

# Introducing Daintree's Sensor Network Analyzer



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## About this Introduction Guide

This guide is designed to help you get up and running with your Sensor Network Analyzer (SNA), and to become productive quickly.

If your version of the SNA software includes a 30-day trial of an enhanced edition of the software (Standard or Professional), you can also use this guide to help you evaluate the SNA software thoroughly.

This introduction guide covers the SNA's major features, and provides links to resources (including application notes and product demonstrations) where you can find additional details.

## Getting to know the SNA

1. Use the [SNA Quick Start Guide](#) to install the software and get up and running.
2. Use this introduction guide for a quick tour through the SNA's features and functionality, complete with links to product demonstrations and application notes.
3. Use the SNA's online help (available from the **Help** menu) to find greater detail about any of the features described in this guide.



There are many links from this guide to resources stored on [Daintree's web site](#). Therefore, this guide is designed to be used online with an **Internet connection** available.

Select from the features below to find out how the SNA can help you to achieve your goals:

	Standard	Professional
<a href="#">Capture and playback</a>	✓	✓
<a href="#">Network protocol analysis</a>	✓	✓
<a href="#">Visual network and application analysis</a>	✓	✓
<a href="#">ZigBee and 802.15.4 security</a>		✓
<a href="#">ZigBee performance measurements</a>		✓
<a href="#">"Active" analysis and commissioning</a>		✓
<a href="#">Live network monitoring and maintenance</a>	✓	✓
<a href="#">Advanced features</a>	✓	✓



You can find out more about the differences between the Professional, Standard and Basic editions of the SNA software by reviewing the [comparison matrix](#) on Daintree's web site.

## Capture and playback

	Standard	Professional
<a href="#">Support for third-party capture devices</a> (USB and Ethernet)	✓	✓
<a href="#">Scan channels for network activity</a>	✓	✓
<a href="#">Capture using a single device</a>	✓	✓
<a href="#">Capture using multiple devices (and channels)</a>		✓

### Support for third-party capture devices


Daintree's SNA supports an extensive range of third-party semiconductor development kits and boards as capture devices, including Texas Instruments, Ember, Freescale Semiconductor, Atmel, Integration Associates, Jennic, NEC Electronics, OKI, One RF Technology/Telit, and Renesas.



Visit [Daintree's web site](#) to find out more about supported partner kits and boards, and to download application notes that describe how to install and use capture hardware.

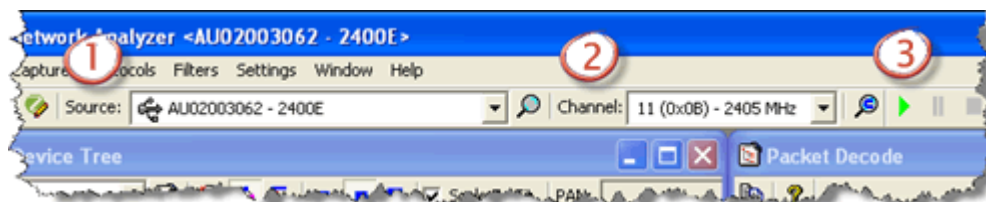
### Scanning channels for network activity


If you aren't sure which channel(s) you want to capture, you can perform a passive channel scan to see which channels are recording network activity.

1. Select the **Source** (capture device).
2. Click the  icon to open the Channel Scan dialog box.
3. Select the channel(s) on which to perform the passive scan, and the number of seconds to scan each selected channel.
4. Click **Scan**. When the scan is complete, the SNA lists all devices detected on each of the scanned channels.


### Capturing using a single device

Starting a simple capture (single device/single channel) is as easy as 1-2-3:



1. Select the **Source** (capture device).
2. Select the **Channel** on which to capture.
3. Click  to start the capture.

When the capture starts, the SNA's windows update to show all capture details in real-time.

Use the  capture controls to pause, stop and restart the capture.

Use the **File** menu to **Save**, **Open** and **Close** capture files.

## Capturing using multiple devices (and channels)

Being able to capture using multiple devices and multiple channels provides a number of benefits over the simple capture described above:

- Multi-channel captures, where each capture device can capture on a different channel, are ideal for capturing from multiple networks or from a single network that uses dynamic channel assignment or frequency agility.
- Multi-device captures, where multiple devices can capture simultaneously on the same channel, are ideal for dispersed networks where one or more devices may be outside the range of a single capture device, or to provide antenna diversity under conditions of marginal reception.



