TI Designs Sub-1GHz Low Cost Mesh Network Design Guide



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Design Resources

TIDU546A
MSP430G2533
CC1101

Tool Folder Containing Design Files Product Folder Product Folder



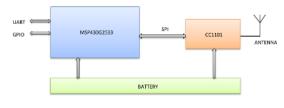
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Design Features

- Self-organization, self-maintenance, no manual collocation needed
- Multi-hop communication to enlarge network coverage
- Multi-routed to avoid the effect of the failure of a single node
- Low cost, low power consumption
- Combination of on-demand query and periodical report
- Turnkey solution for IoT applications

Featured Applications

- Building Automation
- Factory Automation and Control







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1 System Description

This solution uses the MSP430G2533 and CC1101 to implement a mesh network within the sub-1 GHz frequency band.

1.1 MSP430G2533

The Texas Instruments MSP430 family of ultra-low power microcontrollers consists of several devices, featuring different sets of peripherals targeted for various applications. The architecture, combined with five low power modes, is optimized to achieve extended battery life in portable measurement applications. The device features a powerful 16-bit RISC CPU, 16-bit registers, and constant generators that contribute to maximum code efficiency. The digitally-controlled oscillator (DCO) allows wake-up from low-power modes to active mode in less than 1 μ s.

The MSP430G2x33 series are ultra-low-power mixed signal microcontrollers with built-in 16-bit timers, up to 24 I/O capacitive-touch enabled pins, and a built-in communication capability using the universal serial communication interface. In addition, the MSP430G2x33 family members have a 10-bit A/D converter.

Typical applications include low-cost sensor systems that capture analog signals, convert them to digital values, and then process the data for display or for transmission to a host system.

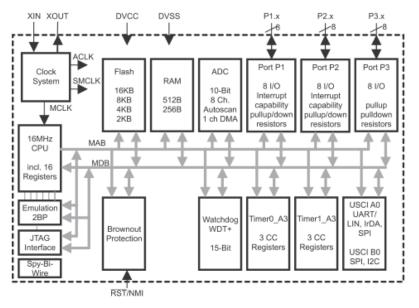


Figure 1. Functional Block Diagram, MSP430G2x33

1.2 CC1101

2

The CC1101 is a low-cost sub-1 GHz transceiver designed for low power wireless applications. The circuit is primarily intended for the ISM (Industrial, Scientific and Medical) and SRD (Short Range Device) frequency bands at 315, 433, 868, and 915 MHz, but can easily be programmed for operation at other frequencies in the 300-348 MHz, 387-464 MHz and 779-928 MHz bands.

The RF transceiver is integrated with a configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 600 kbps. The CC1101 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio.

The main operating parameters and the 64-byte transmit/receive FIFOs of the CC1101 are controlled using an SPI interface. In a typical system, the CC1101 is used together with a microcontroller and a few additional passive components.



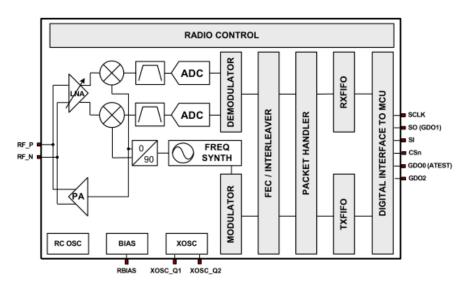
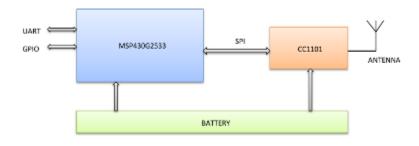


Figure 2. CC1101 Simplified Block Diagram

2 Block Diagram





3 System Design Theory

There are two kinds of devices in the network, a master node and several slave nodes. The master node is used as data collector. There is only one master node in each network. The master node establishes, manages, and maintains the network. The master node stores connection link information of the entire network for routing wireless packets.

Typically, a slave node is connected to one or more sensors. A slave node gets desired information from associated sensors and sends the sensing data through the network to the master node. The number of slave nodes depends on the size of the network. Routing data is not stored in slave nodes. The only information stored in a slave node is the address of its father-node, which is used when actively reporting time-sensitive data, such as an alarm.

On-demand query and periodical active report are supported when the communications in the network are divided into two parts, the downlink and uplink. Downlink contains all communications initiated by the master node. Uplink contains all communications initiated by the slave nodes.



3.1 Master Initiated Operation

After power on, the master node broadcasts a discovery frame. The slave node that receives this broadcast frame joins the network and marks itself as an in-net slave node, and responds to the sender. Periodically, the master node resends the broadcast frame and calls all in-net slave nodes in turn, to broadcast for new nodes and new connections. The master node maintains a link table, which records connections between every two nodes in the network. The master node uses this link table to get the route from the master node to each slave node.

The master node can call any in-net slave node to query for its data. The query frame contains the entire route from the master node to the slave node, including intermediate relay slave nodes. The queried slave node responds with its data to the master node by reversing the route contained in the query frame.

3.2 Slave Initiated Operation

After power on, the slave node broadcasts a join request frame. When the master node or any in-net slave node receives this request frame, it replies with a join response, and reports this newly-established connection to the master node. After receiving the join response, the requesting slave node marks itself as an in-net slave node.

An in-net slave node can actively report data to the master node periodically. The slave node forwards the data frame to its father node (the node which allows it to join the network). The receiver also forwards the data frame to the father node of the receiver. Eventually the data frame is forwarded to the master node.

4



4 Getting Started Hardware

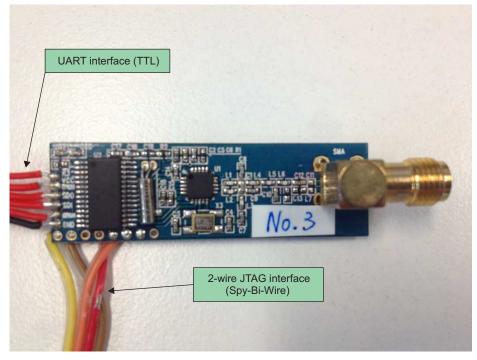


Figure 4. JTAG Connection and UART Connection

4.1 JTAG Connection

To download the program into flash, use the connections between PCBA and JTAG listed in Table 1:

Table 1. PCBA and JTAG Connections

РСВА	JTAG
VCC (Pin-1, Yellow)	VCC_TOOL (Pin-2)
GND (Pin-2, Brown)	GND (Pin-9)
TEST (Pin-5, Red)	TCK (Pin-7)
RESET (Pin-6, Orange)	TDO/TDI (Pin-1)

4.2 UART Connection

To observe network performance, the master node prints topology information and received data through UART. Use the connections between PCBA and PC listed in Table 2. Note: the UART uses TTL level, and should be converted to the RS232 level before the PC can recognize it.

Table 2. PCBA and UART Connections

PCBA	PC UART
SDO (Pin-3)	RXD
SDI (Pin-4)	TXD
GND (Pin-6)	GND

Getting Started Firmware

5 Getting Started Firmware

Follow the steps below to download the firmware into flash.

