

# LabVIEW & USRP Introduction

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# Outline

- Overview of Labs
- Introduction of Hardware & Software
- Installation Guide & Resources
- Contact Information

# Overview of Labs

# Purposes of Labs

- Learn how to bring theory into practice
  - ✓ How to implement a communication system
  - ✓ What are the challenges?
  - ✓ How to overcome the challenges?
- From basic to advanced
  - ✓ Techniques in labs can be extended to WiFi, LTE, etc.
  - ✓ Understand the differences of these system

# Lab Overview

- Basics of LabVIEW and USRP
  - Digital modulation and demodulation
  - Coded transmission (convolutional code)
  - Wideband systems (OFDM transceiver)
- 
- We will use **real-world, over-the-air, real-time** transmission to verify our implementation!

# Software & Hardware

# Software & Hardware

- Software: **LabVIEW**

- ✓ Graphic programming software
- ✓ Block-diagram based environment
- ✓ Available licenses for NTU students



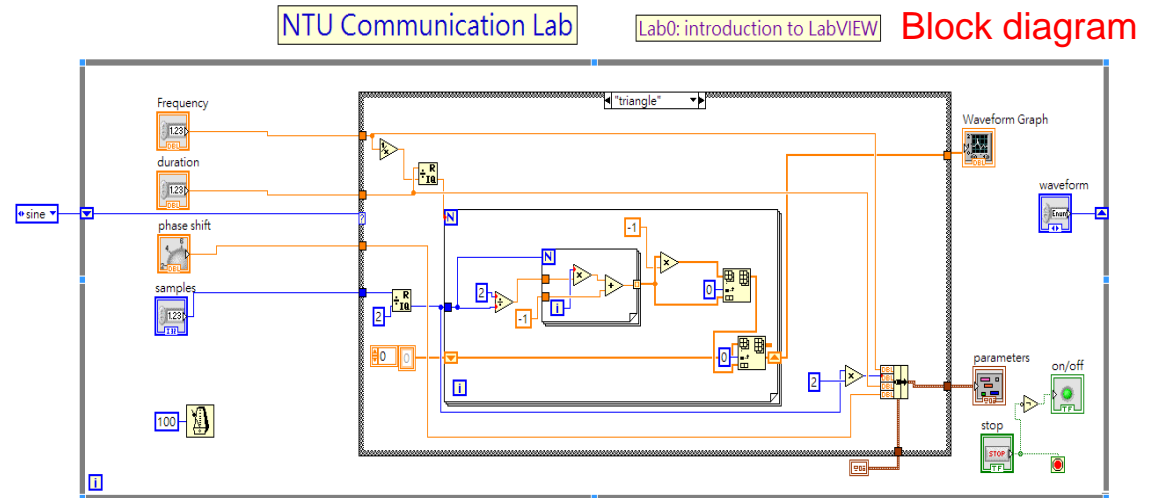
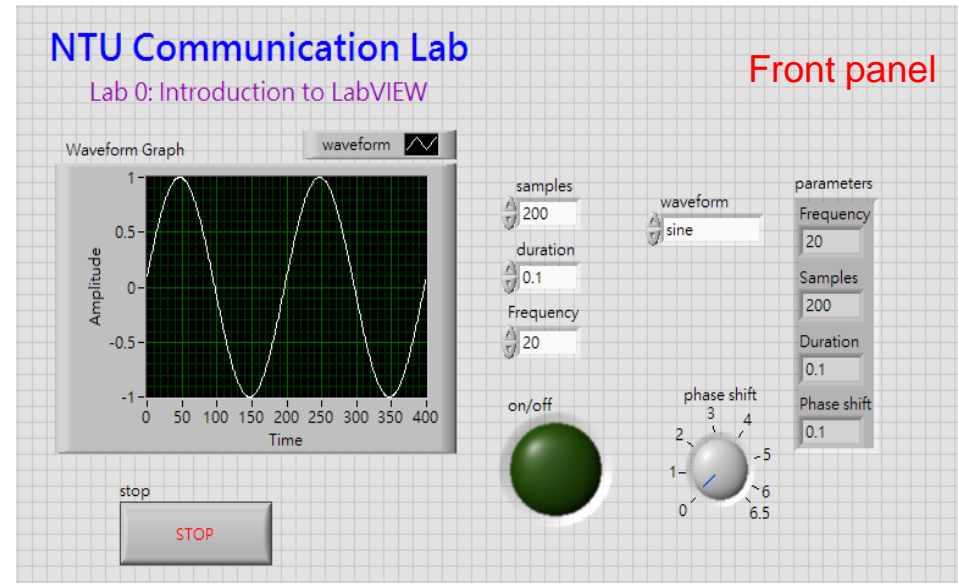
- Hardware: **USRP-2920**

