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USERS GUIDE

EK2100 Evaluation Kit

for SNAP and Portal Version 2.2
Document Revision v1.2



Wireless Technology to Control and Monitor Anything from Anywhere™

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1. Before Getting Started

Welcome to the *EK2100 Users Guide*. This document is a quick tutorial introducing you to the Synapse SNAP product line using a couple of simple, hands-on demonstrations.

This manual is intended to be a brief introduction and includes only the information needed to run the evaluation and sample applications. Much more information is available via other manuals and tutorials. It also focuses on the components actually included in the kit, rather than trying to cover all the different types of SNAP hardware that are available. Just be aware that there exist other types of SNAP-compatible hardware than what you see included in this kit.

Because it is intended to be a **tutorial**, you need to read through it *in order*, as opposed to skipping around within the document. You also need to *actually do the steps* as specified, because later sections assume the steps from previous sections have been completed.

Other Documentation

This document, the EK2100 Evaluation Kit Users Guide, is only one of several included on the CD that comes with the EK2500 kit. Be sure to also take a look at:

- The “SNAP Reference Manual” (600-0007B)

This document contains lots of information on how to use Portal, the software that runs on your PC and allows you to configure and manage your wireless network. This document is also where you will find information on the built-in functions provided by Portal and SNAPpy.

- The “SNAP Hardware Technical Manual” (600-101.01C)

Every switch, button, and jumper of every SNAP board is covered in this hardware reference document.

- The “End Device Quick Start Guide” (600-0001A)
- The “SN171 Proto Board Quick Start Guide” (600-0011C)

These two documents are subsets of the “SNAP Hardware Technical Manual”, and come in handy because they focus on a single board type.

- The “SNAP Sniffer Users Guide” (600026-01A)

Starting with Portal version 2.2.23, a “wireless sniffer” capability is included with Portal. If you follow the instructions in this standalone manual, you will be able to actually *see* the wireless exchanges that are taking place between your SNAP nodes.

For version 2.2, we are going to be splitting the existing “SNAP Reference Manual” up into multiple smaller documents. The new documents include:

- The “Portal Reference Manual” (600024-01A)

Until this document comes out, Portal will be covered in the “SNAP Reference Manual”. This new manual will cover all of the features of the Portal GUI in a standalone document.

- The “SNAP Users Guide” (600025-01A)

This new document will bridge the gap between the various “kit” User Guides and the “SNAP Reference Manual”. It will cover the basics of SNAPpy programming.

- The “SNAP 2.2 Migration Guide” (600023-01A)

There were enough changes between the 2.1 and 2.2 series of SNAP releases that we decided to provide an extra “transition” guide. You should check this document out if you were already a user of SNAP 2.1 and Portal 2.1.

All of these documents are in Portable Document Format (PDF) files on the CD included with each evaluation kit.

Other Sources of Information

There is a dedicated support forum at <http://forums.synapse-wireless.com>.

In the forum, you can see questions and answers posted by other users, as well as post your own questions. The forum also has examples and Application Notes, waiting to be downloaded.

You could also check the company website at www.synapse-wireless.com.

2. Getting Started

Overview

The Synapse **SNAP** product family provides an extremely powerful and flexible platform for developing, deploying and managing 802.15.4 based wireless applications.

SNAP stands for Synapse Network Appliance Protocol. The term is also used somewhat generically to refer to the entire product line. Often when we are talking about SNAP we are implicitly including SNAP, SNAPpy, Portal, and SNAPconnect.

A **SNAP** network consists of individual SNAP nodes. At the heart of each node is a Synapse RF Engine.



Each RF Engine combines a microcontroller, an 802.15.4 radio, and an antenna. The antenna can either be an integral “F” antenna, or a mounting point for an external antenna.

Some RF Engines also include an internal transmit Power Amplifier (PA) for maximum radio range. These nodes can be identified by the wording “RFET” on their label. RF Engines without the extra Power Amplifier are labeled “RFE”. All versions have a receive amplifier for extended range.

Note: *The EK2100 evaluation kit only includes Synapse RFET engines (with an integrated F antenna and an internal PA). Other types of SNAP engines (both from Synapse or other vendors like Panasonic) can be purchased and are fully compatible with both the SN171 Proto board and the SNAPstick USB node. It is important to understand that any type of SNAP Engine can be used with any Synapse “demonstration” board; this is just the combination chosen for this kit.*

The on-board microcontroller has its own internal RAM and ROM. No external components are required for operation.

