Common Lab Setup Guide 2019.1

COMPUTER SETUP

INTRODUCTION

This common lab setup guide is used for all Xilinx course labs. It includes details of software tools installation, lab software requirements, hardware setup, and all collateral material necessary to complete the lab exercises.

Having a properly prepared lab environment removes student frustration and saves valuable class time.

This lab setup guide is a superset of what is required for all course labs. In some instances, there may be more setup than needed for a given lab environment. The area of greatest differences between the requirements is which hardware evaluation board will be used in the course labs. The hardware setup instructions for all supported hardware boards are included in this lab setup guide even though a specific course may not use all the supported boards. Other setup information that may not be used in all lab situations will be mentioned as part of the instructions so they may be skipped.

Labs are tested on various machines running 64-bit Windows and 64-bit Ubuntu (running on VirtualBox in Windows).

The lab environment is delivered as a VirtualBox image on a Windows PC. This VirtualBox image contains a complete host operating system (Ubuntu, 64 bit), Xilinx Vivado® Design Suite 2019.1, Xilinx SDK 2019.1, PetaLinux Tools 2019.1 installation, SDx 2019.1, and all the associated material necessary to complete the lab exercises.

Benefits of this approach include massively reduced course setup time and a guarantee of a reliable lab environment to minimize student difficulties and confusion.

You only need to import the provided OVA file into the VirtualBox Manager and begin running the labs.

Hardware requirements for the VirtualBox environment are:

- Hard disk space for the virtual machine: 200 GB.
- Recommended RAM is 16 GB.
    - **Note:** You can only allocate 50% of the available physical resources to the VM. For example, if you want to allocate RAM up to 16 GB, then your available physical RAM should be 32 GB.

This document is split into three major parts:

- Hardware requirements: Description of the various evaluation demo board hardware.
- Software requirements: Description of the required software tools and necessary host PC drivers.
- Lab files download and installation: Procedure to access and install lab-related files on the host PC.

HARDWARE REQUIREMENTS

This section covers the hardware setup for the following hardware boards:

- ZCU104
- ZCU111 (for the *Designing with the Zynq UltraScale+ RFSoC* course only)

The hardware requirements include information for:

- Required cables
    - Most cables are included as part of the board kit
    - Specialized cables, such as those for the *Designing with the Zynq UltraScale+ RFSoC* course, may not be included in the board kit and must be provided by the user (see the specifics for those courses)
- Power supply and cord set(s)

Minimum Computer Capabilities

The labs and demos provided by the Xilinx Customer Education team are validated on Dell 64-bit laptops with six dual-core Xeon processors and 32 GB of DDR memory.

Other less capable systems can still easily run these labs. One of the most significant issues is that most machines run some flavor of the Windows operating system. Since these labs are written and validated using Linux, it is strongly suggested that the computer used to run these labs uses the Oracle VirtualBox application. VirtualBox enables virtual machines of any operating system to run on a Windows platform.

The Xilinx Customer Education team provides a fully configured virtual machine image for executing the labs and demos. This virtual machine comes complete with all the Xilinx tools and utilities necessary. The only aspect that the user must provide are any licenses for tools or IP.

Note that while the labs and demos are written for and validated on a Linux platform, every effort has been made to ensure that many labs will run under native Windows. The caveat is that certain applications, such as QEMU and PetaLinux, require the Linux OS to run. Labs and demos using these tools CANNOT be run under Windows.

The recommended minimum number of processors when running a virtual machine is eight processors in the host machine with four processors allocated to the virtual machine.

The configuration for VirtualBox is described later in this document; however, it is important to note that the more resources (processors and memory) that are available in the computer, the more resources can be allocated to the virtual machine, which makes for a much better (read: faster execution) lab experience.

Boards - All Classes

Unless otherwise specified, all Xilinx labs that use hardware target the ZCU104 board.

Exceptions:

Zynq UltraScale+ MPSoC Courses

There are several labs that, for the 2019.1 release only, target the ZCU102 board; however, these are software emulation labs that do not require a physical board. At the time that the necessary supporting files are available, these labs will be retargeted for the ZCU104 board.

Designing with the Zynq UltraScale+ RFSoC Course

The *Designing with the Zynq UltraScale+ RFSoC* course targets the ZCU111 board. Some of the labs target the ZCU111 board; however, this is only for demonstration—the board is not required for any of the labs. Currently, only limited simulation is available as the QEMU does not model any of the PL hardware, such as the SD-FECs or Data Converter IP. Any board support is not likely to arrive until version 2019.2 at the earliest.

Xilinx Partial Reconfiguration Tools and Techniques (KCU105) and C-based Design: High-Level Synthesis with the Vivado HLx Tool (KC705) Courses

These courses will be migrated to the ZCU104 board for a future release.

SOFTWARE REQUIREMENTS

All classes:

- Vivado Design or System Edition 2019.1
  - Must include SDK tools
- PetaLinux for most Embedded classes
- Adobe Acrobat Reader
  - Downloadable from: www.adobe.com/products/reader.html

Software drivers for the download cable:

- KC705 and ZC702 boards use the Silicon Image USB to UART Bridge (part number CP2103GM)
- Use Tera Term or GTKTerm or an equivalent serial port monitor
  - GTKTerm provided with the VM

For the *Embedded Systems Design* course only:

- License for Cadence BFM simulation Verilog API tasks
  - Licenses available on ATP accounts
  - Instructions for obtaining licenses can be found here: https://sp-ext.xilinx.com/wws/arc/Lists/Embedded%20Courses/Attachments/13/AXI-BFM%20licenses.pptx

Installing and Configuring VirtualBox

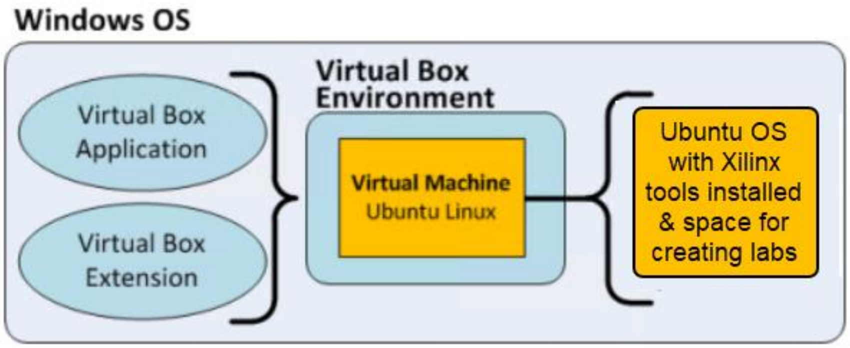
While Windows works for most development situations, there are some tools that are not yet supported under the Microsoft Windows operating system. For the sake of consistency, all Xilinx Customer Education labs are delivered using the Linux environment.

Running Linux under Windows is easily achieved using a virtual machine that forms an isolated container for another OS. The Oracle VirtualBox application was selected as the framework for hosting virtual machines as it works well and is available without the hassles of licensing. The Xilinx Customer Education team provides a VM that is properly configured to run the labs and demos.

The download, installation, and customization of the Oracle VirtualBox Manager only needs to be performed once per Oracle tool release.

There are two types of files needed: the VirtualBox application itself and the Linux OS and tools that will be run within the virtual machine.

The following figure is a quick overview of the process:

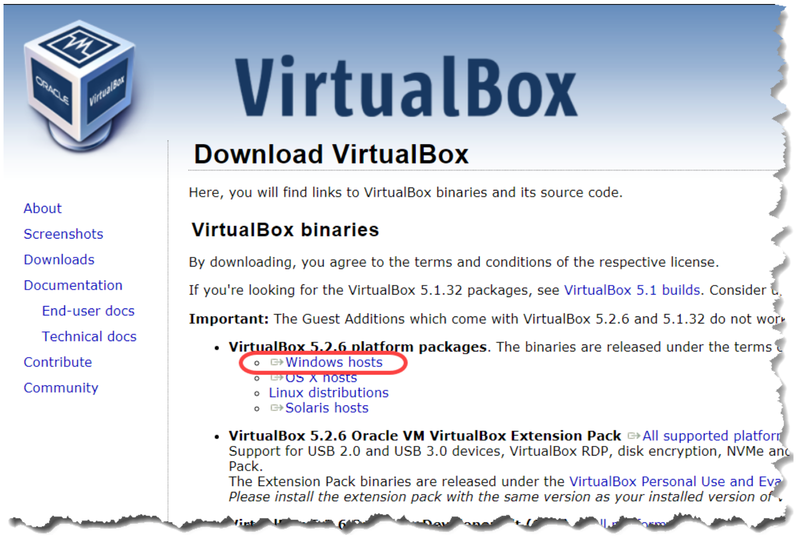


1) Acquire the VirtualBox application files.

There are two files required: the VirtualBox application and its extension.

1. Using an internet browser, go to www.virtualbox.org/wiki/Downloads.
2. Click **Windows hosts** to begin the download of the latest version of the application.

   The example shown here is for the 5.2.6 version of the Virtual Box tools using Google Chrome. The specific version is usually not relevant—just choose the latest.



