ANT+ Device Profile

Controls

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Revision History

Revision	Effective Date	Description
2.0 Dev 1	May 2012	Started profile development
2.0 Dev 2	June 2012	Second draft started. Profile Complete.
2.0_Dev.003	November 2012	Added Generic Command Page Updated section 3.3 Keypad and Generic Control Overview Updated figures in section 4 and consolidated info on background data pages, as it applies to all use cases. Added 7.2.2.1 Request Data Pages Updated Table 8.6 – Device Availability Clarified the field descriptions associated with Data Page 8 Added Command Type 0x03, and serial number field to Common Page 70 Updated common page transmission pattern requirements and added example of how to interleave the optional data pages. Added sections 13.3 Generic vs. Custom Commands and 13.4 Communicating with Different Types of Controllable Device
2.0_Dev.004	November 2012	Renamed 8.1.4 Capabilities to Audio Capabilities Renamed8.2.2 Device Availability to Device Capabilities Renamed8.8 Advanced Capabilities to Available Text Renamed8.8.1.1 Text Capabilities to Text Transfer Speeds Removed the term "text device" throughout as it was undefined and unnecessary.
2.0_Dev.005	November 2012	Added Command Burst (Section 9.5)
2.0_Alpha.001	November 2012	Removed "Future" sections.
2.0_Dev.006	November 2012	Clarified section 14.4
2.0_Dev.007	November 2012	Added requirement for Master to send common page 71 in response to a request (section 11.1.3). Added "Home" command to Table 9-10. Command Value Mapping Restructured section 14: Device Controls Minimum Compliance Renamed Data Page 20 from Text Command to Text Request Clarified meaning of 0x00 in sections 8.4.2, 8.8.1.2, and 8.8.1.3
2.0_Alpha.002	November 2012	Updated revision number to Alpha.
2.0_Dev.008	November 2012	Made it clear that all sequence numbers should be taken from the same number series. Moved 9.6.4 to "9.1.4 - Implementation Details" Added generic control icon
2.0_Beta.001	December 2012	Beta Release – minor typo fixes

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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.

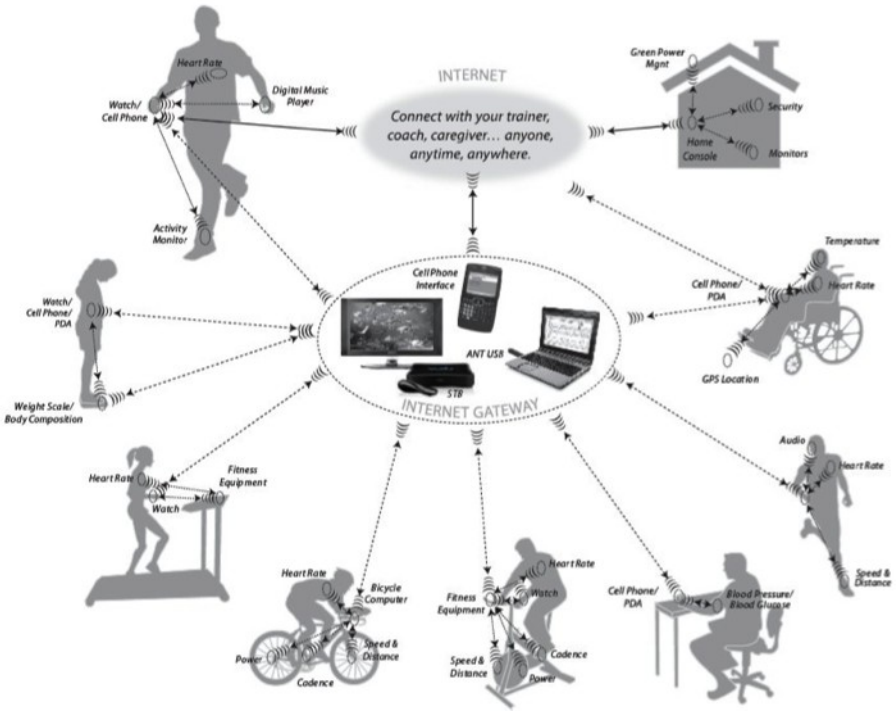


Figure 1-1. ANT+ Device Ecosystem

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 the terms and conditions of the Adopter's Agreement and have downloaded the ANT+ Managed network key. By accepting the Adopter's 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 Overview of Control Devices

Due to its ultra low power budget, ANT is well suited for sending wireless control information between devices that are located within proximity to each other. The ANT+ Controls Device Profile defines interoperability use case and data formats for a variety of remote controllable devices as listed below:

- Audio Control
- Phone Control
- Generic Control
- Keypad Control
- Video Control

3.1 Audio Control Overview

Personal audio devices such as iPods, cell phones, and other types of music players are often used during activities that may also be monitored by many traditional ANT+ devices. For example, people that enjoy running will often wear a music player during their workout. The same can be said for cycling, skiing, and many other activities. In these situations, it is a logical solution to use a single device to display information received from body worn Personal Area Network (PAN) sensors, as well as to act as a remote control for the audio device.

Figure 3-1 illustrates an example of a runner wearing a heart rate sensor, and a speed and distance sensor. Both sensors transmit data to a watch for real time display, and storage of the necessary running metrics. These devices become the PAN of the user. In addition to these sensors, the runner is also using a personal audio device to make the running experience more enjoyable.

Allowing the watch to also act as a remote control for an audio device will allow the user to have a single device to display and control all peripheral devices.

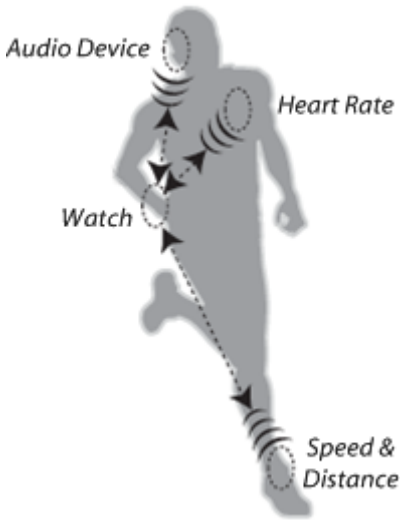


Figure 3-1. Runner with Multiple Peripheral Devices

3.2 Phone Control Overview

Much like audio devices, personal communication devices such as cellular and smart phones are often used during activities that may be monitored by ANT+ devices. For example, hikers will often bring their cellular or smart phones with them to monitor personal communications including SMS messages, emails, and phone calls, while also monitoring data such as speed and distance, GPS location, or other parameters. The same could be said for cycling, skiing, running, and many other activities. In these situations, it may be convenient to use a single display device for information received from body worn sensors that can also act as a remote control for answering/hanging up phone calls and/or receiving/ignoring incoming text notifications.

Figure 3-2 illustrates an example of a hiker wearing a multi-sport speed and distance monitor, watch and carrying a smart phone. The sensor transmits speed and distance data to the hiker's watch for real time display and storage of hiking metrics. Additionally, the watch can be used to monitor smart phone events, allowing the hiker to communicate with friends and family throughout the duration of the hike.

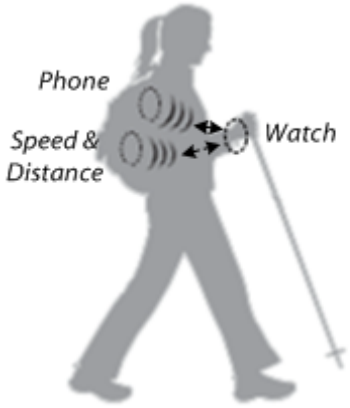


Figure 3-2. Hiker with Multiple Peripheral Devices

Allowing the watch to act as a remote control for the phone, as well as to collect data from other sensors such as heart rate monitors and multi-sport speed and distance sensors provides the user with the ability to monitor personal statistics and control other peripheral devices from a single location, without the need to remove the phone from the backpack or protective case.

3.3 Keypad and/or Generic Control Overview

The ANT+ Controls Device Profile provides the ability to control other ANT+ enabled peripheral devices. The use case is similar to that of a traditional remote control (for example a television remote control) where the user is able to control a peripheral device using button presses (or other actions) to issue commands from the remote control. The remote control device could be a watch or phone, or it could be a dedicated device that is either handheld, or mounted in a convenient position (e.g. within reach of a cyclist's thumb).

It is assumed that the user receives audio and / or visual feedback from the controlled device, and is therefore aware of the current state of the device. The remote control device itself may not be aware of the state of the peripheral device.

The keypad control allows for the push of a button to send a UTF-8 encoded character over the air. In this case, the interpretation of the command is set by the Unicode character on the label of the button that is pushed.

The generic control allows for the push of a button to send an ANT+ defined command. These commands have meanings that apply to many types of peripheral devices, for example menu navigation, and stopwatch control.

It should be noted that generic commands are context dependant, and the command can be interpreted differently, based on the type of object being controlled. For example, in a person's bedroom, a button on the remote might close the curtains, while in the garage; the button might close the garage door.

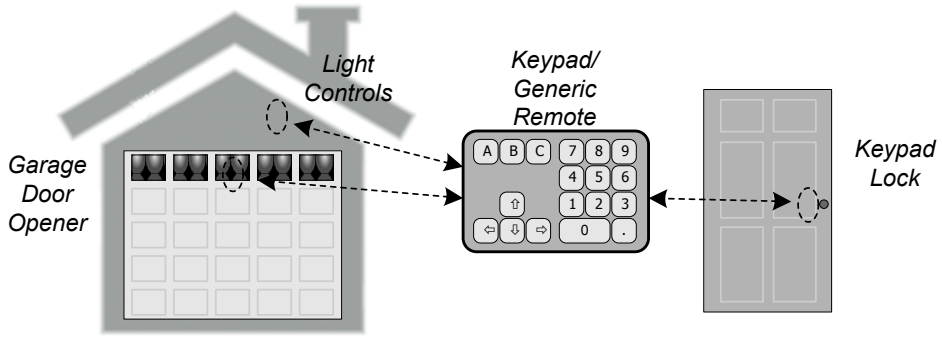


Figure 3-3. Remote Controlled Peripheral Devices

The generic command page also allows for custom commands to be sent. The meaning of these commands is defined by the manufacturer. Devices using custom commands depend on both the remote control and the peripheral device having knowledge of the intended command-function mapping. Custom commands are therefore intended for use in highly specific situations only; where seamless interoperability is not a requirement.

3.4 Video Control Overview

The ANT+ Controls Device Profile also provides for the ability to control both a wireless video recording device and video playback device from a single ANT+ enabled remote control.

Mountain bikers, for example, often use helmet mounted video cameras to record routes and tricks. In this case, it would be useful for the mountain biker to have control of the video camera from a convenient remote device such as a watch or bike computer. Figure 3-4 illustrates a mountain biker using a bicycle power meter, along with a video recording device.

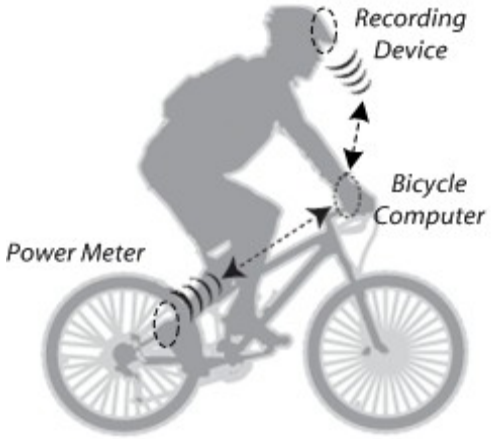


Figure 3-4. Mountain Biker with Multiple Peripheral Devices

The bicycle computer acts as a remote control for the recording device, as well as a data display/collection hub for the power meter. This provides the cyclist with the ability to control all peripheral devices from a single location, without the need to fumble with video controls.

Another example is illustrated in Figure 3-5. An athlete is on an ANT+ enabled treadmill, using a television to make their workout experience more enjoyable. They are also using an ANT+ enabled heart rate monitor. The heart rate monitor transmits the data to the fitness equipment, and the fitness equipment transmits both fitness and heart rate data to the athlete's watch for real time display or storage for review at a later time.

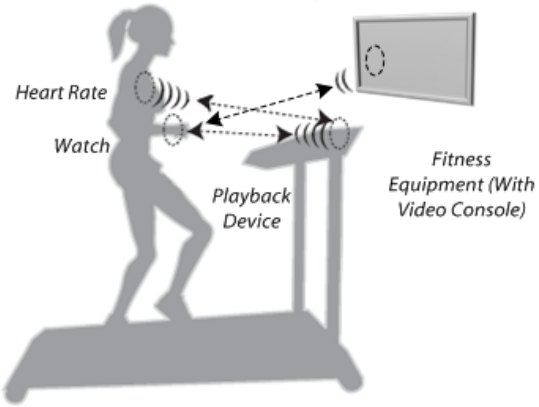


Figure 3-5. Athlete Exercising with Television

The athlete can use the watch to control the current movie clip that is playing out of reach on the television. They can also fast forward though the clip, and pause or stop it without the need to disrupt their workout.

4 Use Case Implementation

The ANT+ Controls Device Profile supports multiple use cases as described in the following sections. Not all use cases must be supported; currently each use case operates independently however, future revisions of this profile will provide recommendations for using multiple control devices in combination. It should be noted that all implementations supported in this Device Profile use a common device type. As such, it is up to the application developer to decide if connection with an appropriate or desired device has been established (refer to section 13.4).

4.1 Audio Control Use Case

Devices that implement audio control will act as either an audio device, or remote control device. In the example described in Figure 3-1, the watch would act as the remote control for the digital music player.

By default, the audio device will update the remote device with data regarding the current state of the device (i.e. playing, paused, stopped), the current volume level, current track time, and the total track time of the current song. This information can be displayed on the audio remote if an accommodating user interface exists on the device.

The audio remote has the ability to interact with the audio player on an as needed basis, as requested by the user. The remote control will be able to change the state of the audio device (i.e. play, stop, pause the current selection), adjust the volume up or down, adjust the shuffle or repeat state of the audio device, or change the current track to the next or previous track.

Some ANT+ audio devices also have the ability to provide the name of the current song to the remote device. This is done through a request by the remote device for the available text page. The available text page provides the remote with the number of subpages that are required to transmit the characters of the song title. Refer to section 8.8 for more information on the available text page. The audio device can then provide the watch with the UTF-8 Character encoding of the song title. This text can be sent in a 'slow feed' mode or a 'fast' mode. For more information, refer to section 8.5.

The basic use case of the ANT+ audio control device is illustrated in Figure 4-1.

