CARETAKER LIBRARY API 1.6.5 REFERENCE MANUAL

Caretaker Medical

October 11, 2018

Contents

Chapter 1

Introduction

The Caretaker library is a cross-platform library to link with Android, Linux, and Windows applications.The library provides an interface to the Caretaker device for wireless vitals signs monitoring.

Scope

This version of the manual covers the Caretaker Library Windows API. The Caretaker library Android and Linux APIs are covered in separate documents. Please contact customer service for copies of the other APIs documentation as needed.

Getting Started

Read the following sections to integrate the library with an application to monitor the Caretaker device.

- Library Integration
- Monitoring from Managed Application, or
- Monitoring from Unmanaged Application

Chapter 2

Library Integration

This section provides an overview of the library integration with Windows applications.

Library Package

Windows versions of the library are released in zip format *ctlibrary-windows-VERSION.zip*, where *VERSION* is the library version number.
The archive bundle contains the following components.

Component	Description
examples	Examples illustrating library usage.
manual	The library API documentation. Documentation is available in pdf and html formats. The pdf version is supplied for completeness though the formatting is optimized for viewing in html format. Open *html/index.html to view the html version main page.*.
Win32	If present, this directory stores the library 32-bit (x86) version.
Win64	If present, this directory stores the library 64-bit (x64) version.
caretaker_static.h	Header file to include when linking with the unmanaged libcaretaker_static.lib.
caretaker_dynamic.h	Header file to include when linking with the unmanaged libcaretaker_dynamic.dll.
libcaretaker_static.lib	The unmanaged C/C++ library image to use for static linking with native applications.
libcaretaker_dynamic.dll	The unmanaged C/C++ library image to use for dynamic linking with native applications.
libcaretaker_clr.dll	Managed CLR library image to use for linking with .NET framework 4.0 or later applications.

Supported Platforms

This library version tested successfully with applications designed for the following configurations.

OS Version

- Windows 7 Version 6.1. 7601 SP1 or later
- Windows 8.1, Update 1 Version 6.3.9600 or later
- Windows 10 Version 1709, Build 16299 or later

Platform

- Win32 (x86)
- Win64 (x64)

Build Tools

- Visual Studio 2015
- Visual Studio 2017

Software Configuration

Windows 7 Version 6.1. 7601 SP1 or later installed for Windows 7 application linked with the library.

Windows 8.1, Update 1 Version 6.3.9600 or later for Windows 8.1 application linked with the library.

Windows 10 Version 1709, Build 16299 or later for Windows 10 application linked with the library.

Hardware Configuration

Bluetooth Low Energy (BLE) will need to be setup on Windows prior to connecting the application to the Caretaker device. Note that native Windows BLE is not supported in this release of the Caretaker library so an external BLE dongle is required. The supported dongles are TI CC2540 dongles. Note Bluegiga BLE112 dongles also work but have shorter range. Plug the dongle into a USB port on the PC and install the necessary drivers. After successful setup, the dongle will appear as a virtual COM port in Windows Device Manager. The library will detect the dongle automatically when it is plugged into the PC thereafter.

Linking with the Managed Library

The Common Language Runtime (CLR) wrapper library (libcaretaker_clr.dll) is available to integrate .NET 4.↩ 0 or later applications with the Caretaker device. To use it, copy libcaretaker_clr.dll (the managed library) and libcaretaker_dynamic.dll (the unmanaged library) to the application project directory then add a reference to libcareteker_clr.dll. For Visual Studio projects, the reference can be added by right-clicking the application project then selecting Add Reference and then browsing to libcaretaker_clr.dll and selecting it.

Note both DLLs will be loaded at runtime when the application is executed and are expected to be located with the application executable (.exe) file. So they must be copied also to the target directory where the application executable file is saved. The copy can be done manually after building the application, or the build can be configured to copy them to the target directory with the executable. For Visual Studio, this can be done by right-clicking the project then selecting Properties and then Build Events and adding the following Post-build event command line.

```
copy /B /Y "$(ProjectDir)libcaretaker_dynamic.dll" "$(TargetDir)"
```

Linking with the Unmanaged Library

Native Win32 applications can link the with the unmanaged library using either implicit or explicit linking.

Implicit Linking

Add the following files to the application project to link implicitly with the library.

- caretaker_static.h
- libcaretaker_static.lib

caretaker_static.h

This header file contains the exported library functions that are callable from within the application. Add it to the application source (or include) folder and then include it in each source file that will call library functions.

libcaretaker_static.lib

Add libcaretaker_static.lib to the application source (or lib) directory and include it in the library path where the linker can find it. If using an external makefile, add libcaretaker_static.lib where the object files (.obj) and other libraries are listed. If Visual Studio, add it to the project Linker Input configuration where the other libraries are listed.

Additionally, the following Windows system libraries must be added to the project to resolve libcaretaker dependencies.

- Setupapi.lib (available in the Windows SDK)

Explicit Linking

For explicit linking with the library, the application must explicitly load and unload libcaretaker_dynamic.dll.

- Call LoadLibrary (or a similar function) to load the DLL and obtain a module handle.
- Call GetProcAddress to obtain a function pointer to each exported function that the application will call.
- Call FreeLibrary when done with the DLL.

Sample code illustrating explicit linking is available in the Unmanaged Explicit Linking Example section.

Debugging

The library supports generating log messages with the following levels of verbosity.

Log Level	Description
0	Show all log messages. This is the most verbose level.
1	Show informational, warning, and error messages only.
2	Show warning and error messages only.
3	Show error messages only. This is the least verbose level.

The application can call the managed CareTaker.Device.SetLibraryLogLevel() API or the unmanaged libct_set_log_level() API to set the log level.

Log messages are written to standard output by default and will be printed to the console if the application was started there. The application can redirect library logs to a file as follows.

```
// Managed application code to redirect library logs to libcaretaker.log
Caretaker.Device.RedirectLibraryLogs();
```

```
// Unmanaged application code to redirect library logs to libcaretaker.log
FILE* logStream = NULL;
freopen_s(&logStream, "libcaretaker.log", "w", stdout);
```

Note log messages from the unmanaged library code will have the following format.

```
DATE       TIME         LEVEL/FILTER   THREAD  MESSAGE
---------- ------------ -------------- ------- -----------------------------------------------
2018-08-01 14:47:34.632 I/libcaretaker (10592) libct_init : Version: 0.0.0.f8b97f70.x64.debug
2018-08-01 14:47:45.566 D/libcaretaker (06040) glue_rcv_thread : started.
```

The log levels are defined as follows.

- D/ –> Debug
- T/ –> Trace
- I/ –> Informational
- W/ –> Warning
- E/ –> Error

Chapter 3

Monitoring from Managed Application

This section provides an illustration to monitor Caretaker data from within a managed (.NET framework) application.

After adding the reference to the library as discussed in the Library Integration section, monitoring the Caretaker device can be done using the managed Device and supporting classes, which are available in the Caretaker name space.

Asynchronous Monitoring

The Caretaker.DeviceObserver class provides an asynchronous interface to object-oriented application to receive Caretaker data and status information in real-time. Using this approach, the application calls Caretaker.Device class methods to read or write device data and receive the data and status information asynchronously in the application's DeviceObserver implementation.

The following code snippets illustrate C# code to create device and observer instances for asynchronous monitoring.

```
// Implement DeviceObserver to receive Caretaker data and status notifications.
public partial class Observer : Caretaker.DeviceObserver
{
    // Override the methods to receive the desired data and status information.
    // See Caretaker.DeviceObserver class documentation for details.
}

// Create the device and observer instances.
// Note the observer instance is passed as the first argument to the device constructor,
// and the second argument autoReconnect=true configures the device instance to automatically
// reconnect if the connection to the Caretaker device is lost, such as when the Caretaker device
// moves out of range.
Observer observer = new Observer();
Caretaker.Device device = new Caretaker.Device(observer, true);

// Establish connection to a device that is advertising and timeout after 20 seconds.
// Note you can call device.ConnectToSerialNumber() to specify the Caretaker serial number to connect
// a specific device, or call device.Scan() to scan for a device.
// The connection status will be notified later to the application's DeviceObserver.OnConnectionStatus()
// implementation with status=CONNECTED if the connection was established.
device.ConnectToAny(20000);

...

// Sometime later after the connection is established, start a calibration to receive data.
// Note StartManualCal() typically is invoked from DeviceObserver.OnConnectionStatus() for the
// CONNECTED status.
device.StartManualCal(120, 75);

// After calibration, the various DeviceObserver methods will be notified when data is received.

...

// Finally, call ReleaseResources() to release unmanaged resources allocated for the device instance.
// Note the device reference is no longer valid after calling ReleaseResources().
// Also, note ReleaseResources() cleans up unmanaged resources such as native threads and may delay the
// application thread as it waits for native threads to exit.
device.ReleaseResources();
device = null;
```

Poll Monitoring

The Caretaker.Device class also provides methods (getters) for procedural applications to poll Caretaker data. However, the methods must be called periodically to receive data after the connection is established. Note methods to get waveform data must be called at least 4 times per second to not drop data, while methods to get numeric data must be called at least once per second.

The following code illustrates snippet of C# code to create the device instance for poll monitoring.

```
// Create the device instance passing null observer as argument.
Caretaker.Device device = Caretaker.Device(null, true);

// Establish connection to a device that is advertising and timeout after 20 seconds.
device.ConnectToAny(20000);

// Poll for connected status and timeout after 21 seconds
int timeout = 21;
while(!device.IsConnected() && --timeout > 0) {
    System.Threading.Thread.Sleep(1000);
}

// Start a calibration to receive data if connection was established.
if ( device.IsConnected() ) {
    device.StartManualCal(120, 75);

    // Poll numeric data, waveform data and status information.
    unsigned int count = 0;
    while(!exit) {
        // poll device status and numeric data once per second
        if ( count % 4 == 0 ) {
            Caretaker.DeviceStatus deviceStatus = device.GetDeviceStatus();
            if (deviceStatus != null) {
                // display device status
            }

            Caretaker.PrimaryVitals vitals = device.GetPrimaryVitals();
            if ( vitals != null ) {
                // display vitals
            }
        }

        // poll waveform data at least 4 times per second
        Caretaker.WaveformDataPoints waveform = mCaretaker.
      GetPulsePressureWaveformDataPoints();
        if (waveform != null)
        {
            // display waveform
        }

        // sleep for 250 milliseconds
        System.Threading.Thread.Sleep(250);
        count++;
    }
}

// Finally, call ReleaseResources() to release unmanaged resources allocated for the device.
// Note the device reference is no longer valid after calling ReleaseResources().
// Also, note ReleaseResources() cleans up unmanaged resources such as native threads and may delay the
// application thread as it waits for native threads to exit.
device.ReleaseResources();
device = null;
```

Chapter 4

Monitoring from Unmanaged Application

This section provides an illustration to monitor Caretaker data from within an unmanaged application.

Overview

Two groups of unmanaged APIs are defined to simplify getting started: Primary and Secondary APIs. The primary API is the core interface required to connect to the Caretaker device to monitor numeric and waveform data, and the secondary API is an auxiliary interface to parse, read and write additional Caretaker data.

The sequence diagram below illustrates how an unmanaged application interacts with the primary functions to connect and start monitoring Caretaker data, which can be summarized as the following six steps.

- **Step 1:** Initialize a library context to associate with a Caretaker device.
- **Step 2:** Discover the device.
- **Step 3:** Connect to the device.
- **Step 4:** Start monitoring device data.
- **Step 5:** Calibrate and start measurements.
- **Step 6:** Handle numeric and waveform data notifications.

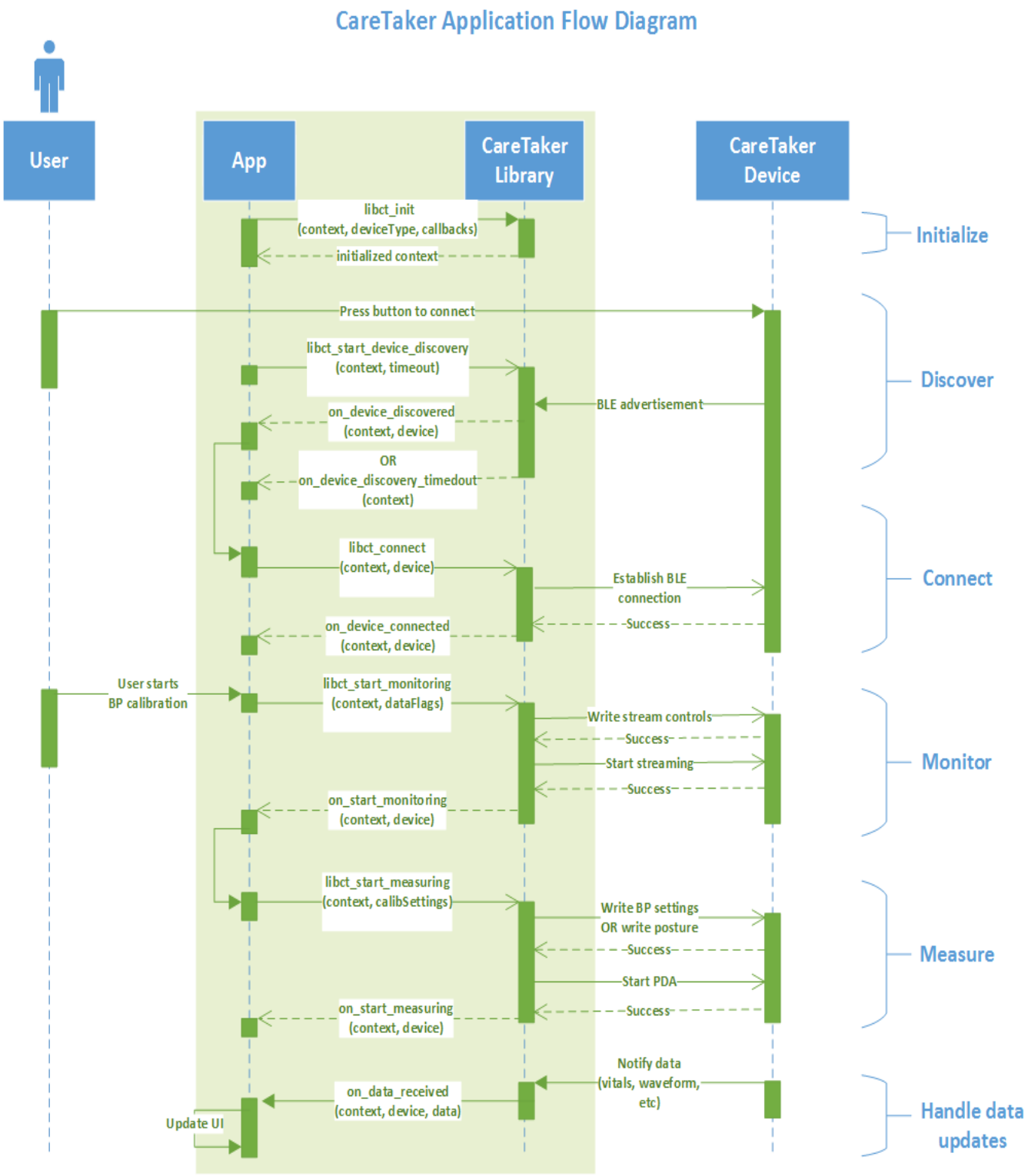

Figure 4.1 Sequence diagram to connect and monitor data.

Note: For simplification the code snippets used throughout this manual omit error handling. It is recommended that any application handle errors returned from library functions appropriately.

Step 1: Initialize a library context

Start by initializing a library context (or library instance) by calling libct_init(). Specify the class of device to associate with this library context in the initialization data. Set the appropriate application callback functions, and set any unused callbacks to null. At a minimum, the following callback functions should be implemented.

- on_device_discovered()
- on_device_connected_ready()
- on_device_disconnected()
- on_data_received()

Next call libct_init() with the context pointer, initialization data, and callback variables. Note the context pointer must be initialized to null prior to being passed to libct_init() to indicate it is not in use, otherwise libct_init() will return error.

```
libct_init_data_t init_data;
memset(&init_data, 0, sizeof(init_data));
init_data.device_class = LIBCT_DEVICE_CLASS_BLE_CARETAKER4;

libct_app_callbacks_t callbacks = { ... }

libct_context_t* context = NULL;
int status = libct_init(&context, &init_data, &callbacks);
if ( LIBCT_FAILED(status) ) {
    // Handle error
}
```

Optionally, after initializing the context, the application specific data can be saved in the context for retrieval and use later in the application callbacks. For example, a C++ main application instance can be set as app specific data for access in the callbacks. See libct_set_app_specific_data() and libct_get_app_specific_data() for more information.

```
libct_set_app_specific_data(context, this);
```

Step 2: Discover a device

If libct_init() returned success, a device context has been created and initialized to start device discovery. Call libct_start_discovery() to scan for nearby devices. It will scan for some specified timeout (20 seconds in the code example below) and automatically stop if the time out has been reached or if libct_stop_discovery() has been explicitly called to stop device discovery.

```
libct_start_discovery(context, 20000);
```

The application will receive notifications later from advertising devices matching the device class specified in the init_data passed to libct_init(). These notifications will be signaled to the application with the following callback functions.

- on_device_discovered()
- on_discovery_timedout()
- on_discovery_failed()

Note: The on_device_discovered() callback must be implemented to receive notification when a matching device is found.

Step 3: Connect to the device

The following implementation illustrates connecting to the first device found. However, by implementing a device white-list to check discovered devices against a known acceptable list, a specific device can be searched for and automatically connected or all discovered devices can be displayed on the application GUI allowing the user to select the appropriate device.

```
void LIBCTAPI on_device_discovered_cb(libct_context_t* context,
      libct_device_t* device) {
    libct_stop_discovery(context);
    libct_connect(context, device);
}
```

After calling libct_connect(), the application will later receive notifications signaling the connection status with the following callbacks.

- on_device_connected_not_ready()
- on_device_connected_ready()
- on_connect_error()
- on_connect_timedout()

Note: The on_device_connected_ready() callback must be implemented to receive notification when the connection is established and the device is ready to receive requests.

Step 4: Monitor device data

After the connection has been established, monitoring vitals from the device can be started. The following is a sample implementation illustrating this in the connection ready callback, but note monitoring the device data can be deferred until other application events are received, such as user input from the application GUI.

```
 void LIBCTAPI on_device_connected_ready_cb(libct_context_t* context,
      libct_device_t* device) {
     int flags = (LIBCT_MONITOR_INT_PULSE |
                  LIBCT_MONITOR_PARAM_PULSE |
                  LIBCT_MONITOR_VITALS |
                  LIBCT_MONITOR_CUFF_PRESSURE |
                  LIBCT_MONITOR_DEVICE_STATUS |
                  LIBCT_MONITOR_BATTERY_INFO);

     libct_start_monitoring(context, flags);
}
```

Note: The application will receive monitor status via theon_start_monitoring() callback. The callback will be invoked only once in response to each libct_start_monitoring() call and is thus a one-shot callback.

Step 5: Calibrate and start measurements

After calling libct_start_monitoring(), the application will start receiving data from the device via the on_data_received() callback, however, the application will not receive valid vitals and waveform data until the blood pressure measurements are calibrated. Again, starting calibration can be deferred until other application events are received, such as user input from the application GUI.

The following code illustrates starting automatic calibration. Note the patient posture must be retrieved elsewhere, such as from the application GUI.

```
libct_cal_t cal;
cal.type = LIBCT_AUTO_CAL;
cal.config.auto_cal.posture = posture;
libct_start_measuring(context, &cal);
```

And the following code illustrates starting manual calibration. Again, the systolic and diastolic initial values must be retrieved elsewhere, such as from the application GUI.

```
libct_cal_t cal;
cal.type = LIBCT_MANUAL_CAL;
cal.config.manual_cal.settings.systolic = systolic;
cal.config.manual_cal.settings.diastolic = diastolic;
libct_start_measuring(context, &cal);
```

Note: The application will receive measurement status via the on_start_measuring() callback, which is a one-shot callback, i.e., the callback will be invoked only once in response to each libct_start_measuring() call.

Step 6: Handle numeric and waveform data updates

If monitoring and measurements were started successfully, the application will start receiving numeric and waveform data updates. The application on_data_received() callback will be notified continuously while data is received from the device.

