RN-HID-UM

Bluetooth HID Profile

RN-HID-UM-1.0r Version 1.0r 1/17/2012

USER MANUAL

OVERVIEW

Roving Networks Bluetooth modules support a variety of Bluetooth profiles, including human interface device (HID), serial port profile (SPP), DUN, HCI, and iAP for use with iPad, iPod and iPhone devices. The Bluetooth HID profile enables customers to develop wireless products such as computer keyboards and keypads, trackballs, mice, and other pointing devices, and game controllers (gamepads, joysticks, steering wheels, etc.). Additionally, Roving Networks has extended the basic HID capability to allow programmability and control of devices such as the iPad.

The HID (Human Interface Device) profile defines the protocol between:

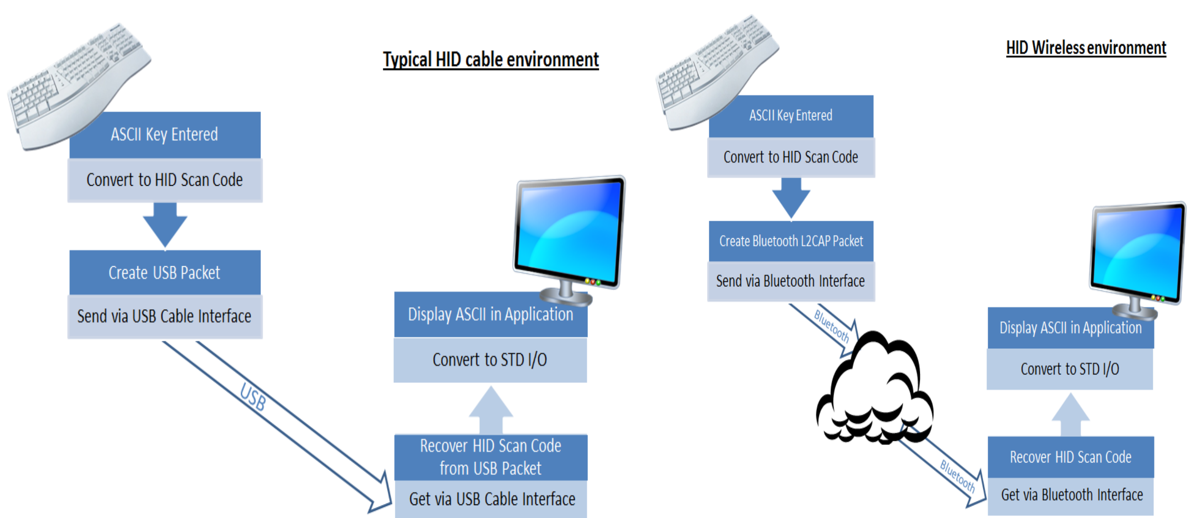
- *Device (HID)*—Services human data input and output to and from the host.
- *Host*—Uses or requests the services of a Human Interface Device.

The Bluetooth HID profile allows users to control the HID descriptor, which defines the device's feature set, and the HID report, which host uses to interpret the data as ASCII values, movement, etc. The HID report format follows the standard universal serial bus (USB) HID protocol as to leverage existing host drivers.

> **NOTE:** This user manual focuses specifically on HID. The Roving Networks Bluetooth *Advanced User Manual* and *Apple User Manual* cover the functionality of all supported Bluetooth profiles. Because the HID profile is derived from Roving Network's standard firmware, many of the concepts and commands found in the *Advanced User Manual* apply as well.

In a typical usage scenario such as a keyboard, a device using the Roving Networks Bluetooth HID profile replaces the USB cable. In this case, the ASCII value of a key press is converted to a scan code in a raw HID report that the Bluetooth module sends over the Bluetooth link to the host. The host driver software decodes the raw HID report and passes the key values to the application running on the PC. Figure 1 shows some typical HID environments.

