CSEE 4840 Embedded System Design Tutorial: Installing Quartus and Related Tools

Stephen A. Edwards Columbia University

2015

This shows how to install Quartus 13.1 under CentOS 5.9 running on a virtual machine (Virtualbox). This will enable you to use your own machine to develop hardware and software for the SoCKit board. You can also connect a SoCKit board to your host machine and program its FPGA through your virtual machine.

1 Download and Install VirtualBox

Download a binary for your platform from https://www.virtualbox.org/wiki/Downloads. Download both the platform-specific "platform package" and the platform-independent "VirtualBox Extension Pack" with the matching version number.

VirtualBox binaries

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

- VirtualBox platform packages. The binaries are released under the terms of the GPL version 2.
 - VirtualBox 4.3.6 for Windows hosts ⇔x86/amd64
 - VirtualBox 4.3.6 for OS X hosts ⇒x86/amd64
 - VirtualBox 4.3.6 for Linux hosts
 - VirtualBox 4.3.6 for Solaris hosts ⇒x86/amd64
- VirtualBox 4.3.6 Oracle VM VirtualBox Extension Pack ⇒ All supported platforms
 Support for USB 2.0 devices, VirtualBox RDP and PXE boot for Intel cards. See this chapter from the User
 Manual for an introduction to this Extension Pack. The Extension Pack binaries are released under the
 VirtualBox Personal Use and Evaluation License (PUEL).
 Please install the extension pack with the same version as your installed version of VirtualBox!
 If you are using VirtualBox 4.2.20, please download the extension pack ⇔ here.
 If you are using VirtualBox 4.0.20, please download the extension pack ⇔ here.

Install the platform package and run it.

Install the VirtualBox Extension Pack: either double-click the file's icon or start VirtualBox, go to File \rightarrow Preferences \rightarrow Extensions, and add the extension. This enables USB 2.0 devices, among other things.



If your host machine is Linux, VirtualBox needs permissions to access USB devices. As root on your host, run usermod -a -G vboxusers *user*, where *user* is the name of the user that runs the VirtualBox. You will need to log out and back in for this change to take effect. Without this step, VirtualBox will give "Failed to access USB subsystem" errors.

2 Download CentOS 5.9

Download the first CentOS 5.9 DVD image from, e.g., http://mirrors.arsc.edu/centos/5.9/isos/.

Download CentOS-5.9-x86_64-bin-DVD-10f2.iso.

If you have an older (32-bit) machine, then download CentOS-5.9-i386-bin-DVD-10f2.iso.

Do not unpack these files: the VM reads .iso files directly.

3 Install CentOS 5.9 on the VM

Start VirtualBox and click "New" to create a new virtual machine. Call it "CentOS 5.9," set the type to "Linux," and the version to "Red Hat (64 bit)" (or just "Red Hat" if you have an older machine).

,	Name Please c machine intend to used thr	and operating system hoose a descriptive name for the ne and select the type of operating sys o install on it. The name you choose oughout VirtualBox to identify this i	w virtual stem you will be machine.
	Name: Type: Version:	CentOS 5.9 Linux Red Hat (64 bit)	÷
(Hide Descri	ption < <u>B</u> ack <u>N</u> ext >	Cancel

Select at least "2048 MB" (2 GB) for memory size. Bigger is better, but do not ask for more than, about half of your host machine's memory. If necessary, change this later with Settings→System→Motherboard→Base Memory.



On the next screen, select "Create a virtual hard drive now." Then select "VDI (VirtualBox Disk Image)." Then select "Dynamically allocated." Finally, set the size to "40 GB" and click "Create."



The virtual machine should now be configured:

	ę	
<u>F</u> ile <u>M</u> achine <u>H</u> elp		
New Settings Start Di	iscard	😵 Details 💿 Snapshots
CentOS 5.9	📃 General	Preview
Powered Off	Name: CentOS 5.9 Operating System: Red Hat (64 bit)	
	System	
	Base Memory: 2048 MB Boot Order: Floppy, CD/DVD-ROM, Hard Disk	CentOS 5.9
	Acceleration: VT-x/AMD-V, Nested Paging, PAE/NX	
	Display	
	Video Memory: 19 MB Remote Desktop Server: Disabled	
	Storage	
	Controller: IDE IDE Secondary Master: [CD/DVD] Empty Controller: SATA SATA Port 0: CentOS 5.9.vdi (Norm	nal, 40.00 GB)
	🖗 Audio	
	Host Driver: PulseAudio	

Click "Start" to boot the virtual machine. Select the first CentOS 5.9 installation DVD image (e.g., "CentOS-5.9-x86_64-bin-DVD-10f2.iso") as the startup disk using Devices→CD/DVD Devices→Choose a virtual CD/DVD disk file...

