Quick Start Guide

ZigBee™ Environment Demonstration (ZeD) Health Care Profile

freescale semiconductor

Contents

About This Guide 2
Audience 2
Revision History 2
Conventions 3
Definitions, Acronyms, and Abbreviations 3

ZeD for Health Care Introduction 4
System Overview 4
Hardware and Software Requirements 5

ZeD Installation 5
Hardware and Software Requirements 5
Installing on the PC 7

Downloading an Embedded Image File 8
Health Care ZeD Image Files 8
Erasing the Board FLASH 8
Starting the Test Tool MC1322x Firmware Loader 9
Loading a MC1320x-QE128 Application. 13

Forming a Network and Starting ZeD 16
Starting the Network on the DCU. 16
Running ZeD 16
Joining the Other Nodes to the Network 19

ZeD Use Case 22
Use Case Requirements 22
Placing the Boards in Application Mode 22
Initializing the ZHC Tunnel and IEEE 11073 Association 23
Visualizing Sensor Measurements 23

Using the CESL Continua Manager GUI with BeeStack Agents 26

About This Guide

This guide provides and introduction to the Freescale's ZigBee® environment Demonstration (ZeD) for the Health Care profile based on the IEEE 11073 document. This guide describes what ZeD is, how to install it, launch it, and how to run a simple demonstration. This guide also shows how to download embedded files to the demonstration boards.

For more information on ZigBee and for Freescale ZigBee downloads, visit www.freescale.com/802154.

MC1322x or MC1320x-QE128 boards are required to run the ZeD Health Care profile.

Audience

This document is intended for ZigBee, custom software and application developers.

Revision History

Current document revision number: 0.0

The following table summarizes revisions to this document since the previous release.

Revision History

Location	Revision
Entire document	First Release of this guide.

Conventions

This document uses the following notational conventions:

- `Courier monospaced type` indicate commands, command parameters, code examples, expressions, datatypes, and directives.
- *Italic type* indicates replaceable command parameters.
- All source code examples are in C.

Definitions, Acronyms, and Abbreviations

The following list defines the abbreviations used in this document.

BDM	Background Debug Module
C	Coordinator
ED	End Device
EVB	MC13192 Evaluation Board with S08GT60 MCU
EVK	Evaluation Kit
GUI	Graphical User Interface
LED	Light Emitting Diode
MCU	MicroController Unit
NCB	MC1321x Network Controller Board with S08GT60 MCU
PC	Personal Computer
PCB	Printed Circuit Board
QE128-EVB	MC1320x Evaluation Board with S08QE128 MCU
R	Router
SARD	MC13192 Sensor Application Reference Design with S08QE128 MCU
SRB	MC1321x Sensor Reference Board with S08GT60 MCU
USB	Universal Serial Bus
ZeD	ZigBee environment Demonstration

ZeD for Health Care Introduction

This guide shows how to install ZeD for Health Care, program the boards using the embedded image files, how to use the ZeD for Health Care Windows GUI to monitor and view the ZigBee network, and demonstrate the functionality of the ZigBee applications.

For more information about the ZeD GUI and the Home Automation or Smart Energy modes for ZeD, see the following documents:

- ZeD Software User's Guide
- ZeD Embedded Software Design User's Guide
- ZeD Quick Start Guide
- ZeD Smart Energy Quick Start Guide

System Overview

The Freescale ZigBee environment Demonstration (ZeD) is a set of software components designed to visualize, monitor, and demonstrate how a ZigBee network functions. This document describes using ZeD to accomplish these tasks for the Health Care ZigBee profile. ZeD functions are closely tied to the capabilities of the Freescale BeeStack and the Freescale BeeKit Wireless Connectivity Toolkit to offer an intuitive view of how a ZigBee network is formed and how that network operates. ZeD also allows users to see how the Health Care Profile applications operate on the ZigBee layer while these applications perform various functions.

ZeD for Health Care supports the Health Care Profile for ZigBee applications. The ZigBee Health Care Profile is defined by the ZigBee Alliance. See www.zigbee.org for more details. As part of the BeeKit Wireless Connectivity Toolkit, ZeD operates with the other BeeKit components to offer a comprehensive and easy to use platform for ZigBee development.

ZeD Installation

Using ZeD with the Health Care profile is designed for use with the Freescale MC1322x or MC1320x-QE128 ZigBee evaluation boards.

ZeD software consists of the following two components:

- Embedded software running on the physical evaluation boards. Each board runs a ZigBee Health Care Application which runs on top of the Freescale BeeStack
- ZeD Windows GUI software running on a PC that allows users to see the state of the network and the functions performed by the embedded applications as these applications communicate over the air using ZigBee

When installing Freescale BeeKit with ZeD, both software components are deployed to the system. The ZeD embedded software consists of embedded image files used to program the boards. The embedded image files are located in the ZeD installation folder on the PC.

Hardware and Software Requirements

Before installing ZeD, ensure that the following requirements are met. If these requirements are not met, ZeD will not function.

- A PC running Microsoft Windows XP®, Microsoft Windows Vista®, Microsoft Windows 7® or Microsoft Windows 2000®.
- Two to five MC1322x Network Node boards, MC1322x Sensor Node boards, or MC1320x-QE128 EVB boards. At a minimum, one of the boards must be configured as the ZigBee Coordinator running the Data Collection Unit ZTC Host (DCU) application. The other boards are needed to demonstrate ZigBee networks and Health Care “over the air” functionality.
- AA batteries and/or USB cables as needed.

NOTE

The coordinator DCU MC1322x embedded image file delivered with ZeD is intended for use with an MC1322x Sensor Node. If an MC1322x Network Node is used instead, its LCD display is disabled.

The boards need to be loaded with ZigBee applications running a specific configuration for ZeD. The image files for these applications are provided in the Embedded Images folder of the ZeD installation folder. See Downloading an Embedded Image File for more details on how to configure and program a board.

