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ANT-FS
Reference Design
User Manual

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Table of Contents

1 Introduction

The ANT File Share (ANT-FS) system specification provides a robust framework for transferring files between two ANT enabled devices. This document describes the PC and embedded reference designs that are provided as part of the ANT-FS developer distribution.

The PC reference designs are useful tools that aid with the development of ANT-FS client and host devices. The PC reference designs make use of the ANT Common Library, a statically linked library that may be compiled directly into Windows, MacOS, and Linux applications. The reference designs provide an example on the usage of the library for the development of ANT-FS applications. Both are distributed as binaries for Windows.

The embedded ANT-FS reference design includes source code that can be compiled directly for use with the MSP430 microcontroller, but may be easily ported to other target architectures due to its modular design.

It is assumed that the reader of this document is familiar with basic ANT concepts, C/C++ programming, and the ANT-FS Technical Specification.

2 Relevant Documents

It is strongly recommended that the reader be familiar with the following documents:

- ANT-FS Technical Specification
- ANT Message Protocol and Usage
- Interfacing with ANT General Purpose Chipsets and Modules

3 ANT-FS PC Reference Designs

The ANT-FS PC reference designs are PC applications that allow the user to test and develop PC host and client ANT-FS devices. The source code for this tool is based on the ANT Common Library files which may be used directly in custom user applications. As such, the ANT-FS PC tools have a dual purpose. First, they serve as development tools that allow the user to test and explore the functionality of ANT-FS. Second, they serve as reference designs showing how to use the library files to develop ANT-FS PC applications.

3.1 ANT Library Files

3.1.1 ANT Common Library

The ANT Common Library (ANT_LIB) is a collection of files and classes that allow full control of an ANT enabled USB stick, including integration of the ANT-FS protocol extension. The entire library is contained within the following three directories:

- **Common:** The *common* directory contains files that provide common functionality, for example checksum (CRC) calculations.
- **Inc:** The *inc* directory contains all relevant include files for creating ANT-FS, or generic ANT, PC applications based on this library.
- **Software**: The *software* directory contains the core functionality of the ANT library. This includes serial drivers, ANT message framing, debugging and threading, and the ANT-FS protocol extension. This directory is further sub-divided into the following four sub-directories:
    - **ANTFS:** contains the files that implement the PC ANT-FS Host and Client classes. Applications with ANT-FS Host and Client functionality interface directly to the ANTFSHost and ANTFSClient classes contained within this directory. The ANTFSHost and ANTFSClient classes interface to lower level serial, framing and threading classes.
    - **Serial:** contains files that handle the serial communication with USB devices. The *Serial* subdirectory also contains the ANT message framing, with all the messages described in the "ANT Message Protocol and Usage" document.
    - **System:** contains functionality for threading, debugging and timing. This functionality has been abstracted such that these services can be used on a variety of OS platforms.
    - **USB:** contains files with handles for USB devices, and provides low level access to the serial drivers. As the ANT Common Library is designed to compile across multiple operating systems, this directory contains files that interface to a virtual com port driver (Mac OS or Linux), libusb driver (PC), iokit driver (Mac OS) and USB Express driver (PC).

For complete documentation of the ANTFSHost and ANTFSClient classes, please refer to the source code. The header files are thoroughly documented with descriptions of each available function.

3.1.2 ANT Managed Library

The ANT Managed Library is a wrapper around the ANT Common Library that allows simplified development of ANT enabled applications using the Microsoft .NET framework. The ANTFS_Host and ANTFS_Client classes in this library expose the ANT-FS functionality in the ANT Common Library to managed applications, while taking care of threading and interoperability with the unmanaged code. For complete documentation of the ANTFS_Host and ANTFS_Client classes, please refer to the source code, and the ANT_NET.xml file.

3.1.3 Architecture Overview

The ANT-FS PC Host tool is a C++/CLI application, interfacing directly to the ANTFSHost class in the ANT Common Library. This class in turn makes use of lower level functionality made available by other library files and classes.

The ANT-FS PC Client tool is a C# application, and interfaces directly to the ANTFS_Client class in the ANT Managed Library. The ANT Managed Library makes use of the ANTFSClient class in the ANT Common library to encapsulate the serial messaging, message framing and threading along with the functionality of an ANT-FS client.

A high level class diagram of the class relationships for this application is depicted in Figure 3-1.

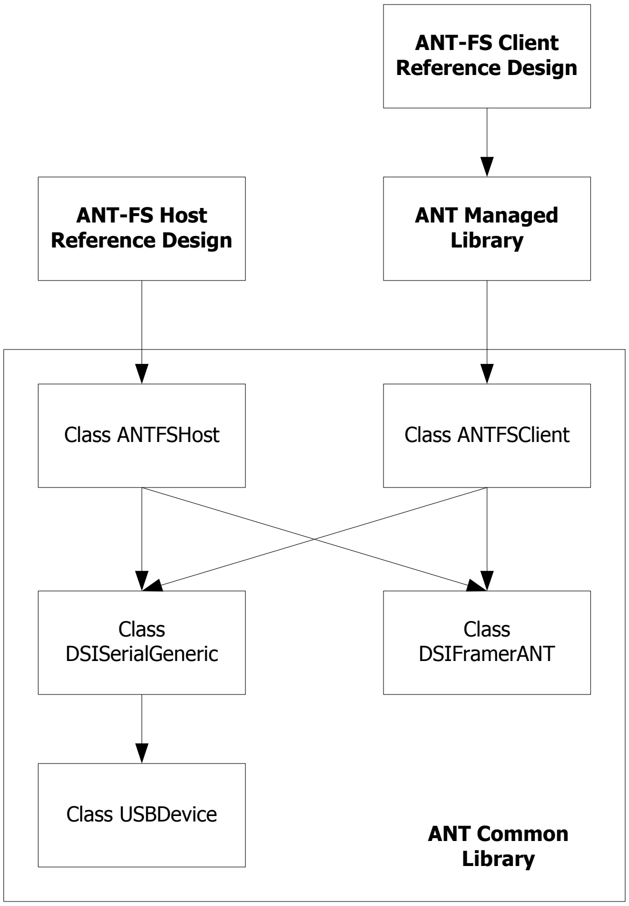


Figure 3-1. Simplified Class Diagram

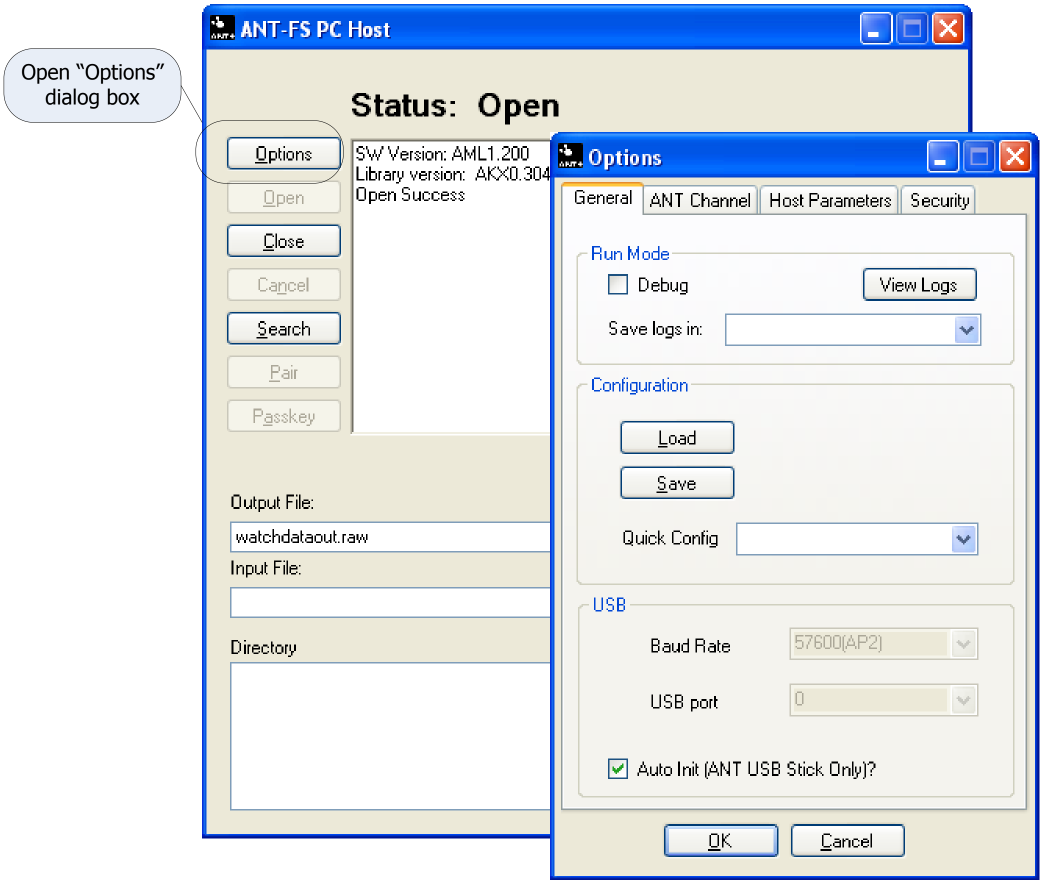
4 ANT-FS PC Host

The ANT-FS PC Host application is a development tool that may be used to exercise almost all of the features of ANT-FS with any ANT-FS enabled Client device. The tool supports all three methods of authentication: pairing, passkey and pass-thru. Also, it allows files to be uploaded or downloaded from a client device, and provides quick configurations to connect to popular ANT-FS devices such as FR-50 or FR-60 watches, as well as other ANT+ devices with file transfer capabilities. However, tool does not do any data decoding or encoding other than optional encryption during a data transfer. Data encoding/decoding is left to the user or other applications.

4.1 Options

The ANT-FS PC Host Development tool allows the user to set several options for a specific ANT-FS implementation. This includes parameters specific to the USB port, the ANT channel and selection of the ANT-FS Client to interface with. On startup, options are loaded from a configuration file called "config.txt" located in the current user's Application Data directory. If this file is missing or corrupt, default options are set. On exit, the application will save its current settings to the "config.txt" file. Furthermore, the application allows the user to save and load configuration files for particular test implementations. More details on this process are provided in later sections.

Options may be viewed and changed by clicking on the "Options" button in the application (Figure 4-1). General options must be changed **prior to** connecting to the USB Stick (Open button), while most other options need to be changed **prior to** beginning the search operation (Search button).



Open "Options" dialog box

Status: Open

SW Version: AML1.200
Library version: AKX0.304
Open Success

Output File: watchdataout.raw
Input File:
Directory

Run Mode
□ Debug
Save logs in:

Quick Config

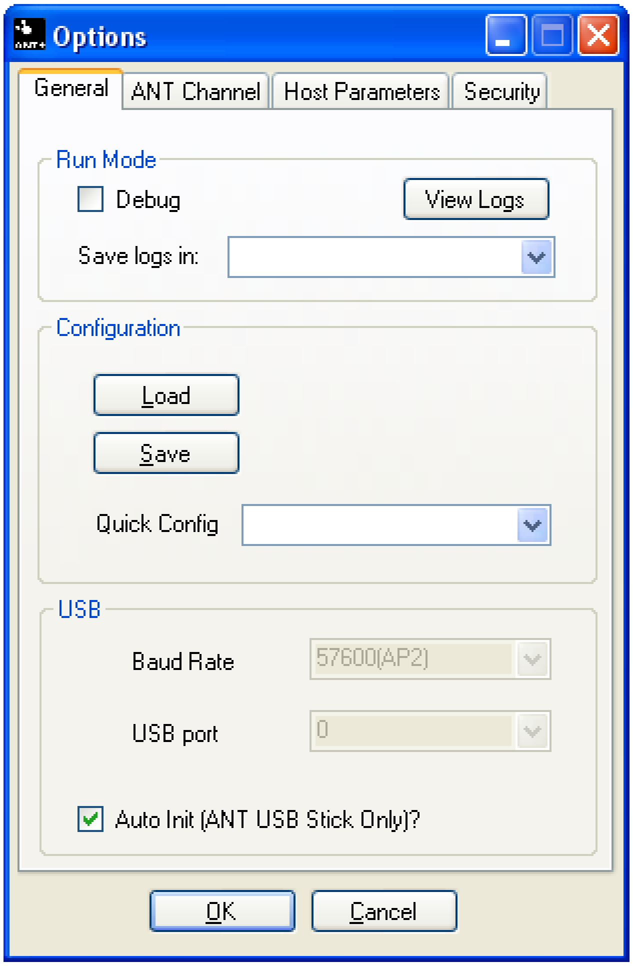
Baud Rate 57600(AP2)
USB port 0
☑ Auto Init (ANT USB Stick Only)?

Figure 4-1. Opening the Options Dialog Box

The options are categorized under four tabs: General, ANT Channel, Client and Security, and are described in the following sections.

4.1.1 General

The "General" tab (Figure 4-2) allows the user to set various options that are not directly applicable to ANT-FS. This includes selecting debug mode and USB port connection settings. It also allows the user to preload and save options from/to a configuration file, or load pre-configured settings for popular ANT-FS devices such as the Garmin FR-60 watch.



□ Debug

Save logs in:

Quick Config

Baud Rate 57600(AP2)

USB port 0

☑ Auto Init (ANT USB Stick Only)?

Figure 4-2. General Options Tab

4.1.1.1 Run Mode

The run mode box is used to specify if the application will run in debug or normal mode. Running the application in debug mode forces the ANT-FS library to generate debug log files as it progresses through an ANT-FS connection, providing useful information for testing and debugging. The debug files generated in the ANT-FS PC Host tool's directory are outlined in Table 4-1.

Table 4-1. Host Log Files

Log File Name	Description
ao_debug_ANTReceive.txt	Log of all ANT channel and protocol events received
ao_debug_ANTFS.txt	Log of ANT-FS events
ao_debug_Application.txt	Log of application initiated events
ao_debug_Timer.txt	Log of timer events
Device0.txt	Log of all communication on the serial port between ANT and the PC.

The Debug mode checkbox MUST be set prior to opening the ANT-FS connection. Log files will not be generated if the Debug mode checkbox is set after opening the connection.

Debug files are stored in the Application Data directory for the current user, for example, for Windows XP:

C:\Documents and Settings\UserName\Application Data\ANTFS_PC_Host\logs

To open the directory containing the logs, click the 'View Logs' button.

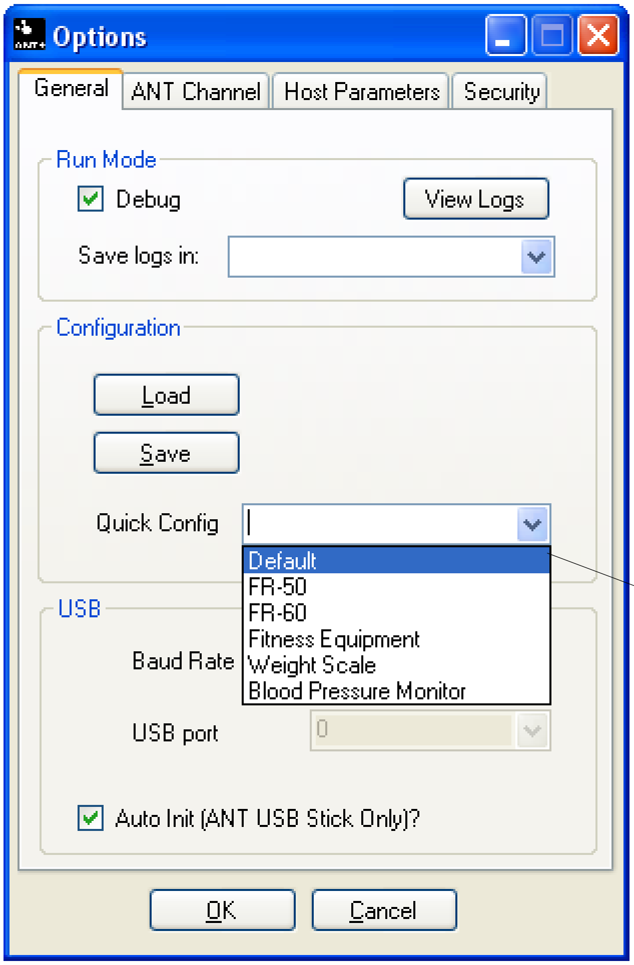
To store the debug files in a different directory, choose the 'Select…' option in the 'Save logs in' pull-down menu, and browse to the desired location. This is particularly useful in selecting different locations for particular debugging sessions. Custom debug file directories are not automatically saved, and must be configured every time the application is started.

4.1.1.2 Configuration

The configuration box allows the user to save the current options to a file, load options from a file, or select a preset configuration from a drop down box.

Click the 'Save' button, to save the current options. A Save File Dialog box will then be opened and the user may specify the desired file name and location. Please note that saving to the "config.txt" file in the base directory will overwrite the default startup configuration. To load options from a previously saved file, click on the 'Load' button and select the desired options file. All options set by the user, including USB port and debug configuration are saved in/loaded from these files.

To select a pre-configured option, select the desired device from the 'Quick Config' drop down box. This will set the ANT Channel options and Client options accordingly to communicate with that device. Using pre-configured options won't affect the USB port or debug settings.