Figure 1. Typical HID Environments



The type of HID device, such as a keyboard, mouse, or joystick, is defined by the HID descriptor in the raw HID report.

FIRMWARE OVERVIEW

To use Roving Networks' Bluetooth HID profile, you must use a special build of firmware, version 6.03 or later. When you purchase a Roving Networks Bluetooth product, you must specify that you wish to use this firmware version so that Roving Networks can load it into the module. The part numbers for ordering modules with the HID profile are RN-41-HID and RN-42-HID.

NOTE: This user guide assumes the reader has an understanding of Roving Networks standard Bluetooth firmware ASCII command interface and command set. It is recommended that you refer to the Bluetooth *Advanced User Manual* prior to reading this document.

Profile Configuration

The HID firmware supports Bluetooth HID and SPP. You switch between these profiles using ASCII commands. By default, the HID profile is enabled in the HID firmware. To switch between HID and SPP, use the following commands:

S~,0	// Enables SPP protocol
R,1	// Reboot to use SPP

To switch back to HID, use the following command:

S~,6	// Enables HID profile
R,1	// Reboot to use HID profile

Device Discovery & Pairing

During pairing, the module determines the HID device type. As part of the Bluetooth protocol, the HID device sends the type. By default, the Roving Networks' modules running the HID profile are discoverable as a keyboard. You can change the device type by setting the descriptor type using the HID flags register.

After first pairing the host to a device with the Bluetooth HID module, the host initiates a connection. However, if the initial connection is broken, as the case when the power is cycled, the device must re-connect to the host. (The host will not initiate a connection.)

Using DTR mode 4 (default) or pairing mode 6 allows the module to auto-connect back to the last paired host. Alternatively, you can reconnect by sending the **C** command from command mode.

HID Flag Register

The HID flag register is a bit-mapped reregister that is configured while in command mode. To set the register, use the **SH,** <*value*> command, where <*value*> is a 4-character hex word. The **GH** command returns the current value of the register. The default factory setting is **0000**, which corresponds to a keyboard.

Table 1 shows the HID flag register bits; currently only the lower 9 bits are defined.

Table 1. HID Flag Register Bits

9	8	7..4	3	2..0
Force HID mode if GPIO11 is high on power-up.	Toggle virtual keyboard on iOS when first connected.	Descriptor type: 0000 = Keyboard 0001 = Game Pad 0010 = Mouse 0011 = COMBO 0100 = JOYSTICK 0101 = DIGITIZER 0110 = SENSOR 0111 = USE CFG 1XXX = Reserved	Send output reports over UART.	Indicates number of paired devices to which the module can reconnect.

Bit 9

Bit 9 is an enable bit that overrides the profile selection mode. When this bit is set, the firmware checks the level of GPIO11 on power up; if it is high, the module switches to HID mode. With this bit, you can set the module's default profile to SPP mode, allowing SPP and remote configuration (for example from Bluetooth clients with SPP). Then, you can use GPIO11 to override SPP mode and enable HID mode.

Bit 8

Bit 8 enables the toggling of the virtual keyboard on iOS devices.

Bits 7-4

Bits 7 through 4 control the following settings:

- The COD that is advertised by the module.
- The HID report descriptor and the available reports.

Bit 3

Bit 3 enables output reports, which are sent by the host to the device over Bluetooth to the UART. These reports are a feedback mechanism to the embedded microcontroller. The output record is formatted as:

<start> *<number of bytes>* *<report>*

0xFE 1 – 8 data

For example, the HID keyboard output reports the keyboard LED status as:

0xFE 0x2 0x1 *<LED status byte>*

Bits 2-0

Bits 2 through 0 define the number of paired hosts to which the module attempts to reconnect after power up. After each successful pairing, the link key is stored in the Bluetooth module. Up to eight paired link keys are stored in FIFO fashion. Upon power up, the module tries to connect to the most recently paired device. If it is not found, the module attempts to connect to the next *N* hosts depending upon the settings of bits 2-0 in the HID register.

