

# ECEN 5623

**RT Services**

# Real-Time Service Types

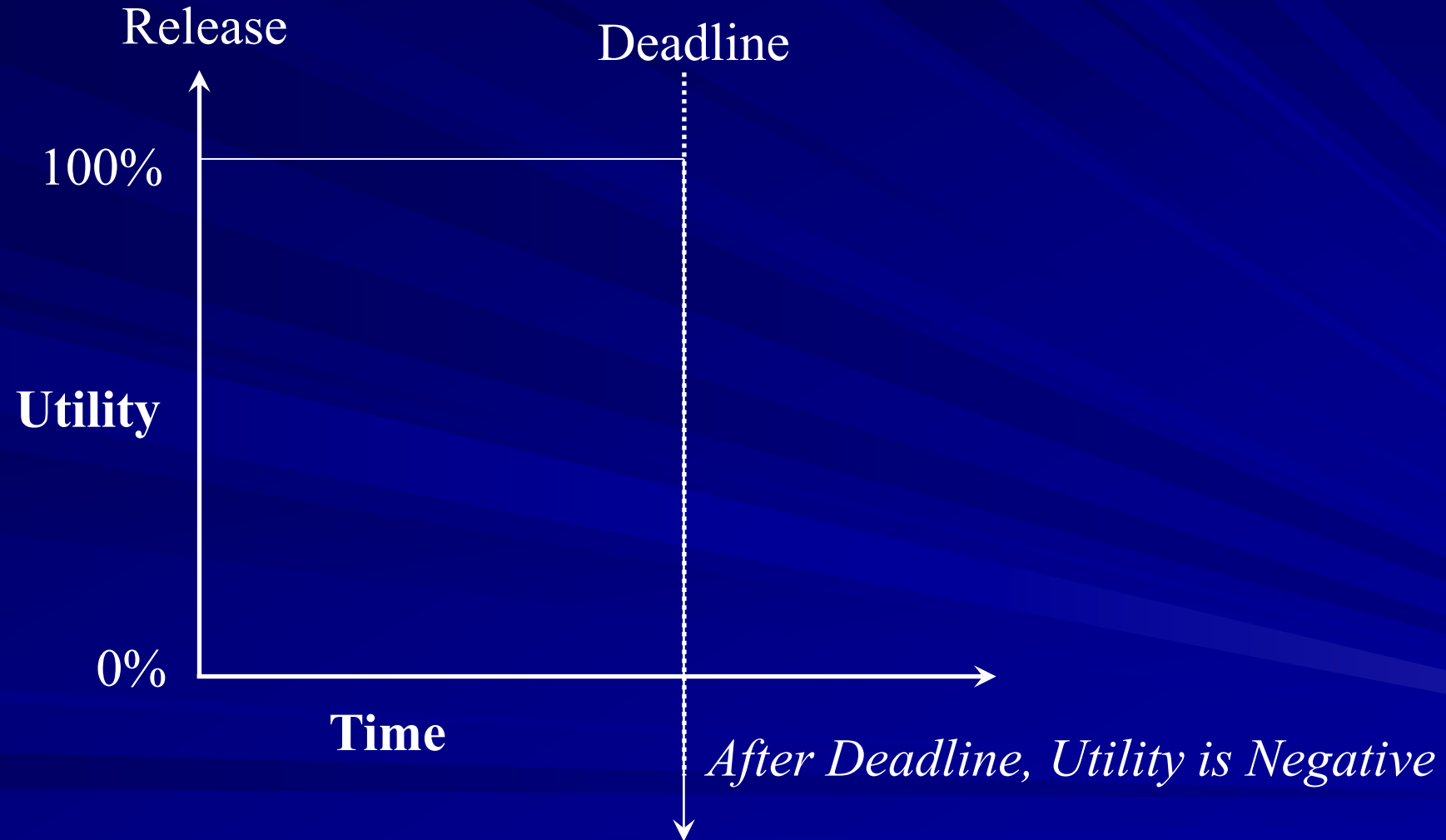
## ■ Types of Services

- **Hard Real-Time** (Flight Software, Anti-Lock Braking)
- **Soft Real-Time** (Multi-media, Audio, Video, Virtual Reality)
- **Best Effort** (E.g. Desktop Applications)
- **Isochronal Hard Real-Time** (Digital Feedback Control Systems)
- **Isochronal Soft Real-Time** (Continuous Media, Video, Audio)

