

A large satellite dish antenna is positioned in a field of tall, dry grass. The dish is white and mounted on a metal structure. The background shows a sunset or sunrise with a blue sky and some clouds. The foreground is a field of tall, dry grass.

MiniZed PetaLinux HDF Tutorial

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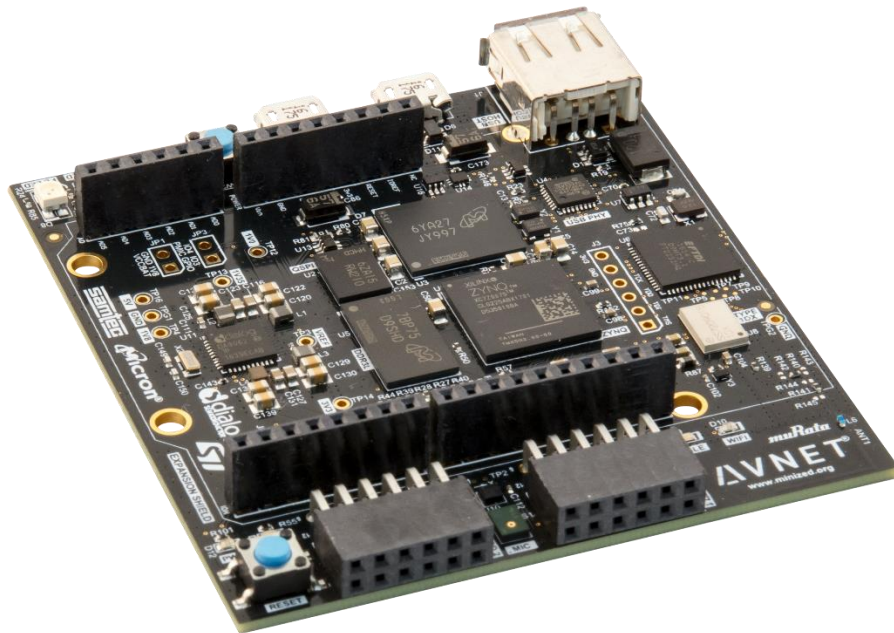
Introduction

Pre-built hardware platforms can help accelerate software development by providing pre-configured settings upon which application code development efforts can launch immediately. The accompanying Hardware Definition File (HDF) for MiniZed .

MiniZed Starter Kit Overview

The MiniZed Starter Kit from Avnet Electronics Marketing provides engineers with a complete system for prototyping and evaluating systems based on the cost-optimized Xilinx Zynq-7000 All Programmable SoC device family.

The versatility of this platform offers an excellent prototyping or proof-of-concept vehicle for your new product. Once you are finished prototyping your new product design and are ready to design your own hardware PCB, the design files can be leveraged to jumpstart your own design and most of the components found on this platform can be purchased directly from Avnet. Please contact your local Avnet FAE for further details.



Design Objectives

This MiniZed tutorial offers system developers an example of how to:

- Use automated build scripts to configure and build the included HDF for the MiniZed Starter Kit
- Target software applications to a prebuilt HDF release on MiniZed

Experiment Setup

This tutorial builds upon the concepts and lab activities of the Avnet MiniZed Tutorials which cover the use of Xilinx Vivado Design Suite in creating/testing a basic Zynq-7000 All-Programmable SoC hardware platform and running software applications. Please refer back to this reference material on the MiniZed community website for further information on how to configure the underlying MiniZed hardware platform.

Example Design Requirements

Software

The software required to build and execute the example design is:

- TeraTerm or another serial terminal emulator
- Cloned Avnet HDL git repository
- Xilinx Vivado Design Suite 2017.1
- Xilinx Software Development Kit (SDK) 2017.1

