DaintreeNetworks

Sensor Network Analyzer
Quick Start Guide

Trademarks and acknowledgements

- ZigBee® is a registered trademark of the ZigBee Alliance.
- 802.15.4™ is a trademark of the Institute of Electrical and Electronics Engineers (IEEE).
- Pentium® is a registered trademark of Intel Corporation.
- Microsoft®, Windows®, and other Microsoft products mentioned herein are trademarks or registered trademarks of Microsoft Corporation.
- SimpliciTI™ is a trademark of Texas Instruments.

These trademarks are registered by their respective owners in certain countries only. Other brands and their products are trademarks or registered trademarks of their respective holders and should be noted as such.

Disclaimer

This guide and any examples it contains are provided as-is and are subject to change without notice. Except to the extent prohibited by law, Daintree Networks makes no express or implied warranty of any kind with regard to this guide, and specifically disclaims the implied warranties and conditions of merchantability and fitness for a particular purpose. Daintree Networks shall not be liable for any errors or incidental or consequential damage in connection with the furnishing, performance or use of this guide and the examples included.

The software described in this guide is furnished under a license agreement or nondisclosure agreement. The software may be used or copied only in accordance with the terms of those agreements.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or any means electronic or mechanical, including photocopying and recording, for any purpose other than the purchaser's personal use, without the written permission of Daintree Networks.

Sensor Network Analyzer Release 3.0 (2009-04-08)

Contents

About this Quick Start Guide

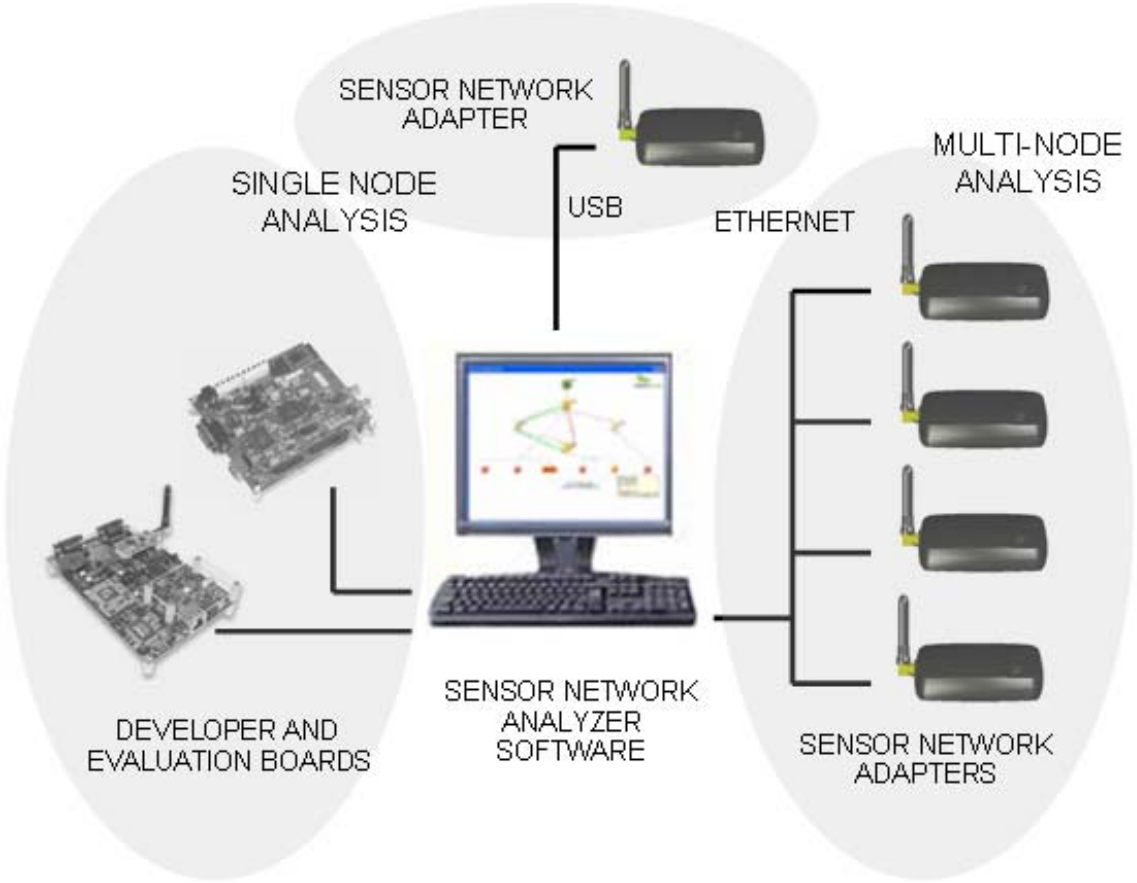
This guide is designed to help you install and start using Daintree Networks' Sensor Network Analyzer (SNA) software and optional 2400E Sensor Network Adapter hardware. It starts by providing a quick overview of these products, before describing how to install them and perform some common tasks.

About the 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.

SNA Release 3.0 and newer also provides support for other standards-based and proprietary protocols such as SimpliciTI (from Texas Instruments), Synkro (from Freescale) and 6LoWPAN.

The SNA works in conjunction with Daintree's 2400E Sensor Network Adapter to provide analysis for small and large networks. With multi-node capture, analysis of large networks across wide areas (such as multiple rooms within a facility) is possible. The SNA application also supports a number of chipset evaluation boards as capture devices, allowing flexibility in using available hardware.



There are three editions of the Sensor Network Analyzer: Professional, Standard, and Basic. Professional and Standard are available to purchase from Daintree Networks, and Basic is provided with many popular semiconductor development kits. Some of these kits also provide 30-day trial licenses for the Professional and/or Standard editions of the SNA software.

