

Airbee-ZNS Lite Version TI2.04

Getting Started Manual



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Revision History

Revision	Version & Date	Description
1.0	05 July 2005	Initial Draft
2.0	06 July 2005	Second Draft
3.0	07 July 2005	Release Version
4.0	21 July 2005	Flashing process change
4.1	22 July 2005	General Edits
4.2	2 Aug 2005	Added notes regarding D4 and D2 LEDs
4.3	2 Aug 2005	General Edits
5.0	8 Sep 2005	Test cases added
5.1	13 Sep 2005	General Edits
6.0	15 Sep 2005	Version change
6.1	18 Sep 2005	Modified screen shots for downloading and flashing the hex files.
6.2	23 Sep 2005	Software version change/ "Caution" under Section 7.2 has been changed
6.3	26 Sep 2005	Revise Z Support Center sign in text.



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1 Introduction

The objective of this manual is to guide the user to establish a network using four TI ZigBee-ready devices and demonstrate the functioning of the mesh network.

The following are covered in the manual:

1. Hardware requirements
2. Software requirements
3. Setting up the devices
4. Establishing the network
5. Transmitting data
6. Demonstrating mesh networking

2 Hardware Requirements

The user has to organize the required hardware tabulated below:

Sl. No.	Item description	Quantity
1	TI devices (MSP430F161x compatible with the schematic SK05P2190109, Rev 09)	4
2	Personal Computer – Pentium IV with CD Drive and 25-Pin Parallel Port	1
3	Power supply source –Batteries 1.5V – (2 x 4 AAA)	8
4	MSP-430 JTAG Flash Emulation Tool	1

3 Software Requirements

Sl. No.	Item description	Remarks
1	WINDOWS 2000 or WINDOWS XP Operating System (please refer to http://www.microsoft.com/windows/ for more information)	User's responsibility
2	IAR Kickstart - Flash software (please refer to → http://focus.ti.com/docs/toolsw/folders/print/iar-kickstart.html/ for more information)	User's responsibility
3	IAR Compiler v3.21a (please refer to http://www.iar.com for more information)	User's responsibility
4	Winzip (please refer to http://www.winzip.com for more information)	User's responsibility

4 Documentation/Software Download Instructions


1. Go to www.airbeewireless.com
2. Click on the link  under 'Z SUPPORT CENTER' (Note: Z Support center is Airbee Wireless' online customer support center).
3. "Sign in" to Airbee Z Support Center.
4. Click on the link 'Downloads'. This link takes you to the download page where the documentation/software is available. Expand "TI" as shown on the left window pane under "Airbee Downloads".



Figure 1. ZSupport Center- Download screen

5. Download following documentation/software:
 - i. Readme
 - ii. HEX_FILES_FOUR_NODE_DEMO_APP- Zipped folder containing following hex files :
 - ABZB_ZADKV2_COORDINATOR_1611&1612.hex – to be flashed on to PAN Coordinator (P)
 - ABZB_ZADKV2_ROUTER1_1611&1612.hex – to be flashed on to Router 1 (R1)
 - ABZB_ZADKV2_ROUTER2_1611&1612.hex - to be flashed on to Router 2 (R2)
 - ABZB_ZADKV2_ROUTER3_1611&1612.hex - to be flashed on to Router 3 (R3)
 - iii. ZADKV2-TI - zipped folder containing:
 - the workspace, ABZB_ZADKV2
 - files for application development
 - IAR IDE workspace (under the Project subfolder)
 - iv. Documentation folder containing:
 - Release Notes
 - Getting Started Manual-Airbee ZNS Lite Version TI2.04 (this document)
 - Programmer's Reference Manual -Airbee ZNS Lite Version TI2.04

5 Hardware Setup

1. Ensure all the four devices provided in the kit are used for the demonstration after flashing them with the Hex files.
2. Arrange them as in Figure 2 so that observing the LED D1 and LED D4 on all the four devices is easy.

The general layout of components, indicating the locations of key (SW1) and LEDs D1, D2 and D3 are as in Figure 2. In this sample application, you will be required to Press SW1 and view D1 and D4 to confirm that the data transmission occurs as programmed.