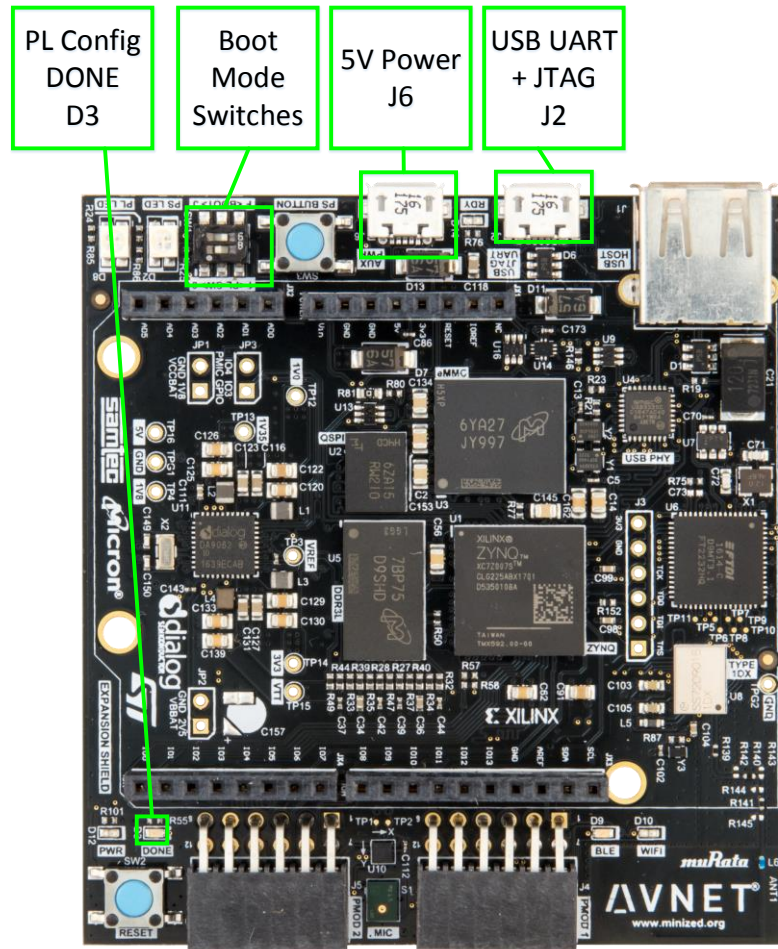
Hardware

The hardware setup used to test this reference design includes:

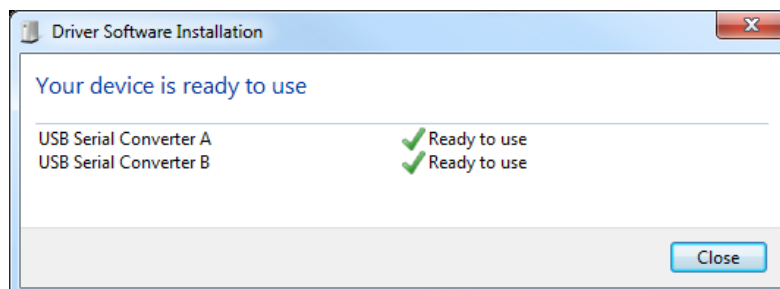
- Lenovo ThinkPad T420 Laptop
 - Intel® Core i5-2540M CPU - 2.60 GHz
 - 4GB DDR3 Memory
- Stock Avnet MiniZed Starter Kit (AES-MINIZED-7Z007-G)
- USB cable (Type A to Micro-USB Type B)

Setting Up for the MiniZed

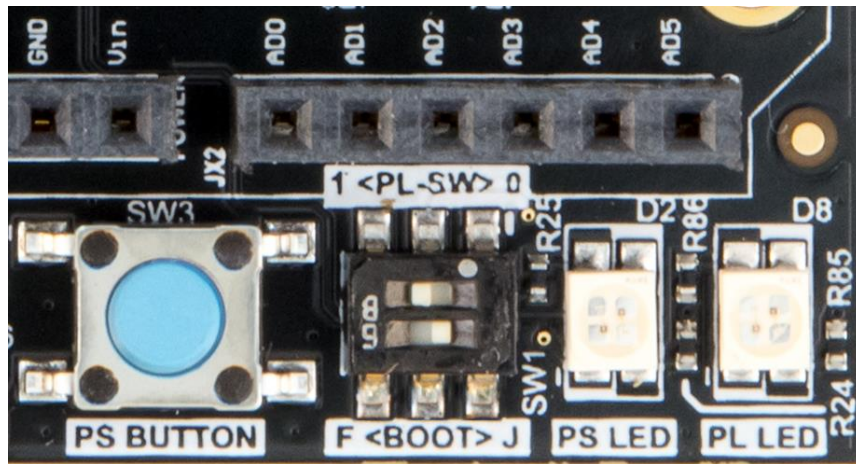
Refer to the following figure and perform the following steps to set up the board.



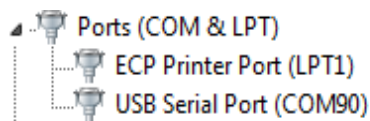
1. A terminal program is required. Tera Term was used in this example which can be downloaded from the Tera Term project on the SourceForge Japan page: tssh2.sourceforge.jp Install Tera Term or another terminal program of your choice.
2. Connect the MiniZed USB-JTAG/UART port J2 to your Windows PC. It should automatically install the proper drivers, giving you a confirmation as shown below:



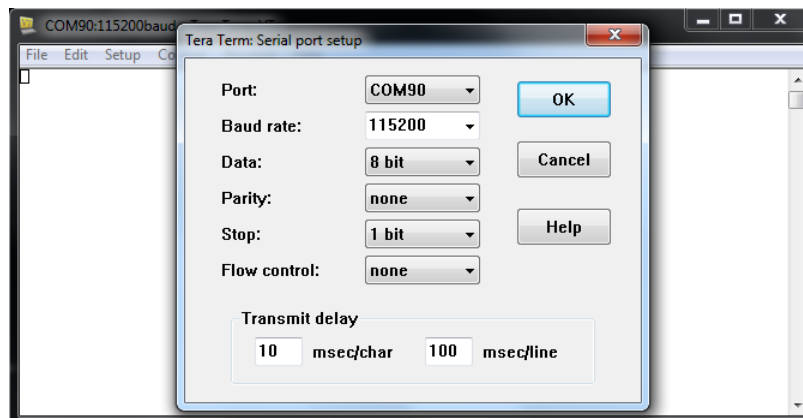
3. In the rare circumstance that the drivers are not auto-installed, then you must manually install the driver for the FTDI FT2232H device. Visit the FTDI website and download the appropriate driver for your operating system. <http://www.ftdichip.com/Drivers/VCP.htm>
4. Make sure the MiniZed is unplugged from the PC. Unzip and install the driver.
5. Reboot your PC then plug in the MiniZed.
6. Set the MiniZed boot mode switch SW1 to JTAG mode ('J' for JTAG) as shown below.



7. Use Device Manager to determine the COM port for the Silicon USB Serial Port. In Windows 7, click Start → Control Panel, and then click Device Manager. Click Yes to confirm.
8. Expand Ports. Note the COM port number for the USB Serial Port device. This example shows COM90.



9. Launch Tera Term and configure for the enumerated COM port at 115200 baud rate using the **Setup→Serial Port** menu.



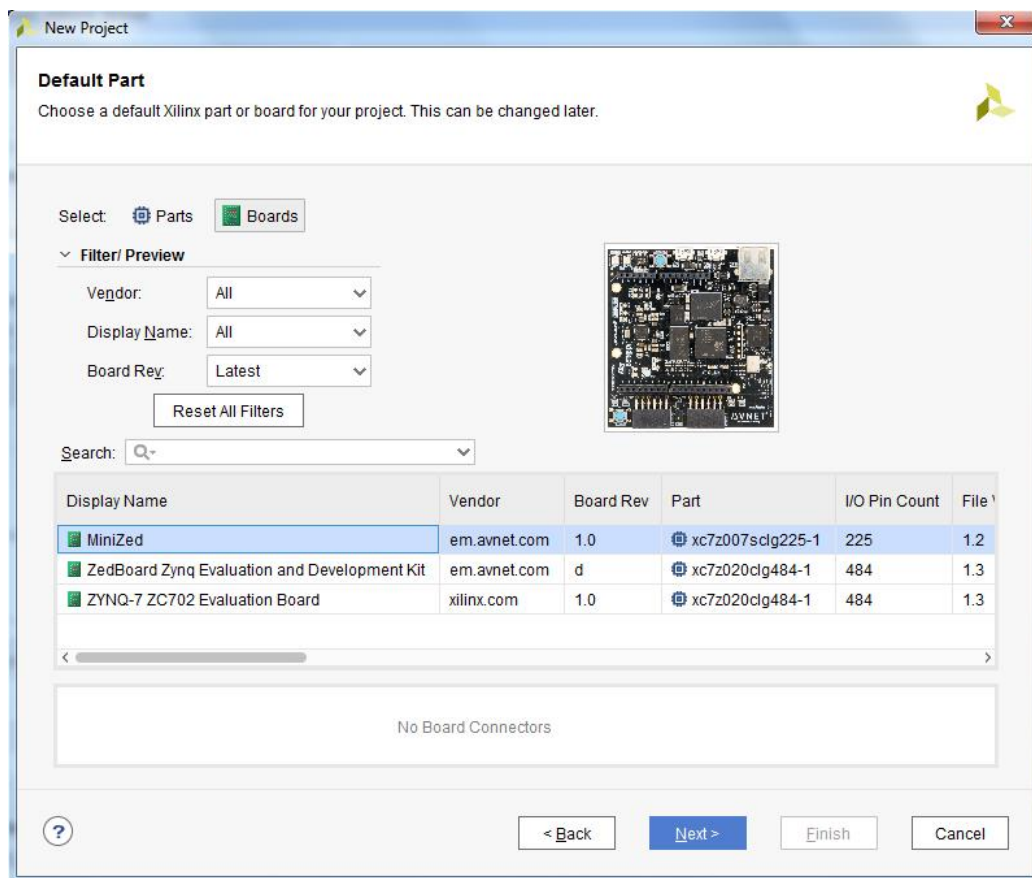
10. A Vivado Board Definition File is provided for the MiniZed Starter Kit in order to automate the hardware platform generation. Without this file in place within the Vivado install folder, the build automation process in Experiment 2 will fail. Download the Vivado Board Definition File which can be used for 2017.1 version of tools from the MiniZed.org Documentation page:

http://minized.org/sites/default/files/documentations/MiniZed_Board_Definition_File_0.zip