The Professional edition provides more functionality than the Standard edition, which in turn provides more functionality than the Basic edition. Note also that the Professional and Standard editions include expert support from Daintree Networks, while the Basic edition is unsupported.

Basic	Provides a protocol analyzer for 802.15.4 and ZigBee networks. Decodes 802.15.4 MAC and ZigBee NWK/APS and includes comprehensive packet filtering.
Standard	All functionality available in the Basic edition. Flexible decode engine supports most standards-based and proprietary protocols plus proprietary ZigBee application profiles. Provides essential features for analysis and testing during application development. Includes comprehensive protocol analysis and basic network and route visualization functionality. Supports ZigBee Application layer decodes including ZDO and ZDL.
Professional	All functionality available in the Basic and Standard editions. Provides a complete set of features for analysis and testing during development, system testing, and trials. Includes comprehensive protocol analysis, network and application visualization, and ZigBee performance measurements. Includes standards-based ZigBee commissioning tool for deployment.

About the 2400E Sensor Network Adapter

The 2400E Sensor Network Adapter is a data capture accessory that acts as an observation point enabling the use of Daintree's SNA software in live IEEE 802.15.4-radio network environments.

Under the control of the SNA Professional edition, the 2400E is also able to start or "actively" join an 802.15.4 or ZigBee network, interact with other devices on it, and gain access to information not available through passive "sniffing" alone. It also provides the ability to configure and commission devices and networks during field trials and deployment.

Being portable and light weight makes the 2400E Adapter suitable for use in remote locations. It also provides flexibility in that it can be connected using either USB or Ethernet.

Find out more

Find out more about the SNA and 2400E in the *Sensor Network Analyzer Online Help,* available from the SNA **Help** menu and the Windows **Start** menu. Find out how to purchase Daintree products from www.daintree.net/purchase or by emailing sales@daintree.net

Installing the SNA software

Minimum system requirements

Before you begin, ensure that you have the following:

- 1 GHz Pentium III equivalent or greater running Windows Vista, XP or 2000
- 512 MB RAM
- 100 MB of available disk space
- Internet connection and administrator privileges on the computer on which you are installing the SNA software
- SNA registration or activation code (provided on the CD case or via email)
- CD drive (if required for CD-based software installation)
- 10/100 Ethernet or USB port for connecting the 2400E Sensor Network Adapter (if required)
- Other ports as required for connecting third-party development/evaluation hardware (see the ReadMe file for a complete list of supported hardware)

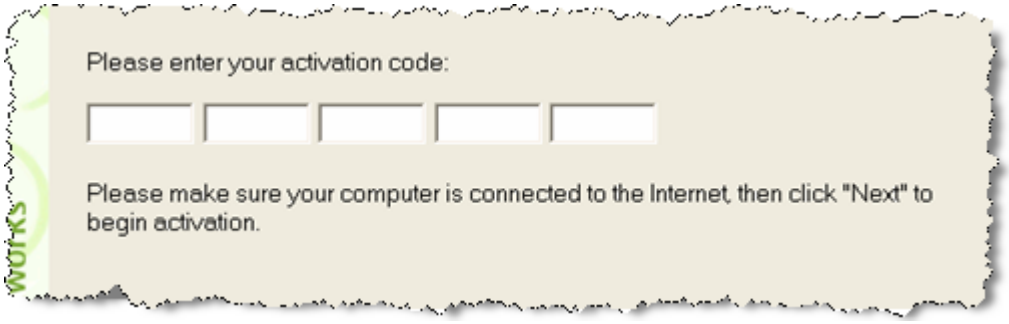
Installing and activating the software

Before you can use the SNA software you need to enter an activation code. You receive this code via email after registering your software on the Daintree web site.

1. Go to www.daintree.net/register to register your software and download the latest release.
2. Enter your email address together with the 15-digit alpha-numeric registration code, which is either on the software CD case or in the evaluation invitation email you received from Daintree Networks. After you click Next, an activation code will be emailed to the address you supply.
3. Follow the link provided to download the latest release of the SNA software. We strongly recommend you do this even if you have the software on CD to ensure you have the latest functionality and fixes.
4. Make sure you are logged in to your computer with administrative privileges, and then run the Sensor Network Analyzer setup program:
   - From download: Unzip and then run the SNA_Setup_v#.exe file (where # is the release version number).
   - From CD: Insert the CD. If the setup program does not start automatically, you can start it manually by running the Setup.exe program.
5. Accept the license agreement, and then follow the instructions in the setup program to complete installing the software. If you have a previous version of SNA installed, it will be automatically uninstalled at this time.
6. When the installation is complete, select to launch the program. We also suggest that you open and read the ReadMe file, which contains details specific to this release.

   The first time you start the SNA software, you'll be prompted to enter your activation code.

7. Enter the 30-digit numeric activation code you received via email after registering the software.



Note that if you are using an evaluation version of the software, your 30-day evaluation period begins when the software is activated.

Once activated, the software is tied to the computer on which it is installed. The activation code cannot be used to run the software on another computer without explicit consent from Daintree Networks.

Solving activation problems

Activation will fail under the following conditions:

- If the Daintree activation server cannot be reached, which is typically caused by problems with your Internet connection, or due to a firewall or proxy server blocking the connection to the activation server.
- If the code you enter has already been used on another computer. You can use each activation code only once.
- If an evaluation version of the SNA software was activated on the computer more than 30 days ago. You are entitled to one 30-day trial only.

Try the following if you have problems activating your software:

1. Check your Internet connection and try again.
2. Try disabling the firewall or proxy long enough to complete the activation.
3. If the above two fail, follow the on-screen instructions for email activation.