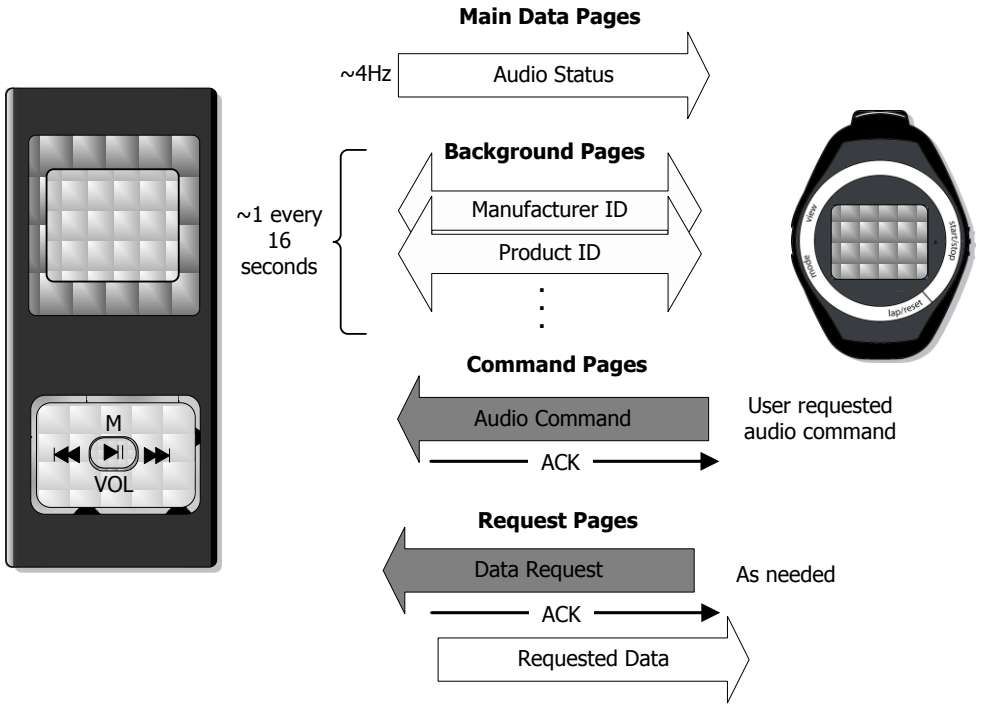


Figure 4-1. Typical Use Case of an ANT+ Audio Control System

4.2 Phone Control Use Case

Devices that implement phone control will act as either a phone, or a remote control device. In the example described in section 3.2, the watch would act as the remote control for the phone.

The ANT+ enabled phone provides information to the user such as call status and (optionally) text notifications. Text notifications can include calendar alerts, SMS messages, email subject lines, or Facebook and Twitter updates.

4.2.1 Call Control

The ANT+ enabled phone has the ability to notify a remote device of any incoming calls. The remote control device can control the phone with commands such as 'hang up', 'ignore' or 'answer'. Additional information may include incoming call number, caller ID and call status (i.e. missed call, on hold, incoming etc.).

By default, the phone broadcasts its availability as shown in Figure 4-2. As a call notification comes in (i.e. incoming call), the phone will update its status accordingly, and notify the remote device by adding the 'call status' page to the transmission pattern. For more information on the required transmission patterns refer to section 12.

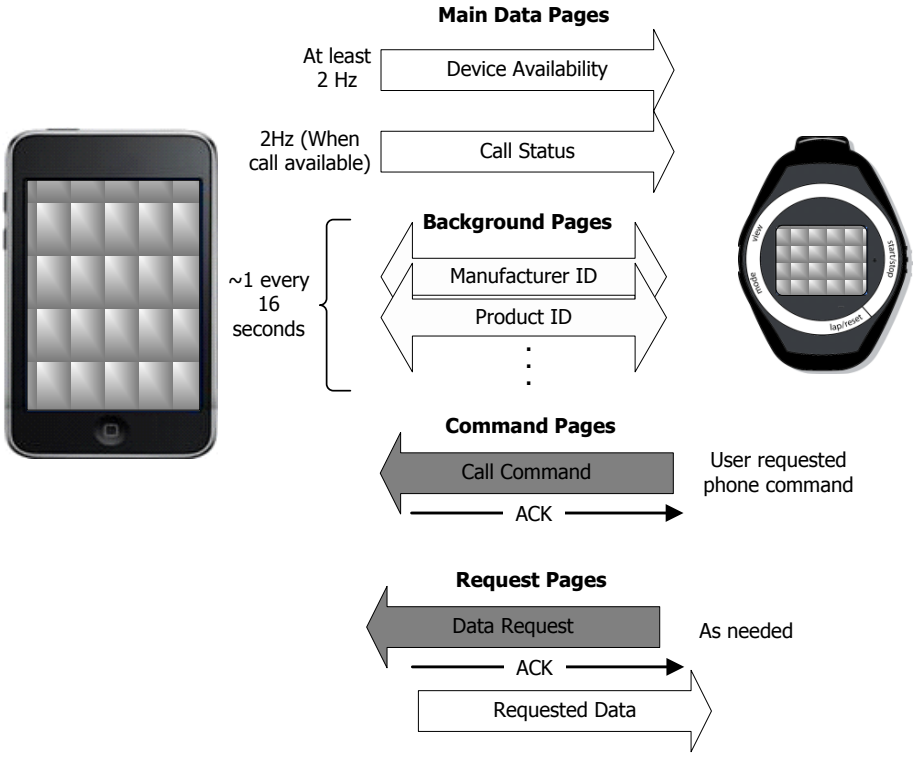


Figure 4-2. Typical Use Case of an ANT+ Call Control System

The remote control device may answer, ignore or hang up the call using the 'call command' page, shown in Figure 4-2, and described in section 9.4. Once the call has been answered, the phone will broadcast its "In-Call" status, indicating the state of the call (i.e. in call, call on hold, etc) via the 'call status' page. Refer to section 8.3 for more information regarding the call status page. When the call ends, either due to the caller hanging up or a 'hang up' command from the remote control device, the phone will return to its default transmission pattern, broadcasting its device availability.

The remote may also request the caller ID of the current caller from the phone as described in section 8.3.1.

4.2.2 Text Control

Text control allows text messages to be transferred from a phone to a remote control device, and is an optional feature of phone control. Similar to call control, the phone device will broadcast its availability by default (Figure 4-3). As text notifications are received, the phone will update its status accordingly, and notify the remote control device by transmitting the text status page. Once a text notification is advertised, the remote may ignore or process the notification by sending the 'text command' page. Refer to section 10.1 for more information on the text command page.

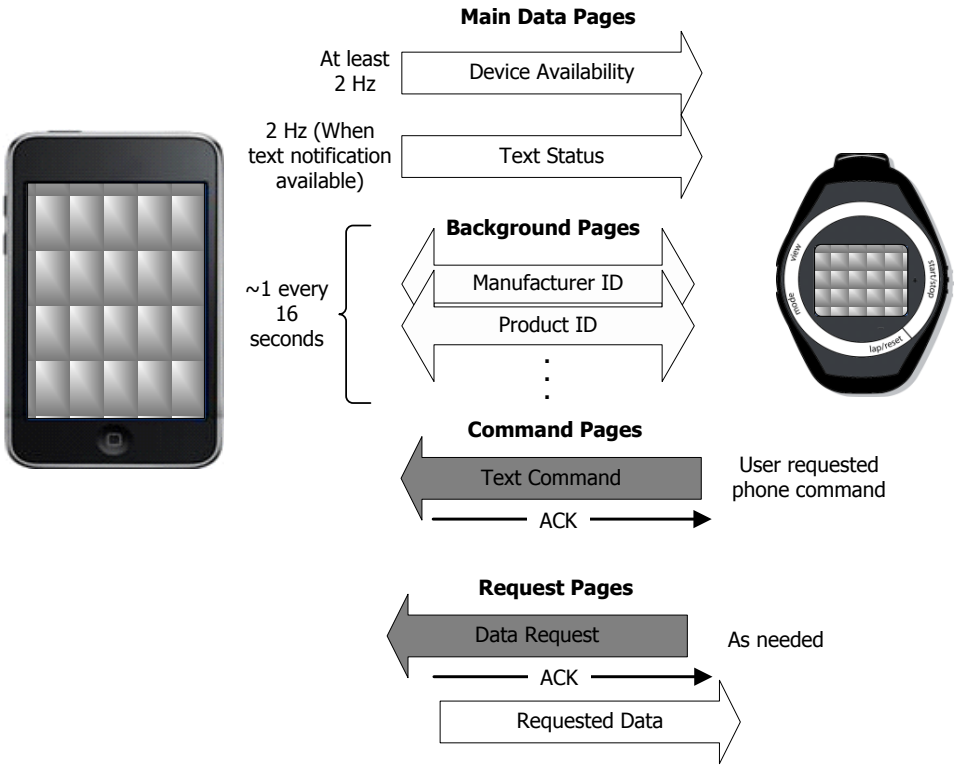


Figure 4-3. Typical Use Case of an ANT+ Text Control System

If the remote chooses to ignore the text notification, the phone will return to broadcasting its default device availability page.

If the remote chooses to process a text notification, it can do so in two ways, depending on the capabilities for the text control device; a 'fast' transfer mode or a 'slow feed' mode. 'Fast' transfer mode involves both the phone and remote control switching to a different RF channel frequency, and a faster channel period to transfer the text information. The text message is split into a number of subpages which contain a null terminated UTF-8 character encoding of the text characters. The subpages are then interleaved with the standard phone control data. As a result, the text message subpages are broadcast at the faster rate on the different RF channel frequency; however, the standard control data transmissions are still maintained at the typical 4 Hz, on the original RF channel frequency. This allows for a peer to peer text exchange, but also maintains the original transmission pattern for any other remote devices that may be connected. Refer to sections 8.5 and 12.2 for more information.

If the remote chooses the 'slow feed' text exchange mode, the text subpages are simply interleaved with the standard transmission pattern at a 2 Hz rate. This allows for the text to be transferred slowly but without interrupting other connected remote controls. For more information, refer to section 8.5.

Text alerts have a priority scheme that allows the most important alert types to be received first. Refer to section 8.4.1.1 for more information.

4.3 Keypad and/or Generic Control Use Case

The ANT+ Controls Device Profile allows an ANT+ keypad or generic remote to control ANT+ enabled peripheral devices. The remote control provides a user interface to send Unicode characters or commands to the peripheral device, similar to the remote shown in Figure 4-4.

By default, the peripheral device transmits the device availability data page, which allows the remote control to determine the peripheral device's capabilities. For more information, refer to section 8.2. Once communication is established, a 'key press' event on the remote control will be transmitted to the peripheral device as a Unicode character (refer to section 9.2), or as a generic (or custom) command (sections 9.5 and 9.6).

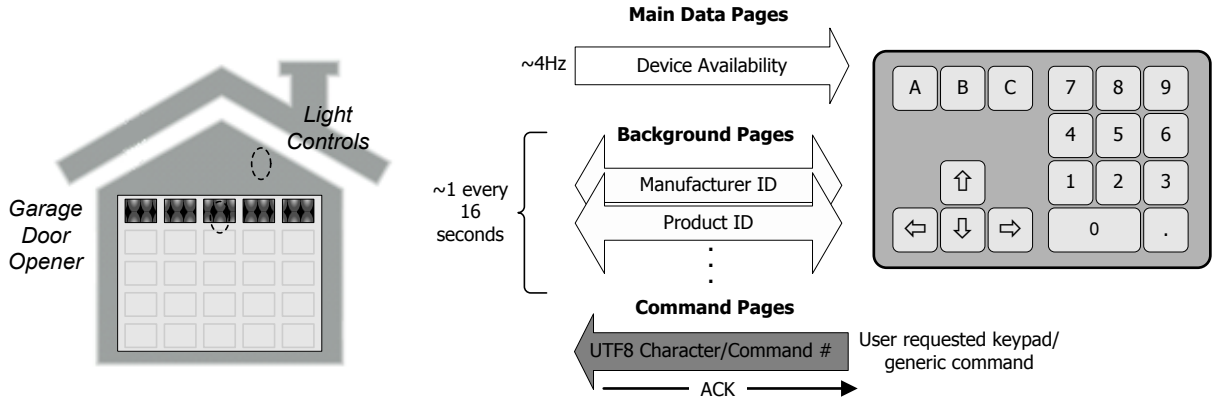


Figure 4-4. Typical Use Case of an ANT+ Keypad and Generic Control System

4.4 Video Control Use Case

Devices that implement video control will act as either a video playback/recording device or a remote control device. A video device may act as a playback device only, a recording device only, or a combination of the two.

The video remote control device shall support both playback and recording video commands.

By default, any ANT+ video device will alternate between broadcasting its device availability, and video status. The status of the video device corresponds to its current state (i.e. playing/recording, stopped, etc) and also its capabilities (i.e. playback and/or recording device). This is illustrated in Figure 4-5.

Depending on the current state of the video device (i.e. playback or recording), the video status provides information on:

- Playback: the current volume, elapsed time of the current video clip, and total time of the current video clip
- Recording: the current recorded time, and the total available recording time.

Please note that although a video device may support both recording and playback features, only a single function can be performed at any given time. For example, a video device cannot playback and record at the same time. The video device can be a playback device, then a recording device, or vice versa. The device could 'play', 'stop', then 'record', but it could not 'play' then 'record'.

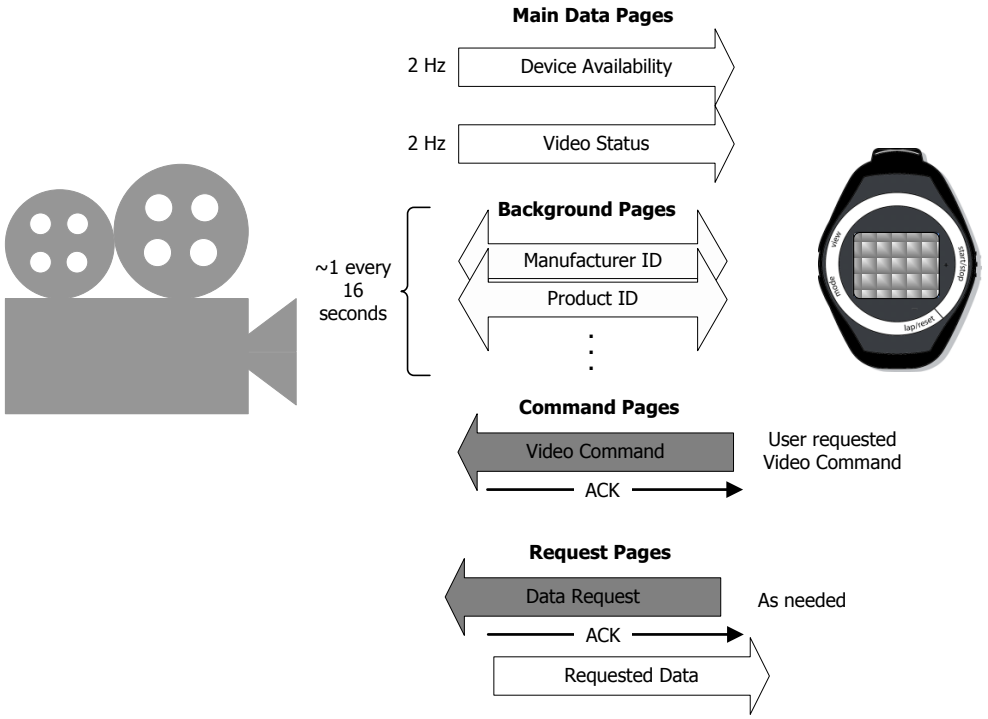


Figure 4-5. Typical Use Case of an ANT+ Video Control System

The remote control device is able to interact with the video device on an as needed basis, as requested by the user. The video remote will send a video command to the video device to change the device state (i.e. stop the current video, pause the current video, play/record the video), adjust volume, or change video clips. This is illustrated in Figure 4-5. Video remote commands shall be sent sequentially, and are independent.

4.5 Background pages

The audio, phone, keypad, generic or video device will provide the remote with slow update background information. This background information can include the manufacturer ID, product information, battery status, memory requirements, and peripheral paired devices. In addition the master device can use common page 70 to request these background pages from the remote as required. Refer to section 11 in this document and the ANT+ Common Pages document for more information on background data pages.

5 Pairing Considerations

All ANT master devices are assigned an ANT channel ID, a value that distinguishes it from other ANT masters. The ANT channel ID is comprised of the device number, device type, and the transmission type. Pairing is the process of a slave device determining the specific channel ID of a given ANT+ sensor (i.e. master). After devices are paired, the slave may remember the channel ID, allowing a simpler search in subsequent connections. For specific details of the channel ID for ANT+ control devices, refer to Section 6. For more details on pairing ANT devices, refer to the ANT AN02 Device Pairing application note. This application note, and all other ANT documentation, can be found at www.thisisant.com/developer/resources/downloads.

