# Design and Implementation of OSEK/VDX Operating System based on the TMO model

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# AGENDA

- INTRODUCTION
- RELATED WORKS
- DESIGN OF OSEK/TMO
- IMPLEMENTATION OF OSEK/TMO
- RESULT
- CONCLUSION & FUTURE WORKS

# INTRODUCTION

- Introduction
- Objectives

# Introduction

- Design and implementation of RTOS for embedded systems using OSEK/VDX standard specifications, named the OSEK/TMO (OSEK/VDX and TMO), which is based on the Time-triggered Message-triggered Object (TMO) structuring scheme

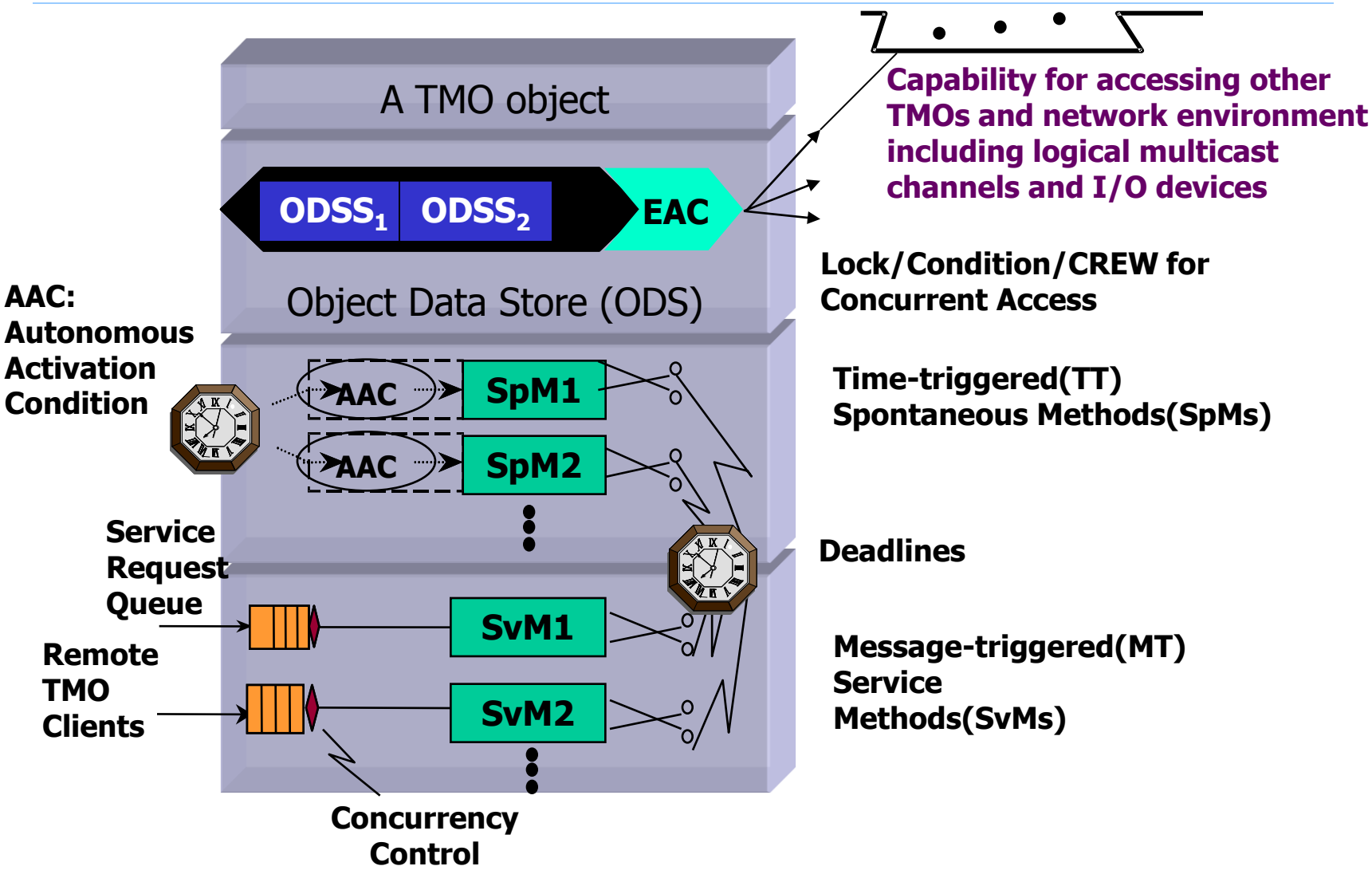
# Objectives

- Compactness in size of OSEK/TMO
- Reusability
- Portability

# RELATED WORKS

- The TMO Model
- The OSEK/VDX
- The MicroC/OS-II
- The uIP

# The TMO Model



# The OSEK/VDX (1/5)

- OSEK is a German acronym for:
  - "**O**ffene **S**ysteme und deren Schnittstellen für die **E**lektronik im **K**raftfahrzeug"
  - "Open systems and corresponding interfaces for automotive electronics"
- VDX is an acronym for:
  - "**V**ehicle **D**istributed e**X**ecutive"
- The main goal of the OSEK/VDX consortium
  - To create open standards for an operating system, communication and network management for distributed units in automotive applications.

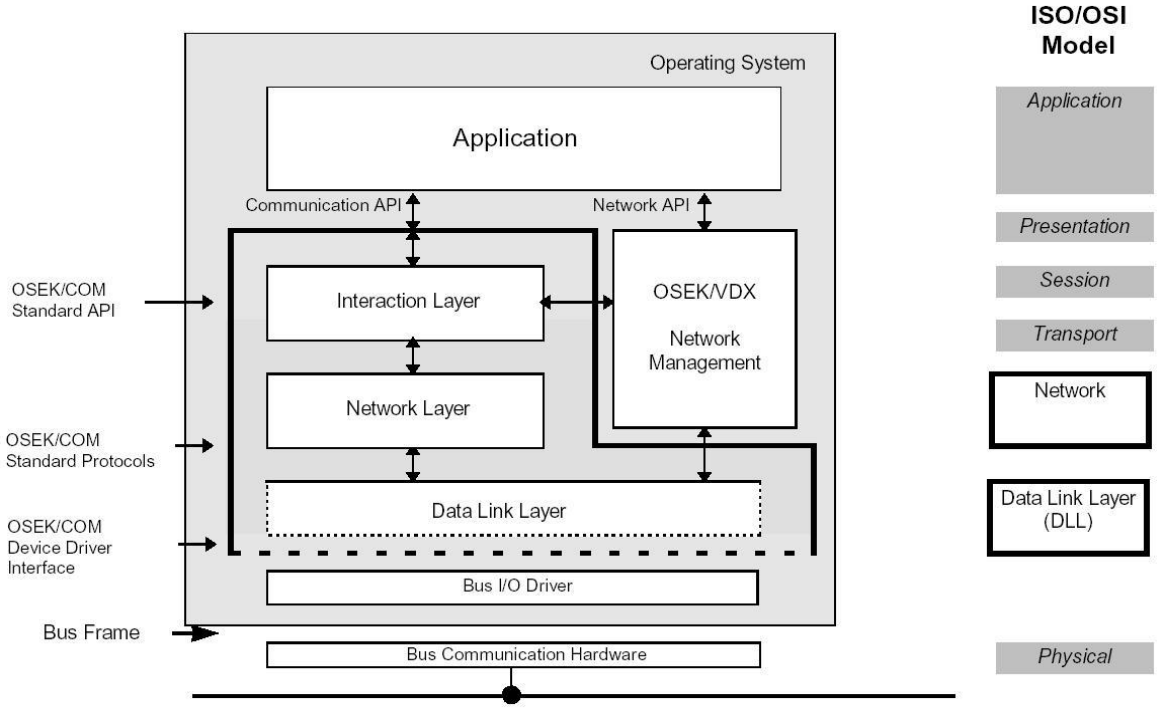
# The OSEK/VDX (2/5)

- The OSEK/VDX Specifications
- OSEK/VDX Operating System (OS)
  - The architecture of the OSEK/VDX OS distinguishes three processing levels:
    - Interrupt level
    - A logical level of for operating systems activities
    - Task level
      - The interrupt levels are assigned higher priorities than task levels.
  - Operating System Services are provided for functionalities like Task Management, Event Management, Resource Management, Counter, Alarm and Error Treatment.

