iWRAP5

USER GUIDE

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Version 1.24

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VERSION HISTORY

Version	Comment
1.0	First draft
1.1	SET CONTROL AUTOPAIR and list of changes from iWRAP4 added
1.2	SET BT FILTER added

1.3	SET BT PAGEMODE new parameters added
	SET CONTROL ECHO new parameters added
	Updated SET to contain information about category specific listings

1.4	SET CONTROL MSC new parameters added BLINK command added DELAY command added

1.5	SET BT BDADDR new command added
	SET CONTROL CD new parameters added

1.6	NO CARRIER ERROR codes added
1.7	SET BT IDENT modified parameter description
1.8	CONNAUTH event/command parameters modified SSPAUTH event/command added
1.9	CONNAUTH example added
1.10	Error Codes updated SET BT IDENT syntax updated

1.11	SET PROFILE HID parameters updated
	HID GET command added
	HID GET command added
	SET BT SCO command added

1.12	SET CONTROL AUDIO new parameters added
	HID event added
	SET CONTROL VOLSCALE command added

1.13	Added aptX configuration instructions into SET CONTROL CODEC
1.14	Removed SET CONTROL PCM command.
1.15	Updated SET BT SCO packet types

1.16	Update PLAY command example
1.17	LICENSE command added Migration from iWRAP4 to iWRAP5 added SET CONTROL PIO command added BYPASSUART command removed ECHO command modified
1.18	Added DEFRAG command
1.19	SET BT SCO examples improved
1.20	Known issues list updated
1.21	Updated SET CONTROL CODEC Updated SET CONTROL GAIN with CVC volume range.
1.22	Updated PIO and SET CONTROL PIO
1.23	Updated description of bit 12 of SET CONTROL CONFIG

1.24	Updated manual to reflect iWRAP5.0.2:
	SET BT SNIFF
	SET CONTROL AUDIO
	SET CONTROL CONFIG

TABLE OF CONTENTS

1 Introduction

iWRAP is an embedded firmware running entirely on the RISC processor of WT12, WT11, WT41 and WT32 modules. It implements the full Bluetooth protocol stack and many Bluetooth profiles as well. All software layers, including application software, run on the internal RISC processor in a protected user software execution environment known as a Virtual Machine (VM).

The host system can interface to iWRAP firmware through one or more physical interfaces, which are also shown in the figure below. The most common interfacing is done through the UART interface by using the ASCII commands that iWRAP firmware supports. With these ASCII commands, the host can access Bluetooth functionality without paying any attention to the complexity, which lies in the Bluetooth protocol stack. GPIO interface can be used for event monitoring and command execution. PCM, SPDIF, I2S or analog interfaces are available for audio. The available interfaces depend on the used hardware.

The user can write application code to the host processor to control iWRAP firmware using ASCII commands or GPIO events. In this way, it is easy to develop Bluetooth enabled applications.

On WT32 there is an extra DSP processor available for data/audio processing.

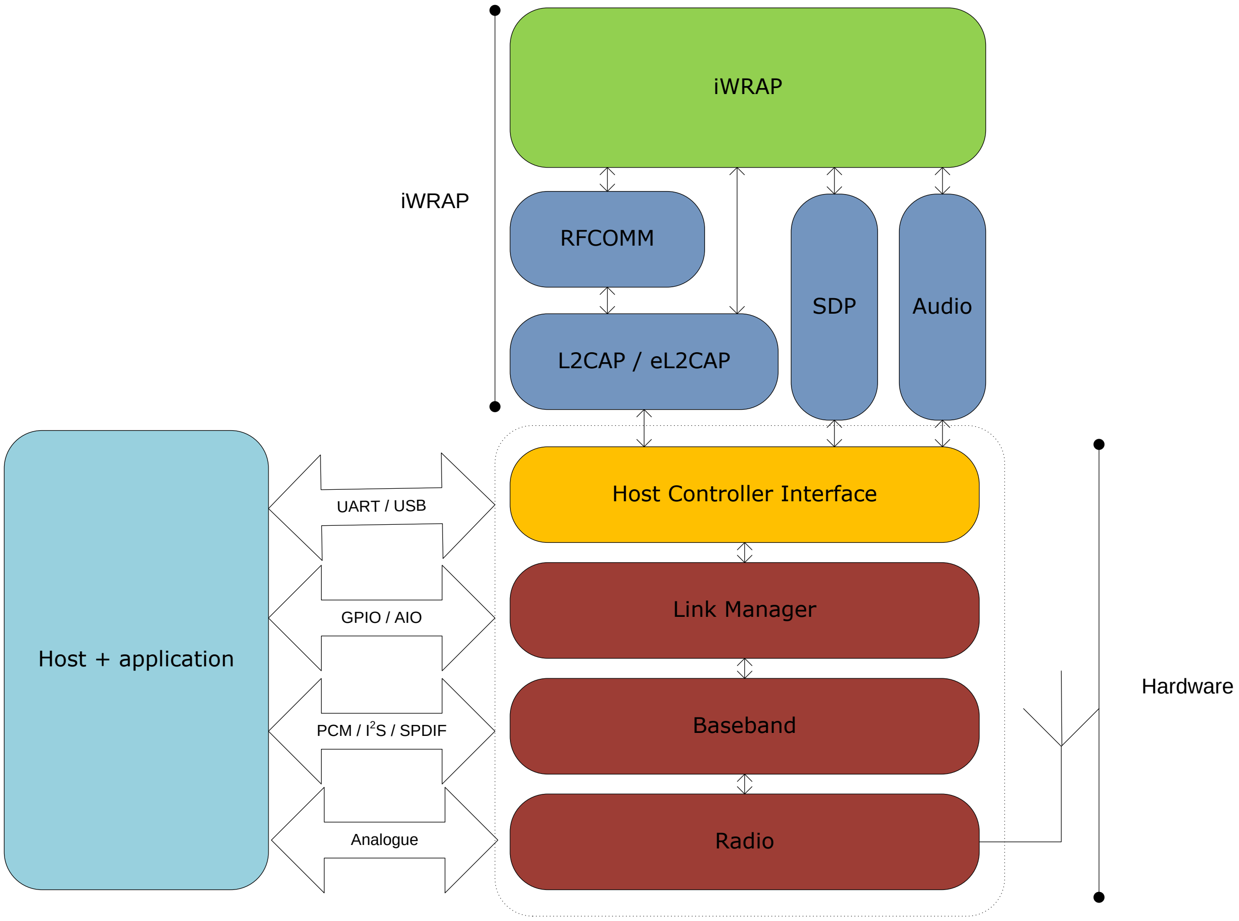


Figure 1: iWRAP Bluetooth stack

In the figure above, a Bluetooth module with iWRAP firmware could be connected to a host system for example through the UART interface. The options are:

- If the host system has a processor, software can be used to control iWRAP by using ASCII based commands or GPIO events.
- If there is no need to control iWRAP, or the host system does not need a processor, iWRAP can be configured to be totally transparent and autonomous, in which case it only accepts connections or automatically opens them.
- GPIO lines that Bluegiga's Bluetooth modules offer can also be used together with iWRAP to achieve additional functionality, such as Carrier Detect or DTR signaling.
- Audio interfaces can be used to transmit audio over a Bluetooth link.

2 Migrating from previous iWRAP versions

This section only applies when upgrading from a previous version; users of new iWRAP5 modules can ignore this.

For users upgrading to iWRAP5 from previous versions, the first consideration is that iWRAP is no longer locked to Bluegiga's address range of 00:07:80:xx:xx:xx, but instead uses a per-module license key. The module will boot without the license key, and function normally, but with the radio interface completely disabled. The following error message will be displayed:

```
WRAP THOR AI (5.0.0 build 603)
Copyright (c) 2003-2012 Bluegiga Technologies Inc.
Built-in self-test error 603.10 - please contact <support@bluegiga.com>
No license key found or license key is wrong!
```

For new modules coming from the factory (including modules with iWRAP3 or iWRAP4), the license key will be written at the factory, and will be preserved in the "factory settings" section of the Persistent Store.

To enter a license key obtained from support@bluegiga.com, you can either use PSTool to write the license to the key "Module security code" (0x025c PSKEY_MODULE_SECURITY_CODE), or use the built-in command **LICENSE**, followed by a **RESET** command.

```
LICENSE 00112233445566778899aabbccddeeff
RESET
WRAP THOR AI (5.0.0 build 603)
Copyright (c) 2003-2012 Bluegiga Technologies Inc.
```

For writing license files in batches while upgrading stocked modules to iWRAP5, please contact support@bluegiga.com.

3 Changes from iWRAP 5.0.1

3.1 New features

- SSP user confirmation auto-accept can be enabled by setting SET CONTROL CONFIG block #3 bit #1: SET CONTROL CONFIG 2 0 0 0.
- New SET PROFILE HID configuration bits #4 and #5, which allow for reception of raw HID output reports and larger HID data channel MTU configuration.
- SET CONTROL AUDIO allows routing input and output to different audio interfaces
- New optional parameter for SET BT SNIFF allows automatic sniff / active mode management

3.2 Issues addressed

3.2.1 General issues

- The radio power table for WT41-A and WT41-E has been adjusted to reduce the difference between power output levels. Since the change does not affect the maximum power output, only the steps between the minimum and maximum power level, it does not affect any radio certifications.
- We have found and implemented a workaround for CSR's S/PDIF issue with getting wrong sampling rates. S/PDIF can be used for A2DP audio, but not for SCO audio. See IWRAP-577 in the list of known issues
- Added missing leading zeroes to SSP CONFIRM events – now iWRAP will always print 6 digits, for example "012345" instead of "12345". The leading zeroes are still missing from SSP PASSKEY notification events (known issue IWRAP-579)
- Command @{link_id} now works for link_ids above 9
- Fixed a bug which caused link_ids above a disconnected link_id to stop working with the @ command; for example, if iWRAP had connections 0, 1 and 2, and connection #1 was disconnected, @2 would no longer work
- Fixed parts of INFO CONFIG output missing when using very low baud rates
- Fixed a bug that limited the maximum number of ACL connections (unique Bluetooth devices) to 6 instead of 7 on BlueCore4-based modules (WT11i, WT12, WT41). On WT32, 6 is still the limit
- Fixed PLAY command and SET CONTROL RINGTONE stopping working after a VOLUME command was issued
- Fixed SET BT PAGEMODE alternate pagemode setting threshold to count active ACLs (unique devices connected to), not active logical links
- Added missing leading zeroes to SSP CONFIRM events
- Fixed a connection issue when making an L2CAP call and an RFCOMM call to a service UUID simultaneously, and the L2CAP connection failed, which caused iWRAP to lose track of the RFCOMM connection state, which in turn caused further SDP connections to fail

3.2.2 A2DP profile issues

- Fixed a memory leak in the stream endpoint discovery subroutines, which caused iWRAP to crash after 15 outgoing A2DP calls

- Fixed a bug in SET CONTROL CODEC that would leave aptX enabled for incoming connections even when it was disabled with SET CONTROL CODEC

3.2.3 HID profile issues

- Added missing Bluetooth HID Handshake response to SET_REPORT packets sent by the HID Host
- Fixed an issue with losing characters in ASCII keyboard mode when the same letter was sent over and over again, but with different Shift key states, e.g. “AaAaAa”
- HID GET now prints the last byte of an odd-numbered HID descriptor correctly; previously it always printed the last byte as zero, even though it was stored and sent over the air correctly
- Fixed HID failure in data mode when SET CONTROL ESCAPE was disabled

3.2.4 iAP profile issues

- Fixed a rare data duplication bug
- Fixed iAP not working with SET CONTROL CONFIG 0040 0000 (print “OK” after each command)
- Fixed a bug with iWRAP hanging in MUX mode when an iAP link was abnormally disconnected in the middle of receiving a MUX frame from the UART that was intended for the iAP link

3.3 Newly discovered known issues

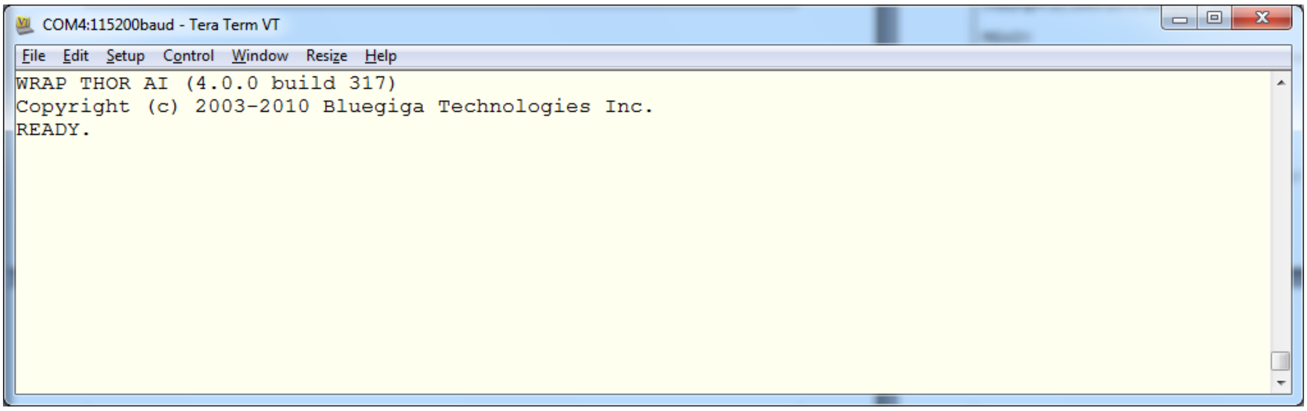
See issues IWRAP-159, IWRAP-533, IWRAP-535, IWRAP-550, IWRAP-574, IWRAP-577, IWRAP-578, IWRAP-579 in Chapter 13.

4 Getting started

To start using iWRAP firmware, you can use, for example, terminal software such as HyperTerminal. When using the terminal software, make sure that the Bluetooth module is connected to your PC's serial port. By default, iWRAP uses the following UART settings:

Baud rate:	115200bps
Data bits:	8
Stop bits:	1
Parity bit:	No parity
HW Flow Control:	Enabled

When you power up your Bluetooth module or evaluation kit, you can see the boot prompt appear on the screen of the terminal software. After the "**READY**." event iWRAP firmware is ready to be used.


COM4:115200baud - Tera Term VT
File Edit Setup Control Window Resize Help

```
WRAP THOR AI (4.0.0 build 317)
Copyright (c) 2003-2010 Bluegiga Technologies Inc.
READY.
```

Figure 2: iWRAP boot prompt

If no READY. event is received the possible reasons are:

- The Bluetooth module is not equipped with iWRAP firmware, but HCI firmware
- The UART logic levels are incorrect
- Boot prompt is disabled with "**SET CONTROL ECHO 0**" setting

4.1 First course to iWRAP

A few very basic iWRAP usage examples are presented below. Just a few very basic use cases are shown and more detailed examples will be presented later in this user guide.

AT command can be sent to iWRAP to test that the firmware is operational. An OK response tells that iWRAP is functional.

```
AT
OK
```

SET command displays the settings of the local Bluetooth device.

```
SET
SET BT BDADDR 00:07:80:ff:ff:f1
SET BT NAME WT32-A
SET BT CLASS 001f00
SET BT IDENT BT:47 f000 4.0.0 Bluegiga iWRAP
SET BT LAP 9e8b33
SET BT PAGEMODE 4 2000 1
SET BT POWER 0 0 0
SET BT ROLE 0 f 7d00
SET BT SNIFF 0 20 1 8
SET BT MTU 667
SET CONTROL BAUD 115200,8n1
SET CONTROL CD 00 0
SET CONTROL ECHO 7
SET CONTROL ESCAPE 43 00 1
SET CONTROL GAIN 8 8
SET CONTROL MSC DTE 00 00 00 00 00 00
SET CONTROL READY 00
SET PROFILE SPP Bluetooth Serial Port
SET
```

INQUIRY command can be used to discover other visible Bluetooth devices in the range. An **INQUIRY_PARTIAL** event is generated as soon as a device is discovered and finally is summary is displayed.

```
INQUIRY 5
INQUIRY_PARTIAL 00:21:86:35:c9:c8 02010c
INQUIRY_PARTIAL 00:07:80:93:d7:66 240408
INQUIRY_PARTIAL a8:7b:39:c3:ca:99 5a020c
INQUIRY 3
INQUIRY 00:21:86:35:c9:c8 02010c
INQUIRY 00:07:80:93:d7:66 240408
INQUIRY a8:7b:39:c3:ca:99 5a020c
```

SET commands can be used to modify the settings of the local Bluetooth device. In the example below Bluetooth PIN code required for pairing is set to “0000” and also the Secure Simple Pairing (SSP) “just works” mode is enabled. The settings are stored on a local non-volatile memory so they need to be configured only once. **With iWRAP5 SSP is always enabled to fulfil Bluetooth 2.1 and later specifications.**

```
SET BT AUTH * 0000

SET BT SSP 3 0
```

A Bluetooth connection is opened with a **CALL** command. A **CALL** event indicates that a connection establishment is in progress and a **CONNECT** event indicates a successful connection.

```
CALL 00:07:80:93:d7:66 1101 RFCOMM

CALL 0

CONNECT 0 RFCOMM 1
```

A **SET RESET** command can be used to return the factory level settings. iWRAP is reset as indicated by the boot prompt.

```
SET RESET

WRAP THOR AI (4.0.0 build 317)

Copyright (c) 2003-2010 Bluegiga Technologies Inc.

READY.
```

5 iWRAP modes

iWRAP has two basic operational modes, **command mode** and **data mode**. In command mode, ASCII commands can be given to iWRAP firmware to perform various actions or to change configuration settings. Command mode is the default mode when there are no Bluetooth connections. Data mode, on the other hand, is used to transmit and receive data over a Bluetooth link. Data mode is only available if there is a Bluetooth connection. It is possible to switch between modes at any time assuming the conditions for data mode are fulfilled. The mode transitions are illustrated below.

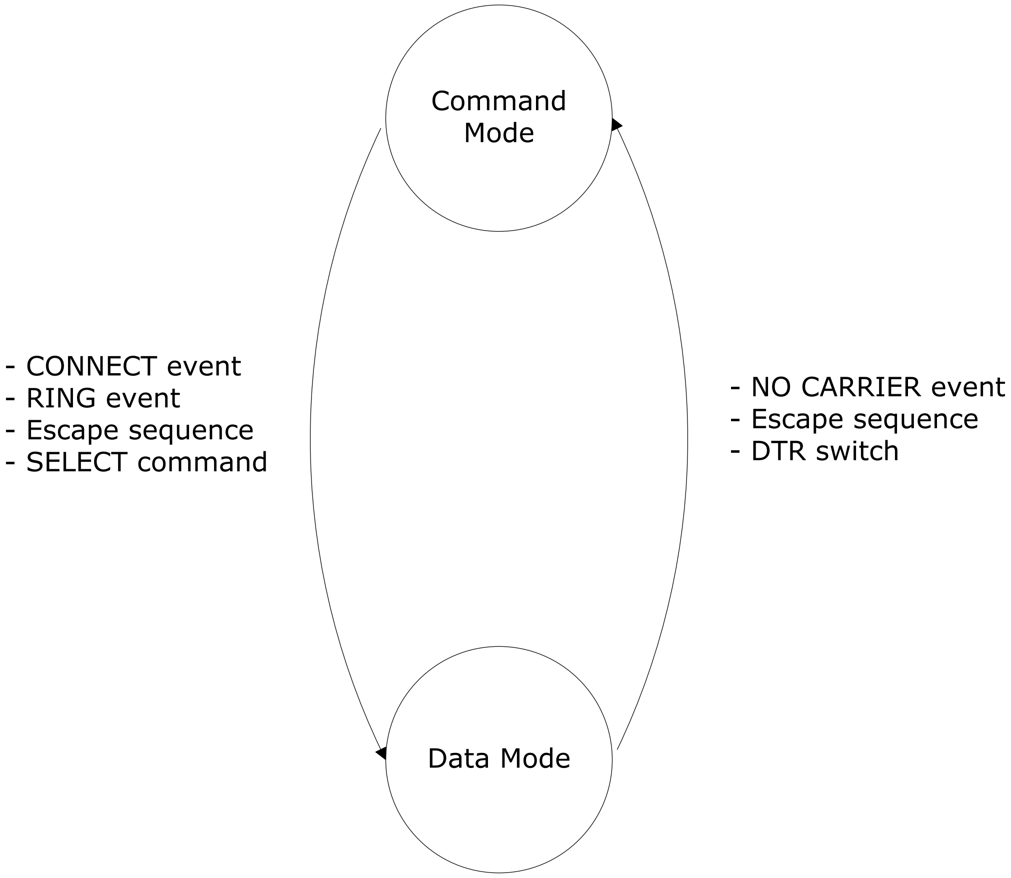


Figure 3: Mode transitions

Initial mode	Target mode	Requirements for state transition
Command Mode (no Bluetooth connections) In this mode, ASCII commands can be given to iWRAP.	Data Mode	A connection is successfully created by using the **CALL** command and **CONNECT** event indicating that a successful connection is received. A remote device opens a Bluetooth connection to iWRAP. A **RING** event indicating that a connection is received. If iWRAP events are disabled the **carrier detect** (CD) pin can also be used to indicate data or command mode.
Data Mode In this mode, all data is sent transparently from UART interface to Bluetooth connection.	Command Mode	The user switches mode by sending an **escape sequence** to iWRAP firmware or by toggling the DTR pin. A link is terminated (closed by the remote device or by link loss) and **NO CARRIER** event is received.
Command Mode (active connection) In this mode, ASCII commands can be given to iWRAP.	Data Mode	User switches the mode either by sending an escape sequence to iWRAP firmware or by using the **SELECT** command.

Table 1: iWRAP mode transitions explained

5.1 The escape sequence

The escape sequence causes the iWRAP firmware to toggle between command mode and data mode. The escape sequence consists of three (3) escape characters that are defined by the **SET CONTROL ESCAPE** command. By default, the escape character is '+'.

Do not enter any character before and/or after the escape sequence for a guard time, which is 1 second. Furthermore, send the escape characters individually, not as a string.

With default settings, the escape sequence is:

< 1 second sleep> +++ < 1 second sleep>

When a successful state transition from data mode to command mode is made, iWRAP sends a "**READY.**" event to indicate that it is ready to receive commands.

The same escape sequence or the **SELECT** command can be used to return to data mode.

5.2 Command mode

The command mode is the default mode when iWRAP is powered up. In command mode, ASCII commands can be entered to iWRAP to perform various functions.

Notes:

- In command mode, if there are active Bluetooth connections, the data from remote devices is buffered into iWRAP buffers.
- Because of the embedded nature of iWRAP, buffering capabilities are low and only small amounts of data can be received to buffers. The amount of data which can be buffered depends on the firmware version and the state of iWRAP. Usually, it is around 1000 bytes, but may vary radically.
- **The LIST** command shows active connections and the amount of buffered data.

5.3 Data mode

Data mode is the default mode when there are one or more Bluetooth connections. In data mode, all data is sent transparently from UART interface to the Bluetooth link and vice versa.

Notes:

- When iWRAP enters command mode from data mode, a “READY” event occurs, unless events are masked away by using the “SET CONTROL ECHO” command.
- The DTR pin can be used instead of the escape sequence to switch from data mode to command mode. This allows much faster mode switching and no guard time is needed. The DTR pin can be enabled by using the “**SET CONTROL ESCAPE**” command.
- When enabled, the DTR line can be configured also for closing the active connection or for a reset.
- The Carrier Detect (CD) pin can be used to indicate either a Bluetooth connection or data mode. The CD pin can be enabled and configured by using the “**SET CONTROL CD**” command.
- The “**SET CONTROL BIND**” command can be used in conjunction with the “**SET CONTROL ESCAPE**” command to allow data-command-data mode switches with the same GPIO line; consider in fact the following commands together: “SET CONTROL ESCAPE - 20 1” and “SET CONTROL BIND 0 20 F SELECT 0”

5.4 Multiplexing mode

In iWRAP version 2.1.0 and newer, there is a special mode called multiplexing mode. In this mode, iWRAP does not have separate commands or data modes, but data, commands and events are all handled in one single mode. There is, however, a special protocol to separate commands and events from the actual data. This protocol must be used between the host system and iWRAP firmware.

The advantage of multiplexing mode is that several Bluetooth connections can be handled simultaneously and there is no need to do time consuming data-command-data mode switching. However, the downside is that the performance of iWRAP is reduced, since the firmware needs to handle the multiplexing protocol and it causes overhead.

To learn more about multiplexing mode, see the description of the "**SET CONTROL MUX**" command.

5.5 HFP and HSP modes

iWRAP 2.2.0 and newer support Bluetooth Hands-Free (v.1.6) profile. This profile includes a lot of control messaging and events, which are handled in command mode. In other words, when a HFP connection is opened or received no state transition occurs, but iWRAP stays in command mode, where all HFP messaging is done. Refer to HFP profile usage for more information.

5.6 OBEX mode

IWRAP4 and newer versions support Bluetooth Object Push Profile (OPP) or File Transfer Protocol (FTP) modes. The operation in this mode is quite similar to HFP mode. For example, there are no separate command and data modes, but iWRAP always stays in command mode. Refer to OPP and FTP profile usage for more information.

5.7 A2DP mode

As of iWRAP3, Bluetooth Advanced Audio Distribution Profile (A2DP) is supported. This profile also includes control messaging and events, which are handled in command mode. In other words, when an A2DP connection is opened or received no state transition occurs, but iWRAP stays in command mode, where all A2DP messaging is done.

5.8 AVRCP mode

As of IWRAP3, Bluetooth Audio/Video Remote Control Profile (AVRCP) is supported. This profile also includes control messaging and events, which are handled in command mode. In other words, when an AVRCP connection is opened or received no state transition occurs, but iWRAP stays in command mode, where all AVRCP messaging is done.

5.9 PBAP mode

As of IWRAP4, Bluetooth Phone Book Access Profile (PBAP) is supported. This profile also includes control messaging and events, which are handled in command mode. In other words, when a PBAP connection is opened or received no state transition occurs, but iWRAP stays in command mode, where all PBAP messaging is done.

6 Technical details

Feature	Value
MAX simultaneous ACL connections	7 (6 with WT32)
MAX simultaneous SCO connections	1
MAX data rate	550 kbps (WTxx to BT2.0 USB dongle) 500 kbps (WTxx to WTxx) 450 kbps (WTxx to BT1.1-BT1.2 device) N/A (MUX data rate) 50 kbps (OBEX transfer)
MAX UART baud rate	1800000 bps
Typical data transmission delay	10-15ms
Minimum data transmission delay	5-10ms
Typical SCO delay	30-40ms
Typical A2DP delay (*	150-200ms
A2DP coding/encoding methods	SBC, aptX**
PIN code length	Configurable from 0 to 16 characters.
Encryption length	From 0 to 128** bits
MAX simultaneous pairings	16
MAX Friendly name length	Configurable up to 248 characters
RFCOMM Packet size	Configurable from 21 to 1009
Supported Bluetooth profiles (iWRAP5)	GAP, SPP, HFP (v.1.6 with wideband speech), HSP (v.1.2) A2DP, AVRCP (1.3 CT, 1.0 TG), HID, DUN, DI, OPP, FTP, HDP, PBAP and MAP.
Supported power saving modes	Sniff and deep sleep
Bluetooth QD ID	iWRAP 5.0: B019486 iWRAP 4.0: B016540 iWRAP 3.0: B014328 iWRAP 2.2.0: B012647

Secure Simple Pairing modes	Just works mode Man-in-the-middle protection (MITM) Out-of-Band (OOB) pairing
Echo canceling and noise reduction	Clear Voice Capture (cVc) algorithm. A licensable 3rd party product.

Table 2: Technical details

*) Alternative coding methods (aptX, FastStream) exist to reduce the delay to 40-90ms or to improve audio quality.

**) Custom firmware needs to be request from *support@bluegiga.com*

7 iWRAP command reference

iWRAP can be used and controlled from the host system by sending ASCII commands through the UART interface to iWRAP.

This section explains the iWRAP commands and their syntax. Some simple usage examples and tips are also given.

NOTES:

- The parser is not case sensitive!
- iWRAP commands must end with a line feed **"\n"** character.
- By default iWRAP does not print OK to indicate that the command has been executed, but this feature can be separately enabled with **SET CONTROL CONFIG** command.

7.1 Command listings

All the available iWRAP commands are listed and briefly described in the tables below. The detailed description of each command can be found later.

Command:	iWRAP version:	HW version:	Short description
AUTH	iWRAP 2.2.0	ALL	Authenticates Bluetooth pairing
BER	iWRAP 2.2.0	ALL	Reads Bit Error Rate
CALL	iWRAP 2.1.0	ALL	Opens Bluetooth connections
CLOCK	iWRAP 3.0	ALL	Reads Piconet clock
CLOSE	iWRAP 2.1.0	ALL	Closes Bluetooth connections
CONNAUTH	iWRAP 4.0.0.	ALL	Authenticate incoming connections
CONNECT	iWRAP 3.0	ALL	Connects Bluetooth links
ECHO	iWRAP 2.2.0	ALL	Echoes data to Bluetooth connection
IC	iWRAP 2.2.0	ALL	Inquiry cancel
IDENT	iWRAP 3.0	ALL	Identifies a Bluetooth device
INQUIRY	iWRAP 2.1.0	ALL	Searches other Bluetooth devices
KILL	iWRAP 3.0	ALL	Kills Bluetooth connections
L2CAP	iWRAP 3.0	ALL	Sets up L2CAP psm
LIST	iWRAP 2.1.0	ALL	Lists Bluetooth connections
NAME	iWRAP 2.2.0	ALL	Does friendly name discovery
PAIR	iWRAP 3.0	ALL	Pairs with a Bluetooth device
PING	iWRAP 2.2.0	ALL	Pings a Bluetooth connection
RFCOMM	iWRAP 3.0	ALL	Sets up RFCOMM channels
RSSI	iWRAP 2.2.0	ALL	Reads RSSI of a connection

SCO ENABLE	iWRAP 2.2.0	ALL	Enables SCO connections
SCO OPEN	iWRAP 2.2.0	ALL	Opens SCO connection
SDP	iWRAP 2.2.0	ALL	Browse SDP records
SDP ADD	iWRAP 2.2.0	ALL	Create SDP entries
SELECT	iWRAP 2.1.0	ALL	Selects a Bluetooth connection
TEST	iWRAP 2.2.0	ALL	Enables self test modes
TESTMODE	iWRAP 2.2.0	ALL	Enables Bluetooth test mode
TXPOWER	iWRAP 2.2.0	ALL	Reads TX power level

Table 3: Commands related to Bluetooth actions

Command:	iWRAP version:	HW version:	Short description
@	iWRAP 4.0.0.	ALL	Shortcut for “SET {link_id} SELECT”
AIO	iWRAP 4.0.0	ALL	Read AIO values
A2DP	iWRAP3.0	WT32	A2DP streaming control
AT	iWRAP 2.1.0	ALL	Attention
BATTERY	iWRAP 3.0	WT32	Reads battery level
BCSP_ENABLE	iWRAP 3.0	ALL	Enables BCSP mode
BLINK	iWRAP 5.0.0	ALL	Configures LED blinking
BOOT	iWRAP 2.2.0	ALL	Boots module into different modes
BYPASSUART	iWRAP 3.0	ALL	Enables UART bypass
DEFRAG	iWRAP 3.0	ALL	Defrags PS key storage
DELAY	iWRAP 5.0.0	ALL	Delay before executing a command
HELP	iWRAP 2.2.0	ALL	Prints help
HID GET	iWRAP 5.0.0	ALL	HID descriptor reading
HID SET	iWRAP 5.0.0	ALL	HID descriptor writing
INFO	iWRAP 2.2.0	ALL	Prints firmware information
PIO	iWRAP 3.0	ALL	Reads & Writes PIO statuses
RESET	iWRAP 2.1.0	ALL	Does a software reset
SET	iWRAP 2.1.0	ALL	Lists iWRAP configuration
SET RESET	iWRAP 3.0.0	ALL	Restores factory settings
SLEEP	iWRAP 2.2.0	ALL	Enables deep sleep
TEMP	iWRAP 3.0	ALL	Reads internal temperature sensor

VOLUME	iWRAP 3.0	ALL	Changes volume level

Table 4: Generic commands

Command:	iWRAP version:	HW version:	Short description
SET BT OPP	iWRAP 2.2.0	ALL	Enable OPP profile
SET BT AUTH	iWRAP 2.1.0	ALL	Set PIN code
SET BT BDADDR	iWRAP 2.1.0	ALL	Read BD_ADDR
SET BT CLASS	iWRAP 2.1.0	ALL	Set Class-of-Device
SET BT FILTER	iWRAP 5.0.0	ALL	Inquiry result filter
SET BT IDENT	iWRAP 3.0	ALL	Set DI profile data
SET BT LAP	iWRAP 2.2.0	ALL	Set inquiry access code
SET BT MTU	iWRAP 4.0.0	ALL	Configure Bluetooth connection MTU
SET BT NAME	iWRAP 2.1.0	ALL	Change friendly name
SET BT PAGEMODE	iWRAP 2.1.0	ALL	Set page mode and timeout
SET BT PAIR	iWRAP 2.1.0	ALL	Manage pairings
SET BT PAIRCOUNT	iWRAP 4.0.0	ALL	Limit the number of stored pairings
SET BT POWER	iWRAP 2.2.0	ALL	Set TX power levels
SET BT ROLE	iWRAP 2.1.0	ALL	Set role and supervision timeout
SET BT SCO	iWRAP 5.0.0	ALL	Configure SCO audio parameters
SET BT SNIFF	iWRAP 2.2.0	ALL	Manage automatic sniff mode
SET BT SSP	iWRAP 4.0.0	ALL	Configure SSP capabilities

Table 5: Bluetooth settings related SET commands

Command:	iWRAP version:	HW version:	Short description
SET CONTROL AUDIO	iWRAP 4.0.0	WT32	Configure hardware audio interfaces
SET CONTROL AUTOCALL	iWRAP 2.1.0	ALL	Manage automatic connection control
SET CONTROL AUTOPAIR	iWRAP 5.0.0	ALL	Manage automatic pairing
SET CONTROL BATTERY	iWRAP 4.0.0.	WT32	Change battery configuration
SET CONTROL BAUD	iWRAP 2.1.0	ALL	Change UART baud rate
SET CONTROL BIND	iWRAP 2.2.0	ALL	Manage GPIO bindings
SET CONTROL CD	iWRAP 2.1.0	ALL	Manage Carrier Detect (CD) signal
SET CONTROL CODEC	iWRAP 4.0.0	WT32	Configures the internal audio codec
SET CONTROL CONFIG	iWRAP 2.1.0	ALL	Manage configuration bits
SET CONTROL ECHO	iWRAP 2.1.0	ALL	Manage echo mode
SET CONTROL GAIN	iWRAP 3.0	WT32	Manage ADC and DAC gains
SET CONTROL INIT	iWRAP 2.1.0	ALL	Manage start-up command
SET CONTROL MICBIAS	iWRAP 3,0	WT32	Control MIC bias settings
SET CONTROL MSC	iWRAP 2.2.0	ALL	Manage MSC functionality
SET CONTROL MUX	iWRAP 2.2.0	ALL	Manage MUX mode
SET CONTROL PCM	iWRAP 3.0-4.0	ALL	Manage PCM settings. Removed in iWRAP5.
SET CONTROL PIO	iWRAP 5.0.0	ALL	Sets the initial direction of the PIOs
SET CONTROL PREAMP	iWRAP 4.0	WT32	Enable/disable 20dB preamplifier
SET CONTROL RINGTONE	iWRAP 4.0	All	Set HFP/HSP ringtone
SET CONTROL READY	iWRAP 4.0	All	Tells when iWRAP firmware is ready
SET CONTROL VOLSCALE	iWRAP 5.0.0	WT32	Scale the volume levels

SET CONTROL VREGEN	iWRAP 3.0	WT32	Manage VREG_EN functionality

Table 6: Module configuration related SET commands

Command:	iWRAP version:	HW version:	Short description
SET {link_id} ACTIVE	iWRAP 2.1.0	ALL	Disable Bluetooth link power saving
SET {link_id} MASTER	iWRAP 2.1.0	ALL	Set Bluetooth link to master
SET {link_id} MSC	iWRAP 2.2.0	ALL	Set Bluetooth link MSC status
SET {link_id} PARK	only iWRAP 2.2.0	ALL	Enable Park state on a Bluetooth link
SET {link_id} SELECT	iWRAP 3.0	ALL	Set Bluetooth link to active status
SET {link_id} SLAVE	iWRAP 2.1.0	ALL	Set Bluetooth link to slave
SET {link_id} SNIFF	iWRAP 2.1.0	ALL	Enable Sniff mode on a Bluetooth link

Table 7: Bluetooth connection related SET commands

Command:	iWRAP version:	HW version:	Short description
SET PROFILE A2DP	iWRAP 3.0.0	WT32	Enable / disable A2DP profile
SET PROFILE BGIO	iWRAP 4.0.0.	ALL	Enable / disable BGIO profile
SET PROFILE HDP	iWRAP 4.0.0	All but WT32	Enable / disable HDP profile
SET PROFILE HFP	iWRAP 2.1.0	ALL	Enable / disable HFP profile
SET PROFILE HFP-AG	iWRAP 2.1.0	ALL	Enable / disable HFP profile (AG)
SET PROFILE HID	iWRAP 3.0	ALL	Enable / disable HID profile
SET PROFILE HSP	iWRAP 4.0.0	ALL	Enable / disable HSP profile
SET PROFILE OPP	iWRAP 3.0.0	ALL	Enable / disable OPP profile
SET PROFILE OTA	iWRAP 3.0.0	ALL	Enable / disable OTA profile
SET PROFILE PBAP	iWRAP 4.0.0	ALL	Enable / disable PBAP profile
SET PROFILE SPP	iWRAP 2.1.0	ALL	Enable / disable SPP profile

Table 8: Supported Bluetooth profile commands

*) HDP capable firmware only

7.2 List of changes from iWRAP 4

iWRAP4	iWRAP5	Short description
-	BLINK	New command BLINK allows generation of square wave for example to blink a LED.
BYPASSUART	Command removed	
CONNAUTH connection types: L2CAP == 0 RFCOMM == 1	CONNAUTH connection type parameters changed L2CAP == 2 RFCOMM == 3	New connection types for CONNAUTH
-	DELAY	New command to allow delay before executing a command.
ECHO supports only ASCII command and always appends \r\n at the end of the message	ECHO command can have binary data as payload and \r\n can be removed with SET CONTROL CONFIG	
L2CAP can have only 2-4 digit PSMs	L2CAP can have only 2 digit PSMs	In iWRAP5 the L2CAP PSM is 2 digit only.

