Conducting a Site Survey and Interpreting the Results

I.   Overview

A Site Survey, also known as a Radio Signal Strength Indication (RSSI), analyzes the radio communications link between the Gateway and any Receiver within the network by analyzing the radio signal strength of received data packets and reporting the number of missed packets that required a retry.

II.   Performing a Site Survey

A. Base Systems

Initiate a Site Survey using the Gateway's buttons and LCD menu system.

1. Remove the rotary dial access cover.
2. To check the status of Node (Receiver) 1, change the Gateway's right rotary dial to 1.
   The Gateway is now enabled to read the status of Node 1; the display scrolls through the Node's I/O status.
3. Single-click button 1 to scroll across the menu levels until reaching the Site Survey (SITE) menu.
4. Single-click button 2 to enter the Site Survey menu.
5. Single-click button 2 to begin conducting a Site Survey with the Node selected in step 2.
   The Gateway analyzes the quality of the signal from the selected Node by counting the number of data packets it receives from the Node.
6. Examine reception readings (M, R, Y, G) of the Gateway at various locations.
   Site survey results display as a percentage. M represents the percent of missed packets while R, Y, and G represent the percent of received packets at a given signal strength.
   M = Percent of missed packets; R = RED marginal signal; Y = YELLOW good signal; G = GREEN excellent signal. Record the results.
7. Change the Gateway's right rotary dial to conduct a Site Survey with another Node and repeat steps 2 through 6.
8. To end the Site Survey, double-click button 2.
9. Change the Gateway's right rotary dial back to 0.
   The LCD displays the device readings for the Gateway.

10. Double-click button 2 to move back to the top level menu.
11. Single-click button 1 to return to RUN mode.
12. Install the rotary dial access cover, referring to the Maintenance section of Tucor Technical Note TN098 to create an IP67 seal.

B. Link Systems

Site surveys can be conducted from either the Gateway/Gateway Controller (master), repeater, or Data Radio/Receiver (slave) radios. A master radio is always a parent, and the slave radios are always children radios within the radio communication relationship. A repeater radio, however, may be both a child radio to the master or another repeater and a parent radio to other repeater or slave radios. When the site survey runs, serial and I/O data radio communication between that parent and its children stops.
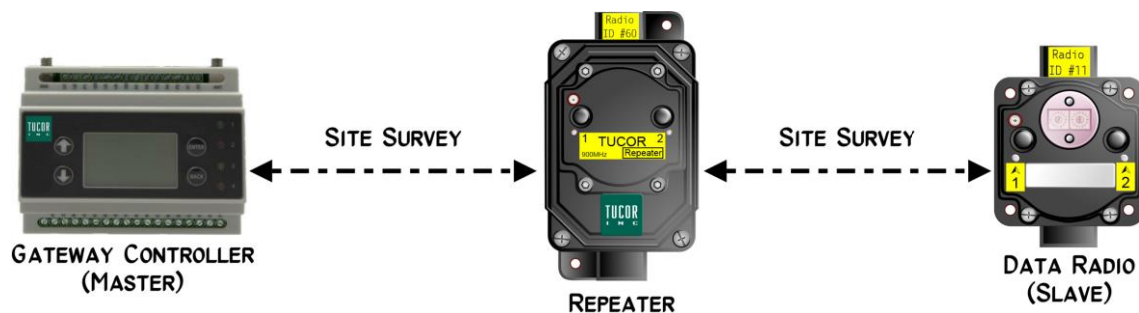
Other radios bound within the same network remain synchronized to the network but are blocked from sending data while the site survey is running. The site survey analyzes the signal strength between the selected child and its parent radio only. Disable site survey on one radio before initiating it from another. Radios in site survey mode have a solid green LED for the duration of the site survey and the LCD display scrolls the results. Because the statistics represent the lesser of the round-trip results, one person can ascertain the link quality from either device. Single-click button 2 to pause or resume auto-scrolling the site survey results. While paused, button 1 single-step advances through the four signal strength categories: green, yellow, red, and missed. Double-click button 2 to exit the results display.