# The OSEK/VDX (3/5)

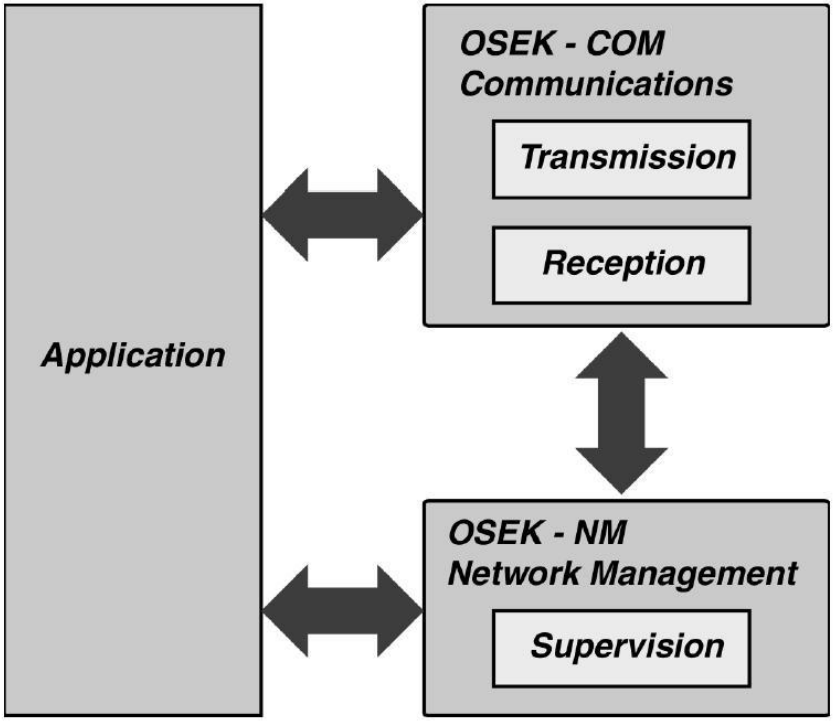
- The OSEK/VDX Specifications
- OSEK/VDX Communication (COM)
  - Provides interfaces and protocols for the data transfer within Vehicle Networks Systems.

- Positioning of OSEK/VDX COM within the OSEK/VDX Architecture:



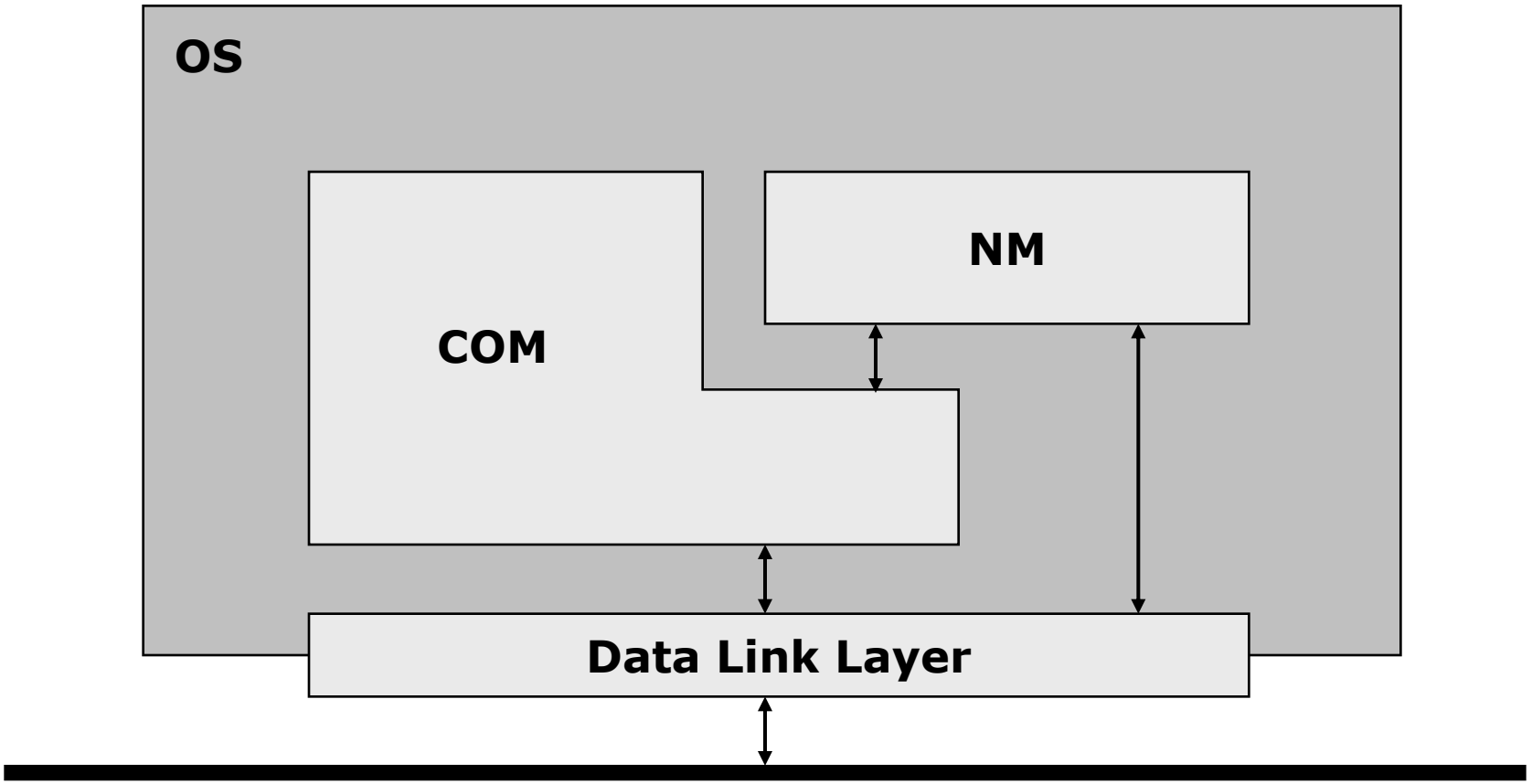
# The OSEK/VDX (4/5)

- The OSEK/VDX Specifications
- OSEK/VDX Network Management (NM)
  - Gives support in order to guarantee the reliability and safety of a Distributed System.



