Jacob Hreshchyshyn
Rithvik Arun

Analysis:

Problem Definition:

The task is to choose an operating system structure for a system that monitors the events of the objects, which are logged manually into the system by analysts. These objects will be contained within a 5ft x 10ft x 10ft storage room. These objects are stored within the storage room for no longer than three days. This monitoring process involves running a set of algorithms for determining whether objects within a storage room react when placed near each other. Analysts can also inform the system that objects within the room are reacting with each other. Only restricted personnel within the storage facility can access the monitoring process information through a control room interface.

The operating system structure would require six levels of security clearance in order to restrict reading/writing access for storage room information to personnel authorized to work within the control room. The first four levels (levels 5 - 2) of security would be for authorized personnel interacting with the system. The remaining two (levels 1 - 0) security levels would protect OS and hardware information and would not be accessible by storage personnel. Personnel with a certain security clearance level can access information with the corresponding level. For example, personnel with a security clearance level of 3 can read information at level 3 and up to level 5. On the other hand, personnel with a security clearance level of 3 can write information at level 3 and down to level 2 (the last 2 levels are reserved for OS and hardware operations). Lower security levels correspond to higher level numbers.

In addition, the operating system structure should be fast enough to detect and record a single reaction within a storage room within three seconds after that reaction has occurred. Because the system will require multiple layers of security, this system should be maintainable enough to allow modifications to reduce system overhead over time. The operating system would need to be chosen as soon as possible as it has a deadline of three months.

The available operating system structures to choose from are the following: Simple, Layered, Microkernel, and Modular.

In a Simple structure, every system component can communicate with every other component, each component has equal privilege, and all components have unrestricted hardware access.

In a Layered structure, each kth layer (in 0 to N) may only call functions defined by lower layers. Only layer 0 has direct access to hardware.

A microkernel has an explicit separation of base kernel functionality from system programs, where new pieces of system functionality are added as component plugins, which do not directly communicate with each other or other programs. The microkernel also supports process management, resource allocation, and communication.

A modular structure has the same properties as the microkernel, but also supports communication between all modules.

Assumptions:

- That the dimensions of the room are 5ft x 10ft x 10 ft is an assumption to clarify how many objects can be stored within the room since that was not defined. The room may be filled to max capacity.
- That objects may be stored in a room for no longer than three days is an assumption to clarify what the requirements meant by storing objects “for a short amount of time”.
- That only privileged personnel can access system process information was assumed since we determined that information regarding stored objects should not be made public to any working individual within the facility. Additionally, the problem does not specify whether any worker can access such information or if the information is available only to personnel who work in the control room.
- All system metrics regarding efficiency, and maintainability were assumed.

Metrics:

- The operating system structure should be secure by allowing privileged access to storage room information to control room personnel. This means that there should be six layers of abstraction to account for the four levels of security clearance and two levels for OS and hardware operations.
- The operating system should be efficient enough to detect and record a single reaction within a storage room within three seconds after the reaction has occurred.
- The operating system structure for the system should be developed within three months.

Design/Choice:

The appropriate operating system structure would be a layered system structure.

Justification:

Because the system requires multiple levels of security to handle different personnel privileges, a layered system structure would be the best choice since it is a natural way to handle multiple layers of separation between subsystems which access information of differing levels of sensitivity.

In addition, because the system structure only needs to be efficient enough to detect changes in the room within 3 seconds after the change has occurred, the system structure should be fast enough to satisfy this requirement despite the additional overhead caused by the process of upper layers accessing information from lower layers.

To potentially reduce the overhead caused by these function calls, modifications can be made to the system to improve the performance of the system by increasing the computational power of the system as technology improves over time. Because the system structure would utilize a layered approach, allowing for multiple abstractions between system processes, the structure would be capable of supporting such maintainability.

The layered system structure would be better than a simple system structure because a simple system would not have the layers of security needed to support multiple security clearance levels. Simple system structures can also be hard to maintain which will cause problems when the system needs to be upgraded.

Additionally, the layered system structure is a better choice than a microkernel system structure because the layered approach naturally keeps the different layers separate from each other, which is exactly what we need in terms of security for the system. Also, the microkernel system structure would take longer to construct because there can be difficulty finding the different plugins to support the system. This is not acceptable due to the deadline we are presented with. The layered system structure already suits the needs of our problem and can be implemented with lower risk of passing the three month deadline.

Lastly, the layered system structure is a better choice than a modular system structure since the modular approach does not offer the same level of security that a layered system structure would. Because the modular structure supports communication between every other existing module in the system, it would be much more difficult to implement the six-level security requirement needed for the system. A layered approach, by design, would support the needed separations in security clearance.