

Connecting ADI TRx to the ZCU102 or ZC706/ZYNQ3

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- ▶ First, setup the hardware

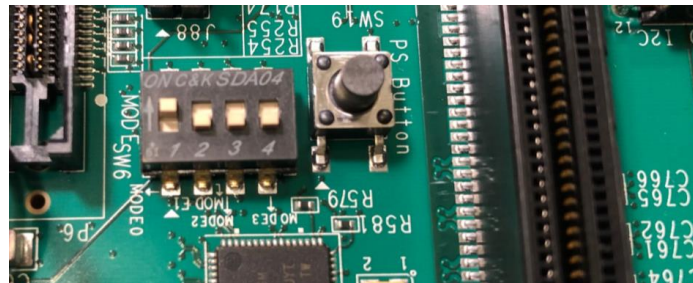
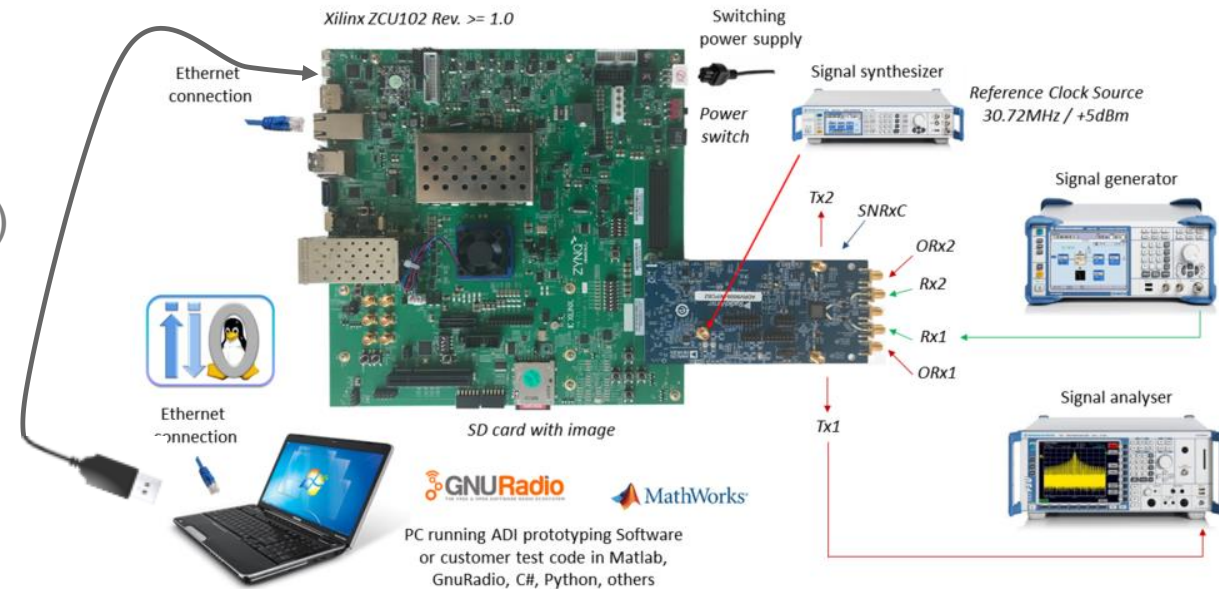
- ▶ Then, there are TWO Ways to Connect to the FPGA!
 1. Use a simple DHCP Server.
This is preferred by me!!!!

 2. Direct Connection via Ethernet
IF you have to.....

Setup the Hardware

ZCU102 Hardware Setup

- Need to have:
 - SD Card in place
 - Ethernet cable between laptop & FPGA board
 - USB cable between UART and laptop (J83 on ZCU102)
 - Power cable connected
 - SDR board in the correct HPC slot:
 - AD9371 (or FMCOMMSx or DAQ2) board goes in slot 0
 - ADRV9009 board goes in HPC slot 1 (closest to SD card)
 - (shown in figure on the right)
 - 30.72 MHz reference clock connected to SDR board
 - (see next slide for some options on this)
- Don't bother with HDMI or display port connections. They don't seem to work on the ZCU102
- DIP switches at SW6 need to be UP DN DN DN (up is toward SD card, DN is away from SD card)



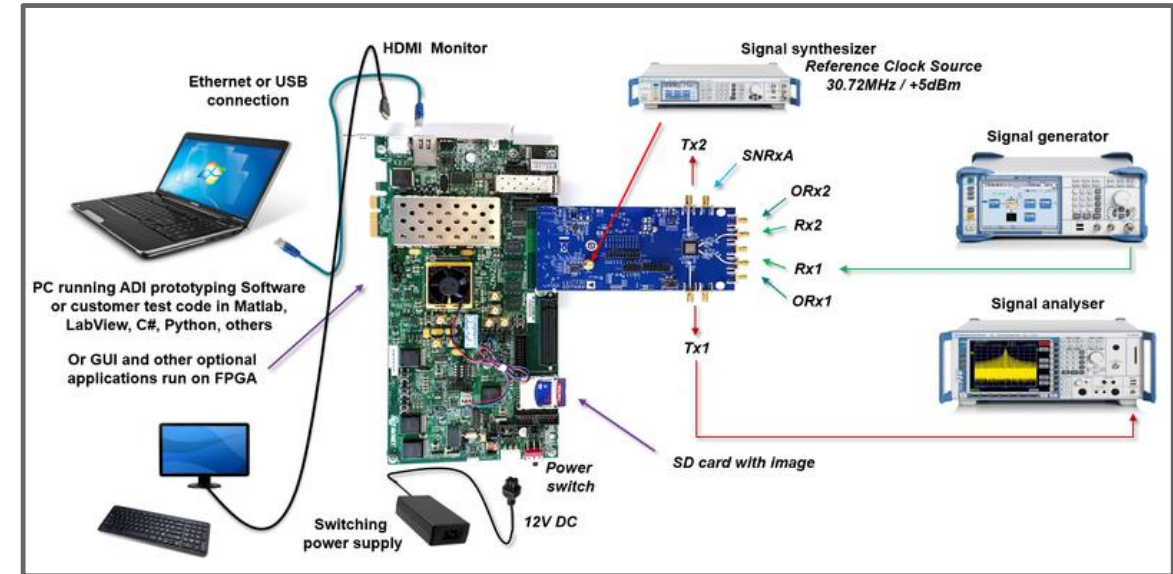
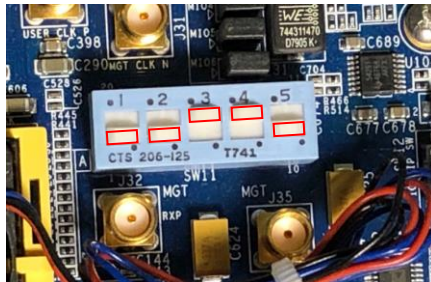
ZYNQ3 (and ZC706) Hardware Setup

► Need to have:

- SD Card in place
- Ethernet cable between laptop & FPGA board
- USB cable between UART and laptop (J21 on ZC706)
- Power cable connected
- SDR board in the correct HPC slot:
 - AD936x (i.e. FMCOMMSx) board goes in J5 (LPC) (closest to SD card)
 - AD9371 and ADRV9009 goes in J37 (HPC) (closest to ethernet)
- 30.72 MHz reference clock connected to SDR board
 - (see next slide for some options on this)

► DIP switches at SW11 need to be:

