wahoo FITNESS

GEMSAFE APPLICATION REFERENCE AND COMMAND API

Developer Guide

Version 0.3

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1 GEMSAFE APPLICATION

1.1 Overview

The GEMSAFE application is a part of a complete system known as GymConnect. The GymConnect system is comprised of the following elements:

- A Fitness Equipment device (which supports CSAFE and the custom GymConnect CSAFE protocol)
- A Wahoo Fitness GEM module running the GEMSAFE embedded application
- A Bluetooth Low Energy central/master (iOS, Android etc) running an application which supports the GymConnect API

The GEMSAFE application is designed to interface with a fitness equipment device over a serial connection using CSAFE protocol; read exercise data from the fitness equipment device, provide a method(s) for establishing a Bluetooth connection; communicate exercise data to a connected Bluetooth device with compatible application; and optionally broadcast workout data over ANT+.

1.2 GEMSAFE Fitness Equipment Communications

In the GymConnect system, all communication with the fitness equipment is performed using the Fitlinxx Communications Specification for Fitness Equipment (CSAFE) Protocol , see http://www.fitlinxx.com/CSAFE/ for full details.

The Wahoo Fitness GEM module running GEMSAFE operates autonomously as a CSAFE master and the fitness equipment device/console is the CSAFE slave. Terminology in the remainder of this document will use CSAFE Master when referring to Wahoo Fitness GEM module running GEMSAFE and CSAFE Slave when referring to the Fitness Equipment Device/Console.

The Wahoo Fitness GEM module running the GEMSAFE embedded application (the CSAFE master) uses standard CSAFE commands in conjunction with the custom “GymConnect” CSAFE command and associated protocol in order to communicate with the fitness equipment device (the CSAFE slave). The custom “GymConnect” CSAFE command and protocol has been designed to provide functionality that is not provided by the standard CSAFE protocol.

The GymConnect CSAFE protocol operates in a similar manner to the fitness industry’s CSAFE protocol, allowing for easier implementation in fitness equipment consoles/devices.

Details of the GymConnect CSAFE protocol can be found in section 2 of this document.

Configuration of GEMSAFE operating parameters is accomplished using the custom “GymConnect” CSAFE command/response format.

The GEMSAFE embedded application acts as a CSAFE master, and as such there is a defined process that it must follow to configure the CSAFE slave before it is able to request workout data from the CSAFE slave. The state machine diagram in Figure 1 provides an overview of how the GEMSAFE application operates.

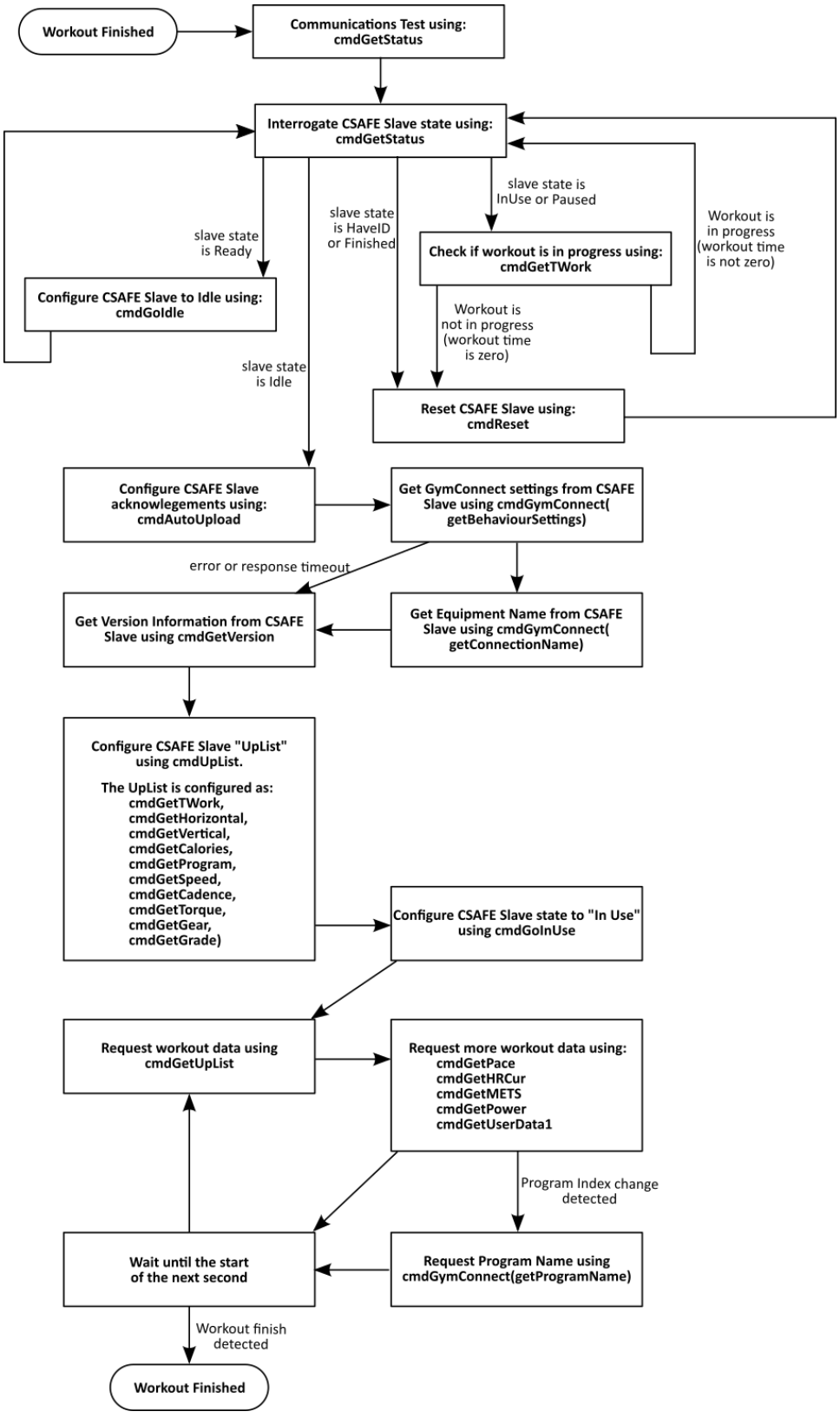

Figure 1: GEMSAFE CSAFE Master State Machine

1.2.1 Boot Up and Reset

Upon power up or reset, the GEM module running the GEMSAFE application will establish a link with the fitness equipment device over the GEM module's serial interface. The GEM module automatically negotiates baud rate between the GEM module and fitness equipment device. The supported baud rates are 9600 (the CSAFE standard baud rate) and 115200bps. The CSAFE master determines a successful negotiation of baud rate with the CSAFE slave by issuing the CSAFE command cmdGetStatus and getting a response from the slave.

1.2.2 Initial Status Check and Slave State Handling

Once the serial communications link has been established, the GEMSAFE application examines the CSAFE slave state using the CSAFE command cmdGetStatus. The initial state of the slave will affect how the CSAFE master will proceed with initialization of the salve.

1.2.2.1 InUse or Paused State

If the CSAFE slave reports that it is in InUse or Paused CSAFE slave state, the GEMSAFE application will then check if a workout is currently in progress. The CSAFE master does this by requesting the current workout time from the CSAFE slave using the cmdGetTWork command. A non-zero workout time indicates that a workout is in progress, and the CSAFE master will not proceed in this case and will re-check the state after a short delay (see state machine Figure 1).

If the workout time is zero, then the CSAFE master (GEMSAFE application) assumes that a workout is not in progress, and the cmdReset CSAFE command is then issued to reset the CSAFE slave (reset the fitness equipment's CSAFE interface).