The following code snippet illustrates processing data received from the device in the application on_data_received() callback. See the stream data structure for data format details.

```
void LIBCTAPI on_data_received_cb(libct_context_t* context,
      libct_device_t* device, libct_stream_data_t* data) {
   // Obtain the application instance set earlier with libct_set_app_specific_data().
   // Note libct_get_app_specific_data() returns null if libct_set_app_specific_data() was not
   // called earlier to set the application instance.
   MainWindow* window = (MainWindow*) libct_get_app_specific_data(context);

   // Update device status
   if ( data->device_status->valid ) {
        // ... check device status flags
   }

   // Update vitals
   libct_vitals_t* vitals = libct_get_last_dp(data, vitals);
   if ( vitals && vitals->valid ) {
        window->setHr(vitals->heart_rate);
        window->setRes(vitals->respiration);
        window->setMap(vitals->map);
        window->setBp(vitals->systolic, vitals->diastolic);
   }

   // Update the pulse rate waveform
   unsigned int idx;
   libct_pulse_t* pulse;
   for_each_dp(data, idx, pulse, raw_pulse) {
        if ( pulse && pulse->valid ) {
             window->rawPulseWaveform->add(pulse->timestamp, pulse->
      value);
        }
```

```
    }

    // Update the pulse pressure waveform
    for_each_dp(data, idx, pulse, int_pulse) {
         if ( pulse && pulse->valid ) {
              if ( pulse && pulse->valid ) {
                   window->intPulseWaveform->add(pulse->timestamp, pulse->
       value);
              }
         }
    }
}
```

Chapter 5

Module Index

5.1 Modules

Here is a list of all modules:

Chapter 6

Data Structure Index

6.1 Data Structures

Here are the data structures with brief descriptions:

Chapter 7

Module Documentation

7.1 Unmanaged Device Information

This modules describes the interface to retrieve general information about the Caretaker device.

Data Structures

- class libct_device_t

  Handle used to identify a connected device the application is monitoring.

Macros

- #define libct_device_get_state(dev) (dev)->get_state(dev)

  Convenience macro to device->get_state(device).
- #define libct_device_uninitialized(dev) (((dev)->get_state(dev)) & LIBCT_STATE_UNITIALIZED)

  Returns non-zero (true) if the device is not initialized, and zero (false) otherwise.
- #define libct_device_intialized(dev) (libct_device_uninitialized(dev))

  Returns non-zero (true) if the device is initialized, and zero (false) otherwise .
- #define libct_device_discovering(dev) (((dev)->get_state(dev)) & LIBCT_STATE_DISCOVERING)

  Returns non-zero (true) if discovering the device, and zero (false) otherwise.
- #define libct_device_connecting(dev) (((dev)->get_state(dev)) & LIBCT_STATE_CONNECTING)

  Returns non-zero (true) if connecting to the device, and zero (false) otherwise.
- #define libct_device_connected(dev) (((dev)->get_state(dev)) & LIBCT_STATE_CONNECTED)

  Returns non-zero (true) if connected to the device, and zero (false) otherwise.
- #define libct_device_disconnecting(dev) (((dev)->get_state(dev)) & LIBCT_STATE_DISCONNECTING)

  Returns non-zero (true) if disconnecting from the device, and zero (false) otherwise.
- #define libct_device_disconnected(dev) (((dev)->get_state(dev)) & LIBCT_STATE_DISCONNECTED)

  Returns non-zero (true) if disconnected from the device, and zero (false) otherwise.
- #define libct_device_monitoring(dev) (((dev)->get_state(dev)) & LIBCT_STATE_MONITIORING)

  Returns non-zero (true) if receiving data from the device, and zero (false) otherwise.
- #define libct_device_measuring(dev) (((dev)->get_state(dev)) & LIBCT_STATE_MEASURING)

  Returns non-zero (true) if taking blood pressure measurements, and zero (false) otherwise.
- #define libct_device_get_class(dev) (dev)->get_class(dev)

  Convenience macro to device->get_class(device).

- #define libct_device_get_name(dev) (dev)->get_name(dev)

  Convenience macro to device->get_name(device).
- #define libct_device_get_address(dev) (dev)->get_address(dev)

  Convenience macro to device->get_address(device).
- #define libct_device_get_serial_number(dev) (dev)->get_serial_number(dev)

  Convenience macro to device->get_serial_number(device).
- #define libct_device_get_hw_version(dev) (dev)->get_hw_version(dev)

  Convenience macro to device->get_hw_version(device).
- #define libct_device_get_fw_version(dev) (dev)->get_fw_version(dev)

  Convenience macro to device->get_fw_version(device).
- #define libct_device_get_context(dev) (dev)->get_context(dev)

  Convenience macro to device->get_context(device).

7.1.1 Detailed Description

This modules describes the interface to retrieve general information about the Caretaker device.

7.1.2 Macro Definition Documentation

7.1.2.1 libct_device_get_state

```
#define libct_device_get_state(
              dev ) (dev)->get_state(dev)
```

Convenience macro to device->get_state(device).

Parameters

dev	Pointer to the device instance.

7.1.2.2 libct_device_uninitialized

```
#define libct_device_uninitialized(
              dev ) (((dev)->get_state(dev)) & LIBCT_STATE_UNITIALIZED)
```

Returns non-zero (true) if the device is not initialized, and zero (false) otherwise.

Parameters

dev	Pointer to device instance.

7.1.2.3 libct_device_discovering

```
#define libct_device_discovering(
              dev ) (((dev)->get_state(dev)) & LIBCT_STATE_DISCOVERING)
```

Returns non-zero (true) if discovering the device, and zero (false) otherwise.

Parameters

dev	Pointer to device instance.

7.1.2.4 libct_device_connecting

```
#define libct_device_connecting(
              dev ) (((dev)->get_state(dev)) & LIBCT_STATE_CONNECTING)
```

Returns non-zero (true) if connecting to the device, and zero (false) otherwise.

Parameters

dev	Pointer to device instance.

7.1.2.5 libct_device_connected

```
#define libct_device_connected(
              dev ) (((dev)->get_state(dev)) & LIBCT_STATE_CONNECTED)
```

Returns non-zero (true) if connected to the device, and zero (false) otherwise.

Parameters

dev	Pointer to device instance.

7.1.2.6 libct_device_disconnecting

```
#define libct_device_disconnecting(
              dev ) (((dev)->get_state(dev)) & LIBCT_STATE_DISCONNECTING)
```

Returns non-zero (true) if disconnecting from the device, and zero (false) otherwise.

Parameters

dev	Pointer to device instance.

7.1.2.7 libct_device_disconnected

```
#define libct_device_disconnected(
              dev ) (((dev)->get_state(dev)) & LIBCT_STATE_DISCONNECTED)
```

Returns non-zero (true) if disconnected from the device, and zero (false) otherwise.

Parameters

dev	Pointer to device instance.

7.1.2.8 libct_device_monitoring

```
#define libct_device_monitoring(
              dev ) (((dev)->get_state(dev)) & LIBCT_STATE_MONITIORING)
```

Returns non-zero (true) if receiving data from the device, and zero (false) otherwise.

Parameters

dev	Pointer to device instance.

7.1.2.9 libct_device_measuring

```
#define libct_device_measuring(
              dev ) (((dev)->get_state(dev)) & LIBCT_STATE_MEASURING)
```

Returns non-zero (true) if taking blood pressure measurements, and zero (false) otherwise.

Parameters

dev	Pointer to device instance.

7.1.2.10 libct_device_get_class

```
#define libct_device_get_class(
              dev ) (dev)->get_class(dev)
```

Convenience macro to device->get_class(device).

Parameters

dev	Pointer to the device instance.

7.1.2.11 libct_device_get_name

```
#define libct_device_get_name(
              dev ) (dev)->get_name(dev)
```

Convenience macro to device->get_name(device).

Parameters

dev	Pointer to the device instance.

7.1.2.12 libct_device_get_address

```
#define libct_device_get_address(
              dev ) (dev)->get_address(dev)
```

Convenience macro to device->get_address(device).

Parameters

dev	Pointer to the device instance.

7.1.2.13 libct_device_get_serial_number

```
#define libct_device_get_serial_number(
              dev ) (dev)->get_serial_number(dev)
```

Convenience macro to device->get_serial_number(device).

Parameters

dev	Pointer to the device instance.

7.1.2.14 libct_device_get_hw_version

```
#define libct_device_get_hw_version(
              dev ) (dev)->get_hw_version(dev)
```

Convenience macro to device->get_hw_version(device).

Parameters

dev	Pointer to the device instance.

7.1.2.15 libct_device_get_fw_version

```
#define libct_device_get_fw_version(
              dev ) (dev)->get_fw_version(dev)
```

Convenience macro to device->get_fw_version(device).

Parameters

dev	Pointer to the device instance.

7.1.2.16 libct_device_get_context

```
#define libct_device_get_context(
              dev ) (dev)->get_context(dev)
```

Convenience macro to device->get_context(device).

Parameters

dev	Pointer to the device instance.

7.2 Unmanaged Primary API

The group of primary functions that are required to connect to a Caretaker device and monitor data.

Functions

- LIBCTEXPORT int libct_init (libct_context_t **context, libct_init_data_t *data, libct_app_callbacks_t *callbacks)

  Initializes device context.
- LIBCTEXPORT void libct_deinit (libct_context_t *context)

  De-initializes the context.
- LIBCTEXPORT int libct_start_discovery (libct_context_t *context, unsigned long timeout)

  Discover the device.
- LIBCTEXPORT int libct_stop_discovery (libct_context_t *context)

  Stop device discovery.
- LIBCTEXPORT int libct_connect (libct_context_t *context, libct_device_t *device)

  Connect to a device.
- LIBCTEXPORT int libct_disconnect (libct_context_t *context)

  Disconnect from a device.
- LIBCTEXPORT int libct_start_monitoring (libct_context_t *context, int flags)

  Start monitoring data at the remote caretaker device.
- LIBCTEXPORT int libct_stop_monitoring (libct_context_t *context)

  Stops monitoring.
- LIBCTEXPORT int libct_start_measuring (libct_context_t *context, libct_cal_t *cal)

  Start taking measurement.
- LIBCTEXPORT int libct_stop_measuring (libct_context_t *context)

  Stops measuring.

7.2.1 Detailed Description

The group of primary functions that are required to connect to a Caretaker device and monitor data.

7.2.2 Function Documentation

7.2.2.1 libct_init()

```
LIBCTEXPORT int libct_init (
            libct_context_t ** context,
            libct_init_data_t * data,
            libct_app_callbacks_t * callbacks )
```

Initializes device context.

Call this function to initialize a device context before calling any other library functions with the said context.

Note

You can initialize multiple contexts if you wish to connect to multiple devices simultaneously, but you must call libct_deinit() from the same thread to de-initialize each context when it is no longer needed.

Parameters

context	Address to store the created context. **IMPORTANT:** Initialize the context pointer to null before passing it. The internal library code depends on this to ensure the context is initialized only once.
data	Data to initialize the context.
callbacks	The application callback functions to receive asynchronous notifications. This pointer must not be null, or else your application will not receive notifications notifying connection and data events. However, you can set function pointers within this structure that you don't care about to null. **NOTE:** You can set application specific data to use inside your callbacks with libct_set_app_specific_data() after initialization, and later retrieve it with libct_get_app_specific_data() to get the application instance data to act upon inside the callbacks.

Returns

An appropriate status code indicating success or error.

7.2.2.2 libct_deinit()

```
LIBCTEXPORT void libct_deinit (
            libct_context_t * context )
```

De-initializes the context.

Call this function to release resources when you no longer need the context.

IMPORTANT: The application must call dibct_deinit() some time after calling libct_init() to prevent resource leaks. libct_deinit() must not be called from any library callback function. Library callbacks are called from internal library threads that this function attempts to kill. As such, it must only be called from an application thread.

Parameters

context	The context returned from libct_init().

7.2.2.3 libct_start_discovery()

```
LIBCTEXPORT int libct_start_discovery (
            libct_context_t * context,
            unsigned long timeout )
```

Discover the device.

This function start scanning for devices specify by the device class in the initialization data passed earlier to libct_init(). Scan results will be notified asynchronously via the application callbacks passed to libct_init(); specifically, these discovery callback functions will be invoked some time later with the results when devices are discovered or if scanning timed out or failed.

- on_device_discovered()
- on_discovery_timedout()
- on_discovery_failed()

Note

Devices must be advertising and be within range for this method to discover them. Press the button on the caretaker to start advertising. Note the caretaker only advertises for 20 seconds after pressing the button and then stops.

Parameters

context	The context returned from libct_init().
timeout	Scanning will be canceled after the number of milliseconds specified by this timeout and the application discovery timeout callback will be invoked.

Returns

An appropriate status code indicating success or error.

7.2.2.4 libct_stop_discovery()

```
LIBCTEXPORT int libct_stop_discovery (
            libct_context_t * context )
```

Stop device discovery.

Call this function to stop device discovery previously started with libct_start_discovery().

Parameters

context	The context returned from libct_init().

Returns

An appropriate status code indicating success or error.

7.2.2.5 libct_connect()

```
LIBCTEXPORT int libct_connect (
            libct_context_t * context,
            libct_device_t * device )
```

Connect to a device.

Call this method after device discovery to establish connection to the device. The results will be notified asynchronously via the application callbacks passed to libct_init(); specifically, one or more of the following callback functions will be invoked some time later with the results if the connection is established, timed out or failed.

- on_device_connected_not_ready()
- on_device_connected_ready()
- on_connect_error()
- on_connect_timedout()

Parameters

context	The context returned from libct_init().
device	A discovered device notified with your application callback on_device_discovered().

Returns

An appropriate status code indicating success or error.

7.2.2.6 libct_disconnect()

```
LIBCTEXPORT int libct_disconnect (
            libct_context_t * context )
```

Disconnect from a device.

Call this method after calling libct_connect() to clean up resources that were allocated by the connect call.

IMPORTANT: The application must call libct_disconnect() to release connection resources before calling libct_connect() subsequently on the same context. Otherwise, the subsequent connect calls may fail. Also, the application must not call libct_disconnect() from any library callback function. Library callbacks are called from internal library threads and this function attempts to kill. As such, it must only be called from an application thread.

Parameters

context	The context returned from libct_init().

Returns

An appropriate status code indicating success or error.

7.2.2.7 libct_start_monitoring()

```
LIBCTEXPORT int libct_start_monitoring (
            libct_context_t * context,
            int flags )
```

Start monitoring data at the remote caretaker device.

Call this function after the connection is established with the device to start monitoring data or to change the data being monitored.

Calling this function will trigger your application's on_start_monitoring() to be invoked some time later with results. Also, if monitoring was started successfully, data from the device will be notified to your application's on_data_received() continuously until stopped explicitly by calling to libct_stop_monitoring() or if the device becomes disconnected.

Parameters

context	The context returned from libct_init().
flags	Bitwise OR of monitor flags specifying the data to monitor. **Note:** The stream data packets notified to the application depends on these flags. So you can control the amount of data reported to the application by specifying only the monitoring flags corresponding to the data you care about.

Returns

An appropriate status code indicating success or error.

7.2.2.8 libct_stop_monitoring()

```
LIBCTEXPORT int libct_stop_monitoring (
            libct_context_t * context )
```

Stops monitoring.

Call this method to stop monitoring data after calling libct_start_monitoring() successfully.

Calling this function will trigger on_stop_monitoring() to be invoked sometime later with results.

Parameters

context	The context returned from libct_init().

Returns

An appropriate status code indicating success or error.

7.2.2.9 libct_start_measuring()

```
LIBCTEXPORT int libct_start_measuring (
            libct_context_t * context,
            libct_cal_t * cal )
```

Start taking measurement.

If monitoring was started successfully, call this function to initialize (calibrate) blood pressure settings with either auto or manual calibration then start taking vital sign measurements.

Calling this function will trigger on_start_measuring() to be invoked sometime later with results.

Parameters

context	The context returned from libct_init().
cal	Auto or manual calibration settings.

Returns

An appropriate status code indicating success or error

7.2.2.10 libct_stop_measuring()

```
LIBCTEXPORT int libct_stop_measuring (
            libct_context_t * context )
```

Stops measuring.

Call this method to stop measuring data after calling libct_start_measuring() successfully.

Calling this function will trigger on_stop_measuring() to be invoked sometime later with results.

Parameters

context	The context returned from libct_init().

Returns

An appropriate status code indicating success or error.

7.3 Unmanaged Secondary API

The group of auxiliary functions and macros available to parse, read and write additional Caretaker device data.

Macros

- #define libct_dp_count(data, memb) (data)->memb.count

  Returns the count of data points of the specified member array contained in stream data received at the application.
- #define libct_get_dp(data, memb, pos)

  Extract a single data point from the specified member array contained in stream data received at the application.
- #define libct_get_last_dp(data, memb) libct_get_dp(data, memb, (data)->memb.count-1)

  Extract the newest data point from the specified member array contained in stream data received at the application.
- #define libct_get_first_dp(data, memb) libct_get_dp(data, memb, 0)

  Extract the oldest data point from the specified member array contained in stream data received at the application.
- #define for_each_dp(data, idx, dp, memb) for(idx=0; (idx<(data)->memb.count) && (dp=((data)->memb.↩ datapoints) ? &(data)->memb.datapoints[idx] : NULL); idx++)

  Iterate over data points of the specified member array to extract from stream data received at the application.
- #define libct_inc_cuff_pressure(context) libct_adjust_cuff_pressure((context), 1)

  Increments the cuff pressure in 10 mmHg increment.
- #define libct_dec_cuff_pressure(context) libct_adjust_cuff_pressure((context), 0)

  Decrements the cuff pressure in 10 mmHg increment.

Functions

- LIBCTEXPORT libct_device_t * libct_get_device (libct_context_t *context)

  Returns the device handle.
- LIBCTEXPORT void libct_set_app_specific_data (libct_context_t *context, void *data)

  Sets application specific data that can be retrieved and used later in the callbacks.
- LIBCTEXPORT void * libct_get_app_specific_data (libct_context_t *context)

  Retrieve application specific data.
- LIBCTEXPORT const char * libct_get_version_string (void)

  Get the library version info.
- LIBCTEXPORT const char * libct_get_build_date_string (void)

  Get the library build date and time string.
- LIBCTEXPORT void libct_set_log_level (int level)

  Sets the library log level.
- LIBCTEXPORT int libct_recalibrate (libct_context_t *context)

  Re-calibrates the device.
- LIBCTEXPORT int libct_adjust_cuff_pressure (libct_context_t *context, int direction)

  Adjusts the cuff pressure in 10 mmHg increment/decrement.
- LIBCTEXPORT int libct_rd_cuff_pressure (libct_context_t *context)

  Reads the cuff pressure.
- LIBCTEXPORT int libct_vent_cuff (libct_context_t *context)

  Deflates the cuff pressure.
- LIBCTEXPORT int libct_clr_status (libct_context_t *context)

  Clears the device status.
- LIBCTEXPORT int libct_diag_flush (libct_context_t *context)

  Invoke the device diagnostic plumbing tree flush.
- LIBCTEXPORT int libct_wrt_snr_min (libct_context_t *context, int snr)

Writes the device noise filter parameter.

- LIBCTEXPORT int libct_rd_snr_min (libct_context_t *context)

  Reads the device noise filter parameter.
- LIBCTEXPORT int libct_wrt_display_state (libct_context_t *context, unsigned char state)

  Turns the device display on/off.
- LIBCTEXPORT int libct_rd_display_state (libct_context_t *context)

  Reads the device display state.
- LIBCTEXPORT int libct_wrt_recal_itvl (libct_context_t *context, unsigned int itvl)

  Writes the recalibration interval.
- LIBCTEXPORT int libct_rd_recal_itvl (libct_context_t *context)

  Reads the recalibration interval.
- LIBCTEXPORT int libct_wrt_waveform_clamping (libct_context_t *context, unsigned char value)

  Writes the device waveform clamping setting.
- LIBCTEXPORT int libct_rd_waveform_clamping (libct_context_t *context)

  Reads the device waveform clamping setting.
- LIBCTEXPORT int libct_rd_vitals_filter (libct_context_t *context)

  Reads the current filter settings to enable or disable filtering outlier vitals measurements.
- LIBCTEXPORT int libct_wrt_vitals_filter (libct_context_t *context, unsigned char value)

  Writes the filter settings to enable or disable filtering outlier vitals measurements.
- LIBCTEXPORT int libct_wrt_simulation_mode (libct_context_t *context, unsigned char mode)

  Writes the device simulation mode.
- LIBCTEXPORT int libct_wrt_motion_timeout (libct_context_t *context, int timeout)

  Writes the motion tolerance timeout parameter.
- LIBCTEXPORT int libct_rd_motion_timeout (libct_context_t *context)

  Reads the motion tolerance timeout parameter.
- LIBCTEXPORT int libct_rd_persistent_log (libct_context_t *context)

  Reads the device log messages.

7.3.1 Detailed Description

The group of auxiliary functions and macros available to parse, read and write additional Caretaker device data.

7.3.2 Macro Definition Documentation

7.3.2.1 libct_dp_count

```
#define libct_dp_count(
              data,
              memb ) (data)->memb.count
```

Returns the count of data points of the specified member array contained in stream data received at the application.

Parameters

data	The stream data received in your on_data_received() application callback.
memb	The stream data member whose data point count is being queried.

Returns

The extracted data point on success, and null on failure.

7.3.2.2 libct_get_dp

```
#define libct_get_dp(
              data,
              memb,
              pos )
```

Value:

```
({\
    __typeof__((data)->memb.datapoints[0]) *dp = NULL; \
    if ( (data)->memb.count && (pos) < (data)->memb.count ) { \
        dp = &(data)->memb.datapoints[(pos)]; \
    } \
    (dp);\
})
```

Extract a single data point from the specified member array contained in stream data received at the application.

Parameters

data	The stream data received in your on_data_received() application callback.
memb	The stream data member name of the data point to extract.
pos	The position of the data point to extract.