Download the [Multi-node and multi-channel capture with the SNA](#) application note for step-by-step instructions for performing both types of multi-capture.

## Network protocol analysis

	Standard	Professional
<a href="#">Decode packets to the field and byte level</a>	✓	✓
<a href="#">Filter packets</a>	✓	✓
<a href="#">Customize Packet List details</a>	✓	✓
<a href="#">Select different protocols to decode</a>	✓	✓
<a href="#">Add new protocol definitions</a>	✓	✓

The SNA's Packet List, Packet Timeline and Packet Decode windows provide a comprehensive protocol decoder for wireless embedded networks such as ZigBee, IEEE 802.15.4 and 6LoWPAN.



View the [Using the SNA's flexible decode engine](#) product demonstration for an overview of the SNA's protocol decoder including how to filter and customize packet details, and how to select which network protocol to decode.

## Decoding packets to the field and byte level

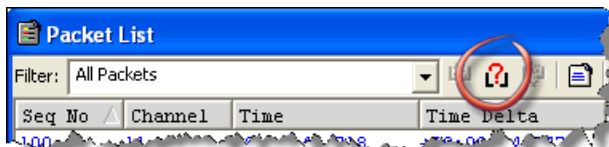
The SNA's Packet List, Packet Timeline and Packet Decode windows are correlated, in that if you select a packet in either the Packet List or Packet Timeline window, the same packet will be displayed in all three windows:


1. The **Packet List** window lists all received packets sequentially with summary information.
2. The **Packet Timeline** window shows packet events over time on a per-device basis.
3. The **Packet Decode** window displays the decoded structure of an individual packet (selected through either the Packet List or Packet Timeline window). At the bottom of this window is a Packet Data pane, which shows bytes in hexadecimal and ASCII.



## Filtering packets

Filters allow you to quickly locate packets of interest from among thousands (or tens of thousands). The SNA provides many pre-defined filters, or you can quickly create your own.



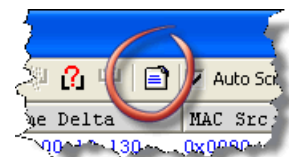
Select a filter from the **Filter** drop-down list, or click  to create a new filter. You can also right-click a field in the Packet Decode window, and then select **Add to Filter**.



Download the [Using filters with the SNA](#) application note for step-by-step instructions for creating and applying filters.

## Customizing Packet List details

You can customize the details shown in the Packet List window to show the information that is most relevant to you in a way that makes it easy to read and understand.



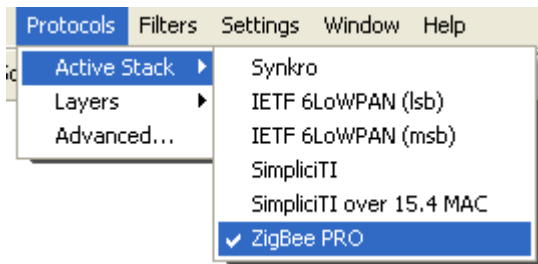
You can customize the Packet List details in the following ways:

- Select which fields to show/hide as columns.
- Select the order in which to display columns.
- Rename columns.
- Change the color of individual fields and entire layers (in both the Packet List and Packet Decode windows).

## Selecting different protocols to decode

With release 3.0 and newer, the SNA includes a flexible decode engine, which enables it to decode multiple standards-based and proprietary network protocols.


1. From the SNA's **Protocols** menu, select the **Active Stack** (network protocol) that you want to decode.
2. From the **Protocols** menu, select the **Layers** within the selected network protocol that you want to decode (if required).



The currently selected protocol is shown in the status bar at the bottom of the SNA's main window. The layers and filters available for selection are determined by the currently selected network protocol.

## Adding new protocol definitions

Some protocols are automatically installed with the SNA software. Others are available on request from Daintree Networks, and are provided as .exe files. You need to install these on your computer before they can be used:

1. Run the .exe file provided by Daintree Networks. This installs the protocol decode definition files in the SNA's Profiles directory.
2. Start the SNA to load the new definitions. Or if the SNA is already running, click the  (Reload) icon from the main SNA toolbar.



[Email Daintree](#) to find out more and request network protocol definitions files.

