ANT+ Device Profile

Stride Based Speed and Distance Monitor

ANT+ Managed Network Document
D00000830 Rev 1.3
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Copyright Information and Usage Notice

Revision History

Revision	Effective Date	Description
0.A	January 19, 2006	Preliminary Release
0.B	March 15, 2006	Updated Message Payload fields
0.C	March 15, 2006	Updated confidentiality classification. Added message decoding guide.
0.D	March 20, 2006	Update data-flow section.
0.E	March 24, 2006	Edits on message payload fields
0.F	October 23, 2006	Message Format Clarifications
0.G	March 1, 2007	Added additional message pages
0.H	April 3, 2007	Update status byte. Add Stride Count to message.
0.I	February 27, 2008	Updated format and added optional data fields to pages
1.0	September 5, 2008	Updated format for official release.
1.1	January, 2009	Added Page 3 – Page 2 format with Calories Added Summary Pages
-	March, 2010	Proposal: Added speed capabilities pages Added ankle position, and changed chest to "other" in status field
1.2	June 2010	Release
1.3	January 28, 2011	Edited "Copyright Information and Usage Notice" section

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1 Overview of ANT+

The ANT+ Managed Network is comprised of a group of devices that use the ANT radio protocol and ANT+ Device Profiles to determine and standardize wireless communication between individual devices. This management of device communication characteristics provides interoperability between devices in the ANT+ network.

Developed specifically for ultra low power applications, the ANT radio protocol provides an optimal balance of RF performance, data throughput and power consumption.

ANT+ Device Profiles have been developed for devices used in personal area networks and can include, but are not limited to, devices that are used in sport, fitness, wellness, and health applications. Wirelessly transferred data that adheres to a given device profile will have the ability to interoperate with different devices from different manufacturers that also adhere to the same standard. Within each device profile, a minimum standard of compliance is defined. Each device adhering to the ANT+ Device Profiles must achieve this minimum standard to ensure interoperability with other devices.

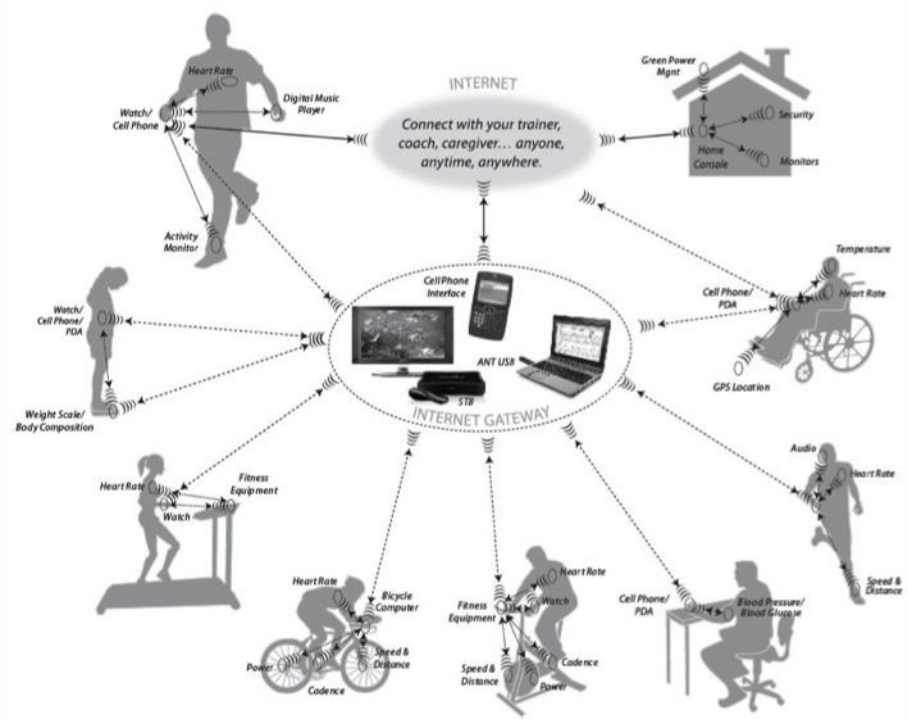

Figure 1-1. ANT+ Device Ecosystem

This document details the wireless communication between devices adhering to this ANT+ Device Profile. The typical use case of the device(s), wireless channel configuration, data format(s), minimum compliance for interoperability, and implementation guidelines are also detailed.

IMPORTANT:

If you have received this document you have agreed to, and signed, the ANT+ Managed Network license agreement and have received the ANT+ Managed Network Key. By signing the license agreement and receiving the ANT+ device profiles you agree to:

- **Implement and test your product to this specification in its entirety**
- **To implement only ANT+ defined messages on the ANT+ managed network**

2 Related Documents

Refer to current versions of the listed documents. To ensure you are using the current versions, check the ANT+ website at www.thisisant.com or contact your ANT+ representative.

1. ANT Message Protocol and Usage
2. ANT+ Common Data Pages

3 Typical Use Case of a Stride Based Speed and Distance Monitor

A stride based speed and distance monitor (SDM) is a personal body-worn device that allows the wearer to measure the number of strides taken, the speed at which he or she is traveling and/or the distance he or she has covered based on stride measurements and calculations. Some examples of SDMs include the foot-worn pods that go on, or in, a shoe and reconstruct strides to compute speed and distance while walking or running. Similarly, pedometers that may be worn on the waist or elsewhere are also considered SDMs. There are other profiles that allow for the measurement of speed and distance obtained from sensors that are not stride based. If there is some uncertainty about what device profile to use, please contact the ANT+ Alliance at antalliance@thisisant.com for more information.