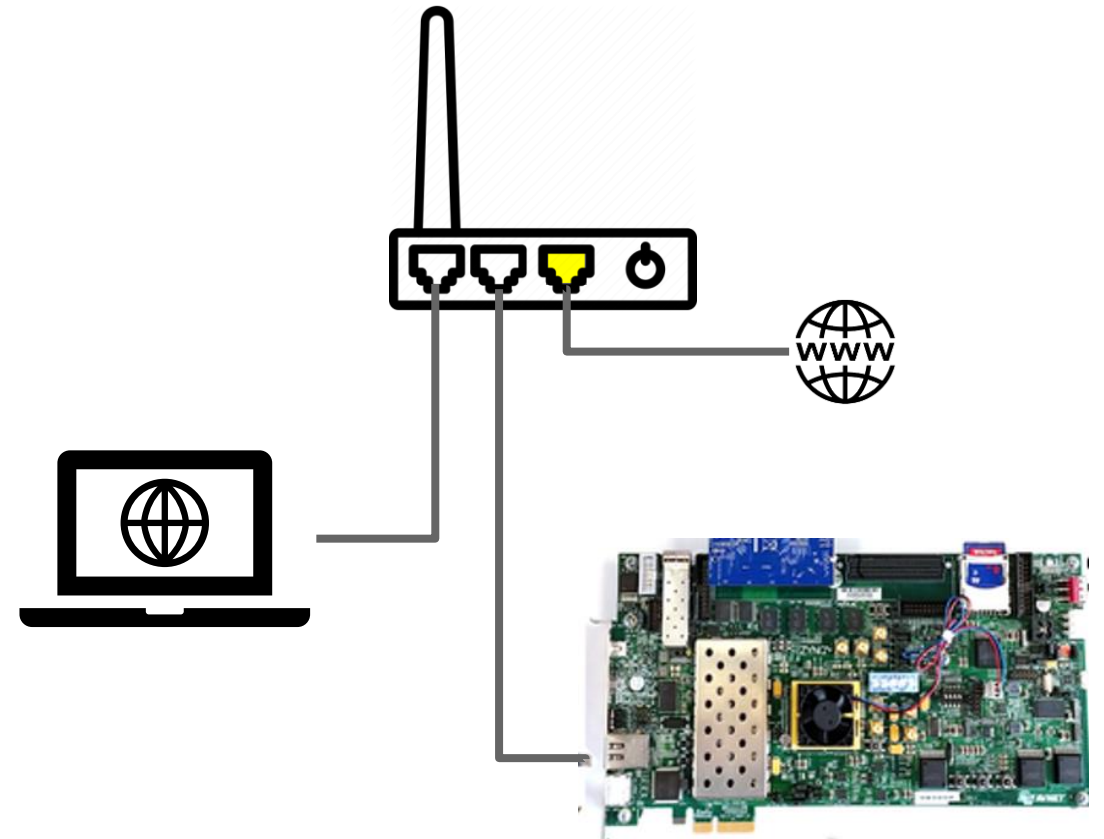
- 1, 2, and 5 are down
- 3, 4 are up



Connect to FPGA via DHCP Server

DHCP Router Connections

- ▶ Get a router (not a switch)
- ▶ Connect internet to its primary ethernet port
 - This is not necessary, but it is helpful so that your computer, and also the fpga board has access to the internet (for updates)
- ▶ Connect your computer to an ethernet port on the router
- ▶ Connect the FPGA to an ethernet port on the router



Configure the Router

- ▶ Log into the Router
 - Address, username, and password on back of the router
 - For my TPLINK router, I went to <http://192.168.0.1/>
- ▶ Setup the router as a DHCP Server
 - Start IP address of 192.168.0.2
 - End IP address of 192.168.0.99
 - You are telling the router: “Things that get plugged into you, you will assign one of those IP addresses to it!”
- ▶ Disable Wireless
 - It’s probably a good idea to not blast WiFi into your SDR measurements!)

http://192.168.0.1/

TL-WR940N/TL-WR941ND

Status

Quick Setup

WPS

Network

Wireless

DHCP

- DHCP Settings

- DHCP Client List

- Address Reservation

Forwarding

Security

Parental Control

Access Control

Advanced Routing

Bandwidth Control

DHCP Settings

DHCP Server: ☐ Disable ☒ Enable

Start IP Address:

End IP Address:

Address Lease Time: minutes (1~2880 minutes, the default value is 120)

Default Gateway: (Optional)

Default Domain: (Optional)

Primary DNS: (Optional)

Secondary DNS: (Optional)

Save

Check Your Windows Connection

- ▶ To see if all this is working, you can check your computer's assigned IP
- ▶ Type "ipconfig" at a windows cmd prompt
- ▶ You can see, my USB Ethernet adapter is now assigned to 192.168.0.2
 - This is within the range we told the router, so the DHCP is working!
- ▶ You don't really need to know your computer's IP address, but it may be useful for any debug

```
C:\Users\jkraft>ipconfig

Windows IP Configuration

Ethernet adapter Npcap Loopback Adapter:

    Connection-specific DNS Suffix  . : 
    Link-local IPv6 Address . . . . . : fe80::4b3:8599:ac7:f06a%6
    Autoconfiguration IPv4 Address. . : 169.254.240.106
    Subnet Mask . . . . . : 255.255.0.0
    Default Gateway . . . . . : 

Ethernet adapter Ethernet 2:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

Ethernet adapter Ethernet 60:

    Connection-specific DNS Suffix  . : 
    Link-local IPv6 Address . . . . . : fe80::7c76:7e2d:741:69c4%99
    IPv4 Address. . . . . : 192.168.0.2
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.0.1

Wireless LAN adapter Wi-Fi:

    Connection-specific DNS Suffix  . : 
    Link-local IPv6 Address . . . . . : fe80::58b:3582:ff66:b090%9
    IPv4 Address. . . . . : 192.168.1.18
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1

Ethernet adapter Bluetooth Network Connection:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

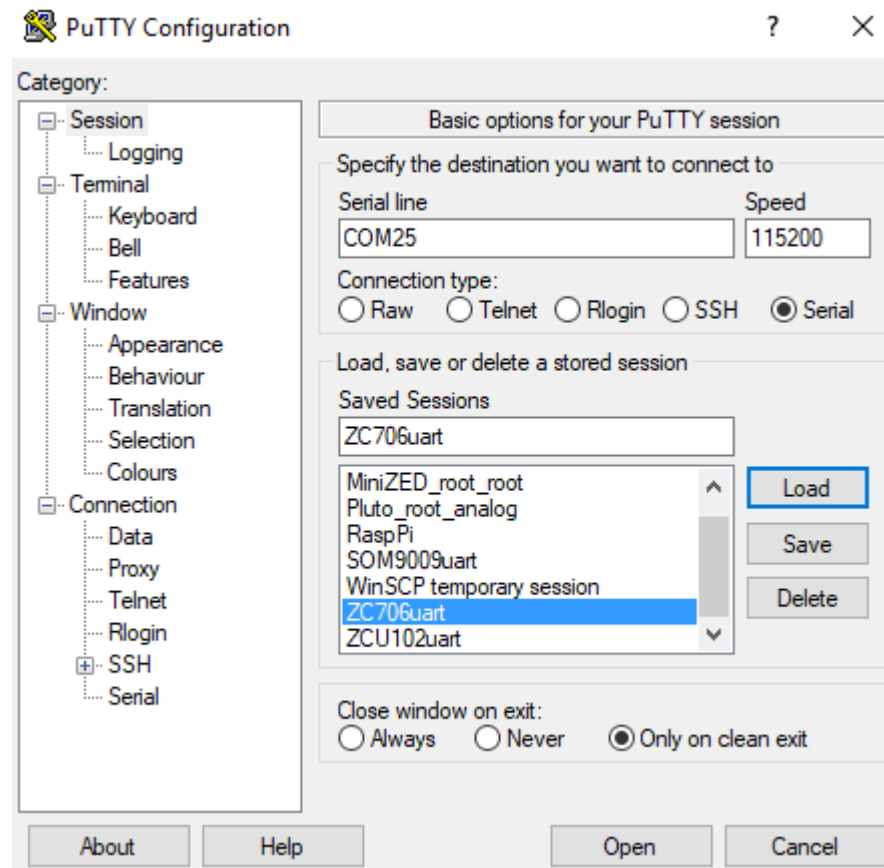
Tunnel adapter Teredo Tunneling Pseudo-Interface:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

C:\Users\jkraft>
```

PuTTY to the FPGA

- ▶ Connect a USB cable from computer to FPGA board
 - If you followed the “Hardware Setup” section at the beginning, then this is done already
- ▶ Find the COM port and puTTY over:



PuTTY to the FPGA

- ▶ Once you're connected, type "ifconfig" to see the assigned IP address
- ▶ Type "dhclient eth0 -v"
 - This dynamically assigns the IP address (so not static)

```
root@linaro-ubuntu-desktop:~# dhclient eth0 -v
Internet Systems Consortium DHCP Client 4.1-ESV-R4
Copyright 2004-2011 Internet Systems Consortium.
All rights reserved.
For info, please visit https://www.isc.org/software/dhcp/

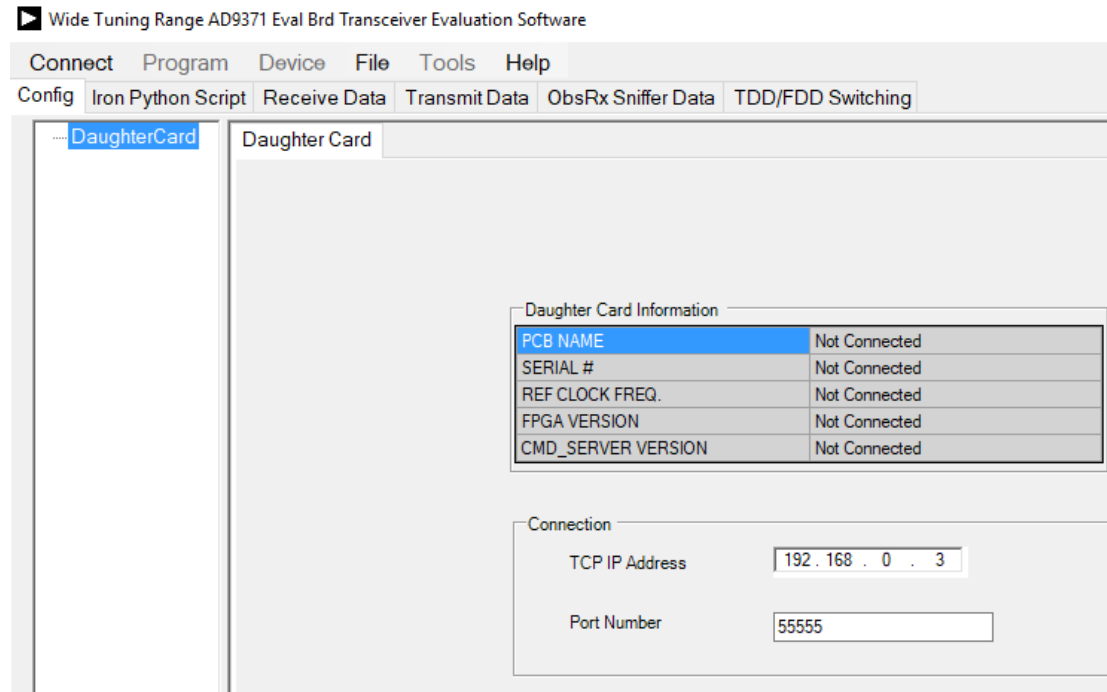
Listening on LPF/eth0/00:0a:35:00:01:22
Sending on   LPF/eth0/00:0a:35:00:01:22
Sending on   Socket/fallback
DHCPREQUEST of 192.168.0.3 on eth0 to 255.255.255.255 port 67
DHCPACK of 192.168.0.3 from 192.168.0.1
Rather than invoking init scripts through /etc/init.d, use the service(8)
utility, e.g. service smbd reload

Since the script you are attempting to invoke has been converted to an
Upstart job, you may also use the reload(8) utility, e.g. reload smbd
RTNETLINK answers: File exists
bound to 192.168.0.3 -- renewal in 82424 seconds.
root@linaro-ubuntu-desktop:~#
```

- ▶ Here, you can see I'm getting assigned 192.168.0.3

Connect with TES

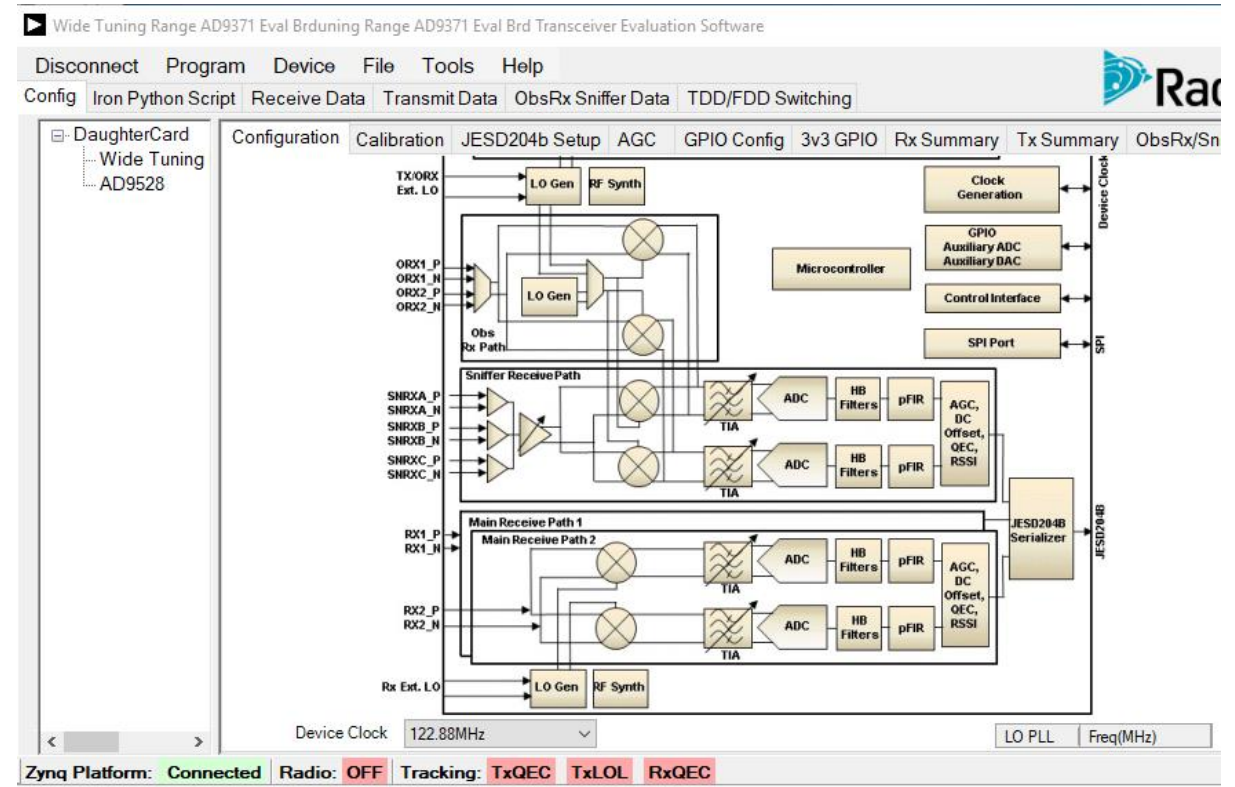
- For TES, put that assigned FPGA IP address in the TCP IP address field
- Click “Connect”



- Of course, the TES SD card must be in the FPGA board, and wait 30 sec after FPGA power up (until the LEDs stop blinking in a Knight Ryder Sequence, and turn off)

Connect with TES

- ▶ The lower left corner, should now say “Connected”
 - If you haven’t run TES in a while, the GUI may ask you to update the Platform Files. Just go ahead and do that. Then the FPGA will reboot, redo the dhcp command in Putty, then click connect in TES, and you should be good!
- ▶ Now just setup the radio config, and press “Program”