SET	SET
	SET BT
	SET CONTROL
	SET PROFILE
		In iWRAP it is possible to print a subset of the full SET listing

-	SET BT BDADDR	New command for reading local the Bluetooth address without need to parse the output of the SET command.

-	SET BT FILTER	New command
SET BT IDENT allowed modifications only to the description field.	SET BT IDENT allows replacing of the Bluegiga vendor information with customer VID received from USB Implementer’s forum	
SET BT PAGEMODE has **3** parameters	SET BT PAGEMODE has **5** parameters	In iWRAP5 it is possible to set the page mode to change depending on the amount of connections the module has. Backwards compatible.
-	SET BT PAIR	Issuing SET BT PAIR without parameters prints list of pairings. This is more practical way to parse existing pairings than reading the SET command
SET BT PAIR prints link key bytes in different order than what Frontline Air sniffer software expects.	SET BT PAIR prints in the exact same byte ordering as Frontline software expect.	The byte ordering was reversed to streamline the sniffing procedure.
-	SET BT SCO	New command for configuring the SCO audio connection parameters
SET CONTROL AUDIO has 4 parameters	SET CONTROL AUDIO has 6 parameters	New optional parameters for indicating A2DP streaming with GPIO and for keeping the DSP always turned on.
-	SET CONTROL AUTOPAIR	New command
SET CONTROL CD has **2** parameters	SET CONTROL CD has **3** parameters	In iWRAP5 it is possible to have separate IOs for indicating connection existence and whether the module is in data mode or not.

SET CONTROL ECHO has **3** bits to configure	SET CONTROL ECHO has **4** bits to configure	In iWRAP5 it is possible to disable printing of SYNTAX ERROR messages.
SET CONTROL MSC has **7** parameters	SET CONTROL MSC has **8** parameters	In iWRAP5 it is possible to use optional RESET parameter for reseting the IO states after SPP connection disconnects.
-	SET CONTROL PIO	Initial configuration for the PIO direction and bias.
SET CONTROL PCM	Command removed	In iWRAP5 the configuration of PSkey PCM_CONFIG32 needs to be done using PStool application.
-	SET CONTROL VOLSCALE	New command
SET PROFILE HID ON	SET PROFILE HID has several parameters	In iWRAP5 it is possible to configure which HID descriptors are available. In iWRAP4 it was always keyboard and mouse that where enabled. **Note: Not backwards compatible syntax.**
SSP can be disabled using SET BT SSP command	SSP always enabled. SET BT SSP will result default setting which is SET BT SSP 3 0	It is not possible to disable Secure Simple Pairing in iWRAP5. Legacy pairing is supported with devices which are *Bluetooth* 2.0 or lower.
If SSP and PIN code are disabled connections can be unecrypted.	Connections between iWRAP and any BT 2.1 device or above are always encrypted.	It is not possible to disable Secure Simple Pairing in iWRAP5. Legacy pairing is supported with devices which are *Bluetooth* 2.0 or lower.

If SSP and PIN code are disabled connections can be created without pairing.	Connections between iWRAP and any BT 2.1 device or above create a pairing.	It is not possible to disable Secure Simple Pairing in iWRAP5. Legacy pairing is supported with devices which are *Bluetooth* 2.0 or lower.
	Added SSPAUTH event	Occurs when SSP pairing is attempted and CONNAUTH events are enabled in SET CONTROL CONFIG
ERROR CODE	ERROR CODE	Error codes in general are different between iWRAP4 and iWRAP5
NO CARRIER {link_id} ERROR 406 RFC_CONNECTION_FAILED	NO CARRIER {link_id} ERROR c01 RFC_L2CAP_CONNECTION_FAILED	Error code changed
NO CARRIER {link_id} ERROR 409 RFC_ABNORMAL_DISCONNECT	NO CARRIER {link_id} ERROR c0c RFC_L2CAP_LINK_LOSS	Error code changed
NO CARRIER {link_id} ERROR 415 RFC_DLC_ALREADY_EXISTS	NO CARRIER {link_id} ERROR 1407 RFC_CHANNEL_ALREADY_EXISTS	Error code changed

7.3 Typographical conventions

The ASCII commands and their usage are further described in this chapter.

Commands and their output synopsis are presented as follows:

Synopsis
COMMAND {*required* *parameter*} [*optional* *parameter*] STATIC TEXT [*2ND OPTIONAL PARAMETER*]

Command parameters, on the other hand, are described like this:

Description	
parameter	Description

Responses to the command are described as shown in the table below:

Response	
RESPONSE {*parameters*}	
parameter	Description

Events generated by commands or actions are described as follows:

Event	
EVENT	Description

The list format shows how the current command configuration appears after the SET command is issued:

List format
COMMAND {*required parameter*} [*optional parameter*]

Finally, examples shown are described like this:

iWRAP COMMAND iWRAP COMMAND RESPONSE(S)

7.4 @

Command @ can be used to read send commands to a dedicated profile parser like Hands-Free Profile’s AT-command parser.

7.4.1 Syntax

Synopsis:
@ {*link_id*} {*command*}

Description:	
link_id	Numeric connection identifier
{command}	Command to send to the parser

Response:
None.

7.4.2 Examples

```
CALL a8:7b:39:c3:ca:99 111F HFP          (HFP connection establishment)

CALL 0

CONNECT 0 HFP 3

HFP 0 BSRF 491

HFP 0 STATUS "battchg" 5

HFP 0 STATUS "signal" 5

HFP 0 STATUS "service" 1

HFP 0 STATUS "call" 0

HFP 0 STATUS "callsetup" 0

HFP 0 STATUS "callheld" 0

HFP 0 STATUS "roam" 0

HFP 0 READY
```

```
RING 1 a8:7b:39:c3:ca:99 SCO

HFP 0 VOLUME 5

HFP 0 VOLUME 5

HFP 0 VOLUME 5

HFP 0 VOLUME 5

HFP 0 VOLUME 5

HFP 0 NETWORK "elisa"

NO CARRIER 1 ERROR 113 HCI_ERROR_OETC_USER

@0 ATD777;                                   ("ATD777;" sent to link ID 0)

HFP 0 OK

HFP 0 STATUS "callsetup" 2

RING 1 a8:7b:39:c3:ca:99 SCO

HFP 0 VOLUME 6

HFP 0 VOLUME 5

HFP 0 STATUS "callsetup" 3
```

The above example shows how @ command can be used to send an AT command to the HFP profile parser. @ command replaces “**SET *{link_id}* SELECT”** command and simplifies the software implementation in multi-profile use cases.

7.5 AIO

Command **AIO** can be used to read the value of ADC converters. WT12 does not have any AIO pins, WT32 has AIO0 and AIO1, all other modules have AIO1.

7.5.1 Syntax

Synopsis:
AIO {*source*}

Description:	
source	Source AIO to read. Valid values: 0 = AIO0 on WT32 1 = AIO1 on all except WT12 4 = Internal voltage reference

Response:	
AIO {*source*} {*value*}	
source	Source AIO to read
value	Value of the AIO

7.5.2 Examples

```
AIO 0
AIO 0 0015
```

7.6 AT

Command **AT**, "attention", can be used to check that iWRAP is functional and in command mode.

7.6.1 Syntax

Synopsis
AT

Response
OK

7.6.2 Examples

```
AT
OK
```

Tip:

- In iWRAP3 or older version iWRAP commands do not produce replies telling that command was successful or execution has finished. AT command can be used to provide this functionality, but appending AT into the end of other iWRAP commands.

Appending AT after “SET BT AUTH” command:

```
SET BT AUTH * 4564\r\nAT\r\n
OK
```

7.7 AUTH

AUTH command can be used to reply to **AUTH** event to perform interactive pairing. **AUTH** event is only displayed if **SET CONTROL CONFIG** bit 11 is set.

7.7.1 Syntax

Synopsis:
AUTH {*bd_addr*} [*pin_code]*

Description:	
bd_addr	Bluetooth device address of the remote device
pin_code	Bluetooth pin code

Response:
No response

Events:	
PAIR {bd_addr} {link_key}	This event occurs if **PAIR** event is enabled with **SET CONTROL CONFIG** and pairing is successful.

7.7.2 Examples

Interactive pairing with AUTH command, initiated from remote device.

```
AUTH 00:07:80:81:66:8c?

AUTH 00:07:80:81:66:8c 6666
```

Declining pairing with AUTH command.

```
AUTH 00:07:80:81:66:8c?

AUTH 00:07:80:81:66:8c
```

Pairing with AUTH command and with **PAIR** event enabled.

```
AUTH 00:07:80:81:66:8c?

AUTH 00:07:80:81:66:8c 6666
PAIR 00:07:80:81:66:8c 0 16b9515e878c39ed785ba4499322079e
```

7.8 AVRCP PDU

AVRCP PDU command is used by the AVRCP Controller to send metadata request Protocol Data Units to the Target.

7.8.1 Syntax

Synopsis
AVRCP PDU {*PDU_ID*} [*parameters*]

Description	
10	Get capabilities command. Query for events or Company_ID's the Target supports. Parameters: **2** Query supported Company_ID's. **3** Query supported events.
11	List player application settings. No parameters.
12	List possible values for a player application setting. Parameters: **{setting_id}** See list at the end of this command's description.
13	Get current values of player application settings. Parameters: **{number of settings}** Number of following parameters. Followed by: **{setting_id}** See list at the end of this command's description.
14	Set current values of player application settings. Parameters: **{number of settings}** Number of setting_id-value-pairs that follow.

	Followed by: **{setting_id} {value}** See list at the end of this command's description.
20	Get attributes of the currently playing track. Parameters: **{number of attributes}** Number of attributes that follow. If zero, list all available information. Followed by (unless number of attributes is zero): **[attribute_id]** See list at the end of this command's description.
30	Get the playing status, length and position of the current track. No parameters.
31	Register notification of events. This will request the Target to notify us when a track is changed for instance. Parameters: **{event_id}** See list at the end of this command's description.

Events
AVRCP {*PDU_ID name*}_RSP [*parsed data*] **AVRCP RSP PDU_ID {*PDU_ID*}, data: [*unparsed data*]** **AVRCP {*PDU_ID name*}_RSP REJ**

7.8.2 Examples

Ask the Target which events it supports.

```
AVRCP PDU 10 3
AVRCP GET_CAPABILITIES_RSP EVENT COUNT 3 PLAYBACK_STATUS_CHANGED
TRACK_CHANG
ED PLAYBACK_POSITION_CHANGED
```

Ask the Target about its player application settings, their possible values and change a value.

```
AVRCP PDU 11
AVRCP LIST_APPLICATION_SETTING_ATTRIBUTES_RSP COUNT 2 REPEAT SHUFFLE
AVRCP PDU 12 2
AVRCP LIST_APPLICATION_SETTING_VALUES_RSP COUNT 3 1 2 3
AVRCP PDU 13 1 2
AVRCP GET_APPLICATION_SETTING_VALUE_RSP COUNT 1 REPEAT OFF
AVRCP PDU 14 1 2 2
AVRCP SET_APPLICATION_SETTING_VALUE_RSP
AVRCP PDU 13 1 2
AVRCP GET_APPLICATION_SETTING_VALUE_RSP COUNT 1 REPEAT SINGLE_TRACK
```

Ask the Target about the title and artist of the song that is currently playing and ask it to notify us if the playback status changes.

```
AVRCP PDU 20 2 1 2

AVRCP GET_ELEMENT_ATTRIBUTES_RSP COUNT 2 TITLE “Cold Women and Warm Beer”
ARTIST “The Black League”

AVRCP PDU 31 1 1
AVRCP REGISTER_NOTIFICATION_RSP INTERIM PLAYBACK_STATUS_CHANGED PLAYING
(the interim response is received right after the request to confirm we were registered for notification)
AVRCP REGISTER_NOTIFICATION_RSP CHANGED PLAYBACK_STATUS_CHANGED PAUSED
(the changed response is received when the playing status changes)
```

7.9 BATTERY

Command **BATTERY** is used to read the current voltage of the module battery. Works only with WT32.

7.9.1 Syntax

Synopsis:
BATTERY

Description:
None

Response:
None

Events:	
BATTERY {mv}	Current battery voltage in millivolts.

7.9.2 Examples

Reading battery voltage.

```
BATTERY
BATTERY 3673
```

7.10 BCSP_ENABLE

Command **BCSP_ENABLE** is used to boot the device and enter BCSP mode; it is an alias for **BOOT 1**. See the documentation of **BOOT** command for a detailed explanation of iWRAP boot modes.

7.10.1 Syntax

Synopsis:
BCSP_ENABLE

Description:
None

Response:
No response

Events:
None

7.10.2 Examples

Switching iWRAP into BCSP mode. BCSP link establishment packets are sent after command has been executed.

```
BCSP_ENABLE

À

        ?¯WWUo`À

                        ?¯WWUo`À

                                ?¯WWUo`À

                                        ?¯WWUo`À
```

7.11 BER

The **BER** command returns the Bit Error Rate of the given link ID.

7.11.1 Syntax

Synopsis:
BER {*link_id*}

Description:	
link_id	Numeric connection identifier

Response:	
BER {*bd_addr*} {*ber*}	
bd_addr	Bluetooth address of the remote device
ber	Average Bit Error Rate on the link. Possible values are from 0.0000 to 100.0000.

Events:
None

7.11.2 Examples

Checking the Bit Error Rate of an active connection.

```
LIST
LIST 1
LIST 0 CONNECTED RFCOMM 320 0 0 3 8d 8d 00:60:57:a6:56:49 1 OUTGOING ACTIVE MASTER
PLAIN

BER 0
BER 00:60:57:a6:56:49 0.0103                (Bit Error Rate is 0.0103 per cent)
```

Note:

- Works only for BDR links.

7.12 BLINK

Blink command allow generation of periodic square wave which can be used for example for driving a LED. The timings are not complitely accurate an some jitter may occur.

7.12.1 Syntax

Synopsis:
BLINK [{pio_mask} {off_time} {on_time}]

Description:	
pio_mask	Pio mask for IOs that BLINK command should control.
off_time	Defines how long time the IO stays low per period. Hex value, unit is ms. 100 (hex) = 256(dec) ms
on_time	Defines how long time the IO stays high per period. Hex value, unit is ms. 100 (hex) = 256(dec) ms

Response:
No response

Disable:
BLINK

Events:
None

7.12.2 Examples

Sets the PIO7 to stay low for 256ms and then high for 256ms. The process continues until BLINK command is issued without parameters.

```
BLINK 80 100 100
```

7.13 BOOT

The **BOOT** command is used to temporarily restart the module so that it will operate in one of the HCI modes.

After issuing this command, the module will immediately enter the selected HCI mode. After a reset, the module will boot in iWRAP mode again.

The boot mode change can be made permanent by writing the boot mode to PS-key: “Initial device bootmode”. See chapter “Switching between iWRAP and HCI firmware”

7.13.1 Syntax

Synopsis:
BOOT {*boot_mode*}

Description:	
boot_mode	**0000** iWRAP **0001** HCI, BCSP, 115200,8E1 **0003** HCI, USB **0004** HCI, H4, 115200,8N1

Response:
No response

7.13.2 Examples

Boot to BCSP mode. Same as issuing **BCSP_ENABLE** command.

```
BOOT 1
    • Ò• ¯WWUo`À
            • Ò• ¯WWUo`À
                    • Ò• ¯WWUo`À
                            • Ò• ¯WWUo`À
```

7.14 CALL

The **CALL** command is used to initiate Bluetooth connections to the remote devices. Connections are closed by using command **CLOSE**. Currently open connections can be viewed by using command **LIST**.

7.14.1 Syntax

Synopsis
CALL {*address*} {*target*} {*connect_mode*} [MTU {*payload size*}]

Description	
address	Bluetooth address of the remote device
target	RFCOMM, HFP or HFP-AG, HID or A2DP target for the connection. The target can be one of the following: **channel** RFCOMM channel number HFP channel number HFP-AG channel number Format: xx (hex) **uuid16** 16-bit UUID for searching channel Format: xxxx (hex) **uuid32** 32-bit UUID for searching channel Format: xxxxxxxx (hex) **uuid128** 128-bit UUID for searching channel Format: xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx (hex) **L2CAP psm** 16-bit L2CAP psm. Must be an odd value. Format: xxxx (hex)
connect_mode	Defines the connection mode to be established. Possible modes are:

	RFCOMM Normal RFCOMM connection **HFP** Opens a connection in the Hands Free device mode. **HFP-AG** Opens a connection in the Hands Free Audio Gateway mode. **A2DP** Opens a connection in the Advanced Audio Distribution Profile (A2DP) mode. L2CAP psm for A2DP is 19. **AVRCP** Opens a connection in the Audio Video Remote Control Profile (AVRCP) mode. L2CAP psm for AVRCP is 17. **HID** Opens a connection in the HID keyboard mode or HID mouse mode. L2CAP psm for HID is 11. **L2CAP** Opens a generic L2CAP connection. **PBAP** Opens a Phone Book Access Profile connection. **OPP** Opens an OBEX Object Push Profile connection. **FTP** Opens an OBEX File Transfer Profile connection. **HSP** Opens a Bluetooth Headset Profile connection **HSP-AG** Opens a Bluetooth Headset Profile Audio Gateway connection **HDP** Opens a Bluetooth Health Device Profile connection
MTU	Indicates that the default MTU value will be overridden.
payload size	Payload size to use in bytes. Range: 21 to 1009.

Response	
CALL {*link_id*}	
link_id	Numeric connection identifier

Events	
CONNECT	Delivered if the **CALL** command is successful.
NO CARRIER	Delivered if the **CALL** command fails.
PAIR	If the **PAIR** event is enabled by using "**SET CONTROL CONFIG**", it will be displayed during the call if paring has to be done.
CLOCK	If piconet clock event is enabled, **CLOCK** event will be displayed.
AUTH	If interactive pairing mode is enabled and no paring exists, **AUTH** event will be displayed.

7.14.2 Examples

Creating a successful connection to 00:07:80:80:52:27 using Serial Port Profile.

(UUID16 SPP = 1101)

```
CALL 00:07:80:80:52:27 1101 RFCOMM
CALL 0
CONNECT 0 RFCOMM 1
```

Creating a successful connection to 00:07:80:80:52:27 using RFCOMM channel 1.

```
CALL 00:07:80:80:52:27 1 RFCOMM
CALL 0
CONNECT 0 RFCOMM 1
```

Unsuccessful SPP connection attempt to 00:07:80:80:52:26.

```
CALL 00:07:80:80:52:26 1101 RFCOMM
CALL 0
NO CARRIER 0 ERROR 406 RFC_CONNECTION_FAILED
```

Creating a successful connection to 00:07:80:80:52:27 with MTU 600.

```
CALL 00:07:80:80:52:27 1 RFCOMM MTU 600
CALL 0
CONNECT 0 RFCOMM 1
```

Creating a successful A2DP connection

```
CALL 00:07:80:80:52:27 19 A2DP
CALL 0
CONNECT 0 A2DP 19
CONNECT 1 A2DP 19
```

Creating a successful AVRCP connection

```
CALL 00:07:80:80:52:27 17 AVRCP
CALL 0
CONNECT 0 AVRCP 17
```

Creating a successful HID connection

```
CALL 00:07:80:80:52:27 11 HID
CALL 0
CONNECT 0 HID 11
CONNECT 1 HID 13
```

Creating a successful PBAP connection

```
CALL 00:07:80:80:52:27 112F PBAP
CALL 0
CONNECT 0 PBAP 5
```

Creating a successful OBEX OPP connection

```
CALL 00:07:80:80:52:27 1105 OPP
CALL 0
CONNECT 0 OPP 2
```

Creating a successful Health Device Profile MCAP Communications Link (MCL)

```
CALL 00:07:80:80:52:27 1001 HDP
CALL 0
CONNECT 0 HDP 4097
```

Opening a HSP connection from iWRAP to Headset Audio Gateway (phone).

```
CALL 00:07:80:80:52:27 1008 HSP
CALL 0
CONNECT 0 HSP 5
```

Opening a HSP connection from iWRAP (HSP-AG) to Headset.

```
CALL 00:07:80:80:52:26 1008 HSP-AG
CALL 0
CONNECT 0 HSP-AG 5
```

Note:

- If **CALL** is used with **CHANNEL** instead of **UUID**, it will be on average around 300ms faster, since there is no need to do service discovery. However when calling directly with RFCOMM channel you need to be sure that the profile you want to connect to is always in that RFCOMM channel. RFCOMM channel assignments are manufacturer specific and vary between different Bluetooth devices.

7.15 CLOCK

CLOCK command can be used to read the Bluetooth Piconet clock value. This is useful if time synchronization between different Piconet devices needs to be achieved.

7.15.1 Syntax

Synopsis:
CLOCK {*link_id*}

Description:	
link_id	Numeric connection identifier

Response:
No response

Events:	
CLOCK {bd_addr} {clock}	CLOCK event occurs, if valid ***link_id*** is used.
SYNTAX ERROR	If incorrect parameters are given.

7.15.2 Examples

Reading Piconet clock value:

```
CLOCK 0
CLOCK 00:07:80:12:34:56 3bb630
```

Note:

- Piconet clock is extremely useful when time needs to be synchronized between Piconet slaves. All the slaves in the Piconet are synchronized to master's clock and they share the same clock value.

- Accuracy is 625us, but it also takes some time for the iWRAP to perform the **CLOCK** command and display the result. This time can not be unambiguously defined as it depends on the state of iWRAP.

7.16 CLOSE

Command **CLOSE** is used to terminate a Bluetooth connection.

7.16.1 Syntax

Synopsis:
CLOSE {*link_id*}

Description:	
link_id	Numeric connection identifier from a previously used command **CALL** or from event **RING**.

Response:
No response

Events:	
NO CARRIER	This event is delivered after the link has been closed.

7.16.2 Examples

Closing an active connection:

```
CALL 00:60:57:a6:56:49 1103 RFCOMM
CALL 0
CONNECT 0 RFCOMM 1
[+++]                        (data mode -> command mode transition)
READY.

CLOSE 0
NO CARRIER 0 ERROR 0
```

7.17 CONNAUTH

CONNAUTH command can be used to authorize incoming Bluetooth connections. It is used to reply to **CONNAUTH events** which are activated by setting the bit 4 of the *optional_block_1* of the **SET CONTROL CONFIG** configuration command.

7.17.1 Syntax

Synopsis:
CONNAUTH {*bd_addr*} {*protocol_id* } {*channel_id*} [OK]

Description:	
bd_addr	Bluetooth device address of the remote device trying to connect.
protocol_id	Protocol ID of the incoming connection **1** Security manager - Bonding **2** L2CAP **3** RFCOMM
channel_id	Channel number of the incoming connection. Either PSM in the case of L2CAP or channel number in the case of RFCOMM
OK	Optional flag, which decides if the connection is accepted or not. If the flag is used the connection is accepted and if it is not used the connection is declined.

Response:
None

Events:
None

7.17.2 Examples

Accepting incoming SPP connection requires accepting first the lower level L2CAP connection and then the actual RFCOMM channel in which the SPP data flows.

```
CONNAUTH 00:07:80:90:f5:47 2 3?          #do you accept L2CAP connection to PSM 3?

CONNAUTH 00:07:80:90:f5:47 2 3 OK

CONNAUTH 00:07:80:90:f5:47 3 1?          #do you accept RFCOMM connection to channel 1?

CONNAUTH 00:07:80:90:f5:47 3 1 OK
RING 0 00:07:80:90:f5:47 1 RFCOMM        #Incoming RFCOMM connection to channel 1 opened
```

Note:

- **CONNAUTH** events will **not** be generated for connections using an authenticated (MITM-enabled) SSP link key, because the CSR baseband controller will treat such links authenticated by definition.

7.18 CONNECT

iWRAP can act as a repeater / range extender for RFCOMM connections by using the **CONNECT** command which will transparently link two ongoing connections together as a connection between the two remote devices.

7.18.1 Syntax

Synopsis:
CONNECT {*link_id1*} {*link_id2*}

Description:	
link_id_1	Numeric connection identifier as displayed by the LIST command.
link_id_2	Numeric connection identifier as displayed by the LIST command.

Response:
None

Events:
None

7.18.2 Examples

Piping two RFCOMM connections.

```
SET BT PAGEMODE 3
RING 0 00:07:80:87:69:2f 1 RFCOMM
RING 1 00:07:80:87:68:ec 1 RFCOMM
+++                          (Data to command mode transition)
READY.
LIST                         (List active connections)
LIST 2
LIST 0 CONNECTED RFCOMM 320 0 0 33 8d 1 00:07:80:87:69:2f 1 INCOMING ACTIVE SLAVE
PLAIN 0
LIST 1 CONNECTED RFCOMM 320 0 0 31 8d 8d 00:07:80:87:68:ec 1 INCOMING ACTIVE MASTER
PLAIN 0

CONNECT 0 1
```

First the page mode is set to 3 so that iWRAP is able to receive 2 connections. Second **LIST** command is issued to show that two connections exist. Finally the connections are piped with **CONNECT** command. After this has been done iWRAP transparently sends all data from 1st connection to the 2nd one and vice versa.

7.19 ECHO

The **ECHO** command sends a specified string of characters to the active link specified by the '***link_id***' parameter. This command can be used, for example, with command **SET CONTROL BIND** to send an indication of activity over a Bluetooth link.

7.19.1 Syntax

Synopsis:
ECHO {*link_id*} [*string*]

Description:	
link_id	Numeric connection identifier
string	User-determined string of characters. Use \xx for escaping hex data. By default \r\n is appended at the end of the ***string.*** This can be avoided by enabling SET CONTROL CONFIG bit 12 from the optional Block 2.

Response:
No response

Events:
None

7.19.2 Examples

ECHO 0 DATA	**(Sends "DATA\r\n" to link with ID 0)**

ECHO 0 DATA\00\01	**(Sends "DATA\x00\x01\r\n" to link with ID 0)**

7.20 DEFRAG

This command defragments persistent store memory. The command will reset iWRAP. iWRAP will run DEFRAG during normal power up procedure if it needed. DEFRAG command forces the iWRAP to perform defragmentation procedure even if it would not be needed.

7.20.1 Syntax

Synopsis:
DEFRAG

Description:
None

Response:
No response

Events:
None

7.21 DELAY

With **DELAY**, it is possible to delay execution of iWRAP commands.

7.21.1 Syntax

Synopsis:
DELAY {*id*} [*delay*] [*command*]

Description:	
Id	Delay timer ID. Multiple paraller DELAYs can be launched using different **id**s. ***id*** range is 0-7
delay	Decimal value in ms. Delay after the **command** is launched.
command	Standard iWRAP command or string to be sent to the active Bluetooth link. The maximum length for ***command*** is 31 characters.

Disable:	
DELAY {id}	To disable DELAY before it is executed. Use **id** parameter to define the DELAY timer that you want to cancel.

Response:
No response

List format:	
DELAY {*id*} [*delay*] [*command*]	If no binding exists, **"SET CONTROL DELAY"** will not be displayed

7.21.2 Examples

Set module to pagemode 0 (Not connectable and not visible in inquiry) after 60s from DELAY command execution.

```
DELAY 0 60000 SET BT PAGEMODE 0
```

Set module to pagemode 0 (Not connectable and not visible in inquiry) after 60s from module boot. Could be used to allow pairing during first 60s of device operation.

```
SET CONTROL INIT DELAY 0 60000 SET BT PAGEMODE 0
```

7.22 HID GET

Is used for reading HID descriptors which are visible in the HID profile SDP record. For more information how to set up the HID profile please read the HID application note.

7.22.1 Syntax

Synopsis:
HID GET

Response:	
HID GET {length} {descriptor}	To disable DELAY before it is executed. Use **id** parameter to define the DELAY timer that you want to cancel.

Description:	
Length	Length of the descriptor. Format is a uint16 in hexadecimal format.
Descriptor	Descriptor printed as hex numbers in ASCII format. The descriptor is entire USB HID report descriptor in hexadecimal format.

7.23 HID SET

Is used to set HID descriptors which are visible in the HID profile SDP record. For more information how to set up the HID profile please read the HID application note.

7.23.1 Syntax

Synopsis:
HID SET {length} {descriptor}

Description:	
Length	Length of the descriptor. Format is a uint16 in hexadecimal format.
Descriptor	Descriptor printed as hex numbers in ASCII format. The descriptor is entire USB HID report descriptor in hexadecimal format.

Response:	

7.24 INQUIRY

Command **INQUIRY** is used to find other Bluetooth devices in the area i.e. to make a device discovery.

7.24.1 Syntax

Synopsis:
INQUIRY {*timeout*} [NAME] [LAP {*lap*}]

Description:	
timeout	The maximum amount of time (in units of 1.28 seconds) before the inquiry process is halted. Range: 1-48
NAME	Optional flag to automatically request the friendly name for found devices. See command **NAME** for more information about the remote name request.
LAP	Optional flag for specifying that inquiry access code will be used.
lap	Value for inquiry access code. The following values are possible: **9E8B33** General/Unlimited Inquiry Access Code (GIAC). This is the default value unless “**SET BT LAP**” is used. **9E8B00** Limited Dedicated Inquiry Access Code (LIAC). **9E8B01-9E8B32** and **9E8B34-9E8B3F** Reserved for future use.

Response:	

INQUIRY {*num_of_devices*}
and
INQUIRY {*addr*} {*class_of_device*}	

num_of_devices	The number of found devices
addr	Bluetooth device address
class_of_device	Bluetooth Class of Device

Events:	
INQUIRY_PARTIAL	These events are delivered as devices are found.
INQUIRY_EXTENDED	These events are delivered when Bluetooth 2.1 + EDR devices are found that support Extended Inquiry Response (EIR)
NAME	These events are delivered after **INQUIRY** if the ***NAME*** flag is present.
NAME_ERROR	These events are delivered after **INQUIRY** if the ***NAME*** flag is present and the name discover fails.