Each Synapse RF Engine includes 19 General Purpose I/O (GPIO) pins, which can be configured as digital inputs or outputs. Many of these same 19 GPIO pins can also be switched to alternate functionality:

- 8 can be analog inputs
- 4 can be serial data lines (2 TX pins, 2 RX pins)
- 4 can be serial handshake lines (2 RTS pins, 2 CTS pins)

Although 19 I/O pins are available, you only have to hook up the exact functionality required by your application. The *minimal* hookup to an RF Engine consists of two wires:

- One wire for VCC (2.7-3.4 volts DC)
- One wire for GND

The RF Engines contain core code (written in C) that implements basic wireless networking functionality. This core code also implements an interpreter for a subset of the Python programming language. Synapse has named this subset of Python **SNAPpy**.

You can find details on the SNAPpy language, and how it compares to Python, in the SNAP Reference Manual. For now, the important point is to understand that SNAP nodes do implement a scripting language.

SNAPpy scripts can be uploaded into RF Engines “Over The AIR” (OTA), or over the serial interfaces. These scripts effectively define the personality of each node – by changing the SNAPpy scripts uploaded into a node, you can completely change the node’s behavior.

RF Engines can be designed into your own products, acting as a slave device to your main microcontroller or microprocessor. In many cases the RF Engine can take over the functionality of the original main processor, in *addition* to adding wireless capability and SNAPpy scripting.

In addition to discrete RF Engine modules, Synapse also sells a growing portfolio of SNAP **nodes** that accept RF Engines, but then extend their capabilities with additional I/O hardware.

Two different kinds of SNAP nodes are included in this evaluation kit:

- One USB SNAPstick
- One SN171 Proto Board

Details about each of these boards can be found in the SNAP Hardware Technical Manual, as well as their associated ‘quick-start’ guides

A Portal into Your Network

Portal is a standalone software application which runs on any standard PC with Microsoft Windows 2000 or higher. Using a USB or RS232 interface, it connects to any **RF Engine** in the SNAP Wireless Network, becoming a user interface for the entire network.



Note: – most of the icons shown in the previous diagram were taken directly from the Portal user interface.



is used within Portal to generically represent a SNAP node.



is used within the Portal user interface to represent Portal itself.

The version of Portal that comes with this particular evaluation kit supports six nodes, but you can license versions for higher node counts.

Once connected, Portal provides the capability to *interactively* build an *intelligent* wireless network. You can:

- Discover new SNAP Devices
- Upload *intelligence* to those Devices over the air, using SNAPpy scripts
- Customize Portal to suit your specific application

Interactively - you do all this within Portal, observing the results immediately.

Intelligent - the network is purpose-built for your application.

Synapse's **Portal** administrative software is included in this evaluation kit. Details regarding **Portal's** installation and use are presented later in this document.

For more information about using Portal, refer to the “Portal Reference Manual”.

Throughout this manual, the term “Portal PC” is used to refer to the PC that Portal is running on.

SNAPconnect

Synapse also licenses a standalone *SNAPconnect* application, giving you XML-RPC access into your SNAP network. Running on Windows or Linux, this software provides a XML-RPC API which can be used by client software written in Python, JAVA, C#, C++, etc. This allows backend systems to participate seamlessly in the SNAP network.

This *SNAPconnect* software is not included in this evaluation kit, and is not mentioned in the remainder of this document.

Evaluation Kit Hardware

To demonstrate many of the capabilities of Synapse *RF Engines*, *SNAP* and *Portal*, we've bundled them together in an evaluation kit form – the EK2100.



The EK2100 evaluation kit comes with management software, a power supply, an external battery holder, a pair of AA batteries, a screwdriver and a bag of components (refer to the *EK2100 Kit Contents* document). The kit also contains *two different kinds* of SNAP demonstration nodes:

- One SN132 SNAPstick USB Module
- One SN171 Proto Board

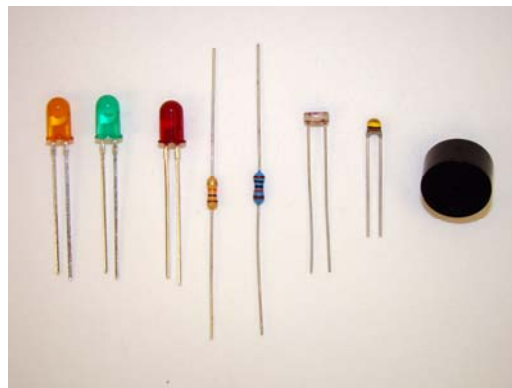
Remember: *You do not have to use the various “demo” boards in order to use the RF Engines in your own projects.*

Also: *If you crave even more fun, additional boards can be purchased from Synapse to expand you evaluation network.*

We tend to hate to hear the words “*some assembly required*”. Hopefully, we can make an exception with this kit. As you work through the upcoming demonstrations you will get the chance to “play” along and connect various sensors and indicators. Your kit should have come with a screwdriver and bag of various electronic components.

