

Chapter 12

Multiple Choice Questions

1. A current trend in I/O device technology and I/O subsystem is
- A) there is an increasingly broad variety of I/O devices.
 - B) new devices are similar to the previous I/O devices that makes it easier to incorporate them in operating systems.
 - C) to encapsulate the oddities of different I/O devices, the device drivers present device-specific interface for each device to the I/O subsystem.
 - D) All of the above.

Ans: A

Section: 12.1

Difficulty: Easy

2. Which of the following is TRUE about a serial port controller and a fibre channel (FC) bus controller?
- A) Both FC bus controller and serial port controller are often implemented as separate circuit boards.
 - B) A serial-port controller is a simple device controller, while an FC bus controller is complex.
 - C) Both FC bus controller and serial port controller are used in PCs.
 - D) All of the above.

Ans: B

Section: 12.2

Difficulty: Easy

3. In memory-mapped I/O
- A) main memory of the computing device is used for communicating with the I/O devices using the standard I/O instructions.
 - B) main memory of the computing device is used for communicating with the I/O devices using the special I/O instructions.
 - C) address space of the computing device is used for communicating with the I/O devices using the standard I/O instructions.
 - D) address space of the computing device is used for communicating with the I/O devices using the special I/O instructions.

Ans: C

Section: 12.2.1

Difficulty: Difficult

4. A control register in an I/O device control

- A) is written by the host to send output.
- B) is written by the host to choose half-duplex communication.
- C) is read by the host to get input.
- D) contains status bits that can be read by the host.

Ans: C

Section: 12.2

Difficulty: Medium

5. In polling I/O, the main inefficiency comes from

- A) the hardware controller when it notifies the CPU that the device is ready for service.
- B) the basic polling operation that may be comprised of several CPU instructions.
- C) polling when it is attempted repeatedly yet rarely finds a device ready for service.
- D) the slow data transfer rate between a device and the host.

Ans: C

Section: 12.2.2

Difficulty: Difficult

6. Interrupt chaining

- A) allows CPU to defer processing of low-priority interrupts without masking all interrupts.
- B) splits interrupt management between first level and second level interrupt handlers.
- C) is used to handle interrupts but not exceptions.
- D) is a compromise between the overhead of a huge interrupt table and the inefficiency of dispatching to a single interrupt handler.

Ans: D

Section: 12.2.3

Difficulty: Medium

7. In DMA-based I/O,

- A) CPU is relieved from data transfer and is interrupted after every word has been transferred to initiate the next word transfer.
- B) cycle stealing can slow down the CPU computation, but off-loading the data-transfer work to a DMA controller generally improves the total system performance.
- C) interrupt mechanism is not used.
- D) data is transferred to/from a single block of memory, but not to/from multiple blocks.

Ans: B

Section: 12.2.4

Difficulty: Difficult

8. Escape (or back door) in application I/O interface

- A) allows a user to interrupt a device at any time.
- B) allows access to a few additional devices, such as a time-of-day clock and a timer.
- C) transparently passes arbitrary commands from an application to a device driver.
- D) enables managing of devices with widely varying speeds ranging from a few bytes per second to gigabytes per second.

Ans: C

Section: 12.3

Difficulty: Medium

9. Component that measures elapsed time and to trigger operations is called a

- A) programmable interval timer.
- B) high performance event timer.
- C) network time protocol.
- D) socket.

Ans: A

Section: 12.3.3

Difficulty: Medium

10. In a blocking system call, the execution of a process is suspended

- A) until the process is woken up by some other process.
- B) until a fixed amount of time has elapsed.
- C) the kernel raises the priority of that process.
- D) the I/O has completed.

Ans: D

Section: 12.3.4

Difficulty: Easy

11. Buffering in I/O is used to

- A) cope with a speed mismatch between the producer and consumer of a data stream.
- B) provide adaptations for devices that have different data-transfer sizes.
- C) support copy semantics for application I/O.
- D) All of the above.

Ans: D

Section: 12.4.2

Difficulty: Medium

12. Technique used to improve I/O efficiency by temporarily storing copies of data is called

- A) spooling.
- B) buffering.
- C) caching.
- D) memory mapping.

Ans: C

Section: 12.4.2

Difficulty: Easy

13. Which of the following is NOT a technique used for managing power consumption in mobile devices?

- A) Power collapse.
- B) chilling with natural sources such as lake water, and solar panels.
- C) Component level power management.
- D) Wakelocks.

Ans: B

Section: 12.4.8

Difficulty: Easy

14. Which of the following is FALSE about streams?

- A) A stream is a full-duplex connection between a device driver and a user-level process.
- B) Each stream module contains a pair of queues.
- C) The number of modules in a stream is fixed by the operating system.
- D) Messages may be dropped in a stream even if flow control is implemented.