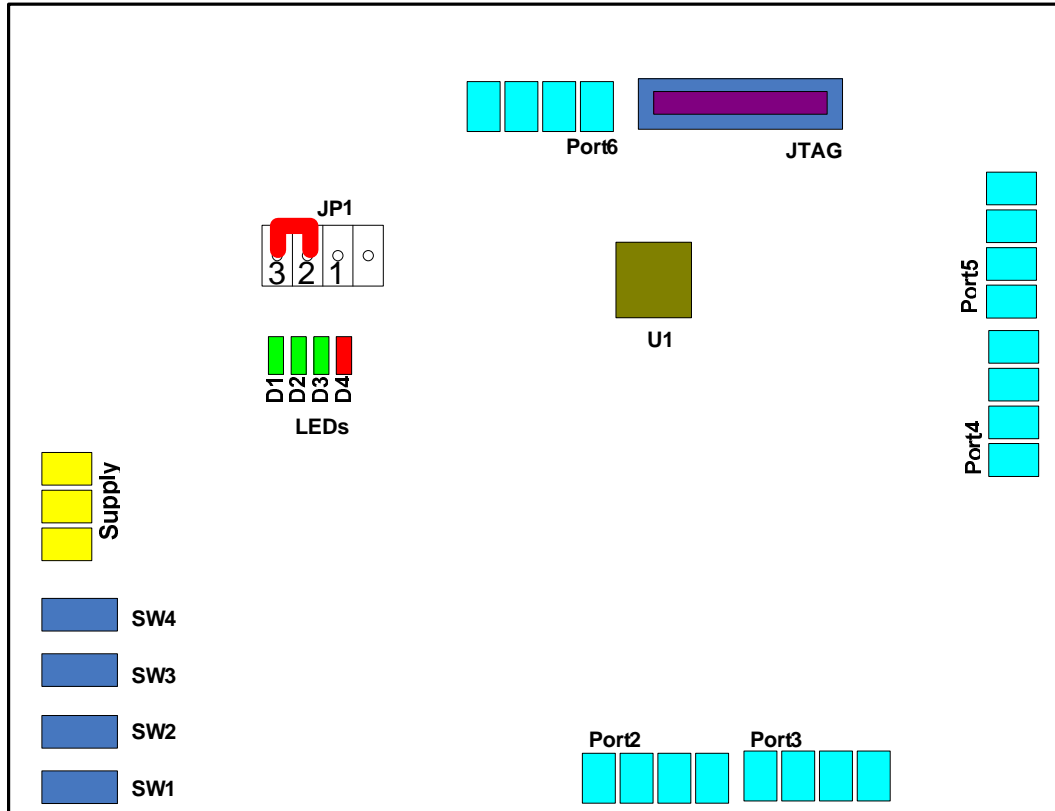


Figure 2. General Component lay-out in a TI device

Insert jumper between terminals 2 and 3 at JP1 to power 'ON' the device


6 Flashing Program Code in TI board

The program code is flashed on to the TI board using IAR-Embedded Workbench Kickstart version3 – MSP430 Development Tool. Download this development tool (freeware) from webpage→ <http://focus.ti.com/docs/toolsw/folders/print/iar-kickstart.html> and install following the guided onscreen procedure.

The IAR Embedded Workbench icon is now available in the Desktop.

6.1 Flashing Program Code

To flash program code:

