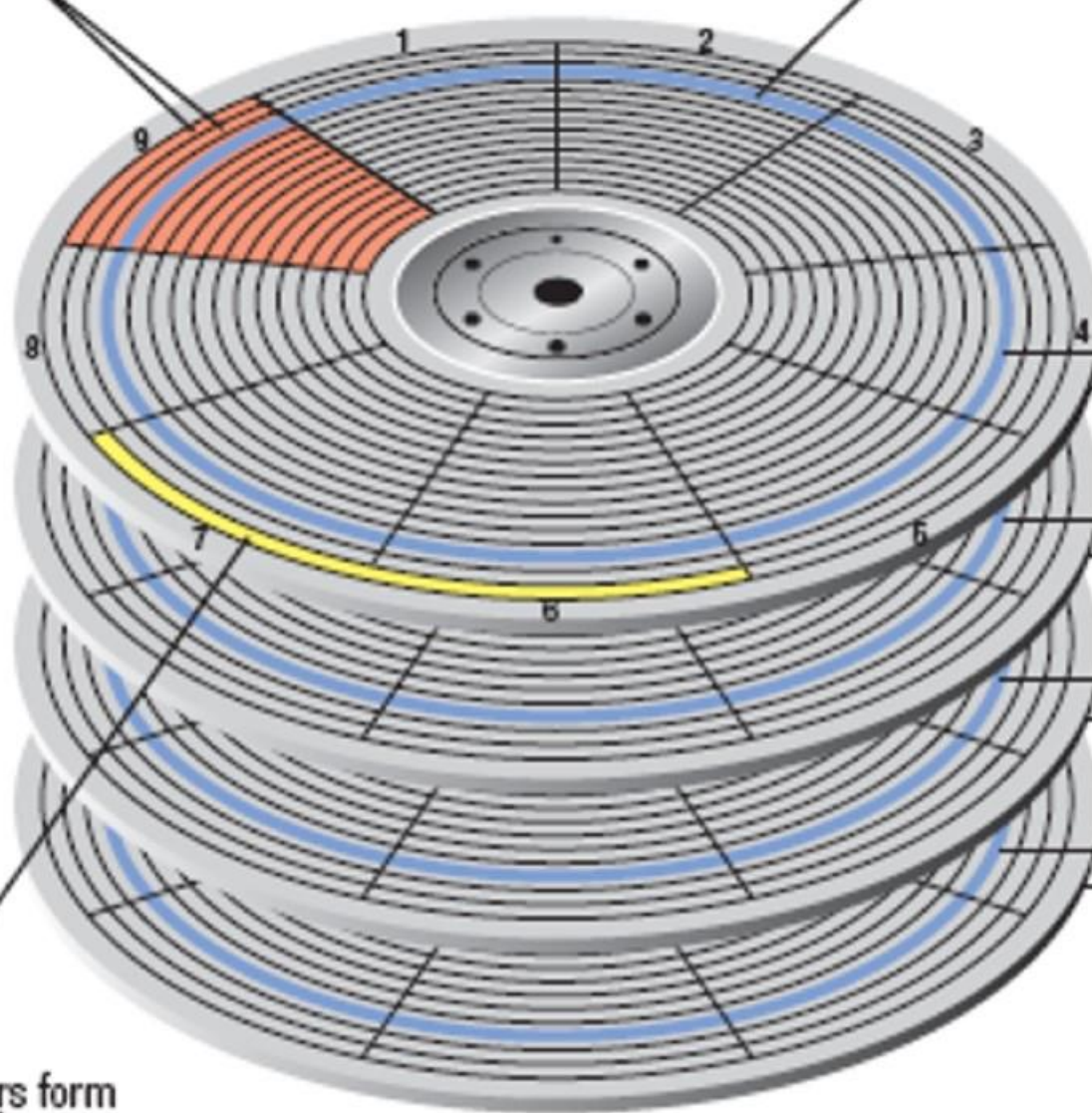
- Hard drive: Used to store most programs and data.
 - Can be internal and external.
 - Can be encrypted.
- Magnetic hard drives:
 - Use metal hard disks.
 - Read/write heads magnetize particles to represent the data's 0s and 1s.
- Solid-state drives (SSDs):
 - Use flash memory technology.
 - Use less power and have no moving parts.
 - Particularly appropriate for portable computers.

SECTORS

Each disk is divided into pie-shaped groups of sectors.

TRACKS

Data is stored on circular tracks; the 0s and 1s are represented magnetically.