## Visual network and application analysis

	Standard	Professional
<a href="#">Visualize your network</a>	✓	✓
<a href="#">Get details about network devices</a>	✓	✓
<a href="#">Get details about routes</a>	✓	✓
<a href="#">Customize the visual display</a>	✓	✓
<a href="#">View devices on a floor plan</a>		✓
<a href="#">Get details about APS endpoints and bindings</a>		✓
<a href="#">Display performance measurements</a>		✓

### Visualizing your network

The Visual Device Tree (VDT) window provides a graphical representation of network topology and information flows between devices in a wireless embedded network. It automatically detects network formation, reports changes to the network structure, and notifies of the state of individual devices in the network (especially with regard to formation).

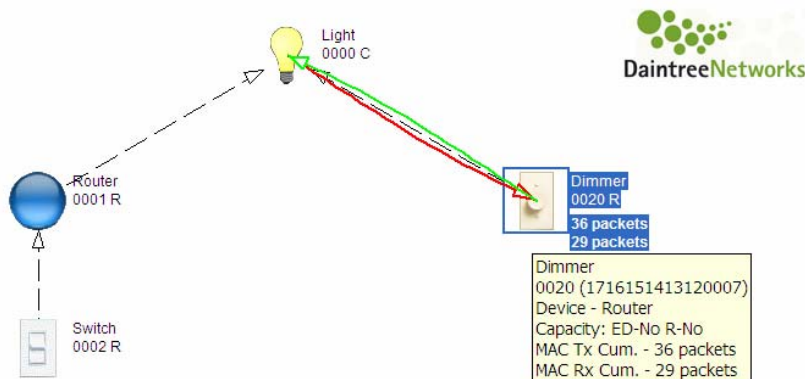


Download the [Visual network analysis using the SNA](#) application note for step-by-step instructions for using and customizing visualization options.

Note that visualization is supported for all protocols that use IEEE 802.15.4 MAC Associations. The SNA Standard edition can visualize a maximum of 10 devices, and the Professional edition can visualize up to the system limit.

### Getting details about network devices

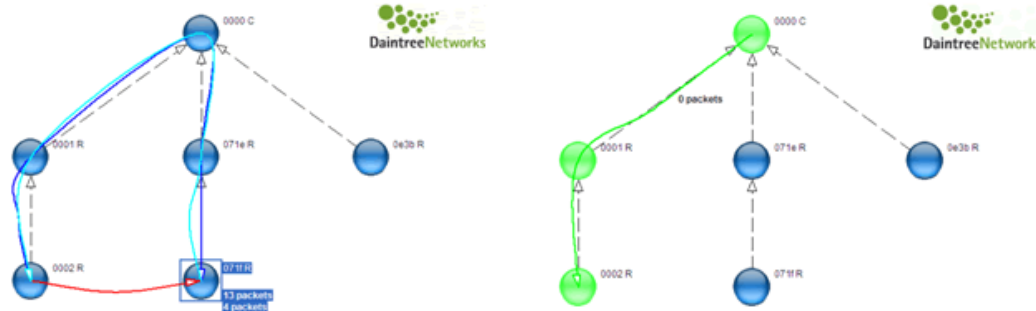
Select devices in the SNA's visual device windows (either by clicking or positioning the cursor over them) to display additional details including long address, device type and measurements.



## Getting details about routes

Routes are shown as a spline that intersects each device the route traverses, with an arrowhead showing the direction of the route.

Click a device to show only those routes that begin or end with that device. Or click a route spline to highlight all devices the route traverses.



## Customizing the visual display

You can select to view the visual device details in Tree, Radial or Text formats:



- **Tree** shows the coordinator at the top as the root of the tree. This layout is the most intuitive representation for small- and medium-sized networks.
- **Radial** draws the device tree with the coordinator in the middle and devices shown in a ring. This layout is the most efficient representation for larger networks. (The radial view is available only for the SNA Professional edition.)
- **Text** shows a tree-view of the network topology in text form. This layout provides topology information for multiple PANs, and within each PAN, the device hierarchy.

