Lecture 05
Storage

Information Technology Fundamentals

IT-06016402

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Storage

Primary Storage	Secondary Storage	Offline Storage	Tertiary Storage
• It is the main memory where data and information are stored • It is called "memory" • Volatile/Non Volatile in nature • Examples are RAM, ROM, etc.	• It is referred to the external memory where data is stored permanently • Long-time storage • It is called "storage medium" • Non-volatile in nature • Examples are HDD, SSD, etc.	• It is called disconnected or removable storage. • It is a computer data storage on a medium or a device that is not under the control of a processing unit • It must be inserted or connected by a human operator before a computer can access it again. • Examples are CD DVD USB Flash Drive	• Similar to secondary storage, but can only be accessed via a network device. • Access is even slower. • It uses additional robotic mechanisms to transfer media between their long-term storage locations and available drives without human intervention. • Examples are NAS SAN – Tape Optical Disc

Google Drive a physical

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Storage

A <u>storage medium</u> is the physical material on which a computer keeps data, information, programs, and applications

<u>Cloud storage</u> keeps information on servers on the Internet, and the actual media on which the files are stored are transparent to the user

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Storage Device

- A storage device is the hardware that records and/or retrieves items to and from storage media

Read

- Reading is the process of transferring items from a storage medium into memory

Input

Write

- Writing is the process of transferring items from memory to a storage medium

Output

It is not I/O device

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Storage

Internal Hard Disk | Internal Solid-State Drive | External Hard Drive | Memory Cards | USB Flash Drive | Cloud Storage | Optical Discs

Network Attached Storage Device | Magnetic Stripe Card | Smart Card | RFID Tags | NFC Tags | Film

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Capacity

- Capacity is the number of bytes a storage medium can hold

1 Byte = 8 bit

Storage Term	Short Form	Approximate Number of Byte	Exact Number of Byte
Kilobyte	KB	1 thousand (10^3)	$2^{10} = 1,024$
Megabyte	MB	1 million (10^6)	$2^{20} = 1,048,576$
Gigabyte	GB	1 billion (10^9)	$2^{30} = 1,073,741,824$
Terabyte	TB	1 trillion (10^{12})	2^{40}
Petabyte	PB	1 quadrillion (10^{15})	2^{50}
Exabyte	EB	1 quintillion (10^{18})	2^{60}
Zettabyte	ZB	1 sextillion (10^{21})	2^{70}
Yottabyte	YB	1 septillion (10^{24})	2^{80}

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Access Time

- Access time measures:
  - The amount of time it takes a storage device to locate an item on a storage medium
  - The time required to deliver an item from memory to the processor
- Some manufacturers use transfer rate
  - Kbps (kilobyte per second)
  - Mbps (Megabyte per second)
  - Gbps (Gigabyte for second)

L₁ Cache (the fastest)