Track 13 of Disk 1, top surface

Track 13 of Disk 1, bottom surface

Track 13 of Disk 2, top surface

Track 13 of Disk 2, bottom surface

Track 13 of Disk 3, top surface

Track 13 of Disk 3, bottom surface

Track 13 of Disk 4, top surface

Track 13 of Disk 4, bottom surface

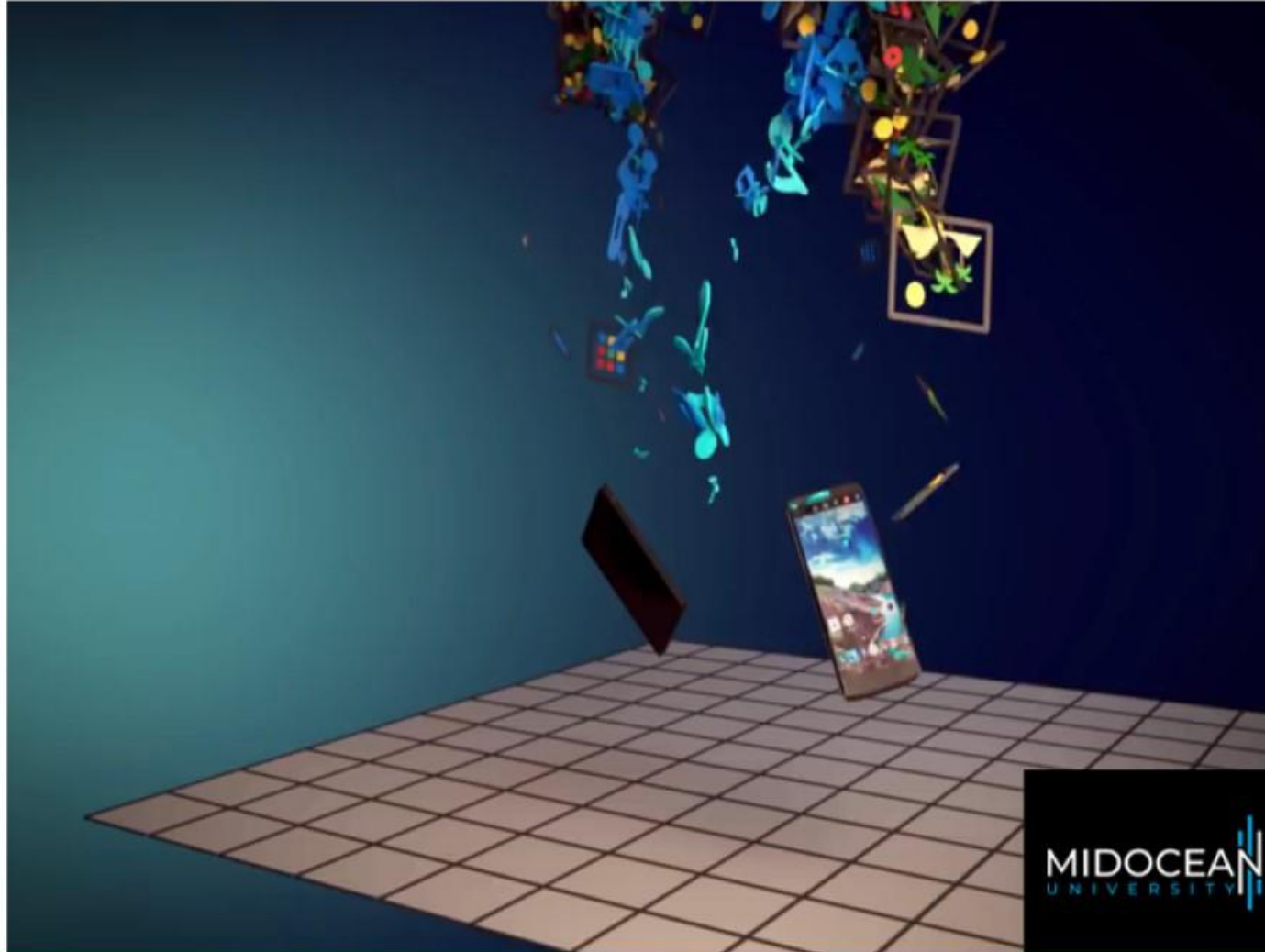
CYLINDER

A cylinder consists of a vertical stack of tracks, the same relative track on each disk surface.

CLUSTERS

One or more sectors form a cluster, the smallest storage area on a disk.

Solid State Drives (SSDs)



External Hard Drives



FULL-SIZED EXTERNAL HARD DRIVES

Are about the size of a 5 by 7-inch picture frame, but thicker; this drive holds 1.5 TB.



PORTABLE HARD DRIVES (MAGNETIC)

Are about the size of a 3 by 5-inch index card, but thicker; this drive holds 500 GB.



PORTABLE HARD DRIVES (SSD)

Are about the size of a credit card, but thicker; this drive holds 18 MB.



EXPRESSCARD HARD DRIVES

Fit into an ExpressCard slot; this drive holds 32 GB.

