

Deephi DNNDK Tutorial for Ultra96

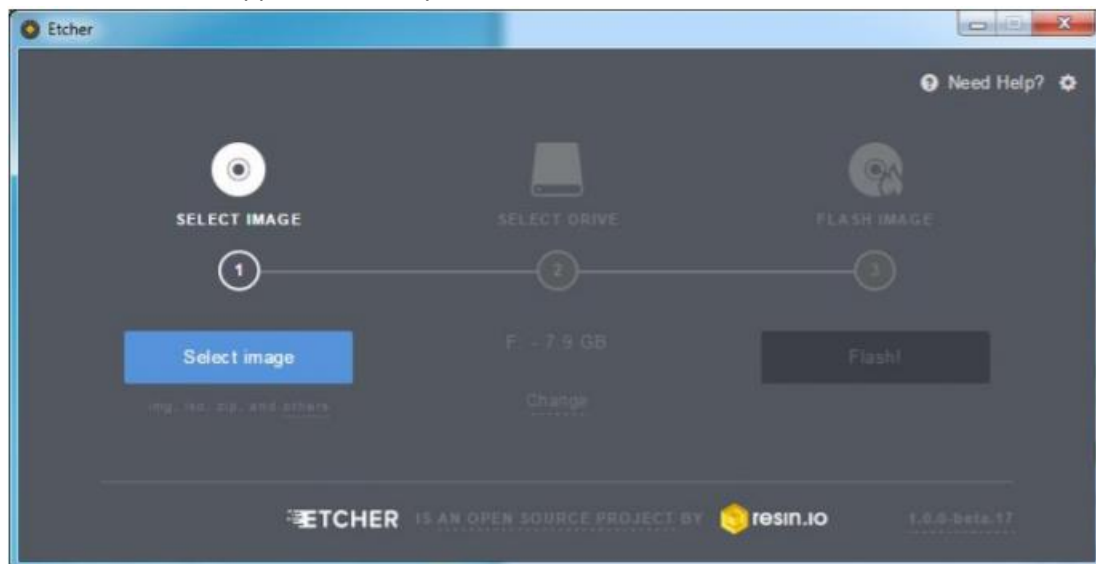
Version 1.0 [June 25, 2019]

In this tutorial we are going to run DNNDK SDK tools and sample applications on Ultra96 board.

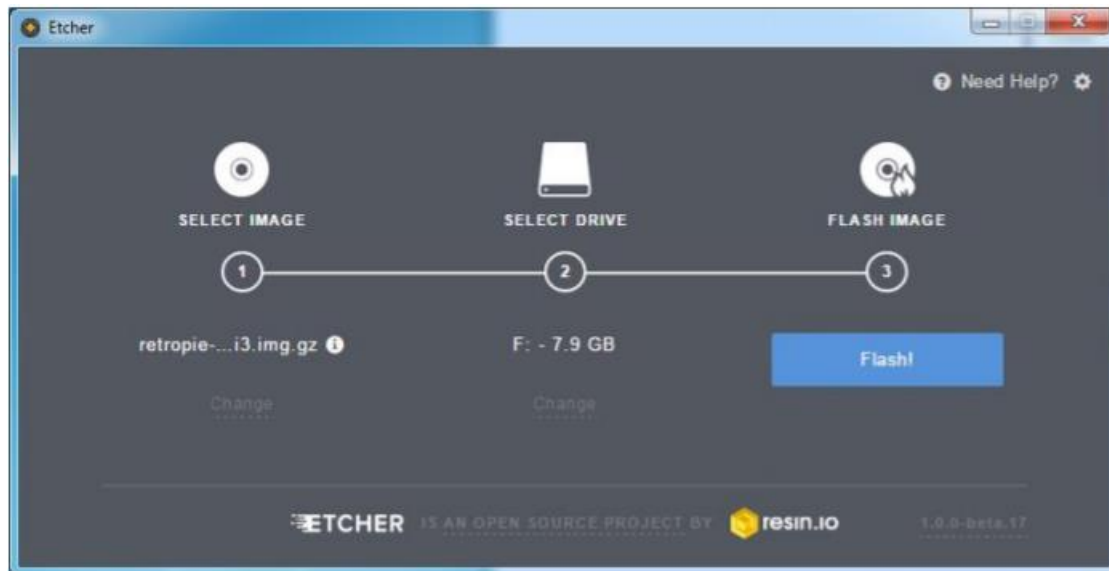
1. First download [DDNK SDK](#) and board Image for Ultra96.
2. When goto the link download '[xilinx-ultra96-desktop-stretch-2018-12-10.img.zip](#)' which supports DNNDK version 2.08: [xilinx dnndk v2.08](#) [if you don't get the DNNDK v2.08 then let us know at info@logictronix.com, we can provide you].

Product	Documentation	Image Download	DNNDK Version	File Size	MD5 Checksum
ZCU102 Kit	ZCU102 User Guide (UG1182)	xilinx-zcu102-prod-dpu1.4-2018.3-desktop-buster-2019-04-24.img.zip	v3.0	657 MB	d49eab4d293d8d1af40fcc369e1c4f53
		2018-12-04-zcu102-desktop-stretch.img.zip	v2.08	571 MB	d0d5faf8ece80b96f5591d09756d5a5d
ZCU104 Kit	ZCU104 User Guide (UG1267)	xilinx-zcu104-prod-dpu1.4-desktop-buster-2019-04-23.img.zip	v3.0	655 MB	503661dd1ee4549a562775034b95d0c8
		2018-12-04-zcu104-desktop-stretch.img.zip	v2.08	571 MB	ada2420c4afbd89efdeea741e0917e26
Avnet Ultra 96	Ultra 96 User Guide	xilinx-ultra96-prod-dpu1.4-desktop-buster-2019-05-31.img.zip	v3.0	576 MB	c9c6a5f5a772077abc8ffde6ea8f3db
		xilinx-ultra96-desktop-stretch-2018-12-10.img.zip	v2.08	566 MB	c5d2422063213b4bc4c18a3223c6adc8