1.2.2.2 HaveID or Finished State

If the CSAFE slave reports that it is in the HaveID or Finished CSAFE slave state, the cmdReset CSAFE command is issued to reset the CSAFE slave (reset the fitness equipment's CSAFE interface).

1.2.2.3 Ready State

The GEMSAFE application will attempt to configure the fitness equipment device to the Idle state once it is in the Ready State. The GEMSAFE application will check to ensure the CSAFE slave is in the Idle state by issuing the command cmdGetStatus.

1.2.2.4 Idle State

Once the fitness equipment CSAFE slave state has changed to Idle, the GEMSAFE application will proceed with the remaining initialization/setup steps.

1.2.3 Configuration of the CSAFE Slave and GEMSAFE Application Configuration

The GEMSAFE application, acting as the CSAFE master, configures the fitness equipment CSAFE slave as required for the system to operate correctly. During this process a number of custom GymConnect CSAFE commands are used to read GEMSAFE behavior settings stored in the fitness equipment device.

The steps are as follows:

- The GEMSAFE application configures the slave to automatically acknowledge commands by issuing the cmdAutoUpload CSAFE command with an AutoUpload value of flgAutoStatus and flgAck
- The GEMSAFE application requests GEMSAFE behavior settings from the CSAFE slave by issuing the cmdGymConnect custom GymConnect CSAFE command, with a sub command of getBehaviourSettings (see GymConnect Custom CSAFE Protocol section for details). If the CSAFE slave responds, the GEMSAFE application will configure itself based on the behavior settings provided by the fitness equipment device. For further details on GEMSAFE behavior settings see section 1.5 Custom Operating Modes and Settings.
- If the slave responded to the previous cmdGymConnect(getBehaviourSettings) command, the GEMSAFE application requests the Bluetooth connection name prefix by issuing the cmdGymConnect custom GymConnect CSAFE command, with a sub command of getConnectionName.
- The GEMSAFE application issues the cmdGetVersion CSAFE command in order to obtain manufacturer and software version information from the fitness equipment.
- The GEMSAFE application issues the cmdUpList CSAFE command in order to configure the CSAFE slave's "up list". The Up List is always configured with the following commands: cmdGetTWork, cmdGetHorizontal, cmdGetVertical, cmdGetCalories, cmdGetProgram, cmdGetSpeed, cmdGetCadence, cmdGetTorque, cmdGetGear, cmdGetGrade.
- The GEMSAFE application issues the cmdGoInUse CSAFE command to put the CSAFE slave into the InUse state.

At this point, the GEMSAFE application and GEM module is fully configured and ready for a workout to begin.

1.2.4 Operation Before and During a Workout

Once the startup/configuration sequence is complete, the CSAFE master will begin continuously "polling" the CSAFE slave for data related to the current workout. This polling occurs regardless of the workout state and does not affect the behavior of the GEMSAFE application except due to end of workout events/state.

Once per second, the CSAFE master issues the cmdGetUpList CSAFE command. This command instructs the slave to send the various workout data fields defined in the UpList configuration performed in section 1.2.3 Configuration of the CSAFE Slave and GEMSAFE Application Configuration. A short time later, the CSAFE master issues CSAFE commands cmdGetPace, cmdGetHRCurrent, cmdGetMETS, cmdGetPower, cmdGetUserData1 to retrieve additional workout data fields which are not included in the UpList as an UpList can only contain ten items.

1.2.4.1 Program Level and Program Name

When the GEMSAFE application detects a change in the "Program Level" (as reported by the cmdGetProgram CSAFE command), the custom cmdGymConnect command is issued containing the getProgramName "sub command" (see section 2 for details). If the CSAFE slave implements this command, it will then respond with a string containing the "program name". This program name can then be sent over Bluetooth.

Note: This automatic behavior can be disabled – see section 1.5.1.1 Disable automatic Program Name refresh behavior for details.

1.2.4.2 End of Workout Detection and Handling

The GEMSAFE application continues to poll the fitness equipment for the workout data until the end of the workout is detected. The end of the workout is detected when the CSAFE slave changes state to Finished and the CSAFE master is notified of this new state.

The GEMSAFE application handles the Finished state by re-initializing the CSAFE connection by performing the setup and configuration steps again. – Figure 1 illustrates this process.

1.2.5 Notifications to the CSAFE Slave

There are multiple notifications that can be sent to the CSAFE slave to notify the CSAFE slave that certain events have occurred.

All notifications are disabled by default – the CSAFE slave must enable individual notifications as a part of the cmdGymConnect response. See getBehaviourSettings, Notification Configuration in section 2.4.4 GymConnect Command Response Data Formats for details.

1.3 GEMSAFE Bluetooth Communications

The GEMSAFE application manages Bluetooth advertising, connecting and disconnecting behaviors according to a number of settings, events and conditions. This behavior is illustrated in Figure 2 through Figure 5, and further described in the following sections.

