GNSDK for Desktop Developers Guide

Object-Oriented APIs

(Gracenote Developer Portal Edition)

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Preface

Start Here - Doc Roadmap

GNSDK for Desktop provides a broad range of documentation and sample code to help you develop GNSDK applications. The documentation is in two formats:

- HTML5 Help
- PDF

In general, each of these contain the same content. The main difference is that the PDF documentation does not contain API Reference content because of its size and complexity. API Reference documentation is generated from the GNSDK source files and provided in HTML format accessible from the HTML5 Help system.

Doc Set Summary

GNSDK for Desktop has the following doc set:

Document	**Description**
GNSDK for Desktop Help	The most comprehensive format of GNSDK for Desktopdocumentation. Includes API Reference and Developers Guide content.
GNSDK for Desktop Developers Guide	Detailed information about developing GNSDK for Desktop applications in a printable format. No API Reference content.
GNSDK for Desktop Release Notes (*PDF only*)	Summary of what's new and changed in this release.

API Reference Documentation

You can develop GNSDK for Desktop applications using several popular object-oriented languages. The following table describes these APIs and where to find the corresponding API Reference documentation:

API Name	**Description**	**Location in Package**
C++ API Reference	API descriptions of the GNSDK for Desktop C++ interface.	/docs/html/Content\api_ref_cplusplus/start_here.html
C# API Reference	API descriptions of the GNSDK for Desktop C# interface.	/docs/html/Content\api_ref_csharp/start_here.html
Java (J2SE) API Reference	API descriptions of the GNSDK for Desktop Java J2SE interface.	docs/Content/api_ref_java/html/index.html
Java (Android) API Reference	API descriptions of the GNSDK for Desktop Java Android interface	docs/Content/api_ref_java_android/html/index.html

Python API Reference	API descriptions of the GNSDK for Desktop Python interface.	docs/Content/api_ref_python/html/index.html

Sample Applications

Code Samples	Description	Location in Package
Java Sample applications	Applications you can compile and run that demonstrate specific GNSDK for Desktop features.	samples_java
C++ Sample applications	Applications you can compile and run that demonstrate specific GNSDK for Desktopfeatures.	samples_cplusplus
C# Sample applications	Applications you can compile and run that demonstrate specific GNSDK for Desktopfeatures.	sample/sample.sln

Concepts

Introduction

About Gracenote

A pioneer in the digital media industry, Gracenote combines information, technology, services, and applications to create ingenious entertainment solutions for the global market.

From media management, enrichment, and discovery products to content identification technologies, Gracenote allows providers of digital media products and the content community to make their offerings more powerful and intuitive, enabling superior consumer experiences. Gracenote solutions integrate the broadest, deepest, and highest quality global metadata and enriched content with an infrastructure that services billions of searches a month from thousands of products used by hundreds of millions of consumers.

Gracenote customers include the biggest names in the consumer electronics, mobile, automotive, software, and Internet industries. The company's partners in the entertainment community include major music publishers and labels, prominent independents, and movie studios.

Gracenote technologies are used by leading online media services, such as Apple iTunes®, Pandora®, and Sony Music Unlimited, and by leading consumer electronics manufacturers, such as Pioneer, Philips, and Sony, and by nearly all OEMs and Tier 1s in the automotive space, such as GM, VW, Nissan, Toyota, Hyundai, Ford, BMW, Mercedes Benz, Panasonic, and Harman Becker.

For more information about Gracenote, please visit: www.gracenote.com.

What is Gracenote SDK?

Gracenote SDK (GNSDK) is a platform that delivers Gracenote technologies to devices, desktop applications, web sites, and backend servers. GNSDK enables easy integration of Gracenote technologies into customer applications and infrastructure—helping developers add critical value to digital media products, while retaining the flexibility to fulfill almost any customer need.

GNSDK is designed to meet the ever-growing demand for scalable and robust solutions that operate smoothly in high-traffic server and multithreaded environments. GNSDK is also lightweight—made to run in desktop applications and even to support popular portable devices.

GNSDK for Desktop and Gracenote Products

GNSDK for Desktop provides convenient access to Gracenote Services (Gracenote's suite of advanced media recognition, enriched content, and discovery services paired with robust infrastructure), enabling easy integration of powerful Gracenote products into customer applications and devices. Gracenote products provided by GNSDK for Desktop are summarized in the table below.

Gracenote Products	GNSDK for Desktop Modules	Module Description
MusicID^{TM}	MusicID, MusicID-File	MusicID (CD TOC, Text, Stream and File Fingerprint); MusicID-File (LibraryID, AlbumID and TrackID Fingerprint Identification) Enables MusicID recognition for identifying CDs, digital music files, and streaming audio and delivers relevant metadata such as track titles, artist names, album names, and genres. Also provides library organization and direct lookup features.
VideoID^{TM} and Video Explore^{TM}	Video	Provides video item recognition for DVD and Blu-ray products via TOCs. Provides extended video recognition and searching, enabling user exploration and discovery features.
Music Enrichment	Link	A mechanism for retrieving enriched content including cover art, artist images, biographies and reviews.
Playlist	Playlist, MoodGrid	Generates playlists based on music descriptors. Includes More Like This™ functionality to generate a playlist similar to the currently playing track. Also supports creation of MoodGrids to visually group content based on mood metadata.

Modules Overview

GNSDK for Desktop consists of several modules that support specific Gracenote products. The principal module required for all applications is the GNSDK Manager. Others are optional, depending on the functionality of the applications you develop and the products you license from Gracenote.

General GNSDK for Desktop Modules

GNSDK Manager: Required. GNSDK Manager provides core functionality necessary to all Gracenote modules.

Link: Optional.The Link module provides access to enriched metadata. To use this module, your application requires special metadata entitlements.

Contact your Gracenote Global Services & Support representative for more information.

DSP: Optional. Provides digital signal processing functionality required for fingerprint generation.

SQLite: Optional . The SQLite module provides a local storage solution for GNSDK for Desktop using the SQLite database engine. This module is primarily used to manage a local cache of queries and content that the GNSDK for Desktop modules make to Gracenote Service. SQLite is a software module that implements a self-contained, server-less, zero-configuration, transactional SQL database engine. SQLite is the most widely deployed SQL database engine in the world. The source code for SQLite is in the public domain. Information on SQLite can be found at http://www.sqlite.org.

Submit: Provides functionality necessary to submit metadata parcels to Gracenote database.

Product-Specific Modules

MusicID: Provides CD TOC, text, and fingerprint identification for music.

MusicID-File: Provides file-based music identification using LibraryID, AlbumID, and TrackID processing functionality.

MusicID-Stream: Designed specifically to recognize music delivered as a continuous stream. Use this library in applications that need to recognize streaming music in real time and on-demand.

VideoID: Provides DVD and BluRay identification, and Text search for video; encompasses the VideoID and Video Explore products.

Playlist: Provides functionality to generate and manage playlists and playlist collections. Also supports creation of MoodGrids to visually group content based on mood metadata.

Gracenote MetaData

Gracenote Media Elements

Gracenote Media Elements are the software representations of real-world things like CDs, Albums, Tracks, Contributors, and so on. The following is a partial list of the higher-level media elements represented in GNSDK for Desktop:

Music

- Music CD
- Album
- Track
- Artist
- Contributor

Video

- Video Product (DVD/Blu-Ray)
- AV Work
- Contributor
- Series
- Season

Music Terminology

The following terms are used throughout the music documentation. For a detailed list of GNSDK terms and definitions, see the Glossary.

- **Album** - A collection of audio recordings, typically of songs or instrumentals.
- **Audio Work** - A collection of classical music recordings.
- **Track** - A song or instrumental recording.
- **Artist** - The person or group primarily responsible for creating the Album or Track.
- **Contributor** - A person that participated in the creation of the Album or Track.

Video Terminology

The following terms are used throughout the video documentation. For a detailed list of GNSDK terms and definitions, see the Glossary.

- **Video Work** - A Work refers to the artistic creation and production of a Film, TV Series, or other form of video content. The same Work can be released on multiple Product formats across territories. For example, The Dark Knight Work can be released on a Blu-ray Product in multiple countries. A TV Series such as Lost is also a Work. Each individual episode comprising the Series is also a unique Work. Although the majority of Works are commercially released as a Product, not all Works have a Product counterpart. For example, a TV episode which airs on TV, but is not released on DVD or Blu-ray is considered a Work to which no Product exists.
- **Video Product** - A Product refers to the commercial release of a Film, TV Series, or video content. Products contain a unique commercial code such as a UPC (Univeral Product Code), Hinban, or EAN (European Article Number). Products are for the most part released on a physical format, such as a DVD or Blu-ray.
- **Video Disc** - A video disc can be either DVD (Digital Video Disc) or Blu-ray. DVD is an optical disc storage format, invented and developed by Philips, Sony, Toshiba, and Panasonic in 1995. DVDs offer higher storage capacity than Compact Discs while having the same dimensions. Blu-ray is an optical disc format designed to display high definition video and store large amounts of data. The name Blu-ray Disc refers to the blue laser used to read the disc, which allows information to be stored at a greater density than is possible with the longer-wavelength red laser used for DVDs.
- **Video Side** - Both DVDs and Blu-ray discs can be dual side. Double-Sided discs include a single layer on each side of the disc that data can be recorded to. Double-Sided recordable DVDs come in two formats: DVD-R and DVD+R, including the rewritable DVD-RW and DVD+RW. These discs can hold about 8.75GB of data if you burn to both sides. Dual-side Blu-ray discs can store 50 GB of data (25GB on each side).
- **Video Layer** - Both DVDs and Blu-ray Discs can be dual layer. These discs are only writable on one side of the disc, but contain two layers on that single side for writing data to. Dual-Layer recordable DVDs come in two formats: DVD-R DL and DVD+R DL. They can hold up to 8.5GB on the two layers. Dual-layer Blu-ray discs can store 50 GB of data (25GB on each layer).
- **Video Clip** - A short video presentation.
- **Contributor** - A Contributor refers to any person who plays a role in a Work. Actors, Directors, Producers, Narrators, and Crew are all consider a Contributor. Popular recurring Characters such as Batman, Harry Potter, or Spider-man are also considered Contributors.
- **Credit** - A credit lists the contribution of a person (or occasionally a company, such as a film studio) to a Video Work.
- **Character** - An imaginary person represented in a Video Work of fiction.
- **Feature** - A video feature has a full-length running time usually between 60 and 120 minutes. A feature is the main component of a DVD or Blu-ray disc which may, in addition, contain extra, or bonus, video clips and features.
- **Filmography** - All of the Works associated with a Contributor in the Gracenote Service, for example: All Works that are linked to Tom Hanks.
- **Franchise** - A collection of related Video Works. For example: Batman, Friends, Star Wars, and CSI.
- **Chapter** - A Video feature may contain chapters for easy navigation and as bookmarks for partial

viewing.

- **Season** - A Season is an ordered collection of Works, typically representing a season of a TV series. For example: CSI: Miami (Season One), CSI: Miami (Season Two), CSI: Miami (Season Three).
- **Series** - A Series is a collection of related Works, typically in sequence, and often comprised of Seasons (generally for a TV series), for example: CSI: Miami, CSI: Vegas, CSI: Crime Scene Investigation.

Genre and Other List-Dependent Values

GNSDK for Desktop uses list structures to store strings and other information that do not directly appear in results returned from Gracenote Service. Lists generally contain information such as localized strings and region-specific information. Each list is contained in a corresponding List Type.

Some Gracenote metadata is grouped into hierarchical lists. Some of the more common examples of list-based metadata include genre, artist origin, artist era, and artist type. Other list-based metadata includes mood, tempo, roles, and others.

Lists-based values can vary depending on the locale being used for an application. That is, some values will be different depending on the chosen locale of the application. Therefore, these kinds of list-based metadata values are called *locale-dependent.*

Genres and List Hierarchies

One of the most commonly used kinds of metadata are genres. A genre is a categorization of a musical composition characterized by a particular style. The list system enables genre classification and hierarchical navigation of a music collection. The Genre list is very granular for two reasons:

- To ensure that music categories from different countries are represented and that albums from around the world can be properly classified and represented to users based on the user’s geographic location and cultural preferences.
- To relate different regionally-specific music classifications to one another, to provide a consistent user experience in all parts of the world when creating playlists with songs that are similar to each other.

The Gracenote Genre System contains more than 2200 genres from around the world. To make this list easier to manage and give more display options for client applications, the Gracenote Genre System groups these genres into a relationship hierarchy. Most hierarchies consists of three levels: level-1. level-2, and level-3.

- Level-1
  - Level-2
    - Level-3

For example, the partial genre list below shows two, level-1 genres: Alternative & Punk and Rock.

Each of these genres has two, level-2 genres. For Rock, the level-2 genres shown are Heavy Metal and 50's Rock. Each level-2 genre has three level-3 genres. For 50's Rock, these are Doo Wop, Rockabilly, and Early Rock and Roll. This whole list represents 18 genres.

- Alternative & Punk
  - Alternative
    - Nu-Metal
    - Rap Metal
    - Alternative Rock
  - Punk
    - Classic U.K. Punk
    - Classic U.S. Punk
    - Other Classic Punk
- Rock
  - Heavy Metal
    - Grindcore
    - Black Metal
    - Death Metal
  - 50's Rock
    - Doo Wop
    - Rockabilly
    - Early Rock & Roll

Other category lists include: origin, era, artist type, tempo, and mood.

Simplified and Detailed Hierarchical Groups

In addition to hierarchical levels for some metadata, the Gracenote Genre System provides two general kinds of hierarchical groups (also called list hierarchies). These groups are called *Simplified* and *Detailed*.

You can choose which hierarchy group to use in your application for any of the locale/list-dependent values. Your choice depends on how granular you want the metadata to be.

The Simplified group retrieves the coarsest (largest) grain, and the Detailed group retrieves the finest (smallest) grain, as shown below.

> Below are examples of a Simplified and Detailed Genre Hierarchy Groups. The values below are for documentation purposes only. Please contact your Gracenote Global Services & Support representative for more information.

> Below are examples of a Simplified and Detailed Genre Hierarchy Groups. The values below are for documentation purposes only.

Example of a Simplified Genre Hierarchy Group

- Level-1: 10 genres
  - Level-2: 75 genres
    - Level-3: 500 genres

Example of a Detailed Genre Hierarchy Group

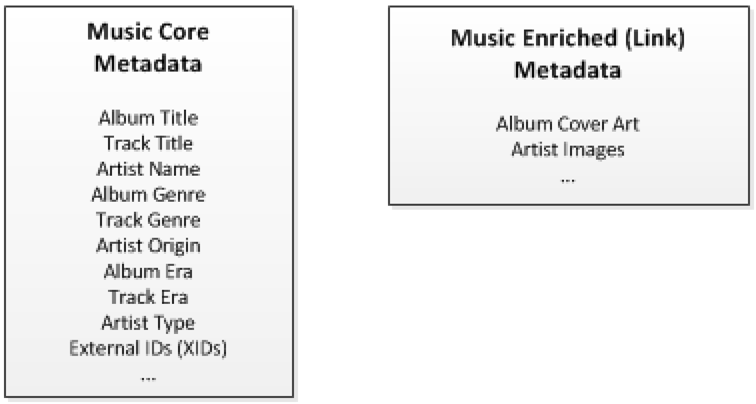
- Level-1: 25 genres
    - Level-2: 250 genres
        - Level-3: 800 genres

Contact your Gracenote representative for more detail.

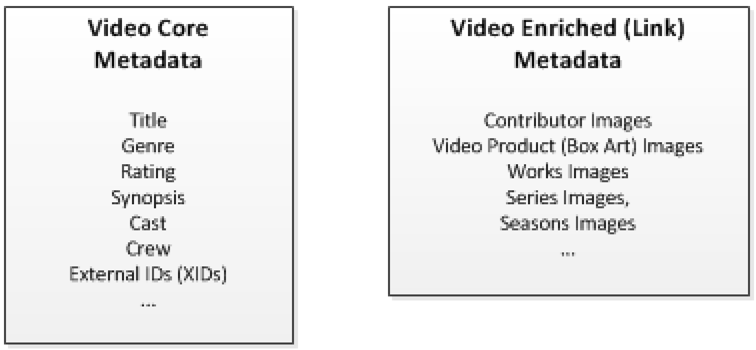
Core and Enriched Metadata

All Gracenote customers can access core metadata from Gracenote for the products they license. Optionally, customers can retrieve additional metadata, known as *enriched metadata*, by purchasing additional metadata entitlements.

The following diagram shows the core and enriched metadata available for Music.



The following diagram shows the core and enriched metadata available for Video.



Mood and Tempo (Sonic Attributes)

Gracenote provides two metadata fields that describe the sonic attributes of an audio track. These fields, mood and tempo, are track-level descriptors that capture the unique characteristics of a specific recording.

Mood is a perceptual descriptor of a piece of music, using emotional terminology that a typical listener might use to describe the audio track. Mood helps power Gracenote Playlist.

Tempo is a description of the overall perceived speed or pace of the music. Gracenote mood and tempo descriptor systems include hierarchical categories of increasing granularity, from very broad parent categories to more specific child categories.

NOTE: Tempo metadata is available online-only.

To use this feature, your application requires special metadata entitlements. Contact your Gracenote Global Services & Support representative for more information.

Classical Music Metadata

This topic discusses Gracenote classical music support, Three-Line-Solution (TLS), and GNSDK for Desktop's support for accessing classical music metadata from Gracenote Service. Gracenote TLS provides the four basic classical music metadata components—composer, album name, artist name, and track name—in a standard three-field media display for albums, artists, and tracks, as follows:

Classical Three-Line Display: Metadata Mapping

Field	Three-line Display
Track	[Composer Short Name]: [Work Title] In {Key}, {Opus}, {Cat#}, {"Nickname"} – [Movement#]. [M. Name]
Artist	{Soloist(s)}, {Conductor}; {Ensemble}, {Choral Ensemble}
Album	As printed on the spine

Classical Three-Line Display: Metadata Mapping Example

Field	Three-line Display
Track	Vivaldi: The Four Seasons, Op. 8/1, "Spring" – 1. Allegro
Artist	Joseph Silverstein, Seiji Ozawa; Boston Symphony Orchestra
Album	Vivaldi: The Four Seasons

- Composer: The composer(s) that are featured on an album are listed by their last name in the album title (where applicable). In the examples noted below, the composer is Beethoven.
- Album Name: In most cases, a classical album's title is comprised of the composer(s) and work(s) that are featured on the product, which yields a single entity in the album name display. However, for albums that have formal titles (unlike composers and works), the title is listed as it is on the product.
- General title example: Beethoven: Violin Concerto
- Formal title example: The Best Of Baroque Music
- Artist Name: A consistent format is used for listing a recording artist(s)—by soloist(s), conductor, and ensemble(s)—which yields a single entity in the artist name display. For example: Hilary Hahn; David Zinman: Baltimore Symphony Orchestra

- Track Name: A consistent format is used for listing a track title—composer, work title, and (where applicable) movement title—which yields a single entity in the track name display. For example: Beethoven: Violin Concerto In D, Op. 61 – 1. Allegro Ma Non Troppo

Third-Party Identifiers and Preferred Partners

Link can match identified media with third-party identifiers. This allows applications to match media to IDs in stores and other online services—facilitating transactions by helping connect queries directly to commerce.

Gracenote has preferred partnerships with several partners and matches preferred partner content IDs to Gracenote media IDs. Entitled applications can retrieve IDs for preferred partners through Link.

Clean-up and Collaborative Artists

Gracenote powers an easier navigation experience by utilizing Gracenote's clean metadata. Slight misspellings and nicknames can be cleaned-up into a single name for quicker, more accurate navigation. For example, tracks by "CCR", "C.C.R" and "Creedence Clearwater Revival" can all be cleaned up into a single "Creedence Clearwater Revival" entity.

Collaborations between two or more artists can often clutter an entire screen. For example, the Santana album "Supernatural" contains a number of collaborations such as "Santana featuring Rob Thomas" and "Santana featuring Dave Matthews" which would appear individually when navigating by Artist. Gracenote enhances the navigation experience with Collaborative Artists by providing the ability to consolidate by the Primary Artist. All of Santana's tracks, including collaborations, can be grouped under a single "Santana" artist making it much easier to navigate.

Music Modules

Music Module Overview

The following diagram summarizes the kinds of identification queries each Music module supports.

MusicID Overview

MusicID allows application developers to deliver a compelling digital entertainment experience by giving users tools to manage and enjoy music collections on media devices, including desktop and mobile devices. MusicID is the most comprehensive identification solution in the industry with the ability to recognize, categorize and organize any music source, be it CDs, digital files, or audio streams. MusicID also seamlessly integrates with Gracenote's suite of products and provides the foundation for advanced services such as enriched content and linking to commerce.

Media recognition using MusicID makes it possible for applications to access a variety of rich data available from Gracenote. After media has been recognized, applications can request and utilize:

- Album, track, and artist names
- Genre, origin, era and type descriptors
- Mood and tempo descriptors
- Music Enrichment content, including cover art, artist images, biographies, and reviews

GNSDK for Desktop accepts the following types of inputs for music recognition:

- CD TOCs
- File fingerprints
- Stream fingerprints
- Text input of album and track titles, album and track artist names, and composer names
- Media element identifiers
- Audio file and folder information (for advanced music recognition)

CD TOC Recognition

MusicID-CD is the component of GNSDK for Desktop that handles recognition of audio CDs and delivery of information including artist, title, and track names. The application provides GNSDK for Desktop with the TOC from an audio CD and MusicID-CD will identify the CD and provide album and track information.

TOC Identification

The only information that is guaranteed to be on every standard audio CD is a Table of Contents, or TOC. This is a header at the beginning of the disc giving the precise starting location of each track on the CD, so that CD players can locate the tracks and compute the track length information for their display panels.

This information is given in frames, where each frame is 1/75 of a second. Because this number is so precise, it is relatively unlikely that two unrelated CDs would have the same TOC. This lets Gracenote use the TOC as a relatively unique identifier.

The example below shows a typical TOC for a CD containing 13 tracks:

```
150 26670 52757 74145 95335 117690 144300 163992 188662 209375 231320 253150 281555 337792
```

The first 13 numbers represent the frames from the beginning of the disc that indicate the starting locations of the 13 tracks. The last number is the offset of the lead out, which marks the end of the CD program area.

Multiple TOC Matches

An album will often have numerous matching TOCs in the Gracenote database. This is because of CD manufacturing differences. More popular discs tend to have more TOCs. Gracenote maintains a catalog of multiple TOCs for many CDs, providing more reliable matching.

The following is an example of multiple TOCs for a single CD album. This particular album has 22 popular TOCs and many other less popular TOCs.

```
150 26670 52757 74145 95335 117690 144300 163992 188662 209375 231320 253150 281555 337642
```

```
150 26670 52757 74145 95335 117690 144300 163992 188662 209375 231320 253150 281555 337792
```

```
182 26702 52790 74177 95367 117722 144332 164035 188695 209407 231362 253182 281587 337675
```

```
150 26524 52466 73860 94904 117037 143501 162982 187496 208138 230023 251697 279880 335850
```

Multiple TOCs and Fuzzy Matching

Gracenote MusicID utilizes several methods to perform TOC matches. This combination of matching methods allows client applications to accurately recognize media in a variety of situations.

- Exact Match – when there is only one Product match for a queried CD TOC
- Multi-Exact Match – when there are multiple Product matches for a queried CD TOC
- Fuzzy Match – allows identification of media that has slight known and acceptable variations from well-recognized media.

Text-Based Recognition

You can identify music by using a lookup based on text strings. The text strings can be extracted from an audio track's file path name and from text data embedded within the file, such as mp3 tags. You can provide the following types of input strings:

1. Album title
2. Track title
3. Album artist
4. Track artist
5. Track composer

Text-based lookup attempts to match these attributes with known albums, artists, and composers. The text lookup first tries to match an album. If that is not possible, it next tries to match an artist. If that does not succeed, a composer match is tried. Adding as many input strings as possible to the lookup improves the results.

If a query handle populated with text inputs is passed to gnsdk_musicid_find_matches(), then best-fit objects will be returned. In this instance, you might get back album matches or contributor matches or both. Album matches are generally ranked higher than contributor matches

Fingerprint-Based Recognition

You can use MusicID or MusicID-File to identify music using an audio fingerprint. An Audio fingerprint is data that uniquely identifies an audio track based on the audio waveform. The online Gracenote Media Service uses audio fingerprints to match the audio from a client application to the Gracenote Music Database.

Waveform Recognition

A fingerprint is generated from a short audio sample of about six seconds. The fingerprint is sent to Gracenote Services for identification. Accessing fingerprints requires an Internet connection, which must be provided by the application.

There are two basic types of fingerprints:

- MusicID (File fingerprint)
- MusicID (Stream)

MusicID (File fingerprint) recognizes audio files such as those generated when ripping a CD. It uses the first portion of the audio file for recognition.

MusicID (Stream) can identify music using short samples from anywhere within a song. Fingerprints can be generated from a variety of audio sources, including recorded and degraded sources such as radios and televisions. This enables music identification using arbitrary audio sources—including sampling music via mobile devices.

Your application can retain fingerprints for a collection of audio files so they can be used later in queries. For example, your application can fingerprint an entire collection of files in a background thread and reuse them later.

About DSP

The DSP module is an internal module that provides Digital Signal Processing functionality used by other GNSDK for Desktop modules. This module is optional unless the application performs music identification or generates audio features for submission to Gracenote.

MusicID-File Overview

MusicID-File provides advanced file-based identification features not included in the MusicID module. MusicID-File can perform recognition using individual files or leverage collections of files to provide advanced recognition. When an application provides decoded audio and text data for each file to the library, MusicID-File identifies each file and, if requested, identifies groups of files as albums.

At a high level, MusicID-File APIs implement the following services:

- Identification through waveform fingerprinting and metadata
- Advanced processing methods for identifying individual tracks or file groupings and collections
- Result and status management

MusicID-File can be used with a local database, but it only performs text-matching locally. Fingerprints are not matched locally.

NOTE: MusicID-File queries never return partial results. They always return full results.

Waveform and Metadata Recognition

The MusicID-File module utilizes both audio data and existing metadata from individual media files to produce the most accurate identification possible.

Your application needs to provide raw, decoded audio data (pulse-code modulated data) to MusicID-File, which processes it to retrieve a unique audio fingerprint. The application can also provide any metadata available for the media file, such as file tags, filename, and perhaps any application metadata. MusicID-File can use a combination of fingerprint and text lookups to determine a best-fit match for the given data.

The MusicID module also provides basic file-based media recognition using only audio fingerprints. The MusicID-File module is preferred for file-based media recognition, however, as its advanced recognition process provides significantly more accurate results.

Advanced Processing Methods

The MusicID-File module provides APIs that enable advanced music identification and organization. These APIs are grouped into the following three general categories - LibraryID, AlbumID, and TrackID.

LibraryID

LibraryID identifies the best album(s) for a large collection of tracks. It takes into account a number of factors, including metadata, location, and other submitted files when returning results. In addition, it automatically batches AlbumID calls to avoid overwhelming device and network resources.

Normal processing is 100-200 files at a time. In LibraryID, you can set the batch size to control how many files are processed at a time. The higher the size, the more memory will be used. The lower the size, the less memory will be used and the faster results will be returned. If the number of files in a batch exceeds batch size, it will attempt to make an intelligent decision about where to break based on other factors.

All processing in LibraryID is done through callbacks (e.g., fingerprinting, setting metadata, returned statuses, returned results, and so on.). The status or result callbacks provide the only mechanism for accessing Response GDOs.

AlbumID

AlbumID identifies the best album(s) for a group of tracks. For example, while the best match for a track would normally be the album where it originally appeared, if the submitted media files as a group are all tracks on a compilation album, then that is identified as the best match. All submitted files are viewed as a single group, regardless of location.

AlbumID assumes submitted tracks are related by a common artist or common album. Your application must be careful to only submit files it believes are related in this way. If your application cannot perform such grouping use LibraryID which performs such grouping internally

TrackID

TrackID identifies the best album(s) for a single track. It returns results for an individual track independent of any other tracks submitted for processing at the same time. Use TrackID if the original album a track appears on is the best or first result you want to see returned before any compilation, soundtrack, or greatest hits album the track also appears on.

MusicID-File Best Practices

- Use LibraryID for most applications.LibraryID is designed to identify a large number of audio files. It gathers the file metadata and then groups the files using tag data.LibraryID can only return a single, best match
- Use TrackID or AlbumID if you want all possible results for a track. You can request AlbumID and TrackID to return a single, best album match, or all possible matches. .
- Use AlbumID if your tracks are already pretty well organized by album. For memory and performance reasons, you should only provide a small number of related tracks. Your application should pre-group the audio files, and submit those groups one at a time.
- Use TrackID for one off track identifications and if the original album that a track appears on is the best or first result you want to see returned. TrackID is best for identifying outliers, that is those tracks unable to be grouped by the appliction for use with AlbumID. You can provide many files at once, but the memory consumed is directly proportional to the number of files provided. o Tkeep memory down you should submit a small number of files at a time

Usage Notes

- As stated above, TrackID and AlbumID are not designed for large sets of submitted files (more than an album's worth). Doing this could result in excessive memory use.
- For all three ID methods, you need to add files for processing manually, one-at-a-time. You cannot add all the files in a folder, volume, or drive in a single call.

MusicID vs. MusicID-File

Deciding whether to use the MusicID or MusicID-File SDK depends upon whether you are doing a "straightforward lookup" or "media recognition."