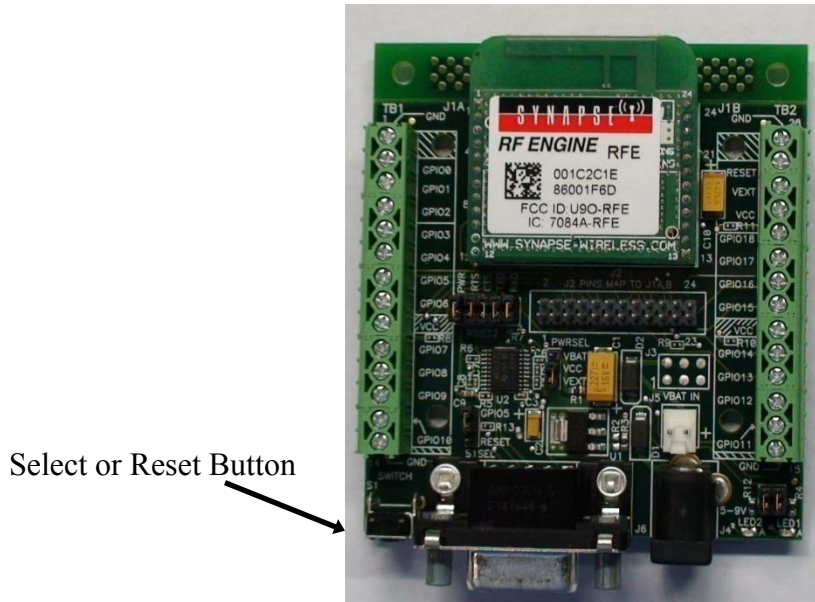
Your bag should include the following:

- 3 LEDs (1 amber, 1 green, 1 red)
- 1 10K Ohm resistor (beige)
- 1 100K Ohm resistor (blue)
- 1 Photo-cell (circular sensor)
- 1 Thermistor
- 1 Piezo buzzer (small black disc)



Before getting down to business let's talk a little more about the two SNAP demonstration boards included with this kit:

SN171 Proto Board



The Synapse SN171 Proto (prototyping) Board provides easy access to all 19 General Purpose Input/Output (GPIO) pins available on the SNAP RF Engine. 8 of these pins (GPIO 11-18) can also serve as analog inputs.

All of the onboard RF Engine (RFE) signals are made available at easy access screw terminal blocks located on either side of the node. These same signals are also made available in a more compact form in the center of the board. A single dual row header provides a connection point for a ribbon-cable (or some other form of wiring harness) from some other circuit board.

The SN171 can be powered by an external power supply (5-9 VDC) or two AA batteries. An external battery holder is also included in the kit for battery operation.

One quick note: The SN171 does not support the same external voltage range as other Synapse evaluation boards. It supports a range of only 5-9 VDC.

More information about this module's hardware can be found in the *SN171 Quick Start Guide* and the *SNAP Hardware Technical Manual* found on the included CD.

SN132 SNAPstick USB module

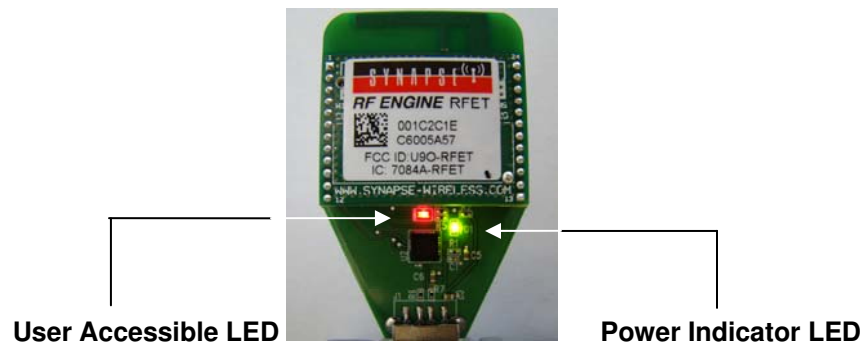


The Synapse SN132 SNAPstick USB module does not provide access to the entire range of GPIO pins available through the SN171 Proto Board. Instead, it provides a simple and compact way to connect a PC running Portal to a SNAP network.

A Tri-color LED is available as an output indicator. This component has the ability to emit a red, green, or amber light. It can be controlled by manipulating GPIO pins 0 and 1 via SNAPpy scripts. The following table describes the interaction of output pins and resulting colors. Notice that the LED lines are active LOW.

