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Demo Platform for Wireless Sensor Network. EV-ADRN-WSN-1Z

FEATURES

Plug and Play Wireless Sensor Network
Compatible with ADuCRF101 platform
Compatible with ADF7024 platform
Several Sensor Types supported
Runs ADRadioNET wireless communications protocol
RoHS compliant

GENERAL DESCRIPTION

The Wireless Sensor Network (WSN) demo platform is a flexible, modular system for evaluating all aspects of a WSN. It offers both an out-of-the-box demonstration system, and can also be used as a development platform. It contains all of the hardware and software necessary to implement a plug-and-play WSN. It comes with one CenterPoint node and two End Nodes that have been pre-configured to communicate with each other.

The End Nodes are compatible with several sensor types. Once connected, the sensor data will begin streaming to the CenterPoint.

The software tools allow configuration and evaluation of the network. The CenterPoint GUI tool offers a host of node and network evaluation tools. These allow the user to see all of the data streaming from the nodes, and lots of other useful data about the node and the network performance.

The ANodeConfig tool allows the network to be reconfigured for different data rates, sleep times etc. through an intuitive GUI, so that no code writing is necessary.

SYSTEM BLOCK DIAGRAM

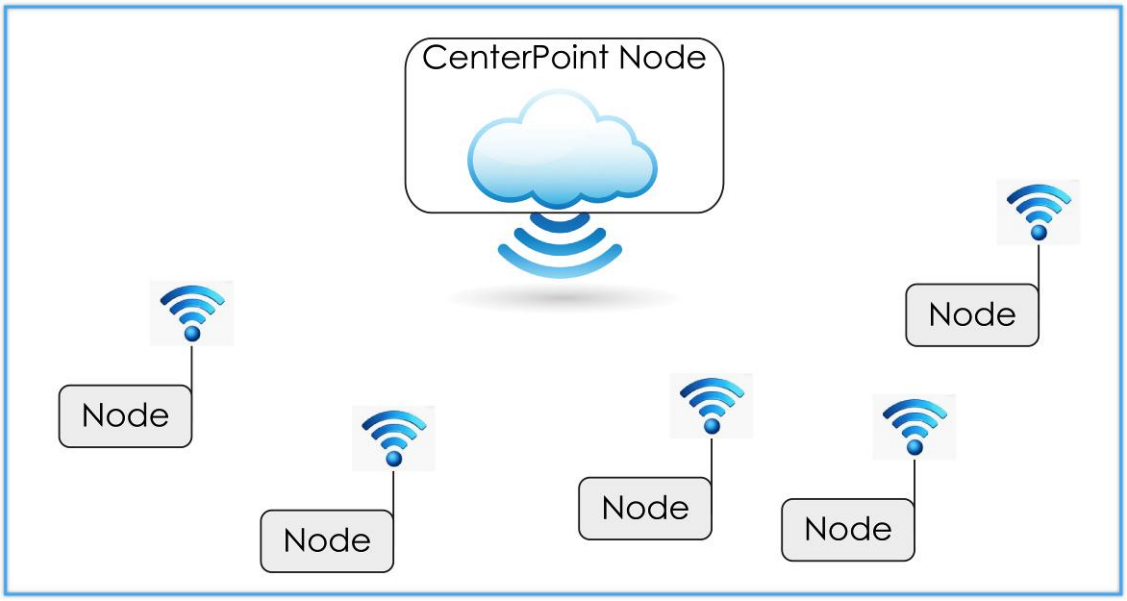

Figure 1. System Block Diagram

TABLE OF CONTENTS

REVISION HISTORY

9/12—Revision 0: Initial Version

QUICK START GUIDE

This section explains how to connect everything together to get the network up and running. Alternatively, there is a video tutorial included in the software CD that outlines these steps.

1. Install the software package that is located in the "Start Here" folder of the USB memory stick . As part of this Install package, the ANodeCenterPoint GUI will be installed.

