Mobile Client iOS Implementation Guide

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Overview

This document is the Implementation Guide to the application programming interface (API) of the Gracenote Mobile Client software library. It provides conceptual background, implementation guidance, and example code to aid software developers in building application programs incorporating Gracenote Mobile Client services. For complete reference information on the Mobile Client API, see the included Reference Guide delivered as HTML pages.

> **Note**
>
> For brevity's sake, most of the programming examples in this manual do not check for errors. In an actual production application, your code should check each library call's returned result and take appropriate measures in case of error or failure. For more complete example code, including full error checking, see the Sample Application included with the Mobile Client distribution package.

Deployment

Mobile Client is delivered as an Xcode project that can be integrated into an iPhone development environment that uses the Xcode integrated development environment (IDE).

Creating an iPhone Development Environment

iPhone development requires a specific environment. The details of creating such an environment can be obtained from http://developer.apple.com/iphone.
Before proceeding, ensure that your environment is equipped with the following:

- Macintosh OS
- Xcode
- iPhone SDK installed
- Apple Developer Provisioning Certificate
- App ID
- Provisioning File

To obtain the iPhone SDK, Apple Developer Provisioning Certificate, App ID, and Provisioning File, you must be a registered Apple Developer; see http://developer.apple.com/iphone for further details.

Using the Sample Application

The Mobile Client sample application is provided as source within an Xcode project. To run the sample application, follow the instructions in the *Getting Started with the iOS Sample Application* document.

Migrating to this Release

Supported Sampling Rates for MusicID-Stream and MusicID-File

As of Release 3.1, the supported sampling rates for MusicID-Stream and MusicID-File are:

- 8000 Hz
- 44100 Hz

GNConfig - No Longer Supported, Renamed, and Changed Default Parameters

Several GNConfig parameters were renamed in Mobile Client 2.5.2 to improve consistency and extensibility. You **must** migrate your code to match the new naming conventions.

The tables below summarizes the changes made, including the parameters that are deprecated and no longer supported.

No Longer Supported

No Longer Supported Name	New Name	Comments
`genre` and `genreId` properties in `GNSearchResponse`	`trackGenre` and `albumGenre`	As of Version 2.5: Replace `GNSearchResponse` properties `genre` with `trackGenre` and `genreId` with `albumGenre`. Multiple genre levels can now be returned, so genres are delivered as a collection of `GNDescriptor` objects that contain a genre descriptor and a genre identifier. The properties `genre` and `genreId` will NO LONGER return the descriptor and identifier from the lowest level genre returned to Mobile Client.

isGenreCoverArtEnabled	content.coverArt.genreCoverArt	
lang	content.lang	
preferredLinkSource	content.link.preferredSource	
webservices.coverArtSizePreference	content.coverArt.sizePreference	
webservices.gzipEnabled	N/A	
webservices.isSingleBestMatchPreferred	content.musicId.queryPreference.singleBestMatch	

Case Change Only

Cases are changed for consistency. Older case is supported. No deprecation.

Old Name	New Name
Content.contributor.images	content.contributor.images
Content.review	content.review
Content.contributor.biography	content.contributor.biography

Changed Default Values

Name	New Default Value	As of
content.coverArt	false	Version 2.5.8
content.country	null	Version 2.5.8 Prior to this, the default value was USA

New GNConfig Property

Property	Type	Default	As of	Description
content.allowfullresponse	Boolean string	False	3.1	Indicates if Gracenote response should contain full or partial metadata. Note that this only applies to local cache lookup. The following operations use local cache lookup: 1. GNRecognizeStream.idNow 2. GNOperations.recognizeMIDStreamFromMic 3. GNOperations.recognizeMIDStreamFromPcm

Deprecated GNSearchResponse Properties

Old Name	New Name
bestresponse.artistImage	bestresponse.contributorImage

New GNSearchResponse Property

Property	Type	As of	Description
`partial`	Boolean	3.1	Indicates if response contains full or partial metadata.

GNStatus Change

The `GNStatus` RECORDING value has been removed and replaced with LISTENING.

Technical Requirements

Hardware	iPhone, iPad
Platform	iOS 4.2.3 or higher
Xcode version	4.3 or higher
Framework library size	13.3 MB [1]

[1] For details see Framework Size (see page 9)

Framework Size

The framework size reported above reflects the combined size of the universal framework for all iOS architectures: armv7 and armv7s for the device, and i386 for the simulator. The total executable code for any single architecture is ~2.2MB. When linking the framework to your compiled application, the linker will automatically strip out the unneeded architectures as well as any framework symbols your app does not utilize. See the linker option "`-dead_strip`" for more information.

For example, the sample application `GN_Music_SDK_iOS.app` has a total executable size of 2.2MB for the armv7 and armv7s architectures. This includes the app code and all linked SDK code. If the app is built for a single architecture, i.e. armv7 only, the compiled executable is 1.1MB. This is clearly much smaller than the entire SDK and illustrates how the linker strips unused symbols, reducing total app size.

See Xcode build settings for more information about setting build architectures and linker settings.

Apple Framework Dependencies

Ensure that your environment is equipped with the following before proceeding:

- `MediaPlayer.framework`
- `AudioToolbox.framework`
- `CoreData.framework`
- `CoreLocation` (this and `MapKit.framework` are required for Sample app and if your app is using GPS)

- `AVFoundation.framework` (must be weak-referenced in application)
- `CoreMedia`
- `Security.framework`
- `libxml2.dylib`
- `libsqlite.dylib`
- `libz.dylib` - Used for ingesting bundles and creating local cache. See *Storing Audio Fingerprint Data from Bundles in Local Cache* for more information.


To enable file sharing, add **Application supports iTunes file sharing = True** in the `plist` file.

Linker Flags

The following linker flag must be used:

- `-lsdtc++`

Configuration and Authentication

Mobile Client uses a *configuration object* of type `GNConfig` to control its behavior. You can configure this object to alter Mobile Client behavior.

To obtain a configuration object, use the `GNConfig:init` method. This method returns a `GNConfig` instance that must be stored and used with Gracenote operations (see the section Operations (see page 11)). The method takes a Gracenote-provided *client identifier*. See your Gracenote Professional Services representative to obtain your identifier.

```
GNConfig* config;

// Generate configuration object
config = [GNConfig init: @"12345678-ABCDEFGHIJKLMNOPQRSTUVWXYZ012345"];
```

The client identifier is used to generate authentication information, which is stored in the object and used in turn to gain access to Gracenote's cloud-based services.

To customize this object, you can set its properties with the `GNConfig:setProperties` method. For example, you can configure the preferred language for metadata returned from Gracenote:

```
// Set preferred language to Japanese
[config setProperty: @"content.lang" value: @"jpn"];
```

See the `GNConfig.h` documentation in the *Mobile Client iOS API Reference Guide* for a complete list of customizable properties.

Operations

An *operation* is a Mobile Client performed request, such as creating a fingerprint or recognizing an audio stream. The Mobile Client class `GNOperations` provides methods for invoking operations.

Invoking Operations

Operations run asynchronously to the application invoking them, and return their results via a mechanism known as a *result-ready object* (described below under Receiving Results (see page 11)). Each operation must be provided a configuration object generated by `GNConfig:init`, along with a result-ready object to receive the results:

```
// Create result-ready object to receive recognition result
ApplicationSearchResultReady* searchResultReady = [ApplicationSearchResultReady alloc];

// Invoke operation
[GNOperations recognizeMIDStreamFromMic: searchResultReady config: config];
```

Operations call result-ready and status-changed methods in the application's main thread. As a best practice, any time-consuming or complex computational processes should not be run in the main thread. Doing so will block the UI and may cause the application to behave poorly and impact performance. For example, retrieving cover art should be run in a background thread.

Receiving Results

Result-ready objects implement one of the following Mobile Client protocols, depending on the type of operation:

- `GNFingerprintResultReady`
- `GNSearchResultReady`

Mobile Client calls the result-ready object's `GNResultReady` method when a result is generated. Your application can use this method to process the result:

```
// Result-ready object implements GNSearchResultReady protocol
@ interface ApplicationSearchResultReady : NSObject <GNSearchResultReady>
{
}

// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Application code to process operation result
}
@ end


- (void) recognizeFromMic (GNConfig*) config
{
    // Create result-ready object to receive recognition result
    ApplicationSearchResultReady* searchResultReady = [ApplicationSearchResultReady alloc];

    // Invoke recognition operation
    [GNOperations recognizeMIDStreamFromMic: searchResultReady config: config];
}
```

Audio Recognition

Mobile Client provides 3 Gracenote technologies for audio recognition:

1. MusicID-Stream (see page 14), for audio delivered from a microphone or other streaming audio source (such as a radio signal or streaming Internet source),
2. MusicID-File (see page 22), for audio extracted from an audio file (such as a `.wav` or `.mp3` file)
3. AlbumID (see page 24), for identifying groups of audio files using fingerprints, text inputs, tag data, and Gracenote Identifiers. AlbumID can also use this data to group files into albums.

The results of all recognition operations are returned to the application via a result-ready object implementing the `GNSearchResultReady` interface.

Note

If requested (and the application is "entitled"), Mobile Client can also provide cover art and Link identifiers with the recognition results; see Retrieving Cover Art (see page 40) and Retrieving Link Data (see page 47), below, for further information.

In some cases, stream-based recognition can take longer than file-based. When recognizing an audio file, use file-based recognition to obtain the best response time.

Setting Up a Local Cache of Music Metadata for MusicID Stream

Gracenote provides a local cache of fingerprints and metadata of some example songs. The SDK uses this data to attempt a local ID prior to attempting an online lookup. If a song is not found locally, the SDK then performs an online lookup. The GNMobileClient uses SQLite as a local database, which requires the `libsqlite.dylib` in the `GracenoteMusicID.framework`.

Beginning with Mobile Client 3.1, Gracenote makes available a *bundle* of fingerprints and metadata for currently trending tracks that your application can download. Contact Gracenote Professional Services for the download location. Once downloaded, your application can *ingest* the bundle and create a local cache with methods provided through the `GnConfig` class - `loadCache` and `clearCache`.

The `clearCache` API has two signatures:

1. `(GNCacheStatus*) clearCache;`
2. `(GNCacheStatus*) clearCache:(BOOL) compactDatabase;`

As its parameter implies, the second call gives your application the option to de-fragment and compact the local database. On a `clearCache` call, your application should only invoke a compact if you are NOT going to do a subsequent `loadCache` call and the storage space needs to be reclaimed. Calling `clearCache` without vacuuming and then `loadCache:new_bundle_file_path` will not increase the current database size unless the new bundle requires additional space. Compacting the database can take 5 or more seconds and it is recommended your application do this on a background thread. For a local database containing 1000 tracks, compacting can save approximately 22MB in device memory.

Note that matching from local cache can measurably improve SDK performance.

Sample code that reads in bundle and sets up local cache:

```
//
// Example - from the Sample app in GN_Music_SDK_iOSViewController.m
//
-(void)setUpRecognizePCMSession{

    NSString *bundleFileName = @"161.b";
    NSString *filePath = [[NSBundle mainBundle] pathForResource:bundleFileName ofType:nil];

    if (filePath !=nil && filePath.length != 0) {
      GNCacheStatus *status = [self.config loadCache:filePath];
        NSLog(@"Load Cache Status : %@",[status statusString]);
    }

    NSString *sdkVersion = [self.config getProperty:@"version"];
    NSString *version = [NSString stringWithFormat:@"GNSDK %@", sdkVersion];
    [self setStatus:version showStatusPrefix:FALSE];
}
```

To implement local audio fingerprint storage:

1. Contact Gracenote Professional Services for the bundle download site.
2. In your application, download the bundle to device storage.
3. In your application, call the `GNConfig.loadCache()` method to set up a local cache from the bundle. As a best practice, call this method in background thread.
4. Delete the bundle from device storage when done.

Full and Partial Metadata Responses From Local Cache

In a local cache identification request, you can indicate if your app is returned a full or partial metadata response with the `GNConfig.allowfullresponse` field (new in 3.1). In a partial metadata response, the following fields are returned:

- Album title
- Artist (track level)
- Track title
- Track duration (in milliseconds)
- Track match position
- Track GNID (Gracenote ID)
- Album GNID

The `GNSearchResponse. partial` flag (new in 3.1) indicates if your response contains full or partial metadata results. Note that the SDK returns a full metadata response only i f a single, best match response is returned.

To get full metadata after a partial response, your app would need to call `GNOperations.fetchByTrackId`.

Since the local cache only contains partial metadata, a locally-identified match requires an additional online lookup for full metadata. Doing this will require an Internet connection and an additional 800ms -1 second to resolve the request. If `GNConfig.allowfullresponse` is `true,` and you do NOT have an Internet connection, your app will receive an "Internet Connection" error.

Note that it is possible for `partial` and `allowFullResponse` to both be `true`. This can occur if the network is not available and metadata is returned from cache. Your application should check the value of `partial` EVEN IF `allowFullResponse` is `true` and not assume full metadata.

The following operations use local cache lookup:

1. GNRecognizeStream.idNow
2. GNOperations.recognizeMIDStreamFromMic
3. GNOperations.recognizeMIDStreamFromPcm

MusicID-Stream

MusicID-Stream can be used to recognize a song snippet, such as a recording received from the device microphone or from an Internet stream. Mobile Client provides the following APIs for MusicID-Stream recognition:

- `GNAudioSourceMic:` Class that provides microphone management and recording listening - start/stop, pause/resume listening.
- `GNRecognizeStream`: Class designed for fastest streaming audio recognition from a microphone source.
- `GNOperations.recognizeMIDStreamFromMic`: Method designed for simplicity.