Returns

The extracted data point on success, and null on failure.

7.3.2.3 libct_get_last_dp

```
#define libct_get_last_dp(
              data,
              memb ) libct_get_dp(data, memb, (data)->memb.count-1)
```

Extract the newest data point from the specified member array contained in stream data received at the application.

Parameters

data	The stream data received in your on_data_received() application callback.
memb	The stream data member name of the data point to extract.

Returns

The extracted data point on success, and null on failure.

7.3.2.4 libct_get_first_dp

```
#define libct_get_first_dp(
              data,
              memb ) libct_get_dp(data, memb, 0)
```

Extract the oldest data point from the specified member array contained in stream data received at the application.

Parameters

data	The stream data received in your on_data_received() application callback.
memb	The stream data member name of the data point to extract.

Returns

The extracted data point on success, and null on failure.

7.3.2.5 for_each_dp

```
#define for_each_dp(
              data,
              idx,
              dp,
              memb ) for(idx=0; (idx<(data)->memb.count) && (dp=((data)->memb.datapoints) ?
&(data)->memb.datapoints[idx] :  NULL); idx++)
```

Iterate over data points of the specified member array to extract from stream data received at the application.

Parameters

data	The stream data received in your on_data_received() application callback.
idx	Iterator variable of type unsigned integer.
dp	Pointer variable of type corresponding to the memb argument.
memb	The stream data member name of the data points to extract.

7.3.2.6 libct_inc_cuff_pressure

```
#define libct_inc_cuff_pressure(
              context ) libct_adjust_cuff_pressure((context), 1)
```

Increments the cuff pressure in 10 mmHg increment.

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.2.7 libct_dec_cuff_pressure

```
#define libct_dec_cuff_pressure(
            context ) libct_adjust_cuff_pressure((context), 0)
```

Decrements the cuff pressure in 10 mmHg increment.

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3 Function Documentation

7.3.3.1 libct_get_device()

```
LIBCTEXPORT libct_device_t* libct_get_device (
            libct_context_t * context )
```

Returns the device handle.

Call this function to get a pointer to the device instance associated with the context.

Parameters

context	The context returned from libct_init().

Returns

Device object or NULL;

See also

The device APIs

7.3.3.2 libct_set_app_specific_data()

```
LIBCTEXPORT void libct_set_app_specific_data (
             libct_context_t * context,
             void * data )
```

Sets application specific data that can be retrieved and used later in the callbacks.

Basically, this function provides the means to bind your callback application code with the library context. For example, set application instance data after initializing the library, and then retrieve the instance data using libct_get_app_specific_data() inside the callbacks.

```
// QT main window initialization
MainWindow::MainWindow(QWidget *parent) :
   QMainWindow(parent),
   ui(new Ui::MainWindow)
{
     ui->setupUi(this);
     setWindowTitle(QString("SampleApp"));

     // initialize ui (code not shown)

     // initialize the library
     int status = libct_init(&context, &init_data, &callbacks);
     if ( LIBCT_FAILED(status) ) {
         // handle error
     }

     // set main window instance to act upon in the callbacks
     libct_set_app_specific_data(context, this);
}

// libcaretaker callback - called to notify data from the device
void on_data_received_cb(libct_context_t* context, libct_device_t* device,
      libct_stream_data_t* data) {
     MainWindow* window = (MainWindow*) libct_get_app_specific_data(context);

     // display the most recent vitals
     libct_vitals_t* vitals = libct_get_last_dp(data, vitals);
     if ( vitals && vitals->valid ) {
         window->setHr(vitals->heart_rate);
         window->setRes(vitals->respiration);
         window->setMap(vitals->map);
         window->setBp(vitals->systolic, vitals->diastolic);
     }
}
```

Parameters

context	The context returned from libct_init().
data	Generic pointer to the application specific data, or null to clear the existing pointer.

7.3.3.3 libct_get_app_specific_data()

```
LIBCTEXPORT void* libct_get_app_specific_data (
             libct_context_t * context )
```

Retrieve application specific data.

Retrieves application specific data last set with libct_set_app_specific_data().

Parameters

context	The context returned from libct_init().

7.3.3.4 libct_get_version_string()

```
LIBCTEXPORT const char* libct_get_version_string (
            void  )
```

Get the library version info.

Call this function to get the library version.

Returns

The library version string.

7.3.3.5 libct_get_build_date_string()

```
LIBCTEXPORT const char* libct_get_build_date_string (
            void  )
```

Get the library build date and time string.

Call this function to get the library build date and time.

Returns

The library build date string.

7.3.3.6 libct_set_log_level()

```
LIBCTEXPORT void libct_set_log_level (
            int level )
```

Sets the library log level.

Call this function to set the log level to increase or decrease log messages verbosity.

Parameters

level	One of the following log levels. • 0 - shows all logs, most verbose • 1 - shows only info, warning, and error logs • 2 - shows only warning and error logs • 3 - shows only error logs, least verbose

7.3.3.7 libct_recalibrate()

```
LIBCTEXPORT int libct_recalibrate (
            libct_context_t * context )
```

Re-calibrates the device.

Call this function sometime later after calling libct_start_measuring() to force vital signs re-calibration at the device while taking measurements.

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.8 libct_adjust_cuff_pressure()

```
LIBCTEXPORT int libct_adjust_cuff_pressure (
            libct_context_t * context,
            int direction )
```

Adjusts the cuff pressure in 10 mmHg increment/decrement.

Note

The macros libct_inc_cuff_pressure() and libct_dec_cuff_pressure() simplify this function so you should use them instead.

Parameters

context	The context returned from libct_init().
direction	Zero - Decrement pressure. Nonzero - Increment pressures

See also

libct_inc_cuff_pressure()
libct_dec_cuff_pressure()

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.9 libct_rd_cuff_pressure()

```
LIBCTEXPORT int libct_rd_cuff_pressure (
            libct_context_t * context )
```

Reads the cuff pressure.

Results will be notified later with on_rd_cuff_pressure_rsp().

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.10 libct_vent_cuff()

```
LIBCTEXPORT int libct_vent_cuff (
            libct_context_t * context )
```

Deflates the cuff pressure.

Results will be notified later with on_vent_cuff_rsp().

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.11 libct_clr_status()

```
LIBCTEXPORT int libct_clr_status (
            libct_context_t * context )
```

Clears the device status.

Results will be notified later with on_clr_status_rsp().

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.12 libct_diag_flush()

```
LIBCTEXPORT int libct_diag_flush (
            libct_context_t * context )
```

Invoke the device diagnostic plumbing tree flush.

Results will be notified later with on_diag_flush_rsp().

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.13 libct_wrt_snr_min()

```
LIBCTEXPORT int libct_wrt_snr_min (
            libct_context_t * context,
            int snr )
```

Writes the device noise filter parameter.

Results will be notified later with on_wrt_snr_min_rsp().

Parameters

context	The context returned from libct_init().
snr	The minimum signal-to-noise value. Valid range [0, 100].

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.14 libct_rd_snr_min()

```
LIBCTEXPORT int libct_rd_snr_min (
            libct_context_t * context )
```

Reads the device noise filter parameter.

Results will be notified later with on_rd_snr_min_rsp().

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.15 libct_wrt_display_state()

```
LIBCTEXPORT int libct_wrt_display_state (
            libct_context_t * context,
            unsigned char state )
```

Turns the device display on/off.

Results will be notified later with on_rd_snr_min_rsp().

Parameters

context	The context returned from libct_init().
state	Display state to write: 0 = off, 1 = on.

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.16 libct_rd_display_state()

```
LIBCTEXPORT int libct_rd_display_state (
            libct_context_t * context )
```

Reads the device display state.

Results will be notified later with on_rd_snr_min_rsp().

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.17 libct_wrt_recal_itvl()

```
LIBCTEXPORT int libct_wrt_recal_itvl (
            libct_context_t * context,
            unsigned int itvl )
```

Writes the recalibration interval.

Results will be notified later with on_wrt_recal_itvl_rsp().

Parameters

context	The context returned from libct_init().
itvl	The recalibration interval in minutes. The acceptable range is [30, 240].

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.18 libct_rd_recal_itvl()

```
LIBCTEXPORT int libct_rd_recal_itvl (
            libct_context_t * context )
```

Reads the recalibration interval.

Results will be notified later with on_rd_recal_itvl_rsp().

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.19 libct_wrt_waveform_clamping()

```
LIBCTEXPORT int libct_wrt_waveform_clamping (
            libct_context_t * context,
            unsigned char value )
```

Writes the device waveform clamping setting.

Status will be notified later with on_wrt_waveform_clamping().

Parameters

context	The context returned from libct_init().
value	Clamp setting: 1 = ON, 0 = OFF.

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.20 libct_rd_waveform_clamping()

```
LIBCTEXPORT int libct_rd_waveform_clamping (
            libct_context_t * context )
```

Reads the device waveform clamping setting.

Status will be notified later with on_rd_waveform_clamping().

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.21 libct_rd_vitals_filter()

```
LIBCTEXPORT int libct_rd_vitals_filter (
            libct_context_t * context )
```

Reads the current filter settings to enable or disable filtering outlier vitals measurements.

Status will be notified later with on_rd_vitals_filter().

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.22 libct_wrt_vitals_filter()

```
LIBCTEXPORT int libct_wrt_vitals_filter (
            libct_context_t * context,
            unsigned char value )
```

Writes the filter settings to enable or disable filtering outlier vitals measurements.

Status will be notified later with on_wrt_vitals_filter().

Parameters

context	The context returned from libct_init().
value	Filter setting value: 1 = Enable, 0 = Disable.

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.23 libct_wrt_simulation_mode()

```
LIBCTEXPORT int libct_wrt_simulation_mode (
            libct_context_t * context,
            unsigned char mode )
```

Writes the device simulation mode.

Note

The device does not provide real-time data when simulation mode is enabled. Hard-coded numeric and waveform data (i.e., synthetic data) is provided. As such, simulation mode should be enabled for demonstration and test purposes only.

Parameters

context	The context returned from libct_init().
mode	Simulation mode: 1 = Enable, 0 = Disable.

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.24 libct_wrt_motion_timeout()

```
LIBCTEXPORT int libct_wrt_motion_timeout (
            libct_context_t * context,
            int timeout )
```

Writes the motion tolerance timeout parameter.

Parameters

context	The context returned from libct_init().
timeout	Time out in seconds. Acceptable range [0, 30]

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.25 libct_rd_motion_timeout()

```
LIBCTEXPORT int libct_rd_motion_timeout (
            libct_context_t * context )
```

Reads the motion tolerance timeout parameter.

Status will be notified later with on_rd_motion_timeout().

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.3.3.26 libct_rd_persistent_log()

```
LIBCTEXPORT int libct_rd_persistent_log (
            libct_context_t * context )
```

Reads the device log messages.

Status will be notified later with on_rd_persistent_log().

Note

Reading the device log is a slow request so the results will be delayed by many seconds.

Parameters

context	The context returned from libct_init().

Returns

Success if a request was queued to be sent to the device, and error otherwise.

7.4 Managed API for .NET Applications

This module describes the Caretaker library managed APIs to be used with .NET applications.

Data Structures

- class Caretaker::DeviceStatus

  Managed class defining device status.
- class Caretaker::BatteryStatus

  Managed class defining battery status.
- class Caretaker::CuffStatus

  Managed class defining cuff status.
- class Caretaker::PrimaryVitals

  Managed class defining the primary vitals measured by the Caretaker.
- class Caretaker::SecondaryVitals

  Managed class defining the secondary vitals measured by the Caretaker.
- class Caretaker::DeviceObserver

  Managed class defining the application observer interface to receive real-time notifications.
- class Caretaker::Device

  Managed class for .NET applications to monitor the Caretaker device.

Enumerations

- enum Caretaker::ConnectionStatus { Caretaker::ConnectionStatus::SCAN_ERROR = 0, Caretaker::ConnectionStatus::SCAN_TIMEOUT = 1, Caretaker::ConnectionStatus::CONNECT_ERROR = 2, Caretaker::ConnectionStatus::CONNECT_TIMEOUT = 3, Caretaker::ConnectionStatus::CONNECTED = 4, Caretaker::ConnectionStatus::DISCONNECTED = 5, Caretaker::ConnectionStatus::CONNECTION_LOST =6 }

  Managed class defining connection status codes notified with DeviceObserver::OnConnectionStatus().
- enum Caretaker::StartStatus { Caretaker::StartStatus::STARTED = 0, Caretaker::StartStatus::START_ERROR = 1 }

  Windows application managed class defining start status.
- enum Caretaker::StopStatus { Caretaker::StopStatus::STOPPED = 0, Caretaker::StopStatus::STOP_ERROR = 1 }

  Managed class defining stop status.
- enum Caretaker::PatientPosture { Caretaker::PatientPosture::SITTING = 1, Caretaker::PatientPosture::SUPINE = 3 }

  Managed class defining patient postures.

7.4.1 Detailed Description

This module describes the Caretaker library managed APIs to be used with .NET applications.

7.4.2 Enumeration Type Documentation

7.4.2.1 ConnectionStatus

```
enum Caretaker::ConnectionStatus  [strong]
```

Managed class defining connection status codes notified with DeviceObserver::OnConnectionStatus().

Enumerator

SCAN_ERROR	Error while scanning for a device. Scan errors are typically due to protocol errors such as when the BLE dongle is not plugged.
SCAN_TIMEOUT	Scanning for a device timed out.
CONNECT_ERROR	Error while establishing connection to the device.
CONNECT_TIMEOUT	Connecting to the device timed out.
CONNECTED	The connection was established with the device successfully.
DISCONNECTED	The application initiated disconnect completed successfully.
CONNECTION_LOST	The connection to the device was lost. Typically, the connection is lost after the Caretaker device moves outside the BLE range. **Note** The Device instance can be configured to reconnect automatically when the device moves back in range by setting the autoReconnect argument to true when invoking the Device constructor to create the instance.

7.4.2.2 StartStatus

`enum Caretaker::StartStatus [strong]`

Windows application managed class defining start status.

Start status codes are notified with DeviceObserver::OnStartStatus() so the application must implement this method to receive them.

Enumerator

STARTED	The previous call to Device::StartManualCal() or Device::StartAutoCal() completed successfully.
START_ERROR	The previous call to Device::StartManualCal() or Device::StartAutoCal() completed with error.

7.4.2.3 StopStatus

`enum Caretaker::StopStatus [strong]`

Managed class defining stop status.

Stop status codes are notified with DeviceObserver::OnStopStatus() so the application must implement this method to receive them.

Enumerator

STOPPED	The previous call to Device::Stop() completed successfully.
STOP_ERROR	The previous call to Device::Stop() completed with error.

7.4.2.4 PatientPosture

```
enum Caretaker::PatientPosture  [strong]
```

Managed class defining patient postures.

Pass these values as argument to Device::StartAutoCal() for automatic calibration.

Enumerator

SITTING	Medical body position for sitting.
SUPINE	Medical body position for supine.

7.5 Unmanaged Explicit Linking Example

This section provides an illustration of linking the libcaretaker library explicitly with unmanaged applications.

This section provides an illustration of linking the libcaretaker library explicitly with unmanaged applications.

To link explicitly to the Caretaker library, the application must explicitly load and unload libcaretaker_dynamic.lib.

- Call LoadLibrary (or a similar function) to load the DLL and obtain a module handle.
- Call GetProcAddress to obtain a function pointer to each exported function that the application will call.
- Call FreeLibrary when done with the DLL.

```
typedef int (LIBCTAPI* LP_LIBCT_INIT)(libct_context_t**,
      libct_init_data_t*, libct_app_callbacks_t*);
typedef void (LIBCTAPI* LP_LIBCT_DEINIT)(libct_context_t*);

...

HINSTANCE hDLL;                   // Handle to DLL
libct_context_t* context;         // libcaretaker context
LP_LIBCT_INIT LibctInit;     // initialization function pointer
LP_LIBCT_DEINIT LibctDeinit; // de-initialization function pointer

// Setup to connect to a Caretaker 4 device
libct_init_data_t initData;
memset(initData, 0, sizeof(initData));
initData.device_class = LIBCT_DEVICE_CLASS_BLE_CARETAKER4;

// Setup your application callbacks. (Only one is illustrated here but add more as needed.)
libct_app_callbacks_t appCallbacks;
memset(appCallbacks, 0, sizeof(appCallbacks));
appCallbacks.on_device_discovered = OnDeviceDiscovered;


hDLL = LoadLibrary("libcaretaker_dynamic.dll");
if (hDLL != NULL)
{
    LibctInit = (LP_LIBCT_INIT_FUNC)GetProcAddress(hDLL, "libct_init");
    if (!LibctInit)
    {
        // handle the error
        FreeLibrary(hDLL);
        return SOME_ERROR_CODE;
    }

    LibctDeinit = (LP_LIBCT_INIT_FUNC)GetProcAddress(hDLL, "libct_deinit");
    if (!LibctDeinit)
    {
        // handle the error
        FreeLibrary(hDLL);
        return SOME_ERROR_CODE;
    }


    // Initialize the library
    context = NULL
    int status = LibctInit(&context, &initData, &appCallbacks);
    if ( LIBCT_FAILED(status) )
    {
        // handle the error
        FreeLibrary(hDLL);
        return SOME_ERROR_CODE;
    }

    // Add your application code to connect and monitor data

    // Exit when done
    status = LibctDeinit(context);
    FreeLibrary(hDLL);
}
```

Chapter 8

Data Structure Documentation

8.1 Caretaker::BatteryStatus Class Reference

Managed class defining battery status.

Data Fields

- Int32 voltage

  The battery voltage in millivolts.
- Int32 timestamp

  Milliseconds time-stamp from the device associated with the data.

8.1.1 Detailed Description

Managed class defining battery status.

Battery status information is notified with DeviceObserver::OnBatteryStatus() so the application must implement this method to receive it.

8.1.2 Field Documentation

8.1.2.1 voltage

```
Int32 Caretaker::BatteryStatus::voltage
```

The battery voltage in millivolts.

8.1.2.2 timestamp

```
Int32 Caretaker::BatteryStatus::timestamp
```

Milliseconds time-stamp from the device associated with the data.

The documentation for this class was generated from the following file:

- CaretakerDevice.h

8.2 Caretaker::CuffStatus Class Reference

Managed class defining cuff status.

Data Fields

- Int32 actualPressure

  The actual cuff pressure in mmHg.
- Int32 targetPressure

  The target cuff pressure in mmHg.
- Int32 signalToNoise

  The signal to noise ratio Divide by 10 to convert to percentage.
- Int32 timestamp

  Milliseconds time-stamp from the device associated with the data.

8.2.1 Detailed Description

Managed class defining cuff status.

Cuff status information is notified with DeviceObserver::OnCuffStatus() so the application must implement this method to receive it.

8.2.2 Field Documentation

8.2.2.1 actualPressure

```
Int32 Caretaker::CuffStatus::actualPressure
```

The actual cuff pressure in mmHg.

8.2.2.2 targetPressure

```
Int32 Caretaker::CuffStatus::targetPressure
```

The target cuff pressure in mmHg.

8.2.2.3 signalToNoise

```
Int32 Caretaker::CuffStatus::signalToNoise
```

The signal to noise ratio Divide by 10 to convert to percentage.

```
displaySNR = MIN(100, status.signalToNoise / 10);
displaySNR = MAX(0, displaySNR);
```

8.2.2.4 timestamp

```
Int32 Caretaker::CuffStatus::timestamp
```

Milliseconds time-stamp from the device associated with the data.

The documentation for this class was generated from the following file:

- CaretakerDevice.h

8.3 Caretaker::Device Class Reference

Managed class for .NET applications to monitor the Caretaker device.

Data Structures

- class LibraryCallback

  This is an internal class representing a callback into the unmanaged library code.

Public Member Functions

- Device (DeviceObserver^ observer, Boolean autoReconnect)

  Creates a Device instance.
- ~Device ()

  Destructor.
- void ReleaseResources ()

  Release unmanaged library resources allocated for the Device instance.
- Boolean StartScan (UInt32 timeout)

  Initiates scanning for nearby Caretaker devices.
- Boolean StopScan ()

  Call this method to stop scanning after calling StartScan().
- Boolean ConnectToSerialNumber (String^ sn, UInt32 timeout)

  Initiates connecting to the Caretaker device with the specified serial number.
- Boolean ConnectToMacAddress (String^ address, UInt32 timeout)

  Initiates connecting to the Caretaker device with the specified MAC address.
- Boolean ConnectToAny (UInt32 timeout)

  Initiates connecting to any Caretaker device that is advertising for a connection.
- Boolean Disconnect ()

  Initiates disconnecting from the remote device if connected.
- Boolean StartAutoCal (PatientPosture posture)

  Perform an automatic calibration and then start taking measurements if connected.
- Boolean StartManualCal (Int32 systolic, Int32 diastolic)

  Perform a manual calibration and then start taking measurements if connected.
- Boolean Stop ()

  Call this method after calling StartAutoCal() or StartManualCal() to stop the device.
- Boolean IsConnected ()

  Returns true if the device is connected and false otherwise.
- Boolean IsConnecting ()

  Returns true while attempting to establish connection to device and false otherwise.
- Boolean Calibrating ()

  Returns true if the device is calibrating, and false otherwise.
- Boolean Calibrated ()

  Returns true if the device is calibrated, and false otherwise.
- Boolean CalibrationFailed ()

  Returns true if the device was calibrating and the calibration failed, and false otherwise.
- String GetName ()

  Returns the device friendly name or null if the name is not available.
- String GetMacAddress ()

  Returns the device MAC address or null if the MAC address is not available.
- String GetSerialNumber ()

  Returns the device serial number or null if the serial number is not available.
- String GetFirmwareVersion ()

  Returns the device firmware version or null if the firmware version is not available.
- String GetHardwareVersion ()

  Returns the device hardware version or null if the hardware version is not available.
- String GetLibraryVersion ()

  Returns the library version or null if the library version is not available.
- String GetLibraryBuildDate ()

  Returns the library build date or null if the build date is not available.
- DeviceStatus GetDeviceStatus ()

Method to poll device status.