Run Mode

☑ Debug

Save logs in:

Configuration

Quick Config

- Default
- FR-50
- FR-60
- Fitness Equipment
- Weight Scale
- Blood Pressure Monitor

USB

Baud Rate

USB port 0

☑ Auto Init (ANT USB Stick Only)?

Select preset ANT-FS client to connect to

Figure 4-3. Selecting Pre-Configured Options

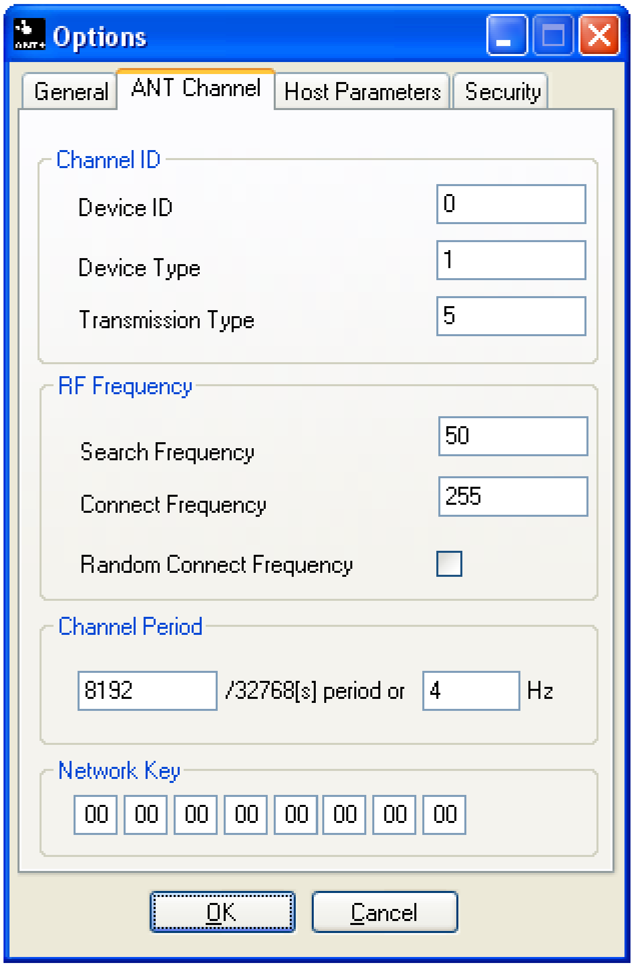
4.1.1.3 USB

The USB box allows the user to select the USB port configuration. The baud rate selected will depend on the ANT chip mounted on the USB stick. The AP1 connects at 50000, and all other ANT solutions connect at 57600. The USB Port drop down menu is used to select the port to which the USB stick is connected. As a general rule, the first USB stick connected to a PC will be assigned port 0, the next port 1 and so on, provided all USB sticks have the same VID/PID. The Auto Init option enables the library to automatically select the baud rate for a USB stick connected to port 0; this feature is only available for ANT USB1 and USB2 sticks (black plastic case). Selecting this option will disable the baud and port options. This option is generally recommended for production level products to alleviate the user from having to select a specific baud rate and USB port number.

If no USB stick is connected, clicking open will not fail. Instead the library will poll the USB periodically until a USB stick is detected.

4.1.2 ANT Channel

The "ANT Channel" tab allows the user to set specific ANT channel parameters. This includes channel ID, search and connect radio frequencies, channel period and network key. All other channel parameters are set by the ANT-FS library. Caution must be exercised when changing the channel parameters as this may interfere with the interoperability of devices.



Channel ID

Device ID: 0

Device Type: 1

Transmission Type: 5

RF Frequency

Search Frequency: 50

Connect Frequency: 255

Random Connect Frequency: □

Channel Period

8192 /32768[s] period or 4 Hz

Network Key

00 00 00 00 00 00 00 00

Figure 4-4. ANT Channel Options Tab

4.1.2.1 Channel ID

The Channel ID refers to the 4 byte ANT channel ID that is comprised of a 2 byte Device ID, 1 byte Device Type and 1 byte Transmission Type.If not searching for a specific, known, channel ID it is recommended that the host wildcards both the Device ID and Transmission Type fields.

4.1.2.2 RF Channel Frequency

There are two RF channel frequencies relevant to ANT-FS. The first is the Search frequency. This is the frequency at which the ANT-FS channel is opened and searches for client devices in the Link Layer. The second radio frequency is the Connect Frequency. This is the frequency at which communication above the Link Layer will occur. The Connect Frequency is set by the host using the LINK command as per the ANT-FS Protocol specification. The Connect Frequency may be explicitly set to a specific, or random, value. If set to a random value, the host library will choose from one of the frequencies listed in Table 4-2.

Table 4-2. RF Channel Frequency Table (in MHz) for Random Link

Random Frequency Values															
2403	2407	2415	2420	2425	2429	2434	2440	2445	2449	2354	2460	2465	2470	2475	2480

Once the frequency is set by the LINK Command, the ANT-FS session will remain at that frequency for the duration of the Authenticate and Transport layers. It is important to implement this level of frequency agility as the Transport Layer requires significant bursting, consuming high bandwidth which may interfere with other ANT-FS devices in the area. Therefore, it is recommended to use the random frequency feature implemented by the ANT Common Library as this will decrease the likelihood of multiple devices within the Transport Layer operating on the same RF channel frequency.

4.1.2.3 Channel Period

The channel period is controlled by the host and does not necessarily need to match that of the client while in the Link layer. The host will set the client's channel period using the Link command. In order to conserve power, the client may be designed to beacon at lower message rates.

The channel period is set as a fraction of a 32kHz counter. For example, to set a 4Hz message rate, the count is:

count = 32768/4 = 8192

Alternatively, the channel period can be configured in Hz. The data will be updated automatically depending on user input.

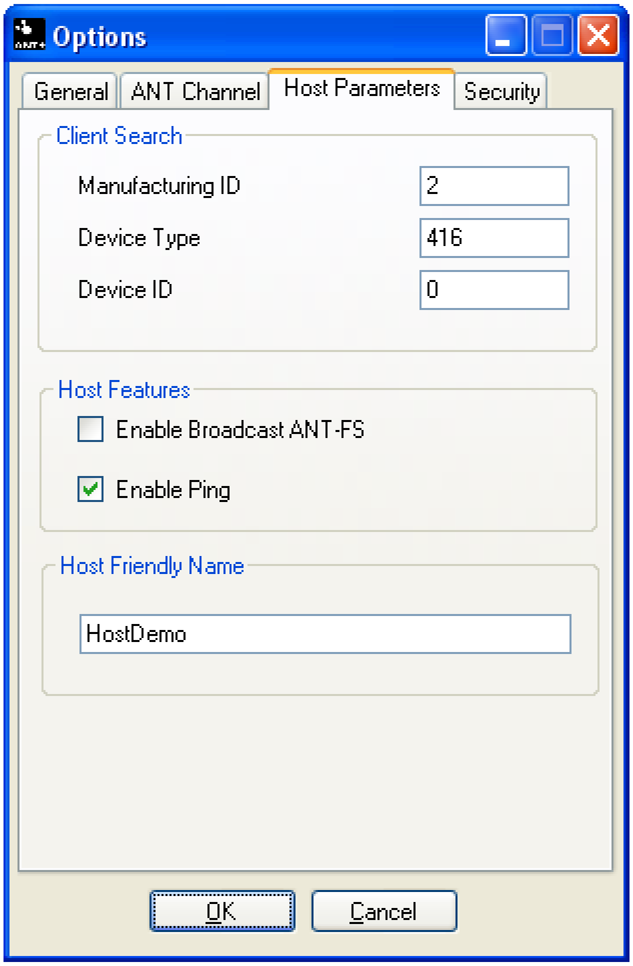
4.1.2.4 Network Key

The network key can be set to a public, managed or private network key. Please contact Dynastream Innovations for information on obtaining network keys.

The network is entered as hex byte pairs, without the leading 0x.

4.1.3 Host Parameters

The "Host Parameters" options tab (Figure 4-5) allows the user to enter details regarding the particular client device that the host wishes to connect to. This includes beacon parameters such as Manufacturing ID and Device Type, as well as the Device ID of a particular device. This tab also provides configuration details for managing ANT-FS sessions.



Client Search

Manufacturing ID: 2

Device Type: 416

Device ID: 0

Host Features

□ Enable Broadcast ANT-FS

☑ Enable Ping

Host Friendly Name

HostDemo

Figure 4-5. Host Parameters Options Tab

4.1.3.1 Client Search

The "Client Search" options tab lets the user specify the identifier of the client that it will search for. The client has a device descriptor consisting of 3 parameters. The Manufacturing ID and Device Type are both 2 byte values that are included in the beacon of the client while it is in Link state. For managed networks, the Manufacturing ID is maintained by Dynastream. Please contact Dynastream for further details.

The Device ID is a 4 byte value that is passed to the host from the client during the Authentication Layer. This value is often derived from the serial number of the device. All three client parameters may be set explicitly or wild carded by setting to 0.

4.1.3.2 Host Features

The 'Host Features' group refers to specific features the host uses to manage ANT-FS sessions.

To allow the host device to discover and request an ANT-FS session from a broadcast device, select the 'Enable Broadcast ANT-FS Search' option. When this option is enabled, the ANT-FS host will find a broadcasting device matching the configured ANT channel parameters, and will automatically request an ANT-FS session..

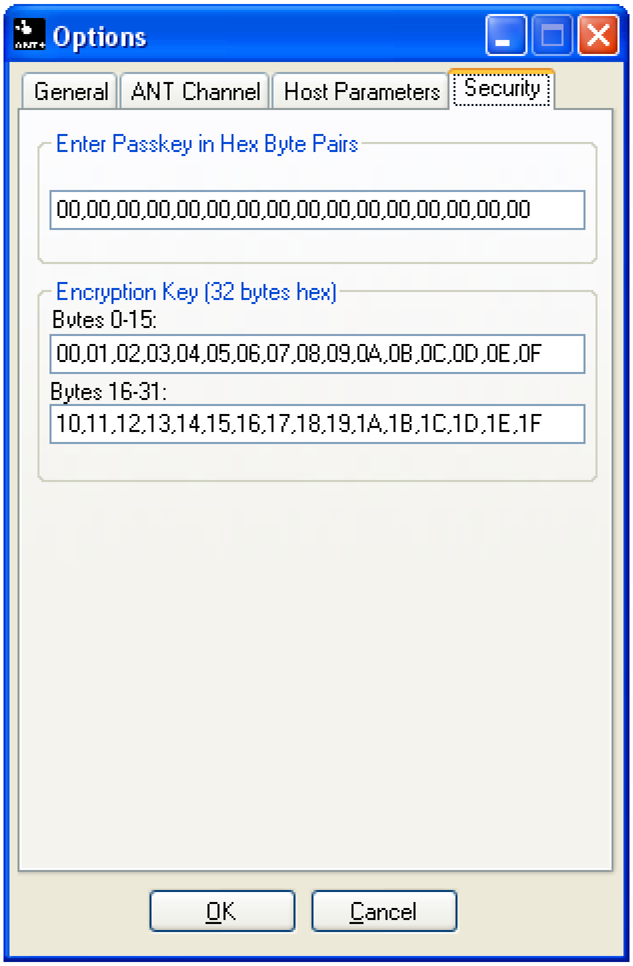
To ensure an ANT-FS session is maintained, select the 'Enable Ping' option. The host will periodically send a Ping message to prevent the client from timing out and returning to the unconnected Link state.

4.1.3.3 Friendly Name

The Friendly Name is a string that the host may pass to the client as part of the Authentication process. The client may display the friendly name to its user before proceeding with a connection. The friendly name may be up to 255 bytes long. This field is optional and may be omitted by setting the text box to blank (i.e. 0 length string).

4.1.4 Security

The 'Security' options tab (Figure 4-6) refers to control settings for the authentication and confidentiality of the ANT-FS session.



Enter Passkey in Hex Byte Pairs

00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00

Encryption Key (32 bytes hex)

Bytes 0-15:

00,01,02,03,04,05,06,07,08,09,0A,0B,0C,0D,0E,0F

Bytes 16-31:

10,11,12,13,14,15,16,17,18,19,1A,1B,1C,1D,1E,1F

Figure 4-6. Security Options Tab

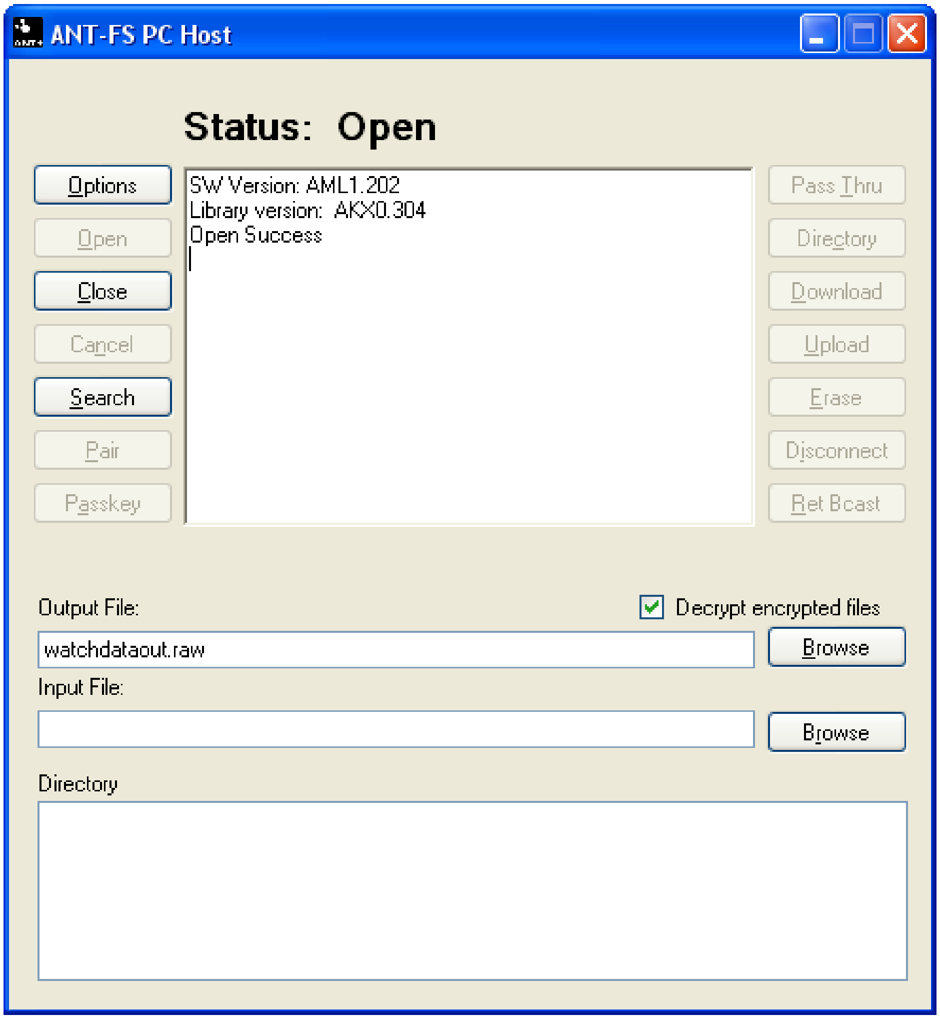
4.1.4.1 Passkey

The passkey is used to authenticate the client device using the passkey method of authentication. If it is known, the user may enter the passkey explicitly.

The passkey is also sent to the client as part of the pairing process. As such, if the passkey has been obtained during pairing, it will be displayed here, and made available for future use. The passkey may be up to 255 bytes long, and should be entered as ASCII hex byte values (without the 0x) and separated by a comma as shown in Figure 4-6.

4.1.4.2 Encryption Key

The encryption key is used to encrypt and decrypt transmitted data. If a file is marked with the Crypto flag, the file will be encrypted when it is uploaded and downloaded from a client device. Files will be decrypted before they are stored on the file system if the 'Debug encrypted files' checkbox on the main window is selected, as shown in Figure 4-7. The encryption key is a 32 byte value, and should be entered as ASCII hex byte values (without 0x) and separated by a comma as shown in Figure 4-6.



Status: Open

```
SW Version: AML1.202
Library version:  AKX0.304
Open Success
```

Output File: watchdataout.raw

☑ Decrypt encrypted files

Input File:

Directory

Figure 4-7. Main Window

4.2 General Operation

The ANT-FS PC Host Tool is designed such that each ANT-FS layer can be stepped through with each appropriate button press. Care must be taken to ensure that timeouts are not exceeded while stepping through the layers. Buttons are only enabled if the host is in a state that is appropriate for a particular action. For example, the Pair button will not be enabled unless the host is in the Authentication Layer. The current status of the application is displayed in the Status label at the top of the main window, as depicted in Figure 4-7.

4.2.1 Open

The first step is to open and connect to the ANT USB stick. Pressing the 'Open' button will initialize the ANT library and connect to the USB stick at the specified baud rate and USB Port. The host will attempt to connect to the first available USB stick, polling the USB ports until one is found. The USB port parameters are set in the Options dialog box as described in Section 4.1.1.3. The status text will show "Idle polling USB" while attempting to connect to a USB stick, and "Open" when it is connected to a USB stick.

4.2.2 Close

The 'Close' button will destroy all ANT-FS library threads, and close the connection to the USB stick. It will also destroy any memory that was allocated to downloaded or uploaded files. Any transactions that were in progress will be aborted immediately, which should force the client to timeout and return to the unconnected Link Layer.