At this point, clicking in the virtual machine window passes control of the mouse and keyboard to the virtual machine; the right control key returns control to your host operating system.

We will simplify this later.

Press Return in the VM to install CentOS 5.9 in graphical mode:



Select "Skip" when it asks about testing the installation media.

Select your preferred language and keyboard layout.

Allow it to "Remove linux partition on selected drives and create default layout."

Allow it to make eth0 (the network connection) active on boot and have it set the hostname automatically via DHCP.

Choose and remember a good root password.

Allow it to install software for the default "Desktop - Gnome" task (you won't need the others).

Start the installation process; it will take a while.

Click on "Reboot" when it says "Congratulations." Your virtual machine should now reboot into CentOS 5.9 and present you with a welcome screen.



Click "Next." Leave the firewall enabled with SSH trusted.

Click "Forward." **Important:** Set the SELinux Setting to "Disabled." Leaving SELinux enabled will prevent Quartus from starting and give cryptic "cannot restore segment prot" errors.

Create a user account for yourself.

Click "Finish" and allow the system to reboot.

Log in as root on the vм.

Open a terminal window by selecting Applications→Accessories→Terminal.

Type "yum update -y" to install system updates (-y tells it to skip prompts). When I did this, it downloaded and installed over 200 packages.

4 Install VirtualBox Guest Additions on the VM

From http://download.virtualbox.org/virtualbox/4.2.16/ (replace 4.2.16 with the VirtualBox version you installed; see Help→About Virtualbox...to check the version), download VBoxGuestAdditions_4.2.16.iso

Log in as root on the vм.

Open a terminal window by selecting Applications \rightarrow Accessories \rightarrow Terminal.

Type "yum install -y gcc kernel-devel"

Mount the Guest Additions ISO file by selecting

Devices→CD/DVD Devices→Choose a virtual CD/DVD disk file...and then selecting the VBoxGuestAdditions ISO file.

Type "cd /media/VBOX*"

Type "./VBoxLinuxAdditions.run" and let the additions compile and install themselves.

Reboot the VM. It should start up in a much larger window and no longer require you to click to focus the mouse in the VM window.

5 Download Quartus 13.1, Updates, and the SoC Design Suite

On your host machine, download Quartus II Web Edition v13.1 from http://dl.altera. com/?edition=web

Select "Linux," "Direct Download," "Combined Files" and download "Quartus-web-13.1.0.162-linux.tar."



You may have to sign up for a (free) account to do this.

Download any updates (e.g., QuartusSetup-13.1.1.166.run.crdownload)

Download "SoC Embedded Design Suite (EDS)" under "Additional Software."