You can find out more about licensing and activation at www.daintree.net/support

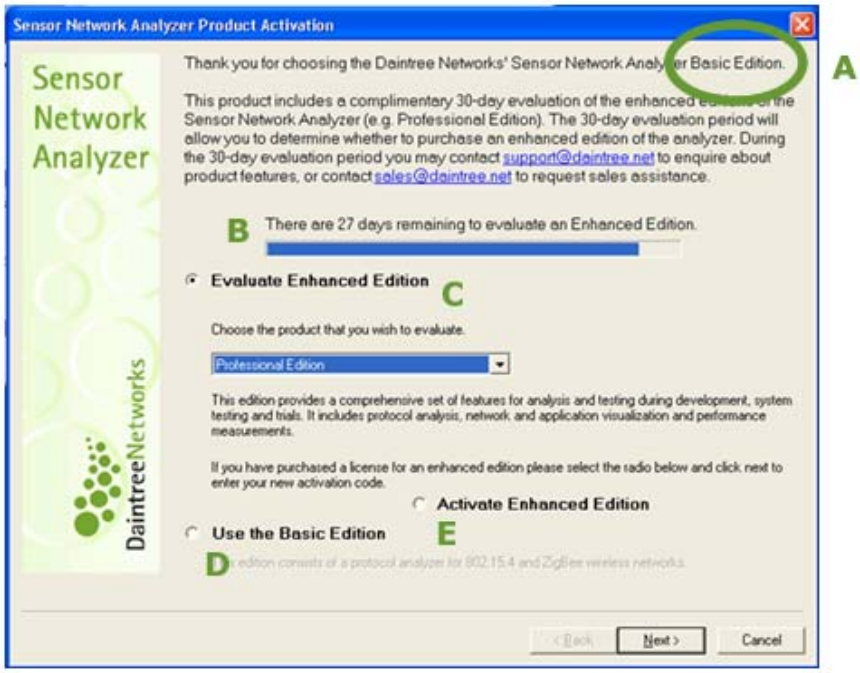
Running an evaluation version of the software

There are three different SNA editions: Basic, Standard, and Professional. If you are running an evaluation version of the software, you have 30 (consecutive) days in which to evaluate and compare the Basic and Enhanced (Professional and/or Standard) editions.

A brief summary of the differences between software editions is provided on page 5. You can find out more in the *Sensor Network Analyzer User Guide* (available from the SNA **Help** menu).

Note that some versions of the SNA evaluation software provide trials of both the Standard and Professional editions, while others provide the Standard edition only. The following instructions show details for an evaluation where both Standard and Professional trials are available, and highlights any differences between these and the Standard-only trials.

1. If the SNA software is not already running, start it in one of the following ways:
   - Double-click the SNA icon on your computer's desktop.
   - From the Windows **Start** menu, select **Daintree Networks** > **Sensor Network Analyzer**.
2. Make sure **Evaluate Enhanced Edition** is selected (C). Then choose either the **Standard** or **Professional** (if available) edition from the list:



   A. The edition of the software you are licensed to run (usually, the Basic edition). This edition will continue to function at the end of the evaluation period.

   B. The number of days that remain in the 30-day evaluation period.

   C. Run an "enhanced" edition of the software: either Standard or Professional (if available).

   D. Run the Basic edition of the software.

   E. Activate a license to upgrade to either the Standard or Professional edition of the software.

3. Click **Next** to start the selected edition of software. Note that once the SNA software is running, the only way to switch from one edition to another is to close, and then re-open the software with the new edition selected.

Activating an enhanced edition of the software

If after evaluating the SNA software you decide to purchase a license for either the Standard or Professional (enhanced) edition, you will receive a new activation code from Daintree. You can enter this code and activate your software in either of the following ways:

- Select **Activate Enhanced Edition** (E) option shown above.
- From the SNA **Help** menu, select **Activate License**.

Take a quick tour of Sensor Network Analyzer

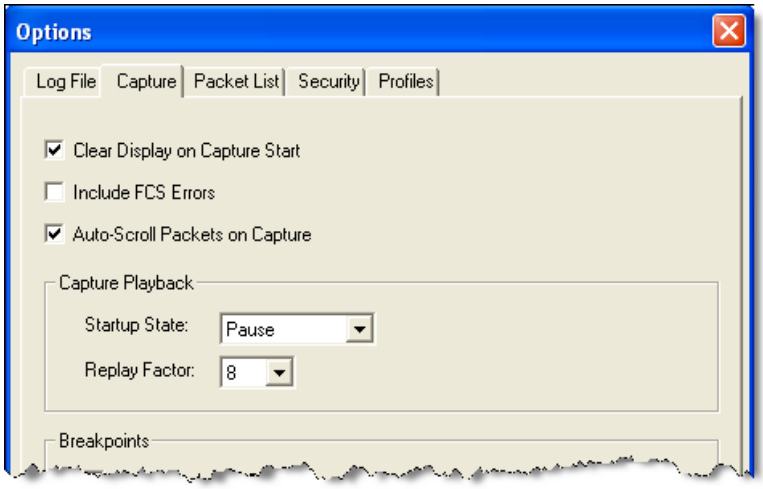
One of the best ways to see the key features of the SNA is to open files that were captured from live networks.

The SNA software comes with sample capture files, which you can find in the **Daintree Networks/Sensor Network Analyzer/Capture Files** directory.

Note that in the following procedure, which uses the SNA Professional edition, any functionality that is not available in the Standard or Basic SNA editions is highlighted in yellow. See page 15 for the differences you'll see if you take this tour using either the Standard or Basic SNA editions.

