RSSI Extended Information

ABSTRACT

Knowledge of the received signal strength indication (RSSI) from a transmitting ANT device can be useful in a variety of applications. ANT RSSI can be used to assist in device pairing by providing a means of acquiring the master generating the strongest received signal. RSSI can also be used in proximity applications by providing feedback on the transmitting device's signal strength with respect to the receiver. This application note provides an overview of ANT RSSI extended information, and describes the steps to enable and interpret RSSI output.

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1 Introduction

Extended messaging is an advanced ANT feature that allows an ANT node to provide its host application with additional information regarding the received data message. Extended data can include channel ID, received signal strength indication (RSSI), and/or timestamp information. Refer to the "ANT Message Protocol and Usage" document for details.

The RSSI value represents the signal strength of a received message. Configured correctly, extended messaging allows an ANT device to report the RSSI value of a received message.

Enabling RSSI information can provide more flexibility in acquiring the appropriate device than provided by the Proximity Search feature. RSSI provides the ability to associate a value with each transmitting device that can be used to indicate the relative distance of the transmitter with respect to the receiver. For more information on the Proximity Search feature, please refer to the "Proximity Search" application note.

RSSI can be useful in a variety of applications. One possible example is a key-fob that auto-locks a car once it detects that the RSSI has fallen below a certain threshold value.

2 Relevant Documents

It is highly recommended that the following documents be read and understood prior to using this application note:

- ANT Message Protocol and Usage
- AN12 – Proximity Search

3 Overview of Extended Messaging

Extended messaging allows an ANT device to pass additional information to the host application, along with the received data message. Devices capable of providing RSSI information use the "flagged" extended messaging format (i.e. legacy extended messaging format is not supported). Refer to the "ANT Message Protocol and Usage" document for more details.

The flagged extended message format is shown in Figure 1.

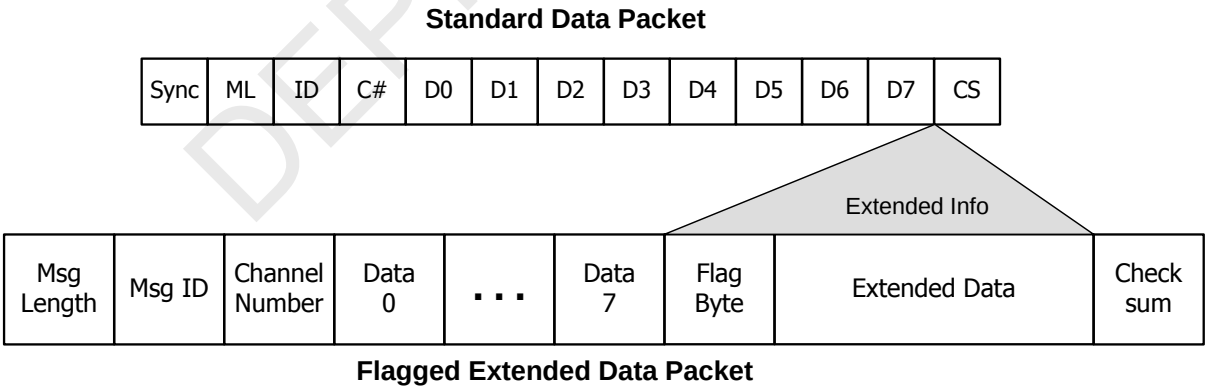

Figure 1. Flagged extended message format

ANT appends the extended data bytes to the serial message that is passed to the host application, as shown in Figure 1. The host application shall check the message length and flag byte to determine the presence, and content, of extended data.

4 RSSI Extended Output

The *Lib Config (0x6E)* message facilitates the addition of RSSI information to the standard 8-byte data payload of each received ANT message.

4.1 Enabling RSSI Output

Extended messaging is disabled by default. If RSSI is desired, extended messaging must be configured using the *Lib Config (0x6E)* message **prior** to opening the channel. For more details, refer to the "ANT Message Protocol and Usage" document.

Lib Config (0x6E) enables extended messaging by use of a flag byte parameter.. To enable RSSI output bit 6 (mask 0x40) of the flag byte shall be set high.