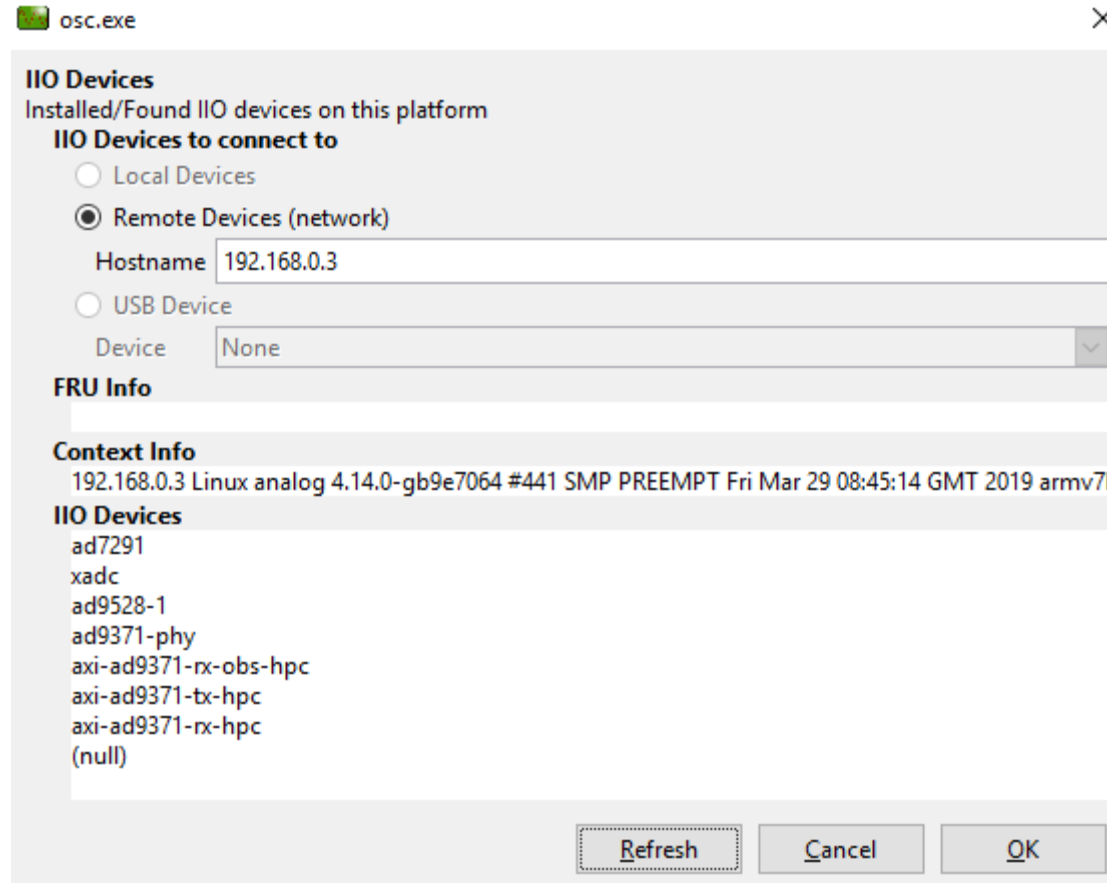
Connect with IIO Scope

- ▶ Of course, the IIO SD card must be in the FPGA board, and wait 30 sec after FPGA power up
- ▶ Open IIOscope
- ▶ Enter the IP address (192.168.0.3 for this example)



Connect with IIO Scope

- ▶ Press “Refresh”
- ▶ THEN hit “OK”



The screenshot shows a Windows-style dialog box titled "osc.exe" with a close button (X) in the top right corner. The dialog is divided into several sections:

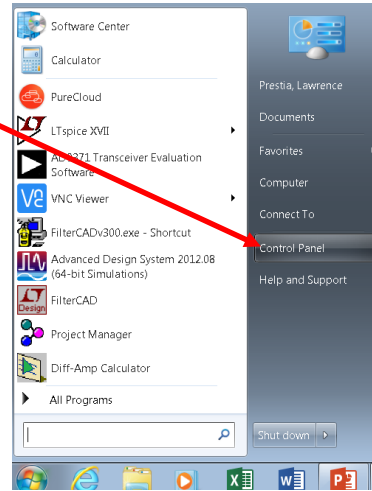
- IIO Devices**: A section header.
- Installed/Found IIO devices on this platform**: A subtitle.
- IIO Devices to connect to**: A section with three radio buttons:
 - ☐ Local Devices
 - ☒ Remote Devices (network)
 - ☐ USB Device
- Hostname**: A text input field containing "192.168.0.3".
- Device**: A dropdown menu currently showing "None".
- FRU Info**: A section header with a text input field below it.
- Context Info**: A section header with a text input field containing "192.168.0.3 Linux analog 4.14.0-gb9e7064 #441 SMP PREEMPT Fri Mar 29 08:45:14 GMT 2019 armv7l".
- IIO Devices**: A list of device names:
 - ad7291
 - xadc
 - ad9528-1
 - ad9371-phy
 - axi-ad9371-rx-obs-hpc
 - axi-ad9371-tx-hpc
 - axi-ad9371-rx-hpc
 - (null)
- Buttons**: At the bottom right, there are three buttons: "Refresh" (with a dotted border), "Cancel", and "OK".

Direct Connection via Ethernet (set a Static IP)

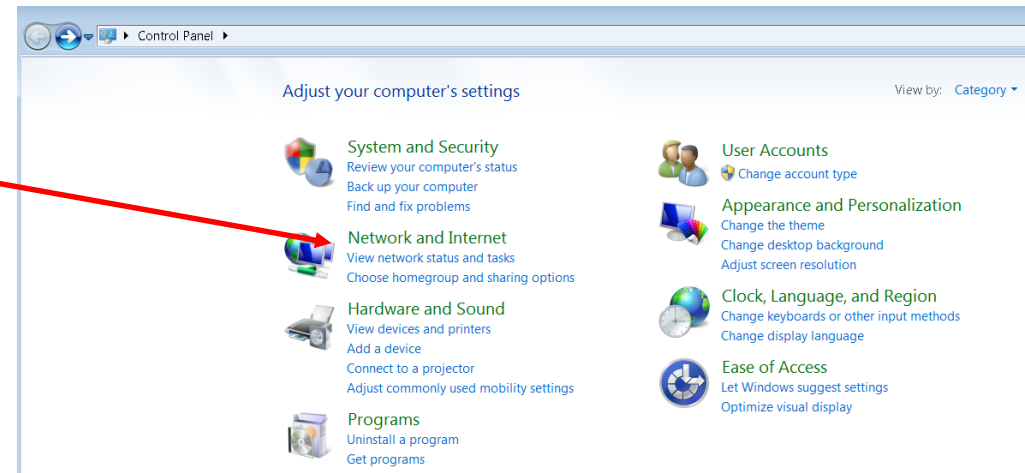
Set a Static IP Address (1)

