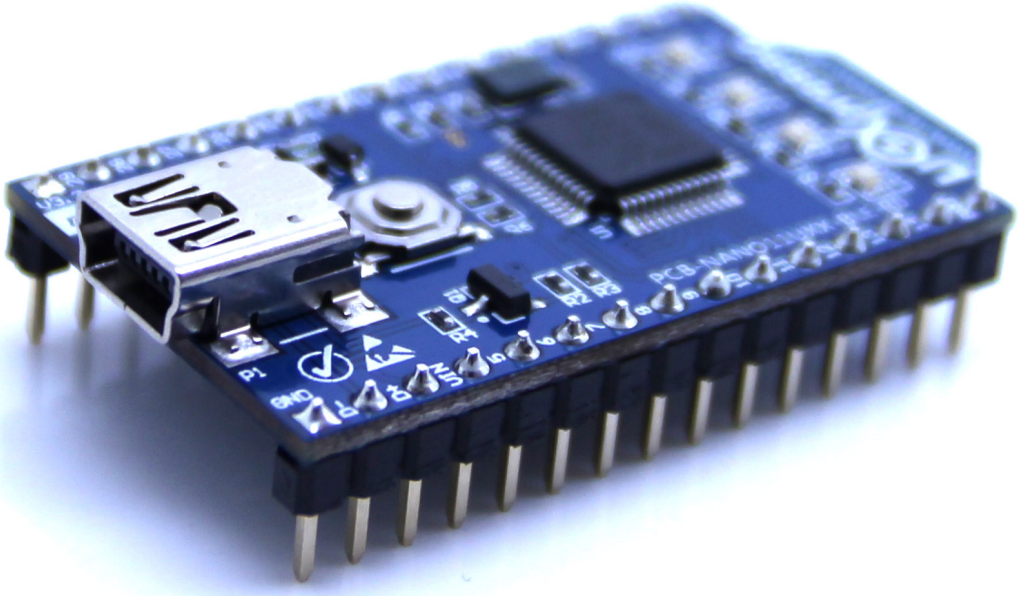
Getting Started with uCXpresso.BLE



2014/4/1

v1.0.2

History:

2014/3/16 Add Overview

2014/3/12 Add “Create A New Project”, “Serial Terminal & Debug”

2014/3/11 First Edition

Overview

First of all, an espresso is necessary,

The uCXpresso.BLE framework have to work on the LPCXpresso IDE, you need to install the LPCXpresso IDE in your system first. The LPCXpresso IDE are available for Windows, Linux and Mac OS/X, also you can download the LPCXpresso IDE from www.lpcware.com with a free license after register. About LPCXpresso IDE, please refer to http://www.lpcware.com/lpcxpresso/download

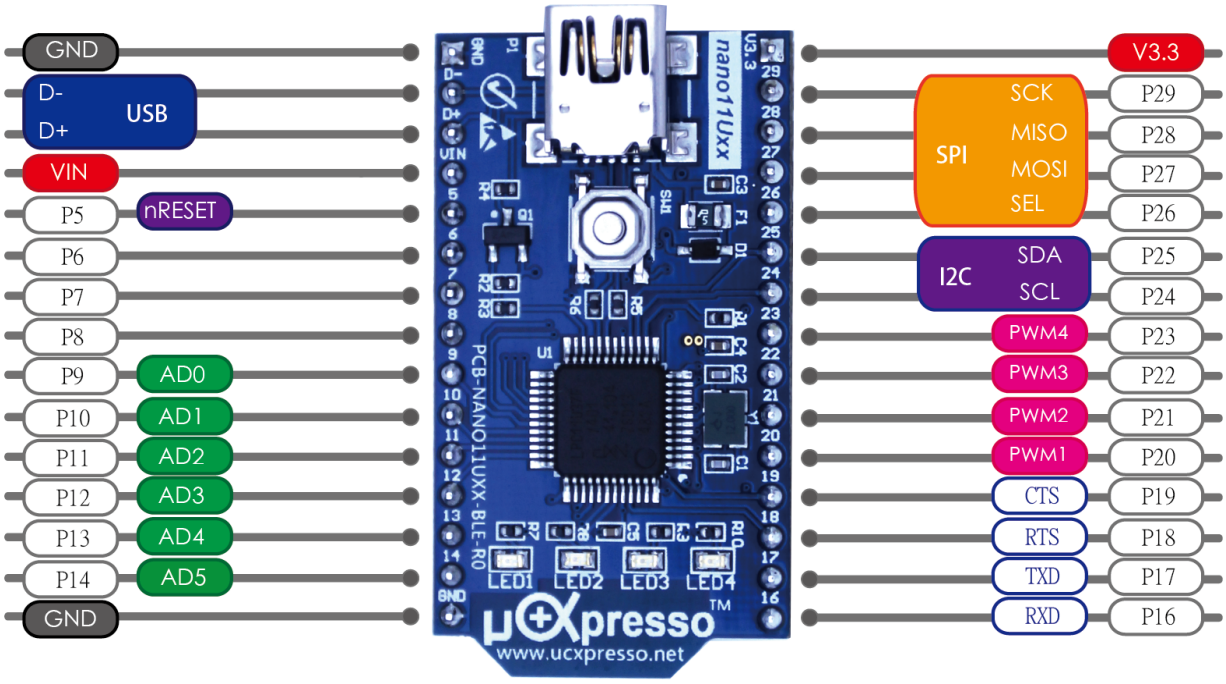
The uCXpresso.BLE is a RTOS C++ framework that port for the ARM Cortex-M0 MCU and BLE (Bluetooth Low Energy), and provides many features such as Peripherals (ADC, PWM, I2C, SPI, PIO, Interrupt, Timer….), BLE Services (Serial, Proximity, Heart Rate Meter…) and Multi-Thread (RTOS Thread, Semaphore, Mutex, MailBox…).

Easy to use with C++ framework:

Ex. A LED on the pin 19 of nano11U37

```
CPin led(P19);      // connect led object to P19 pin
led.output();       // set P19 as an output pin
led = HIGH;         // set P19 to HIGH (turn on LED)
```

Multiple Pin Definition:



Ex. Set P20 as an input pin

```
CPin key(P20);          // connect key object to P20
key.input();            // set key as an input pin with internal Pull-Up.
if ( key==LOW ) {       // check key PIN LEVEL
     ...
}
```

Ex. Set P20 as a PWM output

```
CPwm::period(0.02);     // set globel PWM period time to 20ms
CPwm servo(PWM1);       // connect servo object to PWM1 (P20)
servo.enable();         // enable the servo PWM to output
servo.dutyCycle(0.8);   // set servo duty-cycle to 80%
servo = 0.005;          // set servo PWM period to 5ms
```

Multi-Thread

The uCXpresso.BLE framework is base on an advanced Real-Time operating system (RTOS) that called the FreeRTOS, and using the multi thread and class library will simplify your design, coding and maintenance.

Final,

Let uCXpresso C++ Framework to shorten your developed time, improves the qualities and enjoy in working.

1. Upgrade Your LPCXpresso IDE

1.1. Increase VM memory for Windows System

a. Close LPCXpesso if executing.

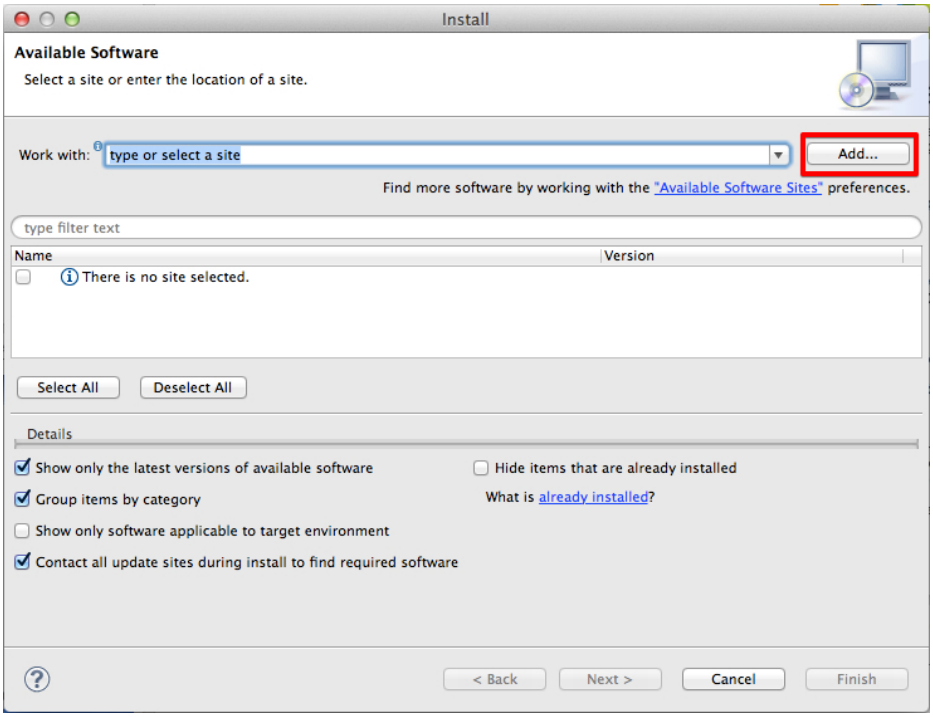
b. Open c:/nxp/LPCXpresso_x.x/lpcxpresso/lpcxpresso.ini

c. Modify MaxPermSize to 512

1.2 Install new software (Eclipse Plug-in)

LPCXpresso Main Menu > Help > Install New Software…

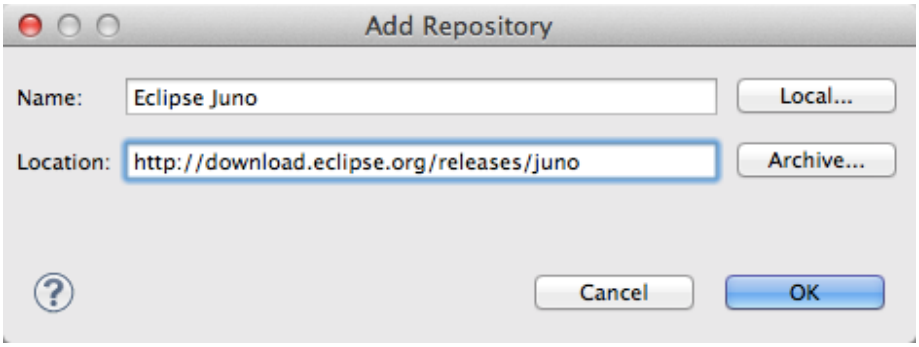
Click [Add]



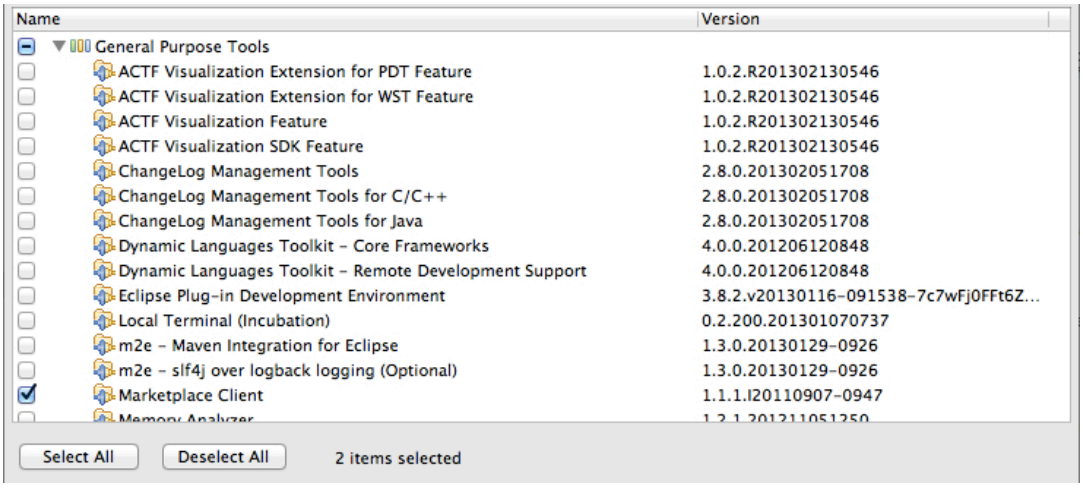
1.3 Install Eclipse Plug-In

Name: Eclipse Juno

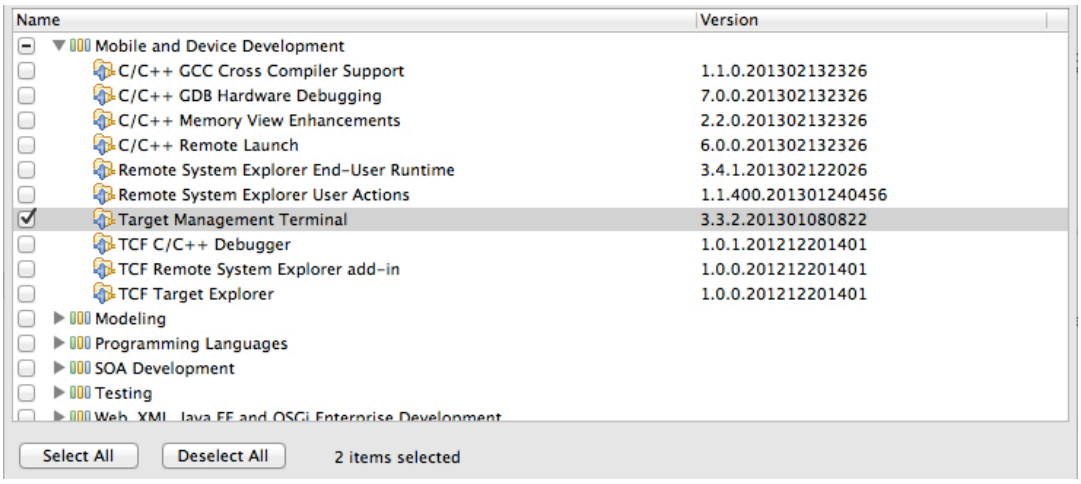
Location: http://download.eclipse.org/releases/juno