The following items are required to reprogram the boards using the ZeD embedded software image files for the MC1320x-QE128 boards:

- The BDM Support kit including the USB HCS08/HCS12 Multilink BDM from P&E Microcomputer Systems, Inc
- The BDM Software provided with the BeeKit Wireless Connectivity ToolKit

To reprogram the boards using the ZeD embedded software image files for the ARM7/MC1322x platforms either of the following items are required:

- J-Link JTAG Debugger and programming tools available in IAR Embedded Workbench IDE
- MC1322x Firmware Loader available in Freescale Test Tool 11.0.0 and later

If users intend to customize the existing applications or develop their own ZigBee applications, they will also need the following items:

- The Freescale BeeKit Wireless Connectivity Toolkit with ZeD, Test Tool and a license for Freescale BeeStack development . Refer to the BeeKit Wireless Connectivity ToolKit User's Guide for details on how to install and use BeeKit
- The Freescale CodeWarrior Development Studio for Freescale HC(S)08 Microcontrollers, Version 6.1 Special Edition (Full License) (Requires 60K upgrade for 802.15.4 and BeeStack) or later for the HCS08 platforms.
- IAR Embedded Workbench for ARM, Version 5.20 or 5.30 (Requires 256K Edition). Refer to the BeeStack 2007 documentation such as the ZigBee Applications User's Guide for information about the network stack and template applications that come with the BeeStack codebase.

Installing on the PC

ZeD is installed by default with the BeeKit Wireless Connectivity Toolkit software. To install ZeD, make sure that while installing BeeKit, the ZeD component check box is selected as shown in Figure 1.

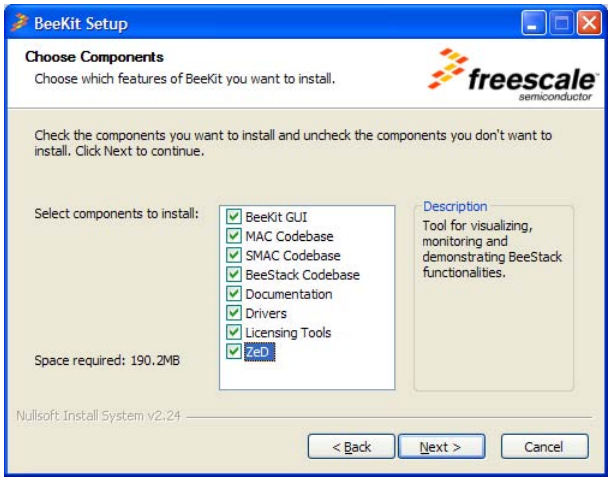

Figure 1. Selecting ZeD to be Installed From the BeeKit Installer

Refer to the *BeeKit Wireless Connectivity Toolkit Quick Start Guide* for details on how to use the BeeKit installer.

By default, the installation program copies the ZeD software to the PC hard drive in the following folder location:

```
Program Files\Freescale\ZeD v.v.v
```

The installation program also creates shortcuts to the ZeD PC GUI and the embedded image file folder in the following Windows Start Menu location.

```
Start -> Programs -> Freescale BeeKit -> ZeD v.v.v -> Freescale ZeD
v.v.v
```

The installation program can also place a shortcut to the ZeD application on the PC desktop. In the above path examples, v.v.v designates a 3-digit version number, for example, 1.6.0. Health Care applications must be run using ZeD 1.6.0 or later.

Downloading an Embedded Image File

This section shows how to load the ZeD Health Care embedded image files to the development board using the Test Tool MC1322x Firmware Loader program and HiWave for the MC1320x-QE128 boards.

Health Care ZeD Image Files

The ZeD Health Care embedded image files are placed in the `Embedded/MC1322xHC or Embedded/QE128HC` folders which are located in the ZeD installation folder. ZeD also comes with BeeKit solution files which can be used to customize the applications and generate user-defined applications. The following image files are available:

- `Hc DataCollectionUnit ZTC Host`
- `Hc Thermometer`
- `Hc WeightScale`
- `Hc BloodPressureMonitor`
- `Hc GlucoseMeter`

Erasing the Board FLASH

Before downloading the new code, the FLASH on the boards needs to be erased. To erase the FLASH, perform the following tasks for each board:

1. Connect the board to a USB port and power it on.
2. Use two jumpers and short together the pin pairs marked VREFH (ADC2_VrefH) and VREFL (ADC2_VrefL) on the board. These pin pairs are clearly marked on the board and can be found next to the JTAG port.
3. Press the Reset Switch on the board and wait 5 seconds.
4. Unplug the board from the USB port.
5. Remove the two jumpers.
6. Plug the board back in the USB port.
7. Press the Reset Switch on the board again.

Starting the Test Tool MC1322x Firmware Loader

To begin loading the embedded images to the boards, launch the Test Tool application by clicking: Programs -> Freescale Test Tool -> Test Tool.

1. From the Test Tool main menu choose View -> Firmware Loader -> MC1322x Firmware Loader. The Firmware Loader window appears as shown in Figure 2.