- ✓ Software defined radio
- ✓ No need to worry about RF front end!
- ✓ Efficient communication system prototyping
- ✓ Experiment through real-world transmission



# LabVIEW Interface

- Front panel
  - ✓ 參數輸入輸出的介面
- Block diagram
  - ✓ 主要程式設計的介面

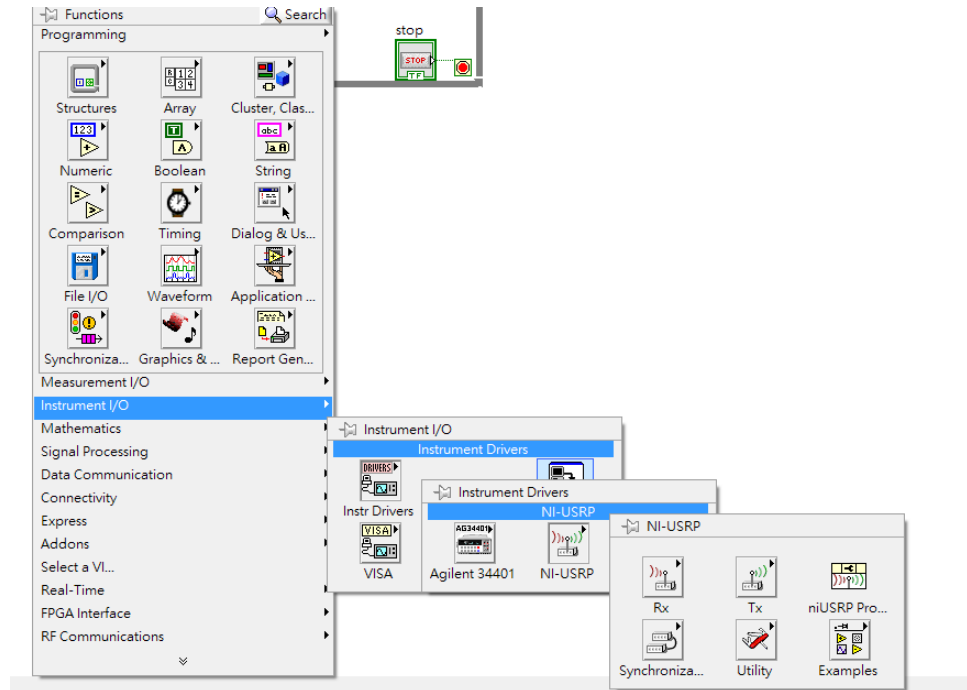




# LabVIEW Toolkit

- LabVIEW通信相關套件

- ✓ Modulation
- ✓ Real-time
- ✓ NI USRP
- ✓ NI MyRIO
- ✓ NI FPGA
- ✓ ...



# NI USRP-2920

- RF 硬體參數:

- ✓ Frequency range: 50MHz to 2.2GHz
- ✓ Maximum I/Q sample rate: 25MS/s
- ✓ Gain range: 0dB to 31dB

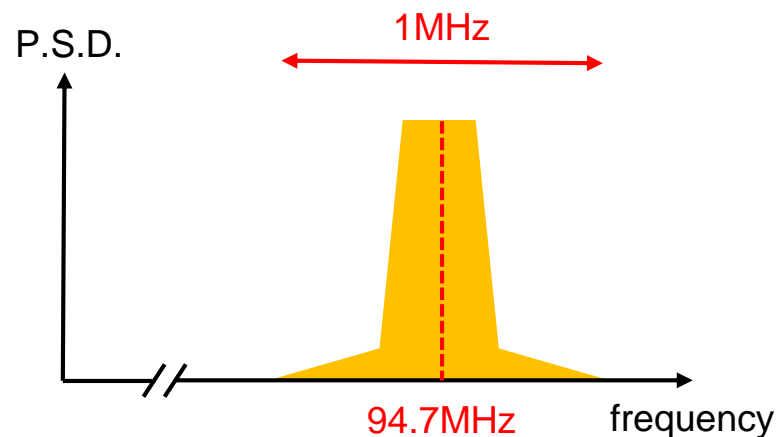
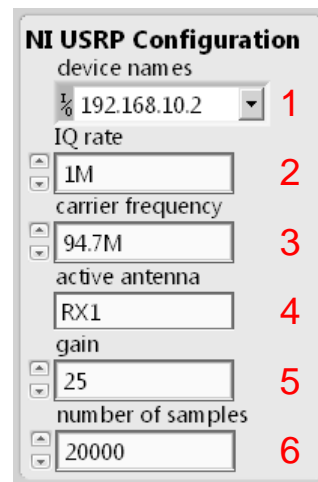
- 特色:

- ✓ 透過Ethernet 與PC交換資料
- ✓ 雙天線(一傳一收)
- ✓ 支援MIMO cable



# NI USRP RF 傳收參數

- 裝置名稱: USRP 的 IP 位址
- IQ 速率: 取樣速率，約等同於頻寬
- 載波頻率: 目標頻率
- 天線: 選擇要傳收的天線連接埠
- 增益: RF端的訊號放大倍率
- 取樣數量: 接收端每次擷取的樣本數量



# LabVIEW Installation

# Resources

- 台大計中授權軟體下載
  - ✓ 搜尋"labVIEW"
  - ✓ 下載LabVIEW 2014 DVD1
- LabVIEW額外套件 (optional)
  - ✓ LabVIEW 2014 Modulation toolkits (DVD2)
- 國家儀器National Instrument(資源下載)
  - ✓ <http://www.ni.com/downloads/zht/>
- 國家儀器論壇 (範例程式及問題討論)
  - ✓ <http://forums.ni.com/>

# Step 1: Download LabVIEW

- Brought to you by NTU
  - ✓ **Only** for NTU students
- ISO file
  - ✓ Free resources: Daemons tool...
- May need an NI account
  - ✓ You can apply one with NTU mail for free

## LabView (Fall 2014)

2014/10/13

### LabView (Fall 2014)

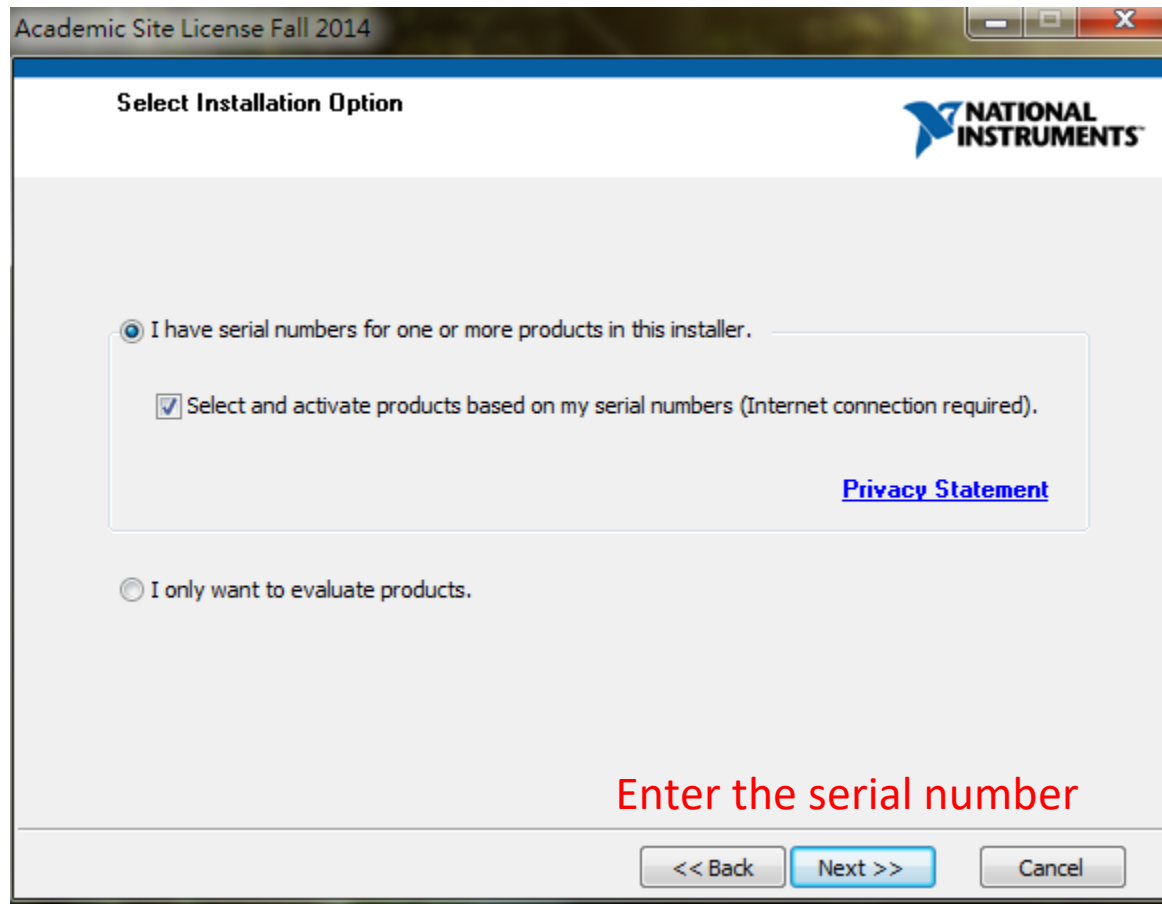
1. Software from the LabVIEW Core DVDs.
2. NI LabVIEW 2014 FPGA Module.
3. NI Device Drivers.