4.2.3 Cancel

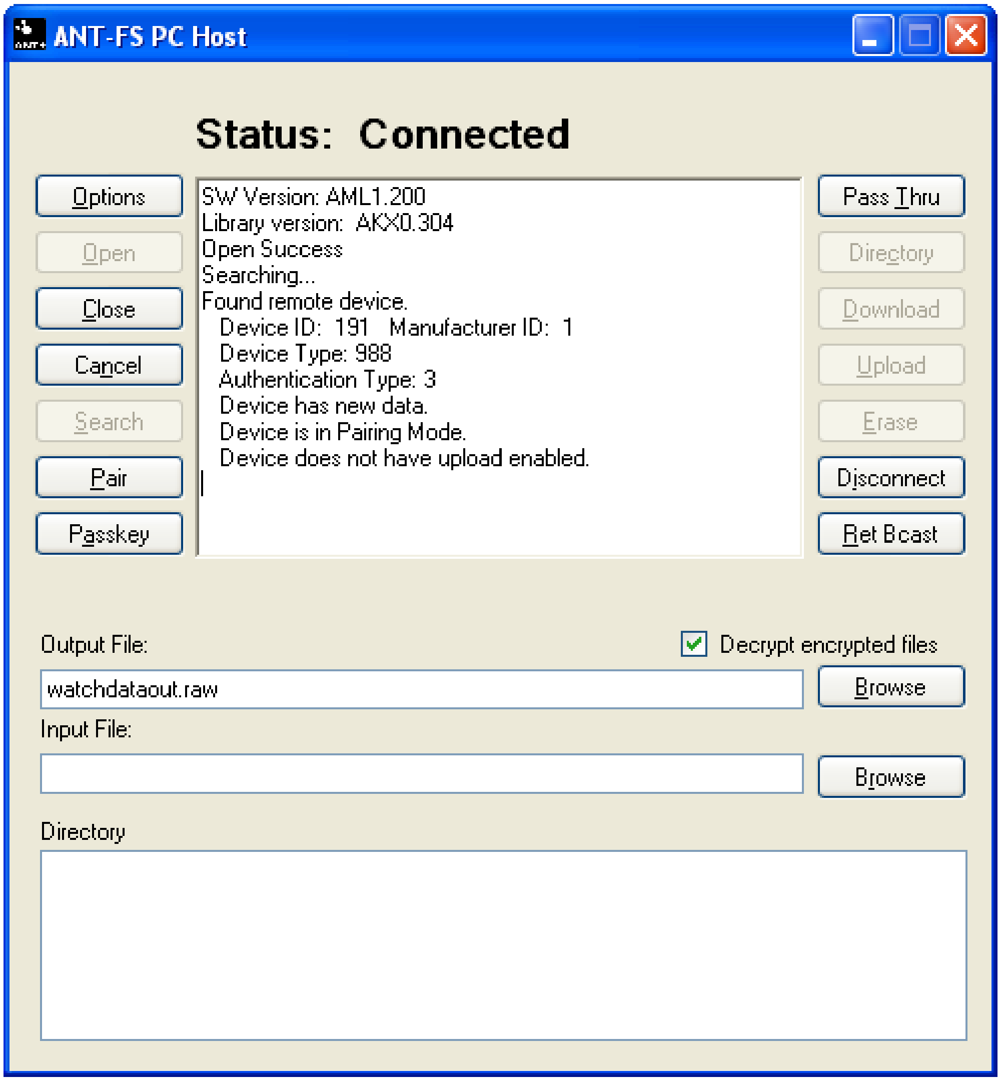
Pressing 'Cancel' will abort the current ANT-FS operation and return to the layer prior to the cancelled operation. If Cancel is pressed while the host is connected to a client but no operations are taking place, the host will disconnect from the client, returning to the Link Layer.

4.2.4 Search and Connect

Pressing the 'Search' button will set the host ANT channel's network key, channel period, channel ID and then open the channel; initiating the search for the specified client, at the designated frequency. Once a matching client is found, the host will send a Link command to the client, specifying the Connect RF channel frequency and channel period.

The host will then wait until the client beacon is detected at the new frequency indicating that it has progressed to the Authentication state. Once in the Authentication Layer, the host will request the serial number of the device by sending the AUTH command with Auth type set to 0 (serial number request). If the request was successful, the host will acquire the serial number (Device ID) of the client. If a Device ID was configured in the 'Client' options tab, the host will only proceed if the IDs match. The host is now connected to the client and will progress to the Authentication state. If any step in this sequence fails, the host will return to the Link Layer searching state.

Figure 4-8 shows a successful search for a Garmin FR-60 client device. Note that the client parameters, including beacon contents, are listed in the text box of the application window. The status of the host is reflected in the Status label on top of the text box.



Status: Connected

```
SW Version: AML1.200
Library version:  AKX0.304
Open Success
Searching...
Found remote device.
   Device ID:  191   Manufacturer ID:  1
   Device Type: 988
   Authentication Type: 3
   Device has new data.
   Device is in Pairing Mode.
   Device does not have upload enabled.
```

Output File: watchdataout.raw

☑ Decrypt encrypted files

Input File:

Directory

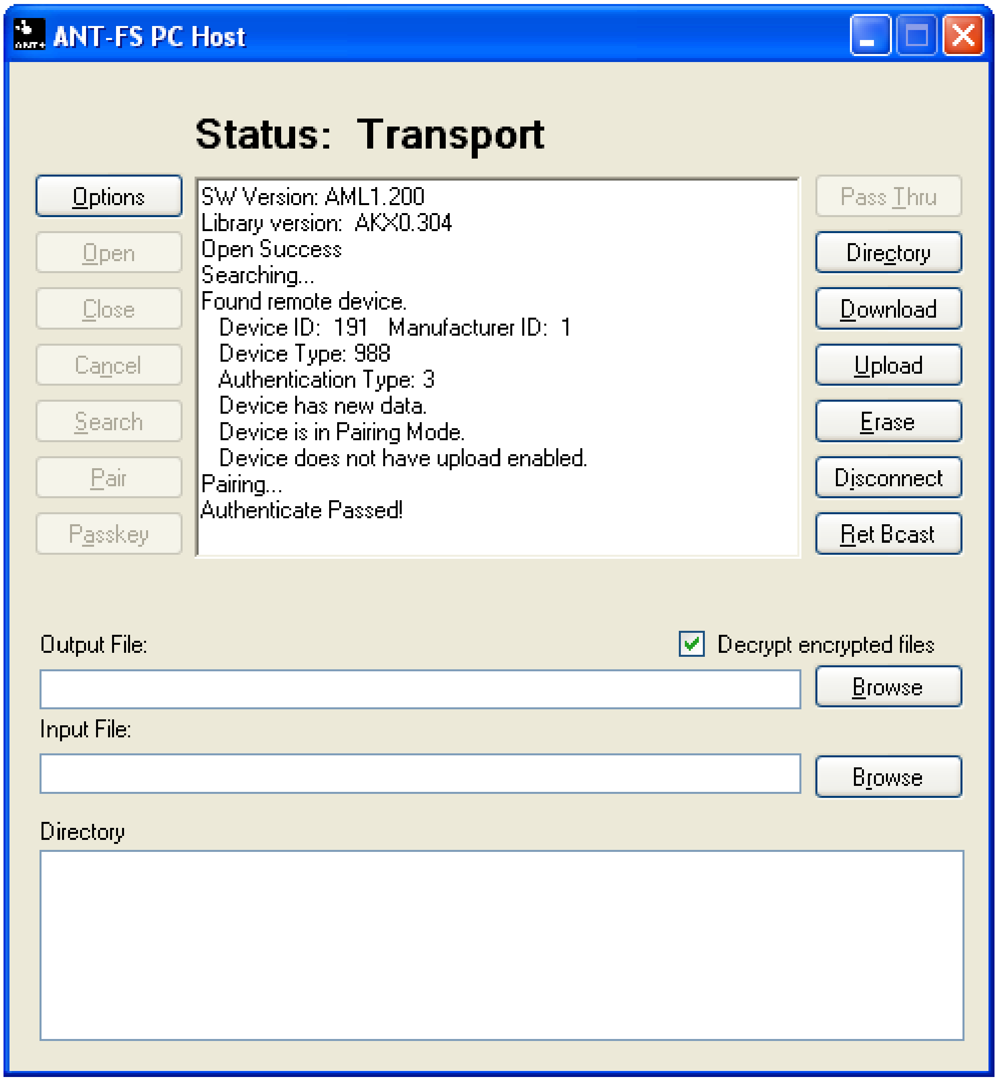
Figure 4-8. Successful Search and Connect to a Client Device

4.2.5 Authentication

Once both client and host devices have successfully exchanged Link commands/responses, they will be in the Authentication state. The ANT-FS PC Host application supports three methods of authentication: pairing, passkey and pass-thru, as described earlier.

4.2.5.1 Pair

The user may pair to the client device by pressing the 'Pair' button. The host will send a pairing request to the client, which the client may accept or reject. Figure 4-9 shows the ANT-FS Host after completing a successful pairing request. If the request is accepted, the client may also send a passkey to the host which can be used for future passkey authentication. Please note that this operation will overwrite whatever passkey was previously set in the options dialog.



```
SW Version: AML1.200
Library version:  AKX0.304
Open Success
Searching...
Found remote device.
   Device ID:  191   Manufacturer ID:  1
   Device Type: 988
   Authentication Type: 3
   Device has new data.
   Device is in Pairing Mode.
   Device does not have upload enabled.
Pairing...
Authenticate Passed!
```

☑ Decrypt encrypted files

Figure 4-9. Pairing Accepted by Client

4.2.5.2 Passkey

If the passkey for a client is known, then the passkey method of authentication may be used. If the passkey matches that of the client, authentication will pass; however, if the passkey does not match, the client will reject the request and the host will return to the unconnected Link state. The passkey may be entered directly via the Options dialog, or acquired as part of the pairing process.

4.2.5.3 Pass Thru

If supported by the client, pass-thru authentication may also be used. In this mode the host simply asks the client to move to the Transport Layer, without requesting permission or providing passkey data.

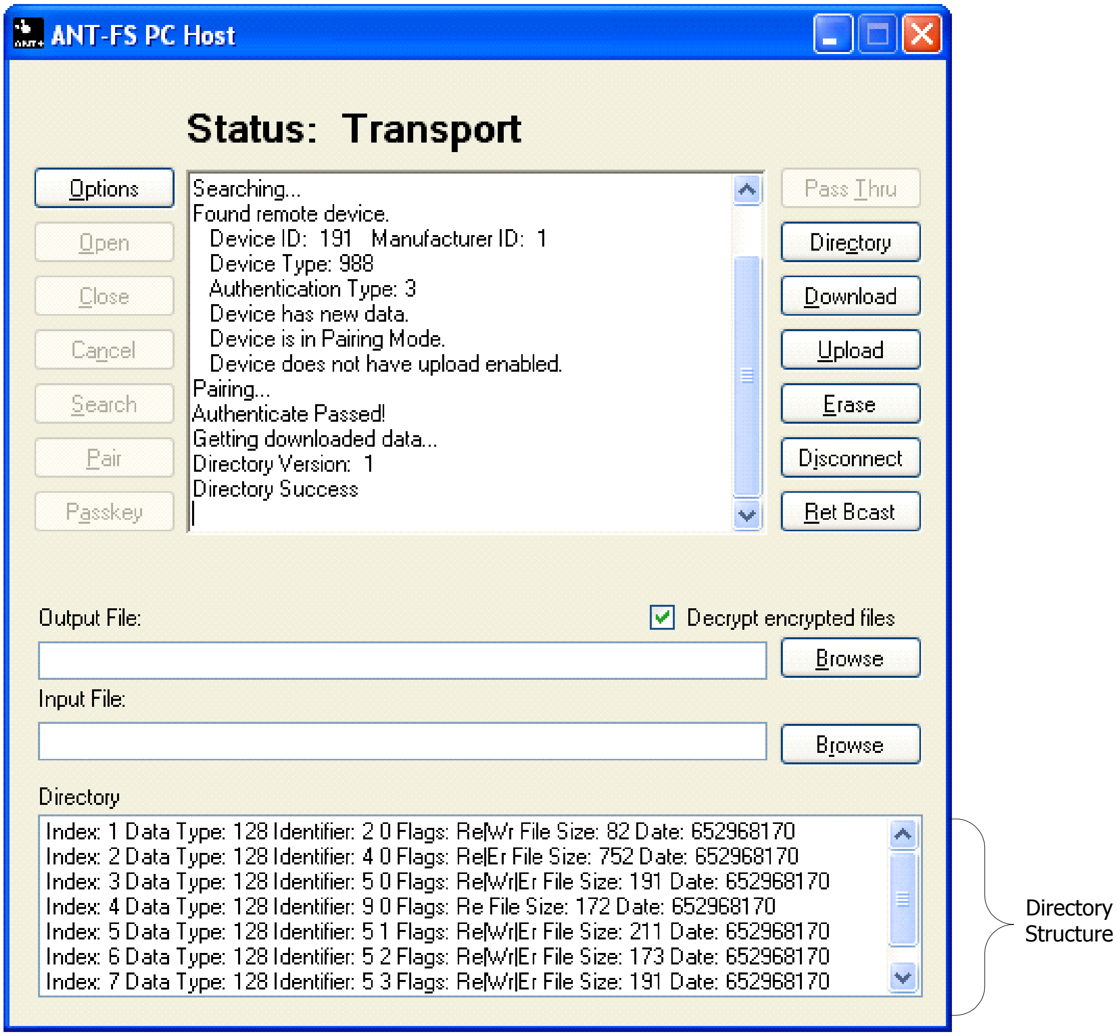
If authentication is successful, both the Client and the host will move to the Transport Layer.

4.2.6 Transport

Once in the transport layer, the user may upload, download and erase files on the client device. It is recommended that the host request the client's directory structure before doing any other operations. The directory structure is a special file located at index 0 that describes the file contents of the client device. Please note that some devices may not implement the directory structure. For example, the FR-50 is a single file device and does not have a directory structure; instead, it stores a single file at location 0.

4.2.6.1 Directory

Pressing the 'Directory' button prompts the host to request the file located at file index 0 on the client device. The application will interpret this downloaded file to be a directory structure and display the contents in the lower text box titled "Directory". If the client device is a known single file device, this button should not be used. It is recommended that ALL new client devices implement a directory structure, and that the host request the directory prior to any other Transport Layer commands. Figure 4-10 shows an example directory structure downloaded from an ANT-FS PC Client.



```
Searching...
Found remote device.
   Device ID:  191   Manufacturer ID:  1
   Device Type: 988
   Authentication Type: 3
   Device has new data.
   Device is in Pairing Mode.
   Device does not have upload enabled.
Pairing...
Authenticate Passed!
Getting downloaded data...
Directory Version:  1
Directory Success
```

```
Index: 1 Data Type: 128 Identifier: 2 0 Flags: Re|Wr File Size: 82 Date: 652968170
Index: 2 Data Type: 128 Identifier: 4 0 Flags: Re|Er File Size: 752 Date: 652968170
Index: 3 Data Type: 128 Identifier: 5 0 Flags: Re|Wr|Er File Size: 191 Date: 652968170
Index: 4 Data Type: 128 Identifier: 9 0 Flags: Re File Size: 172 Date: 652968170
Index: 5 Data Type: 128 Identifier: 5 1 Flags: Re|Wr|Er File Size: 211 Date: 652968170
Index: 6 Data Type: 128 Identifier: 5 2 Flags: Re|Wr|Er File Size: 173 Date: 652968170
Index: 7 Data Type: 128 Identifier: 5 3 Flags: Re|Wr|Er File Size: 191 Date: 652968170
```

Figure 4-10. Downloaded Directory Structure

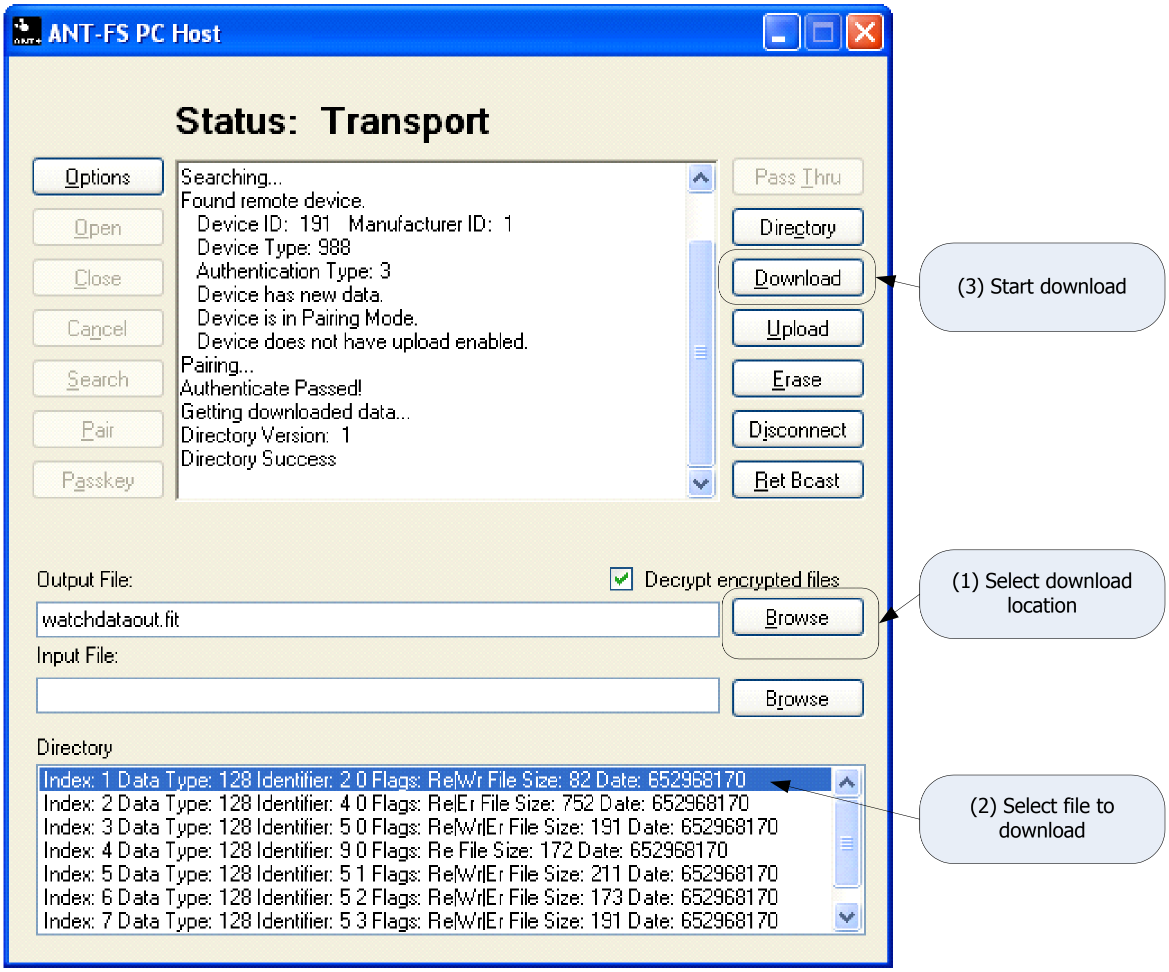
Refer to the ANT-FS Technical Specification for details of the directory structure.