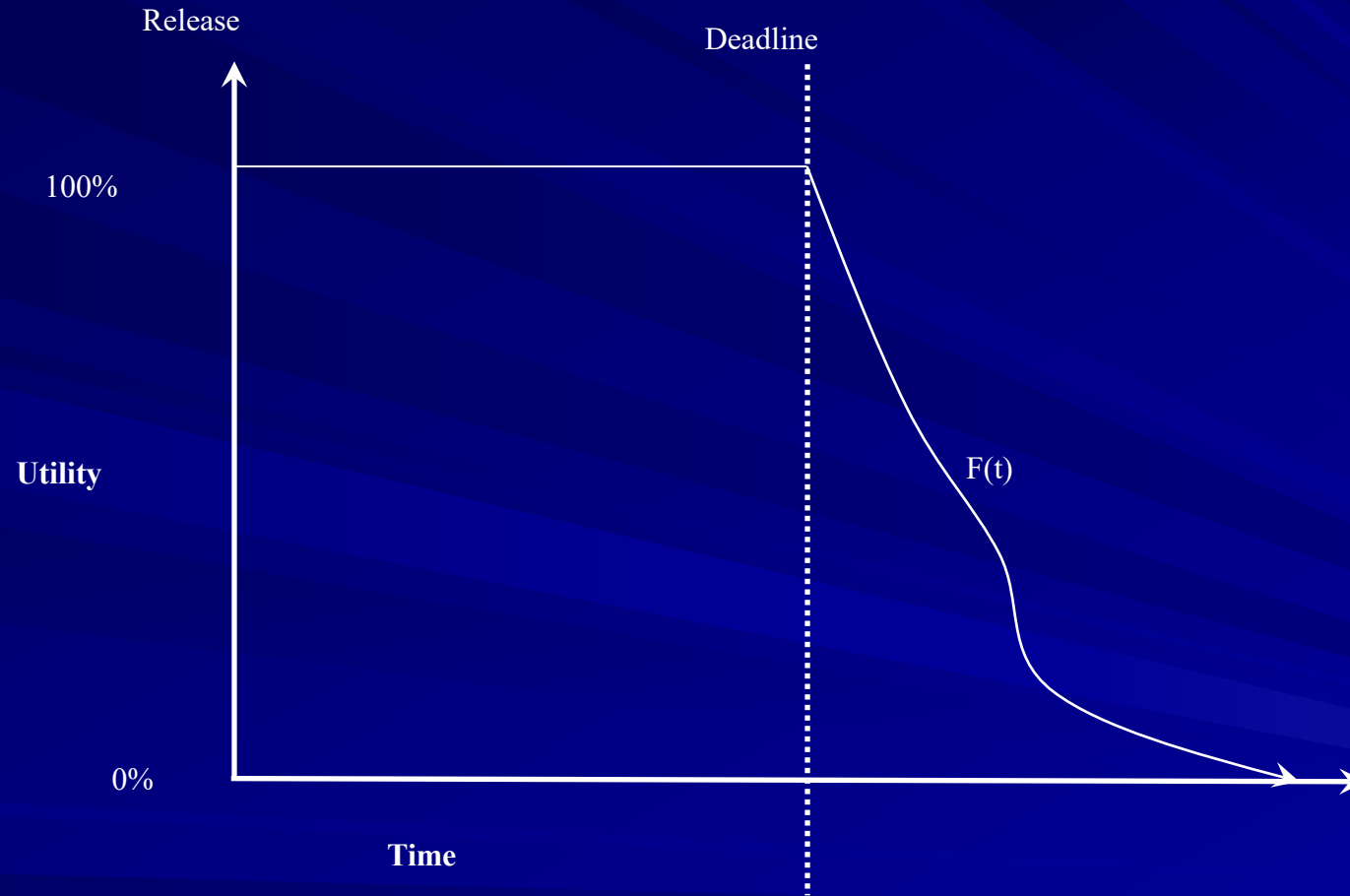
## ■ Real-Time Service Types in Terms of Utility

- Utility Curve Shows Value/Harm of Response Over Time
  - From Release
  - Both Before and After Deadline Relative to Release
- Full Utility - Service Performs as Required
- Zero Utility- Service is Not Provided
  - Drop-out Causes No Harm
- Negative Utility
  - Harm to System and/or User and Significant Loss of Assets