1. Double click the  icon on the desktop. The IAR Embedded Workbench welcome screen is displayed.

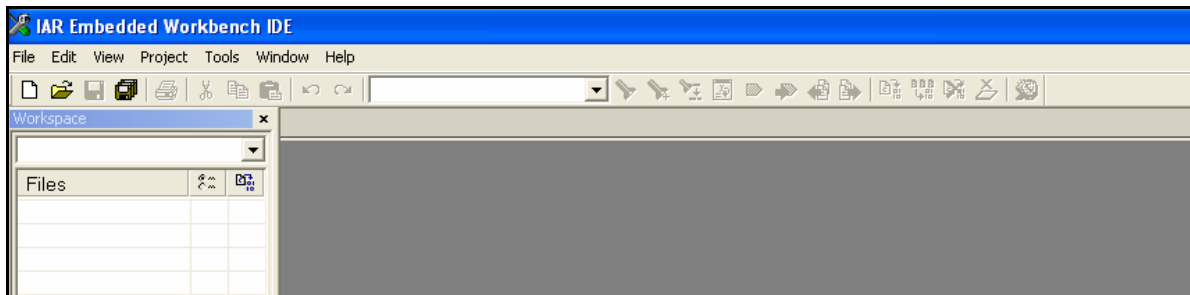


Figure 3. IAR Embedded Workbench welcome screen

2. In the menu bar of figure 3, select **project→create new project**. The Create New Project screen is displayed.

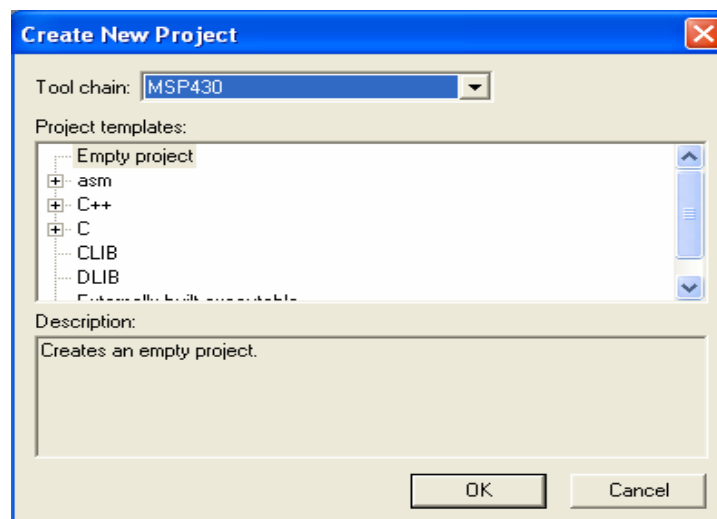


Figure 4. Create New project screen

3. In Project templates dialog, select **Empty Project**
4. Click **OK**. The 'Save as' window is displayed.

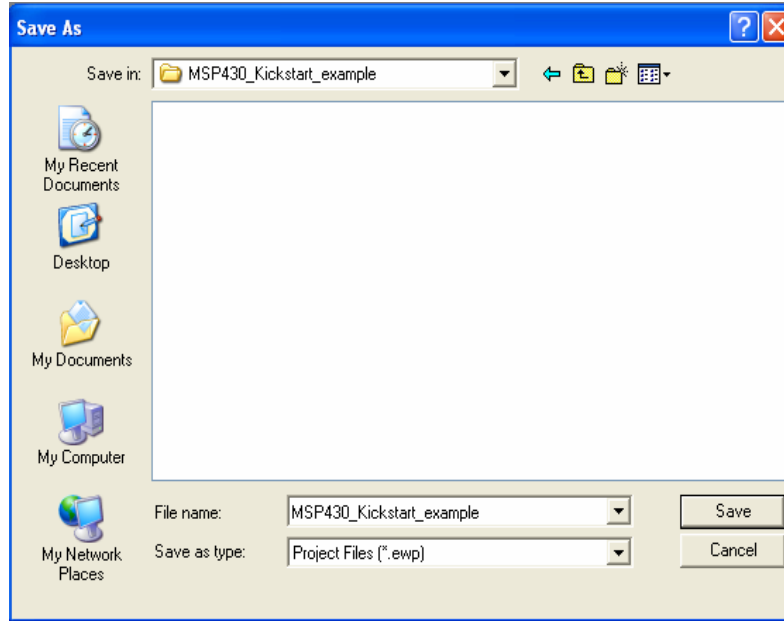


Figure 5. Save as Window

5. Enter the file name and click **Save**. The Options screen is displayed.

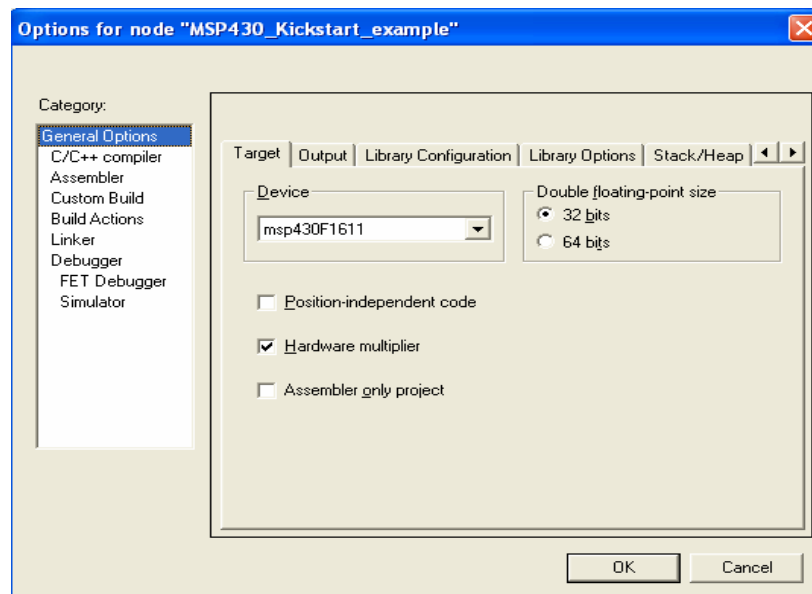


Figure 6. Options screen

6. Select the category **General Options**.
7. Select the **Target** tab in the menu bar.
8. Select the device as **msp430F1611**.
9. Select **Hardware multiplier**.
10. Select **32 bits** under double floating point size.

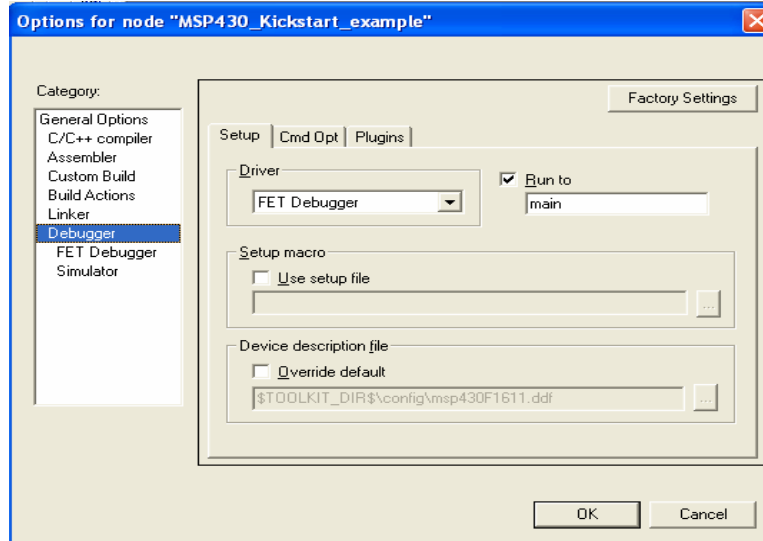


Figure 7. Debugger option screen

11. In the same screen, select the category as **Debugger**.
12. Select the **Setup** tab in the menu bar.
13. Select driver as **FET Debugger**.
14. Click **OK**.
15. Right click the file to select **Add files**. The Add Files screen will be displayed.

