

March 28, 2017 · **FPGA**

Installing Xilinx Vivado (2016.4) and Intel Modelsim Starter Edition (16.1) on 64-bit Ubuntu (16.10)

The problem with Linux

So you've got your new FPGA board(s) and want to setup a nice and clean development environment but you got sick of Windows and its terrible command line and want access to a multitude of freely available scientific/engineering tools. Moreover most researchers/hobbyists distribute their work mainly for Linux, plus all major EDA vendors these days support Linux as well. This looks like the perfect OS for your FPGA projects!

The problem is, even in 2017 installing tools in Linux is nowhere near as smooth as it is in Windows. Linux is by nature fragmented, different distributions have different kernels, libraries, desktop environments, etc. and on top of that users may configure their operating system in a myriad of different ways. EDA vendors cannot support every single configuration, only a handful of distributions are officially supported - usually the enterprise editions (RedHat, Suse) plus a few

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stable/major ones (eg. CentOS) - and only specific releases.

Xilinx Vivado v2016.4 **officially supports the following distributions:**

- Red Hat Enterprise Workstation/Server 7.1 and 7.2 (64-bit)
- Red Hat Enterprise Workstation 6.7 and 6.8 (64-bit)
- Red Hat Enterprise Workstation 5.11 (64-bit)
- SUSE Linux Enterprise 11.4 and 12.1 (64-bit)
- Cent OS 6.8 (64-bit)
- Ubuntu Linux 16.04 LTS (64-bit)

while Intel Modelsim **officially only supports**

- Red Hat Enterprise Linux 5.10 (64-bit)
- Red Hat Enterprise Linux 6.5 (64-bit)
- Red Hat Enterprise Linux 7.2 (64-bit)

Of course *officially*, doesn't mean they can't be installed in other distributions provided we have the right setup. There are various sources on the web where people have successfully installed those tools in Ubuntu [\[1\]](#) [\[2\]](#) [\[3\]](#).

However those solutions didn't work for me out of the box, probably because they refer to different tool/OS versions. I managed to make it work using various bits and pieces from different guides/forums. The following guide is for:

- Ubuntu 16.10 64-bit (yakkety)
- Xilinx Vivado 2016.4 WebPack
- ModelSim-Intel FPGA Starter Edition 16.1*

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* actually Modelsim version is **10.5b**, 16.1 is the version of the complete Intel Quartus Prime Standard Edition suite

Install Xilinx Vivado

1) Go to <https://www.xilinx.com/support/download.html> and download the linux self-extracting web installer. You need to create a free Xilinx account first (if you don't already have one), but it will prompt you so

2) Open a terminal in the folder you downloaded the file and run

```
chmod +x Xilinx_Vivado_SDK_2016.4_0124_1_Lin64.bin
```

to make it executable

3) If you install Vivado in the default path (**/opt/Xilinx**) you need to run the installer with root privileges. That's not necessary if you install in your *home* directory. I personally install my tools in /opt in my home PC (single user environment) so I need to launch the installer with `sudo`

```
sudo ./Xilinx_Vivado_SDK_2016.4_0124_1_Lin64.bin
```

4) In the first screen click next. In the second screen enter your Xilinx user ID and password, select Download and Install Now and click next.