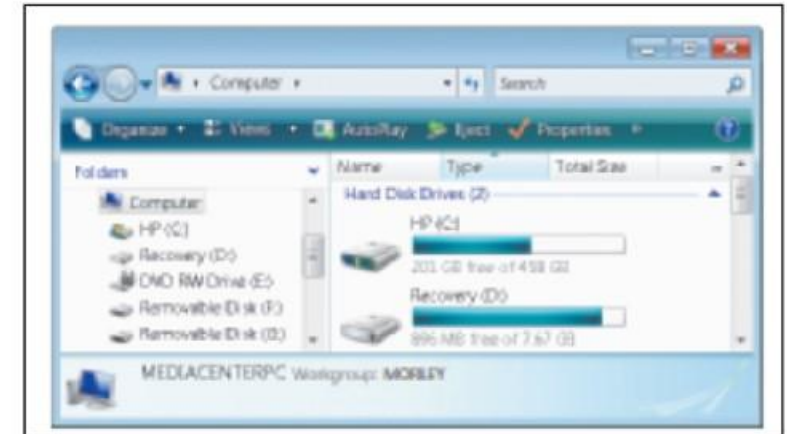
Hard Drive Speed and Caching

- Disk access time: Total time that it takes for a hard drive to read or write data.
 - Consists of seek time, rotational delay and data movement time.
- Disk cache: Dedicated part of RAM used to store additional data adjacent to data retrieved during a disk fetch to improve system performance.
- Hybrid hard drive:
 - Combination of flash memory and magnetic hard drive.
 - Uses flash memory for cache.
 - Allows encryption to be built into the drive.

Fragmentation and Defragmentation

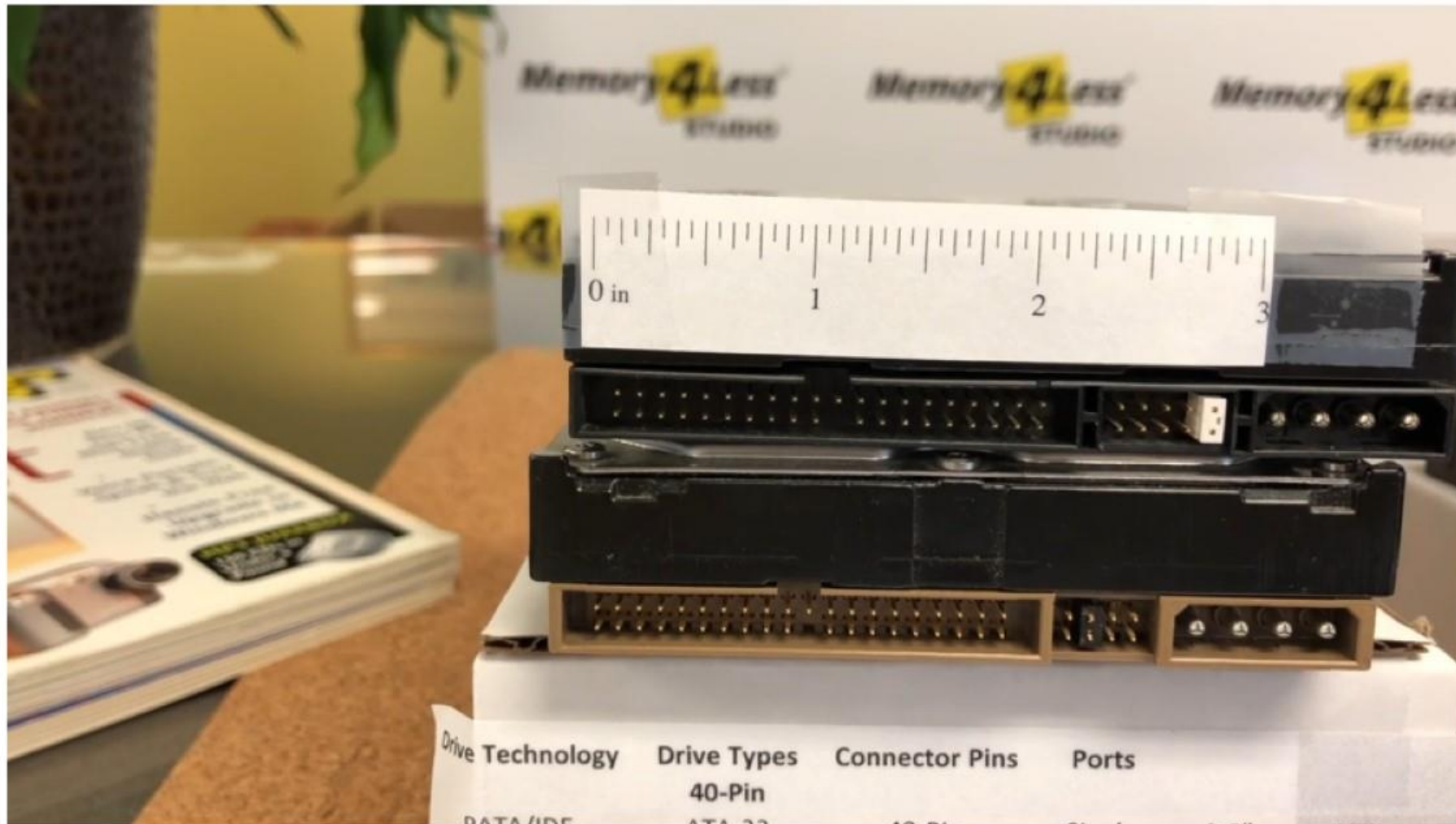
Partitioning and File Systems

- Partitioning: Logically divides the physical capacity of a single drive into separate areas, called partitions.
 - Partitions function as independent hard drives.
 - Referred to as logical drives.
 - Increase efficiency (smaller drives use smaller clusters).
- Partitions used to:
 - Create a recovery partition.
 - Create a new logical drive for data.
 - Create a dual boot system.
- File system: Determines the cluster size, maximum drive size, and maximum file size
 - FAT, FAT32, and NTFS