5.1 Open IAR Project

Double click the project file, and open the project.

New folder			
Name	Date modified	Туре	Size
퉬 Debug	2014-11-14 13:50	File folder	
🔒 Lib	2014-11-14 13:50	File folder	
🌗 Master	2014-11-14 13:51	File folder	
settings	2014-11-14 13:58	File folder	
퉬 Slave	2014-11-14 13:55	File folder	
퉬 Source	2014-11-14 14:03	File folder	
Mesh Network.dep	2014-11-14 14:04	DEP File	4 KB
Mesh Network.ewd	2014-11-14 14:00	EWD File	22 KB
Mesh Network.ewp	2014-11-14 14:02	EWP File	58 KB
Mesh Network	2014-11-14 13:52	IAR IDE Workspace	1 KB
📄 path	2014-11-14 14:03	TXT File	0 KB

Figure 5. Project File Folder

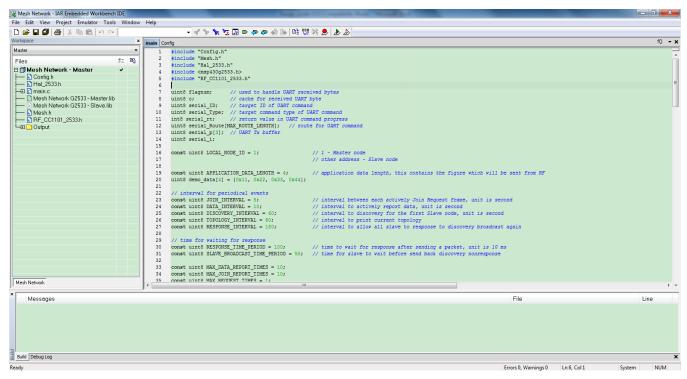


Figure 6. IAR Project

5.2 Master Node

To download firmware into the master node, follow these steps:

- 1. Select the Master configuration in the ComboBox (See Figure 7)
- 2. Comment line 5 in Config.h. (See Figure 8)
- Change the value of constant LOCAL_NODE_ID to 1 to assign node address to master node. (See Figure 9) (Note: The master node should be assigned address 1, and address 0 is reserved for broadcast address. Slave nodes can use addresses 2 255.)
- 4. Rebuild the project and download into Flash of the master node.

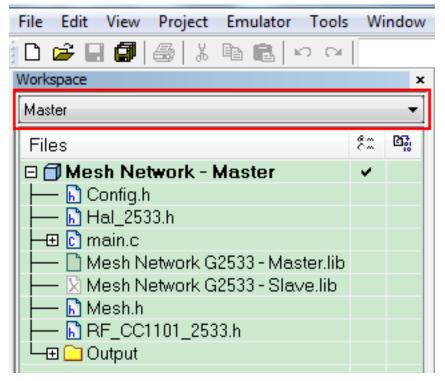


Figure 7. Select Master Configuration

7

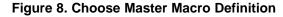
Getting Started Firmware



Getting Started Firmware

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🔀 Mesh Network - IAR Embedded Workbench IDE		
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Master 👻	I #ifndef_CONFIG_H_	
Files 8: Bi	2 #define _CONFIG_H_	Â
🗆 🗇 Mesh Network - Master 🗸 🗸	3 3 4 define MASTER	
Config.h	5 // #define SLAVE	
- 🔁 Hal_2533.h	6	
Hesh Network G2533 - Master,lib	7 //+define SHIFTER	
Mesh Network G2533 - Master.lib	5 9 #define MAX NODE NUMBER 8 // max number of support node in the network	
Mesh.h	10 #define MAX NODE NUMBER DIV8 (uint8) (MAX NODE NUMBER - 1) / 8 + 1)	
- RF_CC1101_2533.h	11	
Let 🖸 Output	12 ////////////////////////////////////	E
	13 // Standard Defines	
	15 // Steinder bernies	
	16 ////////////////////////////////////	
	17 the fif !defined(FALSE)	
	18 define FALSE 0	
	20 sendif	
	21 + if !defined (TRUE)	
	22 #define TRUE (!FALSE)	
	23 - #endif	
	24 25 = #12 idefined (NULL)	
	25 #1 :0erine(NOLD) 26 #define NUL (void *)0	
	27 - endif	
	28	
	29 typedef signed char int8;	
	30 typedef unsigned char uints;	
	32 typedef signed short int16;	
	33 typedef unsigned short uintl6;	
	34	
Mesh Network	35 tymedef signed long int.32:	
×		
Messages	File	Line
Buid Debug Log		×
Ready	Errors 0, Warnings 0 Ln 4, Col 19	System NUM



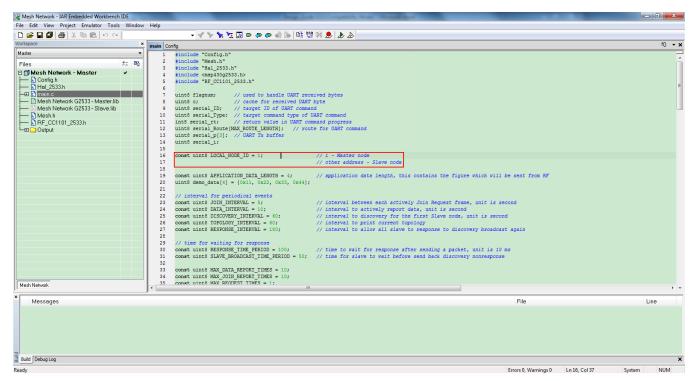


Figure 9. Assign Node ID to Master Node

5.3 Slave Node

To download firmware into slave nodes, follow these steps:



- 1. Select the Slave configuration in the ComboBox. (See Figure 10)
- 2. Comment line 4 in Config.h. (See Figure 11)
- Change the value of constant LOCAL_NODE_ID to desired node ID to assign node address to each slave node. (See Figure 12) (Note: The master node should be assigned address 1, and address 0 is reserved for broadcast address. Slave nodes can use addresses 2 – 255.)
- 4. Rebuild the project and download into Flash of each slave node.