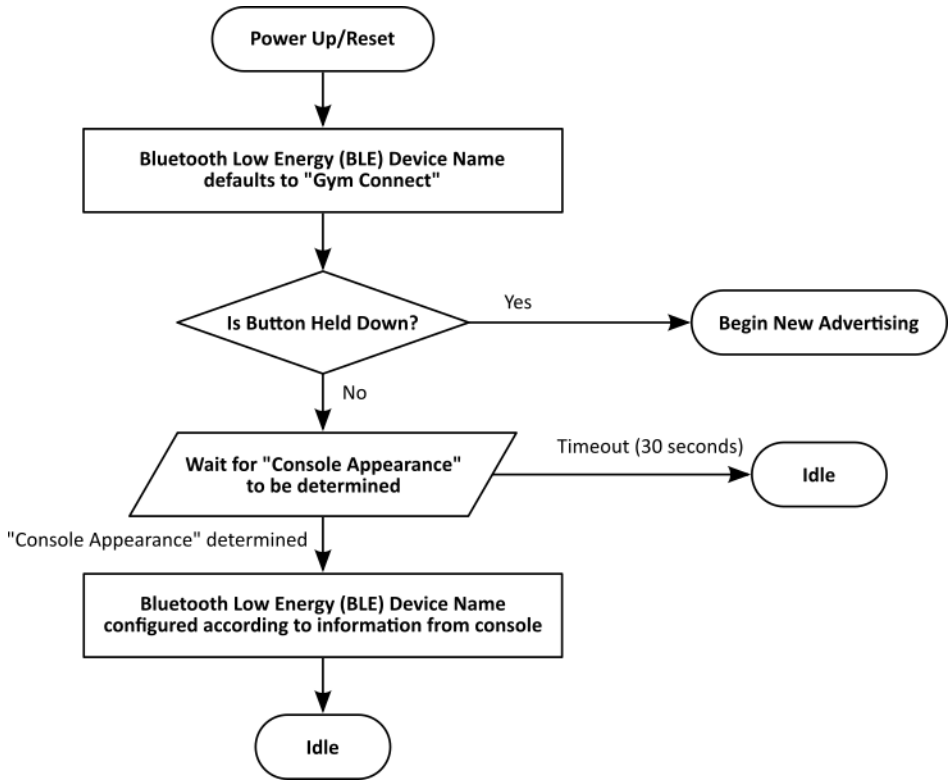

Figure 2: GEMSAFE Bluetooth Behavior - Power Up to Idle

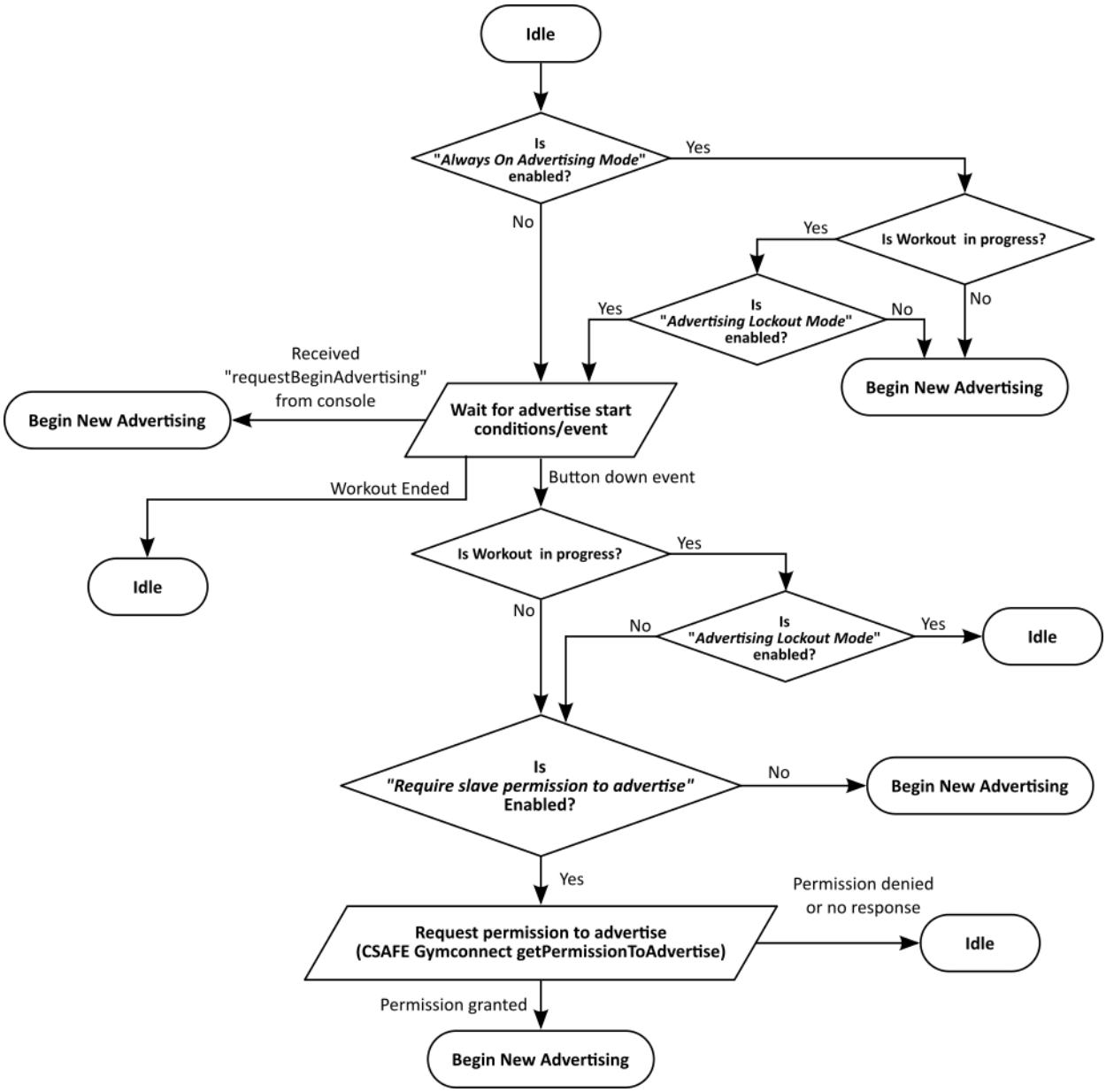

Figure 3: GEMSAFE Bluetooth Behavior - Idle to Advertising

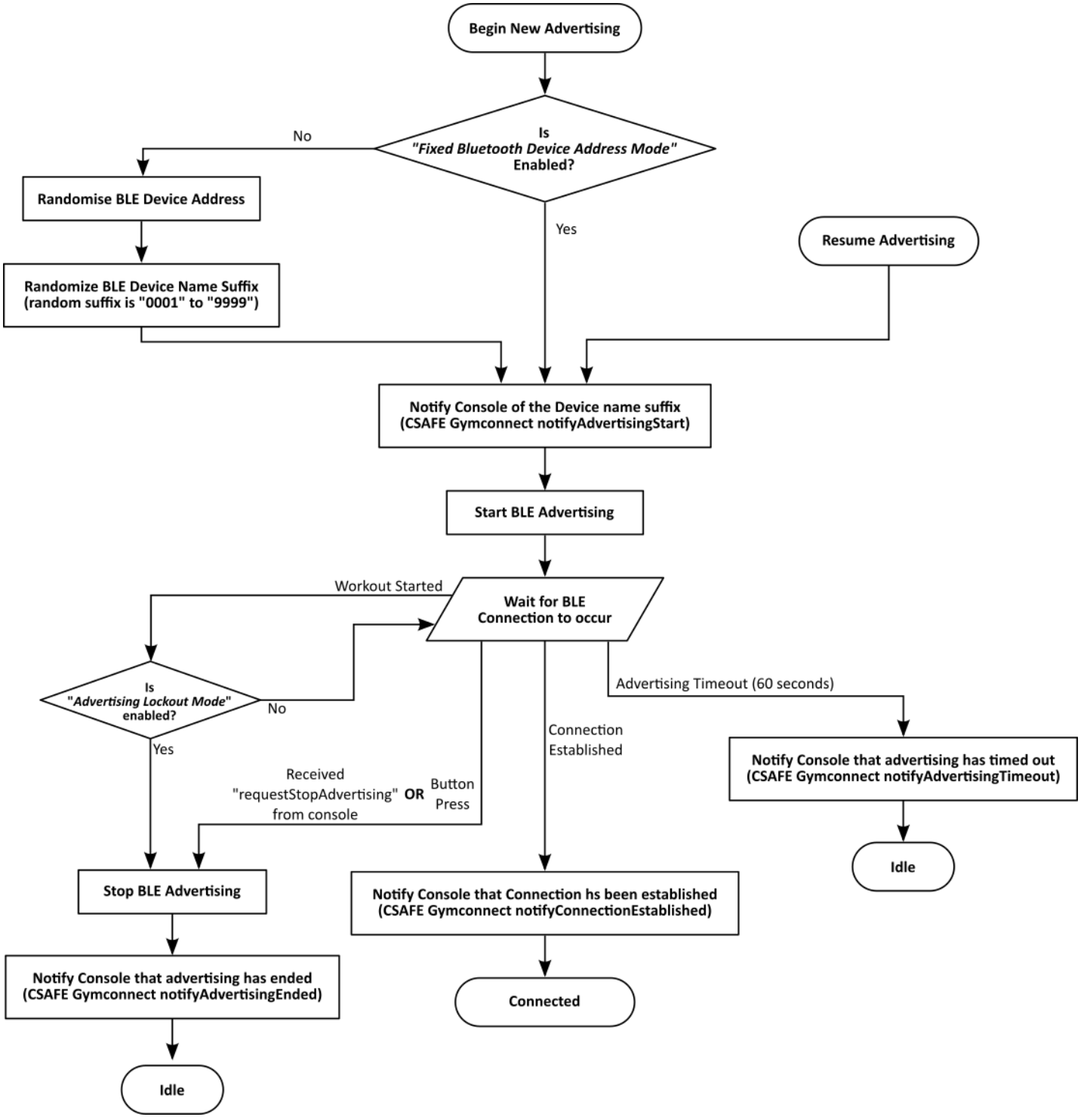

Figure 4: GEMSAFE Bluetooth Behavior - Advertising to Connected

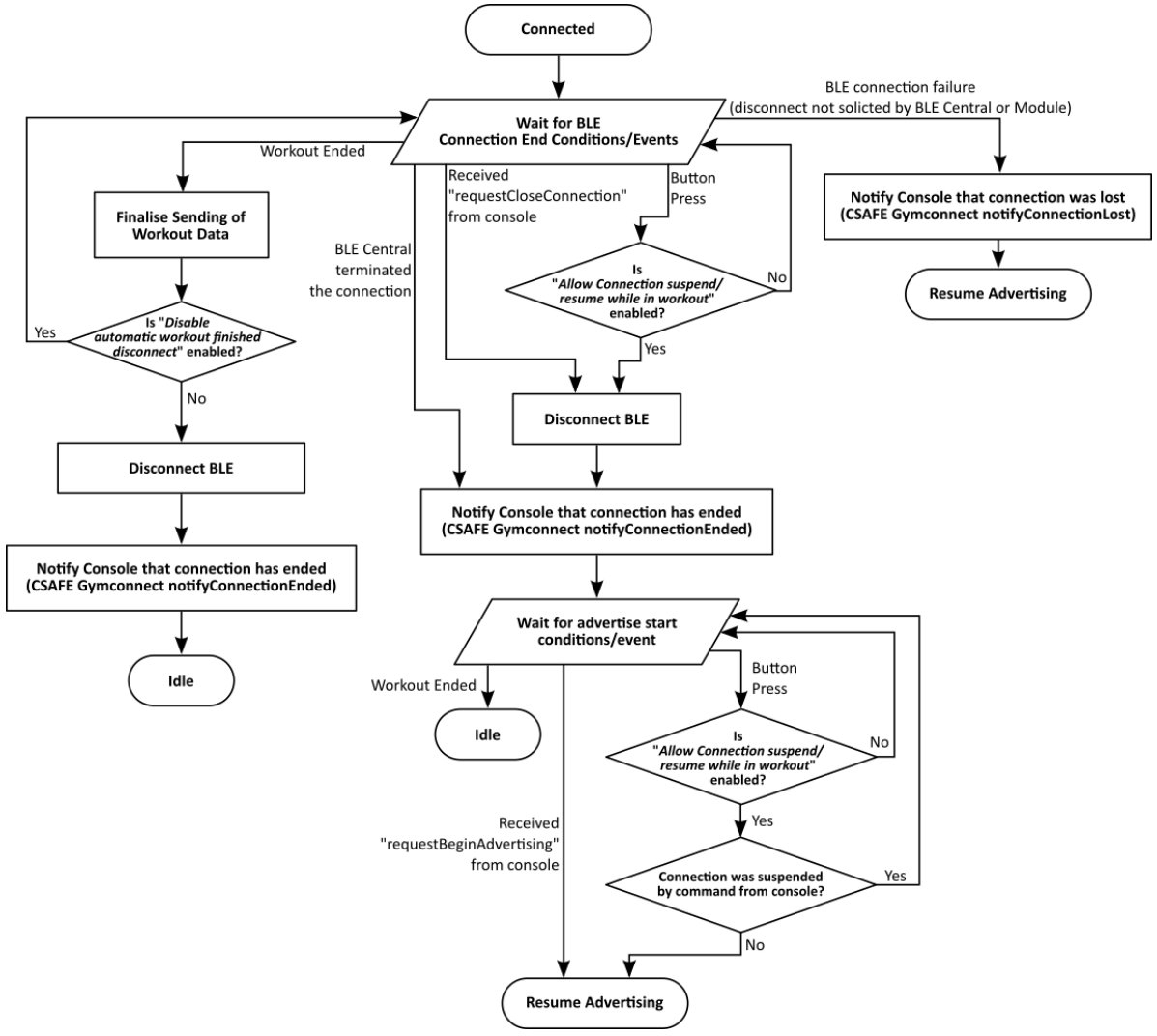

Figure 5: GEMSAFE Bluetooth Behavior – Connected

1.3.1 Establishing Bluetooth Connection (Advertising)

The GEMSAFE application assumes that a person using the fitness equipment device will establish a Bluetooth connection with their smartphone or tablet running a compatible GymConnect application such as Wahoo Fitness RunFit.

The GEMSAFE application supports a number of methods for initiating a connection between the GEM enabled fitness equipment device and the user's smartphone with GymConnect compatible application. The Bluetooth 4.0 technology used in the GEM module requires that a device "advertise" itself to the connecting device. The GEMSAFE application allows for advertising to be initiated in the following ways:

- Always On Advertising
- Button Press Advertising
- Fitness Equipment Requested Advertising

Depending on the GEMSAFE application configuration (see section 1.2.3), the GEMSAFE application may be required to request permission from the CSAFE slave to begin advertising, this is detailed in section 1.3.1.4 Request Slave Permission to Advertise).

The GEMSAFE application provides an indication of active advertising and connection through an I/O line of the GEM module (see the GEM module hardware manual for specific pin configuration). The duty cycle of the advertising indication can be customized using the GEMSAFE behavior settings, see section 1.1.1.1 for additional details.

1.3.1.1 Always On Advertising Mode

When the "Always On Advertising" mode is enabled, the GEMSAFE application will continually advertise after GEMSAFE application startup and connection to fitness equipment has been completed and a Bluetooth central is not connected . (See GymConnect Custom CSAFE Protocol section, getBehaviourSettings, Always On Advertising Mode.)

Always On Advertising mode is mainly intended for use in a home or individually owned environment as opposed to a Gym/Public setting. Always on Advertising in the latter setting would make user connections to the correct fitness equipment device difficult.

Depending on the requirements, it may be appropriate to use this mode in conjunction with the Fixed Bluetooth Device Address Mode option (See section 1.5.2.3 for details).