1. Set up LAN laptop settings for communications.

a) Start, Control Panel,

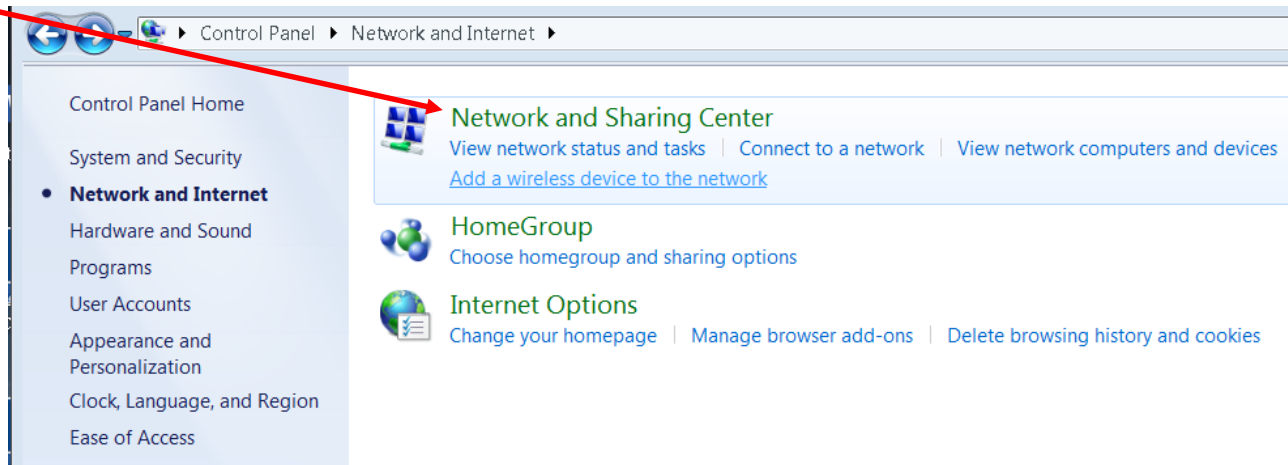


b) Network and Internet

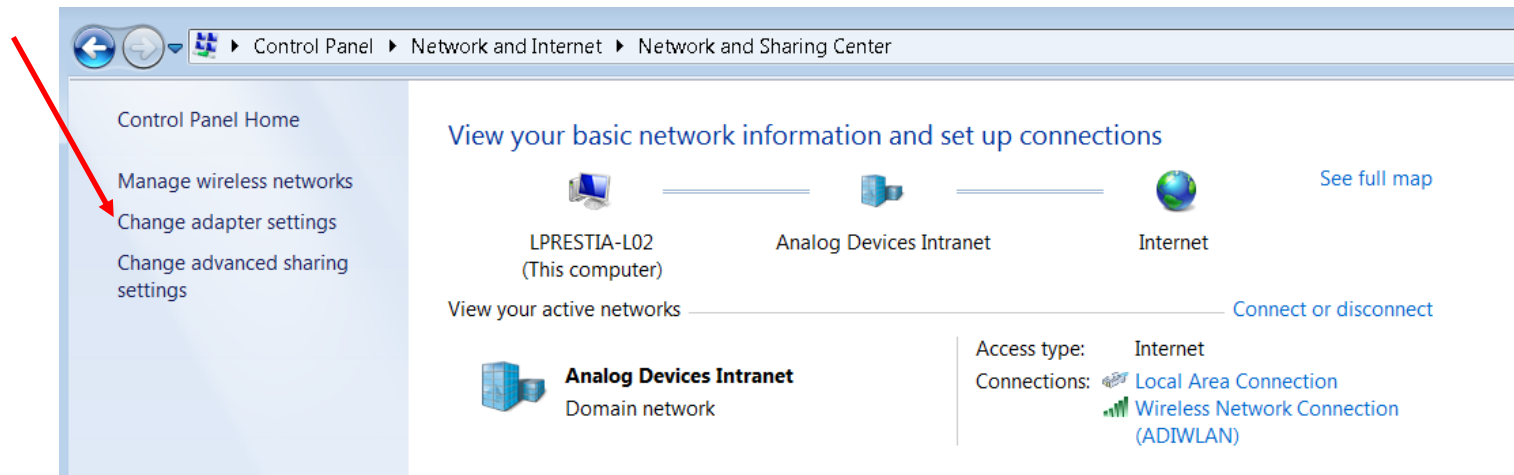


Set a Static IP Address (2)

c) Network and Sharing Center

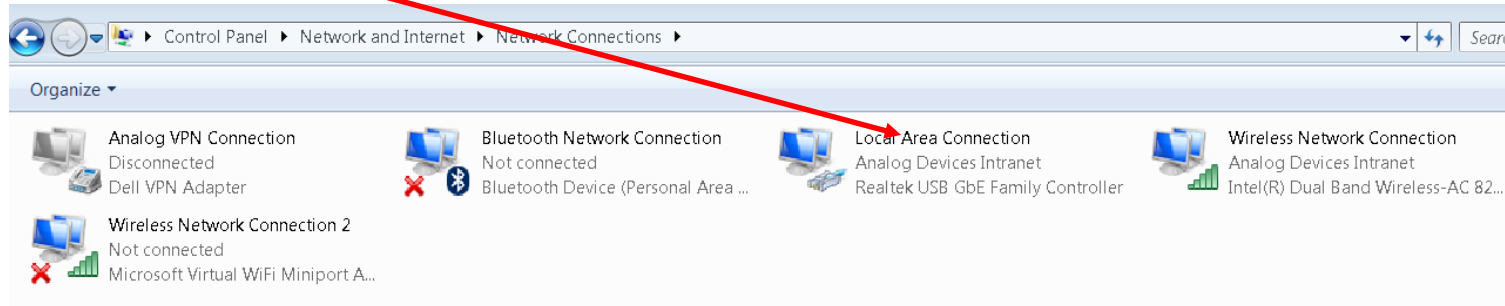


d) Change adapter settings

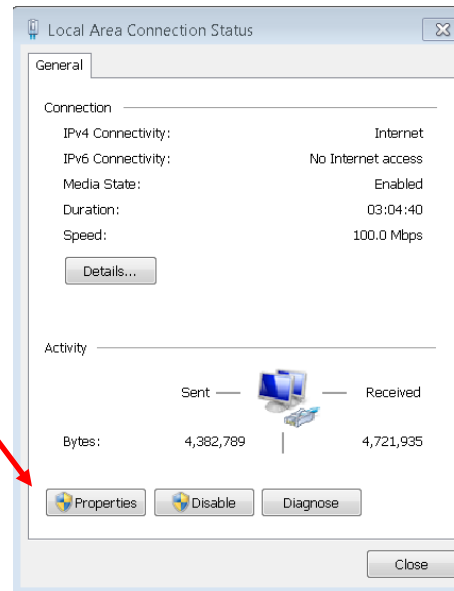


Set a Static IP Address (3)

e) Local Area Connection or Ethernet

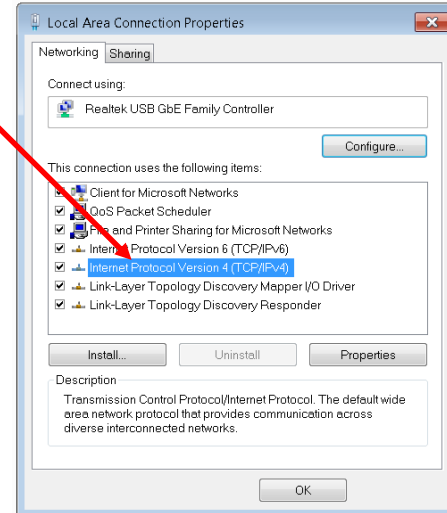


f) Properties

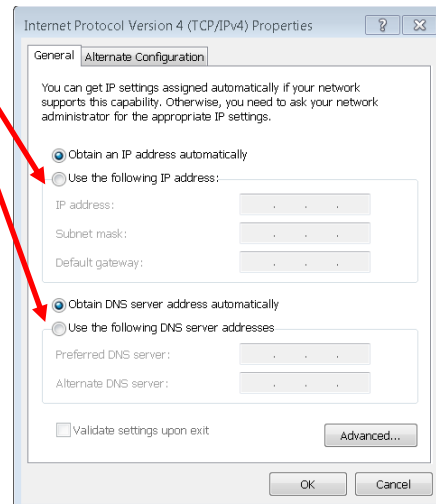


Set a Static IP Address (4)

g) Internet Protocol Version 4 (double-click)

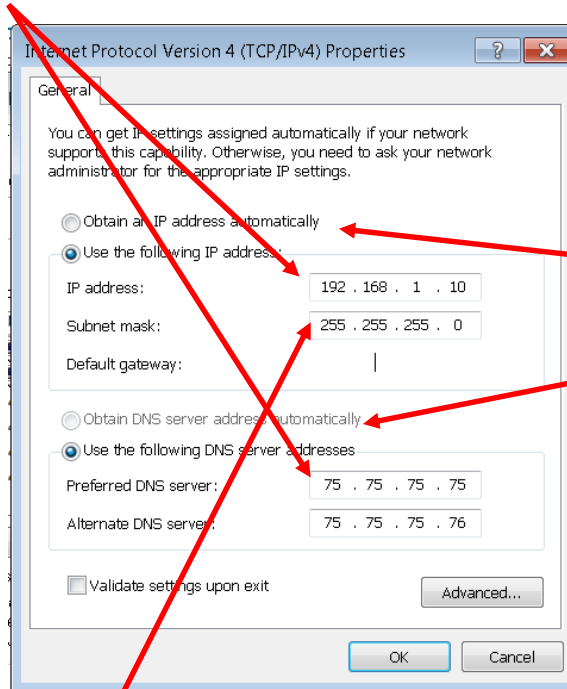


f) Use the following...