# Hard Real-Time Service Utility

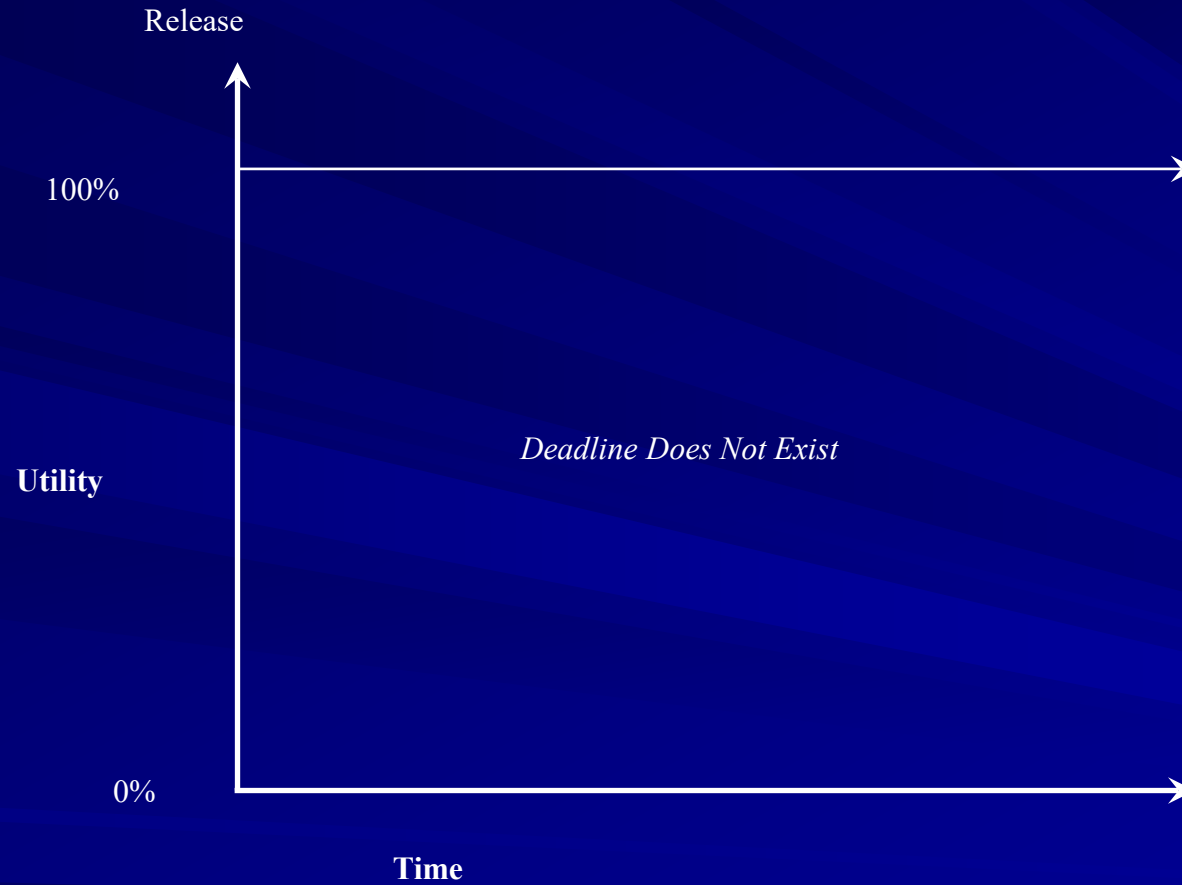


# Soft Real-Time Service Utility

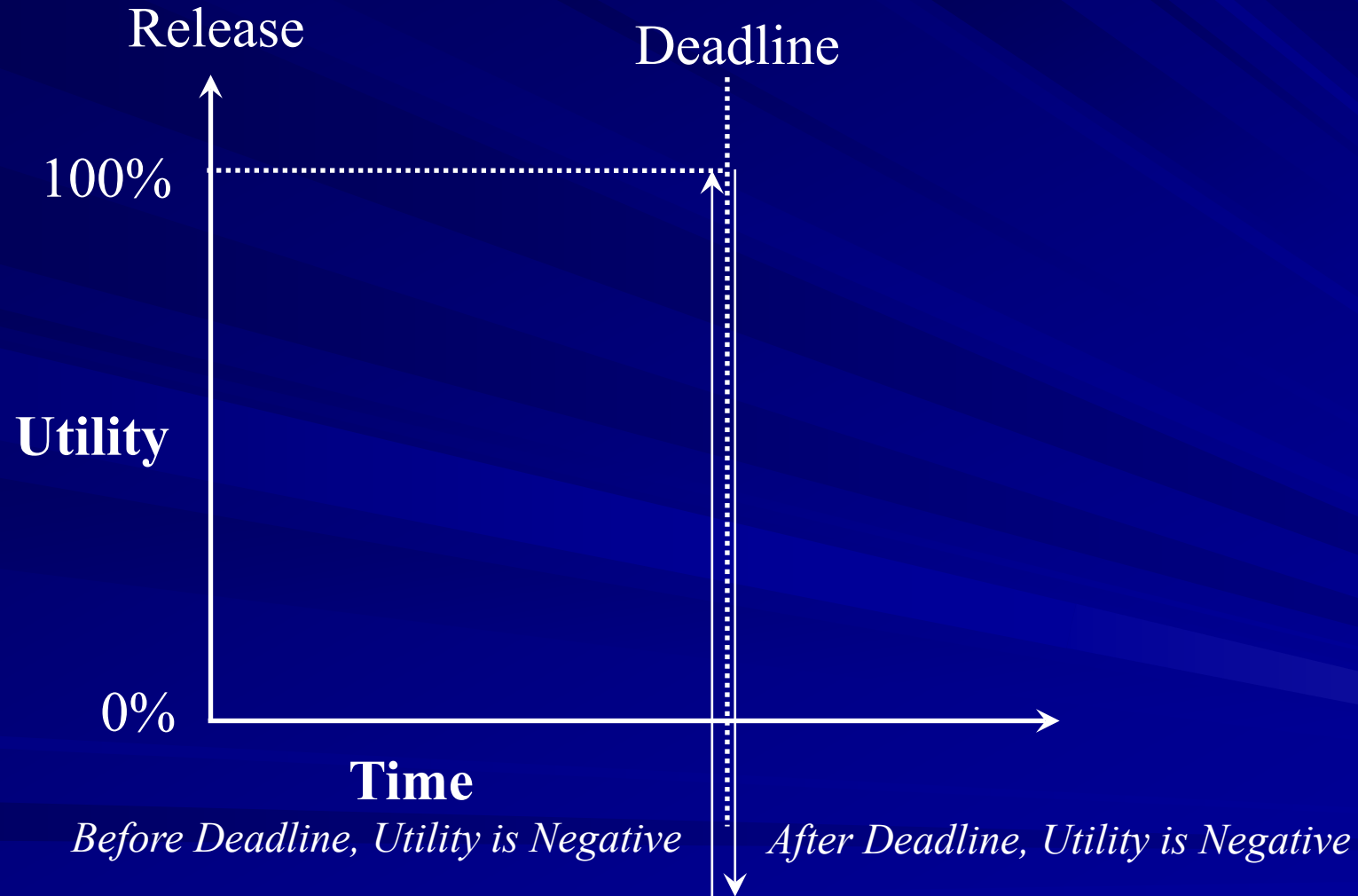


*After Deadline, Utility Diminishes  
According to Some Function  $F(t)$*

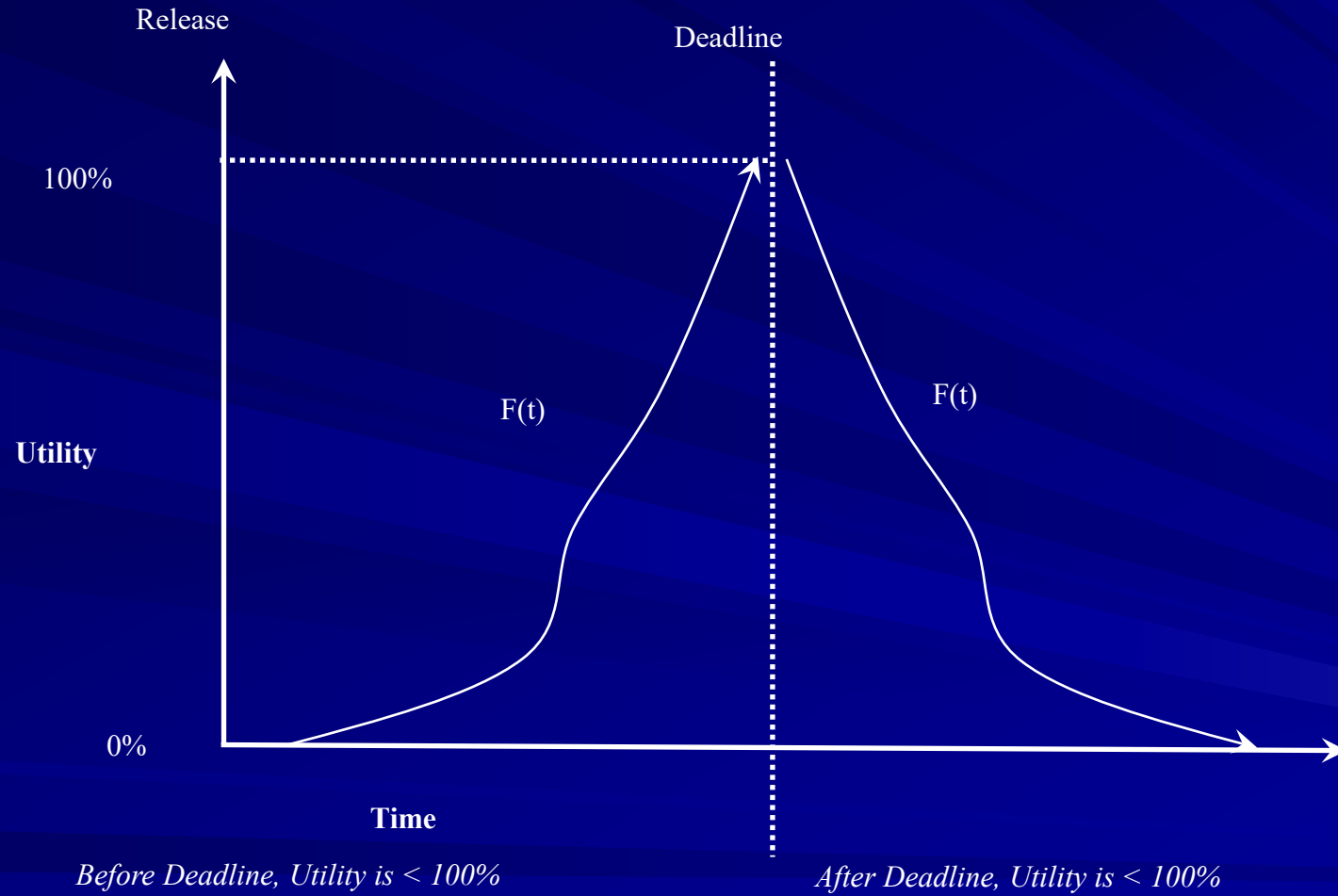
# Best Effort Service Utility



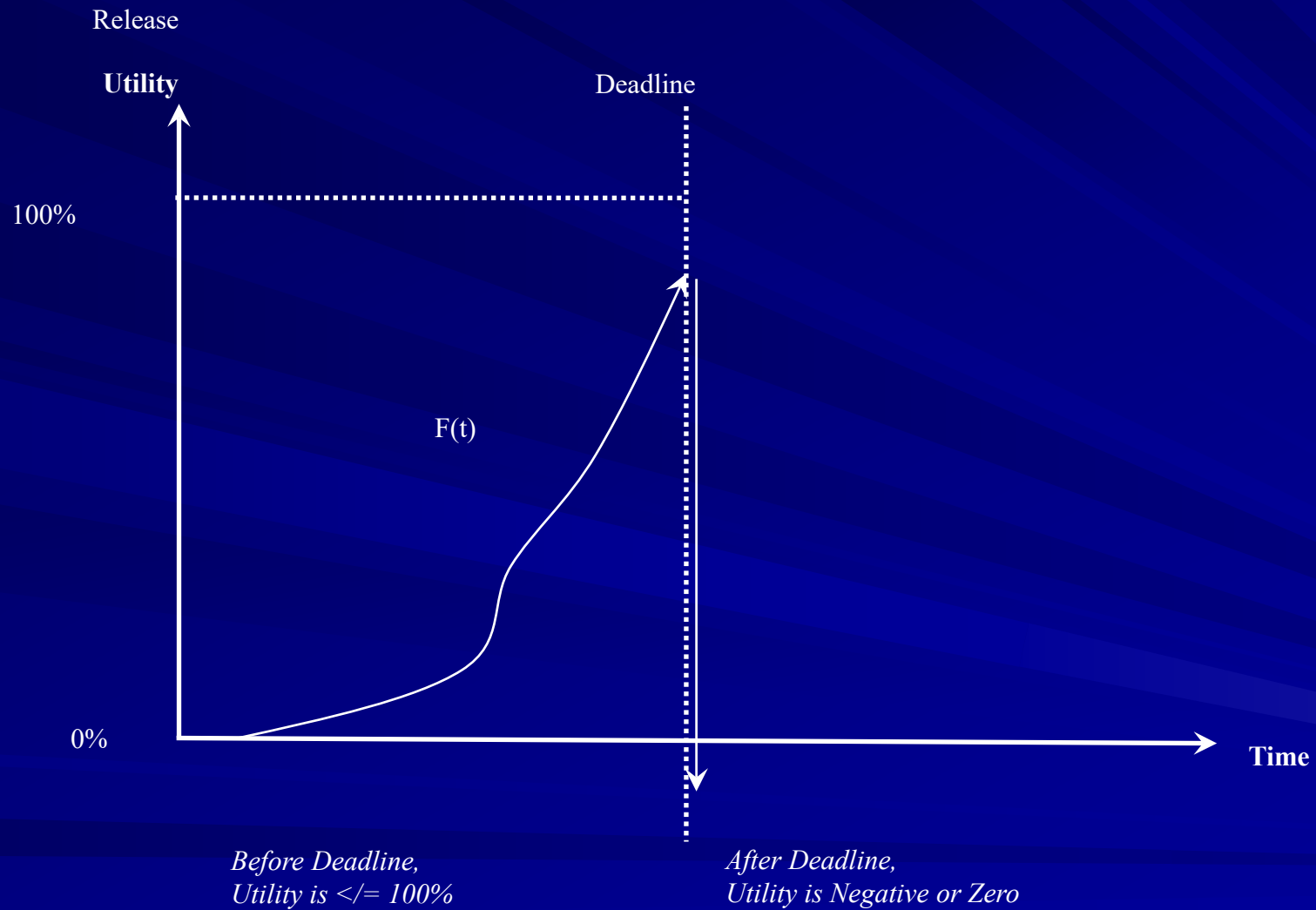
# Isochronal Hard Real-Time Utility



# Isochronal Soft Real-Time Utility



# Anytime Utility Curve





# Is Web Browsing a Real-Time Service?

- A. Yes
- B. No

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## Is Web Browsing a Real-Time Service?