Memory	RAM	Fast

Storage	SSDs	
	Hard Disks	
	USB Flash Drives	
	Memory Cards	
	Optical Discs	Slow

Access Time/Transfer Rate

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Storage

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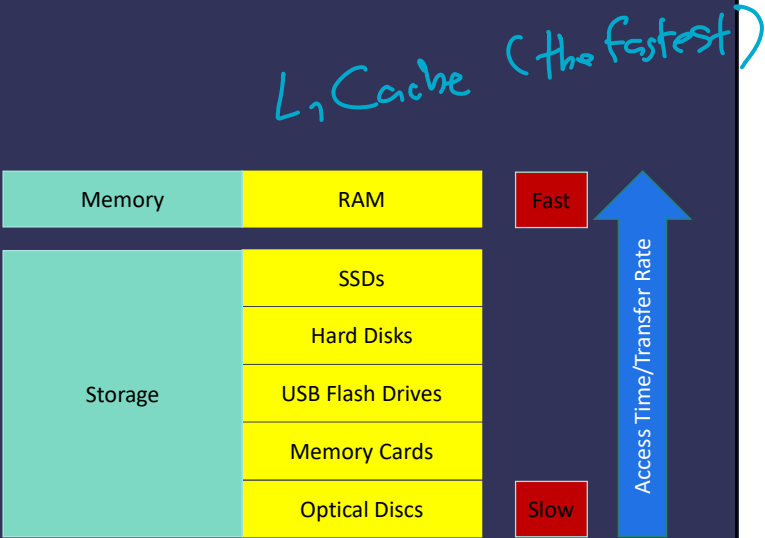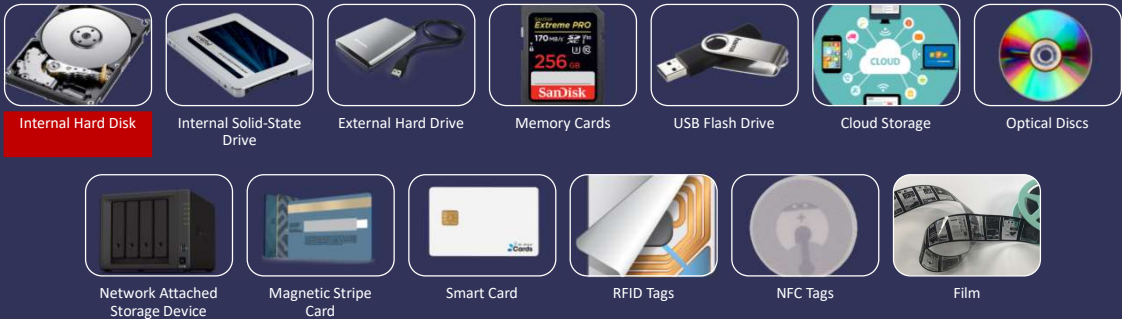
Hard Disk

- A hard disk, also called a hard disk drive (HDD) contains one or more inflexible, circular platters that use magnetic particles to store data, instructions, and information

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Hard Disk

- The storage capacity of hard disks varies and is determined by:
  - The number of platters the hard disk contains
  - Whether the disk uses longitudinal or perpendicular recording
    Density

| N⇔S | S⇒N | N⇔S | S⇒N | Longitudinal |
| Perpendicular |

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Hard Disk

- The two most common form factors for modern HDDs are 3.5-inch, for desktop computers, and 2.5-inch, primarily for laptops
- Disk read/write heads are the small parts of a disk drive which move above the disk platter and transform the platter's magnetic field into electrical current (read the disk) or, vice versa, transform electrical current into magnetic field (write the disk).
- Formatting is the process of dividing the disk into tracks and sectors
- Revolutions per minute, RPM, is used to help determine the access time on computer hard drives. Most common RPM rates, in both laptop and desktop PCs, are between 5400 and 7200 RPM.

Track
Track Sector
Platter
Disk Sector
Head
Cluster
Actuator Arm
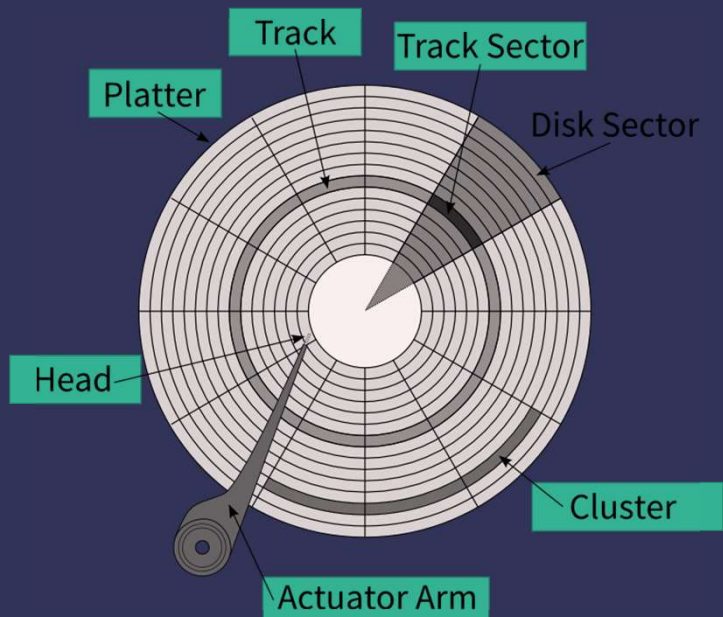
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Hard Disk