Ans: C

Section: 12.6

Difficulty: Medium

15. Which of the following principles is used to improve the efficiency of I/O?

- A) Reduce the number of times that data must be copied in memory while passing between device and application.
- B) Move processing primitives into hardware, to allow their operation in device controllers to be concurrent with CPU and bus operation.
- C) Increase concurrency by using DMA-knowledgeable controllers or channels to offload simple data copying from the CPU.
- D) All of the above.

Ans: D

Section: 12.7

Difficulty: Easy

Essay Questions

1. Explain the concept of a bus and daisy chain. Indicate how they are related.

Ans: A bus is merely a set of wires and a rigidly defined protocol that specifies a set of messages that can be sent on the wires. The messages are conveyed by patterns of electrical voltages applied to the wires with defined timings. A daisy chain is a device configuration where one device has a cable that connects another device which has a cable that connects another device, and so on. A daisy chain usually operates as a bus.

Section: 12.2

Difficulty: Medium

2. Explain the difference between a serial-port controller and a SCSI bus controller.

Ans: A serial-port controller is a simple device controller with a single chip (or portion of a chip) that controls the signals on the wires of a serial port. By contrast, a SCSI bus controller is not simple. Because the SCSI protocol is complex, the SCSI bus controller is often implemented as a separate circuit board that plugs into the computer.

Section: 12.2

Difficulty: Medium

3. Explain the concept of polling between a host and a controller.

Ans: When a host tries to access the controller, it constantly reads the status of a "busy register" and waits for the register to clear. This repetitive checking is termed polling.

Section: 12.2.1

Difficulty: Medium

4. What is interrupt chaining?

Ans: Interrupt chaining is a technique in which each element in the interrupt vector points to the head of a list of interrupt handlers. When an interrupt is raised, the handlers on the corresponding list are called one by one, until one is found that can service the request. This is a compromise between the overhead of a huge interrupt table and the inefficiency of dispatching to a single interrupt handler.

Section: 12.2.2

Difficulty: Medium

5. Why is DMA used for devices that execute large transfers?

Ans: Without DMA, programmed I/O must be used. This involves using the CPU to watch status bits and feed data into a controller register one byte at a time. Therefore, DMA was developed to lessen the burden on the CPU. DMA uses a special-purpose processor called a DMA controller and copies data in chunks.

Section: 12.2.3

Difficulty: Easy

6. What is the purpose of a programmable interval timer?

Ans: The programmable interval timer is hardware used to measure elapsed time and to trigger operations. The scheduler uses this mechanism to generate an interrupt that will preempt a process at the end of its time slice.

Section: 12.3.3

Difficulty: Medium

7. Give an example of when an application may need a nonblocking I/O system call.

Ans: If the user is viewing a web browser, then the application should allow keyboard and mouse input while it is displaying information to the screen. If nonblocking is not used, then the user would have to wait for the application to finish displaying the information on the screen before allowing any kind of user interaction.

Section: 12.3.4

Difficulty: Medium

8. What are the three reasons that buffering is performed?

Ans: A buffer is a memory area that stores data while they are transferred between two devices or between a device and an application. One reason for buffering is handle data when speed mismatches between the producer and consumer of a data stream exist. The second reason is to adapt between devices that have different data-transfer sizes. The third reason is to support copy semantics for application I/O.

Section: 12.4.2

Difficulty: Medium

9. What is the purpose of a UNIX mount table?

Ans: The UNIX mount table associates prefixes of path names with specific device names. To resolve a path name, UNIX looks up the name in the mount table to find the longest matching prefix; the corresponding entry gives the device name.

Section: 12.5

Difficulty: Medium

10. UNIX System V implements a mechanism called STREAMS. What is this mechanism?

Ans: STREAMS enables an application to assemble pipelines of driver code dynamically. A stream is a full-duplex connection between a device driver and a user-level process. It consists of a stream head that interfaces with the user process and a driver end that controls the device. It may also include stream modules between them.

Section: 12.6

Difficulty: Difficult

True/False Questions

1. An expansion bus is used to connect relatively high speed devices to the main bus.

Ans: False

Section: 12.2

Difficulty: Medium

2. A maskable interrupt can never be disabled.

Ans: False

Section: 12.2.2

Difficulty: Medium

3. A dedicated device cannot be used concurrently by several processes or threads.

Ans: True

Section: 12.3

Difficulty: Easy

4. Vectored IO allows one system call to perform multiple IO operations involving a single location.

Ans: False

Section: 12.3.5

5. An I/O system call returns a one-bit information about the status of the call.

Ans: True

Section: 12.4.5

Difficulty: Easy

6. In UNIX, part of a path name includes a device name.

Ans: False

Section: 12.5

Difficulty: Easy