

Diagnostic Instructions

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Introduction

Qualified Persons

⚠ WARNING

The equipment covered by this publication must be installed, operated, and maintained by qualified persons who are knowledgeable in the installation, operation, and maintenance of radios in electric power distribution equipment, along with the associated hazards. A qualified person is a radio technician who is qualified to install transmission-power-limited radio equipment per FCC Part 15, and who is trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages to which the qualified person will be exposed
- The proper use of the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near energized parts of electrical equipment

These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

Read this Instruction Sheet

NOTICE

Read this instruction sheet thoroughly and carefully before installing or operating your S&C SpeedNet Radio. Familiarize yourself with the Safety Information on page 3. The latest version of this publication is available online in PDF format at sandc.com/en/support/product-literature/.

Retain this Instruction Sheet Proper Application

This instruction sheet is a permanent part of your S&C SpeedNet Radio. Designate a location where you can easily retrieve and refer to it.

⚠ WARNING

The equipment in this publication must be selected for a specific application. The application must be within the ratings furnished for the selected equipment.

Warranty

The standard warranty contained in S&C's standard conditions of sale, as set forth in Price Sheet 150, applies to the SpeedNet Radio and its associated options, except for the first paragraph of said is replaced by the following:

(1) General: The seller warrants to the immediate purchaser or end user for a period of 10 years from the date of shipment that the equipment delivered will be of the kind and quality specified in the contract description and will be free of defects of workmanship and material. Should any failure to conform to this warranty appear under proper and normal use within 10 years after the date of shipment, the seller agrees, upon prompt notification thereof and confirmation that the equipment has been stored, installed, operated, and maintained in accordance with recommendations of the seller and standard industry practice, to correct the nonconformity either by repairing any damaged or defective parts of the equipment or (at seller's option) by shipment of necessary replacement parts. The seller's warranty does not apply to any equipment that has been disassembled, repaired, or altered by anyone other than the seller. This limited warranty is granted only to the immediate purchaser or, if the equipment is purchased by a third party for installation in third-party equipment, the end user of the equipment. The seller's duty to perform under any warranty may be delayed, at the seller's sole option, until the seller has been paid in full for all goods purchased by the immediate purchaser. No such delay shall extend the warranty period.

Replacement parts provided by the seller or repairs performed by the seller under the warranty for the original equipment will be covered by the above special warranty provision for its duration. Replacement parts purchased separately will be covered by the above special warranty provision. Warranty of the SpeedNet Radio is contingent upon the installation, configuration, and use of the SpeedNet Radio and software in accordance with S&C's applicable instruction sheets. This warranty does not apply to major components not of S&C manufacture, such as batteries, and other communication devices, not of S&C manufacture. However, S&C will assign to immediate purchaser or end user all manufacturers' warranties that apply to such major components.

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet as well as on labels attached to SpeedNet Radio. Familiarize yourself with these types of messages and the importance of the various signal words, as explained below.

⚠ DANGER
“DANGER” identifies the most serious and immediate hazards that <i>will likely</i> result in serious personal injury or death if instructions, including recommended precautions, are not followed.


⚠ WARNING
“WARNING” identifies hazards or unsafe practices that <i>can</i> result in serious personal injury or death if instructions, including recommended precautions, are not followed.

⚠ CAUTION
“CAUTION” identifies hazards or unsafe practices that <i>can</i> result in minor personal injury if instructions, including recommended precautions, are not followed.

NOTICE
“NOTICE” identifies important procedures or requirements that <i>can</i> result in product or property damage if instructions are not followed.

Following Safety Instructions

If you do not understand any portion of this instruction sheet and need assistance, contact your nearest S&C Sales Office or S&C Authorized Distributor. Their telephone numbers are listed on S&C’s website sandc.com Or call S&C Headquarters at (773) 338-1000; in Canada, call S&C Electric Canada Ltd. at (416) 249-9171.

NOTICE	
Read this instruction sheet thoroughly and carefully before installing or operating your S&C SpeedNet Radio.	

Replacement Instructions and Labels

If you need additional copies of this instruction sheet, contact your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

It is important that any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting your nearest S&C Sales Office, S&C Authorized Distributor, S&C Headquarters, or S&C Electric Canada Ltd.

Applicable Software

These instructions apply to SpeedNet Radio Firmware Version SpeedNet_v2.1. The version number can be found on the KeyGen software **Revision Information-Admin-Firmware** tab. See Figure 1.

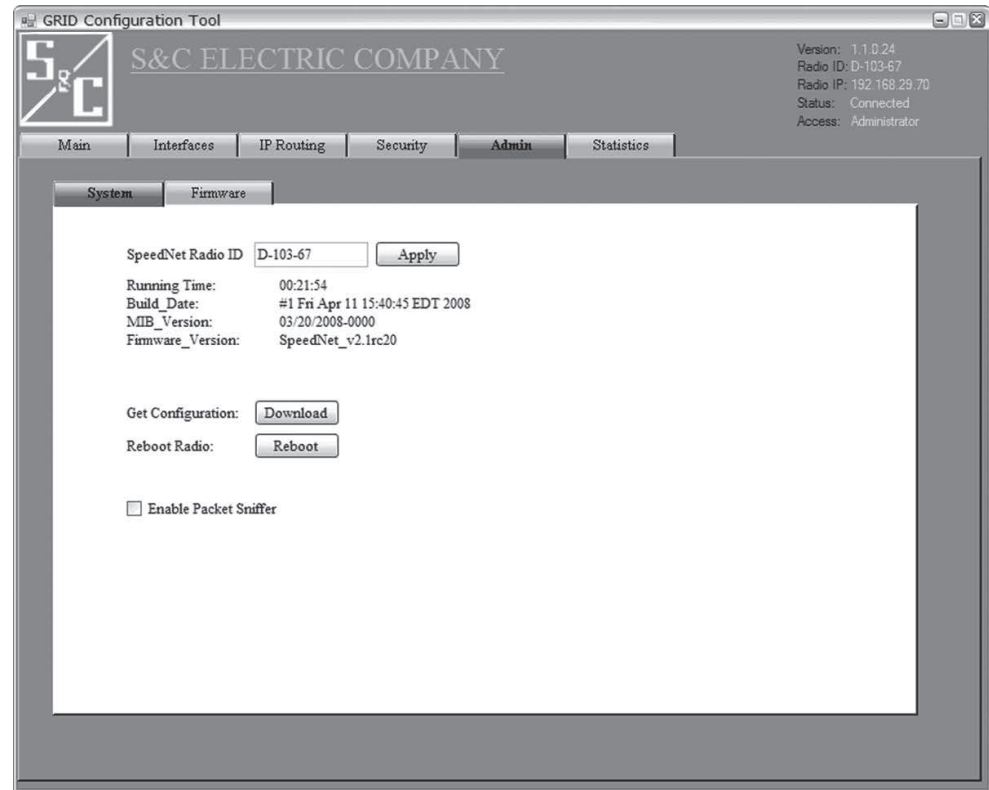


Figure 1. KeyGen Software Revision Information-Admin-Firmware tab.