Workspace		×
Slave		-
Files	23	C.
🗆 🗇 Mesh Network - Slave	¥.	
📙 🔚 Config.h		
├ 🔓 Hal_2533.h		
Hain.c		
📙 🖂 Mesh Network G2533 - Master.lib		
📙 📄 Mesh Network G2533 - Slave.lib		
⊨ 🔓 Mesh.h		
🖵 🕀 🗀 Output		

Figure 10. Select Slave Configuration

Kesh Network - IAR Embedded Workbench IDE	Property and property of the second sec	
File Edit View Project Emulator Tools Window		
D 😅 🖬 🕼 🎒 👗 🗞 🛍 🛍 🗠 🗠	- 🖌 🏷 🧏 🖾 🖻 🧔 🧔 🎯 🏟 📾 🖤 🏶 🤌 🤌 🖉	
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Slave -		
Files 8: Big	2 #define_CONFIG H_	Â
Mesh Network - Slave		
Config.h	4 2/define MASTER 5 define SLAVE	
Hand 🔁 🖸 main.c 🔹	7 //#define SNIFFER	
Mesh Network G2533 - Master.lib	8	
Mesh Network G2533 - Slave.lib	9 #define MAX_NODE_NUMBER 8 // max number of support node in the network 10 #define MAX_NODE_NUMBER_DIV8 (uint8)((MAX_NODE_NUMBER - 1) / 8 + 1)	
RF_CC1101_2533.h		
	12 ////////////////////////////////////	-
	14 // Standard Defines 15 //	
	17 🖶 #if !defined (FALSE)	
	18 #define FALSE 0	
	19 • tendif 20	
	21 #if !defined(TRUE)	
	22 define TRUE (IFALSE)	
	23 - #endif	
	24	
	25 → #if idefined (NULL) 26 → #define NULL (vold *10	
	20 + dendif 27 + dendif	
	28	
	29 typedef signed char int8;	
	30 typedef unsigned char uint8; 31	
	31 32 typedef signed short int16;	
	33 typedef unsigned short uint16;	
	34	
Mesh Network	35 typedef signed long int32:	
×		
Messages	File	Line
Build Debug Log		×
Ready	Errors 0, Warnings 0 Ln 4, Col 3	System NUM

Figure 11. Choose Slave Macro Definition

9



Getting Started Firmware

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Hep • * * * * * * * * * * * * * * * * * * *	後 1999 96 🕭 🐌 🕹	f0
<pre>main * Confg *</pre>		f0
1 #include "Config.h" 2 #include "Mesh.h"		10
2 #include "Mesh.h"		
4 #include <msp430g2533.h></msp430g2533.h>		
5 #include "RF_CC1101_2533.h"		
6		
7 uint8 flagnum; // used to handle UART	received bytes	
	route for UART command	
16 const uint8 LOCAL NODE ID = 2;	// 1 - Master node	
17	// other address - Slave node	
18		
<pre>19 const uint8 APPLICATION_DATA_LENGTH = 4;</pre>	// application data length, this contains the figure which will	be sent from RF
	44};	
	and the second	
		cona
		a d
		14
		t again
	,, include to deloy del bidye to response to descovery broadeds	o uguza
30 const uint8 RESPONSE TIME PERIOD = 100;	// time to vait for response after sending a packet, unit is 10	ns
32		
35 const wints MAX REQUEST TIMES = 1:	III	
		File Line
	<pre>6 7 uinc8 flagnum; // used to handle UARF 8 uinc8 c; // cache for received 9 uinc8 serial [D; // target D of UART ci 10 uinc8 serial_Type; // target D of UART ci 10 uinc8 serial_Type; // target D of UART ci 11 uinc8 serial_Noure(MAX_ROUTE_LENGTH); // 13 uinc8 serial_Noure(MAX_ROUTE_LENGTH); // 14 uinc8 serial_Noure(MAX_ROUTE_LENGTH); // 15 const uint8 LOCAL_NODE_ID = 2; 15 16 const uint8 LOCAL_NODE_ID = 2; 17 17 18 const uint8 LOCAL_NODE_ID = 2; 17 19 const uint8 LOCAL_NODE_ID = 2; 17 19 const uint8 LOCAL_NODE_ID = 2; 19 const uint8 LOCAL_NODE_ID = 2; 19 const uint8 LOCAL_NODE_ID = 2; 10 const uint8 LOCAL_NODE_ID = 2; 10 const uint8 LOCAL_NODE_ID = 6; 10 const uint8 DATON_NITERVAL = 5; 10 const uint8 DATONE_INTERVAL = 60; 10 const uint8 DEFOUSE_INTERVAL = 60; 11 const uint8 ESFOUSE_INTERVAL = 60; 12 const uint8 ESFOUSE_INTERVAL = 60; 13 const uint8 ESFOUSE_INTERVAL = 60; 14 const uint8 ESFOUSE_INTERVAL = 60; 15 const uint8 ESFOUSE_INTERVAL = 60; 16 const uint8 ESFOUSE_INTERVAL = 60; 17 const uint8 ESFOUSE_INTERVAL = 60; 18 const uint8 ESFOUSE_INTERVAL = 60; 19 const uint8 ESFOUSE_INTERVAL = 60; 19 const uint8 ESFOUSE_INTERVAL = 60; 10 const uint8 ES</pre>	<pre> uintS flagnum;</pre>

Figure 12. Assign Node ID to Slave Node



6 Test Setup

In this test, a master node (addressed No.1) and 7 slave nodes (addressed No.2 – No.8) are used in this demo.

6.1 GUI

Open the GUI, select the proper COM port, set the baud rate to 9600, and click Open to open the COM port. COM Data area displays all frame master node receives. Query command and maintenance information also display in this area. Received Data area displays decoded data frame master node receives. The Link Table area displays all connections established between each two nodes in the network. The Route Table area displays routes from the master node to each slave node.

MainWindow			F	
Received Data	Show Active Data	Serial Port Configuration Com COM1 • Open BaudRate 9600 • Close	COM Data 🔍 Sh	ow COM Data
		Data Query Node ID 0x02 • Query Route Table		
Link Table	☑ Show Link Table	Koute Table		

Figure 13. GUI

Test Setup



Test Setup

6.2 Power On

Switch on master node and all slave nodes. The network is set up automatically immediately after all nodes power on. Slave nodes actively try to join the network. Nodes which are already in-net report new connections to the master node.

MainWindow		
Received Data Show Active	Data Serial Port Configuration	COM Data
	Com COM4 • Open	AA AA 05 00 04 80 00 00 BB BB AA AA 05 00 03 80 00 00 BB BB
	BaudRate 9600 - Close	AA AA 07 01 04 82 00 00 04 03 BB BB AA AA 05 00 02 80 00 00 BB BB New node join
	Data Querri	AA AA 07 01 03 82 00 00 03 02 BB BB AA AA 07 01 01 04 82 00 00 04 02 BB BB AA AA 05 00 06 80 00 00 BB BB
	Data Query	AA AA 07 01 04 82 00 00 04 06 BB BB AA AA 07 01 04 82 00 00 04 06 BB BB new connection report
	Node ID 0x02 • Query	AA AA 05 00 05 80 00 00 BB BB AA AA 07 01 06 82 00 00 06 05 BB BB
	Route Table Show Route Table	AA AA 07 01 04 82 00 00 04 05 B8 BB AA AA 07 01 04 82 00 00 04 05 B8 BB
Link Table	ble	AA AA 07 01 04 82 00 00 04 05 B8 BB F AA AA 07 01 04 82 00 00 04 05 B8 BB
		AA AA 07 01 04 82 00 00 04 05 BB BB AA AA 05 00 07 80 00 00 BB BB
		AA AA 07 01 04 82 00 00 04 07 BB BB
		AA AA 07 01 06 82 00 00 06 07 BB BB
		AA AA 07 01 06 82 00 00 06 07 BB BB AA AA 07 01 06 82 00 00 06 07 BB BB
		AA AA 07 01 03 82 00 00 03 06 BB BB
		AA AA 07 01 06 82 00 00 06 08 BB BB
		AA AA 07 01 05 82 00 00 05 07 BB BB
		AA AA 07 01 03 82 00 00 03 06 BB BB AA AA 07 01 05 82 00 00 05 07 BB BB
		AA AA 07 01 03 82 00 00 03 07 88 88
		AA AA 07 01 05 82 00 00 05 07 BB BB
		AA AA 07 01 04 82 00 00 04 07 BB BB *

Figure 14. Power On



7 Test Data

7.1 Initial Topology

All nodes join the network quickly after power on. The initial topology is established and maintained by the master node. Routes are found from the master node to each slave node.