SDMs are worn on, or close, to the body and transmit stride, speed and/or distance information to a watch or other display device. Some SDMs can compute additional information such as cadence. The display device can be a watch, cell phone, piece of fitness equipment, or other personal display device.

Figure 3-1 below illustrates the typical SDM use case. The speed and distance monitor transmits the user's stride, speed, distance, and possibly cadence information in the main data pages. Some device-specific information is transmitted at a slower rate in the common data pages.

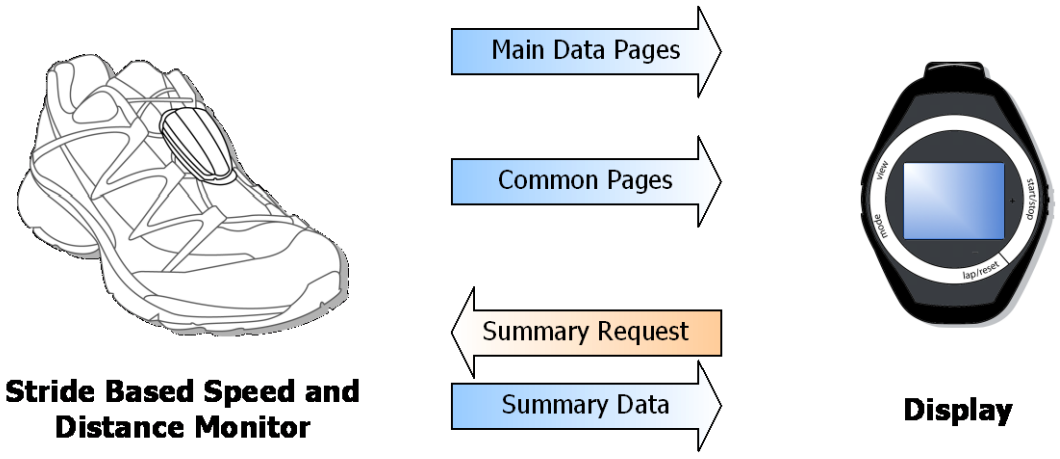

Figure 3-1. Standard Use Case of an ANT+ Stride Based Speed and Distance Monitor

Some SDM's may also have the ability to send summary data pages. These pages are transmitted in response to a summary data request from the display.

3.1 Messages Transmitted from the ANT+ Stride Based Speed and Distance Monitor

All ANT+ messages sent by the SDM (i.e. main, common and request/summary data pages) use page numbers to distinguish different data page formats; the first byte of the ANT+ data payload is always used to indicate the data page number. This message format allows a number of different pages to be sent by the SDM with different data in each page.

The SDM is able to transmit the following data pages:

- **Main data pages:** broadcast at a rate of approximately 4Hz.
- **Common data pages:** there are two required pages containing manufacturer information. A common data page is sent every 65 messages. The manufacturer may choose to include other ANT+ common data pages.
- **Summary data pages:** are not required. These pages contain summary data and are transmitted in response to a request from the display.

Figure 3-2 shows the different main data pages and common data pages that can be sent from the SDM.