Troubleshooting Overview

Communication problems manifest themselves as operational deficiencies, such as a team out of ready, a missing SCADA report, or no response from a control. Communication integrity is the first area to investigate. If you find that the radio system is working properly, check the control devices. If operation problems are occurring in more than one location, check the communication point common to all the nodes where trouble has been observed; simultaneous malfunctions in different locations are unlikely.

Review the network diagram to find the single communication point closest to the problem, that transfers data from all the problem nodes. See Figure 4. Use the flowcharts in Figures 2 and 3 on pages 5 through 7 to check communication system performance.

Loss of Nodes

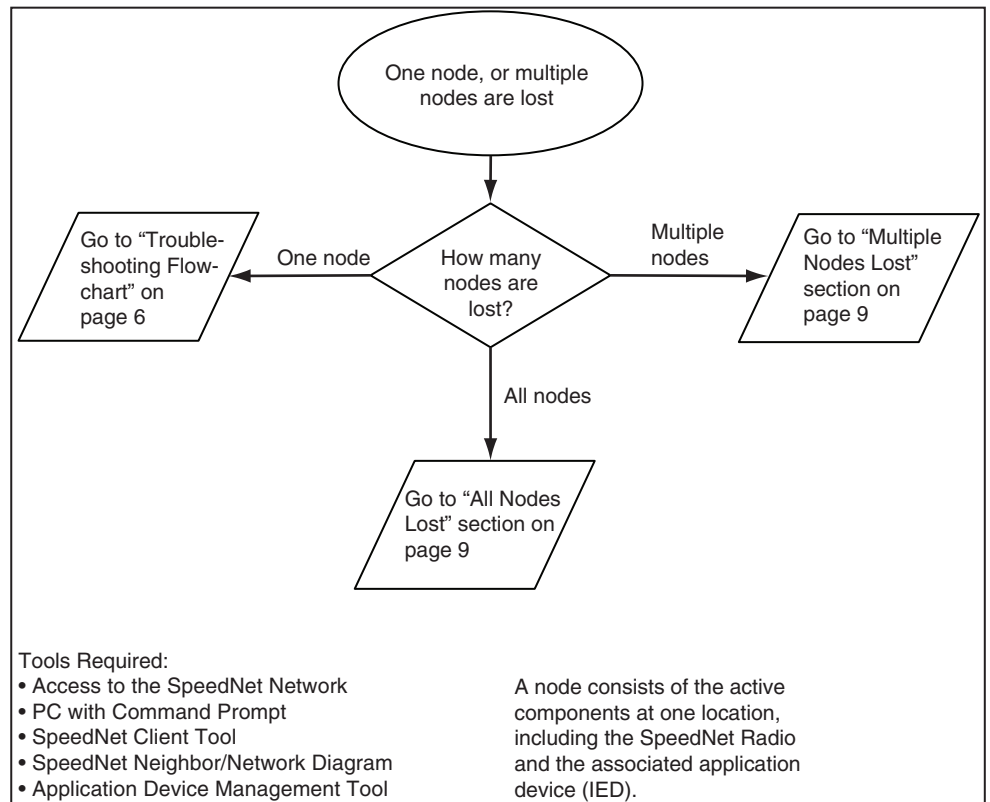


Figure 2. Diagnosing lost node

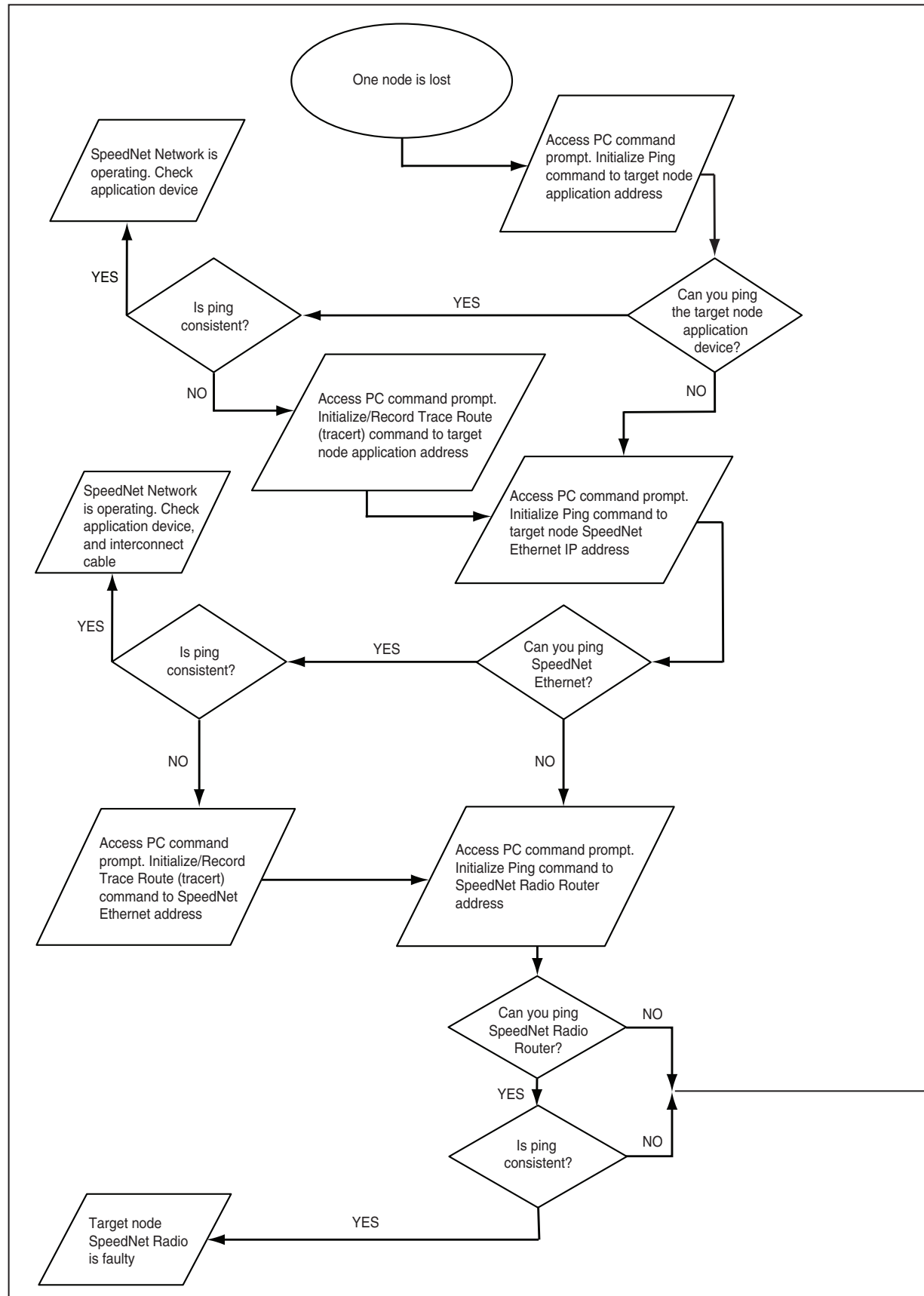
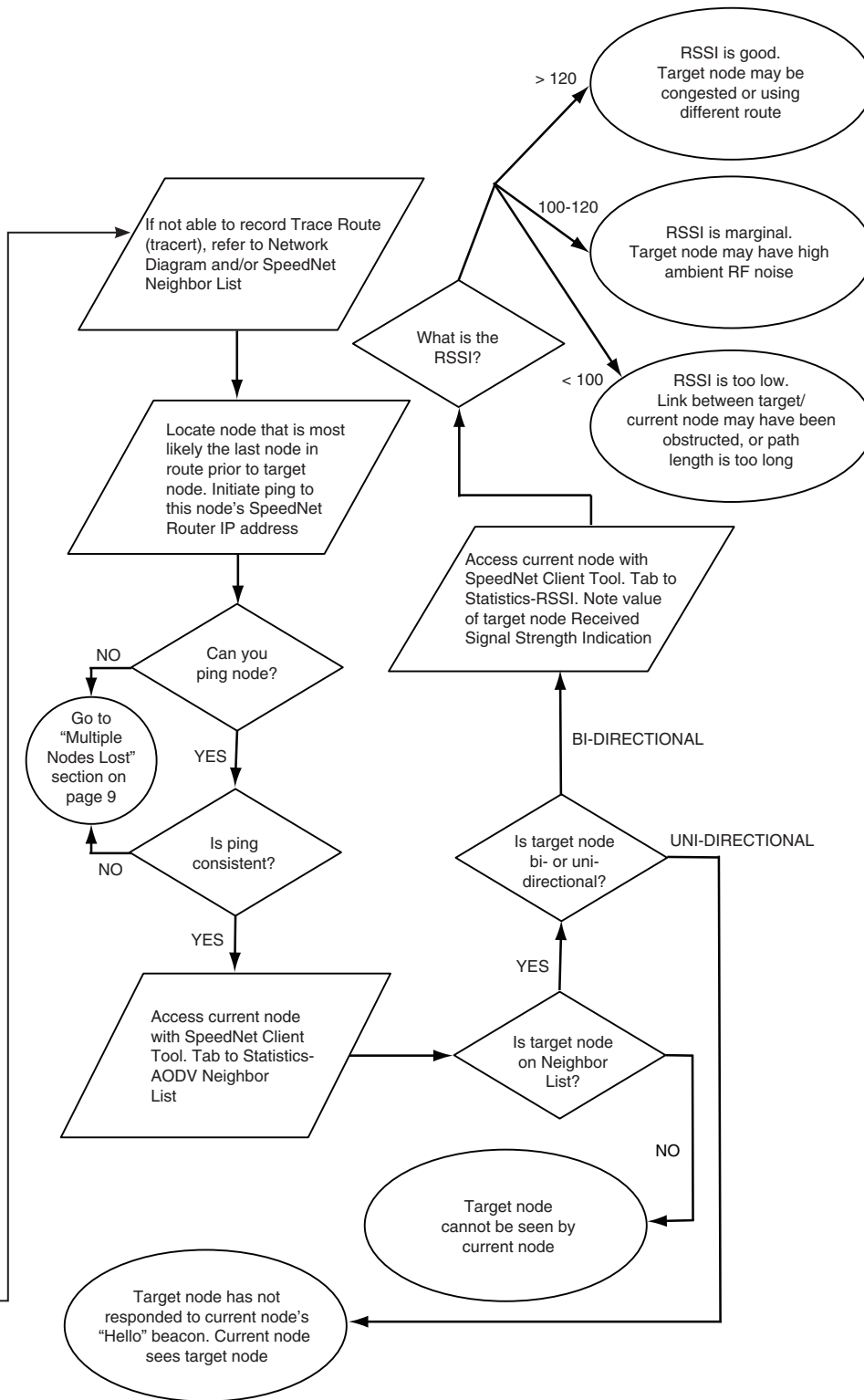


Figure 3. Troubleshooting flowchart.



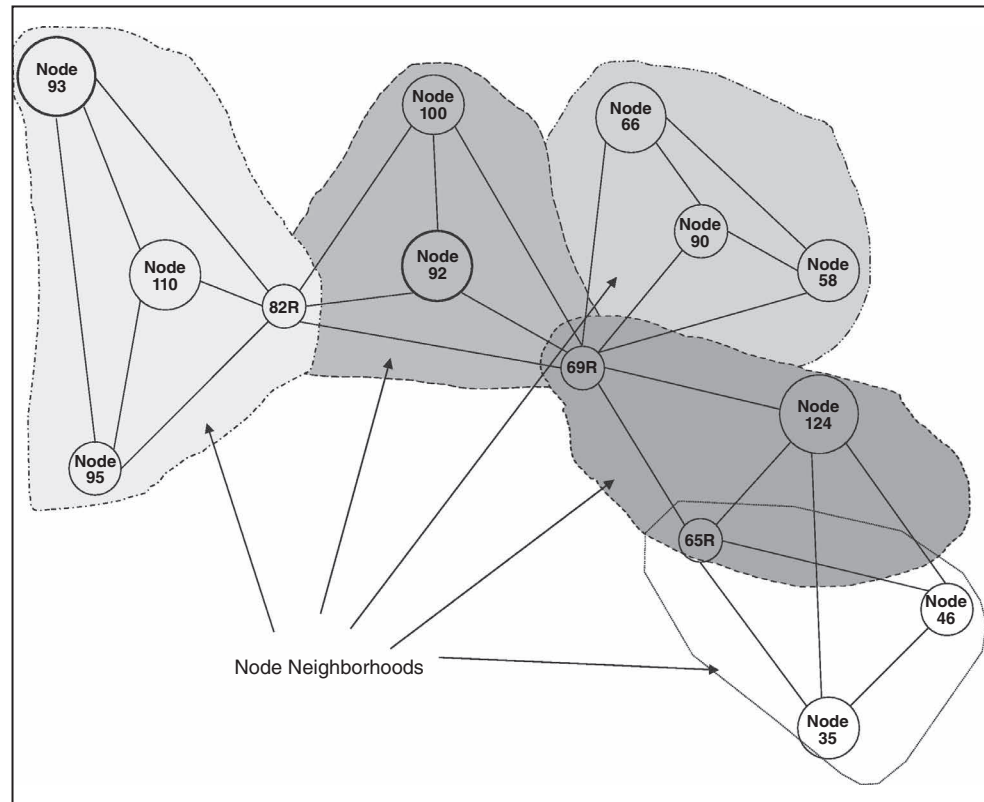


Figure 4. Network diagram.