The effect of this mode can be seen in Figure 3: GEMSAFE Bluetooth Behavior - Idle to Advertising.

1.3.1.2 Button Press Advertisement

The GEMSAFE application has a dedicated pin that is used as an input for a "pairing" button. The GEMSAFE application will initiate Bluetooth advertising when the voltage on this pin reaches a specified state – i.e. when a button connected to the pin has been pressed. Please see the GEM hardware manual for specific I/O pin assignments and voltage levels.

Note: button presses are reported to the CSAFE slave via the notifyButtonPressed event if the CSAFE slave has enabled that particular notification. See section 1.2.5 and notifyButtonPressed in section 2.4.2 for details.

1.3.1.3 Fitness Equipment Requested Advertising

The fitness equipment (CSAFE slave) can request for advertising to begin by issuing the requestBeginAdvertising "unsolicited response" to the CSAFE master. (See requestBeginAdvertising in section 2.4.2 GymConnect Command IDs).

1.3.1.4 Request Slave Permission to Advertise

As previously mentioned, the GEMSAFE application may be required to request permission from the CSAFE slave to begin advertising. The GEMSAFE application will request permission from the CSAFE slave if the following conditions are true:

- The Require slave permission to advertise setting has been enabled (see section 1.5.2.4 GEMSAFE Requires Permission to Advertise)
- Advertising was initiated by a button press (see section Button Press Advertisement)

The GEMSAFE application requests permission via the getPermissionToAdvertise GymConnect CSAFE command (see section 2.4.2 GymConnect Command IDs). The CSAFE slave then responds, either granting permission or denying it (see getPermissionToAdvertise in section 2.4.4 GymConnect Command Response Data Formats).

If permission is denied, the GEMSAFE application takes no further action; the button press is effectively ignored.

1.3.2 Bluetooth Advertising Start and the Bluetooth Connection Name

When Bluetooth advertising is started, the GEMSAFE application will advertise its Bluetooth Connection Name (also known as a Bluetooth Device Name).

The Bluetooth Connection Name is constructed by combining the CSAFE slave's "Connection Name" (see getConnectionName in section 2.4.4 GymConnect Command Response Data Formats) and something called the "Connection ID". The "Connection ID" is a random 4 digit number automatically generated by the GEMSAFE application.

If the fitness equipment device does not provide a "Connection Name", the GEMSAFE application uses the default name "Gym Connect".