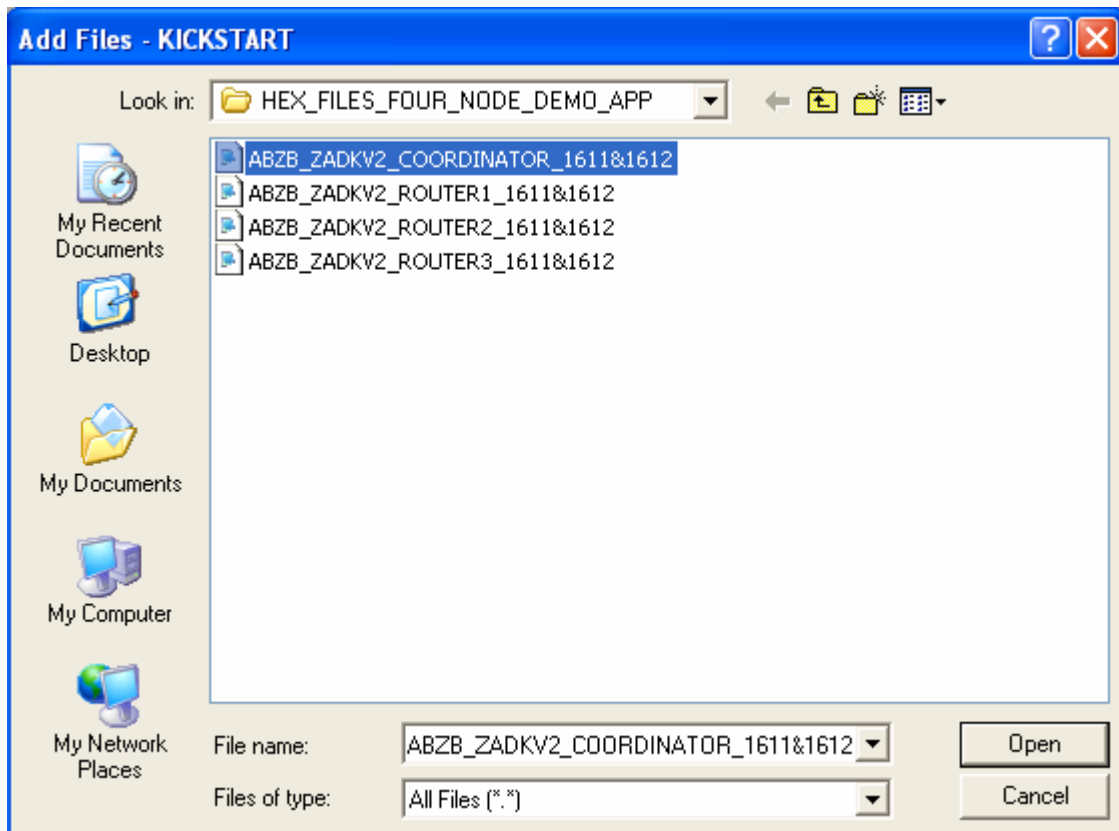


Figure 8. Add files screen

16. Select the hex file to be flashed into the TI board.

17. Click **Open**. The following screen is displayed.

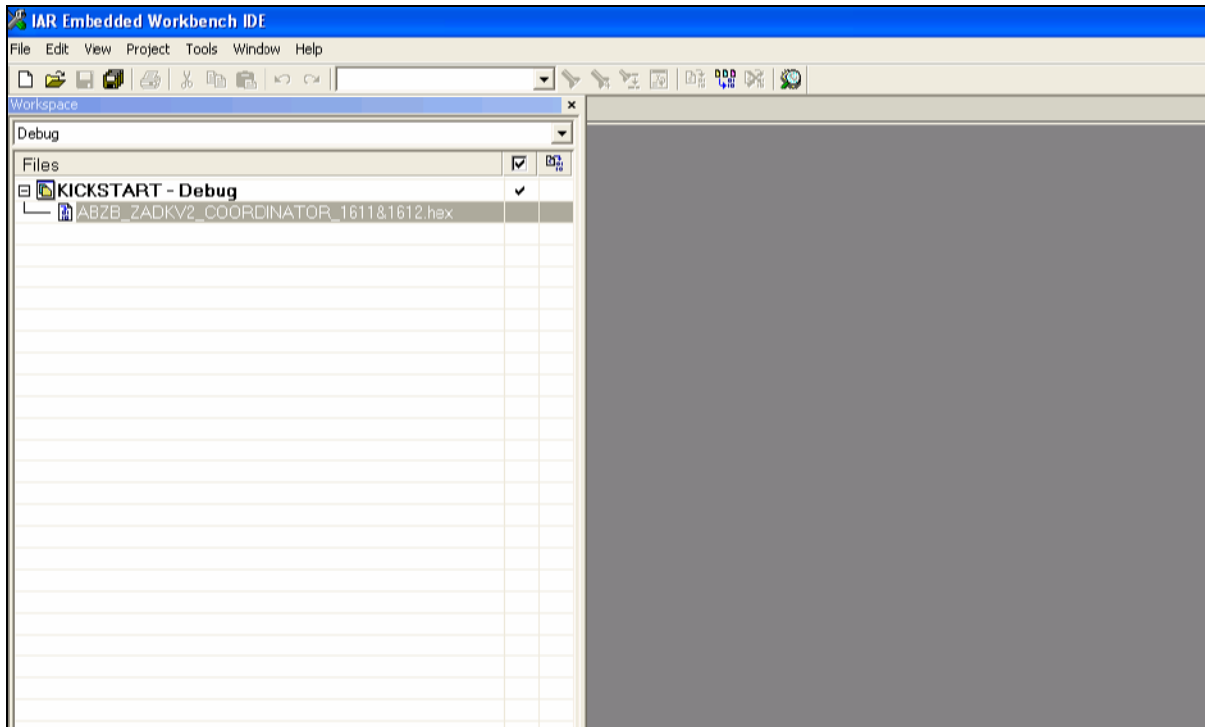



Figure 9. Flash emulation screen

To view the flashing process, click  icon (In case of MSP430F1612, the message as below appears)

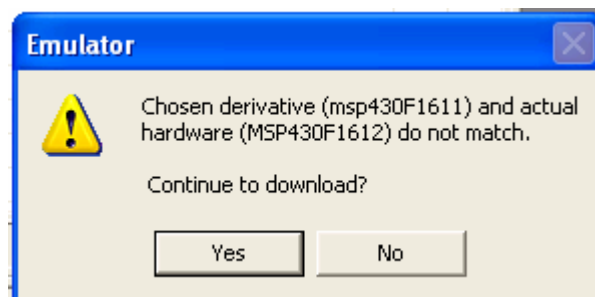


Figure 10. Warning message for Emulator Screen

Click **Yes**. The hex file is embedded into the target board.

Alternatively these flashing tools can be downloaded from freeware and used to flash the program code into TI board

Flashing Tool	Web page for the Link
MSP GANG430	http://focus.ti.com/docs/toolsw/folders/print/msp-gang430.html#supportsoftware
MSP-PRGS430	http://focus.ti.com/docs/toolsw/folders/print/msp-prgs430.html
FET-PRO430	http://www.elprotronic.com/fetpro430.html

MSP-FET430UIF	http://focus.ti.com/docs/toolsw/folders/print/msp-fet430uif.html
MSP-FET430PIF	http://focus.ti.com/docs/toolsw/folders/print/msp-fet430pif.html

7 Application Network

7.1 Topology - Mesh

The topology of the network established by the sample application using four TI devices is as below:

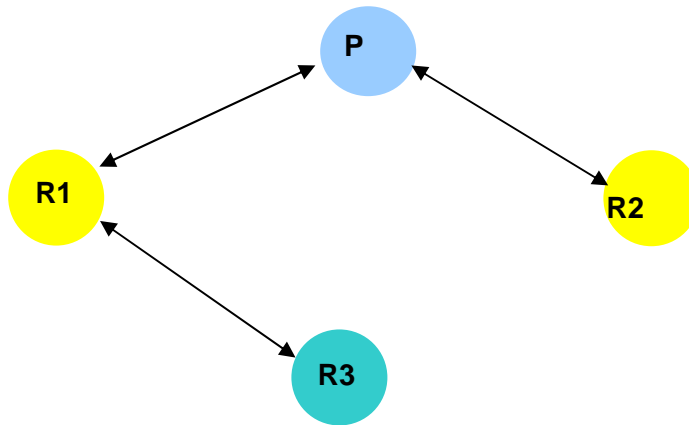


Figure 11. Network Topology – Mesh

In this sample application:

The network forms with Router 1 and Router 2 joining PAN Coordinator and Router 3 joining Router 1

PAN Coordinator is bound to Router 3 and vice-versa. Router 1 is bound to Router 2 and vice-versa.

7.2 Establish the Network

To establish the network as described in 7.1:

1. Start the PAN Coordinator by connecting the battery to device 'P'. LED D2 will glow indicating the successful formation of a network by the PAN Coordinator. **Be sure that this application is operated 'only' on Channel 18 at 2440 MHz to view sniffer outputs.**

CAUTION:

1. If the red LED D4 glows solid, it indicates a communication failure between the transceiver and microcontroller. To correct a communication failure, the hardware should be reset.
To reset the hardware and restart the device, remove the jumper and carefully replace it.
2. The green LED D2 must glow solid to indicate successful PAN network formation and successful Router joining. Flickering of D2 indicates a network communication error.
3. If no LEDs glow, the hardware has to be reset as indicated above.