4.2.6.2 Download

Downloading a file requires three steps. First, the user must select a file name and location on the hard drive to which downloaded client data is stored. The user may set the file name in the "Output File:" text box or using the browse button to the right of the text box. The Browse button also opens a dialog box that will allow the user to change the file location.

Secondly, the user shall specify the file index of the data to download from the client. This is done by selecting one of the files listed in the directory structure. . The selected file location must exist and be readable (Re flag), otherwise the download will fail.

Finally, to start the download process, click the 'Download' button, OR double click the selected file in the directory structure, as shown in Figure 4-11. Once downloading commences, the status will be displayed in the status box at the top of the application.



Status: Transport

```
Searching...
Found remote device.
   Device ID:  191   Manufacturer ID:  1
   Device Type: 988
   Authentication Type: 3
   Device has new data.
   Device is in Pairing Mode.
   Device does not have upload enabled.
Pairing...
Authenticate Passed!
Getting downloaded data...
Directory Version:  1
Directory Success
```

Output File: watchdataout.fit

☑ Decrypt encrypted files

Input File:

Directory

```
Index: 1 Data Type: 128 Identifier: 2 0 Flags: Re|Wr File Size: 82 Date: 652968170
Index: 2 Data Type: 128 Identifier: 4 0 Flags: Re|Er File Size: 752 Date: 652968170
Index: 3 Data Type: 128 Identifier: 5 0 Flags: Re|Wr|Er File Size: 191 Date: 652968170
Index: 4 Data Type: 128 Identifier: 9 0 Flags: Re File Size: 172 Date: 652968170
Index: 5 Data Type: 128 Identifier: 5 1 Flags: Re|Wr|Er File Size: 211 Date: 652968170
Index: 6 Data Type: 128 Identifier: 5 2 Flags: Re|Wr|Er File Size: 173 Date: 652968170
Index: 7 Data Type: 128 Identifier: 5 3 Flags: Re|Wr|Er File Size: 191 Date: 652968170
```

(3) Start download

(1) Select download location

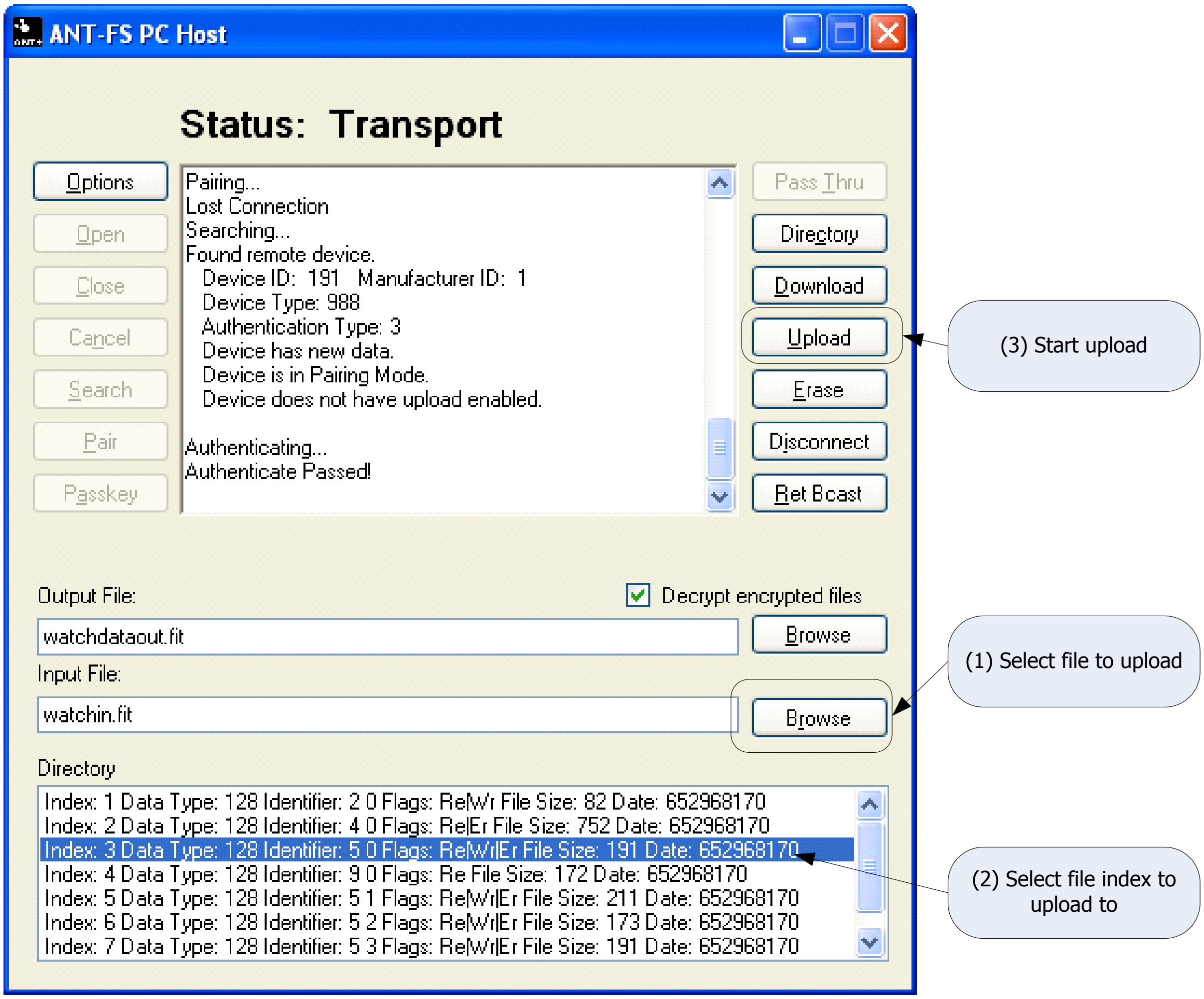
(2) Select file to download

Figure 4-11. Starting Download from Client

If the directory was not downloaded (for example if the client is a single file device), pressing the download button will force a download of the file from index 0. In other words, if no file is explicitly specified by selecting from the directory structure, clicking download will try to download data from file index 0. This is the only method to download data from an FR-50 watch.

4.2.6.3 Upload

Uploading a file is very similar to downloading a file. The first step is to download the directory structure from the client device. Next, select a file to upload in the Input File text box. This file may be of any size and content, provided that it is supported by the client device. Once a file is selected, a file location (or index) must be selected in the directory structure. The selected file location must exist and be writeable (Wr flag), otherwise the upload will fail. Finally, pressing the 'Upload' button will commence the file upload. The process for a successful file transfer is illustrated in Figure 4-12.



Status: Transport

```
Pairing...
Lost Connection
Searching...
Found remote device.
  Device ID: 191  Manufacturer ID: 1
  Device Type: 988
  Authentication Type: 3
  Device has new data.
  Device is in Pairing Mode.
  Device does not have upload enabled.

Authenticating...
Authenticate Passed!
```

Output File: watchdataout.fit

☑ Decrypt encrypted files

Input File: watchin.fit

Directory

```
Index: 1 Data Type: 128 Identifier: 2 0 Flags: Re|Wr File Size: 82 Date: 652968170
Index: 2 Data Type: 128 Identifier: 4 0 Flags: Re|Er File Size: 752 Date: 652968170
Index: 3 Data Type: 128 Identifier: 5 0 Flags: Re|Wr|Er File Size: 191 Date: 652968170
Index: 4 Data Type: 128 Identifier: 9 0 Flags: Re File Size: 172 Date: 652968170
Index: 5 Data Type: 128 Identifier: 5 1 Flags: Re|Wr|Er File Size: 211 Date: 652968170
Index: 6 Data Type: 128 Identifier: 5 2 Flags: Re|Wr|Er File Size: 173 Date: 652968170
Index: 7 Data Type: 128 Identifier: 5 3 Flags: Re|Wr|Er File Size: 191 Date: 652968170
```

(3) Start upload

(1) Select file to upload

(2) Select file index to upload to

Figure 4-12. Uploading a file to the Client Device

Uploading files to a single file client device is not supported by this reference design.

An easy way to test uploads is to first download a file from the client, and then try to upload the same file back.

4.2.7 Erase.

To erase a file from the client device, the user must select a file from the directory structure and click erase. The host will send a request to the client to erase the selected file. The selected file location must exist and be eraseable (Er flag), otherwise the erase operation will fail.

4.2.8 Disconnecting

The host may disconnect from the client at any time. To disconnect from the client device simply press the ‘Disconnect’ button while in any layer. Disconnect will put the client and the host back into the Link Layer. It does not disconnect the application from the USB stick.

4.2.9 Return to Broadcast

The host may disconnect from a client that supports Broadcast ANT-FS, and request it to return to its broadcast state instead of Link. To instruct a client to return to broadcast, press the ‘Ret Bcast’ button while in any layer. This will put the client back into broadcast mode, if it supports this feature, or into the Link layer. In this particular implementation, the host will return to the Link layer.

5 ANT-FS PC Client

The ANT-FS PC Client application is a development tool that may be used to demonstrate almost all ANT-FS client features with any ANT-FS enabled host device. The tool supports all three methods of authentication: pairing, passkey and pass-thru. It allows configuration of a directory, associated with data in the file system, and downloading files to a host device. Upload functionality is not currently supported. The client tool also provides quick configurations to beacon as preset ANT-FS devices, such as fitness watches or other ANT+ file based devices. The tool does not perform any decoding or encoding of data, other than optional encryption during data transfer.

5.1 Options

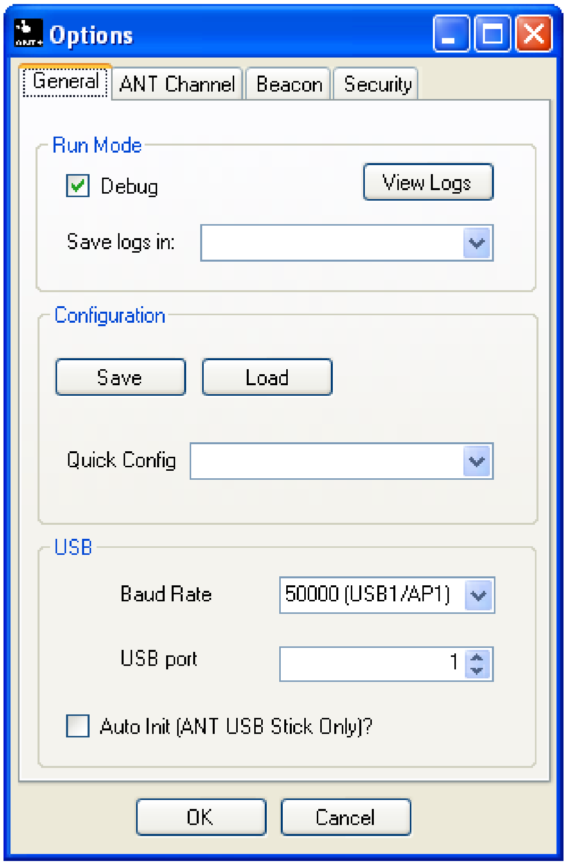
The ANT-FS PC Client Development tool allows the user to set several options for a specific ANT-FS implementation. This includes parameters specific to the USB port, the ANT channel and selection of the beacon configuration. On startup, options are loaded from a configuration file called "ClientConfig.txt" located in the current user's Application Data directory. If this file is missing or corrupt, default options are set. On exit, the application will save its current settings to the "ClientConfig.txt" file. Furthermore, the application allows the user to save and load configuration files for particular test implementations. More details on this process are provided in later sections.

Options may be viewed and changed by clicking on the "Options" button in the application. General options must be changed **prior to** connecting to the USB Stick (Open button), while most other options need to be changed **prior to** opening the beacon (Open Beacon button).

The options are categorized under four tabs: General, ANT Channel, Beacon and Security, and are described in the following sections.

5.1.1 General

The "General" tab (Figure 5-1) allows the user to set various options that are not directly applicable to ANT-FS. This includes selecting debug mode and USB port connection settings. It also allows the user to preload and save options from/to a configuration file, or load preset configurations.



☑ Debug

Save logs in:

Quick Config

Baud Rate 50000 (USB1/AP1)

USB port 1

□ Auto Init (ANT USB Stick Only)?

Figure 5-1. General Options Tab

5.1.1.1 Run Mode

When running in debug mode, the ANT-FS library will generate debug log files during the ANT-FS session. This provides useful information for testing and debugging ANT-FS connections, on both client and host sides. Debug files generated in the ANT-FS PC Client tool's directory are outlined in Table 5-1.

Table 5-1. Client Log Files

Log File Name	Description
ao_debug_ClientANTReceive.txt	A log of all ANT channel and protocol events received
ao_debug_ANTFSClient.txt	A log of ANT-FS events
ao_debug_ClientApplication.txt	A log of application initiated events
ao_debug_ClientTimer.txt	A log of timer events
Device0.txt	A log of all communication on the serial port between ANT and the PC.

Debug mode MUST be set prior to opening the ANT-FS connection. Checking the Debug box after opening the connection will have no effect.

The debug files are stored in the Application Data directory for the current user, for example:

C:\Documents and Settings\UserName\Application Data\ANTFS_PC_Client\logs

To open the directory containing the logs, click the 'View Logs' button.

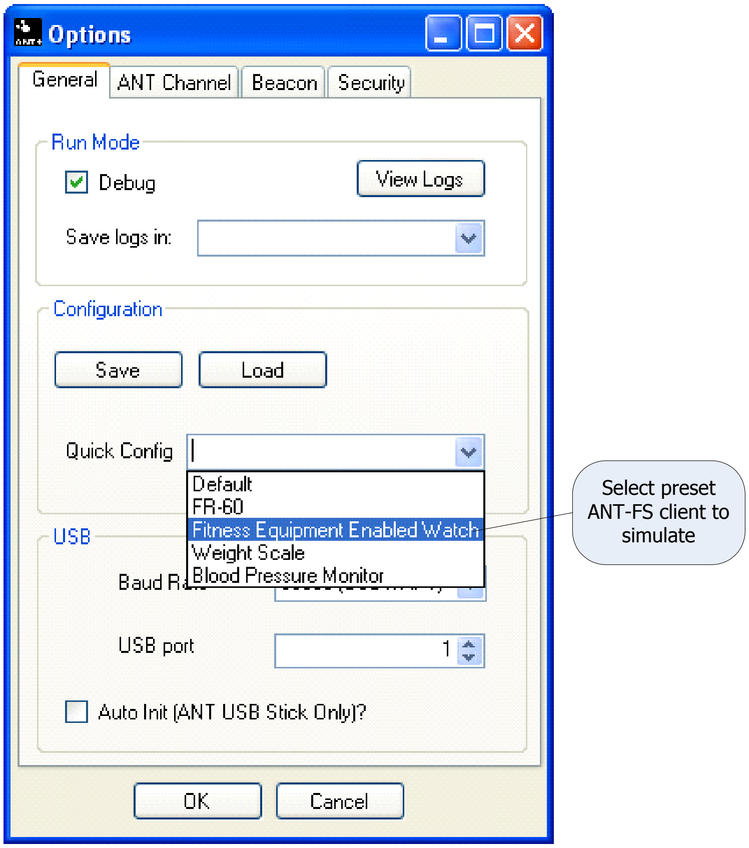
To store the debug files in an alternate location, select the 'Select…' option in the 'Save logs in' pull-down menu, and browse to the desired location. This is particularly useful to select a different location for a particular debugging session. Custom debug file directories are stored in the configuration.