If the notification is enabled, the "Connection ID" will be sent to the CSAFE slave using the notifyAdvertisingStart notification (see 2.4.2 GymConnect Command IDs). This event is enabled/disabled in the GEMSAFE behavior settings (see section 1.2.5 Notifications to the CSAFE Slave).

If the Fixed Bluetooth Device Address Mode setting is enabled (part of the GymConnect CSAFE getBehaviourSettings response – see section 1.5.2.3 Fixed Bluetooth Device Address Mode), the Bluetooth connection name will not contain the random "Connection ID", instead the "Connection Name" will be used without modification.

For example, the full Bluetooth Connection Name advertising name could be: Treadmill 5211. In the mobile application, the fitness equipment device will appear in a manner similar to that shown in Figure 6 when the application scans for available GEM enabled fitness equipment.

Figure 6: Smartphone App scanning for GEM enabled fitness equipment

1.3.3 Advertising Timeout or Stop

During the course of advertising, certain events/conditions will cause the advertising to stop.

1.3.3.1 Advertising Timeout

The advertising will timeout after 60 seconds (the default value), at which point it will automatically stop. The GEMSAFE application will send the notifyAdvertisingTimeout notification if it is enabled (see section 1.2.5 Notifications to the CSAFE Slave).

If "Always On Advertising Mode" is enabled, advertising will not timeout. (See 1.3.1.1 Always On Advertising Mode for details.)

The advertising timeout duration can be customized via the GEMSAFE application settings. See 1.5.3.2 Custom Advertising Timeout for details.

1.3.3.2 Advertising Stopped By Button Press

The user can stop the advertising by pressing the "pair button". The GEMSAFE application will send the notifyAdvertisingEnded notification if it is enabled (see section 1.2.5 Notifications to the CSAFE Slave).

1.3.3.3 Fitness Equipment Requests Stop Advertising

The CSAFE Slave can request the GEMSAFE application to stop advertising by issuing the requestStopAdvertising "unsolicited response" to the CSAFE master. (See requestStopAdvertising in section 2.4.2 GymConnect Command IDs). The GEMSAFE application will send the notifyAdvertisingEnded notification if the notification is enabled (see section 1.2.5 Notifications to the CSAFE Slave).

1.3.4 Connection Establishment

The GEMSAFE application is now advertising and ready to accept a Bluetooth connection from a Bluetooth Low Energy Central/Master (for example, an Apple iOS device or an Android device).

Using the Wahoo Fitness RunFit application as an example, the next step is for the user to select the correct GEM enabled device from the list presented in the application. The Bluetooth Connection name with unique identifier, if displayed on the fitness equipment device, can provide a visual indication to the user of which device they should select from the list.

Once the user selects the device in their application, a connection attempt will be initiated between the users mobile device and the fitness equipment device. Once the connection is successfully completed, the user can begin their workout on the fitness equipment device.

If a connection is not established, then the GEMSAFE application will either continue advertising or cease advertising depending on the advertisement settings configured in the GEMSAFE behavior settings. See 1.3.3.1 Advertising Timeout for details.

1.3.5 Successful Connection

After a successful connection is made between the user's smartphone and GEM enabled fitness equipment device, the GEMSAFE application will send the notifyConnectionEstablished notification to the CSAFE slave (fitness equipment device) if the notification is enabled (see section 1.2.5 Notifications to the CSAFE Slave).

1.3.6 Bluetooth Operation While Workout Active

Once the CSAFE slave has been configured by the CSAFE master (see section 1.2 GEMSAFE Fitness Equipment Communications for details) the GEMSAFE application will automatically poll the CSAFE slave to retrieve the current workout data. While a Bluetooth connection is established, the workout data will be sent to the users connected Bluetooth device using the custom, Wahoo Fitness, Fitness Equipment Profile. Details of the Wahoo Fitness Fitness Equipment Profile can be found on Wahoo Fitness' gym website at http://www.wahoogym.com. The mobile application on the user's smartphone will be responsible for interpreting the data. The following is an example of how workout data can be displayed to the user in a mobile application:

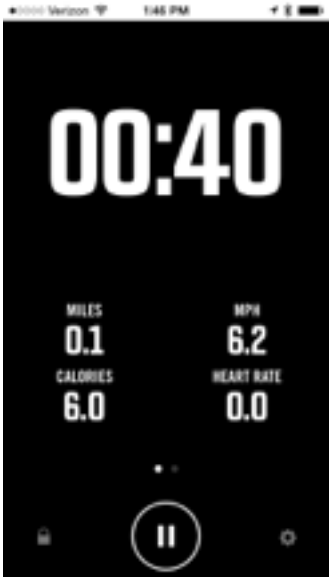

Figure 7: Wahoo Fitness RunFit application showing workout data

Wahoo Fitness provides a full SDK for application developers to use to create an application compatible with Wahoo Fitness' GEM module. The SDK is available on Wahoo Fitness' website at www.wahoofitness.com.

1.3.7 Bluetooth Handling for Workout Finished

If the fitness equipment workout is completed, the GEMSAFE application will detect this (see section 1.2.4.2 End of Workout Detection and Handling).

The fitness equipment finished state is conveyed from the GEMSAFE application over Bluetooth to the mobile application. At this point, the mobile application will be responsible for what is done with the accumulated workout data. For example, the Wahoo Fitness RunFit application automatically prompts the user if they want to save the workout and keep it in their workout history as shown in Figure 8.

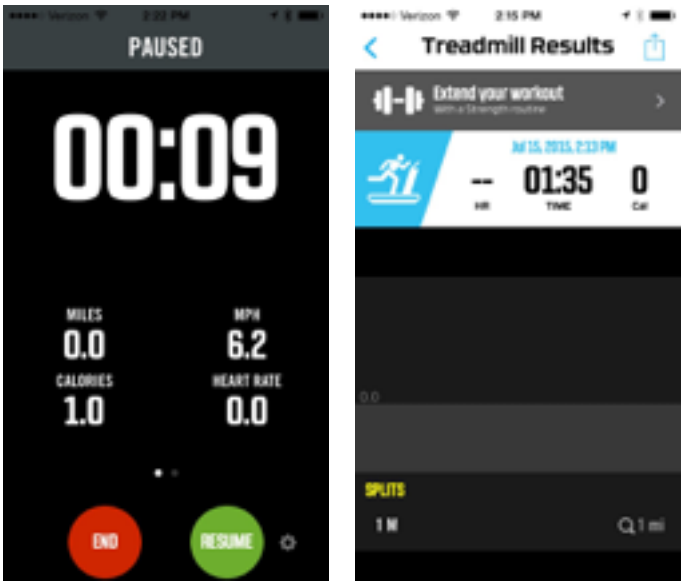

Figure 8: Wahoo Fitness RunFit behavior at end of workout

Following this, the Bluetooth connection may or may not be terminated by the GEMSAFE application – see section 1.3.8.4.2 Workout Finished Initiated Disconnection for details.

1.3.8 Bluetooth Disconnection

There are several conditions that will result in a Bluetooth disconnection; these conditions are covered in this section.

1.3.8.1 Unsolicited Disconnection (Connection Lost)

If neither the Bluetooth central/master (smartphone) nor the GEMSAFE application requests a disconnection, this is considered to be an "Unsolicited Disconnection".

When this situation is detected by the GEMSAFE application, it will send the notifyConnectionLost notification to the CSAFE slave if the notification is enabled (see section 1.2.5 Notifications to the CSAFE Slave).

The GEMSAFE application will then automatically re-advertise with the same Bluetooth device name and Bluetooth Device address so that the previously connected Bluetooth central/master (smartphone) can attempt to re-establish the connection.

1.3.8.2 Bluetooth Central Initiated Disconnection

If the user disconnects the Bluetooth Central/Master (the smartphone app) from the GEM enabled fitness equipment device, the GEMSAFE application will send the notifyConnectionEnded notification to the CSAFE slave if the notification is enabled (see section 1.2.5 Notifications to the CSAFE Slave).

