CS 4410
Operating Systems

Review 2

Summer 2011

Cornell University

Today

- File System
- Storage
- Networking
- Security

File-System Interface

- Files
  - Logical storage unit
  - Independent entity
  - Attributes
  - Operations
  - Per-process table VS System-wide table
- Directories
  - Organize files
  - Logical Structure
    - Single-level
    - Two-level
    - Tree-structured
    - Acyclic graph

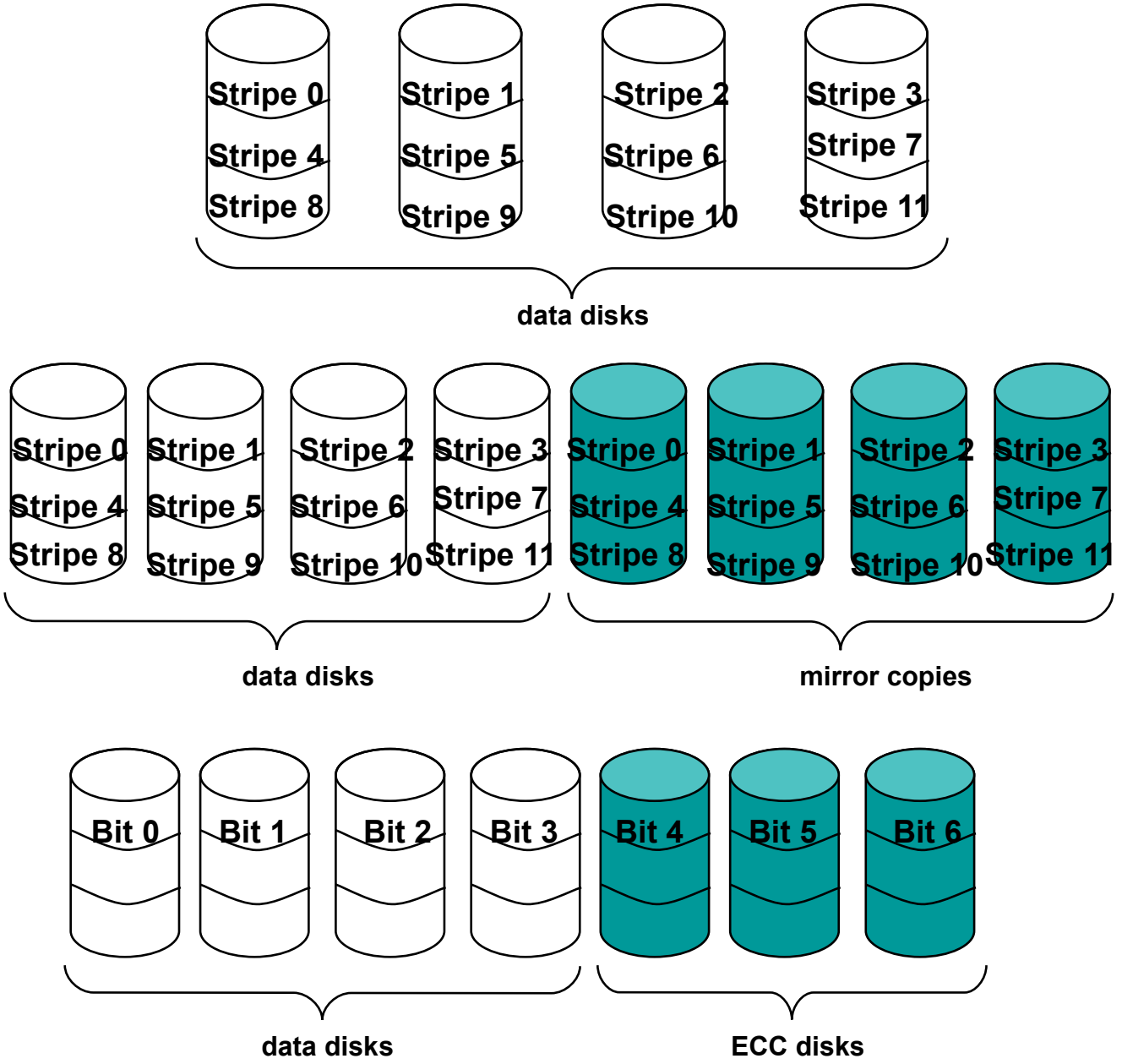
File-System Implementation

- File Control Block (FCB)
- Directory:
  - The main function of the directory system is to map the ASCII name of the file onto the information needed to locate the data.
  - Implementation:
    - Linear List
    - Hash Table
- Allocation
  - Data is saved as blocks in the hard disk.
  - Contiguous
  - Linked
  - Indexed
    - Unix i-node
- Free-space management