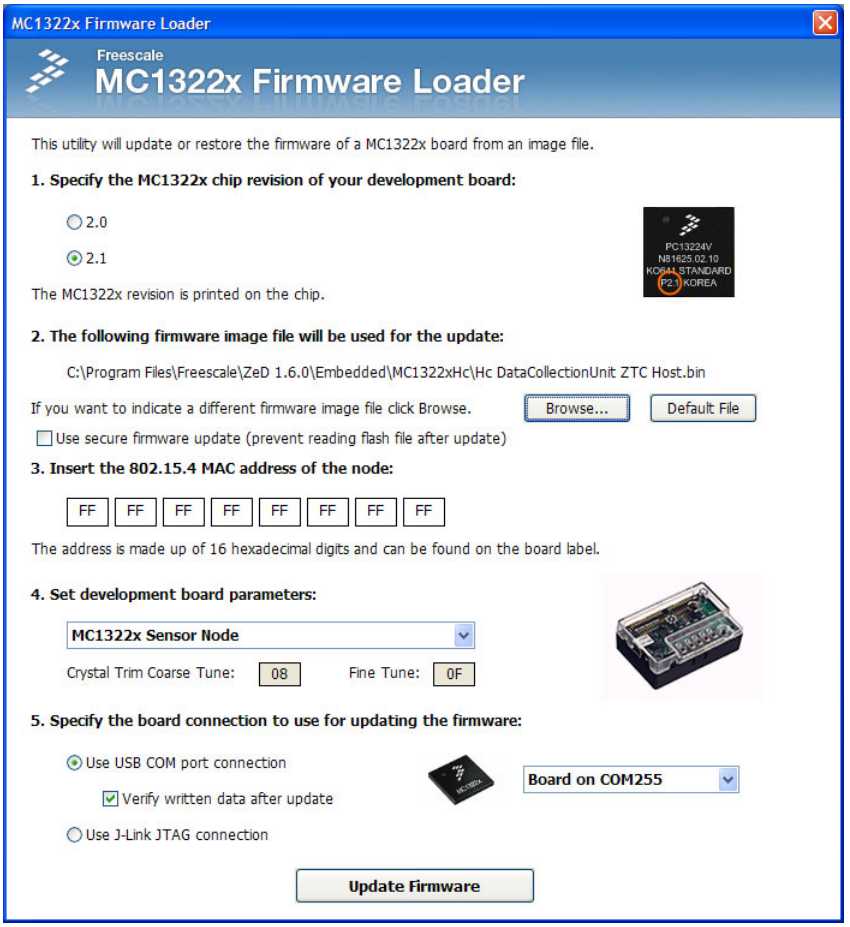

Figure 2. Test Tool MC1322x Firmware Loader

Loading a MC1322x Application

This example uses the Data Collection Unit ZTC Host application. To load the `Hc DataCollectionUnit ZTC Host.bin` application image file on a MC1322x board:

1. Connect the MC1322x board to the PC using a USB cable and power it on. The board flash must be erased as described in the previous section.
2. If the board drivers are not already installed, the Windows “Found New Hardware” wizard appears. Steer the system to the driver location (Freescale Drivers folder) which by default is at the following location:

   ```
   Program Files\Freescale\Drivers
   ```

3. Disconnect any other boards from the PC.
4. In the Test Tool MC1322x Firmware Loader set the chip revision to 2.1.
5. Click Browse... and explore to choose `x:\Program Files\Freescale\ZeD v.v.v\Embedded\MC1322xHC\HC DataCollectionUnit ZTC Host.bin`.
6. Set the MAC address to the address on the label on the board (the number starting with 00 50 C2).

7. Set the board connection to “Use USB COM port” connection. Make sure the board COM port is displayed on the right side of the connection controls. Configuration must look as in Figure 3.

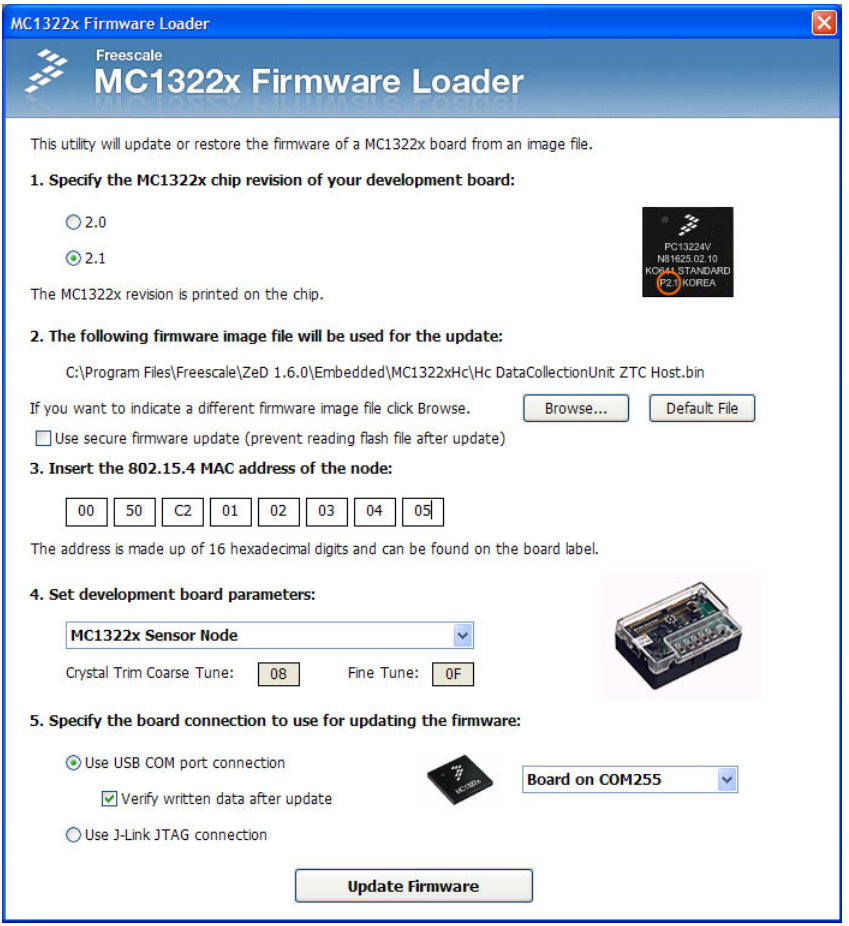

Figure 3. Firmware Loader Configuration for DCU Image Loading

8. Press the Update Firmware button.

9. Press the Reset switch on the board when indicated by the status message as shown in Figure 4. The message also contains the flash erase procedure details if that has not been yet performed.