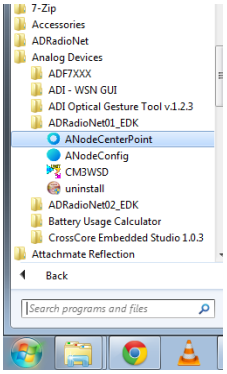

Figure 2. ANodeCenterPoint GUI

2. Basestation setup. Connect an antenna to J4 of the basestation node. Connect J3 of the basestation node to J2 of the USB interface board. Connect the USB interface board to the pc using the USB cable provided. (If the pc pops up a message to say it is installing device driver software, wait until that is complete before moving to the next step).

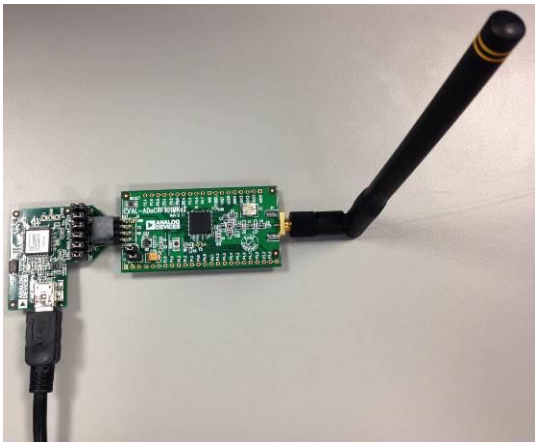

Figure 3. Basestation Setup

6. On the WSN GUI, once a node has been powered up, raw data will appear in the large window of the GUI.

3. Run the WSN GUI. Click the "Find Devices" button at the top. A "Searching" message will briefly appear. A CenterPoint node will be found.

4. Click on this node. Some details will appear in the Device Details window.

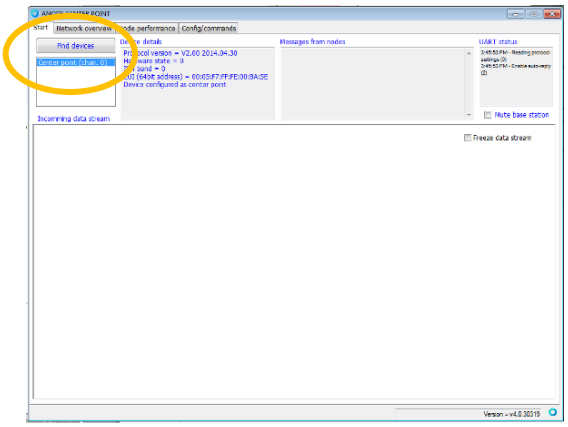

Figure 4. CenterPoint GUI

5. Bunch WSN Node setup: Connect a jumper into position LK2 C .

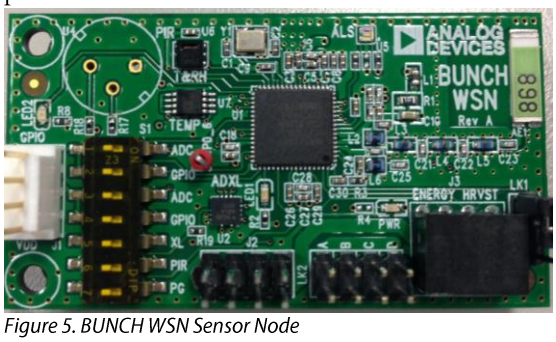

Figure 5. BUNCH WSN Sensor Node

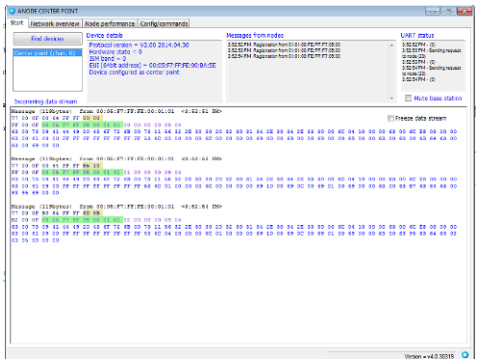

Figure 9. Raw Data Appearing

7. Data will appear in the Network Overview tab. The sensor data will then start streaming in from each node at regular intervals.