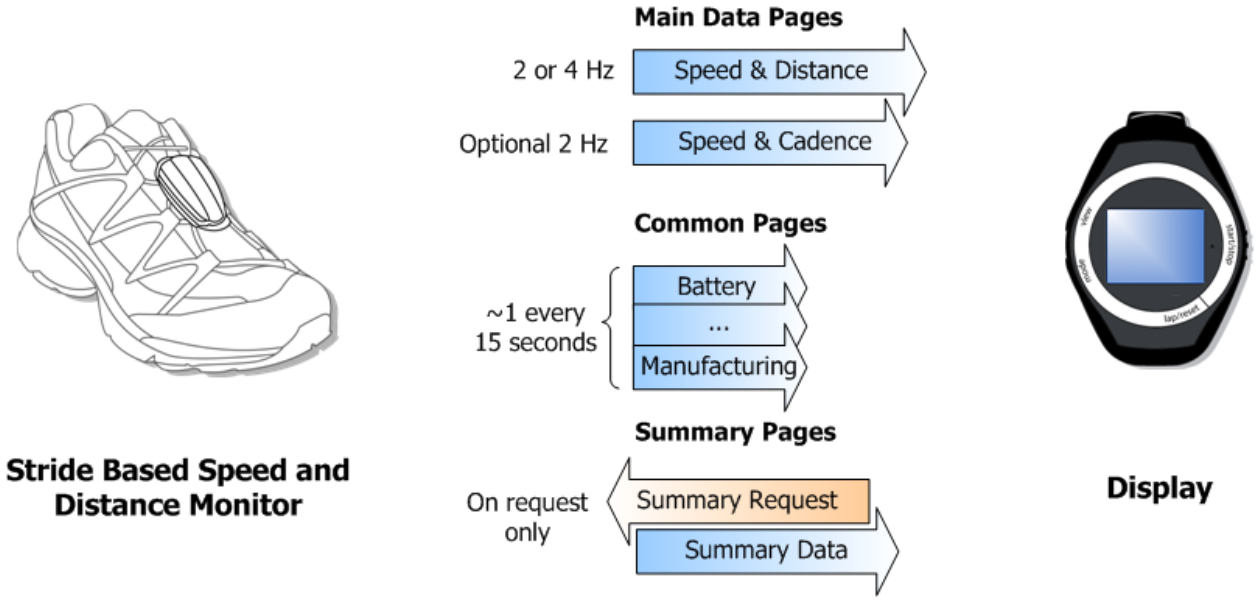

Figure 3-2. Timing of ANT+ Stride Based Speed and Distance Data Pages

Note, not all ANT+ SDM's will have the ability to respond to summary data page requests. If this is the case, the SDM transmitter will simply ignore the request, and the display shall elegantly handle this lack of response. Request data pages shall be sent as acknowledged messages. This will allow the display to know that the request was received, even if no summary data is sent in response; if summary data is available, these shall be sent using broadcast messages as requested by the display.

3.2 ANT+ Stride Based Speed and Distance Monitor Receiver Implementation

At a minimum, the receiver shall be able to decode main data pages 1 and 2. The ability to decode common data pages 80 and 81 is left to the developer. The display may also optionally implement the transmission of the request data page and the appropriate decoding of the requested summary data pages.

Legacy ANT+ SDM devices and receivers shall only transmit and decode the minimum data set. For maximum performance and interoperability, it is recommended that receivers have the capability to decode all of the defined data pages that can be sent from an ANT+ stride based speed and distance monitor as outlined in this document.

4 Channel Configuration

Channel configuration parameters of the SDM and other ANT+ enabled devices are defined by the ANT protocol. Refer to the ANT Message Protocol and Usage document for definitions of the various channel parameters.

4.1 Slave Channel Configuration

The device expected to receive data from an ANT+ stride based speed and distance monitor must configure an ANT channel with its parameters set according to Table 4-1.

Table 4-1. ANT Channel Configuration for Receiving SDM Information

Parameter	Value	Comment
Channel Type	Slave (0x00)	The SDM is a master channel device; therefore the display or storage device must be configured as the slave.
Network Key	ANT+ Managed Network Key	The ANT+ Managed Network Key is governed by the ANT+ Managed Network licensing agreement.
RF Channel Frequency	57	RF Channel 57 (2457 MHz) is used for the ANT+ stride based speed and distance monitor.
Transmission Type	0 for searching	The transmission type must be set to 0 for a pairing search. Once the transmission type is learned, the receiving device should remember the type for future searches. To be future compatible, any returned transmission type is valid. Future versions of this spec may allow additional bits to be set in the transmission type.
Device Type	124 (0x7C)	Device type shall be set to 124 (0x7C) to search for/pair to an ANT+ SDM. Please see the ANT Message Protocol and Usage document for more details.
Device Number	1 – 65535 0 for searching	Set the Device Number parameter to zero to allow a wildcard search. Once the device number is learned, the receiving device should remember the number for future searches. Please see the ANT Message Protocol and Usage document for more details.
Channel Period	8134 or 16268 counts	Data is sent from the SDM every 8134/32768 seconds (~4.03 Hz); however the receive rate may be set lower if required (refer to section 4.1.1).
Search Timeout	(Default = 30 seconds)	The default search timeout is set to 30 seconds in the ANT protocol. This timeout is implementation specific and can be set by the developer to the appropriate value for the system.

4.1.1 Slave Channel Period

The channel period is set up such that the display device can receive data at the full rate (~4.03 Hz) or at half of this rate. This allows data to be received 4 times a second or twice a second. The allowed receive rates for the display devices are:

- 8134 counts (~4.03 Hz)
- 16268 counts (~2.01 Hz)

The minimum receive rate allowed is 16268 counts (~2.01 Hz).

The lower receive rate conserves more power, but this is made at the expense of latency, as it results in data updates at a slower rate. The choice of display device receive rate is left to the developer; however, only 1 of the two specified rates shall be used. Failure to use one of the allowed receive rates could cause unpredictable behavior with current or future ANT+ SDM devices.

In order to account for the two receive rates, care must be taken when sending data pages from the SDM and attention must be given to the transmission requirements of each data page. These requirements have been specifically set to ensure that all of the transmitted data pages can be received by receivers listening at different rates.

4.2 Master Channel Configuration

The ANT+ stride based speed and distance monitor shall establish its ANT channel as shown in Table 4-2.

Table 4-2. ANT Channel Configuration for Transmitting Stride Based Speed and Distance Information

Parameter	Value	Comment
Channel Type	Master (0x10)	Within the ANT protocol, the master channel (0x10) allows for bi-directional communication channels and utilizes the interference avoidance techniques and other features inherent to the ANT protocol.
Network Key	ANT+ Managed Network Key	The ANT+ Managed Network Key is governed by the ANT+ Managed Network licensing agreement.
RF Channel Frequency	57	RF Channel 57 (2457 MHz) is used for the ANT+ stride based speed and distance monitor.
Transmission Type	5 (0x05)	ANT+ devices follow the transmission type definition as outlined in the ANT protocol.
Device Type	124 (0x7C)	124 (0x7C) – indicates the device is an ANT+ SDM Please see the ANT Message Protocol and Usage document for more details.
Device Number	1-65535	This is a two-byte field that allows for unique identification of a given SDM. It is imperative that the implementation allow for a unique device number to be assigned to a given device. NOTE: The device number for the transmitting sensor shall not be 0x0000.
Channel Period	8134 counts	Data is transmitted every 8134/32768 seconds (approximately 4.03 Hz).

