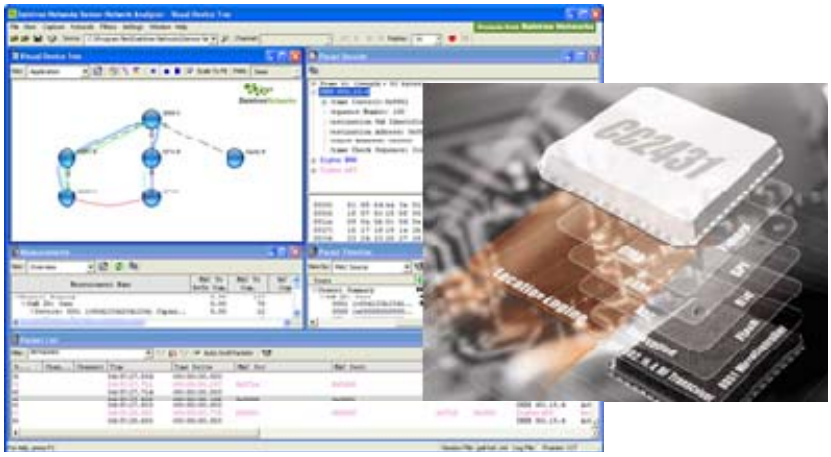
DaintreeNetworks

Start-up commissioning and binding using TI's SoC and the Daintree Networks Sensor Network Analyzer

Application Note AN018



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Sensor Network Analyzer Release 2.3 (2008-06-27)

About commissioning

Commissioning is the physical deployment, addressing, and logical binding of nodes to form a functional network. You commission all types of networks including those used for testing and field trials, and live deployed networks.

In its broadest sense, commissioning encompasses a wide range of tasks, including a survey of the radio and physical environment, the placement of devices, configuration of parameters, application binding, optimization of network and device parameters, and testing and verification of correct operation.

Often, non- and semi-technical issues need to be considered, including the skills and workflow practices of the installer, ease and identification and accessibility of devices, and interoperability and coexistence with other wireless or wired systems.

While consideration for commissioning is often focused on the installer, the ability to easily configure and commission ZigBee systems during development and testing, as well as field trials, can also significantly speed up the development and product delivery to market.

This application note provides instructions of how to perform start-up commissioning of the Texas Instruments CC2430 or CC2431 System on a Chip (SoC) using Daintree's Sensor Network Analyzer.

About Daintree's Sensor Network Analyzer (SNA)

The SNA combines a powerful protocol analyzer with network visualization, measurements and diagnostics for IEEE 802.15.4™ and ZigBee® applications. It provides automatic display of network formation, topology changes, and router and coordinator state changes allowing rapid detection of incorrect network behavior and identification of device or network failures.

It also provides a powerful commissioning tool that helps to hide the complexity of the underlying technology, and provides straight-forward configuration, testing and troubleshooting capabilities. Its graphical representations makes if fast and easy for installers to monitor network formation and measure key parameters such as link quality and bindings.

Visit www.daintree.net to find out more about Daintree's SNA.

About TI's CC2430/CC2431 SOC

The CC2430 and CC2431 from Texas Instruments provide a true System-on-Chip (SoC) solution specifically tailored for IEEE 802.15.4 and ZigBee applications.

Visit the Texas Instruments web site at www.ti.com/zigbee for details about the SoC solution.

How does start-up commissioning work?

This is the initial configuration of a device that tells it which network to join and the way in which it should join that network. It typically consists of the following steps:

1. If required, load the required firmware to all devices.
2. Use the SNA to start a new Commissioning Network with a Daintree 2400E (or other active device) as coordinator.
3. Turn on the remaining devices, and then commission each device by setting all parameters required to start, and then join, the new live network.
4. Use the SNA to monitor the new live network.
5. This application note also describes how to add bindings as required.

Loading firmware to devices

Daintree provides a number of firmware files specifically for use with TI's CC2430 and CC2431 modules. You can find full details in the "*SNA Firmware Guide for TI's CC2430 and CC2431*" document, which is available from the Daintree web site at http://www.daintree.net/partners/ti-chipcon.php

The following notes apply to these firmware files:

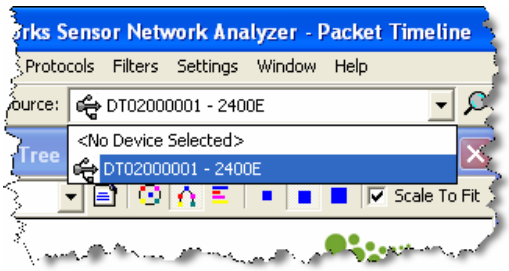
- After loading the *TI-2430-ZBv2sp1-RC-HA-OnOffLight-20080808r6.hex (Coordinator-capable Router)* firmware to a device, you need to commission it before it will behave as a coordinator. Prior to commissioning, it will behave as a router and attempt to join an existing network.
- The Light and Switch firmware have been designed to join a network with an Extended Pan ID (EPID) of 01:23:45:67:89:ab:cd:ef. Therefore, you must configure your intended coordinator to use this EPID.