Download VirtualBox

Here, you will find links to VirtualBox binaries and its source code.

VirtualBox binaries

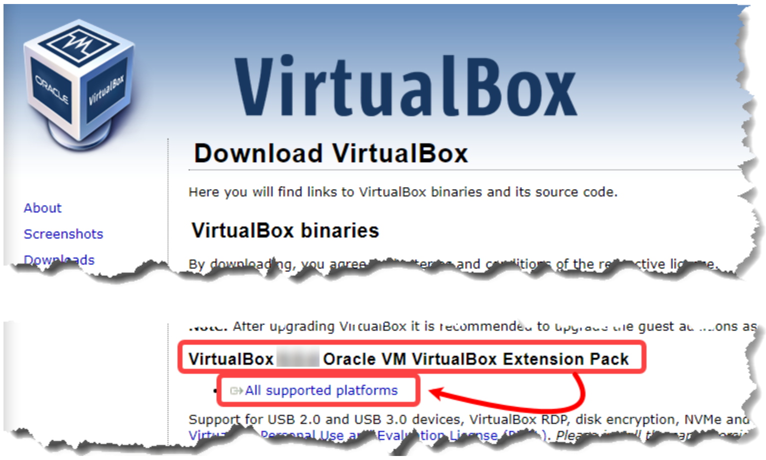
By downloading, you agree to the terms and conditions of the respective license.

If you're looking for the VirtualBox 5.1.32 packages, see VirtualBox 5.1 builds. Consider t

Important: The Guest Additions which come with VirtualBox 5.2.6 and 5.1.32 do not wor

- **VirtualBox 5.2.6 platform packages**. The binaries are released under the terms o
  - Windows hosts
  - OS X hosts
  - Linux distributions
  - Solaris hosts
- **VirtualBox 5.2.6 Oracle VM VirtualBox Extension Pack** All supported platforr
  Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption, NVMe anc Pack.
  The Extension Pack binaries are released under the VirtualBox Personal Use and Eva
  Please install the extension pack with the same version as your installed version of

3. Locate the entry for the VirtualBox Extension Pack.
4. Click the **All supported platforms** link to download the extension pack (operating system agnostic).



Download VirtualBox

Here you will find links to VirtualBox binaries and its source code.

VirtualBox binaries

By downloading, you agree to the terms and conditions of the respective license.

Note: After upgrading VirtualBox it is recommended to upgrade the guest additions as

VirtualBox [redacted] Oracle VM VirtualBox Extension Pack

- All supported platforms

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption, NVMe and

The extension provides support for USB devices and other enhanced functionality. It is important that the version of the extension matches the version of the application.

2) **[ATPs only]** Download the virtual machine and the starting points archive.

These files are not available to the population at large. Students should contact their ATPs if they wish to acquire these files. AEs/FAEs/Xilinx employees/distributor employees should contact their managers. Individual licenses are still required when using the VM.

1. Using an internet browser, go to ATP Resource Center (ARC).
2. Select any of the 2019.1 courses.

   The VM is a very large file, upwards of 50 GB. This large file is compressed and broken into 8 GB chunks to allow for an easier recovery if connection is lost during the download process.
3. Download each of the VirtualBox virtual machine files.

   You may need to confirm user information before the download begins. Use the back arrow to return to the location of the downloads to download the next file.
4. Extract the downloaded files by using the 7 Zip tool.

   You only need to click the file with the .7z extension. 7 Zip will find all the other zip chunks and decompress them. The 7 Zip tool can be downloaded from www.7-zip.org/download.html.
5. Download the starting points zip file from ARC.
6. Unzip the files by using the 7 Zip tool.

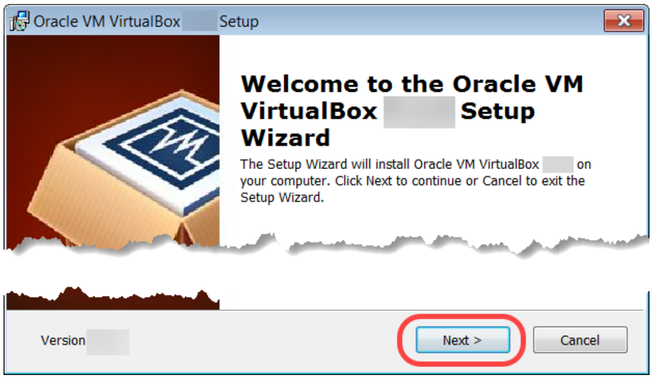
   When the extraction completes, you will see Ubuntu_VM.ova. This is the configured virtual machine to use.Now after extracting you should be able to see the following file: *Ubuntu_VM.ova.*

3) Install the VirtualBox application.

1. Navigate to the location where you saved the *VirtualBox-[version information]-Win.exe* file.
2. Double-click the **VirtualBox-[version information]-Win.exe** file.

   Alternatively, right-click and run as administrator.
3. If your OS requests permission or confirmation to install this application, click either **Yes** or **Run**.

   You will be greeted with the Welcome screen.



Oracle VM VirtualBox Setup

Welcome to the Oracle VM VirtualBox Setup Wizard

The Setup Wizard will install Oracle VM VirtualBox on your computer. Click Next to continue or Cancel to exit the Setup Wizard.

4. Click **Next** to continue.

   The Custom Setup screen enables you to customize various aspects of the VirtualBox. The default settings are sufficient for the needs of the VM that you will be running.
5. Click **Next** to accept the default settings and continue to the next dialog box.

This dialog box enables you select how you and your OS interface with the VirtualBox application. Again, the default settings are sufficient; however, you can deselect any options based on how you want your machine to access the application.

6. Click **Next** to move to the final phase of installation.

   Here you are warned that you will lose any internet connection when proceeding. Ensure that all downloads have completed.

7. Click **Yes** to proceed to the installation dialog box.
8. At the next dialog box, click **Install** to begin the actual installation process.

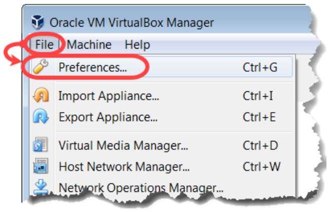
   You may be asked to confirm the installation. If so, click **Yes** or **OK**.

9. When the final dialog box opens, click **Finish** to complete the installation process and launch VirtualBox.

   If Windows asks if you want to restart the application in administrator mode, click **Yes**.

4) Install the extensions to VirtualBox.

1. Within the VirtualBox Manager, select **File** > **Preferences** to open the preferences dialog box.



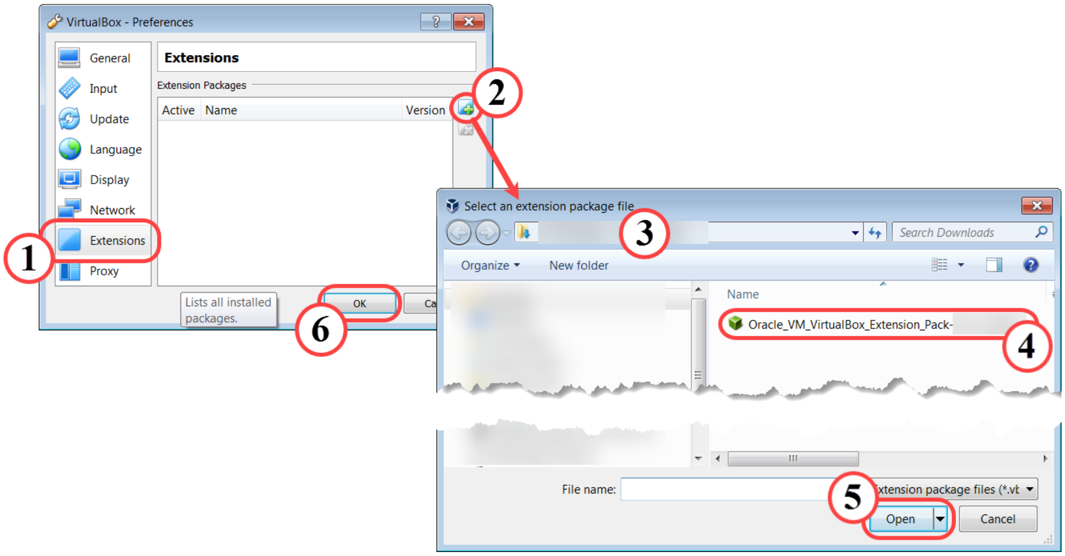
   The VirtualBox - Preferences dialog box opens.

2. Select **Extensions** from the left-hand navigation pane (1).
3. Click the **Add** icon to add the extension (2).

   This will open a file browser window.

4. Navigate to the directory containing the downloaded extension pack (3).
5. Select **Oracle_VM_VirtualBox_Extension_Pack-[version]** (4).
6. Click **Open** to accept this file (5).

The dialog box closes and the extension appears in the Extension Packages window.



7. Click **OK** to complete the process of adding the extension to the VB application (6).
   VirtualBox now opens a new dialog box asking you to confirm the installation process.
8. Click **Install** to install the extension.
9. Carefully read the VirtualBox license in its entirety.
   Once you reach the bottom of the agreement, the buttons will become enabled.
   Alternatively, you can scroll to the bottom.
10. Click **I Agree** to continue the installation process.
    When the extension has been completely installed, a dialog box will open.
11. Click **OK** to continue.