The implementation of the pairing process is left to the developer's discretion.

6 Channel Configuration

The definition of channel configuration parameters for an ANT+ control device, and any other ANT enabled device, are found in the ANT Message Protocol and Usage document. Please refer to this document for a definition of the various channel parameters.

6.1 Slave Channel Configuration

The remote control will act as the slave, and should configure an ANT channel using the channel parameter values listed in Table 6-1.

Table 6-1. ANT Channel Configuration for Receiving Control Information

Parameter	Value	Comment
Channel Type	Slave (0x00)	The controllable device is a master channel device; therefore the remote control 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 (0x39)	RF Channel 57 (2457 MHz) is used for ANT+ control devices.
Transmission Type	0 for pairing	The transmission type must be set to 0 for a pairing search. Once the transmission type is learned, the slave device may remember this 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	16 (0x10)	Set to 16 (0x10) when searching to pair to an ANT+ controllable device. 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 slave device should remember the number for future searches. Please see the ANT Message Protocol and Usage document for more details.
Channel Period	8192 counts	Data is transmitted every 8192/32768 seconds (4 Hz) from the controllable device.
Search Timeout	Varies (Default = 30 s)	The default search timeout is set to 30 seconds in the ANT protocol. This timeout is implementation specific and can be set by the designer to the appropriate value for the system.

6.1.1 Transmission Type

The most significant nibble of the transmission type may optionally be used to extend the device number from 16 bits to 20 bits. In this case, the most significant nibble of the transmission type becomes the most significant nibble of the extended 20 bit device number. Therefore, a wildcard pairing scheme shall always be used by a remote device that does not know the transmission type of the control device that it is searching for.

6.1.2 Channel Period

The channel period is set such that the remote device shall receive data at a rate of 8192 counts (4 Hz).

6.2 Master Channel Configuration

The ANT+ controllable device shall establish its ANT channel as shown in Table 6-2.

Table 6-2. ANT Channel Configuration for Transmitting Control Information

Parameter	Value	Comment
Channel Type	Master (0x10)	Master channel (0x10) allows for bi-directional communication and utilizes 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 (0x39)	RF Channel 57 (2457 MHz) is used for the ANT+ controllable device.
Transmission Type	5 (0x05)	This indicates that the device will use paged data.
Device Type	16 (0x10)	Denotes ANT+ controllable device.
Device Number	1-65535	Two byte field that allows for unique identification of a given control device. It is imperative that the implementation allow for unique device numbers to be assigned. NOTE: The device number shall not be 0x0000 for the transmitting sensor.
Channel Period	8192 counts	Data is transmitted every 8192 /32768 seconds (4 Hz).

6.2.1 Transmission Type

The most significant nibble of the transmission type may optionally be used to extend the device number from 16 bits to 20 bits. In this case, the most significant nibble of the transmission type becomes the most significant nibble of the 20 bit device number.

6.2.2 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 device's serial number as the ANT Channel's device number.

The controllable device shall not have a device number of 0 (0x0000). Care should be taken if the device number is derived from the lower 16-bits of a larger serial number. In this case, ensure that serial numbers that are multiples of 0x10000 (65536) are handled correctly such that the device number is not set to 0.

6.2.3 Channel Period

The required channel period is 4 Hz.

7 Message Payload Format

All ANT messages have an 8 byte data payload. The following sections describe the data format for an ANT+ control system.

7.1 ANT+ Message Data Formats

Almost all ANT+ messages are formatted according to pre-defined data pages. The first byte contains the data page number, and the remaining 7 bytes are used for sensor specific data.

Table 7-1. ANT+ General Message Format

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

7.2 Data Page Types

There are multiple types of data pages that are supported by the ANT+ Controls Device Profile. These pages are divided into three distinct types: main, command and background data pages.

7.2.1 Main Data Pages

These data pages contain the main data content of ANT+ controllable devices. Section 8 of this document details main data page formats.

7.2.2 Command Data Pages

These data pages contain command information sent as needed from the remote control device. A detailed list of capabilities and requirements are discussed in the following sections. Section 9 of this document details the command data page formats.

The command burst, and the generic command data page follow an ANT+ Common Page format. Please refer to the ANT+ Common Pages document for further details.

7.2.3 Request Data Pages

Data pages 20 and 70 are used to request other data pages from the receiving device, for example to request transfer of text subpage data, or missed pages.

7.2.4 Background Data Pages

Background data pages contain slow changing data and are sent at relatively lower data rates. Currently all background data pages follow ANT+ common page formats. These pages contain information on a device's manufacturer, battery voltage, temperature, etc. Please see Section 11 in this document and the ANT+ Common Pages document for more details on background data pages.

See Section 13 for the minimum data and timing requirements of ANT+ control devices to be compliant with this profile.

8 Main Data Page Formats

This section describes the main data page formats supported in the ANT+ Controls Device Profile. Refer to section 13 for page requirements of different ANT+ control devices.

8.1 Data Page 1 - Audio Update Data

The audio update page is the primary data page sent from an audio device. **This is a required page for audio devices** and fields shall be formatted as described in Table 8-1. This page shall not be sent by any device that is not an audio device.

Table 8-1. Data Page 1 Format – Audio Update Data

Byte	Description	Length	Value	Units
0	Page Number	1 Byte	1 (0x01) – Audio Update Page	N/A
1	Volume	1 Byte	Volume given as a percentage: 0 – 100 Unknown – 255 (0xFF)	N/A
2	Total Track Time (LSB)	2 Bytes	The total time of the current track. This allows for the remote device to show an updating progress bar if desired. Unknown – 65535 (0xFFFF)	Seconds
3	Total Track Time(MSB)			
4	Current Track Time (LSB)	2 Bytes	Number of seconds in the current track, this value does not rollover. Min – 0s Max – 65534s (~18hours) Unknown – 65535 (0xFFFF)	Seconds
5	Current Track Time (MSB)			
6	Audio Capabilities	1 Byte	Bit field. Refer to Table 8-2.	N/A
7	State	1 Byte	Gives the current state of the music player. See Table 8-3 for the possible states of the audio device. Unknown – 255 (0xFF)	N/A

8.1.1 Volume

The volume data field is an optional field that can be used to transmit the current volume of the audio device. The volume is given as a percentage to allow for easy mapping of volume settings across different devices. If this data field is not populated, it shall contain the unknown value as shown in Table 8-1.

8.1.2 Total Track Time

This field gives the length of the current track in seconds. This allows the remote device to create a progress bar to display to the user (if desired). If this field is unused or unknown it shall be set as described in Table 8-1.

8.1.3 Current Track Time

The audio device shall transmit the current progression, in seconds, through the track with every transmission of this data page. If this field is unused or unknown it shall be set as described in Table 8-1.

8.1.4 Audio Capabilities

This bit field is used to indicate the capabilities of the audio device. This is an optional field and shall be set to 0xFF if unused. If bit 7 of the audio capabilities field is set, the entire field shall be ignored. The remaining bits shall be set as described in Table 8-2.

Table 8-2. Audio Device Capabilities Bit Field Description

Bit	Description	Value
7	Ignore Field	0 – Interpret bit field 1 – Ignore bit field
3:6	Reserved	Set to 0
2	Custom Repeat Mode Support	0 – Does NOT support a custom repeat mode 1 – Supports a custom repeat mode
1	Custom Shuffle Mode Support	0 – Does NOT support a custom shuffle mode 1 –Supports a custom shuffle mode
0	Song Title Support	0 – Does NOT support song title transfer 1 –Supports song title transfer

8.1.5 State

The state data field indicates the current state of the audio device. If the state of the audio device is not known, the field shall be set as shown in Table 8-3. Note that if the state of the audio device is unknown, bits 0-3 (repeat and shuffle states) shall not be interpreted.

Table 8-3. Audio Device State Values

Bits	Description	Value
4-7	Audio Device State	Describes Audio State: 0 – Off: The audio device is off 1 – Play: The audio device is in play mode 2 – Pause: the audio device is paused 3 – Stop: the audio device is stopped 4 – Busy: the audio device is busy 5 – Fast forward: the audio device is fast forwarding 6 – Rewind: the audio device is rewinding 7 – 14: Reserved 15 – Unknown: bits 0-3 are ignored
2-3	Repeat State	Describes Audio Repeat State: 0 – Off/Unsupported 1 – Current Track 2 - All Songs 3 – Custom
0-1	Shuffle State	Describes Audio Shuffle State: 0 – Off/Unsupported 1 – Track Level 2 – Album Level 3 - Custom

8.2 Data Page 2 – Control Device Availability

The control device availability page is the primary data page sent from all controllable devices except audio or video devices. This data page indicates which features are supported by a specific controllable device, allowing a remote control to determine which commands may be sent.

This is a required data page of non-audio or non-video devices. All fields shall be formatted as described in Table 8-4.

Table 8-4. Data Page 2 Format – Device Availability Page

Byte	Description	Length	Value	Units
0	Page Number	1 Byte	2 (0x02) – Control Device Availability Page	N/A
1	Current Notifications	1 Byte	Bit field indicating specific device notifications. Set as described in Table 8-5.	N/A
2	Reserved	1 Byte	Reserved for future use. Set to 0x00.	N/A
3	Reserved	1 Byte	Reserved for future use. Set to 0x00.	N/A
4	Reserved	1 Byte	Reserved for future use. Set to 0x00.	N/A
5	Reserved	1 Byte	Reserved for future use. Set to 0x00.	N/A
6	Reserved	1 Byte	Reserved for future use. Set to 0x00.	N/A
7	Device Capabilities	1 Byte	Bit field indicating supported control features. Set as described in Table 8-6.	N/A

8.2.1 Current Notifications

This bit field indicates relevant, device-specific notifications as described in Table 8-5.

Table 8-5. Current Notifications Bit Field Description

Bit	Description	Value
0	Call Notification	0 – Device not in call OR not supported 1 – Device "in call"
1	Text Notification	0 – Device has no text notifications OR not supported 1 – Device has new text notification
2-6	Reserved	Reserved for future use. Set to 0.
7	Maximum number of remotes connected	0 – No limit specified, or limit not reached. 1 – Limit reached: Device cannot connect to additional remotes.

8.2.1.1 Call Notification

The call notification allows a control device to determine if a call device is currently "in call". A call device that is in call shall also transmit the call status data page (data page 3) as described in section 8.3.

If call control is not supported, as indicated in the device capabilities field (Byte 7, bit 1), then the call notification bit shall be set to 0. Refer to section 8.2.2 for more information on the device capabilities field.

8.2.1.2 Text Notification

The text notification allows a control device to determine if a phone currently has an outstanding text notification. A phone that has an outstanding text notification shall also transmit the text status data page (data page 4) as described in section 8.4.

If text control is not supported, as indicated in the device capabilities field (Byte 7, bit 2), then the text notification bit shall be set to 0.

8.2.1.3 Maximum Number of Remotes Connected

This field is used to indicate whether the controllable device is connected to the maximum number of remote control devices that it can support. Specifying this limit is optional, and if no limit is specified then this bit shall be set to 0. If a limit is specified, (e.g. max 3 remotes are supported at the same time) then this field shall be set to 0 while zero, one or two remotes are connected to the controllable device, and set to 1 if three remotes are connected. If a fourth remote attempts to send commands to the controllable device, these commands may be rejected.

8.2.2 Device Capabilities

The device capabilities bit field indicates which control features are supported by the master device. It shall be set as shown in Table 8-6.

Table 8-6. Device Capabilities Bit Field Description

Bit	Description
0	0 – Audio control NOT supported 1 – Audio control supported
1	0 – Call control NOT supported 1 – Call control supported
2	0 – Text control NOT supported 1 – Text control supported
3	0 – Keypad control NOT supported 1 – Keypad control supported
4	0 – Generic control NOT supported 1 – Generic control supported
5	0 – Video control NOT supported 1 – Video control supported
6	Reserved for future use. Set to 0.
7	Reserved for future use. Set to 0.

Note: Both bits 1 and 2 refer to a phone control device. A phone device will set bit 1, and optionally bit 2. Bit 2 indicates whether an ANT+ phone device supports text exchange. This is optional for a phone device. If text is supported, the remote control shall request the available text data page (refer to section 8.8) to determine if the controllable device supports a high speed text exchange mode, as described in section 8.5.3. A remote device shall request a high speed text exchange **only** if the control device supports high speed text exchange.

If a phone device supports caller ID exchange, the text feature shall be supported, and bit 2 shall be set.

8.3 Data Page 3 – Call Status

The call status page is used to indicate the status of a call and, optionally, the number of the caller. **This is a required data page of phone control devices**. Bytes 0 and 1 are required fields, with optional call number field formatted as described in Table 8-7.

Table 8-7. Data Page 3 Format – Call Status Page

Byte	Description	Length	Value	Units
0	Page Number	1 Byte	3 (0x03) – Call Status Page	N/A
1	Caller ID Available	1 Bit (bit 7)	0 - caller ID NOT available 1 - caller ID available	N/A
	Call Status	7 Bits (bits 0:6)	Indicates current status of the call. Set as described in Table 8-8.	
2	Call Number (LSB)	6 Bytes	Contains the phone number of the current caller Special Values: Emergency – 0x000000000000 Withheld – 0x000000000001 Unknown – 0xFFFFFFFFFFFF	N/A
3	Call Number			
4	Call Number			
5	Call Number			
6	Call Number			
7	Call Number (MSB)			

8.3.1 Caller ID Available

This bit is used to indicate if the phone is able to transmit the current caller's ID. If this bit is set to 1, it indicates that the caller ID of the caller is available for text transfer.

If the caller ID of the current call is desired, the remote control shall use common page 70 to request the available text page in order to determine the number of subpages required to successfully transmit the caller ID. For more information on the available text page, refer to section 8.8. The remote control can then use data page 20 to request the caller ID as text subpaged data (section 8.5).

If the phone does not support text exchange, as indicated by the device capabilities bit field in data page 2 (section 8.2), or does not support caller ID exchange, or the current caller ID is not available, this bit shall be set to 0.

If a phone device supports caller ID exchange, the text feature shall be supported. The device capabilities bit field shall be set appropriately, as described in section 8.2.2.

8.3.2 Call Status

The call status field indicates the state of the current call. Refer to Table 8-8 for details.

Table 8-8. Call Status Field Description

Byte	Description
0	Reserved
1	Incoming Call
2	In Call
3	Call on Hold
4	Missed Call
5-15	Reserved

Note that an incoming call shall overwrite a previous missed call.

8.3.3 Call Number

This number is the hexadecimal representation of the caller's phone number and allows for a 15 digit phone number. For example, the phone number 1-403-555-5555 shall be set as 0x0003449594E3. This is an optional field and shall be set as described in Table 8-7 if unused or unknown.

8.4 Data Page 4 – Text Status

The text status page is used to indicate that a new text notification has been received. This is an optional data page of phone control devices. Bytes 0, 1, and 2 are required fields, formatted as described in Table 8-9.

Table 8-9. Data Page 4 Format – Text Status Page

Byte	Description	Length	Value	Units
0	Page Number	1 Byte	4 (0x04) – Text Status Page	N/A
1	Alert ID	1 Byte	Indicates the type of text alert. Set as described in Table 8-10.	N/A
2	Number of Subpages	1 Byte	Indicates the number of subpages accompanying the text alert. If no subpages are available: set to 0x00	N/A
3	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
4	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
5	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
6	Remote Serial Number (LSB)	2 Bytes	The serial number of the remote control device. Unregistered/Unknown – 65535 (0xFFFF)	N/A
7	Remote Serial Number (MSB)			

8.4.1 Alert ID

This field indicates the type of text notification received by the call device. It shall be set as described in Table 8-10.