Gateway Controller Radio	Gateway, Repeater or Data Radio/Receiver
  Navigate to the Site Survey menu. 	 Press the left button (#1) until the display reads *SITE then, press the right button (#2) to enter the Site Survey menu. **Master radio:** The displays reads CHLDRN **Repeater radio:** The display reads PARENT **Slave radio:** The display reads PARENT
Using the UP & DOWN arrows, select the Radio ID/Device # to be surveyed and press ENTER. 	Select the MultiHop radio to analyze: **From the master:** Single-click button 2 to display the child radio's device address. (A radio's device address is displayed under its *RUN menu). Single click button 1 to scroll between all the master radio's children. When you reach the child radio, you want to run the site survey with, single-click button 2. **From the repeater:** Single-click button 1 to cycle between PARENT and CHLDRN. Single-click button 2 to select PARENT or CHLDRN. If conducting the site survey with one of the repeater's children, single-click button 1 to scroll among a repeater's children radios. (Each data radio's device address is displayed under its *RUN menu.) Single-click button 2 at the device address screen to select the child or parent and begin the site survey. **From the slave:** Single-click button 2 to display PARENT. Single-click button 2 to begin the site survey.
The site survey begins. The status of the survey is displayed along with the number of retries. Any number of retries may indicate a communications issue.	The site survey begins. LED 2 on both the parent and child radios flash for every received RF packet. To indicate the parent is in site survey mode, LED 1 is a solid green. The data radio analyzes the quality of the signal between the parent and child by counting the number of data packets received and measuring the signal strength (green, yellow, and red).
The results are displayed on the LCD. Press BACK to return to the previous menu.	While in progress, single-click button 2 to pause or resume auto-scrolling the results. While paused, button 1 single-step advances through the four signal strength categories. Double-click button 2 to exit the results display. Double-click button 2 again to end Site Survey. The devices automatically resume operation.

III. Interpreting the Site Survey Results

Site Survey results are listed as a percentage of data packets received and indicate the signal strength of the received signal.

	Result	Description
	Green	Packets received at a strong signal strength. A strong signal strength is greater than −90 dBm at the receiver.
	Yellow	Packets received at a good signal strength. A good signal is between −90 and −100 dBm at the receiver.
	Red	Packets received at a weak signal strength. A weak signal is less than −100 dBm at the receiver.
	Missed	Packets not received on the first transmission and requiring a retry.

Judging if the reliability of a network's signal meets the needs of the application is not just a matter of green, yellow, and red packets received. In the normal operating mode, when data packets are not received, the transmitter re-sends the packet until all data is received.

For slow monitoring applications such as a tank farm, where data is required in terms of seconds or minutes, receiving most of the data in the 'red' range, indicating a weak but reliable signal, transmits enough data for accurate monitoring. Nodes positioned near the outside range of the radio signal may have 90% of the data packets received in the red zone, again indicating a weak, but reliable signal.

We recommend keeping the missed packets average to less than 10% for Base and Link and 5% for Ethernet. When the network misses more than 10% of the data packets, the signal is usually too unreliable, or obstacles may be interfering with the signal. When Site Survey reports the missed packets are 10% or higher, improve the radio system performance by:

- **Mounting the network's antennas higher** to clear obstacles in the area and improve the line of sight between devices.
- **Using higher gain antennas** to focus the energy of the radio signal in a specific direction and extend the signal's range.
- **Adding data radios to the network** to extend the range of a radio network. For more information on data radios.

IV. Improving Your Site Survey Results

If your Site Survey results have more yellow than green, consider replacing the Receiver antenna with one the following:
- Use a 3 dBi 12" Omni or a 6 dBi 24" Omni antenna.
- Use a 6 dBi Yagi (directional) antenna.

If the distance between devices is greater than (2000') line-of-sight or objects, such as trees or man-made obstructions, interfere with the path, and the MISSED packet count exceeds 10 per 100 packets, consider the following steps:
- Install the antenna(s) remotely at a higher position (requires an antenna extension cable);
- Use a higher gain antenna;
- Decrease the distance between devices; or
- Use Repeater Radio's (only for Link system).

A. Performance Levels

Very strong signal strength is 100 green signals (displayed on the LCD) If the included 2 dBi OMNI antenna does not achieve this signal strength, use a different omni antenna, such as the 3" 3 dBi external antenna or 12" 3 dBi antenna (higher performance). You may also use a low-gain directional antenna, such as the 6.5 dBd Yagi antenna.