Use the MusicID SDK to perform a straightforward lookup. A lookup is considered straightforward if the application has a single type of data and would like to retrieve the Gracenote results for it. The source of the data does not matter (for example, the data might have been retrieved at a different time or from various sources). Examples of straightforward lookups are:

- Doing a lookup with text data only
- Doing a lookup with an audio fingerprint only
- Doing a lookup with a CD TOC
- Doing a lookup with a GDO value

Each of the queries above are completely independent of each other. The data doesn't have to come from actual media (for example, text data could come from user input). They are simply queries with a single, specific input.

Use the MusicID-File SDK to perform media recognition. MusicID-File performs recognition by using a combination of inputs. It assumes that the inputs are from actual media and uses this assumption to determine relationships between the input data. This SDK performs multiple straightforward lookups for a single piece of media and performs further heuristics on those results to arrive at more authoritative results. MusicID-File is capable of looking at other media being recognized to help identify results (for example, AlbumID).

> ⚠ If you only have a single piece of input, use MusicID. It is easier to use than MusicID-File, and for single inputs MusicID and MusicID-File will generate the same results.

MusicID-Stream

You can use MusicID-Stream to recognize music delivered as a continuous stream. Specifically, MusicID-Stream performs these functions:

- Recognizing streaming music in real time and on-demand .
- Automatically manages buffering of streaming audio.
- Continuously identifies the audio stream when initiated until it generates a response.

After establishing an audio stream, the application can trigger an identification query at any time. For example, this action could be triggered on-demand by an end user pressing an "Identify" button provided by the application UI.

The identification process identifies the buffered audio. Up to seven seconds of the most recent audio is buffered. If there is not enough audio buffered for identification, MusicID-Stream waits until enough audio is received. The identification process spawns a thread and completes asynchronously.

The application can identify audio using Gracenote Service online database or a local database. The default behavior attempts a local database match. If this fails, the system attempts an online database match.

Radio Overview

Gracenote Radio allows you monitor audio streams, providing recognition and metadata retrieval for terrestrial, Internet, and satellite radio stations. Gracenote Radio is a subset of MusicID-Stream, and is intended for use without any end-user interaction.

Radio:

- Recognizes streaming audio from traditional radio sources, including AM/FM, HD, DAB, and others.
- Recognizes music automatically without the need to start or stop recognition.
- Supports broadcast metadata such as title, artist, or station.

An application can use the information that Radio provides to display the song's metadata and imagery (if licensed), or in combination with other Gracenote software to generate playlists or other specialized applications based on the radio listening habits of the end-user.

Gracenote Radio requires the following in order to function optimally:

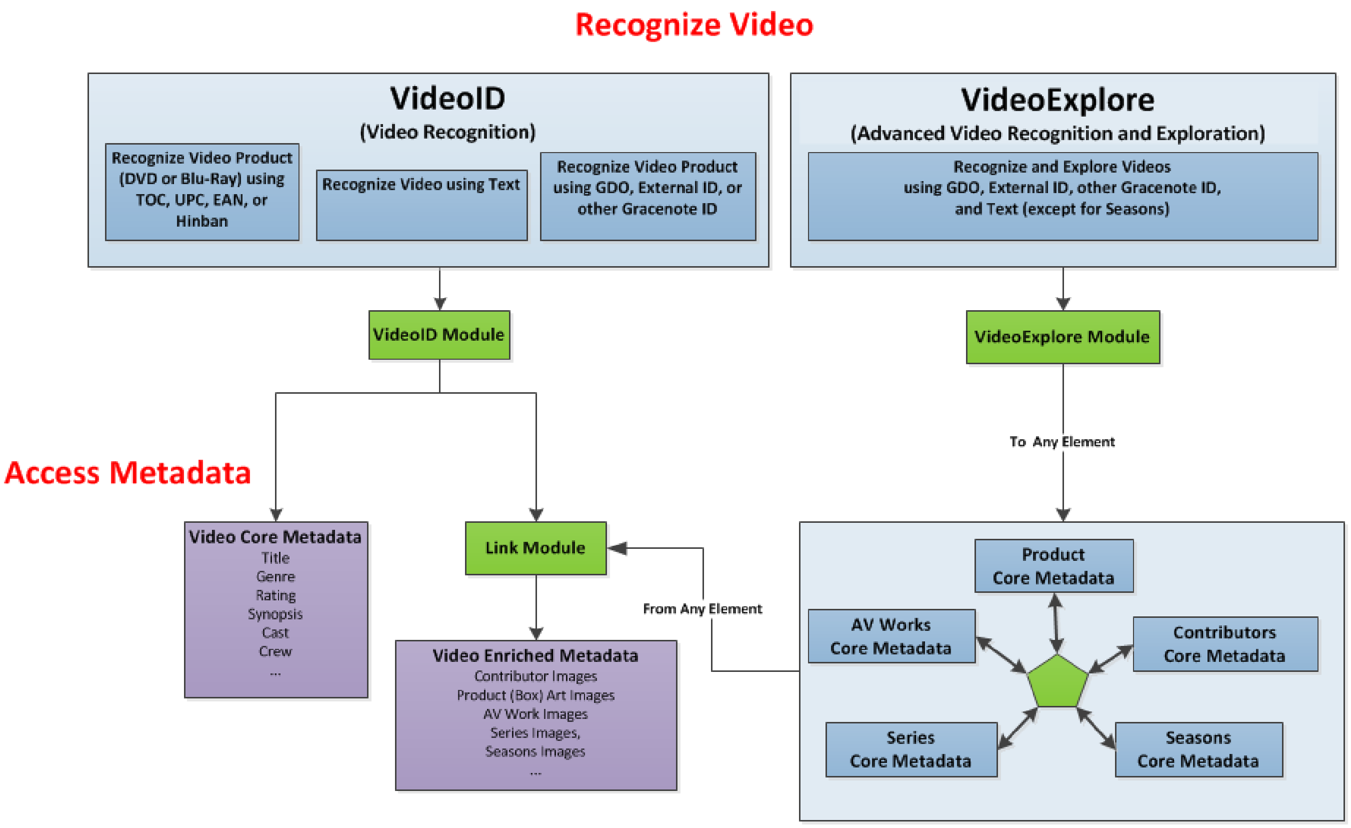
- Clean audio (such as line-in and other audio sources that are not from a microphone)
- Any available broadcast metadata (such as RDS or shoutcast metadata).
- Specific application interactions (such as station changes).

Video Modules

Video Module Overview

GNSDK provides two modules for implementing video features: VideoID and VideoExplore:

- VideoID supports recognizing DVDs and Blu-ray discs, and enables access to related metadata such as title, genre, rating, synopsis, cast and crew.
- Video Explore enables access to additional video elements and their metadata, visual assets, trailers, and commerce links.



VideoID Overview

VideoID can recognize Products (DVDs/Blu-Ray discs) using any of the following as input:

- TOC (table of contents)
- Text (a Product title)
- External ID, such as UPC, EAN, and Hinban codes
- GDO other Gracenote ID for the Product, such as a GNID, or TUI/TUI Tag combination.

VideoID applications support these features:

- Recognize a Product using any of the input types listed above.
- Enable access to core metadata from a Product GDO
- Enable access to enriched metadata from a Product GDO using the Link module

VideoExplore Overview

Using VideoExplore, an application can perform advanced video recognition and exploration using any of the following as input:

- Text, such as Product and AV Work titles, and names of Series and Contributors.
- External ID, such as UPC, EAN, and Hinban codes
- GDO other Gracenote ID for the Product, such as a GNID, or TUI/TUI Tag combination.

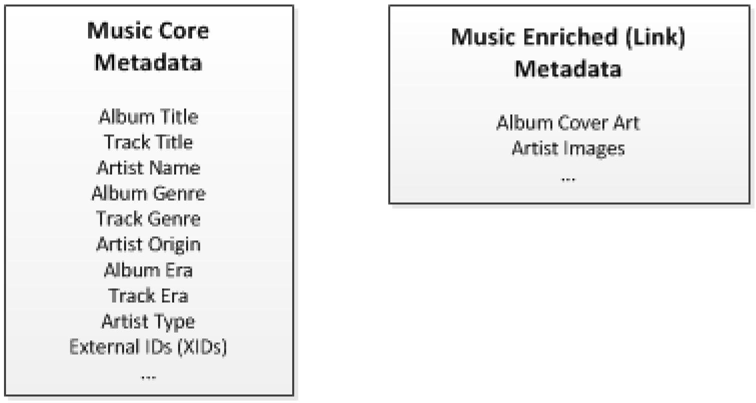
VideoExplore applications support these features:

- Recognize Products, AV Works, Contributors, Series, and Seasons using the above inputs. Note: Text is not supported for Seasons. Seasons can be retrieved using GDOs returned through other GNSDK queries
- Enable access to core metadata from any video GDO
- Enable access to enriched metadata from any video GDO using the Link module
- Perform suggestion searches for titles of Product, AV Work, Contributors, and Series. Request and receive suggestions for matching Contributors, Series and AV Works using user Text inputs. Suggestion searches enables applications to minimize the number of character inputs necessary for a user to find a match. GNSDK will return suggestions, if available, using a GDO.
- Navigate from one video element to a related video elements and access their core metadata.

Enriched Content Module (Link)

Link Module Overview

The Link module allows applications to access *enriched content* beyond standard core metadata. The diagram below show the difference between core metadata and enriched content for music.

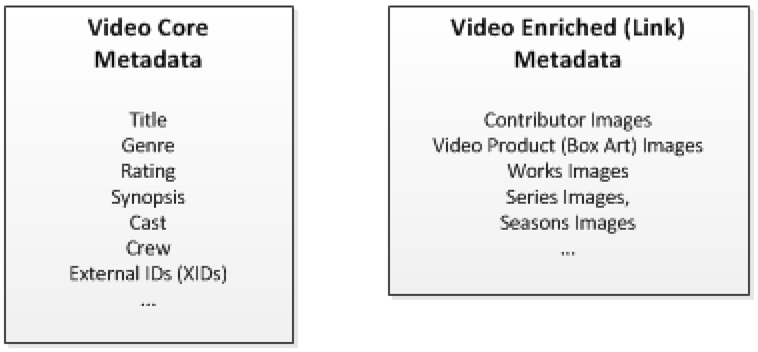


Link allows applications to access and present enriched content related to media that has been identified using GNSDK identification features. Link delivers third-party content identifiers matched to the identified media, which can then be used to retrieve enriched content from Gracenote. Link can also return any custom information that a customer has linked to Gracenote data—such as their own media identifiers.

Without Link, developers themselves must match and integrate data from various sources to present a targeted, relevant content experience to end-users during music playback. By providing developers with the ability to retrieve enriched content, Gracenote enables its customers to generate new revenue streams while improving the music listening experience.

Enriched content offered through Gracenote Link includes:

- Music enrichment:
  - Album cover art
  - Artist images
  - Album reviews
  - Artist biographies
- Third-party IDs



Music Enrichment

Link provides access to Gracenote Music Enrichment—a single-source solution for enriched content including cover art, artist images, biographies, and reviews. Link and Music Enrichment allow applications to offer enriched user experiences by providing high quality images and information to complement media.

Gracenote provides a large library of enriched content and is the only provider of fully licensed cover art, including a growing selection of international cover art. Music Enrichment cover art and artist images are provided by high quality sources that include all the major record labels.

Image Formats and Dimensions

Gracenote provides images in several dimensions to support a variety of applications. Applications or devices must specify image size when requesting an image from Gracenote. All Gracenote images are provided in the JPEG (.jpg) image format.

Available Image Dimensions

Gracenote provides images to fit within the following six square dimensions. All image sizes are available online and the most common 170x170 and 300x300 sizes are available in a local database.

Image Dimension Name	Pixel Dimensions
75	75 x 75
170	170 x 170
300	300 x 300

Image Dimension Name	Pixel Dimensions
450	450 x 450
720	720 x 720
1080	1080 x 1080

Please contact your Gracenote Global Services & Support representative for more information.

Source images are not always square, and may be proportionally resized to fit within the specified square dimensions. Images will always retain their original aspect ratio.

Common Media Image Dimensions

Media images exist in a variety of dimensions and orientations. Gracenote resizes ingested images according to carefully developed guidelines to accommodate these image differences, while still optimizing for both developer integration and the end-user experience.

Music Cover Art

Although CD cover art is often represented by a square, it is commonly 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 radically different in shape.

Artist Images

Artist and contributor images, such as publicity photos, come in a wide range of sizes and both portrait and landscape orientations.

Video contributor images are most often provided in portrait orientation.

Genre Images

Genre Images are provided by Gracenote to augment Cover Art and Artist Images when unavailable and to enhance the genre navigation experience. They are square photographic images and cover most of the Level 1 hierarchy items.

Video Cover Art

Video cover art is most often taller than it is wide (portrait orientation). For most video cover art, this means that images will completely fill the vertical dimension of the requested image size, and will not fill the horizontal dimension. Therefore, while mostly fixed in height, video images may vary slightly in width. For example, requests for a "450" video image will likely return an image that is exactly 450 pixels tall, but close to 300 pixels wide.
As with CD cover art, the dimensions of video covers also include packaging variants such as box sets which sometimes result in significant variations in video image dimensions.

Video Image Dimension Variations

Video imagery commonly conforms to the shape of a tall rectangle with either a 3:4 or 6:9 aspect ratio. Image dimension characteristics of Gracenote Video imagery are provided in the following sections as guidelines for customers who want to implement Gracenote imagery into UI designs that rely on these aspect ratios. Gracenote recommends, however, that applications reserve square spaces in UI designs to accommodate natural variations in image dimensions.

Video (AV Work) Images

AV Work images typically conform to a 3:4 (width:height) aspect ratio.

3:4 (± 10%)	Narrower	Wider	Narrowest	Widest
98%	1%	1%	1:2	9:5

Video Product Images

Video Product images typically conform to a 3:4 (width:height) aspect ratio

3:4 (± 10%)	Narrower	Wider	Narrowest	Widest
90%	5%	5%	1:3	5:1

Video Contributor Images

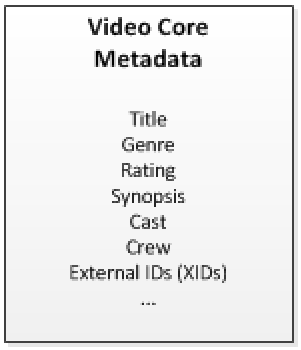
Video Contributor images typically conform to a 6:9 (width:height) aspect ratio. Two ranges are provided due to larger variation in image dimensions.

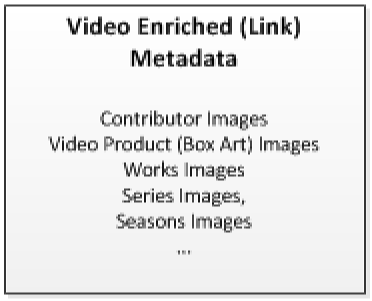
6:9 (± 20%)	Narrower	Wider	Narrowest	Widest
90%	0%	10%	1:3	9:5

6:9 (± 10%)	Narrower	Wider	Narrowest	Widest
69%	1%	30%	1:3	9:5

Video Enrichment Overview

All Gracenote customers can access core metadata products they license. Optionally, customers can access additional metadata, known as enriched metadata by purchasing additional metadata entitlements. Applications generally access enriched metadata using the Link module APIs. Enriched metadata includes Product box art, images, video trailers, and others.





Discovery Features

Playlists

Playlist provides advanced playlist generation enabling a variety of intuitive music navigation methods. Using Playlist, applications can create sets of related media from larger collections—enabling valuable features such as More Like This™ and custom playlists—that help users easily find the music they want.

Playlist functionality can be applied to both local and online user collections. Playlist is designed for both performance and flexibility—utilizing lightweight data and extensible features.

Playlist builds on the advanced recognition technologies and rich metadata provided by Gracenote through GNSDK for Desktop to generate highly relevant playlists.

Collection Summaries

Collection summaries store attribute data to support all media in a candidate set and are the basis for playlist generation. Collection summaries are designed for minimal memory utilization and rapid consumption, making them easily applicable to local and server/cloud-based application environments.

Playlists are generated using the attributes stored in the active collection summary. Collection summaries must, therefore, be refreshed whenever media in the candidate set or attribute implementations are modified.

Playlist supports multiple collection summaries, enabling both single and multi-user applications.

More Like This

More Like This is a powerful and popular navigation feature made possible by Gracenote and GNSDK for Desktop Playlist. Using More Like This, applications can automatically create a playlist of music that is similar to user-supplied seed music. More Like This is commonly applied to an application's currently playing track to provide users with a quick and intuitive means of navigating through their music collection.

Gracenote recommends using More Like This to quickly implement a powerful music navigation solution. Functionality is provided via a dedicated API to further simplify integration. If you need to create custom playlists, you can use the Playlist Definition Language.

.Playlist Requirements and Recommendations

This topic discusses requirements and recommendations for your Playlist implementation.

Simplified Playlist Implementation

Gracenote recommends streamlining your implementation by using the provided More Like This function, gnsdk_playlist_generate_morelikethis(). It uses the More Like This algorithm to generate optimal playlist results and eliminates the need to create and validate Playlist Definition Language statements.

Playlist Content Requirements

Implementing Playlist has these general requirements:

- The application integrates with GNSDK for Desktop's MusicID or MusicID-File (or both) to recognize music media and create valid GDOs.
- The application uses valid unique identifiers. A unique identifier must be a valid UTF-8 string of unique media identifier data. For more information, see "Unique Identifiers" on page 26.

> Unique identifiers are essential to the Playlist generation process. The functionality cannot reference a media item if its identifier is missing or invalid.

Playlist Storage Recommendations

GNSDK for Desktop provides the SQLite module for applications that may need a storage solution for collections. You can dynamically create a collection and release it when you are finished with it. If you choose this solution, you must store the GDOs or recognize the music at the time of creating the collection.

Your application can also store the collection using the serialization and deserialization functions.

Playlist Resource Requirements

The following table lists resource requirements for Playlist's two implementation scenarios:

Use Case	**Typical Scenario**	**Number of Collection Summaries**	**Application Provides Collection Summary to Playlist**	**Required Computing Resources**
Single user	Desktop user Mobile device user	Generally only one	Once, normally at start-up	Minimal-to-average, especially as data is ingested only once or infrequently

Use Case	Typical Scenario	Number of Collection Summaries	Application Provides Collection Summary to Playlist	Required Computing Resources
Multiple users	Playlist server Playlist - in-the-cloud system	Multiple; requires a unique collection summary for each user who can access the system	Dynamically and multiple times; typically loaded with the playlist criteria at the moment before playlist generation	Requires more computing resources to ensure an optimal user experience

Playlist Level Equivalency for Hierarchical Attributes

Gracenote maintains certain attribute descriptors, such as Genre, Era, Mood, and Tempo, in multi-level hierarchies. For a descriptions of the hierachies, see "Mood and Tempo (Sonic Attributes)" on page 8. As such, Playlist performs certain behaviors when evaluating tracks using hierarchical attribute criteria.

Track attributes are typically evaluated at their equivalent hierarchy list-level. For example, Rock is a Level 1 genre. When evaluating candidate tracks for a similar genre, Playlist analyzes a track's Level 1 genre.

However, Seeds contain the most granular-level attribute. When using a SEED, Playlist analyzes tracks at the respective equivalent level as is contained in the Seed, either Level 2 or Level 3.

Key Playlist Components

Playlist operates on several key components. The GNSDK for Desktop Playlist module provides functions to implement and manage the following key components within your application.

Media metadata: Metadata of the media items (or files)

The media may be on MP3s on a device, or a virtual collection hosted on a server. Each media item must have a unique identifier, which is application-defined.

Playlist requires recognition results from GNSDK for Desktop for operation, and consequently must be implemented with one or both of GNSDK for Desktop's music identification modules, MusicID and MusicID-File.

Attributes: Characteristics of a media item, such as Mood or Tempo

Attributes are Gracenote-delivered string data that an application can display; for example, the Mood attribute Soulful Blues.

When doing recognition queries, if the results will be used with Playlist, set the ‘enable playlist’ query option to ensure proper data is retrieved for the result (GNSDK_MUSICID_OPTION_ENABLE_PLAYLIST or GNSDK_MUSICIDFILE_OPTION_ENABLE_PLAYLIST).

Unique Identifiers

When adding media to a collection summary, an application provides a unique identifier and a GDO, which contains the metadata for the identifier. The identifier is a value that allows the application to identify the physical media being referenced. The identifier is not interpreted by Playlist; it is only returned to the application in Playlist results. An identifier is generally application-dependent. For example, a desktop application typically uses a full path to a file name for an identifier, while an online application typically uses a database key. The media GDO should contain relevant metadata for the media referenced by the identifier. In most cases the GDO comes from a recognition event for the respective media (such as from MusicID). Playlist will take whatever metadata is relevant for playlist generation from the given GDO. For best results, Gracenote recommends giving Album Type GDOs that have matched tracks to this function; Track Type GDOs also work well. Other GDOs are supported, but most other types lack information for good Playlist generation.

Collection Summary

A collection summary contains the distilled information GNSDK for Desktop Playlist uses to generate playlists for a set of media.

Collection summaries must be created and populated before Playlist can use them for playlist generation. Populating collection summaries involves passing a GDO from another GNSDK for Desktop identification event (for example, from MusicID) along with a unique identifier to Playlist. Collection Summaries can be stored so they do not need to be reconstructed before every use.

Storage

The application can store and manage collection summaries in local storage.

Seed

A seed is the GDO of a media item in the collection summary used as input criteria for playlist generation. A seed is used to generate More Like This results, or in custom PDL statements. For example, the seed could be the GDO of a particular track that you'd like to use to generate More Like This results.

Playlist generation

GNSDK for Desktop provides two Playlist generation functions: a general function for generating any playlist, gnsdk_playlist_generate_playlist(), and a specific function for generating a playlist that uses the Gracenote More Like This algorithm, gnsdk_playlist_generate_morelikethis().

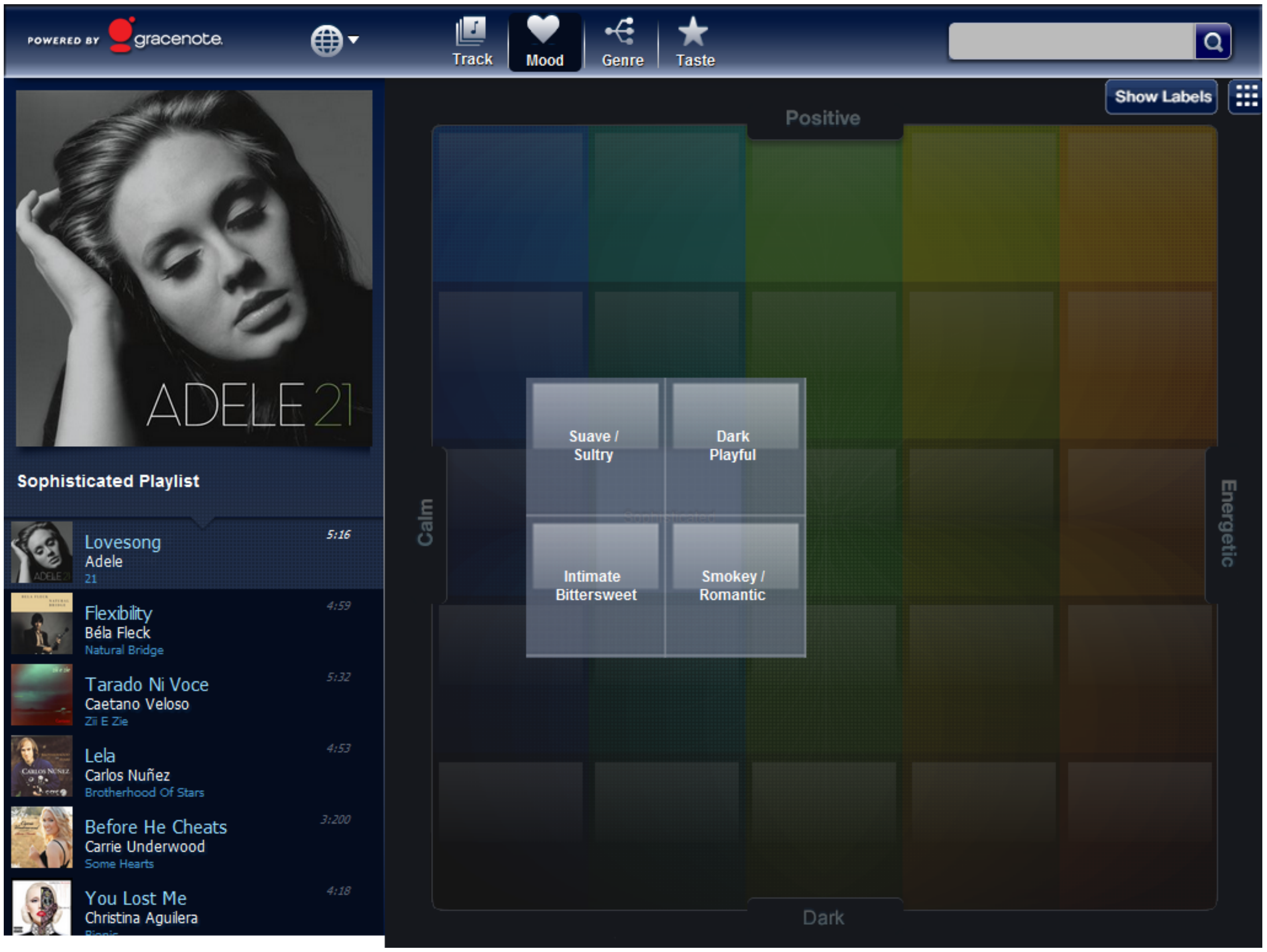
NOTE: Gracenote recommends streamlining your Playlist implementation by using the provided More Like This™ function, gnsdk_playlist_generate_morelikethis(), which uses the More Like This algorithm to generate optimal playlist results and eliminates the need to create and validate PDL statements.

MoodGrid Overview

The MoodGrid library allows applications to generate playlists and user interfaces based on Gracenote Mood descriptors. MoodGrid provides Mood descriptors to the application in a two-dimensional grid that represents varying degrees of moods across each axis. One axis represents energy (calm to energetic) and the other axis represents valence (dark to positive). When the user selects a mood from the grid, the application provides a playlist of music that corresponds to the selected mood. Additional filtering support is provided for genre, origin, and era music attributes.

Mood Descriptors are delivered with track metadata from queries to MusicID, MusicID-File, or MusicID-Stream services.

The MoodGrid data representation is a 5x5 or 10x10 grid. Each element of the grid corresponds to a Gracenote Mood category ID (Level 1 for 5x5 and Level 2 for 10x10), which can be used to create a list of playable songs in the user's collection characterized by that mood. Each Level 1 Mood maps to four, more granular, Level 2 Moods. For example, a Level 1 Mood might be "Romantic", and the corresponding Level 2 Moods might be "Suave/Sultry", "Dark/Playful", "Intimate/Bittersweet", and "Smokey/Romantic", providing a greater level of detail within the "Romantic" Mood.


POWERED BY gracenote
Track
Mood
Genre
Taste
Show Labels
Positive
Calm
Energetic
Dark
Suave / Sultry
Dark Playful
Intimate Bittersweet
Smokey / Romantic
ADELE 21
Sophisticated Playlist
Lovesong Adele 21 5:16
Flexibility Béla Fleck Natural Bridge 4:59
Tarado Ni Voce Caetano Veloso Zii E Zie 5:32
Lela Carlos Nuñez Brotherhood Of Stars 4:53
Before He Cheats Carrie Underwood Some Hearts 3:200
You Lost Me Christina Aguilera 4:18

Note: The pictured implementation of MoodGrid is centered upon the collection and arrangement of track Mood descriptors across the dimensions of energy (calm to energetic) and valence (dark to positive). The actual layout and navigation of these moods is entirely dependent upon the implementation of the application's user interface. Gracenote's MoodGrid does not necessarily need to be presented in the square representation demonstrated above.

Rhythm Overview

Rhythm enables seamless integration of any audio source with online music services within a single application. Depending on the supported features of each online music service, an identified track can be used to link to a service to:

- Play that song
- Play more songs from that artist/album or
- Create an adaptive radio session

The identified track can be from any music source including terrestrial radio, CD, audio file or even another music service provided the track has been identified using Gracenote recognition technology.

Gracenote Rhythm allows you to create highly relevant and personalized adaptive radio stations and music recommendations for end users. Radio stations can be created with seed artists and tracks or a combination of genre, era, and mood, and can support Digital Millennium Copyright Act (DCMA) sequencing rules.

Rhythm includes the ability for an end user to specify whether they have played a track, like or dislike it, or want to skip past it. Rhythm can reconfigure the radio station playlist to more closely reflect end user preferences. In addition, it supports cover art retrieval, third-party links, and metadata content exploration.

Rhythm can:

- **Create a Radio Station:** Creating a radio station requires a User ID and a seed (artist, track, genre, era, or mood). Creating a radio station generates a track playlist.
- **Adapt to User Feedback:** End users can provide feedback (play, like, dislike, skip) about songs in the current radio station's playlist. This can result in modifying a playlist or generating a new one altogether.
- **Tune a Radio Station:** Reconfigure an existing radio station playlist based on track popularity and similarity.
- **Create a Playlist:** Rhythm can create a track playlist without the overhead of creating a radio station.

Radio station creation returns a radio station ID and a track playlist. The radio ID is used in subsequent actions on the station, its playlist, or its tuning parameters. Rhythm builds radio stations using GDOs. MusicID can retrieve the necessary GDOs by looking up artist names, album titles, or track titles. To create a playlist, Rhythm uses:

- Artist ID
- Track TUI (Title Unique Identifier)
- Genre, mood, or era attributes
- More than one of the above in combination

Multiple seed stations create a greater variety of results. Once you create a radio station, you can examine its entire playlist (up to 25 tracks at a time). End users can take various feedback event actions on the playlist such as:

- Track like
- Track dislike
- Track skipped
- Track played
- Artist like
- Artist dislike

When feedback is sent, Rhythm reconfigures the station’s playlist accordingly. Rhythm supports the retrieval of the playlist at any time before or after feedback is provided.

