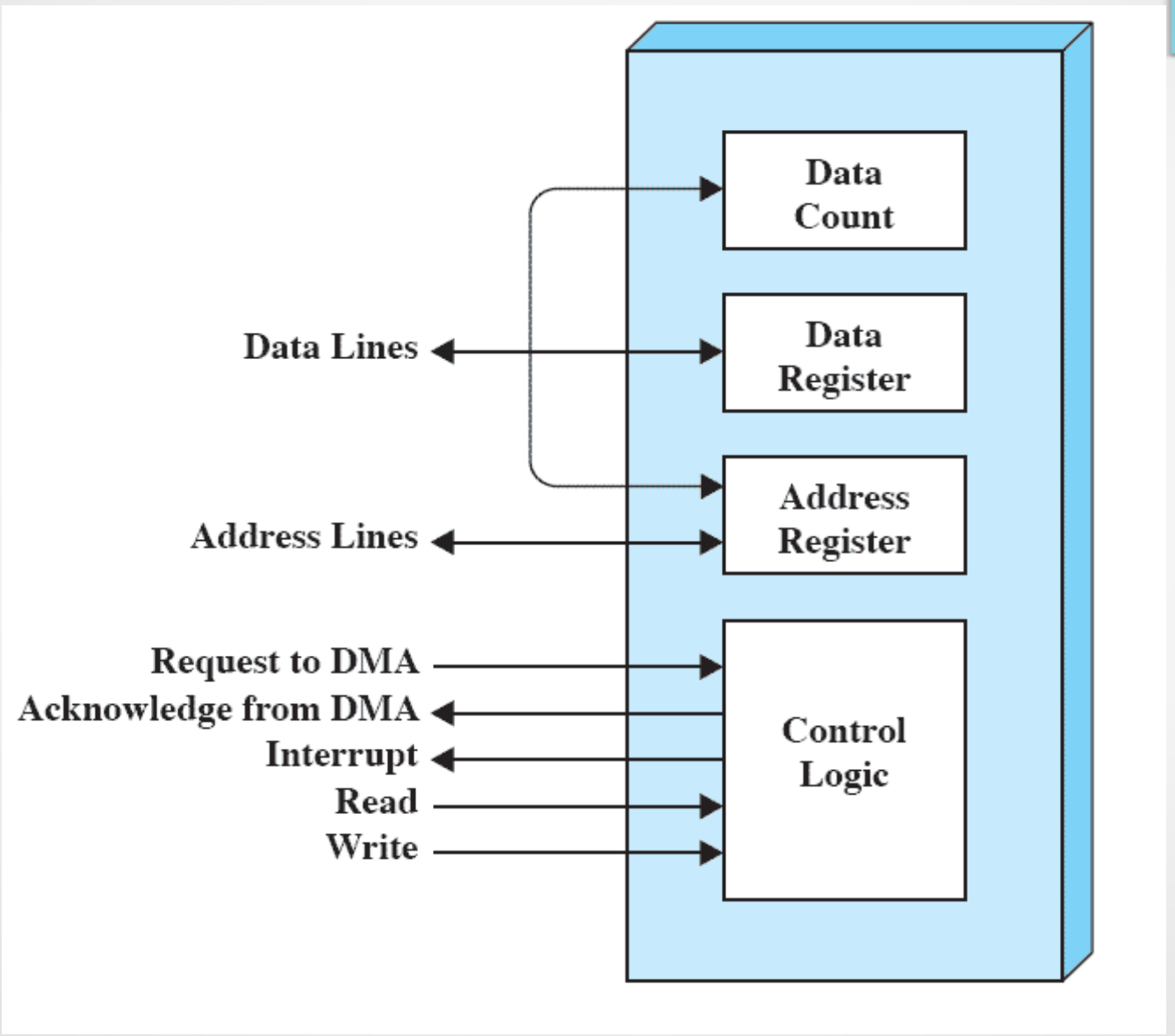
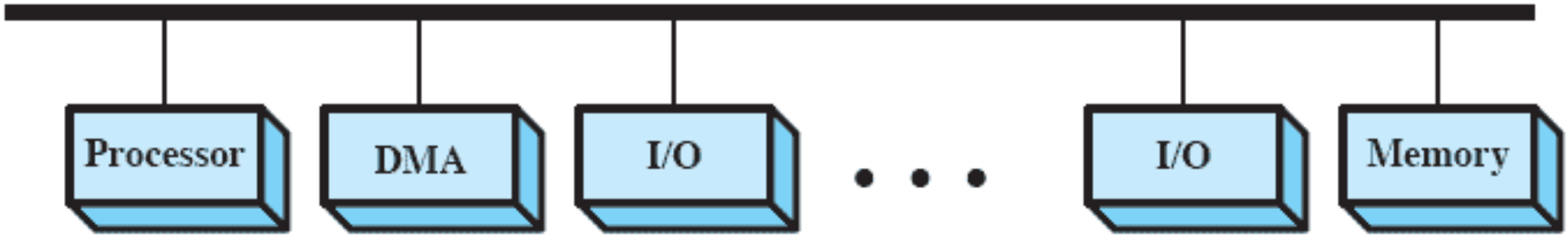
Direct Memory Address