- `GNOperations.recognizeMIDStreamFromPcm`: Method designed for flexibility in audio input from a non-microphone source.

> ⚠ The `GNAudioSourceMic` APIs are designed to give developers a simpler interface with improved recognition, particularly in difficult audio environments. With these APIs, your application is responsible for managing the Audio Session. This includes setting the Audio Session to the appropriate category for your application and activating/deactivating the Audio Session as necessary. You may want to use these APIs if, for example, your app needs to restart the audio while running in the background. For more information, see Apple's Audio Session reference documentation.

Supported Sampling Rates for MusicID-Stream:

- 8000 Hz
- 44100 Hz

GNAudioSourceMic

This class provides 3 methods for complete microphone management and listening:

- Start or resume listening - `startRecording`
- Pause listening - `pauseRecording`
- Stop listening - `stopRecording`

> ℹ It is recommended that, if possible, your app use this class, as it provides the easiest way to interface with the device microphone.

The following steps illustrate how to use the `GNAudioSourceMic class:`

1. Allocate and Initialize a `GNAudioConfig` object with these recommended settings:
    - Number of channels: mono (1)
    - Sample rate: 44.1K (entered as 44100.0)
    - Bytes per sample: 16-bit mono(2)
2. Allocate a `GNAudioSourceMic` object using your `GNAudioConfig` object.
3. Instantiate a class which implements `GNAudioSourceDelegate` and code a `audioBufferDidBecomeReady` method for it. The SDK calls this method when recorded audio is available.
4. Set the class that implements `GNAudioSourceDelegate` as a delegate to your `GNAudioSourceMic` object.
5. To start or resume listening, call `startListening`.
6. To pause listening, call `pauseListening`.
7. To stop listening, call `stopListening`.

Using `GnAudioSourceMic` code sample:

```
//** Class which implements GNAudioSourceDelegate
@interface GN_Music_SDK_iOSViewController : UIViewController <GNAudioSourceDelegate>
{
//** ...
```

```
//** Allocate and initialize Audio Configuration object
audioConfig = [GNAudioConfig gNAudioConfigWithSampleRate:44100 bytesPerSample:2 numChannels:1];

//** Allocate and initialize GNAudioSourceMic object
audioSourceMicObj = [GNAudioSourceMic gNAudioSourceMic:self.audioConfig];

//**
//** Provide GNAudioSourceDelegate to GNAudioSourceMic object.
//** SDK calls delegate's "audioBufferDidBecomeReady" method when recorded data is
//** available.
//**
audioSourceMicObj.delegate=self;

//** Start or resume listening
[audioSourceMicObj startRecording];

//...
// Stop listening
// [audioSourceMicObj stopRecording];

// Pause listening
// [audioSourceMicObj pauseRecording];

//** Sample audioBufferDidBecomeReady method
//**
- (void) audioBufferDidBecomeReady:(GNAudioSource*)audioSource samples:(NSData*)samples {
    NSError *err;

    //**
    //** Call GNRecognizeStream.writeBytes method which performs ID and returns results
    //**
    err = [self.recognizeFromStream writeBytes:samples];

    if (err) {
        NSLog(@"ERROR: %@",[err localizedDescription]);
    }
}
```

GNRecognizeStream

The `GNRecognizeStream` class provides APIs to quickly recognize streaming audio coming from a device's microphone. Using this class, a Mobile Client application can continually stream audio from the microphone to an audio buffer as PCM (pulse-code modulation) data.

Though buffering begins immediately, the sample application calls the `idNow` method to initiate the audio recognition process. All results are delivered as a result-ready object implementing the `GNSearchResultReady` interface. During the audio recognition process, Mobile Client sends operation progress status updates to the application.

The following steps illustrate how to use the `GNRecognizeStream class:`

1. Initialize `GNConfig`. If the device has a bundle, set up the local database using `localCache()`. For more information, see Setting Up a Local Cache of Music Metadata for MusicID Stream (see page 12).
2. Initialize a `GNAudioConfig` object with these recommended settings:
   - Number of channels: mono (1)-
   - Sample rate: 44.1K (entered as 44100.0)
   - Bytes per sample: 16-bit mono(2)
3. Create a class that implements receiving buffered audio input from the device microphone (see the `GN_Music_SDK_iOSViewController` class in the sample application for an example implementation) . The method you need to implement is `(void) audioBufferDidBecomeReady:(GNAudioSource*)audioSource samples:(NSData*)samples.`
4. Create a class that implements the `GNSearchResultReady` protocol to receive a recognition result. The Mobile Client SDK invokes this in the main thread when a search result is ready.
5. Call `startRecognizeSession:audioConfig:` passing in your `GNSearchResultReady` object and `GNAudioConfig` object.
6. Start recording using the class instance you created in Step 3.
7. As audio input is buffered continually, write the samples to the SDK using the `GNRecognizeStream.writeBytes:` method.
8. Implement a recognition operation (`idNow`) when user taps an **ID Now** button.
9. Once a match is found, your app receives a `GNSearchResult` object in its `GNSearchResultReady` callback.
10. Call `GNRecognizeStream.stopRecognizeSession` to stop recognition session and `stopRecording` to stop recording when your application goes into the background.

> **Note**
>
> After `idNow` is called, the Sample Application remains in "recognition mode" until the audio is recognized. Repeated requests (such as repeated tapping of an **ID Now** button) are ignored.

Best Practices for GNRecognizeStream

Follow these guidelines when implementing MusicID-Stream recognition with `GNRecognizeStream`.

- Use this class in conjunction with an `GNAudioSourceMic` instance for a complete end-to-end listening and identification solution.
- Gracenote recommends using an audio buffer size of 2048 bytes for best matches.
- Once started, the recognition session will continually buffer audio received from the microphone until you stop the session. For example, you may want to stop the session when the application goes into background mode, or when the user receives a phone call.
- Callbacks for `GNRecognizeStream` are called on a background thread. If your callback needs to update the UI, it should switch to the main thread.

Best Practices for Handling Interrupts While Recording

To handle interrupts while recording, you should implement an interrupt listener which stops/start recording depending on interruption state. The following code from the sample application implements this:

```
// To register interruptionListenerCallback in Audio Session (To be placed in ViewDidLoad)
AudioSessionInitialize (
                            NULL,
                            NULL,
                            interruptionListenerCallback,
                            self
                            );
// Implementation of interruptionListenerCallback method
void interruptionListenerCallback (

                                  void    *inUserData,
                                  UInt32  interruptionState
                                  ) {

    GN_Music_SDK_iOSViewController *controller = (GN_Music_SDK_iOSViewController *) inUserData;

    if (interruptionState == kAudioSessionBeginInterruption && ([UIApplication
sharedApplication].applicationState==UIApplicationStateActive || [UIApplication
sharedApplication].applicationState==UIApplicationStateInactive))
    {

        NSLog(@"Inturpt Begin");
        [controller.objAudioSource stopRecording];

    } else if (interruptionState == kAudioSessionEndInterruption && ([UIApplication
sharedApplication].applicationState==UIApplicationStateActive || [UIApplication
sharedApplication].applicationState==UIApplicationStateInactive) ) {

        NSLog(@"Inturpt ended");
        [controller.objAudioSource startRecording];

    }
}
```

You should stop the recording and the GNRecognizeStream session when the application goes into the background and it should be restarted when the application returns to the foreground as shown here:

```
-(void)applicationDidEnterInBackground{

    [self.objAudioSource stopRecording];
    [self.recognizeFromPCM stopRecognizeSession];

}

-(void)applicationWillEnterInForeground{

    RecognizeStreamOperation *op = [RecognizeStreamOperation recognizeStreamOperation:self.config];
```

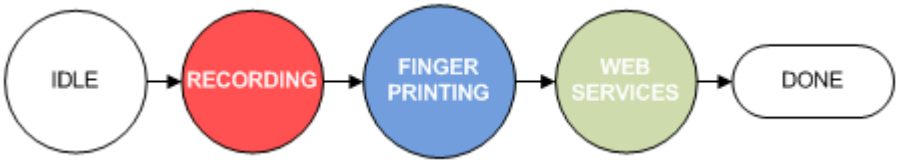
```
    [self.recognizeFromPCM startRecognizeSession:op audioConfig:self.audioConfig];
    [self.objAudioSource startRecording];
}
```

If the User wants to set playback or similar functionality along with the MSDK recording functionality then appropriate audio session properties like `AudioSessionCategory_PlayAndRecord` need to be set.

GNOperations.recognizeMIDStreamFromMic

`GNOperations.recognizeMIDStreamFromMic` recognizes audio recorded from the microphone and is the simplest way to recognize music playing in the user's environment.

When invoked, Mobile Client takes device microphone control and records 6.5 seconds of audio. This audio is processed and a MusicID-Stream fingerprint is generated. The fingerprint is then submitted to Gracenote Web Services for recognition. The result is delivered via an object that implements the `GNSearchResultReady` interface.



Status flow in stream-based audio recognition

The following example shows how to invoke `GNOperations.recognizeMIDStreamFromMic`.

```
// Create result-ready object to receive recognition result
ApplicationSearchResultReady* searchResultReady = [ApplicationSearchResultReady alloc];

// Invoke recognition operation
[GNOperations recognizeMIDStreamFromMic: searchResultReady config: config];
```

During audio recognition, Mobile Client sends status updates to notify the application of progress.

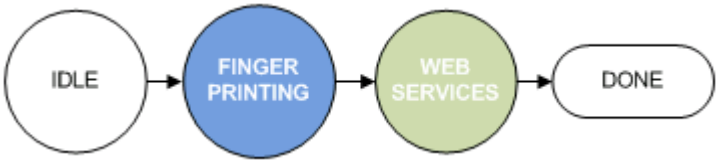
Note

No more than one application can access the microphone at a time; consequently, recording is a blocking operation. The iOS platform blocks attempts to access a microphone that is already in use.

GNOperations.recognizeMIDStreamFromPcm

`GNOperations.recognizeMIDStreamFromPcm` recognizes audio provided as PCM (pulse-code modulation) buffered data. This provides the application with additional flexibility: for example, the application can recognize audio from external streaming audio sources such as a radio signal or an Internet stream.

When invoked, Mobile Client reads the PCM audio data. The audio is processed and a MusicID-Stream fingerprint is generated. The fingerprint is then submitted to Gracenote Web Services for recognition. The result is delivered via an object implementing the `GNSearchResultReady` interface.



Status flow in PCM-based audio recognition

The following example shows how to invoke `GNOperations.recognizeMIDStreamFromPcm`.

```
// Create PCM sample buffer
GNSampleBuffer* sampleBuffer = [GNSampleBuffer gNSampleBuffer: samples bytesPersample: 1 numChannels: 1
sampleRate: 8000];

// Create result-ready object to receive recognition result
ApplicationSearchResultReady* searchResultReady = [ApplicationSearchResultReady alloc];

// Invoke recognition operation
[GNOperations recognizeMIDStreamFromPcm: searchResultReady config: config sampleBuffer: sampleBuffer];
```

During audio recognition, Mobile Client will send operation progress status updates to your application.

Note

The PCM audio sample must be at least 6.5 seconds long for Mobile Client to successfully generate a MusicID-Stream fingerprint.

Audio Sessions and Audio Categories

Mobile Client does not create an iOS audio session, and consequently does not set an iOS audio category when recording audio from the microphone. This leaves your application free to set the audio category appropriately. Although Mobile Client may still be able to record from the microphone even without setting the audio category, Gracenote recommends that you do create an audio session and set the audio category yourself. This will allow your application to react appropriately to system events and state changes, such as when a phone call is received. For information on audio sessions and audio categories, see the *Audio Session Programming Guide,* available from Apple (http://developer.apple.com/library/ios/#documentation%2FAudio%2FConceptual%2FAudioSessionProgrammingGuide%2FCo).

If your application needs to incorporate audio features beyond Mobile Client's microphone-recognition capability, it *must* create an audio session and set the audio category. For example, if the application is required to play audio and also use Mobile Client to recognize audio from the microphone, it must use the playing and recording audio category.

Recording audio categories should be used only while the device is actually recording. When using Mobile Client's recognize-from-microphone feature, set the audio category to the appropriate recording category before invoking the operation, then monitor the operation's status-changed events and switch to a non-recording category when recording has completed. See Status Change Updates (see page 48), below, for more information.

Note

For some applications, it may be inconvenient for Mobile Client to access the audio subsystem. In this case, audio can still be recognized through Mobile Client's recognize-from-PCM functionality. Your application can interact with the audio subsystem to obtain raw PCM audio data and provide it to Mobile Client for recognition.

For more information on the different implementation options, contact your Gracenote Professional Services representative.

MusicID-File

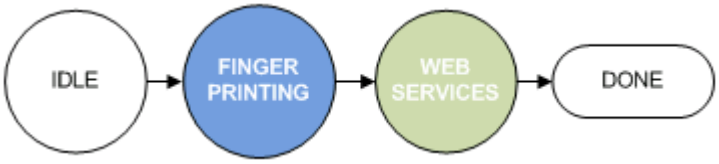
MusicID-File can be used to recognize an audio file.

Mobile Client provides two methods for invoking a MusicID-File recognition, one designed for simplicity, the other for flexibility.

GNOperations.recognizeMIDFileFromFile

`GNOperations.recognizeMIDFileFromFile` recognizes audio files stored on the device.

When invoked, Mobile Client decodes the audio file. The audio is processed and a MusicID-File fingerprint is generated. The fingerprint is then submitted to Gracenote Web Services for recognition. The result is delivered via an object implementing the `GNSearchResultReady` protocol.