serial XXXXXXXXXX

Download DVD 1  
(optional) DVD 2

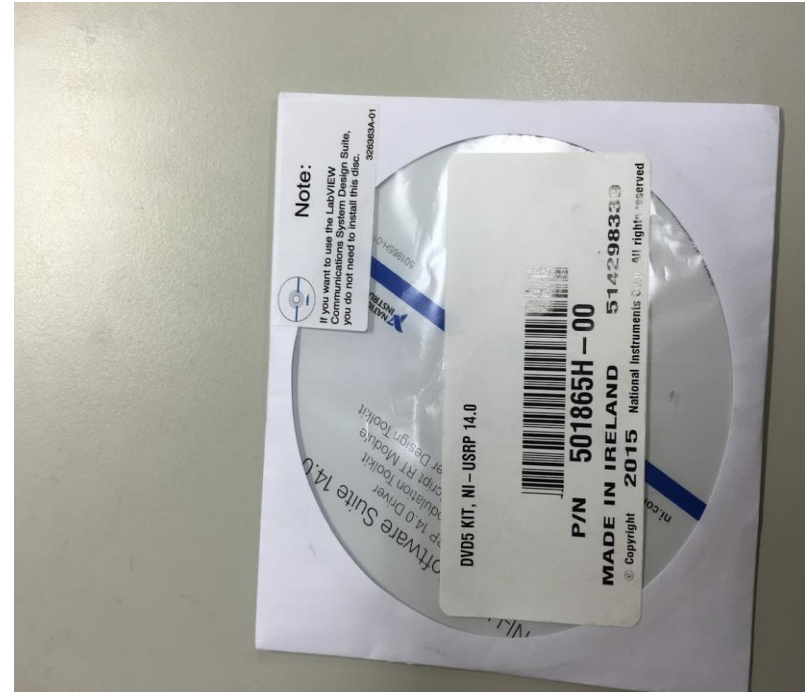
|   |                |                             |
|---|----------------|-----------------------------|
| DVD 1 of 3  | Filesize: 7.1G | <a href="#">download 下載</a> |
| DVD 2 of 3  | Filesize: 7.3G | <a href="#">download 下載</a> |
| DVD 3 of 3  | Filesize: 7.1G | <a href="#">download 下載</a> |
| NI LabVIEW 2014 FPGA<br>Module for Windows                    | Filesize: 7.3G | <a href="#">download 下載</a> |
| NI LabVIEW 2014 FPGA<br>Module for Linux                      | Filesize: 7.2G | <a href="#">download 下載</a> |
| NI LabVIEW 2014 for<br>Linux and Mac OS X<br>10.8.0 to 10.9.0 | Filesize: 3.1G | <a href="#">download 下載</a> |
| NI Device Drivers   | Filesize: 7.8G | <a href="#">download 下載</a> |