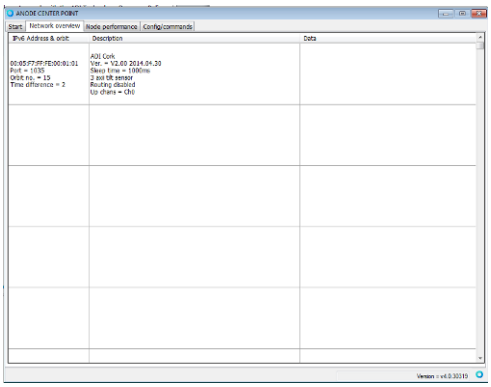

Figure 10. Data Streaming

8. Repeat steps 4 & 5 for any additional node. Each node will appear in its own row of the Network Overview Window of the GUI.

EVALUATION BOARD HARDWARE

OVERVIEW

The WSN platform is modular and flexible. This allows the user to connect different combinations of sensors, and design a customized network of sensors in a very short time. The hardware comes pre-programmed, so that it works out of the box without any programming necessary by the user.

SCHEMATICS

For schematics and layout files, see separate documentation included with the evaluation kit, or go to wiki.analog.com/wsn

RF101 MINIKIT

The ADuCRF101 minikit board consists of the ADuCRF101 , with a programming interface (J3), and an RF antenna (J4). This board is used as the Centerpoint node (also known as Basestation node, Collector Node, Gateway node)

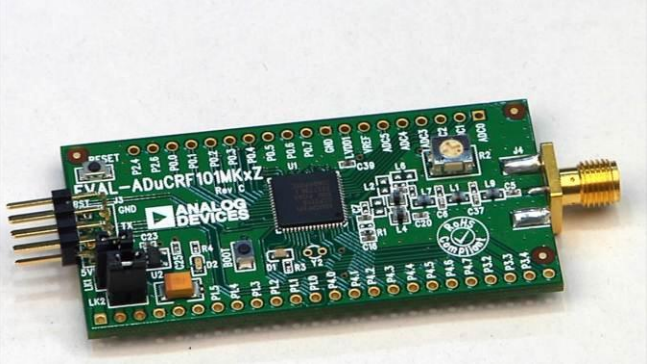

Figure 11. RF101 Minikit

BUNCH WSN BOARDS

The BUNCH WSN board is compatible with the WSN platform also. It comes with the following on-board sensors: ADXL362 accelerometer, ADT75 temperature, Panasonic PIR sensor, Avago Ambient Light Sensor. It also has a 4-pin connector for connecting to a GPIO. It can also be powered in several ways, allowing the ability to evaluate energy harvesting and battery technologies.

The kit comes with 2 of these boards. One board is configured to send accelerometer data from the ADXL362. The other is configured to send humidity and temperature data from the SHT21.

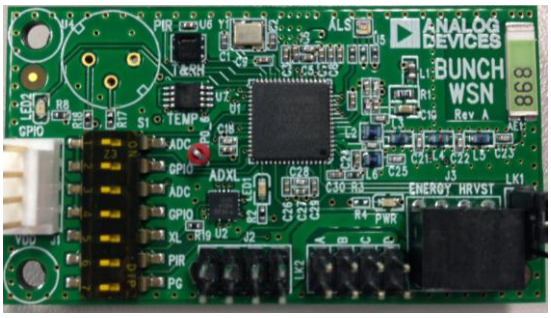

Figure 12. BUNCH WSN Board.

TINY WSN BOARDS

The Tiny WSN board is compatible with the WSN platform also. It comes with the on-board ADXL362 accelerometer.

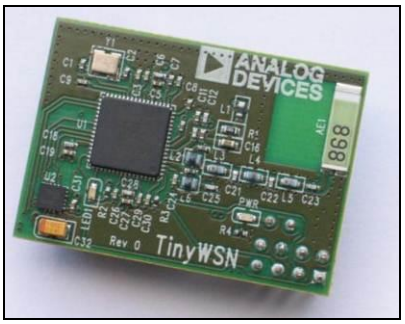

Figure 13. TinyWSN board.

