Embedded Operating System Characteristics

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What is an EOS?

- An operating system for an embedded system
  - Limited amount of HW
- Main characteristics
  - Efficient
  - Reliable
  - Customizable
  - Real time
- Generally written in C, to interact “better” with HW

EOS: When and why?

For simple application

- no need of OS

OS necessary for

- managing many resources
- running several tasks
- controlling HW resources efficiently

EOS vs. Standard OS

Standard OS

- an environment where user and computer interact
- to perform a huge variety of tasks
- optimized for the average case
- applications can be installed on the top of the OS

EOS

- only one type of task
- often without any, or little, user intervention
- optimized for worst case
- applications and OS are a single executable image

EOS: Features (1)

Real time operations	Reactive	Configurable
• Hard real time vs. Soft real time	• It acts in response to the environment (user and/or sensors)	• Embedded systems are designed “per application” • EOS must implement only what is strictly necessary

EOS: Features (2)

Streamline protection mechanisms	Direct use of interrupts	Fast and small
• Untested SW are rarely added to the system • Limited protection mechanisms for I/O	• Fundamental for implementing reactivity • More control over the peripherals vs. traditional OS • To be accurately considered for real time scenarios	• Limited HW resources requires high customization for fast execution • Unwanted modules must be removed at compilation time • Small footprint is fundamental • Special tasks for necessary I/O devices rather than all drivers in the OS kernel

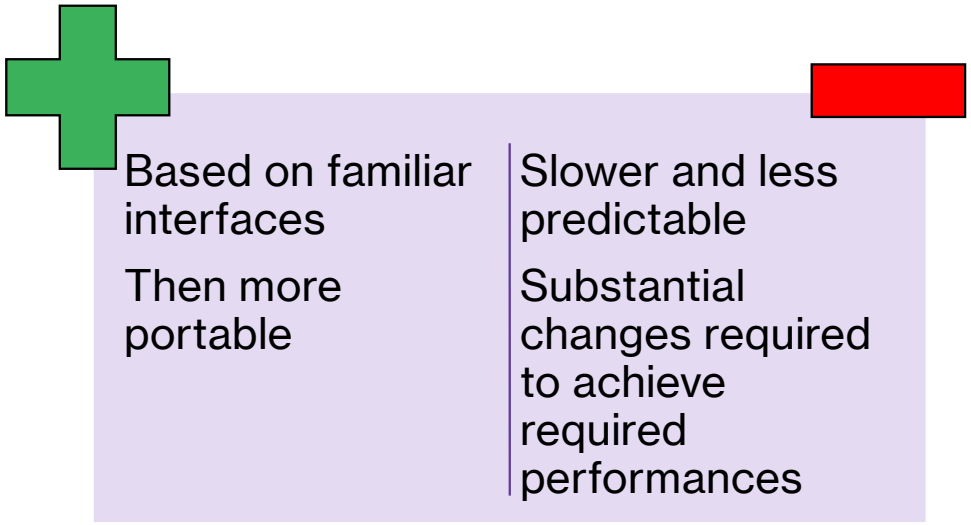
EOS: Adapt or make from scratch?

TAKE AN EXISTING OS AND ADAPT IT FOR THE EMBEDDED APPLICATION

DESIGN AND IMPLEMENT AN OS INTENDED SOLELY FOR EMBEDDED USE

Adapting a standard OS

- Take a commercial OS (e.g., Linux, Windows) and add:
  - real time capability
  - streamlining operations
  - necessary functionality



Design of a new ad-hoc embedded OS

- Fast and lightweight process or thread switch
- Scheduling policy is real time and dispatcher module is part of scheduler
- Small size (< 1 MB)
- Response time to external interrupts < 10 μs
- Interrupts are disabled for short intervals
- Fixed or variable-sized partitions for memory management
- Special sequential files that can accumulate data at a fast rate

EOS examples: a non comprehensive list

Proprietary

- VxWorks
- QNX
- iOS family
- Windows CE

Open source

- FreeRTOS
- eCos
- Embedded Linux
- Android
- WearOS
- mbed OS
- Contiki
- TinyOS

https://en.wikipedia.org/wiki/List_of_operating_systems#Embedded