Hard Drive Interface Standards

- Hard drive interface standards: Determine how a drive connects to the computer.
- Common standards:
 - Parallel ATA (PATA): older, slower standard.
 - Serial ATA (SATA).
 - eSATA: uses USB or Firewire via expansion card for faster speeds.
 - SCSI and the newer serial attached SCSI (SAS).
 - Fibre Channel.
 - Fibre Channel over Ethernet (FCoE).
 - Internet SCSI (iSCSI).



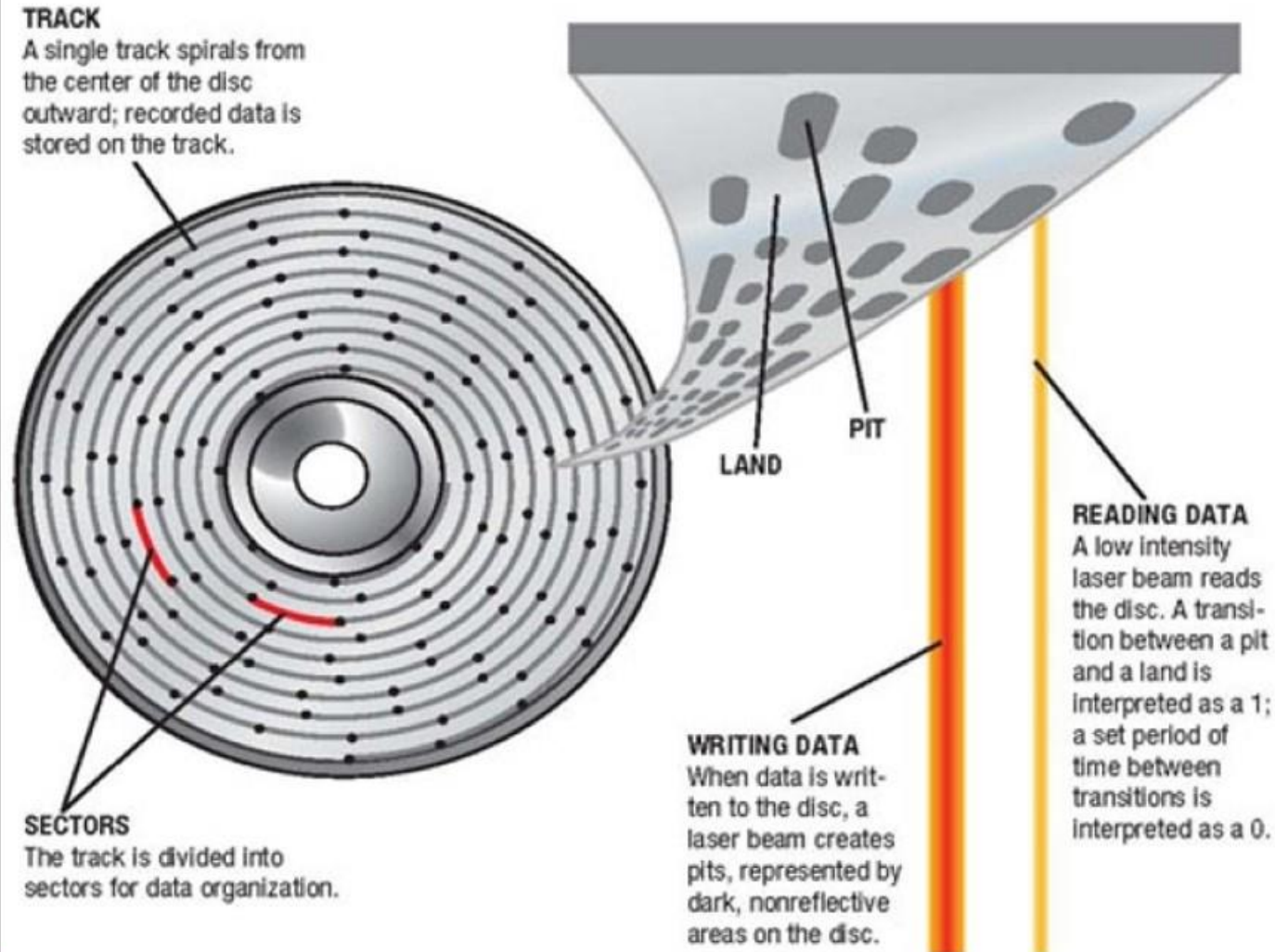
CD, DVD, Blu-ray



Optical Discs

- Optical discs: store data optically (using laser beams).
 - Divided into sectors like magnetic discs but use a single spiral track (groove).
 - Data is stored in 0s and 1s.
- Pits and lands are used to represent 1s and 0s.
- Can be:
 - Read-only: Surface is molded or stamped to represent the data.
 - Recordable or rewritable: Reflectivity of surface is changed by a laser.