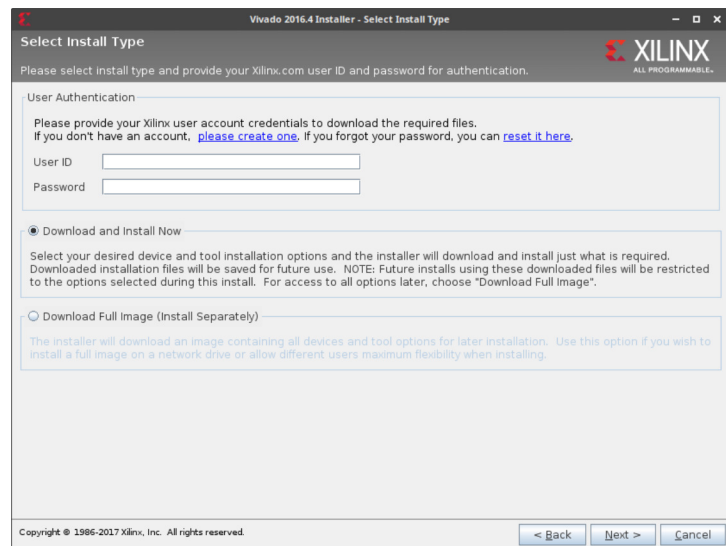
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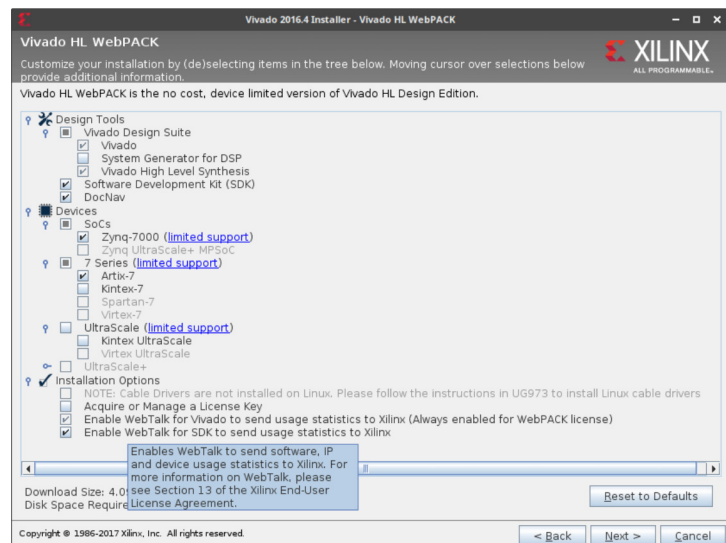
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In the third screen check all boxes and click next. In the following screen select Vivado HL WebPACK and click next

5) The fifth screen lets you select the devices and tools you want to install. Personally I only install the devices that I own, to save space. Note that the WebPACK edition doesn't support all devices, but thankfully it supports the most popular ones used by hobbyists (visit <https://www.xilinx.com/products/design-tools/vivado/vivado-webpack.html> for a full list of supported devices). I also don't install System Generator for DSP, but that's just me.



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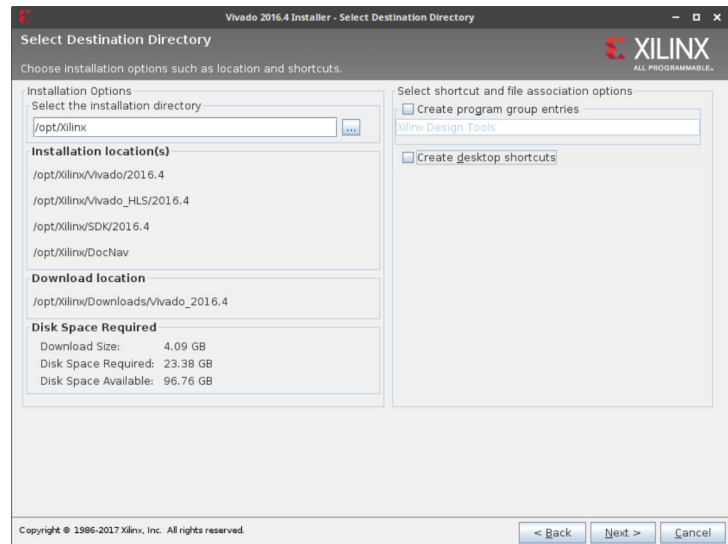
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Click next. In the next screen select the installation directory. I leave it to the default and also un-check the boxes for desktop shortcuts and group entries (I always launch vivado from the command line)



Click next and then Install. Depending on your internet bandwidth this may take some time

6) After installation is finished, open `~/.bashrc` in a text editor and add the following line

```
source /opt/Xilinx/Vivado/2016.4/settings6  
4.sh
```

then in the terminal run

```
source ~/.bashrc  
vivado &
```

If everything went well you should be seeing the Vivado main window.