If later, during the same workout, the user presses the "pair button", then the GEMSAFE application will re-advertise (with the same Bluetooth device name and Bluetooth Device address). This "button press connection resume" behavior can be disabled via a setting; See section 1.5.2.5 Allow Connection suspend/resume while in workout for details.

1.3.8.3 Button Press Initiated Disconnection

By default, if the user presses the "pair button" while a Bluetooth connection is active, the connection will be closed. The GEMSAFE application will send the notifyConnectionEnded notification to the CSAFE slave (fitness equipment device) if the notification is enabled (see section 1.2.5 Notifications to the CSAFE Slave).

If later, during the same workout, the user presses the button again, then the GEMSAFE application will re-advertise (with the same Bluetooth device name and Bluetooth Device address).

The above behavior can be disabled via a setting; See section 1.5.2.5 Allow Connection suspend/resume while in workout for details.

1.3.8.4 Fitness Equipment Initiated Disconnection

1.3.8.4.1 CSAFE Request for Disconnection

The CSAFE slave can explicitly request that the connection be closed by issuing the requestCloseConnection "unsolicited response" to the GEMSAFE application. (See requestCloseConnection in section 2.4.2 GymConnect Command IDs). The GEMSAFE application will disconnect the Bluetooth connection and send the notifyConnectionEnded notification to the CSAFE slave if the notification is enabled (see section 1.2.5 Notifications to the CSAFE Slave).

1.3.8.4.2 Workout Finished Initiated Disconnection

If the fitness equipment device workout is completed, the GEMSAFE application will detect this (see section 1.2.4.2 End of Workout Detection and Handling). By default, the GEMSAFE application will automatically terminate the Bluetooth connection. Automatic disconnection is controlled in the GEMSAFE behavior settings - See 1.5.2.6 Disable automatic workout finished disconnect for details.

1.4 External Sensor Data Transfer to Fitness Equipment

The GEMSAFE application can be configured to send Heart Rate (HR) and/or Cadence being collected by the users smartphone from a Bluetooth HR or Cadence sensor. To send these values to the fitness equipment device, the GEMSAFE application behavior should be configured to enable this feature; see section 1.2.5 Notifications to the CSAFE Slave.

Once the behavior settings are enabled and an active connection between the fitness equipment device and the user's smart phone has been established, the GEMSAFE application will send the HR and/or Cadence to the fitness equipment device using the notifyHeartRateValue and notifyCadenceValue events whenever the smartphone app or other Bluetooth Central application provides this sensor data over the Bluetooth link.

1.5 Custom Operating Modes and Settings

There are a number of special operating modes and settings available to customize the operation of the GEMSAFE application. These modes/settings are detailed in this section.

1.5.1 Settings which alter CSAFE Master Operation

1.5.1.1 Disable automatic Program Name refresh behavior

Figure 1: GEMSAFE CSAFE Master State Machine provides an illustration of how the GEMSAFE application behaves as a CSAFE master. This diagram shows that the CSAFE master will "request program name" whenever a "program index change [is] detected". This behavior however can be disabled by use of the Disable automatic Program Name refresh behavior setting. This setting is part of the getBehaviourSettings response. See section 2.4.4 GymConnect Command Response Data Formats for details.

Note: Regardless of this setting, at any time, the CSAFE slave can inform the CSAFE master that the program name should be refreshed by issuing the requestProgramNameRefresh "unsolicited response" to the CSAFE master. (See requestProgramNameRefresh in section 2.4.2 GymConnect Command IDs).

1.5.2 Special operating modes

All settings contained in this section are enabled/disabled as part of the getBehaviourSettings response. See section 2.4.4 GymConnect Command Response Data Formats for details.

1.5.2.1 Always On Advertising Mode

When the "Always On Advertising Mode" is enabled, the GEMSAFE application will always advertise when it is not connected. See section 1.3.1.1 Always On Advertising Mode for details.

1.5.2.2 Advertising Lockout Mode

If "Advertising Lockout Mode" is enabled, the GEMSAFE application will prevent the user from initiating Bluetooth advertising via the "pair button" when a workout is in progress. For the full effects of this mode, please examine Figure 3: GEMSAFE Bluetooth Behavior - Idle to Advertising and Figure 4: GEMSAFE Bluetooth Behavior - Advertising to Connected.

1.5.2.3 Fixed Bluetooth Device Address Mode

By default, the GEMSAFE application uses a randomized Bluetooth device address and adds a random suffix to the Bluetooth Device Name for each new instance of advertising (see Figure 4: GEMSAFE Bluetooth Behavior - Advertising to Connected). The GEMSAFE application does support using fixed Bluetooth device address, which will also cause the Bluetooth Connection Name to exclude the random suffix (see section 1.3.2 Bluetooth Advertising Start and the Bluetooth Connection Name for more information about the Bluetooth connection name).

1.5.2.4 GEMSAFE Requires Permission to Advertise

The CSAFE slave can control when the GEMSAFE application is allowed to advertise by enabling the "Require slave permission to advertise" setting.

The setting name is Require slave permission to advertise.

If this behavior is enabled, the GEMSAFE application will send the getPermissionToAdvertise command (See GymConnect Custom CSAFE Protocol section, GymConnect Command IDs) to the CSAFE slave before advertising begins (see Figure 3: GEMSAFE Bluetooth Behavior - Idle to Advertising for illustration).

The CSAFE slave must then respond to the getPermissionToAdvertise command, either granting permission or denying it. (See GymConnect Custom CSAFE Protocol section, 2.4.4 GymConnect Command Response Data Formats).

1.5.2.5 Allow Connection suspend/resume while in workout

This mode allows the user to suspend/resume the Bluetooth connection during a workout by use of the “pair button”. See Figure 5: GEMSAFE Bluetooth Behavior – Connected for an illustration of how this affects the operation of the system/product.

1.5.2.6 Disable automatic workout finished disconnect

When this mode is enabled, the GEMSAFE application will not terminate the Bluetooth connection when the workout finishes. See Figure 5: GEMSAFE Bluetooth Behavior – Connected.

1.5.3 Other Settings

All settings mentioned in this section are enabled/disabled as part of the getBehaviourSettings response. See section 2.4.4 GymConnect Command Response Data Formats for details.

1.5.3.1 ANT+ Fitness Equipment Profile Broadcasting

In addition to sharing workout data over a Bluetooth connection, the GEMSAFE application can be configured to simultaneously broadcast workout data over ANT+ using the ANT+ Fitness Equipment Profile.

1.5.3.2 Custom Advertising Timeout

The advertising timeout duration can be customized with this setting.

1.5.3.3 Custom Advertising LED Pattern

The “advertising LED pattern” (the LED blink on/off duration during Bluetooth advertising) can be customized with this setting.

1.5.3.4 Custom BLE Radio Transmit Power

This setting controls the Bluetooth Low Energy Transmit Power setting.

1.5.3.5 Custom ANT Radio Transmit Power

This setting controls the ANT Radio Transmit Power setting.

1.6 Fitness Equipment (CSAFE Slave) Request Commands

Documentation for these “CSAFE slave to CSAFE master” (Fitness Equipment device to GEMSAFE application) request commands can be found in the GymConnect Custom CSAFE Protocol, 2.4.2 GymConnect Command IDs section. These commands are sent from the CSAFE Slave as “unsolicited responses” to the CSAFE master.