5.1.1.2 Configuration

The Configuration box allows the user to save current options to a file, load options from a file, or select a preset from a drop down box.

To save the current options, click 'Save'. This will open a Save File Dialog box where the user can specify the desired file location and name. Please note that saving to the "ClientConfig.txt" file in the Application Data directory will overwrite the default startup configuration. To load options from a previously saved file, simply click on the 'Load' button and select the desired options file. All options set by the user, including USB port and debug configuration are saved in/loaded from these files.

To select a pre-configured option, select the desired device from the 'Quick Config' drop down box. This will set the ANT Channel options and beacon parameters corresponding to the device to simulate. Using pre-configured options won't affect the USB port or debug settings. For successful communication between the PC Host and Client tools, select the same preset for both devices.



☑ Debug

Save logs in:

Quick Config
- Default
- FR-60
- Fitness Equipment Enabled Watch
- Weight Scale
- Blood Pressure Monitor

USB port 1

□ Auto Init (ANT USB Stick Only)?

Select preset ANT-FS client to simulate

Figure 5-2. Client Preset Configurations

5.1.1.3 USB

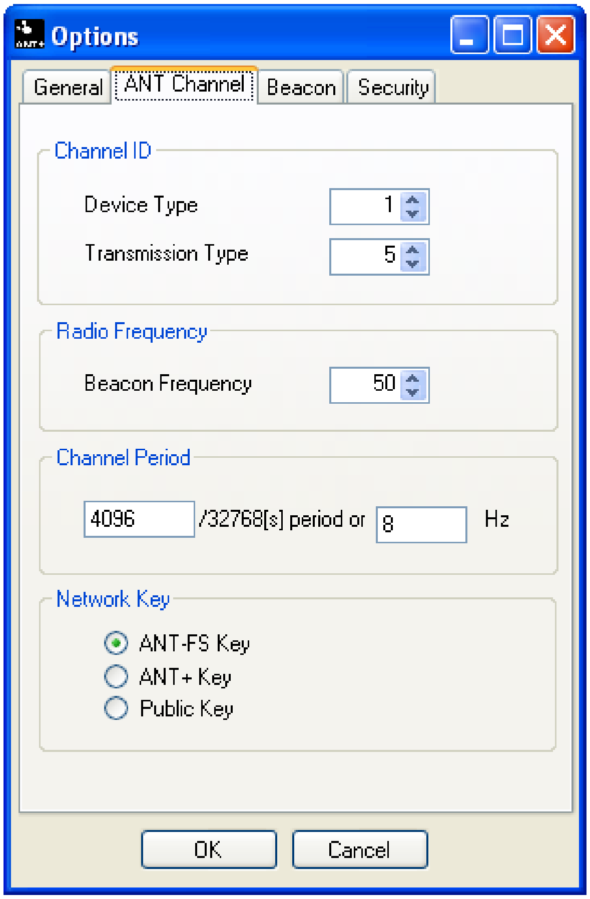
The USB group box allows the user to select the USB port configuration. The baud rate selected will depend on the ANT chip mounted on the USB stick (AP1 connects at 50000, all other solutions at 57600). The USB Port selects the port the USB stick is connected to. As a general rule, the first USB stick plugged into the PC will be assigned port 0, the next port 1 and so on, provided all USB sticks have the same

VID/PID. The Auto Init option enables the library to automatically select the baud rate for a USB stick connected to port 0; this feature is only available for ANT USB1 and USB2 sticks (black plastic case). Selecting this option will disable the baud and port options. This option is generally recommended for production level products to alleviate the user from having to select a specific baud rate and USB port number.

If no USB stick is plugged in, clicking open will not fail. Instead the library will poll the USB periodically until a USB stick is detected.

5.1.2 ANT Channel

The "ANT Channel" tab allows the user to set the ANT channel specific parameters. This includes channel ID, beacon RF channel frequency, channel period and network key. All other channel parameters are set by the ANT-FS library. Caution must be exercised when changing the channel parameters as this may interfere with the interoperability of devices.



Channel ID

Device Type 1

Transmission Type 5

Radio Frequency

Beacon Frequency 50

Channel Period

4096 /32768[s] period or 8 Hz

Network Key

● ANT-FS Key
○ ANT+ Key
○ Public Key

Figure 5-3. ANT Channel Options Tab

5.1.2.1 Channel ID

Channel ID refers to the 4 byte ANT channel ID (2 byte Device ID, 1 byte Device Type and 1 byte Transmission Type). The Device ID is derived from the lower two bytes of the client serial number (Beacon tab), so it is only necessary to configure the Device Type and Transmission Type. No wildcards (0) are allowed on the client device.

5.1.2.2 Radio Frequency

The beacon frequency is the frequency at which the ANT-FS channel is open, where the client advertises its presence through the beacon in the Link Layer. The ANT-FS specification sets this number at 2450MHz, while most ANT+ devices operate at 2457MHz.

5.1.2.3 Channel Period

This box represents the channel period of the client device while in the Link Layer. The channel period is set as a fraction of a 32kHz counter. For example, to set a 4Hz message rate, the count is:

count = 32768/4 = 8192

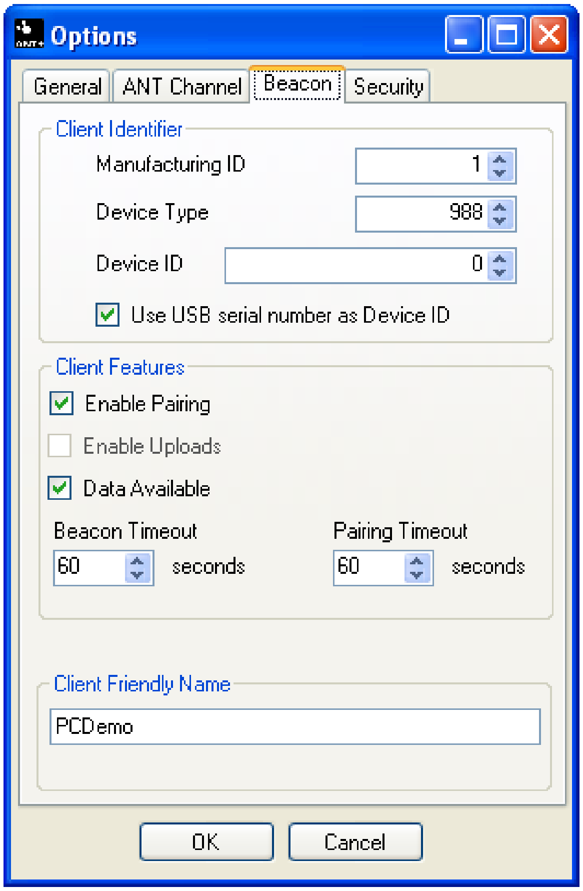
Alternatively, the channel period can be configured in Hz. The input boxes will be updated automatically depending on user input.

5.1.2.4 Network Key

The network key can be set to the ANT-FS, ANT+ or public key. Most ANT+ file based profiles specify the use of the ANT+ key.

5.1.3 Beacon

The 'Beacon' tab (Figure 5-4) includes configuration options for the ANT-FS client beacon. This includes device identifier parameters, such as the Manufacturing ID and Device Type, as well as the Device ID. This tab also provides configuration parameters for the capabilities of the client device, and allows the user to specify an optional friendly name.



Client Identifier

Manufacturing ID 1

Device Type 988

Device ID 0

☑ Use USB serial number as Device ID

Client Features

☑ Enable Pairing

☐ Enable Uploads

☑ Data Available

Beacon Timeout 60 seconds

Pairing Timeout 60 seconds

Client Friendly Name

PCDemo

Figure 5-4. Beacon Options Tab

5.1.3.1 Client Identifier

The client is identified with 3 parameters: manufacturing ID, Device Type and Device ID. The Manufacturing ID and Device Type are both 2 byte values that are included in the client's beacon while in the Link state. For managed networks, the Manufacturing ID is maintained by Dynastream. Please contact Dynastream for further details.

The Device ID is a 4 byte value that identifies a particular device, and can be sent to the host during the Authentication Layer, upon request. The Manufacturing ID and Device Type must not be set to zero – wildcards are not allowed on the client device.

To automatically set the serial number of the USB device as the client Device ID, select the option 'Use USB serial number as Device ID' or set the Device ID to 0.

5.1.3.2 Client Features

The 'Client Features' group refers to options related to the capabilities of the client device. To allow the pairing authentication method, select the 'Enable Pairing' checkbox. If this option is selected, the client will indicate in its beacon that pairing is supported, and that it will process pairing authentication requests. If this option is not selected, pairing authentication requests will automatically be rejected.

To enable uploads in the client device, select the 'Enable Uploads' checkbox. Note, uploads are not currently supported in this tool.

To indicate data availability in the client's beacon, select the 'Data Available' option. This allows a host device to determine whether a connection is desired.

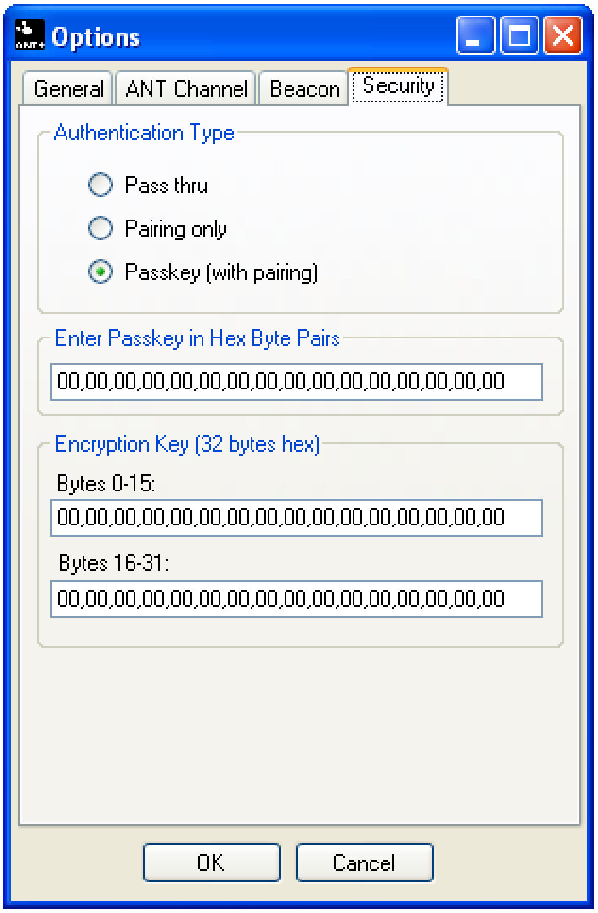
There are two timeouts that are relevant to an ANT-FS Session: beacon and pairing timeouts. The 'Beacon Timeout' is the duration a client will wait without receiving any commands from the host before returning to the Link Layer. The 'Pairing Timeout' is the time a client will wait for a user to respond to a pairing request. If no response is received within the pairing timeout, the request will be rejected. To set the timeouts for an ANT-FS session, specify the beacon and pairing timeout values in seconds. For an infinite timeout (i.e. session never times out) set to 255.

5.1.3.3 Client Friendly Name

The friendly name is a string that the client may optionally pass to the host as part of the authentication process. The host can use the friendly name to display to the user before proceeding with a connection. The friendly name may be up to 255 bytes long. This field is optional and may be omitted by setting the text box to blank (or 0 length string).

5.1.4 Security

The 'Security' options tab (Figure 4-6) refers to control settings for authentication and confidentiality of the ANT-FS session.



Authentication Type

○ Pass thru
○ Pairing only
● Passkey (with pairing)

Enter Passkey in Hex Byte Pairs: 00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00

Encryption Key (32 bytes hex)

Bytes 0-15: 00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00

Bytes 16-31: 00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00

Figure 5-5. Security Options Tab

5.1.4.1 Authentication Type

The authentication type indicates the authentication methods supported in the client device and shall be included in the beacon. Available authentication types for this implementation are given in Table 5-2.

Table 5-2. Authentication Type

Authentication Type	Description
Pass thru	All three authentication methods (pass thru, pairing, passkey) are available
Pairing only	Only pairing authentication is available.
Passkey (with pairing)	Pairing and passkey authentication are available.

For more details on the operation of the different authentication types, refer to the ANT-FS Technical Specification.

5.1.4.2 Passkey

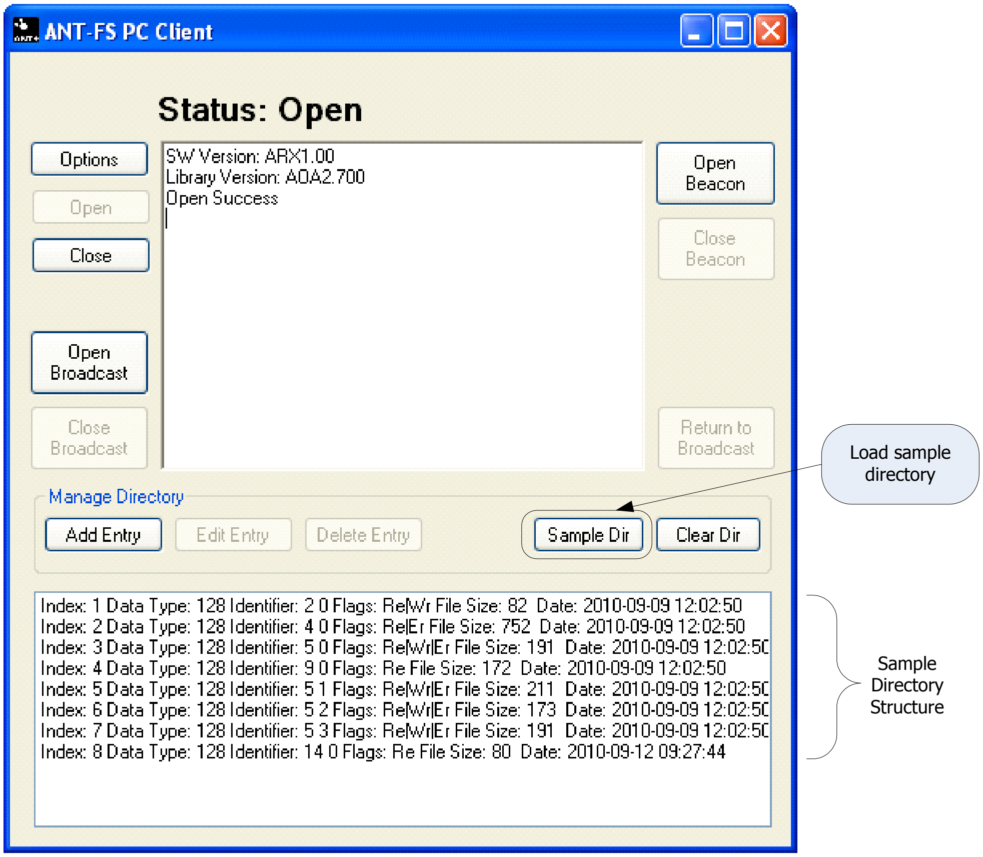
The passkey is used to authenticate a host device. The passkey transmitted by the host shall be compared with the value configured in the client device. The passkey may be up to 255 bytes long, and entered as ASCII hex byte values without the 0x and separated by a comma as shown in Figure 5-5.

5.1.4.3 Encryption Key

The encryption key is used to encrypt and decrypt transmitted data. If a file is marked with the Crypto flag, the file will be encrypted when it is downloaded to a host device. Files will be decrypted before they are stored on the file system if the 'Debug encrypted files' checkbox on the main window is selected. The encryption key is a 32 byte value, and should be entered as ASCII hex byte values without the 0x and separated by a comma as shown in Figure 5-5.