Status flow in file-based audio recognition

Mobile Client can recognize audio files in the following formats:

- `.wav`
- `.mp3`
- `.aac`
- `.caf`
- `.aaif`

The following sampling rates are supported, in both monaural and stereo:

- 8000 Hz
- 44100 Hz

This functionality is available only for certain devices running iOS 4.0 or higher. As shown in the following table, all supported devices can recognize audio files stored in the document directory and most can also recognize files in the iPod library:

Device	Document directory	iPod library
iPod Touch, 4th generation	Yes	Yes
iPhone 3G	Yes	No
iPhone 3Gs	Yes	Yes

iPhone 4 or higher	Yes	Yes

⚠ Files containing video components are not supported.

⚠ To recognize audio files stored in the device's document directory, you must enable iTunes file sharing by setting **Application supports iTunes file sharing = True** in your application's `plist` file.

Also, iOS may occasionally deny access to files in the document directory based on the state and actions of other applications running on the device. For example, this could happen if

- there is an incoming phone call
- your application is in the background and another application starts playback

In these cases, Mobile Client will return an appropriate error. It is recommended that you test your application to ensure that it responds appropriately to such iOS limitations.

⚠ Processing an audio file requires approximately 20 seconds of audio and that audio must come from the start of the track.

⚠ Invoking file-based recognition on an audio file stored in the iPod library will cause it to stop being played if it is currently being played by the iPod.

To recognize audio from a file, use the method `GNOperations:recognizeMIDFileFromFile`. This method requires a URL to the desired file, as shown in the following code fragment:

```
// Create URL from file path
NSURL* fileURL = [NSURL fileURLWithPath: filePath];

// Use URL to recognize audio file
RecognizeFromFileOperation* op = [RecognizeFromFileOperation recognizeFromFileOperation: config];
[GNOperations recognizeMIDFileFromFile: op config: config fileUrl: fileURL];
```

GNOperations.recognizeMIDFileFromPcm

`GNOperations.recognizeMIDFileFromPcm` recognizes audio provided as a buffer of PCM (pulse-code modulation) data. This provides the application with additional flexibility: for instance, file formats not directly supported by Mobile Client can be decoded by the application to PCM and recognized via this method.

When invoked, Mobile Client reads the PCM audio data. The audio is processed and a MusicID-File fingerprint is generated. The fingerprint is then submitted to Gracenote Web Services for recognition. The result is delivered via an object that implements the `GNSearchResultReady` interface.

Status flow in PCM-based audio recognition

The following example shows how to invoke `GNOperations.recognizeMIDFileFromPcm`.

```
// Create PCM sample buffer
GNSampleBuffer* sampleBuffer = [GNSampleBuffer gNSampleBuffer: samples bytesPersample: 1 numChannels: 1
sampleRate: 8000];

// Create result-ready object to receive recognition result
ApplicationSearchResultReady* searchResultready = [ApplicationSearchResultReady alloc];

// Invoke recognition operation
[GNOperations recognizeMIDFileFromPcm: searchResultready config: config sampleBuffer: sampleBuffer];
```

During audio recognition, Mobile Client sends status updates to notify the application of progress.

⚠ Processing an audio file requires approximately 20 seconds of audio from the track's start.

AlbumID

AlbumID is a powerful and flexible recognition processing tool that can be used to provide advanced recognition of audio files within the user's collection. By leveraging contextual information about the audio files, AlbumID can effectively identify, group, and organize a collection, providing clean and consistent metadata. It is best used for:

- Analyzing groups of media files, where the grouping of results is as important as the accuracy of the individual results
- Receiving responses that match the contextual data of an audio file, such as metadata from ID3 tags

AlbumID can be used to recognize items in the application's document directory or in the device's iPod library. It uses a variety of combinations of the following recognition methods and inputs:

- MusicID-File fingerprinting: Audio files in supported formats are decoded and a MusicID-File fingerprint is then generated.
- Text search and text comparison: Metadata from ID3 tags extracted from supported file formats or additional text information provided by the application are used to search for appropriate tracks and albums.
- Gracenote Identifiers: Audio files sometimes have an associated Gracenote Identifier, which Mobile Client can use for consideration during the identification process.
- Audio file groupings: Files can be analyzed in groups, which allows common albums to be determined based on the tracks in the group.
- Audio file name and file-system (folder) location: As music collections are often grouped by directory (Artist/Album/Track), file name and location can also used during identification. Only files in the application's Document directory can be recognized.

⚠ Fingerprints cannot be generated for files containing video components.

⚠ To recognize audio files stored in the device's document directory, you must enable iTunes file sharing by setting **Application supports iTunes file sharing = True** in your application's `plist` file.

iOS can occasionally deny access to document directory files based on the state and actions of other running device applications. This could, for example, happen in the following cases:

- There is an incoming phone call
- Your application is in the background and another application starts playback

In these cases, Mobile Client will return an appropriate error. It is recommended that you test your application to ensure that it responds appropriately to such iOS limitations.

An audio file requires approximately 20 seconds of audio to successfully generate a fingerprint.

Invoking AlbumID with fingerprinting on an audio file stored in the iPod library will cause it to stop if the iPod is currently playing it. The AlbumID configuration can be altered to omit fingerprinting.

While commerce identifiers can be requested, AlbumID does not support the preference of a specific identifier over the actual Album a song came from. These preferred results can instead be obtained by using `GNOperations.recognizeMIDFileFromFile` or `GNOperations.recognizeMIDFileFromPcm`. See MusicID-File (see page 22) for more information.

Mobile Client provides various ways to invoke AlbumID, allowing the developer to choose between a simplified or more flexible implementation.

You can improve retrieval performance for AlbumID by retrieving enriched content in the background. For more information, see Improving Retrieval Performance by Using Enriched Content URLs (see page 65).

Calling AlbumID Operations Serially

An application should call AlbumID operations serially (one at a time). An application should only call another operation after the previous operation has completed. If multiple AlbumID operations are called concurrently with many tracks (for example, 1000 tracks per AlbumID directory operation), it might impact device performance and cause the application to run out of memory.

GNOperations.albumIdFromMPMediaItemCollection:config:collection

`GNOperations.albumIdFromMPMediaItemCollection:config:collection` can be used to recognize items from the device's iPod library. A collection of `MPMediaItem` objects can be provided for recognition.

The following code sample shows how to invoke `GNOperations.albumIdFromMPMediaItemCollection:config:collection`

```
// Using MPMediaPickerController get MPMediaItemCollection for selected files from iPodLibrary
//
// Create result-ready object to receive recognition result.
// ApplicationSearchResultReady must implement the GNSearchResultReady interface
//
- (void)mediaPicker: (MPMediaPickerController *)mediaPicker didPickMediaItems:(MPMediaItemCollection
*)mediaItemCollection {
ApplicationSearchResultReady* searchResultready = [ApplicationSearchResultReady alloc];


// Invoke AlbumID operation with the result-ready object, a GNConfig object
// instance and a MPMediaItemCollection which contains iPod library files to identify
//
?[GNOperations albumIdFromMPMediaItemCollection:searchResultready config:config
```



```
collection:mediaItemCollection];
}
```

GNOperations.albumIdDirectory:config:directoryPath

`GNOperations.albumIdDirectory:config:directoryPath` takes a single directory path and identifies all directory audio files, including those in sub-directories. This method can only recognize files in the application's Document directory.

The following code example shows how to invoke `GNOperations.albumIdDirectory`.

```
// Create result-ready object to receive recognition result.
// ApplicationSearchResultReady must implement the GNSearchResultReady interface
ApplicationSearchResultReady* searchResultready = [ApplicationSearchResultReady alloc];

// Invoke AlbumID operation with the result-ready object, a GNConfig object
// instance and the root of the directory tree to be processed
[GNOperations albumIdDirectory:searchResultReady config:config directoryPath:documentDirectryPath];
```

When invoked, this method performs the following operations:

1. Searches the directory tree and locates audio files that are supported by the Gracenote MusicID-File audio decoder or AlbumID tag decoder
2. Generates MusicID-File fingerprints for files in supported formats
3. Extracts information tags from supported formats which can include artist, album and track information, and Gracenote Identifiers
4. The recognition inputs collected via the above steps are combined with the file name and path, and delivered to the Gracenote Service for identification; this may result in multiple queries to the Gracenote Service
5. The identification results are delivered to the application

The behavior of `GNOperations.albumIdDirectory:config:directoryPath` can be controlled via the AlbumID configuration parameters. See AlbumID Configuration (see page 28) for more information.

GNOperations.albumIdFile:config:filePaths

`GNOperations.albumIdFile:config:filePaths` takes the filenames and paths of a collection of audio files and applies AlbumID identification for grouping and organizing.
This method allows targeted identification of groups of audio files, or a single audio file, utilizing all of the recognition technologies available to AlbumID. This method can only recognize files in the application's Document directory.

The following code example shows how to invoke `GNOperations.albumIdFile:config:filePaths`.

```

```



```
// Create result-ready object to receive recognition result.
// ApplicationSearchResultReady must implement the GNSearchResultReady interface
ApplicationSearchResultReady* searchResultready = [ApplicationSearchResultReady alloc];

// Assemble a collection of audio files filename and path
NSArray *filesToIdentify = [NSArray arrayWithObjects:filePath1,filePath2,filePath3,nil];

// Invoke AlbumID operation with the result-ready object, a GNConfig object
// instance and a collection of files to identify
[GNOperations albumIdFile:searchResultReady config:config filePaths:filesToIdentify];
```

When invoked, this method performs the following operations:

1. Generates MusicID-File fingerprints for files in supported formats
2. Extracts information tags from supported formats which can include artist, album and track information and Gracenote Identifiers
3. The recognition inputs collected via the above steps are combined with the file name and path and delivered to the Gracenote Service for identification; this may result in multiple queries to the Gracenote Service

The behavior of `GNOperations.albumIdFile:config:filePaths` can be controlled via the AlbumID configuration parameters. See AlbumID Configuration (see page 28) for more information.

GNOperations.albumIdList:config:list

`GNOperations.albumIdList:config:list` takes a collection of objects where each object contains the recognition inputs for an audio file. Recognition inputs are:

1. MusicID-File Fingerprint
2. Textual metadata:
    1. Artist Name
    2. Album Title
    3. Track Title
    4. Track Number
3. File name and path
4. Gracenote Identifiers

AlbumID does not require all of the above inputs to be effective; it can use only those provided to assist identification. Note this also means that text can be used if no fingerprint can be created, allowing AlbumID to be used for audio files that Mobile Client cannot access or decode. Mobile Client does not provide a method to export Gracenote Identifiers from a file directly to the application; however, the query result contains these identifiers, which can be used for subsequent AlbumID List queries.

The following code example shows how to invoke `GNOperations.albumIdList:config:list`.


```
// Create result-ready object to receive recognition result.
// ApplicationSearchResultReady must implement the GNSearchResultReady interface
ApplicationSearchResultReady* searchResultready = [ApplicationSearchResultReady alloc];

// Assemble a collection of GNAlbumIdAttributes objects.
// Each GNAlbumIdAttributes has the recognition inputs for a specific file.
ArrayList<GNAlbumIdAttributes> filesToIdentify = new ArrayList<GNAlbumIdAttributes>();

// Assemble the recognition inputs for individual audio files into GNAlbumIdAttributes instances
    GNAlbumIdAttributes * fileAttrib = [GNAlbumIdAttributes gNAlbumIdAttributes:@""
                                        identifier:@"List1"
                                        albumTitle:@"Keep the Faith"
                                        trackTitle:@""
                                        trackNumber:@""
                                        genre:nil
                                        artist:@"Bon Jovi"
                                        gnId:nil
                                        fingerPrintData:fingerprintString];
NSArray *filesToIdentify = [NSArray arrayWithObjects: fileAttrib,nil];

// Invoke AlbumID operation with the result-ready object, a GNConfig object
// instance and a collection of files to identify
[GNOperations albumIdList: searchResultready config:config list: filesToIdentify];
```

When this method is invoked, the recognition inputs for each file are delivered to Gracenote Web Services for identification, which may result in multiple queries to Gracenote Web Services.

The behavior of `GNOperations.albumIdList` can be controlled via the AlbumID configuration parameters. See AlbumID Configuration (see page 28) for more information.

AlbumID Configuration

To control AlbumID behavior, your application can configure the `GNCOnfig` object used for AlbumID operations. The configuration parameters are described below.

Parameter	Description	Default
`content.albumId.queryPreference.useTagData`	If `true`, AlbumID uses textual metadata to identify an audio file.	`true`
`content.albumId.queryPreference.useFingerprint`	If `true`, AlbumID uses MusicID-Fingerprints to identify an audio file.	`true`
`content.albumId.queryPreference.useGN_ID`	If `true`, AlbumID uses a Gracenote Identifier to identify an audio file.	`true`

AlbumID Query Load

AlbumID is capable of recognizing large music collections and, in most cases, will use multiple queries for track recognition and retrieval of related content.

To assist with recognition, Mobile Client groups audio files. The number of groupings determines how many queries are used for recognition. Audio file groupings are based on:

1. The audio files' metadata (tag data is used to group similar tracks)
2. The audio files' organization (files can be grouped based on the directories they reside in)
3. The limit of the recognition interface

Because track metadata and organization impacts file groupings, it is difficult to predict how many recognition queries will be needed.

Once audio files are recognized, your application can access related content via the result objects. Although queries are batched in multiple groups, the responses for all the grouped queries are provided to the application at one time, at operation end.

The example below provides an indication of the number of queries that are required for AlbumID. This example can be extrapolated to larger collections requiring similar content to be delivered.