HID REPORTS

The module interprets input on the UART and generates an HID report that is sent over the Bluetooth link to the host. Input to the module is interpreted as shown in Table 2.

Table 2. Data Interpretation

Binary Input	Function
0	Disconnect if connected from the host.
0x1 - 0xF	Converted to special keys like home, page up, backspace, etc.
0x10 - 0x7E	Translation mode: printable ASCII characters.
0x7F	Toggle virtual keyboard on iPhone.
0x80 - 0xDF	Interprets input as actual scan code.
0xE0 - 0xE7	Sends modifier keys Left Shift, Left Alt, Right Shift, etc.
0xE8 - 0xEF	Interprets input as actual scan code.
0xF0 - 0xFC	Reserved for custom reports.
0xFD	Raw mode: input is RAW report.
0xFE	Interpretive mode: input is shorthand report.
0xFF	Sends output report to UART.

See “Scan Code Tables: UART (ASCII) to HID Report” on page 10 for a complete table of UART input to HID report.

Translation Mode

Translation mode is the simplest way to send HID reports for printable ASCII characters. When the Bluetooth module’s UART receives a printable ASCII value, it is converted into a keyboard raw HID report. Two reports are sent for each character; the first report indicates that the key is pressed and the second indicates that it is released. For example:

a is translated into:

0xFD	**0x9**	**0x1**	**0x0**	**0x04**	**0x0**	**0x0**	**0x0**	**0x0**	**0x0**	**0x0**	**0x0**	**0x0**	*Key Press*

0xFD	**0x9**	**0x1**	**0x0**	**0x00**	**0x0**	**0x0**	**0x0**	**0x0**	**0x0**	**0x0**	**0x0**	**0x0**	*Key Release*

A is translated into:

0xFD	0x9	0x1	0x2	0x0	0x04	0x0	0x0	0x0	0x0	0x0	0x0	0x0	0x0	*Key Press*

0xFD	0x9	0x1	0x0	0x00	0x00	0x0	0x0	0x0	0x0	0x0	0x0	0x0	0x0	*Key Release*

Notice that the scan code for A is the same as the previous raw report except the modifier byte indicates the left Shift key is pressed. If multiple scan codes are sent, the modifier applies to all of them.

Keyboard Shorthand Mode

The Roving Networks HID profile supports shorthand for implementing keyboards. The advantage of this mode is that multiple keyboard keys can be sent with minimal characters over the UART, which optimizes bandwidth because the module does not have to send a keyboard report. Shorthand reports start with **0xFE** and have variable length. The shorthand format is:

0xFE	Length	Modifier	Scan Code 1	Scan Code 2	Scan Code 3	Scan Code 4	Scan Code 5	Scan Code 6

where Length = 0, 2, 3, 4, 5, 6, or 7, depending on how many keys are sent.

For example, shorthand for the **a**, **b**, and **c** keys is:

0xFE	0x3	0x0	0x4	0x05	0x06

The Bluetooth module converts this shorthand into the following raw HID reports that are sent over the Bluetooth link:

0x9	0x1	0x0	0x04	0x5	0x6	0x0	0x0	0x0	0x0	0x0	0x0

Shorthand to release all three keys is:

0xFE	0x0

Raw Report Mode

The start byte **0xFD** indicates a raw HID report. In the Bluetooth module, the start byte is stripped and the following bytes are sent without interpretation. The Raw HID report consists of a start byte, length, descriptor type (which defines the type of HID device), and data specified in scan codes or encoded values. The format of the data depends on the descriptor type. HID reports are sent one report at a time.

The raw report format is:

Start (1Byte)	Length (1 Byte)	Descriptor (1 Byte)	Data Length – one Byte for the descriptor

The keyboard report format is:

0xFD	9	1	Modifier	0x00	Scan code 1	Scan code 2	Scan code 3	Scan code 4	Scan code 5	Scan code 6

The modifier byte is a bit mask interpreted as shown below. For example, you can use **0x2** or **0x20** to turn a lower case **a** into an upper case **A**.