<i>Desired LED Color</i>	<i>Value of GPIO Pin 0</i>	<i>Value of GPIO Pin 1</i>
Red	Low	High
Green	High	Low
Amber	Low	Low

A second green LED is used to indicate that power is being supplied to the module. It cannot be controlled by the user.



Power to this module is provided via a standard USB connection. This allows for the SNAPstick to be powered using a PC or other USB power source (such as an AC adaptor).



Note: *The Portal software does not need to be installed for the SNAPstick to draw power from a PC's USB port.*

More information about this module's hardware can be found in the *SNAPstick Quick Start Guide* and the *SNAP Hardware Technical Manual* (located on the included CD).

Demonstration Time

The following section takes the user through a series of step-by-step demonstrations. These demos will serve as a brief introduction to the capabilities of Synapse's SNAP RF engines and Portal software.

Each segment builds upon the concepts of the previous demonstration and they are most effective if executed in order. However, this is certainly not mandatory.

SNAPstick USB Connection

Go ahead and connect the SNAPstick USB module to an open USB slot on the PC or a USB power adapter. If you do connect to a PC, the following dialog box will appear:



Since we have not installed the correct software yet (we'll do that later in this document), we are not ready to do this - just click on **“Cancel”** for now.

Demonstration 1: Counting Straight Out of the Box

Ok. Now it's time to actually play with our new toys.

Both nodes come from the factory preloaded with a demo SNAPpy script. Although this demo script showcases only a small portion of the capabilities of a SNAP node, it provides a quick way to get familiar with the nodes, without having to install any software on your PC.

GOAL: To demonstrate how SNAP nodes can interact without the need for controller software. They work straight out of the box.

Step 1 – By now you should have the SNAPstick USB module plugged into your PC or USB power supply. The module will have a single green LED lit to indicate it is up and running.

Try and keep the SNAPstick in a place where you can see the LEDs. Since this is the only form of output on this particular node, we'll use them in a couple of demonstrations.

Note: Don't install the software just yet.

While the module is drawing power from the USB connection, it is not yet interacting with any installed software. SNAP RF engines (and the demonstration boards that utilize them) do not require the Portal software to operate. Once a SNAPpy script is loaded into a unit, it can become a completely autonomous node in a network.

Step 2 - Power up the SN171 proto-board using the 9V AC adapter provided with your evaluation kit. You should see the yellow LED (LED2) begin to flash. This means we are ready to push some buttons.

If your nodes are on and each has a lit LED, proceed to the next section. Otherwise, here are some trouble-shooting tips that may help:

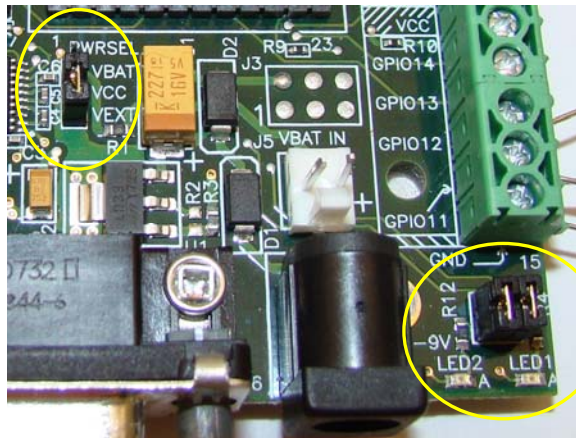
Troubleshooting

Tip #1: Verify the power related jumpers:

Your SN171 “proto-board” node should have come from the factory preconfigured to work with an external DC power supply. Still, as a double-check, verify that the VCC jumper is in the VEXT position (connecting pins 2-3), not the VBAT position (connecting pins 1-2).

Tip #2: Verify the LED related jumpers:

The SN171 “proto-board” node should come from the factory preconfigured to enable its two on-board LEDs (one yellow, one green). If the unit is not blinking its yellow LED, it is worth verifying that the LED1 and LED2 jumpers are both installed.



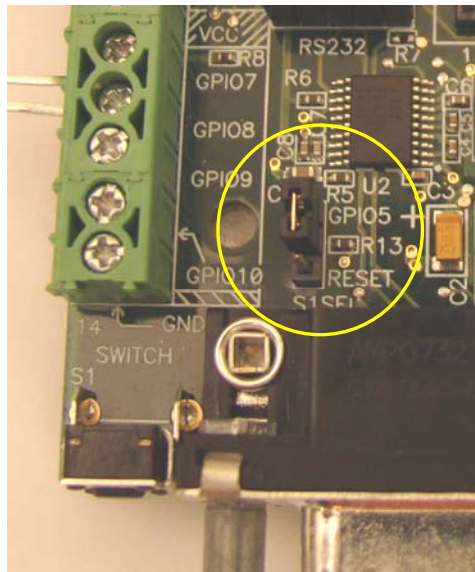
Now back to the action...