The SpeedNet Radios broadcast a “Hello” beacon and a timing beacon. When another SpeedNet Radio receives these beacons it adds that radio to its Neighbor List, which includes all SpeedNet Radios active in that RF neighborhood. This list is created only with AODV enabled. If AODV is off, the routes have been manually configured and entered in the static route tables.

Multiple Nodes Lost

Refer to Figure 4 network diagram on page 8. As an example of lost multiple nodes, consider no transmissions being received from Node 35 and Node 46. A mesh network is defined as having at least two paths to each node. Repeater 69R is the radio closest to the problem that has only two paths to both Node 35 and Node 46, so Repeater 69R is a good location to start looking at system conditions. If you can ping Repeater 69R and the ping is consistent, you have proven communication to that radio. Then, use the Application Device Management Tool at Repeater 69R and open the AODV Neighborhood list for that radio, which is on the Statistics tab - AODV screen.

Check to see whether Repeater 65R and Node 124 (acting as a repeater) are on the AODV Neighbor List of Repeater 69R. If 65R and 124 are listed, check their RSSI data in both directions. If RSSI is below the configured Link Threshold (configured on the IP Routing tab - Ad Hoc Routing screen), it indicates a radio transmission problem, and you should physically check the radio transmitting the low RSSI. It may have lost transmit power, or there is an antenna problem.

If signal strengths are above the Link Threshold for both Repeater 65R and Node 124, go to both Repeater 65R and Node 124 and check the Neighbor List of each and the RSSI data for Node 35 and Node 46. If Nodes 35 and 46 are functional, then the lost transmissions are probably because of an automation application problem. Functioning radios will have an RSSI level above the configured Link Threshold.

When multiple nodes are lost, there is usually a problem at a communication point common to all the lost nodes. The logical place to start looking for a communication failure is that common point, Repeater 69R in the example above.

All Nodes Lost

If all nodes fail or are inoperative, this usually indicates a problem with SpeedNet Radio setup or a network configuration problem such as firewall configuration. If you can ping the head-end radio, there is a radio setup problem. If you can't ping the head-end radio, there is a computer network problem or the head-end radio is inoperative.

Radio setup problems could include path configuration. There may be no return path defined.

LED Indicators

The SpeedNet Radio front panel contains indicators for power, wireless, and Ethernet connectivity.

If all indicators are off, see Figure 5.

The radio has no power.



Figure 5. Power is off.

If the Power LED indicator is lit (with other indicators in any state), see Figure 6.

The radio is powered.



Figure 6. Power LED Indicator is lit.

If the Wireless - Link LED indicator is lit, See Figure 7.

The radio is frequency-hopping in synchronization with other radios in the same network, but data are not being transmitted.



Figure 7. Wireless - Link LED indicator is lit.

**LED Indicators –
continued**

If the Wireless - Link LED indicator is flashing amber, see Figure 8.

The radio has lost frequency-hopping synchronization with other radios in the network.



Figure 8. Wireless - Link LED indicator is flashing amber.

If the Wireless - Link LED indicator is lit, and the Wireless - Tx and Ethernet Link/Act LED indicators are flashing, see Figure 9.

The radio is transmitting data.



Figure 9. Wireless - Link LED indicator is lit, and Wireless - Tx and Ethernet Link/Act LEDs are flashing.

If the Wireless - Link LED indicator is lit, and the Wireless - Rx and Ethernet Link/Act LEDs are flashing, see Figure 10.

The radio is receiving data.



Figure 10. Wireless - Link, LED indicator is lit, and Wireless - Rx and Ethernet Link/Act LED indicator are flashing.

Troubleshooting

LED Indicators – continued

If the Wireless - Link LED indicator is lit, the Wireless - Tx and Wireless - Rx LED indicators are flashing, and the Ethernet Link/Act LED indicator is off, see Figure 11.

The radio is acting as a repeater, and there is no Ethernet traffic with the Intelligent Electronic Device.



Figure 11. Wireless - Link LED indicator is lit, Tx and Rx LED indicator are flashing.

Error Messages

Error messages are generated by the Network Management System. If you need help understanding an error message, contact the S&C Global Support and Monitoring Center at 888-456-1100; outside the U.S., call 773-338-1000.

Statistics Screen

The *Statistics* screen displays statistics on the radio network and Ethernet interfaces, as well as ICMP, UDP, IP, Wireless, Batt Status, AODV, and RSSI statistics. The system log can be viewed from the *Statistics* screen and the Signal Strength Display can be started from the *Statistics* screen. See Figure 12.

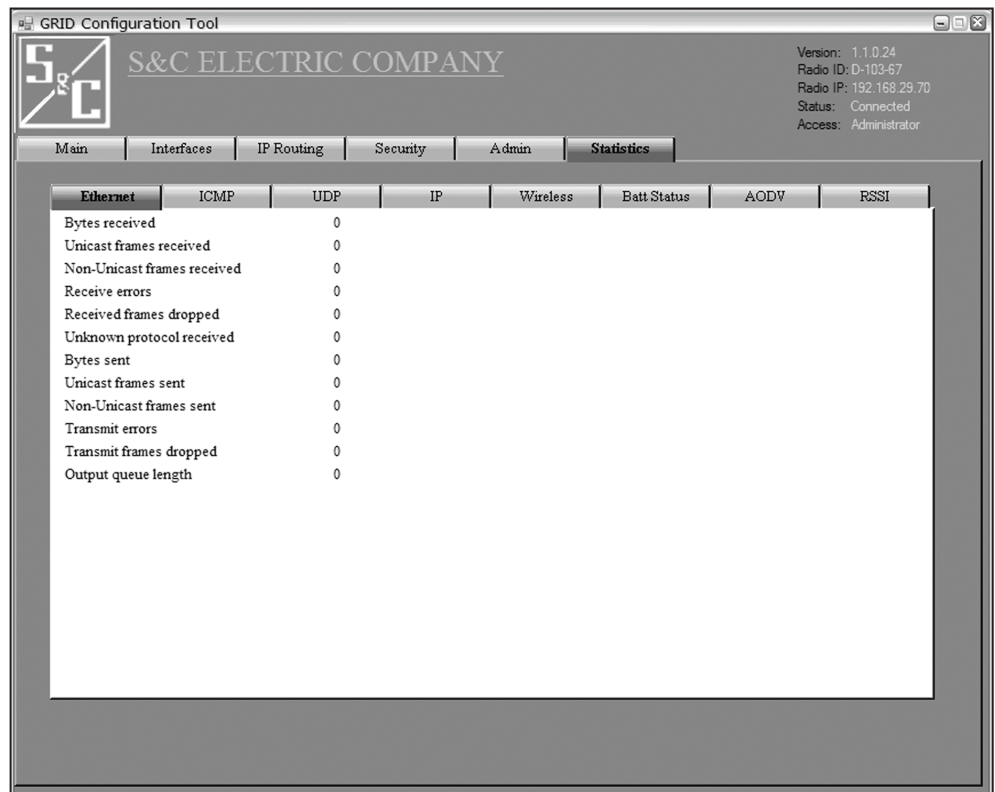


Figure 12. *Statistics - Ethernet* screen.