POWERING THE NODES

There are several methods to power the nodes. A CR2032 coin cell battery comes with every board. The nodes can also be powered using external power sources, using the UART/USB board. It is advised to remove the links when the nodes are not in use. This saves the battery.

Board	Power Source	Connector	Connect Link
BUNCH WSN	CR2032 Battery	None	LK2 Position C
BUNCH WSN	USB	J2	None
BUNCH WSN	Energy Harvesting	J3	LK2 Position D
TinyWSN	CR2032 Battery	None	LK1
TinyWSN	USB	J1	None
NEST WSN	CR2032 Battery	None	LK2 Position B
NEST WSN	USB	J1	LK2 Position A LK2 Position B

Table 1. Powering the sensor nodes

POWER MANAGEMENT OF THE NODES

When using the node, there are different options for power management. These include the ability to use or bypass an LDO, and to include or exclude a supercap in the design. See schematics for more details.

Board	Description	Connect Links
BUNCH WSN	Power Node directly from battery (bypass ADP160 LDO)	LK2 Position C
BUNCH WSN	Power Node from battery through ADP160 LDO	LK1 Position A LK2 Position A LK2 Position B
BUNCH WSN	Power Node directly from Energy Harvesting J3 connector (bypass ADP160 LDO)	LK2 Position D
BUNCH WSN	Power Node from Energy Harvesting J3 connector through ADP160 LDO	LK1 Position B LK2 Position A LK2 Position B

Table 2. Power Management of Sensor Nodes

GUI

OVERVIEW

The WSN GUI consists of two separate programs.

1. The CenterPoint GUI is used to observe and analyze the data that is being sent over the network
2. The ANode Config GUI is used to reconfigure parameters such as RF Frequency, data rate etc. The nodes have been pre-programmed, so the ANode Config GUI is not needed initially.

Note: Nodes cannot be connected to both the ANode Config & ANode CenterPoint tools at the same time. Do not run both GUIs at the same time.

CENTERPOINT GUI

To get the GUI up and running, follow this procedure.

1. Connect a basestation node to the PC, as shown above in the section called Setting Up the Network.
2. Run the GUI.
3. Click on the "Find Devices" If a basestation node is correctly connected, then a message appears saying that a device has been found

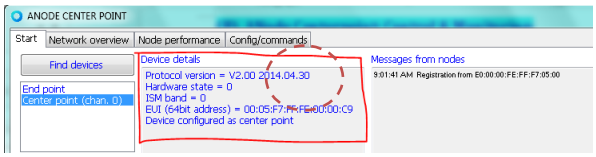

Figure 14. Starting the CenterPoint GUI

4. Power up one of the End Nodes. It should self-register on the network, and appear in the GUI, in the Network Overview tab. Each node that joins the network will be populated on a new row. Here 2 nodes can be seen:

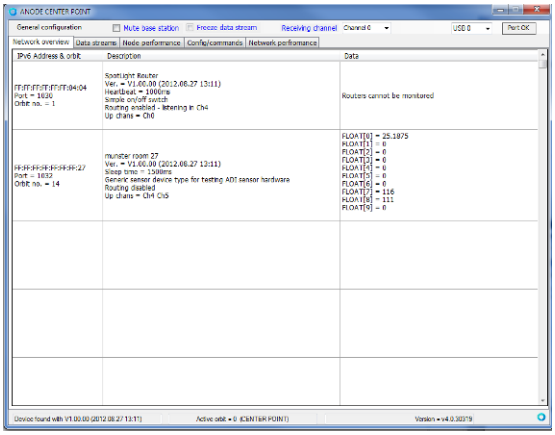

Figure 15. CenterPoint GUI with2 nodes registered

The first column of the Network Overview tab gives details of the node's IP address. The Description column gives more details about the node's name, sleep time, and the channel it is sending data upstream. The Data column shows data that the node is sending upstream.

The Node Performance Tab shows more statistical data about the network performance of each node.