A station’s behavior may also be tuned by changing playlist generation behavior. For example, you can get difference responses based on options for popularity or similarity.

Platform Development Guidelines

Supported Platforms and System Requirements

GNSDK for Desktop provides multi-threaded, thread-safe technology for the following common platforms.

Gracenote Developer Portal System Requirements

Platform	Architecture	Bit	S/S	OS	Compiler/Note
Android	armeabi-v7a	32-bit	shared		gcc 4.6
iOS	armv7	32-bit static		iOS 4.3 and above	gcc 4.2.1
	armv7s				
	x86				
Linux	arm	32-bit	shared		gcc 4.5.1
	mips	32-bit	static		gcc 4.5.2
	x86	32-bit	shared	2.6 kernel and above	gcc 3.4.6
		64-bit	shared		
MacOS	x86	32-bit	shared	OSX 10.4 and above	gcc 4.2.1
		64-bit			
Windows	x86	32-bit	shared	Windows XP or above	MS Visual studio 2012
		64-bit			
Winphone8	ARM	32-bit	shared		MS Visual studio 2012
	x86				
Winrt	ARM	32-bit	shared		MS Visual studio 2012
	x86				

*The GNU C Library (glibc), revision 2.3.2 and newer, is typically available on Linux distributions released during or after 2003.

NOTE: All platforms above go through QA testing, however, only select platforms go through full regression testing.

Modules in the GNSDK Package

GNSDK provides the following modules for application development. For more information about these modules, search this documentation or refer to the table of contents.

GNSDK for Desktop Modules

- DSP
- LINK
- LOOKUP_LOCAL
- LOOKUP_LOCALSTREAM
- MANAGER
- MOODGRID
- MUSICID
- MUSICID_FILE
- MUSICID_MATCH
- MUSICID_STREAM
- PLAYLIST
- STORAGE_SQLITE
- SUBMIT
- VIDEO

GNSDK Desktop for the Gracenote Developer Network

- DSP
- LINK
- LOOKUP_LOCAL
- LOOKUP_LOCALSTREAM
- MANAGER
- MOODGRID
- MUSICID
- MUSICID_FILE
- MUSICID_STREAM
- PLAYLIST
- STORAGE_SQLITE
- VIDEO

Memory Usage

The memory usage of GNSDK for Desktop depends on a number of different factors, including the use of multiple threads, type of recognition, size of a user's collection, number of simultaneous devices connected, metadata requested, etc. Typical integrations can use anywhere from 5 MB to 30 MB depending on what use cases the application is addressing. There is no "magic number" to describe the memory usage requirements of GNSDK for Desktop.

Memory Usage Guidelines

The following guidelines for RAM are based on measurements of both local and online lookups in a single-threaded environment on the BeagleBoard xM embedded platform. Use of multiple threads, such as with multiple online lookups, can theoretically result in increased maximum memory usage. However, this would require highly unlikely alignment of threads.

Beagle Board xM	
CPU Type	ARM Cortex A8
CPU Speed	1 GHz
CPU Endianness	Little
Storage Size	512 MB
Storage Type	NAND Flash
RAM size	512 MB
RAM type	LPDDR
OS	Angstrom Linux

RAM Requirements

GNSDK for Desktop may utilize more memory than indicated below. Gracenote always recommends that customers measure heap usage on their device running their application code and utilizing Gracenote's memory usage callback functionality.

Measured RAM Requirements describe the memory usage using the hardware, software and test sets outlined. The measured RAM requirements are for peak usages and will be smaller the majority of time. Recommended RAM Requirements account for future Gracenote feature enhancements.

Feature Set	**Measured RAM Requirements***	**Recommended RAM Requirements***
MusicID (CD, Text) Music Enrichment (Cover Art)	3 MB	8 MB
MusicID (CD, Text) Music Enrichment (Cover Art) MusicID (File) Playlist, MoodGrid (10K Tracks)	6 MB	14 MB
MusicID (CD, Text) Music Enrichment (Cover Art) MusicID (File) Playlist, MoodGrid (20K Tracks)	9 MB	20 MB

Feature Set	Measured RAM Requirements*	Recommended RAM Requirements*
MusicID (CD, Text) Music Enrichment (Cover Art) MusicID (File) Playlist, MoodGrid (40K Tracks)	12 MB	32 MB

*MusicID (Text) lookups were done with a 5K track sample set in the feature set without Playlist and with 10K, 20K and 40K tracks for the corresponding Playlist size. MusicID (CD) lookup measurements were done using a 25K sample set of CD TOCs. MusicID (File) fingerprint lookups were done using 167 tracks from 11 albums.

Playlist Memory Usage

Memory usage for Playlist is directly correlated to the number of tracks available for playlisting. For smaller libraries, RAM requirements may be lower. For libraries with a larger number of songs, RAM requirements may increase. Memory usage increases at a rate of ~0.3 MB per thousand tracks.

Playlist relies on a Collection Summary of stored attribute data of a user’s music collection. These collection summaries are designed to take up a minimal amount of disk space and are directly proportional to the user’s collection size. Developers should take into account disk storage to persist these collection summaries which grow at the rate of ~110 KB per thousand tracks.

Android

Deploying Android Applications

To access GNSDK in an Android application, add the GNSDK jar and native shared libraries to your application’s libs folder. Copy the jar libraries directly into the libs folder.Copy the native shared libraries into the architecture sub-folders under libs.

The table below shows the GNSDK Android libraries and their location in the package

Jar	Location
gnsdk.jar and gnsdk_helpers.jar	…/wrappers/gnsdk_java/jar/android
libgnsdk_marshall.so	…/wrappers/gnsdk_java/lib/android_*
libgnsdk_*.so	…/lib/android_*

GNSDK uses GABI++ for C++ support and requires that libgabi++_shared.so is included in the application’s architecture sub-folder under libs. The libgabi++_shared.so is an Android library provided in the Android NDK

GNSDK Android Permissions

To use the GNSDKproperly in your Android application,configure the application with the follow settings:

- Record audio
- Write to external storage
- Access Internet
- Access network state

Add these permissions to the Android application's AndroidManifest.xml file.

Using the Sample Applications

GNSDK provides working, command-line sample applications that demonstrate common queries and application scenarios. The package also provides sample databases you can use when developing your applications. Gracenote recommends stepping through the sample applications with a debugger to observe module usage and API calls.

⚠ Currently, there are no Android sample applications for GNSDK.

Sample Applications

Folder under `/samples`	**Modules Used**	**Description**
musicid_ image_ fetch	Link—A module that allows applications to access and present enriched content related to media that has been identified using identification features.	Does a text search and finds images based on match type (album or contributor). It also finds an image based on genre.
musicid_ gdo_ navigation	MusicID—Enables MusicID recognition for identifying CDs, digital music files and streaming audio and delivers relevant metadata such as track titles, artist names, album names, and genres. Also provides library organization and direct lookup features.	Uses MusicID to look up Album matches. It demonstrates how to navigate the album match that returns basic track information, including artist, credits, title, track number, and genre.
musicid_ lookup_ album_toc	MusicID	Looks up an Album based on its TOC (Table of Contents)—an area on CDs, DVDs, and Blu-ray discs that describes the unique track layout of the disc. using either a local database or online.
musicid_ lookup_ matches_ text	MusicID	Performs a sample text query with album, track and artist inputs.
musicid_ stream	MusicID	Uses MusicID-Stream to fingerprint and identify a music track.
musicid_ file_ albumid	MusicID-File—A feature of the MusicID product that identifies digital music files using a combination of waveform analysis technology, text hints and/or text lookups.	Uses AlbumID for advanced audio recognition. The audio file's folder location and its similarity to other audio files are used to achieve more accurate identification.

Folder under `/samples`	Modules Used	Description
musicid_ file_ libraryid	MusicID-File	Uses LibraryID to perform additional scanning and processing of all the files in an entire collection. This enables LibraryID to find groupings that are not captured by AlbumID processing
musicid_ file_trackid	MusicID-File	Uses TrackID, the simplest MusicID-File processing method to process each audio file independently, without regard for any other audio files in a collection.
moodgrid	Playlist—A set of tracks from a user's music collection, generated according to the criteria and limits defined by a playlist generator.	Provides a complete MoodGrid sample application.
playlist	Playlist	Demonstrates using the Playlist APIs to create More Like This and custom playlists.
submit_ album	Submit	Demonstrates editing an Album object and submitting it to Gracenote
submit_ feature	Submit	Demonstrates processing music features and submitting a parcel to Gracenote

Implementing Applications (All Platforms)

About the Implementing Applications Documentation

This section is intended as a general guide for applications using the object-oriented GNSDK, which supports development in a number of object-oriented languages such as C++, C#, Java, Android Java and Objective-C. This document discusses classes and methods in a generic sort of way while showing brief inline code snippets in different languages. For your particular language, some naming could be slightly different. Java, for example, uses camelcasing (first letter is lower-case). This is a small difference, but for other languages, like Objective-C, the differences could be more involved. To help with this, dropdown code samples in specific programming languages are provided.

For specific programming language implementation details, see the language's respective API reference documentation.

Basic Application Steps

To get started with GNSDK development, Gracenote recommends you follow these general steps, some of which are required and some of which are optional but recommended:

1. Required initialization—see *"Setup and Initialization"* :
   - **Get authentication**—Get a Client ID/Tag and license file from Gracenote Global Services & Suppor (GSS)t. These are used for initial authorization and in every query.
   - **Include necessary header files**—Include the header files and classes for your platform that your application requires.
   - **Initialize SDK** —Instantiate and initialize a GNSDK Manager object (`GnManager` class).
   - **Get a User Object** —Instantiate and initialize a User object (`GnUser`). All queries require a User object with correct Client ID information. You can create a new User, or deserialize an existing User, to get a User object.
2. Not required but suggested initialization:
   - **Enable logging**—Gracenote recommends that GNSDK logging be enabled to some extent. This aids in debugging applications and reporting issues to Gracenote. See *"Using Gracenote SDK Logging"* for more information.
   - **Load a locale(s)**—Gracenote recommends using locales as a convenient way to group locale-dependent metadata specific to a region (such as Europe) and language that should be returned from the Gracenote service. In addition, some metadata requires having a locale loaded. See *"Loading a Locale"* for more information.
   - **Enable GNSDK storage and caching**—See "Enabling and Using GNSDK Storage" for

more information. This is not required (unless you are doing local lookups), but highly recommended.

3. Perform queries to identify music. See "Identifying Music" To identify video, see "Identifying Video" for more information.
4. Parse query result objects for desired metadata. See "Processing Returned Metadata Results" for more information.
5. Exit the application when done, no cleanup necessary.

Setup and Initialization

To get started with GNSDK development:

1. Get a Client ID/Tag and License file for application authentication from Gracenote Global Services & Support. See Authorizing a GNSDK Application.
2. Include the GNSDK header for your platform to include all necessary libraries and headers. See Including Header Files.
3. Instantiate a `GnManager` object. See Instantiating a GNSDK Manager Object.
4. Instantiate a `GnUser` user object. See Instantiating a User Object.

Authorizing a GNSDK Application

Gracenote uses product licensing and server-side entitlements to manage your application's access to metadata.

As a Gracenote customer, Gracenote Global Services & Support works with you to determine the kind of products you need (such as MusicID, Playlist, and so on). Gracenote also determines the metadata your application requires for the products you license.

Gracenote uses this information to create a unique customer ID (called a Client ID/Tag), a license file, and server-side metadata entitlements specifically tailored to your application.

When developing a GNSDK application, you must include a Client ID and license file to authorize your application with Gracenote. In general, the License file enables your application to use the Gracenote products (and their corresponding GNSDK modules) that you purchased. Gracenote Media Services uses the Client ID to enable access to the metadata your application is entitled to use.

All applications are entitled to a set of core metadata based on the products that are licensed. Your application can access enriched metadata through server-side metadata entitlements. Contact your Gracenote Global Services & Support representative for more information.

Some applications require a local (embedded) database for metadata. These systems do not access Gracenote Media Services to validate metadata entitlements and access metadata. Instead, metadata entitlements are pre-applied to the local database.

Client ID/Tag

Each GNSDK customer receives a unique Client ID string from Gracenote. This string uniquely identifies each application to Gracenote Media Services and lets Gracenote deliver the specific metadata the application requires.

A Client ID/Tag string consists of two sets of numbers separated with a hyphen, e.g., 123456-789123456789012312. The number before the hyphen is considered the 'ID' and the number after, the 'Tag'.

License File

Gracenote provides a license file along with your Client ID. The license file notifies Gracenote to enable the GNSDK products you purchased for your application.

⚠ You should secure your Gracenote client id, tag and license information. Something similar to the way Android recommends protecting a Google Play public key from malicious hackers: http://developer.android.com/google/play/billing/billing_best_practices.html

Including Header Files

GNSDK consists of a set of shared modules. The GNSDK Manager module is required for all applications. All other modules are optional. Your application's feature requirements determine which additional modules should be used.

For convenience, all your application has to do is include a single GNSDK header file and all necessary header files and libraries will be automatically included.

Java

```
import com.gracenote.gnsdk.*;
```

Objective-C

```
#import <GnSDKObjC/Gn.h>
```

Windows Phone C#

```
using Gracenote;
```

C++

```
#include "gnsdk.hpp"
```

C#

```
using GracenoteSDK;
```

Instantiating a GNSDK Manager Object

The first thing your application needs to do is initialize an SDK Manager object (`GnManager`) using the GNSDK library path and the contents of the license file you obtained from GGSS. The SDK Manager object is used to monitor an application's interaction with Gracenote.

Specifying the License File

Your application must provide the license file when you allocate a `GnManager` object. This class' constructor gives you the following options for submitting the license file:

- **Null-terminated string**—Set the input mode parameter to `GnLicenseInputMode.kLicenseInputModeString` and pass the license file as a null-terminated string (see examples below).
- **Filename**—Set the input mode parameter to `GnLicenseInputMode.kLicenseInputModeFilename` and pass the relative filename in the string parameter.

Code samples

Java

```
// Load GNSDK native library
static {
    try {
          System.loadLibrary("gnsdk_java_marshal");
        } catch (UnsatisfiedLinkError unsatisfiedLinkError) {
           System.err.println("Native code library failed to load\n" +
unsatisfiedLinkError.getMessage());
           System.exit(1);
        }
}

// Initialize GNSDK
gnsdk = new GnManager(libraryPath,                                    // SDK Libraries location
                      gnsdkLicenseFilePath,                           // License file path and name
                      GnLicenseInputMode.kLicenseInputModeFilename);  // Input License as a file
```

Android Java

```
private String gnsdkLicense = <get license as string from asset>;
Context context = this.getApplicationContext();

// Initialize GNSDK
gnsdk = new GnManager(context,                                      // Android Context
                      gnsdkLicense,                                 // License as a string
                      GnLicenseInputMode.kLicenseInputModeString);  // Input License as a string
```

Objective-C

```
@property  (strong) GnManager *gnManager;
NSError*    error = nil;
NSString*  resourcePath  = [[NSBundle mainBundle] pathForResource:
                            gnsdkLicenseFilename ofType: nil];
NSString*   licenseString = [NSString stringWithContentsOfFile: resourcePath
                             encoding: NSUTF8StringEncoding
                             error: &error];
self.gnManager = [[GnManager alloc] initWithLicense: licenseString licenseInputMode:
kLicenseInputModeString];
```

Windows Phone C#

```
/*
```

```
* Initalize GNSDK
*/
string licenseString = ReadFile(App.gnLicenseFileName_);
App.gnManager_ = new GnManager(licenseString, GnLicenseInputMode.kLicenseInputModeString);
```

C++ code sample

```
/**
* Initalize SDK
*/
GnManager gnMgr(licenseFile, kLicenseInputModeFilename);
```

C#

```
/* Initialize SDK */
GnManager manager = new GnManager(gnsdkLibraryPath, licenseFile,
GnLicenseInputMode.kLicenseInputModeFilename);
```

Instantiating a User Object

To make queries, every application is required to instantiate a User object (`GnUser`). Most devices will only have one user; however, on a server, for example, there could be a number of users running your application. Gracenote uses the Client ID and Client Tag to verify that the licensed and allowable users quota has not been exceeded.

`GnUser` objects can be created 'online,' which means the Gracenote back-end creates and verifies them. Alternatively, they can be created 'local only,' which means the SDK creates and uses them locally.

For example (Java):

```
// Create user for video and music
gnUser = new GnUser(gnUserStore, clientId, clientTag, "1.0");
```

Saving the User Object to Persistent Storage

User objects should be saved to persistent storage. If an app registers a new user on every use instead of retrieving it from storage, then the user quota maintained for the Client ID is quickly exhausted. Once the quota is reached, attempting to create new users will fail. To maintain an accurate usage profile for your application, and to ensure that the services you are entitled to are not being used unintentionally, it is important that your application registers a new user only when needed, and then stores that user for future use.

To save to persistent storage, you have the option to implement the `IGnUserStore` interface which requires you to implement two methods: `LoadSerializedUser` and `StoreSerializedUser`.

On mobile and ACR platforms (Android, iOS, Windows), the SDK provides the `GnUserStore` class, a platform-specific implementation of the `IGnUserStore` interface. Storage on these devices is implemented in platform-specific ways. On Android, for example, the User object is saved to shared preferences.

Example implementation of `IGnUserStore` (C++):

```
/*-----------------------------------------------------------------------------
 *  class UserStore
 *    Example implementation of interface: IGnUserStore
 *      Loads and stores User data for the GnUser object. This sample stores the
 *      user data to a local file named 'user.txt'.
 *      Your application should store the user data to an appropriate location.
 */
class UserStore : public IGnUserStore
{
public:
    GnString
    LoadSerializedUser(gnsdk_cstr_t clientId)
    {
        std::fstream    userRegFile;
        std::string     fileName;
        std::string     serialized;
        GnString        userData;

        fileName = clientId;
        fileName += "_user.txt";

        userRegFile.open(fileName.c_str(), std::ios_base::in);
        if (!userRegFile.fail())
        {
            userRegFile >> serialized;
            userData = serialized.c_str();
        }
        return userData;
    }

    bool
    StoreSerializedUser(gnsdk_cstr_t clientId, gnsdk_cstr_t userData)
    {
        std::fstream userRegFile;
        std::string  fileName;

        fileName = clientId;
        fileName += "_user.txt";


        /* store user data to file */
        userRegFile.open(fileName.c_str(), std::ios_base::out);
        if (!userRegFile.fail())
        {
            userRegFile << userData;
            return true;
        }
        return false;
    }
};
```

You can then pass an instance of this class as a parameter in a `GnUser` constructor and the SDK will automatically read the User object from storage and use it to create a new User ID. The SDK may also periodcally `SaveSerializedUser` when user data changes.

Allocating a User object code samples:

C++

```
UserStore userStore;
GnUser gnUser = GnUser(userStore, clientId, clientIdTag, applicationVersion);
```

Java

```
GnUser gnUser = new GnUser( new UserStore(), clientId, clientIdTag, CLIENT_APP_VERSION );
```

C#

```
GnUser gnUser = GetUser(manager, clientId, clientIdTag, applicationVersion, lookupMode);
```

Loading a Locale

GNSDK provides *locales* as a convenient way to group locale-dependent metadata specific to a region (such as Europe) and language that should be returned from the Gracenote Service. A locale is defined by a group (such as Music), a language, a region and a descriptor (indicating level of metadata detail), which are identifiers to a specific set of lists in the Gracenote Service.

Using locales is relatively straightforward for most applications to implement. However, it is not as flexible or complicated as accessing lists directly - most locale processing is handled in the background and is not configurable. For most applications though, using locales is more than sufficient. Your application should only access lists directly if it has a specific reason or use case for doing so.

To load a locale, allocate a `GnLocale` object with one of the class constructors. The `GnLocale` constructors take parameters indicating the following:

- **Group** - Group type of locale such as Music, Playlist or Video that can be easily tied to the application's use case
- **Region** - Region the application is operating in, such as US, China, Japan, Europe, and so on, possibly specified by the user configuration
- **Language** - Language the application uses, possibly specified by the user configuration
- **Descriptor** - Additional description of the locale, such as Simplified or Detailed for the list hierarchy group to use, usually determined by the application's use case
- **Status callback (optional)** - One of the constructors takes a `GnStatusEventsListener` callback object

Locales have the following space requirements: 2MB for a music only locale, 6MB for a music and playlist locale.

For example:

- A locale defined for the USA of English/ US/Detailed returns detailed content from a list written in English for a North American audience.
- A locale defined for Spain of Spanish/Global/Simplified returns list metadata of a less-detailed nature, written in Spanish for a global Spanish-speaking audience (European, Central American, and South American).

Java/Android Java

```
GnLocale locale =
       new GnLocale(GnLocaleGroup.kLocaleGroupMusic,
                GnLanguage.kLanguageEnglish,
                GnRegion.kRegionGlobal,
                GnDescriptor.kDescriptorDefault,
                gnUser);
```

```
locale.setGroupDefault();
```

Objective-C

```
GnLocale *locale =
          [[GnLocale alloc] initWithGnLocaleGroup: kLocaleGroupMusic
                            language: kLanguageEnglish
                            region: kRegionGlobal
                            descriptor: kDescriptorSimplified
                            user: self.gnUser
                            statusEventsDelegate: nil];

[locale setGroupDefault:&localeError];
```

Windows Phone C#

```
GnLocale locale =
         new GnLocale(GnLocaleGroup.kLocaleGroupMusic,
                      GnLanguage.kLanguageEnglish,
                      GnRegion.kRegionGlobal,
                      GnDescriptor.kDescriptorDefault,
                      App.mGnUser,
                      null
                 );

locale.SetGroupDefault();
```

C++

```
/* Set locale with desired Group, Language, Region and Descriptor */
GnLocale locale( GnSDK::kLocaleGroupMusic,
                 GnSDK::kLanguageEnglish,
                 GnSDK::kRegionDefault,
                 GnSDK::kDescriptorSimplified,
                 user,
                 GNSDK_NULL); /* Use &statusEvents instead of GNSDK_NULL to view progress */

/* Set this locale as default for the duration of gnsdk */
locale.SetGroupDefault();
```

Locale-Dependent Data

Thr following metdata fields require having a locale loaded:

- artist type - levels 1-2
- era - levels 1-3
- genre - levels 1-3
- mood - levels 1-2
- origin - levels 1-4
- tempo - levels 1-3
- role
- role category
- entity type
- composition form
- instrumentation
- package display language

Default Regions and Descriptors

When loading a locale, your application provides inputs specifying group, language, region, and descriptor. Region and descriptor can be set to “default.”

When no locales are present in the local database, or no local database is enabled, and the application is configured for online access, GNSDK uses the Global region when the default region is specified, and the Detailed descriptor when the default descriptor is specified.

Otherwise, when “default” is specified, GNSDK filters the local database and loads a locale matching the group and language (and the region and descriptor, if they are not specified as default). Complete locales (those with all sub-components present) are preferred over incomplete locales. If, after filtering, the local database contains multiple equally complete locales, a default locale is chosen using the defaults shown in the table below:

Regional GDB	Available Locales	Default Locale
North America (NA)	US and Latin America	US
Latin America (LA)	Latin America	Latin America
Korea (KR)	Korea	Korea
Japan (JP)	Japan	Japan
Global (GL)	Global, Japan, US, China, Taiwan, Korea, Europe, and Latin America	Global
Europe (EU)	Europe	Europe
China (CN)	China and Taiwan	China

If no locales are present after filtering the local database, an error is returned.

Default regions and descriptors can be used to write generic code for loading a locale. For example, consider an application targeted for multiple devices: one with a small screen, where the Simplified locales are desired; and one with a large screen, where more detail can be displayed to the user, and the Detailed locales are desired. The application code can be written to generically load locales with the “default” descriptor, and each application can be deployed with a local database containing simplified locales (small-screen version), or detailed locales (large-screen version). GNSDK loads the appropriate locales based on the contents of the local database.

Locale Groups

Setting the locale for a group causes the given locale to apply to a particular media group - Music, Playlist, Video or EPG. For example, setting a locale for the Music group applies the locale to all music-related objects. When a locale is loaded, all lists necessary for the locale group are loaded into memory. For example, setting the locale for the Playlist group causes all lists needed to generate playlists to be loaded.

Once a locale has been loaded, you must call the `GnLocale`'s `SetGroupDefault` method before retrieving locale-dependent values.

Multi-Threaded Access

Since locales and lists can be accessed concurrently, your application has the option to perform such actions as generating a Playlist or obtaining result display strings using multiple threads.

Typically, an application loads all required locales at start up, or when the user changes preferred region or language. To speed up loading multiple locales, your application can load each locale in its own thread.

Updating Locales and Lists

GNSDK supports storing locales and their associated lists locally, which improves access times and performance. Your application must enable a database module (such as SQLite) to implement local storage. For more information, See "Enabling and Using GNSDK Storage" .

Update Notification

Periodically, your application may need to update any locale lists that are stored locally. As a best practice, Gracenote recommends registering a locale update notification callback or, if you are using lists directly, a lists update nortification callback. To do this, you need to code an `IGnSystemEvents` delegate that implements the locale or list update methods—`LocaleUpdateNeeded` or `ListUpdateNeeded`—and provide that delegate as a parameter to the `GnManager`'s `EventHandler` method. When GNSDK internally detects that a locale or list is out of date, it will call the appropriate callback. Detection occurs when a requested list value is not found. This is done automatically without the need for user application input. Note, however, that if your application does not request locale-dependent metadata or missing locale-dependent data, no detection will occur.

> Updates require the user lookup mode option to be set to online lookup - `kLookupModeOnline`(default) or online lookup only—`kLookupModeOnlineCacheOnly`. This allows the SDK to retreive locales from the Gracenote Service. You may need to toggle this option value for the update process. For more information about setting the user option, "Setting Local and Online Lookup Modes".

Once your app receives a notification, it can choose to immediately do the update or do it later. Gracenote recommends doing it immediately as this allows the current locale/list value request to be fulfilled, though there is a delay for the length of time it takes to complete the update process.

> The GNSDK does not set an internal state or persistant flag indicating an update is required; your application is responsibile for managing the deferring of updates beyond the notification callback.

Locale Behavior

How locales are stored, accessed and updated depends on how you have configured your storage and lookup options as shown in the following table. For information on configuring lookup modes see "Setting Local and Online Lookup Modes".

Storage Provider Initialized	GnLookupMode Enum	Behavior
Either	`kLookupModeOnlineNoCache`	Locales are always downloaded and stored in RAM, not local storage.
Not initialized	`kLookupModeOnline`	Locales are always downloaded and stored in RAM, not local storage.
Initialized	`kLookupModeOnline`	If downloaded, locales are read from local storage. Downloaded locales are written immediately to local storage.
Not Initialized	`kLookupModeOnlineNoCacheRead`	Locales are always downloaded and stored in RAM.
Initialized	`kLookupModeOnlineNoCacheRead`	Locales are always downloaded and stored in RAM and local storage. Locale data is always read from RAM, not local storage.
Initialized	`kLookupModeOnlineCacheOnly` `kLookupModeLocal`	Locale data is read from local storage. If requested data is not in locale storage the load attempt fails. Local storage is updated when new versions become available. The application developer is responsible for providing that mechanism.

⚠ Locale behavior may not change if the lookup mode is changed after the locale is loaded. For example, if a locale is loaded when the lookup mode is `kLookupModeOnline`, locale data will be read from local storage even if the lookup mode is changed.

Best Practices

Practice	Description
Applications should use locales.	Locales are simpler and more convenient than accessing lists directly. An application should only use lists if there are specific circumstances or use cases that require it.
Apps should register a locale/list update notification callback and, when invoked, immediately update locales/lists.	See the ***Update Notification*** section above.

Practice	Description
Applications can deploy with pre-populated list stores and reduce startup time.	On startup, a typical application loads locale(s). If the requested locale is not cached, the required lists are downloaded from the Gracenote Service and written to local storage. This procedure can take time. Customers should consider creating their own list stores that are deployed with the application to decrease the initial startup time and perform a locale update in a background thread once the application is up and running.
Use multiple threads when loading or updating multiple locales.	Loading locales in multiple threads allows lists to be fetched concurrently, reducing overall load time.
Update locales in a background thread.	Locales can be updated while the application performs normal processing. The SDK automatically switches to using new lists as they are updated. ⚠ If the application is using the GNSDK Manager Lists interface directly and the application holds a list handle, that list is not released from memory and the SDK will continue to use it.
Set a persistence flag when updating. If interrupted, repeat update.	If the online update procedure is interrupted (such as network connection/power loss) then it must be repeated to prevent mismatches between locale required lists. Your application should set a *persistence* flag before starting an update procedure. If the flag is still set upon startup, the application should initiate an update. You should clear the flag after the update has completed.
Call the `GnManager::StorageCompact` method after updating lists or locales.	As records are added and deleted from locale storage, some storage solutions, such as SQLite, can leave empty space in the storage files, artificially bloating them. You can call the `GnManager::StorageCompact` method to remove these. ⚠ The update procedure is not guaranteed to remove an old version of a list from storage immediately because there could still be list element references which must be honored until they are released. Therefore, your application should call the `GnSDK::StorageCompact` method during startup or shutdown after an update has finished.