Set a Static IP Address (5)

g) Fill in IP Address, Preferred DNS, Alternate DNS with values shown



IMPORTANT – Change back to OBTAIN...AUTOMATICALLY when done

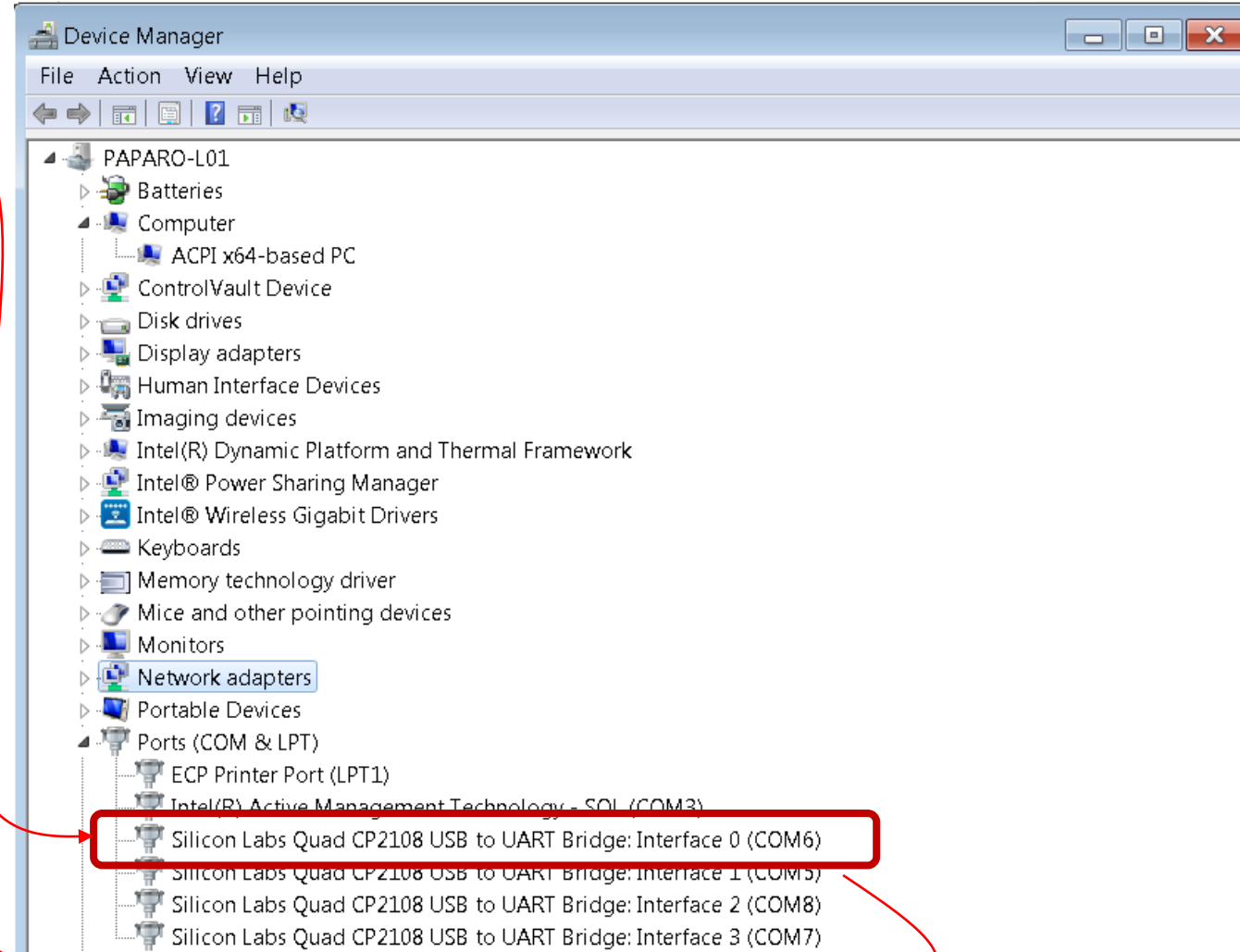
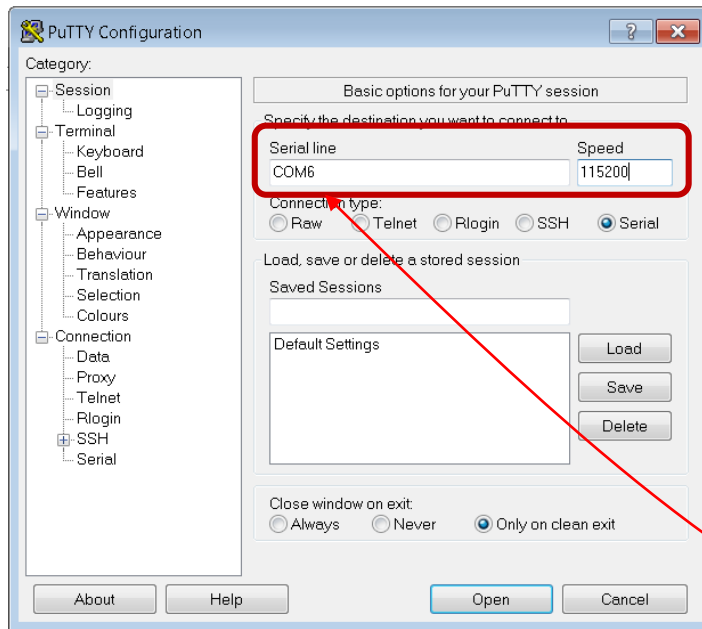
f) Subnet fills in automatic

g) OK, OK

Connecting to the FPGA Board

Power Up FPGA Board

- Open Device Manager & find USB to UART Bridge “Interface 0”
 - You may need to download and install the CP2108 drivers from Silicon labs
- Open PuTTY and use Serial Link to connect to that COM port. Baud rate will be 115200.



Connecting to the FPGA Board

- ▶ When board is finished booting, you should see this, ending with the “root@analog:~#” cmd prompt
 - You may have to hit return a few times to get the command prompt

- ▶ If you are using the ZCU102 board and if the terminal output only gives you something like these two lines:

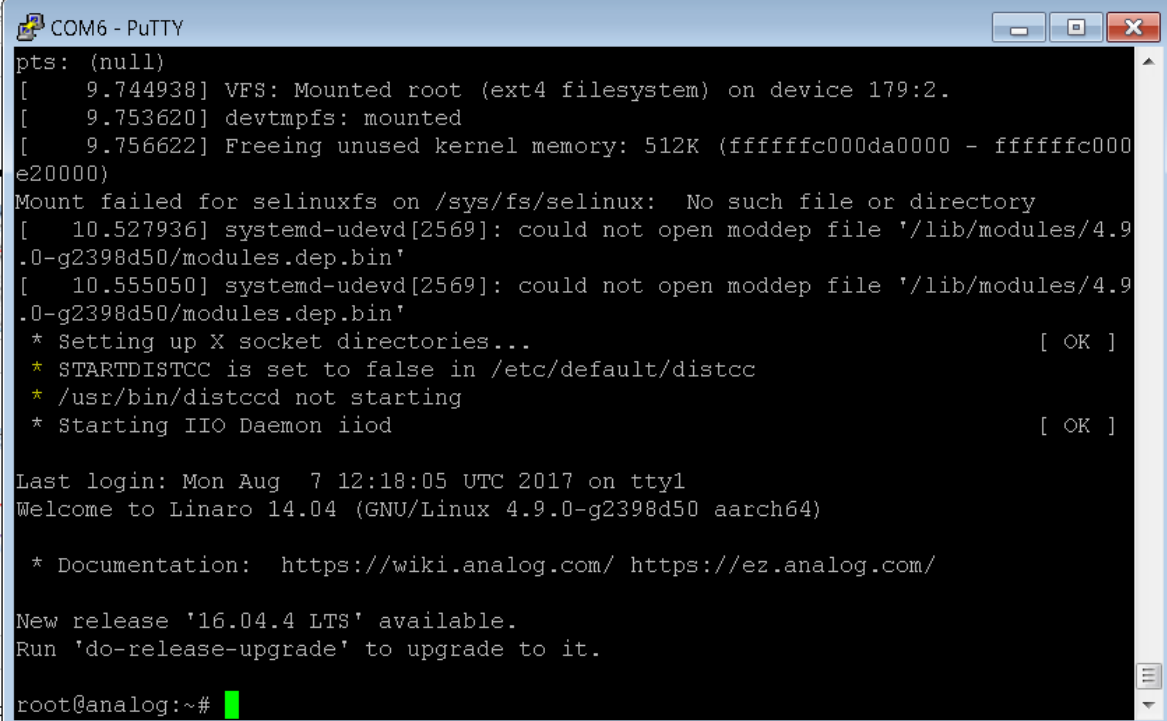
*Xilinx Zynq MP First Stage Boot Loader
Release 2017.4 Jun 26 2018 - 10:06:15*