Ethernet

The Ethernet tab displays the following:

Bytes received

This is the total number of bytes received from the radio. The bytes received, together with the bytes sent, represent the total data transfer on the communications links involving the radio.

Unicast frames received

This is the total number of single destination (unicast) frames sent directly to the radio.

Non-unicast frames received

This is the total number of non-unicast frames sent directly to the radio.

Receive errors

This is the total number of receive errors.

Received frames dropped

This is the total number of frames received and then discarded.

Unknown protocol received

This is the total number of frames received with unidentified protocol errors.

Bytes sent

This is the total number of bytes sent to the designated radio router.

Unicast frames sent

This is the total number of single destination (unicast) frames sent from the radio.

Ethernet – continued

Non-unicast frames sent

This is the total number non-unicast frames sent from the radio.

Transmit errors

This is the total number of transmit errors. This error is received from the application device indicating a problem with the IntelliRupter® PulseCloser® Fault Interrupter.

Transmit frames dropped

This is the total number of frames transmitted and then discarded. This error is received from the application device indicating a problem with the IntelliRupter® fault interrupter.

Output queue length

This is the error received from the application device indicating a problem with the IntelliRupter fault interrupter.

Internet Control Message Protocol (ICMP)

The **Internet Control Message Protocol (ICMP)** tab displays data packet errors and control and informational messages. The information is gathered using the **Ping** command to provide feedback regarding problems in the communication environment. See Figure 13.

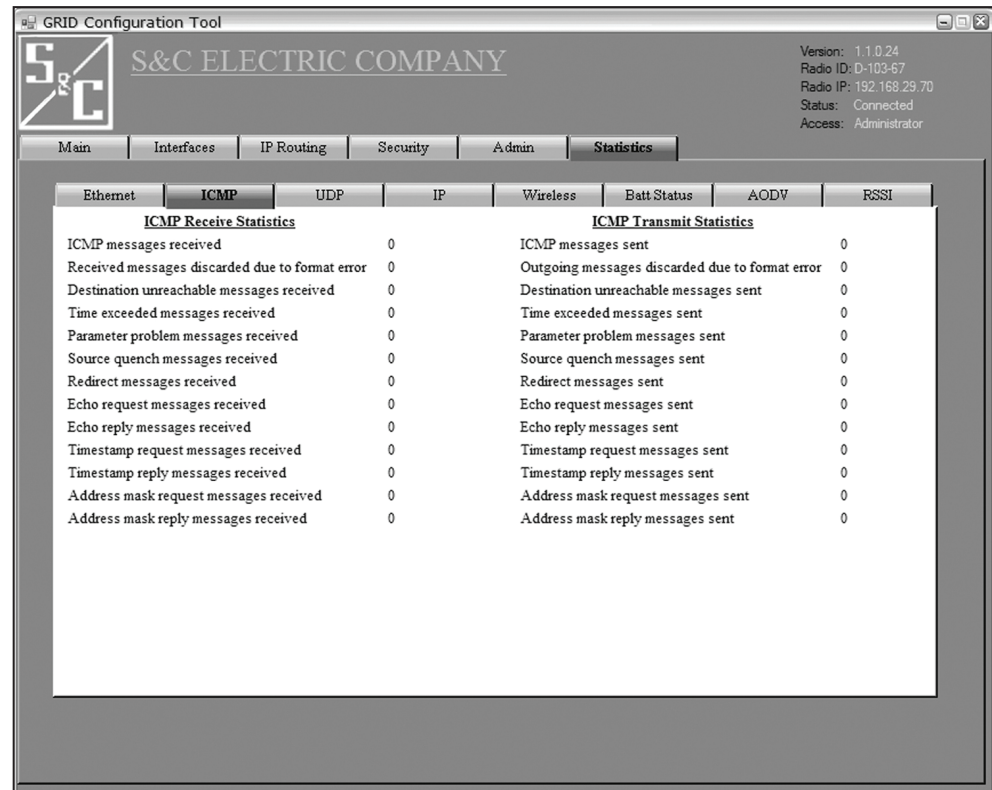


Figure 13. Statistics - ICMP screen.

ICMP Receive Statistics

ICMP messages received

This is the total number of messages received by the radio.

Received messages discarded due to format errors

This is the total number of messages received by radio which were not delivered because of format errors.

Destination unreachable messages received

This is the total number of messages received by the radio which have not reached their intended destinations.

Time exceeded messages received

This is the total number of messages received by the radio which exceeded their time to live.

Parameter problem messages received

This is the total number of parameter problem messages received. A parameter problem message is sent when an error in a IP header of a datagram is detected.

Source quench messages received

This is the total number of source quench messages received. A source quench message is sent to request a reduction in the rate of packet transmission.

Redirect messages received

This is the total number of redirect messages received. A redirect is sent when a better route for the datagram is detected.

Echo request messages received

This is the total number of echo requests received. An echo request causes the receiving radio to send an echo reply message back to the originating radio.

Echo reply messages received

This is the total number of echo replies received. An echo reply is sent to respond to an echo request.

Timestamp request messages received

This is the total number of timestamp requests received. A timestamp causes the radio to send a timestamp reply to the originating radio.

Timestamp reply message received

This is the total number of timestamp replies received. A timestamp reply is sent in response to a timestamp request. Timestamps replies and requests measure the transmission speed of datagrams on a network.

Address mask request messages received

This is the total number of address mask requests received. An address mask request is sent to determine the number of bits in the subnet mask for its local subnet.

Address mask reply messages received

This is the total number of address mask responses received. An address mask response is sent in response to an address mask request.

ICMP Transmits Statistics

ICMP messages sent

This is the total number of messages sent by the radio.

Outgoing messages discarded due to format errors

This is the total number of messages received by radio which were not delivered because of format errors.

Destination unreachable messages sent

This is the total number of messages sent by the radio which have not reached their intended destinations.

Time exceeded messages sent

This is the total number of messages sent by the radio which exceeded their time to live.

Parameter problem messages sent

This is the total number of parameter problem messages sent. A parameter problem message is sent when an error in a IP header of a datagram is detected.

Source quench messages sent

This is the total number of source quench messages sent. A source quench message is sent to request a reduction in the rate of packet transmission.

Redirect messages sent

This is the total number of redirect messages sent. A redirect is sent when a better route for the datagram is detected.

Echo request messages sent

This is the total number of echo requests sent. An echo request causes the receiving radio to send an echo reply message back to the originating radio.

Echo reply messages sent

This is the total number of echo replies sent. An echo reply is sent to respond to an echo request.

Timestamp request messages sent

This is the total number of timestamp requests sent. A timestamp causes the radio to send a timestamp reply to the originating radio.

Timestamp reply message sent

This is the total number of timestamp replies sent. A timestamp reply is sent in response to a timestamp request. Timestamps replies and requests measure the transmission speed of datagrams on a network.