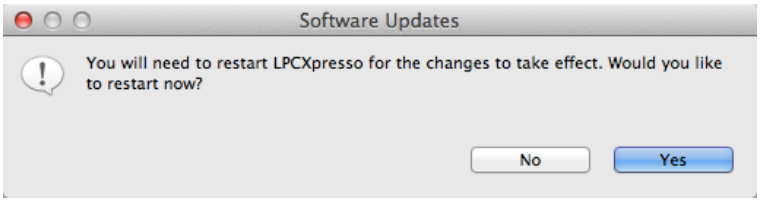
In General Purpose Tools section, select “Marketplace Client”



In Mobile and Device Development section, select “Target Management Terminal”



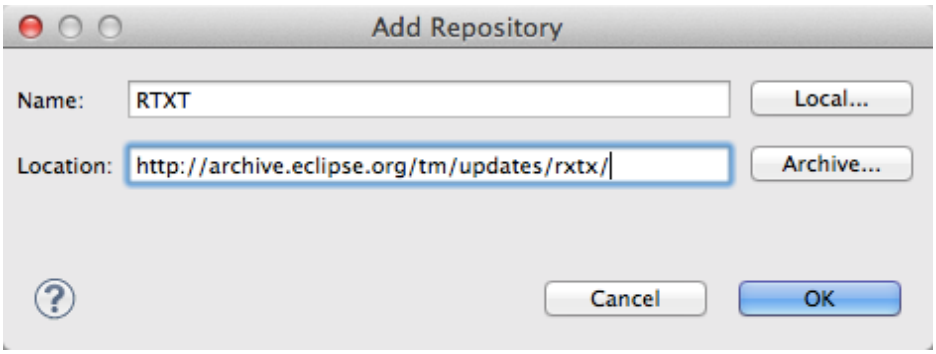
Click [Next] to start the installation. In progress, you need to [Confirm >] the Selected Features, and [accept] the licenses of software, and click [OK] to confirm any security-warning message, click [Yes] to restart and finish the installation if need.



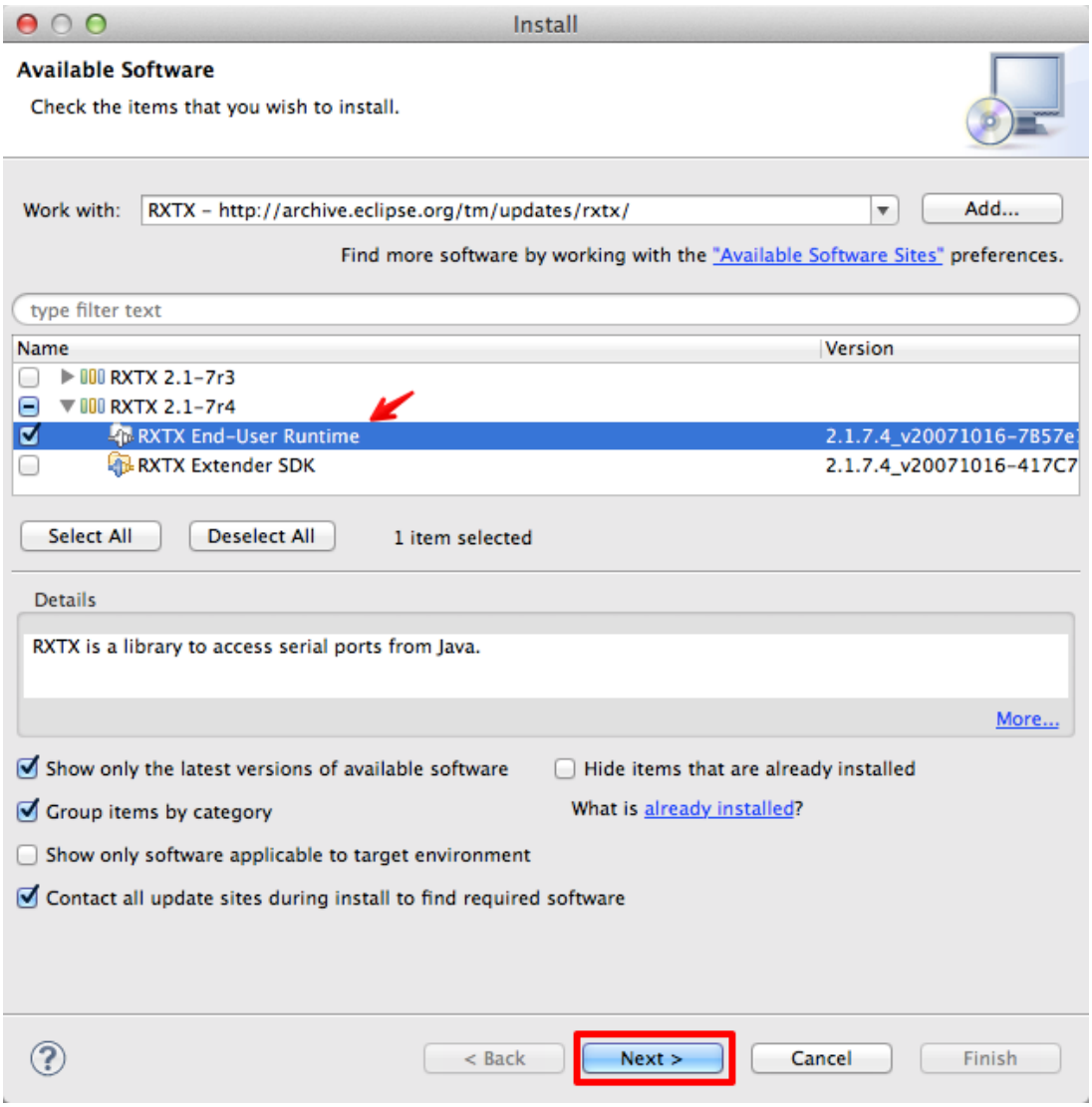
1.4. Install RXTX Plug-in

Name: RXTX

Location: http://archive.eclipse.org/tm/updates/rxtx/



Select latest version “RXTX End-User Runtime”



Click [Next] to start the installation.

Remark:

For Mac OS/X user, you have to follow below steps to enable the USB CDC virtual COM. Port:

1. Open Terminal App of OS/X
2. Type :

   sudo mkdir /var/lock

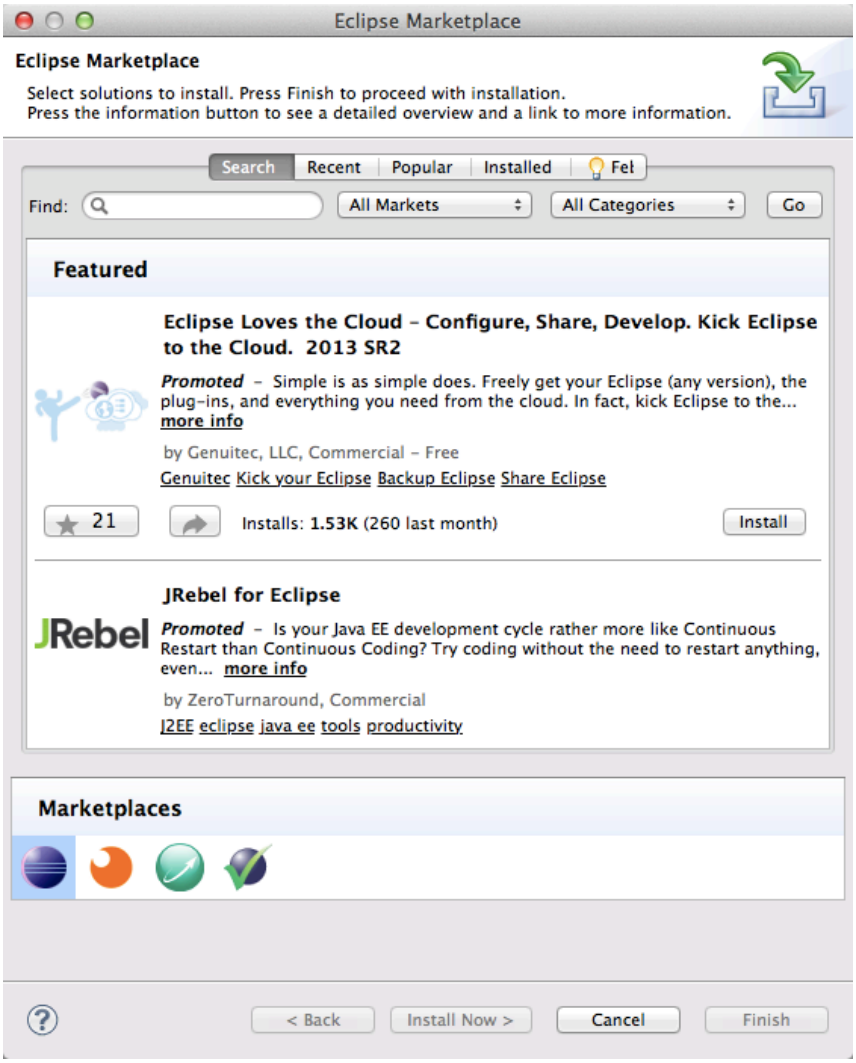
   sudo chmod a+rw /var/lock

In Windows System, The USB CDC driver can be download from below link:

for NANO11Uxx : http://www.embeda.com.tw/tw/wp-content/uploads/2014/01/nano11Uxx_usb_driver.zip (unzip and copy INF file to desktop, and USBCOM port driver direct to the INF file.)

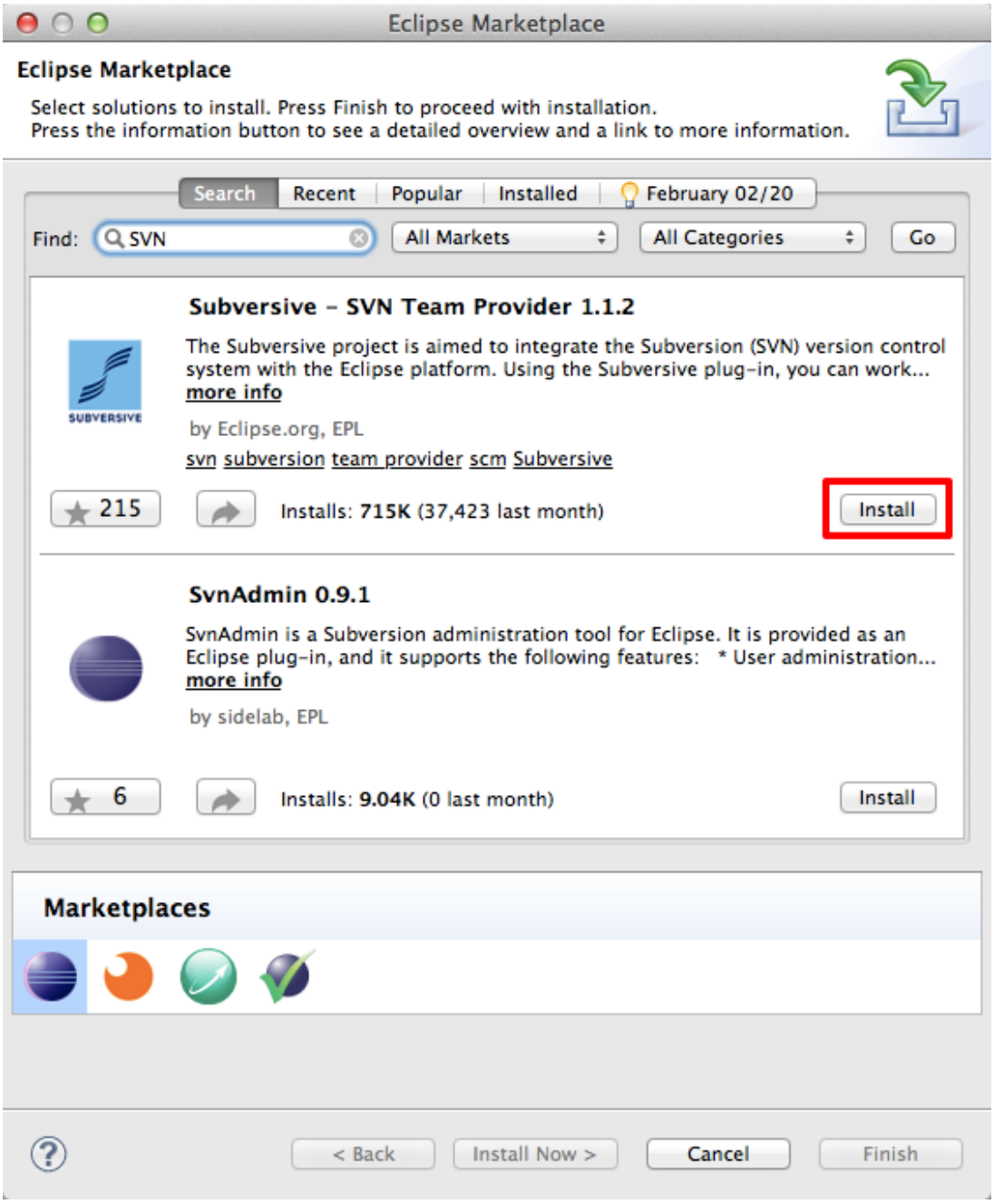
1.5. Install new software from Eclipse Marketplace

