

1. We have stressed the need for an operating system to make efficient use of the computing hardware. When is it appropriate for the operating system to forsake this principle and to "waste" resources? Why is such a system not really wasteful?

Different computer systems are built to accomplish different tasks. Single user computer systems (Personal computer) is built to maximize the work (or play) that the user is performing. In this case, the operating system is designed mostly for ease of use. Unlike a system like an embedded system, a single user computer build in a user friendly environment. Thus it includes many such utilities that comes in handy such as GUI, built in software, services like in modern operating systems.

Most users have no proper knowledge of how the computer system work. So the operating system manufacture needs to consider all these aspects and make users life easier by providing them user friendly system. So allocating resources for such unnecessary utilities is not a waste when the manufacturer needs to build a user friendly computer system

2. What is the main difficulty that a programmer must overcome in writing an operating system for a real-time environment?

In a real-time environment the system must be able to read data, process data and take actions as soon as possible. Most of the real-time systems are like embedded systems that designed as task specific device. In this type of a system, the hardware is composed with limited resources. Therefore, the operating system should be able to do the specified task within given short time period using limited resources. Thus, it should be capable of efficient process management, I/O management, memory management etc

3. How does the distinction between kernel mode and user mode function as a rudimentary form of protection (security) system?

By dividing operating system into user mode and kernel mode, underling important operations like memory management, process management, I/O management, data, resources will not accessible for users since they are in the user mode. These are really crucial operations and could damage the system. Those operations will be handled by the OS in it's kernel mode by giving abstraction to the users. Also hardware devices are accessible only when the operating system is in kernel mode. Therefore, by restricting user actions by having two modes will secure the system.

4. Some early computers protected the operating system by placing it in a memory partition that could not be modified by either the user job or the operating system itself. Describe two difficulties that you think could arise with such a scheme.

Since operating system is stored in the memory partition, it will not be able to modify or update it even if a bug found on the system. Also some critical data like passwords access control information that are required by or generated by the operating system would have to pass through unprotected memory slots and they can be exposed to unauthorized users. Therefor, it will reduce the protection of important data.

5. Give two reasons why caches are useful. What problems do they solve? What problems do they cause? If a cache can be made as large as the device for which it is caching (for instance, a cache as large as a disk), why not make it that large and eliminate the device?

1. Supply data to CPU in a higher speed.
2. Increase the throughput and improve performance of an application
3. Increase memory hits by following improvement policies like least recently used, first in first out

Problems cause

1. The data in the cache must be kept consistent with the data in the application. If an application has a data value change, and the datum is also in the cache, the cache must also be updated. In a multi process system when multiple processes are using the same data, that particular data has to be updated according to each one of the processes. This leads to a cache inconsistency in multi processor system.
2. Since the cache size is small, it could increase the cache misses.

Manufacturing caches is a lot more expensive than manufacturing slow secondary storage devices. Therefore, it is not possible to make larger caches for general computers

6. In a multi programming and time-sharing environment, several users share the system simultaneously. This situation can result in various security problems.

- a What are two such problems?
 - (a) In a shared environment one user can steal or corrupt data of another user
 - (b) One user can prevent another user from accessing to the system resources.
- b Can we ensure the same degree of security in a time-shared machine as in a dedicated machine? Explain your answer.

This depends on the functionality of the operating system of the machine

If we can ensure that the operating system works as we expect and it does not share resources between users and users can only read, write to their own resources then it preserves the security we expect from the system But if the operating system has bugs we cannot ensure that system preserve security of our own resources

7. Describe the differences between symmetric and asymmetric multiprocessing. What are three advantages and one disadvantage of multiprocessor systems?

The primary difference between Symmetric and Asymmetric Multiprocessing is that in Symmetric Multiprocessing all the processors in the system run tasks in the operating system. But, in Asymmetric Multiprocessing not all of the multiple interconnected processors are treated equally only the master processor run tasks in the operating system.