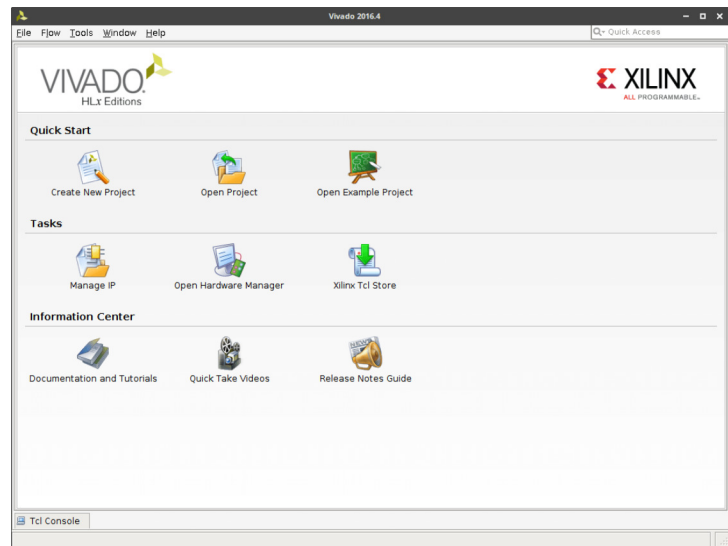
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The WebPACK versions of Vivado after 2016.x don't require a license any more, so everything should be working fine.

7) You may have noticed that during installation (see step 5 above) the option to install cable drivers is grayed out, with a note to check guide **UG973**. If you own a Xilinx Platform USB cable you will need to manually install them:

```
cd /opt/Xilinx/Vivado/2016.4/data/xicom/cable_drivers/lin64/install_script/install_drivers
sudo ./install_drivers
```

You may need to reboot.

Do not follow any older guides that tell you to download and install the drivers from the Xilinx website, those drivers won't work on Ubuntu 16.10

8) An extra step is needed to make Xilinx SDK work. If you run `xsdk` from the command line you get the following error:

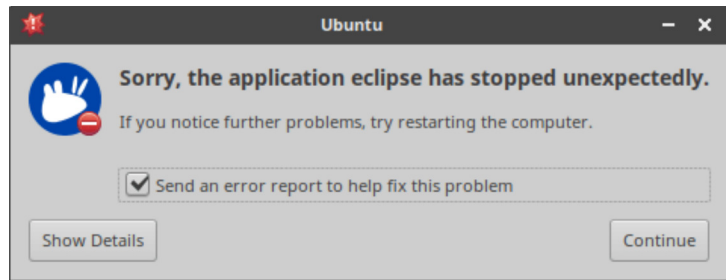
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Open the file `/opt/Xilinx/SDK/2016.4/bin/xsdk` in a text editor (vi, nano, etc.)

```
sudo nano /opt/Xilinx/SDK/2016.4/bin/xsdk
```

and add the following line:

```
export SWT_GTK3=0
```

9) You may also get this error when running SDK

```
/opt/Xilinx/SDK/2016.4/lib/lnx64.o/libstdc++  
+.so.6: version `GLIBCXX_3.4.20' not found  
(required by /usr/lib/x86_64-linux-gnu/libp  
roxy.so.1)  
Failed to load module: /usr/lib/x86_64-linu  
x-gnu/gio/modules/libgiolibproxy.so
```

It's probably because libstdc++.so.6 shipped with SDK is an older/incompatible version. The solution is to use your system's library instead. In a terminal execute the following commands

```
sudo mv /opt/Xilinx/SDK/2016.4/lib/lnx64.o/  
libstdc++.so.6 /opt/Xilinx/SDK/2016.4/lib/ln  
x64.o/libstdc++.so.6.orig  
sudo ln -s /usr/lib/x86_64-linux-gnu/libstd  
c++.so.6 /opt/Xilinx/SDK/2016.4/lib/lnx64.o  
/libstdc++.so.6
```

Solution taken from here

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Execute `xsdk &` and it should now run without errors

Install Intel Modelsim

Optionally you can install Intel (ex Altera) Modelsim Starter Edition for simulations. The Vivado simulator is great for most designs, but I find Modelsim more versatile and I'm more used to it to be honest (used it professionally for many years). Alternatively you can use freeware simulators like ghdl (for VHDL) and Icarus (for Verilog) but I'm not familiar with either tool.