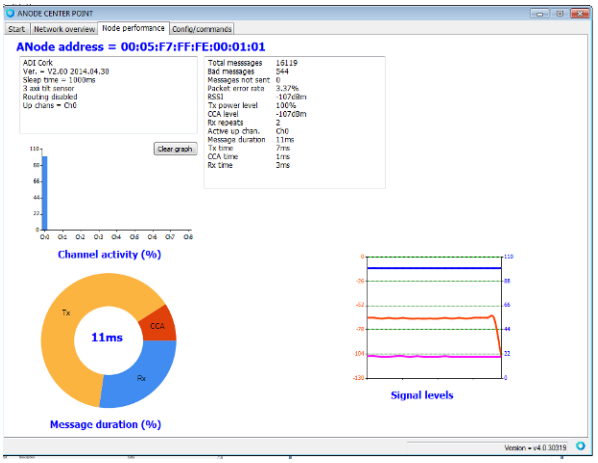

Figure 16. Node Performance Tab

It is possible to perform 2-way communication in the network. This is performed using the Config/Commands Tab of the GUI.

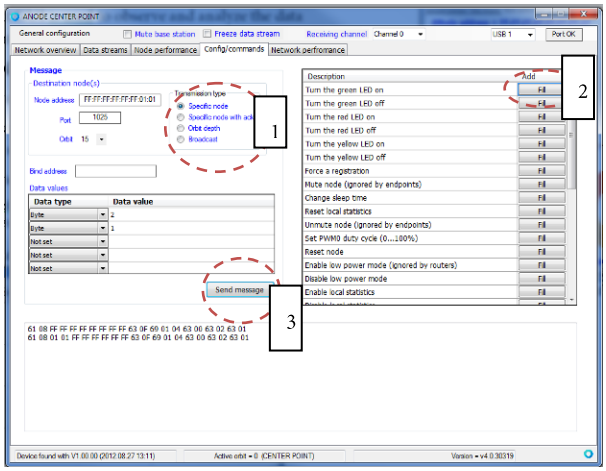

Figure 17. Config / Commands Tab

1. Click on Specific node or Broadcast button
2. Click on the "Fill" button for the "Turn the Green LED on" line.
3. Click "Send Message" button.
4. Check the node, to see if the Green LED has been turned on. If you clicked on the Broadcast button, then all nodes should have their Green LED turned on.

Another useful tool here is to dynamically change the sleep time of a node.

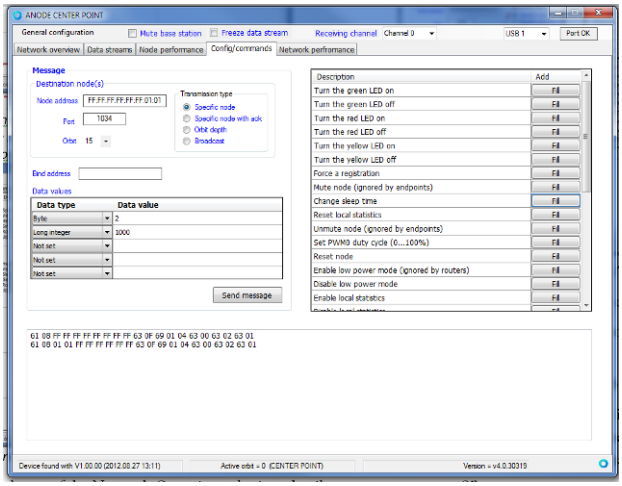

Figure 18. Config / Commands Tab

1. Click on Specific node
2. Click on the “Fill” button for the “Change Sleep Time” line.
3. The Long Integer Data Value can be changed. The value entered here is the sleep time in msecs. So changing this value to 2500 will change the sleep time to 2.5 seconds.
4. Click “Send Message” button.
5. Check the Node Performance tab, to see if the data is now coming in at the new rate. If 2.5 seconds was set as the sleep time, then the total messages value should be incrementing every 2.5 seconds.

ANODE CONFIG GUI

This GUI is used to configure or reconfigure MAC and PHY layer settings of any node in the network. Since each node is pre-programmed, this is not necessary when getting the system up and running, it is only needed for advanced development.