The flicker of red LED D4 is so quick that it is barely detectable, but indicates healthy communication of data.

2. Start Router 1 by connecting the battery to device 'R1'. LED D2 will glow indicating the

successful network join status of Router 1 with the PAN Coordinator.

3. Start Router 2 by connecting the battery to device 'R2'. LED D2 will glow indicating the successful network join status of Router 2 with the PAN Coordinator.
4. Start Router 3 by connecting the battery to device 'R3'. LED D2 will glow indicating the successful network join status of Router 3 with Router 1.

The TI board has the transceiver IC on a mountable PCB board. Ensure the PCB is securely attached to the TI board so that the communication is proper.

The devices must be started in the above sequence only or the network may malfunction.

8 Sample Application Demonstration

The demonstration of the functioning of sample application provided with the Airbee ZNS-Lite kit involves the following steps:

Following sub-sections guide you to demonstrate data transmission in:

- Normal Path
- Self-healing path

8.1 Data Transmission – Normal Path

With the network topology as in 7.1, check the transmission following steps below:

8.1.1 Transmission From PAN Coordinator to Router 3 through Router 1

1. Follow the steps in 7.2 to re-establish the network.
2. Press key SW1 (as shown in the general layout- Figure 2) at the PAN Coordinator.
3. Observe the LED D1 (as shown in the general layout) at Router 3 to glow. Observe the brief flickering of the red LED D4 (as shown in the general layout) on Router 1.
4. Press key SW1 at the PAN Coordinator to switch 'OFF'.
5. Observe the LED D1 at Router 3 to stop glowing.
6. Observe the brief flickering of the red LED D4 on Router 1.

- ***Steps 2 through 4 confirm the occurrence of transmission from PAN Coordinator to Router 3 through Router 1.***
- ***Similarly, data transmission can be observed from Router 3 to PAN Coordinator.***

8.1.2 Transmission from Router 1 to Router 2 through PAN Coordinator

1. Follow the steps in 7.2 to re-establish the network.
2. Press key SW1 at Router 1.
3. Observe the LED D1 at Router 2 begin to glow. Observe the brief flickering of the red LED D4 on the PAN Coordinator.
4. Press key SW1 at Router 1.
5. Observe the LED D1 at Router 2 stop glowing.
6. Observe the brief flickering of the red LED D4 on the PAN Coordinator.

- ***Steps 2 through 4 confirm the occurrence of transmission from Router 1 to Router 2 through PAN Coordinator.***
- ***Similarly, data transmission from Router 2 to Router 1 through PAN Coordinator can be demonstrated.***

8.2 Data Transmission – Self-healing path

8.2.1 Transmission from PAN Coordinator to Router 3 with Router 1 disabled

1. Follow the steps in 7.2 to re-establish the network.
2. Disconnect power supply to Router 1 by removing either the battery or the jumper between terminals 2 and 3 (JP1) as shown in Figure 2.

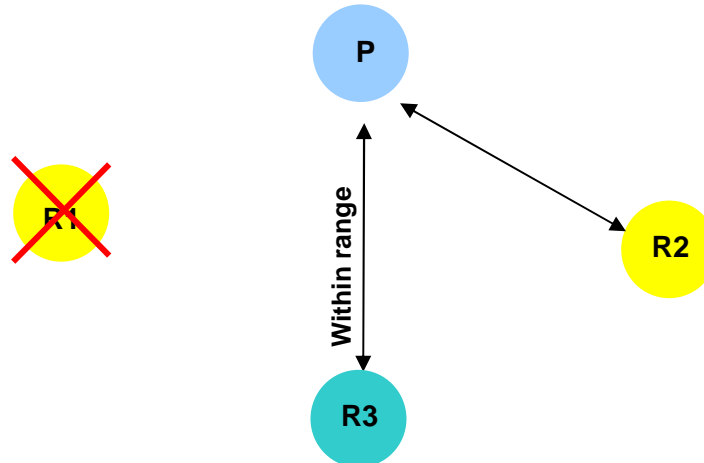


Figure 12. Router 1 Disabled

3. Press key SW1 at the PAN Coordinator.
4. Observe the LED D1 at Router 3 begin to glow when the key at the PAN Coordinator is pressed for the third time manually.
5. Press the key SW1 at the PAN Coordinator.
6. Observe the LED D1 at Router 3 stops glowing.