- BatteryStatus GetBatteryStatus ()

  Method to poll battery status.

- CuffStatus GetCuffStatus ()

  Method to poll cuff status.

- array< PrimaryVitals > GetPrimaryVitals ()

  Method to poll primary vitals.

- array< SecondaryVitals > GetSecondaryVitals ()

  Method to poll secondary vitals.

- WaveformDataPoints GetPulseRateWaveformDataPoints ()

  Method to poll pulse rate waveform data points.

- WaveformDataPoints GetPulsePressureWaveformDataPoints ()

  Method to poll pulse pressure waveform data points.

- Boolean IncrementCuffPressure ()

  Increments the cuff pressure in 10 mmHg increment.

- Boolean DecrementCuffPressure ()

  Decrements the cuff pressure in 10 mmHg increment.

- Boolean VentCuff ()

  Deflates the cuff pressure.

- Boolean PeformDiagnosticsFlush ()

  Flushes the device diagnostic plumbing tree.

- Boolean WriteSnrMinimum (Int32 snr)

  Writes the device noise filter parameter.

- Boolean ReadSnrMinimum ()

  Reads the device noise filter parameter.

- Boolean WriteMotionTolerance (Int32 value)

  Writes the device motion tolerance parameter.

- Boolean ReadMotionTolerance ()

  Reads the device motion tolerance parameter.

- Boolean TurnDisplayOff ()

  Turns the device display screen off.

- Boolean TurnDisplayOn ()

  Turns the device display screen on.

- Boolean ReadDisplayState ()

  Reads the display state.

- Boolean Recalibrate ()

  Recalibrate blood pressure measurements.

- Boolean WriteRecalibrationInterval (UInt32 interval)

  Writes the calibration interval.

- Boolean ReadRecalibrationInterval ()

  Reads the calibration interval.

- Boolean WriteWaveformClampSetting (Byte value)

  Writes the setting to enable or disable clamping the waveforms.

- Boolean ReadWaveformClampSetting ()

  Read the waveform clamping setting.

- Boolean WriteVitalsFilterSetting (Byte value)

  Writes the filter settings to enable or disable filtering outlier vitals measurements.

- Boolean ReadVitalsFilterSetting ()

  Reads the current filter settings to enable or disable filtering outlier vitals measurements.

- Boolean ReadPersistentLog ()

  Reads the device logs.

- Boolean EnableSimulationMode (Boolean mode)

  Writes the device simulation mode.
- Boolean ClearStatus ()

  Clears the device status.

Static Public Member Functions

- static void SetLibraryLogLevel (Int32 level)

  Sets the library log level.
- static Boolean RedirectLibraryLogs ()

  Redirects library logging to plain-text file libcaretaker.log

Protected Member Functions

- !Device ()

  Finalizer Gets called when the object's memory is about to be reclaimed by the garbage collector.

8.3.1 Detailed Description

Managed class for .NET applications to monitor the Caretaker device.

This class is a wrapper to the unmanaged libcaretaker_dynamic.dll library to allow .NET applications to monitor the Caretaker device. The class is defined in the managed libcaretaker_clr.dll library so the application must reference libcaretaker_clr.dll to access this and supporting managed classes.

8.3.2 Constructor & Destructor Documentation

8.3.2.1 Device()

```
Caretaker::Device::Device (
            DeviceObserver^ observer,
            Boolean autoReconnect )
```

Creates a Device instance.

The device instance represents a proxy to the Caretaker device to which it has established a connection and provides an interface for the application to monitor the Caretaker device.

IMPORTANT The application must call ReleaseResources() to explicitly release unmanaged library resources allocated for the device instance when it is no longer needed. Not calling ReleaseResources() will leave unmanaged resources alive and unaccessible (i.e, zombie resources) that could still maintain the connection to the device after the device instance goes out of scope.

Parameters

observer	The application DeviceObserver implementation to receive Caretaker numeric and waveform data and event notifications in real-time. Passing null disables notifications and the application must call getters to poll for numeric data.
autoReconnect	Set this argument to true to reconnect automatically after the connection is lost. On reconnects, data streams will be re-enabled automatically if enabled prior to the disconnect.

8.3.2.2 ~Device()

```
Caretaker::Device::~Device ( )
```

Destructor.

Gets called when the object is about to go out of scope, .i.e, destroyed.

8.3.3 Member Function Documentation

8.3.3.1 ReleaseResources()

```
void Caretaker::Device::ReleaseResources ( )
```

Release unmanaged library resources allocated for the Device instance.

The application must call this method to clean things up in the unmanaged code when the Device instance is no longer needed. Note for C++ applications, the Device destructor ~Device() may not be called so ReleaseResources() must be called explicitly to release library resources. Not calling ReleaseResources() will leave unmanaged resources alive and unaccessible (i.e, zombie resources) that could still maintain the connection to the Caretaker device after the Device instance goes out of scope.

IMPORTANT: The application must not call Disconnect() or ReleaseResources() from any DeviceObserver methods. The DeviceObserver methods are called from unmanaged threads that the aforementioned methods attempt to kill. As such, Disconnect() or ReleaseResources() must only be called from an application thread, otherwise the application could deadlock.

Also, ReleaseResources() invalidates the device instance so after calling it the application should set the Device reference to null to prevent further use.

Also, ReleaseResources() may delay the calling application thread for a couple seconds as it waits for unmanaged\ threads to exit.

8.3.3.2 StartScan()

```
Boolean Caretaker::Device::StartScan (
            UInt32 timeout )
```

Initiates scanning for nearby Caretaker devices.

If the serial number or MAC address of the Caretaker device is known, call ConnectToSerialNumber() or ConnectToMacAddress() to establish connection with the device. Otherwise, call StartScan() to scan for nearby Caretaker devices that are advertising. Each device discovered will be notified with DeviceObserver::OnDeviceDiscovered() passing the discovered device name, serial number, and MAC address to the application. The application must then call ConnectToSerialNumber() or ConnectToMacAddress() to connect to the desired, discovered device.

Parameters

timeout	Milliseconds to timeout the scan operation.

Returns

True if scanning was initiated and false otherwise.

8.3.3.3 ConnectToSerialNumber()

```
Boolean Caretaker::Device::ConnectToSerialNumber (
            String^ sn,
            UInt32 timeout )
```

Initiates connecting to the Caretaker device with the specified serial number.

The Caretaker device must be advertising for this method to establish connection.

If the connection sequence was initiated, DeviceObserver::OnConnectionStatus() will be notified later with the connection status.

Parameters

sn	Serial number of the Caretaker device to connect to. Passing a null or empty address returns failure.
timeout	Milliseconds to timeout connecting.

Returns

True if the connection sequence was initiated and false otherwise. This method also returns false if a previous connection sequence is executing or if the application is already connected to a device. To workaround this scenario, call Disconnect() before calling this method.

8.3.3.4 ConnectToMacAddress()

```
Boolean Caretaker::Device::ConnectToMacAddress (
            String^ address,
            UInt32 timeout )
```

Initiates connecting to the Caretaker device with the specified MAC address.

The Caretaker device must be advertising for this method to establish connection.

If the connection sequence was initiated, DeviceObserver::OnConnectionStatus() will be notified later with the connection status.

Parameters

address	MAC address of the Caretaker device to connect to. Passing a null or empty address returns failure.
timeout	Milliseconds to timeout connecting.

Returns

True if the connection sequence was initiated and false otherwise. This method also returns false if a previous connection sequence is executing or if the application is already connected to a device. To workaround this scenario, call Disconnect() before calling this method.

8.3.3.5 ConnectToAny()

```
Boolean Caretaker::Device::ConnectToAny (
            UInt32 timeout )
```

Initiates connecting to any Caretaker device that is advertising for a connection.

If the connection sequence was initiated, DeviceObserver::OnConnectionStatus() will be notified later with the connection status.

Parameters

timeout	Milliseconds to timeout connecting.

Returns

True if the connection sequence was initiated and false otherwise. This method also returns false if a previous connection sequence is executing or if the application is already connected to a device. To workaround this scenario, call Disconnect() before calling this method.

8.3.3.6 Disconnect()

```
Boolean Caretaker::Device::Disconnect ( )  [inline]
```

Initiates disconnecting from the remote device if connected.

If the disconnection sequence was initiated, DeviceObserver::OnConnectionStatus() will be notified later with connection status.

IMPORTANT: The application must not call Disconnect() or ReleaseResources() from any DeviceObserver methods. The DeviceObserver methods are called from unmanaged threads that the aforementioned methods attempt to kill. As such, Disconnect() or ReleaseResources() must only be called from an application thread, otherwise the application could deadlock.

Returns

Returns true if disconnecting from the device was initiated and false otherwise.

8.3.3.7 StartAutoCal()

```
Boolean Caretaker::Device::StartAutoCal (
            PatientPosture posture )
```

Perform an automatic calibration and then start taking measurements if connected.

If true is returned, DeviceObserver::OnStartStatus() and OnDeviceStatus() will be notified later with start and calibration status, respectively.

The application will start receiving data if the start process completed successfully.

Parameters

posture	The patient posture.

Returns

Returns true if start was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.8 StartManualCal()

```
Boolean Caretaker::Device::StartManualCal (
            Int32 systolic,
            Int32 diastolic )
```

Perform a manual calibration and then start taking measurements if connected.

If true is returned, DeviceObserver::OnStartStatus() and OnDeviceStatus() will be notified later with start and calibration status, respectively.

The application will start receiving data if the start process completed successfully.

Parameters

systolic	Initial systolic pressure. Acceptable range [30, 250].
diastolic	Initial diastolic pressure. Acceptable range [10, 150].

Returns

Returns true if start was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.9 Stop()

```
Boolean Caretaker::Device::Stop ( )
```

Call this method after calling StartAutoCal() or StartManualCal() to stop the device.

This will also stop data and device status notifications.

If true is returned, DeviceObserver::OnStopStatus() will be notified later with stop status.

Returns

Returns true if stop was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.10 Calibrating()

```
Boolean Caretaker::Device::Calibrating ( )  [inline]
```

Returns true if the device is calibrating, and false otherwise.

Note this is the same as GetDeviceStatus()->calibrating.

8.3.3.11 Calibrated()

```
Boolean Caretaker::Device::Calibrated ( )  [inline]
```

Returns true if the device is calibrated, and false otherwise.

Note this is the same as GetDeviceStatus()->calibrated.

8.3.3.12 CalibrationFailed()

```
Boolean Caretaker::Device::CalibrationFailed ( )  [inline]
```

Returns true if the device was calibrating and the calibration failed, and false otherwise.

This method summarizes the various DeviceStatus flags reporting calibration failure.

8.3.3.13 GetName()

```
String Caretaker::Device::GetName ( )
```

Returns the device friendly name or null if the name is not available.

Note

The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns null.

8.3.3.14 GetMacAddress()

```
String Caretaker::Device::GetMacAddress ( )
```

Returns the device MAC address or null if the MAC address is not available.

Note

The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns null

8.3.3.15 GetSerialNumber()

```
String Caretaker::Device::GetSerialNumber ( )
```

Returns the device serial number or null if the serial number is not available.

Note

The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns null

8.3.3.16 GetFirmwareVersion()

```
String Caretaker::Device::GetFirmwareVersion ( )
```

Returns the device firmware version or null if the firmware version is not available.

Note

The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns null

8.3.3.17 GetHardwareVersion()

```
String Caretaker::Device::GetHardwareVersion ( )
```

Returns the device hardware version or null if the hardware version is not available.

Note

The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns null.

8.3.3.18 GetDeviceStatus()

```
DeviceStatus Caretaker::Device::GetDeviceStatus ( )  [inline]
```

Method to poll device status.

Returns

The last device status received from the device or null if it is not available.

8.3.3.19 GetBatteryStatus()

```
BatteryStatus Caretaker::Device::GetBatteryStatus ( )  [inline]
```

Method to poll battery status.

Returns

The last battery status received from the device or null if it is not available.

8.3.3.20 GetCuffStatus()

```
CuffStatus Caretaker::Device::GetCuffStatus ( )  [inline]
```

Method to poll cuff status.

Returns

The last cuff status received from the device or null if it is not available.

8.3.3.21 GetPrimaryVitals()

```
array<PrimaryVitals> Caretaker::Device::GetPrimaryVitals ( )  [inline]
```

Method to poll primary vitals.

Returns

Array of last primary vitals received from the device or null if they are not available.

8.3.3.22 GetSecondaryVitals()

```
array<SecondaryVitals> Caretaker::Device::GetSecondaryVitals ( )  [inline]
```

Method to poll secondary vitals.

Returns

The last secondary vitals received from the device or null if they are not available.

8.3.3.23 GetPulseRateWaveformDataPoints()

```
WaveformDataPoints Caretaker::Device::GetPulseRateWaveformDataPoints ( )  [inline]
```

Method to poll pulse rate waveform data points.

Note

If the application is polling, this method must be called at least 4 times per second to not drop data.

Returns

The last pulse rate data points received from the device or null if they are not available.

8.3.3.24 GetPulsePressureWaveformDataPoints()

```
WaveformDataPoints Caretaker::Device::GetPulsePressureWaveformDataPoints ( )  [inline]
```

Method to poll pulse pressure waveform data points.

Note

If the application is polling, this method must be called at least 4 times per second to not drop data.

Returns

The last pulse rate data points received from the device or null if they are not available.

8.3.3.25 IncrementCuffPressure()

```
Boolean Caretaker::Device::IncrementCuffPressure ( )
```

Increments the cuff pressure in 10 mmHg increment.

This method issues a write request to the device to adjust the cuff pressure up 10 mmHg and may take a couple seconds to take effect.

Use GetCuffStatus() to monitor the target and actual cuff pressure values.

See also

DecrementCuffPressure
GetCuffStatus
VentCuff

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.26 DecrementCuffPressure()

```
Boolean Caretaker::Device::DecrementCuffPressure ( )
```

Decrements the cuff pressure in 10 mmHg increment.

This method issues a write request to the device to adjust the cuff pressure down 10 mmHg and may take a couple seconds to effect.

Use GetCuffStatus() to monitor the target and actual cuff pressure values.

See also

IncrementCuffPressure
GetCuffStatus
VentCuff

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.27 VentCuff()

```
Boolean Caretaker::Device::VentCuff ( )
```

Deflates the cuff pressure.

This method issues a write request to the device to deflate cuff pressure.

Use GetCuffStatus() to monitor the target and actual cuff pressure values.

See also

DecrementCuffPressure
DecrementCuffPressure
GetCuffStatus

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.28 PeformDiagnosticsFlush()

```
Boolean Caretaker::Device::PeformDiagnosticsFlush ( )
```

Flushes the device diagnostic plumbing tree.

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.29 WriteSnrMinimum()

```
Boolean Caretaker::Device::WriteSnrMinimum (
            Int32 snr )
```

Writes the device noise filter parameter.

Parameters

snr	The minimum signal-to-noise value. Acceptable range [0, 100].

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

See also

GetCuffStatus
ReadSnrMinimum

8.3.3.30 ReadSnrMinimum()

```
Boolean Caretaker::Device::ReadSnrMinimum ( )
```

Reads the device noise filter parameter.

Use GetCuffStatus() to monitor the signal-to-noise (snr) ratio at the device. Use ReadSnrMinimum() to get an immediate reading of the current value.

On success, the result is notified later with DeviceObserver::OnReadSnrMinimum().

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.31 WriteMotionTolerance()

```
Boolean Caretaker::Device::WriteMotionTolerance (
            Int32 value )
```

Writes the device motion tolerance parameter.

Parameters

value	Timeout in seconds. Acceptable range [0, 30].

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

See also

ReadMotionTolerance

8.3.3.32 ReadMotionTolerance()

```
Boolean Caretaker::Device::ReadMotionTolerance ( )
```

Reads the device motion tolerance parameter.

On success, the result is notified later with DeviceObserver::OnReadMotionTolerance().

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.33 TurnDisplayOff()

```
Boolean Caretaker::Device::TurnDisplayOff ( )
```

Turns the device display screen off.

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.34 TurnDisplayOn()

```
Boolean Caretaker::Device::TurnDisplayOn ( )
```

Turns the device display screen on.

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.35 ReadDisplayState()

```
Boolean Caretaker::Device::ReadDisplayState ( )
```

Reads the display state.

On success, the result is notified later with DeviceObserver::OnReadDisplayState().

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.36 Recalibrate()

```
Boolean Caretaker::Device::Recalibrate ( )
```

Recalibrate blood pressure measurements.

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

See also

WriteRecalibrationInterval
ReadRecalibrationInterval

8.3.3.37 WriteRecalibrationInterval()

```
Boolean Caretaker::Device::WriteRecalibrationInterval (
            UInt32 interval )
```

Writes the calibration interval.

Parameters

interval	The recalibration interval in minutes. Acceptable range [10, 1440].

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

See also

Recalibrate
ReadRecalibrationInterval

8.3.3.38 ReadRecalibrationInterval()

```
Boolean Caretaker::Device::ReadRecalibrationInterval ( )
```

Reads the calibration interval.

On success, the result is notified later with DeviceObserver::OnReadRecalibrationInterval().

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

See also

Recalibrate
WriteRecalibrationInterval

8.3.3.39 WriteWaveformClampSetting()

```
Boolean Caretaker::Device::WriteWaveformClampSetting (
            Byte value )
```

Writes the setting to enable or disable clamping the waveforms.

Parameters

value	Clamp setting: 0 = OFF, 1 = ON.

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

See also

ReadWaveformClampSetting

8.3.3.40 ReadWaveformClampSetting()

```
Boolean Caretaker::Device::ReadWaveformClampSetting ( )
```

Read the waveform clamping setting.

On success, the result is notified later with DeviceObserver::OnReadWaveformClampSetting().

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

See also

WriteWaveformClampSetting

8.3.3.41 WriteVitalsFilterSetting()

```
Boolean Caretaker::Device::WriteVitalsFilterSetting (
            Byte value )
```

Writes the filter settings to enable or disable filtering outlier vitals measurements.

Parameters

value	Filter setting: 0 = OFF, 1 = ON.

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

See also

ReadVitalsFiltersSettings

8.3.3.42 ReadVitalsFilterSetting()

```
Boolean Caretaker::Device::ReadVitalsFilterSetting ( )
```

Reads the current filter settings to enable or disable filtering outlier vitals measurements.

On success, the result is notified later with DeviceObserver::OnReadVitalsFilterSetting().

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

See also

WriteVitalsFilterSetting

8.3.3.43 ReadPersistentLog()

```
Boolean Caretaker::Device::ReadPersistentLog ( )
```

Reads the device logs.

On success, the result is notified later with DeviceObserver::OnReadPersistentLog().

Note

Reading the device log is a slow request so the results will be delayed by many seconds.

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.44 SetLibraryLogLevel()

```
static void Caretaker::Device::SetLibraryLogLevel (
            Int32 level )  [static]
```

Sets the library log level.

Note

Library logs are written to standard out by default, which maybe the console for console applications. Use RedirectLibraryLogs() to redirect library logs to a file.

Parameters

level	One of the following log levels. • 0 - shows all logs, most verbose • 1 - shows only info, warning, and error logs • 2 - shows only warning and error logs • 3 - shows only error logs, least verbose

8.3.3.45 EnableSimulationMode()

```
Boolean Caretaker::Device::EnableSimulationMode (
            Boolean mode )
```

Writes the device simulation mode.

Note

The device does not provide real-time data when simulation mode is enabled. Hard-coded numeric and waveform data (i.e., synthetic data) is provided. As such, simulation mode should be enabled for demonstration and test purposes only.

Parameters

mode	Simulation mode: 1 = Enable, 0 = Disable.

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

8.3.3.46 ClearStatus()

```
Boolean Caretaker::Device::ClearStatus ( )
```

Clears the device status.

Returns

Returns true if the request to the device was initiated and false otherwise. The application must only call this method after the connection is established with the device, i.e., after calling one of the connect methods and connection status CONNECTED is notified. Otherwise, the method returns false.

The documentation for this class was generated from the following file:

- CaretakerDevice.h

8.4 Caretaker::DeviceObserver Class Reference

Managed class defining the application observer interface to receive real-time notifications.