AlbumID Query Load Example

Consider an audio collection organized as shown below.

Assume:

- All tracks have accurate Artist Name, Album Title, and Track Title tag data.
- No Gracenote Identifiers are known for any of the files.

```
/sdcard/Red Hot Chili Peppers/By The Way/By The Way.mp3
/sdcard/Red Hot Chili Peppers/By The Way/Universally Speaking.mp3
/sdcard/Red Hot Chili Peppers/By The Way/This Is The Place.mp3
/sdcard/Red Hot Chili Peppers/By The Way/Dosed.mp3
/sdcard/Red Hot Chili Peppers/By The Way/Don't Forget Me.mp3
/sdcard/Red Hot Chili Peppers/By The Way/...
/sdcard/Midnight Oil/10, 9, 8, 7, 6, 5, 4, 3, 2, 1/Outside World.mp3
/sdcard/Midnight Oil/10, 9, 8, 7, 6, 5, 4, 3, 2, 1/Only The Strong.mp3
/sdcard/Midnight Oil/10, 9, 8, 7, 6, 5, 4, 3, 2, 1/Short Memory.mp3
/sdcard/Midnight Oil/10, 9, 8, 7, 6, 5, 4, 3, 2, 1/Read About It.mp3
/sdcard/Midnight Oil/10, 9, 8, 7, 6, 5, 4, 3, 2, 1/Scream In Blue.mp3
/sdcard/Midnight Oil/10, 9, 8, 7, 6, 5, 4, 3, 2, 1/...
```

Using `albumIdDirectory`, the base directory `/sdcard` would be provided. The AlbumID algorithm will create two groups, one for Red Hot Chili Peppers and one for Midnight Oil. An identification query is generated for each group.

After identification is completed, the results are provided via a result-ready object. The application can then process the individual track results by processing the respective `GNSearchResponse` object.

Related content, such as Cover Art, is not included in the initial result set. When the application calls `GNSearchResponse.getCoverArt()`, a query is generated to fetch the cover art.

The application should only call `GNSearchResponse.getCoverArt()` for one track on each album. This is to avoid the same Cover Art from being fetched more than once. The application should include some intelligence to ensure this.

In this example, the minimum number of queries required to identify the audio tracks and retrieve the track and album metadata and cover art for each album is four:

- Two queries for identification
- One query to retrieve Cover Art for the Red Hot Chili Peppers' album By The Way
- One query to retrieve Cover Art for Midnight Oil's album 10, 9, 8, 7, 6, 5, 4, 3, 2, 1

Applications can minimize the number of queries made through correct configuration, analysis, and result storage. Your Gracenote Professional Services representative can help design an appropriate solution for your specific needs.

Single Best Match and Multiple Matches

The MusicID-Stream and MusicID-File audio recognition operations can return a *single best match* or multiple matches. The default configuration returns a single best match, but, to change this, you can configure the `GNConfig` instance used when invoking the recognition operation. The multiple match configuration property is described below.

Parameter	Description	Default
`content.musicId.queryPreference.singleBestMatch`	If `true`, a single best match is returned for MusicID-Stream and MusicID-File recognition operations. If `false`, multiple matches are returned.	`true`

When configured for a single best match, characteristics of all possible matches are compared against your application's specific criteria. To change the best match criteria, you can set configuration object properties.

When multiple matches are configured, all matches are delivered, up to ten maximum. Your application can then apply its own criteria to determine the best match to display to the user. Your app could also allow the user to choose the best match.

Text and Lyric Fragment Search operations always return multiple matches and AlbumID always returns a single match.

Single best match queries can be configured to return cover art in the recognition response. Cover art is not delivered with the responses containing multiple matches; however, it can be retrieved with an additional Gracenote Identifier (see Retrieving Related Content by Gracenote Identifier (see page 46)).

Fingerprints

Gracenote Web Services uses audio fingerprints to match audio with metadata and cover art. Mobile Client can generate audio fingerprints from either of the following sources:

- Audio captured from the microphone or other streaming audio source
- Pulse-code modulation (PCM-encoded) audio stored in a buffer

Generating a Fingerprint

Fingerprints are returned via a result-ready object implementing the Mobile Client `GNFingerprintResultReady` protocol. When a result is generated, Mobile Client calls the result-ready object's `GNResultReady` method. Your application can use this method to process the result:

```
// Result-ready object implements GNFingerprintResultReady protocol
@ interface ApplicationFingerprintResultReady : NSObject <GNFingerprintResultReady>
{
}
@ end

// Provide implementation for GNResultReady method
@ implementation ApplicationFingerprintResultReady
- (void) GNResultReady: (GNFingerprintResult*) result
{
    // Application code to process fingerprint result
}
@ end
```

Your application must create the result-ready object and provide it when invoking the fingerprint generation operation:

```
// Create result-ready object to receive fingerprint result
ApplicationFingerprintResultReady* fingerprintResultReady = [ApplicationFingerprintResultReady alloc];

// Invoke fingerprint generation operation
[GNOperations fingerprintMIDStreamFromPcm: fingerprintResultReady config: config sampleBuffer:
sampleBuffer];
```

Searching by Fingerprint

To submit a fingerprint to Gracenote Web Services for matching, use the `GNOperations:searchByFingerprint` method:

```
// Create result-ready object to receive matching result
ApplicationSearchResultReady* searchResultReady = [ApplicationSearchResultReady alloc];

// Invoke matching operation
[GNOperations searchByFingerprint: searchResultReady config: config fingerprintData: fp];
```

A collection of possible matches is returned as the search result. During fingerprint matching, Mobile Client sends operation status updates to your application.

Status flow in fingerprint matching

Text Search

Using the `GNOperations:searchByText:config:artist:albumTitle:trackTitle` method, Mobile Client can perform a text-based search in the Gracenote database for an album title, track title, and/or artist name. These three fields can be combined in different ways to narrow the search results:

```
// Create result-ready object to receive search result
ApplicationSearchResultReady* searchResultReady = [ApplicationSearchResultReady alloc];

// Invoke search operation
[GNOperations searchByText: searchResultReady config: config artistName: artistName albumTitle: albumTitle
trackTitle: trackTitle];
```

A collection of possible matches is returned as the search result. To get an exact match, use a Gracenote unique identifier instead of a text search (see Retrieving Related Content by Gracenote Identifier (see page 46) , below). During the search process, Mobile Client sends operation status updates to your application.

Status flow in text search

Lyric Fragment Search

Using the `GNOperations:searchByLyricFragment:config:lyricFragement:artist` method, Mobile Client can search the Gracenote database using a lyric fragment, optionally augmented with an artist name:

```
// Create result-ready object to receive search result
ApplicationSearchResultReady* searchResultReady = [ApplicationSearchResultReady alloc];

// Invoke search operation
[GNOperations searchByLyricFragment: searchResultReady config: config lyricFragment: lyricFragment artist:
artistName];
```


A collection of possible matches is returned as the search result. During the search process, Mobile Client sends operation status updates to your application.

Status flow in lyric fragment search

Retrieving Related Content

Mobile Client can retrieve content related to an audio recognition result, including:

- Genre
- Mood
- Tempo
- Origin
- Era
- Artist Type
- Cover Art
- Artist Images
- Artist Biographies
- Album Reviews

You can retrieve related content from an audio recognition operation result or via a Gracenote unique album or track identifier.

For more information on using Mobile Client returned images, see Image Resizing Best Practice (see page 58).

Genre

Mobile Client returns album and track level genre descriptors with a recognition or search result. Genre descriptors can be displayed to the end-user or can be used to categorize music in the user's collection for organization, navigation, or playlist generation.

Genre Levels

Gracenote has multiple levels of genre descriptors. Each level describes the related music with a different amount of detail and granularity.

Two options for genre are available: `DEFAULT` and `EXTENDED`. The `DEFAULT` option returns a single, default genre descriptor in the result. The `EXTENDED` option returns multiple levels of genre descriptors in the result.

The recommended option to use depends upon the application, its use-cases, and target audience. Some applications might want to use the `DEFAULT` option, as it is the simplest and contains the most commonly known genres. Other apps might want to provide a richer genre experience via the multiple levels in the `EXTENDED` option. Applications might also use the `EXTENDED` option to give their users a choice of which genre level is used.

You can configure Mobile Client operation genre options with the following `GNConfig` object property. This object is used when invoking a `GNOperations` method.

Parameter	Description	Default
`content.genre.level`	Sets the option for the genre descriptors returned; DEFAULT and EXTENDED	`DEFAULT`

Genre Localization

You can configure Mobile Client to deliver genres specific to a supported country and language with the following `GNConfig` object properties:

Parameter	Description	Default
`content.lang`	Specifies the language of the delivered genre descriptors (using ISO lang code)	""
`content.country`	Specifies the country of the delivered genre descriptors (using ISO country code)	"" Prior to release 2.5.8, the default was "USA".

See Localization and Internationalization (see page 50) for more information.

Accessing Genres

Genre data is delivered via a result-ready object in a `GNDescriptor` instance. Since multiple genre levels can be delivered for a single album or track, a collection of `GNDescriptor` objects is returned.

The delivered genre levels are stored in an array of `GNDescriptor` objects. The order of the `GNDescriptor` objects in the collection is representative of their level.

A descriptor and an identifier define a genre. The descriptor is a word or phrase describing the genre and should only be used for end-user display. Because descriptor names and user language settings are subject to change, the identifier is best suited for dealing with genre associations in a programmatic fashion.

The `GNDescriptor` object is fully described in the data dictionary, see GNDescriptor (see page 54).

The following code snippet shows how genres can be retrieved from a result-ready object.

```
// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestResponse = [result bestResponse];

    if (bestResponse != nil)
    {
        // Extract related content from response
        NSArray* trackMood = bestResponse.trackGenre;
        NSArray* albumMood = bestResponse.albumGenre;

        // Display or store album and track genre as desired
    }
}
@ end
```

Mood

Mobile Client can return track level mood descriptors with a recognition or search result. Mood descriptors can be displayed to the end-user or can be used to categorize music in the user's collection for organization, navigation, or playlist generation.

Your application must be entitled to retrieve mood data. To entitle your application, please contact your Gracenote Professional Services representative.

You can configure a Mobile Client operation to include mood descriptors in its response with the following `GNConfig` object properties. This object is used when the operation is invoked.

Parameter	Description	Default
`content.mood`	Set to `true` to enable retrieval of mood descriptors	`false`
`content.mood.level`	Sets the option for the mood descriptors returned; `DEFAULT` and `EXTENDED`	`DEFAULT`

Mood Levels

Gracenote has multiple levels of mood descriptors. Each level describes the related music with a different amount of detail and granularity.

Two options for mood are available, `DEFAULT` and `EXTENDED`. The `DEFAULT` option returns a single, default mood descriptor in the result. The `EXTENDED` option returns multiple levels of mood descriptors.

The recommended option to use depends upon the application, its use cases, and target audience. Some applications might want to use the `DEFAULT` option, as it is the simplest and contains the most commonly known moods. Other applications might want to provide a richer experience via the `EXTENDED` option. Applications might also use the the `EXTENDED` option to give their users a choice of which mood level is used.

Mood Localization

To configure Mobile Client to deliver moods in a supported language, you can set the following `GNConfig` object property. This object is used when invoking a `GNOperation`.

Parameter	Description	Default
`content.lang`	Specifies the language of the delivered mood descriptors	""

See Localization and Internationalization (see page 50) for more information.

Accessing Moods

Mood data is delivered via a result-ready object in a `GNDescriptor` instance. Since multiple mood levels can be delivered for a single track, a `GNDescriptor` object array is returned. The order of the `GNDescriptor` objects in the array is representative of their level.

A descriptor and an identifier define a mood . The descriptor is a word or phrase describing the mood and should only be used for end-user display. Because descriptor names and user language settings are subject to change, the identifier is best suited for dealing with mood associations in a programmatic fashion.

The `GNDescriptor` object is fully described in the data dictionary, see GNDescriptor (see page 54).

The following code snippet shows how mood data can be retrieved from a result-ready object.

```
// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestResponse = [result bestResponse];

    if (bestResponse != nil)
    {
        // Extract related content from response
        NSArray* trackMood = bestResponse.mood;

        // Display or store track mood as desired
    }
}
@ end
```


Tempo

Mobile Client can return track-level tempo data with a recognition or search result. Tempo data can be displayed to the end-user or can be used to categorize music in the user's collection for organization, navigation, or playlist generation.

Your application must be entitled to retrieve tempo data. To entitle your application, contact your Gracenote Professional Services representative.

You can configure a Mobile Client operation to include tempo data in its response with the following `GNConfig` object properties. This object is used when invoking the operation.

Parameter	Description	Default
`content.tempo`	Set to `true` to enable retrieval of tempo descriptors	`false`
`content.tempo.level`	Sets the option for the tempo descriptors returned; `DEFAULT` and `EXTENDED`	`DEFAULT`

Tempo Levels

Gracenote has multiple levels of tempo descriptors. Each level describes the related music with a different amount of detail and granularity.

Two options for tempo are available: `DEFAULT` and `EXTENDED`. The `DEFAULT` option returns a single, default tempo descriptor in the result. The `EXTENDED` option returns multiple levels of tempo descriptors.

The recommended option to use depends upon the application, its use cases, and its target audience. Some applications might want to use the `DEFAULT` option, and other applications might want to provide a richer experience via the `EXTENDED` option. Applications might also use the `EXTENDED` option to give their users a choice of which tempo level is used.

Tempo Localization

To configure Mobile Client to deliver tempo in a supported language you can set the following `GNConfig` object property:

Parameter	Description	Default
`content.lang`	Specifies the language of the delivered tempo descriptors	""

See Localization and Internationalization (see page 50) for more information.