7.24.2 Examples

Basic INQUIRY command example

```
INQUIRY 1
INQUIRY_PARTIAL 00:14:a4:8b:76:9e 72010c
INQUIRY_PARTIAL 00:10:c6:62:bb:9b 1e010c
INQUIRY 2
INQUIRY 00:14:a4:8b:76:9e 72010c
INQUIRY 00:10:c6:62:bb:9b 1e010c
```

An INQUIRY with NAME resolution

```
INQUIRY 1 NAME
INQUIRY_PARTIAL 00:14:a4:8b:76:9e 72010c
INQUIRY 1
INQUIRY 00:14:a4:8b:76:9e 72010c
NAME 00:14:a4:8b:76:9e "SWLTMIKKO_3"
```

An INQUIRY command with LIAC in use

```
INQUIRY 1 LAP 9E8B00
INQUIRY_PARTIAL 00:07:80:80:52:15 111111
INQUIRY_PARTIAL 00:07:80:80:52:27 111111
INQUIRY 2
INQUIRY 00:07:80:80:52:15 111111
INQUIRY 00:07:80:80:52:27 111111
```

An INQUIRY command with RSSI enabled

```
INQUIRY 1
INQUIRY_PARTIAL 00:14:a4:8b:76:9e 72010c “” -71
INQUIRY_PARTIAL 00:10:c6:62:bb:9b 1e010c “” -73
INQUIRY 2
INQUIRY 00:14:a4:8b:76:9e 72010c
INQUIRY 00:10:c6:62:bb:9b 1e010c
```

An INQUIRY command with EIR responses

```
INQUIRY 2
INQUIRY_PARTIAL 00:18:42:f1:a5:be 5a020c "" -92
INQUIRY_PARTIAL 00:17:e4:ef:f9:01 50020c "" -92
INQUIRY_EXTENDED 00:07:80:87:68:ec RAW 0909575433322d53616d020a0800
INQUIRY_PARTIAL 00:07:80:87:68:ec 200428 "WT32-Sam" -73
INQUIRY 3
INQUIRY 00:18:42:f1:a5:be 5a020c
INQUIRY 00:17:e4:ef:f9:01 50020c
INQUIRY 00:07:80:87:68:ec 200428
```

7.25 IC

The **IC** (inquiry cancel) command can be used to stop an on-going inquiry.

7.25.1 Syntax

Synopsis:
IC

Description:
No Description

Response:	

INQUIRY {*num_of_devices*}
INQUIRY {*addr*} {*class_of_device*}	

num_of_devices	The number of found devices
addr	Bluetooth address of a found device
class_of_device	Bluetooth Class of Device of a found device

Events:
None

7.25.2 Examples

```
INQUIRY 5
INQUIRY_PARTIAL 00:14:a4:8b:76:9e 72010c “” -71
INQUIRY_PARTIAL 00:10:c6:62:bb:9b 1e010c “” -73
IC
INQUIRY 2
INQUIRY 00:14:a4:8b:76:9e 72010c
INQUIRY 00:10:c6:62:bb:9b 1e010c
```

Note:

- IC command cancels the inquiry only if issued before the "**INQUIRY {num_of_devices}**" message. The name resolution process can not be cancelled with **IC.**

7.26 IDENT

IDENT command can be used to identify a remote Bluetooth device with the Bluetooth Device ID profile.

7.26.1 Syntax

Synopsis:
IDENT {*bd_addr*}

Description:	
bd_addr	Bluetooth device address of the remote device

Response:
No response

Events:	
IDENT	**IDENT** event is raised if a successful response is received
IDENT ERROR	**IDENT ERROR** event is raised if identification fails

7.26.2 Examples

Successful IDENT of a remote Bluetooth device.

```
IDENT 00:07:80:00:a5:a5
IDENT 00:07:80:00:a5:a5 BT:47 f000 3.0.0 “Bluegiga iWRAP”

IDENT 00:07:80:82:42:d8
IDENT 00:07:80:82:42:d8 BT:47 b00b 3.2.0 “Bluegiga Access Server”
```

Using IDENT to try to identify a remote Bluetooth device without success.

```
IDENT 00:07:80:00:48:84

IDENT ERROR 2 00:07:80:00:48:84 NOT_SUPPORTED_BY_REMOTE
```

7.27 INFO

INFO displays information about iWRAP version and features.

7.27.1 Syntax

Synopsis:
INFO [*CONFIG* | *BOOTMODE*]

Description:	
CONFIG	Optional flag that displays more detailed information about the firmware for example changed parameters.
BOOTMODE	Displays bootmode parameters

Response:
Information about iWRAP version and features.

Events:
None.

7.27.2 Examples

```
INFO

WRAP THOR AI (4.0.0 build 313)

Copyright (c) 2003-2010 Bluegiga Technologies Inc.

Compiled on Apr  8 2010 11:23:45, running on WT32-A module, psr v26

     A2DP AVRCP BATTERY FTP MAP MICBIAS PBAP PIO=0x07ff SSP SUBRATE VOLUME

     - BOCK3 version 313 (Apr  8 2010 11:23:38) (max acl/sco 7/1)

     - Bluetooth version 2.1, Power class 3

     - Loader 6302, firmware 6302 (56-bit encryption), native execution mode

     - up 0 days, 01:12, 0 connections (pool 2)

READY.
```

Detailed information display:

```
INFO CONFIG

WRAP THOR AI (4.0.0 build 313)

Copyright (c) 2003-2010 Bluegiga Technologies Inc.

Compiled on Apr  8 2010 11:23:45, running on WT32-A module, psr v26

     A2DP AVRCP BATTERY FTP MAP MICBIAS PBAP PIO=0x07ff SSP SUBRATE VOLUME

     - BOCK3 version 313 (Apr  8 2010 11:23:38) (max acl/sco 7/1)

     - Bluetooth version 2.1, Power class 3

     - Loader 6302, firmware 6302 (56-bit encryption), native execution mode

     - up 0 days, 00:00, 0 connections (pool 1)

     - User configuration:

&02ac = 0000 0000 002b 0000 0000 0000 0000 0000 0000 0000 0042 0000 0000 0000 0010 0000 0000 0000 0000 029b 0000 0000 0000 0000

&02ad = 5457 3233 412d

&02b1 = 0000 0000 0000

READY.
```

Note:

- When requesting a custom firmware configuration from Bluegiga, it useful to attach output of "**INFO CONFIG**" to the request.

7.28 KILL

Command **KILL** is used to explicitly terminate all ACL connections between two devices.

7.28.1 Syntax

Synopsis:
KILL {*bd_addr*} [*reason*]

Description:	
bd_addr	Bluetooth address of the connected remote device.
reason	Reason for disconnecting the ACL link; see Chapter 9 for a listing of possible error codes. The default value is 0x115: HCI_ERROR_OETC_POWERING_OFF, device is about to power off. All existing RFCOMM connections will disconnect with reason RFC_ABNORMAL_DISCONNECT.

Response:
None

Events:	
NO CARRIER	This event is delivered after the link is closed.

7.29 L2CAP

Command **L2CAP** is used to create a L2CAP psm for L2CAP connections to the local device.

7.29.1 Syntax

Synopsis:
L2CAP {*psm*}

Description:	
psm	L2CAP psm; must be an two digit odd number in hex.

Response:
No response

Events:	
SYNTAX ERROR	If an invalid UUID is given.

7.29.2 Examples

Making an L2CAP call between two iWRAPs:

```
L2CAP 37                               (Creates L2CAP psm 37 on the local device)
CALL 00:07:80:12:34:56 37 L2CAP        (Opening L2CAP connection to a remote device)
CALL 0
CONNECT 0 L2CAP 37
```

7.30 LICENSE

The **LICENSE** command can be used to write an iWRAP5 license key when directly interfacing to the Persistent Store is not possible. A reset is required to take the key into use. SET RESET does not overwrite the license key even though the license key would have been set using the LICENSE command.

7.30.1 Syntax

Synopsis:
LICENSE {*key*}

Description:	
key	128-bit (32 character) hexadecimal formatted license key

Response:
No response

Events:	
SYNTAX ERROR	If an invalid key is given.

7.30.2 Examples

```
LICENSE 00112233445566778899aabbccddeeff
RESET
```

7.31 LIST

Command **LIST** shows the count of active connection and detailed information about each connection.

7.31.1 Syntax

Synopsis:
LIST

Description:
No description

Response:	
LIST {*num_of_connections*} **LIST {*link_id*} CONNECTED {*mode*} {*blocksize*} 0 0 {*elapsed_time*} {*local_msc*} {*remote_msc*} {*addr*} {*channel*} {*direction*} {*powermode*} {*role*} {*crypt*} {*buffer*} [ERETX]**	
num_of_connections	Number of active connections. Possible values range from 0 to 7.
link_id	Numeric connection identifier
mode	**RFCOMM** Connection type is RFCOMM **L2CAP** Connection type is L2CAP **SCO** Connection type is SCO
blocksize	RFCOMM, L2CAP or SCO data packet size, that is, how many bytes of data can be sent in one packet
elapse_time	Link life time in seconds
local_msc	Local serial port modem status control (MSC) bits.
remote_msc	Remote serial port modem status control (MSC) bits.
addr	Bluetooth device address of the remote device

channel	RFCOMM channel or L2CAP psm number at remote device
direction	Direction of the link. The possible values are: **OUTGOING** The connection has been initiated by the local device. **INCOMING** The connection has been initiated by the remote device
powermode	Power mode for the link. The possible values are: **ACTIVE** Connection is in active mode, no power saving in use **SNIFF** Connection is in sniff mode **HOLD** Connection is in hold mode **PARK** Connection is in park mode
role	Role of the link. The possible values are: **MASTER** iWRAP is the master device of this connection **SLAVE** iWRAP is the slave device of this connection
crypt	Encryption state of the connection. The possible values are: **PLAIN** Connection is not encrypted **ENCRYPTED** Connection is encrypted
buffer	Tells the amount of data (in bytes) that is stored in the incoming data buffer.
ERETX	This flag is visible is enhanced retransmission mode is in use. At the moment only used with HDP connections.

Events:
No events raised

7.31.2 Examples

Listing active connections:

```
LIST
LIST 1
LIST 0 CONNECTED RFCOMM 320 0 0 3 8d 8d 00:60:57:a6:56:49 1 OUTGOING ACTIVE MASTER PLAIN 0
```

7.32 NAME

Command **NAME** can be used to perform a friendly name discovery.

7.32.1 Syntax

Synopsis:
NAME {*bd_addr*}

Description:	
bd_addr	Bluetooth address of the connected remote device.

Response:	
NAME {*bd_addr*} "{*name*}" or **NAME ERROR {*error_code*} {*bd_addr*} {*reason*}**	
bd_addr	Bluetooth address of the connected remote device.
name	Friendly name of the remote device
error_code	Error code
reason	ASCII description of the reason

Events:
None.

7.32.2 Examples

Making a successful name discovery

```
NAME 00:07:80:FF:FF:F1

NAME 00:07:80:FF:FF:F1 "WT32-A"
```

Name discovery error because of page timeout

```
NAME 00:07:80:FF:FF:F2

NAME ERROR 0x104 00:07:80:FF:FF:F2 HCI_ERROR_PAGE_TIMEOUT
```

7.33 PAIR

Command **PAIR** can be used to pair with other Bluetooth devices. Pairing mode can be traditional or Secure Simple Pairing.

7.33.1 Syntax

Synopsis
PAIR {*bd_addr*}

Description	
bd_addr	Bluetooth device address of the device remote device

Response	
PAIR {*bd_addr*} {*result*}	
bd_addr	Bluetooth device address of the device remote device
result	**OK** Pairing successful **FAIL** Pairing failed

Events	
PAIR {bd_addr} {status}	This event occurs if PAIR event is enabled with "**SET CONTROL CONFIG**" and pairing is successful.
SYNTAX ERROR	This event occurs if incorrect parameters are given.
AUTH	This event occurs if interactive pairing is enabled with "**SET CONTROL CONFIG**".

Note:

- In iWRAP5 if pin codes are not set PAIR will return "**PAIR {*bd_addr*} FAIL**" since the link keys can not be generated.
- In iWRAP3 and older version and similar situation iWRAP returned "**PAIR {*bd_addr*} OK".**

Bluetooth 2.1 + EDR specification mandates:

When the authentication attempt fails, a waiting interval shall pass before the verifier will initiate a new authentication attempt to the same claimant, or before it will respond to an authentication attempt initiated by a device claiming the same identity as the failed device. For each subsequent authentication failure, the waiting interval shall be increased exponentially. That is, after each failure, the waiting interval before a new attempt can be made, could be for example, twice as long as the waiting interval prior to the previous attempt1. The waiting interval shall be limited to a maximum.

The maximum waiting interval depends on the implementation. The waiting time shall exponentially decrease to a minimum when no new failed attempts are made during a certain time period. This procedure prevents an intruder from repeating the authentication procedure with a large number of different keys.

7.33.2 Conventional pairing examples

Successful pairing with a remote device when pin code is enabled with **SET BT AUTH** (no SSP).

```
PAIR 00:07:80:12:34:56
PAIR  00:07:80:12:34:56 OK
```

Unsuccessful pairing with a remote device when pin code is enabled with SET BT AUTH (no SSP).

```
PAIR 00:07:80:12:34:56
PAIR  00:07:80:12:34:56 FAIL
```

7.33.3 Secure Simple Pairing examples

Successful Secure Simple Pairing with “Just Works” mode (SET BT SSP 3 0). With the “just works” mode users do not need to use any PIN code, but it is automatically generated and exchanged by the Bluetooth devices.

```
PAIR 00:07:80:12:34:56
PAIR  00:07:80:12:34:56 OK
```

Secure Simple Pairing with Man-in-the-Middle (MITM) protection enabled.

Device 1:

BD_ADDR: 00:07:80:81:66:8c

SSP mode: “SET BT SSP 0 1” (display only, MITM enabled)

Device 2:

BD_ADDR 00:07:80:89:a4:85

SSP mode: “SET BT SSP 2 1” (keyboard only, MITM enabled)

Device 1:

```
PAIR 00:07:80:93:d7:66

SSP PASSKEY 00:07:80:93:d7:66 633237

PAIR 00:07:80:89:a4:85 OK
```

Device 2:

```
SSP PASSKEY 00:07:80:ff:ff:f1 ?

SSP PASSKEY 00:07:80:81:66:8c 633237
```

1. First **PAIR** command is issued on device 1.
2. Then **SSP PASSKEY** event is displayed on device 1 and a 6 digit number is displayed for numeric comparison.
3. A **SSP PASSKEY** event is displayed on device 2 to indicate that numeric comparison needs to be made.
4. The numeric comparison is responded with **SSP PASSKEY** command on device 2 and the 6 digit number is given as a parameter.
5. If the number is correct paring is successful and this is indicated on the device that initiated pairing.

Successful SSP pairing with Man-in-the-Middle (MITM) protection enabled.

Device 1:

BD_ADDR: 00:07:80:81:66:8c

SSP mode: “SET BT SSP 1 1” (display + yes/no button, MITM enabled)

Device 2:

BD_ADDR 00:07:80:89:a4:85

SSP mode: “SET BT SSP 1 1” (display + yes/no button, MITM enabled)

Device 1:

```
PAIR 00:07:80:89:a4:85
SSP CONFIRM 00:07:80:89:a4:85 951521 ?

SSP CONFIRM 00:07:80:89:a4:85 OK
PAIR 00:07:80:89:a4:85 OK
```

Device 2:

```
SSP CONFIRM 00:07:80:81:66:8c 951521 ?

SSP CONFIRM 00:07:80:81:66:8c OK
```

1. First **PAIR** command is issued on device 1.
2. Then **SSP CONFIRM** event is displayed on device 1 and a number is displayed for numeric comparison.
3. A **SSP CONFIRM** event is displayed on device 2 to indicate that numeric comparison needs to be made.
4. Both devices need to acknowledge that the number displayed on both devices is the same. This is done with **SSP CONFIRM** command.
5. If the number is correct paring is successful and this is indicated on the device that initiated pairing.

Example of pairing with Out-of-Band keys:

Device 1:

```
SSP GETOOB
SSP SETOOB H:fc3e453f7f3f6ff0bf226e26385ec538 R:bbca555c64244fe6696c004c9be61ac4

(transmit these two keys to the remote device using some other medium than Bluetooth, for example
NFC)

(receive keys and Bluetooth address from remote device)
SSP SETOOB H:0252d1100594897b221942ce052ae422 R:911b72e1e9c7a98460de9d23abff5095
PAIR 00:07:80:89:a4:85
PAIR 00:07:80:89:a4:85 OK
```

Device 2:

```
(receive keys from remote device via some medium)

SSP SETOOB H:fc3e453f7f3f6ff0bf226e26385ec538 R:bbca555c64244fe6696c004c9be61ac4

SSP GETOOB
SSP SETOOB H:0252d1100594897b221942ce052ae422 R:911b72e1e9c7a98460de9d23abff5095

(transmit these two keys and Bluetooth address to the remote device)
```

1. Device 1 generates OOB pairing keys, and transmits them to Device 2
2. Device 2 receives OOB pairing keys, sets them as its pairing key pair
3. Device 2 generates its own OOB pairing keys, transmits them and its Bluetooth address to Device 1
4. Device 1 receives OOB pairing keys and Bluetooth address, sets keys as its pairing key pair
5. Device 1 uses received Bluetooth address to initiate Bluetooth pairing, which will use both generated key pairs to authenticate the link

7.34 PIO

The command **PIO** is used to get and set PIO states and directions.

7.34.1 Syntax

Synopsis
PIO {*command*} [*mask] [states*]

Description	
command	**GET** Read the contents of the PIO register. Bits that are set denote pins that are pulled up. **GETDIR** Read the contents of the PIO direction register. Bits that are set denote output pins; others are input pins. **GETBIAS** Read the contents of the PIO bias register. Bits that are set denote pins that are pulled up/down strongly, others are pulled up/down weakly. **SET {*mask*} {*states*}** Set the contents of the PIO register; the first parameter is the bit mask for deciding which PIOs are affected, the second parameter is the bits to set/unset. **SETDIR {*mask*} {*states*}** Set the contents of the PIO direction register. You need to make a PIO as output before it can be controlled locally with PIO SET. **SETBIAS {*mask*} {*states*}** Set the contents of the PIO bias register. By default, all pins are pulled up/down weakly. **RESET** Set the registers to iWRAP defaults.
mask	The hexadecimal bitmask that defines which PIOs are affected.
states	The hexadecimal bitmask that defines the states of the PIOs specified by ***mask***.

Response	
	None for set commands.
PIO GET {*state*}	Response for PIO GET; displays PIO register value.
PIO GETDIR {*state*}	Response for PIO GETDIR.
PIO GETBIAS {*state*}	Response for PIO GETBIAS.

Events
None

7.34.2 Examples

Playing with PIO7

```
PIO GET                    (Read PIO statues)

PIO GET 0

PIO SETDIR 80 80           (Sets PIO7 to output)
PIO SET 80 80              (Sets PIO7 high)
PIO GETDIR                 (Reads PIO directions)
PIO GETDIR 80
PIO GET                    (Reads PIO statuses)
PIO GET 80
PIO RESET                  (Reset PIOs)

PIO GETDIR
PIO GETDIR 0

PIO GET
PIO GET 0
```

Note:

- There are 6 usable IO pins (PIO2-PIO7) on the WT11/12/41 modules and 11 GPIO lines (PIO0-PIO10) on the WT32. Therefore the range for the mask and state parameters for the WT11/12 is 4-FF and for the WT32 it is 0-07FF.
- The default values for the PIO registers are all zero; except for the WT11-A/E the direction register is set so that PIO0 and PIO1 are outputs.
- Switches on the evaluation kits can also affect PIO values. For instance, if on the WT32 evaluation kit PIO8 is routed to USB and the USB charger is in place, PIO8 will be high.

7.35 PLAY

Command **PLAY** is used to generate tones or beeps.

7.35.1 Syntax

Synopsis:
PLAY {*string*}

Description:	
string	String of tones to play If empty string is given iWRAP stops playing the previous ringtone. * WHOLENOTE + HALFNOTE - QUARTERNOTE ; EIGHTHNOTE : SIXTEENTHNOTE , THIRTYSECONDNOTE . SIXTYFOURTHNOTE a-g notes 0-9 selects octave for the following notes, 4 by default _ rest !

	timbre sine(default) **"** timbre square **#** timbre saw **%** timbre triangle **&** timbre triangle2 **/** timbre clipped sine **(** timbre plucked

Response:	
PLAY OK	Returned when play command has finished
PLAY BUSY	Returned if previous play command is still being executed

Events:
None.

Modern desk phone ring:

```
PLAY 6,gfgfgf__gfgfgf______gfgfgf__gfgfgf
PLAY OK
```

Movie theme ring tone:

```
PLAY &-5aaa;f:_6c-5a;f:_6c-5a_-6eee;f:_6c-5a;f:_6c-5a
PLAY OK
```

7.36 RFCOMM

Command **RFCOMM** is used to create a RFCOMM channel for general RFCOMM connections.

7.36.1 Syntax

Synopsis:
RFCOMM {*action*}

Description:	
action	**CREATE** Creates a generic RFCOMM channel.

Response:	
RFCOMM {*channel*}	
channel	RFCOMM channel number

Events:
None

7.36.2 Examples

Creating a generic RFCOMM channel.

```
RFCOMM CREATE
RFCOMM 2
```

7.37 RESET

Command **RESET** is used to perform a software reset.

7.37.1 Syntax

Synopsis:
RESET

Description:
No description

Response:
No response

7.38 RSSI

The **RSSI** command returns the Receiver Signal Strength Indication of the link given as a parameter.

7.38.1 Syntax

Synopsis:
RSSI {*link_id*}

Description:	
link_id	Numeric connection identifier

Response:	
RSSI {*bd_addr*} {*rssi*}	
bd_addr	Bluetooth address of the remote device
rssi	Receiver Signal Strength Indication. Possible values are from +20 to -128. 20 = Good link -128 = Poor link

Events:
None

7.38.2 Examples

Checking the RSSI of an active connection:

```
LIST

LIST 1

LIST 0 CONNECTED RFCOMM 320 0 0 3 8d 8d 00:60:57:a6:56:49 1 OUTGOING ACTIVE MASTER
PLAIN

RSSI 0
RSSI 00:60:57:a6:56:49 -10                    (RSSI is -10)
```

7.39 SCO ENABLE

The **SCO ENABLE** command enables support for SCO (audio) connections. This command is needed if SCO connections are used none of the audio profiles (HFP or HSP) are enabled.

7.39.1 Syntax

Synopsis:
SCO ENABLE

Description:
None

Response:
None

Events:
None

Note:

- The SCO ENABLE command must be given every time after reset; it is not stored on flash memory.
- “SET CONTROL INIT” can be used to automatically issue one “SCO ENABLE” command.
- IF HFP or HSP profiles are enabled SCO ENBLED command is not needed.

7.40 SCO OPEN

The **SCO OPEN** command is used to open a SCO connection on top of an existing RFCOMM link.

7.40.1 Syntax

Synopsis:
SCO OPEN {*link_id*}

Description:	
link_id	Numeric connection identifier

Response:
None

Response:
None

Events:	
CONNECT	If SCO connection was opened successfully
NO_CARRIER	If connection opening failed

Note:

- The SCO ENABLE command must be given before the SCO OPEN command can be used.

7.40.2 Examples

Creating an SCO connection to another iWRAP device:

```
SCO ENABLE

CALL 00:07:80:80:52:27 1 RFCOMM
CALL 0
CONNECT 0 RFCOMM 1
[+++]                          (Command to data mode transition)
```

```
SCO OPEN 0                    (SCO is opened on top of the existing RFCOMM link with ID 0)
CONNECT 1 SCO
```

7.41 SDP

The **SDP** command can be used to browse the available services on other Bluetooth devices.

7.41.1 Syntax

Synopsis:
SDP {*bd_addr*} {*uuid*} [*ALL*]

Description:	
bd_addr	Bluetooth address of the remote device
uuid	Service to look for UUID "1002" stands for root and returns all the services the remote device supports.
ALL	Optional flag to read all the SDP information from the remote device.

Response:	
SDP {***bd_addr***} < I SERVICENAME S "**service_name**" > < I PROTOCOLDESCRIPTORLIST < < U L2CAP ***psm***> < U RFCOMM I ***channel*** > > > **SDP**	
bd_addr	Bluetooth address of the remote device
service name	Name of the service. For example "Serial Port Profile"
psm	L2CAP psm of the profile (if L2CAP based profile)
channel	RFCOMM channel of the profile (if RFCOMM based profile)

Events:
None

7.41.2 Examples

Browsing the SDP root record to retrieve all SDP entries

```
SDP 00:07:80:89:a4:85 1002
SDP 00:07:80:89:a4:85 < I SERVICENAME S "Bluetooth Serial Port" > < I
PROTOCOLDESCRIPTORLIST < < U L2CAP > < U RFCOMM I 01 > > >
SDP 00:07:80:89:a4:85 < I SERVICENAME S "Stereo headset" > < I PROTOCOLDESCRIPTORLIST
< < U L2CAP I 19 > < U 0019 I 100 > > >
SDP
```

Searching for SPP profile

```
SDP 00:07:80:93:d7:66 1101

SDP 00:07:80:93:d7:66 < I SERVICENAME S "Bluetooth Serial Port" > < I
PROTOCOLDESCRIPTORLIST < < U L2CAP > < U RFCOMM I 01 > > >

SDP
```

Searching for SPP profile using the ALL flag.

```
SDP 00:07:80:93:d7:66 1101 ALL

SDP 00:07:80:93:d7:66 < I 0 I 10000 > < I 1 < U 00001101-0000-1000-8000-00805f9b34fb > > < I
PROTOCOLDESCRIPTORLIST < < U L2CAP > < U RFCOMM I 01 > > > < I 5 < U BROWSE > > < I 6
< I 656e I 6a I 100 > > < I SERVICENAME S "Bluetooth Serial Port" >

SDP
```

Some devices return the protocol descriptions using 128-bit format and older iWRAP version could not parse them correctly. The response might therefore look like this. iWRAP5 can parse 128-bit protocol description lists and display them correctly.

```
SDP 00:17:4b:67:a8:c3 1101
SDP 00:17:4b:67:a8:c3 < I SERVICENAME S "Bluetooth SPP" > < I PROTOCOLDESCRIPTORLIST <
< U 00000100-0000-1000-8000-00805f9b34fb > < U 00000003-0000-1000-8000-00805f9b34fb I 19 >
> >
```

According to the Bluetooth specification:

00000100-0000-1000-8000-00805f9b34fb	=L2CAP
00000003-0000-1000-8000-00805f9b34fb	=RFCOMM

7.41.3 Known issues

Symptom: Launching a new SDP query immediately after receiving a failing SDP query, can cause the SDP engine to stop working. Typically takes multiple failing SDP queries in row before occurring.

Resolution: After receiving “SDC_OPEN_SEARCH_FAILED_PAGE_TIMEOUT” as reason for error, one should wait at least 50ms before issuing new SDP query.

7.42 SDP ADD

The **SDP ADD** command can be used to modify a local service record to add new RFCOMM based services. This is useful if one wants to implement a Bluetooth profile iWRAP itself does not support.

7.42.1 Syntax

Synopsis:
SDP ADD {*uuid*} {*name*}

Description:	
uuid	Identifier of the service **uuid16** 16-bit UUID Format: xxxx (hex) **uuid32** 32-bit UUID Format: xxxxxxxx (hex) **uuid128** 128-bit UUID Format: xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx (hex)
name	Name of the service

Response:	
SDP {*channel*}	
channel	RFCOMM channel where the service is bound to

Events:
None

7.42.2 Examples

Adding a Dial-Up Networking profile

```
SDP ADD 1103 Dial-Up Networking
SDP 2
```

Note:

- The service record will be cleared when a reset is made, so **SDP ADD** command(s) must be given every time after a reset.

- "**SET CONTROL INIT**" can be used to automatically run "**SDP ADD**" command after a reset.

7.43 SELECT

Command **SELECT** can be used to switch from command mode to data mode.

7.43.1 Syntax

Synopsis:
SELECT {*link_id*}

Description:	
link_id	Numeric connection identifier

Response:
No response if a valid link is selected. iWRAP goes to data mode of the link ***link_id***.

Events:	
SYNTAX ERROR	This event occurs if an invalid ***link_id*** is given

7.43.2 Examples

Changing between links:

```
LIST
LIST 2
LIST 0 CONNECTED RFCOMM 668 0 0 243 8d 8d 00:07:80:80:38:77 1 OUTGOING ACTIVE
MASTER ENCRYPTED
LIST 1 CONNECTED RFCOMM 668 0 0 419 8d 8d 00:07:80:80:36:85 1 OUTGOING ACTIVE
MASTER ENCRYPTED
SELECT 1                    (iWRAP switches  to data mode with link ID 1)
```

7.44 SET

With the **SET** command, you can display or configure different iWRAP configuration values.

7.44.1 Syntax of SET Commands

Synopsis:
SET [{*category*} [{*option*} {*value*}]]

Description:	
Without any parameters, **SET** displays the current configuration. Using the **category** as the only parameter, only the settings which are under that category are listed.	
category	Category of setting **BT** Changes different Bluetooth related settings. See **SET BT** commands for more information about options. **CONTROL** Changes different iWRAP settings. See **SET CONTROL** commands for more information about options. **PROFILE** Activates or deactivates Bluetooth profiles. **link_id** This command is used to control the various settings related to Bluetooth links in iWRAP. These are, for example, master, slave and power save modes (SNIFF and ACTIVE).
option	Option name, which depends on the category. See the following sections for more information.
value	Value for the option. See the following sections for more information.

Response:	
None if issued with parameters	
SET {*category*} {*option*} {*value*}	If no parameters given displays current iWRAP settings.

Events:
None

7.44.2 Examples

Listing current settings:

```
SET
SET BT BDADDR 00:07:80:80:c2:37
SET BT NAME WT12
SET BT CLASS 50020c
SET BT AUTH * 9078
SET BT LAP 9e8b33
SET BT PAGEMODE 4 2000 1
SET BT PAIR 00:07:cf:51:f6:8d 9c4e70d929a83812a00badba7379d7c2
SET BT PAIR 00:14:a4:8b:76:9e 90357318b33817002c5c13b62ac6507f
SET BT PAIR 00:60:57:a6:56:49 3b41ca4f42401ca64ab3ca3303d8ccdc
SET BT ROLE 0 f 7d00
SET BT SNIFF 0 20 1 8
SET CONTROL BAUD 115200,8n1
SET CONTROL CD 80 0
SET CONTROL ECHO 7
SET CONTROL ESCAPE 43 00 1
SET
```

7.45 SET BT AUTH

SET BT AUTH shows or sets the local device's PIN code.

7.45.1 Syntax

Synopsis:
SET BT AUTH {*mode*} {*pin_code*}

Description:	
mode	Pin code usage mode: ***** Pin code will be displayed by "**SET**" command. **-** Pin code will NOT be displayed by "**SET**" command.
pin_code	PIN code for authorized connections. Authorization is required if this option is present. The PIN code can be from 0 to 16 characters.

Response:
No response

Events:
None

List format:	
	If PIN code is not set "**SET BT AUTH** *" is not displayed
SET BT AUTH * {*pin_code*}	If PIN code is set
SET BT AUTH *	If pin code set with "**SET BT AUTH –**"

Note:

If command "SET BT AUTH *" is given, PIN code will be disabled and no encryption can be used during Bluetooth connections.

7.46 SET BT BDADDR

SET BT BDADDR shows the local device's Bluetooth address.

7.46.1 Syntax

Synopsis:
SET BT BDADDR

Description:
No description

Response:
SET BT BDADDR {bdaddr}

Events:
None

List format:	
SET BT BDADDR {*bd_addr*}	
bd_addr	Bluetooth device address of the local device

Note:

- This value is read-only!

7.47 SET BT CLASS

SET BT CLASS sets the local device's Bluetooth Class-of-Device (CoD). Class of device is a parameter, which is received during the device discovery procedure, indicating the type of device and which services are supported.

7.47.1 Syntax

Synopsis:
SET BT CLASS {*class_of_device*}

Description:	
class_of_device	Bluetooth Class-of-Device of the local device **AUTO** If this flag is used iWRAP automatically sets the class of device during boot time.

Response:
None

Events:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

List format:
SET BT CLASS {*class_of_device*}

Note:

- The class-of-device parameter should reflect the features and supported profiles of a Bluetooth device. Refer to the Bluetooth specification for more information.
- A useful tool to work out Class of Device can be found from:

  http://bluetooth-pentest.narod.ru/software/bluetooth_class_of_device-service_generator.html

7.48 SET BT FILTER

SET BT FILTER command provides filtering options for the INQUIRY results. The filter makes it possible to limit the amount of inquiry results so that it shows only devices that you are interested in. SET BT FILTER affects also the devices that SET CONTROL AUTOPAIR can detect.

7.48.1 Syntax

Synopsis:
SET BT FILTER {cod} {cod_mask} [rssi [address address_mask]

Description:	
Cod	If class of device of a device found in inquiry matches the **cod** when ran through a **cod_mask** it will be shown in inquiry results**.** Below is description of this process in more programming orientated notation: If **(**device_cod & **cod_mask == cod)** then show device
cod_mask	Is used as a bit mask for the CoD found in inquiry. Please see **cod** parameter description for more information.
Rssi	Sets the lower threshold for RSSI. Setting **rssi** to 0 disables RSSI filtering. The allowed range of values is -128 to -1.
address	If Bluetooth address of a device found in inquiry matches the **address** when ran through a **address_mask** it will be shown in inquiry results**.** Below is description of this process in more programming orientated notation: If **(**device_address & **address_mask == address)** then show device
address_mask	Is used as a bit mask for the Bluetooth address found in inquiry. Please see **address** parameter description for more information.

Disable:
SET BT FILTER

Response:
None

Events:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

List format:
SET BT FILTER {cod} {cod_mask} [rssi [address address_mask]

7.48.2 Examples

Filters inquiry results to only include peripherals.

```
SET BT FILTER 0500 1F00
```

Filters inquiry results to only include devices with RSSI of -65 dB or better.

```
SET BT FILTER 0 0 -65
```

Filters inquiry results to only include devices with address :::66::*.

```
SET BT FILTER 0 0 0 00:00:00:66:00:00 00:00:00:FF:00:00
```

7.49 SET BT IDENT

This command changes the device identification information. By default vendor and product information of Bluegiga is used. The settings can be replaced in case system in which the module is used has a valid vendor ID from USB Implementer's forum. A reset is needed for the setting to take place.

7.49.1 Syntax

Synopsis:
SET BT IDENT {*src*}:{*vendor_id*} {*product_id*} {*version*} [*descr*]

Description:	
src	This attribute indicates which organization assigned the VendorID attribute. There are two possible values: BT for the Bluetooth Special Interest Group (SIG) or USB for the USB Implementer's Forum.
vendor_id	Intended to uniquely identify the vendor of the device. The Bluetooth SIG or the USB IF assigns VendorIDs. Bluegiga's VendorID is 47.
product_id	Intended to distinguish between different products made by the vendor in question. These IDs are managed by the vendors themselves, and should be changed when new features are added to the device.
version	Vendor-assigned version string indicating device version number. This is given in the form of major.minor.revision, for example "3.0.0".
descr	Optional freeform product description string.