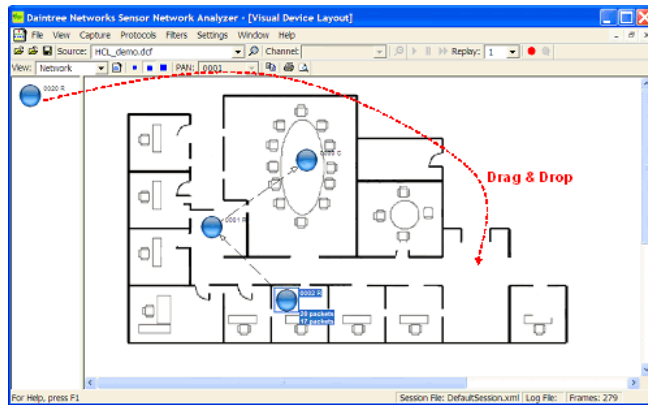
You can also customize the details shown in the visual device windows:

- From the SNA's **Settings** menu, select **Visual Options**. You can then specify settings including the following:
  - Show or hide long address, health, measurements and type for devices.
  - Show or hide route measurements and unicast, broadcast and failed/malformed routes.
  - Show or hide associations between devices, and if you select to show them, specify the format (e.g. color, width) in which to show them.
  - Show or hide ZDO endpoints and bindings.
  - See the **SNA's online help** for a complete list of the options you can set.

## Viewing devices on a floor plan

The SNA Professional edition provides an alternative view to the VDT, the Visual Device Layout (VDL) window, which allows you to overlay your devices on a floor plan or other image.

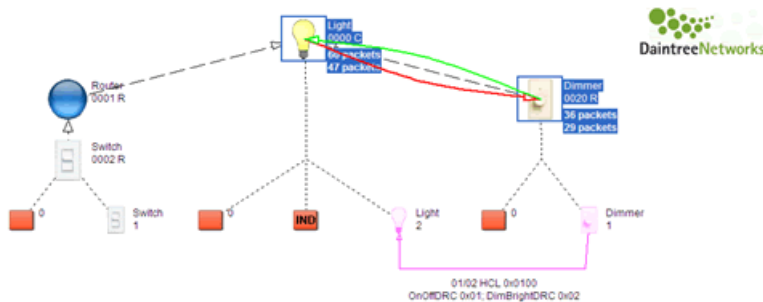
1. From the **View** menu, select **Visual Device Layout**.
2. From the **Settings** menu, select **Visual Options**, and then select the image to display.
3. Drag and drop devices on to the image as required to best represent your network.



## Getting details about APS endpoints and bindings

The SNA Professional edition shows APS endpoints along the bottom of the visual device windows, with bindings represented by a line linking two endpoints.

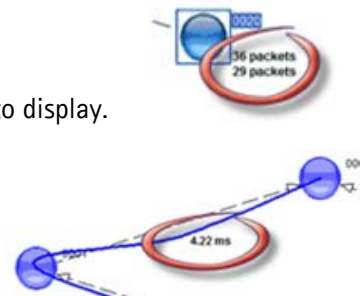
You can view additional information about endpoints and bindings by selecting them in the same way as routes and devices.



## Displaying performance measurements

With the SNA Professional edition, you can select to show or hide measurements for individual devices and for routes in the visual device windows.

1. From the **Settings** menu, select **Visual Options**.
2. Select the **Devices** tab, and then select up to two measurements to display.
3. Select the **Routes** tab, and then select one measurement to display.
4. Click **OK** to save your settings.



## ZigBee and 802.15.4 security

	Standard	Professional
<a href="#">Decrypt packets at Network and Application layer</a>	✓	✓
<a href="#">Auto-detect security keys</a>		✓
<a href="#">Implement security on live networks</a>		✓

### Decrypting packets at the Network and Application layer

The SNA can decrypt packets at the Network and Application layer when it knows the security key used to encrypt data, and then display details in its protocol decoder windows:

- Packets that are successfully decrypted are shown in the **Packet List** in clear text, post decryption.
- The **Packet Decode** window decodes the contents of the decrypted packet (in clear text after decryption). Additional security headers and trailers added to the encrypted packet, such as the Auxiliary Header and MIC field, are left in place and decoded.

### Auto-detecting security keys

The SNA Professional edition can automatically discover security keys, which it stores in its Security Key database.

- **Network Keys** are often shared over-the-air between a parent or trust center and a new device on the network using Transport-Key messages. The SNA can automatically discover, store and use these keys.
- **Link Keys** can be generated when the SNA captures SKKE-1 and SKKE-2 APS Command messages between two devices. Note that to generate a Link Key using this method, the Security Key database must contain a Master Key for the two devices. This Master Key can be either manually entered by the user, or automatically detected from a Key Transport message.