5) Locate the training directory.

The training directory on the host may be located anywhere. The important point here is that you will need to tell the VirtualBox Manager where you have put the host side training directory.

1. Unzip the starting points file to the host's training directory.
2. Make note of this location as you will need to enter it into the settings for the virtual machine.

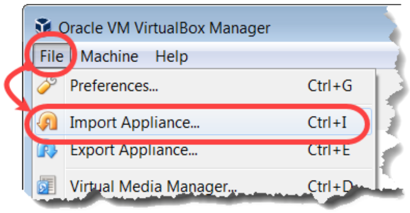
6) Launch the VirtualBox Manager application.

1. Select **Start Menu** > **Oracle VM VirtualBox** > **Oracle VM VirtualBox** to launch the VirtualBox Manager program.
   Alternatively, if a desktop or taskbar icon is available, you may simply click it.
   When the VirtualBox Manager opens, the left-hand pane will show all of the available virtual machines.
   With the VirtualBox application open and the extension installed, you can create a new virtual machine.

Caution: Before starting with the steps of assembling the virtual machine make sure that you have a directory named **training** in the **C drive** of your Windows machine. This directory will serve as a shared directory between the Linux virtual machine and the Windows host OS. You may locate the training directory anywhere in the host system; however, the instructions assume that *C:\training* is used.

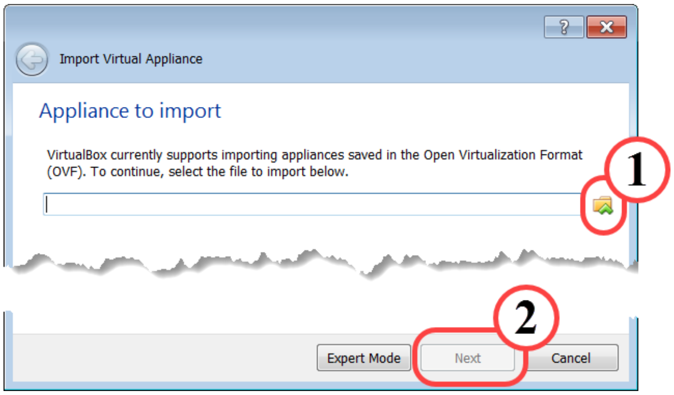
1) Create a new virtual machine based on the downloaded image.

1. Select **File** > **Import Appliances** to import the existing OVA file.



The Import Virtual Appliance dialog box opens.

2. Click the **Folder** icon in the right of the window to search for the appliance to import (1).



VirtualBox currently supports importing appliances saved in the Open Virtualization Format (OVF). To continue, select the file to import below.

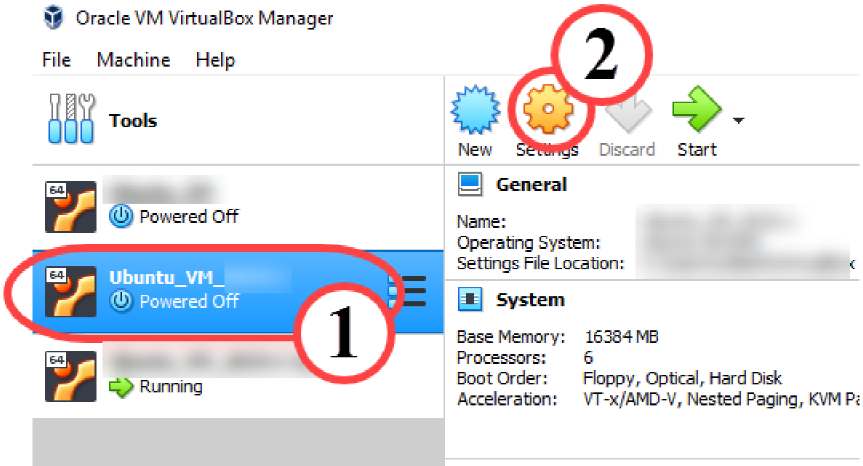
3. Browse to the location where the Ubuntu_VM.ova file is located.
4. Either double-click the **Ubuntu_VM.ova** file or select the file and click **Open** to load the image.
5. Click **Next** to continue the import process (2).

   The Appliance Settings dialog box opens. You can verify the VM settings here, such as number of CPUs, RAM information, and Network Adapter.
6. Click **Import** to create a new virtual machine based on the downloaded image files.

   Configuring appliance settings will be performed next.

2) Modify the VirtualBox settings.

1. Select the virtual machine from the list of VMs to access the virtual machine's settings (1).
2. Click the gear icon to open the settings for this VM (2).



[redacted]

General

Name: [redacted]
Operating System: [redacted]
Settings File Location: [redacted]

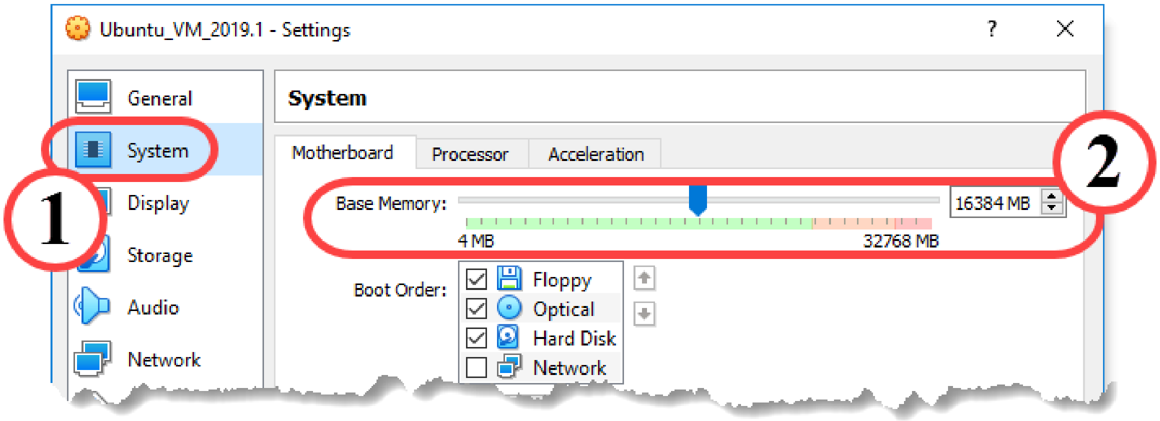
System

Base Memory: 16384 MB
Processors: 6
Boot Order: Floppy, Optical, Hard Disk
Acceleration: VT-x/AMD-V, Nested Paging, KVM Pa

3. Click **System** to access the system settings that will allocate how much of the host's resources will be available to the VM (1).
4. Set the amount of the host's memory to be used by the VM via the slider bar or the number field (2).

   Hint: The more memory that is allocated to the VM, the faster the VM will run. Similarly, the more memory on the host, the more that can be allocated to the VM.

   Note: The VirtualBox Manager reserves a minimum amount of memory for the host as indicated by the red portion of the slider bar.



System

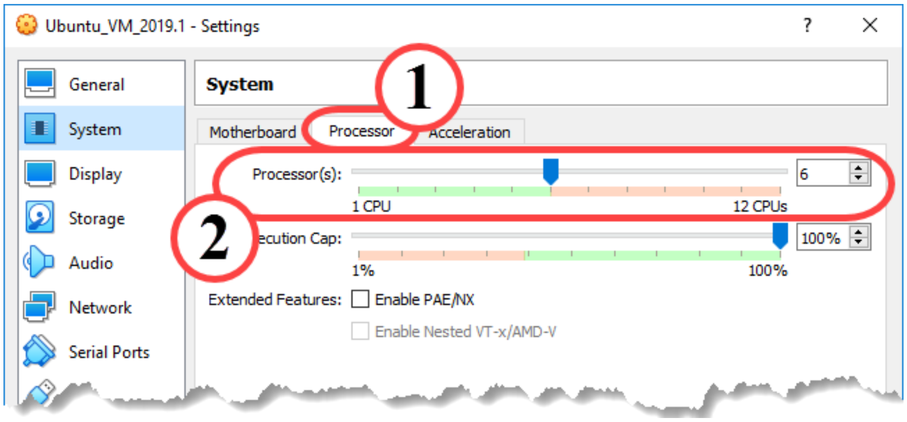
Base Memory: 16384 MB

Boot Order:
☑ Floppy
☑ Optical
☑ Hard Disk
☐ Network

5. Select the **Processor** tab to view the processor settings (1).
6. Select the number of processors to be used by the VM (2).

   Hint: The more processors allocated to the VM, the faster the VM will run.

Note: The VirtualBox Manager reserves a minimum number of processors (about half) for the host as indicated by the red portion of the slider bar.