Click LPCXpresso Main Menu > Help > Marketplace…

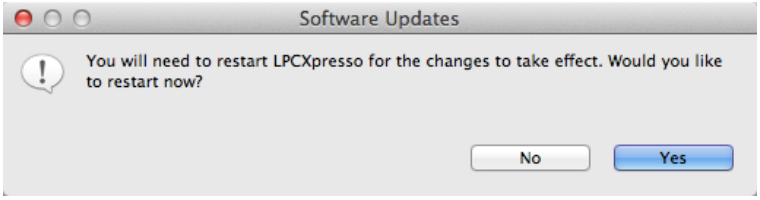


1.6 Install Subversion – SVN Team Provider (Plug-in)

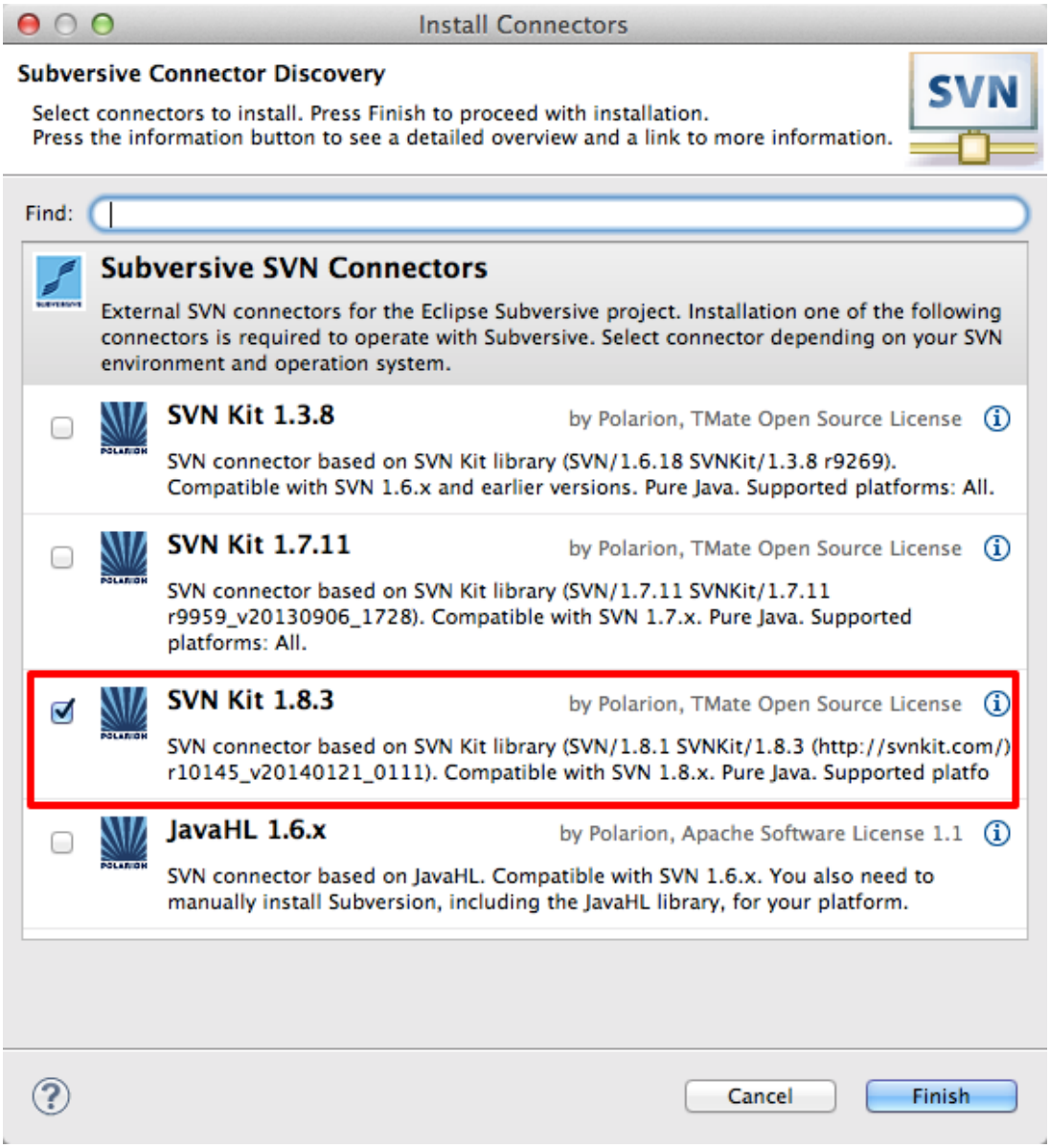
In Find, input “SVN” and click [Go]



Click [Install] to start the installation. In progress, you need to [Confirm >] the Selected Features, and [accept] the licenses of software, and click [OK] to confirm any security-warning message. Click [Yes] to restart and finish the installation if need.



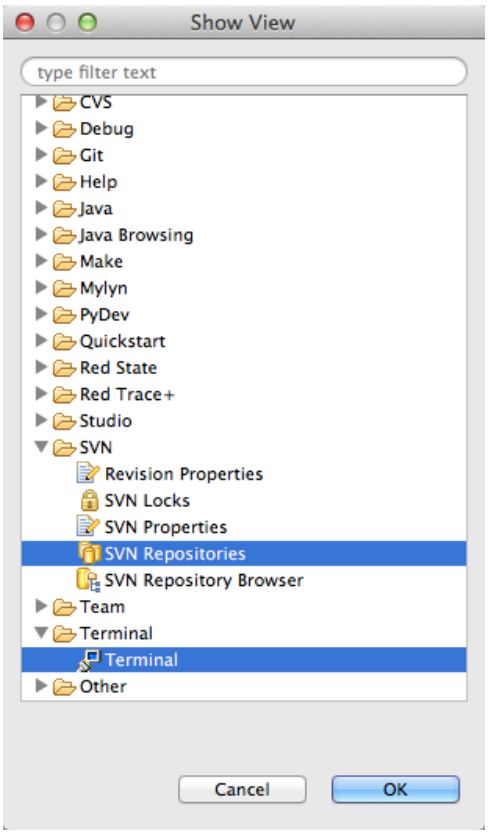
After restart, you may need to install the SVN connector kit:



Select the latest version “SVN Kit x.x.x”, and click [Finish] to start the installation. Confirm and click [Next], and [accept] the licenses of software, and click [OK] to confirm any security-warning message. Click [Yes] to restart and finish the installation if need.

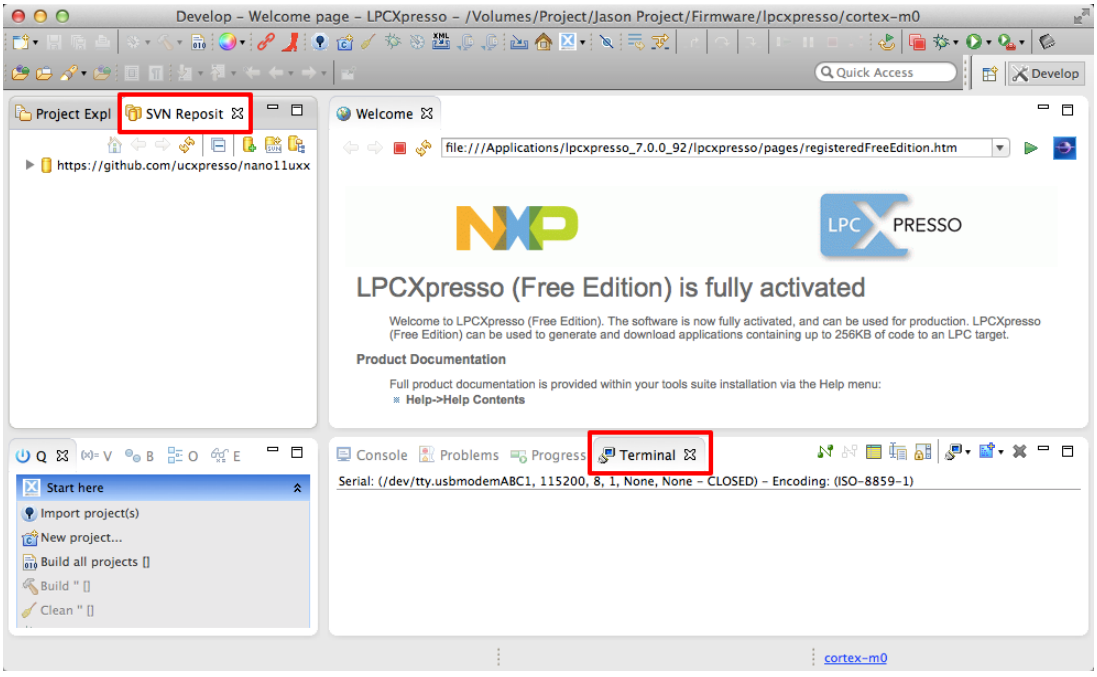
1-7. Show the SVN and Terminal Views

Click LPCXpresso Main Menu > Window > Show View > Other…



Select the “SVN Repositories” and “Terminal”, click [OK]

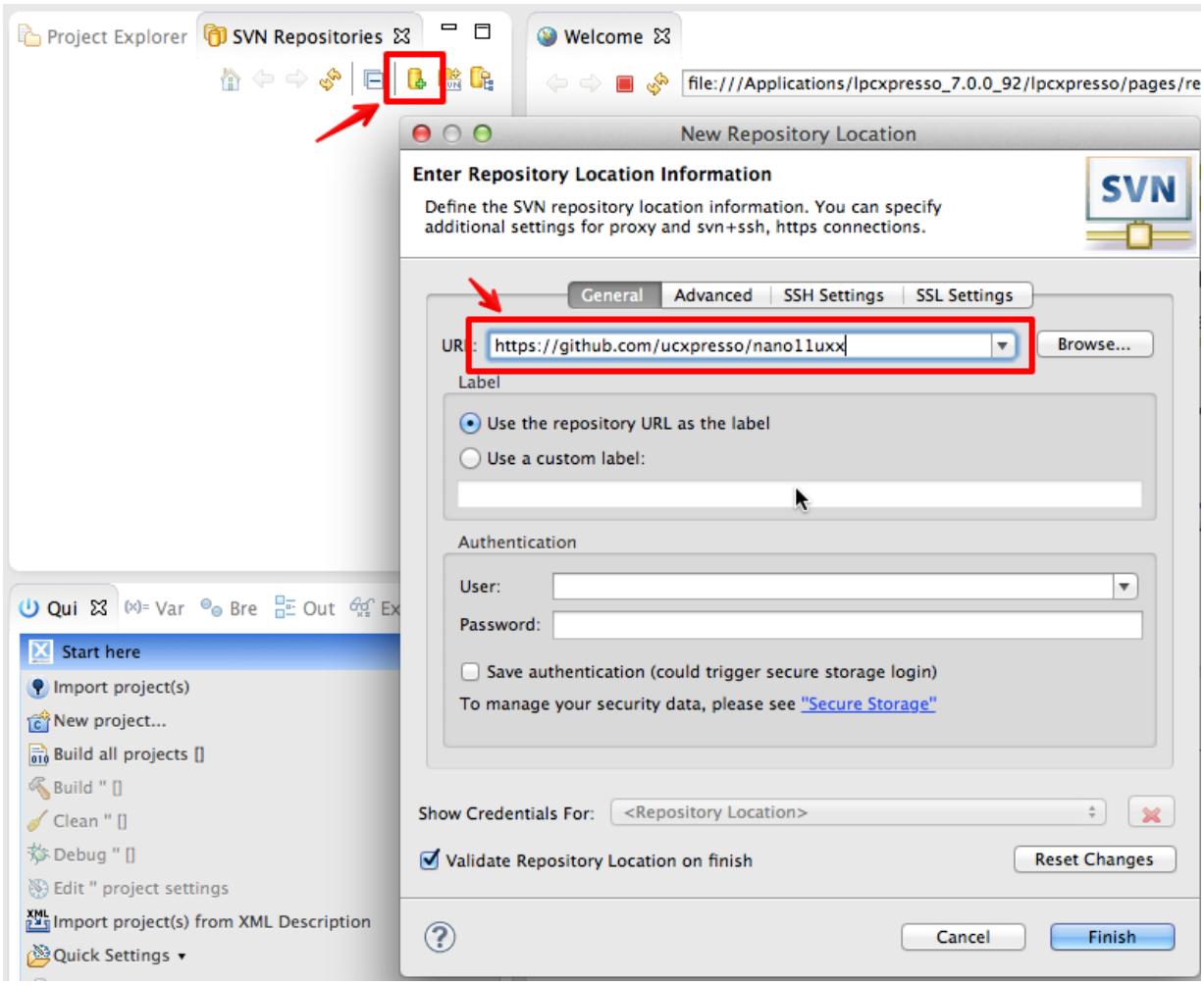
Move the “SVN Repositories” Tab to “Project Explorer” right side (optional)