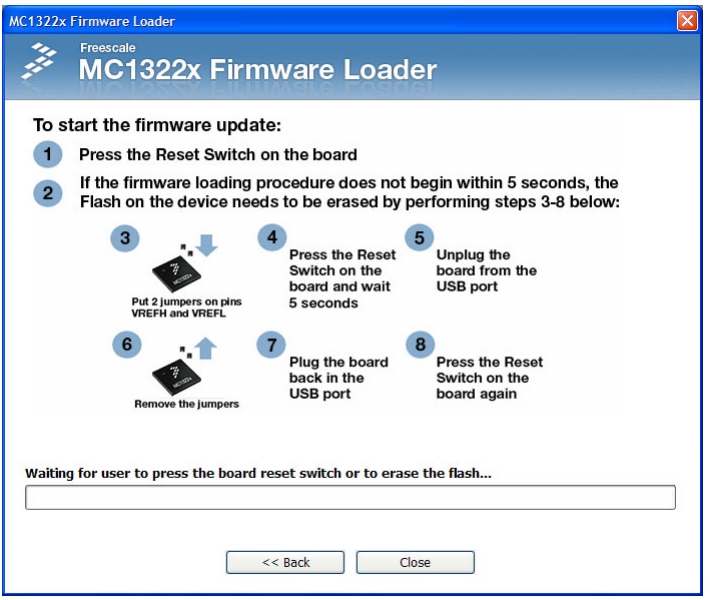

Figure 4. Image Loader (Reset Board Message)

10. Wait until the firmware update completes.
11. Reset the board when done. LED1 on the board should flash.
12. Press the Back button to return to the main Firmware Loader page and repeat Steps 1-11 to load the other four embedded images to the other boards.

Loading a MC1320x-QE128 Application

The following sections show how to load an embedded image file to an HCS08 based board (in particular MC1320x-QE128) using the HiWave program included with the CodeWarrior IDE.

Connecting the BDM

Before downloading the code, connect the BDM pod to the board. Every board has a 6 pin BDM port, marked on the PCB. The BDM connector must be inserted into the BDM port. The red wire from the BDM connector must be on the same side as the number 1 pin of the BDM port. After powering on the board, the blue and the yellow LEDs on the BDM turn on. This means that the BDM is properly connected to the board. If the blue and the yellow LEDs are not on, check the connection and try again.

Locating the HiWave Application

The HiWave application is located in the root folder of the CodeWarrior IDE binaries which by default installs in:

```
Program Files\Freescale\CodeWarrior for Microcontrollers V6.1\prog\
```

for CodeWarrior 6.1.

Loading the Application

To load the `Hc DataCollectionUnit ZTC Host.s19` application image file on a QE128 board using HiWave, perform the following steps:

1. Launch HiWave. The HiWave main window appears as shown in Figure 5.

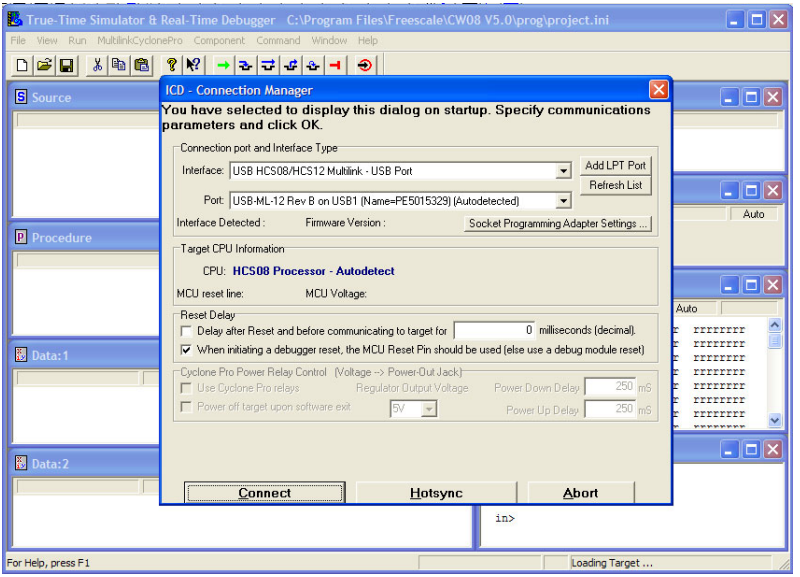

Figure 5. Establishing Communication Between the BDM and the Board

2. Click on the Connect button in the ICD Connection Manager window.
3. As shown in Figure 6, from the menu bar of the HiWave main window choose MultilinkCyclonePro-> Load... (CTRL+L).

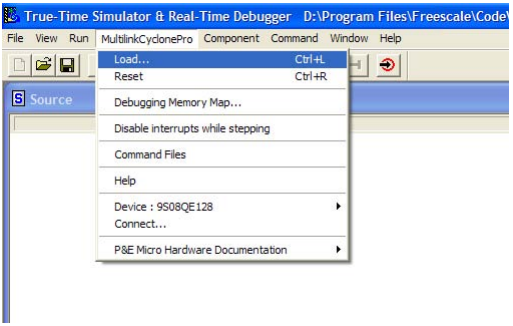

Figure 6. Loading the .abs File

4. Look in the following directory:

```
Program Files\Freescale\ZeD v.v.v\Embedded\QE128Hc
```

5. Ensure that the Files of type is search for executable files as follows:

```
Motorola S-Record (*.s?*)
```

6. Look for the following File name:

```
Hc DataCollectionUnit ZTC Host.s19
```

7. As shown in Figure 7, ensure that the `Hc DataCollectionUnit ZTC Host.s19` is highlighted and click on the Open button.