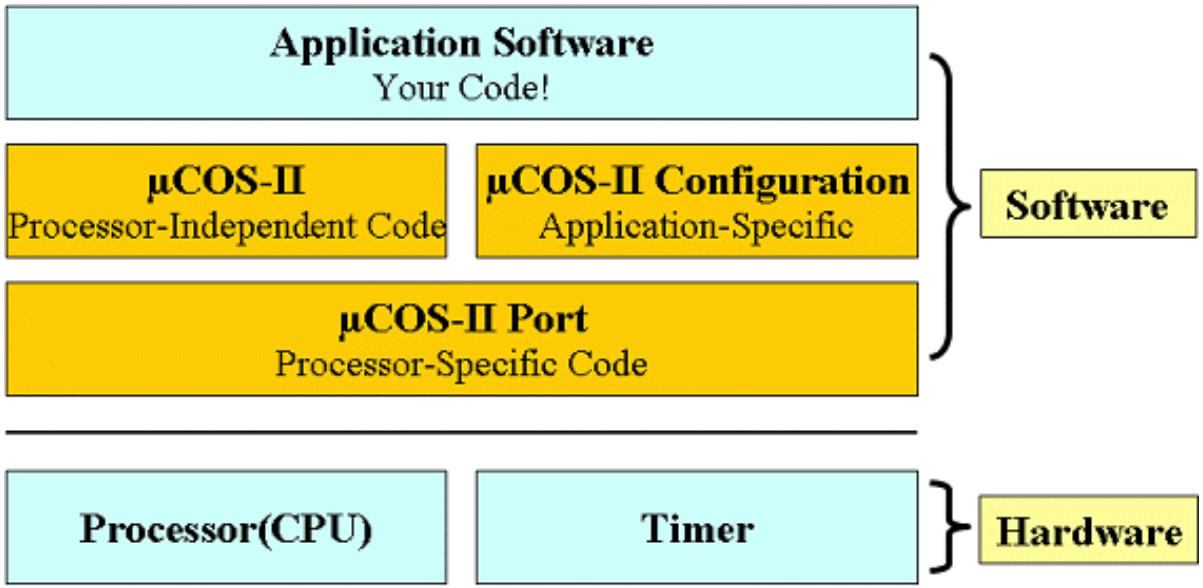
# The OSEK/VDX (5/5)

- The OSEK/VDX Specifications Architecture



# The MicroC/OS-II

- Portable
- ROMable
- Scalable
- Preemptive
- Multitasking
- Deterministic
- Task Stacks
- Services
  - Mutual Exclusion, Semaphores, Message Mailbox, Message Queue, Task Management, Time Management, and more



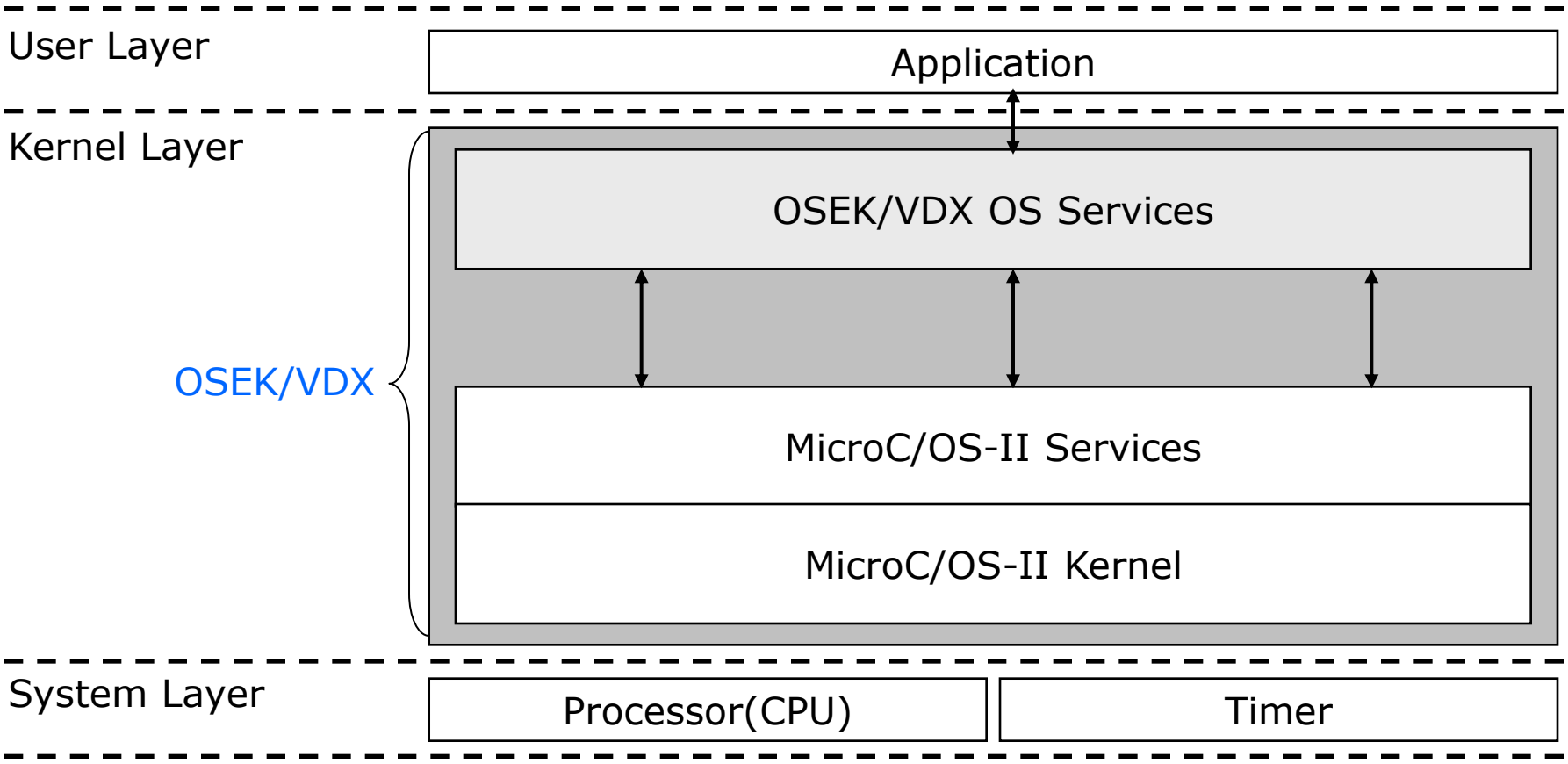
# The uIP – A Free Small TCP/IP Stack

- Open Source TCP/IP Stack
- By Adam Dunkels
- uIP implements four of the basic protocols in the TCP/IP protocol suite.
  - Address Resolution Protocol (ARP)
  - Internet Protocol (IP)
  - Internet Control Message Protocol (ICMP)
  - Transmission Control Protocol (TCP)
- uIP Homepage
  - http://www.dunkels.com/adam/uip/