4.2.1 Master Channel Type

A bidirectional master channel type (0x10) is used to take advantage of the interference avoidance technology inherent to the ANT protocol. Master channel types other than 0x10 do not make use of the interference avoidance techniques and are susceptible to interference from other 2.4GHz sources including other ANT and ANT+ devices.

4.2.2 Master Device Number

The device number needs to be as unique as possible across production units. An example of achieving this specification is to use the lowest two bytes of the serial number of the device for the device number of the ANT channel parameter.

The device number of the stride based speed and distance monitor shall not be 0x0000. Be careful if the device number is derived from the lower 16-bits of a larger serial number that multiples of 0x10000 (65536) do not cause the device number to be set to 0.

5 Message Payload Format

5.1 ANT+ Message Data Formats

All ANT messages have an 8 byte payload. For ANT+ messages, the first byte contains the data page number and the remaining 7 bytes are used for sensor-specific data.

Table 5-1. ANT+ General Message Format

Byte #	Description	Length
0	Data Page Number	1 Bytes
1-7	Sensor Specific Data	7 Bytes

5.2 Data Page Types

Multiple data pages are supported in the ANT+ stride based speed and distance monitor device profile. These pages are divided into two distinct types of data:

- Main Data Pages: describe the measurements made by the SDM
- Requested Summary Data Pages:
- Common Data Pages: contain information about the SDM device

5.2.1 Main Data Pages

The main data pages contain stride based data, and are broadcast continuously from the SDM at a rate of 4Hz. The only exception is the transmissions of a common data page every 65 messages.

Data page 1 is a required data page that must be sent from every ANT+ stride based speed and distance monitor at a minimum rate of 2 Hz.

Data page 2 is an optional format that can be sent from the SDM if desired. If data page 2 is sent it must be sent at a minimum rate of 2Hz. Refer to section 5.7.1 for a detailed description on the implementation and timing requirements of page 2 data.

5.2.2 Common Data Pages

The common data pages are defined pages that are used by most ANT+ devices. These pages give background information, such as manufacturer information and battery voltage. Please refer to section 5.7 for more details on common data pages.

Common data page messages shall be sent every 65 messages. This will allow full manufacturer information to be broadcast at least once every 32.27 seconds. Refer to section 5.7.1 for details on transmission requirements.

5.3 Data Page Requirements

The ANT+ stride based speed and distance monitor must transmit byte 6 of the main data page 1; other measurement fields of this data page are optional and may be used at the developer's discretion. The ANT+ stride based speed and distance monitor must transmit common data pages 80 and 81 as detailed in section 5.7.1. These required fields are the minimum data set that must be sent from the ANT+ SDM and are outlined in Table 5-2. Receiving devices compatible with the ANT+ stride based speed and distance monitor must be able to decode the minimum data set.

Table 5-2. Required Data Elements of the Stride Based Speed and Distance Monitor

Required Data Page	Section of Required Data Page
Page 1	Byte 6 – Stride Count
Common Page 80 – Manufacturer ID	Entire Data Page
Common Page 81 – Product ID	Entire Data Page

It is suggested that each manufacturer's receiver implementation be able to decode all of the data pages of the ANT+ stride based speed and distance monitor, providing interoperability with all manufacturers of ANT+ SDM devices.

5.4 Data Page 1: Main Format

Page 1 is the main data page for stride based speed and distance monitors. All SDMs shall send this page at a minimum rate of 2Hz. Most fields in this message are optional with the exception of bytes 0 and 6. Any optional field that is not used shall be set to the value stated in Table 5-3.

Please refer to section 6 for important information about sending and interpreting the data contained in this table.

Table 5-3. SDM Data Page 1 Format

Byte	Description	Length	Value	Units	Rollover
0	Data Page Number	1 Byte	Data Page Number = 0x01	N/A	N/A
1	Time - Fractional	1 Byte	Fractional SDM sensor time of the last distance and/or speed computation. Set to 0x00 when unused	1/200 sec	N/A
2	Time - Integer	1 Byte	SDM time of the last distance and/or speed computation. Time starts when SDM is powered ON and continues until it is powered OFF. Set to 0x00 when unused.	Seconds (s)	256
3	Distance - Integer	1 Byte	Accumulated distance. Set to 0x00 when unused.	meters (m)	256
4	Distance - Fractional	Upper 4 bits	Fractional distance. Set to 0x00 when unused.	1/16 meters	N/A
4	Instantaneous Speed - Integer	Lower 4 bits	Instantaneous speed is intended to be appropriately filtered by the SDM, such that the receiving unit can directly display this value to the user. Set to 0x00 when unused.	m/s	N/A
5	Instantaneous Speed – Fractional	1 Byte	Fractional instantaneous speed. Set to 0x00 when unused.	1/256 m/s	N/A
6	Stride Count	1 Byte	Accumulated strides. This value is incremented once for every two footfalls. **This is a required field.**	Strides	256
7	Update Latency	1 Byte	The time elapsed between the last speed and distance computation and the transmission of this message. Set to 0x00 when unused.	1/32 sec	N/A

