

## Course Description

This course tackles the most sophisticated aspects of the Vivado® Design Suite and Xilinx hardware. This course enables you to use the advanced capabilities of the Vivado Design Suite to achieve design closure.

**Level** – FPGA 4

**Course Duration** – 2 days

**Course Part Number** – FPGA-VDES4-ILT

**Who Should Attend?** – Engineers who seek advanced training in using Xilinx tools to improve FPGA performance and utilization while also increasing productivity

### Prerequisites

- *Designing FPGAs Using the Vivado Design Suite 2 course*
- *Designing FPGAs Using the Vivado Design Suite 3 course*
- At least six months of design experience with Xilinx tools and FPGAs

### Software Tools

- Vivado Design or System Edition 2017.3

### Hardware

- Architecture: UltraScale™ and 7 series FPGAs\*
- Demo board: Kintex®-7 FPGA KC705 board

\* This course focuses on the UltraScale and 7 series architectures. Check with your local Authorized Training Provider for specifics or other customizations.

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

- Apply appropriate I/O timing constraints and design modifications for source-synchronous and system-synchronous interfaces
- Analyze a timing report to identify how to center the clock in the data eye
- Utilize floorplanning techniques to improve design performance
- Employ advanced implementation options, such as incremental compile flow, physical optimization techniques, and re-entrant mode as last mile strategies
- Utilize Xilinx security features, bitstream encryption, and authentication using AES for design and IP security
- Identify advanced FPGA configurations, such as daisy chains and gangs, for configuring multiple FPGAs in a design
- Debug a design at the device startup phase to debug issues related to startup events, such as MMCM lock and design coming out of reset
- Use Tcl scripting in non-project batch flows to synthesize, implement, and generate custom timing reports

## Course Outline

### Day 1

- UltraFast Design Methodology: Design Closure {Lecture}
- Scripting in Vivado Design Suite Non-Project Mode {Lecture, Lab}
- Hierarchical Design {Lecture}
- Managing Remote IP {Lecture, Lab}
- I/O Timing Scenarios {Lecture}
- System-Synchronous I/O Timing {Lecture, Demo}
- Source-Synchronous I/O Timing {Lecture, Lab}
- Timing Constraints Priority {Lecture}
- Case Analysis {Lecture}
- Introduction to Floorplanning {Lecture}
- Design Analysis and Floorplanning {Lecture, Lab}
- Congestion {Lecture}

- Introduction to the Xilinx Tcl Store {Lecture, Demo}
- Incremental Compile Flow {Lecture, Lab}

### Day 2

- Physical Optimization {Lecture, Lab}
- Vivado Design Suite ECO Flow {Lecture, Lab}
- Power Management Techniques {Lecture}
- Daisy Chains and Gangs in Configuration {Lecture}
- Bitstream Security {Lecture, Demo}
- Vivado Design Suite Debug Methodology {Lecture}
- Trigger and Debug at Device Startup {Lecture, Demo}
- Trigger Using the Trigger State Machine in the Vivado Logic Analyzer {Lecture, Lab}
- Debugging the Design Using Tcl Commands {Lecture, Lab}
- Using Procedures in Tcl Scripting {Lecture}
- Using Lists in Tcl Scripting {Lecture}
- Using regexp in Tcl Scripting {Lecture, Lab}
- Debugging and Error Handling in Tcl Scripts {Lecture}

## Topic Descriptions

### Day 1

- UltraFast Design Methodology: Design Closure – Introduces the UltraFast™ design methodology guidelines covered in this course.
- Scripting in Vivado Design Suite Non-Project Mode – Write Tcl commands in the non-project batch flow for a design.
- Hierarchical Design – Overview of the hierarchical design flows in the Vivado Design Suite.
- Managing Remote IP – Store IP and related files remote to the current working project directory.
- I/O Timing Scenarios – Overview of various I/O timing scenarios, such as source- and system-synchronous, direct/MMCM capture, and edge/center aligned data.
- System-Synchronous I/O Timing – Apply I/O delay constraints and perform static timing analysis for a system-synchronous input interface.
- Source-Synchronous I/O Timing – Apply I/O delay constraints and perform static timing analysis for a source-synchronous, double data rate (DDR) interface.
- Timing Constraints Priority – Identify the priority of timing constraints.
- Case Analysis – Understand how to analyze timing when using multiplexed clocks in a design.
- Introduction to Floorplanning – Introduction to floorplanning and how to use Pblocks while floorplanning.
- Design Analysis and Floorplanning – Explore the pre- and post-implementation design analysis features of the Vivado IDE.
- Congestion - Identifies congestion and addresses congestion issues.
- Introduction to the Xilinx Tcl Store – Introduces the Xilinx Tcl Store.
- Incremental Compile Flow – Utilize the incremental compile flow when making last-minute RTL changes.

### Day 2

- Physical Optimization – Use physical optimization techniques for timing closure.
- Vivado Design Suite ECO Flow – Use the ECO flow to make changes to a previously implemented design and apply changes to the original design.
- Power Management Techniques – Identify techniques used for low power design.
- Daisy Chains and Gangs in Configuration – Introduces advanced configuration schemes for multiple FPGAs.

- Bitstream Security – Understand the Xilinx bitstream security features such as readback disable, bitstream encryption, and authentication.
- Vivado Design Suite Debug Methodology – Understand and follow the debug core recommendations. Employ the debug methodology for debugging a design using the Vivado logic analyzer.
- Trigger and Debug at Device Startup – Debug the events around the device startup.
- Trigger Using the Trigger State Machine in the Vivado Logic Analyzer – Use trigger state machine code to trigger the ILA and capture data in the Vivado logic analyzer.
- Debugging the Design Using Tcl Commands – Use Tcl scripting for VLA designs for adding probes and making connections to probes.
- Using Procedures in Tcl Scripting - Employ procedures in Tcl scripting.
- Using Lists in Tcl Scripting – Employ lists in Tcl scripting.
- Using regexp in Tcl Scripting – Use regular expressions to find a pattern in a text file while scripting an action in the Vivado Design Suite.
- Debugging and Error Handling in Tcl Scripts – Understand how to debug errors in a Tcl script.

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