The Starter Edition has a limitation of 10,000 lines and 3,000 instances but it's free (the full featured one costs ~2000\$). **Unfortunately it's also a pain to install in Ubuntu...**

1) First go to <https://www.altera.com/> and create an account

2) Go to http://dl.altera.com/?product=modelsim_ae#tabs-2 and click the *Individual Files* tab. Click the download button for *ModelSim-Intel FPGA Edition*.

3) After download finishes, open a terminal where you downloaded the file and enter

```
chmod +x ModelSimSetup-16.1.0.196-linux.run
sudo ./ModelSimSetup-16.1.0.196-linux.run
```

(`sudo` is not necessary if you're going to install in your home folder)

4) Click next in the first two screens, accept the license agreement and click next. Choose installation path and click next. My installation

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directory is **/opt/intelFPGA/16.1** so the rest of the guide will assume this path and use `sudo` where necessary. Click next to start the installation and then Finish.

5) Open **~/bashrc** and add this line

```
export PATH=$PATH:/opt/intelFPGA/16.1/model  
sim_ase/bin
```

then in the terminal run

```
source ~/.bashrc  
vsim &
```

Oops..

```
- $ vsim &  
[1] 5170  
- $ Error: cannot find "/opt/intelFPGA/16.1/modelsim_ase/bin/./linux_rh60/vsim"  
█
```

Well, that's one of a dozen errors you may get until you have everything right so from now on I'll just describe all the necessary steps without showing the intermediate error messages

6) Open **/opt/intelFPGA/16.1/modelsim_ase/bin/vsim** in a text editor

- Search for `linux_rh60` and change it to `linux`
- Search for `MTI_VCO_MODE:-"` and change it to `MTI_VCO_MODE:-"32"`
- Search for `dir=`dirname "$arg0"`` and under that line add `export`
`LD_LIBRARY_PATH=${dir}/lib32`

save and close

7) Modelsim is a 32-bit application and needs

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some 32-bit libraries. In the terminal run

```
sudo dpkg --add-architecture i386
sudo apt-get update
sudo apt-get install libxft2:i386 libxext6:
i386 libncurses5:i386
```

8) We also need **libpng12-0:1386** but in Ubuntu 16.10 that library is not in the repository. We can download it from this link:

http://launchpadlibrarian.net/233197172/libpng12-0_1.2.54-1ubuntu1_i386.deb

Go to where you downloaded the file and run

```
sudo dpkg -i libpng12-0_1.2.54-1ubuntu1_i386.deb
```

9) There's also some kind of incompatibility with the latest freetype library, so we need to install an older version. Version 2.5.0.1 seems to be working. You can build it from source, but thankfully there's an already compiled 32-bit version for Ubuntu at https://launchpad.net/ubuntu/+source/freetype/2.5.0.1-0ubuntu2/+build/5222114/+files/libfreetype6_2.5.0.1-0ubuntu2_i386.deb

Click on the link above to download it. Go to where you downloaded the file and enter

```
mkdir libfreetype
dpkg -x libfreetype6_2.5.0.1-0ubuntu2_i386.deb libfreetype
sudo mkdir /opt/intelFPGA/16.1/modelsim_ase/lib32
sudo cp libfreetype/usr/lib/i386-linux-gnu/libfreetype.so.6* /opt/intelFPGA/16.1/model
```

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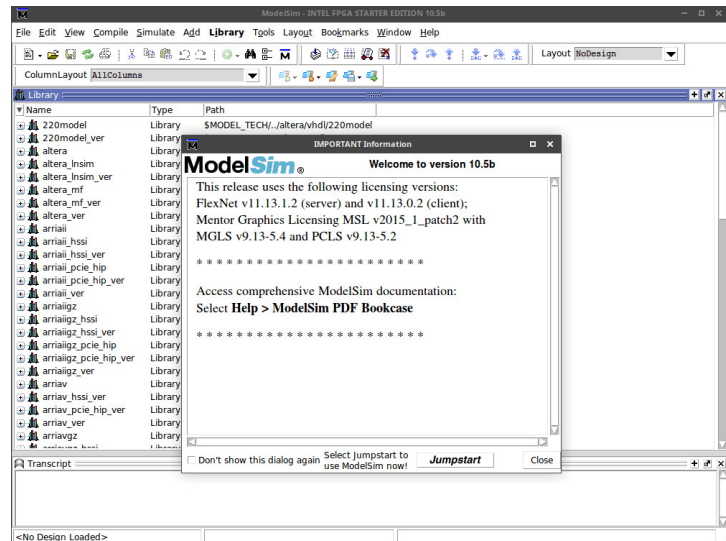