Accessing Tempo Data

Tempo data is delivered via a result-ready object in a `GNDescriptor` instance. Since multiple tempo levels could be delivered for a single album or track, an array of `GNDescriptor` objects is returned. The order of the `GNDescriptor` objects in the array is representative of their level.

A descriptor and an identifier define a tempo. The descriptor is a word or phrase describing the tempo and should only be used for end-user display. Because descriptor names and user language settings are subject to change, the identifier is best suited for dealing with tempo associations in a programmatic fashion.

The `GNDescriptor` object is fully described in the data dictionary, see GNDescriptor (see page 54).

The following code snippet shows how tempo data can be retrieved from a result-ready object.

```
// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestResponse = [result bestResponse];

    if (bestResponse != nil)
    {
        // Extract related content from response
        NSArray* trackTempo = bestResponse.tempo;

        // Display or store track tempo as desired
    }
}
@ end
```

Origin, Era, and Artist Type

Mobile Client can return origin, era, and artist type data with a recognition or search result. Origin data gives the geographic location most strongly associated with the artist. Era data gives the time period most strongly associated with the artist. Artist type data gives the artist's gender and composition (solo, duo, group). Origin, era, and artist type data can be displayed to the end-user or used to categorize music in the user's collection for organization, navigation, or playlist generation.

You can configure a Mobile Client operation to include origin, era, and artist type data in its response with the following `GNConfig` object properties. This object is used when the operation is invoked.

Parameter	Description	Default
`content.origin`	Set to `true` to enable retrieval of origin descriptors	`false`
`content.era`	Set to `true` to enable retrieval of era descriptors	`false`
`content.artistType`	Set to `true` to enable retrieval of artist type descriptors	`false`

⚠ Origin, era, and artist type data is delivered as a bundle. If the value of any of the parameters is set to TRUE, all three types of descriptors are delivered. To turn off descriptor delivery, all three parameters must be set to FALSE.

Origin, Era, and Artist Type Levels

Gracenote has multiple levels of origin, era, and artist type descriptors. Each level describes the related music with a different amount of detail and granularity. You can configure the following `GNConfig` properties to determine the origin, era, and artist type descriptors returned:

`content.origin.level`	Sets the option for the origin descriptors returned; `DEFAULT` and `EXTENDED`	`DEFAULT`
`content.era.level`	Sets the option for the era descriptors returned; `DEFAULT` and `EXTENDED`	`DEFAULT`
`content.artistType.level`	Sets the option for the artist type descriptors returned; `DEFAULT` and `EXTENDED`	`DEFAULT`

Two options for origin, era, and artist type descriptors are available: `DEFAULT` and `EXTENDED`. The `DEFAULT` option returns a single, default descriptor in the result. The `EXTENDED` option returns multiple levels of descriptors in the result.

The recommended option to use depends upon the application, its use cases, and target audience. Some applications might want to use the DEFAULT option, and other applications might want to provide a richer experience via the EXTENDED option. Applications might also use the EXTENDED option to give their users a choice of which level is used.

Origin, Era, and Artist Type Localization

You can configure Mobile Client to deliver origin, era, and artist type in a supported language. This can be done with the following `GNConfig` object property. This object is used when invoking a `GNOperation`.

Parameter	Description	Default
`content.lang`	Specifies the language of the delivered tempo descriptors	""

See Localization and Internationalization (see page 50) for more information.

Accessing Origin, Era, and Artist Type Data

Origin, era, and artist type data is delivered via a result-ready object in a GNDescriptor instance. Since multiple levels can be delivered, an array of GNDescriptor objects is returned. The order of the GNDescriptor objects in the array is representative of their level.

A descriptor and an identifier define origin, era, and artist type. The descriptor is a word or phrase describing the origin, era, or artist type and should only be used for end-user display. Because descriptor names and user language settings are subject to change, the identifier is best suited for dealing with origin, era, and artist type associations in a programmatic fashion.

The `GNDescriptor` object is fully described in the data dictionary, see GNDescriptor (see page 54).

The following code snippet shows how origin, era, and artist type data can be retrieved from a result-ready object.

```
// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestResponse = [result bestResponse];

    if (bestResponse != nil)
    {
        // Extract related content from response
        NSArray* originDescriptorsArray = bestResponse.origin;
        NSArray* eraDescriptorsArray = bestResponse.era;
        NSArray* artistTypeDescriptorsArray = bestResponse.artistType;

        // Display or store origin, era, and artist type as desired
    }
}
@ end
```

Retrieving Cover Art

Mobile Client can return album Cover Art with a recognition or search result. Cover Art can be used effectively to enrich the user experience.

Note that only the cover art URL is returned with the result. To get the actual image data, your app needs to invoke the `GNCoverArt.data` accessor method, which should be done in a background thread. See the Sample App for an example of getting cover art data in a background thread.

Your application must be entitled to retrieve Cover Art. To entitle your application, please contact your Gracenote Professional Services representative.

You can configure a Mobile Client operation to include Cover Art in its response with the following `GNConfig` object property. This object is used when invoking the operation.

Parameter	Description	Default
`content.coverArt.sizePreference`	Comma-separated list of cover art size preferences. Also specifies size preference for artist images.	`"SMALL,MEDIUM,THUMBNAIL,LARGE,XLARGE"`

The `sizePreference` parameter takes a comma-separated list of Cover Art sizes, in preference order. Mobile Client returns the first Cover Art image that matches a list size. If a size is not in the list, it is not returned.


If the list contains an invalid size preference, Mobile Client ignores the list and uses the default list instead.

For more information on using Mobile Client returned images, see Image Resizing Best Practice (see page 58).

To improve performance, retrieve cover art in the background. For more information, see Improving Retrieval Performance by Using Enriched Content URLs (see page 65).

Genre Cover Art

If cover art for a particular album is not available, Gracenote returns genre-themed artwork . You can set a `GNConfig` property to disable this option:

Parameter	Description	Default
`content.coverArt.genreCoverArt`	Set to `true` to receive genre cover art when album cover art is not available	`true`

⚠ To receive genre art, both `content.coverArt.genreCoverArt` and `content.coverArt` **must** be set to `true`. Your application also **must** be entitled for cover art.

The Cover Art `sizePreference GNConfig` parameter determines the Genre Cover Art size returned.

For more information on using Mobile Client returned images, see Image Resizing Best Practice (see page 58).

Accessing Cover Art

Cover Art is delivered via a result-ready object as a GNCoverArt object. Cover Art is provided as raw data in NSdata datatype that can be easily used to draw an image.

The `GNCoverArt` object is fully described in the data dictionary, see GNCoverArt (see page 55).

The following code snippet shows how Cover Art can be retrieved from a result-ready object.

```
// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestResponse = [result bestResponse];

    if (bestResponse != nil)
    {
        // Extract related content from response
        GNCoverArt* coverArt = bestResponse.coverArt;

        // Display or store cover art as desired
    }
}
@ end
```

Artist Images

Mobile Client can return an Artist Image with a recognition or search result. Artist Images can be used to effectively enrich the user experience.

Your application must be entitled to retrieve Artist Images. To entitle your application, please contact your Gracenote Professional Services representative.

You can configure a Mobile Client operation to include an Artist Image in its response with the following `GNConfig` object parameters:

Parameter	Description	Default
`content.contributor.images`	Set to `true` to enable retrieval of artist images	`false`
`content.coverArt.sizePreference`	Comma-separated list of artist image size preferences. Also specifies size preference for cover art images.	`"SMALL,MEDIUM,THUMBNAIL,LARGE,XLARGE"`

The `sizePreference` parameter takes a comma-separated list of Artist Image sizes in preference order. Mobile Client returns the first Artist Image that matches a list size. If a size is not in the list, it is not returned.

For more information on using Mobile Client returned images, see Image Resizing Best Practice (see page 58).

To improve performance for some operations, retrieve artist images in the background. For more information, see Improving Retrieval Performance by Using Enriched Content URLs (see page 65).

Accessing Artist Images

Artist Images are delivered via a result-ready object as a `NSData`. The raw data can be easily used to draw an image.

The following code snippet shows how artist images can be retrieved from a result-ready object.

```
// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestResponse = [result bestResponse];

    if (bestResponse != nil)
    {
        // Extract related content from response
        GNImage artistImage = bestResponse.contributorImage;
        NSData* artistImageData = artistImage.data;


        // Display or store artist image as desired
    }
}
@ end
```


Artist Biographies

Mobile Client can return an Artist Biography with a recognition or search result. You can use Artist Biographies to enrich the user experience.

Your application must be entitled to retrieve Artist Biographies. To entitle your application, please contact your Gracenote Professional Services representative.

You can configure a Mobile Client operation to include an Artist Biography in its response with a `GNConfig` object property:

Parameter	Description	Default
`content.contributor.biography`	Set to `true` to enable retrieval of artist biographies	`false`

To improve performance for some operations, retrieve artist biographies in the background. For more information, see Improving Retrieval Performance by Using Enriched Content URLs (see page 65).

Accessing Artist Biographies

Artist Biographies are delivered via a result-ready object as a collection of `String` objects, where each `String` contains a biography paragraph.

The following code snippet shows how an artist biography can be retrieved from a result-ready object:

```
// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestResponse = [result bestResponse];

    if (bestResponse != nil)
    {
        // Extract related content from response
        NSArray* artistBiography = bestResponse.artistBiography;

        // Display or store artist biography as desired
    }
}
@ end
```

Album Reviews

Mobile Client can return an Album Review with a recognition or search result. You can use Album Reviews to enrich the user experience.

Your application must be entitled to retrieve Album Reviews. To entitle your application, please contact your Gracenote Professional Services representative.

You can configure a Mobile Client operation to include Album Reviews in its response with the following `GNConfig` object property:

Parameter	Description	Default
`content.review`	Set to `true` to enable retrieval of album reviews	`false`

To improve performance for some operations, retrieve album reviews in the background. For more information, see Improving Retrieval Performance by Using Enriched Content URLs (see page 65).

Accessing Album Reviews

Album Reviews are delivered via a result-ready object as a collection of `String` objects, where each `String` contains a review paragraph.

The following code snippet shows how you can retrieve an album review from a result-ready object:

```
// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestResponse = [result bestResponse];

    if (bestResponse != nil)
    {
        // Extract related content from response
        NSArray* albumReview     = bestResponse.albumReview;

        // Display or store album review as desired
    }
}
@ end
```

Retrieval Methods

You can retrieve Related content from the results returned from an audio recognition operation or from a Gracenote unique album or track identifier.

Retrieving Related Content for a Single Best Match

The single best match result returned from an audio recognition operation can contain related content. You can use the following methods to retreive the respective content:

- `GNSearchResponse:coverArt`
- `GNSearchResponse:contributorImage`
- `GNSearchResponse:getArtistBiography`
- `GNSearchResponse:getAlbumReview`

To retrieve this content, you need to configure the appropriate `GNConfig` object (provided to the operation) properties.

The following code example shows how to configure the `GNConfig` object, initiate a recognition event, and retrieve the related content from the returned result:

```
// Set configuration properties
[config setProperty: @"content.coverArt" value: @"1"];
[config setProperty: @"content.contributor.images" value: @"1"];
[config setProperty: @"content.contributor.biography" value: @"1"];
[config setProperty: @"content.review" value: @"1"];


// Define result-ready object to extract related content from recognition result
@ interface ApplicationSearchResultReady : NSObject <GNSearchResultReady>
{
}

// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestResponse = [result bestResponse];

    if (bestResponse != nil)
    {
        // Extract related content from response
        GNCoverArt* coverArt     = bestResponse.coverArt;
        NSData*  artistImage     = bestResponse.contributorImage;
        NSArray* artistBiography = bestResponse.artistBiography;
        NSArray* albumReview     = bestResponse.albumReview;

        // Display related content as desired
    }
}
@ end


// Use configuration object when invoking a recognition operation
- (void) recognizeFromMic: (GNConfig*) config
{
    // Create result-ready object to receive retrieval result and extract related content
    ApplicationSearchResultReady* searchResultReady = [ApplicationSearchResultReady alloc];

    // Invoke recognition operation
    [GNOperations recognizeMIDStreamFromMic: searchResultReady config: config];
}
```


For subsequent operations after an initial identification, retrieving related content from a Gracenote album or track identifier is more efficient than repeating the full recognition process. To minimize response time, extract and store the Gracenote Identifier after the initial recognition operation and use it for subsequent retrieval operations, as shown in the next section.