5.2 Managing the Directory

Before data can be downloaded from an ANT-FS client device, its directory must be configured to specify the data files available for download, along with additional information about each file, such as size, type, date and access permission flags. For a detailed description of the directory structure, refer to the ANT-FS Technical Specification.



```
SW Version: ARX1.00
Library Version: AOA2.700
Open Success
```

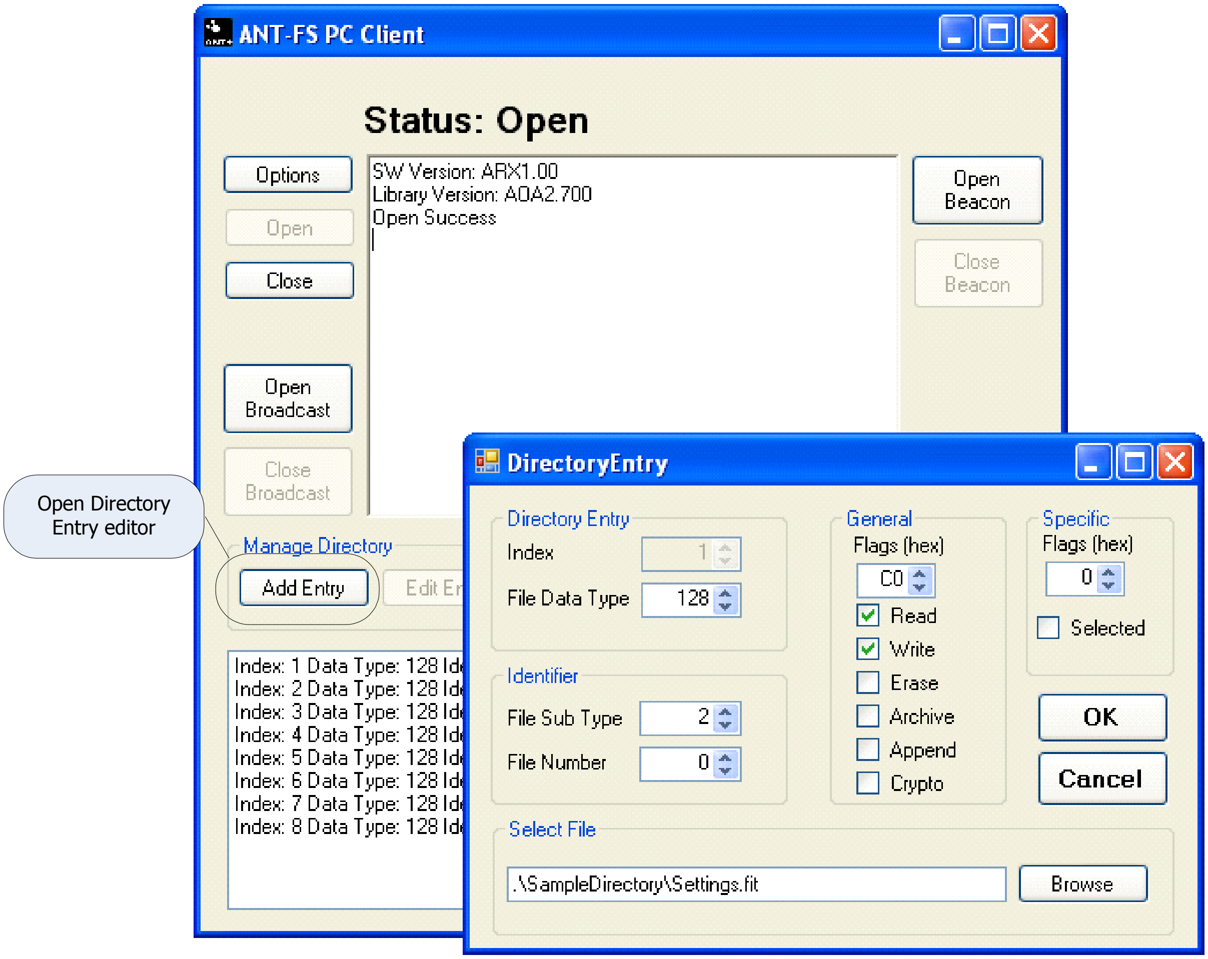
```
Index: 1 Data Type: 128 Identifier: 2 0 Flags: Re|Wr File Size: 82  Date: 2010-09-09 12:02:50
Index: 2 Data Type: 128 Identifier: 4 0 Flags: Re|Er File Size: 752  Date: 2010-09-09 12:02:50
Index: 3 Data Type: 128 Identifier: 5 0 Flags: Re|Wr|Er File Size: 191  Date: 2010-09-09 12:02:50
Index: 4 Data Type: 128 Identifier: 9 0 Flags: Re File Size: 172  Date: 2010-09-09 12:02:50
Index: 5 Data Type: 128 Identifier: 5 1 Flags: Re|Wr|Er File Size: 211  Date: 2010-09-09 12:02:50
Index: 6 Data Type: 128 Identifier: 5 2 Flags: Re|Wr|Er File Size: 173  Date: 2010-09-09 12:02:50
Index: 7 Data Type: 128 Identifier: 5 3 Flags: Re|Wr|Er File Size: 191  Date: 2010-09-09 12:02:50
Index: 8 Data Type: 128 Identifier: 14 0 Flags: Re File Size: 80  Date: 2010-09-12 09:27:44
```

Figure 5-6. Loading the sample directory

The 'Manage Directory' section in the main windows allows configuration of the client directory. For quick start, press the 'Sample Dir' button, as shown inFigure 5-6. This will load a set of sample files into the directory. These example files are provided with the application and include example FIT Settings, Activity, Workout, Weight and Blood Pressure files.

5.2.1 Adding and Editing Directory Entries

To manually add a custom file to the directory, select the "Add Entry" button. This will open the Directory Entry editor window. The "Directory Entry" editor window can also be launched by selecting an existing entry from the directory structure, and clicking the "Edit Entry" button.



Status: Open

```
SW Version: ARX1.00
Library Version: AOA2.700
Open Success
```

```
Index: 1 Data Type: 128 Id
Index: 2 Data Type: 128 Id
Index: 3 Data Type: 128 Id
Index: 4 Data Type: 128 Id
Index: 5 Data Type: 128 Id
Index: 6 Data Type: 128 Id
Index: 7 Data Type: 128 Id
Index: 8 Data Type: 128 Id
```

Directory Entry
Index: 1
File Data Type: 128

Identifier
File Sub Type: 2
File Number: 0

General
Flags (hex): C0
☑ Read
☑ Write
□ Erase
□ Archive
□ Append
□ Crypto

Specific
Flags (hex): 0
□ Selected

Select File
.\SampleDirectory\Settings.fit

Open Directory Entry editor

Figure 5-7. Opening the directory entry editor

5.2.2 Directory Entry Editor

The 'Directory Entry' editor window allows the user to set up and modify all parameters of an entry in the directory. For a detailed description of ANT-FS directory formats, refer to the ANT-FS Technical Specification.

The index uniquely identifies the file within the directory; this value is incremented with each new file added to the directory.

The file data type specifies the file type; set to 128 for FIT files.

The Identifier group allows specific file details to be configured. For FIT files, the identifier field is divided into File Sub Type and File Number. The File Sub Type indicates the FIT file type; for example, a Workout or Settings file. The File Number is the number of the particular instance of a given file/sub type. For example, if multiple workout files are available in the device, they would all have the same file sub type, but different file numbers.

The General and Specific Flags section allows the user to select flags providing additional information about the files. The flags can be selected individually by clicking on the associated checkbox. The hex byte representing the flag bit field will be updated automatically as flags are selected or removed.

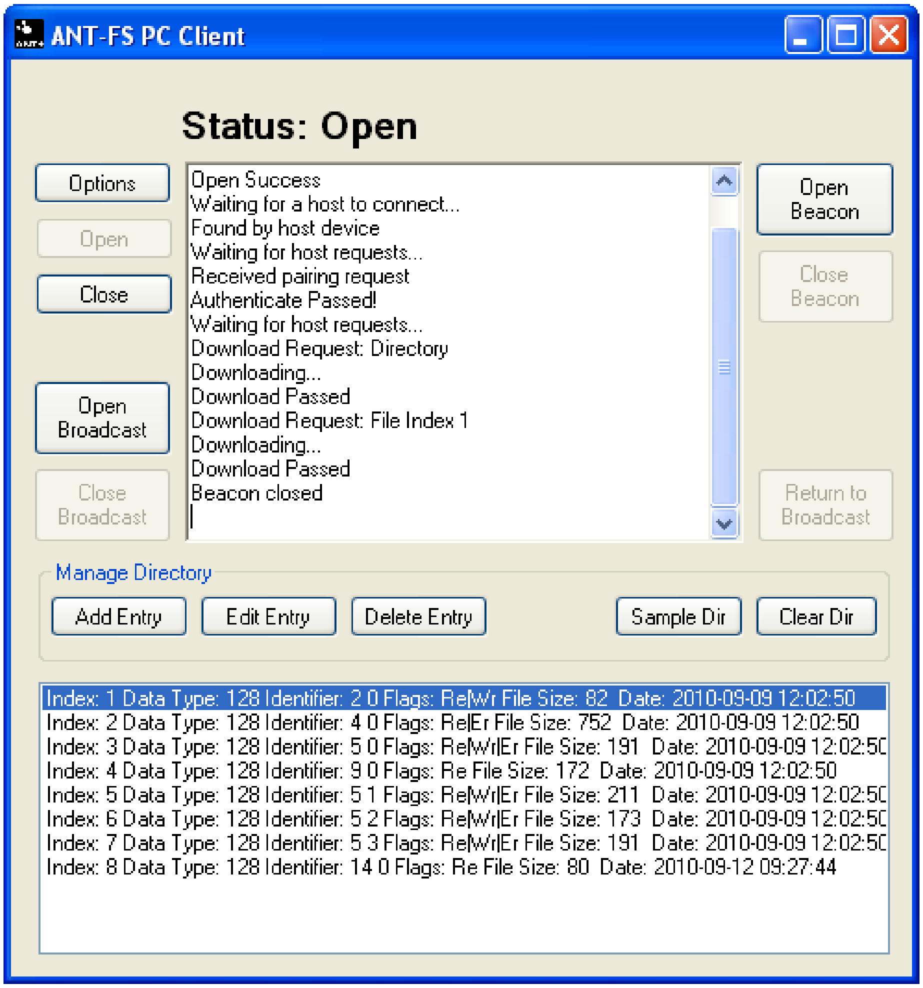
To associate a data file with the entry, click 'Browse' and select a file from the file system. Once all the details are complete, click 'OK' to finish editing the entry, returning to the main window. To return without saving any changes, click 'Cancel'.

5.2.3 Deleting Directory Entries

To delete a single entry from the directory, select the file from the directory listing and click 'Delete Entry'. To delete all entries in the directory; click on 'Clear Dir'. Deleting entries from the directory does not delete any files from the file system.

5.3 General Operation

The ANT-FS PC Client Tool is designed such that each ANT-FS layer can be stepped through with each appropriate button press. Most ANT-FS operations are initiated by the host and handled automatically by the client according to its configuration. Buttons are only enabled if the client is in a state that is appropriate for a particular action. The current status of the application is displayed in the Status label at the top of the main window, as seen in Figure 5-8.



Status: Open

```
Open Success
Waiting for a host to connect...
Found by host device
Waiting for host requests...
Received pairing request
Authenticate Passed!
Waiting for host requests...
Download Request: Directory
Downloading...
Download Passed
Download Request: File Index 1
Downloading...
Download Passed
Beacon closed
```

```
Index: 1 Data Type: 128 Identifier: 2 0 Flags: Re|Wr File Size: 82  Date: 2010-09-09 12:02:50
Index: 2 Data Type: 128 Identifier: 4 0 Flags: Re|Er File Size: 752  Date: 2010-09-09 12:02:50
Index: 3 Data Type: 128 Identifier: 5 0 Flags: Re|Wr|Er File Size: 191  Date: 2010-09-09 12:02:50
Index: 4 Data Type: 128 Identifier: 9 0 Flags: Re File Size: 172  Date: 2010-09-09 12:02:50
Index: 5 Data Type: 128 Identifier: 5 1 Flags: Re|Wr|Er File Size: 211  Date: 2010-09-09 12:02:50
Index: 6 Data Type: 128 Identifier: 5 2 Flags: Re|Wr|Er File Size: 173  Date: 2010-09-09 12:02:50
Index: 7 Data Type: 128 Identifier: 5 3 Flags: Re|Wr|Er File Size: 191  Date: 2010-09-09 12:02:50
Index: 8 Data Type: 128 Identifier: 14 0 Flags: Re File Size: 80  Date: 2010-09-12 09:27:44
```

Figure 5-8. Main Window

5.3.1 Open

Before any other action is taken, the ANT USB stick must first be opened and connected to. This is accomplished by pressing the 'Open' button. The Open button will initialize the ANT library and connect to the USB stick at the specified baud rate and USB Port. The client will attempt to connect to the first available USB stick, polling the specified USB port until one is found.

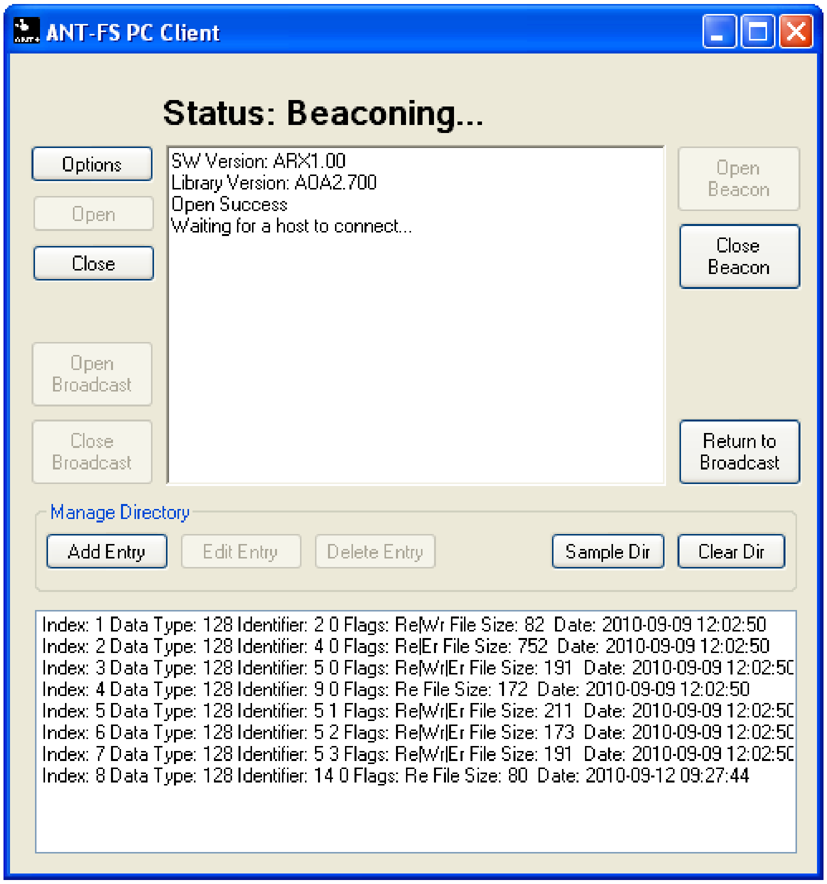
The USB port parameters are set in the Options dialog box as described earlier. The Status text will show "Idle polling USB" while attempting to connect to a USB stick, and "Open" when it is connected to a USB stick.

5.3.2 Close

The 'Close' button will close all ANT channels, destroy all ANT-FS library threads, and close the connection to the USB stick. It will also destroy any memory that was allocated to files in transfer. Any transactions that were in progress will be aborted immediately, which should force the host to timeout and return to its default state.

5.3.3 Open Beacon

Pressing the 'Open Beacon' button will configure the ANT channel's parameters and then open the channel. The client will begin to beacon, and will wait to be discovered by a host device. All beacon parameters must be configured **prior** to opening the beacon. Once the ANT channel has been successfully opened, the Status label on top of the text box will change to "Beaconing", as shown in Figure 5-9.



Status: Beaconing...

```
SW Version: ARX1.00
Library Version: AOA2.700
Open Success
Waiting for a host to connect...
```

```
Index: 1 Data Type: 128 Identifier: 2 0 Flags: Re|Wr File Size: 82  Date: 2010-09-09 12:02:50
Index: 2 Data Type: 128 Identifier: 4 0 Flags: Re|Er File Size: 752  Date: 2010-09-09 12:02:50
Index: 3 Data Type: 128 Identifier: 5 0 Flags: Re|Wr|Er File Size: 191  Date: 2010-09-09 12:02:50
Index: 4 Data Type: 128 Identifier: 9 0 Flags: Re File Size: 172  Date: 2010-09-09 12:02:50
Index: 5 Data Type: 128 Identifier: 5 1 Flags: Re|Wr|Er File Size: 211  Date: 2010-09-09 12:02:50
Index: 6 Data Type: 128 Identifier: 5 2 Flags: Re|Wr|Er File Size: 173  Date: 2010-09-09 12:02:50
Index: 7 Data Type: 128 Identifier: 5 3 Flags: Re|Wr|Er File Size: 191  Date: 2010-09-09 12:02:50
Index: 8 Data Type: 128 Identifier: 14 0 Flags: Re File Size: 80  Date: 2010-09-12 09:27:44
```

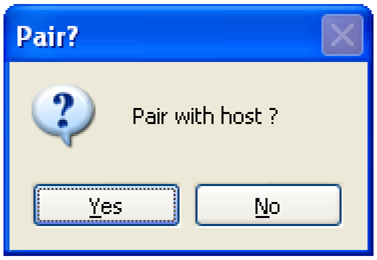
Figure 5-9. Open Beacon

5.3.4 Connecting to a Host Device

Once a host finds the client device, it will send a Link command, and the client shall progress to the Authentication state and wait for an authentication request. The client will process incoming authentication requests based on its configuration, and progress to the Transport layer if the request is accepted, or to the Link layer if it is rejected.

5.3.4.1 Pair

If the host sends a pairing request to the client and pairing authentication is enabled, a pop up window will ask the user to accept or reject the pairing request (Figure 5-10). If the host friendly name was received with the request, it will also be displayed.


Pair?

Pair with host ?

Figure 5-10. Pairing dialog

To accept the pairing request, click “Yes”. The client will then send a response, along with the passkey (if configured). To reject the pairing request, click “No”. If no option is selected before the pairing operation times out, the request will be rejected.