- A head crash occurs when a read/write head touches the surface of a platter
- Always keep a backup of your hard disk

Hair
Read/Write Read
Dust
Smoke
Clearance
Platter

12

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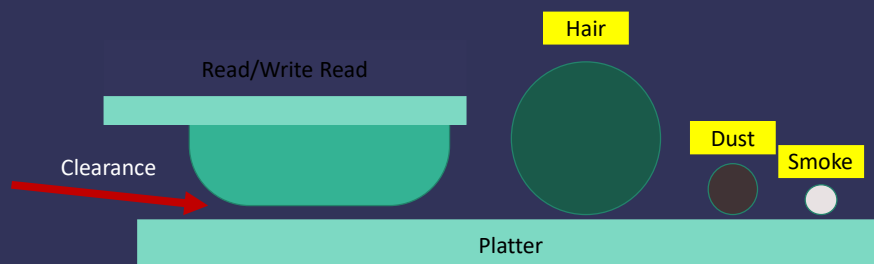
Hard Disk

Mechanical parts of hard disk directly affect the access time

Disk cache, sometimes called a buffer, consists of a memory chip(s) on a hard disk that stores frequently accessed data, instructions, and information

The larger the disk cache, the faster the hard disk

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Storage

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Solid-state Drive

มี processor อยู่ ข้างใน

- SSD is a flash memory storage device that contains its own processor to manage its storage
- An SSD has several advantages over traditional (magnetic) hard disks:

Faster access times	Faster transfer rates	Quieter operation
More durable	Lighter weight	Less power consumption
Less heat generation	Longer life	Defragmentation not required

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Storage

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External Hard Disk

- An external hard disk is a separate freestanding storage device that connects with a cable to a USB port or other port on a computer or mobile device

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Redundant Array of Independent Disks

มีตัวช่วย backup ข้อมูล

- RAID is a data storage virtualization technology
- It is a group of two or more integrated hard disks or SSDs that is for the purposes of data redundancy, performance improvement, or both.

https://en.wikipedia.org/wiki/RAID

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Storage

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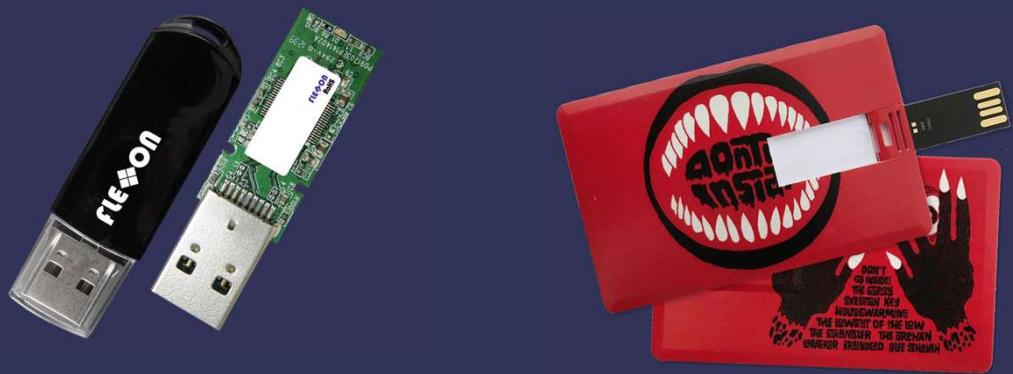Network Attached Storage Device | Magnetic Stripe Card | Smart Card | RFID Tags | NFC Tags | Film
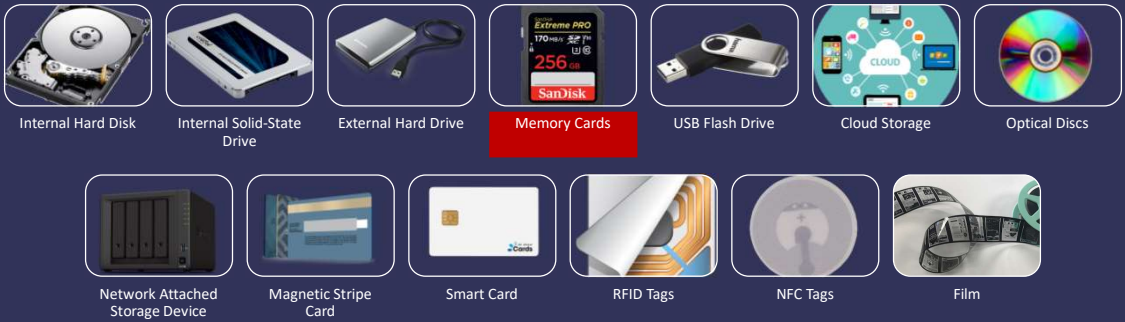
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Memory Card