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True (Yes)

False (no)

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# Issues Beyond Policy and Feasibility

## ■ Latency Control

- Do We Allow Deadline Over-runs?
  - Over-runs Use Resources That Could Be Used By Services On Time So Far
  - Do We Need to Execute a Missed Deadline Call-back Handler?
  - Should We Just Immediately Terminate a Service Release That Misses its Deadline?

## ■ Dealing with Non-Determinism

- Do We Always Have to Assume Worst Case?
  - WCET
  - Shortest Period (Worst Case Release Frequency)
- When Have We Tested Long Enough to Have Verified Worst Case Assumptions?

## ■ Overhead

- Lump it Into Worst Case?, Ignore it?

# Identify the following curves

- A. Hard Real-Time Service Utility
- B. Soft Real-Time Service Utility
- C. Best Effort Real-Time Service Utility
- D. Isochronal Real-Time Service Utility
- E. Anytime Real-Time Service Utility

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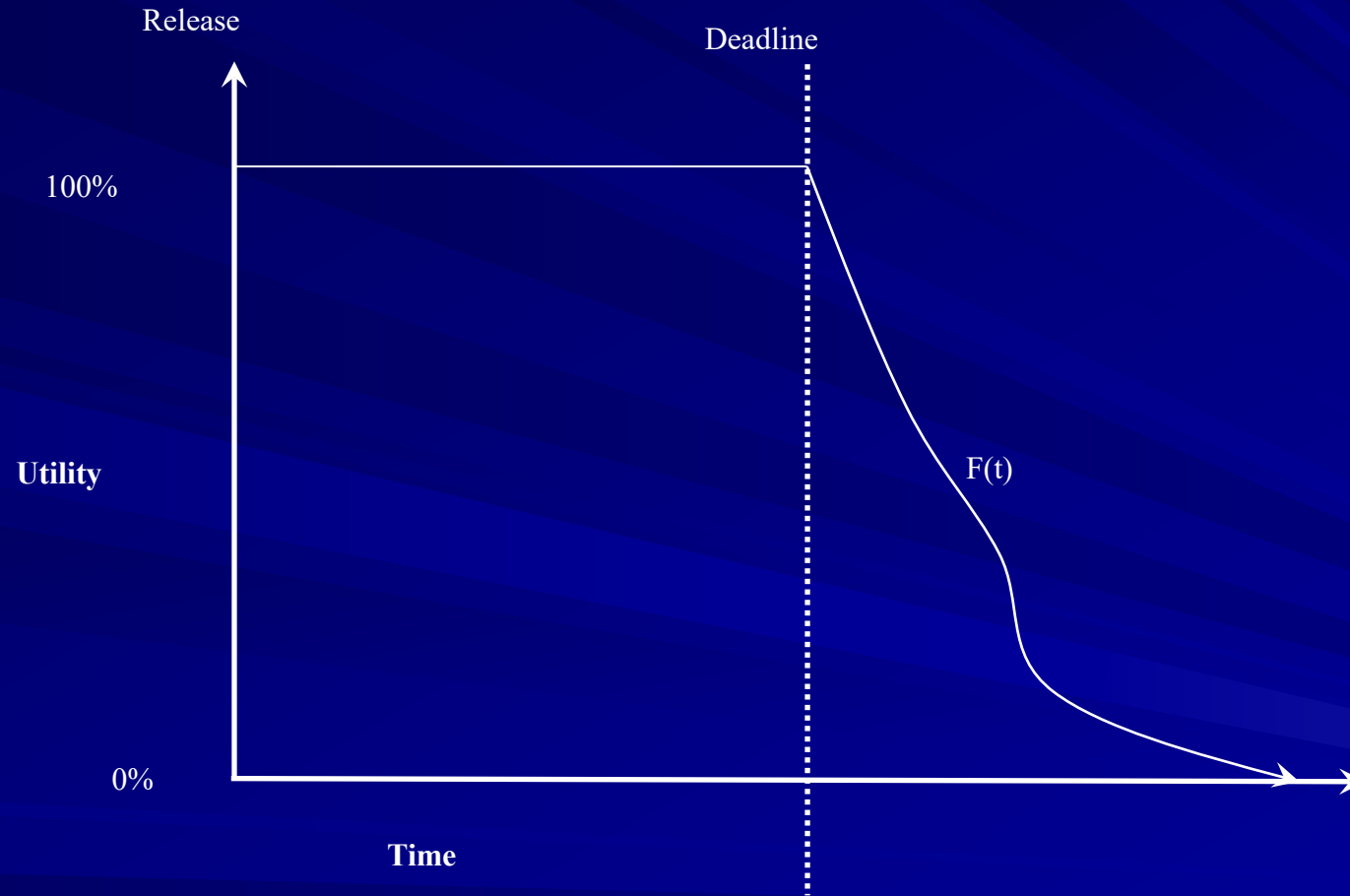
## What type of Service Curve is this?