Retrieving Related Content by Gracenote Identifier

Gracenote unique album and track identifiers can be obtained from any Gracenote product, enabling Mobile Client to be easily integrated into a larger music identification system. The following code example shows how to obtain a Gracenote Identifier for a specific album and use it to retrieve related content; the same technique can be used to retrieve related content for a track identifier instead of an album identifier, by using the methods `GNSearchResponse:fetchRelatedContent:forTrackId` and `GNOperations:fetchByTrackId:config:trackId:` instead of `GNSearchResponse:fetchRelatedContent:forAlbumId` and `GNOperations:fetchByAlbumId:config:albumId`:

```
// Result-ready object to extract related content from recognition result by album identifier:
// Provide implementation for GNResultReady method
@ implementation ApplicationGetGnIdResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestresponse = [result bestResponse];
    if (bestresponse != nil)
    {
        // Extract album identifier and store for later use
        gnAlbumID = bestResponse.albumId;

        // Retrieve related content using album identifier
        [self fetchRelatedContent: self.config forTrackId: bestresponse.trackId];
    }
}
@ end


// Initial recognition request; result will contain a Gracenote album identifier
// Create result-ready object to receive search result and extract and store track identifier and related
content
ApplicationGetGnIdResultReady* getGnIdResultReady = [ApplicationGetGnIdResultReady alloc];

// Invoke recognition operation
[GNOperations recognizeMIDStreamFromMic: getGnIdResultReady config: config];


// Later retrieval request using previously stored album identifier
- (void) fetchRelatedContent: config forAlbumId: albumId
{
    // Set configuration properties
    [config setProperty: @"content.contributor.images" value: @"1"];
    [config setProperty: @"content.contributor.biography" value: @"1"];
    [config setProperty: @"content.review" value: @"1"];
```



```
    // Create result-ready object to receive retrieval result
    ApplicationSearchResultReady* searchResultReady = [ApplicationSearchResultReady alloc];
    [GNOperations fetchByAlbumId: searchResultReady config: config trackId: albumId];
}


// Define result-ready object to extract related content from recognition result:
// Provide implementation for GNResultReady method
@ implementation ApplicationSearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    // Get best response from search result
    GNSearchResponse* bestresponse = [result bestResponse];

    // Extract related content from response
    if (bestresponse != nil)
    {
        NSArray* albumReview     = bestResponse.albumReview;
        NSArray* artistBiography = bestResponse.artistBiography;
        GNImage*  artistImage     = bestResponse.contributorImage;
    }
}
```

During the retrieval process, Mobile Client sends operation status updates to your application.

Status flow in related content retrieval by Gracenote Identifier

You can retrieve Track and Album Identifiers from any Gracenote product, allowing you to easily integrate Mobile Client into a larger music identification system.

Retrieving Link Data

When an application is appropriately entitled, Mobile Client returns Link identifiers for all responses provided in a result-ready Object instance. The identifiers can be sourced from a third party (such as Amazon.com), or they can be specific to your organization. You can use such Link data, for example, to redirect the user to a site (such as Amazon) where they can purchase the matched track, or as a key into your own data catalog. Consult your Gracenote Professional Services representative for further information about the Link product and typical uses in commerce, or to entitle your application for Link access. These examples demonstrate coding this functionality:

```
// Result-ready object implements GNFingerprintResultReady protocol
@ interface SearchResultReady : NSObject <GNFingerprintResultReady>{
}
@ end
```

```
// Provide implementation for GNResultReady method
@ implementation SearchResultReady
- (void) GNResultReady: (GNSearchResult*) result
{
    GNSearchResponse* bestresponse = [result bestResponse];
    if (response != nil)
    {
        NSArray linkItems = [response albumLinkData];
        if (linkItems != nil)
        {
            NSEnumeration* e = [linkItems objectEnumerator];
            id object;
            while (object = [e nextObject])
            {
                // Use link data as desired
            }
        }
    }
}
@ end
```

To tune audio recognition events to prefer results containing Link identifiers from a specific source, set the `GNConfig` object's `content.link.preferredSource` property. The `GNConfig` object is used when invoking the audio recognition method, as shown here:

```
// Set the preferred source property to prefer results that contain Link IDs
// from a specific source
GNConfig* config = [GNConfig init: @"12345678-ABCDEFGHIJKLMNOPQRSTUVWXYZ012345"];
[config setProperty: @"content.link.preferredSource" value: @"Amazon"];
[GNOperations recognizeMIDStreamFromMic: searchResultReadyObject config: config];
```

Gracenote Web Services returns the best available match containing a Link identifier from that source, if available. Note, however, that the single best match returned is not necessarily guaranteed to contain a Link identifier from the preferred source, if none of the available matches contains one from that source.

While commerce identifiers can be requested, AlbumID does not support the preference of a specific identifier over the actual Album a song came from. You can, instead, obtain preferred results using `GNOperations.recognizeMIDFileFromFile` or `GNOperations.recognizeMIDFileFromPcm`. See MusicID-File (see page 22) for more information.

Status Change Updates

When performing an operation, Mobile Client sends status updates to the application via the `GNOperationStatusChanged` protocol.
To receive status changed updates, the application must create a class that implements a result-ready protocol and `GNOperationStatusChanged`. An object instance must be provided when the operation is invoked.

Your app can use status changed updates to keep the user notified of operation progress. The percent completed is also provided but, currently, only for microphone recorded audio.

The callbacks for handling status changes and results are called on the main thread. As a best practice, your app should keep the main thread readily available for this purpose and run any other time-consuming tasks in the background.

These examples demonstrate coding this functionality:

```
// Result-ready object implements GNSearchResultReady and
// GNOperationStatusChanged protocols
@ interface SearchResultsStatusReady : NSObject <GNSearchResultReady, GNOperationStatusChanged>
{
}
@ end
```

```
// Provide implementation for GNOperationStatusChanged method
@ implementation SearchResultsStatusReady

// Method to handle the status changed updates from the operation
- (void) GNStatusChanged: (GNStatus*) status
{
    NSString* msg;
    if (status.status == LISTENING)
    {
        msg = [NSString stringWithFormat: @"%@ %d@", status.message, status.percentDone, @"%"];
    }
    else
    {
        msg = status.message;
    }

    // Display status message to user
}

// Method to handle result returned from operation
- (void) GNResultReady: (GNSearchResult*) result
{
}
@ end
```

```
// Create the result-ready object to receive the recognition results then invoke
// the operation
SearchResultsStatusReady* resultready = [SearchResultsStatusReady alloc];
[GNOperations recognizeMIDStreamFromMic: resultready config: config];
```

Canceling an Operation

Mobile Client supports canceling a running operation. To cancel an operation, the application must call the `GNOperations:cancel` method with the same result-ready object instance that was provided when invoking the operation. Mobile Client uses the result-ready object instance to identify which operation to cancel. These examples demonstrate coding this functionality:


```
//** Create the result-ready object and invoke the operation
SearchResultsStatusReady* resultready = [SearchResultsStatusReady alloc];
[GNOperations recognizeMIDStreamFromMic: resultready config: config];
```

```
//** Use the result-ready object provided when invoking the operation to cancel
//** the operation
[GNOperations cancel: resultReady];

//** You can also use the cancelAll method to cancel all operations
[GNOperations cancelAll: resultReady];
```

Important: When `GNOperations:cancel` or `GNOperations:cancel`All is called, the associated operation(s) are stopped. `cancel` and `cancelAll` are non-blocking calls and, once invoked, your application can continue with other operations and calls. Your application will not receive any additional information about the cancelled operation(s).

In `GNRecognizeStream`, `stopRecognizeSession` cancels the IDNow operation and stops the session as well.

To cancel the IDNow operation without stopping the session, call `GNRecognizeStream.cancelIdNow`.

For more information on canceling operations, contact your Gracenote Professional Services representative.

Localization and Internationalization

You can configure Mobile Client to deliver metadata specific to a supported language or country with the following `GNConfig` properties:

Parameter	Description
`content.lang`	Specifies the language for the delivered metadata
`content.country`	Specifies the country for the delivered metadata. The default for this is `null`, prior to 2.5.8 it was USA.

The specified language and country can affect the delivered metadata in various ways:

1. When a supported country is specified, the genre descriptors for that country are delivered
2. When a supported language is specified, album and track metadata are delivered in that language, if available
3. When a supported language is specified, genre, mood, tempo, origin, era, and artist type descriptors are delivered in that language, if available

Check with Gracenote Professional Services for the full set of supported *ISO 639-2* languages.
All *ISO 3166-1 alpha-3* country codes are supported.

Using Mobile Client Debug Logging

You can configure Mobile Client to output useful debugging information to the console. To enable debugging, set the `GNConfig` object `debugEnabled` property to "1", "true", or "True", and provide that object instance when invoking an operation, as shown in the example. Note that only operations that are passed a `GNConfig` object instance with debugging enabled will generate logging output.

```
[config setProperty: @"debugEnabled" value: @"1"];
```

The debug log feature is provided for development only. Production applications cannot have debug log generation enabled or provide an option to enable it.

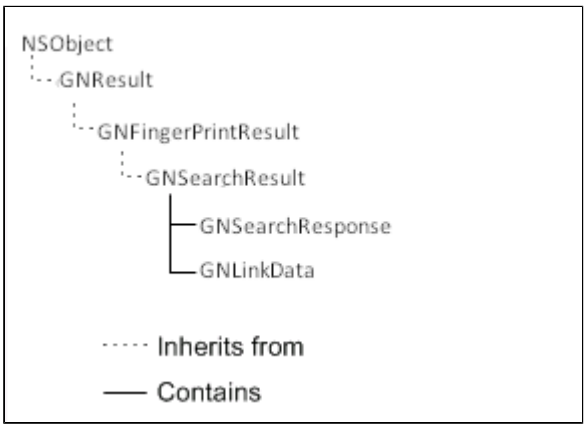
During validation, Gracenote ensures debug log generation is not and cannot be enabled by the application.

Data Dictionary

This section describes the different data fields returned from Mobile Client. Two different types of results can be generated by Mobile Client: a music search result and a fingerprint creation result. Both result types are described in the sections below.

Search Result

A Mobile Client search result returns a variety of metadata fields that can be used to enrich the user experience. The following sections contain a description of each field and the hierarchy in which the fields are delivered to your application.



GNSearchResult

Contains the result(s) of a search operation.

Field	Description	Type	Accessor	Comments
Responses	Collection of albums that contain tracks that were matched by the search operation	NSArray	`responses`	
Best Response	Album that contains the track that is the best match of the search operation	`GNSearchResponse`	`bestResponse`	

GNSearchResponse

Describes the metadata fields for an album and the track on that album that was matched by the search operation.

Field	Description	Type	Accessor	Comments
Adjusted Song Position	Indicates current position in song	NSString	`adjustedSongPosition`	Measures milliseconds since the beginning of the song. For the `idNow and recognizeFromMic` operations, this field returns the song position at the time `adjustedSongPosition` is called, assuming continuous song playback since the operation was initiated. Not supported for the `recognizeMIDStreamFromPCM` operation.
Album Artist Name	Name of the album level artist	NSString	`albumArtist`	
Album Artist Name Betsumei	Japanese alternate names and pronunciations for album level artist name	NSString	`albumArtistBetsumei`	
Album Artist Name Yomi	Japanese phonetic representation of album level artist name	NSString	`albumArtistYomi`	
Album Genre	Album level genre descriptors	NSArray	`albumGenre`	
Album ID	Gracenote unique identifier for the album	`NSString`	`albumId`	
Album Link Data	Link identifiers related to the album	`NSArray`	`albumLinkData`	albumLinkData can be nil
Album Release Year	Year the album was released in	`NSString`	`albumReleaseYear`	
Album Review	Album review	NSArray	`albumReview`	albumReview may or may not be nil
Album Title	Title of the album	`NSString`	`albumTitle`	
		`NSString`	`albumTitleYomi`	

Album Title Yomi	Japanese phonetic representation of Album Title			
Album Track Count	Number of tracks on the album	`NSInteger`	`albumTrackCount`	-1 if no track
Artist Biography	Artist's biography	`NSArray`	`artistBiography`	artistBiography may or may not be nil
Artist Era	Era descriptors	`NSArray`	`era`	
Artist Image	Image of artist who contributed in the album	`GNImage`	`contributorImage`	contributorImage may or may not be nil
Artist Origin	Origin descriptors	`NSArray`	`origin`	
Artist Type	Artist type descriptors	`NSArray`	`artistType`	
Cover Art	Album cover art	`GNCoverArt`	`coverArt`	When cover art is not available, genre art may be returned (based on availability)
Partial	Is full or partial metadata returned flag	Bool	`partial`	Indicates if your response contains full or partial metadata results. Note that this flag will only be true if a single, best match response is returned.
Language	Language of metadata returned.	NSString	`language`	Returns either null or 3-character ISO 639-2 language code, e.g., "eng" (English), "kor" (Korean), etc. This value is returned if you have set a preferred language for track metadata with GNConfig.content.lang. If the preferred language is not available, then whatever is available will be returned
Track Artist Name	Name of the album artist	`NSString`	`artist`	
Track Artist Name Betsumei	Japanese alternate names and pronunciations for Artist name	`NSString`	`artistBetsumei`	
Track Artist Name Yomi	Japanese phonetic representation of Artist name	`NSString`	`artistYomi`	
Track duration	Length of track in milliseconds	`NSString`	`songDuration`	
Track Genre	Track genre	`NSarray`	`trackGenre`	genre can be nil
Track ID	Gracenote unique identifer for the track	`NSString`	`trackId`	trackId can be nil in the case of Lyric_search
		`NSArray`	`trackLinkData`	trackLinkData can be nil

Track Link Data	Link identifiers related to the track			
Track Match Position	Indicates at what timeslice within the song the audio sample was matched	`NSString`	`songPosition`	Measures milliseconds since beginning of song; only applies to MusicID-Stream
Track Mood	Track level mood descriptors	`NSArray`	`mood`	
Track Number	One-based index of the track on the album	`NSInteger`	`trackNumber`	-1 if no trackNumber
Track Tempo	Track level tempo descriptors	`NSArray`	`tempo`	
Track Title	Title of the track	`NSString`	`trackTitle`	
Track Title Yomi	Japanese phonetic representation of Track Title	`NSString`	`trackTitleYomi`	

GNAlbumIdSearchResult

Contains the result(s) of an albumId search operation.

Field	Description	Type	Accessor	Comments
No Match Responses	AlbumId results with No_Match	`NSMutableArray`	noMatchResponses	
Error Responses	AlbumId results with GNAlbumIDFileError	NSMutableArray	errorResponses	

GNAlbumIdSearchResponse

Describes the metadata fields for an album and the track on that album that was matched by the albumId search operation. Inherited from GNSearchResponse. Contains all GNSearchResponse objects and fileIndent used in albumId operation per file.