- *If any of the intermediate devices are disconnected from the network, the data transmission between the other devices takes place only when the key is pressed for the third time i.e. the LED does not glow for the first two presses and glows only on the third press*
- *Steps 2 through 6 confirm the transmission from the PAN Coordinator to Router 3 occurs directly even if Router 1 fails.*
- *Similarly, data transmission can be demonstrated from Router 3 to PAN Coordinator.*
- *The device leaving the network (in this case R1) cannot rejoin. In order to include R1 in the network, restart the network as in 7.2.*

8.2.2 Transmission from PAN Coordinator to Router 3 with Router 1 disabled - Hopping through Router 2

Conditions	Router 1 disabled
	Router 3 out of range with respect to PAN Coordinator (farther than 10meters) but within the transmission range of Router 2
	Router 2 within transmission range with PAN Coordinator

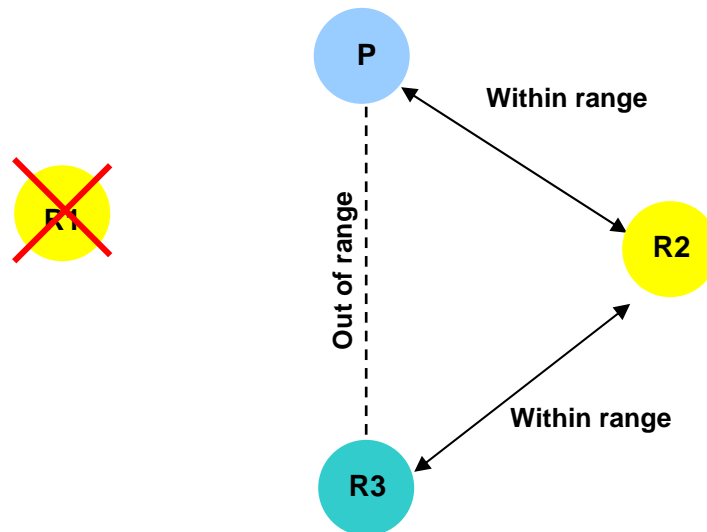


Figure 13. Hopping through Router 2

1. Follow the steps in Section 7.2 to re-establish the network.
2. Disconnect power supply to Router 1 by removing either the battery or the jumper between terminals 2 and 3 (JP1) as shown in Figure 2.
3. Press key SW1 at the PAN Coordinator.
4. Observe the LED D1 at Router 3 begin to glow when the key is pressed for the third time manually, where Router 3 is discovered through Router 2.
5. Press the key SW1 at the PAN Coordinator.
6. Observe that the LED D1 at Router 3 stops glowing. Observe the brief flickering of the red LED D4 on Router 2.

- **Steps 2 through 6 confirm that the transmission from the PAN Coordinator to Router 3 hops through Router 2.**
- **Similarly, data transmission can be demonstrated from Router 3 to PAN Coordinator.**

8.2.3 Transmission from R1 to R2 with PAN Coordinator Disabled

Conditions	PAN Coordinator disabled
	Router 2 out of range with respect to Router 1 (farther than 10 meters) but within the transmission range of Router 3
	Router 2 within transmission range with PAN Coordinator

1. Follow the steps mentioned in Section 7.2 to re-establish the network.
2. Disconnect power supply to PAN Coordinator by removing either the battery or the jumper between terminals 2 and 3 (JP1) as shown in Figure 2.

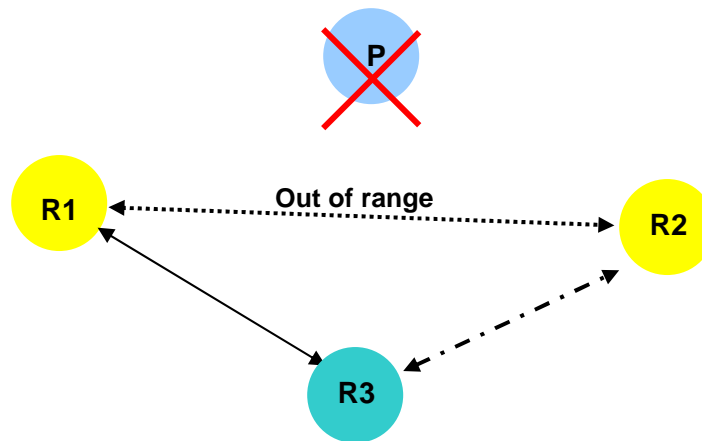


Figure 14. PAN Coordinator Disabled

3. Press key SW1 at Router 1.
4. Observe the LED D1 at Router 2 glows. Observe the brief flickering of the red LED D4 on Router 3.
5. Press the key SW1 at Router 1.
6. Observe that the LED D1 at Router 2 stops glowing.
7. Press key SW1 at Router 2.
8. Observe the LED D1 at Router 1 begin to glow.
9. Press the key SW1 at Router 2.
10. Observe that the LED D1 at Router 1 stops glowing.
11. Similarly, data transmission can be observed from Router 2 to Router 1.

The demonstrations 8.2.1 to 8.2.3 establish the 'Self-healing' capability of the network, by ensuring data delivery to the destination, with the bound device either disabled or the receiver device located beyond the transmission range.