The pre-loaded script (“McastCounter.py”) will keep track of a global count. This count is incremented every time a ‘button press’ is registered.

Step 3 - Push the button on the proto-board. You will notice the LEDs on the proto-board and SNAPstick change pattern with each button press. Press-and-hold the button and you will see the LED configuration return to its original state (i.e. the count returns to zero).

More Troubleshooting

If you are not seeing the LEDs change on the proto-board make sure that the button is enabled. The jumper located up and to the right of the button is set to for ‘GPIO5’ (connecting pins 1 and 2) and not to ‘reset’ (pins 2 and 3).



This demonstration is a simple way to show a couple of key points:

- The nodes are immediately able to communicate with each other - There is no such thing as a “network join time” with SNAP.
- Any node can talk to any other node - There is no central “coordinator” node with SNAP.
- No PC software required – There is no need for software installed on a PC to “coordinate” the nodes, they can think for themselves.
- Using SNAPpy scripts, SNAP nodes can autonomously respond to changes in their environment – This button press could easily be some form of digital or analog sensor reading.

The counting you just observed is accomplished using the multicast capabilities of SNAP. If other modules were added to the network, they too would track the button count and could even participate in the counting.

The first example was pretty simple. Let’s expand on things and include a look at how nodes can interact with Synapse’s Portal software.

So, without further ado, we will move onto the next step; installing Synapse’s Portal software application...

3. Installing Portal

The Synapse Network Evaluation Kit contains a CD with the Portal Installer as well as RF Engine support documentation. This CD provides all the software you need to get started with SNAP and Portal. Additional updates and the most current release of this software will always be available on the Synapse support forum – so you may want to check for updates before installing.

Note: The version numbers related to the software you are installing may be higher than those depicted in the following screen-shots

Updates on the Web

You'll find the latest version of Portal on the Synapse Support Forum at <http://forums.synapse-wireless.com> (look under Software Releases -> latest Releases)

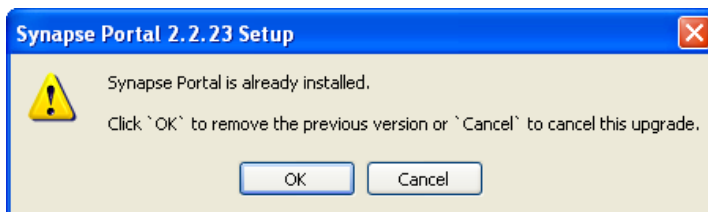
Portal comes bundled with the latest SNAP firmware and documentation.

There is also a company website at <http://www.synapse-wireless.com>

Running Setup

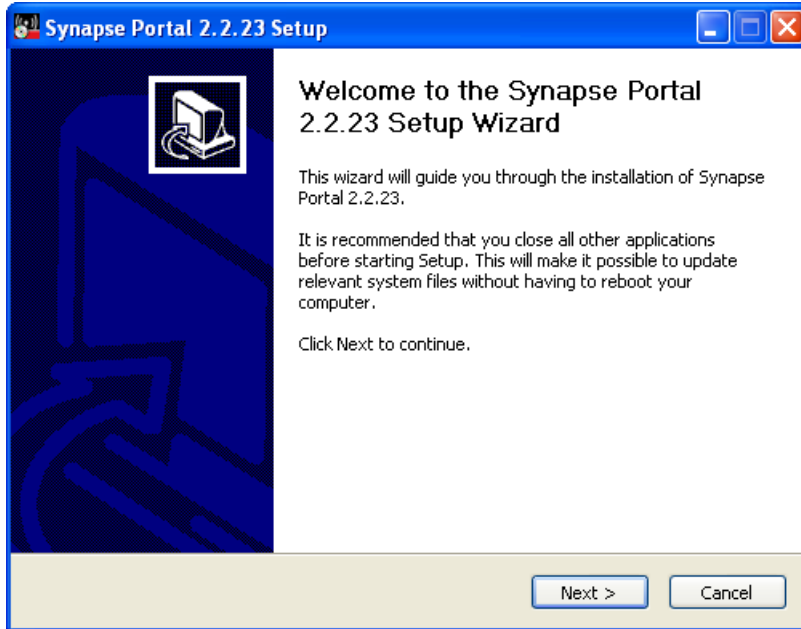
Insert the **Synapse Portal CD**, and run the **Portal -EK2100-setup.exe** you'll find there. (Windows "AutoRun" may launch this for you automatically)

