A comparison between the 3 types of real-time systems

Based on the consequences of a task missing its deadline, a real-time system can be classified as hard, soft, or firm real-time. It is not necessary for all tasks in a real-time application to be classified in the same category; however, different tasks in a real-time system may be classified in different categories.

1. **Hard Real-Time System:**
   The hard real-time definition considers any missed deadline to be a system failure. This scheduling is used extensively in mission critical systems where failure to conform to timing constraints results in a loss of life or property.

   The task deadlines are in the order of micro or milliseconds.

   Many hard real-time systems are safety critical

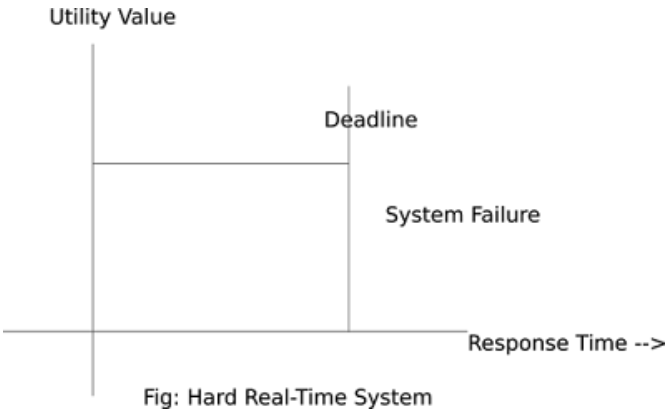

Fig: Hard Real-Time System

   For example, Industrial Control Applications, On-board computers, Robots

2. **Soft Real-Time System:**
   The soft real-time definition allows for frequently missed deadlines, and as long as tasks are timely executed their results continue to have value. Completed tasks may have increasing value up to the deadline and decreasing value past it.

   If several tasks miss deadline, then the performance of the system is said to have degraded.

Fig. 28.15 Utility of the Results Produced by a Soft Real-Time Task as a Function of Time

For example, web browsing. Normally, after an URL (Uniform Resource Locater) is clicked, the corresponding web page is fetched and displayed within a couple of seconds on the average. However, when it takes several minutes to display a requested page, we still do not consider the system to have failed, but merely express that the performance of the system has degraded.

3. Firm Real-Time System:

A firm real-time system is one in which a few missed deadlines will not lead to total failure, but missing more than a few may lead to complete or catastrophic system failure.

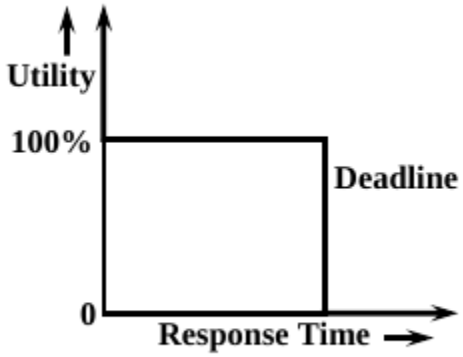

Fig. 28.14 Utility of Result of a Firm Real-Time Task with Time

Every firm real-time task is associated with some predefined deadline before which it is required to produce its results. However, unlike a hard real-time task, even a firm real-time task does not complete within its deadline, the system doesn't fail but the late results are merely discarded. In other words, the utility of the results computed by a firm real-time task becomes zero after the deadline.

Examples: A video conferencing application, Satellite-based surveillance applications