Practice	Description

Local only applications should set the user handle option for lookup mode to local only.	If your application wishes to only use the Locales in pre-populated Locales storage, then it must set the user handle lookup mode to local.
	For example (C++)
	`/* Set lookup mode (all queries done with this user will inherit the lookup mode) */`
	`user.Options().LookupMode(kLookupModeLocal);`

To simplify the implementation of multi-region applications, use the default region and descriptor.	The Locale subsystem can infer a region and descriptor from the Locale store that can be used in place of the region and descriptor deaults when loading a locale. This can simplify implementing an application intended to be deployed in different regions with its own region specific pre-populated Locale store. If you are deploying your app to multiple regions with a pre-populated Locale store containing locales for all target regions then you should use `kRegionDefault` and `kDescriptorDefault` when loading a locale. In this case, the same region and descriptor are used based on defaults hardcoded into the SDK.

Using Gracenote SDK Logging

The `GnLog` class has methods to enable Gracenote SDK logging, set options, write to the SDK log, and disable SDK logging.

There are 3 approaches you can take to implementing logging using the GNSDK:

1. **Enable GNSDK logging**—This creates log file(s) that you and Gracenote Global Services & Support can use to evaluate and debug any problems your application might encounter when using the SDK
2. **Enable GNSDK logging and add to it**—Use the `GnLog Write` method to add your application's log entries to the GNSDK logs.
3. **Implement your own logging mechanism (via the logging callback)**— Your logging callback, for example, could write to the console, Unix Syslog, or the Windows Event Log.

Gracenote recommends you implement callback logging (see Implementing Callback Logging). On some platforms, e.g., Android, GNSDK logging can cause problematic system delays. Talk to your GGSS representative for more information.

Enabling GNSDK Logging

To use Gracenote SDK logging:

1. Instantiate a `GnLog` object.

   This class has two constructors: both require you to set a log file name and path, and a `IGnLogEvents` logging callback delegate (`GnLogEventsDelegate` in Objective-C). One of the constructors also allows you to set logging options, which you can also set via class methods. These include ones for:

   - What type of messages to include: error, warning, information or debug (`GnLogFilters`)
   - What fields to log: timestamps, thread IDs, packages, etc. (`GnLogColumns`)
   - Maximum size of the log file in bytes, synchronous or asynchronous logging, and archive options (`GnLogOptions`)

2. Call the `GnLog Enable(PackageID)` method to enable logging for specific packages or all packages.

   A *package* is a GNSDK Library as opposed to a module, which is a block of functionality within a package. See the `GnLogPackageType` enums for more information on GNSDK packages.

   Note that `Enable` returns its own `GnLog` object to allow method chaining.

3. Call the `GnLog Write` method to write to the GNSDK log

4. Call the `GnLog Disable(PackageID)` method to disable logging for a specific package or all packages.

Logging code samples

Java

```
// Enable GNSDK logging
String gracenoteLogFilename = Environment.getExternalStorageDirectory().getAbsolutePath() +
File.separator + gnsdkLogFilename;
gnLog = new GnLog(gracenoteLogFilename, null);
gnLog.columns(new GnLogColumns().all());
gnLog.filters(new GnLogFilters().all());
gnLog.enable(GnLogPackageType.kLogPackageAll);
```

Objective-C

```
NSString *docsDir = [GnAppDelegate applicationDocumentsDirectory];
docsDir = [docsDir stringByAppendingPathComponent:@"log.txt"];

self.gnLog = [[GnLog alloc] initWithLogFilePath:docsDir
filters:[[[GnLogFilters alloc]init]all]
columns:[[[GnLogColumns alloc]init]all]
options:[[[GnLogOptions alloc]init]maxSize:0]
logEventsDelegate:self];

// Max size of log: 0 means a new log file will be created each run
[self.gnLog options: [[[GnLogOptions alloc] init]maxSize:0]];
[self.gnLog enableWithPackage:kLogPackageAllGNSDK error:nil];
```

C#

```
/* Enable GNSDK logging */
```

```
App.gnLog_ = new GnLog(Path.Combine(Windows.Storage.ApplicationData.Current.LocalFolder.Path,
"sample.log"), (IGnLogEvents)null);

App.gnLog_.Columns(new GnLogColumns().All);
App.gnLog_.Filters(new GnLogFilters().All);

GnLogOptions options = new GnLogOptions();
options = options.MaxSize(0);
options = options.Archive(false);
App.gnLog_.Options(options);

App.gnLog_.Enable(GnLogPackageType.kLogPackageAll);
```

C++

```
/* Enable GNSDK logging */
GnLog sampleLog(
                 "sample.log",                        /* File to write log to (optional if using
delegate) */
                 GnLogFilters().Error().Warning(),    /* Include only error and warning entries */
                 GnLogColumns().All(),                /* Add all columns to log: timestamps, thread
IDs, etc */
                 GnLogOptions().MaxSize(0).Archive(false),   /* Max size of log: 0 means a new log
file will be created each run. Archiving of logs disabled. */
                 GNSDK_NULL                           /* Optional callback delegate for logging
messages */
   );
sampleLog.Enable(kLogPackageAllGNSDK);
```

The GNSDK logging system can manage multiple logs simultaneously. Each call to the enable API can enable a new log, if the provided log file name is unique. Additionally, each log can have its own filters and options.

Implementing Callback Logging

You also have the option to direct GNSDK to allow a logging callback, where you can determine how best to capture and disseminate specific logged messages. For example, your callback function could write to its own log files or pass the messages to an external logging framework, such as the console, Unix Syslog, or the Windows Event Log.

Enabling callback is done with the `GnLog` constructor where you have the option to pass it a `IGnLogEvents` (`GnLogEventsDelegate` in Objective-C) callback, which takes callback data, a package ID, a filter mask, an error code, and a message field.

Enabling and Using GNSDK Storage

To improve performance, your application can enable internal GNSDK storage and caching. The GNSDK has two kinds of storage, each managed through a different class:

1. **Online stores for lookups**—The GNSDK generates these as lookups take place. Use `GnStoreOps` methods to manage these.
2. **Local lookup databases**—Gracenote Global Support & Services (GGSS) generates these databases, which differ based on region, configuration, and other factors, and ships them to

customers as read-only files. These support TUI, TOC and text lookup for music searches. The `GnLookupLocal` class can be used to manage these databases.

To enable and manage GNSDK storage:

1. Enable a *storage provider* (SQLite) for GNSDK storage
2. Allocate a `GnManager` object for online stores (optional)
3. Allocate a `GnLookupLocal` object for local lookup databases (optional)
4. Set a folder location(s) for GNSDK storage (required)
5. Manage storage through `GnManager` and `GnLookupLocal` methods

Enabling a Provider for GNSDK Storage

Before GNSDK storage can take place, you need to enable a storage provider. Right now, that means using the GNSDK SQLite module. Note that this is for GNSDK use only—your application cannot use this database for its own storage.

* For information on using SQLite, see http://sqlite.org.

* Note that enabling SQLite prevents linking to an external SQLite library for your own use.

In the future, other database modules will be made available, but currently, the only option is SQLite.

To enable local storage, you need to call the `GnStorageSqlite`'s `Enable` method which returns a `GnStorageSqlite` object.

C++

```
/* Enable StorageSQLite module to use as our database engine */
GnStorageSqlite& storageSqlite = GnStorageSqlite::Enable();
```

Java

```
GnStorageSqlite gnStorageSqlite = GnStorageSqlite.enable();
```

Objective-C

```
self.gnStorageSqlite = [GnStorageSqlite enable: &error];
```

Windows Phone C#

```
App.gnStorageSqlite_ = GnStorageSqlite.Enable;
```

GNSDK Stores

Once enabled, the GNSDK manages these stores:

Stores	Description
Query store	The query store caches media identification requests
Lists store	The list store caches Gracenote display lists
Content store	The content stores caches cover art and related information

You can get an object to manage these stores with the following `GnManager` methods:

- `GnStoreOps& QueryCacheStore`—Get an object for managing the query cache store.
- `GnStoreOps& LocalesStore`—Get an object for managing the locales/lists store.
- `GnStoreOps& ContentStore`—Get an object for managing the content store.

GNSDK Databases

Once enabled, the GNSDK manages these databases as the following `GnLookupLocal::GnLocalStorageName` enums indicate:

Database (GnLookupLocal)	Description
`kLocalStorageContent`	Used for querying Gracenote content.
`kLocalStorageMetadata`	Used for querying Gracenote metadata.
`kLocalStorageTOCIndex`	Used for CD TOC searching.
`kLocalStorageTextIndex`	Used for text searching.

Setting GNSDK Storage Folder Locations

You have the option to set a folder location for all GNSDK storage or locations for specific stores and databases. You might, for example, want to set your stores to different locations to improve performance and/or tailor your application to specific hardware. For example you might want your locale list store in flash memory and your image store on disk.

If no locations for storage are set, the GNSDK, by default, uses the current directory. To set a location for all GNSDK storage, use the `GnStorageSqlite StorageLocation` method.

Use the `GnStoreOps`' `Location` method or the `GnLookupLocal`'s `StorageLocation` method to set specific store or database locations. `StorageLocation` takes a database enum and a path location string. To set a store location, you would need to allocate a `GnStoreOps` object for a specific cache using `GnManager` methods and call its `Location` method.

C++ example of setting a location for all stores and databases using SQLite:

```
/* Set default folder location for all SQLite storage */
storageSqlite.StorageLocation(".");
```

Java

```
gnStorageSqlite.storageLocation(getExternalFilesDir(null).getAbsolutePath());
```

Objective-C

```
[self.gnStorageSqlite storageLocationWithFolderPath:[GnAppDelegate applicationDocumentsDirectory]
error: &error];
```

Windows Phone C#

```
App.gnStorageSqlite_.StorageLocation(Windows.Storage.ApplicationData.Current.LocalFolder.Path);
```

Getting Local Lookup Database Information

You can retrieve manifest information about your local databases, including database versions, available image sizes, and available locale configurations. Your application can use this information to request data more efficiently. For example, to avoid making queries for unsupported locales, you can retrieve the valid locale configurations contained in your local lists cache.

Image Information

GNSDK provides album cover art, and artist and genre images in different sizes. You can use the `kImageSize` key with the `GnLookupLocal`'s `StorageInfo` method to retrieve available image sizes. This allows you to request images in available sizes only, rather than spending cycles requesting image sizes that are not available.

Use the `GnLookupLocal`'s `StorageInfoCount` method to provide ordinals to the `StorageInfo` method to get the image sizes.

Database Versions

To retrieve the version number for a local database, use the `kGDBVersion` key with the `StorageInfo` method. Use an ordinal of 1 to get the database version.

C++ example:

```
gnsdk_cstr_t  gdb_version = gnLookupLocal.StorageInfo(kMetadata, kGDBVersion, ordinal);
```

Getting Available Locales

Use the `GnLocale`'s `LocalesAvailable` method to get valid locale configurations available in your local lists store. Locale configurations are combinations of values that you can use to set the locale for your application. This method returns values for group, region, language and descriptor. Returns a count of the values available for a particular local database and local storage key.

Setting Online Cache Expiration

You can use the `GnUser`'s `CacheExpiration` method to set the maximum duration for which an item in the GNSDK query cache is valid. The duration is set in seconds and must exceed one day (> 86400). Setting this option to a zero value (0) causes the cache to start deleting records upon cache hit, and not write new or updated records to the cache; in short, the cache effectively flushes itself. The cache will start caching records again once this option is set to a value greater than 0. Setting this option to a value less than 0 (for example: -1) causes the cache to use default expiration values.

Managing Online Cache Size and Memory

You can use the following `GnStorageSqlite` methods to manage online cache size on disk and in memory:

- **`MaximumSizeForCacheFileSet`**—Sets the maximum size the GNSDK cache can grow to in kilobytes; for example "100" for 100 Kb or "1024" for 1 MB. This limit applies to each cache that is created. If the cache files' current size already exceeds the maximum when this option is set, then the passed maximum is not applied. When the maximum size is reached, new cache entries are not written to the database. Additionally, a maintenance thread is run that attempts to clean up expired records from the database and create space for new records. If this option is not set the cache files default to having no maximum size.
- **`MaximumMemorySizeForCacheSet`**— Sets the maximum amount of memory SQLite can use to buffer cache data. The value passed for this option is the maximum number of Kilobytes of memory that can be used. For example, "100" sets the maximum to 100 KB, and "1024" sets the maximum to 1 MB.

Setting Local and Online Lookup Modes

You can set lookup modes to determine if GNSDK lookups are done locally or online. GNSDK is designed to operate exactly the same way in either case. You can use the `GnUser.LookupMode` method to set this option for the user. You can also set this option for specific queries.

The terms *local* and *online* apply to the following:

1. **Online lookup**—Refers to queries made to the Gracenote service over the Internet.
2. **Online queries stored locally**—The GNSDK generates these as lookups take place. Even though they are stored locally, online stores are considered part of online lookup, not local lookup. The `GnManager` class can be used to manage these stores. Note that this store requires your application to enable GNSDK storage and caching. See *"Enabling and Using GNSDK Storage"* for more information.

Supported Lookup Modes

GNSDK supports the following lookup mode options as shown with these `GnLookupMode` enums:

- **`kLookupModeOnline`**—This is the default lookup mode. If a cache exists, the query checks it first for a match. If no match is found in the cache, then an online query to the Gracenote Service is performed. If a result is found there, it is stored in the local online cache. If no connection to the Gracenote Service exists, the query will fail. The length of time before cache lookup query expires can be set via the user object.
- **`kLookupModeLocal`**—This mode forces the lookup to be done against any local databases only. Local stores created from (online) query results are not queried in this mode. If no local database exists, the query will fail.

The local and online modes are the standard modes for applications to choose between. The other online options (`kLookupModeOnlineNoCache`, `kLookupModeOnlineNoCacheRead`, and `kLookupModeOnlineCacheOnly`) are variations of the online mode. These additional online lookup modes give more control over when the SDK is allowed to perform a network connection and how to use the online queries stored locally. The online-query store is used as a performance aid for online queries. If no storage provider is present, no online-query store is utilized.

Setting lookup mode for user code sample (C++):

```
/* Set lookup mode (all queries done with this user will inherit the lookup mode) */
user.Options().LookupMode(kLookupModeLocal);
```

Objective-C:

```
NSError *error = nil;
[[self.gnUser options] lookupModeWithLookupMode:kLookupModeLocal error:&error];
```

Default Lookup Mode

If the application does not set one, the GNSDK sets a default lookup mode—`kLookupModeOnline`—unless the GNSDK license file limits all queries to be local-only, which prevents the SDK from connecting online. When this limit is set in the license file, the lookup mode defaults to `kLookupModeLocal`.

Setting the Lookup Mode for a User or Specific Query

You can set the lookup mode as a user option or set it separately as a specific query option. Calling the `GnUser.LookupMode` method applies the option to all queries using the user handle. You can also use the `GnMusicId.LookupMode` , `GnMusicIdFile.LookupMode`, or `GnMusicIdStream.LookupMode` methods to override this for specific queries.

User example (C++):

```
GnUser user = GnUser(userStore, clientId, clientIdTag, applicationVersion);
/* Set user to match our desired lookup mode (all queries done with this user will inherit the
lookup mode) */
user.Options().LookupMode(kLookupModeLocal);
```

Query example (C++):

```
/* Perform the query */
music_id.Options().LookupMode(kLookupModeLocal);
GnResponseAlbums response = music_id.FindAlbums(albObject);
```

Query example (Objective-C):

```
GnMusicIdStreamOptions *options = [self.gnMusicIDStream options];
[options lookupMode:kLookupModeLocal error:&error];
```

Using Both Local and Online Lookup Modes

Your application can switch between local and online lookups, as needed.

Identifying Music

The GNSDK supports identifying music in three different modules:

- **Music-ID**—Provides support for identifying music using the following:
    - CD TOC
    - Text search
    - Fingerprints
    - Gracenote identifier

  The `GnMusicId` class supports this functionality. See "Identifying Music Using a CD-TOC, Text, or Fingerprints (MusicID)" for more information.

- **Music-ID File**—Provides support for identifying music stored in audio files. The `GnMusicIdFile` class supports this functionality. See "Identifying Audio Files (MusicID-File)" for more information.

- **Music-ID Stream**—Provides support for identifying music that is delivered in real-time as an end-user listens. For example: listening to a song on the radio or playing a song from a media player. You can identify streaming music using audio fingerprints generated from a streaming audio source, typically through a microphone. The `GnMusicIdStream` class provides support for this functionality. On some platforms, the `GnMic` class is available for listening to a device microphone.

  For more information, see "Identifying Streaming Audio (MusicID-Stream)".

Identifying Music Using a CD-TOC, Text, or Fingerprints (MusicID)

The MusicID module is the GNSDK component that handles recognition of non-streaming music though a CD TOC, audio source, fingerprint or search text. MusicID is implemented using the `GnMusicId` class. The MusicID-File module is the GNSDK component that handles audio file recognition, implemented through the `GnMusicIdFile` class. For information on identifying audio files and using the `GnMusicIdFile` class, see "Identifying Audio Files (MusicID-File)".

MusicID Queries

The `GnMusicId` class provides the following query methods:

- **`FindAlbums`**—Call this with an album or track identifier such as a CD TOC string, an audio source, a fingerprint, or identifying text (album title, track title, artist name, track artist name or composer name). This method returns a `GnResponseAlbums` object for each matching album.

- **`FindMatches`**—Call this method with identifying text. The method returns a `GnResponseDataMatches` object for each match, which could identify an album or a contributor.

Notes:

- A `GnMusicId` object's life time is scoped to a single recognition event and your application should create a new one for each event.

- During a recognition event, status events can be received via a delegate object that implements `IGnStatusEvents` (`GnStatusEventsDelegate` in Objective-C).

- A recognition event can be cancelled by the `GnMusicId` cancel method or by the "canceller" provided in each events delegate method.

Options for MusicID Queries

The `GnMusicId::Options` class allows you to set the following options:

- **`LookupData`**—Set `GnLookupData` options to enable what data can be returned, e.g., classical data, sonic data, playlist, external IDs, etc.
- **`LookupMode`**—Set a lookup option with one of the `GnLookupMode` enums. These include ones for local only, online only, online nocache, etc.
- **`PreferResultLanguage`**—Use one of the `GnLanguage` enums to set the preferred language for results.
- **`PreferResultExternalId`**—Set external ID for results from external provider. External IDs are 3rd party IDs used to cross link this metadata to 3rd party services.
- **`PreferResultCoverart`**—Specifies preference for results that have cover art associated.
- **`ResultSingle`**—Specifies whether a response must return only the single best result. Default is `true`.
- **`ResultRangeStart`**— Specifies result range start value.
- **`ResultCount`**— Specifies maximum number of returned results.

Identifying Music Using a CD TOC

MusicID-CD is the component of GNSDK that handles recognition of audio CDs and delivery of information including artist, title, and track names. The application provides GNSDK with the TOC from an audio CD and MusicID-CD will identify the CD and provide album and track information.

To identify music using a CD-TOC:

- Instantiate a `GnMusicId` object with your user handle.
- Set a string with your TOC values
- Call the `GnMusicId::FindAlbums` method with your TOC string.
- Process the `GnResponseAlbum` metadata result objects returned.

The code samples below illustrates a simple TOC lookup for local and online systems. The code for the local and online lookups is the same, except for two areas. If you are performing a local lookup, you must initialize the SQLite and Local Lookup libraries, in addition to the other GNSDK libraries:

C++ code sample

```
gnsdk_cstr_t toc= "150 14112 25007 41402 54705 69572 87335 98945 112902 131902 144055 157985 176900
189260 203342";
GnMusicId music_id(user);

music_id.Options().LookupData(kLookupDataContent);
GnResponseAlbums response = music_id.FindAlbums(toc);
```

Java and Android Java code sample

```
GnMusicId GnMusicId = new GnMusicId(user);
String toc = "150 14112 25007 41402 54705 69572 87335 98945 112902 131902 144055 157985 176900
189260 203342";
GnResponseAlbums responseAlbums = GnMusicId.findAlbums(toc);
```

Objective-C code sample

```
Under construction
```

C# and Windows Phone C# code sample

```
string toc = "150 14112 25007 41402 54705 69572 87335 98945 112902 131902 144055 157985 176900
189260 203342";
try
{
    using (GnStatusEventsDelegate midEvents = new MusicIdEvents())
    {
         GnMusicId GnMusicId = new GnMusicId(user, midEvents);
         GnResponseAlbums gnResponse = GnMusicId.FindAlbums(toc);
    }
}
```

Identifying Music Using Text

Using the GNSDK's MusicID module, your application can identify music using a lookup based on text strings. Besides user-inputted text, text strings can be extracted from an audio track's file path name and from text data embedded within a file, such as mp3 tags. You can provide the following types of input strings:

- Album title
- Track title
- Album artist
- Track artist
- Track composer

Text-based lookup attempts to match these attributes with known albums, artists, and composers. The text lookup first tries to match an album. If that is not possible, it next tries to match an artist. If that does not succeed, a composer match is tried. Adding as many input strings as possible to the lookup improves the results.

Text-based lookup returns "best-fit" objects, which means that depending on what your input text matched, you might get back album matches or contributor matches.

Identifying music using text is done using the `GnMusicId` class that has numerous methods for finding albums, tracks, and matches

To identify music using text:

1. Code an events handler object callbacks for status events (optional).
2. Instantiate a `GnMusicId` object with your User object and events handler object. Note that the events handler is optional.
3. Call the `GnMusicId::FindAlbums` method with your text search string(s).
4. Process metadata results returned

C++ code sample

```
/* Set the input text as album title, artist name, track title and perform the query */
GnResponseAlbums response = music_id.FindAlbums("Supernatural", "Africa Bamba", "Santana", GNSDK_
NULL, GNSDK_NULL);
```

Android Java and Java code sample

```
GnMusicId musicId = new GnMusicId( gnUser, new StatusEvents() );
```

```
GnResponseAlbums result = musicId.findAlbums( album, track, artist, null, null );
```

Objective-C code sample

```
musicId = [[GnMusicId alloc] initWithGnUser: self.gnUser statusEventsDelegate: self];

[self.cancellableObjects addObject: musicId];

[[musicId options] lookupData:kLookupDataContent bEnable:YES error:&amp;error];

self.queryBeginTimeInterval = [[NSDate date] timeIntervalSince1970];

[self enableOrDisableControls:NO];

dispatch_async(dispatch_get_global_queue(DISPATCH_QUEUE_PRIORITY_BACKGROUND, 0), ^{
         NSError *textSearchOperationError = nil;
         GnResponseAlbums *responseAlbums = [musicId findAlbumsWithAlbumTitle: albumTitle
                                                 trackTitle: trackTitle
                                                 albumArtistName: artistName
                                                 trackArtistName: artistName
                                                 composerName: nil
                                                 error: &amp;textSearchOperationError];
        });
}
```

C# and Windows Phone C# code sample

```
/* Set the input text as album title, artist name, track title and perfor the query */
GnResponseAlbums gnResponse = musicID.FindAlbums("Supernatural", "Africa Bamba", "Santana");
```

Identifying MusCic Using Fingerprints

You can identify music using an audio fingerprint. An audio fingerprint is data that uniquely identifies an audio track based on the audio waveform. You can use MusicID or MusicID-File to identify music using an audio fingerprint. The online Gracenote Media Service uses audio fingerprints to match the audio from a client application to the Gracenote Music Database. For more information, see *Fingerprint-Based Recognition*.

PCM Audio Format Recommendations

GNSDK fingerprinting supports the following PCM audio formats:

- **Sample Sizes**—16-bit
- **Channels**—1 or 2 (mono or stereo)
- **Sample Rates**—11025 Hz, 16000 Hz, 22050 Hz, 24000 Hz, 32000 Hz, 44100 Hz, 48000 Hz

Applications should use the highest quality audio possible to ensure the best results. Lower quality audio will result in less accurate fingerprint matches. Gracenote recommends at least 16-bit, stereo, 22050 Hz.

Do not resample or downsample audio to target these frequencies. Send the best quality audio that you have available.

MusicID Fingerprinting

The MusicID fingerprinting APIs give your application the ability to provide audio data as an identification mechanism. Note that if you want to do recognition using fingerprints and metadata together, and possibily have many files to do at once, then MusicID-File fingerprinting is probably the better solution. See *"Identifying Audio Files (MusicID-File)"*

There are four `GnMusicId` fingerprinting methods:

- **`FingerprintFromSource`**—Generates a fingerprint from a provided audio source. **Gracenote recommends using this**, as it encapsulates the below three calls (and additionally required code) into one.
- **`FingerprintBegin`**—Initialize fingerprint generation.
- **`FingerprintWrite`**—Provides uncompressed audio data for fingerprint generation. You can call this after `FingerprintBegin` to generate a native Gracenote Fingerprint Extraction (GNFPX) or Cantametrix (CMX) fingerprint.
- **`FingerprintEnd`**—Finalizes fingerprint generation.

Identifying music using MusicID fingerprinting examples:

C++ code sample

```
Under construction
```

Android Java code sample

```
Under construction
```

Objective-C code sample

```
Under construction
```

Windows Phone C# code sample

```
Under construction
```

C# code sample

```
/*-----------------------------------------------------------------------------
*  SetFingerprintBeginWriteEnd
*/
private static void
SetFingerprintBeginWriteEnd(GnMusicId GnMusicId)
{
    bool complete = false;

    FileInfo file = new FileInfo(@"..\..\..\data\05-Hummingbird-sample.wav");

    using (BinaryReader b = new BinaryReader(File.Open(file.FullName, FileMode.Open,
FileAccess.Read)))
    {
                b.BaseStream.Position = 0;

                /* skip the wave header (first 44 bytes). we know the format of our sample files*/
                b.BaseStream.Seek(44, SeekOrigin.Begin);

                byte[] audioData = b.ReadBytes(2048);

                GnMusicId.FingerprintBegin(GnFingerprintType.kFingerprintTypeGNFPX, 44100, 16, 2);
                while (audioData.Length > 0)
                {
                    complete = GnMusicId.FingerprintWrite(audioData, (uint)audioData.Length);
                    if (true == complete)
                        break;
                    else
                        audioData = b.ReadBytes(2048);
                }

                GnMusicId.FingerprintEnd();

                if (false == complete)
                {
                    /* Fingerprinter doesn't have enough data to generate a fingerprint.
                        Note that the sample data does include one track that is too short to
fingerprint. */
                    Console.WriteLine("\nWarning: input file does contain enough data to generate a
fingerprint :" + file.FullName);
                }
    }
}

/*-----------------------------------------------------------------------------
*  MusicidFingerprintAlbum
*/
private static void
MusicidFingerprintAlbum(GnUser user)
{
    Console.WriteLine("\n*****Sample MID-Stream Query*****");

    try
    {
        GnMusicId GnMusicId = new GnMusicId(user);

        /* Set the input fingerprint */
        SetFingerprintBeginWriteEnd(GnMusicId);

        /* Perform the search */
        GnResponseAlbums response = GnMusicId.FindAlbums(GnMusicId.FingerprintDataGet(),
GnFingerprintType.kFingerprintTypeGNFPX);

        DisplayFindAlbumResutlsByFingerprint(response);

    }
    catch (GnException e)
    {
    }
}
```

Java code sample

```
Under construction
```

Identifying Audio Files (MusicID-File)

The MusicID-File module can perform recognition using individual audio files or leverage collections of files to provide advanced recognition. When an application provides decoded audio and text data for each file to the library, MusicID-File identifies each file and, if requested, identifies groups of files as albums.

Music-ID File provides three mechanisms for identification:

1. **TrackID**—TrackID identifies the best album(s) for a single track. It returns results for an individual track independent of any other tracks submitted for processing at the same time.
2. **AlbumID**—AlbumID identifies the best album(s) for a group of tracks. Use AlbumID when identifying submitted files as a group is important. For example, if all the submitted tracks were originally recorded on different albums, but exist together on a greatest hits album, then that will be the first match returned.
3. **LibraryID**—LibraryID identifies the best album(s) for a large collection of tracks. Besides metadata and other submitted tracks, LibraryID also takes into account a number of factors, such as location on device, when returning results.

For more information about the differences between TrackID, AlbumID, and LibraryID see the MusicID-File Overview

MusicID-File is implemented with the **`GnMusicIdFile`** class.

To identify audio from a file:

1. Code an `IGnMusicIdFileEvents` delegate class (`GnMusicIdFileEventsDelegate` in Objective-C) containing callbacks for results, events, and identification (metadata, fingerprint, etc.).
2. Instantiate a `GnMusicIdFile` object with your User object and events delegate object.
3. Call the `GnMusicIdFile::FileInfos` method to get a `GnMusicIdFileInfoManager` object.
4. For each file you want to identify, instantiate a `GnMusicIdFileInfo` object for it using the `GnMusicIdFileInfoManager` object's `Add` method.
5. For each instantiated `GnMusicIdFileInfo` object, set the file's path with the object's `FileName` method and assign it an identifier to correlate it with returned results.
6. Call one of the `GnMusicIdFile` query methods.
7. Handle metadata results in an events delegate callback.

Implementing an Events Delegate

To receive `GnMusicIdFile` notifications for results, events, and identification (metadata, fingerprint, etc.), your application needs to implement the `IGnMusicIdFileEvents` event delegate (`GnMusicIdFileEventsDelegate` in Objective-C) provided upon `GnMusicIdFile` object construction. This events delegate can contain callbacks for the following:

- Results handling
- Status event handling
- Other event handling
- Fingerprinting for identification
- Metadata for identification

Please note that these callbacks are optional, but you will want to code a results handling callback at a minimum, in order to get results. In addition, fingerprint and metadata identification can be done automatically when you create an audio file object (see next section) for each file you want to identify.