NOTE – if a previous version of Portal (for example, version 2.0) was already installed on your computer, you will get an initial dialog box like the following:

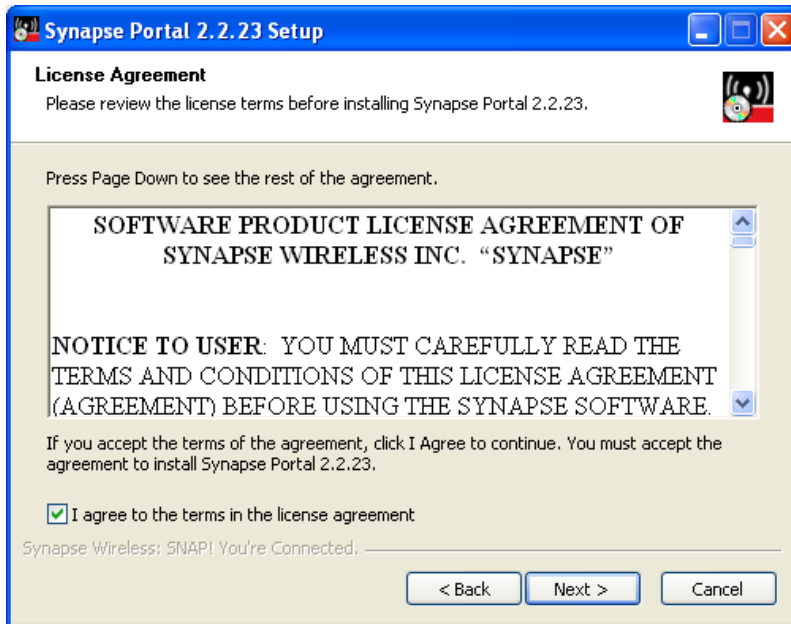


You must click the "OK" button in order to install the newer version.

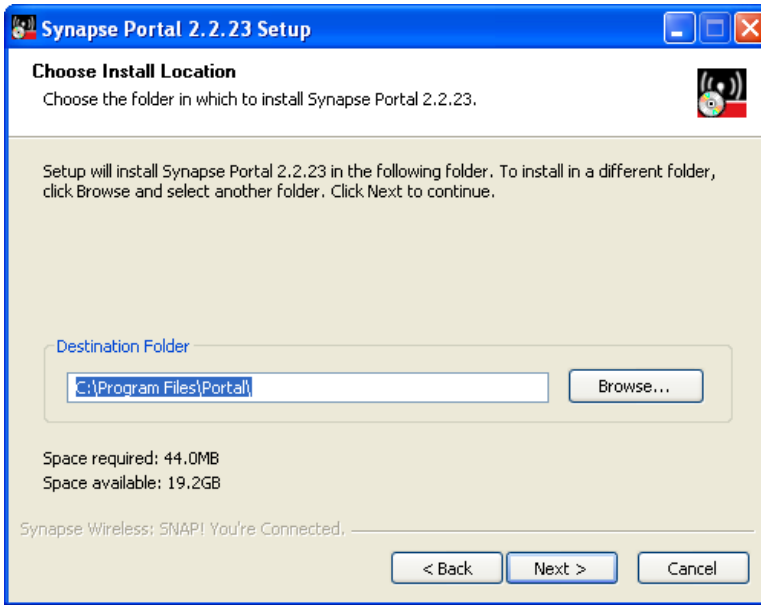
A dialog box similar to the following will appear (your version number may be higher).



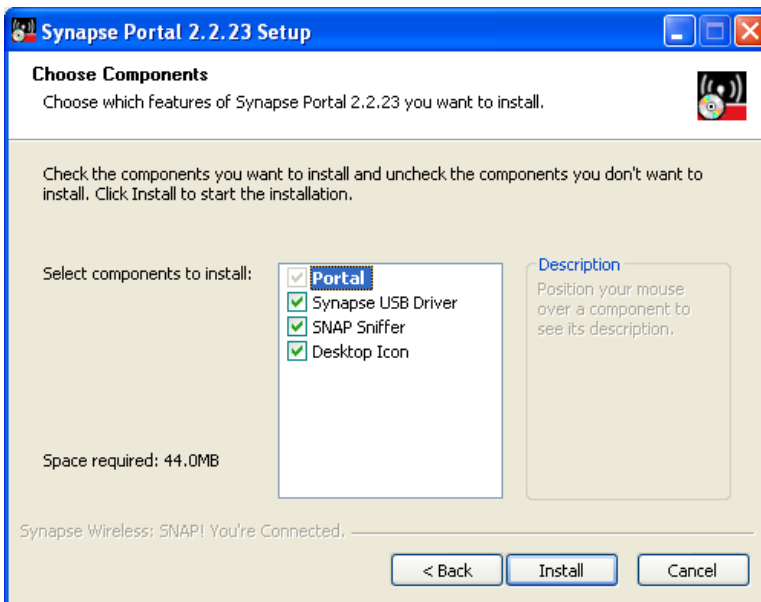
Click the **Next** button to get the following:



Read the license agreement, check the “*I agree*” box and then click on **Next**.