5.4.1 SDM Time Conversion

Byte 1 of the page 1 data format is the fractional time of the last computation using a 1/200 time base. Most embedded platforms use a binary time base derived from a 32.768kHz crystal. It may be more natural to have a time base that keeps track of 1/256 seconds. However the value sent in byte 1 must use the 1/200 time base. The conversion from a 1/256 time base to the 1/200 time base is as follows:

```
UCHAR TIME_200 = USHORT( TIME_256 * 25 ) >> 5;
```

If the processor used does not have the single byte multiply capability then the code sample shown below describes how this operation can be performed without using the multiplication operator:

```
USHORT Temp = TIME_256;

Temp += Temp << 1;

Temp += TIME_256 >> 3;

Temp >>= 2;

UCHAR TIME_200 = Temp;
```

In these code examples TIME_256 is the variable that holds the binary time base value and is a single byte variable. TIME_200 is also a single byte variable and contain the actual value that will be sent in the first byte of data page 1.

5.5 Page 2 – 15: Supplementary Data Pages

The supplementary data pages are used to transmit the user's cadence and instantaneous speed, and other supplementary data. All supplementary data pages follow the base template described by Data Page 2, and can also provide additional, page-specific information as described in the following sections.

5.5.1 Data Page 2: Base Template

Data page 2 provides the base template for all supplementary pages as described in Table 5-4. Most fields in this message are optional. Any optional field that is not used shall send the value as stated in the Value column of Table 5-4. **Refer to section 6 for important information regarding the sending and interpreting of data contained in this table.**

Table 5-4. SDM Data Page 2 (Base Supplementary) Format

Byte	Description	Length	Value	Units	Rollover
0	Data Page Number	1 Byte	Data Page Number	N/A	N/A
1	Reserved	1 Byte	Value = 0xFF	N/A	N/A
2	Reserved	1 Byte	Value = 0xFF	N/A	N/A
3	Cadence - Integer	1 Byte	Measure of strides accumulated in time. Set to 0x00 when unused.	Strides per Minute	256
4	Cadence - Fractional	Upper 4 bits	Fractional cadence. Set to 0x00 when unused.	1/16 Strides per Minute	N/A
4	Instantaneous Speed – Integer	Lower 4 bits	Instantaneous speed is intended to be appropriately filtered by the SDM, such that the receiving unit can directly display this value to the user. Set to 0x00 when unused.	m/s	N/A
5	Instantaneous Speed – Fractional	1 Byte	Fractional instantaneous speed. Set to 0x00 when unused.	1/256 m/s	N/A
6	Reserved	1 Byte	Value = 0xFF	N/A	N/A
7	Status	1 Byte	SDM status flags – see Table 5-5.	Binary	

5.5.1.1 Status Byte Description

The Status byte is a bit field describing attributes of the SDM as described in Table 5-5.

Table 5-5. Status Flag Description

Bit(s)	Contents	Value (binary)	Meaning
7,6	SDM Location	00	Laces
		01	Midsole
		10	Other
		11	Ankle
5,4	Battery Status	00	OK (New)
		01	OK (Good)
		10	OK
		11	Low Battery
3,2	SDM Health	00	OK
		01	Error
		10	Warning
		11	Reserved
1, 0	Use State	00	Inactive
		01	Active
		10	Reserved
		11	Reserved

Battery status may be set or interpreted differently depending on the SDM and/or receiving device. Some SDMs may output the battery status as only OK (New) or Low Battery; similarly, some receiving devices may show only OK or Low Battery. A receiver that can interpret all four battery status flags generally has a battery level indicator; if receiving data from an SDM that can only output New and Low Battery, the interface indicates a fresh battery until the time the SDM detects a low battery. Conversely, a receiver that implements only OK and Low Battery in the interface must interpret all states except Low Battery as OK.

5.5.2 Data Page 3: Calories

Data Page 3 follows the Page 2 Base Template format as described in Section 5.5.1, and adds a field for calories, as described in Table 5-6. Most fields in this message are optional, however, if this data page is used, the calories (byte 6) field must be set. Any optional field that is not used shall send the value as stated in Table 5-6.

Table 5-6. SDM Data Page 3 (Calories) Format

Byte	Description	Length	Value	Units	Rollover
0	Data Page Number	1 Byte	Data Page Number = 0x02	N/A	N/A
1	Reserved	1 Byte	Value = 0xFF	N/A	N/A
2	Reserved	1 Byte	Value = 0xFF	N/A	N/A
3	Cadence - Integer	1 Byte	Measure of strides accumulated in time. Set to 0x00 when unused.	Strides per Minute	256
4	Cadence - Fractional	Upper 4 bits	Fractional cadence. Set to 0x00 when unused.	1/16 Strides per Minute	N/A
4	Instantaneous Speed – Integer	Lower 4 bits	Instantaneous speed is intended to be appropriately filtered by the SDM, such that the receiving unit can directly display this value to the user. Set to 0x00 when unused.	m/s	N/A
5	Instantaneous Speed – Fractional	1 Byte	Fractional instantaneous speed. Set to 0x00 when unused.	1/256 m/s	N/A
6	Calories	1 Byte	Accumulated calories **If page 3 is used, this field must be valid.**	kcal	256
7	Status	1 Byte	SDM status flags – see Table 5-5.	Binary	

The status byte is a bit field describing attributes of the SDM and is detailed in Table 5-5. **Refer to section 6 for important information about sending and interpreting the data contained in this table.**

5.5.3 Pages 4–15: Reserved for Future Use

Any future defined supplementary main data pages for the ANT+ stride based speed and distance monitor will follow the Data Page 2 format. Additional data may be placed in the reserved fields (bytes 1, 2, and 6) of the base template and a new page number assigned. This allows any device that is capable of decoding data page 2 to be able to interpret the cadence, speed, and status fields of any of the future defined supplementary data pages.