Address mask request messages sent

This is the total number of address mask requests sent. An address mask request is sent to determine the number of bits in the subnet mask for its local subnet.

Address mask reply messages sent

This is the total number of address mask responses sent. An address mask response is sent in response to an address mask request.

User Datagram Protocol

The **User Datagram Protocol (UDP)** tab displays information on datagrams that networked SpeedNet Radios have sent to each other. The information is internally generated by the application layer and uses ports to allow application-to-application communication. See Figure 14.

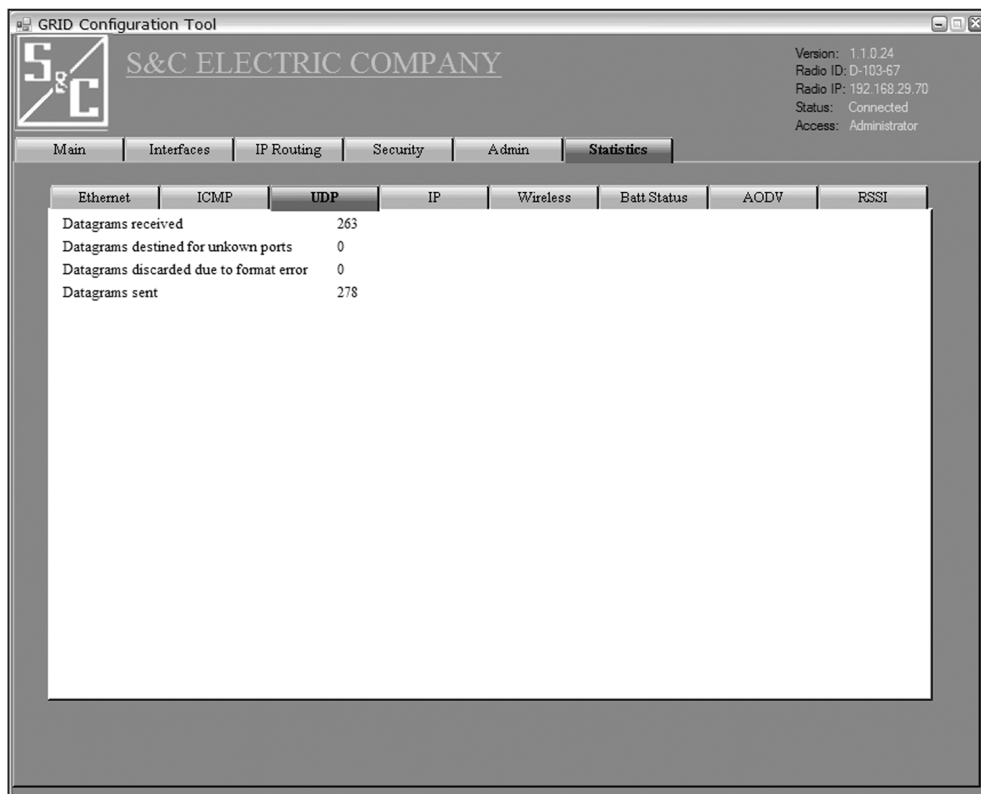


Figure 14. *Statistics - UDP* screen.

Datagrams received

This is the total number of datagrams successfully delivered.

Datagrams destined for unknown ports

This is the total number of datagrams with no application at the destination port.

Datagrams discarded due to format error

This is the total number of datagrams which were not delivered due to format errors.

Datagrams sent

This is the total number of datagrams sent.

Internet Protocol (IP)

The **Internet Protocol (IP)** tab displays detailed IP information about the SpeedNet Radio. See Figure 15.

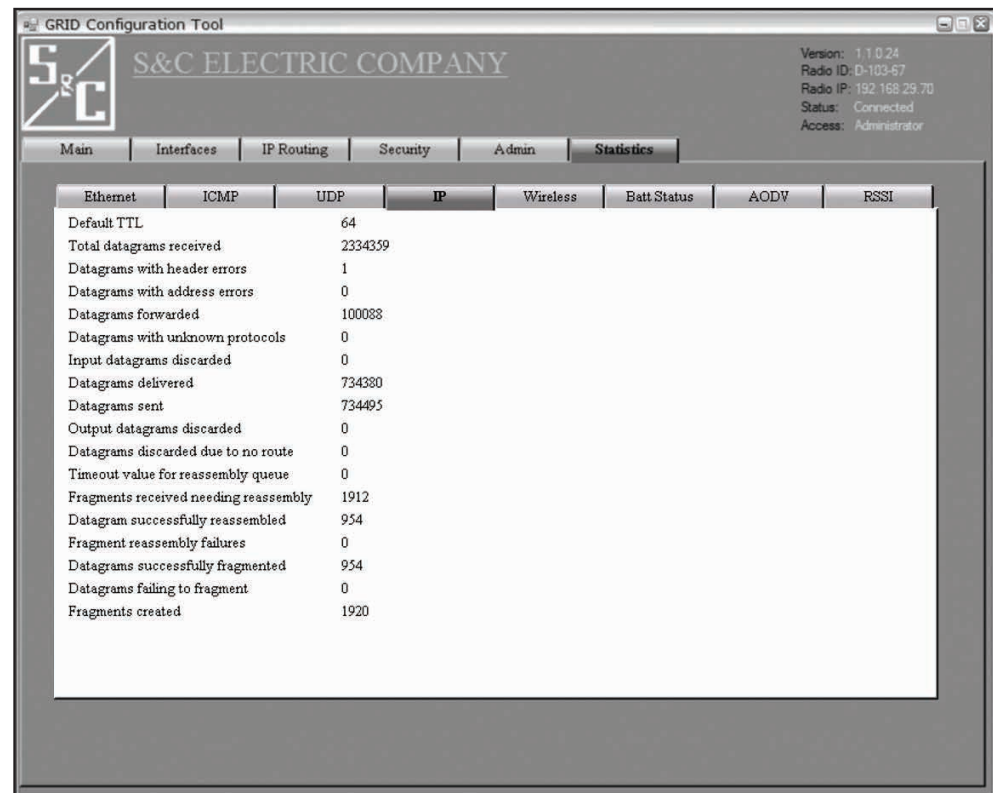


Figure 15. Statistics - IP screen.

Default TTL

This is the time-to-live value used to determine when timeout occurs.

Total datagrams received

This is the total number of data packets received.

Datagrams with header errors

This is the total number of data packets received containing errors in the header (i.e., incorrect IP header length, which must be at least 20 characters).

Datagrams with address errors

This is the total number of data packets received containing address errors.

Datagrams forwarded

This is the total number of data packets forwarded because the radio was not the intended target.

Datagrams with unknown protocols

This is the total number of data packets received with protocols not recognized by the radio.

Input datagrams discarded

This is the total number of data packets received which were discarded because the node was too busy.

Datagrams delivered

This is the total number of data packets delivered to the application.

**Internet Protocol –
continued****Datagrams sent**

This is the total number of data packets sent.