Please unzip the file contents into the following folder of the Vivado 2017.1 install directory:

<Xilinx_install>\Vivado\2017.1\data\boards\board_files

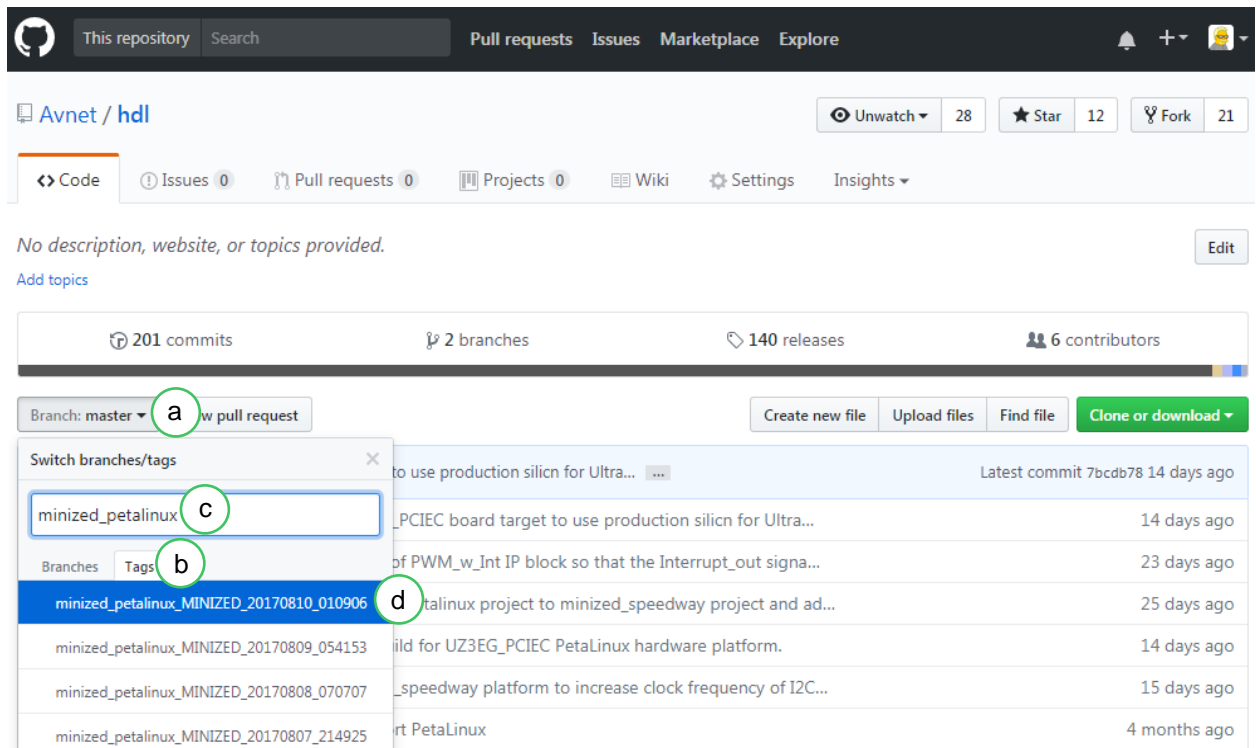
This enables the MiniZed to become an available board selection option during the new project creation process under Vivado and also will allow board automation settings to take hold during the automated build process performed later in Experiment 2.



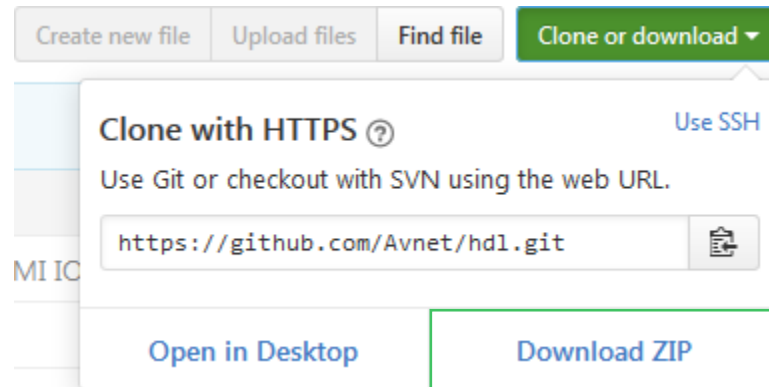
Experiment 1: Clone the Avnet HDL Repository

In this section, the design files for the reference design will be retrieved from the Avnet HDL Github repository.

1. Use your favorite web browser and navigate to the following web site :
<https://github.com/Avnet/hdl>
2. The steps below describe how to fetch the specific project we want from the repository.
 - a. Click the **Branch:master** button.
 - b. Click the **Tags** tab
 - c. Specify the following search criteria: **minized_petalinux**
3. Select the **minized_petalinux_MINIZED_20170810_010906** tag. This will retrieve a known working version of the design files for the MiniZed PetaLinux hardware platform for the MiniZed Starter kit.