Field	Description	Type	Accessor	Comments
GNSearchResponse	All GNSearchResponse metadata			Inherited from GNSearchResponse
File Ident	File Identifier	NSString	fileIdent	

GNDescriptor

Defines a Gracenote descriptor. The genre, mood, tempo, origin, era, and artist type data delivered by Mobile Client is referred to as descriptors. This object describes a descriptor by providing its name and identifier.

Field	Description	Type	Accessor	Comments
Descriptor	Descriptor name	NSString	itemData	
ID	Descriptor identifier	NSString	itemId	

GNAlbumIdFileError

Container class for the errors that can occur in AlbumId operations.

Field	Description	Type	Accessor	Comments
Error Message	Indicates results with error	NSString	errMessage	
Error Code	Error code for file	NSString	errCode	
File Indent	File identifier	NSString	fileIdent	

GNLinkData

Holds a collection of Link identifiers and their providers.

Field	Description	Type	Accessor	Comments
Id	Actual value from the provider	`NSString`	`uid`	
Source	The provider of the Link identifier, such as "Amazon"	`NSString`	`source`	

GNCoverArt

Contains the cover art image for an album.

Field	Description	Type	Accessor	Comments
Data	Cover art image as a data stream	NSData	`data`	
MIME Type	Cover art data type. This can be used to approriately read and render the cover art image.	`NSString`	`mimeType`	
Size	The size of the cover art returned as THUMB, SMALL, MEDIUM, LARGE or XLARGE. For the size in pixels see Image Resizing Best Practice (see page 58).	`NSString`	`size`	

GNImage

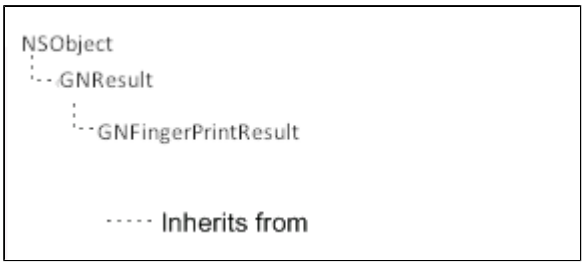
Contains the contributor image for an album.

Field	Description	Type	Accessor	Comments
Data	Contributor image as a data stream.	`byte[]`	`getData`	

MIME Type	Contributor data type. This is used to read and render the contributor image appropriately.	`String`	`getMimeType`	
Size	The size of the contributor image returned as THUMB, SMALL, MEDIUM, LARGE or XLARGE. For the size in pixels see Image Resizing Best Practice (see page 58).	`String`	`getSize`	

Fingerprint Creation Result

A Mobile Client fingerprint creation result delivers the created fingerprint to your application in a simple hierarchy described below.



GNFingerprintResult

Field	Description	Type	Accessor	Comments
Fingerprint Data	Fingerprint generated by operation. The fingerprint can be used to recognize the audio.	`NSString`	`fingeprintData`	The fingerprint data can be sent to other Gracenote products for other uses.

Considerations

Best Practice for Receiving Results and Status Change Updates

The callbacks for handling status changes (`GNOperationStatusChanged` interface implementation) and results (`GNSearchResultReady` interface implementation) are called on the main thread. As a best practice, your app should keep the main thread readily available for these callbacks and run any other time-consuming tasks in the background.

Callbacks for `GNRecognizeStream` are invoked on a background thread. If your callback needs to update the UI, it should switch to the main thread.

Best Practice for Receiving Full and Partial Metadata Responses

Set `GNConfig.allowFullResponse` to `true` only when your application requires full(extended) metadata.

If application can live with partial metadata, always set `allowFullResponse` to `false`. Only ask for full metadata when required. This will improve your match/response time.

Recognizing Audio from the Microphone

The following practices are recommended when recognizing audio from the microphone:

- Provide clear and concise onscreen instructions on how to record the audio:
  - Most failed recognitions are due to incorrect operation by the user.
  - Clear and concise instructions help the user correctly operate the application, resulting in a higher match rate and a better user experience.

- While recording audio from the microphone display a progress indicator:
  - When Mobile Client is recording from the microphone, the application can receive status updates. The status updates indicate what percentage of the recording is completed.
  - The status updates are issued at every tenth percentile of completion, meaning 10%, 20%, 30%, and so on.
  - Use this information to display a progress bar (indicator) to notify the user.
  - When recording has finished use vibration or a tone (or both) to notify the user.

- Visual only notifications can hamper the user experience because:
  - The user may not see the notification if they are holding the handset up to an audio source.
  - The user may pull the device away from an audio source to check if recording has completed. This may result in a poor quality recording.
  - While Web Services is being contacted, display an animation that indicates the application is performing a function. If the application appears to halt the user may believe the application has crashed.
  - If no match is found, reiterate the usage instructions and ask the user to try again.

Recognizing Audio from a File using MusicID-File

The following practices are recommended when recognizing audio from a file when using MusicID-File. For best practices regarding AlbumID operations, please contact your Professional Services representative.

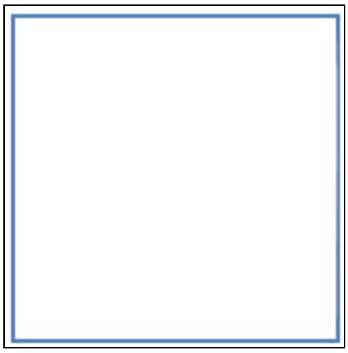
- Allow the user to select multiple files for recognition. Submit them concurrently for fastest results.
- Limit the number of stored results and pending recognitions:
  - File recognition operations can run concurrently, which allows many requests to be issued at once.
  - Each recognition operation and each returned result requires memory.
  - Be careful to limit the number of results stored and pending recognition operations, to avoid exhausting the device's RAM.
- While Web Services is being contacted, display an animation that indicates the application is performing a function. If the application appears to halt, the user may believe the application has crashed.

Image Resizing Best Practice

Summary
This topic provides guidance on image implementation by discussing Gracenote's use of predefined square dimensions to accommodate variances among image orientations.

Description
Gracenote provides a variety of images as part of our enhanced content offerings. For Mobile Client, these include Cover Art, Artist, and Genre images.
To accommodate variation in the images' dimensions, we resize the images to fit within standardized image dimensions a predefined-square so that the longest dimension equals the dimensions of one side of the square, while the other dimension is somewhat short of the full square. The following images show how an image is resized within the predefined square. (Note that the outline for the square is used here only to demonstrate layout. We do not recommend displaying this outline on your application's user interface.)

Predefined Square



Horizontally-oriented Image Examples

Vertically-oriented Image Examples

The following sections discuss the differences between music images and give the standard image dimensions for each image type.

Music Cover Art

While CD cover art is often represented by a square, it is more accurately a bit wider than it is tall. The dimensions of these cover images vary from album to album. Some CD packages, such as a box set, might even be a radically different shape.

Gracenote Standard Image Dimensions: Music Cover Art

Size	W x H (Pixels)
Thumbnail	75 x 75
Small	170 x 170
Medium	450 x 450

Large	720 x 720
Extra Large	1080 x 1080

Artist Images

Like music Cover Art, Artist images are seldom square, and are generally more obviously rectangular than music cover art. Because music artists range from solo performers to bands with many members, the images may either be wide or tall.

Gracenote Standard Image Dimensions: Artist Images

Size	W x H (Pixels)
Thumbnail	75 x 75
Small	170 x 170
Medium	450 x 450
Large	720 x 720
Extra Large	1080 x 1080

Image Implementation Recommendation

For all images: We recommend that the image be centered horizontally and vertically within the predefined square dimensions, and that the square be transparent so that the background shows through. This results in a consistent presentation despite variation in the image dimensions.

Searching by Text, Lyric Fragment, and Fingerprint

The following practices are recommended when searching by text, lyric fragment, and fingerprint.

- Allow user to input as much information as possible:
  - Text search allows artist name, album title and track title to be entered. Allow the user to input all of these fields and pass them to Gracenote for the search
  - Lyric Fragment search can be augmented with the artist name. Allow the user to provide the artist name and ensure it is passed to Gracenote for the search.
- While Web Services is being contacted display an animation that indicates the application is performing a function. If the application appears to halt the user may believe the application has crashed.

Retry Facility

Occasionally Mobile Phone Handsets are unable to successfully create a network connection. This could be because the Mobile Phone Handset is not within range of a suitable network or the network is temporarily unavailable due to device or network limitations.

It is recommended that you implement a retry facility that retries the user request several times before reporting to the user that the request could not be fulfilled. A retry facility allows temporary network unavailability to go unnoticed by the user.

Resource Management

Mobile Client is a compact library that provides easy access to rich content that can enhance the user's experience. Its compact size and simplicity are not indicative of the vast amount of content it can quickly deliver.

It is important that your application is prepared to correctly manage requests for content and is able to handle the content when it is delivered.

For more information on the resource management topics discussed below please contact your Gracenote Professional Services representative.

Storing Content in RAM

The richness of the content delivered by Mobile Client and the speed of delivery can easily result in megabytes of data being transferred to the device. This can quickly consume the RAM resources available to applications, especially those operating in a resource-limited environment.

Applications must consider carefully how data is stored and how long it is stored.

If your application performs a single track recognition and then displays the result, the RAM resources are unlikely to be exhausted. But if the application performs thousands of track recognitions and intends to display all the returned data, then RAM usage will become an issue.

Applications should limit the amount of data they attempt to store in RAM. For example, an application that recognizes a user's entire song collection could limit the number of recognition results using paging. The application can recognize a small number of songs, display the results for the user to peruse, and then when prompted by the user, recognize the next set of songs. For more information, see Result Paging (see page 62).

Applications should also consider what needs to be stored in RAM. It might be acceptable for your application to store data returned from Mobile Client directly into persistent memory, only using RAM to display small subsets of the data to the user.

The schemes used to manage RAM resources will vary greatly with use case and implementation. It is important that dealing correctly with data delivered from Mobile Client be a major consideration for the development team early in the design phase.

Request Flow Control

Mobile Client is capable of processing multiple requests concurrently. This facility allows an application to obtain results faster than issuing one query at a time.

There is no limit to the number of requests that can be issued; Mobile Client queues the requests until they can be processed. Each request, whether it is queued or being processed, consumes RAM. If requests are issued faster than they can be processed, the application may run out of memory.

To avoid this situation an application should implement flow control for issuing requests. The number of requests pending (queued or being processed) should be capped at a maximum. It is recommended that you limit the number of pending requests to five.

Applications should issue requests until the number of pending requests reaches the predefined maximum. No further requests should be issued until the number of pending requests drops below the predefined maximum.

In addition, all layers in the application stack should implement request flow control, or be capable of rejecting requests from upper layers.

For example, if you are developing a middleware layer that interfaces upper layer applications with Mobile Client, your middleware layer should implement flow control. If the number of pending requests rises to the predefined maximum, the layer should reject any new requests until the number of pending requests drops below the predefined maximum. Sophisticated applications will also provide notifications to upper layers when requests can and can't be accepted (similar to a modem's XON and XOFF commands).

Result Paging

In addition to request flow control, an application with user navigable results should optimally use results paging to limit the number of requests issued and results stored. Paging can also be used to ensure the application is responsive.

Results paging can be effective in applications that can display a large number of results in sections, such as a scrolling display, or paged results where Next and Previous controls are used for result navigation.

It is recommended that such applications store the result for three (3) pages: the current page, the previous page and the next page. As the user navigates through the pages, the results in the current, previous, and next pages change. As they change the application can delete stored results and retrieve new results as they are needed to fill the current, previous, and next pages.

Using this scheme the previous and next pages are pre-retrieved, making the application responsive as the user navigates.

Limiting the total number of results pre-retrieved also limits the amount of content that is stored in RAM. Gracenote recommends using five results per page. If the user is limited to moving one results page at a time, only one page of results needs to be retrieved with each move. This limits the number of concurrent queries to five, as recommended in Request Flow Control (see page 61).

Error Handling

When an operation cannot be completed, Mobile Client generates the appropriate error information and returns it via a result-ready Object. Your application should handle the error conditions and proceed accordingly.

In the event of an error, Mobile Client returns an error code and an error message. The error code can be used by your application to react to specific error conditions. The error message contains error condition information, which provides additional clues to the error's cause. Error messages are not suitable for display to the end-user, as they contain technical information and are English-language specific; they are also subject to change without warning. The error message displayed to the user should be derived from the error code.

Sophisticated implementations may provide an error notification mechanism that allows errors to be investigated in deployed applications. For example, your application can send error information to a support server or prompt the user to send error information to an email address. Once notification of an error has been received, technical personnel can investigate the error accordingly.

GNResult.FPXFailure and GNResult.FPXFingerprintingFailure

These errors are generated if Mobile Client cannot generate a fingerprint from an audio sample. Your application should indicate that the audio cannot be recognized due to an invalid or unsupported format.

GNResult.FPXListeningFailure

This error is generated when Mobile Client cannot obtain the microphone for recording an audio sample. Your application should indicate to the user that the microphone is required to record music for identification and to try again after closing any applications that may be using the microphone.

GNResult.WSRegistrationInvalidClientIdFailure

This error is generated when the Client ID provided to Mobile Client is not successfully authenticated by Web Services. Your application should indicate to the user that the music identification service is unavailable.

If you are notified of this error via an error notification mechanism, notify your Gracenote Professional Services representative.

GNResult.WSNetworkFailure

This error is generated when the device does not have a valid network connection; for example, a Mobile Phone Handset may not be within range of a suitable network. Your application should indicate that a working Internet connection is required and to try again when the connection is restored.