Note: A node cannot be connected to both the ANode Config & ANode CenterPoint tools at the same time. In other words, when connecting a node to one of the tool, ensure that the same is not connected to the other tool.

To get the GUI up and running, follow this procedure.

1. Connect a node to the PC, as shown above in the section called Setting Up the Network.
2. Run the ANodeConfig GUI tool from the "Start→ All Programs →Analog Devices →ADRadioNet01_EDK" folder.
3. Click on the "Find Devices" button as shown below. (Initially it shows "No devices" for a short duration.)

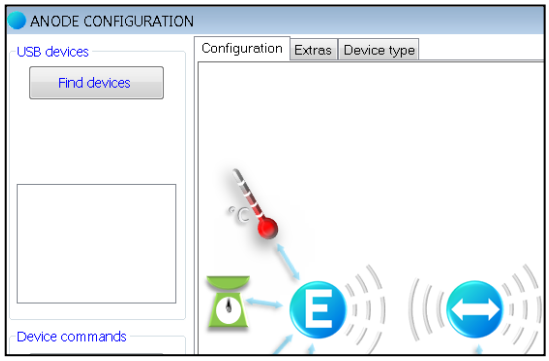

Figure 19. Starting the ANODE Config GUI

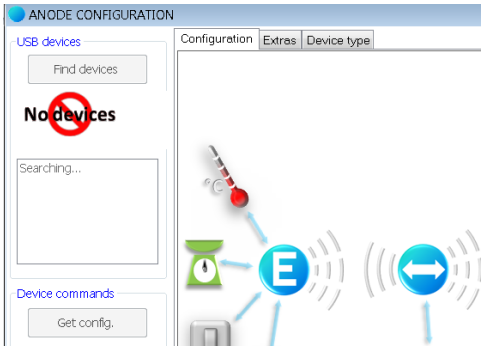

Figure 20

If this status is not changing from "No devices", then reset the device using RESET button.

In few moments, upon detecting the devices, the following update is seen. (In the following example, the device is "Not configured" yet although the firmware is loaded)

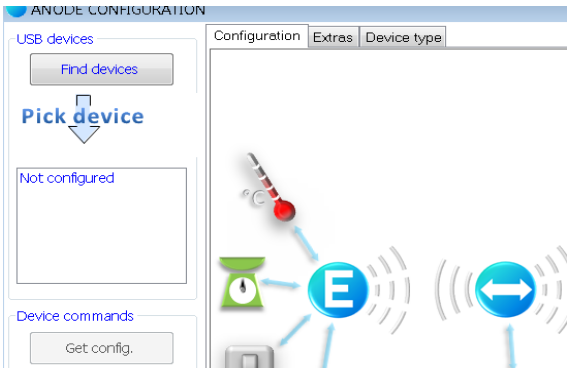

Figure 21

Click on the "Not Configured" device to pick the device to configure.

Choose the "Node function" you wish the node to have

Once chosen, the main interface window will appear. The image below shows the config window for an End Node

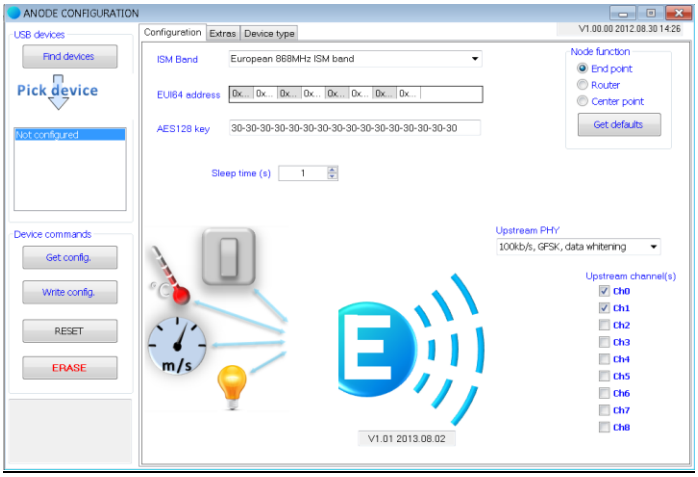

Figure 22.