2. Install uCXpresso.BLE Framework

2.1 Using GitHub Repositories

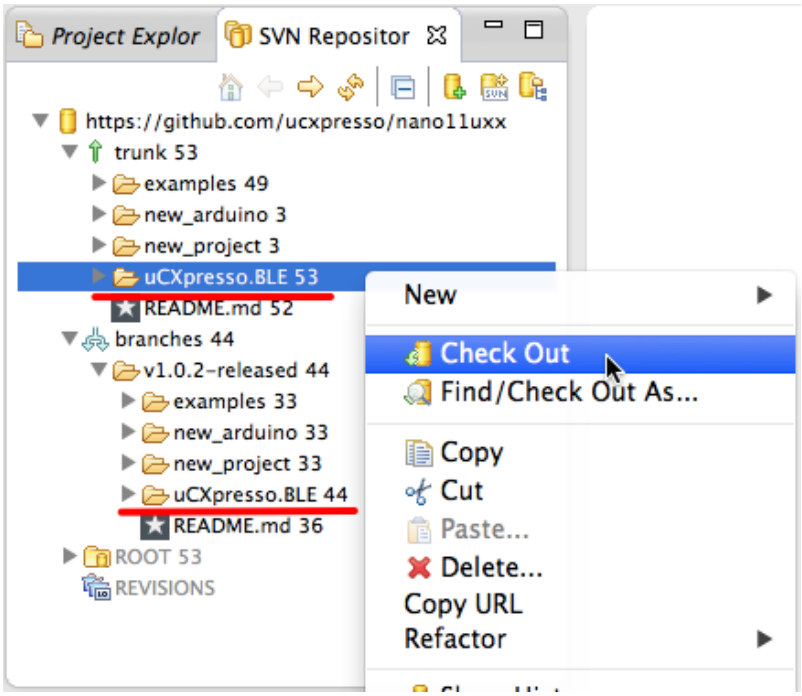
In “SVN Repositories” Tab, Click “New Repository Location”,



and URL Input: https://github.com/ucxpresso/nano11uxx

2.2 Check Out uCXpresso.BLE framework

Expand the uCXpresso.BLE SVN repository

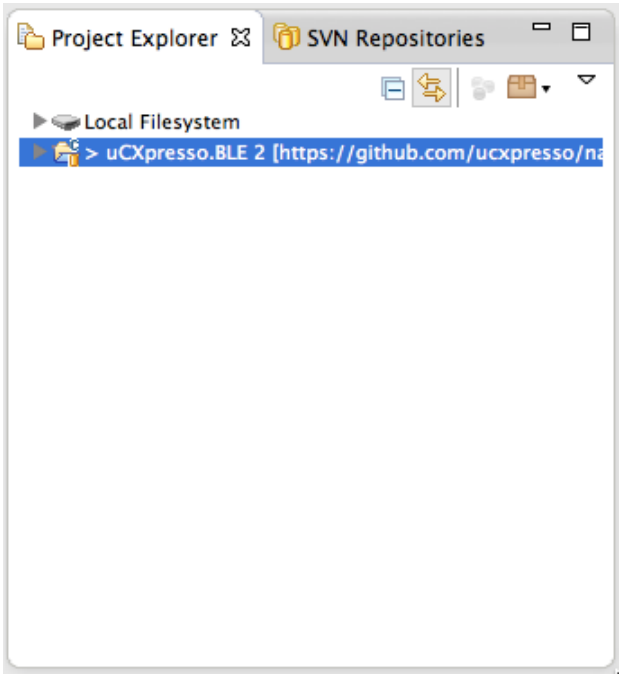


trunk: uCXpresso.BLE RC (Release Candidate) version

branches: All released version

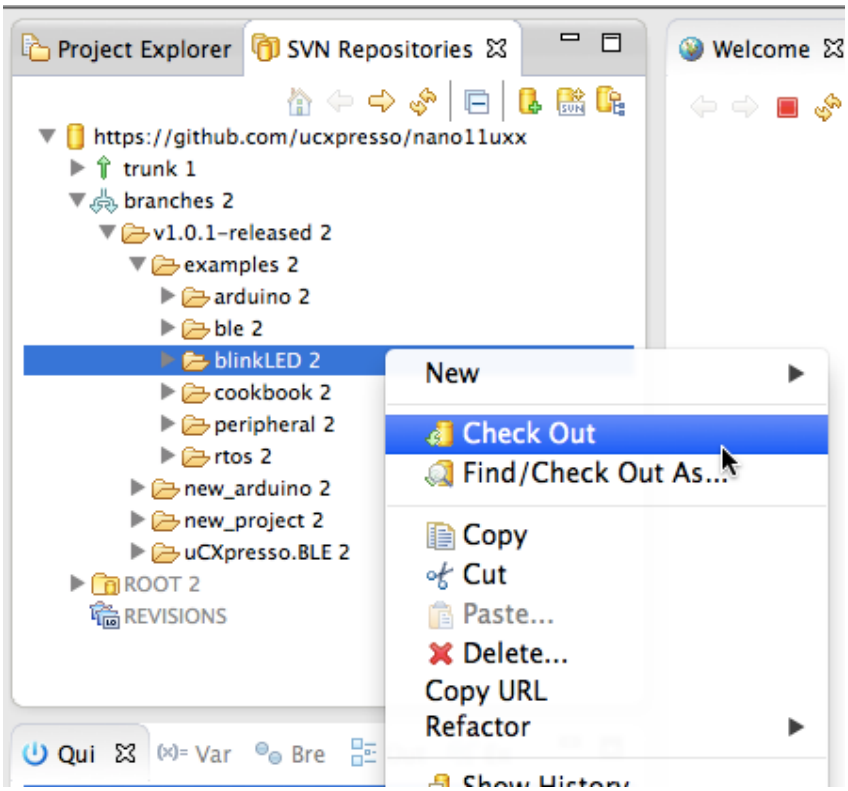
Select “uCXpresso.BLE” folder, and click right button of mouse, and click “Check Out” in drop down menu.

The uCXpresso.BLE framework show in your workspace after check out.



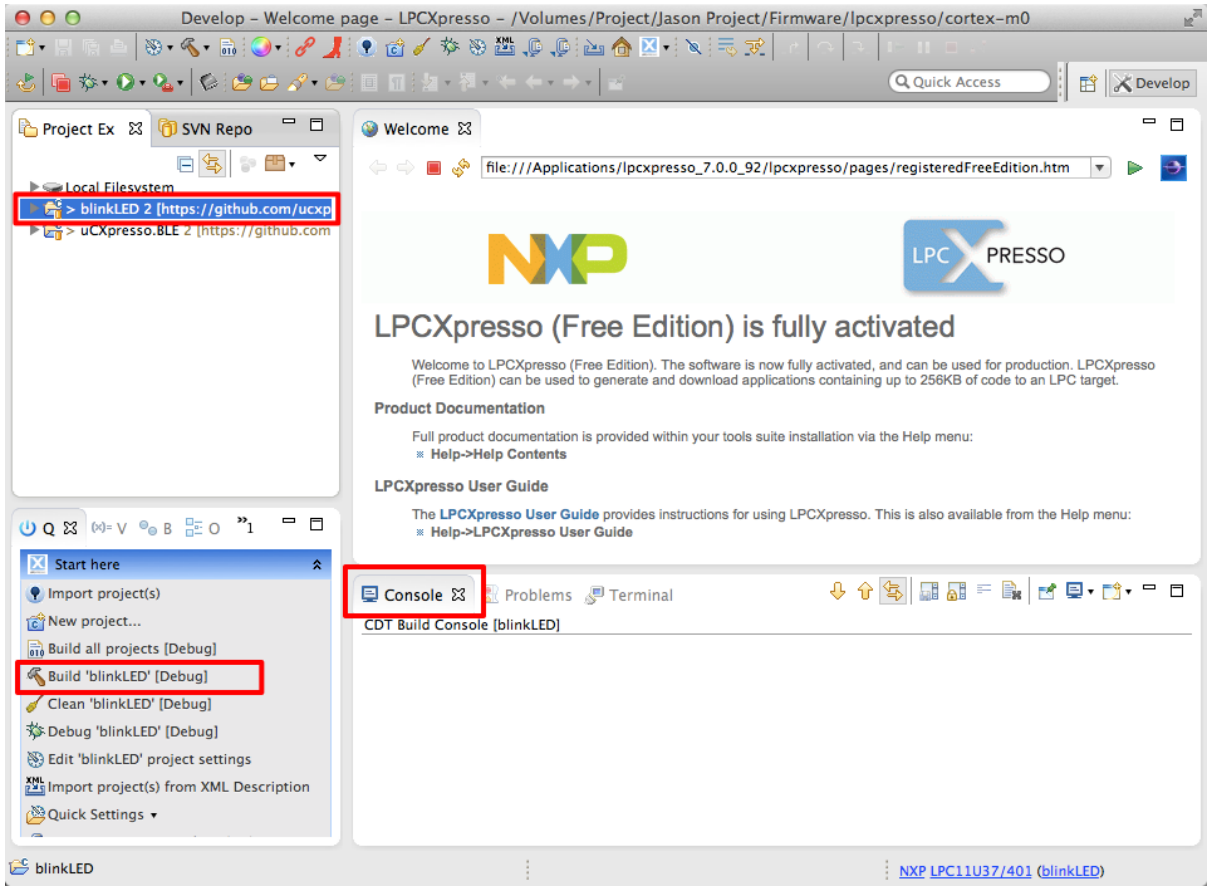
2.3 Check Out example “blinkLED”

In SVN Repositories Tab, select the “blinkLED” folder in “/examples”, then Check Out it.

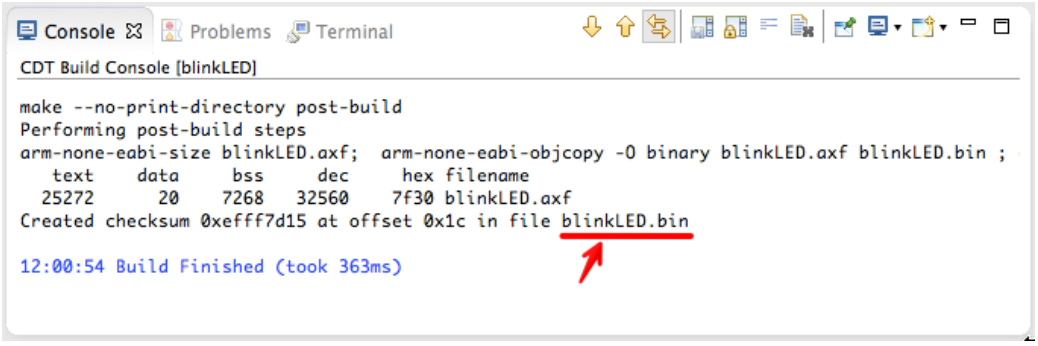


2.4 Build the "blinkLED" example project

1. Click "blinkLED" Project on Project Explorer View.
2. Click "Console" View
3. Click "Build 'blinkLED' [Debug] on Quick Start View.



In Console View, the compiler will create a "blinkLED.bin" image file.