See the documentation for the TI CC2430/CC2431 SoC if you require instructions for loading firmware to your devices.

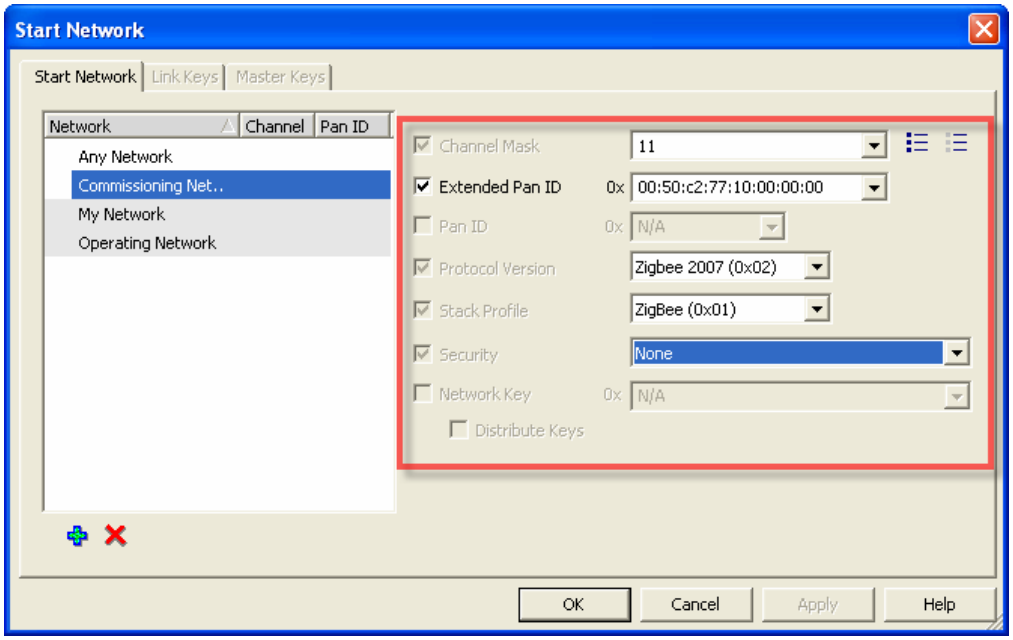
Starting a commissioning network

The following example uses Daintree's 2400E Sensor Network Adapter as the network coordinator. You can also use any device that supports the SNA's active analysis features such as the Integration USB Dongle.

1. Start the SNA application and connect the 2400E Sensor Network Adapter to your computer via USB.
2. Select the 2400E from the **Source** list.



3. From the **Settings** menu, select **Device Manager**, or click the Device Manager icon from the main SNA toolbar. This opens the Device Manager dialog box.
4. On the Device Manager dialog box, click the **Commission** tab. Then click your active device (to select it) and click ▶ to start a new network.
5. On the Start Network dialog box **Start Network** tab, click **Commissioning Network** to select it. Then enter the settings to use for your network, which must include the following if you are using the Daintree-TI firmware:
   - **EPID** of 00:50:c2:77:10:00:00:00
   - **Security** of None



6. Click **OK** to start the network using the specified settings.

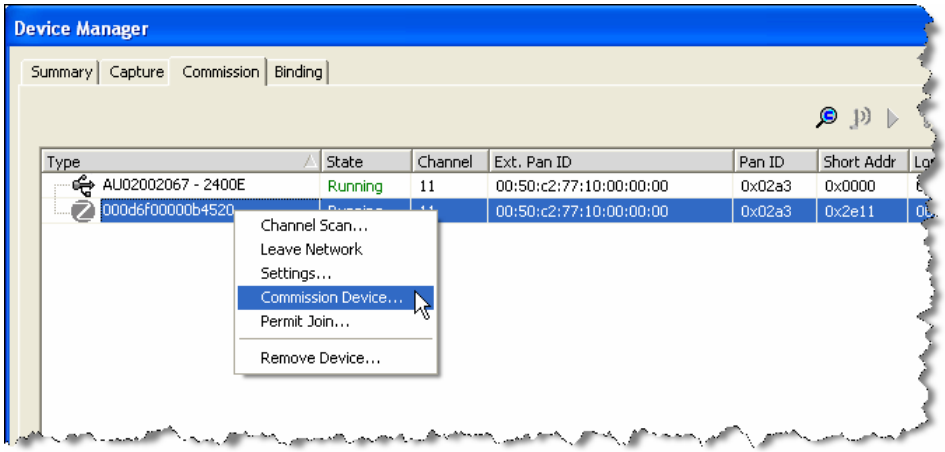
Commissioning devices

Note that all remaining instructions assume the use of the Daintree-TI firmware.