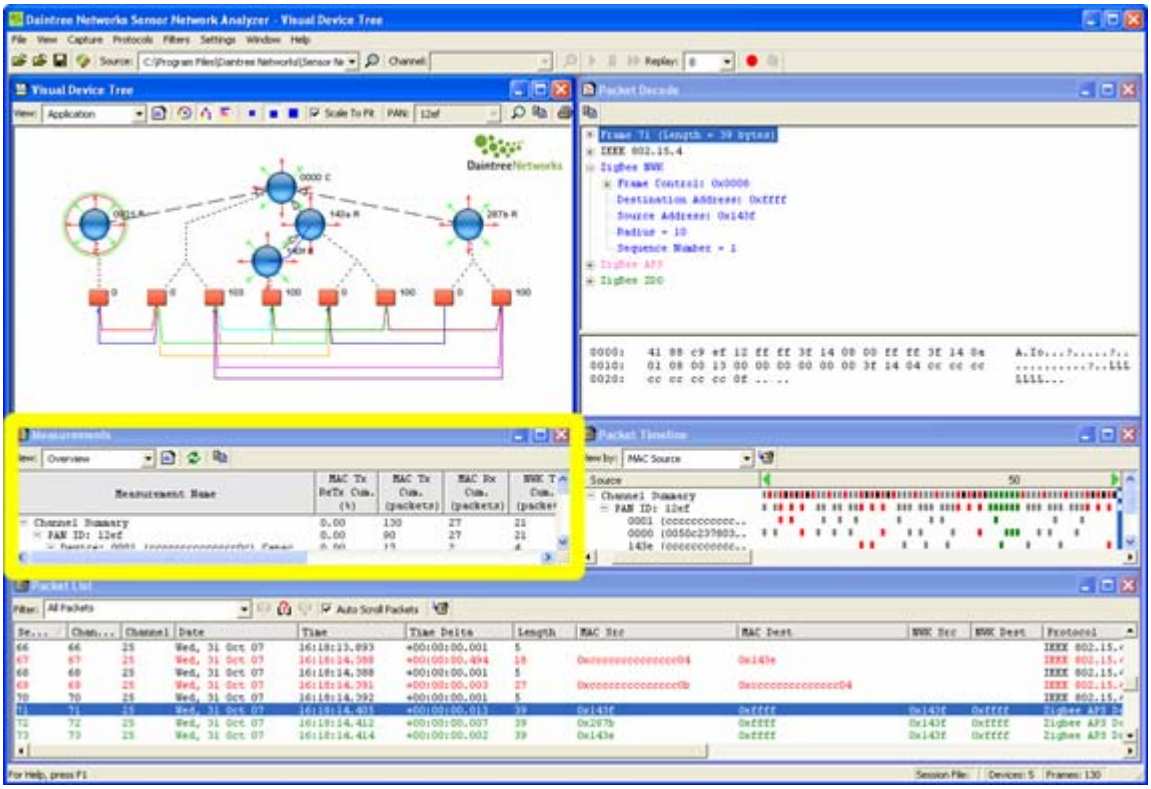
Playback captured traffic

1. Start the software if it is not already running. If available, select to run the Professional edition of the software. (See page 7 to find out how.)
2. From the SNA **Settings** menu, select **Options**. Then in the **Options** dialog box, select the **Capture** tab.
3. On the **Capture** tab, select a **Capture Playback Startup State** of **Pause** and a **Replay Factor** of **8**, and then click **OK**. This provides you with control over when to start the playback and the speed at which to run it.



4. From the SNA **File** menu, select **Open Capture File**. Then select to open the **HA_demo.dcf** file. This file demonstrates a simple home lighting control application. (Note that a version of this file is also available with breakpoints, which cause the playback to pause and display comments at points of interest.)
5. Use the playback options to control the speed at which the captured file is played. Use **Step** to play the file one packet at a time, or **Play** to play based on the specified **Replay** speed factor. **Fast Forward** causes the file to play almost instantaneously.

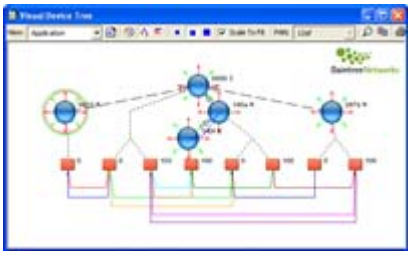
As the traffic is played back, you'll see it update each one of the SNA windows. On completion of the playback, your screen will look similar to the following:



Here's a description of what is shown in each one of these windows.

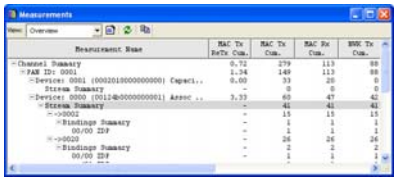
Visual Device Tree window

This window shows network topology using a device association tree:



- Devices are added dynamically based on 802.15.4 Association Response messages.
- Lines are shown between parent and child devices to indicate an association.
- The number of Routes displayed on the Visual Device Tree can be varied by editing **Visual Options** (available from the **Settings** menu).
- Routes can be filtered by selecting (clicking on) a device to display only those Routes associated with the selected device.
- Routes can be selected (clicked on) to highlight each of the devices traversed by the selected Route.
- APS Endpoints are shown along the bottom of the Visual Device Tree, with bindings represented by a line linking two endpoints.
- Toolbar buttons are available to change Views, Layouts (radial, tree, text), and the size of the visual network representation.

Measurements window



This window shows network-wide statistics. (Note that this window is available only in the SNA Professional edition.)

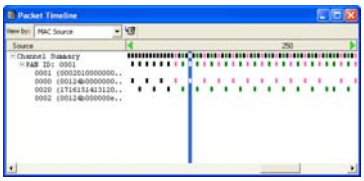
- You can expand the Measurements view to display the full set of available statistics.
- Measurements are broken down by Channel, PAN, Device, Stream (Source/Destination Device Pair), and Route.
- The measurements to show and hide can be customized by clicking or selecting the **Settings** > **Measurements Options** menu item.