Note:

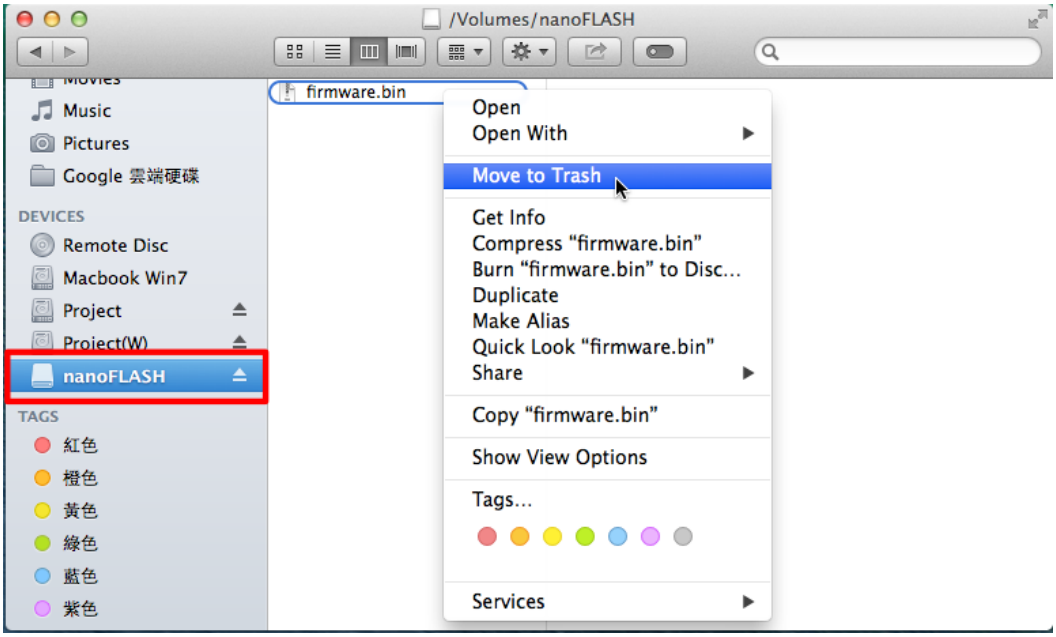
code size = text + data = 25292 bytes

ram size = data + bss = 7288 bytes

3. Download Image File

3.1 Erase Flash Code Memory

First, you need to erase the flash memory for new binary image. Click the "ISP" button on the nano11U37-BLE. In Finder (or File Manager) will creates an USB Disk and called "nanoFLASH"



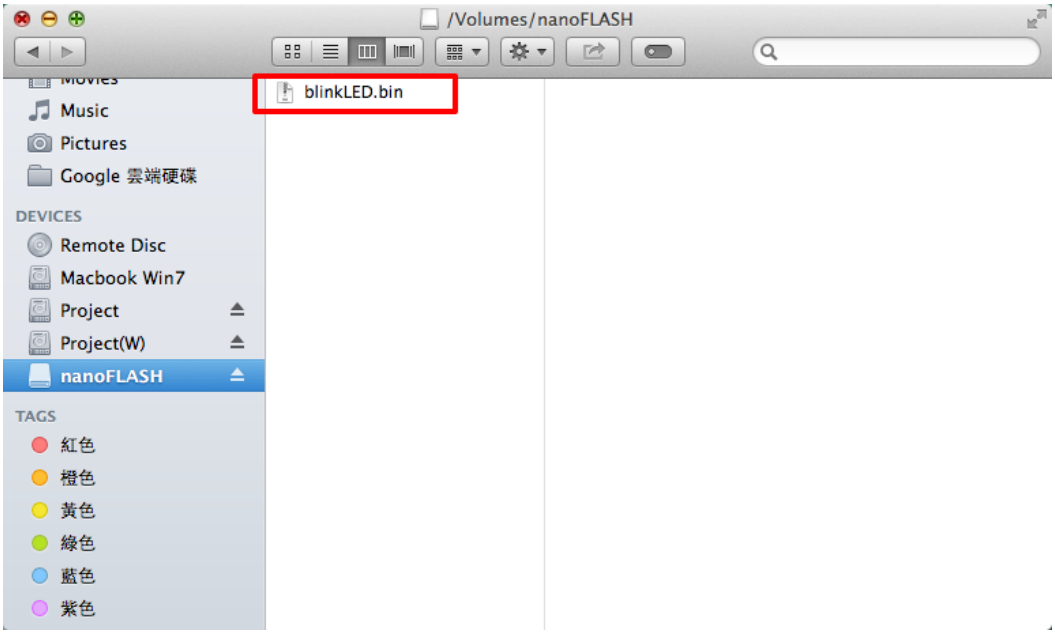
Remove the "firmware.bin" and move to trash.

Note:

In ISP (bootloader) mode: The LED1, LED2, LED3 and LED4 are blink together.

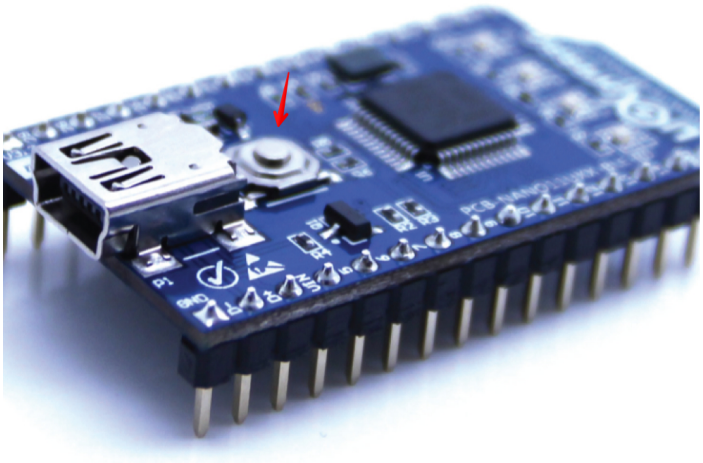
3.2 Program Flash Code Memory

Copy the “blinkLED.bin” from “blinkLED\Debug” folder to nanoFLASH



Eject the “nanoFLASH” disk and click the “ISP” button of NANO11U37-BLE again to execute your binary code. (In App Mode)

Note:

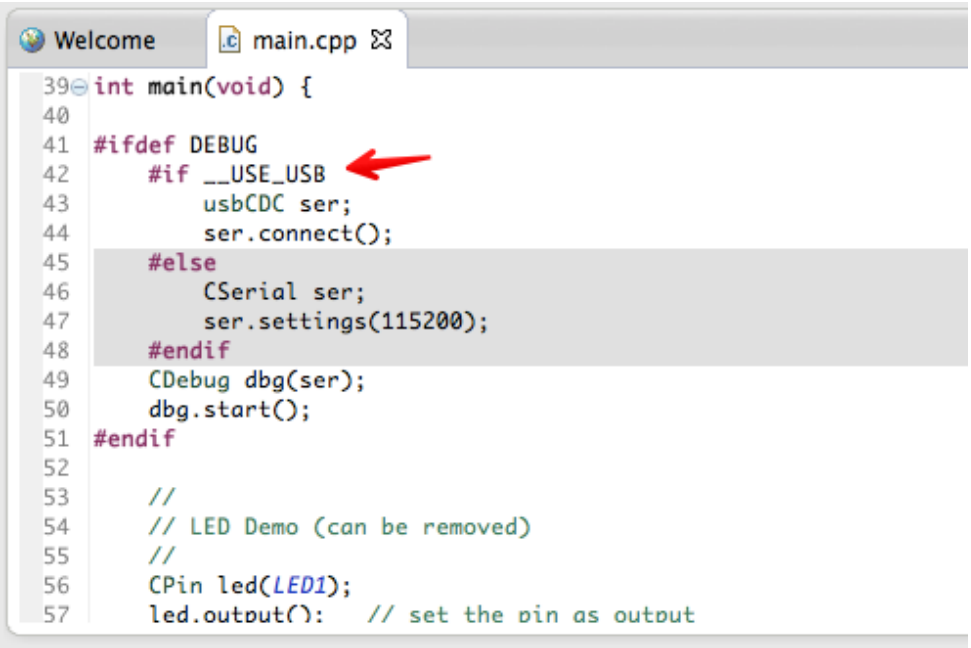


The “ISP” button.

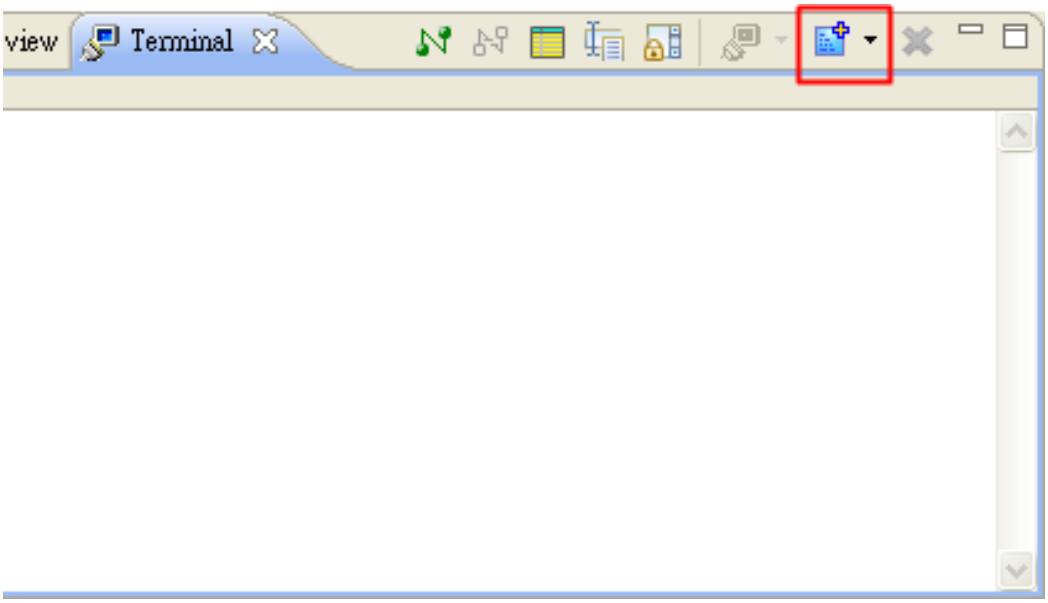
4. Serial Terminal & Debug

4.1 Serial Terminal (Use USB CDC Virtual COM. Port)

In main.cpp of blinkLED, the usbCDC will be enabled.



In Terminal View, click “New Terminal Connection” to add a new connection.

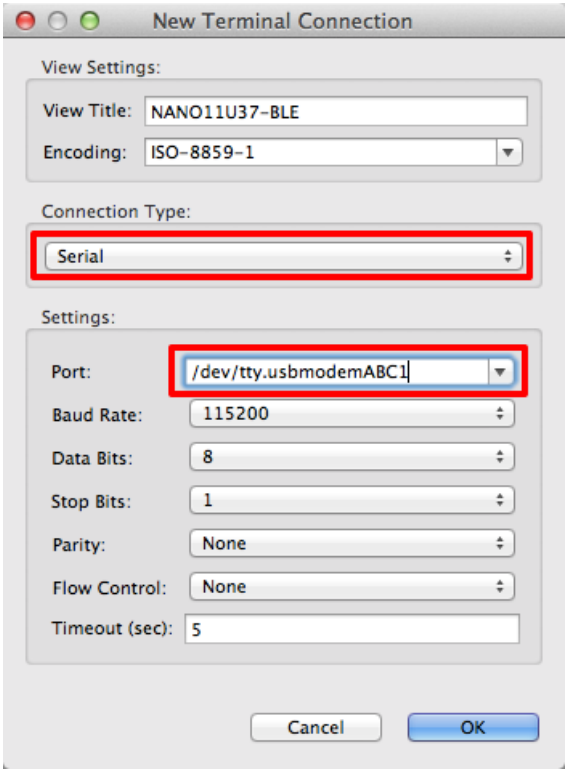


In Terminal Settings:

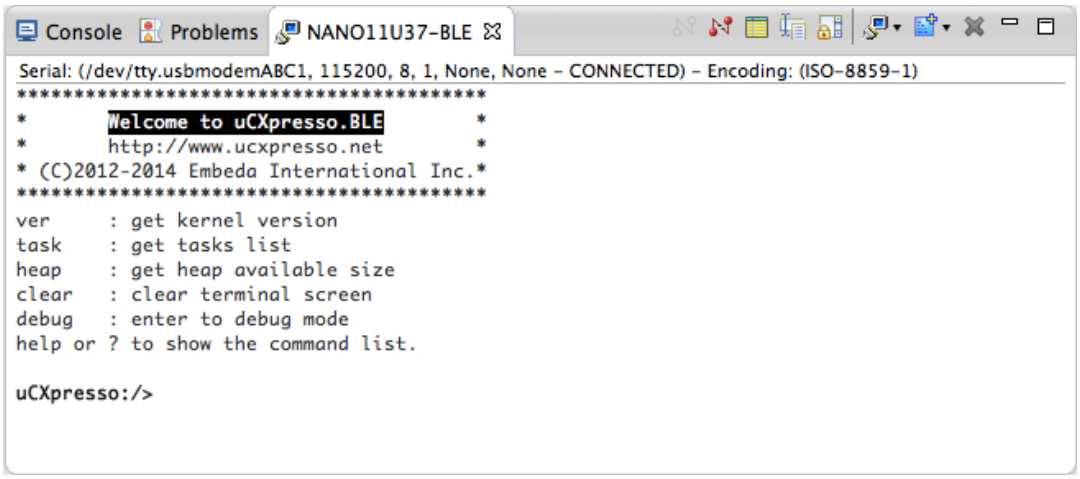
1. View Title: NANO11U37-BLE

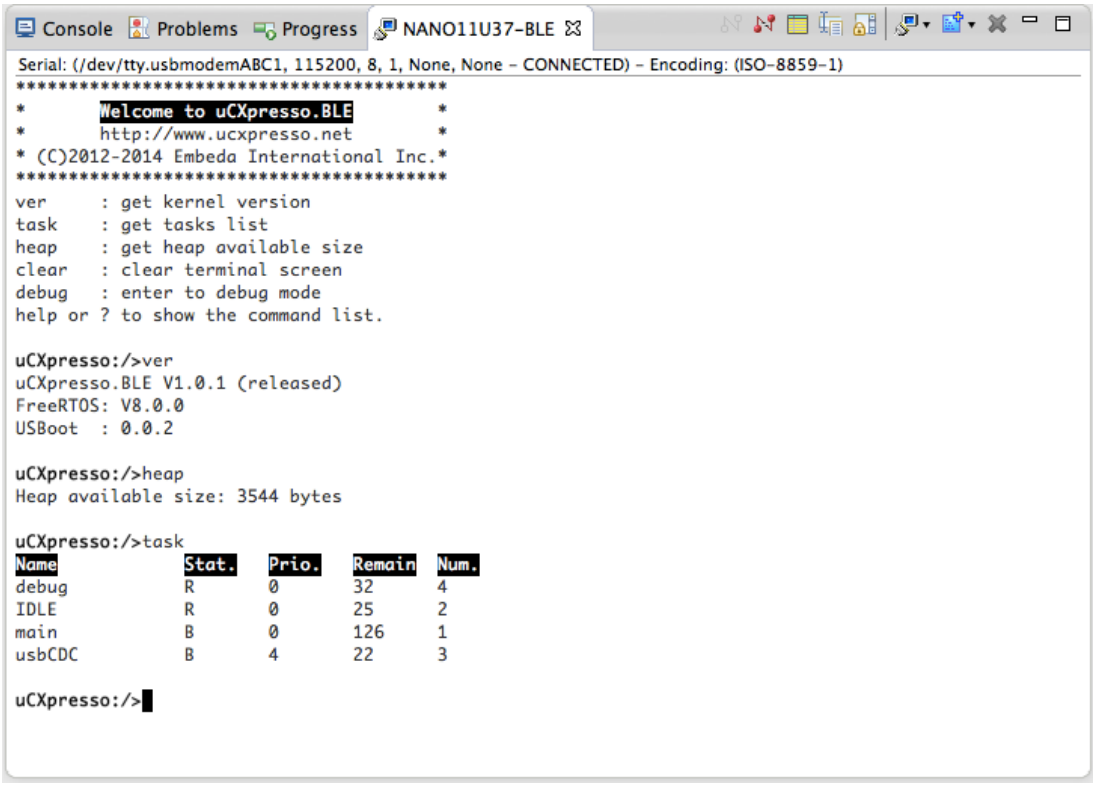
2. Connection Type: Serial

3. Port : /dev/tty.usbmodemABC1 (for Mac OS/X)



The blinkLED serial shell will run in the Terminal View





Command:

ver, to show the kernel & module version.

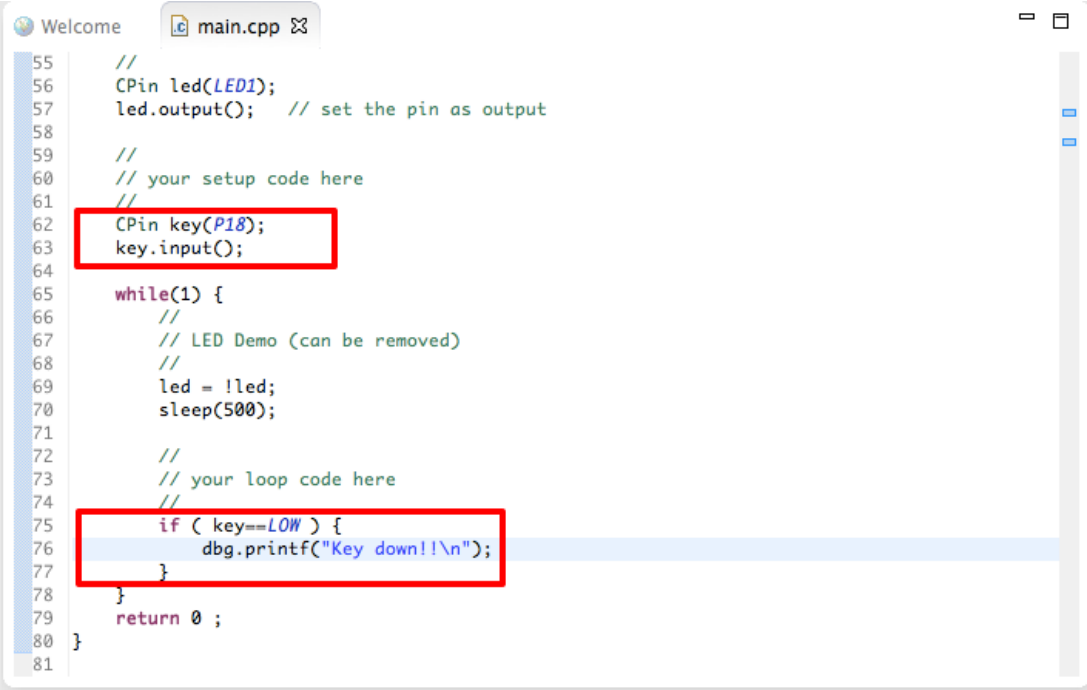
heap, to check the available size of heap memory.

task, to check all of tasks in the system.

debug, to enter to debug mode to view the DBG(…) message from user's program.

4.2 Debug

Add 'key' object in main.cpp of blinkLED project.

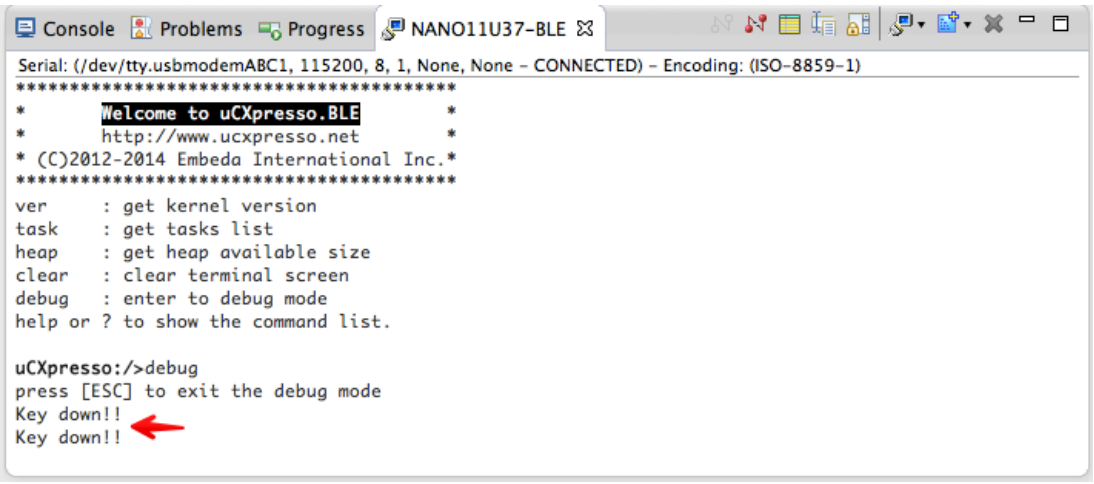


```
Welcome   main.cpp
55      //
56      CPin led(LED1);
57      led.output();   // set the pin as output
58
59      //
60      // your setup code here
61      //
62      CPin key(P18);
63      key.input();
64
65      while(1) {
66          //
67          // LED Demo (can be removed)
68          //
69          led = !led;
70          sleep(500);
71
72          //
73          // your loop code here
74          //
75          if ( key==LOW ) {
76              dbg.printf("Key down!!\n");
77          }
78      }
79      return 0 ;
80  }
81
```

And add the key check in while loop.

Build Debug and download blinkLED.bin to nanoFLASH, then execute it.

In Terminal View, input 'debug' command to enter the debug mode:



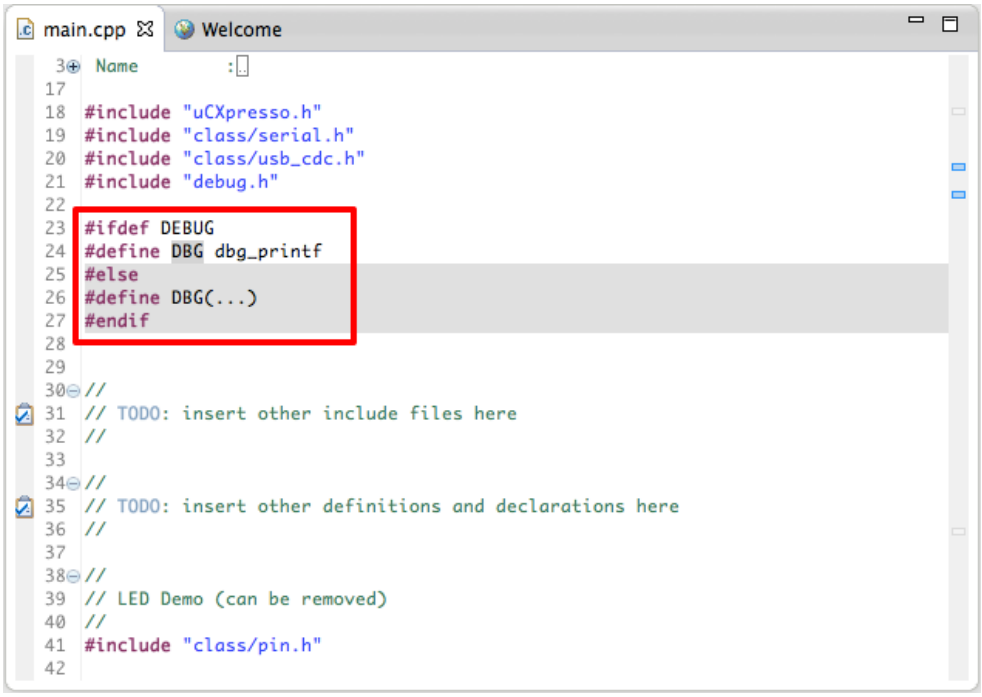
```
Console  Problems  Progress  NANO11U37-BLE
Serial: (/dev/tty.usbmodemABC1, 115200, 8, 1, None, None - CONNECTED) - Encoding: (ISO-8859-1)
*****************************************
*       Welcome to uCXpresso.BLE        *
*       http://www.ucxpresso.net        *
* (C)2012-2014 Embeda International Inc.*
*****************************************
ver     : get kernel version
task    : get tasks list
heap    : get heap available size
clear   : clear terminal screen
debug   : enter to debug mode
help or ? to show the command list.

uCXpresso:/>debug
press [ESC] to exit the debug mode
Key down!!
Key down!!
```

Try to push the key (pin 18) to LOW, and you can see the debug message to show in the terminal view.

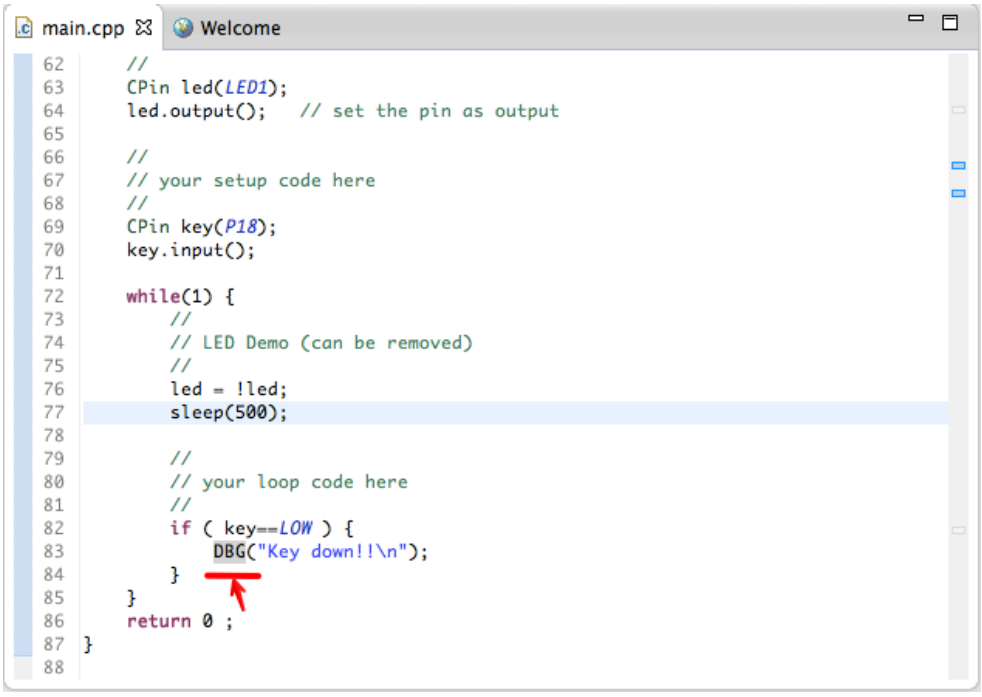
4.3 Made an invalidly debug message code.