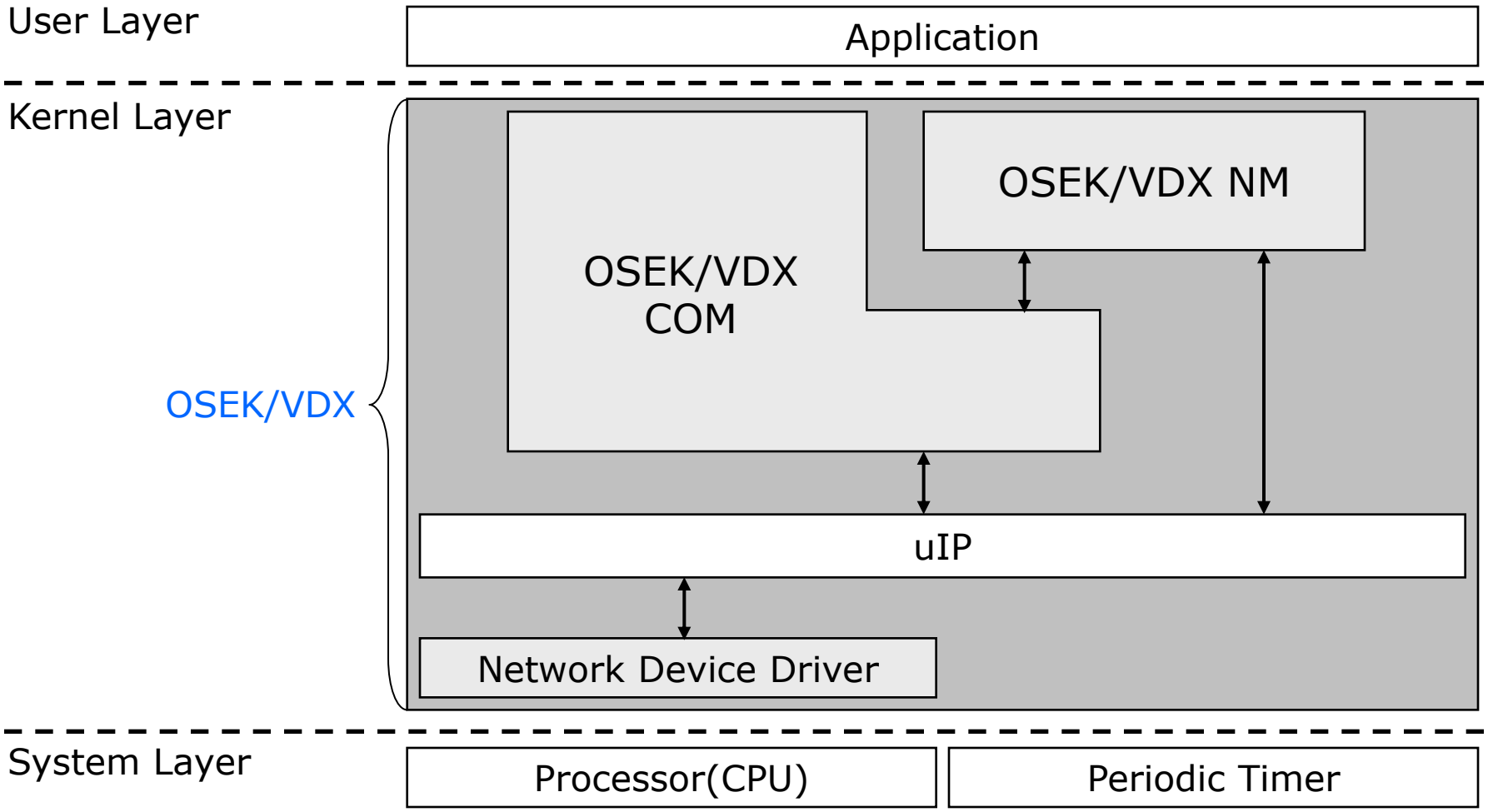
# DESIGN OF OSEK/TMO

- Design of OSEK/VDX
- TCP/IP stack for OSEK/VDX
- The OSEK/TMO Architecture
  - SpM and SvM's Detailed Design