Android Java code sample

```
/**
* GNSDK MusicID-File event delegate
*/
private class MusicIDFileEvents extends IGnMusicIdFileEvents {

   HashMap<String, String> gnStatus_to_displayStatus;

   public MusicIDFileEvents(){
      gnStatus_to_displayStatus = new HashMap<String,String>();
      gnStatus_to_displayStatus.put("kMusicIdFileCallbackStatusProcessingBegin", "Begin processing
file");
      gnStatus_to_displayStatus.put("kMusicIdFileCallbackStatusFileInfoQuery", "Querying file
info");
      gnStatus_to_displayStatus.put("kMusicIdFileCallbackStatusProcessingComplete", "Identification
complete");
   }

   // ...other delegate events

}
```

Objective-C code sample

```
#pragma mark - MusicIDFileEventsDelegate Methods

-(void) musicIdFileAlbumResult: (GnResponseAlbums*)albumResult currentAlbum: (NSUInteger)
currentAlbum totalAlbums: (NSUInteger)totalAlbums cancellableDelegate: (id <GnCancellableDelegate>)
canceller
{
    [self.cancellableObjects removeObject: canceller];

    if (self.cancellableObjects.count==0)
    {
        self.cancelOperationsButton.enabled = NO;
    }

    [self processAlbumResponseAndUpdateResultsTable:albumResult];
}

    if(self.cancellableObjects.count==0)
    {
        self.cancelOperationsButton.enabled = NO;
    }

   [self enableOrDisableControls:YES];
   [self processAlbumResponseAndUpdateResultsTable:result];
}

   // ...other delegate events
```

Windows Phone C# code sample

```
#region IGnMusicIdFileEvents

      void IGnMusicIdFileEvents.GatherFingerprint(GnMusicIdFileInfo fileinfo, uint current_file,
uint total_files, IGnCancellable canceller)
      {
        return;
      }

      void IGnMusicIdFileEvents.GatherMetadata(GnMusicIdFileInfo fileinfo, uint current_file, uint
total_files, IGnCancellable canceller)
      {
        return;
      }

      void IGnMusicIdFileEvents.MusicIdFileComplete(GnError musicidfile_complete_error)
      {
            List<AlphaKeyGroup<RespAlbum>> DataSource = AlphaKeyGroup<RespAlbum>.CreateGroups
(respAlbList_,
            System.Threading.Thread.CurrentThread.CurrentUICulture,
            (RespAlbum s) => { return s.Title; }, true);

              Deployment.Current.Dispatcher.BeginInvoke(() =>
              {
              TBStatus.Text = "Status : MusicIDFile Completed Successfully";
                ToggleUIBtnsVisibility(true);
              LLRespAlbum.ItemsSource = DataSource;
              });
      }

      // ...other delegate events
```

C++ code sample

```
/*
 * Callback delegate classes
 */

/* Callback delegate called when performing MusicID-File operation */
class MusicIDFileEvents : public IGnMusicIdFileEvents
{
public:
       virtual void
       StatusEvent(GnStatus status,
                                        gnsdk_uint32_t percent_complete,
                                        gnsdk_size_t bytes_total_sent,
                                        gnsdk_size_t bytes_total_received,
                                        IGnCancellable& canceller)
       {
               std::cout << "status (";

               switch (status)
               {
               case gnsdk_status_unknown:
                       std::cout <<"Unknown ";
                       break;

               case gnsdk_status_begin:
                       std::cout <<"Begin ";
                       break;
```

```
                case gnsdk_status_connecting:
                        std::cout <<"Connecting ";
                        break;

                case gnsdk_status_sending:
                        std::cout <<"Sending ";
                        break;

                case gnsdk_status_receiving:
                        std::cout <<"Receiving ";
                        break;

                case gnsdk_status_disconnected:
                        std::cout <<"Disconnected ";
                        break;

                case gnsdk_status_complete:
                        std::cout <<"Complete ";
                        break;

                default:
                        break;
                }

                std::cout << "), % complete ("
                                        << percent_complete
                                        << "), sent ("
                                        << bytes_total_sent
                                        << "), received ("
                                        << bytes_total_received
                                        << ")"
                                        << std::endl;

                GNSDK_UNUSED(canceller);
        }
    //... more delegate events


};
```

C# code sample

```
Under construction
```

Java code sample

```
Under construction
```

Adding Audio Files for Identification

To add audio files for identification:

1. Call the `GnMusicIdFile::FileInfos` method to get a `GnMusicIdFileInfoManager` object.
2. For each file you want to identify, instantiate a `GnMusicIdFileInfo` object for it using the

`GnMusicIdFileInfoManager` object's `Add` method.

Each audio file must be added with a unique identifer string that your application can use to correlate results in callbacks with a specific file. Audio files can be added as a `GnAudioFile` (only available on some platforms) instance.

3. Set the file's path with the `GnMusicIdFileInfo::FileName` method.

   `GnMusicIdFileInfo` objects are used to contain the metadata that will be used in identification and will also contain results after a query has completed. MusicID-File matches each `GnMusicIdFileInfo` object to a track within an album.

> Adding audio files as a `GnAudioFile` instance (only available on some platforms) allows `GnMusicIdFile` to automatically extract metadata available in audio tags (artist, album, track, track number, etc.,) and fingerprint the raw audio data, saving your application the need to do this in event delegate methods.

Setting Audio File Identification

To aid in identification, your application can call `GnMusicIdFileInfo` methods to get/set CDDB IDs, fingerprint, path and filename, FileInfo identifier (set when FileInfo created), media ID (from Gracenote), source filename (from parsing) and application, Media Unique ID (MUI), Tag ID (aka Product ID), TOC offsets, track artist/number/title, and TUI (Title Unique Identifier).

Android Java code sample

```
@Override
public void gatherMetadata(GnMusicIdFileInfo fileInfo, long currentFile, long totalFiles,
IGnCancellable cancelable) {

   MediaMetadataRetriever mmr = new MediaMetadataRetriever();
   try {
          mmr.setDataSource(fileInfo.fileName());
          fileInfo.albumTitle(mmr.extractMetadata(MediaMetadataRetriever.METADATA_KEY_ALBUM));
          fileInfo.albumArtist(mmr.extractMetadata(MediaMetadataRetriever.METADATA_KEY_
ALBUMARTIST));
          fileInfo.trackTitle(mmr.extractMetadata(MediaMetadataRetriever.METADATA_KEY_TITLE));
          fileInfo.trackArtist(mmr.extractMetadata(MediaMetadataRetriever.METADATA_KEY_ARTIST));
          try {
                  long trackNumber = Long.parseLong(mmr.extractMetadata
(MediaMetadataRetriever.METADATA_KEY_CD_TRACK_NUMBER));
                  fileInfo.trackNumber(trackNumber);
               } catch (NumberFormatException e) {}

           } catch (IllegalArgumentException e1) {
                 Log.e(appString, "illegal argument to MediaMetadataRetriever.setDataSource");
        } catch (GnException e1) {
                 Log.e(appString, "error retrieving filename from fileInfo");
           }
}
```

Objective-C code sample

```
-(void) gatherMetadata: (GnMusicIdFileInfo*) fileInfo
                  currentFile: (NSUInteger) currentFile
                       totalFiles: (NSUInteger) totalFiles
```

```
   cancellableDelegate: (id <GnCancellableDelegate>) canceller
{
    NSError *error = nil;
    NSString* filePath = [fileInfo fileName:&error];

    if (error)
    {
        NSLog(@"Error while retrieving filename %@ ", [error localizedDescription]);
    }
    else
    {
        AVAsset *asset = [AVAsset assetWithURL:[NSURL fileURLWithPath:filePath]];
        if (asset)
        {
            NSArray *metadataArray =  [asset metadataForFormat:AVMetadataFormatID3Metadata];

            for(AVMetadataItem* item in metadataArray)
            {
                NSLog(@"AVMetadataItem Key = %@ Value = %@",item.key, item.value );

                if([[item commonKey] isEqualToString:@"title"])
                {
                    [fileInfo trackTitleWithValue:(NSString*) [item value] error:nil];
                }
                else if([[item commonKey] isEqualToString:@"albumName"])
                {
                    [fileInfo albumTitleWithValue:(NSString*) [item value] error:nil];
                }
                else if([[item commonKey] isEqualToString:@"artist"])
                {
                    [fileInfo trackArtistWithValue:(NSString*) [item value] error:nil];
                }
            }
        }
    }
}
```

Windows Phone C# code sample

```
void IGnMusicIdFileEvents.GatherMetadata(GnMusicIdFileInfo fileinfo, uint current_file, uint total_
files, IGnCancellable canceller)
{
   return;
}
```

C++ code sample

```
GnMusicIdFileInfo fileinfo;
fileinfo = midf.FileInfos().Add(fileIdent);
fileinfo.FileName(filePath);
fileInfo.AlbumArtist( "kardinal offishall" );
fileInfo.AlbumTitle ( "quest for fire" );
fileInfo.TrackTitle ( "intro" );
```

C# code sample

```
Under construction
```

Java code sample

```
Under construction
```

MusicID-File Fingerprinting

The MusicID-File fingerprinting APIs give your application the ability to provide audio data as an identification mechanism. This enables MusicID-File to perform identification based on the audio itself, as opposed to performing identification using only the associated metadata. Use the MusicID-File fingerprinting APIs during an events delegate callback.

There are four `GnMusicIdFileInfo` fingerprinting methods:

- **`FingerprintFromSource`**—Generates a fingerprint from a provided audio source. **Gracenote recommends using this**, as it encapsulates the below three calls (and additionally required code) into one.
- **`FingerprintBegin`**—Initialize fingerprint generation.
- **`FingerprintWrite`**—Provides uncompressed audio data for fingerprint generation.
- **`FingerprintEnd`**—Finalizes fingerprint generation.

Android Java code sample

```
@Override
public void gatherFingerprint(GnMusicIdFileInfo fileInfo, long currentFile, long totalFiles,
IGnCancellable cancelable){
   try {
          fileInfo.fingerprintFromSource( new GnAudioFile( new File(fileInfo.fileName())) );
       } catch (GnException e) {
         Log.e(appString, "error in fingerprinting file: " + e.getErrorAPI() + ", " +
e.getErrorModule() + ", " + e.getErrorDescription());
       }
}
```

Objective-C code sample

```
[musicIDFileInfo fingerprintFromSource:(id <GnAudioSourceDelegate> )gnAudioFile error:&error];
```

Windows Phone C# code sample

```
Under construction
```

C++ code sample

```
file = fileInfo.FileName();

std::ifstream audioFile (file, std::ios::in | std::ios::binary);
if ( audioFile.is_open() )
{
    /* skip the wave header (first 44 bytes). the format of the sample files is known,
     * but please be aware that many wav file headers are larger then 44 bytes!
     */
    audioFile.seekg(44);
    if ( audioFile.good() )
    {
        /* initialize the fingerprinter
         * Note: The sample files are non-standard 11025 Hz 16-bit mono to save on file size
         */
         fileInfo.FingerprintBegin(11025, 16, 1);

        do
        {
            audioFile.read(pcmAudio, 2048);
            complete = fileInfo.FingerprintWrite((gnsdk_byte_t*)pcmAudio,
                                             (gnsdk_size_t)audioFile.gcount()
                    );

            /* does the fingerprinter have enough audio? */
            if (GNSDK_TRUE == complete)
            {
                break;
            }
        }
        while ( audioFile.good() );

       if (GNSDK_TRUE != complete)
       {
            /* Fingerprinter doesn't have enough data to generate a fingerprint.
               Note that the sample data does include one track that is too short to fingerprint. */
           std::cout << "Warning: input file does contain enough data to generate a fingerprint:\n"
<< file <<"\n";
           fileInfo.FingerprintEnd();
        }
    }
    else
    {
        std::cout << "\n\nError: Failed to skip wav file header: " << file <<"\n\n";
    }
}
```

C# code sample

```
/*-----------------------------------------------------------------------------
 *  GatherFingerprint
 */
public override void
GatherFingerprint(GnMusicIdFileInfo fileInfo, uint currentFile, uint totalFiles, IGnCancellable
canceller)
{
    byte[]     audioData  = new byte[2048];
    bool       complete   = false;
    int        numRead    = 0;
    FileStream fileStream = null;

    try
    {
        string filename = fileInfo.FileName;
        if (filename.Contains('\\'))
            fileStream = new FileStream(filename, FileMode.Open, FileAccess.Read);
        else
            fileStream = new FileStream(folderPath + filename, FileMode.Open, FileAccess.Read);

       /* check file for existence */
       if (fileStream == null || !fileStream.CanRead)
       {
           Console.WriteLine("\n\nError: Failed to open input file: " + filename);
       }
       else
       {
          /* skip the wave header (first 44 bytes). we know the format of our sample files, but
please
             be aware that many wav file headers are larger then 44 bytes! */
           if (44 != fileStream.Seek(44, SeekOrigin.Begin))
           {
               Console.WriteLine("\n\nError: Failed to seek past header: %s\n", filename);
           }
           else
           {
               /* initialize the fingerprinter
                  Note: Our sample files are non-standard 11025 Hz 16-bit mono to save on file size
*/
               fileInfo.FingerprintBegin(11025, 16, 1);

               numRead = fileStream.Read(audioData, 0, 2048);
               while ((numRead) > 0)
               {
                   /* write audio to the fingerprinter */
                   complete = fileInfo.FingerprintWrite(audioData, Convert.ToUInt32(numRead));

                  /* does the fingerprinter have enough audio? */
                   if (complete)
                   {
                       break;
                   }

                   numRead = fileStream.Read(audioData, 0, 2048);
              }
              fileStream.Close();

              /* signal that we are done */
              fileInfo.FingerprintEnd();
              Debug.WriteLine("Fingerprint: " + fileInfo.Fingerprint + " File: " +
fileInfo.FileName);
           }
        }

        if (!complete)
        {
            /* Fingerprinter doesn't have enough data to generate a fingerprint.
            Note that the sample data does include one track that is too short to fingerprint. */
           Console.WriteLine("Warning: input file does contain enough data to generate a
fingerprint:\n" + filename);
        }

    }
    catch (FileNotFoundException e)
    {
        Console.WriteLine("FileNotFoundException " + e.Message);
    }
    catch (IOException e)
    {
        Console.WriteLine("IOException " + e.Message);
    }
    finally
    {
        try
        {
            fileStream.Close();
        }
        catch (IOException e)
        {
            Console.WriteLine("IOException " + e.Message);
        }
    }
}
```

Java code sample

```
Under construction
```

Setting Options for MusicID-File Queries

To set an option for your MusicID-File query, instantiate a `GnMusicIdFileOptions` object using the `GnMusicIdFile::Options` method and call its methods. For example, you can set an option for local lookup. By default, a lookup is handled online, but many applications will want to start with a local query first then, if no match is returned, fall back to an online query.

MusicID-File Query Options:

- **`LookupData`**—Set `GnLookupData` options to enable what data can be returned, e.g., classical data, sonic data, playlist, external IDs, etc.
- **`LookupMode`**—Set a lookup option with one of the `GnLookupMode` enums. These include ones for local only, online only, online nocache, etc.
- **`BatchSize`**— In LibraryID, you can set the batch size to control how many files are processed at a time. The higher the size, the more memory will be used. The lower the size, the less memory will be used and the faster results will be returned.
- **`ThreadPriority`**—Use one of the `GnThreadPriority` enums to set thread priority, e.g., default, low, normal, high, etc.
- **`OnlineProcessing`**—Enable (`true`) or disable (`false`) online processing.
- **`PreferResultLanguage`**—Use one of the `GnLanguage` enums to set the preferred language for results.
- **`PreferResultExternalId`**—Set external ID for results from external provider. External IDs are 3rd party IDs used to cross link this metadata to 3rd party services.

Making a MusicID-File Query

`GnMusicIdFile` provides the following query methods:

- **`DoTrackId`**—Perform a Track ID query.
- **`DoTrackIdAsync`**—Perform an asynchronous Track ID query.
- **`DoAlbumId`**—Perform an Album ID query.
- **`DoAlbumIdAsync`**—Perform an asynchronous Album ID query.
- **`DoLibraryId`**—Perform a Library ID query.
- **`DoLibraryIdAsync`**—Perform an asynchronous Library ID query.

Note that GNSDK processing is always done asynchronously and returns results via callbacks. With the blocking functions, your app waits until processing has completed before continuining.

Options When Making Query Call

When you make a `GnMusicIdFile` query method call, you can set the following options at the time of the call (as opposed to setting options with `GnMusicIdFileOptions` object—see above):

- **Return matches** - Have MusicID-File return all results found for each given `GnMusicIdFileInfo`
- **Return albums** - Only album matches are returned (default)
- **Return all** - Have MusicID-File return all results found for each given `GnMusicIdFileInfo`
- **Return single** - Have MusicID-File return the single best result for each given `GnMusicIdFileInfo` (default)

C++ code sample

```
/* Launch AlbumID */
midf.DoAlbumId(kQueryReturnSingle, kResponseAlbums );
```

Objective-C code sample

```
dispatch_async(dispatch_get_global_queue(DISPATCH_QUEUE_PRIORITY_DEFAULT, 0),  ^{
   NSError *error = nil;
   [musicIDFileInfo fingerprintFromSource:(id <GnAudioSourceDelegate> )gnAudioFile error:&error];
   error = nil;
   [gnMusicIDFile doAlbumId:kQueryReturnSingle responseType:kResponseAlbums error:&error];
});
```

Identifying Streaming Audio (MusicID-Stream)

The functionality for identifying streaming audio is contained in the **Music-ID Stream** module. This module contains the `GnMusicIdStream` class that is designed to identify raw audio received in a continuous stream. You should instantiate one instance of this class for each audio stream you are using. `GnMusicIdStream` can be started and stopped as the audio stream starts and stops. There is no need to destroy and recreate a `GnMusicIdStream` instance due to breaks in the audio stream.

Using this class, your application primarily needs to provide two things:

1. Code an `IGnMusicIdStreamEvents` events delegate object (`GnMusicIdStreamEventsDelegate` in Objective-C) that receives callbacks for results, status messages, and other events.
2. Code a class that implements the `IGnAudioSource` (`GnAudioSource` in Objective-C) interface.

> For some platforms (e.g., iOS and Android), Gracenote provides the `GnMic` helper class that implements the `IGnAudioSource` interface. If available, your application can use this class to process streaming audio from a device microphone.

Notes:

- At any point, your application can stop audio processing. When stopped, automatic data fetching ceases or, if audio data is being provided manually, attempts to write data for processing will fail.

Internally, `GnMusicIdStream` clears and releases all buffers and audio processing modules. Audio processing can be restarted at any time.

- Identification spawns a thread that completes asynchronously. However, methods for both synchronous and asynchronous identification are provded. If the sychronous method is called, the identification is still performed asynchronously and results delivered via a delegate implementing `IGnMusicIdStreamEvents`, and the method does not return until the identification is complete. If a request is pending, any new ID requests are ignored.
- Audio is identified using either a local database or the Gracenote online service. The default is to attempt a local identification first before going online. Local matches are only possible if `GnLookupLocalStream` is enabled and a MusicID-Stream fingerprint bundle ingested.
- Internally, `GnMusicIdStream` pulls data from the audio source interface in a loop, so you may want to start automatic audio processing in a background thread to avoid stalling the main thread.
- At any point, your application can request an identification of buffered audio. The identification process spawns a thread and completes asynchronously. Use the method `IdentifyAsync` to identify music.
- You can call `IdentifyCancel` to stop an identification operation. Note that cancelling does not cease audio processing and your application can continue requesting identifications.
- You can instantiate a `GnMusicIdStream` object with a locale. Locales are a convenient way to group locale-dependent metadata specific to a region (such as Europe) and language that should be returned from the Gracenote service. See "Loading a Locale" for more information.

To identify streaming audio from an audio source (`IGnAudioSource` implementation):

1. Code a `IGnMusicIdStreamEvents` delegate class (`GnMusicidStreamEventsDelegate` in Objective-C) to handle results, statuses, and other events.
2. Instantiate a `GnMusicIdStream` object with your User object, a `GnMusicIdStreamPreset` enum, and a `IGnMusicIdStreamEvents` events delegate object. This establishes a MusicID-Steam audio channel. The `GnMusicIdStreamPreset` enum can be for either 'microphone' or 'radio' (e.g., speaker).
3. Instantiate a `IGnAudioSource` object representing the audio source you wish to identify. On some platforms (iOS, Android, Windows Phone), Gracenote provides the `GnMic` class, which is a `IGnAudioSource` implementation for the device microphone.
4. Call the `IGnAudioSource` instance's `sourceInit` method to initialize your audio source.
5. Call the `GnMusicIdStream` instance's `AudioProcessStart` method with your `IGnAudioSource` object. This starts the retrieval and processing of audio.

   Note that, as an alternative to the above two steps, you could call the `GnMusicIdStream` instance's `audioProcess` method with PCM string data that you have captured through any means.

6. To identify audio, call `GnMusicIdStream.IdentifyAlbumAsync`. Results are delivered

asychnronously as audio is received.

7. Handle results and statuses in your event delegate callbacks.

Setting Options for Streaming Audio Queries

You can use `GnMusicIdStreamOptions` methods to set options for streaming audio queries. For example, you can set an option for local lookup. By default, a lookup is done online, but many applications will want to start with a local query first then, if no match is found, go online.

`GnMusicIdStreamOptions` Query Option Methods:

- **`LookupData`**—Set `GnLookupData` options to enable what data can be returned, e.g., classical data, sonic data, playlist, external IDs, etc.
- **`LookupMode`**—Set a lookup option with one of the `GnLookupMode` enums. These include ones for local only, online only, online nocache, etc.
- **`NetworkInterface`**—Set a specific network interface to use with this object's connections.
- **`PreferResultLanguage`**—Use one of the `GnLanguage` enums to set the preferred language for results.
- **`PreferResultExternalId`**—Specifies preference for results with external IDs. External IDs are 3rd party IDs used to cross link this metadata to 3rd party services.
- **`PreferResultCoverart`**—Specifies preference for results with cover art.
- **`ResultSingle`**—Specifies whether a response must return only the single best result. Default is `true`.
- **`ResultRangeStart`**— Specifies the result range start value. This must be less than or equal to the total number of results. If greater than the total number, no results are returned.
- **`ResultCount`**— Specifies the result range count value.

Android Java code sample

```
MusicIDStreamEvents musicIDStreamEvents = new MusicIDStreamEvents();

/**
 * GNSDK MusicID-Stream event delegate
 */
private class MusicIDStreamEvents extends GnMusicIdStreamEventsListener {

    HashMap<String, String> gnStatus_to_displayStatus;

    public MusicIDStreamEvents(){
        gnStatus_to_displayStatus = new HashMap<String,String>();
        gnStatus_to_displayStatus.put("kStatusStarted", "Identification started");
        gnStatus_to_displayStatus.put("kStatusFpGenerated", "Fingerprinting complete");

        //gnStatus_to_displayStatus.put("kStatusIdentifyingOnlineQueryStarted", "Online query
started");
        gnStatus_to_displayStatus.put("kStatusIdentifyingEnded", "Identification complete");
    }

    @Override
    public void statusEvent( GnStatus status, long percentComplete, long bytesTotalSent, long
bytesTotalReceived, IGnCancellable cancellable ) {
        //setStatus( String.format("%d%%",percentComplete), true );
    }

    @Override
    public void musicIdStreamStatusEvent( GnMusicIdStreamStatus status, IGnCancellable cancellable )
{
        if(gnStatus_to_displayStatus.containsKey(status.toString())){
             setStatus( String.format("%s", gnStatus_to_displayStatus.get(status.toString())), true
);
        }
    }

    @Override
    public void musicIdStreamResultAvailable( GnResponseAlbums result, IGnCancellable cancellable )
{
        activity.runOnUiThread(new UpdateResultsRunnable( result ));
        setStatus( "Success", true );
        setUIState( UIState.READY );
    }
}

private void startContinuousListening() throws GnException{

    if ( gnMicrophone == null ){
        gnMicrophone = new GnMic();
        gnMicrophone.start();
    } else {
        gnMicrophone.resume();
    }

    GnMusicIdStream = new GnMusicIdStream( gnUser, GnMusicIdStreamPreset.kPresetRadio,
musicIDStreamEvents );
    queryObjects.add( GnMusicIdStream.canceller() ); // retain event object so we can cancel if
requested
    GnMusicIdStream.options().resultSingle( true );

    Thread audioProcessThread = new Thread(new AudioProcessRunnable());
    audioProcessThread.start();
}

/**
 * GnMusicIdStream object processes audio read directly from GnMic object
 */
class AudioProcessRunnable implements Runnable {

    @Override
    public void run() {
        try {

                GnMusicIdStream.audioProcessStart( gnMicrophone );

        } catch (GnException e) {
            Log.e( appString, e.getErrorCode() + ", " + e.getErrorDescription() + ", " +
e.getErrorModule() );
            showError( e.getErrorAPI() + ": " +  e.getErrorDescription() );

        }
    }
}
```

Objective-C code sample

```
-(void) setupMusicIDStream
{
    __block NSError *musicIDStreamError = nil;
    self.gnMusicIDStream = [[GnMusicIDStream alloc] initWithUser:self.gnUser
musicIDStreamEventsDelegate:self error:&musicIDStreamError];

    musicIDStreamError = nil;
    [self.gnMusicIDStream optionResultSingle:YES error:&musicIDStreamError];

    musicIDStreamError = nil;
    dispatch_async(dispatch_get_global_queue(DISPATCH_QUEUE_PRIORITY_DEFAULT, 0), ^
       {
           [self.gnMusicIDStream audioProcessStartWithAudioSource:self.gnMic
error:&musicIDStreamError];

           if(musicIDStreamError)
           {
               dispatch_async(dispatch_get_main_queue(), ^
               {

                   NSLog(@"Error while starting Audio Process With AudioSource - %@",
[musicIDStreamError localizedDescription]);
                });
           }

       });
}
#pragma mark - GnMusicIDStreamEventsDelegate Methods

-(void) midstreamStatusEvent:(GnMusicIDStream*) gnMusicIDStream status:(GnAudioStatus) status
{
    NSString *statusString = nil;

    switch (status)
    {
        case  AudioStatusInvalid:
            statusString = @"Error";
            [self performSelectorOnMainThread:@selector(updateStatus:) withObject:statusString
waitUntilDone:NO];

            break;
        case AudioStatusIdentifyingStarted:
            statusString = @"Identifying";
            [self performSelectorOnMainThread:@selector(updateStatus:) withObject:statusString
waitUntilDone:NO];
            break;

        /*... More audio statuses */

    }
}
```

Windows Phone C# code sample

```
// Create and setup gracenote musicid stream instance
App.mMusicIDStream = new GnMusicIdStream(App.mGnUser, this);
App.mMusicIDStream.Options.ResultSingle(true);
App.mMusicIDStream.Options.LookupData(GnLookupData.kLookupDataContent,true);
App.mDispatcherTimer.Start();
App.mMicrophone.Start();
App.mMusicIDStream.AudioProcessStart((uint)App.mMicrophone.SampleRate, 16, 1);
```

```
#region IGnMusicIdStreamEvents

void IGnMusicIdStreamEvents.MusicIdStreamResultAvailable(GnResponseAlbums result, IGnCancellable
canceller)
{
   ClearResults();
   ShowAlbums(result, true, false);
}

void IGnMusicIdStreamEvents.MusicIdStreamStatusEvent(GnMusicIdStreamStatus status_, IGnCancellable
canceller)
{
   return;
}

void IGnMusicIdStreamEvents.StatusEvent(GnStatus status_, uint percent_complete, uint bytes_total_
sent, uint bytes_total_received, IGnCancellable canceller)
{
   Deployment.Current.Dispatcher.BeginInvoke(() =>
   {
      string status = null;
      switch (status_)
      {
         case GnStatus.kStatusDisconnected: status = "Disconnected"; break;
         case GnStatus.kStatusBegin:     status = "Begin";           break;
         case GnStatus.kStatusComplete:  status = "Complete";        break;
         case GnStatus.kStatusConnecting:status = "Connecting";      break;
         case GnStatus.kStatusProgress:  status = "Progress";        break;
         case GnStatus.kStatusReading:   status = "Reading";         break;
         case GnStatus.kStatusSending:   status = "Sending";         break;
         case GnStatus.kStatusUnknown:   status = "Unknown";         break;
         case GnStatus.kStatusWriting:   status = "Writing";         break;
         case GnStatus.kStatusErrorInfo: status = "ErrorInfo";       break;

      }

       TBStatus.Text = "Status : " + status + "\t(" + percent_complete.ToString() + "%)";
     });

 }
#endregion
```

C++ code sample

```
/*-----------------------------------------------------------------------------
*  do_musicid_stream
*/
static void
do_musicid_stream(GnUser& user)
{
   std::cout << std::endl << "*****Sample MID-Stream Query*****" << std::endl;

   MusicIDStreamEvents* mids_events = new MusicIDStreamEvents;

   try
   {
      GnMusicIdStream mids(user, kPresetRadio, mids_events);

      /* create microphone to use as audio source */
      GnMic        mic(44100, 16, 1);
      /* pass Mic through GnWavCapture to record audio for testing (optional) */
      GnWavCapture wavrec(mic, "mic_record.wav");

      /* We want to add Content (eg: image URLs) data to our lookups */
      mids.Options().LookupData(kLookupDataContent, true);

      /* starts identification in background thread - will wait for audio if none yet */
      mids.IdentifyAsync();

      /* provide audio continuously until GnMusicIdStream::AudioProcessStop() is called */
      mids.AudioProcessStart(wavrec);

      /* We called GnMusicIdStream::AudioProcessStop() on 'gnsdk_mids_identifying_ended'
       * status callback which caused the above to return */
   }
   catch (GnError& e)
   {
      std::cout << e.ErrorAPI() << "\t" << std::hex << e.ErrorCode() << "\t" >>  e.ErrorDescription
() << std::endl;
   }

   delete mids_events;
}

/* IGnStatusEvents : overrider methods of this class to get delegate callbacks */
class MusicIDStreamEvents : public IGnMusicIdStreamEvents
{
   /*-----------------------------------------------------------------------------
    *  StatusEvent
    */
   void
   StatusEvent(gracenote::GnStatus status, gnsdk_uint32_t percent_complete, gnsdk_size_t bytes_
total_sent, gnsdk_size_t bytes_total_received, IGnCancellable& canceller)
   {
      std::cout << "status (";

      switch (status)
      {
         case gnsdk_status_unknown:
              std::cout <<"Unknown ";
              break;

         case gnsdk_status_begin:
              std::cout <<"Begin ";
              break;

         //...more statuses
      }
   }

   /*-----------------------------------------------------------------------------
    *  MidStreamStatusEvent
    */
   virtual void
      MusicIdStreamStatusEvent(GnMusicIdStreamStatus status, IGnCancellable& canceller)
      {
         switch (status)
         {
            case gnsdk_mids_status_invalid:
            std::cout <<"Invalid status!" << std::endl;
            break;
            case gnsdk_mids_identifying_started:
            std::cout <<"Identification: started" << std::endl;
                       break;

                       //...more statuses

         }
      }

/*----------------------------------------------------------------------------
 *  MidStreamResultAvailable
 */
virtual void
    MusicIdStreamResultAvailable(GnResponseAlbums& result, IGnCancellable& canceller)
    {
       if (result.ResultCount() > 0)
       {
          metadata::album_iterator it_album = result.Albums().begin();

          for (; it_album != result.Albums().end(); ++it_album)
          {
             GnAlbum album = *it_album;

             /* Get Track Artist, if not available, use Album Artist */
             gnsdk_cstr_t artist_name = album.TracksMatched()[0]->Artist().Name().Display();
             if (artist_name == GNSDK_NULL)
                artist_name = album.Artist().Name().Display();

             /* Get cover art URL for 'small' image */
             gnsdk_cstr_t cover_url = album.Content(kContentTypeImageCover).Asset
(kImageSizeSmall).Url();
             if (cover_url == GNSDK_NULL)
                cover_url = "no url";

             std::cout <lt; std::endl;
             std::cout <lt; "      Track : " <lt; album.TracksMatched()[0]->Title().Display() <lt;
std::endl;
             std::cout <lt; "      Artist: " <lt; artist_name <lt; std::endl;
             std::cout <lt; "      Cover : " <lt; cover_url <lt; std::endl;
          }
       }
       else
       {
          std::cout <lt; "      No match found" <lt; std::endl;
       }
       std::cout <lt; std::endl;

       GNSDK_UNUSED(canceller);
    }
};
```

Identifying Video

The GNSDK provides two modules for implementing video features: **VideoID** and **VideoExplore**:

- **VideoID** supports recognizing Products and enables access to related metadata such as title, genre, rating, synopsis, cast and crew. A Product refers to the commercial release of a Film, TV Series, or video content. Products contain a unique commercial code such as a UPC (Universal Product Code) or ISAN (International Standard Audiovisual Number). Products are for the most part released on a physical format, such as a DVD or Blu-ray.