Download the [Implementing ZigBee Key Establishment Security with the SNA](#) application note for instructions on how to passively sniff traffic using Network and Link Keys (see page 10).

### Implementing security on live networks

Use the SNA Professional edition and a device capable of ["active" analysis](#) to start and join secured networks. You can validate the security algorithm of your device.



Download the [Implementing ZigBee Key Establishment Security with the SNA](#) application note for step-by-step instructions for starting, joining and re-joining networks that use Key Establishment security.

## ZigBee performance measurements

	Standard	Professional
<a href="#">Select which measurements to view</a>		✓
<a href="#">Filter measurement details</a>		✓
<a href="#">Correlate the Measurements and VDT windows</a>		✓

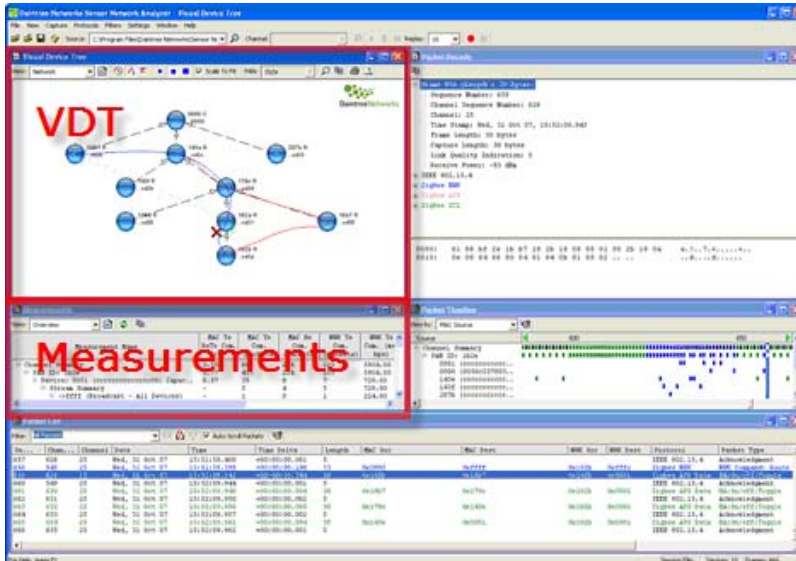
The SNA Professional edition provides a ZigBee performance analysis system. Use this to help ensure that your network meets necessary performance requirements.



Download the [Using measurements with the SNA](#) application note for step-by-step instructions for using the SNA's measurement system, plus a description of all available measurements.

### Selecting which measurements to view

Measurement details are shown on the dedicated Measurements window and also the Visual Device Tree (VDT) and Visual Device Layout (VDL) windows.



Selecting measurements to view in the visual device windows is [described previously](#) in this guide.

You can also select which measurements to show in the more detailed Measurements window:

1. From the SNA's **Settings** menu, select **Measurement Options**.
2. Use the tabs across the top of the Measurements Options dialog box to select the layers for which you want to customize measurements. (See the SNA's online help for instructions.)
3. Click **OK** to save and apply your settings.

## Filtering measurement details

You can apply filters to make measurements of interest easier to find:

1. On the Measurements window, right-click the measurement for which you want to create the filter, and select **Filter**.
2. Use the right-click context menu to select the filter you want to apply. The context menu options differ depending on the type of item you selected. (See the online help for details.)

The filter you select applies to not only the Measurements window, but also to the Packet List and Packet Timeline windows.

## Correlating the Measurements and VDT and VDL windows

You can select any device, route or binding within the Measurement window, and quickly locate it on the VDT or VDL:

1. Right-click the device, route or binding you want to locate, and select **Select Visual**.
2. Select to locate the item in either the Visual Device **Tree** or Visual Device **Layout** window.

## "Active" analysis and commissioning

	Standard	Professional
<a href="#">Actively scan channels</a>		✓
<a href="#">Start a network</a>		✓
<a href="#">Join a network</a>		✓
<a href="#">Discover network structure and measurements</a>		✓
<a href="#">Configure and commission devices</a>		✓
<a href="#">Add bindings (including service discovery)</a>		✓

The SNA Professional edition can enable Daintree's 2400E Sensor Network Adapter, Ember's EM250, and Integration's ZigBee Dongle to perform not only passive capture and analysis, but also to start or join a ZigBee network, and then to **actively** request information from and send commands to other devices on that network.