- A Hard Real-Time Service Utility
- B Soft Real-Time Service Utility
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- D Isochronal Real-Time Service Utility
- E Anytime Real-Time Service Utility

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# Soft Real-Time Service Utility



*After Deadline, Utility Diminishes  
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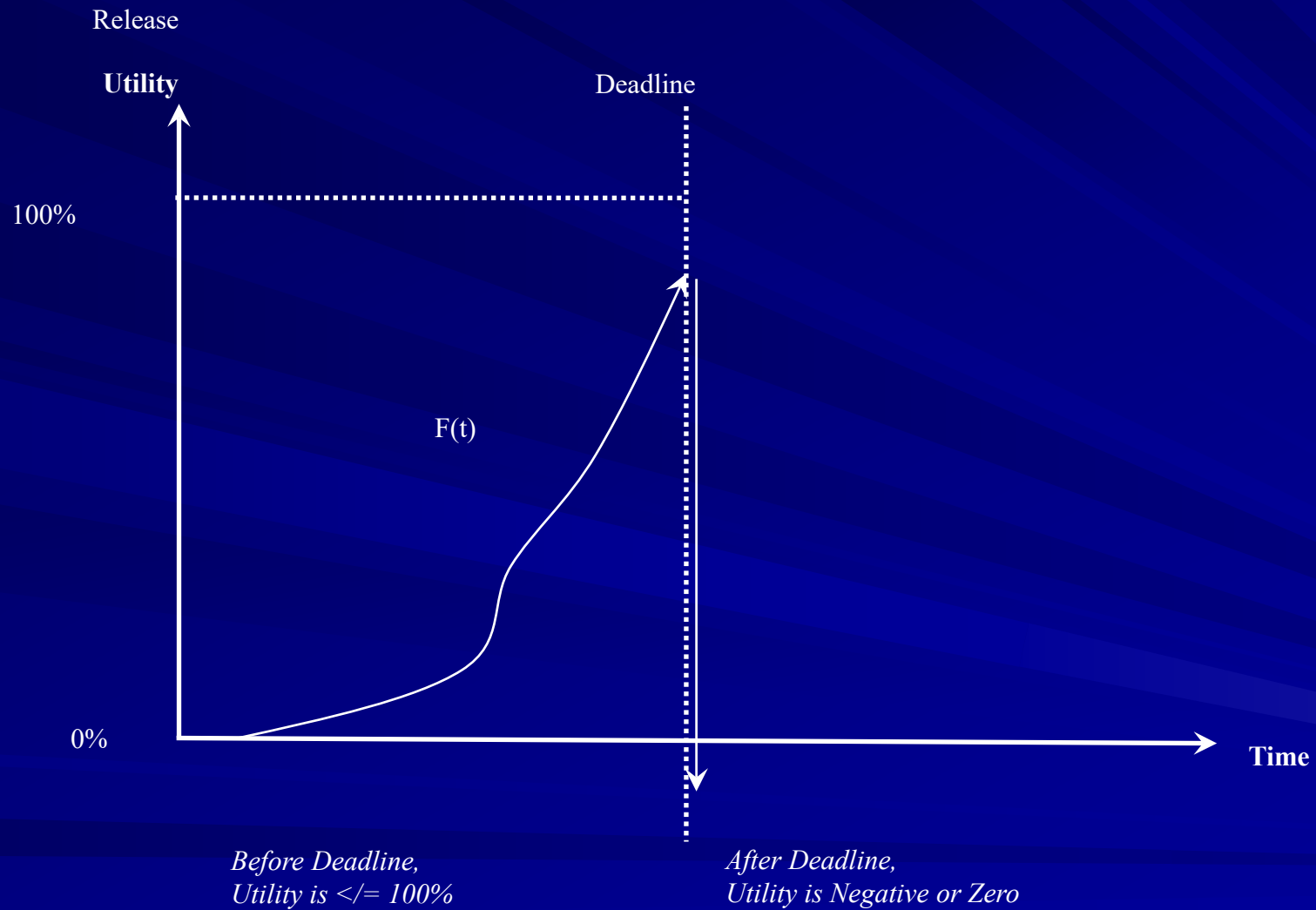
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# Anytime Utility Curve