  VideoID supports these features:

  - Recognize a Product using any of the input types listed below.
  - Enable access to core metadata from a Product data object
  - Enable access to enriched metadata from a Product object using the Link module

- **Video Explore** enables advanced recognition of video elements and their metadata. You can use Video Explore to navigate among Products, AV Works, Contributors, Series, and Seasons. For more information, See "Video Explore Overview"

Using VideoID for Recognition

You can use the following video identifiers in VideoID recognition queries:

- **TOC** (table of contents)—TOCs must be generated as XML strings using the GNSDK `tocgen` library that you can find in the /utilities folder.
- **Text**—See *"Video Text Search Queries"* for more information.
- **External IDs**—Such as UPC or ISAN (International Standard Audiovisual Number) codes. See the `GnVideoExternalIdType` enums for a complete list of allowable codes.
- Gracenote data object or other Gracenote ID for a Product, such as a GNID, GNUID, or TUI/TUI Tag combination.

Using Video Find Queries

You can use the following **`GnVideo`** methods to do Video Identification and Video Explore queries:

- **`FindProducts`**— You can use `FindProducts` to search for products using a TOC, a Gracenote data object, text or an external ID.
- **`FindWorks`**— A Work refers to the artistic creation and production of a Film, TV Series, or other form of video content. The same Work can be released on multiple Product formats across territories. For example, The Dark Knight Work can be released on a Blu-ray Product in multiple countries. A TV Series such as Lost is also a Work. Each individual episode comprising the Series is also a unique Work. Although the majority of Works are commercially released as a Product, not all Works have a Product counterpart. For example, a TV episode which airs on TV, but is not released on DVD or Blu-ray is considered a Work to which no Product exists. You can use `FindWorks` to search for Works using a TOC, a Gracenote data object, text or an External ID.
- **`FindSeasons`**—A Season is an ordered collection of Works, typically representing a season of a TV series. For example: CSI: Miami (Season One), CSI: Miami (Season Two), CSI: Miami (Season Three). You can use `FindSeasons` to search for Seasons using a Gracenote data object or an

External ID. This query requires Video Explore licensing.

- **`FindSeries`**— A Series is a collection of related Works, typically in sequence, and often comprised of Seasons (generally for a TV series), for example: CSI: Miami, CSI: Vegas, CSI: Crime Scene Investigation. You can use `FindSeries` to search for Series using a Gracenote data object, search text, or an External ID. This query requires Video Explore licensing.
- **`FindContributors`**—A Contributor refers to any person who plays a role in a Work. Actors, Directors, Producers, Narrators, and Crew are all considered Contributors. Popular recurring Characters such as Batman, Harry Potter, or Spider-man are also considered Contributors. You can use `FindContributors` to search for Contributors using a Gracenote data object, search text, or an External ID. This query requires Video Explore licensing.
- **`FindObjects`**—Performs a Video Explore query for any type of video object. Use this function to retrieve a specific Video Explore object that a Gracenote data object references or to retrieve all the Video Explore objects (Contributors, Products, Seasons, Series, and Works) associated with a particular external ID. This query is useful when you are unsure of all the potential object types that exist for a particular Gracenote data object or External ID. This query requires Video Explore licensing.
- **`FindSuggestions`**—Use this function to suggest potential matching titles, names, and series as a user enters text in a search query. You can search using a Gracenote data object or text. For a text search, you can set the type of search with a `GnVideoSearchType` enum and the type of field to search on (contributor name, character name, work franchise, work series, work title, product tile, series title, etc.) with a `GnVideoSearchField` enum.

  Your license determines what suggestion searches your app can perform:

  - To query for Product titles requires VideoID or Video Explore licensing
  - To query for everything else requires Video Explore licensing.

Setting Options for VideoID and Video Explore Queries

The `GnVideoOptions` class allows you to set the following options for VideoID and Video Explore queries:

- **`ResultPreferLanguage`**—Sets the preferred language for returned results, applies only to TOC lookups.
- **`ResultRangeStart`**—Queries can return multiple results. This option allows you to set the starting ordinal number for returned results; useful for paging through results.
- **`ResultCount`**—Queries can return multiple results. This options sets the maximum number of results that can be returned; useful for paging through results.
- **`LookupData`**—Indicates additional data to include in results - content (e.g., images), classical, sonic, playlisting attributes, global IDs, external IDs, additional credits, etc. See the `GnLookupData` enums for a complete list.
- **`QueryNoCache`**—Flag to indicate whether query results should come from cache or the Gracenote service. Results from the service may be more recent. If `false`, cache is searched first, if no match is found, then the Gracenote service is queried.

- **`QueryCommerceType`**—Specifies that a TOC lookup include the disc's commerce type.
- **`ResultFilter`**—Use a list value to filter Video Explore query results. Filters are ignored for non-text related queries. Filtering on list elements is restricted to Works queries and is limited to genre, production type, serial type and origin (see the **`GnVideoListElementFilterType`** enums for the most up-to-date list). You can also filter on a season number, an episode number, or a series episode number; see the **`GnVideoFilterType`** enums for a complete list.

Video Text Search Queries

As enumerated with **`GnVideoSearchType`** defines, there are two types of video search queries:

- **Normal**—Default search for contributor, product, and work title searches; for example, a search using a keyword of *dark*, *knight*, or *dark knight* retrieves the title *Dark Knight*. This search type recognizes only full words so, for example, entering only *dar* does not work.
- **Anchored**— Can be used for product title and suggestion searches. Retrieves results that begin with the same characters as exactly specified; for example, entering *dar*, *dark*, *dark k*, or *dark kni* retrieves the title *Dark Knight,* but entering *knight* will not. This search type recognizes both partial and full words.

The **`GnVideoSearchField`** enums specify fields where a text search should take place:

- Contributor names
- Character names
- Work franchise
- Work series
- Work titles
- Product titles
- Series titles
- Search all (not available for suggestion searches)

Setting a Locale for Video Operations

Using VideoID or Video Explore requires creating a `GnVideo` instance with a `GnUser` object. Optionally, you can additionally allocate it with a `GnLocale` object and that locale will be used for all `GnVideo` operations.

Video-ID Examples

C++ text search

```
LookupStatusEvents videoEvents;

GnVideo myVideoId(user, &videoEvents);

/* Set result range to return up to the first 20 results */
myVideoId.Options().ResultRangeStart(1);
myVideoId.Options().ResultCount(20);

GnResponseVideoProduct videoResponse = myVideoId.FindProducts( "Star", kSearchFieldProductTitle,
kSearchTypeDefault );
```

C++ seasons search using TUI/Tui Tag

```
gnsdk_cstr_t tuiID  = "238047322";
gnsdk_cstr_t tuiTag = "5C46058E04036C88490972A653C64A1D";

/*---------------------------
 * Get Simpson's First Season
 */
printf("\n*****Sample Video Seasons Search: '%s'*****\n", "Simpsons First Season");

GnVideo videoid(user);

/* Create Seasons object from TUI and TUI Tag */
GnVideoSeason seasonObject(tuiID, tuiTag);

printf("\nPerforming the search...\n");
GnResponseVideoSeasons videoSeasonsResponse = videoid.FindSeasons(seasonObject);

GnVideoSeason season = videoSeasonsResponse.Seasons().at(0).next();
```

C++ works search with filter

```
LookupStatusEvents searchEvents;

/* Create video query */
GnVideo myVideoID(user, &searchEvents);

printf("*****Sample Video Work Search: *****\n");

/* load video genre list from service ( online ) */
LookupStatusEvents listEvents;

GnList list(kListTypeGenreVideos,
            kLanguageEnglish,
            kRegionDefault,
            kDescriptorSimplified,
            user,
            &listEvents);

 /* Set filter - no comedies dammit! */
 GnListElement listElement = list.ElementByString("Comedy");

myVideoID.Options().ResultFilter(kListElementFilterGenre, listElement, false);

/* Perform the search */
GnResponseVideoWork videoWorksResponse = myVideoID.FindWorks(searchText,
kSearchFieldContributorName, kSearchTypeDefault);

printf("\nProduct Match Count:%d \n", videoWorksResponse.Works().count());
```

C++ suggestions search

```
gnsdk_cstr_t   suggestionTitle = GNSDK_NULL;
gnsdk_cstr_t   searchText      = "spider";


try
{
    GnVideo myVideoID(user);

    GnResponseVideoSuggestions responseVideoSuggestions = myVideoID.FindSuggestions( searchText,
kSearchFieldProductTitle, kSearchTypeAnchored );
    gnsdk_uint32_t   rangeStart  = responseVideoSuggestions.RangeStart();
    gnsdk_uint32_t   rangeEnd    = responseVideoSuggestions.RangeEnd();
    gnsdk_uint32_t   rangeCount  = responseVideoSuggestions.RangeTotal();
    gnsdk_uint32_t   resultCount = responseVideoSuggestions.RangeEnd();

    if (resultCount > 0)
    {
        std::cout << std::endl << rangeStart << " - " << rangeEnd << " of " << rangeCount << "
suggestions for \'" << searchText << "\' " << std::endl;
    }

    for (gnsdk_uint32_t i = 1; i <= resultCount; i++)
    {
        suggestionTitle = responseVideoSuggestions.SuggestionTitle(i);
        std::cout << "\t" << i << " : " << suggestionTitle << std::endl;
    }
}
```

Java suggestions search

```
private static void videoSearchSuggetion(GnUser user, String suggestion)
    throws GnException {
    int match = 0;
    int moreResults = 1;
    int pageStart = 1;
    int pageCount = 20;
    String searchTerm = null;
    System.out.println("\n*****Sample VideoID Suggestion Lookup*****\n");
    while (1 == moreResults) {
        moreResults = 0;
        GnVideo video = new GnVideo(user);

        /* Set the search options */
        video.options().resultRange( pageStart,  pageCount );

        /*
         * Set the input text and perform the search with no optional data
         * passed to callback function
         */
        GnResponseVideoSuggestions responseVideoSuggestions = video
            .findSuggestions(suggestion,
                    GnVideoSearchField.kSearchFieldProductTitle,
                    GnVideoSearchType.kSearchTypeAnchored);

        /* Handle the results. Retrieve number of search terms in result */
        long rangeStart = responseVideoSuggestions.rangeStart();
        long rangeEnd = responseVideoSuggestions.rangeEnd();
        long rangeCount = responseVideoSuggestions.rangeTotal();
        long count = responseVideoSuggestions.rangeTotal();

       /* Get search term */
        if (count > 0)
            System.out.println("\t" + rangeStart + " - " + rangeEnd
                + " of " + rangeCount + " suggestions for \'"
                + suggestion + "\'");

       /* Get search term */
        for (long i = 1; i <= count; i++) {
            searchTerm = responseVideoSuggestions.suggestionTitle(i);
            if (searchTerm != null)
```

```
                System.out.println("\t" + ++match + ": " + searchTerm);
        }
        if (rangeCount > rangeEnd) {
            moreResults = 1;
            pageStart += pageCount;
        }
     }
}
```

Java work contributors search

```
/* Find contributors for work */
private static void findContributor(GnUser user, GnDataObject pWorkHandle)
    throws GnException {
    int count = 0;
    GnVideo mVideoID = new GnVideo(user);
    GnResponseContributor contribResponse = mVideoID.findContributors(pWorkHandle);
    GnContributorIterable contrib = contribResponse.contributors();
    GnContributorIterator gnContributorIterator = contrib.getIterator();
    System.out.println("\nContributors:");

    /* Find all contributors */
    while (gnContributorIterator.hasNext()) {
        GnNameIterable gnNameIterable = gnContributorIterator.next().namesOfficial();
        GnNameIterator gnNameIterator = gnNameIterable.getIterator();
        while (gnNameIterator.hasNext()) {
            GnName contribName = gnNameIterator.next();
            System.out.println("\t" + ++count + " : "
            + contribName.display());
         }
     }
}
```

C# find works for contributor

```
/* Do a video works lookup */
private static void
    DoVideoWorkLookup(GnUser user)
    {
        string searchText = "Harrison Ford";
        int    count      = 0;
        /* Console.WriteLine("\n*****Sample Video Work Lookup:*****\n"); */

        /* Get Product based on TOC */
        using (LookupStatusEvents videoEvents = new LookupStatusEvents())
        {
            GnVideo video = new GnVideo(user, videoEvents);

                       /* Perform Search */
            GnResponseVideoWork gnResponseVideoWork = video.FindWorks(searchText,
            GnVideoSearchField.kSearchFieldContributorName,
            GnVideoSearchType.kSearchTypeDefault);

            GnVideoWorkEnumerable gnVideoWorkEnumerable = gnResponseVideoWork.Works;

            Console.WriteLine("\nAV Works for Harrison Ford:");

            foreach (GnVideoWork work in gnVideoWorkEnumerable)
            {
                /* Work title*/
                GnTitle workTitle = work.OfficialTitle;
                Console.WriteLine("\t" + ++count + ": " + workTitle.Display);
            }
        }
    }
```

Processing Returned Metadata Results

Processing returned metadata results is pretty straight-forward—objects returned can be traversed and accessed like any other objects. However, there are three things about returned results you need to be aware of:

1. **Needs decision**—A result could require an additional decision from an application or end user.
2. **Full or partial results**—A result object could contain full or partial metadata
3. **Locale-dependent data**—Some metadata requires that a locale be loaded.

Needs Decision

Top-level response classes—`GnResponseAlbums`, `GnResponseTracks`, `GnResponseContributors`, `GnResponseDataMatches`—contain a "needs decision" flag. In all cases, Gracenote returns high-confidence results based on the identification criteria; however, even high-confidence results could require additional decisions from an application or end user. For example, all multiple match responses require the application (or end user) make a decision about which match to use and process to retrieve its metadata. Therefore, the GNSDK flags every multiple match response as "needs decision".

A single match response can also need a decision. Though it may be a good candidate, Gracenote could determine that it is not quite perfect.

In summary, responses that require a decision are:

- Every multiple match response
- A single match response that Gracenote determines needs a decision from the application or end user, based on the quality of the match and/or the mechanism used to identify the match (such as text, TOC, fingerprints, and so on).

Example needs decision check (C++):

```
GnResponseAlbums response = music_id.FindAlbums(albObject);
needs_decision =response.NeedsDecision();
if(needs_decision)
{
    /* Get user selection. Note that is not an SDK method */
       user_pick = doMatchSelection(response);
}
```

Objective-C:

```
/* Perform the query */
GnResponseAlbums *response = [musicId findAlbumsWithGnDataObject:dataAlbum error:&error];

if ( [[response albums] allObjects].count != 0)
{
   needsDecision = [response needsDecision];
   /* See if selection of one of the albums needs to happen */
   if (needsDecision)
   {
      // Get User selection. Note that is not an SDK method
         choiceOrdinal = [self doMatchSelection:response];
   }
   // ...

}
```

Full and Partial Metadata Results

A query response can return 0-n matches. As indicated with a `fullResult` flag, a match can contain either full or partial metadata results. A partial result is a subset of the full metadata available, but enough to perform additional processing. One common use case is to present a subset of the partial results (e.g., album titles) to the end user to make a selection. Once a selection is made, you can then do a secondary query, using the partial object as a parameter, to get the full results (if desired).

Example followup query (C++):

```
/* Get first match */
GnAlbum album = response.Albums().at(0).next();
bool fullResult = album.IsFullResult();

/* If partial result, do a follow-up query to retrieve full result */
if (!fullResult)
{
    /* Do followup query to get full data - set partial album as query input. */
    GnResponseAlbums followup_response = music_id.FindAlbums(album);

    /* Now our first album has full data */
    album = followup_response.Albums().at(0).next();
}
```

Objective-C:

```
GnAlbum *album = [[[response albums] allObjects] objectAtIndex:choiceOrdinal];

BOOL fullResult = [album isFullResult];

/* if we only have a partial result, we do a follow-up query to retrieve the full album */
if (!fullResult)
{
   /* do followup query to get full object. Setting the partial album as the query input. */
   GnResponseAlbums *followupResponse = [musicId findAlbumsWithGnDataObject:dataAlbum error:&error];

   /* now our first album is the desired result with full data */
   album = [[followupResponse albums] nextObject];

   // ...

}
```

Note that, in many cases, the data contained in a partial result is more than enough for most users and applications. For a list of values returned in a partial result, see the Data Model in the GNSDK API Reference.

Locale-Dependent Data

GNSDK provides locales as a convenient way to group locale-dependent metadata specific to a region (such as Europe) and language that should be returned from the Gracenote service. A locale is defined by a group (such as Music), a language, a region and a descriptor (indicating level of metadata detail), which are identifiers to a specific set of lists in the Gracenote Service.

There are a number of metadata fields that require having a locale loaded. For more information, see "Loading a Locale".

Accessing Enriched Content

To access enriched metadata content, such as cover art and artist images, you can purchase additional metadata entitlements and use the content URLs returned from queries in your application. Enriched content URLs can be returned in every result object (`GnAlbum`, `GnTrack`, etc).

To access enriched content:

- Purchase additional entitlements for enriched content
- Enable the query option for retrieving enriched content
- For each match object returned, iterate through its `GnContent` objects
- For each `GnContent` object, iterate through its `GnAsset` objects
- For each `GnAsset` object, get its content URL and use that for accessing the Gracenote service

Setting the Query Option for Enriched Content

To get enriched content returned from your queries, you need to enable the query option for this. You can do this using the `LookupData` method and the `kLookupDataContent` enum.

C++ example:

```
/* Enable retrieval of enriched content */
musicid.Options().LookupData(kLookupDataContent, true);
```

Objective-C example:

```
GnMusicIdStreamOptions *options = [self.gnMusicIDStream options];
[options lookupData:kLookupDataContent enable:YES error:&musicIDStreamError];
```

Processing Enriched Content

Enriched content is returned in `GnContent` objects. As indicated with these `GnContentType` enums, the following types of content can be returned:

- **`kContentTypeImageCover`**—Cover art
- **`kContentTypeImageArtist`**—Artist image

- **`kContentTypeImageVideo`**—Video image
- **`kContentTypeBiography`**—Artist biography
- **`kContentTypeReview`**—Review

Each `GnContent` object can contain one or more elements of that type as represented with a `GnAsset` object.

Note that not all enriched content can be retrieved from every metadata object. Different objects have different types of enriched content available. The following object methods are available for accessing content:

- `GnContent GnTrack::Review() const;`
- `GnContent GnAlbum::CoverArt() const;`
- `GnContent GnAlbum::Review() const;`
- `GnContent GnContributor::Image() const;`
- `GnContent GnContributor::Biography() const;`
- `gnsdk_cstr_t GnContributor::BiographyVideo() const;`—For video only

Each `GnAsset` object contains the following fields:

- **`Dimension`**—Asset dimension
- **`Bytes`**—Size of content asset in bytes
- **`Size`**—Pixel image size as defined with a `GnImageSize` enum, e.g., `kImageSize110` (110x110)
- **`Url`**—URL for retrieval of asset from Gracenote service.

Retrieving and parsing enriched content code samples:

Android Java code sample

```
         /**
          * Helpers to load and set cover art image in the application display
          */
        private void loadAndDisplayCoverArt( GnAlbum album, ImageView imageView ){
                Thread runThread = new Thread( new CoverArtLoaderRunnable( album, imageView ) );
                runThread.start();
        }
        class CoverArtLoaderRunnable implements Runnable {
                GnAlbum         album;
                ImageView       imageView;
                CoverArtLoaderRunnable( GnAlbum album, ImageView imageView){
                        this.album = album;
                        this.imageView = imageView;
                }
                @Override
                public void run() {
                        String coverArtUrl = album.content(GnContentType.
                                             kContentTypeImageCover).
                                             asset(GnImageSize.
                                             kImageSizeSmall).url();
                        Drawable coverArt = null;
                        if (coverArtUrl != null && !coverArtUrl.isEmpty()) {
                            URL url;
                            try {
                                url = new URL("http://" +
                                                coverArtUrl);
                                InputStream input = new
                                BufferedInputStream(url.openStream());
                              coverArt =
                                Drawable.createFromStream(input, "src");
                              } catch (Exception e) {
                                    e.printStackTrace();
                              }
                      }
                      if (coverArt != null) {
                              setCoverArt(coverArt, imageView);
                      } else {
                              setCoverArt(getResources().getDrawable(R.drawable.no_cover_art),imageView);
                      }
              }
      }
      private void setCoverArt( Drawable coverArt, ImageView coverArtImage ){
              activity.runOnUiThread(new SetCoverArtRunnable(coverArt, coverArtImage));
      }
      class SetCoverArtRunnable implements Runnable {
              Drawable coverArt;
              ImageView coverArtImage;
              SetCoverArtRunnable( Drawable locCoverArt, ImageView locCoverArtImage) {
                      coverArt = locCoverArt;
                      coverArtImage = locCoverArtImage;
              }
              @Override
              public void run() {
                      coverArtImage.setImageDrawable(coverArt);
              }
      }
```

Objective-C code sample

```
for(GnAlbum* album in albums)
{
   /* Get CoverArt */
   GnContent *coverArtContent = [album content:kContentTypeImageCover];
   GnAsset *coverArtAsset = [coverArtContent asset:kImageSizeSmall];
   NSString *URLString = [NSString stringWithFormat:@"http://%@", [coverArtAsset url]];
   GnContent *artistImageContent = nil;//[album content:kContentTypeImageArtist];
   GnAsset *artistImageAsset = [artistImageContent asset:kImageSizeSmall];
   NSString *artistImageURLString = [NSString stringWithFormat:@"http://%@", [artistImageAsset
url]];
   GnContent *artistBiographyContent = [album content:kContentTypeBiography];
   NSString *artistBiographyURLString = [NSString stringWithFormat:@"http://%@",
[[[artistBiographyContent assets] nextObject] url]];
   GnContent *albumReviewContent = [album content:kContentTypeReview];
   NSString *albumReviewURLString = [NSString stringWithFormat:@"http://%@", [[[albumReviewContent
assets] nextObject] url]];
}
```

Windows Phone C# code sample

```
public RespAlbum(gnsdk_cppcx.GnAlbum gnAlbum, bool bTakeMachedTrack)
{
   this.Title = gnAlbum.Title.Display;
   if (false == bTakeMachedTrack)
   {
      if(0 != gnAlbum.Tracks.Count())
         this.TrackTitle = gnAlbum.Tracks.ElementAt(0).Title.Display;
      else
         this.TrackTitle = "";
   }
   else
   {
      if(0 != gnAlbum.TracksMatched.Count())
         this.TrackTitle = gnAlbum.TracksMatched.ElementAt(0).Title.Display;
      else
         this.TrackTitle = "";
   }
   this.ArtistName = gnAlbum.Artist.Name.Display;
   this.Genre = gnAlbum.Genre(gnsdk_cppcx.GnDataLevel.kDataLevel_1);
   this.ImageUrl = "http://" + gnAlbum.Content(gnsdk_
cppcx.GnContentType.kContentTypeImageCover).Asset(gnsdk_cppcx.GnImageSize.kImageSizeSmall).Url;
   if ("http://" == ImageUrl)
   {
      this.ImageUrl =  "/Assets/emptyImage.png";
   }
}
```

C++ code sample

```
static void
displayContentUrls(GnAlbum& album)
{
       /* content urls for album */
       content_iterator itr = album.Contents().begin();
       for (; itr != album.Contents().end(); ++itr)
       {
               GnContent content = *itr;
               switch (content.ContentType())
               {
               case kContentTypeImageCover:
                       std::cout << "cover art: " << std::endl;
                       break;
               case kContentTypeImageArtist:
                       std::cout << "artist image: " << std::endl;
                       break;
               case kContentTypeImageVideo:
                       std::cout << "video image: " << std::endl;
                       break;
               case kContentTypeBiography:
                       std::cout << "biography: " << std::endl;
                       break;
               case kContentTypeReview:
                       std::cout << "review: " << std::endl;
                       break;
               default:
                       break;
               }
               asset_iterator aItr = content.Assets().begin();
               for (; aItr != content.Assets().end(); ++aItr)
               {
                       GnAsset asset = *aItr;
                       switch (content.ContentType())
                       {
                       case kContentTypeImageCover:
                       case kContentTypeImageArtist:
                       case kContentTypeImageVideo:
                               switch (asset.Size())
                               {
                               default:
                                       break;
```

```
                                }
                        }
                        std::cout << "\turl: " << asset.Url() << std::endl;
                        std::cout << std::endl;
                }
        }
}
```

C# code sample

```
Under construction
```

Java code sample

```
Under construction
```

Discovery Features

Generating a Playlist

You can easily integrate the Playlist SDK into your media management application. Note that your application should already have identifiers for all its media and its own metadata database. The Playlist module allows your application to create Playlists—sets of related media—from larger collections. ***Collection Summaries***, that you create, are the basis for generating playlists. Collection Summaries contain attribute data about a given set of media. For Playlist operations—create, populate, store, delete, etc.—use the `GnPlaylistCollection` class.

To generate a Playlist:

1. Create a Collection Summary
2. Populate the Collection Summary with media objects, most likely returned from Gracenote queries
3. (Optional) Store the Collection Summary
4. (Optional) Load the stored Collection Summary into memory in preparation for Playlist results generation
5. Generate a Playlist from a Collection Summary using either the More Like This functionality or with a Playlist Description Language (PDL) statement (see the Playlist PDL Specification).
6. Access and display Playlist results.

Creating a Collection Summary

To create a Collection Summary, your application needs to instantiate a `GnPlaylistCollection` object:

C++

```
playlist::GnPlaylistCollection myCollection;
myCollection= playlist::GnPlaylistCollection("MyCollection");
```

C#

```
GnPlaylistCollection playlistCollection;
playlistCollection = GnPlaylist.CollectionCreate("sample_collection");
```

Java

```
GnPlaylistCollection myCollection = new GnPlaylistCollection();
```

This call creates a new, empty Collection Summary. The next step is to populate it with media items that you can use to generate Playlists.

Note: Each new Collection Summary that you create must have a unique name. Although it is possible to create more than one Collection Summary with the same name, if these Collection Summaries are then saved to local storage, one Collection will override the other. To avoid this, ensure that Collection Summary names are unique.

Populating a Collection Summary

To build a Collection Summary, your application needs to provide data for each media item you want it to contain. To add an item, and provide data, use the `GnPlaylistCollection.Add` method. This API takes a media identifier (any application-determined unique string) and an album, track or contributor match object. The match object should come from a recognition event using MusicID, MusicID-File or other GNSDK module.