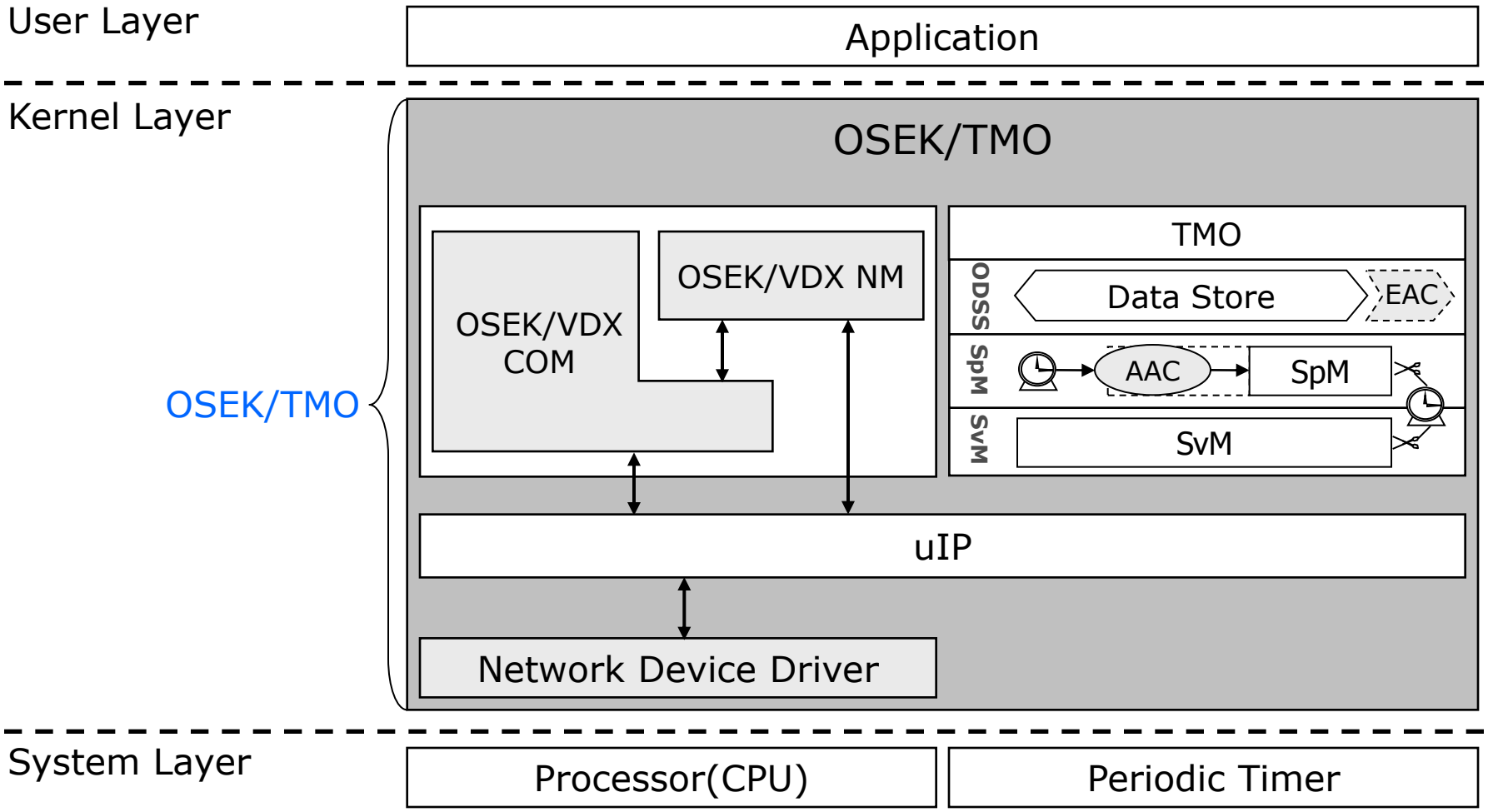
# Design of OSEK/VDX



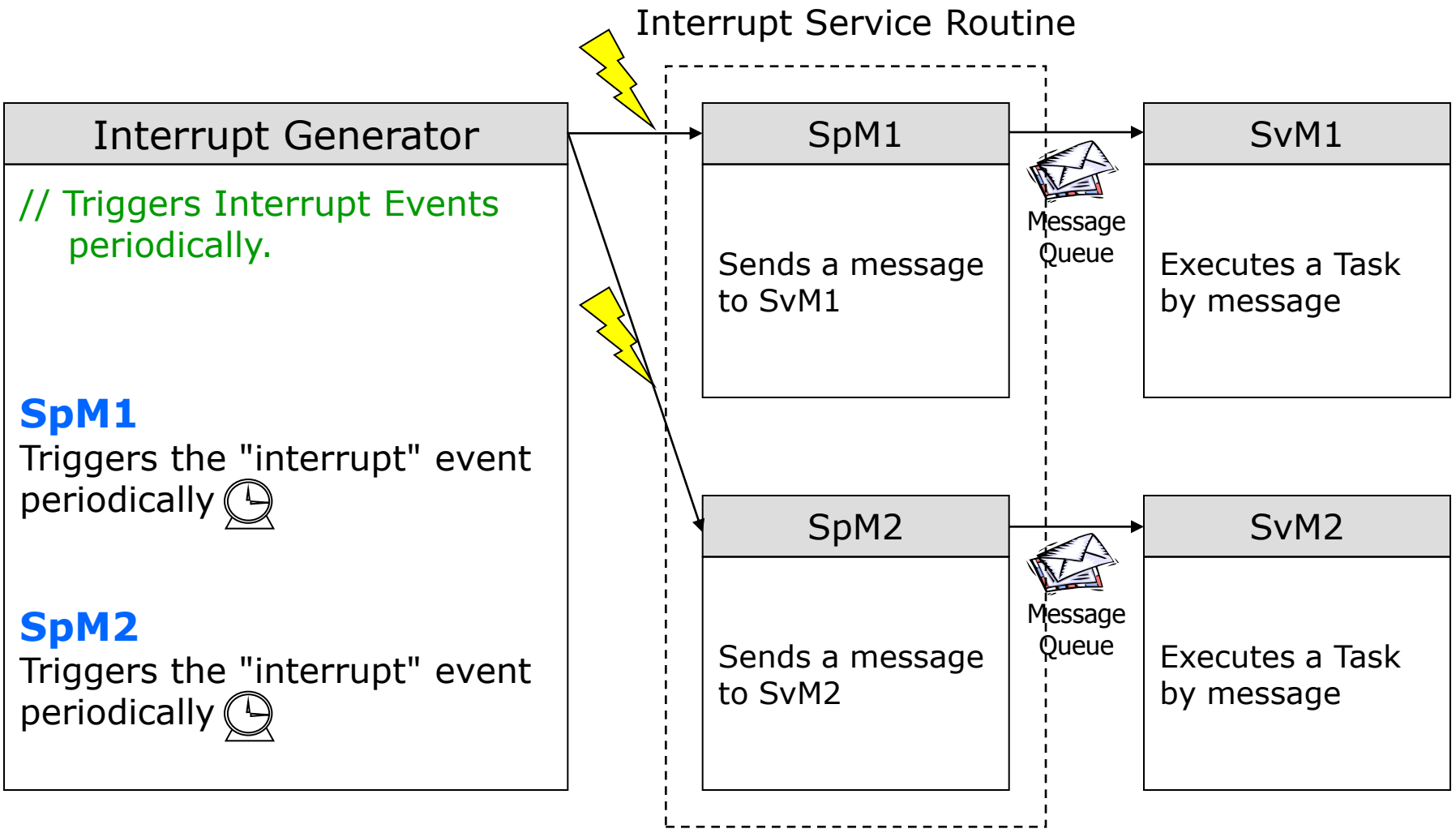
# TCP/IP stack for OSEK/VDX



# The OSEK/TMO Architecture



# SpM and SvM's Detailed Design



# IMPLEMENTATION OF OSEK/TMO

- Development Environment
- Booting Method 1 (Floppy Diskette)
- Booting Method 2 (USB Memory)

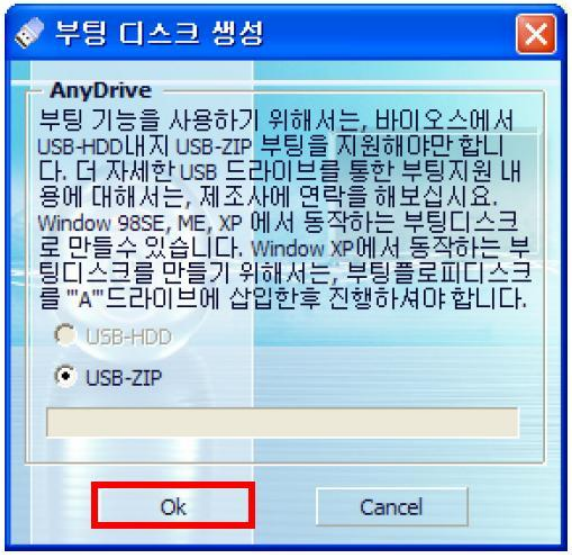
# Development Environment

- Porting OSEK/TMO OS on x86 in protected mode
- Microsoft Visual C++ 6.0
- Microsoft Macro Assembly (MASM 6.15)
- Bochs 2.2.1(x86 Emulator)
- WinImage 5.0