8.3 Rejoining Network

8.3.1 Rejoining of Router2

Conditions	PAN Coordinator(parent device) is enabled Router 2 disconnected from network
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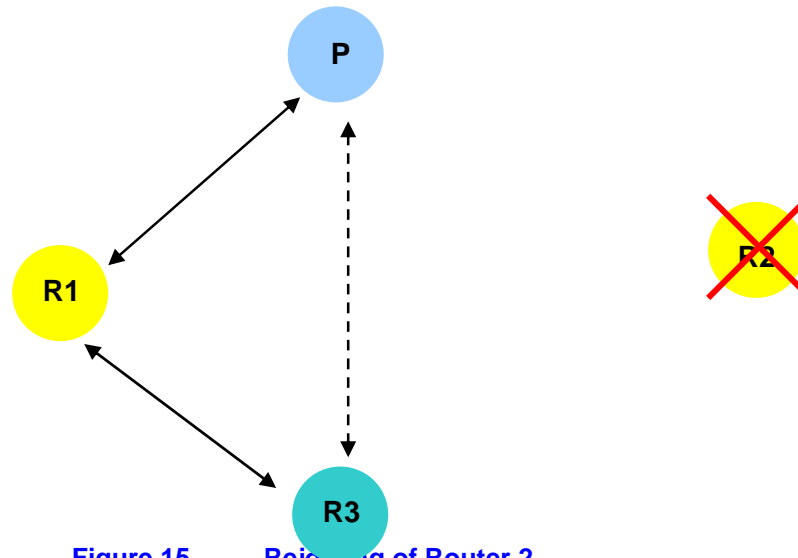


Figure 15. Rejoining of Router 2

1. Disconnect power supply to Router 2 by removing either the battery or the jumper between terminals 2 and 3 (JP1) as shown in Figure 2.
2. Start Router 2 by connecting the battery or by inserting the jumper between the terminals 2 and 3 (JP1) as in Figure 2. LED D2 will glow indicating the successful network rejoin of Router 2 with the PAN Coordinator.
3. Press key SW1 at Router 2.
4. Observe LED D1 at Router 1 glow.
5. Press key SW1 at Router 1.
6. Observe LED D1 at Router 2 glow.

Follow the steps (excluding (1) first step) explained in sections 8.1.1, 8.1.2, 8.2.1, 8.2.2 and 8.2.3 to test transmissions within the network. The first step is excluded since the network is already established.

8.3.2 Rejoining of Router3

Conditions	Router1 (parent device) is enabled Router 3 disconnected from network
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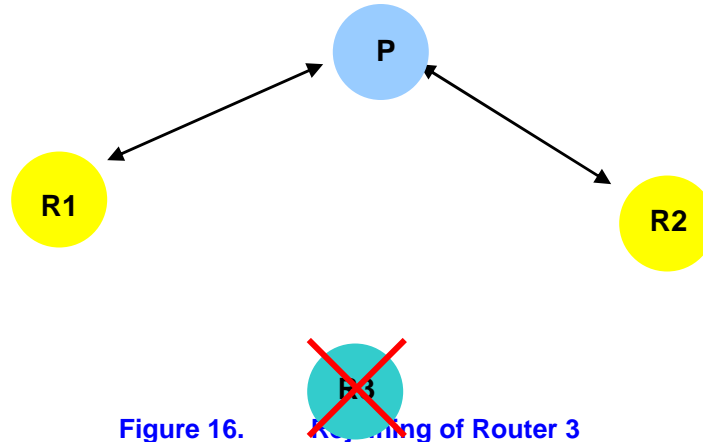


Figure 16. Rejoining of Router 3

1. Disconnect power supply to Router 3 by removing either the battery or the jumper between terminals 2 and 3 (JP1) as shown in Figure 2.
2. Start Router 3 by connecting the battery or by inserting the jumper between the terminals 2 and 3 (JP1). LED D2 will glow indicating the successful network rejoin of Router 3 with Router 1.
3. Press key SW1 at Router 3.
4. Observe LED D1 at PAN Coordinator glow.
5. Press key SW1 at Router 3.
6. Observe that LED D1 at PAN Coordinator stops glowing.

Note: When the parent device is disabled, the child devices cannot rejoin the network.

Follow the steps (excluding (1) first step) explained in sections 8.1.1, 8.1.2, 8.2.1, 8.2.2, 8.2.3 to test transmissions within the network. The first step is excluded since the network is already established.

8.4 Error messages

- If LED D2 in the PAN Coordinator does not glow, it indicates that the network has not formed.
- If LED D2 in any of the Routers does not glow, it indicates that the device has not joined the network.



9 Technical Support

Click on “**Submit a Ticket**” in Airbee “Z Support Center” to submit a trouble ticket to one of our customer representatives. “Z Support Center” is a link under www.airbeewireless.com

10 Application Development

Please refer to the Programmer’s Reference Manual for the development of custom applications.

This Airbee-ZNS Lite is designed to work only for TI devices. The software will not support any other platform. The devices may not perform reliably if placed near a 2.4 GHz source such as a microwave oven, etc.