Respone:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

Events:
None

List format:
SET BT IDENT {*src*}:{*vendor_id*} {*product_id*} {*version*} [*descr*]

7.49.2 Examples

Changing the description string, but using VID and PID from Bluegiga:

```
SET BT IDENT BT:47 f000 5.0.0 My Description String

RESET
```

Using own VID and PID.

```
SET BT IDENT USB:99 ffff 1.0.0 My Description String

RESET
```

7.50 SET BT LAP

This command configures the Inquiry Access code (IAC) that iWRAP uses. IAC is used in inquiries and inquiry responses.

7.50.1 Syntax

Synopsis:
SET BT LAP {*iac*}

Description:	
iac	Value for the inquiry access code. The following values are possible: **9e8b33** General/Unlimited Inquiry Access Code (GIAC). This is the default value. **9e8b00** Limited Dedicated Inquiry Access Code (LIAC). **9e8b01 - 9e8b32** and **9e8b34-9e8b3f** Reserved for future use.

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

Events:
None.

List format:
SET BT LAP {*iac*}

Note:

- IAC is very useful in cases where the module needs to be visible in the inquiry but only for dedicated devices, such as other iWRAP modules, but not for standard devices like PCs or mobile phones. When the value of IAC is left to default value “**9E8B33”** (GIAC**)** iWRAP will be visible for all devices capable of making an inquiry. On the other, hand when IAC is set to **9E8B00** (LIAC), only devices capable of making limited inquiry will be able to discover iWRAP. Using LIAC will usually speed up the inquiry process since standard Bluetooth device like mobile phones and PC will normally not respond to inquiry.

7.51 SET BT MTU

SET BT MTU configures the Maximum Transfer Unit (payload size) for Bluetooth RFCOMM connections. iWRAP tries to use this MTU by default for all outgoing RFCOMM connections, and this is the maximum iWRAP will accept for incoming connections.

7.51.1 Syntax

Synopsis:
SET BT MTU {*mtu*}

Description:	
mtu	Maximum Transfer Unit. Valid range: 21 to 1009.

Response:
None

Events:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

List format:
SET BT NAME {*mtu*}

Note:

- The remote device may not accept as large MTU as iWRAP wants to use and MTU may be limited to a smaller value.

7.51.2 Examples

Changing the default MTU to 1000 bytes.

```
SET BT MTU 1000
```

7.52 SET BT NAME

SET BT NAME configures the local device’s friendly name.

7.52.1 Syntax

Synopsis:
SET BT NAME {*friendly_name*}

Description:	
friendly_name	Friendly name of the local device

Response:
None

Events:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

List format:
SET BT NAME {*friendly_name*}

Note:

- The maximum length of a friendly name is 16 characters in iWRAP 2.0.2 and older. In iWRAP 2.1.0 and newer versions, the maximum length is 256 characters.

- If ***friendly_name*** is left empty, some devices (like PCs or PDAs) may have problems showing the device in the inquiry.

7.53 SET BT PAIRCOUNT

This command can be used to set the maximum amount of pairings iWRAP will accept.

7.53.1 Syntax

Synopsis
SET BT PAIRCOUNT {*max_pairings*}

Description	
max_pairings	**0-16** Valid values are 0-16 (decimal). Values 0 and 16 disable pair count limiting.

Response
None

Events	
PAIR {bd_addr} ERR_MAX_PAIRCOUNT	This event will be received when the maximum number of pairings already exists, and the pair event config bit is set, and the automatically delete old pairings config bit is not set.

List format
SET BT PAIRCOUNT {*max_pairings*}

Note:

It is highly recommended that config bit 12 (automatically make room for new pairings) is set, because if the maximum pair count is reached and a remote party wishes to pair to us, they may see a successful pairing followed by a failed connection attempt, because we have no room to store the new link key – while at the same time they have stored it.

Also, **SET BT PAIRCOUNT** should never be issued before all the pairings are cleared, because it may not parse partially filled pairing tables correctly. When using **SET BT PAIRCOUNT**, you should set it only once. If you need to change the pairing count, delete all old pairings before doing it.

7.54 SET BT PAGEMODE

SET BT PAGEMODE configures or displays the local device's page mode.

Page mode controls whether iWRAP can be seen in the inquiry and whether it can be connected. This command can also be used to change the page timeout.

7.54.1 Syntax

Synopsis:
SET BT PAGEMODE *{page_mode}* *{page_timeout}* *{page_scan_mode}* [{alt_page_mode} {conn_count}]

Description:	
page_mode	This parameter defines the Bluetooth page mode. **0** iWRAP is NOT visible in the inquiry and does NOT answers calls **1** iWRAP is visible in the inquiry but does NOT answers calls **2** iWRAP is NOT visible in the inquiry but answers calls **3** iWRAP is visible in the inquiry and answers calls **4** Just like mode 3 if there are NO connections. If there are connections, it is like mode 0. (default value)
page_timeout	**0001 – FFFF** Page timeout defines how long the connection establishment can take before an error occurs. Page timeout is denoted as a hexadecimal number (HEX) and calculated as in the example below: 2000 (HEX) equals 8192 (DEC). Multiply it by 0.625 and you get the page timeout in milliseconds. In this case, it is 5120 ms (8192 * 0,625ms).
page_scan_mode	This parameter configures the Bluetooth page scan mode. The possible values are: **0** Mode R0 means that iWRAP IS connectable all the time. High current consumption! Since iWRAP is all the time connectable, it will not be visible in the inquiry, no matter what the page mode

	configuration is. **1** Mode R1 means that iWRAP is connectable every 1.28 sec (the default value) **2** Mode R2 means that iWRAP is connectable every 2.56 sec (lowest power consumption)
alt_page_mode	Alternative page mode which is applied when the connection count reaches ***conn count.*** Has same possible values as the ***page_mode.***
conn_count	When module has equal amount or more connections compared to ***conn_count, alt_page_mode*** is used as the page mode.

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

Events:
None

List format:
SET BT PAGEMODE {*page_mode*} {*page_timeout*} {*page_scan_mode*} [{alt_page_mode} {conn_count}]

Note:

- If page scan mode is set to 0 iWRAP will be visible even if page mode is set to 1.
- Command "**SET BT PAGEMODE**" returns default values.
- If no alternative page mode is set the list format will only contain the first three parameters

7.55 SET BT PAIR

SET BT PAIR displays or configures the local device's pairing information.

7.55.1 Syntax

Synopsis:
SET BT PAIR {*bd_addr*} {*link_key*}

Description:	
bd_addr	Bluetooth address of the paired device
link_key	Link key shared between the local and the paired device. If this value is empty, pairing for the given Bluetooth address will be removed. Link key is 32hex values long.

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

Events:
None

List format:	
	SET BT PAIR is not displayed if there are no pairings
SET BT PAIR {*bd_addr*} {*link_key*}	One line per pairing is displayed

Note:

- iWRAP supports up to 16 simultaneous pairings. If 16 devices have been already paired, new pairings will not be stored.
- If command "**SET BT PAIR ***" is given, all pairings will be removed.
- Issuing "**SET BT PAIR"** without parameters lists current pairings.
- Note that the byte ordering has changed since iWRAP4 to avoid the need to convert link keys to Frontline sniffer software format.

7.56 SET BT POWER

This command changes the TX power parameters of the Bluetooth module. Notice that **SET BT POWER** will automatically round the powers levels to the closest value which exists in a so called radio power table.

7.56.1 Syntax

Synopsis:
SET BT POWER [RESET] | [{*default*} {*maximum*} [*inquiry*]]

Description:	
	If no parameters are given, displays current TX power settings.
RESET	Returns default TX power values and resets iWRAP
default	Default TX power in dBm. The default TX power used for **CALL** and **NAME** operations and when responding to inquiries and connection requests.
maximum	Maximum TX power in dBm. Bluetooth power control may raise the TX power up to this value.
inquiry	Transmit power in dBm used for **INQUIRY** operation. This is an optional parameter introduced in iWRAP version 3.0.0: if not given, inquiry power is unchanged; by default is equal to the default TX power.

Respone:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

Events:
None

List format:
SET BT POWER {*default*} {*maximum*} {*inquiry*}

7.56.2 Examples

Change the default TX power to 0, maximum TX power to 4 and inquiry power to 0.

```
SET BT POWER 0 4 0
```

Note:

Please see the table below for the Bluetooth power classes:

Power class:	Max. TX power:	Nominal TX power:	Minimum TX power:
1	**20 dBm**	**N/A**	**0dBm**
2	**4dBm**	**0dBm**	**-6 dBm**
3	**0dbm**	**N/A**	**N/A**

Table 9: Power TX power classes as defined in Bluetooth specification

- The values passed with "**SET BT POWER**" will always be rounded to the next available value in the radio power table.
- If possible, always use default values!

7.57 SET BT ROLE

This command configures or displays the local device's role configuration. With the "**SET BT ROLE**" command, iWRAP's master-slave behavior can be configured. This command can also be used to set the supervision timeout and link policy.

7.57.1 Syntax

Synopsis:
SET BT ROLE {*ms_policy*} {*link_policy*} {*supervision_timeout*}

Description:		
ms_policy	This parameter defines how the master-slave policy works. **0**	
		This value allows master-slave switch when calling, but iWRAP does not request it when answering (default value).
	1	
		This value allows master-slave switch when calling, and iWRAP requests it when answering.
	2	
		If this value is set, master-slave switch is not allowed when calling, but it is requested for when answering. This bitmask controls the link policy modes. It is represented in a hexadecimal format.
link_policy	**Bit 1**	
		If this bit is set, Role switch is enabled
	Bit 2	
		If this bit is set, Hold mode is enabled
	Bit 3	
		If this bit is set, Sniff mode is enabled
	Bit 4	
		If this bit is set, Park state is enabled
	F	
		This value enables all of the above modes (the default value)
	0	

	This value disables all of the above modes
supervision_timeout	**0001 – FFFF** Supervision timeout controls how long a Bluetooth link is kept open if the remote end does not answer. Supervision timeout is denoted as a hexadecimal number (HEX) and is calculated as in the example below: 12C0 (HEX) is 4800 (DEC). Multiply it by 0,625 and you get the supervision timeout in milliseconds. In this case, it is 3000 ms (4800 * 0,625ms). In other words, the remote end can be silent for three seconds until the connection is closed.

Response:
None

Events:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

List format:
SET BT ROLE {*ms_policy*} {*link_policy*} {*supervision_timeout*}

Note:

- If a master-slave switch occurs during the connection setup the supervision timeout set with **SET BT ROLE** in the master device will not be used, unless **SET CONTROL CONFIG** bit 3 in config block 1 is set. This forces iWRAP to update the supervision timeout after a master-slave switch.
- Command **"SET BT ROLE"** restores default values.

7.58 SET BT SCO

This command sets the SCO parameters used for (regular) CVSD and MSBC connections. MSBC is supported by WT32 for HFP1.6 connections where both end support Wide Band Speech.

7.58.1 Syntax

Synopsis:
SET BT SCO {esco_latency} {esco_retx} {esco_packets} [msbc_latency msbc_retx msbc_packets] [NOWBS]

Description:	
esco_latency	Maximum latency in milliseconds (hexadecimal number). FF means that iWRAP has no preference about the maximum latency.
esco_retx	Retransmission effort: **0** No retransmission **1** Power saving optimized retransmission **2** Link quality optimized retransmission **FF** No preference
esco_packets	Mask of allowed esco and sco packets: **001** HV1 **002** HV2 **004** HV3 **008** EV3 **010** EV4 **020** EV5 **040** 2-EV3 **080** 3-EV3 **100** 2-EV5 **200** 3-EV5
msbc_latency **msbc_retx** **msbc_packets**	**msbc_latency**, **msbc_retx** and **msbc_packets** have the same values as esco_* but are used only for MSBC connections. If the values are omitted, defaults are used. MSBC is the codec used in Wide Band Speech in HFP 1.6 connections.
[NOWBS]	Optional flag **NOWBS** disables the Wide Band Speech codec.

Response:
None

Events:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

List format:
SET BT SCO {esco_latency} {esco_retx} {esco_packets} [msbc_latency msbc_retx msbc_packets]

Note:

- **esco_packets** combines allowed packets for both eSCO and legacy SCO connections.
- IWRAP first tries to establish eSCO connection (using the selected EV packets) and if that fails falls back to SCO connection (using the selected HV packets).
- Legacy SCO connections don't allow setting of maximum latency or retx effort.

7.58.2 Examples

Default settings.

```
SET BT SCO A 1 4D D 2 48
```

This example disables MSBC (Wide Band Speech) codec, but allows eSCO and SCO packets.

```
SET BT SCO NOWBS
```

Disable legacy SCO packets.

```
SET BT SCO A 1 48 D 2 48
```

Disable eSCO packets and MSBC and allow only legacy SCO packets (Do not use with iPhone).

```
SET BT SCO A 1 5 D 2 0 NOWBS
```

7.59 SET BT SNIFF

This command enables or disables automatic sniff mode for Bluetooth connections. Notice that remote devices may not support sniff.

7.59.1 Syntax

Synopsis:

SET BT SNIFF {*max*} {*min*} [{*attempt*} {*timeout*}] [duration]
or
SET BT SNIFF 0

Description:	
Max	Maximum acceptable interval in Baseband slots (0.625ms) Range: **0004** to **FFFE**; only even values are valid Time = ***max*** * 0.625 msec Time Range: 2.5 ms to 40959 ms
Min	Minimum acceptable interval in Baseband slots (0.625ms) Range: **0002** to **FFFE**; only even values, up to ***max***, are valid Time = ***min*** * 0.625 ms Time Range: 1.25 ms to 40959 ms
attempt	Number of Baseband TX-RX slots to listen to per sniff cycle Time = N * 1.25 ms Range for N: **0001 – 7FFF** Time Range: 1.25 ms - 40959 ms
timeout	Number of Baseband TX-RX slots to keep listening to after sending or receiving data Time = N * 1.25 ms Range for N: **0000 – 7FFF** Time Range: 0 ms - 40959 ms
duration	This enables automatic sniff mode management, so the firmware will take care of monitoring link activity, and will automatically go to sniff mode after the defined period of inactivity. Time = N * 1 s Range for N: **0001 – 7FFF** Time Range: 1 s – 32767 s Number of seconds to wait for activity in active mode before going to sniff mode. Any activity on the ACL will cause iWRAP to go back to active mode again.

Response:
None

Events:
None

List format:
SET BT SNIFF {*max*} {*min*} {*attempt*} {*timeout*} [duration]

Note:

- Supervisor timeout set with “**SET BT ROLE**” must be longer than maximum acceptable sniff interval.

- “**SET BT SNIFF 0**” disables sniff mode altogether (this is the default, shown in the output of **SET** command at line "**SET BT SNIFF 0 20 1 8**").

- You can not change sniff mode on the fly with “**SET BT SNIFF**”, but you need to close all active Bluetooth connections, then change the sniff setting and reopen the connections. If you want to be able to control the sniff mode on the fly, use the command “**SET {link_id} SNIFF**”.

- **IT IS HIGHLY RECOMMENDED TO USE THE OPTIONAL DURATION PARAMETER!** Specifying a reasonable duration to stay active before going to sniff mode when a period of inactivity has passed means your device will stay active when it needs to transmit or receive data, and will go into sniff mode when it does not. Thus you do not need to actively manage going into and out of sniff mode.

7.59.2 Examples

Set iWRAP to stay active until 15 seconds of inactivity has passed. After 15 seconds, iWRAP will attempt to go to sniff mode with sniff interval between 4 and 16 slots, 2 TX-RX slots of listening per sniff cycle, and keeping listening to for a minimum of 8 TX-RX slots after receiving / transmitting something before beginning a new sniff cycle.

```
SET BT SNIFF 10 4 2 8 15
```

7.60 SET BT SSP

This command configures the Bluetooth 2.1 + EDR compliant Secure Simple Pairing mode.

7.60.1 Syntax

Synopsis
SET BT SSP {*capabilities*} {*mitm*}

Description	
capabilities	**0** Display only **1** Display + yes/no button **2** Keyboard only **3** None
Mitm	**0** Man-in-the-middle protection not required (but if the remote end requires MITM, iWRAP will attempt MITM as well) **1** Man-in-the-middle protection required. Due to how the CSR baseband controller works, link keys without MITM protection may be generated if the remote end does not have suitable capabilities, and the iWRAP user wrongly accepts the MITM confirmation request. The subsequent connection will fail, but the unauthenticated key will still exist. See **SET CONTROL CONFIG** optional block 3, bit 0 for forcing iWRAP to discard such link keys.

Response
None

Events
None

List format
SET BT SSP {*capabilities*} {*mitm*}

Note:

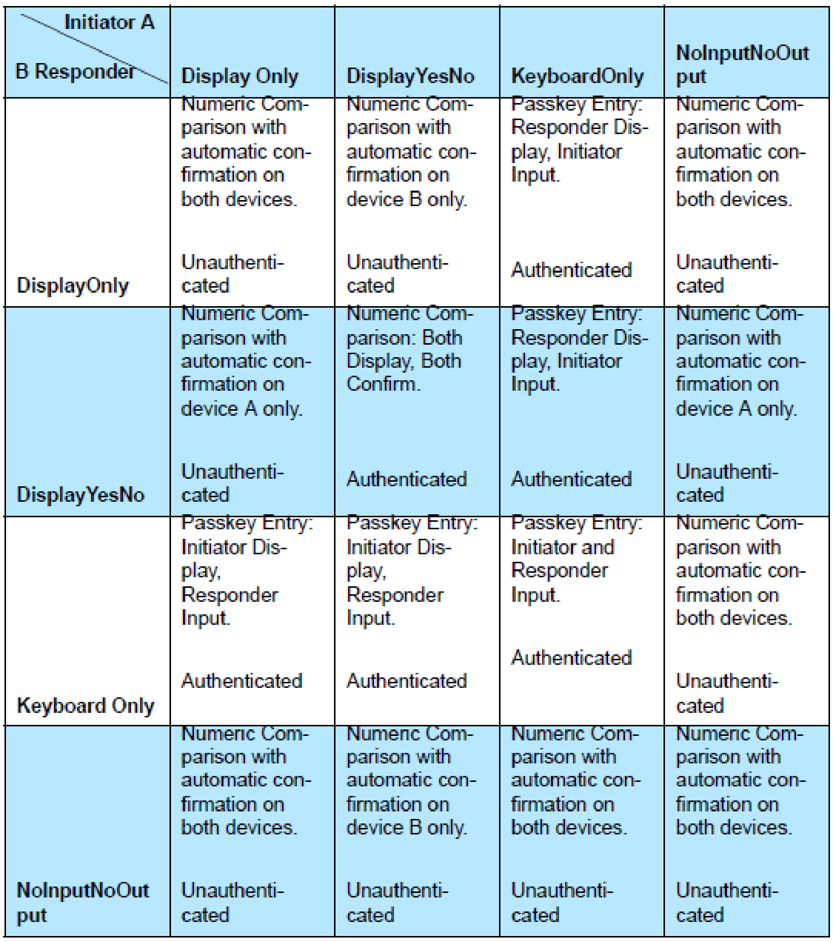
- According to the Bluetooth 2.1 + EDR specification SSP pairing must always be enabled.

The Bluegiga recommendation is that that the “just works” mode is enabled and to support older devices without SSP also the PIN code is enabled. If the remote device will not support SSP iWRAP will fall back to PIN code. Recommended configuration is therefore

“SET BT SSP 3 0”

“SET BT AUTH * {*pin*}”

- Man in the middle protection does not work if either end claims to be a "display only" device while the other end is "display with buttons".



Initiator A B Responder	Display Only	DisplayYesNo	KeyboardOnly	NoInputNoOutput
DisplayOnly	Numeric Comparison with automatic confirmation on both devices. Unauthenticated	Numeric Comparison with automatic confirmation on device B only. Unauthenticated	Passkey Entry: Responder Display, Initiator Input. Authenticated	Numeric Comparison with automatic confirmation on both devices. Unauthenticated
DisplayYesNo	Numeric Comparison with automatic confirmation on device A only. Unauthenticated	Numeric Comparison: Both Display, Both Confirm. Authenticated	Passkey Entry: Responder Display, Initiator Input. Authenticated	Numeric Comparison with automatic confirmation on device A only. Unauthenticated
Keyboard Only	Passkey Entry: Initiator Display, Responder Input. Authenticated	Passkey Entry: Initiator Display, Responder Input. Authenticated	Passkey Entry: Initiator and Responder Input. Authenticated	Numeric Comparison with automatic confirmation on both devices. Unauthenticated
NoInputNoOutput	Numeric Comparison with automatic confirmation on both devices. Unauthenticated	Numeric Comparison with automatic confirmation on device B only. Unauthenticated	Numeric Comparison with automatic confirmation on both devices. Unauthenticated	Numeric Comparison with automatic confirmation on both devices. Unauthenticated

Figure 4: IO capability mapping to authentication stage 1

To summarize Figure 4, the only ways the MITM protection procedure can successfully produce an authenticated link key are:

- Display only:
  - Keyboard only, Passkey Entry
- Display Yes/No:
  - Display Yes/No, Numeric Comparison
  - Keyboard only, Passkey Entry
- Keyboard only:
  - Display only, Passkey Entry
  - Display Yes/No, Passkey Entry

No input / output can only perform the Out of Band MITM protection procedure. It has no other method of generating authenticated link keys. Please see SSP SETOOB for details.

7.61 SET CONTROL AUDIO

This command controls the physical interface routing of audio on WT32.

7.61.1 Syntax

Synopsis
SET CONTROL AUDIO {*sco_routing* | *sco_in* / *sco_out*} {*a2dp_routing* | *a2dp_in* / *a2dp_out*} [EVENT] [KEEPALIVE] [AAx]

Description	
sco_routing ***a2dp_routing*** ***sco_in*** ***sco_out*** ***a2dp_in*** ***a2dp_out***	**INTERNAL** Routes SCO/A2DP input and output through the internal PCM codec to the analogue input and output. **PCM** Routes SCO/A2DP to the PCM pins (see the WT32 schematic). On the WT32, instead of PCM, we recommend using the I2S interface, because I2S is more reliable and easier to configure, especially when switching between voice and high-quality audio data, which use different sampling rates. **I2S** Routes SCO/A2DP to the PCM pins with the module acting as I2S master. **I2S_SLAVE** Same as above, but acting as Slave. **SPDIF** Routes A2DP to the PCM pins in S/PDIF encoding. Using the S/PDIF interface is not possible for SCO audio, because the S/PDIF interface does not work with sample rates under 32kHz. See known issue IWRAP-577. If the new ***sco_in / sco_out*** and ***a2dp_in / a2dp_out*** format is used, the input and output interfaces can be different. Otherwise the same interface will be used for both input and output.
EVENT	Issue this to receive audio routing events (and DSP codec events in WT32.)
KEEPALIVE	Prevents DSP from powering down between A2DP streams. Removes possible clicks and pops from the beginning of the analog audio stream. Might decrease also A2DP latency. Increases power consumption when not streaming audio.
AAx	GPIO for A2DP stream indication. Can have values from AA0 to AA11 where the **x** indicates GPIO used for indicating ongoing A2DPstream.

Response
None

Events	
AUDIO ROUTE {link_id} {type} {channels}	This event occurs when the audio routings are changed; e.g. when an A2DP or SCO connection is started or closed. **{link_id}** indicates the link ID of the connection where the audio is received or sent. **{type}** indicates the type of the audio (SCO, A2DP or TUNE). **{channels}** indicates which channels are used for the audio: LEFT, RIGHT, or LEFT RIGHT.
A2DP CODEC {codec} {channel_mode} {rate} [BITPOOL {bitpool}]	This event occurs with a WT32 when a codec is loaded into the DSP, e.g. when an A2DP starts or resumes after SCO is disconnected. **{codec}** indicates which codec is used. Only SBC is included in the standard iWRAP. APT-X is integrated into a special version of iWRAP, which can be evaluated on demand; please contact our Sales department for further information. MP3 is also available on request. **{channel_mode}** can be JOINT_STEREO, STEREO, DUAL_CHANNEL or MONO. **{rate}** is the sampling rate in Hz. **{bitpool}** is an SBC parameter, and will not be displayed for other codecs. For audio Sink, the valid range is displayed, for example "2-250", whereas for the Source the exact bitpool parameter is shown, for example "32". The higher the bitpool, the better the audio quality, but the higher the bandwidth requirement.

List format

SET CONTROL AUDIO {*sco_routing*} {*a2dp_routing*} [EVENT] [KEEPALIVE] [AAx]
or
SET CONTROL AUDIO {*sco_in / sco_out*} {*a2dp_in / a2dp_out*} [EVENT] [KEEPALIVE] [AAx]

7.61.2 Examples

Configure voice data to use the analogue interface as its input, while routing all outgoing audio data to I2S:

```
SET CONTROL AUDIO INTERNAL / I2S I2S
```

7.62 SET CONTROL AUTOCALL

SET CONTROL AUTOCALL enables or disables the AUTOCALL functionality in iWRAP.

When the AUTOCALL feature is enabled, iWRAP tries to form a connection with a paired (see **"SET BT PAIR"**) device until the connection is established. If the connection is lost or closed, iWRAP tries to reopen it.

If there are several paired devices in iWRAP memory, an inquiry (transparent to the user) is made and the first paired device found is connected.

7.62.1 Syntax

Synopsis:
SET CONTROL AUTOCALL {*target*} {*timeout*} {*profile*}

Description:	
target	RFCOMM, HFP or HFP-AG, HID or A2DP target for the connection. The target can be one of the following: **channel** RFCOMM channel number HFP channel number HFP-AG channel number Format: xx (hex) **uuid16** 16-bit UUID for searching channel Format: xxxx (hex) **uuid32** 32-bit UUID for searching channel Format: xxxxxxxx (hex) **uuid128** 128-bit UUID for searching channel Format: xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx (hex) **L2CAP psm** 16-bit L2CAP psm Format: xxxx (hex)
timeout	Timeout between calls (in milliseconds)
profile	Defines the connection mode to be established. Possible modes are:

	RFCOMM Normal RFCOMM connection **HFP** Opens a connection in the Hands Free device mode. **HFP-AG** Opens a connection in the Hands Free Audio Gateway mode. **A2DP** Opens a connection in the Advanced Audio Distribution Profile (A2DP) mode or Audio Video Remote Control Profile (AVRCP) mode. L2CAP psm for A2DP is 19 and for AVRCP 17. **HID** Opens a connection in the HID keyboard mode or HID mouse mode. L2CAP psm for HID is 11. **L2CAP** Opens a generic L2CAP connection. **“Any other profile”** Any other type of profile can also be used.

Disable:
SET CONTROL AUTOCALL

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

Events:
None

List format:	
	If AUTOCALL is not enabled, **“SET CONTROL AUTOCALL”** will not be displayed

SET CONTROL AUTOCALL {*target*} {*timeout*} {*profile*}	When AUTOCALL is enabled

Note:

- If AUTOCALL is enabled no manual “CALL” commands should be given to iWRAP.
- INQUIRY commands may fail when AUTOCALL is enabled, because AUTOCALL makes inquiries (transparent to the user) if multiple devices are paired.

7.62.2 Examples

Periodically every 5000ms tries to call to paired devices’s service with UUID 1101.

```
SET CONTROL AUTOCALL 1101 5000 RFCOMM
```

7.63 SET CONTROL AUTOPAIR

SET CONTROL AUTOPAIR enables or disables the AUTOPAIR functionality in iWRAP.

When the AUTOPAIR feature is enabled, iWRAP tries to create a pairing with devices it finds in inquiry. The pairing can be attempted using multiple PIN codes.

Please see SET BT FILTER command for information how to limit the amount of devices the INQUIRY process discovers. AUTOPAIR functionality can be used together with AUTOCALL functionality. AUTOPAIR feature is paused when there is active connection or whenever there is existing pairing.

7.63.1 Syntax

Synopsis:
SET CONTROL AUTOPAIR {interval} {timeout} [PIN code list]

Description:	
interval	Defines the period between autopairing attempts (in units of 1.28 seconds)
timeout	Defines the inquiry timeout (in units of 1.28 seconds)
PIN code list	Space delimited list of PIN codes that are used for pairing attempts. PIN code set with SET BT AUTH command is included by default.

Disable:
SET CONTROL AUTOPAIR

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

Events:
None

List format:	
	If AUTOPAIR is not enabled, **“SET CONTROL AUTOPAIR”** will not be displayed
SET CONTROL AUTOPAIR {interval} {timeout} [PIN code list]	When AUTOPAIR is enabled

7.63.2 Examples

Enables autopairing with period of 25 seconds and inquiry timeout of 5 seconds. Pin codes 1234 and 8888 will be tried automatically.

```
SET CONTROL AUTOPAIR 20 4 1234 8888
```

7.64 SET CONTROL BATTERY

This command enables low battery indication and automatic shutdown. This command is only for WT32 module.

7.64.1 Syntax

Synopsis
SET CONTROL BATTERY {*low*} {*shutdown*} {*full*} {*mask*}

Description	
low	When battery voltage drops below this level, iWRAP will start sending low battery warning events, and drives high the PIO(s) according to ***mask***. Maximum value is 3700 (millivolts).
shutdown	When battery voltage drops below this level, iWRAP will automatically shut itself down to prevent the battery from completely draining. Maximum value is 3300 (millivolts).
full	When battery voltage rises above this level, the low battery warnings cease and the low battery indicator PIO(s) is/are driven low.
mask	Hexadecimal PIO mask to select the PIO(s) used to indicate low battery status.

Response
None

Events	
BATTERY LOW {voltage}	This event indicates that the battery is low. iWRAP will keep sending these events until the battery is full. **{voltage}** current battery voltage in millivolts.
BATTERY SHUTDOWN {voltage}	This event indicates that the battery voltage has fallen below the shutdown threshold. The module will shut down immediately. **{voltage}** current battery voltage in millivolts.
BATTERY FULL {voltage}	This event indicates that the battery is full and low battery warnings will cease. **{voltage}** current battery voltage in millivolts.

List format
SET CONTROL BATTERY {*low*} {*shutdown*} {*full*} {*mask*}

7.65 SET CONTROL BAUD

This command changes the local device's UART settings.

7.65.1 Syntax

Synopsis:
SET CONTROL BAUD {*baud_rate*},8{*parity*}{*stop_bits*}

Description:	
baud_rate	UART baud rate in bps. See modules data sheet for suitable values.
parity	UART parity setting **n** No parity **e** Even parity **o** Odd parity
stop_bits	Number of stop bits in UART communications **1** One stop bit **2** Two stop bits

Response:
None

Events:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

List format:
SET CONTROL BAUD {*baud_rate*},8{*parity*}{*stop_bits*}

7.65.2 Examples

Configuring local UART to 9600bps, 8 data bits, no parity and 1 stop bit

```
SET CONTROL BAUD 9600,8N1
```

Note:

- If you enter an incorrect or invalid baud rate and can not access iWRAP any more, the only way to recover the module is via the SPI interface by deleting the value of PS-key : PSKEY_USR26. Please see chapter 11.1 PS-keys and how to change them for information how to change the PS-keys.

7.66 SET CONTROL BIND

With **SET CONTROL BIND**, it is possible to bind iWRAP commands to GPIO pins.

7.66.1 Syntax

Synopsis:
SET CONTROL BIND {*pri*} [*io_mask*] [*direction*] [*command*]

Description:	
pri	Command priority. Determines the order in which the commands bound to a PIO are executed (lowest ***pri*** is executed first). ***pri*** range is 0-7 ***pri*** is an absolute value for all bindings, so there cannot be two or more similar ***pri*** values (also across SET CONTROL BIND commands with different ***io_mask***) If only ***pri*** parameter is given, then the current bind will be removed.
io_mask	Determines which PIO is to be bind. In WT12, WT11 and WT41 possible PIOs are PIO2 to PIO7 In WT32 possible PIOs are PIO0 to PIO10 This is a hexadecimal value. Example: PIO5 is referred to by 100000bin (5th bit is one) = 20 hex. Note: In iAP builds, PIOs 6 and 7 cannot be used as part of io_mask.
direction	Determines whether PIO is triggered on rising, falling, or on both edges of the signal. Possible values are: **RISE** Command is executed on rising edge. **FALL** Command is executed on falling edge. **CHANGE** Command is executed on rising and falling edge.
command	Standard iWRAP command or string to be sent to the active Bluetooth link. The maximum length for ***command*** is 31 characters.

Response:
No response

List format:	
	If no binding exists, **"SET CONTROL BIND"** will not be displayed
SET CONTROL BIND {*pri*} [*io_mask*] [*direction*] [*command*]	When a binding exists

7.66.2 Examples

Example of binding PIO5 to close the connection with ID 0 and delete all pairings after PIO5 has fallen.

```
SET CONTROL BIND 0 20 FALL CLOSE 0
SET CONTROL BIND 1 20 FALL SET BT PAIR *
```

7.67 SET CONTROL CD

This command enables or disables the carrier detect signal (CD) in iWRAP.

Carrier detect signal can be used to indicate that iWRAP has an active Bluetooth connection. With "**SET CONTROL CD**" command, one PIO line can be configured to act as a CD signal.

7.67.1 Syntax

Synopsis:
SET CONTROL CD {*cd_mask*} {*mode*} [datamode_mask]

Description:	
cd_mask	This is a bit mask, which defines the GPIO lines used for CD signaling For example, value 20 (HEX) must be used for PIO5. 20 (HEX) = 100000 (BIN) For PIO6, the value is 40 40 (HEX) = 1000000 (BIN)
mode	This parameter defines how the carrier detect signal works. **0** CD signal is driven high if there are one or more connections. **1** CD signal is driven high only in data mode. **2** IO(s) selected with ***cd_mask*** are used for indicating the exitence of a connection. 3rd parameter **datamode_mask** is mandatory and defines which IO(s) are used for indicating that the module is in data mode.
datamode_mask	Can be only used in case the **mode** parameter is set to 2. Defines which GPIO lines used for CD signaling For example, value 20 (HEX) must be used for PIO5. 20 (HEX) = 100000 (BIN) For PIO6, the value is 40 40 (HEX) = 1000000 (BIN)

Events:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

List format:
SET CONTROL CD {*cd_mask*} {*mode*} [datamode_mask]

7.67.2 Examples

This configuration raises PIO7 when there is ongoing connection. PIO5 is raised when module is also in data mode.

```
SET CONTROL CD 80 2 20
```

7.68 SET CONTROL CODEC

This command controls the preference of A2DP audio codecs, channel modes and sampling rates for A2DP. In A2DP connections it's always the device establishing the connection, who decides which parameters to use and the device receiving the connection needs to adapt to those parameters despite the configuration set with **SET CONTROL CODEC**.