C++

```
/* Create a unique identifier for every track that is added to the playlist.
   Ideally the ident allows for the identification of which track it is.
   e.g. path/filename.ext , or an id that can be externally looked up.
*/
ss.str("");
ss << index << "_" << ntrack;

/*
    Add the the Album and Track GDO for the same ident so that we can
    query the Playlist Collection with both track and album level attributes.
*/
std::string result = ss.str();
collection.Add(result.c_str(), album);     /* Add the album*/
collection.Add(result.c_str(), *itr);      /* Add the track*/
```

C#

```
/* Create a unique identifier for every track that is added to the playlist.
   Ideally, the identifier allows for the identification of which track it is.
   e.g. path/filename.ext , or an id that can be externally looked up.
*/
string uniqueIdent = countOrdinal + "_" + trackOrdinal;playlistCollection.Add(uniqueIdent, album);

/*
   Add the the Album and Track GDO for the same identifier so we can
   query the Playlist Collection with both track and album level attributes.
*/
playlistCollection.Add(uniqueIdent, album);
playlistCollection.Add(uniqueIdent, track);
```

Java

```
String uniqueIdent = "";
uniqueIdent = String.valueOf(index).concat("_").concat(String.valueOf(ntrack));

/*
 * Add the the Album and Track GDO for the same identifier so we can
 * query the Playlist Collection with both track and album level attributes.
 */
```

```
gnPlaylistCollection.add(uniqueIdent, gnAlbum);
gnPlaylistCollection.add(uniqueIdent, gnTrack);
```

Retrieving Playlist Attributes in Queries

When creating a MusicID or MusicID-File query to populate a playlist, you must set the following query options to ensure that the appropriate Playlist attributes are returned (depending on the type of query):

- `GnLookupData.kLookupDataSonicData`
- `GnLookupData.kLookupDataPlaylist`

C++

```
musicId.Options().LookupData(kLookupDataSonicData, true);
musicId.Options().LookupData(kLookupDataPlaylist, true);
```

How Playlist Gathers Data

When given an album match object, Playlist extracts necessary album data, traverses to the matched track, and extracts necessary track data. Playlist stores this data for the given identifier. If the album object does not contain the matched track , no track data is collected. Playlist also gathers data from both the album and track contributors as detailed below.

When given a track match object, Playlist gathers any necessary data from the track, but it is not able to gather any album-related data (such as album title). Playlist also gathers data from the track contributors as detailed below.

When given a contributor match object (or traversing into one from an album or track), Playlist gathers the necessary data from the contributor. If the contributor is a collaboration, data from both child contributors is gathered as well.

Working with Local Storage

You can store and manage Collection Summaries in local storage with the `GnPlaylistStorage`'s `Store` method, which takes a `GnPlaylistCollection` object. **Prior to doing this, your application should enable a storage solution such as SQLite.**

C++

```
/* Instantiate SQLite module to use as our database engine*/
GnStorageSqlite storageSqlite;

/* This module defaults to use the current folder when initialized,
** but we set it manually here to demonstrate the option.
 */
storageSqlite.Options().StorageLocation(".");

/* Initialize Storage for storing Playlist Collections */
playlist::GnPlaylistStorage plStorage;
plStorage.Store(myCollection);
```

C#

```
/* Initialize Storage for storing Playlist Collections */
playlist::GnPlaylistStorage plStorage;
```

```
gnStorage.StorageFolder = "../../../sample_db";
playlist.StoreCollection(playlistCollection);
```

Java

```
// Initialize Storage for storing Playlist Collections
GnStorageSqlite storage = new GnStorageSqlite();
GnPlaylistStorage plStorage = GnPlaylist.collectionStorage();
plStorage.store(myCollection);
```

Other `GnPlaylistStorage` methods include ones for:

- Setting a storage location specifically for playlist collections
- Removing a collection from storage
- Loading a collection from storage
- Getting the number of collections stored
- Compacting storage

Generating a Playlist Using More Like This

To streamline your Playlist implementation, you can use the `GnPlaylistCollection`'s `GenerateMoreLikeThis` method, which uses the "More Like This" algorithm to obtain results, eliminating the need to use Playlist Definition Language (PDL) statements.

You can use the `GnPlaylistMoreLikeThisOptions` class to set the following options when generating a More Like This Playlist. Please note that these options are not serialized or stored.

Option Method	Description
`MaxTracks`	Maximum number of tracks returned in a 'More Like This' playlist. Must evaluate to a number greater than 0.
`MaxPerArtist`	Maximum number of tracks per artist returned in a 'More Like This' playlist. Must evaluate to a number greater than 0.
`MaxPerAlbum`	Maximum number of results per album returned. Must evaluate to a number greater than 0.
`RandomSeed`	Randomization seed value used in calculating a More Like This playlist. Must evaluate to a number greater than 0. To re-create a playlist, use the same number - different numbers create different playlists. If "0", using a random seed is disabled.

C++

```
/* Change the possible result set to be a maximum of 30 tracks. */
collection.MoreLikeThisOptions().MaxTracks(30);

/* Change the max per artist to be 20 */
collection.MoreLikeThisOptions().MaxPerArtist(20);

/* Change the max per album to be 5 */
collection.MoreLikeThisOptions().MaxPerAlbum(5);
```

To generate a More Like This playlist, call the `GnPlaylistCollection`'s `GenerateMoreLikeThis` method with a user object handle and a Gracenote data object, such as the object of the track that is currently playing.

C++

```
/* Generating more like this Playlist */
/* Create seed data to generate more like this playlist*/
/*
 * A seed gdo can be any recognized media gdo.
 * In this example, we are using a gdo from a track in the playlist collection summary,
 * randomly selecting the 5th element
 */
playlist::GnPlaylistIdentifier ident      = collection.MediaIdentifiers().at(4).next();
playlist::GnPlaylistMetadata   seed_album = collection.Metadata(user, ident);
playlist::GnPlaylistResult resultMoreLikeThis = collection.GenerateMoreLikeThis(user, seed_album,
topColl));
```

C#

```
/*
 * A seed gdo can be any recognized media gdo.
 * In this example we are using the a gdo from a random track in the playlist collection summary
 */
GnPlaylistIdentifier identifier = playlistCollection.MediaIdentifiers.at(3).Current;
GnPlaylistMetadata data = playlistCollection.Metadata(user, identifier);
playlistCollection.MoreLikeThisOptionSet
(GnPlaylistCollection.GenerateMoreLikeThisOption.kMoreLikeThisMaxPerAlbum, 5);
GnPlaylistResult playlistResult = playlistCollection.GenerateMoreLikeThis(user, data);
```

Java

```
GnPlaylistMetadata getSeedData( GnUser gnUser, GnPlaylistCollection collection ) throws GnException
{
   // Create seed data to generate more like this playlist
   // A seed gdo can be any recognized media gdo.
   // In this example we are using the a gdo from a track in the playlist collection summary
   // In this case , randomly selecting the 5th element
   GnPlaylistIdentifier ident      = collection.mediaIdentifiers().at(4).next();
   GnPlaylistMetadata   seedAlbum  = collection.metadata( gnUser, ident );
   return seedAlbum;
}

//...

// Set options
collection.options().moreLikeThis( GnPlaylistMoreLikeThisOption.kMoreLikeThisMaxTracks, 30 );
collection.options().moreLikeThis( GnPlaylistMoreLikeThisOption.kMoreLikeThisMaxPerArtist, 10 );
collection.options().moreLikeThis( GnPlaylistMoreLikeThisOption.kMoreLikeThisMaxPerAlbum, 5 );

GnPlaylistResult resultCustomMoreLikeThis = collection.generateMoreLikeThis( gnUser, getSeedData(
gnUser, collection ) );
```

Generating a Playlist Using PDL (Playlist Description Language)

The GNSDK Playlist Definition Language (PDL) is a query syntax, similar to Structured Query Language (SQL), that enables flexible custom playlist generation using human-readable text strings. PDL allows developers to dynamically create custom playlists. By storing individual PDL statements, applications can create and manage multiple preset and user playlists for later use.

PDL statements express the playlist definitions an application uses to determine what items are included in resulting playlists. PDL supports logic operators, operator precedence, and in-line arithmetic. PDL is based on Structured Query Language (SQL). This section assumes you understand SQL and can write SQL statements.

Note: Before using PDL statements, carefully consider if the provided More Like This functionality meets your design requirements. More Like This functionality eliminates the need to create and validate PDL statements.

To generate a playlist using PDL, you can use the `GnPlaylistCollections`'s `GeneratePlaylist` method which takes a PDL statement as a string and returns `GnPlaylistResult` objects.

To understand how to create a PDL statement, see the *Playlist PDL Specification* article.

Accessing Playlist Results

When you generate a Playlist from a Collection Summary, using either More Like This or executing a PDL statement, results are returned in a `GnPlaylistResult` object.

C++

```
/*-----------------------------------------------------------------------------
 *  display_playlist_results
 */
void display_playlist_results(GnUser& user, playlist::GnPlaylistCollection& collection,
playlist::GnPlaylistResult& result)
{
   /* Generated playlist count */
   int resultCount = result.Identifiers().count();

   printf("Generated Playlist: %d\n", resultCount);
   playlist::result_iterator itr = result.Identifiers().begin();

   for (; itr != result.Identifiers().end(); ++itr)
   {
      playlist::GnPlaylistMetadata data = collection.Metadata(user, *itr);

      printf("Ident '%s' from Collection '%s':\n"
             "\tGN_AlbumName  : %s\n"
             "\tGN_ArtistName : %s\n"
             "\tGN_Era        : %s\n"
             "\tGN_Genre      : %s\n"
             "\tGN_Origin     : %s\n"
             "\tGN_Mood       : %s\n"
             "\tGN_Tempo      : %s\n",
             (*itr).MediaIdentifier(),
             (*itr).CollectionName(),
              data.AlbumName(),
              data.ArtistName(),
              data.Era(),
              data.Genre(),
              data.Origin(),
              data.Mood(),
              data.Tempo()
       );
   }
}
```

C#

```
private static void
EnumeratePlaylistResults(GnUser user, GnPlaylistCollection playlistCollection, GnPlaylistResult
playlistResult)
{
    GnPlaylistMetadata gdoAttr = null;
    string ident = null;
    string collectionName = null;
    uint countOrdinal = 0;
    uint resultsCount = 0;
    GnPlaylistCollection tempCollection = null;

    resultsCount = playlistResult.Identifiers.count();

    Console.WriteLine("Generated Playlist: " + resultsCount);

    GnPlaylistResultIdentEnumerable playlistResultIdentEnumerable = playlistResult.Identifiers;
    foreach (GnPlaylistIdentifier playlistIdentifier in playlistResultIdentEnumerable)
    {
        collectionName = playlistIdentifier.CollectionName;
        ident = playlistIdentifier.MediaIdentifier;

        Console.Write("    " + ++countOrdinal + ": " + ident + " Collection Name:" +
collectionName);

        /* The following illustrates how to get a collection handle
           from the collection name string in the results enum function call.
           It ensures that Joined collections as well as non joined collections will work with
minimal overhead.
        */
        tempCollection = playlistCollection.JoinSearchByName(collectionName);

        gdoAttr = tempCollection.Metadata(user, playlistIdentifier);

        PlaylistGetAttributeValue(gdoAttr);

    }
}

private static void
PlaylistGetAttributeValue(GnPlaylistMetadata gdoAttr)
{
    /* Album name */
    if (gdoAttr.AlbumName != "")
        Console.WriteLine("\n\t\tGN_AlbumName:" + gdoAttr.AlbumName);

    /* Artist name */
    if (gdoAttr.ArtistName != "")
        Console.WriteLine("\t\tGN_ArtistName:" + gdoAttr.ArtistName);

    /* Artist Type */
    if (gdoAttr.ArtistType != "")
        Console.WriteLine("\t\tGN_ArtistType:" + gdoAttr.ArtistType);

    /*Artist Era */
    if (gdoAttr.Era != "")
        Console.WriteLine("\t\tGN_Era:" + gdoAttr.Era);

    /*Artist Origin */
    if (gdoAttr.Origin != "")
```

```
        Console.WriteLine("\t\tGN_Origin:" + gdoAttr.Origin);

    /* Mood */
    if (gdoAttr.Mood != "")
        Console.WriteLine("\t\tGN_Mood:" + gdoAttr.Mood);

    /*Tempo*/
    if (gdoAttr.Tempo != "")
        Console.WriteLine("\t\tGN_Tempo:" + gdoAttr.Tempo);
}
```

Java

```
private static void enumeratePlaylistResults(
    GnUser user,
    GnPlaylistCollection playlistCollection,
    GnPlaylistResult playlistResult
) throws GnException {
    int countOrdinal = 0;
    GnPlaylistMetadata data = null;
    GnPlaylistCollection tempCollection = null;
    String collectionName = null;
    System.out.println("Generated Playlist: " + playlistResult.identifiers().count());

    GnPlaylistResultIdentIterator gnPlaylistResultIdentIterator = playlistResult.identifiers().begin
();

    /* Iterate through results */
       while (gnPlaylistResultIdentIterator.hasNext()) {
        GnPlaylistIdentifier playlistIdentifier = gnPlaylistResultIdentIterator.next();

        collectionName = playlistIdentifier.collectionName();

        System.out.println("    "+ ++countOrdinal +": "+playlistIdentifier.mediaIdentifier()+
                                " Collection Name:"+playlistIdentifier.collectionName());

        /* The following illustrates how to get a collection handle
           from the collection name string in the results enum function call.
           It ensures that Joined collections as well as non joined collections will work with
minimal overhead.
        */
        tempCollection = playlistCollection.joinSearchByName(collectionName);

        data = tempCollection.metadata(user, playlistIdentifier);

        playlistGetAttributeValue(data);
    }
}

private static void playlistGetAttributeValue(GnPlaylistMetadata data) {

    /* Album name */
    if (data.albumName() != "" && data.albumName() != null)
        System.out.println("\t\tGN_AlbumName:" + data.albumName());

    /* Artist name */
    if (data.artistName() != "" && data.artistName() != null)
        System.out.println("\t\tGN_ArtistName:" + data.artistName());

    /* Artist Type */
    if (data.artistType() != "" && data.artistType() != null)
```

```
        System.out.println("\t\tGN_ArtistType:" + data.artistType());

    /*Artist Era */
    if (data.era() != "" && data.era() != null)
        System.out.println("\t\tGN_Era:" + data.era());

    /*Artist Origin */
    if (data.origin() != "" && data.origin() != null)
        System.out.println("\t\tGN_Origin:" + data.origin());

    /* Mood */
    if (data.mood() != "" && data.mood() != null)
        System.out.println("\t\tGN_Mood:" + data.mood());

    /*Tempo*/
    if (data.tempo() != "" && data.tempo() != null)
        System.out.println("\t\tGN_Tempo:" + data.tempo());
}
```

Working with Multiple Collection Summaries

Creating a playlist across multiple collections can be accomplished by using joins. Joins allow you to combine multiple collection summaries at run-time, so that they can be treated as one collection by the playlist generation functions. Joined collections can be used to generate More Like This and PDL-based playlists.

For example, if your application has created a playlist based on one device (collection 1), and another device is plugged into the system (collection 2), you might want to create a playlist based on both of these collections. This can be accomplished using one of the `GnPlaylistCollection` join methods.

Joins are run-time constructs for playlist generation that support seamless identifier enumeration across all contained collections. They do not directly support the addition or removal of data objects, synchronization, or serialization across all collections in a join. To perform any of these operations, you can use the join management functions to access the individual collections and operate on them separately.

To remove a collection from a join, call the `GnPlaylistCollection`'s `JoinRemove` method.

Join Performance and Best Practices

Creating a join is very efficient and has minimal CPU and memory requirements. When collections are joined, GNSDK internally sets references between them, rather than recreating them. Creating, deleting, and recreating joined collections when needed can be an effective and high-performing way to manage collections.

The original handles for the individual collections remain functional, and you can continue to operate on them in tandem with the joined collection, if needed. If you release an original handle for a collection that has been entered into a joined collection, the joined collections will continue to be functional as long as the collection handle representing the join remains valid.

A good practice for managing the joining of collections is to create a new collection handle that represents the join, and then join all existing collections into this handle. This helps remove ambiguity as to which original collection is the parent collection representing the join.

Synchronizing Collection Summaries

Collection summaries must be refreshed whenever items in the user's media collection are modified. For example, if you've created a collection summary based on the media on a particular device, and the media on that device changes, your application must synchronize the Collection Summary.

1. Adding all existing (current and new) unique identifiers, using the `GnPlaylistCollection`'s `SyncProcessAdd` method.
2. Calling the `GnPlaylistCollection`'s `SyncProcessExecute` method to process the current and new identifiers and using the callback function to add or remove identifiers to or from the Collection Summary.

Iterating the Physical Media

The first step in synchronizing is to iterate through the physical media, calling the `GnPlaylistCollection`'s `SyncProcessAdd` method for each media item. For each media item, pass the unique identifier associated with the item to the method. The unique identifiers used must match the identifiers that were used to create the Collection Summary initially.

Processing the Collection

After preparing a Collection Summary for synchronization using the `GnPlaylistCollection`'s `SyncProcessAdd` method, call the `GnPlaylistCollection`'s `SyncProcessExecute` method to synchronize the Collection Summary's data. During processing, the callback function will be called for each difference between the physical media and the collection summary. This means the callback function will be called once for each new media item, and once for each media item that has been deleted from the collection. The callback function should add new and delete old identifiers from the Collection Summary.

Playlist PDL Specification

The GNSDK for Desktop Playlist Definition Language (PDL) is a query syntax, similar to Structured Query Language (SQL), that enables flexible custom playlist generation using human-readable text strings. PDL allows developers to dynamically create custom playlists. By storing individual PDL statements, applications can create and manage multiple preset and user playlists for later use.

PDL statements express the playlist definitions an application uses to determine what items are included in resulting playlists. PDL supports logic operators, operator precedence and in-line arithmetic. PDL is based on Search Query Language (SQL). This section assumes you understand SQL and can write SQL statements.

> ⚠ **NOTE:** Before implementing PDL statement functionality for your application, carefully consider if the provided More Like This function, gnsdk_playlist_generate_morelikethis( ) meets your design requirements. Using the More Like This function eliminates the need to create and validate PDL statements.

PDL Syntax

This topic discusses PDL keywords, operators, literals, attributes, and functions.

Note: Not all keywords support all operators. Use gnsdk_playlist_statement_validate() to check a PDL Statement, which generates an error for invalid operator usage.

Keywords

PDL supports these keywords:

Keyword	Description	Required or Optional	PDL Statement Order
GENERATE PLAYLIST	All PDL statements must begin with either GENERATE PLAYLIST or its abbreviation, GENPL	Required	1
WHERE	Specifies the attributes and threshold criteria used to generate the playlist. If a PDL statement does not include the WHERE keyword, Playlist operates on the entire collection.	Optional	2
ORDER	Specifies the criteria used to order the results' display. If a PDL statement does not include the ORDER keyword, Playlist returns results in random order. Example: Display results in based on a calculated similarity value; tracks having greater similarity values to input criteria display higher in the results. The expression format is: <identifier> <operator> <identifier>	Optional	3
LIMIT	Specifies criteria used to restrict the number of returned results. Also uses the keywords RESULT and PER. Example: Limiting the number of tracks displayed in a playlist to 30 results with a maximum of two tracks per artist. The expression format is: <identifier> <operator> <identifier>	Optional	4

Keyword	Description	Required or Optional	PDL Statement Order
SEED	Specifies input data criteria from one or more idents. Typically, a Seed is the This in a More Like This playlist request. Example: Using a Seed of Norah Jones' track Don't Know Why to generate a playlist of female artists of a similar genre. The expression format is: <identifier> <operator> <identifier>	Optional	NA

Example: Keyword Syntax

This PDL statement example shows the syntax for each keyword. In addition to <att_imp>, <expr>, and <score> discussed above, this example shows:

- <math_op> is one of the valid PDL mathematical operators.
- <number> is positive value.
- <attr_name> is a valid attribute, either a Gracenote-delivered attribute or an implementation-specific attribute.

```
GENERATE PLAYLIST
 WHERE <att_imp> [<math_op> <score>][ AND|OR <att_imp>]
ORDER <expr>[ <math_op> <expr>]
 LIMIT [number RESULT | PER <attr_name>][,number [ RESULT | PER <attr_name>]]
```

Operators

PDL supports these operators:

Operator Type	Available Operators
Comparison	>, >=, <, <=, ==, !=, LIKE LIKE is for fuzzy matching, best used with strings; see PDL Examples
Logical	AND, OR
Mathematical	+, -, *, /

Literals

PDL supports the use of single (') and double (") quotes, as shown:

- Single quotes: 'value one'
- Double quotes: "value two"

- Single quotes surrounded by double quotes: "'value three'"

You must enclose a literal in quotes or Playlist evaluates it as an attribute.

Attributes

Most attributes require a Gracenote-defined numeric identifier value or GDO Seed.

- Identifier: Gracenote-defined numeric identifier value is typically a 5-digit value; for example, the genre identifier 24045 for Rock. These identifiers are maintained in lists in Gracenote Service; download the lists using GNSDK for Desktop Manager's Lists and List Types APIs
- GDO Seed: Use GNSDK Manager's GDO APIs to access XML strings for Seed input.

The following table shows the supported system attributes and their respective required input. The first four attributes are the GOET attributes.

The delivered attributes have the prefix GN_ to denote they are Gracenote standard attributes. You can extend the attribute functionality in your application by implementing custom attributes; however, do not use the prefix GN_.

Name	Attribute	Required Input
Genre Origin Era Artist Type Mood Tempo	GN_Genre GN_Origin GN_Era GN_ArtistType GN_Mood GN_Tempo	Gracenote-defined numeric identifier value GDO Seed XML string
Artist Name Album Name	GN_ArtistName GN_AlbumName	Text string

Functions

PDL supports these functions:

- RAND(max value)
- RAND(max value, seed)

PDL Statements

This topic discusses PDL statements and their components.

Attribute Implementation <att_imp>

A PDL statement is comprised of one or more attribute implementations that contain attributes, operators, and literals. The general statement format is:

"GENERATE PLAYLIST WHERE <attribute> <operator> <criteria>"

You can write attribute implementations in any order, as shown:

GN_ArtistName == "ACDC"

or

"ACDC" == GN_ArtistName

WHERE and ORDER statements can evaluate to a score; for example:

"GENERATE PLAYLIST WHERE LIKE SEED > 500"

WHERE statements that evaluate to a non-zero score determine what idents are in the playlist results. ORDER statements that evaluate to a non-zero score determine how idents display in the playlist results.

Expression <expr>

An expression performs a mathematical operation on the score evaluated from a attribute implementation.

[<number> <math_op>] <att_imp>

For example:

3 * (GN_Era LIKE SEED)

Score <score>

Scores can range between -1000 and 1000.

For boolean evaluation, True equals 1000 and False equals 0.

Note: For more complex statement scoring, concatenate attribute implementations and add weights to a PDL statement.

Example: PDL Statements

The following PDL example generates results that have a genre similar to and on the same level as the seed input. For example, if the Seed genre is a Level 2: Classic R&B/Soul, the matching results will include similar Level 2 genres, such as Neo-Soul.

```
"GENERATE PLAYLIST WHERE GN_Genre LIKE SEED"
```

This PDL example generates results that span a 20-year period. Matching results will have an era value from the years 1980 to 2000.

```
"GENERATE PLAYLIST WHERE GN_Era >= 1980 AND GN_Era < 2000"
```

This PDL example performs fuzzy matching with Playlist, by using the term LIKE and enclosing a string value in single (') or double (") quotes (or both, if needed). It generates results where the artist name may be a variation of the term ACDC, such as:

- ACDC
- AC/DC
- AC*DC

```
"GENERATE PLAYLIST WHERE (GN_ArtistName LIKE 'ACDC')"
```

The following PDL example generates results where:

- The tempo value must be less than 120 BPM.
- The ordering displays in descending order value, from greatest to least (119, 118, 117, and so on).
- The genre is similar to the Seed input.

```
"GENERATE PLAYLIST WHERE GN_Tempo > 120 ORDER GN_Genre LIKE SEED"
```

Implementing Moodgrid

The MoodGrid library allows applications to generate playlists and user interfaces based on Gracenote Mood descriptors. MoodGrid provides Mood descriptors to the application in a two-dimensional grid that represents varying degrees of moods across each axis. One axis represents energy (calm to energetic) and the other axis represents valence (dark to positive). When the user selects a mood from the grid, the application can provide a playlist of music that corresponds to the selected mood. Additional filtering support is provided for genre, origin, and era music attributes.

For more information on Moodgrid, see the *Moodgrid Overview*

The Moodgrid APIs:

- Encapsulate Gracenote's Mood Editorial Content (mood layout and ids).
- Simplify access to MoodGrid results through x,y coordinates.
- Allow for multiple local and online data sources through MoodGrid Providers.
- Enable pre-filtering of results using genre, origin, and era attributes.
- Support 5x5 or 10x10 MoodGrids.
- Provide the ability to go from a cell of a 5x5 MoodGrid to any of its expanded four Moods in a 10x10 grid.

Implementing MoodGrid in an application involves the following steps:

1. Allocating a `GnMoodgrid` class.
2. Enumerating the data sources using MoodGrid Providers
3. Creating and populating a MoodGrid Presentation
4. Filtering the results, if needed

Prerequisites

Using the MoodGrid APIs requires the following modules:

- GNSDK Manager
- SQLite (for local caching)
- MusicID
- Playlist
- MoodGrid

If you are using MusicID to recognize music, you must enable Playlist and DSP data in your query. You must be entitled to use Playlist—if you are not, you will not get an error, but MoodGrid will return no results. Please contact your Gracenote Global Service & Support representative for more information.

Enumerating Data Sources using MoodGrid Providers

GNSDK automatically registers all local and online data sources available to MoodGrid. For example, if you create a playlist collection using the Playlist API, GNSDK automatically registers that playlist as a data source available to MoodGrid. These data sources are referred to as *Providers*. MoodGrid is designed to work with multiple providers. You can iterate through the list of available Providers using the `GnMoodgrid` class' providers method. For example, the following call returns a handle to the first Provider on the list (at index 0):

C++ code sample

```
moodgrid::GnMoodgrid myMoodgrid;
moodgrid::GnMoodgridProvider myProvider = *(myMoodgrid.Providers().at(0));
```

C# code sample

```
GnMoodgrid moodgrid = new GnMoodgrid();
GnMoodgridProvider provider = moodgrid.Providers.at(0).next();
```

Java code sample

```
GnMoodgrid myMoodGrid = new GnMoodgrid();
GnMoodgridProvider myProvider = myMoodGrid.providers().at(0).next();
```

You can use the `GnMoodGridProvider` object to retrieve the following information

- Name
- Type
- Requires network

Creating and Populating a MoodGrid Presentation

Once you have a `GnMoodgrid` object, you can create and populate a MoodGrid Presentation with Mood data. A Presentation is a `GnMoodgridPresentation` object that represents the MoodGrid, containing the mood name and playlist information associated with each grid cell.