# Step 2: Install LabVIEW



# Step 3: Install USRP modules

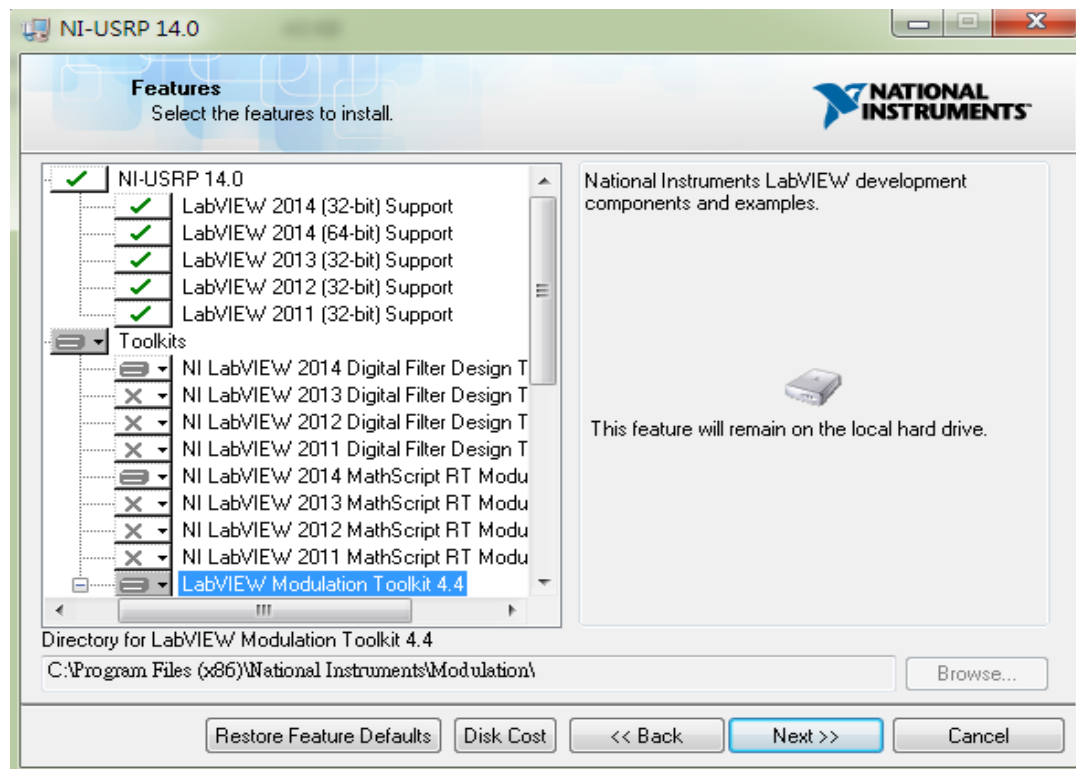
- Each group has one NI-USRP DVD
  - ✓ Install on Lab PC or laptop with CD-ROM
- For those who do not have CD-ROM
  - ✓ Download from NI.com
  - ✓ Burn the DVD to ISO file





# Step 4: Install Modulation toolkit

- The NI-USRP DVD contains Modulation toolkit



# Alternative method

- Download from NI support
  - ✓ NI-USRP 14.0
  - ✓ <http://www.ni.com/download/ni-usrp-14.0/4999/en/>
  - ✓ Or search “NI USRP” at the support page of NI website

# Alternative method

- NI Modulation Toolkit
  - ✓ NI Account required

NATIONAL INSTRUMENTS

台灣 (Taiwan) | 我的帳號 Teng-Hui... | 登出

解決方案 選購 **支援** 社群

首頁 > 支援 > 下載 > NI 產品下載 > 搜尋結果

搜尋完整網站

搜尋範圍

- Downloads
- Product Downloads
- Drivers
- Camera Network
- DataPlugins

縮小依據

- 產品
  - LabVIEW Add-ons (15)
  - RF (11)
- 版本
  - 4.4 (1)
  - 4.3.4 (1)
  - 4.3.3 (1)
  - 4.1.1 (1)
  - 4.1 (1)