- requestBeginAdvertising: CSAFE slave requests GEMSAFE application to begin Bluetooth advertising (or resume it, depending on the current state). See Figure 3: GEMSAFE Bluetooth Behavior - Idle to Advertising.
- requestStopAdvertising: CSAFE slave requests GEMSAFE application to stop current Bluetooth advertising. See Figure 4: GEMSAFE Bluetooth Behavior - Advertising to Connected.
- requestCloseConnection: CSAFE slave requests GEMSAFE application to close current Bluetooth connection. See Figure 5: GEMSAFE Bluetooth Behavior – Connected.
- requestReboot: CSAFE slave requests GEMSAFE application to reboot. This is useful if the CSAFE slave wants the GEMSAFE application to perform initialization again so that new settings can take effect.
- requestProgramNameRefresh: CSAFE slave requests GEMSAFE application to refresh the program name. See sections 1.2.4.1 Program Level and Program Name and 1.5.1.1 Disable automatic Program Name refresh behavior for more details.

2 GymConnect Custom CSAFE Protocol

2.1 GymConnect Command ID

Wahoo Fitness has defined a custom CSAFE command called GymConnect that has been implemented as a CSAFE long command. CSAFE long commands are commands that are accompanied by data. The custom GymConnect CSAFE command ID is OxOF (OFH).

This ID has been chosen because it falls at the very end of the "Commands that Control the State of the Slave" command ID range in the CSAFE protocol. Detailed information on the CSAFE protocol can be found at: http://www.fitlinxx.com/csafe/

2.2 Gym Connect Command Message Format

The GymConnect CSAFE command message has the following format:

Long Command ID	Data Byte Count	Data

Name	Size (Bytes)	Description
Long Command ID	1	The custom Wahoo Fitness CSAFE command ID = OxOF (OFH)
Data Byte Count	1	Number of Data bytes for this command not counting either the Command byte or the Data Byte Count byte. Range 0-255.
Data	Variable	One or more GymConnect Command data structures

2.3 Response Message Format

A GymConnect command response packet follows the normal CSAFE format, which is:

CSAFE Response Structure:

Status Byte	Zero or more Data Structures

A GymConnect Data Structure has the form:

Identifier	Data Byte Count	Data

<table>
<tr><th>Name</th><th>Size (Bytes)</th><th colspan="3">Description</th></tr>
<tr><td>Identifier</td><td>1</td><td colspan="3">In the case of GymConnect, this will be GymConnect CSAFE Long Command ID = 0x0F</td></tr>
<tr><td>Data Byte Count</td><td>1</td><td colspan="3">Number of Data bytes (not including this field and preceding field(s)).</td></tr>
<tr><td rowspan="3">Data</td><td rowspan="3">Variable</td><td>Name</td><td>Size (Bytes)</td><td>Description</td></tr>
<tr><td>GymConnectCmdID</td><td>1</td><td>The GymConnectCmdID</td></tr>
<tr><td>GymConnect Command Response Data</td><td>variable (can be empty)</td><td>The response data in the GymConnect Command Response Data format (Identifier,Byte Count, Data)</td></tr>
</table>

Note: The CSAFE slave can send “unsolicited responses” to the CSAFE MASTER. GymConnectCmdIDs above 0x80 are denoted as “unsolicited responses”

2.4 GymConnect Commands

2.4.1 GymConnect Command Data Structure

Name	Size (Bytes)	Description
GymConnectCmdID	1	The GymConnect Command ID
Data length	1	Number of Data bytes (does not include this field and preceding field(s).
Data	Variable	Data related to the command. Details of the GymConnect Command Data Format is provided in chapter x of this document.

Note: The CSAFE slave can send certain “unsolicited responses” to the GymConnect (CASFE master). The GymConnectCmdIDs above 0x80 are all denoted as “unsolicited responses”.

2.4.2 GymConnect Command IDs

ID	Name	Direction	Description
0x00	UNUSED	Master to slave	
0x01	getBehaviourSettings	Master to slave	This command is sent to the CSAFE slave during power up and allows customizations in the default GymConnect behavior.
0x02	getPermissionToAdvertise	Master to slave	Sent to the CSAFE slave when the master wants permission to advertise and only used when "Require slave permission to advertise" has been set in the behavior settings. This command will not be issued if Always On Advertising Mode is enabled.
0x10	getConnectionName	Master to slave	Sent to the CSAFE slave during power up. The name (string) provided by the CSAFE slave is used in the Bluetooth device name.
0x11	notifyAdvertisingStart	Master to slave	This command is sent from the GymConnect device to the CSAFE slave when the GymConnect begins advertising for a Bluetooth Low Energy (BLE) connection. It is intended that the CSAFE slave (Brainboard/fitness equipment) will display the “Connection ID” to the user (human on/at the fitness equipment) so that they can more easily identify which BLE peripheral (GymConnect device) to connect to. The “Connection ID” will appear as a suffix in the BLE device name. Note: if Fixed Bluetooth Device Address Mode is enabled, this notification will still be issued, the included “Connection ID” can be empty.
0x12	notifyAdvertisingTimeout	Master to slave	Sent to the CSAFE slave when Bluetooth advertising has timed out and a Bluetooth connection is not established within the pre defined advertising period. This event will not occur if Always On Advertising Mode is enabled.
0x13	notifyAdvertisingEnded	Master to slave	Notifies the CSAFE slave that advertising was stopped deliberately. Note: advertising stops when a connection is established, however in this case the Advertising Ended notification is not used. This event will not occur if Always On Advertising Mode is enabled. Note: Advertising will stop automatically.
0x14	notifyConnectionEstablished	Master to slave	Notifies the CSAFE slave that a connection was established.
0x15	notifyConnectionLost	Master to slave	Notifies the CSAFE slave that the connection has been lost unexpectedly. As this is unexpected a new period of advertising will begin automatically.
0x16	notifyConnectionEnded	Master to slave	Notifies the CSAFE slave that the connection was ended deliberately.
0x30	notifyHeartRateValue	Master to slave	Notifies the CSAFE slave of a new heart rate value. This value should be discarded after a short period of time, to prevent use of "stale" values.

ID	Name	Direction	Description
0x31	notifyCadenceValue	Master to slave	Notifies the CSAFE slave of a new cadence value. This value should be discarded after a short period of time, to prevent use of "stale" values.
0x32	notifyButtonPressed	Master to slave	Notifies the CSAFE slave that the button has been pressed. Note: this can be used by the CSAFE slave to trigger an event such as a sound or turn on an LED.
0x50	getProgramName	Master to slave	Sent to the CSAFE slave to get the current Program name.
0x51	getManufacturerName	Master to slave	Sent to the CSAFE slave to get the equipment manufacturer name. Note: the CSAFE slave can ignore this command.
0x80	requestBeginAdvertising	Slave to Master	This command is considered an "unsolicited response" and is used by the CSAFE slave to initiate advertising. The command has no effect if Always On Advertising Mode is enabled. Note: If a CSAFE slave receives this command, it should ignore it.
0x81	requestStopAdvertising	Slave to Master	This command is considered an "unsolicited response" and is used by the CSAFE slave to stop advertising. The command has no effect if Always On Advertising Mode is enabled. Note: If a CSAFE slave receives this command, it should ignore it.
0x82	requestCloseConnection	Slave to Master	This command is considered an "unsolicited response" and is used by the CSAFE slave to close an active Bluetooth connection. Note: If a CSAFE slave receives this command, it should ignore it.
0x83	requestReboot	Slave to Master	This command is considered an "unsolicited response" and is used by the CSAFE slave to reboot the GEM module. Note: This is useful to force the GymConnect to refresh the behaviour settings.
0x84	requestProgramNameRefresh	Slave to Master	This command is considered an "unsolicited response" and is used by the CSAFE slave to request the Master to refresh the Program name. Note: This is useful to force the GymConnect to refresh the behavior settings.