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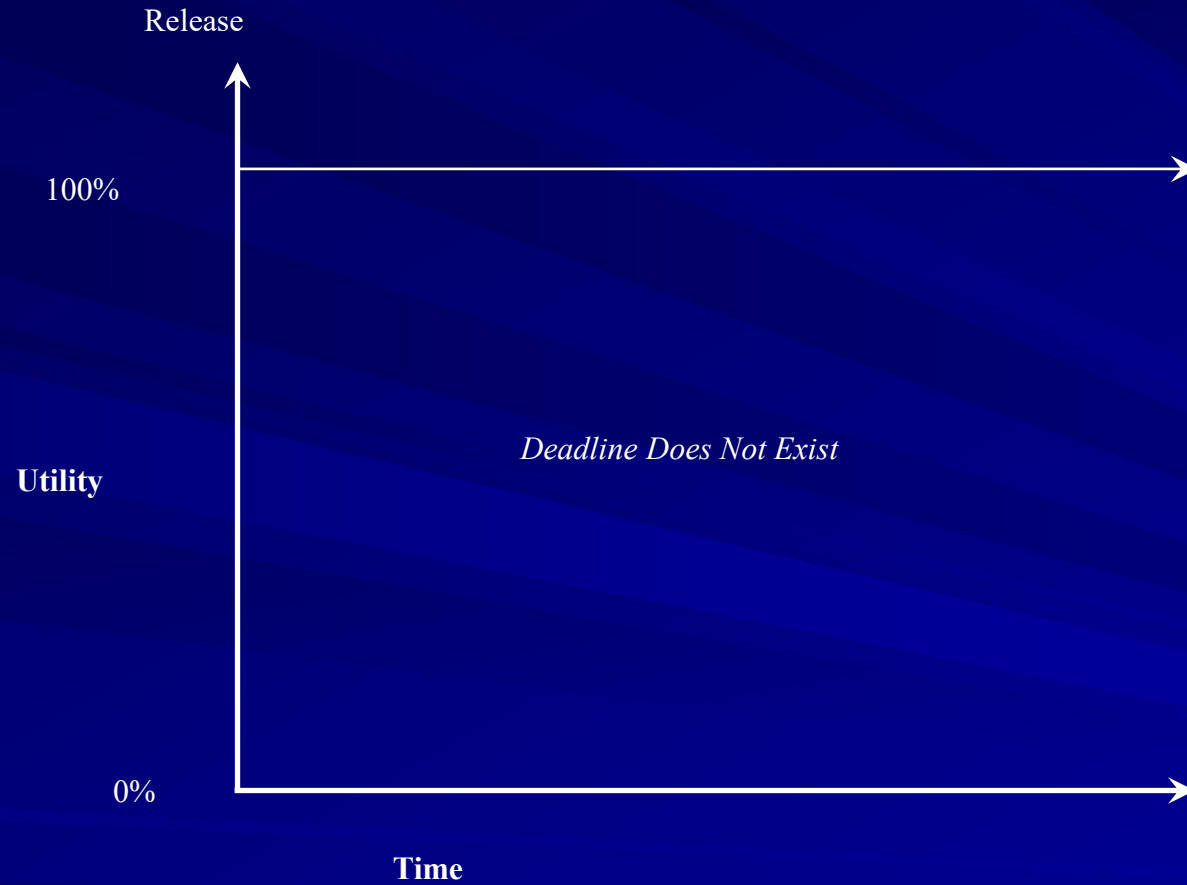
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# Best Effort Service Utility