產品下載結果

Product Downloads | **Modulation toolkit**

需要不只一個產品? 深入了解新的網路式安裝程式或立即選擇下載項目。

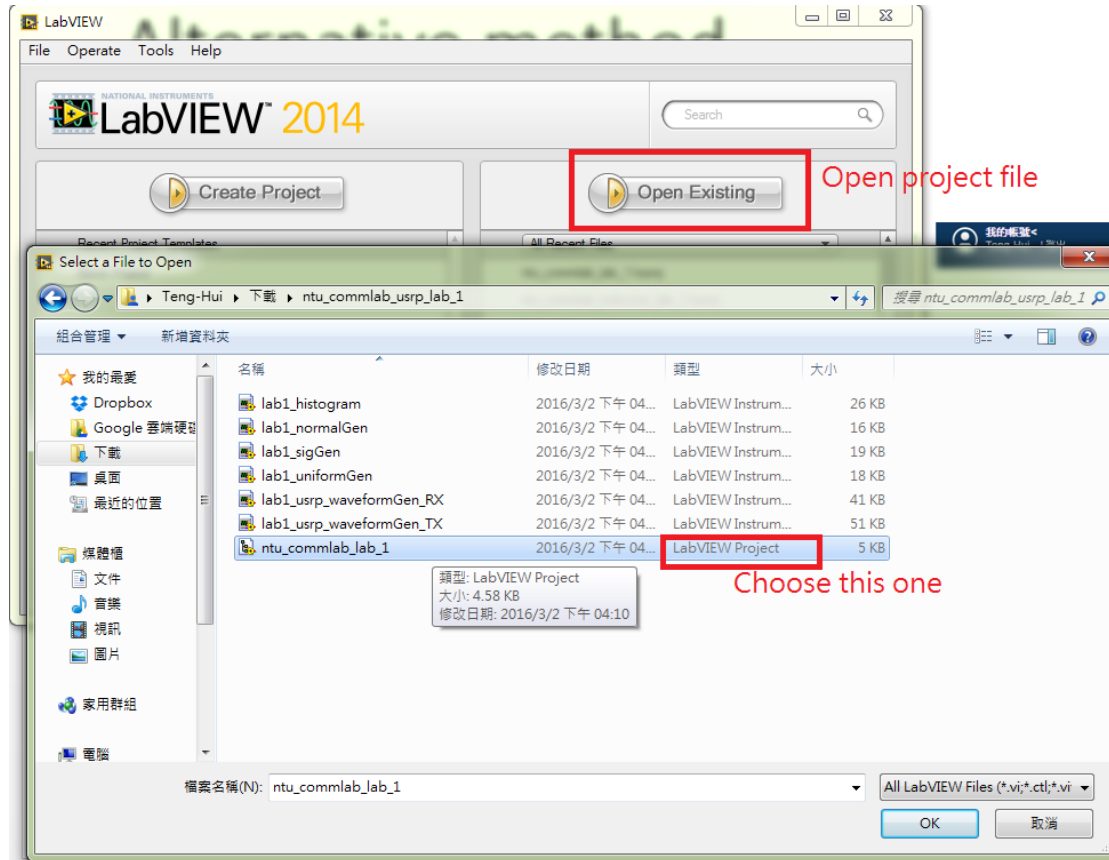
語言: 英文 / 中文 | 檢視: 10 | 三田

顯示 1-10 項結果 (共 18 項)

| Product/Version                  | Language            | Operating System   | Release Date  | Download |
|----------------------------------|---------------------|--|---------------|----------|
| LabVIEW Modulation Toolkit 4.3.3 | English<br>Japanese | Windows 7<br>Windows Vista<br>Windows XP 32-bit<br>Windows Server 2008 R2 64-bit<br>Windows Server 2003 R2 32-bit  | 2012 February | ↓ 下載     |
| NI Modulation Toolkit 15.0       | English<br>Japanese | Windows 8.1<br>Windows 8<br>Windows 7<br>Windows Vista<br>Windows XP (SP3) 32-bit<br>Windows Server 2012 R2 64-bit<br>Windows Server 2008 R2 64-bit<br>Windows Server 2003 R2 32-bit | 2015 June     | ↓ 下載     |

# Open project file

- All USRP lab will be given as a LabVIEW project



# USRP Guide

# Step 1: Connect the power line, Ethernet cable, antennas



# Step 2: Configure the IP address

網路連線

控制台 > 網路和網際網路 > 網路連線

組合管理 停用這個網路裝置 診斷這個連線 重新命名這個連線 檢視這個連線的狀態 變更這個連線的設定

乙太網路  
網路  
Realtek PCIe GBE Family C...

乙太網路 內容

網路功能 驗證

連線方式:  
Realtek PCIe GBE Family Controller  
設定(C)...