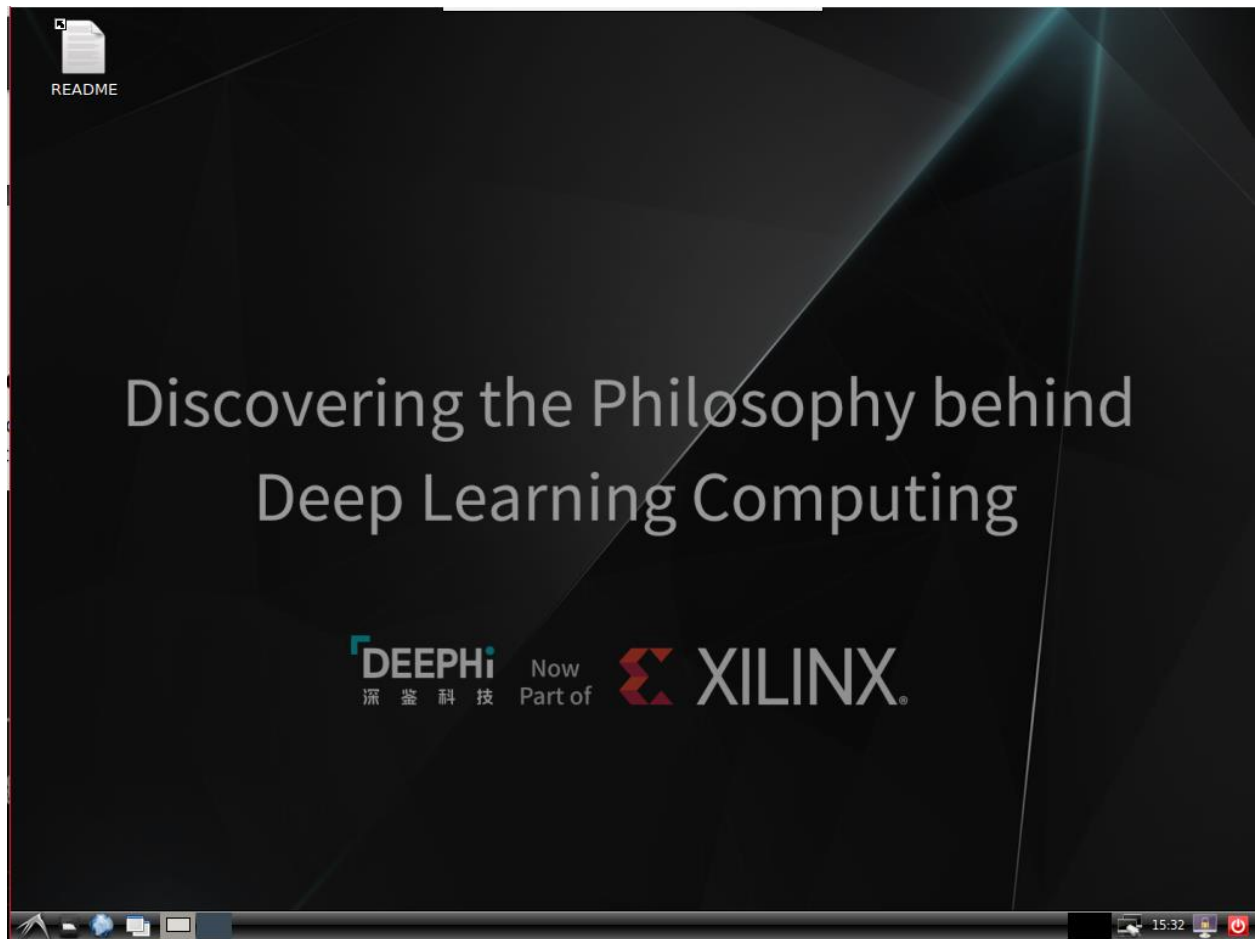
3. Then flash the downloaded OS image to the SDCard.
4. To flash the OS we use a software called Etcher. You can download it from <https://etcher.io/>
5. Install the Etcher. Eject any external storage devices such as USB flash drives and backup hard disks before flashing. This makes it easier to identify the SD card. Then, insert the SD card into the slot on your computer, or into the reader.
6. Launch the Etcher application, will you see screen as shown below.



7. Select the image file by clicking Select Image. You can select a .zip or .gz compressed file.
8. Etcher tries to detect the SD card. Verify the drive designation and check the image size to make sure that it is correct. And Click Flash.