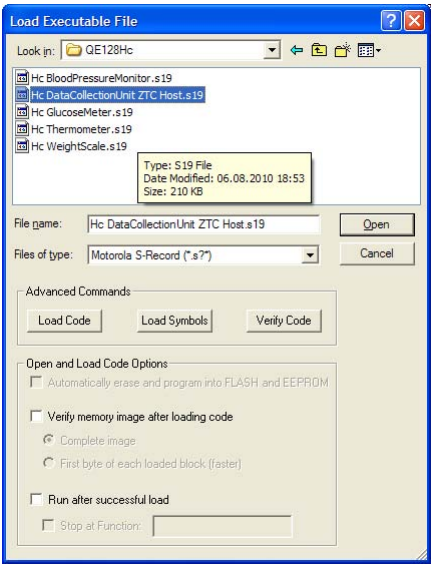

Figure 7. Open *.s19 file

8. As shown in Figure 8, click on the Yes button to erase and program the flash memory on the board.

Figure 8. Erase and Program Flash memory

9. Wait until programming is complete.
10. Close the HiWave application and reset the board.

Forming a Network and Starting ZeD

This section provides the steps required to form a Health Care network using the evaluation boards running the Freescale BeeStack and the ZigBee sample applications. This section also shows how to start ZeD to monitor and view network status.

Starting the Network on the DCU

To start the ZigBee network, perform the following steps:

1. Select the board loaded with the Data Collection Unit ZTC Host (DCU) application. This board serves as the ZigBee Coordinator.
2. Using a USB cable, connect the DCU to the computer that will be running ZeD. For the board drivers to work correctly, ensure that the USB cable is connected directly to the PC and not to a USB external hub.
3. Press SW1 on the DCU on the MC1322x board or SW2 on the MC1320x-EVB board. Wait for the LED1 and LED 2 to turn on. The network is now started.

Running ZeD

Before joining the other nodes to the network, run the ZeD Graphical User Interface by performing the following tasks.

1. Start ZeD from the Windows Start Menu at:

   ```
   Start -> Programs -> Freescale BeeKit -> ZeD v.v.v -> Freescale ZeD v.v.v
   ```

   or by using the Freescale ZeD application shortcut on the Windows desktop.

   In the above path examples, v.v.v designates a 3-digit version number, for example, 1.6.0. Health Care applications must be run using ZeD 1.6.0 or later

2. If ZeD is started for the first time, it displays a short introduction message on how to connect the DCU board (ZigBee Coordinator) to the PC as shown in Figure 9.

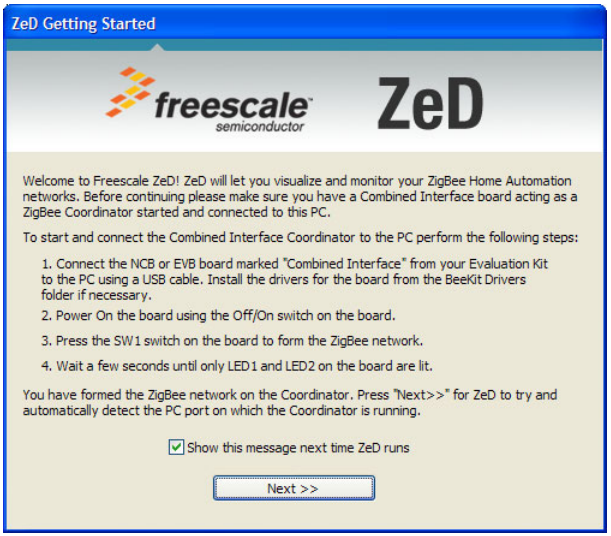

Figure 9. ZeD Getting Started Message

3. After pressing the Next>> button, ZeD tries to automatically detect the COM port that corresponds to the DCU board serving as the ZigBee Coordinator. Figure 10 shows the ZeD window as it tries to autodetect the DCU board.

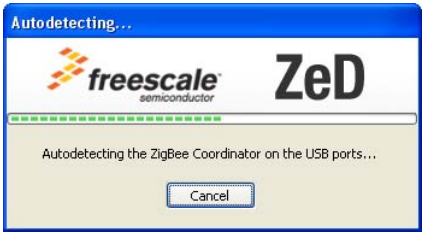

Figure 10. Automatic Detection of the ZigBee Coordinator Port

4. If the DCU board is detected, the board port is displayed in the list as having the type “ZigBee Coordinator (Autodetected)” as shown in the Coordinator Selection window (Figure 11).

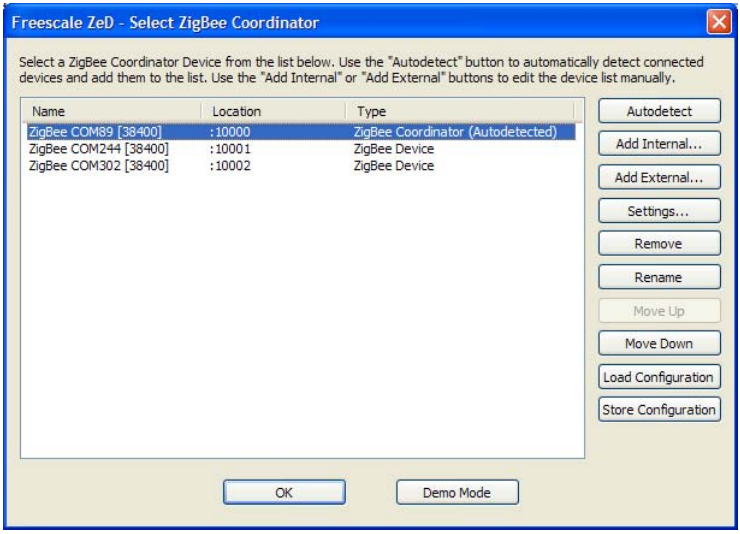

Figure 11. ZigBee Coordinator Selection Window

If no port appears in the list, or the first port in the list has the type “ZigBee Device” and not “ZigBee Coordinator (Autodetected)”, then ZeD has not been able to detect the coordinator board. If this occurs, check for the following:

- The board is properly connected via the USB cable to the PC and that the board drivers are correctly installed. See the *ZeD Software User’s Guide* for a detailed description of virtual board ports and how they are assigned.
- The ZigBee network is formed on the DCU coordinator board. LED1 and LED2 on the boards are on when the network is properly formed.
- There are no other instances of ZeD running on the PC.
- The port of the coordinator is not in use by other software such as Freescale Test Tool.

After checking these items, press the Autodetect button on the Coordinator Selection Window to repeat the Coordinator autodetection process.