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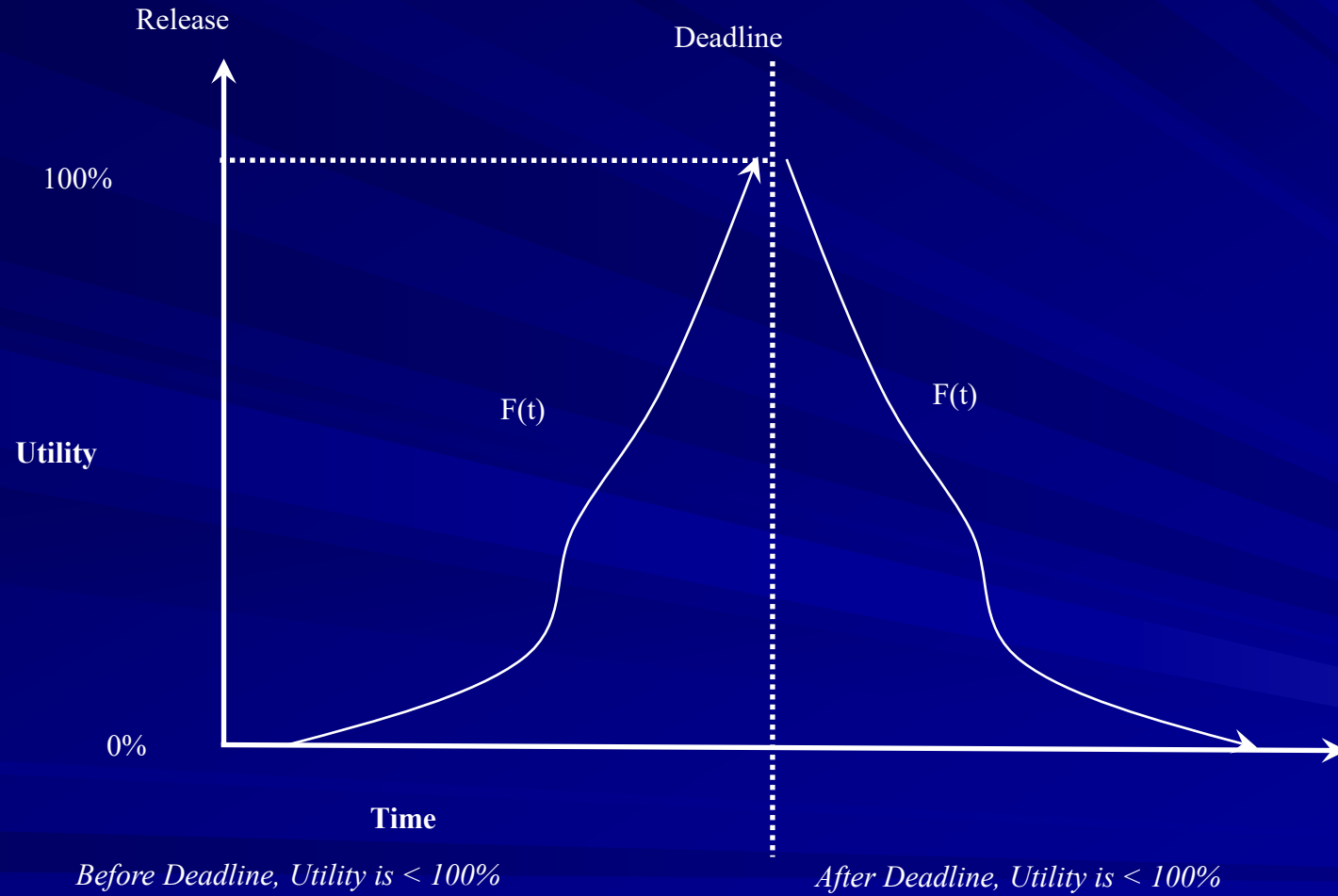
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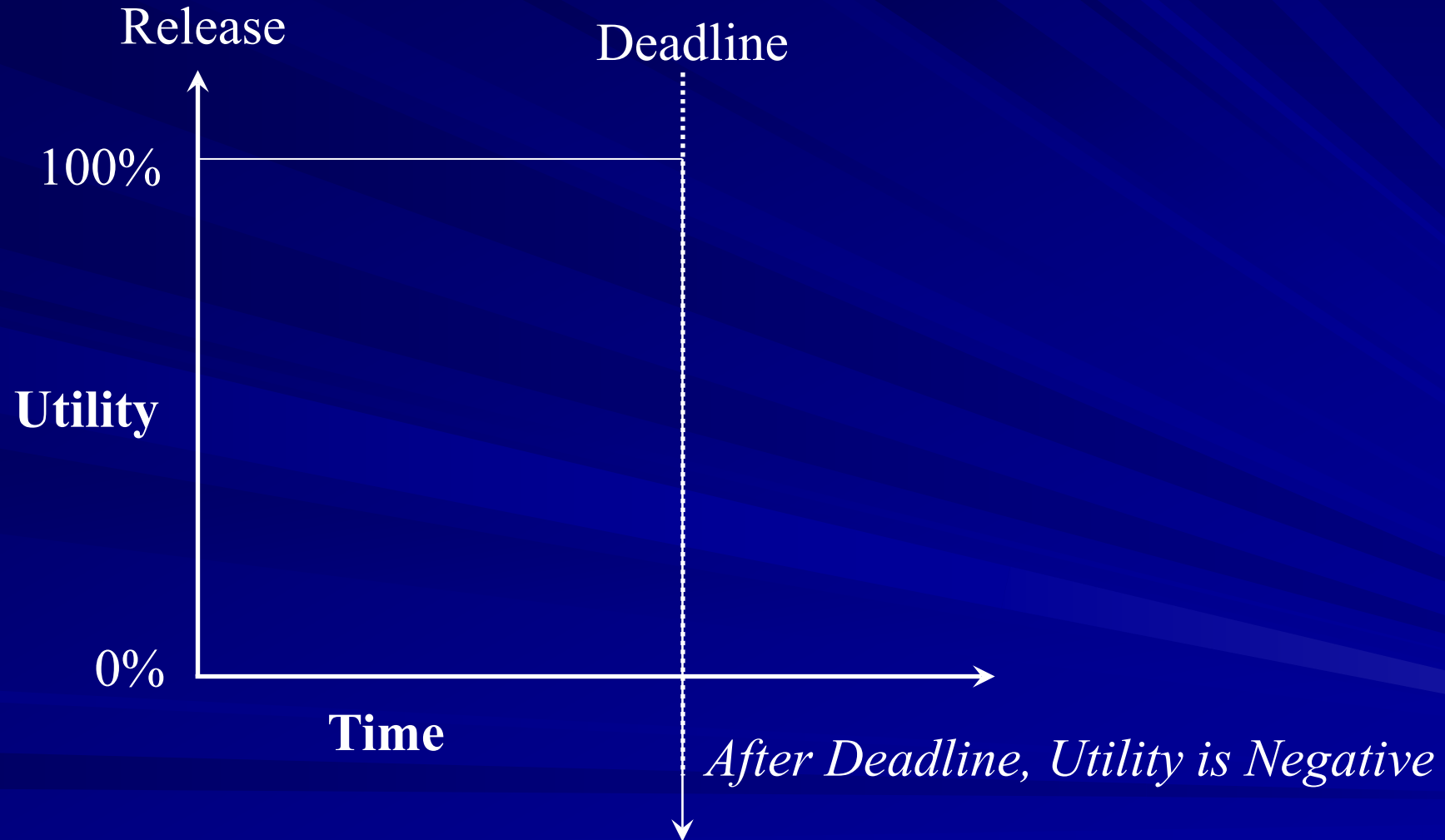
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# Isochronal Soft Real-Time Utility



# Hard Real-Time Service Utility



# Isochronal Hard Real-Time Utility