1. Turn on the remaining devices.

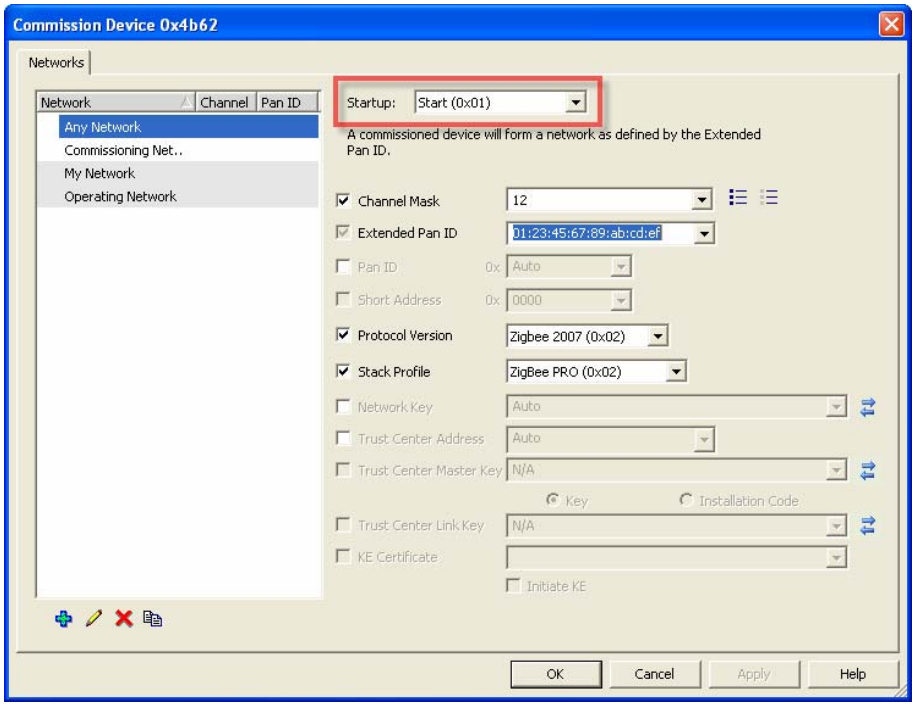
   As each device joins your commissioning network, you will see it appear on both the Visual Device Tree window and the Commission tab of the Device Manager dialog box.

2. On the Device Manager > Commission tab, right-click the device that will act as the coordinator in your new network, and then select **Commission Device**.



3. On the Commission Device dialog box, click ✚ and enter a name under which to save the settings for the new "live" network (called Operating Network in the example below). Then enter the settings for the new coordinator:

   - **Startup** must be **Start (0x01)** to start the new network with the device as coordinator.
   - **Extended Pan ID** should be unique to ensure that subsequent devices join this new network correctly.



4. Click **OK** to save the settings.

   This causes the device to leave the Commissioning Network, and go off to start the new Operating Network as coordinator. When that is complete, the device will disappear from the Visual Device Tree and Device Manager for the Commissioning Network.

5. Commission each remaining device as described in steps 2 through 4, with the following exceptions:
   - Select **Operating Network** from the list of available networks as a fast way to commission all devices with the same parameters.
   - **Startup** should be set to **Rejoin**, which causes the device to join a network using the specified channel and EPID.

Monitoring the new operating network

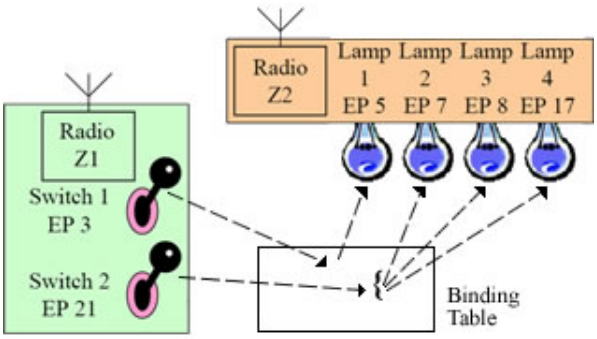
After all devices are commissioned to leave the Commissioning Network and join the new Operating Network, the Visual Device Tree and Device Manager will show only the 2400E Adapter.