5.3.4.2 Passkey

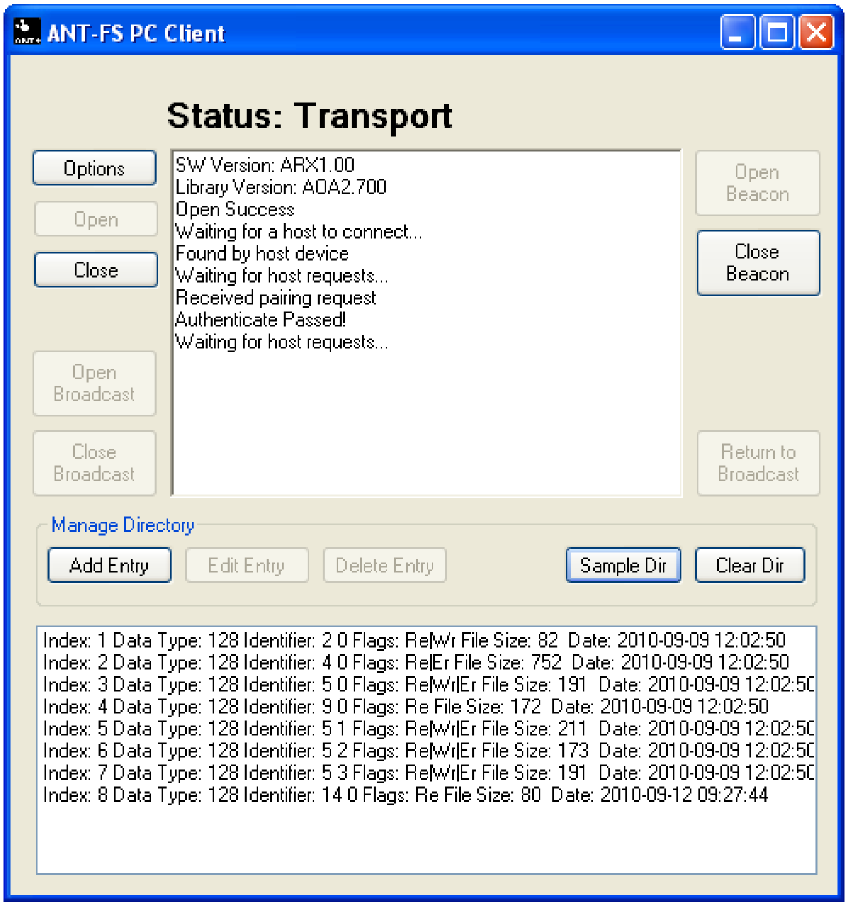
If the host sends a passkey authentication request and passkey authentication is enabled, the client will compare the passkey provided by the host with the one configured in the ‘Security’ options tab. If the passkey matches, authentication will pass; otherwise, it will be rejected.

5.3.4.3 Pass Thru

If the host requests pass-thru authentication, and the client supports pass through, the client will simply move to the Transport Layer, without requiring additional authentication parameters.

5.3.5 Transport

Once in the transport layer, the client waits for requests from the host device, and handles them automatically. If the host requests to download a file, the client will find it in the directory and send the download. If the host requests to erase a file, the client will remove the entry from the directory, but will not erase any files from the file system. The Status label at the top will be updated to reflect the current status of the client.



```
SW Version: ARX1.00
Library Version: AOA2.700
Open Success
Waiting for a host to connect...
Found by host device
Waiting for host requests...
Received pairing request
Authenticate Passed!
Waiting for host requests...
```

```
Index: 1 Data Type: 128 Identifier: 2 0 Flags: Re|Wr File Size: 82  Date: 2010-09-09 12:02:50
Index: 2 Data Type: 128 Identifier: 4 0 Flags: Re|Er File Size: 752  Date: 2010-09-09 12:02:50
Index: 3 Data Type: 128 Identifier: 5 0 Flags: Re|Wr|Er File Size: 191  Date: 2010-09-09 12:02:50
Index: 4 Data Type: 128 Identifier: 9 0 Flags: Re File Size: 172  Date: 2010-09-09 12:02:50
Index: 5 Data Type: 128 Identifier: 5 1 Flags: Re|Wr|Er File Size: 211  Date: 2010-09-09 12:02:50
Index: 6 Data Type: 128 Identifier: 5 2 Flags: Re|Wr|Er File Size: 173  Date: 2010-09-09 12:02:50
Index: 7 Data Type: 128 Identifier: 5 3 Flags: Re|Wr|Er File Size: 191  Date: 2010-09-09 12:02:50
Index: 8 Data Type: 128 Identifier: 14 0 Flags: Re File Size: 80  Date: 2010-09-12 09:27:44
```

Figure 5-11. Transport Layer

5.3.6 Disconnecting from a Host Device

5.3.6.1 Disconnect

The client can process requests to disconnect from the host device at any time during the session. If a disconnect request is received, the client will stop all pending operations, and will return to the Link state, or broadcast mode, depending on the request (see Sections 4.2.8 and 4.2.9).

5.3.6.2 Close Beacon

The client can end the session and stop beaconing at any time without waiting for a request from the host. To do this, click the 'Close Beacon' button while in any layer. The application will remain connected to the USB stick, and will either close the channel or return to broadcast mode, depending on its initial mode of operation.

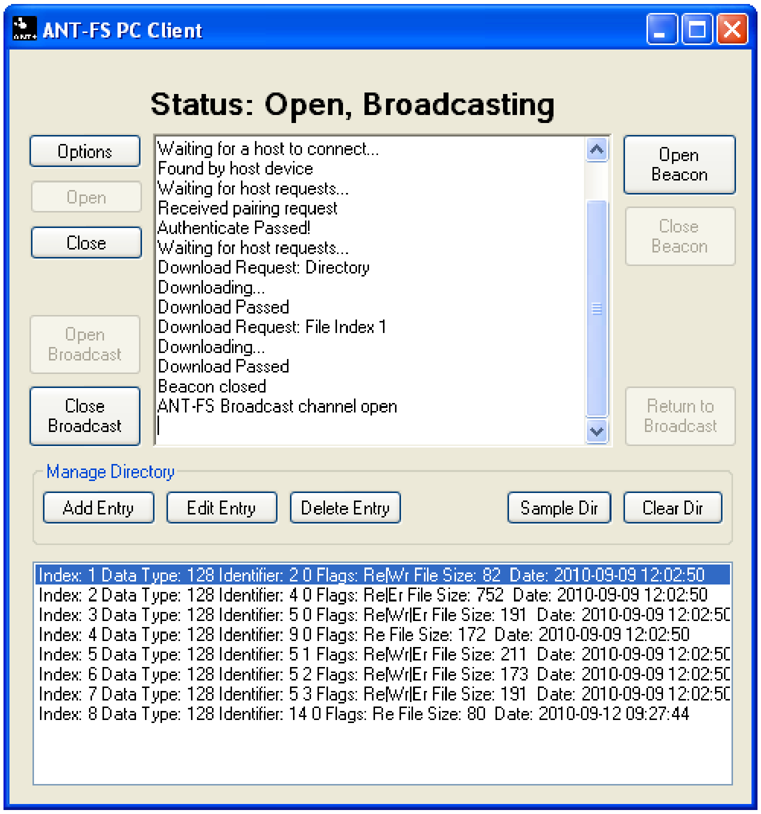
5.3.7 Broadcast ANT-FS

Broadcast ANT-FS provides a mechanism for ANT-FS to take place on a device that is already broadcasting on an established channel, without having to open a second channel. For a detailed description of this feature, refer to the ANT-FS Technical Specification.

The ANT-FS PC Client incorporates some features to simulate broadcast ANT-FS devices, including the ability to initiate in standard broadcast mode, processing requests to begin an ANT-FS session and returning to broadcast mode after the ANT-FS session is ended.

5.3.7.1 Open Broadcast

To establish a standard ANT broadcast channel, press the 'Open Broadcast' button. The ANT channel will be configured as per the 'ANT Channel' options tab. Once the channel is successfully opened, the client will begin broadcasting. The last byte of the payload will be increased sequentially, in a similar manner to ANTwareII. The Status label will be updated to reflect that the client device is "Open, Broadcasting" (Figure 5-12).



Status: Open, Broadcasting

```
Waiting for a host to connect...
Found by host device
Waiting for host requests...
Received pairing request
Authenticate Passed!
Waiting for host requests...
Download Request: Directory
Downloading...
Download Passed
Download Request: File Index 1
Downloading...
Download Passed
Beacon closed
ANT-FS Broadcast channel open
```

```
Index: 1 Data Type: 128 Identifier: 2 0 Flags: Re|Wr File Size: 82  Date: 2010-09-09 12:02:50
Index: 2 Data Type: 128 Identifier: 4 0 Flags: Re|Er File Size: 752  Date: 2010-09-09 12:02:50
Index: 3 Data Type: 128 Identifier: 5 0 Flags: Re|Wr|Er File Size: 191  Date: 2010-09-09 12:02:50
Index: 4 Data Type: 128 Identifier: 9 0 Flags: Re File Size: 172  Date: 2010-09-09 12:02:50
Index: 5 Data Type: 128 Identifier: 5 1 Flags: Re|Wr|Er File Size: 211  Date: 2010-09-09 12:02:50
Index: 6 Data Type: 128 Identifier: 5 2 Flags: Re|Wr|Er File Size: 173  Date: 2010-09-09 12:02:50
Index: 7 Data Type: 128 Identifier: 5 3 Flags: Re|Wr|Er File Size: 191  Date: 2010-09-09 12:02:50
Index: 8 Data Type: 128 Identifier: 14 0 Flags: Re File Size: 80  Date: 2010-09-12 09:27:44
```

Figure 5-12. Starting in Broadcast ANT-FS mode

Once the channel receives a request for an ANT-FS session, it will maintain its current channel configuration and commence transmitting the ANT-FS link beacon. After the client has moved into the Link state, its operation is identical to that described in Sections 5.3.3 to 5.3.6.

The client can also begin an ANT-FS session without waiting for a request from the host. To do this, press the 'Open Beacon' button while the device is broadcasting.

5.3.7.2 Close Broadcast

The client can stop broadcasting at any time. To do this, click the 'Close Broadcast' button. The ANT channel will be closed, but the application will remain connected to the USB stick.

5.3.7.3 Return to Broadcast

The client can return to broadcast mode at any time during an ANT-FS session if a disconnect command is received from the host device. It is also possible to return to broadcast mode while in Link state without waiting for a request from the host. To do this, press the 'Return to Broadcast' button while in the Link layer. The client will stop transmitting the ANT-FS beacon, but the channel will remain open.

6 ANT-FS Embedded Client

The ANT-FS Embedded client reference design consists of firmware that implements the ANT-FS client functionality. The ANT-FS reference design intends to illustrate the basic operation of an ANT-FS client as well as provide a reference design for the development of ANT-FS embedded client devices.

The ANT-FS embedded client reference design can be used in conjunction with the ANT-FS PC Host tool to explore most ANT-FS features. This reference design supports all three methods of authentication defined in the ANT-FS specification: pairing, passkey and pass-thru. It also supports the simulation of downloading and erasing files. Other functionality that is not defined in the ANT-FS specification, such as the user interface, file system implementation and data decoding/encoding are left to the application.

6.1 Architecture Overview

The general architecture of the ANT-FS Embedded client reference design is illustrated in Figure 6-1.

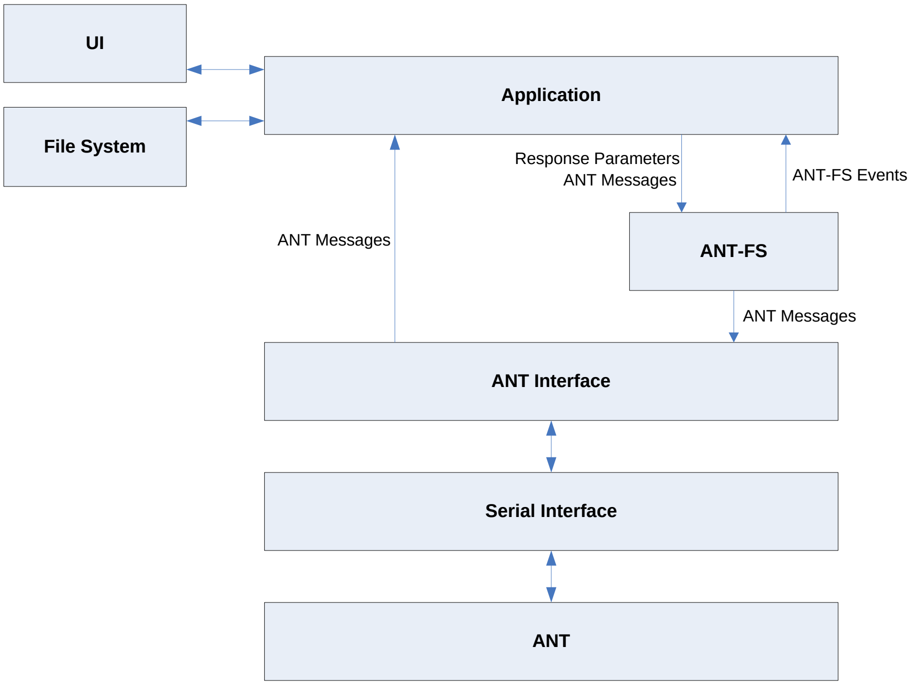


Figure 6-1. ANT-FS Embedded Client Architecture

The serial interface handles communication with ANT. Byte synchronous communication is enabled by default, but drivers for bit synchronous and asynchronous communication are also available. The ANT Interface handles the ANT protocol messaging. When ANT messages are received by the application, they are sent to the ANT-FS module for further processing. The ANT-FS module contains the core functionality of ANT-FS, and can be easily incorporated into custom applications. The application also processes ANT-FS events, which are generated when user interaction or access to the file system is required.

The source code for the ANT-FS Embedded Client reference design is organized in the directories described in the following two sections.

6.1.1 base

The *base* directory contains files that provide the basic functionality of the reference design. This includes hardware specific functionality, such as serial drivers, I/O, and timers, as well as more generic functionality for ANT embedded applications, such as ANT message framing and CRC and checksum calculations.

6.1.2 antfs

The *antfs* directory contains all relevant files for the development of ANT-FS embedded client applications. This directory includes the core ANT-FS embedded implementation, as well as a sample ANT-FS enabled application and a sample directory structure to demonstrate the downloading and erasing operations.

6.2 Reference Design Setup

The firmware for the ANT-FS Embedded Client reference design has been written for an MSP430F2274 MCU using a byte synchronous serial interface to an ANT module. A block diagram of the setup is shown in Figure 6-2. Although specific to this hardware platform, the firmware has been written such that it is easily ported to any target host MCU. For more information regarding interfacing a host MCU to ANT, please refer to the "Interfacing with ANT General Purpose Chipsets and Modules" document.

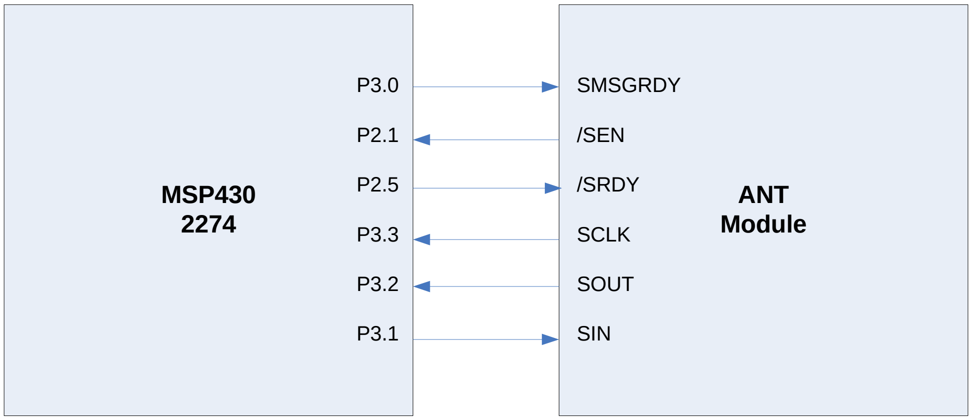


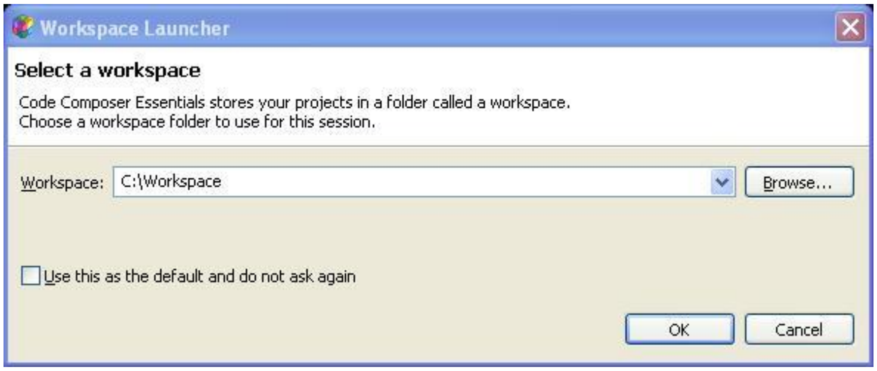
Figure 6-2. ANT/MCU Connectivity

The ANT-FS Embedded Client reference design can be compiled with Code Composer Essentials, a development environment for the MSP430 available as a free download from Texas Instruments:

http://focus.ti.com/docs/toolsw/folders/print/msp-cce430.html

The following steps illustrate how to set up and compile the source of the ANT-FS Embedded Client reference design:

1. Open Code Composer Essentials and select a Workspace. The workplace directory will hold all your working projects and files.