- Processor delegates I/O operation to the DMA module
- DMA module transfers data directly to or form memory
- When complete DMA module sends an interrupt signal to the processor

DMA Block Diagram



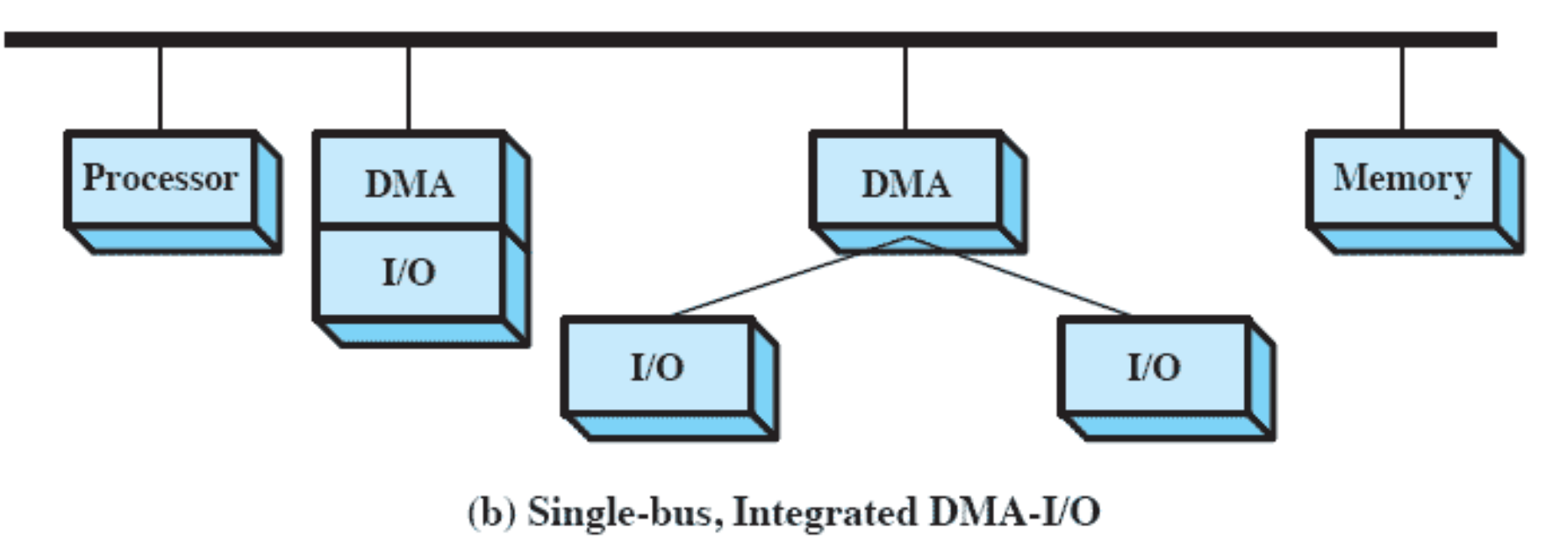
DMA Configurations:Single Bus



(a) Single-bus, detached DMA

- DMA can be configured in several ways
- Shown here, all modules share the same system bus

