Spearix Eval Kit GUI at a Glance

Summary of the Graphical User Interface Windows and What They Mean

May 7, 2024

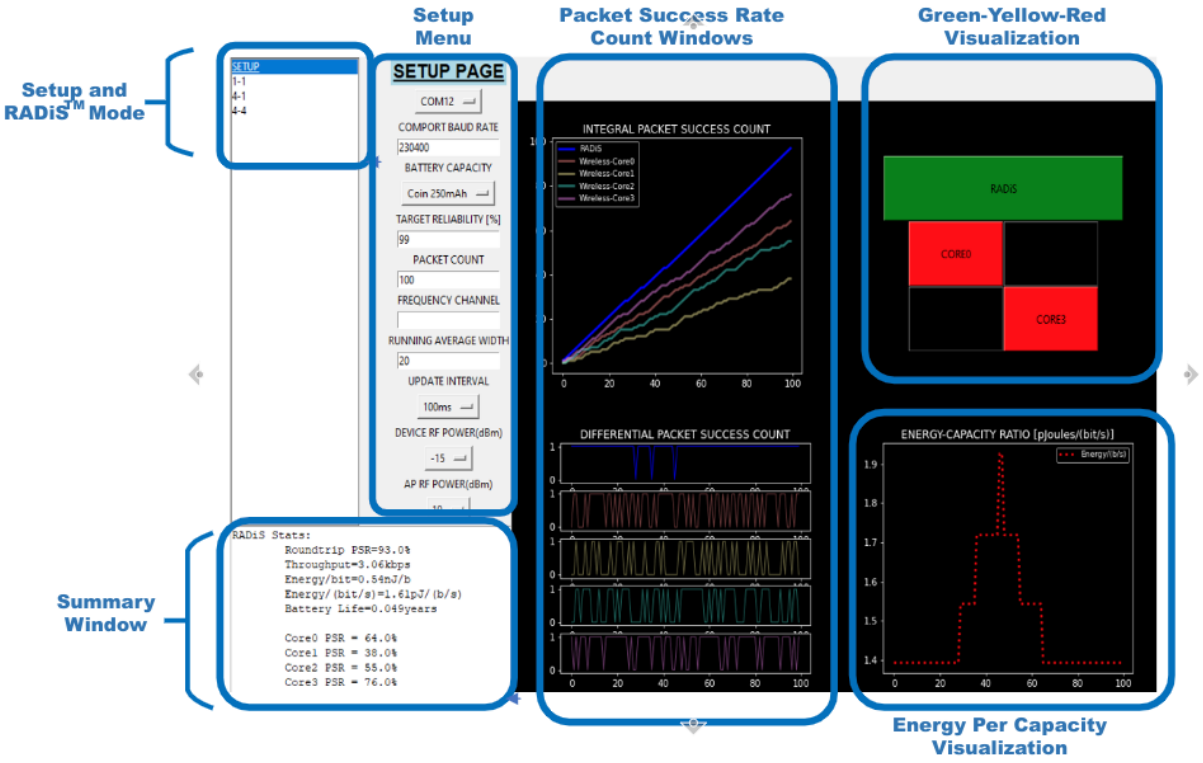
Info@spearix.com

Introduction

The Spearix SPX210C4 EVK Evaluation Kit employs a graphical user interface (GUI) designed to visualize environmental effects of aggressors affecting the 2.4 GHz spectrum quickly and accurately.

The GUI is the first of its kind based on packet error rate (PER) or packet success rate (PSR). Packet success rate represents a more consistent representation of actual channel capacity than do other metrics such as receive signal strength indicator (RSSI) or “bars.” Link quality indicator (LQI) often derived from the received quality of the preamble may also be used but is less consistent than metrics based on PSR.

The main sections of the GUI are as follows:



The Visualization Windows

Packet Sucess Rate Count Window

The packet success rate (PSR) count window receives statistics from the evaluation kit hardware and summarizes PSR. It displays in real time as the packets fly. The plots represent packets generated on the device side and sent to the access point side. Packets are considered successful when both the preamble and CRC code are valid. Note PSR and PER are directly related as below:

$$PSR = 1 - PER$$

Integral PSR Count Window

The integral PSR window plots the successfully received packets accumulated over time. In an ideal case, where one successful packet is received for each packet expected to be received, the slope of is 1 to 1 or a perfect diagonal case. The top blue line is composite RADiS™ and the other traces are each individual core. Each core is plotted in a distinct color and the performance of each individual core can be seen over the entire number of packets transmitted.

Differential PSR Count Window

The differential PSR count window displays packet by packet success and loss for each core throughout the total number of packets sent. In the ideal case where all packets are received successfully, the trace will be solidly at the high state with no transitions toward the low state. Each transition toward the low state is a failed or lost packet. The top blue trace is RADiS™ composite performance. The other traces represent each individual core.