- It is a removable flash memory storage device that you insert and remove from a slot in a computer, mobile device, or card reader/writer

SD	Secured Digital (SD) Card	2 GB (Max)
SDHC	Secured Digital High Capacity (SDHC) Card	32 GB (Max)
SDXC	Secure Digital Extended Capacity (SDXC) card	2 TB (Max)
SDUC	Secure Digital Ultra Capacity (SDUC) card	128 TB (Max)

(handwritten annotations: ↑capacity; SD, SDHC, SDXC, SDUC; High; Extended; Ultra)
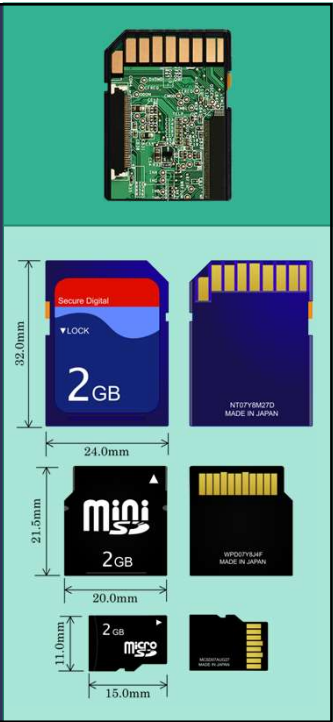
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Memory Card

Minimum sequential write speed	Speed Class			Corresponding video format			
	Speed Class	UHS Speed Class	Video Speed Class (new)	8K video	4K video	Full HD / HD video	Standard Video
Card image	microSDHC	microSDXC I	microSDXC II V90	The necessary speed varies by each recording/playback device condition, even in the same format.			
90MB/sec			V90	✓			
60MB/sec			V60	✓	✓		
30MB/sec		U3	V30	✓	✓	✓	
10MB/sec	C10	U1	V10		✓	✓	✓
6MB/sec	C6		V6		✓	✓	✓
4MB/sec	C4					✓	✓
2MB/sec	C2						✓

https://www.kingston.com/en/solutions/personal-storage/memory-card-speed-classes

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Memory Card

Compact Flash

Memory Stick

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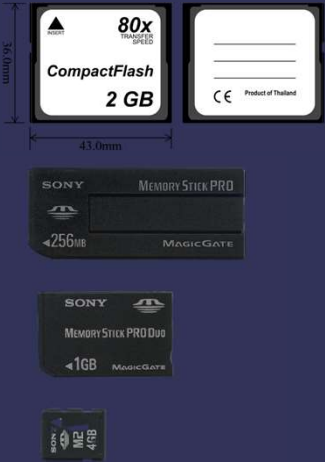
Memory Card

Card Reader/Writer	Printer

Laptop	Smartphone/Tablet

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USB Flash Drive

• USB flash drives plug into a USB port on a computer or mobile device

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Cloud Storage

- Cloud storage is an Internet service that provides storage to computer or mobile device users

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Storage

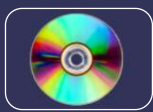| Internal Hard Disk | Internal Solid-State Drive | External Hard Drive | Memory Cards | USB Flash Drive | Cloud Storage | Optical Discs |

