
DATABASE

CSE3103 : Database
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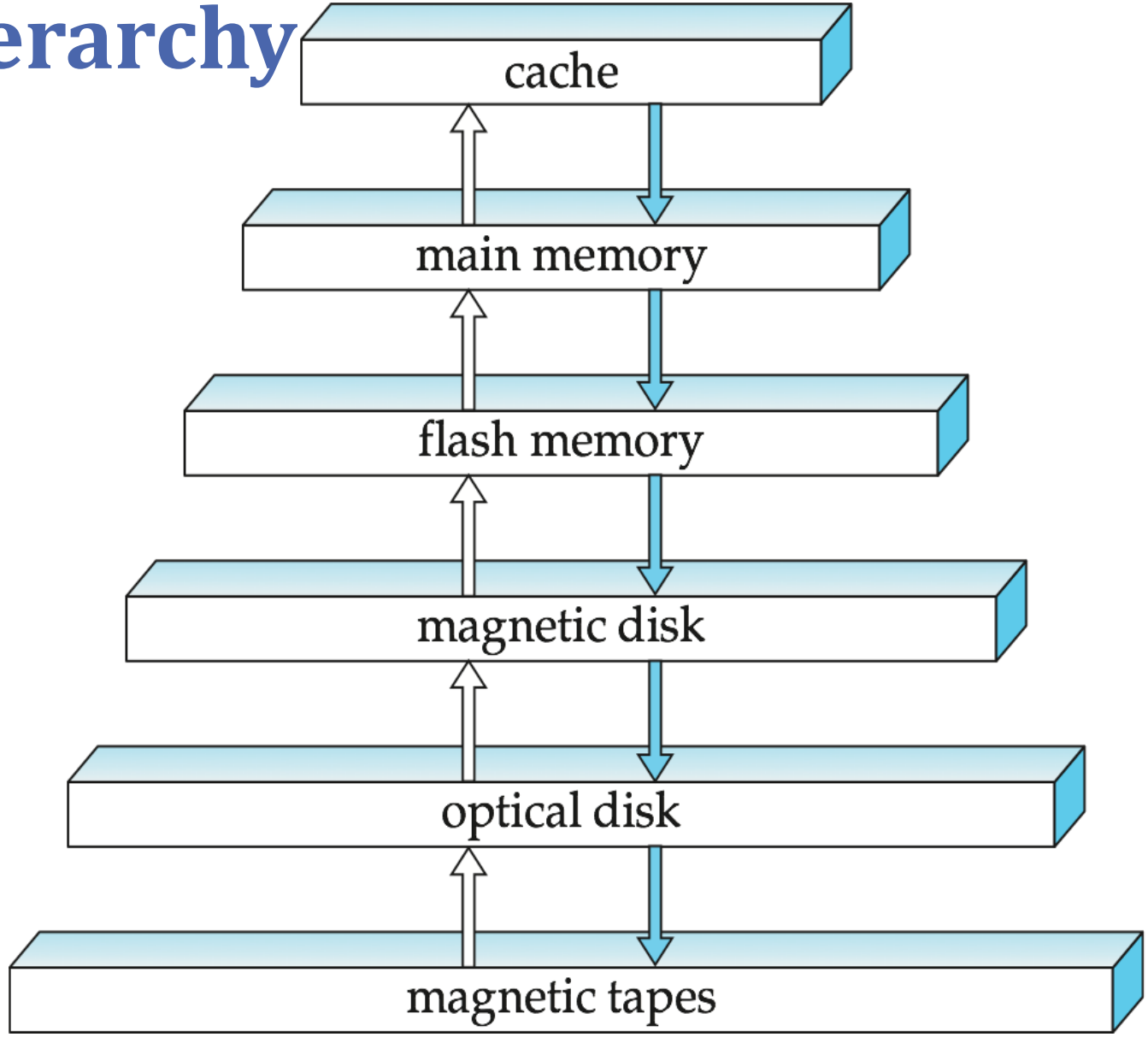
Classification of Physical Storage Media

- Speed with which data can be accessed
- Cost per unit of data
- Reliability
  - data loss on power failure or system crash
  - physical failure of the storage device
- Can differentiate storage into:
  - **volatile storage:** loses contents when power is switched off
  - **non-volatile storage**:
    - Contents persist even when power is switched off.
    - Includes secondary and tertiary storage, as well as batter- backed up main-memory.