Output datagrams discarded

This is the total number of data packets sent which were discarded because the node was too busy.

Datagrams discarded due to no route

This is the total number of data packets discarded because of incorrect routing information.

Timeout value for reassembly queue

This is the duration before the reassembly queue is cleared and the connection is dropped.

Fragments received needing reassembly

This is the total number of data packet fragments received needing reassembly. If a data packet cannot be sent in a single transmission, it will be broken into fragments and then reassembled upon receipt.

Datagrams successfully reassembled

This is the total number of data packets received and reassembled.

Fragment reassembly failures

This is the total number of data packets received that could not be reassembled.

Datagrams successfully fragmented

This is the total number of data packet fragments generated.

Datagrams failing to fragment

This is the total number of data packets discarded because they needed to be fragmented, but could not be.

Fragments created

This is the total number of fragments created.

Wireless Statistics

The **Wireless** tab displays information internally generated by the link layer. The data are recorded and compared to previously recorded data. See Figure 16.

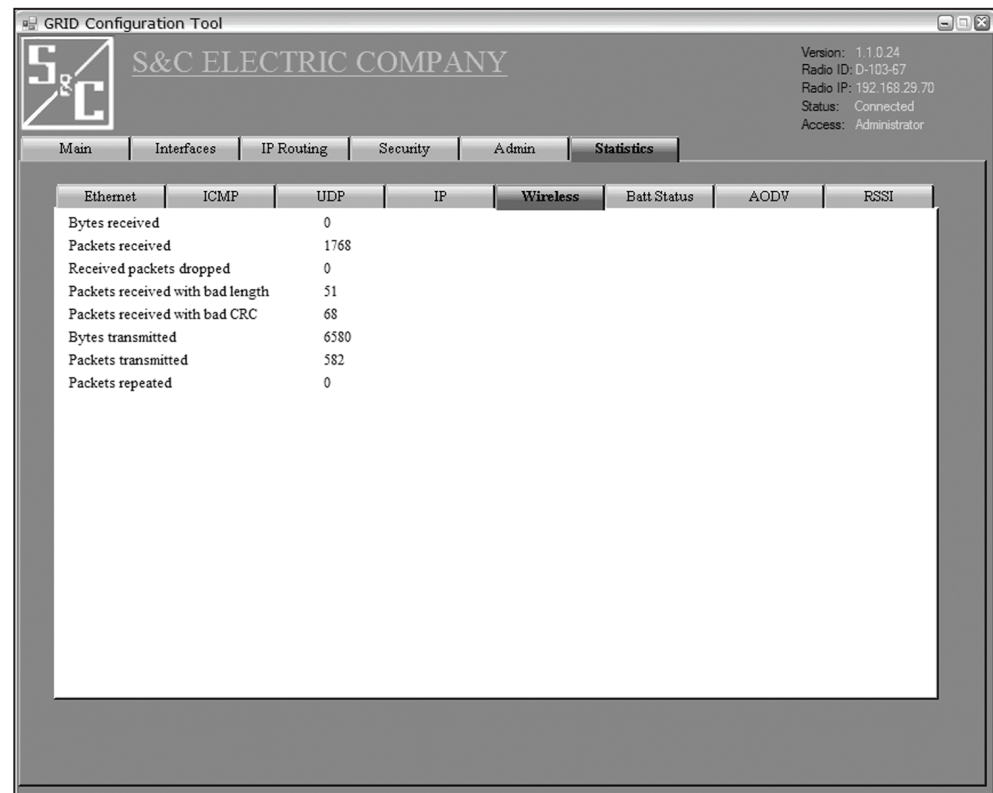


Figure 16. *Statistics - Wireless* screen.

Bytes received

This is the total number of bytes successfully received.

Packets received

This is the total number of packets successfully received.

Received packets dropped

This is the total number of packets received that failed the validation check for problems such as a corrupted CRC address.

Packets received with bad length

This is the total number of packets received with checksum error involving length.

Packets received with bad CRC

This is the total number of packets received with checksum error.

Bytes transmitted

This is the total number of bytes transmitted in packets.

Packets transmitted

This is the total number of packets transmitted to a specific IP address.

Packets repeated

This is the total number of repeated packet transmissions. If a transmission results in a receive confirmation, that packet transmission is repeated.

Battery Status

The **Battery Status** tab displays battery performance information. This information can be downloaded into a text file. See Figure 17.

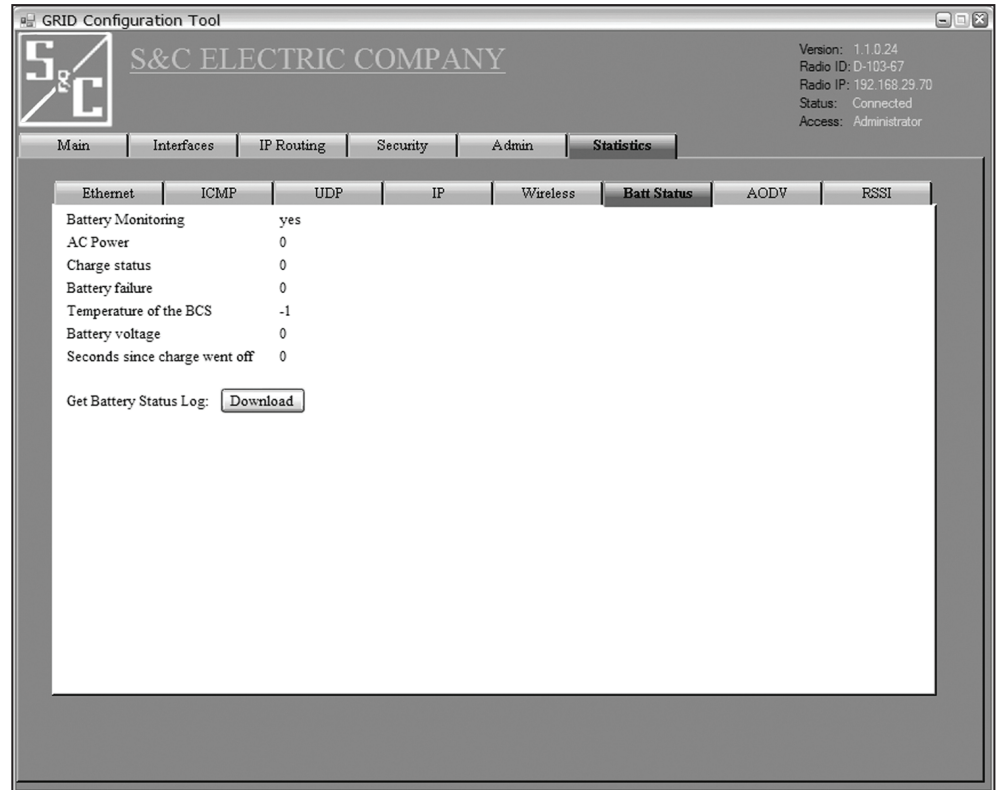


Figure 17. Statistics - Batt Status screen.