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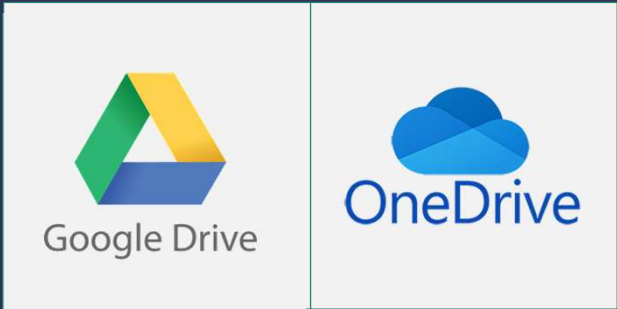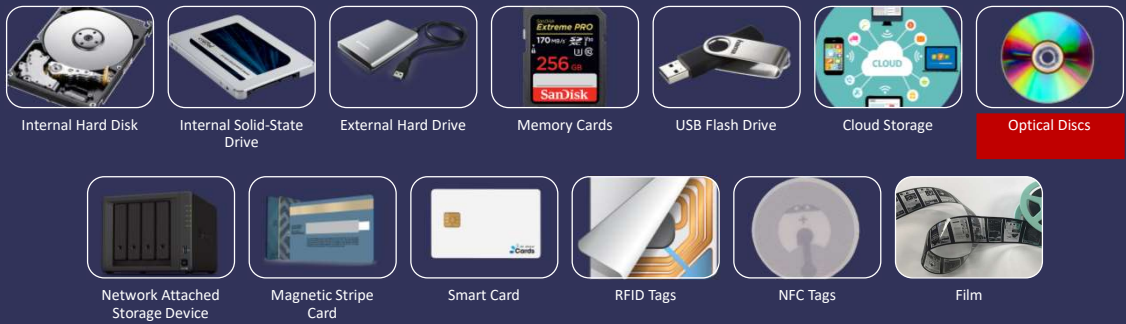
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Optical Disc

- An optical disc consists of a flat, round, portable disc made of metal, plastic, and lacquer that is written and read by a laser

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How a Laser Reads Data on an Optical Disc

Disc

PIT

LAND

Lens

0

Lens

1

Light-sensing
Diode

Light-sensing
Diode

Prism

Prism

Laser
Diode

Laser
Diode

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CD –vs– DVD

ระยะห่าง Particle
CD < DVD
↳ DVD หนาแน่นชิดกว่า
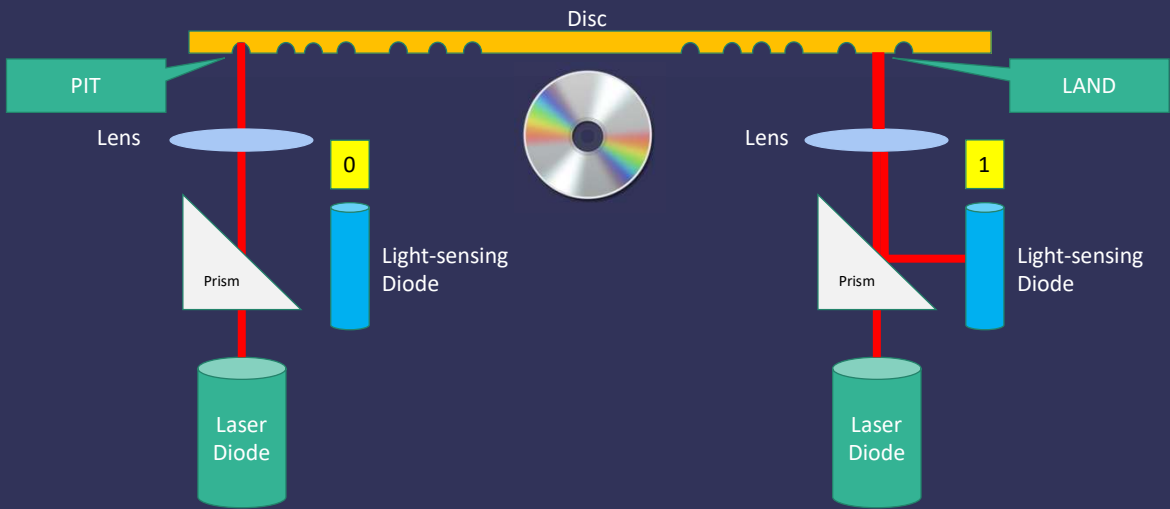
CD