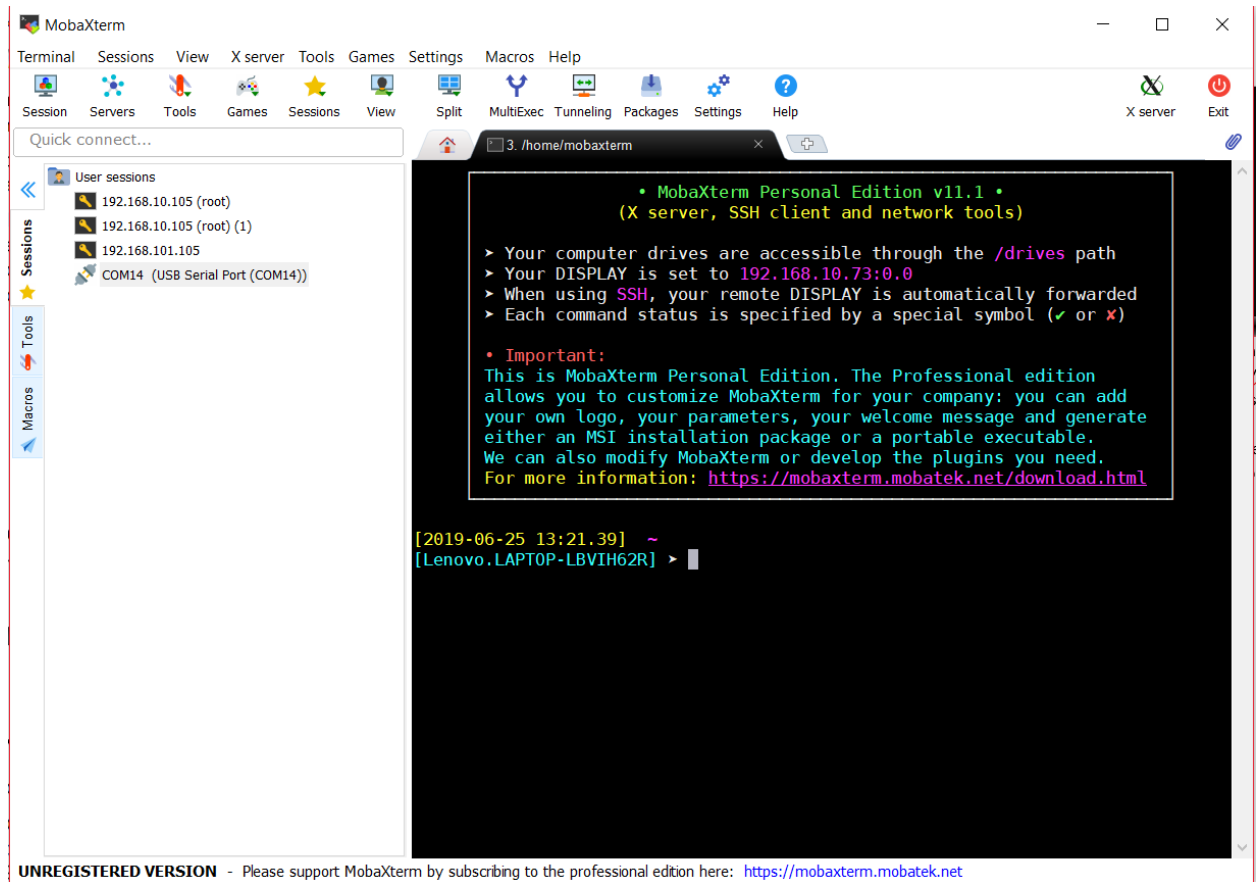


9. Now we are going to boot the Ultra96 board with this SDCard.
10. Insert the SDCard into board and connect the UART interface to the host PC and other peripherals as required.
11. Turn on the power, and wait for the system to boot.
12. Configure the UART with following settings:
 - baud rate: 115200 bps
 - data bit: 8
 - stop bit:1
 - no parity
13. Wait for the system to boot. You will see the system booting in the UART terminal. For UART connection we are using [MobaXterm software](#).
14. The login credentials are
 - username: root
 - password: root
15. You can also access the board as Standalone by connecting keyboard, mouse and monitor. After booting, a Linux GUI desktop is displayed.