To create a MoodGrid Presentation, use the `GnMoodgrid` class' "create presentation" method, passing in the user handle and the MoodGrid type. The type can be one of the enumerated values in

`GnMoodgridPresentationType`: either a 5x5 or 10x10 grid. The method returns a `GnMoodgridPresentation` object:

C++ code sample

```
moodgrid::GnMoodgridPresentation myPresentation =  myMoodgrid.CreatePresentation(user,
GnMoodgridPresentationType.kMoodgridPresentationType5x5);
```

C# code sample

```
presentation = moodGrid.CreatePresentation(user,
GnMoodgridPresentationType.kMoodgridPresentationType10x10);
```

Java code sample

```
GnMoodgridPresentation myPresentation = myMoodGrid.createPresentation(user,
GnMoodgridPresentationType.kMoodgridPresentationType5x5);
```

Iterating Through a MoodGrid Presentation

Each cell of the Presentation is populated with a mood name an associated playlist. You can iterate through the Presentation to retrieve this information from each cell:

C++ code sample

```
/* Create a moodgrid presentation for the specified type */
moodgrid::GnMoodgridPresentation myPresentation =  myMoodgrid.CreatePresentation(user, type);

moodgrid::GnMoodgridPresentation::data_iterator itr = myPresentation.Moods().begin();

for (; itr != myPresentation.Moods().end(); ++itr) {

    /* Find the recommendation for the mood */
    moodgrid::GnMoodgridResult result = myPresentation.FindRecommendations(myProvider, *itr);

    printf("\n\n\tX:%d  Y:%d\tMood Name: %s\tMood ID: %s\tCount: %d\n", itr->X, itr->Y,
myPresentation.MoodName(*itr), myPresentation.MoodId(*itr), result.Count());

    moodgrid::GnMoodgridResult::iterator result_itr = result.Identifiers().begin();

    /* Iterate the results for the identifiers */
    for (; result_itr != result.Identifiers().end(); ++result_itr) {
        printf("\n\n\tX:%d  Y:%d", itr->X, itr->Y);

        printf("\nident:\t%s\n", result_itr->MediaIdentifier());
        printf("group:\t%s\n", result_itr->Group());

        playlist::GnPlaylistMetadata   data = collection.Metadata(user, result_itr->MediaIdentifier
(), result_itr->Group());

        printf("Album:\t%s\n", data.AlbumName());
        printf("Mood :\t%s\n", data.Mood());
    }
}
```

C# code sample

```
/* Create a moodgrid presentation for the specified type */
presentation = moodGrid.CreatePresentation(user, gnMoodgridPresentationType);

/* Query the presentation type for its dimensions */
```

```
GnMoodgridDataPoint dataPoint = moodGrid.Dimensions(gnMoodgridPresentationType);
Console.WriteLine("\n PRINTING MOODGRID " + dataPoint.X + " x " + dataPoint.Y + " GRID ");

/* Enumerate through the moodgrid getting individual data and results */
GnMoodgridPresentationDataEnumerable moodgridPresentationDataEnumerable = presentation.Moods;


foreach (GnMoodgridDataPoint position in moodgridPresentationDataEnumerable)
{
    uint x = position.X;
    uint y = position.Y;

    /* Get the name for the grid coordinates in the language defined by Locale */
    string name = presentation.MoodName(position);

    /* Get the mood id */
    string id = presentation.MoodId(position);

    /* Find the recommendation for the mood */
    GnMoodgridResult moodgridResult = presentation.FindRecommendations(provider, position);

    /* Count the number of results */
    count = moodgridResult.Count();
    Console.WriteLine("\n\n\tX:" + x + "  Y:" + y + " name: " + name + " count: " + count + " ");

    /* Iterate the results for the idents */
    GnMoodgridResultEnumerable identifiers = moodgridResult.Identifiers;
    foreach (GnMoodgridIdentifier identifier in identifiers)
    {
        string ident = identifier.MediaIdentifier;
        string group = identifier.Group;
        Console.WriteLine("\n\tX:" + x + " Y:" + y + " \nident:\t" + ident + "  \ngroup:\t" + group
);
    }
}
```

Java code sample

```
/* Create a moodgrid presentation for the specified type */
GnMoodgridPresentation myPresentation = myMoodGrid.createPresentation(user, type);

/* Query the presentation type for its dimensions */
GnMoodgridDataPoint dataPoint = myMoodGrid.dimensions(type);
System.out.println("\n PRINTING MOODGRID " + dataPoint.getX() + " x " + dataPoint.getY() + " GRID
");

GnMoodgridPresentationDataIterator itr = myPresentation.moods().begin();

while(itr.hasNext()) {
    GnMoodgridDataPoint position = itr.next();

    /* Find the recommendation for the mood */
    GnMoodgridResult moodgridResult = myPresentation.findRecommendations(myProvider, position);

    System.out.println("\n\n\tX:" + position.getX()
        + "  Y:" + position.getY()
        + " name: "+ myPresentation.moodName(position)
        + " count: " + moodgridResult.count()
        + " ");

    GnMoodgridResultIterator resultItr = moodgridResult.identifiers().begin();
    while(resultItr.hasNext()) {
        GnMoodgridIdentifier resultIdentfier = resultItr.next();

        System.out.println("\n\tX:" + position.getX() + " Y:" + position.getY()+" ");
        System.out.println("ident:\t" + resultIdentfier.mediaIdentifier()+"  ");
        System.out.println("group:\t" + resultIdentfier.group());

    }
}
```

Filtering MoodGrid Results

You can use genre, origin, and era to filter MoodGrid results. If you apply a filter, the results that are returned are pre-filtered, reducing the amount of data transmitted. For example, the following call sets a filter to limit results to tracks that fall within the Rock genre.

C++ code sample

```
Under construction
```

C# code sample

```
Under construction
```

Java code sample

```
Under construction
```

Implementing Rhythm

You can use the Rhythm API to:

- Create radio stations with a *seed* value.
- Generate a playlist with or without having to create a radio station.
- Adjust a radio station's playlist with feedback events and tuning parameters

Using Rhythm in your application involves doing some or all of the following:

1. Creating a Rhythm query with initial seed value.
2. Set Rhythm query options to fine-tune the results you want to see returned.
3. Generating a playlist, either as recommendations or when creating a radio station.
4. Retrieving the playlist.
5. For radio stations:
   - Sending feedback events (track/artist like/dislike/skip etc.) which may alter the station's playlist queue.
   - Retrieving playlists altered from feedback events
   - Saving a radio station for later retrieval.

Creating a Rhythm Query

Before using Rhythm, follow the usual steps to initialize GNSDK for Desktop. The following GNSDK for Desktop modules must be initialized:

- GNSDK Manager
- MusicID (optional to retrieve GnDataObjects)
- Playlist (optional to use generated playlists)
- Rhythm

For more information on initializing the GNSDK for Desktop modules, see “Initializing an Application.”

To create a Rhythm query:

1. Instantiate a `GnRhythmQuery` object with your User object.
2. Call the `GnRhythmQuery`’s `AddSeed` method with a `GnDataObject` seed that you can get with a MusicID query.

> If you are using MusicID to recognize music, you must enable Playlist and DSP data in your MusicID query.

Code Samples

C++

```
// Instantiate the query with a Gracenote user object
GnRhythmQuery rhythmQuery(user);

// Assume we start with a serialized data object (from MusicID)
// to create our seed.
GnDataObject seed = GnDataObject::Deserialize(serializedDataObject);
rhythmQuery.AddSeed(seed);
```

Java

```
// Instantiate the query with a Gracenote User object
GnRhythmQuery rhythmQuery   = new GnRhythmQuery(user);
// Assume we start with a serialized data object (from MusicID)
// to create our seed.
GnDataObject seed = GnDataObject.deserialize(serializedDataObject);
rhythmQuery.addSeed(seed);
```

Setting Rhythm Query Options

You can use the following `GnRhythmQueryOptions` methods to set options for a Rhythm Query.

- **`FocusPopularity`**—Set wth a number indicating how popular tracks should be. Range is 0-1000. Default is 1000 (very popular).
- **`FocusSimilarity`**—Set wth a number indicating how similar tracks should be. Range is 0-1000. Default is 1000 (very similar).
- **`LookupData`**—Request additional content in your results: classical, sonic, external IDs (3rd-party) identifiers, global IDs, credits, etc. See the `GnLookupData` enums for a complete list.
- **`RecommendationMaxTracksPerArtist`**—Specify a maximum number of tracks per artist for recommended playlist results. Range is 1-1000.

- **`RecommendationRotationRadio`**—Specifying `true` will cause results to be sequenced in a radio-like fashion. Choosing `false` will return normal recommendation results without sequencing. Default is `false`.
- **`ReturnCount`**—Specify how many tracks can be returned. The range is 1-25. Default is 5.
- **`StationDMCA`**—DMCA stands for Digital Millenium Copyright Act. When creating a radio station, you have the option to enable DMCA rules, which reduces the repetition of songs and albums in conformance with DMCA guidelines.

Generating Recommendations

Once you have a seeded query, you can create a recommendations playlist, which uses less overhead than also creating a radio station

To generate a Rhythm query recommendations playlist:

1. Call your `GnRhythmQuery` object"s `GenerateRecommendations` method.

   C++

   ```
   GnResponseAlbums recommendations = rhythmQuery.GenerateRecommendations();
   ```

   Java

   ```
   GnResponseAlbums recommendations = rhythmQuery.generateRecommendations();
   ```

2. Iterate through the generated `GnResponseAlbums` object.

Once you have a playlist, you can iterate through it to get album and track information.

Creating a Radio Station and Playlist

Creating a radio station and a playlist allows you to modify the playlist through feedback or tuning.

To create a radio station and playlist:

1. Instantiate a `GnRhythmStation` object, using your `GnRhythmQuery` object:

   C++

   ```
   GnRhythmStation rhythmStation(rhythmQuery);
   ```

   Java

   ```
   GnRhythmStation rhythmStation = new GnRhythmStation(rhythmQuery);
   ```

   The Rhythm station object is how you provide feedback and tuning information.

2. To generate a radio station playlist, use the `GnRhythmStation` `GeneratePlaylist` method:

   C++

   ```
   GnResponseAlbums playlist = rhythmStation.GeneratePlaylist();
   ```

Java

```
GnResponseAlbums playlist = rhythmStation.generatePlaylist();
```

Providing Feedback

Once you have created a station, you cannot generate a new playlist for it with a different seed. To use a different seed you would have to create a new station. However, you can use feedback events to modify an existing station's playlist. The following `GnRhythmEvent` enums indicate the supported feedback events and how they affect a radio station's playlist:

- **`kRhythmEventTrackPlayed`**— Track marked as played. Advances the play queue (drops track being played and adds additional track to end of queue).
- **`kRhythmEventTrackSkipped`**— Track marked as skipped. Advances the queue by one.
- **`kRhythmEventTrackLike`**— Track marked as liked. Does not change the playlist queue.
- **`kRhythmEventTrackDislike`**— Track marked as disliked. Modifies the playlist queue but does not drop the disliked track. To do that, combine this with a track skipped event.
- **`kRhythmEventArtistLike`**— Artist marked as liked. Does not change the playlist queue.
- **`kRhythmEventArtistDislike`**— Artist marked as disliked. Modifies the playlist queue.

For a more detailed explanation on how feedback events modify a playlist, reference the Rhythm API documentatioin on the Gracenote developer portal:
https://developer.gracenote.com/sites/default/files/web/rhythm/index.htm

See the *How Feedback Events Affect the Queue* article.

To provide feedback about a Station's playlist use the Station object's `Event` method. This method takes a `GnRhythmEvent` enum and a `GnDataObject`. You set the event, and either the track or artist for the event. For example, the following two functions send event information about a track or an artist to a station.

Code samples

C++

```
GnArtist artist = playlist.Albums().at(1)->Artist();
rhythmStation.Event(kRhythmEventArtistDislike, artist);

GnTrack track = playlist.Albums().at(1)->TrackMatched();
rhythmStation.Event(kRhythmEventTrackLike, track);
```

Java

```
GnArtist artist = playlist.albums().at(1).next().artist();
rhythmStation.event(kRhythmEventArtistDislike, artist);

GnTrack track = playlist.albums().at(1).next().trackMatched();
rhythmStation.event(kRhythmEventTrackLike, track);
```

Tuning a Radio Station

You can set options to adjust a radio station and its playlist after initial creation. Use the Rhythm station object's `Options()` methods to change values. These options are the same as the Rhythm query options.

For example, the following C++ code turns DMCA support on:

```
rhythmStation.Options().StationDMCA(true);
```

Saving and Retrieving Radio Stations

Rhythm saves all created radio stations within the Gracenote service. Stations can be recalled through the station ID, which your application can store locally. To retrieve the station ID for storage, use the Station object's `StationId()` method.

Once you have the station ID, an application can save it to persistent storage and recall it at any later date. Station IDs are permanently valid. To retrieve a station create a `GnRhythmStation` object with the Station ID and associated user. This retrieval can take place during your app's current running or any future running.

For example, the following C++ code saves and retrieves a Station:

```
// Get station ID

gnsdk_cstr_t stationId = rhythmStation.StationId();

// Save the ID for later retrieval...

// Create a station based on the saved station ID
GnRhythmStation rhythmStation(stationId, user);
```

Best Practices and Design Requirements

Image Best Practices

Gracenote images – in the form of cover art, artist images and more – are integral features in many online music services, as well as home, automotive and mobile entertainment devices. Gracenote maintains a comprehensive database of images in dimensions to accommodate all popular applications, including a growing catalog of high-resolution (HD) images.

Gracenote carefully curates images to ensure application and device developers are provided with consistently formatted, high quality images – helping streamline integration and optimize the end-user experience. This topic describes concepts and guidelines for Gracenote images including changes to and support for existing image specifications.

Using a Default Image When Cover Art Is Missing

Occasionally, an Album result might have missing cover art. If the cover art is missing, Gracenote recommends trying to retrieve the artist image, and if that is not available, trying to retrieve the genre image.

If none of these images are available, your application can use a default image as a substitute. Gracenote distributes an clef symbol image to serve as a default replacement. The images are in jpeg format and located in the /images folder of the package. The image names are:

- music_75x75.jpg
- music_170x170.jpg
- music_300x300.jpg

Image Resizing Guidelines

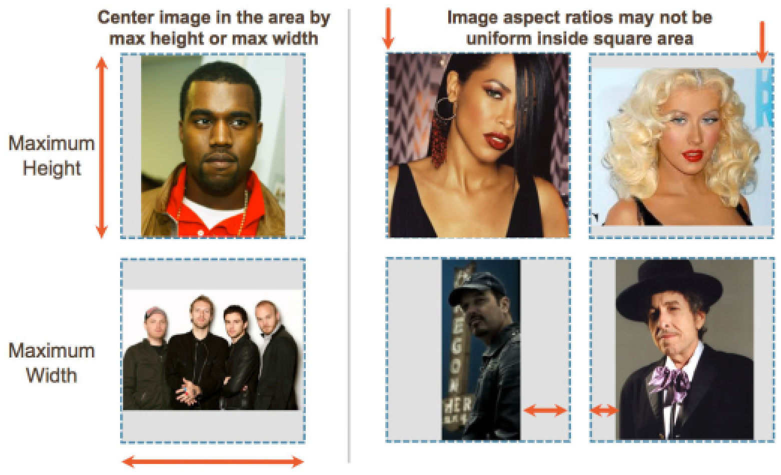
Gracenote images are designed to fi

t within squares as defined by the available image dimensions. This allows developers to present images in a fixed area within application or device user interfaces. Gracenote recommends applications center images horizontally and vertically within the predefined square dimensions, and that the square be transparent such that the background shows through. This results in a consistent presentation despite variation in the image dimensions. To ensure optimum image quality for end-users, Gracenote recommends that applications use Gracenote images in their provided pixel dimensions without stretching or resizing.

Gracenote resizes images based on the following guidelines:

- **Fit-to-square**: images will be proportionally resized to ensure their largest dimension (if not square) will fit within the limits of the next lowest available image size.
- **Proportional resizing**: images will always be proportionally resized, never stretched.
- **Always downscale**: smaller images will always be generated using larger images to ensure the highest possible image quality

Following these guidelines, all resized images will remain as rectangles retaining the same proportions as the original source images. Resized images will fit into squares defined by the available dimensions, but are not themselves necessarily square images.


Center image in the area by max height or max width
Image aspect ratios may not be uniform inside square area
Maximum Height
Maximum Width

For Tribune Media Services (TMS) video images only, Gracenote will upsize images from their native size (288 x 432) to the closest legacy video size (300 x 450) – adhering to the fit-to-square rule for the 450 x 450 image size. Native TMS images are significantly closer to 300 x

450. In certain situations, downsizing TMS images to the next lowest legacy video size (160 x 240) can result in significant quality degradation when such downsized images are later displayed in applications or devices.

Collaborative Artists Best Practices

The following topic provides best practices for handling collaborations in your application.

Handling Collaborations when Processing a Collection

When looking up a track using a text-based lookup, such as when initially processing a user's collection, use the following best practices:

- If the input string matches a single artist in the database, such as "Santana," associate the track in the application database with the single artist.
- If the input string matches a collaboration in the database, such as "Santana featuring Rob Thomas," associate the track in the application database with the primary collaborator and the collaboration. In this case, the Contributor, "Santana featuring Rob Thomas," will have a Contributor child, "Santana," and the track should be associated with "Santana" and "Santana featuring Rob Thomas."
- If the input string is a collaboration, but does not match a collaboration in the database, GNSDK for Desktop attempts to match on the primary collaborator in the input, which would be "Santana" in this example. If the primary collaborator matches an artist in the database, the result will be the single artist. There will be an indication in the result that only part of the collaboration was matched. Associate the track in the application database with the single artist and with the original input string.

Displaying Collaborations during Playback

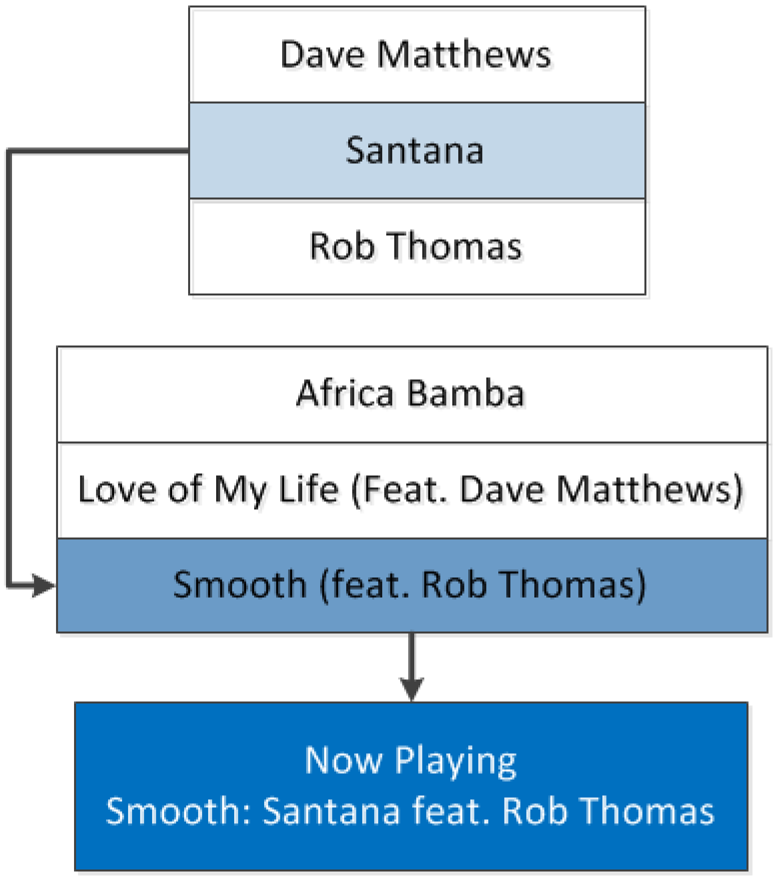
When determining what should be displayed during playback of music, use the following best practices:

- When a track by a single artist is playing, your application should display the Gracenote normalized text string. For example, when a track by Santana is playing, "Santana" should be displayed.
- When a track by a collaboration is playing, and GNSDK for Desktop has matched the collaboration, the application should display the collaboration name. For example, when a track by "Santana featuring Rob Thomas" is playing, the collaboration name "Santana featuring Rob Thomas" should be displayed.
- When a track by a collaboration is playing, but only part of the collaboration was matched, Gracenote recommends that you display the original tag data for that track during playback. For example, when a track by "Santana featuring Unknown Artist" is playing, but only "Santana" was matched, the collaboration name "Santana featuring Unknown Artist" should be displayed. Gracenote recommends that you do not overwrite the original tag data.

Displaying Collaborations in Navigation

When creating navigation in your application, use the following best practices:

- If the user is navigating through the interface, and comes to “Santana” in a drop-down list, all tracks by “Santana” should be displayed, including tracks on which Santana is the primary collaborator. The list should be created using the associations that you created during the initial text-lookup phase. If the user selects “Play songs by Santana,” all songs by Santana and songs on which Santana is the primary collaborator can be played.
- Gracenote does not recommend that collaborations appear in drop-down lists of artists. For example, don’t list “Santana” and “Santana featuring Rob Thomas” in the same drop-down list. Instead, include “Santana” in the drop-down list.


Dave Matthews
Santana
Rob Thomas
Africa Bamba
Love of My Life (Feat. Dave Matthews)
Smooth (feat. Rob Thomas)
Now Playing
Smooth: Santana feat. Rob Thomas

Handling Collaborations in Playlists

When creating a playlist, if the user is able to select a collaboration as a seed, then only songs by that collaboration should be played. For example, if the user selects “Santana featuring Rob Thomas” as a seed for a playlist, they should only hear songs by that specific collaboration. This only applies to playlists of the form “Play songs by <artist>.” It does not apply to “More Like This” playlists, such as “Play songs like <artist>,” which use Gracenote descriptors to find similar artists.

UI Best Practices for Audio Stream Recognition

The following are recommended best practices for applications that recognize streaming audio. 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 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.

Provide Clear and Accessible Instructions

Most failed recognitions are due to incorrect operation by the user. Provide clear and concise instructions to help the user correctly operate the application to result in a higher match rate and a better user experience.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.
- Use universal street sign images with written instructions to guide the user.

Provide a 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.

Display a Progress Indicator During Recognition

When listening to audio, the application can receive status updates. The status updates indicate what percentage of the recording is completed. Use this information to display a progress bar (indicator) to notify the user.

Use Animations During Recognition

Display a simple image or animation that shows how to properly perform audio recognition, such as holding the device near the audio source if applicable.

Using Vibration, Tone, or Both to Indicate Recognition Complete

The user may not see visual notifications if they are holding the recording device up to an audio source. Also, 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.

Display Help Messages for Failed Recognitions

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 audio recognition.

Data Models

The following table links to GNSDK for Desktop data models for the corresponding query response type:

- **Music**
  - GnResponseAlbums
  - GnResponseTracks
  - GnResponseContributors
- **Video**
  - GnResponseVideoObjects
  - GnResponseVideoProduct
  - GnResponseVideoSeasons
  - GnResponseVideoSeries
  - GnResponseVideoWork
- **MusicID-Match**
  - GnResponseDataMatches

API Reference Documentation

You can develop GNSDK for Desktop applications using several object-oriented languages. The following table describes these APIs and where to find the corresponding API Reference documentation :

API Name	**Description**	**Location in Package**
C++ API Reference	API descriptions of the GNSDK for Desktop C++ interface	docs/html/Content/api_ref_cplusplus/start_here.html
C# API Reference	API descriptions of the GNSDK for Desktop C# interface.	docs/html/Content/api_ref_csharp/start_here.html
Java (J2SE) API Reference	API descriptions of the GNSDK for Desktop Java interface.	docs/Content/api_ref_java_j2se/html/index.html
Java (Android) API Reference	API descriptions of the GNSDK for Desktop Java Android interface	docs/Content/api_ref_java_android/html/index.html
Python API Reference	API descriptions of the GNSDK for Desktop Python interface	docs/Content/api_ref_python/html/index.html

GNSDK Glossary

A

AV Work

In general, the terms Audio-Visual Work, Work, and AV Work are interchangeable. A distinct artistic or cerebral creation created by one or more contributors, and expressed through text, audio, video, images, or any combination of these. The term work is conceptual and used to encompass related products. For example, the director Ridley Scott's body of work includes the video products Alien, Blade Runner, Thelma and Louise, Gladiator, Hannibal, and Prometheus. AV Works can be grouped by Franchise (for example, all CSI TV shows), Series (all seasons of CSI: Miami), and Season (all episodes of Season 2 of CSI: Miami).

C

Client ID

Each customer receives a unique Client ID string from Gracenote. This string uniquely identifies each application and lets Gracenote deliver the specific features for which the application is licensed. The Client ID string has the following format: 123456-789123456789012312. The first part is a six-digit Client ID, and the second part is a 17-digit Client ID Tag.

Contributor

A Contributor refers to any person who plays a role in an AV Work. Actors, Directors, Producers, Narrators, and Crew are all consider a Contributor. Popular recurring Characters such as Batman, Harry Potter, or Spider-man are also considered Contributors in Video Explore.

Credit

A credit lists the contribution of a person (or occasionally a company, such as a record label) to a recording. Generally, a credit consists of: The name of the person or company. The role the person played on the recording (an instrument played, or another role such as composer or producer). The tracks affected by the contribution. A set of optional notes (such as “plays courtesy of Capitol records”). See Role

E

Episode

A specific instance of a TV Program in a TV Series.

F

Features

Term used to encompass a particular media stream's characteristics and attributes; this is metadata and information accessed from processing a media stream. For example, when submitting an Album's Track, this includes information such as fingerprint, mood, and tempo metadata (Attributes).

Filmography

All of the Works associated with a Contributor in the Gracenote Service, for example: All Works that are linked to Tom Hanks.

Fingerprint

Fingerprint Types: Cantametrix Philips microFAPI nanoFAPI

Franchise

A collection of related Works. Each of the following examples is a unique franchise: Batman Friends Star Wars CSI

G

Generation Criterion

A selection rule for determining which tracks to add to a playlist.

Generator

Short for playlist generator. This is a term used to indicate that an artist has at least one of the extended metadata descriptors populated. The metadata may or may not be complete, and the artist text may or may not be locked or certified. See also: extended metadata, playlist optimized artist.

Genre

A categorization of a musical composition characterized by a particular style.

L

Link Module

A module available in the Desktop and Auto products that allows applications to access and present enriched content related to media that has been identified using identification features.

M

Manual Playlist

A manual playlist is a playlist that the user has created by manually selecting tracks and a play order. An auto-playlist is a playlist generated automatically by software. This distinction only describes the initial creation of the playlist; once created and saved, all that matters to the end-user is whether the playlist is static (and usually editable) or dynamic (and non-editable). All manual playlists are static; the track contents do not change unless the end-user edits the playlist. An auto-playlist may be static or dynamic.

Mediography

All of the Works associated with a Contributor in the Gracenote Service, for example: All works that are linked to Tom Hanks.

Metadata

Data about data. For example, metadata such as the artist, title, and other information about a piece of digital audio such as a song recording.

Mood

Track-level perceptual descriptor of a piece of music, using emotional terminology that a typical listener might use to describe the audio track; includes hierarchical categories of increasing granularity. See Sonic Attributes.

More Like This

A mechanism for quickly generating playlists from a user’s music collection based on their similarity to a designated seed track, album, or artist.

Multiple Match

During CD recognition, the case where a single TOC from a CD may have more than one exact match in the MDB. This is quite rare, but can happen. For example with CDs that have only one track, it is possible that two of these one-track CDs may have exactly the same length (the exact same number of frames). There is no way to resolve these cases automatically as there is no other information on the CD to distinguish between them. So the user must be presented with a dialog box to allow a choice between the alternatives. See also: frame, GN media database, TOC.

MusicID Module

Enables MusicID recognition for identifying CDs, digital music files and streaming audio and delivers relevant metadata such as track titles, artist names, album names, and genres. Also provides library organization and direct lookup features.

MusicID-File Module

A feature of the MusicID product that identifies digital music files using a combination of waveform analysis technology, text hints and/or text lookups.

P

Playlist

A set of tracks from a user's music collection, generated according to the criteria and limits defined by a playlist generator.

Popularity

Popularity is a relative value indicating how often metadata for a track, album, artist and so on is accessed when compared to others of the same type. Gracenote's statistical information about the popularity of an album or track, based on aggregate (non-user-specific) lookup history maintained by Gracenote servers. Note that there's a slight difference between track popularity and album popularity statistics. Track popularity information identifies the most popular tracks on an album, based on text lookups. Album popularity identifies the most frequently looked up albums, either locally by the end-user, or globally across all Gracenote users. See Rating and Ranking

Product

A Product refers to the commercial release of a Film, TV Series, or video content. Products contain a unique commercial code such as a UPC, Hinban, or EAN. Products are for the most part released on a physical format, such as a DVD or Blu-ray.

R

Ranking

For Playlist, ranking refers to any criteria used to order songs within a playlist. So a playlist definition (playlist generator) may rank songs in terms of rating values, or may rank in terms of some other field, such as last-played date, bit rate, etc.

Rating

Rating is a value assigned by a user for the songs in his or her collection. See Popularity and Ranking.

Role

A role is the musical instrument a contributor plays on a recording. Roles can also be more general, such as composer, producer, or engineer. Gracenote has a specific list of supported roles, and these are broken into role categories, such as string instruments, brass instruments. See Credit.

S

Season

An ordered collection of Works, typically representing a season of a TV series. For example: CSI: Miami (Season One), CSI: Miami (Season Two), CSI: Miami (Season Three)

Seed Track, Disc, Artist, Genre

Used by playlist definitions to generate a new playlist of songs that are related in some way, or similar, to a certain artist, album, or track.This is a term used to indicate that an artist has at least one of the extended metadata descriptors populated. The metadata may or may not be complete, and the artist text may or may not be locked or certified. See also: extended metadata, playlist optimized artist, playlist-related terms.

Series

A collection of related Works, typically in sequence, and often comprised of Seasons (generally for television series); for example, CSI Las Vegas. A Series object may have varying structures of Episodes and Seasons objects. Three common Series object structure hierarchies are - Series object contains only Episode objects; for example, Ken Burns' The Civil War series. Series object contains multiple Seasons objects that contain multiple Episodes objects; for example, the animated television series The Simpsons. Series object contains one or more independent Episodes objects (meaning, not contained within Seasons objects) and multiple Seasons objects that contain multiple Episodes objects. This structure occurs for cases when a pilot episode (represented by an independent Episode object) is developed into a series. An example of this is Cartoon Network's Samurai Jack series, which was initially launched as a television movie and then later developed into a television series.

Sonic Attributes

The Gracenote Service provides two metadata fields that describe the sonic attributes of an audio track. These fields, mood and tempo, are track-level descriptors that capture the unique characteristics of a specific recording. Mood is a perceptual descriptor of a piece of music, using emotional terminology that a typical listener might use to describe the audio track. Tempo is a description of the overall perceived speed or pace of the music. The Gracenote mood and tempo descriptor systems include hierarchical categories of increasing granularity, from very broad parent categories to more specific child categories.

T

Target Field

The track attribute used by a generation criterion for selecting tracks to include in a generated playlist.

Tempo

Track-level descriptor of the overall perceived speed or pace of the music; includes hierarchical categories of increasing granularity. See Sonic Attributes.

Title

Also referred to as Title Set. DVDs and Blu-ray discs may contain multiple titles. A typical movie DVD may be comprised of multiple titles, one of which comprises the main feature (in this case, the movie) and is referred to as the main title. Other titles, or extras, are often comprised of previews, behind-the-scenes documentaries, or other content.

TOC

Table of Contents. An area on CDs, DVDs, and Blu-ray discs that describes the unique track layout of the disc.

TOP

Table of Programs. The list of program addresses found on a DVD that allows the GN MusicID system to find the DVD in the MDB.

V

Video Explore

Provides extended video recognition and searching, enabling user exploration and discovery features.

Video ID Module

Provides video item recognition for DVD and Blu-ray products via TOCs.

W

Work

See AV Work