7.68.1 Syntax

Synopsis
SET CONTROL CODEC {*codec*} {*channel_mode*} {*sampling_rate*} {*priority*}

Description	
codec	Which codec to configure. Standard iWRAP supports only SBC. APT-X codec is available upon request.
channel_mode	Valid channel modes are JOINT_STEREO, STEREO, DUAL_CHANNEL or MONO.
sampling_rate	Valid sampling rates for SBC are 48000 (A2DP sink only unless using I2S), 44100, 32000 and 16000. APT-X supports only 48000 (A2DP sink only unless using I2S) and 44100.
priority	This is used to determine which codec to use in case both the module and the remote end support multiple codecs. Lower priority number means higher preference.

Response
None

Events
None

List format
SET CONTROL CODEC {*codec*} {*channel_mode*} {*sampling_rate*} {*priority*}

7.68.2 Examples

Configuring the SBC codec for joint stereo 44.1kHz sampling rate and highest priority.

```
SET CONTROL CODEC SBC JOINT_STEREO 44100 0
```

Note:

- Use the EVENT parameter of the SET CONTROL AUDIO configuration command to display a message related to the codec being loaded into the DSP.

Configuring the aptX codec for joint stereo 44.1kHz sampling rate and highest priority and SBC codec with same parameters and lower priority.

```
SET CONTROL CODEC APT-X JOINT_STEREO 44100 0

SET CONTROL CODEC SBC JOINT_STEREO 44100 1
```

Note:

- Requires version of iWRAP5 firmware with aptX codec support

7.69 SET CONTROL CONFIG

This command enables or disables various functional features in iWRAP. These features are described below.

7.69.1 Syntax

Synopsis
SET CONTROL CONFIG [[[[optional_block_3] *optional_block_2*] *optional_block_1*] *config_block* | LIST]

Description	
	If no parameters are given, lists the current configuration values.
list	Same as above, but additionally prints short descriptions of active configuration bits.
config_block	Hexadecimal number that specifies configuration bits, with bit 0 being the least significant (right hand) bit. **Bit 0** If this bit is set, the RSSI value will be visible in the inquiry results **Bit 1** "Bluetooth clock caching". If this bit is set, iWRAP will store the clock states of devices discovered in inquiry. This may speed up connection establishment if the connected device has responded to inquiry. **Bit 2** "Interlaced inquiry scan". If this bit is set, interlaced inquiry will be used. As a rule, interlaced inquiry is a little bit faster than regular inquiry. **Bit 3** "Interlaced page scan". If this bit is set, interlaced page (call) will be used. As a rule, interlaced page is a little bit faster than regular page. **Bit 4** "Deep sleep enabled". If this bit is set, 'Deep sleep' power saving mode will be used. Deep sleep is an aggressive power saving mode used when there are no connections. **Bit 5** "Bluetooth address in CONNECT". If this bit is set, the Bluetooth address of the remote end will be displayed on the CONNECT event. **Bit 6**

	Not used. Must be set to 0. **Bit 7** Displays the **PAIR** event after successful pairing. **Bit 8** Enables SCO links. This bit must be 1 if you use audio profiles. *Note: this is always set unless bit 2 of optional block 1 is set.* **Bit 9** Must be set to 0. **Bit 10** Must be set to 0. **Bit 11** Enables interactive pairing mode. Where pin code is prompted rather then pin code set with “SET BT AUTH” used. **Bit 12** If this bit is set, when the maximum number of pairings (16 unless a lower limit is specified by SET BT PAIRCOUNT) is exceeded, then iWRAP4 and earlier randomly replaces one of the existing pairings, while iWRAP5 replaces the oldest paired device. If this bit is not set and the pairing count is exceeded, the pairing will fail. **Bit 13** If this bit is set CLOCK event will be displayed on CONNECT and RING events. **Bit 14** If this bit is set UART will be optimized for low latency instead of throughput. **Bit 15** If this bit is set low inquiry priority is used. This feature reduces inquiry priority and number of inquiry responses but improves simultaneous data transfer performance.
optional_block_1	Hexadecimal number that specifies additional configuration options. **Bit 0** If this bit is set. All changing iWRAP configuration with SET commands will be disabled. The only way to enable SET commands are by deleting PS-key: “user configuration data 30” **Bit 1** “Enhanced Inquiry Response (EIR)”. If this bit is set, iWRAP will display **INQUIRY_EXTENDED** reports during inquiry. There is a known issue regarding EIR; please see issue #478 in the known issues section. **Bit 2**

	Disables automatic setting of config block bit 8. **Bit 3** If this bit is set, iWRAP will always set the link supervision timeout after a Master/Slave switch. **Bit 4** If this bit is set, iWRAP will display the **CONNAUTH** or **SSPAUTH** events before accepting an incoming connection or pairing request. This allows the user to accept or reject each connection or pairing attempt individually. **Bit 5** If this bit is set, iWRAP will not automatically enter data mode when an RFCOMM connection is opened. **Bit 6** If this bit is set, iWRAP will display "OK." after each successful command. The message is printed synchronously, e.g. once iWRAP receives the command, no other messages can be printed in between the command's normal output and the "OK." confirmation. Please note that some commands, such as BATTERY and A2DP STREAMING START/STOP, may appear to trigger a synchronous response, but in reality request an event that, while quick to appear, will appear after "OK." is printed. **Bit 7** If this bit is set, the iWRAP Hands-Free Profile handler will not automatically send an error reply to AT commands it does not understand. This is useful when the user wants to implement their own proprietary commands. Note that the user must implement their own error message sending if this bit is set, since it is mandatory to reply even to unknown commands. **Bits 8-15** These are temporary configuration bits, for internal use only. They cannot be set or unset.
optional_block_2	**Bits 0-7** These are temporary configuration bits, for internal use only. They cannot be set or unset. **Bits 8-9** These bits are reserved and should be zero. **Bit 10** Show RSSI value in the final inquiry results. **Bit 11** This bit is reserved and should be zero.

	Bit 12 Do not automatically add CR/LF to strings sent with ECHO command. **Bit 13** Do not print any events while in data mode. **Bits 14-15** These bits are reserved and should be zero.
optional_block_3	**Bit 0** When MITM protection is required by iWRAP, discard link keys which are not MITM-protected. If this bit is not set, the keys will be generated, but connections using them will be rejected. Setting this bit will generate the result ERR_MITM_REQUIREMENT_NOT_MET in pairing events (if enabled) and pairing responses (if pairing initiated by iWRAP). Example, iWRAP initiates: **PAIR 00:07:80:9a:db:b3** PAIR 00:07:80:9a:db:b3 4 90a25f576caa1df834557f45e8fd9251 ERR_MITM_REQUIREMENT_NOT_MET PAIR 00:07:80:9a:db:b3 ERR_MITM_REQUIREMENT_NOT_MET Example, pairing events enabled and other end initiates: SSP CONFIRM 00:07:80:9a:db:b3 599139 ? **SSP CONFIRM 00:07:80:9a:db:b3 ok** (SHOULD NOT ACCEPT!) PAIR 00:07:80:9a:db:b3 4 ae6a57e4a888e3cd6bdb7f46973cb468 ERR_MITM_REQUIREMENT_NOT_MET **Bit 1** Setting this bit will cause iWRAP to automatically accept SSP numeric comparison requests. “SSP CONFIRM {number} ?” events will not be printed. **Bits 2-15** Reserved.

Response	
None	If any configuration blocks are given.
SET CONTROL CONFIG {optional_block_3 optional_block_2 optional_block_1 config_block}	If no parameters are given.
SET CONTROL CONFIG {optional_block_3 optional_block_2 optional_block_1	If LIST was issued.

config_block} {descriptions}	

Events
None

List format
None

7.69.2 Examples

Setting optional block 3 bit 0 (discard unauthenticated link keys), optional block 2 to zero (no effect), setting bits 4 and 6 (connection authorization, command confirmation) of optional block 1, setting bits 0 and 5 (inquiry with RSSI and show Bluetooth address in connect events) of config block.

```
SET CONTROL CONFIG 0001 0000 0050 0021

SET CONTROL CONFIG LIST
SET CONTROL CONFIG 0000 0000 0050 0121 INQUIRY_WITH_RSSI CONN_BD KLUDGE
AUTHORISE_REQ PRINT_OK MITM_DISCARD_L4_KEY
OK.
```

7.70 SET CONTROL ECHO

This command changes the echo mode of iWRAP.

7.70.1 Syntax

Synopsis:
SET CONTROL ECHO {*echo_mask*}

Description:	
Echo_mask	Bit mask for controlling the display of echo and events **Bit 0** If this bit is set, the start-up banner is visible. **Bit 1** If this bit is set, characters are echoed back to client in command mode. **Bit 2** This bit indicates if set events are displayed in command mode. **Bit 3** If this bit is set, SYNTAX ERROR messages are disabled.

Events:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

List format:
SET CONTROL ECHO {*echo_mask*}

Warning!

If every bit is set off (value 0), it is quite impossible to know the iWRAP status.

If Bit 2 is set off, it is very hard to detect whether iWRAP is in command mode or in data mode. This can, however, be solved if one IO is used to indicate that iWRAP is in data mode (**"SET CONTROL CD"**).

If you want to disable receiving iWRAP events while in data mode, use the SET CONTROL CONFIG block 2 bit 13.

7.71 SET CONTROL ESCAPE

This command is used to select the escape character used to switch between command and data modes. This command also enables, sets and disables DTR signaling over a selectable GPIO line.

7.71.1 Syntax

Synopsis:
SET CONTROL ESCAPE *{esc_char} {dtr_mask} {dtr_mode}*

Description:	
esc_char	Decimal ASCII value defining the escape character to be used in the escape sequence. Use “-“ to disable escape sequence. The default value is 43, which corresponds to “+”
dtr_mask	Bit mask for selecting the digital I/O pins used for DTR. For example, for I/O 5, the bit mask is **00100000** and **dtr_mask** is then **20** (HEX). Note: In iAP builds, PIOs 6 and 7 cannot be used in **dtr_mask**.
dtr_mode	**0** DTR Disabled. **1** Return to command mode when DTR line transitions from low to high. (It happens, for instance, when pressing the DSR button on the evaluation board, which is linked to pin number 5, after configuring the firmware according to example below.) **2** Close the active connection when DTR line transitions from low to high. **3** Soft reset iWRAP when DTR line transitions from low to high.

Events:	
SYNTAX ERROR	This event occurs if incorrect parameters are given

List format:
SET CONTROL ESCAPE *{esc_char} {dtr_mask} {dtr_mode}*

7.71.2 Example

Disable default escape character “+” and set DTR to GPIO5 for escaping from data to command mode:

```
SET CONTROL ESCAPE - 20 1
```

7.72 SET CONTROL GAIN

In WT32, the **SET CONTROL GAIN** command is used to control the internal codec's input and output gain. In WT11, WT12 and WT41, when PCM frame is configured for 13-bit samples with padding in 16-bit slots, this command is meant to control the 3-bit audio attenuation used by some Motorola codecs and other compatible codecs.

7.72.1 Syntax

Synopsis:
SET CONTROL GAIN [{*input*} {*output*} [*DEFAULT*]]

Description:	
	If no parameters are given, returns the input and output gain ranges.
input	Input gain. Range: WT32: 0-16 (hex) , others: must be set to 0. Ignored in CVC enabled builds.
output	Output gain. Range: WT32: 0-16 (hex) , others: 0-7 (hex). For CVC enabled builds, the range is 0-F (hex).
DEFAULT	If given, configures given input and output gain as default values and save them in the persistent store.

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given.

Events:
None:

List format:
SET CONTROL GAIN {*default input*} {*default output*}

Note:

- When issuing the SET command, **SET CONTROL GAIN** always shows the default input/output gain levels, not the currently active ones.

- On A2DP **source** the input gain should be set to a low value, otherwise the A2DP audio quality will suffer radically.

- Listed below are the different parameter values and their corresponding approximate gains for the WT32.

Parameter value	Gain (dB)
0	-24
1	-21
2	-18
3	-15
4	-12
5	-9
6	-6
7	-3
8	0
9	3
a	6
b	9
c	12
d	15
e	18
f	21
10	24
11	27
12	30
13	33
14	36
15	39
16	42

7.73 SET CONTROL INIT

SET CONTROL INIT lists or changes the initialization command in iWRAP. This command is run when iWRAP is started or reset.

7.73.1 Syntax

Synopsis:
SET CONTROL INIT [*command*]

Description:	
	If no command is given, will erase the initialization command.
command	Any of the available iWRAP commands. This command is automatically executed every time iWRAP starts (after power-on, RESET or watchdog event)

Events:
None

List format:
SET CONTROL INIT {*command*}

7.73.2 Examples

To remove all pairings after reset:

```
SET CONTROL INIT SET BT PAIR *
```

To change baud rate to 115200 bps after reset:

```
SET CONTROL INIT SET CONTROL BAUD 115200,8n1
```

Warning!

Issuing **SET CONTROL INIT RESET** will cause iWRAP to enter an infinite reset loop, rendering it unusable until the persistent store user key #27 is removed by hand.

7.74 SET CONTROL MICBIAS

SET CONTROL MICBIAS controls the linear regulator that drives current through the dedicated mic bias pin.

7.74.1 Syntax

Synopsis:
SET CONTROL MICBIAS [{*voltage*} {*current*}]

Description:	
	If no parameters are given, returns current mic bias settings.
voltage	Voltage driven through the mic bias pin. Range 0-F (hex).
current	Current driven through the mic bias pin. Range: 0-F (hex). The setting values and their corresponding typical voltage and current ranges are in the table below.

Value	Voltage (V)	Current (mA)
0	1.61 - 1.80	0.237 - 0.394
1	1.65 - 1.86	0.296 - 0.492
2	1.71 - 1.93	0.354 - 0.589
3	1.76 - 1.98	0.412 - 0.687
4	1.84 - 2.06	0.471 - 0.785
5	1.89 - 2.14	0.530 - 0.883
6	1.97 - 2.23	0.589 - 0.980
7	2.04 - 2.32	0.647 - 1.078
8	2.18 - 2.46	0.706 - 1.176
9	2.27 - 2.58	0.764 - 1.273
10	2.39 - 2.72	0.823 - 1.371
11	2.50 - 2.87	0.882 - 1.469
12	2.70 - 3.09	0.940 - 1.566
13	2.85 - 3.29	0.998 - 1.664
14	3.07 - 3.56	1.057 - 1.762
15	3.28 - 3.84	1.116 - 1.859

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given.

Events:
None

List format:
SET CONTROL MICBIAS {*voltage*} {*current*}

Note:

- With WT32 you should not use the mic biasing directly, but only as a digital enable disable signal. The mic bias line suffers from a noise and the recommendation is to use an external mic biasing.

7.75 SET CONTROL MUX

SET CONTROL MUX can be used to enable or disable the multiplexing mode. This chapter describes the usage of the command as well as the operation of multiplexing mode.

7.75.1 Syntax

Synopsis:
SET CONTROL MUX {*mode*}

Description:	
mode	Multiplexing mode **0** Multiplexing mode disabled. Normal (data-command) mode enabled **1** Multiplexing mode enabled. Multiplexing protocol must be used to talk to iWRAP.

Events:	
READY	READY event occurs after a successful mode change.

List format:	
	Nothing is displayed when multiplexing mode is disabled.
SET CONTROL MUX 1	This string is displayed when multiplexing mode is enabled.

7.75.2 Examples

To enable multiplexing mode:

```
SET CONTROL MUX 1
¿READY.
```

To disable multiplexing mode

```
BF FF 00 11 53 45 54 20 43 4f 4e 54 52 4f 4c 20 4d 55 58 20 30 00
READY
```

The command is "**SET CONTROL MUX 0**" in the frame format used by MUX mode. The command must be sent in hex format, not in ASCII format.

Note:

- When multiplexing mode is enabled, no ASCII commands can be given to iWRAP but the multiplexing protocol must be used. Multiplexing mode can be disabled by deleting PSKEY_USR3 with PSTool.
- ASCII commands do not need to end with"\r" when multiplexing mode is used.

7.75.3 Using Multiplexing Mode

The multiplexing protocol format is presented below:

Length:	Name:	Description:	Value:
8 bits	SOF	Start of frame	0xBF
8 bits	LINK	Link ID	0x00 - 0x06 or 0xFF (control)
6 bits	FLAGS	Frame flags, reserved for future use	0x00
10 bits	LENGTH	Size of data field in bytes	-
0-1023 Bytes	DATA	Data	-
8 bits	nLINK	{LINK} XOR 0xFF	-

Table 10: Multiplexing frame format

When multiplexing mode is enabled, all the commands and data sent from host to iWRAP must be sent by using the frame format described above instead of plain ASCII commands. Also, the responses and data coming from iWRAP to the host are sent using the same format. iWRAP firmware autonomously processes the frames and decides whether they contain control commands or data which should be forwarded to its destination.

The advantage of multiplexing mode is that there is no need to do special command-data –command mode switching since data and commands are transmitted in the same mode. This saves a lot of time especially in multipoint scenarios, where - in the worst case - switching from data mode to command mode can take more than two seconds.

Also in scenarios where there are several connections, receiving data simultaneously from several devices is difficult if multiplexing mode is not used. In normal (data/command) mode, only one connection can be active (in data mode) at a time, and it can only be used to transmit or receive data. If there is any data received from the other connection during normal mode, the data is stored to small iWRAP buffers and received when the connections become active (data mode of the connection enabled).

The figure in the next page illustrates the host-iWRAP-host communications in multiplexing mode.

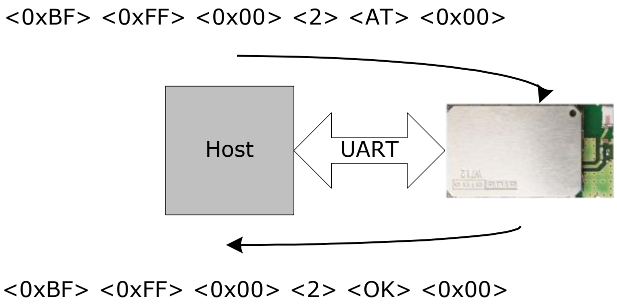

<0xBF> <0xFF> <0x00> <2> <AT> <0x00>
Host
UART
<0xBF> <0xFF> <0x00> <2> <OK> <0x00>

Figure 5: Host-iWRAP-Host communication

The figure below illustrates host-iWRAP-remote device communication when multiplexing mode is in use. The key thing is that the remote device does not need to know anything about the multiplexing communication and frame format, but it sees the connection as a standard Bluetooth connection.

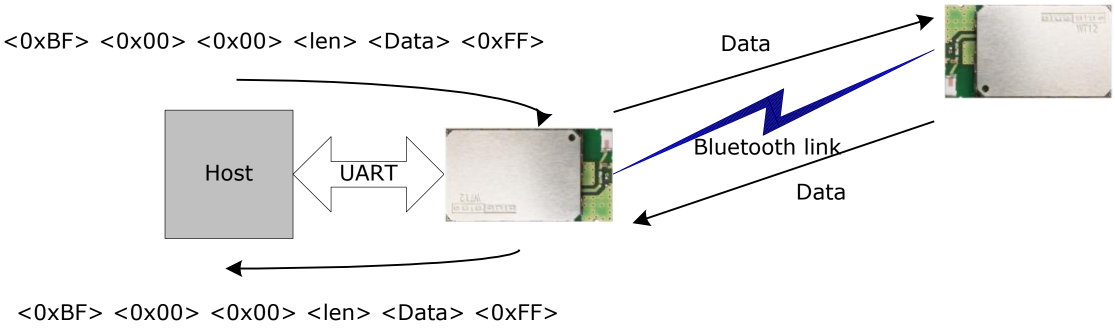

<0xBF> <0x00> <0x00> <len> <Data> <0xFF>
Data
Host
UART
Bluetooth link
Data
<0xBF> <0x00> <0x00> <len> <Data> <0xFF>

Figure 6: Host-iWRAP-remote device communications

At the moment, seven (7) simultaneous connections can be used in multiplexing mode.

Tips:

In MUX mode the processor of the module is highly utilized and on the edge of its performance. This may be seen as a instability of Bluetooth connections, especially if 3 or more connections are used or data rate is high. There are however a few tricks how the stability of the Bluetooth connections can be improved:

1. Use SNIFF mode: Using sniff mode reduces the rate the master device needs to poll the active connections are leaves more time for the processor to parse or generate the multiplexing protocol. Therefore as aggressive as possible sniff mode should be used.
2. Optimize Bluetooth packet size by using MTU option in CALL command: Using smaller Bluetooth packet size improves the multiplexing performance.

On the next page, there is a simple C-code example on how to create a simple multiplexing frame containing an iWRAP command.

```
//HOW TO CREATE A SIMPLE FRAME

char outbuf[128];                  //Buffer for frame

char* cmd = “SET”;                 //ASCII command

int link = 0xff, pos=0;            //0xFF for control channel

int len = strlen(cmd);             //Calc. length of ASCII command

//Generate packet

outbuf[pos++]=0xbf;                //SOF

outbuf[pos++]=link;                //Link  (0xFF=Control,  0x00  =  connection  1,
etc.)

outbuf[pos++]=0;                   //Flags

outbuf[pos++]=len;                 //Length

//Insert data into correct position in the frame

memmove(outbuf+pos cmd, len);

pos += len;                        //Move to correct position

outbuf[pos++]=link^0xff;           //nlink
```

7.76 SET CONTROL MSC

With iWRAP firmware, it is possible to transmit all the UART modem signals over the SPP (Serial Port Profile) Bluetooth link. The signals DSR, DTR, RTS, CTS, RI and DCD can be specified to GPIO pins on the WRAP THOR modules. The **SET CONTROL MSC** command is used to do this.

7.76.1 Syntax

Synopsis:
SET CONTROL MSC [[mode] [[DSR] [[DTR] [[RTS] [[CTS] [[RI] [[DCD] [RESET]]]]]]]

Description:	
mode	Mode of the device iWRAP connects to. The mode can be: **DTE** or **nDTE** and **DCE or nDCE** **NOTE:** DTE means that remote Bluetooth device is DTE (so iWRAP is DCE and device connected to iWRAP is DTE). nDTE and nDCE means that the signals are active low, not active high.
DSR	Data Set Ready. Select PIO with a bitmask. See the note below on how to select the PIO.
DTR	Data Terminal Ready. See the note below on how to select the PIO.
RTS	Request To Send. See the note below on how to select the PIO.
CTS	Clear To Send. See the note below on how to select the PIO.
RI	Ring Indicator. See the note below on how to select the PIO.
DCD	Data Carrier Detect. See the note below on how to select the PIO.
RESET	If RESET is written as the last parameter the IO states will be reseted after SPP connection disconnects.

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given.

Events:
None

Note:

- In iAP builds, PIOs 6 and 7 cannot be used in SET CONTROL MSC
- The PIO pin is selected with a bit mask. For example, if you want to use PIO3, you will then have a bit mask where the third bit is 1, that is, 1000. This bit mask value is then given in the command in hexadecimal format. 1000(bin) = 8(hex).
- If MUX mode is in use physical PIO statuses do not change even if SET CONTROL MSC is used, since in MUX mode it would be hard tell which of the connections defines the MSC signal statuses.
- When the connection is closed the status of MSC signals are not automatically reset, but they are left to the last known state.

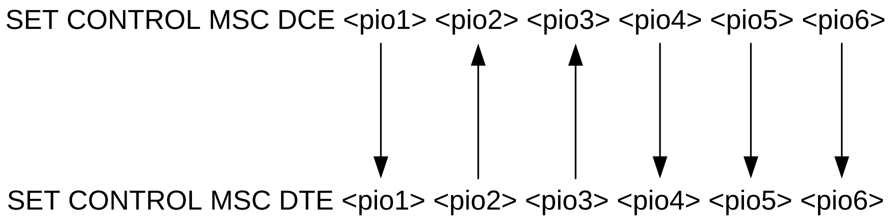

SET CONTROL MSC DCE <pio1> <pio2> <pio3> <pio4> <pio5> <pio6>
SET CONTROL MSC DTE <pio1> <pio2> <pio3> <pio4> <pio5> <pio6>

Figure 7: MSC signal directions

7.77 SET CONTROL PIO

This command set the initial direction and bias of the GPIOs after the boot.

7.77.1 Syntax

Synopsis:
SET CONTROL PIO {dir} {bias}

Description:	
dir	This is a bit mask, which defines the GPIO lines to modify. This parameter sets the contents of the PIO direction register. Setting a bit to 1 will make the corresponding GPIO an output. By default it has value of 0x00, that is, all pins are inputs.
bias	This is a bit mask, which defines the GPIO lines to modify. This parameter sets the contents of the PIO bias register. By default, all pins are pulled up/down weakly, that is, by default it has value of 0x00. Setting a bit to 1 will make the corresponding GPIO to have a strong pull up/down. It is valid only for input pins.

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given.

Events:
None:

List format:
SET CONTROL PIO {dir} {bias}

7.78 SET CONTROL PREAMP

This command enables of disables the 20dB microphone preamplifier on WT32.

7.78.1 Syntax

Synopsis:
SET CONTROL PREAMP {*left*} {*right*}

Description:	
left	**1** 20dB preamplifier is enabled for left channel **0** 20dB preamplifier is disabled for left channel
right	**1** 20dB preamplifier is enabled for right channel **0** 20dB preamplifier is disabled for right channel

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given.

Events:
None:

List format:
SET CONTROL PREAMP {*left*} {*right*}

7.79 SET CONTROL RINGTONE

Configures a ring tone that the HFP Hands-Free or HSP Headset will play when a RING event is received, but the Audio Gateway does not provide an in-band ring tone.

7.79.1 Syntax

Synopsis:
SET CONTROL RINGTONE {*ringtone*}

Description:	
	If no parameter is given, remove the ring tone.
ringtone	Ring tone to play. See the description of PLAY command for more details.

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given.

Events:
None:

List format:	
	Nothing is displayed if ring tone is not enabled.
SET CONTROL RINGTONE {*ringtone*}	This string is displayed when ring tone is enabled.

7.80 SET CONTROL READY

This command can be used to dedicate a GPIO pin to indicate that the iWRAP firmware is ready to be used. A typical use case is to indicate a reset condition.

7.80.1 Syntax

Synopsis:
SET CONTROL READY {*piomask*}

Description:	
piomask	A piomask to indicate which GPIOs are used for the signal. Value **0** disables the feature.

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given.

Events:
None:

List format:	
SET CONTROL READY {*piomask*}	This string is displayed when ring tone is enabled.

7.80.2 Examples

Using PIO7 to indicate iWRAP ready state.

```
SET CONTROL READY 80
```

7.81 SET CONTROL VOLSCALE

Maps WT32's codec output gains to VOLUME command levels. min_gain is used with VOLUME 0, max_gain with VOLUME 15. This is useful where the default maximum gain (0x16) would cause distortion.

The formula for calculating the gain for each volume level is:

output_gain = min_gain + (((volume << 8) / VOLUME_MAX * (max_gain - min_gain)) >> 8)

7.81.1 Syntax

Synopsis:
SET CONTROL VOLSCALE [{min_gain} {max_gain}]

Description:	
min_gain	Sets the minimum gain which can be set with VOLUME 0 command. Format:Hex Value range: 0-16
max_gain	Sets the maximum gain which can be set with VOLUME 15 command. Format:Hex Value range: 0-16

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given.

Events:
None:

List format:	
SET CONTROL VOLSCALE {min_gain} {max_gain}	This string is displayed when volscale is enabled.

Notes:

- SET CONTROL VOLSCALE without parameters lists the current settings
- SET CONTROL VOLSCALE 0 0 disables command

7.82 SET CONTROL VREGEN

SET CONTROL VREGEN is used to set the behavior of the internal software-controlled regulator on the module. The PIO's specified by the ***PIO mask*** parameter will be pulled high by the regulator as specified by the ***mode*** parameter.

7.82.1 Syntax

Synopsis:
SET CONTROL VREGEN {*mode*} {*PIO mask*}

Description:	
mode	**0** Regulator is enabled on rising edge when its input voltage (VREG_ENA) rises past around 1V and will hold the PIO's high. **Warning:** using this mode may or may not, depending on your setup, keep the module powered on until its power source is disconnected or regulator mode is switched! **1** Regulator is enabled on rising edge (of VREG_ENA) and holds the PIO voltage up until a falling edge is encountered, at which point the regulator will pull the voltage down. **2** Regulator is enabled on rising edge and holds the voltage up until another rising edge followed by a falling edge is encountered, at which point the regulator will bring the voltage down.
PIO mask	Bit mask used to specify which PIO's are held up by the regulator. This parameter is given in hexadecimal format.

Response:	
SYNTAX ERROR	This event occurs if incorrect parameters are given.

Events:
None

List format:

SET CONTROL VREGEN {*mode*} {*PIO mask*}

7.82.2 Examples

Building a setting in which a switch is toggled to power on the module, and keep it powered on until the switch is first toggled back, then toggled up and down again (rising edge followed by falling edge); PIO2 is pulled high to hold up an external regulator

SET CONTROL VREGEN 2 4 (4 in hexadecimal is 100 in binary)

Note:

- Valid for WT32 only
- See the WT32 Design Guide located at http://techforum.bluegiga.com for further information on the design of the module and regulator**.**

7.83 SET {link_id} ACTIVE

This command disables all the power save modes for the defined, active Bluetooth link and sets it into active mode.

7.83.1 Syntax

Synopsis:
SET {*link_id*} ACTIVE

Description:	
link_id	Numeric connection identifier

Events:
None

7.83.2 Examples

Changing from SNIFF to active:

```
LIST

LIST 1

LIST 0 CONNECTED RFCOMM 320 0 0 3 8d 8d 00:60:57:a6:56:49 1 OUTGOING SNIFF MASTER
PLAIN

SET 0 ACTIVE

LIST

LIST 0 CONNECTED RFCOMM 320 0 0 3 8d 8d 00:60:57:a6:56:49 1 OUTGOING ACTIVE MASTER
PLAIN
```

7.84 SET {link_id} MASTER

This command attempts to switch the link to Piconet master. Notice that this may not be allowed by the remote end.

7.84.1 Syntax

Synopsis:
SET {*link_id*} MASTER

Description:	
link_id	Numeric connection identifier

Events:
None

7.84.2 Examples

Changing from slave to master:

```
LIST

LIST 1

LIST 0 CONNECTED RFCOMM 320 0 0 3 8d 8d 00:60:57:a6:56:49 1 OUTGOING ACTIVE SLAVE PLAIN

SET 0 MASTER

LIST

LIST 0 CONNECTED RFCOMM 320 0 0 3 8d 8d 00:60:57:a6:56:49 1 OUTGOING ACTIVE MASTER PLAIN
```

7.85 SET {link_id} MSC

This command can be used to set the MSC (ETSI TS 07.10 modem control signals) of a particular SPP link. With this command the MSC statuses can be changed without physically binding them to PIO lines with SET CONTROL MSC.

7.85.1 Syntax

Synopsis:
SET {*link_id*} MSC {msc}

Description:	
link_id	Numeric connection identifier. Defines which connection's msc is controlled.
msc	Bitmask defining the control signal statuses. **Bit 0** The EA bit is set to 1 in the last octet of the sequence; in other octets EA is set to 0. iWRAP will automatically set this to 1. **Bit 1** Flow Control (FC). The bit is set to 1 when the device is unable to accept frames. Flow control is automatically handled by the RFCOMM stack, so this bit is reserved and shall be set to zero. **Bit 2** Ready To Communicate (RTC). The bit is set to 1 when the device is ready to communicate. **Bit 3** Ready To Receive (RTR). The bit is set to 1 when the device is ready to receive data. **Bit 4** Reserved for future use. Set to 0. **Bit 5** Reserved for future use. Set to 0. **Bit 6** Incoming call indicator (IC). The bit is set to 1 to indicate an incoming call. **Bit 7** Data Valid (DV). The bit is set to 1 to indicate that valid data is being sent.

Events:
None

7.86 SET {link_id} SLAVE

This command attempts to switch the link to Piconet slave. Notice that this may not be allowed by the remote end.

7.86.1 Syntax

Synopsis:
SET {*link_id*} SLAVE

Description:	
link_id	Numeric connection identifier

Events:
None

7.87 SET {link_id} SNIFF

This command attempts to enable SNIFF mode for the defined Bluetooth link. Whether this command is successful or not, depends on if the remote end allows sniff to be used.

7.87.1 Syntax

Synopsis:

SET {*link_id*} SNIFF {max} {min} [{attempt} {timeout}]
or
SET {*link_id*} SNIFF {avg}

Description:	
max	Maximum acceptable interval in milliseconds Range: **0004** to **FFFE**; only even values are valid Time = ***max*** * 0.625 msec Time range: 2.5 ms to 40959 ms
min	Minimum acceptable interval in milliseconds Range: **0002** to **FFFE**; only even values, up to ***max***, are valid Time = ***min*** * 0.625 ms Time range: 1.25 ms to 40959 ms
attempt	Number of Baseband receive slots for sniff attempt. Length = N* 1.25 ms Range for N: **0001 – 7FFF** Time range: 0.625ms - 40959 ms
timeout	Number of Baseband receive slots for sniff timeout. Length = N * 1.25 ms Range for N: **0000 – 7FFF** Time range: 0 ms - 40959 ms
avg	Shortcut, sets ***max*** to 1.5 * ***avg***, ***min*** to 0.67 * ***avg***, ***attempt*** to 1 and ***timeout*** to 8.

Events:
None

Note:

- Supervisor timeout set with “**SET BT ROLE**” must be longer than maximum acceptable sniff interval.

7.88 SET {link_id} SUBRATE

This command attempts to enable sniff subrating mode for the defined Bluetooth link. Whether this command is successful or not, depends on if the remote end allows sniff subrate mode to be used.

Sniff sub-rating (SSR) provides a means to further reduce power consumed by link management. SSR allows either device to increase the time between sniff anchor points. While this change will reduce the responsiveness of the link, it also reduces the number of packets that are exchanged to maintain the link and thus reduces power consumption.