5.5.4 Supplementary Data Page Transmission Requirements

Supplementary Main Data Pages are not required; however, if a supplementary page is sent, it must be sent at a minimum 2Hz rate (16268 counts). The recommended pattern for interleaving data page 1 and with supplementary data pages are: 1, 1, X, X, 1, 1, X, X, 1, 1, X, X, repeating for 64 messages, where 'X' is the supplementary data page. Note that each data page must be sent twice consecutively, ensuring that each page is received even if the receiving device is operating at the minimum allowable receive rate (2Hz).

5.6 Summary Request Pages

Summary request data pages allow an ANT+ SDM to send summary data to a receiving device, upon request only. A summary data page is sent in response to a Request Data Page as described in the ANT+ Common Pages document and section 5.8.

The request data page also indicates the transmission requirements of the response page. The ANT+ SDM further specifies that the requested summary data page shall be sent using broadcast messages, not acknowledged. Note that although the requested transmission response is specified as broadcast, if the SDM supports request pages, all requested transmission response types shall be supported. Refer to section 5.8 for more details.

5.6.1 Page 16: Distance & Strides Since Battery Reset

Page 16 may be used to transmit total cumulative distance and stride count. This page is transmitted on request.

Table 5-7. SDM Data Page 16 Format

Byte	Description	Length	Value	Units	Rollover
0	Data Page Number	1 Byte	Data Page Number = 0x10	N/A	N/A
1-3	Stride Count	3 Bytes	Accumulated strides since battery change. This value is incremented once for every two footfalls. Set to 0 when unused.	strides	16777216
4-7	Distance	4 Bytes	Accumulated distance. Set to 0 when unused.	1/256 meters	4294967296 (i.e 16777216 meters)

5.6.2 Page 17 - 21: Reserved

Data pages 17 through 21 are reserved for future request summary pages.

5.6.3 Page 22 : Capabilities

In the main (Data Page 1) and supplementary main (Data Page 2 and 3) formats, there is no explicit means to indicate that optional values will not be sent by a sensor. Page 22 is used to indicate the specific broadcast data capabilities of a sensor. Page 22 is requested by the display/receiving device, and is only required if some fields in pages 1-15 are not supported by the sensor. In other words, if there are unused fields in data pages 1-15, the SDM shall be able to transmit the capabilities page on request. If all fields are supported by the sensor, it may ignore the page request.

Table 5-8. SDM Data Page 22 Format

Byte	Description	Length	Value	Units	Rollover
0	Data Page Number	1 Byte	Data Page Number = 0x16	N/A	N/A
1	Capabilities	1 Byte	See description below	-	-
2-7	Reserved	6 Bytes	Reserved for Future use. Set all bytes to 0xFF. Do not interpret these bytes	-	-

5.6.4 Capabilities Bit Field

The capabilities bit field is used to describe a sensor's specific broadcast capabilities as described in Table 5-9.

Table 5-9. Capabilities Flag Description

Bit(s)	Contents	Value (binary)	Meaning
6-7	Reserved	0	Default – Set values to 0
5	Calorie Capability Byte 6 of page 0x03	0	Calories is not valid
		1	Calories is valid
4	Cadence Capability Byte 3-4 of pp 0x02-15	0	Cadence is not valid
		1	Cadence is valid
3	Latency Capability Byte 7 of Page 0x01	0	Latency is not valid
		1	Latency is valid
2	Speed Capability Bytes 5-6 of pp 0x01-15	0	Speed is not valid
		1	Speed is valid
1	Distance Capability Bytes 3-4 of Page 0x01	0	Distance is not valid
		1	Distance is valid
0	Time Stamp Capability Bytes 1-2 of Page 0x01	0	Time is not valid
		1	Time is valid

5.6.5 Pages 23–63: Reserved

These pages are reserved for future use. For more details on page numbering of device profile specific pages and ANT+ common data pages please refer to the ANT+ Common Data Pages document.

5.7 Required Common Data Pages

Common data pages are pages that can be sent/received from any ANT+ device that has a transmission type indicating the ability to send/receive common pages. Refer to the ANT+ Common Data Pages document for more details.

5.7.1 Transmission Requirements for Common Data Pages

A common data page message must be sent by an ANT+ stride based speed and distance monitor every 65th message. To be compatible with devices that receive the SDM data at a rate of 16268 counts (~2.01Hz) a common data page is sent twice consecutively every 65th message.

Figure 5-1 illustrates how these pages shall be transmitted to be compatible with a receiver listening at a 2.01Hz rate.