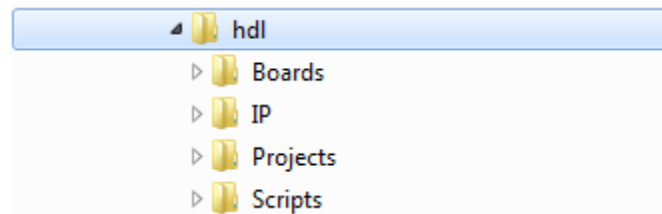
4. Click the Clone or download **Clone or download** button and select **Download zip**.



5. Save and extract the zip archive to a folder of your choice. Navigate to the cloned repository folder.

Note: To save space and make these tutorial instructions easier to read we will refer to this folder throughout this document as the <installation> folder.

6. Rename the **hdl-minized_petalinux_MINIZED_20170810_010906** folder to **hdl**. You should see the following directory structure:



NOTE: The exact directory name is not critical, but it must remain short on Windows machines, due to the directory length limitation of Windows

The <installation>\hdl repository contains the following sub-directories:

Directory	Content Description
<installation>\hdl\Boards	contains board related files
<installation>\hdl\IP	contains the IP cores used by the ref designs
<installation>\hdl\Projects	contains project related files
<installation>\hdl\Scripts	contains scripts used to automatically build the designs

For the MiniZed HDF example design, the following content is of interest:

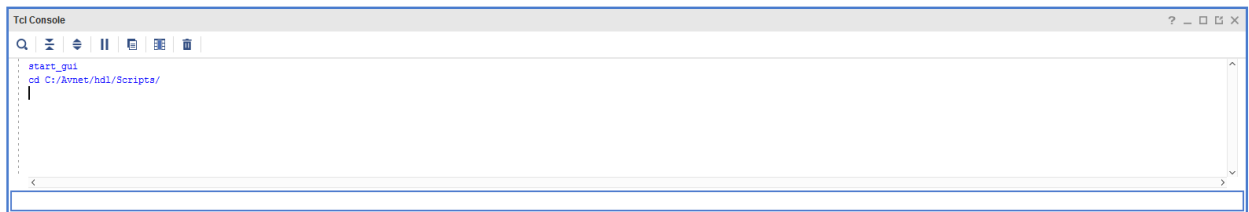
Directory	Content Description
<installation>\hdl\Projects\minized_petalinux	Folder containing files for basic PetaLinux design on MiniZed Starter Kit
<installation>\hdl\Scripts\make_minized_petalinux.tcl	TCL script to launch the build of the reference design for a MiniZed Starter Kit target

Experiment 2: Build the MiniZed PetaLinux HDF

In this section, the Vivado project will be created and built with TCL scripts, implementing the Zynq-7000 hardware platform reference design for MiniZed Starter Kit.

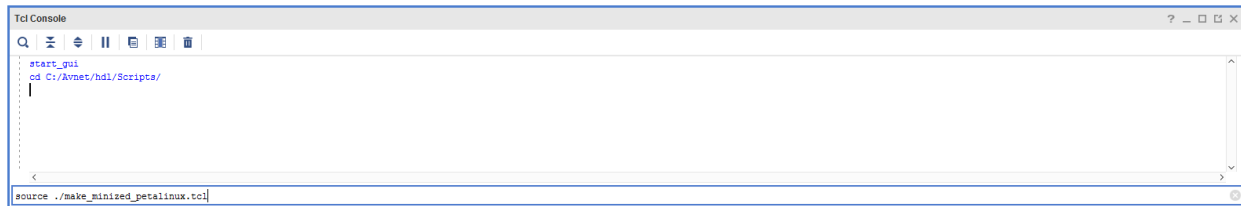
1. Launch Vivado 2017.1 from either the desktop icon or
Start → All Programs → Xilinx Design Tools → Vivado 2017.1 → Vivado 2017.1
2. Using the Vivado TCL Console, change directory to <installation>\hdl\Scripts folder:

```
cd <installation>/hdl/Scripts
```

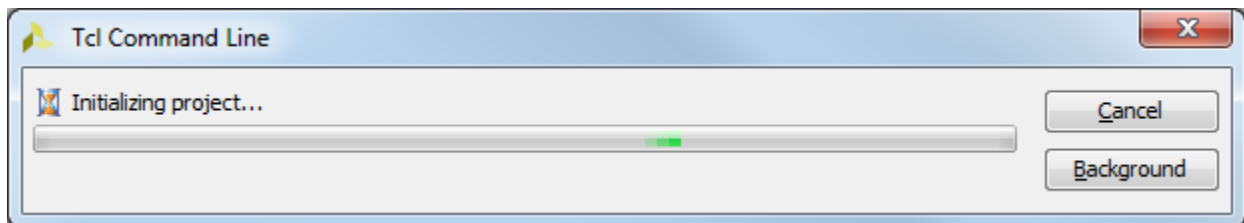


3. Launch the automated project build script with the following TCL command.

```
source ./make_minized_petalinux.tcl
```



You will see the following window showing progress as Vivado works to build the design.