DVD

CD	DVD	HD DVD	Blu-ray
l = 800 nm	l = 400 nm	l = 200 nm	l = 150 nm
w = 600 nm	w = 320 nm	w = 200 nm	w = 130 nm
p = 1.6 μm	p = 740 nm	p = 400 nm	p = 320 nm
ø = 1.6 μm	ø = 1.1 μm	ø = 620 nm	ø = 480 nm

https://en.wikipedia.org/wiki/Optical_disc

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Optical Disc

- Optical discs commonly store items in a single track that spirals from the center of the disc to the edge of the disc
- Track is divided into evenly sized sectors

Single track spiral to edge of disc

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CD –vs– DVD

R (Read)
RW (Rewrite)

CD

- A CD-ROM can be read from but not written to
  - Single-session disc
- A CD-R is an optical disc on which users can write once, but not erase
- A CD-RW is an erasable multisession disc

DVD

- A DVD-ROM is a high-capacity optical disc on which users can read but not write on or erase
- A DVD-R or DVD+R are competing DVD-recordable WORM formats, on which users can write once but not erase
- DVD-RW, DVD+RW, and DVD+RAM are competing DVD-rewritable formats that users can write on multiple times

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Storage

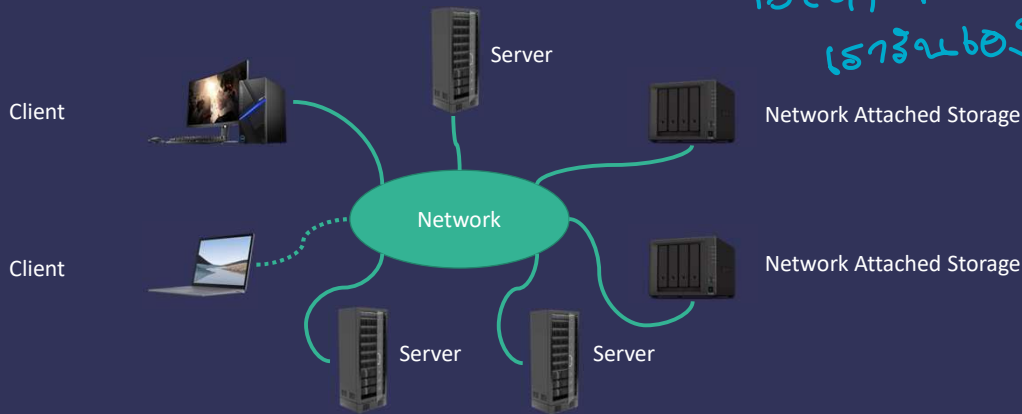|						
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Enterprise Storage

- Enterprise hardware allows large organizations to manage and store data and information using devices intended for heavy use, maximum efficiency, and maximum availability
- It employs RAID to duplicate data, instructions, and information to improve data reliability

A	A'

Mirroring

A1	A2
B1	B2
C1	C2

Striping
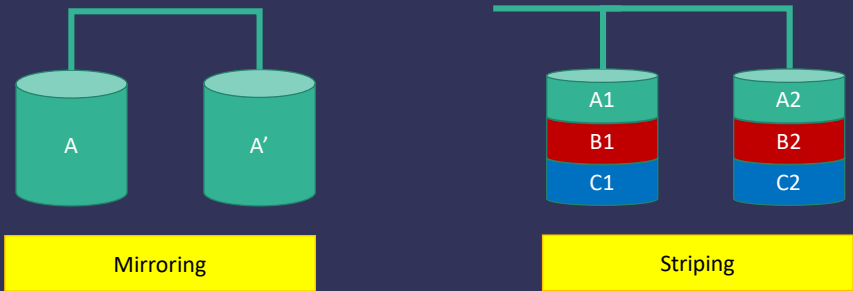
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Network attached storage (NAS)

only one

- NAS is a server that is placed on a network with the sole purpose of providing storage to users, computers, and devices attached to the network

local host (เราร้อนเอง)