Optical Discs



Optical Drives

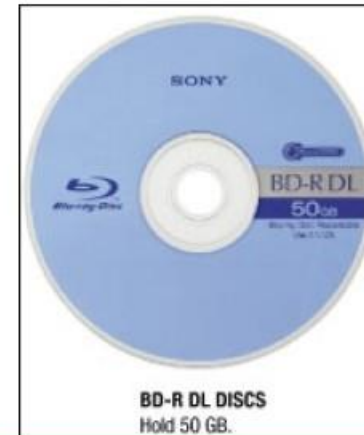
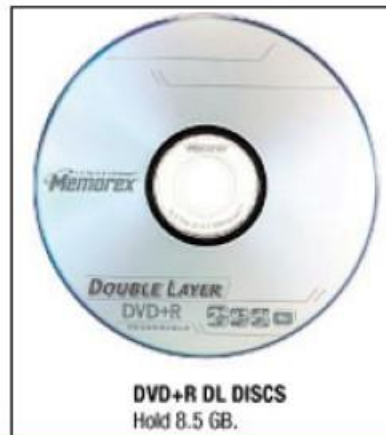
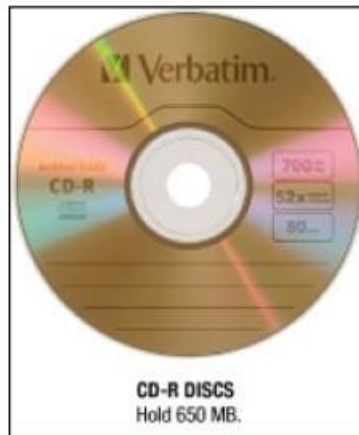
- Optical drives: Designed for type of disc: CD, DVD, or Blu-Ray Disc (BD):
 - Can be read-only, recordable, or rewritable.
 - Downward compatible.
 - Can support single or dual layer discs.
- Burning: Recording data onto disc:
 - CD discs: Use infrared lasers; hold 650 MB.
 - DVD discs: Use red lasers; hold 4.7 GB (single-layer).
 - BD discs: Use blue-violet lasers; hold 25 GB (double-layer).
- Can be internal or external drives:
 - External drives typically USB.

Read-Only Discs

- Read-only disc: Can be read from, but not written to, by the user.
 - CD-ROM (compact disc read-only memory).
 - DVD-ROM (digital video disc read-only memory).
 - BD-ROM (Blu-Ray disc read-only memory).
- Normally come pre-recorded:
 - Software programs.
 - Clip art and other graphics.
 - Music.
 - Movies.
 - Games (UMD, Wii, Xbox, etc..)

Recordable Discs

- Recordable disc: Can be written to, but cannot be erased and reused
 - CD-R discs.
 - DVD-R/DVD+R discs; can be dual-layer.
 - BD-R; can be dual-layer.
- Used for back up, sending large files to others, creating custom music CDs, storing home movies, etc.



Rewritable Discs

- Rewritable disc: Can be recorded on, erased, and overwritten just like magnetic discs.
 - CD-RW.
 - DVD-RW.
 - BD-RE; can be dual layer.
- Use phase-change technology:
 - Heating and cooling process is used to change the reflectivity of the disc.
 - Can be changed back to erase the disc.

Flash Memory Systems

- Chip-based storage medium:
 - No moving parts so more resistant to shock and vibration, require less power, make no sound.
 - Solid-state storage system.
- Most often found in the form of:
 - Flash memory cards.
 - USB flash drives.
 - Solid-state drives.
 - Hybrid hard drives.
- Very small and so are very appropriate for use with digital cameras, digital music players, GPS devices, notebook computers, mobile devices, etc.