The *Lib Config (0x6E)* message is only available on certain ANT chips and modules, and RSSI extended information is not supported on all devices that support *the LibConfig(0x6E)* command. Refer to section 9.4 of the "ANT Message Protocol and Usage" document and product data sheets for more information on device capabilities.

4.2 Example Implementation

Figure 2 outlines the steps to configure RSSI extended information on a slave device. Boxes with dashed outlines are optional steps; if not specifically set, default values for these parameters are used. Boxes shaded in grey refer to parameters that are required to establish any ANT channel. White boxes relate to parameters that should be configured to enable extended RSSI data.

First, the *Assign Channel* (0x42) command assigns a channel type. This example assigns a bi-directional slave channel type.

Next, the channel ID and channel period should be set as desired. This example sets a completely wild-card channel ID and uses a 4Hz channel period.

Finally, enable extended messaging using the *LibConfig(0x6E)* message and the appropriate flag byte.

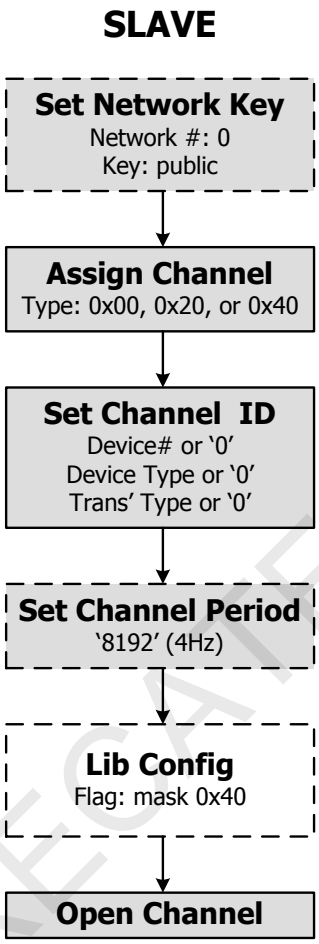

Figure 2. Enabling RSSI extended data at the receiver

RSSI extended information can be used in a variety of situations ranging from synchronized channels to scanning mode.

4.3 Decoding RSSI Data

If RSSI output is enabled, bit 6 (mask 0x40) of the flag byte shall be set to indicate that RSSI information is present in the extended data bytes. An ANT node that is configured to report only RSSI data will receive a message as shown in Figure 3.

Extended RSSI data includes the measurement type, RSSI value, and threshold configuration value.

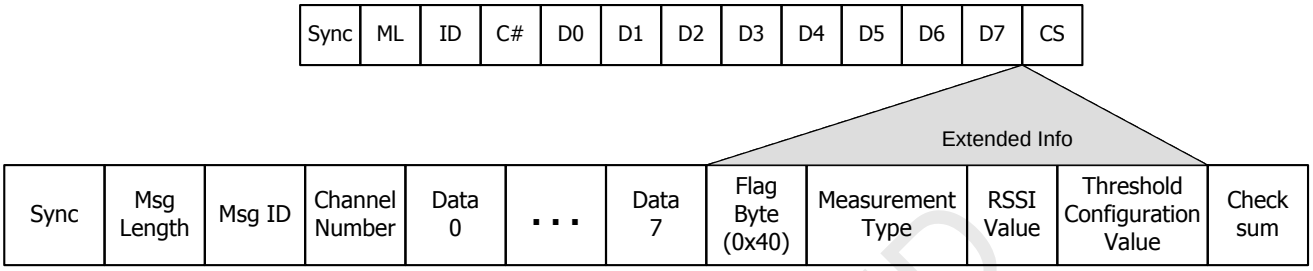

Figure 3. RSSI extended data

4.3.1 Measurement Type

The measurement type represents the units of the received data message, and indicates how to interpret the RSSI value field. The value 0x20 indicates the presence of valid RSSI data, reported in units of dBm. **A value other than 0x20 indicates that the RSSI value field shall not be interpreted.**

4.3.2 RSSI Value

The RSSI value is a signed integer value that corresponds to the measured RSSI of the received message on the associated channel. When the measurement type is 0x20 this value ranges between 127 to -128 dBm.