Server

Client

Network

Network Attached Storage

Client

Network Attached Storage

Server   Server

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Cloud หรือ local host

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Storage Area Network (SAN)

- A storage area network (SAN) is a high-speed network with the sole purpose of providing storage to other attached servers

SAN จัดเก็บข้อมูลไปยัง server

Client

Client

Client

Network

Server

Server

Server

RAID

RAID

Storage Area Network

Tape

Optical Disc
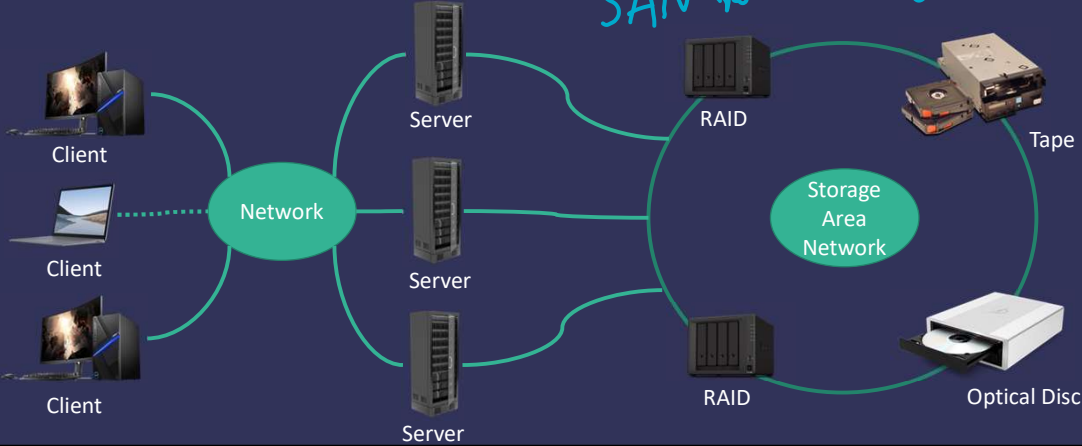
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Magnetic Tape System

- Tape is a magnetically coated ribbon of plastic capable of storing large amounts of data and information
- A tape drive reads and writes data and information on a magnetic tape
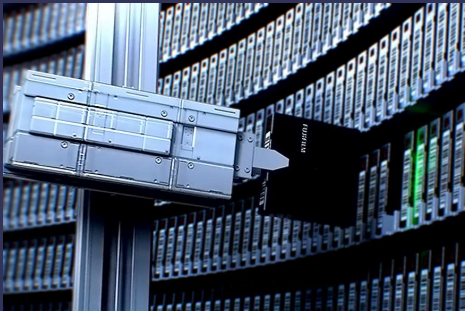
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Other Types of Storage