Flash Memory Cards

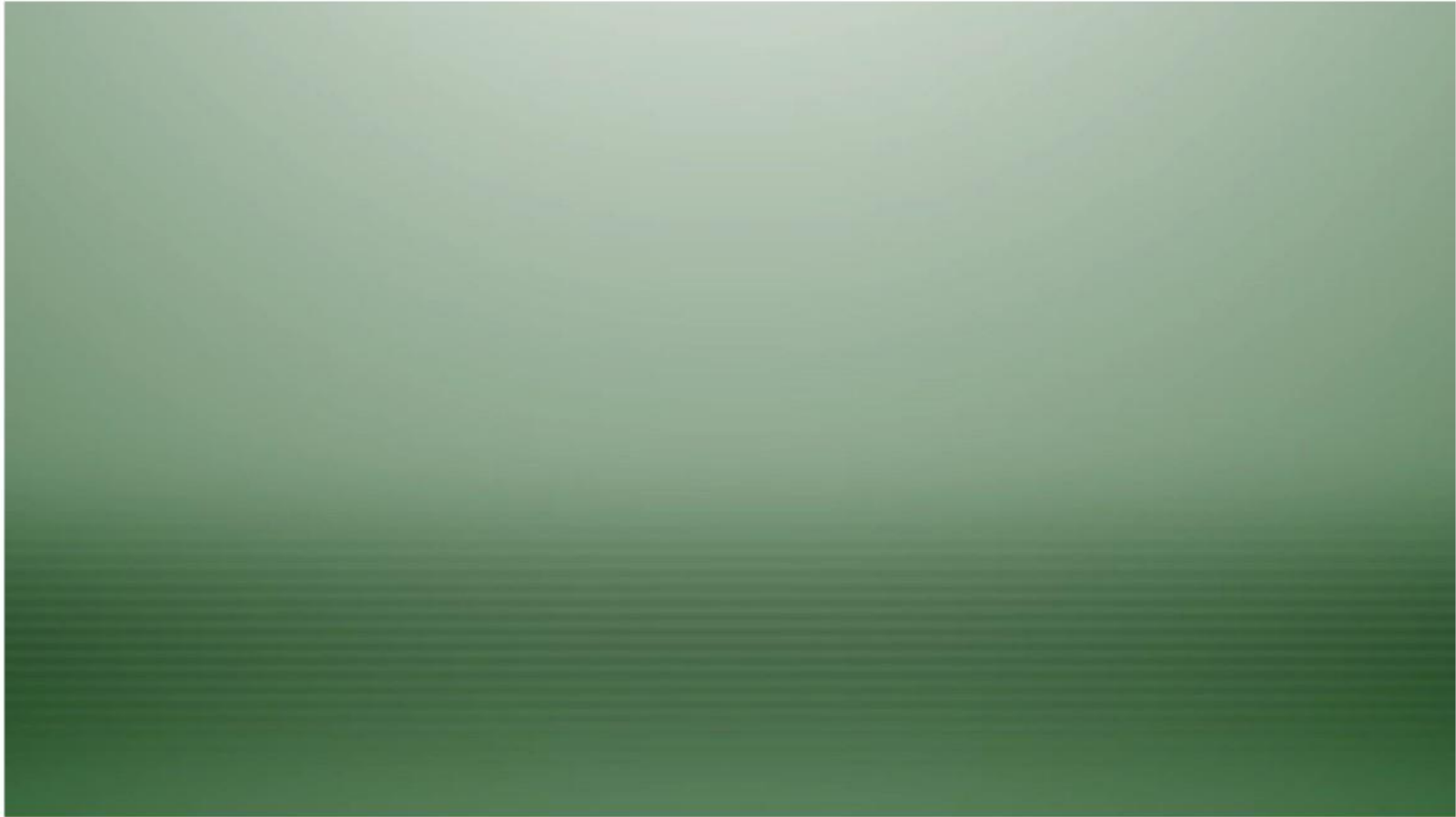
- Flash memory card: A small card containing one or more flash memory chips, controller chips, and metal contacts to connect the card to the device or reader that it is being used with.
 - CompactFlash.
 - Secure Digital (SD).
 - Secure Digital High Capacity (SDHC).
 - Secure Digital Extended Capacity (SDXC).
 - MultiMedia Card (MMC).
 - xD Picture Card.
 - Memory Stick.
- Read by flash memory card reader.