MainWindow		and handle have	
Received Data	Social Port Configuration	COM Data	
(V) SHOW ACTIVE LIBOR	Serial Port Configuration		Show COM Data
2014-09-01 10:53:32 No.08 88 88 88 88 active report	Com COM4 Open	AA AA 07 01 05 82 00 00 05 07 BB BB AA AA 07 01 03 82 00 00 03 06 BB BB	1
	BaudRate 9600 • Close	AA AA 07 01 05 82 00 00 05 07 BB BB AA AA 07 01 04 82 00 00 04 07 BB BB	
		AA AA 07 01 04 82 00 00 04 08 BB BB AA AA 07 01 03 82 00 00 03 06 BB BB AA AA DD 08 11 11 11 11 11 11 180 11 11	80.80.80.80
	Data Query	11 80 11 80 80 11 11 11 11 11 11 10 11 11 AA AA 07 01 02 02 00 01 02 01 88 88	
	Node ID 0x02 • Query	AA AA 07 01 03 02 00 01 03 01 BB BB AA AA 07 01 06 02 00 01 06 01 BB BB	
	Route Table Show Route Table	AA AA 08 01 02 02 00 02 06 02 01 BB BB AA AA 07 01 02 03 00 01 02 01 BB BB	topology information
Link Table Show Link Table	01>02 01>03	AA AA 08 01 03 02 00 02 05 03 01 BB BB AA AA 07 01 03 03 00 01 03 01 BB BB	
0102 0103 0104 0105 0106 0107 0203 0204	01>04 01>05 01>06	AA AA 08 01 04 02 00 02 02 04 01 B8 B8 AA AA 08 01 04 02 00 02 07 04 01 B8 B8	
0304 0306 0405 0406 0407 0408	01>07 01>04>08	AA AA 07 01 04 03 00 01 04 01 BB BB AA AA 08 01 05 02 00 02 04 05 01 BB BB AA AA 08 01 05 02 00 02 06 05 01 BB BB	
0506 0507 0607 0608		AA AA 07 01 05 03 00 01 05 01 05 08 BB AA AA 08 01 06 02 00 02 05 06 01 BB BB AA AA 08 01 06 02 00 02 05 06 01 BB BB	
		AA AA 0A 01 02 84 00 00 08 88 88 88 88 AA AA 07 01 06 03 00 01 06 01 BB BB	BB BB
	route from	Master to each Slave BB BB	
all useful connections	Todie from	AA AA 08 01 04 03 00 02 08 04 01 BB BB	
			-

Figure 15. Initial Topology

7.2 Topology with More Connections

More connections are established by discovery, initiated by the master node. Each slave node actively reports data to the master node every minute.

eceived Data	Show Active Data	Serial Port Configurat		COM Data	Show COM Data
014-09-01 10:53:32 No.08 88 88 88 88 014-09-01 10:54:12 No.07 77 77 77 77 77 77 77 77 014-09-01 10:54:14 No.07 77 77 77 77 77 014-09-01 10:54:16 No.05 55 55 55 014-09-01 10:54:16 No.04 44 44 44 014-09-01 10:54:16 No.04 44 44 44 014-09-01 10:54:17 No.03 33 33 33 014-09-01 10:54:18 No.02 22 22 22 22 actively report d ink Table 11-02 0103 0104 0105 0106 1 2-03 0204 0206 0207 304 03-05 0306 405 0406 0407 0408 5-06 0507 607 0608	a ctive report cti	Com COM4 BaudRate 9600 Data Query Node ID 0x02 Route Table 01>02 01>03 01>04 01>08	Open Close Query	AA AA 07 01 03 02 00 01 02 01 18 B B AA AA 08 01 04 02 00 02 02 04 01 B AA AA 08 01 04 02 00 02 07 04 01 B AA AA 08 01 04 02 00 02 07 04 01 B AA AA 08 01 05 02 00 02 04 05 01 B AA AA 08 01 05 02 00 02 06 05 01 B AA AA 08 01 05 02 00 02 06 05 01 B AA AA 08 01 05 02 00 02 05 06 01 B AA AA 08 01 00 22 00 02 05 06 01 B AA AA 08 01 00 28 400 00 08 88 88 AA AA 07 01 02 84 00 00 08 88 88 AA AA 07 01 07 02 00 02 06 07 01 B AA AA 08 01 07 02 00 02 06 07 01 B AA AA 08 01 07 02 00 02 06 07 01 B AA AA 08 01 07 02 00 02 06 07 01 B AA AA 08 01 07 84 00 00 07 77 77 AA AA 08 01 02 84 00 00 05 55 55 AA AA 08 01 07 84 00 00 07 77 77 AA AA 08 01 03 84 00 00 02 22 22 AA AA 08 01 11 11 11 11 11 18 01 AA AA 07 01 02 84 00 00 02 22 22 AA AA 00 01 12 84 00 00 02 22 22 AA AA 00 01 12 84 00 00 02 22 22 AA AA 00 01 12 84 00 00 02 22 22 AA AA 00 01 12 84 00 00 02 22 22 AA AA 00 01 11 11 11 11 11 18 00 AA AA 07 01 02 03 00 01 02 01 B B AA AA 07 01 02 03 00 01 02 01 B B AA AA 07 01 02 03 00 01 03 01 B B AA AA 07 01 03 30 00 103 01 B B B AA AA 07 01 04 03 00 01 30 18 B B AA AA 07 01 03 30 00 103 01 B B B AA AA 07 01 03 30 00 103 01 B B B AA AA 07 01 03 30 00 103 01 B B B AA AA 07 01 03 30 00 103 01 B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA AA 07 01 03 30 00 103 01 B B B B AA 00 01 03 00 00 01 30 1B B B B B AA 00 01 03 00 00 01 30 1B B B B B AA 00 01 03 00 00 01 30 1B B B B B AA 00 01 03 00 00 01 30 1B B B B B AA 00 01 03 00 00 01 30 1B B B B B AA 00 01 03 00 00 01 30 1B B B B B AA 00 01 03 00 00 01 30 00 00 01 B B B B AB 00 00 01 03 01 00 01 B B B B B AB 00 00 01 03 00 00 01 00 01 B B B B B 00 00 00 00 00 00 00 00 00 00 00 0	8 BB 8 BB
more connecti		I topology		AA AA 07 01 05 03 00 01 05 01 BB BB	3

Figure 16. Topology with More Connections



Test Data

7.3 Respond Discovery Broadcast

Each slave node is called by the master node to generate a discovery broadcast and find more connections. Any new connections are reported to the master node.