Advantages

1. Increased throughput by increasing the number of processors
2. Increased reliability. Since the workload is distributed evenly between the multiple processors it becomes more reliable and accurate
3. Economy of scale. Multiprocessor systems can save money, by sharing power supplies, housings, and peripherals

Disadvantage: Operating Systems and programs need to be specifically designed to take advantage of the multi-processors.

8. How are network computers different from traditional personal computers? Describe some usage scenarios in which it is advantageous to use network computers.

Each of the networked computer relies on the centralized computer for most of its services. Therefore, it can have a minimal operating system to manage its resources.

A general computer is a standalone device which should be able to provide all the functionalities user expects. Therefore, it should have a advanced operating system than a network computer.

Network computers usage scenarios

1. Network computers are used in most of the financial firms where they want to establish shared resource system
2. Software maintenance can be reduced by using network computer. All the software patches and updates can be rolled out for all users in one go.

9. What is the purpose of interrupts? How does an interrupt differ from a trap? Can traps be generated intentionally by a user program? If so, for what purpose?

The purpose of having interrupt is to get the CPU's attention to an event when the event occurred rather than without wasting CPU by checking the particular event has occurred.

The main difference between trap and interrupt is that trap is triggered by a user program to invoke OS functionality while interrupt is triggered by a hardware device to allow the processor to execute the corresponding interrupt handler routine.

Traps can be generated by user programs intentionally. Usually they are generated for debugging reasons such as catching arithmetic errors.

10. Direct memory access is used for high-speed I/O devices in order to avoid increasing the CPU's execution load

- a How does the CPU interface with the device to coordinate the transfer?

Inorder to complete DMA operation first CPU sets up DMA registers, which contain a pointer to the source of a transfer, a pointer to the destination of the transfer, and a counter of the number of bytes to be transferred. Then the DMA controller places addresses on the bus to perform transfer

- b How does the CPU know when the memory operations are complete?

When the operation completes DMA controller interrupts the CPU to acknowledge.

- c The CPU is allowed to execute other programs while the DMA controller is transferring data. Does this process interfere with the execution of the user programs? If so, describe what forms of interference are caused.

If a user program need to access the main memory a problem occurs since the DMA controller is the bus master at that moment. Since the DMA controller and the CPU use the same bus a problem will occur if both of these need to access the memory.

11. Some computer systems do not provide a privileged mode of operation in hardware. Is it possible to construct a secure operating system for these computer systems? Give arguments both that it is and that it is not possible.

It's is possible to have a such operating system and it should be kept in the control or monitoring mode all the time. This system should run one process at a time and should monitor it until it finish.

Since above type of system can run single process at a time they are not possible to deploy as they are less efficient.

12. Many SMP systems have different levels of caches; one level is local to each processing core, and another level is shared among all processing cores. Why are caching systems designed this way?

The level of caches are separated by the access speed and the size. Higher the speed lower the size.

Genrally, the fastest cache is closer to the processor and it is the smallest in size. Typically, faster cache are more costly. Therefore, smaller and faster caches are placed local to each CPU, and shared caches that are larger, yet slower, are shared among several different processors.

13. Describe a mechanism for enforcing memory protection in order to prevent a program from modifying the memory associated with other programs.

The processor could monitor and track locations where each programs are kept in the memory and isolate them from other programs by limiting access.

14. Identify several advantages and several disadvantages of open-source operating systems. Include the types of people who would find each aspect to be an advantage or a disadvantage.

Advantages

1. Created by skillful and talented people in collaboration
2. They are cheaper than commercial products. Users can afford it.
3. Created by skillful and talented people in collaboration. Therefore the system is highly reliable. Since there are so many developers are working bugs will be handled as fast
4. students and programmers there is certainly an advantage to being able to view and modify the source code

Disadvantages

1. Commercial operating system companies will get a competition with open source products.
2. Might not be as user-friendly as commercial versions
3. Don't come with extensive support. Some functionalities might not support for users