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Right GUI	Right Alt	Right Shift	Right Ctrl	Left GUI	Left Alt	Left Shift	Left Ctrl

The mouse raw report format is:

0xFD	5	2	Buttons	X-stop	Y-stop	Wheel

The consumer report format in keyboard or combo mode is:

0xFD	3	3	Data Byte	Data Byte

The joystick format is:

0xFD	6	Not used	Buttons	X1	Y1	X2	Y2

In combo mode, it is possible to send both for a keyboard and mouse HID reports. In this case, if you wanted to enter an **A** and move the mouse you can use either of the following methods:

A:

0XFD	0x5	0x2	0x0	0x1	0x20	0x20	0x20

or

0xFD	0x9	0x1	0x2	0x0	0x04	0x0	0x0	0x0	0x0	0x0	0x0	0x0	0x0

0XFD	0x5	0x2	0x0	0x1	0x20	0x20	0x20

Special Reports & Modes

This section describes special modes and reports, including output reports, virtual keyboards, a key-map register, etc.

Output Reports

Because the host controls the modifier keys' state, the HID device must be able to request the current status. The output report code **0xFF** is reserved to return the current status of the Caps Lock, Num Lock, and Scroll Lock keys over the UART. Because an HID device can only toggle these keys, it tells the device the state of the keys. This functionality is particularly useful when multiple HID devices are in the system and the Bluetooth device needs to update the state of these keys. The format is sent as:

0xFF	**Status Byte**

Table 3 shows the status byte definitions.

Table 3. Status Byte Definitions

Key	Status Bit
Num Lock	1
Caps Lock	2
Scroll Lock	4

Apple Virtual Keyboard

When the module is connected to an iOS device, the virtual keyboard is hidden. However, in some applications it is useful or required to display the keyboard for data entry on the touch screen of the iOS device. Toggling GPIO9 displays or hides the virtual keyboard. GPIO9 must go from low to high for at least 200 ms for the toggle to occur.

NOTE: The virtual keyboard toggle must be enabled in the HID flag register for this feature to work.

Key Map Register

This register allows you to replace any ASCII code with another ASCII code. It is useful in cases where you want to toggle special keys that the device cannot generate. For example, the touch keyboard on an iOS device is **0x7F**, but the device cannot generate **0x7F**.

If the register is non-zero, the upper byte is the key to replace, and the lower is the replacement. The command to set the register is **S=,** < *value*>, where <*value*> is a 4-character hex word. To obtain the current value of the register, use the **G=** command. (The value also shows up in the advanced settings using the **E** command.) The default factory setting is 0000 (not enabled).

For example, to use the tilda (~), which is **0xfe**, to toggle the keyboard, enter the command **S=,7e7f**.

Disconnect Key

A special hex key value **0x00** (zero) causes a Bluetooth disconnect, which allows you to control the connection by sending a single key. To disconnect, send **0x0**.

Combining the disconnect feature with the key map register, any key can be used as a disconnect key. For example to set the capital Z key (hex 5A) as the disconnect key, use the following command:

S=,5A00 // Map Z key as the disconnect key

Consumer Report

You can use a HID raw report to send additional keys as a consumer report. The format is:

0xFD	**3**	**3**	**Low Byte**	**High Byte**

Table 4 shows the data byte format.

Table 4. Data Byte Format

Consumer Key Function	Report Bit
AC Home	0x1
AL Email Reader	0x2
AC Search	0x4
AL Keyboard Layout (Virtual Apple Keyboard Toggle)	0x8
Volume Up	0x10
Volume Down	0x20
Mute	0x40
Play/Pause	0x80
Scan Next Track	0x100
Scan Previous Track	0x200
Stop	0x400
Eject	0x800
Fast Forward	0x1000
Rewind	0x2000
Stop/Eject	0x4000
AL Internet Browser	0x8000

For example, to raise the volume, send:

0xFD	**0x03**	**0x03**	**0x10**	**0x00**

To release the key, send:

0xFD	**0x03**	**0x03**	**0x00**	**0x00**

SCAN CODE TABLES: UART (ASCII) TO HID REPORT

Table 5 shows the UART-to HID input conversion.