eceived Data		Show Active Data	Serial Po	rt Configura	tion	COM Data	Show COM Dat
014-09-01 10:54:16 No.05	55 55 55 55					AA AA 0A 01 07 84 00 00 07 77 77 7	77 77 BB BB
014-09-01 10:54:16 No.04	44 44 44 44	active report	Com	COM4 ·	Open	AA AA 0A 01 06 84 00 00 06 66 66 6	66 66 BB BB
014-09-01 10:54:17 No.03	33 33 33 33	active report				AA AA 0A 01 05 84 00 00 05 55 55 5	55 55 BB BB
	22 22 22 22		BaudRate	9600 •	Close	AA AA 0A 01 04 84 00 00 04 44 44 4	44 44 BB BB
014-09-01 10:54:32 No.08	88 88 88 88	active report		5000		AA AA 0A 01 03 84 00 00 03 33 33 3	33 33 BB BB
014-09-01 10:55:14 No.07		active report				AA AA 0A 01 02 84 00 00 02 22 22 2	22 22 BB BB
14-09-01 10:55:14 No.06	66 66 66 66	active report	Data Qu	erv		AA AA DD 08 11 11 11 11 11 11 80	11 11 80 11 11 80
14-09-01 10:55:15 No.05			Duta Qu	,		11 11 11 80 80 11 11 11 11 11 180	0 11 11 80 BB BB
014-09-01 10:55:16 No.04						AA AA 07 01 02 02 00 01 02 01 BB E	
14-09-01 10:55:17 No.03			Node ID	0x02 •	Query	AA AA 07 01 03 02 00 01 03 01 BB E	BB
	22 22 22 22	active report				AA AA 07 01 06 02 00 01 06 01 BB E	BB
14-09-01 10:55:32 No.08						AA AA 08 01 02 02 00 02 06 02 01 E	38 BB
	Slave n	node respon	ds to Disc	covery Bro	adcast	AA AA 07 01 02 03 00 01 02 01 BB B	BB
nk Table	0.0.00	io de reepen				AA AA 08 01 03 02 00 02 06 03 01 B	38 BB
пктаріе			01>04			AA AA 07 01 03 03 00 01 03 01 BB B	
102 0103 0104 01	05 0106 0	107				AA AA 08 01 04 02 00 02 02 04 01 E	
203 0204 0206 02	07		01>05 01>06			AA AA 08 01 04 02 00 02 07 04 01 E	
304 0305 0306			01>06			AA AA 07 01 04 03 00 01 04 01 BB B	
405 0406 0407 04	08		01>07			AA AA 08 01 05 02 00 02 04 05 01 B	
506 0507			01>04	>08		AA AA 08 01 05 02 00 02 06 05 01 E	
507 0608						AA AA 07 01 05 03 00 01 05 01 BB B	
						AA AA 08 01 06 02 00 02 05 06 01 B	
						AA AA 0A 01 02 84 00 00 08 88 88 8	
						AA AA 07 01 06 03 00 01 06 01 BB B	
						AA AA 08 01 07 02 00 02 05 07 01 E	
						AA AA 07 01 07 03 00 01 07 01 BB B	
						AA AA 09 01 04 02 00 03 06 08 04 0 AA AA 08 01 04 03 00 02 08 04 01 E	

Figure 17. Respond Discovery Broadcast

7.4 Data Request and Response

Each node can be queried for its data in an on-demand pattern.

MainWindow	THE R. P. LEWIS CO.	a literate i successi i literate il		
Received Data	Show Active Data	Serial Port Configuration	COM Data	
2014-09-01 10:55:32 No.08 88 88 88 2014-09-01 10:55:51 No.02 22 22 22 2014-09-01 10:55:55 No.08 88 88 88 2014-09-01 10:56:12 No.08 88 88 88 2014-09-01 10:56:13 No.07 77777 2014-09-01 10:56:15 No.05 55 55 55	88 active report - 22 88 active report 68 active report 6 66 active report 55 55 active report	Com COM4 Open BaudRate 9600 Close	AA AA 07 01 07 03 00 01 07 01 B8 B8 AA AA 09 01 04 02 00 03 06 08 04 01 B8 B8 AA AA 08 01 04 03 00 02 08 04 01 B8 B8 AA AA 08 01 04 03 00 02 08 04 01 B8 B8 AA AA 08 01 02 05 00 01 02 01 22 22 22 22 B8 B8 AA AA 0C 01 04 05 00 01 02 01 22 22 22 22 B8 B8 AA AA 0C 01 04 05 00 02 08 04 01 88 88 88 88 B8 B8	
2014-09-01 10:56:17 No.04 44 44 44 2014-09-01 10:56:17 No.03 33 33 33 2014-09-01 10:56:18 No.02 22 22 22 2014-09-01 10:56:48 No.02 22 22 22 2014-09-01 10:56:48 No.02 22 22 22	33 active report 22 active report 88	Node ID 0x02 • Query Route Table Show Route Table 01>02	AA AA 0A 01 02 84 00 00 08 88 88 88 88 88 BB BB AA AA 0A 01 07 84 00 00 07 77 77 77 77 78 BB AA AA 0A 01 06 84 00 00 66 66 66 66 BB BB AA AA 0A 01 05 84 00 00 05 55 55 55 55 BB BB AA AA 0A 01 05 84 00 00 04 44 44 44 44 BB BB AA AA 0A 01 03 84 00 00 03 33 33 33 38 BB BB AA AA 0A 01 03 284 00 00 02 22 22 22 22 BB BB	
Link Table 0102 0103 0104 0105 010 0203 0204 0206 0207 0304 0305 0306 0405 0406 0407 0408 0506 0507 0607 0608	I Show Link Table 6 0107	01>03 01>04 01>05 01>06 01>07 01>04>08	AA AA DD 08 11 11 11 11 11 11 80 11 11 80 11 11 80 11 11 11 80 80 11 11 11 11 11 11 80 11 11 80 88 88	ata requ
and data query request			AA AA 07 10 0 03 00 01 07 01 BB 3B 01 04 08 AA AA 08 01 04 07 00 02 08 04 01 BB 5B AA AA 08 01 04 03 00 02 08 04 01 BB 5B AA AA CC 08 04 BB 5B AA AA CC 01 04 05 00 02 08 04 01 3B 88 88 88 BB BB AA AA CC 02 04 BB BB AA AA CC 02 04 BB BB AA AA CC 02 04 BB BB	
			data	respons





7.5 New Route used between No.1 and No.8

The route between No.1 and No.8 is replaced, from No.1 -> No.4 -> No.8, to No.1 -> No.2 -> No.8, as a new connection between No.2 and No.8 is established.