Wait about 5 to 10 minutes for the build to complete. The build will automatically perform the following steps for you.

- Create and build the hardware design with Vivado 2017.1, including the IP Integrator block design, and output a Programmable Logic bistream file. The resulting project resides at the following path:

<installation>\hdl\Projects\minized_petalinux\MINIZED\minized_petalinux.xpr

- Create the FPGA bitstream file (minized_petalinux_wrapper.bit)

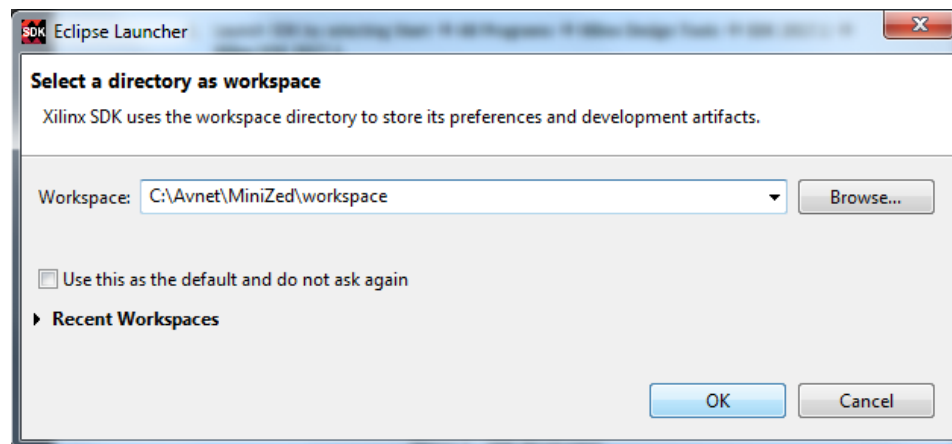
<installation>\hdl\Projects\minized_petalinux\MINIZED\minized_petalinux.runs\impl_1\minized_petalinux_wrapper.bit



Experiment 3: Using the HDF for Software Applications

This section uses the HDF created from the previous experiments (or the prebuilt one included with the archive) to provide a hardware platform from which SDK Standalone applications can be built. The first requirement within SDK is to import a hardware platform.

1. Launch SDK by selecting Start → All Programs → Xilinx Design Tools → SDK 2017.1 → Xilinx SDK 2017.1
2. Select a workspace. Click OK.

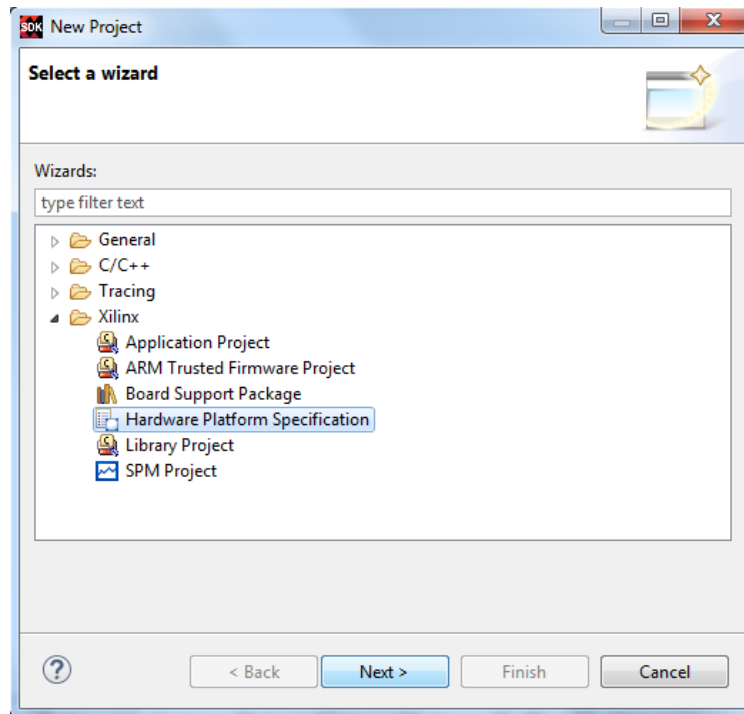


3. Close the Welcome screen by clicking the close button on the **Welcome** tab.

Now we will import the Zynq hardware platform that was designed and built during the previous experiments.