Public Member Functions

- virtual void OnDeviceDiscovered (Device^ device, String^ name, String^ serialNumber, String^ mac↩ Address)

  Notification sent to report a discovered device after the application called Device::StartScan().
- virtual void OnConnectionStatus (Device^ device, ConnectionStatus status)

  Notification sent to report Device::Connect() and Device::Disconnect() status.
- virtual void OnStartStatus (Device^ device, StartStatus status)

  Notification sent to report Device::StartAutoCal() and Device::StartManualCal() status.
- virtual void OnStopStatus (Device^ device, StopStatus status)

  Notification sent to report Device::Stop() status.
- virtual void OnPulseRateWaveformDataPoints (Device^ device, WaveformDataPoints^ dataPoints)

  Notification sent to report real-time pulse rate (raw pulse) waveform data.
- virtual void OnPulsePressureWaveformDataPoints (Device^ device, WaveformDataPoints^ dataPoints)

  Notification sent to report real-time pulse pressure (integrated pulse) waveform data.
- virtual void OnParameterizedPulse (Device^ device, WaveformDataPoints^ dataPoints, Int16 t0, Int16 t1, Int16 t2, Int16 t3, Int32 p0, Int32 p1, Int32 p2, Int32 p3)

  Notification sent to report the most recent parameterized pulse including pulse snapshot waveform and pulse parameters.
- virtual void OnDeviceStatus (Device^ device, DeviceStatus^ status)

  Notification sent to report real-time device status information.
- virtual void OnBatteryStatus (Device^ device, BatteryStatus^ status)

  Notification sent to report real-time battery status information.
- virtual void OnCuffStatus (Device^ device, CuffStatus^ status)

  Notification sent to report real-time cuff status information.
- virtual void OnPrimaryVitals (Device^ device, array< PrimaryVitals >^ vitals)

  Notification sent to report real-time primary vitals.
- virtual void OnSecondaryVitals (Device^ device, array< SecondaryVitals >^ vitals)

  Notification sent to report real-time secondary vitals.
- virtual void OnReadSnrMinimum (Device^ device, Boolean status, Int32 snr)

  Notification sent to report Device::ReadSnrMinimum() transaction result.
- virtual void OnReadDisplayState (Device^ device, Boolean status, Boolean state)

  Notification sent to report Device::ReadDisplayState() transaction result.
- virtual void OnReadRecalibrationInterval (Device^ device, Boolean status, UInt32 interval)

  Notification sent to report Device::OnReadRecalibrationInterval() transaction result.
- virtual void OnReadVitalsFilterSetting (Device^ device, Boolean status, Byte value)

  Notification sent to report Device::ReadVitalsFilterSetting() transaction result.
- virtual void OnReadMotionTolerance (Device^ device, Boolean status, int timeout)

  Notification sent to report Device::ReadMotionTolerance() transaction result.
- virtual void OnReadPersistentLog (Device^ device, Boolean status, String^ log)

  Notification sent to report Device::ReadPersistentTolerance() transaction result.
- virtual void OnReadWaveformClampSetting (Device^ device, Boolean status, Byte value)

  Notification sent to report Device::ReadWaveformClampSetting() transaction result.

8.4.1 Detailed Description

Managed class defining the application observer interface to receive real-time notifications.

Extend this class in the application and override the methods to receive Caretaker data and event notifications.

IMPORTANT: The DeviceObserver methods are called from unmanaged threads within the Caretaker library so the application cannot access user interface (UI) elements from these methods directly. The following C# snippet illustrates one way to dispatch work asynchronously to the application main thread to update the UI.

```
public override void OnConnectionStatus(Device device,onnectionStatus status)
{
    if (status == ConnectionStatus.CONNECTED)
   {
       Application.Current.Dispatcher.BeginInvoke(new Action(() => {
            // add code to update UI here
        }));
   }
}
```

Connection status and device discovery events are notified directly from the low-level stack thread so that these events are reported immediately to the application. However, the low-level stack thread cannot tolerate blocking calls in the application or else data and other events from the device may be lost. As such, the application must not perform any blocking operations in OnDeviceDiscovered() or OnConnectionStatus(). For example, the application should call the asynchronous Application.Current.Dispatcher.BeginInvoke() instead of the synchronous Application.Current.Dispatcher.Invoke() to update status on the UI without blocking.

In contrast, other observer notifications reporting device status and data are called from an application interfacing thread in the library that can tolerate blocking calls in the application without dropping data so either Application.↩ Current.Dispatcher.BeginInvoke() or Application.Current.Dispatcher.Invoke() can be called from these methods to update the UI.

Finally, the application must not call Disconnect() or ReleaseResources() from any DeviceObserver methods. The DeviceObserver methods are called from library threads that the aforementioned methods attempt to kill. As such, Disconnect() or ReleaseResources() must be called from an application thread, otherwise the application may deadlock.

8.4.2 Member Function Documentation

8.4.2.1 OnDeviceDiscovered()

```
virtual void Caretaker::DeviceObserver::OnDeviceDiscovered (
             Device^ device,
             String^ name,
             String^ serialNumber,
             String^ macAddress )  [inline], [virtual]
```

Notification sent to report a discovered device after the application called Device::StartScan().

The application must call Device::ConnectToSerialNumber() or Device::ConnectToMacAddress() to connect to the desired, discovered device.

IMPORTANT: Device discovery events are notified directly from the low-level stack thread to report these events immediately to the application. The low-level stack thread cannot tolerate blocking calls in the application or else data and other events may be lost. As such, the application must not call any methods that block in OnDeviceDiscovered(). For example, call the asynchronous Application.Current.Dispatcher.BeginInvoke() that doesn't block instead of the synchronous Application.Current.Dispatcher.Invoke() that blocks to forward these events to the application main thread.

Parameters

device	The Device instance.
name	The discovered Caretaker device name.
serialNumber	The discovered Caretaker device serial number.
macAddress	The discovered Caretaker device MAC address.

8.4.2.2 OnConnectionStatus()

```
virtual void Caretaker::DeviceObserver::OnConnectionStatus (
            Device^ device,
            ConnectionStatus status )  [inline], [virtual]
```

Notification sent to report Device::Connect() and Device::Disconnect() status.

IMPORTANT: Connection status events are notified directly from the low-level stack thread to report these events immediately to the application. The low-level stack thread cannot tolerate blocking calls in the application or else data and other events may be lost. As such, the application must not call any methods that block in OnConnectionStatus(). For example, call the asynchronous Application.Current.Dispatcher.BeginInvoke() that doesn't block instead of the synchronous Application.Current.Dispatcher.Invoke() that blocks to forward these events to the application main thread.

Parameters

device	The Device instance.
status	The connection status.

8.4.2.3 OnStartStatus()

```
virtual void Caretaker::DeviceObserver::OnStartStatus (
            Device^ device,
            StartStatus status )  [inline], [virtual]
```

Notification sent to report Device::StartAutoCal() and Device::StartManualCal() status.

Parameters

device	The Device instance.
status	The start status.

8.4.2.4 OnStopStatus()

```
virtual void Caretaker::DeviceObserver::OnStopStatus (
```

```
            Device^ device,
            StopStatus status )  [inline], [virtual]
```

Notification sent to report Device::Stop() status.

Parameters

device	The Device instance.
status	The stop status.

8.4.2.5 OnPulseRateWaveformDataPoints()

```
virtual void Caretaker::DeviceObserver::OnPulseRateWaveformDataPoints (
            Device^ device,
            WaveformDataPoints^ dataPoints )  [inline], [virtual]
```

Notification sent to report real-time pulse rate (raw pulse) waveform data.

Parameters

device	The Device instance.
dataPoints	Pulse rate waveform data points.

8.4.2.6 OnPulsePressureWaveformDataPoints()

```
virtual void Caretaker::DeviceObserver::OnPulsePressureWaveformDataPoints (
            Device^ device,
            WaveformDataPoints^ dataPoints )  [inline], [virtual]
```

Notification sent to report real-time pulse pressure (integrated pulse) waveform data.

Parameters

device	The Device instance.
dataPoints	Pulse pressure waveform data points.

8.4.2.7 OnParameterizedPulse()

```
virtual void Caretaker::DeviceObserver::OnParameterizedPulse (
            Device^ device,
            WaveformDataPoints^ dataPoints,
            Int16 t0,
```

```
            Int16 t1,
            Int16 t2,
            Int16 t3,
            Int32 p0,
            Int32 p1,
            Int32 p2,
            Int32 p3 )  [inline], [virtual]
```

Notification sent to report the most recent parameterized pulse including pulse snapshot waveform and pulse parameters.

Parameters

device	The Device instance.
dataPoints	Parameterized pulse waveform data points.
t0	Pulse onset index.
t1	First pulse peak index.
t2	Second pulse peak index.
t3	Third pulse peak index.
p0	Integrated pulse onset value.
p1	First integrated pulse peak value.
p2	Second integrated pulse peak value.
p3	Third integrated pulse peak value.

8.4.2.8 OnDeviceStatus()

```
virtual void Caretaker::DeviceObserver::OnDeviceStatus (
            Device^ device,
            DeviceStatus^ status )  [inline], [virtual]
```

Notification sent to report real-time device status information.

Parameters

device	The Device instance.
status	The device status.

8.4.2.9 OnBatteryStatus()

```
virtual void Caretaker::DeviceObserver::OnBatteryStatus (
            Device^ device,
            BatteryStatus^ status )  [inline], [virtual]
```

Notification sent to report real-time battery status information.

Parameters

device	The Device instance.
status	The battery status.

8.4.2.10 OnCuffStatus()

```
virtual void Caretaker::DeviceObserver::OnCuffStatus (
            Device^ device,
            CuffStatus^ status )  [inline], [virtual]
```

Notification sent to report real-time cuff status information.

Parameters

device	The Device instance.
status	The cuff status.

8.4.2.11 OnPrimaryVitals()

```
virtual void Caretaker::DeviceObserver::OnPrimaryVitals (
            Device^ device,
            array< PrimaryVitals >^ vitals )  [inline], [virtual]
```

Notification sent to report real-time primary vitals.

IMPORTANT: Application.Current.Dispatcher.BeginInvoke() executes asynchronous processing on the main thread to update the UI, so call the synchronous Application.Current.Dispatcher.Invoke() instead to throttle library calls as OnPrimaryVitals() maybe called once or multiple times per second to report vitals to the application depending on the Caretaker's update interval setting as well as queuing in the library. If Dispatcher.BeginInvoke() is called instead, the application must be capable of handling high library call volumes to prevent application freeze.

Parameters

device	The Device instance.
vitals	Array of primary vitals.

8.4.2.12 OnSecondaryVitals()

```
virtual void Caretaker::DeviceObserver::OnSecondaryVitals (
            Device^ device,
            array< SecondaryVitals >^ vitals )  [inline], [virtual]
```

Notification sent to report real-time secondary vitals.

For internal and research use only.

IMPORTANT: Application.Current.Dispatcher.BeginInvoke() executes asynchronous processing on the main thread to update the UI, so call the synchronous Application.Current.Dispatcher.Invoke() instead to throttle library calls as OnSecondaryVitals() maybe called once or multiple times per second to report vitals to the application depending on the Caretaker's update interval setting as well as queuing in the library. If Dispatcher.BeginInvoke() is called instead, the application must be capable of handling high library call volumes to prevent application freeze.

Parameters

device	The Device instance.
vitals	Array of secondary vitals.

8.4.2.13 OnReadSnrMinimum()

```
virtual void Caretaker::DeviceObserver::OnReadSnrMinimum (
            Device^ device,
            Boolean status,
            Int32 snr )  [inline], [virtual]
```

Notification sent to report Device::ReadSnrMinimum() transaction result.

Parameters

device	The Device instance.
status	Set to true if the transaction succeeded, and false otherwise.
snr	The SNR value if the transaction succeeded.

8.4.2.14 OnReadDisplayState()

```
virtual void Caretaker::DeviceObserver::OnReadDisplayState (
            Device^ device,
            Boolean status,
            Boolean state )  [inline], [virtual]
```

Notification sent to report Device::ReadDisplayState() transaction result.

Parameters

device	The Device instance.
status	Set to true if the transaction succeeded, and false otherwise.
state	The display state if the transaction succeeded: True if the display is turned on, and false otherwise.

8.4.2.15 OnReadRecalibrationInterval()

```
virtual void Caretaker::DeviceObserver::OnReadRecalibrationInterval (
            Device^ device,
            Boolean status,
            UInt32 interval )  [inline], [virtual]
```

Notification sent to report Device::OnReadRecalibrationInterval() transaction result.

Parameters

device	The Device instance.
status	Set to true if the transaction succeeded, and false otherwise.
interval	The recalibration interval in minutes if the transaction succeeded.

8.4.2.16 OnReadVitalsFilterSetting()

```
virtual void Caretaker::DeviceObserver::OnReadVitalsFilterSetting (
            Device^ device,
            Boolean status,
            Byte value )  [inline], [virtual]
```

Notification sent to report Device::ReadVitalsFilterSetting() transaction result.

Parameters

device	The Device instance.
status	Set to true if the transaction succeeded, and false otherwise.
value	Filter setting on success: 0 = OFF, 1 = ON.

8.4.2.17 OnReadMotionTolerance()

```
virtual void Caretaker::DeviceObserver::OnReadMotionTolerance (
            Device^ device,
            Boolean status,
            int timeout )  [inline], [virtual]
```

Notification sent to report Device::ReadMotionTolerance() transaction result.

Parameters

device	The Device instance.
status	Set to true if the transaction succeeded, and false otherwise.
timeout	Motion tolerance timeout in seconds.

8.4.2.18 OnReadPersistentLog()

```
virtual void Caretaker::DeviceObserver::OnReadPersistentLog (
            Device^ device,
            Boolean status,
            String^ log )  [inline], [virtual]
```

Notification sent to report Device::ReadPersistentTolerance() transaction result.

Parameters

device	The Device instance.
status	Set to true if the transaction succeeded, and false otherwise.
log	Device logs.

8.4.2.19 OnReadWaveformClampSetting()

```
virtual void Caretaker::DeviceObserver::OnReadWaveformClampSetting (
            Device^ device,
            Boolean status,
            Byte value )  [inline], [virtual]
```

Notification sent to report Device::ReadWaveformClampSetting() transaction result.

Parameters

device	The Device instance.
status	Set to true if the transaction succeeded, and false otherwise.
value	Clamp setting: 0 = OFF, 1 = ON.

The documentation for this class was generated from the following file:

- CaretakerDevice.h

8.5 Caretaker::DeviceStatus Class Reference

Managed class defining device status.

Data Fields

- Boolean pdaEnabled

  An indicator of whether the system PDA measurement system is enabled.

- Boolean simulationEnabled

  An indicator of whether the system is in simulation mode.
- Boolean pressureControlIndicator

  An indicator of whether the system is currently running closed loop pressure control.
- Boolean inflatedIndicator

  An indicator of whether the system has been inflated to pressure.
- Boolean clockWrapAround

  The system clock (time since reset) has wrapped around its index.
- Boolean batteryVoltageLow

  The battery voltage sensor has indicated the battery is near drop-out.
- Boolean criticalTemperature

  The on-board temperature sensor has detected critically high temperature.
- Boolean pumpOverrun

  The pump has violated an overrun condition.
- Boolean betaProcessing

  The system has finished finding the oscillometric curve and is processing the beta (offset) value.
- Boolean autoCalMode

  The system has been started and running in auto-calibration mode.
- Boolean manualCalMode

  The system has been started and running in manual calibration mode.
- Boolean motionEvent

  The system is having trouble getting a good reading due to too much motion.
- Boolean dataValid

  There are valid vital signs measurements.
- Boolean calibrating

  The system is currently calibrating the blood pressure system.
- Boolean calibrated

  The system has current valid calibration.
- Boolean inflateFailed

  Cuff did not inflate to expected value within timeout.
- Boolean calibrationFailed

  Calibration Failure: The calibration values were out of range or oscillometric curve had invalid shape.
- Boolean poorSignal

  Calibration Failure: The system failed to calibrate or timed out process signals so measurements were aborted.
- Boolean calibrationOffsetFailed

  Calibration Failure: The calibration offset calculation failed to identify pulses due to movement.
- Boolean noPulseTimeout

  Calibration Failure: The systems has gone greater than 15 minutes without a valid heart beat.
- Boolean cuffTooLoose

  Calibration Failure: The calibration pump up identified the cuff was too loose.
- Boolean cuffTooTight

  Calibration Failure: The calibration pump up identified the cuff was too tight.
- Boolean weakSignal

  Calibration Failure: Calibration oscillometric curve amplitude is too weak to verify reading.
- Boolean badCuff

  Calibration Failure: The cuff is not holding pressure as expected.
- Boolean recalSoon

  An automatic recalibration will be occurring shortly.
- Boolean tooManyFails

  Calibration Failure: Auto calibration failed too many consecutive times try manual calibration.
- Int16 calibrationPercentage

Calibration percentage complete.

- Boolean charging

  The device is charging.

- Boolean chargeComplete

  Charging complete.

- Int16 posture

  The last posture used for auto-calibration.

- Boolean invalidDataEntry

  Invalid input received in the last command.

8.5.1 Detailed Description

Managed class defining device status.

Device status information is notified with DeviceObserver::OnDeviceStatus() so the application must implement this method to receive it.

8.5.2 Field Documentation

8.5.2.1 dataValid

```
Boolean Caretaker::DeviceStatus::dataValid
```

There are valid vital signs measurements.

This is used to notify the GUI if data should be displayed or hidden.

8.5.2.2 invalidDataEntry

```
Boolean Caretaker::DeviceStatus::invalidDataEntry
```

Invalid input received in the last command.

The documentation for this class was generated from the following file:

- CaretakerDevice.h

8.6 libct_app_callbacks_t Struct Reference

Structure used to provide asynchronous notifications to the application.

Data Fields

- void(∗ on_device_discovered)(libct_context_t ∗context, libct_device_t ∗device)

  Function pointer to the application callback to receive scan notifications in response to calling libct_start_discovery().
- void(∗ on_discovery_timedout)(libct_context_t ∗context)

  Function pointer to the application callback to receive timeout notification in response to calling libct_start_discovery().
- void(∗ on_discovery_failed)(libct_context_t ∗context, int error)

  Function pointer to the application callback to receive error notification in response to calling libct_start_discovery().
- void(∗ on_device_connected_not_ready)(libct_context_t ∗context, libct_device_t ∗device)

  Function pointer to the application callback to receive early connection notification in response to calling libct_connect().
- void(∗ on_device_connected_ready)(libct_context_t ∗context, libct_device_t ∗device)

  Function pointer to the application callback to receive connection notification in response to calling libct_connect().
- void(∗ on_connect_error)(libct_context_t ∗context, libct_device_t ∗device, const char ∗error)

  Function pointer to the application callback to receive error notification in response to calling libct_connect().
- void(∗ on_connect_timedout)(libct_context_t ∗context, libct_device_t ∗device)

  Function pointer to the application callback to receive timed out notification in response to calling libct_connect().
- void(∗ on_device_disconnected)(libct_context_t ∗context, libct_device_t ∗device)

  Function pointer to the application callback to receive disconnect notification.
- void(∗ on_start_monitoring)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive notification in response to calling libct_start_monitoring().
- void(∗ on_stop_monitoring)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive notification in response to calling libct_stop_monitoring().
- void(∗ on_start_measuring)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive notification in response to calling libct_start_measuring().
- void(∗ on_stop_measuring)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive notification in response to calling libct_stop_measuring().
- void(∗ on_data_received)(libct_context_t ∗context, libct_device_t ∗device, libct_stream_data_t ∗data)

  Function pointer to the application callback to receive data notifications.
- void(∗ on_data_error)(libct_context_t ∗context, libct_device_t ∗device, const char ∗error)

  Function pointer to the application callback to receive data error notification.
- void(∗ on_rd_snr_min_rsp)(libct_context_t ∗context, libct_device_t ∗device, int snr, int status)

  Function pointer to the application callback to receive status in response to calling libct_rd_snr_min().
- void(∗ on_wrt_snr_min_rsp)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive status in response to calling libct_wrt_snr_min().
- void(∗ on_rd_display_state_rsp)(libct_context_t ∗context, libct_device_t ∗device, unsigned char state, int status)

  Function pointer to the application callback to receive status in response to calling libct_rd_display_state().
- void(∗ on_wrt_display_state_rsp)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive status in response to calling libct_wrt_display_state().
- void(∗ on_rd_recal_itvl_rsp)(libct_context_t ∗context, libct_device_t ∗device, unsigned int itvl, int status)

  Function pointer to the application callback to receive status in response to calling libct_rd_recal_itvl().
- void(∗ on_wrt_recal_itvl_rsp)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive status in response to calling libct_wrt_recal_itvl().
- void(∗ on_rd_cuff_pressure_rsp)(libct_context_t ∗context, libct_device_t ∗device, int pressure, int status)

  Function pointer to the application callback to receive status in response to calling libct_rd_cuff_pressure().
- void(∗ on_vent_cuff_rsp)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive status in response to calling libct_vent_cuff().
- void(∗ on_clr_status_rsp)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive status in response to calling libct_clr_status().
- void(∗ on_diag_flush_rsp)(libct_context_t ∗context, libct_device_t ∗device, int status)

Function pointer to the application callback to receive status in response to calling libct_diag_flush().