Ubuntu_VM_2019.1 - Settings

System

Processor(s): 6

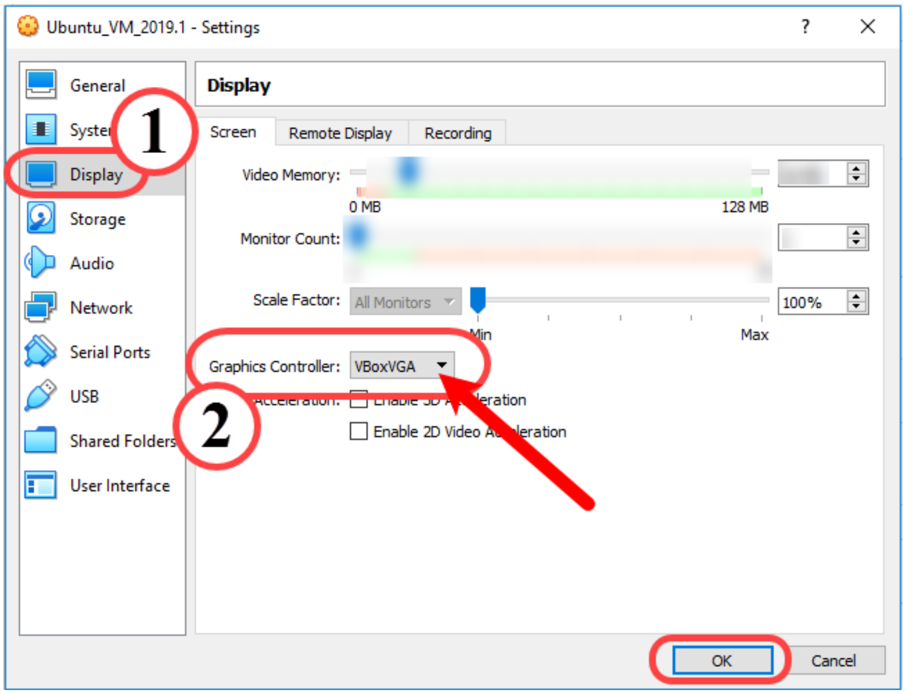
...ecution Cap: 100%

Extended Features: ☐ Enable PAE/NX

☐ Enable Nested VT-x/AMD-V

7. Select Display in the navigation pane to set the Video Display (1).
8. Select **VBoxVGA** from the Graphics Controller drop-down list to select the video emulator (2).

Note: VBoxVGA is a suggested starting point – text and graphics are large and clear. You can choose other settings to best suit the VM that you are running.



Ubuntu_VM_2019.1 - Settings

Display

Video Memory:

Monitor Count:

Scale Factor: All Monitors 100%

Graphics Controller: VBoxVGA

Acceleration: ☐ Enable 3D Acceleration

☐ Enable 2D Video Acceleration

Note: Many systems will need to have the network settings configured. This varies widely from machine to machine based on the specific hardware. The process is similar for network configuration as it is for any other configuration—select the Network option from navigation on the left, then make the selections that are best suited to your machine.

If you unzipped the training files to a location other than the default of C:\training, then you must tell the VM where you have installed it.

9. Click "**Shared Folders**" to access the list of shared folders.
10. Under Machine Folders, click **sf_training**.

    This will open a dialog box.
11. Change the **Folder Path** field to the location where you have unzipped your folder.
12. Click **OK** to save the modification.
13. Click **OK** to accept these options and exit.

3) [Optional] Remove the warning messages related to the keyboard and mouse when the VM starts.

1. Press <**Windows key** + **R**> to access the Windows command entry interface.

   This opens a window in which you can directly run programs.
2. Enter `cmd` to launch a DOS command shell.
3. From the command shell, enter the following to navigate to where the Oracle VirtualBox tools are installed:

   ```
   cd <VBM path>
   ```

   where VBM path is the path to where the Oracle VirtualBox tools were installed. Typically, this is *C:\Program Files\Oracle\VirtualBox*, but may vary based on the specifics of your installation.
4. Enter the following to instruct the VirtualBox Manager to suppress all warning and error messages:

   ```
   VBoxManage setextradata global GUI/SuppressMessages "all"
   ```
5. Enter `exit` to close the DOS command shell.

Running the Linux VM in Windows

As the Xilinx labs are written for the Linux environment, a Linux virtual machine is provided by the Customer Education team.

You will need to open this virtual machine to run the labs. This can be done at the beginning of each lab if you choose to shut the machine down between labs, or opened once and exited only when the desired labs have been performed.

Starting from the Windows environment, here are the steps to run the Ubuntu Linux VM.

1) Launch the VirtualBox Manager application.

The instructions for this lab are provided for the Linux environment. While Microsoft Windows works for most development situations, there are some tools that are not yet supported under the Windows operating system. For the sake of consistency, all Xilinx Customer Education labs are delivered using the Linux environment.

Running Linux under Windows is easily achieved using a virtual machine that forms an isolated container for another OS. The Oracle VirtualBox application was selected as the framework for hosting virtual machines as it works well and is available without the hassles of licensing. The Xilinx Customer Education team provides a VM that is properly configured to run the labs and demos. If you need to install VirtualBox and the VM, consult the lab setup guide in which this procedure is described in detail.

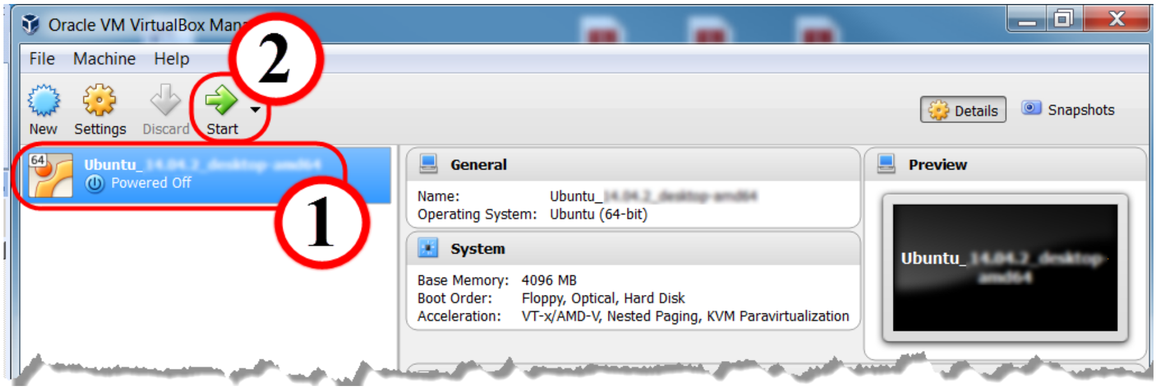
1. Select **Start Menu** > **Oracle VM VirtualBox** > **Oracle VM VirtualBox** to launch the VirtualBox Manager program.

   Alternately, if a desktop or taskbar icon is available, you can simply click it.

   When the VirtualBox Manager opens, the left-hand pane will show all of the available virtual machines. If Ubuntu_VM is absent, refer to the lab setup guide for instructions on how to download, install, and configure the VM.

2. Double-click the **Ubuntu_VM** virtual machine (1).

   Alternately, you can single-click the virtual machine of choice, then click the green right arrow icon to launch the selected virtual machine (2).



Name: Ubuntu_[redacted]
Operating System: Ubuntu (64-bit)

Base Memory: 4096 MB
Boot Order: Floppy, Optical, Hard Disk
Acceleration: VT-x/AMD-V, Nested Paging, KVM Paravirtualization

   The Ubuntu_VM virtual machine will now launch in a new window. It takes a few moments to boot. If any warning messages appears, such as anything regarding the mouse or keyboard, click the "x" on the line with the error and continue.

3. Click the **Maximize** (□) icon in the window title bar to expand the screen to its full size, if not already maximized.

If you are using SDK or SDx, perform the next set of instructions. For Vivado Design Suite and other tool users, this exploration is optional.

1) Once Linux is up and running, identify the locations of key files.

1. Press <**Ctrl** + **Alt** + **T**> to open a terminal window.

   A new terminal window opens.

2. Enter the following in the terminal window to see the location of where the training directory has been located:

```
echo $TRAINING_PATH
```

3. Note the location here as you will be referring to it for every lab: ______________________________________

   Important: SDK/SDx users: Henceforth, wherever you see $TRAINING_PATH you will need to type the information that you just discovered as the path. Vivado Design Suite users can use the variable name as is. Please keep this information handy!

   Repeat tasks 2 and 3 for the following commands:

   echo $XILINX_PATH ______________________

   echo $VERSION ______________________

   Note: An additional accelerator variable has been provided for you. Each lab that is in your training directory has a shortcut. Instead of referencing the lab directory with $TRAINING_PATH/<topic-name>, you can use $<topic-name>.