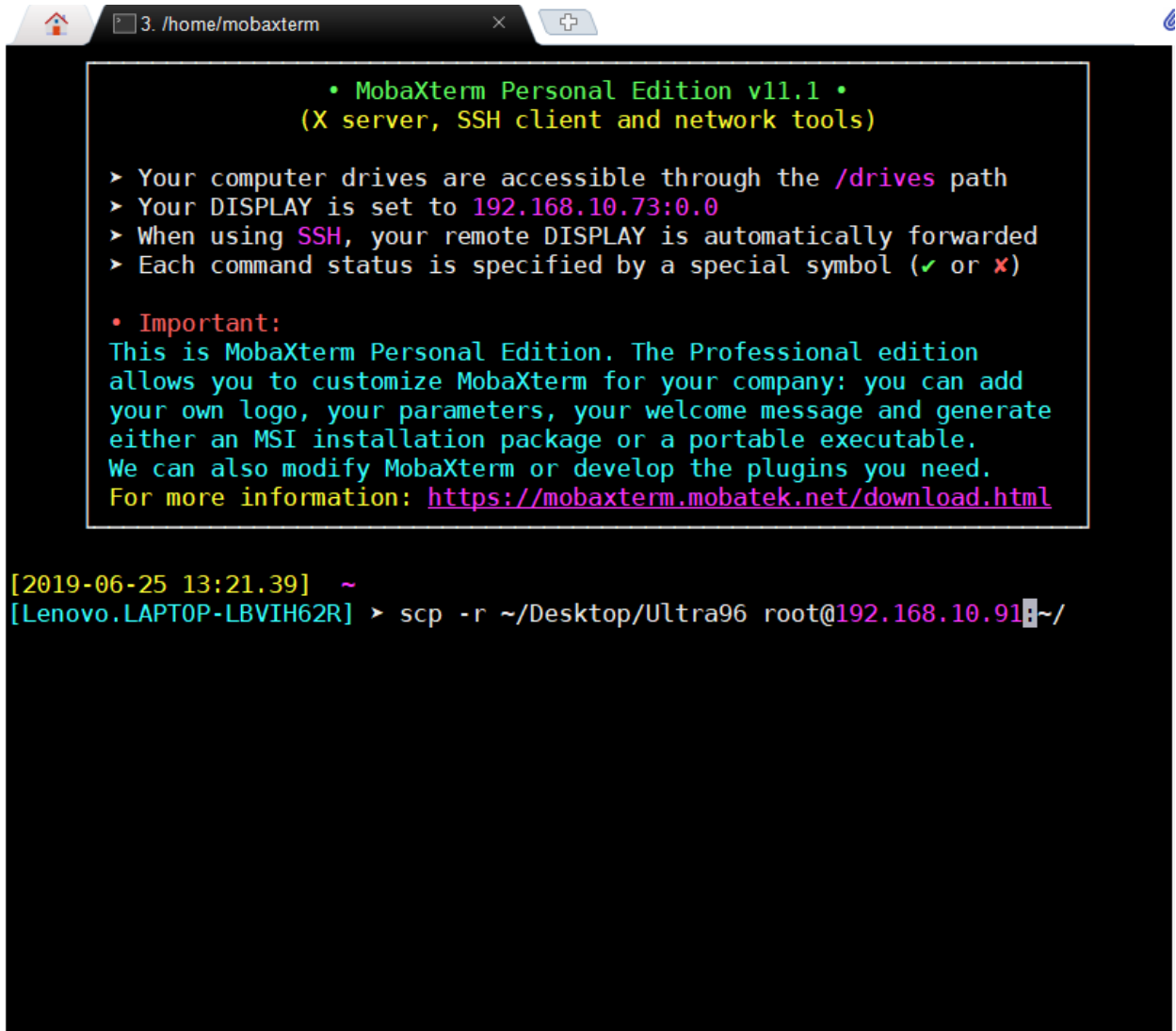


Now you have to copy the DNNDK package [Copy Ultra96 folder from [xilinx dnndk v2.08](#) or [xlnx dnndk v3.0 190531.tar.gz](#)] from the host machine to the evaluation board. You can do this through Ethernet connection or Wifi and using MobaXterm for transfer.

16. In our case we used Wifi connection where our host PC was also connected. (How to connect Wifi is shown at the end)
17. After the board has been connected to the same network, open MobaXterm and Click Start local terminal to open a terminal where the filesystem of Windows can be accessed.



18. Extract the DNNDK v2.08 package on the host PC. To transfer you use the following method:
For example, suppose that the DNNDK package is located under the root directory of disk D. In this case, use the following commands to extract and copy the package for the Ultra96 board with IP address 192.168.10.91



```
3. /home/mobaxterm

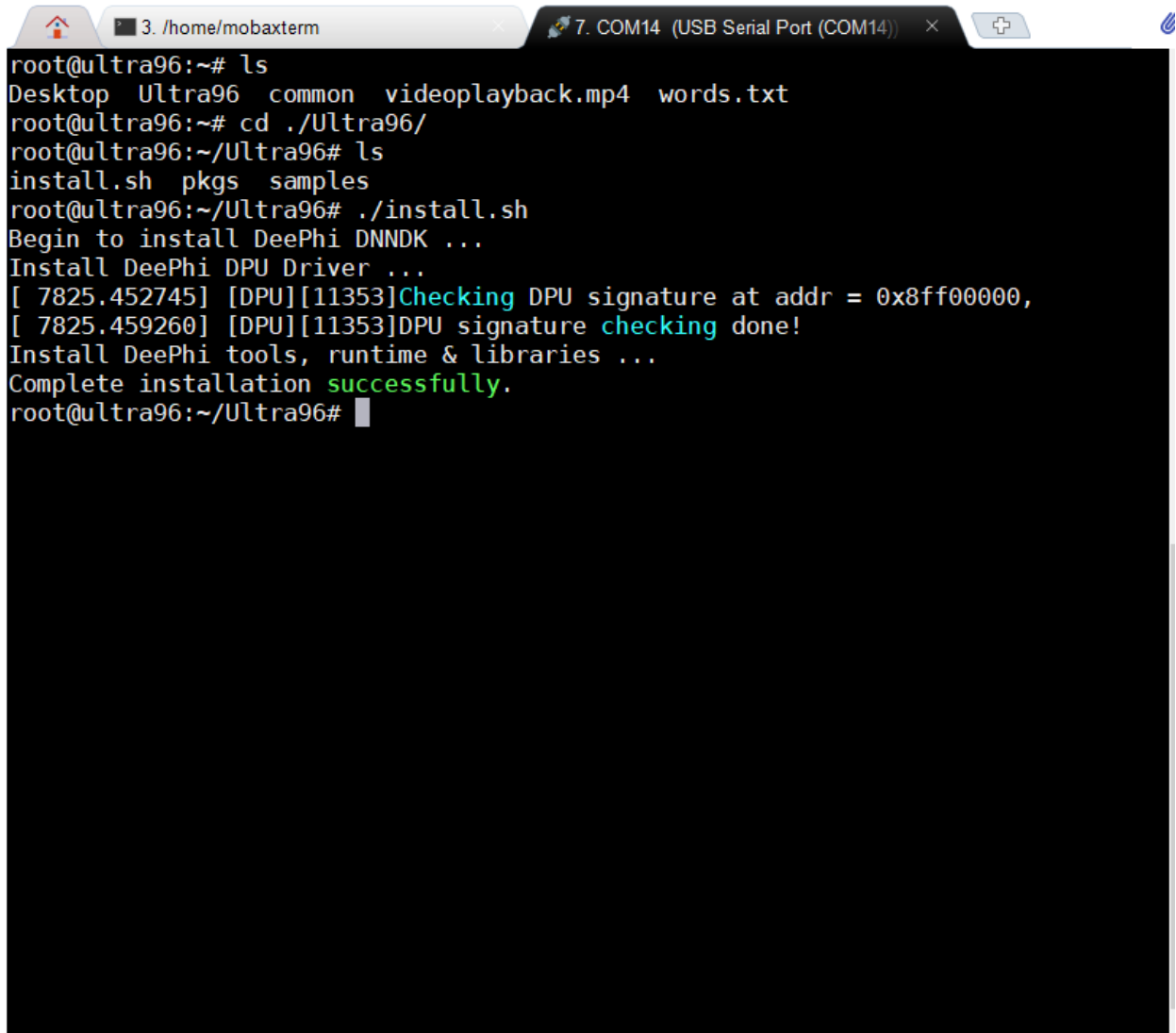
• MobaXterm Personal Edition v11.1 •
(X server, SSH client and network tools)

> Your computer drives are accessible through the /drives path
> Your DISPLAY is set to 192.168.10.73:0.0
> When using SSH, your remote DISPLAY is automatically forwarded
> Each command status is specified by a special symbol (✓ or ✗)

• Important:
This is MobaXterm Personal Edition. The Professional edition
allows you to customize MobaXterm for your company: you can add
your own logo, your parameters, your welcome message and generate
either an MSI installation package or a portable executable.
We can also modify MobaXterm or develop the plugins you need.
For more information: https://mobaxterm.mobatek.net/download.html

[2019-06-25 13:21:39] ~
[Lenovo.LAPTOP-LBVIH62R] > scp -r ~/Desktop/Ultra96 root@192.168.10.91:~/
```