CONFIGURING A CENTERPOINT NODE

Select the Node function as “Center Point”.

Click on “Get defaults”.

Choose ISM band (as European 868MHz ISM band).

Enter a valid MAC Address (as shown in picture below).

Choose PAN ID. (*or leave it as default*)

Choose data rate from “Downstream PHY” dropdown menu.

Choose Channel from “Downstream Channel” dropdown menu.

Under “Options” tab, choose “Enabled auto Tx Power” and other additional parameters.

Under “Device type”, add Device description.

Now, click on “Write Config”.

User can reset the device and check the settings by clicking “Get Config”, or close the tool, give hardware reset to the board, and restart the tool to check the configuration.

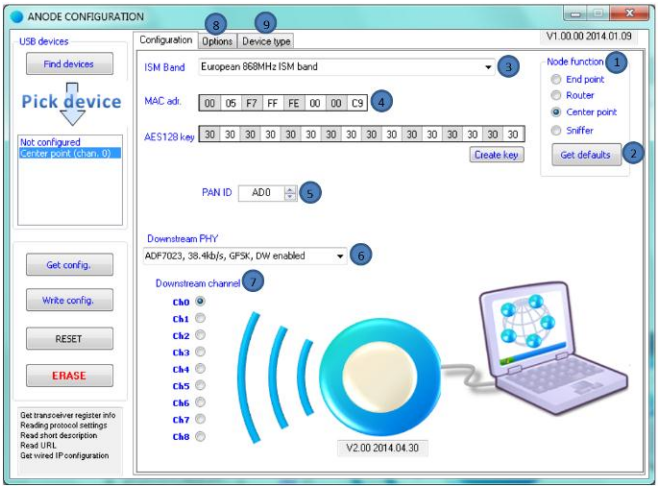

Figure 23

Hint: Make sure that the down-channel frequency & data rate matches with the up-channel frequency of the routers in the upper orbit, in order for the communication to happen.

CONFIGURING A ROUTER NODE

Select the Node function as “Router”. Click on “Get defaults”.

Choose ISM band (as European 868MHz ISM band).

Enter a valid MAC Address (as shown in picture below).

Select the Heartbeat in seconds (keep alive message interval to CP. Keep this value around 30sec/1min).

Select orbit as between 1 and 14.

Choose Down-Channel data rate (should be same as the up-channel data rate of router/end point in the upper orbits) from Downstream PHY dropdown box.

Select the Down-channel (should be same as the up-channel of router/end point in the upper orbits) from the given 9 channels under Downstream channel.

Choose Up-Channel data rate (should be same as the down-channel data rate of router/Center point in the upper orbits) from Upstream PHY dropdown box.

Select the up-channel (should be same as the down-channel of router/Center point in the upper orbits) from the given 9 channels under Upstream channel(s).

Under “Options” tab, choose “Enabled auto Tx Power” and other additional parameters.

Under “Device type” tab, update “Device description".

Now, click on “Write Config”.

User can reset the device and check the settings by clicking “Get Config”, or close the tool, give hardware reset to the board, and restart the tool to check the configuration.

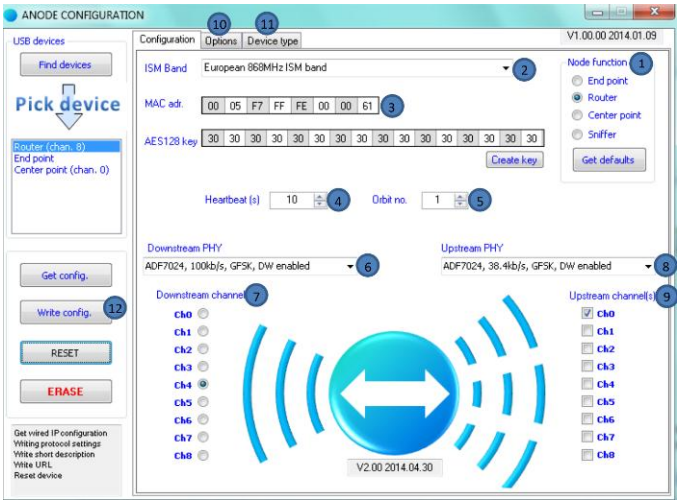

Figure 24

CONFIGURING AN ENDPOINT NODE

Select the Node function as “End point”.