這個連線使用下列項目(O):

- Client for Microsoft Networks
- File and Printer Sharing for Microsoft Networks
- VirtualBox NDIS6 Bridged Networking Driver
- QoS 封包排程器
- Juniper Network Service
- 網際網路通訊協定第 4 版 (TCP/IPv4)
- Microsoft Network Adapter 多工器通訊協定

安裝(N)... 解除安裝(U) 內容(R)

描述  
傳輸控制通訊協定/網際網路通訊協定 (TCP/IP)。這是預設的廣域網路通訊協定，提供不同網路之間的通訊能力。

確定 取消

網際網路通訊協定第 4 版 (TCP/IPv4) - 內容

一般

如果您的網路支援這項功能，您可以取得自動指派 IP 設定。否則，您必須詢問網路系統管理員正確的 IP 設定。

自動取得 IP 位址(O)

使用下列的 IP 位址(S):

IP 位址(I): 192 . 168 . 10 . 1

子網路遮罩(U): 255 . 255 . 255 . 0

預設閘道(D): 192 . 168 . 10 . 2

自動取得 DNS 伺服器位址(B)

使用下列的 DNS 伺服器位址(E):

慣用 DNS 伺服器(P): . . .

其他 DNS 伺服器(A): . . .

結束時確認設定(L)

進階(M)...