- void(∗ on_wrt_waveform_clamping)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive status in response to calling libct_wrt_waveform_clamping().
- void(∗ on_rd_waveform_clamping)(libct_context_t ∗context, libct_device_t ∗device, unsigned char value, int status)

  Function pointer to the application callback to receive status in response to calling libct_rd_waveform_clamping().
- void(∗ on_rd_vitals_filter)(libct_context_t ∗context, libct_device_t ∗device, int value, int status)

  Function pointer to the application callback to receive status in response to calling libct_rd_vitals_filter().
- void(∗ on_wrt_vitals_filter)(libct_context_t ∗context, libct_device_t ∗device, int status)

  Function pointer to the application callback to receive status in response to calling libct_wrt_vitals_filter().
- void(∗ on_rd_motion_timeout)(libct_context_t ∗context, libct_device_t ∗device, int timeout, int status)

  Function pointer to the application callback to receive status in response to calling libct_rd_motion_timeout().
- void(∗ on_rd_persistent_log)(libct_context_t ∗context, libct_device_t ∗device, const char ∗log, unsigned int len, int status)

  Function pointer to the application callback to receive status in response to calling libct_rd_persistent_log().

8.6.1 Detailed Description

Structure used to provide asynchronous notifications to the application.

This structure is a container of function pointers to your application callback functions to receive asynchronous notifications. Note you are not required to implement all callback functions. Instead, initialize the libct_app_callbacks_t object to zeros and then set only the function pointers to the callback functions you care about. However, you must implement at least the following callbacks to connect and receive data from the device.

- on_device_discovered()
- on_device_connected_ready()
- on_device_disconnected()
- on_data_received()

IMPORTANT: When implementing a callback function, you must include **LIBCTAPI** in the function signature to specify the calling convention. This ensures the application and library are using the same calling convention to prevent corrupting the stack. Some platforms, such as Windows, support many calling conventions and **LIBCT↩ API** will be set to the default one. If you don't specify **LIBCTAPI** in the callback implementation, the application source code may not compile or serious failures may occur at runtime due to stack corruption. See the sample implementations included with the member descriptions below for details.

8.6.2 Field Documentation

8.6.2.1 on_device_discovered

```
void( * libct_app_callbacks_t::on_device_discovered) (libct_context_t *context, libct_device_t
*device)
```

Function pointer to the application callback to receive scan notifications in response to calling libct_start_discovery().

These notifications are sent to the application during device discovery to notify a discovered device when scanning for Caretaker devices.

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_device_discovered(libct_context_t* context,
      libct_device_t* device)
{
     const char* address = libct_device_get_address(device);
     const char* name = libct_device_get_name(device);

    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_device_discovered = on_device_discovered;
```

Parameters

context	The context returned from libct_init().
device	The discovered device. **Note:** This device object will be recycled when the callback returns so do not save the device pointer. Instead, make a copy of the device info if needed. Also, since a connection is not established to the device at this point, device functions that require the connection to be established will not return anything useful. You can only call the following functions safely on the device object passed to this callback. • libct_device_t::get_address() • libct_device_t::get_name()

See also

on_discovery_timedout()
on_discovery_failed()

8.6.2.2 on_discovery_timedout

```
void( * libct_app_callbacks_t::on_discovery_timedout) (libct_context_t *context)
```

Function pointer to the application callback to receive timeout notification in response to calling libct_start_discovery().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_discovery_timedout(libct_context_t* context)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_discovery_timedout = on_discovery_timedout;
```

Parameters

context	The context returned from libct_init().

See also

on_device_discovered()
on_discovery_failed()

8.6.2.3 on_discovery_failed

```
void( * libct_app_callbacks_t::on_discovery_failed) (libct_context_t *context, int error)
```

Function pointer to the application callback to receive error notification in response to calling libct_start_discovery().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_discovery_failed(libct_context_t* context, int error)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_discovery_failed = on_discovery_failed;
```

Parameters

context	The context returned from libct_init().
error	Generic error code describing the failure.

See also

on_device_discovered()
on_discovery_timedout()

8.6.2.4 on_device_connected_not_ready

```
void( * libct_app_callbacks_t::on_device_connected_not_ready) (libct_context_t *context, libct_device_t
*device)
```

Function pointer to the application callback to receive early connection notification in response to calling libct_connect().

This is an early notification to allow the application to update the device connection status, however, the device is not ready for IO at this stage of the connection sequence.

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_device_connected_not_ready(
      libct_context_t* context, libct_device_t* device)
{
    // update connection status
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_device_connected_not_ready =
      on_device_connected_not_ready;
```

Parameters

context	The context returned from libct_init().
device	The connected device. **Note:** Since the connection is established to the device at this point there is no restriction on which device functions you can call to obtain information about the device.

See also

on_connect_error()
on_connect_timedout()

8.6.2.5 on_device_connected_ready

```
void( * libct_app_callbacks_t::on_device_connected_ready) (libct_context_t *context, libct_device_t
*device)
```

Function pointer to the application callback to receive connection notification in response to calling libct_connect().

At this stage, the device is ready for IO and the application can issue requests to the device.

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_device_connected_ready(libct_context_t* context,
      libct_device_t* device)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_device_connected_ready =
      on_device_connected_ready;
```

Parameters

context	The context returned from libct_init().
device	The connected device. **Note:** Since the connection is established to the device at this point there is no restriction on which device functions you can call to obtain information about the device.

See also

on_connect_error()
on_connect_timedout()

8.6.2.6 on_connect_error

```
void( * libct_app_callbacks_t::on_connect_error) (libct_context_t *context, libct_device_t
*device, const char *error)
```

Function pointer to the application callback to receive error notification in response to calling libct_connect().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature..

```
void LIBCTAPI on_connect_error(libct_context_t* context,
      libct_device_t* device, const char* error)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_connect_error = on_connect_error;
```

Parameters

context	The context returned from libct_init().
device	The affected device. **Note:** Since there is no connection to the device the device functions requiring a connection will not return anything useful.
error	String describing error.

See also

on_device_connected_not_ready()
on_device_connected_ready()
on_connect_timedout()

8.6.2.7 on_connect_timedout

```
void( * libct_app_callbacks_t::on_connect_timedout) (libct_context_t *context, libct_device_t
*device)
```

Function pointer to the application callback to receive timed out notification in response to calling libct_connect().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_connect_timedout(libct_context_t* context,
      libct_device_t* device)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_connect_timedout = on_connect_timedout;
```

Parameters

context	The context returned from libct_init().
device	The affected device. **Note:** Since there is no connection to the device the device functions requiring a connection will not return anything useful.

See also

on_device_connected_not_ready()
on_device_connected_ready()
on_connect_error()

8.6.2.8 on_device_disconnected

```
void( * libct_app_callbacks_t::on_device_disconnected) (libct_context_t *context, libct_device_t
*device)
```

Function pointer to the application callback to receive disconnect notification.

The disconnect notification is notified after the connection is established with the device and the connection is lost such as when the device moves out of range and disconnects.

The disconnect notification is also notified when the application calls libct_disconnect() to disconnect explicitly. However, the notification to the application is not guaranteed to occur for this scenario, which should be okay since the application initiated the disconnect.

IMPORTANT: The application must not call libct_disconnect() or libct_deinit() from within this or any library callback function. Callbacks are called from internal library threads that these functions attempt to kill. As such, libct_disconnect() and libct_deinit() must only be called from an application thread.

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_device_disconnected(libct_context_t* context,
      libct_device_t* device)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_device_disconnected = on_device_disconnected;
```

Parameters

context	The context returned from libct_init().
device	The disconnected device.

8.6.2.9 on_start_monitoring

```
void( * libct_app_callbacks_t::on_start_monitoring) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive notification in response to calling libct_start_monitoring().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_start_monitoring(). If success, the application on_data_received() will be notified repeatedly with data from the device until libct_stop_monitoring() is called subsequently or the device is disconnected.

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_start_monitoring(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_start_monitoring = on_start_monitoring;
```

Parameters

context	The context returned from libct_init().
device	The device being monitored.
status	Status indicating success or failure: zero on success and non-zero otherwise.

See also

on_data_received()

8.6.2.10 on_stop_monitoring

```
void( * libct_app_callbacks_t::on_stop_monitoring) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive notification in response to calling libct_stop_monitoring().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_stop_monitoring(). If success, the application on_data_received() will stop receiving data notifications.

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_stop_monitoring(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_stop_monitoring = on_stop_monitoring;
```

Parameters

context	The context returned from libct_init().
device	The device being monitored.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.11 on_start_measuring

```
void( * libct_app_callbacks_t::on_start_measuring) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive notification in response to calling libct_start_measuring().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_start_measuring(). If success, the device will begin pulse decomposition analysis (PDA) and vital sign measurements (blood pressure, heart rate, etc) will be notified to the application on_data_received() callback.

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_start_measuring(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_start_measuring = on_start_measuring;
```

Parameters

context	The context returned from libct_init().
device	The device providing measurements.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.12 on_stop_measuring

```
void( * libct_app_callbacks_t::on_stop_measuring) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive notification in response to calling libct_stop_measuring().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_stop_measuring(). If success, the device will stop pulse decomposition analysis (PDA) and vital sign measurements (blood pressure, heart rate, etc) will stop.

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_stop_measuring(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_stop_measuring = on_stop_measuring;
```

Parameters

context	The context returned from libct_init().
device	The device providing measurements.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.13 on_data_received

```
void( * libct_app_callbacks_t::on_data_received) (libct_context_t *context, libct_device_t
*device, libct_stream_data_t *data)
```

Function pointer to the application callback to receive data notifications.

These notifications are sent repeatedly to the application to hand-off data received from the device some time after calling libct_start_monitoring() successfully.

Data notified via this callback depends on the monitor flags passed to libct_start_monitoring() and whether or not libct_start_measuring() was called to start taking vital sign measurements. See libct_stream_data_t for data details.

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_data_received(libct_context_t* context,
      libct_device_t* device, libct_stream_data_t* data)
{
    // handle data
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_data_received = on_data_received;
```

Parameters

context	The context returned from libct_init().
device	The device originating the data.
data	Stream packet containing the data received from the device. **NOTE:** The stream data packet is created with dynamic memory that will be freed after the callback returns. So you should not save pointer(s) to the data, instead copy individual fields into application memory as needed if you need to access it after on_data_received() returns. Do not copy the entire libct_stream_data_t structure as it is a structure of pointers and doing so will be saving pointers to freed memory after the callback returned.

See also

on_data_error()

8.6.2.14 on_data_error

```
void( * libct_app_callbacks_t::on_data_error) (libct_context_t *context, libct_device_t *device,
const char *error)
```

Function pointer to the application callback to receive data error notification.

This notification is sent if the library encounters error receiving or processing data.

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_data_error(libct_context_t* context,
      libct_device_t* device, const char* error)
{
    // handle error
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_data_error = on_data_error;
```

Parameters

context	The context returned from libct_init().
device	The affected device.
error	String describing the error.

8.6.2.15 on_rd_snr_min_rsp

```
void( * libct_app_callbacks_t::on_rd_snr_min_rsp) (libct_context_t *context, libct_device_t
*device, int snr, int status)
```

Function pointer to the application callback to receive status in response to calling libct_rd_snr_min().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_rd_snr_min().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_rd_snr_min_rsp(libct_context_t* context,
      libct_device_t* device, int snr, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_rd_snr_min_rsp = on_rd_snr_min_rsp;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
snr	Minimum signal-to-noise value on success.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.16 on_wrt_snr_min_rsp

```
void( * libct_app_callbacks_t::on_wrt_snr_min_rsp) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive status in response to calling libct_wrt_snr_min().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_wrt_snr_min().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_wrt_snr_min_rsp(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_wrt_snr_min_rsp = on_wrt_snr_min_rsp;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.17 on_rd_display_state_rsp

```
void( * libct_app_callbacks_t::on_rd_display_state_rsp) (libct_context_t *context, libct_device_t
*device, unsigned char state, int status)
```

Function pointer to the application callback to receive status in response to calling libct_rd_display_state().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_rd_display_state().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_rd_display_state_rsp(libct_context_t* context,
      libct_device_t* device, unsigned char state, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_rd_display_state_rsp =
      on_rd_display_state_rsp;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
state	The device display state on success: 0 = off, 1 = on.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.18 on_wrt_display_state_rsp

```
void( * libct_app_callbacks_t::on_wrt_display_state_rsp) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive status in response to calling libct_wrt_display_state().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_wrt_display_state().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_wrt_display_state_rsp(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_wrt_display_state_rsp =
      on_wrt_display_state_rsp;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.19 on_rd_recal_itvl_rsp

```
void( * libct_app_callbacks_t::on_rd_recal_itvl_rsp) (libct_context_t *context, libct_device_t
*device, unsigned int itvl, int status)
```

Function pointer to the application callback to receive status in response to calling libct_rd_recal_itvl().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_rd_recal_itvl().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_rd_recal_itvl_rsp(libct_context_t* context,
      libct_device_t* device, unsigned int itvl, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_rd_recal_itvl_rsp = on_rd_recal_itvl_rsp;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
itvl	The recalibration interval in minutes on success.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.20 on_wrt_recal_itvl_rsp

```
void( * libct_app_callbacks_t::on_wrt_recal_itvl_rsp) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive status in response to calling libct_wrt_recal_itvl().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_wrt_recal_itvl().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_wrt_recal_itvl_rsp(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_wrt_recal_itvl_rsp = on_wrt_recal_itvl_rsp;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.21 on_rd_cuff_pressure_rsp

```
void( * libct_app_callbacks_t::on_rd_cuff_pressure_rsp) (libct_context_t *context, libct_device_t
*device, int pressure, int status)
```

Function pointer to the application callback to receive status in response to calling libct_rd_cuff_pressure().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_rd_cuff_pressure().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_rd_cuff_pressure_rsp(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_rd_cuff_pressure_rsp =
      on_rd_cuff_pressure_rsp;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
pressure	The cuff pressure in mmHg on success.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.22 on_vent_cuff_rsp

```
void( * libct_app_callbacks_t::on_vent_cuff_rsp) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive status in response to calling libct_vent_cuff().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_vent_cuff().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_vent_cuff_rsp(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_vent_cuff_rsp = on_vent_cuff_rsp;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.23 on_clr_status_rsp

```
void( * libct_app_callbacks_t::on_clr_status_rsp) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive status in response to calling libct_clr_status().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_clr_status().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_clr_status_rsp(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_clr_status_rsp = on_clr_status_rsp;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.24 on_diag_flush_rsp

```
void( * libct_app_callbacks_t::on_diag_flush_rsp) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive status in response to calling libct_diag_flush().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_diag_flush().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_diag_flush_rsp(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_diag_flush_rsp = on_diag_flush_rsp;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.25 on_wrt_waveform_clamping

```
void( * libct_app_callbacks_t::on_wrt_waveform_clamping) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive status in response to calling libct_wrt_waveform_clamping().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_wrt_waveform_clamping().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_wrt_waveform_clamping(libct_context_t* context,
                                       libct_device_t* device
                                       int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_wrt_waveform_clamping =
      on_wrt_waveform_clamping;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.26 on_rd_waveform_clamping

```
void( * libct_app_callbacks_t::on_rd_waveform_clamping) (libct_context_t *context, libct_device_t
*device, unsigned char value, int status)
```

Function pointer to the application callback to receive status in response to calling libct_rd_waveform_clamping().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_wrt_waveform_clamping().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_rd_waveform_clamping(libct_context_t* context,
                                      libct_device_t* device,
                                      unsigned char value
                                      int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_rd_waveform_clamping =
      on_rd_waveform_clamping;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
value	Clamp setting: 1 = ON, 0 = OFF
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.27 on_rd_vitals_filter

```
void( * libct_app_callbacks_t::on_rd_vitals_filter) (libct_context_t *context, libct_device_t
*device, int value, int status)
```

Function pointer to the application callback to receive status in response to calling libct_rd_vitals_filter().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_rd_vitals_filter().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_rd_vitals_filter(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_rd_vitals_filter = on_rd_vitals_filter;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
value	The median filter value when success. 0 = Disabled, 1 = Enabled.
status	Status indicating success or failure: zero on success and nonzero otherwise.

8.6.2.28 on_wrt_vitals_filter

```
void( * libct_app_callbacks_t::on_wrt_vitals_filter) (libct_context_t *context, libct_device_t
*device, int status)
```

Function pointer to the application callback to receive status in response to calling libct_wrt_vitals_filter().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_wrt_vitals_filter().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_wrt_vitals_filter(libct_context_t* context,
      libct_device_t* device, int status)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_wrt_vitals_filter = on_wrt_vitals_filter;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
status	Status indicating success or failure: zero on success and non-zero otherwise.

8.6.2.29 on_rd_motion_timeout

```
void( * libct_app_callbacks_t::on_rd_motion_timeout) (libct_context_t *context, libct_device_t
*device, int timeout, int status)
```

Function pointer to the application callback to receive status in response to calling libct_rd_motion_timeout().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_rd_motion_timeout().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_rd_motion_timeout(libct_context_t* context,
      libct_device_t* device, int status, int timeout)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_rd_motion_timeout = on_rd_motion_timeout;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
status	Status indicating success or failure: zero on success and non-zero otherwise.
timeout	Motion timeout value in seconds.

8.6.2.30 on_rd_persistent_log

```
void( * libct_app_callbacks_t::on_rd_persistent_log) (libct_context_t *context, libct_device_t
*device, const char *log, unsigned int len, int status)
```

Function pointer to the application callback to receive status in response to calling libct_rd_persistent_log().

This notification will be sent only once (one-shot) to notify success or failure after calling libct_rd_persistent_log().

The following example illustrates a sample implementation of the callback. Note you must specify **LIBCTAPI** in the function signature.

```
void LIBCTAPI on_rd_persistent_log(libct_context_t* context,
                                   libct_device_t* device,
                                   const char* log,
                                   unsigned int len,
                                   int timeout)
{
    // do something
}
```

And you can set the function pointer as follows.

```
libct_app_callbacks_t callbacks = {0};
callbacks.on_rd_persistent_log = on_rd_persistent_log;
```

Parameters

context	The context returned from libct_init().
device	The device associated with the context.
log	The device persistent log.
len	Log length.
status	Status indicating success or failure: zero on success and non-zero otherwise.

The documentation for this struct was generated from the following file:

- caretaker.h

8.7 libct_battery_info_t Class Reference

Battery info data point within the libct_stream_data_t packet.

Data Fields

- bool valid

  The other fields are valid when this field is non-zero (true) and invalid otherwise.
- int voltage

  The battery voltage in millivolts.
- unsigned int timestamp

  Time stamp from the device associated with the data.

8.7.1 Detailed Description

Battery info data point within the libct_stream_data_t packet.

8.7.2 Field Documentation

8.7.2.1 voltage

```
int libct_battery_info_t::voltage
```

The battery voltage in millivolts.

8.7.2.2 timestamp

```
unsigned int libct_battery_info_t::timestamp
```

Time stamp from the device associated with the data.

The documentation for this class was generated from the following file:

- caretaker.h

8.8 libct_bp_settings_t Class Reference

Structure to write the caretaker manual blood pressure settings.

Data Fields

- unsigned short systolic
  Systolic pressure setting used for blood pressure calibration.
- unsigned short diastolic
  Diastolic pressure setting used for blood pressure calibration.

8.8.1 Detailed Description

Structure to write the caretaker manual blood pressure settings.

8.8.2 Field Documentation

8.8.2.1 systolic

```
unsigned short libct_bp_settings_t::systolic
```

Systolic pressure setting used for blood pressure calibration.

Acceptable range [30, 250].

8.8.2.2 diastolic

```
unsigned short libct_bp_settings_t::diastolic
```

Diastolic pressure setting used for blood pressure calibration.

Acceptable range [10, 150].

The documentation for this class was generated from the following file:

- caretaker.h

8.9 libct_cal_curve_t Class Reference

Calibration curve data point within the libct_stream_data_t packet.

Data Fields

- bool valid
  The other fields are valid when this field is non-zero (true) and invalid otherwise.
- int data_id
  Data ID.
- float val1
  Value 1.
- float val2
  Value 2.
- float val3
  Value 3.
- char * alternateData
  Alternate Data - does not come from device.

8.9.1 Detailed Description

Calibration curve data point within the libct_stream_data_t packet.

Note

The cal curve data is for internal use or research only

8.9.2 Field Documentation

8.9.2.1 valid

```
bool libct_cal_curve_t::valid
```

The other fields are valid when this field is non-zero (true) and invalid otherwise.

8.9.2.2 data_id

```
int libct_cal_curve_t::data_id
```

Data ID.

8.9.2.3 val1

```
float libct_cal_curve_t::val1
```

Value 1.

8.9.2.4 val2

```
float libct_cal_curve_t::val2
```

Value 2.

8.9.2.5 val3

```
float libct_cal_curve_t::val3
```

Value 3.

The documentation for this class was generated from the following file:

- caretaker.h

8.10 libct_cal_t Struct Reference

Structure used to pass calibration data to libct_start_measuring().

