Continuous Scanning Mode for Asynchronous Topologies

ABSTRACT

The continuous scanning mode offers the possibility of asynchronous data communication between multiple transmitters and a single scanning device continuously listening for any incoming messages. This application note describes the operation and configuration of ANT nodes in continuous scanning mode. Source code for a PC based application for a node in continuous scanning mode is provided.

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1 Introduction

The continuous scanning mode[1] allows an ANT node to asynchronously receive transmissions from multiple devices, regardless of their respective message rates. In scanning mode, the radio is active full time, so it is able to receive messages from transmitting nodes at any time.

Please note that operation of a node in continuous scanning mode is different from the background scanning channel feature available in some ANT parts. Please refer to the "ANT Channel Search and Background Scanning Channel" application note for more details on this channel type.

The following application note details the main features of the continuous scanning mode, and describes the design and implementation of a continuous scanning mode PC application. Sample code for the PC application is also provided.

2 Relevant Documents

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

- ANT Message Protocol and Usage
- ANT Development Kit User Manual

3 Bill of Materials

The following is a list of the hardware and software tools required for using the software implementation.

1 x ANT Development Kit (ANTDTK3)

4 Continuous Scanning Mode

An ANT node in scanning mode continuously listens for any transmissions in an asynchronous fashion, allowing it to receive data from multiple nodes operating on the same network and RF frequency, as shown in Figure 1.

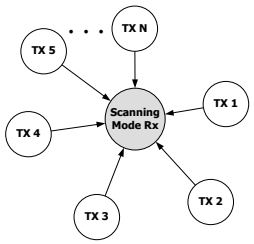

Figure 1. Network Diagram

[1] Feature available on some ANT devices, please check datasheets for capabilities.

ANT channels are synchronous in nature: a master device transmits a data packet, in the forward direction, every channel period and the slave device synchronizes with the master to receive the data, as illustrated in Figure 2.

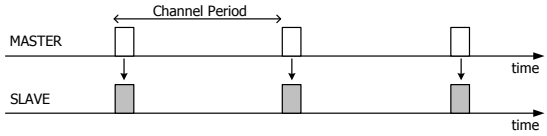

Figure 2. Operation of an ANT channel

ANT's continuous scanning mode, on the other hand, foregoes all synchronous channelization. As shown in Figure 3, communication with a continuous scanning node is asynchronous: the device in scanning mode is receiving the entire time, and can receive messages from any master device on the same RF space regardless of its channel period. All of the radio resources are occupied while in scanning mode; hence, no other channels can be open on a node in scanning mode.

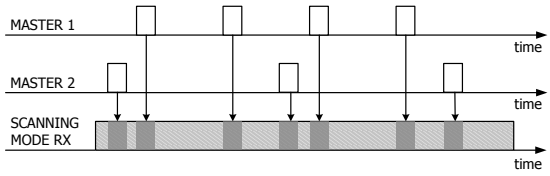

Figure 3. Operation of continuous scanning mode

The operation of a node in scanning mode is transparent to master devices. As such, no special configuration is required on the master side. However, it is recommended that master devices communicating with a scanning device have a unique channel ID, to allow the scanning node to correctly identify the source of each received message.

4.1 Receive-Only Scanning Mode

A node in continuous scanning mode can be configured for bidirectional or receive-only communication.

Even though the continuous scanning mode makes full use of the radio, receiving 100% of the time; if a scanning node is configured for bidirectional communication, it is still possible to transmit data in response to a message from a master. In this case, it will also automatically send acknowledgements when receiving acknowledged and burst data. This could be a problem if the scanning device is not the intended destination of the data. If a node in bidirectional scanning mode is used to listen in on the communication between a pair of nodes using acknowledged or burst data, the scanning device will also

automatically send acknowledgements, disrupting the communication session.

For this reason, receive-only configurations are recommended for diagnostic applications. In receive-only mode, the scanning device is unable to transmit, and thus will not respond to acknowledged or burst data. This is illustrated in Figure 4, where the device in scanning mode is used to listen in on the communication session between a master and slave. Note that the scanning device must have knowledge of the network key and RF frequency configuration of the master and slave devices.

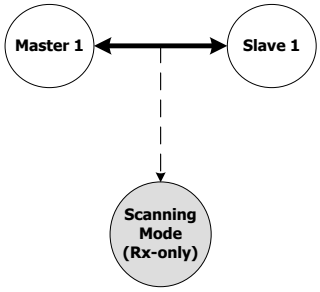

Figure 4. Receive-only scanning mode

4.2 Bandwidth

In an ANT network, master devices perform the channel management necessary to provide coexistence between multiple ANT transmissions. For this reason, the available bandwidth is determined by the master nodes, regardless of the type of receiving device.

The number of simultaneous transmissions that can be supported by a single scanning device is limited by the available bandwidth, which is determined by the master devices. Thus, a node configured in scanning mode can support the equivalent number of transmissions that can be supported by independent master/slave pairs in a given RF space, as illustrated in Figure 5. The host MCU on the scanning device must also have sufficient resources to support the transmissions.