5. Ensure that the COM port of the ZigBee Coordinator is highlighted and click the OK button. This launches the ZeD main window. ZeD connects to the ZigBee Coordinator and will use it as a gateway to find out information about the other nodes in the network. Once the coordinator application type is detected, the ZeD main view changes to reflect the fact that it has detected a Health Care Profile DCU as shown in Figure 12.

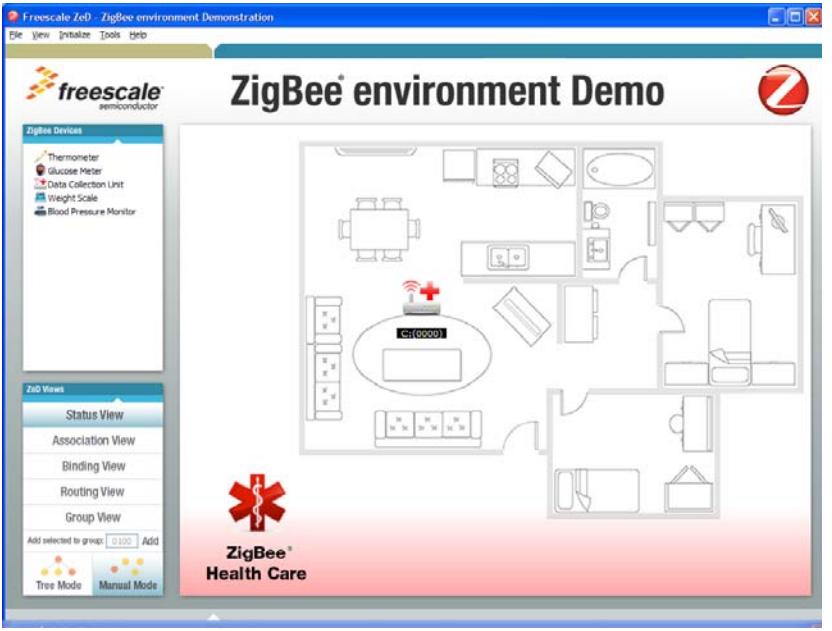

Figure 12. ZigBee Main Window After DCU Detection

Joining the Other Nodes to the Network

Users can now continue to form the Health Care ZigBee network by joining the other four boards.

1. Power on the other boards by connecting them to other USB ports or using AA batteries.
2. Turn ON the other boards using the OFF/ON switch.
3. Press SW1 on the Hc Thermometer MC1322x board or SW2 on the MC1320x-QE128 board. That board joins the network. When the board has joined, LED1 and LED2 on the board turn continuously on and the “Running Device” message is shown on the board LCD.

4. Wait until the node is detected in the ZeD GUI where it appears as a new icon as shown in Figure 13.

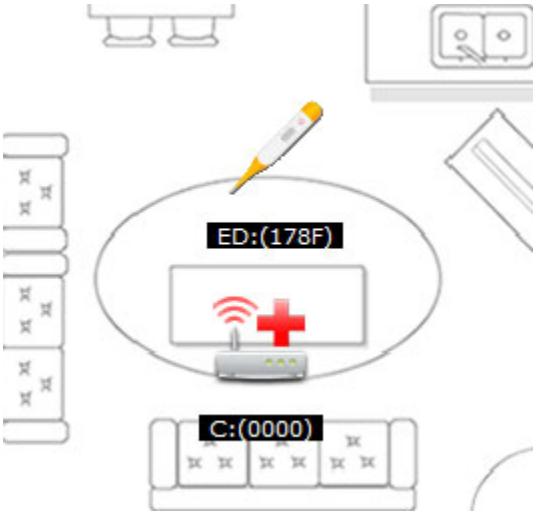

Figure 13. HcThermometer Joined the Network as a New Node

5. Press SW1 on the Hc WeightScale MC1322x board or SW2 on the MC1320x-QE128 board. The boards joins the network.
6. Wait until the node is detected in the ZeD GUI where it appears as a new icon as shown in Figure 14.

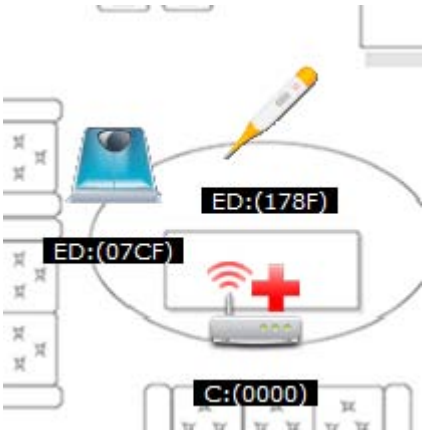

Figure 14. Hc WeightScale Joined the Network as a New Node

7. Press SW1 on the Hc BloodPressureMonitor MC1322x board or SW2 on the MC1320x-QE128 board.

8. Wait until the node is detected in the ZeD GUI where it appears as a new icon as shown in Figure 15.

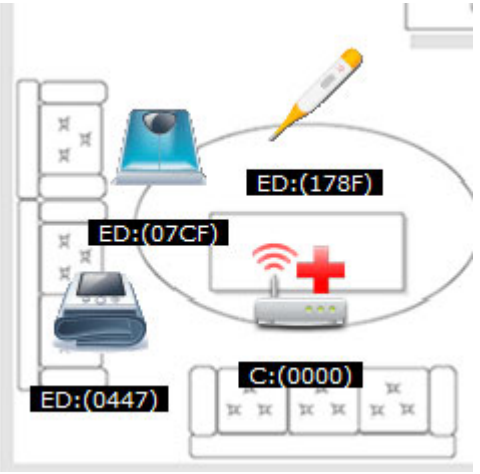

Figure 15. Hc BloodPressureMonitor Joined the Network as a New Node

9. Press SW1 on the Hc GlucoseMeter MC1322x board or SW2 on the MC1320x-QE128 board. That board joins the network. When the board has joined, LED1 on the board turns continuously on.
10. Wait until the node is detected in the ZeD GUI where it appears as a new icon as shown in Figure 16.