Physical Storage Media

- **Cache** – fastest and most costly form of storage; volatile; managed by the computer system hardware.
- **Main memory**:
  - fast access (10s to 100s of nanoseconds; 1 nanosecond = 10^{-9} seconds)
  - generally too small (or too expensive) to store the entire database
    - capacities of up to a few Gigabytes widely used currently
    - Capacities have gone up and per-byte costs have decreased steadily and rapidly (roughly factor of 2 every 2 to 3 years)
  - **Volatile** — contents of main memory are usually lost if a power failure or system crash occurs.

Storage Hierarchy



Storage Hierarchy (Cont.)

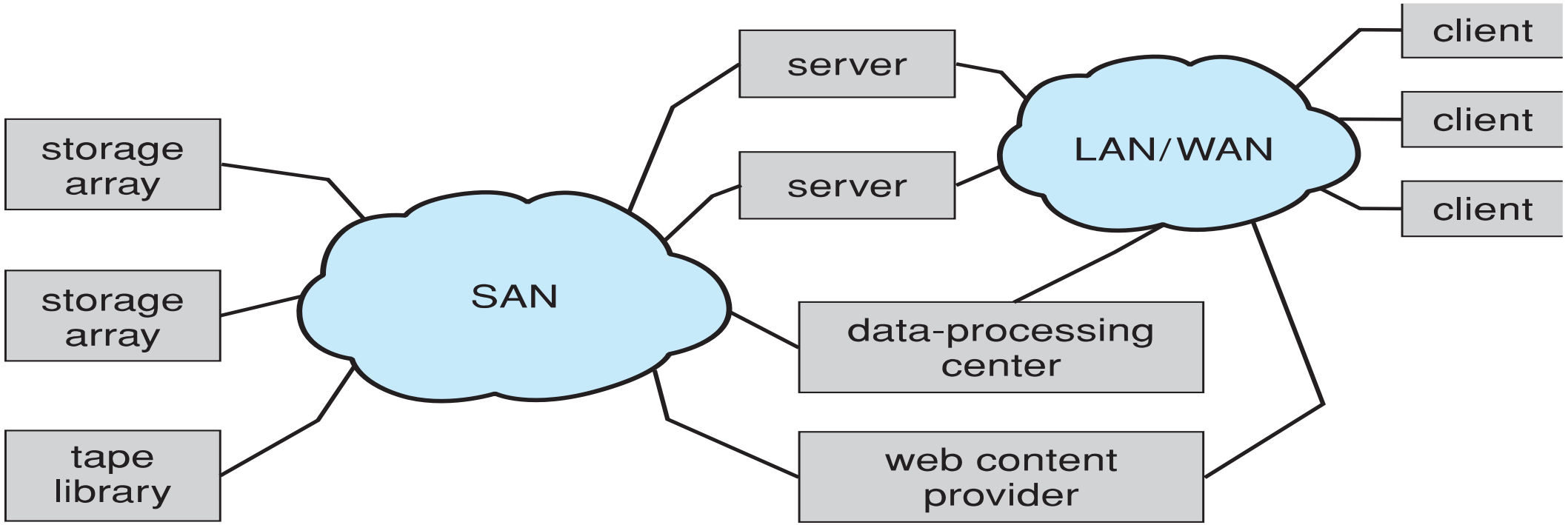
- **Primary storage:** Fastest media but volatile (cache, main memory).
- **Secondary storage:** next level in hierarchy, non-volatile, moderately fast access time
  - also called **on-line storage**
  - E.g. flash memory, magnetic disks
- **Tertiary storage:** lowest level in hierarchy, non-volatile, slow access time
  - also called **off-line storage**
  - E.g. magnetic tape, optical storage

Disk Subsystem

- Disks usually connected directly to computer system
- In **Storage Area Networks (SAN)**, a large number of disks are connected by a high-speed network to a number of servers
- In **Network Attached Storage (NAS)** networked storage provides a file system interface using networked file system protocol, instead of providing a disk system interface

Storage Area Network

- Common in large storage environments
- Multiple hosts attached to multiple storage arrays - flexible