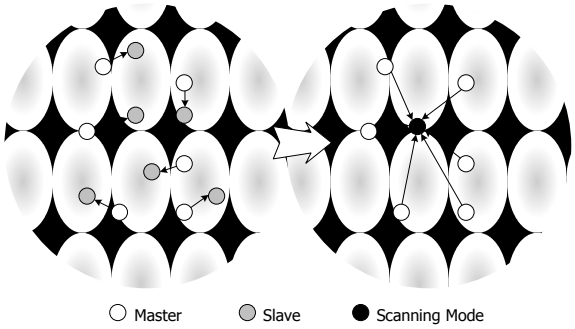

Figure 5. Number of supported connections

4.3 Power and Latency

In continuous scanning mode, the radio is always active, allowing it to receive messages at any time, without the latency associated with channel acquisition on synchronous ANT channels. With the RF continually active, the node will draw significant current (peak Rx current) while in this mode. For this reason, this feature is not recommended for devices under tight power constraints.

5 Operation and Configuration

5.1 Continuous Scanning Mode Setup

The steps required to configure a node in continuous scanning mode are shown in Figure 6. The node can be configured for bidirectional or receive-only communication. Wildcarding can be used by setting any of the Device Number, Device Type and/or Transmission Type fields to 0. Note that operation of the scanning mode is enabled with the *Open Rx Scan Mode* command (0x5B), and that all configuration commands requiring a channel number should set this field to 0.

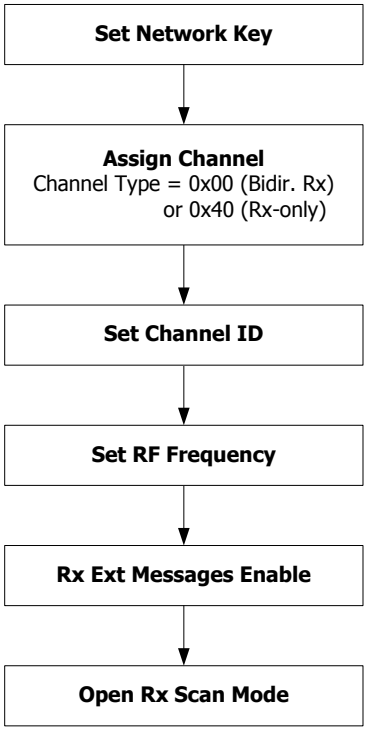

Figure 6. Scanning mode setup

The continuous scanning mode makes full time use of the radio, so no other channels can be open on a continuous scanning device. A CLOSE_ALL_CHANNELS message from ANT will indicate an invalid attempt to start the scanning mode while any channels are open.

5.2 Extended Messages

Extended messages allow ANT to provide the channel ID to the host MCU, along with the received data message. Extended messages help distinguish the source of a message when a device configured in scanning mode is receiving data from multiple masters. Broadcast, acknowledged and burst messages are available in this format.

Extended messages can be enabled using the *Rx Ext Messages Enable* command (0x66). This message format only needs to be enabled in the scanning device (i.e. not in the masters). There are two extended message formats: flagged and legacy.

Flagged extended messages include a flag byte that indicates the presence of extended information (the channel ID). For example, Figure 7 shows the format of a flagged extended broadcast message. The message ID is the same as for standard broadcast data (0x4E), however, the message length and the flag byte indicate the channel ID is after the data. Acknowledged and burst messages follow a similar format.

Sync	Length **14**	Msg ID **0x4E**	Channel Number	Data D0:D7	Flag Byte **0x80**	Channel ID	Check sum

Figure 7. Flagged extended broadcast message

If using the ANT PC Library Interface, the following PC-only events indicate that a flagged extended message has been received from ANT:

- EVENT_RX_FLAG_BROADCAST
- EVENT_RX_FLAG_ACKNOWLEDGED
- EVENT_RX_FLAG_BURST_PACKET

AT3 devices use the legacy extended message format. This format is illustrated in Figure 8. Each extended data type has its own message ID: extended broadcast (0x5D), extended acknowledged (0x5E) and extended burst (0x5F). Also, note the lack of a flag byte and the presence of the channel ID before, rather than after, the data.

Sync	Length **13**	Msg ID **0x5D**	Channel Number	Channel ID	Data D0:D7	Check sum

Figure 8. Legacy extended broadcast message

If using the ANT PC Library, the following PC-only events indicate that a legacy extended message has been received from ANT:

- EVENT_RX_EXT_BROADCAST
- EVENT_RX_EXT_ACKNOWLEDGED
- EVENT_RX_EXT_BURST_PACKET

Note that when a burst transfer is received, only the first packet of the burst is an extended message; the remaining packets will consist of standard burst messages.

5.3 Transmitting Data in Scanning Mode

Extended messages can be used to transmit data from a continuous scanning device to a specific master; in this case, data can only be transmitted as a response to an incoming message from that master. All three data types, broadcast, acknowledged and burst data, are supported.