19. On the Ultra96 board, change to the `~/Ultra96/` directory and run `install.sh`



```
root@ultra96:~# ls
Desktop Ultra96 common videoplayback.mp4 words.txt
root@ultra96:~# cd ./Ultra96/
root@ultra96:~/Ultra96# ls
install.sh pkgs samples
root@ultra96:~/Ultra96# ./install.sh
Begin to install DeePhi DNNDK ...
Install DeePhi DPU Driver ...
[ 7825.452745] [DPU][11353]Checking DPU signature at addr = 0x8ff00000,
[ 7825.459260] [DPU][11353]DPU signature checking done!
Install DeePhi tools, runtime & libraries ...
Complete installation successfully.
root@ultra96:~/Ultra96#
```

20. Also transfer the common folder inside the DNNDK zip to the board in the same way. Then copy the common folder inside the ~/Ultra96/samples folder. This common folder contains sample images.
21. We can now test the example applications inside the Ultra96 folder. Following example applications are present:
 - adas_detection
 - inception_v1
 - mobilenet_mt
 - resnet50_mt
 - inception_v1_mt
 - pose_detection
 - segmentation
 - face_detection
 - mobilenet
 - resnet50

- **video_analysis**

22. **First we need to compile them.** To compile goto each example folder and run 'make' command.
23. Lets goto resnet50 folder and run make command.

```
root@ultra96:~# ls
Desktop Ultra96 common videoplayback.mp4 words.txt
root@ultra96:~# cd ./Ultra96/
root@ultra96:~/Ultra96# ls
install.sh pkgs samples
root@ultra96:~/Ultra96# ./install.sh
Begin to install DeePhi DNNDK ...
Install DeePhi DPU Driver ...
[ 7825.452745] [DPU][11353]Checking DPU signature at addr = 0x8ff00000,
[ 7825.459260] [DPU][11353]DPU signature checking done!
Install DeePhi tools, runtime & libraries ...
Complete installation successfully.
root@ultra96:~/Ultra96# ls
install.sh pkgs samples
root@ultra96:~/Ultra96# cd ./samples/
root@ultra96:~/Ultra96/samples# ls
adas_detection inception_v1 mobilenet_mt resnet50_mt
common          inception_v1_mt pose_detection segmentation
face_detection  mobilenet       resnet50       video_analysis
root@ultra96:~/Ultra96/samples# cd ./resnet50
root@ultra96:~/Ultra96/samples/resnet50# ls
Makefile build model resnet50 src
root@ultra96:~/Ultra96/samples/resnet50# make
g++ -c -O2 -Wall -Wpointer-arith -std=c++11 -ffast-math -mcpu=cortex-a53 /root/Ultra96/samples/resnet50/src/main.cc -o /root/Ultra96/samples/resnet50/build/main.o
g++ -O2 -Wall -Wpointer-arith -std=c++11 -ffast-math -mcpu=cortex-a53 /root/Ultra96/samples/resnet50/build/main.o /root/Ultra96/samples/resnet50/model/dpu_resnet50_0.elf -o resnet50 -L/usr/local/lib -lopencv_highgui -lopencv_shape -lopencv_video -lopencv_videoio -lopencv_imgcodecs -lopencv_imgproc -lopencv_core -lhlineon -ln2cube -ldputils
root@ultra96:~/Ultra96/samples/resnet50#
```