Packet List window

This window shows a scrolling list of packets:

- The selected Packet from the Packet List is shown in the **Packet Decode** window.
- A Filter can be applied to the Packet List to display only packets matching a given criteria (typically the value of one or more protocols fields).
- Filters can be applied through the **Filters** menu, Filters toolbar icon, or by right-clicking a protocol field in the **Packet Decode** window.

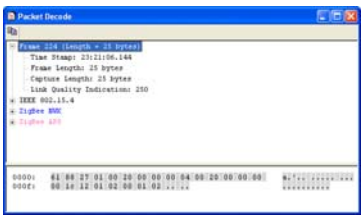
Packet Timeline window



This window shows color-coded packet events on a per device basis:

- The selected packet in the **Packet List** and the Packet Timeline windows are correlated. Selecting a packet in either window will select the corresponding packet in the other, and also update the **Packet Decode** window.
- Packet events are color-coded to indicate MAC Commands (red), MAC Beacons (grey), NWK (blue), APS (pink), and Application layer (green).

Packet Decode window



This window shows details about the currently selected packet.

- Select a packet in either the **Packet List** or **Packet Timeline** window to show its details here.
- Packet details are shown using the same color-coding as the Packet Timeline window.
- Click the ⊞ signs to drill down and view packet details.
- The bottom pane of the window shows a raw hex dump of the selected packet.

Using a floor plan to show device locations

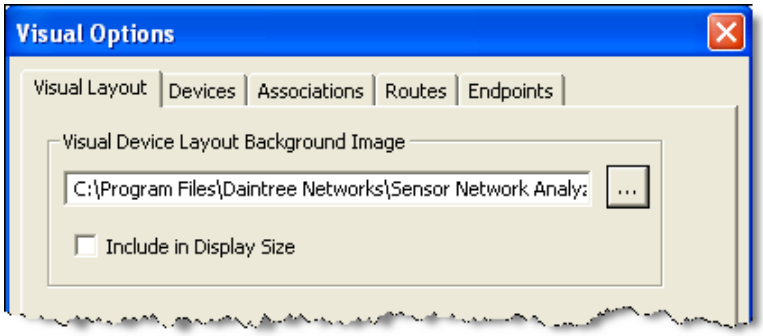
Another visual device window is available, which is not displayed by default. Using the **Visual Device Layout** window, you can specify a background image that represents the floor plan or physical surroundings of the network, and then place devices on that plan to show their locations.

Background images can be in either bitmap or jpeg formats.

Note: This feature is available only in the Professional edition of the SNA software.

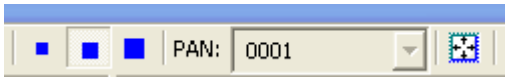
1. Keep the **HA_demo.dcf** file open (that you used in the previous steps).
2. From the **View** menu, select **Visual Device Layout** to open the Visual Device Layout window.

   Notice that the devices shown in the left pane of the Visual Device Layout window are the same as those shown in the Visual Device Tree window.
3. Click the Visual Device Layout window to make sure it is selected, and then from the **Settings** menu, select **Visual Options**.
4. Click the  button in the Visual Options dialog box, and then select the **BasicFloorPlan.jpg** background image. You can find this file in the **Sensor Network Analyzer/Graphics/BackgroundImages** directory.

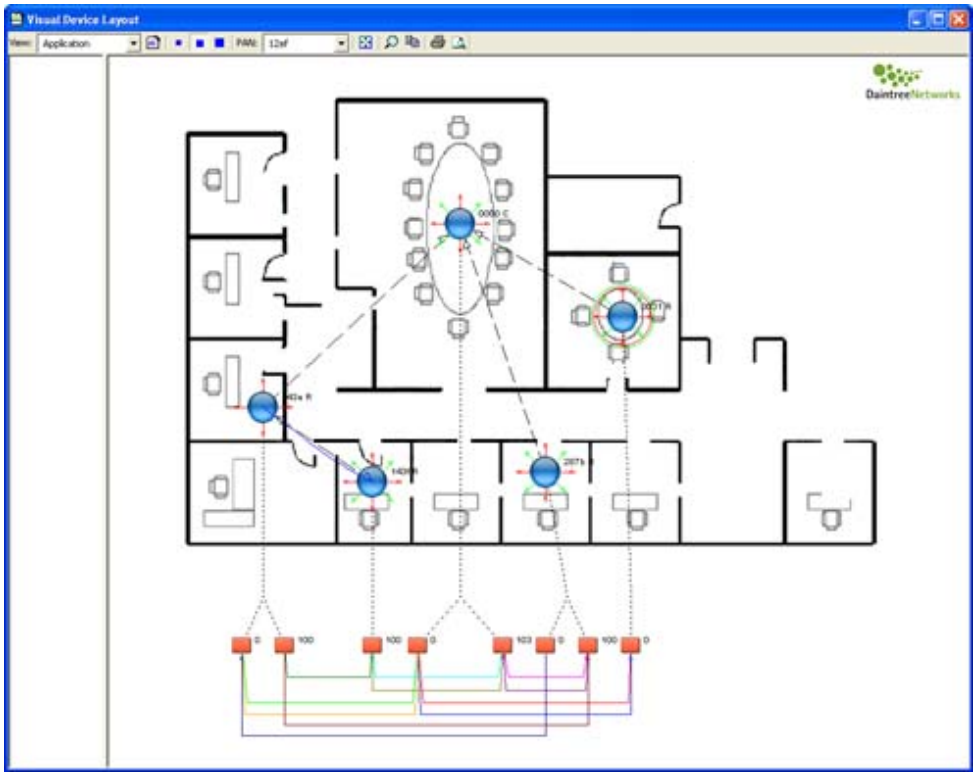


5. Once the floor plan is displayed, drag the devices from the left pane of the Visual Device Layout window and place them on the floor plan shown in the right pane.