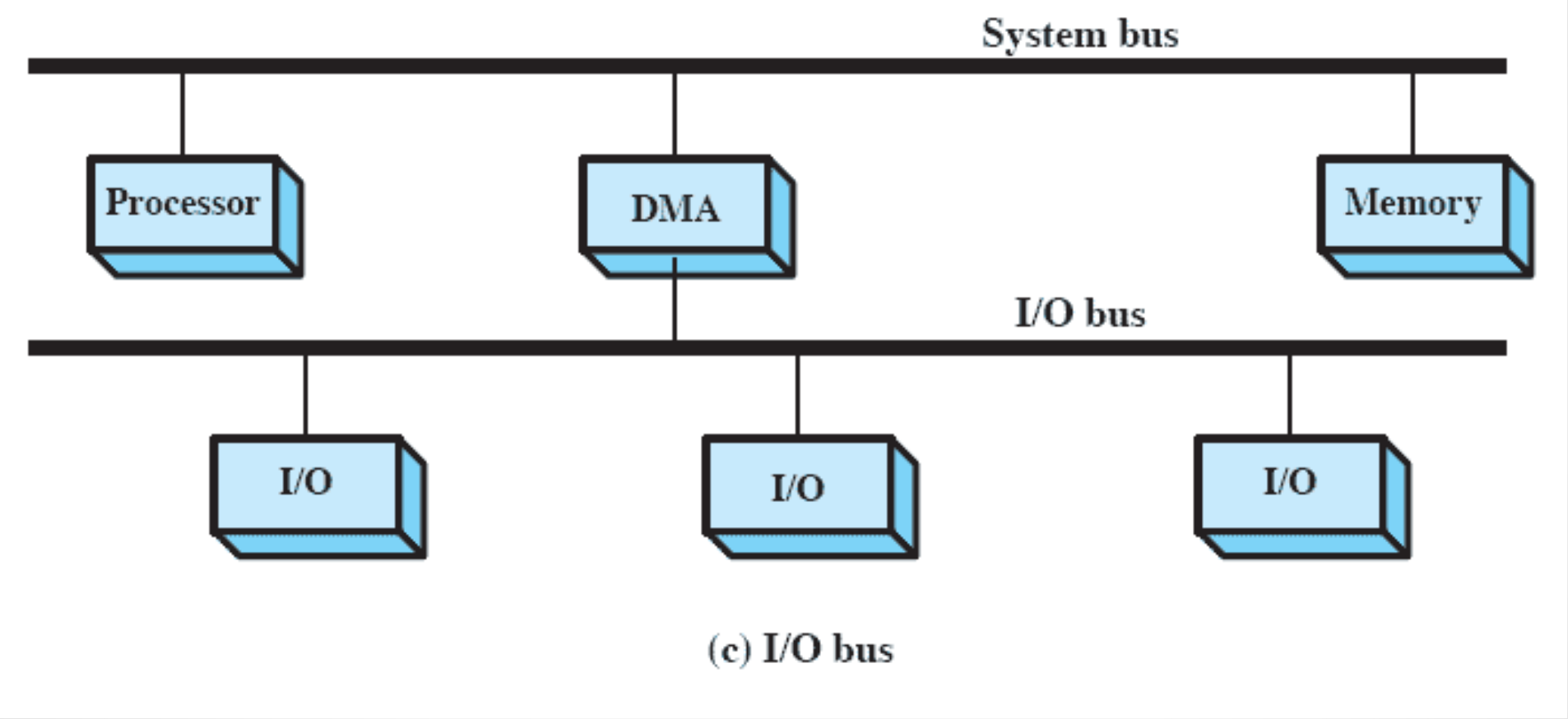
DMA Configurations: Integrated DMA & I/O