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```
sim_ase/lib32
```

Now run `vsim &` and hopefully that's what you'll see



Install Xilinx libraries for Modelsim

If you want to use Modelsim to simulate Xilinx IP cores you need to compile the Xilinx libraries for Modelsim. Officially the Vivado compiler does not support the Intel Modelsim Starter Edition, but there is a workaround.

1) Create a symbolic link named **linuxpe** that points to the Modelsim **linux** directory

```
sudo ln -s /opt/intelFPGA/16.1/modelsim_ase  
/linux /opt/intelFPGA/16.1/modelsim_ase/lin  
uxpe
```

2) Create a folder named **xilinx** in the **modelsim_ase** folder

```
sudo mkdir /opt/intelFPGA/16.1/modelsim_ase  
/xilinx
```

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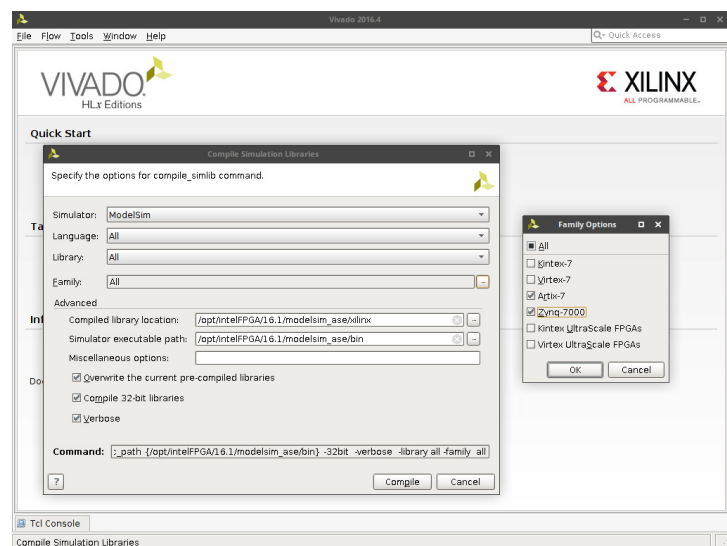
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3) Open Vivado with root privileges (if you installed Modelsim in /opt). We need to specify the complete path because vivado is not in the PATH for the root user

```
sudo /opt/Xilinx/Vivado/2016.4/bin/vivado &
```

4) From the *Tools* menu select *Compile Simulation Libraries*. In Family Options select the devices you need. Set the rest of the options as shown and click *Compile*



5) The compiler created a **modelsim.ini** file in your home folder which contains the paths for every xilinx library.

These are a lot of libraries and probably you won't need most of them. I always leave the major Xilinx libraries and comment out the unnecessary/rarely used ones

By major libraries I mean the following:

secureip, unisim, unimacro, unifast (for VHDL)

unisims_ver, unimacro_ver, unifast_ver, simprimis_ver (for Verilog)

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The rest are just IP libraries which you will only need if you plan to simulate those IPs (as part of a zynq/microblaze simulation for example). If you ever need them you can either uncomment them here or add them in you project **modelsim.ini** file (Modelsim always creates a **modelsim.ini** file in your project directory)

Anyway, here's how my xilinx **modelsim.ini** [Library] section looks like:

```
; Copyright 1991-2009 Mentor Graphics Corp  
oration  
;  
; All Rights Reserved.  
;  
; THIS WORK CONTAINS TRADE SECRET AND PROP  
RIETARY INFORMATION WHICH IS THE PROPERTY  
OF  
; MENTOR GRAPHICS CORPORATION OR ITS LICEN  
SORS AND IS SUBJECT TO LICENSE TERMS.  
;  
  