Strong signal strength is represented by some green signals and some yellow signals (very few red signals and very few missed signals) or four flashes per second. To improve your radio performance, consider using a different omni antenna, such as 3" 3 dBi external antenna 12" 3 dBi antenna (higher performance), , 6 dBi antenna, or 8 dBi antenna. You may also use a low-gain directional antenna, such as the 6.5 dBd Yagi antenna. We also recommend installing the antenna(s) remotely at a higher position.

B. Antenna Performance

3 dBi	6 dBi	8 dBi
70° beam width	70° beam width	12° beam width
12" Height	24" Height	63" Height
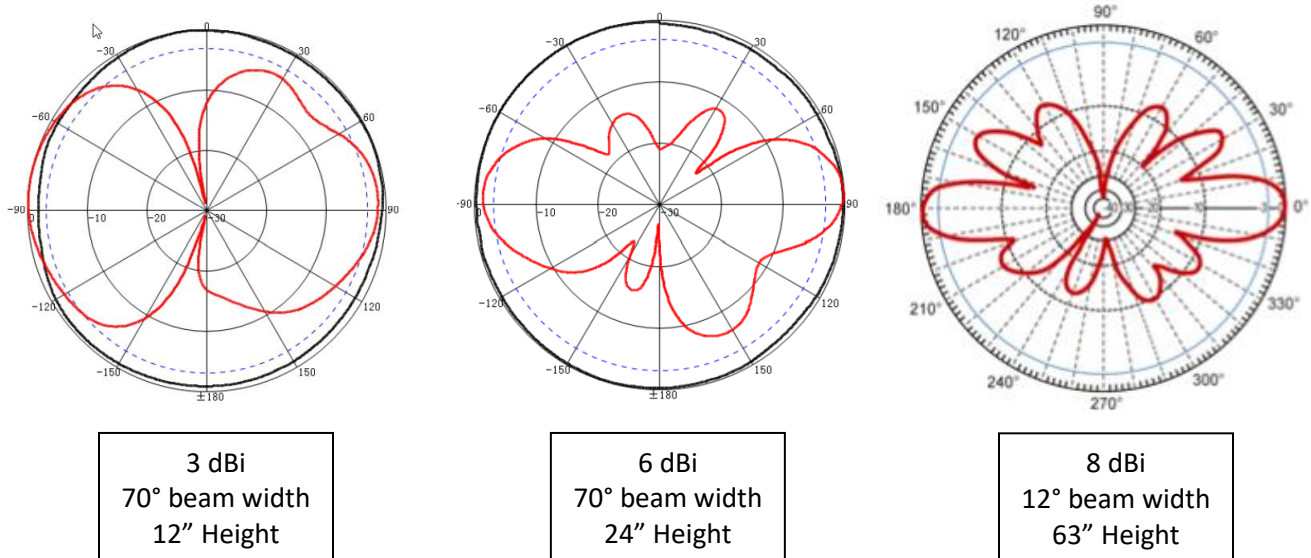
Over the years there have been several different reference antennas used; however, today an isotropic radiator is preferred as the standard antenna for comparison. As noted, the isotropic antenna transmits equal amounts of power in all directions (like a light bulb).

To increase the directivity of a bulb's light (the antenna's energy), similar to a flashlight or automobile headlamp in this example, a reflector (antenna) is added behind the bulb. At a distance, in the light bean, the light bulb now appears to be much brighter. The amount that the bulb appears brighter compared to the bulb without a reflector is the directivity of the reflector (antenna).

When the directivity is the converted to decibels we call it the antenna gain relative to an isotropic source (dBi). Typically, the higher the gain, the more efficient the antenna's performance, and the farther the range that the antenna will operate. For every 6 dBi in gain, you double the range of the antenna.

C. Improving Results within a Link System

Add a repeater radio to the network and enable the forced routing function on the radio with a weak signal to force it to use a repeater. The repeater radio must have 0 missed packets to the gateway for Tucor to accept the job.

If you cannot use forced routing or add a repeater radio to the network, use a 8 dBi omni-direction antenna or a 10 dBi directional antenna.

We also recommend raising the radio units to a higher elevation, either by physically moving the devices or installing the antenna(s) remotely at a higher position.

The absent of signals may also be due to the distance between the Gateway (master) and Receiver/Data Radio (slave) radios, terrain, or physical obstructions such as buildings. If this is the case, please contact Tucor for further assistance.