eceived Data	Show Active Data	Serial Po	rt Configuratior	1		Show COM Data
014-09-01 11:01:13 No.06 66 66 66 66		~	COM4 •	Open	AA AA 08 01 04 02 00 02 07 04 01 BB BB	
014-09-01 11:01:14 No.05 55 55 55 55		Com	COM4 *		AA AA 08 01 04 02 00 02 08 04 01 BB BB	
014-09-01 11:01:15 No.04 44 44 44 44 014-09-01 11:01:16 No.03 33 33 33 33		0			AA AA 07 01 04 03 00 01 04 01 BB BB	
014-09-01 11:01:16 No.03 53 53 53 53 014-09-01 11:01:17 No.02 22 22 22 22		BaudRate	9600 •	Close	AA AA 08 01 05 02 00 02 04 05 01 BB BB	
014-09-01 11:01:17 No.02 22 22 22 22 22 22 22 22 22 22 22 22 2					AA AA 08 01 05 02 00 02 06 05 01 BB BB	
014-09-01 11:02:11 N0:08 88 88 88 88 014-09-01 11:02:12 No:07 77 77 77 77					AA AA 07 01 05 03 00 01 05 01 BB BB AA AA 08 01 06 02 00 02 05 06 01 BB BB	
014-09-01 11:02:12 No.07 77777777		Data Qu	ery			
14-09-01 11:02:14 No.05 55 55 55 55					AA AA 07 01 06 03 00 01 06 01 BB BB AA AA 08 01 07 02 00 02 06 07 01 BB BB	
014-09-01 11:02:14 No.03 55 55 55 55 014-09-01 11:02:15 No.04 44 44 44 44		Node ID	0x02 •	Query	AA AA 08 01 07 02 00 02 06 07 01 BB BB AA AA 08 01 07 02 00 02 02 07 01 BB BB	
014-09-01 11:02:16 No.03 33 33 33 33		NODE ID		Query	AA AA 08 01 07 02 00 02 02 07 01 BB BB AA AA 07 01 07 03 00 01 07 01 BB BB	
014-09-01 11:02:17 No.02 22 22 22 22					AA AA 08 01 02 03 00 02 08 02 01 BB BB	
14-05-01 11:02:17 140:02 22 22 22 22 2	. ocure report	Route Ta	ble 📝 Show	Route Table	AA AA 08 01 02 03 00 02 08 02 01 88 88 AA AA 0A 01 02 84 00 00 08 88 88 88 88	00.00
		01>02			AA AA 0A 01 02 84 00 00 08 88 88 88 88 88 AA AA 0A 01 07 84 00 00 07 77 77 77 77	
ink Table	Show Link Table	01>03			AA AA 0A 01 06 84 00 00 06 66 66 66 66	
		01>04			AA AA 0A 01 05 84 00 00 05 55 55 55 55	
102 0103 0104 0105 0106	0107	01>05			AA AA 0A 01 04 84 00 00 04 44 44 44 44	
203 0204 0206 0207 0208		01>06			AA AA 0A 01 03 84 00 00 03 33 33 33 33	
304 0305 0306		01>07			AA AA 0A 01 02 84 00 00 02 22 22 22 22 22	
405 0406 0407 0408		01>02>	-08		AA AA DD 08 11 11 11 11 11 11 180 11 11	
506 0507	\mathbf{X}				11 11 11 80 80 11 11 11 11 11 11 80 11 1	
507 0608	\mathbf{X}				AA AA 07 01 02 03 00 01 02 01 BB BB	
					AA AA 07 01 03 03 00 01 03 01 BB BB	
	$\langle \rangle$	1			AA AA 07 01 04 03 00 01 04 01 BB BB	
		1			AA AA 07 01 05 03 00 01 05 01 BB BB	
					AA AA 07 01 06 03 00 01 06 01 BB BB	
	route	e /			AA AA 07 01 07 03 00 01 07 01 BB BB	
	replace				AA AA 08 01 02 03 00 02 08 02 01 BB BB	

Figure 19. New Route used between No.1 and No.8

7.6 New Connection found between No.3 and No.7

A new connection between No.3 and No.7 is established during periodic network maintenance.

eceived Data	Show Active Data	Serial Port Configuration		Show COM Dat
014-09-01 11:13:12 No.06 66 66 014-09-01 11:13:12 No.05 55 55		Com COM4 •		02 00 02 07 04 01 BB BB 03 00 01 04 01 BB BB
14-09-01 11:13:12 No.04 44 44		com	101101010101	02 00 02 04 05 01 BB BB
14-09-01 11:13:14 No.03 33 33		BaudRate acces	11 11 00 01 07	02 00 02 06 05 01 BB BB
14-09-01 11:13:15 No.02 22 22		9600 ·	Cluse	03 00 01 05 01 BB BB
14-09-01 11:14:09 No.08 88 88	88 88 active report			02 00 02 05 06 01 BB BB
14-09-01 11:14:11 No.07 77 77		Data Ouemu	AA AA 07 01 06	03 00 01 06 01 BB BB
14-09-01 11:14:11 No.06 66 66	66 66 active report	Data Query	AA AA 08 01 07	02 00 02 06 07 01 BB BB
14-09-01 11:14:12 No.05 55 55	55 55 active report		AA AA 07 01 07	03 00 01 07 01 BB BB
14-09-01 11:14:13 No.04 44 44	44 44 active report	Node ID 0x02 •	Query AA AA 09 01 02	02 00 03 06 08 02 01 BB BB
014-09-01 11:14:14 No.03 33 33			AA AA 09 01 02	02 00 03 04 08 02 01 BB BB
)14-09-01 11:14:15 No.02 22 22	22 22 active report	Route Table		03 00 02 08 02 01 BB BB
	•	01>02	AA AA 0A 01 02	84 00 00 08 88 88 88 88 BB BB
nk Table		01>02 01>03		84 00 00 07 77 77 77 77 BB BB
lik labie	Show Link Table	01>03		84 00 00 06 66 66 66 66 BB BB
102 0103 0104 0105 01	06 0107	01>05		84 00 00 05 55 55 55 55 BB BB 84 00 00 04 44 44 44 44 BB BB
203 0204 0205 0206 02	07 0208	01>06		84 00 00 04 44 44 44 44 BB BB 84 00 00 03 33 33 33 33 BB BB
304 0305 0306 0307		01>07		84 00 00 02 22 22 22 28 BB BB
405 0406 0407 0408		01>02>08		1 11 11 11 11 11 80 11 11 11 11 11 11
506 0507				11 11 11 11 11 11 80 11 11 80 BB BB
507 0608				03 00 01 02 01 BB BB
				03 00 01 03 01 BB BB
\ new c	onnection			03 00 01 04 01 BB BB
			AA AA 07 01 05	03 00 01 05 01 BB BB
			AA AA 07 01 06	03 00 01 06 01 BB BB
			AA AA 07 01 07	03 00 01 07 01 BB BB
			AA AA 08 01 02	03 00 02 08 02 01 BB BB

Figure 20. New Connection found between No.3 and No.7

7.7 Call Each Slave Node for Data

Call each node in turn to query for data in an on-demand pattern.