24. Now enter following commands to set the display
 export DISPLAY=:0.0
 xrandr --output DP-1 --mode 800x600
 xset -dpms
25. Run ./resnet50 to test.
26. After completion you will see following screen:


```

3. /home/mobaxterm
7. COM14 (USB Serial Port (COM14))

Load image : PIC_351.jpg

Run DPU Task for ResNet50 ...
  DPU Task Execution time: 39621us
  DPU Task Performance: 194.594GOPS
top[0] prob = 0.997197   name = strawberry
top[1] prob = 0.000708   name = banana
top[2] prob = 0.000552   name = pineapple, ananas
top[3] prob = 0.000261   name = pomegranate
top[4] prob = 0.000203   name = hip, rose hip, rosehip

Load image : PIC_194.jpg

Run DPU Task for ResNet50 ...
  DPU Task Execution time: 39598us
  DPU Task Performance: 194.707GOPS
top[0] prob = 0.392847   name = white wolf, Arctic wolf, Canis lupus tundrarum
top[1] prob = 0.238274   name = dingo, warrigal, warragal, Canis dingo
top[2] prob = 0.185568   name = coyote, prairie wolf, brush wolf, Canis latrans
top[3] prob = 0.144520   name = timber wolf, grey wolf, gray wolf, Canis lupus
top[4] prob = 0.015232   name = Arctic fox, white fox, Alopex lagopus

Load image : PIC_113.jpg

Run DPU Task for ResNet50 ...
  DPU Task Execution time: 39600us
  DPU Task Performance: 194.697GOPS
top[0] prob = 0.481993   name = cucumber, cuke
top[1] prob = 0.227677   name = zucchini, courgette
top[2] prob = 0.107547   name = acorn squash
top[3] prob = 0.014555   name = head cabbage
top[4] prob = 0.011335   name = artichoke, globe artichoke
root@ultra96:~/Ultra96/samples/resnet50#

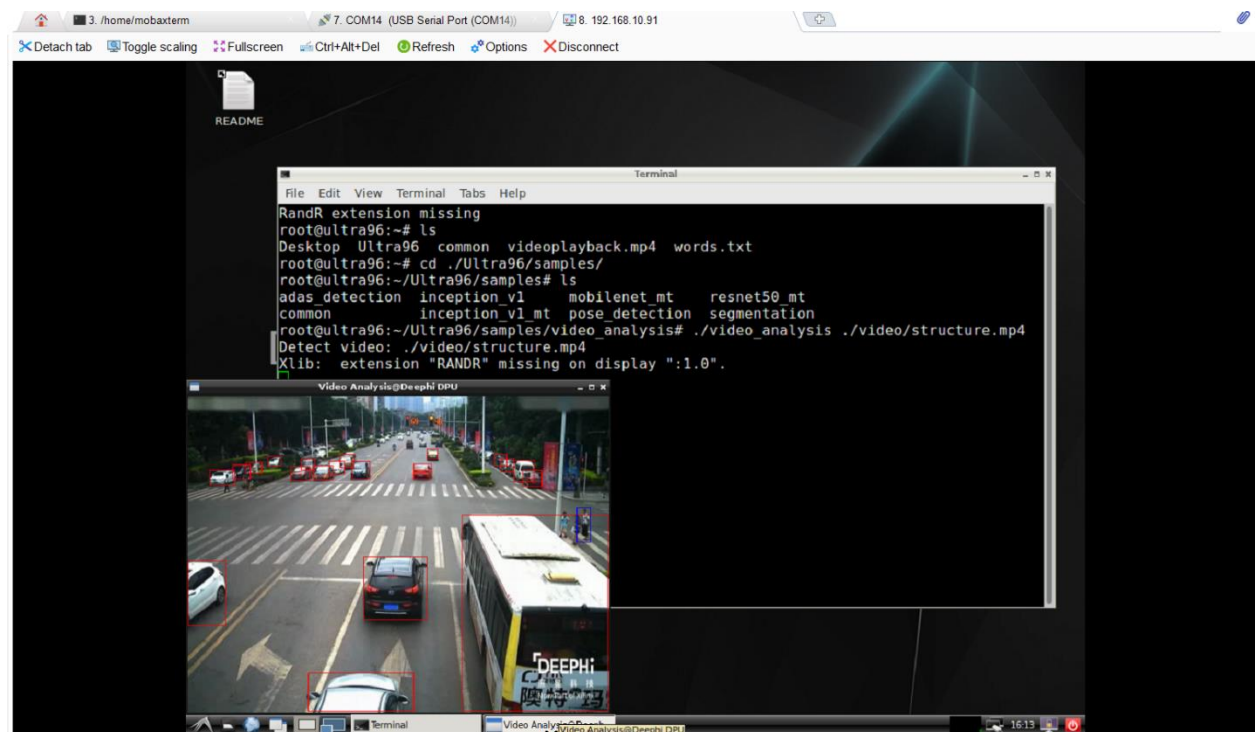
```

27. Similarly you can also run application like video_analysis, adas_detection. For these we require GUI to see its execution.
28. We have setup VNC viewer for that purpose. Setting up VNC viewer is shown at the end of this tutorial.
29. To run video_analysis app, change the directory to ~/Ultra96/samples/video_analysis
30. Run 'make' command
31. Then run command
./video_analysis ./video/structure.mp4
32. You will see Video display with object detection.


```

Terminal
File Edit View Terminal Tabs Help
RandR extension missing
root@ultra96:~# ls
Desktop Ultra96 common videoplayback.mp4 words.txt
root@ultra96:~# cd ./Ultra96/samples/
root@ultra96:~/Ultra96/samples# ls
adas_detection inception_v1 mobilenet_mt resnet50_mt
common inception_v1_mt pose_detection segmentation
root@ultra96:~/Ultra96/samples/video_analysis# ./video_analysis ./video/structure.mp4

```



Setup Wifi in Ultra96 board through terminal

1. Create a file `wpa_supplicant.conf` file inside `/etc`.
`vi /etc/wpa_supplicant.conf`
2. You put your SSID and password into `/etc/wpa_supplicant.conf` (requires `sudo` if not as root user)

```
network={
    ssid="ssid_name"
    psk="password"
}
```

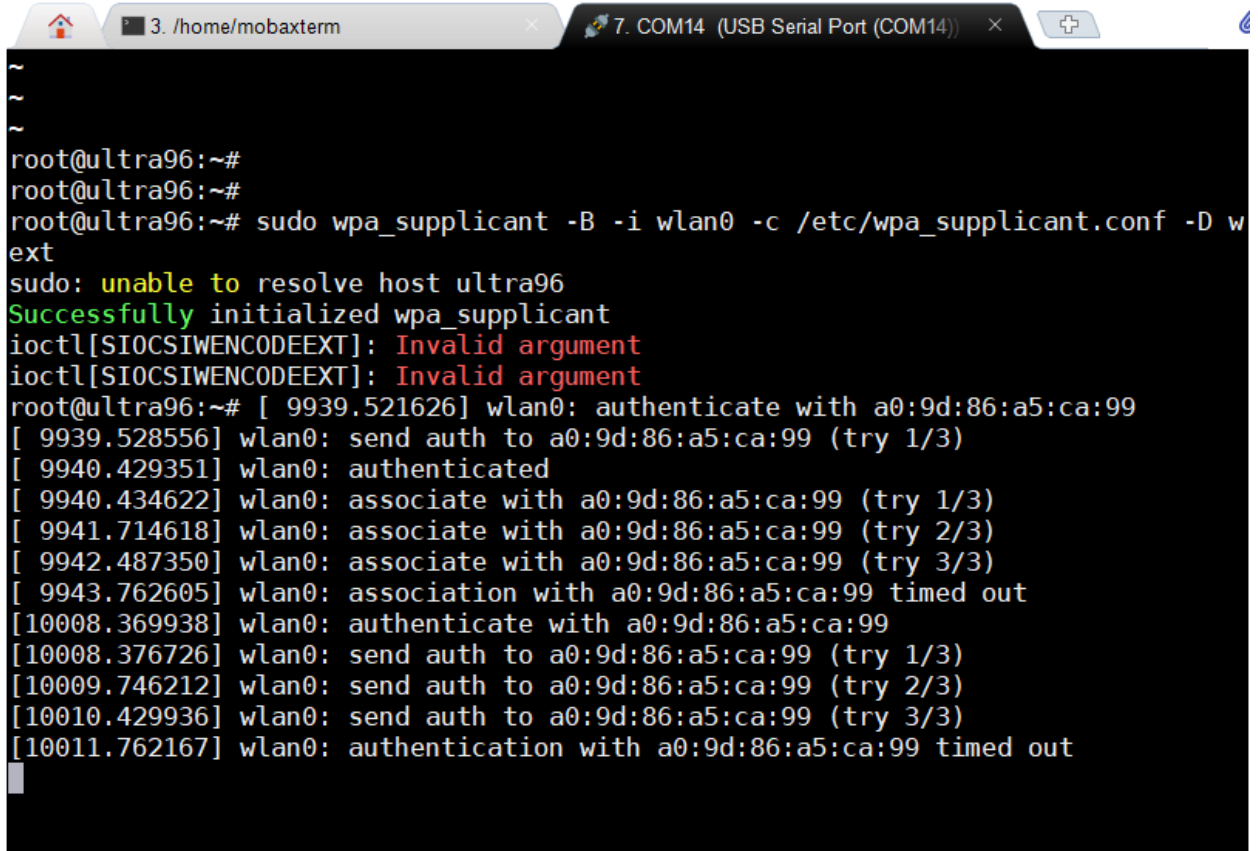
A screenshot of a terminal window titled "7. COM14 (USB Serial Port (COM14))". The terminal shows a configuration snippet for a network interface:

```
network={  
    ssid="[REDACTED]"  
    psk="[REDACTED]"  
}
```