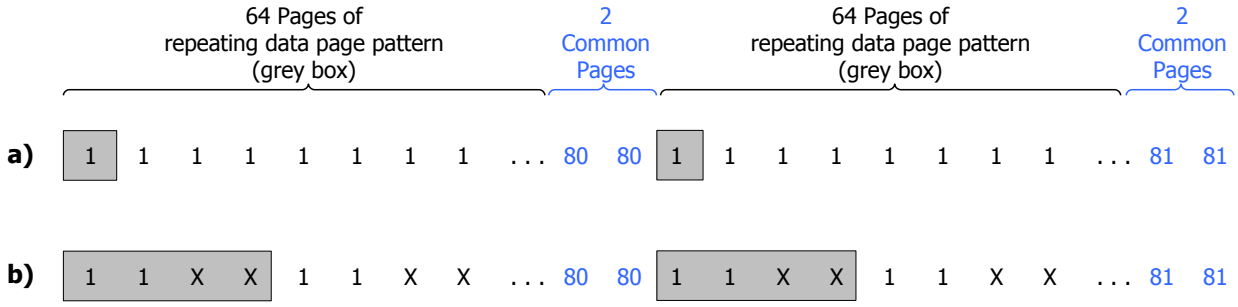

Figure 5-1. Transmission Requirements for Common Data Pages (a) Main Data Page 1 only (b) Main Data Page 1 and Supplementary Pages 'X'

5.8 Common Page 70 (0x46): Request Data Page

Common Data Page 70 allows an ANT+ device to request a specific data page from another ANT+ device; in this case, it allows the receiving device to request summary data pages from an ANT+ SDM. Not all SDM's will have the capability to respond to a request data page. As such, the request data page must be sent using an acknowledged message. This will allow the receiving device to know that the request was successfully received, whether the requested page is received or not. Refer to the ANT+ Common Pages document for more details.

The request data page shall be formatted as shown in Table 5-10.

Table 5-10. Common Data Page 70 Format

Byte	Description	Length	Value	Units
0	Command ID	1 Byte	70 (0x46) – Data Page Request	N/A
1	Reserved	1 Byte	Value = 0xFF	N/A
2	Reserved	1 Byte	Value = 0xFF	N/A
3	Subfield 1	1 Byte	Value: 255 (0xFF) - Invalid	N/A
4	Subfield 2	1 Byte	Value: 255 (0xFF) – Invalid	N/A
5	Requested Transmission Response	1 Byte	Refer to ANT+ Common Pages	N/A
6	Requested Page Number	1 Byte	Requested Summary Data Page Number	N/A
7	Command Type	1 Byte	Value = 1 (0x01) for Request Data Page	N/A

5.8.1 Requested Transmission Response

The SDM profile specifies that the requested transmission response shall be of broadcast message types (i.e. not acknowledged messages). However, if the SDM does support request pages, it must be able to support all requested transmission response types. Refer to the ANT+ Common Pages document for more details on the request data page and possible requested transmission response types.

5.9 Common Page 80 (0x50): Manufacturer's Identification

Common data page 80 transmits the manufacturer's ID, model number, and hardware revision.

Table 5-11. Common Data Page 80 Format

Byte	Description	Length	Value	Units	Rollover
0	Data Page Number	1 Byte	0x50 – Common Page 80	N/A	N/A
1	Reserved	1 Byte	Value = 0xFF	N/A	N/A
2	Reserved	1 Byte	Value = 0xFF		
3	HW Revision	1 Byte	To be set by the manufacturer.	N/A	N/A
4	Manufacturer ID LSB	2 Bytes	Contact the ANT+ Alliance for a current list of manufacturing IDs, or to receive a manufacturing ID.	N/A	N/A
5	Manufacturer ID MSB				
6	Model Number LSB	2 Bytes	To be set by the manufacturer.	N/A	N/A
7	Model Number MSB				

For the current list of Manufacturer Identification values, or if you wish to be added to this list, please contact the ANT+ Alliance at antalliance@thisisant.com.

5.10 Common Page 81 (0x51): Product Information

Common data page 81 transmits the device's software revision and its 32-bit serial number.

Table 5-12. Common Data Page 81 Format

Byte	Description	Length	Value	Units	Rollover
0	Data Page Number	1 Byte	0x51 – Common Page 81	N/A	N/A
1	Reserved	1 Byte	Value = 0xFF	N/A	N/A
2	Reserved	1 Byte	Value = 0xFF		
3	SW Revision	1 Byte	To be set by the manufacturer.	N/A	N/A
4	Serial Number (Bits 0 – 7)	4 Bytes	The lowest 32 bits of the serial number. Value 0xFFFFFFFF to be used for devices without serial numbers.	N/A	N/A
5	Serial Number (Bits 8 – 15)				
6	Serial Number (Bits 16 – 23)				
7	Serial Number (Bits 24 – 31)				

5.11 Other Common Data Pages

Other common data pages that are listed in the ANT+ Common Data Pages document can be sent from the ANT+ SDM. The timing requirement for other common data pages are the same as described in section 5.7.1. Other common data pages are implemented in the SDM at the discretion of the developer. Pages 80 and 81 are required and must be sent every 65 messages. Other pages must be interleaved with the required common data pages.

The recommended pattern is:

1. [64 main data pages]
2. 80
3. [64 main data pages]
4. 80
5. [64 main data pages]
6. 81
7. [64 main data pages]
8. 81
9. [64 main data pages]
10. other common data page (if more than 80 & 81),
11. [64 main data pages]
12. other common data page
13. Repeat

6 Implementation Guidelines

6.1 Transmitting Stride Based Speed and Distance Monitor Data

6.1.1 Filtering Instantaneous Data

The instantaneous data fields, velocity and cadence, should contain data that can be displayed directly by the receiver without requiring any further computations or filtering. Since raw instantaneous data is expected to be somewhat noisy (due to stride effects, for example), the SDM must apply appropriate filtering prior to transmitting instantaneous data. Since all filtering and computations take place on the SDM side, the receiver shall display these data fields directly.