Xilinx Licensing

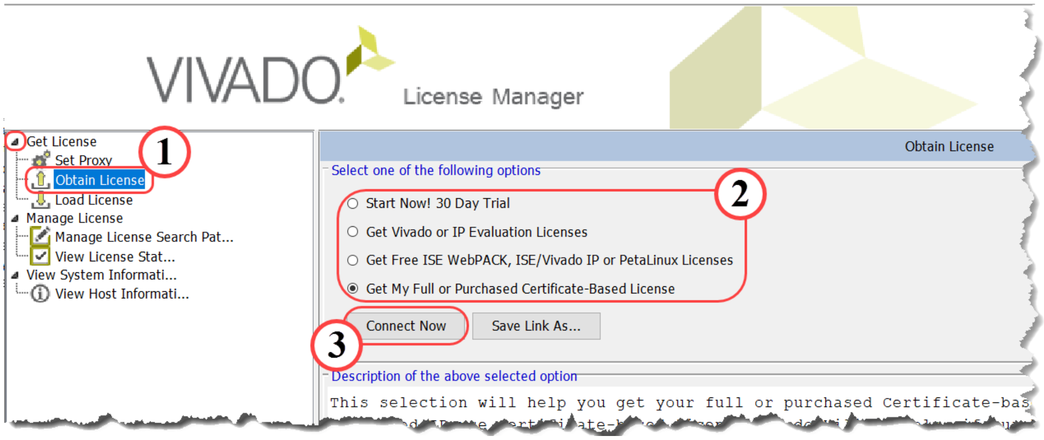
Licenses are required to synthesize and implement designs using the Vivado tools. The RFSoC course requires an additional license for the SD FEC IP.

You will be using the License Manager to add your existing license to the tools. If you are using a VM, perform this instruction from within the VM. If you plan on executing labs in both the VM as well as the Windows environment, you will need to generate and install licenses in both environments.

1) Open the Vivado License Manager.

1. Double-click the Vivado Design Suite icon to open the Vivado Design Suite.
2. Select **Help** > **Manage License** to open the Vivado License Manager (VLM).
3. Select **Obtain License** from the navigation panel on the left (1).
4. Select the type of license you are looking for.

   Typically, this is either the 30 day trial or the full license.
5. Click **Connect Now** to connect to the Xilinx license server.



Select one of the following options

○ Start Now! 30 Day Trial

○ Get Vivado or IP Evaluation Licenses

○ Get Free ISE WebPACK, ISE/Vivado IP or PetaLinux Licenses

● Get My Full or Purchased Certificate-Based License

Description of the above selected option

```
This selection will help you get your full or purchased Certificate-bas
```

A web browser window opens. The remainder of the tasks will take place here.

6. Sign in to the Xilinx site with your xilinx.com account.
7. Fill in the fields and click **Next** to accept the licensing agreement.

   The Product Licensing page opens.
8. Select the proper account.

   The options will vary depending upon your relationship with Xilinx. It is up to you to determine the proper access.

   The page will load the proper Certificate Based Licenses that you are eligible for.
9. Select **Vivado Design Suite HL System Edition, Node-Locked License**.
10. For the RFSoC course, select the SD-FEC license.
11. Click **Generate Node-Locked License**.
12. Select the **Host ID** (you may need to "Add a host.." before you can select it).
13. Click **Next**.
14. Confirm the new license request and click **Next**.

    The Xilinx license server will generate the license and send it to your email address. Alternatively, you can download the license directly from the Manage Licenses table.

15. Close the pop-up window.
16. Close the browser tab/window.

    You now need to return to the Vivado License Manager tool.
17. Select **Load License** from the left panel.
18. Click **Copy License**.
19. Navigate to where you put the license.
20. Select the license.
21. Click **Open** to load the license.
22. Close the Vivado License Manager.

2) For the RFSoC course only, special licenses are required for the Soft-Decision FEC IP.

1. Use the Xilinx licensing website and request licenses for the SD-FEC FEC IP for each machine that will use the SD-FEC IP (Communication and Networking).

   www.xilinx.com/products/intellectual-property/sd-fec.html

Java and the JRE

Many of the tools that are provided to both ease development and accelerate student productivity are provided as Java JAR files. These files can only be run when a Java Runtime Environment (JRE) is present.

Note: The JRE is pre-installed with the provided virtual machine image and you can skip this section.

If you need to install the JRE in your native Linux or Windows system, then proceed with the following instructions.

1. Download the JRE from java.com/en/download.

   Linux Installation

   Here are the commands for loading the JRE from a Linux terminal window:
2. Run an update.
   ```
   sudo apt update
   ```
3. Install the current version of the JRE:
   ```
   sudo apt install default-jre
   ```
   Note: It is possible that this may not install the latest version. If the latest version is not getting installed, go to dzone.com/articles/installing-openjdk-11-on-ubuntu-1804-for-real
4. Verify the version of Java:
   ```
   java -version
   ```
   Windows Installation
5. Double-click the installer that was downloaded in task 1 above to open the installer.
6. Install the JRE into its default location, usually *C:\Program Files (x86)*.

Setting the Environment Variables in Linux

The provided scripts and instructions leverage the use of several environment variables. These variables *MUST* be set properly to successfully complete the labs.

If you are using the provided Linux VM, these variables are set for you and no further work needs to be done.

If you are running a native Linux system, you will need to make a few basic modifications to your system so that the labs run smoothly.

First, you will need to unzip the *Linux_native_setup.zip* file. This file contains the following files:

- `profile` - Replaces the profile script in `/etc` and defines the necessary environment variables. You must modify this script (instructions included in the script) to match your system's configuration.
- `setupProfile.sh` - Copies and configures the profile and other files included in this script into their proper locations. Once the profile script is modified, you only need to run this script.
- `sudoers` - Gives users super user privileges (you may need to modify this for your configuration).
- `xsct.desktop/xsct_logo` - Adds the Xilinx Software Command Line Tool to the taskbar.
- `envVarSetter.tcl` - Scans the `$TRAINING_PATH` directory and turns all directories into shortcuts to help the students quickly navigate to the proper topic cluster files.
- `oneTime.sh` - Needs to be configured with the proper paths (like profile) and run only once.

Once the `profile` and `sudoers` files are modified, execute the `oneTime.sh` script. This script copies the `sudoers` file to `/etc`, disables the software updaters, uninstalls `xic`, installs the Java JRE (if not already installed), installs a file comparison tool called `diffuse`, installs the profiler and associated Tcl scripts, and adds the XSCT shortcut to the taskbar. This script only needs to be run once.

Understanding the Lab Environment

The labs and demos provided in this course are designed to run under the provided Linux platform. The provided Linux platform has a customized lab environment. These customizations have been made to simplify and enhance your learning experience. Many labs and demos can be successfully executed in the Windows environment as well. Topics including PetaLinux, Yocto, and QEMU are generally not supported under Windows.

The instructions, for the sake of brevity, are expressed using the Linux notation. This includes the forward slash ('/') as the hierarchy separator instead of the Windows backslash ('\'). For students who want to run under Windows, it is their responsibility to use the correct hierarchy separator.

Windows users can run Linux using the VirtualBox tool from Oracle. Details on how to acquire and install this tool can be found in the lab setup guide. The Xilinx Customer Education group offers a preconfigured virtual machine image and includes all the tools necessary to run the labs. Some tools and IP do require licenses, which are the responsibility of the student.

Several environment variables, described in detail in the lab setup guide, which also discusses how you can customize the environment for your situation, are provided for ease of use. Most notably, many environment variables have been defined to reduce the amount of typing you need to do when entering paths.

These environment variables are:

- XILINX_PATH - points to the installation directory for the Xilinx tools. Tools such as the Vivado Design Suite and SDK can be found here.
- PETALINUX_PATH - points to the installation directory for the Xilinx PetaLinux tools. Often this is within XILINX_PATH, but some choose to install it elsewhere.
- TRAINING_PATH - points to the space allocated for students to work through their labs. This directory includes prebuilt images and starting points for the labs and demos.
- <topic name> - points to the specific name of the topic within the TRAINING_PATH directory. For example, $TRAINING_PATH/Open_AMP is shortened to just $Open_AMP.

This lab uses $<topic name> to indicate the directory for this lab, which is equivalent to $TRAINING_PATH/<topic name>.

These environment variables work well in the Vivado Design Suite and scripts, but not in Eclipse-based tools such as SDK and the SDx™ environment. When using the Vivado tools, you can use $<topic name> and the tools will automatically expand the $<topic name> environment variable for you. However, when you see the notation $<topic name>/workspace in SDK or the SDx environment, you should interpret it in its expanded form as /home/xilinx/training/<topic name>/workspace.

This lab assumes that you are starting with a Linux environment. If you are working on a Windows system, refer to the lab setup guide to see how to use the Oracle VirtualBox application to run the Xilinx Customer Education pre-configured Ubuntu Linux virtual machine.

Understanding the Training Directory in the VM Environment

Xilinx provides the customer training VM environment for executing the labs and demos. This environment is fully loaded with all the Xilinx tools necessary to successfully complete these labs and demos. Lab and demo files are provided as a separate zipped file containing the student-ready starting points, which can be downloaded from ARC or www.xilinx.com/training/downloads.htm. These starting points need to be extracted into the training directory on the *host* system before starting a lab/demo.

The Xilinx Customer Education VM environment contains an /etc/profile script that scans the VM's training directory. If there are any directories in the host systems' training directory that are absent in the VM's training directory, these directories are copied from the host to the VM.

This means that if students reboot their VM, their work is preserved.