1. On the Device Manager > Commission tab, right-click the 2400E, and then select **Leave Network** to leave the Commissioning Network.
2. On the Device Manager > Commission tab, right-click the 2400E, and then select **Join Network**.
3. On the Join Network dialog box, select **Operating Network** from the list of available networks to cause the 2400E to join your new live network.

   When the Join is successful, the SNA will update all windows to show details for the new Operating network.

Adding bindings

Bindings are connections between end devices in a ZigBee network, such as a connection between a light switch and the light that it operates. Each binding supports a specific Application Profile, and each message type is represented by a Cluster (within that profile).

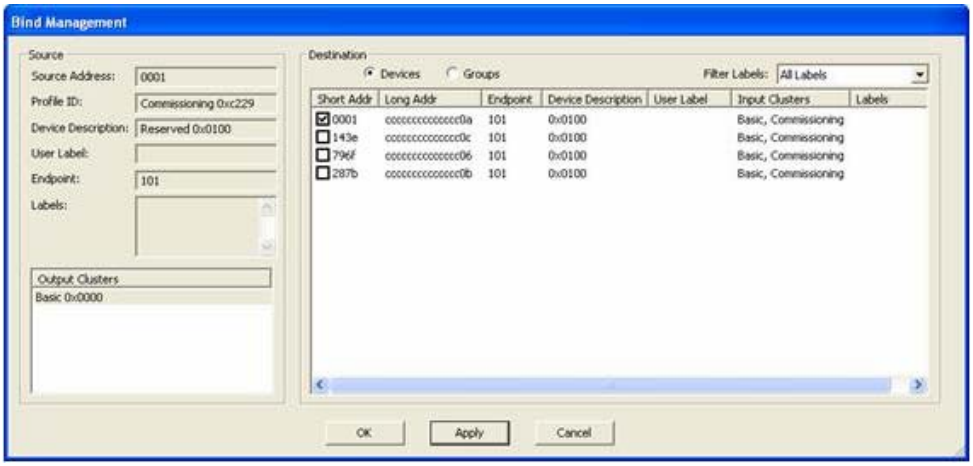


You can create bindings between endpoints that use the same Application Profile and that have associated Output/Input Clusters (for example, one with an On/off Output Cluster, and another one with an On/off Input Cluster).

1. On the Device Manager dialog box, click the **Binding** tab. Then click  to perform a service discovery, during which the SNA will find and display details about each device's application profile and output/input clusters.
2. Select the endpoint for which you want to create a binding, and then click  to open the Bind Management dialog box.

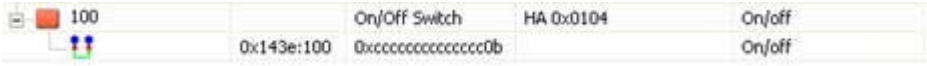
3. On the Bind Management dialog box, select the Output Cluster for which you want to create the bindings. (If the device contains only one Cluster, it is automatically selected for you.)

   The SNA lists all of the available endpoints that match the selected Application Profile and Output Cluster.



4. To **add** a new binding, click the box next to its Short Address. You can also **remove** an existing binding, by clearing the box next to its Short Address.

5. Click **OK** to save the bindings and display their details on the Device Manager > Binding tab and also in the Visual Device Tree window.



Where to next?

In addition to binding individual endpoints, you can also group together a number of endpoints and bind them as a single entity. For example, you may want to use a single endpoint to control all lights in a conference room or all heating units on a single floor.

The TI CC2430/CC2431 SOC solutions also support advanced features including Locationing and Over-the-air firmware upgrades.

You can find out more about these advanced features in the SNA online help:

- From the SNA **Help** menu, select **User Guide**:
  - See the **Commission** section for information about Group commissioning and Group bindings.
  - See the **Locationing** section for information on how to locate devices whose where-abouts is unknown or subject to change.
  - See the **Over The Air Upgrades** section for information about upgrading device firmware wirelessly over your ZigBee network.

SNA firmware

The SNA provides a number of firmware files that can be used with TI's CC2430 and CC2431 for home automation.

