Real Time Systems: Introduction

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Introduction

For a system to be considered *real-time* is is required that it can **guarantee** time requirements. For example:

- Actions that a headlight can do must be completed in less than 20ms
- Time from no power to full power should be completed in less than 5ms

This can seem unintuitive since a *fast* system could comply with this requirement, but the main difference is that in RTS, the **time elapsed** for a **task** is bounded.

Embedded System

An *embedded system* is a computer system that **performs specific tasks**. It differs from traditional operating system in that it **is not generic**, only able to **perform a specific task**, and lastly, it is generally **built to fulfill Real-Time requirements**.

Concepts

Notation

Notation: tasks

Each task is denoted as τ_i. The basic information we need about each task is:

- It's computing time
- It's period
- It's deadline

Notation: Compute Time

The compute time is denoted as C. It might also be denoted as c

Notation: Deadline

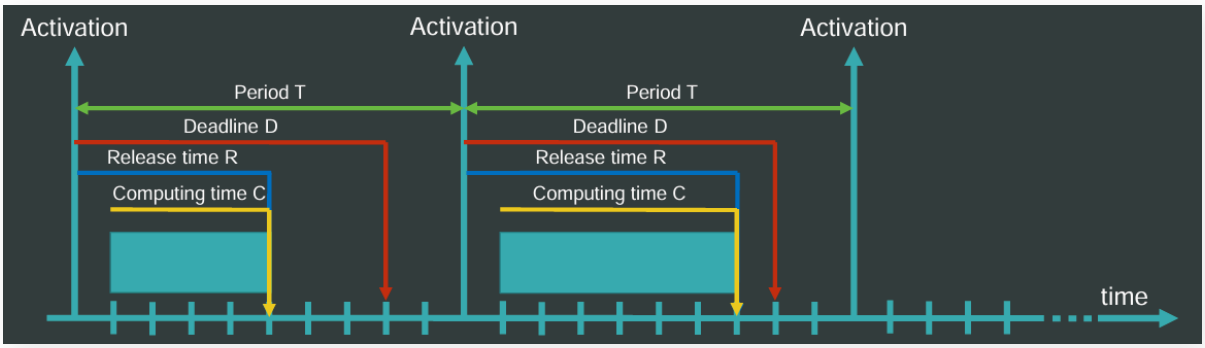
A deadline is denoted as D. d refers to the absolute deadline.

Notation: Period

A period is denoted as T. t refers to a time.

Time Requirements

For any task we have a series of *time concepts*



Period

A period T indicates a **fixed** periodically repeating time frame that tasks must be executed. The task itself does not need to be executed right at the start of a period, but must be done before it send.

Deadline

A deadline D is a time limit within the period where the task must be executed before reaching it. It can be the same as the period or earlier.

Computing Time

The *computing time* C is the time that it takes for a task to execute itself.

Release Time

The *release time* is the time until the task is executed after the start of a period

Missing Deadline Effects

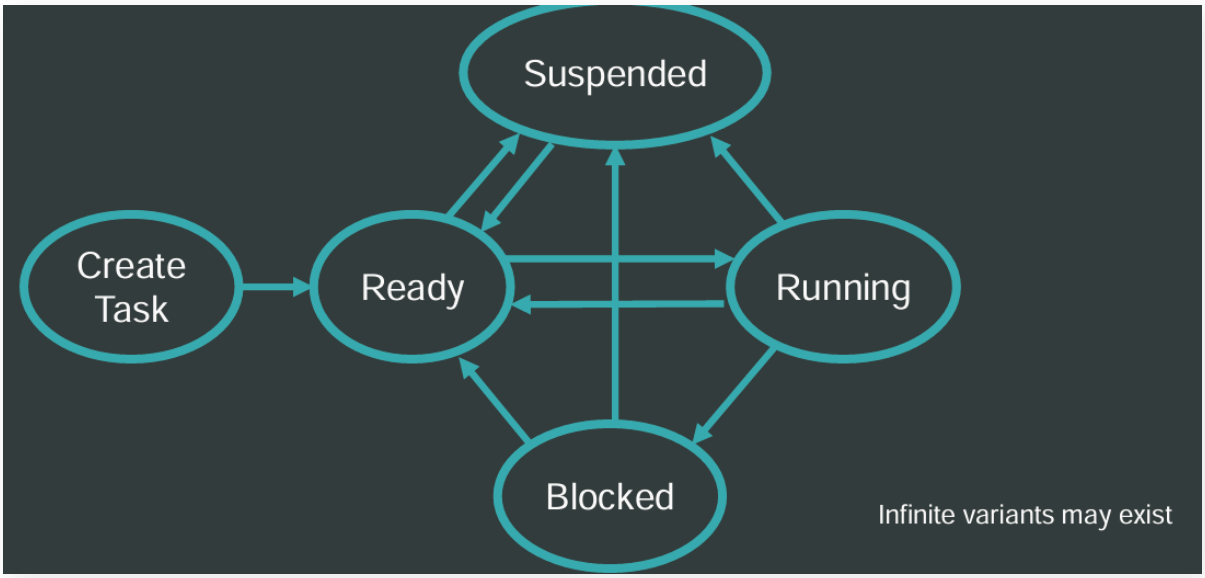
The effects of missing a deadline varies from the Real-Time model.

Task States

A task always has a **state** associated to it. This state it is used to indicate the task's life-cycle. All task can be in one of these states:

- **Ready**: It is ready to be ran or suspended
- **Running**: It currently is being executed
- **Suspended**: It's not being executed
- **Blocked**

Generally, the task life-cycle is the following:



Other Concepts

A list of other keywords and concepts:

- Schedulers:
  - Cyclic
  - Rate Monotonic
  - Deadline Monotonic
  - Earliest Deadline First
  - Earliest Due Date
- Worst Case Execution Time ($WCET$)
- Real-Time Operating System (RTOS)
- Task related:
  - Latency
  - Jitter
  - Granularity
- Priorities:
  - Fixed and dynamic priorities
  - Priority inversions
- Task execution:
  - Critical Section (CS)
  - Resource Allocation

Summary

What's A Real Time System?

A Real Time System is a system where the *task completion time* must be **bounded**.

Why is RTS Needed?

It guarantees safety and critical timing constraints

What Differs between *hard* and *soft* RTS?

A **hard** RTS has strict time requirements on *Deadline* requirements. While a **soft** RTS has more loose requirements over it.

What is a *task*?

A task is a piece of code that the system executes.

What is a *period*?

A period is a consistent and repeating time window. The duration depends on the task itself

Main Concepts

See Concepts.