Table 8-10. Alert ID Field

Value	Description
0	No Alert
1	Calendar Alert
2	SMS received
3	Email received
4	Twitter update received
5	Facebook update received
6-255	Reserved

8.4.1.1 Alert Priority

All text notifications are handled serially. This means the phone only presents the remote device with one single notification at a time. The recommended best practice to facilitate appropriate notification is to use an alert priority scheme. A sample alert priority scheme is shown in Table 8-11.

Table 8-11. Alert Priority

Alert	Priority
Calendar	Highest
SMS	
Email	
Twitter	

Facebook	Lowest

Note that the implementation of the priority scheme is manufacturing specific on the phone device.

In the case where a new alert has higher priority than the current alert, the current alert shall be replaced by the new alert. For example, a phone is currently indicating an email has been received, but it has not been handled by the remote device. If a calendar alert occurs, the phone shall change the alert ID from "email received" to "calendar event received". Once the remote device has correctly handled the calendar event, the phone may then return to the prior "email received" notification.

8.4.2 Number of Subpages

This field indicates the number of subpages of text that are associated with the text alert. This is a required field. If a device does not support text transfer, or no subpages are available, this number shall be set to 0x00.

8.4.3 Remote Serial Number

Text notifications are intended to be peer to peer. This can be achieved by registering remotes with the phone device, and using this field to indicate the serial number of the remote device that the text notification is intended for.

If no controller has been registered with the phone, this field shall be set to 0xFFFF indicating the text notification is for ANY connected remote device.

If the phone receives a request from a remote control that is not registered, the user could be prompted to accept the request, the request could be ignored if no confirmation is received from the user.

Prompting the user to register a primary controller is a recommended best practice to avoid race conditions. Please refer to section 13.1 for recommendations on the registration process.

8.5 Data Page 5 – Text Subpaged Data

The text subpaged data page is used to transfer text data from the phone or audio device to the remote device. These pages are sent on request from a remote device only. They may be transmitted at the standard 4 Hz (interleaved every second channel period) rate, or at a requested channel period and RF channel frequency (interleaved between the standard 4 Hz transmission pattern). Refer to sections 10.1 and 10.2 for more details on requesting this page.

Data page 5 is an optional data page that may be used by text control devices. All fields shall be set as described in Table 8-12.

Table 8-12. Data Page 5 Format – Text Subpaged Data Page

Byte	Description	Length	Value	Range
0	Page Number	1 Byte	5 (0x05) – Text Subpaged Data Page	N/A
1	Subpage Number	1 Byte	Subpage Number Invalid: 0xFF	0-254
2	Text Byte 0	6 Bytes	UTF-8 encoded text data. Refer to section 8.5.2 for details.	N/A
3	Text Byte 1			
4	Text Byte 2			
5	Text Byte 3			
6	Text Byte 4			
7	Text Byte 5			

8.5.1 Subpage Number

This field is used to indicate the order of the text subpages that is being sent. If three subpages of text are requested by the slave, then the first subpage shall have its subpage number set to 0x00, the second shall have its subpage number set to 0x01, and the third shall its subpage number set to 0x02. When the next set of subpages is requested, this sequence shall begin again from zero.

8.5.2 Text

UTF-8 encoded text data.

Subpage numbers and text bytes shall be populated in the order in which the characters appear in the text string. Remaining bytes shall be null terminated (unless the last byte in the string corresponds to byte 7). For example:

This is an example string

Shall be transmitted across the air in 5 pages formatted as shown below:

Subpage 0: [05][00][54][68][69][73][20][69]

Subpage 1: [05][01][[73][20][61][6E][20][65]

Subpage 2: [05][02][78][61][6D][70][6C][65]

Subpage 3: [05][03][20][73][74][72][69][6E]

Subpage 4: [05][04][67][00][00][00][00][00]

Note that if the characters being transmitted are ASCII characters, then it takes only byte per character to encode them in UTF-8. Characters requiring special punctuation, accented characters, or letters from languages with different character sets require extra bytes per character (refer to section 9.2.2).

This example includes some 2 byte UTF-8 characters:

¡Hola! ¿Qué tal?

Shall be transmitted across the air in 4 subpages formatted as shown below:

Subpage 0: [05][00][C2][A1][48][6F][6C][61]

Subpage 1: [05][01][21][20][C2][BF][51][75]

Subpage 2: [05][02][C3][A9][20][74][61][6C]

Subpage 3: [05][03][3F][00][00][00][00][00]

Note, subpage numbers are 0 inclusive.

8.5.3 Transmission Requirements

If high speed text exchange is supported by the audio or phone device, a request for text data (data page 20, section 10.1) shall initiate a text exchange on the requested RF channel and period. Otherwise, a slow feed text exchange mechanism shall be used. Subpages are interleaved with standard control data pages as described in section 12.

For example, when a phone device has a new text notification, it shall indicate in data page 4 (section 8.4) the type of text notification received and the number of subpages of text necessary to transmit the text notification (N). The remote device may then request the text data, and the phone device shall transmit subpages 0 through N–1. Any missed subpages may be requested by the remote device using data page 70. For more information regarding data page 70, refer to section 10.2.

Similarly, if an audio remote wishes to request the song title of the currently playing song, it shall request the available text page (data page 8, section 8.8) using data page 70. The available text page will state the number of subpages required to transmit the full text of the song title, and indicate whether high speed text exchange is supported by the audio device. After the number of subpages is known, the audio remote may request the song title using data page 20 (section 10.1). The audio device shall transmit subpages 0 through N–1. Any missed subpages may be requested by the remote device using data page 70. For more information regarding data page 70, refer to section 10.2.

Subpages are interleaved with standard control data pages as described in section 12. The phone or audio device shall continue interleaving the subpages until the remote device sends a clear notification message (data page 20), or until an application level timeout. An appropriate timeout may be rotation based; for example, after 3 rotations of subpages 0:N.

8.6 Data Page 6 – Stored Text Count

The stored text count page is used to indicate how many text notifications are currently stored on the phone device. **This is an optional data page of phone devices and is sent on request only.**

Byte 0 is a required field, with optional text notification count fields as described in Table 8-13.

Table 8-13. Data Page 6 Format – Stored Text Count Page

Byte	Description	Length	Value	Units
0	Page Number	1 Byte	6 (0x06) – Stored Text Count Page	N/A
1	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
2	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
3	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
4	Unread SMS count	1 Byte	Count of unread SMS on phone device Unknown – 255 (0xFF)	N/A
5	Unread Email count	1 Byte	Count of unread Emails on phone device Unknown – 255 (0xFF)	N/A
6	Unread Twitter update Count	1 Byte	Count of unread Twitter updates on phone device Unknown – 255 (0xFF)	N/A
7	Unread Facebook update Count	1 Byte	Count of unread Facebook updates on phone device Unknown – 255 (0xFF)	N/A

8.6.1 Unread SMS Count

The number of SMS messages that are unread on the phone device. If this field is not used, or is unknown, it shall be set as described in Table 8-13.

8.6.2 Unread Email Count

The number of unread emails currently stored in the phone device. If this field is not used, or is unknown, it shall be set as described in Table 8-13.

8.6.3 Unread Twitter Update Count

The number of unread Twitter updates currently stored on the phone device. If this field is not used, or is unknown, it shall be set as described in Table 8-13.

8.6.4 Unread Facebook Update Count

The number of unread Facebook updates currently stored on the phone device. If this field is not used, or is unknown, it shall be set as described in Table 8-13.

8.7 Data Page 7 – Video Update Data

The video update page is the primary data page sent from a video device. **This is a required page for video devices** and fields shall be formatted as described in Table 8-14. This page shall not be sent by any device that is not a video device.

Table 8-14. Data Page 7 Format – Video Update Page

Byte	Description	Length	Value	Units
0	Page Number	1 Byte	7 (0x07) – Video Update Page	N/A
1	Volume	1 Byte	Bit 7 Indicates if muted (1) or not (0) Bit 6:0 Volume given as a percentage: 0 – 100 Special Value (bits0:7): Unknown/Invalid – 255 (0xFF)	N/A
2	Time Remaining (LSB)	2 Bytes	The total time remaining on the video device. For a playback device, this is the time remaining on the video clip. For a recorder device, this is the amount of time remaining that is available for recording. Unknown – 65535 (0xFFFF)	Seconds
3	Time Remaining (MSB)			
4	Time Progressed (LSB)	2 Bytes	Current number of seconds into playback/recording, this value does not rollover. Min – 0s Max – 65534s (~18hours) Unknown – 65535 (0xFFFF)	Seconds
5	Time Progressed (MSB)			
6	Capabilities	1 Byte	Indicates the video device's capabilities. Refer to Table 8-15.	N/A
7	State	1 Byte	Gives the current state of the video device. See Table 8-16 for the possible states of the video device. Unknown – 255 (0xFF)	N/A

8.7.1 Volume

The volume data field is an optional field that can be used to transmit the current volume of the video device. The volume is given as a percentage to allow for easy mapping of volume settings across different devices. If this data field is not populated, it shall contain the unknown value as shown in Table 8-14.

The MSB (bit 7) shall be used to indicate if the volume has been muted or not. If this bit is set, the device is muted. When the device is un-muted, this bit shall be set to 0, and volume shall be indicated by bits 0:6.

This field shall be set to invalid or unknown (0xFF) for devices that do not support video playback.

8.7.2 Time Remaining

The time remaining field is a required data field. This field gives the amount of time (in seconds) remaining to record video, or to be played back. If unused, set as described in Table 8-14.

8.7.3 Time Progressed

The time progressed field is a required data field. The video device shall transmit the current progression, in seconds, into the recording, or being played back. If unused, set as described in Table 8-14.

8.7.4 Capabilities

The capabilities bit field is used to indicate the video device's capabilities. This is a required field and shall be set according to Table 8-15. To use data page 7, **at least one of video recorder or video playback must be supported**.

Table 8-15. Video Device Capabilities Bit Field Description

Bit	Description	Value
2:7	Reserved. Set to 0.	Set to 0
1	Video Playback Support	0 – Does NOT support Video Playback 1 –Supports custom Video Playback
0	Video Recorder Support	0 – Does NOT support Video Recorder 1 –Supports Video Recorder

8.7.5 State

The State data field indicates the current state of the video device. If the video device state is not known, the fields shall be set as shown in Table 8-16.

Table 8-16. Video Device State Values

Value	Description	Playback Requirements	Record Requirements
0	Off: the video device is off	Supported	Supported
1	Play: the video device is in play mode	Supported	Not Supported
2	Pause: the video device is paused	Optional	Optional
3	Stop: the video device is stopped	Supported	Supported
4	Busy: the video device is busy	Optional	Optional
5	Fast Forward: the video device is fast forwarding through video clip	Optional	Optional
6	Rewind: the video device is re-winding through video clip	Optional	Optional
7	Record: the video device is recording	Not Supported	Supported
8 – 254	Reserved	Reserved	Reserved
255	Unknown	Supported	Supported

Some video devices have multiple functions, such as smart phones. If the device is in a call, or some other state, that does not allow for the video device to be active, the 'Busy' state may be used.

8.8 Data Page 8 – Available Text Page

The available text page is used to indicate information about the text that is available for transfer, and the available text transfer speeds of a controllable device. For example, it indicates how many subpages of text are required to send the song title, or caller ID. **This is a required page of audio control devices that support song title exchange, and phone control devices that support caller ID and/or high speed text exchange. This page is sent on request only.**

Bytes 0 and 1 are required fields, formatted as described in Table 8-17.

Table 8-17. Data Page 8 Format – Available Text

Byte	Description	Length	Value	Units
0	Page Number	1 Byte	8 (0x04) – Available Text	N/A
1	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
2	Subpage 1	1 Byte	Byte 2 indicates the format of bytes 4 and 5.	N/A
3	Subpage 2	1 Byte	Byte 3 indicates the format of bytes 6 and 7.	N/A
4	Data Field 1 (LSB)	2 Bytes	Data field as indicated by subpage 1. Refer to section 8.8.1	N/A
5	Data Field 1 (MSB)			
6	Data Field 2 (LSB)	2 Bytes	Data field as indicated by subpage 2. Refer to section 8.8.1.	N/A
7	Data Field 2 (MSB)			

8.8.1 Subpage 1 & 2 Fields

The subpage 1 and subpage 2 fields are used to describe the content of bytes 4-5 and 6-7 respectively. Bytes 4 and 5 shall contain the data associated with the subpage indicated by subpage 1. Similarly, Bytes 6 and 7 shall contain the data associated with the subpage indicated by subpage 2. Subpages are assigned as shown in Table 8-18

Table 8-18. Subpage Number

Value	Description
0	Text Transfer Speeds
1	Song Title Subpages
2	Caller ID Subpages
3- 255	Reserved

8.8.1.1 Text Transfer Speeds

If either subpage 1 or subpage 2 indicates the text transfer speeds subpage, then the associated data field (LSB) shall contain the channel periods that are supported by the controllable device for text transfers. The remaining byte of the associated data field shall be set to 0xFF. Refer to section 8.5.3 for more information on text exchange.

This field shall be set as described in Table 8-19.

Table 8-19. Text Transfer Supported Channel Periods

Value	Channel Period (Hz)
0-2	Reserved. Do not interpret
3	4 (slow feed)
4	8
5	12
6	16
5-255	Reserved

Note that a higher channel period is inclusive of the channel periods below it. In other words, if a device supports 12 Hz, it also supports 8 Hz and 4 Hz. Likewise, if a device supports 16 Hz, it also supports 12 Hz, 8 Hz, and 4 Hz.

8.8.1.2 Song Title Subpages

For an audio device this field indicates the number of text data pages (to a maximum of 255) that are required to transmit the currently playing track title. Refer to section 8.5.1 for more information.

This field shall be set to 0 if the number of subpages to transmit song title is unknown, song title text exchange is not supported, or if the controllable device is not an audio device.

8.8.1.3 Caller ID Subpages

For a phone device, this field indicates the number of text data pages (to a maximum of 255) that are required to transmit the current caller ID. Refer to section 8.5.1 for more information.

This field shall be set to 0 if the number of subpages to transmit caller ID is unknown, caller ID text exchange is not supported, or if the controllable device is not a phone device.

8.9 Data Pages 9 – 15: Future Pages

As new sensors are developed using the Controls Device Profile, new data messages may be added to allow new kinds of information to be transmitted. These data pages are reserved for future use.

9 Command Data Page Formats

9.1 Data Page 16 – Audio/Video Command

The audio/video command data page is typically sent by the remote control to initiate an action on the audio or video device. **As this data page is sent on an as needed basis, it shall be sent using an acknowledged message**. This allows the remote control to determine if the message was successfully received. If this data page is not successfully acknowledged, it is left to the application to determine if the data page needs to be resent. The audio or video device shall handle repeat messages gracefully.

Bytes 0 and 7 are required fields, with optional volume increment and serial number fields.

Table 9-1. Data Page 16 Format – Audio/Video Command Page

Byte	Description	Length	Value	Units	Rollover or Range
0	Page Number	1 Byte	16 (0x10) – Audio/Video Command Page	N/A	N/A
1	Serial Number (LSB)	2 Bytes	The serial number of the remote control device. Special Values: Unknown – 65535 (0xFFFF)	N/A	N/A
2	Serial Number (MSB)				
3	Sequence #	1 Byte	Increment for each new command. Note that sequence numbers for all command pages are taken from the same series.	N/A	256
4	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A	N/A
5	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A	N/A
6	Volume Increment	1 Byte	Indicates the % amount an audio/video device shall increase/decrease in volume. 0x00: Reserved Default Increments/Invalid – 255 (0xFF)	%	1 – 100
7	Audio/Video Command Identifier	1 Bit (bit 7)	0 if controlling an audio device 1 if controlling a video device	N/A	N/A
	Command Number	7 Bits (bits 0:6)	See Table 9-2 for a listing of valid command requests.	N/A	N/A

9.1.1 Serial Number

The serial number field contains the serial number of the remote control that sent the command request. This allows the audio or video device to identify which remote the command originated from, and to choose whether to act on, or ignore, the command request.