- **Home Automation Light (with Groups included) used for flashing from TI's Flash Programmer:**
  - TI-2430-ZBv2sp1-R-HA-OnOffLight-20080612r4.hex (Router)
  - TI-2430-ZBv2sp1-RC-HA-OnOffLight-20080808r6.hex (Coordinator-capable Router)
- **Home Automation Switch (with source bindings included) used for flashing from TI's Flash Programmer:**
  - TI-2430-ZBv2sp1-ED-HA-OnOffSwitch-20080612r5.hex (End Device)
  - TI-2430-ZBv2sp1-R-HA-OnOffSwitch-20080612r4.hex (Router)

Notes:

- For more information about (and to download) ***TI's Flash Programmer***, visit zigbee.ti.com and select **Downloads** > **CC2430** or **CC2431** (depending on which you are using) > **Tools and Software** > **Chipcon Flash Programmer**.
- For more information about the other firmware that Daintree provides for TI's CC2430 and CC2431, visit http://www.daintree.net/partners/ti-chipcon.php

Home Automation Light (with Groups included) used for flashing from TI's Flash Programmer

Firmware for Home Automation Light (with Groups Included) used for flashing from TI's Flash Programmer. (See "Notes" on page 9 to find out more about TI's Flash Programmer.)

There are two firmware files provided. Select the file to use based on whether routers are *coordinator-capable*:

- TI-2430-ZBv2sp1-R-HA-OnOffLight-20080612r4.hex (Router)
- TI-2430-ZBv2sp1-RC-HA-OnOffLight-20080808r6.hex (Coordinator-capable Router)

The table below shows the features and settings for these files, all of which are common between the two files.

Home Automation Light	• Security = Network Layer • In Clusters # Groups # ON/OFF • Hardware = TI Battery boards with CC2430 or CC2431 • Functionality: LED D1 is turned on and off.

Commissioning	• Extended PAN id = 0x0050c27710000000 • Channels = 0x07FFF800 // all channel # Preferred Channels = 11, 14, 15, 19, 20, 24, 25 • In Clusters # Commissioning # Basic • Out Cluster # Basic • Functionality: During network join the LED D1 is flashed until it is joined to a network or is flashing slower if join failed. Reset to default settings is done by pressing (or holding down) button S1 during joining and the LED is on for 3 sec if reset has been done. When forming a new network, or scanning to join a network, the devices scans the channels using the Preferred Channels before scanning the rest of the channels in order to avoid the most commonly used WiFi channels and to improve the user experience during installation.
ZCL ON/OFF	• ON • OFF • TOGGLE
ZCL Groups	• Add • View • Get Membership • Remove • Remove All • Add If Identifying
ZDO Optional features	• NWK_addr_req • Mgmt_Lqi_rsp • Mgmt_Leave_rsp • Mgmt_Permit_Joining_rsp

Home Automation Switch (with source bindings included) used for flashing from TI's Flash Programmer

Firmware for Home Automation Switch (with source bindings Included) used for flashing from TI's Flash Programmer. (See "Notes" on page 9 to find out more about TI's Flash Programmer.)

There are two firmware files provided. Select the file to use based on whether devices are *end devices* or *routers*:

- TI-2430-ZBv2sp1-ED-HA-OnOffSwitch-20080612r5.hex (End Device)
- TI-2430-ZBv2sp1-R-HA-OnOffSwitch-20080612r4.hex (Router)

The table below shows the features and settings for these files, most of which are common. Any variations are highlighted in red for easy identification.

Home Automation Switch	• Security = Network Layer • Receiver on when idle (only for end devices: TI-2430-ZBv2sp1-ED-HA-OnOffSwitch-20080612r5.hex) • Out Cluster # ON/OFF • Hardware = TI Battery boards with CC2430 or CC2431 • Source binding • Functionality: When pressing button S1 group toggle HA messages or unicast toggle HA messages are sent over the air. To toggle between groups and unicast messages hold button S1 until LED D1 is flashed.
Commissioning	• Extended PAN id = 0x0050c27710000000 • Channels = 0x07FFF800 // all channel # Preferred Channels = 11, 14, 15, 19, 20, 24, 25 • In Clusters # Commissioning # Basic • Out Cluster # Basic • Functionality: During network join the LED D1 is flashed until it is joined to a network or is flashing slower if join failed. Reset to default settings is done by pressing (or holding down) button S1 during joining and the LED is on for 3 sec if reset has been done. When forming a new network, or scanning to join a network, the devices scans the channels using the Preferred Channels before scanning the rest of the channels in order to avoid the most commonly used WiFi channels and to improve the user experience during installation.
ZCL ON/OFF	• ON • OFF • TOGGLE
ZDO Optional features	• Bind_req • Bind_rsp • Unbind_req • Unbind_rsp • NWK_addr_req • IEEE_addr_req • Mgmt_Bind_req • Mgmt_Lqi_rsp • Mgmt_Leave_rsp • Mgmt_Permit_Joining_rsp