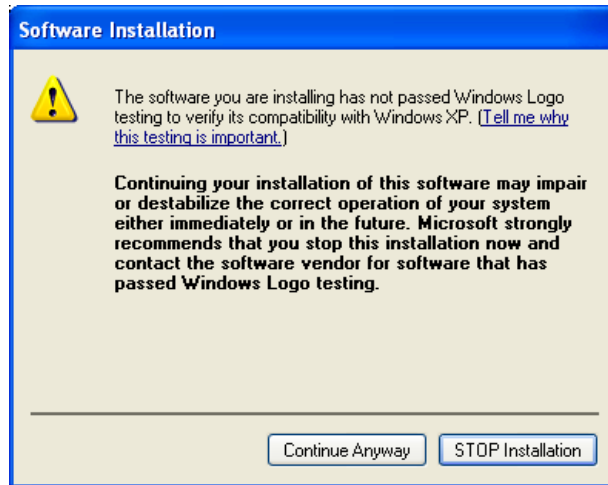


You can either enter the desired destination folder manually, browse to the desired folder, or just click on **Next** to accept the default.



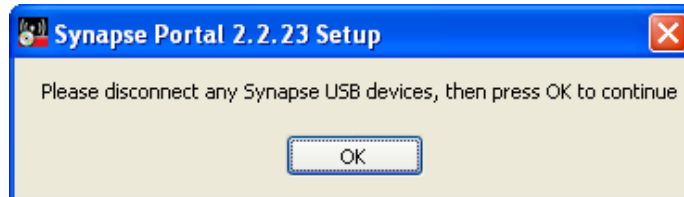
Make sure the desired components are checked, and click on **Install**.

Depending on the version of Windows running on your PC, you may get a warning dialog similar to the following:

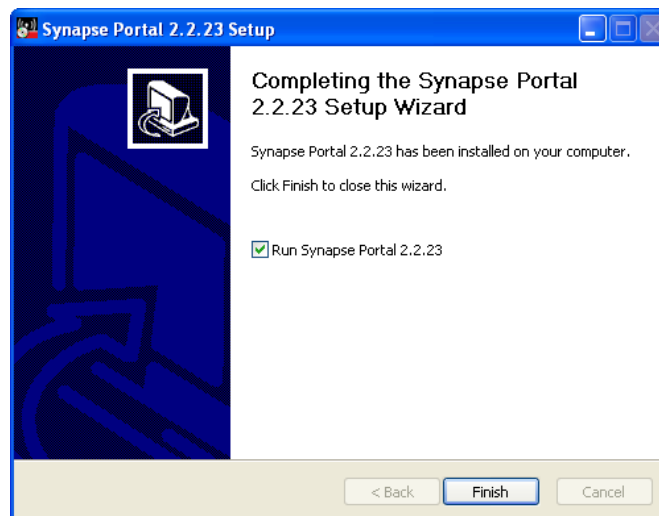


The warning is harmless, and you should click on *Continue Anyway* to proceed with the installation.

After several files have been processed, you will get the following dialog box:



To ensure that the latest Synapse USB drivers can be installed, you must not be running the old versions of these drivers. Disconnect any Synapse USB devices to ensure this, and then click on the "OK" button. The installation process will continue.



You have now successfully installed **Portal**. There will be a **Portal** icon on your Windows *Desktop*, as well as in the *Start Menu*.

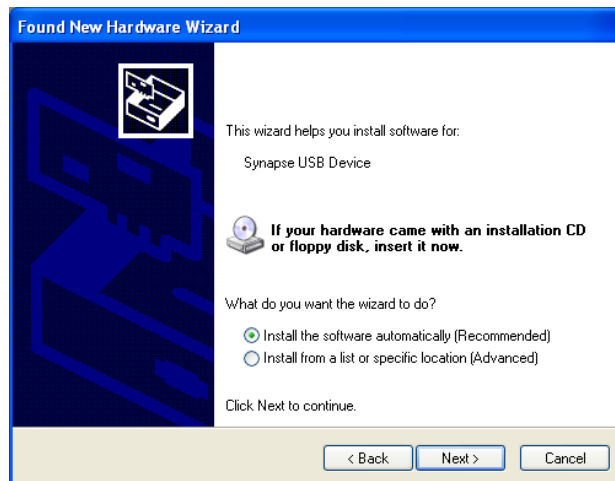
Note: *The Synapse Portal CD also contains Hardware and Software Documentation and Release Notes.*

USB Setup

The SNAPstick requires that the Synapse USB drivers be installed in order to properly communicate with Portal. Make sure the SNAPstick module is connected to an available USB port. Since we have yet to install any drivers for this device, the following dialog box should appear:



The correct software is already available (you just installed it when you installed Portal!), there is no need for Windows to connect to Windows Update – just click on “**No, not this time**” and then click on **Next**.



