

## Course Description

This two-day course is structured to provide software developers with a catalog of OS implementation options, including hypervisors, various Linux implementations, booting and configuring a system, and power management for the Zynq® UltraScale+™ MPSoC family.

**Level** – Embedded Software 3

**Course Duration** – 2 days

**Price** – \$1600 or 16 Xilinx Training Credits

**Course Part Number** – EMBD-ZUPSW-ILT

**Who Should Attend?** – Software developers interested in understanding the OS and other capabilities of the Zynq UltraScale+ MPSoC device.

### Prerequisites

- General understanding of embedded and real-time operating systems
- Familiarity with issues related to implementing a complex embedded system
- Recommended:
  - [Embedded Systems Software Design](#)
  - [Zynq All Programmable SoC System Architecture](#)
  - [Embedded Design with PetaLinux Tools](#)

### Software Tools

- Vivado® Design Suite 2017.3
  - May require special Zynq UltraScale+ MPSoC family license
- Hardware emulation environment:
  - VirtualBox
  - QEMU
  - Ubuntu desktop
  - PetaLinux

### Hardware

- Host computer for running the above software\*

\* This course focuses on the Zynq UltraScale+ MPSoC architecture. Check with [North Pole Engineering, Inc.](#) for the specifics of the in-class lab board or other customizations. This version of the class does not use a physical board, but rather a local emulation environment and the Vivado Design Suite.

After completing this comprehensive training, you will have the necessary skills to:

- Distinguish between asymmetric multi-processing (AMP) and symmetric multi-processing (SMP) environments
- Identify situations when the ARM® TrustZone technology and/or a hypervisor should be used
- Effectively use power management strategies and leverage the capabilities of the platform management unit (PMU)
- Define the boot sequences appropriate to the needs of the system
- Define the underlying implementation of the application processing unit (APU) and real-time processing unit (RPU) to make best use of their capabilities

## Course Outline

### Day 1

- Zynq UltraScale+ MPSoC Application Processing Unit {Lecture, Lab}
- Zynq UltraScale+ MPSoC Real-Time Processing Unit {Lecture, Demo, Lab}
- ARM TrustZone Technology {Lecture}
- QEMU {Lecture, Demo, Lab}
- Zynq UltraScale+ MPSoC HW-SW Virtualization {Lecture, Demo, Lab}
- MultiProcessor Software Architecture {Lecture}
- Hypervisors {Lecture, Demo, Lab} (pairs with OpenAMP, but not SMP)
- OpenAMP {Lecture, Lab} (pairs with the Xen Hypervisor, but not SMP)

- Linux {Lecture, Demo}

### Day 2

- Yocto {Lecture, Demo, Lab}
- Open Source Library (Linux) {Lecture, Demo, Lab}
- FreeRTOS {Lecture, Demo, Lab}
- Zynq UltraScale+ MPSoC Software Stack {Lecture, Demo}
- Zynq UltraScale+ MPSoC PMU {Lecture, Lab}
- Zynq UltraScale+ MPSoC Power Management {Lecture, Lab}
- Zynq UltraScale+ MPSoC Booting {Lecture, Lab}

## Topic Descriptions

### Day 1

- Zynq UltraScale+ MPSoC Application Processing Unit – Introduction to the members of the APU, specifically the Cortex™-A53 processor and how the cluster is configured and managed.
- Zynq UltraScale+ MPSoC Real-Time Processing Unit – Introduction to the various elements within the RPU and different modes of configuration.
- ARM TrustZone Technology – Illustrates the use of the ARM® TrustZone technology.
- QEMU – Introduction to the Quick Emulator, which is the tool used to run software for the Zynq UltraScale+ MPSoC device when hardware is not available.
- Zynq UltraScale+ MPSoC HW-SW Virtualization – Covers the hardware and software elements of virtualization. The lab demonstrates how hypervisors can be used.
- MultiProcessor Software Architecture – Introduces several potential architectures and illustrate the strengths of each.
- Hypervisors – Description of generic hypervisors and discussion of some of the details of implementing a hypervisor using Xen.
- OpenAMP – Introduction to the concept of OpenAMP.
- Linux – Discussion and examples showing how to configure Linux to manage multiple processors.

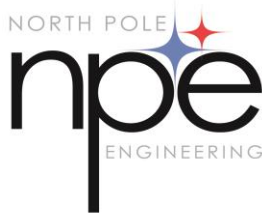
### Day 2

- Yocto – Compares and contrasts the kernel building methods between a "pure" Yocto build and the PetaLinux build (which uses Yocto "under-the-hood").
- Open Source Library – Introduction to open-source Linux and the effort and risk-reducing PetaLinux tools.
- FreeRTOS – Overview of FreeRTOS with examples of how it can be used.
- Zynq UltraScale+ MPSoC Software Stack – Introduction to what a software stack is and a number of stacks used with the Zynq UltraScale+ MPSoC.
- Zynq UltraScale+ MPSoC PMU – Investigation into the the tools and techniques for debugging a Zynq UltraScale+ MPSoC device.
- Zynq UltraScale+ MPSoC Power Management – Overview of the PMU and the power-saving features of the device.
- Zynq UltraScale+ MPSoC Booting – How to implement the embedded system, including the boot process and boot image creation. Also how to detect a failed boot.

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