The implication is that if a fresh installation of a specific topic cluster is required, then the topic cluster directory in the VM's training directory must be removed (`rm -rd $<topic name>`) and the VM must be rebooted. Similarly, if the entire VM training directory needs to be refreshed, then the user merely needs to type `rm -rd $TRAINING_PATH`, then reboot the VM.

Launching and Configuring the Tera Term Terminal Program in Serial Port Mode

Maintaining consistency in the instructions is an important aspect of the lab experience. The labs will use general and vague commands such as "Open the terminal emulator". Depending on the system that you are using, you must know which terminal emulator to configure and launch. Here are the instructions for opening a terminal emulator for both the Linux and Windows environments.

Generally, the software labs will use the serial terminal built into the SDK/SDx tools; however, there are some labs that will require you to communicate with the board without using the SDK/SDx tools. These situations require the use of a third-party serial port emulator.

Xilinx Customer Education has tested Tera Term for the Windows environment and GTKTerm for Linux. The GTKTerm tool is pre-installed with the Xilinx Customer Education VM. Both terminal emulators listed here run independently of the Xilinx tools. If you have another terminal emulator that you prefer, you can certainly use it; however, you are responsible for figuring out how to configure it.

Linux

GTKTerm is a simple GTK+ terminal used to communicate with the serial port. Other terminal emulators may be used; however, the installation and configuration instruction provided here are for GTKTerm.

GTKTerm is already installed in the VM provided by the Xilinx Customer Education team; however native Linux users may need to install GTKTerm.

1) [Native Linux users] Acquire and install the GTKTerm software from the command line.

1. Press <**Ctrl** + **Alt** + **T**> to open a new terminal.
2. Download and install GTKTerm:

   ```
   [host] $ sudo apt install gtkterm
   ```
3. When prompted for the password, enter the super user password.

   The tools will install in about a minute or less.

2) Launch GtkTerm and set the port configuration.

1. Press <**Ctrl** + **Alt** + **T**> launch a Linux terminal window.

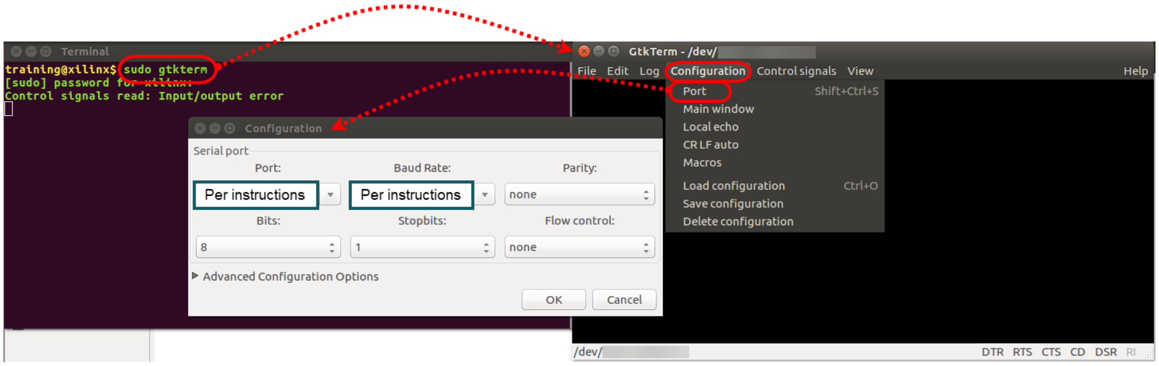
2. Enter the following to launch GtkTerm from the terminal window:
   `sudo gtkterm`
3. When prompted for the password, enter the super-user password. VM users will use "**`xilinx`**".

   Note: While the application will run as a regular user, you must be a super user to access the ports.

   When the GtkTerm window opens, perform the following.
4. Select **Configuration** > **Port** to open the Configuration dialog box.
5. Identify the port associated with your board and set the port as **/dev/ttyUSBx** (where x could be 0, 1, 2, 3 etc.)
6. Set the baud rate to **115200**.

   Leave the rest of the settings at their default.

   Note: You can open multiple instances of **`/dev/USBx`** if you are unable to find out which port your UART is connected to.



```
training@xilinx$ sudo gtkterm
[sudo] password for xilinx:
Control signals read: Input/output error
```

Configuration

Serial port

Port: Per instructions

Baud Rate: Per instructions

Parity: none

Bits: 8

Stopbits: 1

Flow control: none

   [Optional]: You can save these settings so that you do not have to reconfigure GtkTerm each time you open it by selecting **Configuration** > **Save configuration**.

   If you save the configuration as "default" this configuration will open when GtkTerm starts. Otherwise you can save the configuration by another name; however, you will then need to load the configuration each time you start GtkTerm.
7. Click **OK** to save the settings and leave the terminal open.

Windows

Tera Term is a popular public domain terminal emulation program. It is capable of operating as a serial port terminal or as a telnet client.

1) Download and install Tera Term.

1. Acquire and install the Tera Term software from any legitimate site. Recommended sites:
   - ttssh2.osdn.jp/index.html.en (Tera Term home page with documentation)
   - osdn.net/projects/ttssh2
   - en.sourceforge.jp/projects/ttssh2
   - logmett.com
2. Install per instructions.

   There are two types of downloads: a traditional zip install, and a self installing version, which is recommended.

[Optional]

Certain drivers like installing their com port numbers using high numbered serial ports. Tera Term does not accept these port numbers by default, so you will need to override the Tera Term settings:

1. Open **TERATERM.INI** (found in the install path for Tera Term) with an ASCII text editor.
2. Set to MaxComPort=256.
3. Save and close the INI file.
3. Use the **Setup** > **Save Setup** option to save the setup.

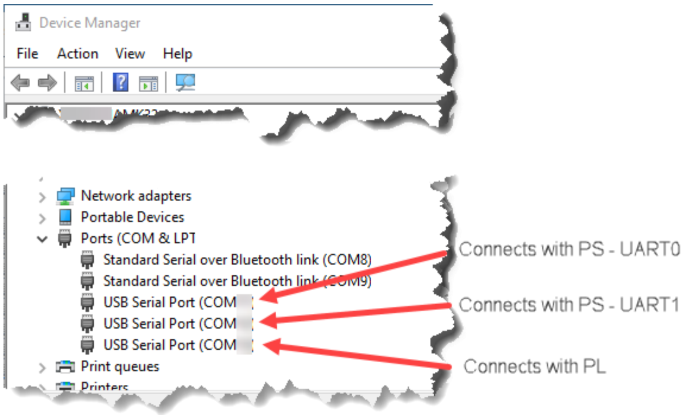
2) Launch the Tera Term terminal program.

1. Double-click the **Tera Term** icon on the Windows desktop to launch Tera Term.

   Alternatively, you can select **Start** > **All Programs** > **Tera Term** > **Tera Term**.
2. Select **Serial** as the connection (1).
3. Click the **Port** drop-down list to view the available COM ports (2).

   Note: If your port is not listed, exit Tera Term, power cycle your board and re-start this step.
4. Select the COM # (3).

   Hint: MPSoC and RFSoC devices display three COM ports. Their specific numbers may vary based on the USB enumeration process; however, the first two COM ports connect to the UARTs in the PS and the third connects to PL pins.

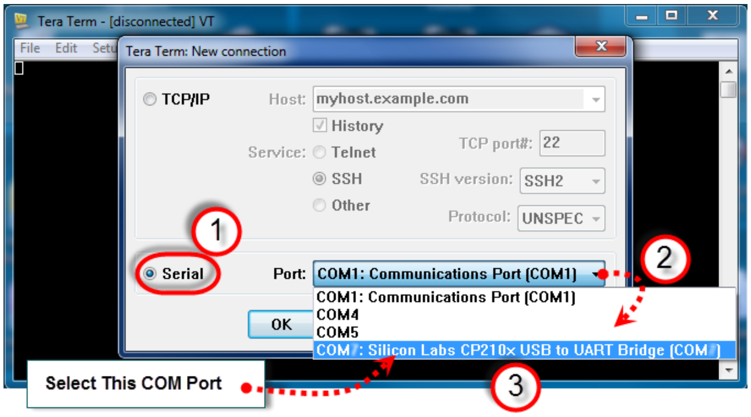


- Network adapters
- Portable Devices
- Ports (COM & LPT
  - Standard Serial over Bluetooth link (COM8)
  - Standard Serial over Bluetooth link (COM9)
  - USB Serial Port (COM
  - USB Serial Port (COM
  - USB Serial Port (COM
- Print queues
- Printers

Connects with PS - UART0

Connects with PS - UART1

Connects with PL



○ TCP/IP Host: myhost.example.com

☑ History

Service: ○ Telnet TCP port#: 22

● SSH SSH version: SSH2

○ Other Protocol: UNSPEC

● Serial Port: COM1: Communications Port (COM1)

COM1: Communications Port (COM1)
COM4
COM5
COM : Silicon Labs CP210x USB to UART Bridge (COM)

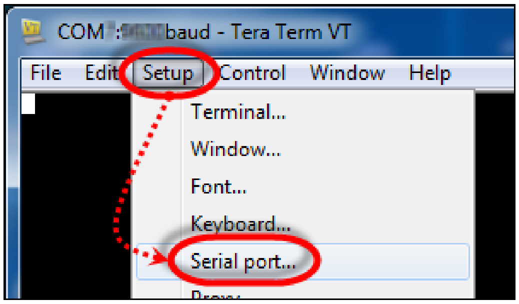
Select This COM Port

Note: The COM port setting is specific to the computer being used and may need to be different than shown. Use the COM port # that was discovered in the previous step.