Download the ["Active" analysis and configuration using the SNA](#) application note for more information about active analysis and the features listed below.

## Actively scanning channels

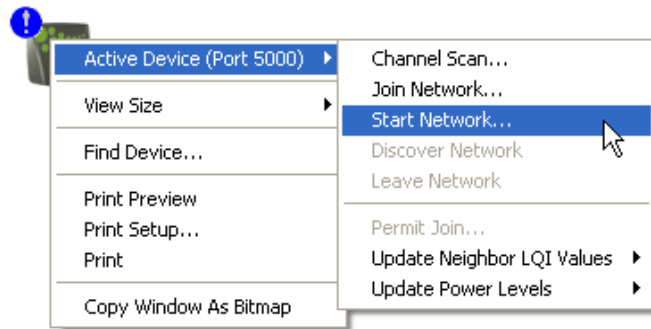
In addition to [passive scans](#) (described previously), the SNA Professional edition supports the following types of scans:

- **Active:** The active device sends three beacon requests on each selected channel, and then waits for a response from one or more devices. Each device that responds to the beacon request is listed with details including PAN ID, Short Address on that PAN, the detected LQI of the Beacon response, and whether or not the Beacon Payload indicates that the device is accepting associations.
- **Energy Detect:** Shows the ambient energy level (in dBm) detected on each channel. Channels with low energy levels are more suitable for starting a new network, indicating low levels of interference and the unlikely presence of other networks.

## Starting a network

You can start a new network using any active device as its coordinator.

1. Right-click the active device on the VDT, and then select **Active Device > Start Network**.



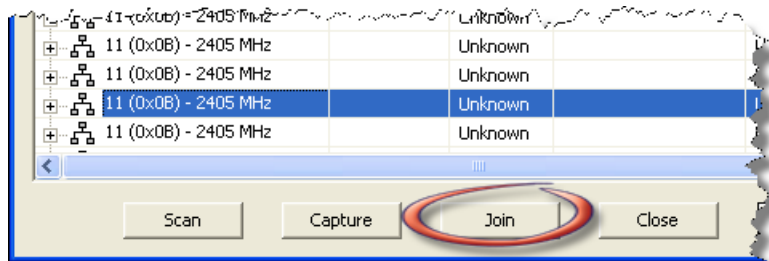
2. Specify the settings you want to use for your new network including channel, EPID, protocol version, stack profile and security. (See the online help for details.)

When the network starts, all SNA windows are updated to show details of the new network.

## Joining a network

There are two ways to join a network:

- After performing a channel scan, you can click a device to select it, and then click the **Join** button to join the selected network.



- On the VDT, right-click the active device, and then select **Active Device > Join Network** and specify settings for the network you want to join.

## Discovering network structure and measurements

After starting or joining a network, you can actively discover information about that network to display on the VDT window,

- Right-click the active device on the VDT, and then select **Active Device** to access the following options:
  - **Discover Network** to discover the structure of a network that has already formed, and update the VDT to show the network topology.
  - **Update Neighbor LQI Values** to discover the Neighbor Link Quality Indicator (LQI) values for an individual device or the entire network, and then display those values on the VDT.
  - **Update Power Levels** to discover the battery or power levels for an individual device or the entire network, and then display those values on the VDT.

## Configuring and commissioning devices

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.



View the [Start-up commissioning](#) product demonstration for an overview of commissioning and the SNA's commissioning functionality.



Download the [Start-up commissioning using the SNA](#) application note for step-by-step instructions on how to commission devices.

## Adding bindings (including service discovery)

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).

Start by using the SNA to perform a service discovery, during which it finds and displays details about each device's capabilities including endpoint details, application profile ID, and output and input clusters.

You can then create bindings between endpoints that use the same application profile and have associated output/input clusters. The SNA allows you to create and manage bindings for individual devices and for groups of devices.



Download the [Binding and group commissioning using the SNA](#) application note for step-by-step instructions for performing a service discovery and creating bindings.