# Booting Method 1 (Floppy Diskette)

# Booting Method 2 (USB Memory)

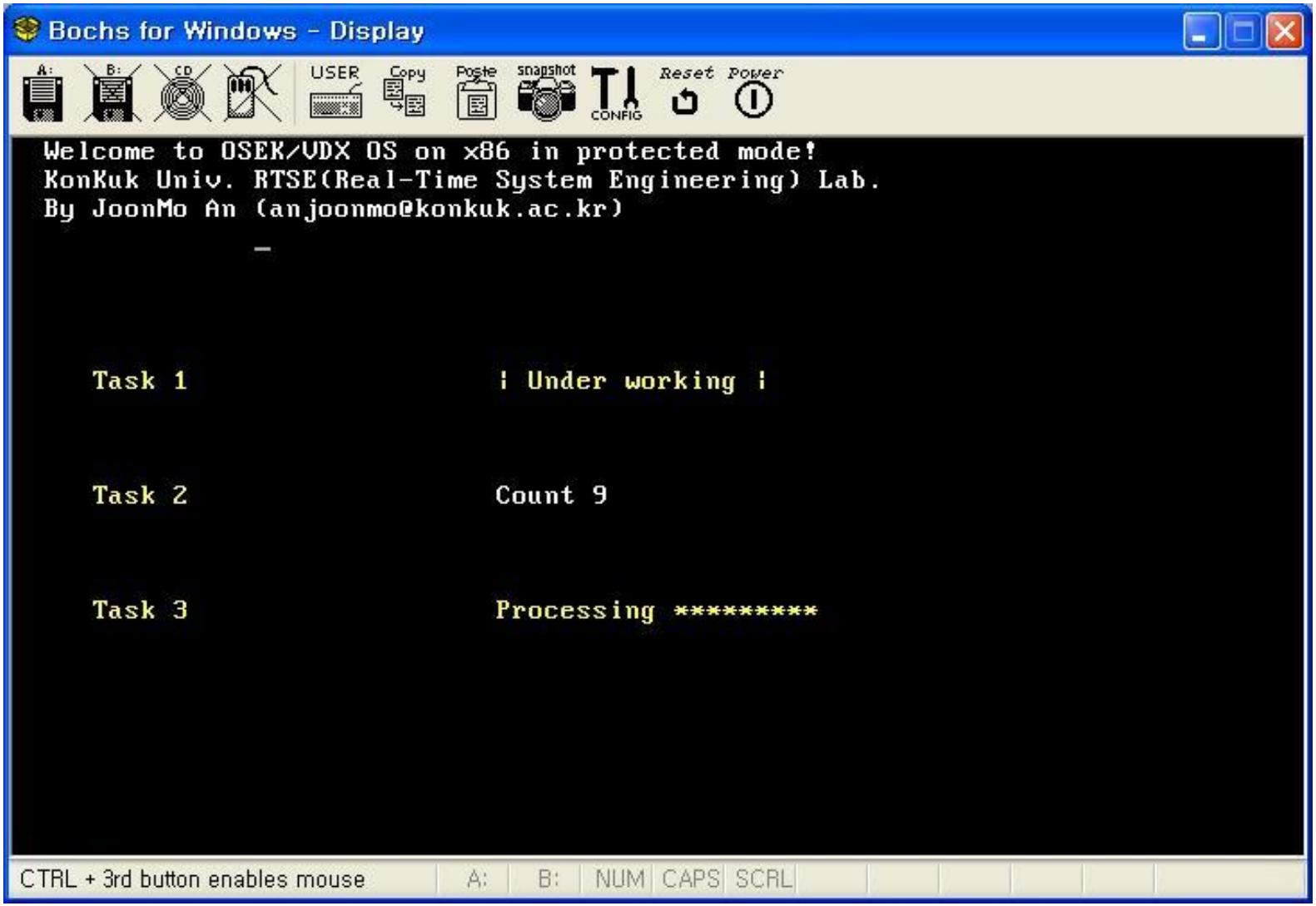




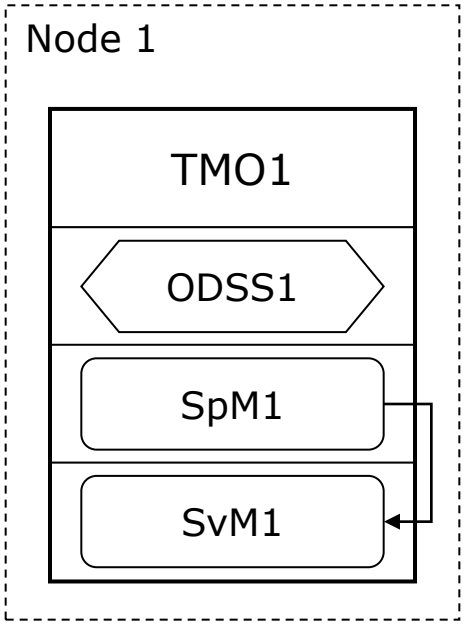
# RESULT

- Test Application for OSEK/VDX
- Test Application for OSEK/TMO
- Automobile Safety Intelligence System (ASIS)

# Test Application for OSEK/VDX



# Test Application for OSEK/TMO(1/3)




- **NODE 1**

  **TMO1:**

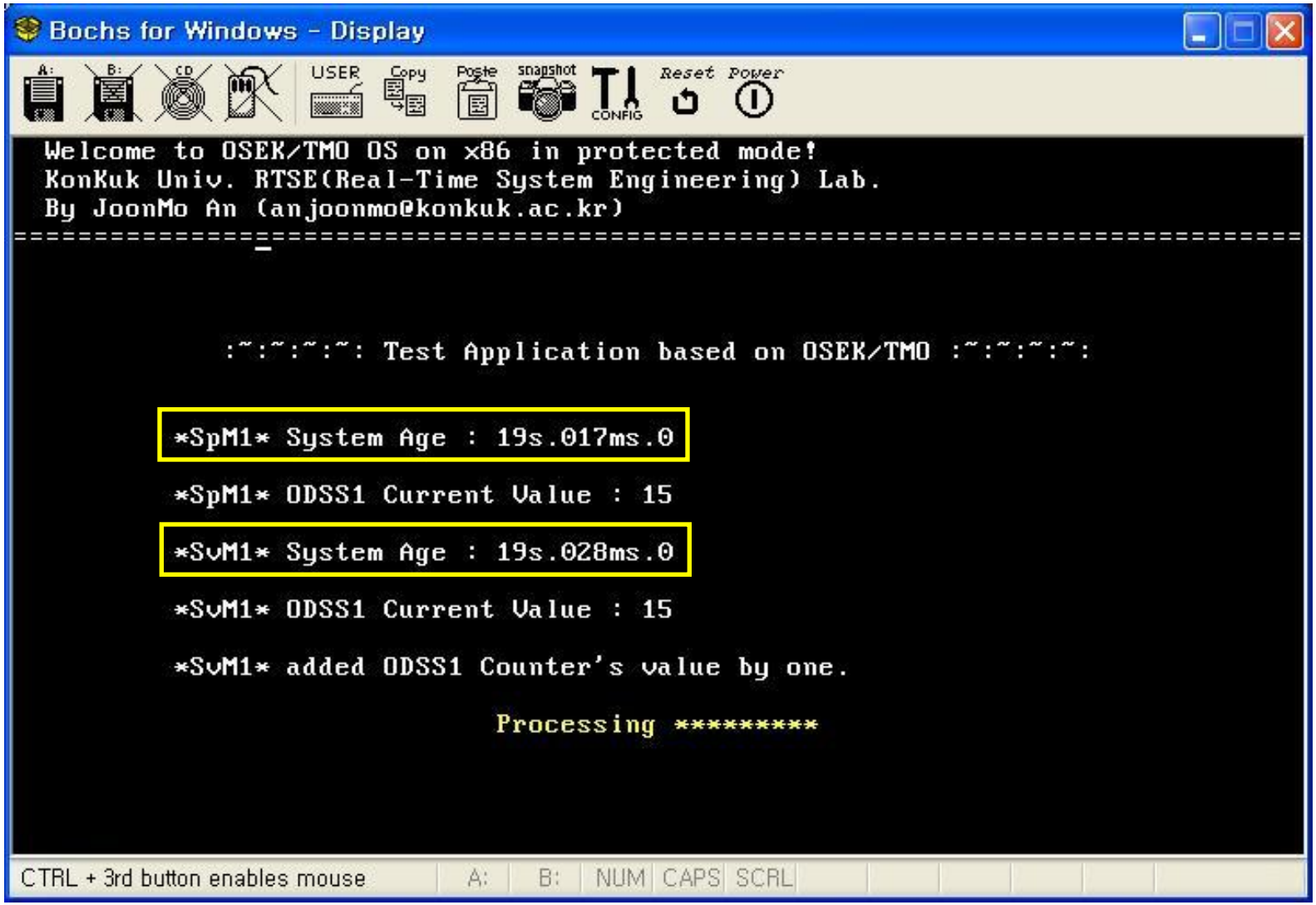
  ODSS1: Maintains a Counter, initial value is 0.

  SpM1: Gets ODSS1 Counter's current value and prints it.
  Gets current System Age and prints it.
  Calls SvM1.

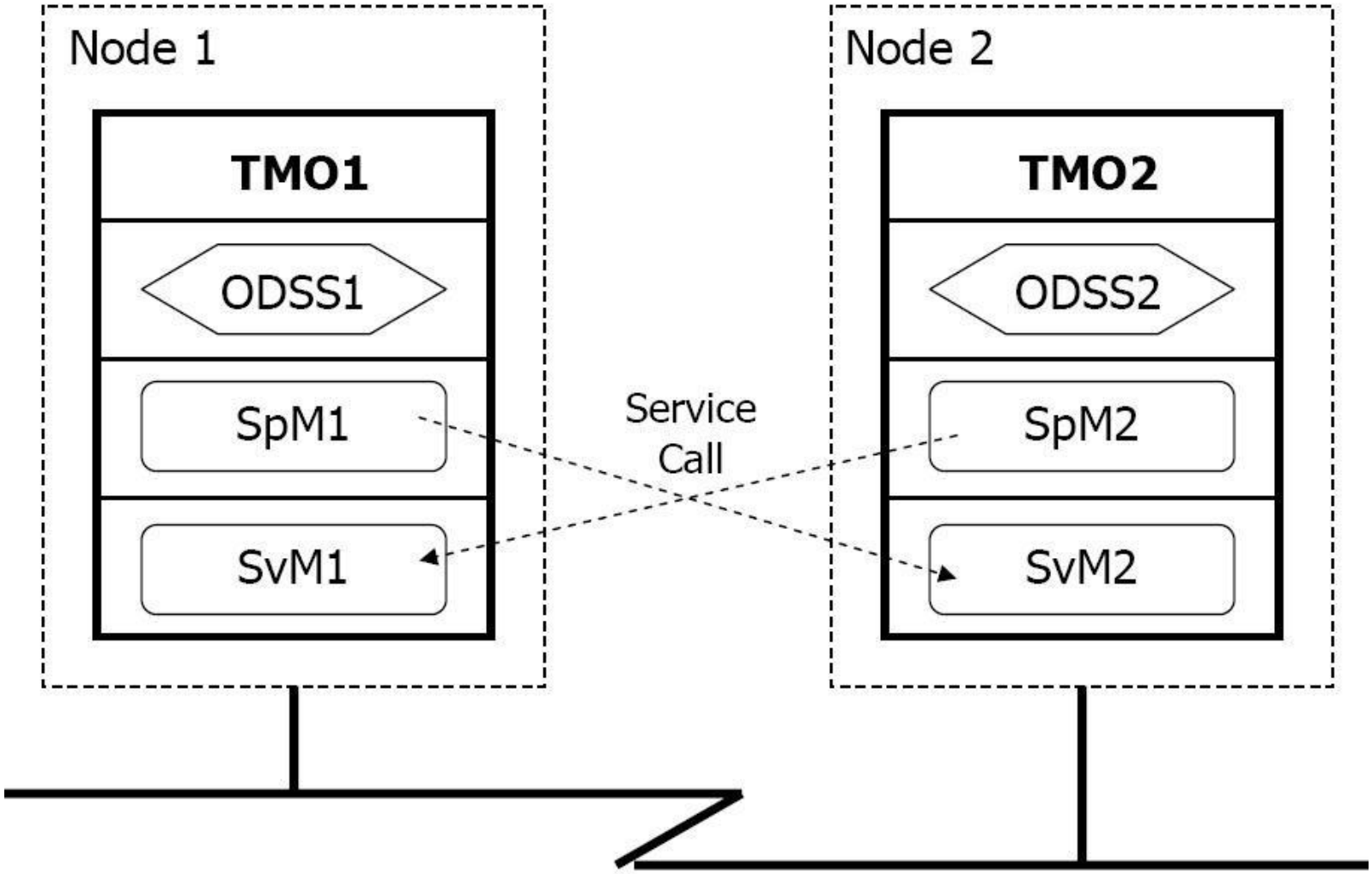
  SvM1: Gets ODSS1 Counter's current value and prints it.
  Gets current System Age and prints it.
  Increment ODSS1 Counter's value by one.

```
// AAC Information
MicroSec from    = 5 * 1000 * 1000;    // 5 sec
MicroSec every   = 1 * 1000 * 1000;    // 1 sec
MicroSec by      = 100 * 1000;         // 0.1 sec
MicroSec until   = FOREVER;            // forever
```

