**Course Description**

This course provides software developers with an overview of the capabilities and support for the Zynq UltraScale+™ MPSoC family from a software development perspective.

The emphasis is on:
- Reviewing the catalog of OS implementation options, including hypervisors, and various Linux implementations
- Booting and configuring a system
- Applying various power management techniques for the Zynq UltraScale+ MPSoC family

**Level** – Embedded Software 3

**Course Duration** – 2 days

**Price** –

**Course Part Number** – EMBD-ZUPSW

**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

**Software Tools**
- Vivado® Design Suite 2019.1
  - 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 your local Authorized Training Provider for the specifics of the in-class lab environment 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

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**Course Outline**

**Day 1**

- **Application Processing Unit**
  - Introduction to the members of the APU, specifically the Cortex™-A53 processor and how the cluster is configured and managed. (Lecture, Lab)
- **Real-Time Processing Unit**
  - Introduction to the various elements within the RPU and different modes of configuration. (Lecture, Demo, Lab)
- **ARM TrustZone Technology**
  - Illustrates the use of the ARM® TrustZone technology. (Lecture)
- **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. (Lecture, Demo, Lab)
- **HW-SW Virtualization**
  - Covers the hardware and software elements of virtualization. The lab demonstrates how hypervisors can be used. (Lecture, Demo, Lab)
- **MultiProcessor Software Architecture**
  - Introduces several potential architectures and illustrate the strengths of each. (Lecture)
- **Hypervisors**
  - Description of generic hypervisors and discussion of some of the details of implementing a hypervisor using Xen. (Lecture, Demo, Lab) (Pairs with OpenAMP, but not SMP)
- **OpenAMP**
  - Introduction to the concept of OpenAMP. (Lecture, Lab) (Pairs with the Xen Hypervisor, but not SMP)
- **Linux**
  - Discussion and examples showing how to configure Linux to manage multiple processors. (Lecture, Demo)

**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"). (Lecture, Demo, Lab)
- **Open Source Library (Linux)**
  - Introduction to open-source Linux and the effort and risk-reducing PetaLinux tools. (Lecture, Demo, Lab)
- **FreeRTOS**
  - Overview of FreeRTOS with examples of how it can be used. (Lecture, Demo, Lab)
- **Software Stack**
  - Introduction to what a software stack is and a number of stacks used with the Zynq UltraScale+ MPSoC. (Lecture, Demo)
- **PMU**
  - Introduction to the concepts of power requirements in embedded systems and the Zynq UltraScale+ MPSoC. (Lecture, Lab)
- **Power Management**
  - Overview of the PMU and the power-saving features of the device. (Lecture, Lab)
Booting
How to implement the embedded system, including the boot process and boot image creation. Also how to detect a failed boot. (Lecture, Lab)

First Stage Boot Loader
Introduction to the FSBL, its importance, and how it can be implemented and debugged. (Lecture, Demo, Lab)

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