Received Data	Show Active Data	Serial Port Configuration	on COM Dat	a Show CO	M Data
014-09-01 11:17:11 No.06 66 66 66 66	active report			1 05 84 00 00 05 55 55 55 55 BB BB	
014-09-01 11:17:11 No.05 55 55 55 55	active report	Com COM4 •	Open AA AA OA O	1 04 84 00 00 04 44 44 44 44 BB BB	
014-09-01 11:17:12 No.04 44 44 44 44	active report		AA AA 0A 0	1 03 84 00 00 03 33 33 33 33 BB BB	
	active report	BaudRate 9600	Close AA AA 0A 0	1 02 84 00 00 02 22 22 22 22 BB BB	
014-09-01 11:17:15 No.02 22 22 22 22	active report	3000		8 11 11 11 11 11 11 80 11 11 11 11 11	11
014-09-01 11:17:40 No.02 22 22 22 22	2		11 11 11 11	80 11 11 11 11 11 11 80 11 11 80 BB B	В
014-09-01 11:17:43 No.03 33 33 33 33	3	Data Query	AA AA 07 0	L 02 03 00 01 02 01 BB BB	
014-09-01 11:17:45 No.04 44 44 44 44		out query	AA AA 07 0	L 03 03 00 01 03 01 BB BB	
014-09-01 11:17:47 No.05 55 55 55 55			AA AA 07 0	L 04 03 00 01 04 01 BB BB	
014-09-01 11:17:49 No.06 66 66 66 66	5	Node ID 0x08 •	Query AA AA 07 0	L 05 03 00 01 05 01 BB BB	
014-09-01 11:17:51 No.07 77 77 77 77			AA AA 07 0	L 06 03 00 01 06 01 BB BB	
014-09-01 11:17:53 No.08 88 88 88 88	3 1	Route Table	AA AA 08 0	L 07 02 00 02 03 07 01 BB BB	
	· ·	v sho	W Koute Table AA AA 07 0	L 07 03 00 01 07 01 BB BB	
		01>02	AA AA 08 0	L 02 03 00 02 08 02 01 BB BB	
ink Table	🕢 show Link Table	01>03	AA AA CC 0		
0102 0103 0104 0105 0106	0107	01>04	AA AA 0B 0	L 02 05 00 01 02 01 22 22 22 22 BB BB	
203 0204 0205 0206 0207		01>05	AA AA CC 0	3 04 BB BB	
304 0305 0306 0307	~~~~~	01>06		L 03 05 00 01 03 01 33 33 33 33 BB BB	
0405 0406 0407 0408	\	01>07	AA AA CC 0		
506 0507	\	01>02>08	/ / / / / / / / / / / /	L 04 05 00 01 04 01 44 44 44 48 BB	
607 0608			AA AA CC 0		
			/	L 05 05 00 01 05 01 55 55 55 55 BB BB	
			AA AA CC 0		
		/		L 06 05 00 01 06 01 66 66 66 66 BB BB	
			AA AA CC 0		
				L 07 05 00 01 07 01 77 77 77 77 BB BB	
	dat	a query	AA AA CC 0		
			AA AA OC O	1 02 05 00 02 08 02 01 88 88 88 88 BB	RR

Figure 21. Call Each Slave Node for Data

7.8 Slight Topology Change

Connections between nodes continually change during operation, as wireless communication is easily influenced. The route table, however, remains stable with only slight changes in topology.

	ow Active Data	Serial Por	t Configuratio	n	COM Data	Show COM Da
014-09-01 13:47:44 No.05 55 55 55 55 active					AA AA 07 01 05 03 00 01 05 01 BB BB	
014-09-01 13:47:45 No.04 44 44 44 44 active		Com	COM4 •	Open	AA AA 07 01 06 03 00 01 06 01 BB BB	
014-09-01 13:47:47 No.03 33 33 33 33 active					AA AA 07 01 07 03 00 01 07 01 BB BB	
014-09-01 13:47:48 No.02 22 22 22 22 active		BaudRate	9600 -	Close	AA AA 08 01 02 03 00 02 08 02 01 BB	
014-09-01 13:47:51 No.06 66 66 66 66 active		L. L.			AA AA 0A 01 02 84 00 00 08 88 88 88	88 BB BB
014-09-01 13:48:41 No.08 88 88 88 88 active					AA AA 0A 01 07 84 00 00 07 77 77 77	
014-09-01 13:48:42 No.07 77 77 77 77 active		Data Que	rv		AA AA 0A 01 06 84 00 00 06 66 66 66	66 BB BB
014-09-01 13:48:43 No.06 66 66 66 66 active			.,		AA AA 0A 01 05 84 00 00 05 55 55 55	55 BB BB
014-09-01 13:48:44 No.05 55 55 55 55 active			0.00		AA AA 0A 01 04 84 00 00 04 44 44 44	
014-09-01 13:48:45 No.04 44 44 44 44 active		Node ID	0x02 •	Query	AA AA 0A 01 03 84 00 00 03 33 33 33	
014-09-01 13:48:46 No.03 33 33 33 33 active					AA AA 0A 01 02 84 00 00 02 22 22 22 22	
014-09-01 13:48:47 No.02 22 22 22 22 active	report	Route Tab	le 🛛 Sho	v Route Table	AA AA DD 08 11 11 11 11 11 11 80 11	
	•			I HOUSE TOUL	11 11 11 11 11 11 11 11 11 11 11 11 11	1 11 80 BB BB
ink Table		01>02 01>03			AA AA 07 01 02 02 00 01 02 01 BB BB	
Sho	ow Link Table	01>03			AA AA 07 01 03 02 00 01 03 01 BB BB	
0102 0103 0104 0105 0106 0107		01>04			AA AA 07 01 06 02 00 01 06 01 BB BB	
203 0204 0205 0206 0207 0208		01>05			AA AA 08 01 02 02 00 02 06 02 01 BB	BB
0304 0305 0306 0307 0308		01>06			AA AA 07 01 02 03 00 01 02 01 BB BB	
0405 0406 0407 0408		01>07 01>02>0			AA AA 08 01 03 02 00 02 05 03 01 BB	BB
506 0507 0508		01>02>0	10		AA AA 07 01 03 03 00 01 03 01 BB BB	
0607 0608					AA AA 08 01 04 02 00 02 02 04 01 BB	
					AA AA 08 01 04 02 00 02 07 04 01 BB	88
					AA AA 07 01 04 03 00 01 04 01 BB BB	
					AA AA 08 01 05 02 00 02 04 05 01 BB	
more co	nnection	for route	selection		AA AA 08 01 05 02 00 02 06 05 01 BB	88
more co	milection	riorroute	, selection		AA AA 07 01 05 03 00 01 05 01 BB BB	
					AA AA 08 01 06 02 00 02 05 06 01 BB	88





7.9 After Two Hours Running

Call each node in turn to query for data in an on-demand pattern and get the desired response.