SSR is particularly useful for devices that have periods of activity separated by long periods of inactivity. A computer mouse would be a good example. A user working with a word processor might use the mouse to open a document and position the cursor. Once that is accomplished the user might use only the keyboard for an extended time, never touching the mouse. During these periods of inactivity, the mouse can move into SSR mode and reduce its power consumption.

7.88.1 Syntax

Synopsis:
SET {*link_id*} SUBRATE {*remote_latency*} {*remote_timeout*} {*local_latency*}

Description:	
link_id	Numeric connection identifier
remote_latency	The value is specified in units of baseband slots (625 µs). This value is used by the link manager (LM) layer to calculate the value of max_sniff_subrate, which is sent as a parameter of the LMP command used to start sniff subrating.
remote_timeout	The value Is specified in units of baseband slots (625 µs). This value is used by the link manager (LM) layer to determine when to transition a device from sniff mode to sniff sub-rating mode.
local_latency	The value is specified in units of baseband slots (625 µs). This value is used by the link manager (LM) layer to calculate the value of max_sniff_subrate, which is sent as a parameter of the LMP command used to start sniff subrating.

Events:
None

Note:

Refer to the Bluetooth specification for more information.

7.89 SET {link_id} SELECT

With this command, you can define the active Bluetooth connection for the iWRAP command wrapped. This command is useful for example when two simultaneous Hands-Free connections or one Hands-Free connection and one A2DP connection is used

7.89.1 Syntax

Synopsis:
SET {*link_id*} SELECT

Description:	
link_id	Numeric connection identifier of the link where the modem status is to be sent.

Response:
No response

Note:

- iWRAP uses an internal command parser/wrapped with some Bluetooth profiles like Hands-Free profile. The internal parser handles commands like HANGUP, VOLUME etc. and transfers them into AT-commands defined in the Hands Free profile specification. To be able to send the commands you need to have correct Bluetooth link / parser selected and this can be done with **SET {link_id} SELECT** command.

7.90 SET PROFILE

The **SET PROFILE** command can be used to enable or disable the available Bluetooth profiles: SPP, OPP, HFP and HFP-AG, A2DP, AVRCP and HID.

7.90.1 Syntax

Synopsis:
SET PROFILE {*profile_name*} [*SDP_name*]

Description:	
profile_name	Specify the profile to be enabled or disabled. Possible profile acronyms are: **SPP** Serial Port Profile **HFP** Hands Free Profile **HFP-AG** Hands Free Profile Audio Gateway **OPP** Object Push Profile **A2DP SINK** Advanced Audio Distribution Profile Sink mode. SDP name can not be changed with A2DP sink. Profile is disabled with "**SET PROFILE A2DP**" **A2DP SOURCE** Advanced Audio Distribution Profile Source mode. SDP name can not be changed with A2DP sink. Profile is disabled with "**SET PROFILE A2DP**" **AVRCP CONTROLLER** A/V Remote Control Profile controller mode. No ***SDP_name*** can be given. **AVRCP TARGET** A/V Remote Control Profile target mode. No ***SDP_name*** can be given.

	HID {features} {subclass} {version} {country_code} {BTlang} {USBlang} {service_name} Please see HID application note for more information about the profile syntax. **HSP** HSP profile in Headset mode. No ***SDP_name*** can be given. **HSP-AG** HSP Audio Gateway mode. No ***SDP_name*** can be given. **HDP SINK {mdep}** Health Device Profile sink. ***mdep*** defines the IEEE device data type. **HDP SOURCE {mdep}** Health Device Profile source. ***mdep*** defines the IEEE device data type. **PBAP** Phone Book Access Profile client. No ***SDP_name*** can be given.x **BGIO** Bluegiga IO Profile sensor mode **OTA** Bluegiga OTA profile
SDP_name	**ON** Enables the profile with default SDP name. ***<string>*** Enables the profile with ***string*** used as SDP name. Maximum length is 49 characters. Notice that SDP name can ne be set for the following profiles: A2DP, HSP and HID If this parameter is not given, the profile will be disabled.

Response:
No response

7.90.2 Examples

Example of enabling HFP profile.

```
SET PROFILE HFP My Hands-Free

SET
SET BT BDADDR 00:07:80:80:c2:37
SET BT NAME WT12
SET BT CLASS 001f00
SET BT AUTH * 6666
SET BT LAP 9e8b33
SET BT PAGEMODE 4 2000 1
SET BT ROLE 0 f 7d00
SET BT SNIFF 0 20 1 8
SET CONTROL BAUD 115200,8n1
SET CONTROL CD 80 0
SET CONTROL ECHO 7
SET CONTROL ESCAPE 43 00 1
SET CONTROL MSC DTE 00 00 00 00 00 00
SET PROFILE HFP My Hands-Free
SET PROFILE SPP Bluetooth Serial Port
SET
RESET
```

Example of enabling OTA profile. The ***password*** is needed to connect the OTA profile.

```
SET PROFILE OTA password
SET
SET BT BDADDR 00:07:80:80:c2:37
SET BT NAME WT12
SET BT CLASS 001f00
SET BT AUTH * 6666
SET BT LAP 9e8b33
SET BT PAGEMODE 4 2000 1
SET BT ROLE 0 f 7d00
SET BT SNIFF 0 20 1 8
SET CONTROL BAUD 115200,8n1
SET CONTROL CD 80 0
SET CONTROL ECHO 7
SET CONTROL ESCAPE 43 00 1
SET CONTROL MSC DTE 00 00 00 00 00 00
SET PROFILE OTA
SET
RESET
```

Note:

- iWRAP must be reset for the profile to be activated or deactivated.
- With PBAP profile no SDP name can be given. The only possible ***SDP_name*** is **ON**.
- If you want to use the HFP or HFP-AG audio profiles, enable also the support for SCO links, by setting “**SET CONTROL CONFIG**” bit 8 to 1. This is “**SET CONTROL CONFIG 100**” if no other configuration bits are enabled. This is only required with iWRAP 2.2.0.

7.91 SET RESET

The **SET RESET** command returns the factory settings of the module.

7.91.1 Syntax

Synopsis:
SET RESET

Description:
None.

Response:
iWRAP resets.

Events:
None

Note:

- **SET RESET** does not clear the pairings. They must be reset with "**SET BT PAIR ***".

7.92 SLEEP

The **SLEEP** command will force deep sleep on. After issuing this command, the module will enter deep sleep until a Bluetooth connection is received or something is received from the UART interface in command mode. The SLEEP command will also work when there are one or more active connections and iWRAP is in command mode and sniff power saving mode is used for the connections.

Deep sleep mode puts the processor into a reduced duty cycle mode.

7.92.1 Syntax

Synopsis:
SLEEP

Description:
None.

Response:
None

Events:
None

Note:

- If UART data is used to wake up the module from the deep sleep, the first byte sent to UART is “lost” to wake the module up.
- Refer to power consumption documents for more information about power consumption in deep sleep mode.
- Deep sleep might sometimes be used even if there are active Bluetooth connections. However all the connections need to ne in aggressive sniff power saving mode.
- With iAP profile the deep sleep only works if PSKEY_PIO_DEEP_SLEEP_EITHER_LEVEL is set to be 0xc0

7.93 SSPAUTH

SSPAUTH command can be used to authenticate incoming SSP pairing attempts. It is used to reply to **SSPAUTH** events. SSPAUTH events will occur after they are enabled from SET CONTROL CONFIG (bit 4 of *optional_block_1*).

7.93.1 Syntax

Synopsis:
SSPAUTH {*bd_addr*} [OK]

Description:	
bd_addr	Bluetooth device address of the remote device trying to connect.
OK	Optional flag, which decides if the connection is accepted or not. If the flag is used the connection is accepted and if it is not used the connection is declined.

Response:
None

Events:
None

7.93.2 Examples

Allowing a SSP pairing attempt to enter the pairing process. Note: could be followed by SSP CONFIRM or SSP PASSKEY.

```
SSPAUTH 00:07:80:90:f5:47?
SSPAUTH 00:07:80:90:f5:47 OK
```

7.94 SSP CONFIRM

SSP CONFIRM command is used to confirm or cancel SSP requests from other Bluetooth devices.

7.94.1 Syntax

Synopsis
SSP CONFIRM {*bd_addr*} [*OK*]

Description	
bd_addr	Bluetooth device address of the device initiating SSP request
OK	OK flag confirms the SSP request. If left empty the request is denied.

Response
None

Events
None

7.95 SSP PASSKEY

SSP PASSKEY command is used to confirm or cancel SSP PASSKEY requests from other Bluetooth devices.

7.95.1 Syntax

Synopsis
SSP PASSKEY {*bd_addr*} {*pass_key*}

Description	
bd_addr	Bluetooth device address of the device initiating SSP request
pass_key	Common pass key used for authentication

Response
None

Events
None

7.96 SSP GETOOB

This command can be used to retrieve an Out-of-Band pairing key pair from iWRAP, to be sent to the other party over a different medium. Retrieving a new OOB key pair invalidates any previously retrieved key pairs.

7.96.1 Syntax

Synopsis
SSP GETOOB

Description
None

Response	
SSP SETOOB H:{key1} R:{key2}	
key1	128-bit security key
key2	123-bit security key

Events
None

Get OOB-keys from iWRAP

```
SSP GETOOB
SSP SETOOB H:fc3e453f7f3f6ff0bf226e26385ec538 R:bbca555c64244fe6696c004c9be61ac4
```

7.97 SSP SETOOB

This command can be used to set the Out-of-Band pairing key pair received from the remote device into iWRAP.

7.97.1 Syntax

Synopsis
SSP SETOOB H:{key1} R:{key2}

Description	
key1	128-bit security key
key2	123-bit security key

Response
None

Events
None

Set OOB-keys into iWRAP

```
SSP SETOOB H:fc3e453f7f3f6ff0bf226e26385ec538 R:bbca555c64244fe6696c004c9be61ac4
```

7.98 TEMP

This command reads the value of internal temperature sensor. This value should not be considered very reliable. The value can be compensated by modifying PS-key PSKEY_TEMPERATURE_CALIBRATION.

7.98.1 Syntax

Synopsis:
TEMP

Description:
None.

Response:	
TEMP {*temp*}	
temp	Temperature in Celsius

Events:
None.

7.98.2 Examples

Reading the value of internal temperature sensor.

```
TEMP
TEMP 31
```

Note:

- The refresh rate of the temperature sensor is not very high.

7.99 TEST

The **TEST** command is used to give radio test commands to iWRAP. The commands are the same that can be given by using CSR BlueTest software. TEST commands must only be used for testing purposes, not for application functionality.

7.99.1 Syntax

Synopsis:
TEST {*mode*} [*mode_specific_parameters*]

Description:	
mode & ***mode_specific_parameters***	RF Test mode Supported test modes are: **RAW {testid} {param1} {param2} {param3}** Raw tunnel for launching any CSR RF test. Takes always three parameters evet though the test would require less parameters. Set the unused parameters to 0. **PAUSE** Pause halts the current test and stops any radio activity. **TXSTART {lo_freq} {level} {mod_freq}** Enables the transmitter in continuous transmission at a designated frequency (**lo_freq**) with a designated output power (**level**) and designated tone modulation frequency (**mod_freq**). **lo_freq:** range 2402 – 2480 (MHz) **level**: 0xYYZZ where YY corresponds to Radio Power Table's "Basic Ext PA" and can range from 00 to FF (that is, 0 to 255 in decimal, as seen in the Radio Power Table's view of PSTool) while ZZ corresponds to "Basic Int PA" and can range from 00 to 3F (0 to 63) **mod_freq:** range 0 – 32767 (recommended values 0 or 256) **TXDATA1 {lo_freq} {level}** Enables the transmitter with a designated frequency (**lo_freq**) and output power (**level)**. Payload is PRBS9 data. In this mode, the receiver is not operating. **TXDATA2 {cc} {level}** Enables the transmitter with a simplified hop sequence designated by country code **{cc}** and output power **{level}**. Payload is PRBS9 data. In this mode, the receiver is not operating. Related test spec name: **TRM/CA/01/C** (output power),

TRM/CA/02/C (power density).

cc range: 0 – 3 (default = 0)

RXSTART {lo_freq} {highside} {attn}

Enables the receiver in continuous reception at a designated frequency (**lo_freq**) with a choice of low or high side modulation (**highside**) and with designated attenuation setting (**attn**).

highside range: 0 or 1 (default = false = 0)

attn: range: 0 – 15

DEEPSLEEP

Puts the module into deep-sleep after a delay of half a second until woken by a reset or activity on UART.

PCMLB {pcm_mode}

Sets the PCM to loop back mode, where the data read from PCM input is output again on the PCM output.

If **pcm_mode** = 0, module is slave in normal 4-wire configuration

If **pcm_mode** = 1, module is master in normal 4-wire configuration

If **pcm_mode** = 2, module is master in Manchester encoded 2-wire configuration

PCMEXTLB {pcm_mode}

Sets the PCM to external loop back mode, whereby the data written to PCM output is read again on the input. Check is made that the data read back is the same as that written.

The external loop back may be a simple wire.

Modes are save as above.

LOOPBACK {lo_freq} {level}

Receives data on set frequency **lo_freq** for data packets and then retransmits this data on the same channel at output power **level**.

CFGXTALFTRIM {xtal_ftrim}

This command can be used to set the crystal frequency trim value directly from iWRAP. This is not a permanent setting!

xtal_ftrim range: 0 – 63

PCMTONE {freq} {ampl} {dc}

Plays a constant tone on the PCM port.

freq range: 0 – 5

ampl range : 0-8

dc: 0 – 60096 (set to 0)

SETPIO {mask} {bits}

	Sets PIO high or low according to given parameters. NOTE: This command sets the PIO regardless of other usage! **mask**: Bit mask specifying the PIOs that are to be set **bits**: the bit values If you use hexadecimals, put 0x in front of the value, otherwise they are interpreted as decimals. **GETPIO** Gets the status of all the PIO lines. **AUDIOLOOPBACK {freq} {mono} {interface}** Loops back the audio received from the audio input to the audio output using **freq** sampling rate. On WT32, valid sampling rates are 8000, 11025, 22050, 32000, 44100 and 48000. On other modules, only 8000 is valid for the default PCM codec. **48000 is a valid rate only if the internal PCM codec is not selected.** If **mono** is set to 0, both input channels are looped to their respective output channels. If **mono** is set to 1, the left input channel will be looped to both left and right output channels where applicable. This parameter is meaningful only on WT32, on other modules its value does not matter. The parameter **interface** selects which of the configured interfaces in SET CONTROL AUDIO to use; 0 selects the SCO interface, 1 selects the A2DP interface. Once again, this parameter is only meaningful on WT32, which has I2S, SPDIF and internal PCM interfaces in addition to the possibility of using an external PCM.

Response:
OK for successful execution **ERROR** for unsuccessful execution

7.99.2 Examples

TEST TXSTART 2441 0xFF3F 0 (Enables carrier wave @ 2441Mhz)
OK

TEST PCMTONE 1 5 0 (Enables PCM tone signal)
OK

Note:

- Always consult Bluegiga Technologies about the right parameters for RF testing. The TX power parameters are unique for each module: WT11, WT12 and WT32.

- If **TEST** command is used a reset should be made before returning to normal operation.

7.100 TESTMODE

The **TESTMODE** command is used to put the iWRAP into a Bluetooth test mode, where a Bluetooth tester can control the hardware. Reset must be done to recover normal operation.

7.100.1 Syntax

Synopsis:
TESTMODE

Description:
No description.

Response:
TEST 0

Events:
None

7.101 TXPOWER

The **TXPOWER** command can be used check the TX output power level of an active Bluetooth link.

7.101.1 Syntax

Synopsis:
TXPOWER {*link_id*}

Description:	
link_id	Numeric connection identifier

Response:	
TXPOWER {*bd_addr*} {*txpower*}	
bd_addr	Bluetooth address of the remote device
txpower	User TX power level in dBm

Events:
None

7.101.2 Examples

Checking the TX power level of an active connection:

```
LIST
LIST 1
LIST 0 CONNECTED RFCOMM 320 0 0 3 8d 8d 00:60:57:a6:56:49 1 OUTGOING ACTIVE MASTER
PLAIN
TXPOWER 0
TXPOWER 00:60:57:a6:56:49 3              (TX power level is 3 dBm)
```

7.102 PBAP

PBAP command is used to retrieve phone book entries or call history from a PBAP PSE device.

7.102.1 Syntax

Synopsis
PBAP {*path*} {*count*} [*offset*] [*filter*] [*format*]

Description		
path	**Left HEX** Store to retrieve data from. **0** Phone **1** SIM card	**Right HEX** Phone book or call history to read. **0** Phonebook **1** Incoming call history **2** Outgoing call history **3** Missed call history **4** Combined call history
count	Number of entries to be retrieved. **0** Returns phone book size **FFFF** Retrieves all entries	
offset	Offsets from which to start the retrieve from.	
filter	This is a bit mask to filter the response. If this is left to 0 all fields will be returned. Mandatory attributes for vCard 2.1 are VERSION ,N and TEL and they are returned always. Mandatory attributes for vCard 3.0 are VERSION, N, FN and TEL and they are also returned always. **bit 0**	

	VERSION vCard Version **Bit 1** FN Formatted pbap Name **bit 2** N Structured Presentation of Name **bit 3** PHOTO Associated Image or Photo **bit 4** BDAY Birthday **bit 5** ADR Delivery Address **bit 6** LABEL Delivery **bit 7** TEL Telephone Number **bit 8** EMAIL Electronic Mail Address **bit 9** MAILER Electronic Mail **bit 10** TZ Time Zone **bit 11** GEO Geographic Position **bit 12** TITLE Job **bit 13** ROLE Role within the Organization **bit 14** LOGO Organization Logo **bit 15** AGENT vCard of Person Representing **bit 16** ORG Name of Organization

	bit 17 NOTE Comments **bit 18** REV Revision **bit 19** SOUND Pronunciation of Name **bit 20** URL Uniform Resource Locator **bit 21** UID Unique ID **bit 22** KEY Public Encryption Key **bit 23** NICKNAME Nickname **bit 24** CATEGORIES Categories **bit 25** PROID Product ID **bit 26** CLASS Class information **bit 27** SORT-STRING String used for sorting operations **bit 28** X-IRMC-CALL-DATETIME Time stamp
format	**1** Return vcard 3.0 **0** Return vcard 2.1

Response	
{OBEX header} {vCARD}	
OBEX header	OBEX header. See the header descriptions below.
vCARD	vCARD data

Length	Name	Description	Value
8 bits	Begin	Start of OBEX frame.	0xFC (last frame) or 0xFB (more frames to follow)
8 bits	Length	Length of full frame	0x00 – 0xFF
8 bits	Length	Length of full frame	0x00 – 0xFF
8 bits	Body	Body or end-of-body.	0x49 (last frame) 0x48 (more frames to follow)
8 bits	Length of data	Length of data field	0x00 – 0xFF
8 bits	Length of data	Length of data field	0x00 – 0xFF

Table 11: OBEX header

Events	
OBEX AUTH	This event occurs if the server requires authentication

7.102.2 Examples

This example will retrieve the first 2 phone book entries from the phone memory.

NOTE: OBEX frame in brackets.

```
PBAP 00 2

{0xFC 0x00 0xD8 0x4} 0x01 0xD2} BEGIN:VCARD
VERSION:2.1
N:
TEL:
END:VCARD
BEGIN:VCARD
VERSION:2.1
REV:20090209T230141Z
UID:33e2c83138e30149-00e1403769bb27b9-389
N:Emergency;Number;;;
X-CLASS:private
TEL;VOICE;WORK:+112
END:VCARD
```

This example read first six placed calls from the phone.

NOTE: OBEX frames bold and in brackets.

```
PBAP 02 6

{0xFB 0x01 0xFF 0x48 0x01 0xFC}BEGIN:VCARD
VERSION:2.1
N:
TEL:+1234567896
X-IRMC-CALL-DATETIME;DIALED:20090414T082710Z
END:VCARD
BEGIN:VCARD
VERSION:2.1
N:
TEL:+1234567895
X-IRMC-CALL-DATETIME;DIALED:20090414T082707Z
END:VCARD
BEGIN:VCARD
VERSION:2.1
```

```
N:
TEL:+1234567894
X-IRMC-CALL-DATETIME;DIALED:20090414T082704Z
END:VCARD
BEGIN:VCARD
VERSION:2.1
N:
TEL:+1234567893
X-IRMC-CALL-DATETIME;DIALED:20090414T082623Z
END:VCARD
BEGIN:VCARD
VERSION:2.1
N:
TEL:+1234567892
X-IRMC-CALL-DATETIME;DIALED:20090414T08262{0xFC 0x00 0x7D 0x49 0x00 0x7A}0Z
END:VCARD
BEGIN:VCARD
VERSION:2.1
N:
TEL:+1234567891
X-IRMC-CALL-DATETIME;DIALED:20090414T082613Z
END:VCARD
```

7.103 VOLUME

Command **VOLUME** is used to modify and read the module's line out volume level. The command also reports the volume level to HFP-AG in case HFP connection is active.

7.103.1 Syntax

Synopsis:
VOLUME [{*vol*}]

Description:	
vol	New volume level value; leave blank to read current volume level. **0…15** Sets volume level: Range 0-15. In iWRAP 3.0.0 the range is 0-9. **down** Decreases volume level by one. **up** Increases volume level by one.

Response:
None

Events:	
VOLUME {vol}	Current volume level.

8 iWRAP Events

Events are a mechanism that iWRAP uses to notify the user for completed commands, incoming connections etc.

Note:

- If iWRAP is in data mode (data is being transmitted and no multiplexing mode is used) the only possible event is **NO CARRIER** indicating that connection was closed or lost.

- iWRAP is designed so that unwanted events can be safely ignored. Events **CONNECT**, **NO CARRIER** and **RING** change the mode of operation and therefore they cannot be ignored.

- Events can be masked away by removing **Bit 2** from command **SET CONTROL ECHO**.

8.1 AUTH

AUTH event indicates that someone is trying to pair with iWRAP.

8.1.1 Syntax

Synopsis:
AUTH {*bd_addr*}?

Description:	
bd_addr	Bluetooth device address of the remote device

Note:

- The **AUTH** event occurs only if interactive pairing is enabled with "**SET CONTROL CONFIG**" command.

8.2 BATTERY

The **BATTERY** event is used to report the current battery voltage to the user.

8.2.1 Syntax

Synopsis:
BATTERY {*mv*}

Description:	
mv	Current battery voltage in millivolts.

8.3 CONNECT

The **CONNECT** event is used to notify the user for a successful link establishment.

8.3.1 Syntax

Synopsis:
CONNECT {*link_id*} {SCO | RFCOMM | A2DP | HID | HFP | HFP-AG {*target*} [*address*]}

Description:	
link_id	Numeric connection identifier
target	Connected RFCOMM channel number or L2CAP psm
address	Address of the remote end. This is displayed only if bit 5 is set in "**SET CONTROL CONFIG**".

Note:

iWRAP automatically enters data mode after the **CONNECT** event if multiplexing mode is disabled.

8.4 CONNAUTH

The **CONNAUTH** event indicates an incoming Bluetooth connection, which needs to be authorized with the **CONNAUTH** command.

8.4.1 Syntax

Synopsis:
CONNAUTH {*bd_addr*} {*protocol_id* } {*channel_id*}?

Description:	
bd_addr	Bluetooth device address of the remote device
protocol_id	Protocol ID of the incoming connection **1** Security manager - Bonding **2** L2CAP **3** RFCOMM
channel_id	Channel number of the incoming connection. Either PSM in the case of L2CAP or channel number in the case of RFCOMM

Response:
None

Events:
None.

Note:

- By default the connections are accepted automatically. **CONNAUTH** events need to be separately enabled with **SET CONTROL CONFIG** command (bit 4 of *optional_block_1*).
- **CONNAUTH** events will **not** be generated for connections using an authenticated (MITM-enabled) SSP link key, because the CSR baseband controller will treat such links authenticated by definition.

8.5 CLOCK

CLOCK event indicates the Piconet clock value for a specific Bluetooth connection.

8.5.1 Syntax

Synopsis:
CLOCK {*bd_addr*} {*clock*}

Description:	
bd_addr	Bluetooth device address of the remote device
clock	Piconet clock value

All the devices in a Bluetooth Piconet are synchronized to a same clock (master clock). The CLOCK event displays the clock value and it can for example be used for time synchronization of the Piconet slaves and master. The accuracy of the Piconet clock is 625us.

8.6 HID

HID output report creates HID event in iWRAP. The HID output report indicates the CAPS LOCK etc. led statuses back to the HID device. For more information please refer to iWRAP HID application note.

8.6.1 Syntax

Synopsis:
HID {link_id} OUTPUT {data_length} {data}

Description:	
link_id	Numeric connection identifier. Indicates from which link the HID Output Report is coming from.
data_length	Describes the length of the HID output report payload
data	The HID output report payload.

8.7 IDENT

IDENT event informs that a remote Bluetooth device has been identified by using the Device ID profile and reports the identification data sent by the remote device.

8.7.1 Syntax

Synopsis:
IDENT {*src*}:{*vendor_id*} {*product_id*} {*version*} "[*descr*]"

Description:	
src	This attribute indicates which organization assigned the VendorID attribute. There are two possible values: BT for the Bluetooth Special Interest Group (SIG) or USB for the USB Implementer's Forum.
vendor_id	Intended to uniquely identify the vendor of the device. The Bluetooth SIG or the USB IF assigns VendorIDs. Bluegiga's VendorID is 47.
product_id	Intended to distinguish between different products made by the vendor in question. These IDs are managed by the vendors themselves, and should be changed when new features are added to the device.
version	Vendor-assigned version string indicating device version number.
descr	Optional freeform product description string.

8.8 IDENT ERROR

IDENT ERROR event informs that a remote Bluetooth could not be identified by the Device ID profile.

8.8.1 Syntax

Synopsis:
IDENT ERROR {*error_code*} {*address*} [*message*]

Description:	
error_code	Code describing the error
address	Bluetooth address of the device
message	Optional verbose error message

8.9 INQUIRY_PARTIAL

The **INQUIRY_PARTIAL** event is used to notify the user for a found Bluetooth device. This event precedes response for the **INQUIRY** command.

8.9.1 Syntax

Synopsis:
INQUIRY_PARTIAL {*address*} {*class_of_device*} [{*cahced_name*} {*rssi*}]

Description:	
address	Bluetooth address of the found device
class_of_device	C Bluetooth Class of Device of the found device
cached_name	User friendly name of the found device if already known
rssi*	Received Signal Strength of the found device

*) RSSI is a value between -128 and +20. The lower the value, the lower the signal strength.

Note:

***cached_name* and *rssi* are only visible if “Inquiry with RSSI” is enabled with “SET CONTROL CONFIG”.**

8.10 NO CARRIER

The **NO CARRIER** event is used to notify the user for a link loss or, alternatively, a failure in the link establishment.

8.10.1 Syntax

Synopsis:
NO CARRIER {*link_id*} ERROR {*error_code*} [*message*]

Description:	
link_id	Numeric connection identifier
error_code	Code describing the error
message	Optional verbose error message

8.11 NAME

The **NAME** event is used to notify the user for a successful lookup for Bluetooth friendly name of the remote device.

8.11.1 Syntax

Synopsis:
NAME {*address*} {"*friendly_name*"}

Description:	
address	Bluetooth device address of the device
friendly_name	Friendly name of the device

8.12 NAME ERROR

The **NAME ERROR** event is used to notify the user for a Bluetooth friendly name lookup failure.

8.12.1 Syntax

Synopsis:
NAME ERROR {*error_code*} {*address*} [*message*]

Description:	
error_code	Code describing the error
address	Bluetooth address of the device
message	Optional verbose error message

8.13 OBEX AUTH

The **OBEX AUTH** event is used to notify that the PBAP server device requires authentication.

8.13.1 Syntax

Synopsis	
OBEX AUTH [USERID:<*userid*> [READONLY]] [REALM:<*realm*>]?	
userid	TBD
realm	TBD

Description
TBD UserID must be given in authentication response READONLY: only readonly access allowed realm: authentication realm first byte is encoding: 0 ASCII 1 ISO-8859-1 2 ISO-8859-2 3 ISO-8859-3 4 ISO-8859-4 5 ISO-8859-5 6 ISO-8859-6 7 ISO-8859-7 8 ISO-8859-8 9 ISO-8859-9 0xFF = 255 UNICODE OBEX AUTH <pincode>

8.14 PAIR

The **PAIR** event is used to notify the user for a successful pairing.

8.14.1 Syntax

Synopsis:
PAIR {*address*} {*key_type*} {*link_key*}

Description:	
address	Bluetooth device address of the paired device
key_type	Type of link key **0** Combination key **1** Local unit key **2** Remote unit key **3** Debug combination key **4** Unauthenticated combination key **5** Authenticated combination key **5** Changed combination key **0x07-0xFF** Reserved
link_key	Link key shared between the local and the paired device

Note:

- The **PAIR** event is enabled or disabled with the "**SET CONTROL CONFIG**" command.
- If the **PAIR** event is enabled the event will also be shown during the **CALL** procedure and also before the **RING** event, if pairing occurs.

8.15 READY

The **READY** event is used to notify the user for switching to command mode or to indicate that iWRAP is ready to be used after a reset or after a successful switch between normal or multiplexing mode has been done.

8.15.1 Syntax

Synopsis:
READY.

Description:
None

8.16 RING

The **RING** event is used to notify the user for an incoming connection.

8.16.1 Syntax

Synopsis:
RING {*link_id*} {*address*} {SCO | {*channel*} {profile}}

Description:	
link_id	Numeric connection identifier
address	Bluetooth device address of the device
channel	Local RFCOMM channel, L2CAP psm or SCO channel
profile	Profile or protocol indicator. Indicates the profile or protocol type. For example: RFCOMM or L2CAP HFP, HSP, A2DP, AVRCP, OBEX etc.

8.17 SSPAUTH

The **SSPAUTH** event indicates an incoming SSP pairing attempt, which needs to be authorized with the **SSPAUTH** command. These events will be generated only if CONNAUTH events are enabled with SET CONTROL CONFIG.

8.17.1 Syntax

Synopsis:
SSPAUTH { *bd_addr* }?

Description:	
bd_addr	Bluetooth device address of the remote device

8.18 SSP COMPLETE

SSP COMPLETE event is generated when SPP pairing attempt has failed.

8.18.1 Syntax

Synopsis
SSP COMPLETE {*bd_addr*} {error}

Description	
bd_addr	Bluetooth device address of the device initiating SSP request
Error	Error message indicating the reason for the pairing attempt to fail

8.19 SSP CONFIRM

SSP CONFIRM event is generated when remote device if requesting for a SSP pairing that requires PIN code. Use **SSP CONFIRM** command to accept or reject the pairing request.

8.19.1 Syntax

Synopsis
SSP CONFIRM {*bd_addr*} {passkey} ? (for devices with Display Yes/No capabilities – requires SSP CONFIRM command, or the pairing will time out and fail) **SSP CONFIRM {*bd_addr*} {passkey}** (for devices with Display, but no Yes/No button, or no I/O capabilities – no further action is needed, the baseband controller will automatically accept)

Description	
bd_addr	Bluetooth device address of the device initiating SSP request
passkey	Passkey that needs to be confirmed. Typically the other device is showing this on their screen.

8.20 SSP PASSKEY

SSP PASSKEY event is generated when remote device if requesting for a SSP pairing that requires PIN code. Use **SSP PASSKEY** command to accept or reject the pairing request.

8.20.1 Syntax

Synopsis
SSP PASSKEY {*bd_addr*} ?

Description	
bd_addr	Bluetooth device address of the device initiating SSP request

9 iWRAP Error Messages

This chapter briefly presents the iWRAP error messages.

9.1 HCI Errors

HCI errors start with code: **0x100**

ERROR MESSAGE	CODE	Explanation
HCI_SUCCESS	0x00	Success
HCI_ERROR_ILLEGAL_COMMAND	0x01	Unknown HCI command
HCI_ERROR_NO_CONNECTION	0x02	Unknown connection identifier
HCI_ERROR_HARDWARE_FAIL	0x03	Hardware Failure
HCI_ERROR_PAGE_TIMEOUT	0x04	Page timeout
HCI_ERROR_AUTH_FAIL	0x05	Authentication failure
HCI_ERROR_KEY_MISSING	0x06	PIN or key missing
HCI_ERROR_MEMORY_FULL	0x07	Memory capacity exceeded
HCI_ERROR_CONN_TIMEOUT	0x08	Connection timeout
HCI_ERROR_MAX_NR_OF_CONNS	0x09	Connection Limit Exceeded
HCI_ERROR_MAX_NR_OF_SCO	0x0a	Synchronous connection limit to a device exceeded
HCI_ERROR_MAX_NR_OF_ACL	0x0b	ACL Connection Already Exists
HCI_ERROR_COMMAND_DISALLOWED	0x0c	Command Disallowed
HCI_ERROR_REJ_BY_REMOTE_NO_RES	0x0d	Connection Rejected due to Limited Resources
HCI_ERROR_REJ_BY_REMOTE_SEC	0x0e	Connection Rejected Due To Security Reasons
HCI_ERROR_REJ_BY_REMOTE_PERS	0x0f	Connection Rejected due to Unacceptable BD_ADDR
HCI_ERROR_HOST_TIMEOUT	0x10	Connection Accept Timeout Exceeded
HCI_ERROR_UNSUPPORTED_FEATURE	0x11	Unsupported Feature or Parameter Value
HCI_ERROR_ILLEGAL_FORMAT	0x12	Invalid HCI Command Parameter
HCI_ERROR_OETC_USER	0x13	Remote User Terminated Connection
HCI_ERROR_OETC_LOW_RESOURCE	0x14	Remote Device Terminated Connection due to Low Resources

HCI_ERROR_OETC_POWERING_OFF	0x15	Remote Device Terminated Connection due to Power Off
HCI_ERROR_CONN_TERM_LOCAL_HOST	0x16	Connection Terminated By Local Host
HCI_ERROR_AUTH_REPEATED	0x17	Repeated Attempts
HCI_ERROR_PAIRING_NOT_ALLOWED	0x18	Pairing Not Allowed
HCI_ERROR_UNKNOWN_LMP_PDU	0x19	Unknown LMP PDU
HCI_ERROR_UNSUPPORTED_REM_FEATURE	0x1a	Unsupported Remote Feature / Unsupported LMP Feature
HCI_ERROR_SCO_OFFSET_REJECTED	0x1b	SCO Offset Rejected
HCI_ERROR_SCO_INTERVAL_REJECTED	0x1c	SCO Interval Rejected
HCI_ERROR_SCO_AIR_MODE_REJECTED	0x1d	SCO Air Mode Rejected
HCI_ERROR_INVALID_LMP_PARAMETERS	0x1e	Invalid LMP Parameters
HCI_ERROR_UNSPECIFIED	0x1f	Unspecified Error
HCI_ERROR_UNSUPP_LMP_PARAM	0x20	Unsupported LMP Parameter Value
HCI_ERROR_ROLE_CHANGE_NOT_ALLOWED	0x21	Role Change Not Allowed
HCI_ERROR_LMP_RESPONSE_TIMEOUT	0x22	LMP Response Timeout
HCI_ERROR_LMP_TRANSACTION_COLLISION	0x23	LMP Error Transaction Collision
HCI_ERROR_LMP_PDU_NOT_ALLOWED	0x24	LMP PDU Not Allowed
HCI_ERROR_ENC_MODE_NOT_ACCEPTABLE	0x25	Encryption Mode Not Acceptable
HCI_ERROR_UNIT_KEY_USED	0x26	Link Key Can Not be Changed
HCI_ERROR_QOS_NOT_SUPPORTED	0x27	Requested QoS Not Supported
HCI_ERROR_INSTANT_PASSED	0x28	Instant Passed
HCI_ERROR_PAIR_UNIT_KEY_NO_SUPPORT	0x29	Pairing With Unit Key Not Supported

Table 12: HCI errors

Please see Bluetooth 2.0+EDR core specification page 493 for more information about error codes.