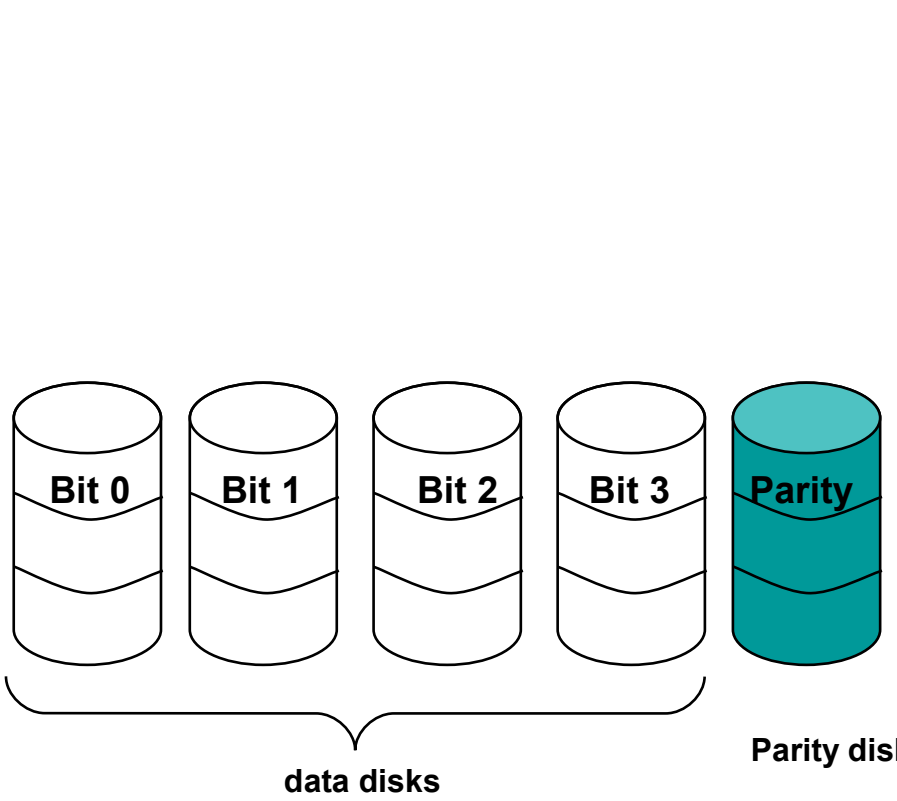
Mass-Storage Structure

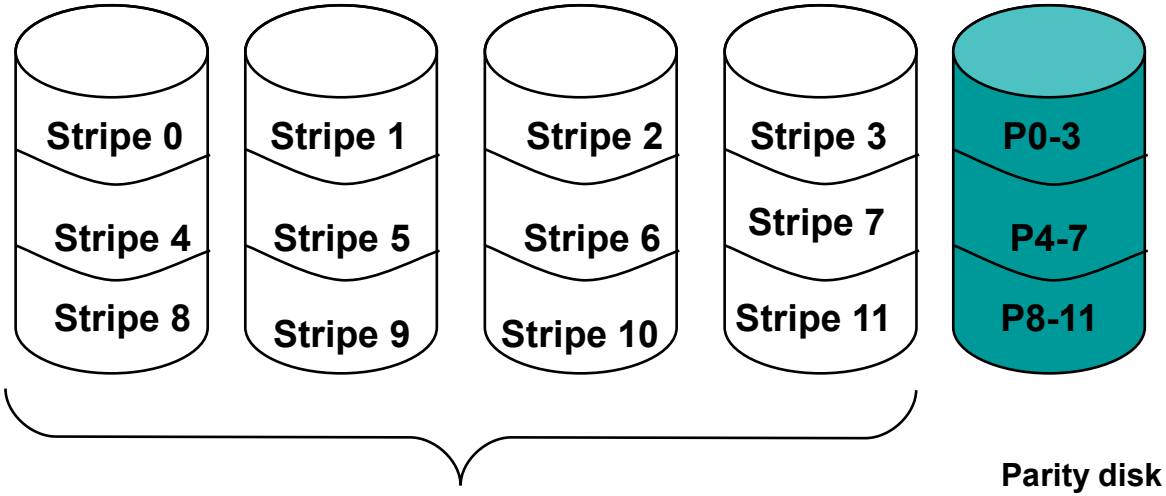
- Magnetic Disk
  - Platter, Cylinder, Track, Sector
- Disk Speed
  - Transfer rate, positioning time
- Disk Scheduling
  - The OS decides which request (read, write blocks) to service.
  - Target: Least head movements.
  - FCFS
  - SSTF
  - SCAN, C-SCAN
  - LOOK, C-LOOK
- RAID
  - Performance → Stripping
  - Reliability → Redundant data (mirroring).