Received Data	Show Active Data	Serial Po	ort Configurat	ion	COM Data	Show COM Data
2014-09-01 13:51:43 No.06 66 66 66 60		~	COM4 •	Open	AA AA 08 01 02 02 00 02 07 02 01 BB	
014-09-01 13:51:43 No.05 55 55 55 55 014-09-01 13:51:45 No.04 44 44 44		Com		Open	AA AA 07 01 02 03 00 01 02 01 BB BB	
014-09-01 13:51:45 No.04 44 44 44 44 44 44 44		BaudRate			AA AA 08 01 03 02 00 02 05 03 01 BB	
014-09-01 13:51:45 No.05 35 35 35 35 014-09-01 13:51:46 No.02 22 22 22 22		Baudkate	9600 -	Close	AA AA 07 01 03 03 00 01 03 01 BB BB AA AA 08 01 04 02 00 02 07 04 01 BB	
014-09-01 13:52:09 No.02 22 22 22 22 22					AA AA 08 01 04 02 00 02 07 04 01 BB AA AA 07 01 04 03 00 01 04 01 BB BB	
014-09-01 13:52:12 No.03 33 33 33 33					AA AA 07 01 04 03 00 01 04 01 BB BB AA AA 08 01 05 02 00 02 04 05 01 BB	
014-09-01 13:52:12 No.04 44 44 44 44	-	Data Qu	ery		AA AA 08 01 05 02 00 02 04 05 01 BB	
014-09-01 13:52:16 No.05 55 55 55 5					AA AA 08 01 05 02 00 02 08 05 01 BB	
014-09-01 13:52:19 No.06 66 66 66	-	Node ID	0x08 -	Query	AA AA 07 01 05 05 00 01 05 01 BB BB	
014-09-01 13:52:21 No.07 77 77 77 77		Node ID		Query	AA AA 07 01 06 03 00 01 06 01 BB	
014-09-01 13:52:23 No.08 88 88 88 88	8	Route Ta			AA AA 08 01 07 02 00 02 05 07 01 BB	
	·	Route Ta	able 🔍 s	how Route Table	AA AA 07 01 07 03 00 01 07 01 BB BB	
		01>02			AA AA 08 01 02 03 00 02 08 02 01 BB	
ink Table	Show Link Table	01>03			AA AA CC 02 04 BB BB	
		01>04			AA AA 0B 01 02 05 00 01 02 01 22 22	22 22 BB BB
102 0103 0104 0105 0106		01>05			AA AA CC 03 04 BB BB	
203 0204 0205 0206 0207 304 0305 0306 0307 0308	0208	01>06			AA AA 0B 01 03 05 00 01 03 01 33 33	33 33 BB BB
405 0406 0407 0408		01>07			AA AA CC 04 04 BB BB	
1405 0406 0407 0408 1506 0507 0508		01>02	>08		AA AA 0B 01 04 05 00 01 04 01 44 44	44 44 BB BB
607 0608					AA AA CC 05 04 BB BB	
007 0008					AA AA 0B 01 05 05 00 01 05 01 55 55	55 55 BB BB
					AA AA CC 06 04 BB BB	
					AA AA 0B 01 06 05 00 01 06 01 66 66	66 66 BB BB
					AA AA CC 07 04 BB BB	
					AA AA 0B 01 07 05 00 01 07 01 77 77	77 77 BB BB
					AA AA CC 08 04 BB BB	
					AA AA 0C 01 02 05 00 02 08 02 01 88	88 88 88 BB BB

Figure 23. After Two Hours Running

Test Data



Design Files

8 Design Files

8.1 Schematics

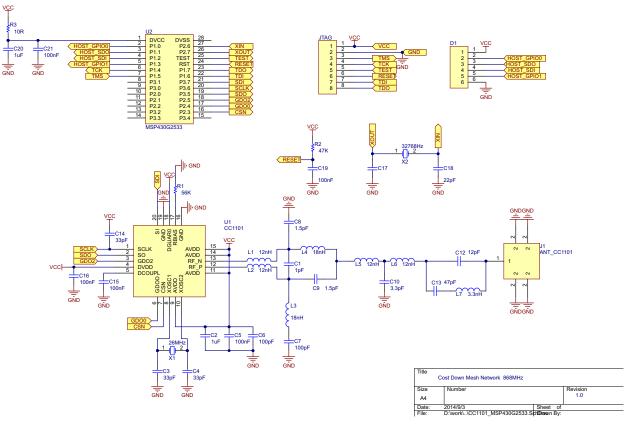


Figure 24. Schematic



8.2 Bill of Materials

ltem	Qty	Reference	Value	Part Description	PCB Footprint
1	1	X1	26 MHz	Crystal Oscillator	XIAL4P-SMT3*2X5
2	1	X2	32768 Hz	Crystal Oscillator	XIAL-2*5V - noSMT
3	1	C1	1 pF	Capacitor	C/0402
4	2	C2, C20	1 uF	Capacitor	C/0402
5	3	C3, C4, C14	33 pF	Capacitor	C/0402
6	5	C5, C15, C16, C19, C21	100 nF	Capacitor	C/0402
7	2	C6, C7	100 pF	Capacitor	C/0402
8	2	C8, C9	1.5 pF	Capacitor	C/0402
9	1	C10	3.3 pF	Capacitor	C/0402
10	1	C12	12 pF	Capacitor	C/0402
11	1	C13	47 pF	Capacitor	C/0402
12	2	C17, C18	22 pF	Capacitor	C/0402
13	1	D1		DIP6 Connector	Con6p_1mm
14	1	J1		SMA connector	SMB_V-RJ45
15	1	JTAG		DIP8 Connector	CN8P-2.0 - NoBoard
16	4	L1, L2, L5, L6	12 nH	Inductor	0402-A
17	2	L3, L4	18 nH	Inductor	0402-A
18	1	L7	3.3 nH	Inductor	0402-A
19	1	R1	56k	Resistor	R/0402
20	1	R2	47k	Resistor	R/0402
21	1	R3	10R	Resistor	R/0402
22	1	U1		CC1101	IC-QFN20-RTJ4X4
23	1	U2		MSP430G2533	IC-SSOP28(DBQ)

Table 3. BOM

Design Files



Design Files

8.3 PCB Layouts

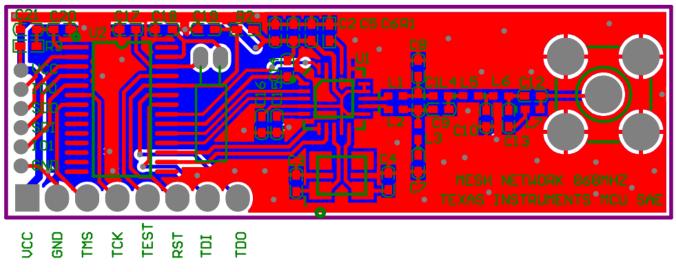


Figure 25. PCB Layouts

9 References

- 1. MSP430G2533 Mixed Signal Microcontroller (SLAS734F)
- 2. CC1101 Low-Power Sub-1 GHz RF Transceiver (SWRS061H)



10 About the Author

FAN ZHANG is an MCU Systems Application Engineer at Texas Instruments, responsible for developing system solutions for IoT (Internet of Things) and industrial applications. Fan brings to this role his extensive experience in WSN (Wireless Sensor Network) applications, wireless network protocols, and system control logic. Fan got his master's degree in Pattern Recognition and Intelligent System in Donghua University.

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