Flash Memory Cards

SD Card Form Factors



USB Flash Drives



USB Flash Drives

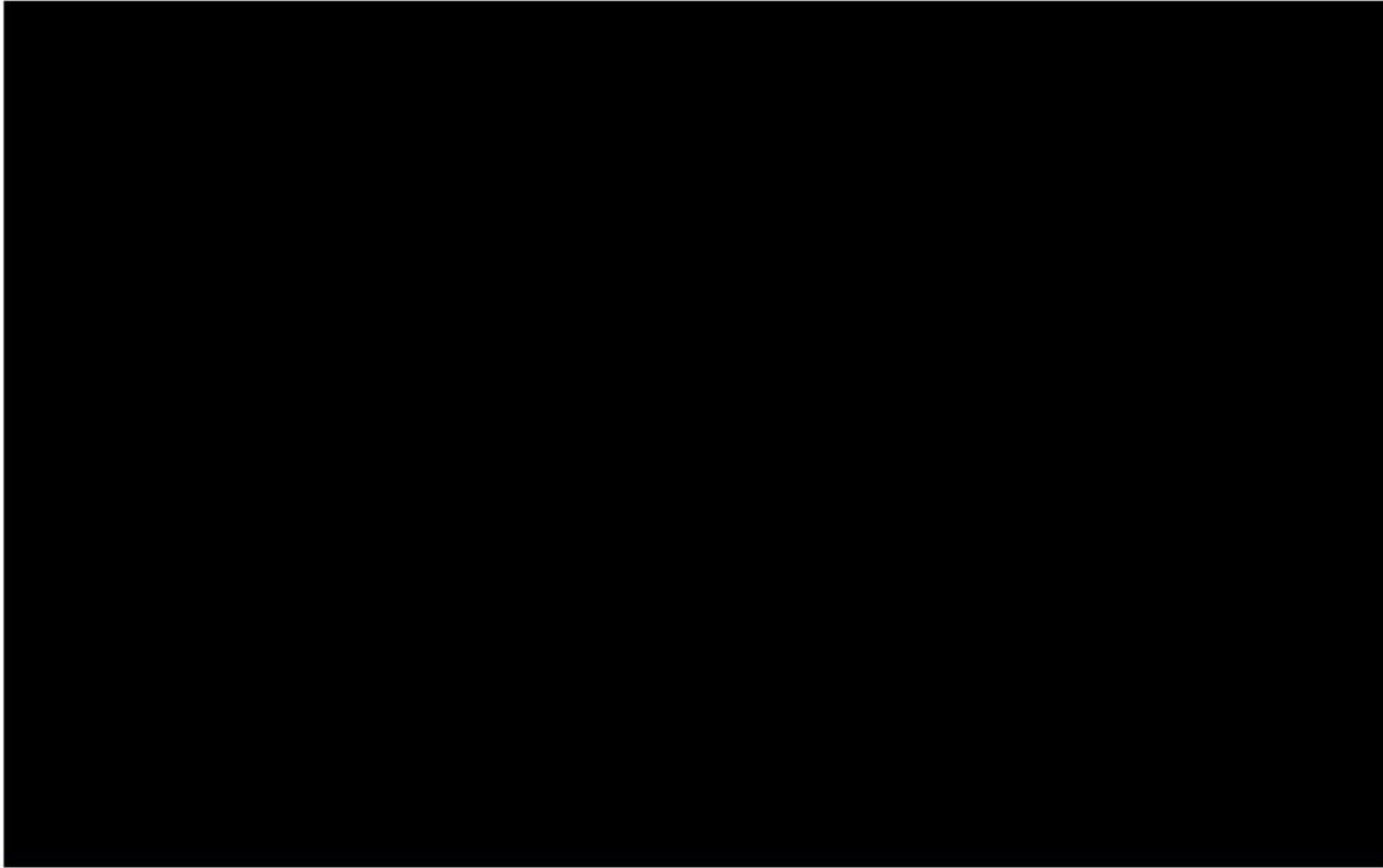
- USB flash drives: Consist of circuite board, memory chips and controller.
 - Typically portable drives that connect to and are powered by a USB port.
 - Also called USB flash memory drives, thumb drives, jump drives.



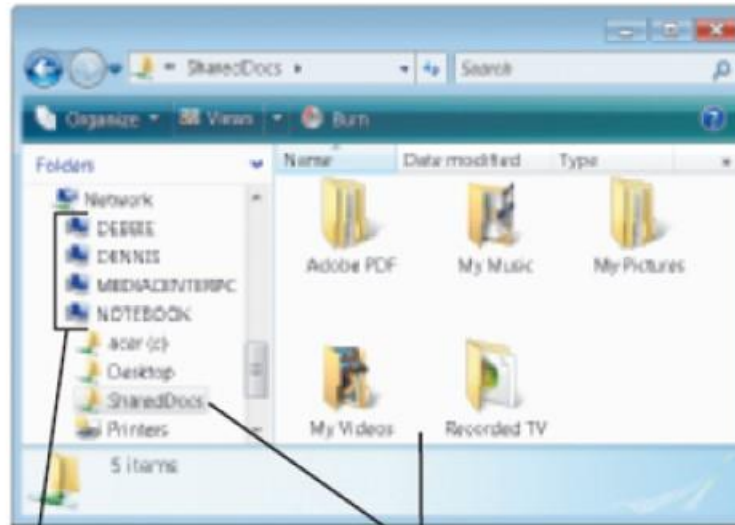
Other Types of Storage Systems

- Remote storage: Using a storage device not directly a part of the computer being used.
 - Network storage: Via a local network.
 - Network attached storage (NAS): Connected directly to a network.
 - Storage area network (SAN): Separate network of hard drives or other storage devices which is attached to the main network.
 - Online storage or cloud storage: Accessed via the Internet:
 - Via Web sites (Flickr, Facebook, Google Docs, etc.).
 - Via online storage sites (Box.net, SkyDrive, etc.).

SAN Vs. NAS



Remote Storage Systems



Computers on this network.

Items in the SharedDocs folder on the computer called NOTEBOOK.

SHARED FOLDERS

Shared folders on network computers appear and are accessed in a manner similar to local folders.



NETWORK ATTACHED STORAGE (NAS) DEVICES

This wireless NAS device holds 1 TB of data and provides storage for all computers on the network.