This is not a required field, and shall be set to 0xFFFF if not used.

9.1.2 Sequence #

In order to allow a master device to differentiate between repeat commands and new commands sent by a slave; each time that a new command is sent, the sequence number shall be incremented (see section 9.1.4). Note that this is a rollover field, and that:

The sequence numbers for all command pages shall be taken from the same number series. For example if an audio command is sent with sequence number 0 and is followed by a generic command, then a call command, and then another audio command, these commands shall be sent with sequence numbers 1, 2, and 3 respectively.

9.1.3 Command Number

The command number data field determines the command that is being sent to the audio or video device. Table 9-2 describes the different commands that are defined for this purpose. Note, not all commands are supported by all devices.

Table 9-2. Audio/Video Control Commands

Value	Description	Audio	Playback Video	Video Recorder
0	Reserved	N/A	N/A	N/A
1	Play	Supported	Supported	Not Supported
2	Pause	Optional	Optional	Optional
3	Stop	Supported	Supported	Supported
4	Volume Up	Optional	Optional	Optional
5	Volume Down	Optional	Optional	Optional
6	Mute/Un-mute	Optional	Optional	Optional
7	Clip/Track Ahead	Optional	Optional	Not Supported
8	Clip/Track Back	Optional	Optional	Not Supported
9	Repeat Current Track	Optional	Not Supported	Not Supported
10	Repeat All	Optional	Not Supported	Not Supported
11	Repeat Off	Optional	Not Supported	Not Supported
12	Shuffle Songs (tracks)	Optional	Not Supported	Not Supported
13	Shuffle Albums	Optional	Not Supported	Not Supported
14	Shuffle Off	Optional	Not Supported	Not Supported
15	Fast Forward Through Clip/Track	Optional	Optional	Optional
16	Fast Rewind Through Clip/Track	Optional	Optional	Optional
17	Custom Repeat	Optional	Not Supported	Not Supported
18	Custom Shuffle	Optional	Not Supported	Not Supported
19	Record	Not Supported	Not Supported	Supported
20 - 127	Reserved for future use	N/A	N/A	N/A

9.1.4 Implementation Details

The slave sends the command message to the master on the reverse channel. If the message is not successful, it is up to the application layer to retry the message.

It is possible that the message is successfully received by the master, but the acknowledgement to the slave fails. This could result in the slave repeating the command. The master can identify such repeat commands by matching the incoming sequence # and slave ID. The master shall ignore any repeated commands; however, it is recommended that after a short timeout, the master shall allow commands that appear to be repeated (i.e. that have a matching sequence # and slave ID). This timeout will prevent the master from accidentally blocking new commands after the command sequence number field has rolled over. The duration of the timeout is application specific, but one minute is recommended.

9.2 Data Page 17 – Character Command

The character command page allows for a remote control device to send any valid UTF-8 character from the remote to a keypad controllable device. The UTF-8 character set encompasses all Unicode characters, including ASCII characters and multiple language support. At an application level, the message payload content shall directly correspond to the character that represents the desired command.

As this data page is sent on an as needed basis, it shall be sent using an acknowledged message. If this data page is not successfully acknowledged, it is left to the application to determine if the data page needs to be resent. The control device shall handle repeat messages gracefully.

Table 9-3. Data Page 17 Format – UTF-8 Character Command Page

Byte	Description	Length	Value	Units	Rollover or Range
0	Page Number	1 Byte	17 (0x11) – UTF-8 Character Command Page	N/A	N/A
1	Serial Number (LSB)	2 Bytes	The serial number of the remote control device. Special Values: Unknown – 65535 (0xFFFF)	N/A	N/A
2	Serial Number (MSB)				
3	Sequence #	1 Byte	Increment for each new command. Note that sequence numbers for all command pages are taken from the same series. Refer to section 9.1.2.	N/A	256
4	UTF-8 Character LSB	4 Bytes	These 4 bytes shall comprise a valid UTF-8 encoding of a Unicode character. Refer to Table 9-4 for valid ranges.	N/A	N/A
5	UTF-8 Character				N/A
6	UTF-8 Character				N/A
7	UTF-8 Character MSB				N/A

9.2.1 Serial Number

The serial number field contains the serial number of the remote control that sent the command request. This allows the controllable device to identify which remote the command originated from, and to choose whether to act on, or ignore, the command request.

This is not a required field, and shall be set to 0xFFFF if not used.

9.2.2 UTF-8 Character

This field contains the UTF-8 character sent from the remote control. UTF-8, or 8-bit Unicode Transformation Format, is a variable-length character encoding for Unicode. Unicode is a computing industry standard for the consistent encoding, representation and handling of text expressed in most of the world's writing systems. Valid UTF-8 values are defined by the RFC 3629 standard and the Unicode Standard 5.0. Please refer to these standards for the full definition of how to use UTF-8 encoding.

For reference, Table 9-4 illustrates the bit arrangement of a Unicode code into a 4 byte UTF-8 encoding.

Table 9-4. UTF-8 Encoding

Unicode Character Range	Byte 1	Byte 2	Byte 3	Byte 4
U+0000 - U+007F	00 - 7F			
U+0080 - U+07FF	C2 - DF	80 - BF	80 - BF	
U+0800 - U+0FFF	E1 - EC	80 - BF	80 - BF	
U+1000 - U+CFFF	E1 - EC	80 - BF	80 - BF	
U+D000 - U+D7FF	ED	80 - 9F	80 - BF	
U+D800 - U+DFFF	ill-formed			
U+E000 - U+FFFF	EE - EF	80 - BF	80 - BF	
U+10000 - U+3FFFF	F0	90 - BF	80 - BF	80 - BF
U+40000 - U+FFFFF	F1 - F3	80 - BF	80 - BF	80 - BF
U+100000 - U+10FFFF	F4	80 - 8F	80 - BF	80 - BF

9.3 Data Page 18 – Reserved

9.4 Data Page 19 – Call Command

The call command data page is typically sent by the remote control to initiate an action on the phone device. **As this data page is sent on an as needed basis, it shall be sent using an acknowledged message**. If this data page is not successfully acknowledged, it is left to the application to determine if the data page needs to be resent. The phone device shall handle repeat messages gracefully.

This is a required page of phone devices. Bytes 0 and 7 are required, and the serial number field is optional.

Table 9-5. Data Page 19 Format – Call Command Data Page

Byte	Description	Length	Value	Units	Rollover or Range
0	Page Number	1 Byte	19 (0x13) – Call Command Page	N/A	N/A
1	Serial Number (LSB)	2 Bytes	The serial number of the remote control device. Special Values: Unknown – 65535 (0xFFFF)	N/A	N/A
2	Serial Number (MSB)				
3	Sequence #	1 Byte	Increment for each new command. Note that sequence numbers for all command pages are taken from the same series. Refer to section 9.1.2.	N/A	256
4	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A	N/A
5	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A	N/A
6	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A	N/A
7	Command Number	1 Byte	See Table 9-6 for a listing of valid command requests.	N/A	N/A

9.4.1 Serial Number

The serial number field contains the serial number of the remote control that sent the command request. This allows the phone device to identify which remote issued the command, and to choose whether to act on, or ignore, the command request.

This is not a required field, and shall be set to 0xFFFF if not used.

9.4.2 Command Number

The command number data field determines the command being sent to the call device. Table 9-6 describes the different commands that are defined for this purpose.

Table 9-6. Call Control Commands

Value	Description
0	Reserved
1	Answer Call
2	Silence Ringer (ignore call)
3	Hang up
4-255	Reserved

9.5 Common Data Page 72: Command Burst

The command burst is used by an ANT+ generic remote control device (slave) to issue a sequence of commands to an ANT+ generic controllable device (master). This allows a slave device to issue multiple commands to a master device, while providing a means of error checking and resolving ambiguities in case of reception failures. The issued commands are sent as a burst message that contains information about the burst length, the ID of slave device issuing the command, and information about the commands themselves.

All ANT+ generic master devices shall be able to receive and respond to the command burst. Command burst is optional for ANT+ generic slave devices, but is recommended in cases where individual commands need to be sent more often than once every channel period (250ms).

Compared to sending multiple standalone reverse channel commands, the command burst provides improved robustness and reduced latency. As the command and sequence information are received at the same time, there is no need for the master to maintain status across channel periods or to resolve possible contention between command messages sent from multiple slaves.

The command burst identifies the ID of the slave requesting the command. In applications where authentication is required between a slave and master, this will allow a master to reject the command if needed, based on the identity of the slave.

The command burst message uses the burst message format. This means that all packets are sent on the same message period.

Table 9-7. Command Burst Format

	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
Packet 1	Page Number	Requested Command ID	Command Sequence #	Burst Length	Reserved: 0xFFFFFFFF			
Packet 2	Slave Manufacturer ID		Slave Product ID		Slave Serial Number			
Packet 3:N	Command Data – See Table 9-9							

Data packets 1 and 2 give information about the command burst, and identify the slave device. These packets are formatted as described in Table 9-8 below.

Table 9-8. Global Data Page 72 – Command Burst Packets 1 and 2

Burst Packet 1

Byte	Description	Length	Description	Rollover or Range
0	Page number	1 Byte	72 (0x48) – Command Burst	N/A
1	Requested Command ID	1 Byte	0x01: High density command sequence (timestamp) 0x02: High density command sequence (sequence number) All other Values: Reserved for future use	0-255
2	Command Sequence #	1 Byte	Set to invalid: 0xFF	N/A
3	Burst Length	1 Byte	Number of packets in burst command	3-8
4-7	Reserved	4 Bytes	Reserved for future use: 0xFFFFFFFF	N/A

Burst Packet 2

Byte	Description	Length	Value	Units
0-1	Slave Manufacturer ID	2 Bytes	Defined by ANT+ Alliance. Use 0xFFFF if undefined	N/A
2-3	Slave Product ID	2 Bytes	Defined by Manufacturer	N/A
4-7	Slave Serial Number	4 Byte	Defined by manufacturer. Unique ID for specific product Use 0xFFFFFFFF for devices without a serial number	N/A

9.5.1 Requested Command ID

This is the ID of the command being requested. ANT+ generic control devices shall set this field to indicate that a high density command sequence is being sent. The command sequence can include commands identified by timestamp at the time of button press, or by a sequence number.

Set this field to 0x01 to indicate a high density command sequence using timestamps; or set it to 0x02 to indicate a high density command sequence using sequence numbers. This is a required field, and no invalid values are permitted.

9.5.2 Command Sequence #

As this command burst contains a sequence of commands with their associated timestamps or sequence numbers, this command sequence # field should not be used, and should be set to 0xFF.

9.5.3 Burst Length

The burst length is the total number (N) of burst packets that will be sent, including packets 1 and 2. The minimum burst length is 3, and the maximum is 8. For ANT+ generic control devices this is a maximum of 8 packets.

9.5.4 Slave Identification

Burst Packet 2 provides information that identifies the slave device.

9.5.4.1 Slave Manufacturer ID

Manufacturer numbers are maintained by the ANT+ Alliance. To receive the list of manufacturer identification values, or to be allocated a value, please contact the ANT+ Alliance at ANTAlliance@thisisant.com.

9.5.4.2 Slave Product ID

This value is manufacturer specific and not controlled by ANT+.

9.5.4.3 Slave Serial Number

The slave serial number field contains four bytes used to help uniquely identify the product (i.e. serial number). This value is also manufacturer specific and not controlled by ANT+.

9.5.5 Command Data

Data packets 3 to N contain the sequence of commands to be executed by the master device. Two commands can be sent per packet, up to a maximum of 12 commands per burst (i.e. max 12 commands per 250ms channel period). The format of data packets 3 to N depends on the value of the command ID specified in packet 1 and is detailed in Table 9-9.

Table 9-9. Global Data Page 72 – Command Burst Packets 3 to N

Burst Packets 3 – N: Requested Command ID=0x01

Byte	Description	Length	Value	Units	Rollover
0	Timestamp LSB	2 Bytes	Timestamp of the button press that generated the command in bytes 2-3.	1/32768s	2s
1	Timestamp MSB				
2	Command Number LSB	2 Bytes	See Table 9-10	N/A	N/A
3	Command Number MSB				
4	Timestamp LSB	2 Bytes	Timestamp of the button press that generated the command in bytes 6-7.	1/32768s	2s
5	Timestamp MSB				
6	Command Number LSB	2 Bytes	See Table 9-10	N/A	N/A
7	Command Number MSB				

Burst Packets 3 – N: Requested Command ID=0x02

Byte	Description	Length	Value	Units	Rollover
0	Sequence Number	1 Byte	Sequence number of the command in bytes 2-3. Increment for each new command. Note that sequence numbers for all command pages are taken from the same series. Refer to section 9.1.2.	N/A	255
1	Reserved	1 Byte	Reserved for future use: Set to 0xFF	N/A	N/A
2	Command Number LSB	2 Bytes	See Table 9-10	N/A	N/A
3	Command Number MSB				
4	Sequence Number	1 Byte	Sequence number of the command in bytes 6-7. Increment for each new command. Note that sequence numbers for all command pages are taken from the same series. Refer to section 9.1.2.	N/A	255
5	Reserved	1 Byte	Reserved for future use: Set to 0xFF	N/A	N/A
6	Command Number LSB	2 Bytes	See Table 9-10	N/A	N/A
7	Command Number MSB				

9.5.6 Timestamp

The timestamp field indicates the time at which the command was initiated by the user. This allows the rate at which the user initiated the commands to be preserved, as well as making each request from the slave unique. The timestamp field a 32768Hz clock to record the time at which a button is pressed. Each stamp tick represents a 1/32768s interval. This field rolls over once every 2s.

9.5.7 Sequence Number

In order to allow a master device to differentiate between repeat commands and new commands sent by a slave; each time that a new command is sent, the sequence number shall be incremented. Refer to section 9.5.9. Note that this is a rollover field, and that:

The sequence numbers for all command pages shall be taken from the same number series. For example if an audio command is sent with sequence number 0 and is followed by a generic command, then a call command, and then another audio command, these commands shall be sent with sequence numbers 1, 2, and 3 respectively.

The sequence numbers in packets 3 to N of a command burst shall also form part of this series: i.e.

- The sequence number in packet 3 byte 0 will be one higher that of the last command sent (e.g. 4)
- The sequence number in byte 4 will be one increment higher than that in byte 0 (e.g. 5)
- The sequence numbers in bytes 0 and 4 of the remaining packets will each be incremented by one (e.g. 6, 7, 8…) with a possible exception on the final byte 4 as described in section 9.5.8.

This example is illustrated in Figure 9-1.