2.4.3 GymConnect Command Data Formats

Note: All data is packed in Little Endian format, this includes multi-byte bit flags

Command	Command Data	
requestStopAdvertising	No command data.	
requestReboot	No command data.	
requestProgramNameRefresh	No command data.	
requestCloseConnection	No command data.	
requestBeginAdvertising	No command data.	
notifyHeartRateValue	**Type**	**Description**
	uint16	Heart rate value in BPM
notifyConnectionLost	No command data.	
notifyAdvertisingStart	**Type**	**Description**
	char[1 to 10]	A character array (string) representing the "Connection ID". This will not be null terminated.
notifyConnectionEstablished	No command data.	
notifyConnectionEnded	No command data.	
notifyCadenceValue	**Type**	**Description**
	uint16	Cadence value in RPM/Steps per minute.
notifyButtonPressed	No command data.	
notifyAdvertisingTimeout	No command data.	
notifyAdvertisingEnded	No command data.	
getProgramName	No command data.	
getPermissionToAdvertise	No command data.	
getConnectionName	No command data.	
getBehaviourSettings	No command data.	

2.4.4 GymConnect Command Response Data Formats

All data is packed in Little Endian format, this includes multi-byte bit flags.

Command	Response Data				
getBehaviourSettings	Name	Field Requirement	Type	Description	
	Settings	Mandatory	32 bit field	Bit	Description
				0	Disable automatic workout finished disconnect
				1	ANT+ Fitness Equipment Profile transmission enabled
				2	Require slave permission to advertise
				3	Disable automatic Program Name refresh. When enabled the getProgramName command is issued when the server detects a change in program ID/index as reported by the cmdGetProgram command.
				4	Always On Advertising Mode. When enabled, the module will always automatically advertise. If enabled, Require slave permission to advertise (bit 2) will have no effect.
				5	Fixed Bluetooth Device Address Mode. When enabled, the Bluetooth device address is fixed.
				6	Custom Advertising Timeout. If set, requires field C0 to be present in this response packet.
				7	Custom Advertising LED Pattern. If set, requires field C1 to be present in the response packet.
				8	Advertising Lockout Mode. When enabled, advertising will be locked out when a workout is in progress/active (this includes paused state).

<table>
<tr><th>Command</th><th colspan="5">Response Data</th></tr>
<tr><td rowspan="20"></td><td rowspan="4"></td><td rowspan="4"></td><td rowspan="4"></td><td>9</td><td>Allow Connection suspend/ resume while in workout
When enabled, pressing the button once during a workout will suspend the Bluetooth connection. A second button press will restart advertising with the same Bluetooth device address.</td></tr>
<tr><td>10</td><td>Use Custom Bluetooth Radio Transmit Power
If set, requires field C2 to be present in this response packet.</td></tr>
<tr><td>11</td><td>Use Custom ANT Radio Transmit Power. If set, requires field C3 to be present in this response packet.</td></tr>
<tr><td>12 -31</td><td>RESERVED</td></tr>
<tr><td rowspan="11">Notification Configuration</td><td rowspan="11">Mandatory</td><td rowspan="11">32 bit field</td><td colspan="2">Enables notification messages. Setting a bit to 1 will enable the specific notification message</td></tr>
<tr><th>Bit Number</th><th>Description</th></tr>
<tr><td>0</td><td>notifyConnectionID</td></tr>
<tr><td>1</td><td>notifyAdvertisingTimeout</td></tr>
<tr><td>2</td><td>notifyAdvertisingEnded</td></tr>
<tr><td>3</td><td>notifyConnectionEstablished</td></tr>
<tr><td>4</td><td>notifyConnectionLost</td></tr>
<tr><td>5</td><td>notifyConnectionEnded</td></tr>
<tr><td>6</td><td>notifyHeartRateValue</td></tr>
<tr><td>7</td><td>notifyCadenceValue</td></tr>
<tr><td>8</td><td>notifyButtonPressed</td></tr>
<tr><td>9 to 31</td><td>RESERVED</td></tr>
<tr><td>Custom Advertising Timeout</td><td>C0</td><td>uint16</td><td colspan="2">Custom Advertising Timeout (in seconds)
A value of zero will disable the advertising timeout.</td></tr>
</table>

Command	Response Data			
	Custom Advertising LED Pattern	C1	uint8[2]	Custom Advertising LED Pattern The values are interpreted as follows: byte[0] = LED On period, in 64ths of a second byte[1] = LED Off period, in 64ths of a second Note: An On period setting of 0 will disable the LED during advertising.
	Custom Bluetooth Transmit Power	C2	int8 (signed)	Custom BLE Radio Transmit Power, in dBm. Note: The module will use the nearest valid transmit power.
	Custom ANT Transmit Power	C3	int8 (signed)	Custom ANT Radio Transmit Power, in dBm. The module will use the nearest valid transmit power to the requested power setting.
getPermissionToAdvertise	**Type**	**Description**		
	byte	zero: Permission denied. non-zero: Permission granted		
getConnectionName	**Type**	**Description**		
	byte[1 to 40]	A string for "Connection Name" prefix used during advertising. The complete advertising name uses the "Connection Name" prefix with a randomly regenrated four digit number used as the suffix as the "Connection ID". The encoding should be UTF-8 (ASCII can be used as UTF-8 is backwards compatible with ASCII). This will not be null terminated.		
notifyConnectionID	No response data.			
notifyAdvertisingTimeout	No response data.			
notifyAdvertisingEnded	No response data.			
notifyConnectionEstablished	No response data.			
notifyConnectionLost	No response data.			
notifyConnectionEnded	No response data.			
notifyHeartRateValue	No response data.			
notifyCadenceValue	No response data.			
notifyButtonPressed	No response data.			

getProgramName	**Type**	**Description**
	byte[1 to 40]	A string representing the name of the current Program. The encoding should be UTF-8 (ASCII can be used as UTF-8 is backwards compatible with ASCII). This will not be null terminated.
getManufacturerName	**Type**	**Description**
	byte[1 to 20]	A string representing the manufacturer name of the equipment. The encoding should be UTF-8 (ASCII can be used as UTF-8 is backwards compatible with ASCII). This will not be null terminated.
requestBeginAdvertising	No response data.	
requestStopAdvertising	No response data.	
requestCloseConnection	No response data.	
requestReboot	No response data.	
requestProgramNameRefresh	No response data.	

2.5 Using Customizable Official CSAFE Commands

The CSAFE specification lists a number of commands that are documented as being "Custom" ("Interpreted As" and "Valid Range"). This section details how GEMSAFE application defines/interprets the format of these commands.

2.5.1 cmdGetUserData1

The CSAFE cmdGetUserData1 response is formatted to convey one or more fitness equipment workout measurements. The CSAFE Slave can ignore the cmdGetUserData1 request.

Note: all data is packed in Little Endian format, this includes multi-byte bit flags.

The format of the cmdGetUserData1 response is interpreted by the CSAFE Master as follows:

Field Index	Field Type	Size	Required/Optional
0	uint16ValueWithUnit	3	Required
1	uint16ValueWithUnit	3	Optional
2	uint16ValueWithUnit	3	Optional
	...		
9	uint16ValueWithUnit	3	Optional

Where each uint16ValueWithUnit field is interpreted as follows:

Field Index	Field Type	Size	Required/Optional
Value	CSAFE Integer (unsigned 16 bit integer)	2	Required
Unit specifier	CSAFE Unit specifier	1	Required

2.5.2 cmdGetSerial

The CSAFE cmdGetSerial command response is undefined/"custom". The CSAFE master will interpret the value as an ASCII string. The string does not need to be null terminated, but a null character (zero value) is permitted. If one or more null characters are included in the string, only the characters that precede the first null character are recognized.

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FITNESS

90 W. Wieuca Road N.E. Suite 110
Atlanta, GA 30342
Telephone: 1-877-978-1112
Email: support@wahoofitness.com
www.wahoofitness.com