5. Click **OK**.

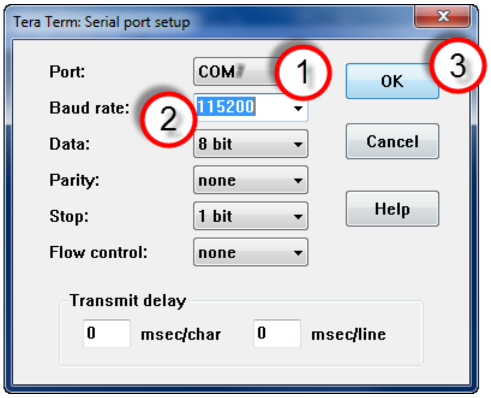
   The terminal console window opens.

6. Select **Setup** > **Serial Port**.



   The Tera Term Serial Port Setup dialog box opens.

7. Confirm that the proper serial port has been selected (1).
8. Set the baud rate to **115200** (2).



Port: COM[redacted]
Baud rate: 115200
Data: 8 bit
Parity: none
Stop: 1 bit
Flow control: none
Transmit delay
0 msec/char 0 msec/line

Note: The COM port setting is specific to the computer being used and may need to be different than shown. Use the COM port # that was discovered in the previous step.

9. Click **OK** (3).

   Tera Term is now configured to receive and transmit serial information to/from the evaluation board.

Setting Static Host IP Address on Laptop (Windows 7)

These instructions illustrate how to change to or set up a *static* IP address on the host computer. Follow the reverse of these instructions to change back to a DHCP-received address.

For labs that require an Ethernet connection between the laptop host computer, the hardwired Ethernet settings on your host machine must be set up properly to work with the hardware evaluation board. Typically, the PC's Ethernet port is set to automatically request an IP address from the network DHCP client server. Because the hardwire Ethernet connection will attach directly to the hardware evaluation board, there will not be a DHCP server to supply the needed IP address for the host computer. It is therefore necessary to reconfigure the TCP/IP client (laptop) with its own *static* IP address. After you are finished with this lab, you can revert this step and set TCP/IP properties to obtain an IP address automatically.

Most Xilinx software applications use an IP address of 192.168.1.11. The host computer is required to have an IP address of 192.168.1.**num**, where **num** is any number between 2 and 255 except 11 (which is reserved for the Xilinx hardware).

Windows

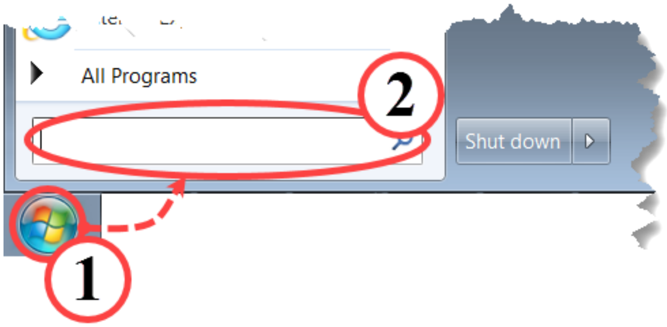
1) Set the static host IP address.

1. If wireless is on, it is suggested that you **turn if off** with the switch on your computer or disable in settings.

   How to perform this will vary with different PC wireless hardware.

   While this step should not be necessary, there has been reports that the wired Ethernet port does not work with static address (192.168.1.**num**) using the same base subnet address of the wireless adapter.
2. **[Windows 7 users]:** Click **Start** (1).
3. **[Windows 7 users]:** Enter the following into the search bar (2):

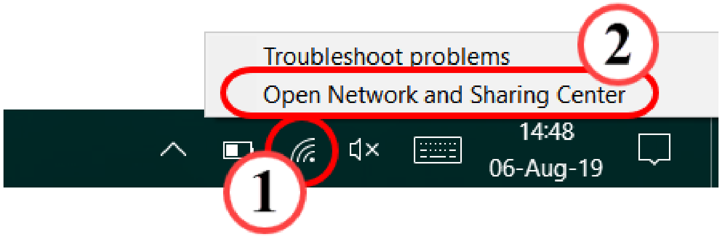
   network and sharing center



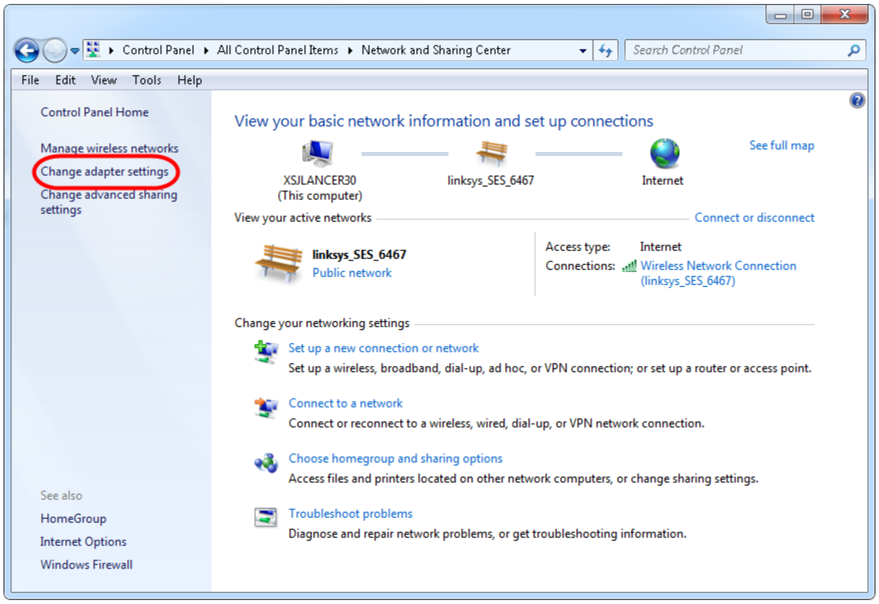
Note: You may be asked to confirm opening the Device Manager. If so, click **Yes**.

[Windows 10 users]: Right-click the networking icon on the bottom-right corner of the taskbar (1).

[Windows 10 users]: Select **Open Network and Sharing Center** (2).



4. From the Network and Sharing Center left pane, select **Change Adapter Settings**.



View your basic network information and set up connections

View your active networks

linksys_SES_6467
Public network

Access type: Internet
Connections: Wireless Network Connection (linksys_SES_6467)

Change your networking settings

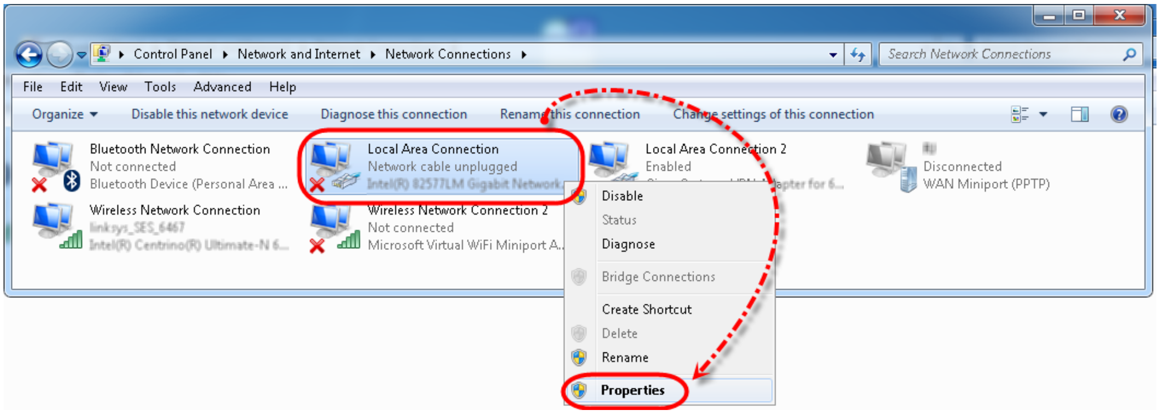
Set up a new connection or network
Set up a wireless, broadband, dial-up, ad hoc, or VPN connection; or set up a router or access point.

Connect to a network
Connect or reconnect to a wireless, wired, dial-up, or VPN network connection.

Choose homegroup and sharing options
Access files and printers located on other network computers, or change sharing settings.

Troubleshoot problems
Diagnose and repair network problems, or get troubleshooting information.

5. Select the Ethernet adapter to be used.
6. Right-click and select **Properties**.


Control Panel ▸ Network and Internet ▸ Network Connections ▸
Search Network Connections
File Edit View Tools Advanced Help
Organize ▾
Disable this network device
Diagnose this connection
Rename this connection
Change settings of this connection
Disable
Status
Diagnose
Bridge Connections
Create Shortcut
Delete
Rename
Properties

Bluetooth Network Connection
Not connected
Bluetooth Device (Personal Area ...

