

Chapter 3 Basic Input/Output

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Contents

Consider the I/O capability of computers as seen from the programmer's point of view. Introduce only basic I/O operations, provided in all computers.

- Accessing I/O Devices
- I/O Device Interface
- Communication Methods with CPU
 - Program-controlled I/O (Polling)
 - Interrupt-driven I/O
 - Direct Memory Access (DMA)

Computer Organization & Architecture

7-1 I/O Interface

Wang Guohua

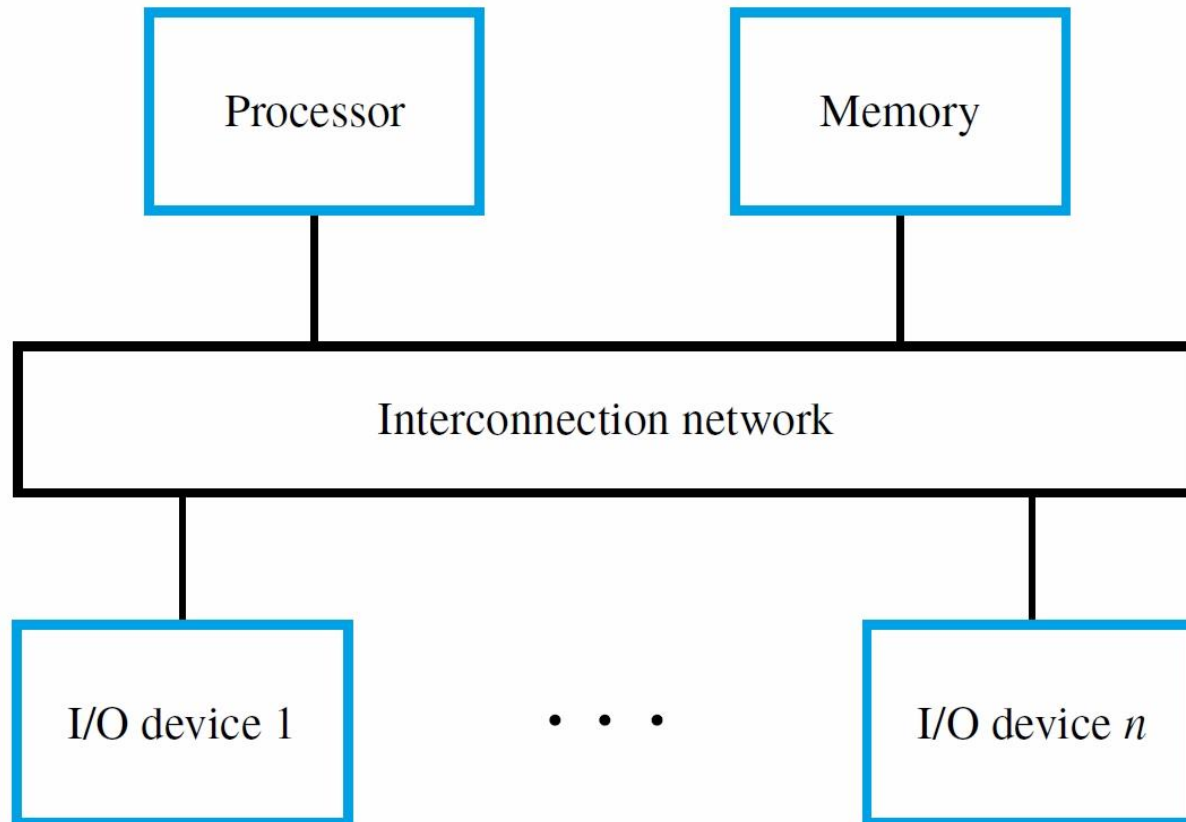
School of Software Engineering

Contents of this lecture

- Accessing I/O Devices
 - Memory-mapped I/O
 - Separated I/O (Isolated I/O)
- I/O Device Interface

Accessing I/O Devices (1)

- Computer system components communicate through an interconnection network.



Accessing I/O Devices (2)

- Address space and memory access concepts from preceding chapter also apply to I/O devices.
- Each I/O device must consist of some addressable locations.
 - These locations are accessed with Load and Store instructions.
 - These locations are implemented as I/O registers.

Accessing I/O Devices (3)

- Memory-mapped I/O
 - The I/O devices and the memory share the same address space.
 - No special commands for I/O.
 - I/O looks just like memory read/write.
 - Example:

Load	R2, DATAIN
Store	R2, DATAOUT
 - DATAIN is the address of a register in an input device.
 - DATAOUT is the address of a register in an output device.

Accessing I/O Devices (4)

- Memory-mapped I/O
 - Advantage
 - Any machine instruction that can access memory can be used to transfer data to or from an I/O device.
 - Disadvantage
 - Valuable memory address space is used up.

Accessing I/O Devices (5)

- Separated I/O (Isolated I/O)
 - Separate address spaces.
 - Special I/O instructions to perform I/O transfers.
 - E.g., IN, OUT
 - Advantage
 - I/O devices deal with few address lines.
 - Note
 - A separate I/O address space does not necessarily mean that the I/O address lines are physically separate from the memory address lines.