Green-Yellow-Red Visualization Window

The GUI maintains a running average of PSR and compares with multiple thresholds to display a color-coded block for each core and for the total RADiS™ composite performance. The window of average is programmable and set using RUNNING AVERAGE WIDTH parameter in the setup menu. The colors and the number of retransmissions required to maintain a base reliability set using TARGET RELIABILITY parameter in setup menu. Exhibited color relates directly to reliability. Since each retransmission exhausts energy from the battery, the color exhibited can also link to overall battery life.

Green—1 or 0

Yellow—2

Red—3

Black—More than 3

Energy per Capacity Visualization

In IoT and battery powered sensor systems, the total cost of ownership is directly linked to battery life of weaker wireless links. This window visualizes the true cost of unreliable links in terms of battery life. As errors occur, the energy per bit per second increases.

The Setup Menu

The setup menu is used to establish the conditions of the test. The data rate is fixed to 250kbps as per the IEEE802.15.4 standard. However, other parameters can be changed, and some selections reflect user conditions. Below are the options.

COM

The COM port is read automatically and is used to connect to the access point eval board through USB. User has no option to change it.

COM PORT BAUD RATE

This is the rate between the host process on the access point eval board and the COM port on the host PC. It is fixed to 230400kbps. Note: this is not the baud rate of the wireless interface.

BATTERY CAPACITY

User selectable battery capacity used to calculate the total battery life reported after each test. The default is 250mAh, typical of a coin cell.

TARGET RELIABILITY (%)

The user can define a reliability by which to grade the visualization. Typical values are 90 to 99. The default is 99.

PACKET COUNT

This parameter sets the total number of packets to be sent from the device side to the access point side. Upon synch and before each test begins, both sides become aware of the number of packets. This is the total number of packets used to calculate PSR statistics. PSR of each expected packet is displayed by the GUI as they are received or missed. The packet count limits the statistical significance of the reliability. More packets are necessary to measure higher reliability. For example, 100 packets enables 99%, 1000 packets enables 99.9%, 10000 packets enables 99.99% etc.

FREQUENCY CHANNEL

Leave blank or as default for sequential frequency hopping. Enter the number of channels to hop and the list of channels to start hopping to select frequencies and blacklist others.

For example, 1, 11 is fixed frequency where core 0 remains on channel 11. For additional details, see the complete User Guide.

RUNNING AVERAGE WINDOW

Sets the number of packets to be used in the running average calculation that designates the color threshold of each core in the Green-Yello-Red visualization window.

UPDATE INTERVAL

Time between packets. Each packet window is 10ms. This sets the duty cycle. Longer intervals result in lower effective throughput.

DEVICE POWER

The device side transmits RF power and is user selectable from –20dBm to 10dBm. In the case of multi-core operation, this refers to power within each transmitter. Device power mainly affects the reliability of upstream data from the device to the access point which is the typical use case in battery operated IoT applications.

ACCESS POINT POWER

The access point side transmit RF power is user selectable from –20dBm to 10dBm. In the case of multi-core operation, this refers to power within each transmitter. Access point power mainly affects the return acknowledgment (ACK) reliability downstream from the access point to the device which may affect round trip reliability. For more details see the complete user guide.

Setup and RADiS™ Mode Window

The setup window is used to establish parameters of the test.

Since RADiS is scalable, it's possible to operate with minimized diversity and also asymmetrically with the access point using more cores than the device side. The GUI provides 3 options. The highest gain occurs when both sides maximize the number of cores used.

Mode	Description	Expected Gain
1-1	No diversity, AP Core0 connecting with device Core0	0dB
4-1	Asymmetric, AP using 4 cores, device using only Core0	6dB
4-4	AP using 4 cores, device using 4 cores	12dB

Summary Window

The GUI reports final statistics when the test stops running.

ROUNDTRIP PSR

Total number of correct packets divided by PACKET COUNT parameter. Packets are considered correct if the preambles were received correctly AND the CRC value was correct AND the acknowledgment (ACK) back to the device side was also received. All three criteria establish a round trip, not one-way reliability.

THROUGHPUT

Total payload in bits received divided by total elapsed test time.

Energy per Bit

Total energy used was divided by number of bits transmitted during the test, divided by PSR to account for inefficiency of lost packets and retransmissions to achieve the target reliability.

Energy per Bit per Second

Energy per bit divided by total test time divided by PSR to account for inefficency of lost packets.

Battery Life

Estimated life of battery selected in the setup menu assuming the update interval.

Individual Core PSR

Report PSR for each individual core. Reported to provide a baseline of best- and worst-case core performance.

For additional details see the full User Guide.