## Live network monitoring and maintenance

	Standard	Professional
<a href="#">Monitor and troubleshoot</a>	✓	✓
<a href="#">Upgrade firmware over-the-air</a>		✓
<a href="#">Locate devices</a>		✓

### Monitoring and troubleshooting

You can use the SNA to passively monitor networks. The protocol analyzer and visualization tools help to quickly identify and locate problems (and potential problems).

Using the SNA Professional edition with a device capable of [active analysis](#), you can join the network and actively poll devices to obtain information not available through passive sniffing alone.

### Upgrading firmware over-the-air

The SNA Professional edition allows you to upgrade the firmware on single or multiple devices over-the-air (rather than having to physically update each individual device). This can help to save time and reduce errors (such as some devices being forgotten or not correctly updated).

This functionality is supported for Texas Instruments SoC solutions that include the OAD (Over the Air Download) Flash Board 1.0.



Download the [Upgrading firmware over-the-air using TI's SoC and the SNA](#) application note for step-by-step instructions for performing an over-the-air upgrade.

### Locating devices

Locationing allows you to find the position of devices whose whereabouts is unknown or subject to change.

The SNA Professional edition provides ZigBee locationing support for the Texas Instruments CC2431 location engine.



View the [Device locationing](#) product demonstration for an overview of locationing using the TI location engine.



Download the [Locating ZigBee nodes using TI's SoC and the SNA](#) application note for background information and instructions for device locationing.

## Advanced features

	Standard	Professional
<a href="#">Define custom protocols and profiles</a>	✓	✓
<a href="#">Log traffic for offline analysis</a>	✓	✓
<a href="#">Use the Command Line Interface (CLI)</a>	✓	✓
<a href="#">Use the Application Program Interface (API)</a>		✓

### Defining custom protocols and profiles

All ZigBee public application profiles, and some network protocols (including ZigBee PRO and 6LoWPAN) are included standard with the SNA. Additional network protocols are available on request from Daintree Networks.

You can also create your own XML-based network protocol and application profile definitions and copy them to the Profiles directory.



[Email Daintree](#) to find out more or if you require any assistance with creating network protocol definitions or private ZigBee application profile definitions.

### Logging traffic for offline analysis

You can write all network activity to a log file, which can be analyzed offline at a later time.

When enabled, logging runs in the background, automatically saving all incoming packets to file as they are received.

1. From the SNA's **Settings** menu, select **Options**.
2. On the Log File tab, select **Enable Logging**.
3. Specify all logging options (see the online help for details), and then click **OK**.

### Using the Command Line Interface (CLI)

The SNA provides a set of command line options that allow you to run the most common operations without using the graphical user interface including the following:

- Capture
- Decode
- Filter

You can display an online summary (including syntax) of CLI commands by typing the following:

```
> sna -h
```

## Using the Application Profile Interface (API)

The SNA Professional edition provides an XML-based string over TCP/IP socket API (Application Program Interface) to send and receive commands over-the-air using Daintree's 2400E Sensor Network Adapter.

Using a combination of the SNA, an active device and the API, you can allow you to quickly prototype, test and validate.



Download the [Testing and Validating Smart Energy Devices using the SNA](#) application note for an example of how the API can be used.



The **SNA API Reference Guide** provides detailed information about the API. It is available from the SNA's documentation folder (from the Windows **Start** menu, select **Daintree Networks > Documentation**).

## Find out more about the SNA

Refer to the following to find out more about Daintree's Sensor Network Analyzer.

### Product documentation

The following documents are available from the SNA's **Help** menu:

- **Quick Start Guide** – Installation and configuration instructions for the SNA software and 2400E Sensor Network Adapter hardware, followed by a quick tour to get you started.
- **Online Help** – Detailed operating instructions covering all SNA functionality.
- **API Reference Guide** – Descriptions and examples for all available API commands.

### Support tools

The following resources are available from [Daintree's web site](#):

- [Quick Reference](#) – A one-page overview showing how to access the SNA's main features.
- [Frequently Asked Questions](#) – Get answers to questions about a range of topics including installation, licensing, protocol decodes, visualization and security.
- [Application Notes](#) – Get general information about how to use the SNA for a specific purpose, plus configuration information and usage instructions to assist with using third-party capture devices.
- [Glossary of Terms](#) – Find definitions for terms or acronyms.
- [Technology Resources](#) – Find out more about the network protocols and technologies supported by the SNA, with resources including white papers, primers and links to industry standards.