Data Fields

- int type
  Calibration type.
- union {
  struct {
  short posture
  Patient posture.
  } auto_cal
  Calibration configuration when type is LIBCT_AUTO_CAL.
  struct {
  libct_bp_settings_t **settings**
  } manual_cal
  Calibration configuration when type is LIBCT_MANUAL_CAL.
  } config

  Calibration data.

8.10.1 Detailed Description

Structure used to pass calibration data to libct_start_measuring().

8.10.2 Field Documentation

8.10.2.1 type

```
int libct_cal_t::type
```

Calibration type.

Set to one of the calibration types.

8.10.2.2 posture

```
short libct_cal_t::posture
```

Patient posture.

Set to one of the patient postures.

8.10.2.3 config

```
union { ... } libct_cal_t::config
```

Calibration data.

The documentation for this struct was generated from the following file:

- caretaker.h

8.11 libct_cal_type_t Class Reference

The Caretaker calibration types.

8.11.1 Detailed Description

The Caretaker calibration types.

The documentation for this class was generated from the following file:

- caretaker.h

8.12 libct_context_t Class Reference

An opaque type representing a library instance associated with (or bound to) a device the application is monitoring.

8.12.1 Detailed Description

An opaque type representing a library instance associated with (or bound to) a device the application is monitoring.

The context is used internally to manage the library instance so its data structure is not exposed to the application. As such, the application cannot create a library context explicitly. A library context can only be created by calling libct_init() to initialize a library instance, which sets the context pointer passed in the first argument. If the call succeeded, the application can use the context to call other library functions, but must call libct_deinit() to destroy the context when it is no longer needed. Destroying the context releases resources that were allocated when the context was initialized, so the application is required to call libct_deinit() to release the context, and not doing so will leak system resources.

```
// Initialize library instance, which returns a device context pointer.
libct_context_t* context = NULL;
int status = libct_init(&context, &init_data, &app_callbacks);
if ( LIBCT_FAILED(status) {
    // Handle error
    return status;
}

// Connect to a device and monitor data (code not shown)

// Destroy context
 libct_deinit(context);
```

The documentation for this class was generated from the following file:

- caretaker.h

8.13 libct_cuff_pressure_t Class Reference

Cuff pressure data point within the libct_stream_data_t packet.

Data Fields

- bool valid

  The other fields are valid when this field is non-zero (true) and invalid otherwise.
- int value

  cuff pressure actual value.
- int target

  cuff pressure target value.
- int snr

  signal to noise ratio.
- unsigned int timestamp

  Time stamp from the device associated with the data.

8.13.1 Detailed Description

Cuff pressure data point within the libct_stream_data_t packet.

8.13.2 Field Documentation

8.13.2.1 valid

```
bool libct_cuff_pressure_t::valid
```

The other fields are valid when this field is non-zero (true) and invalid otherwise.

8.13.2.2 value

```
int libct_cuff_pressure_t::value
```

cuff pressure actual value.

8.13.2.3 target

```
int libct_cuff_pressure_t::target
```

cuff pressure target value.

8.13.2.4 snr

```
int libct_cuff_pressure_t::snr
```

signal to noise ratio.

8.13.2.5 timestamp

```
unsigned int libct_cuff_pressure_t::timestamp
```

Time stamp from the device associated with the data.

The documentation for this class was generated from the following file:

- caretaker.h

8.14 libct_device_class_t Class Reference

Classes of devices that can be monitored by this library.

8.14.1 Detailed Description

Classes of devices that can be monitored by this library.

The documentation for this class was generated from the following file:

- caretaker.h

8.15 libct_device_state_t Class Reference

The Caretaker device states.

8.15.1 Detailed Description

The Caretaker device states.

The documentation for this class was generated from the following file:

- caretaker.h

8.16 libct_device_status_t Class Reference

Device status data point within the libct_stream_data_t packet.

Data Fields

- bool valid

  The other fields are valid when this field is non-zero (true) and invalid otherwise.
- long long value

  Integer value representing logically OR of all status flags, which essentially is the raw value from the device.
- bool pda_enabled

  An indicator of whether the system PDA measurement system is enabled.
- bool simulation_enabled

  An indicator of whether the system is in simulation mode.
- bool pressure_control_indicator

  An indicator of whether the system is currently running closed loop pressure control.
- bool inflated_indicator

  An indicator of whether the system has been inflated to pressure.
- bool clock_wrap_around

  The system clock (time since reset) has wrapped around its index.

- bool battery_voltage_low

  The battery voltage sensor has indicated the battery is near drop-out.
- bool critical_temperature

  The on-board temperature sensor has detected critically high temperature.
- bool pump_overrun

  The pump has violated an overrun condition.
- bool ble_temperature_sensor_paired

  The BLE Temperature Sensor is paired and actively communicating with CareTaker.
- bool ble_handheld_paired

  The a BLE hand-held device is paired and actively communicating with CareTaker.
- bool ble_stream_control

  TThe current stream control status bit of the BLE stream.
- bool cellular_control

  The current stream control status bit of the cellular stream.
- bool serial_stream_control

  The current stream control status bit of the serial stream.
- bool auto_cal_mode

  The system has been started and running in auto-calibration mode.
- bool manual_cal_mode

  The system has been started and running in manual calibration mode.
- bool motion_event

  The system is having trouble getting a good reading due to too much motion.
- bool poor_signal

  The system failed to calibrate or timed out process signals so measurements were aborted.
- bool data_valid

  There are valid vital signs measurements.
- bool calibrating

  The system is currently calibrating the blood pressure system.
- bool calibrated

  The system has current valid calibration.
- bool beta_processing

  The system has finished finding the oscillometric curve and is processing the beta (offset) value.
- bool inflate_failed

  Cuff did not inflate to expected value within timeout.
- bool calibration_failed

  The calibration values were out of range or oscillometric curve had invalid shape.
- bool calibration_offset_failed

  Too much movement.
- bool no_pulse_timeout

  The systems has gone greater than 3 minutes without a valid heart beat.
- bool cuff_too_loose

  The calibration pump up identified the cuff was too loose.
- bool cuff_too_tight

  The calibration pump up identified the cuff was too tight.
- bool weak_signal

  Calibration oscillometric curve amplitude is too weak to verify reading.
- bool bad_cuff

  The cuff is not holding pressure as expected.
- bool ble_adv

  The Bluetooth module is advertising.
- bool recal_soon

An automatic recalibration will be occurring shortly.

- bool too_many_fails

  Auto-calibration failed too many consecutive times try manual calibration.
- short autocal_pct

  Auto-calibration percentage complete.
- bool charging

  The device is charging.
- bool chargeComplete

  Charging complete.
- short posture

  Posture.
- bool invalid_data_entry

  Invalid input received in the last command.

8.16.1 Detailed Description

Device status data point within the libct_stream_data_t packet.

8.16.2 Field Documentation

8.16.2.1 simulation_enabled

```
bool libct_device_status_t::simulation_enabled
```

An indicator of whether the system is in simulation mode.

8.16.2.2 inflated_indicator

```
bool libct_device_status_t::inflated_indicator
```

An indicator of whether the system has been inflated to pressure.

8.16.2.3 clock_wrap_around

```
bool libct_device_status_t::clock_wrap_around
```

The system clock (time since reset) has wrapped around its index.

8.16.2.4 battery_voltage_low

```
bool libct_device_status_t::battery_voltage_low
```

The battery voltage sensor has indicated the battery is near drop-out.

8.16.2.5 pump_overrun

```
bool libct_device_status_t::pump_overrun
```

The pump has violated an overrun condition.

8.16.2.6 ble_temperature_sensor_paired

```
bool libct_device_status_t::ble_temperature_sensor_paired
```

The BLE Temperature Sensor is paired and actively communicating with CareTaker.

8.16.2.7 ble_stream_control

```
bool libct_device_status_t::ble_stream_control
```

TThe current stream control status bit of the BLE stream.

8.16.2.8 manual_cal_mode

```
bool libct_device_status_t::manual_cal_mode
```

The system has been started and running in manual calibration mode.

8.16.2.9 motion_event

```
bool libct_device_status_t::motion_event
```

The system is having trouble getting a good reading due to too much motion.

8.16.2.10 poor_signal

```
bool libct_device_status_t::poor_signal
```

The system failed to calibrate or timed out process signals so measurements were aborted.

8.16.2.11 data_valid

```
bool libct_device_status_t::data_valid
```

There are valid vital signs measurements.

This is used to notify the GUI if data should be displayed or hidden.

8.16.2.12 calibration_offset_failed

```
bool libct_device_status_t::calibration_offset_failed
```

Too much movement.

The calibration offset calculation failed to identify pulses due to movement.

8.16.2.13 weak_signal

```
bool libct_device_status_t::weak_signal
```

Calibration oscillometric curve amplitude is too weak to verify reading.

8.16.2.14 bad_cuff

```
bool libct_device_status_t::bad_cuff
```

The cuff is not holding pressure as expected.

8.16.2.15 ble_adv

```
bool libct_device_status_t::ble_adv
```

The Bluetooth module is advertising.

8.16.2.16 recal_soon

```
bool libct_device_status_t::recal_soon
```

An automatic recalibration will be occurring shortly.

8.16.2.17 too_many_fails

```
bool libct_device_status_t::too_many_fails
```

Auto-calibration failed too many consecutive times try manual calibration.

8.16.2.18 invalid_data_entry

```
bool libct_device_status_t::invalid_data_entry
```

Invalid input received in the last command.

The documentation for this class was generated from the following file:

- caretaker.h

8.17 libct_device_t Class Reference

Handle used to identify a connected device the application is monitoring.

Data Fields

- int(∗ get_state)(struct libct_device_t ∗thiz)

  Return a device state enumeration representing the current state of the library context that is associated with this device.
- int(∗ get_class)(struct libct_device_t ∗thiz)

  Return the device class that was set in the initialization data passed to libct_init().
- const char ∗(∗ get_name)(struct libct_device_t ∗thiz)

  Return the device manufacturer friendly name.
- const char ∗(∗ get_address)(struct libct_device_t ∗thiz)

  Return the device address.
- const char ∗(∗ get_serial_number)(struct libct_device_t ∗thiz)

  Return the device serial number.
- const libct_version_t ∗(∗ get_hw_version)(struct libct_device_t ∗thiz)

  Return the device hardware version.
- const libct_version_t ∗(∗ get_fw_version)(struct libct_device_t ∗thiz)

  Return the device firmware version.
- libct_context_t ∗(∗ get_context)(struct libct_device_t ∗thiz)

  Return the library context bound to this device.

8.17.1 Detailed Description

Handle used to identify a connected device the application is monitoring.

The device handle is used to identify and aggregate general information about a connected device, such as the device name, address, serial number, etc., that the application can query. Note each device handle is associated with a library context and you can retrieve it anytime with libct_get_device() passing the context as argument. As such, you should not hold on to device handles in your application code as they may change when the devices they are associated with become disconnected.

The device handle primary purpose is to identify data notified to your application callbacks.

8.17.2 Field Documentation

8.17.2.1 get_state

```
int( * libct_device_t::get_state) (struct libct_device_t *thiz)
```

Return a device state enumeration representing the current state of the library context that is associated with this device.

You would invoke the function as follows, but note a convenience macro with simpler interface than the function is available.

```
// These two calls are similar, but the second is simpler.
// (1) Use the device function.
int state = device->get_state(device);

// (2) Or use macro with simpler interface.
int state = libct_device_get_state(device);
```

Parameters

thiz	The device instance.

See also

libct_device_get_state()
libct_device_uninitialized()
libct_device_intialized()
libct_device_discovering()
libct_device_connecting()
libct_device_connected()
libct_device_disconnecting()
libct_device_disconnected()
libct_device_monitoring()
libct_device_measuring()

8.17.2.2 get_class

```
int( * libct_device_t::get_class) (struct libct_device_t *thiz)
```

Return the device class that was set in the initialization data passed to libct_init().

You would invoke the function as follows, but note a convenience macro with simpler interface than the function is available.

```
// These two calls are similar, but the second is simpler.
// (1) Use the device function.
int class = device->get_class(device);

// (2) Or use macro with simpler interface.
int class = libct_device_get_class(device);
```

Parameters

thiz	The device instance.

See also

libct_device_get_class()

8.17.2.3 get_name

```
const char*( * libct_device_t::get_name) (struct libct_device_t *thiz)
```

Return the device manufacturer friendly name.

You would invoke the function as follows, but note a convenience macro with simpler interface than the function is available.

```
// These two calls are similar, but the second is simpler.
// (1) Use the device function.
const char* name = device->get_name(device);

// (2) Or use macro with simpler interface.
const char* name = libct_device_get_name(device);
```

Parameters

thiz	The device instance.

See also

libct_device_get_name()

8.17.2.4 get_address

```
const char*( * libct_device_t::get_address) (struct libct_device_t *thiz)
```

Return the device address.

You would invoke the function as follows, but note a convenience macro with simpler interface than the function is available.

```
// These two calls are similar, but the second is simpler.
// (1) Use the device function.
const char* address = device->get_address(device);

// (2) Or use macro with simpler interface.
const char* address = libct_device_get_address(device);
```

Parameters

thiz	The device instance.

See also

libct_device_get_address()

8.17.2.5 get_serial_number

```
const char*( * libct_device_t::get_serial_number) (struct libct_device_t *thiz)
```

Return the device serial number.

You would invoke the function as follows, but note a convenience macro with simpler interface than the function is available.

```
// These two calls are similar, but the second is simpler.
// (1) Use the device function.
const char* sn = device->get_serial_number(device);

// (2) Or use macro with simpler interface.
const char* sn = libct_device_get_serial_number(device);
```

Parameters

thiz	The device instance.

See also

libct_device_get_serial_number()

8.17.2.6 get_hw_version

```
const libct_version_t*( * libct_device_t::get_hw_version) (struct libct_device_t *thiz)
```

Return the device hardware version.

You would invoke the function as follows, but note a convenience macro with simpler interface than the function is available.

```
// These two calls are similar, but the second is simpler.
// (1) Use the device function.
const libct_version_t* version = device->get_hw_version(device);

// (2) Or use macro with simpler interface.
const libct_version_t* version = libct_device_get_hw_version(
      device);
```

Parameters

thiz	The device instance.

See also

libct_device_get_hw_version()

8.17.2.7 get_fw_version

```
const libct_version_t*( * libct_device_t::get_fw_version) (struct libct_device_t *thiz)
```

Return the device firmware version.

You would invoke the function as follows, but note a convenience macro with simpler interface than the function is available.

```
// These two calls are similar, but the second is simpler.
// (1) Use the device function.
const libct_version_t* version = device->get_fw_version(device);

// (2) Or use macro with simpler interface.
const libct_version_t* version = libct_device_get_fw_version(
      device);
```

Parameters

thiz	The device instance.

See also

libct_device_get_fw_version()

8.17.2.8 get_context

```
libct_context_t*( * libct_device_t::get_context) (struct libct_device_t *thiz)
```

Return the library context bound to this device.

You would invoke the function as follows, but note a convenience macro with simpler interface than the function is available.

```
// These two calls are similar, but the second is simpler.
// (1) Use the device function.
libct_context_t* context = device->get_context(device);

// (2) Or use macro with simpler interface.
libct_context_t* context  = libct_device_get_context(device);
```

Parameters

thiz	The device instance.

The documentation for this class was generated from the following file:

- caretaker.h

8.18 libct_init_data_t Struct Reference

Structure defining initialization data passed to libct_init().

Data Fields

- int device_class
  The device class.

8.18.1 Detailed Description

Structure defining initialization data passed to libct_init().

8.18.2 Field Documentation

8.18.2.1 device_class

```
int libct_init_data_t::device_class
```

The device class.

The documentation for this struct was generated from the following file:

- caretaker.h

8.19 libct_monitor_flags_t Class Reference

Data monitor flags passed to libct_start_monitoring()

8.19.1 Detailed Description

Data monitor flags passed to libct_start_monitoring()

The documentation for this class was generated from the following file:

- caretaker.h

8.20 libct_param_pulse_t Class Reference

Parametrized pulse data within the libct_stream_data_t packet.

Data Fields

- bool valid
  The other fields are valid when this field is non-zero (true) and invalid otherwise.
- short protocol_header
  Date transfer control byte used internally to assemble the data.
- short t0
  Pulse onset time (index).
- short t1
  First pulse peak time (index).
- short t2
  Second pulse peak time (index).
- short t3
  Third pulse peak time (index).
- int p0
  Integrated pulse onset value.
- int p1
  First integrated pulse peak value.
- int p2
  Second integrated pulse peak value.
- int p3
  Third integrated pulse peak value.
- short ibi
  Inter-beat interval (1/HR) in samples @ 500Hz.
- short as
  Arterial stiffness.
- short sqe
  Signal quality estimate.
- short pressure
  The most recent raw ADC cuff pressure.
- unsigned int time
  Relative system time of occurrence.
- int waveform_len
  The number of signed int8 snapshot data points.
- char waveform [0]
  The pulse snapshot waveform data.

8.20.1 Detailed Description

Parametrized pulse data within the libct_stream_data_t packet.

The parametrized pulse data is an aggregate of the pulse parameters and pulse snapshot waveform data.

8.20.2 Field Documentation

8.20.2.1 valid

```
bool libct_param_pulse_t::valid
```

The other fields are valid when this field is non-zero (true) and invalid otherwise.

8.20.2.2 protocol_header

```
short libct_param_pulse_t::protocol_header
```

Date transfer control byte used internally to assemble the data.

8.20.2.3 t0

```
short libct_param_pulse_t::t0
```

Pulse onset time (index).

8.20.2.4 t1

```
short libct_param_pulse_t::t1
```

First pulse peak time (index).

8.20.2.5 t2

```
short libct_param_pulse_t::t2
```

Second pulse peak time (index).

8.20.2.6 t3

```
short libct_param_pulse_t::t3
```

Third pulse peak time (index).

8.20.2.7 p0

```
int libct_param_pulse_t::p0
```

Integrated pulse onset value.

8.20.2.8 p1

```
int libct_param_pulse_t::p1
```

First integrated pulse peak value.

8.20.2.9 p2

```
int libct_param_pulse_t::p2
```

Second integrated pulse peak value.

8.20.2.10 p3

```
int libct_param_pulse_t::p3
```

Third integrated pulse peak value.

8.20.2.11 ibi

```
short libct_param_pulse_t::ibi
```

Inter-beat interval (1/HR) in samples @ 500Hz.

8.20.2.12 as

```
short libct_param_pulse_t::as
```

Arterial stiffness.

8.20.2.13 sqe

```
short libct_param_pulse_t::sqe
```

Signal quality estimate.

8.20.2.14 pressure

```
short libct_param_pulse_t::pressure
```

The most recent raw ADC cuff pressure.

8.20.2.15 time

```
unsigned int libct_param_pulse_t::time
```

Relative system time of occurrence.

8.20.2.16 waveform_len

```
int libct_param_pulse_t::waveform_len
```

The number of signed int8 snapshot data points.

The documentation for this class was generated from the following file:

- caretaker.h

8.21 libct_posture_t Class Reference

Patient postures.

8.21.1 Detailed Description

Patient postures.

The documentation for this class was generated from the following file:

- caretaker.h

8.22 libct_pulse_ox_t Class Reference

Pulse oximetry data point within the libct_stream_data_t packet.

Data Fields

- bool valid

  The other fields are valid when this field is non-zero (true) and invalid otherwise.
- int sao2

  Blood oxygen level (percentage).
- int pulse_rate

  Pulse rate in beats per minute (30-200BPM).
- unsigned int timestamp

  Time stamp from the device associated with the data.

8.22.1 Detailed Description

Pulse oximetry data point within the libct_stream_data_t packet.

Note

Reserved for future use.

8.22.2 Field Documentation

8.22.2.1 sao2

```
int libct_pulse_ox_t::sao2
```

Blood oxygen level (percentage).

8.22.2.2 pulse_rate

```
int libct_pulse_ox_t::pulse_rate
```

Pulse rate in beats per minute (30-200BPM).

8.22.2.3 timestamp

```
unsigned int libct_pulse_ox_t::timestamp
```

Time stamp from the device associated with the data.

The documentation for this class was generated from the following file:

- caretaker.h

8.23 libct_pulse_t Class Reference

Raw or integrated pulse data point within the libct_stream_data_t packet.

Data Fields

- bool valid
  The other fields are valid when this field is non-zero (true) and invalid otherwise.
- short value
  Pulse value.
- unsigned int timestamp
  Counter value associated with the pulse value.

8.23.1 Detailed Description

Raw or integrated pulse data point within the libct_stream_data_t packet.

8.23.2 Field Documentation

8.23.2.1 timestamp

```
unsigned int libct_pulse_t::timestamp
```

Counter value associated with the pulse value.

The documentation for this class was generated from the following file:

- caretaker.h

8.24 libct_pulse_waveform_t Struct Reference

Pulse waveform data returned from the device as a result of a previous read request.