Choose “**Install the software automatically...**” and click on **Next**.

Depending on the version of Windows you are running, you may get a warning dialog similar to the following:



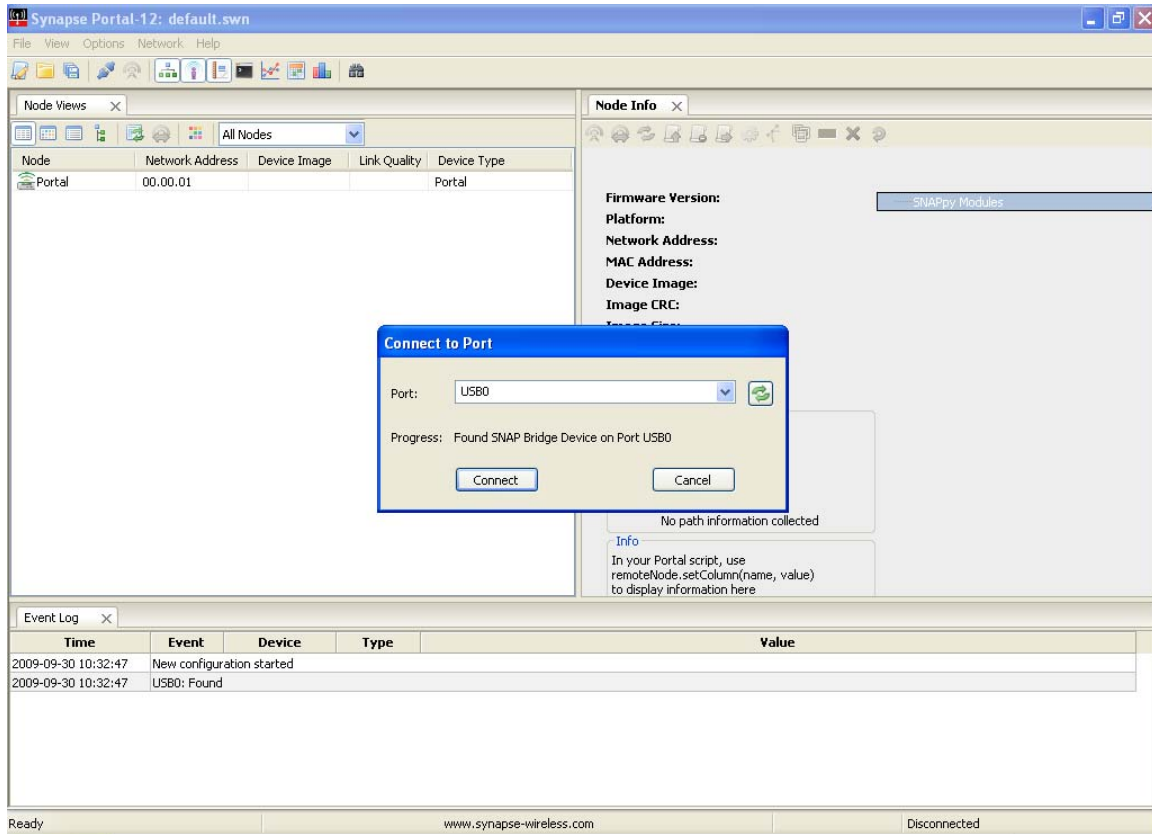
This warning is harmless, and you should click on **Continue Anyway**.



Congratulations! Your *Synapse USB Device* is installed and ready to be used by Portal.

Program Launch

After installation, launch the Portal program by double-clicking on the Portal icon on your desktop (or from the start menu). You should see a screen similar to the following:



If you do see something similar, you have now successfully installed Portal and detected a USB connected bridge device.

Note: The Portal PC (the PC that the Portal software is running on) has no 802.15.4 radio of its own.

One of the SNAP nodes must act as a “bridge” for it. Portal will connect directly to this bridge node, using either a USB or RS232 connection.

Portal will then be able to communicate to the rest of the SNAP nodes indirectly, by sending packets across the directly connected bridge node.

For our purposes, the SNAPstick will act as the bridge.