   If required, you can use controls at the top of the Visual Device Layout window to resize the floor plan and devices.



As you place each device, notice how associations between devices are shown and updated:

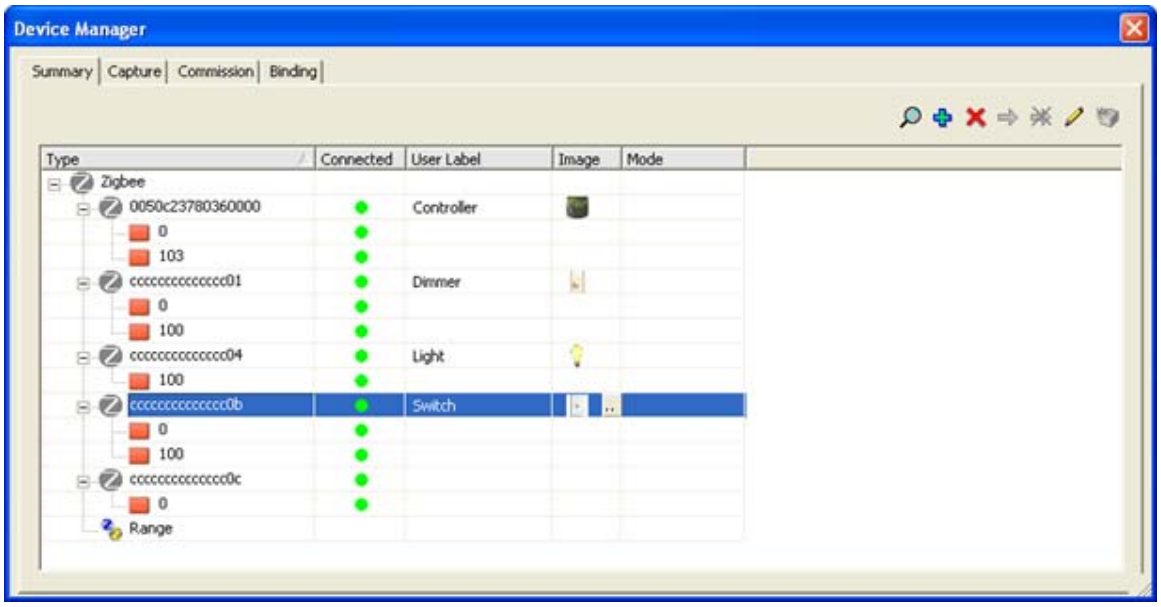


Adding device names and icons

You can help to make your floor plan easier to use by adding descriptive names and images to help better identify each device.

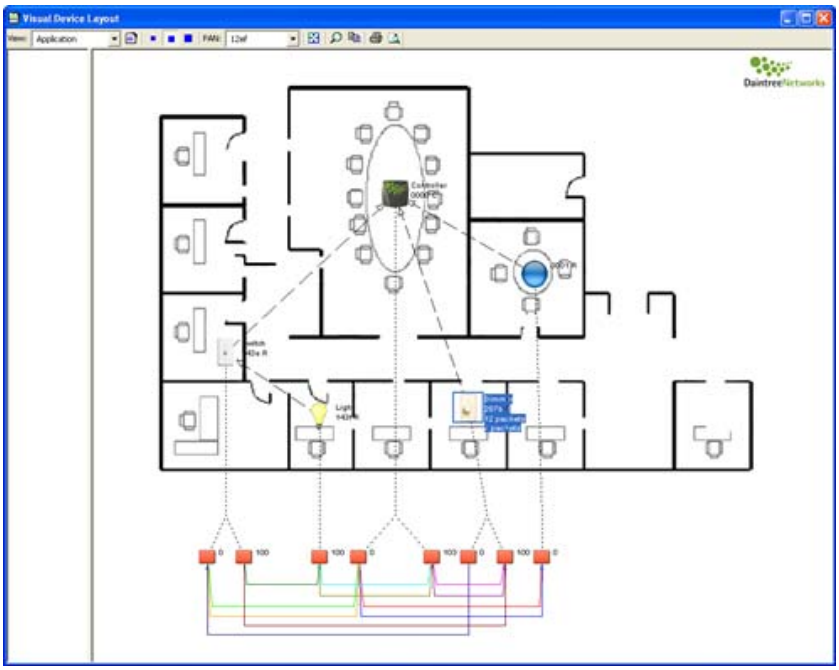
The device names and icons you add here are shown in both the Visual Device Tree and Visual Device Layout windows.

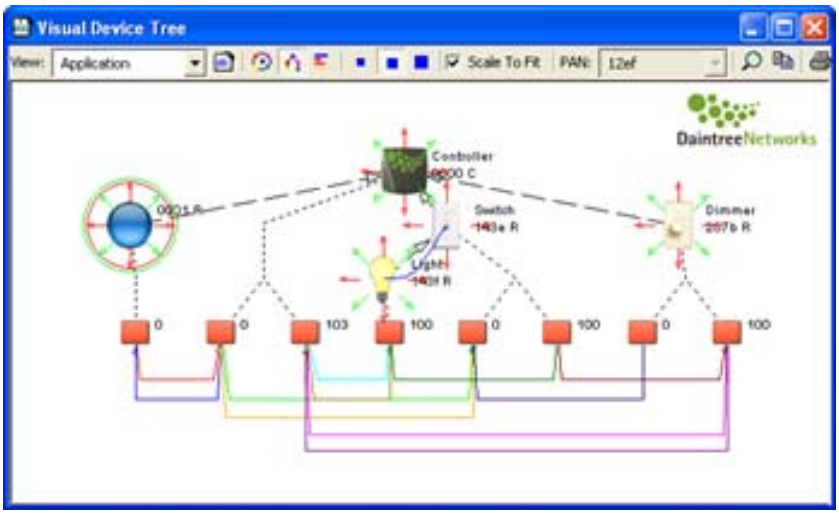
1. From the **Settings** menu, select **Device Manager**.