9.2 SDP Errors

SDP errors start with code: **0x300**

ERROR MESSAGE	CODE	Explanation
SDC_OK	0x00	-
SDC_OPEN_SEARCH_BUSY	0x01	SDP search is busy
SDC_OPEN_SEARCH_FAILED	0x02	SDP search failed
SDC_OPEN_SEARCH_OPEN	0x03	-
SDC_OPEN_DISCONNECTED	0x04	-
SDC_OPEN_SEARCH_FAILED_PAGE_TIMEOUT	0x05	SDP search failed due page timeout
SDC_OPEN_SEARCH_FAILED_REJ_PS	0x06	-
SDC_OPEN_SEARCH_FAILED_REJ_SECURITY	0x07	SDP search failed because of security
SDC_OPEN_SEARCH_FAILED_REJ_RESOURCES	0x08	SDP search failed because of insufficient resources
SDC_OPEN_SEARCH_FAILED_SIGNAL_TIMEOUT	0x09	-
SDC_ERROR_RESPONSE_PDU	0x10	-
SDC_NO_RESPONSE_DATA	0x11	Empty response - no results for the UUID that was requested
SDC_CON_DISCONNECTED	0x12	Remote device disconnected
SDC_CONNECTION_ERROR	0x13	Remote device refused connection
SDC_CONFIGURE_ERROR	0x14	L2CAP config failed
SDC_SEARCH_DATA_ERROR	0x15	Search data is invalid
SDC_DATA_CFM_ERROR	0x16	Failed to transmit PDU
SDC_SEARCH_BUSY	0x17	Search is busy
SDC_RESPONSE_PDU_HEADER_ERROR	0x18	The response had a header error
SDC_RESPONSE_PDU_SIZE_ERROR	0x19	The response had a size error
SDC_RESPONSE_TIMEOUT_ERROR	0x1a	The response has timed out
SDC_SEARCH_SIZE_TOO_BIG	0x1b	The size of the search will not fit into the L2CAP packet
SDC_RESPONSE_OUT_OF_MEMORY	0x1c	

SDC_RESPONSE_TERMINATED	0x1d	
SDC_OPEN_SEARCH_FAILED_PAGE_TIMEOUT	305	SDP search failed because of page timeout
SDC_OPEN_SEARCH_FAILED_REJ_TIMEOUT	305	SDP search failed because of page timeout

Table 13: SDP errors

9.3 RFCOMM Errors

RFCOMM errors start with code: ***0x400***

ERROR MESSAGE	CODE	Explanation
RFC_CONNECTION_REJ_SECURITY	403	No valid link key exists or could be generated. This means the pin code does not exist, is wrong, or Secure Simple Pairing could not be completed.
RFC_ABNORMAL_DISCONNECT	405	Abnormal disconnection. The other device suddenly stopped responding, or sent an invalid response and the link had to be disconnected.
RFC_REMOTE_REFUSAL	406	The remote end refused the connection on the RFCOMM level. This means that the remote device supports RFCOMM, but rejected our connection.
RFC_INVALID_CHANNEL	408	iWRAP attempted to connect to a non-existant channel.
RFC_INVALID_PAYLOAD	40a	-
RFC_INCONSISTENT_PARAMETERS	40b	There was something wrong with the connection setup parameters; usually a software bug in either iWRAP or the remote end.
RFC_PEER_VIOLATED_FLOW_CONTROL	40c	The remote end violated our flow control requirements.
RFC_RES_ACK_TIMEOUT	40d	No RFCOMM acknowledgement was received on time.
RFC_L2CAP_CONNECTION_FAILED	c01	The L2CAP connection failed before RFCOMM connection setup was even started.
RFC_CONNECTION_KEY_MISSING	c02	Other end has deleted the pairing key. Pairing needs to be either removed locally also or PAIR command needs to be issued for restoring the pairing. SECURITY WARNING: other end might miss the pairing key because it is faking the Bluetooth address.
RFC_L2CAP_LINK_LOSS	c0c	The L2CAP link was lost for some reason.
RFC_CONNECTION_REJ_SSP_AUTH_FAIL	-	RFCOMM connection failed because of SSP authentication

		failure
L2CAP_CONNECTION_SSP_AUTH_FAIL	-	L2CAP connection failed because of SSP authentication failure

Table 14: RFCOMM errors

9.4 L2CAP Errors

L2CAP errors start with code: ***0x9000***

ERROR MESSAGE	CODE	Explanation
L2CAP_CONNECTION_NOT_READY	9000	
L2CAP_CONNECTION_REJ_PSM	9002	
L2CAP_CONNECTION_REJ_SECURITY	9003	
L2CAP_CONNECTION_REJ_RESOURCES	9004	
L2CAP_RESULT_CONFTAB_EXHAUSTED	9019	
L2CAP_RESULT_PEER_ABORTED	901a	
L2CAP_CONNECTION_KEY_MISSING	9802	Other end has deleted the pairing key. Pairing needs to be either removed locally also or PAIR command needs to be issued for restoring the pairing. SECURITY WARNING: other end might miss the pairing key because it is faking the Bluetooth address.

10 Supported Bluetooth Profiles

10.1 RFCOMM with TS07.10

The RFCOMM protocol emulates the serial cable line settings and status of an RS-232 serial port and is used for providing serial data transfer. RFCOMM connects to the lower layers of the Bluetooth protocol stack through the L2CAP layer.

By providing serial-port emulation, RFCOMM supports legacy serial-port applications while also supporting the OBEX protocol among others. RFCOMM is a subset of the ETSI TS 07.10 standard, along with some Bluetooth specific adaptations.

The RFCOMM protocol supports up to 60 simultaneous connections between two Bluetooth devices. The number of connections that can be used simultaneously in a Bluetooth device is implementation-specific.

For the purposes of RFCOMM, a complete communication path involves two applications running on different devices (the communication endpoints) with a communication segment between them. The figure above shows the complete communication path. (In this context, the term application may mean other things than end-user application; e.g. higher layer protocols or other services acting on behalf of end-user applications.)

RFCOMM is intended to cover applications that make use of the serial ports of the devices in which they reside. In the simple configuration, the communication segment is a Bluetooth link from one device to another (direct connect), see the figure to the left. Where the communication segment is another network, Bluetooth wireless technology is used for the path between the device and a network connection device like a modem. RFCOMM is only concerned with the connection between the devices in the direct connect case, or between the device and a modem in the network case.

RFCOMM can support other configurations, such as modules that communicate via Bluetooth wireless technology on one side and provide a wired interface on the other side, as shown in the figure below. These devices are not really modems but offer a similar service. They are therefore not explicitly discussed here.

Basically two device types exist that RFCOMM must accommodate. Type 1 devices are communication end points such as computers and printers. Type 2 devices are those that are part of the communication segment; e.g. modems. Though RFCOMM does not make a distinction between these two device types in the protocol, accommodating both types of devices impacts the RFCOMM protocol.

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/RFCOMM.htm

10.2 Service Discovery Protocol (SDP)

SDAP describes how an application should use SDP to discover services on a remote device. It illustrates several approaches to managing the device discovery via Inquiry and Inquiry Scan and service discovery via SDP. The ideas contained in the SDAP specification augment the basic specifications provided in GAP, SDP, and the basic processes of device discovery. The use cases for SDAP are intended to encompass the majority of service discovery scenarios associated with all profiles and devices.

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/SDAP.htm

10.3 Serial Port Profile (SPP)

A scenario would be using two devices, such as PCs or laptops, as virtual serial ports and then connecting the two devices via Bluetooth technology.

The SPP defines two roles, Device A and Device B.

1. Device A – This is the device that takes initiative to form a connection to another device (initiator).

2. Device B – This is the device that waits for another device to take initiative to connect (acceptor).

The applications on both sides are typically legacy applications, able and wanting to communicate over a serial cable (which in this case is emulated). But legacy applications cannot know about Bluetooth procedures for setting up emulated serial cables, which is why they need help from some sort of Bluetooth aware helper application on both sides. (These issues are not explicitly addressed in this profile; the major concern here is for Bluetooth interoperability.)

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/SPP.htm

10.4 Headset Profile (HSP)

The HSP describes how a Bluetooth enabled headset should communicate with a computer or other Bluetooth enabled device such as a mobile phone.

HSP defines two roles, that of an Audio Gateway (AG) and a Headset (HS):

3. Audio Gateway (AG) – This is the device that is the gateway of the audio, both for input and output, typically a mobile phone or PC.
4. Headset (HS) – This is the device acting as the Audio Gateway’s remote audio input and output mechanism.

The Baseband, LMP and L2CAP are the OSI layer 1 and 2 Bluetooth protocols. RFCOMM is the Bluetooth adaptation of GSM TS 07.10. SDP is the Bluetooth Service Discovery Protocol. Headset Control is the entity responsible for headset-specific control signalling; this signalling is AT command based.

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/HSP.htm

10.5 Hands-Free Profile (HFP)

HFP describes how a gateway device can be used to place and receive calls for a hand-free device.

The HFP defines two roles, that of an Audio Gateway (AG) and a Hands-Free unit (HF):

- Audio Gateway (AG) – This is the device that is the gateway of the audio, both for input and output, typically a mobile phone.

- Hands-Free Unit (HF) – This is the device acting as the Audio Gateway’s remote audio input and output mechanism. It also provides some remote control means.

Hands-Free control is the entity responsible for Hands-Free unit specific control signaling; this signaling is AT command based.

Although not shown in the model to the left, it is assumed by this profile that Hands-Free Control has access to some lower layer procedures (for example, Synchronous Connection establishment).

The audio port emulation layer shown in the figure to the left is the entity emulating the audio port on the Audio Gateway, and the audio driver is the driver software in the Hands-Free unit.

For the shaded protocols/entities in the figure to the left, the Serial Port Profile is used as the base standard. For these protocols, all mandatory requirements stated in the Serial Port Profile apply except in those cases where this specification explicitly states deviations.

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/HFP.htm

10.6 Dial-up Networking Profile (DUN)

DUN provides a standard to access the Internet and other dial-up services over Bluetooth technology. The most common scenario is accessing the Internet from a laptop by dialing up on a mobile phone wirelessly. It is based on SPP and provides for relatively easy conversion of existing products, through the many features that it has in common with the existing wired serial protocols for the same task. These include the AT command set specified in ETSI 07.07 and PPP.

Like other profiles built on top of SPP, the virtual serial link created by the lower layers of the Bluetooth protocol stack is transparent to applications using the DUN profile. Thus, the modem driver on the data-terminal device is unaware that it is communicating over Bluetooth technology. The application on the data-terminal device is similarly unaware that it is not connected to the gateway device by a cable.

DUN describes two roles, the gateway and terminal devices. The gateway device provides network access for the terminal device. A typical configuration consists of a mobile phone acting as the gateway device for a personal computer acting as the terminal role.

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/DUN.htm

10.7 OBEX Object Push Profile (OPP)

OPP defines the roles of push server and push client. These roles are analogous to and must interoperate with the server and client device roles that GOEP defines. It is called push because the transfers are always instigated by the sender (client), not the receiver (server). OPP focuses on a narrow range of object formats to maximize interoperability. The most common acceptable format is the vCard. OPP may also be used for sending objects such as pictures or appointment details.

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/OPP.htm

10.8 OBEX File Transfer Profile (FTP)

FTP defines how folders and files on a server device can be browsed by a client device. Once a file or location is found by the client, a file can be pulled from the server to the client, or pushed from the client to the server using GOEP.

The FTP defines two roles, that of a Client and a Server:

- Client – The Client device initiates the operation, which pushes and pulls objects to and from the Server.
- Server – The Server device is the target remote Bluetooth device that provides an object exchange server and folder browsing capability using the OBEX Folder Listing format.

The Baseband, LMP and L2CAP are the OSI layer 1 and 2 Bluetooth protocols. RFCOMM is the Bluetooth adaptation of GSM TS 07.10. SDP is the Bluetooth Service Discovery Protocol. OBEX is the Bluetooth adaptation of IrOBEX.

The RFCOMM, L2CAP, LMP, and Baseband interoperability requirements are defined in GOEP.

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/FTP.htm

10.9 Advanced Audio Distribution Profile (A2DP)

A2DP describes how stereo-quality audio can be streamed from a media source to a sink.

The profile defines two roles of an audio device: source and sink.

- Source (SRC) – A device is the SRC when it acts as a source of a digital audio stream that is delivered to the SNK of the Piconet.

- Sink (SNK) – A device is the SNK when it acts as a sink of a digital audio stream delivered from the SRC on the same Piconet.

A2DP defines the protocols and procedures that realize distribution of audio content of high-quality in mono or stereo on ACL channels. The term “advanced audio,” therefore, should be distinguished from “Bluetooth audio,” which indicates distribution of narrow band voice on SCO channels as defined in the baseband specification.

This profile relies on GAVDP. It includes mandatory support for low complexity subband codec (SBC) and supports optionally MPEG-1,2 Audio, MPEG-2,4 AAC and ATRAC.

The audio data is compressed in a proper format for efficient use of the limited bandwidth. Surround sound distribution is not included in the scope of this profile.

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/A2DP.htm

10.10 Audio Video Remote Control Profile (AVRCP)

AVRCP is designed to provide a standard interface to control TVs, hi-fi equipment, or others to allow a single remote control (or other device) to control all the A/V equipment to which a user has access. It may be used in concert with A2DP or VDP.

The AVRCP defines two roles, that of a controller and target device.

- Controller – The controller is typically considered the remote control device.

- Target – The target device is the one whose characteristics are being altered.

This protocol specifies the scope of the AV/C Digital Interface Command Set (AV/C command set, defined by the 1394 trade association) to be applied, realizing simple implementation and easy operability. This protocol adopts the AV/C device model and command format for control messages and those messages are transported by the Audio/Video Control Transport Protocol (AVCTP).

In AVRCP, the controller translates the detected user action to the A/V control signal, and then transmits it to a remote Bluetooth enabled device. The functions available for a conventional infrared remote controller can be realized in this protocol. The remote control described in this protocol is designed specifically for A/V control only.

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/AVRCP.htm

10.11 Human Interface Device Profile (HID)

The HID profile defines the protocols, procedures and features to be used by Bluetooth HID such as keyboards, pointing devices, gaming devices and remote monitoring devices.

The HID defines two roles, that of a Human Interface Device (HID) and a Host:

- Human Interface Device (HID) – The device providing the service of human data input and output to and from the host.

- Host – The device using or requesting the services of a Human Interface Device.

The HID profile uses the universal serial bus (USB) definition of a HID device in order to leverage the existing class drivers for USB HID devices. The HID profile describes how to use the USB HID protocol to discover a HID class device's feature set and how a Bluetooth enabled device can support HID services using the L2CAP layer. The HID profile is designed to enable initialization and control self-describing devices as well as provide a low latency link with low power requirements.

The Bluetooth HID profile is built upon the Generic Access Profile (GAP), specified in the Bluetooth Profiles Document; see Referenced Documents. In order to provide the simplest possible implementation, the HID protocol runs natively on L2CAP and does not reuse Bluetooth protocols other than the Service Discovery Protocol.

Source: Bluetooth SIG, URL:

http://www.bluetooth.com/Bluetooth/Technology/Works/HID.htm

10.12 Phone Book Access Profile (PBAP)

Phone Book Access Profile (PBAP) is a profile that allows exchange of Phone Book Objects between devices. It can be used for example between a car kit and a mobile phone to:

1. Allow the car kit to display the name of the incoming caller;
2. Allow the car kit to download the phone book so the user can initiate a call from the car display

The PBAP defines two roles:

- Phone Book Server Equipment (PSE)**:** this role is for the device that contains the source phone-book objects; for example, a mobile phone.
- Phone Book Client Equipment (PCE) role**:** this role is for the device that retrieves phone-book objects from the PSE device; for example, a portable navigation device (PND).

iWRAP firmware supports PCE role.

10.13 Health Device Profile (HDP)

The Bluetooth Health Device Profile (HDP) allows the transmission of health and medical related data between Bluetooth devices. The typical uses cases are wireless blood pressure monitors, weight scales, blood glucose meters and ECG transmitters. The HDP profile offers unique features and extra reliability not included in the other Bluetooth profiles. A key feature in the HDP profile is also the application level interoperability defined by a set of IEEE 11073-xxxxx standards.

he HDP defines two roles:

- HDP sink**:** this role is for the device that receives the data from one or several medical sensors and processes it or relays it to other services like Personal Health Records.
- HDP source**:** this role is for the device that is used to make the measurements and transmit them over Bluetooth connection for future processing, for example a blood pressure meter.

10.14 Device Identification Profile (DI)

TDB

10.15 Bluegiga Proprietary Profiles

10.15.1 Bluegiga IO Profile (BGIO)

The BGIO profile is a Bluegiga proprietary profile based on the Bluetooth RFCOMM. BGIO allows one to read/write the status of GPIO and AIO lines of Bluegiga's Bluetooth modules. The controlling is made using a Bluegiga proprietary binary protocol over the Bluetooth RFCOMM connection.

Like in the Serial Port Profile there are two roles in the BGIO profile:

1. Device A – This is the device that takes initiative to form a connection to another device (initiator).

2. Device B – This is the device that waits for another device to take initiative to connect (acceptor).

10.15.2 Over-the-Air Profile (OTA)

The OTA profile is a 2nd Bluegiga proprietary profile based on the Bluetooth RFCOMM. OTA profile allows one to wirelessly configure the iWRAP firmware settings of Bluegiga's Bluetooth modules. The controlling is made using ASCII based iWRAP commands over the Bluetooth RFCOMM connection. OTA profile also includes a second level of authentication and does not only rely on Bluetooth pairing.

The OTA profile only contains one role:

- Device A – This is the device that takes initiative to form a connection to another device (initiator).

The connecting device can be any Bluetooth device supporting the Bluetooth Serial Port Profile.

10.16 UUIDs of Bluetooth profiles

The table below lists the UUIDs of different Bluetooth profiles.

UUID:	*Bluetooth* Profile:
0001	SDP
0003	RFCOMM
0008	OBEX
000C	HTTP
000F	BNEP
0100	L2CAP
1000	Service Discovery Server Service ClassID
1001	Browse Group Descriptor Service ClassID
1002	Public Browse Group
1101	Serial Port Profile
1102	LAN Access Using PPP
1103	Dial up Networking
1104	IrMC Sync
1105	OBEX Object Push Profile
1106	OBEX File Transfer Profile
1107	IrMC Sync Command
1108	Headset
1109	Cordless Telephony
110A	Audio Source
110B	Audio Sink
110C	A/V_Remote Control Target
110D	Advanced Audio Distribution Profile (A2DP)
110E	A/V_Remote Control
110F	Video Conferencing

1110	Intercom
1111	Fax
1112	Headset Audio Gateway
1113	WAP
1114	WAP_CLIENT
1115	Personal Area Networking User
1115	PANU
1116	Network Access Point
1116	NAP
1117	Group Network
1117	GN
1118	Direct Printing
1119	Reference Printing
111A	Imaging
111B	Imaging Responder
111C	Imaging Automatic Archive
111D	Imaging Referenced Objects
111E	Hands-Free
111F	Hands-Free Audio Gateway
1120	Direct Printing Reference Objects Service
1121	ReflectedUI
1122	Basic Printing
1123	Printing Status
1124	Human Interface Device Service
1125	Hardcopy Cable Replacement
1126	HCR_Print
1127	HCR_Scan

1128	Common_ISDN_Access
1129	Video Conferencing GW
112A	UDI_MT
112B	UDI_TA
112C	Audio/Video
112D	SIM_Access
112E	Phonebook Access - PCE
112F	Phonebook Access - PSE
1130	Phonebook Access
1200	PnP Information
1201	Generic Networking
1202	Generic File Transfer
1203	Generic Audio
1204	Generic Telephony
1205	UPNP_Service
1206	UPNP_IP_Service
1300	ESDP_UPNP_IP_PAN
1301	ESDP_UPNP_IP_LAP
1302	ESDP_UPNP_L2CAP
1303	Video Source
1304	Video Sink
1305	Video Distribution

Table 15: UUIDs and Profiles

For more information, please go to (login required):

- https://programs.Bluetooth.org/apps/content/?doc_id=49709

11 Useful Information

This chapter contains useful information about iWRAP and its usage.

11.1 PS-keys and how to change them

The Bluegiga Bluetooth modules use Cambridge Silicon Radio's (CSR) Bluetooth chips. The CSR chips contain a set of low level parameters called PS-keys that can be used to change the behaviour of the Bluetooth chips. These parameters can also be changed on the Bluegiga Bluetooth modules. Usually they do not need to be modified as they are optimized by Bluegiga Technologies for each module, but if necessary it should be done carefully and understanding what the parameters will do.

Software called PSTool allow the user to change the PS-keys of the module. PSTool is part of the Bluesuite software package, which can be downloaded from Bluegiga's Tech Forum.

The parameters can be changed over the UART or SPI interfaces. With UART a typical level sifter can be used but SPI interface requires a special programming cable is required. The programming cable is included in all the evaluation kits and the schematics are also available in the Tech Forum.

To get access to the PS-keys over UART interface the following steps need to be done:

1. Connect the Bluetooth module via RS232 to a Windows PC

2. Power up the Bluetooth module

3. Open a terminal connection to iWRAP and issue command: "**BOOT 1**" to switch to BCSP mode.

   Alternatively "**BOOT 4**" can be used to switch to H4 mode.

4. Close the terminal software and Open PSTool application

5. Use connection settings: **BCSP**, **COMn** and **115200** (or H4 if you switched to H4 mode)

6. Change the necessary PS-keys.

   Remember to press **SET** in PSTool after every parameter change.

7. Close PSTool and reset your module.

With SPI interface are exactly the same, except that you can skip step 3 and you also need to select SPI as the connection method.

NOTE:

- When using BCSP or H4, the UART baud rate does NOT depend on the iWRAP's "**SET CONTROL BAUD**" setting, but is defined by using PS key "PSKEY_UART_BAUD RATE". By default, the parameter has value 115200 bps.

- It is possible to configure the module in a way that the UART interface does not respond to BCSP or H4. In this situation the SPI interface is the only way to connect to the module and restore the factory settings.

- You can always recover the factory settings by reinstalling the firmware with the **iWRAP Update Client** available in the Bluegiga's Tech Forum.

11.2 BlueTest radio test utility

BlueTest is software, which can be used to perform several built-in radio tests, such as Bit Error Rate (BER) measurements, TX power measurements and RX measurements. It is usually required to enable various radio test modes for certification purposes.

Just like PSTool BlueTest can be used over UART and SPI interfaces and BlueTest also supports BCSP and H4 protocols.   uses the BCSP protocol to talk to the module and can be used in a similar way as PSTool. i

To use BlueTest over UART interface the following steps need to be done:

1. Connect the Bluetooth module via RS232 to a Windows PC
2. Power up the Bluetooth module
3. Open a terminal connection to iWRAP and issue command: ”**BOOT 1**” to switch to BCSP mode.
4. Alternatively “**BOOT** 4” can be used to switch to H4 mode.
5. Close the terminal software and Open BlueTest application
6. Use connection settings: **BCSP**, **COMn** and **115200** (or H4 if you switched to H4 mode)
7. Perform the necessary radio tests
8. Close BlueTest and reset your module.

With SPI interface are exactly the same, except that you can skip step 3 and you also need to select SPI as the connection method.

Always consult Bluegiga Technologies before performing any radio tests for certification purposes. Many radio tests require the configuration of radio power parameters and they are unique to each module type. Using incorrect parameters may lead to failures in certification testing.

Some of the BlueTest radio tests can also be enabled with iWRAP commands. Please see the documentation of **TEST** command.

11.3 Switching between iWRAP and HCI firmware

The iWRAP firmware build also contains the lower level Host Controller Interface (HCI) firmware. The user can quite easily switch the firmware configuration between iWRAP and HCI. The firmware mode is controlled with a single PS-key called: PSKEY_INITIAL_BOOTMODE and by changing its value the firmware mode can be switched easily.

The values for PSKEY_INITIAL_BOOTMODE are exactly the same as the parameters for the **BOOT** command. They were:

- 0000: iWRAP mode
- 0001: HCI, BCSP protocol (default: 115200,8e1)
- 0003: HCI, USB (default: bus powered, design identical to USB on evaluation kits)
- 0004: HCI, H4 protocol (default: 115200,8n1)

If the interface parameters for the BCSP and H4 modes need to be changed, additional PS-keys need to be modified. The PS-keys are:

- PSKEY_UART_BAUDRATE : Configures the UART baud rate
- PSKEY_UART_CONFIG_H4 : Configures the H4 interface
- PSKEY_UART_CONFIG_BCSP : Configures the BCSP interface
- PSKEY_USB_XXXX : Several keys exists for USB configuration.

  Please refer to the USB design guide for more information.

An alternative way to switch the firmware configuration is to reinstall the firmware with the **iWRAP Update Client** available in the Bluegiga's Tech Forum.

11.4 Firmware updates

11.4.1 Firmware update over SPI

The SPI interface is dedicated only for firmware updates. The Onboard Installation Kit (SPI programming cable) and a Windows software called iWRAP update client (or BlueTest) can be used to update or restore the firmware over SPI interface.

The iWRAP update client always restores the firmware to a factory status and settings. BlueFlash software, which is part of BlueTest package can be used to make dedicated firmware updates, which for example leave the user configuration (iWRAP settings and PS-keys) intact.

iWRAP update client is an easier and the suggested way to do the firmware upgrade instead of BlueFlash. iWRAP update client can recognize the hardware and software version of the module and reflash correct firmware and parameters into the module, and the user just needs to select the firmware version. With BlueFlash it is possible to install incorrect firmware to the module damage its operation.

11.4.2 Firmware update over UART

The firmware can also be updated over the UART interface. A protocol called Device Firmware Upgrade (DFU) is available for this purpose. BlueSuite software package contains a tool called DFUWizard tool, which allows the updates to be made from a Windows based PC in a similar way as with iWRAP update client. Bluegiga has also a SerialDFU tool available, which can be used for the same purpose. The difference however is that SerialDFU is written in Python and can be used on other operating systems and it can also write PS-keys into the module during the update.

The DFU protocol is and open protocol can be integrated into various systems for example to perform on the field updates. Please contact Bluegiga Technologies by sending email to support@bluegiga.com for the DFU protocol description and sample code.

Typical DFU firmware update files are:

iWRAP version update :	200-300kB
iWRAP + *Bluetooth* stack:	70-900kB
Full update:	~1MB

Note:

- More information and instructions about firmware updates can be found from *Firmware & Parameters User Guide*, which is available in Tech Forum.

11.5 UART hardware flow control

Hardware flow control is enabled by default and it should not be disabled unless mandatory, because without the hardware flow control the data transmission may not be reliable. However if the hardware flow control must be disabled it can be done by changing the value of PS-key: PSKEY_UART_CONFIG_XXX.

(XXX = USR, H4, H5 or BCSP).

With iWRAP, the PS key is PSKEY_UART_CONFIG_USR.

- If PSKEY_UART_CONFIG_USR is **08a8**, HW flow control is enabled
- If PSKEY_UART_CONFIG_USR is **08a0**, HW flow control is disabled

Hardware flow control can be disabled also with a proper hardware design. If the hardware flow control is enabled from PS-keys, but no flow control is used, the following steps should be implemented in the hardware design:

- CTS pin must be grounded
- RTS pin must be left floating

WARNING:

- If hardware flow control is disabled and iWRAP buffers are filled (in command or data mode), the firmware may hang and needs a physical reset to survive. Therefore, hardware flow control should be used whenever possible to avoid this situation.
- However, if hardware flow control must be disabled, the host system should be designed in a way that it can recognize that the firmware has hung and is able to survive it.

11.6 RS232 connections diagram

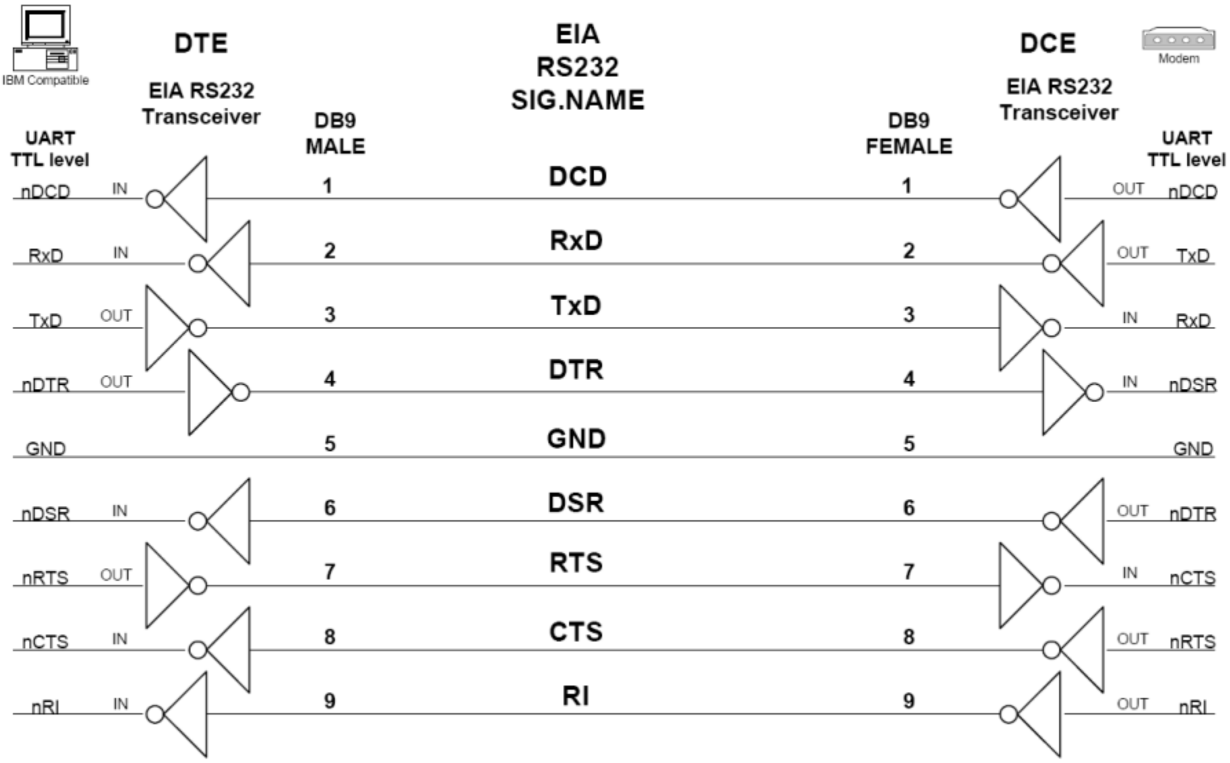


Figure 8: RS232 connections

12 General Bluetooth Information

12.1 Secure Simple Pairing (SSP) Overview

The primary goal of Secure Simple Pairing is to simplify the pairing procedure for the user. Secondary goals are to maintain or improve the security in Bluetooth wireless technology. Since high levels of security and ease-of-use are often at opposite ends of the spectrum in many technologies and products, much care has been taken to maximize security while minimizing complexity from the end user's point of view.

12.1.1 SECURITY GOALS

Secure Simple Pairing has two security goals: protection against passive eavesdropping and protection against man-in-the-middle (MITM) attacks (active eavesdropping). It is a goal of Secure Simple Pairing to exceed the maximum security level provided by the use of a 16 alphanumeric PIN with the pairing algorithm used in Bluetooth Core Specification version 2.0 + EDR and earlier versions. Note that many Bluetooth devices compliant with Bluetooth Core Specification 2.0 + EDR and earlier versions use a 4-digit PIN or a fixed PIN of commonly known values significantly limiting the security on the link.

12.1.2 PASSIVE EAVESDROPPING PROTECTION

A strong link key coupled with a strong encryption algorithm is necessary to give the user protection against passive eavesdropping. The strength of the link key is based on the amount of entropy (or randomness) in its generation process which would not be known by an attacker. Using legacy pairing, the only source of entropy is the PIN which, in many use cases, is typically four digits either selected by the user or fixed for a given product. Therefore, if the pairing procedure and one authentication exchange is recorded one can run an exhaustive search to find the PIN in a very short amount of time on commonly available computing hardware. With Secure Simple Pairing, the recording attack becomes much harder as the attacker must have solved a hard problem in public key cryptography in order to derive the link key from the recorded information. This protection is independent of the length of the passkey or other numeric values that the user must handle. Secure Simple Pairing gives the same resistance against the recording and passive eavesdropping attacks even when the user is not required to do anything.

Secure Simple Pairing uses Elliptic Curve Diffie Hellman (ECDH) public key cryptography as a means to thwart passive eavesdropping attacks. ECDH provides a very high degree of strength against passive eavesdropping attacks but it may be subject to MITM attacks, which however, are much harder to perform in practice than the passive eavesdropping attack.