Made an invalidly debug message code in [Release Build]



Using the #ifdef DEBUG to block and define the DBG to dbg_printf, and #else to block and define the DBG(...) to nothing.

Rename dbg.printf(...) to DBG(...) in your program

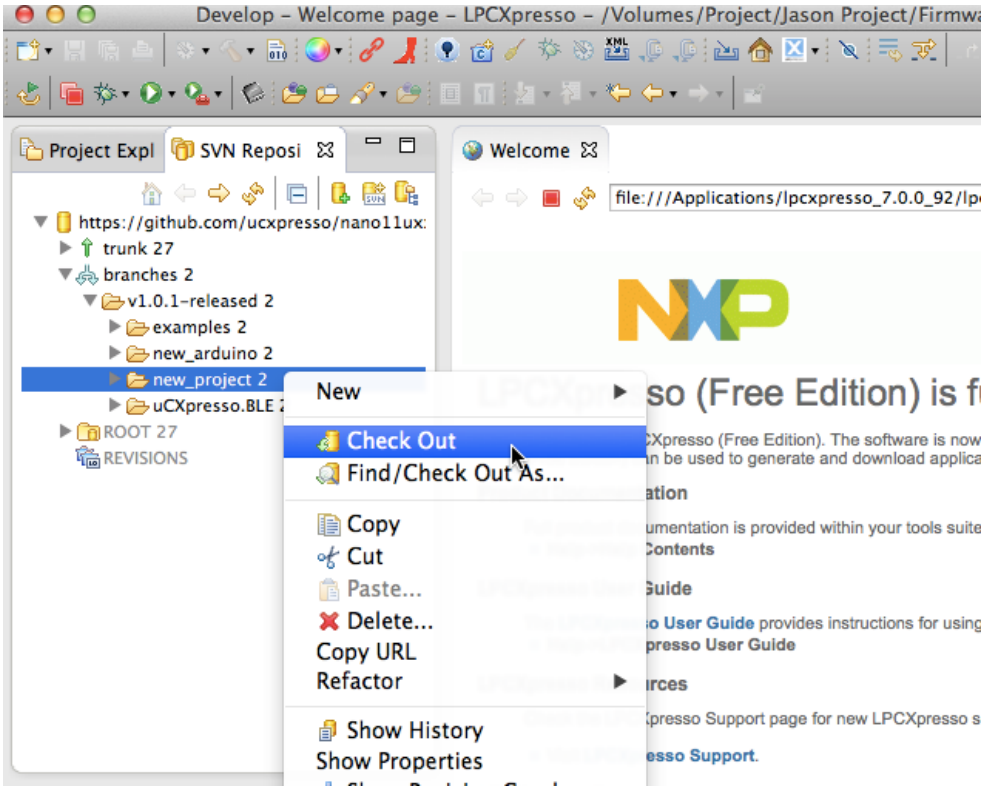


Now, The DBG(...) message code will be create in the [Debug Build] only, not in the [Release Build].

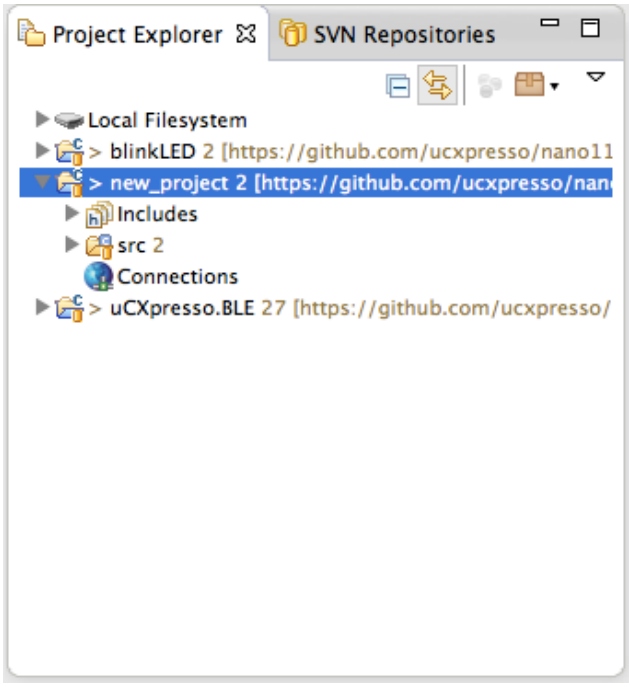
5. Create A New Project

5.1 Check Out the “new_project” template

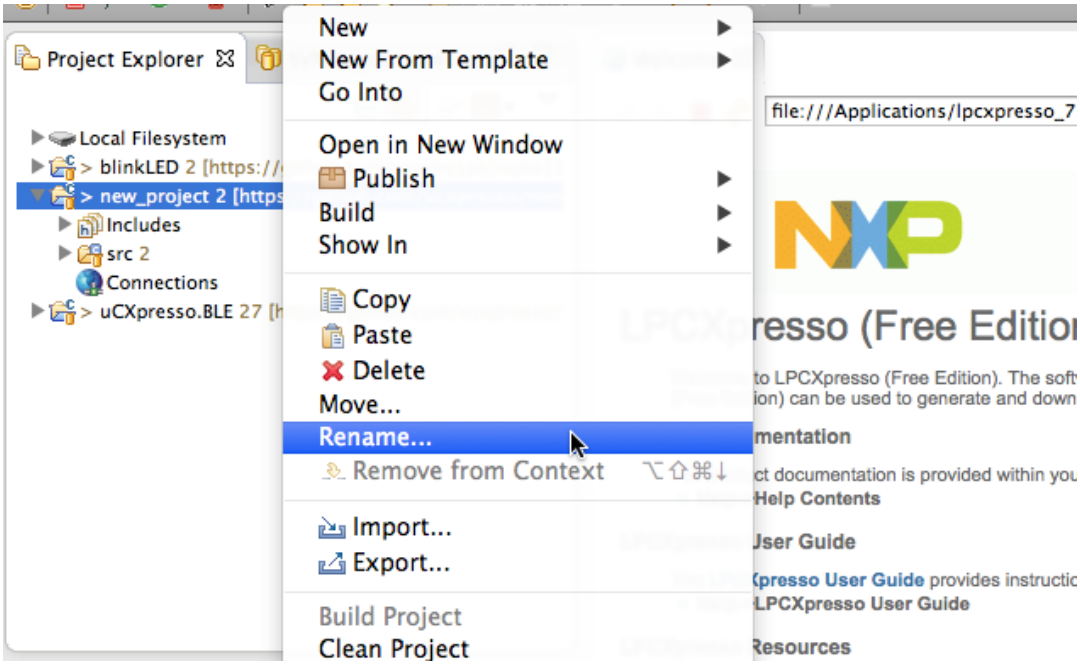
In SVN Repositories View, expand the three and “Check Out” the “new_project” to workspace.



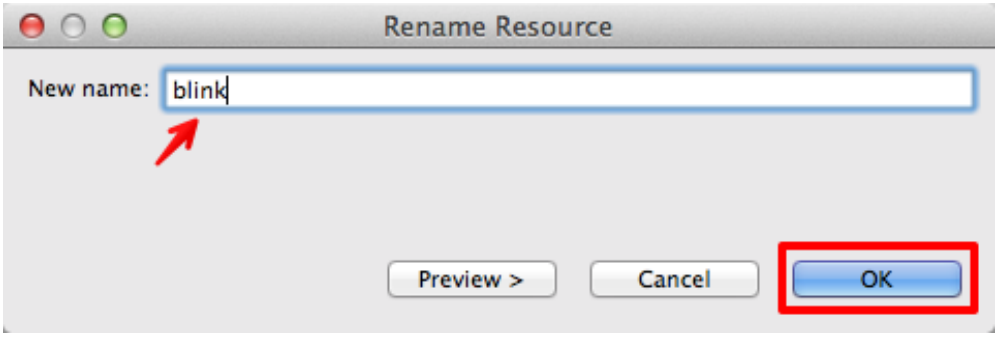
The “new_project” will show in workspace after Check Out.



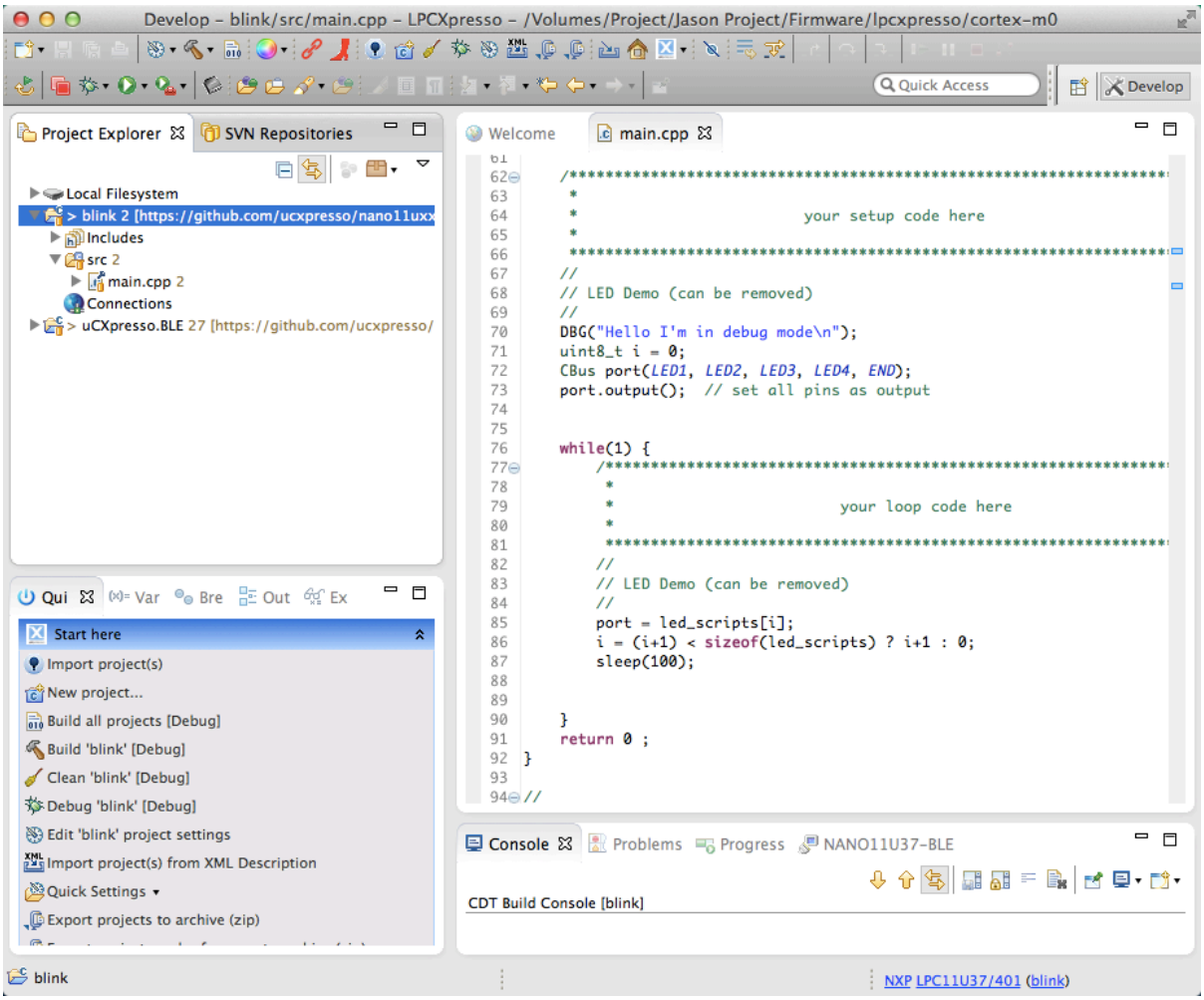
Rename the “new_project” to new project name what you want.



For example to rename to “blink” as below,



An empty project “blink” is in the workspace.



Expand the ‘src’ folder of new ‘blink’ project, and start to program your main.cpp.