2. In the **User Label** column, type a name for each device. (Double-click devices in the Visual Device Layout window to quickly find their details in the Device Manager.)
3. In the **Image** column, click the ... button and select to **Browse Image**. Go to the **Sensor Network Analyzer/Graphics/DeviceIcons** directory, and select an image for each device. Or if you prefer, you can select your own bitmap images.

Notice how the device names and images you specify are updated in both the Visual Device Layout and Visual Device Tree windows.

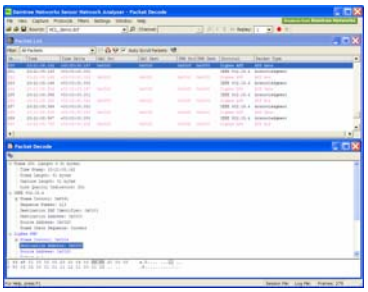




Playback with SNA Standard and Basic editions

If you open and run the **HA_demo.dcf** capture file (see page 9) using the Professional, Standard, and Basic editions, you'll notice some differences:





	Prof.	Stand.	Basic
Packet List, Packet Timeline & Packet Decode windows	✓	✓	✓
Maximum number of network nodes that can be shown in Visual Device Tree window	Capture system limit	10	Not supported
APS layer endpoints shown in Visual Device Tree window	✓		
Visual Device Layout window supported	✓		
Measurements window supported	✓		
Device Manager support to add and remove devices	✓	✓	✓
Full Device Manager support including commissioning and bindings	✓		
Live Capture support for single device	✓	✓	✓
Live Capture support for multiple devices and multiple channels	✓		
ZigBee Application Layer decodes (ZDO, HCL, etc.) supported	✓	✓	

You can find out more about the SNA software in the *Sensor Network Analyzer Online Help,* which is available from the SNA **Help** menu and the Windows **Start** menu.

You can find out more about purchasing the SNA enhanced editions (Professional and Standard) from www.daintree.net/purchase or by emailing sales@daintree.net.

Capturing live traffic

If you have a 2400E Sensor Network Adapter or other supported capture device, you can also capture traffic from a live network. The SNA supports the following capture devices:

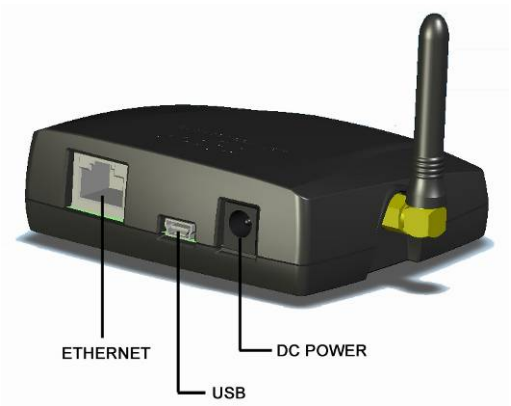
- Daintree Networks 2400E Sensor Network Adapter
- Third-party hardware components—see the **Read Me** file (in the **Sensor Network Analyzer/Docs** directory) for a complete list of supported vendors and hardware

The following instructions describe how to install and use the 2400E Sensor Network Adapter as a capture device. If you want to use a different capture device, refer to the instructions that came with that device. Further information, including application notes, is also available from the Daintree web site at www.daintree.net/support.

Connecting the 2400E Sensor Network Adapter

The 2400E can be connected to your system using either USB or Ethernet.

- When connected via USB, the 2400E draws its power from the USB connection, so the DC power connection is not required.
- When connected via Ethernet, the 2400E also requires to be connected to 9V DC power.



Connecting the 2400E via USB

1. Connect the 2400E to a USB port on the computer running the SNA software.
2. If this is the first time the 2400E has been connected, complete the steps in the **Found New Hardware** wizard:
   - The driver is located in the **Daintree Networks/Drivers/2400E** directory.
   - If you are presented with multiple drivers, choose the file called **ftd2xx.inf**.
   - Select to **Continue** if a message warns that the 2400E's software has not passed Windows Logo testing.

Once the 2400E is connected and its driver is installed, it is automatically added to the SNA's list of available capture devices. No additional configuration is required.

You are now ready to start capturing traffic.

Note: See the *Sensor Network Analyzer User Guide* for instructions on how to connect and use the 2400E via Ethernet (from the SNA **Help** menu, select **User Guide**).

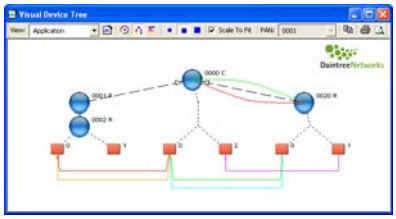
Starting and controlling a live capture

Once the 2400E is connected by either USB or Ethernet, you're ready to start capturing traffic.

1. Select the 2400E as the **Source** capture device. You can click  to get the SNA software to find all available capture devices and refresh the Source list.
2. Select the **Channel** on which you want to capture traffic. You can click  to get the SNA software to scan all available channels for details (see page 18).
3. Click  to start the capture. Measurements will automatically start when the capture starts.

   You can use the capture controls  to pause, stop, and restart Measurements multiple times within the capture session. Restarting Measurements clears all statistics from the Measurements window, and clears all routes and endpoint bindings from the Visual Device Tree. (Note that measurements and endpoint bindings are available in the Professional edition only.)

Visual Device Tree window



The Visual Device Tree (VDT) window shows details about the live network from which you are capturing data (in the same way as it did when you replayed a capture file).

It shows all devices that join the network **after** you begin capturing with the 2400E. Therefore, any devices that existed on the network before the capture began are not shown.