Using the security protocols in the Bluetooth Core Specification version 2.0 + EDR and earlier with a 16 numeric digit PIN achieves about 53 bits of entropy whereas a 16 character alphanumeric, case sensitive PIN yields about 95 bits of entropy when the entire 62 character set is used ([0, … 9, 'A', … 'Z', 'a', … 'z']). Secure Simple Pairing has approximately 95 bits of entropy using the FIPS approved P192 elliptic curve which is at least as good as the entropy in Bluetooth Core Specification 2.0 + EDR and earlier using a 16 character, alphanumeric, case sensitive PIN. Secure Simple Pairing, therefore, exceeds the security requirements of the Bluetooth SIM Access Profile (SAP) which is the profile with the most stringent security requirements. ECDH cryptography was selected over standard Diffie Hellman (often referred to as DH76) since it is computationally less complex and less likely to exceed the low computational capacity in common Bluetooth Controllers.

12.1.3 MAN-IN-THE-MIDDLE PROTECTION

A man-in-the-middle (MITM) attack occurs when a user wants to connect two devices but instead of connecting directly with each other they unknowingly connect to a third (attacking) device that plays the role of the device they are attempting to pair with. The third device then relays information between the two devices giving the illusion that they are directly connected. The attacking device may even eavesdrop on communication between the two devices (known as active eavesdropping) and is able to insert and modify information on the connection. In this type of attack, all of the information exchanged between the two devices are compromised and the attacker may inject commands and information into each of the devices thus potentially damaging the function of the devices. Devices falling victim to the attack are capable of communicating only when the attacker is present. If the attacker is not active or out range, the two victim devices will not be able to communicate directly with each other and the user will notice it.

To prevent MITM attacks, Secure Simple Pairing offers two user assisted numeric methods: numerical comparison or passkey entry. If Secure Simple Pairing would use 16 decimal digit numbers, then the usability would be the same as using legacy pairing with 16 decimal digit PIN. The chance for a MITM to succeed inserting its own link keys in this case is a 1 in 1016 = 253 pairing instances, which is an unnecessarily low probability.

Secure Simple Pairing protects the user from MITM attacks with a goal of offering a 1 in 1,000,000 chance that a MITM could mount a successful attack. The strength of the MITM protections was selected to minimize the user impact by using a six digit number for numerical comparison and Passkey entry. This level of MITM protection was selected since, in most cases, users can be alerted to the potential presence of a MITM attacker when the connection process fails as a result of a failed MITM attack. While most users feel that provided that they have not compromised their passkey, a 4-digit key is sufficient for authentication (i.e. bank card PIN codes), the use of six digits allows Secure Simple Pairing to be FIPS compliant and this was deemed to have little perceivable usability impact.

12.1.4 ASSOCIATION MODELS

Secure Simple Pairing uses four association models referred to as Numeric Comparison, Just Works, Out Of Band, and Passkey Entry. Each of these association models are described in more detail in the following sections.

The association model used is deterministic based on the I/O capabilities of the two devices.

12.1.4.1 Numeric Comparison

The Numeric Comparison association model is designed for scenarios where both devices are capable of displaying a six digit number and both are capable of having the user enter "yes" or "no". A good example of this model is the cell phone / PC scenario.

The user is shown a six digit number (from "000000" to "999999") on both displays and then asked whether the numbers are the same on both devices. If "yes" is entered on both devices, the pairing is successful.

The numeric comparison serves two purposes. First, since many devices do not have unique names, it provides confirmation to the user that the correct devices are connected with each other. Second, the numeric comparison provides protection against MITM attacks.

Note that there is a significant difference from a cryptographic point of view between Numeric Comparison and the PIN entry model used by Bluetooth Core Specification and earlier versions. In the Numeric Comparison association model, the six digit number is an artifact of the security algorithm and not an input to it, as is the case in the Bluetooth security model. Knowing the displayed number is of no benefit in decrypting the encoded data exchanged

12.1.4.2 Just Works

The Just Works association model is primarily designed for scenarios where at least one of the devices does not have a display capable of displaying a six digit number nor does it have a keyboard capable of entering six decimal digits. A good example of this model is the cell phone/mono headset scenario where most headsets do not have a display.

The Just Works association model uses the Numeric Comparison protocol but the user is never shown a number and the application may simply ask the user to accept the connection (exact implementation is up to the end product manufacturer). The Just Works association model provides the same protection as the Numeric Comparison association model against passive eavesdropping but offers no protection against the MITM attack.

When compared against today's experience of a headset with a fixed PIN, the security level of the Just Works association model is considerably higher since a high degree of protection against passive eavesdropping is realized.

12.1.4.3 Out of Band

The Out of Band (OOB) association model is primarily designed for scenarios where an Out of Band mechanism is used to both discover the devices as well as to exchange or transfer cryptographic numbers used in the pairing process. In order to be effective from a security point of view, the Out of Band channel should provide different properties in terms of security compared to the Bluetooth radio channel. The Out of Band channel should be resistant to MITM attacks. If it is not, security may be compromised during authentication.

The user's experience differs a bit depending on the Out of Band mechanism. As an example, with a Near Field Communication (NFC) solution, the user(s) will initially touch the two devices together, and is given the option to pair the first device with the other device. If "yes" is entered, the pairing is successful. This is a single touch experience where the exchanged information is used in both devices. The information exchanged includes discovery information (such as the Bluetooth Device Address) as well as cryptographic information. One of the devices will use a Bluetooth Device Address to establish a connection with the other device. The rest of the exchanged information is used during authentication.

The OOB mechanism may be implemented as either read only or read/write. If one side is read only, a one-way authentication is performed. If both sides are read/write, a two-way authentication is performed.

The OOB protocol is selected only when the pairing process has been activated by previous OOB exchange of information and one (or both) of the device(s) gives OOB as the IO capabilities. The protocol uses the information which has been exchanged and simply asks the user to confirm connection. The OOB association model supports any OOB mechanism where cryptographic information and the Bluetooth Device Address can be exchanged. The OOB association model does not support a solution where the user has activated a Bluetooth connection and would like to use OOB for authentication only.

12.1.4.4 Passkey Entry

The Passkey Entry association model is primarily designed for the scenario where one device has input capability but does not have the capability to display six digits and the other device has output capabilities. A good example of this model is the PC and keyboard scenario.

The user is shown a six digit number (from "000000" to "999999") on the device. If the value entered on the second device is correct, the pairing is successful. Note that there is a significant difference from a cryptographic point of view between Passkey Entry and the PIN entry model used by Bluetooth Core Specification 2.0 + EDR and earlier versions. In the Passkey Entry association model, the six digit number is independent of the security algorithm and not an input to it, as is the case in the 2.0 + EDR security model. Knowing the entered number is of no benefit in decrypting the encoded data exchanged between the two devices.

Source: Specification of The Bluetooth System Version 2.1 + EDR, The Bluetooth SIG, 26 July 2007

12.2 Sniff power saving mode

In Sniff mode, the duty cycle of the slave's activity in the piconet may be reduced. If a slave is in active mode on an ACL logical transport, it shall listen in every ACL slot to the master traffic, unless that link is being treated as a scatternet link or is absent due to hold mode. With sniff mode, the time slots when a slave is listening are reduced, so the master shall only transmit to a slave in specified time slots. The sniff anchor points are spaced regularly with an interval of Tsniff.

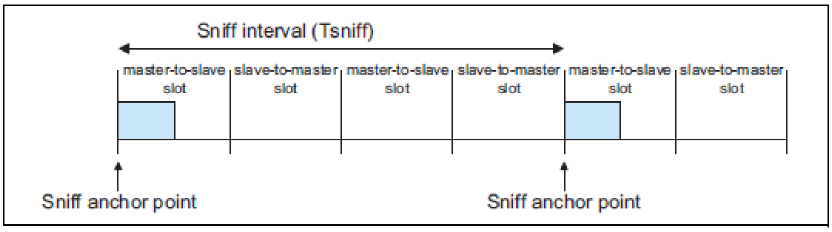


Figure 9: Sniff anchor points

The slave listens in master-to-slave transmission slots starting at the sniff anchor point. It shall use the following rules to determine whether to continue listening:

- If fewer than Nsniff attempt master-to-slave transmission slots have elapsed since the sniff anchor point then the slave shall continue listening.
- If the slave has received a packet with a matching LT_ADDR that contains ACL data (DM, DH, DV, or AUX1 packets) in the preceding Nsniff timeout master- to-slave transmission slots then it shall continue listening.
- If the slave has transmitted a packet containing ACL data (DM, DH, DV, or AUX1 packets) in the preceding Nsniff timeout slave-to-master transmission slots then it shall continue listening.
- If the slave has received any packet with a matching LT_ADDR in the preceding Nsniff timeout master-to-slave transmission slots then it may continue listening.
- A device may override the rules above and stop listening prior to Nsniff timeout or the remaining Nsniff attempt slots if it has activity in another piconet.

It is possible that activity from one sniff timeout may extend to the next sniff anchor point. Any activity from a previous sniff timeout shall not affect activity after the next sniff anchor point. So in the above rules, only the slots since the last sniff anchor point are considered.

Note that Nsniff attempt =1 and Nsniff timeout =0 cause the slave to listen only at the slot beginning at the sniff anchor point, irrespective of packets received from the master.

Nsniff attempt =0 shall not be used.

Sniff mode only applies to asynchronous logical transports and their associated LT_ADDR.Sniff mode shall not apply to synchronous logical transports, therefore, both masters and slaves shall still respect the reserved slots and retransmission windows of synchronous links.

To enter sniff mode, the master or slave shall issue a sniff command via the LM protocol. This message includes the sniff interval Tsniff and an offset Dsniff. In addition, an initialization flag indicates whether initialization procedure 1 or 2 shall be used. The device shall use initialization 1 when the MSB of the current master clock (CLK27) is 0; it shall use initialization 2 when the MSB of the current master clock (CLK27) is 1. The slave shall apply the initialization method as indicated by the initialization flag irrespective of its clock bit value CLK27. The sniff anchor point determined by the master and the slave shall be initialized on the slots for which the clock satisfies the applicable equation:

CLK27-1 mod Tsniff = Dsniff for initialization 1

(CLK27,CLK26-1) mod Tsniff = Dsniff for initialization 2

this implies that Dsniff must be even

After initialization, the clock value CLK(k+1) for the next sniff anchor point shall be derived by adding the fixed interval Tsniff to the clock value of the current sniff anchor point:

$$CLK(k+1) = CLK(k) + Tsniff$$

Source: Specification of The Bluetooth System Version 2.1 + EDR, The Bluetooth SIG, 26 July 2007

13 Known Issues

Issue		Explanation
-	Listing remote SDP record may run out of memory	When a service discovery is made by using the SDP command and if root mode is used and remote device supports many services, iWRAP may run out of memory and reset. To overcome this, only a specific service should be searched for instead of using root mode.
-	Inquiry RSSI and clock caching	If RSSI in the inquiry and clock offset caching are enabled, connections can not be opened. This is a bug in the CSR firmware.
-	HW flow control	If HW flow control is not used and iWRAP buffers are filled either in data or command mode the firmware will reset itself. This is a feature of the CSR UART subsystem.
-	SET CONTROL INIT RESET	Issuing SET CONTROL INIT RESET will result in an infinite reset loop. PSKEY_USR_27 must be deleted to survive this condition.
238	SELECT [link_id] with MUX mode	SELECT [link_id] can be issued in MUX mode and it puts iWRAP into normal data mode.
670	Outgoing connections	Outgoing HFP, HID, A2DP etc. connections can be made even if the profile is not locally enabled. This may cause strange behavior, usually disconnections, since if the profiles are not enabled iWRAP will not behave according to the profile specification.
711	PIO bindings	Binding SET CONTROL ESCAPE or CD or MSC to a PIO event with SET CONTROL BIND and triggering the PIO event causes iWRAP to run out of stack memory and crash.
717	Switching between MUX and normal mode when connections are already in place	iWRAP's data and command modes get mixed when an RFCOMM connection is active and the user switches from MUX to normal mode or from normal mode to MUX mode. In the former case iWRAP will not receive any data from the other end; in the latter case any data received from the other end will be output to the UART even though iWRAP is in command mode.
478	Inquiry with EIR enabled may crash the chip	In an environment with many Bluetooth devices, using EIR may crash the chip, because the chip's memory simply runs out. This is a CSR issue.
746	Sending long commands too quickly will freeze iWRAP	Sending a 512+ bytes long command will hang the iWRAP command parser. Also, sending multiple long commands (say, 200 bytes long, 10 times in a row) in quick succession may cause this. The UART buffers fill, the chip asserts the CTS pin and will not accept any more data from the UART. Only a reset will recover iWRAP. The workaround is simple: use the OK flag (see **SET CONTROL CONFIG**) and wait until each command is

		processed before sending a new command, and don't send commands which exceed 511 bytes (including carriage return and line feed).
742	Long SET CONTROL BIND commands	**SET CONTROL BIND has** a limitation of 30 characters in the command.
763	A2DP and sniff mode	Using sniff mode with A2DP and then issuing “A2DP STREAMING STOP” on A2DP sink terminates the connection. However this only occurs if “**SET {link_id} SNIFF 4 4**” or “**SET {link_id} SNIFF 4 2**” values are used.
501	Page timeout / supervision timeout	Page timeout MUST BE smaller then supervision timeout, or otherwise a failed page will close all active connections.
680	SET CONTROL READY does not check if PIO is valid	An invalid PIO mask can be given to SET CONTROL READY command.
544	Page scan mode 0	If page scan mode is set to 0 iWRAP will be visible even if page mode is set to 1.
586	Bluesoleil (v. 6.2.227.11) and HFP	iWRAP sends AT+COPS command during HFP connection negotiation, which is not answered by Bluesoleil. This causes iWRAP to close the HFP connection after a 10 second timeout. This is an issue of the Bluesoleil Bluetooth stack
712	SET CONTROL ESCAPE	SET CONTROL ESCAPE inputs the escape character in hexadecimal format, but prints it in the SET listing in decimal format.
723	RING event received in data mode	If you make two Bluetooth connections to iWRAP, the RING event of the 2nd connection is received while in data mode. This can be avoided by using MUX mode or using SET CONTROL CONFIG block #2 bit #13.
827	Closing connection after ECHO command	With iWRAP5 if the connection is closed very quickly after data has been sent with ECHO command the data may be lost. Some sleep should be added between ECHO and CLOSE commands. To make sure that the data has been sent over the Bluetooth link, either implement a protocol that acknowledges reception of packets, or check from the output of LIST command that there is no buffered outgoing data in the RFC/L2C buffers.
835	Two concurrent CALLs to service UUID	iWRAP cannot execute more than one SDP search at a time. This means that you must wait for the CONNECT or NO CARRIER event for an outgoing connection before initiating another call to a service UUID. This limitation does not concern calls to L2CAP PSMs or RFCOMM channels.
851	SDP during inquiry	If SDP query is made during inquiry process, iWRAP will crash.
877	Very small supervision timeout	Using 1-3 as a supervision timeout will cause the Bluetooth

		connection to be closed so quickly that the RING event is not received and only NO CARRIER is displayed.
826	PLAY with insufficient parameters	If PLAY command is issued with insufficient parameters f.ex “**PLAY 8**” iWRAP will play random noise until the ringtone is stopped with “**PLAY**”
IWRAP-159	OBEX PUT	OBEX PUT command with invalid parameters will put the OBEX handler in an invalid state, and the connection needs to be restarted in order to recover
IWRAP-533	Receiving OBEX FORBIDDEN response to an OBEX command	SYNTAX ERROR is incorrectly printed after receiving an OBEX FORBIDDEN response
IWRAP-535	Incorrect AIO configuration	The analogue input pin on the WT11i is driven low on boot, causing the command AIO to report 0
IWRAP-550	PAGEMODE 4	If pairing is initiated to / from two devices at the exact same time, it is possible to pair and be connected to two devices even if SET BT PAGEMODE 4 is used. The workaround is to set the maximum number of ACLs (0x000d PSKEY_MAX_ACLS) to 1.
IWRAP-574	Deep sleep and WT32	WT32 will not wake up from deep sleep as quickly as the other modules: instead of requiring one extra character from the UART to wake up, it will actually require 2-3 “AT\r\n“ sequences before it wakes up
IWRAP-577	S/PDIF cannot be used with voice data	The S/PDIF interface does not support sampling rates other than 32kHz, 44.1kHz and 48kHz. This is a CSR hardware and/or firmware limitation. Therefore it cannot be used for voice data, which uses 8kHz (CVSD) or 16kHz (Wide-Band Speech) sampling rates.
IWRAP-578	RFCOMM flow control failure with Windows 7	When iWRAP receives a constant stream of data from a Windows 7 or XP PC with any generic Bluetooth radio, the connection suddenly terminates with NO CARRIER ERROR 40c RFC_PEER_VIOLATED_FLOW_CONTROL. This is a CSR firmware issue, and the only known workaround is to limit the data rate.
IWRAP-579	SSP PASSKEY notification event	SSP PASSKEY notification event is missing leading zeroes in the generated passkey, for example “006789” is printed as “6789”.

Table 16: Known issues in iWRAP

14 iWRAP Usage Examples

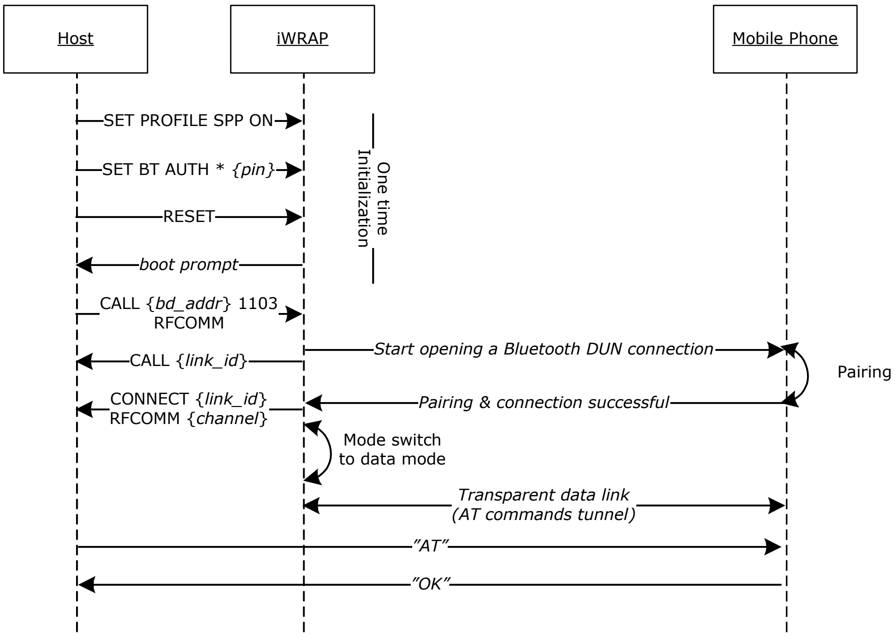
This section contains various iWRAP configuration and usage examples. Most of the examples are now available as separate application notes are not any more included in the iWRAP user guide.

14.1 Serial Port Profile

Please see a Serial Port Profile application note.

14.2 Dial-up Networking

The Dial-Up Networking (DUN) profile allows you for example to connect to phone phones and control their GSM modem with AT commands. The most common use cases for DUN are sending SMS messages or connecting to Internet via GPRS or 3G. The simple below shows how to open a Dial-Up Networking connection to a phone and how to send an AT command to the phone.



Host
iWRAP
Mobile Phone
SET PROFILE SPP ON
SET BT AUTH * {pin}
RESET
boot prompt
One time Initialization
CALL {bd_addr} 1103 RFCOMM
CALL {link_id}
Start opening a Bluetooth DUN connection
Pairing
CONNECT {link_id} RFCOMM {channel}
Pairing & connection successful
Mode switch to data mode
Transparent data link (AT commands tunnel)
"AT"
"OK"

Figure 10: How to open a DUN connection to a mobile phone

In iWRAP the Bluetooth code must be set, since most of the mobile phones always require the PIN code authentication, before allowing the Dial-Up Networking connection.

It may be wise to do the pairing from the mobile phone and make the iWRAP module 'trusted'. Once this is done, the phone does not ask for the PIN code every time the connection is opened.

Notice that not all the mobile phones support the same AT commands, since some of the commands are optional and some mandatory.

Refer to the following AT command specifications for more information and examples: 3GPP TS 27.005 and 3GPP TS 07.07.

14.3 Hands-Free Audio Gateway Connection to a Headset Device

Please see HFP and HSP profiles application note.

14.4 Hands-Free connection to a Mobile Phone

Please see HFP and HSP profiles application note.

14.5 Human Interface Device profile example

Please see HID Profile application note.

14.6 Wireless IO Replacement

iWRAPs can be used to do wireless IO replacement, that is, to transmit the status of GPIO PINs over the SPP link. This means that if the status of the local IO changes, so does the status of the remote IO. This functionality can be accomplished by using the MSC (Modem Status Control) feature in iWRAP.

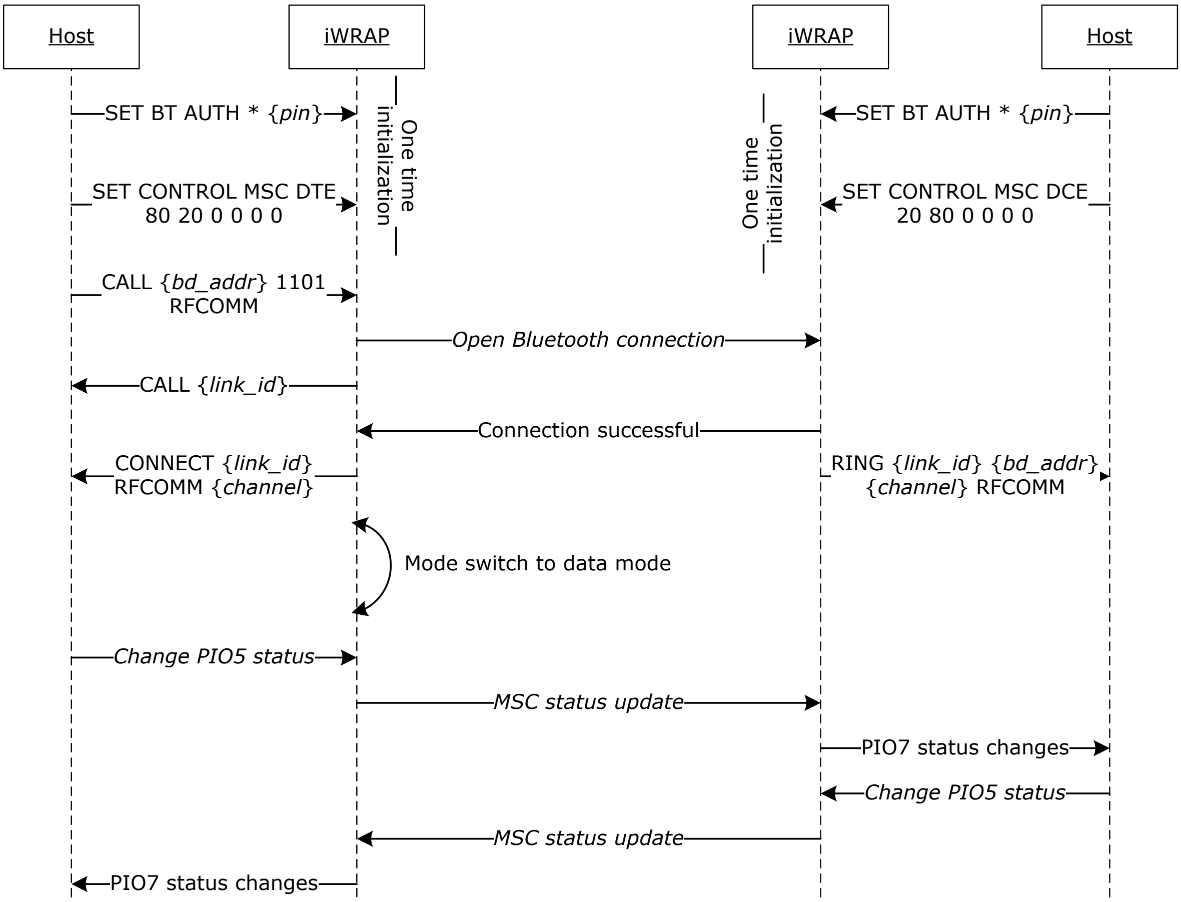


Figure 11: Wireless IO replacement connection

The example above was done with WT12 evaluation kits. In the evaluation kit, there is a DSR button in PIO5 and a LED in PIO7. Parameter 80 matches with PIO7 and parameter 20 with PIO5. So whenever DSR button is pressed in the local device, the LED status changes in the remote end.

NOTE:

- Switching the IO status very rapidly may reset iWRAP as the GPIO interrupts are handled with low priority. Therefore MSC feature is not feasible for radio GPIO sampling application.

- There is also a delay when transmitting the MSC status over the Bluetooth link. Without power saving in use, this delay is roughly 20ms and if power saving is in use, the delay depends on SNIFF mode parameters.

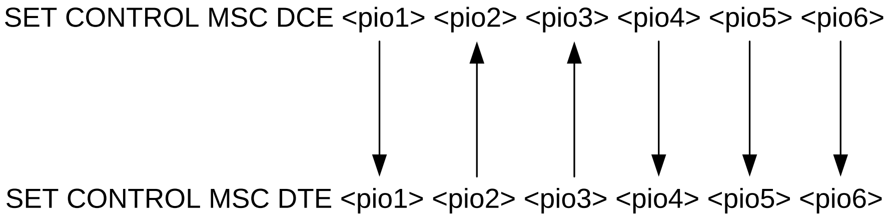

SET CONTROL MSC DCE <pio1> <pio2> <pio3> <pio4> <pio5> <pio6>
SET CONTROL MSC DTE <pio1> <pio2> <pio3> <pio4> <pio5> <pio6>

Figure 12: MSC signal directions

14.7 A2DP Sink

Please see A2DP and AVRCP application note.

14.8 A2DP Source

Please see A2DP and AVRCP application note.

14.9 AVRCP Connection

Please see A2DP and AVRCP application note.

14.10 Over-the-Air Configuration

iWRAP3 has Over-the-Air (OTA) configuration interface, which allows one to configure iWRAP settings over a *Bluetooth* SPP connection. OTA gives one access to standard iWRAP commands which also available over UART interface. This example shows how OTA interface can be accessed from another iWRAP device.

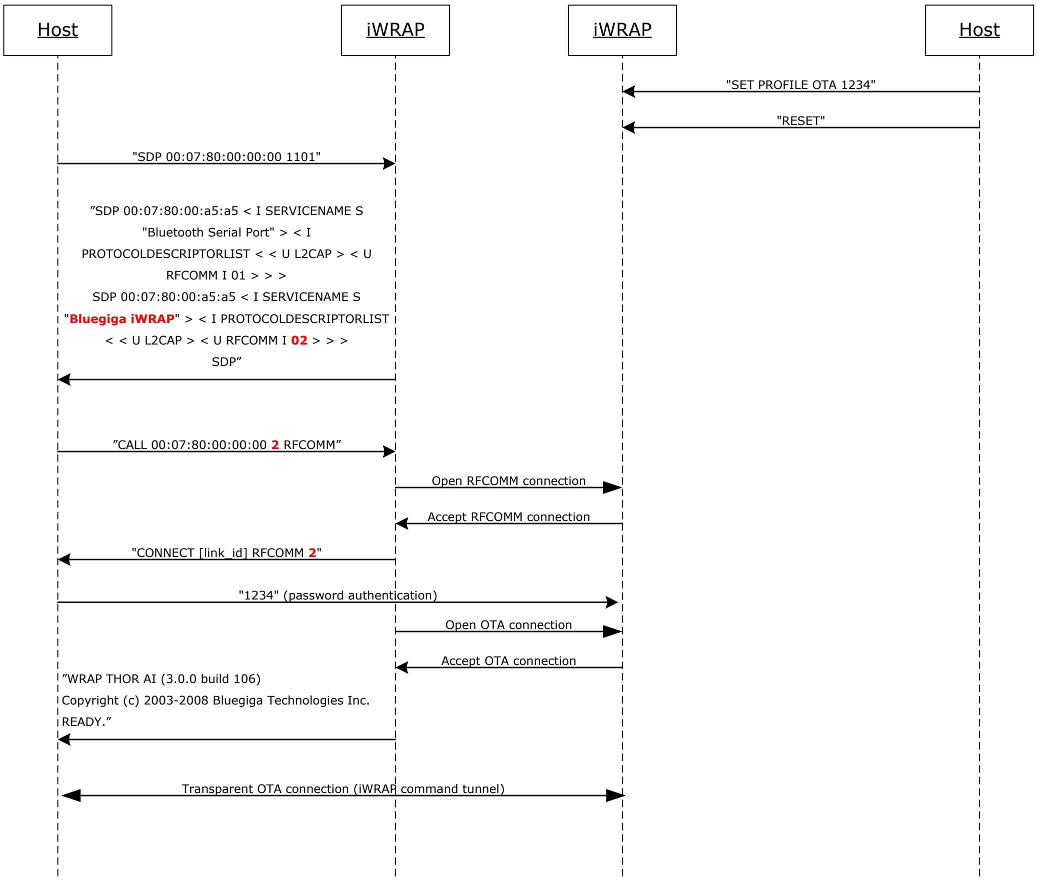

Host
iWRAP
iWRAP
Host
"SET PROFILE OTA 1234"
"RESET"
"SDP 00:07:80:00:00:00 1101"
"SDP 00:07:80:00:a5:a5 < I SERVICENAME S "Bluetooth Serial Port" > < I PROTOCOLDESCRIPTORLIST < < U L2CAP > < U RFCOMM I 01 > > > SDP 00:07:80:00:a5:a5 < I SERVICENAME S "Bluegiga iWRAP" > < I PROTOCOLDESCRIPTORLIST < < U L2CAP > < U RFCOMM I 02 > > > SDP"
"CALL 00:07:80:00:00:00 2 RFCOMM"
Open RFCOMM connection
Accept RFCOMM connection
"CONNECT [link_id] RFCOMM 2"
"1234" (password authentication)
Open OTA connection
Accept OTA connection
"WRAP THOR AI (3.0.0 build 106) Copyright (c) 2003-2008 Bluegiga Technologies Inc. READY."
Transparent OTA connection (iWRAP command tunnel)

Figure 13: Over-the-Air connection example

On a remote iWRAP OTA is simply activated by issuing iWRAP command: **SET PROFILE OTA {*password*}** and by performing a reset.

In the Bluetooth interface OTA is seen as a standard Bluetooth Serial Port Profile service with a fixed service name "***Bluegiga iWRAP***".

When OTA connection is opened the first thing that needs to be done is to send the password from the controlling device to the controlled iWRAP. If the password is correct iWRAP boot prompt will be displayed, otherwise the connection will be closed.

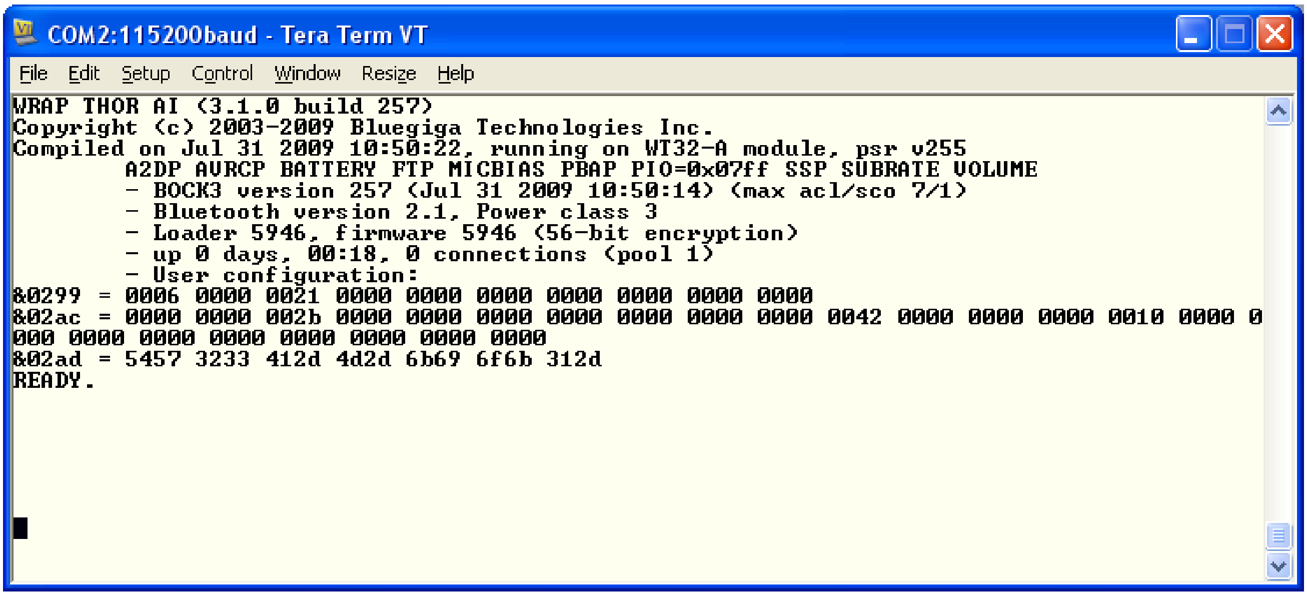
There is a special use case for OTA to remotely read/write the GPIO pins of the iWRAP under control.

15 Technical support

- For technical questions and problems, please contact: support@bluegiga.com
- Firmware, parameters, tools and documentation can be downloaded from: http://techforum.bluegiga.com

15.1 Sending email to technical support

In case you facing problems with iWRAP firmware, always remember to include the output of "**INFO CONFIG**" command to your email. This way we can replicate the exact setup that you have and solve the problems faster.



COM2:115200baud - Tera Term VT
File Edit Setup Control Window Resize Help

```
WRAP THOR AI (3.1.0 build 257)
Copyright (c) 2003-2009 Bluegiga Technologies Inc.
Compiled on Jul 31 2009 10:50:22, running on WT32-A module, psr v255
        A2DP AVRCP BATTERY FTP MICBIAS PBAP PIO=0x07ff SSP SUBRATE VOLUME
        - BOCK3 version 257 (Jul 31 2009 10:50:14) (max acl/sco 7/1)
        - Bluetooth version 2.1, Power class 3
        - Loader 5946, firmware 5946 (56-bit encryption)
        - up 0 days, 00:18, 0 connections (pool 1)
        - User configuration:
&0299 = 0006 0000 0021 0000 0000 0000 0000 0000 0000 0000
&02ac = 0000 0000 002b 0000 0000 0000 0000 0000 0000 0000 0042 0000 0000 0000 0010 0000 0
000 0000 0000 0000 0000 0000 0000 0000
&02ad = 5457 3233 412d 4d2d 6b69 6f6b 312d
READY.
```

Table 17: INFO CONFIG output

16 Contact information

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