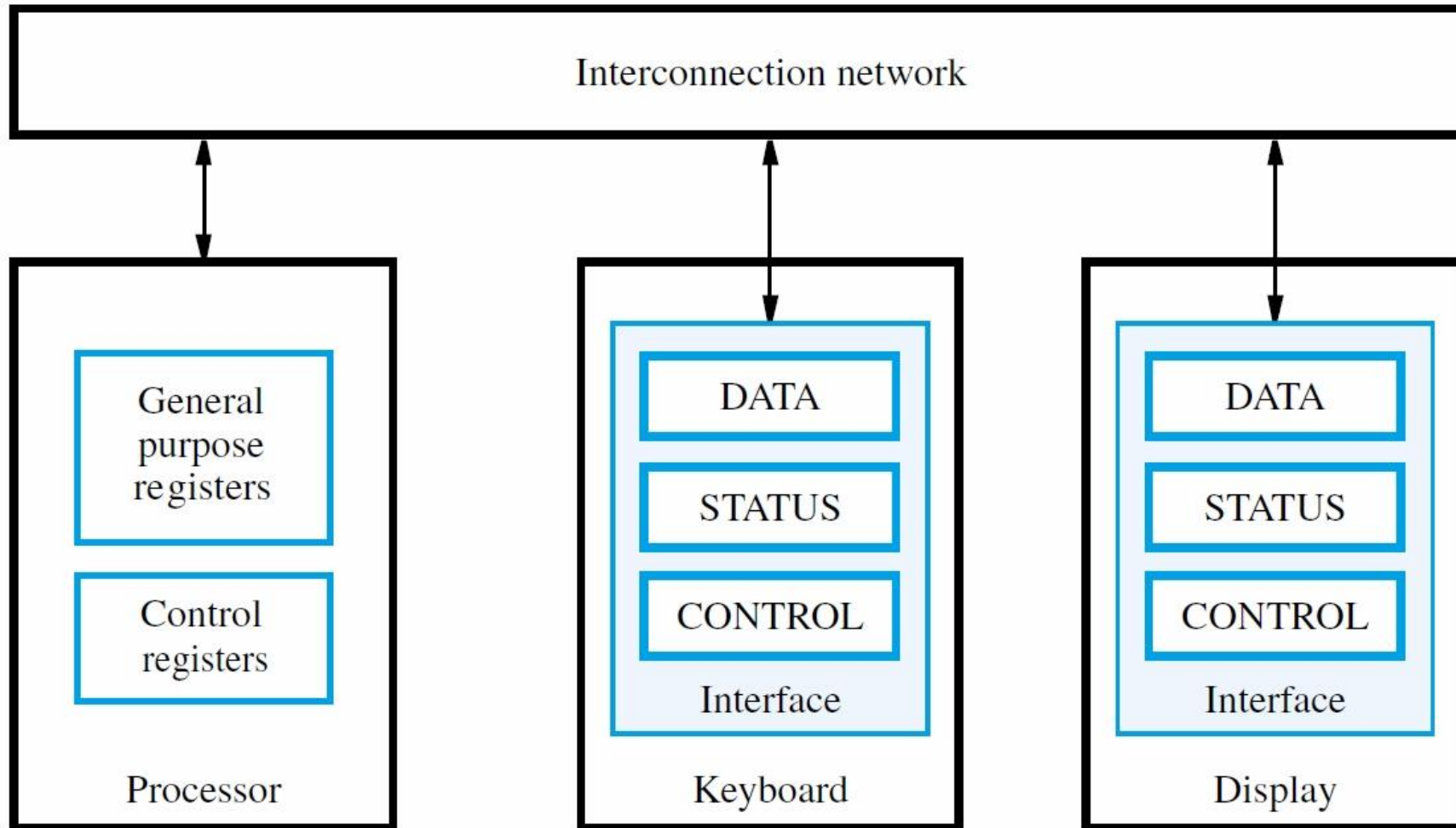
I/O Device Interface (1)

- I/O Device Problems
 - Wide variety of peripherals
 - Delivering different amounts of data
 - At different speeds
 - In different formats
 - All slower than CPU and RAM
 - Need I/O interfaces

I/O Device Interface (2)

- I/O Device Interface
 - An I/O device interface is a circuit between a device and the interconnection network.
 - Provides the means for data transfer and exchange of status and control information.
 - Includes data, status, and control registers accessible with Load and Store instructions.
 - Memory-mapped I/O enables software to view these registers as locations in memory.

I/O Device Interface (3)



Quiz (1)

1. About memory-mapped I/O, which of the following is **not** true?
 - A. The I/O devices and the memory share the same address space.
 - B. Any machine instruction that can access memory can be used to transfer data to or from an I/O device.
 - C. Valuable memory address space is used up.
 - D. I/O devices deal with few address lines.

Quiz (2)

2. What is the difference between memory-mapped I/O and isolated I/O?

– **Memory-mapped I/O:**

- The I/O devices and the memory share the same address space.
- No special commands for I/O. Any machine instruction that can access memory can be used to transfer data to or from an I/O device.
- Valuable memory address space is used up.

– **Isolated I/O:**

- Separate address spaces
- Special I/O instructions to perform I/O transfers.
- I/O devices deal with few address lines.