Using the SNA Professional edition, you can update the VDT window so that it shows all devices:

1. On the VDT window, right-click the 2400E, and then select **Active Device > Discover Network**. This causes the following to occur:
   - The SNA clears the VDT window and list of devices on the current channel and PAN.
   - The 2400E sends requests into the network to dynamically discover the network topology.
   - As devices are detected, the SNA updates the Visual Device Tree and Measurements windows, and shows the sequence of all packets transmitted and received in its Packet List.

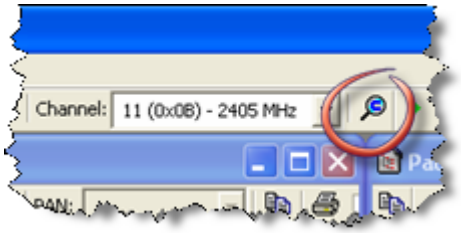
Note that the **Discover Network** option is available only for capture devices that also support "active" analysis (such as the Daintree 2400E). If the **Active Device** option is not available when you right-click your capture device, you must start the capture first (before any other devices join the network) if you want to view all devices in the Visual Device Tree window.

Note also that the SNA Standard edition shows a maximum of 10 devices in the VDT and does not show APS layer endpoints.

Channel scans

In addition to network discovery, you can also use the 2400E to perform a channel scan, which provides details about devices and activity on selected channels.

1. On the main SNA toolbar, click the Channel Scan icon.



2. Select to perform an **Active** scan, and then select the **Source** (2400E) and channels on which you want to perform the scan. You can use the and icons to quickly select or de-select all channels.
3. Click the **Scan** button to begin the channel scan. This causes the 2400E to send beacon requests on each selected channel, and then wait for a response from one or more devices.

   Each device that responds is listed in the table at the bottom of the Channel Scan dialog box, with details including PAN ID, Short Address on that PAN, detected LQI of the Beacon response, and whether or not the device is accepting associations.
4. Click a device in the table to select it. You can then click the **Capture** button to start capturing on that channel, or else the **Join** button to join the selected device (or PAN).

Note: The **Active Channel Scan** and **Join Device/Network** options are available only when using the SNA Professional edition with capture devices that also support "active" analysis (such as the Daintree 2400E). If these options are not available for your capture device, you can still perform a **Passive Channel Scan**, which shows details of all devices and activity detected on the selected channel(s) over a specified period of time.

Using the SNA's flexible decode engine

Release 3.0 (and newer) of the SNA provides the ability to decode most popular standards-based and proprietary protocols (in addition to ZigBee and IEEE 802.15.4).

Some network protocol definitions are available from Daintree (and their partners) including 6LoWPAN, SimpliciTI (from Texas Instruments) and Synkro (from Freescale). You can also create your own protocol definitions.

Decode details for each protocol stack and layer are stored as XML files in the SNA's Profiles directory. When the SNA first starts, it checks the Profiles directory to see which protocols are available. You can select any one of the available network protocols, and then customize the way in which decode details are shown.

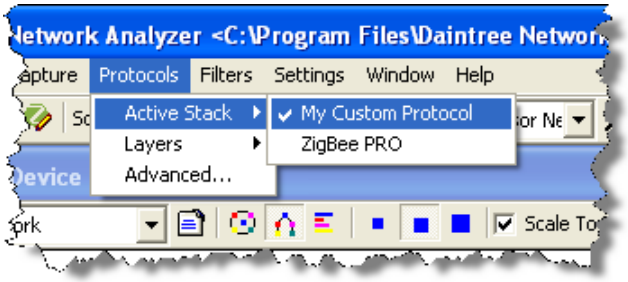
Decode details are shown in the SNA's Packet List, Packet Timeline and Packet Decode windows. The Visual Device Tree window shows a graphical representation of network activity for protocols that use IEEE 802.15.4 MAC Associations. The Measurements window shows performance measurements for ZigBee and IEEE 802.15.4.

Note that flexible decodes are available only in the Standard and Professional editions of the SNA.

Selecting the protocol stack and layers

Note that the selections you make are hierarchical, in that each selection determines what future options are available. For example, if you select the ZigBee PRO stack, only options that are applicable to ZigBee PRO are available.

1. From the **Protocols** menu, select **Active Stack**, and then select the protocol stack to use. The SNA lists all protocol stacks for which XML definition files exist in its Profiles directory.



2. From the **Protocols** menu, select **Layers**, and then select which layers of the selected protocol stack you want to decode.

   Note that because of the size and complexity of some protocol stacks, the **Layers** option lists only top-level layers (that is, those with children). You can use the **Advanced** option to select and de-select the child layers.

3. From the **Protocols** menu, select **Advanced** to open the Protocol Layers dialog box. Click the ⊞ markers or the **Expand All** button to view details for child layers (hidden by default).

   Select the layers you want to decode, and then click **OK** to save your selections.

   The SNA will immediately begin to use the stack and layers you have selected for the protocol decodes shown in its Packet List, Packet Timeline and Packet Decode windows, and for defining Filters.

Where to next?

Now that you've see how the basics work, you can start exploring the SNA to get an understanding of the full capabilities of this product.

The Introducing Daintree's SNA user guide (available from www.daintree.net/support/doco.php) takes you through the SNA's key features. You can also refer to the SNA's online help for detailed descriptions of all of the SNA's functionality (available from the SNA **Help** menu and the Windows **Start** menu).

The Daintree web site includes other useful information, such as

- www.daintree.net/support for FAQs, application notes, and other supporting information
- www.daintree.net/products for product information including data sheets and online tours
- www.daintree.net/resources for general information about the ZigBee and IEEE 802.15.4 technologies, including white papers and a glossary
- www.daintree.net/purchase to purchase Daintree products online
- www.daintree.net/contact to contact the Daintree sales or support teams

Index