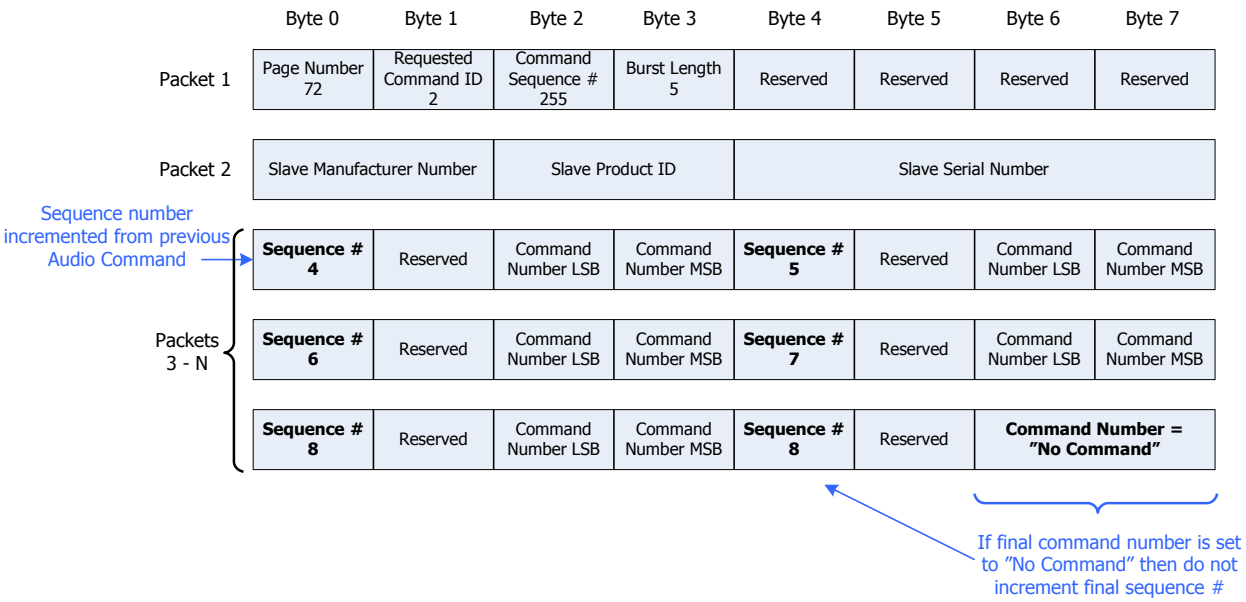


Figure 9-1. Illustration of Sequence Number Usage

9.5.8 Command Number

This field indicates the command being requested by the user. The command field determines which command is being requested by an ANT+ generic remote control device, and is detailed in Table 9-10.

Table 9-10. Command Value Mapping

Value	Command	Description
0	Menu Up	Move up to the previous menu item in the list (same hierarchy level)
1	Menu Down	Move down to the next menu item in the list (same hierarchy level)
2	Menu Select	Select the current menu item, i.e. initiate listed function, or move into sub menu
3	Menu Back	Move up one level in the menu hierarchy
4	Home	Return to the home screen
5 - 31	Reserved	Reserved for future use
32	Start	Start the timer counting from the existing value.
33	Stop	Stop the timer counting.
34	Reset	Reset the timer value to zero.
35	Length	Mark the time as a completed length
36	Lap	Mark the time as a completed lap
37-32767	Reserved	Reserved for future use
32768 – 65534	Custom Commands	Custom commands as defined by Manufacturer
65535	No Command*	No command issued*

*If an odd number of commands are being sent then the command field in bytes 6-7 of the final packet should contain the value 65535 (0xFFFF) indicating "No Command", and the receiving device should ignore the command. Bytes 4-5 of a packet that correspond to a "No Command" value, shall be set to same values as those used in bytes 0-1 of that packet; i.e. sequence numbers/timestamps shall not increment when a "No Command" value is sent.

Please contact us if your use case requires additional commands to be defined. Note that custom commands are intended only for use in cases where interoperability is not required.

The following condition applies to sending custom commands as part of this profile:

- Manufacturers choosing to use custom commands, must maintain a consistent implementation across all their ANT+ devices i.e. different model numbers shall not have different commands associated with a given Custom Command ID.

9.5.9 Implementation Details

The slave sends the command burst message to the master on the reverse channel. If all burst packets are successfully acknowledged, the slave knows that the entire command request has been received. If the burst is not successful, then it is up to the slave device's application layer to retry the entire burst.

The master will only process the command if the whole burst is successfully received. On the final burst packet, it is possible for the packet to be successfully received by the master, but for the acknowledgement to the slave to fail. This may result in the slave repeating the command burst on the next message period. It may also be the case that the user has initiated additional commands by the time the command burst is retried. In this case the new burst command could include a set of retried commands followed by additional new commands within the same burst message. The receiving device shall ignore the repeat commands, and process any new commands in this message.

The master can identify such repeat commands by matching the incoming slave ID, and sequence number or timestamp. However, it is recommended that after a short timeout, the master shall allow commands that appear to be repeated (i.e. that have a matching slave ID, and sequence number or timestamp). This timeout will prevent the master from accidentally blocking new commands after the command sequence number field has rolled over.

9.6 Common Data Page 73: Generic Command Page

The generic command page allows a remote control device to send commands that can be received by a wide selection of controllable devices. These commands include menu navigation, and stopwatch control (start/stop and set time markers). The commands are generic and can be used in many use cases, allowing interoperability of common functions between devices from different manufacturers. **All ANT+ generic master devices shall be able to receive and respond to the generic command page.**

As this data page is sent on an as needed basis from the slave to the master, it shall be sent using an acknowledged message.

The command page is used to allow a slave device to issue a command to a master device, while providing a means of error checking and resolving ambiguities in case of reception failures. The issued command is sent as a reverse channel message that contains information about the ID of the slave device issuing the command, and information about the command itself.

The Command Page identifies the ID of the slave requesting the command. In applications where authentication is required between a slave and master, this will allow a master to reject the command if needed, based on the identity of the slave. Please refer to the ANT+ Common Pages Document for more details.

Table 9-11. Page 73 Format – Generic Command Data Page

Byte	Description	Length	Description	Rollover or Range
0	Page number	1 Byte	73 (0x49) – Command Page	N/A
1-2	Slave Serial Number	2 Bytes	The serial number of the remote control device. Unknown: 65535 (0xFFFF)	N/A
3-4	Slave Manufacturer ID	2 Bytes	Defined by ANT+ Alliance. Use 0xFFFF if undefined	N/A
5	Sequence #	1 Byte	Increment for each new command. Note that sequence numbers for all command pages are taken from the same series. Refer to section 9.1.2.	256
6-7	Command Number	1 Byte	See Table 9-10. Command Value Mapping	Packets

9.6.1 Slave Identification

Bytes 1-4 provide information that identifies the slave device. As the Slave ID does not include a way to identify the specific model of a device, the following condition applies to the custom commands that may be sent using this page:

- Manufacturers choosing to use custom commands, must maintain a consistent implementation across all their ANT+ devices i.e. different model numbers shall not have different commands associated with a given Custom Command ID.

9.6.1.1 Slave Serial Number

The slave serial number field contains two bytes used to help uniquely identify the product. This value is also manufacturer specific and not controlled by ANT+.

9.6.1.2 Slave Manufacturer ID

Manufacturer numbers are maintained by the ANT+ Alliance. To receive the list of manufacturer identification values, or to be allocated a value, please contact the ANT+ Alliance at ANTAlliance@thisisant.com.

9.6.2 Command Number

This is the ID of the command being requested. The command ID data field determines which command is being requested by an ANT+ control device, and is detailed in Table 9-10. Please contact us if your use case requires additional commands to be defined. Note that custom commands are intended only for use in cases where interoperability is not required.

10 Request Data Page Formats

10.1 Data Page 20 – Text Request

The text command data page is sent by the remote to request text notification data from the phone device. This page also allows the remote control to request the text data at a higher data rate if desired.

If a higher data rate is requested, the remote control shall also request this exchange to take place over a temporary RF channel frequency (i.e. **NOT 2457MHz**), and the remote and phone devices shall return to the default channel period and RF frequency once the application level timeout has been reached, or the text is cleared by the remote control.

If the RF space is changed, this higher rate data is interleaved with the standard ANT+ control device page rotation. Refer to section 8.5.3 for more details.

As this data page is sent on an as needed basis, it shall be sent using an acknowledged message. If this data page is not successfully acknowledged, it is left to the application to determine if the data page needs to be resent. The receiving device shall handle repeat messages gracefully.

This is a required page of phone devices that implement that text control feature of the Device Profile. Bytes 0 and 7 are required, with optional serial number, RF frequency, channel period, and number of subpages fields.

Table 10-1. Page 20 Format – Text Request Data Page

Byte	Description	Length	Value	Units
0	Page Number	1 Byte	20 (0x14) – Text Command Page	N/A
1	Serial Number (LSB)	2 Bytes	The serial number of the remote control device. Special Values: Unknown – 65535 (0xFFFF)	N/A
2	Serial Number (MSB)			
3	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
4	RF Channel Frequency	1 Byte	Specifies the requested RF channel frequency Special Values: Use Default ANT+ RF Frequency – 255 (0xFF) Do Not Use: 57 (0x39)	N/A
5	Channel Period	1 Byte	Specifies the channel period to switch to. Refer to Table 10-2 for allowable values. Special Value: Use Default Beacon Period – 255 (0xFF)	N/A
6	Number of Subpages Requested	1 Byte	Used to indicate the max number of subpages requested. i.e. 0 to 'M' pages of 'N' Special Values: All Subpages – 255 (0xFF)	N/A
7	Text Command	1 Byte	See Table 10-3 for a listing of valid command requests.	N/A

10.1.1 Serial Number

The serial number field contains the serial number of the remote control device that sent the request. This allows the phone control device to identify which remote issued the request, and to choose whether to respond or ignore it.

This is not a required field, and shall be set to 0xFFFF if not used.

10.1.2 RF Channel Frequency

The RF channel frequency field allows the remote device to specify a temporary RF space to exchange text data at a higher rate (if desired and supported by the phone control device). This field specifies the RF channel frequency at which the text data exchange shall take place. When requesting the text data exchange state, this field must be populated with a valid RF channel frequency that is different to the default ANT+ RF channel frequency.

Allowable frequency values may depend on regulatory requirements. The ANT+ Controls Device Profile supports a maximum frequency range of 2403MHz to 2480MHz.

For remotes that do not support text exchange, or when an 'ignore/clear notification' command is desired, this field shall be set to 0xFF as described in Table 10-1.

If the channel period is changed to a value that is not the default value, the RF channel frequency shall also be changed to a value that is not the default value. This ensures that text data does not create interference with other ANT+ devices. The controllable device shall ignore any text commands that do not meet this requirement.

This field shall not be set to 57.

10.1.3 Channel Period

The channel period field allows the remote device to specify a temporary channel period to facilitate the exchange of text data at a higher rate (if desired and supported by the phone control device). This field specifies the channel period at which the text data exchange will take place. This field must be populated with one of the valid channel period values listed in Table 10-2.

Table 10-2. Allowable Channel Period Values

Value	Channel Period (Hz)
0-3	Reserved. Do not interpret
4	8
5	12
6	16
5-254	Reserved

For remotes that do not support text exchange, or when an 'ignore/clear notification' command is desired, this field shall be set to 0xFF as described in Table 10-1.

If the RF channel frequency is changed to a value that is not the default value the channel period shall also be changed to a value that is not the default value. This ensures that text data does not create interference with other ANT+ devices. The controllable device shall ignore any text commands that are received that do not meet this requirement.

10.1.4 Number of Subpages Requested

This field allows a remote control to restrict the number of subpages of text that the audio or phone device shall send. For example, if N subpages are available, the remote may request M (<N) subpages to be sent.

If this field is unused, or all subpages are desired, this field shall be set as described in Table 10-1. If an 'ignore/clear notification' command is desired, this field shall be set to 0.

10.1.5 Text Command

The text command field determines the command that is being sent to the phone device. Bits 0 through 6 are used to indicate the text notification that the command applies to, and the most significant bit (bit 7) is used to indicate whether or

not the phone device shall clear or process the text notification indicated in bits 0 through 6. Table 10-3 shows the different commands that are defined for this purpose. **Note that if the remote is requesting song title or caller ID, bit 7 shall always be set to 1.**

Table 10-3. Text Control Commands

Bit(s)	Value	Description
7	0	Ignore/Clear Notification[1]
	1	Request Text (i.e. Process Notification)
0:6	0	Calendar Event
	1	SMS received
	2	Email received
	3	Twitter update received
	4	Facebook update received
	5	Request Song Title[2]
	6	Request Caller ID[3]
	7 – 127	Reserved

Remote controls that do not support text data exchange, or that wish to return the phone to its default state, shall set bit 7 to 0, indicating the phone device should clear the current text notification.

[1] Ignore/Clear Notification is also used to stop a page 5 rotation

[2] Note that the advanced capabilities data page shall be requested prior to requesting the song title. For more information, please refer to section 8.8.

[3] Note that the advanced capabilities data page shall be requested prior to requesting the caller ID. For more information, please refer to section 8.8.

10.2 Common Data Page 70 (0x46) – Request Data Page

The request data page allows a device to request a specific data page from another device. In the case of the ANT+ controls profile, it allows the remote to request data pages from a controllable device. Some examples include requesting any missed subpages, as outlined in section 8.5, the stored text count, as outlined in section 8.6, and/or the available text page, as outlined in section 8.8.

The request data page may also be used by the controllable device (master) to request common pages from the remote device (slave). An example would be the controllable device requesting the battery status of the remote control device. In this case common page 70 may be interleaved as a regular part of the transmission pattern (e.g. every 65 pages) or used in an ad-hoc fashion as prompted by the user or application.

The request page is sent as an acknowledged message from a remote device, or as a broadcast message from a controllable device.

If text notifications are supported, the phone device must be able to respond to requests for data page 5 and 8. The phone device may optionally respond to requests for the other data pages in this profile. The contents of the request data page are detailed in Table 10-4; however for more details on using this page, refer to the ANT+ Common Pages Document.

Table 10-4. Common Data Page 70 Format

Byte	Description	Length	Value	Units
0	Data Page Number	1 Byte	70 (0x46) – Data Page Request	N/A
1-2	Slave Serial Number	2 Bytes	Serial number of slave that page is being requested from Set to invalid (0xFF) for command types other than 0x03	N/A
3	Descriptor Byte 1	1 Byte	Allows the relevant subpage number to be requested. Valid Values: 0 – 254 Special Values: Invalid – 255 (0xFF)	N/A
4	Descriptor Byte 2	1 Byte	Allows an additional subpage number to be requested. Valid Values: 0 – 254 Special Values: Invalid – 255 (0xFF)	N/A
5	Requested Transmission Response	1 Byte	Describes transmission characteristics of the data requested. Bit 0-6: Number of times to transmit requested page. Bit 7: Set to 0 (Setting bit 7 to 1 means the device replies using acknowledged messages if possible.) Special Values: 0x80 – Transmit until a successful acknowledge is received. 0x00 – Invalid	N/A
6	Requested Page Number	1 Byte	Page number to transmit.	N/A
7	Command Type	1 Byte	Set to 1 (0x01) for Request Data Page Set to 3 (0x03) for Request Data Page from Slave	N/A

10.2.1 Slave Serial Number

This field shall be used if the command type field is set to "0x03: Request Data Page from Slave", and shall be set to the serial number of the slave device intended to respond to the request. In all other cases this field should be set to invalid.

10.2.2 Descriptor Bytes 1 & 2

The descriptor bytes allow for the requesting of data pages that have subfields associated with them.

Descriptor byte 1 shall be set to the desired subpage number when requesting data page 5 or 8. It shall be set to invalid for requesting pages that do not have subpage fields.

Descriptor byte 2 shall be set the desired subpage field for requesting data page 8, as described in section 8.8.1. It shall be set to invalid for requesting pages that do not support more than 1 subpage field at a time.

10.2.3 Requested Transmission Response

When requesting a data page from the control device, **the remote shall only request broadcast message types**. Acknowledged message types shall not be requested. Therefore, this field shall **not** have bit 7 set.

10.2.4 Requested Page Number

This field shall be used to indicate the page number that is being requested.

10.2.5 Command Type

When requesting a data page from a controllable device, this field shall be set to 0x01. When requesting a data page from a remote control device, this field shall be set to 0x03.

10.3 Data Pages 21 – 63 Reserved

Data Pages 21 – 63 are reserved for future use.

