Chapter 7

Computer Technology and Multimedia Operating Systems (MOS)

Multimedia Operating System

The operating system is the shield of the computer hardware against all software components. It provides a comfortable environment for the execution of programs, and it ensures effective utilization of the computer hardware. The operating system offers various services related to the essential resources of a computer: CPU, main memory, file system, storage, networking device and all input and output devices. *Operating system is the layer between hardware and the applications.*

Multimedia application demands that human perceive these media in a natural, error freeway. *An audio application will involve:*

- I/O devices: microphone, speakerphone
- CPU: processing the data
- Memory: temporarily store the data
- Network: real-time transmission of the data

The key to the Multimedia OS is the real-time processing of the continuous data:

- *CPU management:* appropriate scheduling is necessary.
- *Memory management:* guaranteed timing delay and buffer management.
- *File system:* allows transparent and guaranteed continuous retrieval of audio and video data to any application using the file system.
- To guarantee real-time processing of the media data, one concept used is resource reservation. The resource is reserved prior to the execution of the application. This has to be performed for all components along the data path of a multimedia application.

Real-Time Multimedia OS

A real-time process is a process which delivers the results of the processing in a given time-span.

Real-time system:

"A system in which the correctness of a computation depends not only on obtaining the right result, but also upon providing the result on time."

Deadline: -

A deadline represents the latest acceptable time for the presentation of a processing result. It marks the border between normal (correct) and anomalous (failing) behavior. A realtime system has both hard and soft deadlines.

Soft deadline:

The term soft deadline is often used for a deadline which cannot be exactly determined and which failing to meet does not produce and unacceptable result. If violated does not result in unacceptable results.

Hard deadline:

Hard deadlines should never be violated. A hard deadline violation is a system failure. Hard deadlines are determined by the physical characteristics of real-time processes.

Characteristics of Real-time Systems

- Predictably fast response to time-critical events and accurate timing information. For example, in the control system of a nuclear power plant, the response to a malfunction must occur within a well-defined period to avoid a potential disaster.
- High degree of schedulability. Schedulability refers to the degree of resource utilization at which, the deadline of each time-critical task can be taken into account.
- Stability under transient overload. Under system overload, the processing of critical tasks must be ensured. These critical tasks are vital to the basic functionality provided by the system.

Some traditional real-time applications include manufacturing and monitoring systems. New applications include multimedia system, surveillance, etc.

Characteristics of Multimedia OS

- More fault-tolerant – compare to the real-time system for nuclear power plant control, the system in a video playback product will cause less damage if some errors occur.
- Deadlines tend to be soft – for example, small errors in video playback timing is not noticeable.
- Schedulability consideration is much easier because the media streams tend to be periodic (results of sampling) and consistent.
- Bandwidth requirement is not always stringent – more compression or lower resolution can always be used to achieve lower bit rates.

Resource Management

Multimedia is a real-time application. This implies a certain amount of data must be handled within a specified time frame. Multimedia requires a tremendous number of resources to accommodate. Audio and video files consume large space on secondary storage. Computing and processing multimedia files requires many CPU cycles and efficient I/O. Some argue today's workstations and networks do not meet the requirements of current multimedia applications.

Essentially, they cannot ensure consistent, on-time data delivery. There are three reasons for this:

- Capacity of system resources is too low (performance is too low)
- The existing resources are not assigned to tasks efficiently (resource scheduling is poor).
- Access to resources is not controlled properly to avoid conflict (resource reservation is insufficient).

Multimedia systems with integrated audio and video processing are at the limit of their capacity, even with data compression and utilization of new technologies. Current computers do not allow processing of data according to their deadlines without any resource reservation and real-time process management. Processing is this context refers to any kind of manipulation and communication of data. This stage of development is known as the window of insufficient resources.

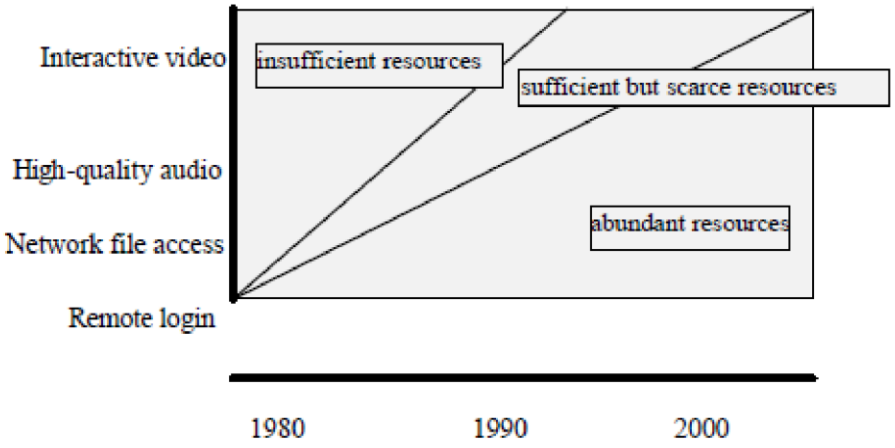

Figure: Window of insufficient resources.

Resources:

A resource is a system entity required by tasks for manipulating data. Each resource has a set of distinguishing characteristics classified using the following scheme:

- Active resources and passive resource:

Active resources: An active resource is the CPU or a network adapter for protocol processing; it provides service.

Passive resources: A passive resource is the main memory, communication bandwidth or a file system; it denotes some system capability required by active resources.

- Resources can be used exclusively by one process at a time or shared between various processes.

Active resources: Active resources are often ***exclusive***.

Passive resources: Passive resources can usually be ***shared*** among processes.

- A resource that exists only once in the system is known as a single, otherwise it is a multiple resource. In a transputer-based multiprocessor system, the individual CPU is a multiple resource.

Process Management

Process management deals with the resource main processor. The capacity of this resource is specified as processor capacity. The process manager maps single processes onto resources according to a specified scheduling policy such that all processes meet their requirements. In most systems, a process under control of the process manager can adopt one of the following states:

- In the initial state, no process is assigned to the program. The process in the idle state.
- If a process is waiting for an event, i.e., the process lacks one of the necessary resources for processing, it is the blocked state.
- If all necessary resources are assigned to the process, it is ready to run. The process only needs the processor for the execution of the program.
- A process is running as long as the system processor is assigned to it.

The process manager is the scheduler. This component transfers a process into the ready to run state by assigning it a position in the respective queue of the dispatcher, which is the essential part of the operating system kernel. The dispatcher manages the transition from ready to run to run. In most operating systems, the next process to run is chosen according to a priority policy. Between processes with the same priority, the one with the longest ready time is chosen.

File Systems

The file system is said to be the most visible part of an operating system. Most programs write or read files. Their program code, as well as user data, are stored in files. The organization of the file system is an important factor for the usability and convenience of the operating system.
A file is a sequence of information held as a unit for storage and use in a computer system.
Files are stored in secondary storage, so they can be used by different applications.
The file system provides access and control functions for the storage and retrieval of files. From the user's viewpoint, it is important how the file system allows file organization and structure. The internals, which are more important in our context i.e, the organization of the file system,

deal with the representation of information in files, their structure and organization in secondary storage.