| Magnetic Stripe Card | Smart Card | RFID Tag |

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Near Field Communications

NFC - tags
อาจจะแปะโทรศัพท์
แล้วเอา BTS

An NFC-enabled device contains an NFC chip

An NFC tag contains a chip and an antenna that contains information to be transmitted
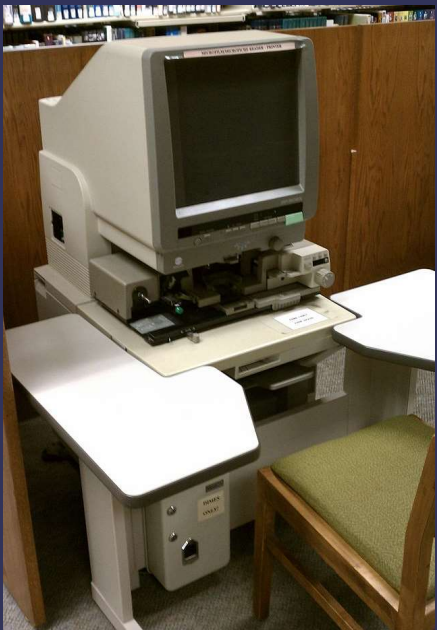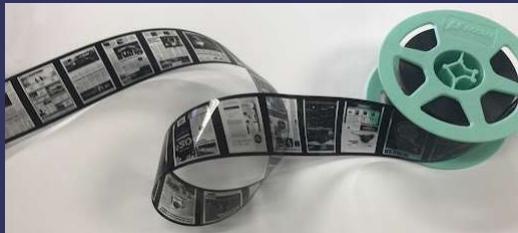
Most NFC tags are self-adhesive
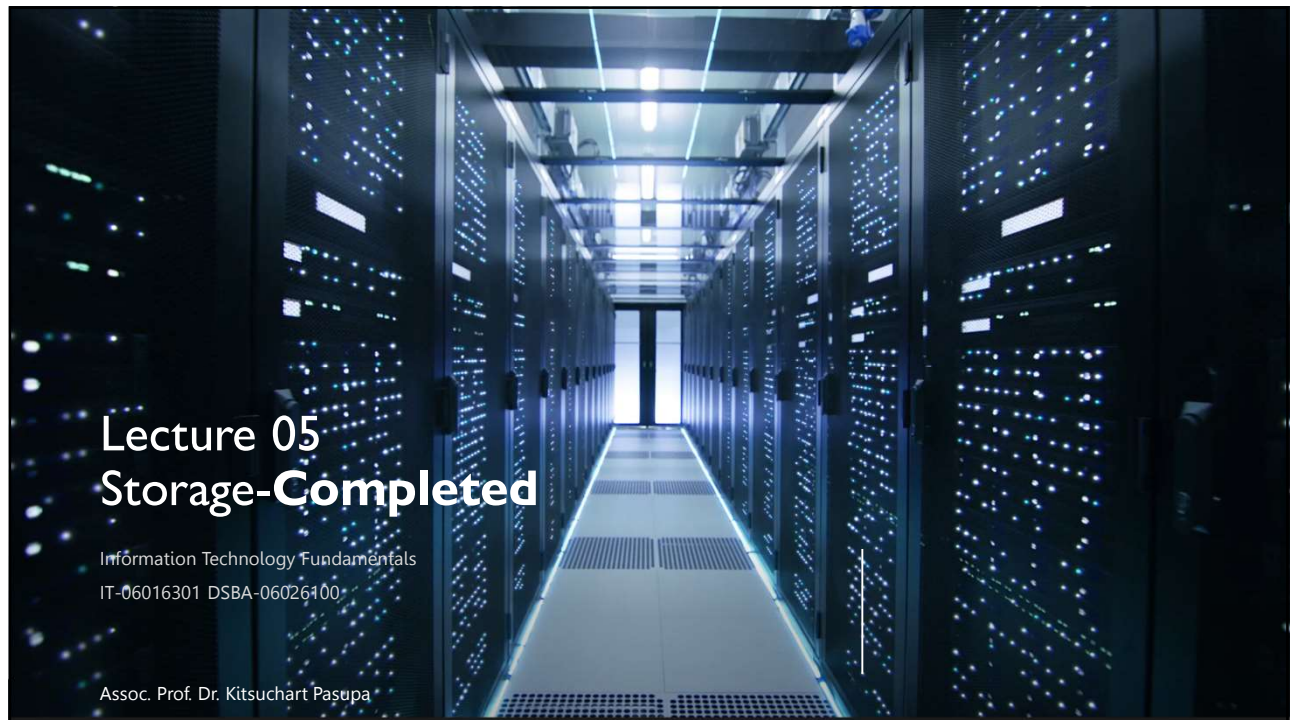
chip ฝังไว้ด้วยใน
มีการใช้ตลาดได้เลย

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Film

- Microfilm and microfiche store microscopic images of documents on a roll or sheet film

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Lecture 05
Storage-**Completed**

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