11 Background Data Pages

11.1 Required Common Data Pages

ANT+ control devices support several ANT+ common data pages, as outlined in the following sections. Common data pages can be sent from any ANT+ device that has a transmission type indicating that it is able to interpret them. Refer to the ANT+ Common Data Pages document for details of these data pages.

Common data page transmission timing requirements are detailed in section 11.3.

11.1.1 Common Page 80 (0x50) – Manufacturer's Identification

This common data page allows for the manufacturer's ID, model number and hardware revision to be transmitted. **This is a required data page for all control devices.** The fields shall be set as described in Table 11-1.

Table 11-1. Common Data Page 80 Format

Byte	Description	Length	Value	Units
0	Data Page Number	1 Byte	80 (0x50) – Manufacturer's ID	N/A
1	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
2	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
3	HW Revision	1 Byte	To be set by the manufacturer.	N/A
4	Manufacturer ID (LSB)	2 Bytes	Contact the ANT+ Alliance for a current list of manufacturing IDs, or to be assigned a manufacturing ID.	N/A
5	Manufacturer ID (MSB)			
6	Model Number (LSB)	2 Bytes	To be set by the manufacturer.	N/A
7	Model Number (MSB)			

11.1.2 Common Page 81 (0x51) – Product Information

This common data page allows for the software revision and the device's 32 bit serial number to be transmitted. **This is a required data page for all control devices.** The fields shall be set as described in Table 11-2.

Table 11-2. Common Data Page 81 Format

Byte	Description	Length	Value	Units
0	Data Page Number	1 Byte	81 (0x51) – Product ID	N/A
1	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
2	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
3	SW Revision	1 Byte	To be set by the manufacturer.	N/A
4	Serial Number (LSB)	4 Bytes	The lowest 32 bits of the serial number. Special Values: Unknown – 4294967295 (0xFFFFFFFF)	N/A
5	Serial Number			
6	Serial Number			
7	Serial Number (MSB)			

11.1.3 Common Page 71 (0x47) – Command Status

The purpose of the Command Status page is to confirm the status of commands sent from a slave to master device. This page is sent in the forward direction only, from master to slave. To confirm that the command was successful, the slave may use the Request Data Page (page 70) to request the Command Status page (page 71) from the master.

It is a requirement that a controllable device (master) be able to send this page as a broadcast message in response to a request from the slave. This is to facilitate testing and certification of the device. However there is no requirement for the remote control device (slave) to request or process this page.

Table 11-3. Common Data Page 71 – Command Status Data Page

Byte	Description	Length	Value	Units
0	Data Page Number	1 Byte	Page 71 (0x47) – Command Status	N/A
1	Last Received Command ID	1 Byte	Indicates data page number of the last command page received. Refer to section 11.1.3.1 for allowable values. 0 – 254 255 is used to indicate that no command has yet been received	N/A
2	Sequence #	1 Byte	0-254: Sequence number used by Slave in last received command request. 255 is used to indicate that no command has yet been received	N/A
3	Command Status	1 Byte	0 = Pass: command received and processed successfully 1 = Fail: command received and processed unsuccessfully 2 = Not Supported 3 = Rejected – e.g. due to invalid/unregistered remote 4 = Pending: command received and not yet processed 5-254 = Reserved – Do not send or interpret 255 = Uninitialized (Never received a command)	N/A
4-7	Data	4 Bytes	Response data specific to received command ID. Refer to Table 11-4	N/A

11.1.3.1 Last Received Command ID

This field is used to indicate the command ID of the last command received by the master from any slave. This value shall be set to the data page number of the last command page received:

- Data Page 16 – Audio/Video Command
- Data Page 17 – Character Command
- Data Page 19 – Call Command
- Data Page 72 – Command Burst
- Data Page 73 – Generic Command

The command ID shall NOT be set to the value of a request message data page, such as page 20 or page 70. If no command has been received, this value shall be set to 255.

11.1.3.2 Sequence

Set to value contained in the sequence number field of the last received command message. If the command burst was the last command to be received then use the sequence number of the last command within the burst, if available. If the command burst uses time stamps then set the sequence number field to match the LSB of the timestamp.

11.1.3.3 Command Status

This byte indicates the status of the previously received command. At reset or battery insertion, the value shall be set to 255 to indicate that no command has yet been received.

11.1.3.4 Response Data

4 Bytes are allocated for response data specific to the previous command. This should be completed as per Table 11-4 below.

Table 11-4. Response Data

<table>
<tr><th rowspan="2">Byte</th><th colspan="5">Last Received Command ID</th></tr>
<tr><th>Audio/Video</th><th>Character</th><th>Call</th><th>Command Burst</th><th>Generic</th></tr>
<tr><td>1</td><td>16 (0x10)</td><td>17 (0x11)</td><td>19 (0x13)</td><td>72 (0x48)</td><td>73 (0x49)</td></tr>
<tr><td>4</td><td>Byte 7 of page 16: Audio/Video Command Identifier, and Command Number</td><td rowspan="4">Bytes 4-7 of page 17: UTF-8 Character</td><td>Byte 7 of page 19: Command Number</td><td rowspan="2">Bytes 2-3 of command burst packet N: Command*</td><td rowspan="2">Bytes 6-7 of page 73: Requested Command ID</td></tr>
<tr><td>5</td><td>Set to 0xFF</td><td>Set to 0xFF</td></tr>
<tr><td>6</td><td>Set to 0xFF</td><td>Set to 0xFF</td><td rowspan="2">Bytes 6-7 of command burst packet N: Command*</td><td>Set to 0xFF</td></tr>
<tr><td>7</td><td>Set to 0xFF</td><td>Set to 0xFF</td><td>Set to 0xFF</td></tr>
</table>

*N represents the final packet in a command burst.

11.2 Optional Common Pages

11.2.1 Common Data Page 82 (0x52): Battery Status

This page is sent to allow the battery voltage and status of a device to be transmitted. This is an optional data page of control devices. If used, all fields shall be set as described in Table 11-5.

Table 11-5. Common Data Page 82 Format

Byte	Description	Length	Value	Units	Rollover
0	Data Page Number	1 Byte	82 (0x52) – Battery Status	N/A	N/A
1	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A	N/A
2	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A	N/A
3	Cumulative Operating Time (LSB)	3 bytes	This will give the cumulative operating time of the device and shall be reset on insertion of a new battery. Range = 0 – 16777215 ticks	2 seconds 16 seconds	1.1 years 8.5 years
4	Cumulative Operating Time				
5	Cumulative Operating Time (MSB)				
6	Fractional Battery Voltage	1 Byte	Value = 0 – 255 (0x00 – 0xFF)	1/256 (V)	N/A
7	Descriptive Bit Field	1 Byte	Battery Status, Cumulative Operating Time Resolution, and Coarse Battery Voltage See ANT+ Common Pages document for more details.	Binary	N/A

11.2.2 Common Page 85 (0x55) – Memory Level

This common data page allows for the device's memory levels to be transmitted. This is an optional data page of control devices. If used, all fields shall be set as described in Table 11-6.

Table 11-6. Common Data Page 85 Format

Byte	Description	Length	Value	Units
0	Data Page Number	1 Byte	85 (0x55) – Memory Level	N/A
1	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
2	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
3	Reserved	1 Byte	255 (0xFF) – Reserved for future use	N/A
4	% Used	1 Byte	0 – 100 % in 0.5% increments	0.5 %
5	Total Size (LSB)	1 Byte	Total Memory Size in 0.1 increments Max – 6553.5	N/A
6	Total Size (MSB)			
7	Total Size Unit	1 Byte	Bit 7: 0 – bit 1 – byte Bit 0 - 6: 000000 – base unit 000001 – kilo 000010 – Mega 000011 – Tera 000100 to 000101 - reserved	N/A

11.2.3 Common Page 86 (0x56) – Paired Devices

The paired devices common data page allows a device to describe other ANT devices it is paired to, and communicate the status of those devices. If used, all fields shall be set as described in Table 11-7.

Table 11-7. Common Data Page 86 Format

Byte	Description	Length	Value	Units
0	Data Page Number	1 Byte	86 (0x56) – Paired Devices	N/A
1	Peripheral Device Index	1 Byte	If multiple peripheral devices are in the system, this field provides an index to which device is being referenced.	N/A
2	Total Number of connected devices	1 Byte	Provides the total number of peripheral devices in a system.	N/A
3	Channel State	1 Byte	Bit 7: Paired/Unpaired 1 – paired 0 – not paired Bits 3:6: Connection State 0 – closed channel 1 – searching 2 – synchronised 3:F – reserved Bits 0:2: Network Key 0 – public 1 – private 2 – ANT+ Managed 3 – ANT-FS key 4:7 – reserved	N/A
4	Peripheral Device ID: Device Number (LSB)	2 Bytes	Provides the Device Number of the peripheral device indexed in byte 1	N/A
5	Peripheral Device ID: Device Number (MSB)			
6	Peripheral Device ID: Transmission Type	1 Byte	Provides the Transmission Type of the peripheral device indexed in byte 1	N/A
7	Peripheral Device ID: Device Type	1 Byte	Provides the Device Type of the peripheral device indexed in byte 1	N/A

11.3 Transmission Timing Requirements for Common Data Pages

The required common data pages (80 and 81) shall be sent every 65 messages. Figure 11-1 illustrates how these pages shall be transmitted in order to be compatible with the ANT+ Controls Device Profile. 64 pages of main data pages are broadcast, followed by common data page 80. Another 64 main data pages are broadcast, followed by common data page 81. After the next 64 messages, common data page 80 is sent. Common page 81 would then be sent after another 64 main data pages, and the pattern would continue to repeat for the duration of the connection.

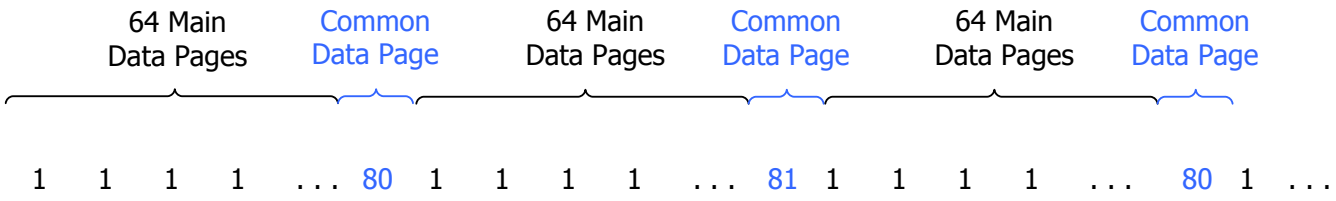


Figure 11-1. Transmission Requirements for Common Data Pages

Optional common data pages 82, 85 and 86, may additionally be interleaved if desired. If they are used, then each page shall be interleaved at least once every 130 messages, between the transmissions of the required pages 80 and 81. A recommended pattern that would achieve this is illustrated in Figure 11-2.

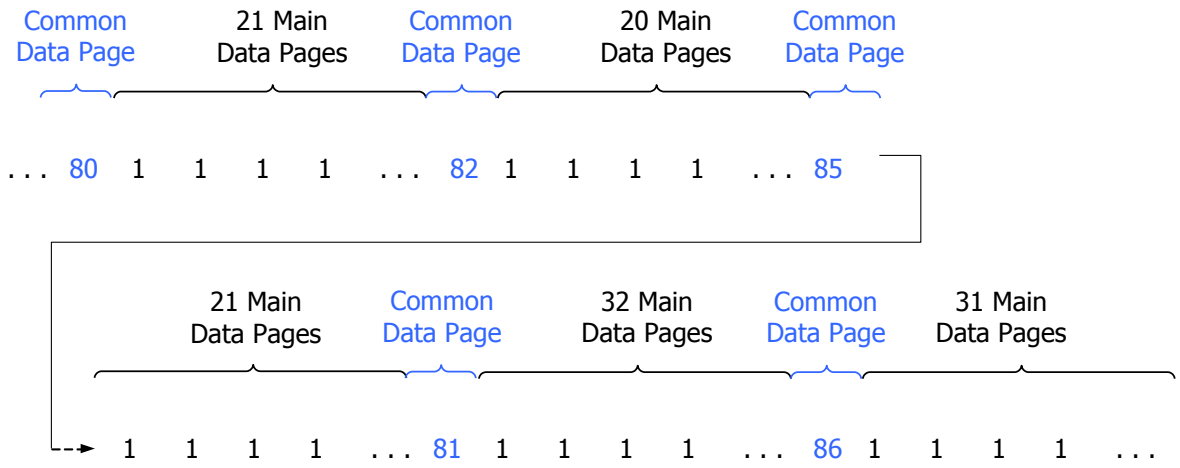


Figure 11-2. Recommended Transmission Pattern for Optional Common Data Pages

11.4 Requesting Background Pages from the Remote Control

Common pages are typically used to send information from the master device to the slave. In most ANT+ device profiles the slave is a display device, and the user can access information directly from it. Contrastingly, in the ANT+ Controls Device Profile the slave is a remote control device, which may or may not include a display. It may therefore be desirable to send background pages such as Battery Status from the slave to the master device. This can be done using request page 70 as described in section 10.2

12 Recommended Transmission Patterns

The recommended transmission patterns for controllable (master) devices are described in the following sections.

12.1 Default Operation

The recommended default operation for the master devices described in the ANT+ Controls Device Profile is shown in Table 12-1.

Table 12-1. Recommended Default Operation Transmission Patterns for ANT+ Control Devices

Use Case	Audio Control	Phone Control	Keypad/Generic	Video Control
Default Operation	Page 1 only	Page 2 only	Page 2 only	Page 7 only
Call Alert Only	N/A	Repeating pattern: 2,3	N/A	N/A
Text Alert Only	N/A	Repeating rotation: 2,4	N/A	N/A
Text & Call Alert	N/A	Repeating rotation: 2,3,4,3	N/A	N/A

12.2 Transmitting Patterns while Processing Text Alerts/Text Requests

A remote device may request text data using data page 20. The remote may request the text data one of two ways:

- Over the standard ANT+ 2457 MHz , 4 Hz channel. Text data interleaved every second channel period.
- At a higher data rate, and different RF channel frequency (i.e. NOT 2457 MHz) as requested by the remote control. Text interleaved in between standard 4 Hz transmission pattern.

Note: in order to request a song title from an audio device, the remote must first request the available text data page (page 8) to determine the number of subpages associate with the song title. Only after the number of subpages has been received can the remote device request the song title text. Refer to section 8.8 for more details.

12.2.1 Text Alerts over Standard ANT+ Control Channel

Table 12-2 shows the recommended transmission patterns for sending text data over the standard ANT+ control channel.

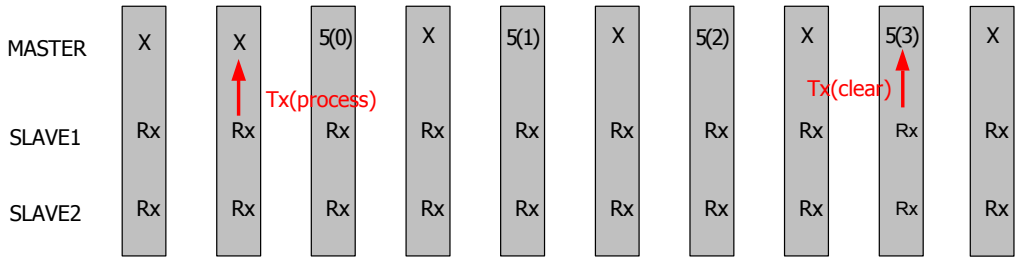
Table 12-2. Recommended Transmission Patterns: Standard Channel Text Data

Use Case	Text Control Device	Audio Control Device
Default Operation	Repeating pattern: 2,5	Repeating pattern: 1,5
Call Alert (incoming)	Repeating pattern: 3,5	N/A
Call Alert (In call)	Repeating pattern: 2,5,3,5	N/A

Figure 12-1 describes a situation in which two remote controls (slave 1 and slave 2) are receiving data from the same phone. The phone device indicates it has a text alert for slave 1 (i.e. slave 1's serial number is in data page 4). The text data is contained in 4 subpages.