4.3.3 Threshold Configuration Value

The threshold configuration value is a signed integer that reports the power level of the threshold bin configured through Proximity Search. This value is reported in units of dBm. For more information on threshold bins and Proximity Search, refer to the "Proximity Search" application note.

If Proximity Search is not used, the threshold configuration value is -128dBm (0x80). If Proximity Search is enabled by configuring a non zero bin, the threshold configuration value will report the power level corresponding to the last configured bin.

4.4 Worked Example

This example uses an ANT device with RSSI reporting capabilities. The device number is wild carded (i.e. set to 0x0000), and both the device type and transmission type are set to 0x01. *LibConfig(0x6E)* is configured using the flag byte of 0xC0; enabling the channel ID and RSSI extended data bytes. The device is then opened in continuous scanning mode (i.e. ANT_OpenRxScanMode). The host application is ANTware II, available at www.thisisant.com, but this can be implemented in any custom application

Two master nodes are configured using arbitrary device numbers, and the same device type and transmission type as the slave device. Figure 4 highlights the message transaction between the host application and ANT.

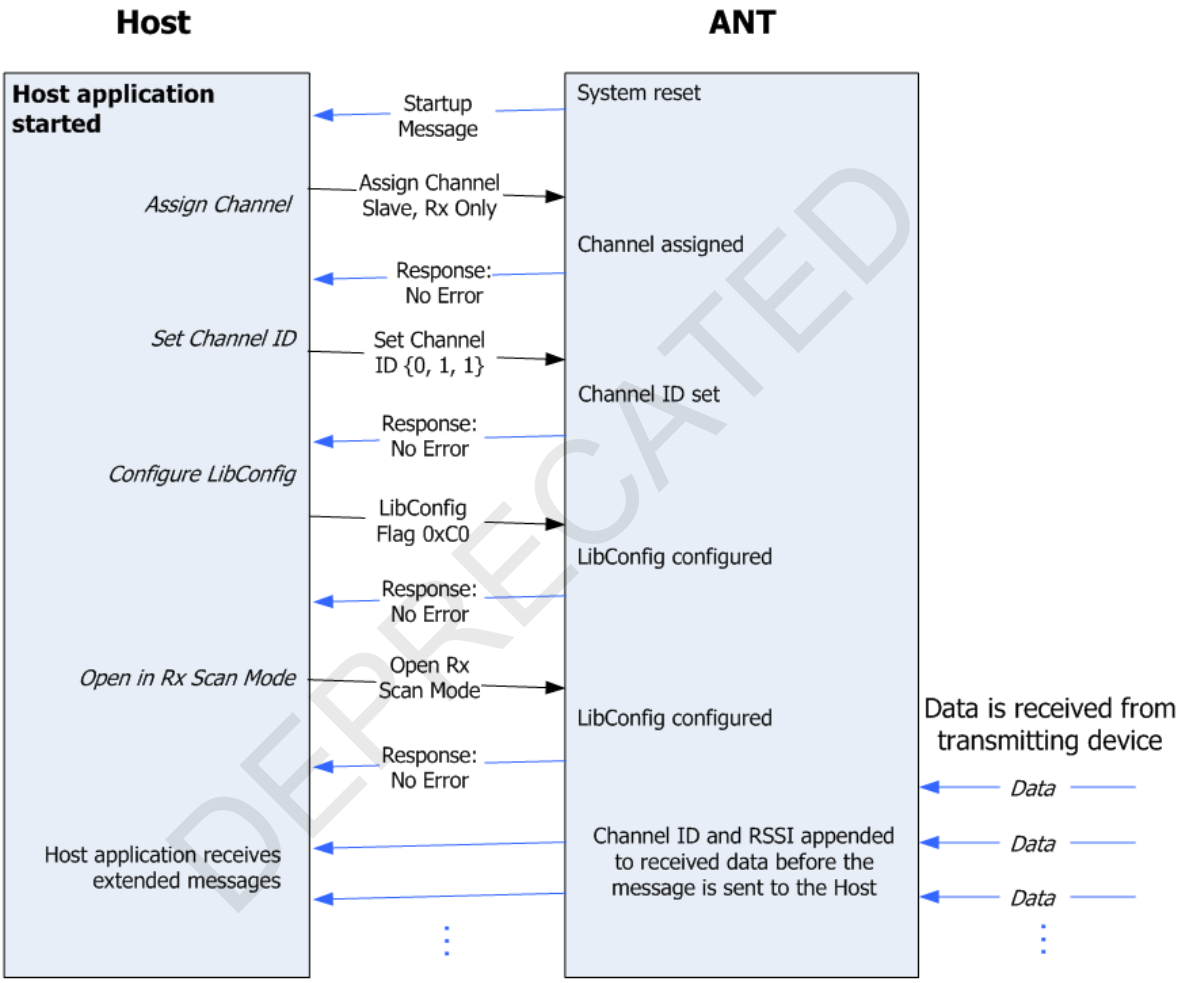

Figure 4. Exchange of messages between the host and ANT

Figure 5 shows the ANTware II output panel of the slave device. Each received broadcast message has the typical 8 byte data payload, followed by the flag byte (0xC0), and extended data. The flag byte matches the value used to configure *LibConfig(0x6E),* and indicates the presence of channel ID and RSSI extended data. The 7 bytes of extended data include 4 bytes for the channel ID, and 3 bytes for the RSSI data as described in section 4.3. The length of the extended data will vary depending on the flag byte used to configure extended messaging.

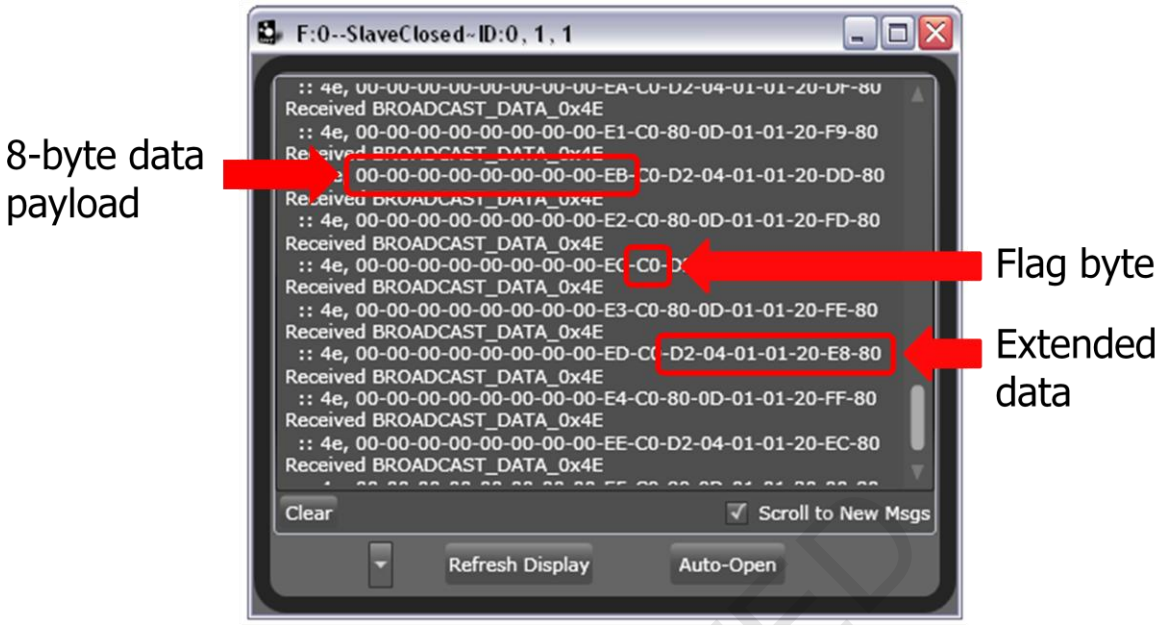

Figure 5. Example channel ID and RSSI extended data

The flag byte indicates the presence, and order, of extended data; **if bit 7 of the flag byte is high (mask 0x80); channel ID information shall be expected first**. If Bit 6 is set high (mask 0x40), RSSI values can be expected directly to the right of the channel ID information. Note that, if *LibConfig(0x6E)* was not configured with the channel ID bit set high, RSSI output would be directly to the right of the flag byte. For more information on the order of extended data bytes with other fields enabled, refer to the "ANT Message Protocol and Usage" document.