- Then you are probably using an old version of boot files. You need update with the latest version here:

https://wiki.analog.com/resources/tools-software/linux-software/zynq_images

- More info on this issue here:

<https://ez.analog.com/fpga/f/q-a/108363/adrv9009-support-for-xilinx-zcu102-rev-1-1>



```
COM6 - PuTTY
pts: (null)
[ 9.744938] VFS: Mounted root (ext4 filesystem) on device 179:2.
[ 9.753620] devtmpfs: mounted
[ 9.756622] Freeing unused kernel memory: 512K (fffffc000da0000 - fffffc000e20000)
Mount failed for selinuxfs on /sys/fs/selinux: No such file or directory
[ 10.527936] systemd-udevd[2569]: could not open moddep file '/lib/modules/4.9.0-g2398d50/modules.dep.bin'
[ 10.555050] systemd-udevd[2569]: could not open moddep file '/lib/modules/4.9.0-g2398d50/modules.dep.bin'
* Setting up X socket directories... [ OK ]
* STARTDISTCC is set to false in /etc/default/distcc
* /usr/bin/distccd not starting
* Starting IIO Daemon iiod [ OK ]

Last login: Mon Aug 7 12:18:05 UTC 2017 on tty1
Welcome to Linaro 14.04 (GNU/Linux 4.9.0-g2398d50 aarch64)

* Documentation: https://wiki.analog.com/ https://ez.analog.com/

New release '16.04.4 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

root@analog:~#
```

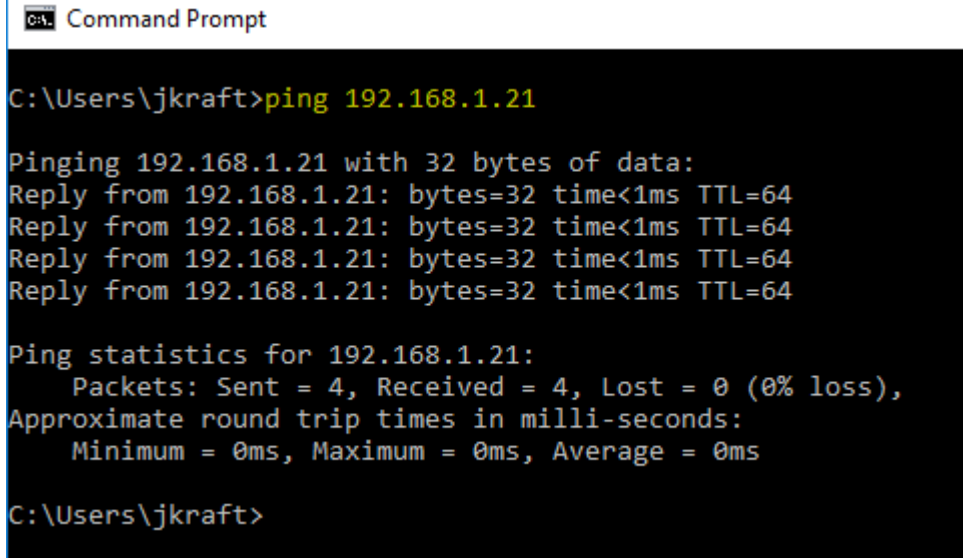
Setting IP address of FPGA Board

- ▶ First: type `ifconfig` to check if an IP address has been assigned
 - If there is no IP address, then from PuTTY window, configure the board for a static IP address by typing `enable_static_ip.sh 192.168.1.21`
 - The “1.21” ending could really be anything that doesn’t conflict with something else already connected
 - If an IP address is already assigned, then you can use that address
 - Or, to change, type `ifconfig eth0 192.168.1.10` (or whatever address you want)
 - To return the FPGA to a dynamic IP address (i.e. to allow the FPGA board to access the internet via ethernet), type `sudo enable_dhcp.sh`
- ▶ To confirm the ip address, type `ifconfig`
 - You should get back a bunch of info confirming the inet6 addr
- ▶ To verify the TRx cards connected, type `iio_attr -a -d`

```
root@analog:~# iio_attr -a -d
Using auto-detected IIO context at URI "local:"
IIO context has 8 devices:
  iio:device3: ad9371-phy, found 9 device attributes
  iio:device1: ad9528-1, found 9 device attributes
  iio:device6: axi-ad9371-rx-hpc, found 0 device attributes
  iio:device4: axi-ad9371-rx-obs-hpc, found 1 device attributes
  iio:device2: ad7291, found 0 device attributes
  iio:device0: ams, found 1 device attributes
  iio_sysfs_trigger:, found 2 device attributes
  iio:device5: axi-ad9371-tx-hpc, found 0 device attributes
root@analog:~#
```

