

IoT Assignment 02 – Operating System

Background

There are many different types of operating systems being used for embedded systems design and for IoT devices. You are to write a short report on some of the alternatives.

Real-Time OS

One class of operating systems are the so-called real-time operating system (RTOS). There are several types of RTOS available. RTOS's typically only have a very minimum of services. They also typically require very little overhead and have a minimal memory footprint. One distinguishing feature is that these systems are typically compiled and linked together with the application program, to form a single executable image. Finally, the "real-time" name indicates that the systems uses deterministic scheduling and is able to provide guaranteed response times for each thread.

The minimalistic approach makes these operating systems very well suited for low cost and low complexity devices.

"Normal OS"

The RTOS operating systems are not well suited for all systems. Sometimes the available hardware is able to support "normal" operating systems, and then it may make sense to have a full OS available. That is, the device probably doesn't have much in terms of peripherals, etc. The "standard" OS must therefore be ported to the target environment, and not all OS's can be tailored this way.

The most common OS for this segment of devices is probably Linux. There are many Linux distros that target the IoT market. Windows 10 is also an alternative, and Microsoft makes a version of Win10 for ARM-based systems. Other alternatives also exist, some based on the BSD design (Open BSD, Free BSD).

There are a number of issues with these "standard" systems. In an IoT context, the systems are relatively power-hungry (not good for battery powered designs) and they require relatively powerful hardware. They are also mostly not well equipped for real-time requirements. Still, the IoT market place is very diverse, and even very cheap hardware can support a full OS these days. IoT-adapted normal OS's is therefore a strongly growing segment.

Some IoT Operating Systems

Here you have a short list of some of the OS's that are used for IoT systems. Some of these are open source, while others are proprietary and paid-for.

- Intel (Wind River) VxWorks, https://www.windriver.com/products/vxworks/#certified_products
- RIOT OS, <http://www.riot-os.org/#features>
- INTEGRITY RTOS, <https://www.ghs.com/products/rtos/integrity.html>
- FreeRTOS, <http://www.freertos.org/>
- Contiki, <http://www.contiki-os.org/>
- Linux based systems
 - Ubuntu for IoT, <https://www.ubuntu.com/internet-of-things>
 - Ostro Linux, <https://ostroproject.org/>
- ARM mbed OS, <https://www.mbed.com/en/development/mbed-os/>
- Nucleus RTOS, <https://www.mentor.com/embedded-software/nucleus/processor-support>
- Windows 10 for IoT. <https://www.microsoft.com/en-us/WindowsForBusiness/windows-iot>
- Android (Brillo), <https://developer.android.com/things/index.html>
- Apple iOS/WatchOS - <https://developer.apple.com/watchos/> <https://developer.apple.com/homekit/>

Target architectures

There are three target processor architectures that you shall have in mind. These will be the potential target for the operating systems.

- ATmega2560 - <http://www.microchip.com/wwwproducts/en/ATmega2560>
- ARM Cortex M7 - <http://www.nxp.com/docs/en/white-paper/CORTEXM7WP.pdf>
- ARM Cortex A5 - <http://www.microchip.com/wwwproducts/en/ATSAMA5D24>
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Sources

You are also expected to be critical of the sources. There may be “fake news”, but more likely some sources don't really get the facts right.

Recommended sources include security consultant companies and anti-malware companies.

- Make sure you reference the sources that you use!
- Make sure you don't copy large amounts of text – that is plagiarism.
- Quoting is permitted – with a proper reference and not too much copied.

Check out this info: <https://www.uia.no/en/library/hjelp-og-veiledning/citing-sources>

The Assignment

Select 4 of the operating systems (only one Linux system permitted) and write a short report comparing the systems. Each OS should be described (one page each). The aspects that you should try to address are:

- Target processor (which of the three potential CPU/MPU architectures)
- Cost/price of OS
- Communications stack (IP support etc.)
- Process model (processes, threads, co-operative, preemptive, ...)
- Real-time support
- Typical use of this OS
- Support for security services
- Drawback of this OS
- Other aspects that YOU find important

You do not need to recommend any OS, but should indicate what they are good for and what they are not so good for.

The target audience is ICT engineers that have a deep technical background and a reasonable understanding of security.

Deliverables (**deadline: 08.10.2018 12:00**)

- Report (6-7 pages)
- Presentation of key findings (max 10 minutes presentation).