(b) Single-bus, Integrated DMA-I/O

- Direct Path between DMA and I/O modules
- This substantially cuts the required bus cycles

DMA Configurations: I/O Bus



(c) I/O bus

- Reduces the number of I/O interfaces in the DMA module

Operating System Design Issues

Operating System Design Issues

- Design Objectives:
  - Efficiency
  - Generality

Goals: Efficiency

- Most I/O devices extremely slow compared to main memory
- Use of multi-programming allows for some processes to be waiting on I/O while another process executes
- I/O cannot keep up with processor speed
  - Swapping used to bring in ready processes
  - But this is an I/O operation itself

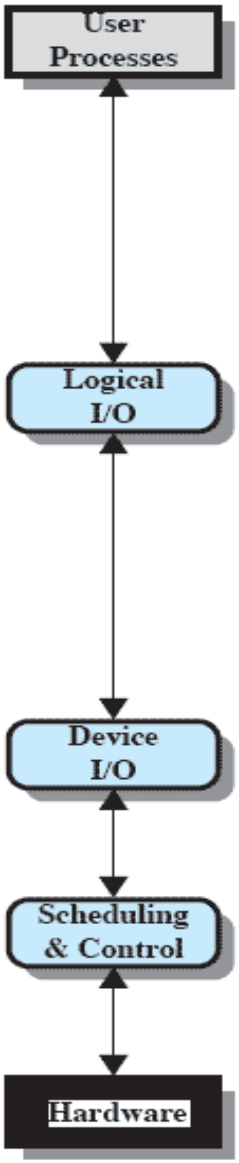
Generality

- For simplicity and freedom from error it is desirable to handle all I/O devices in a uniform manner
- Hide most of the details of device I/O in lower-level routines
- Difficult to completely generalize, but can use a hierarchical modular design of I/O functions

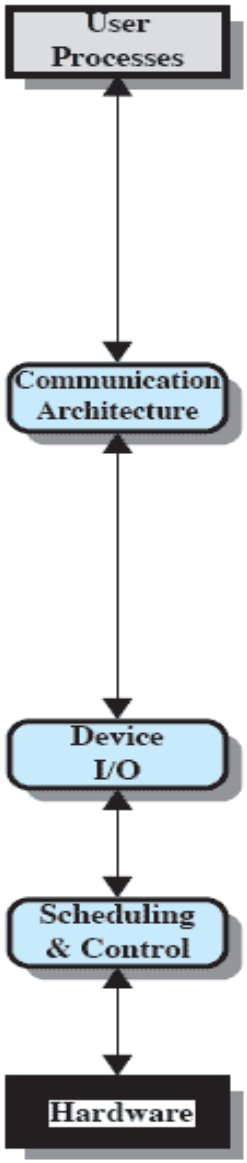
Hierarchical design

- Functions of the operating system should be separated according to their complexity, their characteristic time scale, and their level of abstraction.
- Leads to an organization of the operating system into a series of layers.
- Each layer performs a related subset of the functions required of the operating system
- Layers should be defined so that changes in one layer do not require changes in other layers
- Each layer relies on the next lower layer to perform more primitive functions
- It provides services to the next higher layer.

A Model of I/O Organization



(a) Local peripheral device



(b) Communications port

(c) File system

Local peripheral device

- Considering a local peripheral device,
- Logical I/O:
  - Deals with the device as a logical resource.
  - Concerned with managing general I/O functions on behalf of user process.
- Device I/O:
  - Converts requested operations into sequence of I/O instructions.
- Scheduling and Control
  - Performs actual queuing and control operations.
  - Interrupts are handled at this layer.

Communications Port

- Similar to previous but the logical I/O module is replaced by a communications architecture,
  - This consist of a number of layers.
  - An example is TCP/IP,

File System

- Representative structure for managing I/O on a secondary storage deceive that support a file system,
- Directory management
  - Concerned with user operations affecting files (add, delete, reorganize)
- File System
  - Logical structure and operations (open, close, read, write)
- Physical organization
  - Converts logical names to physical addresses