RAID


Stripe 0
Stripe 4
Stripe 8
Stripe 1
Stripe 5
Stripe 9
Stripe 2
Stripe 6
Stripe 10
Stripe 3
Stripe 7
Stripe 11
data disks
Stripe 0
Stripe 4
Stripe 8
Stripe 1
Stripe 5
Stripe 9
Stripe 2
Stripe 6
Stripe 10
Stripe 3
Stripe 7
Stripe 11
Stripe 0
Stripe 4
Stripe 8
Stripe 1
Stripe 5
Stripe 9
Stripe 2
Stripe 6
Stripe 10
Stripe 3
Stripe 7
Stripe 11
data disks
mirror copies
Bit 0
Bit 1
Bit 2
Bit 3
Bit 4
Bit 5
Bit 6
data disks
ECC disks

RAID


Bit 0
Bit 1
Bit 2
Bit 3
Parity
data disks
Parity disk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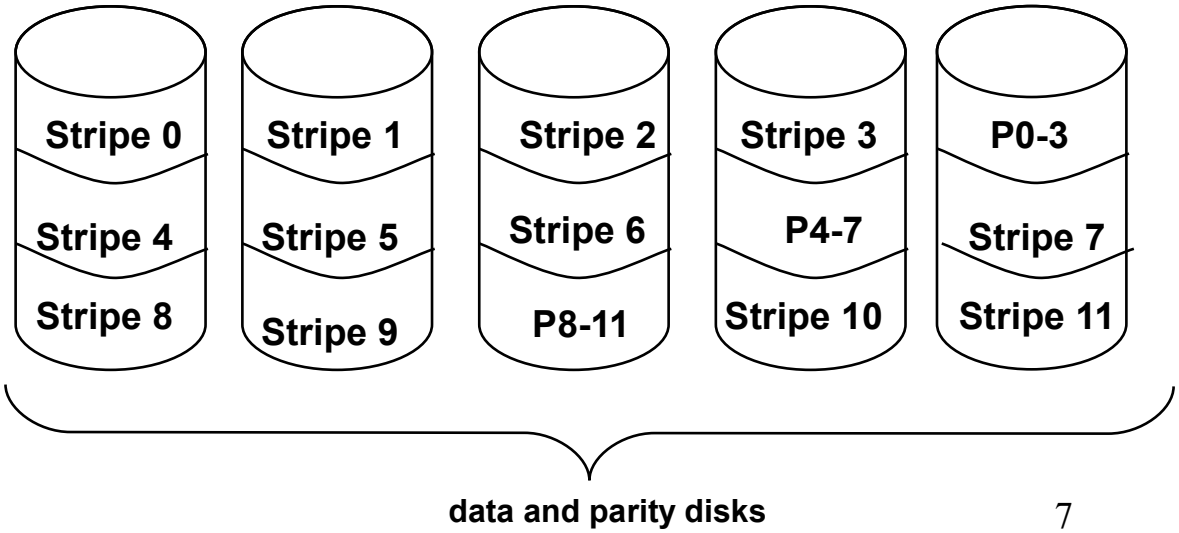
Stripe 8
Stripe 1
Stripe 5
Stripe 9
Stripe 2
Stripe 6
Stripe 10
Stripe 3
Stripe 7
Stripe 11
P0-3
P4-7
P8-11
data disks
Parity disk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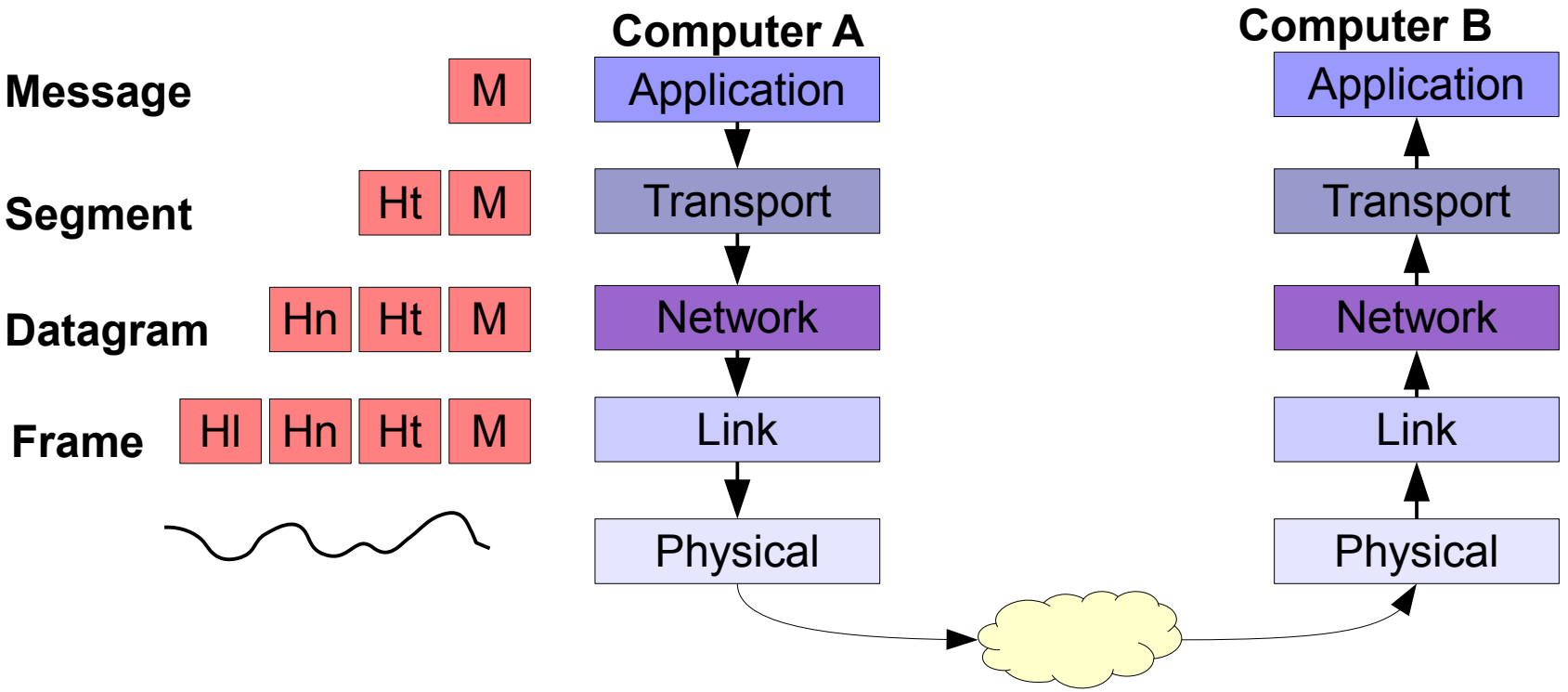
Stripe 5
Stripe 9
Stripe 2
Stripe 6
P8-11
Stripe 3
P4-7
Stripe 10
P0-3
Stripe 7
Stripe 11
data and parity disks

Networking

- Processes that belong to remote computers need to exchange data.
  - Layered Protocols



Networking

- Each protocol offers services to the above protocols.
- A **transport protocol** “transfers” data from one process to a remote process.
  - It takes care of losses or reordering.
  - Needed identification: port number.
- A **network protocol** “transfers” datagrams from one computer to another computer.
  - It takes care of the efficient routing of packets.
  - Needed identification: ip address
  - Device that operates at this level: Router
- A **link protocol** “transfers” frames from one network node to another physically connected node.
  - It takes care of how the nodes share the access of the common communication media.
  - Needed identification: MAC address
  - Device that operates at this level: Switch

DNS

- Domain Name Service
- Translates Domains Names into IP addresses.
- DNS resolvers are responsible for a subset of the Domain Name Space.

Security

- Four-level protection:
  - Physical, Human, Operating System, Network
- Threats:
  - Trojan Horse, Stack and Buffer Overflow, Viruses, Worms, Denial of Service
- User-Authentication
  - Passwords, One-time Passwords, Biometrics
- Protection
  - OS: Principle of least privilege
  - Protection Domain: collection of access rights.
  - Access matrix
    - Global Table, Access Lists for Objects, Capability Lists for Domains

Thank you!!!