[Library]  
others = $MODEL_TECH/../../modelsim.ini  
  
; Altera Primitive libraries  
;  
; VHDL Section  
;  
;  
; Verilog Section  
;  
  
secureip = /opt/intelFPGA/16.1/modelsim_as  
e/xilinx/secureip
```

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```
unisim = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/unisim  
  
unimacro = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/unimacro  
  
unifast = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/unifast  
  
unisims_ver = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/unisims_ver  
  
unimacro_ver = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/unimacro_ver  
  
unifast_ver = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/unifast_ver  
  
simprims_ver = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/simprims_ver  
  
;xpm = /opt/intelFPGA/16.1/modelsim_ase/xilinx/  
xpm  
  
;ecc_v2_0_12 = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/ecc_v2_0_12  
  
;mipi_dphy_v3_0_1 = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/mipi_dphy_v3_0_1  
  
;emc_common_v3_0_5 = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/emc_common_v3_0_5  
  
;v_vcresampler_v1_0_5 = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/v_vcresampler_v1_0_5  
  
;axi_infrastructure_v1_1_0 = /opt/intelFPGA/16.1/  
modelsim_ase/xilinx/axi_infrastructure_v1_1_0  
  
;bsip_v1_1_0 = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/bsip_v1_1_0  
  
;fifo_generator_v13_0_5 = /opt/intelFPGA/16.1/  
modelsim_ase/xilinx/fifo_generator_v13_0_5  
  
;xau_i_v12_2_7 = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/xau_i_v12_2_7  
  
;sem_v4_1_7 = /opt/intelFPGA/16.1/modelsim_ase/  
xilinx/sem_v4_1_7
```

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```
;lmb_bram_if_cntlr_v4_0_10 = /opt/intelFPGA/16.1/modelsim_ase/xilinx/lmb_bram_if_cntlr_v4_0_10
;jesd204_v7_1_1 = /opt/intelFPGA/16.1/modelsim_ase/xilinx/jesd204_v7_1_1
;l_ethernet_v2_0_1 = /opt/intelFPGA/16.1/modelsim_ase/xilinx/l_ethernet_v2_0_1
;hdc22_cipher_v1_0_0 = /opt/intelFPGA/16.1/modelsim_ase/xilinx/hdc22_cipher_v1_0_0
;axi_amm_bridge_v1_0_1 = /opt/intelFPGA/16.1/modelsim_ase/xilinx/axi_amm_bridge_v1_0_1
;etc, etc
```

NOTE: if you run the compiler with `sudo` the file owner is root so you may need to change the owner (or alter the file using `sudo`)

Modelsim by default also includes Altera libraries. If you don't own any Altera devices you can comment them out in the main **modelsim.ini** file located at **/opt/intelFPGA/16.1/modelsim_ase/modelsim.ini**

Now at the terminal run

```
vsim &
```

You should see the Xilinx libraries like in the picture below:

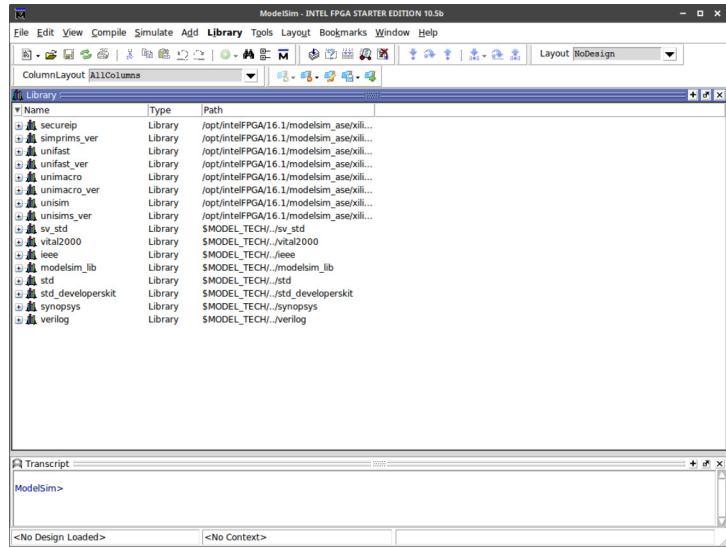
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And you're done. Easy, right? :)

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