4. Select File → New → Project.

5. Expand the Xilinx item, and select **Hardware Platform Specification** then click the **Next** button.



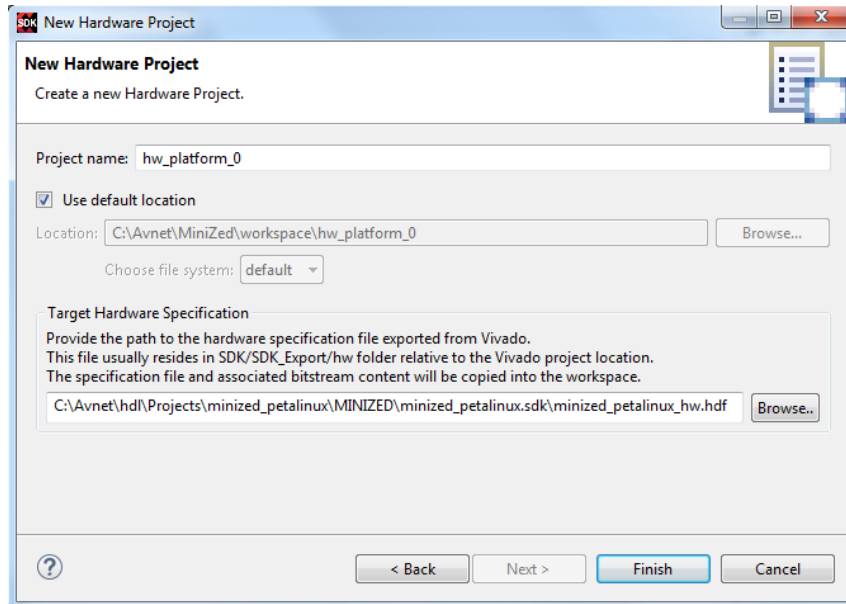
If you had simply launched SDK from Vivado, it would have automatically named and imported your hardware platform for you. The disadvantage in this method is that it obscures how the hardware platform gets imported. For consistency, this tutorial will use the same default name that Vivado would have used.

6. Enter **hw_platform_0** for the Project name.
7. Click Browse and select the **minized_petalinux_hw.hdf** file generated during the Export process from Vivado. This will be included in the archive provided by the hardware engineer. Or, if you are continuing from the first tutorial, you will find it in a similar location as here:

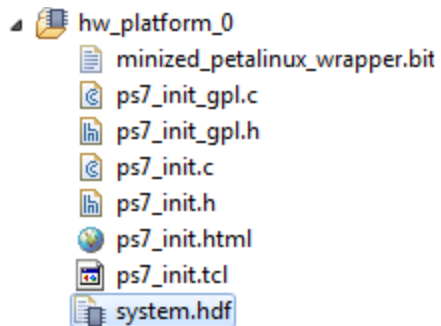
<installation>/hdl/Projects/minized_petalinux/MINIZED/minized_petalinux.sdk/

8. After selecting **minized_petalinux_hw.hdf**, click **Open**.

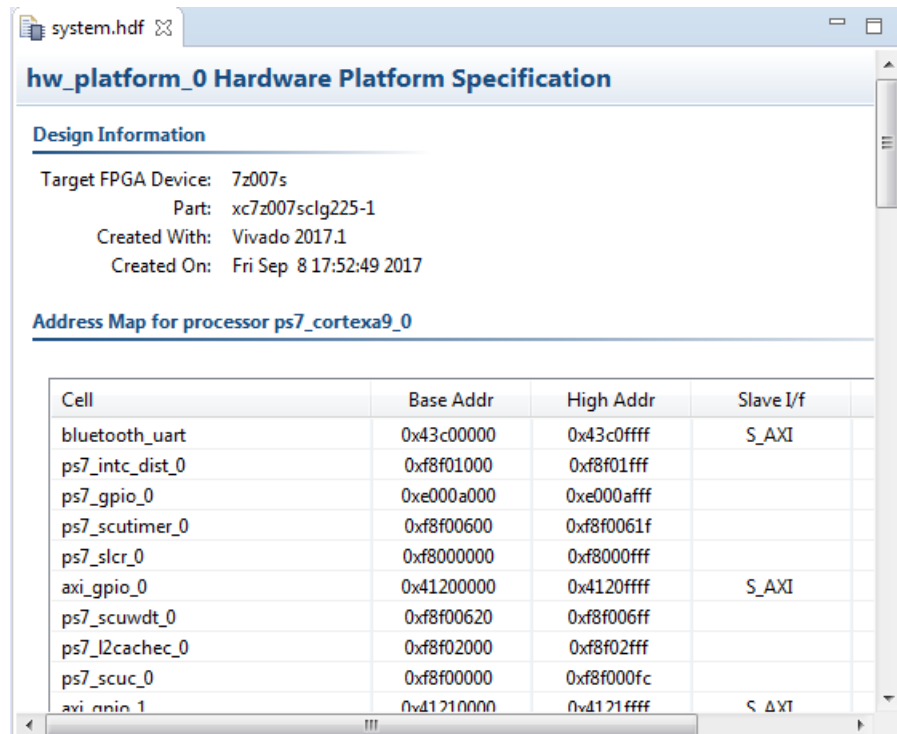
9. The Bitstream is embedded in the HDF, so it is not separately specified here. Click Finish.