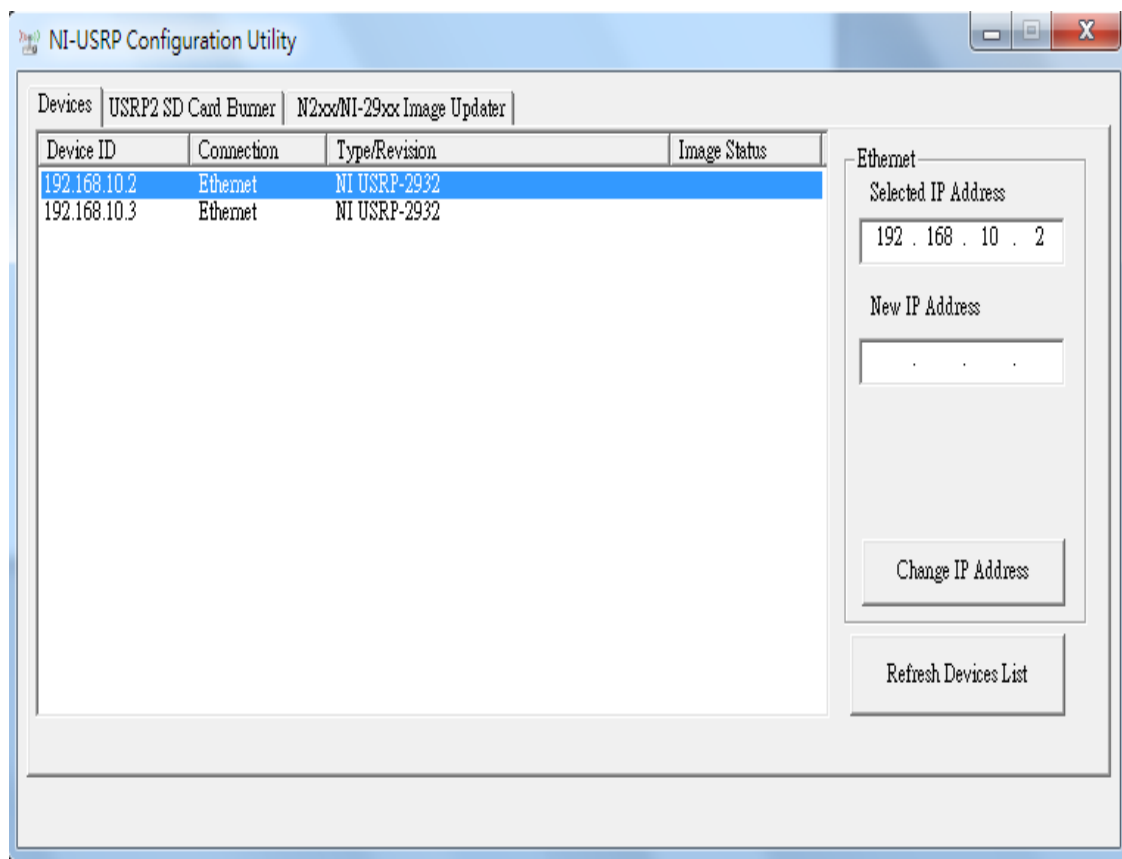
確定 取消

# Step 3: Open “NI-USRP Configuration Utility”

- See things similar to the following if you setup correctly



2018/3/5



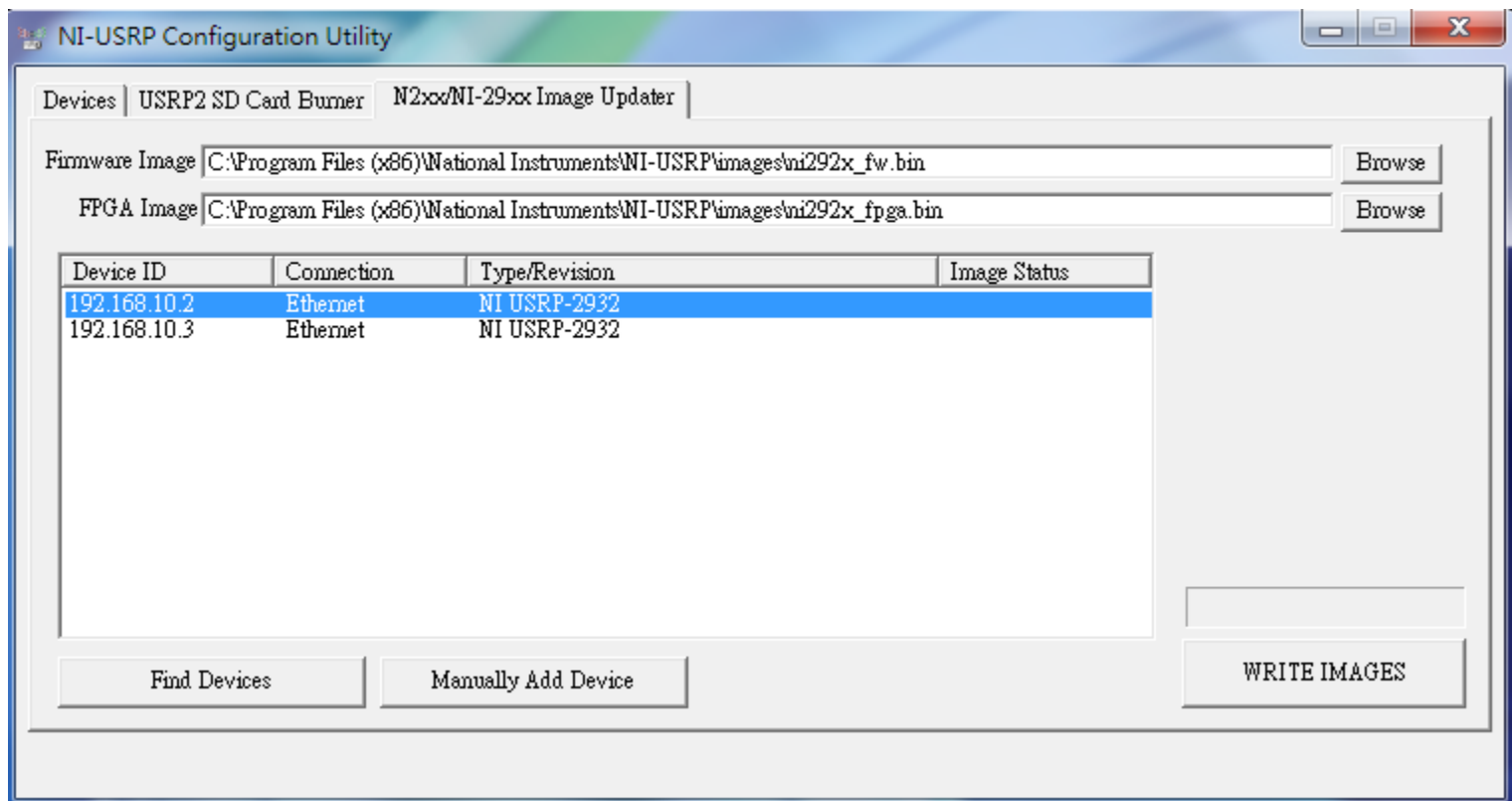
Communication Systems Lab, Sp18

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# Step 4: Update the FPGA firmware

- If there's something wrong



# Warm-up

- You can learn to use Labview and USRP on this website
  - ✓ <http://www.labviewpro.net/>

# Contact Information

- Contact TAs for any problem you cannot solve

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✓ 周柏均

[d02942012@ntu.edu.tw](mailto:d02942012@ntu.edu.tw)