GNResult.WSFailure

This error is generated when Gracenote Web Services cannot fulfill a request from the Mobile Client. The accompanying error message is a description of the error condition as provided by Gracenote Web Services.

Your application should indicate that the user's request could not be fulfilled at the present time. Do not display the error message to the user, as it contains technical information that is generally not comprehensible to a user. Also, do not attempt to parse the message, as messages returned from Web Services change regularly without warning.

If your application provides an error notification mechanism, forward the error message to your technical personnel. Also provide the message to your Gracenote Professional Services Representative for further analysis, if required.

GNResult.WSInvalidDataFormatError

This error is generated when Mobile Client cannot parse the response received from Gracenote Web Services. This canoccur due to corruption of the results data. Your application should indicate to the user that their request failed and offer to retry the query.

GNResult.UnhandledError

This error code is reported when an unexpected error occurs that is outside the normal operation of Mobile Client and outside the scope of Mobile Client's error capture capabilities. The possible causes of such an error are very broad and include (but are not limited to) platform errors, third-party library errors, hardware errors, and other similar types of errors.

Your application should indicate that an error occurred and that the current request could not be completed.

Limiting Query Time

Mobile Client imposes time limits (timeouts) for the amount of time a device takes to create an Internet connection or fulfill an Internet request. These times can vary depending on:

- The device internal resources (memory, MIPS, and so on.)
- The capacity of the Internet connection (the amount of data that can be transported by the air interface)
- The availability of the Internet connection (devices may move in and out of signal range or the network may become congested)

The timeouts chosen by Mobile Client are based on the most limited device with the most limited Internet connection capacity and availability. Consequently, for high end devices, these timeouts may be considered too long.

It is recommended that devices impose their own query timeout mechanism that cancels a query when it exceeds an application specified time limit. This allows the application the flexibility to limit query lengths in accordance with the capabilities of the host devices.

When initiating a query to the Gracenote database via Mobile Client, start an application timer with an application specified timeout. If the timer expires before the query completes, cancel the query using the GNOperations.cancel() method.

⚠ When calling AlbumID operations, do not set a timer. AlbumID directory operations can take a long time, depending on many factors, such as the number of tracks in the directory, processor speed, network speed, type, and other factors.

Improving Retrieval Performance by Using Enriched Content URLs

There may be cases when you wish to retrieve metadata, descriptors, or external identifiers as quickly as possible, while lazy-loading enriched content such as cover art in the background. To achieve this, Mobile Client features a set of APIs that allows you to extract the URL pointers to the enriched content, giving you greater control over when you load the additional content. Mobile Client provides the following APIs, each of which retrieves a different type of enriched content (cover art, artist images, album reviews and artist biographies):

- GNSearchResponse.coverArt().url()
- GNSearchResponse.contributorImage().url()
- GNSearchResponse.albumReviewUrl()
- GNSearchResponse.artistBiographyUrl()

Each API returns a string containing the URL for the enriched content. The returned value will be nil if no enriched content is available. In the case of cover art, if there is no cover art available, the URL for genre art may be returned (provided the property for genre art is set).

⚠ Enriched content URLs are temporary; therefore, the application must be configured to handle expired URLs. Gracenote currently supports content URLs for a lifespan of one hour, but this may be subject to change. Please contact your Gracenote Professional Services representative to discuss best practices for temporary caching and error handling.

The following code examples show how to retrieve the enriched content URLs:

```
// Retrieve cover art URL
GNCoverArt *coverArt = response.coverArt;
if (coverArt !=nil) {
        NSLog(@"%@",coverArt.url);
    } else{
        NSLog(@"CoverArt is nil");
    }


// Retrieve artist image URL
GNImage *contributorGNImage = response.contributorImage;
if (contributorGNImage!=nil) {
        NSLog(@"%@",contributorGNImage.url);
    }else {
        NSLog(@"ContributorImage is nil");
    }
```



```
// Retrieve artist biography URL
NSString *artistBiographyUrl = response.artistBiographyUrl;

// Retrieve album review URL
NSString *albumReviewUrl = response.albumReviewUrl;
```

Error Handling

When the application accesses the URLs, it should handle HTTP errors gracefully. The following table lists the types of HTTP errors that might occur and the corresponding action to take:

Error	Action
HTTP 500 error	Retry fetching the URL once.
HTTP 412 error (Precondition failed)	The URL has expired. The application should request a new URL from the Mobile Client SDK, using `GNSearchResponse.getTrackId()` to get the Gracenote Identifier. The application should then use `GNOperations.fetchByTrackID()` before fetching the URL.
HTTP 4xx error (other 400-level errors)	Handle as if the URL has expired: request a new URL and try fetching the asset again. If that fails, the application should log an error and not attempt further retries

AlbumID Operations

As a best practice, the application should retrieve the URLs for tracks separately from `GNSearchResponse` after making an AlbumID request. The application should optimize and retrieve the cover art, artist image, album review, and artist biography URLs (and images and data) for one track in the album and not for each track.

Glossary

Link Data	When query results are returned by Gracenote, they can contain Link data that directly pertains to the result it is embedded in. A single piece of Link data consists of an identifier (Integer) and a source (String). The source is the provider of the identifier, such as Amazon.com. The identifier is a unique key into the provider's catalog that can be used to present the user with additional content or services. A single result can contain multiple pieces of Link data from multiple providers.
Lyric Fragment	A segment of lyrics from a track.
PCM (Pulse Coded Modulation)	Pulse Coded Modulation is the process of converting an analog in a sequence of digital numbers. The accuracy of conversion is directly affected by the sampling frequency and the bit-depth. The sampling frequency defines how often the current level of the audio signal is read and converted to a digital number. The bit-depth defines the size of the digital number. The higher the frequency and bit-depth, the more accurate the conversion.
PCM Audio	PCM data generated from an audio signal.
Result Ready Object	An object that implements a Result Ready Protocol is a Result Ready Object. An instance of a Result Ready Object must be provided when invoking a Mobile Client operation so the operation can deliver results to the application.

Result Ready Protocol	Mobile Client defines Objective-C protocols that allow Mobile Client operations to deliver results to the application. These protocols are known as Result Ready Protocols.
Single Best Match	Certain audio recognition products provided by Mobile Client return a single result; the single best match. The single best match is determined by Web Services, based on criteria specific to the application. This criteria can be refined by the application.

Troubleshooting

Sample Application Does Not Start

Problem

When running the Sample Application it does start or hangs with a blank black screen.

Solution

Ensure your Client ID is correctly provided to the GNConfig init method in the viewDidLoad method in GN_Music_SDK_iOSViewController.m.

Invalid Client Identifier Exception

Problem

When calling GNConfig.init, an exception displays with the following message:

> *invalid clientId*

Solution

Ensure that your Client ID is correctly provided to GNConfig.init in the correct form, which is:

```
<Client ID>-<Client ID Tag>
```

Your Client ID and Client ID Tag are provided by your Gracenote Professional Services representative.

IO Exception While Connecting to Web Services

Problem

The following error occurs when performing a query:

> *[Mobile:5000] webservices http status: 500: IO exception while connecting to webservices*

Ensure that your device and application have a working connection with the Internet.

This error can be seen due to loss of connectivity with the Internet or Internet traffic congestion on the handset.

Advanced Implementations

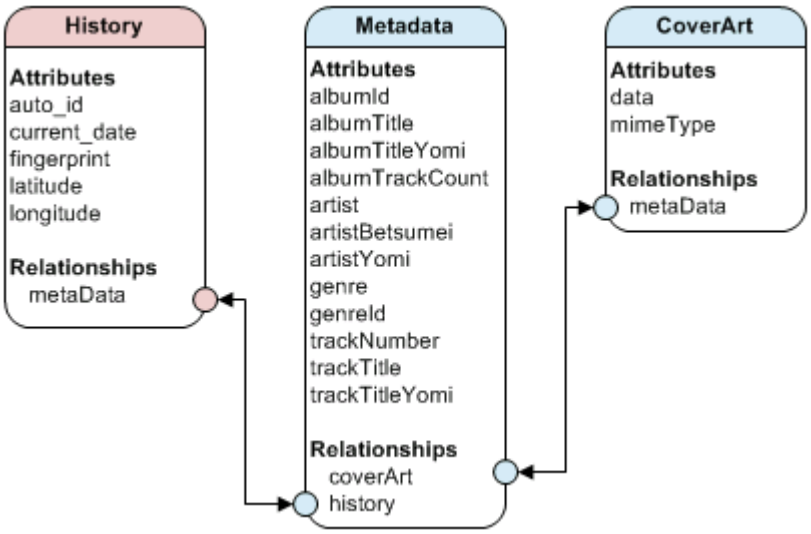
User History

The Mobile Client Sample Application includes a user history feature. It stores the results of certain operations and allows the user to view them. When viewed, the history record displays the recognized music, including Cover Art and the location of the user when the operation occurred.

The feature uses a local SQLite database to store the user history information.

Data Model

A simple data model is used to store the data as shown below.



Mobile Client Sample Application User History Database Data Model

To simplify interactions with the database, the implementation uses `NSManagedObjectContext`. `NSManagedObjectContext` presents an interface to the underlying SQLite database via objects. An object-based interface is easy to create, edit, and recall. Although the Mobile Client Sample Application uses SQLite, `NSManagedObjectContext` can be used to provide an object interface to various types of persistent storage.

`NSManagedObjectContext` allows the database object model to be completely implemented in classes. In this case the data model is implemented in:

- `History.m & h`
- `Metadata.m & h`
- `CoverArt.m & h`

Adding Entries

When results for an appropriate operation are received, an entry is added to the database. Only results from the following operations are stored:

- Recognizing music from the microphone
- Recognizing music from a PCM sample
- Searching by fingerprint

The process of adding an entry to the database is included in the base search operation class `SearchByOperation`. This allows it to be invoked in the thread that calls `GNResultReady` for any of the operations mentioned above. Before adding an entry, a check is made to ensure the database exists, and if it doesn't, it is created.

Each record in the database contains a unique ID. The ID is generated by incrementing the ID of the last entry added to the database. IDs are later used by the mechanism that prunes the database, keeping it within a predetermined size.

A single synchronized method is used to add an entry to the database. Synchronization is essential to guarantee the integrity of the mechanism used to generate unique IDs and the procedure used to create a database if it doesn't already exist.

Limiting Database Size

The size of the database cannot be allowed to grow indefinitely. After adding an entry to the database, its size is checked to determine if it exceeds a predefined limit of 1000 entries. If there are more than 1000 entries, the oldest entries in the database are deleted, bringing the size back to the predetermined limit.

Recalling Entries

The Mobile Client Sample Application exports a mutable copy of the entries in the database in an array. The data contained within the export can then be used to populate a UI that allows the user to navigate the entries. For large databases, a paging mechanism can be used to reduce the number of entries exported into memory at any one time.

UI Best Practices Using MusicID-Stream

Gracenote periodically conducts analysis on its MusicID-Stream product to evaluate its usage and determine if there are ways we can make it even better. Part of this analysis is determining why some MusicID-Stream recognition queries do not find a match.

Consistently Gracenote finds that the majority of failing queries contain an audio sample of silence, talking, humming, singing, whistling or live music. These queries fail because the Gracenote MusicID-Stream service can only match commercially released music.

Such queries are shown to usually originate from applications that do not provide good end user instructions on how to correctly use the MusicID-Stream service. Therefore Gracenote recommends that application developers consider incorporating end user instructions into their applications from the beginning of the design phase. This section describes the Gracenote recommendations for instructing end users on how to use the MusicID-Stream service in order to maximize recognition rates and have a more satisfied user base.

This section is specifically targeted to applications running on a user's cellular handset, tablet computer, or similar portable device, although end user instructions should be considered for all applications using MusicID-Stream. Not all recommendations listed here are feasible for every application. Consider them options for improving your application and the experience of your end users.

Clear and Accessible

All instructions provided to the user should be easy to understand and accessible at any time. For example:

- Use pictures instead of text
- Provide a section in the device user manual (where applicable)
- Provide a help section within the application
- Include interactive instructions embedded within the flow of the application. For example, prompt the user to hold the device to the audio source.

Rotating Help Message upon Failed Recognition

When a recognition attempt fails, display a help message with a hint or tip on how to best use the MusicID-Stream service; a concise, useful tip can persuade a user to try again. Have a selection of help messages available; show one per failed recognition attempt but rotate which message is displayed.

Allow the User to Provide Feedback

When a recognition attempt fails, allow the user to submit a hint with information about what they are looking for. Based on the response, the application could return a targeted help message about the correct use of MusicID-Stream.

Audio Listening Animation

While the device is recording an audio sample, display a simple image or animation that explains how to correctly use MusicID-Stream.

Audio Listening Progress Indicator or Countdown

Use a progress bar or countdown to indicate how long the application will be recording. The user can use this information to assist in collecting an audio sample that can be successfully recognized.

Audio Listening Completed Cues

Some failing MusicID-Stream recognitions are caused by insufficient or incomplete recording of the song. To assist the user in assessing if recording is complete, visual, audible and tangible cues can be used, such as:

- Display a message (only useful if the user is looking at the display)
- Sound a tone or tune (not useful in load environments)
- Vibrate the handset (always useful)

Use Street Sign-like Images

Street sign images are universal and easily recognizable. These can be used to provide clear instructions about where and how to use and not to use the MusicID-Stream service.

Demo Animation

Provide a small, simple animation that communicates how to use the application. Make this animation accessible at all times from the Help section.

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Common Crypto

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MD5 Message-Digest Algorithm