Download and in	stall instructions:									
Add-on Software	e									
If you have already installed Quartus II software: 1. Download the add-on software you want to install. 2. Run the downloaded installation file. If you have not already installed the Quartus II software: 1. Download the Quartus II software installation files, device files, and add-on software you want to install in the same temporary directory. 2. Run the QuartusSetupWeb-13.1.0.162.run file.										
						Stand-Alone Sof	tware			
						1. Download the	stand-alone software	e you want to ir	istall into a temporary di	rectory.
						2. Run the down	loaded installation file	e.		
						Read Altera Soft	Read Altera Software v13.1 Installation FAQ			
Quick Start Guid	e									
Add-On Softwa	ire									
Altera SDK f	or OpenCl 🚯									
Altera SDK f Size: 499.2 N	or OpenCL 🕖 18 MD5: 3985FBFE11	19D55D9F56637	E7324CC36D	0						
Altera SDK f Size: 499.2 N	or OpenCL i 18 MD5: 3985FBFE11	L9D55D9F56637	E7324CC36D	0						
Altera SDK f Size: 499.2 M DSP Builder Size: 86.4 M	or OpenCL () 18 MD5: 3985F8FE11 3 MD5: 008084D76E	19D55D9F56637 76BB22E3D37C	E7324CC36D 338719EB17	0						
Altera SDK f Size: 499.2 M DSP Builder Size: 86.4 Mi Ouartus II H	or OpenCL () 18 MD5: 3985F8FE11 3 MD5: 008084D76E; 1elp	19D55D9F56637 76BB22E3D37C	E7324CC36D 338719EB17	0						
Altera SDK f Size: 499.2 M DSP Builder Size: 86.4 Mt Quartus II H Size: 353.7 M	or OpenCL () 18 MD5: 3985F8FE11 3 MD5: 008084D76E3 lelp 18 MD5: E8F6A670E1	L9D55D9F56637 76BB22E3D37C L6726C23C46C/	E7324CC36D 338719EB17 A9C1B07F116	0 0 0						
Altera SDK f Size: 499.2 N DSP Builder Size: 86.4 M Quartus II H Size: 353.7 N Stand-Alone So	or OpenCL ③ HB MD5: 3985F8FE11 A MD5: 008084D76E; Help HB MD5: E8F6A670E1	19D55D9F56637 76BB22E3D37C 16726C23C46C4	E7324CC36D 338719EB17 A9C1B07F116	0 0						
Altera SDK f Size: 499.2 M DSP Builder Size: 86.4 M Quartus II H Size: 353.7 M Stand-Alone Sc Quartus II P	or OpenCL ③ HB MD5: 3985F8FE11 A MD5: 008084D76E; Help HB MD5: E8F6A670E1 Offware rogrammer and Sig	19D55D9F56637 76BB22E3D37C 16726C23C46C4 16726T11	E7324CC36D 338719EB17 A9C1B07F116	0						
Altera SDK f Size: 499.2 N DSP Builder Size: 86.4 M Quartus II H Size: 353.7 N Stand-Alone Sc Quartus II P Size: 217.0 N	or OpenCL ③ HB MD5: 3985F8FE11 A MD5: 008084D76E; Help HB MD5: E8F6A670E1 Oftware trogrammer and Sig HB MD5	19D55D9F56637 76BB22E3D37C 16726C23C46C4 16726C23C46C4	E7324CC36D 338719EB17 A9C1B07F116	000000000000000000000000000000000000000						
Altera SDK f Size: 499.2 N DSP Builder Size: 86.4 M Quartus II H Size: 353.7 N Stand-Alone Sc Quartus II P Size: 217.0 N SoC Embedo	or OpenCL ③ HB MD5: 3985F8FE11 HB MD5: 008084D76E: Help HB MD5: E8F6A670E1 Oftware Programmer and Sig HB MD5: 11 Held Design Suite (E	I9D55D9F56637 76BB22E3D37C I6726C23C46C4 JNaITap II VCFACUDAELC8 IDS)	E7324CC36D 338719EB17 A9C1B07F116	0						

6 Install Quartus 13.1, Updates, and Extras

Move the downloaded Quartus files into a folder on your host machine named, e.g., "Quartus."

On the VM, select Devices→Shared Folders..., and add a share. Select the path to the folder in which the Quartus .tar file resides. (I called my folder */home/sedwards/Downloads/Quartus*; yours will be different). Call the share "Quartus."

🛞 🗉 CentOS 5.9 - Settings					
📃 General	Shared Folders				
 System Display Storage Audio Network Serial Ports USB Shared Folders 	Shared Folders Folders List Name Path Auto-Mount Access Machine Folders Transient Folders Folder Path: //ome/sedwards/Downloads/Quartus Folder Name: Quartus Folder Name: Quartus Auto-mount Auto-mount Make Permanent Cancel OK Select a settings category from the list on the left-hand side and move the				
	mouse over a settings item to get more information.				
Help	<u>Cancel</u>				

Log in as root on the vм.

Open a terminal window by selecting Applications→Accessories→Terminal.

Type "mount -t vboxsf Quartus /mnt"

Type "tar xf /mnt/Quartus*.tar"

Type "./setup.sh"

Once the Quartus installation wizard starts, direct it to install in /opt/altera/13.1.