Ensure that your laptop can talk to that address

- ▶ Open Command prompt & ping the address.



```
CA: Command Prompt

C:\Users\jkraft>ping 192.168.1.21

Pinging 192.168.1.21 with 32 bytes of data:
Reply from 192.168.1.21: bytes=32 time<1ms TTL=64
Reply from 192.168.1.21: bytes=32 time<1ms TTL=64
Reply from 192.168.1.21: bytes=32 time<1ms TTL=64
Reply from 192.168.1.21: bytes=32 time<1ms TTL=64

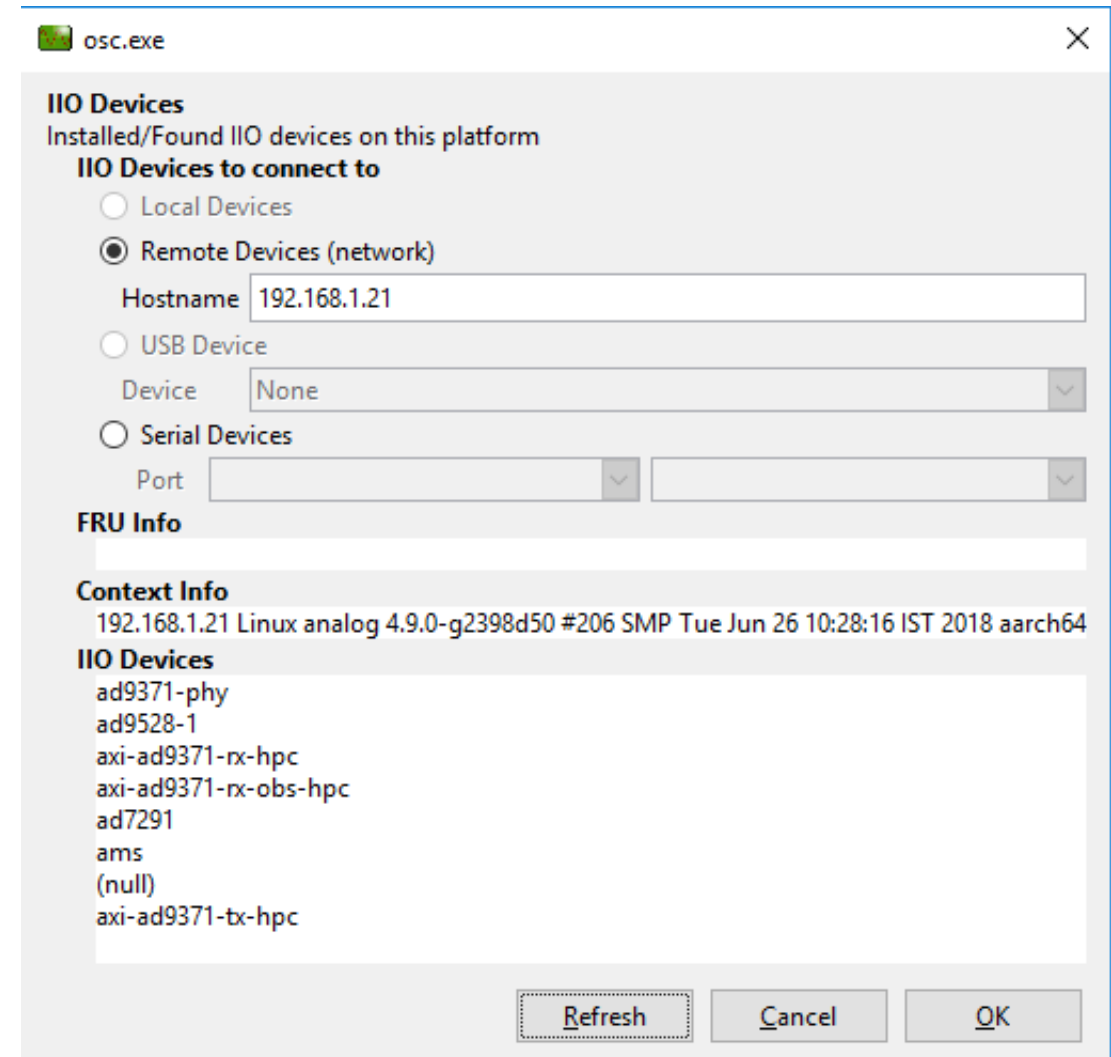
Ping statistics for 192.168.1.21:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Users\jkraft>
```

- ▶ If no response:
 - check IP address of your laptop (see “Set Static IP Address” instructions above)

Launch IIOScope

- ▶ Download IIOscope here:
 - https://wiki.analog.com/resources/tools-software/linux-software/iio_oscilloscope
- ▶ Enter the IP address you used above with the `enable_static_IP.sh` command (i.e. 192.168.1.21)
 - Click refresh
 - You should then see a bunch of IIO Devices listed
 - Then click ok.



osc.exe

IIO Devices
Installed/Found IIO devices on this platform

IIO Devices to connect to

☐ Local Devices

☒ Remote Devices (network)
Hostname

☐ USB Device
Device

☐ Serial Devices
Port

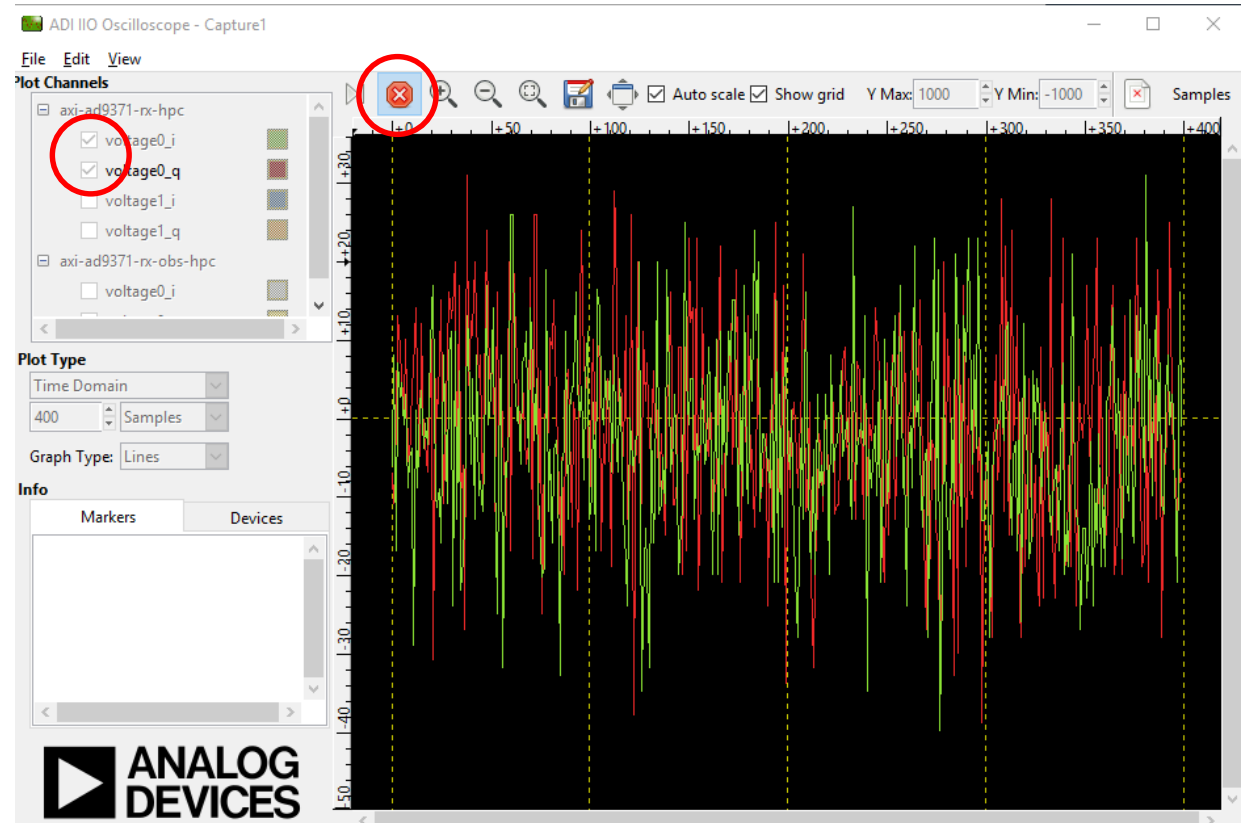
FRU Info

Context Info
192.168.1.21 Linux analog 4.9.0-g2398d50 #206 SMP Tue Jun 26 10:28:16 IST 2018 aarch64

IIO Devices
ad9371-phy
ad9528-1
axi-ad9371-rx-hpc
axi-ad9371-rx-obs-hpc
ad7291
ams
(null)
axi-ad9371-tx-hpc

Confirm IIO Scope Operation

- ▶ If a capture window is not open:
 - Then go to File→New Plot
- ▶ In the “Capture” window:
 - Click on voltage0_i and voltage 0_q
 - Then press “Play”
 - You should see a rapidly updating scope



Shutdown and Troubleshooting

Safely Shutdown

- ▶ To shutdown gracefully (i.e. not corrupt the SD card):

- `sudo shutdown -h now` command from PUTTY

- ▶ Troubleshooting:

- If unable to see devices in iio-oscilloscope, you could have the wrong HPC spot
- If unable to boot and FPGA board and you see some red LEDs? Likely a bad SD card or SW06 in wrong position.
- If unable to boot past first stage boot loader? Likely a bad SD card
- If unable to connect from laptop, check the network config (see above section on configuring a static IP)

Command Summary

► Terminal Commands:

- `enable_static_ip.sh 192.168.1.21`
 - Sets IP address (to 192.168.1.21)
- `ifconfig`
 - Check's IP address
- `ifconfig eth0 192.168.1.10`
 - Changes IP address (to 192.168.1.10 in this example)
- `iio_attr -a -d`
 - See what devices are connected
- `poweroff` **or** `sudo shutdown -h now`
 - Safely shutdown the FPGA
- `reboot`
 - Restarts the FPGA