The left side of the terminal has a vertical scrollbar with tick marks. At the bottom right, there are status indicators: "3,17-24" and "All".

3. Save the file and run following commands:

```
sudo wpa_supplicant -B -i wlan0 -c /etc/wpa_supplicant.conf -D wext  
sudo dhclient wlan0
```



```
3. /home/mobaxterm 7. COM14 (USB Serial Port (COM14))
~
~
~
root@ultra96:~#
root@ultra96:~#
root@ultra96:~# sudo wpa_supplicant -B -i wlan0 -c /etc/wpa_supplicant.conf -D w
ext
sudo: unable to resolve host ultra96
Successfully initialized wpa_supplicant
ioctl[SIOCSIWENCDEEXT]: Invalid argument
ioctl[SIOCSIWENCDEEXT]: Invalid argument
root@ultra96:~# [ 9939.521626] wlan0: authenticate with a0:9d:86:a5:ca:99
[ 9939.528556] wlan0: send auth to a0:9d:86:a5:ca:99 (try 1/3)
[ 9940.429351] wlan0: authenticated
[ 9940.434622] wlan0: associate with a0:9d:86:a5:ca:99 (try 1/3)
[ 9941.714618] wlan0: associate with a0:9d:86:a5:ca:99 (try 2/3)
[ 9942.487350] wlan0: associate with a0:9d:86:a5:ca:99 (try 3/3)
[ 9943.762605] wlan0: association with a0:9d:86:a5:ca:99 timed out
[10008.369938] wlan0: authenticate with a0:9d:86:a5:ca:99
[10008.376726] wlan0: send auth to a0:9d:86:a5:ca:99 (try 1/3)
[10009.746212] wlan0: send auth to a0:9d:86:a5:ca:99 (try 2/3)
[10010.429936] wlan0: send auth to a0:9d:86:a5:ca:99 (try 3/3)
[10011.762167] wlan0: authentication with a0:9d:86:a5:ca:99 timed out
```

4. Wifi will be connected in few minutes.
5. Check IP by running command 'ifconfig'

Setup VNC Viewer in Ultra96 board

1. On the board execute the following commands. You will require internet connection to the board through Wifi or Ethernet before running these commands.

```
apt-get update
```

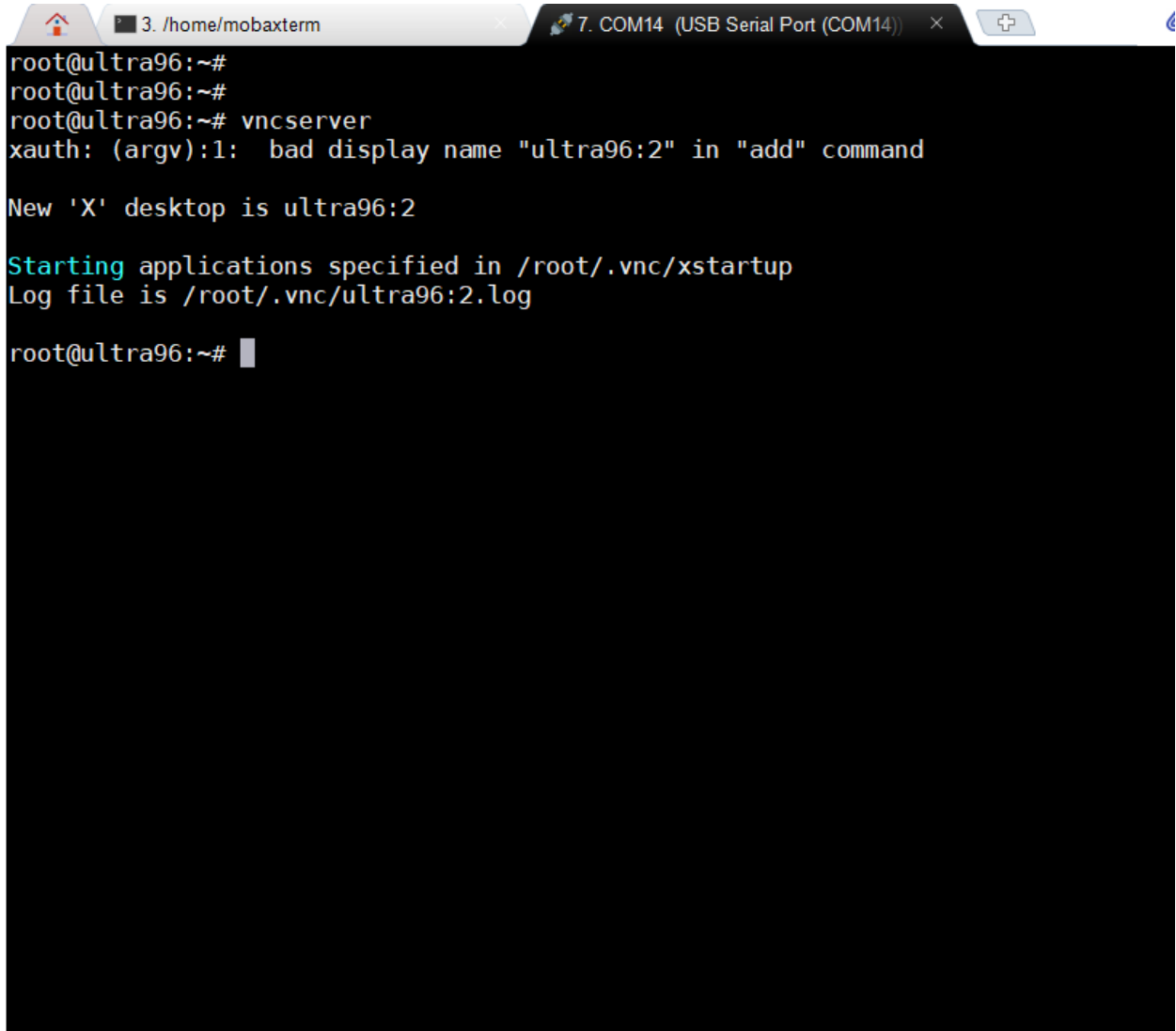
```
apt-get -y upgrade
```

```
apt-get install xfce4 xfce4-goodies gnome-icon-theme tightvncserver xfonts-base
```