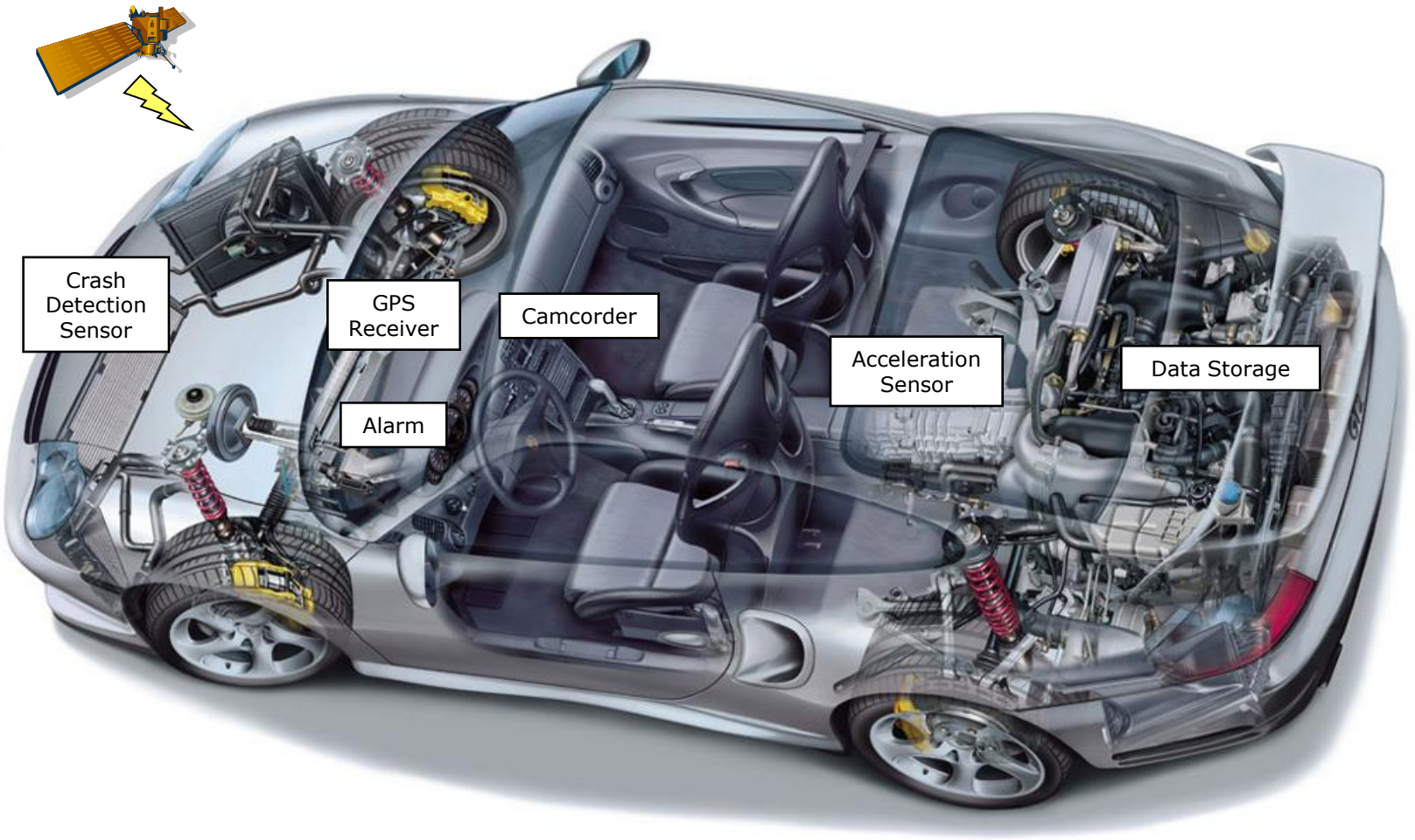
# Test Application for OSEK/TMO(2/3)