Local Area Connection
Network cable unplugged
Intel(R) 82577LM Gigabit Network

Local Area Connection 2
Enabled
...apter for 6...

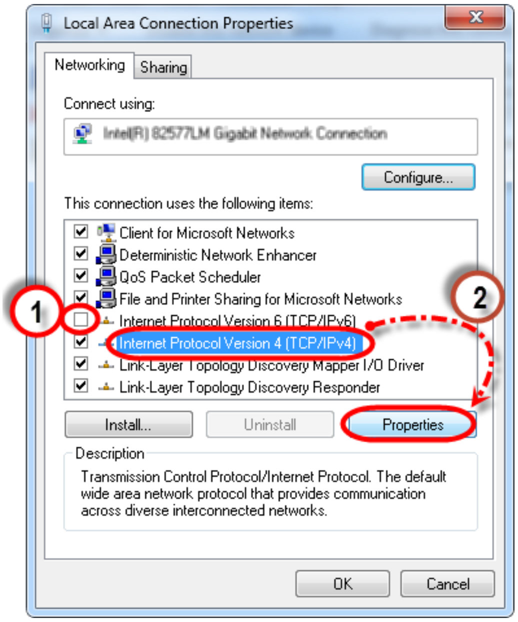
Disconnected
WAN Miniport (PPTP)

Wireless Network Connection
linksys_SES_6467
Intel(R) Centrino(R) Ultimate-N 6...

Wireless Network Connection 2
Not connected
Microsoft Virtual WiFi Miniport A...

7. Click **Yes** to make changes (if necessary).

8. Deselect **Internet Protocol Version 6 (TCP/IPv6)** (1).
9. Select **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties** (2).



Local Area Connection Properties

Networking | Sharing

Connect using:

Intel(R) 82577LM Gigabit Network Connection

Configure...

This connection uses the following items:

☑ Client for Microsoft Networks
☑ Deterministic Network Enhancer
☑ QoS Packet Scheduler
☑ File and Printer Sharing for Microsoft Networks
□ Internet Protocol Version 6 (TCP/IPv6)
☑ Internet Protocol Version 4 (TCP/IPv4)
☑ Link-Layer Topology Discovery Mapper I/O Driver
☑ Link-Layer Topology Discovery Responder

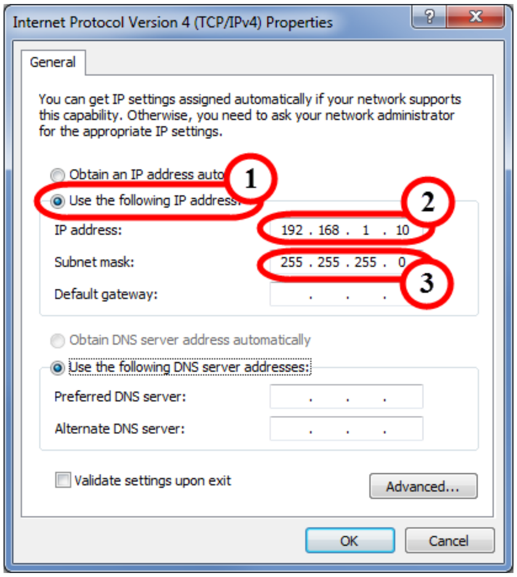
Install... | Uninstall | Properties

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

OK | Cancel

10. Select **Use the following IP address** (1).
11. Enter **192.168.1.10** in the IP address field (2).
    This value is fairly arbitrary, but it cannot be the same as the IP address designated for the board.
    The Subnet mask field should fill in with **255.255.255.0** automatically after leaving the IP address field (3).



Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address auto
● Use the following IP address:

IP address: 192 . 168 . 1 . 10
Subnet mask: 255 . 255 . 255 . 0
Default gateway: . . .

○ Obtain DNS server address automatically
● Use the following DNS server addresses:

Preferred DNS server: . . .
Alternate DNS server: . . .

□ Validate settings upon exit

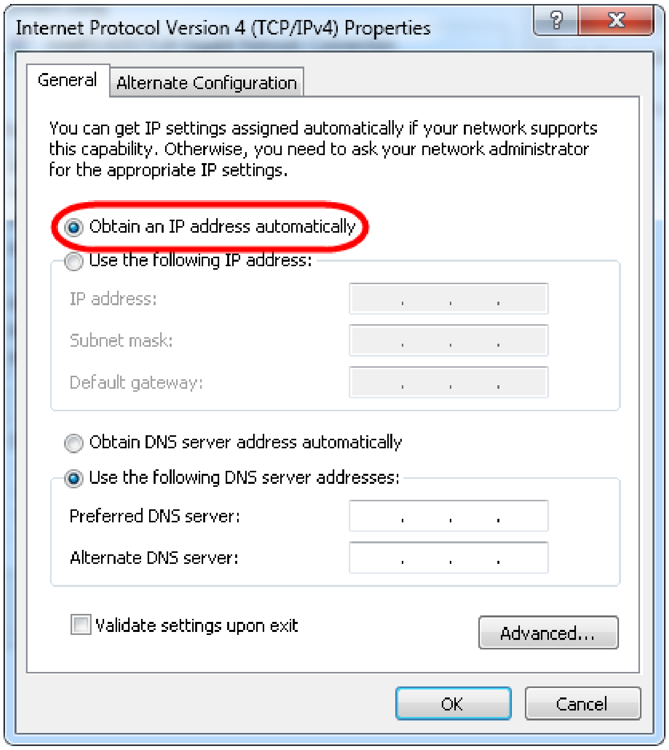
Advanced...

OK | Cancel

12. Click **OK**.
13. Click **Close**.
14. Close the Control Panel.

2) To return to a DHCP-obtained address, follow the same steps to revert the settings.

1. Select the **Internet Protocol Version 6 (TCP/IPv6)** option.
2. Select **Internet Protocol Version 4 (TCP/IPv4)** and click **Properties**.
3. Select **Obtain an IP address automatically**.



You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

● Obtain an IP address automatically

○ Use the following IP address:

IP address: . . .

Subnet mask: . . .

Default gateway: . . .

○ Obtain DNS server address automatically

● Use the following DNS server addresses:

Preferred DNS server: . . .

Alternate DNS server: . . .

□ Validate settings upon exit

4. Click **OK**.
5. Click **Close**.

Linux

1) Set the static host IP address.

1. Press <**Ctrl** + **Alt** + **T**> to open a new terminal.
2. Enter the following command to set the static IP:

```
[host] $ ifconfig eth0 192.168.1.10
```

3. Exit the terminal:

```
[host] $ exit
```

2) To return to a DHCP-obtained address, follow the same steps to revert the settings.

1. Reboot the Linux machine or VM to revert the static IP settings that you set in the previous step.

Preparing an SD Card [Common for Windows and Linux]

1) Prepare an SD card.

1. Insert an SD card into the PC's SD card slot.
2. **[Linux users]:** Make sure that you copy the SD card files from Linux to the *C:\training* directory by entering the following command:

   ```
   [host]$ cp -rf <path_to_sd_card_files> /media/sf_training
   ```
3. Browse to the SD card drive using Windows Explorer.

   Optional: You may want to erase or reformat the SD card at this time, which may prevent any unwanted interaction with other files that may be on the card.
4. Open a second Windows Explorer window to browse to *the location of the files you want to copy to the SD card*, which will be copied to the SD card.

   Be aware that many SD card images are delivered as compressed files. You will need to ensure that these files are properly decompressed unless otherwise indicated.
5. Drag-and-drop all the files from the source directory to the SD card directory.

   This will automatically copy the files onto the SD card.

   Note: The files should go into the root of the SD card unless there are specific instructions to the contrary.
6. Close both Windows Explorer windows.
7. Remove the SD card from the PC card slot.
8. Turn off power to the hardware platform.

   Note: The boot selection switches or jumpers must be properly set to boot from the SD card. See the appropriate section in the *Lab Setup Guide*.
9. Insert the SD card into its slot on the hardware platform.

LAB FILES DOWNLOAD & INSTALLATION

The lab files are organized by topic and are typically located on the host PC in the *C:\training* directory as a root. It is important to maintain this directory location and structure as some of the tool project files (especially SDK, for example) use absolute file locations. Ignoring this warning will lead to erratic tool behavior.

Lab files can be downloaded from one of two locations:

- sp-ext.xilinx.com/wws/arc/materials
  - ARC ATP access only
  - Includes class presentation slides
  - Password protected
- www.xilinx.com/training/downloads.htm
  - Public access, but does require Xilinx registration
  - Lab files only

Note that a registered xilinx.com user ID is required.

The delivery format is a zip file, the size of which will vary depending on the course. The zip file preserves the needed file directory structure. Unzip the file to the root of the *C:\* drive and the files will be placed in the *training* directory.

The public access site download contains only the lab files while the ARC ATP site download includes the course presentation slides. The ARC site also includes the various course collateral documents as well previous course versions.