Then start VNC Server with command:

```
vncserver
```

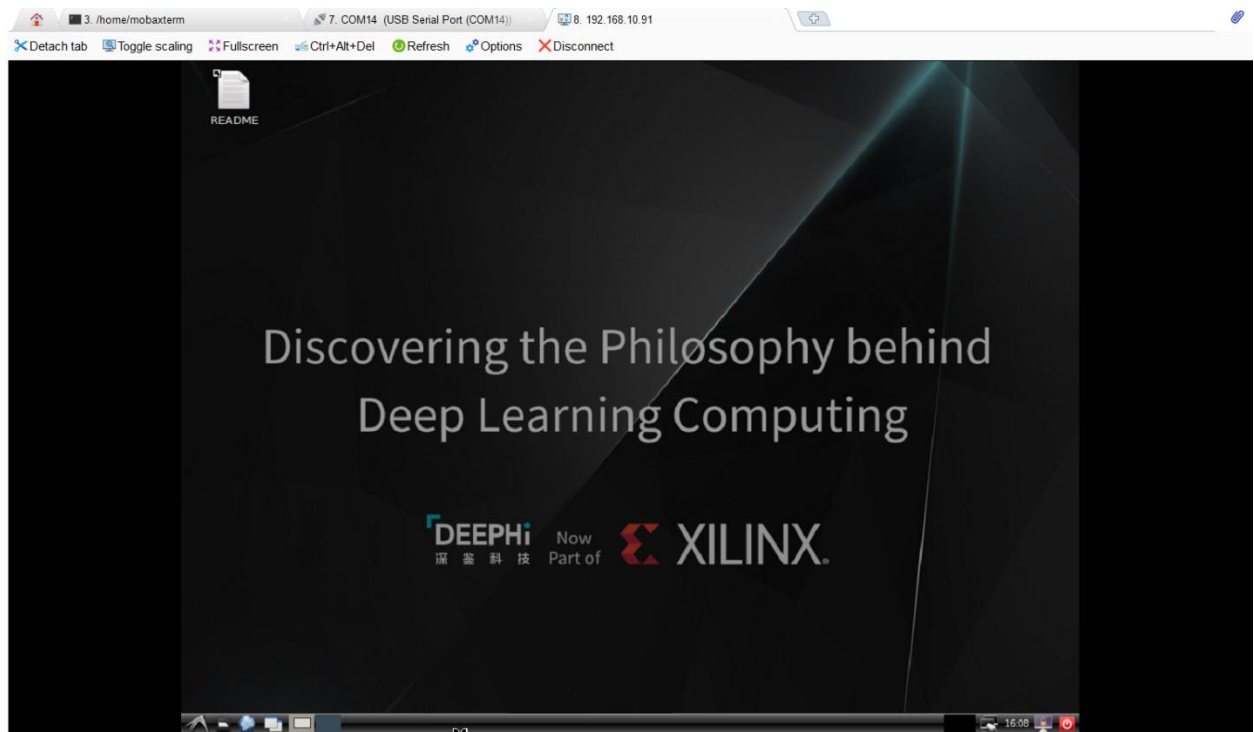
As it is your first time running the server, you will be asked to set a password that clients will use to connect. Keep this password in mind for later. You can also set a view-only password, which allow users to see the screen but not interact with it. Passwords should be 6-8 characters.



```
root@ultra96:~#  
root@ultra96:~#  
root@ultra96:~# vncserver  
xauth: (argv):1: bad display name "ultra96:2" in "add" command  
  
New 'X' desktop is ultra96:2  
  
Starting applications specified in /root/.vnc/xstartup  
Log file is /root/.vnc/ultra96:2.log  
  
root@ultra96:~#
```

By default, VNC connections are served on ports starting at 5901 for the first display.

2. Now connect using a VNC Client. Here we use MobaXterm.
3. In MobaXterm choose New Session and Select VNC. Then Enter the board IP address. You can also use any other VNC Client software to connect.
4. Click Ok and you will be asked connection Password that you set before. Enter the Password and click ok.
5. You will then see the GUI Screen.



6. With this process you will not require a Monitor setup.

References:

1. UG1327, Xilinx
2. PG338
3. Hackster.io

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