Table 5. UART-to-HID Scan Code

UART Input	HID Code	HID Function
0	NA	Disconnect if Connected
1	0x49	Insert
2	0x4A	Home
3	0x4B	Page up
4	0x4C	delete
5	0x4D	end
6	0x4E	Page down
7	0x4F	Right arrow
8	0x2A	Backspace
9	0x2B	TAB
10	0x28	Enter
11	0x50	Left arrow
12	0x51	Down arrow
13	0x28	Enter
14	0x52	Up arrow
15-26	0x3A-45	F1 - F12
27	0x29	Escape
28	0x39	Caps lock
29	0x47	Scroll lock
30	0x48	Break-pause
31	0x53	Num lock
32-126		Printable ASCII characters
127	0x65	Toggle iPhone virtual keyboard
0x80-0xDF	0x80-0xDF	Sends actual scan code
0xE0	0xE0	Left Control
0xE1	0xE1	Left Shift
0xE2	0xE2	Left Alt
0xE3	0xE3	Left GUI
0xE4	0xE4	Right Control
0xE5	0xE5	Right Shift
0xE6	0xE6	Right Alt
0xE7	0xE7	Right GUI
0xE8-0xEF	0xE8-0xEF	Sends actual scan code
0xF0-0xFC	Reserved for future	Custom reports
0xFD		Raw report
0xFE		Shorthand report
0xFF		Sends output report to UART

Table 6 shows the ASCII to HID scan codes.

Table 6. ASCII to HID Report (to Host) Scan Codes

ASCII	Code
System Power	81
System Sleep	82
System Wake	83
No Event	00
Overrun Error	01
POST Fail	02
ErrorUndefined	03
a A	04
b B	05
c C	06
d D	07
e E	08
f F	09
g G	0A
h H	0B
i I	0C
j J	0D
k K	0E
l L	0F

ASCII	Code
m M	10
n N	11
o O	12
p P	13
q Q	14
r R	15
s S	16
t T	17
u U	18
v V	19
w W	1A
x X	1B
y Y	1C
z Z	1D
1 !	1E
2 @	1F
3 #	20
4 $	21
5 %	22

ASCII	Code
6 ^	23
7 &	24
8 *	25
9 (	26
0)	27
Return	28
Escape	29
Backspace	2A
Tab	2B
Space	2C
- _	2D
= +	2E
[{	2F
] }	30
\ |	31
Europe 1	32
; :	33
‘ “	34
, <	36

ASCII	Code
. >	37
/ ?	38
Caps Lock	39
F1	3A
F2	3B
F3	3C
F4	3D
F5	3E
F6	3F
F7	40
F8	41
F9	42
F10	43
F11	44
F12	45
Print Screen	46
Scroll Lock	47
Break (Ctrl-Pause)	48
Pause	48

REFERENCES

[1] Bluetooth SG, Human interface Profile overview

URL: https://www.bluetooth.org/Building/HowTechnologyWorks/ProfilesAndProtocols/HID.htm

[2] USB.org, HID usage tables

URL: http://www.usb.org/developers/devclass_docs/Hut1_12v2.pdf

[3] USB.org, HID technology

URL: http://www.usb.org/developers/hidpage/

RESOURCES & RELATED DOCUMENTS

For more information, refer to the following sources, which are available on the Support page on the Roving Networks website at http://www.rovingnetworks.com/support.php:

- *Bluetooth Advanced User Manual*
- *iAP Bluetooth Evaluation Kit for Developing Accessories Compatible with iOS Devices User Manual*

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