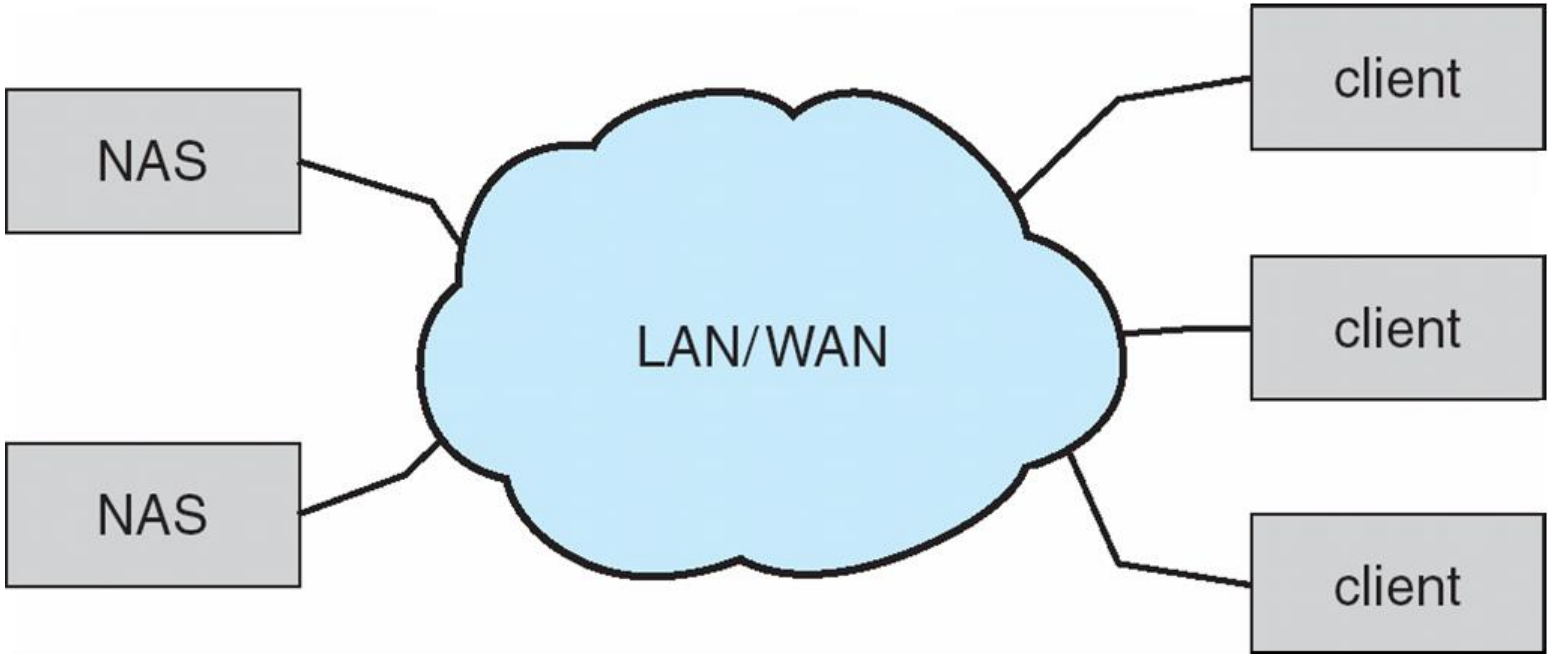


Storage Area Network (Cont.)

- SAN is one or more storage arrays
  - Connected to one or more Fibre Channel switches
- Hosts also attach to the switches
- Storage made available via **LUN Masking** from specific arrays to specific servers
- Easy to add or remove storage, add new host and allocate it storage
  - Over low-latency Fibre Channel fabric
- Why have separate storage networks and communications networks?
  - Consider iSCSI, FCOE

Network-Attached Storage

- Network-attached storage (**NAS**) is storage made available over a network rather than over a local connection (such as a bus)
  - Remotely attaching to file systems



Network-Attached Storage

- NFS and CIFS are common protocols
- Implemented via remote procedure calls (RPCs) between host and storage over typically TCP or UDP on IP network
- **iSCSI** protocol uses IP network to carry the SCSI protocol
  - Remotely attaching to devices (blocks)


data
distributed
database
DBMS
shared
parallel
system
architecture
DBMSs
network
processing
systems
performance
access
centralized
processors
Distributed
DDBMS
multiple
sites
Parallel
processor
nothing
memory
computer
disk
single
sites
may
applications
computers
site
require
physically
users
logically
stored
number
local
sometimes
provide
decentralized
large
one
Shared
technology
Figure
bottleneck
interconnection
application
management
transparent
organizational
administered
Management
fragments
typically
major
replicated
also
many
make
disks
directly
distinction
Database
logical
development
definition
nodes
capable
control
scalability
approach
improve
computing
split
order
scalable
architectures
islands
resources
remote
defined
controlled
based
structure
collection
provides
global
associated
incompatible
way
consists
partitioned
used
least
must
System
mode
databases
user
per
makes
often
com
Date
operational
referred
communication
distribution
eliminates
reliability
across
fact
within
machines
like
discuss
share
large