The steps below describe how to transmit an extended data message from a device configured in scanning mode:

1. Assign a channel to the network (any channel other than channel 0).
2. Set the channel ID of this new channel to match the channel ID of the intended destination (master) of the message.
3. Send the extended message, appending the channel ID of the destination master (configured in step 2) to the data.

Once the host sends the extended message to ANT, the message will remain pending until data matching the channel ID is received by the scanning device. Once a matching transmission is received, ANT will send the data to the master in the reverse direction. A successful transmission will be indicated by an EVENT_TX or EVENT_TRANSFER_TX_COMPLETED, as shown in Figure 9.

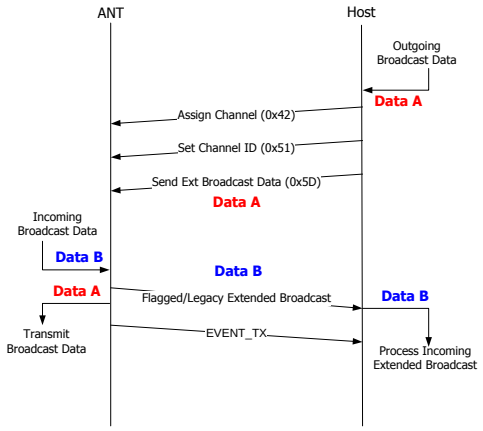

Figure 9. Transmitting data in scanning mode

Please note that while the procedure for transmitting data from a scanning device involves configuring additional channels, this does not mean that other ANT channels are used for transmitting data. The scanning device simply uses the resources, such as buffer space, of these channels to handle the outgoing extended messages.

6 Implementation Example

A PC application is available to illustrate the configuration and operation of the continuous scanning mode. Source code for the application (Visual C++) is provided.

The PC application can be used with an ANT USB interface board (such as the one included in the ANT Development Kit) along with an ANT module with scanning mode capabilities. The application can communicate with multiple masters (for example, multiple instances of ANTware), as long as they match the configured RF frequency and channel ID mask.

In order to use this application, in an ANTUSB interface board, select the appropriate USB port, and click "Connect". You can configure the channel ID mask and RF frequency. The Rx-only checkbox can be used to set the node in scanning mode as a receive-only device. After setting all the configuration parameters, click "Config Scan Mode", and then "Open Scan Mode". The application will display any incoming messages.

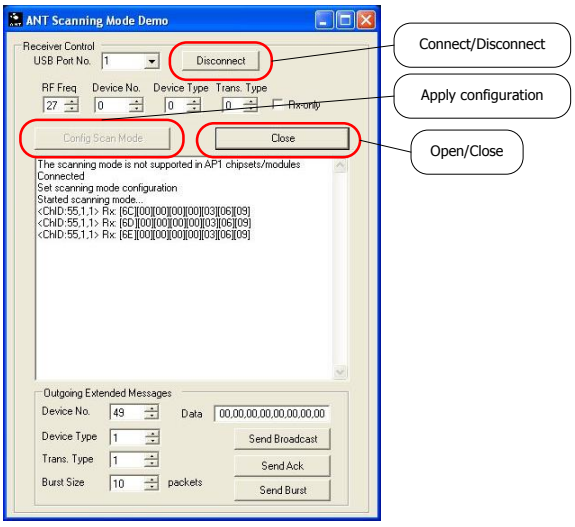

Figure 10. Configuration of the scanning mode demo

To send data from the continuous scanning application, configure the channel ID and data payload in the "Outgoing Messages Section", and click on the "Send" button corresponding to the data type you wish to send. If using burst data, you can also specify the burst size. Make sure the fields for the channel ID match the destination master device. The data will be transmitted over the air as soon as a message is received from that master device.

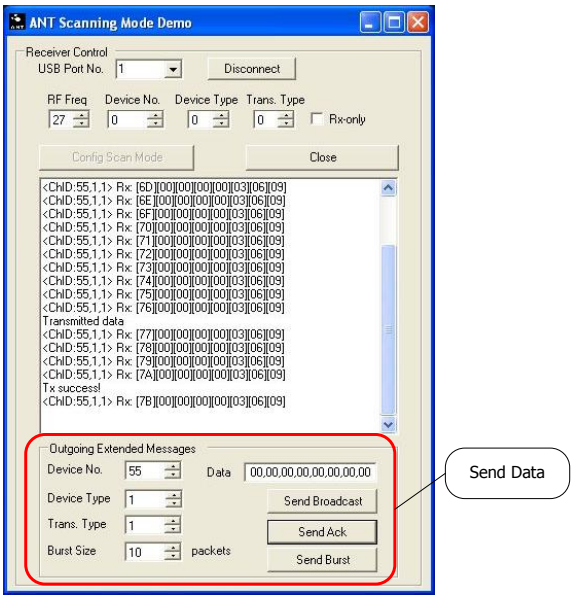

Figure 11. Sending data from the scanning mode demo

7 Closing Remarks

This application note provides details on the operation of the continuous scanning mode, along with sample source showing how to implement a PC based scanning device.