Figure 16. Hc GlucoseMeter Node

11. Users have now successfully formed a five node Health Care ZigBee network.

ZeD Use Case

This section describes how to use ZeD to initialize a standard Health Care scenario. The PC GUI will initialize the ZigBee Health Care tunnel connection between the DCU and each sensor Agent. Then the user can perform the simulated reading and sending of a sensor measurement to the DCU. The value of the measurement is shown in the ZeD GUI..

Use Case Requirements

Before running through the use case, follow the steps described in Forming a Network and Starting ZeD, to first form the five node network and run the ZeD GUI. The boards also must be placed in Application Mode as described in the following section.

Placing the Boards in Application Mode

This section describes how to place the boards in Application Mode so that the user interface on the boards can perform application specific functions. After starting the network or being joined to a network, the boards are in Configuration Mode and the switches on the boards have functions related to the network formation process. By placing the boards in Application Mode, the functions of the switches and change to application related functions.

For example, in Application Mode, SW3 on the Health Care MC1322x agent boards or SW4 on the MC1320x-QE128 agent boards performs the sending of the simulated sensor measurement to the DCU. Refer to the ZigBee Application User Guide for more details on the user interface of the boards.

To switch between board modes, press and hold SW1 on each board for about two seconds.

When the boards go from Configuration Mode to Application Mode, there should be a change in the state of the LED1 on the board which goes off. For all the Network Node boards, the second line of the LCD displays “App” instead of “Cfg”.

Initializing the ZHC Tunnel and IEEE 11073 Association

This section shows how ZeD can be used to establish ZHC Tunnel connections between the Agent devices and the DCU and exchange association messages at the IEEE 11073 level. To initialize the agent connections and perform association:

1. From the ZeD menu bar choose Initialize -> Associate ZHC Agents as shown in Figure 17.

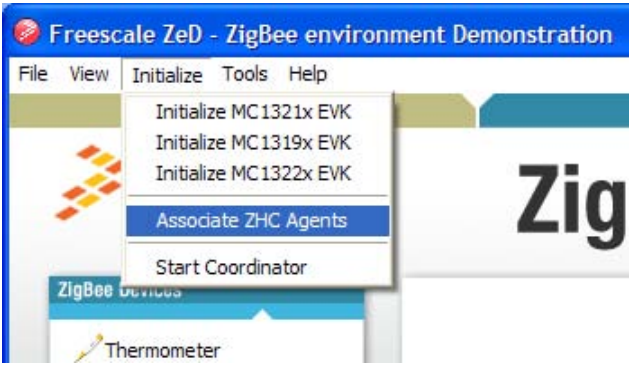

Figure 17. Initializing the Agent Connections

2. Wait until the initialization process completes and the pop-ups with the "Associating Health Care Agents. Please Wait..." message disappears.

Visualizing Sensor Measurements

To visualize sensor measurements from the ZHC agents, perform the following steps after the initialization shown in the previous section. This example uses the Thermometer agent.

1. Place the agent board in application mode as shown in Placing the Boards in Application Mode. (LED 1 should switch off and the LCD will display "App" instead of "Cfg").

2. Double click the Thermometer icon in the ZeD GUI house plan and select the Thermometer tab in the property window. The tab window will show the agent image and the instantaneous measurement values as shown in Figure 18.

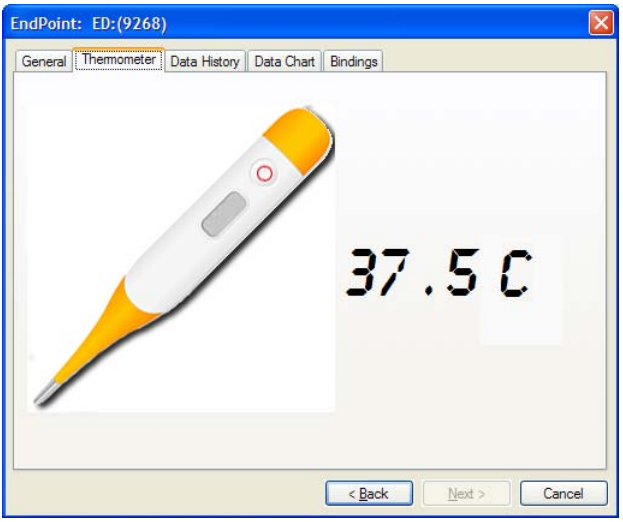

Figure 18. Visualizing Measurements

4. Press SW3 on the MC1322x Thermometer board or SW4 on the MC1320x-QE128 Thermometer board. A temperature measurement shall be sent over the air.
5. The measurement is shown in the Temperature tab on the ZeD GUI.
6. Press SW1 or SW2 on the MC1322x Thermometer board or SW2 or SW3 the MC1320x-QE128 Thermometer board to increase and decrease the simulated value of the temperature.
7. Press SW3 (or SW4 on the QE128 board) again to send the new value of the measurement. The value will update on the Temperature tab.

8. Select the Data Chart tab in the Thermometer property window to view a graph chart of the received measurement values as shown in Figure 19.

Figure 19. Measurement Data Chart

9. Select the Data History tab in the Thermometer property window to view a list view of the received measurement values as shown in Figure 20.