6.2 Receiving Stride Based Speed and Distance Monitor Data

6.2.1 Handling Missed Messages

Distance is sent as a cumulative (as opposed to incrementing) value, and no special handling is required for missed messages. Correct distance is restored after any RF outage as soon as the communication link is restored, provided that the message-outage duration does not exceed the time it takes for the cumulative counters to roll over (time to travel 256m). The same is true of the stride count, which is also a cumulative value.

For instantaneous data, such as speed, pace, or cadence, data from the most recent received message should be used for display purposes.

6.2.2 Decoding Cumulative Data Fields (Distance, Stride Count, and Time)

Since Page 1 of the SDM data message contains cumulative data fields (time, distance, and stride count) which periodically roll over during the course of a user's run, the display device needs to reconstruct these fields. The reconstruction procedure for the distance field is:

1. Initialize CumulativeDistance to 0; initialize PreviousMessageDistance to the distance in the first SDM data message.

2. For each subsequent SDM sensor Data message:

    a. CumulativeDistance += MessageDistance – PreviousMessageDistance

    b. If PreviousMessageDistance > MessageDistance, CumulativeDistance += 256m

    c. PreviousMessageDistance = MessageDistance

Cumulative time and stride count can be reconstructed in a similar fashion.

6.2.3 Displaying Distance

If available, the cumulative distance value sent from the SDM should be displayed by the receiver. It is NOT recommended to use the instantaneous velocity and time fields to compute distance. Depending on the particulars of the SDM algorithm, instantaneous speed is filtered to varying degrees whereas distance may have been computed directly. The filtering on the instantaneous speed can lead to errors if it is used to compute distance.

Also, missed messages lead to errors when distance is computed from instantaneous speed since the instantaneous speed is unknown during the outage. Since the distance value continues to accumulate during the outage, missing RF messages do not add error to the SDM distance as long as the outage is not long enough for the distance to roll over (256m).

6.2.4 Displaying Velocity and Cadence

If available, the received instantaneous velocity should be used by the receiving, rather than have the receiving device computing it. Accumulated distance can remain constant across multiple RF message transmission intervals; consequently, calculating instantaneous velocity from the instantaneous distance data in the RF message and the time between messages results in additional noise in the velocity data stream.

Instantaneous data fields such as velocity and cadence are intended to be displayed directly by the receiver. Any required filtering takes place on the sensor side such that the data transmitted to the receiver is ready to be displayed. No further filtering of instantaneous data fields is required by the receiver.

6.2.5 Displaying Pace

It may be desirable to display the pace (typically expressed as minutes per mile or minutes per kilometer) rather than, or in addition to, the velocity (typically expressed in meters per second, miles per hour, or kilometers per hour). Instantaneous pace can be computed directly from instantaneous velocity however it should be noted that since the conversion of velocity to pace is a non-linear mapping, the noise on the velocity measurement is amplified at low velocities and attenuated at high velocities.

6.2.6 Displaying Averages

The average velocity should be computed using the accumulated distance divided by the time elapsed since the session start. This approach is preferred over averaging instantaneous velocities since these values have typically been filtered and because instantaneous velocity is unknown when messages are missed.

6.2.7 Update Latency

The update latency field in data page 1 represents the time from the end of the last motion event to the time at which the message was transmitted. This time includes computation time as well as the delay before the message is actually transmitted, which depends on the message rate. This value can be used by the receiver for synchronization of the distance data to receiver time or receiver events, such as reconstructing actual distance at the time of a "lap mark".

6.2.8 User Calibration

It is intended that the SDM send accurate speed and distance without the need for further calibration. However, it may be desirable to make it possible for the user to calibrate the system to further improve the accuracy (for example to personalize it to his or her particular stride mechanics).

The user calibration is a process that defines a scaling factor that is stored by the receiver. The receiver then applies this scaling factor to the speed and distance reported by the SDM to further improve the accuracy for the particular user.

6.2.9 Common Data Pages

It is important that the receiver be able to decode all of the data pages that can be sent from an ANT+ speed and distance monitor. Section 6.3 of this document gives code examples showing how to implement code so that the receiver is compatible with all types of ANT+ SDM devices regardless of what data pages a specific implementation of a SDM supports. It is suggested that the ANT+ stride based speed and distance monitor receiver implements capabilities to decode all ANT+ SDM data pages as outlined in this document.

6.3 Receiver Implementation Code Example

The ANT+ Reference Code contains files that show embedded sample code for implementing both a receiving device and a transmitting device. These code files have been written in C and have been compiled for a Texas Instruments MSP430 micro-processor.

Most of this code is re-usable on any embedded platform with necessary changes in the code to the serial drivers and some hardware specific code.

This code used in conjunction with the ANT+ Sensor Simulator and the ANT+ Display Simulator provides the necessary tools for ANT+ sensor and receiver development. For further details on the ANT+ reference code visit the ANT+ website at www.thisisant.com or contact the ANT+ Alliance at ANTAlliance@thisisant.com.