Installing Quartus II Web Edition (Free) 13	3.1.0.162			
Installation directory	ADERA.			
Please specify the directory where Quartus II Web Edition (Free) 13.1.0.162 will be installed Installation directory //opt/altera/13.1				

Under "Devices," make sure "Cyclone V" is selected (the others are unnecessary).



Let the installation complete; this will take a while.

Terminate the installer (don't start Quartus yet).

Install any updates. Type "chmod +x /mnt/QuartusSetup*.run" and then "/mnt/QuartusSetup*

Specify /opt/altera/13.1 as the installation directory (i.e., as you specified earlier).

Install the Embedded Design Suite: Type "chmod +x /mnt/SoC*" and "/mnt/Soc*.run."

Specify /opt/altera/13.1 as the installation directory (i.e., as you specified earlier).

To make a desktop icon, type

```
cat > ~/Desktop/Quartus.desktop <<EOF
[Desktop Entry]
Type=Application
Version=0.9.4
Name=Quartus II 13.1 (64-bit) Web Edition
Comment=Quartus II 13.1 (64-bit)
Icon=/opt/altera/13.1/quartus/adm/quartusii.png
Exec=/opt/altera/13.1/quartus/bin/quartus --64bit
Terminal=false
Path=/opt/altera/13.1
EOF
```

7 Optional: Enable USB JTAG

If you want to program the FPGA on the SoCKit board using your computer, do the following. As root on the VM, add the following *udev* rules file:

```
cat > /etc/udev/rules.d/51-sockit.rules <<EOF
BUS=="usb", SYSFS{idVendor}=="09fb", SYSFS{idProduct}=="6010", MODE="0666"
BUS=="usb", SYSFS{idVendor}=="09fb", SYSFS{idProduct}=="6810", MODE="0666"
EOF
```

When the vM is running and you have the SoCKit board connected to your host machine, select Devices \rightarrow USB Devices \rightarrow Altera CV SoCKit to make the vM see the connected JTAG device.

Now, as a normal user, when you have a SoCKit board connected to your computer, "/opt/altera/13.1/quartus/bin/jtagconfig" should report something like

1) CV SoCKit [USB 1-1] 02D020DD 5CSEBA6(.|ES)/5CSEMA6/.. 4BA00477 SOCVHPS

Use a slightly different *udev* rule under Ubuntu and other Debian-based distributions (*not* CentOS):

```
cat > /etc/udev/rules.d/51-sockit.rules <<EOF
ATTR{idVendor}=="09fb", ATTR{idProduct}=="6010", MODE="0666"
ATTR{idVendor}=="09fb", ATTR{idProduct}=="6810", MODE="0666"
EOF
```

8 Optional: Debugging USB JTAG

Turn on and connect the SoCKit board. Check that the Altera "USB Blaster" appears:

\$ lsusb | grep 09fb: Bus 001 Device 036: ID 09fb:6810 Altera

If it is not listed, the board may not be powered on or the JTAG USB port (nearest the corner) may not be connected to the workstation. Note that your bus and device number may differ.

Check the permissions on the port, based on the bus and device you saw above:

```
$ ls -1 /dev/bus/usb/001/036
crw-rw-rw- 1 root root 189, 35 Jan 17 21:16 /dev/bus/usb/001/036
```

Finally, verify that the JTAG daemon is able to locate the hardware:

```
$ jtagconfig
1) CV SoCKit [1-6.2.3]
02D020DD 5CSEBA6(.|ES)/5CSEMA6/..
4BA00477 SOCVHPS
```

The most common problem is incorrect permissions (no world write) on the device, e.g.,

```
$ jtagconfig
No JTAG hardware available
$ ls -l /dev/bus/usb/001/036
crw-rw-r-- 1 root root 189, 35 Jan 17 21:16 /dev/bus/usb/001/036
$ sudo killall jtagd
$ lsusb | grep 09fb:
Bus 001 Device 041: ID 09fb:6810 Altera
$ sudo chmod 666 /dev/bus/usb/001/041
$ jtagconfig
1) CV SoCKit [1-6.2.3]
02D020DD 5CSEBA6(.|ES)/5CSEMA6/..
4BA00477 SOCVHPS
```