Data Fields

- struct {
  libct_pulse_t * **datapoints**
  unsigned int **count**
  } int_pulse

  Array of integrated waveform pulse data points.
- struct {
  libct_param_pulse_t * **datapoints**
  unsigned int **count**
  } param_pulse

  Array of parameterize pulse waveform data points.
- long receive_time

  Value of local clock (in milliseconds) when this stream packet was received.

8.24.1 Detailed Description

Pulse waveform data returned from the device as a result of a previous read request.

Note this data is returned only after an explicit read of raw pulse waveform data.

8.24.2 Field Documentation

8.24.2.1 receive_time

```
long libct_pulse_waveform_t::receive_time
```

Value of local clock (in milliseconds) when this stream packet was received.

This time stamp is used to measure processing latency and for history logging. It differs from time stamp found in each data point generated by the remote device.

The documentation for this struct was generated from the following file:

- caretaker.h

8.25 libct_status_t Class Reference

Function return status codes.

8.25.1 Detailed Description

Function return status codes.

The documentation for this class was generated from the following file:

- caretaker.h

8.26 libct_stream_data_t Class Reference

This structure is used to hand-off data received from the remote device to the application.

Data Fields

- libct_device_t * device
  Reference to the device that generated this data.
- libct_device_status_t device_status
  Device status information.
- libct_battery_info_t battery_info
  Battery information.
- struct {
  libct_vitals_t * datapoints
  Array of vital sign datapoints.
  unsigned int count
  The count of datapoints.
  } vitals
  Array of vital sign data points.
- struct {
  libct_cuff_pressure_t * datapoints
  Array of cuff pressure data points.
  unsigned int count
  The count of data points.
  } cuff_pressure
  Array of cuff pressure data points.
- struct {
  libct_temperature_t * datapoints
  Array of temperature data points.
  unsigned int count
  The count of data points.
  } temperature
  Array of temperature data points.

- struct {
  libct_pulse_ox_t * datapoints
  Array of spo2 data points.
  unsigned int count
  The count of data points.
  } pulse_ox

  Array of pulse oximetry data points.
- struct {
  libct_vitals2_t * datapoints
  Array of secondary vital sign data points.
  unsigned int count
  The count of data points.
  } vitals2

  Array of secondary vital sign data points.
- struct {
  libct_pulse_t * datapoints
  Array of raw pulse (pulse rate) data points.
  unsigned int count
  The count of data points.
  } raw_pulse

  Array of raw pulse (pulse rate) waveform data points.
- struct {
  libct_pulse_t * datapoints
  Array of integrated pulse (pulse pressure) data points.
  unsigned int count
  The count of data points.
  } int_pulse

  Array of integrated pulse (pulse pressure) waveform data points.
- struct {
  libct_param_pulse_t * datapoints
  Array of parameterize pulse (pulse snapshot) data points.
  unsigned int count
  The count of data points.
  } param_pulse

  Array of parameterized pulse data.
- struct {
  libct_cal_curve_t * datapoints
  Array of calibration curve data points.
  unsigned int count
  The count of data points.
  } cal_curve

  Array of calibration curve data points.
- long receive_time

  Value of local clock (in milliseconds) when this stream packet was received.

8.26.1 Detailed Description

This structure is used to hand-off data received from the remote device to the application.

Data from the device is sent automatically after calling libct_start_monitoring() successfully, and delivered to your application via the on_data_received() callback function. This data structure is a container of arrays grouping one or more records of the same data type at different time instances. The various array data types are not produced coherently at the device so not all fields will be populated in stream data packets delivered to the application. If no data is available for a given array, the array data points field will be set to null and the count set to zero to signal no data.

The stream data packets notified to the application depends on the monitor flags passed to libct_start_monitoring() and whether or not libct_start_measuring() was called to start taking vital sign measurements. So you can control the data reported to the application by specifying only the monitoring flags corresponding to the data you care about.

With the exception of the device_status and battery_info data members that are not array fields, the following convenience macros are available to access array entries within the stream data packet. More details about usage is provided in the description for each stream data member where the macros apply.

- libct_dp_count()
- libct_get_dp()
- libct_get_first_dp()
- libct_get_last_dp()
- for_each_dp()

8.26.2 Field Documentation

8.26.2.1 device

```
libct_device_t* libct_stream_data_t::device
```

Reference to the device that generated this data.

8.26.2.2 device_status

```
libct_device_status_t libct_stream_data_t::device_status
```

Device status information.

8.26.2.3 battery_info

```
libct_battery_info_t libct_stream_data_t::battery_info
```

Battery information.

8.26.2.4 datapoints [1/8]

```
libct_vitals_t* libct_stream_data_t::datapoints
```

Array of vital sign datapoints.

8.26.2.5 count

```
unsigned int libct_stream_data_t::count
```

The count of datapoints.

The count of data points.

8.26.2.6 vitals

```
struct { ... } libct_stream_data_t::vitals
```

Array of vital sign data points.

For convenience, you can use the macros libct_get_last_dp(), libct_get_first_dp(), and libct_get_dp() to extract a single vital sign data point from the stream packet like so.

```
libct_vitals_t* dp = libct_get_last_dp(data,
      vitals);
if ( dp && dp->valid ) {
    // use most recent vitals data point
}
```

Alternatively, you could iterate over all vital sign data points with the for_each_dp() macro like so.

```
libct_vitals_t* dp;
unsigned int idx;
for_each_dp(data, idx, dp, vitals) {
    if ( dp && dp->valid ) {
        // use vitals data point
    }
}
```

8.26.2.7 datapoints [2/8]

```
libct_cuff_pressure_t* libct_stream_data_t::datapoints
```

Array of cuff pressure data points.

8.26.2.8 cuff_pressure

```
struct { ... } libct_stream_data_t::cuff_pressure
```

Array of cuff pressure data points.

For convenience, you can use the macros libct_get_last_dp(), libct_get_first_dp(), and libct_get_dp() to extract a single cuff pressure data point from the stream packet like so.

```
libct_cuff_pressure_t* dp = libct_get_last_dp(data,
      cuff_pressure);
if ( dp && dp->valid ) {
    // use most recent cuff pressure data point
}
```

Alternatively, you could iterate over all cuff pressure data points with the for_each_dp() macro like so.

```
libct_cuff_pressure_t* dp;
unsigned int idx;
for_each_dp(data, idx, dp, cuff_pressure) {
    if ( dp && dp->valid ) {
        // use cuff pressure data point
    }
}
```

8.26.2.9 datapoints [3/8]

```
libct_temperature_t* libct_stream_data_t::datapoints
```

Array of temperature data points.

8.26.2.10 temperature

```
struct { ... } libct_stream_data_t::temperature
```

Array of temperature data points.

For convenience, you can use the macros libct_get_last_dp(), libct_get_first_dp(), and libct_get_dp() to extract a single temperature data point from the stream packet like so.

```
libct_temperature_t* dp = libct_get_last_dp(data,
      temperature);
if ( dp && dp->valid ) {
    // use most recent temperature data point
}
```

Alternatively, you could iterate over all temperature data points with the for_each_dp() macro like so.

```
libct_temperature_t* dp;
unsigned int idx;
for_each_dp(data, idx, dp, temperature) {
    if ( dp && dp->valid ) {
        // use temperature data point
    }
}
```

8.26.2.11 datapoints [4/8]

```
libct_pulse_ox_t* libct_stream_data_t::datapoints
```

Array of spo2 data points.

8.26.2.12 pulse_ox

```
struct { ... } libct_stream_data_t::pulse_ox
```

Array of pulse oximetry data points.

For convenience, you can use the macros libct_get_last_dp(), libct_get_first_dp(), and libct_get_dp() to extract a single spo2 data point from the stream packet like so.

```
libct_pulse_ox_t* dp = libct_get_last_dp(data,
      pulse_ox);
if ( dp && dp->valid ) {
    // use most recent spo2 data point
}
```

Alternatively, you could iterate over all spo2 data points with the for_each_dp() macro like so.

```
libct_pulse_ox_t* dp;
unsigned int idx;
for_each_dp(data, idx, dp, pulse_ox) {
    if ( dp && dp->valid ) {
        // use spo2 data point
    }
}
```

8.26.2.13 datapoints [5/8]

```
libct_vitals2_t* libct_stream_data_t::datapoints
```

Array of secondary vital sign data points.

8.26.2.14 vitals2

```
struct { ... } libct_stream_data_t::vitals2
```

Array of secondary vital sign data points.

Note

The secondary vitals are for internal use or research only.

For convenience, you can use the macros libct_get_last_dp(), libct_get_first_dp(), and libct_get_dp() to extract a single secondary vital sign data point from the stream packet.

```
libct_vitals2_t* dp = libct_get_last_dp(data,
      vitals2);
if ( dp && dp->valid ) {
    // use most recent secondary vitals data point
}
```

Alternatively, you could iterate over all secondary vital sign data points with the for_each_dp() macro like so.

```
libct_vitals2_t* dp;
unsigned int idx;
for_each_dp(data, idx, dp, vitals) {
    if ( dp && dp->valid ) {
        // use secondary vitals data point
    }
}
```

8.26.2.15 datapoints [6/8]

```
libct_pulse_t* libct_stream_data_t::datapoints
```

Array of raw pulse (pulse rate) data points.

Array of integrated pulse (pulse pressure) data points.

8.26.2.16 raw_pulse

```
struct { ... } libct_stream_data_t::raw_pulse
```

Array of raw pulse (pulse rate) waveform data points.

For convenience, you could iterate over all raw pulse data points with the for_each_dp() macro like so.

```
libct_pulse_t* dp;
unsigned int idx;
for_each_dp(data, idx, dp, raw_pulse) {
    if ( dp && dp->valid ) {
        // use pulse data point
    }
}
```

8.26.2.17 int_pulse

```
struct { ... } libct_stream_data_t::int_pulse
```

Array of integrated pulse (pulse pressure) waveform data points.

For convenience, you could iterate over all integrated pulse data points with the for_each_dp() macro like so.

```
libct_pulse_t* dp;
unsigned int idx;
for_each_dp(data, idx, dp, int_pulse) {
    if ( dp && dp->valid ) {
        // use pulse data point
    }
}
```

8.26.2.18 datapoints [7/8]

```
libct_param_pulse_t* libct_stream_data_t::datapoints
```

Array of parameterize pulse (pulse snapshot) data points.

8.26.2.19 param_pulse

```
struct { ... } libct_stream_data_t::param_pulse
```

Array of parameterized pulse data.

The data is an aggregate of the pulse parameters and pulse snapshot waveform data.

For convenience, you can use the macros libct_get_last_dp(), libct_get_first_dp(), and libct_get_dp() to extract a single pulse snapshot from the stream packet like so.

```
libct_param_pulse_t* dp = libct_get_last_dp(data,
      param_pulse);
if ( dp && dp->valid ) {
    // use most recent pulse snapshot
}
```

Alternatively, you could iterate over all pulse snapshot data points with the for_each_dp() macro like so.

```
libct_param_pulse_t* dp;
unsigned int idx;
for_each_dp(data, idx, dp, pulse_param) {
    if ( dp && dp->valid ) {
        // use pulse snapshot
    }
}
```

8.26.2.20 datapoints [8/8]

```
libct_cal_curve_t* libct_stream_data_t::datapoints
```

Array of calibration curve data points.

8.26.2.21 cal_curve

```
struct { ... } libct_stream_data_t::cal_curve
```

Array of calibration curve data points.

Note

The cal curve data is for internal use or research only

For convenience, you can use the macros libct_get_last_dp(), libct_get_first_dp(), and libct_get_dp() to extract a single calibration curve data point from the stream packet like so.

```
libct_cal_curve_t* dp = libct_get_last_dp(data,
      cal_curve);
if ( dp && dp->valid ) {
    // use most recent calibration curve data point
}
```

Alternatively, you could iterate over all calibration curve data points with the for_each_dp() macro like so.

```
libct_cal_curve_t* dp;
unsigned int idx;
for_each_dp(data, idx, dp, cal_curve) {
    if ( dp && dp->valid ) {
        // use calibration curve data point
    }
}
```

8.26.2.22 receive_time

```
long libct_stream_data_t::receive_time
```

Value of local clock (in milliseconds) when this stream packet was received.

This time stamp is used to measure processing latency and for history logging. It differs from time stamp found in each data point generated by the remote device.

The documentation for this class was generated from the following file:

- caretaker.h

8.27 libct_temperature_t Class Reference

Temperature data point within the libct_stream_data_t packet.

Data Fields

- bool valid

  The other fields are valid when this field is non-zero (true) and invalid otherwise.
- int value

  The temperature value.
- unsigned int timestamp

  Time stamp from the device associated with the data.

8.27.1 Detailed Description

Temperature data point within the libct_stream_data_t packet.

Note

Reserved for future use.

8.27.2 Field Documentation

8.27.2.1 value

```
int libct_temperature_t::value
```

The temperature value.

8.27.2.2 timestamp

```
unsigned int libct_temperature_t::timestamp
```

Time stamp from the device associated with the data.

The documentation for this class was generated from the following file:

- caretaker.h

8.28 libct_version_t Struct Reference

CareTaker version information.

Data Fields

- int major
  major version number
- int minor
  minor version number
- int revision
  revision number
- int build
  build number

8.28.1 Detailed Description

CareTaker version information.

The documentation for this struct was generated from the following file:

- caretaker.h

8.29 libct_vitals2_t Class Reference

Secondary Vitals data point within the libct_stream_data_t packet.

Data Fields

- bool valid
  The other fields are valid when this field is non-zero (true) and invalid otherwise.
- unsigned short blood_volume
  Blood volume in mS.
- unsigned char cardiac_output
  Cardiac output in L/min.
- unsigned short ibi
  Inter-beat Interval in mS.
- unsigned short lvet
  Left ventricular ejection time.
- float p2p1
  P ratio.
- float hrComp
  hrComp
- float pr
  pr
- int reserved [7]
  Reserved for future use.
- unsigned int timestamp
  Time stamp from the device associated with the data.

8.29.1 Detailed Description

Secondary Vitals data point within the libct_stream_data_t packet.

Note

The secondary vitals are for internal use or research only.

8.29.2 Field Documentation

8.29.2.1 blood_volume

```
unsigned short libct_vitals2_t::blood_volume
```

Blood volume in mS.

8.29.2.2 timestamp

```
unsigned int libct_vitals2_t::timestamp
```

Time stamp from the device associated with the data.

The documentation for this class was generated from the following file:

- caretaker.h

8.30 libct_vitals_t Class Reference

Vitals data point within the libct_stream_data_t packet.

Data Fields

- bool valid

  The other fields are valid when this field is non-zero (true) and invalid otherwise.
- bool bp_status

  An indicator if a valid blood pressure was found or if the algorithm failed.
- bool map_status

  An indicator of if a valid MAP measurement has been integrated.
- bool hr_status

  An indicator if a valid HR has been determined.
- bool respiration_status

  An indicator if a valid respiration reading was found.
- bool integration_error

  General catchall for integration errors.
- bool differentiation_error

  A discontinuity was detected in the differentiation.
- bool p12_finder_error

  Unable to locate P1 P2 within the pulse.
- bool p3_finder_eError

  Unable to locate P3 within the pulse.
- bool min_index_out_of_range

  The onset of the pulse was not found in the allowable window, so the values are being discarded.
- bool max_index_out_of_range

  The index of the minimum point in the integral was out of range.
- bool slope_out_of_range

  The slope correction of the integrated pulse was out of range.
- short systolic

  Systolic measurement.
- short diastolic

  Diastolic measurement.
- short map

  Mean arterial pressure value.
- short heart_rate

  Heart rate measurement.
- short respiration

  Respiration measurement.
- short as

  AS factor.
- short sqe

  Signal quality estimate (sqe).
- unsigned int timestamp

  Time stamp from the device associated with the data.

8.30.1 Detailed Description

Vitals data point within the libct_stream_data_t packet.

8.30.2 Field Documentation

8.30.2.1 valid

```
bool libct_vitals_t::valid
```

The other fields are valid when this field is non-zero (true) and invalid otherwise.

8.30.2.2 bp_status

```
bool libct_vitals_t::bp_status
```

An indicator if a valid blood pressure was found or if the algorithm failed.

True indicates pulse information is valid.

8.30.2.3 systolic

```
short libct_vitals_t::systolic
```

Systolic measurement.

8.30.2.4 diastolic

```
short libct_vitals_t::diastolic
```

Diastolic measurement.

8.30.2.5 map

```
short libct_vitals_t::map
```

Mean arterial pressure value.

8.30.2.6 heart_rate

```
short libct_vitals_t::heart_rate
```

Heart rate measurement.

8.30.2.7 respiration

```
short libct_vitals_t::respiration
```

Respiration measurement.

8.30.2.8 as

```
short libct_vitals_t::as
```

AS factor.

8.30.2.9 sqe

```
short libct_vitals_t::sqe
```

Signal quality estimate (sqe).

Values are in the range [0, 1000], so the sqe can be expressed relatively as a percentage by dividing by 10, .i.e. sqe/10 %.

8.30.2.10 timestamp

```
unsigned int libct_vitals_t::timestamp
```

Time stamp from the device associated with the data.

The documentation for this class was generated from the following file:

- caretaker.h

8.31 Caretaker::Device::LibraryCallback Class Reference

This is an internal class representing a callback into the unmanaged library code.

8.31.1 Detailed Description

This is an internal class representing a callback into the unmanaged library code.

The documentation for this class was generated from the following file:

- CaretakerDevice.h

8.32 Caretaker::PrimaryVitals Class Reference

Managed class defining the primary vitals measured by the Caretaker.

Data Fields

- Int16 systolic

  Systolic measurement in mmHg.
- Int16 diastolic

  Diastolic measurement in mmHg.
- Int16 map

  Mean arterial pressure in mmHg.
- Int16 heartRate

  Heart rate measurement in beats per minute (bpm).
- Int16 respiration

  Respiration measurement in breaths per minute (BPM).
- Int16 asFactor

  AS factor.
- Int16 signalQualityEstimate

  Signal quality estimate expressed in percentage.
- Int32 timestamp

  Milliseconds time-stamp from the device associated with the data.

8.32.1 Detailed Description

Managed class defining the primary vitals measured by the Caretaker.

8.32.2 Field Documentation

8.32.2.1 systolic

```
Int16 Caretaker::PrimaryVitals::systolic
```

Systolic measurement in mmHg.

8.32.2.2 diastolic

```
Int16 Caretaker::PrimaryVitals::diastolic
```

Diastolic measurement in mmHg.

8.32.2.3 map

```
Int16 Caretaker::PrimaryVitals::map
```

Mean arterial pressure in mmHg.

8.32.2.4 heartRate

```
Int16 Caretaker::PrimaryVitals::heartRate
```

Heart rate measurement in beats per minute (bpm).

8.32.2.5 respiration

```
Int16 Caretaker::PrimaryVitals::respiration
```

Respiration measurement in breaths per minute (BPM).

8.32.2.6 asFactor

```
Int16 Caretaker::PrimaryVitals::asFactor
```

AS factor.

8.32.2.7 signalQualityEstimate

```
Int16 Caretaker::PrimaryVitals::signalQualityEstimate
```

Signal quality estimate expressed in percentage.

Divide by 100 to convert to percentage.

```
displaySQE = MIN(100, vitals.signalQualityEstimate / 100);
displaySQE = MAX(0, displaySQE);
```

8.32.2.8 timestamp

```
Int32 Caretaker::PrimaryVitals::timestamp
```

Milliseconds time-stamp from the device associated with the data.

The documentation for this class was generated from the following file:

- CaretakerDevice.h

8.33 Caretaker::SecondaryVitals Class Reference

Managed class defining the secondary vitals measured by the Caretaker.

Data Fields

- UInt16 bloodVolume

  Blood volume in mS.
- Byte cardiacOutput

  Cardiac output in L/min.
- UInt16 interbeatInterval

  Inter-beat Interval in mS.
- UInt16 lvet

  Left ventricular ejection time.
- Single p2p1Ratio

  P ratio.
- Single hrComp

  hrComp
- Single pr

  pr
- Int32 timestamp

  Milliseconds time-stamp from the device associated with the data.

8.33.1 Detailed Description

Managed class defining the secondary vitals measured by the Caretaker.

Only for internal or research use.

8.33.2 Field Documentation

8.33.2.1 bloodVolume

```
UInt16 Caretaker::SecondaryVitals::bloodVolume
```

Blood volume in mS.

8.33.2.2 timestamp

```
Int32 Caretaker::SecondaryVitals::timestamp
```

Milliseconds time-stamp from the device associated with the data.

The documentation for this class was generated from the following file:

- CaretakerDevice.h

8.34 Caretaker::WaveformDataPoints Class Reference

Pulse waveform data points Each data point is of format (t,v), where t is a monotonically incrementing counter representing time-stamp, and v is the pulse sample at time t.

Public Member Functions

- **WaveformDataPoints** (array< Int32 > ^ values, array< Int32 > ^ timestamps)

Data Fields

- array< Int32 > values
  The waveform v values.
- array< Int32 > timestamps
  The waveform t values.

8.34.1 Detailed Description

Pulse waveform data points Each data point is of format (t,v), where t is a monotonically incrementing counter representing time-stamp, and v is the pulse sample at time t.

The documentation for this class was generated from the following file:

- CaretakerDevice.h