Click on “Get defaults”.

Choose ISM band (as European 868MHz ISM band).

Enter a valid MAC Address (as shown in picture below).

Choose Up-Channel data rate (should be same as the down-channel data rate of router/Center point in the upper orbits) from dropdown.

Select the up-channel (should be same as the down-channel of router/Center point in the upper orbits) from the given 9 channels.

Select the “Sleep time” in seconds (device sleep interval, say 3 seconds).

Under “Options” tab, choose “Enabled auto Tx Power” and other additional parameters.

Under “Device type” tab, Enter Device description.

Now, click on “Write Config”.

User can reset the device and check the settings by clicking “Get Config”, or close the tool, give hardware reset to the board, and restart the tool to check the configuration.

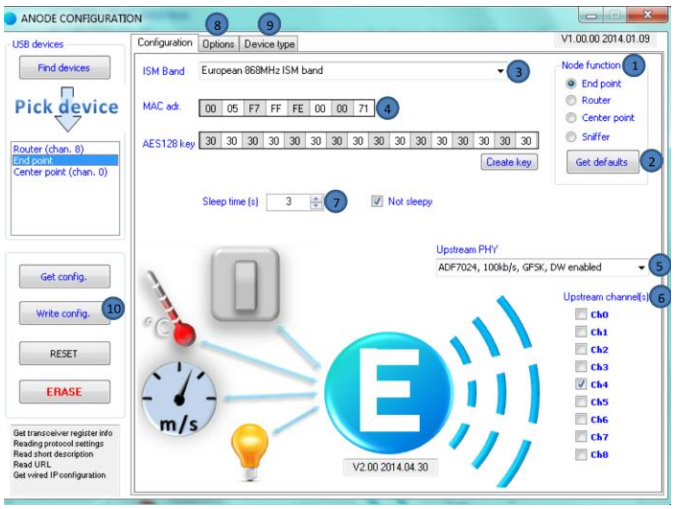

Figure 25

Useful Hint: When user need to re-configuring the endpoints, connect the ANodeConfig tool and complete the new configuration. Then close the ANodeConfig tool and reset the unit to comeback with updated configuration.

REPROGRAMMING NODES

OVERVIEW

It is possible to reprogram the sensor nodes. ADI provides example files that can be programmed instead of the code that comes flashed onto the nodes when shipped from the factory. This section explains what these files are, and how to reprogram nodes:

Table 3. Sensor Node default files.

File	Board	Sensors	Default	Description
CenterPoint1.out	ADuCRF101 Minikit	None	Yes (ADRN-WSN-1Z)	Basestation Node for ADRN-WSN-1Z
Bunch T&RH.out	BUNCH WSN	SHT21	Yes (Bunch WSN)	Sends temperature and humidity data
Bunch ADXL362.out	BUNCH WSN	ADXL362	Yes (Bunch WSN)	Sends Accelerometer data

ORDERING INFORMATION

RELATED LINKS

Table 4.

Resource	Description
EngineerZone Homepage	Support Homepage
ADuCRF101	Product Page, ADuCRF101 Integrated ADC, MCU and RF transceiver.
ADXL362	Product Page, ADXL362 Accelerometer
ADXL345	Product Page, ADXL345 Accelerometer
ADT75	Product Page, ADT75 temperature sensor
ADT7310	Product Page, ADT7310 temperature sensor
AD7151	Product Page, AD7151 Capacitive to Digital Converter
ADP121	Product Page, ADP121 LDO
ADP160	Product Page, ADP160 LDO
WSN Homepage	WSN Homepage

NOTES

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

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