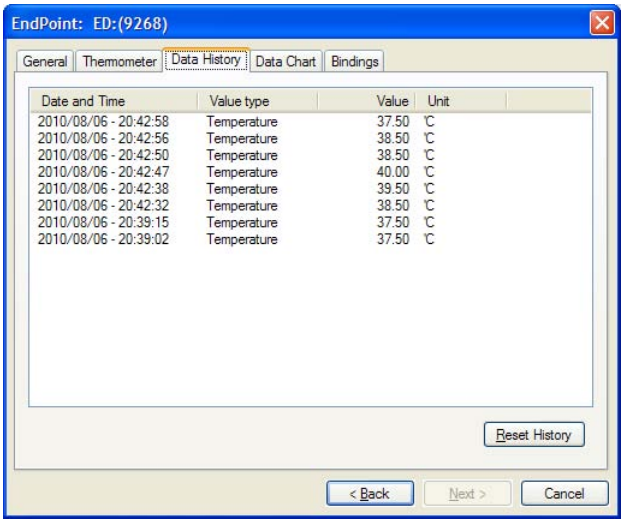

Figure 20. Measurement Data History

Using the CESL Continua Manager GUI with BeeStack Agents

The CESL Continua Manager GUI is a user interface used for simulating an IEEE 11073 Manager device. ZeD can be used as a gateway to connect Freescale ZigBee Health Care agent nodes to the Continua Manager running on the local host or on a networked PC. To connect a ZigBee Health Care agent to the Continua Manager perform the following steps:

1. Start a network on a DCU ZTC Host node and join the agent node as shown in Joining the Other Nodes to the Network.
2. Start the Continua Manager GUI software as shown in Figure 21 and click the “Start Transport” button.

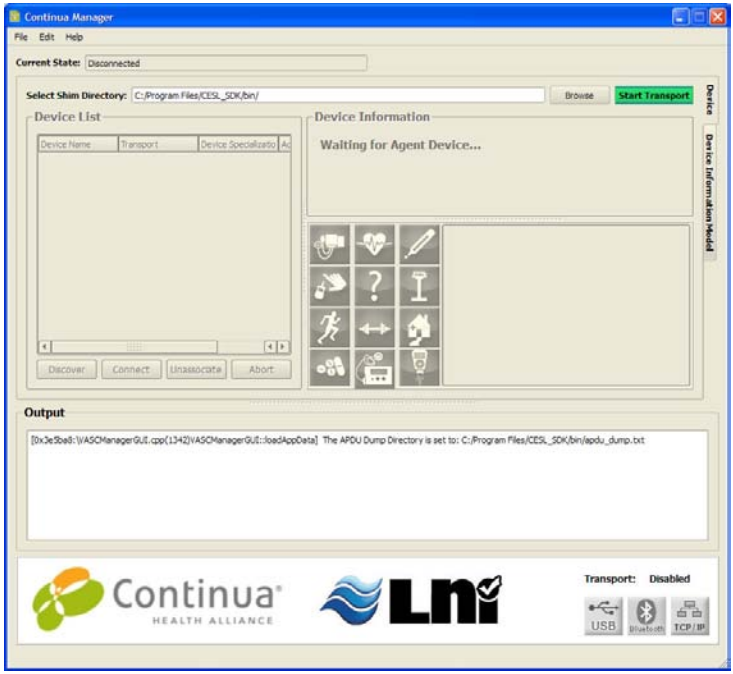

Figure 21. Continua Manager

4. From the ZeD menu bar choose Tools -> Options and choose the Advanced tab in the Options dialog as shown in Figure 22.

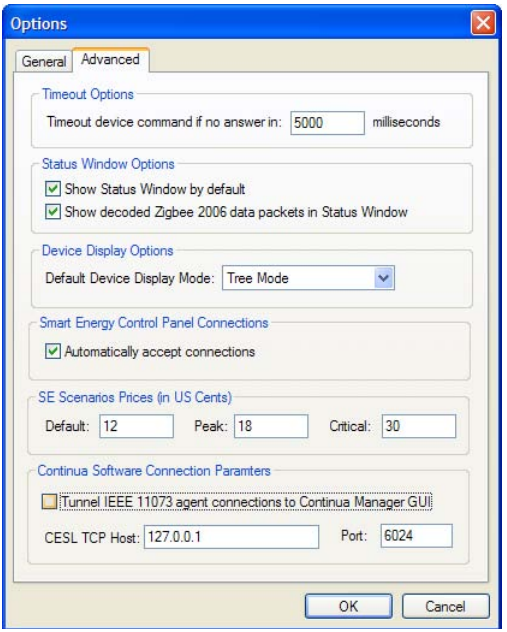

Figure 22. ZeD Options

6. Check the “Tunnel IEEE 11073 agent connections to Continua Manager GUI” check box.
7. Ensure the TCP connection parameters to the Continua Manager GUI are correct. If the software runs on the same PC as the ZeD GUI and the default port settings have not been modified, the parameters should be 127.0.0.1 for the host and 6024 for the port.
8. Perform the ZHC tunnel initialization from the ZeD menu by choosing Initialize -> Associate ZHC Agents.

9. When the ZHC tunnel is created, the connection is automatically forwarded to the Continua Manager GUI over a TCP/IP link. The agent appears as connected and then associates to the CESL manager as shown in Figure 23.

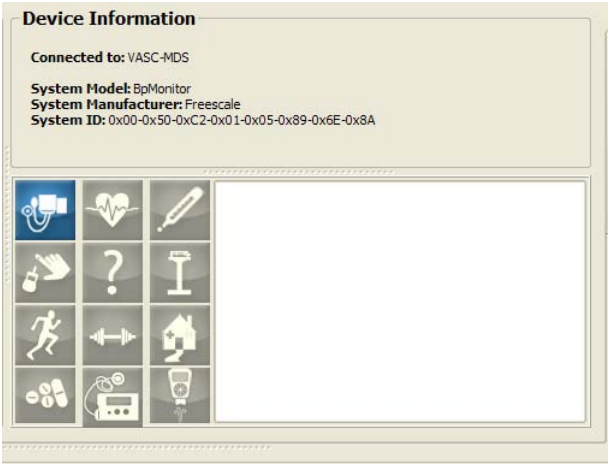

Figure 23. ZHC Blood Pressure Monitor Connected to Continua GUI

11. Use SW3 in application mode on the Agent board to send simulated sensor measurements from the agent to the manager. Notice how the values are received and displayed in the Continua Manager GUI as shown in Figure 24.

Figure 24. Blood Pressure Monitor Measurement Values

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