Slave 1 requests the text data over the default ANT+ controls channel (Tx (process)). The phone device then adds data page 5 to its page rotation, and transmits the data pages 2 Hz. This pattern continues until the slave device clears the text notification (Tx (clear)), or until an application level timeout.

The phone device then returns to the standard ANT+ controls data page rotation.



Data Page 'X' Represents Standard ANT+ Control Transmission Pattern
Grey Box Represents 4 Hz Channel Period

Figure 12-1. Slow Feed Text Exchange

12.2.2 Text Alerts over High Speed Channel

A remote control may request text data at a higher rate, and different RF channel frequency, while still maintaining the standard control transmission pattern. In other words, the controllable device maintains the 4 Hz transmission patterns as defined in section 8.5.3, and transmits text data using data page 5 on "off frequency" channel periods.

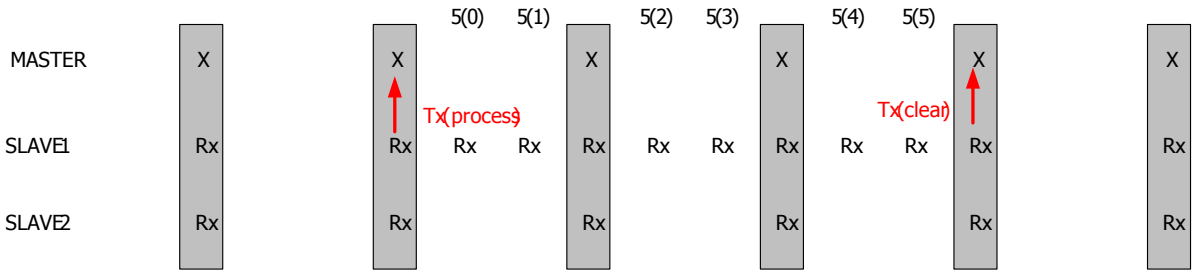
A remote control may only request high speed text exchange if support is indicated in the available text page (section 8.8).

For example, a phone is transmitting at 4 Hz, and two remote controls are receiving (slave 1 and slave 2). The phone indicates it has a text alert for slave 1 (i.e. slave 1's serial number is in data page 4). The text data fits in 6 subpages.

Slave 1 requests high speed text exchange (Tx (process) in Figure 12-2). The phone then switches to the new RF frequency and channel period (e.g. 12 Hz) and sends the first text subpages 5(0) and 5(1). It then changes back to the ANT+ RF channel frequency (2457MHz) to send the default data page and maintain the standard 4 Hz transmission for slave 2.

The phone switches back to the requested RF channel frequency and channel period to send the next text data subpages 5(2) and 5(3) before returning to the standard ANT+ RF channel frequency and standard ANT+ control data page rotation. This pattern continues until the slave device clears the text notification (Tx (clear)), or until an application level timeout.

The phone device then returns to the standard ANT+ controls 4 Hz data page rotation.



Data Page 'X' Represents Standard ANT+ Control Transmission Pattern
Grey Box Represents 4 Hz Channel Period

Figure 12-2. High Speed Text Exchange

13 Design Considerations

The following section outlines considerations to take into account when designing an ANT+ control system.

13.1 Remote Serial Number

The remote serial number is always included in a command page. This allows the controllable device to choose whether or not a requested command should be processed. Note that this can affect interoperability because a controllable device may not respond to a requested command if it originated from a device that has not been registered with the controllable device.

An application level registration process is highly recommended in this situation. Note however, that the remote may not have knowledge of the registration process required on a controllable device. This could have an impact on the interoperability of a remote/controllable device because a controllable device might not respond to a device that it is not registered with. However, a registration process allows peer to peer communication in text applications, and avoids ambiguity when identifying repeat commands based on sequence numbers.

13.1.1 Remote Registration

It may be desirable for some controllable devices (i.e. phone devices) to provide a process of registration in which a primary remote is registered, and only commands originating from that device are processed by the controllable device. The registration of one primary device with the controllable device allows for peer to peer exchange of information.

Controllable devices are unable to process multiple devices simultaneously. For this reason text exchange should only be handled on a peer to peer basis. If a primary remote has not been established, there is a possible race condition in which any remote may request the text data from a phone device. The registration of a primary controller also ensures that the text data is intended for the remote device chosen by the user.

For example, a controllable device may register the first device it receives a text command page from and register it as the primary remote. The controllable device might then provide the user with the option to accept the device, or to keep looking for a device to register with. Additionally, it may be desirable for the controllable device to allow the user the option to clear the registered device, and re-register with a new device.

It is strongly recommended that no remote device set their serial number to invalid (i.e. 0xFFFF) to reduce the possibility of race conditions and to allow for a unique primary controller to be registered.

13.2 Song Title Request

Due to the nature of the song title request mechanism, a possible race condition exists in which the song title may be requested at the end of the currently playing song. For example, if a request for the number of subpages is received by an audio device at the end of the song, it will transmit the number of subpages required for that song. However, once the remote requests the song title, the controllable device may have already started playing the next song. In this case, there is a potential for the "number of subpages" received and the actual number of transmitted subpages to be off.

The application developer should take this possible race condition into account when designing an ANT+ audio control system that supports the song title feature.

13.3 Generic vs Custom Commands

It is strongly recommended that generic commands are used instead of custom commands wherever possible. Custom commands are intended for proprietary use only. If no generic command exists for the function that you wish to perform then please contact us about adding it to the profile.

13.4 Communicating with Different Types of Controllable Device

When a remote control is designed to control more than one device type, the remote will need to recognise the type of device it is connected to and send the appropriate command page. For example if the remote is connected to an audio player, the remote would send command page 16, if it is connected to a bike computer it would send page 17, and if it is connected to a generic device (e.g. a bike computer) it would send page 73.

The remote control can allow the user to select which commands are sent, for example by using different buttons for the different command sets, or via a mode switch to select audio / video / keypad / generic.

Alternatively the remote can automatically detect which mode to set itself into. This can be done based on the capabilities field in data page 2, or based on which page numbers are received from the master (i.e. receiving data page 1 indicates that the device is an audio player). However this approach could be problematic when the remote connects to a master device that is capable of acting as two or more kinds of controllable device simultaneously.

14 Device Controls Minimum Compliance

All ANT+ control devices shall adhere to the minimum requirements described in this section, in addition to the case specific requirements outlined in sections 14.1 to 14.5:

- A master device shall only send broadcast messages to the slave, and shall never send acknowledged or burst messages.
- A display shall not decode reserved bytes in received data pages.
- The display shall handle gracefully the receipt of undefined data pages.

The requirements detailed in Table 14-1 apply to all ANT+ control devices.

Table 14-1. Required Data Elements for all ANT+ Control Systems

Required Data Page	Transmission Requirements
Page 71 – Command Status Page	It is a requirement that a controllable device (master) be able to send common page 71 as a broadcast message in response to a request from the slave. This is to facilitate testing and certification of the master device. However there is no requirement for the remote control device (slave) to request or process this page.
Common Page 80 – Manufacturer ID	Common page sent at least once every 65th message. Refer to section 11.3.
Common Page 81 – Product ID	Common page sent at least once every 65th message. Refer to section 11.3.

14.1 Audio Control Minimum Compliance

All ANT+ audio devices shall transmit data page 1 at a minimum rate of 2Hz. Details for this data page can be found in section 8.1. Common data pages 80 and 81 shall be transmitted as detailed in section 11.1.

The audio device shall also be able to receive and respond appropriately to command page 16 with a minimum compliance of commands 1 and 3.

All ANT+ audio remote controls shall be able to decode the required data page 1 as well as be able to decode common data pages 80 and 81. The ANT+ remote control shall also be able to send the command data page 16 with a minimum compliance of commands 1 and 3 as detailed in Table 9-2.

The ANT+ audio remote control devices must support the basic commands as outlined in Table 14-2; however, it is recommended that all of the audio commands are supported by the remote as well as optional features such as song title. For further display considerations refer to section 14.6.

Table 14-2. Required Data Elements of the ANT+ Audio Control System

Required Data Page	Transmission Requirements
Page 1 – Audio Update Page	At least 0.5 Hz.
Page 16 – Command Request Page	Sent from the remote device on request by the user. Sent as acknowledged message.

14.2 Phone Control Minimum Compliance

All ANT+ phone devices shall transmit data page 2 at a minimum 2Hz message rate. Details for this data page can be found in section 8.2. Common data pages 80 and 81 shall be transmitted as detailed in section 11.1.

The phone device shall be able to send an appropriately formatted data page 3 (call status page, outlined in section 8.3), and be able to receive and respond appropriately to call control page 19.

All ANT+ phone remote controls shall be able to decode the required data pages 2 and 3 as well as be able to receive common data pages 80 and 81. The ANT+ remote control shall also be able to send the command data page 19 with a minimum compliance of commands 1 and 2 as detailed in Table 9-6.

The ANT+ phone remote control must support the basic commands as outlined in Table 14-3; however, it is recommended that all of the phone commands, and optional features associated with ANT+ phone controls are supported by the remote. For further display considerations refer to section 14.6.

Table 14-3. Required Data Elements of the ANT+ Phone Control System

Required Data Page	Transmission Requirements
Page 2 – Device Availability	At least 0.5 Hz.
Page 3 – Call Status	At 2 Hz when 'in-call'
Page 19 – Call Command Page	Sent from the remote device on request by the user. Sent as an acknowledged message

14.3 Keypad Control Minimum Compliance

ANT+ keypad controllable devices shall transmit data page 2 at a minimum 4 Hz message rate. Details for this data page can be found in section 8.12. Common data pages 80 and 81 shall be transmitted as detailed in section 11.1.

The keypad controllable device shall also be able to receive and respond appropriately to character command page 17 as detailed in section 9.2.

All ANT+ keypad control devices shall be able to receive the required data page 2, as well as be able to receive common data pages 80 and 81. The ANT+ keypad remote device shall also be able to send the character command data page 17.

The ANT+ keypad remote control must support the basic commands as outlined in Table 14-4. For further display considerations refer to section 14.6.

Table 14-4. Required Data Elements of the ANT+ Keypad Control System

Required Data Page	Transmission Requirements
Page 2 – Device Availability	At least 2 Hz.
Page 17 – UTF-8 Character Command	Sent from the remote device on request by the user. Sent as an acknowledged message.

14.4 Generic Control Minimum Compliance

All ANT+ generic controllable devices shall transmit data page 2 as a default, this will be at ~4Hz message rate for devices that only implement generic control, and at a minimum 2Hz message rate for devices implementing additional use cases. Common data pages 80 and 81 shall be transmitted as detailed in section 11.1.

The generic controllable device shall also be able to receive and respond appropriately to command burst 72 (section 9.5), and generic command page 73 (section 9.6).

All ANT+ generic remote controls shall be able to receive the required data page 2 as well as be able to receive common data pages 80 and 81. The ANT+ generic remote control device shall also be able to send the command burst 72 and/or the generic command data page 73. The ANT+ generic remote control shall support at least two of the generic commands.

The ANT+ generic remote control must support the basic commands as outlined in Table 14-5. For further display considerations refer to section 14.6.

Table 14-5. Required Data Elements of the ANT+ Generic Control System

Required Data Page	Transmission Requirements
Page 2 – Device Availability	At least 2 Hz, and ~4Hz for devices that only implement the generic control use case.
Page 72 –Command Burst*	Sent from the remote device on request by the user. Sent as a burst message.
Page 73 – Generic Command Page*	Sent from the remote device on request by the user. Sent as an acknowledged message.

* It is a requirement that a controllable device (master) be able to receive common page 72 and page 72. The remote control device (slave) must support at least one of these two pages.

14.5 Video Control Minimum Compliance

All ANT+ video control devices shall transmit data page 7 at a minimum of 2Hz, as well as data page 2 at a minimum of 2 Hz. Refer to sections 8.7 and 8.2 respectively for details on requirements for data page 7 and data page 2. Common data pages 80 and 81 shall be transmitted as detailed in section 11.1.

The video device shall also be able to receive and respond appropriately to command data page 16 with a minimum compliance of commands as detailed in Table 9-2 (at least one of the video columns recording/playback must be supported).

All ANT+ video remote controls shall be able to receive the required data page 7, as well as be able to receive common data pages 80 and 81. The ANT+ remote control shall also be able to send the command request data page 16 with a minimum compliance of commands as detailed in Table 9-2 (both video columns recording/playback must be supported).

The ANT+ video remote control must support the basic commands as outlined in Table 14-6; however, it is recommended that all of the video commands are supported by the remote. For further display considerations refer to section 14.6.

Table 14-6. Required Data Elements of the ANT+ Video Control System

Required Data Page	Transmission Requirements
Page 7 – Video Update Page	At least 2 Hz
Page 16 – Command Request Page	Sent from the remote device on request by the user. Sent as an acknowledged message.

14.6 Display Considerations

It is suggested that the remote control be able to decode as many of the ANT+ Controls data pages that make sense for the particular use case. For example, it would be useful for an audio remote to also have support for phone control, and video control; however, if that audio remote is a watch, keypad support may not be feasible.

Providing support for as many implementations as possible will provide the remote with interoperability with as many manufacturers of ANT+ controllable devices as possible.

It should be noted that all of the implementations supported in this Device Profile use a common device type. As such, it is up to the application developer to decide if connection with an appropriate or desired device has been established. For example, a remote that is intended to connect to a garage door opener should check at the application level that it is not connecting to an audio device.

15 ANT+ Interoperability Icons

Each ANT+ Device Profile has an associated icon. Devices that are compliant with these profiles are able to use these icons on the packaging and documentation of the device. This allows the end user to know which devices will interoperate and what performance to expect from a given device.

The ANT+ Controls Device Profile has defined multiple icons that can be used for devices in compliance with this Device Profile.

15.1 Audio Control Icon

This icon is used on devices within a system to indicate to the end user the ability to remotely control audio devices. It will also tell the user that the remote control may have the ability to display some information about the audio device and the current track.

See section 14.1 for a detailed description of the minimum data set that must be maintained by the audio device and remote control in order to bear this icon.

15.1 Phone Control Icon

This icon is intended to be used on devices within a system to indicate to the end user the ability to remotely control phone devices. It will also tell the user that the remote control may have the ability to display some information about the phone device, including caller ID, and text notifications.

Refer to section 14.2 for a detailed description of the minimum data set that must be maintained by the remote control and controllable device in order to bear this icon.

15.2 Keypad Control Icon

This icon is used on devices within a system to indicate to the end user the ability to send Unicode key characters from the remote to controllable devices. The entire set of Unicode characters is supported via UTF-8 encoding.

See section 14.3 for a detailed description of the minimum data set that must be maintained by the remote control and controllable device in order to bear this icon.

15.3 Generic Control Icon

This icon is intended to be used in conjuction with one or more of the other icons to indicate to the end user the ability to send generic commands from the remote device to the controllable device.

See section 14.4 for a detailed description of the minimum data set that must be maintained by the remote control and controllable device in order to bear this icon.

15.4 Video Control Icon

This icon is intended to be used in conjunction with one or more of the other icons to indicate to the end user ability to remotely control video playback or recording devices. It will also tell the user that the remote control may have the ability to display some information about the video device, and the currently playing/recording video clip

See section 14.5 for a detailed description of the minimum data set that must be maintained by the remote control and controllable device in order to bear this icon.