Battery Monitoring

This display indicates whether **Battery Monitoring** mode has been activated in the **Interfaces Serial** tab.

AC Power

1 = ON, 0 = OFF

Charge status

0 = ON, 1 = OFF

Battery failure

0 = ON, 1 = OFF

Temperature of BCS

This is the internal temperature of the SpeedNet Radio, in °F.

Battery voltage

This should be 2 to 13 volts unless the battery is discharging.

Seconds since charge went off

This is the duration ac power has been turned off.

Ad hoc On-Demand Distance Vector Routing (AODV)

The **Ad hoc On-Demand Distance Vector Routing (AODV)** tab allows route information to be handled automatically by AODV, the SpeedNet Radio's Ad Hoc Networking algorithm seen at the RF level. See Figure 18.

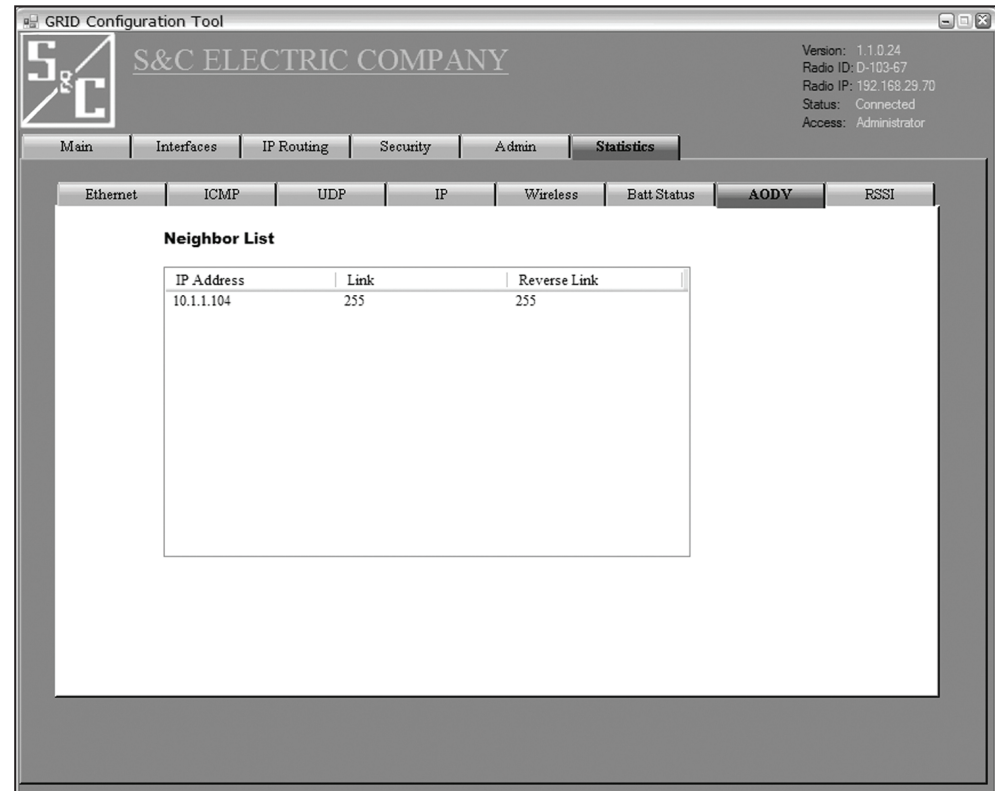


Figure 18. Statistics - AODV screen.

The Neighbor List contains the IP address and the signal strength of any local SpeedNet Radio. This list is only populated when AODV has been enabled.

IP Address

These are the radios whose transmissions can be received at this radio.

Link and Reverse Link

This is the received Signal Strength Indication for a transmission in each direction on that radio link.

A signal strength of 255 is the strongest RSSI data indication; regular signal strength is generally between 30 and 170. The factory default Link Threshold is 100. If RSSI is below 100, the radio will not choose that link as a route. The radio always seeks the route with the least number of nodes and the highest RSSI in each direction.

Received Signal Strength Indicator (RSSI)

The **Received Signal Strength Indicator (RSSI)** tab shows the signal strength and MAC address of each radio in the neighborhood. See Figure 19.

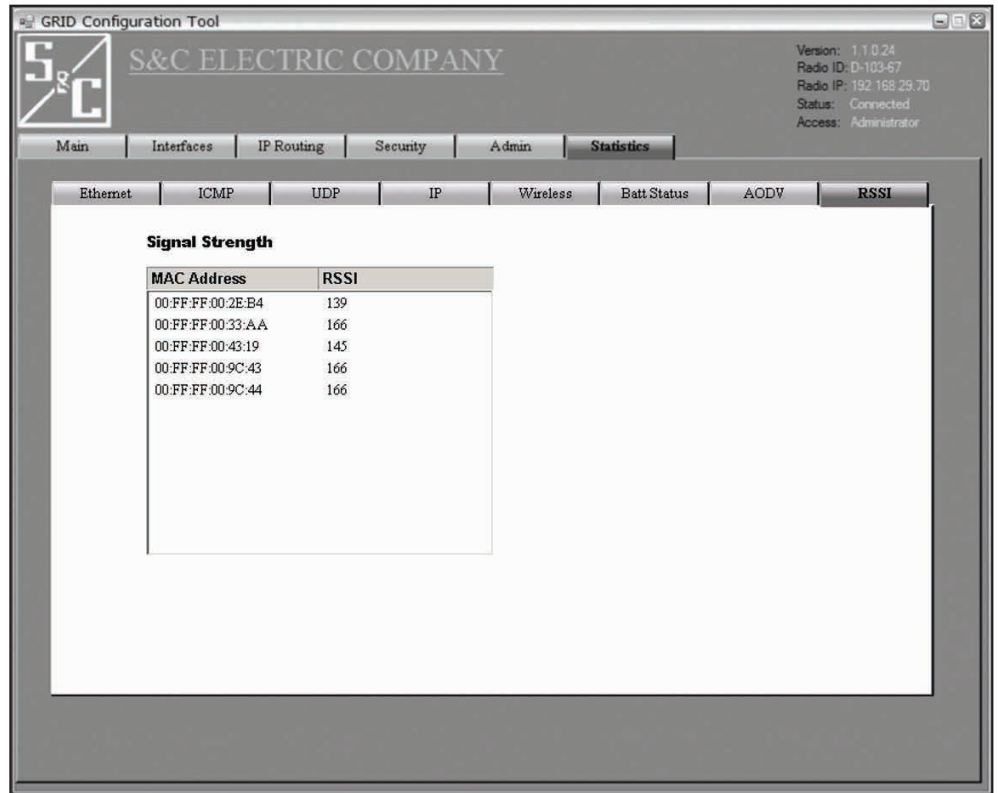


Figure 19. *Statistics - RSSI* screen.

Each radio periodically transmits an RSSI beacon to transfer RSSI data, and every transmission also includes embedded RSSI data.