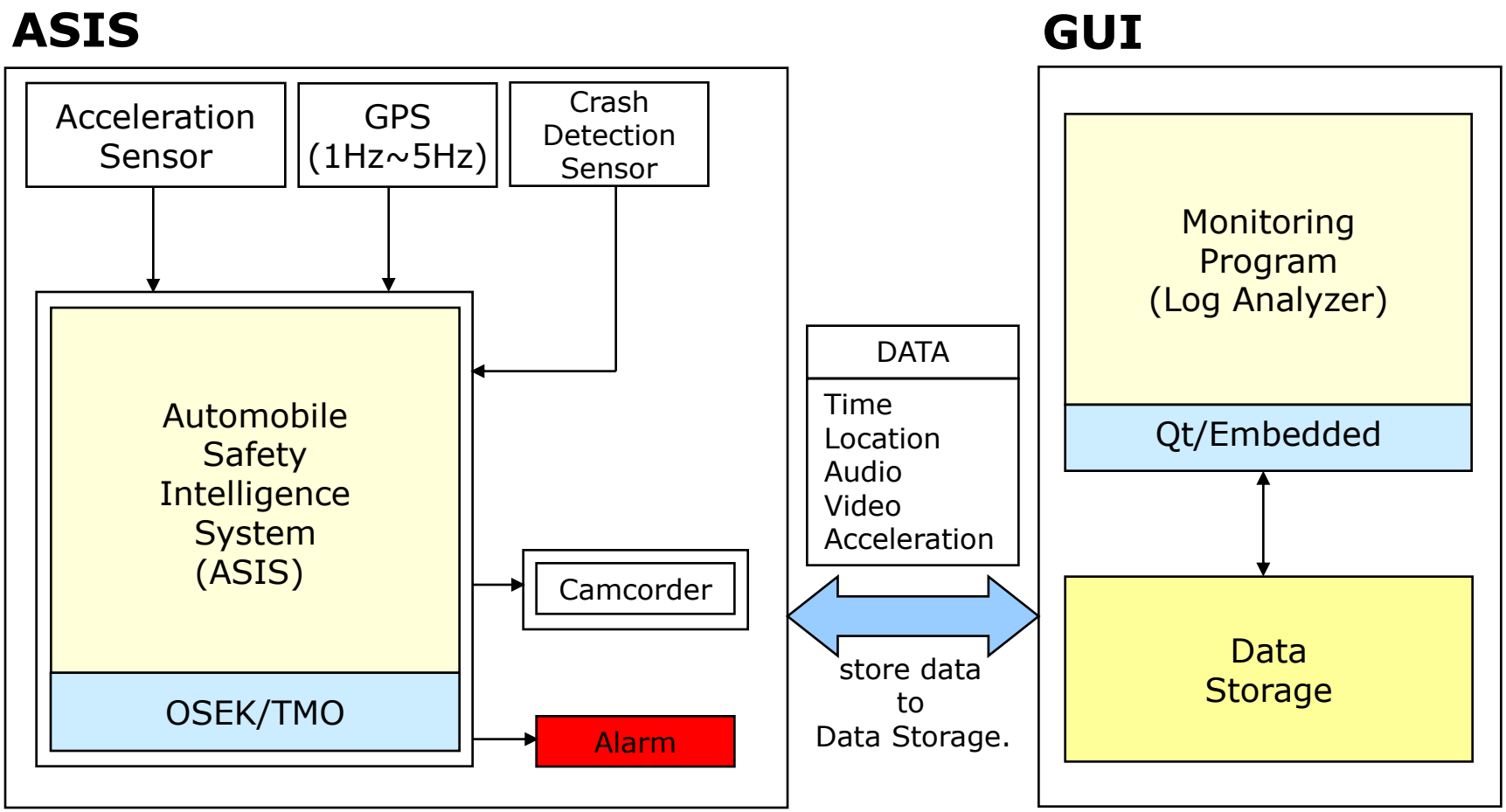
# Test Application for OSEK/TMO(3/3)



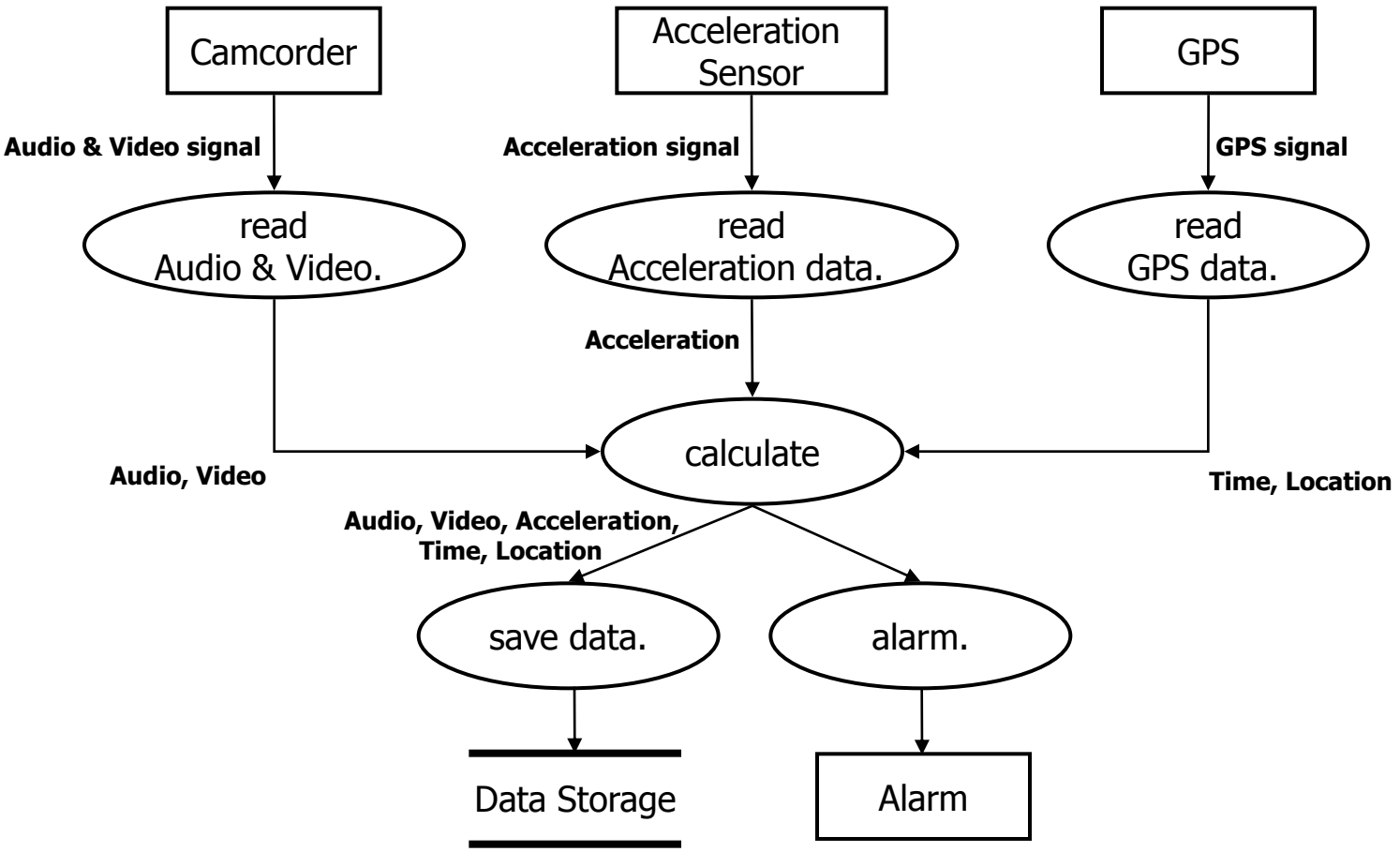
# ASIS Architecture



# ASIS Design


ASIS
GUI
Acceleration Sensor
GPS (1Hz~5Hz)
Crash Detection Sensor
Automobile Safety Intelligence System (ASIS)
OSEK/TMO
Camcorder
Alarm
DATA
Time
Location
Audio
Video
Acceleration
store data to Data Storage.
Monitoring Program (Log Analyzer)
Qt/Embedded
Data Storage

# ASIS Data Flow Diagram



# CONCLUSION & FUTURE WORKS

- Comparison of Two TMO Engines
- Conclusion
- Future Works

# Comparison of Two TMO Engines

| | **TMOSM/Linux** | **OSEK/TMO** |
|---|---|---|
| **Type** | Middleware | Kernel |
| **Application Mode** | User mode | Kernel mode |
| **Compatibility** | Binary compatible | Source patch |
| **Portability** | Lots of Hardware platforms and devices | Various but Restricted |
| **Timing Accuracy** | High | Higher |
| **Size** | Linux + app(300KB). | Kernel + app.<br>= 60KB ~ 100KB |
| **Application Domain** | Multimedia,<br>Soft real-time app. | Networked control,<br>Small application,<br>Single-TMO engine |

# Conclusion

- An analysis of the features of OSEK/VDX and MicroC/OS-II
- A design and implementation of OSEK/TMO based on the TMO model for embedded systems
- Test Application based on OSEK/TMO
- Testing OSEK/TMO on x86 CPU
- OSEK/TMO will be used as a small TMO engine in a time-critical networked control applications such as automobile control.

# Future Works

- Function extension
  - Restricted API
- Test bed construction for automobile
- Monitoring program and simulation environment development
- Development of the visual OSEK/TMO builder
  - Integration development environment
- An analysis of the performance of OSEK/TMO

# Q & A

Thank you very much!!

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