Real Time Operating System (RTOS)

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Real-time **operating systems (RTOS)** are used in environments where a large number of events, mostly external to the computer system, must be accepted and processed in a short time or within certain deadlines. such applications are industrial control, telephone switching equipment, flight control, and real-time simulations.

With an RTOS, the processing time is measured in tenths of seconds. This system is time-bound and has a fixed deadline. The processing in this type of system must occur within the specified constraints. Otherwise, This will lead to system failure.

Examples of real-time operating systems are airline traffic control systems, Command Control Systems, airline reservation systems, Heart pacemakers, Network Multimedia Systems, robots, etc.

What is a Real-Time Operating System (RTOS)?

A real-time operating system (RTOS) is a special kind of operating system designed to handle tasks that need to be completed quickly and on time. Unlike general-purpose operating systems (GPOS), which are good at multitasking and user interaction, RTOS focuses on doing things in real time.

The idea of real-time computing has been around for many years. The first RTOS was created by Cambridge University in the 1960s. This early system allowed multiple processes to run at the same time, each within strict time limits.

Over the years, RTOS has improved with new technology and the need for reliable real-time performance. These systems are now more powerful, efficient, and full of features, and they are used in many industries, including aerospace, defense, medical science, multimedia, and more.

Types of Real-Time Operating System

The real-time operating systems can be of 3 types –

RTOS

Hard Real-Time Operating System

These operating systems guarantee that critical tasks are completed within a range of time. For example, a robot is hired to weld a car body. If the robot welds too early or too late, the car cannot be sold, so it is a hard real-time system that requires complete car welding by the robot hardly on time., scientific experiments, medical imaging systems, industrial control systems, weapon systems, robots, air traffic control systems, etc.

Soft Real-Time Operating System

This operating system provides some relaxation in the time limit. For example – Multimedia systems, digital audio systems, etc. Explicit, programmer-defined, and controlled processes are encountered in real-time systems. A separate process is changed by handling a single

external event. The process is activated upon the occurrence of the related event signaled by an interrupt.

Multitasking operation is accomplished by scheduling processes for execution independently of each other. Each process is assigned a certain level of priority that corresponds to the relative importance of the event that it services. The processor is allocated to the highest-priority processes. This type of schedule, called, priority-based preemptive scheduling is used by real-time systems.

Firm Real-time Operating System

RTOS of this type have to follow deadlines as well. In spite of its small impact, missing a deadline can have unintended consequences, including a reduction in the quality of the product. Example: Multimedia applications.

What is the Purpose of RTOS?

Unlike general-purpose operating systems (GPOS) like Windows or Linux, which are good at multitasking and handling various applications, a real-time operating system (RTOS) is designed to manage time-sensitive tasks precisely.

The main goal of an RTOS is to perform critical tasks on time. It ensures that certain processes are finished within strict deadlines, making it perfect for situations where timing is very important. It is also good at handling multiple tasks at once.

An RTOS provides real-time control over hardware resources, like random access memory (RAM), by ensuring predictable and reliable behavior. It uses system resources efficiently while maintaining high reliability and responsiveness. By managing multiple tasks effectively, an RTOS ensures smooth operation even when the system is under heavy use or changing conditions.

Uses of RTOS

- Defense systems like RADAR.
- Air traffic control system.
- Networked multimedia systems.
- Medical devices like pacemakers.
- Stock trading applications.

Different Between Regular and Real-Time operating systems

Regular OS	Real-Time OS (RTOS)
Complex	Simple
Best effort	Guaranteed response
Fairness	Strict Timing constraints
Average Bandwidth	Minimum and maximum limits
Unknown components	Components are known
Unpredictable behavior	Predictable behavior
Plug and play	RTOS is upgradeabl

Advantages

The advantages of real-time operating systems are as follows:

- **Maximum Consumption:** Maximum utilization of devices and systems. Thus more output from all the resources.
- **Task Shifting:** Time assigned for shifting tasks in these systems is very less. For example, in older systems, it takes about 10

microseconds. Shifting one task to another and in the latest systems, it takes 3 microseconds.

- **Focus On Application:** Focus on running applications and less importance to applications that are in the queue.
- **Real-Time Operating System In Embedded System:** Since the size of programs is small, RTOS can also be embedded systems like in transport and others.
- **Error Free:** These types of systems are error-free.
- **Memory Allocation:** Memory allocation is best managed in these types of systems.

Disadvantages

The disadvantages of real-time operating systems are as follows:

- **Limited Tasks:** Very few tasks run simultaneously, and their concentration is very less on few applications to avoid errors.
- **Use Heavy System Resources:** Sometimes the system resources are not so good and they are expensive as well.
- **Complex Algorithms**: The algorithms are very complex and difficult for the designer to write on.
- **Device Driver And Interrupt Signals:** It needs specific device drivers and interrupts signals to respond earliest to interrupts.
- **Thread Priority:** It is not good to set thread priority as these systems are very less prone to switching tasks.
- **Minimum Switching:** RTOS performs minimal task switching.

Conclusion

In conclusion, a Real-Time Operating System (RTOS) is crucial for managing tasks that need to be completed quickly and on time. It ensures precise and reliable performance, making it ideal for applications like defense systems, air traffic control, multimedia, medical devices, and stock trading. By providing real-time control over hardware and efficient

multitasking, RTOS guarantees smooth and predictable operation even under heavy use.

Real Time Operating System (RTOS) – FAQs

How is an RTOS different from a general-purpose operating system (GPOS)?

Unlike GPOS like Windows or Linux, which focus on multitasking and flexibility, an RTOS is designed to execute time-sensitive tasks with precision and reliability.

What are the main uses of an RTOS?

An RTOS is used in applications where timing is critical, such as defense systems (e.g., RADAR), air traffic control, multimedia systems, medical devices (e.g., pacemakers), and stock trading applications.

Why is timing important in an RTOS?

Timing is crucial because certain tasks must be completed within strict deadlines to ensure the system's proper and safe operation.

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