6. RTOS Thread

6.1 Overview

This is an example of how to make four threads to control the LED1, LED2, LED3 and LED4 respectively.

6.2 Make your thread class

Includes the CThread class to provide the thread features.

main.cpp

```
 */

#include "uCXpresso.h"
#include "class/serial.h"
#include "class/usb_cdc.h"
#include "debug.h"

#ifdef DEBUG
#define DBG     dbg_printf
#else
#define DBG(...)
#endif

//
// TODO: insert other include files here
//
#include <class/thread.h>

//
// TODO: insert other definitions and declarations here
//
```

Creates a “tskLED1” thread and inherits from CThread class.

main.cpp

```
// TODO: insert other include files here
//
#include <class/thread.h>

//
// TODO: insert other definitions and declarations here
//

class tskLED1 : public CThread {
protected:

    virtual void run() {
        CPin led(LED1);     // use LED1
        //
        // thread run-loop
        //
        while(isAlive()) {
            led = !led;     // blink led
            sleep(100);
        }
    }
};
```

Implements the “virtual void run()” member function. and have to understand that “run()” member function is the life-cycle of thread. Put the isAlive() in the while-loop to check whether thread is actively or not.

In the same way, to make other tskLED2, tskLED3 and tskLED4 threads to control the different LEDs and different sleep-time.

main.cpp

```
52
53  class tskLED2 : public CThread {
54  protected:
55
56      virtual void run() {
57          CPin led(LED2);     // use LED2
58          //
59          // thread run-loop
60          //
61          while(isAlive()) {
62              led = !led;     // blink led
63              sleep(200);
64          }
65      }
66  };
67
68  class tskLED3 : public CThread {
69  protected:
70
71      virtual void run() {
72          CPin led(LED3);     // use LED3
73          //
74          // thread run-loop
75          //
76          while(isAlive()) {
77              led = !led;     // blink led
78              sleep(300);
79          }
80      }
81  };
82
83  class tskLED4 : public CThread {
84  protected:
85
86      virtual void run() {
87          CPin led(LED4);     // use LED4
88          //
89          // thread run-loop
90          //
91          while(isAlive()) {
92              led = !led;     // blink led
93              sleep(400);
94          }
95      }
96  };
```

Start the threads

main.cpp

```
114
115     /*********************************************************************
116      *
117      *                          your setup code here
118      *
119      *********************************************************************/
120     tskLED1 led1;
121     led1.start("led1");     // task name = "led1"
122
123     tskLED2 led2;
124     led2.start("led2");     // task name = "led2"
125
126     tskLED3 led3;
127     led3.start("led3");     // task name = "led3"
128
129     tskLED4 led4;
130     led4.start("led4");     // task name = "led4"
131
132     while(1) {
```

Remark:

The example uses the LED1~LED4, so you need to remove the all of the original LED demo code from main.cpp as below:

To build the example and download the binary file to nano11U37. You will see that LED1, LED2, LED3 and LED4 are blinking standalone.

The final example “blink_thread” project on the GitHub:

/nano11uxx/examples/rtos :

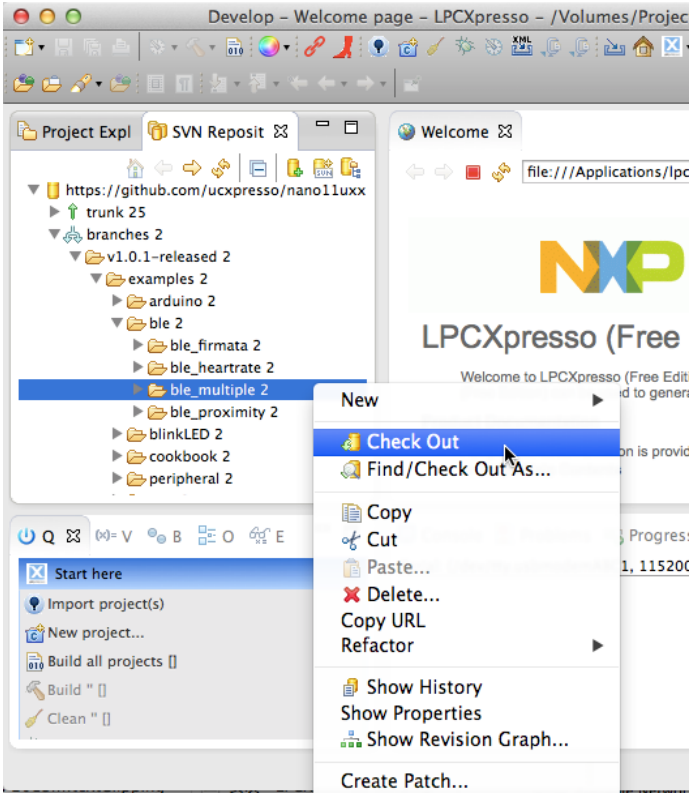
https://github.com/ucxpresso/nano11uxx/tree/master/examples/rtos/blink_thread

Appendix A. Examples

A.1 ble_multipile project

The ble_multiple project included:

1. Tickless Power Save Feature
2. BLE Arduino Firmata Test
3. BLE Battery Level Service
4. BLE Heath Thermometer Service
5. BLE Proximity Service



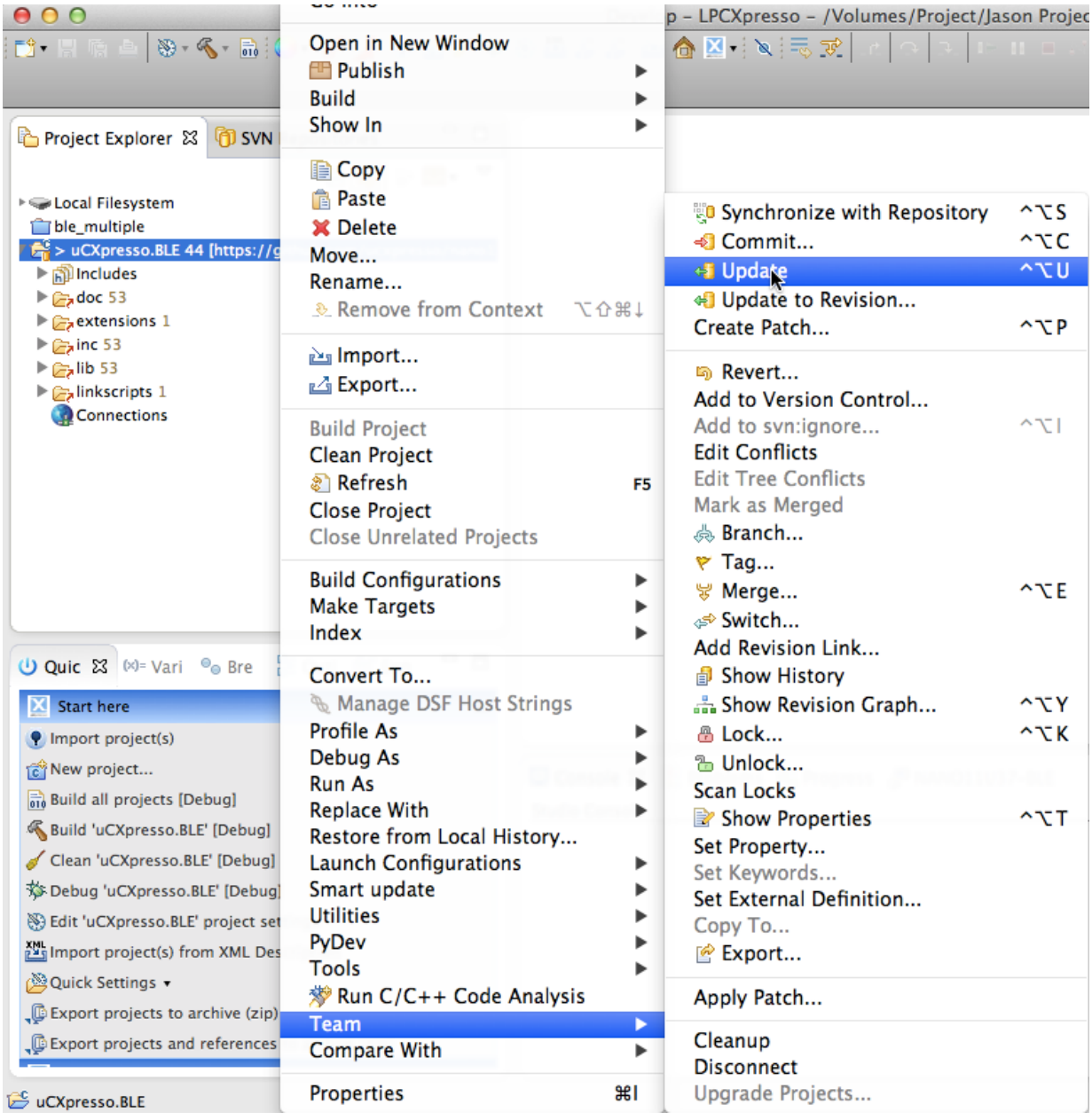
iOS App : BLE Arduino

https://itunes.apple.com/tw/app/ble-arduino/id547628998

Youtube Firmata Demo: http://youtu.be/7v7_mqfynRA

Appendix B. Update uCXpresso.BLE framework

When your uCXpresso.BLE is check-out from the trunk of SVN repository, you may use this Appendix A to update your uCXpresso.BLE framework.
Click right button of mouse on the “uCXpresso.BLE”,
in drop down menu , select Team > Update

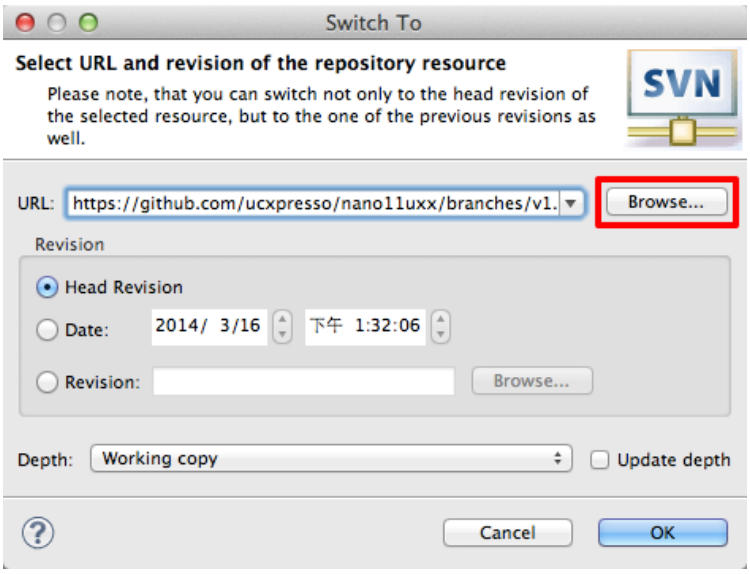


Appendix C. Switch uCXpresso.BLE version Branch

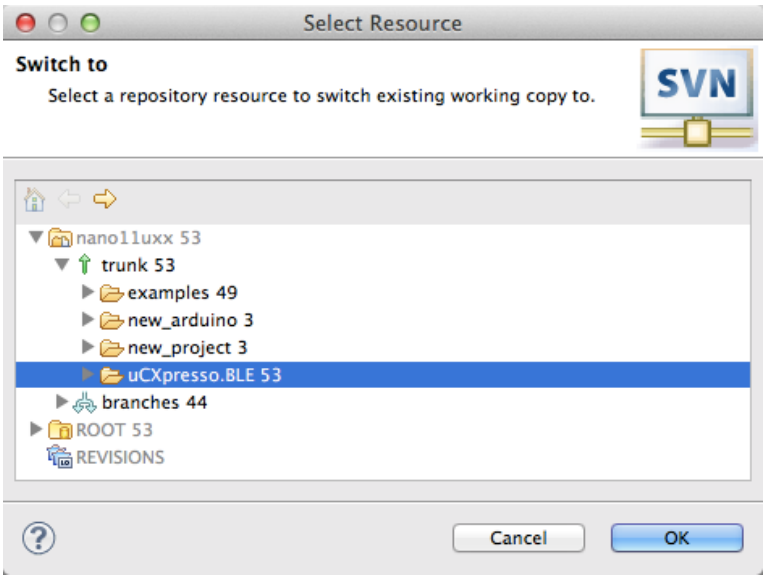
C.1 Switch SVN Branch

To switch the uCXpresso.BLE version branch, click the right button of mouse on the “uCXpresso.BLE” in Project Explorer View.

Select drop down menu “Team” > “Switch…” :



Click [Browse…] select resource (ex. select to trunk/uCXpresso.BLE)



Click [OK] on “Select Resource” > Click [OK] on “Switch To”

Final, see the Appendix A to update the uCXpresso.BLE framework.

Appendix D. Class Manual

D.1 Online Class Manual

https://rawgithub.com/ucxpresso/nano11uxx/master/uCXpresso.BLE/doc/doxygen/html/index.html