Workspace Launcher

Select a workspace

Code Composer Essentials stores your projects in a folder called a workspace.
Choose a workspace folder to use for this session.

Workspace: C:\Workspace

□ Use this as the default and do not ask again

Figure 6-3. Selecting a workspace

2. To add the ANT-FS client embedded reference design to your workspace, select *File > Import* from the menu.

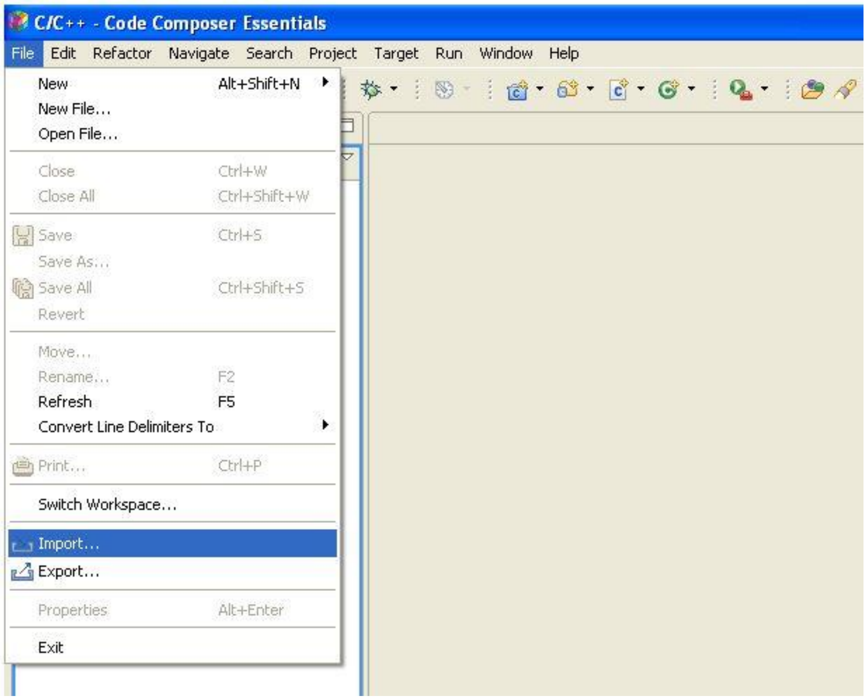
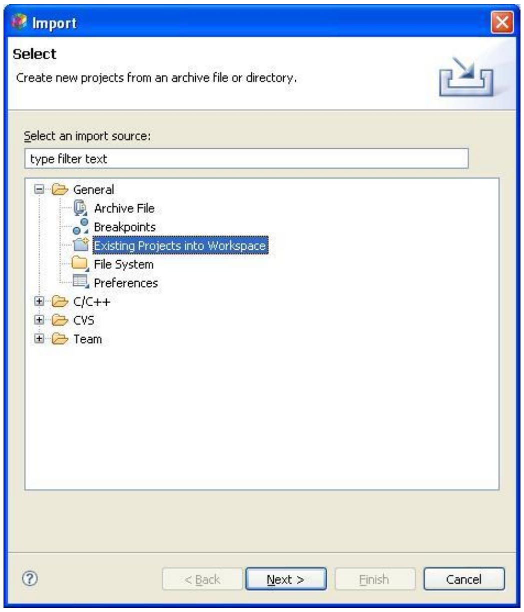


Figure 6-4. Importing a project

3. Select "Existing Projects into Workspace" as the import source



Import

Select

Create new projects from an archive file or directory.

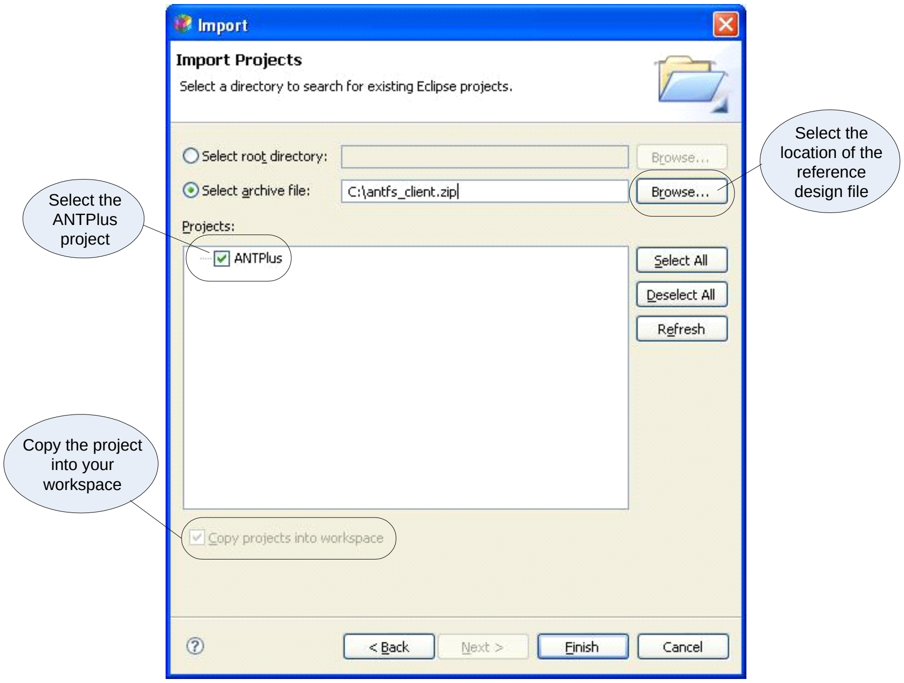
Select an import source:

type filter text

- General
  - Archive File
  - Breakpoints
  - Existing Projects into Workspace
  - File System
  - Preferences
- C/C++
- CVS
- Team

Figure 6-5. Importing an existing project

4. Browse to the ANT-FS Embedded Client reference design location. Select the ANTPlus Project. It is not necessary to decompress the reference design, as the ZIP archive can be imported directly into your workspace. Make sure the option to "Copy projects into workspace" is checked; this option should already be checked by default if you are importing a project from a ZIP archive.



Import

Import Projects

Select a directory to search for existing Eclipse projects.

○ Select root directory:

● Select archive file: C:\antfs_client.zip

Projects:

☑ ANTPlus

☑ Copy projects into workspace

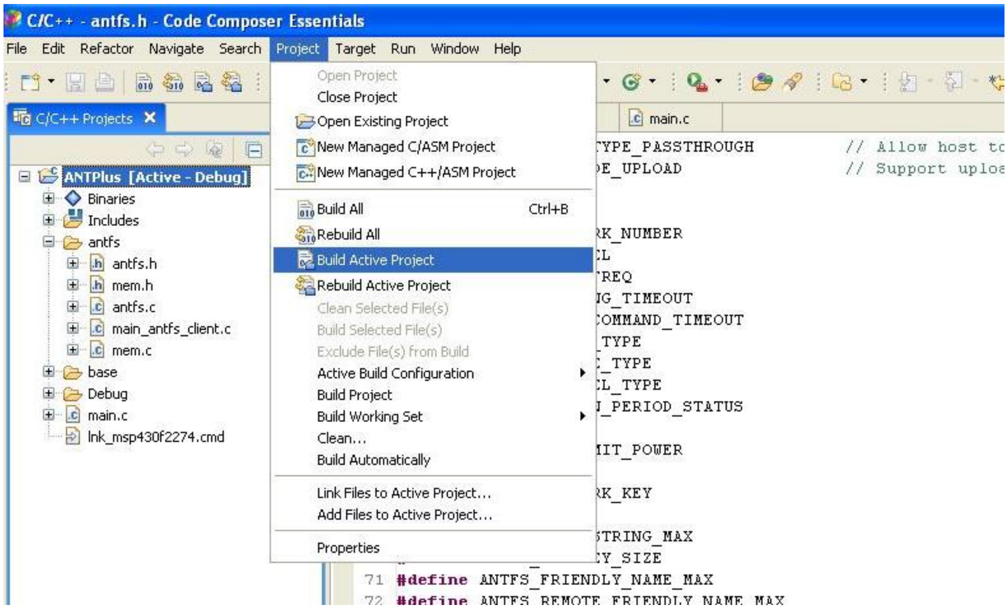
Select the location of the reference design file

Select the ANTPlus project

Copy the project into your workspace

Figure 6-6. Importing the ANT-FS Embedded Client Reference Design

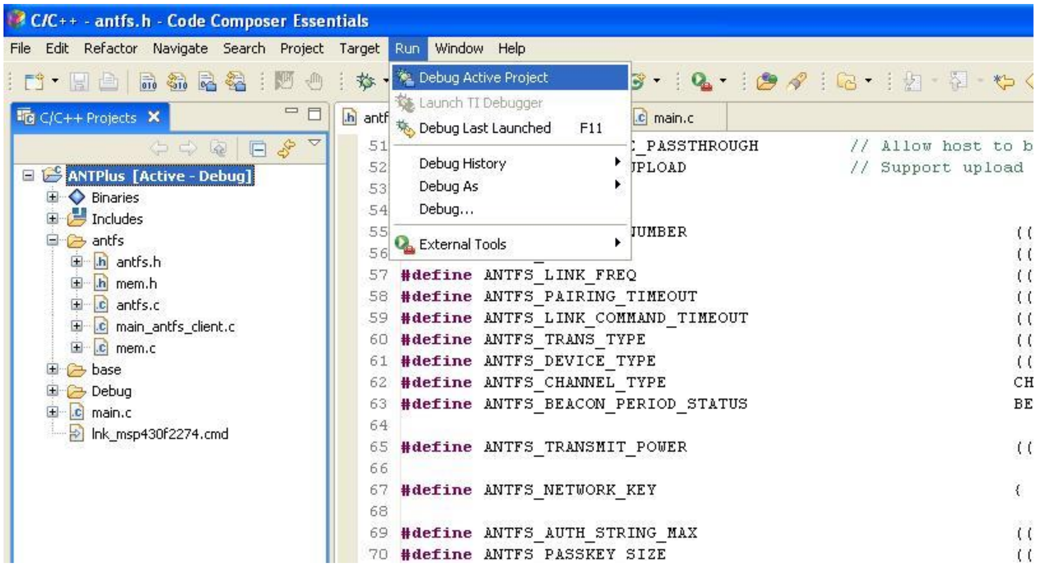
5. To load the embedded firmware on the target processor, you will first need to build the project. Select *Project > Build Active Project* from the menu. You will need to add the ANT-FS network key to the antfs.h file before you are able to successfully build the project.



```
YPE_PASSTHROUGH          // Allow host tc
E_UPLOAD                 // Support uploa

K_NUMBER
L
REQ
G_TIMEOUT
OMMAND_TIMEOUT
TYPE
_TYPE
L_TYPE
_PERIOD_STATUS

IT_POWER

K_KEY

TRING_MAX
Y_SIZE
#define ANTFS_FRIENDLY_NAME_MAX
#define ANTFS_REMOTE_FRIENDLY_NAME_MAX
```

Figure 6-7. Building a project

6. After the project is build successfully, select *Run > Debug Active Project* to load the firmware on the target processor and run it.



```
_PASSTHROUGH             // Allow host to b
PLOAD                    // Support upload


UMBER                                   ((
                                        ((
#define ANTFS_LINK_FREQ                 ((
#define ANTFS_PAIRING_TIMEOUT           ((
#define ANTFS_LINK_COMMAND_TIMEOUT      ((
#define ANTFS_TRANS_TYPE                ((
#define ANTFS_DEVICE_TYPE               ((
#define ANTFS_CHANNEL_TYPE              CH
#define ANTFS_BEACON_PERIOD_STATUS      BE

#define ANTFS_TRANSMIT_POWER            ((

#define ANTFS_NETWORK_KEY               {

#define ANTFS_AUTH_STRING_MAX           ((
#define ANTFS_PASSKEY_SIZE              ((
```

Figure 6-8. Debugging a project

For more details on developing using Code Composer Essentials and the MSP430, please refer to the Technical Documentation for this tool provided by Texas Instruments.

6.3 Options

The ANT-FS Embedded Client reference design provides the user several configuration options to suit various ANT-FS implementations. These include ANT channel parameters, ANT-FS protocol settings and implementation specific details of the ANT-FS Client. Client specific parameters can be configured on *main_antfs_client.c*, while ANT channel and general ANT-FS parameters can be set on *antfs.h*. Table 6-1 lists the configuration parameters available on the ANT-FS Embedded Client reference design.

Table 6-1. ANT-FS Client Configuration Parameters

Parameter		Description
ANT Channel Parameters	ANTFS_NETWORK_KEY	ANT-FS Network Key.
	ANTFS_DEVICE_TYPE	Device Type (Channel ID).
	ANTFS_TRANS_TYPE	Transmission Type (Channel ID).
	ANTFS_LINK_FREQ	RF channel frequency of the client device while in the Link layer. This frequency should match the search frequency of the host device. The default value is 2450MHz.
	ANTFS_BEACON_PERIOD_STATUS	Message period of the client device while in the Link layer. The default value is 8 Hz.
ANT-FS General Parameters	ANTFS_COMMAND_TIMEOUT	Maximum time (in seconds) the client device will wait without receiving any commands from the host before switching to the Link layer.
	ANTFS_PAIRING_TIMEOUT	Maximum time (in seconds) the client will wait for user response to a pairing request during the authentication stage.
ANT-FS Client Parameters	ANTFS_CLIENT_ESN	Serial number of the client device. The device number in the Channel ID is derived from the lower two bytes of the serial number. The four bytes of the serial number are sent to the host during the Authenticate layer as the device ID.
	ANTFS_CLIENT_NAME	Friendly name of the client device. The length of this string should not exceed ANTFS_REMOTE_FRIENDLY_NAME_MAX.
	ANTFS_CLIENT_DEV_TYPE	Device Type (ANT-FS Client Identifier).
	ANTFS_CLIENT_MANUF_ID	Manufacturing ID (ANT-FS Client Identifier).
	ANTFS_CLIENT_PASSKEY	Passkey used in the pairing and passkey authentication methods. Its length should be equal to ANTFS_PASSKEY_SIZE.

The reference design implements the pairing, pass key and pass-thru authentication methods, which can be enabled using compile switches. All three authentication methods are enabled by default. Upload functionality can also be enabled through a compile switch. The compile switches can be set on *antfs.h*, and are listed below.

Table 6-2. ANT-FS Client Compile Switches

Parameter	Description
ANTFS_AUTH_TYPE_PAIRING	Use pairing and passkey exchange authentication
ANTFS_AUTH_TYPE_PASSKEY	Use passkey authentication
ANTFS_AUTH_TYPE	Allow host to bypass authentication
ANTFS_INCLUDE_UPLOAD	Support upload operation

To establish communication, the host and client devices should have matching configurations. The host device may wish to wildcard any of the fields in the Channel ID and Client Identifier by setting them to zero, but the network key and RF channel frequency should be the same. The channel period of the client does not necessarily need to match the channel period of the host.

As an example, a simple user interface consisting of an LED and two buttons is used for events where user interaction is required. The pins used as digital inputs/outputs can be configured in the *Config.h* file.

6.4 General Operation

The ANT-FS Embedded Client reference design progresses automatically through each ANT-FS layer, as per the commands received from the ANT-FS host. User interaction is only required when using pairing authentication, to confirm or reject a pairing request.

6.4.1 Start

Compile and load the firmware for the reference design as described in section 6.2. To load the firmware on the target MCU, you can select *Run > Debug Active Project*, and then run the reference design by selecting *Run > Run* while in debug mode.

6.4.2 Connect

Once a host detects a client with ANT Channel and ANT-FS client parameters matching its search criteria, it will send a Link command to the client, specifying the Link RF channel frequency and channel period. The client will automatically switch to the new frequency and channel period, and indicate in its beacon that it has moved to the Authentication stage.

6.4.3 Authenticate

Once both the client and host are in the Authentication layer, the host can request to pair with the client device. The ANT-FS Embedded Client reference design supports three methods of authentication: pairing, passkey and pass-thru.

When using the passkey and pass-thru authentication methods, the client will automatically accept or reject the authentication as outlined by the ANT-FS specification. Intervention from the user is only required when using the pairing authentication method. If the client receives a pairing request from the host, it will turn on an LED to let the user know that a host device wishes to pair with it. The user can accept or reject the pairing request by pressing the one of the appropriate buttons. If no response from the user is received before the pairing timeout expires, the request will be rejected.

6.4.4 Download

A sample directory structure is implemented in this reference design, however, no actual files or file systems are present in the reference design.

The client will send the directory to the host if it receives a request to download the directory (file index 0). When the host requests a download for any other files, the client will check if the file exists in its directory, and if there is permission to download that file. If the file can be downloaded, the client will simulate a file by sending sequential data with size matching the requested file size; otherwise, it will reject the download.

6.4.5 Upload

When the host requests an upload, the client will check if the file index exists in its directory, if there is permission to write on that file, and if there is enough space to write the requested data. Once the client sends a response accepting the upload request, the host can start uploading data. The reference design does not include actual files, so data is not written to memory; however, the client keeps track of the CRC of the received data to verify the integrity of the upload.

6.4.6 Erase

If the client receives a request to erase a file, it will check in its directory to see if the file exists and if there is permission to erase that file. As there are no actual files to delete in this reference design, if the file can be erased, the client will simply send a response to the host indicating the file was erased; otherwise, it will reject the request.