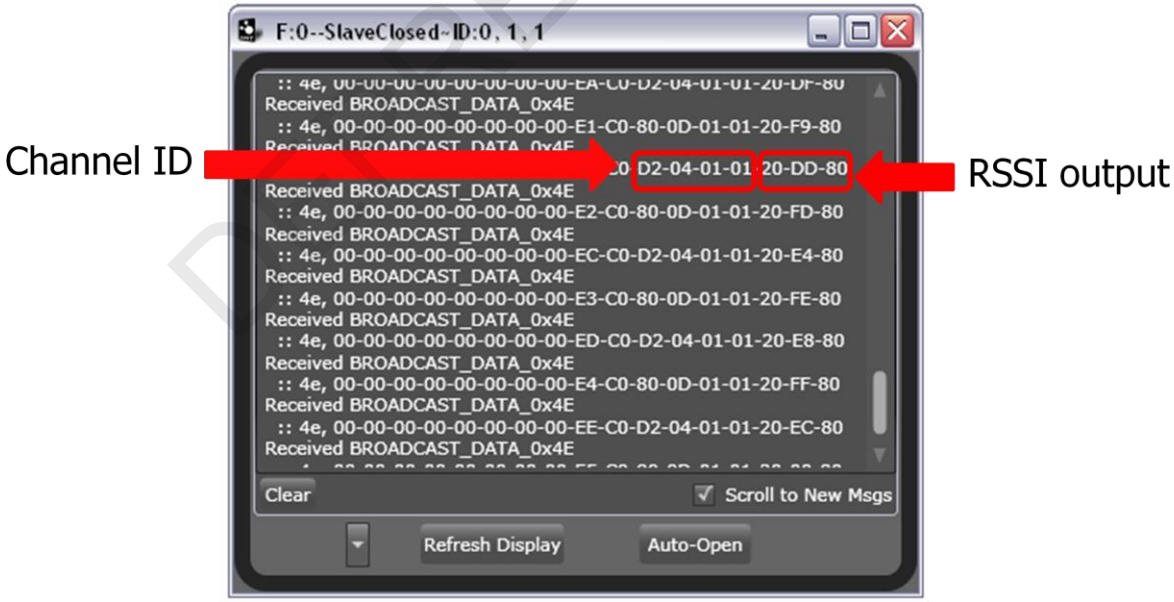

Figure 6. Breakdown of the extended data

Figure 6 illustrates the breakdown of the extended data message. In this case, the extended data consists of

[D2][04][01][01][20][DD][80]

The flag byte indicates that channel ID data is present; therefore the first 4 bytes represent the channel ID: device number 1234, device type 1, and transmission type 1.

[D2][04][01][01][20][DD][80]

The subsequent 3 bytes make up the RSSI data, as described in section 4.3. This corresponds to a measurement type of 0x20 (i.e. RSSI is valid and reported in dBm), an RSSI value of 0xDD (i.e. -35 dBm), and a threshold configuration value of 0x80, or -128 dBm (i.e. proximity search disabled).

[D2][04][01][01]**[20][DD][80]**

5 Design Considerations

RSSI readings may vary widely due to the nature of wireless communication. RF environment and system design (i.e. antenna design and orientation, device packaging, etc.) can affect signal strength. As a result, direct correlations of received RSSI value and distance between devices should not be made. Specific use cases and hardware should be thouroughly tested in order to determine appropriate threshold values for specific applications. Even rigorously tested distance to RSSI value correlations for specific use cases should allow for a significant margin of error due to the unpredictable nature of wireless communication. Some factors affecting performance that should be considered include, but are not limited to:

- Varying performance (e.g. output power) of similar devices from same/different manufacturers
- Varying performance of the *same* devices from the *same* manufacturers
- The presence of continuous wave/sporadic interference
- Antenna orientation
- Incorrect user interaction

In an effort to account for all possible factors affecting wireless link performance, RSSI values should be selected, even under the worst case scenarios.

6 Closing Remarks

This application note describes the ANT RSSI output feature and design considerations for effective implementation.

If any of the concepts presented in this application note are unclear or for further inquiries, please go to www.thisisant.com.