10. Notice the PS7 Zynq hardware platform is now visible in the Project Explorer window pane.



11. If you select the HDF file, SDK will show you information about the hardware platform (not the HDF raw code itself).



The screenshot shows a window titled 'system.hdf' with a tab 'hw_platform_0 Hardware Platform Specification'. The window is divided into two main sections: 'Design Information' and 'Address Map for processor ps7_cortexa9_0'.

Design Information

- Target FPGA Device: 7z007s
- Part: xc7z007sclg225-1
- Created With: Vivado 2017.1
- Created On: Fri Sep 8 17:52:49 2017

Address Map for processor ps7_cortexa9_0

Cell	Base Addr	High Addr	Slave I/f
bluetooth_uart	0x43c00000	0x43c0ffff	S_AXI
ps7_intc_dist_0	0xf8f01000	0xf8f01fff	
ps7_gpio_0	0xe000a000	0xe000afff	
ps7_scutimer_0	0xf8f00600	0xf8f0061f	
ps7_slcr_0	0xf8000000	0xf8000fff	
axi_gpio_0	0x41200000	0x4120ffff	S_AXI
ps7_scuwdt_0	0xf8f00620	0xf8f006ff	
ps7_l2cachec_0	0xf8f02000	0xf8f02fff	
ps7_scuc_0	0xf8f00000	0xf8f000fc	
axi_gpio_1	0xd1210000	0xd121ffff	S_AXI

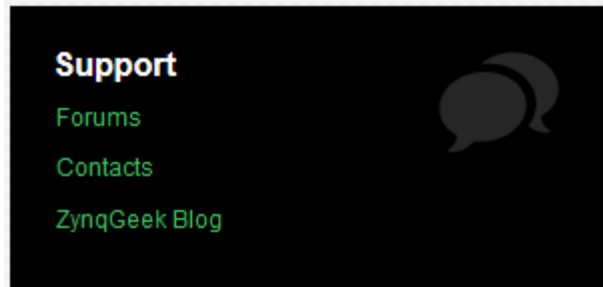
12. You are now ready to begin your Standalone software development upon the imported prebuilt hardware platform. For more information, refer back to the MiniZed tutorials 02 to 04 for information on how to further utilize the hardware platform for software development.

<http://minized.org/support/design/18891/146>

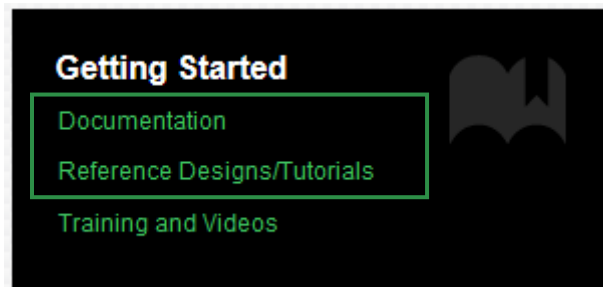
Appendix: Getting Support

Avnet Support

- Technical support is offered online through the minized.org website support forums. MiniZed users are encouraged to participate in the forums and offer help to others when possible.
<http://minized.org/forums/zed-english-forum>
<http://minized.org/forums/software-application-development>



- For questions regarding the MiniZed community website, please direct questions to the minized.org Web Master (webmaster@minized.org).
- To access the most current collateral for the MiniZed, visit the community support page (www.minized.org/content/support) and click on either Documentation or Reference Designs/Tutorials as shown below:



- MiniZed Starter Kit Documentation
<http://microzed.org/support/documentation/18891>
- MiniZed Starter Kit Reference Designs
<http://minized.org/support/design/18891/146>

Xilinx Support

For questions regarding products within the Product Entitlement Account, send an email message to the Customer Service Representative in your region:

- Canada, USA and South America - isscs_cases@xilinx.com
- Europe, Middle East, and Africa - eucases@xilinx.com
- Asia Pacific including Japan - apaccase@xilinx.com

For technical support, including the installation and use of the product license file, contact Xilinx Online Technical Support at www.xilinx.com/support. The following assistance resources are also available on the website:

- Software, IP and documentation updates
- Access to technical support Web tools
- Searchable answer database with over 4,000 solutions
- User forums

Revision History

Date	Version	Revision
08 Sep 17	01	Initial Release
09 Sep 17	02	Added further notes to the section covering installation of the MiniZed Board Definitions File and the importance of having these in place for build automation.