Smart Cards

- Smart card: Credit card-sized piece of plastic that contains some computer circuitry (processor, memory, and storage).
 - Stores small amount of data (about 64 KB or less).
 - Commonly used to store prepaid amounts of digital cash or personal information.
 - Smart card readers are built into or attached to a computer, keyboard, vending machine, or other device.
 - Some smart cards store biometric data.
 - Can be used in conjunction with encryption and other security technologies.

How smart card work



Smart Cards



Holographic Storage

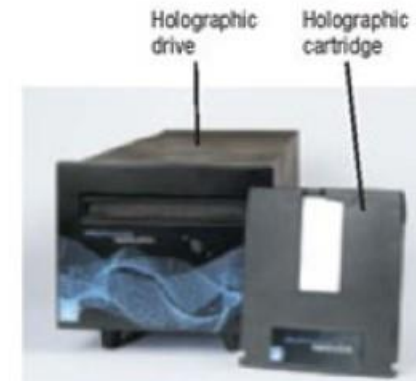
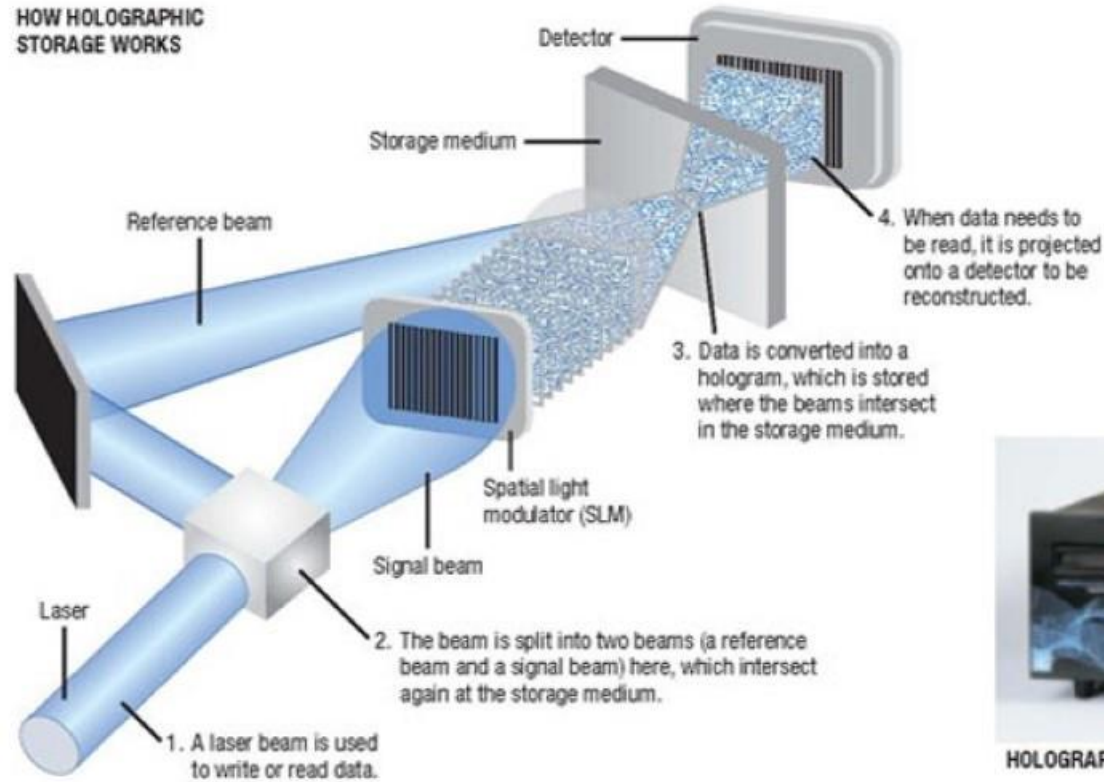
- Holographic storage: Store data as holograms.
 - Emerging type of 3D storage technology.
 - Uses two green laser beams to store data in three dimensions:
 - Reference beam.
 - Signal beam.
 - Potential initial applications for holographic data storage systems include:
 - High-speed digital libraries.
 - Image processing for medical, video, and military purposes.
 - Any other applications in which data needs to be stored or retrieved quickly in large quantities but rarely changed.

Holographic Storage



Holographic Storage

HOW HOLOGRAPHIC STORAGE WORKS



HOLOGRAPHIC DRIVES AND CARTRIDGES

Evaluating Your Storage Alternatives

- Factors to consider:
 - Speed.
 - Compatibility.
 - Storage capacity.
 - Convenience.
 - Portability.
- Most users require:
 - Hard drive.
 - DVD or BR drive.
 - Flash memory card reader.
 - USB port connecting USB devices.

Review

- Hard Drives (Magnetic , SSD).
- Optical Discs.
- Flash Memory Cards.
- USB Flash Drives.
- Remote storage:
 - ❖ Network attached storage (NAS).
 - ❖ Storage area network (SAN).
 - ❖ Online storage or cloud storage.

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